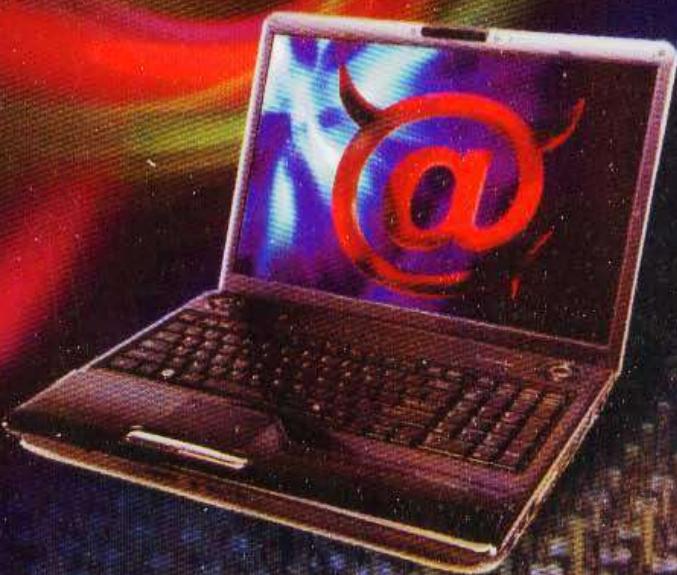


Foreword by
Dr. Kamlesh Bajaj, Data Security Council of India

CYBER SECURITY

**Understanding Cyber Crimes,
Computer Forensics and Legal Perspectives**



Nina Godbole • Sunit Belapure

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CYBER SECURITY

Understanding Cyber Crimes, Computer Forensics and Legal Perspectives

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This book will help you understand the various types of cyber crimes, computer forensics and legal perspectives. It also covers the basics of how to protect your organization from cyber attacks. The book is designed for students, professionals, and anyone interested in learning about cybersecurity and its impact on business, society, and the future.

The book covers topics such as network security, data protection, and privacy laws. It also discusses the latest trends in cybersecurity, including AI and machine learning, and how they can be used to prevent cyber attacks. The book is written in a clear and concise style, making it easy to understand even for those who are new to the field. It is an excellent resource for anyone looking to learn more about cybersecurity and its importance in today's world.

**Nina Godbole
Sunit Belapure**

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First Edition: 2011

Reprint: 2018

ISBN: 978-81-265-2179-1

www.wileyindia.com

Printed at: Bhushan Printline

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1

Introduction to Cybercrime

Learning Objectives

After reading this chapter, you will able to:

- Learn what cybercrime is and appreciate the importance of cybercrime as the topic.
- Understand the different types of cybercrime.
- Understand the difference between cybercrime and cyberfraud.
- Learn about different types of cybercriminals and the motives behind them.
- Get an overview of cybercrime scenario in India as well as the overall global perspective.
- Understand the legal perspective on cybercrime including the Indian ITA 2000 and its latest amendment known as the ITA 2008.

1.1 Introduction

Almost everyone is aware of the phenomenal growth of the Internet (the statistics on Indian growth for Internet and mobile usage are indicated through links provided in Ref. #26, Additional Useful Web References, Further Reading). Given the unrestricted number of free websites, the Internet has undeniably opened a new way of exploitation known as cybercrime. These activities involve the use of computers, the Internet, cyberspace (see Box 1.1) and the worldwide web (WWW). Interestingly, cybercrime is *not* a new phenomena; the first recorded cybercrime took place in the year 1820. It is one of the most talked about topics in the recent years. Figure 1.1, based on a 2008 survey in Australia, shows the cybercrime trend. Also refer to Appendix L.

While the worldwide scenario on cybercrime looks bleak, the situation in India is not any better. Indian corporate and government sites have been attacked or defaced more than 780 times between February 2000 and December 2002. There are also stories/news of other attacks; for example, according to a story posted on 3 December 2009, a total of 3,286 Indian websites were hacked in 5 months – between January and June 2009 (see Ref. #2, Articles and Research Papers, Further Reading).

Similar data for later years is presented in Tables 1.1–1.4; the data in those tables show statistics related to various cybercrimes and cases registered under cybercrimes by motives and suspects in States and Union Territories (UTs).

1.2 Cybercrime: Definition and Origins of the Word

With the backdrop of information in the previous section and the statistics presented in Tables 1.1 and 1.2, let us understand the origins of the term *cybercrime*. Reaching consensus on a definition of computer

Box 1.1**Cyberspace, Cybersquatting, Cyberpunk, Cyberwarfare and Cyberterrorism****Cyberspace**

This is a term coined by William Gibson, a science fiction writer, in his Sci-fi novel *Neuromancer* (published in 1984) – he suggested it as a "consensual hallucination." According to his vision about near-future computer network (as at the time when he coined the term in 1984), "cyberspace" is where users mentally travel through matrices of data. Conceptually, "cyberspace" is the "nebulous place" where humans interact over computer networks. The term "cyberspace" is now used to describe the Internet and other computer networks. In terms of computer science, "cyberspace" is a worldwide network of computer networks that uses the Transmission Control Protocol/Internet Protocol (TCP/IP) for communication to facilitate transmission and exchange of data. A common factor in almost all definitions of cyberspace is the sense of place that they convey – cyberspace is most definitely a place where you chat, explore, research and play.

Cybersquatting

The term is derived from "squatting" which is the act of occupying an abandoned/unoccupied space/building that the squatter does not own, rent or otherwise have permission to use. Cybersquatting, however, is a bit different in that the domain names that are being squatted are (sometimes but not always) being paid for by the cybersquatters through the registration process. Cybersquatters usually ask for prices far greater than those at which they purchased it. Some cybersquatters put up derogatory or defamatory remarks about the person or company the domain is meant to represent in an effort to encourage the subject to buy the domain from them. This term is explained here because, in a way, it relates to cybercrime given the intent of cybersquatting. Cybersquatting is the act of registering a popular Internet address, usually a company name, with the intent of selling it to its rightful owner. From an affected individual's point of view, cybersquatting means registering, selling or using a domain name with the intent of profiting from the goodwill of someone else's trademark. In this nature, it can be considered to be a type of cybercrime. Cybersquatting is the practice of buying "domain names" that have existing businesses names. In other words, cyber-squatting involves the pre-emptive registration of trademarks by third parties as domain names. It is done with the intent to sell those "domain names" to earn profit. Comparing cybersquatting to online extortion, Senator Spencer Abraham, a Michigan Republican, introduced to Congress the Anti-Cybersquatting Consumer Protection Act. This bill, if enacted, would make cybersquatting illegal. Violators would be charged a fine of up to \$300,000. The World Intellectual Property Organization (WIPO) has also outlined anti-cybersquatting tactics, which have been endorsed by Internet Corporation for Assigned Names and Numbers (ICANN). Ironically enough, someone recently registered www.wipo.com in order to sell it back to WIPO for several thousand dollars. Even though legislation has not been enacted, almost all cybersquatting court-case decisions are against cybersquatters. We can see that the topic of "domain name disputes" is closely connected with cybersquatting, because domain name disputes arise largely from the practice of cybersquatting. Such disputes happen because cybersquatters exploit the first-come, first-served nature of the domain name registration system to register names of trademarks, famous people or businesses with which they have no connection. Since registration of domain names is relatively simple, cybersquatters can register numerous examples of such names as domain names. As the holders of these registrations, cybersquatters often then put the domain names up for auction, or offer them for sale directly to the company or person involved, at prices far beyond the cost of registration. Alternatively, they can keep the registration and use the name of the person or business associated with that domain name to attract business for their own sites.

In India, "cybersquatting" is considered to be an "Intellectual Property Right" (IPR) evil (see Ref. #29, Additional Useful Web References, Further Reading). In India, "cybersquatting" is seen to interfere with the "Uniform Dispute Resolution Policy" (a contractual obligation to which all domain name registrants are presently subjected to). It also affects the rights of Indians who have to face charges of "Squatting" in respect of international generic domain names such as dot com, dot org, etc. The terms "trademark" and "intellectual property" are explained in Chapter 10.

Box 1.1 Cyberspace, Cybersquatting, . . . (Continued)

Cyberpunk and Cyberwarfare

According to science fiction literature, the words "cyber" and "punk" emphasize the two basic aspects of cyberpunk: "technology" and "individualism." The term "cyberpunk" could mean something like "anarchy via machines" or "machine/computer rebel movement." This word first appeared as the title of a short story "Cyberpunk" by Bruce Bethke, published in science fiction stories magazine, AMAZING, Vol. 57, No. 4, November 1983. It is quite interesting to note that the word was coined in the early spring of 1980, and applied to the "bizarre, hard-edged, high-tech" science fiction emerging in the 1980s. The story is about a bunch of teenage hackers/crackers. The idea behind calling it "cyberpunk" was to invent a new term that will express the juxtaposition of punk attitudes and high technology. For the terms "hackers," "crackers" and others, readers may like to refer to specific pages of the source mentioned at the end of this box. Also refer to Chapter 10.

Cyberwarfare, for many people, means information warriors unleashing vicious attacks against an unsuspecting opponent's computer networks, wreaking havoc and paralyzing nations. This perception seems to be correct as the terms cyberwarfare and cyberterrorism have got historical connection in the context of attacks against infrastructure. The term "information infrastructure" refers to information resources, including communication systems that support an industry, institution or population. Cyberattacks are often presented as threat to military forces and the Internet has major implications for espionage and warfare. Information warfare (see Ref. #9, Books, Further Reading) covers a range of activities of which cyberattacks may be the least important.

Cyberterrorism

This term was coined in 1997 by Barry Collin, a senior research fellow at the Institute for Security and Intelligence in California. Cyberterrorism seems to be a controversial term. Some authors choose a very narrow definition, relating to deployments, by known terrorist organizations, of disruption attacks against information systems for the primary purpose of creating alarm and panic. However, this narrow definition makes it difficult to identify any instances of cyberterrorism. There is a broad definition stated by Kevin G. Coleman of the Technolytics Institute:

The premeditated use of disruptive activities, or the threat thereof, against computers and/or networks, with the intention to cause harm or further social, ideological, religious, political or similar objectives or to intimidate any person in furtherance of such objectives.

There is a lot of misinterpretation in the definition of cyberterrorism, the term consisting of familiar word "cyber" and less familiar word "terrorism." Although "cyber" is the term we can understand (see Section 1.2), the term terrorism is difficult to define. The ambiguity in the definition brings in vagueness in action, as D. Denning pointed in her work saying that "'an E-Mail bomb' may be considered as 'hacktivism' by some and 'cyberterrorism' by others" (for terms such as "activism," "hacktivism" and "cyberterrorism", see Ref #13, Additional Web References, Further Reading). There is a degree of understanding of the meanings of cyberterrorism, either from the popular media, other secondary sources or personal experience; however, the specialists use different definitions. "Cyberterrorism", as well as other contemporary "terrorisms" appear as a mixture of words terrorism and a meaning of an area of application. Barry Collin defined cyberterrorism as the convergence of cybernetics and terrorism. In the same year, Mark Pollitt, special agent for the FBI, offers a working definition:

Cyberterrorism is the premeditated, politically motivated attack against information, computer systems, computer programs and data which result in violence against noncombatant targets by sub national groups or clandestine agents.

We can also define cyberterrorism as: Use of information technology and means by terrorist groups and agents. Refer to Chapter 10.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices* (Box 11.2, p. 170 and Box 38.12, p. 926), Wiley India.

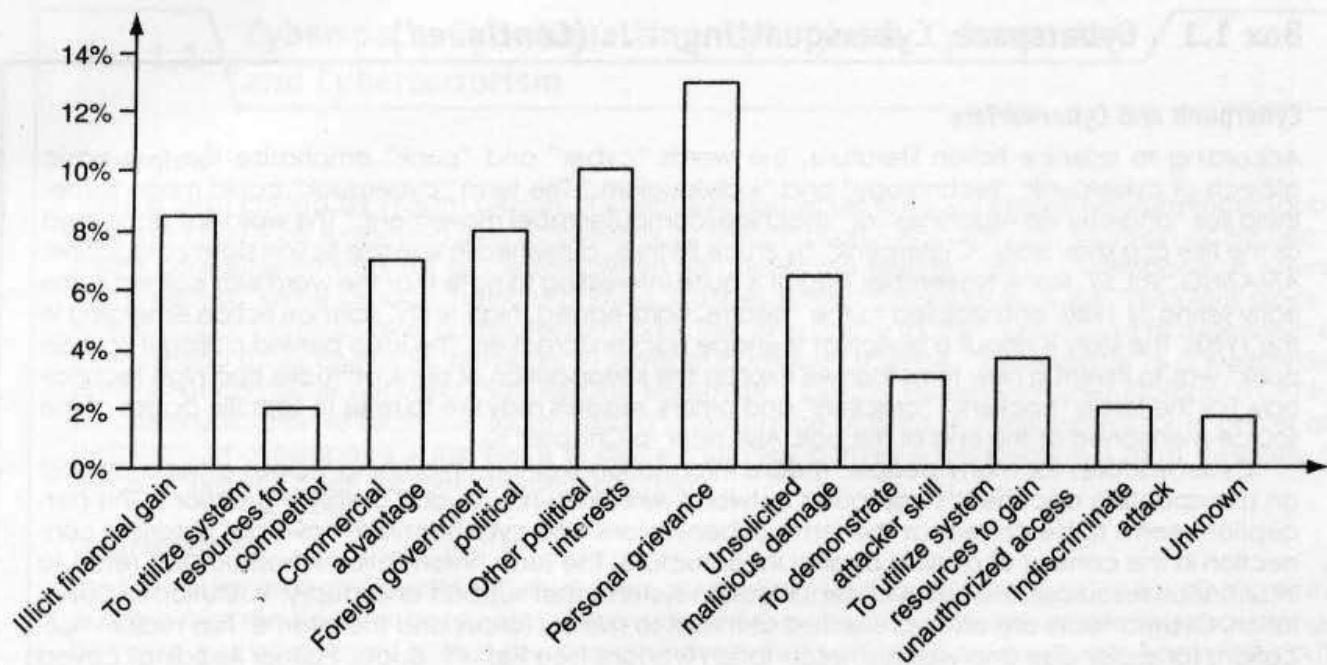


Figure 1.1 Cybercrime trend.

Source: 2008 Pacific Islands Computer Crime and Security Survey. Adapted from *Cybercrime: Threats, Challenges* presentation by Wipul Jayawickrama at the Computer Security Week 2008 in Brisbane, Australia (reproduced with permission).

crime is difficult. One definition that is advocated is, “*a crime conducted in which a computer was directly and significantly instrumental.*” This definition is not universally accepted. It, however, initiates further discussion to narrow the scope of the definition for “cybercrime”: for example, we can propose the following alternative definitions of computer crime:

1. Any illegal act where a special knowledge of computer technology is essential for its perpetration, investigation or prosecution.
2. Any traditional crime that has acquired a new dimension or order of magnitude through the aid of a computer, and abuses that have come into being because of computers.
3. Any financial dishonesty that takes place in a computer environment.
4. Any threats to the computer itself, such as theft of hardware or software, sabotage and demands for ransom.

Here is yet another definition: “*cybercrime (computer crime) is any illegal behavior, directed by means of electronic operations, that targets the security of computer systems and the data processed by them.*” Note that in a wider sense, “computer-related crime” can be any illegal behavior committed by means of, or in relation to, a computer system or network; however, this is not cybercrime.

Statute and treaty law both refer to “cybercrime.” The term “cybercrime” relates to a number of other terms that may sometimes be used interchangeably to describe crimes committed using computers. Computer-related crime, Computer crime, Internet crime, E-crime, High-tech crime, etc. are the other synonymous terms. Cybercrime specifically can be defined in a number of ways; a few definitions are:

1. A crime committed using a computer and the Internet to steal a person’s identity (identity theft) or sell contraband or stalk victims or disrupt operations with malevolent programs. Refer to Chapter 5.

Table 1.1 | Cybercrimes/cases registered and persons arrested under IT Act during 2004–2007

| Sr. No. | Crime Heads | Cases Registered | | | % Variation in 2007 over 2006 | | | Persons Arrested | | | % Variation in 2007 over 2006 | | |
|------------|--|------------------|------------|------------|-------------------------------------|-------------|-----------|------------------|------------|------------|-------------------------------------|------|------|
| | | 2004 | | 2005 | 2006 | 2007 | | 2004 | 2005 | 2006 | 2007 | 2004 | 2005 |
| | | | | | | | | | | | | | |
| 1 | Tampering computer source documents | 2 | 10 | 10 | 11 | 10.0 | 0 | 10 | 8 | 2 | -75 | | |
| 2 | Hacking with computer system | 14 | 33 | 25 | 20 | -20.0 | 31 | 27 | 34 | 25 | -26.5 | | |
| | (i) Loss/damage to computer resource/utility | | | | | | | | | | | | |
| | (ii) Hacking | 12 | 41 | 34 | 46 | 35.3 | 1 | 14 | 29 | 23 | -20.7 | | |
| 3 | Obscene publication/transmission in electronic form | 34 | 88 | 69 | 99 | 43.5 | 21 | 125 | 81 | 86 | 6.2 | | |
| 4 | Failure | 0 | 1 | 0 | 2 | - | 0 | 0 | 0 | 1 | - | | |
| | (i) Of compliance/orders of Certifying Authority | | | | | | | | | | | | |
| | (ii) To assist in decrypting the information intercepted by government agency | 0 | 0 | 0 | 2 | - | 0 | 0 | 0 | 0 | - | | |
| 5 | Unauthorized access/attempt to access to protected computer system | 0 | 0 | 0 | 4 | - | 0 | 0 | 0 | 0 | - | | |
| 6 | Obtaining licence or digital signature certificate by misrepresentation/suspension of fact | 0 | 0 | 0 | 11 | - | 0 | 0 | 0 | 11 | - | | |
| 7 | Publishing false digital signature certificate | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | - | | |
| 8 | Fraud digital signature certificate | 0 | 1 | 1 | 3 | 200.0 | 0 | 3 | 0 | 3 | - | | |
| 9 | Breach of confidentiality/privacy | 6 | 3 | 3 | 9 | 200.0 | 7 | 13 | 2 | 3 | 50.0 | | |
| 10 | Other | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | - | | |
| | Total | 68 | 177 | 142 | 207 | 45.8 | 60 | 192 | 154 | 154 | 0.0 | | |

Source: <http://www.nasscom.org/download/Cybercrimes in India 2003.pdf> (28 February 2009).

Table 1.2 | Cybercrimes/cases registered and persons arrested under IPC during 2004–2007

| Sr. No. | Crime Heads | Cases Registered | | | | % Variation in 2007 over 2006 | Persons Arrested | | | | % Variation in 2007 over 2006 |
|------------|---|------------------|------------|------------|------------|-------------------------------------|------------------|------------|------------|------------|-------------------------------------|
| | | 2004 | 2005 | 2006 | 2007 | | 2004 | 2005 | 2006 | 2007 | |
| 1 | Offences by/ against public servant | 0 | 0 | 0 | 0 | — | 0 | 0 | 0 | 0 | — |
| 2 | False electronic evidence | 0 | 0 | 0 | 0 | — | 0 | 0 | 0 | 0 | — |
| 3 | Destruction of electronic evidence | 0 | 0 | 0 | 0 | — | 0 | 0 | 0 | 0 | — |
| 4 | Forgery | 77 | 48 | 160 | 217 | 35.6 | 81 | 71 | 194 | 264 | 36.1 |
| 5 | Criminal breach of trust/ fraud | 173 | 186 | 90 | 73 | -18.9 | 181 | 215 | 121 | 85 | -29.8 |
| 6 | Counterfeiting | | | | | | | | | | |
| | (i) Property/ mark | 12 | 0 | 13 | 8 | -38.5 | 8 | 0 | 7 | 23 | 228.6 |
| | (ii) Tampering | 7 | 9 | 0 | 5 | — | 16 | 0 | 0 | 8 | — |
| | (iii) Currency/ stamps | 10 | 59 | 48 | 36 | -25.0 | 43 | 82 | 89 | 49 | -44.9 |
| 7 | Total | 279 | 302 | 311 | 339 | 9.0 | 329 | 368 | 411 | 429 | 4.4 |

Source: <http://www.nasscom.org/download/Cybercrimes in India 2003.pdf> (28 February 2009).

2. Crimes completed either on or with a computer.
3. Any illegal activity done through the Internet or on the computer.
4. All criminal activities done using the medium of computers, the Internet, cyberspace and the WWW.

According to one information security glossary,^[1] cybercrime is any criminal activity which uses network access to commit a criminal act. Opportunities for the exploitation due to weaknesses in information security are multiplying because of the exponential growth of Internet connection (see Ref. #26, Additional Useful Web References, Further Reading). Cybercrime may be internal or external, with the former easier to perpetrate. The term “cybercrime” has evolved over the past few years since the adoption of Internet connection on a global scale with hundreds of millions of users. *Cybercrime* refers to the act of performing a criminal act using cyberspace as the communications vehicle (the term “cyberspace” is explained in Box 1.1). Some people argue that a cybercrime is not a crime as it is a crime against software and not against a person or property. However, while the legal systems around the world scramble to introduce laws to combat cyber-criminals (refer to Section 1.5), two types of attack are prevalent:

1. **Techno-crime:** A premeditated act against a system or systems, with the intent to copy, steal, prevent access, corrupt or otherwise deface or damage parts of or the complete computer system. The 24 × 7 connection to the Internet makes this type of cybercrime a real possibility to engineer from anywhere in the world, leaving few, if any, “finger prints.”

Table 1.3 | 2005 Cases under cybercrime – part A

Cases registered under cybercrimes by motives and suspects during 2005 [(States and Union Territories (UTs))]

| Sr. No. | State/UT | Motives | | | | | | Total | |
|------------|-------------------|-------------------------------|-----------------|-----------|------------------|---------------------------------------|-----------------------|----------------------------|-----|
| | | Revenge/ Setting Scores | Greed/ Money | Extortion | Cause Dispute | Satisfaction of Gaining Control | Fraud/Illegal Gain | Eve teasing/ Harassment | |
| 1 | Andhra Pradesh | 0 | 0 | 0 | 3 | 18 | 0 | 3 | 58 |
| 2 | Arunachal Pradesh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | Assam | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 4 | Bihar | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | Chhattisgarh | 0 | 4 | 0 | 0 | 0 | 1 | 0 | 46 |
| 6 | Goa | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 |
| 7 | Gujarat | 0 | 2 | 0 | 1 | 0 | 1 | 0 | 151 |
| 8 | Haryana | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 6 |
| 9 | Himachal Pradesh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | Jammu & Kashmir | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | Jharkhand | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | Karnataka | 4 | 4 | 0 | 3 | 0 | 0 | 10 | 38 |
| 13 | Kerala | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | Madhya Pradesh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | Maharashtra | 2 | 4 | 0 | 2 | 1 | 7 | 11 | 27 |
| 16 | Manipur | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | Meghalaya | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | Mizoram | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 | Nagaland | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | Orissa | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 4 |
| 21 | Punjab | 0 | 0 | 0 | 1 | 0 | 7 | 0 | 6 |
| 22 | Rajasthan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42 |
| 23 | Sikkim | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 |
| | | | | | | | | | 18 |
| | | | | | | | | | 0 |
| | | | | | | | | | 0 |

(Continued)

Table 1.3 | (Continued)

| Sr. No. | State/UT | Motives | | | | | | | Total |
|--------------------------|---------------|-------------------------------|-----------------|-----------|---------------------|---|-----------------------|----------------------------|------------|
| | | Revenge/ Setting Scores | Greed/ Money | Extortion | Cause Disruptive | Prank/ Satisfaction of Gaining Control | Fraud/Illegal Gain | Eve Teasing/ Harassment | |
| 24 | Tamil Nadu | 0 | 0 | 2 | 10 | 0 | — | 9 | 22 |
| 25 | Tripura | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | Uttar Pradesh | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 4 |
| 27 | Uttarakhand | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | West Bengal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total (States) | | 6 | 15 | 2 | 17 | 4 | 55 | 36 | 461 |
| <i>Union Territories</i> | | | | | | | | | |
| 29 | A & N Islands | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | Chandigarh | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 2 |
| 31 | D & N Haveli | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | Daman & Diu | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 33 | Delhi | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 15 |
| 34 | Lakshadweep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 35 | Pondicherry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total (UTs) | | 0 | 1 | 0 | 0 | 0 | 2 | 1 | 16 |
| Total (All India) | | 6 | 16 | 2 | 17 | 4 | 57 | 37 | 481 |
| <i>Cities</i> | | | | | | | | | |
| 36 | Agra | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 37 | Ahmedabad | 0 | 2 | 0 | 1 | 0 | 1 | 0 | 5 |
| 38 | Allahabad | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 39 | Amritsar | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | Asansol | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 41 | Bangalore | 4 | 4 | 0 | 3 | 0 | 16 | 10 | 38 |
| 42 | Bhopal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43 | Chennai | 0 | 0 | 2 | 10 | 0 | 0 | 8 | 20 |
| 44 | Coimbatore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

(Continued)

Table 1.3 | (Continued)

| Sr. No. | State/UT | Motives | | | | | | Total | |
|-----------------------|----------------|--------------------------------|-----------------|-----------|------------------|---|------------------------|----------------------------|------------|
| | | Revenge/ Settling Scores | Greed/ Money | Extortion | Cause Dispute | Prank/ Satisfaction of Gaining Control | Fraud/Illlegal Gain | Eve Teasing/ Harassment | |
| 45 | Delhi (City) | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 15 |
| 46 | Dhanbad | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 47 | Faridabad | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 48 | Hyderabad | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 49 | Indore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | Jabalpur | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 51 | Jaipur | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | Jamshedpur | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 53 | Kanpur | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | Kochi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 55 | Kolkata | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | Lucknow | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 57 | Ludhiana | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | Madurai | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 59 | Meerut | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | Mumbai | 0 | 5 | 0 | 0 | 0 | 0 | 1 | 2 |
| 61 | Nagpur | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 |
| 62 | Nasik | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 63 | Patna | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | Pune | 0 | 0 | 0 | 1 | 0 | 4 | 3 | 1 |
| 65 | Rajkot | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | Surat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 146 |
| 67 | Vadodara | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | Varanasi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 69 | Vijayawada | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| 70 | Vishakhapatnam | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total (Cities) | | 4 | 11 | 2 | 15 | 0 | 26 | 173 | 257 |

Table 1.4 | 2005 Cases under cybercrime – part B

| Sr. No. | State/UT | Suspects | | | | | | Total |
|-----------------------|----------------------|-------------------------------|---------------------------------------|--|------------------------|---|------------|------------|
| | | Foreign National /Group | Disgruntled Employee/ Employees | Cracker/ Student/ Professional Learners | Business Competitor | Neighbors/ Friends and Relatives | Others | |
| States | | | | | | | | |
| 1 | Andhra Pradesh | 0 | 0 | 3 | 11 | 8 | 60 | 82 |
| 2 | Arunachal Pradesh | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | Assam | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 4 | Bihar | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | Chhattisgarh | 0 | 0 | 20 | 0 | 0 | 26 | 46 |
| 6 | Goa | 0 | 0 | 0 | 0 | 0 | 3 | 3 |
| 7 | Gujarat | 0 | 2 | 2 | 1 | 0 | 150 | 155 |
| 8 | Haryana | 0 | 0 | 0 | 2 | 1 | 6 | 6 |
| 9 | Himachal Pradesh | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | Jammu & Kashmir | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | Jharkhand | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | Karnataka | 4 | 13 | 1 | 0 | 7 | 13 | 38 |
| 13 | Kerala | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | Madhya Pradesh | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | Maharashtra | 0 | 2 | 0 | 0 | 5 | 20 | 27 |
| 16 | Manipur | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | Meghalaya | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | Mizoram | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 | Nagaland | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | Orissa | 0 | 0 | 0 | 2 | 0 | 4 | 6 |
| 21 | Punjab | 0 | 8 | 6 | 1 | 0 | 35 | 50 |
| 22 | Rajasthan | 0 | 0 | 11 | 0 | 0 | 7 | 18 |
| 23 | Sikkim | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | Tamil Nadu | 0 | 15 | 1 | 0 | 3 | 3 | 22 |
| 25 | Tripura | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | Uttar Pradesh | 0 | 0 | 2 | 0 | 0 | 2 | 4 |
| 27 | Uttaranchal | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | West Bengal | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total (States) | | 4 | 40 | 46 | 17 | 24 | 330 | 458 |

(Continued)

Table 1.4 | (Continued)

| Sr. No. | State/UT | Suspects | | | | | | Total |
|--------------------------|--------------------------|-------------------------------|---------------------------------------|--|------------------------|---|------------|------------|
| | | Foreign National /Group | Disgruntled Employee/ Employees | Cracker/ Student/ Professional Learners | Business Competitor | Neighbors/ Friends and Relatives | Others | |
| Union Territories | | | | | | | | |
| 29 | A & N Islands | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | Chandigarh | 0 | 0 | 1 | 0 | 0 | 1 | 2 |
| 31 | D & N Haveli | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | Daman & Diu | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 33 | Delhi | 0 | 2 | 0 | 0 | 0 | 16 | 18 |
| 34 | Lakshadweep | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 35 | Pondicherry | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total (UTs) | 0 | 2 | 1 | 0 | 0 | 17 | 20 |
| | Total (All India) | 4 | 42 | 47 | 17 | 24 | 347 | 478 |
| Cities | | | | | | | | |
| 36 | Agra | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 37 | Ahmedabad | 0 | 2 | 2 | 1 | 0 | 4 | 9 |
| 38 | Allahabad | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 39 | Amritsar | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | Asansol | 0 | 0 | 0 | 0 | 7 | 13 | 38 |
| 41 | Bangalore | 4 | 13 | 1 | 0 | 0 | 0 | 0 |
| 42 | Bhopal | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43 | Chennai | 0 | 14 | 0 | 0 | 0 | 0 | 0 |
| 44 | Coimbatore | 0 | 0 | 0 | 0 | 0 | 16 | 18 |
| 45 | Delhi (City) | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| 46 | Dhanbad | 0 | 0 | 0 | 0 | 0 | 3 | 3 |
| 47 | Faridabad | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | Hyderabad | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 49 | Indore | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | Jabalpur | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 51 | Jaipur | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | Jamshedpur | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 53 | Kanpur | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | Kochi | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 55 | Kolkata | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | Lucknow | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 57 | Ludhiana | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | Madurai | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 59 | Meerut | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | Mumbai | 0 | 0 | 0 | 0 | 0 | 8 | 8 |

(Continued)

Table 1.4 | (Continued)

| Sr. No. | State/UT | Suspects | | | | | | | Total |
|-----------------------|----------------|-------------------------------|---------------------------------------|--|------------------------|---|------------|------------|-------|
| | | Foreign National /Group | Disgruntled Employee/ Employees | Cracker/ Student/ Professional Learners | Business Competitor | Neighbors/ Friends and Relatives | Others | | |
| 61 | Nagpur | 0 | 0 | 0 | 0 | 2 | 1 | 3 | |
| 62 | Nasik | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 63 | Patna | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 64 | Pune | 0 | 0 | 0 | 0 | 1 | 8 | 9 | |
| 65 | Rajkot | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 66 | Surat | 0 | 0 | 0 | 0 | 0 | 146 | 146 | |
| 67 | Vadodara | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 68 | Varanasi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 69 | Vijayawada | 0 | 0 | 0 | 2 | 0 | 0 | 2 | |
| 70 | Vishakhapatnam | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total (Cities) | | 4 | 31 | 3 | 3 | 13 | 203 | 257 | |

Source: <http://ncrb.nic.in/crime2005/cii-2005/Table%2018.8.pdf> (1 March 2009).

2. **Techno-vandalism:** These acts of “brainless” defacement of websites and/or other activities, such as copying files and publicizing their contents publicly, are usually opportunistic in nature. Tight internal security, allied to strong technical safeguards, should prevent the vast majority of such incidents.

There is a very thin line between the two terms “computer crime” and “computer fraud”; both are punishable (see Tables 1.1–1.4). Cybercrimes (harmful acts committed from or against a computer or network) differ from most terrestrial crimes in four ways: (a) how to commit them is easier to learn, (b) they require few resources relative to the potential damage caused, (c) they can be committed in a jurisdiction without being physically present in it and (d) they are often not clearly illegal.

The term cybercrime has some stigma attached and is notorious due to the word “terrorism” or “terrorist” attached with it, that is, cyberterrorism (see explanation of the term in Box 1.1). Cyberterrorism is defined as “any person, group or organization who, with terrorist intent, utilizes accesses or aids in accessing a computer or computer network or electronic system or electronic device by any available means, and thereby knowingly engages in or attempts to engage in a terrorist act commits the offence of cyberterrorism.” Cybercrime, especially through the Internet, has grown in number as the use of computer has become central to commerce, entertainment and government.

The term *cyber* has some interesting synonyms: fake, replicated, pretend, imitation, virtual, computer-generated. Cyber means combining forms relating to Information Technology, the Internet and Virtual Reality. This term owes its origin to the word “cybernetics” which deals with information and its use; furthermore, cybernetics is the science that overlaps the fields of neurophysiology, information theory, computing machinery and automation.^[2] However, beyond this, there does not seem to be any further connection to the term “cybernetics” as per other sources searched.^[3–5] According to Wikipedia,^[6] cybernetics is the interdisciplinary study of the structure of regulatory systems. It is closely related to control theory and systems theory.

People are curious to know how cybercrimes are planned and how they actually take place (explained in Chapter 2). Worldwide, including India, cyberterrorists usually use computer as a tool, target or both for

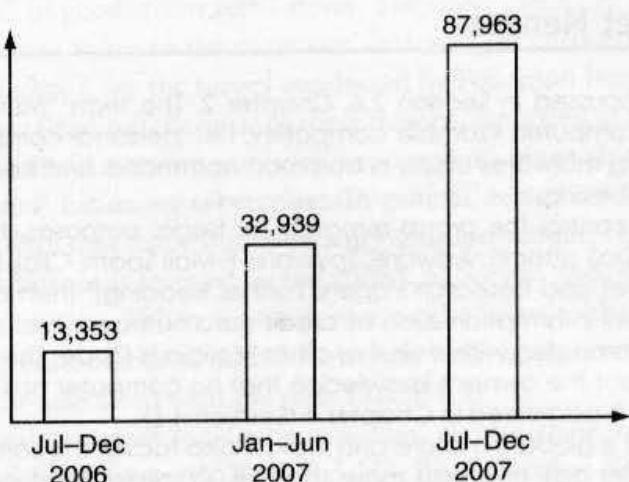


Figure 1.2 Rise in the number of Phishing hosts.

Source: Symantec (International Telecommunications Society, 17th Biennial Conference, Montreal, Canada, June 24–27, 2008).

their unlawful act to gain information which can result in heavy loss/damage to the owner of that intangible sensitive information. [See Further Reading, Books, Ref. #3 for a pointer to data privacy and understanding terms such as sensitive information, personal information (PI) and sensitive personal information (SPI).] Internet is one of the means by which the offenders can gain priced sensitive information of companies, firms, individuals, banks and can lead to intellectual property (IP) crimes (such as stealing new product plans, its description, market program plans, list of customers, etc.), selling illegal articles, pornography/child pornography, etc. This is done using methods such as Phishing, Spoofing, Pharming, Internet Phishing, wire transfer, etc. and use it to their own advantage without the consent of the individual. “Phishing” refers to an attack using mail programs to deceive or coax Internet users into disclosing confidential information that can be then exploited for illegal purposes. Figure 1.2 shows the increase in Phishing hosts.

1.3 Cybercrime and Information Security

Lack of information security gives rise to cybercrimes. This subject is explained in greater detail in Chapter 9. Let us refer to the amended Indian Information Technology Act (ITA) 2000^[7] in the context of cybercrime. From an Indian perspective, the new version of the Act (referred to as *ITA 2008*) provides a new focus on “Information Security in India.” “Cybersecurity” means protecting information, equipment, devices, computer, computer resource, communication device and information stored therein from unauthorized access, use, disclosure, disruption, modification or destruction. The term incorporates both the physical security of devices as well as the information stored therein. It covers protection from unauthorized access, use, disclosure, disruption, modification and destruction. (For a thorough discussion about these aspects, see Ref. #2, Books, Further Reading.

Where financial losses to the organization due to insider crimes are concerned (e.g., leaking customer data), often some difficulty is faced in estimating the losses because the financial impacts may not be detected by the victimized organization and no direct costs may be associated with the data theft. The 2008 CSI Survey^[8] on computer crime and security supports this. Cybercrimes occupy an important space in information security domain because of their impact. For anyone trying to compile data on business impact of cybercrime, there are number of challenges. One of them comes from the fact that organizations do not explicitly incorporate the cost of the vast majority of computer security incidents into their accounting as opposed to, say,

Box 1.2 The Botnet Menace!

The topic of Botnets is discussed in Section 2.6, Chapter 2. The term "Botnet" is used to refer to a group of compromised computers (zombie computers, i.e., personal computers secretly under the control of hackers) running malwares under a common command and control infrastructure. Figure 1.3 shows how a "zombie" works.

A Botnet maker can control the group remotely for illegal purposes, the most common being denial-of-service attack (DoS attack), Adware, Spyware, E-Mail Spam, Click Fraud (see reference links provided in Ref. #5, Articles and Research Papers, Further Reading), theft of application serial numbers, login IDs and financial information such as credit card numbers, etc. An attacker usually gains control by infecting the computers with a virus or other Malicious Code. The computer may continue to operate normally without the owner's knowledge that his computer has been compromised. The topic of computer viruses is addressed in Chapter 4 (Section 4.6).

The problem of Botnet is global in nature and India is also facing the same. India has an average of 374 new Bot attacks per day and had more than 38,000 distinct Bot-infected computers in the first half of the year 2009. Small and medium businesses in the country are at greater risk, as they are highly vulnerable to Bots, Phishing, Spam and Malicious Code attacks. Mumbai with 33% incidences tops the Bot-infected city list, followed by New Delhi at 25%, Chennai at 17% and Bangalore at 13%. Tier-II locations are now also a target of Bot-networks with Bhopal at 4% and Hyderabad, Surat, Pune and Noida at 1% each.

The Internet is a network of interconnected computers. If the computers, computer systems, computer resources, etc. are unsecured and vulnerable to security threats, it can be detrimental to the critical infrastructure of the country. We have witnessed the incidence of Cyberwar against Estonia and the same is possible against any country including India.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India (Chapter 3, Section 3.7, Fig. 3.8).

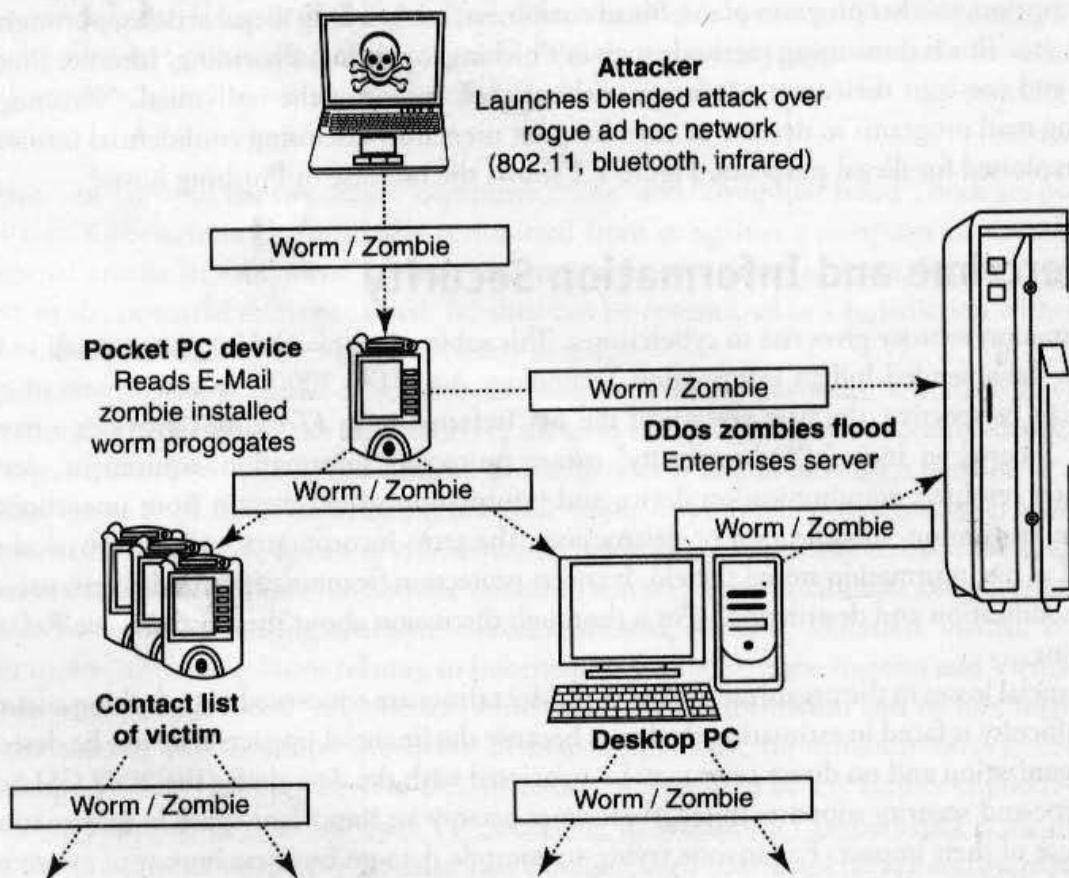


Figure 1.3 | How a zombie works.

accounting for the “shrinkage” of goods from retail stores. The other challenge comes from the difficulty in attaching a quantifiable monetary value to the corporate data and yet corporate data get stolen/lost (most notably through loss/theft of laptops, see the survey conducted by Ponemon Institute in Ref. #19, Additional Useful Web References, Further Reading). Because of these reasons, reporting of financial losses often remains approximate. In an attempt to avoid negative publicity, most organizations abstain from revealing facts and figures about “security incidents” including cybercrime. In general, organizations perception about “insider attacks” seems to be different than that made out by security solution vendor. However, this perception of an organization does not seem to be true as revealed by the 2008 CSI Survey. Awareness about “data privacy” too tends to be low in most organizations. When we speak of financial losses to the organization and significant insider crimes, such as leaking customer data, such “crimes” may not be detected by the victimized organization and no direct costs may be associated with the theft (Table 1.5).

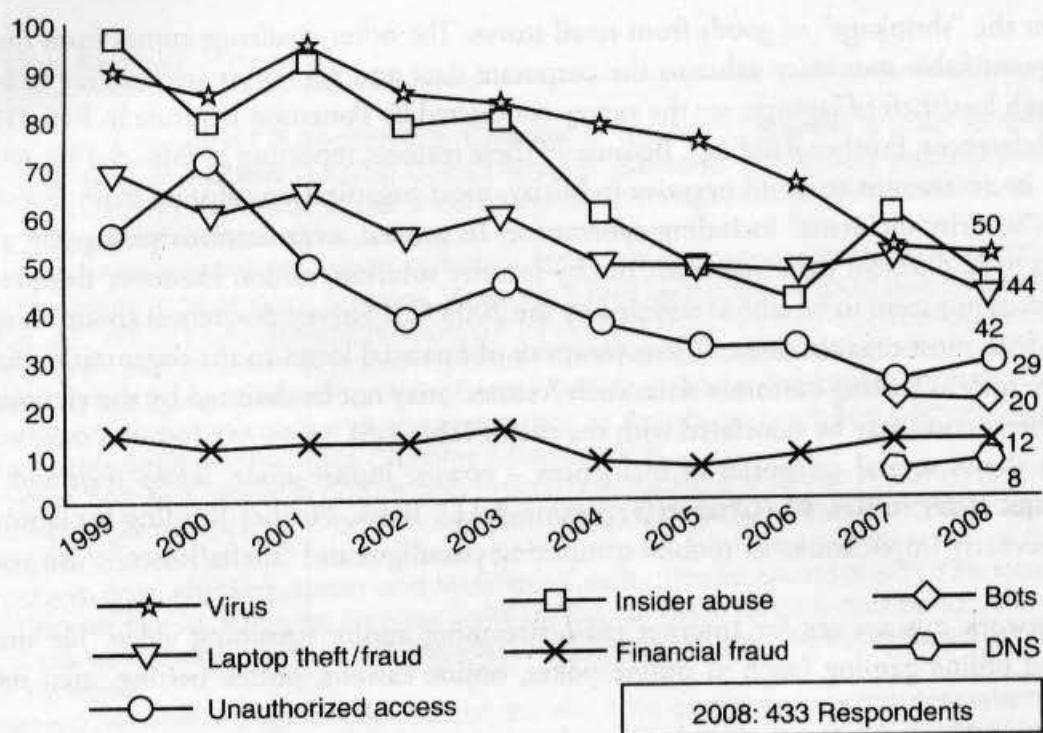
Figure 1.4 shows several categories of incidences – *viruses*, *insider abuse*, *laptop theft* and *unauthorized access* to systems. Refer to Ref. #1 (Chapter 3, Section 3.11), Book, Further Reading for laptop threats and information security implications in mobile computing paradigm and “thefts/losses.” Also read Chapter 9 of this book.

Typical network misuses are for Internet radio/streaming audio, streaming video, file sharing, instant messaging and online gaming (such as online poker, online casinos, online betting, etc.; refer to <http://>

Table 1.5 | Cybercrime trend over the years (1999–2008)

| <i>Types of Cybercrime</i> | <i>2004 (%)</i> | <i>2005 (%)</i> | <i>2006 (%)</i> | <i>2007 (%)</i> | <i>2008 (%)</i> |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|
| Denial of service (DoS) | 39 | 32 | 25 | 25 | 21 |
| Laptop theft | 49 | 48 | 47 | 50 | 42 |
| Telecom fraud | 10 | 10 | 8 | 5 | 5 |
| Unauthorized access | 37 | 32 | 32 | 25 | 29 |
| Viruses (addressed in Chapter 4) | 78 | 74 | 65 | 52 | 50 |
| Financial fraud | 8 | 7 | 9 | 12 | 12 |
| Insider abuse | 59 | 48 | 42 | 59 | 44 |
| System penetration | 17 | 14 | 15 | 13 | 13 |
| Sabotage | 5 | 2 | 3 | 4 | 2 |
| Theft/loss of proprietary information | 10 | 9 | 9 | 8 | 9 |
| • from mobile devices | | | | | 4 |
| • from all other sources | | | | | 5 |
| Website defacement (see Figs. 1.6–1.10) | 7 | 5 | 6 | 10 | 6 |
| Abuse of wireless network | 15 | 16 | 14 | 17 | 14 |
| Misuse of web application | 10 | 5 | 6 | 9 | 11 |
| Bots (see Box 1.2; more in Chapter 2) | | | | 21 | 20 |
| DoS attacks | | | | 6 | 8 |
| Instant messaging abuse | | | | 25 | 21 |
| Password sniffing (explained in Chapter 2) | | | | 10 | 9 |
| Theft/loss of customer data | | | | 17 | 17 |
| • from mobile devices | | | | | 8 |
| • from all other sources | | | | | 8 |

Source: 2008 CSI Computer Crime and Security Survey available at the link <http://i.cmpnet.com/v2.goci.com/pdf/CSIsurvey2008.pdf> (15 March 2009).

**Figure 1.4** Major types of incidents by percentage.

Source: 2008 CSI Computer Crime and Security Survey available at the link <http://i.cmpnet.com/v2.gocsi.com/pdf/CSIsurvey2008.pdf> (15 March 2009).

(en.wikipedia.org/wiki/Online_gambling). Online gambling is illegal in some countries – for example, in India. However, India has yet to pass laws that specifically deal with the issue, leaving a sort of legal loophole in the meantime. (In Ref. #20, Additional Useful Web References, Further Reading, we have provided links to refer to about legal status of online gambling in India. The Indian online gambling market is estimated to be worth 1–5 billion US\$!)

1.4 Who are Cybercriminals?

Cybercrime involves such activities as child pornography; credit card fraud; cyberstalking; defaming another online; gaining unauthorized access to computer systems; ignoring copyright, software licensing and trademark protection; overriding encryption to make illegal copies; software piracy and stealing another's identity (known as identity theft) to perform criminal acts (see detailed discussion on identity theft in Chapter 5). Cybercriminals are those who conduct such acts. They can be categorized into three groups that reflect their motivation (see Ref. #2, Books, Further Reading):

1. **Type I: Cybercriminals – hungry for recognition**
 - Hobby hackers;
 - IT professionals (social engineering is one of the biggest threat);
 - politically motivated hackers;
 - terrorist organizations.
2. **Type II: Cybercriminals – not interested in recognition**
 - Psychological perverts;
 - financially motivated hackers (corporate espionage);

- state-sponsored hacking (national espionage, sabotage);
 - organized criminals.
- 3. Type III: Cybercriminals – the insiders**
- Disgruntled or former employees seeking revenge;
 - competing companies using employees to gain economic advantage through damage and/or theft.

Thus, the typical “motives” behind cybercrime seem to be greed, desire to gain power and/or publicity, desire for revenge, a sense of adventure, looking for thrill to access forbidden information, destructive mindset and desire to sell network security services. This is explained in Chapter 10. Cybercafes are known to play role in committing cybercrimes. A link about cybercafes under ITA 2008 (amendment to Indian ITA 2000) is provided in Ref. #23, Additional Useful Web References, Further Reading. Another link, describing views if the amended ITA 2000 is stringent enough for cybercriminals, is provided in the same section as Ref. #24.

1.5 Classifications of Cybercrimes

Table 1.6 presents a scheme for cybercrime classification (broad and narrow classification).

Crime is defined as “*an act or the commission of an act that is forbidden, or the omission of a duty that is commanded by a public law and that makes the offender liable to punishment by that law*” (Webster Dictionary). Cybercrimes are classified as follows:

1. Cybercrime against individual

- *Electronic mail (E-Mail) Spoofing and other online frauds*: Refer to Section 1.5.1 of this chapter and Chapter 4 for more details.
- *Phishing, Spear Phishing* and its various other forms such as Vishing (Section 3.8.4) and Smishing (Section 3.8.5): Refer to Chapter 5 for discussion about Phishing and Spear Phishing.
- *Spamming*: It is explained in Section 1.5.2.
- *Cyberdefamation*: It is explained later in Section 1.5.3.
- *Cyberstalking and harassment*: It is explained in Chapter 2.
- *Computer sabotage*: It is explained later in Section 1.5.15.
- *Pornographic offenses*: It is explained in Section 1.5.13.
- *Password sniffing*: This also belongs to the category of cybercrimes against organization because the use of password could be by an individual for his/her personal work or the work he/she is doing using a computer that belongs to an organization. It is explained in Section 1.5.19 (also see Table 1.5).

Table 1.6 | Classifying cybercrimes – broad and narrow

| | <i>Cybercrime in Narrow Sense</i> | <i>Cybercrime in Broad Sense</i> | |
|------------------|--|--|---|
| Role of computer | <i>Computer as an object</i> The computer/information stored on the computer is the subject/target of the crime | <i>Computer as a tool</i> The computer/or information stored on the computer constitutes an important tool for committing the crime | <i>Computer as the environment or context</i> The computer/information stored on the computer plays a non-substantial role in the act of crime, but does contain evidence of the crime |
| Examples | Hacking, computer sabotage, DDoS-attacks (distributed denial-of-service attacks), virtual child pornography | Computer fraud, forgery distribution of child pornography | Murder using computer techniques, bank robbery and drugs trade |

2. Cybercrime against property

- *Credit card frauds:* Refer to Chapter 5 for Phishing and Spear Phishing and Chapter 11, Section 11.4 (in CD).
- *Intellectual property (IP) crimes:* Basically, IP crimes include software piracy, copyright infringement, trademarks violations, theft of computer source code, etc. (refer to Chapters 9 and 10).
- *Internet time theft:* It is explained in Section 1.5.4 as well as in Chapter 11 (Mini-Case 4, Section 11.3.4).

3. Cybercrime against organization

- *Unauthorized accessing of computer:* Hacking is one method of doing this and hacking is a punishable offense (see point 2 in Box 1.7).
- *Password sniffing:* It is explained in Section 1.5.19 (also see Table 1.5).
- *Denial-of-service attacks* (known as DoS attacks): It is explained more in detail in Chapter 4.
- *Virus attack/dissemination of viruses:* Refer to Chapter 4 for detailed discussion on this.
- *E-Mail bombing/mail bombs:* It is explained in Section 1.5.16.
- *Salami attack/Salami technique:* It is explained in Section 1.5.5.
- *Logic bomb:* It is explained in Section 1.5.15 (Computer Sabotage).
- *Trojan Horse:* It is explained more in detail in Chapter 4.
- *Data diddling:* It is explained in Section 1.5.6. Refer to Section 11.2.6, Chapter 11.
- *Crimes emanating from Usenet newsgroup:* It is explained in Section 1.5.9.
- *Industrial spying/industrial espionage:* It is explained in Section 1.5.10.
- *Computer network intrusions:* It is explained in Section 1.5.18.
- *Software piracy –* It is explained in Section 1.5.14. Also refer to Section 9.2.2, Chapter 9.

4. Cybercrime against Society

- *Forgery:* It is explained in Section 1.5.7 (see Table 1.6 and Box 1.6).
- *Cyberterrorism:* Refer to Box 1.1 and Box 1.7, and Section 1.2 for detailed discussion on this.
- *Web jacking:* It is explained in Section 1.5.8.

5. Crimes emanating from Usenet newsgroup:

By its very nature, Usenet groups may carry very offensive, harmful, inaccurate or otherwise inappropriate material, or in some cases, postings that have been mislabeled or are deceptive in another way. Therefore, it is expected that you will use caution and common sense and exercise proper judgment when using Usenet, as well as use the service at your own risk.

Let us take a brief look at some of the cybercrime forms mentioned above.

1.5.1 E-Mail Spoofing

A spoofed E-Mail is one that appears to originate from one source but actually has been sent from another source. For example, let us say, Roopa has an E-Mail address roopa@asianlaws.org. Let us say her boyfriend Suresh and she happen to have a show down. Then Suresh, having become her enemy, spoofs her E-Mail and sends obscene/vulgar messages to all her acquaintances. Since the E-Mails appear to have originated from Roopa, her friends could take offense and relationships could be spoiled for life. See Box 2.7 in Chapter 2.

1.5.2 Spamming

People who create electronic Spam are called *spammers*. Spam is the abuse of electronic messaging systems (including most broadcast media, digital delivery systems) to send unsolicited bulk messages indiscriminately. Although the most widely recognized form of Spam is E-Mail Spam, the term is applied to similar abuses in other media: instant messaging Spam, Usenet newsgroup Spam, web search engine Spam, Spam in blogs, wiki Spam, online classified ads Spam, mobile phone messaging Spam, Internet forum Spam, junk fax transmissions, social networking Spam, file sharing network Spam, video sharing sites, etc.

Spamming is difficult to control because it has economic viability – advertisers have no operating costs beyond the management of their mailing lists, and it is difficult to hold senders accountable for their mass mailings. Spammers are numerous; the volume of unsolicited mail has become very high because the barrier to entry is low. The costs, such as lost productivity and fraud, are borne by the public and by Internet service providers (ISPs), who are forced to add extra capacity to cope with the deluge. Spamming is widely detested, and has been the subject of legislation in many jurisdictions – for example, the CAN-SPAM Act of 2003.

Another definition of spamming is in the context of “search engine spamming.” In this context, spamming is alteration or creation of a document with the intent to deceive an electronic catalog or a filing system. Some web authors use “subversive techniques” to ensure that their site appears more frequently or higher number in returned search results – this is strongly discouraged by search engines and there are fines/penalties associated with the use of such subversive techniques. Those who continually attempt to subvert or Spam the search engines may be permanently excluded from the search index. Therefore, the following web publishing techniques should be avoided:

1. Repeating keywords;
2. use of keywords that do not relate to the content on the site;
3. use of fast meta refresh;
4. redirection;
5. IP Cloaking;
6. use of colored text on the same color background;
7. tiny text usage;
8. duplication of pages with different URLs;
9. hidden links;
10. use of different pages that bridge to the same URL (gateway pages).

Further discussion on each of the above is beyond the scope of this chapter which is meant to be only an overview of cybercrimes.

1.5.3 Cyberdefamation



Cyberdefamation is a cognizable offense.

Let us first understand what the term entails. CHAPTER XXI of the Indian Penal Code (IPC) is about DEFAMATION. In Section 499 of CHAPTER XXI of IPC, regarding “defamation” there is a mention that

“Whoever, by words either spoken or intended to be read, or by signs or by visible representations, makes or publishes any imputation concerning any person intending to harm, or knowing or having reason to believe that such imputation will harm, the reputation of such person, is said, except in the cases hereinafter expected, to defame that person.”

Cyberdefamation happens when the above takes place in an electronic form. In other words, “cyberdefamation” occurs when defamation takes place with the help of computers and/or the Internet, for example, someone publishes defamatory matter about someone on a website or sends an E-Mail containing defamatory information to all friends of that person. According to the IPC Section 499:

1. It may amount to defamation to impute anything to a deceased person, if the imputation would harm the reputation of that person if living, and is intended to be hurtful to the feelings of his family or other near relatives.

Box 1.3 Internet: A New Fuel for Defamation?

The Web allows an instant global publication of information at a very low cost. Information, which would not normally be revealed prior to the advent of the Internet, can now be obtained by practically anyone. The relatively low cost of connecting to the Internet and the ease of establishing one's own website means that the opportunity for defamation has increased considerably. Now, on the Internet everyone may be a publisher and may be sued as a publisher. A key feature of the Internet is that users do not have to reveal their true identity to send E-Mail or post messages on bulletin boards. Figure 1.5 shows the humor regarding this on the lighter side. Users are able to communicate and make such postings anonymously or under assumed names.

"Faceless" communication channel is the unique feature brought about by the Internet. Not only that but also people can access the Internet in privacy and seclusion of their own homes or offices. These features of the Internet plus the interactive, responsive nature of communications on the Internet means that now the users are far less inhibited about the contents of their messages resulting in cyberspace becoming excessively prone to defamation.

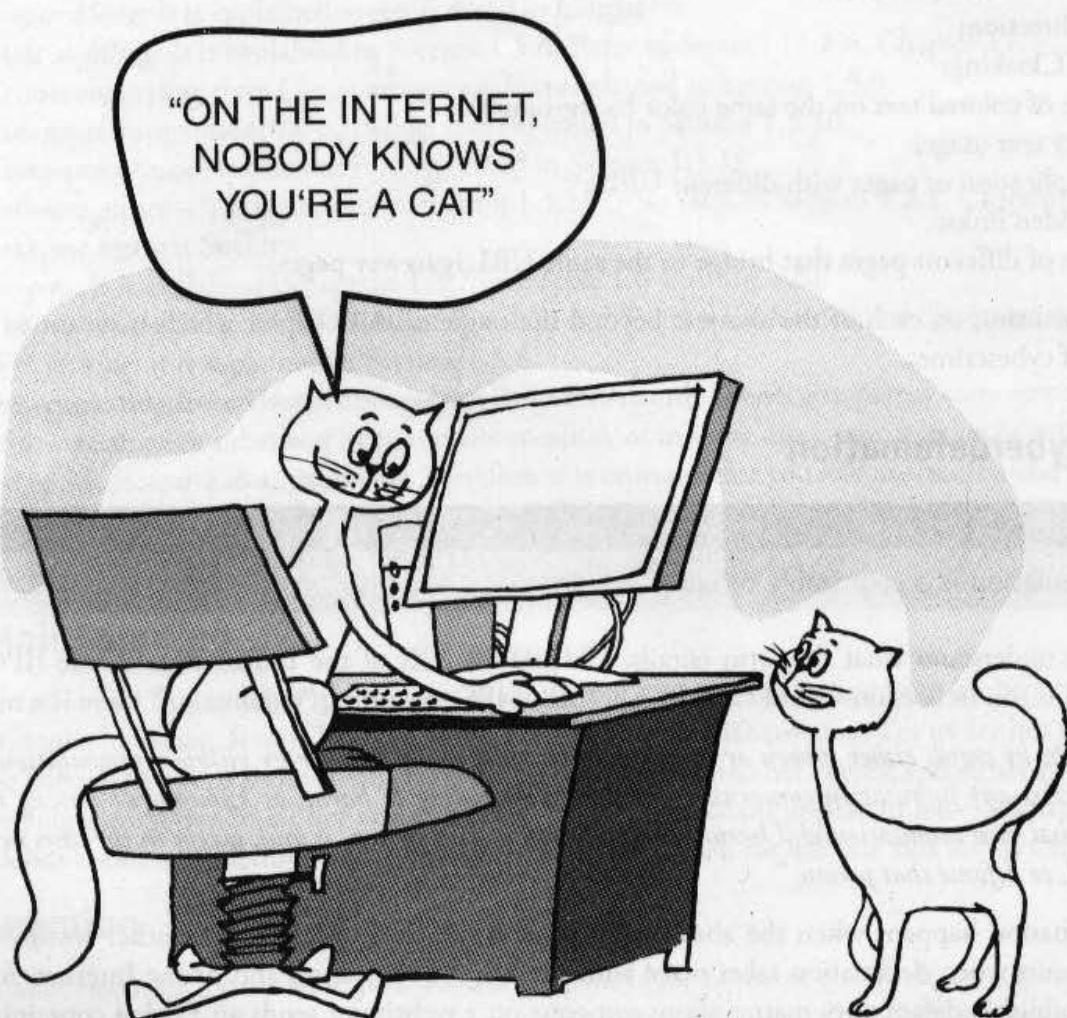


Figure 1.5 | Anonymity for Internet users.

2. It may amount to defamation to make an imputation concerning a company or an association or collection of persons as such.
3. An imputation in the form of an alternative or expressed ironically, may amount to defamation.
4. No imputation is said to harm a person's reputation unless that imputation directly or indirectly, in the estimation of others, lowers the moral or intellectual character of that person, or lowers the character of that person in respect of his caste or of his calling, or lowers the credit of that person, or causes it to be believed that the body of that person is in a loathsome state or in a state generally considered as disgraceful.

Libel is written defamation and *slander* is oral defamation. When determining whether or not defamation has taken place, the only issue to consider is whether a person of ordinary intelligence in society would believe that the words would indeed injure the person's reputation. Even if there is no (apparent) damage to a person's reputation, the person who made the allegations may still be held responsible for defamation.

The law on defamation attempts to create a workable balance between two equally important human rights: *The right to an unimpaired reputation* and *the right to freedom of expression*. In a cybersociety, both these interests are increasingly important. Protection of reputation is arguably even more important in a highly technological society, because one may not even encounter an individual or organization other than through the medium of the Internet. Some courts have held that the plaintiff must also have to show that the defamatory statements were unlawful and that it must not be for the defendant to justify his conduct by showing that the statements were in accordance with law. India's first case of cyberdefamation, at the Delhi Court, assumed jurisdiction over a matter where a corporate reputation was being defamed through E-Mails and passed an important ex-parte injunction. Further details on this case can be read at the link <http://cyberlaws.net/cyberindia/defamation.htm> (14 December 2009). Readers can also refer to the link http://en.wikipedia.org/wiki/Cyber_defamation_law (14 December 2009) for understanding cyberdefamation law.

1.5.4 Internet Time Theft

Such a theft occurs when an unauthorized person uses the Internet hours paid for by another person. Basically, Internet time theft comes under hacking because the person who gets access to someone else's ISP user ID and password, either by hacking or by gaining access to it by illegal means, uses it to access the Internet without the other person's knowledge. However, one can identify time theft if the Internet time has to be recharged often, even when one's own use of the Internet is not frequent. The issue of Internet time theft is related to the crimes conducted through "identity theft." In Chapter 11, there is a case described about theft of Internet time.

1.5.5 Salami Attack/Salami Technique

These attacks are used for committing financial crimes. The idea here is to make the alteration so insignificant that in a single case it would go completely unnoticed; for example a bank employee inserts a program, into the bank's servers, that deducts a small amount of money (say ₹ 2/- or a few cents in a month) from the account of every customer. No account holder will probably notice this unauthorized debit, but the bank employee will make a sizable amount every month. In Chapter 11, there are a number of examples, illustrations provided about use of Salami Technique in real life. Refer to Section 11.2 Real-Life Examples (Section 11.2.13 Example 13: Small "Shavings" for Big Gains! and Section 11.2.20 Example 20: The Petrol Pump Fraud).

1.5.6 Data Diddling

A data diddling attack involves altering raw data just before it is processed by a computer and then changing it back after the processing is completed. Electricity Boards in India have been victims to data diddling

programs inserted when private parties computerize their systems. In Chapter 11, there are a number of data diddling examples (refer to Section 11.2.6 Example 6: Doodle me Diddle!).

1.5.7 Forgery

Counterfeit currency notes, postage and revenue stamps, marksheets, etc. can be forged using sophisticated computers, printers and scanners. Outside many colleges there are miscreants soliciting the sale of fake marksheets or even degree certificates. These are made using computers and high quality scanners and printers. In fact, this is becoming a booming business involving large monetary amount given to student gangs in exchange for these bogus but authentic looking certificates.

1.5.8 Web Jacking

Web jacking occurs when someone forcefully takes control of a website (by cracking the password and later changing it). Thus, the first stage of this crime involves “password sniffing.” The actual owner of the website does not have any more control over what appears on that website.

1.5.9 Newsgroup Spam/Crimes Emanating from Usenet Newsgroup

As explained earlier, this is one form of spamming. The word “Spam” was usually taken to mean excessive multiple posting (EMP). The advent of Google Groups, and its large Usenet archive, has made Usenet more attractive to spammers than ever. Spaming of Usenet newsgroups actually predates E-Mail Spam. The first widely recognized Usenet Spam titled *Global Alert for All: Jesus is Coming Soon* (though not the most famous) was posted on 18 January 1994 by Clarence L. Thomas IV, a sysadmin at Andrews University. It was a fundamentalist religious tract claiming that “this world’s history is coming to a climax.” The newsgroup posting Bot Serdar Argic also appeared in early 1994, posting tens of thousands of messages to various newsgroups, consisting of identical copies of a political screed relating to the Armenian Genocide.

1.5.10 Industrial Spying/Industrial Espionage

Spying is not limited to governments. Corporations, like governments, often spy on the enemy. The Internet and privately networked systems provide new and better opportunities for espionage. “Spies” can get information about product finances, research and development and marketing strategies, an activity known as “industrial spying.” However, cyberspies rarely leave behind a trail. Industrial spying is not new; in fact it is as old as industries themselves. The use of the Internet to achieve this is probably as old as the Internet itself. Traditionally, this has been the reserved hunting field of a few hundreds of highly skilled hackers, contracted by high-profile companies or certain governments via the means of escrow organizations (it is said that they get several hundreds of thousands of dollars, depending on the “assignment”).

With the growing public availability of Trojans and Spyware material (for Trojans and Spyware discussion, refer to Chapter 4 in the book and Chapter 3 of Ref. #1, Books, Further Reading), even low-skilled individuals are now inclined to generate high volume profit out of industrial spying. This is referred to as “Targeted Attacks” (which includes “Spear Phishing”). This aspect of *Industrial Spying* is the one to be addressed in the fight against cybercrime.

Organizations subject to online extortion tend to keep quiet about it to avoid negative publicity about them. Not surprisingly, this also applies very well to organizations that are victim of focused attacks aiming at stealing corporate data, Intellectual Property or whatever else that may yield a competitive advantage for a rival company.

One interesting case is the famous Israeli Trojan story,^[9] where a software engineer in London created a Trojan Horse program specifically designed to extract critical data gathered from machines infected by his program. He had made a business out of selling his Trojan Horse program to companies in Israel, which would use it for industrial spying by planting it into competitors' networks. The methods used to inoculate the Trojan Horse were varied and sometimes quite inventive, ranging from simple E-Mail traps to the mailing of promotional CDs infected with the evil program! More about Trojan Horse is addressed in Chapter 2.

There are also the E-Mail worms automating similar "data exfiltration features." For example, the main characteristic of mass mailing worm deemed W32.Myfip.A^[10] is to scan the hard drive of infected machines for all files with the following extensions: .pdf, .doc, .dwg, .sch, .pcb, .dwt, .dwf, .max, .mdb. Such files are uploaded on an FTP server owned by the cybercrooks, with the aim of stealing as much IP as possible wherever it can be and then selling it to people who are ready to pay for it. There are two distinct business models for cybercrime applied to industrial spying: *Selling Trojan-ware* and *Selling Stolen Intellectual Property*.

1.5.11 Hacking

Although the purposes of hacking are many, the main ones are as follows:

1. Greed;
2. power;
3. publicity;
4. revenge;
5. adventure;
6. desire to access forbidden information;
7. destructive mindset.

Every act committed toward breaking into a computer and/or network is hacking and it is an offense. Hackers write or use ready-made computer programs to attack the target computer. They possess the desire to destruct and they get enjoyment out of such destruction. Some hackers hack for personal monetary gains, such as stealing credit card information, transferring money from various bank accounts to their own account followed by withdrawal of money. They extort money from some corporate giant threatening him to publish the stolen information that is critical in nature. Government websites are hot on hackers' target lists and attacks on Government websites receive wide press coverage. For example, according to the story posted on December 2009, the NASA site was hacked via SQL Injection (see Ref. #22, Additional Useful Web References, Further Reading). SQL Injection is covered more in detail in Chapter 4. Examples of prominent websites hacked are shown in Figs. 1.6–1.10.

Hackers, crackers and phrackers^[11] are some of the oft-heard terms. The original meaning of the word "hack" meaning an elegant, witty or inspired way of doing almost anything originated at MIT. The meaning has now changed to become something associated with the breaking into or harming of any kind of computer or telecommunications system. Some people claim that those who break into computer systems should ideally be called "crackers" and those targeting phones should be known as "phreaks" (see Chapter 17, Box 17.3 of Ref. #3, Books, Further Reading).

1.5.12 Online Frauds

Refer to Chapter 11, Section 11.7: Online Scams. There are a few major types of crimes under the category of hacking: Spoofing website and E-Mail security alerts, hoax mails about virus threats (refer to Chapter 4), lottery frauds and Spoofing. In Spoofing websites and E-Mail security threats, fraudsters create authentic

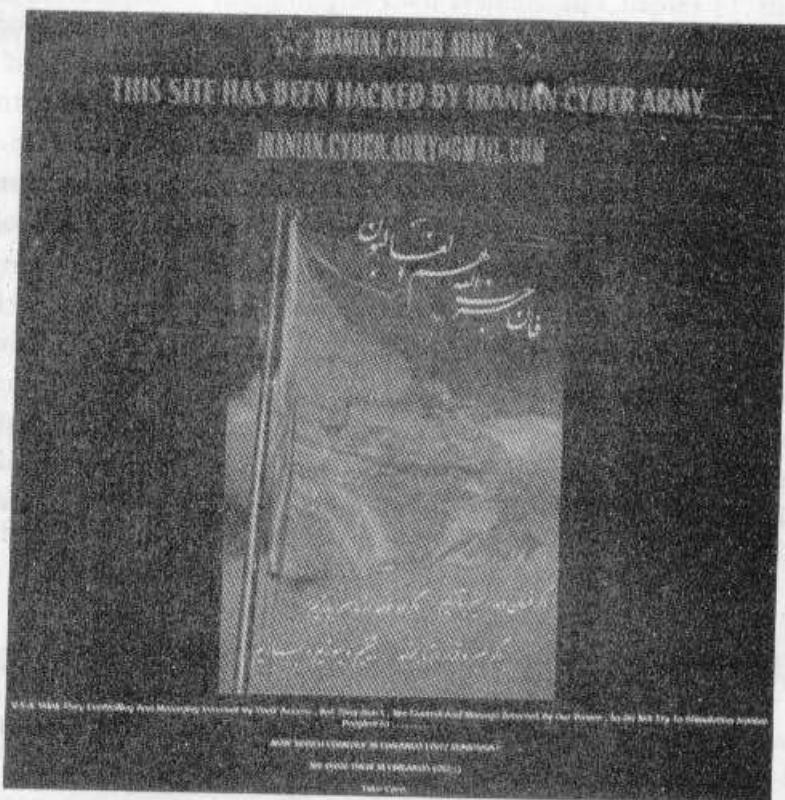


Figure 1.6 Twitter site hacked.

Source: <http://thenextweb.com/files/2009/12/Twitter-Hacked.png> (14 July 2010).

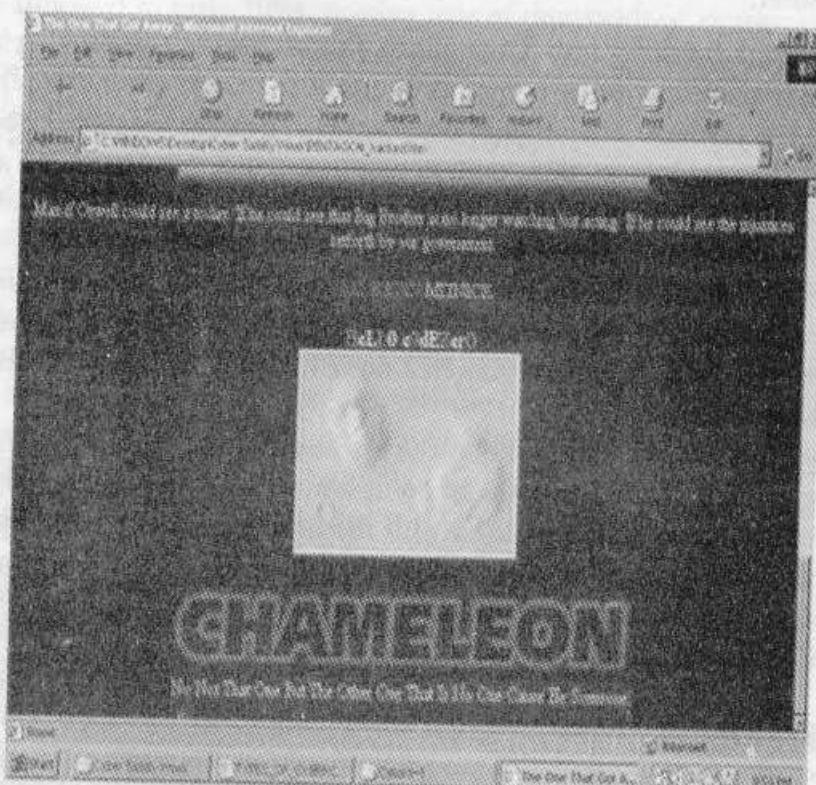


Figure 1.7 Pentagon, the US site defaced.

Source: <http://www.keylogger.org/news-world/hackers-attack-pentagon-1086.html>

Box 1.4 The Story of a Hacked Website

Nadya Suleman (Nadya Denise Doud-Suleman Gutierrez), famously known as "Octomom" in the media, is an American woman who came to international attention when she gave birth to octuplets in January 2009. Nadya launched a website to solicit donations for her family. However, her site was immediately hacked by a group of vigilante mothers! Nadya's website originally featured photos of all eight octuplets, a thank you note from Suleman, images of children's toys and a large donation button for viewers to send money through. Suleman also provided an address where people can send items such as diapers and baby food formula. The site was hacked and brought down within hours. The original homepage was left defaced as seen in Fig. 1.8.

The site was tagged by the famous hacker group MOD, also known as the Mothers of Disappointment. The mysterious group has a history of attacking personal sites they disapprove of; so much for the "psychology" of hackers! Probably these "Mothers" were hungry for "recognition" (recall the classification of cybercriminals in Section 1.4).

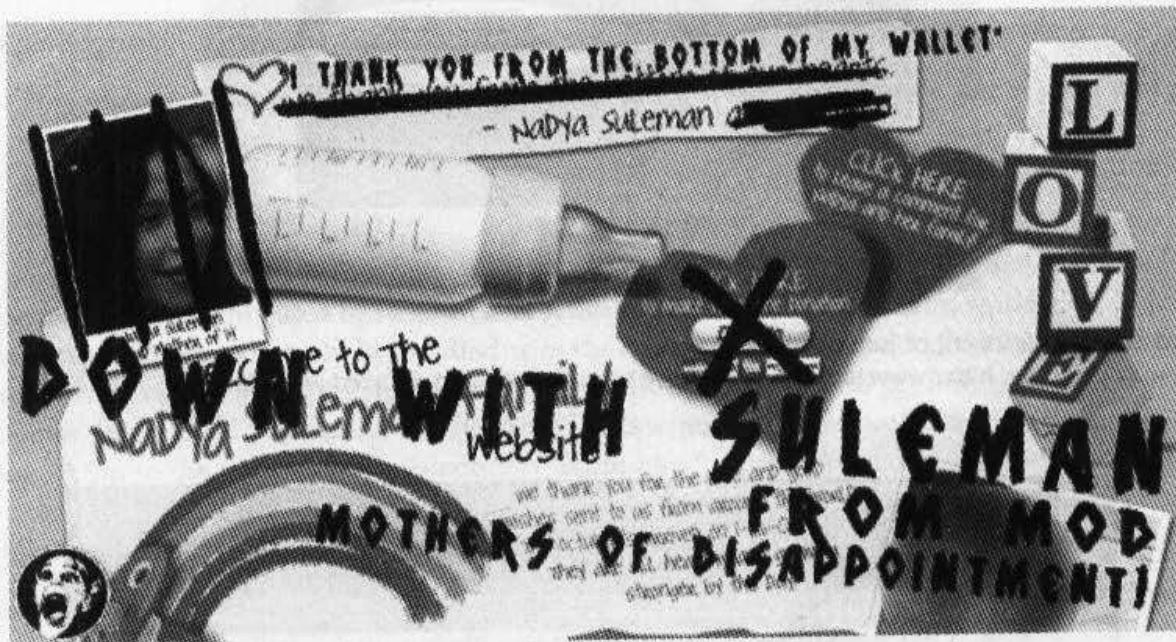


Figure 1.8 Octomom's defaced website.

Source: <http://weeklyworldnews.com/headlines/6233/nadya-sulemans-website-hacked/>

looking websites that are actually nothing but a spoof (see Chapter 5 for details of Spoofing). The purpose of these websites is to make the user enter personal information which is then used to access business and bank accounts. Fraudsters are increasingly turning to E-Mail to generate traffic to these websites. This kind of online fraud is common in banking and financial sector. Refer to Chapter 11, Section 11.4. There is a rise in the number of financial institutions' customers who receive such E-Mails which usually contain a link to a spoof website and mislead users to enter user ids and passwords on the pretence that security details can be updated or passwords changed. It is wise to be alert and careful about E-Mails containing an embedded link, with a request for you to enter secret details. It is strongly recommended not to input any sensitive information that might help criminals to gain access to sensitive information, such as bank account details, even if the page appears legitimate.

In virus hoax E-Mails, the warnings may be genuine, so there is always a dilemma whether to take them lightly or seriously. A wise action is to first confirm by visiting an antivirus site such as McAfee, Sophos or Symantec before taking any action, such as forwarding them to friends and colleagues.

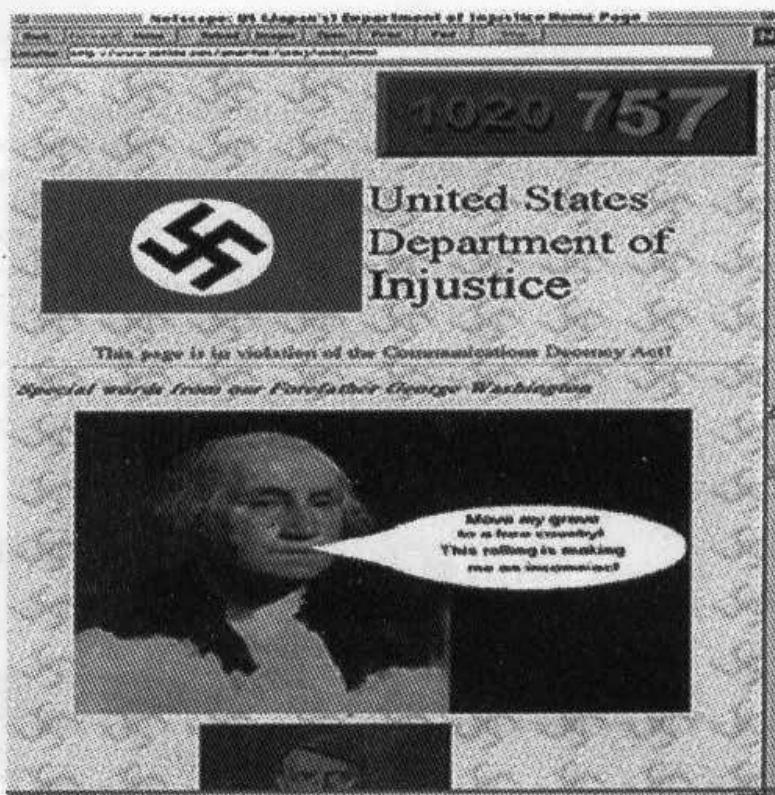


Figure 1.9 | Department of justice site defaced.

Source: <http://www.technize.com/see-all-the-hacked-and-defaced-websites/>

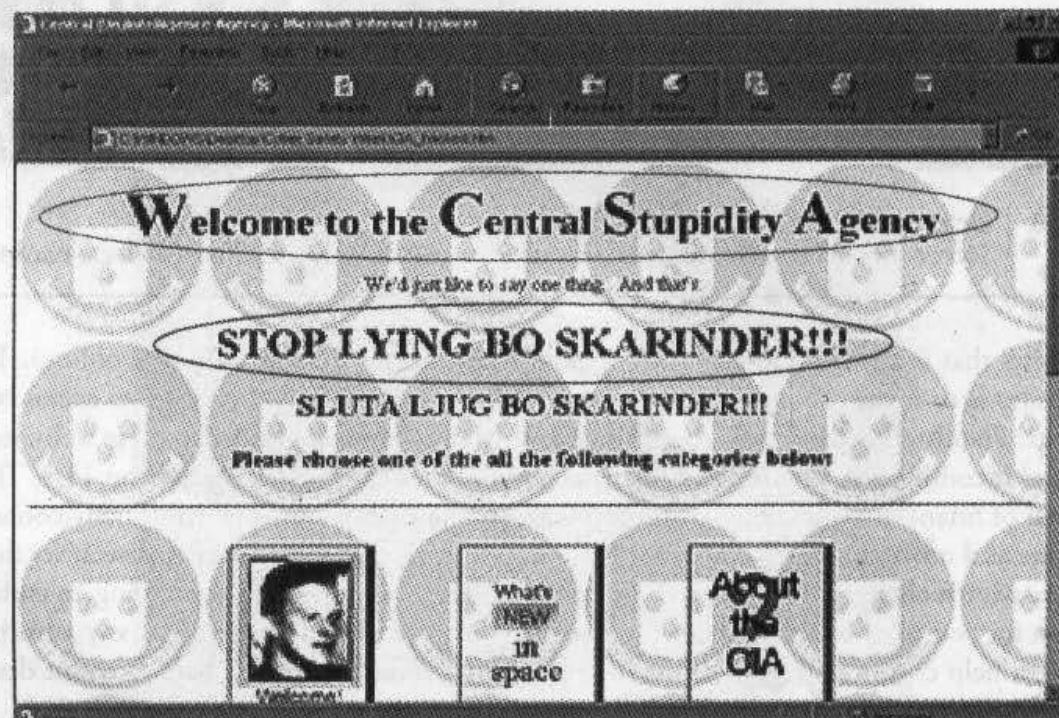


Figure 1.10 | CIA (Central Intelligence Agency), the US, website defaced.

Source: <http://www.technize.com/see-all-the-hacked-and-defaced-websites/>

Lottery frauds are typically letters or E-Mails that inform the recipient that he/she has won a prize in a lottery. To get the money, the recipient has to reply, after which another mail is received asking for bank details so that the money can be directly transferred. The E-Mail also asks for a processing fee/handling fee. Of course, the money is never transferred in this case; the processing fee is swindled and the banking details are used for other frauds and scams. Refer to Section 11.7.6, Chapter 11.

“Spoofing” means illegal intrusion, posing as a genuine user. A hacker logs-in to a computer illegally, using a different identity than his own. He is able to do this by having previously obtained the actual password. He creates a new identity by fooling the computer into thinking that the hacker is the genuine system operator and then hacker then takes control of the system. He can commit innumerable number of frauds using this false identity.

1.5.13 Pornographic Offenses

“Child pornography” means any visual depiction, including but not limited to the following:

1. Any photograph that can be considered obscene and/or unsuitable for the age of child viewer;
2. film, video, picture;
3. computer-generated image or picture of sexually explicit conduct where the production of such visual depiction involves the use of a minor engaging in sexually explicit conduct.

Child pornography is considered an offense. Unfortunately, child pornography is a reality of the Internet. The Internet is being highly used by its abusers to reach and abuse children sexually, worldwide. In India too, the Internet has become a household commodity in the urban areas of the nation. Its explosion has made the children a viable victim to the cybercrime. As the broad-band connections get into the reach of more and more homes, larger child population will be using the Internet and therefore greater would be the chances of falling victim to the aggression of pedophiles. “Pedophiles” are people who physically or psychologically coerce minors to engage in sexual activities, which the minors would not consciously consent to. Here is how pedophiles operate:

- Step 1:** Pedophiles use a false identity to trap the children/teenagers (using “false identity” which in itself is another crime called “identity theft”). ID Theft is addressed in Chapter 5.
- Step 2:** They seek children/teens in the kids’ areas on the services, such as the Teens BB, Games BB or chat areas where the children gather.
- Step 3:** They befriend children/teens.
- Step 4:** They extract personal information from the child/teen by winning his/her confidence.
- Step 5:** Pedophiles get E-Mail address of the child/teen and start making contacts on the victim’s E-Mail address as well. Sometimes, these E-Mails contain sexually explicit language.
- Step 6:** They start sending pornographic images/text to the victim including child pornographic images in order to help child/teen shed his/her inhibitions so that a feeling is created in the mind of the victim that what is being fed to him is normal and that everybody does it.
- Step 7:** At the end of it, the pedophiles set up a meeting with the child/teen out of the house and then drag him/her into the net to further sexually assault him/her or to use him/her as a sex object.

This is the irony of the “digital world”; in physical world, parents know the face of dangers and they know how to avoid and face the problems by following simple rules and accordingly they advice their children to keep away from dangerous things and ways. However, it is possible, even in the modern times most parents may not know the basics of the Internet and the associated (hidden) dangers from the services offered over

the Internet. Hence most children may remain unprotected in the cyberworld. Pedophiles take advantage of this situation and lure the children, who are not advised by their parents or by their teachers about what is right/wrong for them while browsing the Internet. Legal remedies exist only to some extent; for example, Children's Online Privacy Protection Act or COPPA is a way of preventing online pornography. Interested readers are referred to COPPA sites.^[12] Readers would like to note that Net Nanny and Cybersitter^[13] are software, originally designed for parents concerned about their children's unrestricted access to the seamier side of the Internet, which can be used to block a user's access to websites containing "dangerous" or "offensive" material.

1.5.14 Software Piracy

This is a big challenge area indeed. (Readers may like to refer to Chapter 38 and other relevant pages of Ref. #3, Books, Further Reading.) Cybercrime investigation cell of India defines "software piracy" as *theft of software through the illegal copying of genuine programs or the counterfeiting and distribution of products intended to pass for the original*. There are many examples of software piracy: *end-user copying* – friends loaning disks to each other, or organizations under-reporting the number of software installations they have made, or organizations not tracking their software licenses; *hard disk loading with illicit means* – hard disk vendors load pirated software; *counterfeiting* – large-scale duplication and distribution of illegally copied software; *illegal downloads from the Internet* – by intrusion, by cracking serial numbers, etc. Beware that those who buy pirated software have a lot to lose: (a) getting untested software that may have been copied thousands of times over, (b) the software, if pirated, may potentially contain hard-drive-infecting viruses, (c) there is no technical support in the case of software failure, that is, lack of technical product support available to properly licensed users, (d) there is no warranty protection, (e) there is no legal right to use the product, etc.

Economic impact of software piracy is grave (see Fig. 1.11). According to the Fourth Annual BSA and IDC Global Software Piracy Study,^[14] in Asia Pacific 55% of the software installed in 2006 on personal computers (PCs) was obtained illegally, while software losses due to software piracy amounted to US\$ 11.6 billion. The Global Software Piracy Study mentioned covers all packaged software that runs on personal computers, including desktops, laptops and ultraportables. The study includes operating systems, systems software such as databases and security packages, business applications and consumer applications such as PC games, personal finance and reference software. Refer to Section 9.2.2, Chapter 9.

The BSA/IDC study of year 2006 did not include other types of software such as those which run on servers or mainframes or software sold as a service. It is shocking to know that 35% of the software installed in 2006 on PCs worldwide was obtained illegally, amounting to nearly \$40 billion in global losses due to software piracy. Progress was seen in a number of emerging markets, most notably in China, where the piracy rate dropped 10 percentage points in 3 years, and in Russia, where piracy fell seven percentage points over 3 years. Figure 1.12 shows the regional scenario on piracy rate.

1.5.15 Computer Sabotage

The term "sabotage" has been mentioned many times in this chapter (Table 1.5, Section 1.2, Section 1.4 – Type II criminals, Table 1.6). The use of the Internet to hinder the normal functioning of a computer system through the introduction of worms, viruses (refer to Chapter 4) or logic bombs, is referred to as computer sabotage. It can be used to gain economic advantage over a competitor, to promote the illegal activities of terrorists or to steal data or programs for extortion purposes. Logic bombs are event-dependent programs created to do something only when a certain event (known as a trigger event) occurs. Some viruses may be termed as logic bombs because they lie dormant all through the

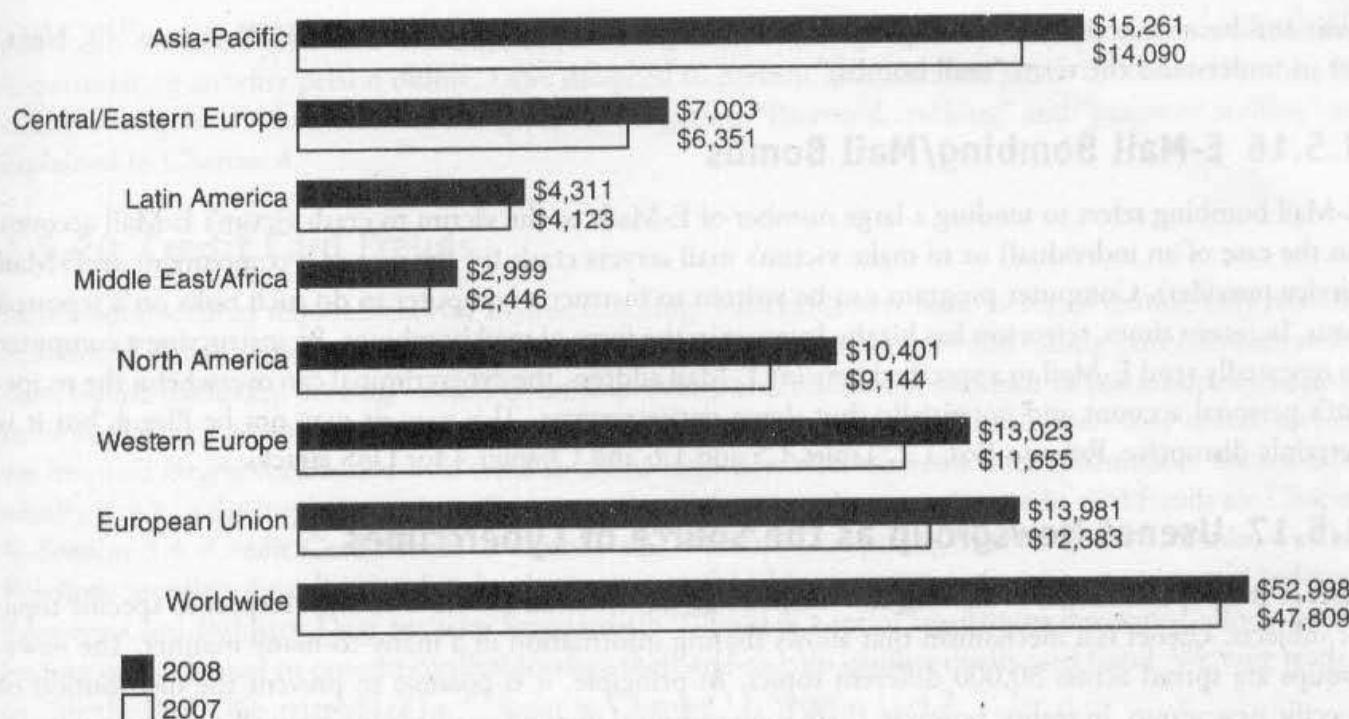


Figure 1.11 Dollars lost (year 2008) due to (software) piracy – regional scenario.

Source: BSA-IDC Global 2008 Piracy Study released on May 2009 at the following link:
<http://global.bsa.org/globalpiracy2008/studies/globalpiracy2008.pdf> (29 January 2010).

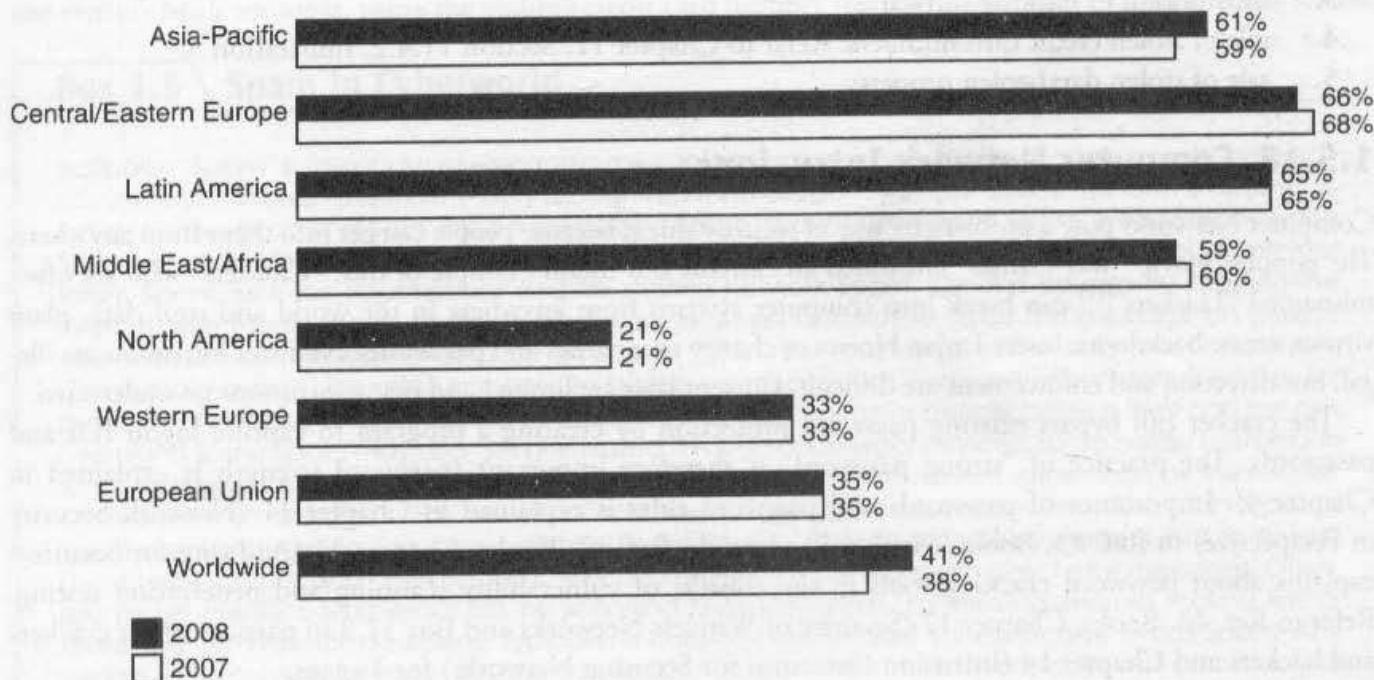


Figure 1.12 Regional picture on piracy rate.

Source: BSA-IDC Global 2008 Piracy Study released on May 2009 at the following link:
<http://global.bsa.org/globalpiracy2008/studies/globalpiracy2008.pdf> (29 January 2010).

year and become active only on a particular date (e.g., the Chernobyl virus and Y2K viruses^[15]). Next, let us understand the term “mail bombs.”

1.5.16 E-Mail Bombing/Mail Bombs

E-Mail bombing refers to sending a large number of E-Mails to the victim to crash victim's E-Mail account (in the case of an individual) or to make victim's mail servers crash (in the case of a company or an E-Mail service provider). Computer program can be written to instruct a computer to do such tasks on a repeated basis. In recent times, terrorism has hit the Internet in the form of mail bombings. By instructing a computer to repeatedly send E-Mail to a specified person's E-Mail address, the cybercriminal can overwhelm the recipient's personal account and potentially shut down entire systems. This may or may not be illegal, but it is certainly disruptive. Refer to Box 1.2, Tables 1.5 and 1.6 and Chapter 4 for DoS attacks.

1.5.17 Usenet Newsgroup as the Source of Cybercrimes

Usenet is a popular means of sharing and distributing information on the Web with respect to specific topic or subjects. Usenet is a mechanism that allows sharing information in a many-to-many manner. The newsgroups are spread across 30,000 different topics. In principle, it is possible to prevent the distribution of specific newsgroup. In reality, however, there is no technical method available for controlling the contents of any newsgroup. It is merely subject to self-regulation and net etiquette. It is feasible to block specific newsgroups, however, this cannot be considered as a definitive solution to illegal or harmful content. It is possible to put Usenet to following criminal use:

1. Distribution/sale of pornographic material;
2. distribution/sale of pirated software packages;
3. distribution of hacking software;
4. sale of stolen credit card numbers. Refer to Chapter 11, Section 11.4.2, Illustration 5;
5. sale of stolen data/stolen property.

1.5.18 Computer Network Intrusions

Computer Networks pose a problem by way of security threat because people can get into them from anywhere. The popular movie “War Games” illustrated an extreme but useful example of this. “Crackers” who are often misnamed “Hackers”^[11] can break into computer systems from anywhere in the world and steal data, plant viruses, create backdoors, insert Trojan Horses or change user names and passwords. Network intrusions are illegal, but detection and enforcement are difficult. Current laws are limited and many intrusions go undetected.

The cracker can bypass existing password protection by creating a program to capture logon IDs and passwords. The practice of “strong password” is therefore important (password strength is explained in Chapter 4). Importance of passwords and password rules is explained in Chapter 11 (Network Security in Perspective) in Ref. #3, Books, Further Reading. In Ref. #3, Books, Chapter 35 (Auditing for Security) explains about password cracking tools in the context of vulnerability scanning and penetration testing. Refer to Ref. #3, Books, Chapter 17 (Security of Wireless Networks and Box 17.3 in particular) for crackers and hackers and Chapter 14 (Intrusion Detection for Securing Networks) for Trojans.

1.5.19 Password Sniffing

Password Sniffers are programs that monitor and record the name and password of network users as they login, jeopardizing security at a site. Whoever installs the Sniffer can then impersonate an authorized user

and login to access restricted documents. Laws are not yet set up to adequately prosecute a person for impersonating another person online. Laws designed to prevent unauthorized access to information may be effective in apprehending crackers using Sniffer programs. "Password cracking" and "password sniffing" are explained in Chapter 4.

1.5.20 Credit Card Frauds

Information security requirements for anyone handling credit cards have been increased dramatically recently. Millions of dollars may be lost annually by consumers who have credit card and calling card numbers stolen from online databases. Security measures are improving, and traditional methods of law enforcement seem to be sufficient for prosecuting the thieves of such information. Bulletin boards and other online services are frequent targets for hackers who want to access large databases of credit card information. Such attacks usually result in the implementation of stronger security systems. For more on credit card frauds see Chapter 3, Section 3.4 (Credit Card Frauds in Mobile and Wireless Computing Era) in Ref. #1, Books, Further Reading. Security of cardholder data has become one of the biggest issues facing the payment card industry. Payment Card Industry Data Security Standard (PCI-DSS) is a set of regulations developed jointly by the leading card schemes to prevent cardholder data theft and to help combat credit card fraud. We urge readers to visit the PCI-DSS-related URLs.^[16] Refer to Chapter 11, Section 11.4.2.

1.5.21 Identity Theft

Identity theft is a fraud involving another person's identity for an illicit purpose. This occurs when a criminal uses someone else's identity for his/her own illegal purposes. Phishing and identity theft are related offenses (the topic is addressed in Chapter 5). Examples include fraudulently obtaining credit, stealing money from the victim's bank accounts, using the victim's credit card number (recall the discussion in the previous section

Box 1.5 Spam in Cyberworld

Basically, "Spam" is the abuse of electronic messaging systems to send unsolicited bulk messages indiscriminately. Although the most widely recognized form of Spam is E-Mail Spam, this term is applied to similar abuses in other media: instant messaging Spam, Usenet newsgroup Spam, web search engine Spam, Spam in blogs, wiki Spam, online classified ads Spam, mobile phone messaging Spam, Internet forum Spam, junk fax transmissions and file sharing network Spam. Spam is caused by flooding the Internet with many copies of the same message, in an attempt to force the message on people who would not otherwise choose to receive it. Often, this may result in the notorious DoS attack. Commercial advertising often happens to be the cause of Spam. Such advertisements are often for products of dubious reputation and fraud schemes meant to make people believe they can get rich overnight! Some Spam may also get generated through quasi-legal services. Spam hardly costs much to the sender; most of the costs are paid for by the recipient or the carriers rather than by the sender.

People who engage in the activity of electronic Spam are called spammers. Two main types of Spam are worth mentioning: "cancelable Usenet Spam" in which a single message is sent to several Usenet newsgroups and "E-Mail Spam" which targets individual users with direct mail messages. Often, spammers create E-Mail Spam lists by scanning Usenet postings, by stealing Internet mailing lists or searching the Web for addresses. Typically, it costs money to users if they receive E-Mail Spam. Any person with measured phone service can read or receive their mail. Spam does not cost much to people. Spam does, however, cost money to ISPs and to online service providers to transmit Spam. Unfortunately, subscribers end up paying these costs because the costs are transmitted directly to subscribers.

For further details, refer to Ref. #3 (Chapter 11, Denial-of-Service attacks, p. 177), Books, Further Reading.

about credit card frauds), establishing accounts with utility companies, renting an apartment or even filing bankruptcy using the victim's name. The cyberimpersonator can steal unlimited funds in the victim's name without the victim even knowing about it for months, sometimes even for years!

Thus far, we have provided an overview of various types of well-known cybercrimes. In most cybercrime forms, computers and/or other digital devices end up getting used as one or a combination of the following:

1. As the tool for committing cybercrime;
2. crime involving attack against the computer;
3. use for storing information related to cybercrime/information useful for committing cybercrime.

1.6 Cybercrime: The Legal Perspectives

Greater details on this are discussed in Chapter 6 and only a brief discussion is done in this section. Cybercrime poses a mammoth challenge. In the first comprehensive presentation of computer crime, *Computer Crime: Criminal Justice Resource Manual* (1979) (see Ref. #2, Additional Useful Web References, Further Reading), computer-related crime was defined in the broader meaning as: *any illegal act for which knowledge of computer technology is essential for a successful prosecution*. International legal aspects of computer crimes were studied in 1983. In that study, computer crime was consequently defined as: *encompasses any illegal act for which knowledge of computer technology is essential for its perpetration*.

Cybercrime, in a way, is the outcome of "globalization." However, globalization does not mean globalized welfare at all. Globalized information systems accommodate an increasing number of trans-national offenses. The network context of cybercrime makes it one of the most globalized offenses of the present and the most modernized threats of the future. This problem can be resolved in two ways. One is to divide information systems into segments bordered by state boundaries (cross-border flow of information). The other is to incorporate the legal system into an integrated entity obliterating these state boundaries. Apparently, the first way is unrealistic. Although all ancient empires including Rome, Greece and Mongolia became historical remnants, and giant empires are not prevalent in current world, the partition of information systems cannot be an imagined practice. In a globally connected world, information systems become the unique empire without tangible territory.

1.7 Cybercrimes: An Indian Perspective

India has the fourth highest number of Internet users in the world. According to the statistics posted on the site (<http://www.iamai.in/>), there are 45 million Internet users in India, 37% of all Internet accesses happen from cybercafes and 57% of Indian Internet users are between 18 and 35 years. The population of educated youth is high in India. It is reported that compared to the year 2006, cybercrime under the Information Technology (IT) Act recorded a whopping 50% increase in the year 2007.^[17] A point to note is that the majority of offenders were under 30 years. The maximum cybercrime cases, about 46%, were related to incidents of cyberpornography, followed by hacking. In over 60% of these cases, offenders were between 18 and 30 years, according to the "Crime in 2007" report of the National Crime Record Bureau (NCRB). Box 1.6 shows the Indian Statistics on cybercrimes. Also revisit Tables 1.1–1.4.

The Indian Government is doing its best to control cybercrimes. For example, Delhi Police have now trained 100 of its officers in handling cybercrime and placed them in its Economic Offences Wing. As at the time of writing this, the officers were trained for 6 weeks in computer hardware and software, computer networks comprising data communication networks, network protocols, wireless networks and network security.

Box 1.6 Cybercrimes: Indian Statistics

(A) Cybercrimes: Cases of Various Categories under ITA 2000

217 cases were registered under IT Act during the year 2007 as compared to 142 cases during the previous year (2006), thereby reporting an increase of 52.8% in 2007 over 2006. 22.3% cases (49 out of 217 cases) were reported from Maharashtra followed by Karnataka (40), Kerala (38) and Andhra Pradesh and Rajasthan (16 each).

45.6% (99 cases) of the total 217 cases registered under ITA 2000 were related to obscene publication/transmission in electronic form, known as cyberpornography. 86 persons were arrested for committing such offenses during 2007. There were 76 cases of hacking with computer system during the year wherein 48 persons were arrested. Out of the total (76) hacking cases, the cases relating to loss/damage of computer resource/utility under Section 66(1) of the IT Act were 39.5% (30 cases) whereas the cases related to hacking under Section 66(2) of IT Act were 60.5% (46 cases).

Maharashtra (19) and Kerala (4) registered maximum cases under Section 66(1) of the IT Act out of total 30 such cases at the National level. Out of the total 46 cases relating to hacking under Section 66(2), most of the cases (31) were reported from Karnataka followed by Kerala (7) and Andhra Pradesh (3). 29.9% of the 154 persons arrested in cases relating to ITA 2000 were from Maharashtra (46) followed by Karnataka and Madhya Pradesh (16 each). The age-wise profile of persons arrested in cybercrime cases under ITA 2000 showed that 63.0% of the offenders were in the age group 18–30 years (97 out of 154) and 29.9% of the offenders were in the age group 30–45 years (46 out of 154). Tamil Nadu reported two offenders whose ages were below 18 years.

India is said to be the "youth country" given the population age distribution. From the potential resources perspective, this is supposed to be a great advantage; assuming that these youths will get appropriate training to develop the required professional skills in them. However, from cyber-crime perspective, this youth aspect does not seem good as revealed by cybercrime statistics in India. Crime head-wise and age-group-wise profile of the offenders arrested under ITA 2000 revealed that 55.8% (86 out of 154) of the offenders were arrested under "Obscene publication/transmission in electronic form" of which 70.9% (61 out of 86) were in the age group 18–30 years. 50% (24 out of 48) of the total persons arrested for "Hacking with Computer Systems" were in the age group of 18–30 years.

(B) Cybercrimes: Cases of Various Categories under IPC Section

A total of 339 cases were registered under IPC Sections during the year 2007 as compared to 311 such cases during 2006, thereby reporting an increase of 9.0%. Madhya Pradesh reported maximum number of such cases, nearly 46.6% of total cases (158 out of 339) followed by Andhra Pradesh 15.6% (53 cases) and Chhattisgarh 15.3% (52 cases). Majority of the crimes out of total 339 cases registered under IPC fall under two categories, viz., Forgery (217) and Criminal Breach of Trust or Fraud (73). Although such offenses fall under the traditional IPC crimes, these cases had the cyberovertones wherein computer, Internet or its enabled services were present in the crime and hence they were categorized as Cybercrimes under IPC. The cyberforgery (217 cases) accounted for 0.33% out of the 65,326 cases reported under cheating. The cyberfrauds (73) accounted for 0.47% of the total Criminal Breach of Trust cases (15,531).

The cyberforgery cases were the highest in Madhya Pradesh (133) followed by Chhattisgarh (26) and Andhra Pradesh (22). The cases of cyberfraud were highest in Madhya Pradesh (20) followed by Punjab (17) and Andhra Pradesh (15). A total of 429 persons were arrested in the country for Cybercrimes under IPC during 2007. 61.5% offenders (264) of these were taken into custody for offenses under "Cyberforgery," 19.8% (85) for "Criminal Breach of Trust/Fraud" and 11.4% (49) for "Counterfeiting Currency/Stamps."

States such as Madhya Pradesh (166), Anhra Pradesh (83), Chhattisgarh (82) and Punjab (69) have reported higher arrests for cybercrimes registered under IPC. The age-group-wise profile of the arrested persons showed that 55.2% (237 of 429) were in the age group of 30–45 years and 29.4% (126 of 429) of the offenders were in the age group of 18–30 years. Only four offenders from Chhattisgarh were below 18 years of age. Crime head-wise and age-wise profile of the offenders arrested under Cybercrimes (IPC) offenders involved in forgery cases were more in the age group of 30–45 (54.9%, 145

Box 1.6 Cybercrimes: . . . (Continued)

of 264). 57.6% of the persons arrested under Criminal Breach of Trust/Cyberfraud offenses were in the age group 30–45 years (49 out of 85).

(C) Incidence of Cybercrimes in Cities

17 out of 35 mega cities did not report any case of cybercrime (neither under the IT Act nor under IPC Sections) during the year 2007. A total of 17 mega cities have reported 118 cases under IT Act and 7 mega cities reported 180 cases under various sections of IPC. There was an increase of 32.6% (from 89 cases in 2006 to 118 cases in 2007) in cases under IT Act as compared to previous year (2006), and an increase of 26.8% (from 142 cases in 2006 to 180 cases in 2007) of cases registered under various sections of IPC. Bengaluru (40), Pune (14) and Delhi (10) have reported high incidence of cases (64 out of 118 cases) registered under IT Act, accounting for more than half of the cases (54.2%) reported under the Act. Bhopal has reported the highest incidence (158 out of 180 cases) of cases reported under IPC sections accounting for 87.8%.

1.8 Cybercrime and the Indian ITA 2000

In India, the ITA 2000 was enacted after the United Nation General Assembly Resolution A/RES/51/162 in January 30, 1997 by adopting the Model Law on Electronic Commerce adopted by the United Nations Commission on International Trade Law. This was the first step toward the Law relating to E-Commerce at international level to regulate an alternative form of commerce and to give legal status in the area of E-Commerce. It was enacted taking into consideration UNICITRAL model of Law on Electronic Commerce (1996).^[18]

1.8.1 Hacking and the Indian Law(s)

Cybercrimes are punishable under two categories: the ITA 2000 and the IPC (see Tables 1.1 and 1.2). A total of 207 cases of cybercrime were registered under the IT Act in 2007 compared to 142 cases registered in 2006. Under the IPC too, 339 cases were recorded in 2007 compared to 311 cases in 2006. There are some noteworthy provisions under the ITA 2000, which is said to be undergoing key changes very soon (as at the time of writing this, Table 1.7).

Table 1.7 | The key provisions under the Indian ITA 2000 (before the amendment)

| <i>Section Ref. and Title</i> | <i>Chapter of the Act and Title</i> | <i>Crime</i> | <i>Punishment</i> |
|---|--|---|--|
| Sec. 43 (Penalty for damage to computer, computer system, etc.) | CHAPTER IX Penalties and Adjudication | Damage to computer system, etc. | Compensation for ₹ 1 crore (₹ 10,000,000). |
| Sec. 66 (Hacking with computer system) | CHAPTER XI Offences | Hacking (with intent or knowledge). | Fine of ₹ 2 lakhs (₹ 200,000) and imprisonment for 3 years. |
| Sec. 67 (Publishing of information which is obscene in electronic form) | CHAPTER XI Offences | Publication of obscene material in electronic form. | Fine of ₹ 1 lakh (₹ 100,000), imprisonment of 5 years and double conviction on second offence. |

(Continued)

Table 1.7 | (Continued)

| <i>Section Ref. and Title</i> | <i>Chapter of the Act and Title</i> | <i>Crime</i> | <i>Punishment</i> |
|---|-------------------------------------|--|--|
| Sec. 68 (Power of controller to give directions) | CHAPTER XI Offences | Not complying with directions of controller. | Fine up to ₹ 2 lakhs (₹ 200,000) and imprisonment of 3 years. |
| Sec. 70 (Protected system) | CHAPTER XI Offences | Attempting or securing access to computer of another person without his/her knowledge. | Imprisonment up to 10 years. |
| Sec. 72 (Penalty for breach of confidentiality and privacy) | CHAPTER XI Offences | Attempting or securing access to computer for breaking confidentiality of the information of computer. | Fine up to ₹ 1 lakh (₹ 100,000) and imprisonment up to 2 years. |
| Sec. 73 (Penalty for publishing Digital Signature Certificate false in certain particulars) | CHAPTER XI Offences | Publishing false digital signatures, false in certain particulars. | Fine of ₹ 1 lakh (₹ 100,000) or imprisonment of 2 years or both. |
| Sec. 74 (Publication for fraudulent purpose) | CHAPTER XI Offences | Publication of Digital Signatures for fraudulent purpose. | Imprisonment for the term of 2 years and fine of ₹ 1 lakh (₹ 100,000). |

Source: Information Technology Act 2000, Act no. 21, accessible at the URL: http://www.commonlii.org/in/legis/num_act/ita2000258/ (22 February 2000).

Box 1.7 Hacking and the ITA 2008

The number of Offenses to be monitored has increased. According to cyberlaw experts, "Any criminal activity that uses a computer either as an instrumentality, target or a means for perpetrating further crimes comes within the ambit of cybercrime." Cases of Spam, hacking, cyberstalking and E-Mail fraud are rampant and, although cybercrimes cells have been set up in major cities, the problem is that most cases remain unreported due to a lack of awareness. In a milieu like this, there are a number of pertinent questions in the minds of a commoner: When can consumers approach a cybercrime cell? What should the victims do? How does one maintain security online?

Any and every incident of cybercrime involving a computer or electronic network can be reported to a police station, irrespective of whether it maintains a separate cell or not. CHAPTER XI of the original ITA 2000 lists a number of activities that may be taken to constitute cybercrimes. This includes tampering with computer source code, hacking, publishing or transmitting any information in electronic form that is lascivious, securing access to a protected system, and breach of confidentiality and privacy. In the original ITA 2000, the following is stated under CHAPTER XI (Offences):

1. Whoever with the intent to cause or knowing that he is likely to cause wrongful loss or damage to the public or any person destroys or deletes or alters any information residing in a computer resource or diminishes its value or utility or affects it injuriously by any means, commits hack.
2. Whoever commits hacking shall be punished with imprisonment up to 3 years, or with fine which may extend up to ₹ 2 lakhs (₹ 200,000), or with both.

Box 1.7 Hacking . . . (Continued)

In the amendment to the IT Act 2000, now known as the ITA 2008, several offenses have been added to the Act. The amendments have now revealed a whole bundle of surprises which will make the cybercrime police jump. Existing Sections 66 and 67 (in the original ITA 2000) on hacking and obscene material have been updated by dividing them into more crime-specific subsections, thereby making cybercrimes punishable.

In Section 66, hacking as a term has been removed. This section has now been expanded to include Sections 66A (offensive messages), 66B (receiving stolen computer), 66C (identity theft), 66D (impersonation), 66E (voyeurism) and 66F (cyberterrorism). Section 66F is a new section of the ITA 2008 (recent amendments to the Indian ITA 2000). It covers "Cyberterrorism" and makes it punishable with imprisonment up to life term. This may cover hacking, DoS attacks, Port Scanning, spreading viruses, etc., if it can be linked to the object of terrorizing people. Conspiracy is also covered under the section. The offense is not bailable or compoundable. Refer to Chapter 4 to know more on computer viruses.

1.9 A Global Perspective on Cybercrimes

Cybercrime definitions were provided in Section 1.2. As mentioned there, statute and treaty law both refer to cybercrime. In Australia, cybercrime has a narrow statutory meaning as used in the *Cyber Crime Act* 2001, which details offenses against computer data and systems. However, a broad meaning is given to cybercrime at an international level. In the Council of Europe's (CoE's) *Cyber Crime Treaty*, cybercrime is used as an umbrella term to refer to an array of criminal activity including offenses against computer data and systems, computer-related offenses, content offenses and copyright offenses. This wide definition of cybercrime overlaps in part with general offense categories that need not be Information & Communication Technology (ICT)-dependent, such as white-collar crime and economic crime. Figure 1.13 shows countries taking actions against Spam. Although this status is from the International Telecommunication Union (ITU) survey conducted in 2005, we get an idea about the global perspective. The status on E-Mail Spam legislation by country is available at the site http://en.wikipedia.org/wiki/E-mail_spam_legislation_by_country (29 January 2010). ITU activities on countering Spam can be read by visiting the link www.itu.int/spam (8 May 2010).

The Spam legislation scenario mentions "none" about India as far as E-Mail legislation in India is concerned. The legislation refers to India as a "loose" legislation, although there is a mention in Section 67 of Indian ITA 2000. See Table 1.7.

About 30 countries have enacted some form of anti-Spam legislation (see Fig. 1.13). There are also technical solutions by ISPs and end-users. However, in spite of this, so far there has been no significant impact on the volume of Spam with spammers sending hundreds of millions of messages per day. The growing phenomenon is the use of Spam to support fraudulent and criminal activities – including attempts to capture financial information (e.g., account numbers and passwords) by masquerading messages as originating from trusted companies ("brand-spoofing" or "Phishing") – and as a vehicle to spread viruses and worms. On mobile networks, a peculiar problem is that of sending of bulk unsolicited text messages aimed at generating traffic to premium-rate numbers. As there are no national "boundaries" to such crimes under cybercrime realm, it requires international cooperation between those who seek to enforce anti-Spam laws.

Thus, one can see that there is a lot to do toward building confidence and security in the use of ICTs and moving toward international cooperation agenda. This is because in the 21st century, there is a growing dependency on ICTs that span the globe. There was a rapid growth in ICTs and dependencies that led to shift in perception of cybersecurity threats in mid-1990s. The linkage of cybersecurity and critical infrastructure protection has become a big issue as a number of countries have began assessment of threats,

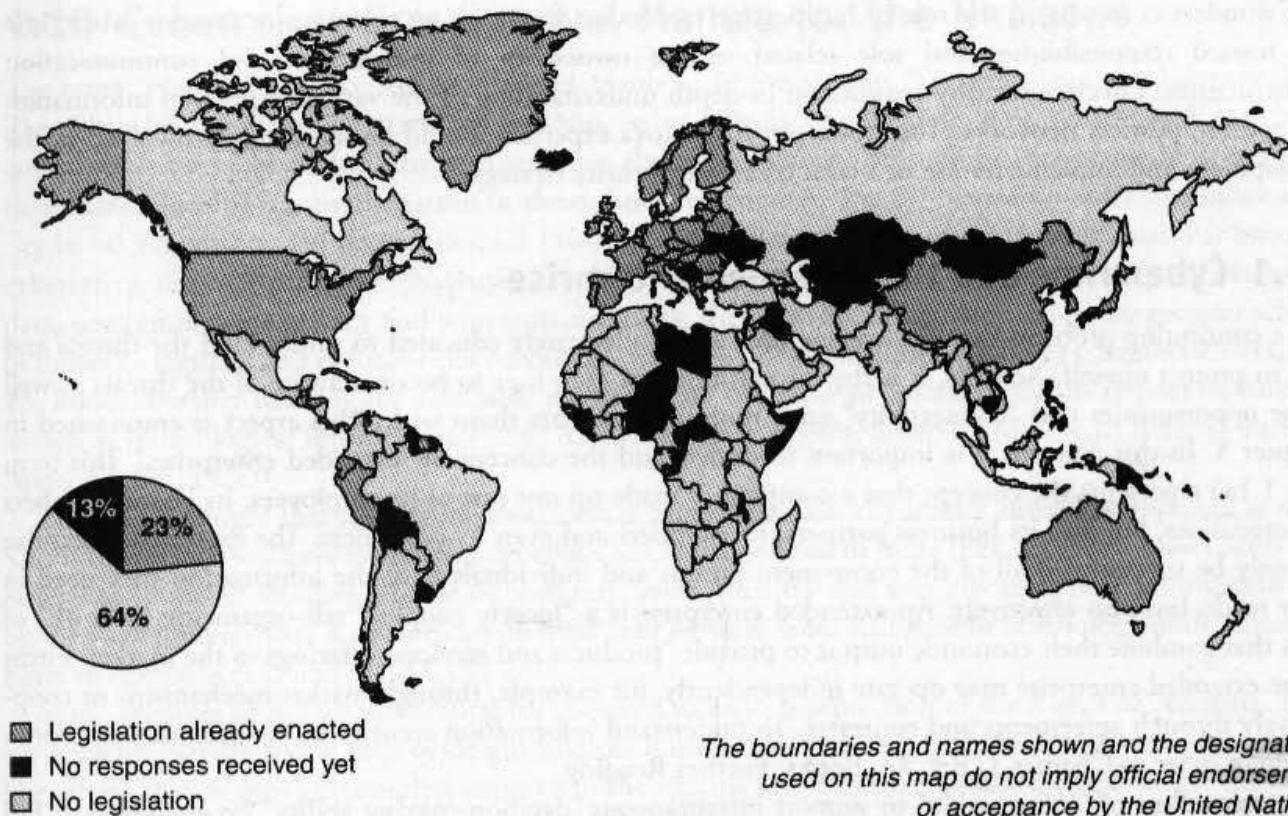


Figure 1.13 Worldwide picture on anti-Spam legislation.

Source: From the Presentation by Cristina Bueti, Programme Coordinator International Telecommunication Union, at the EU Spam Symposium, June 2006 at Maastricht, Holland – presentation can be accessed at the URL: <http://spamsymposium.eu/files/Cristina%20Bueti.ppt#1> (8 May 2010).

vulnerabilities and started exploring mechanisms to redress them. Recently, there have been a number of significant developments such as

1. August 4, 2006 Announcement: The US Senate ratifies CoE Convention on Cyber Crime. The convention targets hackers, those spreading destructive computer viruses (refer to Chapter 4), those using the Internet for the sexual exploitation of children or the distribution of racist material, and terrorists attempting to attack infrastructure facilities or financial institutions. The Convention is in full accord with all the US constitutional protections, such as free speech and other civil liberties, and will require no change to the US laws.
2. In August 18, 2006, there was a news article published “ISPs Wary About ‘Drastic Obligations’ on Web Site Blocking.” European Union (EU) officials want to debar suspicious websites as part of a 6-point plan to boost joint antiterrorism activities. They want to block websites that incite terrorist action. Once again it is underlined that monitoring calls, Internet and E-Mail traffic for law enforcement purposes is a task vested in the government, which must reimburse carriers and providers for retaining the data.
3. CoE Cyber Crime Convention (1997–2001) was the first international treaty seeking to address Internet crimes by harmonizing national laws, improving investigative techniques and increasing cooperation among nations.^[19] More than 40 countries have ratified the Convention to date.

One wonders as to what is the role of business/private sector in taking up measures to prevent cybercrime and toward responsibilities and role related to the ownership of information and communication infrastructures. Effective security requires an in-depth understanding of the various aspects of information and communication networks. Therefore, private sector's expertise should be increasingly involved in the development and implementation of a country's cybersecurity strategy.

1.9.1 Cybercrime and the Extended Enterprise

It is a continuing problem that the average user is not adequately educated to understand the threats and how to protect oneself. Actually, it is the responsibility of each user to become aware of the threats as well as the opportunities that "connectivity" and "mobility" presents them with. This aspect is emphasized in Chapter 3. In this context, it is important to understand the concept of "extended enterprise." This term (Fig. 1.14) represents the concept that a company is made up not just of its employees, its board members and executives, but also its business partners, its suppliers and even its customers. The extended enterprise can only be successful if all of the component groups and individuals have the information they need in order to do business effectively. An extended enterprise is a "loosely coupled, self-organizing network" of firms that combine their economic output to provide "products and services" offerings to the market. Firms in the extended enterprise may operate independently, for example, through market mechanisms or cooperatively through agreements and contracts. To understand information security in the extended enterprise paradigm, refer to Chapter 1, Ref. #3, Books, Further Reading.

Seamless flow of "information" to support instantaneous "decision-making ability" (as envisaged in Bill Gates' *Business@the Speed of Thought*) is crucial for the "external enterprise." This becomes possible through the "interconnectedness." Due to the interconnected features of information and communication technologies, security overall can only be fully promoted when the users have full awareness of the existing threats and dangers. Governments, businesses and the international community must, therefore, proactively help users' access information on how to protect themselves.

Given the promises and challenges in the extended enterprise scenario, organizations in the international community have a special role in sharing information on good practices, and creating open and accessible enterprise information flow channels for exchanging of ideas in a collaborative manner. International cooperation at the levels of government, industry, consumer, business and technical groups to allow a global and coordinated approach to achieving global cybersecurity is the key.

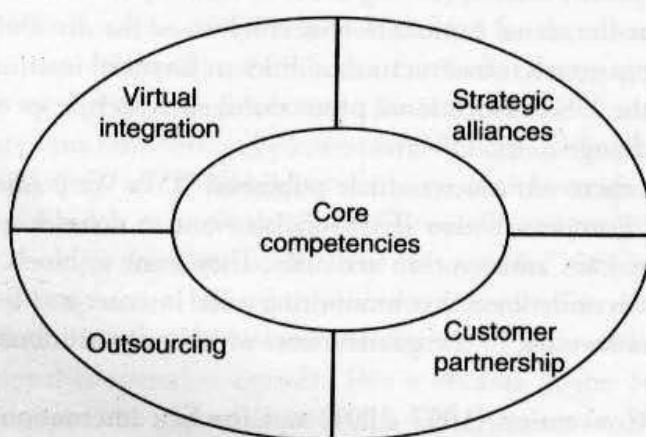


Figure 1.14 | Extended enterprise.

1.10 Cybercrime Era: Survival Mantra for the Netizens

The term “Netizen” was coined by Michael Hauben. Quite simply, “Netizens” are the Internet users. Therefore, by corollary, “Netizen” is someone who spends considerable time online and also has a considerable presence online (through websites about the person, through his/her active blog contribution and/or also his/her participation in the online chat rooms). The 5P Netizen mantra for online security is: (a) Precaution, (b) prevention, (c) Protection, (d) Preservation and (e) Perseverance. For ensuring cybersafety, the motto for the “Netizen” should be “Stranger is Danger!” If you protect your customer’s data, your employee’s privacy and your own company, then you are doing your job in the grander scheme of things to regulate and enforce rules on the Net through our community. [Refer to Chapters 29–31, Ref. #3, Books, Further Reading for a detailed discussion on the topic of “privacy” and its impact on business as well as technological impact on privacy (RFID, Software Agents, Smart Cards, etc.).] Refer to Part I of Appendix D (in CD).

NASSCOM urges that cybercrime awareness is important, and any matter should be reported at once. This is the reason they have established cyberlabs across major cities in India (Ref. #6, Additional Useful Web References, Further Reading). More importantly, users must try and save any electronic information trail on their computers. That is all one can do until laws become more stringent or technology more advanced. Refer to Appendices U and V (in CD).

Some agencies have been advocating for the need to address protection of the Rights of Netizens. There are agencies that are trying to provide guidance to innocent victims of cybercrimes. However, these NGO-like efforts cannot provide complete support to the victims of cybercrimes and are unable to get the necessary support from the Police. There are also a few incidents where Police have pursued false cases on innocent IT professionals. The need for a statutorily empowered agency to protect abuse of ITA 2000 in India was, therefore, a felt need for quite some time. Chapter 6 addresses further details on the Indian ITA 2000 and its subsequent amendments in the year 2008.

1.11 Concluding Remarks and Way Forward to Further Chapters

This chapter sets the context for the rest of the book; in that sense, this is a “curtain raiser” chapter. Having provided a broad overview about cybercrime, in the subsequent chapters reader will be taken through other key aspects of cybercrime: how the crimes are planned, the tools and methods used for launching the attacks, light on legal aspects of cybercrime, cyberforensics, social as well as psychological and ethical dimensions of cybercrime, organizational implications, career implications, etc. Chapter 11 has extensive illustrations on cybercrime. For the reasons of confidentiality and protection of individual privacy, the names and other details are masked; however the scenarios are real. If there happens to exist any individual by the name mentioned, living or deceased, then it would be a pure coincidence. A key message, as we end this chapter, is for the ethical hacking community; while some people argue that there should be no such term as “ethical hacking” because there cannot be anything ethical about hacking, the need for and availability of professional certifications such as “Certified Ethical Hacking” is purely for investigative nature. Even such individuals who work on commercial terms when invited to hack systems for vulnerability assessment, should remember that their job is highly onerous and that they should bear in mind their ethical responsibility all the time. These aspects are explained in Chapter 35, Ref. #3, Books, Further Reading.

SUMMARY

Cyberspace is one of the great legal frontiers of our time. Cybercrime is a term which is used to describe the act in which computers and networks are targeted for criminal activity. Such crimes have emerged as a new class of crimes, rapidly increasing due to extensive use of the Internet and IT-enabled services. We learnt in this chapter that there are many types of computer-related crimes. Cybercrimes range from tampering with computer documents, hacking and

cyberpornography to false electronic evidence, unauthorized access to protected computer documents and breach of confidentiality. Within India and worldwide, there has been a phenomenal rise in the incidents of cybercrime. The issue of cybercrime continues to grow as a controversy for several reasons. We need laws that protect us from computer crimes, but we also need laws that are not so controlling that they compromise our civil liberties and constitutional rights.

REVIEW QUESTIONS

1. What is cybercrime? How do you define it?
2. How do we classify cybercrimes? Explain each one briefly.
3. What are the different types of cybercriminals?
4. Is there a difference between “cybercrime” and “cyberfraud”? Explain.
5. How do viruses get disseminated? Explain with diagrams.
6. Write a short note on “Indian Legal Perspective on Cybercrime.” You may like to augment your note using your own research, in addition to the material presented in this chapter.
7. How do you think cybercrime has relevance in the extended enterprise context? Explain.
8. Explain in your own words what you understand about the global cooperation required in fighting against cybercrime.

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 The official COPPA website coming up soon, visit the site at: <http://www.mccoppa.co.uk/home1/index.html> (13 March 2009).
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The appendices that serve as extended material for the topics addressed in this chapter are: A, B, D, E, F, J, K, L, M, O, P, Q, U, V. These are provided in the companion CD.

2

Cyberoffenses: How Criminals Plan Them

Learning Objectives

After reading this chapter, you will be able to:

- Understand different types of cyberattacks.
 - Get an overview of the steps involved in planning cybercrime.
 - Understand tools used for gathering information about the target.
 - Get an overview on social engineering – what and how.
 - Learn about the role of cybercafes in cybercrime.
 - Understand what cyberstalking is.
 - Learn about Botnets and attack vector.
 - Get an overview on cloud computing – what and how.
-

2.1 Introduction

Technology is a “double-edged sword” as it can be used for both good and bad purposes. People with the tendency to cause damages or carrying out illegal activities will use it for bad purpose. Computers and tools available in IT are also no exceptions; like other tool, they are used as either target of offense or means for committing an offense. In today’s world of Internet and computer networks, a criminal activity can be carried out across national borders with “false sense of anonymity”; without realizing, we seem to pass on tremendous amount of information about ourselves. Are we sure this will never be misused? Figure 2.1 gives us an idea about all those agencies that collect information about the individuals (i.e., Personally Identifiable Information such as date of birth, personal E-Mail address, bank account details and/or credit card details, etc. explained in Section 5.3.1, Chapter 5).

Chapter 1 provided an overview of *hacking, industrial espionage, network intrusions, password sniffing, computer viruses*, etc. They are the most commonly occurring crimes that target the computer. Cybercriminal use the World Wide Web and Internet to an optimum level for all illegal activities to store data, contacts, account information, etc. The criminals take advantage of the widespread lack of awareness about cybercrimes and cyberlaws among the people who are constantly using the IT infrastructure for official and personal purposes. People who commit cybercrimes are known as “Crackers” (Box 2.1).

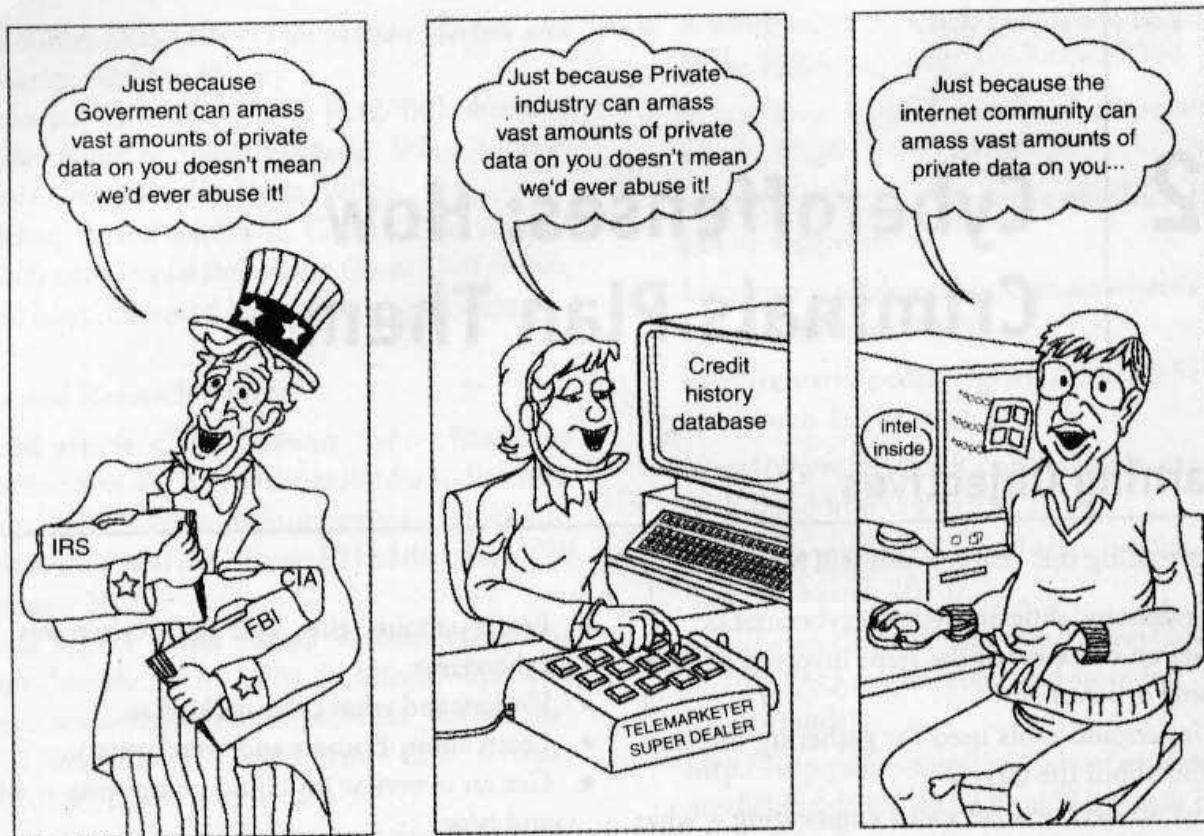


Figure 2.1 We all vouch for keeping your personal information secret!

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices* (Fig. 29.14), Wiley India.

Box 2.1 Hackers, Crackers and Phreakers

Hacker: A hacker is a person with a strong interest in computers who enjoys learning and experimenting with them. Hackers are usually very talented, smart people who understand computers better than others. The term is often confused with cracker that defines someone who breaks into computers (refer to Box 2.2).

Brute force hacking: It is a technique used to find passwords or encryption keys. Brute force hacking involves trying every possible combination of letters, numbers, etc., until the code is broken.

Cracker: A cracker is a person who breaks into computers. Crackers should not be confused with hackers. The term "cracker" is usually connected to computer criminals. Some of their crimes include vandalism, theft and snooping in unauthorized areas.

Cracking: It is the act of breaking into computers. Cracking is a popular, growing subject on the Internet. Many sites are devoted to supplying crackers with programs that allow them to crack computers. Some of these programs contain dictionaries for guessing passwords. Others are used to break into phone lines (called "phreaking"). These sites usually display warnings such as "These files are illegal; we are not responsible for what you do with them."

Cracker tools: These are programs used to break into computers. Cracker tools are widely distributed on the Internet. They include password crackers, Trojans, viruses, war dialers and worms.

Phreaking: This is the notorious art of breaking into phone or other communication systems. Phreaking sites on the Internet are popular among crackers and other criminals.

War dialer: It is program that automatically dials phone numbers looking for computers on the other end. It catalogs numbers so that the hackers can call back and try to break in.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices* (Box 11.2), Wiley India.

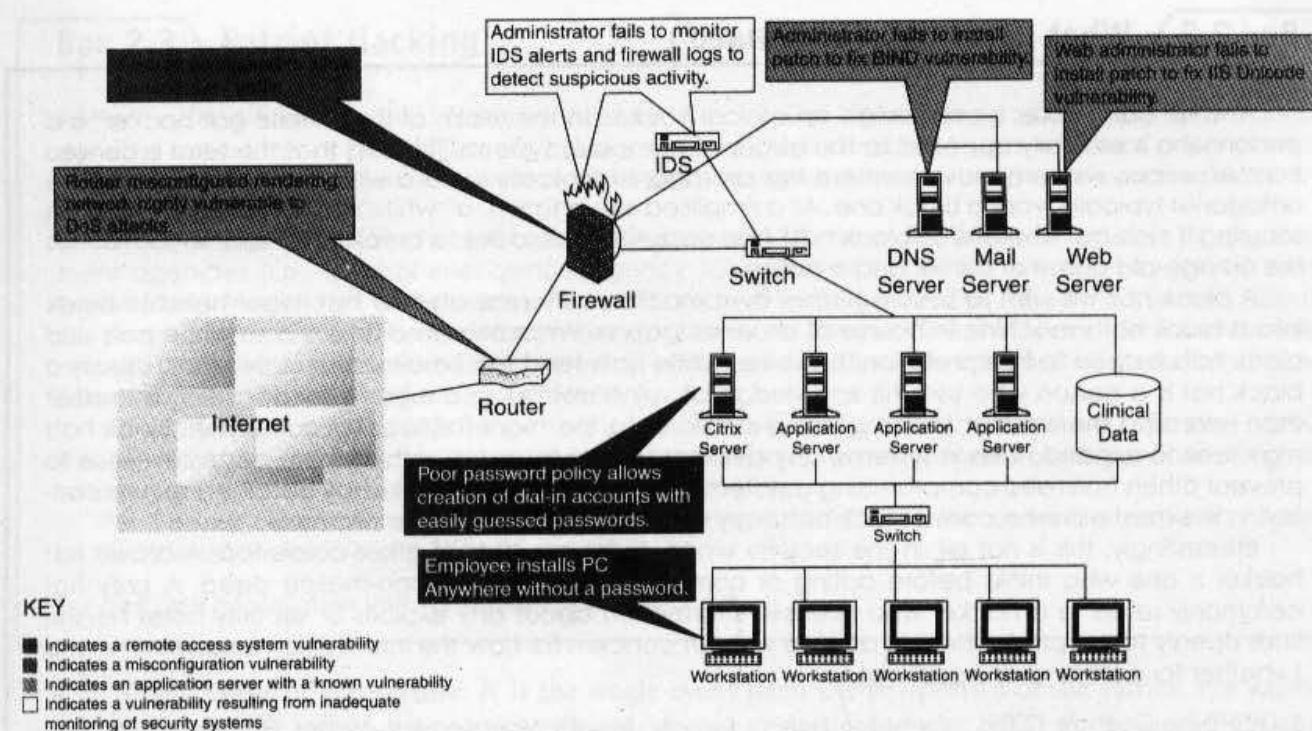


Figure 2.2 Network vulnerabilities – sample network.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices* (Fig. 11.6), Wiley India.

An attacker would look to exploit the vulnerabilities in the networks, most often so because the networks are not adequately protected. The categories of vulnerabilities that hackers typically search for are the following:

1. Inadequate border protection (border as in the sense of network periphery);
2. remote access servers (RASs) with weak access controls;
3. application servers with well-known exploits;
4. misconfigured systems and systems with default configurations.

To help the reader understand the network attack scenario, Fig. 2.2 illustrates a small network highlighting specific occurrences of several vulnerabilities described above.

Box 2.2 What Color is Your Hat in the Security World?

When Edward De Bono wrote his epoch making the book *The Six Thinking Hats* most successful concept that helps people to be more productive, focused, and mindfully involved, little did he know that the hats would follow suit in other domains too!! Just read on to discover about the "hats" in security world. And not only that, but also be conscious to know if any of these hats are around you to jeopardize the security of your information assets on the network.

A *black hat* is also called a "cracker" or "dark side hacker." Such a person is a malicious or criminal hacker. Typically, the term "cracker" is used within the security industry. However, the general public uses the term hacker to refer to the same thing. In computer jargon, the meaning of "hacker" can be much broader. The name comes from the opposite of "white hat hackers."

Box 2.2 What Color . . . (Continued)

A white hat hacker is considered an ethical hacker. In the realm of IT, a "white hat hacker" is a person who is ethically opposed to the abuse of computer systems. It is said that the term is derived from American western movies, where the protagonist typically wore a white cowboy hat and the antagonist typically wore a black one. As a simplified explanation, a "white hat" generally focuses on securing IT systems, whereas a "black hat" (the opposite) would like to break into them, so this sounds like an age-old game of a thief and a police.

A black hat will wish to secure his/her own machine whereas a white hat might need to break into a black hat's machine in course of an investigation. What exactly differentiates white hats and black hats is open to interpretation; however, white hats tend to cite altruistic motivations. Usually a black hat is a person who uses his knowledge of vulnerabilities and exploits for private gain, rather than revealing them either to the general public or to the manufacturer for correction. Black hats may seek to expand holes in systems; any attempts made to patch software are generally done to prevent others from also compromising a system over which they have already obtained secure control. In the most extreme cases, black hats may work to cause damage maliciously.

Interestingly, this is not all; in the security world, there are hats of other colors too. A brown hat hacker is one who thinks before acting or committing a malice or non-malice deed. A grey hat commonly refers to a hacker who releases information about any exploits or security holes he/she finds openly to the public. He/she does so without concern for how the information is used in the end (whether for patching or exploiting).

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices* (Box 17.3), Wiley India.

2.1.1 Categories of Cybercrime

Cybercrime can be categorized based on the following:

1. The target of the crime and
2. whether the crime occurs as a single event or as a series of events.

As explained in Section 1.5, Chapter 1, cybercrime can be targeted against individuals (persons), assets (property) and/or organizations (government, business and social).

1. **Crimes targeted at individuals:** The goal is to exploit human weakness such as greed and naivety. These crimes include financial frauds, sale of non-existent or stolen items, child pornography (explained in Section 1.5.13, Chapter 1), copyright violation, harassment, etc. with the development in the IT and the Internet; thus, criminals have a new tool that allows them to expand the pool of potential victims. However, this also makes difficult to trace and apprehend the criminals.
2. **Crimes targeted at property:** This includes stealing mobile devices such as cell phone, laptops, personal digital assistant (PDAs), and removable medias (CDs and pen drives); transmitting harmful programs that can disrupt functions of the systems and/or can wipe out data from hard disk, and can create the malfunctioning of the attached devices in the system such as modem, CD drive, etc.
3. **Crimes targeted at organizations:** Cyberterrorism is one of the distinct crimes against organizations/governments. Attackers (individuals or groups of individuals) use computer tools and the Internet to usually terrorize the citizens of a particular country by stealing the private information, and also to damage the programs and files or plant programs to get control of the network and/or system (see Box 2.3).

Box 2.3 Patriot Hacking

Patriot hacking^[1] also known as Digital Warfare, is a form of vigilante computer systems' cracking done by individuals or groups (usually citizens or supports of a country) against a real or perceived threat. Traditionally, Western countries, that is, developing countries, attempts to launch attacks on their perceived enemies.

Although patriot hacking is declared as illegal in the US, however, it is reserved only for government agencies [i.e., Central Intelligence Agency (CIA) and National Security Agency (NSA)] as a legitimate form of attack and defense. Federal Bureau of Investigation (FBI) raised the concern about rise in cyberattacks like website defacements (explained in Box 1.4, Chapter 1) and denial-of-service attacks (DoS – refer to Section 4.9, Chapter 4), which adds as fuel into increase in international tension and gets mirrored it into the online world.

After the war in Iraq in 2003, it is getting popular in the North America, Western Europe and Israel. These are countries that have the greatest threat to Islamic terrorism and its aforementioned digital version.

The People's Republic of China is allegedly making attacks upon the computer networks of the US and the UK. Refer to Box 5.15 in Chapter 5.

For detailed information visit www.patriothacking.com

- 4. **Single event of cybercrime:** It is the single event from the perspective of the victim. For example, unknowingly open an attachment that may contain virus that will infect the system (PC/laptop). This is known as hacking or fraud.
- 5. **Series of events:** This involves attacker interacting with the victims repetitively. For example, attacker interacts with the victim on the phone and/or via chat rooms to establish relationship first and then they exploit that relationship to commit the sexual assault (refer to Section 2.4 on "Cyberstalking").

2.2 How Criminals Plan the Attacks

Criminals use many methods and tools to locate the vulnerabilities of their target. The target can be an individual and/or an organization. (The custodian of a property can be an individual or an organization; for discussion purpose not mentioned here.) Criminals plan passive and active attacks (see Sections 2.2.2 and 2.2.3 for more details on these topics). Active attacks are usually used to alter the system (i.e., computer network) whereas passive attacks attempt to gain information about the target. Active attacks may affect the availability, integrity and authenticity of data whereas passive attacks lead to breaches of confidentiality.

In addition to the active and passive categories, attacks can be categorized as either inside or outside. An attack originating and/or attempted within the security perimeter of an organization is an inside attack; it is usually attempted by an "insider" who gains access to more resources than expected. An outside attack is attempted by a source outside the security perimeter, maybe attempted by an insider and/or an outsider, who is indirectly associated with the organization, it is attempted through the Internet or a remote access connection.

The following phases are involved in planning cybercrime:

1. Reconnaissance (information gathering) is the first phase and is treated as passive attacks.
2. Scanning and scrutinizing the gathered information for the validity of the information as well as to identify the existing vulnerabilities.
3. Launching an attack (gaining and maintaining the system access).

2.2.1 Reconnaissance

The literal meaning of “Reconnaissance” is *an act of reconnoitering – explore, often with the goal of finding something or somebody (especially to gain information about an enemy or potential enemy)*.

In the world of “hacking,” reconnaissance phase begins with “Footprinting” – this is the preparation toward preattack phase, and involves accumulating data about the target’s environment and computer architecture to find ways to intrude into that environment. Footprinting gives an overview about system vulnerabilities and provides a judgment about possible exploitation of those vulnerabilities. The objective of this preparatory phase is to understand the system, its networking ports and services, and any other aspects of its security that are useful for launching the attack.

Thus, an attacker attempts to gather information in two phases: passive and active attacks. Let us understand these two phases.

2.2.2 Passive Attacks

A passive attack involves gathering information about a target without his/her (individual’s or company’s) knowledge. It can be as simple as watching a building to identify what time employees enter the building premises. However, it is usually done using Internet searches or by Googling (i.e., searching the required information with the help of search engine Google) an individual or company to gain information.

1. Google or Yahoo search: People search to locate information about employees (see Table 2.1).
2. Surfing online community groups like Orkut/Facebook will prove useful to gain the information about an individual.
3. Organization’s website may provide a personnel directory or information about key employees, for example, contact details, E-Mail address, etc. These can be used in a social engineering attack to reach the target (see Section 2.3).
4. Blogs, newsgroups, press releases, etc. are generally used as the mediums to gain information about the company or employees.
5. Going through the job postings in particular job profiles for technical persons can provide information about type of technology, that is, servers or infrastructure devices a company maybe using on its network.

Box 2.4 Tips for Effective Search with “Google” Search Engine

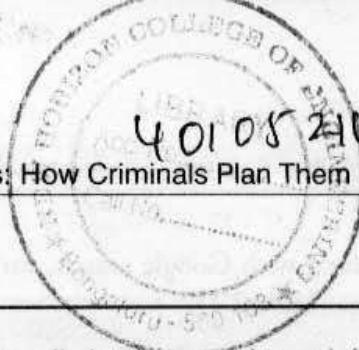
The Google search engine can be used indigenously to perform “Reconnaissance” phase of an attack. The following commands can be used effectively in the Google search engine.

http://groups.google.com: This site can be used to search the Google newsgroups.

Site: If you include [site:] in your query, Google will restrict the results to those websites in the given domain. For instance, [help site:www.google.com] will find pages about help within www.google.com. [help site:.com] will find pages about help within .com URLs (uniform resource locator). Note that, there should be no space between the “site:” and the domain. This feature is also available through advanced search page, under Advanced Web Search > Domains.

Filetype: This will search within the text of a particular type of file. The file type to search must be typed after the colon.

Link: The query [link:] will list the webpages that have links to the specified webpage. For instance, [link: www.google.com] will list webpages that have links pointing to the Google homepage. Note that there can be no space between the “link:” and the webpage URL. This functionality is also accessible from the advanced search page, under Page Specific Search > Links.



Box 2.4 Tips for . . . (Continued)

Inurl: If you include [inurl:] in your query, Google will restrict the results to documents containing that word in the URL. For instance, [inurl:google search] will return documents that mention the word "google" in their URL, and mention the word "search" anywhere in the document (URL or no). Note that there should be no space between the "inurl:" and the following word. Putting "inurl:" in front of every word in your query is equivalent to putting "allinurl:" in front of your query; this implies [inurl:google inurl:search] is the same as [allinurl: google search].

Cache: If you include other words in the query, Google will highlight those words within the cached document. For instance, [cache: www.google.com web] will show the cached content with the word "web" highlighted. This feature is also accessible by clicking on the "Cached" link on Google's main results page. The query [cache:] will show the version of the webpage that Google has in its cache. For instance, [cache: www.google.com] will show Google's cache of the Google homepage. Note that there should be no space between the "cache:" and the webpage URL.

Related: The query [related:] will list webpages that are "similar" to a specified webpage. For instance, [related: www.google.com] will list webpages that are similar to the Google homepage. Note that there should be no space between the "related:" and the webpage URL. This feature is also accessible by clicking on the "Similar Pages" link on Google's main results page, and from the advanced search page, under Page Specific Search > Similar.

Info: The query [info:] will present some information that Google has about that webpage. For instance, [info: www.google.com] will show information about the Google homepage. Note that there should be no space between the "info:" and the webpage URL. This feature is also accessible by typing the webpage URL directly into a Google search box.

Define: The query [define:] will provide a definition of the word/phrase you enter after it, gathered from various online sources. The definition will be for the entire phrase entered (i.e., it will include all the words in the exact order you typed them).

Stocks: If you begin a query with the [stocks:] operator, Google will treat the rest of the query terms as stock ticker symbols and will link to a page showing stock information for those symbols. For instance, [stocks: intc yhoo] will show information about Intel and Yahoo. (Note that you must type the ticker symbols, not the company name.) This feature is also available if you search just on the stock symbols (e.g., [intc yhoo]) and then click on the "Show stock quotes" link on the results page.

Allintitle: If you start a query with [allintitle:], Google will restrict the results to those with all of the query words in the title. For instance, [allintitle: google search] will return only documents that have both "google" and "search" in the title. This feature is also available through advanced Search page, under Advanced Web Search > Occurrences.

Intitle: If you include [intitle:] in your query, Google will restrict the results to documents containing that word in the title. For instance, [intitle:google search] will return documents that mention the word "google" in their title and the word "search" anywhere in the document (title or no). Note that there should be no space between the "intitle:" and the following word. Putting [intitle:] in front of every word in your query is equivalent to putting [allintitle:] at the front of your query; this implies that [intitle:google intitle:search] is the same as [allintitle: google search].

Allinurl: If you start a query with [allinurl:], Google will restrict the results to those with all of the query words in the URL. For instance, [allinurl: google search] will return only documents that have both "google" and "search" in the URL.

Note that [allinurl:] works on words, not on URL components. In particular, it ignores punctuation. Thus, [allinurl: foo/bar] will restrict the results to page with the words "foo" and "bar" in the URL, but won't require that they be separated by a slash within that URL, that they be adjacent, or that they be in that particular word order. There is currently no way to enforce these constraints.

Source: <http://www.google.com.tw/help/operators.html>

Network sniffing is another means of passive attack to yield useful information such as Internet Protocol (IP) address ranges, hidden servers or networks, and other available services on the system or network. The network traffic is sniffed for monitoring the traffic on the network – attacker watches the flow of data to see what time certain transactions take place and where the traffic is going.

Along with Google search, various other tools are also used for gathering information about the target/victim (Table 2.1).

Table 2.1 | Tools used during passive attacks

| Name of the Tool | Brief Description | Remarks |
|--------------------------|---|--|
| Google Earth | <p>Google Earth is a virtual globe, map, and geographic information program. It maps the Earth by the superimposition of images obtained from satellite imagery and provides aerial photography of the globe.</p> <p>It is available under three different licenses: Google Earth, a free version with limited functionality; Google Earth Plus (discontinued), with additional features; and Google Earth Pro intended for commercial use.</p> | <p>For more details on this tool, visit: http://earth.google.com/</p> <p>Like "Google Earth," similar details can be obtained from http://www.wikimapia.org/</p> <p>Indian Space Research Organization (ISRO) unveiled its beta version of Bhuvan (meaning Earth in Sanskrit), a Web-based tool like Google Earth, that promises better 3-D satellite imagery of India than is currently being offered by Google Earth and that too with India-specific features such as weather information and even administrative boundaries of all states and districts, visit: http://bhuvan.nrsc.gov.in/</p> |
| Internet Archive | The Internet Archive is an Internet library, with the purpose of offering permanent access for researchers, historians and scholars to historical collections that exist in digital format. It includes texts, audio, moving images, and software as well as archived webpages in our collections. | An attacker gets the information about latest update made to the target's website as well as can dig the information which maybe available in the history (e.g., contact list of executives and higher management officials are always updated). For more details on this tool, visit: http://www.archive.org/index.php |
| Professional Community | LinkedIn is an interconnected network of experienced professionals from around the world, representing 170 industries and 200 countries. | One can find details about qualified professionals. For more details on this tool, visit: http://www.linkedin.com/ |
| People Search | People Search provides details about personal information: date of birth, residential address, contact number, etc. | <p>To name a few, visit:</p> <ul style="list-style-type: none"> • http://www.whitepagesinc.com • http://www.intelius.com/ • http://www.whitepages.com/ |
| Domain Name Confirmation | <p>To perform searches for domain names (e.g., website names) using multiple keywords. This helps to enable to find every registered domain name in "com," "net," "org," "edu," "biz," etc.</p> | <p>For more details on this tool, visit:</p> <ul style="list-style-type: none"> • http://www.namedroppers.com/ • http://www.binarypool.com/bytess.html |

(Continued)

Table 2.1 | (Continued)

| <i>Name of the Tool</i> | <i>Brief Description</i> | <i>Remarks</i> |
|--------------------------|--|---|
| WHOIS | <p>This is a domain registration lookup tool. This utility is used for communicating with WHOIS servers located around the world to obtain domain registration information.</p> <p>WHOIS supports IP address queries and automatically selects the appropriate WHOIS server for IP addresses. This tool will lookup information on a domain, IP address, or a domain registration information. You can select a specific WHOIS server, or you can use the “Default” option which will select a server for you.</p> | <p>For more details on this tool, visit:</p> <ul style="list-style-type: none"> • http://whois.domaintools.com/ • http://www.whois.net/ • http://www.samspade.org/ <p>For further details of this lookup utility, visit:</p> <ul style="list-style-type: none"> • http://resellers.tucows.com/opensrs/whois/ • http://www.nsauditordocs.html/tools/Whois.htm |
| Nslookup | <p>The name nslookup means “name server lookup.” The tool is used on Windows and Unix to query domain name system (DNS) servers to find DNS details, including IP addresses of a particular computer and other technical details such as mail exchanger (MX) records for a domain and name server (NS) servers of a domain.</p> | <p>For more details on this tool, visit:</p> <ul style="list-style-type: none"> • http://www.kloth.net/services/nslookup.php • http://nslookup.downloadsoftware4free.com/ |
| Dnsstuff | <p>Using this tool, it is possible to extract DNS information about IP addresses, mail server extensions, DNS lookup, WHOIS lookups, etc.</p> | <p>For more details on this tool, visit: http://www.dnsstuff.com/</p> |
| Traceroute | <p>This is the best tool to find the route (i.e., computer network path) to a target system. It determines the route taken by packets across an IP network.</p> | <p>For more details on this tool, visit: http://www.rjsmith.com/traceroute.html</p> |
| VisualRoute Trace | <p>This is a graphical tool which determines where and how virtual traffic on the computer network is flowing between source and target destination.</p> | <p>For more details on this tool, visit: http://www.visualware.com/</p> |
| eMailTrackerPro | <p>eMailTrackerPro analyzes the E-Mail header and provides the IP address of the system that sent the mail.</p> | <p>For more details on this tool, visit: http://www.emailtrackerpro.com/</p> |
| HTTrack | <p>This tool acts like an offline browser. It can mirror the entire website to a desktop. One can analyze the entire website by being offline.</p> | <p>For more details on this tool, visit: http://www.httrack.com/</p> |
| Website Watcher | <p>The tool can be used to keep the track of favorite websites for an update. When the website undergoes an update/change, this tool automatically detects it and saves the last two versions onto the desktop.</p> | <p>For more details on this tool, visit: http://www.aignes.com/</p> |
| Competitive Intelligence | <p>Competitive intelligence can provide information related to almost any product, information on recent industry trends, or information about geopolitical indications. Effective use of competitive intelligence can reveal attack against the website or an industrial espionage.</p> | <p>To name a few, visit:</p> <ul style="list-style-type: none"> • http://digital.com/ • http://www.amity.edu/aici/ |

Note: IP is Internet Protocol here.

2.2.3 Active Attacks

An active attack involves probing the network to discover individual hosts to confirm the information (IP addresses, operating system type and version, and services on the network) gathered in the passive attack phase. It involves the risk of detection and is also called "*Rattling the doorknobs*" or "*Active reconnaissance*."

Active reconnaissance can provide confirmation to an attacker about security measures in place (e.g., whether the front door is locked?), but the process can also increase the chance of being caught or raise a suspicion.

Table 2.2 gives the list of tools used for active attacks – some of the tools are also used during "vulnerability assessment" and/or "penetration testing." Refer to Appendix E in CD.

Table 2.2 | Tools used during active attacks

| Name of the Tool | Brief Description | Remarks |
|------------------|--|--|
| Arphound | This is a tool that listens to all traffic on an Ethernet network interface. It reports IP/media access control (MAC) address pairs as well as events, such as IP conflicts, IP changes and IP addresses with no reverse DNS, various Address Resolution Protocol (ARP) Spoofing and packets not using the expected gateway. | This is open-source software. For more details on this tool and download, visit: http://www.nottale.net/index.php?project=arphound |
| Arping | This is a network tool that broadcasts ARP packets and receives replies similar to "ping." It is good for mapping a local network and finding used IP space. It broadcasts a "who-has ARP packet" on the network and prints answers. It is very useful when trying to pick an unused IP for a Net to which routing does not exist as yet. | This is open-source software. For more details on this tool and download, visit: http://www.habets.pp.se/synscan/programs.php?prog=arping |
| Bing | This is used for Bandwidth Ping. It is a point-to-point bandwidth measurement tool based on ping. It can measure raw throughput between any two network links. Bing determines the real (raw as opposed to available or average) throughput on a link by measuring Internet Control Message Protocol (ICMP) echo requests roundtrip times for different packet sizes for each end of the link. | This is open-source software. For installation and usage information, visit: http://ai3.asti.dost.gov.ph/sat/bing.html |
| Bugtraq | This is a database of known vulnerabilities and exploits providing a large quantity of technical information and resources. | This software is for free usage. Visit the following site for more details: http://www.securityfocus.com/bid |
| Dig | This is used to perform detailed queries about DNS records and zones, extracting configuration, and administrative information about a network or domain. | This is open-source software. For additional technical details, visit: http://www.isc.org/index.pl?/sw/bind/ |
| DNStracer | This is a tool to determine the data source for a given DNS server and follow the chain of DNS servers back to the authoritative sources. | This is also open-source software. For additional technical details, visit: http://www.mavetju.org/unix/dnstracer.php |

(Continued)

Table 2.2 | (Continued)

| <i>Name of the Tool</i> | <i>Brief Description</i> | <i>Remarks</i> |
|-------------------------|---|---|
| Dsniff | This is a network auditing tool to capture username, password, and authentication information on a local subnet. | This is open-source software. For additional technical details, visit: http://monkey.org/~dugsong/dsniff/ |
| Filesnarf | This is a network auditing tool to capture file transfers and file sharing traffic on a local subnet. | This is also open-source software. For additional technical details, visit: http://monkey.org/~dugsong/dsniff/ |
| FindSMB | This is used to find and describe server message block (SMB) servers on the local network. | It is open-source software; visit the following site for downloads: http://us3.samba.org/samba/ |
| Fping | This is a utility similar to ping used to perform parallel network discovery. | For this open-source software, visit: http://www.fping.com/ |
| Fragroute | This intercepts, modifies and rewrites egress traffic destined for a specified host, implementing several intrusion detection system (IDS) evasion techniques. | This is another open-source material; visit: http://www.monkey.org/~dugsong/fragroute/ |
| Fragtest | This tests the IP fragment reassembly behavior of the Transmission Control Protocol (TCP) stack on a target. It intercepts, modifies and rewrites egress traffic destined for a specified host, implementing most of the attacks. | For more details on this open-source software, visit: http://www.monkey.org/~dugsong/fragroute/ |
| Hackbot | This is a host exploration tool, simple vulnerability scanner and banner logger. | Another open-source software, whose details can be found at: http://freshmeat.net/projects/hackbot/ |
| Hmap | This is used to obtain detailed fingerprinting of web servers to identify vendor, version, patch level, including modules and much more. <i>Hmap</i> is a web server fingerprinting tool. | Details of this open-source software can be found at: http://ujeni.murkyroc.com/hmap/ |
| Hping | This is a TCP/IP packet assembler and analyzer. It can perform firewall ruleset testing, port scanning, network type of service/quality-of-service (TOS/QOS) testing, maximum transmission unit (MTU) discovery, alternate-protocol traceroute, TCP stack auditing, and much more. Using <i>hping</i> you can do the following: <ul style="list-style-type: none"> • Firewall testing; • advanced port scanning; • network testing, using different protocols, TOS, fragmentation; • manual path MTU discovery; • advanced traceroute, under all the supported protocols; • remote OS fingerprinting; • remote uptime guessing; • TCP/IP stacks auditing; • hping can also be useful to students that are learning TCP/IP. | This is open-source software. For additional technical details, visit: http://www.hping.org/ |

(Continued)

Table 2.2 | (Continued)

| <i>Name of the Tool</i> | <i>Brief Description</i> | <i>Remarks</i> |
|-------------------------|--|--|
| Hping | Hping works on the following Unix-like systems: Linux, FreeBSD, NetBSD, OpenBSD, Solaris, MacOs X, Windows. | This is open-source software. For additional technical details, visit: http://www.vanheusden.com/hping/ |
| Htting | This is similar to "ping," that is, hping, but for HTTP requests. It shows how long a URL will take to connect, send a request, and receive a reply. | |
| Hunt | This is a tool for exploiting well-known weaknesses in the TCP/IP protocol suite. | This is also open-source software. For additional technical details, visit: http://lin.fsid.cvut.cz/~kra/index.html |
| Libwhisker | This is an application library designed to assist in scannabilities. | Details of this open-source software can be found at: http://www.wiretrip.net/rfp/lw.asp |
| Mailsnarf | This is a network auditing tool to capture SMTing for CGI/web vulnerP and POP3 E-Mail traffic (including message headers, bodies, and attachments) on a local subnet. | For this open-source software, you can visit: http://monkey.org/~dugsong/dsniff/ |
| Msgsnarf | This is a network auditing tool to capture instant message (Yahoo, MSN, ICQ, iChat, AIM, and many more) traffic on a local subnet. | Same as above |
| NBTScan | This is a utility for scanning networks for NetBIOS information. It reports IP address, NetBIOS name, logged-in username, and MAC address. | Details of this open-source material can be found at: http://www.inetcat.org/software/nbtscan.html |
| Nessus | This is a powerful, fast, and modular security scanner that tests for many thousands of vulnerabilities. ControlScans' system can also be used to create custom Nessus reports. | To know more about this open-source utility, visit: http://www.nessus.org/ |
| Netcat | This is a utility to read and write custom TCP/ User Datagram Protocol (UDP) data packets across a network connection for network debugging or exploration. | Explore more details of this open-source utility at: http://www.atstake.com/research/tools/network_utilities/ |
| Nikto | This is a web server vulnerability scanner that tests over 2,600 potentially dangerous files/CGIs on over 625 types of servers. This tool also performs comprehensive tests against web servers for multiple items and version-specific problems on over 230 servers. Scan items and plugins are frequently updated and can be automatically updated (if desired). | Nikto is an open-source web server scanner; visit the following site for more detail: http://www.cirt.net/code/nikto.shtml |
| Nmap | This is a port scanner, operating system fingerprinter, service/version identifier, and much more. Nmap is designed to rapidly scan large networks. | For details of this open-source software, visit: http://insecure.org/nmap/ |

(Continued)

Table 2.2 | (Continued)

| <i>Name of the Tool</i> | <i>Brief Description</i> | <i>Remarks</i> |
|-------------------------|---|--|
| Pathchar | This is a network tool for inferring the characteristics of Internet paths, including Layer 3 hops, bandwidth capacity, and autonomous system information. | For further details, visit: http://ee.lbl.gov/ |
| Ping | This is a standard network utility to send ICMP packets to a target host. | For further details, visit: http://www.controls.com/auditingtools.html# |
| ScanSSH | <p>This supports scanning a list of addresses and networks for open proxies, SSH Protocol servers, and Web and SMTP servers. Where possible, it displays the version number of the running services.</p> <p>ScanSSH supports the following features:</p> <ul style="list-style-type: none"> • Variable scanning speed: per default, ScanSSH sends out 100 probes per second; • open proxy detection; • random sampling: it is possible to randomly sample hosts on the Internet. | The first version of the ScanSSH Protocol scanner was released in September 2000. For further details and downloading the current version, visit: http://www.monkey.org/~provos/scanssh/ |
| SMBclient | <p>This helps a client to talk to an SMB (Samba, Windows File Sharing) server. Operations include getting files from the server, putting files on the server, retrieving directory information, and much more.</p> <p>It is an open-source/free software suite that has, since 1992, provided file and print services to all types of SMB/common Internet file system (CIFS) clients, including the numerous versions of Microsoft Windows operating systems. Samba is freely available under the GNU General Public License.</p> | |
| SMTPscan | This is a tool to determine the type and version of a remote Simple Mail Transfer Protocol (SMTP) mail server based on active probing and analyzing error codes of the target SMTP server. | For further details, visit: http://www.greyhats.org/outils/smtpscan/ |
| TCPdump | It is a network tool for the protocol packet capture and dumper program. | For further details, visit: http://ee.lbl.gov/ |
| TCPreplay | <p>This is a utility to read captured TCPdump/pcap data and “replay” it back onto the network at arbitrary speeds.</p> <p>TCPreplay is a suite of licensed tools written by Aaron Turner for Unix operating systems. It gives you the ability to use previously captured traffic to test a variety of network devices. It allows you to classify traffic as client or server; rewrite open system interconnection (OSI) Layers 2, 3 and 4 headers; and finally replay the traffic back onto the network and through other</p> | TCPreplay suite includes the following tools: <ul style="list-style-type: none"> • TCPprep: It is a multi-pass packet capture (pcap) file preprocessor which determines packets as client or server and creates cache files used by TCPreplay and TCPrewrite. • TCPrewrite: It is a pcap file editor which rewrites TCP/IP and Layer 2 packet headers. |

(Continued)

Table 2.2 | (Continued)

| <i>Name of the Tool</i> | <i>Brief Description</i> | <i>Remarks</i> |
|-------------------------|---|---|
| | devices such as switches, routers, firewalls, network-based intrusion detection system (NIDS), and intrusion prevention system (IPS). TCPReplay supports both single and dual NIC modes for testing both sniffing and inline devices. TCPReplay is used by numerous firewalls, IDS, IPS, and other networking vendors, enterprises, universities, laboratories, and open-source projects. | <ul style="list-style-type: none"> • TCPReplay: It replays pcap files at arbitrary speeds onto the network. • TCPReplay-edit: It replays and edits pcap files at arbitrary speeds onto the network. • TCPbridge: It bridges two network segments with the power of TCPrewrite. For further details, visit: http://tcpreplay.synfin.net/trac/ |
| THC-Amap | This is a scanner to remotely fingerprint and identify network applications and services. | For further details, visit: http://freeworld.thc.org/releases.php |
| Traceroute | This is a standard network utility to trace the logical path to a target host by sending ICMP or UDP packets with incrementing tunneled transport layer security (TTLs). | For further details, visit: http://ee.lbl.gov/ |
| URLsnarf | This is a network auditing tool to capture HTTP traffic on a local subnet. | For further details, visit: http://monkey.org/~dugsong/dsniff/ |
| XProbe2 | This is a tool employing several techniques to actively fingerprint the operating system of a target host. | For further details, visit: http://www.sys-security.com/html/projects/X.html |

Note: IP is Internet Protocol here.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices* (Table 35.2), Wiley India.

2.2.4 Scanning and Scrutinizing Gathered Information

Scanning is a key step to examine intelligently while gathering information about the target. The objectives of scanning are as follows:

1. **Port scanning:** Identify open/close ports and services. Refer to Box 2.5.
2. **Network scanning:** Understand IP Addresses and related information about the computer network systems.
3. **Vulnerability scanning:** Understand the existing weaknesses in the system.

Box 2.5 Ports and Ports Scanning

A port is an interface on a computer to which one can connect a device. TCP/IP Protocol suite made out of the two protocols, TCP and UDP, is used universally to communicate on the Internet. Each of these has ports 0 through 65536 (i.e., the range is from 2^0 to 2^{16} for binary address calculation). The port numbers are divided into three ranges:

Box 2.5 Ports and Ports . . . (Continued)

1. Well-known ports (from 0 to 1023);
2. registered ports;
3. dynamic and/or private ports.

The list of well-known port numbers and short description about the services offered by each of these are provided in Table 2.3.

Table 2.3 | Well-known port numbers

| Port Number | Port Description | Port Number | Port Description |
|--------------------|---|--------------------|--|
| 1 | TCP port service multiplexer (TCPMUX) | 118 | Structured query language (SQL) services |
| 5 | Remote job entry (RJE) | 119 | NNTP (Newsgroup) |
| 7 | ECHO | 137 | NetBIOS name service |
| 18 | Message Send Protocol (MSP) | 139 | NetBIOS datagram service |
| 20 | FTP – Data | 143 | Internet Message Access Protocol (IMAP) |
| 21 | FTP – Control | 150 | NetBIOS session service |
| 22 | Secure shell (SSH) remote log-in protocol | 156 | SQL server |
| 23 | Telnet | 161 | Simple Network Management Protocol (SNMP) |
| 25 | Simple Mail Transfer Protocol (SMTP) | 179 | Border Gateway Protocol (BGP) |
| 29 | MSG ICP | 190 | Gateway Access Control Protocol (GACP) |
| 37 | Time | 194 | Internet relay chat (IRC) |
| 42 | Nameserv (host name server) | 197 | Directory location service (DLS) |
| 43 | WHOIS | 389 | Lightweight Directory Access Protocol (LDAP) |
| 49 | Log-in (log-in host protocol) | 396 | Novell netware over IP |
| 53 | Domain name system (DNS) | 443 | Secure Hypertext Transfer Protocol (S-HTTP) |
| 69 | Trivial File Transfer Protocol (TFTP) | 444 | Simple Network Paging Protocol (SNPP) |
| 70 | Gopher services | 445 | Microsoft-DS |
| 79 | Finger | 458 | Apple quick time |
| 80 | HTTP | 546 | DHCP client |
| 103 | X.400 Standard | 547 | DHCP server |
| 108 | SNA gateway access server | 563 | SNEWS |
| 109 | POP2 | 569 | MSN |
| 110 | POP3 | 1080 | Socks |
| 115 | Simple File Transfer Protocol (SFTP) | | |

Box 2.5 Ports and Ports . . . (*Continued*)

There are some well-known IP ports (0–999) that require scanning owing to vulnerabilities known about them. In TCP/IP and UDP networks, a port is an endpoint to a logical connection and the way a client program specifies a specific server program on a computer in a network. Some ports have numbers that are preassigned to them by the Internet Assigned Numbers Authority (IANA), an organization working under the auspices of the Internet Architecture Board (IAB), responsible for assigning new Internet-wide IP addresses.

Table 2.3 lists the well-known ports along with the services run on them. Although public servers are important for communication and data transfer over the Internet, they open the door to potential security breaches by threat agents, such as malicious hackers. Vulnerability scanning employs software that seeks out security flaws based on a database of known flaws, testing systems for the occurrence of these flaws, and generating a report of the findings that an individual or an enterprise can use to tighten the network's security.

Port Scanning

A "port" is a place where information goes into and out of a computer and so, with port scanning, one can identify open doors to a computer. Ports are basically entry/exit points that any computer has, to be able to communicate with external machines. Each computer is enabled with three or more external ports. These are the ports used by the computer to communicate with the other computers, printer, modem, mouse, video game, scanner, and other peripherals. The important characteristic about these "external ports" is that they are indeed external and visible to the naked eye. Port scanning is often one of the first things an attacker will do when attempting to penetrate a particular computer. Tools such as Nmap (Table 2.2 lists a few vulnerability assessment tools) offer an automated mechanism for an attacker to not only scan the system to find out what ports are "open" (meaning being used), but also help to identify what operating system (OS) is being used by the system.

Port scanning is similar to a thief going through your neighborhood and checking every door and window on each house to see which ones are open and which ones are locked. Port scanning is an act of systematically scanning a computer's ports. In technological terms, "port scanning" refers to the act of using various open-ended technologies, tools, and commands to be able to communicate with another remote computer system or network, in a stealth mode, without being apparent, and be able to obtain certain sensitive information about the functions of system and the properties of the hardware and the software being used by the remote systems.

In "portscan," a host scans for listening ports on a single target host. In "portsweep," a host scans multiple hosts for a specific listening port. The result of a scan on a port is usually generalized into one of the following three categories:

1. **Open or accepted:** The host sent a reply indicating that a service is listening on the port.
2. **Closed or not listening:** The host sent a reply indicating that connections will be denied to the port.
3. **Filtered or blocked:** There was no reply from the host.

TCP/IP suite of protocols is used to communicate with other computers for specific message formats. Most of these protocols are tied to specific port numbers that are used to transfer particular message formats as data. Security administrators as well as attackers have a special eye on few well-known ports and protocols associated with it.

1. Ports 20 and 21 – File Transfer Protocols (FTP) – are used for uploading and downloading of information.
2. Port 25 – Simple Mail Transfer Protocol (SMTP) – is used for sending/receiving E-Mails.
3. Port 23 – Telnet Protocol – is used to connect directly to a remote host and Internet control message.
4. Port 80 – It is used for Hypertext Transfer Protocol (HTTP).
5. Internet Control Message Protocol (ICMP) – It does not have a port abstraction and is used for checking network errors, for example, ping.

Box 2.5 Ports and Ports . . . (Continued)

Open ports present two vulnerabilities of which administrators must be wary:

1. Vulnerabilities associated with the program that is delivering the service.
2. Vulnerabilities associated with the OS that is running on the host.

Closed ports present only the latter of the two vulnerabilities that open ports do. Blocked ports do not present any reasonable vulnerabilities. There is also the possibility that there are no known vulnerabilities in either the software (program) or the OS at the given time.^[2]

The scrutinizing phase is always called “enumeration” in the hacking world. The objective behind this step is to identify:

1. The valid user accounts or groups;
2. network resources and/or shared resources;
3. OS and different applications that are running on the OS.

Most of the tools listed in Table 2.2 are used for computer network scanning as well.



Usually, most of the attackers consume 90% of the time in scanning, scrutinizing and gathering information on a target and 10% of the time in launching the attack.

2.2.5 Attack (Gaining and Maintaining the System Access)

After the scanning and enumeration, the attack is launched using the following steps:

1. Crack the password (we will address it in Chapter 4);
2. exploit the privileges;
3. execute the malicious commands/applications;
4. hide the files (if required);
5. cover the tracks – delete the access logs, so that there is no trail illicit activity.

2.3 Social Engineering

Social engineering is the “technique to influence” and “persuasion to deceive” people to obtain the information or perform some action. Social engineers exploit the natural tendency of a person to trust social engineers’ word, rather than exploiting computer security holes. It is generally agreed that people are the weak link in security and this principle makes social engineering possible. A social engineer usually uses telecommunication (i.e., telephone and/or cell phone) or Internet to get them to do something that is against the security practices and/or policies of the organization.

Social engineering involves gaining sensitive information or unauthorized access privileges by building inappropriate trust relationships with insiders. It is an art of exploiting the trust of people, which is not doubted while speaking in a normal manner. The goal of a social engineer is to fool someone into providing valuable information or access to that information. Social engineer studies the human behavior so that

Box 2.6 Social Engineering Example

Mr. Joshi: Hello?

The Caller: Hello, Mr. Joshi. This is Geeta Thomas from Tech Support. Due to some disk space constraints on the file server, we will be moving few user's home directories to another disk. This activity will be performed tonight at 8:00 p.m. Your account will be a part of this move and will be unavailable temporarily.

Mr. Joshi: Ohh ... okay. I will be at my home by then, anyway.

Caller: Great!!! Please ensure to log off before you leave office. We just need to check a couple of things. What is your username?

Mr. Joshi: Username is "pjoshi." None of my files will be lost in the move, right?

Caller: No sir. But we will have to check your account to ensure the same. What is the password of that account?

Mr. Joshi: My password is "ABCD1965," all characters in upper case.

Caller: Ok, Mr. Joshi. Thank you for your cooperation. We will ensure that all the files are there.

Mr. Joshi: Thank you. Bye.

Caller: Bye and have a nice day.

people will help because of the desire to be helpful, the attitude to trust people, and the fear of getting into trouble. The sign of truly successful social engineers is that they receive information without any suspicion. A simple example is calling a user and pretending to be someone from the service desk working on a network issue; the attacker then proceeds to ask questions about what the user is working on, what file shares he/she uses, what his/her password is, and so on (see Box 2.6).

2.3.1 Classification of Social Engineering

Human-Based Social Engineering

Human-based social engineering refers to person-to-person interaction to get the required/desired information. An example is calling the help desk and trying to find out a password.

1. **Impersonating an employee or valid user:** "Impersonation" (e.g., posing oneself as an employee of the same organization) is perhaps the greatest technique used by social engineers to deceive people. Social engineers "take advantage" of the fact that most people are basically helpful, so it seems harmless to tell someone who appears to be lost where the computer room is located, or to let someone into the building who "forgot" his/her badge, etc., or pretending to be an employee or valid user on the system.
2. **Posing as an important user:** The attacker pretends to be an important user – for example, a Chief Executive Officer (CEO) or high-level manager who needs immediate assistance to gain access to a system. The attacker uses intimidation so that a lower-level employee such as a help-desk worker will help him/her in gaining access to the system. Most of the low-level employees will not ask any question to someone who appears to be in a position of authority.
3. **Using a third person:** An attacker pretends to have permission from an authorized source to use a system. This trick is useful when the supposed authorized personnel is on vacation or cannot be contacted for verification.
4. **Calling technical support:** Calling the technical support for assistance is a classic social engineering example. Help-desk and technical support personnel are trained to help users, which makes them good prey for social engineering attacks.



Figure 2.3 | Social engineering – shoulder surfing.

5. **Shoulder surfing:** It is a technique of gathering information such as usernames and passwords by watching over a person's shoulder while he/she logs into the system, thereby helping an attacker to gain access to the system (Fig. 2.3).
6. **Dumpster diving:** It involves looking in the trash for information written on pieces of paper or computer printouts. This is a typical North American term; it is used to describe the practice of rummaging through commercial or residential trash to find useful free items that have been discarded. It is also called dumpstering, binning, trashing, garbing or garbage gleaning. "Scavenging" is another term to describe these habits. In the UK, the practice is referred to as "binning" or "skipping" and the person doing it is a "binner" or a "skipper."

In practice, *dumpstering* is more like fishing around than diving in. Usually, people dumpster dive to search the items, to reclaim those, which have been disposed of but can still be put to further use, for example, E-Waste, furniture, clothes, etc. The term "dumpster diving" may have originated from the notional image of someone leaping into large rubbish bins, the best known of which are produced under the name "dumpster." "Scavenging" is equivalent of "dumpster diving," in the digital world. It is a form in which discarded articles and information are scavenged in an attempt to obtain/recover advantageous data, if it is possible to do so. Consider, for example, going through someone's trash to recover documentation of his/her critical data [e.g., social security number (SSN) in the US, PAN number in India, credit card identity (ID) numbers, etc.]. According to a definition in the glossary of terms for the convoluted terminology of information warfare, "scavenging" means "searching through object residue (e.g., discarded disks, tapes, or paper) to acquire sensitive data without authorization."

Computer-Based Social Engineering

Computer-based social engineering refers to an attempt made to get the required/desired information by using computer software/Internet. For example, sending a fake E-Mail to the user and asking him/her to re-enter a password in a webpage to confirm it.

1. **Fake E-Mails:** The attacker sends fake E-Mails (see Box 2.7) to numerous users in such that the user finds it as a legitimate mail. This activity is also called “Phishing” (we shall address it in Chapter 5). It is an attempt to entice the Internet users (netizens) to reveal their sensitive personal information, such as user-names, passwords and credit card details by impersonating as a trustworthy and legitimate organization and/or an individual. Banks, financial institutes and payment gateways are the common targets. Phishing is typically carried out through E-Mails or instant messaging and often directs users to enter details at a website, usually designed by the attacker with abiding the look and feel of the original website. Thus, Phishing is also an example of social engineering techniques used to fool netizens. The term “Phishing” has been evolved from the analogy that Internet scammers are using E-Mails lures to *fish* for passwords and financial data from the sea of Internet users (i.e., netizens). The term was coined in 1996 by hackers who were stealing AOL Internet accounts by scamming passwords without the knowledge of AOL users. As hackers have a tendency of replacing “f” with “ph,” the term “Phishing” came into being.

Box 2.7 Fake E-Mails

Free websites are available to send fake E-Mails. From Fig. 2.4, one can notice that “To” in the text box is a blank space. Hence, anyone can fill any E-Mail address with the intention of fooling the receiver of the E-Mail. In such a case when the receiver will read the mail, he/she would think that the E-Mail has been received from a legitimate sender.

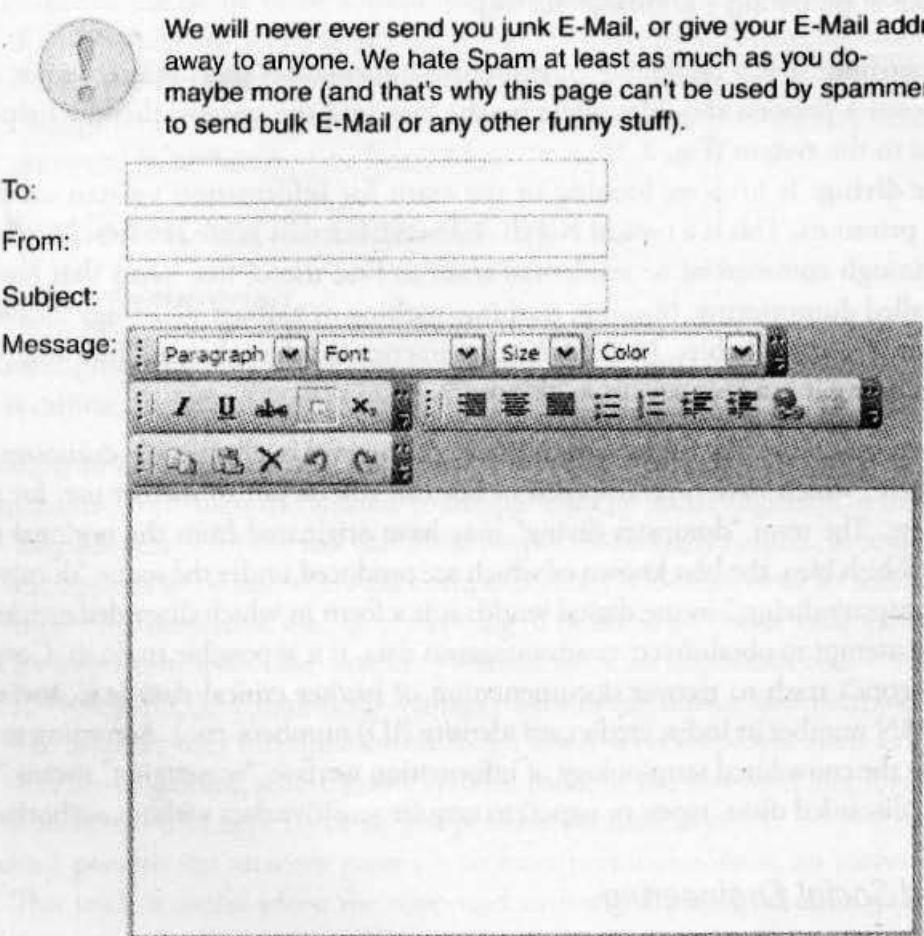


Figure 2.4

Sending fake E-Mails.

Source: <http://deadfake.com/Send.aspx> (2 April 2009).

2. **E-Mail attachments:** E-Mail attachments are used to send malicious code to a victim's system, which will automatically (e.g., keylogger utility to capture passwords) get executed. Viruses, Trojans, and worms can be included cleverly into the attachments to entice a victim to open the attachment. We will address keylogger, viruses, Trojans, and worms in Chapter 4.
3. **Pop-up windows:** Pop-up windows are also used, in a similar manner to E-Mail attachments. Pop-up windows with special offers or free stuff can encourage a user to unintentionally install malicious software.

Social engineering indeed is a serious concern as revealed by the following past statistics on numbers:

1. As per Microsoft Corporation recent (October 2007) research, there is an increase in the number of security attacks designed to steal personal information (PI) or the instances of tricking people to provide it through social engineering. According to an FBI survey, on average 41% of security-related losses are the direct result of employees stealing information from their companies. The average cost per internal incident was US\$ 1.8 million.
2. The Federal Trade Commission (FTC) report of 2005 shows that "more than one million consumer fraud and ID theft complaints have been filed with federal, state, and local law enforcement agencies and private organizations" (2005, Consumer Fraud and Identity Theft section, para 1; we will discuss ID Theft in Chapter 5).
3. According to a 2003 survey [released on 2 April 2006 by the United States Department of Justice (Identity Theft Hits Three Percent, para 1)], "An estimated 3.6 million – or 3.1% – of American households became victims of ID theft in 2004." This means that now, more than ever, individuals are at a high risk of having their PI stolen and used by criminals for their own personal gain.

Typically, many organizations have information valuable enough to justify expensive protection mechanisms/security mechanisms. Critical information may include patient records in the medical and healthcare domain [known as protected health information (PHI)], corporate financial data, electronic funds transfers, access to financial assets in the financial services domain, and PI about clients or employees. Compromising critical information can have serious consequences, including the loss of customers, criminal actions being brought against corporate executives, civil law cases against the organization, loss of funds, loss of trust in the organization, and collapse of the organization. To respond to the threats, organizations implement InfoSec plans to establish control of information assets. However, "social engineers" try to devise a way to work their way around this to obtain the valuable information, an illicit act on ethical grounds.

Social engineering succeeds by exploiting the trust of the victim. Hence, continuous training/awareness sessions about such attacks are one of the effective countermeasures. Strict policies about service desk staff never asking for personally identifying information, such as username and passwords, over the phone or in person can also educate potential victims and recognize a social engineering attempt.



Social engineering and dumpster diving are also considered passive information-gathering methods.

2.4 Cyberstalking

The dictionary meaning of "stalking" is an "*act or process of following prey stealthily – trying to approach somebody or something.*" Cyberstalking has been defined as the use of information and communications technology, particularly the Internet, by an individual or group of individuals to harass another individual, group

of individuals, or organization. The behavior includes false accusations, monitoring, transmission of threats, ID theft, damage to data or equipment, solicitation of minors for sexual purposes, and gathering information for harassment purposes.^[3]

Cyberstalking refers to the use of Internet and/or other electronic communications devices to stalk another person. It involves harassing or threatening behavior that an individual will conduct repeatedly, for example, following a person, visiting a person's home and/or at business place, making phone calls, leaving written messages, or vandalizing against the person's property. As the Internet has become an integral part of our personal and professional lives, cyberstalkers take advantage of ease of communication and an increased access to personal information available with a few mouse clicks or keystrokes.

2.4.1 Types of Stalkers

There are primarily two types of stalkers.

1. **Online stalkers:** They aim to start the interaction with the victim directly with the help of the Internet. E-Mail and chat rooms are the most popular communication medium to get connected with the victim, rather than using traditional instrumentation like telephone/cell phone. The stalker makes sure that the victim recognizes the attack attempted on him/her. The stalker can make use of a third party to harass the victim.
2. **Offline stalkers:** The stalker may begin the attack using traditional methods such as following the victim, watching the daily routine of the victim, etc. Searching on message boards/newsgroups, personal websites, and people finding services or websites are most common ways to gather information about the victim using the Internet (see Table 2.1). The victim is not aware that the Internet has been used to perpetuate an attack against them.

2.4.2 Cases Reported on Cyberstalking

The majority of cyberstalkers are men and the majority of their victims are women. Some cases also have been reported where women act as cyberstalkers and men as the victims as well as cases of same-sex cyberstalking. In many cases, the cyberstalker and the victim hold a prior relationship, and the cyberstalking begins when the victim attempts to break off the relationship, for example, ex-lover, ex-spouse, boss/subordinate, and neighbor. However, there also have been many instances of cyberstalking by strangers.

2.4.3 How Stalking Works?

It is seen that stalking works in the following ways:

1. Personal information gathering about the victim: Name; family background; contact details such as cell phone and telephone numbers (of residence as well as office); address of residence as well as of the office; E-Mail address; date of birth, etc.
2. Establish a contact with victim through telephone/cell phone. Once the contact is established, the stalker may make calls to the victim to threaten/harass.
3. Stalkers will almost always establish a contact with the victims through E-Mail. The letters may have the tone of loving, threatening or can be sexually explicit. The stalker may use multiple names while contacting the victim.
4. Some stalkers keep on sending repeated E-Mails asking for various kinds of favors or threaten the victim.

Box 2.8 Cyberbullying

The National Crime Prevention Council defines Cyberbullying as "when the Internet, cell phones or other devices are used to send or post text or images intended to hurt or embarrass another person."

www.StopCyberbullying.org, an expert organization dedicated to Internet safety, security, and privacy defines cyberbullying as "a situation when a child, tween, or teen is repeatedly 'tormented, threatened, harassed, humiliated, embarrassed, or otherwise targeted' by another child, tween, or teen using text messaging, E-Mail, instant messaging, or any other type of digital technology."

The practice of cyberbullying is not limited to children and, while the behavior is identified by the same definition in adults, the distinction in age groups is referred to as cyberstalking or cyberharassment when perpetrated by adults toward adults.^[4]

Source: <http://en.wikipedia.org/wiki/Cyber-bullying> (2 April 2009).

5. The stalker may post the victim's personal information on any website related to illicit services such as sex-workers' services or dating services, posing as if the victim has posted the information and invite the people to call the victim on the given contact details (telephone numbers/cell phone numbers/E-Mail address) to have sexual services. The stalker will use bad and/or offensive/attractive language to invite the interested persons.
6. Whosoever comes across the information, start calling the victim on the given contact details (telephone/cell phone nos), asking for sexual services or relationships.
7. Some stalkers subscribe/register the E-Mail account of the victim to innumerable pornographic and sex sites, because of which victim will start receiving such kind of unsolicited E-Mails (refer to Chapter 5).

2.4.4 Real-Life Incident of Cyberstalking

Case Study

The Indian police have registered first case of cyberstalking in Delhi^[5] – the brief account of the case has been mentioned here. To maintain confidentiality and privacy of the entities involved, we have changed their names.

Mrs. Joshi received almost 40 calls in 3 days mostly at odd hours from as far away as Kuwait, Cochin, Bombay, and Ahmadabad. The said calls created havoc in the personal life destroying mental peace of Mrs. Joshi who decided to register a complaint with Delhi Police.

A person was using her ID to chat over the Internet at the website www.mirc.com, mostly in the Delhi channel for four consecutive days. This person was chatting on the Internet, using her name and giving her address, talking in obscene language. The same person was also deliberately giving her telephone number to other chatters encouraging them to call Mrs. Joshi at odd hours.

This was the first time when a case of cyberstalking was registered. Cyberstalking does not have a standard definition but it can be defined to mean threatening, unwarranted behavior, or advances directed by one person toward another person using Internet and other forms of online communication channels as medium.

2.5 Cybercafe and Cybercrimes

In February 2009, Nielsen survey^[6] on the profile of cybercafes users in India, it was found that 90% of the audience, across eight cities and 3,500 cafes, were male and in the age group of 15–35 years; 52% were graduates and postgraduates, though almost over 50% were students. Hence, it is extremely important to understand the IT security and governance practiced in the cybercafes.

In the past several years, many instances have been reported in India, where cybercafes are known to be used for either real or false terrorist communication. Cybercrimes such as stealing of bank passwords and subsequent fraudulent withdrawal of money have also happened through cybercafes. Cybercafes have also been used regularly for sending obscene mails to harass people.

Public computers, usually referred to the systems, available in cybercafes, hold two types of risks. First, we do not know what programs are installed on the computer – that is, risk of malicious programs such as *keyloggers* or *Spyware*, (we will discuss it in Chapter 4) which maybe running at the background that can capture the keystrokes to know the passwords and other confidential information and/or monitor the browsing behavior. Second, over-the-shoulder peeping (i.e., shoulder surfing) can enable others to find out your passwords. Therefore, one has to be extremely careful about protecting his/her privacy on such systems, as one does not know who will use the computer after him/her.

Indian Information Technology Act (ITA) 2000^[7] (it is discussed in great detail in Chapter 6) does not define cybercafes and interprets cybercafes as “network service providers” referred to under the erstwhile Section 79, which imposed on them a responsibility for “due diligence” failing which they would be liable for the offenses committed in their network. The concept of “due diligence” was interpreted from the various provisions in cyber-cafe regulations where available or normal responsibilities were expected from network service providers.

Cybercriminals prefer cybercafes to carry out their activities. The criminals tend to identify one particular personal computer (PC) to prepare it for their use. Cybercriminals can either install malicious programs such as keyloggers and/or Spyware or launch an attack on the target – techniques used for this are discussed in Chapter 4. Cybercriminals will visit these cafes at a particular time and on the prescribed frequency, maybe alternate day or twice a week.

A recent survey conducted in one of the metropolitan cities in India reveals the following facts (this is an eye-opener after going through the following observations:

1. Pirated software(s) such as OS, browser, office automation software(s) (e.g., Microsoft Office) are installed in all the computers.
2. Antivirus software is found to be not updated to the latest patch and/or antivirus signature.
3. Several cybercafes had installed the software called “Deep Freeze” for protecting the computers from prospective malware attacks. Although such intent is noble, this software happens to help cybercriminals hoodwink the investigating agencies. Deep Freeze can wipe out the details of all activities carried out on the computer when one clicks on the “restart” button.^[8] Such practices present challenges to the police or crime investigators when they visit the cybercafes to pick up clues after the Internet Service Provider (ISP) points to a particular IP address from where a threat mail was probably sent or an online Phishing attack (Phishing attacks are explained in Chapter 5) was carried out, to retrieve logged files.
4. Annual maintenance contract (AMC) found to be not in a place for servicing the computers; hence, hard disks for all the computers are not formatted unless the computer is down. Not having the AMC is a risk from cybercrime perspective because a cybercriminal can install a Malicious Code on a computer and conduct criminal activities without any interruption.
5. Pornographic websites and other similar websites with indecent contents are not blocked.
6. Cybercafe owners have very less awareness about IT Security and IT Governance.
7. Government/ISPs/State Police (cyber cell wing) do not seem to provide IT Governance guidelines to cybercafe owners.
8. Cybercafe association or State Police (cyber cell wing) do not seem to conduct periodic visits to cybercafes – one of the cybercafe owners whom we interviewed expressed a view that the police will not visit a cybercafe unless criminal activity is registered by filing an First Information Report (FIR). Cybercafe owners feel that police either have a very little knowledge about the technical aspects involved in cybercrimes and/or about conceptual understanding of IT security.

There are thousands of cybercafes across India. In the event that a central agency takes up the responsibility for monitoring cybercafes, an individual should take care while visiting and/or operating from cybercafe.



There is an expectation that the Indian Computer Emergency Team referred to under Section 70B of ITA 2008 may itself be designated as the agency of the Central Government with a national jurisdiction and (Computer Emergency Response Team) CERT, and may itself be stepping into the shoes of the Indian Computer Emergency Team.^[7,8]

Here are a few tips for safety and security while using the computer in a cybercafe:

1. **Always logout:** While checking E-Mails or logging into chatting services such as instant messaging or using any other service that requires a username and a password, always click “logout” or “sign out” before leaving the system. Simply closing the browser window is not enough, because if somebody uses the same service after you then one can get an easy access to your account. However, do not save your login information through options that allow automatic login. Disable such options before logon.
2. **Stay with the computer:** While surfing/browsing, one should not leave the system unattended for any period of time. If one has to go out, logout and close all browser windows.
3. **Clear history and temporary files:** Internet Explorer saves pages that you have visited in the history folder and in temporary Internet files. Your passwords may also be stored in the browser if that option has been enabled on the computer that you have used. Therefore, before you begin browsing, do the following in case of the browser Internet Explorer:
 - Go to *Tools* → *Internet options* → click the *Content* tab → click *AutoComplete*. If the checkboxes for passwords are selected, deselect them. Click *OK* twice.
 - After you have finished browsing, you should clear the history and temporary Internet files folders. For this, go to *Tools* → *Internet options* again → click the *General* tab → go to *Temporary Internet Files* → click *Delete Files* and then click *Delete Cookies*.
 - Then, under history, click clear history. Wait for the process to finish before leaving the computer.
4. **Be alert:** One should have to stay alert and aware of the surroundings while using a public computer. Snooping over the shoulder is an easy way of getting your username and password.
5. **Avoid online financial transactions:** Ideally one should avoid online banking, shopping or other transactions that require one to provide personal, confidential and sensitive information such as credit card or bank account details. In case of urgency one has to do it; however, one should take the precaution of changing all the passwords as soon as possible. One should change the passwords using a more trusted computer, such as at home and/or in office.
6. **Change passwords:** The screenshot displayed in Fig. 2.5 by ICICI Bank about changing the bank account/transaction passwords is the best practice to be followed.^[9]
7. **Virtual keyboard:** Nowadays almost every bank has provided the virtual keyboard on their website. The advantages of utilizing virtual keyboard and its functions are displayed in the screenshot shown in Fig. 2.6.^[10]
8. **Security warnings:** One should take utmost care while accessing the websites of any banks/financial institution. The screenshot in Fig. 2.7 displays security warnings very clearly (marked in bold rectangle), and should be followed while accessing these financial accounts from cybercafe.

The screenshot shows the ICICI Bank website's security section. On the left, there's a sidebar with links like 'Secure Banking', 'Secure Yourself While...', 'Learn More', and 'Contact US'. The main content area features a banner about 'Cyber Cafe Security' and a detailed paragraph about the importance of changing passwords when using shared computers. To the right, there are links for 'Login' (Personal, Corporate, Money2India, Young Stars), 'Forgot Password' (New user?, Forgot user ID & Password), and 'New User - Register Now'. A sidebar on the far right also mentions 'Internet Banking Demo' and 'Online Security'.

Figure 2.5 | Cybercafe security.

Source: <http://www.icicibank.com/pfsuser/temp/cybersec.htm> (27 June 2009).

This screenshot shows the 'Virtual Keyboard for Internet Banking' application. It includes a virtual keyboard layout, instructions for using the virtual keyboard to protect against password theft, steps to use it, and details about specific keys like Caps Lock and Back Space. The application is presented as a separate window or tab.

Figure 2.6 | Virtual keyboard.

Source: <http://www.icicibank.com/pfsuser/webnews/virtualkeybord.htm> (27 June 2009).

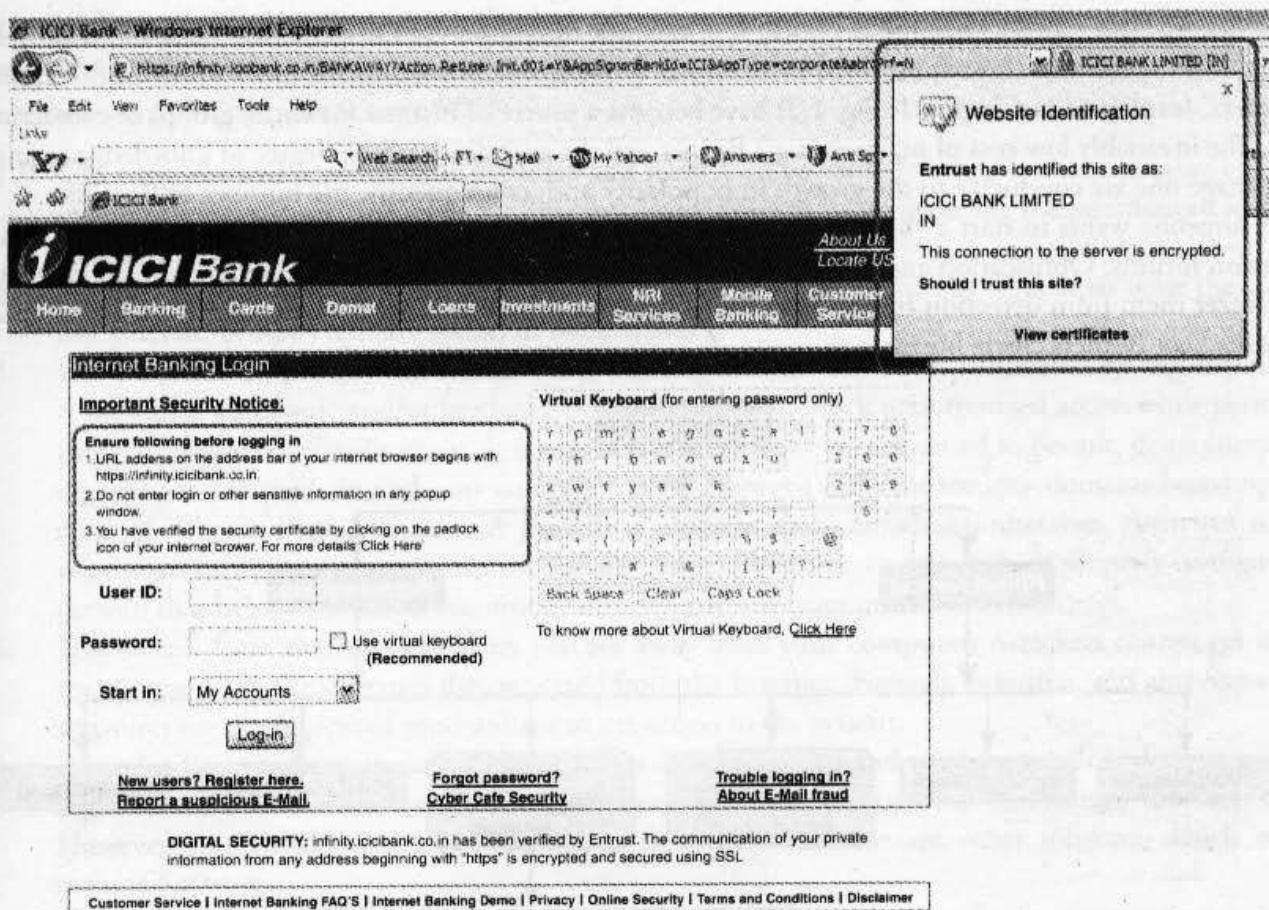


Figure 2.7 | Security warnings.
Source: <http://www.icicibank.com/pfsuser/webnews/virtualkeyboad.htm> (27 June 2009).

Individual should take care while accessing computers in public places, that is, accessing the Internet in public places such as hotels, libraries and holiday resorts. Moreover, one should not forget that whatever is applicable for cybercafes (i.e., from information security perspective) is also true in the case of all other public places where the Internet is made available (refer to Appendix J in CD). Hence, one should follow all tips about safety and security while operating the systems from these facilities.

2.6 Botnets: The Fuel for Cybercrime

2.6.1 Botnet

The dictionary meaning of Bot is “(*computing*) an automated program for doing some particular task, often over a network.”

Botnet is a term used for collection of software robots, or Bots, that run autonomously and automatically. The term is often associated with malicious software but can also refer to the network of computers using distributed computing software.^[11]

In simple terms, a Bot is simply an automated computer program (explained in Box 1.2, Chapter 1). One can gain the control of your computer by infecting them with a virus or other Malicious Code that gives the access. Your computer system maybe a part of a Botnet even though it appears to be operating normally. Botnets are often used to conduct a range of activities, from distributing Spam and viruses to conducting denial-of-service (DoS) attacks (the term is discussed in detail in Chapter 4).

A Botnet (also called as zombie network) is a network of computers infected with a malicious program that allows cybercriminals to control the infected machines remotely without the users' knowledge. "Zombie networks" (explained in Chapter 1, Fig. 1.3) have become a source of income for entire groups of cybercriminals. The invariably low cost of maintaining a Botnet and the ever diminishing degree of knowledge required to manage one are conducive to the growth in popularity and, consequently, the number of Botnets.

If someone wants to start a "business" and has no programming skills, there are plenty of "Bot for sale" offers on forums. Obfuscation and encryption of these programs' code can also be ordered in the same way to protect them from detection by antivirus tools. Another option is to steal an existing Botnet. Figure 2.8 explains how Botnets create business.

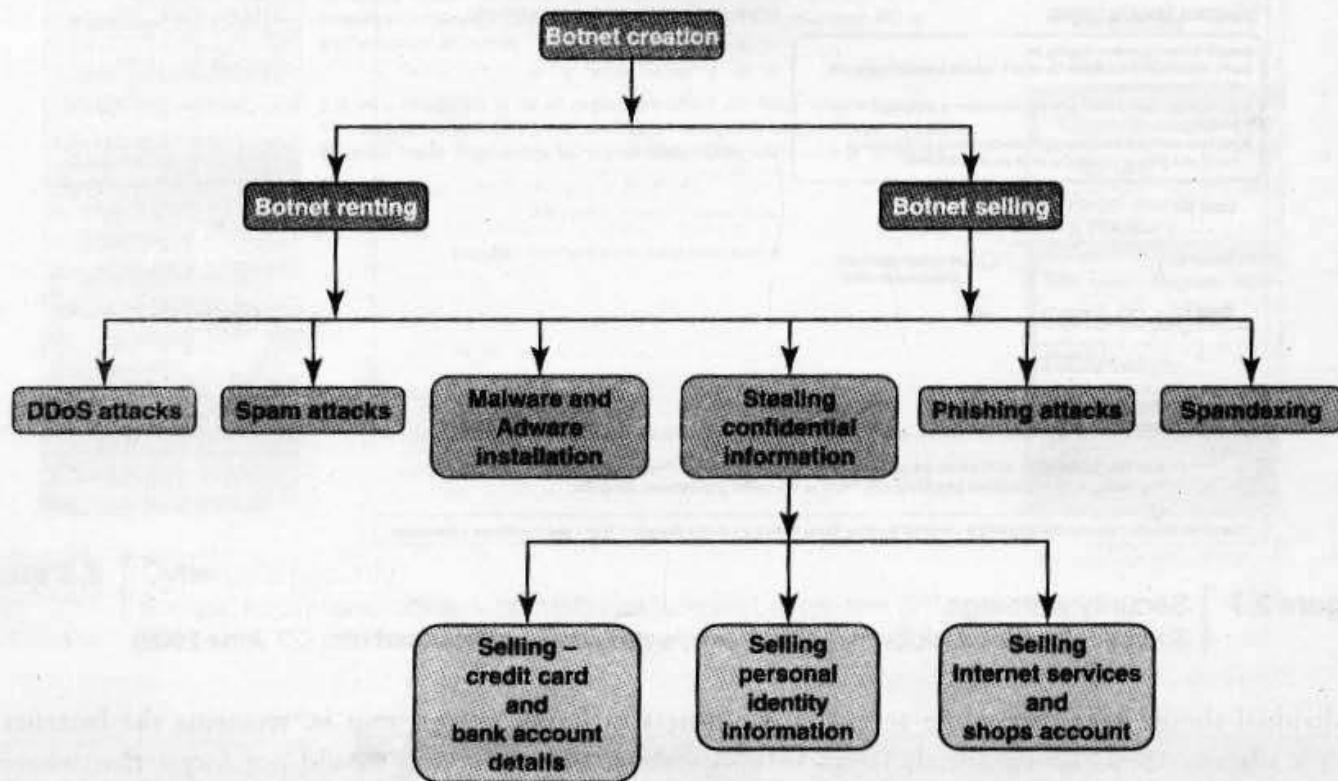


Figure 2.8 | Botnets are used for gainful purposes.

Box 2.9 Explanation for Technical Terms used in Fig. 2.8

Malware: It is malicious software, designed to damage a computer system without the owner's informed consent. Viruses and worms are the examples of malware.

Adware: It is advertising-supported software, which automatically plays, displays, or downloads advertisements to a computer after the software is installed on it or while the application is being used. Few Spywares are classified as Adware.

Spam: It means unsolicited or undesired E-Mail messages (this is discussed in detail in Chapter 5).

Spamdexing: It is also known as search Spam or search engine Spam. It involves a number of methods, such as repeating unrelated phrases, to manipulate the relevancy or prominence of resources indexed by a search engine in a manner inconsistent with the purpose of the indexing system.

DDoS: Distributed denial-of-service attack (DDoS) occurs when multiple systems flood the bandwidth or resources of a targeted system, usually one or more web servers. These systems are compromised by attackers using a variety of methods (this is discussed in details in Chapter 4).

One can reduce the chances of becoming part of a Bot by limiting access into the system. Leaving your Internet connection ON and unprotected is just like leaving the front door of the house wide open. One can ensure following to secure the system:^[12,13]

1. **Use antivirus and anti-Spyware software and keep it up-to-date:** It is important to remove and/or quarantine the viruses. The settings of these softwares should be done during the installations so that these softwares get updated automatically on a daily basis.
2. **Set the OS to download and install security patches automatically:** OS companies issue the security patches for flaws that are found in these systems.
3. **Use a firewall to protect the system from hacking attacks while it is connected on the Internet:** A firewall is a software and/or hardware that is designed to block unauthorized access while permitting authorized communications. It is a device or set of devices configured to permit, deny, encrypt, decrypt, or proxy all (in and out) computer traffic between different security domains based upon a set of rules and other criteria. A firewall is different from antivirus protection. Antivirus software scans incoming communications and files for troublesome viruses vis-à-vis properly configured firewall that helps to block all incoming communications from unauthorized sources.
4. **Disconnect from the Internet when you are away from your computer:** Attackers cannot get into the system when the system is disconnected from the Internet. Firewall, antivirus, and anti-Spyware softwares are not foolproof mechanisms to get access to the system.
5. **Downloading the freeware only from websites that are known and trustworthy:** It is always appealing to download free software(s) such as games, file-sharing programs, customized toolbars, etc. However, one should remember that many free software(s) contain other software, which may include Spyware.
6. **Check regularly the folders in the mail box – “sent items” or “outgoing” – for those messages you did not send:** If you do find such messages in your outbox, it is a sign that your system may have infected with Spyware, and maybe a part of a Botnet. This is not foolproof; many spammers have learned to hide their unauthorized access.
7. **Take an immediate action if your system is infected:** If your system is found to be infected by a virus, disconnect it from the Internet immediately. Then scan the entire system with fully updated antivirus and anti-Spyware software. Report the unauthorized accesses to ISP and to the legal authorities. There is a possibility that your passwords may have been compromised in such cases, so change all the passwords immediately.

2.7 Attack Vector

An “attack vector” is a path or means by which an attacker can gain access to a computer or to a network server to deliver a payload or malicious outcome. Attack vectors enable attackers to exploit system vulnerabilities, including the human element. Attack vectors include viruses, E-Mail attachments, webpages, pop-up windows, instant messages, chat rooms, and deception. All of these methods involve programming (or, in a few cases, hardware), except deception, in which a human operator is fooled into removing or weakening system defenses.^[14]

To some extent, firewalls and antivirus software can block attack vectors. However, no protection method is totally attack-proof. A defense method that is effective today may not remain so for long because attackers are constantly updating attack vectors, and seeking new ones, in their quest to gain unauthorized access to computers and servers. Refer to Box 2.10.

Box 2.10 Zero-Day Attack

A zero-day (or zero-hour) attack^[17] is a computer threat which attempts to exploit computer application vulnerabilities that are unknown to anybody in the world (i.e., undisclosed to the software vendor and software users) and/or for which no patch (i.e., security fix) is available. Zero-day exploits are used or shared by attackers before the software vendor knows about the vulnerability.

Sometimes software vendors discover the vulnerability but developing a patch can take time. Alternatively, software vendors can also hold releasing the patch reason to avoid flooding the customers with numerous individual updates. A "zero-day" attack is launched just on or before the first or "zeroth" day of vendor awareness, reason being the vendor should not get any opportunity to communicate/distribute a security fix to users of such software. If the vulnerability is not particularly dangerous, software vendors prefer to hold until multiple updates (i.e., security fixes commonly known as patches) are collected and then release them together as a package.

Malware writers are able to exploit zero-day vulnerabilities through several different attack vectors.

Zero-day emergency response team (ZERT): This is a group of software engineers who work to release non-vendor patches for zero-day exploits. Nevada is attempting to provide support with the Zeroday Project at www.zerodayproject.com, which purports to provide information on upcoming attacks and provide support to vulnerable systems. Also visit the weblink <http://www.isotf.org/zert> to get more information about it.

Source: http://en.wikipedia.org/wiki/Zero_day_attack (9 October 2009).

The most common malicious payloads are viruses (which can function as their own attack vectors), Trojan Horses, worms, and Spyware (refer to Chapter 4). If an attack vector is thought of as a guided missile, its payload can be compared to the warhead in the tip of the missile.

In the technical terms, *payload* is the necessary data being carried within a packet or other transmission unit – in this scenario (i.e., attack vector) payload means the malicious activity that the attack performs. From the technical perspective, payload does not include the “overhead” data required to get the packet to its destination. Payload may depend on the following point of view: “What constitutes it?” To a communications layer that needs some of the overhead data to do its job, the payload is sometimes considered to include that part of the overhead data that this layer handles. However, in more general usage, the payload is the bits that get delivered to the end-user at the destination.^[15,16]

The attack vectors described here are how most of them are launched.^[16,18]

1. **Attack by E-Mail:** The hostile content is either embedded in the message or linked to by the message. Sometimes attacks combine the two vectors, so that if the message does not get you, the attachment will. Spam is almost always carrier for scams, fraud, dirty tricks, or malicious action of some kind. Any link that offers something “free” or tempting is a suspect.
2. **Attachments (and other files):** Malicious attachments install malicious computer code. The code could be a virus, Trojan Horse, Spyware, or any other kind of malware. Attachments attempt to install their payload as soon as you open them.
3. **Attack by deception:** Deception is aimed at the user/operator as a vulnerable entry point. It is not just malicious computer code that one needs to monitor. Fraud, scams, hoaxes, and to some extent Spam, not to mention viruses, worms and such require the unwitting cooperation of the computer’s operator to succeed. Social engineering and hoaxes are other forms of deception that are often an attack vector too.
4. **Hackers:** Hackers/crackers are a formidable attack vector because, unlike ordinary Malicious Code, people are flexible and they can improvise. Hackers/crackers use a variety of hacking tools, heuristics,

- and social engineering to gain access to computers and online accounts. They often install a Trojan Horse to commandeer the computer for their own use.
5. **Headless guests (attack by webpage):** Counterfeit websites are used to extract personal information. Such websites look very much like the genuine websites they imitate. One may think he/she is doing business with someone you trust. However, he/she is really giving their personal information, like address, credit card number, and expiration date. They are often used in conjunction with Spam, which gets you there in the first place. Pop-up webpages may install Spyware, Adware or Trojans.
 6. **Attack of the worms:** Many worms are delivered as E-Mail attachments, but network worms use holes in network protocols directly. Any remote access service, like file sharing, is likely to be vulnerable to this sort of worm. In most cases, a firewall will block system worms. Many of these system worms install Trojan Horses. Next they begin scanning the Internet from the computer they have just infected, and start looking for other computers to infect. If the worm is successful, it propagates rapidly. The worm owner soon has thousands of “zombie” computers to use for more mischief.
 7. **Malicious macros:** Microsoft Word and Microsoft Excel are some of the examples that allow macros. A macro does something like automating a spreadsheet, for example. Macros can also be used for malicious purposes. All Internet services like instant messaging, Internet Relay Chat (IRC), and P2P file-sharing networks rely on cozy connections between the computer and the other computers on the Internet. If one is using P2P software then his/her system is more vulnerable to hostile exploits.
 8. **Foistware (sneakware):** Foistware is the software that adds hidden components to the system on the sly. Spyware is the most common form of foistware. Foistware is quasi-legal software bundled with some attractive software. Sneak software often hijacks your browser and diverts you to some “revenue opportunity” that the foistware has set up.
 9. **Viruses:** These are malicious computer codes that hitch a ride and make the payload. Nowadays, virus vectors include E-Mail attachments, downloaded files, worms, etc.

2.8 Cloud Computing

The growing popularity of cloud computing and virtualization among organizations have made it possible, the next target of cybercriminals. Cloud computing services, while offering considerable benefits and cost savings, move servers outside the organizations security perimeter, which makes it easier for cybercriminals to attack these systems.

Cloud computing is Internet (“cloud”)-based development and use of computer technology (“computing”).^[19] The term cloud is used as a metaphor for the Internet, based on the cloud drawing used to depict the Internet in computer networks. Cloud computing is a term used for hosted services delivered over the Internet. A cloud service has three distinct characteristics which differentiate it from traditional hosting:

1. It is sold on demand – typically by the minute or the hour;
2. it is elastic in terms of usage – a user can have as much or as little of a service as he/she wants at any given time;
3. the service is fully managed by the provider – a user just needs PC and Internet connection.

Significant innovations into distributed computing and virtualization as well as improved access speed over the Internet have generated a great demand for cloud computing.

2.8.1 Why Cloud Computing?

The cloud computing has following advantages^[20]:

1. Applications and data can be accessed from anywhere at any time. Data may not be held on a hard drive on one user's computer.
2. It could bring hardware costs down. One would need the Internet connection.
3. Organizations do not have to buy a set of software or software licenses for every employee and the organizations could pay a metered fee to a cloud computing company.
4. Organizations do not have to rent a physical space to store servers and databases. Servers and digital storage devices take up space. Cloud computing gives the option of storing data on someone else's hardware, thereby removing the need for physical space on the front end.
5. Organizations would be able to save money on IT support because organizations will have to ensure about the desktop (i.e., a client) and continuous Internet connectivity instead of servers and other hardware.

The cloud computing services can be either private or public. A public cloud sells services to anyone on the Internet (see Table 2.4 for cloud computing service providers). A private cloud is like a proprietary network or a data center that supplies the hosted services to a limited number of people. When a service provider uses public cloud resources to create a private cloud, the result is called a "virtual private cloud." The goal of cloud computing is to provide easy, scalable access to the computing resources and IT services.

Table 2.4 | Cloud computing service providers

| Sr. No. | Service Providers | Weblink |
|---------|---|---|
| 1. | Amazon: It offers flexible, simple, and easy computing environment in the cloud that allows development of applications. | http://aws.amazon.com/ec2/ |
| 2. | 3Tera: It offers AppLogic grid OS that enables infrastructure solutions according to the changing needs of business. | http://www.3tera.com/ |
| 3. | Force.com: It allows building of core business applications like enterprise resource planning (ERP), human resource management (HRM), and supply chain management (SCM). | http://www.salesforce.com/platform/ |
| 4. | Appistry-Cloud Computing Middleware: It allows easily scalable cloud computing for a wide variety of applications and services for both public and private clouds. | http://www.appistry.com/ |
| 5. | Microsoft Live Mesh: This cloud setup synchronizes the files with the all users' devices like laptop, Mac, mobile phone, or others and allows to access the files from any device as well as enables sharing of files. | https://www.mesh.com/Welcome/default.aspx |
| 6. | AppNexus: This helps a user to launch several operating systems, run a variety of applications, load balance these applications, and store huge amount of secure data. | http://www.appnexus.com/ |

(Continued)

Table 2.4 | (Continued)

| <i>Sr. No.</i> | <i>Service Providers</i> | <i>Weblink</i> |
|----------------|--|---|
| 7. | Flexiscale: It is self-service through control panel or API – features full self-service – start/stop/delete, change memory/CPU/storage/IPs of virtual dedicated servers. | http://www.flexiscale.com/ |
| 8. | GoogleApp Engine: This is a free setup that allows the users to run their web application on Google infrastructure. | http://www.google.com/apps/intl/en/business/index.html |
| 9. | GoGrid: It offers unique multiserver control panel that enables the user to deploy and manage load-balanced cloud servers. | http://www.gogrid.com/ |
| 10. | Terremark Enterprise Cloud: It provides the power to the user for computing resources for user's mission-critical applications. | http://www.terremark.com/services/cloudcomputing/theenterprisecloud.aspx |

Source: <http://blog.taragana.com/index.php/archive/top-10-cloud-computing-service-provider/> (9 October 2009).



Although cloud computing is an emerging field, the idea has been evolved over few years. It is called cloud computing because the data and applications exist on a "cloud" of Web servers.

2.8.2 Types of Services

Services provided by cloud computing are as follows^[19]:

1. **Infrastructure-as-a-service (IaaS):** It is like Amazon Web Services that provide virtual servers with unique IP addresses and blocks of storage on demand. Customers benefit from an Application Programmable Interface (API) from which they can control their servers. As customers can pay for exactly the amount of service they use, like for electricity or water, this service is also called utility computing.
2. **Platform-as-a-service (PaaS):** It is a set of software and development tools hosted on the provider's servers. Developers can create applications using the provider's APIs. Google Apps is one of the most famous PaaS providers. Developers should take notice that there are not any interoperability standards; therefore, some providers may not allow you to take your application and put it on another platform.
3. **Software-as-a-service (SaaS):** It is the broadest market. In this case, the provider allows the customer only to use its applications. The software interacts with the user through a user interface. These applications can be anything from Web-based E-Mail to applications such as Twitter or Last.fm.

2.8.3 Cybercrime and Cloud Computing

Nowadays, prime area of the risk in cloud computing is protection of user data. See Table 2.5 to understand major areas of concerns in cloud computing domain.

Table 2.5 | Risks associated with cloud computing environment

| Sr. No. | Area | What is the Risk? | How to Remediate the Risk? |
|----------------|--|--|--|
| 1. | Elevated user access | Any data processed outside the organization brings with it an inherent level of risk, as outsourced services may bypass the physical, logical, and personnel controls and will have elevated user access to such data. | Customer should obtain as much information as he/she can about the service provider who will be managing the data and scrutinizing vendor's monitoring mechanism about hiring and oversight of privileged administrators, and IT controls over the access privileges. |
| 2. | Regulatory compliance | Cloud computing service providers are not able and/or not willing to undergo external assessments. This can result into non-compliance with various standards/laws like the US government's Health Insurance Portability and Accountability Act (HIPAA), or Sarbanes-Oxley; the European Union's Data Protection Directive or the credit card industry's Payment Card Industry Data Security Standard (PCI DSS). | The organization is entirely responsible for the security and integrity of their own data, even when it is held by a service provider. Hence, organization should force cloud computing service providers to undergo external audits and/or security certifications and submit the report on periodic basis. |
| 3. | Location of the data | The organizations that are obtaining cloud computing services may not be aware about where the data is hosted and may not even know in which country it is hosted. | Organizations should ensure that the service provider is committed to obey local privacy requirements on behalf of the organization to store and process the data in the specific jurisdictions. |
| 4. | Segregation of data | As the data will be stored under stored environment, encryption mechanism should be strong enough to segregate the data from other organizations, whose data are also stored under the same server. | Organization should be aware of the arrangements made by the service provider about segregation of the data. In case of encryption mechanism, the service provider should display encryption schemes and testing of the mechanism by the experts. |
| 5. | Recovery of the data | Business continuity in case of any disaster – availability of the services and data without any disruption. Application environment and IT infrastructure across multiple sites are vulnerable to a total failure. | Organization should ensure the enforcement of contractual liability over the service provider about complete restoration of data within stipulated timeframe. Organization should also be aware of Business Continuity Plan/Disaster Recovery Plan (BCP/DRP) established by the service provider. |
| 6. | Information security violation reports | Due to complex IT environment and several customers logging in and logging out of the hosts, it becomes difficult to trace inappropriate and/or illegal activity. | Organization should enforce the contractual liability toward providing security violation logs at frequent intervals. |
| 7. | Long-term viability | In case of any major change in the cloud computing service provider (e.g., acquisition and merger, partnership breakage), the service provided is at the stake. | Organization should ensure getting their data in case of such major events. |

The risk areas identified in Table 2.5 are considered to be key obstacles to adoption of cloud computing and making it an area of active research across the globe.

SUMMARY

In this chapter we have discussed how technology is used in a different way for conducting illegal activities against a person, property, and/or organizations including governments. Considerable amount of time is spent in gathering information about a target. Therefore, one should have adequate knowledge about the technology to use, the different tools and techniques. Public networks and cybercafes are used to hide the ID for information gathering as well as launching attacks and hence it becomes important to take utmost care while operating/surfing through such facilities. People are the weakest link in the security domain and, hence, they get either exploited/deceived

to obtain the required information; thus, this is called social engineering. Cyberstalking is another way through which criminals interact with victims directly, avoiding face-to-face conversation. Criminals do this either for harassing and/or threatening behavior or to get the information from the victim. The Internet has become an integral part of the lifestyle nowadays and IT is found to be pervasive – the result is cloud computing; however, we should also be aware of threats inducing from such technologies like Botnets and attack vectors. Every technology has some limitations and attackers having good amount of knowledge will always try to exploit it.

REVIEW QUESTIONS

- How are cybercrimes classified? Explain with examples.
- Explain the difference between passive and active attacks. Provide examples.
- What is social engineering?
- What is cyberstalking? As per your understanding is it a crime under the Indian IT Act?
- Explain how Botnets can be used as a fuel to cybercrime.
- What are the different attacks launched with attack vector. Explain.
- Explain cloud computing and cybercrime.

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FURTHER READING

Books

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2. Graves, K. (2007) *CEH – Official Certified Ethical Hacker Review Guide*, Wiley Publishing Inc., IN, USA.
3. Milhorn, H.T. (2007) *Cybercrime: How to Avoid Becoming a Victim*, Universal Publishers, USA.

The appendices that serve as extended material for the topic addressed in this chapter are: A, B, C, D, E, F, J, L. These are provided in the companion CD.

3

Cybercrime: Mobile and Wireless Devices

Learning Objectives

After reading this chapter, you will be able to:

- Understand the security challenges presented by mobile devices and information systems access in the cybercrime world.
- Understand the challenges faced by the mobile workforce and their implications under the cybercrime era.
- Get an overview on mitigation strategy like the CLEW for possible protection of credit card users.
- Learn about security issues arising due to use of media players.
- Understand the organizational security implications with electronic gadgets and learn what organizational measures need to be implemented for protecting information systems from threats in mobile computing area.
- Understand Smishing and Vishing attacks in the Mobile World.
- Understand the security issues arising due to daily use of removable media such as pen/zip drives in this mobile environment.

3.1 Introduction

In this modern era, the rising importance of *electronic gadgets* (i.e., mobile hand-held devices) – which became an integral part of business, providing connectivity with the Internet outside the office – brings many challenges to secure these devices from being a victim of cybercrime. In the recent years, the use of laptops, personal digital assistants (PDAs), and mobile phones has grown from limited user communities to widespread desktop replacement and broad deployment. According to Quocirca Insight Report (2009),^[1] by the end of 2008 around 1.5 billion individuals around the world had the Internet access. In November 2007, mobile phone users were numbered 3.3 billion, with a growing proportion of those mobile devices enabled for the Internet access. The complexity of managing these devices outside the walls of the office is something that the information technology (IT) departments in the organizations need to address. Remote connection has extended from fixed location dial-in to wireless-on-the-move, and smart hand-held devices such as PDAs have become networked, converging with mobile phones. Furthermore, the maturation of the PDA and advancements in cellular phone technology have converged into a new category of mobile phone device: the *Smartphone*.

Smartphones combine the best aspects of mobile and wireless technologies and blend them into a useful business tool. Although IT departments of organizations as yet are not swapping employees' company-provided

PDAs (as the case may be) for the Smartphones, many users may bring these devices from home and use them in the office. Research in Motion's (RIM) BlackBerry Wireless Hand-held is an alternate technology. According to Research in Motion Annual Report (2009),^[2] there are over 175,000 organizations with BlackBerry Enterprise Server installed behind the corporate firewall (i.e., corporations that use the BlackBerry enterprise server and client/server software for data communication between corporate BlackBerry devices and other mail systems). Thus, the larger and more diverse community of mobile users and their devices increase the demands on the IT function to secure the device, data and connection to the network, keeping control of the corporate assets, while at the same time supporting mobile user productivity. Clearly, these technological developments present a new set of security challenges to the global organizations.

3.2 Proliferation of Mobile and Wireless Devices

Today, incredible advances are being made for mobile devices. The trend is for smaller devices and more processing power. A few years ago, the choice was between a wireless phone and a simple PDA. Now the buyers have a choice between high-end PDAs with integrated wireless modems and small phones with wireless Web-browsing capabilities. A long list of options is available to the mobile users. A simple hand-held mobile device provides enough computing power to run small applications, play games and music, and make voice calls. A key driver for the growth of mobile technology is the rapid growth of business solutions into hand-held devices. Figure 3.1 shows some typical hand-held devices.

As the term "mobile device" includes many products. We first provide a clear distinction among the key terms: mobile computing, wireless computing and hand-held devices. Figure 3.2 helps us understand how these terms are related. Let us understand the concept of mobile computing and the various types of devices.



Figure 3.1 Typical hand-held devices.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

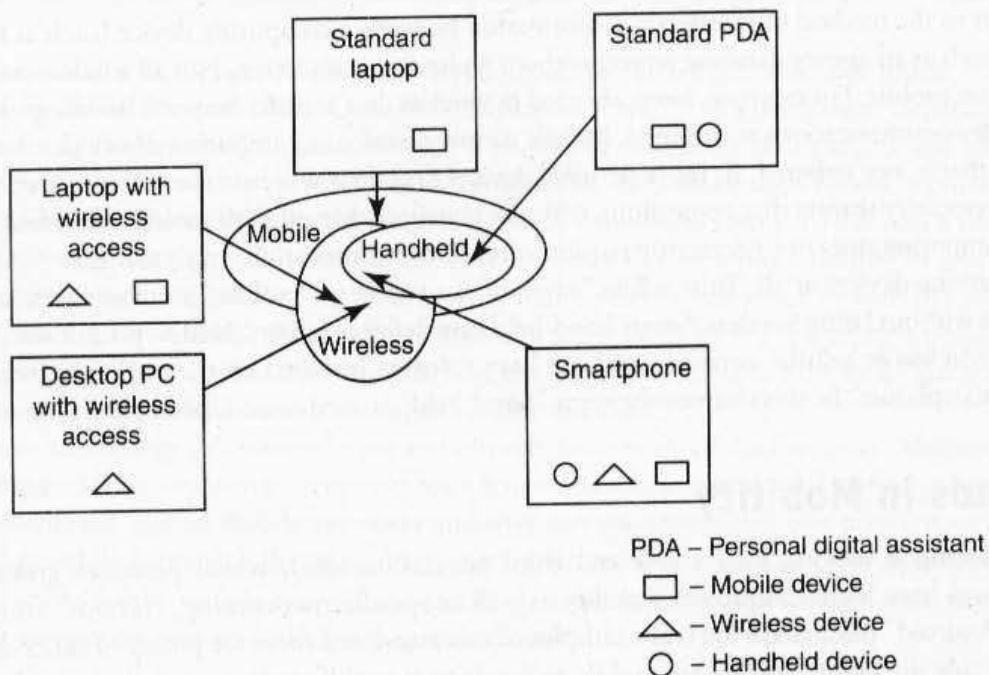


Figure 3.2 | Mobile, wireless and hand-held devices.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

Mobile computing is “taking a computer and all necessary files and software out into the field.” Many types of mobile computers have been introduced since 1990s.^[3] They are as follows:

1. **Portable computer:** It is a general-purpose computer that can be easily moved from one place to another, but cannot be used while in transit, usually because it requires some “setting-up” and an AC power source.
2. **Tablet PC:** It lacks a keyboard, is shaped like a slate or a paper notebook and has features of a touch-screen with a stylus and handwriting recognition software. Tablets may not be best suited for applications requiring a physical keyboard for typing, but are otherwise capable of carrying out most tasks that an ordinary laptop would be able to perform.
3. **Internet tablet:** It is the Internet appliance in tablet form. Unlike a Tablet PC, the Internet tablet does not have much computing power and its applications suite is limited. Also it cannot replace a general-purpose computer. The Internet tablets typically feature an MP3 and video player, a Web browser, a chat application and a picture viewer.
4. **Personal digital assistant (PDA):** It is a small, usually pocket-sized, computer with limited functionality. It is intended to supplement and synchronize with a desktop computer, giving access to contacts, address book, notes, E-Mail and other features.
5. **Ultramobile PC:** It is a full-featured, PDA-sized computer running a general-purpose operating system (OS).
6. **Smartphone:** It is a PDA with an integrated cell phone functionality. Current Smartphones have a wide range of features and installable applications.
7. **Carputer:** It is a computing device installed in an automobile. It operates as a wireless computer, sound system, *global positioning system* (GPS) and DVD player. It also contains word processing software and is Bluetooth compatible.
8. **Fly Fusion Pentop computer:** It is a computing device with the size and shape of a pen. It functions as a writing utensil, MP3 player, language translator, digital storage device and calculator.

Wireless refers to the method of transferring information between a computing device (such as a PDA) and a data source (such as an agency database server) without a physical connection. Not all wireless communication technologies are mobile. For example, lasers are used in wireless data transfer between buildings, but cannot be used in mobile communications at this time. Mobile simply describes a computing device that is not restricted to a desktop, that is, not tethered. As more personal devices find their way into the enterprise, corporations are realizing cybersecurity threats that come along with the benefits achieved with mobile solutions.

Mobile computing does not necessarily require wireless communication. In fact, it may not require communication among devices at all. Thus, while “wireless” is a subset of “mobile,” in most cases, an application can be mobile without being wireless. Smart hand-holds are defined as hand-held or pocket-sized devices that connect to a wireless or cellular network, and can have software installed on them; this includes networked PDAs and Smartphones. In this chapter the term “hand-held” is used as an all-embracing term.

3.3 Trends in Mobility

Mobile computing is moving into a new era, third generation (3G), which promises greater variety in applications and have highly improved usability as well as speedier networking. “iPhone” from Apple and Google-led “Android” phones are the best examples of this trend and there are plenty of other developments that point in this direction. This smart mobile technology is rapidly gaining popularity and the attackers (hackers and crackers) are among its biggest fans.

It is worth noting the trends in mobile computing; this will help readers to realize the seriousness of cybersecurity issues in the mobile computing domain. Figure 3.3 shows the different types of mobility and their implications.

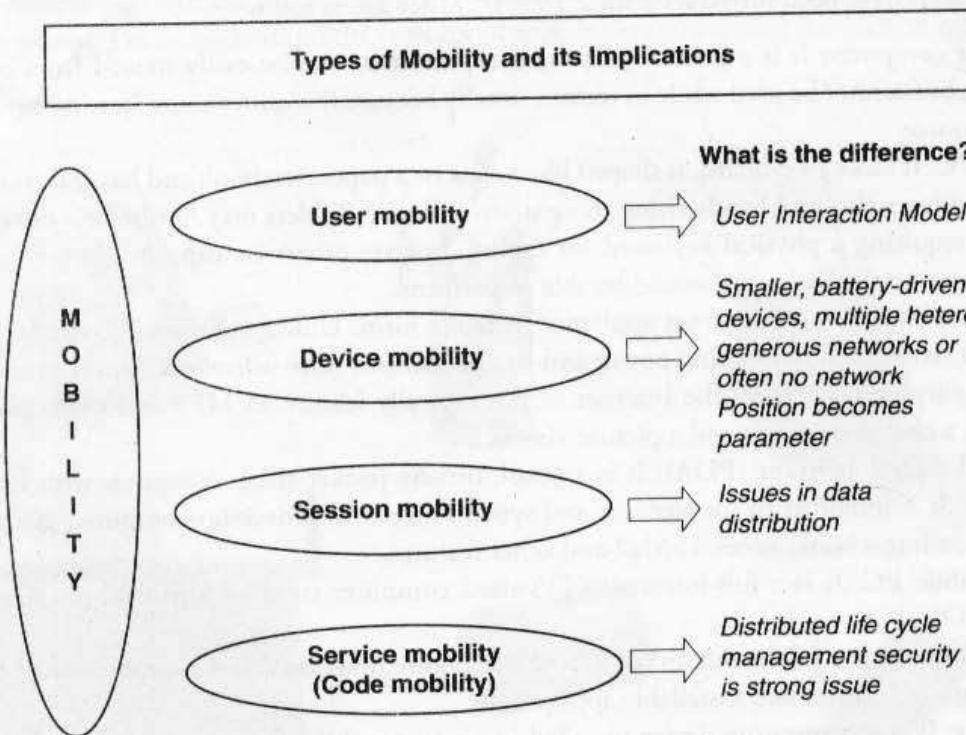


Figure 3.3

Mobility types and implications.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

To assess major challenges in the mobility domain, let us see the statistics found during the surveys. In one such survey,^[4] reported by Quocirca, employees working in government departments have lost or mislaid over 1,000 laptops, lost more than 500 phones or mobile E-Mail gadgets and lost over 700 other mobile devices (i.e., probably memory sticks, cameras, etc.). Another such survey, reported by Quocirca,^[5] of the 2,853 respondents, 29% had a broad experience of wireless laptops, 14% had a broad experience of smart hand-helds, with around a further 60% in each case having a more limited or unofficial experience. Findings from surveys like these help us demystify many perceptions about mobile and wireless connectivities. The results of surveys like these indicate that we are grappling with a “perception problem”; most people have not as yet come to terms with the fact that the hand-held devices may look “harmless” but they can cause serious cybersecurity issues to the organizations (see Box 3.1).

The new technology 3G networks are not entirely built with IP data security. Moreover, IP data world when compared to voice-centric security threats is new to mobile operators. There are numerous attacks that can be committed against mobile networks and they can originate from two primary vectors. One is from outside the mobile network – that is, public Internet, private networks and other operator’s networks – and the other is within the mobile networks – that is, devices such as data-capable handsets and Smartphones, notebook computers or even desktop computers connected to the 3G network.

Box 3.1 Key Findings for Mobile Computing Security Scenario

1. **With usage experience, awareness of mobile users gets enhanced:** Survey showed that those with broad wireless laptop experience place less emphasis on this aspect for the deployment of smart hand-helds. However, an experience of small hand-held deployment boosted the numbers seeing the need for increased provision of user support and training.
2. **People continue to remain the weakest link for laptop security:** Antivirus software, secured virtual private network (VPN) access and personal firewalls are deployed over two-thirds of IT professionals, but those with a broad wireless experience regard loss, damage or unauthorized use as their major concerns. These depend on the care taken by the users and well-communicated security policies.
3. **Wireless connectivity does little to increase burden of managing laptops:** The cost and complexity of device management is seen as an issue by around half of the IT professionals surveyed. However, the level of challenge perceived to affect security, device management and use support is unaffected by a broader experience of wireless laptop deployment.
4. **Laptop experience changes the view of starting a smart hand-held pilot:** The key concerns for starting a smart hand-held are security and the cost of devices, but these lessen for those with a broad wireless laptop experience. However, the concern over choosing the most appropriate devices rises with experience; users cite further concerns over interoperability and compatibility.
5. **There is naivety and/or neglect in smart hand-held security:** Although plenty of emphasis is placed on security, a large number of IT departments do not enforce security for smart hand-helds as well as for laptops or they leave it in the hands of the users. This is more prevalent in those with limited or unofficial smart hand-held activity, but even those with a broad experience (almost one-third of those surveyed) do not treat smart hand-held security as seriously as laptops.
6. **Rules rather than technology keep smart hand-helds' usage in check:** Businesses with an existing experience of smart hand-helds favored a policy of controlled deployment, with almost two-thirds of those surveyed providing a limited choice of devices, and only one-third of the surveyed population was user of technology solution based on continuous synchronization. However, broad experience increases the use of other automated solutions, such as centralized software management and remote device deactivation.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

Popular types of attacks against 3G mobile networks^[6] are as follows:

1. **Malwares, viruses and worms:** Although many users are still in the transient process of switching from 2G, 2.5G to 3G, it is a growing need to educate the community people and provide awareness of such threats that exist while using mobile devices. Here are few examples of malware(s) specific to mobile devices:
 - *Skull Trojan:* It targets Series 60 phones equipped with the Symbian mobile OS.
 - *Cabir Worm:* It is the first dedicated mobile-phone worm; infects phones running on Symbian OS and scans other mobile devices to send a copy of itself to the first vulnerable phone it finds through Bluetooth Wireless technology. The worst thing about this worm is that the source code for the Cabir-H and Cabir-I viruses is available online.
 - *Mosquito Trojan:* It affects the Series 60 Smartphones and is a cracked version of "Mosquitos" mobile phone game.
 - *Brador Trojan:* It affects the Windows CE OS by creating a svchost.exe file in the Windows start-up folder which allows full control of the device. This executable file is conductive to traditional worm propagation vector such as E-Mail file attachments (refer to Appendix C).
 - *Lasco Worm:* It was released first in 2005 to target PDAs and mobile phones running the Symbian OS. Lasco is based on Cabir's source code and replicates over Bluetooth connection.
2. **Denial-of-service (DoS):** The main objective behind this attack is to make the system unavailable to the intended users. Virus attacks can be used to damage the system to make the system unavailable (we will address this attack in detail under Chapter 4). Presently, one of the most common cyber-security threats to wired *Internet service providers* (ISPs) is a distributed denial-of-service (DDoS) attack. DDoS attacks are used to flood the target system with the data so that the response from the target system is either slowed or stopped. Botnets/zombies are used to create enough traffic to impose that kind of damage (we have addressed zombies in Chapter 1 and Botnets in Chapter 2).
3. **Overbilling attack:** Overbilling involves an attacker hijacking a subscriber's IP address and then using it (i.e., the connection) to initiate downloads that are not "Free downloads" or simply use it for his/her own purposes. In either case, the legitimate user is charged for the activity which the user did not conduct or authorize to conduct.
4. **Spoofed policy development process (PDP):** These types of attacks exploit the vulnerabilities in the GTP [General Packet Radio Service (GPRS) Tunneling Protocol].
5. **Signaling-level attacks:** The Session Initiation Protocol (SIP) is a signaling protocol used in IP multimedia subsystem (IMS) networks to provide Voice Over Internet Protocol (VoIP) services. There are several vulnerabilities with SIP-based VoIP systems.

To know more on this topic, readers may visit http://www.igr-inc.com/uploads/free_white_papers/3G-MobileSecurity_Jan07.pdf



Mobile Security Processing System (MOSES) is a programmable security processor platform that enables secure data and multimedia communications in next-generation wireless mobile computing. MOSES was developed to meet the security challenges in emerging mobile technology such as 3G and 4G mobile phones and PDAs. It is a security processing architecture to provide secure (i.e., tamper-resistant) and efficient (i.e., high performance, low power) execution of security processing functions. It constitutes three key components, such as Security Processing Engine (SPE), a hierarchical secure memory subsystem and security-enhanced communication architecture, from hardware perspective.

3.4 Credit Card Frauds in Mobile and Wireless Computing Era

These are new trends in cybercrime that are coming up with mobile computing – mobile commerce (M-Commerce) and mobile banking (M-Banking). Credit card frauds are now becoming commonplace given the ever-increasing power and the ever-reducing prices of the mobile hand-held devices, factors that result in easy availability of these gadgets to almost anyone. *Mobile credit card transactions* are now very common; new technologies combine low-cost mobile phone technologies with the capabilities of a point-of-sale (POS) terminal.

Today belongs to “mobile computing,” that is, *anywhere anytime computing*. The developments in wireless technology have fuelled this new mode of working for white collar workers. This is true for credit card processing too; wireless credit card processing is a relatively new service that will allow a person to process credit cards electronically, virtually anywhere. Wireless credit card processing is a very desirable system, because it allows businesses to process transactions from mobile locations quickly, efficiently and professionally. It is most often used by businesses that operate mainly in a mobile environment. These businesses include mobile utility repair service businesses, locksmiths, mobile windshield repair and others. Some upscale restaurants are using wireless processing equipment for the security of their credit card paying customers. Figure 3.4 shows the basic flow of transactions involved in purchases done using credit cards.^[7] Credit card companies, normally, do a good job of helping consumers resolve identity (ID) theft problems (refer to Chapter 5) once they occur. But they could reduce ID fraud even more if they give consumers better tools to monitor their accounts and limit high-risk transactions (Box 3.2).

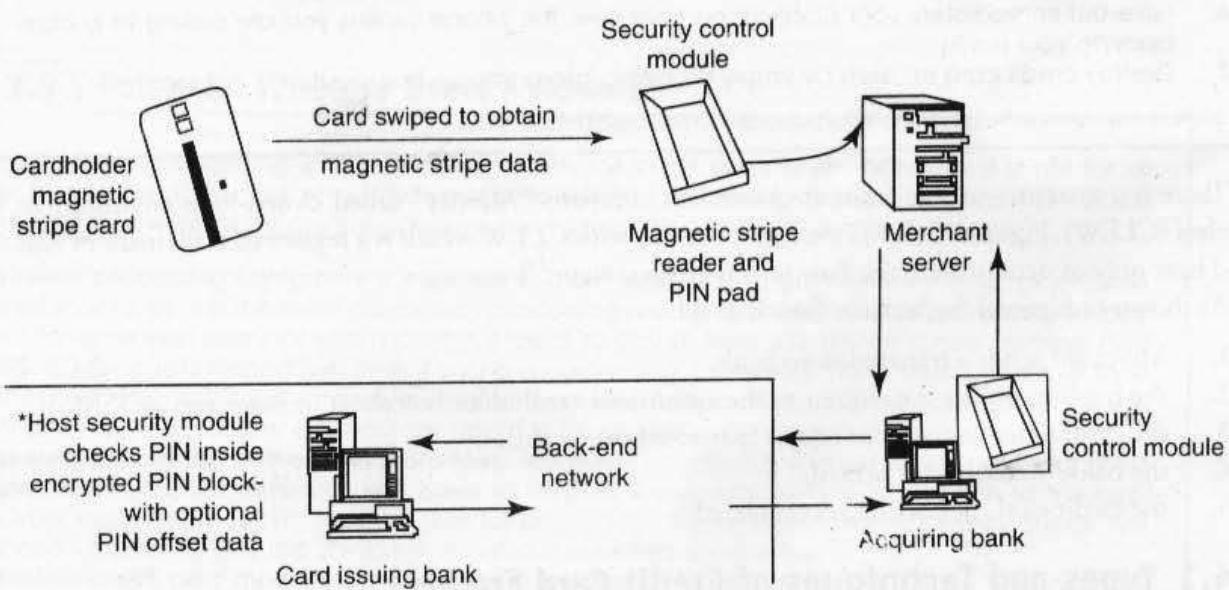


Figure 3.4 | Online environment for credit card transactions.
Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

Box 3.2 Tips to Prevent Credit Card Frauds

The current topic is about credit card frauds in mobile and wireless computing era, however, we would like to include these tips to prevent credit card frauds^[8] caused due to individual ignorance about a few known facts.

Do's

1. Put your signature on the card immediately upon its receipt.
2. Make the photocopy of both the sides of your card and preserve it at a safe place to remember the card number, expiration date in case of loss of card.
3. Change the default personal identification number (PIN) received from the bank before doing any transaction.
4. Always carry the details about contact numbers of your bank in case of loss of your card.
5. Carry your cards in a separate pouch/card holder than your wallet.
6. Keep an eye on your card during the transaction, and ensure to get it back immediately.
7. Preserve all the receipts to compare with credit card invoice.
8. Reconcile your monthly invoice/statement with your receipts.
9. Report immediately any discrepancy observed in the monthly invoice/statement.
10. Destroy all the receipts after reconciling it with the monthly invoice/statement.
11. Inform your bank in advance, about any change in your contact details such as home address, cell phone number and E-Mail address.
12. Ensure the legitimacy of the website before providing any of your card details.
13. Report the loss of the card immediately in your bank and at the police station, if necessary.

Dont's

1. Store your card number and PINs in your cell.
2. Lend your cards to anyone.
3. Leave cards or transaction receipts lying around.
4. Sign a blank receipt (if the transaction details are not legible, ask for another receipt to ensure the amount instead of trusting the seller).
5. Write your card number/PIN on a postcard or the outside of an envelope.
6. Give out immediately your account number over the phone (unless you are calling to a company/to your bank).
7. Destroy credit card receipts by simply dropping into garbage box/dustbin.

Source: <http://www.ftc.gov/bcp/edu/pubs/consumer/credit/cre07.shtm>

There is a system available from an Australian company "Alacrity" called closed-loop environment for wireless (CLEW). Figure 3.5 shows the flow of events with CLEW which is a registered trademark of Alacrity used here only to demonstrate the flow in this environment.^[9]

As shown in Figure 3.5, the basic flow is as follows:

1. Merchant sends a transaction to bank;
2. the bank transmits the request to the authorized cardholder [*not* short message service (SMS)];
3. the cardholder approves or rejects (password protected);
4. the bank/merchant is notified;
5. the credit card transaction is completed.

3.4.1 Types and Techniques of Credit Card Frauds

Traditional Techniques

The traditional^[10] and the first type of credit card fraud is paper-based fraud – *application fraud*, wherein a criminal uses stolen or fake documents such as utility bills and bank statements that can build up useful personally Identifiable Information (PII) (refer to Chapter 5) to open an account in someone else's name.

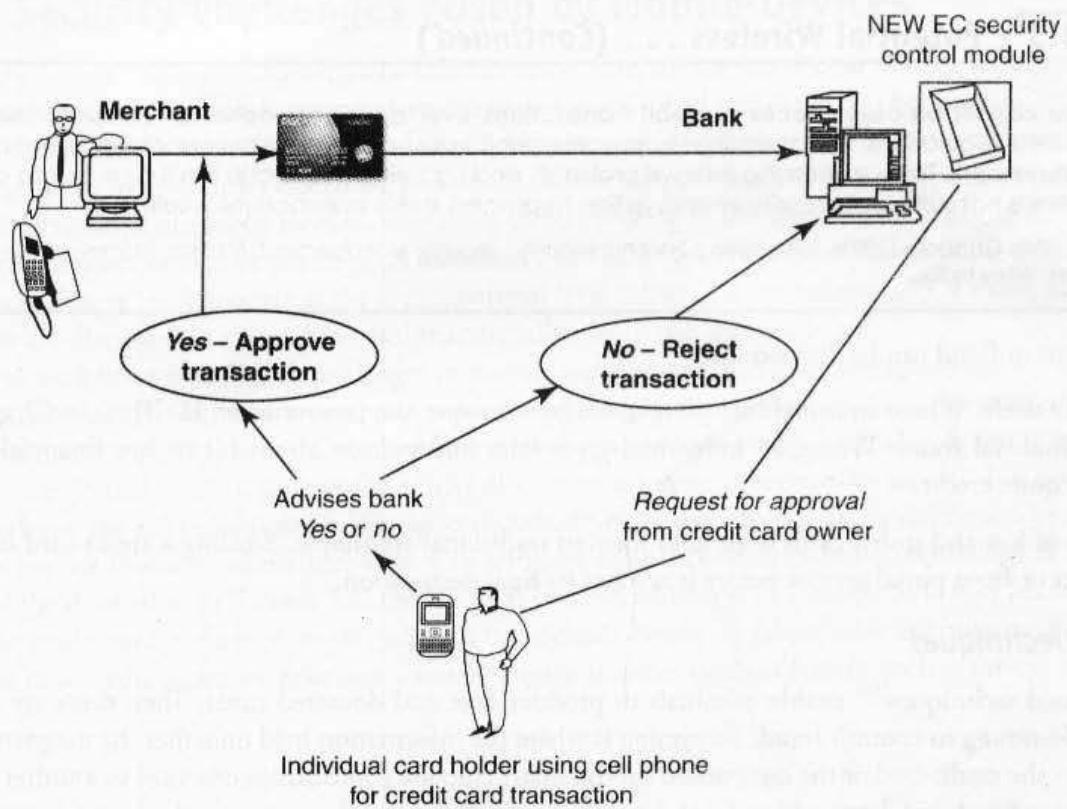


Figure 3.5 | Closed-loop environment for wireless (CLEW).

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

Box 3.3 Potential Wireless Users – Beware!

Although wireless processing is a very good system for many companies, however, it is not for all mobile businesses. There are some drawbacks to wireless processing that many potential wireless users should be aware of before they venture into wireless processing. They are as follows:

- Wireless processing equipment is expensive:** There is no way to get around this. Wireless credit card machines are the most advanced processing terminals available. You get what you pay for! For a wireless terminal with a printer, expect to pay at least US\$ 800 for a new terminal and US\$ 700 for a refurbished terminal. If you are purchasing a terminal that is much cheaper than any other you find, it is most likely outdated equipment that uses outdated cellular networks. In other words, it is a scam, and you are about to buy a really expensive paperweight.
- Wireless processing comes with extra fees:** Just like a cell phone, wireless credit card machines operate on cellular networks. You have to pay for this cellular service in addition to the high cost of equipment. Luckily, wireless fees for processing are nowhere near what they are for cell phones. Expect to pay US\$ 20–25 per month for a wireless service fee.
- Wireless credit card machines are subject to cellular coverage blackouts:** I know what you are thinking – “My cell phone works almost everywhere, so my wireless credit card machine will too.” Sadly, this is not the case. Wireless credit card processing uses a business cellular network called the Motient or Mobitex network. Your cell phone may be using a network called code division multiple access (CDMA) or time division multiple access (TDMA) [global system for mobile communications (GSM)] or some other technology-based network. The coverage that your cell phone gets is much greater than the wireless processing network. There can be some states in your country with no coverage for wireless processing at all.

Box 3.3 Potential Wireless . . . (Continued)

4. **You cannot process checks or debit transactions over a wireless network:** Currently owing to federal regulations, it is impossible to process debit transaction or electronic checks over a wireless network. This is something that will probably end up being allowed in the future, but as of now there is not sufficient security or encryption to process these transactions wireless.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

Application fraud can be divided into

1. **ID theft:** Where an individual pretends to be someone else (see more on ID Theft in Chapter 5).
2. **Financial fraud:** Where an individual gives false information about his or her financial status to acquire credit.

Illegal use of lost and stolen cards is another form of traditional technique. Stealing a credit card is either by pickpocket or from postal service before it reaches its final destination.

Modern Techniques

Sophisticated techniques^[10] enable criminals to produce fake and doctored cards. Then there are also those who use skimming to commit fraud. Skimming is where the information held on either the magnetic strip on the back of the credit card or the data stored on the smart chip are copied from one card to another (see more on skimming frauds in Chapter 11 in CD). Site cloning and false merchant sites on the Internet are becoming a popular method of fraud and to direct the users to such bogus/fake sites is called Phishing (see more on this in Chapter 5). Such sites are designed to get people to hand over their credit card details without realizing that they have been directed to a fake weblink/website (i.e., they have been scammed).

1. **Triangulation:** It is another method of credit card fraud and works in the fashion as explained further.
 - The criminal offers the goods with heavy discounted rates through a website designed and hosted by him, which appears to be legitimate merchandise website.
 - The customer registers on this website with his/her name, address, shipping address and valid credit card details.
 - The criminal orders the goods from a legitimate website with the help of stolen credit card details and supply shipping address that have been provided by the customer while registering on the criminal's website.
 - The goods are shipped to the customer and the transaction gets completed.
 - The criminal keeps on purchasing other goods using fraudulent credit card details of different customers till the criminal closes existing website and starts a new one.

Such websites are usually available for few weeks/months, till the authorities track the websites through which the criminal has enticed the individuals to reveal their personal details, which enabled the criminal to commit the transactions by using the credit card details of these customers. The entire investigation process for tracking and reaching these criminals is time-consuming, and the criminals may close such fake website in between the process that may cause further difficulty to trace the criminal. The criminals aim to create a great deal of confusion for the authorities so that they can operate long enough to accumulate a vast amount of goods purchased through such fraudulent transactions.

2. **Credit card generators:** It is another modern technique – computer emulation software – that creates valid credit card numbers and expiry dates. The criminals highly rely on these generators to create valid credit cards. These are available for free download on the Internet.

3.5 Security Challenges Posed by Mobile Devices

Mobility brings two main challenges to cybersecurity: first, on the hand-held devices, information is being taken outside the physically controlled environment and second remote access back to the protected environment is being granted. Perceptions of the organizations to these cybersecurity challenges are important in devising appropriate security operating procedure. When people are asked about important issues in managing a diverse range of mobile devices, they seem to be thinking of the ones shown in Fig. 3.6.

As the number of mobile device users increases, two challenges are presented: one at the device level called "microchallenges" and another at the organizational level called "macrochallenges." Of these, some microchallenges are discussed in this section and macrochallenges in the next section.

Some well-known technical challenges in mobile security are: *managing the registry settings and configurations, authentication service security, cryptography security, Lightweight Directory Access Protocol (LDAP) security, remote access server (RAS) security, media player control security, networking application program interface (API) security, etc.* In this section, we provide a brief discussion on these cybersecurity aspects. For most of the discussion here, the reference point is Windows mobile development given that the developers of the Windows OS are on the forefront of the technology in terms of their mobile computing technological initiatives. In view of the discussion in Section 3.4, the ID theft (we will address it in Chapter 5) is now becoming a major fraud in credit card business domain, wherein individual's *Personally Identifiable Information (PII)* is misused to open new credit accounts, take new loans or engage in other types of frauds, such as misuse of the victim's

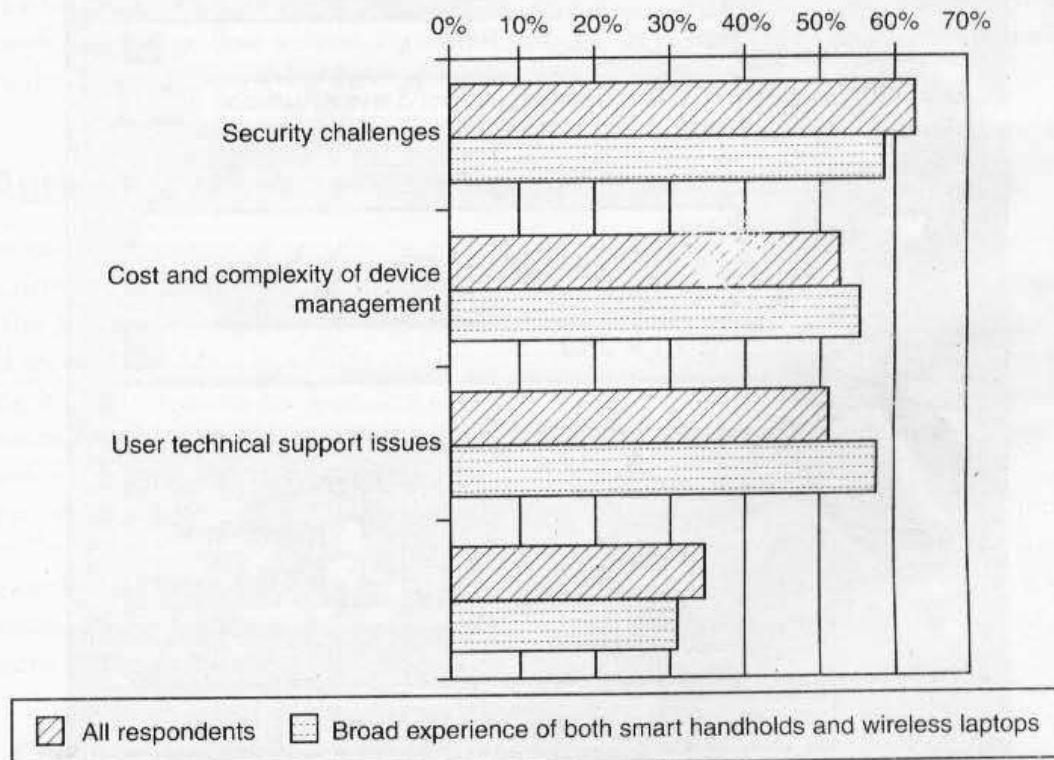


Figure 3.6 Important issues for managing mobile devices.
Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

name and identifying information when someone is charged with a crime, when renting an apartment or when obtaining medical care.

3.6 Registry Settings for Mobile Devices

Let us understand the issue of registry settings on mobile devices through an example: Microsoft ActiveSync is meant for synchronization with Windows-powered personal computers (PCs) and Microsoft Outlook. ActiveSync acts as the gateway between Windows-powered PC and Windows mobile-powered device, enabling the transfer of applications such as Outlook information, Microsoft Office documents, pictures, music, videos and applications from a user's desktop to his/her device. In addition to synchronizing with a PC, ActiveSync can synchronize directly with the Microsoft exchange server so that the users can keep their E-Mails, calendar, notes and contacts updated wirelessly when they are away from their PCs. In this context,

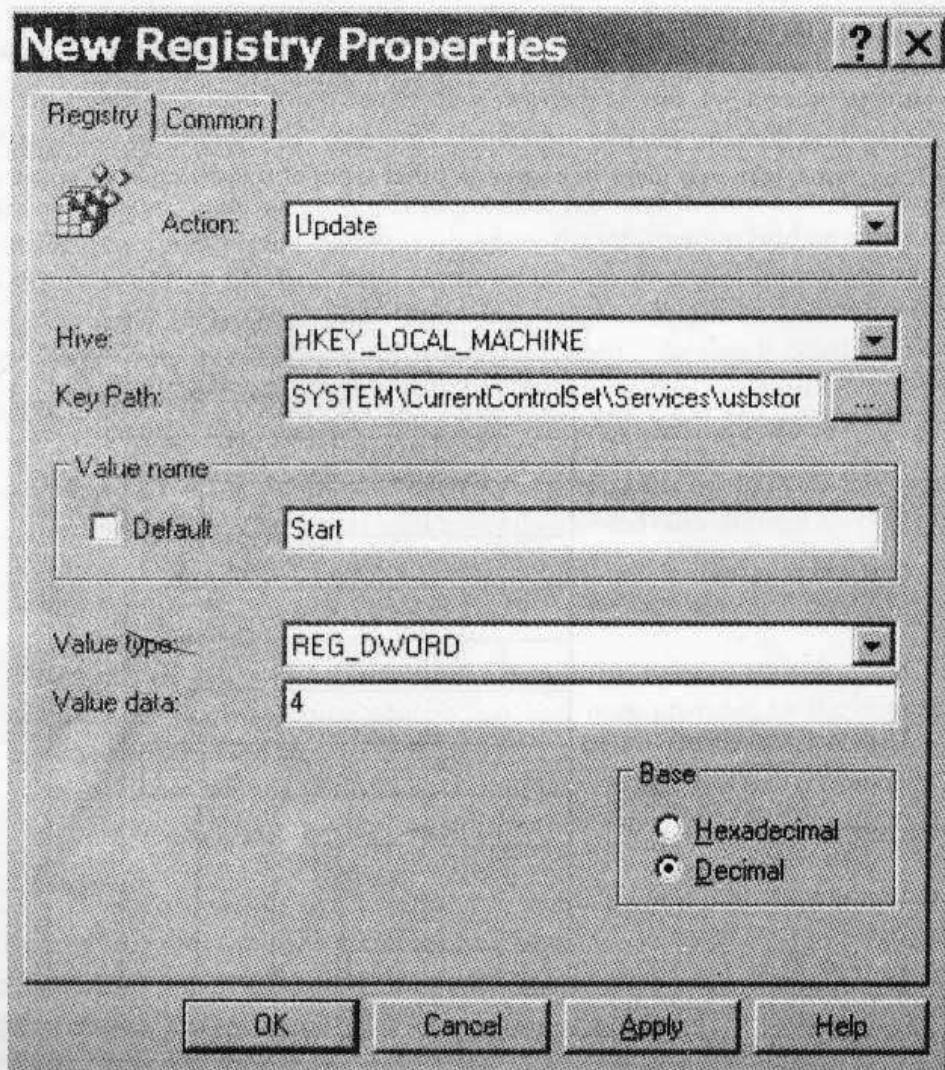


Figure 3.7 Registry value browsing.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

registry setting becomes an important issue given the ease with which various applications allow a free flow of information.

Thus, establishing trusted groups through appropriate registry settings becomes crucial. One of the most prevalent areas where this attention to security is applicable is within “group policy.” Group policy is one of the core operations that are performed by Windows Active Directory. As a supporting point, consider the following: within the last 2 years, Microsoft has doubled the number of group policy settings that it ships with the OS. There are now nearly 1,700 settings in a standard group policy. The emphasis on most of the group policy settings is security.

There is one more dimension to mobile device security: new mobile applications are constantly being provided to help protect against *Spyware, viruses, worms, malware* (we will address it in Chapter 4) and other Malicious Codes that run through the networks and the Internet. Microsoft and other companies are trying to develop solutions as fast as they can, but the core problem is still not being addressed. According to the experts, the core problem to many of the mobile security issues on a Windows platform is that the baseline security is not configured properly. When you get a computer installed or use a mobile device for the first time, it may not be 100% secure. Even if users go through every *Control Panel setting* and *group policy* option, they may not get the computer to the desired baseline security. For example, the only way to get a Windows computer to a security level that will be near bulletproof is to make additional *registry* changes that are not exposed through any interface. There are many ways to complete these registry changes on every computer, but some are certainly more efficient than others.

Naive users may think that for solving the problem of mobile device security there are not many registry settings to tackle. However, the reality is far different! The reality of the overall problem becomes prevalent when you start researching and investigating the abundance of “registry hacks” that are discussed in Microsoft Knowledge Base articles. Figure 3.7 displays an illustration of how some tools allow users to browse to the desired registry value on their mobile devices.

3.7 Authentication Service Security

There are two components of security in mobile computing: *security of devices* and *security in networks*. A secure network access involves mutual authentication between the device and the base stations or Web servers. This is to ensure that only authenticated devices can be connected to the network for obtaining the requested services. No Malicious Code can impersonate the service provider to trick the device into doing something it does not mean to. Thus, the networks also play a crucial role in security of mobile devices. Some eminent kinds of attacks to which mobile devices are subjected to are: *push attacks, pull attacks* and *crash attacks* (see Figs. 3.8–3.10).

Authentication services security is important given the typical attacks on mobile devices through wireless networks: *DoS attacks, traffic analysis, eavesdropping, man-in-the-middle attacks* and *session hijacking*. We will continue further technical discussion on such topics in Chapter 4. Security measures in this scenario come from *Wireless Application Protocols* (WAPs), use of *VPNs*, *media access control (MAC) address filtering* and development in 802.xx standards.

3.7.1 Cryptographic Security for Mobile Devices

In this section we will discuss a technique known as *cryptographically generated addresses* (CGA). CGA is Internet Protocol version 6 (IPv6) that addresses up to 64 address bits that are generated by hashing owner's public-key address. The address the owner uses is the corresponding private key to assert address ownership

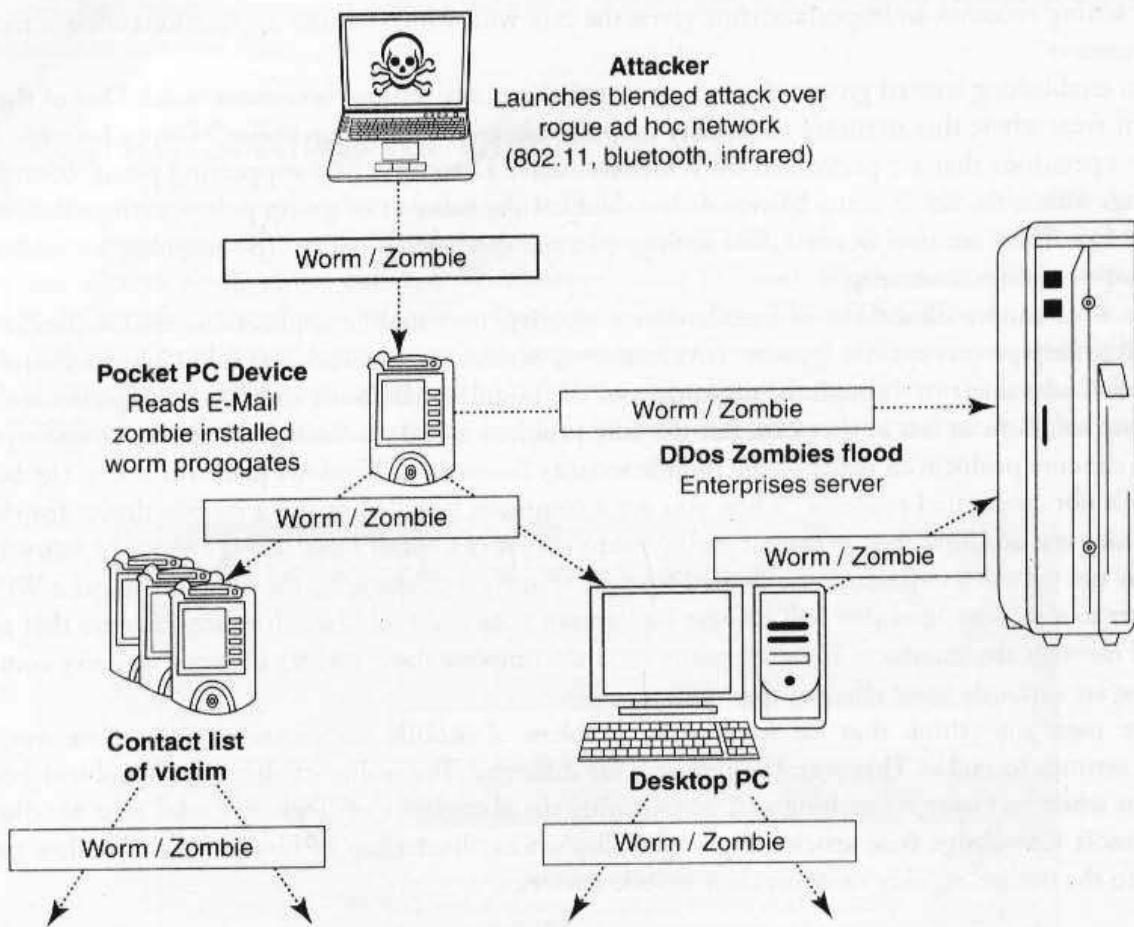


Figure 3.8 Push attack on mobile devices. DDoS implies distributed denial-of-service attack.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

and to sign messages sent from the address without a public-key infrastructure (PKI) or other security infrastructure. Deployment of PKI provides many benefits for users to secure their financial transactions initiated from mobile devices. CGA-based authentication can be used to protect IP-layer signaling protocols including neighbor discovery (as in *context-aware mobile computing applications*) and mobility protocols. It can also be used for key exchange in opportunistic Internet Protocol Security (IPSec). Palms (devices that can be held in one's palm, illustrated in Fig. 3.1) are one of the most common hand-held devices used in mobile computing. *Cryptographic security controls* are deployed on these devices. For example, the *Cryptographic Provider Manager* (CPM) in Palm OS5 is a system-wide suite of cryptographic services for securing data and resources on a palm-powered device. The CPM extends encryption services to any application written to take advantage of these capabilities, allowing the encryption of only selected data or of all data and resources on the device.

3.7.2 LDAP Security for Hand-Held Mobile Computing Devices

LDAP is a software protocol for enabling anyone to locate individuals, organizations and other resources such as files and devices on the network (i.e., on the public Internet or on the organization's Intranet). In a network, a directory tells you where an entity is located in the network. LDAP is a light weight (smaller

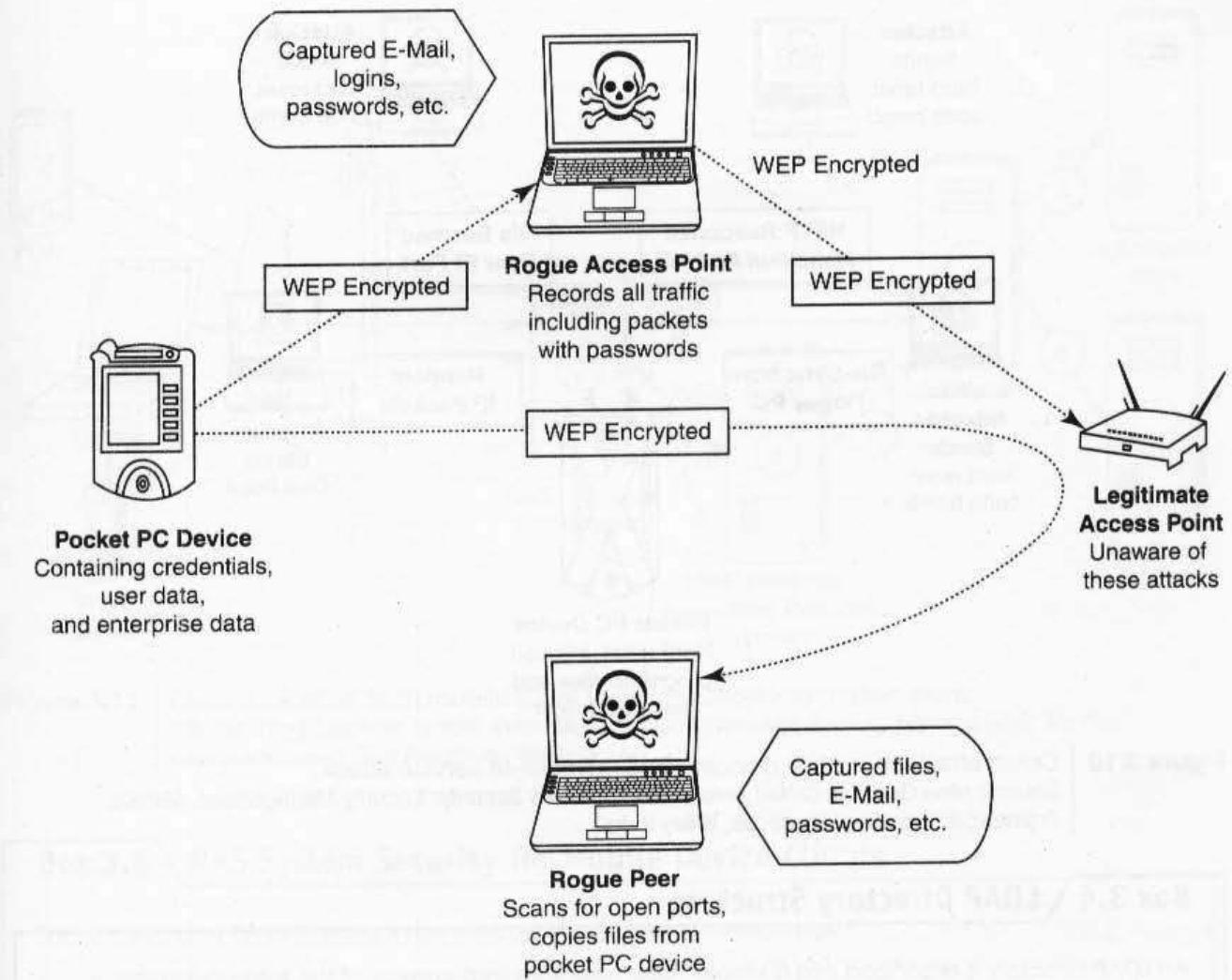


Figure 3.9 Pull attack on mobile devices.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

amount of code) version of Directory Access Protocol (DAP) because it does not include security features in its initial version. It originated at the University of Michigan and has been endorsed by at least 40 companies. Centralized directories such as LDAP make revoking permissions quick and easy. Box 3.4 describes the directory structure of LDAP.

3.7.3 RAS Security for Mobile Devices

RAS is an important consideration for protecting the business-sensitive data (refer to Chapter 5) that may reside on the employees' mobile devices. In terms of cybersecurity, mobile devices are sensitive. Figure 3.11 illustrates how access to an organization's sensitive data can happen through mobile hand-held devices carried by employees. In addition to being vulnerable to unauthorized access on their own, mobile devices also provide a route into the systems with which they connect. By using a mobile device to appear as a registered user (*impersonating* or *masquerading*) to these systems, a would-be cracker is then able to steal data or compromise corporate systems in other ways.

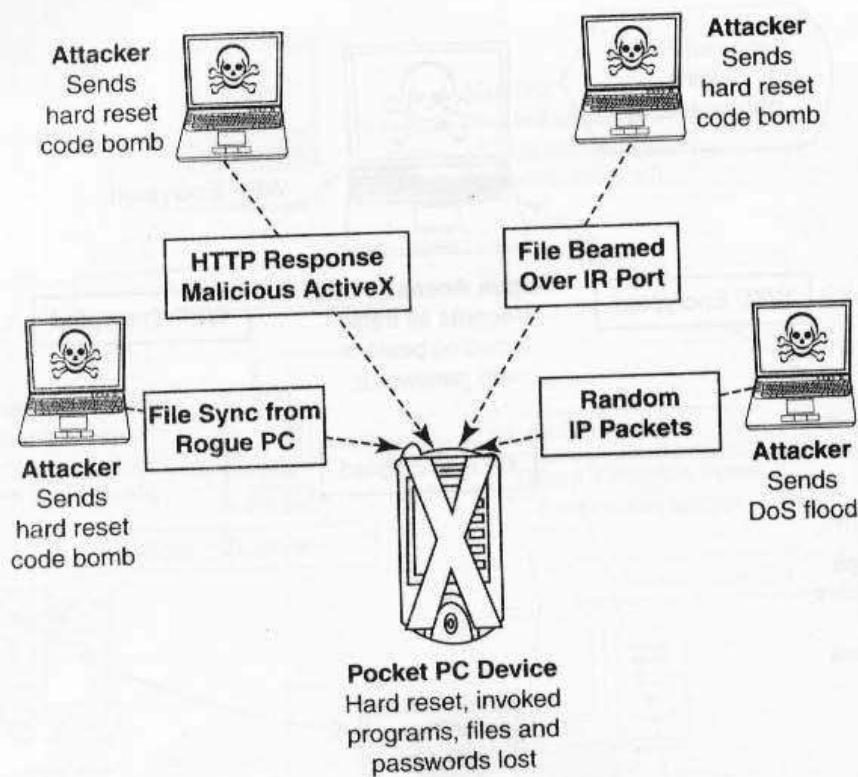


Figure 3.10 Crash attack on mobile devices. DoS – Denial-of-service attack.
Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

Box 3.4 LDAP Directory Structure

An LDAP directory is organized into a simple "tree" structure that consists of the following levels:

1. Root Directory (the source of the tree or the starting point) which branches out to
2. Countries, which branches out to
3. Organizations, which branches out to
4. Organizational units (divisions/departments and so forth), which further branches out to
5. Individuals (which, in turn, include files, shared IT resources such as printers and people)

An LDAP server is called a *Directory Systems Agent* (DSA). It receives a request from a user, takes responsibility for the request, passing it to other DSAs as necessary, but ensuring a single coordinated response for the user. An LDAP directory can be distributed among many servers. Each server can have a replicated version of the total directory that is synchronized periodically.

Source: <http://www.csgnetwork.com/glossary1.html>

Another threat comes from the practice of *port scanning* (refer to Box 2.5 in Chapter 2). First, attackers use a domain name system (DNS) server to locate the *IP address* of a connected computer (either the mobile device itself or a gateway server to which it connects). A *domain* is a collection of sites that are related in some sense. Second, they scan the ports on this known IP address, working their way through its Transmission Control Protocol (TCP)/User Datagram Protocol (UDP) stack to see what communication ports are unprotected by firewalls. For instance, *File Transfer Protocol* (FTP) transmissions are typically assigned to port 21. If this port is left unprotected, it can be misused by the attackers (see Box 3.5).

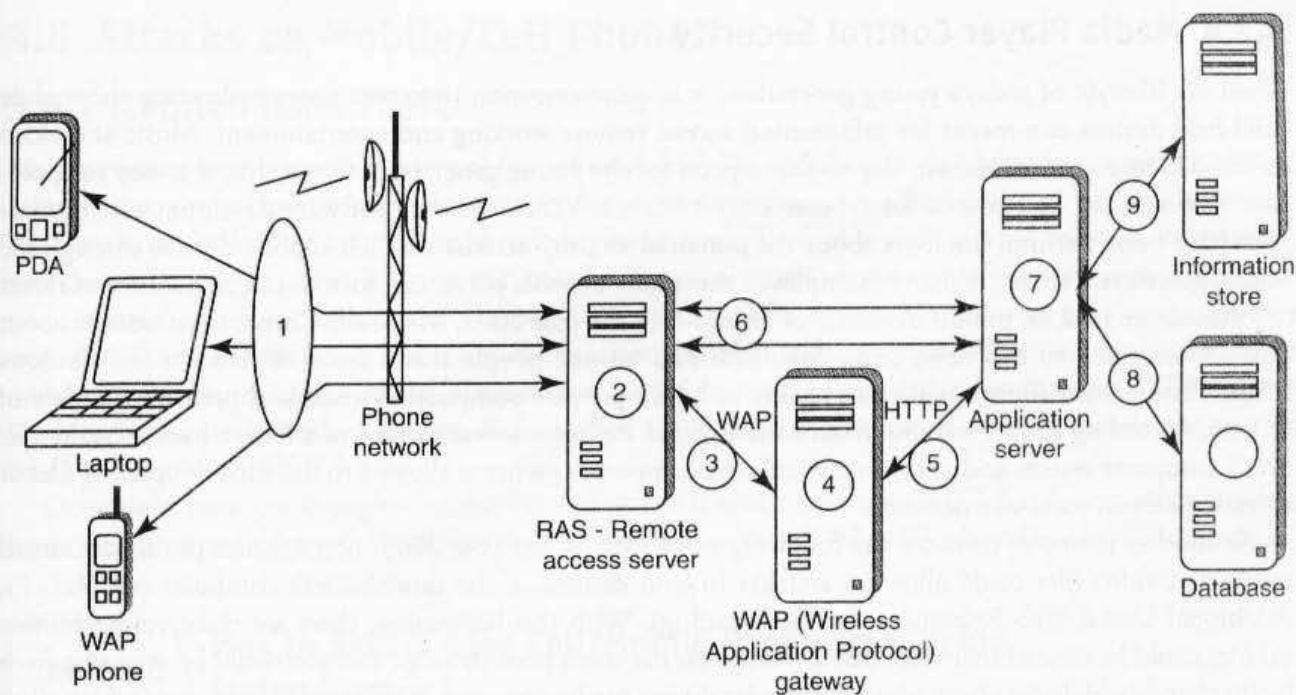


Figure 3.11 Communication from mobile client to organization information store.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

Box 3.5 RAS System Security for Mobile Device Clients

The security of a RAS system can be divided into following three areas:

1. The security of the RAS server;
2. the security of the RAS client;
3. the security of data transmission.

Although the desired level of security of the RAS server can be controlled through implementation of local security guidelines, the RAS client (e.g., a mobile hand-held device) is typically not under the complete control of the IT personnel who is responsible for the local area network (LAN). The security of the data transmission media is generally completely out of their control. For this reason, protection of communications between the client and the server must be secured by additional means.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

Protecting against port scanning requires software that can trap unauthorized incoming data packets and prevent a mobile device from revealing its existence and ID. A *personal firewall* on a pocket PC or Smartphone device can be an effective protective screen against this form of attack for the users connecting through a direct Internet or RAS connection. For situations where all connections to the corporate network pass through a gateway, placing the personal firewall on the gateway itself could be the simplest solution, because it avoids the need to place a personal firewall on each mobile device. In either case, deploying secure access methods that implement *strong authentication keys* will provide an additional protection.

3.7.4 Media Player Control Security

Given the lifestyle of today's young generation, it is quite common to expect them embracing the mobile hand-held devices as a means for information access, remote working and entertainment. Music and video are the two important aspects in day-to-day aspects for the young generation. Given this, it is easy to appreciate how this can be a source for cybersecurity breaches. Various leading software development organizations have been warning the users about the potential security attacks on their mobile devices through the "music gateways." There are many examples to show how a media player can turn out to be a source of threat to information held on mobile devices. For example, in the year 2002, Microsoft Corporation warned about this.^[11] According to this news item, Microsoft had warned people that a series of flaws in its Windows Media Player could allow a malicious hacker to hijack people's computer systems and perform a variety of actions. According to this warning from Microsoft, in the most severe exploit of a flaw, a hacker could take over a computer system and perform any task the computer's owner is allowed to do, such as opening files or accessing certain parts of a network.

As another example, consider the following news item of the year 2004: corrupt files posing as normal music and video files could allow an attacker to gain control of the downloader's computer (see Ref. #5, Additional Useful Web References, Further Reading). With this happening, there are three vulnerabilities: (a) files could be created that will open a website on the user's browser (e.g., the user could be accessing from his/her hand-held device) from where remote JavaScript can be operated; (b) files could be created which allow the attacker to download and use the code on a user's machine or (c) media files could be created that will create buffer overrun errors. We will continue further technical discussion on "buffer overflow" in Chapter 4.

In Section 3.6, we have discussed registry settings in connection with the mobile devices' security. This topic becomes important in the context of the current section too. Registry of a computing device is an important concept; it stores information necessary to configure the system for applications and hardware devices. It also contains information that the OS continually references during an operation. In the registry, some keys control the behavior of the Windows Media Player control. Microsoft, through its developer network MSDN, describes details of registry value settings on the mobile devices. With the increase in our mobile workforce and the resulting increase in the number of mobile computing hand-held devices used by the young employees of most IT and software organizations, it would be quite common to expect such cybersecurity attacks and hence one should be ready for security measures.

3.7.5 Networking API Security for Mobile Computing Applications

With the advent of electronic commerce (E-Commerce) and its further off-shoot into *M-Commerce*, online payments are becoming a common phenomenon with the *payment gateways* accessed remotely and possibly wirelessly. Furthermore, with the advent of *Web services* and their use in mobile computing applications (see Ref. #3, Articles and Research Paper, Further Reading), the API becomes an important consideration.

Already, there are organizations announcing the development of various APIs to enable software and hardware developers to write single applications that can be used to target multiple security platforms present in a range of devices such as mobile phones, portable media players, set-top boxes and home gateways.

Most of these developments are targeted specifically at securing a range of embedded and consumer products, including those running OSs such as Linux, Symbian, Microsoft Windows CE and Microsoft Windows Mobile (the last three are the most commonly used OSs for mobile devices). Technological developments such as these provide the ability to significantly improve cybersecurity of a wide range of consumer as well as mobile devices. Providing a common software framework, APIs will become an important enabler of new and higher value services.

3.8 Attacks on Mobile/Cell Phones

3.8.1 Mobile Phone Theft

Mobile phones have become an integral part of everybody's life and the mobile phone has transformed from being a luxury to a bare necessity. Increase in the purchasing power and availability of numerous low cost handsets have also lead to an increase in mobile phone users. Theft of mobile phones has risen dramatically over the past few years. Since huge section of working population in India use public transport, major locations where theft occurs are bus stops, railway stations and traffic signals. Many Insurance Companies have stopped offering Mobile Theft Insurance due to a large number of false claims. When anyone loses his/her mobile phone, more than anything "Contact List" and "Personally Identifiable Information (PII)" (refer to Chapter 5), that really matter, are lost. Refer to Box 3.6 to learn about tips on securing mobile phone from being stolen and/or lost.

One might have just thought that his/her cell phone is much safer than a PC that is very often attacked by viruses; however, criminals made this thought as false statement. After PC, the criminals' (i.e., attackers')

Box 3.6

Tips to Secure your Cell/Mobile Phone from being Stolen/Lost

Nowadays, mobiles/cell phones are becoming fancier and expensive hence increasingly liable to theft. Criminals are interested in accessing wireless service and seek potential possibility to stealing the ID.

Ensure to note the following details about your cell phone and preserve it in a safe place^[12]:

1. Your phone number;
2. the make and model;
3. color and appearance details;
4. PIN and/or security lock code;
5. IMEI number.

The International Mobile Equipment Identity (IMEI)

It is a number unique to every GSM, WCDMA and iDEN cell phone. It is a 15-digit number and can be obtained by entering *#06# from the keypad.

The IMEI number is used by the GSM network to identify valid devices and therefore can be used to stop a stolen phone from accessing the network in that country. For example, if a mobile phone is stolen, the owner can call his or her service provider and instruct them to "lock" the phone using its IMEI number. This will help to stop the usage of phone in that country, even if a SIM is changed.

Visit the weblink <http://www.numberingplans.com/?page=analysis&sub=imeinr> to check all information about your cell phone such as manufacturer, model type and country of approval of a handset.

1. Add a security mark on your cell phone. Use permanent marker and print your alternate contact number and short address on your cell phone instrument as well as on battery. In case someone finds your handset, it is easier to contact you if the finder of your cell phone would like to return it to you.
2. Set a password and ensure the password is strong enough so that a finder of your cell phone cannot easily guess it.
3. In case of loss of your cell phone, register a complaint with cell phone service provider immediately, using your IMEI number, to enable your service provider to block your cell phone and your account details. Preserve all the details of launched complaints, that is, obtain confirmation in writing from your service provider that your phone has been disabled.

Box 3.6 Tips to Secure your . . . (Continued)

4. In case of loss of your cell phone, register a complaint at the police station and obtain FIR. Preserve all the details for launched complaints, that is, FIR report.
5. Keep an eye on your phone while traveling. During the security check at the airport security, ensure to retrieve your cell phone immediately once it enters the x-ray machine – criminals often steal phones during these vulnerable seconds.
6. Keep Wi-Fi and Bluetooth OFF when it is not required to be in use. Airports, coffee shops, hotels and all other public places wherever free Wi-Fi zone is available, criminals always have an eye to seek the vulnerability to steal information.
7. Periodic backup is important and especially if you are traveling, backup before traveling is necessary. It takes only few minutes to take backup but it is always helpful in case you lose your cell phone during traveling.
8. Do not forget to apply all the updates for cell phone software/firmware, received from manufacturers, which are routinely provided to update vulnerabilities fixes.
9. Only download applications from reputable sources – specific care should be taken while downloading plug-in applications on the cell phone. It is always advised to use the recommendations provided by cell phone manufacturers' to download directly from the Web.

Install antitheft software on your cell phone

Antitheft software does not allow the criminal to use another SIM card in the stolen cell phone. When a SIM card is changed, the system asks for a verification code. Even if the criminal manages to break this code, the phone sends out a message regarding the change of SIM to two selected contacts from the cell phone contact directory with the new SIM number. So, it becomes easy to trace the address of the new cell phone number from the service provider and thus to trace the cell. Only the owners of the cell phone will know about the installed antitheft software, as it does not show any icons on the menu. Following are few antitheft software(s) available in the market:

1. **GadgetTrak:** <http://www.gadgettrak.com/products/mobile/>
2. **Back2u:** <http://www.bak2u.com/phonebakmobilephone.php>
3. **WaveSecure:** <https://www.wavesecure.com/>
4. **F-Secure:** <http://www.f-secure.com/>

Source: <http://www.wikihow.com/Protect-a-Mobile-Phone-from-Being-Stolen>

new playground has been cell phones, reason being the increasing usage of cell phones and availability of Internet using cell phones. Another reason is increasing demand for Wi-Fi zones in the metropolitans and extensive usage of cell phones in the youths with lack of awareness/knowledge about the vulnerabilities of the technology.

The following factors contribute for outbreaks on mobile devices:

1. **Enough target terminals:** The first Palm OS virus was seen after the number of Palm OS devices reached 15 million. The first instance of a mobile virus was observed during June 2004 when it was discovered that an organization “Ojam” had engineered an antipiracy Trojan virus in older versions of their mobile phone game known as Mosquito. This virus sent SMS text messages to the organization without the users' knowledge.
2. **Enough functionality:** Mobile devices are increasingly being equipped with office functionality and already carry critical data and applications, which are often protected insufficiently or not at all. The expanded functionality also increases the probability of malware.
3. **Enough connectivity:** Smartphones offer multiple communication options, such as SMS, MMS, synchronization, Bluetooth, infrared (IR) and WLAN connections. Therefore, unfortunately, the increased amount of freedom also offers more choices for virus writers.

3.8.2 Mobile Viruses

A mobile virus is similar to a computer virus that targets mobile phone data or applications/software installed in it. Virus attacks on mobile devices are no longer an exception or proof-of-concept nowadays. In total, 40 mobile virus families and more than 300(+) mobile viruses have been identified. First mobile virus was identified in 2004 and it was the beginning to understand that mobile devices can act as vectors to enter the computer network.

Mobile viruses get spread through two dominant communication protocols – Bluetooth and MMS. Bluetooth virus can easily spread within a distance of 10–30 m, through Bluetooth-activated phones (i.e., if Bluetooth is always ENABLED into a mobile phone) whereas MMS virus can send a copy of itself to all mobile users whose numbers are available in the infected mobile phone's address book. Readers may visit <http://symbianpoint.com/types-latest-list-mobile-viruses.html> to know the list of latest mobile viruses (few viruses have been discussed in Section 3.3 Trends in Mobility).

It is interesting to note that, like Computer Virus Hoax, variants of Mobile Phone Virus Hoax^[13] have been circulating since 1999. These hoax messages either will be sent through E-Mail or through SMS to the mobile users. The example of such hoax is given.

"All mobile users pay attention!!!!!!!"

If you receive a phone call and your mobile phone displays (XALAN) on the screen don't answer the call, END THE CALL IMMEDIATELY, if you answer the call, your phone will be infected by a virus. This virus WILL ERASE all IMEI and IMSI information from both your phone and your SIM card, which will make your phone unable to connect with the telephone network. You will have to buy a new phone. This information has been confirmed by both Motorola and Nokia. There are over 3 Million mobile phones being infected by this virus in all around the world now. You can also check this news in the CNN website.

PLEASE FORWARD THIS PIECE OF INFORMATION TO ALL YOUR FRIENDS HAVING A MOBILE PHONE."

How to Protect from Mobile Malwares Attacks

Following are some tips to protect mobile from mobile malware attacks^[14]:

1. Download or accept programs and content (including ring tones, games, video clips and photos) only from a trusted source.
2. If a mobile is equipped with Bluetooth, turn it OFF or set it to non-discoverable mode when it is not in use and/or not required to use.
3. If a mobile is equipped with beam (i.e., IR), allow it to receive incoming beams, only from the trusted source.
4. Download and install antivirus software for mobile devices.

3.8.3 Mishing

Mishing is a combination of mobile phone and Phishing (we will address this in Chapter 5). Mishing attacks are attempted using mobile phone technology. M-Commerce is fast becoming a part of everyday life. If you use your mobile phone for purchasing goods/services and for banking, you could be more vulnerable to a Mishing scam. A typical Mishing attacker uses call termed as *Vishing* or message (SMS) known as *Smishing*. Attacker will pretend to be an employee from your bank or another organization and will claim a need for your personal details. Attackers are very creative and they would try to convince you with different reasons why they need this information from you.

3.8.4 Vishing

Vishing is the criminal practice of using social engineering (refer to Section 2.3 in Chapter 2) over the telephone system, most often using features facilitated by VoIP, to gain access to personal and financial information from the public for the purpose of financial reward. The term is a combination of V – voice and Phishing (we will address Phishing in detail under Chapter 5). Vishing is usually used to steal credit card numbers or other related data used in ID theft schemes from individuals.^[15] (We will address ID Theft in detail in Chapter 5.)

The most profitable uses of the information gained through a Vishing attack include:

1. ID theft;
2. purchasing luxury goods and services;
3. transferring money/funds;
4. monitoring the victims' bank accounts;
5. making applications for loans and credit cards.

How Vishing Works

The criminal can initiate a Vishing attack using a variety of methods, each of which depends upon information gathered by a criminal and criminal's will to reach a particular audience.

1. **Internet E-Mail:** It is also called Phishing mail (we will address this in Chapter 5).

2. **Mobile text messaging:** Refer to Smishing explained in Section 3.8.5.
3. **Voice-mail:** Here, victim is forced to call on the provided phone number, once he/she listens to voicemail.
4. **Direct phone call:** Following are the steps detailing on how direct phone call works:
 - The criminal gathers cell/mobile phone numbers located in a particular region and/or steals cell/mobile phone numbers after accessing legitimate voice messaging company.
 - The criminal often uses a war dialer to call phone numbers of people from a specific region, and that to from the gathered list of phone numbers.
 - When the victim answers the call, an automated recorded message is played to alert the victim that his/her credit card has had fraudulent activity and/or his/her bank account has had unusual activity. The message instructs the victim to call one phone number immediately. The same phone number is often displayed in the spoofed caller ID, under the name of the financial company the criminal is pretending to represent.
 - When the victim calls on the provided number, he/she is given automated instructions to enter his/her credit card number or bank account details with the help of phone keypad.
 - Once the victim enters these details, the criminal (i.e., visher) has the necessary information to make fraudulent use of the card or to access the account.
 - Such calls are often used to harvest additional details such as date of birth, credit card expiration date, etc.

Some of the examples of vished calls, when victim calls on the provided number after receiving phished E-Mail and/or after listening voicemail, are as follows:

1. **Automated message:** Thank you for calling (name of local bank). Your business is important to us. To help you reach the correct representative and answer your query fully, please press the appropriate number on your handset after listening to options.
 - Press 1 if you need to check your banking details and live balance.
 - Press 2 if you wish to transfer funds.
 - Press 3 to unlock your online profile.
 - Press 0 for any other query.

2. Regardless of what the victim enters (i.e., presses the key), the automated system prompts him to authenticate himself: "The security of each customer is important to us. To proceed further, we require that you authenticate your ID before proceeding. Please type your bank account number, followed by the pound key."
3. The victim enters his/her bank account number and hears the next prompt: "Thank you. Now please type your date of birth, followed by the pound key. For example 01 January 1950 press 01011950."
4. The caller enters his/her date of birth and again receives a prompt from the automated system: "Thank you. Now please type your PIN, followed by the pound key."
5. The caller enters his PIN and hears one last prompt from the system: "Thank you. We will now transfer you to the appropriate representative."

At this stage, the phone call gets disconnected, and the victim thinks there was something wrong with the telephone line; or visher may redirect the victim to the real customer service line, and the victim will not be able to know at all that his authentication was appropriated by the visher.

How to Protect from Vishing Attacks

Following are some tips to protect oneself from Vishing attacks^[16]:

1. Be suspicious about all unknown callers.
2. Do not trust caller ID. It does not guarantee whether the call is really coming from that number, that is, from the individual and/or company – caller ID Spoofing is easy.
3. Be aware and ask questions, in case someone is asking for your personal or financial information.
4. Call them back. If someone is asking you for your personal or financial information, tell them that you will call them back immediately to verify if the company is legitimate or not. In case someone is calling from a bank and/or credit card company, call them back using a number displayed on invoice and/or displayed on website.
5. Report incidents: Report Vishing calls to the nearest cyberpolice cell with the number and name that appeared on the caller ID as well as the time of day and the information talked about or heard in a recorded message.

3.8.5 Smishing

Smishing is a criminal offense conducted by using social engineering techniques similar to Phishing. The name is derived from "SMS PhISHING." SMS – Short Message Service – is the text messages communication component dominantly used into mobile phones. Refer to Box 3.7 to know how SMS can be abused by using different methods and techniques other than information gathering under cybercrime.

Box 3.7 Pretexting, Sexting and VoIP Spam

Pretexting

It is also a form of social engineering, wherein a pretexter hides his/her purpose and/or identity to get the personal information/sensitive data about another individual. For example, the pretexter may claim his/her affiliation with a survey agency, financial institute or bank. Usually, victims are targeted over the phone and enticed to reveal their information or perform an action. It is more than a simple lie as it most often involves some prior research or setup and the use of pieces of known information (e.g., for impersonation: date of birth, pet names of family members and last bill amount) to establish legitimacy in the mind of the target.^[17]

This technique is often used to trick the executives to disclose the information about their customer and/or their competitor and is used by private investigators to obtain telephone records, banking

Box 3.7 Pretexting, . . . (Continued)

records, utility records and other information directly from junior representatives of an organization. However, nowadays, this technique is also used by the criminals through Vishing and Smishing attacks.

Sexting

It is the practice of sending sexually explicit text messages and photos over the cell phone. It is becoming an increasingly hot topic both in schools/colleges and in the workplace. Although most of the people think instantly of cell phones as sexting devices, digital photography, Internet (i.e., websites) and even few video game systems are also contributing sexting.^[18]

Sexting is a complex topic and no one-size-fits-all solution is available, reason being that it embraces everything from gentle naughty-blue pictures to slimy pornography. Many teens (especially, girls) who believe they are sending a private message, may have their messages widely distributed, sometimes even immediately available on porno sites. So, it is important that parents should keep an eye on the cell phones provided to the kids. Kids should be made aware that "Information shared electronically never dies" and any message such as sexting may come back to haunt them even after months and years.

VoIP Spam

VoIP Spam is the proliferation of unwanted, automatically dialed and prerecorded phone calls using VoIP. Some pundits have taken to referring to it as "Spam over Internet telephony" (SPIT).^[19] VoIP systems, such as E-Mail and other Internet applications, are susceptible to abuse by criminals to initiate unsolicited and unwanted communications. Increasingly, telemarketers, prank callers and other telephone system abusers are likely to target VoIP systems, particularly, if VoIP tends to supplant conventional telephony.

Smishing uses cell phone text messages to deliver a lure message to get the victim to reveal his/her PI. The popular technique to "hook" (method used to actually "capture" your information) the victim is either provide a phone number to force the victim to call or provide a website URL to force the victim to access the URL, wherein, the victim gets connected with bogus website (i.e., duplicate but fake site created by the criminal) and submits his/her PI.

Smishing works in the similar pattern as Vishing. A few examples of Smishing are provided herewith to demonstrate how the victim is forced to disclose PI.

1. "We are happy to send our confirmation toward your enrolment for our 'xxxxxxxx Club Membership.' You will be charged ₹ 50/- per day, unless you reconfirm your acceptance of your membership on our "Membership Office Contact no. XXXXXXXXXXXX."
2. "[(Name of popular online bank) is confirming that you have purchased LCD TV set, worth of ₹ 90,000/- only from (name of popular computer company)]. Visit www.abcdef.com if you did not make this online purchase."

How to Protect from Smishing Attacks

Following are some tips to protect oneself from Smishing attacks:

1. Do not answer a text message that you have received asking for your PI. Even if the message seems to be received from your best friend, do not respond, because he/she may not be the one who has actually sent it.
2. Avoid calling any phone numbers, as mentioned in the received message, to cancel a membership and/or confirming a transaction which you have not initiated but mentioned in the message. Always call on the numbers displayed on the invoice and/or appearing in the bank statements/passbook.

Box 3.8 SMS Blocker

India-based organization Optinno Mobitech Pvt. Ltd. has innovated and launched an application, smsBlocker, which runs on mobile phones and ensures 100% Spam blockage. smsBlocker is powered with a unique intuitive algorithm to detect and block Spam SMS automatically. However, mobile user can also customize the filtering levels as per his/her own privacy requirements. smsBlocker is configured to the unique mobile handset identification number, that is, IMEI. Thus, if a mobile user changes the mobile handset, smsBlocker will not work on the new mobile handset; however, if SIM card is changed it will not affect smsBlocker. smsBlocker is designed for all mobile handsets that support Symbian OS. It is interesting to note that smsBlocker does not require GPRS/Internet connection.

Source: <http://www.smsblocker.in> (30 July 2010).

3. Never click on a hot link received through message on your Smartphone or PDA. Hot links are links that you can click, which will take you directly to the Internet sites. Smishing messages may have hot links, wherein you click on the link and download Spyware to your phone without knowing. Once this software has been downloaded, criminals can easily steal any information that is available on your cell phone and have access to everything that you do on your cell phone.

3.8.6 Hacking Bluetooth

Bluetooth is an open wireless technology standard used for communication (i.e., exchanging data) over short distances (i.e., using short length radio waves) between fixed and/or mobile devices (see Box 3.9). Bluetooth is a short-range wireless communication service/technology that uses the 2.4-GHz frequency range for its transmission/communication. The older standard – Bluetooth 1.0 has a maximum transfer speed of 1 Mbps (megabit per second) compared with 3 Mbps by Bluetooth 2.0.

When Bluetooth is enabled on a device, it essentially broadcasts “I’m here, and I’m able to connect” to any other Bluetooth-based device within range. This makes Bluetooth use simple and straightforward, and it also makes easier to identify the target for attackers. The attacker installs special software [see Table 3.1 for list of software(s) which are termed as *Bluetooth hacking tools*] on a laptop and then installs a Bluetooth antenna. Whenever an attacker moves around public places, the software installed on laptop constantly scans the nearby surroundings of the hacker for active Bluetooth connections. Once the software tool used by the attacker finds and connects to a vulnerable Bluetooth-enabled cell phone, it can do things like download address book information, photos, calendars, SIM card details, make long-distance phone calls using the hacked device, bug phone calls and much more.

Box 3.9 Bluetooth

The word Bluetooth is an anglicized form of Danish *Blåtand* – Harald Bluetooth was king of Denmark in the 10th century, who managed to unite Denmark and parts of Norway into a single kingdom. The king was killed in 986 AD during a battle with his son. Choosing this name indicates how important companies from the Nordic region (nations including Denmark, Sweden, Norway and Finland) are to the communications industry, even if this name says little about the way the technology works. The implication is that Bluetooth does the same with communication protocols, uniting them into one universal standard. *blå* in modern Scandinavian languages means blue and (historically) correct translation of Old Norse *Harald Blátönn* could be Harald Bluetooth.

The Bluetooth logo is a bind rune merging the Germanic runes  (Hagall) and  (Berkana).

Table 3.1 | Bluetooth hacking tools

| Sr. No. | Name of the Tool | Description |
|---------|------------------|---|
| 1 | BlueScanner | This tool enables to search for Bluetooth enable device and will try to extract as much information as possible for each newly discovered device after connecting it with the target. |
| 2 | BlueSniff | This is a GUI-based utility for finding discoverable and hidden Bluetooth-enabled devices. |
| 3 | BlueBugger | The buggers exploit the vulnerability of the device and access the images, phonebook, messages and other personal information. |
| 4 | Bluesnarfer | If a Bluetooth of a device is switched ON, then Bluesnarfing makes it possible to connect to the phone without alerting the owner and to gain access to restricted portions of the stored data. |
| 5 | BlueDiving | Bluediving is testing Bluetooth penetration. It implements attacks like Bluebug and BlueSnarf. |

Bluejacking, Bluesnarfing, Bluebugging and *Car Whisperer* are common attacks that have emerged as Bluetooth-specific security issues.

1. **Bluejacking:** It means *Bluetooth + Jacking* where Jacking is short name for *hijack* – act of taking over something. Bluejacking is sending unsolicited messages over Bluetooth to Bluetooth-enabled devices such as mobile phones, PDAs or computers (within 10-m radius), for example, sending a visiting card which will contain a message in the name field. If the user does not recognize/realize what the message is, he/she might allow the contact to be added to her/his address book, and the contact can send him messages that might be automatically opened because they are coming from a known contact. Bluejacking is harmless, as bluejacked users generally do not understand what has happened and hence they may think that their phone is malfunctioning.
2. **Bluesnarfing:** It is the unauthorized access from a wireless device through a Bluetooth connection between cell phones, PDAs and computers. This enables the attacker to access a calendar, contact list, SMS and E-Mails as well as enable attackers to copy pictures and private videos.
3. **Bluebugging:** It allows attackers to remotely access a user's phone and use its features without user's attention. During initial days, the attacker could simply listen to any conversation his/her victim is having; however, further developments in Bluebugging tools have enabled the attacker with the ability to take control of the victim's phone and to conduct many more activities such as initiate phone calls; send and read SMS; read and write phonebook contacts; eavesdrop on phone conversations and connect to the Internet.
4. **Car Whisperer:** It is a piece of software that allows attackers to send audio to and receive audio from a Bluetooth-enabled car stereo. Further research is underway to know whether Bluetooth attackers could do anything more serious such as disabling airbags or brakes through this kind of attack. The researchers are also investigating about possibility of an attacker accessing a telephone address book once the connection gets established with the Bluetooth system through this kind of attack.

Among the four above-mentioned attacks, Bluesnarfing is claimed to be much more serious than Bluejacking. These vulnerabilities are an inevitable result of technological innovation, and device manufacturers' continuously research and release firmware upgrades to address new challenges/problems as they arise.

Box 3.10 Hacking Mobile Phones

Chris Paget, a hacker, conducted a demonstration on how to intercept mobile phone calls using an equipment that costs not more than US\$ 1,500, at a DefCon conference in Las Vegas.

The hacker used a simple antenna and some basic radio equipments to broadcast a GSM signal and pretend to be a telecom service provider. After this clever trick, it is possible for a hacker to forward his/her own calls and listen to any conversation that takes place within the network.

Although this demonstration is limited to GSM networks, the hacker is quite confident about causing disruption into 3G mobile networks with a simple noise generator and a power amplifier.

Smart readers can immediately conclude that although INTEGRITY is always challenged during the transmitting of the text messages, the threat of breaching the voice communication has also become important under cybersecurity.

Source: <http://www.geekwithlaptop.com/hacker-demonstrates-powerful-mobile-interception-at-minimal-expense> (3 August 2010).



“Bluetooth and Bluetooth Security” is a separate subject in itself. Readers may visit the following websites to explore more on this topic:

- <https://www.bluetooth.org/apps/content/>
- <http://www.bluetooth.com/English/Pages/default.aspx>
- <http://www.bluetoothhack.info/>

3.9 Mobile Devices: Security Implications for Organizations

3.9.1 Managing Diversity and Proliferation of Hand-Held Devices

In the previous sections we have talked about the microissues of purely technical nature in mobile device security. In this section, we focus on the macroissues at the organizational level. Given the threats to information systems through usage of mobile devices, the organizations need to establish security practices at a level appropriate to their security objectives, subject to legal and other external constraints. Some organizations will implement security procedures and tools extensively, whereas others will place more value on cost and convenience. Whatever approaches an organization chooses, it is important that the policy-making effort starts with the commitment from a Chief Executive Officer (CEO), President or Director who takes cybersecurity seriously and communicates that throughout an organization. The best security technology features will be found to be worthless if there is no organization policy or automated enforcement to ensure that they are actually used.

In some cases, for example, senior executives have been given special access rights to the corporate network which can circumvent standard security procedures. Cybersecurity is always a primary concern; even then, at times, there is still some short sightedness. Most organizations fail to see the long-term significance of keeping track of who owns what kind of mobile devices. Mobile devices of employees should be registered in corporate asset register irrespective of whether or not the devices have been provided by the organization. In addition (recall the microlevel technical issues discussed in the previous section), close monitoring of these devices is required in terms of their usage. When an employee leaves, it is important to remove his/her logical as well as physical access to corporate resources because employees (for malicious or other reasons) could be using their mobile devices to connect into the corporate networks. Thus, mobile devices that belong to the company should be returned to the IT department and, at the very least, should be deactivated and cleansed.

Box 3.11**TrustZone Technology for Mobile Devices – Toward Security of M-Commerce Applications**

About 2 years back, Trusted Logic Security Module was announced for Microsoft Windows CE 5.0. With this, developers of Windows CE 5.0 can use Trusted Logic software to increase electronic transaction security in ARM-powered(R) devices, which is very pertinent in the M-Commerce paradigm.

The Windows CE 5.0 evaluation version of the security module, coupled with the ARM TrustZone technology, provides consumers with a more secure environment for electronic transactions such as M-Banking, E-Commerce and digital rights management (DRM) (refer to Appendix N). This security can be designed into ARM-powered consumer devices such as mobile phones, payment terminals and set-top boxes.

The security module implements the TrustZone APIs to enable smooth evolution and compatibility with future versions of the software running on ARM TrustZone technology-enabled processors. The software is part of a portfolio of embedded security products offered by ARM and developed under a recently announced agreement between Trusted Logic and ARM.

ARM TrustZone architecture extensions build security into the processor itself whereas TrustZone software provides trusted foundation software, protected by the hardware, enabling OS providers, handset vendors and silicon designers to expand and develop their own security solutions on top of an interoperable framework. Currently, security-aware applications must be rewritten for every security platform they run on. However, the new TrustZone Software API provides a standard interface for these applications to be partitioned and to communicate with a secure-side component independent of the actual system implementation.

According to experts, M-Commerce applications can now target multiple security platforms and speed up the development. Industry analysts say that this is a technical collaboration between Microsoft and ARM. This is being considered as a good step toward making mobile devices more secure and is critical to the success of next-generation mobile applications.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

In addition, employees should be encouraged to register with the IT department any devices they use for themselves, so that access can be provisioned in a controlled manner and de-provisioned appropriately when the employee leaves.

Younger workers (also referred to as Gen-Y) are pushing many enterprises to embrace mobility solutions. These younger workers prefer instant/text messaging instead of E-Mail, and frequently use social networking services such as Facebook, MySpace and Twitter. They often prefer to use personal, consumer-oriented devices (both laptops and mobile devices) in the work environment, and adapt quickly to new technology. In contrast, older workers are found to be slow to accept mobility solutions and rely almost entirely on voice communications and E-Mail. These old workers often do not see the benefit of instant messaging and social networking. Interestingly, at the same time these older workers are often found to be on the seat that provides authority and control for staffing and budget, and they can therefore greatly influence mobility policy. These different points of view between younger and older workers have created a mobility generational gap. Older workers sometimes see younger workers as being "spoiled" whereas younger workers sometimes see older workers as a barrier to progress.

3.9.2 Unconventional/Stealth Storage Devices

We have already mentioned about mobile phones and media players used by the employees. In this section, we would like to emphasize upon widening the spectrum of mobile devices and focus on secondary storage devices, such as compact disks (CDs) and Universal Serial Bus (USB) drives (also called zip drive, memory sticks) used by employees. As the technology is advancing, the devices continue to decrease in size and emerge in new shapes and sizes – unconventional/stealth storage devices available nowadays are difficult to detect and have become a

prime challenge for organizational security. It is advisable to prohibit the employees in using these devices [see Figs. 3.12(a) and (b)]. Their small size allows for easy concealment anywhere in a bag or on the body.

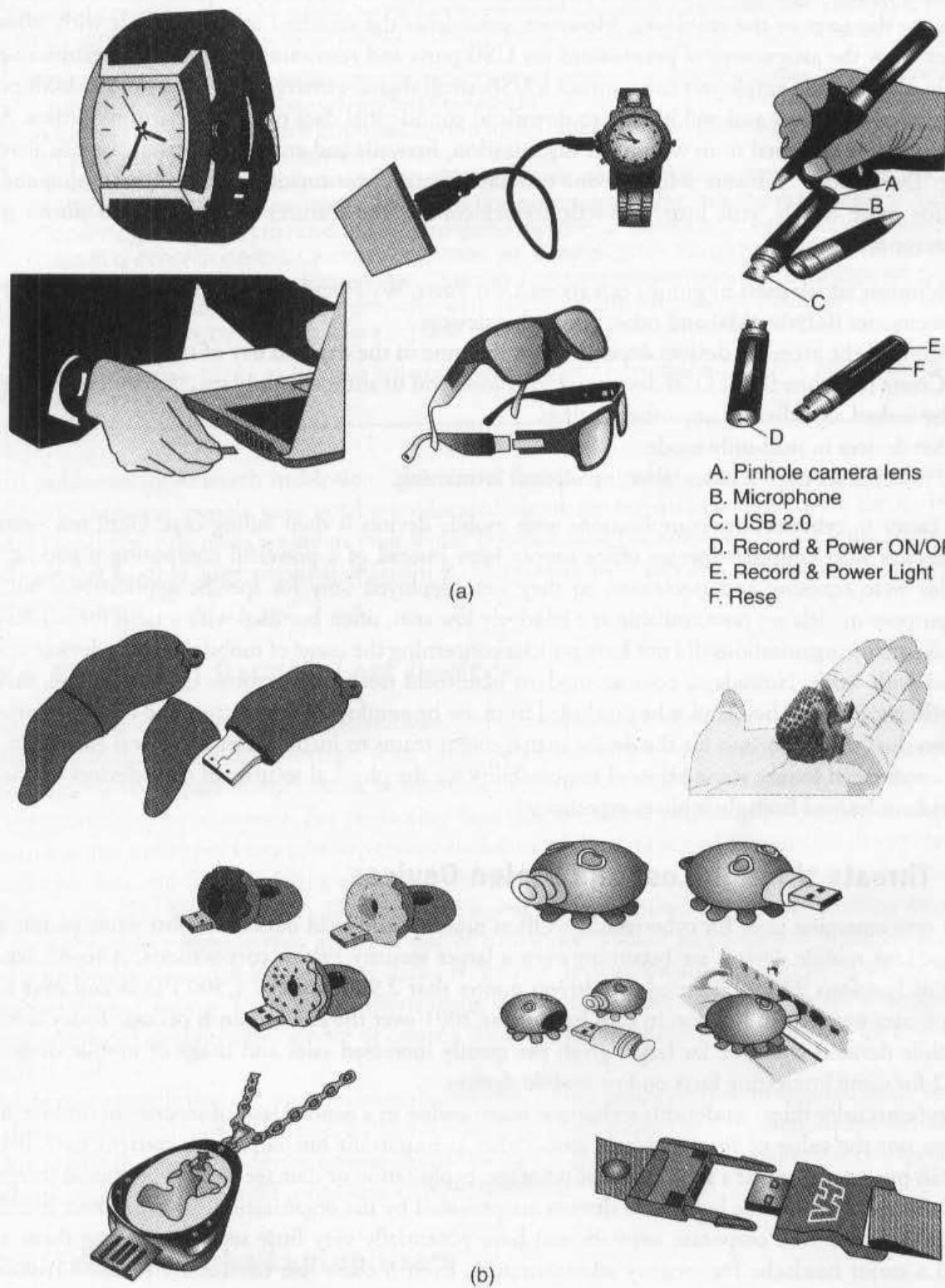


Figure 3.12 | Unconventional/stealth storage devices.

Firewalls and antivirus software are no defense against the threat of open USB ports. Not only can *viruses*, *worms* and *Trojans* (we will discuss more in Chapter 4) get into the organization network, but can also destroy valuable data in the organization network. Organization has to have a policy in place to block these ports while issuing the asset to the employee. However, sometimes the standard access controls with Windows OS do not allow the assignment of permissions for USB ports and restricting these devices becomes next to impossible. Disgruntled employees can connect a USB/small digital camera/MP3 player to the USB port of any unattended computer and will be able to download confidential data or upload harmful viruses. As the malicious attack is launched from within the organization, firewalls and antivirus software are not alerted.

Using "DeviceLock" software solution, one can have control over unauthorized access to plug and play devices (for more details, visit <http://www.devicelock.com/>). The features of the software allows system administrator to:

1. Monitor which users or groups can access USB Ports, Wi-Fi and Bluetooth adapters, CD read-only memories (CD-ROMs) and other removable devices.
2. Control the access to devices depending on the time of the day and day of the week.
3. Create the white list of USB devices which allows you to authorize only specific devices that will not be locked regardless of any other settings.
4. Set devices in read-only mode.
5. Protect disks from accidental or intentional formatting.

Another factor in cybersecurity complications with mobile devices is their falling cost. Until few years ago, mobile devices were considered as an office supply item instead of a powerful computing platform. Early hand-holds were *expensive* and *specialized*, so they were deployed only for specific applications, but more general-purpose models are now available at a relatively low cost, often bundled with a tariff for wireless connection. So, many organizations did not have policies concerning the usage of mobile/wireless devices at work/connected with work. Nowadays, because modern hand-held devices for mobile computing are, at times, good productivity tools, they cannot be precluded from use by employees, contractors and other business entities. Given this, it is important for the device management teams to include user awareness education; thus, they get encouraged to take some personal responsibility for the physical security of their devices, as many IT managers have learned from their bitter experience.

3.9.3 Threats through Lost and Stolen Devices

This is a new emerging issue for cybersecurity. Often mobile hand-held devices are lost while people are on the move. Lost mobile devices are becoming even a larger security risk to corporations. A report based on a survey of London's 24,000 licensed cab drivers quotes that 2,900 laptops, 1,300 PDAs and over 62,000 mobile phones were left in London in cabs in the year 2001 over the last 6-month period. Today this figure (lost mobile devices) could be far larger given the greatly increased sales and usage of mobile devices. See Box 3.12 for some interesting facts on lost mobile devices.

The cybersecurity threat under this scenario is scary; owing to a general lack of security in mobile devices, it is often not the value of the hand-held device that is important but rather the content that, if lost or stolen, can put a company at a serious risk of sabotage, exploitation or damage to its professional integrity, as most of the times the mobile hand-held devices are provided by the organization. Most of these lost devices have wireless access to a corporate network and have potentially very little security, making them a weak link and a major headache for security administrators. Even if these lost devices are personal, the issue is no less serious given the resulting privacy exposures! Gartner Group had predicted that by 2003 there will be over one billion mobile devices in use globally. This is true going by the sales figures quoted in annual

Box 3.12 Getting Lost!!

Cities and countries in which drivers were surveyed were Chicago; Copenhagen, Denmark; Helsinki, Finland; London; Munich, Germany; Oslo, Norway; Paris; Stockholm, Sweden and Sydney, Australia.

1. Pointsec Mobile Technologies, Inc. has discovered where lost electronic devices go: they wind up in the back seats of taxis all around the world!!
2. A survey of 935 cabbies in 9 countries turned up 85 notebook computers, 227 PDAs and 2,238 cell phones lost in cabs in the last 6 months.
3. As per Gartner 2002 report, nearly 250,000 hand-held devices were left behind in the US airports in 2002, and of those, only about 30% were traced back and returned to their owners.
4. Copenhagen appears to have the most forgetful cell phone users, with 719 phones left behind in 100 cabs in a 6-month period. Chicago cab riders left behind 387 in the same period. In total, 97 PDAs and 20 notebooks were reported lost in Chicago. London cabbies reported 23 laptops left behind.
5. As per Gartner 2004 study, a company with 5,000 or more employees could save US\$ 300,000–500,000 annually by tagging, tracking and recovering mobile phones and PDAs.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

reports published by Research in Motion. This shows that the popularity of mobile devices is increasing at a rapid rate; however, people have not been educated about the importance of securing them. The picture is indeed scary; mobile users are in an even worse position now because they are far more reliant on their mobile devices to store large amounts of sensitive information with very few concerned about backing it up or protecting it.

3.9.4 Protecting Data on Lost Devices

Given the above discussion, readers can appreciate the importance of data protection especially when it resides on a mobile hand-held device. At an individual level, employees need to worry about this. There are two reasons why cybersecurity needs to address this issue: data that are persistently stored on the device and always running applications. For protecting data that are stored persistently on a device, there are two precautions that individuals can take to prevent disclosure of the data stored on a mobile device: (a) encrypting sensitive data and (b) encrypting the entire file system (this may be useful when using data outside of a database, such as in a spreadsheet). Data that are stored on hard disks in persistent memory or on removable memory sticks (whether they are in or out of the device) should be protected. There are many third-party solutions/tools available to protect data on the lost devices, including encrypting the servers where a database file is residing. There are solutions using which individuals can enforce a self-destruct policy to destroy privileged data on a lost device or create a database action to delete the data on a user's device using a suitable tool.

A key point here is that the organizations should have a clear policy on how to respond to the loss or theft of a device, whether it is data storage, a PDA or a laptop. There should be a method for the device owner to quickly report the loss, and device owners should be aware of this method. Writing the emergency contact information on the device itself is unlikely to be very helpful.

3.9.5 Educating the Laptop Users

Often it so happens that corporate laptop users could be putting their company's networks at risk by downloading non-work-related software capable of spreading viruses and Spyware. This is because the software

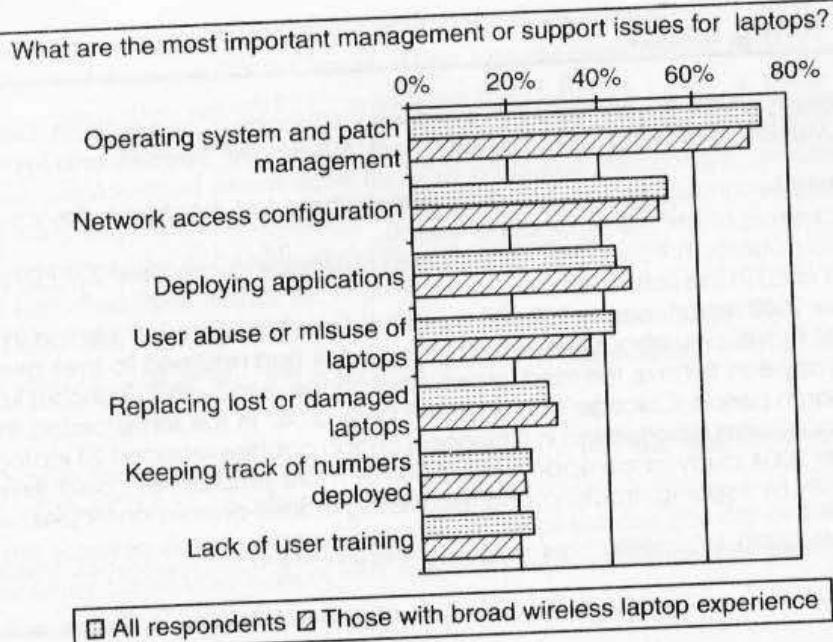


Figure 3.13 | Most important management or support issues for laptops.
Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

assets on laptops become more complex as more applications are used on an increasingly sophisticated OS with diverse connectivity options.

According to year 2004 finding, through one survey, it was found that some 86% of employees with laptops admitted to installing software onto their machines when outside of the office, with many using their laptops to access peer-to-peer websites and downloading illegal music files and movies. As per one survey of 500 European business laptop users, Malicious Code, such as Spyware and viruses, is infecting laptops and consequently business networks when they are reconnected to the corporate systems.

The result from a survey quoted in Fig. 3.13 further supports this point on cybersecurity threats from corporate laptop users. However, despite the growth in corporate security risks, resulting from mobile working, the tone of most of the security-awareness surveys shows that only half of the companies have tools in place to manage the Internet access on laptops, with only one-quarter of businesses physically enforcing these policies. An important point to be noted is that the policies and procedures put in place for support of laptop have evolved over the years to be able to cope successfully with managing laptops, connected by wireless means or otherwise. This shows how much role “perception” plays in terms of most people perceiving laptops as greater culprits compared with other innocuous-looking mobile hand-held devices.

3.10 Organizational Measures for Handling Mobile Devices-Related Security Issues

So far, we have discussed micro- and macrolevel security issues with mobile devices used for mobile computing purposes and what individuals can do to protect their personal data on mobile devices. In this section, we discuss what organizations can do toward safeguarding their information systems in the mobile computing paradigm.

3.10.1 Encrypting Organizational Databases

Critical and sensitive data reside on databases [say, applications such as customer relationship management (CRM) that utilize patterns discovered through *data warehousing* and *data mining* (DM) techniques] and with the advances in technology, access to these data is not impossible through hand-held devices. It is clear that to protect the organizations' data loss, such databases need encryption. We mention here two algorithms that are typically used to implement strong encryption of database files: Rijndael (pronounced rain-dahl or Rhine-doll), a block encryption algorithm, chosen as the new Advanced Encryption Standard (AES) for block ciphers by the National Institute of Standards and Technology (NIST). (See Ref. #13, Additional Useful Web References, Further Reading). The other algorithm used to implement strong encryption of database files is the Multi-Dimensional Space Rotation (MDSR) algorithm developed by Casio.

The term "strong encryption" is used here to describe these technologies in contrast to the simple encryption. *Strong encryption* means that it is much harder to break, but it also has a significant impact on performance. Database file encryption technology, using either the AES or the MDSR algorithms, makes the database file inoperable without the key (password). Encrypting the database scrambles the information contained in the main database file (i.e., all temporary files and all transaction log files) so that it cannot be deciphered by looking at the files using a disk utility. There is a performance impact for using strong encryption. A weaker form of encryption is also available that has negligible performance impact.

When using strong encryption, it is important *not* to store the key on the mobile device: this is equivalent to leaving a key in a locked door. However, if you lose the key, your data are completely inaccessible. The key is case-sensitive and must be entered correctly to access your database. The key is required whenever you want to start the database or you want to use a utility on your database. For greater security there is an option available that instructs the database server to display a dialog box where the user can enter the encryption key. This option is necessary because the encryption key should not be entered on the machine in clear text. To protect the scenario of information attack/stealing through the mobile devices connecting to corporate databases, additional security measures are possible through enforcing a self-destruct policy that is controlled from the server. When a device that is identified as lost or stolen connects to the organization server, IT department can have the server send a package to destroy privileged data on the device.

3.10.2 Including Mobile Devices in Security Strategy

The discussion so far makes a strong business case – in recognition of the fact that our mobile workforce is on the rise, organizational IT departments will have to take the accountability for cybersecurity threats that come through inappropriate access to organizational data from mobile-device–user employees. Encryption of corporate databases is not the end of everything. However, enterprises that do not want to include mobile devices in their environments often use security as an excuse, saying they fear the loss of sensitive data that could result from a PDA being stolen or an unsecured wireless connection being used. Their concerns are no longer viable. There are technologies available to properly secure mobile devices. These should be good enough for most organizations. Corporate IT departments just need to do their homework. For example, there are ways to make devices lock or destroy the lost data by sending the machine a special message. Also, some mobile devices have high-powered processors that will support 128-bit encryption. Although mobile devices do pose unique challenges from a cybersecurity perspective, there are some general steps that the users can take to address them, such as integrating security programs for mobile and wireless systems into the overall security blueprint. A few things that enterprises can use are:

1. Implement strong asset management, virus checking, loss prevention and other controls for mobile systems that will prohibit unauthorized access and the entry of corrupted data.

2. Investigate alternatives that allow a secure access to the company information through a firewall, such as mobile VPNs.
3. Develop a system of more frequent and thorough security audits for mobile devices.
4. Incorporate security awareness into your mobile training and support programs so that everyone understands just how important an issue security is within a company's overall IT strategy.
5. Notify the appropriate law-enforcement agency and change passwords. User accounts are closely monitored for any unusual activity for a period of time.

In the next section, our focus is on security policies relating to mobile devices.

3.11 Organizational Security Policies and Measures in Mobile Computing Era

3.11.1 Importance of Security Policies relating to Mobile Computing Devices

Proliferation of hand-held devices used makes the cybersecurity issue graver than what we would tend to think. People (especially, the youth) have grown so used to their hand-holds that they are treating them like wallets! For example, people are storing more types of confidential information on mobile computing devices than their employers or they themselves know; they listen to music using their hand-held devices (we have already discussed the threats through media player when we talked about microlevel technical issues for cybersecurity threats through these devices). One should think about not to keep credit card and bank account numbers, passwords, confidential E-Mails and strategic information about organization, merger or takeover plans and also other valuable information that could impact stock values in the mobile devices. Imagine the business impact if an employee's USB, pluggable drive or laptop was lost or stolen, revealing sensitive customer data such as credit reports, social security numbers (SSNs) and contact information. Not only would this be a public relations (PR) disaster, but it could also violate laws and regulations. One should give a deep thought about the potential legal troubles for a public company whose sales reports, employee records or expansion plans may fall into wrong hands.

When controls cannot be implemented to protect data in the event they are stolen, the simplest solution is to prevent users from storing proprietary information on platforms deemed to be insufficiently secure. This sort of policy can be difficult to enforce, however, by increasing awareness of the user, it can be reasonably effective. Information classification and handling policy should clearly define what sorts of data may be stored on mobile devices. In the absence of other controls, simply not storing confidential data on at-risk platforms will mitigate the risk of theft or loss.

A survey^[20] released by the Ponemon Institute, on behalf of Cellcrypt (www.cellcrypt.com), reveals that large and medium businesses are putting themselves at risk as a result of cell phone voice call interception. According to this survey of 75 companies and 107 senior executives in the US, it costs US corporations on average US\$ 1.3 million each time a corporate secret is revealed to unauthorized parties. About 18% of respondents estimate such losses to occur weekly or more frequently, 61% at least monthly and 90% at least annually.

The survey asked the participants about the likelihood of six separate scenarios involving the use of cell phones to communicate sensitive and confidential information occurring in their organizations. The scenarios described the following:

1. A CEO's administrative assistant uses a cell phone to arrange ground transportation that reveals the CEO's identity and location.

2. The finance and accounting staff discusses earnings of press release and one participant on the call is using a cell phone.
3. A conference call among senior leaders in the organization in which cell phones are sometimes used.
4. A sales manager conducting business in Asia uses, his/her cell phone to communicate with the home office.
5. An external lawyer asks for proprietary and confidential information while using his cell phone.
6. A call center employee assists a customer using a cell phone to establish an account and collects personal information (including SSN).

3.11.2 Operating Guidelines for Implementing Mobile Device Security Policies

In situations such as those described above, the ideal solution would be to prohibit all confidential data from being stored on mobile devices, but this may not always be practical. Organizations can, however, reduce the risk that confidential information will be accessed from lost or stolen mobile devices through the following steps:

1. Determine whether the employees in the organization need to use mobile computing devices at all, based on their risks and benefits within the organization, industry and regulatory environment.
2. Implement additional security technologies, as appropriate to fit both the organization and the types of devices used. Most (and perhaps all) mobile computing devices will need to have their native security augmented with such tools as strong encryption, device passwords and physical locks. Biometrics techniques (retinal scans, iris scans, etc.) can be used for authentication and encryption and have great potential to eliminate the challenges associated with passwords.
3. Standardize the mobile computing devices and the associated security tools being used with them. As a matter of fundamental principle, security deteriorates quickly as the tools and devices used become increasingly disparate.
4. Develop a specific framework for using mobile computing devices, including guidelines for data-syncing, the use of firewalls and anti-malware software and the types of information that can be stored on them.
5. Centralize management of your mobile computing devices. Maintain an inventory so that you know who is using what kinds of devices.
6. Establish patching procedures for software on mobile devices. This can often be simplified by integrating patching with syncing or patch management with the centralized inventory database.
7. Label the devices and register them with a suitable service that helps return recovered devices to the owners.
8. Establish procedures to disable remote access for any mobile devices reported as lost or stolen. Many devices allow the users to store usernames and passwords for website portals, which could allow a thief to access even more information than on the device itself.
9. Remove data from computing devices that are not in use or before re-assigning those devices to new owners (in case of company-provided mobile devices to employees). This is to preclude incidents through which people obtain “old” computing devices that still had confidential company data.
10. Provide education and awareness training to personnel using mobile devices. People cannot be expected to appropriately secure their information if they have not been told how.

3.11.3 Organizational Policies for the Use of Mobile Hand-Held Devices

The first step in securing mobile devices is creating company policies that address the unique issues these devices raise. Such questions include what an employee should do if a device is lost or stolen. We have talked about this in Section 3.9.4.

There are many ways to handle the matter of creating policy for mobile devices. One way is creating a distinct mobile computing policy. Another way is including such devices under existing policy. There are also approaches in between, where mobile devices fall under both existing general policies and a new one. In the hybrid approach, a new policy is created to address the specific needs of the mobile devices (such as what to do if they are lost or stolen) but more general usage issues fall under general IT policies. As a part of this approach, the “acceptable use” policy for other technologies is extended to the mobile devices. There may not be a need for separate policies for wireless, LAN, wide area network (WAN), etc. because a properly written network policy can cover all connections to the company data, including mobile and wireless.

Companies new to mobile devices may adopt an umbrella mobile policy but they find over time that they will need to modify their policies to match the challenges posed by different kinds of mobile hand-held devices. For example, wireless devices pose different challenges than non-wireless devices. Also, employees who use mobile devices more than 20% of the time will have different requirements than less-frequent users. It may happen that over time, companies may need to create separate policies for the mobile devices on the basis of whether they connect wirelessly and with distinctions for devices that connect to WANs and LANs.

It is never too early to start planning for mobile devices, even when a company, at a given point of time, cannot afford creating any special security policies to mitigate the threats posed by mobile computing devices to cybersecurity. It is, after all, an issue of new technology adoption for many organizations. By contemplating its uses, companies may think of ways they can use it and, perhaps just as important, how their competitors will use it.

3.12 Laptops

As the price of computing technology is steadily decreasing, usage of devices such as the laptops is becoming more common. Although laptops, like other mobile devices, enhance the business functions owing to their mobile access to information anytime and anywhere, they also pose a large threat as they are portable.

Box 3.13 Spy Phone Software!!!

Spy Phone software is installed on the mobile/cell phone of employees, if the employers wants to monitor phone usage. The Spy Phone software is completely hidden from the user, once it is installed and collects all the available data such as SMS messages, incoming/outgoing call history, location tracking, GPRS usage and uploads the collected data to a remote server.

The employer can simply access the designated website hosted by Spy Phone vendor, and after entering his/her account details, he/she can have full access to all the data collected 24 hours a day, 7 days a week. The employer can access this website through the Internet; hence, he/she can keep an eye on their employees, regardless where he/she is in the world. The employer can read all SMS messages (both incoming and outgoing), know who they (employees) are calling or who is calling them and where they were when the call was received.

Following are few Spy Phone Software(s) available in the market:

1. **SpyPhonePlus:** <http://www.spyphoneplus.com/>
2. **FlexiSpy:** <http://www.flexispy.com/>
3. **TheSpyPhone:** <http://www.thespyphone.com/spyphone.html>
4. **Mobile Spy:** <http://www.mobile-spy.com/>

Wireless capability in these devices has also raised cybersecurity concerns owing to the information being transmitted over other, which makes it hard to detect. In this section, we provide an elaborate discussion as to what measures the organizations can take in the face of cybersecurity threat brought by the widespread use of laptops.

The thefts of laptops have always been a major issue, according to the cybersecurity industry and insurance company statistics. Cybercriminals are targeting laptops that are expensive, to enable them to fetch a quick profit in the black market. Very few laptop thieves are actually interested in the information that is contained in the laptop. Most laptops contain personal and corporate information that could be sensitive.

Such information can be misused if found by a malicious user. Senior executives commonly believe that the information stored on their laptops is only useful for them and would not be of any interest to others. Owing to this belief, most senior executives in an organization feel that it is unnecessary to protect the information stored on these laptops. However, this is not true. The following section provides some countermeasures against the theft of laptops, thereby avoiding cybersecurity exposures.

3.12.1 Physical Security Countermeasures

Organizations are heavily dependent upon a mobile workforce with access to information, no matter where they travel. However, this mobility is putting organizations at risk of having a data breach if a laptop containing sensitive information is lost or stolen. Hence, physical security countermeasures are becoming very vital to protect the information on the employees' laptops and to reduce the likelihood that employees will lose laptops. Management also has to take care of creating awareness among the employees about physical security countermeasures by continuous training and stringent monitoring of organizational policies and procedures about these physical security countermeasures.^[21]

1. **Cables and hardwired locks:** The most cost-efficient and ideal solution to safeguard any mobile device is securing with cables and locks, specially designed for laptops. Kensington cables are one of the most popular brands in laptop security cables [see Figs. 3.14 (a) and (b)]. These cables are made of aircraft-grade steel and Kevlar brand fiber, thus making these cables 40% stronger than any other conventional security cables. One end of the security cable is fit into the universal security slot of the laptop and the other end is locked around any fixed furniture or item, thus making a loop. These cables come with a variety of options such as number locks, key locks and alarms. However, the downside of the security cables lies in the fact that one can easily remove detachable bays such as CD-ROM bay, Personal Computer Memory Card Industry Association (PCMCIA) cards (see Ref. #10, Additional Useful Web References, Further Reading), hard disk drive (HDD) bay and other removable devices from the laptop as the cable only secures the laptop from being stolen. The other disadvantage of security cables is when the laptop is locked to an object that is not fixed or is weak enough for anyone to break it. In certain cases of laptop thefts, the thief dismantled or smashed the fixed item to which the laptop was attached to.
2. **Laptop safes:** Safes made of polycarbonate – the same material that is used in bulletproof windows, police riot shields and bank security screens – can be used to carry and safeguard the laptops. The advantage of safes over security cables is that they protect the whole laptop and its devices such as CD-ROM bays, PCMCIA cards and HDD bays which can be easily removed in the case of laptops protected by security cables.
3. **Motion sensors and alarms:** Even though alarms and motion sensors are annoying owing to their false alarms and loud sound level, these devices are very efficient in securing laptops. Once these devices are activated, they can be used to track missing laptops in crowded places. Also owing to

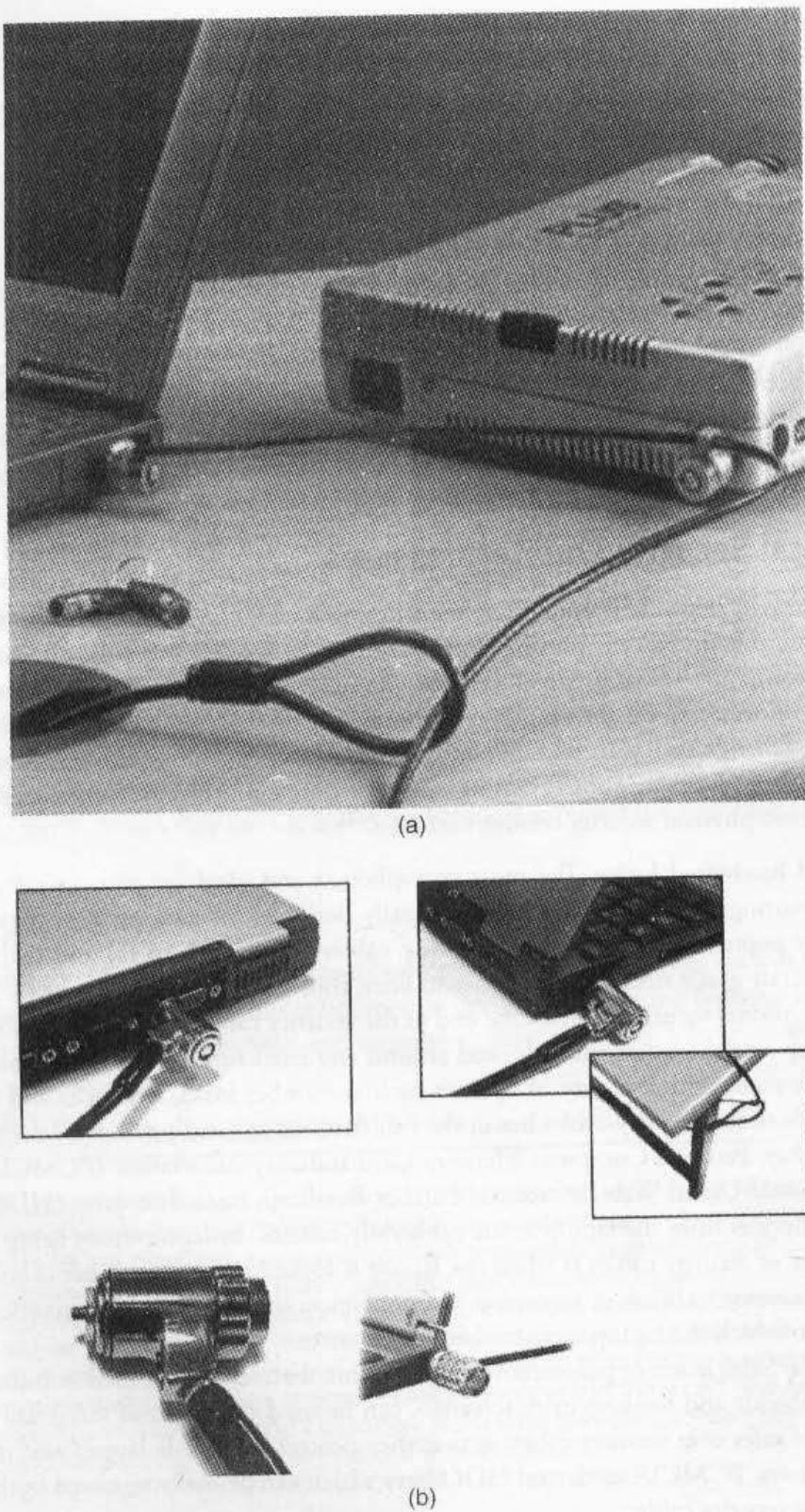


Figure 3.14 (a) Kensington cable locks for laptops. (b) Closer view of cable locks for laptops.
Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

their loud nature, they help in deterring thieves. Modern alarm systems for laptops are designed wherein the alarm device attached to the laptop transmits radio signals to a certain range around the laptop. The owner of the laptop has a key ring device that communicates with the laptop alarm device. The alarm is triggered when the distance between the laptop alarm device and the key ring device crosses the specified range. Also available are security PCMCIA cards that act as a motion detector, an alarm system, and also have the capability to lockdown the laptop if the laptop is moved out of the designated range. They also secure the passwords and encryption keys and prevent access to the OS. These cards have batteries that keep them powered on even when the system is shutdown. Figure 3.15 shows some laptop alarm systems with sensors.

4. **Warning labels and stamps:** Warning labels containing tracking information and identification details can be fixed onto the laptop to deter aspiring thieves. These labels cannot be removed easily and are a low-cost solution to a laptop theft. These labels have an identification number that is stored in a universal database for verification, which in turn makes the resale of stolen laptops a difficult process. Such labels are highly recommended for the laptops issued to top executives and/or key employees of the organizations.
5. **Other measures for protecting laptops are as follows:**
 - Engraving the laptop with personal details;
 - keeping the laptop close to oneself wherever possible;
 - carrying the laptop in a different and unobvious bag making it unobvious to potential thieves;

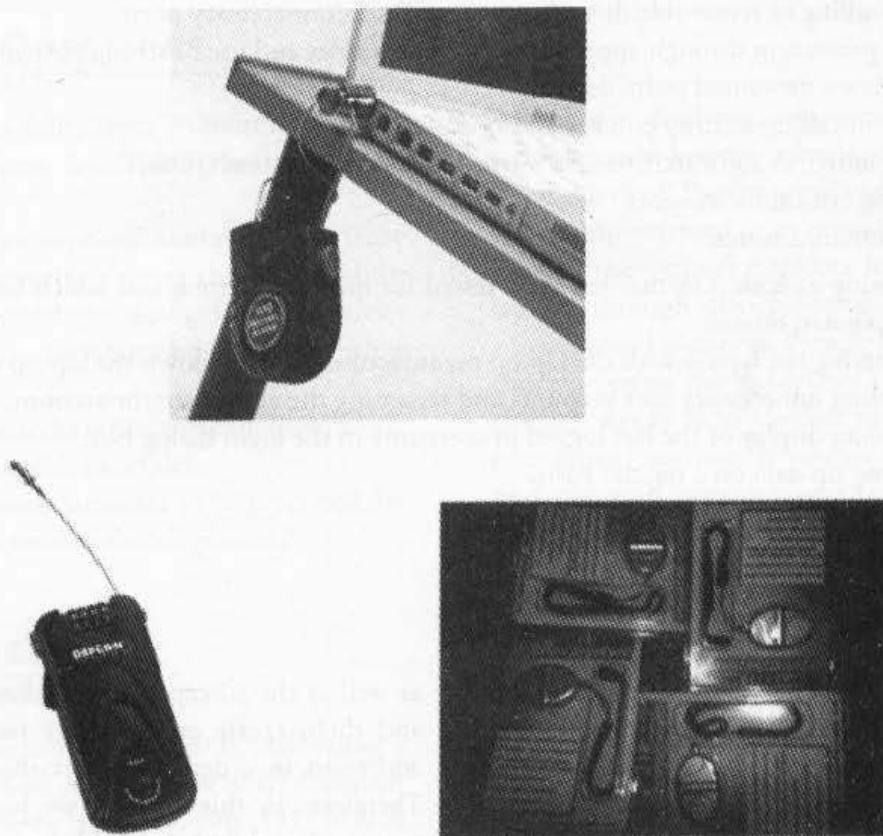


Figure 3.15 | Laptop alarm systems with sensors.

Source: Nina Godbole (2009), *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

- creating the awareness among the employees to understand the responsibility of carrying a laptop and also about the sensitivity of the information contained in the laptop;
- making a copy of the purchase receipt, laptop serial number and the description of the laptop;
- installing encryption software to protect information stored on the laptop;
- using personal firewall software to block unwanted access and intrusion;
- updating the antivirus software regularly;
- tight office security using security guards and securing the laptop by locking it down in lockers when not in use;
- never leaving the laptop unattended in public places such as the car, parking lot, conventions, conferences and the airport until it is fitted with an antitheft device;
- disabling IR ports and wireless cards and removing PCMCIA cards when not in use.

So far, we have discussed protection of corporate laptops in terms of physical access control. However, information systems security also contains logical access controls. This is because, information, be it corporate or private, needs high security as it is the most important asset of an organization or an individual. A few logical access controls are as follows:

1. Protecting from malicious programs/attackers/social engineering.
2. Avoiding weak passwords/open access.
3. Monitoring application security and scanning for vulnerabilities.
4. Ensuring that unencrypted data/unprotected file systems do not pose threats.
5. Proper handling of removable drives/storage mediums/unnecessary ports.
6. Password protection through appropriate password rules and use of strong passwords.
7. Locking down unwanted ports/devices.
8. Regularly installing security patches and updates.
9. Installing antivirus software/firewalls/intrusion detection system (IDSs).
10. Encrypting critical file systems.
11. Other countermeasures:
 - Choosing a secure OS that has been tested for quite some time and which has a high security incorporated into it.
 - Registering the laptop with the laptop manufacturer to track down the laptop in case of theft.
 - Disabling unnecessary user accounts and renaming the administrator account.
 - Disabling display of the last logged in username in the login dialog box.
 - Backing up data on a regular basis.

SUMMARY

Everyday mobile workers take laptop computers and hand-held devices outside of their organizations' secure environment. Cell phones, PDAs, Smartphones, laptop computers and other devices make it convenient to access information anywhere. However, the potential for confidential information to be exploited on these devices and the ability to access corporate networks from outside the firewall,

as well as the susceptibility of these devices to loss and theft, create cybersecurity risks that must be addressed in order to protect the privileged data. Therefore, in this chapter, we have discussed the nature of mobile hand-held devices and how they have the potential to create exposure to information systems security in the organizations. We have emphasized and reiterated the key point that the

widespread use of mobile devices as well as information explosion calls for a higher-level security in the mobile devices. In this chapter, we have discussed cybersecurity challenges in mobile and wireless computing scenario. The challenge here is that IT departments and security professionals need to handle this issue with due seriousness. Mobile devices such as PDAs and Smartphones have become a key tool for traveling employees to help enable their digital lives both in the office and on the road. As more employees, including executives, begin to carry such devices, the amount of sensitive and confidential information at risk increases. Although PDAs and Smartphones can greatly enhance employee productivity, they can also be easily lost or stolen. Without protection, sensitive data stored on mobile devices may be breached, potentially resulting in damages, including lost revenue, regulatory penalties and loss of brand reputation and goodwill of the business enterprise. We have seen the different

kinds of attacks launched on the mobile/cell phones by criminals and also some tips to avoid being victims of such attacks. Thus, the key point is that as mobile technology becomes ubiquitous, mobile security becomes increasingly important. Within a decade, mobile devices (PDAs, cell phones, wrist-watches, etc.) will function as wallets, electronic banks (E-Banks), business cards, proximity keys, as well as the personal information managers (PIMs) and communicators they are today.

Our final key point in this chapter is that protecting the data on a device is just as important as protecting the information flowing between the device and the servers it interacts with. Device security is often something that is left up to the end-user to implement and maintain. Although this is often driven by corporate policy, enterprises often look for ways to take this responsibility out of the hands of end-users and place it under the enforceable control of an administrator.

REVIEW QUESTIONS

1. What are the “mobility types”? Quote day-to-day examples of your familiarity that relates to them.
2. Discuss how “perception” makes people least suspect cybersecurity threats through mobile computing hand-held devices. What measures do you recommend against this situation?
3. What kinds of attacks are possible on mobile/cell phones? Explain with examples.
4. Explain the countermeasures to be practiced for possible attacks on mobile/cell phones.
5. What kinds of cybersecurity measures an organization should have to take in case of portable storage devices? Prepare security guidelines which can be implemented in an organization.
6. Explain the various measures for protection of laptops through physical measures and logical access control measures. Prepare a laptop security checklist using the guidelines provided in this chapter. Apply it to the laptop owner in your educational institute. If you are employed, then find out your organization’s laptop protection policy and related procedures.

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 18. To know scams that target you or your small business, visit: <http://www.scamwatch.gov.au/content/index.phtml/itemId/693900> (20 February 2010).
 19. To learn about mobile device security, visit: <http://www.securelist.com/en/analysis?pubid=170773606> (15 May 2010).
 20. To know about PCI-DSS Standard, visit: https://www.pcisecuritystandards.org/security-standards/pci_dss.shtml (18 July 2010).
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2. Sadlier, G. (October 2003), Mobile Computing Security, INS White Paper.
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The appendices that serve as extended material for the topic addressed in this chapter are: A, B, D, E, L. These are provided in the companion CD.

4

Tools and Methods Used in Cybercrime

Learning Objectives

After reading this chapter, you will be able to:

- Understand about proxy servers and anonymizers.
 - Learn about password cracking.
 - Learn what keyloggers and Spywares do.
 - Get an overview of virus and worms.
 - Learn about Trojan Horses and backdoors.
 - Understand what steganography is.
 - Learn about DoS and DDoS attacks.
 - Learn about SQL injection.
 - Understand buffer overflow.
 - Get an overview of wireless network hacking.
-

4.1 Introduction

In Chapter 2, we have learnt about how criminals/attackers plan cyberoffenses against an individual and/or against an organization. In Chapter 3, we have learnt how mobile technology plays an important role to launch cyberattacks. With this background, in this chapter, we will focus upon different forms of attacks through which attackers target the computer systems. There are various tools and techniques (see Box 4.1) and complex methodologies used to launch attacks against the target. Although discussing all of them is virtually impossible in a single chapter, yet still, we have provided an insight toward these techniques to enable the reader to understand how the computer is an indispensable tool for almost all cybercrimes. As the Internet and computer networks are integral parts of information systems, attackers have in-depth knowledge about the technology and/or they gain thorough knowledge about it. (See Section 10.4.2, Chapter 10 in CD.)

Network attack incidents reveal that attackers are often very systematic in launching their attacks (see Section 7.13, Chapter 7). The basic stages of an attack are described here to understand how an attacker can compromise a network here:

1. **Initial uncovering:** We have explained this in Chapter 2. Two steps are involved here. In the first step called as *reconnaissance*, the attacker gathers information, as much as possible, about the target by legitimate means – searching the information about the target on the Internet by Googling social networking websites and people finder websites. The information can also be gathered by surfing the public websites/searching news articles/press releases if the target is an organization/institute. In the second step, the attacker uncovers as much information as possible on the company's internal network, such as, Internet domain, machine names and the company's Internet Protocol (IP) address ranges. From prevention perspective, at this stage, it is really not possible to detect the attackers because they have done nothing illegal as yet and so their information requests are considered legitimate.

Box 4.1 Scareware, Malvertising, Clickjacking and Ransomware

1. **Scareware:** It comprises several classes of scam software with malicious payloads (explained in chapter 1), or of limited or no benefit, which are sold to consumers via certain unethical marketing practices. The selling approach uses social engineering to cause shock, anxiety or the perception of a threat, generally directed at an unsuspecting user. Some forms of Spyware and Adware also use scareware tactics. Some websites display pop-up advertisement windows or banners with text such as: "Your computer may be infected with harmful Spyware programs. Immediate removal may be required. To scan, click 'Yes' below." These websites can go as far as saying that a user's job, career or marriage would be at risk. Webpages displaying such advertisements for such products are often considered as scareware. Serious scareware applications qualify as rogue software.
2. **Malvertising:** It is a malicious advertising – malware + advertising – an online criminal methodology that appears focused on the installation of unwanted or outright malicious software through the use of Internet advertising media networks, exchanges and other user-supplied content publishing services common to the social networking space. Cybercriminals attempt to distribute malware through advertising. Possible vectors of attack include Malicious Code hidden within an advertisement, embedded into a webpage or within software which is available for download.
3. **Clickjacking:** It is a malicious technique of tricking netizens into revealing confidential information and/or taking control of their system while clicking on seemingly innocuous webpages. Clickjacking takes the form of embedded code and/or script which is executed without netizen's knowledge. Cybercriminals take the advantage of vulnerability across a variety of browsers and platforms to launch this type of attack, for example clicking on a button that appears to perform another function. The term "clickjacking" was coined by Jeremiah Grossman and Robert Hansen in 2008. The exploit is also known as User-Interface (UI) redressing.
4. **Ransomware:** It is computer malware that holds a computer system, or the data it contains, hostage against its user by demanding a ransom for its restoration. It typically propagates as a conventional computer worm, entering a system through, for example, vulnerability in a network service or an E-Mail attachment. It may then
 - disable an essential system service or lock the display at system start-up and
 - encrypt some of the user's personal files.

In both cases, the malware may extort by

- prompting the user to enter a code obtainable only after wiring payment to the attacker or sending an SMS message and accruing a charge;
- urging the user to buy a decryption or removal tool.

Sources: <http://en.wikipedia.org/wiki/Scareware> (10 January 10); <http://www.anti-malvertising.com/> (10 January 10); <http://en.wikipedia.org/wiki/Clickjacking> (10 February 10); [http://en.wikipedia.org/wiki/Ransomware_\(malware\)](http://en.wikipedia.org/wiki/Ransomware_(malware)) (10 January 10).

2. **Network probe:** At the network probe stage, the attacker uses more invasive techniques to scan the information. Usually, a "ping sweep" of the network IP addresses is performed to seek out potential targets, and then a "port scanning" tool (see Table 2.2) is used to discover exactly which services are running on the target system. At this point, the attacker has still not done anything that would be considered as an abnormal activity on the network or anything that can be classified as an intrusion.
3. **Crossing the line toward electronic crime (E-crime):** Now the attacker is toward committing what is technically a "computer crime." He/she does this by exploiting possible holes on the target system. The attacker usually goes through several stages of exploits to gain access to the system. Certain programming errors can be used by attackers to compromise a system and are quite common in practice (see Table 4.1 for list of websites commonly browsed by attackers to obtain the information on the vulnerabilities). Exploits usually include vulnerabilities in common gateway interface (CGI) scripts or well-known buffer-overflow holes, but the easiest way to gain an entry is by checking for default login accounts with easily guessable (or empty) passwords. Once the attackers are able to access a user account without many privileges, they will attempt further exploits to get an administrator or "root" access. Root access is a Unix term

Table 4.1 | Websites and tools used to find the common vulnerabilities

| Website | Brief Description |
|---|---|
| http://www.us-cert.gov/ | US-CERT is the operational arm of the National Cyber Security Division (NCSD) at the Department of Homeland Security (DHS). US-CERT also provides a way for citizens, businesses and other institutions to communicate and coordinate directly with the US government about cybersecurity. US-CERT publishes information about a variety of vulnerabilities under "US-CERT Vulnerabilities Notes." |
| http://cve.mitre.org/ | Common Vulnerabilities and Exposures (CVE) is a dictionary of publicly known information security vulnerabilities and exposures and free for public use. CVE's common identifiers enable data exchange between security products and provide a baseline index point for evaluating coverage of tools and services. |
| http://secunia.com/ | It has thousands of vulnerability lists that are updated periodically. It has vulnerability database and provides in-depth analysis about virus, worm alerts and software vulnerability. |
| http://www.hackerstorm.com/ | This website was created for open-source vulnerability database (OSVBD) tool. Since then it has grown in popularity and provides additional information about penetration testing. The site is updated with whole bunch of news and alerts about vulnerability research. |
| http://www.hackerwatch.org/ | It is an online community where Internet users can report and share information to block and identify security threats and unwanted traffic. |
| http://www.zone-h.org/ | It reports on recent web attacks and cybercrimes and lists them on the website. One can view numerous defaced webpages and details about them. |
| http://www.milworm.com/ | It contains day-wise information about exploits. |
| http://www.osvdb.org/ | OSVDB: This is an open-source vulnerability database providing a large quantity of technical information and resources about thousands of vulnerabilities. |
| http://www.metasploit.com/ | Metasploit is an open-source computer security project that provides information about security vulnerabilities and aids in penetration testing. Its most well-known subproject is the Metasploit Framework, a tool for developing and executing exploit code against a remote target machine. The Metasploit Project is also well-known for antiforensic and evasion tools, some of which are built into the Metasploit Framework. |
| http://www.w00w00.org/files/ LibExploit | LibExploit is a generic exploit creation library. It helps cybersecurity community when writing exploits to test vulnerability. |
| http://www.immunitysec.com/products-canvas.shtml | Canvas is a commercial vulnerability exploitation tool from Dave Aitel's ImmunitySec. It includes more than 150 exploits and also available are VisualSploit Plugin for drag and drop GUI exploit creation (optional). |
| http://www.coresecurity.com/content/core-impact-overview | Core Impact is widely considered to be the most powerful exploitation tool available. It sports a large, regularly updated database of professional exploits, and can do neat tricks such as exploiting one system and then establishing an encrypted tunnel through that system to reach and exploit other systems. |

and is associated with the system privileges required to run all services and access all files on the system (readers are expected to have a basic familiarity with Unix-based systems). "Root" is basically an administrator or super-user access and grants them the privileges to do anything on the system.

4. **Capturing the network:** At this stage, the attacker attempts to "own" the network. The attacker gains a foothold in the internal network quickly and easily, by compromising low-priority target systems. The next step is to remove any evidence of the attack. The attacker will usually install a set of tools that replace existing files and services with Trojan files (*Trojan Horse* is further discussed in detail in this chapter) and services that have a backdoor password. There are a number of "hacking tools" which can clean up log files and remove any trace of an intrusion; most of the time, they are individual programs written by hackers. Such tools provide copies of system files that look and act like real thing, but in fact they provide the attacker a backdoor entry into the system and hide processes he/she might be running on that system and his/her user information. This allows the attacker to return to the system at will, which means that the attacker has "captured" the network. Once the attacker has gained access to one system, he/she will then repeat the process by using the system as a stepping stone to access other systems deeper within the network, as most networks have fewer defenses against attacks from internal sources.
5. **Grab the data:** Now that the attacker has "captured the network," he/she takes advantage of his/her position to steal confidential data, customer credit card information, deface webpages, alter processes and even launch attacks at other sites from your network, causing a potentially expensive and embarrassing situation for an individual and/or for an organization.
6. **Covering tracks:** This is the last step in any cyberattack, which refers to the activities undertaken by the attacker to extend misuse of the system without being detected. The attacker can remain undetected for long periods or use this phase either to start a fresh reconnaissance to a related target system or continued use of resources, removing evidence of hacking, avoiding legal action, etc. (See Table 4.2 to know tools used to cover tracks.)

During this entire process, the attacker takes optimum care to hide his/her identity (ID) from the first step itself. How is it possible is described in the next section.

Table 4.2 | Tools used to cover tracks

| Sr. No. | Website | Brief Description |
|---------|--|---|
| 1 | http://www.ibt.ku.dk/jesper/ ELSave/ | ELSave: It is a tool to save and/or clear an NT event log. ELSave is written by Jesper Lauritsen. The executable is available on the weblink, but source code is not available. |
| 2 | http://ntsecurity.nu/ toolbox/winzapper/ | WinZapper: This tool enables to erase event records selectively from the security log in Windows NT 4.0 and Windows 2000. This program corrupts the event logs, therefore, they must be cleared completely. |
| 3 | http://www.evidence- eliminator.com/ | Evidence eliminator: It is simple and one of the top-quality professional PC cleaning program that is capable of defeating all known investigative Forensic Software. Evidence eliminator permanently wipes out evidence so that forensic analysis becomes impossible. |
| 4 | http://www.traceless.com/ computer-forensics/ | Traceless: It is a privacy cleaner for Internet explorer (IE) that can delete common Internet tracks, including history, cache, typed URLs, cookies, etc. |

(Continued)

Table 4.2 | (Continued)

| Sr. No. | Website | Brief Description |
|---------|---|--|
| 5 | http://www.acesoft.net/ | <p>Tracks Eraser Pro: It deletes following history data:</p> <ul style="list-style-type: none"> • Delete address bar history of IE, Netscape, AOL, Opera. • Delete cookies of IE, Netscape, AOL, Opera. • Delete Internet cache (temporary Internet files). • Delete Internet history files. • Delete Internet search history. • Delete history of autocomplete. • Delete IE plugins (selectable). • Delete index.dat file. • Delete history of start menu run box. • Delete history of start menu search box. • Delete windows temp files. • Delete history of open/save dialog box. • Empty recycle bin. |

4.2 Proxy Servers and Anonymizers

Proxy server is a computer on a network which acts as an intermediary for connections with other computers on that network.

The attacker first connects to a proxy server and establishes a connection with the target system through existing connection with proxy. This enables an attacker to surf on the Web anonymously and/or hide the attack. A client connects to the proxy server and requests some services (such as a file, webpage, connection or other resource) available from a different server. The proxy server evaluates the request and provides the resource by establishing the connection to the respective server and/or requests the required service on behalf of the client. Using a proxy server can allow an attacker to hide ID (i.e., become anonymous on the network).

A proxy server has following purposes:

1. Keep the systems behind the curtain (mainly for security reasons).
2. Speed up access to a resource (through “caching”). It is usually used to cache the webpages from a web server.
3. Specialized proxy servers are used to filter unwanted content such as advertisements.
4. Proxy server can be used as IP address multiplexer to enable to connect number of computers on the Internet, whenever one has only one IP address (visit <http://www.multiproxy.org/multiproxy.htm> for more information).

One of the advantages of a proxy server is that its cache memory can serve all users. If one or more websites are requested frequently, may be by different users, it is likely to be in the proxy's cache memory, which will improve user response time. In fact there are special servers available known as *cache servers*. A proxy can also do logging.

Listed are few websites where free proxy servers can be found:

1. <http://www.proxy4free.com>
2. <http://www.publicproxyservers.com>

3. <http://www.proxz.com>
4. <http://www.anonymitychecker.com>
5. <http://www.surf24h.com>
6. <http://www.hidemyass.com>

An *anonymizer* or an anonymous proxy is a tool that attempts to make activity on the Internet untraceable. It accesses the Internet on the user's behalf, protecting personal information by hiding the source computer's identifying information.^[1] Anonymizers are services used to make Web surfing anonymous by utilizing a website that acts as a proxy server for the web client. In 1997 the first anonymizer software tool was created by Lance Cottrell, developed by Anonymizer.com. The anonymizer hides/removes all the identifying information from a user's computer while the user surfs on the Internet, which ensures the privacy of the user. (See Section 9.7, Chapter 9.)

Listed are few websites where more information about anonymizers can be found:

1. <http://www.anonymizer.com>
2. <http://www.browzar.com>
3. <http://www.anonymize.net>
4. <http://www.anonymouse.ws>
5. <http://www.anonymousindex.com>

Box 4.2 Being Anonymous While Searching on Google!

Google Cookie

Google was the first search engine to use a cookie.^[2] Google set the standard and nowadays cookies are commonplace among search engines. This cookie places a unique ID number on your hard disk. Anytime you visit Google, user gets a Google cookie if a user doesn't already have one. If a user has one then it will read and record the unique ID number. Google can build a detailed list of your search terms over many years. (Google's cookies are set to expire by the year 2038, unless a user deletes before its expiry.)

Cookie

Cookie (also known as HTTP cookie/browser cookie) is a small text file that contains a string of alphanumeric characters and is used for storing netizen's website preferences/authentication while visiting the same webpage again and again or also acts as identifier for server-based session – such browser mechanism of setting and reading cookies invites attackers to use these cookies as "Spyware." There are two types of cookies:

1. Persistent cookie and
2. session cookie.

Persistent cookie is stored by the web browser into the cookie folder on the PC's hard disk. It remains under the cookie folder, which is maintained by the web browser. Session cookie is a temporary cookie and does not reside on the PC once the browser is closed (see Boxes 9.2, 9.3 and 9.4, Chapter 9).

DoubleClick

It is a subsidiary of Google and provides Internet ad-serving services and paid search products listing (DART Search^[3]) and utilize the cookies, which are called DART cookie. Internet Advertising Network was started by Kevin O'Connor and Dwight Merriman in 1995. IAN and the DoubleClick division of Poppe-Tyson were merged into a new corporation named DoubleClick in 1996. DoubleClick was first in the online media representative business, that is, representing websites to sell advertising space to marketers. In 1997 it began offering the online ad serving and management technology they had

Box 4.2 Being Anonymous . . . (Continued)

developed to other publishers as the DART services. The DART cookie is a persistent cookie, which consists of the name of the domain that has set the cookie, the lifetime of the cookie and a "value." DoubleClick's DART mechanism generates a unique series of characters for the "value" portion of the cookie. These DoubleClick DART cookies help marketers learn how well their Internet advertising campaigns or paid search listings perform. Many marketers and Internet websites use DoubleClick's DART technology to deliver and serve their advertisements or manage their paid search listings. DoubleClick's DART products set or recognize a unique, persistent cookie when an ad is displayed or a paid listing is selected. The information that the DART cookie helps to give marketers includes the number of unique users their advertisements displayed to, how many users clicked on their Internet ads or paid listings and which ads or paid listings they clicked on.

G-Zapper

G-Zapper^[4] utility helps to stay anonymous while searching Google. Google stores a unique identifier in a cookie on the computer (i.e., on the hard disk) which allows to track keywords that are searched for. This information is used to compile reports, track user habits and test features. In the future, it would be possible that this information is sold and/or shared with others.

G-Zapper helps to protect users' ID and search history. G-Zapper reads the Google cookie installed on users' PC, displays the date it was installed, determines how long user searches have been tracked and displays Google searches. G-Zapper allows user to automatically delete or entirely block the Google search cookie from future installation.

This utility can be downloaded from <http://www.dummysoftware.com/gzapper.html>

4.3 Phishing

While checking electronic mail (E-Mail) one day a user finds a message from the bank threatening him/her to close the bank account if he/she does not reply immediately. Although the message seems to be suspicious from the contents of the message, it is difficult to conclude that it is a fake/false E-Mail. This message and other such messages are examples of Phishing – in addition to stealing personal and financial data – and can infect systems with viruses and also a method of online ID theft in various cases. Most people associate Phishing with E-Mail messages that spoof or mimic banks, credit card companies or other business such as Amazon and eBay. These messages look authentic and attempt to get users to reveal their personal information.



It is believed that *Phishing* is an alternative spelling of "fishing," as in "to fish for information." The first documented use of the word "Phishing" was in 1996.

4.3.1 How Phishing Works?

Phishers work in the following ways^[5]:

1. **Planning:** Criminals, usually called as phishers, decide the target (i.e., specific business/business house/an individual) and determine how to get E-Mail address of that target or customers of that business. Phishers often use mass mailing and address collection techniques as spammers.
2. **Setup:** Once phishers know which business/business house to spoof and who their victims are, they will create methods for delivering the message and to collect the data about the target. Most often this involves E-Mail addresses and a webpage.

3. **Attack:** This is the step people are most familiar with – the phisher sends a phony message that appears to be from a reputable source.
4. **Collection:** Phishers record the information of victims entering into webpages or pop-up windows.
5. **Identity theft and fraud:** Phishers use the information that they have gathered to make illegal purchases or commit fraud.

Phishing started off as being part of popular hacking culture. Nowadays, more and more organizations/institutes provide greater online access for their customers and hence criminals are successfully using Phishing techniques to steal personal information and conduct ID theft at a global level. We have explained Phishing and Identity Theft in detail in Chapter 5.

4.4 Password Cracking

Password is like a key to get an entry into computerized systems like a lock. Password cracking is a process of recovering passwords from data that have been stored in or transmitted by a computer system.^[6] Usually, an attacker follows a common approach – repeatedly making guesses for the password. The purpose of password cracking is as follows:

1. To recover a forgotten password.
2. As a preventive measure by system administrators to check for easily crackable passwords.
3. To gain unauthorized access to a system.

Manual password cracking is to attempt to logon with different passwords. The attacker follows the following steps:

1. Find a valid user account such as an Administrator or Guest;
2. create a list of possible passwords;
3. rank the passwords from high to low probability;
4. key-in each password;
5. try again until a successful password is found.

Passwords can be guessed sometimes with knowledge of the user's personal information (explained in Chapter 5). Examples of guessable passwords include:

1. Blank (none);
2. the words like "password," "passcode" and "admin";
3. series of letters from the "QWERTY" keyboard, for example, qwerty, asdf or qwertyuiop;
4. user's name or login name;
5. name of user's friend/relative/pet;
6. user's birthplace or date of birth, or a relative's or a friend's;
7. user's vehicle number, office number, residence number or mobile number;
8. name of a celebrity who is considered to be an idol (e.g., actors, actress, spiritual gurus) by the user;
9. simple modification of one of the preceding, such as suffixing a digit, particularly 1, or reversing the order of letters.

An attacker can also create a script file (i.e., automated program) which will be executed to try each password in a list. This is still considered manual cracking, is time-consuming and not usually effective.

Passwords are stored in a database and password verification process is established into the system when a user attempts to login or access a restricted resource. To ensure confidentiality of passwords, the

password verification data is usually not stored in a clear text format. For example, one-way function (which may be either an encryption function or a cryptographic hash) is applied to the password, possibly in combination with other data, and the resulting value is stored. When a user attempts to login to the system by entering the password, the same function is applied to the entered value and the result is compared with the stored value. If they match, user gains the access; this process is called *authentication*.

Even though these functions create hashed passwords, which may be cryptographically secure, an attacker attempts to get possession of the hashed password, which will help to provide a quick way to test guesses for the password by applying the one-way function to each guess and comparing the result to the verification data. The most commonly used hash functions can be computed rapidly and the attacker can test these hashes with the help of password cracking tools (see Table 4.3) to get the plain text password.

Table 4.3 | Password cracking tools

| <i>Website</i> | <i>Brief Description</i> |
|---|--|
| www.defaultpassword.com | Default password(s): Network devices such as switches, hubs and routers are equipped with “default passwords” and usually these passwords are not changed after commissioning these devices into the network (i.e., into LAN). The intruders can gain the access using these default passwords by visiting the said website. |
| http://www.oxid.it/cain.html | Cain & Abel: This password recovery tool is typically used for Microsoft Operating Systems (OSs). It allows to crack the passwords by sniffing the network, cracking encrypted passwords using dictionary, brute force attacks, decoding scrambled passwords and recovering wireless network keys. |
| http://www.openwall.com/john | John the Ripper: This is a free and open-source software – fast password cracker, compatible with many OSs like different flavors of Unix, Windows, DOS, BeOS and OpenVMS. Its primary purpose is to detect weak Unix passwords. |
| http://freeworld.thc.org/thc-hydra | THC-Hydra: It is a very fast network logon cracker which supports many different services. |
| http://www.aircrack-ng.org | Aircrack-ng: It is a set of tools used for wireless networks. This tool is used for 802.11a/b/g wired equivalent privacy (WEP) and Wi-Fi Protected Access (WPA) cracking. It can recover a 40 through 512-bit WEP key once enough encrypted packets have been gathered. It can also attack WPA 1 or 2 networks using advanced cryptographic methods or by brute force. |
| http://www.l0phtcrack.com | L0phtCrack: It is used to crack Windows passwords from hashes which it can obtain from stand-alone Windows workstations, networked servers, primary domain controllers or Active Directory. It also has numerous methods of generating password guesses (dictionary, brute force, etc.). |
| http://airsnort.shmoo.com | AirSnort: It is a wireless LAN (WLAN) tool which recovers encryption keys. It operates by passively monitoring transmissions, computing the encryption key when enough packets have been gathered. It requires approximately 5–10 million encrypted packets to be gathered. Once enough packets have been gathered, AirSnort can guess the encryption password in under a second. It runs under Windows or Linux. |

(Continued)

Table 4.3 | (Continued)

| <i>Website</i> | <i>Brief Description</i> |
|---|---|
| http://www.solarwinds.com | SolarWinds: It is a plethora of network discovery/monitoring/attack tools and has created dozens of special-purpose tools targeted at systems administrators. Security-related tools include many network discovery scanners, a Simple Network Management Protocol (SNMP) brute force cracker, router password decryption and more. |
| http://www.foofus.net/fizzgig/pwdump | Pwdump: It is a Windows password recovery tool. Pwdump is able to extract NTLM and LanMan hashes from a Windows target, regardless of whether Syskey is enabled. It is also capable of displaying password histories if they are available. |
| http://project-rainbowcrack.com | RainbowCrack: It is a hash cracker that makes use of a large-scale time-memory trade-off. A traditional brute force cracker tries all possible plain texts one by one, which can be time-consuming for complex passwords. RainbowCrack uses a time-memory trade-off to do all the cracking-time computation in advance and store the results in so-called "rainbow tables." It does take a long time to precompute the tables but RainbowCrack can be hundreds of times faster than a brute force cracker once the precomputation is finished. |
| http://www.hoobie.net/brutus | Brutus: It is one of the fastest, most flexible remote password crackers available for free. It is available for Windows 9x, NT and 2000. It supports HTTP, POP3, FTP, SMB, TELNET, IMAP, NTP and more. |

Password cracking attacks can be classified under three categories as follows:

1. Online attacks;
2. offline attacks;
3. non-electronic attacks (e.g., social engineering, shoulder surfing and dumpster diving are explained in Chapter 2).

4.4.1 Online Attacks

An attacker can create a script file (i.e., automated program) that will be executed to try each password in a list and when matches, an attacker can gain the access to the system. The most popular online attack is man-in-the-middle (MITM) attack, also termed as "bucket-brigade attack" or sometimes "Janus attack." It is a form of active eavesdropping^[7] in which the attacker establishes a connection between a victim and the server to which a victim is connected. When a victim client connects to the fraudulent server, the MITM server intercepts the call, hashes the password and passes the connection to the victim server (e.g., an attacker within reception range of an unencrypted Wi-Fi wireless access point can insert himself as a man-in-the-middle). This type of attack is used to obtain the passwords for E-Mail accounts on public websites such as Yahoo, Hotmail and Gmail and can also be used to get the passwords for financial websites that would like to gain the access to banking websites.

4.4.2 Offline Attacks

Mostly offline attacks are performed from a location other than the target (i.e., either a computer system or while on the network) where these passwords reside or are used. Offline attacks usually require physical

Table 4.4 | Types of password cracking attacks

| Type of Attack | Description | Example of a Password |
|--------------------|---|-----------------------|
| Dictionary attack | Attempts to match all the words from the dictionary to get the password | Administrator |
| Hybrid attack | Substitutes numbers and symbols to get the password | Adm1n1strator |
| Brute force attack | Attempts all possible permutation-combinations of letters, numbers and special characters | Adm!n@09 |

access to the computer and copying the password file from the system onto removable media. Different types of offline password attacks are described in Table 4.4. Few tools listed in Table 4.2 also use these techniques to get the password in the clear text format.

4.4.3 Strong, Weak and Random Passwords

A weak password is one, which could be easily guessed, short, common and a system default password that could be easily found by executing a brute force attack and by using a subset of all possible passwords, such as words in the dictionary, proper names and words based on the username or common variations on these themes. Passwords that can be easily guessed by acquaintances of the netizens (such as date of birth, pet's name and spouses' name) are considered to be very weak. Here are some of the examples of "weak passwords":

1. Susan: Common personal name;
2. aaaa: repeated letters, can be guessed;
3. rover: common name for a pet, also a dictionary word;
4. abc123: can be easily guessed;
5. admin: can be easily guessed;
6. 1234: can be easily guessed;
7. QWERTY: a sequence of adjacent letters on many keyboards;
8. 12/3/75: date, possibly of personal importance;
9. nbusr123: probably a username, and if so, can be very easily guessed;
10. p@\$\$\\$/\0rd: simple letter substitutions are preprogrammed into password cracking tools;
11. password: used very often – trivially guessed;
12. December12: using the date of a forced password change is very common.

A strong password is long enough, random or otherwise difficult to guess – producible only by the user who chooses it. The length of time deemed to be too long will vary with the attacker, the attacker's resources, the ease with which a password can be tried and the value of the password to the attacker. A student's password might not be worth more than a few seconds of computer time, while a password controlling access to a large bank's electronic money transfer system might be worth many weeks of computer time for trying to crack it. Here are some examples of strong passwords:

1. Convert £100 to Euros!: Such phrases are long, memorable and contain an extended symbol to increase the strength of the password.
2. 382465304H: It is mix of numbers and a letter at the end, usually used on mass user accounts and such passwords can be generated randomly, for example, in schools and business.
3. 4pRte!ai@3: It is not a dictionary word; however it has cases of alpha along with numeric and punctuation characters.

4. MoOoOfIn245679: It is long with both alphabets and numerals.
5. t3wahSetyeT4: It is not a dictionary word; however, it has both alphabets and numerals.

Visit <http://www.microsoft.com/protect/fraud/passwords/checker.aspx> to check the strength of your password.^[8]

4.4.4 Random Passwords

We have explained in the previous section how most secure passwords are long with random strings of characters and how such passwords are generally most difficult to remember. Password is stronger if it includes a mix of upper and lower case letters, numbers and other symbols, when allowed, for the same number of characters. The difficulty in remembering such a password increases the chance that the user will write down the password, which makes it more vulnerable to a different attack (in this case, the paper being lost or stolen and the password discovered). Whether this represents a net reduction in security depends on whether the primary threat to security is internal (e.g., social engineering) or external. A password can, at first sight, be random, but if you really examine it, it is just a pattern. One of these types of passwords is 26845. Although short, it is not easily guessed. However, the person who created the password is able to remember it because it is just the four direction keys on the square number board (found at the right of most keyboards) plus a five in the middle. If you practice it, it is just one swift motion of moving two fingers around the board (which is very easy to use). Forcing users to use system-created random passwords ensures that the password will have no connection with that user and should not be found in any dictionary. Several OSs have included such a feature. Almost all the OSs also include password aging; the users are required to choose new passwords regularly, usually after 30 or 45 days. Many users dislike these measures, particularly when they have not been taken through security awareness training. The imposition of strong random passwords may encourage the users to write down passwords, store them in personal digital assistants (PDAs) or cell phones and share them with others against memory failure, increasing the risk of disclosure.

The general guidelines applicable to the password policies, which can be implemented organization-wide, are as follows:

1. Passwords and user logon identities (IDs) should be unique to each authorized user.
2. Passwords should consist of a minimum of eight alphanumeric characters (no common names or phrases).
3. There should be computer-controlled lists of prescribed password rules and periodic testing (e.g., letter and number sequences, character repetition, initials, common words and standard names) to identify any password weaknesses.
4. Passwords should be kept private, that is, not shared with friends, colleagues, etc. They shall not be coded into programs or noted down anywhere.
5. Passwords shall be changed every 30/45 days or less. Most operating systems (OSs) can enforce a password with an automatic expiration and prevent repeated or reused passwords.
6. User accounts should be frozen after five failed logon attempts. All erroneous password entries should be recorded in an audit log for later inspection and action, as necessary.
7. Sessions should be suspended after 15 minutes (or other specified period) of inactivity and require the passwords to be re-entered.
8. Successful logons should display the date and time of the last logon and logoff.
9. Logon IDs and passwords should be suspended after a specified period of non-use.
10. For high-risk systems, after excessive violations, the system should generate an alarm and be able to simulate a continuing session (with dummy data) for the failed user (to keep this user connected while personnel attempt to investigate the incoming connection).

Similarly, netizens should practice password guidelines to avoid being victim of getting their personal E-Mail accounts hacked/attacked by the attackers.

1. Passwords used for business E-Mail accounts, personal E-Mail accounts (Yahoo/Hotmail/Gmail) and banking/financial user accounts (e.g., online banking/securities trading accounts) should be kept separate.
2. Passwords should be of minimum eight alphanumeric characters (common names or phrases should be phrased).
3. Passwords should be changed every 30/45 days.
4. Passwords should not be shared with relatives and/or friends.
5. Password used previously should not be used while renewing the password.
6. Passwords of personal E-Mail accounts (Yahoo/Hotmail/Gmail) and banking/financial user accounts (e.g., online banking/securities trading accounts) should be changed from a secured system, within couple of days, if these E-Mail accounts has been accessed from public Internet facilities such as cybercafes/hotels/libraries.
7. Passwords should not be stored under mobile phones/PDAs, as these devices are also prone to cyber-attacks (explained in Section 3.8, Chapter 3).
8. In the case of receipt of an E-Mail from banking/financial institutions, instructing to change the passwords, before clicking the weblinks displayed in the E-Mail, legitimacy of the E-Mail should be ensured to avoid being a victim of Phishing attacks (we will explain Phishing attack in detail in Chapter 5).
9. Similarly, in case of receipt of SMS from banking/financial institutions, instructing to change the passwords, legitimacy of the E-Mail should be ensured to avoid being a victim of Smishing attacks (explained in detail in Chapter 3).
10. In case E-Mail accounts/user accounts have been hacked, respective agencies/institutes should be contacted immediately.

4.5 Keyloggers and Spywares

Keystroke logging, often called keylogging, is the practice of noting (or logging) the keys struck on a keyboard, typically in a covert manner so that the person using the keyboard is unaware that such actions are being monitored.^[9]

Keystroke logger or keylogger is quicker and easier way of capturing the passwords and monitoring the victims' IT savvy behavior. It can be classified as software keylogger and hardware keylogger.

4.5.1 Software Keyloggers

Software keyloggers are software programs (see Table 4.5) installed on the computer systems which usually are located between the OS and the keyboard hardware, and every keystroke is recorded. Software keyloggers are installed on a computer system by Trojans or viruses (will discuss more on this in subsequent sections of this chapter) without the knowledge of the user. Cybercriminals always install such tools on the insecure computer systems available in public places (i.e., cybercafes, library – we have already discussed this in Chapter 2) and can obtain the required information about the victim very easily. A keylogger usually consists of two files that get installed in the same directory: a dynamic link library (DLL) file and an EXEcutable (EXE) file that installs the DLL file and triggers it to work. DLL does all the recording of keystrokes.^[10]

Table 4.5 | Software keyloggers

| <i>Website</i> | <i>Brief Description</i> |
|---|---|
| http://www.soft-central.net | SC-KeyLog PRO: It allows to secretly record computer user activities such as E-Mails, chat conversations, visited websites, clipboard usage, etc. in a protected logfile. SC-KeyLog PRO also captures Windows user logon passwords. The captured information is completely hidden from the user and allows to remotely install the monitoring system through an E-Mail attachment without the user recognizing the installation at all. |
| http://www.spytech-web.com | Spytech SpyAgent Stealth: It provides a large variety of essential computer monitoring features as well as website and application filtering, chat blocking and remote delivery of logs via E-Mail or FTP. |
| http://www.relytec.com | All In One Keylogger: It is an invisible keystrokes recorder and a spy software tool that registers every activity on the PC to encrypted logs. This keylogger allows secretly tracking of all activities from all computer users and automatically receiving logs to a desired E-Mail/FTP accounting. With this keylogger, one can read chat conversations, look at the E-Mails as well as watch the sites that have been surfed. |
| http://www.stealthkeylogger.org | Stealth Keylogger: It is a computer monitoring software that enables activity log report where the entire PC keyboard activities are registered either at specific time or hourly on daily basis. The entire log reports are generated either in text or HTML file format as defined by the user. The keylogger facilitates mailing of log report at the specified E-Mail address. |
| http://www.blazingtools.com | Perfect Keylogger: It has its advanced keyword detection and notification. User can create a list of “on alert” words or phrases and keylogger will continually monitor keyboard typing, URLs and webpages for these words or phrases – for example, “bomb,” “sex,” “visiting places around Mumbai” and “Windows vulnerabilities.” When a keyword is detected, perfect keylogger makes screenshot and sends E-Mail notification to the user. |
| http://kgb-spy-software.en.softonic.com | KGB Spy: It is a multifunctional keyboard tracking software, widely used by both regular users and IT security specialists. This program does not just record keystrokes but is also capable of recording language-specific characters. It records all typed data/all keyboard activity. It can be used to monitor children’s activity at home or to ensure employees do not use company’s computers inappropriately. Visit www.refog.com to find more on this product. |
| http://www.spy-guide.net/spybuddy-spy-software.htm | Spy Buddy: This, along with keylogger, has following features: <ul style="list-style-type: none"> • Internet conversation logging; • disk activity logging; • Window activity logging; • application activity logging; • clipboard activity logging; • AOL/Internet explorer history; • printed documents logging; • keylogger keystroke monitoring; • websites activity logging; • screenshot capturing; • WebWatch keyword alerting |

(Continued)

Table 4.5 | (Continued)

| Website | Brief Description |
|---|---|
| http://www.elite-keylogger.com | Elite Keylogger: It captures every keystroke typed, all passwords (including Windows logon passwords), chats, instant messages, E-Mails, websites visited, all program launched, usernames and time they worked on the computer, desktop activity, clipboard, etc. |
| http://www.cyberspysoftware.com | CyberSpy: It provides an array of features and easy-to-use graphical interface along with computer monitoring capabilities such as keep tabs on the employees and keeps track of what children are viewing on the Internet. CyberSpy can be used as complete PC monitoring solution for any home or office. CyberSpy records all websites visited, instant message conversations, passwords, E-Mails and all keystrokes pressed. It also has the ability to provide screenshots at set intervals. |
| http://www.mykeylogger.com | Powered Keylogger: Powered keylogger can be used for the following: <ul style="list-style-type: none"> • <i>Surveillance:</i> It is for anyone to control what happens on the computer when the computer's owner is away. • <i>Network administration:</i> It is for network administrators to control outgoing traffic and sites visited. • <i>Shared PC activity tracking:</i> It is to analyze the usage of shared PC. • <i>Parental control:</i> It helps parents to monitor their children's computer and Internet activity. • <i>Employee productivity monitoring:</i> It helps managers to check and increase productivity of their stuff or just to prevent the leak of important information. |
| http://www.x-pcsoft.com | XPC Spy: XPC Spy is one of the powerful keylogger spy software, runs stealthy under MS Windows and has the following features: <ul style="list-style-type: none"> • Records all keystrokes typed; • records all websites visited; • records all programs executed, folders explored, files opened or edited, documents printed, etc.; • records all windows opened; • records all clipboard text content; • records all system activities; • records webmails sent (database update online, more and more webmail servers are supported); • records all ICQ Messenger chat conversations; • records all MSN Messenger chat conversations; • records all AOL/AIM Messenger chat conversations; • records all Yahoo! Messenger chat conversations; • runs invisible in the background and is protected by password; • is built-in screenshot pictures viewer; • schedules monitor process, sets time to start or stop monitoring; • sends logs report via E-Mail. |

4.5.2 Hardware Keyloggers

To install these keyloggers, physical access to the computer system is required. Hardware keyloggers are small hardware devices. These are connected to the PC and/or to the keyboard and save every keystroke into a file or in the memory of the hardware device. Cybercriminals install such devices on ATM machines to capture ATM Cards' PINs. Each keypress on the keyboard of the ATM gets registered by these keyloggers. These keyloggers look like an integrated part of such systems; hence, bank customers are unaware of their presence.

Listed are few websites where more information about hardware keyloggers can be found:

1. <http://www.keyghost.com>
2. <http://www.keelog.com>
3. <http://www.keydevil.com>
4. <http://www.keykatcher.com>

4.5.3 Antikeylogger

Antikeylogger^[11] is a tool that can detect the keylogger installed on the computer system and also can remove the tool. Visit <http://www.anti-keyloggers.com> for more information.

Advantages of using antikeylogger are as follows:

1. Firewalls cannot detect the installations of keyloggers on the systems; hence, antikeyloggers can detect installations of keylogger.
2. This software does not require regular updates of signature bases to work effectively such as other antivirus and antispy programs; if not updated, it does not serve the purpose, which makes the users at risk.
3. Prevents Internet banking frauds. Passwords can be easily gained with the help of installing keyloggers.
4. It prevents ID theft (we will discuss it more in Chapter 5).
5. It secures E-Mail and instant messaging/chatting.

4.5.4 Spywares

Spyware is a type of malware (i.e., malicious software – see Box 4.3 to know about different types of malwares) that is installed on computers which collects information about users without their knowledge. The presence of Spyware is typically hidden from the user; it is secretly installed on the user's personal computer. Sometimes, however, Spywares such as keyloggers are installed by the owner of a shared, corporate or public computer on purpose to secretly monitor other users.^[12]

It is clearly understood from the term *Spyware* that it secretly monitors the user. The features and functions of such Spywares are beyond simple monitoring. Spyware programs collect personal information about the victim, such as the Internet surfing habits/patterns and websites visited. The Spyware can also redirect Internet surfing activities by installing another stealth utility on the users' computer system. Spyware may also have an ability to change computer settings, which may result in slowing of the Internet connection speeds and slowing of response time that may result into user complaining about the Internet speed connection with Internet Service Provider (ISP). Various Spywares are available in the market and the one that are popular are listed in Table 4.6.

To overcome the emergence of Spywares that proved to be troublesome for the normal user, anti-Spyware softwares (refer to Appendix B: List of Useful Software Utilities and Websites in CD) are available in the market. Installation of anti-Spyware software has become a common element nowadays from computer security practices perspective.

Box 4.3 Malwares

Malware, short for malicious software, is a software designed to infiltrate a computer system without the owner's informed consent (see Box 9.8, Chapter 9). The expression is a general term used by computer professionals to mean a variety of forms of hostile, intrusive or annoying software or program code.^[13] Malware can be classified as follows:

1. **Viruses and worms:** These are known as *infectious malware*. They spread from one computer system to another with a particular behavior (will discuss more on this in Section 4.6).
2. **Trojan Horses:** A Trojan Horse,^[14] Trojan for short, is a term used to describe malware that appears, to the user, to perform a desirable function but, in fact, facilitates unauthorized access to the user's computer system (will discuss more on this in Section 4.7).
3. **Rootkits:** Rootkits^[15] is a software system that consists of one or more programs designed to obscure the fact that a system has been compromised. For further details refer to Section 7.12.1, Chapter 7.
4. **Backdoors:** Backdoor^[16] in a computer system (or cryptosystem or algorithm) is a method of bypassing normal authentication, securing remote access to a computer, obtaining access to plain text and so on while attempting to remain undetected.
5. **Spyware:** For further details see Section 4.5.
6. **Botnets:** For further details see Section 2.6 in Chapter 2.
7. **Keystroke loggers:** For further details see Section 4.5.

Table 4.6 | Spywares

| Website | Brief Description |
|---|--|
| http://www.e-spy-software.com | 007 Spy: It has following key features: <ul style="list-style-type: none"> • Capability of overriding "antispy" programs like "Ad-aware"; • record all websites URL visited in Internet; • powerful keylogger engine to capture all passwords; • view logs remotely from anywhere at anytime; • export log report in HTML format to view it in the browser; • automatically clean-up on outdated logs; • password protection. |
| http://www.spectorsoft.com | Spector Pro: It has following key features: <ul style="list-style-type: none"> • Captures and reviews all chats and instant messages; • captures E-Mails (read, sent and received); • captures websites visited; • captures activities performed on social networking sites such as MySpace and Facebook; • enables to block any particular website and/or chatting with anyone; • acts as a keylogger to capture every single keystroke (including usernames and passwords). |
| http://www.spectorsoft.com | eBlaster: Besides keylogger and website watcher, it also records E-Mails sent and received, files uploaded/downloaded, logging users' activities, record online searches, recording MySpace and Facebook activities and any other program activity. |
| http://www.remotespy.com | Remotespy: Besides remote computer monitoring, silently and invisibly, it also monitors and records users' PC without any need for physical access. Moreover, it records keystrokes (keylogger), screenshots, E-Mail, passwords, chats, instant messenger conversations and websites visited. |

(Continued)

Table 4.6 | (Continued)

| Website | Brief Description |
|---|---|
| http://www.topofbestsoft.com | <p>Stealth Recorder Pro: It is a new type of utility that enables to record a variety of sounds and transfer them automatically through Internet without being notified by original location or source. It has following features:</p> <ul style="list-style-type: none"> • Real-time MP3 recording via microphone, CD, line-in and stereo mixer as MP3, WMA or WAV formatted files; • transferring via E-Mail or FTP, the recorded files to a user-defined E-Mail address or FTP automatically; • controlling from a remote location; • voice mail, records and sends the voice messages. |
| http://www.amplusnet.com | <p>Stealth Website Logger: It records all accessed websites and a detailed report can be available on a specified E-Mail address. It has following key features:</p> <ul style="list-style-type: none"> • Monitor visited websites; • reports sent to an E-Mail address; • daily log; • global log for a specified period; • log deletion after a specified period; • hotkey and password protection; • not visible in add/remove programs or task manager. |
| http://www.flexispy.com | <p>Flexispy: It is a tool that can be installed on a cell/mobile phone. After installation, Flexispy secretly records conversations that happen on the phone and sends this information to a specified E-Mail address.</p> |
| http://www.wiretappro.com | <p>Wiretap Professional: It is an application for monitoring and capturing all activities on the system. It can capture the entire Internet activity. This spy software can monitor and record E-Mail, chat messages and websites visited. In addition, it helps in monitoring and recording of keystrokes, passwords entered and all documents, pictures and folders viewed.</p> |
| http://www.pcphonehome.com | <p>PC PhoneHome: It is a software that tracks and locates lost or stolen laptop and desktop computers. Every time a computer system on which PC PhoneHome has been installed, connected to the Internet, a stealth E-Mail is sent to a specified E-Mail address of the user's choice and to PC PhoneHome Product Company.</p> |
| http://www.spyarsenal.com | <p>SpyArsenal Print Monitor Pro: It has following features:</p> <ul style="list-style-type: none"> • Keep track on a printer/plotter usage; • record every document printed; • find out who and when certain paper printed with your hardware. |

4.6 Virus and Worms

Computer virus is a program that can “infect” legitimate programs by modifying them to include a possibly “evolved” copy of itself. Viruses spread themselves, without the knowledge or permission of the users, to potentially large numbers of programs on many machines. A computer virus passes from computer to computer in a similar manner as a biological virus passes from person to person. Viruses may also contain malicious instructions that may cause damage or annoyance; the combination of possibly Malicious Code with the ability to spread is what makes viruses a considerable concern. Viruses can often spread without any readily visible symptoms. A virus can start on event-driven effects (e.g., triggered after a specific number of executions), time-driven effects (e.g., triggered on a specific date, such as Friday the 13th) or can occur at random. Viruses can take some typical actions:

1. Display a message to prompt an action which may set off the virus;
2. delete files inside the system into which viruses enter;
3. scramble data on a hard disk;
4. cause erratic screen behavior;
5. halt the system (PC);
6. just replicate themselves to propagate further harm.

Figures 4.1–4.3 explain how viruses spread (a) through the Internet, (b) through a stand-alone computer system and (c) through local networks.

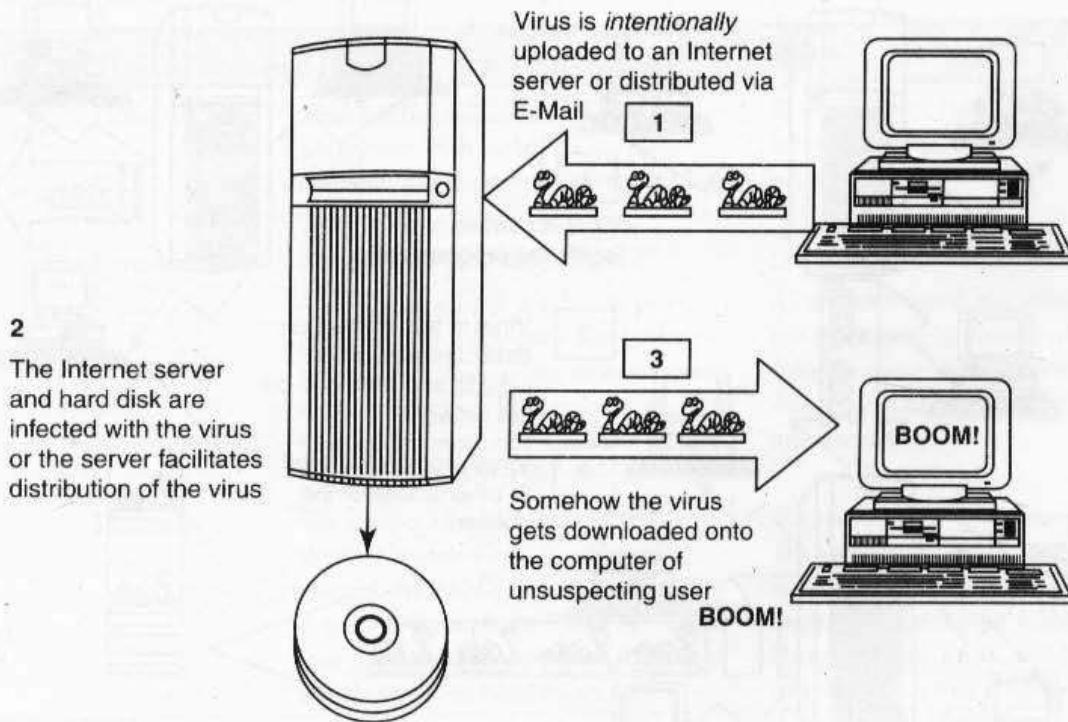


Figure 4.1 | Virus spreads through the Internet.

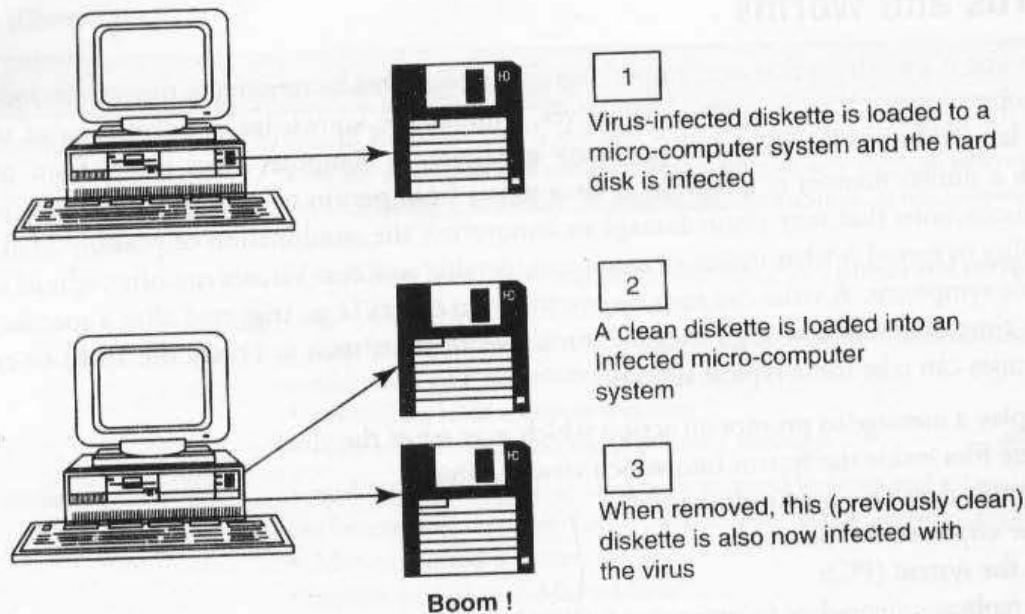


Figure 4.2 | Virus spreads through stand-alone system.

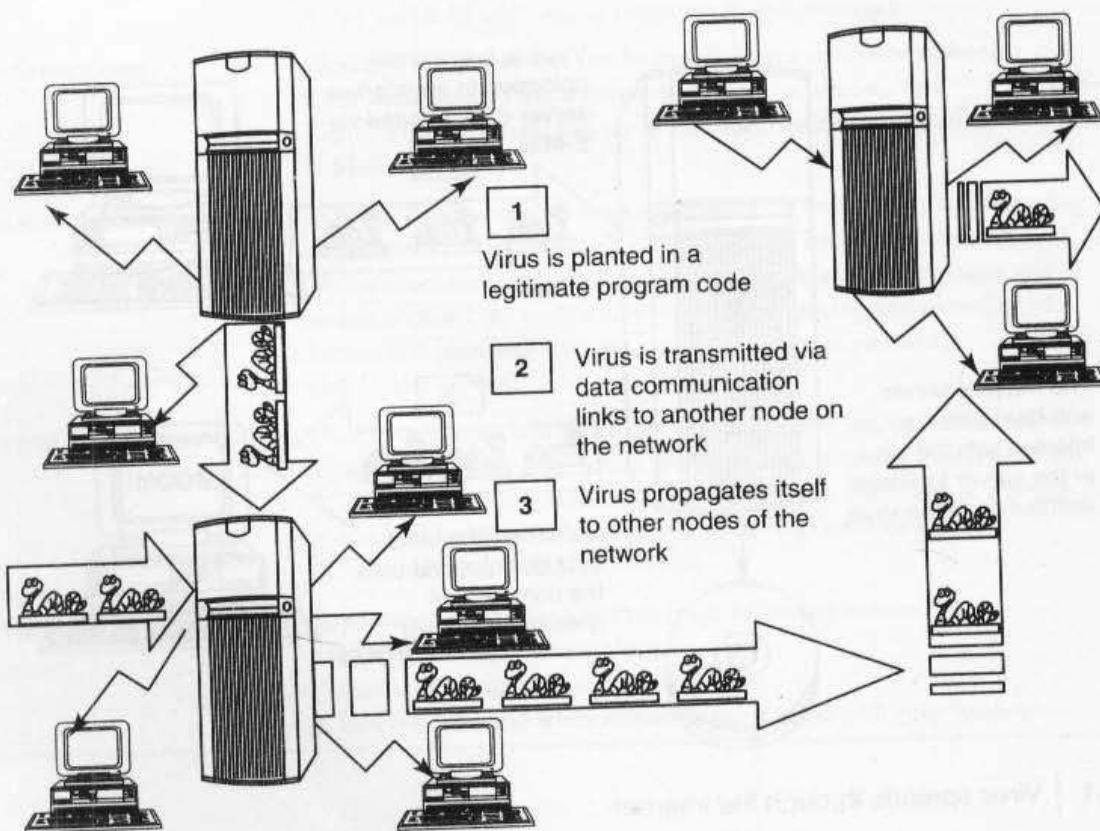


Figure 4.3 | Virus spreads through local networks.

Computer virus has the ability to copy itself and infect the system. The term *virus* is also commonly but erroneously used to refer to other types of malware, Adware and Spyware programs that do not have reproductive ability. A true virus can only spread from one system to another (in some form of executable code) when its host is taken to the target computer; for instance, when a user sent it over the Internet or a network, or carried it on a removable media such as CD, DVD or USB drives. Viruses can increase their chances of spreading to other systems by infecting files on a network file system or a file system that is accessed by another system.^[17]

As explained in earlier sections, the term *computer virus* is sometimes used as a *catch-all phrase* to include all types of malware, Adware and Spyware programs that do not have reproductive ability. Malware includes computer viruses, worms, Trojans, most Rootkits, Spyware, dishonest Adware, crimeware and other malicious and unwanted software as well as true viruses. Viruses are sometimes confused with computer worms and Trojan Horses, which are technically different (see Table 4.7 to understand the difference between computer virus and worm). A worm spreads itself automatically to other computers through networks by exploiting security vulnerabilities, whereas a Trojan is a code/program that appears to be harmless but hides malicious functions. Worms and Trojans, such as viruses, may harm the system's data or performance. Some viruses and other malware have noticeable symptoms that enable computer user to take necessary corrective actions, but many viruses are surreptitious or simply do nothing for user's to take note of them. Some viruses do nothing beyond reproducing themselves.^[17]

Table 4.7 | Difference between computer virus and worm

| Sr. No. | Facet | Virus | Worm |
|---------|-----------------|---|---|
| 1 | Different types | Stealth virus, self-modified virus, encryption with variable key virus, polymorphic code virus, metamorphic code virus | E-Mail worms, instant messaging worms, Internet worms, IRC worms, file-sharing networks worms |
| 2 | Spread mode | Needs a host program to spread | Self, without user intervention |
| 3 | What is it? | A computer virus is a software program that can copy itself and infect the data or information, without the users' knowledge. However, to spread to another computer, it needs a host program that carries the virus | A computer worm is a software program, self-replicating in nature, which spreads through a network. It can send copies through the network with or without user intervention |
| 4 | Inception | The creeper virus was considered as the first known virus. It was spread through ARPANET in the early 1970s. It spreads through the TENEX OS and uses connected modem to dial out to a remote computer and infect it. | The name worm originated from The Shockwave Rider, a science fiction novel published in 1975 by John Brunner. Later researchers John F Shock and Jon A Hupp at Xerox PARC published a paper in 1982, <i>The Worm Programs</i> and after that the name was adopted |
| 5 | Prevalence | Over 100,000 known computer viruses have been there though not all have attacked computers (till 2005) | Prevalence for virus is very high as against moderate prevalence for a worm. |

Source: See [18] in References section.

4.6.1 Types of Viruses

Computer viruses can be categorized^[19] based on attacks on various elements of the system and can put the system and personal data on the system in danger.

1. **Boot sector viruses:** It infects the storage media on which OS is stored (e.g., floppy diskettes and hard drives) and which is used to start the computer system. The entire data/programs are stored on the floppy disks and hard drives in smaller sections called sectors. The first sector is called the BOOT and it carries the master boot record (MBR). MBR's function is to read and load OS, that is, it enables computer system to start through OS. Hence, if a virus attacks an MBR or infects the boot record of a disk, such floppy disk infects victim's hard drive when he/she reboots the system while the infected disk is in the drive. Once the victim's hard drive is infected all the floppy diskettes that are being used in the system will be infected. Boot sector viruses often spread to other systems when shared infected disks and pirated software(s) are used.
2. **Program viruses:** These viruses become active when the program file (usually with extensions .bin, .com, .exe, .ovl, .drv) is excuted (i.e., opened – program is started). Once these program files get infected, the virus makes copies of itself and infects the other programs on the computer system.
3. **Multipartite viruses:** It is a hybrid of a boot sector and program viruses. It infects program files along with the boot record when the infected program is active. When the victim starts the computer system next time, it will infect the local drive and other programs on the victim's computer system.
4. **Stealth viruses:** It camouflages and/or masks itself and so detecting this type of virus is very difficult. It can disguise itself such a way that antivirus software also cannot detect it thereby preventing spreading into the computer system. It alters its file size and conceals itself in the computer memory to remain in the system undetected. The first computer virus, named as Brain, was a stealth virus. A good antivirus detects a stealth virus lurking on the victim's system by checking the areas the virus must have infected by leaving evidence in memory.
5. **Polymorphic viruses:** It acts like a "chameleon" that changes its virus signature (i.e., binary pattern) every time it spreads through the system (i.e., multiplies and infects a new file). Hence, it is always difficult to detect polymorphic virus with the help of an antivirus program. *Polymorphic generators* are the routines (i.e., small programs) that can be linked with the existing viruses. These generators are not viruses but the purpose of these generators is to hide actual viruses under the cloak of polymorphism. The first all-purpose polymorphic generator was the mutation engine (MtE) published in 1991. Other known polymorphic generators are Dark Angel's Multiple Encryptor (DAME), Darwinian Genetic Mutation Engine (DGME), Dark Slayer Mutation Engine (DSME), MutaGen, Guns'n'Roses Polymorphic Engine (GPE) and Dark Slayer Confusion Engine (DSCE).
6. **Macroviruses:** Many applications, such as Microsoft Word and Microsoft Excel, support MACROS (i.e., macrolanguages). These macros are programmed as a macroembedded in a document. Once a macrovirus gets onto a victim's computer then every document he/she produces will become infected. This type of virus is relatively new and may get slipped by the antivirus software if the user does not have the most recent version installed on his/her system.
7. **Active X and Java Control:** All the web browsers have settings about Active X and Java Controls. Little awareness is needed about managing and controlling these settings of a web browser to prohibit and allow certain functions to work – such as enabling or disabling pop-ups, downloading files and sound – which invites the threats for the computer system being targeted by unwanted software(s) floating in cyberspace.

To know more on viruses see Box 4.4 and to know more on the world's worst virus attacks see Table 4.8. As Windows OS is the most used OS across the globe, the lists of viruses displayed in Table 4.8 are the attacks on Windows OS. The terms "Virus" and "Worm" are used interchangeably and hence readers may find that the viruses listed under Table 4.8 may be referred as worms on some websites and/or in some books.

Box 4.4 More about Viruses!

1. The early "hacking" sites that have allowed to download favorite virus are as follows:
 - www.2600.com
 - www.L0pht.com
2. The exhaustive list of viruses can be found at:
[http://en.wikipedia.org/wiki/List_of_computer_viruses_\(all\)](http://en.wikipedia.org/wiki/List_of_computer_viruses_(all))
3. The viruses can attack a system 365 days a year. However, on the designated payload dates, the viruses may do more than just infect the system. Virus calendar can be found at:
<http://home.mcafee.com/virusInfo/VirusCalendar.aspx>
4. **Computer virus hoax:** It is a message warning the recipient of a non-existent computer virus threat. The message is usually a chain E-Mail that tells the recipient to forward it to everyone they know. They often include announcements claimed to be from reputable organizations such as Microsoft, IBM or news sources such as CNN and include emotive language and encouragement to forward the message. These sources are quoted to add credibility to the hoax. The list of virus hoax can be found at:
http://en.wikipedia.org/wiki/Virus_hoax
5. **Unix and Linux OS are immune from computer viruses:** This is a myth that Unix/Linux systems are as susceptible to hostile software attacks as any other systems. However, such systems usually found to be well-protected compared with Microsoft Windows because fast updates are available to most Unix/Linux vulnerabilities. The list of virus/worms found on Unix/Linux systems can be found at:
http://en.wikipedia.org/wiki/Linux_malware

Table 4.8 | The world's worst virus attacks!!!

| Sr. No. | Virus | Brief Description |
|---------|-------------|---|
| 1 | Conficker | It is also known as Downup, Downadup and Kido. It targets Microsoft Windows OS and was first detected in November 2008. It uses flaws in Windows software and dictionary attacks on administrator passwords to co-opt machines and link them into a virtual computer that can be commanded remotely by its authors. The name Conficker is blended from a English term " <i>configure</i> " and the German word " <i>Ficker</i> ," which means "to have sex with" or "to mess with" in colloquial German. |
| 2 | INF/AutoRun | <i>AutoRun</i> and the companion feature <i>AutoPlay</i> are components of the Microsoft Windows OS that dictate what actions the system takes when a drive is mounted. This is the most common threat that infects a PC by creating an "autorun.inf" file. The file contains information about programs meant to run automatically when removable devices are connected to the computer. End-users must disable the AutoRun feature enabled by default in windows. AutoRun functionality is used in attack vector attacks. |

(Continued)

Table 4.8 | (Continued)

| Sr. No. | Virus | Brief Description |
|----------------|---------------------------------------|--|
| 3 | Win32 PSW. OnLineGames | It is a dangerous virus that replicates itself as other viruses and spreads from one computer system to another carrying a payload of destruction. It can infect several computers within few minutes. It is more concerned with gamers around the world, stealing confidential and other financial credentials as well as gaining access to the victim's account. This virus is also termed as Trojan. |
| 4 | Win32/Agent | This virus is also termed as Trojan. It copies itself into temporary locations and steals information from the infected system. It adds entries into the registry, creating several files at different places in the system folder, allowing it to run on every start-up, which enables to gather complete information about the infected system and then transferred to the intruder's system. |
| 5 | Win32/FlyStudio | It is known as Trojan with characteristics of backdoor. This virus does not replicate itself, but spreads only when the circumstances are beneficial. It is called as backdoors because the information stolen from a system is sent back to the intruder. |
| 6 | Win32/Pacex.Gen | This threat designates a wide range of malwares that makes use of an obfuscation layer to steal passwords and other information from the infected system. |
| 7 | Win32/Qhost | This virus copies itself to the System32 folder of the Windows directory giving control of the computer to the attacker. The attacker then modifies the Domain Name Server/System (DNS) settings redirecting the computer to other domains. This is done to compromise the infected machine from downloading any updates and redirect any attempts made to a website that downloads other malicious files on the victim's computer. |
| 8 | WMA/ TrojanDownloader. GetCodec | <p>This threat as the suffix .GetCodec modifies the audio files present on the system to ".wma" format and adds a URL header that points to the location of the new codec. In this manner, the host computer is forced to download the new codec and along with the new codec several other Malicious Codes are also downloaded.</p> <p>This means that the end-user will download the new codec believing that something new might happen, whereas the Malicious Code runs in the background causing harm to the host computer. At present, there is no way to verify the authenticity of the codec being downloaded as a new enhancement or a Trojan Horse; therefore, users must avoid unnecessary downloading of new codecs unless they are downloaded from a trusted website. Unnecessary downloading of codecs should also be avoided.</p> |

Source: <http://www.brighthub.com/computing/smb-security/articles/44811.aspx>

A computer worm is a self-replicating malware computer program.^[20] It uses a computer network to send copies of itself to other nodes (computers on the network) and it may do so without any user intervention. This is due to security shortcomings on the target computer. Unlike a virus, it does not need to attach itself to an existing program. Worms almost always cause at least some harm to the network, if only by consuming bandwidth, whereas viruses almost always corrupt or modify files on a targeted computer.^[18] See Table 4.9 to know more on World's worst worm attacks.

Table 4.9 | The world's worst virus and worm attacks!!!

| <i>Sr. No.</i> | <i>Worm</i> | <i>Brief Description</i> |
|----------------|-------------|---|
| 1 | Morris Worm | <p>It is also known as "Great Worm" or Internet Worm. It was written by a student, Robert Tappan Morris, at Cornell University and launched on 2 November 1988 from MIT. It was reported that around 6,000 major Unix machines were infected by the Morris worm and the total cost of the damage calculated was US\$ 10–100 millions.</p> |
| 2 | ILOVEYOU | <p>It is also known as VBS/Loveletter or Love Bug Worm. It successfully attacked tens of millions of Windows computers in 2000. The E-Mail was sent with the subject line as "ILOVEYOU" and an attachment "LOVE-LETTER-FOR-YOU.TXT.vbs." The file extension "vbs" was hidden, hence the receiver downloads the attachment and opens it to see the contents.</p> |
| 3 | Nimda | <p>It is the most widespread computer worm and a file infector. It can affect Internet's within 22 minutes. Nimda affected both user workstations (i.e., clients) running on Windows 95, 98, Me, NT, 2000 or XP and Servers running on Windows NT and 2000. It is "admin" when this worm's name is spelled backward.</p> |
| 4 | Code Red | <p>This computer worm was observed on the Internet on 13 July 2001. It attacked computers running on Microsoft's IIS web server.</p> <p>The Code Red worm was first discovered and researched by eEye Digital Security employees, Marc Maiffret and Ryan Permeh. They named the worm Code Red because they were drinking Pepsi's "Mountain Dew Code Red" over the weekend. They analyzed it because of the phrase "Hacked by Chinese!" with which the worm defaced websites.</p> <p>On 4 August 2001 "Code Red II" appeared on the Internet and was found to be a variant of the original Code Red worm.</p> |
| 5 | Melissa | <p>It is also known as "Melissa," "Simpsons," "Kwyjibo" or "Kwejeebo." It is a mass-mailing macro worm. Melissa was written by David L. Smith in Aberdeen Township, New Jersey, who named it after a lap dancer he met in Florida. The worm was in a file called "List.DOC" which had passwords that allow the access into 80 pornographic websites. This worm in the original form was sent through an E-Mail to many Internet users. Melissa spread on Microsoft Word 97, Word 2000 and also on Microsoft Excel 97, 2000 and 2003. It can mass-mail itself from E-Mail client Microsoft Outlook 97 or Outlook 98.</p> |
| 6 | MSBlast | <p>The Blaster Worm: It is also known as Lovsan or Lovesan, found during August 2003, which spread across the systems running on Microsoft Windows XP and Windows 2000. The worm also creates an entry under OS registry to launch the worm every time Windows starts. This worm contains two messages hidden in strings. The first, "I just want to say LOVE YOU SAN!!" and so the worm sometimes was called "Lovesan worm." The second message, "Billy gates why do you make this possible? Stop making money and fix your software!!" This message was for Bill Gates, the co-founder of Microsoft and target of the worm.</p> |
| 7 | Sobig | <p>This worm, found during August 2003, infected millions of Internet-connected computers that were running on Microsoft Windows. It was written in Microsoft Visual C++ and compressed using a data compression tool, "tElock." This Worm not only replicates by itself but also a Trojan Horse that it masquerades as something other than malware. It will appear as an E-Mail with one of the following subjects:</p> <ul style="list-style-type: none"> • Re: Approved • Re: Details |

(Continued)

Table 4.9 | (Continued)

| <i>Sr. No.</i> | <i>Worm</i> | <i>Brief Description</i> |
|----------------|--------------|---|
| 8 | Storm Worm | <ul style="list-style-type: none"> • Re: Re: My details • Re: Thank you! • Re: That movie • Re: Wicked screensaver • Re: Your application • Thank you! • Your details <p>It will contain the text as “See the attached file for details” or “Please see the attached file for details.” The E-Mail will also contain an attachment by one of the names mentioned below:</p> <ul style="list-style-type: none"> • application.pif • details.pif • document_9446.pif • document_all.pif • movie0045.pif • thank_you.pif • your_details.pif • your_document.pif • wicked_scr.scr |
| 9 | Michelangelo | <p>This worm, found on 17 January 2007, is also known as a backdoor Trojan Horse that affects the systems running on Microsoft OSs. The Storm worm infected thousands of computer systems in Europe and in the US on Friday, 19 January 2007, through an E-Mail with a subject line about a recent weather disaster, “230 dead as storm batters Europe.”</p> <p>The worm is also known as:</p> <ul style="list-style-type: none"> • Small.dam or Trojan-Downloader.Win32.Small.dam • CME-711 • W32/Nuwar@MM and Downloader-BAI • Troj/Dorf and Mal/Dorf • Trojan.DL.Tibs.Gen!Pac13 • TrojanDownloader-647 • Trojan.Peacomm • TROJ_SMALL.EDW • Win32/Nuwar • Win32/Nuwar.N@MM!CME-711 • W32/Zhelatin • Trojan.Peed, Trojan.Tibs <p>It is a worm discovered in April 1991 in New Zealand. This worm was designed primarily to infect the systems that were running on disk operating system (DOS) systems. Like other boot sector viruses, Michelangelo operated at the BIOS level and remained dormant until 6 March, the birthday of an artist “Michelangelo di Lodovico Buonarroti Simoni” – an Italian Renaissance painter, sculptor, architect and poet.</p> |

(Continued)

Table 4.9 | (Continued)

| Sr. No. | Worm | Brief Description |
|---------|-----------|---|
| 10 | Jerusalem | This worm is also known as "BlackBox." Jerusalem infected the files residing on DOS that was detected in Jerusalem, Israel, in October 1987. It has become memory resident (using 2 KB of memory). Once the system gets infected then it infects every executable file, except "COMMAND.COM." ".COM" files grow by 1,813 bytes when infected by Jerusalem and are not reinfected. Similarly ".EXE" files grow from 1,808 to 1,823 bytes each time they get infected. Jerusalem reinfests ".EXE" files each time the file is loaded until their size is increased that is found to be "too large to load into memory." |

Almost every day new viruses/worms are created and they become new threat to netizens. (See Box 4.4 to know more about viruses.) In summary, in spite of different platforms (i.e., OS and/or applications), a typical definition of computer virus/worms might have various aspects^[21] such as:

1. A virus attacks specific file types (or files).
2. A virus manipulates a program to execute tasks unintentionally.
3. An infected program produces more viruses.
4. An infected program may run without error for a long time.
5. Viruses can modify themselves and may possibly escape detection this way.

4.7 Trojan Horses and Backdoors

Trojan Horse is a program in which malicious or harmful code is contained inside apparently harmless programming or data in such a way that it can get control and cause harm, for example, ruining the file allocation table on the hard disk. A Trojan Horse may get widely redistributed as part of a computer virus.^[22] The term Trojan Horse comes from Greek mythology about the Trojan War (see Box 4.5).

Box 4.5 Trojan War

The Trojan Horse is a tale from the Trojan War, as told in Virgil's Latin epic poem *The Aeneid* Quintus of Smyrna. The events in this story from the Bronze Age took place after Homer's *Iliad* and before his *Odyssey*. It was the stratagem that allowed the Greeks finally to enter the city of Troy and end the conflict. In the best-known version, after a fruitless 10-year siege, the Greeks construct a huge wooden horse in an attempt to once and for all destroy Troy from the inside. According to Quintus, it was Odysseus who came up with the idea of building a great wooden horse in which 30 men could hide to be wheeled into the city without the Trojans knowing. The Greeks build a huge, magnificent wooden horse in 3 days under the leadership of Epeios. Odysseus' plan also calls for one man to remain outside of the horse. This man will act as though the Greeks abandoned him, leaving the horse as a gift for the Trojans. The Greeks chose their soldier Sinon to play this role, as he is the only volunteer. Virgil describes the actual encounter between Sinon and the Trojans; Sinon successfully convinces the Trojans that he has been left behind and the Greeks are gone, and the horse is wheeled inside the city walls as a victory trophy. That night, the Greek soldiers hidden inside the horse emerged and opened the city gates for the rest of the Greek army. They raid and destroy the city of Troy, finally ending the Trojan War.

Source: http://en.wikipedia.org/wiki/Trojan_Horse (11 January 10).

Like Spyware and Adware, Trojans can get into the system in a number of ways, including from a web browser, via E-Mail or in a bundle with other software downloaded from the Internet. It is also possible to inadvertently transfer malware through a USB flash drive or other portable media. It is possible that one could be forced to reformat USB flash drive or other portable device to eliminate infection and avoid transferring it to other machines. (Users would not know that these could infect their network while bringing some music along with them to be downloaded.)

Unlike viruses or worms, Trojans do not replicate themselves but they can be equally destructive. On the surface, Trojans appear benign and harmless, but once the infected code is executed, Trojans kick in and perform malicious functions to harm the computer system without the user's knowledge.

For example, waterfalls.scr is a waterfall screen saver as originally claimed by the author; however, it can be associated with malware and become a Trojan to unload hidden programs and allow unauthorized access to the user's PC.

Visit http://en.wikipedia.org/wiki/List_of_trojan_horses to get the list of noteworthy Trojan Horses. Some typical examples of threats by Trojans^[23] are as follows:

1. They erase, overwrite or corrupt data on a computer.
2. They help to spread other malware such as viruses (by a dropper Trojan).
3. They deactivate or interfere with antivirus and firewall programs.
4. They allow remote access to your computer (by a remote access Trojan).
5. They upload and download files without your knowledge.
6. They gather E-Mail addresses and use them for Spam.
7. They log keystrokes to steal information such as passwords and credit card numbers.
8. They copy fake links to false websites, display porno sites, play sounds/videos and display images.
9. They slow down, restart or shutdown the system.
10. They reinstall themselves after being disabled.
11. They disable the task manager.
12. They disable the control panel.

4.7.1 Backdoor

A backdoor is a means of access to a computer program that bypasses security mechanisms. A programmer may sometimes install a backdoor so that the program can be accessed for troubleshooting or other purposes. However, attackers often use backdoors that they detect or install themselves as part of an exploit. In some cases, a worm is designed to take advantage of a backdoor created by an earlier attack^[24].

A backdoor works in background and hides from the user. It is very similar to a virus and, therefore, is quite difficult to detect and completely disable. A backdoor is one of the most dangerous parasites, as it allows a malicious person to perform any possible action on a compromised system. Most backdoors are autonomic malicious programs that must be somehow installed to a computer. Some parasites do not require installation, as their parts are already integrated into particular software running on a remote host. Programmers sometimes leave such backdoors in their software for diagnostics and troubleshooting purposes. Attackers often discover these undocumented features and use them to intrude into the system.

What a Backdoor Does?

Following are some functions of backdoor^[25]:

1. It allows an attacker to create, delete, rename, copy or edit any file, execute various commands; change any system settings; alter the Windows registry; run, control and terminate applications; install arbitrary software and parasites.

2. It allows an attacker to control computer hardware devices, modify related settings, shutdown or restart a computer without asking for user permission (see Section 7.13.7, Chapter 7).
3. It steals sensitive personal information, valuable documents, passwords, login names, ID details; logs user activity and tracks web browsing habits.
4. It records keystrokes that a user types on a computer's keyboard and captures screenshots.
5. It sends all gathered data to a predefined E-Mail address, uploads it to a predetermined FTP server or transfers it through a background Internet connection to a remote host.
6. It infects files, corrupts installed applications and damages the entire system.
7. It distributes infected files to remote computers with certain security vulnerabilities and performs attacks against hacker-defined remote hosts.
8. It installs hidden FTP server that can be used by malicious persons for various illegal purposes.
9. It degrades Internet connection speed and overall system performance, decreases system security and causes software instability. Some parasites are badly programmed as they waste too many computer resources and conflict with installed applications.
10. It provides no uninstall feature, and hides processes, files and other objects to complicate its removal as much as possible.

Following are a few examples of backdoor Trojans:

1. **Back Orifice:** It is a well-known example of backdoor Trojan designed for remote system administration. It enables a user to control a computer running the Microsoft Windows OS from a remote location. The name is a word play on Microsoft BackOffice Server software. Readers may visit <http://www.cultdeadcow.com/tools/bo.html> to know more about backdoor.
2. **Bifrost:** It is another backdoor Trojan that can infect Windows 95 through Vista. It uses the typical server, server builder and client backdoor program configuration to allow a remote attacker, who uses client, to execute arbitrary code on the compromised machine.
3. **SAP backdoors^[26]:** SAP is an Enterprise Resource Planning (ERP) system and nowadays ERP is the heart of the business technological platform. These systems handle the key business processes of the organization, such as procurement, invoicing, human resources management, billing, stock management and financial planning. Backdoors can present into SAP User Master that supports an authentication mechanism when a user connects to access SAP and ABAP Program Modules which support SAP Business Objects.
4. **Onapsis Bizploit:** It is the open-source ERP penetration testing framework developed by the Onapsis Research Labs. Bizploit assists security professionals in the discovery, exploration, vulnerability assessment and exploitation phases of specialized ERP penetration tests. Readers may visit <http://www.onapsis.com/research.html> to know more about this tool.

4.7.2 How to Protect from Trojan Horses and Backdoors

Follow the following steps to protect your systems from Trojan Horses and backdoors:

1. **Stay away from suspect websites/weblinks:** Avoid downloading free/pirated softwares that often get infected by Trojans, worms, viruses and other things. We have addressed "how to determine a legitimate website" in Chapter 5.
2. **Surf on the Web cautiously:** Avoid connecting with and/or downloading any information from peer-to-peer (P2P) networks, which are most dangerous networks to spread Trojan Horses and other threats. P2P networks create files packed with malicious software, and then rename them to files with the criteria of common search that are used while surfing the information on the Web.

(See Box 4.6 to know more on P2P networks.) It may be experienced that, after downloading the file, it never works and here is a threat that – although the file has not worked, something must have happened to the system – the malicious software deploys its gizmos and the system is at serious health risk. Enabling Spam filter “ON” is a good practice but is not 100% foolproof, as spammers are constantly developing new ways to get through such filters.

3. **Install antivirus/Trojan remover software:** Nowadays antivirus software(s) have built-in feature for protecting the system not only from viruses and worms but also from malware such as Trojan Horses. Free Trojan remover programs are also available on the Web and some of them are really good.

Box 4.6 Peer-to-Peer (P2P) Networks

Peer-to-peer, commonly abbreviated as P2P, is any distributed network architecture composed of participants that make a portion of their resources (such as processing power, disk storage or network bandwidth) directly available to other network participants, without the need for central coordination instances (such as servers or stable hosts). Peers are both suppliers and consumers of resources, in contrast to the traditional client-server model where only servers supply and clients consume.^[27] There are different levels of P2P networking^[28]:

1. **Hybrid P2P:** There is a central server that keeps information about the network. The peers are responsible for storing the information. If they want to contact another peer, they query the server for the address.
2. **Pure P2P:** There is absolutely no central server or router. Each peer acts as both client and server at the same time. This is also sometimes referred to as “serverless” P2P.
3. **Mixed P2P:** It is between “hybrid” and “pure” P2P networks. An example of such a network is Gnutella that has no central server but clusters its nodes around so-called “supernodes.”

Advantages of P2P Networks

1. It enables faster delivery of information from one computer to another by bypassing a central server.
2. It increases personal efficiency and personal empowerment. Users will no longer have to wait in queues to perform essential tasks, as all activities take place at the user's discretion.
3. It represents significant cost savings over client/server models. As resources and computing power are distributed across the entire network, there is no need for expensive centralized servers; this will reduce the need for centralized management, storage and other related resources.
4. It offers easy scalability and all that is necessary for a network to grow is add more peers.
5. It increases a network's fault tolerance. As no part of the system is essential to its operation, you can take down a few nodes and the network remains functional.
6. It leverages previously unused resources found on hundreds of millions of computers (and other services) that are connected to the “edges” of the Internet.
7. It frees up bandwidth on the Internet (or on a private network). In traditional client-server model, the server is the bottleneck and often cannot handle everything the client requests.
8. It requires no centralized management, oversight or control.
9. It offers increased privacy, as all data and messages are directly exchange between two computers.
10. It results in networks that are more flexible and adaptable compared with traditional client-server networks.

Besides all these advantages, there are still many reasons why P2P might not be the right model and is used only for specific set of activities.

Box 4.6 Peer-to-Peer . . . (Continued)

Drawbacks of P2P Networks

1. It propagates all sorts of undesirable items and activities including misinformation.
2. It increases network's, an individual system's, exposure to network attacks, viruses and other malicious damage.
3. It makes no guarantee that content/resources will always be available – any peer can go "dark" if he/she shuts down his/her computer.
4. It does not enforce content ownership (copyright).
5. It cannot enforce standards (either technological or ethical/moral/social).
6. It can be overwhelmed by increased traffic when it is unprepared (Napster uses many clogged university networks).
7. It is plagued by lack of standards, infrastructure and support. It is a kind of "Wild West" of the Internet.
8. Its transactions are difficult to translate into revenues streams and this lack of revenue generation could hinder its future development.

Ares, BitTorrent, Limewire and Kazaa are a few examples of popular P2P file-sharing programs. Readers may visit <http://www.bestsecuritytips.com/xfsection+article.articleid+49.htm> to know more on these popular P2P file-sharing programs.

Source: www.bus.ucf.edu/leigh/ism5937/linked/Ledesma_J.doc (17 May 2010).

4.8 Steganography

Steganography is a Greek word that means “sheltered writing.” It is a method that attempts to hide the existence of a message or communication. The word “steganography” comes from the two Greek words: stegano meaning “covered” and graphein meaning “to write” that means “concealed writing.” This idea of data hiding is not a novelty; it has been used for centuries all across the world under different regimes. The practice dates back to ancient Rome and Greece where the messages were etched into wooden tablets and then covered with wax or when messages were passed by shaving a messenger’s head and then tattooing a secret message on it, letting his hair grow back and then shaving it again after he arrived at the receiving party to reveal the message.

Given the sheer volume of data stored and transmitted electronically in the world today, it is no surprise that countless methods of protecting such data have evolved. One lesser known but rapidly growing method is steganography, the art and science of hiding information so that it does not even appear to exist! Steganography is always misunderstood with cryptography (see Box 4.7 to know difference between these two techniques). The different names for steganography are data hiding, information hiding (explained in Section 7.12.2, Chapter 7) and digital watermarking.

For example, in a digital image the least significant bit of each word can be used to comprise a message without causing any significant change in the image. Steganography can be used to make a digital watermark to detect illegal copying of digital images. Thus, it aids confidentiality and integrity of the data. *Digital watermarking* is the process of possibly irreversibly embedding information into a digital signal. The signal may be, for example, audio, pictures or video. If the signal is copied then the information is also carried in the copy.^[29]

Box 4.7 Difference between Steganography and Cryptography

Steganography is the art and science of writing hidden messages in such a way that no one apart from the intended recipient knows the existence of the message; this is in contrast to cryptography, where the existence of the message itself is not disguised, but the content is obscured. It is said that terrorists use steganography techniques to hide their communication in images on the Internet; most popular images are used such as those of film actresses or other celebrities. In its basic form, steganography is simple. For example, say every fourth letter of a memo could hide a message. This simple technique has an added advantage over encryption that it does not arouse suspicion, that is, there is not much scope for getting started an investigation! Presence of an encryption could set off an investigation, but a message hidden in plain sight would get ignored (see Box 7.13, Chapter 7).

In October 2001, the New York Times published an article claiming that al-Qaeda had used steganographic techniques to encode messages into images, and then transported these via E-Mail and possibly via Usenet to prepare and execute the 11 September 2001 Terrorist Attack.^[30]

The term “cover” or “cover medium” is used to describe the original, innocent message, data, audio, still, video and so on. It is the medium that hides the secret message (see Fig. 4.4). It must have parts that can be altered or used without damaging or noticeably changing the cover media. If the cover media are digital, these alterable parts are called “redundant bits.” These bits or a subset can be replaced with the message that is intended to be hidden. Interestingly, steganography in digital media is very similar to “digital watermarking.” In other words, when steganography is used to place a hidden “trademark” in images, music and software, the result is a technique referred to as “watermarking” (see Table 4.10 to know more about steganography tools).

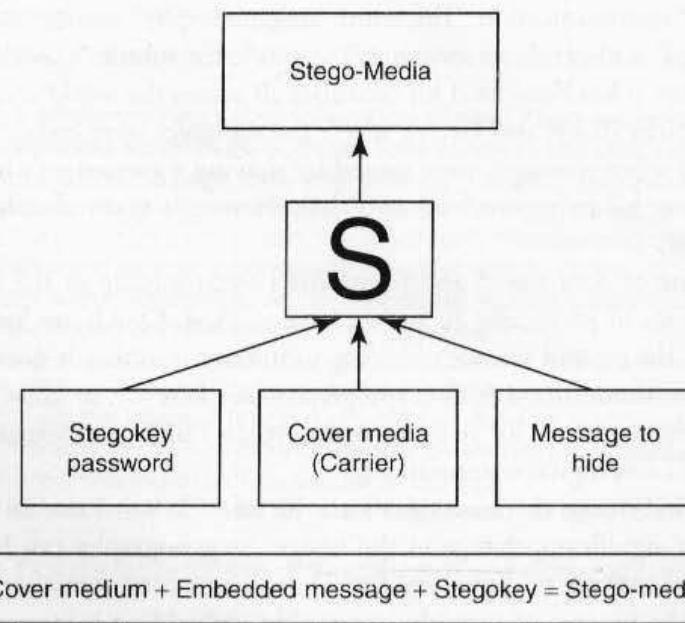


Figure 4.4 How steganography works.

Source: <http://www.cosc.iup.edu/sezekiel/Seminar/steg.ppt#452,15,Steganography%20of%20today's%20talk> (11 May 10).

Table 4.10 | Steganography tools

| <i>Website</i> | <i>Brief Description</i> |
|---|---|
| http://www.securityfocus.com | DiSi-Steganograph: It is a very small, DOS-based steganographic program that embeds data in PCX images. |
| http://www.brothersoft.com/invisible-folders-54597.html | Invisible Folders: It has the ability to make any file or folder invisible to anyone using your PC even on a network. |
| http://www.invisiblesecrets.com | Invisible Secrets: It not only encrypts the data and files for safe-keeping or for secure transfer across the Net but also hides them in places such as picture or sound files or webpages. These types of files are a perfect disguise for sensitive information. |
| http://www.programurl.com/stealth-files.htm | Stealth Files: It hides any type of file in almost any other type of file. Using steganography technique, Stealth Files compresses, encrypts and then hides any type of file inside various types of files (including EXE, DLL, OCX, COM, JPG, GIF, ART, MP3, AVI, WAV, DOC, BMP) and other types of video, image and executable files. |
| http://www.programurl.com/hermetic-stego.htm | Hermetic Stego: It is a steganography program that allows to encrypt and hide contents of any data file in another file so that the addition of the data to the container file will not noticeably change the appearance of that file. This program allows hiding a file of any size in one or more BMP image files with or without the use of a user-specified stego/encryption key so that (a) the presence of the hidden file is undetectable (even by forensic software using statistical methods) and (b) if a user-specified stego key is used then the hidden file can be extracted only by someone, using this software, who knows that stego key. |
| http://www.securstar.com/products_drivecryptpp.php | DriveCrypt Plus (DCPP): It has following features: <ul style="list-style-type: none"> • It allows secure hiding of an entire OS inside the free space of another OS. • Full-disk encryption (encrypts parts or 100% of your hard disk including the OS). • Preboot authentication (before the machine boots, a password is requested to decrypt the disk and start your machine). |
| http://www.petitcolas.net/fabien/steganography/mp3stego | MP3Stego: It hides information in MP3 files during the compression process. The data is first compressed, encrypted and then hidden in the MP3 bit stream. |
| http://compression.ru/video/stego_video/index_en.html | MSU StegoVideo: It allows hiding any file in a video sequence. Main features are as follows: <ul style="list-style-type: none"> • Small video distortions after hiding information. • It is possible to extract information after video compression. • Information is protected with the password. |



Steganography, Sudoku Puzzle and SMS: It is a revised version of information hiding (i.e., steganography) using Sudoku puzzle. This methodology was proposed by Chang et al. during 2008, which was inspired by Zhang and Wang's method and Sudoku solutions. Sudoku game has gained popularity recently and SMS is a popular medium of communication nowadays – messages are concealed into Sudoku puzzle, which are then communicated to intended recipient through SMS. As soon as recipient solves the puzzle, he/she can extract the data hidden into Sudoku puzzle image.

4.8.1 Steganalysis

Steganalysis is the art and science of detecting messages that are hidden in images, audio/video files using steganography. The goal of steganalysis is to identify suspected packages and to determine whether or not they have a payload encoded into them, and if possible recover it. Automated tools are used to detect such steganographed data/information hidden in the image and audio and/or video files (see Table 4.11 for more details).

4.9 DoS and DDoS Attacks

A denial-of-service attack (DoS attack) or distributed denial-of-service attack (DDoS attack) is an attempt to make a computer resource (i.e., information systems) unavailable to its intended users.

4.9.1 DoS Attacks

In this type of criminal act, the attacker floods the bandwidth of the victim's network or fills his E-Mail box with Spam mail depriving him of the services he is entitled to access or provide. Although the means to carry out, motives for, and targets of a DoS attack may vary, it generally consists of the concerted efforts of a person or people to prevent the Internet site or service from functioning efficiently or at all, temporarily or indefinitely. The attackers typically target sites or services hosted on high-profile web servers such as banks, credit card payment gateways, mobile phone networks and even root name servers (i.e., domain name

Table 4.11 | Steganalysis tools

| Website | Brief Description |
|---|--|
| http://www.sarc-wv.com/products/stegalyzeras.aspx | StegAlyzerAS: It is a digital forensic analysis tool designed to scan "suspect media" or "forensic images" of suspect media for known artifacts of steganography applications. |
| http://www.sarc-wv.com/stegalyzerss.aspx | StegAlyzerSS: It is a digital forensic analysis tool designed to scan "suspect media" or "forensic images" of suspect media for uniquely identifiable hexadecimal byte patterns, or known signatures, left inside files when particular steganography applications are used to embed hidden information within them. |
| http://www.spy-hunter.com/stegspydownload.htm | StegSpy: It is a program that is always in progress and the latest version includes identification of a "steganized" file. It detects steganography and the program used to hide the message. The latest version also identifies the location of the hidden content as well. StegSpy identifies programs such as Hiderman, JPHideandSeek, Masker, JpegX and Invisible Secrets. |
| http://www.outguess.org/detection.php | Stegdetect: It is an automated tool for detecting steganographic content in the images. It is capable of detecting several different steganographic methods to embed hidden information in JPEG images. |
| http://stegsecret.sourceforge.net | Stegsecret: It is a steganalysis open-source project that makes detection of hidden information possible in different digital media. It is a JAVA-based multiplatform steganalysis tool that allows the detection of hidden information by using the most known steganographic methods. |
| http://sourceforge.net/projects/vsl | Virtual Steganographic Laboratory (VSL): It is a graphical block diagramming tool that allows complex using, testing and adjusting of methods both for image steganography and steganalysis. |

servers). Buffer overflow technique is employed to commit such kind of criminal attack known as *Spoofing*. The term IP address Spoofing refers to the creation of IP packets with a forged (spoofed) source IP address with the purpose of concealing the ID of the sender or impersonating another computing system. A packet is a formatted unit of data carried by a packet mode computer network. The attacker spoofs the IP address and floods the network of the victim with repeated requests. As the IP address is fake, the victim machine keeps waiting for response from the attacker's machine for each request. This consumes the bandwidth of the network which then fails to serve the legitimate requests and ultimately breaks down.

The United States Computer Emergency Response Team defines symptoms of DoS attacks to include:

1. Unusually slow network performance (opening files or accessing websites);
2. unavailability of a particular website;
3. inability to access any website;
4. dramatic increase in the number of Spam E-Mails received (this type of DoS attack is termed as an E-Mail bomb).

The goal of DoS is not to gain unauthorized access to systems or data, but to prevent intended users (i.e., legitimate users) of a service from using it. A DoS attack may do the following:

1. Flood a network with traffic, thereby preventing legitimate network traffic.
2. Disrupt connections between two systems, thereby preventing access to a service.
3. Prevent a particular individual from accessing a service.
4. Disrupt service to a specific system or person.

4.9.2 Classification of DoS Attacks

See Table 4.12 for classification of DoS attacks.

Table 4.12 | Classification of DoS attacks

| Sr. No. | DoS Attacks | Brief Description |
|---------|--------------------------|--|
| 1 | Bandwidth attacks | Loading any website takes certain time. Loading means complete webpage (i.e., with entire content of the webpage – text along with images) appearing on the screen and system is awaiting user's input. This "loading" consumes some amount of memory. Every site is given with a particular amount of bandwidth for its hosting, say for example, 50 GB. Now if more visitors consume all 50 GB bandwidth then the hosting of the site can ban this site. The attacker does the same – he/she opens 100 pages of a site and keeps on refreshing and consuming all the bandwidth, thus, the site becomes out of service. |
| 2 | Logic attacks | These kind of attacks can exploit vulnerabilities in network software such as web server or TCP/IP stack. |
| 3 | Protocol attacks | Protocols here are rules that are to be followed to send data over network. These kind of attacks exploit a specific feature or implementation bug of some protocol installed at the victim's system to consume excess amounts of its resources. |
| 4 | Unintentional DoS attack | This is a scenario where a website ends up denied not due to a deliberate attack by a single individual or group of individuals, but simply due to a sudden enormous spike in popularity. This can happen when an extremely popular website posts a prominent link to a second, less well-prepared site, for example, as part of a news story. The result is that a significant proportion of the primary sites regular users', potentially hundreds of thousands of people, click that link within a few hours and have the same effect on the target website as a DDoS attack. |

4.9.3 Types or Levels of DoS Attacks

There are several types or levels of DoS attacks as follows:

- Flood attack:** This is the earliest form of DoS attack and is also known as *ping flood*. It is based on an attacker simply sending the victim overwhelming number of ping packets, usually by using the “ping” command, which result into more traffic than the victim can handle. This requires the attacker to have a faster network connection than the victim (i.e., access to greater bandwidth than the victim). It is very simple to launch, but to prevent it completely is the most difficult.
- Ping of death attack:** The ping of death attack sends oversized Internet Control Message Protocol (ICMP) packets, and it is one of the core protocols of the IP Suite. It is mainly used by networked computers’ OSs to send error messages indicating (e.g., that a requested service is not available or that a host or router could not be reached) datagrams (encapsulated in IP packets) to the victim. The maximum packet size allowed is of 65,536 octets. Some systems, upon receiving the oversized packet, will crash, freeze or reboot, resulting in DoS (e.g., the ping of death attack relied on a bug in the Berkeley TCP/IP stack, which also existed on most systems that copied the Berkeley network code).
- SYN attack:** It is also termed as *TCP SYN Flooding*. In the Transmission Control Protocol (TCP), handshaking of network connections is done with SYN and ACK messages. An attacker initiates a TCP connection to the server with an SYN (using a legitimate or spoofed source address). The server replies with an SYN-ACK. The client then does not send back an ACK, causing the server (i.e., target system) to allocate memory for the pending connection and wait. This fills up the buffer space for SYN messages on the target system, preventing other systems on the network from communicating with the target system. Figure 4.5 explains how the DoS attack takes place.

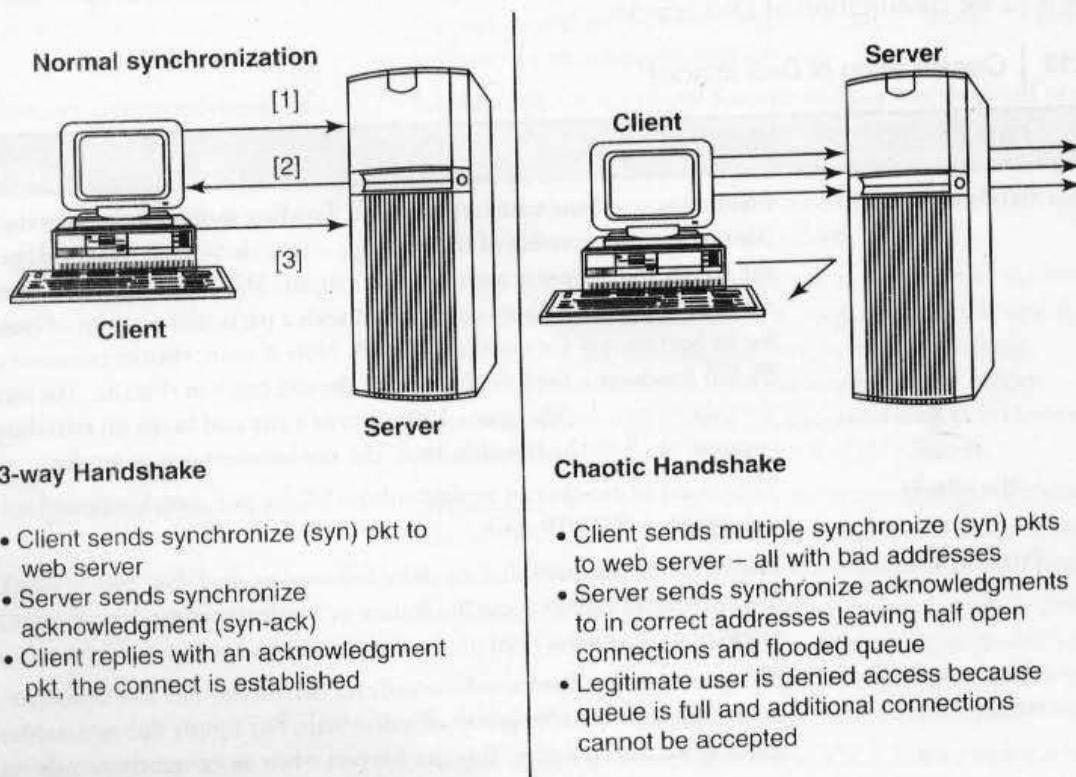


Figure 4.5 | Denial-of-service (DoS) attack.

4. **Teardrop attack:** The teardrop attack is an attack where fragmented packets are forged to overlap each other when the receiving host tries to reassemble them. IP's packet fragmentation algorithm is used to send corrupted packets to confuse the victim and may hang the system. This attack can crash various OSs due to a bug in their TCP/IP fragmentation reassembly code. Windows 3.1x, Windows 95 and Windows NT OSs as well as versions of Linux (i.e., prior to versions 2.0.32 and 2.1.63) are vulnerable to this attack.^[31]
5. **Smurf attack:** It is a way of generating significant computer network traffic on a victim network. This is a type of DoS attack that floods a target system via spoofed broadcast ping messages. This attack consists of a host sending an ICMP echo request (ping) to a network broadcast address (e.g., network addresses with the host portion of the address having all 1s). Every host on the network receives the ICMP echo request and sends back an ICMP echo response inundating the initiator with network traffic. On a multi-access broadcast network, hundreds of machines might reply to each packet. This creates a magnified DoS attack of ping replies, flooding the primary victim. Internet relay chat (IRC) servers are the primary victim of smurf attacks on the Internet [(IRC is a form of real-time Internet text messaging (chat) or synchronous conferencing)].
6. **Nuke:** Nuke^[32] is an old DoS attack against computer networks consisting of fragmented or otherwise invalid ICMP packets sent to the target. It is achieved by using a modified ping utility to repeatedly send this corrupt data, thus slowing down the affected computer until it comes to a complete stop. A specific example of a nuke attack that gained some prominence is the WinNuke, which exploited the vulnerability in the NetBIOS handler in Windows 95. A string of out-of-band data was sent to TCP port 139 of the victim's machine, causing it to lock up and display a *Blue Screen of Death* (BSOD).

4.9.4 Tools Used to Launch DoS Attack

Various tools (see Table 4.13) use different types of traffic to flood a victim, but the objective behind the attack and the result is the same: A service on the system or the entire system (i.e., application/website/network) is unavailable to a user because it is kept busy trying to respond to an exorbitant number of requests. A DoS attack is usually an attack of last resort because it is considered to be an unsophisticated attack as the attacker does not gain access to any information but rather annoys the target and interrupts the service. (See Box 4.8 to know more about blended threats and Box 4.9 for PDoS attacks.)

Table 4.13 | Tools used to launch DoS attack

| Sr. No. | Tool | Brief Description |
|---------|--------------|--|
| 1 | Jolt2 | A major vulnerability has been discovered in Windows' networking code. The vulnerability allows remote attackers to cause a DoS attack against Windows-based machines – the attack causes the target machine to consume 100% of the CPU time on processing of illegal packets. |
| 2 | Nemesy | This program generates random packets of spoofed source IP to enable the attacker to launch DoS attack. |
| 3 | Targa | It is a program that can be used to run eight different DoS attacks. The attacker has the option to launch either individual attacks or try all the attacks until one is successful. |
| 4 | Crazy Pinger | This tool could send large packets of ICMP to a remote target network. |
| 5 | SomeTrouble | It is a remote flooder and bomber. It is developed in Delphi. |

Box 4.8 Blended Threat

Blended threat is a more sophisticated attack that bundles some of the worst aspects of viruses, worms, Trojan Horses and Malicious Code into one single threat. Blended threats can use server and Internet vulnerabilities to initiate, transmit and thereafter spread an attack. Characteristics of blended threats are that

1. They cause harm to the infected system or network.
2. They propagate using multiple methods as attack may come from multiple points.
3. They also exploit vulnerabilities.

To be considered a blended threat, the attack would normally serve to transport multiple attacks in one payload. For example, it would not only just launch a DoS attack but it would also, for example, install a backdoor and maybe even damage a local system in one shot. Additionally, blended threats are designed to use multiple modes of transport. Therefore, while a worm may travel and spread through E-Mail, a single blended threat could use multiple routes including E-Mail, IRC and file-sharing networks.

Finally, rather than a specific attack on predetermined ".exe" files, a blended threat could do multiple malicious acts, such as modify your ".exe" files, HTML files and registry keys at the same time – basically it can cause damage to several areas of your network at one time.

Blended threats are considered to be the worst risk to security since the inception of viruses, as most blended threats require no human intervention to propagate.

Source: <http://www.webopedia.com/didyouknow/internet/2004/virus.asp> (11 January 2010).

Box 4.9 Permanent Denial-of-Service (PDoS) Attack

A PDoS attack damages a system so badly that it requires replacement or reinstallation of hardware. Unlike DDoS attack – which is used to sabotage a service or website or as a cover for malware delivery – PDoS is a pure hardware sabotage. It exploits security flaws that allow remote administration on the management interfaces of the victim's hardware, such as routers, printers or other networking hardware. The attacker uses these vulnerabilities to replace a device's firmware with a modified, corrupt or defective firmware image – a process which when done legitimately is known as flashing. Owing to these features, and the potential and high probability of security exploits on network-enabled-embedded devices (NEEDs), this technique has come to the attention of numerous hacker communities. PhlashDance is a tool created by Rich Smith (an employee of Hewlett-Packard's Systems Security Lab) who detected and demonstrated PDoS vulnerabilities at the 2008 EUsecWest Applied Security Conference in London.

Source: http://en.wikipedia.org/wiki/Denial-of-service_attack (11 May 2010).

4.9.5 DDoS Attacks

In a DDoS attack, an attacker may use your computer to attack another computer. By taking advantage of security vulnerabilities or weaknesses, an attacker could take control of your computer. He/she could then force your computer to send huge amounts of data to a website or send Spam to particular E-Mail addresses. The attack is "distributed" because the attacker is using multiple computers, including yours, to launch the DoS attack.

A DDoS attack is a distributed DoS wherein a large number of zombie systems are synchronized to attack a particular system. The zombie systems (as explained in Chapter 1) are called "secondary victims" and the main target is called "primary victim."

Table 4.14 | Tools used to launch DDoS attack

| Sr. No. | Tool | Brief Description |
|---------|---------------------------|--|
| 1 | Trinoo | It is a set of computer programs to conduct a DDoS attack. It is believed that Trinoo networks have been set up on thousands of systems on the Internet that have been compromised by remote buffer overrun exploit. |
| 2 | Tribe Flood Network (TFN) | It is a set of computer programs to conduct various DDoS attacks such as ICMP flood, SYN flood, UDP flood and Smurf attack. |
| 3 | Stacheldraht | It is written by Random for Linux and Solaris systems, which acts as a DDoS agent. It combines features of Trinoo with TFN and adds encryption. |
| 4 | Shaft | This network looks conceptually similar to a Trinoo; it is a packet flooding attack and the client controls the size of the flooding packets and duration of the attack. |
| 5 | MStream | It uses spoofed TCP packets with the ACK flag set to attack the target. Communication is not encrypted and is performed through TCP and UDP packets. Access to the handler is password protected. This program has a feature not found in other DDoS tools. It informs all connected users of access, successful or not, to the handler(s) by competing parties. |

Malware can carry DDoS attack mechanisms – one of the better-known examples of this is MyDoom. Typically, DoS mechanism triggered on a specific date and time. This type of DDoS attacks involves hardcoding the target IP address prior to release of the malware, hence no further interaction is necessary to launch the attack. A system may also be compromised with a Trojan, allowing the attacker to download a zombie agent. Nowadays, Botnet (as explained in Chapter 2) is the popular medium to launch DoS/DDoS attacks. Attackers can also break into systems using automated tools (see Table 4.14) that exploit flaws in programs that listen for connections from remote hosts.

4.9.6 How to Protect from DoS/DDoS Attacks

Computer Emergency Response Team Coordination Center (CERT/CC) offers many preventive measures from being a victim of DoS attack.^[33]

1. Implement router filters. This will lessen your exposure to certain DoS attacks.
2. If such filters are available for your system, install patches to guard against TCP SYN flooding.
3. Disable any unused or inessential network service. This can limit the ability of an attacker to take advantage of these services to execute a DoS attack.
4. Enable quota systems on your OS if they are available.
5. Observe your system's performance and establish baselines for ordinary activity. Use the baseline to gauge unusual levels of disk activity, central processing unit (CPU) usage or network traffic.
6. Routinely examine your physical security with regard to your current needs.
7. Use Tripwire or a similar tool to detect changes in configuration information or other files (see Table 4.15).
8. Invest in and maintain “hot spares” – machines that can be placed into service quickly if a similar machine is disabled.
9. Invest in redundant and fault-tolerant network configurations.
10. Establish and maintain regular backup schedules and policies, particularly for important configuration information.
11. Establish and maintain appropriate password policies, especially access to highly privileged accounts such as Unix root or Microsoft Windows NT Administrator.

Table 4.15 | Tools for detecting DoS/DDoS attacks

| Sr. No. | Tool | Brief Description |
|---------|--|---|
| 1 | Zombie Zapper | It is a free, open-source tool that can tell a zombie system flooding packets to stop flooding. It works against Trinoo, TFN and Stacheldraht. It assumes various defaults are still in place used by these attack tools, however, it allows you to put the zombies to sleep. |
| 2 | Remote Intrusion Detector (RID) | It is a tool developed in "C" computer language, which is a highly configurable packet snooper and generator. It works by sending out packets defined in the config.txt file, then listening for appropriate replies. It detects the presence of Trinoo, TFN or Stacheldraht clients. |
| 3 | Security Auditor's Research Assistant (SARA) | It gathers information about remote hosts and networks by examining network services. This includes information about the network information services as well as potential security flaws such as incorrectly set up or configured network services, well-known bugs in the system or network utilities system software vulnerabilities listed in the Common Vulnerabilities and Exposures (CVE) database and weak policy decisions. |
| 4 | Find_DDoS | It is a tool that scans a local system that likely contains a DDoS program. It can detect several known DoS attack tools. |
| 5 | DDoSPing | It is a remote network scanner for the most common DDoS programs. It can detect Trinoo, Stacheldraht and Tribe Flood Network programs running with their default settings. |



Computer Emergency Response Team Coordination Center (CERT/CC) was started in December 1988 by the Defense Advanced Research Projects Agency, which was part of the US Department of Defense, after the Morris Worm disabled about 10% of all computers connected to the Internet. It is located at the Software Engineering Institute, a federally funded research center operated by Carnegie Mellon University. It studies Internet security vulnerabilities and provides services to websites that have been attacked. It also publishes security alerts.

Source: <http://www.webopedia.com/TERM/C/CERTCC.html> (31 May 2010).

4.10 SQL Injection

Structured Query Language (SQL) is a database computer language designed for managing data in relational database management systems (RDBMS). SQL injection is a code injection technique that exploits a security vulnerability occurring in the database layer of an application. The vulnerability is present when user input is either filtered incorrectly for string literal escape characters embedded in SQL statements or user input is not strongly typed and thereby unexpectedly executed. It is an instance of a more general class of vulnerabilities that can occur whenever one programming or scripting language is embedded inside another. SQL injection attacks are also known as SQL insertion attacks.^[34]

Attackers target the SQL servers – common database servers used by many organizations to store confidential data. The prime objective behind SQL injection attack is to obtain the information while accessing a database table that may contain personal information such as credit card numbers, social security numbers or passwords. During an SQL injection attack, Malicious Code is inserted into a web form

field or the website's code to make a system execute a command shell or other arbitrary commands. Just as a legitimate user enters queries and additions to the SQL database via a web form, the attacker can insert commands to the SQL server through the same web form field. For example, an arbitrary command from an attacker might open a command prompt or display a table from the database. This makes an SQL server a high-value target and therefore a system seems to be very attractive to attackers.

The attacker determines whether a database and the tables residing into it are vulnerable, before launching an attack. Many webpages take parameters from web user and make SQL query to the database. For example, when a user logs in with username and password, an SQL query is sent to the database to check if a user has valid name and password. With SQL injection, it is possible for an attacker to send crafted username and/or password field that will change the SQL query.

4.10.1 Steps for SQL Injection Attack

Following are some steps for SQL injection attack:

1. The attacker looks for the webpages that allow submitting data, that is, login page, search page, feedback, etc. The attacker also looks for the webpages that display the HTML commands such as POST or GET by checking the site's source code.
2. To check the source code of any website, right click on the webpage and click on "view source" (if you are using IE – Internet Explorer) – source code is displayed in the notepad. The attacker checks the source code of the HTML, and look for "FORM" tag in the HTML code. Everything between the <FORM> and </FORM> have potential parameters that might be useful to find the vulnerabilities.
`<FORM action=Search/search.asp method=post>`
`<input type=hidden name=A value=C>`
`</FORM>`
3. The attacker inputs a *single quote* under the text box provided on the webpage to accept the user-name and password. This checks whether the user-input variable is sanitized or interpreted literally by the server. If the response is an error message such as *use "a" = "a"* (or something similar) then the website is found to be susceptible to an SQL injection attack.
4. The attacker uses SQL commands such as SELECT statement command to retrieve data from the database or INSERT statement to add information to the database.

Here are few examples of variable field text the attacker uses on a webpage to test for SQL vulnerabilities:

1. *Blah' or 1=1--*
2. *Login:blah' or 1=1--*
3. *Password::blah' or 1=1--*
4. *http://search/index.asp?id=blah' or 1=1--*

Similar SQL commands may allow bypassing of a login and may return many rows in a table or even an entire database table because the SQL server is interpreting the terms literally. The double dashes near the end of the command tell SQL to ignore the rest of the command as a comment.

Blind SQL Injection

Blind SQL injection^[34] is used when a web application is vulnerable to an SQL injection but the results of the injection are not visible to the attacker. The page with the vulnerability may not be the one that displays data; however, it will display differently depending on the results of a logical statement injected into the legitimate SQL statement called for that page. This type of attack can become time-intensive because a new statement must be crafted for each bit recovered. There are several tools that can automate these attacks once the location

of the vulnerability and the target information have been established. Readers may refer to Ref. #7, Additional Useful Web References, Further Reading to know about white paper.

In summary, using SQL injections, attackers can:

1. Obtain some basic information if the purpose of the attack is reconnaissance
 - To get a directory listing: Blah' ;exec master..xp_cmdshell "dir c:*.* /s >c:\directory.txt";
 - To ping an IP address: Blah' ;exec master..xp_cmdshell "ping 192.168.1.1".
2. May gain access to the database by obtaining username and their password
 - To get a user listing: SELECT * FROM users WHERE name = "OR '1' = '1'."
3. Add new data to the database
 - Execute the INSERT command: This may enable selling politically incorrect items on an E-Commerce website.
4. Modify data currently in the database
 - Execute the UPDATE command: May be used to have an expensive item suddenly be deeply “discounted.”



mySQLenum: It is a command line automatic blind SQL injection tool for web application that uses MySQL server as its back-end. The main objective of this tool is to provide an easy-to-use command line interface. Readers may visit <http://pentestit.com/2010/01/15/myslenum-automatic-blind-sql-injection-tool/> to know more on this tool.

See Table 4.16 to know some automated tools that are used either to find database vulnerabilities and/or to protect the database applications.

Table 4.16 | Tools used for SQL Server penetration

| Sr. No. | Tool | Brief Description |
|---------|---|--|
| 1 | http://www.appsecinc.com | AppDetectivePro: It is a network-based, discovery and vulnerability assessment scanner that discovers database applications within the infrastructure and assesses security strength. It locates, examines, reports and fixes security holes and misconfigurations as well as identify user rights and privilege levels based on its security methodology and extensive knowledge based on application-level vulnerabilities. Thus, organizations can harden their database applications. |
| 2 | http://www.appsecinc.com | DbProtect: It enables organizations with complex, heterogeneous environments to optimize database security, manage risk and bolster regulatory compliance. It integrates database asset management, vulnerability management, audit and threat management, policy management, and reporting and analytics for a complete enterprise solution. |
| 3 | http://www.iss.net | Database Scanner: It is an integrated part of Internet Security Systems' (ISS) Dynamic Threat Protection platform that assesses online business risks by identifying security exposures in the database applications. Database scanner offers security policy generation and reporting functionality, which instantly measures policy compliance and automates the process of securing critical online business data. Database scanner runs independently of the database and quickly generates detailed reports with all the information needed to correctly configure and secure databases. |

(Continued)

Table 4.16 | (Continued)

| <i>Sr. No.</i> | <i>Tool</i> | <i>Brief Description</i> |
|----------------|--|---|
| 4 | http://www.ca.com/us/ securityadvisor | SQLPoke: It is an NT-based tool that locates Microsoft SQL (MSSQL) servers and tries to connect with the default System Administrator (SA) account. A list of SQL commands are executed if the connection is successful. |
| 5 | http://www.ngssoftware. com/ | NGSSQLCrack: It can guard against weak passwords that make the network susceptible to attack. This is a password cracking utility for Microsoft SQL server 7 and 2000 and identifies user accounts with weak passwords so that they can be reset with stronger ones, thus, protecting the overall integrity of the system. |
| 6 | http://www.security- database.com/toolswatch | Microsoft SQL Server Fingerprint (MSSQLFP) Tool: This is a tool that performs fingerprinting version on Microsoft SQL Server 2000, 2005 and 2008, using well-known techniques based on several public tools that identifies the SQL version and also can be used to identify vulnerable versions of Microsoft SQL Server |

4.10.2 How to Prevent SQL Injection Attacks

SQL injection attacks occur due to poor website administration and coding. The following steps can be taken to prevent SQL injection.

1. **Input validation**
 - Replace all single quotes (escape quotes) to two single quotes.
 - Sanitize the input: User input needs to be checked and cleaned of any characters or strings that could possibly be used maliciously. For example, character sequences such as ; , --, select, insert and xp_ can be used to perform an SQL injection attack.
 - Numeric values should be checked while accepting a query string value. Function – IsNumeric() for Active Server Pages (ASP) should be used to check these numeric values.
 - Keep all text boxes and form fields as short as possible to limit the length of user input.
2. **Modify error reports:** SQL errors should not be displayed to outside users and to avoid this, the developer should handle or configure the error reports very carefully. These errors sometimes display full query pointing to the syntax error involved and the attacker can use it for further attacks.
3. **Other preventions**
 - The default system accounts for SQL server 2000 should never be used.
 - Isolate database server and web server. Both should reside on different machines.
 - Most often attackers may make use of several extended stored procedures such as xp_cmdshell and xp_grantlogin in SQL injection attacks. In case such extended stored procedures are not used or have unused triggers, stored procedures, user-defined functions, etc., then these should be moved to an isolated server.

These are the minimum countermeasures that can be implemented to prevent SQL injection attack. Technocrats may want to know more on this topic and can go through Refs. #8 and #9, Additional Useful Web References.



SQLBlock: SQLBlock is an open data base connectivity (ODBC) driver that acts as an SQL injection protection feature. It blocks the execution and sends an alert to administrator, in case of any client-application attempt to execute any disallowed SQL statements. It works as an ordinary ODBC data source and monitor every SQL statements being executed.

4.11 Buffer Overflow

Buffer overflow, or buffer overrun, is an anomaly where a process stores data in a buffer outside the memory the programmer has set aside for it. The extra data overwrites adjacent memory, which may contain other data, including program variables and program flow control data. This may result in erratic program behavior, including memory access errors, incorrect results, program termination (a crash) or a breach of system security.

Buffer overflows can be triggered by inputs that are designed to execute code or alter the way the program operates. They are, thus, the basis of many software vulnerabilities and can be maliciously exploited. Bounds checking can prevent buffer overflows.

Programming languages commonly associated with buffer overflows include C and C++, which provide no built-in protection against accessing or overwriting data in any part of memory and do not automatically check that data written to an array (the built-in buffer type), which is within the boundaries of that array.^[35]

Buffer overflow occurs when a program or process tries to store more data in a buffer (temporary data storage area) than it was intended to hold. As buffers are created to contain a finite amount of data, the extra information – which has to go somewhere – can overflow into adjacent buffers, corrupting or overwriting the valid data held in them. Although it may occur accidentally through programming error, buffer overflow is an increasingly common type of security attack on data integrity.

The knowledge of C, C++ or any other high-level computer language (i.e., assembly language) is essential to understand buffer overflow, as basic knowledge of process memory layout is very important. A buffer is a contiguous allocated chunk of memory such as an array or a pointer in C. In C and C++, there are no automatic bounds checking on the buffer – which means a user can write past a buffer. For example,

```
int main () {
    int buffer[10];
    buffer[20] = 10;
}
```

This C program is a valid program and every compiler can compile it without any errors. However, the program attempts to write beyond the allocated memory for the buffer, which might result in an unexpected behavior.

4.11.1 Types of Buffer Overflow

Stack-Based Buffer Overflow

Stack buffer overflow occurs when a program writes to a memory address on the program's call stack outside the intended data structure – usually a fixed length buffer. Here are the characteristics of stack-based programming:

1. "Stack" is a memory space in which automatic variables (and often function parameters) are allocated.
2. Function parameters are allocated on the stack (i.e., local variables that are declared on the stack – unless they are also declared as "static" or "register") and are not automatically initialized by the system, so they usually have garbage in them until they are initialized.

3. Once a function has completed its cycle, the reference to the variable in the stack is removed. (Therefore, if a function is called multiple times, its local variables and parameters are recreated and destroyed each time the function is called and exited.)

The attacker may exploit stack-based buffer overflows to manipulate the program in various ways by overwriting:

1. A local variable that is near the buffer in memory on the stack to change the behavior of the program that may benefit the attacker.
2. The return address in a stack frame. Once the function returns, execution will resume at the return address as specified by the attacker, usually a user input-filled buffer.
3. A function pointer, or exception handler, which is subsequently executed.

The factors that contribute to overcome the exploits are

1. Null bytes in addresses;
2. variability in the location of shellcode;
3. differences between environments.



A shellcode is a small piece of code used as a payload in the exploitation of software vulnerability. It is called “shellcode” because it starts with command shell from which the attacker can control the compromised machine.

NOPs

NOP or NOOP (short form of no peration or no operation performed) is an assembly language instruction/command that effectively does nothing at all. The explicit purpose of this command is not to change the state of status flags or memory locations in the code. This means NOP enables the developer to force memory alignment to act as a place holder to be replaced by active instructions later on in program development.

NOP opcode can be used to form an NOP slide, which allows code to execute when the exact value of the instruction pointer is indeterminate (e.g., when a buffer overflow causes a function’s return address on the stack to be overwritten). It is the oldest and most widely used technique for successfully exploiting a stack buffer overflow. It helps to know/locate the exact address of the buffer by effectively increasing the size of the target stack buffer area. The attacker can increase the odds of findings the right memory address by padding his/her code with NOP operation. To do this, much larger sections of the stack are corrupted with the NOOP machine instruction. At the end of the attacker-supplied data, after the NOOP instructions, an instruction is placed to perform a relative jump to the top of the buffer where the shellcode is located. This collection of NOOP is referred to as the “NOP sled” because if the return address is overwritten with any address within the NOOP region of the buffer then it will “slide” down the NOOP until it is redirected to the actual Malicious Code by the jump at the end. This technique requires the attacker to guess where in the stack the NOP sled is compared with small shellcode.

Owing to the popularity of this technique, many vendors of intrusion prevention system will search for this pattern of NOOP machine instructions in an attempt to detect shellcode in use. It is important to note that an NOP sled does not necessarily contain only traditional NOOP machine instructions but also any instruction that does not corrupt the state of machine to a point where the shellcode will not run and can be used in place of the hardware-assisted NOOP. As a result, it has become common practice for exploit writers to compose the NOOP sled with randomly chosen instructions that will have no real effect on the shellcode execution.^[35]

Heap Buffer Overflow

Heap buffer overflow occurs in the heap data area and may be introduced accidentally by an application programmer, or it may result from a deliberate exploit. In either case, the overflow occurs when an application copies more data into a buffer than the buffer was designed to contain. A routine is vulnerable to exploitation if it copies data to a buffer without first verifying that the source will fit into the destination. The characteristics of stack-based and heap-based programming are as follows:

1. “Heap” is a “free store” that is a memory space, where dynamic objects are allocated.
2. The heap is the memory space that is dynamically allocated new(), malloc() and calloc() functions; it is different from the memory space allocated for stack and code.
3. Dynamically created variables (i.e., declared variables) are created on the heap before the execution program is initialized to zeros and are stored in the memory until the life cycle of the object has completed.

Memory on the heap is dynamically allocated by the application at run-time and normally contains program data. Exploitation is performed by corrupting this data in specific ways to cause the application to overwrite internal structures such as linked list pointers. The canonical heap overflow technique overwrites dynamic memory allocation linkage (such as malloc metadata) and uses the resulting pointer exchange to overwrite a program function pointer.

4.11.2 How to Minimize Buffer Overflow

Although it is difficult to prevent all possible attacks, the following methods will definitely help to minimize such attacks:

1. **Assessment of secure code manually:** Buffer overflow occurs when a program or process tries to store more data in a buffer than it was intended to hold. Developers should be educated about minimizing the use of vulnerable functions available in C library, such as strcpy(), strcat(), sprintf() and vsprintf(), which operate on null-terminated strings and perform no bounds checking. The input validation after scanf() function that reads user input into a buffer is very essential.
2. **Disable stack execution:** Malicious Code causes input argument to the program, and it resides in the stack and not in the code segment. Any code that attempts to execute any other code residing in the stack will cause a segmentation violation. Therefore, the simplest solution is to invalidate the stack to execute any instructions. However, the solution is not easy to implement. Although possible in Linux, some compilers [(including GNU Compliance Connection (GCC)] use trampoline functions to implement taking the address of a nested function that works on the system stack being executable. A trampoline is a small piece of code created at run-time when the address of a nested function is taken. It normally resides in the stack and in the stack frame of the containing function and thus requires the stack to be executable. However, a version of the Linux kernel that enforces the non-executable stack is freely available.
3. **Compiler tools:** Over the years, compilers have become more and more aggressive in optimizations and the checks they perform. Various compiler tools already offer warnings on the use of unsafe constructs such as gets(), strcpy(), etc. Developers should be educated to restructure the programming code if such warnings are displayed.
4. **Dynamic run-time checks:** In this scheme, an application has restricted access to prevent attacks. This method primarily relies on the safety code being preloaded before an application is executed. This preloaded component can either provide safer versions of the standard unsafe functions or

Table 4.17 | Tools used to defend/protect buffer overflow

| <i>Sr. No.</i> | <i>Tool</i> | <i>Brief Description</i> |
|----------------|-------------------|--|
| 1 | StackGuard | It was released for GCC in 1997 and published at USENIX Security 1998. It is an extension to GCC that provides buffer overflow protection. It was invented by Crispin Cowan. It is a compiler approach for defending programs and systems against “stack-smashing” attacks. These attacks are the most common form of security vulnerability. Programs that have been compiled with StackGuard are largely immune to stack-smashing attack. Whenever vulnerability is exploited, it detects the attack in progress, raises an intrusion alert and halts the victim program. |
| 2 | ProPolice | The “stack-smashing protector” or SSP, also known as ProPolice, is an enhancement of the StackGuard concept written and maintained by Hiroaki Etoh of IBM. Its name derives from the word propolis. The stack protection provided by ProPolice is specifically for the C and C++ languages. It is also optionally available in Gentoo Linux with the hardened USE flag. |
| 3 | LibSafe | It was released in April 2000 and gained popularity in the Linux community. It does not need access to the source code of the program to be protected. Libsafe protection is system wide and automatically gets attached to the applications. It is based on a middleware software layer that intercepts all function calls made to library functions known to be vulnerable. A substitute version of the corresponding function implements the original function in a way that ensures that any buffer overflows are contained within the current stack frame, which prevents attackers from overwriting the return address and hijacking the control flow of a running program. The real benefit of using libsafe is protection against future attacks on programs not yet known to be vulnerable. |

it can ensure that return addresses are not overwritten. One example of such a tool is libsafe. The libsafe library provides a way to secure calls to these functions, even if the function is not available. It makes use of the fact that stack frames are linked together by frame pointers. When a buffer is passed as an argument to any of the unsafe functions, libsafe follows the frame pointers to the correct stack frame. It then checks the distance to the nearest return address and when the function executes, it makes sure that address is not overwritten.

5. **Various tools are used to detect/defend buffer overflow:** See Table 4.17 to know about few such tools.

4.12 Attacks on Wireless Networks

Even when people travel, they still need to work. Thus, work seems to be moving out of the traditional offices into homes, hotels, airport lounges and taxis. The employee is no longer tied to an office location and is, in effect, “boundaryless.” When one talks to the young generation about their lifestyles, one realizes that gone are those days when an “office” conjured up the image of the four walls, set in the formal setting, typical office decor and with all the formality that one can imagine, which may perhaps be difficult for our new generation to appreciate. In the yesteryears, “working” meant leaving home, commuting to the workplace, spending those typical 9 a.m.–6 p.m. in the office and then shutting down the work and commuting back home or wherever that one wished to be after office hours. The “working” and “away from work” were cleanly delineated distinct states that one could be in. Gone are those days and now we are in the era of computing anywhere, anytime! There is no doubt that workforce “mobility” is on the rise (see Box 9.1, Chapter 9).

The following are different types of “mobile workers”:

1. **Tethered/remote worker:** This is considered to be an employee who generally remains at a single point of work, but is remote to the central company systems. This includes home workers, tele-cottagers and, in some cases, branch workers.
2. **Roaming user:** This is either an employee who works in an environment (e.g., warehousing, shop floor, etc.) or in multiple areas (e.g., meeting rooms).
3. **Nomad:** This category covers employees requiring solutions in hotel rooms and other semi-tethered environments where modem use is still prevalent, along with the increasing use of multiple wireless technologies and devices.
4. **Road warrior:** This is the ultimate mobile user and spends little time in the office; however, he/she requires regular access to data and collaborative functionality while on the move, in transit or in hotels. This type includes the sales and field forces.

Wireless technologies have become increasingly popular in day-to-day business and personal lives. Hand-held devices such as the PDAs allow individuals to access calendars, E-Mail addresses, phone number lists and the Internet. Wireless networks extend the range of traditional wired networks by using radio waves to transmit data to wireless-enabled devices such as laptops and PDAs. Wireless networks are generally composed of two basic elements: (a) access points (APs) and (b) other wireless-enabled devices, such as laptops radio transmitters and receivers to communicate or “connect” with each other (see Fig. 4.6). APs are connected through physical wiring to a conventional network, and they broadcast signals with which a wireless device can connect.

Wireless access to networks has become very common by now in India – for organizations and for individuals. Many laptop computers have wireless cards preinstalled for the buyer, for example, in India, such cards are provided by TATA Indicom, Reliance and Airtel. There are many hotels and equivalent establishments all over the world (including India) where the rooms are “Wi-Fi enabled.” There is no denying that the ability to enter a network while on the move (working away from home or in other locations that are not routine office locations, working while in hotels, etc.) has great benefits (see Box 4.10 for some interesting facts).

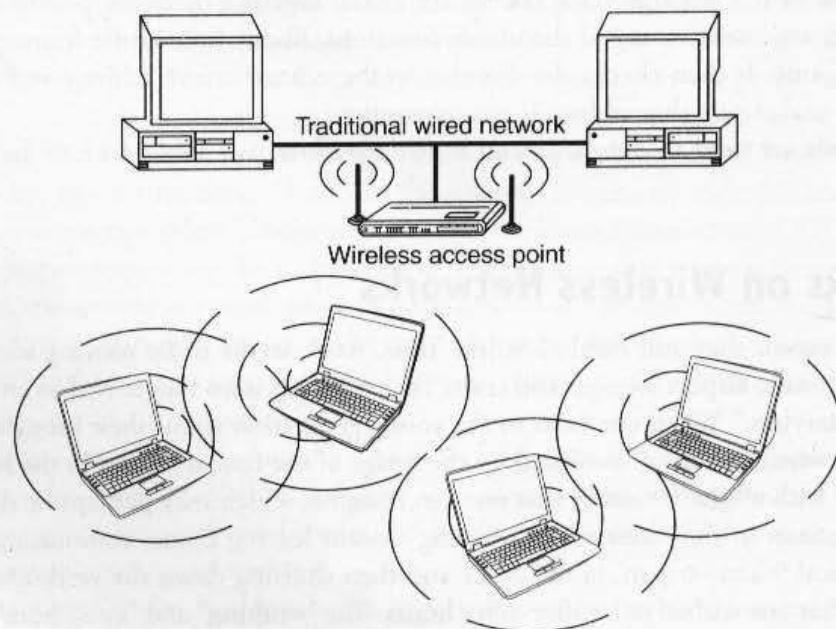


Figure 4.6 | Wireless networks.

Box 4.10 Going Wi-Fi

Start with a laptop computer or other portable device that could benefit from Internet access. Make sure it is wireless. Look for Intel's Centrino sticker or any sign that Wi-Fi is built into the device. If not, you need an external Wi-Fi Personal Computer Memory Card International Association (PCMCIA)-compliant card. Find a public hotspot by searching store windows for stickers that say Wi-Fi Zone, T-Mobile HotSpot or anything indicating a wireless service. Boot up your laptop and login, at home or at a hotel, or get a Wi-Fi router and plug one end into your cable or digital subscriber line (DSL) modem. The router will broadcast the wireless Internet signal in your house and you can sit on the couch and surf the Internet.

Although wireless technology is not new, it is now being used by families who need an easy way to share a fast Internet connection with two or more computers at home. It is helping almost anybody, that is, even the "non-techie," to get Internet access while they buy their daily cup of coffee at a Wi-Fi coffeehouse. This kind of scene is now very common in most Indian metros, including some small cities too.

Cell phones have become indispensable for many who use them to keep track of family members or to call for help in an emergency. Wi-Fi is not there yet, however, the idea of wireless Internet access on every corner is becoming a 24/7 possibility as more companies set up public hotspots. Like cell phones, Wi-Fi is not something you will use every minute, but it can be convenient when you need to check for an E-Mail message or compare the price of an online gift.



Readers may like to visit <http://computer.howstuffworks.com/wifi-quiz.htm> to test fundamental knowledge about wireless networks before going through this section.

Wireless technology is no more buzzword in today's world. Let us understand important components of wireless network, apart from components such as modems, routers, hubs and firewall, which are integral part of any wired network as well as wireless network.

- 1. 802.11 networking standards:** Institute of Electrical and Electronics Engineers (IEEE)-802.11 is a family of standards for wireless local area network (WLAN), stating the specifications and/or requirements for computer communication in the 2.4, 3.6 and 5 GHz frequency bands.
 - **802.11:** It is applicable to WLANs and provides 1 or 2 Mbps transmission in the 2.4 GHz band using either frequency-hopping spread spectrum (FHSS) or direct sequence spread spectrum (DSSS).
 - **802.11a:** It provides 54 Mbps transmission in the 5 GHz band and uses orthogonal frequency-division multiplexing (OFDM) which is more efficient coding technique compared with FHSS and DSSS.
 - **802.11b:** It provides 11 Mbps transmission in the 2.4 GHz band and uses complementary code keying (CCK) modulation to improve speeds. In 1999, ratification was made to the original 802.11 standard, and was termed as 802.11b, which allowed wireless functionality comparable to Ethernet. Although it was being a slowest standard, at the same time being the least expensive, the evolution led to the rapid acceptance of 802.11b across the world as the definitive WLAN technology and known as "Wi-Fi standard."
 - **802.11g:** It provides 54 Mbps transmission in the 2.4 GHz band and the same OFDM coding as 802.11a, hence it is a lot faster than 802.11a and 802.11b.
 - **802.11n:** It is the newest standard available widely and uses multiple-input multiple-output (MIMO) that enabled to improve the speed and range significantly. For example, although

802.11g provides 54 Mbps transmission theoretically, however, it can only achieve 24 Mbps of speed because of network traffic congestion. However, 802.11n can achieve speeds as high as 140 Mbps.

The other important 802 family members are as follows:

- **802.15:** This standard is used for *personal WLANs* and covers a very short range. Hence, it is used for *Bluetooth Technology*.
- **802.16:** It is also known as *WiMax*. It combines the benefits of broadband and wireless, hence it provides high-speed wireless Internet over very long distances and provides access to large areas such as cities. This standard is developed by IEEE working group established in 1999 to develop the standards for *Wireless Metropolitan Area Networks*.

2. Access points: It is also termed as AP. It is a hardware device and/or a software that acts as a central transmitter and receiver of WLAN radio signals. Users of wireless device, such as laptop/PDAs, get connected with these APs, which in turn get connected with the wired LAN. An AP acts as a communication hub for users to connect with the wired LAN.

3. Wi-Fi hotspots: A hotspot is a site that offers the Internet access by using Wi-Fi technology over a WLAN. Hotspots are found in public areas (such as coffee shops, public libraries, hotels and restaurants) and are commonly offered facility throughout much of North America and Europe.

- **Free Wi-Fi hotspots:** Wireless Internet service is offered in public areas, free of cost and that too without any authentication. The users will have to enable the wireless on their devices, search for such hotspots and will have to say (*click*) connect. The Internet facility is made available to the user. As the authentication mechanism on the router is disabled, user gets connected to WLAN and cybercriminals get their prey. As, access to free hotspots cannot be controlled, cybersecurity is always questioned. Readers may visit www.hotspot-locations.com to find wireless hotspots into their area. Hotspot locations is the free global hotspot database of wireless access points made available to the general public.
- **Commercial hotspots:** The users are redirected to authentication and online payment to avail the wireless Internet service in public areas. The payment can be made using credit/debit card through payment gateways such as PayPal. Major airports and business hotels are usually charged to avail wireless Internet service. Some Internet service providers offer virtual private network (VPN) as a security feature but found to be an expensive option.

Although the user has been authenticated while connecting to a hotspot, it does not mean that he/she is on the secured communication channel. A “poisoned/rogue hotspot” is termed to be a free public hotspot set up by the cybercriminals, with the objective of sniffing the data sent by the user. They can easily obtain the User IDs (i.e., login names), decipher the passwords and/or other sensitive information by examining packets sent by the user (see Section 7.9, Chapter 7).

- 4. Service set identifier (SSID):** It is the name of 802.11i WLAN and all wireless devices on a WLAN must use the same SSID to communicate with each other. While setting up WLAN, the user (or WLAN administrator) sets the SSID, which can be up to 32 characters long so that only the users who knew the SSID will be able to connect the WLAN. It is always advised to turn OFF the broadcast of the SSID, which results in the detected network displaying as an unnamed network and the user would need to manually enter the correct SSID to connect to the network. Hence, it is also advised to set the SSID manually rather than leaving it blank. Moreover, it is important to note that turning off the broadcast of the SSID discourages casual wireless snooping, however, it does not stop an attacker trying to attack the network.
- 5. Wired equivalence privacy (WEP):** Wireless transmission is susceptible to eavesdropping and to provide confidentiality, WEP was introduced as part of the original 802.11i Protocol in 1997. It is

- always termed as deprecated security algorithm for IEEE 802.11i WLANs. SSID along with WEP delivers fair amount of secured wireless network.
6. **Wi-Fi protected access (WPA and WPA2):** During 2001, serious weakness in WEP was identified that resulted WEP cracking software(s) being made available to enable cybercriminals to intrude into WLANs. WPA was introduced as an interim standard to replace WEP to improve upon the security features of WEP. WPA2 is the approved Wi-Fi alliance (www.wi-fi.org) interoperable implementation of 802.11i. WPA2 provides a stronger encryption mechanism through Advanced Encryption Standard (AES), which is a requirement for some corporate and government agencies.
 7. **Media access control (MAC):** It is a unique identifier of each node (i.e., each network interfaces) of the network and it is assigned by the manufacturer of a network interface card (NIC) stored in its hardware. MAC address filtering allows only the devices with specific MAC addresses to access the network. The router should be configured stating which addresses are allowed. Although this method appears to be very secure, the attacker can spoof a MAC address, that is, copy the known MAC address to entice the network that the device he/she is using belongs to the network, at the same time it is important to note that, in case you purchase a new device or if any visitors would like to connect to the network, you will need to add the MAC addresses of these new devices to the list of approved addresses.



How to find MAC Address?

Readers may visit www-dcn.fnal.gov/DCG-Docs/mac/ OR www.coffer.com/mac_info/ to know the steps to find the MAC address on the systems running on various operating systems (OS) as well as in case if no OS is installed.

While all this sounds very exciting, it is important to understand that wireless networking has many security issues. Crackers have found wireless networks relatively easy to break into. They are known to use wireless technology to crack into non-wireless networks. Network administrators must be aware of these risks and should stay up to date on any new risks that arise. Users of wireless equipment must be aware of these risks so as to take personal protective measures. As the wireless service technology is getting improved and falling within an easy reach of information technology (IT) as well as non-IT workers, the risks to users of wireless technology have increased exponentially (see Section 9.3.1, Chapter 9).

There were relatively few dangers when wireless technology was first introduced. Although the attackers have no time to latch on to the new technology as wireless was not commonly found in the workplace, however, there are a great number of security risks associated with wireless technology. Some issues are obvious and some are not. At a corporate level, it is the responsibility of the IT department to keep up to date with the types of threats and appropriate countermeasures to deploy. Security threats are growing in the wireless arena. The attackers have learnt that there is much vulnerability in the current wireless protocols, encryption methods and the carelessness and ignorance that exist at the user and corporate IT levels. Cracking methods have become much more sophisticated and innovative with the availability of different tools used to search and hack wireless networks. Cracking has become much easier and more accessible with easy-to-use Windows- and Linux-based tools being made available on the Web at no charge (see Table 4.18).

The overall philosophy behind wired networks vs. wireless networks is “trust.” On a wired network, the hardware is under the direct control of the network administrator, and therefore, the overall attitude toward

Table 4.18 | Tools used for hacking wireless networks

| <i>Website</i> | <i>Brief Description</i> |
|---|--|
| http://www.netstumbler.com/ | NetStumbler: This tool is based on Windows OS and easily identifies wireless signals being broadcast within range. It also has ability to determine signal/noise that can be used for site surveys. |
| http://www.kismetwireless.net/ | Kismet: This tool detects and displays SSIDs that are not being broadcast which is very critical in finding wireless networks. NetStumbler do not have this key functional element – ability to display wireless networks that are not broadcasting their SSID. |
| http://sourceforge.net/projects/airsnort/files/ | Airsnort: This tool is very easy and is usually used to sniff and crack WEP keys (http://airsnort.shmoo.com/). |
| http://wirelessdefence.org/Contents/coWPAttMain.htm | CowPatty: This tool is used as a brute force tool for cracking WPA-PSK and is considered to be the “New WEP” for home wireless security. This program simply tries a bunch of different options from a dictionary file to see if one ends up matching what is defined as the preshared key. |
| http://www.wireshark.org/ | Wireshark (formerly ethereal): Ethereal can scan wireless and Ethernet data and comes with some robust filtering capabilities. It can also be used to sniff out 802.11 management Beacons and probes, and subsequently could be used as a tool to sniff out non-broadcast SSIDs. |

Source: <http://www.ethicalhacker.net/content/view/16/24/> (10 May 10).

the workstations tends to be one of trust. With a wireless network, it is possible that someone could sit in the parking lot with a laptop and access your wireless network. Therefore, the general attitude toward wireless workstations tends to be one of extreme distrust. However, this difference in attitude often causes the same administrators to take extreme positions when it comes to guarding network security. Although they tend to go to extreme lengths at securing a wireless network, at times they almost neglect wired network security. Things to watch out are the following: Are there any unused network jacks or unused switch ports in the office? This is important because if someone was able to sneak into the office and plug a laptop into one of these unused jacks, you may no more have the same level of trust in the hardware on your wired network,

4.12.1 Traditional Techniques of Attacks on Wireless Networks

In security breaches, penetration of a wireless network through unauthorized access is termed as *wireless cracking*. There are various methods that demand high level of technological skill and knowledge, and availability of numerous software tools made it less sophisticated with minimal technological skill to crack WLANs.

1. **Sniffing:** It is eavesdropping on the network and is the simplest of all attacks. Sniffing is the simple process of intercepting wireless data that is being broadcasted on an unsecured network. Also termed as reconnaissance technique, it gathers the required information about the active/available Wi-Fi networks. The attacker usually installs the sniffers remotely on the victim's system and conducts activities such as
 - Passive scanning of wireless network;
 - detection of SSID;
 - collecting the MAC address;
 - collecting the frames to crack WEP.

2. **Spoofing:** The primary objective of this attack is to successfully masquerade the identity by falsifying data and thereby gaining an illegitimate advantage. The attacker often launches an attack on a wireless network by simply creating a new network with a stronger wireless signal and a copied SSID in the same area as a legitimate network. It causes unsuspecting computers to automatically connect to the spoofed network instead of the real one. The attacker can conduct this activity easily because while setting up a wireless network, the computers no longer need to be informed to access the network; rather they access it automatically as soon as they move within the signal range. This convenient feature is always exploited by the attacker.
 - *MAC address Spoofing:* It is a technique of changing an assigned media access control (MAC) address of a networked device to a different one. This allows the attacker to bypass the access control lists on servers or routers by either hiding a computer on a network or allowing it to impersonate another network device.
 - *IP Spoofing:* It is a process of creating IP packets with a forged source IP address, with the purpose of concealing the identity of the sender or impersonating another computing system. To engage in IP Spoofing, the attacker uses a variety of techniques to find an IP address of a trusted host(s) and then modifies the packet headers so that it appears that the packets are coming from that host, that is, legitimate sender.
 - *Frame Spoofing:* The attacker injects the frames whose content is carefully spoofed and which are valid as per 802.11 specifications. Frames themselves are not authenticated in 802.11 networks and hence when a frame has a spoofed source address, it cannot be detected unless the address is entirely faked/bogus.
3. **Denial of service (DoS):** We have explained this attack in detail in Section 4.9.
4. **Man-in-the-middle attack (MITM):** It refers to the scenario wherein an attacker on host *A* inserts *A* between all communications – between hosts *X* and *Y* without knowledge of *X* and *Y*. All messages sent by *X* do reach *Y* but through *A* and vice versa. The objective behind this attack is to merely observe the communication or modify it before sending it out.
5. **Encryption cracking:** It is always advised that the first step to protect wireless networks is to use WPA encryption. The attackers always devise new tools and techniques to deconstruct the older encryption technology, which is quite easy for attackers due to continuous research in this field. Hence, the second step is to use a long and highly randomized encryption key; this is very important. It is a little pain to remember long random encryption; however, at the same time these keys are much harder to crack.

4.12.2 Theft of Internet Hours and Wi-Fi-based Frauds and Misuses

Information communication technology (ICT) is within reach of people nowadays and most of the new systems (i.e., computers) are equipped for wireless Internet access as more and more people are opting for Wi-Fi in their homes. Wireless network into homes is becoming common necessity because of lifestyle and availability of inexpensive broadband routers that can be configured easily and/or there is no need to configure these devices at all because of plug-and-play feature. This enables the Internet on the finger tip of home users and in case, unfortunately, he/she visits a malicious webpage, the router is exposed for an attack. Thus, as the networks become stronger and more prevalent, more of the signals are available outside the home of the subscriber, spilling over into neighbor's apartments, hallways and the street. In today's era of high dependency on the Internet for many aspects of our life and given that predators are lurking around as potential cybercriminals, they (criminals) often wonder how they can find out who they are stealing it from so that they can get an idea if that information is safe. According to a study by Jupiter Research, 14% of wireless

network owners have accessed their neighbor's connection.^[36] It appears that more and more people are logging on for free.

Cybercriminals know that they should not steal Internet hours purchased by others but somehow they want to get their work done without paying for the Internet connection and they also want to know if anyone knows how to find out who they are stealing it from. Here is what they are mostly likely to do: (a) they find out the IP address of the router that you are using, (b) open up a command prompt (go to start click on run with; type cmd and press enter) at the command prompt and (c) type this command ipconfig/all and press enter. Look for the default gateway (this is the router); once you see the IP address type the routers IP address into your browser and you can find out some information about who you are stealing Internet from.

An interesting question is whether "stealing" wireless Internet is illegal. We have discussed it under a mini-case in Chapter 11 (in CD) and readers may visit the URL provided in Ref. #13, Additional Useful Web References, Further Reading. Here is one scenario, given that use of laptops is now common place. Suppose you figure out how to connect the laptop to one of the many wireless networks detected on your laptop. Is this illegal? As we shall learn in Chapter 6 the laws vary around the world. However, for the most part, logging and collecting information, such as surfing the Web or checking E-Mail, from wireless networks that are accessible to anyone with a receiver is OK. The act of wardriving is searching for wireless networks by a moving vehicle using a portable computer or PDA.^[37] Readers may visit the URL mentioned in Ref. #3, Video Clips, Further Reading to watch a small video clip on how wardriving is conducted.

Software for wardriving is freely available and can be downloaded from the Internet – to name a few NetStumbler for Windows, Kismet or SWScanner for Linux, and FreeBSD, NetBSD, OpenBSD, DragonFly BSD, Solaris and KisMac for Macintosh. Wardrivers log and collect information from the wireless access points (WAP) they find while driving (see Box 4.11). Think about radio airwaves: as long as you have a radio, listening to a radio station broadcasting where you are driving is free (at least in the US).

Box 4.11 The New "Wars" in the Internet Era!

Basically, the term "wardriving" was derived from the term wardialing from the 1983 film WarGames, which involved searching for computer systems to connect to, using software that dialed numbers sequentially, to see which ones were connected to a fax machine or computer. Subsequently, many related terms came up:

1. **Warwalking:** It is also known as "warjogging" and is similar in nature to wardriving, except that it is done on foot rather than conducted from a moving vehicle. The disadvantages of this approach consist in slower speed of travel (resulting in fewer and more infrequently discovered networks) and the absence of a convenient computing environment. Consequently, hand-held devices, such as Pocket PCs that can perform tasks while one is walking or standing, have predominated in this area. The inclusion of integrated Wi-Fi (rather than a CompactFlash, i.e., CF is a mass storage device format used in portable electronic devices or PCMCIA add-in card) in Dell Axim, Compaq iPAQ and Toshiba pocket PCs in 2002 – and, more recently, an active Nintendo DS and Sony PSP enthusiast community possessing Wi-Fi capabilities on these devices – has expanded the extent of this practice as the newer Smartphones have also integrated Global Positioning System (GPS). Of recent note, the Nokia N770, N800 and N810 Internet Tablets have very good antennas and will pick up nearly anything in the area, even blocks away from the unit.
2. **Warbiking:** Although warbiking is same as wardriving, it involves searching for wireless networks while on a moving bicycle or motorcycle. This activity is facilitated by the mounting of a Wi-Fi-capable device on the vehicle itself.

Box 4.11 The New "Wars" . . . (Continued)

3. **Warkitting:** Warkitting was identified by Tsow, Jakobsson, Yang and Wetzel in 2006. This is a combination of wardriving and rootkitting – an attack in which the wireless access point's configuration or firmware is modified over the wireless connection. This allows the attacker to control all traffic for the victim and may even permit to disable Secure Socket Layer (SSL) by replacing HTML content, when it is being downloaded. The attacker first discovers vulnerable wireless routers through wardriving and/or by retrieving the necessary data from existing Wi-Fi access point databases such as WiGLE (www.wigle.net) or WiFiMaps (www.wifimaps.com) to carry out a warkitting attack.
4. **WAPkitting:** In this attack, external software clutches the control of router's firmware that can be easily accomplished by exploiting open administrative access. WAPkitting can theoretically proceed by more traditional means such as buffer overflow. The ability to install arbitrary control software on a wireless router opens unlimited possibilities to an attacker.
5. **WAPjacking:** This type of attack is very similar to DNS poisoning attacks. It changes the settings of existing firmware that helps an attacker to engage in malicious configuration of firmware settings; however, it makes no modification to the firmware itself, that is, allow connections to be hijacked and/or rerouted without the user's knowledge. WAPjacking is less powerful attack compared to WAPkitting.

WAPkitting and WAPjacking are independent of the means of infection, and specify the relative modifications done to a WAP upon corruption. Warkitting, on the other hand, does not specify the type of WAP alteration, but it does relate to how infection occurs.

Source: <http://en.wikipedia.org/wiki/Wardriving> (31 May 2010).

Be careful with use of WAPs; when you are using a WAP to gain access to computer on a network, be aware of the local laws/legislations where you are doing it because things can become dangerous from security and privacy as well legal perspective. Maybe if corporations were not in such a hurry to release this technology and thought about it more thoroughly, they would not have to deal with security breaches and creating superior protection for their own systems. The moral of the story is that you must secure your network.

4.12.3 How to Secure the Wireless Networks

Nowadays, security features of Wi-Fi networking products are not that time-consuming and non-intuitive; however, they are still ignored, especially, by home users. Although following summarized steps will help to improve and strengthen the security of wireless network, see Table 4.19 to know the available tools to monitor and protect the wireless networks:

1. Change the default settings of all the equipments/components of wireless network (e.g., IP address/ user IDs/administrator passwords, etc.).
2. Enable WPA/WEP encryption.
3. Change the default SSID.
4. Enable MAC address filtering.
5. Disable remote login.
6. Disable SSID broadcast.
7. Disable the features that are not used in the AP (e.g., printing/music support).
8. Avoid providing the network a name which can be easily identified (e.g., My_Home_Wifi).
9. Connect only to secured wireless network (i.e., do not autoconnect to open Wi-Fi hotspots).
10. Upgrade router's firmware periodically.

Table 4.19 | Tools to protect wireless network

| <i>Website</i> | <i>Brief Description</i> |
|---|--|
| http://www.zamzom.com/ | Zamzom Wireless Network Tool: New freeware tool helps to protect wireless networks and maintain computer security, detects all computer names, Mac and IP addresses utilizing a single wireless network, reveals all computers – both authorized and unauthorized – who have access to any given wireless network. Thus, it helps users to take vital steps toward securing their wireless networks and acts as a measure that should not be overlooked or skipped. |
| http://www.airdefense.net/ | AirDefense Guard: The tool provides advanced intrusion detection for wireless LANs and is based on signature analysis, policy deviation, protocol assessment policy deviation and statistically anomalous behavior. AirDefense detects responds to: <ul style="list-style-type: none"> • Denial-of-service (DoS) attacks; • man-in-the-middle attacks; • identity theft. |
| http://www.loud-fat-bloke.co.uk/tools.html | Wireless Intrusion Detection System (WIDZ): This is an intrusion detection for wireless LANs for 802.11. It guards APs and monitors local frequencies for potentially malevolent activity. It can detect scans, association floods and bogus APs, and it can easily be integrated with other products such as SNORT or Realsecure. |
| http://www.dachb0den.com/projects/bsd-airtools.html | BSD-Airtools: This tool provides a complete toolset for wireless auditing (802.11b). It contains AP detection application, Dstumbler – similar to Netstumbler. It can be used to detect wireless access points and connected nodes, view signal-to-noise graphs, and interactively scroll through scanned APs and view statistics for each. It also contains a BSD-based WEP cracking application (called as Dweputils). |
| http://wifi.google.com/ | Google Secure Access: Google Wi-Fi is a free wireless Internet service offered to the city of Mountain View (California, USA). With your Wi-Fi-enabled device and a Google Account, one can go online for free by accessing the network name “GoogleWi-Fi,” which is secured by Google’s virtual private network (VPN). Google Secure Access encrypts the Internet traffic and sends it through Google’s servers on the Internet. |

11. Assign static IP addresses to devices.
12. Enable firewalls on each computer and the router.
13. Position the router or AP safely.
14. Turn off the network during extended periods when not in use.
15. Periodic and regular monitor wireless network security.

SUMMARY

When information systems are the target of offense, the criminal's goal is to steal information from, or cause damage to, a computer, computer system or computer network. The perpetrators range from teenagers (script kiddies/cyberjoyriders) to organized crime operators and international terrorists.

A computer can be the target of offense; tools may be used in an offense, or may contain evidence of an offense. An understanding of different uses of a computer will provide foundation of the application of the criminal statutes.

The computing technology may also be a tool of an offense. The criminal uses the computer to commit a traditional crime, such as counterfeiting. For example, a counterfeiter that used to engrave plates to create the counterfeit currency can now use sophisticated graphic computers with advanced color printers.

The criminals/attackers have in-depth knowledge about the technology and can use traditional methods/techniques or sophisticated means such as hacking tools to break into the systems. Everybody has to take care of their own systems and this should not be left over to any one person/group of persons (i.e., System Administrator, Chief Information Security Officer). Many scenarios and case illustrations are provided in Chapter 11 (in CD) explaining different

techniques used in cyberattacks. Everybody should follow **R.U.N.S.A.F.E. guidelines:**

1. Refuse to download/install/execute any unknown utilities/tools.
2. Update vital utilities/tools (e.g., OS, antivirus, anti-Spywares, firewalls) regularly.
3. Nullify unnecessary risks.
4. Safeguard own user ID and password.
5. Assure sufficient resources to take care of own systems appropriately.
6. Face insecurity (i.e., what and how much to secure is always a question!).
7. Everybody should do their own job sincerely (i.e., information security is everybody's responsibility similar to "charity begins at home!").

REVIEW QUESTIONS

1. What are the different phases during the attack on the network?
2. What is the difference between proxy server and an anonymizer?
3. What are the different ways of password cracking?
4. How can keyloggers be used to commit a cybercrime?
5. What is the difference between a virus and a worm?
6. What is virus hoax?
7. What is the difference between Trojan Horses and backdoors?
8. What is the difference between steganography and cryptography?
9. Are countermeasures employed against steganography? Explain.
10. What is the difference between DoS and DDoS?
11. What is SQL injection and what are the different countermeasures to prevent the attack?
12. What is Blind SQL injection attack? Can it be prevented?
13. What are different buffer overflow attacks?
14. What are the different components of wireless network?
15. What is the difference between WEP and WPA2?
16. How can wireless networks be comprised?
17. What is the difference between WAPkitting and WAPjacking?

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The appendices that serve as extended material for the topic addressed in this chapter are: A, B, C, D, E, J, L. These are provided in the companion CD.

5

Phishing and Identity Theft

Learning Objectives

After reading this chapter, you will be able to:

- Learn about Phishing and its related techniques.
- Understand different methods of Phishing.
- Get an overview about 3Ps of cybercrime (Phishing, Pharming and Phoraging).
- Understand what Spear Phishing is and how to avoid being victim of Spear Phishing.
- Get an overview of “whaling.”
- Learn about identity (ID) theft and understand ID theft as a major threat to businesses.
- Understand “myths and facts” about ID theft.
- Understand different types of ID thefts.
- Learn about different techniques of ID theft.
- Understand about countermeasures for ID theft.

5.1 Introduction

Chapter 4 has provided an insight on how different methods and tools are used to conduct cyberoffenses and Phishing was introduced in Chapter 4 as one of the methods toward enticing netizens to reveal their personal information that can be used for identity (ID) theft. ID theft involves unauthorized access to personal data. Section 66C of the Indian IT Act states that “*whosoever fraudulently make use of the electronic signature, password or any other unique identification feature of any other person, shall be punished with imprisonment of either description for a term which may extend to three years and shall also be liable to fine which may extend to rupees one lakh.*” Section 66D of the Indian IT Act states that “*whoever, by means for any communication device or computer resource cheats by personation, shall be punished with imprisonment of either description for a term which may extend to three years and shall also be liable for fine which extend to one lakh rupees.*” “Phishing” is the use of social engineering tactics to trick users into revealing confidential information.

Phishing has become a universal phenomenon and a major threat worldwide that affects not only individuals but also all industries and businesses that have an online presence and do online transactions over the Internet. Phishing is equal parts of technology and psychology – resorted to a systematic way to exploit netizens, not only by individual attackers but also by organized criminal groups.

The statistics about Phishing attacks/scams proves *Phishing* to be a dangerous enemy among all the methods/techniques discussed in Chapter 4, because the prime objective behind these attacks is ID theft.

1. The world Phishing map available at www.avira.com^[1] illustrates that the most Phishing attacks are on the rise in Asia, Europe and North America. The virus laboratory at Avira is constantly monitoring the evolution of E-Mail Phishing across the globe.

The E-Mail will usually ask the user to provide valuable information about himself/herself or to “verify” information that the user may have provided in the past while registering for online account. To maximize the chances that a recipient will respond, the phisher might employ any or all of the following tactics:^[10]

1. **Names of legitimate organizations:** Instead of creating a phony company from scratch, the phisher might use a legitimate company's name and incorporate the look and feel of its website (i.e., including the color scheme and graphics) into the Spam E-Mail.
2. **“From” a real employee:** Real name of an official, who actually works for the organization, will appear in the “from” line or the text of the message (or both). This way, if a user contacts the organization to confirm whether “Rajeev Arora” truly is “Vice President of Marketing” then the user gets a positive response and feels assured.
3. **URLs that “look right”:** The E-Mail might contain a URL (i.e., weblink) which seems to be legitimate website wherein user can enter the information the phisher would like to steal. However, in reality the website will be a quickly cobbled copycat – a “spoofed” website that looks like the real thing, that is, legitimate website. In some cases, the link might lead to selected pages of a legitimate website – such as the real company's actual privacy policy or legal disclaimer. We will discuss more on this in Section 5.2.2.
4. **Urgent messages:** Creating a fear to trigger a response is very common in Phishing attacks – the E-Mails warn that failure to respond will result in no longer having access to the account or E-Mails might claim that organization has detected suspicious activity in the users' account or that organization is implementing new privacy software for ID theft solutions.

Here are a few examples of phrases used to entice the user to take the action.

1. **“Verify your account”:** The organization will never ask the user to send passwords, login names, permanent account numbers (PANs) or SSNs and other personal information through E-Mail. For example, if you receive an E-Mail message from Microsoft asking you to update your credit card information, do not respond without any confirmation with Microsoft authorities – this is a perfect example of Phishing attack.
2. **“You have won the lottery”:** The lottery scam is a common Phishing scam known as advanced fee fraud. One of the most common forms of advanced fee fraud is a message that claims that you have won a large sum of money, or that a person will pay you a large sum of money for little or no work on your part. The lottery scam often includes references to big companies, for example, Microsoft. There is no Microsoft lottery. It is observed that most of the phished E-Mails display the name of the agencies/companies situated in Great Britain and hence it is extremely important for netizens to confirm/verify the authenticity of such E-Mails before sending any response.
 - If any E-Mail is received displaying “You have won the lottery in Great Britain,” confirm it on www.gamblingcommission.gov.uk
 - If any E-Mail is received displaying your selection for any job into Great Britain, confirm/verify the details of the organization on www.companieshouse.gov.uk or on <http://www.upmystreet.com/local/uk.html>
3. **“If you don't respond within 48 hours, your account will be closed”:** These messages convey a sense of urgency so that you will respond immediately without thinking. A Phishing E-Mail message might even claim that your response is required because your account might have been compromised.



Visit the weblinks mentioned below to undergo a quiz to test your Phishing IQ:

1. www.sonicwall.com/Phishing/index.html
2. <http://www.washingtonpost.com/wp-srv/technology/articles/phishingtest.html>

Although Phishing is categorized as Spam, it also differs from Spam. Spam attempts to sell a product or service whereas a phished E-Mail seems to be sent by a legitimate organization/institute. As Phishing and legitimate messages appear to be similar, techniques that are applied to Spam messages cannot be applied naively to Phishing messages. The purpose of a phished E-Mail is to obtain sensitive personal information about a netizen/Internet user and to do so E-Mail needs to deceive the intended recipient into believing that it is from a legitimate organization/institute. As a form of deception, a Phishing E-Mail contains no useful information for the intended recipient and thus falls under the category of Spam.

Let us understand the ways to reduce the amount of Spam E-Mails we receive.^[11]

1. Share personal E-Mail address with limited people and/or on public websites – the more it is exposed to the public, the more Spam E-Mails will be received.
2. Never reply or open any Spam E-Mails. Any spam E-Mails that are opened or replied to inform the phishers not only about your existence but also about validity of your E-Mail address.
3. Disguise the E-Mail address on public website or groups by spelling out the sign “@” and the DOT (.); for example, *RajeevATgmailDOTcom*. This usually prohibits phishers to catch valid E-Mail addresses while gathering E-Mail addresses through programs.
4. Use alternate E-Mail addresses to register for any personal or shopping website. Never ever use business E-Mail addresses for these sites but rather use E-Mail addresses that are free from Yahoo, Hotmail or Gmail.
5. Do not forward any E-Mails from unknown recipients.
6. Make a habit to preview an E-Mail (an option available in an E-Mail program) before opening it.
7. Never use E-Mail address as the screen name in chat groups or rooms.
8. Never respond to a Spam E-Mail asking to remove your E-Mail address from the mailing distribution list. More often it confirms to the phishers that your E-Mail address is active.

B. Hoax E-Mails

These are deliberate attempt to deceive or trick a user into believing or accepting that something is real, when the hoaxter (the person or group creating the hoax) knows it is false.^[12] Hoax E-Mails may or may not be Spam E-Mails. It is difficult sometimes to recognize whether an E-Mail is a “Spam” or a “hoax.” The websites mentioned below can be used to check the validity of such “hoax” E-Mails – for example, chain E-Mails. In Chapter 11 in CD, Example 16 illustrates CAN-SPAM Act Violation through E-Mail Stock Fraud (see Section 11.2.16).

1. www.breakthechain.org: This website contains a huge database of chain E-Mails, like we discussed, the phisher sends to entice the netizens to respond to such E-Mails (e.g., from “lottery schemes” to “your wish will come true” E-Mails). One can search the subject line of such an E-Mail or a couple of key words on this website to know whether it is a Spam E-Mail or a legitimate E-Mail.
2. www.hoaxbusters.org: This is an excellent website containing a large database of common Internet hoaxes. It is maintained by the Computer Incident Advisory Capability, which is a division of the US Department of Energy. Hoaxbusters contains information almost about every scam, legend and frivolous warning that exists on the Internet. For example, mail with the subject as “Breaking News” may contain the text as “Barack Obama refused to be the president of the US” and will end with the E-Mail signature as “CNN.”



Visit the weblink to learn few examples of hoax E-Mails at <http://www.westpac.com.au/security/fraud-and-scams/latest-hoax-email-examples>

5.2.1 Methods of Phishing

Let us understand the most frequent methods used by the phishers^[13] to entice the netizens to reveal their personal information on the Internet.

1. **Dragnet:** This method involves the use of spammed E-Mails, bearing falsified corporate identification (e.g., corporate names, logos and trademarks), which are addressed to a large group of people (e.g., customers of a particular financial institution or members of a particular auction site) to websites or pop-up windows with similarly falsified identification. Dragnet phishers do not identify specific prospective victims in advance. Instead, they rely on false information included in an E-Mail to trigger an immediate response by victims – typically, clicking on links in the body of the E-Mail to take the victims to the websites or pop-up windows where they are requested to enter bank or credit card account data or other personal data.
2. **Rod-and-reel:** In this method, phishers identify specific prospective victims in advance, and convey false information to them to prompt their disclosure of personal and financial data. For example, on the phony webpage, availability of similar item for a better price (i.e., cheaper price) is displayed which the victims may be searching for and upon visiting the webpage, victims were asked for personal information such as name, bank account numbers and passwords, before confirming that the “sale” and the information is available to the phisher easily.
3. **Lobsterpot:** This method focuses upon use of spoofed websites. It consists of creating of bogus/phony websites, similar to legitimate corporate ones, targeting a narrowly defined class of victims, which is likely to seek out. See Box 5.4 to know more about other attacks launched on the legitimate websites to grab the user's personal information. These attacks are also known as “content injection Phishing.” Visit <http://www.microsoft.com/protect/fraud/phishing/symptoms.aspx> to see the example of a deceptive URL address linking to a scam website. The phisher places a weblink into an E-Mail message to make it look more legitimate and actually takes the victim to a phony scam site, which appears to be a legitimate website or possibly a pop-up window that looks exactly like the official site. These fake sites are also called “spoofed” websites. Once the netizen is into one of these spoofed sites, he/she might unwittingly send personal information to the con artists. Then they often use your information to purchase goods, apply for a new credit card or otherwise steal your identity. Box 5.5 explains Phishing vis-à-vis Spoofing.
4. **Gillnet:** This technique relies far less on social engineering techniques and phishers introduce Malicious Code into E-Mails and websites. They can, for example, misuse browser functionality by injecting hostile content into another site's pop-up window. Merely by opening a particular E-Mail, or browsing a particular website, netizens may have a Trojan Horse introduced into their systems. In some cases, the Malicious Code will change settings in user's systems so that users who want to visit legitimate banking websites will be redirected to a look alike Phishing site. In other cases, the Malicious Code will record user's keystrokes and passwords when they visit legitimate banking sites, and then transmit those data to phishers for later illegal access to users' financial accounts. We will discuss more on this in the next section while understanding Phishing techniques used by phishers.

Box 5.4 Website Spoofing, XSS and CSRF

Website Spoofing: It is the act of creating a website, as a hoax, with the intention of misleading readers that the website has been created by a different person or organization. Normally, the website will adopt the design of the target website and it sometimes has a similar URL.^[14]

2. The graphical illustrations available on www.m86security.com^[2] exhibit the following facts:
 - Monitoring of continent of origin from where Phishing E-Mails are sent. Europe is the dominant source of Phishing E-Mails.
 - Facebook, HSBC, Paypal and Bank of America are the most targeted organizations in Phishing attacks.
 - US, India and China are the most targeted countries to launch Phishing attacks.
3. The Phishing attacks are monitored on daily basis and displayed on www.phishtank.com.^[3] The statistics displayed are “phishes verified as valid” and “suspected phishes submitted.” It is important to note that more than five million E-Mails are identified as “verified and valid” phished E-Mails almost everyday.
4. According to May 2009 Phishing Monthly Report compiled by Symantec Security Response Anti-Fraud Team^[4]:
 - Total 3,650 non-English Phishing websites were recorded in the month of May 2009 and out of these, French language Phishing sites were the most frequently recorded followed by websites in Italian and Chinese languages.
 - Phishing URLs are categorized based on the top-level domains (TLDs). The most used TLDs in Phishing websites during the month of May 2009 were “.com,” “.net” and “.org” comprising 50%, 9% and 5%, respectively.
5. Phishing Activity Trends Report of Q4-2009^[5] published by Anti-Phishing Working Group (APWG, see Box 5.1) states the Phishing attack trends and statistics for the quarter. It is important to note that:
 - Financial organizations, payment services and auction websites are ranked as the most targeted industry.
 - Port 80 is found to be the most popular port in use followed by Port 443 and Port 8080 among all the phishing attacks.

This chapter aims to lay the foundation to understand Phishing and different techniques and methods of Phishing attacks. One needs to wear *HAT* and put oneself into the *SHOES* of the phisher (scammers who perpetrate Phishing scams) to understand Phishing. Phishers are also getting educated and attempt new methods and techniques to victimize netizens. Therefore, it is crucial to discuss about countermeasures to avoid becoming victim of Phishing attacks, which we have discussed at the end of this chapter. “Phishing”

Box 5.1 APWG (Anti-Phishing Working Group)

The Anti-Phishing Working Group (APWG) – www.antiphishing.org – is an international consortium, founded in 2003 by David Jevans, to bring security products and services companies, law enforcement agencies, government agencies, trade association, regional international treaty organizations and communications companies together, who are affected by Phishing attacks.

APWG has more than 3,200+ members from more than 1,700 organizations and agencies across the globe. To name a few, member organizations are leading security companies such as BitDefender, Symantec, McAfee, VeriSign and IronKey. ING Group, VISA, Mastercard and the American Bankers Association are the members from financial industry.

APWG is focused on eliminating identity theft that results from the growing attacks/scams of Phishing and E-Mail Spoofing. APWG provides a platform to discuss Phishing issues, define the scope of the Phishing problem in terms of costs and share information about best practices to eliminate these attacks/scams.

Source: http://en.wikipedia.org/wiki/Anti-Phishing_Working_Group (9 June 2010).

attacks and “ID theft” both have an impact on individual’s “privacy.” Detailed discussion about “privacy” from all perspectives can be found in Ref. #2, Books, Further Reading.

5.2 Phishing



The word Phishing comes from the analogy that Internet scammers are using E-Mail lures to fish for passwords and financial data from the sea of Internet users. The term was coined in 1996 by hackers who were stealing AOL Internet accounts by scamming passwords from unsuspecting AOL users. As hackers have a tendency of replacing “f” with “ph” the term Phishing came into being.

Source: <http://www.webopedia.com/DidYouKnow/Internet/2005/phishing.asp> (9 June 2010).

Let us take a look at some definitions of the term “Phishing.”

1. **Wikipedia:** It is the criminally fraudulent process of attempting to acquire sensitive information such as usernames, passwords and credit card details by masquerading as a trustworthy entity in an electronic communication.^[6]
2. **Webopedia:** It is an act of sending an E-Mail to a user falsely claiming to be an established legitimate enterprise in an attempt to scam the user into surrendering private information that will be used for ID theft. The E-Mail directs the user to visit a website where they are asked to update personal information, such as passwords and credit card, social security and bank account numbers that the legitimate organization already has. The website, however, is bogus and set up only to steal the users’ information.^[7]
3. **TechEncyclopedia:** It is a scam to steal valuable information such as credit card and social security numbers (SSN), user IDs and passwords. It is also known as “brand Spoofing.” An official-looking E-Mail is sent to potential victims pretending to be from their bank or retail establishment. E-Mails can be sent to people on selected lists or any list, expecting that some percentage of recipients will actually have an account with the organization.^[8]

In summary, Phishing is a type of *deception designed to steal your identity* (i.e., a kind of ID theft fraud). In Phishing schemes, the phisher tries to get the user to disclose valuable personal data – such as credit card numbers, passwords, account data or other information – by convincing the user to provide it under false pretenses. E-Mail is the popular medium used in the Phishing attacks and such E-Mails are also called as Spams; however, not all E-Mails are spam E-Mails. It is important to understand these types of E-Mails with which we deal everyday. We will discuss two such E-Mails: (A) Spam E-Mails (introduced in Section 1.5.2, Chapter 1) and (B) hoax E-Mails.

A. Spam E-Mails

Also known as “junk E-Mails” they involve nearly identical messages sent to numerous recipients. Spam E-Mails have steadily grown since the early 1990s. Botnets (explained in Chapters 1 and 2), networks of virus-infected computers, are used to send about 80% of Spam. Types of Spam E-Mails are as follows:

1. **Unsolicited bulk E-Mail (UBE):** It is *synonym for SPAM* (introduced in Box 1.5, Chapter 1) – unsolicited E-Mail sent in large quantities (see Box 5.2).
2. **Unsolicited commercial E-Mail (UCE):** Unsolicited E-Mails are sent in large quantities from commercial perspective, for example, advertising. See Box 5.3 to know more about US Act on Spam mails.

Box 5.2 SPAMBOTS

SPAMBOT is an automated computer program and/or a script developed, mostly into "C" programming language, to send Spam mails. SPAMBOTS gather the E-Mail addresses from the Internet, to build mailing lists to send unsolicited E-Mail. SPAMBOTS are also known as web crawlers, as they gather E-Mail addresses from numerous websites, chatroom conversations, newsgroups and special-interest group (SIG) postings. SPAMBOT begins its scan on a webpage and search for two things: (a) hyperlinks and (b) E-Mail addresses. It gathers and stores E-Mail addresses and crawls (i.e., follows) through each hyperlink to a new page to gather E-Mail addresses.

The term SPAMBOT is also sometimes used with reference to a program designed to prevent Spam to reach the subscribers of an Internet service provider (ISP). Such programs are called *E-Mail blockers* or *filters*. Such E-Mail blocker and/or filter, occasionally, may block a legitimate E-Mail message which could not be delivered to the intended recipient. This can be avoided by allowing each subscriber to generate a whitelist of specific E-Mail addresses the blocker should pass.

Source: <http://en.wikipedia.org/wiki/Spambot> (26 July 2010).

Box 5.3 CAN-SPAM Act

The CAN-SPAM Act of 2003 (15 U.S.C. 7701, et seq., Public Law No. 108-187, was S.877 of the 108th US Congress), signed into law by President George W. Bush on 16 December 2003, establishes the United States' first national standards for the sending of commercial E-Mail and requires the Federal Trade Commission (FTC) to enforce its provisions. The acronym CAN-SPAM derives from the bill's full name: Controlling the Assault of Non-Solicited Pornography And Marketing Act of 2003. This can also be a play on the usual term for unsolicited E-Mail of this type of Spam. The bill was sponsored in Congress by Senators Conrad Burns and Ron Wyden.

Visit the weblink <http://www.ftc.gov/bcp/edu/pubs/business/ecommerce/bus61.shtm> to know more about this act (see Fig. 1.13, Chapter 1 and Section "Spam Laws" under Section 6.2.2, Chapter 6).

The CAN-SPAM Act is commonly referred to as the "You-Can-Spam" Act because the bill explicitly legalizes most E-Mail Spam. In particular, it does not require E-Mailers to get permission before they send marketing messages. It also prevents states from enacting stronger anti-Spam protections, and prohibits individuals who receive Spam from suing spammers. The Act has been largely unenforced, despite a letter to the FTC from Senator Burns, who noted that "Enforcement is a key factor with regard to the CAN-SPAM legislation." In 2004, less than 1% of Spam was complied with the CAN-SPAM Act of 2003 (see Example 16, Section 11.2.16, Chapter 11 in CD).

Source: http://en.wikipedia.org/wiki/CAN-SPAM_Act_of_2003 (9 June 2010).

Spam E-Mails proved to be a popular medium for phishers to scam users to enter personal information on fake websites using E-Mail forged to look like as if it is from a bank or other organizations such as:^[9]

1. **HSBC, Santander, CommonWealth Bank:** International Banks having large customer base, phishers always dive deep in such ocean to attempt to hook the fish.
2. **eBay:** It is a popular auction site, often mimicked to gain personal information.
3. **Amazon:** It was the top brand to be exploited by phishers till July 2009.
4. **Facebook:** Netizens, who liked to be on the most popular social networking sites such as Facebook, are always subject to threats within Facebook as well as through E-Mail. One can reduce chances of being victim of Phising attack by using the services – security settings to enable contact and E-Mail details as private. In Chapter 7 (Section 7.14) security and privacy threats from social networking sites are discussed.

Box 5.4 Website Spoofing, . . . (Continued)

Cross-site scripting (XSS): XSS^[15] is a type of computer security vulnerability typically found in web applications that enable malicious attackers to inject client-side script into webpages viewed by other users. An exploited cross-site scripting vulnerability can be used by attackers to bypass access controls such as the same origin policy.

1. John often visits a particular website that is hosted by Bill. Bill's website allows John to log in with a username/password pair and store sensitive information such as billing information.
2. Bruce observes that Bill's website contains a reflected XSS vulnerability.
3. Bruce crafts a URL to exploit the vulnerability, and sends John an E-Mail, enticing him to click on a link for the URL under false pretenses.
4. John visits the URL provided by Bruce while logged into Bill's website.
5. The malicious script embedded in the URL executes in John's browser, as if it came directly from Bill's server. The script can be used to send John's session cookie to Bruce. Bruce can then use the session cookie to steal sensitive information available to John (authentication credentials, billing info, etc.) without John's knowledge.

Cascading style sheets is referred to as CSS, hence cross-sites scripting is referred to as XSS. CSS is a style sheet language used to describe the presentation semantics (i.e., look and formatting) of a document written in a markup language such as HTML and XHTML.

Cross-site request forgery (XSRF): XSRF^[16] is also known as a one-click attack or session riding (abbreviated as CSRF or XSRF) and is a type of malicious exploit of a website whereby unauthorized commands are transmitted from a user that the website trusts. Unlike cross-site scripting (XSS), which exploits the trust a user has on a particular site, CSRF exploits the trust that a site has in a user's browser.

1. Bill might be browsing a chat forum where another user, Bruce, has posted a message.
2. Bruce has crafted an HTML image element that references a script on Bill's bank's website.
3. In case Bill's bank keeps his authentication information in a cookie, and if the cookie has not expired, then the attempt by Bill's browser to load the image will submit the withdrawal form with his cookie, thus authorizing a transaction without Bill's approval.
4. This case displays Bill's web browser that is confused into misusing Bill's authority at Bruce's direction.

Box 5.5 Phishing vis-à-vis Spoofing

1. Phishing is used to get the victim to reveal valuable (or at times invaluable) information about him/her. Phishers would use Spoofing to create a fake E-Mail.
2. Spoofing is not intended to steal information but to actually make the victim do something for phishers.
3. Phishing may, at times, require Spoofing to entice the victim into revealing the information but Spoofing does not always necessarily result in Phishing someone else's account.

The Combined Attack – Phishing and Spoofing

Phisher sends an E-Mail, during Income Tax return filing period, from an official looking IT (Income Tax) account which is spoofed. The E-Mail would contain URL to download a new tax form that was recently issued. Once the victim clicks the URL, a "virus cum Trojan Horse" is downloaded to the victim's system. The IT Form may seem official, but like a Trojan Horse, the payload (explained in Section 2.7, Chapter 2) has already been delivered. The virus lies in wait, logging the actions of the victim. Once the victim inputs certain keywords, like bank names, credit card names, social networking websites and so forth, it logs the site and the passwords used. Those results are flagged and sent to the phisher. The virus could then gather the user's E-Mail contacts and send a fake E-Mail to them as well, containing the virus. The phisher now has gained the required personal information as well as virus was sent, downloaded and spread to entice other netizens.

5.2.2 Phishing Techniques

In this section we will discuss common ways, the techniques^[17] used by phishers to launch Phishing attacks.

1. **URL (weblink) manipulation:** URLs are the weblinks (i.e., Internet addresses) that direct the netizens/users to a specific website. In Phishing attack, these URLs are usually supplied as misspelled, for example, instead of www.abcbank.com, URL is provided as www.abcbank1.com. Phishers use Lobsterpot method of Phishing and make the difference of one or two letters in the URLs, which is ignored by netizens. This makes a big difference and it directs users to a fake/bogus website or a webpage. See Box 5.6 to know about an advanced Phishing attack known as homograph attack.
2. **Filter evasion:** This technique use graphics (i.e., images) instead of text to obviate from netting such E-Mails by anti-Phishing filters. Normally, these filters are inbuilt into the web browsers. For example,
 - Internet Explorer version 7 has inbuilt “Microsoft phishing filter.” One can enable it during the installation or it can be enabled post-installation. It is important to note that it is *not enabled* by default.
 - Firefox 2.0 and above has inbuilt “Google Phishing filter,” duly licensed from Google. It is enabled by default.
 - The Opera Phishing filter is dubbed Opera Fraud Protection and is included in version 9.5+.
3. **Website forgery:** In this technique the phisher directs the netizens to the website designed and developed by him, to login into the website, by altering the browser address bar through JavaScript commands. As the netizen logs into the fake/bogus website, phisher gets the confidential information very easily. Another technique used is known as “cloaked” URL – domain forwarding and/or inserting control characters into the URL while concealing the weblink address of the real website.
4. **Flash Phishing:** Anti-Phishing toolbars are installed/enabled (see Table 5.2) to help checking the web-page content for signs of Phishing, but have limitations that they do not analyze flash objects at all. Phishers use it to emulate the legitimate website. Netizens believe that the website is “clean” and is a real website because anti-Phishing toolbar is unable to detect it.
5. **Social Phishing:** Phishers entice the netizens to reveal sensitive data by other means and it works in a systematic manner.
 - Phisher sends a mail as if it is sent by a bank asking to call them back because there was a security breach.
 - The victim calls the bank on the phone numbers displayed in the mail.
 - The phone number provided in the mail is a false number and the victim gets redirected to the phisher.
 - Phisher speaks with the victim in the similar fashion/style as a bank employee, asking to verify that the victim is the customer of the bank. For example, “Sir, we need to make sure that you are indeed our customer. Could you please supply your credit card information so that I can verify your identity?”
 - Phisher gets the required details swimmingly.
6. **Phone Phishing:** We have explained “Mishing” – mobile Phishing attacks (“Vishing” and “Smishing”) in Chapter 3. Besides such attacks, phisher can use a fake caller ID data to make it appear that the call is received from a trusted organization to entice the users to reveal their personal information such as account numbers and passwords. See Box 5.7 to understand the innovative Phishing attack launched on “Android Market” website.

Box 5.6 Homograph Attack

The meaning of homograph is that two words are spelled the same way but differ in meaning (e.g., fair). Phishers use homograph attack on the Internationalized Domain Name (IDN) to deceive the netizens by redirecting them on the phony website which look like the original website.

ASCII has several characters and/or pairs of characters which look alike, for example, "0" (zero) and "O" (o alphabet in uppercase), "1" (L alphabet in lowercase) and "I" (i alphabet in uppercase). For example, the original website www.GOOGLE.com can be registered as www.G00GLE.com. Another example could be www.microsoft.com could be juggled as www.rnicrosoft.com (the letter "m" has been replaced with "r" and "n"). This phenomenon opens a rich vein of opportunities for Phishing attacks. The phisher could create and register a domain name which appears almost identical to an existing domain and takes the netizen to the phony website. Phisher could send E-Mail messages displaying the URL of a phony website, purporting to come from the original site, but directing netizens to the phony website. The phisher could easily record information such as passwords or account details through this spoofed website, while passing traffic through the original website. The netizens will never be able to notice the difference, until some suspicious or unusual activity occurs with their accounts. Visit <http://www.xn--goole-tmc.com/> to experience the explained phenomenon.

Source: http://en.wikipedia.org/wiki/IDN_homograph_attack (25 October 2010).

Box 5.7 Phishing Attack Launched through Android Market

Android: It is an open-source operating system (OS) for mobile phones and is based on Linux kernel. This OS has recently gained popularity with the release of Google's Nexus One phone. The Android Market is similar to iPhone App Store. Currently, around 22,000 applications are available on the Android Market.

According to an article available on <http://news.softpedia.com>, a malware writer succeeded to list a rogue Phishing application called 09Droid on the Android Market website. The application posed to be a shell for mobile banking applications, but, instead found, it is being used to obtain (steal) online banking credentials.

Travis Credit Union (TCU) issued an alert immediately, during the first week of December 2009, stating "Your mobile device may be at risk if you downloaded an application provided by 09Droid from the Android Marketplace; applications from 09Droid are NOT an authorized or legitimate downloadable application for TCU Mobile Banking." TCU also notified its customers through its website, Facebook page and E-Mail, although its services were not targeted by the rogue application.

First Tech Credit Union also issued a similar warning, stating "The financial institution recommends that affected users take their phone to their mobile operator in order to make sure all traces of the malware are removed. The application attempts to steal financial information from consumers, for the likely purpose of Identity Theft."

Source: <http://news.softpedia.com/news/Phishing-Attack-Launched-from-Android-Market-131793.shtml> (26 July 2010).

Phishers usually take a broad approach by sending millions of E-Mail messages that appear to come from popular banks, online auction houses and other business houses. These E-Mail messages, pop-up windows and the websites appear to be official so that they can deceive many netizens to believe that they are legitimate. Unsuspecting netizens often respond to these requests for credit card numbers, passwords, account information or other personal and financial data. According to the 2009 Consumer Reports State of the Net Survey,^[18] Phishing scams cost US\$ 483 million in the US. Thus, we see that Phishing scams involve fraudulent E-Mail messages or fake websites designed to steal identity. Scam artists "phish" in an attempt to persuade millions of netizens/Internet users to disclose sensitive information. Now there is a new version of

an old scam called “Spear Phishing,” a targeted E-Mail attack that a scammer sends only to people within a small group, which is explained in the next section.

5.2.3 Spear Phishing

“Spear Phishing” is a method of sending a Phishing message to a particular organization to gain organizational information for more targeted social engineering. Here is how Spear Phishing scams work; Spear Phishing describes any highly targeted Phishing attack. Spear phishers send E-Mail that appears genuine to all the employees or members within a certain company, government agency, organization or group. The message might look like as if it has come from your employer, or from a colleague who might send an E-Mail message to everyone in the company (such as the person who manages the computer systems); it could include requests for usernames or passwords. Unfortunately, through the modus operandi of the Spear phishers, the E-Mail sender information has been faked or “spoofed.” While traditional Phishing scams are designed to steal information from individuals, Spear Phishing scams work to gain access to a company’s entire computer system. If you respond with a username or password, or if you click on the links or open the attachments in a Spear Phishing E-Mail, pop-up window or website, then you might become a victim of ID theft and you might put your employer or group at risk.

Spear Phishing also describes scams that target people who use a certain product or website. Scam artists use any information they can to personalize a Phishing scam to as specific a group as possible. Thus, “Spear Phishing” is a targeted E-Mail attack that a scammer sends only to people within a small group, such as a company. The E-Mail message might appear to be genuine, but if you respond to it, you might put yourself and your employer at risk. You can help avoid Spear Phishing scams by using some of the same techniques you have already used to help avoid standard Phishing scams (see Box 5.8).

Whaling

This is a specific form of “Phishing” and/or “Spear Phishing” – targeting executives from the top management in the organizations, usually from private companies. The objective is to swindle the executives into revealing confidential information. Whaling targets C-level executives sometimes with the help of information gleaned through Spear Phishing, aimed at installing malware for keylogging or other backdoor access mechanisms.



The names given to various *Internet scams* are found to be amusing. *Whaling* may have been derived from the fact that the people targeted are *top-ranking executives*. The difference between Spear Phishing and whaling appears to be a bit cloudy. It seems, whaling involves more extensive reconnaissance about the target rather than the target being enticed to be a victim of Spear Phishing attack.

E-Mails sent in the whaling scams are designed to masquerade as a critical business E-Mail sent from a legitimate business body and/or business authority. The content of an E-Mail usually involves some kind of falsified industry-wide concern and is meant to be tailored for executives.

Whaling phishers have also forged official looking FBI subpoena E-Mails and claimed that the manager needs to click a link and install special software to view the subpoena. In the case of the recent 2008 FBI subpoena whaling scam, 20,000 corporate CEOs were attacked. Approximately 2,000 of them fell for it and clicked on the whaling link, believing it would download a “special” browser add-on to view the entire subpoena document. In truth, the linked software was a keylogger that secretly recorded the CEOs passwords

and forwarded those passwords to the phisher men. As a result, each of the 2,000 compromised companies were further hacked in some way; a few of them were particularly damaged by the attacks.^[19]

Although the countermeasures of Phishing are covered at the end of Phishing section, however, see Box 5.8 to understand the countermeasures for Spear Phishing.

5.2.4 Types of Phishing Scams

We have seen how phishers use numerous methods and techniques to launch Phishing attacks. The prevalent types of Phishing^[20] scams are discussed in this section.

1. **Deceptive Phishing:** Phishing scams started by broadcasting deceptive E-Mail messages with the objective of ID theft. E-Mails are broadcasted to a wide group of netizens asking about the need to verify banking account information/system failure requiring users to re-enter their personal information/fictitious account charges and/or undesirable account changes/new free services requiring quick action. The netizens easily get enticed and reveal their information by responding to these E-Mails and/or clicking on weblinks or signing onto a fake website designed by the phisher.
2. **Malware-based Phishing:** It refers to scams that involve running Malicious Code on the netizens system. Malware can be launched as an E-Mail attachment or as a downloadable file from a website or by exploiting known security vulnerabilities. For example, small and medium businesses are always found to be ignorant to keep their operating systems (OS) antivirus software up to date with latest patch updates released by vendors. (See Section “The Bane of Malware” under Section 9.3, Chapter 9)
3. **Keyloggers:** We have explained keyloggers in Chapter 4. Malware can embed a keylogger to track keyboard input and send relevant information, maybe the keylogger log, to the phisher through the Internet. The keyloggers can also be embedded into netizen's browser as a small utility program which can start automatically when the browser is opened or can be embedded into system files as device drivers.
4. **Session hijacking:** It is an attack in which netizens' activities are monitored until they establish their bona fide credentials by signing into their account or begin the transaction and at that point the Malicious Code takes over and comport unauthorized actions such as transferring funds without netizen's knowledge. See Box 5.9 to know more about “advanced form of Phishing.”
5. **In-session Phishing:** It is a Phishing attack based upon one web browsing session being able to detect the presence of another session (such as visit to an online banking website) on the same web browser and then a pop-up window is launched that pretends to be opened from the targeted session.

Box 5.8 Avoiding Spear Phishing Scams

There are few precautions you can take to avoid making yourself a victim of Phishing scam:

1. Never reveal personal or financial information in a response to an E-Mail request, no matter who appears to have sent it.
2. If you receive an E-Mail message that appears suspicious, call the person or organization listed in the From line before you respond or open any attached files.
3. Never click links in an E-Mail message that requests personal or financial information. Enter the web address into your browser window instead.
4. Report any E-Mail that you suspect might be a Spear Phishing campaign within your company.
5. You can use the Phishing filter – it scans and helps identify suspicious websites, and provides up-to-the-hour updates and reports about known Phishing sites (see Table 5.2 and Box 5.13, Chapter 5).

Box 5.9 Advanced Form of Phishing – Tabnapping or Tabjacking

Tabs are the web browser tabs and browser tabs that are not in use are called as napping. Most often, netizens work with multiple tabs open with different Web-browsing sessions on each one. In fact, netizens go hours without even realizing that, they have multiple tabs open.

When a netizen visits legitimate website such as banking website and opens a genuine webpage and that webpage is not used, that is, it is kept idle for some time because may be netizen starts surfing other website (i.e., Googling) then, and when the netizen returns back to banking webpage, he/she gets redirected to phished webpage and he/she does not notice it, as he/she never closed the tab.

Phishers have identified a way to invade the browser tabs and change (i.e., replace) it to a page designed to steal the personal information. This is done by checking whether the webpage is idle for a particular time-period, and then phisher redirects the victim to a phished webpage. Phisher judge the idle webpages based on mouse movement, scroll bar movement and keystrokes.

Websites from banking/financial institutes as well as popular sites like Gmail, Orkut, Facebook and Yahoo are primary targets.

For example, netizen opens a tab to view the bank account. Netizen login on the website with his/her user ID and password and then go to another tab. While working with the other tab, phisher replaces the legitimate bank site webpage with a cloned login page developed to steal personal information. When he/she goes back to the tab, bank website, netizen assumes the webpage has timed out and hence requesting you to re-enter your password. If you do then you give the hacker access to your account.

Netizen believes this pop-up window is being a part of the targeted session and is used to steal netizen's personal information/data in the same way as with other Phishing attacks. The advantage of in-session Phishing attack is the phisher does not need the targeted website to be compromised but to rely on modern web browsers to support more than one session. To know more about this, visit http://en.wikipedia.org/wiki/In-session_Phishing (8 June 2010).

6. **Web Trojans:** It pops up to collect netizen's credentials and transmit them to the phisher while netizens are attempting to log in. Such pop-ups are usually invisible.
7. **Pharming:** It is a new threat evolved with a goal to steal online identity of the netizens and Pharming is known as one of the "P" in cybercrime (see Box 5.10).

In Pharming, following two techniques are used:

- **Hosts file poisoning:** The most popular operating system (OS) in the world is *Windows* and it has "host names" in their "hosts" file. A simple text file was used in web address (i.e., URL of website) during early days of the Internet [(i.e., before undertaking a DNS (Domain Name Server) lookup)]. Phisher used to "poison" the host file to redirect the netizen to a fake/bogus website, designed and developed by the phisher, which will "look alike" the original website, to steal the netizen's personal information easily.
 - **DNS-based Phishing:** Phisher tampers with a DNS so that requests for URLs or name service return a fake address and subsequently netizens are directed to a fake site. Netizens usually are unaware that they are entering their personal confidential information in a website controlled by phishers and probably not even in the same country as the legitimate website. DNS-based Phishing is also known as DNS hijacking. Along with this attack Click Fraud is an advanced form of technique evolved to conduct Phishing scams (see Box 5.11).
8. **System reconfiguration attacks:** Phisher can intrude into the netizens' system (i.e., computer) to modify the settings for malicious purposes. For example, URLs saved under *favorites* in the browser might be modified to redirect the netizen to a fake/bogus "look alike" websites (i.e., URL for a website of a bank can be changed from "www.xyzbank.com" to www.xyzbanc.com.).

Box 5.10 Three Ps of Cybercrime – Phishing, Pharming and Phoraging

1. Pharming: It is an attack aiming to redirect a website's traffic to another bogus website. The term Pharming is a neologism based on "farming" and "Phishing."^[21] Pharming has become a major concern for businesses hosting E-Commerce and online banking websites. In Pharming, an attacker cracks vulnerability in an Internet service provider's (ISP) DNS server and hijacks the domain name of a commercial site. Therefore, anyone going to the legitimate site is then redirected to an identical but bogus site.

Antivirus softwares and Spyware removal softwares cannot protect against Pharming. The most efficient way to prevent Pharming is to ensure using secure web connections like HTTPS to access websites such as banking or financial institutions and at the same time accept the valid public-key certificates issued by trusted sources. A certificate from an unknown organization or an expired certificate should not be accepted.

2. Phoraging (pronounced foraging): It is defined as a process of collecting data from many different online sources to build up the identity of someone with the ultimate aim of committing identity theft.^[22]

Phoraging is information diving – searching for information with the aim of identity theft whereby a phisher collects data from various sources such as social networking sites, viruses and Spyware to build up the identity of a person.

The phishers always work in a smarter way, hence nowadays they are focusing on "matrimonial sites" as well as "social networking sites for professionals" (e.g., www.linkedin.com) to reveal personal information such as date of birth, personal E-Mail address, contact details and what not as the members (i.e., users of these websites) cannot post false information on these websites!!

Box 5.11 DNS Hijacking and Click Fraud

DNS hijacking: It is also known as DNS redirection and it is the practice of redirecting the resolution of Domain Name Server (DNS) names to rogue DNS servers, particularly for the practice of Phishing or to direct users' HTTP traffic to the ISP's own web servers where advertisements are served.^[23]

An illegal change to a DNS server directs URL to a different website. In some cases, the new website's URL may have one different letter in the name that might go unnoticed. The bogus website might offer similar and/or competing products for sale, or it may be a vehicle to publicly smear the reputation of the intended website.^[24]

DNS is used to interpret domain names such as www.<domainname>.com (e.g., www.yahoo.com) into an IP address. The IP address consists of numbers such as XXX.XX.XXX.X (e.g., 107.60.132.4) that give the domain a unique identification. An IP address is one-of-a-kind and unique; therefore, it can be used to trace Internet activity back to the PC user as well as identify the exact location of a website. Domain names are used to identify websites because they are easier to remember than a series of numbers that make up an IP address.

DNS hijacking is used by attackers with malicious intent who redirect or "hijack" the DNS addresses to bogus DNS servers for the purpose of injecting malware into your PC, promoting Phishing scams, advertising on high-traffic websites and any other related form of criminal activity.

Once the DNS address is hijacked to a bogus DNS server, it translates the legitimate IP address or DNS name into the IP addresses of malicious websites. DNS hijacking can occur with any website large or small and turn those websites into malicious websites without the knowledge of the netizens.

As the website owners depend upon legitimate DNS servers issued by their ISP, DNS hijackers use malware in the form of a Trojan to exchange the legitimate DNS server assignment by the ISP with a manual DNS server assignment from a bogus DNS server.

When netizens visit the reputable websites with legitimate domain names, they are automatically hijacked to a malicious website that is disguised as the legitimate one. The switch from the legitimate DNS server to the bogus DNS server goes unnoticed by both the netizen and the legitimate website owner. This opens up the malicious website to perform any criminal act that the phisher wishes because the netizen thinks that he/she is on the real website.

Box 5.11 DNS Hijacking . . . (Continued)

DNS hijacking also promotes Click Fraud with such programs as Google Adsense. As there are numerous DNS servers that are bogus, they form a network of websites which results in a lot of traffic. When there is a lot of traffic then you will find a lot of people clicking which results in Click Fraud. The attackers can rack up a lot of money with "click throughs" from programs such as Google Adsense who pay a commission for each click.

Click Fraud: It is a type of Internet crime that occurs in pay-per-click online advertising when a person automated script or computer program imitates a legitimate user of a web browser clicking on an advertisement (ad) for the purpose of generating a charge per click without having actual interest in the target of the ad's link. Click Fraud is the subject of some controversy and increasing litigation because of the advertising networks being a key beneficiary of the fraud.^[25]

It is an illegal practice that occurs when individuals click on a website click through advertisements (either banner ads or paid text links) to increase the payable number of click throughs to the advertiser. The illegal clicks could be either performed by having a person manually clicking the advertising hyperlinks or by using automated software or online Bots (see Section 2.6, Chapter 2) that are programmed to click these banner ads and pay per click text ad links. Research has indicated that Click Fraud is perpetrated by individuals who use Click Fraud to increase their own personal banner ad revenues and also by companies who use Click Fraud as a way to deplete a competitor's advertising budget.^[26] Visit the weblinks mentioned below to explore more on Click Fraud:

1. Exposing Click Fraud: http://news.cnet.com/Exposing-click-fraud/2100-1024_3-5273078.html (18 June 2010).
2. The dark side of online advertising: http://www.businessweek.com/magazine/content/06_40/b4003001.htm (18 June 2010).

Click forensics is the industry leader in scoring, auditing and improving traffic quality for the online advertising community. For online advertisers, traffic quality management aims to improve campaign performance. The goal is to exclude low-quality traffic, eliminate Click Fraud and improve conversion rates. Click forensics optimizes online advertising campaigns. For online publishers, traffic quality management will attract and retain advertisers and ad networks to increase spend and earnings of ad per click. Click forensics has partnered with Yahoo! Click forensics is the leader in eliminating Click Fraud and is the publisher of the Click Fraud Index and the founder of the Click Quality Council. To know more about click forensics, visit <http://www.clickforensics.com/>

9. **Data theft:** Critical and confidential data getting stolen is one of the biggest concerns in the modern times. As more and more information resides on the corporate servers and the Web (including what happens with "cloud computing"), attackers have a boom time because taking away/copying information in electronic form is so easy! Unsecured systems (e.g., computers enabled with the Internet facility and with inappropriate security settings) are often found to be inappropriately maintained from cybersecurity perspective. When such systems are connected, the web servers can launch an attack with numerous methods and techniques. Data theft is a widely used approach to business espionage. Phishers can easily make profit from selling the stealth confidential communications, design documents, legal opinions and employee-related records to those who may want to embarrass or cause economic damage to competitors.
10. **Content-injection Phishing:** In this type of scam, phisher replaces part of the content of a legitimate website with false content to mislead the netizen to reveal the confidential personal information. For example, Phisher may insert Malicious Code to capture netizen's credentials that can secretly collect information and send it to phisher.
11. **Man-in-the-middle Phishing:** In this type of attack, phisher positions himself between the netizen and the legitimate website or system. Phisher records the input being provided by the netizen

but continues to pass it on to the web server so that netizens' transactions are not affected. Later on phisher can either sell or use the information or credentials collected when the user is not active on the system. This attack is very difficult to detect compared to other forms of Phishing. In Chapter 11, the man-in-the-middle (MITM) attack is discussed and explained in detail.

12. **Search engine Phishing:** It occurs when phishers create websites with attractive sounding offers (often found too good to be true) and have them indexed legitimately with search engines. Netizens find websites during their normal course of search for products or services and are trapped to reveal their personal information. For example, phishers set up fake/bogus banking websites displaying an offer of lower credit costs or better interest rates than other banks. Netizens who use these websites to save or make more from interest charges are encouraged to transfer existing accounts and enticed to giving up their details. See Box 5.12 to know more about search engine optimization (SEO) attack, which is an advance form of technique used by the attackers nowadays.
13. **SSL certificate Phishing:** It is an advanced type of scam. Phishers target web servers with SSL certificates to create a duplicitous website with fraudulent webpages displaying familiar "lock" icon. It is important to note that, in such types of scams, SSL certificates are always found to be legitimate as they match the URL of the fake pages that are mimicking the target brands but in reality had no connection to these brands displayed. It is difficult to recognize such websites; however, smart netizens can detect such deception after reviewing the certificate and/or whether the website has been secured with an extended validation SSL certificate.^[27]

Box 5.12 SEO Attacks – Beware While Searching through Search Engines!

Search engine optimization (SEO) is the practice of maximizing the volume or quality of traffic to a website (such as a blog) from search engines via natural or unpaid search results as opposed to other forms of search engine marketing (SEM) which may deal with paid inclusion. SEO considers how search engines work and what people search for. Optimizing a website primarily involves editing its content and HTML and associated coding to increase both its relevance to specific keywords and to remove barriers to the indexing activities of search engines.^[28]

Black hat SEO or spamdexing is a technique^[30] which uses methods such as link farms, keyword stuffing and article spinning that degrade both the relevance of search results and the user experience of search engines. Search engines look for sites that employ these techniques to remove them from their indices.

According to security researcher Dancho Danchev, SEO attack abuses a common practice among websites – caching search queries – an activity designed to boost their rankings among major search engines, such as Google. Attackers inject common search terms and an iframe (<iframe> – HTML tag defines an inline frame that contains another document) script designed to send victims to other sites hosting Malicious Code. The search term and iframe redirect get cached in search engines such as Google.^[29]

The business of using SEO techniques to infuse legitimate websites has become a huge money spinner for attackers. The attackers take advantage of hottest news/stories on the Internet to spread malware – many of them profiting from high-profile deaths and disasters; for example, the death of celebrities such as Michael Jackson have provided rich attractive content for attackers trying to take advantage of trending news stories.

Techniques used for Black hat SEO attacks

1. **Fake antivirus:** Fake security alerts are flooded to netizens to entice them into executing the Malicious Code such as Activex Controls and/or paying for a bogus security product to install them.
2. **SEO page:** Pages stuffed with erroneous keywords, usually designed to feature highly in search engine results, are attacked to misdirect netizens to rogue websites. It is also known as SEO-poisoned pages.

Box 5.12 SEO Attacks – Beware While . . . (Continued)

3. **SEO poisoning:** It is a process of enticing search engine into ranking an SEO page high up in the search results and these results may be manipulated results known as "poisoned."
4. **Black hat SEO kits:** These tools are used to launch and manage SEO attack. They are also known as search engine crawlers that poison search results to redirect netizens to rogue (i.e., bogus) websites. (Readers may visit <http://www.blackhatseo.com> to know more about this tool).

Distributed Phishing Attack (DPA)

We learned that the most common Phishing attack is launched using an E-Mail and fraudulent webpage/website to web host structure. Phisher sends lure E-Mails that entice the victim to follow the URLs displayed in the E-Mail which directs him/her to the phisher's website. As the victim is unable to verify/check legitimacy of the webpage/website, he/she submits personal information. Most often, the Phishing messages and webpages/websites masquerade as banks/financial institutions, government agencies or some other trustworthy entity that could probably ask for personal information.

Distributed Phishing attack is an advanced form of Phishing attack that works as per victim's personalization of the location of sites collecting credentials and a covert transmission of credentials to a hidden coordination center run by the phisher.

In this attack a large number of fraudulent web hosts (i.e., servers controlled by the phisher) are used for each set of lured E-Mails. Each server collects only a tiny percentage of the victim's personal information. This minimizes the possibility that the phisher shutdown the fraudulent web host within hours of initial mailing due to risk of detection of the origin of the fraudulent E-Mail. Each victim is referred to a unique webpage and in the extreme case the benefits of detection are kept minimum. Even if the victim recognizes the fraudulent E-Mail as a component of a Phishing attack, disabling the web server and/or the weblink to the fraudulent web server will not prevent any other potential victims from being betrayed of their personal information. Phishers launch attacks through thousands of servers using collections of compromised systems such as Botnets and/or zombies (explained in Chapters 1 and 2).



Visit the weblink mentioned below to know more examples of Phishing attacks launched through fake/bogus E-Mails: <http://www.doshelp.com/scams-fraud/index.html>

5.2.5 Phishing Toolkits and Spy Phishing

A Phishing toolkit is a set of scripts/programs that allows a phisher to automatically set up Phishing websites that spoof the legitimate websites of different brands including the graphics (i.e., images and logos) displayed on these websites. Phishing toolkits are developed by groups or individuals and are sold in the underground economy. These sophisticated kits are typically difficult to obtain, are quite expensive, and are more likely to be purchased and used by well-organized groups of phishers, rather than average users.

Phishers use hypertext preprocessor (PHP) to develop the Phishing kits. PHP is a general purpose scripting language that was originally designed for web development of dynamic webpages. PHP code is embedded into the HTML source script and interpreted by a web server with the help of a PHP processor module.

Most of the Phishing kits are advertised and distributed at no charge and usually these *free Phishing kits* – also called DIY (Do It Yourself) Phishing kits – may hide backdoors through which the phished information is sent to recipients (may be to the authors of Phishing kits) other than the intended users.

Following are few examples of such toolkits:

1. **Rock Phish:** It is a Phishing toolkit popular in the hacking community since 2005. It allows non-techies to launch Phishing attacks. The kit allows a single website with multiple DNS names to host a variety of phished webpages, covering numerous organizations and institutes.
2. **Xrenoder Trojan Spyware:** It resets the homepage and/or the search settings to point to other websites usually for commercial purposes or porn traffic.^[31]
3. **Cpanel Google:** It is a Trojan Spyware that modifies the DNS entry in the host's file to point to its own website. If Google gets redirected to its website, a netizen may end up having a version of a website prepared by the phisher.^[31]



DIY (Do It Yourself) Phishing kits that are available and/or distributed free of cost, aim not only just to steal personal information but also to infect the system with malware by embedding client-side vulnerabilities.

5.2.6 Phishing Countermeasures

The countermeasures explained in Table 5.1 will prevent malicious attacks that phisher may target to gain the unauthorized access to the system to steal the relevant personal information about the victim, from the system. It is always challenging to recognize/judge the legitimacy of a website while Googling (i.e., surfing on the Internet) and find it more intriguing while downloading any attachment from that particular website (see KRESV test in Appendix C in CD). Box 5.13 explains about "How to recognize legitimate websites," while surfing on the Internet.

Table 5.1 | How to avoid being victim of Phishing attack

| Sr. No. | Security Measures | Brief Description |
|---------|---------------------------------------|--|
| 1 | Keep antivirus up to date | Important aspect is to keep antivirus software up to date because most antivirus vendors have signatures that protect against some common technology exploits. This can prevent things such as a Trojan disguising the web address bar or mimicking the secure link (i.e., HTTPS) |
| 2 | Do not click on hyperlinks in E-Mails | It should always be practiced that, in case an E-Mail has been received from unknown source, clicking on any hyperlinks displayed in an E-Mail should be avoided. This may lead to either the link taking the victim to the website created by the phisher or triggering a Malicious Code installation on the system. Instead, to check out the link, manually retyping it into a web browser is highly recommended. |
| 3 | Take advantage of anti-Spam software | Anti-Spam software can help keep Phishing attacks at a minimum. A lot of attacks come in the form of Spam and by using anti-Spam software, many types of Phishing attacks are reduced because the messages will never end up in the mailboxes of end-users. |

Table 5.1 | (Continued)

| <i>Sr. No.</i> | <i>Security Measures</i> | <i>Brief Description</i> |
|----------------|---|---|
| 4 | Verify https (SSL) | Ensure the address bar displays “https://” rather than just “http://” along with a secure lock icon than has been displayed at the bottom right-hand corner of the web browser while passing any sensitive information such as credit cards or bank information. One may like to check by double-clicking the lock to guarantee the third-party SSL certificate that provides the https service. Always ensure that the webpage is truly encrypted. |
| 5 | Use anti-Spyware software | Keep Spyware down to a minimum by installing an active Spyware solution such as Microsoft anti-Spyware and also scanning with a passive solution such as Spybot. If for some reason your browser is hijacked, anti-Spyware software can often detect the problem and provide a fix. |
| 6 | Get educated | Always update the knowledge to know new tools and techniques used by phishers to entice the netizens and to understand how to prevent these types of attacks. Report any suspicious activity observed to nearest cybersecurity cell. |
| 7 | Use the Microsoft Baseline Security Analyzer (MBSA) | The netizens on the Microsoft platform should use MBSA to ensure the system is up to date by applying all the security patches. MBSA is a free tool available on Microsoft’s website. This protects the IT systems against known exploits in Internet Explorer and Outlook (and Outlook Express) that can be used in Phishing attacks. |
| 8 | Firewall | Firewall can prevent Malicious Code from entering into the system and hijacking the browser. Hence, a desktop (software) such as Microsoft’s built-in software firewall in Windows-XP and/or network (hardware) firewall should be used. It should be up to date in case any cybersecurity patches have been released by the vendor. |
| 9 | Use backup system images | Always keep a backup copy or image of all systems to enable to revert to a original system state in case of any foul play. |
| 10 | Do not enter sensitive or financial information into pop-up windows | A common Phishing technique is to launch a bogus pop-up window when someone clicks on a link in a Phishing E-Mail message. This window may even be positioned directly over a legitimate window a netizen trusts. Even if the pop-up window looks official or claims to be secure, entering sensitive information should be avoided because there is no way to check the security certificate. |
| 11 | Secure the hosts file | The attacker can compromise the hosts file on desktop system and send a netizen to a fraudulent site. Configuring the host file to read-only may alleviate the problem, but complete protection will depend on having a good desktop firewall such as Zone Alarm that protects against tampering by outside attackers and keeps browsing safe. |
| 12 | Protect against DNS Pharming attacks | This is a new type of Phishing attack that does not Spam you with E-Mails but poisons your local DNS server to redirect your web requests to a different website that looks similar to a company website (e.g., eBay or PayPal). This is explained in Box 5.11. |

Source: See [32] in References section.

Box 5.13 How to Judge/Recognize Legitimate Websites

1. ScanSafe (www.scansafe.com) was the first company in the world (founded in 2004) to offer web security. Scandoo (www.Scandoo.com) scans all search results to protect the user from visiting false websites (i.e., websites that spread malicious viruses or Spyware as well as protecting the user from viewing offensive content). Presently this site is not available as improvements for add-on features based on users' feedback is underway.
2. McAfee SiteAdvisor software (www.siteadvisor.com) is a free web security plug-in that provides the user with red, yellow and green website security ratings based on the search results. These ratings are based on tests conducted by McAfee after looking for all kinds of threats such as to name a few Phishing sites, E-Commerce vulnerabilities, browser exploits, etc.

The screenshot shows a web browser window displaying several website reviews. On the left, there's a list of sites with their URLs and short descriptions. To the right, there are two sections: 'Rating Icons' and 'Secure Search Icons'.

Rating Icons:

- McAfee SECURE:** Tested daily for hacker vulnerabilities. (Icon: shield with checkmark)
- SAFE:** Very low or no risk issues. (Icon: checkmark inside circle)
- CAUTION:** Minor risk issues. (Icon: exclamation mark inside circle)
- WARNING:** Serious risk issues. (Icon: exclamation mark inside circle with cross)
- UNKNOWN:** Not yet rated. Use caution. (Icon: question mark inside circle)

Secure Search Icons:

- SECURE SEARCH BOX:** Worry free searching. (Icon: magnifying glass over a search bar)
- BROWSER BUTTON:** Validates site rating. (Icon: McAfee logo with a browser icon)

Source: <http://www.siteadvisor.com/howitworks/index.html>

In addition to the tools explained in Box 5.13, netizens may opt for anti-Phishing utilities (i.e., plug-ins) available for different browsers (Table 5.2) to be protected against Phishing attacks.

We learned that “E-Mail” is the popular medium used by phishers to entice the netizens; every netizen should imbibe it while responding to the received E-Mails. Hence, it is very important for the netizens who are not IT savvy (i.e., Techies – IT Professionals) but are Internet savvy (i.e., continuously surfing on the net) to discover the phished E-Mails. Figure 5.1 shows a simple flowchart explaining how to distinguish between a legitimate E-Mail and a phished E-Mail.

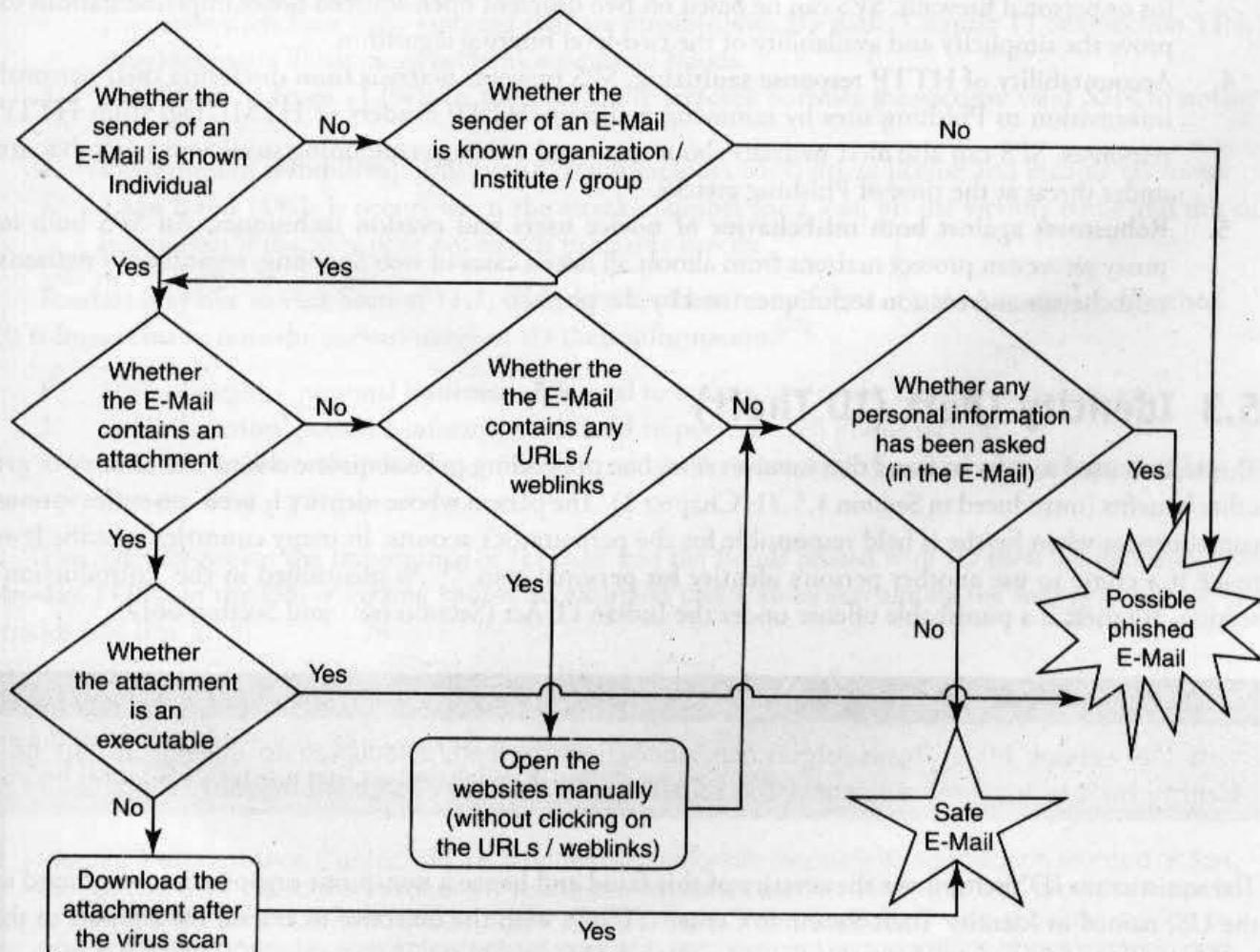
SPS Algorithm to Thwart Phishing Attacks

The proposal of system based on a simple filtering algorithm, Sanitizing Proxy System (SPS), has been suggested under the white paper by the authors Daisuke Miyamoto, Hiroaki Hazeyama and Youki Kadobayashi from Nara Institute of Science and Technology, Japan.

Table 5.2 | Anti-Phishing plug-ins

| Sr. No. | Title | Website | Brief Description |
|---------|---|---|--|
| 1 | Netcraft Toolbar | http://toolbar.netcraft.com/ | It offers protection from Phishing attacks. |
| 2 | TrustWatch | http://wareseeker.com/free-trustwatch/ | It has a toolbar for Internet Explorer users as well as has an extension for Firefox users. |
| 3 | ScamBlocker | http://www.earthlink.net/elink/issue95/security_archive.html | It is an Earthlink Toolbar feature that helps protect users from the latest Phishing threats. |
| 4 | PhishNet 1.2 | http://download.cnet.com/PhishNet/3000-2144_4-10473931.html | It protects users from web Phishing scams. |
| 5 | SpoofStick | http://www.spoofstick.com/ | It helps users detect spoofed (fake) websites. |
| 6 | Google safe browsing | http://www.google.com/tools/firefox/safebrowsing/ | <ul style="list-style-type: none"> • It is used as an extension to Firefox. • It will alert when a webpage tries asking for user's personal or financial information. • It is available in Internet Explorer 7. • It helps protect users from entering Phishing sites. |
| 7 | Windows Internet Explorer's Phishing filter | https://phishingfilter.microsoft.com/PhishingFilterFaq.aspx | |

Source: See [33] in References section.

**Figure 5.1** | Phishing attack – flowchart.

The key idea behind SPS is that web Phishing attack can be immunized by removing part of the content that entices the netizens into entering their personal information. SPS sanitizes all HTTP responses from suspicious URLs with warning messages; however, netizens will realize that they are browsing Phishing sites. The white paper describes SPS filtering algorithm in simple 20 steps and dictates how it can be built in any proxy system, such as a server solution, a personal firewall or a browser plug-in.

The Phishing attack comprised two phases: (a) attraction and (b) acquisition. E-Mail Spoofing attracts netizens, as if it has been sent by a legitimate individual/organization. To acquire personal information, the spoofed E-Mail entices the netizens to execute the attached malware, such as a keylogger or a redirector, or to access a "spoofed" website.

The white paper summarizes the characteristics of SPS in the following points:

1. **Two-level filtering:** SPS employs two-level filtering composed of strict URL filtering and HTTP response sanitizing. By combining two filtering methods, netizens can be protected from revealing their personal information on Phishing sites.
2. **Flexibility of the rule set:** By filtering HTTP responses, the algorithm distinguishes between legitimate websites and other suspicious websites based on a rule set written by the operator of SPS.
3. **Simplicity of the filtering algorithm:** A simple two-level filtering algorithm can be described into 20 steps and can easily apply the SPS functions into existing proxy implementations, browser plugins or personal firewalls. SPS can be based on two different open-sourced proxy implementations to prove the simplicity and availability of the two-level filtering algorithm.
4. **Accountability of HTTP response sanitizing:** SPS prevents netizens from disclosing their personal information to Phishing sites by removing malicious HTTP headers or HTML tags from HTTP responses. SPS can also alert netizens about requested webpage containing suspicious parts that are under threat at the time of Phishing attacks.
5. **Robustness against both misbehavior of novice users and evasion techniques:** An SPS built-in proxy server can protect netizens from almost all deceit cases of web Spoofing, regardless of netizen's misbehavior and evasion techniques used by the phisher.

5.3 Identity Theft (ID Theft)

This term is used to refer to fraud that involves someone pretending to be someone else to steal money or get other benefits (introduced in Section 1.5.21, Chapter 1). The person whose identity is used can suffer various consequences when he/she is held responsible for the perpetrator's actions. In many countries, specific laws make it a crime to use another person's identity for personal gain.^[34] As mentioned in the "introduction" section, ID theft is a punishable offense under the Indian IT Act (Section 66C and Section 66D).



Visit the weblink <http://njaes.rutgers.edu/money/identitytheft/default.asp> to undergo a quiz on identity theft to test your awareness and to get tips to avoid to be victim of identity theft.

The statistics on ID theft proves the severity of this fraud and hence a non-profit organization was found in the US, named as Identity Theft Resource Center (ITRC), with the objective to extend the support to the society to spread awareness about this fraud (see Box 5.14).

According to 2010 Report published by Javelin Strategy & Research^[35] the number of “identity fraud victims” were increased by 12% during 2009 and “amount of fraud” increased by 12.5%. Key statistics noted about total identity frauds in the US are as mentioned below:

1. The total fraud amount was US\$ 54 billion.
2. The average amount spent by the victim was US\$ 373 and the time of 21 hours to resolve the crime.
3. In total, 11.1 million adults were found to be victims of ID theft, which amounts to 4.8% of the population being a victim of identity fraud in 2009.
4. 13% of identity frauds were committed by someone who the victim knew.
5. Online methods accounted for only 11% of ID theft in 2009.
6. Offline methodology such as stolen wallets and paperwork account for almost half (43%) of all ID thefts.

Federal Trade Commission (FTC) has provided the statistics about each one of the identity fraud mentioning prime frauds presented below.^[36]

1. **Credit card fraud (26%)**: The highest rated fraud that can occur is when someone acquires the victim's credit card number and uses it to make a purchase. Chapter 11 (see Section 11.4.2) provides many illustrations on credit card frauds.
2. **Bank fraud (17%)**: Besides credit card fraud, cheque theft and Automatic Teller Machines (ATM) pass code theft have been reported that are possible with ID theft. Chapter 11 (see Section 11.4.1) provides many illustrations on banking-related frauds.
3. **Employment fraud (12%)**: In this fraud, the attacker borrows the victim's valid SSN to obtain a job.
4. **Government fraud (9%)**: This type of fraud includes SSN, driver license and income tax fraud.
5. **Loan fraud (5%)**: It occurs when the attacker applies for a loan on the victim's name and this can occur even if the SSN does not match the name exactly.

Readers may like to visit Section 11.7, Chapter 11, where many forms of online scams are described. It is important to note the various usage of ID theft information.^[37]

1. 66% of victims' personal information is used to open a new credit account in their name.
2. 28% of victims' personal information is used to purchase cell phone service.
3. 12% of victims end up having warrants issued in their name for financial crimes committed by the identity thief.

The statistics proves the importance of ID theft and the frauds related with ID theft are increasing day-by-day. ITRC, in the US, is putting enormous efforts to create awareness among the society to reduce such frauds (see Box 5.14).

Box 5.14 Identity Theft Resource Center (ITRC)

Identity Theft Resource Center (ITRC) is a non-profit, nationally respected organization situated at San Diego, CA, USA, dedicated exclusively to the prevention of identity theft. The ITRC provides support to the society for public education about identity theft. The organization also provides advice to governmental agencies, law enforcement agencies and business organizations about evolving and growing threat of identity theft.

Box 5.14 Identity Theft Resource . . . (Continued)

1. During December 1999, Linda and Jay Foley founded the ITRC, under the umbrella of Privacy Rights Clearinghouse, originally named Victims of Crimes Extended Services (VOICES).
2. In Spring 2000, the name of the organization was changed to the Identity Theft Research Center (ITRC) and was headed by Linda Foley.
3. During 2001, Jay Foley joined the ITRC as a full-time director.
4. In 2007, ITRC staff developed and published a completely new website www.idtheftcenter.org, which is a Google ranked 7 website.



Visit the weblink mentioned below to undergo the tests and quiz to know individuals preparedness toward identity theft: http://www.idtheftcenter.org/artman2/publish/c_theft_test/index.shtml

According to a September 2003 survey conducted by the FTC, an estimated 10 million people in the US found out that they were victims of ID theft in the previous year.^[38] In spite of enough awareness being created and/or trainings conducted in the society, people have their own beliefs about not being a victim of ID theft fraud. Table 5.3 explains myths and facts about ID theft.

Table 5.3 | Myths and facts about identity theft

| Sr. No. | Myth | Fact |
|---------|--|---|
| 1 | There's no way to protect yourself from identity theft. | The risk of identity theft can be minimized by taking preventive measures such as keeping financial records duly protected and private, shredding junk mail, and keeping an eye on who sees/overlooks your personal information. |
| 2 | Identity theft is only a financial crime. | Financial identity theft is theft of information for financial gain, which is most prevalent. However, other types of identity theft are equally dangerous. For example, medical identity theft of personal medical records is used to access medical treatment or drugs, or to make false insurance claims. |
| 3 | It's my bank's fault if I become a victim of identity theft. | Some identity crime does originate with the theft of bank records or is perpetuated by lax security practices. However, the majority of identity theft begins elsewhere. Personal information may be stolen with low-technology tools such as a lost or stolen wallet, checkbook, or a debit or credit card, or more high-technology methods, such as skimming, Phishing and hacking. |
| 4 | It is safe to give your personal information over the phone if your caller ID confirms that it is your bank. | It is never safe to give personal information to unsolicited callers, no matter who they say they are. Caller IDs are easily spoofed. If you believe the caller is legitimate, hang up and call the bank back at its listed phone number. |
| 5 | Checking your credit report periodically or using a credit monitoring service is all you need to do to protect yourself from identity theft. | If anyone wants to be vigilant about identity theft, one should check their credit report regularly and one should also review their bank and credit card statements regularly. One can obtain one's free credit report in the US from each of the three credit bureaus per year from www.AnnualCreditReport.com |

(Continued)

Table 5.3 | (Continued)

| <i>Sr. No.</i> | <i>Myth</i> | <i>Fact</i> |
|----------------|---|--|
| 6 | My personal contact information (mailing address, telephone number, E-Mail address, etc.) is not valuable to an identity thief. | Any information that could be used by a thief to impersonate you should be protected. For example, many people use their E-Mail address as a user ID for online accounts. Consider making your information available on a need-to-know basis only. Often, businesses ask for personal information they really don't need, and will simply omit information you're not willing to give. |
| 7 | Shredding my mail and other personal documents will keep me safe. | Shredding documents that contain personal information before you throw them away is a great way to protect yourself from "dumpster diving," which occurs when attackers search the trash for personal information. However, relying on your shredder alone to protect you is like locking one window while leaving the rest of your house wide open. Think defensively: secure your personal information in your home, in your car and at work, and always use safe online security practices. |
| 8 | I don't use the Internet so my personal information is not exposed online. | Your personal information appears in more places than you might realize, whether it's your medical records, a job application or a school emergency contact form. Many of these records are kept in electronic databases and transmitted online. Social networking sites are another good source of personal information for identity thieves. Even if you do not use them yourself, your friends or members of your family may be sharing personal information about you. Not using the Internet may offer some protection, but it won't keep you safe from online criminals. |
| 9 | Social networking is safe. | Social networking sites such as Facebook, MySpace and Twitter can be fun to use. However, they can be dangerous when it comes to your identity. These sites are used by attackers and others to steal information, trick people and promote a variety of scams. To protect yourself, avoid making personal information available to large groups of "friends," take advantage of the privacy controls offered by most of these sites, and use common sense. |
| 10 | It is not safe to shop or bank online. | Like social networking, shopping and banking online are safe as long as you use common sense and make good choices about where and how you do it. Most importantly, always take care to confirm that a site is legitimate before you use it, watch out for copycat sites and keep your computer safe from viruses. |

Source: See [39] in References section.

5.3.1 Personally Identifiable Information (PII)

The fraudster always has an eye on the information which can be used to uniquely identify, contact or locate a single person or can be used with other sources to uniquely identify a single individual. PII has four common variants based on personal, personally, identifiable and identifying.

The fraudsters attempts to steal the elements mentioned below, which can express the purpose of distinguishing individual identity:

1. Full name;
2. national identification number (e.g., SSN);
3. telephone number and mobile phone number;

4. driver's license number;
5. credit card numbers;
6. digital identity (e.g., E-Mail address, online account ID and password);
7. birth date/birth day;
8. birthplace;
9. face and fingerprints.

The fraudster may search for following about an individual, which is less often used to distinguish individual identity; however these can be categorized as potentially PII because they can be combined with other personal information to identify an individual.

1. First or last name;
2. age;
3. country, state or city of residence;
4. gender;
5. name of the school/college/workplace;
6. job position, grades and/or salary;
7. criminal record.

The information can be further classified as (a) non-classified and (b) classified. [Classification scheme is also explained in Chapter 9 (Section 9.11) in the context of media and asset protection.]

1. Non-classified information

- **Public information:** Information that is a matter of public record or knowledge.
- **Personal information:** Information belongs to a private individual but the individual commonly may share this information with others for personal or business reasons (e.g., addresses, telephone numbers and E-Mail addresses).
- **Routine business information:** Business information that do not require any special protection and may be routinely shared with anyone inside or outside of the business.
- **Private information:** Information that can be private if associated with an individual and individual can object in case of disclosure (e.g., SSN, credit card numbers and other financial information).
- **Confidential business information:** Information which, if disclosed, may harm the business (e.g., sales and marketing plans, new product plans and notes associated with patentable inventions).

2. Classified information

- **Confidential:** Information that requires protection and unauthorized disclosure could damage national security (e.g., information about strength of armed forces and technical information about weapons).
- **Secret:** Information that requires substantial protection and unauthorized disclosure could seriously damage national security (e.g., national security policy, military plans or intelligence operations).
- **Top secret:** Information that requires the highest degree of protection and unauthorized disclosure could severely damage national security (e.g., vital defense plans and cryptologic intelligence systems).

ID theft fraudsters and/or industrial/international spies target to gain the access to private, confidential, secret and top secret information.

5.3.2 Types of Identity Theft

Identity is stolen in order for someone to commit the crime. ID theft is related to many areas:

1. Financial identity theft;
2. criminal identity theft;
3. identity cloning;
4. business identity theft;
5. medical identity theft;
6. synthetic identity theft;
7. child identity theft.

Financial Identity Theft

Financial ID theft includes bank fraud, credit card fraud, tax refund fraud, mail fraud and several more. In total, 25 types of financial ID thefts are investigated by the US Secret Service. Financial identity occurs when a fraudster makes a use of someone else's identifying details, such as name, SSN and bank account details, to commit fraud that is detrimental to a victim's finances. For example, the fraudster fraudulently can open a new credit card account in the victim's name and the card charges up, payment is neglected, leaving the victim with bad credit history (i.e., horrible credit score) and a world of debt. In some cases, the fraudster will completely take over a victim's identity, which enables the fraudster to easily open bank accounts, multiple credit cards, purchase a vehicle, receive a home mortgage or even find employment in the victim's name.

The process of recovering from the crime is often expensive, time-consuming and psychologically painful. Many a times, before a crime is detected, the fraudster is capable of running up hundreds to thousands of dollars worth of debt in the victim's name. This type of fraud often destroys a victim's credit and it may take weeks, months or even years to repair. As technology moves along and fraudsters become more advanced, financial ID theft will continue to pose a great threat to many individuals.

Criminal Identity Theft

It involves taking over someone else's identity to commit a crime such as enter into a country, get special permits, hide one's own identity or commit acts of terrorism. These criminal activities can include:

1. Computer and cybercrimes;
2. organized crime;
3. drug trafficking;
4. alien smuggling;
5. money laundering.

Individuals who commit ID theft are not always out to steal the victim's money or ruin victim's credit. This type of fraud/theft occurs when a fraudster uses the victim's name upon an arrest or during a criminal investigation. The personal information given by a fraudster to a law enforcement officer may include counterfeited document such as driver's license, birth certificate, etc. Unfortunately, the victim of criminal ID theft may not know what warrant has been issued under his/her name for quite some time. The victim will only come to know in case of being detained on a routine traffic stop and arrested due to outstanding and overdue debts. In some cases, the fraudster will appear in court for the violation and enter a guilty plea without the victim's knowledge. This may place the victim's name into countywide or state-wide criminal database with a huge blemish language on the record.

There have been several instances where victims of criminal ID theft do not learn of an impersonation until being denied for employment or terminated from a job. This occurs when an employer conducts a criminal background search and finds that the victim has a criminal history that he/she lied about or charges that forbid him/her from working in that particular environment. When this happens, there is very little a victim can do to salvage the job, as an employer has the right to proceed with termination over entering false information on an application.

The victims of this crime are left with the burden to clear their own name in the eyes of the criminal justice system. It is very important to act quickly in order to minimize the damage and get your life back in order. What makes the process so difficult is the fact that officials working within the criminal justice system are the only ones capable of correcting the data. It is very crucial and important to contact local police department immediately in case of becoming a victim of criminal ID theft. This should be the first step in building a case and clearing your name.

Identity Cloning

Identity cloning may be the scariest variation of all ID theft. Instead of stealing the personal information for financial gain or committing crimes in the victim's name, identity clones compromise the victim's life by actually living and working as the victim. ID clones may even pay bills regularly, get engaged and married, and start a family. In summary, identity cloning is the act of a fraudster living a natural and usual life similar to a victim's life, may be at a different location.

An identity clone will obtain as much information about the victim as possible. They will look to find out what city and state the victim (he/she) was born in, what street he/she grew up on, where he/she attended school and what relationships he/she may have been involved in. They will also want to know information concerning the victim's parents and other family members. In a nutshell, identity clones want as much personal information about the victim as they can attain. This enables them to answer questions in an informative manner when they are on the move or asked about the victim's life.

Business Identity Theft

"Bust-out" is one of the schemes fraudsters use to steal business identity; it is paid less importance in comparison with individual's ID theft. A fraudster rents a space in the same building as victim's office. Then he applies for corporate credit cards using victim's firm name. The application passes a credit check because the company name and address match, but the cards are delivered to the fraudster's mailbox. He sells them on the street and vanishes before the victim discovers the firm's credit is wrecked.^[40] Hence, it is extremely important to protect business sensitive information (BSI) to avoid any further scams.

BSI is the information about the business/organization, privileged in nature and/or proprietary information which, if it is compromised through alteration, corruption, loss, misuse or unauthorized disclosure, could cause serious damage to the organization. Such information is like a "sensitive asset" for the organization.^[41]

Identity theft in the business context occurs most often when someone knocks off the victim's product and masquerades their shoddy goods as victim's. It is a kind of intellectual property theft. Nowadays, technology has made it easier for the trademarks and security devices such as holograms to be knocked off swimmingly. The consumers should no longer rely on trademarks alone to certify the authenticity of the goods and should verify their source of origin.



Visit the counterfeit gallery at the International Anti-Counterfeit Coalition website at <http://iacc.org/about-counterfeiting/counterfeit-gallery/index.php> to test your ability to spot fake consumer products.

Business ID theft may fuel economic and industrial espionage – which is most commonly associated with technology-heavy industries such as computer software and hardware, biotechnology, aerospace, telecommunications, transportation and engine technology, automobiles, machine tools, energy, materials and coatings and so on. See Box 5.15 to know more about industrial spy network.

The consequences of business ID theft may call for a disaster to the business, such as call out from market and damage to the reputation, and hence it is extremely important to employ countermeasures for such type of attacks (see Table 5.4).

Box 5.15 Chinese Ghost Net

China has been accused of attacking a number of groups and institutions through the use of cyber espionage, a fact which already put it high on the research team's "countries of interest" list. GhostNet is a spy network, accused to have been controlled from China, with the objective to hack into government and private sector companies in 103 countries.

GhostNet directs infected computers to download a Trojan known as "gh0st RAT" (also reported as Remote Access Tool) that allows attackers to gain complete and real-time control from commercial Internet access accounts located on the island of Hainan, People's Republic of China. The investigations reveal that GhostNet is capable of taking the entire control of infected computers, including searching and downloading specific files, and covertly operating attached devices such as microphones and web cameras.

This spying attack started with online espionage activities against the Tibetan community and subsequently targeted Foreign Ministries, embassies, banks and NEWS organizations across the world. Although Chinese Government has rejected all these allegations, it is reported that Foreign Ministries of Iran, Bangladesh, Latvia, Indonesia, the Philippines, Brunei, Barbados and Bhutan had been spied on remotely, and the embassies of India, South Korea, Indonesia, Romania, Cyprus, Malta, Thailand, Taiwan, Portugal, Germany and Pakistan were hacked.

The Toronto researchers listed the systems mentioned below as the ones they are highly confident to have been compromised:

1. Office of the Dalai Lama, India.
2. Tibetan Government in Exile, India.
3. Association of Southeast Asian Nations (ASEAN).
4. Asian Development Bank.
5. Associated Press, UK.
6. Consulate General of Malaysia, Hong Kong.
7. Department of Foreign Affairs, Indonesia.
8. Department of Foreign Affairs, Philippines.
9. International Campaign for Tibet.
10. NATO.
11. Russian Federal University Network, Russian Federation.
12. Students for a Free Tibet, US.
13. Taiwan Government Service Network, Taiwan.

If it assumed that GhostNet is a fluke and a deliberate creation of a foreign power (or the creation of a group) other than China, with the objective to search the information to sell at a profit, then there is the likelihood of many GhostNets in operation around the world, which may be operating with some specific objective. The story concludes as, GhostNet is neither the first nor the only one of its kind.

Table 5.4 | (Continued)

| <i>Sr. No.</i> | <i>Facet</i> | <i>Brief Description</i> |
|----------------|--|--|
| 7 | Create the awareness that the Internet is a dangerous place | Ordering something off the Net using a credit card is not dangerous, as long as you are placing your order through a secure site. However, there are other dangers, such as Spyware and viruses, which attempt to download automatically when you or your employees visit certain sites. If you are using Internet Explorer, make sure that you go to "Internet Options" and set the security options to a higher setting on each computer; the default is set to allow just about anything to download. Moreover, if your company has a website, be careful as to what kind of information you post on your site and how. If you are going to place sensitive information on the Net (something you should be very cautious about), such as financial data or customer databases, it needs to be password-protected and encrypted. |
| 8 | Avoid broadcasting information | "The other day while making a purchase at a computer store, an associate asked me for my phone number and popped up all my personal information on a terminal in front of him – right in plain view of five other customers! I was so curious to ask him if he wanted to read it all out loudly to make it even easier for all of them to remember it." This sort of cavalier sharing of personal information, which makes identity theft so easy, has to stop. Train your employees to be sensitive to customer information issues, making sure that they keep customer information private when they're dealing with individual customers. Turning computer screens so that they can't be viewed by anyone except the operator and other practices such as not repeating customer information loudly or not leaving files with customer information lying open on counters should be taken into consideration. |
| 9 | Create and enforce a organization-wide information security policy | The purpose of your security policy is to educate your employees about issues such as identity theft and data protection. It should include information on E-Mail policies (such as what E-Mail filters are in place and how to deal with suspicious E-Mail), computer network access, Internet use policies (such as how to increase browser security settings and safe practices, such as disconnecting from the Net after using it), customer information protection strategies and how to report incidents or violations. In other words, a manual of the issues involved with security and threats such as identity theft and what to do about them. |
| 10 | Disconnect the access of ex-employees immediately | When employees no longer work for your business, you need to be sure that their access to your computer network and company data is cut off immediately. Will all this create more trouble and expense for your small business? Yes. But unfortunately, with identity theft becoming rampant, taking these steps to prevent identity theft for you and your customers is necessary. |

Source: See [42] in References section.

Medical Identity Theft

India is known to have become famous for "medical tourism." Thousands of tourists, every year visit India with dual purpose – touring the country plus getting their medical problems attended to (surgeries, total health check, Kerala massage, etc.) because India has made name for good quality and yet reasonable priced (compared with Europe and the US) in medical services. In the process thousands of medical records of foreigners as well as locals who avail medical facility get created. This has created a boom for cybercriminals.

Table 5.4 | Business identity theft – countermeasures

| <i>Sr. No.</i> | <i>Facet</i> | <i>Brief Description</i> |
|----------------|---|---|
| 1 | Secure your business premises with locks and alarms | Alarm systems are effective deterrents to criminals thinking of breaking into your business, including that intent on identity theft – especially alarm systems that are monitored by a security company. Make sure that external doors have deadbolts and that exposed windows are secured with security film, bars, screens or shatter-proof glass. |
| 2 | Put your business records under lock and key | Store your physical business records, such as customer records and other data on paper, locked in filing cabinets – and lock the filing cabinets at night, or at those times during the day that you and your staff will not be “supervising” access (such as lunch time). Put copies of system and database backups and “important” business data in your safe (or in your security deposit box at the bank if you don’t have an onsite safe). |
| 3 | Shred, shred and shred | Business records of any kind should never just be tossed into the trash or recycling bin where they can become a bonanza for criminals wanting to commit on identity theft; instead, all business records that you no longer have a use for should be shredded. Businesses that operate out of small and home offices can buy inexpensive shredders at any office supply store; for businesses with volumes of material to be disposed of, there are shredding services that will come and do what needs to be done. Pay special attention to the mail, a favorite source for identity theft. Anything that has your name and address on it should be shredded, and that includes most bills. |
| 4 | Be cautious on the phone | It’s easy for someone to pretend to be someone they’re not on the phone. Whether it’s someone who wants personal information on a particular customer, or someone who claims they need to verify one of your personal accounts, don’t give out information over the phone unless you can positively confirm the caller’s identity. <i>“Information thieves and stalkers tell authorities over and over how easily they were able to obtain all sorts of valuable information simply by calling small business owners or personnel departments and asking. Posing as government agencies or credit grantors or health insurance providers, these thieves have found that a well-crafted, believable story can often get past the best locking file cabinets or password-protected computers,”</i> warns the Better Business Bureau. |
| 5 | Limit access to your IT systems | Your computer network needs to be password protected, of course, so that anyone who wanders through your office can’t just access your network. However, you also need to consider issues of internal network access. Does every employee needs to access programs or databases that may contain sensitive information? Password-protect these too and grant access on a “need-to-know” basis to help cut down identity theft. |
| 6 | Protect the IT systems from hackers | Hacking into company systems and databases appears to have become a favorite identity theft technique – perhaps because it’s very easy. Your computer network needs to be protected by firewalls, which help keep out intruders by shutting out unauthorized people and letting others go only to the areas they have privileges to use. You can purchase firewalls at any computer store (or online). Another option for small or home businesses is to purchase and install a small (four to eight port) router. These often have firewall protection capability. If you’re running Windows operating systems, it’s also important that you keep your operating system updated, installing the various patches as they come out. Often these patches are fixes for security holes. (If you use Windows XP, you will be alerted automatically to these updates.) |

(Continued)

Healthcare facilities now are very different compared to how they were used a decade back. There are greater opportunities for protected health information (PHI) changing hands when multiple agencies are connected over computer networks and the Internet – for example, medical representatives, health officers, doctors, medical insurance organizations, hospitals, etc. to name a few (see Fig. 5.2).

Medical facility providers are moving from cumbersome paper records to faster and easier file and trace electronic records; however, the concern over medical ID theft^[43] is growing. The stolen information can be used by the fraudster or sold in the black market to people who “need” them. This could lead to many more cases. For example, invoice of thousands of dollars of emergency medical services was received by a man situated in Houston (Texas), who had never had any health issues, as reported in the New York Times. A fraudster had used this man’s identity for the fraudster’s emergency medical needs.

Medical ID theft can be dangerous not only from a financial perspective as explained in the case above, but also from a medical perspective. If the fraudster has successfully stolen the victim’s identity and received treatment, the record can become part of a victim’s permanent medical record. For example, a patient could be unconscious after an accident. The emergency room reads that during a previous admission the “patient” indicated he/she is not allergic to the medication the doctor believes will be most beneficial for the unconscious patient. Relying on the prior medical record, the doctor administers that drug which, in reality, the patient is severely allergic to.

According to a 2008 Identity Theft Resource Center survey, some of the reasons why medical ID theft is particularly damaging the victims include:

1. Approximately one-third of victims of medical ID theft surveyed had someone else’s medical information or medical history on their medical record, increasing the possibility of patients being treated incorrectly because of incorrect medical records.

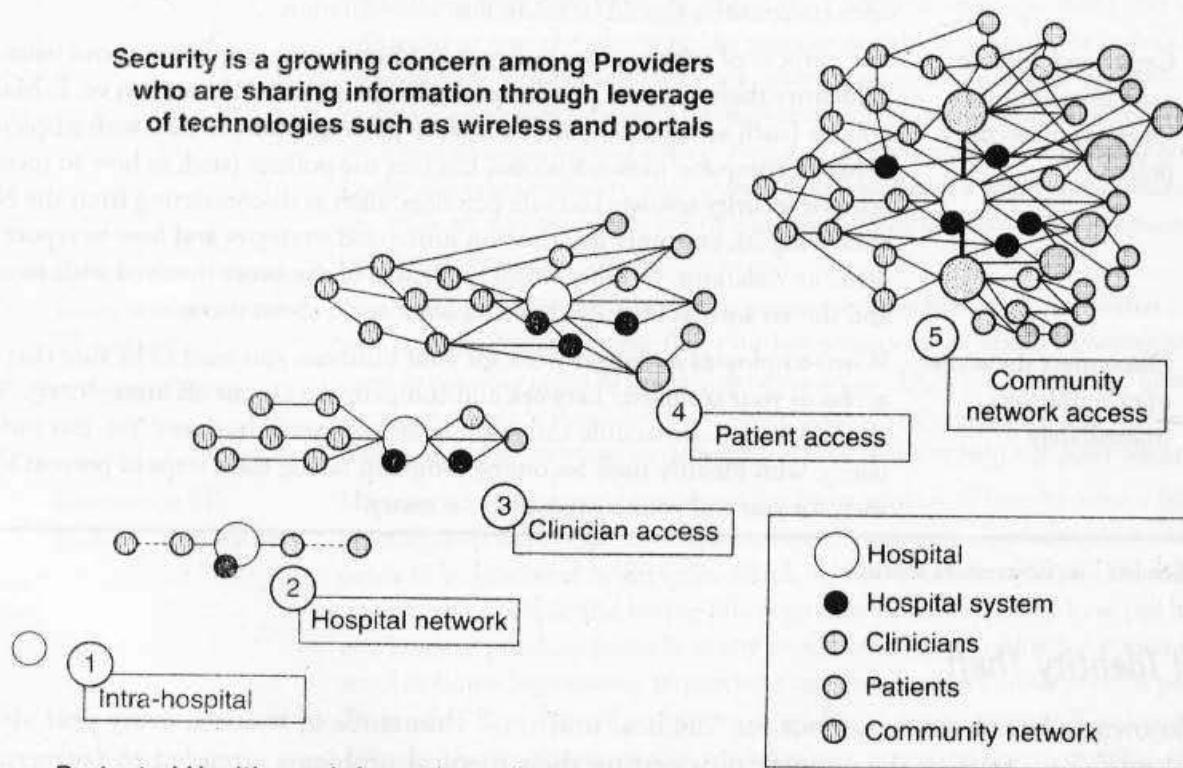


Figure 5.2 | Medical domain – interconnected entities.

2. More than 10% of victims of medical ID theft surveyed were denied health or life insurance for unexplained reasons.
3. More than two-third of victims surveyed receive a bill for medical services that were provided to an imposter.

ModernHealthcare.com reported a noticeable spike in attempted medical ID theft. This has been confirmed during June 2008 wherein the University of Utah Hospital announced that the personal information of 2.2 million patients had been stolen.

The World Privacy Forum estimates that there are more than 250,000 cases of medical ID theft each year and acknowledges that medical ID theft is a crime that can cause great harm to the victims. Medical ID theft has been addressed by HIPAA and HITECH Acts in the US (see Box 5.16 as well as Fig. 5.2).

Synthetic Identity Theft

This is an advanced form of ID theft in the ID theft world. The fraudster will take parts of personal information from many victims and combine them. The new identity is not any specific person, but all the victims can be affected when it is used.

Child Identity Theft

Parents might sometimes steal their children's identity to open credit card accounts, utility accounts, bank accounts and even to take out loans or secure leases because their own credit history is insufficient or too damaged to open such accounts.

Box 5.16 HIPAA, PHI and HITECH

The Health Insurance Portability and Accountability Act (HIPAA) enacted by the US Government in 1996, was sponsored by Senator Edward Kennedy and Senator Nancy Kassebaum. This act not only protects the Health Insurance Coverage but also detects the security and privacy of health data.

1. **HIPAA – Title I:** It regulates the availability and extent of group health plans and certain individual health insurance policies.
2. **HIPAA – Title II:** It defines numerous offenses relating to healthcare and sets civil and criminal penalties for them. It also creates several programs to control fraud and abuse within the healthcare system.

Protected Health Information (PHI) is any information held by the healthcare organizations (such as hospitals, nursing homes, medical service providers and medical insurance companies) which can be interpreted broadly and includes any part of an individual's medical record or payment history.

Health Information Technology for Economic and Clinical Health Act (HITECH Act) is enacted as part of the American Recovery and Reinvestment Act of 2009. Subtitle D of HITECH Act dictates the privacy and security concerns associated with the electronic transmission of health information and extends the complete Privacy and Security Provisions of HIPAA to business associates of healthcare organizations (see Box 6.18, Chapter 6).

5.3.3 Techniques of ID Theft

Identity theft can affect all aspects of a victim's daily life and often occurs far from its victims. The attackers use both traditional, that is human-based, methods as well as computer-based techniques.

1. **Human-based methods:** These methods are techniques used by an attacker without and/or minimal use of technology
 - *Direct access to information:* People who have earned a certain degree of trust (house cleaners, babysitters, nurses, friends or roommates) can obtain legitimate access to a business or to a residence to steal the required personal information.
 - *Dumpster diving:* Retrieving documents from trash bins is very common and explained in Chapter 2.
 - *Theft of a purse or wallet:* Wallet often contains bank credit cards, debit cards, driving license, medical insurance identity card and what not. Pickpockets work on the street as well as in public transport and exercise rooms to steal the wallets and in turn sell the personal information.
 - *Mail theft and rerouting:* It is easy to steal the postal mails from mailboxes, which has poor security mechanism and all the documents available to the fraudster are free of charge, for example, Bank Mail (credit cards and account statements), administrative forms or partially completed credit offers. The fraudster can use your name and other information that may prove to be harmful for an individual in the near future. Therefore, return items to the sender or request a change of address.
 - *Shoulder surfing:* People who loiter around in the public facilities such as in the cybercafes, near ATMs and telephone booths can keep an eye to grab the personal details. This is already explained in Chapter 2.
 - *False or disguised ATMs ("skimming"):* Just as it is possible to imitate a bank ATM, it is also possible to install miniaturized equipment on a valid ATM. This equipment (a copier) captures the card information, using which, duplicate card can be made and personal identification number (PIN) can be obtained by stealing the camera films.
 - *Dishonest or mistreated employees:* An employee or partner with access to the personal files, salary information, insurance files or bank information can gather all sorts of confidential information and can use it to provide sufficient damage.
 - *Telemarketing and fake telephone calls:* This is an effective method for collecting information from unsuspecting people. The caller who makes a "cold call" (supposedly from a bank) asks the victim to verify account information immediately on the phone, often without much explanation or verification. This attack is known as Vishing and it is explained in Chapter 3.
2. **Computer-based technique:** These techniques are attempts made by the attacker to exploit the vulnerabilities within existing processes and/or systems.
 - *Backup theft:* This is the most common method. In addition to stealing equipment from private buildings, attackers also strike public facilities such as transport areas, hotels and recreation centers. They carefully analyze stolen equipment or backups to recover the data.
 - *Hacking, unauthorized access to systems and database theft:* Besides stealing the equipment and/or hardware, criminals attempt to compromise information systems with various tools, techniques and methods (explained in Chapter 4) to gain unauthorized access (see Box 6.1, Chapter 6) to download the required information. See Box 5.17 to know advanced form of ID theft while the victim is in travel mode.
 - *Phishing:* Phishing is explained in Section 5.2.
 - *Pharming:* Pharming is explained in Box 5.10. In summary, the attackers setup typo or matching domain names of the target (usually of popular banks and financial institutions) and install websites with similar look and feel. Hence, even if the user types-in incorrect URL (e.g., instead of www.xyzbank.com, URL is punched as www.xyzbanc.com), the user gets the website with

Box 5.17 Geotagging

Geotagging is the process of adding geographical identification (such as latitude and longitude data) inside the metadata to various media such as photographs, video and/or SMS messages. Besides latitude and longitude coordinates, it can also include altitude, bearing, distance and place names. It is commonly used for photographs. Geotag information, embedded in the metadata, is stored into Exchangeable Image File (EXIF) format or into eXtensible Metadata Platform (XMP) format under the photographs stored in JPEG file format. These data are not visible in the picture itself but are read and written by special programs and most digital cameras and modern scanners. The EXIF data can be read by special programs (visit www.digital-photo-software-guide.com and www.photo-freeware.net for EXIF editors), which can provide maps of the location where the photo was taken. The same geotagged photos, when shared online, can also be linked to several map services.

Risks associated with Geotagging

1. The netizens snap photographs of their families/relatives/friends during a vacation, using cell phones/digital cameras and then immediately upload them on social networking websites such as Twitter/Facebook/Orkut/Myspace. The attacker can decipher these photographs (i.e., EXIF data) to know where the victim is located when he/she took the photographs.
2. The attacker can easily find when the family is not at home and the house is vulnerable to burglary attack.
3. A simple photograph of a car parked outside the house can provide the information about the address of the home.

How to protect from Geotagging

1. Turn OFF location information into cell phones/PDAs and cameras (visit <http://www.icanstalku.com/how.php> to know "How to disable this configuration").
2. Refer to the manual of the device and/or consult the manufacturer of the device to disable this intrusive feature.
3. Be skeptical about uploading the photographs on social networking websites.
4. Be careful while uploading/sharing photographs of kids and spouse through E-Mails and/or uploading those on social networking websites while they may have shared with you while traveling on their own.

Source: <http://en.wikipedia.org/wiki/Geotagging>

the same look and feel. This website is not real and is hosted with the sole purpose to extract personal information from the netizen.

- *Redirectors:* These are malicious programs that redirect users' network traffic to locations they did not intend to visit. For example, port redirection program is loaded by compromising the server and all HTTP Port 80 requests may be redirected to attacker. The highest volume in traffic occurs with Malicious Code that simply modifies the victim's DNS server settings or the hosts file to redirect either some specific DNS lookups or all DNS lookups to a fraudulent DNS server. The fraudulent DNS server replies with "good" answers for most domains. However, when attackers want to direct the victim to a fraudulent site, they simply modify their name server responses. This is particularly effective because the attackers can redirect any of the users requests at any time, and the users would have no idea that this is happening. It is reported that, during December 2005, such an attack was launched against HSBC Brazil, Banco Itau, Banco Banespa and Bradesco banks.
- *Hardware:* During March 2005, police discovered that the London office of the Japanese bank Sumitomo had been the target of a group of hackers for several months. The investigators initially believed that the attackers had used a Trojan. However, after several days of exploration, they found a tiny keystroke-recording device inserted where the keyboard cable connects to the back of the computer. A quick search on the Internet yields a list of a half-dozen companies that sell this type of product.

5.3.4 Identity Theft: Countermeasures

Identity theft is growing day-by-day and people think simple steps such as keeping the credit card and PIN safely will protect them from ID theft. One should be always vigilant and should take optimum care toward protecting the self-identity. Table 5.5 explains some good tips on countermeasures for identity theft.

5.3.5 How to Efface Your Online Identity

Everytime details about your identity and/or about your personal information are revealed on the Internet, you are prone to be a victim for ID theft/fraud. Hence, netizens may think to either protect their identity and/or would like to erase their identity, that is, every footprint available on the Internet. However, it is highly impossible to get one single tool that can completely eradicate each of your footprint from the Internet. Table 5.6 lists few such tools.

Table 5.5 | How to prevent being victim of identity theft

| Sr. No. | Security Measures | Brief Description |
|---------|--|---|
| 1 | Monitor your credit closely | The credit report contains information about your credit accounts and bill paying history so that you can be tipped off when someone is impersonating you. Watch for suspicious signs such as accounts you did not open. You can also consider identity protection services, which range from credit monitoring to database scanning, for extra security. |
| 2 | Keep records of your financial data and transactions | Review your statements regularly for any activity or charges you did not make. |
| 3 | Install security software | Install security software (firewall, antivirus and anti-Spyware software) and keep it up to date as a safety measure against online intrusions. |
| 4 | Use an updated Web browser | Use an updated web browser to make sure you're taking advantage of its current safety features. |
| 5 | Be wary of E-Mail attachments and links in both E-Mail and instant messages. | Use caution even when the message appears to come from a safe sender, as identity information in messages can easily be spoofed (see Appendix C to learn E-Mail security and etiquettes). |
| 6 | Store sensitive data securely | Just as you keep sensitive paper documents under lock and key, secure sensitive online information. This can be done through file encryption software. |
| 7 | Shred documents | It is important to shred the documents that contain personal or financial information (both paper and electronic) before discarding them. This prevents dumpster diving and, in the online world, the ability for hackers to bypass information that has not been permanently deleted from your system. |
| 8 | Protect your PII | Be cautious about giving out your personally identifiable information (PII) to anyone. Find out why the information is needed, and if it's absolutely necessary to give out. Be careful about the details you provide about yourself online, such as on social networking sites. |
| 9 | Stay alert to the latest scams | Awareness and caution are effective methods to counter fraud. Create awareness among your friends and family members by sharing security tips you learn with them. |

Source: See [44] in References section.

Table 5.6 | How to protect/efface your online identity

| Sr. No. | Websites | Brief Description |
|----------------|----------------------------|---|
| 1 | www.giantmatrix.com | Anti Tracks: These are set of tools that appear to be a complete solution to protect your online identity, sensitive data and maintaining the integrity of your system by hiding system's IP address, securely locking and hiding important files and folders and maintaining a healthy system performance, which keeps the system in top-notch condition. |
| 2 | www.privacyeraser.com | Privacy Eraser Pro: It protects Internet privacy by cleaning up all the tracks of Internet and computer activities and supports almost all popular web browsers. The main features of this utility are as follows: <ul style="list-style-type: none"> • Erase Browser Cache Files, Browser History, Cookies, Browser Address Bar History and Browser AutoComplete Memory. • File Shredder: Securely shred files and folders. • Cleaning Free Disk Space (Windows FAT/FAT32/NTFS). • Speed up the system. |
| 3 | www.reputationdefender.com | MyPrivacy: It removes your personal information such as name, address, age, phone, past address and any other related information. It also helps by continuously monitoring the Internet to remove the footprint available on the Internet. |
| 4 | www.suicidemachine.org | Web 2.0 Suicide Machine: It completely roots out your identity from the servers of social networking websites such as MySpace, Twitter and LinkedIn. One will have to reveal the login credentials for the corresponding web applications (webapps) to use this tool. Hence, if he/she does not need them anymore then he/she can let suicide machine eradicate the details from these webapps. <p>It is reported that Facebook have blocked access of Web 2.0 Suicide Machine because Suicide Machine collects login credentials and scrapes Facebook pages. This has been reported as violation of Facebook Statement of Rights and Responsibilities, which has resulted into inability of suicide machine to erase your identity on the Facebook.</p> |
| 5 | www.seppukoo.com | Seppukoo: It is an <i>anti-social network</i> failing to destroy your identity, specifically the footprint on the Facebook. The website is named after the "seppuku ritual suicide" practiced by ancient Japanese samurai warriors and the website draws a parallel between restoring a samurai's honor and the "liberation of the digital body." This website is operated by a group that calls itself Les Liens Invisibles, an "imaginary art group from Italy." |

SUMMARY

Phishers use different methods and techniques with one common goal of deception, to obtain personal information from the netizens. Phishers have strong technical knowledge and have innovative ideas to deceive the netizens into

1. Believing the messages are received from a trusted source.
2. Believing that the website and/or webpage is a trusted organization and/or institution.

3. Entice the Spam filter to identify that a Phishing E-Mail is legitimate.

Phishing attacks cannot be stopped with any technique and/or technology. However, good practices can reduce the prevalence of Phishing and related losses suffered from Phishing scams.

Phishing is a common form of ID theft in which the netizens are tricked into revealing confidential information about them with economic value. ID theft is increasing day-by-day and awareness and

training is the key to fight against numerous attacks launched to entice the people to reveal their personal information. Besides the countermeasures, one has to be continuously vigilant while disclosing personal information and should evenly treat the risk while disclosing personal information on the Internet, while on the phone or while in person. Many scenarios and case illustrations are provided in Chapter 11 explaining Phishing scams and ID theft.

REVIEW QUESTIONS

1. What is Phishing? Explain with examples.
2. Differentiate between Spam and hoax mails.
3. What are the different methods of Phishing attack?
4. What is Spear Phishing? Explain with examples.
5. What is whaling? Explain the difference between whaling and Spear Phishing.
6. What is identity theft? Explain with examples.
7. How can information be classified?
8. What are the different types of ID theft?
9. What are the different techniques of ID theft?
10. How to prevent being a victim of ID theft?

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The appendices that serve as extended material for the topic addressed are: A, C, D, E, L, M, O, V. These are provided in the companion CD.

6

Cybercrime and Cybersecurity: The Legal Perspectives

Learning Objectives

After reading this chapter, you will able to:

- Understand the need for cyberlaws, especially in the Indian context.
- Understand how the laws of different jurisdictions across the world compare against a single benchmark.
- Get an overview of the European Union (EU) legal framework for information privacy to prevent cybercrime.
- Understand legal position on cybercrime with focus on the Indian scenario.
- Learn the strengths and weaknesses of the Indian IT Act along with the amendment to the Act.
- Understand Indian IT Act in cybercrime perspective.
- Understand the meaning of digital signature, public-key infrastructure as well as the implications of digital signature in the context of the Indian IT Act.
- Learn about electronic records and their admissibility in the courts.
- Get an overview of challenges faced in punishing the cybercriminals.
- Understand the Indian challenges in the fight with cybercrime seen from the legal angle.

6.1 Introduction

It is said that cybercrime is the *largest illegal industry*. Cybercrime involves massive, coordinated attacks against the information infrastructure of a country. In this chapter, we want to bring forth the point that knowledge of cyberlaws is essential for people who may directly or indirectly interact with networked services either over the Internet or other proprietary networks of businesses and enterprises of any other types – banks, stock brokers, intra-company and inter-company information exchange systems, etc. We have explained the term *cyberlaw* later in this chapter. It is also essential for those who are involved in heavy and indiscretionary use of social networking sites^[1] (e.g., Orkut, Facebook, Big Adda, etc.). We want to understand the meaning of the term *digital evidence* given that the Indian Information Technology Act (ITA) 2000^[2] and its modification (ITA 2008) mention about *evidence*. In the original ITA 2000,^[3] there is a mention about “special provisions as to ‘evidence relating to electronic record’ and ‘admissibility’ of electronic records.” We also explain the legal position on cybercrime based on Section 1.7 of Chapter 1 and discuss the topic of legal aspects of cybercrime into further details. Although the Indian legislations are important for people in India, we must not lose sight of the world scenario – it is important for global businesses. Therefore, while maintaining focus

on the Indian ITA 2000 and subsequent amendments in year 2008, that is, ITA 2008, this chapter also provides an overview of cybercrime legislations in other countries/regions.*

From an Indian perspective, we have provided adequate focus on the Indian ITA 2000 (previously known as the IT Bill) and its recent amendments known as the ITA 2008 (Amendments to the IT Act that came toward the end of year 2008).

Chapter 1 is the background to appreciate the concepts presented in this chapter. An overview on cybercrime is provided in Chapter 1; many fundamental terms with regard to cybercrime are explained (see Box 1.1) in that chapter along with the classification of cybercrime: (a) an Indian perspective on cybercrime is provided in Section 1.7; (b) reference to the Indian IT Act in the context of cybercrime is provided in Section 1.8; (c) a discussion on the global perspective on cybercrime, with implications for organizations and individuals, is available in Section 1.9. With this background, Fig. 6.1 presents the paradigm for cybersecurity.

The concept of *trust seals* mentioned in Fig. 6.1 is a very important one for electronic commerce (E-Commerce) era. (This concept is explained in Ref. #1, Books, Further Reading.) Figure 6.1 shows the *identity theft* group of crimes (identity theft is discussed in Chapter 5). Countries that are members of the EU^[4] (European Union) have very stringent laws for protection of individual privacy and data privacy. (Readers interested in greater details of data privacy should refer to Ref. #2, Books, Further Reading.) The bottom block in Fig. 6.1 points to the IT infrastructure in organizations (government organizations as well as private or other kinds of organizations). From attack perspective, the intrusion detection system (IDS) are important. Readers new to IDS can refer to Ref. #3, Books, Further Reading.

For the benefit of those who are reading this chapter without having referred to Chapter 1, cybercrime definitions are mentioned here as well. Cybercrime spans not only state but national boundaries as well. Perhaps we should look to international organizations to provide a standard definition of the crime. At the

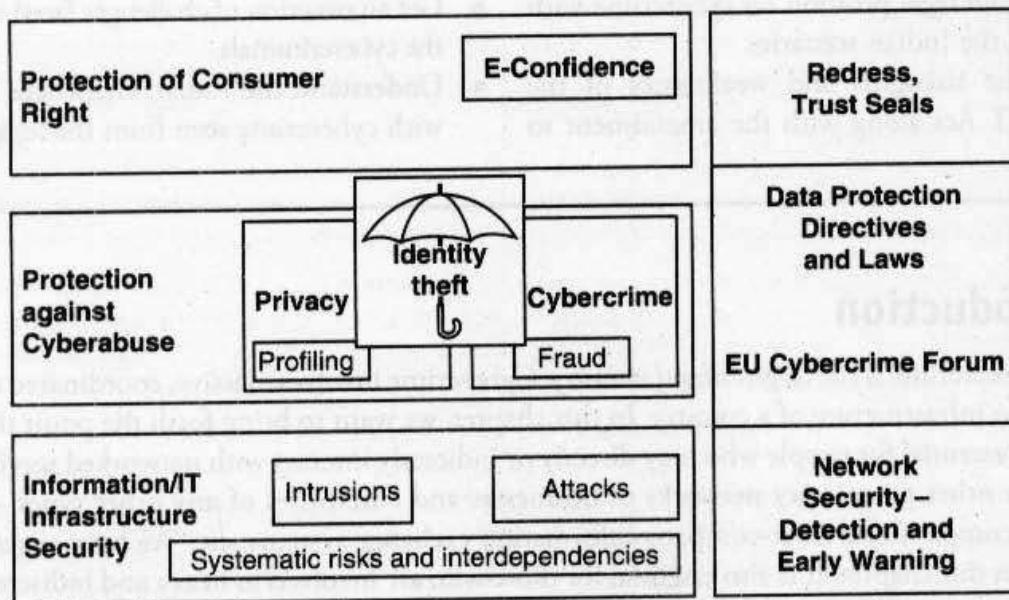


Figure 6.1 | A cybersecurity perspective: European Union.

*caveat – although this chapter provides discussion on the legal aspects of cybercrime, it is important for readers to appreciate that the contents of this chapter are NOT a substitute for consulting the legal experts/legal professionals when a particular case of cybercrime arises with which readers may be confronted or involved with. This is because the legal aspects presented here are based on our awareness and research and by no means, it is claimed to be the perfect or complete knowledge of legal parameters for defending a case. Readers should refer to the paper copy of ITA 2000 and ITA 2008 for exact wordings.

Tenth United Nations Congress on the Prevention of Crime and Treatment of Offenders, in a workshop devoted to the issues of crimes related to computer networks, cybercrime was broken into two categories and defined as:

1. **Cybercrime in a restrictive sense (computer crime):** It is referred to any illegal behavior that is carried out by means of electronic methods targeting the security of computer systems and the data processed by them. This can be considered as a narrow definition of the term *cybercrime*.
2. **Cybercrime in a general sense (computer-related crime):** It is referred to any illegal behavior that is committed by means of, or in relation to, a computer system or network, including such crimes as illegal possession, and offering or distributing information by means of a computer system or network. This can be considered as a broader definition of the term *cybercrime*.

These definitions are complicated by the fact that an act may be illegal in one nation but not in another. There are more concrete examples, including

1. Unauthorized access to computer (see Box 6.1);
2. causing damage to computer data or programs;
3. an act of computer sabotage;
4. doing unauthorized interception of communications;
5. carrying out computer espionage.

Box 6.1 Degrees of Unlawful Access to Computer

In Chapter 1 we mentioned about classification of cybercrimes; one of the cybercrime types mentioned there is unauthorized accessing of computer under the broad category of cybercrime called *cybercrime against property*. Unauthorized access to a computer is most commonly known as *hacking*. Generally, hacking takes place when a person either illegally gains access to a computer system by taking advantage of or overcoming existing security (i.e., passwords and firewalls); or a person exceeds authorized access of a computer. Similarly, cracking is when a person gains unauthorized access (or "hacks") into a computer in order to commit a crime within that computer system. From the legal perspective, computer hacking and cracking statutes are titled *Unlawful Access to a Computer*. Such acts are only crimes when done without the consent of the owner. For framing different legal charges, the breakdown of varying degrees of unlawful access to a computer is as follows:

First-degree access: The crime of unlawful access to a computer is of first degree when a person accesses, causes to be accessed or attempts to access a computer, computer system and computer software for the purpose of defrauding or obtaining money, property or services by fraudulent pretense. Such a person is guilty of unlawful access in the first degree. This crime is a Class C felony.

Second-degree access: Unlawful access is of second degree when a person accesses, causes to be accessed or attempts to access a computer, computer system and computer software, and the crime results in damages or losses of value considered high enough by the law (the value would vary from country to country). This crime is a Class D felony.

Third-degree access: Unlawful access is of third degree when a person accesses, causes to be accessed or attempts to access a computer, computer system and computer software, and the crime results in loss or damage of less than the value that is considered "high" by the prevailing law in the country (this amount varies from country to country). This is a Class A misdemeanor.

Fourth-degree access: Unlawful access is of fourth degree when a person accesses, causes to be accessed or attempts to access a computer, computer system and computer software, but there is no loss or damage. This is a Class B misdemeanor.

First-degree access is the most serious one from the legal perspective. Relate this to item serial number 5 of Table 1.1 in Chapter 1.

Box 6.1 Degrees of Unlawful . . . (Continued)

Computer trespassing is another term to consider. A person is guilty of computer trespass in the second degree if the person, without authorization, intentionally gains access to a computer system or electronic database of another under circumstances not constituting the offense in the first degree.

In other words, *computer trespassing* involves using a computer with knowledge that such use is without authority and with the intention of: (a) deleting or in any way removing, either temporarily or permanently, any computer data; (b) obstructing, interrupting or in any way interfering with the use of a computer program or data and (c) altering, damaging or in any way causing the malfunction of a computer.

In reference to the above-mentioned term *unauthorized access*, note that the law considers *computer trespass* to be a crime. For example, according to Sections 18.2–152.4 of *Virginia State Criminal Law*, computer trespass is deemed to have occurred when any person uses a computer or computer network without authority and with the intent to:

1. Temporarily or permanently remove computer data, computer programs or computer software from a computer or computer network;
2. cause a computer to malfunction regardless of how long the malfunction persists;
3. alter or erase any computer data, computer programs or computer software;
4. effect the creation or alteration of a financial instrument or of an electronic transfer of funds;
5. cause physical injury to the property of another; or make or cause to be made an unauthorized copy, in any form, including, but not limited to, any printed or electronic form of computer data, computer programs or computer software residing in, communicated by or produced by a computer or computer network shall be guilty of the crime of computer trespass which shall be punishable as a Class 1 misdemeanor.

In the US, as per *Virginia State Criminal Law*, if such an act is done maliciously and the value of the property damaged is \$2,500 or more, the offense shall be punishable as a Class 6 felony. (The term *felony* means an offense or a crime or a criminal act or law breaking/wrong doing.)

All forms of cybercrime are increasing rapidly – cybercrime is the latest and perhaps the most complicated problem in the cyberworld; in a way, it is a bane of Information and Computer Technology (ICT). It is said that the US still produces more malware, Spam and viruses than any other country in the world. Illicit IT jobs are increasingly scattered across an anarchic and international Internet, where labor is cheap, legitimate IT jobs are scarce and scammers are insulated from the laws. Maintaining legal, political and technological standards on the Internet is increasingly important, as cyberattacks take a greater toll. In year 2007, Computer Security Institute in the US conducted a survey^[5] according to which, the average financial loss suffered by individual US corporations, agencies and institutions due to cyberattacks was US\$ 350,424. This loss in figure turns out to be more than double compared to that in the year 2006. Total losses from cyberattacks were \$66.9 million, with financial fraud incurring the most damage at \$21.1 million in total losses. Chapter 1 provided the Indian statistics on cybercrime (refer to Tables 1.1–1.4). This is the background for understanding the legal landscape on cybercrime.

6.2 Cybercrime and the Legal Landscape around the World

Before getting into India-specific discussion, we discuss here the world scenario considering the following countries: the US, Europe, Canada, Asia-Pacific and Africa. First, let us examine the term *crime* under the legal microscope. *Crime* is a legal concept and has the sanction of the law. Crime or an offense is “a legal

wrong that can be followed by criminal proceedings which may result into punishment." The hallmark of criminality is that it is breach of the criminal law. Box 6.1 describes various scenarios for the unlawful access to a computer system. We start with a broad view of the legislative analysis in the Asia-Pacific region, followed by a detailed examination of the legal status (with regard to cybercrime and privacy protection) in Australia, China, Hong Kong, India, Indonesia, Japan, Malaysia, New Zealand, Philippines, Singapore, Thailand, South Korea and Vietnam. From this discussion we will realize that the extent and nature of Internet safety, security and privacy legislation in the Asia-Pacific region varies widely. We will also have a discussion on federal laws in the US about cybercrime. Next, we will discuss the EU legal framework to prevent cybercrime.

One of the preconditions for development of the Information Society is for users to have confidence or "trust" in the reliability, security and integrity of electronic communications systems and computerized information processing systems. This is supported by much literature; for example, the work by researchers at the Carnegie Mellon University in their research paper *The Effect of Online Privacy Information on Purchasing Behaviour: An Experimental Study* (accessible at the link <http://weis2007.econinfosec.org/papers/57.pdf>) Individuals will be reluctant to use networks or systems they do not trust. If there is no trust, individuals will tend to either not disclose personal information or provide false information. Therefore, one critical component of the trust framework is *privacy protection* – the provision of assurances by means of law, technology design and industry practice that personal information will be collected, exchanged and used fairly. As far as the law is concerned, the Web, that is the World Wide Web (WWW), still resembles the *wild west*. Bringing about legal governance for behavior on the Web is a specialty evolving rapidly due to innovations on the Internet. Catching cybercriminals under the legal edifice is a challenge. This is so partly because there is "no central authority" that enforces cyberlaw when crimes are committed. Plaintiffs still turn to traditional law enforcement to solve problems.

6.2.1 A Broad View on Cybercrime Law Scenario in the Asia-Pacific Region

When we consider challenges involved in the Asia-Pacific region, for handling cybercrime, we realize that the challenges exist mainly due to the general lack of awareness of information security issues, the rapidly evolving complexity, capacity and reach of ICT, the anonymity afforded by these technologies and the trans-national nature of communication networks. Consequently, only a few countries of the Asia-Pacific region have appropriate legal and regulatory frameworks to meet these challenges. Even where awareness is growing and where legislation may be adequate, capacity to use information security technologies and related procedures as well as to protect against, detect and respond effectively to cybercrime, and to assist other countries, is low. As a result, published cybercrime reports may represent only a small fraction of their incidence and there is a need for more accurate estimates of the prevalence of cybercrime.

Information privacy or data protection in this context is not about keeping personal information secret; rather, it is about creating a trusted framework for collection, exchange and use of personal data in commercial and governmental contexts. The *Fair Information Practices* (FIPs) are explained in detail in Ref. #4, Books, Further Reading. Data protection laws^[6] permit, and even facilitate, the commercial and governmental use of personal data while providing to individuals (a) control over what to disclose, (b) awareness of how their personal data will be used, (c) rights to insist that data are accurate and up to date, and (d) protection when personal information is used to make decisions about a person.

Now let us consider the Australian Cybercrime Act 2001. The Australian Cybercrime Act 2001 came into effect in Australia in April 2002. This was the third time that a Federal Government has passed cybercrime legislation; previous legislation was passed in 1989 and in 1995. Each attempt was meant to reduce the gap between legislation and malicious online activity. However, Cybercrime Act 2001 is the subject of much

controversy as critics argue that it is too broad in jurisdiction, extends police powers too far and threatens to facilitate the unjust conviction of many Information Technology (IT) professionals. This Act provides too broad a definition of *cybercrime*. Much of the criticism is based on that excessively broad definition and the extent to which the Act has been left for interpretation by the courts. Let us take a glimpse of the Australian Cybercrime Act 2001. This Act introduces the following new offenses to the Criminal Code Act 1995.

1. The serious offenses under Division 477 are as follows:
 - *Section 477.1:* Unauthorized access, modification or impairment with intent to commit a serious offense.
 - *Section 477.2:* Unauthorized modification of data to cause impairment.
 - *Section 477.3:* Unauthorized impairment of electronic communication.
2. The other offenses under Division 478 are as follows:
 - *Section 478.1:* Unauthorized access to, or modification of, restricted data.
 - *Section 478.2:* Unauthorized impairment of data in a computer disk, etc.
 - *Section 478.3:* Possession or control of data with intent to commit a computer offense.
 - *Section 478.4:* Producing, supplying or obtaining data with intent to commit a computer offense.

Not surprisingly, the Australian Cybercrime Act 2001 has drawn considerable criticism: it criminalizes far too much and far too easily, leading to severe consequences for IT professionals. This problem arises primarily from the overly broad definitions adopted by this legislation, specifically the breadth of the terms defined (in the Cybercrime Act) has created an even broader scope of potential criminality. Among the most concerning aspects of the Act are the definitions of *restricted data* and *authorization*; the mental elements of the offenses and the actions that constitute an offense: unauthorized access, modification and impairment.

1. **Restricted data:** In order for data to be defined as *restricted*, it simply needs to be held in a computer that uses an access control system. However, it is NOT a requirement that the data itself is protected by an access control system; only the computer needs to be protected by the access control system. According to this definition, the requirement of *restricted data* can be too easily met, as almost all computers are protected by at least a password. Therefore, to be in breach of Section 478.1 of the Australian Cybercrime Act 2001, an individual simply needs to view almost any data without authorization, notwithstanding whether or not that data was secured. This is further complicated by the lack of explanation of what constitutes having “authorization.”
2. **Authorization:** A key requirement for conviction, under any of the Division 477 offenses and half of the Division 478 offenses, is that access, modification or impairment is undertaken without “authorization.” Yet the Australian Cybercrime Act merely states that the action undertaken must be unauthorized, without actually specifying what constitutes authorization. The Act does not, in any way, address situations where authorization may be disputed, revoked or granted conditionally. For example, if an IT professional is hired to undertake some work, and suppose that in the course of that work, the authorization granted to that person is disputed or revoked, then there may exist a basis for prosecution under Section 478.2 (of the Australian Cybercrime Act 2001) for “unauthorized access or modification to restricted data.” The additional requirement of *restricted data* can be easily met, as explained above.

Now let us understand the powers granted by the Australian Cybercrime Act. Under the Act, new powers granted for law enforcement include:

1. The power to remove “a thing” to another place for the purpose of examination or processing to determine whether it may be seized under a warrant, if it is more practical, or there are reasonable grounds that the “thing” includes or is an evidence.

2. The power to "operate electronic equipment" at the warrant premises in order to access data (including data not held at the premises) if the police believe that the data (may) contains evidentiary material.
3. The power to require a person "to provide any information or assistance" that is considered reasonable and is necessary in order to allow the officer to make a copy of data from equipment that might contain evidential material.
4. The power to require a "person with knowledge of a computer or a computer system to assist access," etc.

In conclusion, we note that the enactment of the Australian legislation means that it is now possible that other well-intentioned actions by Australian IT professionals may be regarded as criminal activities. IT professionals must now take more care in the performance of their duties, and must be much more aware of how their actions may be construed, to avoid risk of prosecution for their well-intentioned actions. The Australian Cybercrime Act 2001 heralds an era of de facto censorship in research and development of computer science fields.

6.2.2 Online Safety and Cybercrime Laws: Detailed Perspective on the Current Asia-Pacific Scenario

The extent and nature of Internet safety, security and privacy legislation in the Asia-Pacific region varies widely. In this section, we are going to consider the legislative position in Asia-Pacific countries with regard to data privacy (impacted by most forms of cybercrimes such as, e.g., identity theft), Spam (unwanted mails) and online child safety (because this closely relates to COPPA). Our objective in this section is to gain an understanding of how the laws of different jurisdictions compare against a single benchmark. In some areas such as computer security laws and online child safety laws [such as the Children's Online Privacy Protection Act (COPPA),^[7] also mentioned in Chapter 1], there exist international norms on the best approach to regulation. For example, the Council of Europe's (CoE's) Convention on Cybercrime is widely regarded as the international norm on the criminalization of computer-related conduct, and the International Centre for Missing and Exploited Children (ICMEC) has developed authoritative model legislation that criminalizes the production of, and certain dealings with, child pornography.^[8] This model has been adopted as the benchmark legislation for the computer security and online child safety matters. However, in other areas, such as privacy laws and Spam, there seem to be no international norms.

In the privacy arena, there are numerous regional norms, such as the *Asia-Pacific Economic Co-operation* (APEC) Privacy Framework and the EU's Data Protection Directive, but an international consensus on the best approach to data protection regulation has not yet been reached. However, CoE's Convention on Cybercrime^[9] serves as the benchmark legislation (see Box 6.2). Titles 1, 2 and 5 of the CoE's Convention on Cybercrime serve as the benchmark legislation. The alignment status of various Asia-Pacific countries mentioned in Table 6.1 is in that benchmark reference.

Box 6.2 The APEC Framework on Privacy

Today belongs to "global economy" and information flows are vital to conducting business in a global economy. The APEC Privacy Framework promotes a flexible approach to information privacy protection for APEC Member Economies, while avoiding the creation of unnecessary barriers to information flows. The APEC Privacy Framework is a practical policy approach to enable accountability in the flow of data while preventing impediments to trade. It provides technical assistance to those APEC economies that have not addressed privacy from a regulatory or policy perspective.

Box 6.2 The APEC . . . (Continued)

The framework will enable regional data transfers to the benefit of consumers, businesses and governments. The framework provides clear guidance and direction to businesses in APEC Member Economies on common privacy issues and outlines the impact of these issues on the various legitimate business models. It does this by outlining reasonable expectations of the modern consumer on how their privacy interests should be protected.

There are nine principles to the APEC Privacy Framework:

1. Preventing harm;
2. integrity of personal information;
3. notice;
4. security safeguards;
5. collection limitations;
6. access and correction;
7. uses of personal information;
8. accountability;
9. choice.

Data is the digital currency that fuels the growth in many of today's economies. This framework will facilitate responsible information flows, which creates an essential basis for increased trade and E-Commerce to flourish. It enables government, business and societal benefits by developing domestic markets, improving efficiencies and economic growth, and attracting foreign investment, which also leads to developing local industry. The framework focuses on both domestic and international implementation of privacy standards for APEC Member Economies. It explores new ways of information sharing and cooperation across agencies and authorities to enable transfers of personal information across borders. The framework also provides specific examples of privacy situations and focuses its attention on practical and consistent information privacy protection within this context. The framework balances privacy with all relevant interests while according due recognition to issues of cultural and economic diversity that exist within the APEC Region.

Note: Privacy details are discussed in detail in Ref. #4, Books, Further Reading.

Computer Security Laws

The Australian, New Zealand, Singaporean, Taiwanese and Thai Governments have each enacted robust computer security laws that cover most of the core and computer-related offenses found in the CoE's Convention on Cybercrime. The computer security laws in China, Hong Kong, Japan and South Korea are moderately aligned with the Convention. The enacted laws in Malaysia, the Philippines and Vietnam are moderately to weakly aligned, respectively, with the Convention (see Table 6.1). Malaysia and the Philippines have enacted some computer security offenses; however, the focus of these offenses appears to be on unauthorized access and these countries still rely on their general law to criminalize a number of the acts prohibited by the Convention. Vietnam's implementation of the Convention's core, and computer-related fraud and forgery, offenses appears to be piecemeal and arises from the enactment of multiple, overlapping prohibitions in various instruments, including the Law on Information Technology 2006 and the Law on E-Transactions 2005.

In India, although the ITA 2000 prohibits many of the activities that constitute core offenses under the Convention, the IT Act does not, for the most part, criminalize these activities – it merely provides for significant liability in damages. This civil liability approach is unique in the region. India's Information Technology (Amendment) Bill 2006 (IT Amendment Bill No. 96 of 2000) was proposed to amend the IT Act to criminalize many of the Acts that constitute core offenses under the Convention but only where they are done "dishonestly or fraudulently." In September 2007, the Standing Committee on IT submitted its

Table 6.1 Asia-Pacific region: Alignment of the countries enacted legislation with regard to the benchmark legislation

| Favorable Alignment | Moderate Alignment | Weak Alignment |
|---------------------|--------------------|----------------|
| Australia | China | India |
| New Zealand | Hong Kong | Indonesia* |
| Singapore | Japan | — |
| Taiwan | Malaysia | — |
| Thailand | Philippines | — |
| — | South Korea | — |
| — | Vietnam | — |

*No computer security laws have been enacted.

report on the IT Amendment Bill to address a number of substantive recommendations in respect of the bill. This resulted in the ITA 2008 (amendments to the Indian ITA 2000).

Indonesia's Bill on Electronic Information and Transaction (EIT) is weakly aligned with the Convention (refer to Table 6.1). Partly, this is due to its emphasis on unauthorized access and the protection of government and financial computer systems. Japan and China have also been considering updated cybercrime laws for some time now. The Japanese parliament, since 2004, has a long pending matter of amendment to the criminal code to criminalize the preparation, production, dissemination and use of computer viruses and malware; this has been pending along with a separate piece of legislation that seeks to implement Japan's remaining obligations as a signatory to the Convention on Cybercrime. China has drafted its "National Information Security Regulations." However, neither the content of these regulations nor the timeframe for their enactment is known. Table 6.1 shows the alignment position of the mentioned countries with regard to the CoE's Convention on Cybercrime as the benchmark.

This degree of alignment varies due to the range of Convention offenses covered by the enacted legislation and the restrictive way in which some of the Convention offenses are implemented (e.g., requiring that unauthorized access be obtained by use of a telecommunications line). Take the example of Hong Kong – its general criminal law seems to apply in several cases to computer-facilitated act that is criminalized by the Convention on Cybercrime. It is interesting to know that Hong Kong has enacted fewer offenses with regard to computer security, which is one of the aims to which the Convention is directed. Owing to lack of comprehensive computer security laws, jurisdictions such as Indonesia rely on the application of their existing laws to regulate conducts that are declared criminal by the Convention. Legislatures in Indonesia, India and the Philippines are currently considering comprehensive computer security laws. In India, as we know the IT Act has been amended. The Philippines' proposed Cybercrime Prevention Act of 2005 (HB 3777) is considered to be the most closely aligned with the Convention on Cybercrime. It almost identically reproduces the Convention's core offenses, computer-related fraud and forgery offenses, and ancillary liability provisions.

Data Privacy and Data Protection

Position on privacy laws also greatly varies in the Asia-Pacific region. Table 6.2 shows the alignment position with regard to the benchmark legislation that was mentioned earlier in this discussion. The Microsoft-drafted Model Privacy Bill serves as the benchmark legislation in data privacy arena (referred to as the *Model Bill*). Privacy mature organizations are regulated by prevailing privacy regulations in their respective countries. As such, and as per the FIPS, these organizations must provide a "privacy notice" before collecting "personally identifiable information" (PII). *Privacy notice* is a statement made to a data subject that describes how the

Table 6.2 | Asia-Pacific region: Alignment of the countries enacted legislation with regard to Microsoft Model Privacy Bill

| Favorable Alignment | Moderate Alignment | Weak Alignment |
|---------------------|--------------------|----------------|
| — | Australia | India* |
| — | Hong Kong | Indonesia* |
| — | Japan | Malaysia |
| — | New Zealand | Philippines |
| — | — | Singapore* |
| — | — | South Korea |
| — | — | Taiwan |
| — | — | Thailand |
| — | — | Vietnam |

*No data protection laws have been enacted.

organization collects, uses, retains and discloses personal information. Sometimes, a privacy notice is referred to as a privacy statement, a fair processing statement and even a privacy policy. Providing privacy notice is important to be entitled to use or disclose it for a secondary purpose. The privacy-regulated organization must obtain a prior consent of the data subject – either explicit, Opt-Out or implied – depending on several factors related to the privacy risk involved (see Fig. 6.2).

From privacy perspective, there are two kinds of information about individuals: *aggregated information* and *PII*. Aggregate information or statistical information is complied, that is not personally identifiable. Examples of aggregate information include, but are not limited to, demographics, domain names and website traffic counts. PII is any information that can be traced to a particular individual. Note that *aggregate information* is not considered as PII. For example, information indicating the number of visitors to a particular Internet site. Commonly known examples of PII are the “social security number” (SSN) in USA, personal account number (PAN) in India, name, E-Mail address, phone number, etc. Personal user preferences tracked by a website via a cookie are also considered personally identifiable when linked to other PII provided by a user online. The definition of PII may vary from organization to organization. Some people in the IT industry

Opt-In is a process in which personal information will be processed *only if* the data subject indicates it should be so.

An *Opt-In* is considered to be an *explicit* consent

Opt-Out is a process in which personal information will be processed *unless* the data subject indicates it should be otherwise.

An *Opt-Out* is considered to be an ‘*implicit*’ consent

Related Concepts

Subscribe/unsubscribe Register/unregister double Opt-In

Examples

Yes, Please include me(user needs to uncheck the box if he/she does not wish to be included)

Yes, Please include me ... (user needs to check the box if he/she does not wish to be included)

Figure 6.2 | Opt-In and Opt-Out.

believe that a *dynamic* IP address is NOT a PII because it varies depending on which computer network one is connected to, whereas a *static* IP address is a PII because it is always fixed. *Privacy notice* is considered as a mature privacy practice in organizations.

There are several protected disclosures to which the Model Bill's provisions relating to use and disclosure of PII do not apply. These non-applicability situations include the scenarios where the disclosure is made to service providers and related companies that operate under a common set of internal policies. The Model Bill also contains access and correction as well as security-related provisions, including a breach notification obligation. The breach notification is triggered when a security breach results in (or it is likely that a breach will result in) the misuse of a resident's unencrypted sensitive financial information. Table 6.2 shows alignment position of Asia-Pacific countries with regard to Microsoft's Model Privacy Bill as the benchmark.

According to Organization for Economic Co-operation and Development (OECD) "Guidelines on the Protection of Privacy and Trans-border Flows,"^[10] the data protection laws in Australia, Hong Kong and New Zealand are moderately to favorably aligned with the benchmark legislation. The strengths of these regimes vis-à-vis the Model Bill include their broad application to the private sector and their notice, security and access provisions. There is one aspect of the Model Bill that these regimes have not adopted in full – it is the tiered consent model that takes account of the privacy risk inherent in secondary use or transfer (i.e., a model that imposes more onerous consent requirements where the associated privacy risk is greater). Furthermore, the imposition of restrictions on transborder data flows in Australia and Hong Kong are deviations from the Model Privacy Bill.

If we consider on its own, Japan's Act Concerning the Protection of Personal Information appears to be moderately aligned with the benchmark legislation. Yet, it is possible that the sectoral guidelines to explain the application of the Protection of Personal Information in certain industry sectors may alter this analysis. OECD Guidelines are used by South Korea's data protection regime as well; however, the South Korean data protection regime is less well aligned with the benchmark legislation. South Korea's alignment with the Model Privacy Bill is impacted by a combination of restrictive provisions in the legislation, such as requiring a data subject's consent for transborder data flows within a corporate group, and the way in which the legislation has been interpreted and enforced by the Korea Information and Security Agency (KISA).

Taiwan's Computer-Processed Personal Data Protection Law has limited applicability to certain industries in the private sector. The Taiwanese Law is unique in the region as long as it establishes a mandatory licensing regime for the regulated entities that collect, use or disclose personal data. Thailand does not have legislation for private sector data protection. However, the Official Information Act 1997 does regulate state agencies for dealings with personal information. Vietnam does not seem to have any comprehensive data protection laws of general application. However, the Vietnamese Law on Information Technology 2006 does contain a limited data protection provision applicable to the collection, use and disclosure of personal information in a networked environment. In the E-Transactions Law, there are similar provisions to address the handling of personal information collected as part of an electronic transaction – a very common phenomenon in E-Commerce paradigm. The Philippine Department of Trade and Industry has recently come out with an administrative order with guidelines to protect personal data held by private sector organizations. These voluntary guidelines are a measure of a different kind to the Model Bill; they aim at encouraging private sector organizations to adopt privacy policies rather than penalizing them for not doing so.

Malaysia (as at the time of writing this) does not have a comprehensive data protection legislation. However, the General Consumer Code developed following the Communications and Multimedia Act of 1998, contains provisions toward the protection of personal information collected by licensed telecommunications service providers. China, India, Indonesia and Singapore have not enacted data protection legislation per se. China, India, Indonesia, Malaysia, South Korea, Taiwan and Thailand are currently considering data protection legislation (as the time of writing this). APEC Privacy Framework in 2005 has served as the trigger for reform in this area.

The Taiwanese legislative proposal, when enacted, would bring the country's existing regime more into line with the ideal advocated by the benchmark legislation. The position in South Korea is not so clear; as at the date of writing this, it is understood that the South African Government has plans to consolidate three of their private sector instruments that were previously meant for consolidation into a single bill. The Indonesian and Indian data protection proposals are only minor parts of pending cybercrime legislation. Toward that, in September 2007, India's Standing Committee on IT recommended that India enact a more comprehensive data protection regime as part of the proposed amendments to the IT Act discussed in the computer security section previously.

For a long time, Malaysia, Thailand and China have been contemplating to have a legislation toward data protection. The most recent publicly available draft of the Malaysian legislation contemplated a model similar to Hong Kong's Personal Data Privacy Ordinance, which would stand the pending legislation in good stead vis-à-vis the Model Privacy Bill. It is understood that a further draft of Malaysia's data protection legislation has been prepared since then. The Thai Government is presently considering ways to come closer toward its proposed alignment with the APEC Privacy Framework. China's State Council Normalization Office is in discussions with data protection experts to finalize the content of their proposed legislation which was placed on the National People's Congress legislative agenda in 2008.

Spam Laws

The checklist drafted by Microsoft contains features of effective anti-Spam legislation. It is considered as the benchmark legislation for this part of the discussion. The Microsoft checklist envisages an "Opt-Out" anti-Spam regime to address commercial electronic messages. However, the checklist mentions that transactional or relationship messages (such as messages sent to customers with regard to products or services purchased from the sender) should be excluded from the scope of regulation, as it should contain messages that only have an incidental commercial purpose. The Microsoft checklist contains the usual restrictions on transmitting electronic messages of commercial nature – without an unsubscribe facility or accurate sender and header information – and provides that customers should be able to Opt-Out from the receipt of commercial electronic messages on a product-line basis as well as on a company-wide basis. However, the checklist does not contemplate any "ADV" or other labeling requirement. Effective anti-Spam legislation needs to also include strong antiaddress harvesting and dictionary attack measures, as well as service provider liability provisions that preserve the right of Internet Service Providers (ISPs) and E-Mail service providers to fight against Spam. As far as enforcement is concerned, the Microsoft checklist contemplates enforcement by ISPs, E-Mail service providers and the government. The available remedies should include: (a) civil liability in damages, (b) capped statutory damages that may be adjusted to take into account willful violations and implementation of best practice procedures and (c) criminal sanctions for intentional and unauthorized acts, including those involving fraud.

In recent times, there has been a discernible move in the Asia-Pacific region toward the enactment of anti-Spam legislation. There are now seven countries in this region that have enacted comprehensive anti-Spam legislation: Australia, China, Hong Kong, Japan, New Zealand, Singapore and South Korea. Of these, Hong Kong's Opt-Out regime appears to be the most closely aligned with the checklist, with Australia and New Zealand being positioned not too far behind despite implementing Opt-In models. Singapore has enacted an Opt-Out regime with "bulk" and labeling requirements, whereas the requirements of South Korea's regime vary depending on the medium by which the advertising is transmitted. China's Internet E-Mail Service Management Regulations 2006 are moderately to weakly aligned with the checklist due in part to their application only to E-Mails and their "AD" labeling requirement. Hong Kong and New Zealand are currently the only jurisdictions in the region that explicitly exclude transactional or relationship messages from the scope of regulation.

Philippines, Thailand and Vietnam have enforced anti-Spam measures that are less comprehensive. The broadcast messaging rules implemented in the Philippines are considered as an interim measure designed to address a particular area of concern, namely, Spam SMS and MMS, pending the development of a more comprehensive regime. Thailand chose to enact Spam-related provisions as part of its 2007 computer security legislation. Those provisions are likely to have limited application to Spam that is not fraudulent or designed to interfere with the operation of the recipient's computer system. Two sources of Spam-related obligations are available in Vietnam: (a) the Law on Information Technology 2006 and (b) Decree 142 Specifying Administrative Penalties in the Field of Post, Telecommunications and Radio Frequency. These instruments address "advertisement information" transmitted over networks and "unsolicited messages," respectively. However, neither instrument brings about a comprehensive Spam regime. In the absence of specific anti-Spam legislation, jurisdictions such as India, Indonesia, Malaysia and Taiwan rely on their existing computer security and/or consumer protection laws to regulate Spam activity. In a way, this approach succeeds toward eliminating the consequences of Spam activity; it is increasingly being accepted by legislatures in the region that specific anti-Spam legislation is necessary to reduce Spam volumes.

Legislatures in India, Indonesia, the Philippines and Taiwan are currently considering anti-Spam legislative proposals. Of these proposals, Taiwan's "Opt-Out" legislation appears to be the most advanced in the legislative process, as well as being the most closely aligned with the checklist (the meaning of the term "Opt-Out" has been explained earlier; see Fig. 6.2). In India, the definition of *unsolicited commercial communications* is presently defined and is based on Opt-Out approach solicited by the Reserve Bank of India, that is, those customers who do not want to receive unsolicited commercial communications.

Vietnam's inter-agency taskforce is at an early stage of drafting a diktat on Spam. A draft of the diktat was expected in late 2007. The pending computer security laws in India, Indonesia and the Philippines contain Spam-related provisions. If enacted in their current form, the Spam-related provisions in India's IT Amendment Bill is to apply only to certain limited types of Spam and not mere unsolicited commercial electronic messages. In its report on the IT Amendment Bill, the Standing Committee on IT questioned whether these provisions contained a sufficient response to the problem of Spam. The Committee recommended that India enact specific anti-Spam legislation.

Box 6.3 India and Anti-Spam Legislation

A few years ago, Bill Gates proclaimed that Spam would no longer be a problem in 2006. However it did not happen. Spam is nothing but unsolicited bulk E-Mail (UBE) or unsolicited commercial E-Mail (UCE). Note that Spam is "unsolicited" which means that there is no prior relationship between the parties concerned and the recipient has not explicitly consented to receive the communication. Unsolicited E-Mail, also called "Spam," is a growing concern among corporations and individuals. Spamming was once viewed as a mere nuisance – it is now posing alarming problems. Way back in 2002, losses to US Corporations due to Spamming were a staggering \$8.9 billion. In 2003, Spam costs to all non-corporation Internet users were an estimated \$255 million. With the increasing number of Internet users in India, the absence of any legislation prohibiting Spamming and the dearth of other Spam-control measures, it is time the government took note of this menace.

Spam legislation is non-existent in India. The ITA 2000 does not discuss the issue of Spamming at all. It only refers to punishment for those, who after having secured access to any electronic material without the consent of the person concerned, disclose such electronic material to any other person. It does not have any bearing on violation of individual's privacy in cyberspace. The illegality of Spamming is not considered. The Delhi High Court acknowledged the absence of appropriate legislation concerning Spam in a recent case wherein Tata Sons Ltd and its subsidiary Panatone Finwest Ltd filed a suit against McCoy Infosystems Pvt Ltd for transmission of Spam. It was held that in the absence of statutory protection to check Spam mails on Internet, the traditional tort law principles of trespass to goods as well as law of nuisance would have to be used.

Box 6.3 India and Anti-Spam . . . (Continued)

Spam is harmful because for a number of reasons as follows:

1. **Content:** Most of the objections to Spam come up due to its content. Commercial messages may promote dubious ventures; sometimes messages with sexually explicit material are commonplace. However, the most important objection to Spam messages is that they may contain harmful embedded code and hostile file attachments.
2. **Internet resources consumed:** A significant proportion of all E-Mail traffic constitutes of Spam, resulting in massive consumption of network bandwidth, memory, storage space and other resources. Internet users and system administrators spend a great deal of time reading, deleting, filtering and blocking Spam, as a result of which they pay more for Internet access.
3. **Threat to Internet security:** Spammers frequently tap into Simple Mail Transfer Protocol (SMTP) Servers and direct them to send copies of a message to a long list of recipients. Third-party relaying usually represents theft of service because it is an unauthorized appropriation of computing resources. A company's reputation may be damaged if it is associated with Spam because of third-party relaying.

The legal methods to deal with the Spamming menace are prohibition, enforcement of anti-Spam policies, Opt-Out clause, statutory provisions and enforcement mechanisms. Although there are legal methods to deal with Spam, there is considerable debate whether we need to prohibit or restrict Spam? Even if one assumes that Spam is bad, there are many countervailing issues that must be analyzed with regard to any legislation that prohibits or restricts Spam. These countervailing issues include the following:

1. Civil liberties advocates say that there are constitutional issues to consider which could trickle down to other types of speech over the Internet. Furthermore, different countries have different free speech laws. What may be legal in one country may be entirely unlawful elsewhere. In India, there are strong and explicit freedom of speech protections; the Supreme Court has held commercial advertising to be an inalienable part of freedom of speech which is enshrined in Article 19 of the Constitution. This is the reason why some legislators and advocates argue that the anti-Spam legislation has to be very specific in that the proposed legislation has to truly limit itself to only "commercial E-Mail."
2. Consumer protection laws exist to protect the consumer from fraudulent and deceptive advertising.
3. Legislation prohibiting pornography already exists although some modification to such legislation may be required, so that Internet users have some protection from receiving pornographic materials via Spam.

Indonesia's EIT Bill does not propose to regulate Spam messages per se. Instead, the EIT Bill proposes to require eSellers (i.e., persons who offer to sell goods and services offered through electronic media) to provide complete and correct information in relation to the terms of the contract, the good or service offered and the producer of the good or service. The Spam-related provisions in the Philippines' Cybercrime Prevention Act of 2005 (HB 3777) propose to establish a basic Opt-Out regime (refer to Fig. 6.2). Plans are afoot to amend Japan's law regarding the regulation of transmission of specific E-Mail. The Ministry of Internal Affairs and Communications was to submit a bill to the The National Diet of Japan (Japan's bicameral legislature) in 2008. The Bill was to create an Opt-In regime for Spam E-Mails accessed from computers and mobile phones. Malaysia and China may also enact anti-Spam laws in the future. There was an announcement in August 2007 by the Malaysian Communications and Multimedia Commission saying that it had issued a tender for the provision of consultancy services for studying legislative responses and drafting anti-Spam legislation for Malaysia. As for China, it is understood that the Internet Society of China, supported by the Ministry of Information Industry, is engaged in research to look into various possible approaches toward comprehensive Spam legislation. Draft codes of practice are under consideration in both Hong Kong and New Zealand. These codes of practice are expected to provide regulated entities with further guidance on how to comply with the comprehensive

Table 6.3 | Asia-Pacific region: Alignment of the countries enacted legislation with regard to anti-Spam laws (Microsoft checklist)

| Favorable Alignment | Moderate Alignment | Weak Alignment |
|---------------------|--------------------|----------------|
| Hong Kong | Australia | India* |
| — | China | Indonesia* |
| — | New Zealand | Malaysia |
| — | Singapore | Philippines |
| — | South Korea | Taiwan* |
| — | — | Thailand |
| — | — | Vietnam |

*No Spam laws have been enacted.

anti-Spam regimes that have recently been enacted in Hong Kong and New Zealand. Table 6.3 presents the alignment position of Asia-Pacific countries with regard to the Microsoft checklist for anti-Spam legislation.

Online Protection for Children

This is closely related to COPPA (refer to Chapter 1). For readers' reference, ICMEC stands for International Centre for Missing and Exploited Children. A combination of the child pornography offenses in Title 3 of the Convention on Cybercrime and the core elements of ICMEC's Model Child Pornography Legislation serve as the benchmark instrument for this part of the analysis. The child pornography offenses in Title 3 of the Convention of Cybercrime aim to circumscribe the use of computer systems in the commission of sexual offenses against children. As such, the Convention requires signatories to criminalize acts such as the production of child pornography for the purpose of its distribution through a computer system, and offering, making available, distributing or transmitting child pornography through a computer system. Being in possession of child pornography material in electronic form stored in a computer system is also subject to criminalization. In ICMEC's view, effective child pornography legislation must specifically apply to child pornography and not just pornography in general. Therefore, the legislation must include a definition of child pornography (where a child is a person under the age of 18 irrespective of the age at consent to sexual relations). In an effective child pornography, legislation should also expressly criminalize the possession of child pornography regardless of the intent to distribute, and require ISPs to bring to the notice of relevant authorities all suspected child pornography matters.

Online child safety laws are among the least developed in the region vis-à-vis the benchmark legislation. Most countries have enacted broad obscenity regimes that have some application to online dealing in child pornography. There are only 5 of 14 jurisdictions, namely, Australia, Hong Kong, Japan, South Korea and Taiwan, which have enacted legislation to specifically address child pornography. Three of the fourteen jurisdictions, that is, Australia, Hong Kong and Taiwan, have enacted legislation on computer-facilitated child pornography offenses. The specific child pornography legislation, enacted in the region, generally adheres to the applicable ICMEC principles; however, only Australia and Hong Kong criminalize mere possession of child pornography (i.e., possession, irrespective of the intent to distribute). The computer-facilitated child pornography offenses enacted in Australia, Hong Kong and Taiwan cover most of the prohibited acts under Title 3 of the Convention; Australia is the only jurisdiction in the region to impose an obligation on ISPs and content hosts to report material that they reasonably believe to be child pornography material (a similar provision exists in the US law). Although New Zealand has not enacted specific legislation to combat child pornography, case law confirms that New Zealand's classification regime does apply to child pornography, and certain of the offenses under that regime attract more serious sanctions where the offending publication

promotes sexual exploitation of children, among other things. The Thai Computer Crime Act criminalizes certain computer-facilitated dealings with pornography, it does not specifically refer to child pornography.

Although child pornography is now being touted as a global issue, there is no legislation in India, Indonesia, Malaysia, the Philippines, Singapore and Vietnam to specifically address child pornography. However, the absence of specific child pornography legislation in these countries needs to be understood in the context of these countries' approach to control pornographic content. For example, in some of the Asia-Pacific jurisdictions, such as Malaysia, Singapore and Vietnam, the ISPs are primarily held responsible for control of content as well as hosting of content. However, in Vietnam this responsibility lies with the state, society and schools. As such, these entities will be held responsible if obscene material is transmitted using their services. With this approach to control of content, the need for specific legislation to eradicate child pornography is not perceived as necessary because it is believed that the approach serves to reduce the availability of child pornography online.

Currently, the Philippine, Indian, Indonesian and Japanese legislatures are considering online child safety laws. ITA 2008 addresses child pornography. Most of these pending laws are subsumed in the broader proposals to enact computer security laws. The Philippine legislation specifically applies to child pornography and not to pornography at large. In the Philippines, the enactment of the computer-facilitated child pornography offenses in the Cybercrime Prevention Act is a welcome development – inclusion of these online child pornographic offenses and the associated definitions are based on Title 3 of the Convention on Cybercrime. In Indonesia, the proposals to enact computer-facilitated pornography offenses are considered less comprehensive than the Philippine proposal. It is believed that the Indonesian proposals could benefit from further refinement to get them aligned with the benchmark legislation. Japan has pending computer security legislation; it includes offenses relating to the possession and distribution of obscene electronic records. The Japanese Government plans to amend the Law for Punishing Acts Related to Child Prostitution and Child Pornography, and for Protecting Children. The details of these planned amendments are not available at the date of writing. Way back in 2005, Thailand had considered amendments to its erstwhile online child safety laws, specifically in the area of child pornography. At this point of time, it is not known if or when this legislative proposal will proceed to enactment. As per recommendation of the Indian Standing Committee on IT, the Indian Government has revised the IT Amendment Bill in order to criminalize computer-facilitated dealings with child pornography in accordance with the Convention on Cybercrime. With regard to *online child safety*, the Internet Governance Forum (IGF) is one of the active forums. Table 6.4 shows alignment position of Asia-Pacific countries with regard to Online Child Safety Legislation.

Table 6.4 | Asia-Pacific region: Alignment of the countries enacted legislation with regard to European Cybercrime Convention and ICMEC's Model Child Pornography Legislation

| Favorable Alignment | Moderate Alignment | Weak Alignment |
|---------------------|--------------------|----------------|
| Australia | Hong Kong | India* |
| — | Japan | Indonesia* |
| — | South Korea | Malaysia |
| — | Taiwan | New Zealand |
| — | — | Philippines |
| — | — | Singapore* |
| — | — | Thailand |
| — | — | Vietnam* |

*No online child safety laws have been enacted.

Let us consider three important geographies – Asia-Pacific, Europe (where privacy and security laws are very strictly laid out) and the US (where they have chosen a sector-based approach to information security). Positions in these geographies do differ. For example, in the US, there are state laws for prevention of cybercrime. Readers may visit the link given in Ref. #17, Additional Useful Web References, Further Reading which is about US Laws and Legislation. The US Federal Trade Commission estimates that identity theft affects 9 million Americans annually. The US Congress, in September 2008, passed a crack down on cybercrime after adding an amendment containing most of an anti-Spyware bill. This is further discussed in the following section. To conclude the discussion in this section, we note that the world scenario on legal position on cybercrime differs.

6.2.3 Anti-Spam Laws in Canada

In early 2009, the Canadian Government tabled anti-Spam legislation, Bill C-27, The Electronic Commerce Protection Act, to address Spam, counterfeit websites and Spyware. The proposed legislation also brings amendment to Canada's *Personal Information Protection and Electronic Documents Act* (PIPEDA – see Box 6.4) which covers online privacy in detail and contains many provisions relevant to E-Mail marketing.

Box 6.4 PIPEDA – The Canadian Act for Protecting Personal Information

Canada has two federal privacy laws, the Privacy Act and the *Personal Information Protection and Electronic Documents Act* (PIPEDA). The Privacy Act took effect on 1 July 1983. This Act imposes obligations on some 250 Federal Government departments and agencies to respect privacy rights by limiting the collection, use and disclosure of personal information. It gives individuals the right to access and request correction of personal information about themselves held by these Federal Government Organizations.

Individuals are also protected by the PIPEDA that sets out ground rules for how private sector organizations may collect, use or disclose personal information in the course of commercial activities. The law gives individuals the right to access and request correction of the personal information these organizations may have collected about them. Initially, PIPEDA applied only to personal information about customers or employees that was collected, used or disclosed in the course of commercial activities by the federally regulated private sector, organizations such as banks, airlines and telecommunications companies. The Act now applies to personal information collected, used or disclosed by the retail sector, publishing companies, the service industry, manufacturers and other provincially regulated organizations. The Act does not apply to the personal information of employees of these provincially regulated organizations.

Basically, PIPEDA is based on the FIPs (Fair Information Practices):

1. Principle 1 – Accountability
2. Principle 2 – Identifying purposes
3. Principle 3 – Consent
4. Principle 4 – Limiting collection
5. Principle 5 – Limiting use, disclosure and retention
6. Principle 6 – Accuracy
7. Principle 7 – Safeguards
8. Principle 8 – Openness
9. Principle 9 – Individual access
10. Principle 10 – Challenging compliance

For more information, contact

The Office of the Privacy Commissioner of Canada

112 Kent Street, Ottawa, ON K1A 1H3

www.priv.gc.ca

1-800-282-1376

Note: The PIPEDA and the FIPs are also addressed in Chapter 29 and Appendix H, respectively, in Nina Godbole (2009) *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India.

There are two laws currently being discussed in Canadian legislative assemblies:

1. **Senate Bill S-220:** The bill was introduced by Senator Yoine Goldstein in early February 2009. It is slated to become the *Anti-Spam Act*. It is a private member's bill with private right of action and criminal remedies. Senator Goldstein has already introduced the Anti-Spam Bill in two previous sessions of parliament. The purpose of this bill is to ban UCE. Bill S-220 replaces the Canadian Bill S-202 (see Ref. #20, Additional Useful Web References, Further Reading). The bill would allow the ISPs to refuse, filter and block Spam E-Mails. The S-220 is proposing to consider Phishing attacks also. According to some legislative experts, there could be potential conflicts between the problematic parts of this proposed legislation and the Canadian Charter of Rights and Freedoms. These conflicts are being looked into because it is felt that it would be a simplified justification for removing sections that contain exemption to spamming (Section 8, subsection 3, paragraphs a, b, c, d and g). The motive for this bill is based on the fact that despite the widespread recognition that Spam is a serious problem which costs our economy billions in fraud and lost productivity, Canada remains the only G8 country without an anti-Spam legislation.
2. **Parliamentary Bill C-27:** The bill was tabled by the government in April 2009, with private right of action, coordination between various enforcement agencies, civil remedies. The Electronic Commerce Protection Act (ECPA) (aka: Bill C-27) is an Anti-Spam Act that covers *E-Mail communications, unauthorized installed applications and the alteration of data during transmission between senders and recipients*. The bill forbids anyone from installing a program on a computer that could send an electronic message without the consent of the owner or user. It also forbids anyone in Canada from sending a commercial message to any electronic address unless the receiver has consented. An exception is if the person sending the message has had a business transaction with the recipient in the previous 18 months. Penalties range from up to \$1 million for individual violators to up to \$10 million for organizations. One of the criticisms against the bill is that "the bill as currently drafted would actually ban the use of the Internet by Canadians unless a person with a website had written consent from a consumer to use it." Instead of demanding consent for certain activities, Ottawa needs to define activity that is bad – for example, creating misleading E-Mail headers.

Box 6.5 ECPA: The New Dawn in Canadian Legislation

The Electronic Commerce Protection Act (ECPA) is a law designed to promote and protect electronic communications while discouraging the abuse of these resources that threaten to impair the reliability, efficiency of electronic activities; prevent additional costs to businesses and consumers; protect the privacy and the security of confidential information and strengthen the confidence of Canadians in the use of electronic means of communication and commercial activities. This enactment also makes several amendments to related laws: the Competition Act, PIPEDA, the Canadian Radiotelevision and Telecommunications Commission Act, and the Telecommunications Act.

The ECPA defines a commercial electronic message as an electronic message that consists of: (a) the content, (b) the hyperlinks and (c) the contact information, where the purpose is to encourage participation in a commercial activity that:

1. Offers to purchase, sell, barter or lease a product, goods, a service, land or an interest or right in land;
2. offers to provide a business, investment or gaming opportunity;
3. advertises or promotes anything referred to in (1) or (2);
4. promotes a person, including the public image of a person, as being a person who does anything referred to in any of (1)–(3), or who intends to do so.

Box 6.5 ECPA: . . . (Continued)

The ECPA also clearly states that an electronic message which contains a request for consent (i.e., confirmed Opt-In notices) is also considered to be a commercial electronic message. The ECPA also lists several types of excluded communications such as responses to customers' service enquiries and applications, law enforcement, public safety, the protection of Canada, the conduct of international affairs or the defense of Canada and personal communications.

The governance ambit of ECPA looks very large in the sense, which after reading through the act, it looks like every corporation registered under a Federal or Provincial license for the purposes of Commercial Activity is going to be effected by this law. This covers non-profits, co-ops, sole proprietors and partnerships. The Communications Assistance for Law Enforcement Act (CALEA) is the Amendment of ECPA.

Commercial E-Mail can only be sent to a recipient who has consented to receiving it (express or implied – definition below) and the message complies with the purpose of the ECPA described above. All messages being sent must:

1. Clearly identify the person who sent the message and the person (if different) on whose behalf it is sent – Add your physical postal address and company name to all E-Mails.
2. Provide a method where the recipient can readily contact the person(s) responsible for sending the message (MUST be active for 60 days after the messages was sent) – Enable replies to go to your customer service and stop using No-Reply.
3. Provide a working unsubscribe mechanism (more below) that removes an address within 10 days – The faster the better.

An important point to note is that the ECPA states that an electronic message is considered to have been sent once its transmission has been initiated (by the sender) and that it is irrelevant if the intended recipient address exists or if message reaches its intended destination. This reference makes bounce management even more important for mailers to monitor and clean from your list. When you are working with your clients/members/subscribers and asking for their consent, there are several things you should remember and incorporate into the process:

1. Clearly state the purpose(s) for which the consent is being sought.
2. Clearly identify the person(s) seeking consent.
3. Clearly define any other prescribed information about how data is collected and plans to be used.

There are significant monetary penalties that have been set out within the Act. The maximum penalty for a violation is \$1,000,000 in the case of an individual, and \$10,000,000 in the case of any other person.

For more details on ECPA refer to the link <http://blog.deliverability.com/2009/04/canadas-electronic-commerce-protection-act.html> (19 August 2009).

6.2.4 Cybercrime and Federal Laws in the US

On 15 September 2008, the US House of Representatives approved the bill H.R. 5938. The amendment, as part of Senate Bill S. 2168, was meant to expand the ability of the Federal Government to prosecute criminal of identity theft and to allow victims to seek compensation for the victims' efforts (time and money) spent on trying to restore their credit. The legislation was signed by President George W. Bush. It had provisions for a fine as well as imprisonment up to 5 years for Spyware. It is believed that this amendment closes the gap on existing identity theft laws which originally only allowed federal prosecution under the scenario that the perpetrator used interstate or foreign communications to access a computer. The only exception were cases involving Federal Government computers or financial institutions. With President's action of signing the bill into Law, Federal prosecutors will be empowered to pursue cases having the perpetrator and victim from the same jurisdiction.

The amendment puts a criminal penalty on the use of malicious Spyware and that of keystroke loggers with the intent of damaging a computer. Furthermore, the amendment eliminates the requirement that the loss must exceed \$5,000, thus, making it a bad behavior to send Spyware that causes any loss. Accused criminals (when proved guilty) will need to pay fine as well as face imprisonment up to 1 year. The legislation would make it an offense to use Spyware or keystroke loggers to damage computers and as such there will be up to 10 years imprisonment. With this bill, it is considered a crime to obtain, delete or release data from a computer or to threaten to crash a computer/computer system. With this bill set, cyberextortion is criminalized by making it a criminal offense to demand money with regard to a protected computer. Those who violate this would end up in prison for a period up to 5 years for the first offense and up to 10 years for the second offense. The bill also adds a conspiracy charge to cybercrime laws and allows confiscation of property/equipment/means used to commit cybercrimes. To understand Computer Crime & Intellectual Property Section of the United States Department of Justice visit [9] in References section.

Box 6.6 The Florida Computer Crimes Act

Unauthorized use of computing facilities is a crime under the Florida Computer Crimes Act. The Act provides definitions to the various terms related to computer crime: Offenses against intellectual property, offenses against computer equipment or supplies and offenses against computer users.

The full text of the Florida Computer Crimes Act (1988 version) and a summary of the penalties referenced in the Act are available in the document accessible at the link mentioned at the end of this Box.

The Act specifies the following type of crimes:

1. Offenses against intellectual property;
2. offenses against computer equipment or supplies;
3. offenses against computer users.
 - Computer program means an ordered set of data representing coded instructions or statements that when executed by a computer cause the computer to process data. It means an internally programmed, automatic device that performs data processing.
 - Computer software means a set of computer programs, procedures and associated documentation concerned with the operation of a computer system.
 - Computer system means a set of related, connected or unconnected computer equipment, devices or computer software.
 - Computer network means a set of related, remotely connected devices and communication facilities including more than one computer system with the capability to transmit data among them through communication facilities.
 - Computer system services means providing a computer system or computer network to perform useful work.
 - Property means anything of value as defined in S.812.011 and includes, but is not limited to, financial instruments, information including electronically produced data and computer software and programs in either machine or human-readable form, and any other tangible or intangible item of value.
 - Intellectual property means data, including programs.
 - Instrument means any check, draft, money order, certificate of deposit, letter of credit, bill of exchange, credit card or marketable security.
 - Access means to approach, instruct, communicate with, store data, retrieve data or otherwise make use of any resources of a computer, computer system or computer network.

The Act also defines felony of first, second and third degree. The full text of the Florida Computer Crimes Act (1988 version) and a summary of the penalties as per this Act can be accessed at the following link:
<http://docweb.cns.ufl.edu/docs/d0010/d0010.pdf>

For further details on this act, please refer to the following link:

http://www.clas.ufl.edu/docs/flcrimes/chapter2_1.html (5 December 2009).

6.2.5 The EU Legal Framework for Information Privacy to Prevent Cybercrime

The EU is an economic and political union of 27 member states, located primarily in Europe. Readers can visit the link to understand the EU member countries.^[4] Also see Box 6.7 to know the names of EU member countries. Data protection EU legal framework addressed the principles for information management (fairness, consent, transparency, purpose specification, data retention, security and access). The right to privacy is a highly developed area of law in Europe. All the member states of the EU are also signatories of the European Convention on Human Rights (ECHR). The EU believes that law is the enabler for trust and confidence in the Information Society. However, law is not self-acting; personal data is disclosed by default; online anonymity does not have same status as physical and identification is considered critical for combating crime. However, technology is required to assist in compliance and enforcement. As the global "Information Age" continues to evolve, international understanding of the policy options for data protection also evolves, guided by an understanding of the practical consequences and effectiveness of such laws.

There is a Data Protection Directive (officially Directive 95/46/EC on the protection of individuals with regard to the processing of personal data and on the free movement of such data) known as the EU directive which regulates the processing of personal data within the EU. It is considered as the most important component of EU privacy and human rights law. In 1995, the European Commission implemented the EU directive.

In the EU, cybercrime law is primarily based on the CoE's Convention on Cybercrime (November 2001). Under the convention, member states are obliged to criminalize:

1. Illegal access to computer system (see Box 6.1);
2. illegal interception of data to a computer system;
3. interfering with computer system without rights and intentional interference with computer data without rights;

Box 6.7 The EU Member Countries

The European Union (known as the EU) was formed in 1951. At the time of writing this, there are 27 countries that are member of the EU:

| | | | |
|------------|----------------|------------------------|----------------|
| 1. UK | 8. Italy | 15. Austria | 22. Luxembourg |
| 2. France | 9. Netherlands | 16. Belgium | 23. Estonia |
| 3. Germany | 10. Hungary | 17. Cyprus | 24. Slovakia |
| 4. Denmark | 11. Ireland | 18. Romania | 25. Slovenia |
| 5. Sweden | 12. Poland | 19. Bulgaria | 26. Latvia |
| 6. Finland | 13. Portugal | 20. The Czech Republic | 27. Lithuania |
| 7. Greece | 14. Spain | 21. Malta | |

Bulgaria and Romania are the most recent member states; they joined the EU on 1 January 2007. Other states are also trying to join and negotiations are in progress with them. Figure 6.3 shows the relationships between various supranational European organizations (courtesy Wikipedia). The term *supranational union* implies a supranational political entity that lies somewhere between a "confederation," that is, an association of states and a federation that is a state.

Note: The mention of CoE is referred to, after Box 6.8, in the context of cybercrime legislation.

Box 6.7 The EU . . . (*Continued*)

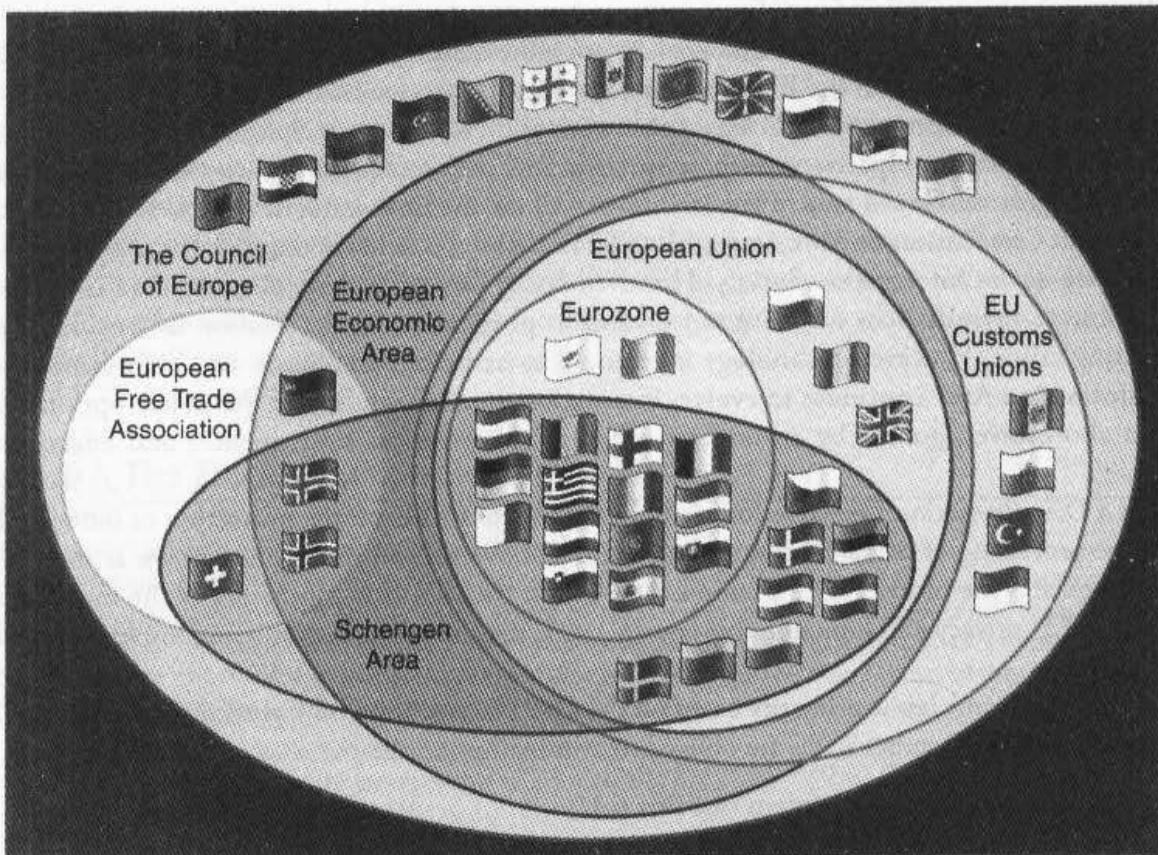


Figure 6.3 Relationships among supranational European organizations.

Note: The color version of the figure is available in CD.

4. the use of inauthentic data with intent to put it across as authentic (data forgery);
5. infringement of copyright-related rights online;
6. interference with data or functioning of computer system;
7. child pornography-related offenses possession/distribution/procuring/producing of child pornographic (recall the discussion in Chapter 1 about COPPA).

Box 6.8 The European Data Protection Directive

Under the EU directive, member states are under obligation to do the following:

1. To ensure that data is processed fairly and lawfully and that it is collected for specified and legitimate purposes and not processed in a manner incompatible with those purposes.
2. The processing of data is adequate, relevant and not excessive in relation to the purposes for which it is collected and/or further processed.
3. The data collected is accurate and kept up to date and in a form which permits identification of data subjects.

Box 6.8 The European . . . (Continued)

4. Personal data may be processed only if:
 - The data subject has unambiguously given his consent;
 - processing is necessary for the performance of a contract to which the data subject is party;
 - processing is necessary for compliance with a legal obligation;
 - processing is necessary in order to protect the interests of the data subject;
 - processing is necessary for the performance of a task carried out in the public interest, etc.
5. The directive prohibits the processing of certain personal data such as personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, health or sex life or processing for the purposes of preventive medicine, medical diagnosis, offenses and criminal convictions, etc. except under certain conditions.
6. To provide to the data subject certain information such as identity of the entity processing the data, purposes of the processing, recipients of the data, etc.
7. If the data was not obtained from the data subject, member states are to provide that the entity processing the data must provide the data subject with information such as identity of the entity, purposes of processing, categories and recipients of data, etc.
8. To provide the right to access the data to the data subjects without constraint at reasonable intervals.
9. The data subject must be provided a right to object to the processing of data relating to him and where there is a justified objection, it must be provided that the processing may no longer involve the data.
10. Apart from imposing an obligation to keep the confidentiality of processing of data, the entity processing the data must be required to implement appropriate technical and organizational measures to protect personal data against accidental or unlawful destruction, accidental loss, unauthorised disclosure, etc.
11. The transfer of personal data to third countries by member states must be done only under certain conditions.

The Data Protection Directive, therefore, covers a whole range of issues associated with processing of personal data in keeping with the twin objectives of the Directive.

In principle, there are similarities between the US regulation and law enforcement of cybercrime in the EU. Cyberfraud (this term is explained in Chapter 1) and making intentional false representations online (that victims rely on) is a federal offense in the US. Identity theft that takes place in the form of unauthorized use of another person's SSN, driver's license, work ID or credit card online is also a federal cybercrime. ID Theft is addressed in Chapter 5.

6.2.6 Cybercrime Legislation in the African Region

There is a common agreement that the African regions are in dire need for legislation to fight cybercrime. Africa is witnessing explosive growth in ICTs. With this growth, however, cybercrime has also become a reality in this part of the world too. African countries, mostly because of inadequate action and controls to protect computers and networks, are targets of attack. A great deal of criminal activity is said to take place from this part of the world. We heard about the Nigerian 419 scam (more on this is discussed in Section 11.7.19, Chapter 11 in CD) or the story of the young Zambian who hacked into a government website and replaced the picture of the erstwhile president Frederick Chiluba with a cartoon! In early 2008, a good number of South African banks became victims of Phishing attacks (Chapter 5 addresses Phishing attacks).

Box 6.9 The European Convention on Cybercrime

In 1997, there was the meeting of experts and the CoE formed a Committee on Crime in Cyberspace. The experts kept meeting in a clandestine fashion for several years. Ultimately, they succeeded in drafting an international treaty entitled the Convention on Cybercrime known as "the Convention." Finally it was released in June 2001. The Convention on Cybercrime is the first international treaty seeking to address cybercrime and Internet crimes by harmonizing national laws, improving investigative techniques and increasing cooperation among nations. It was drawn up by the CoE in Strasbourg with the active participation of the CoE's observer states Canada, Japan and the USA. Of the 34 countries that participated in the ceremonial act of signing the Convention in November 2001, only 6 countries have actually ratified the Convention. No major European country has agreed to be bound by the Convention. The only countries that have ratified it are Albania, Croatia, Estonia, Hungary, Lithuania and Romania.

The main aim of the Convention is to pursue "a common criminal policy aimed at the protection of society against cybercrime, *inter alia* by adopting appropriate legislation and fostering international cooperation." The Convention includes a list of crimes that each signatory state must transpose into their own law. It requires the criminalization of such activities as hacking (including the production, sale or distribution of hacking tools) and offenses relating to child pornography, and expands criminal liability for intellectual property violations. It also requires each signatory state to implement certain procedural mechanisms within their laws. For example, law enforcement authorities must be granted the power to compel an ISP to monitor a person's activities online in real time. Finally, the Convention requires signatory states to provide international cooperation to the "widest extent possible" for investigations and proceedings concerning criminal offenses related to computer systems and data, or for the collection of evidence in electronic form of a criminal offense. Law enforcement agencies will have to assist police from other participating countries to cooperate with their "mutual assistance requests."

In a significant development of March 2009, the CoE has asked India to be a part of its Convention on Cybercrime. This will lead to efficient cooperation with other 47-member countries, whenever such crimes are committed in India.

Credit card-related frauds are on the rise in the continent, especially in Egypt, South Africa, Kenya, Ghana and Nigeria, with losses estimated in billions of US dollars. E-Mail scams seem to be an African specialty, with West African countries among the major perpetrators. In Section 11.4.2 of Chapter 11, there are several illustrations provided on credit card-related frauds.

Some members of the African Union (Mauritius, South Africa and Zambia) have adopted cybercrime legislation. For example, in Botswana, cybercrime bill passed the second reading in the Parliament in December 2007. The bill is expected to go for third reading in the near future before it is signed into law. A draft Information and Communications Bill 2008 has been introduced in Gambia. The bill includes provisions on computer misuse and cybercrime issues. The East Africa region includes Tanzania, Kenya and Uganda. The progress on cybercrime legislation has been slow in this region, except for Uganda. The Computer Misuse Bill was introduced in 2008 in Uganda and a legislative process has started. The East African countries are trying to coordinate efforts so that the legislations should be similar to the cybercrime laws in the Southern African region. A Cybercrime Bill was prepared in Algeria for submitting it to the Parliament by the end of 2008; this is as per information mentioned on the link http://www.magharebia.com/cocoon/awi/xhtml1/en_GB/features/awi/reportage/2008/05/16/reportage-01. Latest update on the Algerian cybercrime bill position may be found at the link: <http://apex.apkn.org/apex-in-detail/information-society-in-africa/algeria> (28 October 2010).

Overall, it looks like the process of strengthening of legislation has been initiated in a large number of African countries, however, the process is rather slow and sometimes incoherent, and not necessarily taking into account international standards. Although there are exceptions and challenges in the African region, the ability of most African countries to investigate, prosecute and adjudicate cybercrime and cooperate internationally is limited. There is a serious risk that African countries develop legislation that is not compatible or harmonized with that of other countries, in particular that of countries providing servers and services with which cooperation would be most necessary. During the period September 2006–February 2009, Economic Crime Division of the Directorate General of Human Rights and Legal Affairs took up a cybercrime project. At the end of that project, they submitted their final report according to which the legislative scenario in some of the African countries emerges to be as presented in Table 6.5.

Table 6.5 | Cybercrime legislation in some of the African countries

| Name of the African Countries | Recommendation on Cybercrime Legislation |
|-------------------------------|--|
| Nigeria | There are several acts in force. They cover several aspects of cybercrime. A draft law on cybercrime is before the Parliament. The draft was expecting CoE review to elicit their support to bring it fully in line with the Convention. An analysis of the draft has been provided by the CoE in January 2008. |
| Ghana | A draft bill on cybercrime is available but needs a review to validate against the provision of the Convention. Accession to the Convention should be considered in the future. |
| Togo | There is no specific legislation in place. A working group needs to be established to develop a law on cybercrime in line with the Convention. |
| Niger | There is a package of laws prepared to provide a legal framework for information and communication technologies. The package has been submitted and is before the Parliament. This package expects deep analysis by the CoE. Accession to the Convention on cybercrime should also be considered. |
| Mali | Currently, no legislation is available. A national law on cybercrime is expected to be developed along the lines of international standards such as the Convention on Cybercrime. |
| Benin | Draft amendments to the criminal code and criminal procedure code are presented to the Parliament. It is recommended that relevant provisions should be reviewed to take into account the Convention on Cybercrime's views. |
| Congo | Currently, no legislation is available; however, review of criminal code and criminal procedure code is underway. It was recommended that a working group be established to develop a specific law on cybercrime in line with the Convention with the support of the CoE. Accession to the Convention should be considered once the law is in place. |

Source: The Report by the Economic Crime Division of the Directorate General of Human Rights and Legal Affairs, Cybercrime project run during the period September 2006–February 2009).

Note: For CoE Convention on Cybercrime frequently asked questions and answers, visit the link at <http://www.cybercrime.gov/> COEFAQs.htm (24 August 2009). To get an idea about the location of the countries in the African continent given in the table, readers can consult the country-wise map of Africa. One such map can be accessed at the following URL: <http://www.africaguide.com/afmap.htm>

In South Africa “peace and security” is recognized as the essential human right. South Africa acknowledges peace and security to be fundamental and intrinsic to the democratic right for its citizens. South Africa being one of the most developed and prosperous economies in the African region, we must understand the legislative position of South Africa about cyberlaws. The discussion in this subsection is with that intent. During 13 November 2008 speech in Geneva at the high-level segment of the ITU Council, Radhakrishna L Padayachie, Deputy Minister of Communications, Republic of South Africa, addressed two issues related to the building of confidence and security in the use of ICTs, namely,

1. The measures that are in place and planned by the Republic of South Africa to enhance cooperation and collaboration on cybersecurity with other stakeholders at the regional, national and global levels and
2. the main challenges that should be tackled to ensure that the information society is safer and more secure at the global level.

In general, however, South African law does not prohibit unwelcome advertising. Advertising by the marketing communications industry is regulated by the Advertising Standards Authority of South Africa. In addition to this, South Africa has also got legislation governing “Spam.” In July 2009, South African President assented to the *Electronic Communications and Transactions Act* (ECT Act) 2002. The purpose of the ECT Act is

“to provide for the facilitation and regulation of electronic communications and transactions; to provide for the development of a national e-Strategy for the Republic; to promote universal access to electronic transactions; to provide for human resource development in electronic transactions; to prevent abuse of information systems; to encourage the use of E-government services; and to provide for matters connected therewith.”

The material in this Act is divided into 14 chapters – among them are Chapter 7 is about Consumer Protection, Chapter 8 is about Protection of Personal Information and Chapter 13 is about Cybercrime.

In South Africa, the Department of Communications is mandated by the Electronic Communications and Transaction Act 2002, among others, to deal with cybercrime and other cybersecurity-related issues:

1. As far as identity management is concerned, the South African Accreditation Authority (SAAA) is responsible for accreditation of authentication services and products and more importantly the accreditation of service providers who will issue advanced digital signatures. This is for the purposes of ensuring business efficiency, quality of services, information security, and privacy and consumer trust in online transactions.
2. For cryptography, South African legislation provides for the registration of the cryptograph service providers with the Department of Communications.
3. South African legislation has the provision for the establishment of a cyberinspectorate, among others, to ensure compliance of cryptography service providers, authentication service providers and critical database management.

In line with the key cybersecurity focus areas developed by the GCA (*Global Cybersecurity Agenda* of the ITU – International Telecommunication Union), the planned framework in South Africa will, among others, encompass the following key features:

1. **Legal measures:** In view of the borderless nature of cyberspace, our national laws that currently address the threat of cybercrime may have to be evaluated against the international best practices envisaged

in the model cybercrime legislation that is recommended as globally applicable and interoperable. This work will necessitate reviewing our existing national laws that deal with cybercrimes.

2. **Technical and procedural measures:** The emphasis will be on providing key measures to promote the adoption of enhanced approaches to improve security and risk management in cyberspace. The Republic of South Africa is working toward establishing Computer Security Incident Response Teams (CSIRTs) under the auspices of the Electronic Communication Security (Pty) Ltd (COMSEC). South Africa is also collaborating with some countries with a view to become a member of the Forum for Incident Response and Security Teams (FIRSTs).

As part of South Africa's determination to collaborate on cybersecurity with other stakeholders at the regional, national and global levels, South Africa has joined the Southern Africa Development Community (SADC) that consists of 14 African countries. SADC countries are on track to harmonize their Internet laws to effectively deal with computer-related crimes, and have finalized legislation for fighting cybercrime. It is said that all the SADC countries have agreed to alter parts of their cybercrime laws and come up with common rules.

For greater details about what the ECT Act of South Africa states about Spam filters, readers are advised to visit Ref. #23, Additional Useful Web References, Further Reading. Having taken an overview of the world legislative picture, now we come to India-specific discussion with focus on the IT Act and its amendments.

6.3 Why Do We Need Cyberlaws: The Indian Context

Cyberlaw is a framework created to give legal recognition to all risks arising out of the usage of computers and computer networks. Under the purview of cyberlaw, there are several aspects, such as, *intellectual property, data protection and privacy, freedom of expression and crimes committed using computers*. The Indian Parliament passed its first cyberlaw, the ITA 2000, aimed at providing the legal infrastructure for E-Commerce in India. ITA 2000 received the assent of the President of India and it has now become the law of the land in India. The Government of India felt the need to enact relevant cyberlaws to regulate Internet-based computer-related transactions in India. It manages all aspects, issues, legal consequences and conflict in the world of cyberspace, Internet or WWW. In the Preamble to the Indian ITA 2000, it is mentioned that it is an act to provide legal recognition for transactions carried out by means of electronic data interchange and other means of electronic communication, commonly referred to as *electronic commerce*. The reasons for enactment of cyberlaws in India are summarized below:

1. Although India possesses a very well-defined legal system, covering all possible situations and cases that have occurred or might take place in future, the country lacks in many aspects when it comes to newly developed Internet technology. It is essential to address this gap through a suitable law given the increasing use of Internet and other computer technologies in India.
2. There is a need to have some legal recognition to the Internet as it is one of the most dominating sources of carrying out business in today's world.
3. With the growth of the Internet, a new concept called *cyberterrorism* came into existence. Cyberterrorism includes the use of disruptive activities with the intention to further social, ideological, religious, political or similar objectives, or to intimidate any person in furtherance of such objectives in the world of cyberspace. It actually is about committing an old offense but in an innovative way.

Keeping all these factors into consideration, Indian Parliament passed the Information Technology Bill on 17 May 2000, known as the ITA 2000. This law is based on Model UNCITRAL law for E-Commerce (see Ref. #11, Articles and Research Papers, Further Reading). It talks about cyberlaws and forms the legal framework for electronic records and other activities done by electronic means. There are strengths as well as limitations in the ITA 2000; they are explained in Sections 6.4.2 and 6.4.3. A legal framework for the cyberworld was conceived in India, in the form of a draft E-Commerce Act 1998 – thereafter, the subject of cyberlaws started haunting the government. The basic law for the cyberspace transactions in India has emerged in the form of the ITA 2000. With that background, the Indian IT Act is briefly discussed in the following section.

6.4 The Indian IT Act

As mentioned above, this Act was published in the year 2000 with the purpose of providing legal recognition for transactions carried out by means of electronic data interchange and other means of electronic communication, commonly referred to as *electronic commerce*. Electronic communications involve the use of alternatives to paper-based methods of communication and storage of information, to facilitate electronic filing of documents with the government agencies. Another purpose of the Indian IT Act was to amend the Indian Penal Code (IPC),^[11] the Indian Evidence Act 1872,^[12] the Bankers' Books Evidence Act 1891,^[13] the Reserve Bank of India Act 1934^[14] and matters connected therewith or incidental thereto. Cybercrimes punishable under various Indian laws are mentioned in Box 6.10. The Reserve Bank of India Act has got Section 58B about Penalties. Subsequently, the Indian IT Act underwent some important changes to accommodate the current cybercrime scenario; a summary of those changes is presented in Table 6.7 – note specially the changes to Section 66 and the corresponding punishments for cyberoffenses. Readers should also refer to Section 6.8.1 (Overview of Changes Made to the Indian IT Act) where the changes are explained in details.

Box 6.10

Cybercrimes and Other Related Crimes Punishable under Indian Laws

1. Under Section 65 of *Indian Copyright Act* any person who knowingly makes, or has in his/her possession, any plate for the purpose of making infringing copies of any work in which Copyright subsists is punishable with imprisonment which may extend to 2 years with fine.
2. Sending pornographic or obscene E-Mails are punishable under Section 67 of the *IT Act*.
 - An offense under this section is punishable on first conviction with imprisonment for a term, which may extend to 5 years and with fine, which may extend to 1 lakh rupees (₹ 100,000).
 - In the event of a second or subsequent conviction, the recommended punishment is imprisonment for a term, which may extend to 10 years and also with fine which may extend to 2 lakh rupees (₹ 2,00,000).
3. E-Mails that are defamatory in nature are punishable under Section 500 of the *Indian Penal Code (IPC)* that recommends an imprisonment of upto 2 years or a fine or both.
4. Threatening E-Mails are punishable under the provisions of the *IPC* pertaining to criminal intimidation, insult and annoyance (CHAPTER XXII) and extortion (CHAPTER XVII).
5. E-Mail spoofing is covered under provisions of the *IPC* with regard to fraud, cheating by personation (CHAPTER XVII) and forgery (CHAPTER XVIII).

The scope and coverage of the Indian IT Act is briefly described in Section 27.4, Ref. #6, Books, Further Reading. The structure of the Indian ITA 2000 is provided in Table 6.6 for readers' immediate reference. The sections mentioned in bold italics are relevant in the discussion of cybercrime and information security.

Table 6.6 | The Indian ITA 2000: Summary of contents (main elements only)

| <i>Chapter Number</i> | <i>Chapter Title</i> | <i>Names of the Sections in the Chapter</i> |
|-----------------------|---|--|
| CHAPTER I | <i>Preliminary</i> | 1. Short title, extent, commencement and applications 2. Definitions of key terms mentioned in the Act 3. Authentication of electronic records |
| CHAPTER II | <i>Digital Signature and Electronic Signature</i> | 4. Legal recognition of electronic records 5. Legal recognition of electronic signatures 6. Use of electronic records and digital signatures in government and its agencies 7. Retention of electronic records 8. Publication of rule, regulation, etc., in Electronic Gazette 9. Sections 6, 7 and 8 not to confer right to insist document should be accepted in an electronic form 10. Power to make rules by Central Government in respect of digital signature |
| CHAPTER III | <i>Electronic Governance</i> | 11. Attribution of electronic records 12. Acknowledgment of receipt 13. Time and place of dispatch and receipt of electronic record |
| CHAPTER IV | <i>Attribution, Acknowledgment and Despatch of Electronic Records</i> | 14. Secure electronic record 15. Secure digital signature 16. Security procedures and practices 17. Appointment of Controller and other officers 18. Functions of Controller 19. Recognition of foreign Certifying Authorities 20. Controller to act as repository 21. License to issue Digital Signature Certificates 22. Application for license 23. Renewal of license 24. Procedure for grant or rejection of license 25. Suspension of license 26. Notice of suspension or revocation of license 27. Power to delegate 28. Power to investigate contraventions 29. <i>Access to computers and data</i> |
| CHAPTER V | <i>Secure Electronic Records and Secure Electronic Signature</i> | 30. Certifying Authority to follow certain procedures 31. Certifying Authority to ensure compliance of the Act, etc. 32. Display of license 33. Surrender of license 34. Disclosure |
| CHAPTER VI | <i>Regulation of Certifying Authorities</i> | |

(Continued)

Table 6.6 | (Continued)

| <i>Chapter Number</i> | <i>Chapter Title</i> | <i>Names of the Sections in the Chapter</i> |
|-----------------------|---|---|
| CHAPTER VII | <i>Electronic Signature Certificates</i> | 35. <i>Certifying Authority to issue Digital Signature Certificate</i> 36. Representations upon issuance of Digital Signature Certificate 37. Suspension of Digital Signature Certificate 38. Revocation of Digital Signature Certificate 39. Notice of suspension or revocation 40. Generating key pair 41. Acceptance of Digital Signature Certificate 42. Control of private key |
| CHAPTER VIII | <i>Duties of Subscribers</i> | 43. Penalty for damage to computer, computer system, etc. 44. Penalty for failure to furnish information return, etc. 45. Residuary penalty 46. Power to adjudicate 47. Factors to be taken into account by the adjudicating officer |
| CHAPTER IX | <i>Penalties, Compensation and Adjudication</i> | 48. Establishment of Cyber Appellate Tribunal 49. Composition of Cyber Appellate Tribunal 50. Qualifications for appointment 51. Term of office, conditions of services, etc. 52. Salary, allowances and other terms and conditions of service of Presiding Officer 53. Filling up of vacancies 54. Resignation and removal 55. Orders constituting Appellate Tribunal 56. Staff of the Cyber Appellate Tribunal 57. Appeal to Cyber Appellate Tribunal 58. Procedure and powers of the Cyber Appellate Tribunal 59. Right to legal representation 60. Limitation 61. Civil Court not to have jurisdiction 62. Appeal to High Court 63. Compounding of contraventions 64. Recovery of penalty or compensation |
| CHAPTER X | <i>The Cyber Regulations Appellate Tribunal</i> | 65. Tampering with computer source documents 66. Computer-related offences 67. Punishment for publishing, transmitting obscene material in electronic form |
| CHAPTER XI | <i>Offences</i> | 66A. <i>Punishment for offensive messages</i> 66B. <i>Punishment for dishonestly receiving stolen computers, etc.</i> |

(Continued)

Table 6.6 | (Continued)

| <i>Chapter Number</i> | <i>Chapter Title</i> | <i>Names of the Sections in the Chapter</i> |
|-----------------------|---|---|
| | 66C. <i>Punishment for ID theft</i> 66D. <i>Punishment for cheating by personation with use of computers</i> 66E. <i>Punishment for privacy violation</i> 66F. <i>Punishment for cyber terrorism</i> | 68. Power of Controller to give directions 69. Power to issue directions for inception or monitoring or decryption of information 70. Protected system 71. <i>Penalty for misrepresentation</i> 72. <i>Penalty for breach of confidentiality and privacy</i> 73. <i>Penalty for publishing Digital Signature Certificate false in certain particulars</i> 74. <i>Publication for fraudulent purpose</i> 75. Act to apply for offence or contravention committed outside India 76. Confiscation 77. Compensation, penalties or confiscation not to interfere with other punishments 78. Power to investigate offences 79. Exemption from liability of intermediary in certain cases |
| CHAPTER XII | <i>Intermediaries not to be Liable in certain Cases</i> | 80. Power of police officer and other officers to enter, search, etc. 81. Act to have overriding effect 82. Chairperson, Members, officers and employees to be public servants 83. Power to give directions 84. Protection of action taken in good faith 85. Offences by companies 86. Removal of difficulties 87. Power of Central Government to make rules 88. Constitution of Advisory Committee 89. Power of Controller to make regulations 90. Power of State Government to make rules |
| CHAPTER XIII | <i>Miscellaneous</i> | |

Note: Digital signature and cryptography concepts, use of symmetric and asymmetric keys, etc. related concepts are explained in Ref. #7, Books, Further Reading. Readers must refer to the paper copy of the IT Act.

From Table 6.6, we can see that in particular, Sections 65, 66, 67, 71, 72, 73 and 74 in CHAPTER XI (Offences) of the Indian ITA 2000 are relevant to the discussion of cybercrime in legal context. The relevant portion from that is as follows:

1. Section 65: Tampering with computer source documents

Whoever knowingly or intentionally conceals, destroys or alters or intentionally or knowingly causes another to conceal, destroy or alter any computer source code used for a computer, computer

programme, computer system or computer network, when the computer source code is required to be kept or maintained by law for the time being in force, shall be punishable with imprisonment up to 3 years, or with fine which may extend up to 2 lakh rupees (₹ 2,00,000), or with both.

Explanation: For the purposes of this section, "computer source code" means the listing of programmes, computer commands, design and layout and programme analysis of computer resource in any form.

2. Section 66: Computer-related offences

- (1) Whoever with the intent to cause or knowing that he is likely to cause wrongful loss or damage to the public or any person destroys or deletes or alters any information residing in a computer resource or diminishes its value or utility or affects it injuriously by any means, commits hacking.
- (2) Whoever commits hacking shall be punished with imprisonment up to 3 years, or with fine which may extend up to 5 lakh rupees (₹ 5,00,000), or with both.

3. Section 67: Punishment for publishing or transmitting obscene material in electronic form

Whoever publishes or transmits or causes to be published in the electronic form, any material which is lascivious or appeals to the prurient interest or if its effect is such as to tend to deprave and corrupt persons who are likely, having regard to all relevant circumstances, to read, see or hear the matter contained or embodied in it, shall be punished on first conviction with imprisonment of either description for a term which may extend to 3 years and with fine which may extend to 5 lakh rupees (₹ 5,00,000) and in the event of a second or subsequent conviction with imprisonment of either description for a term which may extend to 5 years and also with fine which may extend to 10 lakh rupees (₹ 10,00,000).

4. Section 71: Penalty for misrepresentation

Whoever makes any misrepresentation to, or suppresses any material fact from, the Controller or the Certifying Authority for obtaining any license or Digital Signature Certificate, as the case may be, shall be punished with imprisonment for a term which may extend to 2 years, or with fine which may extend to 1 lakh rupees (₹ 1,00,000), or with both.

5. Section 72: Penalty for breach of confidentiality and privacy

Save as otherwise provided in this Act or any other law for the time being in force, any person who, in pursuance of any of the powers conferred under this Act, rules or regulations made there-under, has secured access to any electronic record, book, register, correspondence, information, document or other material without the consent of the person concerned discloses such electronic record, book, register, correspondence, information, document or other material to any other person shall be punished with imprisonment for a term which may extend to 2 years, or with fine which may extend to 1 lakh rupees (₹ 1,00,000), or with both.

6. Section 73: Penalty for publishing Digital Signature Certificate false in certain particulars

- (1) No person shall publish a Digital Signature Certificate or otherwise make it available to any other person with the knowledge that:
 - (a) The Certifying Authority listed in the certificate has not issued it; or
 - (b) the subscriber listed in the certificate has not accepted it; or
 - (c) the certificate has been revoked or suspended, unless such publication is for the purpose of verifying a digital signature created prior to such suspension or revocation.
- (2) Any person who contravenes the provisions of subsection (1) shall be punished with imprisonment for a term which may extend to 2 years, or with fine which may extend to 1 lakh rupees (₹ 1,00,000), or with both.

7. Section 74: Publication for fraudulent purpose

Whoever knowingly creates, publishes or otherwise makes available a Digital Signature Certificate for any fraudulent or unlawful purpose shall be punished with imprisonment for a term which may extend to 2 years, or with fine which may extend to 1 lakh rupees (₹ 1,00,000), or with both.

Table 6.7 presents the brief overview of the significant changes brought out by the IT Amendment Bill 2008. Also refer to Section 6.8.1 (Overview of Changes Made to the Indian IT Act) in which changes are explained in great detail.

Box 6.11 Data Protection and the New Clause 43A under the Amended IT Act

The amended Indian IT Act provides for penalty for damage to computers, computer systems under the title *Penalty and Adjudication* in Section 43 that is widely interpreted as a clause to provide data protection in the country. Unauthorized access to a computer, computer system or computer network is punishable with a compensation of up to 1 crore rupees (₹ 1,00,00,000). This section has been improved to include stealing of computer source code for which compensation can be claimed. (Computer source has been defined.) Data protection has now been made more explicit through insertion of a new Clause 43A that provides for compensation to an aggrieved person whose personal data including sensitive personal data may be compromised by a company, during the time it was under processing with the company, for failure to protect such data whether because of negligence in implementing or maintaining reasonable security practices.

Furthermore, reasonable security practices and procedures will constitute those practices and procedures that protect such information from unauthorized access, damage, use, modification, disclosure or impairment as may be specified in an agreement between the parties or as may be specified in any law in force. In the absence of such an agreement or any law, the Central Government will prescribe security practices and procedures in consultation with professional bodies or associations:

(a) This explanation gives scope for recognition of security professional bodies such as Data Security Council of India (DSCI), which is an industry initiative promoted by NASSCOM. The best practices and standards for security that DSCI may prescribe to the IT and BPO companies may be accepted by the government. Regulation of companies for compliance with such standards and practices can fall within the ambit of DSCI.

(b) Sensitive personal information may be prescribed by the Central Government in consultation with professional bodies or associations. In the context of outsourcing to India, this can be defined to be in line with compliance requirements of the EU (European Union) Data Protection Directive and US laws such as Health Insurance Portability and Accountability Act (HIPAA) or Graham-Leach-Bliley Act (GLBA).

Penalty for breach of confidentiality and privacy: Under Section 72, it is presently restricted to those who gain access to an electronic record or document under the powers conferred under this Act. A new Section 72A has been added that provides punishment for disclosure of information in breach of a lawful contract. Any person including an intermediary who has access to any material containing personal information about another person, as part of a lawful contract, discloses it without the consent of the subject person will constitute a breach and attract punishment with imprisonment of up to 3 years and/or a fine of 5 lakh rupees (₹ 5,00,000). This is a strong deterrent, and also will bring those responsible for breaching data confidentiality, under lawful contracts, to justice. Along with Section 43A, Section 72A strengthens the data protection regime in the country. It will go a long way in promoting trust in transborder data-flows to India.

Note: This information is as per the NASSCOM Whitepaper "Data Protection and Cyber Crime under amended IT Act." The whitepaper was released by DSCI in December 2008. Data Security Council of India (DSCI) is an initiative under NASSCOM.

Table 6.7 | Summary of changes to the Indian IT Act (significant changes brought out by the IT Amendment Bill 2008)

| <i>Section No.</i> | <i>Changes Made</i> |
|----------------------|---|
| 1 | Section 1(4) list of excluded documents removed. To be notified through Gazette. |
| 2 | Section 2(d) modified, and the term "Digital Signature" replaced with "Electronic Signature" in the Act. Section 2(ha) added to define "Communication Device" which will include mobile phones, ATM, PDAs, etc. Section 2(j) "Computer Systems" and "Communication Devices" and "Wire" and "Wireless" added. Section 2(k) "Communication Device" added. Section 2(na) introduced to define the term "Cyber Cafe." Section 2(nb) introduced to define the term "Cyber Security." Section 2(ta) and Section 2(tb) introduces the term of "Electronic Signature" and "Electronic Signature Certificate." Section 2(ua) defines "Indian Computer Emergency Response Team." Section 2(v) "Message" included in the definition of "Information." Section 2(w) "Intermediary" defined. It includes telecom. <i>Note:</i> Service providers, network service providers, Internet service providers, webhosting service providers, search engines, online payment sites, online auction sites, online market places and cyber cafes. |
| 3 | Section 3 now refers to legal recognition of electronic documents. New Section 3A introduced to define Electronic Signature. |
| 4 and 5 | No significant change. |
| 6 | New Section 6A introduced to provide for appointment of service providers in E-Governance services and enable delivery of services by private service providers. |
| 7 | New Section 7A introduced to make audit of electronic documents mandatory wherever the legally physical records were subject to audit. |
| 8 and 9 | No change. |
| 10 | No significant change. New Section 10A specifies that contract formation is possible with offer and acceptance being in electronic form. |
| 11, 12, 13 and 14 | No significant change. |
| 15 and 16 | Defines "Secured Electronic Signature" and redefines "Security Procedure." |
| 17, 18, 19 | No significant change. |
| 20 | Section omitted. |
| 21 | No significant change. |
| 22 and 23 | The amount of specified upper limit on the fees omitted. |
| 24, 25, 26, 27 | No significant change. |
| 28 and 29 | The powers of Controller have been restricted to contraventions under chapter VI. |
| 30 | Consequential Changes with introduction of Electronic Signatures. |
| 31, 32, 33, 34 | No significant change. |
| 35 | Subsection 35(4) modified. |
| 36 | Additional points to be added in the certificate indicated. |

(Continued)

Table 6.7 | (Continued)

| Section No. | Changes Made |
|--------------------|--|
| 37, 38, 39 | No change. |
| 40 | No change in Section 40 but a new section added as mentioned below. New Section 40A specifies the duties of the subscriber of Electronic Signatures Certificate. |
| 41 and 42 | No change. |
| 43 | Two new contraventions added – Contraventions corresponding to earlier Section 65 and Section 66 added for civil liability. Compensation limit removed. New Section 43A included for “Data Protection” need specifies liability for a body corporate handling sensitive data, introduces concept of “reasonable security practices” and sensitive personal data. No limit for compensation. |
| 44 and 45 | No significant change. |
| 46 | The powers of the Adjudicator limited for claims upto ₹ 5 crore (₹ 5,00,00,000), Civil Court’s authority introduced for claims beyond ₹ 5 crore (₹ 5,00,00,000). |
| 47 | No significant change. |
| 48 | Changes name of Cyber Regulations Appellate Tribunal to Cyber Appellate Tribunal. |
| 49 | Cyber Appellate Tribunal (CAT) is made a multimember entity. Provision for benches introduced, non-judicial members can be members of the Tribunal. |
| 50 | Specifies qualifications for appointment of Chairperson and Members of the CAT. |
| 51 and 52 | Specifies terms and other conditions of appointment of Chairman and Members of CAT (Cyber Appellate Tribunal). New Sections 52A, B, C and D introduced defining powers of the Chairperson of CAT for conduct of business. |
| 53, 54, 55, 56 | No significant change. |
| 57, 58, 59, 60 | No change. |
| 61 | Amended to accommodate jurisdiction of Civil Courts for disputes involving claims of over ₹ 5 crore (₹ 5,00,00,000). |
| 62 and 63 | No change. |
| 64 | No significant change. |
| 65 | No change. |
| 66 | <i>Note:</i> This is a notable feature of the changes made – note the “punishments.” The clause has been rewritten with significant changes. Applies to all contraventions listed in Section 43 and shall be punishable with imprisonment for a term which may extend to three(3) years or with fine which may extent up to ₹ 5 lakhs (₹ 5,00,000) and both. The section applies if act is done “dishonestly” or “fraudulently” as defined in CrPC (Criminal Procedure Code). New Sections added under 66A, 66B, 66C, 66D, 66E and 66F to cover new offences. Section 66A: Sending offensive messages. Punishment: Imprisonment for a term which may extend to three years and fine. Section 66B: Receiving a Stolen Computer Resource Punishment: Imprisonment for a term which may extend to three years or with fine which may extend to rupees one lakh (₹ 1,00,000) or with both. |

(Continued)

Table 6.7 | (Continued)

| Section No. | Changes Made |
|--------------------|---|
| | Section 66C: Identity Theft Punishment: Imprisonment for a term which may extend to three years also be liable to fine which may extend to rupees one lakh (₹ 1,00,000). |
| | Section 66D: Cheating by personation Punishment: Imprisonment for a term which may extend to three years and shall also be liable to fine which may extend to one lakh rupees (₹ 1,00,000). |
| | Section 66E: Violation of Privacy Punishment: Imprisonment for a term which may extend to three years or with fine not exceeding two lakh rupees (₹ 2,00,000) or with both. |
| 67 | Section 66F: Cyber Terrorism Punishment: Imprisonment which may extend to imprisonment for life. Fine increased to ₹ 5 lakhs (₹ 5,00,000) for first instance and ₹ 10 lakhs (₹ 10,00,000) for subsequent instance. Imprisonment reduced to three years for first instance and 5 years for subsequent instance. New Section 67A introduced to cover material containing "sexually explicit act." Punishment: On first conviction with imprisonment for a term which may extend to five years and with fine which may extent to 10 lakhs (₹ 10,00,000). In the event of second and subsequent conviction with imprisonment for a term which may extend to seven years and also with fine which may extent to 10 lakhs (₹ 10,00,000). New Section 67B introduced to cover child explicit act or conduct. Punishment: On first conviction with imprisonment for a term which may extend to five years and with fine which may extent to 10 lakhs (₹ 10,00,000). In the event of second and subsequent conviction with imprisonment for a term which may extend to seven years and also with fine which may extent to 10 lakhs (₹ 10,00,000). New Section 67C: This provision will require Intermediaries to preserve and retain certain records for a stated period. Punishment: Imprisonment for a term which may extend to three years and also be liable to pay fine. Refers to the powers of the Controller to direct Certifying Authorities for compliance. No significant change. Penal powers to be applicable only on intentional violation. |
| 68 | Scope extended from decryption to interception, monitoring also. Power lies with the authorized government agency of the Central Government. New Section 69A: Introduced to enable blocking of websites. If an Intermediary is not cooperative. Punishment: Imprisonment for a term which may extent to seven years and also be liable to fine. New section 69B: Provides powers for monitoring and collecting traffic data, etc. If an Intermediary is not cooperative. Punishment: Imprisonment for a term which may extent to three years and also be liable to fine. |
| 70 | Critical Infrastructure System defined and section restricted to only such systems. Security practices to be notified. |
| 70B | New Section 70A: Added to define National Nodal Agency for Critical Information Infrastructure Protection. Indian Computer Emergency Response Team (Cert India) appointed as the Nodal agency for incident response. |
| 71 and 72 | No change. New Section 72A: Introduced for punishment for disclosure of information in breach of lawful Contract (data protection purpose). |

Table 6.7 | (Continued)

| Section No. | Changes Made |
|--------------------|--|
| 73, 74, 75, 76 | No change. |
| 77 | No significant change. New Section 77A: Introduced to provide for Compounding of offences other than offences for which imprisonment for life or imprisonment for a term exceeding three years has been provided. New Section 77B: Introduced to consider all offences punishable with imprisonment of three years and above under the Act as Cognizable offence and offence punishable with imprisonment for 3 years as bailable. |
| 78 | Power to investigate any cognizable offence vested with Inspectors instead of DSPs (Deputy Superintendent of Police). <i>Note:</i> This is notable change of bringing down the investigation authority lower in the hierarchy. |
| 79 | Exemption from liability of intermediary in certain cases – some exceptions have been added – no liability if intermediary provides only Internet access, observed due diligence, had no actual knowledge of offence, etc. New Section 79 A: Introduced to provide for the government to designate any government body as an Examiner of Electronic Evidence. |
| 80 | The powers, earlier available to DSPs, is now made available to Inspectors. <i>Note:</i> This is notable change of bringing down the investigation authority lower in the hierarchy. |
| 81 | Amended to keep the Copyright and Patent Acts fully applicable. |
| 81A | No change. |
| 82 | No significant change. |
| 83 and 84 | No change. Section 84A: New section introduced to enable the government to prescribe encryption methods. New Section 84B: Introduced to make “abettment” punishable as the offence itself is under the IT Act 2000. New Section 84C: Introduced to make an “attempt to commit an offence” punishable with half of the punishment meant for the offence. |
| 85 and 86 | No change. |
| 87 | Consequential changes made. |
| 88 and 89 | No change. |
| 90 | No significant change. |
| 91–94 | Omitted |

Box 6.12 Digital Evidence and its Admissibility in Courts

Digital/electronic evidence is probative information stored in digital form that a party may use at trial. It includes computer printouts, E-Mails, digital photographs, ATM transaction logs, spreadsheets and others. With increased computerization and technology as well as the rise of the digital office, courts have been forced to allow for the admittance of digital evidence. In the Indian ITA 2000, the word *Evidence* appears in Section 58 (Procedure and Powers of the Cyber Appellate Tribunal), The Second Schedule, Clause 65B (Admissibility of Electronic Records). It is said that the enactment and adoption of the Indian Evidence Act was a path-breaking judicial measure introduced in India, which changed the entire system of concepts pertaining to admissibility of evidences in the Indian Courts of Law.

Box 6.12 Digital Evidence and . . . (Continued)

There are challenges in digital evidence handling. Today, the computer technology is very complex, although the usability for the end-users is very high. The extensive amount of data stored on today's computers and the limited resources available to analyze computer evidence are two of the facts that contribute to delays in the return of digital evidence. With the worldwide reach of the Internet, crimes are no longer easily defined as occurring within a particular city, state or even within the country. More and more criminals are coming from around the world and committing crimes against their targeted victims via the Internet. In such situations, law enforcement officials may find it difficult to obtain evidence and even impossible to enforce warrants for searches and seizures of digital evidence stored abroad. The complexity of most types of digital evidence, as well as the methods in which law enforcement comes into control of the evidence, can raise issues of admissibility, that is, admissibility of digital evidence. Courts have noted very important differences. As compared to the more traditional evidence, courts have noted that digital evidence tends to be more voluminous, more difficult to destroy, easily modified, easily duplicated, potentially more expressive and more readily available. More about digital evidence is addressed in Chapters 7 and 8.

6.4.1 Admissibility of Electronic Records: Amendments made in the Indian ITA 2000

The Second, the Third and the Fourth Schedule of the Indian ITA 2000 indicates how the three acts, namely, The Indian Evidence Act 1872, The Bankers' Books Evidence Act 1891 and The Reserve Bank of India Act 1934 have been amended. In this section, these amendments are presented. This is particularly important for the discussion about forensics in Chapter 7. It appears that the maximum amendments have been made to the Indian Evidence Act.

In the Indian Evidence Act, CHAPTER IV is about Oral Evidence and CHAPTER V is about Documentary Evidence. In the Indian IT Act, the Second Schedule presents "Amendments to the Indian Evidence Act of 1872." The text from there pertaining to the amendment is presented below.

The Second Schedule of the Indian ITA 2000: Amendment to the Indian Evidence Act

1. In Section 3:
 - (a) In the definition of "Evidence," for the words "all documents produced for the inspection of the Court," the words "all documents including electronic records produced for the inspection of the Court" shall be substituted;
 - (b) after the definition of "India," the following shall be inserted, namely, the expressions "Certifying Authority," "digital signature," "Digital Signature Certificate," "electronic form," "electronic records," "information," "secure electronic record," "secure digital signature" and "subscriber" shall have the meanings, respectively, assigned to them in the Information Technology Act 2000.
2. In Section 17, for the words "oral or documentary," the words "oral or documentary or contained in electronic form" shall be substituted.
3. After Section 22, the following section shall be inserted, namely, when oral admission as to contents of electronic records is relevant.

"22A. Oral admissions as to the contents of electronic records are not relevant, unless the genuineness of the electronic record produced is in question."
4. In Section 34, for the words "Entries in the books of account," the words "Entries in the books of account, including those maintained in an electronic form" shall be substituted.

5. In Section 35, for the word "record," in both the places where it occurs, the words "record or an electronic record" shall be substituted.
6. For Section 39, the following section shall be substituted, namely, *What evidence to be given when statement forms part of a conversation, document, electronic record, book or series of letters or papers.*

"39. When any statement of which evidence is given forms part of a longer statement, or of a conversation or part of an isolated document, or is contained in a document which forms part of a book, or is contained in part of electronic record or of a connected series of letters or papers, evidence shall be given of so much and no more of the statement, conversation, document, electronic record, book or series of letters or papers as the Court considers necessary in that particular case to the full understanding of the nature and effect of the statement, and of the circumstances under which it was made."

7. After Section 47, the following section shall be inserted, namely, *Opinion as to digital signature where relevant.*

"47A. When the Court has to form, an opinion as to the digital signature of any person, the opinion of the Certifying Authority which has issued the Digital Signature Certificate is a relevant fact."

8. In Section 59, for the words "contents of documents" the words "contents of documents or electronic records" shall be substituted.
9. After Section 65, the following sections shall be inserted, namely, *Special provisions as to evidence relating to electronic record.*

"65A. The contents of electronic records may be proved in accordance with the provisions of Section 65B."

Admissibility of Electronic Records

- 65B. (1) Notwithstanding anything contained in this Act, any information contained in an electronic record which is printed on a paper, stored, recorded or copied in optical or magnetic media produced by a computer (hereinafter referred to as the computer output) shall be deemed to be also a document, if the conditions mentioned in this section are satisfied in relation to the information and computer in question and shall be admissible in any proceedings, without further proof or production of the original, as evidence of any contents of the original or of any fact stated therein of which direct evidence would be admissible.
- (2) The conditions referred to in subsection (1) in respect of a computer output shall be the following, namely,
- (a) The computer output containing the information was produced by the computer during the period over which the computer was used regularly to store or process information for the purposes of any activities regularly carried on over that period by the person having lawful control over the use of the computer;
 - (b) during the said period, information of the kind contained in the electronic record or of the kind from which the information so contained is derived was regularly fed into the computer in the ordinary course of the said activities;
 - (c) throughout the material part of the said period, the computer was operating properly or, if not, then in respect of any period in which it was not operating properly or was out of operation during that part of the period, was not such as to affect the electronic record or the accuracy of its contents and
 - (d) the information contained in the electronic record reproduces or is derived from such information fed into the computer in the ordinary course of the said activities.

- (3) Where over any period, the function of storing or processing information for the purposes of any activities regularly carried on over that period as mentioned in Clause (a) of subsection (2) was regularly performed by computers, whether:
 - (a) By a combination of computers operating over that period; or
 - (b) by different computers operating in succession over that period; or
 - (c) by different combinations of computers operating in succession over that period; or
 - (d) in any other manner involving the successive operation over that period, in whatever order, of one or more computers and one or more combinations of computers, all the computers used for that purpose during that period shall be treated for the purposes of this section as constituting a single computer; and references in this section to a computer shall be construed accordingly.
- (4) In any proceedings where it is desired to give a statement in evidence by virtue of this section, a certificate doing any of the following things, that is to say:
 - (a) Identifying the electronic record containing the statement and describing the manner in which it was produced;
 - (b) giving such particulars of any device involved in the production of that electronic record as may be appropriate for the purpose of showing that the electronic record was produced by a computer;
 - (c) dealing with any of the matters to which the conditions mentioned in subsection (2) relate, and purporting to be signed by a person occupying a responsible official position in relation to the operation of the relevant device or the management of the relevant activities (whichever is appropriate) shall be evidence of any matter stated in the certificate; and for the purposes of this subsection it shall be sufficient for a matter to be stated to the best of the knowledge and belief of the person stating it.
- (5) For the purposes of this section:
 - (a) Information shall be taken to be supplied to a computer if it is supplied thereto in any appropriate form and whether it is so supplied directly or (with or without human intervention) by means of any appropriate equipment;
 - (b) whether in the course of activities carried on by any official, information is supplied with a view to its being stored or processed for the purposes of those activities by a computer operated otherwise than in the course of those activities, that information, if duly supplied to that computer, shall be taken to be supplied to it in the course of those activities;
 - (c) a computer output shall be taken to have been produced by a computer whether it was produced by it directly or (with or without human intervention) by means of any appropriate equipment.

Explanation: For the purposes of this section any reference to information being derived from other information shall be a reference to its being derived there-from by calculation, comparison or any other process.

10. After Section 67, the following section shall be inserted, namely, *Proof as to digital signature*.

“67A. Except in the case of a secure digital signature, if the digital signature of any subscriber is alleged to have been affixed to an electronic record the fact that such digital signature is the digital signature of the subscriber must be proved.”
11. After Section 73, the following section shall be inserted, namely, *proof as to verification of digital signature*.

“73A. In order to ascertain whether a digital signature is that of the person by whom it purports to have been affixed, the Court may direct:

- (a) That person or the Controller or the Certifying Authority to produce the Digital Signature Certificate;
- (b) any other person to apply the public key listed in the Digital Signature Certificate and verify the digital signature purported to have been affixed by that person.”

Explanation: For the purposes of this section, “Controller” means the Controller appointed under subsection (1) of Section 17 of the Information Technology Act 2000.

12. Presumption as to Gazettes in electronic forms

After Section 81, the following section shall be inserted, namely,

“81A. The Court shall presume the genuineness of every electronic record purporting to be the Official Gazette, or purporting to be electronic record directed by any law to be kept by any person, if such electronic record is kept substantially in the form required by law and is produced from proper custody.”

13. Presumption as to electronic agreements

After Section 85, the following sections shall be inserted, namely,

“85A. The Court shall presume that every electronic record purporting to be an agreement containing the digital signatures of the parties was so concluded by affixing the digital signature of the parties.”

14. Presumption as to electronic records and digital signatures

85B (1) In any proceedings involving a secure electronic record, the Court shall presume unless contrary is proved that the secure electronic record has not been altered since the specific point of time to which the secure status relates.

(2) In any proceedings, involving secure digital signature, the Court shall presume unless the contrary is proved that:

(a) The secure digital signature is affixed by subscriber with the intention of signing or approving the electronic record;

(b) except in the case of a secure electronic record or a secure digital signature, nothing in this section shall create any presumption relating to authenticity and integrity of the electronic record or any digital signature.

15. Presumption as to Digital Signature Certificates

85C The Court shall presume, unless contrary is proved, that the information listed in a Digital Signature Certificate is correct, except for information specified as subscriber information which has not been verified, if the certificate was accepted by the subscriber.

16. Presumption as to electronic messages

After Section 88, the following section shall be inserted, namely,

“88A. The Court may presume that an electronic message forwarded by the originator through an electronic mail server to the addressee to whom the message purports to be addressed corresponds with the message as fed into his computer for transmission; but the Court shall not make any presumption as to the person by whom such message was sent.”

Explanation: For the purposes of this section, the expressions “addressee” and “originator” shall have the same meanings, respectively, assigned to them in Clauses (b) and of subsection (1) of Section 2 of the Information Technology Act 2000.

17. Presumption as to electronic records of five years old

After Section 90, the following section shall be inserted, namely,

“90A. Where any electronic record, purporting or proved to be five years old, is produced from any custody which the Court in the particular case considers proper, the Court may presume that

the digital signature which purports to be the digital signature of any particular person was so affixed by him or any person authorized by him in this behalf."

Explanation: Electronic records are said to be in proper custody if they are in the place in which, and under the care of the person with whom, they naturally be; but no custody is improper if it is proved to have had a legitimate origin, or the circumstances of the particular case are such as to render such an origin probable. This explanation applies also to Section 81A.

For Section 131, the following section shall be substituted, namely, production of documents or electronic records which another person, having possession, could refuse to produce.

131. No one shall be compelled to produce documents in his possession or electronic records under his control, which any other person would be entitled to refuse to produce if they were in his possession or control, unless such last-mentioned person consents to their production.

The Third Schedule of the Indian IT Act 2000: Amendment to the Bankers' Books Evidence Act

1. In Section 2:

- (a) For Clause (3), the following clause shall be substituted, namely, '(3) "bankers' books" include ledgers, day-books, cash-books, account-books and all other books used in the ordinary business of a bank whether kept in the written form or as printouts of data stored in a floppy, disc, tape or any other form of electro-magnetic data storage device;
- (b) for Clause (8), the following clause shall be substituted, namely, '(8) "certified copy" means when the books of a bank:
 - (A) Are maintained in written form, a copy of any entry in such books together with a certificate written; the foot of such copy that it is a true copy of such entry, that such entry is contained in one of the ordinary books of the bank and was made in the usual and ordinary course of business and that such book is still in the custody of the bank, and where the copy was obtained by a mechanical or other process which in itself ensured the accuracy of the copy, a further certificate to that effect, but where the book from which such copy was prepared has been destroyed in the usual course of the bank's business after the date on which the copy had been so prepared, a further certificate to that effect, each such certificate being dated and subscribed by the principal accountant or manager of the bank with his name and official title; and
 - (B) consist of printouts of data stored in a floppy, disc, tape or any other electro-magnetic data storage device, a printout of such entry or a copy of such printout together with such statements certified in accordance with the provisions of Section 2A.

2. After Section 2, the following section shall be inserted, namely, *Conditions in the printout*.

"2A. A printout of entry or a copy of printout referred to in subsection (8) of Section 2 shall be accompanied by the following, namely,

- (a) A certificate to the effect that it is a printout of such entry or a copy of such printout by the principal accountant or branch manager and
- (b) a certificate by a person in-charge of computer system containing a brief description of the computer system and the particulars of:
 - (A) The safeguards adopted by the system to ensure that data is entered or any other operation performed only by authorized persons;
 - (B) the safeguards adopted to prevent and detect unauthorized change of data;
 - (C) the safeguards available to retrieve data that is lost due to systemic failure or any other reasons;

- (D) the manner in which data is transferred from the system to removable media like floppies, discs, tapes or other electro-magnetic data storage devices;
 - (E) the mode of verification in order to ensure that data has been accurately transferred to such removable media;
 - (F) the mode of identification of such data storage devices;
 - (G) the arrangements for the storage and custody of such storage devices;
 - (H) the safeguards to prevent and detect any tampering with the system and
 - (I) any other factor which will vouch for the integrity and accuracy of the system.
- (c) a further certificate from the person in-charge of the computer system to the effect that to the best of his knowledge and belief, such computer system operated properly at the material time, he was provided with all the relevant data and the printout in question represents correctly, or is appropriately derived from, the relevant data."

The Fourth Schedule of the Indian IT Act 2000: Amendment to the Reserve Bank of India Act

In the Reserve Bank of India Act 1934, in Section 58, in subsection (2), after Clause (p), the following clause shall be inserted, namely,

"the regulation of fund transfer through electronic means between the banks or between the banks and other financial institutions referred to in Clause (c) of Section 45-1, including the laying down of the conditions subject to which banks and other financial institutions shall participate in such fund transfers, the manner of such fund transfers and the rights and obligations of the participants in such fund transfers."

6.4.2 Positive Aspects of the ITA 2000

The Indian ITA 2000, though heavily criticized for not being specific on cybercrimes, in our opinion, does have a few good points. At the same time, there is, also, fair amount of vagueness in the Act. This is briefly discussed here in this section.

1. Prior to the enactment of the ITA 2000 even an E-Mail was not accepted under the prevailing statutes of India as an accepted legal form of communication and as evidence in a court of law. But the ITA 2000 changed this scenario by legal recognition of the electronic format. Indeed, the ITA 2000 is a step forward.
2. From the perspective of the corporate sector, companies are able to carry out E-Commerce using the legal infrastructure provided by the ITA 2000. Till the coming into effect of the Indian cyberlaw, the growth of E-Commerce was impeded in our country basically because there was no legal infrastructure to regulate commercial transactions online.
3. Corporate will now be able to use digital signatures to carry out their transactions online. These digital signatures have been given legal validity and sanction under the ITA 2000.
4. In today's scenario, information is stored by the companies on their respective computer system, apart from maintaining a backup. Under the ITA 2000, it became possible for corporate to have a statutory remedy if anyone breaks into their computer systems or networks and causes damages or copies data. The remedy provided by the ITA 2000 is in the form of monetary damages, by the way of compensation, not exceeding ₹ 10,000,000.
5. ITA 2000 defined various cybercrimes. Prior to the coming into effect of the Indian Cyberlaw, the corporate were helpless as there was no legal redress for such issues. However, with the ITA 2000 instituted, the scenario changed altogether.

6.4.3 Weak Areas of the ITA 2000

As mentioned before, there are limitations too in the IT Act; those are mainly due to the following gray areas:

1. The ITA 2000 is likely to cause a conflict of jurisdiction.
2. E-Commerce is based on the system of domain names. The ITA 2000 does not even touch the issues relating to domain names. Domain names have not been defined and the rights and liabilities of domain name owners do not find any mention in the law. The law does not address the rights and liabilities of domain name holders.
3. The ITA 2000 does not deal with issues concerning the protection of Intellectual Property Rights (IPR) in the context of the online environment. Contentious yet very important issues concerning online copyrights, trademarks and patents have been left untouched by the law, thereby leaving many loopholes. Thus, the law lacks "Proper Intellectual Property Protection for Electronic Information and Data" – the law misses out the issue of IPR, and makes no provisions whatsoever for copyrighting, trade marking or patenting of electronic information and data. However, the corresponding provisions are available under the Indian Copyright Act (refer to Appendix T in CD).
4. As the cyberlaw is evolving, so are the new forms and manifestations of cybercrimes. The offenses defined in the ITA 2000 are by no means exhaustive. However, the drafting of the relevant provisions of the ITA 2000 makes it appear as if the offenses detailed therein are the only cyberoffenses possible and existing. The ITA 2000 does not cover various kinds of cybercrimes and Internet-related crimes. These include:
 - Theft of Internet hours (see for more details in Chapter 1);
 - cybertheft;
 - cyberstalking (for more details refer to Section 2.4 of Chapter 2);
 - cyberharassment;
 - cyberdefamation (for more details refer to Section 1.5.3 of Chapter 1);
 - cyberfraud (for more details see Chapter 1);
 - misuse of credit card numbers;
 - chat room abuse;
 - cybersquatting (not addressed directly).
5. The ITA 2000 has not tackled vital issues pertaining to E-Commerce sphere like privacy and content regulation to name a few.
6. The Information Technology Act is not explicit about regulation of Electronic Payments, and avoids applicability of IT Act to Negotiable Instruments. The Information Technology Act stays silent over the regulation of electronic payments gateway and rather segregates the negotiable instruments from the applicability of the IT Act. This may have major effect on the growth of E-Commerce in India. This has led to tendencies of banking and financial sectors being irresolute in their stands.
7. IT Act does not touch upon antitrust issues.
8. The most serious concern about the Indian Cyberlaw relates to its implementation. The ITA 2000 does not lay down parameters for its implementation. Also, when Internet penetration in India is extremely low and government and police officials, in general, are not very computer savvy, the new Indian cyberlaw raises more questions than it answers. It seems that the Parliament would be required to amend the ITA 2000 to remove the gray areas mentioned above.

6.5 Challenges to Indian Law and Cybercrime Scenario in India

In the previous section, weak areas of the Indian IT Act were discussed. In that context note that the Indian Law does not provide any definition to the term *cybercrime*. In fact, the IPC does not use the term *cybercrime* at any point even after its amendment by the ITA 2000, supposedly, the Indian cyberlaw. On the contrary, it has a separate Chapter XI entitled *Offences* in which cybercrimes have been declared as penal offenses punishable with imprisonment and fine. The offenses covered under CHAPTER XI of the Indian ITA 2000 include:

1. Tampering with the computer source code or computer source documents;
2. un-authorized access to computer (“hacking” is one such type of act);
3. publishing, transmitting or causing to be published any information in the electronic form which is lascivious or which appeals to the prurient interest;
4. failure to decrypt information if the same is necessary in the interest of the sovereignty or integrity of India, the security of the state, friendly relations with foreign state, public order or for preventing incitement to the commission of any cognizable offense;
5. securing access or attempting to secure access to a protected system;
6. misrepresentation while obtaining, any license to act as a Certifying Authority (CA) or a digital signature certificate;
7. breach of confidentiality and privacy;
8. publication of digital signature certificates which are false in certain particulars;
9. publication of digital signature certificates for fraudulent purposes.

There are legal drawbacks with regard to cybercrimes addressed in India – there is a need to improve the legal scenario. These drawbacks prevent cybercrimes from being addressed in India. First, the difficulties/ drawbacks with most Indians not to report cybercrimes to the law enforcement agencies because they fear it might invite a lot of harassment. Second, their awareness on cybercrime is relatively on the lower side.

Another factor that contributes to the difficulty of cybercrime resolution is that the law enforcement agencies in the country are neither well equipped nor knowledgeable enough about cybercrime. There is a tremendous need for training the law enforcement agencies in India. Not all cities have cybercrime cells. Most investigating officers with the Police force may be well equipped to fight cybercrime.

We need dedicated, continuous and updated training of the law enforcement agencies. There is a lack of dedicated cybercrime courts in the country where expertise in cybercrime can be utilized. There is a need to strengthen the legal scenario in India. It is not adequate to merely enact a law. The law may even be theoretically effective; however, it is of no use if the law is not enforced with true rigor and spirit. Thus, yet another dimension of current challenges in India is that the current law enforcement machinery is not yet well equipped to deal with cyberlaw offenses and contraventions. There is also a crying need for cyber-savvy judges. Judiciary plays a vital role in shaping the enactment according to the order of the day. The cyber cell officials need a sound technical training along with suitable technological support. Preservation of law and order in the society depends heavily on a sound judicial system. A sound cyberlaw training to the judges and lawyers will go a long way in effective enforcement of cyberlaws.

There is a need for a distinct law on cybercrime and appropriate changes should be made in the IPC and the Information Technology Act. Uniform guidelines on cyberforensics tools and strategies should be circulated among investigating officers of cybercrime in the country. There is also a need to expedite

cybercrime trials. As a country, we need to learn constantly from the ever-growing developments in cybercrime all across the world. Fundamentally, what is required is training and orientation of the judiciary and the lawyers. We are still far away from being in the state of "Ideal Cyber Law in India." To achieve that dream, it will require time, money and trained resources. There are good deal of efforts being done in this area and in the near future, the picture of our ability to fight cybercrimes is going to change considerably to rise up to the challenge.

People need to be encouraged to report the matter to the law enforcement agencies with full confidence and trust and without the fear of being harassed. There is perception issue too; the law enforcement agencies dealing with cybercrime need to come up with an extremely tech-savvy and friendly image. The Indian law enforcement agencies can follow the example set by the Federal Bureau of Investigation (FBI) in the US and go all out to strengthen the confidence of the people and companies who report cybercrimes to them. This should be possible because it is promised that complete secrecy would be maintained about all companies and people who report and assist in the investigation. We require apt laws and a proactive approach of the law enforcement agencies to effectively deal with the menace of cybercrime.

Whether the Indian law is practical and helpful in helping to solve cybercrime is a debatable topic. It is difficult to comment on this point. It is indeed helpful in addressing some cybercrimes, and in that sense the law is indeed practical. However, in the areas where the law does not cover some cybercrimes that have already emerged, the law is of no assistance or help whatsoever. The law enforcement agencies have been facing tremendous problems trying to cope with the challenges of emerging cybercrime within the ambit of the IPC, even if a liberal interpretation of it is taken. However, it is important to note that the Law alone does not help in punishing cybercrimes. It only prescribes punishments of various acts of cybercrimes. These acts are made punishable by imprisonment and fine. There are cases where the Indian cyberlaw has not prescribed punishments but has made these acts a ground for claiming compensation from the perpetrator of those acts. For example, if a computer virus is released and any damage caused, the cybercrime is punishable with imprisonment and fine. On the contrary, it can be made a ground for seeking damages up to ₹ 1 crore (₹ 1,00,00,000) against the perpetrator, provided his identity is known. As far as the issue of solving cybercrime goes, the onus lies with the law enforcement agencies and their will to do so. By and large, they are not well equipped enough to deal with cybercrimes and they do not possess the latest forensics tools. If our law enforcement agencies did have the requisite tools and the will, their success rate would indeed be better.

6.6 Consequences of Not Addressing the Weakness in Information Technology Act

In light of the discussion so far, we can see that there are many challenges in the Indian scenario for fight with cybercrime. Cyberlaws of the country are yet to reach the level of sufficiency and adequate security to serve as a strong platform to support India's E-Commerce industry for which they were meant. India has lagged behind in keeping pace with the world in this regard. The consequences of this are visible – India's outsourcing sector may get impacted. There are many news about overseas customer worrying about data breaches and data leakages in India. This can result in breaking India's IT business leadership in international outsourcing market.

Outsourcing is on the rise; if India wishes to maintain its strong position in the global outsourcing market, there should be quick and intelligent steps taken to address the current weaknesses in the Information Technology Act. If this is not addressed in the near future, then the dream of India ruling the world's outsourcing market may not come true.

6.7 Digital Signatures and the Indian IT Act

In this section, some potential problems regarding the terms *digital signatures* and *electronic signatures* are discussed. Public-key certificate and the role of public-key infrastructure (PKI) are also explained. Impact of oversights in ITA 2000 regarding digital signatures is also discussed. For the benefit of readers without technical background, the PKI and related terms are explained. For the discussion in this section, we will refer to Table 1.1 of Chapter 1 (Cybercrimes/Cases Registered and Persons Arrested under IT Act during 2004–2007); there is a mention of “publishing false digital signature certificate,” that is, item No. 7 in that table. CHAPTER XI (Offences) of the Indian IT Action mentions “penalty for publishing false digital signature certificate in certain particulars.” With those threads, in this section we will discuss particularly about digital signatures in context of the Indian IT Act. Before we do that, we need to understand a few technical concepts.

6.7.1 Public-Key Certificate

A public-key certificate is a digitally signed statement from one entity, saying that the public key (and some other information) of another entity has some specific value. A digital signature is a type of electronic signature that is used to guarantee the integrity of the data. When linked to the identity of the signer – using a security token such as X.509 Certificates – a digital signature can be used for non-repudiation, since it links the signer with the signed document. An X.509 Certificate contains information about the certificate subject and the certificate issuer (the CA that issued the certificate). A certificate is encoded in Abstract Syntax Notation One (ASN.1), a standard syntax for describing messages that can be sent or received on a network. The role of a certificate is to associate an identity with a public-key value. A certificate includes:

1. X.509 version information;
2. a serial number that uniquely identifies the certificate;
3. a common name that identifies the subject;
4. the public key associated with the common name;
5. the name of the user who created the certificate, known as the subject name;
6. information about the certificate issuer;
7. signature of the issuer;
8. information about the algorithm used to sign the certificate;
9. some optional X.509 version 3 extensions. For example, an extension exists that distinguishes between CA certificates and end-entity certificates.

Some of the most widely visible application of X.509 Certificates today is in Web browsers (such as Netscape Navigator and Microsoft Internet Explorer) that support the Secure Socket Layer (SSL) Protocol. SSL is a security protocol that provides privacy and authentication for your network traffic. These browsers can only use this protocol with web servers that support SSL. Other technologies that rely on X.509 Certificates include:

1. Code-signing schemes, such as signed Java Archives and Microsoft Authenticode;
2. Secure E-Mail standards, such as privacy-enhanced mail (PEM) and secure/multipurpose Internet mail extensions (S/MIME);
3. E-Commerce protocols, such as secure electronic transactions (SET).

Box 6.13 X.509 Digital Certificates

X.509 was initially issued on July 3, 1988 and was begun in association with the X.500 standard. It assumes a strict hierarchical system of Certifying Authorities (CAs) for issuing the certificates. This contrasts with web of trust models, like PGP, where anyone (not just special CAs) may sign and thus attest to the validity of others' key certificates. Version 3 of X.509 includes the flexibility to support other topologies like bridges and meshes (RFC 4158). It can be used in a peer-to-peer, OpenPGP-like web of trust, but was rarely used that way as of 2004. The X.500 system has never been fully implemented, and the IETF's public-key infrastructure (X.509), or PKIX, working group has adapted the standard to the more flexible organization of the Internet. In fact, the term X.509 Certificate usually refers to the IETF's PKIX Certificate and CRL Profile of the X.509 version 3 certificate standard, as specified in RFC 5280, commonly referred to as PKIX for public-key infrastructure (X.509). In the X.509 system, a CA issues a certificate binding a public key to a particular Distinguished Name in the X.500 tradition, or to an Alternative Name such as an E-Mail address or a DNS-entry.

In cryptography, X.509 is an ITU-T standard for a public-key infrastructure (PKI) for single sign-on (SSO) and privilege management infrastructure (PMI). X.509 specifies, among other things, standard formats for public-key certificates, certificate revocation lists (CRLs), attribute certificates and a certification path-validation algorithm.

Note: For Cryptography and Digital Signature Concepts, see Ref. #7, Books, Further Reading.

6.7.2 Representation of Digital Signatures in the ITA 2000

ITA 2000 had prescribed digital signatures based on Asymmetric cryptosystem and Hash system as the only acceptable form of authentication of electronic documents recognized as equivalent to "signatures" in paper form. When the ITA 2000 was drafted, there was a slip-up in the drafting of Section 35, subsection (3), which made it mandatory for an applicant of a digital signature certificate to enclose a *Certification Practice Statement* along with his application. One of the major deficiencies in the bill, which could hinder implementation, is the provisions regarding the role and function of the CAs as well as the process of issuing digital certificates.

Box 6.14 ITA 2000 Oversight

1. Licensing of Certifying Authorities (CAs)

Section 21 of the Act defines the licensing procedure for CAs. According to the provisions, the applicant for such a license should fulfill the requirements of "qualifications," "expertise," "manpower," "financial resources" and "other infrastructural facilities," which are necessary to issue digital certificates as may be prescribed by the Central Government. Furthermore, "The license will be valid for such period as may be prescribed by the Central Government and would not be transferable or heritable."

Considering the responsibilities that a CA has to discharge, the business of the CAs will involve a heavy investment in terms of infrastructure, manpower and marketing. The licensing period, therefore, has to be long enough to make the business viable. If this is as short as say 1 year, no CA will be able to break even before his first license expires. He will then come up for assessment for the renewal application and judged based on his performance, which may not be reflective of his potential.

In the absence of transferability, he may even be restrained from upgrading his skills through a joint venture partner. If the CA finds it uneconomical to run the business, he will even be prevented from handing over the business to another more efficient entity. In such an event, it would be the Netizens holding certificates issued by such a vacating CA who may suffer.

It is, therefore, necessary that the initial licensing period should be atleast 5 years and no restrictions be placed on the transferability of the ownership of the company that is granted the license. The Controller may, however, retain the right to review the license if he feels that the changes may compromise the interest of the customers of the erstwhile company.

Box 6.14 ITA 2000 Oversight . . . (Continued)

2. Licensing of foreign CAs

In view of the enormous preparations required to set up the CAs business, Indian CAs will take some time to come up with their services. Until such time, the market has to be supported by the foreign CAs. Otherwise, even after the Act is finally in place, it cannot be implemented in the absence of the digital signature infrastructure.

Sadly, the bill has made the task of getting license by foreign CAs unnecessarily complicated and needs an immediate review.

As per the bill, certificates will not be valid unless the issuing CA is approved by the Controller. For a foreign CA to get the approval, he has to open a physical office in India where he has to display (!) the license (Section 32). Before approving the foreign CA, the Controller has to obtain the permission of the Central Government and the fact should be notified in the Gazette.

Whoever drafted the above provision seems to have overlooked the ground realities. First, there are already many users in India who have obtained individual or secured server digital certificates from foreign CAs such as Verisign. Now, if for argument sake, Verisign does not get the license as a CA from the Controller in India; the existing certificates issued by them will not be valid under the Indian law.

Similarly, if an Indian who has obtained a certificate from a licensed CA has to enter into a contract with an Australian counterpart who has a certificate from an Australian CA, the contract may not be considered valid under the Indian cyberlaw unless the Australian CA also obtains license in India.

Will all the certification authorities in every other country agree to open offices in India, apply for license, wait for the government to approve and notify in the Gazette and display the certificates in their Indian offices? The answer is a definite "impossible."

It is, therefore, appropriate if (as is prevailing in some other countries) the validity of certificates from any CA already approved in other countries is automatically extended to India.

3. Do Individuals need to submit Certification Practice Statement?

If the provisions discussed above display only the ignorance of the lawmakers, the reading of Clause 35 leaves one wondering how such blatant errors have gone un-noticed to become law. This section deals with issue of digital certificates by the CAs. Surprisingly, Clause 35.3 says, "Every Such application shall be accompanied by a certification practice statement . . .".

Obviously, the Clauses 35.2 and 35.3 have been borrowed from the clause meant for the processing of an application of a CA requesting a license to issue digital certificates. The wording of Clause 35.4 further indicates that this faux pas is not just a slip but a deliberate insertion in the belief that it is necessary.

These clauses have to be deleted and modified appropriately.

6.7.3 Impact of Oversights in ITA 2000 Regarding Digital Signatures

The oversights, explained in the previous section, result in serious concerns – it is troublesome to imagine what will happen when the rules under the act are drafted. To keep the situation under control, the Ministry of Information and Technology had to urgently establish a task force to assist them in the drafting of the rules. The task force consisted of experts in the field. It is said that now this blunder has been accompanied by more avoidable confusions. Let us understand this. The Information Technology Amendment Bill 2006 was drafted on the basis of the recommendations of an "Expert Committee." The Committee took into consideration a recommendation from technical community that (a) the PKI-based system made the law dependent on a single authentication technology and (b) there was a need to make the law *Technology Neutral* (see Box 6.15 and Box 6.16).

Box 6.15 Digital Signature and Public-Key Infrastructure Technology

Modern day business transactions are computer-based, therefore, IT security services based on cryptography become essential. Public-key cryptography can play an important role in providing needed security services including confidentiality, authentication, digital signatures and integrity. Public-key cryptography uses two electronic keys: a public key and a private key. These keys are mathematically related but the private key cannot be determined from the public key. The public key can be known by anyone while the private key is kept secret by its owner.

As long as there is strong binding between the owner and the owner's public key, the identity of the originator of a message can be traced to the owner of the private key. A PKI provides the means to bind public keys to their owners and helps in the distribution of reliable public keys in large heterogeneous networks. Public keys are bound to their owners by public-key certificates. These certificates contain information such as the owner's name and the associated public key and are issued by a reliable CA.

The widespread use of PKI technology to support digital signatures can help increase confidence of electronic transactions. For example, the use of a digital signature allows a seller to prove that goods or services were requested by a buyer and therefore demand payment. The use of a PKI allows parties without prior knowledge of each other to engage in verifiable transactions.

For example, a buyer interested in purchasing certain goods from company A electronically would need to obtain a public-key certificate from a CA. In one possible scenario, the buyer would generate a public-private key pair, provide a Registration Authority (RA) with a valid photo ID and ask for a certificate. The RA would verify the buyer's identity based on the photo ID and vouch for the identity of the buyer to a CA, who would then issue the certificate. The newly certified buyer can now sign electronic purchase orders for the goods ordered. The vendor of those goods receiving the purchase order can obtain the buyer's certificate and the Certificate Revocation List (CRL) for the CA that issued the buyer's certificate, check that the certificate has not been revoked, and verify the buyer's signature. By verifying the validity of the certificate, the vendor ensures receipt of a valid public key for the buyer; by verifying the signature on the purchase order, the vendor ensures the order was not altered after the buyer issued it.

Once the validity of the certificate and the signature are established, the vendor can ship the requested widgets to company A with the knowledge that their buyer ordered the widgets. This transaction can occur without any prior business relationship between the buyer and the seller. Potentially, a user's private-public key pair can be used for multiple applications. For example, the same key used to sign the purchase order could be used by the buyer to authenticate an electronic payment to the vendor through the buyer's bank.

Most of the processing in the above example can occur automatically depending on the application. After obtaining a certificate, perhaps a click on an icon is all it takes for a user to sign a message. Similarly, the verification process on the receiver's end would occur as a message is received without requiring much intervention from the person receiving the message.

Box 6.16 PKI – Basic Components

The PKI technology has the six basic components:

1. **Public-key certificate:** It is an electronic record that binds a public key to the identity of the owner of a public-private key pair and is signed by a trusted entity.
2. **Certificate revocation list (CRL):** It is a list of certificates that have been revoked. The list is usually signed by the same entity that issued the certificates. Certificates can be revoked for several reasons. For example, a certificate can be revoked if the owner's private key has been lost or if the owner's name changes.
3. **Certification Authority (CA):** A trusted entity that issues and revokes public-key certificates and CRLs.
4. **Registration Authority (RA):** An entity that is trusted by the CA to register or vouch for the identity of users to a CA.

Certificate repository: An electronic site that holds certificates and CRLs. CAs post certificates and CRLs to repositories.

Certificate user: An entity that uses certificates to know, with certainty, the public key of another entity.

To honor this recommendation, the Committee tried to define an umbrella system of “electronic signatures” of which “digital signature” was one of the kinds. In consideration of this, in the Information Technology Amendment Bill 2006, Clause 2, a list of amendments were proposed to replace the word *digital* with the word *electronic* at several places in the principal act where a reference to “digital signature” had been made. However, somewhere along the line, some changes were made which are now appearing as anomalies in the legislation passed.

6.7.4 Implications for Certifying Authorities

The bill needed further amendments based on the Standing Committee report. To address that, instead of drafting a new amendment bill, a bill called “Information Technology Amendment Bill 2008” was drafted and it was introduced in the parliament on 15 December 2008. This bill passed certain amendments to the then pending Information Technology Amendment Bill 2006 (introduced on 15 December 2006) including the name clause of the resulting Act as in the bill introduced on 15 December 2006 which was changed from “Information Technology Amendment Act 2006” to “Information Technology Amendment Act 2008.” In the process of drafting an amendment bill (which was meant for amending a pending bill that was to amend a prevalent act), some serious slip-ups have crept into the Act which is now a law.

Instead of the earlier proposal to call “digital signature” as one type of an umbrella kind “electronic signature,” the current draft introduced a new Section 3A to define *electronic signatures* and retained the earlier Section 3 of *digital signatures*. This has made “electronic signature” a concurrent alternative proposed by law to “digital signature” and both could be used for authentication of electronic documents. As a result, the CAs’ regulations also need to be accommodated for both digital signature as well as electronic signature. Either the current CAs need to be licensed for “electronic signatures” also or there may be new CAs who only apply for being CAs for “electronic signatures” and not opt for having any “digital signature products.”

Public should also be able to “affix digital signature” and “affix electronic signature” as the case may be. They can acquire two different certificates, one for digital signature and the other for electronic signature, which may involve different CAs. The law, therefore, needs to accommodate all these provisions. It appears that the drafting of the bill has resulted in some confusion whereby in some places the digital signature and electronic signature are mentioned together and in some places they are mentioned differently. The net result is inconsistent treatment giving rise to anomalies that could have been avoided.

Section 3A: Electronic Signature

- (1) Notwithstanding anything contained in Section 3, but subject to the provisions of subsection (2), a subscriber may authenticate any electronic record by such electronic signature or electronic authentication that
 - (a) is considered reliable and
 - (b) may be specified in The Second Schedule.
- (2) For the purposes of this section any electronic signature or electronic authentication technique shall be considered reliable if
 - (a) the signature creation data or the authentication data are, within the context in which they are used, linked to the signatory or, as the case may be, the authenticator and of no other person;
 - (b) the signature creation data or the authentication data were, at the time of signing, under the control of the signatory or, as the case may be, the authenticator and of no other person;
 - (c) any alteration to the electronic signature made after affixing such signature is detectable;
 - (d) any alteration to the information made after its authentication by electronic signature is detectable and
 - (e) it fulfills such other conditions which may be prescribed.

- (3) The Central Government may prescribe the procedure for the purpose of ascertaining whether electronic signature is that of the person by whom it is purported to have been affixed or authenticated.
- (4) The Central Government may, by notification in the Official Gazette, add to or omit any electronic signature or electronic authentication technique and the procedure for affixing such signature from the Second Schedule.
Provided that no electronic signature or authentication technique shall be specified in the Second Schedule unless such signature or technique is reliable.
- (5) Every notification issued under subsection (4) shall be laid before each House of Parliament.

6.7.5 The Current Scenario Regarding Digital Signatures under the Indian IT Act

At present, there is no system of electronic signature defined in the Second Schedule and therefore there is no change in the authentication mechanism under the Act. As a result, the present system of digital signatures will continue for the time being and will be the only method of authentication of an electronic document. When the government needs to introduce a new system, it will have to notify through the Official Gazette the relevant procedure that can be considered as reliable. This would also require the notification to be placed before the Parliament.

Obviously, the system should meet the minimum criteria of effectively establishing the authentication of a document to the person who authenticates it and also should ensure that if the document has been changed since it was signed, such alteration becomes noticeable. If we go by the reliability of the Hash algorithms and the Asymmetric cryptosystems used for the current digital signature system that are reviewed worldwide by mathematicians on a regular basis, any alternative system should also meet similar stringent standards. In other words, if any technical solutions need to be considered as a concurrent alternative to the present PKI-based system, then the system has to be not only put to extensive tests within India but also in global circles. Additionally, the system has to be licensed in a manner similar to the manner of licensing CAs at present. We may, therefore, either see the current CAs who may introduce new systems or exclusive "Electronic Signature Certifying Authorities" who may seek license from the government and function along with the current "Digital Signature Certifying Authorities."

However, in the near future, the digital signature system will continue to be the sole system of authentication that would be recognized by Indian law. Thus, the need for "digital signature system" to continue for the time being, results in some serious legal lacuna. In Section 2(d) of the new Act, "affixing of an electronic signature" is defined as

"Affixing Electronic Signature" with its grammatical variations and cognate expressions means adoption of any methodology or procedure by a person for the purpose of authenticating an electronic record by means of Electronic Signature

There is, however, no corresponding definition for "affixing of a digital signature." Fortunately the definition of "digital signature" and "digital signature certificate" remains under Section 2(p) and 2(q) while the definition of "electronic signature" and "electronic signature certificate" has been added under Sections 2(ta) and 2(tb). In Sections 2(ta) and 2(tb), the definition of "electronic signature" and "electronic signature certificate" is given as "includes digital signature" or "digital signature certificate," respectively. This does not mean that the two terms are same; however, the system used in digital signature is considered "reliable" as per Section 3A of the new Act. Owing to the inclusion of digital signature in Sections 2(ta) and 2(tb), the

regulations regarding CAs mentioning *electronic signatures* will be applicable for digital signatures. However, regulations meant for *digital signatures* may not all be applicable to electronic signatures and their issuers.

Sections 37, 38 and 39, meant for suspension and revocation of digital signatures, do not automatically apply for electronic signatures. Although Section 40A specifically speaks of an intended amendment when electronic signature becomes a reality, similar new Sections 37A, 38A and 39A are required in such an event. Additionally, many more sections where only “digital signature” has been mentioned need to be supported by additional sections for electronic signatures. In particular, Section 21, which talks about licensing of CAs, itself needs to be supported with a corresponding section for electronic signatures.

Therefore, as and when procedures for electronic signatures were introduced, several sections needed to undergo changes. This has been another major amendment to the Act. Some of these difficulties could have been avoided by replacing the word “digital signature” by the words “digital signature and electronic signature where relevant” in Clause 2 of the IT Amendment Bill 2006. Now it appears that perhaps clubbing of the terms “digital signature” and “electronic signature” under Section 2 could have been avoided.

The law could have just made an enablement of an alternative to digital signatures and left other things to be added as and when any new system of electronic signature comes for consideration. At this point of time, we are not sure as to (a) what kind of systems can substitute or work along with digital signatures and (b) what kind of changes would be required in the law to accommodate them. The legal confusions created by this may also impact interpretations in “Indian Evidence Act” and there may be interesting battles of interpretations that will confuse and confound legal and judicial officers in courts. If the final draft of the bill had been debated in public space for some time rather than being hurriedly pushed through the Parliament, perhaps some of these confusions could have been avoided.

6.7.6 Cryptographic Perspective on the Indian IT Act

To appreciate the discussion in this section, readers need to be familiar with cryptography and encryption; these aspects are explained in Ref. #7, Books, Further Reading. A few shocking dimensions of digital signatures are explained here.

In plain language, non-repudiation means the assurance that someone cannot deny something. Typically, non-repudiation refers to the ability to ensure that a party to a contract or a communication cannot deny the authenticity of their signature on a document or the sending of a message that they originated. Technically speaking, the term *non-repudiation* has a specific meaning in E-Commerce; it means the intent to accept responsibility of submitting or receiving an electronic message and be bound by its substance. Non-repudiation in E-Commerce systems and electronic messaging systems is important because it protects a sender against the false assertion of the receiver that the message has not been received, and also protects a receiver against the false assertion of the sender that the message has been sent. Theoretically, public-key-based digital signatures are “non-repudiable” and this is one of their most frequently cited benefits. However, when you send an electronic message over the Internet, your digital signature does not prove that you signed the message – it only means that your private key got attached to that message. When talking about “non-repudiation,” an often ignored aspect is that there is something between you and your key and your computer system. If your computer system were infected, the Malicious Code could use your key to sign documents without your knowledge or permission! Even if you wanted to give explicit approval for each signature (e.g., via a fingerprint scanner), the Malicious Code could wait for you to approve a signature and would then sign its own message instead of yours. If the private key is not in tamper-resistant hardware, the Malicious Code can just steal the key as soon as it is used.

Such details may get legitimately ignored in cryptographic designs. It would be wrong to assume that real computer systems implement the theoretical ideal. Your computer may contain viruses. Without due care, your computer may also be accessible to passers-by who could plant Malicious Code or manually sign things with your keys. In such a scenario, if we needed to deny some signature, we would owe the burden of proving the negative, that is, we did not make the signature in question against the presumption that we did. The main risk in believing this popular falsehood stems from the cryptographic concept of “non-repudiation”; so let us revisit the meaning of this term. There are two following definitions for the term *non-repudiation*:

1. **Definition 1 (General):** The intent to accept one's obligation under a contract and be bound for its performance.
2. **Definition 2 (E-Commerce):** The intent to accept responsibility of submitting or receiving an electronic message and to be bound by its substance. Non-repudiation protects a sender against the false assertion of the receiver that the message has not been received and a receiver against the false assertion of the sender that the message has been sent. An essential element of secure E-Commerce, non-repudiation is generally established by the protocol [such a PKI or EDIFACT (see Box 6.17) used in data transfer], and includes legal and security criteria of authentication and report integrity.

Box 6.17 EDIFACT Basics

EDIFACT is an acronym for *EDI for Administration, Commerce and Transport* (EDIFACT). It coordinates international standardization by working through the UN/ECE (United Nations/Economic Commission for Europe). The EDIFACT standard provides:

1. An international EDI standard that works as a set of syntax rules to structure data;
2. an Interactive Exchange Protocol (I-EDI);
3. a set of syntax rules;
4. data elements, segments and codes;
5. standard messages which allow multi-country and multi-industry exchange.

EDIFACT has a hierarchical structure where the top level is referred to as an interchange, and lower levels contain multiple messages which consist of segments, which in turn consist of composites. EDIFACT has been adopted by the International Organization for Standardization (ISO) as the ISO standard ISO 9735. An example of an EDIFACT message used to answer to a product availability request is mentioned below:

```

UNB+IATB;1+6XPPC+LHPPC+940101:0950+1'
UNH+1+PAORES:93:1:IA'
MSG+1:45'
IFT+3+XYZCOMPANY AVAILABILITY'
ERC+A7V:1:AMD'
IFT+3+NO MORE FLIGHTS'
ODI
TVL+240493:1000::1220+FRA+JFK+DL+400+C'
PDI++C:3+Y::3+F::1'
APD+74C:0::6++++++6X'
TVL+240493:1740::2030+JFK+MIA+DL+081+C'
PDI++C:4'
APD+EM2:0:1630::6++++++DA'
UNT+13+1'
UNZ+1+1'

```

Recall that we mentioned two definitions of the term *non-repudiation*. Now let us further understand the traditional legal meaning of “non-repudiation.” There is a definitional *distinction between the legal use of the term “non-repudiation” and its crypto-technical use*. First, let us consider the legal use of the term. In the legal sense, an alleged signatory to a document is always able to repudiate a signature that has been attributed to him or her. The basis for a repudiation of a traditional signature may include:

1. The signature is a forgery.
2. The signature is not a forgery, but was obtained via
 - Unconscionable conduct by a party to a transaction;
 - fraud instigated by a third party;
 - undue influence exerted by a third party.

The common law trust mechanism established to overcome a false claim of non-repudiation is *witnessing*. Witnessing may simply occur at the point of the signature being affixed, that is, with the presence of an independent adult to witness the signing of a document reduces the ability of the signatory to successfully deny the signature as a forgery at a later date. It is always open for the signatory to deny the signature on other grounds such as those already enumerated.

An issue arises whether a digital signature should be treated differently compared with a traditional signature. In the E-Commerce environment, it is presumed that the law should not alter this position with regard to the legal rights of parties to repudiate a digital signature. Governments worldwide have consistently supported this position. The E-Commerce environment should not have different rules from those developed over many centuries in the paper-based environment. These rules have been developed as well as judicially tested to avoid disadvantage to any party in a transaction. Now let us consider the crypto-technical meaning of “non-repudiation.” In general terms, it means

1. In authentication, a service that provides proof of the integrity and origin of data, both in an unforgeable relationship, which can be verified by any third party at any time; or
2. in authentication, an authentication that with high assurance can be asserted to be genuine and that cannot subsequently be refuted.

Coming back to the topic of sending an electronic message over the Internet with “digital signature,” PKI has been touted as the solution to many network security problems. It is known that there are problems that are beyond PKI’s ability to solve; PKI solution vendors do not like this to be mentioned. The worst of all is if a country’s laws are framed in such a way that they make you liable (legally) if your private key is used to sign a document. In Section 42 of the Indian IT Act titled *Control of Private Key*, there is an explanation stating this: *For clarifying doubts, it is hereby declared that the subscriber shall be liable till he has informed the Certifying Authority that the private key has been compromised*.

In spite of the “Controller of Certifying Authority” (CCA) and the CA certifying the digital signature, the total risks involved and the financial injury suffered by the citizen in accepting the digital signature is entirely with the person accepting the digital signature and NOT with the CA or CCA even if it was proved that it was due to the mistake of the CA or CCA.

The Indian ITA 2000 puts the liability on the person who accepts the digital signature (i.e., do it at your risk!). The only way to escape the misplaced legal liability is:

1. Never get your key certified by a CA;
2. never get your public key published for the benefit of the public;
3. never accept digital signature for things that involve legal liability; this does not prevent using digital signature between two trusted friends or partners.

To understand the risks involved in PKI, refer to Ref. #14, Additional Useful Web References, Further Reading.

6.8 Amendments to the Indian IT Act

In Section 6.7.5 we explained about the issue regarding digital signature in the Indian IT Act. There are other aspects as well. According to some experts, Indian law may satisfy European Union's data protection concerns. For example, to win the business in global market, it is essential to create appropriate confidence among investors and foreign companies to assure them that the data sent to India for backoffice operations will indeed be safe, and there are appropriate statutory mechanisms in place should a breach of data take place. Due to this, it is becoming extremely important for India to have in place a distinctive legal regime promoting data protection. In this context, Example 11 in Section 11.2.11 in Chapter 11 brings the following key point to the table:



Indian BPO organizations are classified as *intermediaries* and as such they do have liabilities in case of breached data.

A welcome change is heralded by the amendments to the Indian IT Act. So far, Information Security Experts have been speaking about *cyberlaw compliance* as a part of *Techno Legal Information Security* and advising Companies to formulate an appropriate action plan to comply with cyberlaws as a part of the information security practice. Now this association of cyberlaw with the information security domain has gained additional importance due to some amendments that have been made to ITA 2000.

As a quick note, in the amended Indian IT Act, that is, the ITA 2008 (year 2008 amendments to the Indian IT Act), there is addition of several new offenses that are apt with the new paradigm in today's net-centric digital economy. Section 66 has now been expanded to include Sections 66A (*Offensive Messages*), 66B (*Receiving Stolen Computer*), 66C (*Identity Theft*), 66D (*Impersonation*), 66E (*Violation of Privacy*) and 66F (*Cyber Terrorism*). Section 67 has been expanded to include Sections 67A (*Sexually Explicit Content*) and 67B (*Child Pornography*). However, with these additional sections, police may have some concerns; for example, one such concern could be that under Section 78, now inspectors can undertake investigations of cybercrimes under the Act. This means that it would not only be the DSPs who need to be trained in ITA 2000 but all the inspectors in the state. The implication is that now the training requirements would again grow manifolds. In the paragraphs that follow, we provide an overall outlook on the changes (amendments) made to the Indian IT Act. We have provided a running commentary on Sections 43, 67C, 66B, 69B, 70B(4), 70B(6), 70B(7), 72A, 78, 80 and 85 of the amended IT Act.

First, let us revisit the term *cybersecurity* – in authors' opinion, the amended IT Act makes a sincere effort to consider complete information security infrastructure that exists in the industry. The new legal definition that given to the term *cybersecurity* under the newly inserted Section 2(nb) (Inserted Vide ITAA 2008) – "*Cyber Security*" means protecting information, equipment, devices, computer, computer resource, communication device and information stored therein from unauthorized access, use, disclosure, disruption, modification or destruction.

A Glimpse into Indian IT Act Amendment

Section 2(nb) (Inserted Vide ITAA 2008)

"Cybersecurity" means protecting information, equipment, devices, computer, computer resource, communication device and information stored therein from unauthorized access, use, disclosure, disruption, modification or destruction."

To support the development of the cybersecurity infrastructure, the amendments also focus on

1. Defining penalties for violation;
2. defining appropriate level of compensation;
3. setting up an authority for implementation.



The term *cybersecurity* incorporates both the physical security of devices as well as the information stored therein. It covers "protection from unauthorized access, use, disclosure, disruption, modification and destruction."

To support the development of the cybersecurity infrastructure, the amendments also focus on

1. Defining penalties for violation;
2. defining appropriate level of compensation;
3. setting up an authority for implementation.

As far as "penalties for violation" are concerned, a new offense has been defined, to recognize the need to expressly penalize the "theft" of computer or other communication devices.



Under the newly added Section 66B, the receiver of a stolen computer resource may be liable for punishment.

6.8.1 Overview of Changes Made to the Indian IT Act

Section 66B of the Amended IT Act of India

Punishment for dishonestly receiving stolen computer resource or communication device (Inserted Vide ITA 2008) is presented below.

A Glimpse into Indian IT Act Amendment

Sec 66B: It states punishment for dishonestly receiving stolen computer resource or communication device (Inserted Vide ITA 2008):

"Whoever dishonestly receives or retains any stolen computer resource or communication device knowing or having reason to believe the same to be stolen computer resource or communication device shall be punished with imprisonment of either description for a term which may extend to three years or with fine which may extend to rupees one lakh or with both."

Thus, under Section 66B, receiving a stolen computer or a mobile or even a CD or an E-Mail containing stolen information is liable to punishment with 3 years of imprisonment. The offense would be cognizable

and compoundable. A person becomes liable when he/she receives the information “dishonestly” and is aware that it is “stolen.” This section empowers the police force as they can now book all mobile theft or laptop theft cases under this section. So far, attempts were made to convince the police that any theft of computer device would be “diminishing the value of information residing therein” and therefore should be booked under Section 66. Now it may be easy to convince the police.

Sections 78 and 80 of the Amended IT Act of India

Along with the changes made to Sections 78 and 80 of the ITA 2000, bringing down the authority of investigation from the level of DSPs to the level of inspectors, the number of complaints that need to be registered under “cybercrimes” are now expected to grow considerably in numbers. Therefore, the police may now need to work overtime and will also need to get trained in handling of cybercrimes.

A Glimpse into Indian IT Act Amendment

With the change made to Sections 78 and 80 of the ITA 2000, the authority of investigation is brought down from the previous level of DSPs to the level of inspectors. Now the number of complaints registered under “cybercrimes” are expected to increase manifolds and the police need to work overtime as well as get trained in the handling of cybercrimes.

Section 43 of the Amended IT Act of India

In addition to the provision under Section 66B mentioned above, this section, when read with other changes, increases the possibility of compensation from a maximum of ₹ 1 crore (₹ 10,000,000) to even beyond ₹ 5 crore (₹ 5,00,00,000). Although the fast track “adjudication” is restricted to cases where the compensation is up to ₹ 5 crore (₹ 5,00,00,000), there is no upper limit on the compensation to be claimed.

The newly added Section 43(j) tries to expand the cases where compensation can be claimed to cases when a person without the permission of the owner of a computer, computer resource “steals, conceals, destroys or alters or causes any person to steal, conceal, destroy or alter any computer source code used for a computer resource with an intention to cause damage.”

A Glimpse into Indian IT Act Amendment

The newly added Section 43(j) tries to expand the cases where compensation can be claimed to cases of a person without the permission of the owner of a computer, computer resource “steals, conceals, destroys or alters or causes any person to steal, conceal, destroy or alter any computer source code used for a computer resource with an intention to cause damage.”

1. **Meaning of source code:** “Computer source code” means “the listing of programs, computer commands, design and layout and program analysis of computer resource in any form.”
2. **Advantage of this definition:** It makes it easy for police to understand how to treat a complaint from a software company about stolen data. The penalty for stolen data does not end with the perpetrator of the offense as far as the victim is concerned. The provisions on *data protection* extend the liability for lack of cybersecurity to the companies too.

A Glimpse into Indian IT Act Amendment – Compensation for Failure to Protect Data

Under the newly introduced Section 43A, “Where a body corporate, possessing, dealing or handling any sensitive personal data or information in a computer resource which it owns, controls or operates, is negligent in implementing and maintaining reasonable security practices and procedures and thereby causes wrongful loss or wrongful gain to any person, such body corporate shall be liable to pay damages by way of compensation, to the person so affected.”

Under the newly introduced Section 43A

Where a body corporate, possessing, dealing or handling any sensitive personal data or information in a computer resource, which it owns, controls or operates, is negligent in implementing and maintaining reasonable security practices and procedures and thereby causes wrongful loss or wrongful gain to any person, such body corporate shall be liable to pay damages by way of compensation, to the person so affected.

Note that there is no upper limit to the liability under this section. In understanding the responsibilities under this section, the term *reasonable security practices* becomes vital. As per the explanation to the section, *reasonable security practices and procedures* means security practices and procedures designed to protect such information from unauthorized access, damage, use, modification, disclosure or impairment, as may be specified in an agreement between the parties or as may be specified in any law for the time being in force and in the absence of such agreement or any law, such reasonable security practices and procedures, as may be prescribed by the Central Government in consultation with such professional bodies or associations as it may deem fit.

A Glimpse into Indian IT Act Amendment

As per the explanation to the section, "reasonable security practices and procedures" means security practices and procedures designed to protect such information from unauthorized access, damage, use, modification, disclosure or impairment, as may be specified in an agreement between the parties or as may be specified in any law for the time being in force and in the absence of such agreement or any law, such reasonable security practices and procedures, as may be prescribed by the Central Government in consultation with such professional bodies or associations as it may deem fit.

Section 72A of the Amended IT Act of India

Under this section, a provision has been made for criminal prosecution in the event of breach of information security. It is stated as

"Save as otherwise provided in this Act or any other law for the time being in force, any person including an intermediary who, while providing services under the terms of lawful contract, has secured access to any material containing personal information about another person, with the intent to cause or knowing that he is likely to cause wrongful loss or wrongful gain discloses, without the consent of the person concerned or in breach of a lawful contract, such material to any other person shall be punished with imprisonment for a term, which may extend to three years or with a fine, which may extend to five lakh rupees or with both."

Note again that this offense is cognizable.

A Glimpse into Indian IT Act Amendment

Under Section 72A, there is a provision for Criminal prosecution for breach of information security. This section states, "Save as otherwise provided in this Act or any other law for the time being in force, any person including an intermediary who, while providing services under the terms of lawful contract, has secured access to any material containing personal information about another person, with the intent to cause or knowing that he is likely to cause wrongful loss or wrongful gain discloses, without the consent of the person concerned, or in breach of a lawful contract, such material to any other person shall be punished with imprisonment for a term which may extend to three years, or with a fine which may extend to five lakh rupees, or with both."

Section 85 of the Amended IT Act of India

The principle of “vicarious liability” is based on the concept of causing a damage or injury due to negligence. The term *vicarious liability* is used to indicate that the law holds one person responsible for the misconduct of another, although the first person is free from any personal blameworthiness or fault. The legal principle of vicarious liability applies to hold one person liable for the actions of another when engaged in some form of joint or collective activity. Under Section 85, the organization as well as its directors or officers in-charge of business “shall be” held guilty of the offense committed “by the organization.” Thus, the “vicarious liability” on the companies for “data protection” has been hardened. See the bar below.

A Glimpse into Indian IT Act Amendment

Further under Section 85, the company as well as its Directors or officers in-charge of business “shall be” held guilty of the offense committed “by the company.”

Thus, the “vicarious liability” on the companies for “data protection” has been hardened.

Section 67C of the Amended IT Act of India

Under Section 67C, there is a further responsibility trusted with “intermediaries.” Intermediaries now include body “corporate” to retain information for a certain time as specified by the Central Government. The section reads:

Intermediary shall preserve and retain such information as may be specified for such duration and in such manner and format as the Central Government may prescribe. Any intermediary who intentionally or knowingly contravenes the provisions of subsection (1) shall be punished with an imprisonment for a term, which may extend to three years and shall also be liable to fine.

With regard to this, Example 11 in Section 11.2.11 in Chapter 11 should be read. A key point mentioned in that example is that Indian BPO organizations are classified as *intermediaries* and as such they do have liabilities in case of breached data.

A Glimpse of Indian IT Act Amendment

Under Section 67C, a further responsibility has been cast on “Intermediaries” (which now includes body corporates to retain information for a certain time to be specified by the Central Government). The section reads

- Intermediary shall preserve and retain such information as may be specified for such duration and in such manner and format as the Central Government may prescribe.
- Any intermediary who intentionally or knowingly contravenes the provisions of subsection (1) shall be punished with an imprisonment for a term which may extend to three years and shall also be liable to fine.

This is an important provision to make ISPs, managed service providers (MSPs), responsible along with others who today seem to evade taking the responsibility of preserving information that would serve as evidence in case of cyberoffenses. The duration for which information has to be preserved, needs to be prescribed in the rules and notifications.

Section 69B of the Amended IT Act of India

To address the need for monitoring “cybersecurity,” it is stated that

“The Central Government may, to enhance Cyber Security and for identification, analysis and prevention of any intrusion or spread of computer contaminant in the country, by notification in the official Gazette, authorize any agency of the government to monitor and collect traffic data or information generated, transmitted, received or stored in any computer resource.”

It is important to note that the intermediary or any person in-charge of the computer resource shall when called upon by the agency, which is vested with power under subsection (1), provide technical assistance and extend all facilities to such agency to enable online access or to secure and provide online access to the computer resource generating, transmitting, receiving or storing such traffic data or information. The procedure and safeguards for monitoring and collecting traffic data or information shall be such as may be prescribed. Any intermediary who intentionally or knowingly contravenes the provisions of subsection (2) shall be punished with an imprisonment for a term, which may extend to three years and shall also be liable to fine.

A Glimpse into Indian IT Act Amendment

As a part of the need to monitor cybersecurity, under Section 69B,

- The Central Government may, to enhance cybersecurity and for identification, analysis and prevention of any intrusion or spread of computer contaminant in the country, by notification in the Official Gazette, authorize any agency of the government to monitor and collect traffic data or information generated, transmitted, received or stored in any computer resource.
- The intermediary or any person in-charge of the computer resource shall when called upon by the agency which has been authorized under subsection (1), provide technical assistance and extend all facilities to such agency to enable online access or to secure and provide online access to the computer resource generating, transmitting, receiving or storing such traffic data or information.
- The procedure and safeguards for monitoring and collecting traffic data or information, shall be such as may be prescribed.
- Any intermediary who intentionally or knowingly contravenes the provisions of subsection (2) shall be punished with an imprisonment for a term which may extend to three years and shall also be liable to fine.

Explanation: For the purposes of this section, the term *computer contaminant* has the same meaning as was assigned to it in Section 43. *Traffic data* constitutes any data identifying or purporting to identify any person, computer system or computer network or location to or from which the communication is or may be transmitted. “Traffic data” includes communications origin, destination, route, time, date, size, duration or type of underlying service or any other information. Implementation mechanism: Apart from throwing open registration and investigation of cybercrimes to inspector level, at the national level, a new *nodal agency* comes into being for implementation of cybersecurity.

Section 70B(4) of the Amended IT Act of India

Under this section, it is stated that

The Indian Computer Emergency Response Team shall serve as the national agency for performing the following functions in the area of Cyber Security: collection, analysis and dissemination of information on cyber incidents forecast and alerts of cyber security incidents emergency measures for handling cyber security incidents coordination of cyber incidents response activities issue guidelines, advisories,

vulnerability notes and white papers relating to information security practices, procedures, prevention, response and reporting of cyber incidents such other functions relating to cyber security as may be prescribed.

A Glimpse into Indian IT Act Amendment

Under Section 70B(4), The Indian Computer Emergency Response Team shall serve as the national agency for performing the following functions in the area of cybersecurity:

- Collection, analysis and dissemination of information on cyber incidents;
- forecast and alerts of cybersecurity incidents;
- emergency measures for handling cybersecurity incidents;
- coordination of cyber incidents response activities;
- issue guidelines, advisories, vulnerability notes and white papers relating to information security practices, procedures, prevention, response and reporting of cyber incidents;
- such other functions relating to cybersecurity as may be prescribed.

Section 70B(6) of the Amended IT Act of India

The statement of the section is presented below. Note the terms “service providers,” “intermediaries,” “data centers” and “body corporate.”

A Glimpse into Indian IT Act Amendment

Under Section 70B(6), “*For carrying out the provisions of subsection (4), the agency referred to in subsection (1) may call for information and give direction to the service providers, intermediaries, data centers, body corporate and any other person.*”

Section 70B(7) of the Amended IT Act of India

Under this section, it is stated that “*Any service provider, intermediaries, data centers, body corporate or person who fails to provide the information called for or comply with the direction under subsection (6), shall be punishable with imprisonment for a term, which may extend to one year or with fine, which may extend to one lakh rupees or with both.*” The same is presented below.

A Glimpse into Indian IT Act Amendment

Under Section 70B(7), “*Any person who fails to provide the information called for or comply with the service provider, intermediaries, data centers, body corporate or direction under subsection (6), shall be punishable with imprisonment for a term which may extend to one year or with fine which may extend to one lakh rupees or with both.*”

Finally, to conclude the discussion of this section, we note that the cumulative effect of the above provisions of ITA 2008 is to create a new cybersecurity implementation infrastructure in India and it is considered a highly positive development in the industry. The next steps to be watched are of course how the provisions would be actually implemented through appropriate rules and regulations.

6.8.2 Cybercafe-Related Matters Addressed in the Amendment to the Indian IT Act

The background for cybercafe matters addressed in the Indian IT Act Amendment is interesting. On 29 May 2001 two persons (Jayesh Thakkar and Sunil Thacker) sent a letter to the Chief Justice of the Bombay High Court complaining about the proliferation of pornographic sites on the Internet. The letter was numbered as Writ Petition 2611 of 2001.

During the subsequent hearings, the Internet Users Association of India (IUAI) was permitted to intervene in the matter. The Government of Maharashtra and the Union Territory of India had also appeared in the court. On 28 September 2001, the Division Bench of the High Court presided over by the learned Chief Justice passed an order appointing a Committee to suggest and recommend ways, measures and means to protect/shield minors from access to pornographic and obscene material on the Internet.

Cybercafes continued to attract attention later too. There were several mails sent from a cybercafe threatening terrorist attacks on some of Bangalore's IT companies. In the past also, there have been many instances where E-Mails sent from cybercafes have been used either for real or false terrorist communication. Several cybercrimes including stealing of bank passwords and subsequent fraudulent withdrawal of money have also happened through cybercafes. It was also noticed that cybercafes were regularly used to send obscene mails to harass people. The perceived advantage (from criminals' point of view) of using a cybercafe is that E-Mails are hard to track. We know how terrorists used the wireless technology in the November 2008 attacks in Mumbai (known as "11/26 attacks in Mumbai") and it is also known that the recent blasts in Ahmedabad are being traced to a cybercafe in Navi Mumbai (New Bombay). It is for this reason that cybercafe owners are supposed to ask for or rather insist on proper identification and a contact telephone number as well. However, when we did an informal survey of cybercafes in one city, we found that hardly any such precautions were taken and we also found many other less than desirable practices prevalent in the cybercafes. One can understand why cybercafes have been considered as one of the key intermediaries which need to be regulated. To regulate cybercafes, several states had passed regulations – some under ITA 2000 and some under the State Police Act.

Moreover, the problem was that the Indian ITA 2000 had not defined cybercafes; so they could only be interpreted as "network service providers" under the erstwhile Section 79. This imposed on them a responsibility for "due diligence" failing which they would be liable for the offenses committed in their network. The concept of *due diligence* was interpreted from the various provisions in cybercafe regulations where available or under the normal responsibilities expected from network service providers. Now, the Information Technology Amendment Act 2008 has made many significant changes in the prevailing laws of cyberspace applicable in India, one of which is regarding cybercafes. The ITA 2008 has now provided a specific definition for the term *cybercafe* and also included cybercafes under the term *Intermediaries*. Several aspects of the Act therefore become applicable to cybercafes and there is a need to take a fresh look at what cybercafes are expected to do for cyberlaw compliance. This is explained in Table 6.8.

It is interesting to note that the Karnataka Regulation was notified under Section 90 of ITA 2000 whereas the Tamil Nadu Act was notified under the State Police Act. Now that ITA 2000 has been amended, the provisions under Karnataka Cybercafe Regulation may have to be considered while there may be a question mark on the validity of Tamil Nadu Regulations. Mumbai, Maharashtra and Gujarat who also have some state level regulations may also be in a state similar to that of Tamil Nadu.

Sections 69, 69A and 69B specifically vest the powers in an agency to be designated. They have deliberately avoided the use of the term *police*. The legislative intent is, therefore, indicative that police need not be the agency to exercise the powers under these sections.

Table 6.8 | ITA 2008 and cybercafes

| <i>ITA 2008 Section</i> | <i>What it States</i> | <i>Comment</i> |
|----------------------------------|--|---|
| Section 2(na) | “Cybercafe” means any facility from where access to the Internet is offered by any person in the ordinary course of business to the members of the public. | This definition is an improvement of what was earlier proposed by the Expert Committee and the first draft of ITAA 2006 that had several anomalies. However, this definition may conflict with the definitions given under the current regulations passed by various States. See Note 1 at the end of this table. |
| Section 2(w) | The definition of “Intermediaries” includes “Cybercafes.” The regulations for Intermediaries therefore apply to Cybercafes after ITA 2008 becomes effective. | |
| Section 67C | <ul style="list-style-type: none"> • Intermediary shall preserve and retain such information as may be specified for such duration and in such manner and format as the Central Government may prescribe. • Any intermediary who intentionally or knowingly contravenes the provisions of subsection (1) shall be punished with an imprisonment for a term that may extend to 3 years and shall also be liable to fine. • Where the Central Government or a <i>State Government</i> or any of its officer specially authorized by the Central Government or the State Government, as the case may be, in this behalf may, if satisfied that it is necessary or expedient to do so in the interest of the sovereignty or integrity of India, defense of India, security of the State, friendly relations with foreign States or public order or for preventing incitement to the <i>commission of any cognizable offence</i> relating to above or for investigation of any offence, it may, subject to the provisions of subsection. • For reasons to be recorded in writing, by order, direct any agency of the appropriate Government to <i>intercept, monitor or decrypt</i> or cause to be intercepted or monitored or decrypted any information transmitted received or stored through any computer resource. • The procedure and safeguards subject to which such interception or monitoring or decryption may be carried out, shall be such as may be prescribed. | Thus, the responsibility of Cybercafes has now been clearly defined with a three year imprisonment which is also <i>cognizable, bailable and compoundable</i> . See Note 2 at the end of this table. |
| Section 69 (modified version) | | See Note 3 at the end of this table |

(Continued)

Table 6.8 | (Continued)

| <i>ITA 2008 Section</i> | <i>What it States</i> | <i>Comment</i> |
|-------------------------|---|--|
| 69A | <ul style="list-style-type: none"> • The subscriber or intermediary or any person in charge of the computer resource shall, when called upon by any agency that has been directed under subsection (1), extend all facilities and technical assistance to <ul style="list-style-type: none"> • Provide access to or secure access to the computer resource generating, transmitting, receiving or storing such information; or • intercept or monitor or decrypt the information, as the case may be; or • provide information stored in computer resource. • The subscriber or intermediary or any person who fails to assist the agency shall be punished with an imprisonment for a term which may extend to 7 years and shall also be <i>liable to fine</i>. • Where the Central Government or any of its officer specially authorized by it in this behalf is satisfied that it is necessary or expedient to do so in the interest of sovereignty and integrity of India, defense of India, security of the State, friendly relations with foreign states or public order or for preventing incitement to the commission of any cognizable offence relating to above, it may subject to the provisions of subsections. • For reasons to be recorded in writing, by order direct any agency of the Government or intermediary to block access by the public or cause to be blocked for access by public any information generated, transmitted, received, stored or hosted in any computer resource. • The procedure and safeguards subject to which such blocking for access by the public may be carried out shall be such as may be prescribed. • The intermediary who fails to comply with the direction issued under subsection (1) shall be punished with an imprisonment for a term that may extend to 7 years and also be liable to fine. | <p>The important points to be noted in this section as well as the two other Sections 69A and 69B (quoted below) are</p> <ul style="list-style-type: none"> • These powers are available to both the Central and State Governments who can specially authorize an officer for the purpose. • It can be invoked even for preventing incitement to the commission of any cognizable offence. It is debatable whether the term Cognizable Offence has to be restricted to ITA 2008 only or can be extended to Indian Penal Code or other laws as well. • Government shall prescribe necessary safeguards to be followed by Intermediaries. • The powers include demanding of information stored in a computer. • Non-compliance may result in stiff penalty of imprisonment up to 7 years. |
| 69B | <p>The Government now will have powers to collect "Traffic data" and also seek online access to information in the hands of an intermediary. The section provides:</p> | <p>For the purposes of this section,</p> <ul style="list-style-type: none"> • "computer contaminant" shall have the meaning assigned to it in Section 43; |

(Continued)

Table 6.8 | (Continued)

| <i>IT Act 2008 Section</i> | <i>What it States</i> | <i>Comment</i> |
|----------------------------|--|--|
| | <ul style="list-style-type: none"> • The Central Government may, to enhance cybersecurity and for identification, analysis and prevention of any intrusion or spread of computer contaminant in the country, by notification in the Official Gazette, authorize any agency of the Government to monitor and collect traffic data or information generated, transmitted, received or stored in any computer resource. • The intermediary or any person in-charge of the computer resource shall when called upon by the agency that has been authorized under subsection (1), provide technical assistance and extend all facilities to such agency to enable online access or to secure and provide online access to the computer resource generating, transmitting, receiving or storing such traffic data or information. • The procedure and safeguards for monitoring and collecting traffic data or information, shall be such as may be prescribed. • Any intermediary who intentionally or knowingly contravenes the provisions of subsection (2) shall be punished with an imprisonment for a term that may extend to 3 years and shall also be liable to fine. | <ul style="list-style-type: none"> • “traffic data” means any data identifying or purporting to identify any person, computer system or computer network or location to or from which the communication is or may be transmitted and includes communications origin, destination, route, time, date, size, duration or type of underlying service or any other information. <p>Under this section, Government can force Cybercafes to follow safeguards specified and also demand online access if required.</p> |

Note 1:

- The Karnataka Regulations for Cybercafes define a cybercafe as: *Any premises where the Cyber Cafe Owner/Network Service Provider provides the computer services including Internet access to the public.* Thus, in the Karnataka definition, *any Network Service Provider providing “Computer Services” may be called as the “Cyber Cafe.”*
- According to Tamil Nadu Regulations, a “Browsing Center” means and includes *any establishment by what so ever name called where the general public have an access to Internet in any of its forms, protocols either on payment or free of charges for any purpose including recreation or amusement.* It also says – *a browsing center shall be deemed to be a public place as defined under Sec-3 of Tamil Nadu City Police 1888.* Thus, in the TN definition, any Kiosks in say Airport or a Railway Station where free Internet access is given to public may also qualify as a cybercafe.
- The Tamil Nadu rules require registration of cybercafes and both impose responsibilities such as maintenance of visitor’s register, verification of photo ID, etc.

Note 2:

- Additionally, three important sections have been added to the present Act according to which the government has the powers to intercept, monitor, block and collect traffic data. These sections impose certain responsibilities on the intermediaries and make non-compliance punishable. These regulations also apply to cybercafes.

Note 3:

- This section provides for blocking of websites in any case where prevention of a “cognizable offense” is intended. This can take care of blocking of websites that may host pornographic content, which is an offense under Sections 67, 67A and 67B of ITA 2008.

There is a serious concern that the powers under these sections (see Table 6.8) may be misused. To possibly prevent that, there is a need to set up an agency called *Netizen's Rights Commission* on the lines of the Human Rights Commission, which should have powers to receive complaints, investigate and recommend prosecution of abuse of the powers under Sections 69, 69A and 69B (refer to Table 6.7).

In the event any State Government would like to take up powers under these sections and also provide the benefits of the powers to the police, it would be advisable for the State Government to set up a "State Netizen's Rights Commission"^[15] and appoint the police to take up the scrutiny of the commission or set up a separate non-police agency such as a *State Cybersecurity Authority* and then vest the powers in such an authority. In the meantime, if the Central Government also notifies an agency for the purpose of exercising the authority under Sections 69, 69A and 69B and provides it with national jurisdiction across the country, then there may be a conflict of jurisdiction such as what we today have between the state police and the Central Bureau of Investigation (CBI).

The expectation is that the Indian Computer Emergency Team referred to under Section 70B of ITA 2008 may itself be designated as the agency of the Central Government with a national jurisdiction and Computer Emergency Response Team (CERT). (CERT India is the apex authority in India for cybersafety.) Considering that there are thousands of cybercafes all over India, in the event a central agency takes up the responsibility for monitoring cybercafes, there may be a need for an "All India Cyber Cafe Monitoring Authority" exclusively to meet the requirements of cybercafe regulations. Cybercafes must be now "more than ever" vigilant about security breaches since the protection they could claim under Section 79 has been largely made irrelevant as 79(2C) makes the protection subject to following of "due diligence."

With the security practices to be notified under Sections 69, 69A and 69B, the requirement of "due diligence" would be satisfied only if these security practices are maintained. It would, therefore, be necessary for cybercafes to undergo a *Cyber Law Compliance Audit* for fulfilling the specific requirements under these sections. In that case, if the government does not come out with any security practices guidelines for cybercafes, then also the due diligence requirements have to take into account the expectations under these sections. Either way there is a tough road ahead for cybercafes. At the same time, the police at the state level would be looking for clarification on whether they have the authority under Sections 69, 69A and 69B to regulate the cybercafes. They, however, continue to enjoy some powers under Section 80 with which they can still try to regulate cybercafes.

6.8.3 State Government Powers Impacted by the Amendments to the Indian IT Act

Indian States' legislative administration plays a crucial role in the implementation of the legislations along with the jurisdiction system and police. In this section we explain how the year 2008 amendments to the Indian Act have impacted the powers of the State Government in India. Around 45 amendments have been made to the original Act. It is said that with the passage of ITA 2008 (Amended ITA 2000), the role of State Governments in cyber regulations has undergone a significant change. Let us understand how this has happened.

Section 90 of the India ITA 2000 (Power of State Government to Make Rules) empowers State Government to make *rules* for the purpose of implementing the provisions of the Act assuming new meaning under ITA 2008. In ITA 2000, the section referred to powers required to be exercised under "Section 6" and Section 6 was in relation to E-Governance requirements such as filing of forms, granting of licenses, receipt of money, etc. There were not many other powers conferred on the State Government. Hence, *it could be interpreted that the powers of the state government were intended to be used only for giving effect to Section 6 and perhaps sections relating to the powers of the police.*

Although under ITA 2008, *no change has been made to Section 90*, the words “*...without prejudice to the generality of the foregoing power.*” used in Section 90(2) assume a greater meaning now since ITA 2008 envisages a lot more responsibilities and powers to State Government under the amended provisions. It is now no longer easy to restrict this section to only “Section 6” as it appeared appropriate in the earlier version. Now there are several more sections of ITA 2008 where State Government needs to exercise its powers.

Section 6A is regarding “delivery of services by service providers.” This section is one among the other sections under ITA 2008 that necessitates exercise of power by state. The provisions of Section 7A regarding *audit of E-documents* also apply to the State Governments and hence rules need to be framed for this purpose as well. Section 10 is another section under which rules are to be notified for *use of digital signatures or other approved forms of electronic signatures*, if any. Section 43A defines the liability of *body corporates* with regard to handling of “sensitive personal information” and makes a reference to “*reasonable security practices and procedures specified in any law for the time being in force.*” Owing to the definition of *law* that includes state laws and ordinances, it is possible for State Governments to define reasonable security practices for any class of users such as “cybercafes,” “hotels,” “educational institutions” or even “households.”

As for the *cybercafe regulations*, there is, however, a conflict in Section 67C where the Central Government alone has been vested with the powers to preserve and retain information in a particular manner and format for a specified duration. This is likely to have impact on cyberforensics investigation delays. Presently, some of the *State regulations on cybercafes* already specify such information and hence the State Governments need to review the present notifications and modify them in accordance with the ITA 2008.

Sections 69, 69A and 69B are of crucial importance because they provide powers to State Governments as well as to the Central Government regarding the following:

1. Appointing an officer or agency of the government specially authorized to intercept, monitor, decrypt, block access to any content, collect traffic data or information generated, transmitted, received or stored in any computer resource;
2. notifying procedures and safeguards for exercising the powers as indicated in the above paragraph;
3. defining the term *traffic data*.

Actually, the State Government can consider declaring any officer of the police department as an officer for the purpose of these sections. However, at different places, the Act has mentioned the “powers of the police where relevant” and has used the words “any officer” in Section 69 (Directions of Controller to a Subscriber to Extend Facilities to Decrypt Information) as well as in Sections 27, 28 and 46. The Act has also used the words “any agency of the government” in Sections 69A and 69B. This could perhaps be the intention of the legislature to not vest the powers (under Sections 69, 69A and 69B) with the police either at the state level or with CBI or the National Investigating Agency at the Central level. As a result of this, the State Government has to determine and notify which officer or agency would be entrusted with the responsibilities envisaged under these three sections (Sections 67, 69 and 90) and the procedures, safeguards, etc. to be associated with such appointment.

Under the modified Section 70, the appropriate government can declare any “facility of critical information infrastructure” as a “protected system.” The State Government has to frame rules and procedures to identify such systems, authorize appropriate persons in writing, how they are to be accessed, etc.

There is one more impact of ITA 2000: under Section 78 of ITA 2008, now *inspectors will be authorized to investigate cases* falling under the Act, instead of the DSPs. State governments, which had presently set up cybercrime police stations and cybercrime cells with statewide jurisdiction, need to review the system and consider if there is the need to declare more number of police stations as “cybercrime police stations.” This is especially so since the number of offenses falling under ITA 2008 are expected to outnumber those in the case of ITA 2000. Very importantly, under Section 79A, the Central Government may designate any

department, body or agency of the Central Government or State Government as "examiner of electronic evidence." The State Government may have to, therefore, identify and recommend which state-level agency can be notified for this purpose. The net result is that State Governments will be exercising far more powers under the ITA 2008 than what was envisaged under ITA 2000. The powers also need to be accompanied by several definitions, procedures, safeguards, appointment of agencies, etc.

So a few key points to note are – under these amendments, the Indian Government is now allowed to "intercept messages" from mobile phones, computers and other communication devices to investigate any offense. Recall the recent furore in India about the RIM BlackBerry security matters that were flashed in the newspapers. It is not just about cognizable offense, the kind you witnessed in Mumbai 11/26 – it is about any offense. Also, to be able to effectively formulate a strategy for the State Governments, it requires to constitute an advisory body of experts which may be called the *Cyberlaw Advisory Group* so that detailed action plan can be drawn up for the systematic investigation of cyber-crime which is looming up as the new menace for the country. We can conclude that the ITA 2008 brings considerable amount of empowerment to the State Governments in India for the implementation of cybersecurity legislation.

6.8.4 Impact of IT Act Amendments on Information Technology Organizations

We discussed the powers that can be awarded to the State Governments in India. Now let us understand how the IT Act Amendments are going to impact the IT companies in India. There is a considerable amount of anxiety in the market today – IT and IT-enabled services (ITES) companies in India are keenly watching the amendments passed on by the Parliament in December 2008 to the 8-year-old ITA 2000. Some IT companies in India seem to be satisfied with the amendments. The impression is that ITA 2008 has, in a way, tried to address the demand for "data protection." It has been India's woo that there is no specific law on data protection. India is considered as one of the popular outsourcing destinations in the business process outsourcing (BPO) business zone. The reaction of the Indian IT and ITES companies is important from this perspective. Recall the discussion in Section 6.6 of this chapter.

The original ITA 2000 did provide that *data vandalism* would be *treated as an offense* under Section 66 of the Act with 3 year's imprisonment and eligible for claiming compensation of up to ₹ 1 crore (₹ 1,00,00,000) under Section 43. However, there was no specific indication that this was a measure to protect data in the hands of BPOs. Many in the industry were of the opinion that there are no data protection laws in India. In authors' opinion, this is a fairly valid point.

Although the government introduced a separate bill called *Personal Data Protection Act 2006*^[16] to meet this demand, the bill is still pending in the parliament and is likely to lapse. ITA 2008 has tried to address the demand of the IT industry by specifically introducing two sections, namely, *Section 43A* and *Section 72A*, which specify that they are *measures toward data protection*. This may make the Personal Data Protection Act 2006 redundant and superfluous at least to the extent of punishing breaches in data protection responsibilities of BPOs.

The fact that *India does not have a separate "Privacy Protection Law"* means there is no law so far to guarantee Indian Citizens' right to protect their privacy except for the constitutional rights. "Privacy" has multiple dimensions: *informational, personal, communicational* and *territorial* and we are discussing here the "personal" dimension of privacy. The problem in this regard is that there is no definition of what is *sensitive personal information* and also there is no authority such as the *Data Commissioner* (unlike other countries, e.g., Canada) to whom complaints can be addressed by a data privacy victim. There is also no obligation for countries other than India to whom India sends sensitive personal information for

processing to have an acceptable data protection mechanism, etc.^[17] It is not adequate to simply declare compensation for offense related to data protection. These were already there in law and ITA 2008 may make it little more clarified and little more stringent. Now let us understand if the ITA 2008 has got provisions that can be considered cardinal for "privacy protection." See sections of the ITA 2008 that are presented in Table 6.9.

Table 6.9 | ITA 2008 and Indian IT and ITES companies

| <i>ITA 2008 Section and Title</i> | <i>What it States</i> | <i>Explanation for the Discussion in this Section</i> |
|---|---|--|
| <i>Section 43A: Compensation for failure to protect data</i> | Where a body corporate, possessing, dealing or handling any sensitive personal data or information in a computer resource which it owns, controls or operates, is negligent in implementing and maintaining reasonable security practices and procedures and thereby causes wrongful loss or wrongful gain to any person, such body corporate shall be liable to pay damages by way of compensation, to the person so affected. | <ol style="list-style-type: none"> 1. "Body corporate" means any company and includes a firm, sole proprietorship or other association of individuals engaged in commercial or professional activities. 2. "Reasonable security practices and procedures" means security practices and procedures designed to protect such information from unauthorized access, damage, use, modification, disclosure or impairment, as may be specified in an agreement between the parties or as may be specified in any law for the time being in force and in the absence of such agreement or any law, such reasonable security practices and procedures, as may be prescribed by the Central Government in consultation with such professional bodies or associations as it may deem fit. 3. "Sensitive personal data or information" means such personal information as may be prescribed by the Central Government in consultation with such professional bodies or associations as it may deem fit. |
| <i>Section 72A: Punishment for Disclosure of information in breach of lawful contract</i> | <p>Save as otherwise provided in this Act or any other law for the time being in force</p> <ul style="list-style-type: none"> • any person including an intermediary who • while providing services under the terms of lawful contract • has secured access to any material containing personal information about another person • with the intent to cause or knowing that he is likely to cause wrongful loss or wrongful gain • discloses | |

(Continued)

Table 6.9 | (Continued)

| <i>ITA 2008 Section and Title</i> | <i>What it States</i> | <i>Explanation for the Discussion in this Section</i> |
|---|---|---|
| Section 67C: Preservation and Retention of information by intermediaries | <ul style="list-style-type: none"> • without the consent of the person concerned, or in breach of a lawful contract • such material to any other person • shall be punished with imprisonment for a term which may extend to 3 years, or with a fine which may extend to 5 lakh rupees (₹ 500,000), or with both <p>The section states that:</p> <ul style="list-style-type: none"> • Intermediary shall preserve and retain such information as may be specified for such duration and in such manner and format as the Central Government may prescribe. • Any intermediary who intentionally or knowingly contravenes the provisions of subsection (1) shall be punished with an imprisonment for a term that may extend to 3 years and shall also be liable to fine. | An intermediary is also a member of the IT industry and the definition in Section 2(w) is wide enough to include many service providers. The definition states: <ul style="list-style-type: none"> • “Intermediary” with regard to any particular electronic records, means • any person who on behalf of another person receives, stores or transmits that record or provides any service with regard to that record and • includes telecom service providers, network service providers, Internet service providers, web hosting service providers, search engines, online payment sites, online-auction sites, online market places and cybercafes. |
| Section 69: Powers to issue directions for interception or monitoring or decryption of any information through any computer resource | <ul style="list-style-type: none"> • Where the Central Government or a State Government or any of its officer specially authorized by the Central Government or the State Government, as the case may be, in this behalf may, if satisfied that it is necessary or expedient to do so in the interest of the sovereignty or integrity of India, defense of India, security of the State, friendly relations with foreign States or public order or for preventing incitement to the commission of any cognizable offence relating to above or for investigation of any offence, it may, subject to the provisions of subsection (2), for reasons to be recorded in writing, by order, direct any agency of the appropriate Government to intercept, monitor or decrypt or | |

(Continued)

Table 6.9 | (Continued)

| <i>ITA 2008 Section and Title</i> | <i>What it States</i> | <i>Explanation for the Discussion in this Section</i> |
|---|--|---|
| Section 69A: <i>Power to issue directions for blocking for public access of any information through any computer resource</i> | <p>cause to be intercepted or monitored or decrypted any information transmitted received or stored through any computer resource.</p> <ul style="list-style-type: none"> • The procedure and safeguards subject to which such interception or monitoring or decryption may be carried out, shall be such as may be prescribed. • The subscriber or intermediary or any person in charge of the computer resource shall, when called upon by any agency which has been directed under subsection (1), extend all facilities and technical assistance to: <ul style="list-style-type: none"> • Provide access to or secure access to the computer resource generating, transmitting, receiving or storing such information; or • intercept or monitor or decrypt the information, as the case may be; or • provide information stored in computer resource. • The subscriber or intermediary or any person who fails to assist the agency referred to in subsection (3) shall be punished with an imprisonment for a term that may extend to 7 years and shall also be liable to fine. • Where the Central Government or any of its officer specially authorized by it in this behalf is satisfied that it is necessary or expedient to do so in the interest of sovereignty and integrity of India, defense of India, security of the State, friendly relations with foreign states or public order or for preventing incitement to the commission of any cognizable offense relating to above, it may subject to the provisions of sub-sections (2) for reasons to be recorded in writing, by order direct any agency of the Government or intermediary to block access by the public or cause to | |
| | | (Continued) |

Table 6.9 | (Continued)

| <i>ITA 2008 Section and Title</i> | <i>What it States</i> | <i>Explanation for the Discussion in this Section</i> |
|---|---|--|
| Section 69B: <i>Power to authorize to monitor and collect traffic data or information through any computer resource for Cybersecurity</i> | <p>be blocked for access by public any information generated, transmitted, received, stored or hosted in any computer resource.</p> <ul style="list-style-type: none"> • The procedure and safeguards subject to which such blocking for access by the public may be carried out shall be such as may be prescribed. • The intermediary who fails to comply with the direction issued under subsection (1) shall be punished with an imprisonment for a term which may extend to 7 years and also be liable to fine. • The Central Government may, to enhance Cybersecurity and for identification, analysis and prevention of any intrusion or spread of computer contaminant in the country, by notification in the Official Gazette, authorize any agency of the Government to monitor and collect traffic data or information generated, transmitted, received or stored in any computer resource. • The Intermediary or any person in-charge of the Computer resource shall when called upon by the agency which has been authorized under subsection (1), provide technical assistance and extend all facilities to such agency to enable online access or to secure and provide online access to the computer resource generating, transmitting, receiving or storing such traffic data or information. • The procedure and safeguards for monitoring and collecting traffic data or information, shall be such as may be prescribed. • Any intermediary who intentionally or knowingly contravenes the provisions of subsection (2) shall be punished with an imprisonment for a term which may extend to 3 years and shall also be liable to fine. | <p>• “Computer Contaminant” shall have the meaning assigned to it in Section 43;</p> <p>• “traffic data” means any data identifying or purporting to identify any person, computer system or computer network or location to or from which the communication is or may be transmitted and includes communications origin, destination, route, time, date, size, duration or type of underlying service or any other information.</p> |

Observations with Regard to Section 43A

There are a few observations on Section 43A of the IT Act.

1. The limit for compensation, which was ₹ 1 crore (₹ 1,00,00,000) under Section 43 of ITA 2000 has been removed. In other words, there is no upper limit for damages that can be claimed.
2. The government is expected to define *sensitive personal information* and it is the responsibility of *body corporates* to ensure that reasonable security practices are followed.
3. The definition of *reasonable security practice* is to be determined as explained below.
 - As defined in a mutual contract between the vendor and the processor of data or a data subject and the data processor.
 - As specified in any law for the time being in force.
 - To be specified by the Central Government in consultation with such professional bodies or associations as it may deem fit.

Adherence to *contractual commitments* is a crucial aspect of service delivery. Therefore, the IT and ITES industry should first carefully examine the Service Level Agreements (SLAs) they have contractually committed to their customers. If the contract signed with the end customer or the document of understanding (DoU) signed with business intermediary does not mention the SLAs, then the service delivery organization should examine if there is any law directly impacting their IT Service Delivery activities. If neither is there, then the security practices to be specified by the government as a follow up of ITA 2000 would need to be followed. In the case of healthcare industry, in situations where SLA makes a mention of security practices as defined in Data Protection Act or the Health Insurance Portability and Accountability Act (HIPAA) of 1996 (along with its recent revision through HITECH – *Health Information Technology for Economic and Clinical Health Act* to strengthen the Security Safe Guard Rule – see Box 6.18) or the Graham-Leach-Bliley Act (GLBA), Payment Card Industry–Data Security Standard (PCI-DSS), etc. will take precedence over any other security practice. For greater details about *Regulatory Compliance with International Standards*, readers are advised to refer to Ref. #6, Books, Further Reading.

Box 6.18

HIPAA-HITECH – Data Protection Implications for the Healthcare Industry

HIPAA stands for Health Insurance Portability and Accountability Act and HITECH Act stands for Health Information Technology for Economic and Clinical Health Act. They both are the governing acts in the US. They significantly impact service delivered by the healthcare industry worldwide.

Today, the way healthcare business operates worldwide, there are far more agencies (apart from just the patient and his physician or surgeon) involved with whom sensitive information about patient (known as "PHI" – Protected Health Information) may exchange hands. The regulation is aimed at protecting the PHI. There are "covered entities" who are bound by the HIPAA-HITECH to protect the PHI. Typical "covered entities" in the healthcare industries are: health plan owners (provides or pays the cost of medical care), healthcare clearinghouse (agencies who route electronic data between payers and providers, e.g., billing services), healthcare provider who transmits any health information in an electronic transaction (e.g., hospitals, physicians, public health departments, group homes, home health).

The HIPAA Security Rule applies to electronic protected health information (EPHI) which is individually identifiable in an electronic form:

1. An individual's past, present or future physical or mental health information;
2. an individual's provision of healthcare or
3. past, present or future payment for provision of healthcare

Box 6.18 HIPAA-HITECH – Data Protection . . . (Continued)

The primary objective of the security rule is to protect the confidentiality, integrity and availability of EPHI when it is stored, maintained or transmitted. Under HIPAA-HITECH, covered entities must maintain reasonable and appropriate administrative, physical and technical safeguards to protect the confidentiality, integrity and availability of their EPHI against any reasonably anticipated risks.

There is also the *Privacy Rule in HIPAA*. It is with regard to the Protected Health Information (PHI). The *HIPAA Privacy Rule* applies covered entities that creates or receives health information. This rule covers the use and disclosure of health information about an individual in any format. A point to note is that the *Privacy and Security Rule* are NOT mutually exclusive. There are overlaps and interdependencies between the two rules. Both rules require appropriate and reasonable safeguards.

The IT and ITES industries may be satisfied with this clarification but they should now be concerned about the possibility of large liabilities to which they may be exposed as well as the need to follow compliance of international laws – for example, HIPAA-HITECH, GLBA, etc. mentioned previously. There is also a need to implement “Compliance Audits” to steer clear from the risk of being termed *negligent*. The judgment of what constitutes “negligence” would be left to the wisdom of the “Adjudicator” with regard to claims up to ₹ 5 crore (₹ 5,00,00,000) and a “Civil Judge” with regard to claims beyond ₹ 5 crore (₹ 5,00,00,000). The *unlimited liability* under Section 43A is good for a country that is a net exporter of data for processing. India being a predominant importer of data for processing has “unlimited liability”; however, this would be a hanging sword on the head of BPO company management. Any major calamity may result in a huge international liability that may wipe out the BPO in one single case of security breach. The wisdom of IT industry to force the government to impose a liability and responsibility on them through changes to ITA 2000 instead of voluntary code of ethics is perhaps questionable. In the IT and ITES sectors, there are many European countries with which Indian IT organizations are engaged for business delivery; such organizations are bound by the EU Clause (see Box 6.19).

Box 6.19

The EU Contract Clause – Understanding the Entities and Implications

Software businesses typically involve electronic processing of the data. In Europe, data privacy is considered to be citizens' right. For doing business with countries in the European Union (the EU), it is mandatory to sign the EU Contract Clause whenever transborder flow of information is involved; mainly personal data being imported from the EU countries. The entities to which the personal data belongs are called the *data subjects*.

The term *data subject* is very important in understanding the mandatory requirements of the EU Contract Clause. A data subject is an individual who is the subject of certain personal information. Data subjects can be multitude of people such as applicants, employees (current, former or retired), Multiple contract employees, expatriates, contractors, vendors/consultants, dependents and beneficiaries, retirement plan participants, prospective clients, consumers and customers, and investors. Data subjects could also be professionals related to the industry, patients, business contacts, service providers, agents, contractors and suppliers, market research participants, opinion leaders (influential scientists, academics, leading industry players, public officials, etc.) activists, visitors, etc.

As per EU definition “Personal data shall mean any information relating to an identified or identifiable natural person (data subject); an identifiable person is one who can be identified, directly or indirectly, in particular by reference to an identification number or to one or more factors specific to his physical,

Box 6.19 The EU Contract Clause – Understanding . . . (Continued)

physiological, mental, economic, cultural or social identity." The other important terms associated with personal data with the EU Contract gambit are: the data controller and the data processor. A data controller is commonly the natural or legal organization that alone or jointly with others determines the purposes and means of processing personal information. Determining purposes for which, and how personal information is, or is to be, processed may be the joint responsibility of two or more controllers; it does not need to be exclusive to just one. Determination is common where controllers share a pool of personal information, each processing independently of the other; for example, a number of companies accessing a centralized human resources database.

A data processor is commonly a natural or legal person that processes personal data on behalf of the controller. The origin of the EU Contract Clause is said to lie in the EU Data Protection Directive that compels member nations to enact national data protection laws harmonized with the principles of the directive (or more stringent) and to establish supervisory bodies to enforce the laws. It gives substance to and amplifies the CoE directive, especially, with regard to automated data processing.

The EU Contract Clauses have become important because under the EU Data Protection Directive, data cannot flow outside of EU if a contract is not in place in the exporting country. Both data exporter and data importer are liable to the data subject for illegal data flows. With regard to transborder flow of personal data, the following is important to note:

1. The EU Data Protection Directive requires the consent of the data subject to process their personal data in accordance with the purpose of collection. The data subject is usually an individual but can also be a corporate entity in some countries.
2. Personal data includes data such as E-Mail address, business contact details and other information attributable to an individual.
3. The data is collected and controlled under terms agreed with the data subject; for example, employment agreement, works council agreement, privacy policy, customer agreement or telephone consent.
4. The EU Data Protection Directive gives the data subject rights with regard to their data, including rights in relation to processing data offshore.
5. Local laws in Europe have implemented registration requirements for controllers and processors.
6. The data controller has responsibility to the data subject for handling of the data subject's data.
7. The data processor processes the data in accordance with the data controller's instructions.

Observations with Regard to Section 72A

Refer to Box 6.11 and key point *A Glimpse of Indian IT Act Amendment* under section "Section 72A of the Amended IT Act of India."

1. Under this section, disclosure "without consent" or "in breach of lawful contract" exposes a person including an "intermediary" to 3-year imprisonment. The offense is cognizable but bailable.
2. The disclosure should be either intentional or with knowledge that it may result in wrongful gain or loss (to somebody).
3. The subject material should contain "personal information." Note that unlike Section 43A, this section does not use the term *sensitive personal information*. Hence, "any personal information" can invoke this section if other conditions are satisfied. This applies only when the information is obtained in pursuance to a service offered.
4. Furthermore, under Section 85 (Offences by companies), the liabilities that fall on a company under this section will extend to any officer in-charge of business or director, etc. unless "due diligence" is proved.

There is one concern that arises from this section – it is regarding the use of the words such as "save as otherwise provided ... under any other law for the time being in force." This makes Section 72A subordinate to any such law, if it exists. This could be a source of nuisance litigation in the days to come. Although there

is no mention of a *grievance redressal mechanism* separately for victims of data security breaches in the form of *Data Commissioner*, the adjudication process with the Cyber Appellate Tribunal must be considered as adequate replacement. What is lacking, however, is a method of proactive regulation such as “compulsory registration of data processors” along with “de-registration as a means of penalizing a contravention.”

The need to enforce security norms for data exporters from India has not been specified. However, the extra territorial jurisdiction of this Act as per Section 75 may be interpreted as extending data protection obligations to any external party who under a contract takes up processing of data from India. There are some areas of concern for IT Companies – while the two sections (Sections 43A and 72A) directly impact IT Companies dealing with data processing, some of the following sections also have a significant impact on IT companies and could be source of irritation as well.

Observations with Regard to the EU Contract Clause

Refer to Box 6.19 to know more about the EU Contract Clause. Below are some observations with regard to the EU Contract Clause:

1. Indian data importers have some key obligations – contractual obligations, processing obligations, audit obligations as well as obligations with regard to onward transfers of personal data of data subjects to other countries with inadequate data protection.
2. European data exporter and Indian data importer are liable vis-à-vis data subject for their respective breaches.
3. Data exporter to do due diligence on Indian importer.
4. If data subject suffers damage because of Indian importer's wrong doing, data exporter who failed to use due diligence is also liable for damages.
5. Indian importer can be sued directly by a data subject. However, the data subject must first request data exporter to take action against Indian importer.
6. If data exporter fails to act within a reasonable period of time (1 month), data subject can sue Indian importer directly.

Observations with Regard to Section 67C

Here are some observations with regard to Section 67C of the IT Act:

1. We may note that this definition includes “Telecom Companies” such as AirTel or Reliance Infocomm or Tata Indicom. It includes Google, Rediff, Sify, Ebay.in, cybercafes, etc. It also includes many BPOs who operate as backoffice service providers, data centers, HR service providers, etc.
2. It is clear that a very large number of IT companies come under the scope of the Section 67C.
3. We are awaiting the notification regarding the time for which specified information needs to be preserved under this section. It could be 1 year in the minimum and 6–7 years at the outer end.

What is important to note is that any alleged non-compliance could expose the company and its executives to the penal provisions of this section as well as Section 65. As this is a “cognizable” offense, any “inspector” of police can now start questioning the CEO of a BPO if he is preserving the information, etc. Is it necessary for a police inspector to enter a BPO office and demand such information? Perhaps, this may initially happen with cybercafes. Later, it may happen at the offices of the ISPs and small portal owners. However, we never know if the larger organizations are immune to such intrusion. No discussion in ITA 2008 on privacy issues is complete without a reference to Sections 69, 69A and 69B that enable the government to exert a huge influence on the information security industry.

Although the powers which the government has gained through these three sections are justified in the context of the cybersecurity requirements, in the event appropriate safeguards are not enshrined in the rules and regulations, these three sections will become the most oppressive clauses of the new Act. To understand the reasons for coming to such conclusion, let us explore these three sections (Sections 69, 69A and 69B) in depth.

Observations with Regard to Section 69

We note the following observations with regard to Section 69 of the IT Act:

1. This section provides access to a designated agency of the Central or State Government to any information stored in any computer resource whether in a public place or in a private place, whether at home or at office with the excuse that it is required for prevention of or required for the investigation of any offense.
2. The power is not restricted to information in transit such as E-Mails but also other information that may be stored. This means that any police officer (or such other agency that may be designated under this section) under the excuse of investigating an offense (whether in the interest of national integrity or otherwise) can walk into any IT company and demand that he may intercept (access) information.
3. It is to be noted that non-cooperation by the company can result in imprisonment up to 7 years. The powers under Section 69 are oppressive enough to sit up and take notice. Sections 69A and 69B extend the powers further.

Observations with Regard to Sections 69A and 69B

The following observations with regard to Sections 69A and 69B are worth noting:

1. The two sections (refer to Table 6.9) extend the powers of interception and decryption in Section 69 to power to block access and power to demand "traffic data" from any person who is in possession of the relevant information. Refusal or non-cooperation is a cognizable offense.
2. Sections 69, 69A and 69B, therefore, provide what can be described as *brutal* powers to certain agencies.
3. It is not necessary that the designated agency under these sections should be the "police." However, it is perhaps inevitable that police will either be directly designated as the "designated agency" under this section or will be the authority that will advise action under this section to any other agency otherwise designated. (As is presently the case with CERT-In with regard to blocking of websites with obscene content.) It is possible that the proposed "nodal agency" designated under Section 70B (that is called the Indian Computer Emergency Team which position may be occupied by the CERT-IN after due notification) may be entrusted with the responsibility of implementing the powers under Sections 69, 69A and 69B. However, the nodal agency may act on the basis of recommendations received from the police since it may not have direct capability for investigations.
4. Has any IT industry representative thought about the possible misuse of these sections and what would be the consequences thereof? If not, it is time to do this so that adequate safeguards can also be simultaneously introduced. It is time to think what should be such safeguards, how they should be implemented and which agency should monitor, etc.
5. To repeat my earlier comment, in the current scenario of threats prevailing in India, perhaps it is difficult not to accept such draconian laws as necessary. However, it is the responsibility of all of us to ensure that safeguards which are expected to be in place to prevent abuse of the powers under these three sections are adequate to ensure that the draconian powers are properly reigned and any abuse is adequately punished.
6. In particular, it is absolutely necessary that any agency, vested with powers under these three sections, should be answerable to a monitoring body which should have the powers to receive complaints from the public, conduct its own investigation even against police officers involved and also

prosecute them as necessary. There should be no immunity given to such officials against being held accountable for breaches of propriety and law.

7. Such an agency should be like the "Human Rights Commission" and should be an independent body devoted to the welfare of the Netizens. It can be a new setup of a "Netizen Rights Commission" with the necessary powers. It should not simply be a judicial body with people who may not understand the technical issues involved. It must have representation of private persons of eminence who understand the technology issues and the human right violations that may arise therefrom.
8. If there are legal hurdles to create such a commission, then it is suggested that a *Netizen's Rights Advisory Board* is created in every state, which should receive complaints, investigate and give its recommendations. The recommendations may be taken up for implementation by the Human Rights Commission or the courts to provide justice to the aggrieved.
9. In case appropriate safeguards and a monitoring mechanism are not immediately setup, there is a grave danger lurking ahead for IT companies and their executives who may become pawns in the hands of law enforcement officers who know where the law pinches and is able to tickle the sensitive spots in the IT industry.

6.9 Cybercrime and Punishment

In Section 6.2 there was discussion about the cybercrime legislation around the world. We also discussed the Indian scenario with regard to the ITA 2000 and its subsequent amendments known as the ITA 2008 that is not yet enforced. It is pending because certain rules are to be framed. While of writing this section, there is a growing concern about the rise of cases committed against computers or against information on computers. The phenomenal rise in computer crime has caught attention around the world. The big question is whether cybercriminals can be punished and what types of punishments are in offering for them. In our opinion, in most countries around the world, existing laws are likely to be unenforceable against such crimes, given methods of crime adopted and tools used by cybercriminals (refer to Chapters 2 and 4, respectively). The possible lack of legal protection means that businesses and governments must rely solely on technical measures to protect themselves from those who would steal, deny access to or destroy valuable information. Also refer to Chapters 9 and 10.

The situation is certainly not comfortable because although self-protection is essential, it is not sufficient to make cyberspace a safe place to conduct business. The rule of law must also be enforced. The ability to compete in the new digital economy will be much less for countries where legal protections are inadequate. As cybercrime crosses national borders, nations perceived as havens run the risk of having their electronic messages blocked by the network. National governments should examine their current statutes to determine whether they are sufficient to combat cybercrimes (see Chapter 1). Where gaps exist, governments should draw on best practices from other countries and work closely with industry to enact enforceable legal protections against these new crimes.

Cybercriminals and cyberterrorists around the world seem to be undeterred by the prospect of arrest or prosecution as they lurk on the Net causing an omnipresent menace to the financial health of businesses, to the trust of their customers and as an emerging threat to nations' security. Headlines of cyberattacks command our attention with increasing frequency. When it comes to punishment, it is the peculiar nature of cybercrime/computer crime (as compared to other forms of crime, i.e., non-computer crime) that presents the difficulty. Cybercrimes, which are the harmful acts committed from or against a computer or network, differ from most terrestrial crimes in four ways: (a) They are easy to learn how to commit, (b) they require few resources relative to the potential damage caused, (c) they can be committed in a jurisdiction without being physically present in it and (d) they are often not clearly illegal. The other problem that comes in way of punishing cybercriminals is that the laws of most countries do not clearly prohibit

cybercrimes. Existing terrestrial laws against physical acts of trespass or breaking and entering often do not cover their “virtual” counterparts. Often police officers may not realize (although there are constant efforts by government to educate the police departments on cybercrimes) how cybercrimes are different in nature compared to the traditional forms of crimes. For example, webpages such as the E-Commerce sites hit by widespread, distributed denial-of-service attacks may not be covered by outdated laws as protected forms of property.

In such a scenario, one may ask the following question: Why punishing the cybercriminals is so difficult? Part of the reason is that effective law enforcement is complicated by the transnational nature of cyberspace. Mechanisms of cooperation across national borders to solve and prosecute crimes are complex and slow. Cybercriminals can defy the conventional jurisdictional realms of sovereign nations, originating an attack from almost any computer in the world, passing it across multiple national boundaries or designing attacks that appear to be originating from foreign sources. Such techniques dramatically increase both the technical and legal complexities of investigating and prosecuting cybercrimes.

A key point to note is that the issue of cybercrime is closely related to information security. Although several countries, particularly in Europe and Asia, were found to have addressed a number of these broader information security factors, few countries have been able to demonstrate that adequate legal measures had been taken to ensure that perpetrators of cybercrime would be held accountable for their actions.

Outdated laws and regulations, and weak enforcement mechanisms for protecting networked information, create a hostile environment from the standpoint of conducting E-Business within a country and across national boundaries. Inadequate legal protection of digital information can create barriers to its exchange and shunt the growth of E-Commerce. As E-Business expands globally, the need for strong and consistent means to protect networked information will grow. The overall picture is that substantial improvement is needed in information security. The year 2000 picture was that only a small fraction of countries needing substantial improvement indicated that progress was currently underway – refer to Fig. 6.4; it provides a categorization of the 52 countries surveyed. Figure 6.5 shows the details of laws that have been updated in each of the 19 countries with fully, substantially or partially updated laws in place.

When it comes to punishing the cybercriminals, one other problem is non-uniform treatment of crimes across the world: Crimes are not treated uniformly even in the countries that have got updated legislation for cybercrime and this creates another problem. We conclude about punishment to cybercriminals by summarizing the following key points:

1. **Reliance on terrestrial laws may not be a reliable approach:** Despite the progress being made in many countries, most countries still rely on standard terrestrial law to prosecute cybercrimes. A majority of countries are relying on archaic statutes that predate the birth of cyberspace and have not yet been tested in court.
2. **Weak penalties limit deterrence:** The weak penalties in most updated criminal statutes provide limited deterrence for crimes that can have large-scale economic and social effects.
3. **Self-protection remains the first line of defense:** The general weakness of statutes increases the importance of private sector efforts to develop and adopt strong and efficient technical solutions and management practices for information security.
4. **A global patchwork of laws creates little certainty:** Little consensus exists among countries regarding exactly which crimes need to be legislated against. In the networked world, no island is an island. Unless crimes are defined in a similar manner across jurisdictions, coordinated efforts by law enforcement officials to combat cybercrime will be complicated.
5. **A model approach is needed:** Most countries, particularly those in the developing world, are seeking a model to follow. These countries recognize the importance of banning malicious

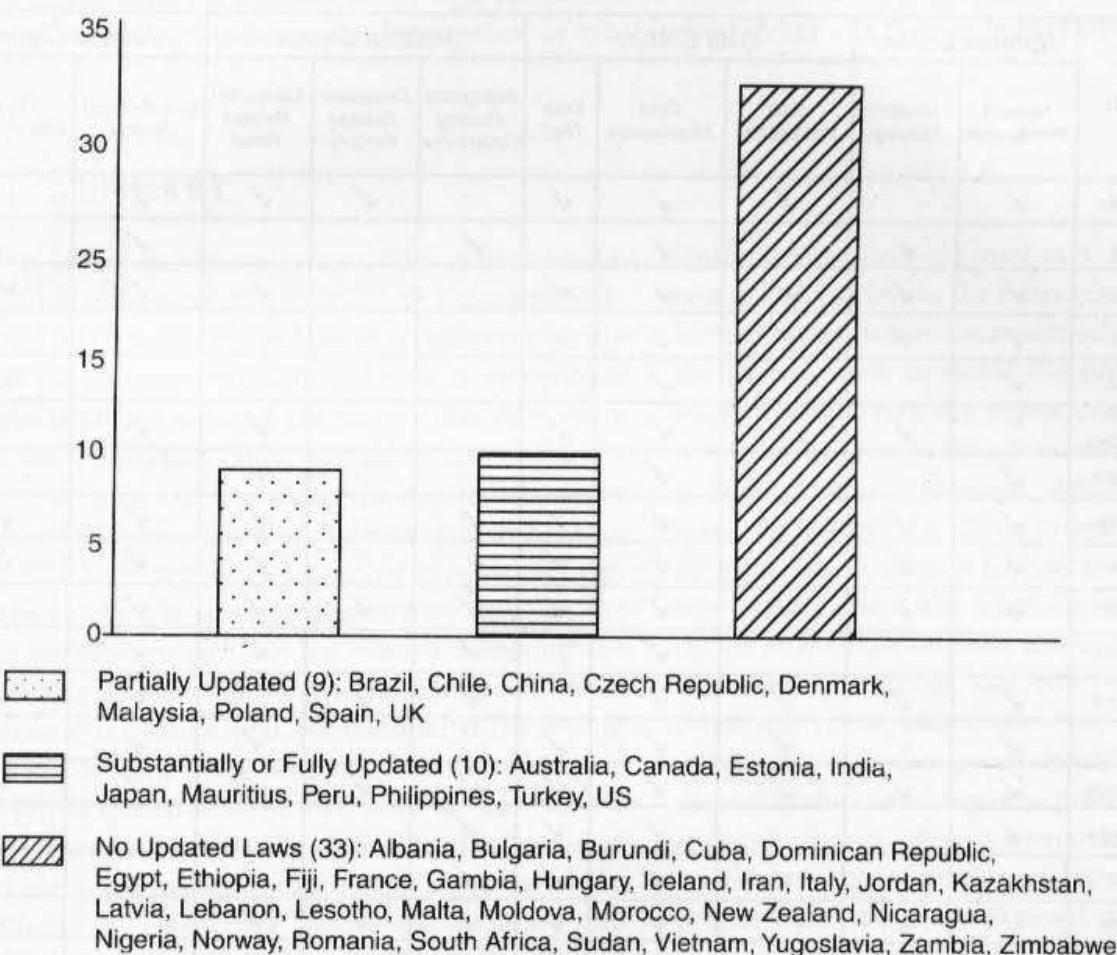


Figure 6.4 | Cybercrime laws: Extent of progress on updating.

computer-related acts in a timely manner to promote a secure environment for E-Commerce. But a few have the legal and technical resources necessary to address the complexities of adapting terrestrial criminal statutes to cyberspace. A coordinated public-private partnership to produce a model approach can help eliminate the potential danger from the inadvertent creation of cybercrime havens.

6.10 Cyberlaw, Technology and Students: Indian Scenario

Recall the discussion in Section 6.5 (Challenges to Indian Law and Cybercrime Scenario in India) in which another dimension to the problem is discussed. India has a peculiar scenario given the current educational system. Most technology students have either nil or low exposure to law and most law students have only limited exposure to information technology. A computer science stream student in a college is taught how to develop programs that can automatically transmit data across the Internet riding on a TCP/IP packet, without alerting him on cybercrimes such as hacking or virus^[18] introduction. The topic of *secure coding* is not included in most syllabi. The Law students should be taught about Trade Marks and Copyrights without recognizing their implications on the electronic documents. As a result, neither the technologist nor the lawyer is trained in his formative years to understand cyberlaw.

| Country | Network Crimes | | Data Crimes | | | Related Crimes | | | Access Crimes | |
|----------------|----------------------|------------------|-------------------|-------------------|------------|--------------------------------|--------------------------|------------------------|---------------------|---------------------|
| | Network Interference | Network Sabotage | Data Interception | Data Modification | Data Theft | Aiding and Abetting Cybercrime | Computer-Related Forgery | Computer-Related Fraud | Unauthorized Access | Virus Dissemination |
| Australia | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | |
| Brazil | | ✓ | | ✓ | | ✓ | | | ✓ | |
| Canada | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| Chile | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | |
| China | ✓ | | | ✓ | | | | | | ✓ |
| Czech Republic | | ✓ | | ✓ | ✓ | | | ✓ | ✓ | |
| Denmark | ✓ | | | ✓ | | | | ✓ | | |
| Estonia | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| India | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Japan | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Malaysia | | | | ✓ | | ✓ | | ✓ | ✓ | |
| Mauritius | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Peru | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | |
| Philippines | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Poland | ✓ | | | ✓ | ✓ | ✓ | | | | |
| Spain | | | ✓ | ✓ | ✓ | ✓ | | ✓ | | |
| Turkey | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| UK | ✓ | ✓ | | ✓ | | ✓ | | | ✓ | |
| US | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |

Figure 6.5

Countries with updated laws.

Notes:

1. Network interference: Impeding or preventing access for others.
2. Network sabotage: Modification or destruction of a network or system.
3. Data interception: Interception of data in transmission.
4. Data modification: Alteration, destruction or erasing of data.
5. Data theft: Taking or copying data, regardless of whether it is protected by other laws, for example, copyright, privacy, etc.
6. Aiding and abetting cybercrime: Enabling the commission of a cybercrime.
7. Computer-related forgery: Alteration of data with intent to represent as authentic.
8. Computer-related fraud: Alteration of data with intent to derive economic benefit from its misrepresentation.
9. Unauthorized access: Hacking or cracking to gain access to a system or data.
10. Virus dissemination: Introduction of software damaging to systems or data.

Given the strides made by India in the IT and ITES as well as BPO domains, there is a strong need for techno-legal experts to demystify cyberlaw and make it possible for a large section of the society to take up study of cyberlaw. In future, Engineering, Commerce and Management colleges need to teach cyberlaw as an extension of computer science, commerce and management education, even while the law colleges try to extend their coverage of criminal laws and IPR laws to the cyberworld. To know more on IPR issues, readers may refer to Ref. #8, Books, Further Reading. Authors firmly believe that the advent of techno-legal

specialists will bring a change in the legal perspective in the country and we can expect fresh ideas to emerge to form building blocks for the development of cyber jurisprudence as a distinct field of study.

SUMMARY

IT is a vast and complex area. The growth in the number of Internet usage fuelled by easier availability of ICT, the widespread use of computers globally and the computer-friendly and tech-savvy younger generation are some of the factors that contribute to the cybercrime. There are many dimensions to cybersecurity; one is having the required *technical expertise* whereas another dimension is to have an *effective legal regime*. Yet another dimension is to have an *effective security infrastructure* that can use the technology and the law toward achieving the objective of securing the information assets of the country. In this chapter, we considered the second dimension. The world laws on cybercrimes embrace multiple dimensions of the issue as seen in the US, Europe, Asia-Pacific and Canadian position on the legal measures taken and being taken. In Indian law, cybercrime has to be voluntary and willful, an act or omission that adversely affects a person or property. The IT Act along with its recent amendment (the ITA 2008) provides the backbone for E-Commerce and India's approach has been to look at E-Governance and E-Commerce primarily from the promotional aspects looking at the vast opportunities and the need to sensitize the population to the possibilities of the information age. It is also said to provide certain authorities and powers to the State Governments in India. However, whether India has a strong Data Protection Act still remains a moot point. There is a general agreement though that there is a strong need to take into consideration the information security aspects of India. In the present global situation where cybercontrol mechanisms are important, we need to push cyberlaws. Cybercrimes are a new class of crimes in India, rapidly expanding due to extensive use of Internet. Getting the right lead and making the right interpretation are very important in solving a cybercrime.

Until recently, many IT professionals lacked awareness of and interest in the cybercrime phenomenon. In many cases, law enforcement officers have lacked the tools needed to tackle the problem; old laws would not quite fit for digital crimes committed, new laws need to catch up to the reality of what is happening. Furthermore, debates over privacy issues do hamper the ability of enforcement agents to gather the evidence needed to prosecute these new cases. There is also a certain amount of antipathy or at the least, distrust among the trio of most important players in any effective fight against cybercrime: law enforcement agencies, common people and computer professionals who need to be abreast of the technologies to prevent/detect cybercrime. Therefore, close cooperation between these entities is crucial if we are to control the cybercrime problem and make the Internet a safe "place" for its users. Law enforcement personnel understand the criminal mindset and know the basics of gathering evidence and bringing offenders to justice. IT personnel understand computers and networks, how they work and how to track down information on them. Common people need to be aware that they can be the target of cybercriminals. Each holds the key to defeating cybercriminals with their strong determination. IT professionals need good definitions of cybercrime to know when and what to report to police, but law enforcement agencies must have statutory definitions of specific crimes to charge a criminal with an offense. The first step in specifically defining individual cybercrimes is to sort all the Acts that can be considered cybercrimes into organized categories. Given the legal legislation enactment scenario in India as well as around the world, punishing the cybercriminals is not easy. However, the discussion in this chapter was aimed at making readers aware about the legal perspective on cybercrime.

REVIEW QUESTIONS

1. Explain the concept of “trust seal.” In your own understanding, along with additional research and discussion with lawyers, explain how it helps as a mitigation for frauds in E-Commerce.
2. What is the meaning of the term “cyberlaw”?
3. What do you understand by the salient features of the Indian IT Act?
4. In your view, do 2008 amendments to the Indian IT Act address the cybercrime issues that may emanate from cybercafe? Explain.
5. What, in your opinion, is required on the legal front to seek world harmony and convergence to bring about global measures to fight the cybercrime challenges? Explain what you think are the areas that need country cooperation across the globe.
6. Quote the Indian IT Act chapters that are relevant in the discussion of cybercrime and information security.
7. Is the current law (India as well as world) adequate to prevent unlawful access to computers? Why?
8. Under the Indian IT Act, is there a legal protection available for “personal data” and “sensitive personal data”? Explain how.
9. Does India have adequate legal means to punish cybercriminals? Explain your view point.
10. Do you feel the legal landscape around the world is integrated and harmonized? Why do you think so? Explain.
11. How does the legal legislation in the Asia-Pacific region compare to that in the European Union? Explain with at least three comparative points.
12. Do you think online child safety is an issue in India? Defend your answer with examples.
13. To prevent cybercrime, how do you think the APEC framework principles as well as the Fair Information Practices (FIPs) could be applied to design a commercial website?
14. Do you think the EU legal framework is strong enough to prevent cybercrimes? Explain why you think so.
15. Do “electronic records” have the admissibility into Indian Courts? Explain why.
16. Describe the strengths and limitations of the Indian ITA 2000. Do you think the limitations/weakness are overcome by the 2008 amendments to the Act? What would be the impact, in your view, of not addressing the current weaknesses in the Indian IT Act?
17. Describe the specific challenges that exist in India with regard to the law and cybercrime scenario in India.
18. In your view, is the issue of “digital certificates” adequately addressed in the Indian IT Act? Explain why.
19. Under the current Indian law (the IT Act) what are the implications for “Certifying Authorities”?
20. Explain the powers endowed upon the State Government as the result of amendments to the Indian IT Act. Do you think that with the amendment to the Indian IT Act, the State Governments in India are better off in investigating cybercrimes emanating from the use of cybercafes? Explain why.
21. How do you think the matter of “Data Protection Law in India” stand with the introduction of the ITA 2008? Do you feel that foreign companies planning to send outsourcing work to India should feel happy with the current developments? Explain your view point.
22. What are your views on punishments for cybercriminals? Is it possible to punish them? If not, then what do you think are the deterring factors in India as well as globally?

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6. Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions about *Creating a Safer Information Society by Improving the Security of Information Infrastructures and Combating Computer-related Crime* is available at: <http://www.usdoj.gov/criminal/cybercrime/intl/EUCommunication.0101.pdf> (21 April 2009).
7. CRS Report for Congress about *Terrorist Capabilities for Cyberattack: Overview and Policy Issues* by John Rollins, Specialist in Terrorism and International Crime Foreign Affairs, Defense, and Trade Division and Clay Wilson, Specialist in Technology and National Security Foreign Affairs, Defense, and Trade Division (Updated January 22, 2007) is available at: <http://www.fas.org/sgp/crs/terror/RL33123.pdf> (3 July 2009).
8. A presentation based on the Proceedings of WSIS Thematic Meeting on Cyber security, about harmonizing National Legal Approaches on Cyber crime is available at: http://www.itu.int/osg/spu/cybersecurity/presentations/session12_schjolberg.pdf (3 March 2009).
9. For documents and links concerning digital evidence, visit: <http://www.khodges.com/digitalphoto/offtopiclinks.htm> (7 July 2009),

- 10.** *The Threat of the Cybercrime Act 2001 to Australian IT Professionals*, a paper by Nelson Chan and Simon Coronel from Department of Computer Science and Software Engineering, The University of Melbourne and Yik Chiat Ong from Faculty of Law, The University of Melbourne. –The paper can be read at: <http://www.cs.berkeley.edu/~benr/publications/auscc03/papers/chan-auscc03.pdf> (12 August 2010).
- 11.** UNCITRAL stands for United Nation's Commission on Internet Trade Law. Uncitral Model Law on Electronic Commerce with Guide to Enactment 1996 with additional article 5 bis as adopted in 1998 United Nations. The UNCITRAL document (refer to Section 6.3) can be visited at: [http://www.genghinieassociati.it/acrobat/it%20security/Leggi/UNCITRAL%20Model%20Law%20on%20Electronic%20Commerce%20\(English\).PDF](http://www.genghinieassociati.it/acrobat/it%20security/Leggi/UNCITRAL%20Model%20Law%20on%20Electronic%20Commerce%20(English).PDF) (16 August 2009).

The Appendices that serve as extended material for the topic addressed in this chapter are: A, B, D, F, J, M, O, P, Q, U, V. These are provided in companion CD.

Note: Laws and Legal/Legislative Provisions mentioned in this chapter are as they stood at the time of writing the texts in the chapter. It is readers' responsibility to refer to the updated documents to know the latest position. For the Indian IT Act, readers should refer to the books available in the market, for example, "BARE ACT."

7

Understanding Computer Forensics

Learning Objectives

After reading this chapter, you will able to:

- Understand the fundamental concepts in cyberforensics.
 - Understand the meaning of the term “cyberforensics and the need for cyberforensics.”
 - Learn what “digital evidence” means along with the base term “forensics science.”
 - Get an overview of cardinal rules of computer forensics.
 - Learn how cyberforensics is used in cybercrime investigations.
 - Understand the legal requirements for cyberforensics and compliance aspects of cyberforensics.
 - Get an overview of the role of forensics experts.
 - Understand the “data privacy issues” involved in cyberforensics.
 - Learn about forensic auditing.
 - Learn about cyberforensic tool available in the market.
 - Understand the challenges faced in cyberforensics.
-

7.1 Introduction

The purpose of this chapter is to address the other side of crime, that is, use of forensic techniques in the investigation of cybercrimes. “Cyberforensics” is a very large domain and addressing it in a single chapter is indeed a challenge. Complex technical aspects involved in digital forensics/computer forensics are not possible to cover in a single chapter. Therefore, this chapter is aimed at only providing a broad understanding about cyberforensics.

The term “chain of custody” has a recurring mention in this chapter because it is a central concept in forensics. We have provided a large number of information resources including several video clips on digital forensics investigation (some demonstrations too), reviews of forensics tools as well as interviews with experts. We recommend readers to visit those links in Video Clips, Further Reading. The discussion in this chapter will serve as background for Chapter 8 where hand-held forensics is addressed. The terms “cyberforensics,” “digital forensics” and “computer forensics” are used interchangeably. Definitions of these terms are provided.

Cyberforensics plays a key role in investigation of cybercrime. “Evidence” in the case of “cyberoffenses” is extremely important from legal perspective. There are legal aspects involved in the investigation as well as handling of the digital forensics evidence. Only the technically trained and experienced experts should be involved in the forensics activities.

The requirements for setting up a digital forensics laboratory are explained in Section 7.11. Toward the end, a ready reckoner of cyberforensics tools is provided in a tabular form for readers' convenience (Tables 7.9, 7.10 and 7.11). Considering the widespread use of hand-held devices [personal digital assistants (PDAs), mobile phones and all its varieties as well as the iPods, etc.], we have addressed the forensics of hand-held devices in the next chapter. Some special topics such as "use of data mining in cyberforensics," "forensics auditing" and "antiforensics" are also discussed in this chapter. Case studies on digital forensics investigations are presented in Chapter 11 (in CD). With this background, let us proceed to understand the historical background.

7.2 Historical Background of Cyberforensics

The different types of cybercrimes are explained in Chapter 1. Computer is either the subject or the object of cybercrimes or is used as a tool to commit a cybercrime. The earliest recorded computer crimes occurred in 1969 and 1970 when student protestors burned computers at various universities. Around the same time, people were discovering methods for gaining unauthorized access to large-time shared computers. Computer intrusion and fraud committed with the help of computers were the first crimes to be widely recognized as a new type of crime.



The Florida Computer Crimes Act was the first computer crime law to address computer fraud and intrusion. It was enacted in Florida in 1978. [Mentioned in Chapter 6, (Box 6.6 in Chapter 6).]

The application of computer for investigating computer-based crime has led to development of a new field called *computer forensics*. Sometimes, computer forensics is also referred to as "digital forensics." Computer forensics/digital forensics has existed for as long as people have stored data inside computers.



"Forensics evidence" is important in the investigation of cybercrimes.

Discussion on the legal side of cybercrime (see Chapter 6) serves as a link to this chapter through the term "evidence," "digital evidence" in particular. Basically, computer forensics experts need digital evidence in cases involving data acquisition, preservation, recovery, analysis and reporting, intellectual property theft, computer misuse (recall the discussion in Chapter 6 about the Indian IT Act – Tables 6.6, 6.7 and 6.8), corporate policy violation, mobile device (PDA, cell phone) data acquisition and analysis, malicious software/application, system intrusion and compromise, encrypted, deleted and hidden files recovery, pornography, confidential information leakage, etc.

Computer forensics is still a relatively new discipline in the domain of computer security. It is a rapidly growing discipline and a fast growing profession as well as business. The focus of computer forensics is to find out digital evidence – such evidence required to establish whether or not a fraud or a crime has been conducted. There is a difference between computer security and computer forensics. Although "computer forensics" is often associated with "computer security," the two are different.



Computer forensics is primarily concerned with the systematic "identification," "acquisition," "preservation" and "analysis" of digital evidence, typically after an unauthorized access to computer or unauthorized use of computer has taken place; while the main focus of "computer security" is the prevention of unauthorized access to computer systems as well as maintaining "confidentiality," "integrity" and "availability" of computer systems.

Information security aspects are explained in detail in Ref. #14, Books, Further Reading. Thus, the goal of computer forensics is to perform a structured investigation on a digital system. For those who are reading this chapter directly before visiting Chapter 1, computer crime is any criminal offense, activity or issue that involves computers.



There are two categories of computer crime: one is the criminal activity that involves using a computer to commit a crime, and the other is a criminal activity that has a computer as a target.

Information security experts consider "cyberlaw compliance" as one of the many aspects of "techno-legal information security." They advise organizations to formulate an appropriate plan of action to comply with cyberlaws as a part of the IS practice. This association of cyberlaw into the information security domain has gained additional importance due to some amendments that have been made to ITA 2000. Typical types of data requested for a digital forensics examination by the law enforcement agencies include: investigation into electronic mail (E-Mail) usage, website history, cell phone usage, cellular and Voice over Internet Protocol (VoIP) phone usage, file activity history, file creation or deletion, chat history, account login/logout records and more. Therefore, it becomes necessary to address the legal issues involved in cyberforensics. This is addressed in Section 7.16.2. Tables 7.9, 7.10 and 7.11 provide the list of forensic tools available in the market. URLs are also provided in Refs. #15, #16, #17 and #18, Additional Useful Web References, Further Reading with information about various laws/statutes pertaining to cybercrime. This information would be particularly useful for cyberlaw students.



Forensics means a "characteristic of evidence" that satisfies its suitability for admission as fact and its ability to persuade based upon proof (or high statistical confidence level).

In precise terms, "forensics science" is the application of science to law and it is ultimately defined by use in court. Forensics science is the application of physical sciences to law in search for truth in civil, criminal and social behavioral matters to the end that injustice shall not be done to any member of society. An alternative definition for digital forensics science is:

the use of scientifically derived and proven methods toward the preservation, collection, validation, identification, analysis, interpretation, documentation and presentation of digital evidence derived from digital sources for the purpose of facilitating or furthering the reconstruction of events found to be criminal, or helping to anticipate unauthorized actions shown to be disruptive to planned operations.



The goal of digital forensics is to determine the “evidential value” of crime scene and related evidence.

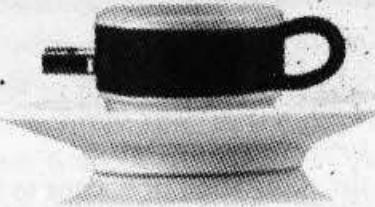
The roles and contributions of the digital forensics/computer forensics experts are almost parallel to those involved as forensics scientists in other crimes, namely, analysis of evidence, provision of expert testimony, furnishing training in the proper recognition, and collection and preservation of the evidence. Now, let us understand the term “digital forensics science.”

7.3 Digital Forensics Science

Digital forensics is the application of analyses techniques to the reliable and unbiased collection, analysis, interpretation and presentation of digital evidence. There is a number of slightly varying definitions. The term *computer forensics*, however, is generally considered to be related to the use of analytical and investigative techniques to identify, collect, examine and preserve evidence/information which is *magnetically stored or encoded*. The objective of “cyberforensics” is to provide digital evidence of a specific or general activity. Following are two more definitions worth considering:

1. **Computer forensics:** It is the *lawful and ethical seizure, acquisition, analysis, reporting and safeguarding of data and metadata derived from digital devices which may contain information* that is notable and perhaps of evidentiary value to the trier of fact in managerial, administrative, civil and criminal investigations. In other words, it is the collection of techniques and tools used to find evidence in a computer.
2. **Digital forensics:** It is the use of *scientifically derived and proven methods* toward the *preservation, collection, validation, identification, analysis, interpretation, documentation and presentation of digital evidence* derived from digital sources for the purpose of facilitation or furthering the reconstruction of events found to be criminal, or helping to anticipate unauthorized actions shown to be disruptive to planned operations.

Box 7.1 COFEE Time!



Computer Online Forensics Evidence Extractor (COFEE) is a USB thumb-drive gadget onto which Microsoft have loaded 150+ “commands” that can, among other things, decrypt passwords, display Internet activity and uncover all data stored on the computer. This interestingly named tool was developed by Anthony Fung, a former Hong Kong police officer now working as a senior investigator on Microsoft’s Internet Safety Enforcement Team. Microsoft’s intent behind creation of COFEE has been exclusively for use by law enforcement agencies. It is believed that while creating the design of this tool, Microsoft perhaps did not take into consideration the feedback about problems faced by law enforcement agencies worldwide. During their ongoing fights against a variety of cybercrimes, law enforcement agencies around the world face some common challenges.

Box 7.1 COFEE . . . (Continued)

Law enforcement professionals need to capture critical evidence on a computer at the scene of an investigation before the evidence is powered down and removed for forensics analysis. Digital evidences, when "live" (e.g., active system processes and network data), must be handled with care because the "live" evidence is volatile. There is always the risk of "volatile evidence" getting lost when the computer is turned off. Therefore, the challenge is how does an officer on the scene effectively do this if he/she is not a trained computer forensics expert?

COFEE helps the law enforcement agencies even when there are no on-the-scene computer forensics capabilities. It enables them to collect live "volatile evidence" more easily, reliably and cost-effectively. Even a law enforcement officer with minimal computer experience, once he/she is taken through the tool tutorial, can use a preconfigured COFEE device. The officer can take advantage of the same common digital forensics tools as used by experts to gather volatile evidence that can prove critical for the investigation. The officer can undertake investigation tasks by simply inserting a USB device into the computer.

On-the-scene, agents can run more than 150 commands on a live computer system. COFEE tool also provides reports in simple format that are easy for later interpretation. These reports can be used by experts and can also be used as supportive evidence for subsequent investigation and prosecution. The COFEE tool and its underlying framework can be tailored to effectively meet the needs of a particular investigation, that is, it can be fully customized. On the lighter side, one wonders if there will also be Total Evidence Analyzer (TEA) soon.

More information on the COFEE^[1] tool can be obtained by visiting the links provided in References. We have provided a link in Ref. #2, Video Clips, Further Reading, where a computer forensics expert explains how digital evidence is seized as part of forensics investigation.

It is difficult to provide a precise definition of "digital evidence" because the evidence is recovered from devices that are not traditionally considered to be computers. Some researchers prefer to expand the definition by including the "collection" and "examination" of all forms of digital data, including the data found in cell phones, PDAs, iPods and other electronic devices. In general, the role of digital forensics is to:

1. Uncover and document evidence and leads.
2. Corroborate evidence discovered in other ways (E-Discovery – see Box 7.3).
3. Assist in showing a pattern of events (data mining has an application here).
4. Connect attack and victim computers (Locard's Exchange Principle – see Box 7.5).
5. Reveal an end-to-end path of events leading to a compromise attempt, successful or not.
6. Extract data that may be hidden, deleted or otherwise not directly available.

The typical scenarios involved are:

1. Employee Internet abuse – more about this is mentioned in Chapter 9;
2. data leak/data breach – unauthorized disclosure of corporate information and data (accidental and intentional);
3. industrial espionage (corporate "spying" activities);
4. damage assessment (following an incident);
5. criminal fraud and deception cases;
6. criminal cases (many criminals simply store information on computers, intentionally or unwittingly) and countless others;
7. copyright violation – more about this is mentioned in Chapter 10 (in CD).

Figure 7.1 shows the kind of data you "see" using forensics tools.

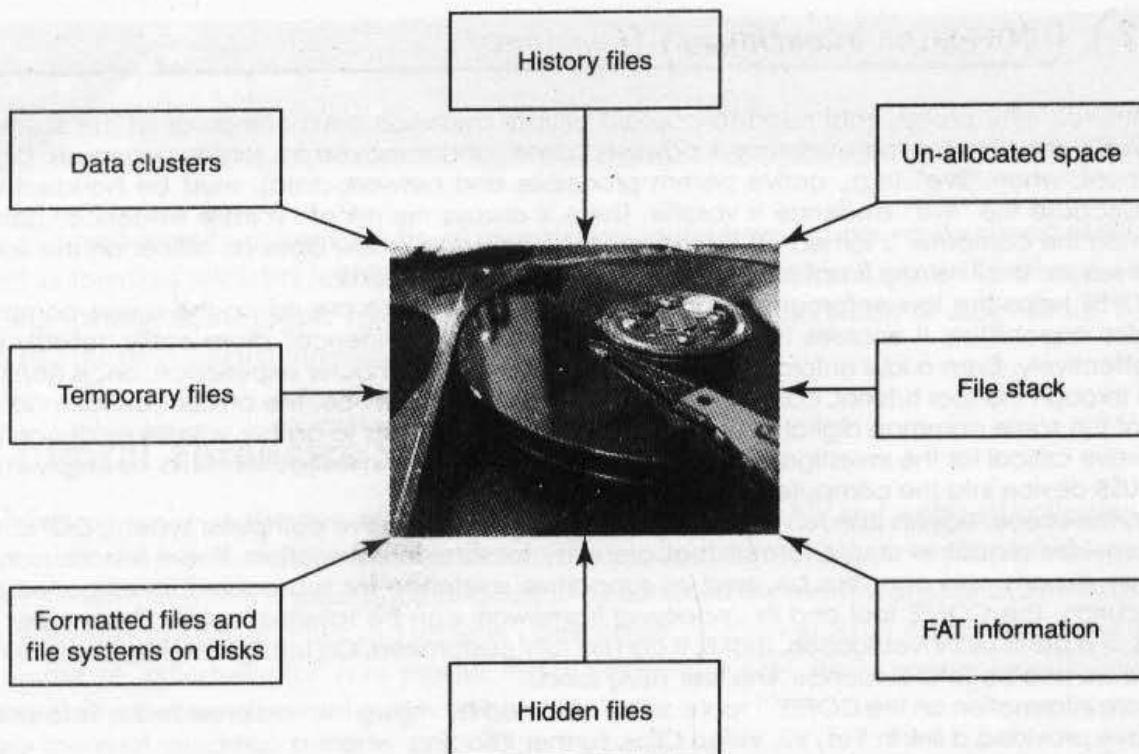


Figure 7.1 | Data seen using forensics tools. FAT means file allocation table.

Using digital forensics techniques, one can:

1. Corroborate and clarify evidence otherwise discovered.
2. Generate investigative leads for follow-up and verification in other ways.
3. Provide help to verify an intrusion hypothesis.
4. Eliminate incorrect assumptions.

Box 7.2 Differences between Forensics Policy and Security Policy

Often people get confused between "forensics policy" and "security policy." They think that the meaning of two terms is the same; however, this is not true. Security policy is a statement that clearly specifies the allowed and disallowed elements with regard to security. It partitions the system states into "secure" and "unauthorized" security policy that helps implement mechanisms to enforce system security policy. On the other hand, forensics policy is a statement that clearly states which assets are forensically important. It also specifies data needed for investigation into breach of those assets.

Forensics policy partitions space of all possible breaches or criminal activity into sets of events that are forensically noteworthy and those that are not. It allows for mechanisms or design decisions to enforce the policy. Here is another way to understand the difference between security policy and forensics policy – violation of security policy leads to insecure information systems/application with vulnerabilities arising due to consequences of break-in or insider misuse. On the other hand, violation of forensics policy means lack of evidence which results in the loss of ability of an organization to prove guilty the people who are involved in cybercrime incidence.

The "goals" defined by forensics policies are different than those defined by security policies. Goals of forensics policies deal with assets, data and possible storage issues. They capture digital evidence; therefore, forensics integrity of data is preserved. They capture enough data to ensure

Box 7.2 Differences between . . . (Continued)

that prosecution is possible. Forensics policy goals specify events that must be handled and data that must be preserved. Events not included in the policy will not need associated data. Here is an example of forensics policy:

1. Goal is to capture data from network intrusions for possible prosecution.
2. This (forensics) policy states that all events identified as intrusions will have their associated data captured and preserved.
3. Enforcement mechanisms: routine preservation of IDS, firewall, router and web server logs for some configurable length of time.

Here is another example of organizational level operating rules derived from an organization's forensics policy:

1. All access to Oracle DB must be monitored.
2. Access logs and administration logs to Oracle DB will be preserved for no less than 1 year.
3. Access and activity to web server is monitored.
4. Apache web server logs will be preserved for 1 year/6 months.
5. Firewall and Snort logs will be preserved for 1 year.
6. Router logs will be preserved for 6 months.
7. Network will be tested every 6 months for congestion situation by overloading it until it begins to drop traffic.
8. Network capacity will be increased before traffic hits the level where packets will be dropped.

7.4 The Need for Computer Forensics

The convergence of Information and Communications Technology (ICT) advances and the pervasive use of computers worldwide together have brought about many advantages to mankind. At the same time, this tremendously high technical capacity of modern computers/computing devices provides avenues for misuse as well as opportunities for committing crime. This has lead to new risks for computer users and also increased opportunities for social harm. The users, businesses and organizations worldwide have to live with a constant threat from hackers who use a variety of techniques and tools to break into computer systems, steal information, change data and cause havoc. The topic of "threats to information systems" is thoroughly discussed in Ref. #12, Books, Further Reading. The widespread use of computer forensics is the result of two factors: the increasing dependence of law enforcement on digital evidence and the ubiquity of computers that followed from the microcomputer revolution.

Box 7.3 Digital Forensics Investigations and E-Discovery

Digital evidence plays a crucial role in the threat management life cycle, from incident response to high-stakes corporate litigation. Forensics discoveries provide the ability to search and analyze various pieces of potential evidence of electronic nature. Evidence can involve computer hard drives, portable storage, floppy diskettes, portable music players and PDAs, just to name a few.

All forms of evidence are verified and duplicated prior to investigation to ensure the integrity of the evidence for litigation purposes if needed. Managers who are responsible for litigation tend to take help from forensics professionals to solve a growing range of evidentiary and investigative challenges.

Key evidence often resides on more than a user hard drive or file server, requiring the capture and analysis of evidence from enterprise productivity servers, network logs or proprietary databases.

Box 7.3 \ Digital Forensics . . . (Continued)

Many threats arise from illegal Internet activities that extend beyond the firewall and require new investigative and forensics approaches. Users are becoming more sophisticated and so are their efforts to circumvent security policies or encrypt, delete or destroy digital evidence. Forensics professionals need supporting solution for the acquisition, management and analysis of digital evidence. Such computer forensics services include the following:

1. Data culling and targeting;
2. discovery/subpoena process;
3. production of evidence;
4. expert affidavit support;
5. criminal/civil testimony;
6. cell phone forensics;
7. PDA forensics.

Specific client requests for forensics evidence extracting solution support include:

1. Index of files on hard drive;
2. index of recovered files;
3. MS Office/user generated document extraction;
4. unique E-Mail address extraction;
5. Internet activity/history;
6. storage of forensics image for 1 year (additional charges then apply);
7. keywords search;
8. chain of custody (see Section 7.8, Figs. 7.10 and 7.11, Boxes 7.4 and 7.12);
9. mail indexing;
10. deleted file/folder recovery;
11. office document recovery;
12. metadata indexing;
13. conversion to PDF;
14. log extraction;
15. instant messaging history recovery;
16. password recovery;
17. format for forensics extracts (DVD, CD, HDD, other);
18. network acquisitions.

Such types of computer evidences are important because quite often the evidence becomes the deciding factor in a criminal, civil or employee dismissal action. Investigations involving trade secrets, commercial disputes, and misdemeanor and felony crimes can be won or lost solely with the introduction of recovered E-Mail and other electronic documentation. If someone makes an attempt to delete, erase or otherwise hide critical evidence, you need the competent data recovery capabilities of forensics discoveries. Evidence that may not be known to attorneys may exist and often can be found during the forensics process. Also, timelines of computer usage is of help in crafting deposition questions and in targeting witnesses for interview.

Computer users typically "delete" incriminating and/or sensitive computer files (e.g., using tools such as "Deep Freeze," a software tool that is actually meant to protect your computer) but the information may still exist in slack space on the computer's hard drive that is hidden (do see the list of links provided at the end of this box). This computer data may linger for months or even years. However, it can be recovered and documented using computer forensics methods and techniques. Unfortunately, there are many examples of computer usage in violation of company policy. Sexual harassment, embezzlement, theft of trade secrets, abuse of the Internet and unauthorized outside employment on company time are just a few examples of violation that warrant a forensics examination of a computer. Even in investigations where hard drives are reformatted in an attempt to hide evidence, forensics discoveries can still potentially recover critical information (do see the list of links provided at the end of this box). Forensic discoveries can also aid in recovering passwords for critical files that have been maliciously set or changed.

Box 7.3 Digital Forensics . . . (Continued)

There are further challenges; for example, many times, computers are reissued when employees leave. Computer that is used continuously may destroy the incriminating evidence that can be used against a former disgruntled employee. Also, constant use of the computer may raise questions as to who created the incriminating evidence and when. To prevent these problems and to preserve potentially valuable information, it is recommended that a strict chain of custody should be followed and the subject computer should be shutdown, that is, the computer on which digital evidence is believed to be residing.

Useful links – The following link has the video where a digital forensics expert explains about E-Discovery and other aspects showing usefulness of digital forensics:

http://www.youtube.com/watch?v=y_BLtefQv40 (27 February 2010).

The following links (accessed on 28 March 2010) provide information about various tools including Deep Freeze:

1. <http://software.informer.com/getfree-deep-format-recover/> (Deep Format Recover Tools);
2. http://www.astahost.com/info.php/Deep-Freeze-Partition_t2571.html (Deep Freeze-related Blog);
3. <http://www.hochstadt.com/protecting-your-computer-using-deep-freeze> (an article here explains how you can protect your computer using "Deep Freeze");
4. <http://technodata.blogspot.com/2006/11/how-to-format-hard-disk-by-disk.html> (this article explains how to format the hard disk);
5. <http://www.softlist.net/search/deep-freeze-2000-xp/> (Deep Freeze 2000 XP Free Downloads);
6. <http://www.pctechguide.com/forums/ubbthreads.php/topics/4391/Hard%20Disk%20re-format> (technical blog);
7. <http://www.bluescreengone.com/comparison.htm> (Table showing Comparison of various Data Recovery and Data Formatting Tools);
8. <http://www.soft82.com/free/remote-yahoo-password-stealer/> (Yahoo Password Recovery Tools and many similar utilities);
9. <http://www.soft82.com/free/free-youtube-downloader-mp3/> (link to many free downloads of useful utilities).

The media, on which clues related to cybercrime reside, would vary from case to case. There are many challenges for the forensics investigator because storage devices are getting miniaturized due to advances in electronic technology; for example, external storage devices such as mini hard disks (pen drives) are available in amazing shapes (Fig. 7.2).

Looking for digital forensics evidence (DFE) is like looking for a needle in the haystack. Here is a way to illustrate why there is always the need for forensics software on suspect media – the capacity of a typical regular hard disk is 500 GB (gigabytes). In an A4 size page, there are approximately 4,160 bytes (52 lines × 80 Characters = 4,160 bytes assuming 1 byte per character). This is equivalent to 4 KB (kilobytes). An A4 size of paper sheet has thickness of 0.004 inches. Data of 4 MB (megabyte; 1,000 times of 4 KB) when printed on A4 size of paper would be 4 inches thick. Data of 4 GB if printed on A4 sheet would be 4,000 inches, that is, 1,000 times of 4 MB. This would turn out to be 4 inches thick. The printout of 500 GB would be 500,000 inches! It would be virtually impossible to "retrieve" relevant forensics data from this heap!! There comes the help from forensics software – it helps sieve relevant data from the irrelevant mass (vital few from trivial many as the proverb goes).

The term "chain of custody" is important (see Box 7.4).



Chain of custody means the chronological documentation trail, etc. that indicates the seizure, custody, control, transfer, analysis and disposition of evidence, physical or electronic.

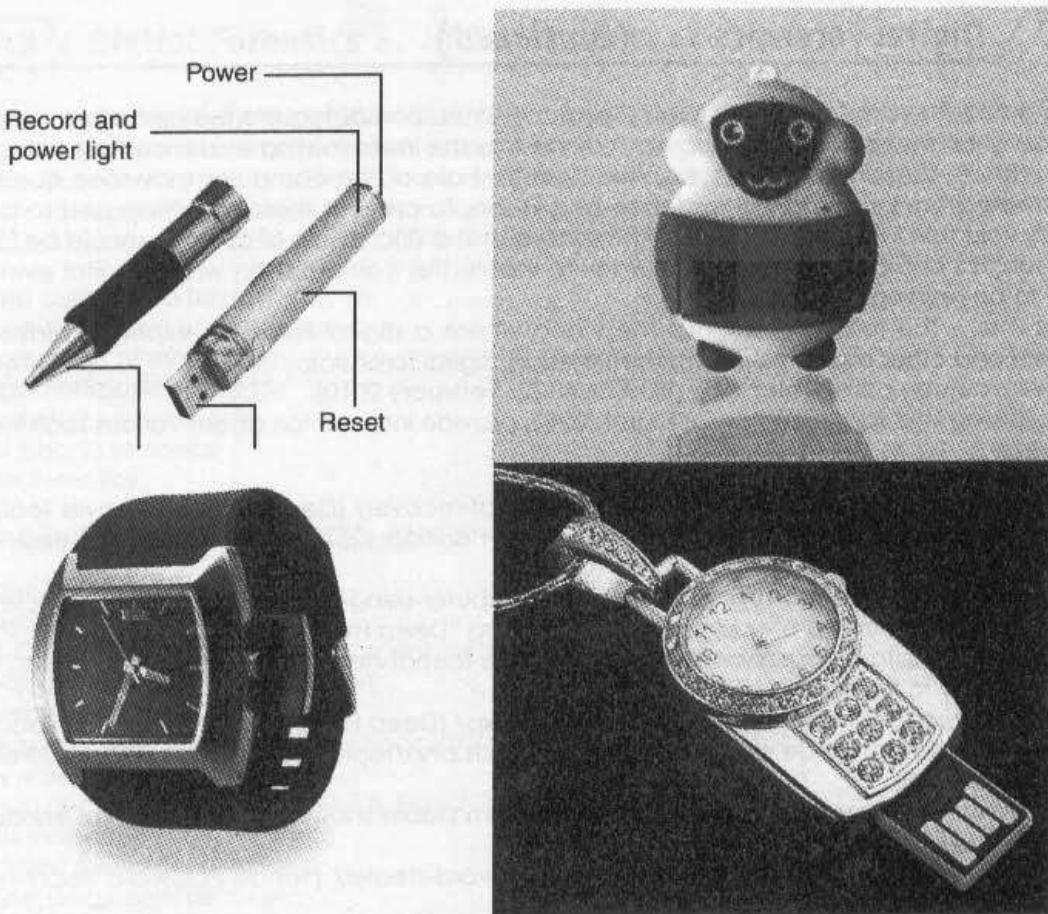


Figure 7.2 Hidden and miniaturized storage media.

Sources: <http://www.ghdigital.com>; <http://www.technology-guide.co.uk>; <http://designyoutrust.com>; <http://gadgethobby.com>

Box 7.4 Chain of Custody Example

The basic idea behind ensuring "chain of custody" is to ensure that the "evidence" is NOT tampered with. The recovery of a "crime weapon" at the murder scene would be an example of "chain of custody." This is explained below.

Case Study

Officer Amar collects the knife and places it into a container, then gives it to forensics technician Balan. Forensics technician Balan takes the knife to the laboratory and collects fingerprints and other evidence from the knife. He then gives the knife and all evidence gathered from the knife to evidence clerk Charu. Charu then stores the evidence until it is needed, documenting everyone who has accessed the original evidence (the knife and original copies of the lifted fingerprints).

The chain of custody requires that from the moment the evidence is collected, every transfer of evidence from one person to another person should be documented as it helps to prove that nobody else could have accessed that evidence. It is advisable to keep the number of evidence transfers as low as possible. In the courtroom, if the defendant challenges the chain of custody of the evidence, it can be proven that the knife in the evidence room is the same knife as found at the crime scene. However, if due to some discrepancies it cannot be proven who had the knife at a particular point in time, then the chain of custody is broken and the defendant can ask to have the resulting evidence declared inadmissible.

In a broader perspective “evidence” includes everything that is used to determine or demonstrate the truth of an assertion. Evidence can be used in court to convict people who are believed to have committed crimes; therefore, evidence must be handled in a scrupulously careful manner to avoid later allegations of tampering or misconduct that can compromise the case of the prosecution toward acquittal or to overturning a guilty verdict upon appeal.

The purpose behind recording the chain of custody is to establish that the alleged evidence is, indeed, related to the alleged crime, that is, the purpose is to establish the integrity of the evidence. In the context of conventional crimes, establishing “chain of custody” is especially important when the evidence consists of fungible goods.



“Fungibility” means the extent to which the components of an operation or product can be interchanged with similar components without decreasing the value of the operation or product.

For a person to be considered as “identifiable person,” he/she must always have the physical custody of a piece of evidence. Practically speaking, this means that a police officer or detective will take charge of a piece of evidence, document its collection and hand it over to an evidence clerk for storage in a secure place. All such transactions as well as every succeeding transaction between evidence collection and its appearance in court need to be completely documented chronologically to withstand legal challenges to the authenticity of the evidence. Documentation must include conditions under which the evidence is collected, the identity of all those who handled the evidence, duration of evidence custody, security conditions while handling or storing the evidence and the manner in which evidence is transferred to subsequent custodians each time such a transfer occurs (along with the signatures of persons involved at each step).



Chain of custody is also used in most evidence situations to maintain the integrity of the evidence by providing documentation of the control, transfer and analysis of evidence.

Chain of custody is particularly important in situations where sampling can identify the existence of contamination and can be used to identify the responsible party. In Section 7.8, the relevance of chain of custody is explained in the context of computer/digital forensics.

7.5 Cyberforensics and Digital Evidence

Cyberforensics can be divided into two domains:

1. Computer forensics;
2. network forensics.

Many security threats are possible through computer networks (to know more on this, readers can refer to Ref. 11, Books, Further Reading). Therefore, “network forensics”^[26] assumes importance in the context of cybercrime.



Network forensics is the study of network traffic to search for truth in civil, criminal and administrative matters to protect users and resources from exploitation, invasion of privacy and any other crime fostered by the continual expansion of network connectivity.

As compared to the “physical” evidence, “digital evidence” is different in nature because it has some unique characteristics. First of all, digital evidence is much easier to change/manipulate! Second, “perfect” digital copies can be made without harming original. At the same time the integrity of digital evidence can be proven. Another subtle aspect (of digital evidence) is that it is usually in the form of the “image” – this means that it is convenient and possible to create a defensible “clone” of storage device. Different information (clues) can be found at different levels of abstraction. Understanding the uniqueness of digital evidence is important for appreciating the phases involved in a digital forensics investigation and maintaining the “chain of custody” (refer to Section 7.8, Figs. 7.10 and 7.11, Boxes 7.4 and 7.12).

There are many forms of cybercrimes: sexual harassment cases – memos, letters, E-Mails; obscene chats or embezzlement cases – spreadsheets, memos, letters, E-Mails, online banking information; corporate espionage by way of memos, letters, E-Mails and chats; and frauds through memos, letters, spreadsheets and E-Mails. In case of computer crimes/cybercrimes, computer forensics helps. Computer forensics experts know the techniques to retrieve the data from files listed in standard directory search, hidden files, deleted files, deleted E-Mail and passwords, login IDs, encrypted files, hidden partitions, etc. Typically, the evidences reside on computer systems, user created files, user protected files, computer created files and on computer networks. Computer systems have the following:

1. Logical file system that consists of
 - File system: It includes files, volumes, directories and folders, *file allocation tables* (FAT) as in the older version of Windows Operating System, clusters, partitions, sectors.
 - Random access memory.
 - Physical storage media: It has magnetic force microscopy that can be used to recover data from overwritten area.
 - (a) Slack space: It is a space allocated to the file but is not actually used due to internal fragmentation and
 - (b) unallocated space.
2. User created files: It consists of address books, audio/video files, calendars, database files, spreadsheets, E-Mails, Internet bookmarks, documents and text files.
3. Computer created files: It consists of backups, cookies, configuration files, history files, log files, swap files, system files, temporary files, etc.
4. Computer networks: It consists of the Application Layer, the Transportation Layer, the Network Layer, the Datalink Layer.

Readers who are not savvy with these terms and concepts can refer to Ref. #11, Books, Further Reading. The Open System Interconnection (OSI) Layer Model (Application Layers, Transportation Layer, Datalink Layer, etc.) is also explained in Ref. #11, Books, Further Reading.

Box 7.5 The Father of Forensics Science – the Sherlock Holmes of France

The year 1877–1966 was the era of Dr. Edmond Locard. He is considered as the pioneer in forensics science and was popularly known as the Sherlock Holmes of France. He formulated the basic principle of forensics science: “Every contact leaves a trace.” This came to be known as Locard’s exchange principle. Following is one of his most famous quotes:

Wherever he steps, wherever he touches, whatever he leaves, even without consciousness, will serve as a silent witness against him. Not only his fingerprints or his footprints, but his hair, the fibers from his clothes, the glass he breaks, the tool mark he leaves, the paint he scratches, the blood or

Box 7.5 \ The Father of . . . (Continued)

semen he deposits or collects. All of these and more bear mute witness against him. This is evidence that does not forget. It is not confused by the excitement of the moment. It is not absent because human witnesses are. It is factual evidence. Physical evidence cannot be wrong, it cannot perjure itself, it cannot be wholly absent. Only human failure to find it, study and understand it, can diminish its value. In other words, Whenever two human beings come into contact, something from one is exchanged to the other, that is, dust, skin cells, hair, etc."

For a short video clip that demonstrates how "Locard Principle" works, one can visit the link: <http://science.howstuffworks.com/locards-exchange-principle.htm/printable> (11 September 2009).

Locard studied medicine and law at Lyon, eventually becoming the assistant of Alexandre Lacassagne, a criminologist and professor. He held this post until 1910, when he began the foundation of his criminal laboratory. He produced a monumental seven-volume work, *Traité de Criminalistique*, and in 1918, developed 12 matching points for fingerprint identification. He continued with his research until his death in 1966.

7.5.1 The Rules of Evidence

This is a very important discussion, especially, for those who are students of legal courses. It was mentioned in Chapter 6 (Section 6.4) that the Indian IT Act amended the Indian Evidence Act. According to the "Indian Evidence Act 1872," "Evidence" means and includes:

1. All statements which the court permits or requires to be made before it by witnesses, in relation to matters of fact under inquiry, are called *oral evidence*.
2. All documents that are produced for the inspection of the court are called *documentary evidence*.

Legal community believes that "electronic evidence" is a new breed of evidence. They also, at times, have an apprehension that the law of evidence as per Indian Evidence Act of 1872 may not hold good for electronic evidence. Some lawyers express doubts and apprehensions about the process of leading electronic evidence in the courts. However, this is not true; the traditional principles of leading evidence, along with certain newly added provisions in the Indian Evidence Act 1972 through the Information Technology Act (ITA) 2000, constitute the body of law applicable to electronic evidence. The challenges, however, need to be understood from the "rules of evidence" perspective.



Paper evidence, the process is clear and intuitively obvious. Digital evidence by its very nature is invisible to the eye. Therefore, the evidence must be developed using tools other than the human eye.

It is only logical that the process used in the case of digital evidence mimic the process that is used for paper evidence. As each step requires the use of tools or knowledge, the process must be documented, reliable and repeatable. The process itself must be understandable to the members of the court. Acquisition of digital evidence is both a legal and technical problem. In fact, these two aspects are irrevocably related. The law specifies what can be seized, under what conditions, from whom and from where. It requires to determine what particular piece of digital evidence is required for examination, that is, is it a particular file or a word processing document or an executable program, etc. It may also require examination to determine where a particular piece of evidence is physically located. Is the file on a local hard drive or is it on a server

located in another legal jurisdiction? In short, it may be necessary to show a technical basis for obtaining the legal authority to search. Likewise, it may require technical skills to actually accomplish the search. The product of this phase is usually raw media, devoid of meaning or usefulness.

There are number of contexts involved in actually identifying a piece of digital evidence:

1. **Physical context:** It must be definable in its physical form, that is, it should reside on a specific piece of media.
2. **Logical context:** It must be identifiable as to its logical position, that is, where does it reside relative to the file system.
3. **Legal context:** We must place the evidence in the correct context to read its meaning. This may require looking at the evidence as machine language, for example, American Standard Code for Information Interchange (ASCII).

The path taken by digital evidence can be conceptually depicted as shown in Fig. 7.3.

Digital evidence originates from a number of sources such as seized computer hard drives and backup media, real-time E-Mail messages, chat room logs, Internet service provider records, webpages, digital network traffic, local and virtual databases, digital directories, wireless devices, memory cards, digital cameras, etc. Digital forensics examiners must consider the trustworthiness of this digital data. Many vendors provide technology solutions to extract this digital data from these devices and networks. Once the extraction of the digital evidence has been accomplished, protecting the digital integrity becomes paramount concern for investigators, prosecutors and those accused.

Similarly for the evidence in regular crimes, it is important to “isolate” the potential evidence. Some important tips are – do not turn ON the computer or review media, restrict physical and remote access, unplug computer power, network and phone line, and document times, people and steps taken. A point to note is that the need to unplug the computer power depends on the crime situation and the type of analysis required. For example, for live analysis of the digital evidence, it would not be advisable to unplug the power. Therefore, it is best to involve qualified specialists early in the process. Following are some guidelines for the (digital) evidence collection phase:

1. Adhere to your site's security policy and engage the appropriate incident handling and law enforcement personnel.
2. Capture a picture of the system as accurately as possible.

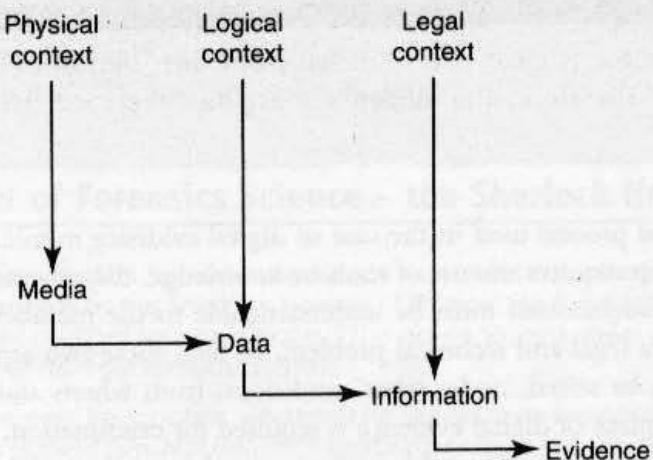


Figure 7.3 | Path of the digital evidence.

3. Keep detailed notes with dates and times. If possible, generate an automatic transcript (e.g., on Unix systems the “script” program can be used; however, the output file it generates should not be given to media as that is a part of the evidence). Notes and printouts should be signed and dated.
4. Note the difference between the system clock and Coordinated Universal Time (UTC). For each timestamp provided, indicate whether UTC or local time is used (since 1972 over 40 countries throughout the world have adopted UTC as their official time source).
5. Be prepared to testify (perhaps years later) outlining all actions you took and at what times. Detailed notes will be vital.
6. Minimize changes to the data as you are collecting it. This is not limited to content changes; avoid updating file or directory access times.
7. Remove external avenues for change.
8. When confronted with a choice between collection and analysis you should do collection first and analysis later.
9. Needless to say, your procedures should be implementable. As with any aspect of an incident response policy, procedures should be tested to ensure feasibility, particularly, in a crisis. If possible, procedures should be automated for reasons of speed and accuracy. Being methodical always helps.
10. For each device, a systematic approach should be adopted to follow the guidelines laid down in your collection procedure. Speed will often be critical; therefore, where there are a number of devices requiring examination, it may be appropriate to spread the work among your team to collect the evidence in parallel. However, on a single given system collection should be done step by step.
11. Proceed from the volatile to the less volatile; order of volatility is as follows:
 - Registers, cache (most volatile, i.e., contents lost as soon as the power is turned OFF);
 - routing table, Address Resolution Protocol (ARP) cache, process table, kernel statistics, memory;
 - temporary file systems;
 - disk;
 - remote logging and monitoring data that is relevant to the system in question;
 - physical configuration and network topology;
 - archival media (least volatile, i.e., holds data even after power is turned OFF).
12. You should make a bit-level copy of the system’s media. If you wish to do forensics analysis you should make a bit-level copy of your evidence copy for that purpose, as your analysis will almost certainly alter file access times. *Try to avoid doing forensics on the evidence copy.*



Address Resolution Protocol (ARP) is a very important part of IP networking. ARP is used to connect OSI Layer 3 (Network) to OSI Layer 2 (Datalink). For most of us this means that ARP is used to link our IP addressing to our Ethernet addressing (MAC Addressing). For you to communicate with any device on your network, you must have the Ethernet MAC address for that device. If the device is not on your LAN, you go through your default gateway (your router). In this case, your router will be the destination MAC address that your PC will communicate with. There are two types of ARP entries: static and dynamic. Most of the time, you will use dynamic ARP entries. What this means is that the ARP entry (the Ethernet MAC to IP address link) is kept on a device for some period of time, as long as it is being used. The opposite of a dynamic ARP entry is static ARP entry. With a static ARP entry, you are manually entering the link between the Ethernet MAC address and the IP address. Because of management headaches and the lack of significant negatives to using dynamic ARP entries, dynamic ARP entries are used most of the time.

7.6 Forensics Analysis of E-Mail

In Chapter 2 (Section 2.3.1), it was mentioned how criminals can use fake mails for various cybercrime offenses. There are tools available that help create fake mails. *Forensics analysis of E-Mails* is an important aspect of cyberforensics analysis – it helps establish the authenticity of an E-Mail when suspected. This aspect is explained in this section – we start with understanding E-Mail components and then the E-Mail header structure is explained. E-Mails are now the most common means of communication worldwide and are often the subject of forensics analysis if this happens to constitute “digital evidence.” Owing to the rising pressures from regulatory agencies and also due to possible litigations in global businesses, organizations are obligated to electronically store information to support discovery and disclosure requests. In this section, we want to discuss how E-Mail messages/IDs can help in forensic analysis of cybercrimes.

An E-Mail system is the hardware and software that controls the flow of E-Mail. The two most important components of an E-Mail system are the E-Mail server and the E-Mail gateway. *E-Mail servers* are computers that forward, collect, store and deliver E-Mail to their clients and E-Mail gateways are the connections between E-Mail servers. *Mail server software* is a network server software that controls the flow of E-Mail and the mail client software helps each user read, compose, send and delete messages. An E-Mail consists of two parts, the header and the body. *Message headers* are the important part for investigating E-Mail messages and hence it will be discussed in detail in this section. The “header” of an E-Mail is very important from forensics point of view – a full header view of an E-Mail provides the entire path of E-Mail’s journey from its origin to its destination. The header view includes the originating Internet Protocol (IP) address and other useful information (see Table 7.1). There is usually a link provided on the E-Mail from its origin to its destination.

Box 7.6 Electronic Messages and the Indian Evidence Act

Section 88 of the Indian Evidence Act is about Presumption as to telegraphic messages. It states the following:

Presumption as to telegraphic messages. The Court may presume that a message, forwarded from a telegraph office to the person to whom such message purports to be addressed, corresponds with a message delivered for transmission at the office from which the message purports to be sent; but the Court shall not make any presumption as to the person by whom such message was delivered for transmission.

As per Section 66A(C) of Indian IT Act any electronic mail or electronic mail message for the purpose of causing annoyance or inconvenience or to deceive or to mislead the addressee or recipient about the origin of such messages (Inserted vide ITAA 2008) shall be punishable with imprisonment for a term which may extend to 2 or 3 years and with fine – refer to URL http://cybercrime.planetindia.net/ch11_2008.htm

In terms of the amended Indian ITA 2000, that is, the ITA 2008 (notified on 5 February 2008), it is interesting to know how the court thinks when it comes to evidences based on E-Mails. As mentioned at the beginning, according to the Section 88A of the Indian Evidence Act, the court may presume that an electronic message forwarded by an originator through an E-Mail server to the addresses, to whom the message purports to be addressed, corresponds with the message as fed into the person’s computer for transmission. However, the court shall not make any “presumption” as to the person by whom such message was sent. Furthermore, it is interesting to note the word “may presume” and the expressions “shall presume” and “conclusive proof.”

1. The word “may presume” denotes that the court may either regard such fact as proved until it is disapproved, or may call for proof of it (Section 4 of the Indian Evidence Act 1872).
2. The word “shall presume” denotes that whenever it is directed by this Act that the court shall presume a fact, it shall regard such fact as proved, unless and until it is disapproved.

Box 7.6 Electronic Messages . . . (Continued)

3. The word "conclusive proof" denotes that when one fact is declared by this Act to be conclusive proof of another, the court shall, on proof of the one fact, regard the other as proved, and shall not allow evidence to be given for the purpose of disapproving it.

Source: Refer to Section 4 of the Indian Evidence Act. It can be downloaded from <http://chddistrictcourts.gov.in/THE%20INDIAN%20EVIDENCE%20ACT.pdf> (22 November 2008).

Table 7.1 | E-Mail header example

1. Return-Path: <secret@hotmail.com>
2. Received: from mailhub-1.net.treas.gov ([10.7.14.10]) by nccmail.usss.treas.gov for <avenit@usss.treas.gov>; Fri, 18 Feb 2000 11:46:07-0500
3. Received: from mx-relay.treas.gov ([199.196.144.6]) by tias4.net.treas.gov via smtpd (for mailhub.net.treas.gov [10.7.8.10]) with SMTP; 18 Feb 2000 16:55:44
4. Received: from hotmail.com (f7.law4.hotmail.com [216.33.149.7]) by mx-relay2.treas.gov for <avenit@usss.treas.gov>; Fri, 18 Feb 2000 11:55:44 -0500 (EST)
5. Message-ID: <20000218165543.56965.qmail@hotmail.com>
6. Received: from 199.196.144.42 by www.hotmail.com with HTTP; Fri, 18 Feb 2000 08:55:43
7. X-Originating-IP: [199.196.144.42]
8. From: "Secret" <secret@hotmail.com>
9. To: avenit@usss.treas.gov
10. CC: smith@aol.com

Header information varies with E-Mail service provider, E-Mail applications and system configuration. As we know, the header part carries information that is needed for E-Mail routing, subject line and time stamps whereas the body contains the actual message/data of an E-Mail. The header and the body are separated by a blank line. The header contains several mandatory and optional fields, trace information and heading fields. The E-Mail header is a sequence of fields (it may not be in a particular order), each consisting of a field name and a field value. An example of a heading field would be: To: xyz@abccom.in. Headers on E-Mail can easily be "spoofed" by spammers and other irresponsible network users. E-Mails, when used in cyberforensics investigation, must get uniquely identified, if, for example, an E-Mail is suspected to be one of the evidence sources.

As mentioned earlier, the body of an E-Mail is separated from the header and it might also contain attachments in the form of MIME or SMIME (also known as S/MIME – secure/multipurpose Internet mail extensions). It is a protocol that provides digital signatures and encryption of Internet MIME messages. It is an encoding protocol (readers can visit the link at <http://email.about.com/cs/standards/a/mime.htm> to understand how MIME works for E-Mails).

We have mentioned previously that an E-Mail has two parts and header is one of those two parts. However, there is a header protocol: when an E-Mail message is sent, the user typically controls only the recipient line(s), that is, *To*, *Cc* and *Bcc*, if mentioned, and the *Subject* and *Date*. The rest of the header information is added by mail software while it is processed. Along the E-Mails route, a server can add or delete lines (anonymous remailer). Table 7.1 shows example of a mail header; for ease of understanding, each element of the header has been numbered. The discussion that follows is with reference to those numbers. *Header Protocol Analysis* is important for investigating evidence that may come in form of an E-Mail.

In Table 7.1, elements 2, 3 and 4 show the route taken by the message from sending to delivery. Every computer that receives this message adds a "Received: field" with its complete address and time stamp; this

helps in tracking delivery problems. Element 5 of the mail header is the Message-ID, a unique identifier for this specific message. The Message-ID is logged and it can be traced through computers that are on the message route if there is a need to track the mail. Element 6 of the E-Mail header shows where the E-Mail was first received from with the IP address of the sender. It also shows the date and time when the message was sent. In this regard, it is important to understand the difference between simple mail transfer protocol (SMTP) and Hypertext Transfer Protocol (HTTP). HTTP is used to transfer displayable webpages and related files whereas SMTP is used to transfer E-Mail. Thus, SMTP is a protocol for sending E-Mail messages between servers whereas HTTP is a set of rules used to browse through Internet commonly used with web browsers such as Internet Explorer, Firefox). When you request, E-Mail logs you and you should ensure that you get them from the right server.

Next, consider element 7 of the sample mail header shown in Table 7.1 – it shows the originating IP address of the sender, but without the date and time the IP address will not allow you to identify the specific user. This may or may not be present in headers. If the IP address is a “Static” Address, you *will* be able to identify the specific user (most IP addresses are “dynamically” assigned). Element 8 indicates the name and E-Mail address of the message originator, that is, the “sender.” Generally, this is the domain name we want to trace. Element 9 shows the name and E-Mail address of the primary recipient; the address may be for a mailing list (sales_dep@company.com) or systemwide *alias* (avenit@usss.treas.gov) or a personal username. The next element, element 10, of the sample mail header lists the names and E-Mail addresses of the “courtesy copy” recipients of the message. Some E-Mails may have “Bcc:” recipients as well; these “blind carbon copy” recipients get copies of the message, however their names and addresses are not visible in the headers.

Once we get the IP address our task is to find the Internet service provider details. The following links are worth visiting:

1. www.all-nettools.com (among other tools; a link to E-Mail tools is available here);
2. www.ip2location.com (there is a utility here that helps you know where your Internet visitors are coming from, that is, which country, which state, which city, which Internet service provider, which domain name, which connection type, which ZIP code, etc. It helps you trace an IP address to Country, Region, City, Latitude, Longitude, ZIP Code, Time Zone, Connection Speed, Internet service provider, Domain Name, IDD Country Code, Area Code, Weather Station Code and Name).
3. www.domaintools.com (there are DNS tool and many other tools available here);
4. www.dnsstuff.com (domain/E-Mail-related tools are accessible from this site);
5. http://www.hackingspirits.com/cyb_forensics/fsic_articles/trace_emails.html is a good link to know tracing the origin of an E-Mail, that is, locating countries from an IP address.

The Internet service provider plays an important role in E-Mail forensics. The Internet service provider provides Internet access to businesses, organizations, schools, colleges and individuals. Examples of Internet service provider are VSNL (Videsh Sanchar Nigam Limited), Sify, Hathway, Rolta, MTNL/BSNL, Reliance, etc. The details available from the Internet service provider are name, address and contact number of the subscriber of the Internet facility, type of IP address, any other relevant information with regard to IP address at a particular given date and time, usage details, etc.

Box 7.7 Points to Remember when you Use E-Mail as an Evidence

1. Ensure the use of E-Mail is subject to agreed procedures, which are supported and enforced by management at a high level. Acceptable Use Policies ought to prescribe good usage and identify bad usage.

Box 7.7 Points to Remember . . . (Continued)

2. Train users of E-Mail about acceptable use of E-Mail, and about their rights and the obligations expected of them.
3. Implement access control mechanisms to computer systems – so that its use can be attributed to a person, a terminal, a date and a time.
4. Ensure computer systems are kept safe and secure so that the systems and the data within are protected from unauthorized access and accidental or deliberate loss and damage.
5. Retention and deletion of E-Mail should be organization-defined and not user-defined. Individual users should not have any discretion as to the categories of E-Mails that should be retained or deleted.
6. Implement a solution that archives and stores E-Mails centrally. The archive should support all the main file formats and also retain metadata.
7. The archive should classify E-Mails entering the archive at the point of entry. The archive should prevent the entry of duplicates.
8. Make sure that the archiving platform facilitates the exporting of evidence as files as a part of the E-Discovery process.
9. Implement an archiving solution that allows full search and retrieval. Metadata should be searchable as should content.
10. Enable logging of all events acting on the archive. The logs should be retained as part of the archive, for auditing and verification purposes.
11. Provide contingency for continuity of both archiving and discovery in the event of an outage.
12. Ensure the archiving platform supports the marking-up of files so that privileged materials can be withheld and/or redacted during E-Discovery.

E-Mail headers are organized bottom-up. This means that the E-Mail was handed from the machines at the bottom of the E-Mail header to the ones at the top of it. These machines are referred to as Message Transfer Agents (MTAs) and each of them adds a “received” section to the E-Mail header, sometimes referred to as “received header.” This is similar to postmarks used in conventional postal systems. The order of the “received” sections is like a stack of pancakes, with the one receiving the E-Mail last at the top of the stack. Refer to Fig. 7.4 – note that there were three received sections (elements 2, 3 and 4 in Table 7.1). This means that three MTAs were involved in the delivery of the E-Mail message with the one at the bottom being the one receiving the original message from the sender.

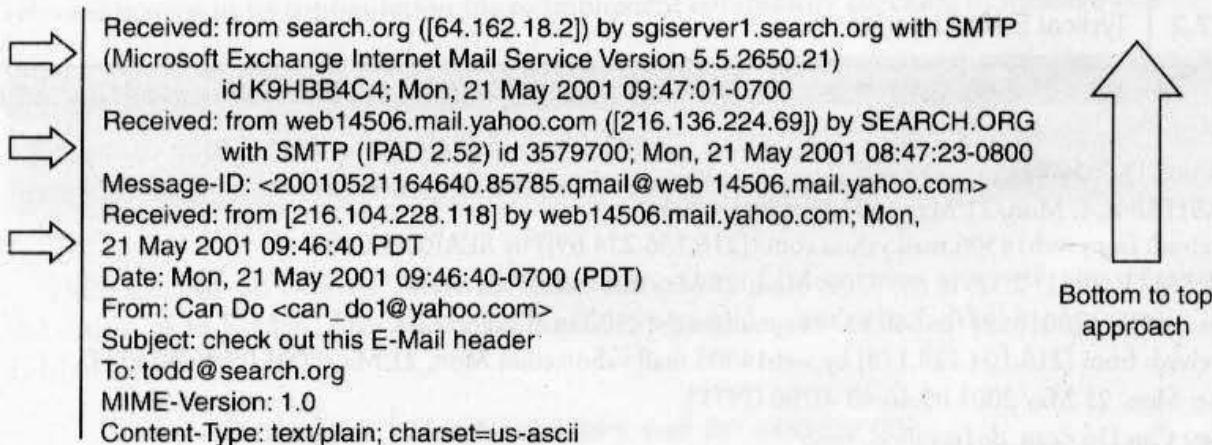


Figure 7.4 Bottom-up approach to tracing E-Mail source.

Source: “Tracing-eMail-Headers.pdf,” Marwan Al-Zarouni, School of Computer and Information Science, Edith Cowan University, Perth, Western Australia. To see a visual example of tracing an E-Mail, readers can visit: <http://www.youtube.com/watch?v=hSvswzSy3oA&feature=related> (15 March 2010). It shows a video clip with demonstrating an E-Mail.



E-Mail tracing is done by examining the header information contained in E-Mail messages to determine their source.

While tracing E-Mails, the “header information” is included along with E-Mails either at the beginning or the end of E-Mail messages. A typical E-Mail header looks like as shown in Table 7.2.

To determine the source of the E-Mail, investigators must first examine the received section at the bottom of the header and work their way up in a bottom to top approach (see Fig. 7.4).

It is also important that during E-Mail investigation cases the logs of all servers in the received chain are examined as soon as possible. The time stamp is very important in E-Mail investigation cases because HTTP and SMTP logs get archived frequently, especially by large Internet service providers. When a log is archived, a considerable amount of time and effort is involved to retrieve and decompress the log files needed to trace E-Mails. Fake E-Mail creation tools are rampantly used by cybercriminals. Therefore, it is possible that some E-Mails have fake headers with fake “from” E-Mail addresses to fool investigators; however, extreme caution and careful scrutiny should be practiced in investigating every part of the E-Mail header (recall it in Chapter 2 in which it is explained that there are tools available that help create fake mails).

Typically, the sender’s E-Mail address can be found after the “From” section of the header. However, that is not the only place it can be found. It can also be found under other sections depending on the E-Mail client uses. These sections include the following (this is not the exhaustive list; it is just an example to give you some idea):

1. . X-originating E-Mail;
2. . X-sender;
3. . return-path.

At times, E-Mail addresses can suggest the method used to generate the E-Mail and the server that the E-Mail originated from (i.e., hotmail, outlook, corporate server, Internet service provider, etc.). However, E-Mail addresses should be viewed with caution by investigators as they can be easily faked. Note that some headers begin with an “X-,” this means that they are X-headers. You can use X-headers to sort and filter

Table 7.2 | Typical E-Mail header

1. Received: from search.org ([64.162.18.2]) by sgiserver1.search.org with SMTP (Microsoft Exchange Internet Mail Service Version 5.5.2650.21)
id K9HBB4C4; Mon, 21 May 2001 09:47:01-0700
2. Received: from web14506.mail.yahoo.com ([216.136.224.69]) by SEARCH.ORG with SMTP (IPAD 2.52) id 3579700; Mon, 21 May 2001 08:47:23-0800
Message-ID: <20010521164640.85785.qmail@web14506.mail.yahoo.com>
3. Received: from [216.104.228.118] by web14506.mail.yahoo.com; Mon, 21 May 2001 09:46:40 PDT
Date: Mon, 21 May 2001 09:46:40 -0700 (PDT)
From: Can Do <can_do1@yahoo.com>
Subject: check out this E-Mail header
To: todd@search.org
MIME-Version: 1.0
Content-Type: text/plain; charset = us-ascii

E-Mails sent by SourceForge. Depending on the context of the message, custom E-Mail headers (X-headers) are added to the E-Mail. The customer headers can be used by E-Mail agents and clients to filter and sort E-Mail. For example, both Outlook and Thunderbird support filtering on custom E-Mail headers. Thus, X-headers are inserted by E-Mail client programs or applications that use E-Mail to pass information to E-Mail handling programs for processing. They may be introduced by large vendors and picked up for use by others. In this way an X-header can be considered as a de facto standard. An example of this is the "X-Mailer" header which many E-Mail clients use to define the E-Mail client application and version used.

Next, let us understand how fake E-Mail addresses can be detected. The sender's E-Mail address can be easily faked and can be hard to detect. If the server mentioned in the bottom "received" section does not match the server of the E-Mail address, this suggests that the E-Mail address is a fake one. An example is shown in Table 7.3.

Note that in Table 7.3 the E-Mail address in the "From" field has "hotmail.com" as the domain for the E-Mail whereas in the received section of the header there is no hotmail server mentioned at all. This is clearly a forged (fake) E-Mail and it is very likely to have a fake "From" address. Also note that the time on the received section is Central European Standard Time (CEST), and hotmail.com servers are not in Europe.

Now let us consider Sendmail. Sendmail is a general purpose Internet work E-Mail routing facility that supports many kinds of mail-transfer and delivery methods, including SMTP used for E-Mail transport over the Internet. Sendmail is a descendant of the delivermail program that was written by Eric Allman. Sendmail is a well-known project of the free and open-source software (OSS) and Unix communities, and has spread both as free software and proprietary software. It is a very widely used MTA. MTAs send mail from one machine to another. Sendmail is not a client program, which you use to read your E-Mail but rather a behind-the-scenes program that actually moves your E-Mail over networks or the Internet to where you want it to go. If there is ever a situation to reconfigure Sendmail, you will also need to have the sendmail.cf package installed. In case you need documentation on Sendmail, you need to install the sendmail-doc package.

To uniquely identify each E-Mail, all MTAs use some sort of unique identifier. This identifier is referred to as "Message-ID." *Message-ID field* is inserted into a header either by mail user agent (MUA) or the first MTA. Even though the Message-ID is optional as per RFC2822, it recommends using it. Sendmail, for example, is one MTA that handles E-Mail delivery and relaying process. Sendmail uses Message-ID for tracing E-Mails and for logging process IDs. It recommends including Message-ID in E-Mails and also recommends setting relevant macros in its configuration file to implement compulsory checking of Message-IDs.



A point to note is that unlike Spoofing other fields in the header, Spoofing Message-ID needs special knowledge. Sendmail-related FAQs are available at <http://www.sendmail.org/faq/section2>.

Deep analysis on Message-IDs may reveal some sort of information that will open a window to trace the source of an E-Mail. Also Message-ID will help to find a particular E-Mail log entry within a log file of E-Mail server.

Table 7.3 | Header of a fake mail (an example only)

Received: from infvic.it (adsl-98-201.38-151.net24.it [151.38.201.98])
by mail-relay2.bpvit.it (Postfix) with ESMTP id 2887550074
for <redazione@infvic.it>; Mon, 19 Apr 2004 10:41:54 +0200 (CEST)
From: sfiorillo@hotmail.com

Only technical envy spammers can spoof the Message-ID cleverly. So deep analysis on Message-IDs may reveal some sort of information that will open a window to trace the source of an E-Mail. Also the Message-ID will help to find a particular E-Mail log entry within a log file of E-Mail server. There are some commonalities between conventional mails and E-Mails; for example, like conventional mail service, when E-Mail is routed from source to destination all intermediate relay servers (SMTP) insert their stamp at the beginning of the header. This stamping procedure helps to trace the E-Mail if such a demand arises. The stamp consists of three fields, namely, "From," "SMTP-ID" and "For."

The text in Table 7.4 shows an E-Mail header that passed through several MTAs, that is, E-Mail header with several identifiers. Each MTA inserted a unique ID in the header of E-Mail. There are several identifiers in the header field of an E-Mail that may help to trace the source of the E-Mail but the context for Fig. 7.4 is limited to Sendmail Message-ID only. Analyzing intermediate SMTP-IDs is beyond the scope of this book. However, in this section, we have briefly discussed intermediate SMTP-IDs.

In the context of E-Mail, "messages" are viewed as having an "envelope" and "contents." The envelope contains information required to accomplish transmission and delivery. The contents contain the object to be delivered to the recipient. The delivery has to be at a valid E-Mail address and this is where the RFC2822 comes into picture.

7.6.1 RFC2822

RFC2822 is the Internet Message Format. According to the Internet specification RFC2822, there are several formats of valid E-Mail addresses, like joshi@host.net, john@[10.0.3.19], "Joshi Ganesh"@host.net or "Joshi Ganesh"@[10.0.3.19]. Many E-Mail address validators on the Web fail to recognize some of those valid E-Mail addresses. Some examples of invalid E-Mail addresses are as follows:

1. joshi@box@host.net: Two at signs (@) are not allowed;
2. .joshi@host.net: Leading dot (.) is not allowed;
3. joshi@-host.net: Leading dash (-) is not allowed in on domain name;
4. joshi@host.web: Web is not a valid top level domain;
5. joshi@[10.0.3.1999]: Invalid IP address.

The RFC2822 standard applies only to the Internet Message Format and some of the semantics of message contents. It contains no specification of the information in the envelope. RFC2822 states that each E-Mail

Table 7.4 | E-Mail header with several identifiers

-
1. Received: from search.org ([64.162.18.2]) by sgiserver1.search.org with SMTP (Microsoft Exchange Internet Mail Service Version 5.5.2650.21)
id K9HBB4C4; Mon, 21 May 2001 09:47:01-0700
 2. Received: from web14506.mail.yahoo.com ([216.136.224.69]) by SEARCH.ORG with SMTP (IPAD 2.52) id 3579700; Mon, 21 May 2001 08:47:23-0800
Message-ID: <20010521164640.85785.qmail@web14506.mail.yahoo.com>
 3. Received: from [216.104.228.118] by web14506.mail.yahoo.com; Mon, 21 May 2001 09:46:40 PDT
Date: Mon, 21 May 2001 09:46:40-0700 (PDT)
From: <can_do1@yahoo.com>
Subject: check out this E-Mail header
To: todd@search.org
-

must have a “globally unique identifier.” This must be included into the header of an E-Mail. The RFC2822 also defines the syntax of Message-ID. It should be like a legitimate E-Mail address and it must be included within a pair of angle brackets. According to RFC2822, Message-ID can appear in three header fields: “Message-ID header,” “in-reply-to header” and “references header.” But Message-ID of the present E-Mail must be included against the “Message-ID” header. Remember that there are SPAM problems and to that, there is no simple solution. E-Mail headers cannot be trusted; not all E-Mail can be traced or authenticated. Only a legitimate mail typically can be traced. However, for SPAM and virus-generated E-Mail it is difficult to know if the headers are absolutely trustworthy.

Readers may refer to Ref. #2, Video Clips, Further Reading in which it is explained how to trace an E-Mail. To conclude this section, we say that tracing an E-Mail is an important forensics activity in instances where an E-Mail is believed to hold a queue for a cybercrime. Understanding the E-Mail header structure is important while tracing an E-Mail and we have discussed that so far. Readers, who are interested in learning about tracking E-Mails, can try out the tutorials available at the following links accessed on 6 December 2009:

1. <http://www.visualware.com/resources/tutorials/email.html> (both download and live demonstrations are available at this link);
2. <http://www.visualware.com/resources/tutorials/emailX.html> (a tutorial on E-Mail tracking tutorial is available here).

7.7 Digital Forensics Life Cycle

As per FBI’s (Federal Bureau of Investigation) view, digital evidence is present in nearly every crime scene. That is why law enforcement must know how to recognize, seize, transport and store original digital evidence to preserve it for forensics examination. Figure 7.5 shows the process model for understanding a *seizure and handling of forensics evidence* legal framework. The cardinal rules to remember are that evidence:

1. is admissible;
2. is authentic;
3. is complete;
4. is reliable;
5. is understandable and believable.

Let us now understand what is involved in the digital forensics process.

7.7.1 The Digital Forensics Process

The digital forensics process needs to be understood in the legal context starting from preparation of the evidence to testifying. Digital forensics evidence consists of exhibits, each consisting of a sequence of bits, presented by witnesses in a legal matter to help jurors establish the facts of the case and support or refute legal theories of the case. The exhibits should be introduced and presented and/or challenged by properly qualified people using a properly applied methodology that addresses the legal theories at issue. The tie between technical issues associated with the digital forensics evidence and the legal theories is the job of “expert witnesses.”

As part of the court procedure, the exhibits are introduced as evidence by either side. *Testimony* is presented to establish the process to identify, collect, preserve, transport, store, analyze, interpret, attribute, and/or reconstruct the information contained in the exhibits and to establish, to the standard of proof required by the matter at hand, that the evidence reflects a sequence of events that is asserted to have produced it. The party must show not only the evidence to be admitted but must also establish that the evidence is

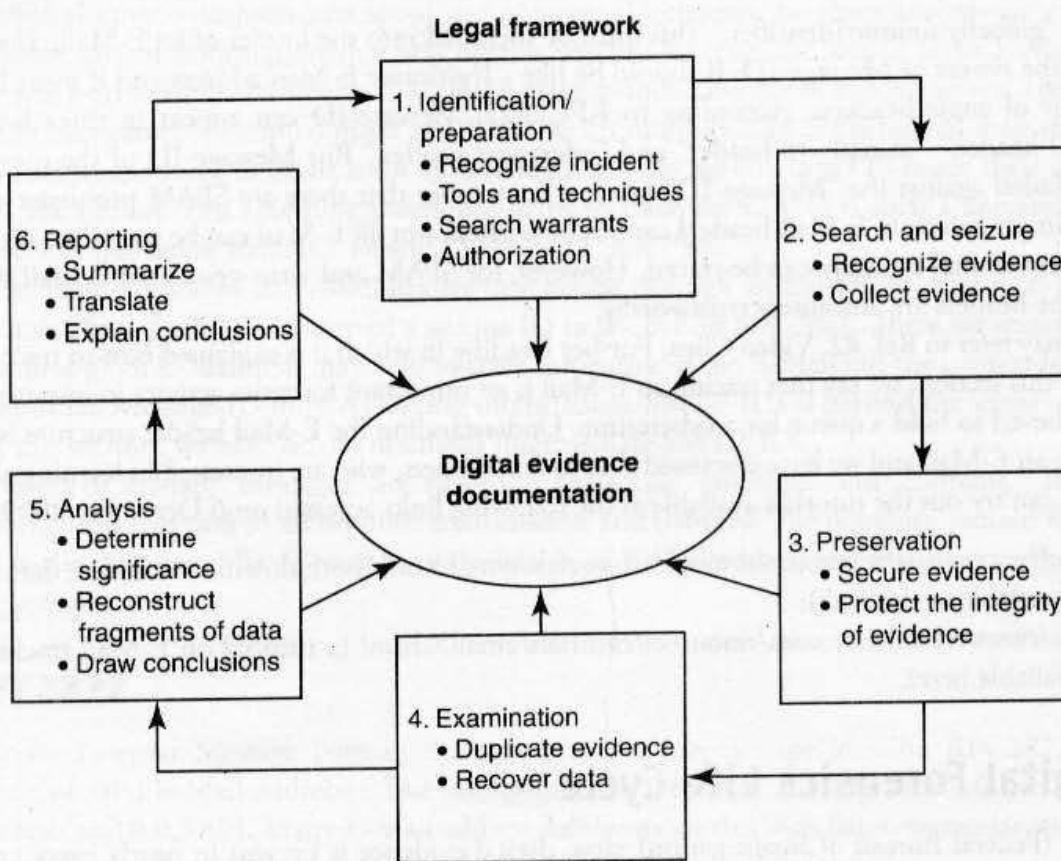


Figure 7.5 | Process model for understanding a seizure and handling of forensics evidence legal framework.

relevant, authentic and that the evidence presented is not the result of hearsay, original writing or the legal equivalent thereof, and more probative than prejudicial.

Usually the assumption is that adequate facts can be established for the introduction of an evidence exhibit. Under this assumption, people involved in the “chain of custody” need to testify a number of aspects relating to the evidence – the testimony would typically include the processes used for creating, handling and introducing the evidence, the method used for collecting the exhibit (i.e. the evidence artifacts) as well as the manner in which the exhibit is brought to court. These people also get involved to testify about the event sequences that may have produced the evidence exhibit. Digital forensics evidence is usually latent, that is, “hidden” in that it can only be seen by the trier of fact at the desired level of detail through the use of tools. In order for tools to be properly applied to a legal standard, it is required that the people who use these tools properly apply their scientific knowledge, skill, experience, training and/or education. They should also use a methodology that is reliable within defined standards to show the history, pedigree and reliability of the tools, proper testing and calibration of those tools, and their application to functions they perform within the limitations of their reliable application.

Non-experts can make statement about evidence to the extent that they can clarify non-scientific issues by stating what they observed. Digital forensics evidence can be challenged by establishing that, by intent or accident, content, context, meaning, process, relationships, ordering, timing, location, corroboration and/or consistency are made or missed by the other side, and that this produced false positives or false negatives in the results presented by the other side. The trier of fact then must determine how the evidence is applied to the matter at hand so as to weigh it against and in conjunction with all of the other evidence and to render judgments about the legal matters that the evidence applies to.

Box 7.8 Forensics Experts – What do they Do?

The role of forensics experts has become a very special one in digital forensics and there are many reasons for it. Handling of digital evidence requires special expertise that comes from training and experience. A lot of protocols come into picture depending on the nature of the evidence; for example, the complexity, volume and delicate nature of relevant electronic evidence. Depending on such nature of the evidence, even expensive hardware and software tools will be required along with the investigator's experience to achieve optimal results. In most cases, it is best to address this through partnership with a third party expert forensics firm.

"Peeking around the data" on your own may destroy relevant date and time stamps and other metadata, and more importantly, it may expose you to sanctions for spoliation. Using overly generic discovery requests ("please provide all electronic data . . .") can produce excessively broad or burdensome requests. The court may reject such request as it may be too expensive and time consuming to fulfill these requests. If digital forensics evidence is properly managed, then a computer forensics expert will be able to focus on the relevant electronic discovery targets, and will be able to lower the eventual cost of litigation and increase the probability of a favorable outcome.

A forensics expert team brings the following additional benefits:

1. **Technology expertise:** This is perhaps the biggest advantage of partnership with a computer forensics expert. As an example of the technological complexity, consider the proliferation of operating systems in the last decade: mainframe operating systems, Windows 95/98, UNIX, Linux, Windows NT, Windows Server, Macintosh, Windows 2000, Windows XP and Novell Netware. Specific forensics tools must be used with each of these file systems, along with training and experience to interpret search results. Although some evidence may be found easily, other evidence may have been deleted, altered, hidden or encrypted. Forensics experts routinely deal with such complexities and nuances.
2. **Forensics methodology:** A comprehensive forensics methodology, repeatable and defensible, has become a key attribute in choosing a forensics expert firm. Proper use of a repeatable process prevents making the same mistake twice, ensures proper chain of custody, leverages successful techniques from prior cases, supports clear and concise testimony, and generally guarantees efficient forensics case management.
3. **Experience and efficiency:** The tools and methods of computer forensics examination are still in their infancy. Experts know how to quickly navigate through the variety of esoteric tools and procedures. Experts also have the experience to cull thousands of files based on patterns and keywords. Therefore, working with experts will efficiently produce relevant results for counsel.

The "chain of custody" concept, too, is a very important one in digital forensics (see Section 7.8). We have provided links in Ref. #2, Video Clips, Further Reading about evidence seizure as part of forensics investigation.

Once the forensics experts know the landscape of the computers and other artifacts involved, they formulate a cost proposal governing all needed activities in the forensics search and analysis. This is combined with a proposed timeline of activities, lists of anticipated deliverables and a plan for production and turnover of evidence. In addition to this, forensics experts also submit a preliminary risk analysis for the forensics service being proposed. This will detail any technical and political obstacles that were envisaged. For forensics findings of any type to be used as admissible evidence in court, the data acquisition, also known as "imaging," of the subject computers must be flawless and defensible in substance and technique. Forensics examiners are trained to follow a carefully developed set of protocols for acquisition of electronic evidence designed to ensure authenticity and diligent chain of custody.

7.7.2 The Phases in Computer Forensics/Digital Forensics

The investigator must be properly trained to perform the specific kind of investigation that is at hand. Tools that are used to generate reports for court should be validated. There are many tools to be used in the process.

One should determine the proper tool to be used based on the case. Broadly speaking, the forensics life cycle involves the following phases:

1. Preparation and identification;
2. collection and recording;
3. storing and transporting;
4. examination/investigation;
5. analysis, interpretation and attribution;
6. reporting;
7. testifying.

To mention very briefly, the process involves the following activities:

1. **Prepare:** Case briefings (see Box 7.9), engagement terms, interrogatories, spoliation prevention, disclosure and discovery planning, discovery requests.
2. **Record:** Drive imaging, indexing, profiling, search plans, cost estimates, risk analysis.
3. **Investigate:** Triage images, data recovery, keyword searches, hidden data review, communicate, iterate.
4. **Report:** Oral vs. written, relevant document production, search statistic reports, chain of custody reporting, case log reporting.
5. **Testify:** Testimony preparation, presentation preparation, testimony.

Let us take a brief look at each of the activites mentioned. Table 7.5 shows phase-wise outcome from the phases mentioned above.

Preparing for the Evidence and Identifying the Evidence

In order to be processed and applied, evidence must first be identified as evidence. It can happen that there is an enormous amount of potential evidence available for a legal matter, and it is also possible that the vast majority of the potential evidence may never get identified. Consider that every sequence of events within a single computer might cause interactions with files and the file systems in which they reside, other processes and the programs they are executing and the files they produce and manage, and log files and audit trails of various sorts. In a networked environment, this extends to all networked devices, potentially all over the world. Evidence of an activity that caused digital forensics evidence to come into being might be contained in a time stamp associated with a different program in a different computer on the other side of the world that was offset from its usual pattern of behavior by a few microseconds. If the evidence cannot be identified

Box 7.9 Case Briefings

In case briefings, consider the following:

1. Ensure that you know both your client's and the adverse party's position, and have seen all relevant paperwork.
2. Try not to project a bias in the case description; the intent should be to consider the case objectively, and provide you with the good news and the bad news (bad news early can be good news).
3. Be upfront in discussing any limitations or restrictions on the forensics investigation, including budgetary constraints, time deadlines, cooperation levels to be expected from the adverse party, required travel, onsite or after-hours forensics imaging requirements, etc.

as relevant evidence, it may never be collected or processed at all, and it may not even continue to exist in digital form by the time it is discovered to have relevance.

Collecting and Recording Digital Evidence

Digital evidence can be collected from many sources. Obvious sources include computers, cell phones, digital cameras, hard drives, CD-ROM, USB memory devices and so on. Non-obvious sources include settings of digital thermometers, black boxes inside automobiles, RFID tags and webpages (which must be preserved as they are subject to change). Special care must be taken when handling computer evidence: most digital information is easily changed, and once changed it is usually impossible to detect that a change has taken place (or to revert the data back to its original state) unless other measures have been taken. For this reason, it is common practice to calculate a cryptographic hash of an evidence file and to record that hash elsewhere, usually in an investigator's notebook, so that one can establish at a later point in time that the evidence has not been modified as the hash was calculated. Figures 7.6 and 7.7 show the media that typically holds digital evidence.



Figure 7.6 Media that can hold digital evidences.

Sources: <http://www.homeofficebuddy.com>; <http://oldcomputers.net>; <http://www.homecomputertalk.com>; <http://www.cyberindian.net>; <http://www.srs-electronicmall.com>; <http://transcriptdivas.co.uk> and <http://images.google.co.in>; <http://www.mobileshop.com>; <http://images.google.co.in>; <http://www.slipperybrick.com>; <http://images.google.co.in>; <http://www.letsgodigital.org>; <http://www.computerrepairofcomplaints.com>; <http://www.indigoshop.co.uk>; <http://www.adorama.com>, <http://sp.sony-europe.com/media/4/1914>, <http://www.video99.co.uk/dat.jpg>



Figure 7.7 | Some more media that can hold digital evidences.

Collecting volatile data requires special technical skills. If the machine is still active, any intelligence that can be gained by examining the applications currently open is recorded. If the machine is suspected of being used for illegal communications, such as terrorist traffic, not all of this information may be stored on the hard drive. If information stored solely in random access memory (RAM) is not recovered before powering down, it may be lost. This results in the need to collect volatile data from the computer at the onset of the response.

Embedded flash memory falls under the family of solid state non-volatile memory; it is used in thumb drives (USB stick), cell phones, game console, secure digital cards (SD cards) and multimedia cards (MMC). This technology differs from the normal hard disk by not containing any moving parts such as arms and cylinders. In addition, the physical size of the embedded memory chips makes it a good candidate to be used in every device that interacts with our daily life. The benefits of embedded memory continue to increase life expectancy of the memory chip due to a reduction of mechanical failure even if it had been used in high vibrated or trembling environment. Figure 7.8 shows the various types of “embedded memories” inside a computer (ROM, PROM, EPROM, EEPROM).

Storing and Transporting Digital Evidence

The following are specific practices that have been adopted in the handling of digital evidence:

1. Image computer media using a write-blocking tool to ensure that no data is added to the suspect device;
2. establish and maintain the chain of custody (refer to Section 7.8);

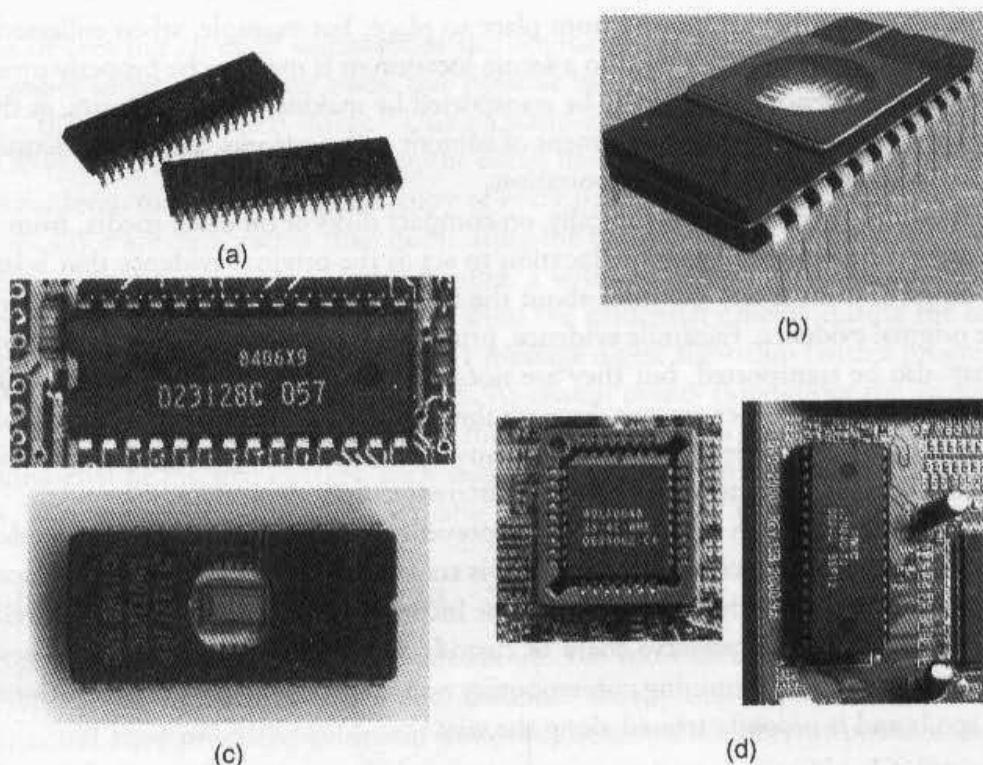


Figure 7.8 | Embedded memories inside computer. (a) Read-only memory (ROM) chips; (b) erasable programmable read-only memory (EPROM) chip; (c) programmable read-only memory (PROM) chips; (d) electrically erasable programmable read-only memory (EEPROM) chips.
Sources: <http://amigakit.leanmancomputing.com>; <http://www.old-computers.com>; <http://upload.wikimedia.org> and <http://www.electrongate.com>; <http://wiki.laptop.org> and <http://www.dv-rec.de>

3. document everything that has been done;
4. only use tools and methods that have been tested and evaluated to validate their accuracy and reliability.



Some of the most valuable information obtained in the course of a forensics examination will come from the computer user. An interview with the user can yield valuable information about the system configuration, applications, encryption keys and methodology. Forensics analysis is much easier when analysts have the user's passphrases to access encrypted files, containers and network servers.

In storage, digital media must be properly maintained for the period of time required for the purposes of trial. Depending on the particular media (see Figs. 7.6 and 7.7), this may involve any number of requirements ranging from temperature and humidity controls to the need to supply additional power or to re-read media. Storage must be adequately secure to assure proper "chain of custody" (refer to Section 7.8), and typically, for evidence areas containing large volumes of evidence, paperwork associated with all actions related to the evidence must be kept to assure that evidence does not go anywhere without being properly traced. Many things can go wrong in storage, including decay over time; environmental changes resulting in the presence or absence of a necessary condition for preservation; direct environmental assault on the media; fires, floods and other external events reaching the evidence; loss of power to batteries and other media-preserving mechanisms; and decay over time from other natural and artificial sources.

Sometimes evidence must be transported from place to place. For example, when collected from a crime scene, the evidence must somehow be moved to a secure location or it may not be properly preserved through a trial. Digital forensics evidence can generally be transported by making exact duplicates, at the level of bits, of the original content. This includes the movement of content over networks, assuming adequate precautions are taken to assure its purity during that transportation.

Evidence is often copied and sent electronically, on compact disks or on other media, from place to place. Original copies are normally kept in a secure location to act as the original evidence that is introduced into the legal proceedings. If there is any question about the bits contained in the evidence, it can be settled by returning to the original evidence. Facsimile evidence, printouts and other similar depictions of digital forensics evidence may also be transported, but they are not a good substitute for the original digital forensics evidence in most cases, among other reasons, because they make it far harder, if not impossible, to properly analyze what the original bits were. For example, many different bit sequences may produce the output depictions, and identical bit sequences may produce different output depictions.

Adequate care must be taken in transportation to prevent spoliation as well. For example, in a hot car, digital media tends to lose bits. Increasingly, evidence is transported electronically from place to place, and even the simplest errors can cause the data arriving to be incorrect or improperly authenticated for legal purposes. Care must also be taken to preserve chain of custody and assure that a witness can testify accurately about what took place, using and retaining contemporary notes, and taking proper precautions to assure that evidence is not spoilt and is properly treated along the way.

Examining/Investigating Digital Evidence

In an investigation in which the owner of the digital evidence has not given consent to have his or her media examined (as in some criminal cases) special care must be taken to ensure that the forensics specialist has the legal authority to seize, copy and examine the data. Sometimes authority stems from a search warrant.



As a general rule, one should not examine digital information unless one has the legal authority to do so. Amateur forensics examiners should keep this in mind before starting any unauthorized investigation.

Now let us understand the difference between live and dead analysis. After that we explain about “imaging of the media.” Traditionally, computer forensics investigations were performed on data at rest, for example, the content of hard drives. This can be thought of as a “dead analysis.” Investigators were told to shutdown computer systems when they were impounded for fear that digital time bombs might cause data to be erased. In recent years, there has been increasingly an emphasis on performing analysis on live systems. One reason is that many current attacks against computer systems leave no trace on the computer’s hard drive; the attacker only exploits information in the computer’s memory. Another reason is the growing use of cryptographic storage: it may be that the only copy of the keys to decrypt the storage is in the computer’s memory; turning OFF the computer will cause that information to be lost.



For the purpose of digital evidence examination, “imaging of electronic media” (on which the evidence is believed to be residing) becomes necessary.

The process of creating an exact duplicate of the original evidentiary media is often called “Imaging.” Computer forensics software packages make this possible by converting an entire hard drive into a single searchable file – this file is called an “image.” Using a stand-alone hard drive duplicator or software imaging tools such as DCFLdd, IXImager or Guymager, the entire hard drive is completely duplicated. This is usually done at the sector level, making a bit-stream copy of every part of the user-accessible areas of the hard drive which can physically store data, rather than duplicating the file system. The original drive is then moved to secure storage to prevent tampering. During imaging, a write protection device or application is normally used to ensure that no information is introduced onto the evidentiary media during the forensics process. The imaging process is verified by using the SHA-1 message digest algorithm (with a program such as sha1sum) or other still viable algorithms such as MD5. At critical points throughout the analysis, the media is verified again, known as “hashing,” to ensure that the evidence is still in its original state. In corporate environments seeking civil or internal charges, such steps are generally overlooked due to the time required to perform them. They are essential for evidence that is to be presented in a courtroom, however.

Analysis, Interpretation and Attribution

Analysis, interpretation and attribution of evidence are the most difficult aspects encountered by most forensics analysts. In the digital forensics arena, there are usually only a finite number of possible event sequences that could have produced evidence; however, the actual number of possible sequences may be almost unfathomably large. In essence, almost any execution of an instruction by the computing environment containing or generating the evidence may have an impact on the evidence. Basically, all digital evidence must be analyzed to determine the type of information that is stored upon it. For this purpose, specialty tools are used that can display information in a format useful to investigators. Such forensics tools include but are not limited to the following list. Readers can refer to links in References to know more about this toolkit. (Also refer to Appendix I in CD.)

1. Access Data’s FTK^[2];
2. guidance Software’s EnCase^[3];
3. Dr. Golden Richard III’s file carving tool Scalpel^[4]; “file carving” is the process of recovering files from an investigative target, potentially without knowledge of the file system structure;
4. Brian Carrier’s Sleuth Kit^[5]: The Sleuth Kit (TSK) is a library and collection of Unix- and Windows-based tools and utilities to allow for the forensics analysis of computer systems.

Typical forensics analysis includes a manual review of material on the media – an example of OS-specific investigation is reviewing the Windows registry. Through this registry inspection, the investigators objective is to look for suspect information, discovering and cracking passwords, performing keyword searches for topics related to the crime, and extracting E-Mail and images for review. Numerous other tools are used in digital forensics investigations to analyze specific portions of information. See Box 7.10 regarding file carving technique. In Chapter 11 (Section 11.6.2), we have provided case studies based on TSK and EnCase.

Box 7.10 File Carving – a Powerful Technique for Digital Forensics

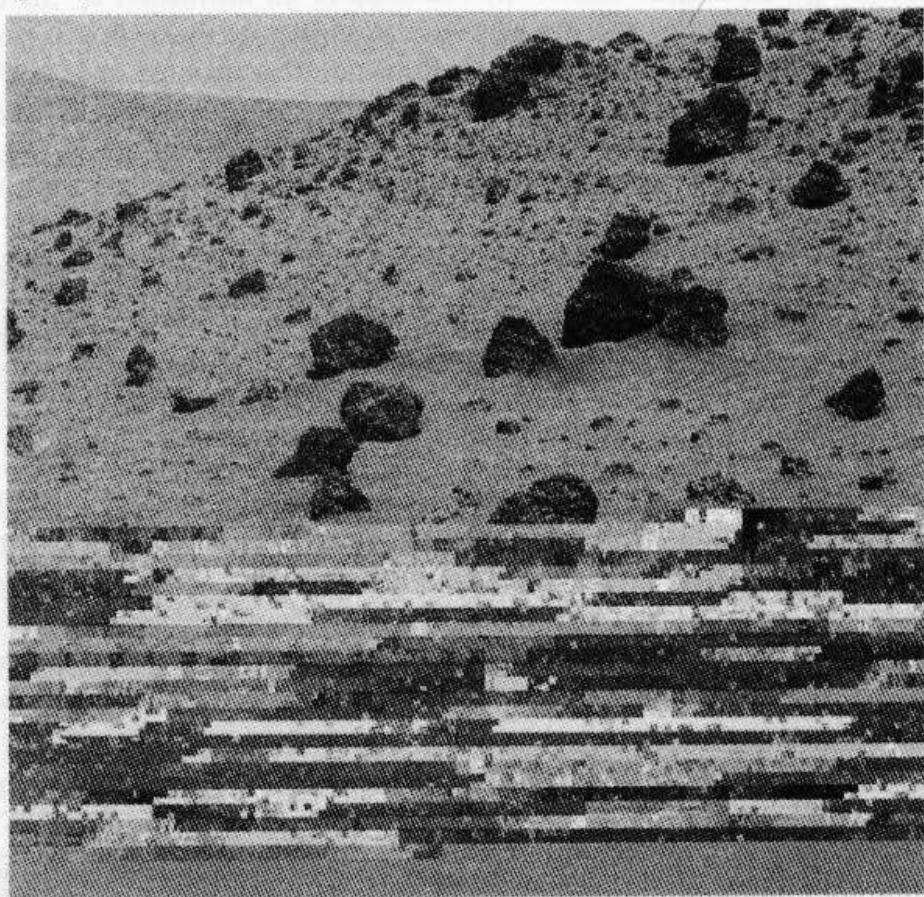
File carving is the process of recovering files from an investigative target, potentially without knowledge of the file system structures. The process is based on information about the format of the file types of interest, as well as on assumptions about how files are typically laid out on block devices. If the file system metadata is used at all, it is typically used only for establishing cluster sizes and avoiding carving of undeleted files (which can be extracted without file carving).

Box 7.10 File Carving . . . (Continued)

File carving is an important technique for digital forensics investigation and for simple data recovery. By using a database of headers and footers (essentially, strings of bytes at predictable offsets) for specific file types, file carvers can retrieve files from raw disk images, regardless of the type of file system on the disk image. Perhaps more importantly, file carving is possible even if the file system metadata has been destroyed. File carving is a particularly powerful technique because files can be retrieved from raw disk images, regardless of the type of file system. File retrieval is possible even if the file system metadata has been completely destroyed. For example, a file deposited on a FAT partition can often be recovered even if the partition is reformatted as NTFS, then ext2, then FAT again, even if bad block checks (which are generally read-only operations) are applied. Although a file system's metadata can be quite fragile, file data is much more resilient. One limitation of the current generation of automatic file carvers is that a file's data must be contiguous to be carved properly.

With some manual intervention or additional work, even non-contiguous data can be carved. Luckily, modern file systems, such as ext2/3 (for Linux) and NTFS (for Windows), are actually quite kind to file carvers. This is because they strive to perform disk allocation which minimizes file fragmentation to reduce seek time and improve file system performance. Even under legacy file systems such as FATx, which are prone to fragmentation, the data of many files of modest size is likely to be unfragmented. This is because file fragmentation, if present, is on cluster boundaries and cluster sizes under FATx tend to be rather large.

File carvers ignore the file system and carve the images directly from data blocks. In cases of fragmented files, the carver returns an imperfect photo, but this image might be sufficient to identify the subject (see Fig. 7.9).

**Figure 7.9**

An image constructed from a fragmented file.

Source: Linux Magazine available at the link: http://www.linux-magazine.com/w3/issue/93/Foremost_Web.pdf (24 December 2009).

As it is not feasible to reconstruct every possible sequence to investigate all the sequences that may have produced the actual evidence in any particular case, forensics analysts focus only on large sets of sequences of events. They tend to characterize evidence aspects in those terms. For example, if the evidence includes a log file that appears to be associated with a file transfer, the name of the file transfer program included in the log file will typically be associated with common behavior of that program and will be used as a basis for the analysis (readers will understand this when they refer to cyberforensics investigation case – Digital Forensics Case Illustration 2: Analysis of Seized Floppy – the Drug Peddler Case in Section 11.6.2 of Chapter 11). The user identity indicated in the log file may be associated with a human or group, and this creates an initial attribution that can then be used as a basis for further efforts to attribute to the standard of proof required. Note, however, that the presence of this record in an audit trail does not mean that the program was ever run at all or that the thing the record indicates ever took place or that the user identified caused the events of interest. There are many possible sequences of events that could result in the presence of such a record. For example, without limiting the totality of possible event sequences, the record could have been placed there maliciously; it could be a record produced by another program that looks similar to the program being considered; it could have been a record produced by the program even though the file transfer failed; the record could have been produced by a Trojan Horse acting for the user or the record could be there because of a failure in a disk write that produced a crosslink between disk blocks associated with different sorts of records.

Analysis, interpretation and attribution of digital forensics evidence can be reconciled with non-digital evidence and digital forensics evidence can be externally stipulated or they can be demonstrated facts. For example, suppose the digital forensics evidence appears to show that person X was present at the local console of a computer in Los Angeles, California, two hours after passing through customs and immigration in London, UK. Suppose further that the network logs from distant systems show that the transfer indeed took place; even then, it is not a reasonable interpretation to assert that the individual was in Los Angeles. Another explanation is possible, whether there are two distinct individuals involved rather than a single individual, a remote control mechanism, alteration of multiple logs in multiple systems, alteration of customs and immigration logs, altered time clocks or any of a long list of other possibilities. Although in some venues, the “do not confuse me with the facts” approach may apply, in a legal setting, digital forensics evidence should reconcile with external reality.

Several open-source tools are available to conduct an analysis of open ports, mapped drives (including through an active VPN connection) and open or mounted encrypted files (containers) on the live computer system. Utilizing open-source tools and commercially available products, it is possible to obtain an image of these mapped drives and the open encrypted containers in an unencrypted format. Open-source forensics tools^[6] for PCs include Knoppix and Helix by US e-fense Inc. These are Unix-based tools used in Linux environment. Commercial imaging tools include Access Data's Forensics Toolkit and Guidance Software's EnCase application.

The above-mentioned open-source tools mentioned can also scan RAM and Registry information to show recently accessed Web-based E-Mail sites and the login/password combination used. Additionally, these tools can also yield login/password for recently accessed local E-Mail applications including MS Outlook. In the event that partitions with Encrypted File System (EFS – file system driver that provides filesystem-level encryption in Microsoft Windows operating systems) are suspected to exist, the encryption keys to access the data can also be gathered during the collection process. With Microsoft's most recent addition, Vista and Vista's use of BitLocker and the Trusted Platform Module (TPM), it has become necessary in some instances to image the logical hard drive volumes before the computer is shutdown.

RAM can be analyzed for prior content after power loss. Although as production methods become cleaner, the impurities used to indicate a particular cell's charge prior to power loss are becoming less common. However, data held statically in an area of RAM for long periods of time are more likely to be detectable using these methods. The likelihood of such recovery increases as the originally applied voltages,

operating temperatures and duration of data storage increases. Holding unpowered RAM below -60°C will help preserve the residual data by an order of magnitude, thus improving the chances of successful recovery. However, it is impractical to do this during a field examination.

Now let us understand *types of digital analysis*. It is important, because, a digital investigation may encounter many formats of digital data and, therefore, there exist several types of analysis. The different analysis types are based on interpretation, or abstraction, layers, which are generally part of the data's design. For example, consider the data on a hard disk, which has been designed with several interpretation layers. The lowest layer may contain partitions or other containers that are used for volume management. Inside each partition is data that has been organized into a file system or database. The data in a file system is interpreted to create files that contain data in an application-specific format. Each of these layers has its own analysis techniques and requirements. Examples of common digital analysis types include:

Box 7.11 The RAID Levels

Explanation of RAID is important in forensics context. RAID data acquisitions are performed as part of computer forensics. RAID stands for Redundant Array of Independent (or inexpensive) Disks. It is a category of disk drives that employs multiple drives in combination for fault tolerance and performance. Although use of RAID disk drives is frequent on servers, the use is not generally necessary for personal computers. With RAID, you can store the same data redundantly, that is, in multiple places in a balanced way to improve overall performance. In late 1980s and early 1990s, computer information servers had to sustain a dramatic increase in capacity expectation in terms of amount of data served and stored on them. Storage technologies had become too expensive to place a large number of high-capacity hard drives in the servers. The response to this situation came through concept of RAID; subsequently RAID became very popular. Note that "data striping" means spreading out blocks of each file across multiple disk drives.

RAID was a system developed as a solution to link together a large number of low-cost hard drives with a view to form a single large capacity storage device that provided superior performance, storage capacity and reliability as compared to older storage solutions. Since then RAID became widely used and is deployed as an enterprise storage method in server markets. However, in the last 5 years it has become much more common in end-user systems.

Attractiveness of RAID comes from the fact that the array of disks distributes data across multiple disks; however, computer user and operating system sees the array as one single disk. The array of disks (RAID) can be set up to serve multiple purposes and offers many advantages such as redundancy, increased performance and lower costs.

Those who are technically savvy may know that there are number of different RAID levels as follows:

1. **Level 0:** This is nothing but a striped disk array without fault tolerance. It provides data striping (spreading out blocks of each file across multiple disk drives) but no redundancy. This results in an improved performance; however, it does not deliver fault tolerance. All data in the array is lost if one drive fails.
2. **Level 1:** This is mirroring and duplexing to provide disk mirroring. Level 1 provides double the rate of read transaction for single disks, but provides the same write transaction rate as single disks.
3. **Level 2:** This is error-correcting coding; however, it is not a typical implementation. This level is rarely used. It stripes data at the bit level rather than the block level.
4. **Level 3:** This is bit-interleaved parity. Level 3 provides byte-level striping with a dedicated parity disk. It is rarely used; probably because it cannot service simultaneous multiple requests.
5. **Level 4:** This is dedicated parity drive. Its use is common for implementation of RAID. Level 4 offers block-level striping (like Level 0) with a parity disk. If a data disk fails, the parity data is used to create a replacement disk. There is a disadvantage to Level 4 in that the parity disk can create write bottlenecks.

Box 7.11 The RAID . . . (Continued)

6. **Level 5:** This is block interleaved distributed parity. The idea here is to provide data striping at the byte level and also to stripe error correction information. Level 5 results in excellent performance and good fault tolerance. It is most popular among RAID implementation methods.
7. **Level 6:** This is independent data disks with double parity. This level provides block-level striping with parity data distributed across all disks.
8. **Level 0+1:** This is nothing but a mirror of stripes. It is not one of the original RAID levels. With this level used, two RAID 0 stripes are created and one RAID 1 mirror is created over them. The use of this level is typically seen for both replicating and sharing data among disks.
9. **Level 10:** This is stripe of mirrors. However, it is not considered to be an original RAID level. With this level, multiple RAID 1 mirrors are created, and a RAID 0 stripe is created over these.
10. **Level 7:** This is a trademark of STC (Storage Computer Corporation). It adds caching to Levels 3 or 4.
11. **RAID S:** This is also known a Parity RAID. It is an EMC Corporation's proprietary striped parity RAID system used in its Symmetrix storage systems.

For desktop computer systems, there are typically three forms of RAID used: RAID 0, RAID 1 and RAID 5.

1. **Media analysis:** It is analysis of the data from a storage device. This analysis does not consider any partitions or other operating system (OS)-specific data structures. If the storage device uses a fixed size unit, such as a sector, then it can be used in this analysis.
2. **Media management analysis:** It is analysis of the management system used to organize media. This typically involves partitions and may include volume management or redundant array of independent (or inexpensive) disks (RAID, see Box 7.11) systems that merge data from multiple storage devices into a single virtual storage device.
3. **File system analysis:** It is the analysis of the file system data inside a partition or disk. This typically involves processing the data to extract the contents of a file or to recover the contents of a deleted file.
4. **Application analysis:** It is the analysis of the data inside a file. Files are created by users and applications. The format of the contents is application-specific.
5. **Network analysis:** It is the analysis of data on a communications network. Network packets can be examined using the OSI Model to interpret the raw data into an application-level stream. Application analysis is a large category of analysis techniques because there are many application types. Some of the most common ones are as follows:
 - *OS analysis:* An OS is an application, although it is a special application because it is the first one that is run when a computer starts. This analysis examines the configuration files and output data of the OS to determine what events may have occurred.
 - *Executable analysis:* Executables are digital objects that can cause events to occur and they are frequently examined during intrusion investigations because the investigator needs to determine what events the executable could cause.
6. **Image analysis:** It was mentioned that the “image” is a single searchable file. Digital images are the target of many digital investigations because some are contraband. This type of analysis looks for information about where the picture was taken and who or what is in the picture. Image analysis also includes examining images for evidence of steganography (steganography in the context of forensics is discussed in Section 7.12).
7. **Video analysis:** Digital video is used in security cameras and in personal video cameras and webcams. Investigations of online predators can sometimes involve digital video from webcams. This type of analysis examines the video for the identification of objects in the video and the location where it was shot.

Reporting

Once the analysis is complete, a report is generated. The report may be in a written form or an oral testimony or it may be a combination of the two. Finally, evidence, analysis, interpretation and attribution must ultimately be presented in the form of expert reports, depositions and testimony. After extracting and analyzing the evidence collected, the results may need to be presented before a wide variety of audience including law enforcement officials, technical experts, legal experts, corporate management, etc. Depending on the nature of the incident or crime, it may become mandatory to present the findings in a court of law. It could be a police investigation or a presentation to appropriate corporate management or it could be an internal company investigation. As a result of the findings in this phase, it should be possible to confirm or discard the allegations with regard to particular crime or suspected incident. The presentation of evidence and its analysis, interpretation and attribution have many challenges.

Presentation of the report is more of an art than a science, but there is a substantial amount of scientific literature on methods of presentation and their impact on those who observe those presentations. Aspects ranging from the order of presentation of information to the use of graphics and demonstrations, all present significant challenges and are poorly defined. In general, reporting is a complex and tricky process and beyond the scope of discussion here. The following are the broad-level elements of the report:

1. Identity of the reporting agency;
2. case identifier or submission number;
3. case investigator;
4. identity of the submitter;
5. date of receipt;
6. date of report;
7. descriptive list of items submitted for examination, including serial number, make and model;
8. identity and signature of the examiner;
9. brief description of steps taken during examination, such as string searches, graphics image searches and recovering erased files;
10. results/conclusions.

In Chapter 11, we present illustrative examples of a digital forensics investigation report (refer to Section 11.6.3).

Testifying

This phase involves presentation and cross-examination of expert witnesses. Depending on the country and legal frameworks in which a cybercrime case is registered, certain standards may apply with regard to the issues of expert witnesses. Digital forensics evidence is normally introduced by expert witnesses except in cases where non-experts can bring clarity to non-scientific issues by stating what they observed or did. For example, a non-expert who works at a company may introduce the data he/she extracted from a company database and discuss how the database works and how it is normally used from a non-technical standpoint. To the extent that the witness is the custodian of the system or its content, he/she can testify to matters related to that custodial role as well.

Only expert witnesses can address issues based on scientific, technical or other specialized knowledge. A witness qualified as an expert by knowledge, skill, experience, training or education may testify in the form of an opinion or otherwise if (a) the testimony is based on sufficient facts or data, (b) the testimony is the product of reliable principles and methods, and (c) the witness has applied the principles and methods reliably to the facts of the case. If facts are reasonably relied upon by experts in forming opinions or inferences, the facts need not be admissible for the opinion or inference to be admitted; however, the expert may in any event be required to disclose the underlying facts or data on cross-examination.



Experts typically have very specialized knowledge about specific things of import to the matter at hand and anyone put up as an expert who does not have the requisite specialized knowledge can be seriously challenged by competent experts and counsel on the other side. Experts who are shown to be inadequate to the task are sometimes chastised in the formal decisions made by the courts, and such witnesses are often unable to work in the field for a period of many years thereafter because counsel for the opposition will bring this out at trial.

Now that we have explained the phases involved in the digital forensics investigation process, to conclude this section, we have summarized in Table 7.5 the outcomes from those phases. After that we have explained about precautions to be taken while collecting electronic evidence.

7.7.3 Precautions to be Taken when Collecting Electronic Evidence

So far we have established how important the digital/computer evidence is for cyberforensics. Therefore, collection of the evidence must happen with due care. Special measures should be taken while conducting a forensics investigation if it is desired for the results to be used in a court of law. One of the most important

Table 7.5 | Digital forensics – phase-wise outputs

| Phase | Activities/Processes | Outputs |
|--|---|--|
| <i>Evidence Preparation and Identification</i> | <ul style="list-style-type: none"> Monitoring authorization and management support, and obtain authorization to do the investigation. Ensuring that operations and infrastructure are able to support an investigation. Providing a mechanism for the incident to be detected and confirmed. Creating an awareness so that the investigation is needed (identify the need for an investigation). Planning for getting the information needed from both inside and outside the investigating organization. Identifying the strategy, policies and previous investigations. Informing the subject of an investigation or other concerned parties that the investigation is taking place. | Plan Authorization Warrant Notification Confirmation |
| <i>Collection and Recording, Preserving and Transportation</i> | <ul style="list-style-type: none"> Determine what a particular piece of digital evidence is, and identifying possible sources of data. Determine where the evidence is physically located. Translating the media into data. Ensuring integrity and authenticity of the digital evidence, for example, write protection, hashes, etc. Packaging, transporting and storing the digital evidence. Preventing people from using the digital device or allowing other electromagnetic devices to be used within an affected radius. Recording the physical scene. Duplicating digital evidence using standardized and accepted procedures. Ensuring the validity and integrity of evidence for later use. | Crime type Potential Evidence Sources Media Devices Event |

(Continued)

Table 7.5 | (Continued)

| <i>Phase</i> | <i>Activities/Processes</i> | <i>Outputs</i> |
|--|--|---|
| <i>Examination/Investigation and Analysis,</i> | <ul style="list-style-type: none"> • Determining how the data is produced, when and by whom. • Determine and validating the techniques to find and interpret significant data. | Log files, file Events log Data |
| <i>Interpretation and Attribution</i> | <ul style="list-style-type: none"> • Extracting hidden data, discovering the hidden data and matching the pattern. • Recognizing obvious pieces of digital evidence and assessing the skill level of suspect. • Transform the data into a more manageable size and form for analysis. • Confirming or refuting allegations of suspicious activity. • Identifying and locating potential evidence, possibly within unconventional locations. • Constructing detailed documentation for analysis and drawing conclusions based on evidence found. • Determining significant based on evidence found. • Testing and rejecting theories based on the digital evidence. • Organizing the analysis results from the collected physical and digital evidence. • Eliminating duplication of analysis. • Build a timeline. • Constructing a hypothesis of what occurred, and comparing the extracted data with the target. • Documenting the findings and all steps taken. | Information |
| <i>Presentation and reporting</i> | <ul style="list-style-type: none"> • Preparing and presenting the information resulting from the analysis phase. • Determine the issues relevance of the information, its reliability and who can testify to it. • Interpreting the statistical from analysis phase. • Clarifying the evidence and documenting the findings. • Summarizing and providing explanation of conclusions. • Presenting the physical and digital evidence to a court or corporate management. • Attempting to confirm each piece of evidence and each event in the chain either along with each other, or independent of one evidence and/or other events. • Proving the validity of the hypothesis and defend it against criticism and challenge. • Communicating relevant findings to a variety of audiences (management, technical personnel, law enforcement). | Evidence, Report |
| <i>Disseminating the case</i> | <ul style="list-style-type: none"> • Ensuring physical and digital property is returned to proper owner. • Determining how and what criminal evidence must be removed. • Reviewing the investigation to identify areas of improvement. • Disseminating the information from the investigation. • Closing out the investigation and preserving knowledge gained. | Evidence Explanation New policies and investigation Procedures Evidence disposed Investigation closed |

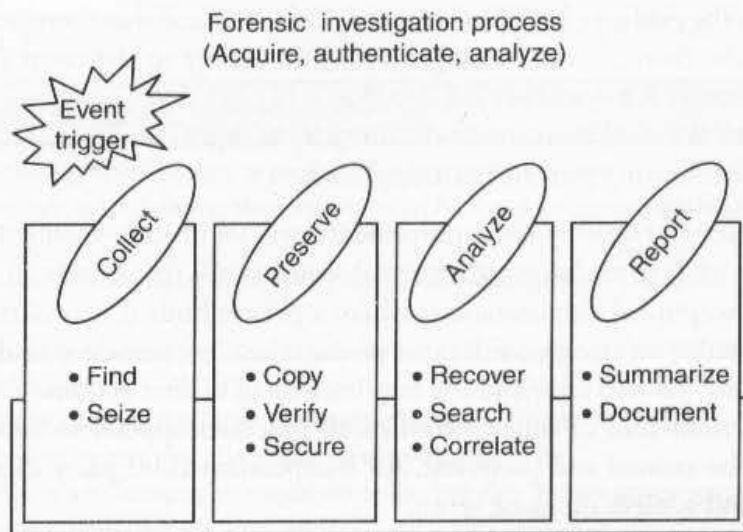


Figure 7.10 | Maintaining chain of custody – 1.

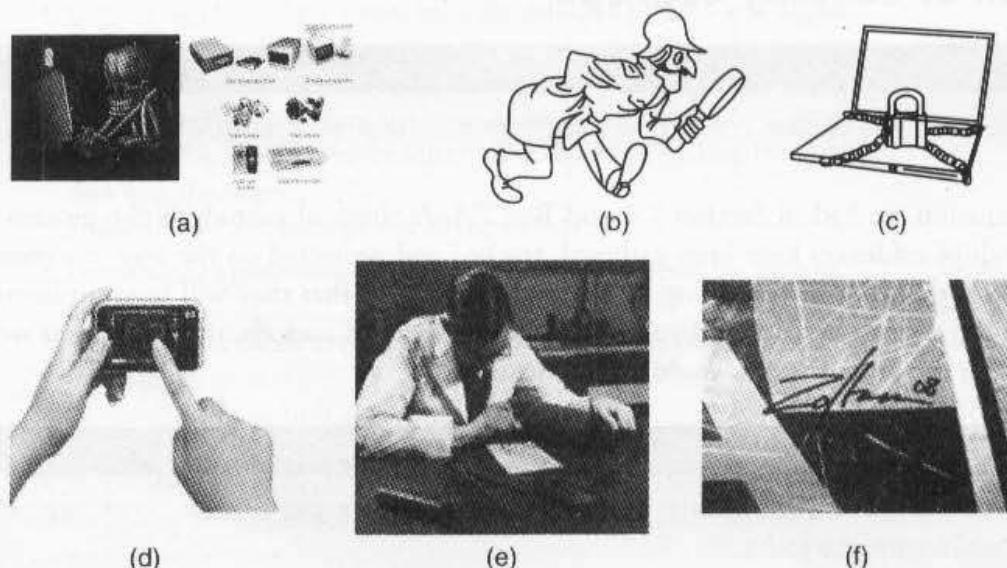


Figure 7.11 | Maintaining chain of custody – 2. (a) Source of evidence – where did it come from? (b) Who found it? (c) Where was it stored/locked up? (d) Who touched it/tampered with it? (e) What did they do to it? What did they do with it? (f) Human signature is always required.

Box 7.12 The Chain of Evidence Concept

A trial can be lost quickly if opposing counsel can show that the evidence chain of custody was violated. Before the world became computerized, proving chain of custody was easier. Attorneys and law enforcement filled out a chain of custody form that showed who had handled the evidence and the dates and times. With so much evidence coming from computers, especially in civil cases, many law firms need chain of custody software that is foolproof.

Box 7.12 The Chain . . . (Continued)

To avoid the risk of mishandling evidence, proper chain of custody procedure should always be strictly observed. This includes a thorough documentation of sources of data, the use of "write-blocking" devices to ensure no data changes take place inadvertently; initial forensics screening of disk drives for relevant data and making bit-for-bit copies of hard drives (images). The chain of custody also ensures that digital fingerprints (file hashes) match up at all stages of investigation, and that documentation (including photography and serial number inventory) of all evidence artifacts, as well as maintaining case logs for all evidence-related activities, is performed.

When preparing for trial, you need reliable chain of custody software supported by experts that know the latest rules. From the time we receive the media to the time we ship the results back, chain of custody is upheld. In a forensics data recovery, the senior individuals on forensics staff are the only ones who have access to the media. This allows for an efficient recovery and limits amount of individuals who have contact with the evidence.

Collecting information regarding the environment and use of the computer or machine under investigation, in an attempt to answer questions such as the following prior to the arrival of the forensics investigator, should be of utmost importance (refer to Figs. 7.10 and 7.11):

1. Who had access to the machine?
2. What level of authorization did all of those individuals having access to the machine have?
3. What was the machine used for?
4. What external devices did the machine connect to or interact with?
5. Which and how many servers did the machine "touch"?
6. Where and how will you store and safeguard the machine and the evidence after seizure?
7. Will you or an external third party be responsible for the storage and safeguarding of the seized machine and associated evidence?

At the very least, the evidence or property custody document should include the following information:

1. Name or initials of the individual collecting the evidence;
2. each person or entity subsequently having custody of it;
3. dates on which the evidence items were collected or transferred;
4. department (or Agency or Unit or Team) name and case number;
5. a brief description of the item seized.

7.9 Network Forensics

Recall the mention of network forensics in Section 7.5. We have already discussed that open networks can be the source of many network-based cyberattacks. In fact, a recent survey done^[7] by the Cop-Tech forum (a joint initiative of cybercrime cell of police and city IT firms) in a leading IT business city revealed that 50% of the Wi-Fi Internet connection in the city continued to be unprotected! A situation like this leads to the point that network forensics professionals need to understand how wireless networks work and the fundamentals of related technology. The topic of wireless network forensics is too vast and this section is aimed at providing an overview only here – from security perspective, they are the most risky ones. To know more about security of wireless networks, refer to Ref. #18, Books, Further Reading. In 1997, Marcus Ranum coined the term "wireless forensics."



Wireless forensics is a discipline included within the computer forensics science, and specifically, within the network forensics field. The goal of wireless forensics is to provide the methodology and tools required to collect and analyze (wireless) network traffic that can be presented as valid digital evidence in a court of law.

The evidence collected can correspond to plain data or, with the broad usage of VoIP technologies, especially over wireless, can include voice conversations. The wireless forensics process involves capturing all data moving over Wi-Fi network and analyzing network events to uncover network anomalies, discover the source of security attacks and investigate breaches on computers and wireless networks to determine whether they are or have been used for illegal or unauthorized activities. When performing wireless forensics, the security analyst must follow the same general principles that apply to computer forensics: identify, preserve and analyze the evidence to impartially report the findings and conclusions. There are many technical challenges for Wi-Fi traffic acquisition. That discussion is beyond the scope of this chapter. We have provided some useful resources on the topic of wireless network forensics in References Section.^[8]

7.10 Approaching a Computer Forensics Investigation

From the discussion so far, we can appreciate that computer forensics investigation is a detailed science. The main phases are: *secure the subject system* (from tampering during the operation); *take a copy of hard drive* (if applicable); *identification and recovery of files* (including those deleted); *access/copy hidden, protected and temporary files*; *study “special” areas on the drive* (e.g., residue from previously deleted files); *investigate data settings from installed applications/programs*; *assess the system as a whole, including its structure*; *consider general factors relating to the user’s activity*; *create detailed report*. Throughout the investigation, it is important to stress that a full audit log of your activities should be maintained. In Chapter 12 (in CD), there is guidance on the topics of building career in cybersecurity.

Cyberforensics experts go by their experience which shows that computer criminals always leave tracks (Locard’s Exchange Principle – Box 7.5); it is just a matter of finding these tracks. However, this is not always easy. Computer technology is continuously evolving. Computers and other communication systems are becoming very complex. People businesses and organizations are connected through all kinds of networks. At the same time, computer crime techniques are becoming more sophisticated and better coordinated (refer to Chapter 4 – Tools and Methods Used in Cybercrime). If evidence collection is done correctly, it is much more useful in apprehending the attacker and stands a much greater chance of being admissible in the event of a prosecution.

Now, let us understand how a forensics investigation is typically approached and the broad phases involved in the investigation. The phases involved are as follows:

1. Secure the subject system (from tampering or unauthorized changes during the investigation);
2. take a copy of hard drive/disk (if applicable and appropriate);
3. identify and recover all files (including deleted files);
4. access/view/copy hidden, protected and temp files;
5. study “special” areas on the drive (e.g., the residue from previously deleted files);
6. investigate the settings and any data from applications and programs used on the system;
7. consider the system as a whole from various perspectives, including its structure and overall contents;
8. consider general factors relating to the user’s computer and other activity and habits in the context of the investigation;
9. create detailed and considered report, containing an assessment of the data and information collected.

Certain things should be avoided during the forensics investigation depending on the nature of the computer system being investigated. For example, one should avoid changing date/time stamps (of files for example) or changing data itself. The same applies to the overwriting of unallocated space (which can happen on reboot for example). “Study it but Do NOT Change” is a useful catch phrase!

While there are some things that should be avoided, there are also other things that cannot be/should not be avoided before taking up a forensics investigation. The engagement contract and non-disclosure agreement (NDA) are some of those crucial not-to-forget things. This is because, customers of computer forensics laboratory must agree to be bound by terms and conditions of service set forth for any services offered by a computer forensics laboratory. In the context of a typical NDA, “customer” means the person, firm or company ordering products or services; “default” means any breach by either party of its obligations or any act, omission, negligence or statement by either party, its employees, agents or subcontractors arising out of or in connection with a contract and in respect of which either party may be legally liable; “the company” means the computer forensics laboratory; “engagement” means any job or jobs assigned to the computer forensics laboratory by the customer.

7.10.1 Typical Elements Addressed in a Forensics Investigation Engagement Contract

Typically, the following important elements are addressed before while drawing up a forensics investigation engagement contract:

1. **Authorization:** The customer will be asked to authorize the computer forensics laboratory or its agents to conduct an evaluation of the data/media/equipment onsite or offsite to determine the nature and scope of the engagement and to enable the company to provide an estimate of the cost of forensics investigation and/or the turnaround. Furthermore, the customer will be asked to agree on facilitating the engagement by providing all authorizations, security or legal clearances as required prior or throughout the course of the forensics investigation engagement.

The customer will be required to authorize the computer forensics laboratory, its employees, independent contractors and agents to securely receive and transport the media/equipment/data to, from and between their premises required to deliver the services contracted by the customer.

The customer will need to represent, warrant and affirm that he/she, or it is the owner or the authorized representative of the owner of the property or the equipment and all of the information and data stored on said property or equipment. By entering the NDA, the customer is supposed to declare that the representations are true and correct. The customer needs to agree to indemnify concerned computer forensics laboratory for any claims against the company related to any jobs assigned to the computer forensics laboratory whose services are engaged for the forensics investigation.

2. **Confidentiality:** The concerned computer forensics is supposed to use any information contained in the data, media and/or equipment provided to the company by the customer only for the purpose of fulfilling the engagement, and is expected to hold such customer information in the strictest confidence. Any confidential information disclosed by the customer under the agreement remains the owner's sole property, and computer forensics laboratory shall employ reasonable measures to prevent the unauthorized use of customer information. Such measures shall not be less than those measures employed by computer forensics laboratory in protecting its own confidential information. The involved computer forensics laboratory cannot disclose confidential information except to its employees, consultants or subcontractors as needed for the sole purpose of performing the engagement. Such information is not to be disclosed to any other party except as required by law. Computer forensics laboratory is to employ appropriate technical and organizational measures to safeguard any customer information, including personal data, and will act only on the instruction of the customer with regard to such information.
3. **Payment:** Customer agrees to pay the computer forensics laboratory all sums authorized from time to time by customer, which will typically include (a) charges for computer forensics laboratory

services; (b) reasonable travel and per diem expenses for onsite work; (c) shipping and insurance and actual expenses, if any, for parts; (d) media and/or off-the-shelf software used in the forensics service engagement. Unless otherwise agreed to in advance by computer forensics laboratory, all such sums are due and payable in advance by company check, bank wire transfer or credit card.

4. **Consent and acknowledgment:** Any consent required of either party becomes effective only if provided in a commercially reasonable manner; this includes but is not limited to, verbal authorization if followed by written confirmation, electronic or otherwise, by the computer forensics laboratory at the earliest possible opportunity. Customer needs to acknowledge that the equipment/data/media may be damaged prior to computer forensics laboratory receipt. Customer also needs to acknowledge that the efforts of the engaged computer forensics laboratory to complete the forensics investigation engagement may result in the destruction of or damage to the equipment/data/media. The computer forensics laboratory will not, however, assume responsibility for additional damage that may occur to the customer's equipment/data/media during computer forensics laboratory efforts to complete the engagement.
5. **Limitation of liability:** The concerned computer forensics laboratory will not consider itself to be liable for any claims regarding the physical functioning of the equipment/media or the condition or existence of data stored on the media supplied before, during or after services. In no event will the forensics laboratory be liable for any loss of data or loss of revenue or profits, goodwill or anticipated savings or any consequential loss whether sustained before, during or after services even if computer forensics laboratory has been advised of the possibility of damages or loss to persons or property.

The customer must be made aware of the inherent risks arising out of possible damage to media or equipment during the course of forensics investigation. Such risks include but are not limited to risks arising from possible destruction or damage to the media or equipment and/or data stored and inability to recover data, or inaccurate or incomplete forensics data recovery, including those that may result from the negligence of computer forensics laboratory involved in the investigation. The customer will be expected to agree that he/she will not hold responsible any of the involved computer forensics laboratory for any direct or indirect damage or loss of equipment or media or data loss. In the case of any damage or loss to the original media or equipment, the liability of the forensics laboratory shall be limited to providing the customer with similar media or equipment of comparable price or capacity.

The maximum aggregate liability of computer forensics laboratory to the customer whether in contract, tort or otherwise for any direct loss or damage including to tangible property suffered by the customer as a result of any default of computer forensics laboratory shall be limited in aggregate to the lesser of the stated sum or an amount equal to the sums paid by the customer under the contract during the preceding number of days stated in the contract (typically 30 days).

Any advice or recommendations given to the customer by the forensics laboratory or its employees or agents as to storage, application and use or preference of the equipments which is not confirmed in writing by the computer forensics laboratory is followed or acted upon entirely at the customer's own risk. Accordingly computer forensics laboratory shall not be liable for any such advice or recommendation which is not so confirmed. Although the computer forensics laboratory is to make every effort to preserve the integrity of any data or equipment related to the engagement, the customer has to agree not to hold the forensics laboratory responsible for any accidental damages to the data or equipment in its possession including but not limited to surface scratches, deformations and cracks.

1. **Customer's representation:** Customer needs to warrant the forensics laboratory that he/she is the owner of, and/or has the right to be in possession of, all equipment/data/media furnished to the laboratory and that collection, possession, processing and transfer of such equipment/data/media are in compliance with data protection laws to which customer is subject to.

2. **Legal aspects/the law side:** Both the parties need to agree that the agreement shall be governed by prevailing law in every particular way including formation and interpretation and shall be deemed to have been made in the country where the contract is signed.
3. **Data protection:** The computer forensics laboratory (engaged in the investigation) will hold the information that the customer has given verbally, electronically or in any submitted form for the purpose of the forensics investigation to be carried out as per contracted services from the forensics laboratory. Customer may apply for a copy of the information that the laboratory hold about customer and customer has the right to have any inaccuracies corrected.
4. **Waiver/breach of contract:** The waiver by either party of a breach or default of any of the provisions on this agreement by either party shall not be construed as a waiver of any succeeding breach of the same or other provisions, nor shall any delay or omission on the part of either party to exercise or avail itself of any right, power or privilege that it has, or may have hereunder operates as a waiver of any breach or default by either party.

7.10.2 Solving a Computer Forensics Case

A real-life example, showing how a case is solved using forensics, is available in Section 11.6.2 (Digital Forensics Case Illustration 2: Analysis of Seized Floppy – the Drug Peddler Case). As for this chapter, we summarized this section by presenting the steps involved in solving a computer forensics case. These are just some broad illustrative steps and they may vary depending on the specific case in hand.

1. Prepare for the forensics examination.
2. Talk to key people to find out what you are looking for and what the circumstances surrounding the case are.
3. If you are convinced that the case has a sound foundation, start assembling your tools to collect the data in question. Identify the target media.
4. Collect the data from the target media. You will be creating an exact duplicate image of the device in question. To do this, you will need to use an imaging software application like the commercial *EnCase* or the open-source *Sleuth Kit/Autopsy*.^[9]
5. To extract the contents of the computer in question, connect the computer you are investigating to a portable hard drive or other storage media and then boot the computer under investigation according to the directions for the software you are using. It is imperative that you follow the directions precisely because this is where the “chain of custody” starts (refer to Section 7.8, Figs. 7.10 and 7.11, and Boxes 7.4 and 7.12). Make sure that you use a write-blocking tool when imaging the media under investigation. This makes sure that nothing is added to the device when you are creating your image.
6. When collecting evidence, be sure to check E-Mail records as well. Quite often, these messages yield a great deal of information (see Section 7.6 for E-Mail forensics).
7. Examine the collected evidence on the image you have created. Document anything that you find and where you found it. There are tools available to help look into open files, encrypted files, and mapped drives and to even analyze network communications. You can look into both commercial products and open-source products.^[6]
8. Analyze the evidence you have collected by manually looking into the storage media and, if the target system has a Windows OS, check the registry. Be sure to look into Internet searches as well as E-Mail and pictures that are stored on the target computer. Many times, criminals will hide incriminating information in pictures and E-Mails through a process called *steganography* (see Section 7.12).
9. Report your findings back to your client. Be sure to provide a clear, concise report; this report may end up as evidence in a court case.

7.11 Setting up a Computer Forensics Laboratory: Understanding the Requirements

There are four broad types of requirements, namely, the physical space, the hardware equipment, the software tools and the forensics procedures to be followed to aid those involved in the cybercrime investigation. Figures 7.12 and 7.13 show how a typical laboratory looks.

First of all there is a physical facility in which the laboratory is set up. This is meant to be the home base for secure storage of evidentiary materials, for the analysis of captured data, for the operation of cloned systems, for the production of final evidence reports and for the physical premises where the forensics professional will perform most of their duties and work. Therefore, it should be designed as a secure storage facility that can also house an office, an operational laboratory and a production facility all rolled into one. The lab home should also have a separate interview facility or a small office/cabin where interviews and/or collaborative investigative procedures can be carried out without disturbing any ongoing technical or forensics work. This is because an investigating officer or attorney with an in-depth knowledge of the case may have queries that can be answered more effectively in collaboration with the forensics investigator. The forensics professionals generally perform specific analysis and/or search actions to find the answer to questions posed by the investigating officer or attorney.

Physical floor space requirement for a forensics laboratory varies depending on the size of the group that will occupy it. The bottom line is that the laboratory space should be in a secure location or contain appropriate measures that will stop unauthorized access to the premises. It should have an adjacent and secure walk-in lock-up vault that can keep intruders from gaining access to its contents as well as to protect the contents from fire/heat, smoke, water and electromagnetic emanations and should generally not be near radio equipment. Figure 7.14 shows cyberforensics equipments and Fig. 7.15 shows different types of connectors that are used with forensics tools.



Figure 7.12 | Cyberforensics laboratory – 1.

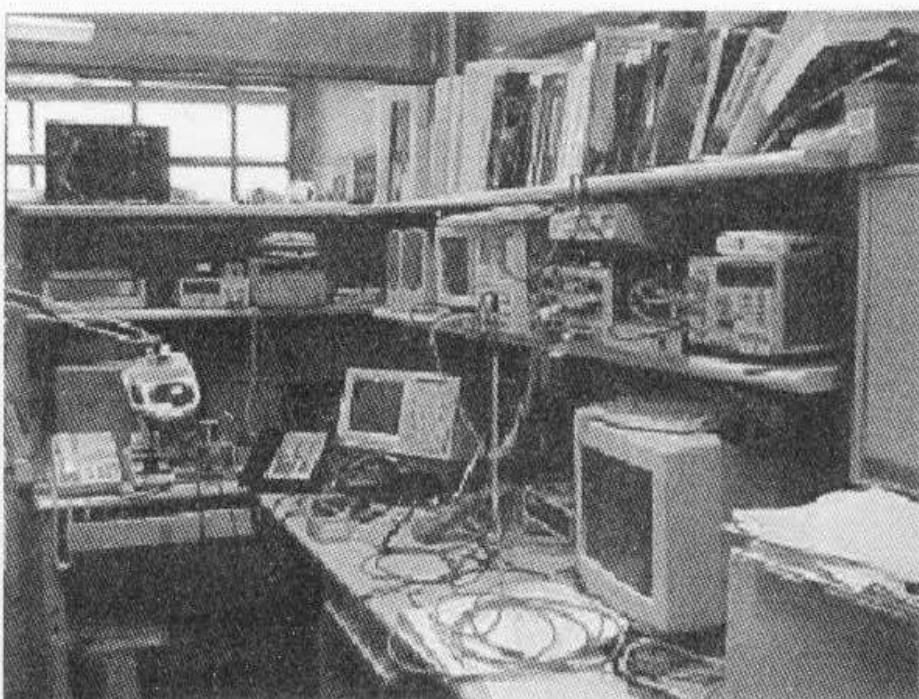


Figure 7.13 | Cyberforensics laboratory – 2.

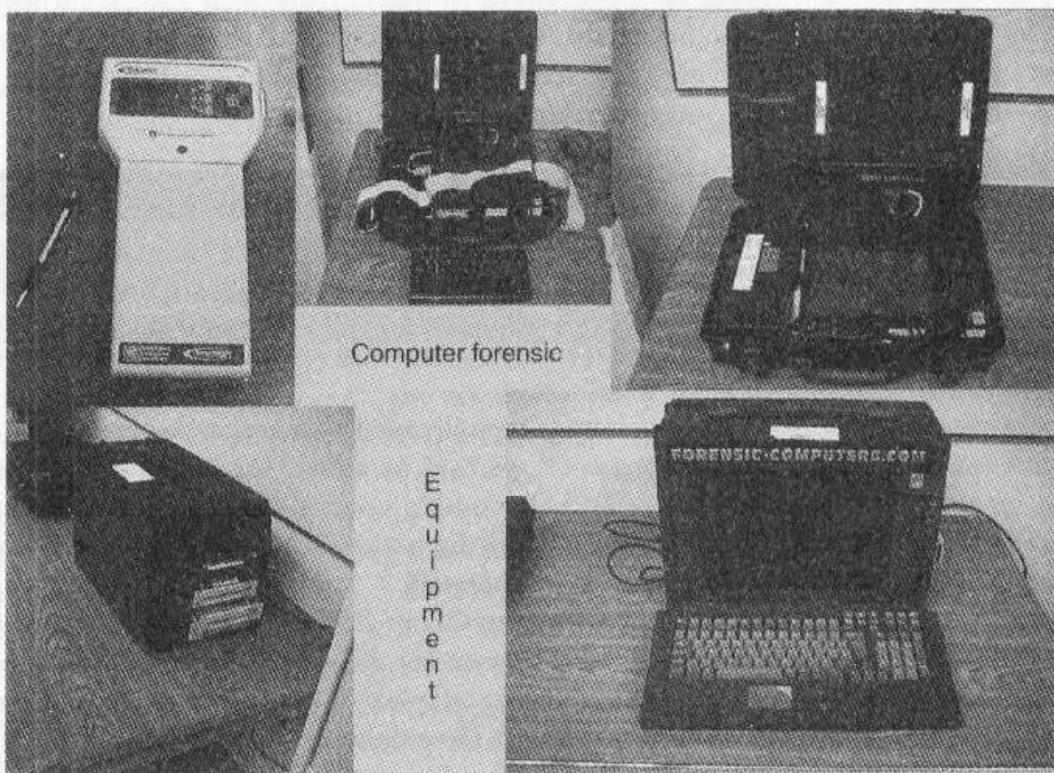


Figure 7.14 | Cyberforensics equipments.

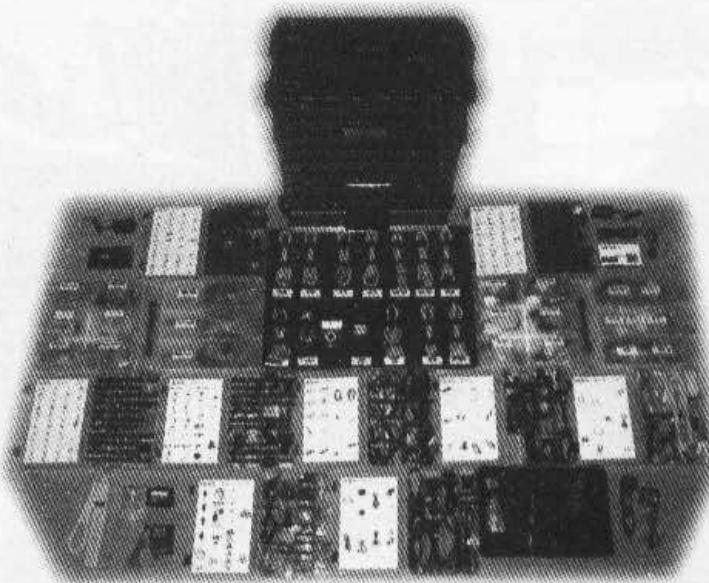


Figure 7.15 | Connectors used with cyberforensics tools.

The laboratory stores valuable items from investigation perspective – seized equipment, as well as official certified evidentiary copies of seized data, will be stored in the fire-proof vault. With the appropriate enforced sign-out/in procedures, it will serve to maintain the chain of evidence (refer to Section 7.8, Figs. 7.10 and 7.11, and Boxes 7.4 and 7.12). Therefore, access to the vault and its contents should be logged as well as locked when not under use, and should be monitored at all times. There must also be adequate lockable storage space for various specialized equipments that will, over the course of investigations, be acquired and used for other investigation. This space must also accommodate consumables like CDs, DVDs, removable hard drives of various capacities, paper, toner cartridges, etc.



Apart from the physical space requirement, another key requirement for a computer forensics laboratory is the hardware items. The laboratory requires a number of computers, including a network server with a large storage capacity (preferably configured for the standard removable hard drives).

The server in the computer forensics laboratory is typically used to manage, document and administer cases, store various software tools and manage one-off specialist hardware. The hardware that must be managed includes, for example, devices like Rimage DVD Publishing Systems^[10] CD production units, CopyPro floppy disk readers, printers, etc. Figure 7.16 shows a disk duplicator equipment to give an idea about such hardware equipment required in a computer forensics laboratory.

The *evidentiary copy of seized data* is usually written to CD or DVD and, because of the large capacity of current hard drives, this can be a time-consuming process (see the paper quoted in References).^[11] Some disk duplication devices (the Rimage, and other units like it), make it possible to create, number and label the media unattended, producing as many as 50 CD/DVDs without intervention. Capturing the contents of floppy disks is even more time consuming, and devices like the CopyPro also can acquire as many as 50 floppy disks without intervention. The capabilities of these types of devices may vary from model to model; the two mentioned (Rimage and CopyPro) are merely examples with specific capacities. There should



Figure 7.16 | Disk duplication equipment in a forensics laboratory.

also be separate Internet connection(s) but NEVER connected to the forensics server. The Internet will be useful for finding and sharing forensics information and techniques and for communicating with other forensics professionals. Staying abreast of developments in this field is a vital part of staying current and updated in the forensics arena. The Internet provides one source to help accomplish this need.

The forensics laboratory also needs a number of workstations for connecting them to the internal network. The number of workstations required in the laboratory will depend on how many forensics expert staff members are employed to work in the laboratory. The workstations will enable them to work on individual cases simultaneously and have access to the shared devices and resources. Portable acquisition computers, that is, the *portable forensics kits* (Fig. 7.17) are also required as many times the forensics staff will need to work on the crime incident site. Ideally, each portable kit should be configured identically with the standard forensics suite of tools and removable hard drives (the same standard hard drives as mentioned earlier) of various capacities.

Each kit should have a robust carrying case that can accommodate extra hard drives. An array of associated connection plugs, converters and a hard drive write blockers (such as "FastBloc" for example) are available. An EnCase Accessory^[12] comes in two types – field edition and laboratory edition (Fig. 7.18). The field versions of the forensics kits will be used for onsite acquisition and/or seizure. It is usually preferable for acquisition to be undertaken in the controlled conditions of the laboratory; however, there are circumstances where this is not practical and an evidentiary acquisition must be undertaken onsite (e.g., when dealing with an Internet service provider).

These kits must also have an assortment of forms, such as labels, tags, pens, tape, evidence bags, an electronic camera, a GPSS, etc., all of which are vital to the process of seizure and acquisition. There will



Figure 7.17 | Portable forensics kits.

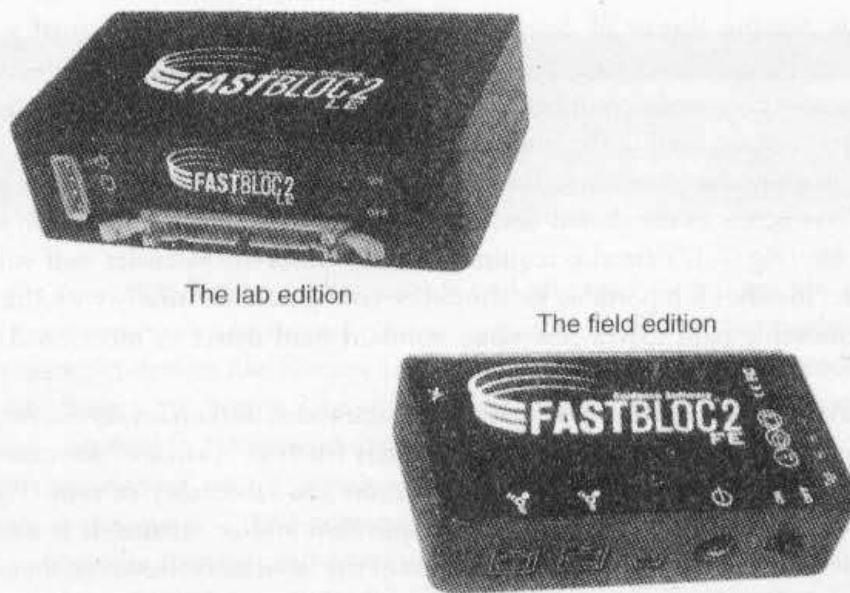


Figure 7.18 | FastBloc – the Field Kit and the Lab Kit. (a) The lab edition and (b) the field edition. Source: Guidance Software's Product Catalogue/Data Sheet titled "The Next Generation of write blockers" can be accessed at the following link: http://www.forensics.ie/images/products/guidance_fastbloc_datasheet.pdf (8 January 2010).

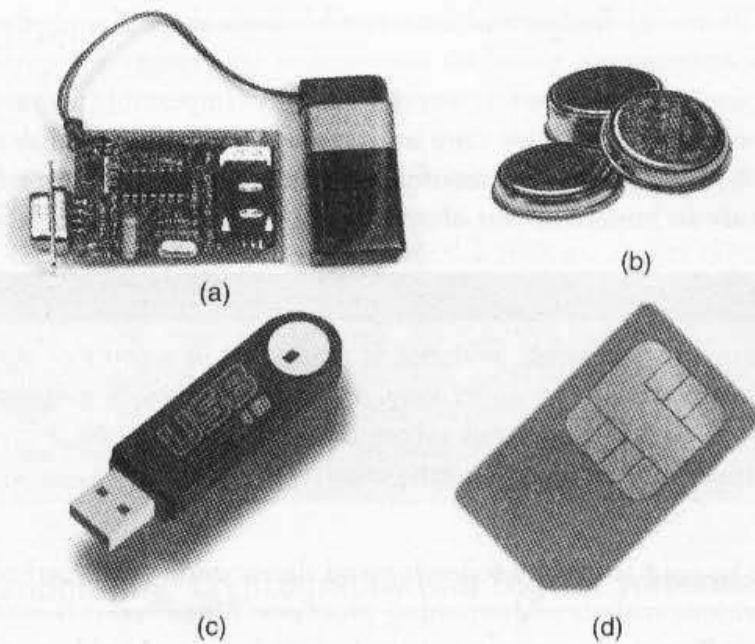


Figure 7.19 | (a) SIM card reader, (b) iButtons, (c) flash memory, (d) SIM card.

be an ongoing need to obtain devices, media, cables, converters and specialized media readers of various types, both for experimental purposes and for the acquisition of evidence from media other than hard drives or floppies (e.g., SIMs, flash memory of various description, iButtons, etc. – see Fig. 7.19). The hardware and physical premises constitute the largest outlay of funds. This, however, is an ongoing process and funds must be allocated regularly for the purchase of new hardware as it finds its way into the public arena.



On the software side, there are several requirements for setting up a forensics laboratory. The standard forensics software package, such as EnCase, WebCase, Forensics Tool Kit, Password Recovery Tool Kit, etc. are expensive products.

Some forensics kits require physical dongles to work and that these must be managed. A dongle is a physical security device (generally connected on the parallel port of the computer) that allows software to be used only when the device is present. In most cases, the capabilities of the software tool outweigh the nuisance and inconvenience of the required dongle. These products tend to be upgraded annually and, in each case, funds must be allocated for the upgrades. However, the software tools that are used comprise a far wider range than just those cited above. Many are freeware and many are not. No single tool performs the entire job of forensics acquisition, analysis and reporting; therefore, we need to use the right tool for the right task. Therefore, the forensics software tool library is extensive and it continues to grow. Having the right tool may make the difference between capturing relevant evidence and not being able to do so – as a result a case may be won or lost. In addition, the standard operational software will be required too; typically, this includes LAN software, OS, administrative software, graphics software, etc. These tools need to be upgraded occasionally; therefore, funds must be allocated for this ongoing process too. The continued cost of software acquisition and upgrades is usually smaller than that of hardware; however, it still constitutes a significant

portion of any forensics laboratory budget and must not be overlooked. The physical price of operating a forensics laboratory is not insignificant.

Orientation/mindset for procedure-based working is very important for a person working in a cyberforensics/computer forensics laboratory. One has to be very meticulous and should have a mindset for attention to details. This is important to be successful in digital forensics work like any other forensics work. Methods and procedures are an important part of operating a successful forensics laboratory.



The main issues that are attacked when evidence is presented in a court of law are credentials and methodology. In some countries, the court may prefer the forensics evidence from government appointed and/or neutral party laboratories rather than the evidence from private agencies where opportunities for manipulation/exploitation are perceived.

Close attention must be paid to strictly following and documenting the methodology adopted by the laboratory for the acquisition, analysis and reporting processes. Moreover, it is equally important to have a formal procedure in handling documents and control of evidence to be able to document the "chain of evidence." These are the main aspects that are unique to a forensics laboratory. There are other procedures and policies that should be in place and enforced, but they are the standards like Internet usage, E-Mail rules, back-up methods, etc. (See Appendix C in CD.)

7.12 Computer Forensics and Steganography

Steganography is the art of information hiding. The threat raised by steganography is very real. Its use is not easy to detect or intercept, as the information does not need to be broadcast across the Internet. The hidden message can reside unsuspectingly on a website, for example, and can be viewed from around the world. The technology is undoubtedly being used for other immoral purposes.



"Steganalysis" is of increasing importance to cybersecurity. Hiding messages in image data, called steganography, is used by criminals and by noncriminals as well to send information over the Internet. The term "steganography" originates from the Greek term for "covered writing."

Steganography was primarily used for "secret communications" to conceal the very existence of the message. Steganography is the art of "hiding information" in seemingly innocuous carriers in an effort to conceal the existence of the embedded information. Interestingly, steganography is not only the art of information hiding, but also the art and science of hiding the fact that communication is even taking place. Although "cryptography" is considered the predecessor of "steganography," steganography differs from cryptography. Cryptography is the art of secret writing, which is intended to make a message unreadable by a third party but does not hide the very existence of the secret communication. While steganography is separate and distinct from cryptography, there are many analogies between the two and, in fact, steganography is categorized as a form of cryptography since *hidden* communication certainly is a form of *secret* writing. In a way, "steganography" and "cryptography" are guided by the same motive that is, to make a message useless for those who want to read it. When steganographic techniques are used, the *message cannot be seen* because it

is hidden and with cryptology techniques applied the *message cannot be deciphered* although it is not hidden. There is one distinct difference, cryptography is dependent on hiding the meaning of the message, whereas steganography is dependent on hiding the presence of a message altogether. Steganography accomplishes its objective through exploiting the Internet technology. The sheer size of the Internet and its vast amounts of data are what accomplishes this fete, and for this reason, it can be a very effective method of securing data transfer, which most of the time is used by the cybercriminals.

Steganography, by its very nature, poses a threat to forensics analysts, as they now must consider a much broader scope of information for analysis and investigation. Steganography is, therefore, considered as one of the "antiforensics methods." "Computer antiforensics" are methods of removal and subversion of evidence with the objective to mitigate results of computer forensics. There are other methods too that act as computer antiforensics, namely, encryption, self-splitting files plus encryption, database rootkits, BIOS rootkits, bypassing integrity checkers, etc. Let us understand "rootkits."

Box 7.13 Steganography, Cryptography and Digital Watermarks

It has been a long-standing desire of human beings to keep sensitive communications secret. Guillermito classification of steganographic software^[13] mentions that the following is possible:

1. Adding data at the end of the carrier file;
2. inserting data in some junk or comment field in the header of the file structure;
3. embedding data in the carrier byte stream, in a linear, sequential and fixed way;
4. embedding data in the carrier byte stream, in a pseudorandom way depending on a password;
5. embedding data in the carrier byte stream, in a pseudorandom way depending on a password, and changing other bits of the carrier file to compensate for the modifications induced by the hidden data to avoid modifying statistical properties of the carrier file.

As mentioned before, "Steganography" is the art of covered or hidden writing. The purpose of steganography is "covert communication" to hide a message from a third party. However, this is different from "cryptography," that is the art of "secret writing," which is intended to render a message unreadable by a third party. However, cryptography does not hide the existence of the secret communication. Although steganography is separate and distinct from cryptography, there are many similarities between the two; therefore, some people categorize steganography as a form of cryptography, as hidden communication is a form of secret writing.

Now let us understand the difference between encryption and steganography. Contents of information kept private and confidential using "encryption" so that only those who have the proper keys (privacy key and public key) can extract the secret contents. On the other hand, the sole purpose of using steganography is to hide the fact of secret message (possibly containing the evidence) if it exists. Therefore, the military calls this "covert communication" and the path for this kind of communication is called "covert channel."^[14] Some good reference links on "covert channels" are provided in Ref. #10, Additional Useful Web References and in Refs. #14, #15 and #20, Articles and Research Papers, Further Reading.

Note yet another difference: steganography hides the covert message but not the fact that two parties are in communication. Steganography techniques generally involve placing a hidden message in some transport medium called the "carrier."

"Digital Watermarking"^[15] is conceptually similar to steganography; however, its technical goals are different. Generally, only a small amount of repetitive information is inserted into the carrier and it is not necessary to hide the watermarking information. It is useful for the watermark to be able to be removed while maintaining the integrity of the carrier. Refer to Appendix N in CD.

Cryptography is discussed in Ref. #16, Books, Further Reading.

7.12.1 Rootkits

The term rootkit is used to describe the mechanisms and techniques whereby malware including viruses, Spyware and Trojans attempt to hide their presence from Spyware blockers, antivirus and system management utilities. Rootkits can be classified as – persistent rootkits, memory-based rootkits, user-mode rootkits and kernel-mode rootkits. These classifications are made depending on whether the malware survives reboot and whether it executes in user mode or kernel mode. Basically, a “rootkit” is a set of tools used after cracking a computer operating system that hides logins, processes, password, etc., which would carefully hide any trace that those commands normally display. Rootkits are installed after an attacker has exploited a system vulnerability and gained root access. Rootkits by themselves do not give an attacker root access; they only work after a system compromise. Rootkits consist of tools that generally have three functions: (a) maintain root access to the system, (b) hide the presence of the attacker and (c) attack (or accelerate attacks) against other systems. From attacker’s perspective, rootkits serve following important functions:

1. The first, and primary, function of a rootkit is to maintain access to the compromised system. This access can happen via any communication channel from an easily detectable telnet shell to a secure shell to covert communication channels overlaid over commonly used protocols. An attacker who cannot maintain access to a host cannot exert his or her control over it.
2. The second main function of a rootkit is to hide, or otherwise obfuscate, the presence of the attacker. The ability to hide the presence of an attacker is what makes the rootkit such a powerful tool and is critical to the success of an attacker in maintaining root access to a system. This is achieved by removing evidence of the compromise and taking measures to misrepresent the system state to curious or confused system administrators. Removing evidence can be achieved through cleaning various log files and temporarily disabling any monitoring demons. How a rootkit chooses to hide its presence and the presence of the attacker is the qualifying characteristic of the rootkit. For example, an attacker could replace commonly used system executables, re-route system calls and install a loadable kernel module in a single rootkit installation. Attackers typically choose more than one method of hiding their presence (like for “defense in depth” think “offense in depth”!).
3. The third function of a rootkit is to perform actions that meet the attacker’s objectives, mainly by attacking or aiding in attacking other systems. This usually means compromising host security (e.g., by using keyloggers), gathering packet traces on the local network, performing vulnerability scans or even launching automated attacks from the compromised host.

Now let us understand “binary rootkits.”

Binary rootkits take administrative utilities and modify them to hide specific connections, processes and activities of specific users. These utilities would also include tools to provide root access to a particular user or when supplied with a particular argument. For example, an attacker could modify the “w” binary to hide his/her user account while logged on, the “ps” command to hide any processes he/she is running, and the “su” command to always allow root access whenever a specific password is supplied. These changes are not limited to the binary files only but source files can also be directly modified by attackers. If the source code is not examined for these inconsistencies, a rebuilt binary that is assumed to be “clean” can be compromised. When the binary tools are deployed, they are often placed inside of a hidden directory until the administrative programs can be fully compromised. An aspect of social engineering is used when creating these directories. Some of the common locations include confusing or unsuspecting directory names, such as /dev/.hdd or /dev/.lib. Others include commonly overlooked directory names such as /etc/... or /etc/.. “ (dot-dot-space). There are, of course, defenses available for rootkits. Let us take a brief look at them.

Binary rootkits can be defeated through the use of file integrity scanners. Most file integrity scanners work by computing checksums, cryptographic checksums or even digital signatures. The file signatures must be created when the system is in an uncorrupted state and are useless if not prepared before a rootkit has been installed. The cryptographic checksum itself is not immune to attack, and care should be taken that it is not recomputed with the corrupted media and overwritten (by writing them to immutable media and storing them offline, for example). However, successful use of this technique also means that any legitimate patches or updates must be followed up by recomputing the checksum (a technique that may fail in practice for frequently updated systems). Binary rootkits can also be detected by system integrity tools. However, certain commonly changed or temporary directories may be ignored by the system integrity scans, so care should be taken by the system administrator to inspect these directories for unusual activities. Further discussion of each of these methods is beyond the scope of this chapter. Readers interested in greater details of these topics should refer to Ref. #4, Additional Useful Web References, Further Reading and Ref. #4, Video Clips, Further Reading.

7.12.2 Information Hiding

Let us now have an overview of some characteristics of information hiding and then we discuss about steganalysis methods for determining the existence of and potential locations of hidden information. Today we are in the “digital age” where the messages can be hidden in images, sound files, text and other digital objects. These messages are invisible to a casual observer. The use of “steganography” on public networks, such as the Internet, is unknown due to its stealthy nature. Unless it is being actively looked for, one would not know that it is there. For example, pop-up ads, photos on sales and purchase portals such as eBay, and

Box 7.14 Hair Splitting Experience for Forensics Investigation Experts!

“Self-splitting files” is a method developed by the Intruders Tiger Team Security. The technique consists of the following:

1. A framework that interprets input files (binary or texts) and places them in sectors marked as bad blocks (but in the truth, they are not).
2. An input file (binary or text) that is divided in several asymmetric parts that are encrypted and placed outside of order in bad blocks;
3. An input file (binary or text) that is wiped after having been processed.
4. An input file (binary or text) that can be in a HTTP(s) or FTP server, and is processed without touching the disk (all in memory).
5. A library that allows the easy interaction of framework with sniffers, etc.
6. A tool that returns a sequence of blocks and a pseudorandom key that must be known to read, remount or execute the file.

Another technique used is the Wipe utility; it makes things difficult for the cyberforensics experts and investigators. Wipe is a name given to the method of safe deletion. In the current file systems, the files are not totally extinguished. When we delete a file (with “rm,” “del,” etc.), the field “link count” is set to zero and the field “deleted time” to the hour that the file is excluded. Therefore, the files can be easily recovered via software methods used in computer forensics. A method to make the recovery of files difficult is the use of the Wipe that does nothing more than open the file and overwrite it several times with pseudorandom (or predefined) content and later unlinks them from “inode” and “directory entries.”

Examples of utility are necrofile e klismafile (the Defiler’s Toolkit). Even after Wipe’s method, files can be recovered through a “ferromagnetic” phenomenon that is called “hysteresis loop.” However, this type of computer forensics method requires equipment with highest cost, and the recover process being each day more and more complex because of the increase of hard disk density and the number of overwrites made by the Wipe.

other recreational sites, all have the potential of containing hidden messages. An average organization is not expected to take on the vast responsibility of searching large websites and newsgroup areas for potential steganographic images. Most organizations can and do, however, monitor network traffic that is entering and exiting the local area network.

The first question is why one would want to "hide" information. In the first category, there are those who are trying to protect their intellectual property rights. There is a high availability of information via the Internet and that makes it increasingly difficult to protect intellectual property and enforce copyright laws. The use of "digital watermarks"^[15] provides a way to insert a copyright notice into a document or image. The watermark is often a small image or text that is repeated frequently throughout the document or image. A similar technique is to embed a digital fingerprint or serial number. Fingerprint presents a certain advantage in that it can be used to trace the copy back to the original and thus it is a powerful tool for prosecuting copyright violators. Therefore, this is about the first category of people who would be interested in "hiding" information.

In the second category are people who are interested in hiding information to convey information in a covert manner and avoid observation by unintended recipients. In this case, the hidden message is more significant than the "carrier" object that is used to transport it. Steganography is often compared to cryptography in its ability to restrict unauthorized access to information. Cryptography is used to encrypt or scramble the data in such a fashion that only the intended recipient can decrypt it. At the outset of this discussion, we explained the difference between "cryptography" and "steganography." There are three common approaches of hiding information in digital images^[16] (a) least significant bit insertion, (b) masking and filtering and (c) algorithms and transformations.

Box 7.15 Hide and Seek in the World of Information Communication

An interesting question is "how do we hide information in the electronic age?" Computers use binary, a combination of zeros and ones to represent text and graphics. The ASCII (American National Standard Code for Information Interchange) is the de facto standard for representing text and certain control characters. ASCII uses one parity bit and seven data bits to represent each character in the English language. For example, an uppercase "A" is represented by 1000001. A digital image is composed of picture elements or "pixels." Each pixel contains information as to the intensity of the three primary colors: red, green and blue. This information can be stored in a single byte (8 bits) or in three bytes (24 bits). For example, in an 8-bit image white is represented by the binary value of 11111111 and black by 00000000.

Current information hiding techniques rely on the use of a cover object (image, document, sound file, etc.) – sometimes known as a carrier. The secret message is then broken down to its individual bits by a steganographic tool (stego-tool) and embedded in the cover object. Many tools will utilize a password or pass-phrase that is necessary to extract the hidden message and is referred to as a stego-key. The result of this process is known as the stego-object.

One would wonder where can information be hidden. Almost anywhere on the Internet! The standard protocol suite used on the Internet is the Transmission Control Protocol/Internet Protocol (TCP/IP). The headers used to transfer data between computers allow the use of flags and certain reserved fields. With the appropriate tool, information can be inserted into these fields. The advantage of this technique is that headers are rarely read by humans and thus makes an ideal place to hide data. The disadvantage of this method is that firewalls can be configured to filter out packets that contain inappropriate data in the reserved fields, thus defeating the steganographic transmission.

Another popular technique for hiding information is to include extra spaces in documents. These spaces may contain hidden characters. Again this is a simple technique for hiding information and consequently is easy to detect and defeat. By opening such a document in a word processor the unusual spacing becomes readily apparent. Reformatting the document can remove the hidden message. The use of audio files can provide a good carrier for hidden messages. By their very nature, sound files tend to be large in size and thus do not attract attention. In particular, the MP3Stego tool can be used to hide information and maintain nearly CD quality sound.

Criminals do a number of activities with their data – they delete data, destroy data, hide data or may also encrypt data – all with the purpose that the traces of their criminal deeds do not fall in the hands of the investigator. As for data destruction, “data sanitization” is an important term to understand. By definition, ‘sanitization method’ is the specific way of using a data destruction program to overwrite the data on a hard drive or other storage device. Technically speaking, there are other methods as well for destroying data. These methods are not based on software overwriting and are also referred to as “data sanitization methods.” Often a question is asked as to which method for data sanitization is the best one. An often quoted method in this regard is the *DoD Data Sanitization Method* – for example the DoD 5220.22-M data sanitization method is usually implemented as a ‘3-pass method’:

1. In Pass 1: “0” is written and the write is verified.
2. In Pass 2: “1” is written and the write is verified.
3. In Pass 3: a random character is written and the write is verified.

There seems almost a universal agreement that overwriting an entire hard drive once with a single character prevents recovery of data from a hard drive even if any software based file recovery method is used. It is believed that most data sanitization methods are over-kill. They claim that a single overwriting of data is adequate to prevent data recovery even if advanced; hardware-based methods are used for extracting information from hard drives. There, however, does not seem to be a universal agreement about this.

We conclude this discussion on the note that there are concerns that terrorists are using steganographic techniques for hiding their messages, terror-related events inside images, text that is displayed on the Internet sites. As the research in steganographic method advances, there can be hopes of abetting the secretive communication methods used by the terrorists in propagating their illicit messages on the Internet about their destructive work. To conclude steganography is one of the threats that needs to be considered and understood for possible future occurrences.

7.13 Relevance of the OSI 7 Layer Model to Computer Forensics

The OSI 7 Layer Model is useful from computer forensics perspective because it addresses the network protocols and network communication processes. The basic familiarity with the OSI 7 Layer Model is assumed for the discussion in this section. To know more about OSI Model and network protocols, refer to Ref. #15, Books, Further Reading. The OSI Model depicted in Fig. 7.20 shows Internet Protocols involved at each of the seven layers. Forensic analyst needs to very well understand how the TCP/IP works.^[17] To effectively perform forensics network analysis, forensics professionals must have a strong understanding of underlying network processes and protocols. Explaining these concepts is beyond the scope of this chapter. Interested readers may refer to the relevant chapter mentioned in Ref. # 15, Books, Further Reading.

In Chapter 1, it was mentioned that “hacking” is one of the cybercrimes – it involves unauthorized access to a computer system. Effective penetration testing requires complete understanding of the methods and motivations of a typical hacker. The steps taken by attackers who hack networks are shown in Fig. 7.21; each is briefly described.

7.13.1 Step 1: Foot Printing

Foot printing includes a combination of tools and techniques used to create a full profile of the organization’s security posture. These include its domain names, IP addresses and network blocks. Some of the tools used

| OSI layers | | Protocols, browser, Calls and browser-based languages | | | | | | | |
|------------|--------------|---|-----|-------------|---------------|--------------------------------|--|--|--|
| Layer 7 | Application | Ping (command) | NFS | Web browser | E-Mail client | Windows file and print sharing | | | |
| Layer 6 | Presentation | | XDR | HTML | MIME | | | | |
| Layer 5 | Session | | RPC | HTTP | SMTP | | | | |
| Layer 4 | Transport | ICMP | UDP | TCP | | NetBEUI | | | |
| Layer 3 | Network | IP | | | | | | | |
| Layer 2 | Datalink | 802.2 | | | | | | | |
| Layer 1 | Physical | Ethernet | | | | | | | |

Figure 7.20 The OSI 7 Layer Model with Internet Protocols. Abbreviations: UDP, User Datagram Protocol; IP, Internet Protocol; ICMP, Internet Control Message Protocol; TCP/IP, Transmission Control Protocol/Internet Protocol; RPC, remote procedure calls; HTTP, Hypertext Transfer Protocol; SMTP, Simple Mail Transfer Protocol; XDR, eXternal data representation; HTML, hypertext markup language; MIME, multipurpose Internet mail extensions; SMB, server message block; NFS, network file system.

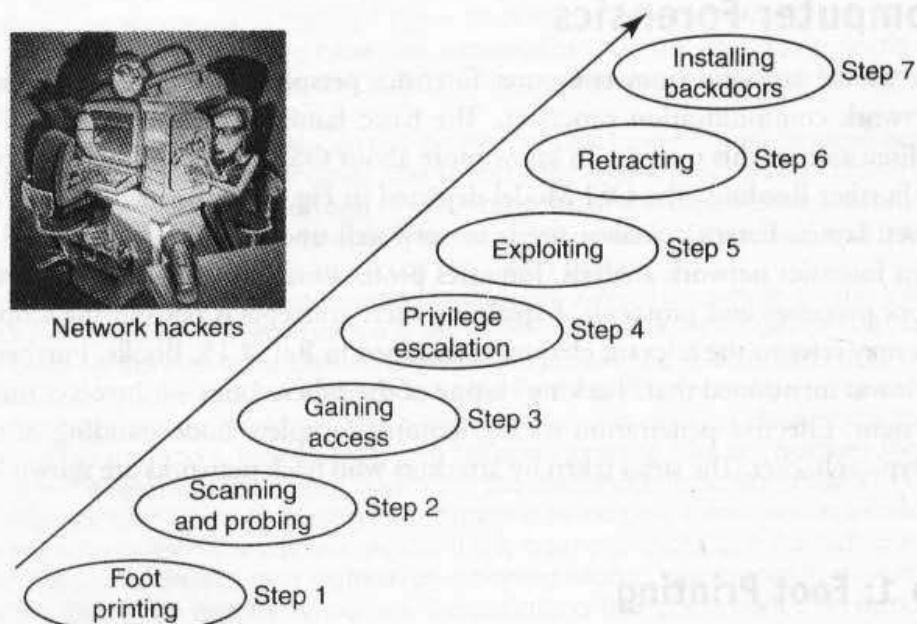


Figure 7.21 Network hacking steps.
Note: This is being illustrated how hacking takes place.

for footprinting are SamSpade, nslookup, traceroute and nettrace (refer to Tables 2.1 and 2.2 in Chapter 2 for a list of tools used during the “active attack” phase). Once the IP address and domain names are known, a hacker will typically perform a series of scans or probes to gather more information about individual machines for the purpose of gaining unauthorized access to the system at a later date. These scans may include ping sweeps, TCP/UDP scans and OS identification. All of these actions can be performed with a single tool called Nmap. Nmap is a free security scanner written by Fyodor.

The tool called “Metasploit” (mentioned in Table 4.1, Chapter 4) was developed as an automated tool to provide useful information to people who perform penetration testing. To know more on penetration testing, refer to Ref. #19, Books, Further Reading. In addition to providing this service, it has also become an automated tool to gain access to insecure computer systems. Metasploit groups exploit both OS and application. Performing a successful exploit has now become as simple as finding out the target’s OS or application, entering the target’s IP address and pressing a button.

7.13.2 Step 2: Scanning and Probing

The hacker will typically send a ping echo request packet to a series of target IP addresses. As a result of this exploratory move by the hacker, the machines assigned to one of these IP address will send out echo response thereby confirming that there is a live machine associated with that address. Similarly, a TCP scan sends a TCP synchronization request to a series of ports and to the machines that provide the associated service to respond. Finally, using tools such as Nmap, the hackers can determine device type and OS details by interpreting the responses. System scanning and probing can provide insights about the easiest path into the targeted system to a hacker. Gaining access takes advantage of specific security weaknesses in the system to allow access via an individual machine.

Uneducated hackers were known as “script kiddies” (refer to Chapter 10) because they could gain access to target machines via scripts that were published on hacker websites. These hackers are increasingly known as “click kiddies” because the process has become as easy as clicking a button. Figure 7.22 shows the network hacker categories.

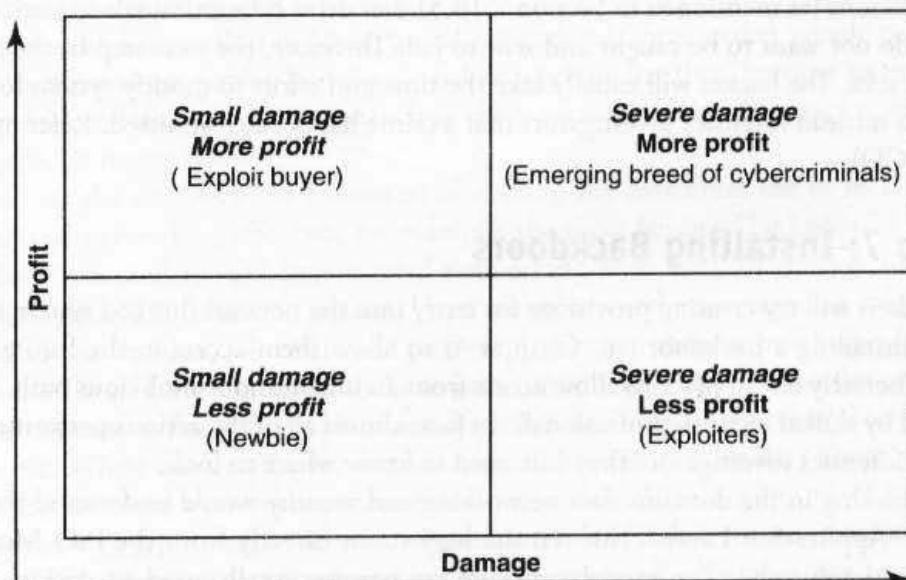


Figure 7.22 | Hacker categories (profit and damage).

7.13.3 Step 3: Gaining Access

The hacker's ultimate goal is to gain access to your system so that he/she can perform some malicious action, such as stealing credit card information, downloading confidential files or manipulating critical data. As each device and OS in your network has a unique security posture, the information provided during system scanning and probing can give the hacker insight as the easiest path into your system. Gaining access takes advantage of specific security weaknesses in the system to allow access via an individual machine.

7.13.4 Step 4: Privilege

When a hacker gains access to the system, he will only have the privileges granted to the user or account that is running the process that has been exploited. Gaining access to root or administrator will allow the hacker more access or greater power throughout the network. All hackers, therefore, would like to gain root or administrator privileges on the network. An exploited application that is running under a root user will give the hacker immediate root access. However, if the application that is exploited is not running under a root, the hacker must perform additional actions to earn it. This usually entails trying to crack the passwords.

7.13.5 Step 5: Exploit

Gaining root access gives the hacker full control on the network. Every hacker seems to have his/her own reasons for hacking. Some hackers do it for fun or a challenge, some do it for financial gain and others do it to "get even" (see Fig. 7.21). Exploiting the system, therefore, will take many forms. Hackers who do it for fun or a challenge will generally change a webpage or leave a "calling card" to let his peers know that he/she was successful. Hackers fall into this category. More often, hackers try to break into systems for financial rewards. This will generally help them to download valuable information that can later be sold to other parties. Sometimes, there can be a disgruntled employee who may gain access to sabotage an important project.

7.13.6 Step 6: Retracting

There are many reasons (as mentioned in Section 7.13.5) that drive cybercriminals to hacking. Whatever the motive, hackers do not want to be caught and sent to jail. Therefore, the next step in the hacker methodology is covering tracks. The hacker will usually take the time and effort to modify system logs to hide his/her actions and try to mislead forensics investigators that a crime has been committed. Refer to Table D.II.13 in Appendix D (in CD).

7.13.7 Step 7: Installing Backdoors

Finally, most hackers will try creating provisions for entry into the network/hacked system for later use. This, they will do by installing a backdoor (see Chapter 4) to allow them access in the future. A backdoor is a security hole deliberately left in place to allow access from an uncommon/unobvious path. These can usually be easily detected by skilled security professionals. In fact, almost all of the actions performed by a hacker can be detected by a forensics investigator. They just need to know where to look.

Professional working in the domains data networking and security would understand the terms "Layer 3" or "Layer 2" or "Application Layer." This terminology stems directly from the ISO Model and how it is applied to practical solutions. The model concepts are conventionally used to design and troubleshoot networks, and the 7 Layer Model is the standard for designing the network protocols. Careful study of the OSI 7 Layer Model can show us support for concepts that we have learnt from more conventional forms

of information security theory. Understanding and applying the model to information security scenarios can also help us assess and address information security threats in a network environment, allowing us to organize efforts to make security assessments and perform forensics analysis of compromised systems and threats presented in theory and found operating in the wild.

Cyberforensics experts have the technical skills that are useful for reading “obfuscated IP addresses.” Those who send Spam, unsolicited commercial junk mail, usually try to keep their true identities secret – otherwise, they would take the brunt from the disgruntled Internet citizens who wish to retaliate. In addition to using a bogus return E-Mail address, they often include obfuscated URLs. Instead of having a human-readable name, or the dotted-decimal format such as 135.17.243.191, a URL may appear in 10-digit integer format (base 256), so it appears like this: <http://2280853951>. More details like this to illustrate the technical skills in cyberforensics investigation are addressed in Chapter 11.

7.14 Forensics and Social Networking Sites: The Security/Privacy Threats

Social networking is one of the most popular activities across the globe in today's digitally connected networked world. Orkut, Facebook, MySpace, Bebo, “Bigadda” (an Indian social networking site), etc. are some familiar names of social networking sites. They are not the only ones, however. There are a surprisingly large number of social networking sites.^[18] Technically speaking, a “social networking site” is defined as Web-based services that allow individuals to:

1. Construct a public or semi-public profile within a bounded system;
2. articulate a list of other users with whom they share a connection;
3. view and traverse their list of connections and those made by others within the system; the nature and nomenclature of these connections may vary from site to site.

Using a social networking site brings like-minded people together for chat, conversation, exchanging ideas and even meeting in real life. Social networking is a popular activity in the Internet days because, it enables people to reach out to their old/long lost friends and classmates, relatives, etc. who may have migrated to other countries. Social networking sites even help connect like-minded people, people with the same professions or collaboration and discussion of ideas. Social networking, thus, makes people part of a worldwide community and so the sites are getting popular. Social networking has thus, become an extension of “sitting around the camp fire” and discussing life events. It is, then, no wonder that the usage of social network sites has increased rapidly in recent years.

Kids, teenagers are the ones who are known to be making the maximum use of social networking sites. There are professional networking sites too; for example, the most famous “LinkedIn.” LinkedIn is a social networking website oriented toward professional networking with over 10 million users spanning 150 industries and more than 400 economic regions. Users are able to and encouraged to create a profile including such information as resumes, job offers and past employers and then to build up a list of connections. The user profile and list of connections can help to gain introduction to someone the user wishes to know through a mutual contact, to find jobs and business opportunities, search for potential candidates (if the user is an employer), etc. While this may be so, there is a lot of discussion these days about the security threats through careless use of social networking sites. Almost everyday, there is some news or other about how people (especially the young generation) are victimized as a result of indiscrete use of social networking sites.

Current litigations, regarding social networking sites, have raised a number concerns: (a) whether the content social networking site violate people's intellectual property rights, (b) whether social networking sites

infringe the privacy of their own users or (c) whether fraudulent or other illegal activity, such as the sale of "knock-off" luxury goods or the promotion of prostitution, occurs with actual or collaborative knowledge shared in the social networking media community. Although these concerns may be perceived by some people as mere exaggerations or over-reaction to the rise of social media networking, the fact remains that adequately preserving the content at issue is critical. Content preservation can be challenging given the dynamic, short-lived and often multi-format nature of social media. In order to properly collect and authenticate social networking content, there is indeed a need for using tools and for executing emerging forensics methodologies. Like in other forensics circumstances, here too, it becomes essential to maintain robust chain of custody documentation to ensure that this highly relevant evidence is authenticated for admissibility. There is generally no control over the content posted on social media networking sites. Even if forensics data has been preserved, high level of forensics skill is required to analyze and quantify the preserved data to answer questions such as:

1. Who posted the offending content?
2. Is there a 'real live' person to whom the offending content can be attributed even when evidence exists?
3. Can we identify the time frame associated with the posting of the offending content?
4. How much of the offending content exists across the entire social networking platform?
5. Is there other evidence that corroborates or supports interpretation of the relevant content?
6. How accurate is the reported physical location?

Such forensics analysis of social media websites/social media networking sites is the need of the hour given criminal activities abound.



Criminal activities can arise from the use of social network sites.

For example, a mother was convicted of computer fraud for her involvement in creating a phony account on MySpace to trick a teenager, who later committed suicide.^[19] There seems to be no respect for "privacy" as if it has become a thing of the past. For example, although LinkedIn is generally well perceived by the media, there seem to be two main privacy issues: (a) LinkedIn does not allow you to remove your profile and (b) it shows member profiles. The good news is that the first privacy concern is now addressed in LinkedIn's privacy policy. The second privacy concern is, surprisingly, perceived as one of the good things about LinkedIn.

All is not well even with "better of kind" professional networking sites like LinkedIn. For example, according to some people LinkedIn first builds the trust of the user, then hooks the user into the system by using easy-to-use simplified forms and finally gets the user to invest through the use of nagging tools.

Facebook (www.facebook.com) is one of the biggest online social networking websites, hosting approximately 25 million users. The website was originally created in February 2004 for college and university students, but since September 2006, it has become available to anyone with an E-Mail address. Facebook has many enticing features that allow users to join many networks (including university networks, geographic networks, vocation networks, etc.), to join groups of common interest and to upload pictures. Figures 7.23 and 7.24 show some interesting data about privacy concerns with regard to social networking sites and the age distribution of social networking site users.

The success of a social networking site depends on the number of users it attracts. In the attempt of wooing the users to their sites and thereby generating revenues, the designers of social networking sites also incline toward making available some material on these sites which may not always be decent. Generally, the

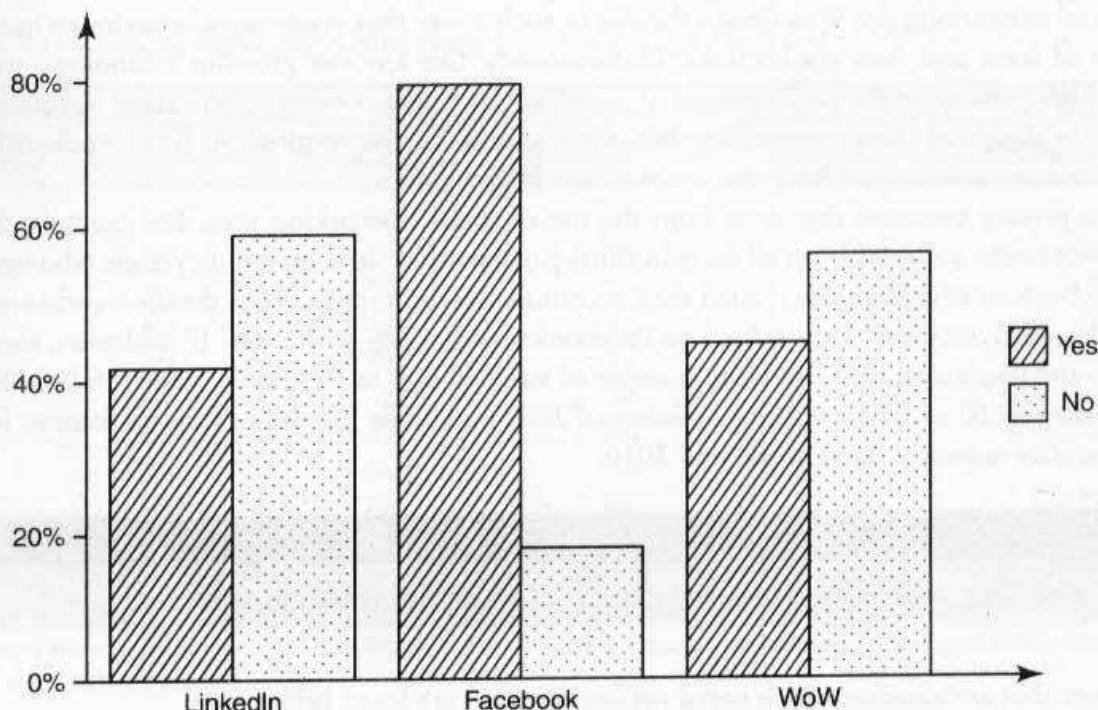


Figure 7.23 User concerns about privacy on social networking sites (LinkedIn, Facebook, WoW).
Source: The Paper by Helen Drislane and Kelly Heffner, 14 May 2007, is available at <http://www.eecs.harvard.edu/cs199r/fp/HelenKelly.pdf> (25 January 2010).

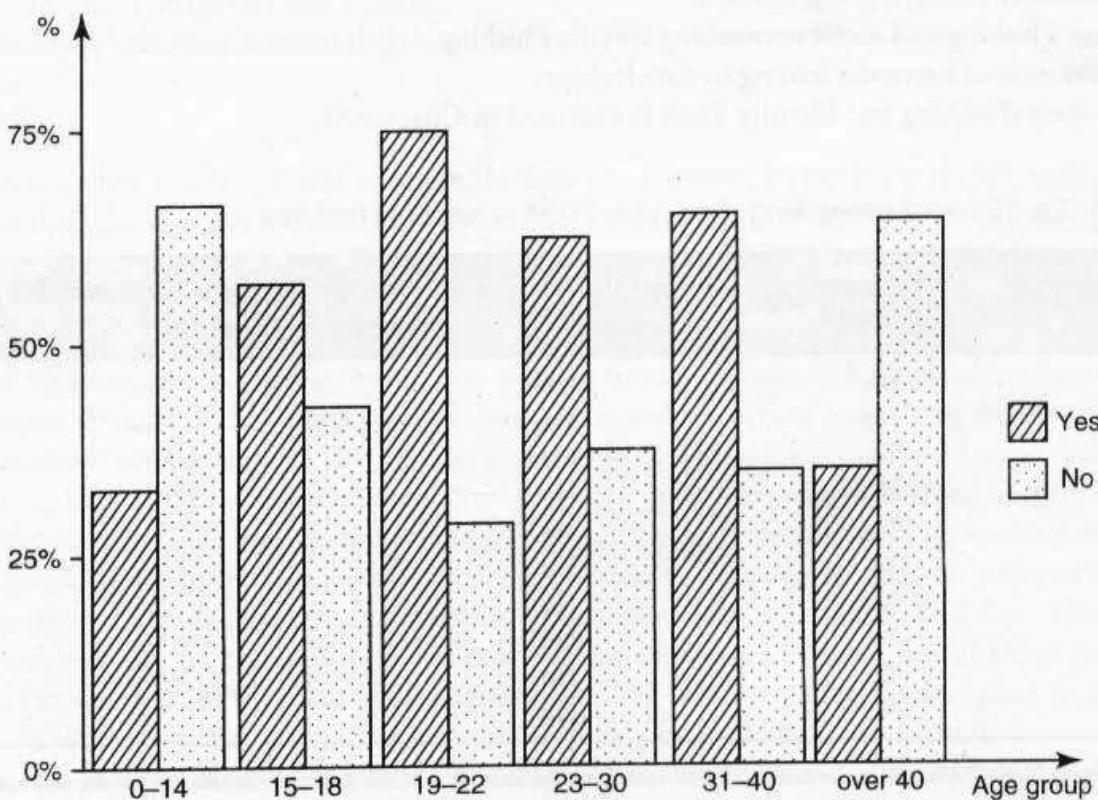


Figure 7.24 Privacy concerns about social networking sites vary with age.
Note: This is with regard to openness about sharing personal information.
Source: The paper by Helen Drislane and Kelly Heffner (14 May 2007) is available at <http://www.eecs.harvard.edu/cs199r/fp/HelenKelly.pdf> (25 January 2010).

aim of a social networking site is to design the site in such a way that encourages behavior to increase both the number of users and their connections. Unfortunately, like any fast growing technology, security has not been a high priority in the development of social network sites. Owing to this, that is, lack of security thinking in the design of social networking sites, significant risks have resulted. At times, these risks seem to outweigh the benefits obtained from the social networking websites.

There are privacy concerns that arise from the use of social networking sites. For example, Facebook's Beacon service tracks activities from all users in third-party partner sites, including people who never signed up with Facebook or who have deactivated their accounts. Beacon captures data details on what users do on the external partner sites and sends it back to Facebook server, along with users' IP addresses, the addresses of webpages the user visits, etc. This is an example of vulnerability in Facebook. Table 7.6 lists the security features on the top 10 social networking websites of 2009 and Table 7.7 shows security features for the top ten social security networks rated in the year 2010.



There are a number of security issues associated with social networking sites.

Security issues that are associated with social networking sites are listed below:

1. Corporate espionage.
2. Cross-site scripting.
3. Viruses and worms.
4. Social networking site aggregators.
5. Spear Phishing and social networking specific Phishing.
6. Infiltration of networks leading to data leakage.
7. ID theft (Phishing and Identity Theft is discussed in Chapter 5).

Table 7.6 | Top 10 social networking sites (year 2009) – security features

| Social Networking Site Name | Supports HTML? | Does the Site Track Visitors? | Does the Site have Customizable Privacy Settings? |
|-----------------------------|----------------|-------------------------------|---|
| Facebook | No | No | Yes |
| Orkut | No | Yes | Yes |
| MySpace | Yes | No | Yes |
| Bebo | No | No | Yes |
| Friendster | No | Yes | Yes |
| Hi5 | Yes | Yes | Yes |
| Netlog | No | No | Yes |
| PerfSpot | Yes | Yes | Yes |
| Yahoo!360 | Yes | No | Yes |
| Zorpia | No | No | Yes |

Note: The listing in Table 7.6 is not in the order of 2009 rating for the sites. It is in the order of "familiarity" of the site name assuming general public familiarity with those names of the sites. In year 2009 "Bebo" had rating 1 while in Year 2010 "Facebook" has got Number 1 rating. In year 2009 "MySpace" had No. 5 rating while in year 2010, it was rated No. 2. "Friendster" enjoyed No. 3 rating in year 2009 whereas its rating in year 2010 has gone down to No. 4. (Source of these changes rating is the link mentioned at the bottom of Table 7.7).

Table 7.7 | Top 10 social networking sites (year 2010) – security features

| <i>Site Name</i> | <i>Privacy Settings Available?</i> | <i>User Blocking Available?</i> | <i>Spam Reporting Available?</i> | <i>Abuse Reporting Available?</i> | <i>Safety Tips Available?</i> |
|------------------|------------------------------------|---------------------------------|----------------------------------|-----------------------------------|-------------------------------|
| Facebook | Yes | Yes | Yes | Yes | Yes |
| MySpace | Yes | Yes | Yes | Yes | Yes |
| Bebo | Yes | Yes | Yes | Yes | Yes |
| Friendster | Yes | Yes | Yes | Yes | No |
| Hi5 | Yes | Yes | Yes | Yes | Yes |
| Orkut | Yes | Yes | Yes | Yes | Yes |
| PerfSpot | Yes | Yes | No | Yes | Yes |
| Yahoo!360 | Yes | Yes | No | Yes | Yes |
| Zorpia | Yes | Yes | No | Yes | No |
| Netlog | Yes | Yes | Yes | Yes | No |

Note: There is full features comparison available in addition to the security features mentioned in the table above. The site overall rating for the social networking sites is available at: <http://social-networking-websites-review.toptenreviews.com/> (24 January 2010). (Sites are listed in the order of year 2010 rating).

8. Bullying.
9. Digital dossier aggregation vulnerabilities, secondary data collection vulnerabilities, face recognition vulnerabilities.
10. Content-based image retrieval (CBIR).
11. Difficulty of complete account deletion.
12. Spam.
13. Stalking.

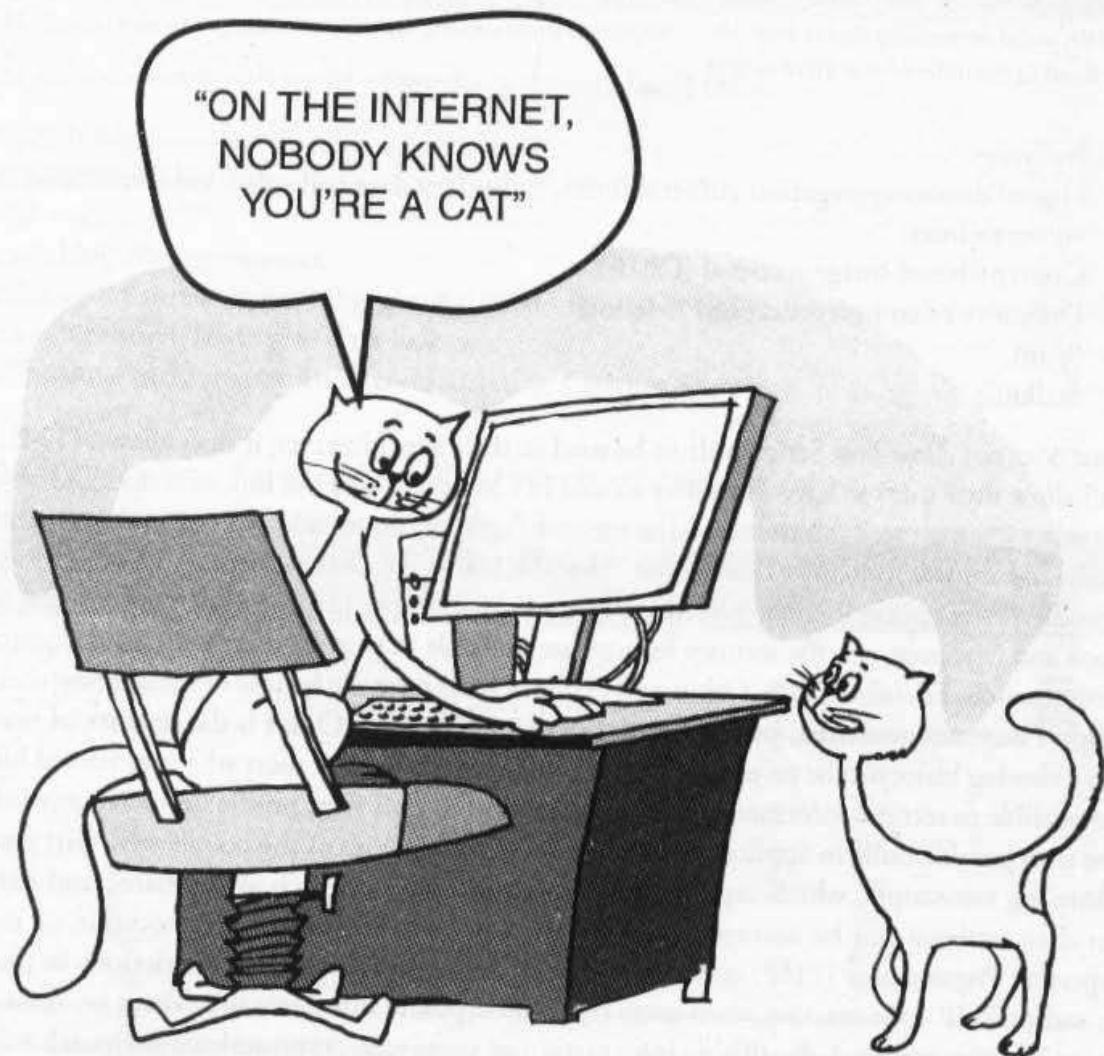
MySpace does not allow Java Script code to be used in their site. However, it does allow HTML code. MySpace and Hi5 allow their users to have the ability to add HTML code that can link to scripts and objects designed to retrieve other visiting user's information. The users of PerfSpot cannot add HTML code to their pages, but there are restrictions on the contents of this code. Yahoo!360 lacks detailed security controls as to who can view the user's profile. Their option is either everyone can view their blog or just friends. In other social networks such as Facebook and MySpace, specific security features are available to provide users with more control over their personal information. Friendster, Hi5, Orkut and PerfSpot users have the benefit of monitoring their profile visitors. This option increases awareness, protection and eases user tracking. Orkut is the only social network that forces the user's viewing history to be revealed if he/she decides to track other users who had viewed his/her profile.

It is possible to retrieve information about the users who visit your profile on social networking sites. Some of these sites provide built-in applications that show the usernames of the people who visit your profile. Other sites store log transcripts, which capture chat session information such as username and date. The function of user data retrieval can be accomplished within a website with user incorporation of either Java Script or Hypertext Preprocessor (PHP) code. Some social networking sites have restrictions in place to make Java Script and/or PHP code inactive when users try to incorporate into their site. There are different methods for capturing the non-personal identifiable information of users who communicate with each other in the virtual world. We have established that user data retrieval can be achieved with use of Web-based scripts.

User data can be retrieved and user data retrieval methods take place in the online environments of websites, IM chat sessions (virtual meetings) and E-Mails. From the user data retrieval methods used, the most important non-personal-identifiable user information that can be retrieved is the IP address. An IP address

Table 7.8 | Retrieving sender's IP address from E-Mail received

| Gmail | Hotmail | Yahoo mail |
|---|--|---|
| <p>1. Access your inbox.</p> <p>2. Select the message you would like to trace for its IP.</p> <p>3. Click on the upside down triangle located on the right, next Reply. You will see options such as "Reply to all," "Forward," "Filter Messages like This," etc.</p> <p>4. Select "Show Original."</p> | <p>1. Make sure you are in classic Mode.</p> <p>2. Right click on the message.</p> <p>3. Select "View Message Source."</p> | <p>1. Select the message.</p> <p>2. Right click on the message.</p> <p>3. Click on "View Full Headers."</p> |

**Figure 7.25** | On the Internet, it does not matter "who" you are as long as you have "ID"!!

can be used for tracking back to a user's location or the user's Internet service provider location. After retrieving the IP address, there are many links available for retrieving the geographical location of the user. It is possible to write a utility to track the visitors to a social networking site. The scripts for developing such utilities can work on any social networking website which allows you to embed HTML code in your homepage. The social networking sites and sales transaction websites that support visitor tracking program utilities are AOL Instant Messenger, eBay, Friendster, Hi5, MySpace and Yahoo!360. The sites that do not support visitor tracking utility programs are Bebo, DeviantArt.com, Facebook, Netlog, Orkut, Perfspot and Zorpia.

Currently, creating a visitor log for Facebook using the Facebook programming API is against the Facebook Developer terms and conditions. Users who attempt to create an application which tracks profile hits without visitor knowledge will be banned from the site if the application is found. Recall the discussion in Section 7.6 – it is possible to retrieve the sender's IP address from an E-Mail you received at your Gmail, Hotmail and Yahoo mail accounts. The steps are presented in Table 7.8.

As a responsible Netizen, you can take a few basic precautions; for example, knowing more about the person communicating with you online can protect you. Owing to the increased amount of crimes being committed over the internet, knowing the true identity and location of others can add another layer of protection on the lighter side, see Fig. 7.25.

Details of tools used for digital forensics with each type of OS (Window, Unix, MAC, etc.) can be studied by referring to technical books on cyber/computer/digital forensics. Some such books are mentioned in Refs. #1–10, Books, Further Reading. There are also links provided in Video Clips, Further Reading for video demonstrations. To conclude this section, we say that providing social networking site users with tools which will help protect them is ideal. Such tools are developed for installation on a user's computer to provide them the ability to retrieve other online user information via chat and social network websites. These tools will also benefit law enforcement agents when crimes are committed. Such tools typically help retrieve the IP address, OS (used on the machine from where the browsing is done) and the browser types associated with the used session for visiting a social networking site. Retrieval of this information occurs upon the virtual contact from that other person, be it by them simply browsing our personal page or by other person contacting via virtual meeting, for example chatting. Now let us understand computer forensics from compliance perspective.

7.15 Computer Forensics from Compliance Perspective

With the rampant use of the Internet, there is so much at stake; corporate data is not safe anymore given that almost all information assets lie on the corporate networks. We are in the era of Net-centric digital economy.



Criminals can gather small pieces about you, about your confidential data to generate what is known as "digital persona," that is, they keep track about your Internet activities, what resides on your corporate networks, etc.

Recall the discussion in Chapter 2 about how cybercriminals plan their attacks. There are cybercrimes and therefore there are investigations. Investigations require "evidences." This takes us to the legal territory where there are a number of legal compliance requirements. Information security compliance requires the precise enforcement of policies and controls. Investigations, in which computer forensics techniques are utilized, become an essential part of this enforcement. Let us revisit our thinking on the key information security laws and regulations that mandate computer forensics for compliance. It is appropriate to address this here in this section because we want to understand how the need for mandatory legal compliance can affect cyberforensics.

7.15.1 The Regulatory Perspective for Forensics at the International Level



Internationally, there are a few laws and regulations that indicate the need for digital investigations: Sarbanes Oxley (the SOX), California SB 1386 (see Box 7.16), Gramm Leach Bliley Act (the GLBA) and Health Insurance Portability and Accountability Act (HIPAA) of 1996.

These laws/regulations specify investigation and response to security breaches or policy violations. Computer forensics makes it easier to meet these requirements.

IT businesses are “global” with customers and IT service supplier organizations operate all over the world. We focus on the aforementioned “Big-4 laws” (SOX, California SB 1386, the GLBA and HIPAA) because they have the broadest implications for commercial organizations. They impact companies that are publicly traded, store financial or medical information or do business in California. To illustrate the implication, let us say that there is a BPO center in India that deals with support to medical entities in California; as such the HIPAA may become relevant under regulatory compliance. Such business scenarios can affect most medium to large businesses as international companies that do business in the US. Such requirements can impact global businesses.

Let us understand the role of computer forensics in achieving compliance to the Big-4 laws mentioned. After recourse to these *Big-4 laws*, we shall examine computer forensics expertise situation in India with regard to the Indian ITA 2008. We will learn that through the requirement for “adequate security practices,” which include “security incident handling,” these laws/legislations become relevant in the context of forensics with cybercrimes.

Box 7.16 California Senate Bill 1386 (Another Angle to Cyberforensics)

The Bill is important for those involved in doing business with an entity in the US. California's first-of-its-kind information security legislation (SB 1386) went into effect on 1 July 2003. This legislation requires entities or individuals who do business in California to notify California residents whenever their unencrypted personal information is reasonably believed to have been compromised. According to California Senate Bill 1386, personal information includes “an individual's first name or first initial and last name in combination with one or more of the following”: a social security number, driver's license number or California Identification Card number, account number and/or credit or debit card information including numbers and passwords, PINs and access codes. The bill also limits coverage to personal data that is “unencrypted.” The statute provides a broad definition for “security breach” as an “unauthorized acquisition of computerized data that compromises the security, confidentiality or integrity of personal information maintained by the person or business.” The statute does not define the term “unauthorized” or specify what evidence of a breach is necessary to trigger notification obligations. The statute also does not resolve on the question whether companies have an affirmative duty to actively monitor and detect security breaches.

According to the Bill, it is mandatory for an organization to follow certain disclosure obligations following the discovery of a security breach that may have compromised customer data. “Notice must be given to any resident of California whose personal information is or is reasonably believed to have been acquired by an unauthorized person.” Notice must be given in “most expedient time possible” and “without unreasonable delay” subject to certain provisions that define what reasonable is for your organization. Organizations that hold personal data on California residents, it becomes essential for IT departments to review the security of consumers' personal information.

1. **The Sarbanes Oxley Act (SOX):** The Act was enacted to fight corporate fraud. Massive financial fraud at Enron, WorldCom, Global Crossing and Arthur Anderson led to the passing of this legislation in 2002. The Securities and Exchange Commission (SEC) is responsible for enforcement of SOX and all publicly traded companies must report yearly on the effectiveness of their financial controls. Corporate Governance has become a critical operational focus of organizations to ensure that they have the proper controls and audit processes in place to prevent and detect fraud.

The legislation has serious consequences for non-compliance. This includes civil and criminal penalties. Section 302 of SOX specifies that CEOs and CFOs are directly responsible for the accuracy of their company's financial reports. Much of the focus on SOX has been regarding Section 404. Section 404 requires management to specify their responsibility for financial controls and report on the adequacy and shortcoming of the controls. Many companies offer products and services to help companies achieve Section 404 compliance. SOX has other provisions that have not received the same attention from technology and service providers.

Many companies recognize the need for computer forensics as part of normal business operations and controls and it therefore indirectly supports Section 404 compliance. For Section 301, case law has established that computer forensics is required to properly investigate fraud. In addition, computer forensics is widely accepted as the only precise and reliable method to determine if digital records have been deleted and/or altered; therefore, computer forensics is needed to maintain compliance with Section 802 (this section of SOX impacts electronic evidence). Computer forensics has proven itself as a tool in fighting against wrongful termination litigation, HR investigations, *theft of intellectual property* and *E-Discovery management*; all of these issues enhance the accuracy of financial reporting, thus supporting Section 404. Sections 301 and 802 compliance will require the use of computer forensics as established by case law and by best practices. In today's world, it becomes essential for organizations to have computer forensics capability anywhere and anytime in their organizations to ensure compliance with Sarbanes Oxley.

2. **California SB 1386 (refer to Box 7.16):** This Bill requires organizations doing business in California to report security breaches that result in the unauthorized disclosure of a resident's private or financial information. The objective for this legislation is to thwart identity theft and consumer fraud. Given that many organizations (IT companies as well as non-IT companies) worldwide are engaged in business with the US, this law affects most domestic and international companies. Disclosure is required if an exposure to individual's "personal information" is involved (see Box 7.16). Notification, however, is not required if the information disclosed was encrypted.

The law allows for civil actions to be brought against non-complying businesses or they may be enjoined by the court. It is crucial for any business to conduct a thorough investigation to determine if it "reasonably" believes that information has been compromised or not. The legislation does not provide a clear definition for "reasonable investigation of a security breach." However, security organizations and government agencies have documented current incident response processes.

The National Institute of Standards and Technology (NIST) provides clear guidance for government and commercial organizations to investigate security incidents.^[20] NIST publication on the *Computer Security Incident Handling Guide*^[20] specifically outlines incident investigation and the role of computer forensics to properly acquire and analyze the incident. NIST also clearly identifies "unauthorized access" as a type of security breach that their process addresses.

3. **Gramm-Leach Bliley Act (GLBA):** This Financial Modernization Act of 1999 (known as the GLBA) has a broad spectrum of qualifications, requirements and regulating parties. Eight agencies and states are charged with managing and enforcing the regulations. The GLBA applies to financial organizations or any organization that collects or transfers private financial information for the purpose of doing business or providing a service to its customers.

There are two aspects of GLBA: (a) the *Financial Privacy Rule* and (b) the *Safeguards Rule*. The Financial Privacy Rule addresses the collection and dissemination of customers' information whereas the Safeguards Rule governs the processes and controls in an organization to protect customers' financial data. The Federal Trade Commission enforces the "Safeguards Rule" in GLBA. In addition to the public embarrassment of non-compliance, organizations may be fined thousands of dollars a day while they are non-compliant.

The Safeguards Rule of GLB calls for financial institutions to:

1. Ensure the security and confidentiality of customer information;
2. protect against any anticipated threats or hazards to the security or integrity of such information;
3. protect against unauthorized access to or use of such information that could result in substantial harm or inconvenience to any customer.

The GLBA is relevant to forensics because computer forensics is an integral part of investigating and auditing all of GLB Safeguards Rule elements mentioned above. For response to incidents, GLBA guidelines require – "*Response programs that specify actions to be taken when the bank suspects or detects that unauthorized individuals have gained access to customer information systems, including appropriate reports to regulatory and law enforcement agencies.*"

Technical guidelines that support GLBA call for extensive Intrusion Detection System (IDS) response by utilizing computer forensics investigations. To know more on IDS, refer to Ref. #17, Books, Further Reading. From the guidelines for security controls and the guidelines for incident response, we believe that GLBA compliance requires the utilization of computer forensics both proactively and for incident response to ensure the privacy of client information and to exhibit due diligence in GLB compliant efforts.

4. **HIPAA (Health Insurance Portability and Accountability Act of 1996):** HIPAA has the primary goal for healthcare providers to improve the privacy and security of their clients' medical information. In the US, healthcare providers (hospitals, medical insurance agents, medical professionals and many allied entities involved in delivery of healthcare services) records clearing houses and health plans must comply with HIPAA. Trading partner organizations that handle medical records electronically would fall under HIPAA rules.

Finalized HIPAA rules include "information security" which encompasses incident response. HIPAA definition of security incident is "... *the attempted or successful unauthorized access, use, disclosure, modification or destruction of information or interference with system operations in an information system.*" HIPAA specifies that there should be thorough analysis and reporting of security incidents – with that comes the need for the forensics investigation. Organizations must, therefore, consider their incident response policies carefully. Generally, such policies are part of organization's overall security policies; much about this is addressed in Chapter 9. Security policy and procedures aspects are addressed in detail in Ref. #13, Books, Further Reading.

Computer forensics software is often specified to be part of any reasonable incident response policy to clearly understand the scope of the incident. Determining, with forensics precision, what information has been compromised, when the compromise took place, what systems were affected, and if malware or backdoors (see Chapter 4) that are invisible to non-forensics tools are still present, are examples of the types of investigations that are essential to having an effective incident response program. Even beyond security incidents, computer forensics plays a natural role in supporting overall information security by providing the investigation of any anomalies that could indicate policy or use violations that could jeopardize HIPAA privacy rules.

Having understood why the Big-4 laws/legislations are important from the forensics compliance perspective, let us understand the changing face of computer forensics in terms of “traditional forensics” (see Fig. 7.26) vs. “remote forensics.” Basically, computer forensics requires accessing system data in a least-intrusive manner. Traditionally, this has meant removing the hard drive from the suspect computer and connecting it to a forensics workstation using a write blocker^[21] (Fig. 7.18).

Compliance requirements in the forensics field require that the (digital) evidence must be “forensically sound.” According to the literature,^[22] a forensically sound copy of a hard drive is as follows:

... created by a method that does not, in any way, alter any data on the drive being duplicated. A forensically sound duplicate must contain a copy of every bit, byte and sector of the source drive, including unallocated empty space and slack space; precisely as such data appears on the source drive relative to the other data on the drive. Finally, a forensically-sound duplicate will not contain any data... other than which was copied from the source drive.

Furthermore, it can be said that the manner used to obtain the evidence must be documented and should be justified to the extent applicable.

As learned in this chapter, one of the key requirements of a sound forensics examination of digital evidence is that the original evidence must not be modified, that is, the examination or capture of digital data from the hard disks of a seized computer must be performed so that the disk contents are not changed (recall the discussion in Sections 7.5 and 7.7). This is because, during forensics acquisition and analysis, it is possible to write to the evidence drive accidentally.

For example, in the US, there are “Federal Rules of Evidence”; to be admissible in a US court, evidence must be both relevant and reliable. The reliability of scientific evidence, such as the output from a digital forensics tool, is ascertained by the judge (as opposed to a jury) in a pre-trial “Daubert Hearing.”^[23] The Daubert Test is an expansion of the court’s prior approach to the admissibility of scientific evidence. To avoid the immediate dismissal of the evidence from court, the investigator should take care not to compromise the evidence.

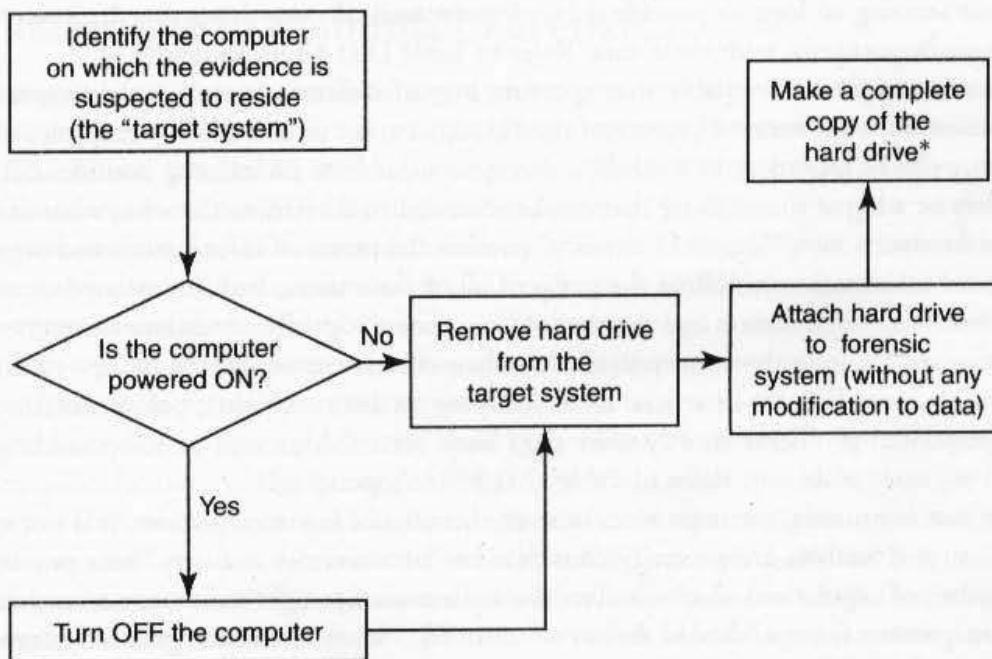


Figure 7.26 | Traditional approach to forensics analysis. *denotes tools/devices mentioned in Fig. 7.14.

The easiest way to ensure this is to use a *write blocker*. The investigator follows a set of procedures that are designed to prevent the execution of any program that would likely modify the disk contents. With the write blocker tool, the forensics investigator can examine the data on disk without alteration. There are several drawbacks with this methodology. First, it is costly and slow to physically remove the disk from a server, and the removal of the disk means downtime and user dissatisfaction. Second, although the data is not altered, important volatile data is lost because the system must be powered off to remove the disk. Although the investigator may utilize system tools and freeware to access this data before the system is shutdown, the data gathered is suspect as it may be compromised by malware running in the server. In other words, the “chain of custody” (the concept was explained in Sections 7.4 and 7.8, and Box 7.4) can be suspected/questioned when the digital evidence is admitted in the court.

Owing to these issues, a new generation of computer forensics tools^[22] has been developed with the capability to examine a live system through your corporate network. By placing a small read-only agent on the server, disk data and volatile system data can be accessed and imaged via the network. There are literature references^[24] (reports/articles, etc.) indicating that this methodology called “remote forensics,” though new, has been successfully utilized in some courts. With the new generation of network-enabled computer forensics, the investigations can be done quickly and at a lower overall cost than traditional computer forensics.

7.15.2 Computer Forensics Compliance Requirements: Implications for Evidential Aspects

Due to the current cyberspace scenario, there is an increasing need for evidence in organizations. There are rising cybersecurity threats as well as compliance needs (as part of security incidence response handling) for presenting the digital evidences/computer evidences. Good digital evidence is thus becoming a business enabler. In the face of the security threats, the incidents that follow and the need for forensics investigations, organizations are turning to logs to provide a continuous trail of everything that happens with their IT systems and, more importantly, with their data. Refer to Table D.II.13 in Appendix D.

Today there are many tools available that generate logs of different types from different sources; such logs allow organizations to generate a picture of the IT activity. Let us consider an example; if a disgruntled employee harbors the ill intention to steal data accesses, a database containing confidential information, there would likely be a log of that activity that can be reviewed to determine the who, what and when of the access to such a database. Such “logs of IT activity” provide the pieces of information and organizations can use those pieces of information to follow the paths of all of their users, bad intentioned or not. Managing these logs can benefit an organization in a number of ways. These logs offer situational awareness and thereby help organizations identify new threats as well as allow their effective investigation. Review of routine logs and detailed analysis of stored logs are beneficial for identifying security incidents, policy violations, fraudulent activity and operational problems shortly after they have occurred, as well as for providing information useful for resolving such problems. Refer to Table D.II.13 in Appendix D.

Considering that log management provides inherent benefits of log management, it is not surprising that log data collection and analysis are generally considered to be a security industry “best practice.” However, there are a number of regulations that mandate the collection, storage, maintenance and review of logs, turning log management from a “should do” to a “must do.” Some of these regulations draw on National Institute of Standards and Technology Computer Security Special Publications (NIST SP) toward detailed log requirements.^[25]

7.15.3 Computer Forensics Expertise Status in India

There is a rise in cybercrimes – recall the overview provided in Chapter 1. In Chapter 6 (Section 6.5) some of the challenges with regard to cybercrime scenario in India were described. With that as a background for this section, it can be inferred that in India, computer forensics is a much needed expertise. At the present, there seems to be a shortage of these skills. India seems to suffer from a two-fold problem: lack of availability of cyberforensics expertise as well as lack of awareness about cyberforensics/digital forensics/computer forensics. Involvement of cyberforensics in the day-to-day activities of individuals as well as corporations is going to increase due to the rising rate of cybercrimes in India (recall the Indian cybercrime data presented in Chapter 1 (Tables 1.1–1.4). ICT has been strongly rooted in India. India has a large youth population with computer usage going high. Due to this it is no surprise that cybercrimes rates are on the rise. This brings the need for increased use of cyberforensics for resolving both civil and criminal issues in India – for example, computer forensics can be used to investigate tax evasion of the accused ones.

To sum up this section, we note that compliance efforts require computer forensics investigation capabilities to investigate privacy and security incidents. The reach of computer forensics must be enterprise-wide and ideally, the response time should be immediate in order to demonstrate that the organization are utilizing best practices in managing and controlling their information security compliance. Organizations need to have a combination of in-house capability supplemented with external expert services. The fact remains that India does not have cyberforensics capabilities and the required manpower in tune with growth of ICT-related crimes and contraventions. Data breaches and cybercrimes in India cannot be reduced till we make strong cyberlaws. Cyberlaws of India need to be supported by sound cybersecurity and effective cyberforensics. In the absence of legal enablement of ICT systems in India, there is not much to expect. We need a good team of techno-legal experts who not only help in the drafting of good laws but also its amendments and enforcement.

7.16 Challenges in Computer Forensics

Although computer forensics has well-developed techniques, investigation of cybercrime is by no means easy. A microcomputer may have 200 GB or more storage capacity. There are more than 5.2 billion messages expected to be sent and received in the US alone per day. There are more than 3 billion indexed webpages worldwide. There are more than 550 billion documents online. Terabytes of data are stored on tape or hard drives. Therefore, looking for forensics evidence among these is like looking for the proverbial needle in the haystack! Over and above this, there is another challenge; most of existing tools and methods allow anyone to alter any attribute associated with digital data. The form of digital data to be analyzed is usually transformed in some way and always processed before scrutiny. Encryption is a major antiforensics technique and key word search can be defeated by renaming file names.

Cybercrime investigators are faced by the challenge of how to collect the specific, probative and case-related information from very large groups of files. They need to use approaches such as link analysis and visualization.^[27] They need to use enabling techniques for lead discovery from very large groups of files; typical techniques used to look for “patterns” are the techniques called text mining and data mining^[27] along with the techniques of intelligent information retrieval; all this is part of “data mining” which is a vast subject not within the scope of this chapter. Readers interested in learning about data mining may refer to Ref. #24, Books, Further Reading . Computer forensics must also adapt quickly to new products and innovations with valid and reliable examination and analysis techniques.

On the network forensics side, there are many challenges. The networks may span multiple time zones and multiple jurisdictions and this makes it necessary to use absolutely trusted timestamps (to ensure the authentication and integrity of timestamps for each piece of network evidence) and ensuring that all jurisdictions collaborate. Moreover, the network data will be available in both offline and real-time modes, the latter requiring the ability to capture and analyze data on the fly. The data could involve many different protocols and the amount of data could potentially be very large due to the increasing size of network bandwidth. A protocol could also involve multiple layers of signal (e.g., voice-over IP or VoIP, HTTP tunneling – for the discussion on tunneling protocols readers can refer to Ref. #15, Books, Further Reading). The current set of computer forensics tools will not be able to handle the real-time and data size/volume. Techniques are required for rapidly tracing a computer criminal's network activities (e.g., IP address) and for mapping a network's topology. There need to be a paradigm shift for network forensics techniques to analyze the rate and size of captured data.

The increasing volume of potential data to examine can create problem for law enforcement. Seizing all the computers at a search site and examining them at the deepest levels are the most significant factors contributing to the examination backlog and yet they are difficult to achieve. In order to alleviate this problem, new data intake and data reduction strategies must be implemented. It is always a good idea to adapt data acquisition strategies to the goals involved in each specific case. These strategies must also be pragmatic with regard to data volume and time constraints. Technological obsolescence must be recognized – yesterday's computer is not the equivalent of today's computer and is not even remotely similar to tomorrow's computer. Failure to recognize this will inevitably result in lost investigative leads and ineffective prosecutions.

Many forensics matters do not go to trial, especially in the business arena where a convincing set of data often suffices to induce an out-of-court settlement, or where investigative techniques are applied on a "need-to-know" basis, such as to determine whether internal or external corporate espionage or malicious activity has occurred. Experts may assist in preparing legal briefs, and they can be requested to provide sworn testimony and opinions in city, state and federal hearings conducted by legislative bodies and their commissions or task forces. They frequently work hand-in-hand with computer security teams to assist in the development of procedural, policy and control techniques to help prevent (or assist in mitigating) losses. Durations of forensics investigations vary; they may take a few hours in complex case analysis or a few days for simple cases, or the investigations can persist over the course of years for complex cases. Although some experts are engaged for the full range of investigative and testimonial tasks, those who are valued for their highly persuasive verbal skills and who can react well to on-the-spot challenges, may only review and present evidence prepared by other forensics computing specialists. Certain digital information, beyond the contents of the data itself, may be pertinent to case development. Such information can include the time and date stamps of files, folder structure hierarchies and message transmission tags. Real-time data collection efforts are more complex because they may need to address legalities and privileges involved in surveillance, and must avoid inadvertent damage claims (such as may occur when a server is made inaccessible for a period of time). Things to be wary of include alterations to the digital media that could occur when the electronic device is turned ON or OFF, and inadvertent activation of Trojan Horse or time-bomb malware that was left behind to corrupt data and confound forensics efforts. One caveat is that "you should only find what is actually there" however, ensuring this can involve the development and implementation of collection, blocking, prevention and tracking techniques. This is where evidence collection kits comprising of software and hardware tools, can be applied and these kits become useful.

7.16.1 Technical Challenges: Understanding the Raw Data and its Structure

In this section, our objective is to understand some of the technical aspects encountered in digital forensics analysis; only a few examples will be provided. Treating all the technical challenges and their greater details

is not within the scope of this chapter as digital forensics is a very large domain. The phases involved in digital forensics investigation (Section 7.7.2) should be kept in mind while going through the discussion here. Familiarity with the basic computer science fundamentals will help to appreciate the discussion in the following paragraphs. We explain only the technical aspects of data representation that a digital forensics investigator must understand.

There are two aspects of the *technical challenges faced in digital forensics investigation* – one is the “complexity” problem and the other is the “quantity” problem involved in a digital forensics investigation. A digital forensics investigator often faces the “complexity problem” because acquired data is typically at the lowest and most raw format. Non-technical people may find it too difficult to understand such format. For resolving the complexity problem, tools are useful; they translate data through one or more “layers of abstraction” until it can be understood. For example, to view the contents of a directory from a file system image, tools process the file system structures so that the appropriate values are displayed. The data that represents the files in a directory exist in formats that are too low level to identify without the assistance of tools.

The directory is a layer of abstraction in the file system. Examples of non-file system layers of abstraction include:

1. ASCII;
2. HTML Files;
3. Windows Registry;
4. Network Packets;
5. Source Code.

Digital forensics is also challenged by the “quantity problem” – it involves the hugeness of digital forensics to analyze. It is inefficient to analyze every single piece of it. Data reduction techniques need to be used to solve this. Data reduction is done by grouping data into one larger event or by removing known data. Examples of abstraction layers are data reduction techniques; for example:

1. Identifying known network packets using IDS signatures;
2. identifying unknown entries during log processing;
3. identifying known files using hash databases;
4. sorting files by their type.

Digital forensics analysis tools aim at accurately presenting all data at an appropriate layer of abstraction and format, so that the tools can be effectively used by an investigator to identify evidence. The required layer of abstraction is dependent on investigator's skill level as well as the investigation requirements. For example, in some cases viewing the raw contents of a disk block is appropriate whereas other cases will require the disk block to be processed as a file system structure. Tools must exist to provide both options. Let us understand the abstraction layer properties with regard to digital forensics. Large amounts of data are analyzed in a more manageable format using the abstraction layers. Abstraction of data layers is a core feature in the design of modern digital systems. This is because, all data, regardless of application, is represented on a disk or network in a generic format, bits that are set to one or zero. For using this generic storage format for custom applications, the data bits are translated by the applications to a structure that meets its needs. The custom format is a layer of abstraction.

ASCII is one basic example of abstraction. Every letter of the English alphabet is assigned to a number between 32 and 127 (for detailed information about ASCII scheme refer to the link <http://en.wikipedia.org/wiki/ASCII>). When a text file is saved, the letters are translated to their numerical representation and the value is saved on the media as bits. When the file is viewed in the raw, it shows a series of ones and zeros. When the ASCII layer of abstraction is applied, the numerical values get mapped to their corresponding

characters and the file is displayed as a series of letters, numbers and symbols. A text editor is an example of a tool operating at this layer of abstraction.

Next, let us consider fat file system example; “FAT” is a file allocation table. FAT file system is one of the most basic file systems that is still used in many computers. It is broken up into three main areas. The first area is the *Boot Sector* that contains the addresses and sizes of structures in this specific file system. The next two areas are the FAT and the *Data Area*. The locations of which are identified in the Boot Sector. The *Data Area* is divided into consecutive sectors called *clusters*. Clusters store the contents of a file or directory. Each cluster has an entry in the FAT that specifies if the cluster is unallocated or which cluster is the next in the file that has allocated it. Files are described by a *directory entry* structure. The directory entry structures are stored in the clusters allocated to the parent directory. The structure contains the file name, time, size and starting cluster. The remaining clusters in the file, if any, are identified using the FAT.

The FAT file system has seven layers of abstraction. The first layer uses just the partition image as input, assuming that the acquisition was done of the raw partition using a tool such as the UNIX “dd” tool. This layer uses the defined Boot Sector structure and extracts the size and location values. Examples of extracted values include:

1. Starting location of FAT;
2. size of each FAT;
3. number of FATs;
4. number of sectors per cluster;
5. location of Root Directory

The abstraction layers of the FAT file system are as follows:

1. Layer 0: Raw file system image;
2. Layer 1: File system image and values from Boot Sector and FAT Entry Size;
3. Layer 2: FAT Area and Data Area;
4. Layer 3: Starting Cluster, FAT Entries;
5. Layer 4: Clusters, Raw Cluster Content and Content Type;
6. Layer 5: Formatted Cluster Content;
7. Layer 6: List of Clusters.

Thus, we see that the digital forensics investigator has to have highly technical skills of understanding the data structure and its representation inside the computer systems where the digital evidence is suspected to reside.

7.16.2 The Legal Challenges in Computer Forensics and Data Privacy Issues



Evidence, to be admissible in court, must be relevant, material and competent, and its probative value must outweigh any prejudicial effect.

Although digital evidence is not unique with regard to relevancy and materiality, there is still a challenge involved. Digital evidence can be easily duplicated and modified; often it can be without even leaving any traces; it can present special problems related to competency. What is more to even reach the point where specific competency questions are answered, digital evidence needs to satisfy the legal admissibility

requirements. Modern computers have enormous data storage facilities. Gigabyte disk drives are common and a single computer may contain several such drives. Seizing and freezing of digital evidence can no longer be accomplished just by burning a single CD-ROM. Failure to freeze the evidence prior to opening the files, coupled with the fact that merely opening the files changes them, can and has invalidated critical evidence. There is also the problem of locating the relevant evidence within massive amounts of data. Examining such volumes of information to find relevant evidence is a daunting task. Owing to this, people often tend to think that there are complicated technical aspects in digital forensics. However, the reality is far from this. Although there are many technical aspects of digital forensics (recall the discussion in the preceding section), they involve understanding the raw data stored inside computer systems, retrieving data from existing or deleted files, interpreting their meaning and putting them within the context of the investigation. Actually, the real challenges involve artificial limitations imposed by constitutional, statutory and procedural issues – we often lose sight of the goal of retrieving evidence!



There are many types of personnel involved in digital forensics/computer forensics: (a) technicians, (b) policy makers and (c) professionals.

Technicians who carry out the technical aspects of gathering evidence. They have sufficient technical skills to gather information from digital devices, understand software and hardware as well as networks. The technical skills include – familiarity with computer hardware – thoroughly knowing the inside of the computer, understanding how hard drives work and their settings, understanding motherboards, understanding how the computer power supply units work and knowing about computer power connections, knowing how computer memory chips work (refer to Fig. 7.8). On the software side, the skills involve thorough understanding of various types of computer OS (e.g., Microsoft OS products, Linux, Unix, etc.), forensics products (diagnostic utilities and forensics diagnostic software and hardware equipment that are available in the market (see Tables 7.9–7.11)). In addition, professional forensics training is a must to enter this domain. They explain many technical aspects such as – difference between “clone” and “image” of drive, how do you make a “forensically sound” duplicate of a drive, how can you prove that the duplicate drive is forensically sound, steps to preserve the forensics evidence, etc. For technicians, forensics analysis of E-Mails is also important – it is explained in Section 7.6.

There are also *Policy Makers*; they establish forensics policies that reflect broad considerations – their main focus is on the big picture, but they must be familiar with computing and forensics also. The other entity involved in a digital forensics investigation is the *Professionals* – the link between policy and execution – who must have extensive technical skills as well as good understanding of the legal procedures. Skills for digital forensics professionals are the following:

1. Identify relevant electronic evidence associated with violations of specific laws;
2. identify and articulate probable cause necessary to obtain a search warrant and recognize the limits of warrants;
3. locate and recover relevant electronic evidence from computer systems using tools;
4. recognize and maintain a chain of custody;
5. follow a documented forensics investigation process.

To know more on technical details, legal professionals and those who are practicing in the cybercrime area may refer to Ref. #16, Additional Useful References, Further Reading.

Box 7.17 Drama in Court! Impact of Cyberforensics on Legal Practitioners

It would be no exaggeration to say that the public is primarily educated about forensics science by Hollywood films and television shows. There is no dearth of investigative news shows, documentaries, docudramas, Hollywood films and crime dramas that show us the horrifying and scary details of computer crimes. For example, on the popular YouTube media, there are hundreds of video clips available on these crimes. The media often focuses on law enforcement personnel who use "forensics" techniques to solve crimes. In a way, this is an update to the Sherlock Holmes crime investigation novels, as he used logic and scientific technique to single out the real suspect, often from a plethora of viable candidates. Probably the most popular recent movie series to focus on the use of forensics techniques are those based on the character of criminal, Hannibal Lector. Each of the three movies (*Silence of the Lambs*, *Red Dragon* and *Hannibal*) featured an FBI forensics profiler as one of its main characters.

In a scenario such as described above, an interesting question to explore is: Given the widespread popularity of forensics crime portrayals, do prosecutors and defense lawyers sense a change in jury expectations? Given the media's current emphasis on the importance of forensics science to resolve criminal investigations, a logical question to ask is if prospective jurors now have a higher expectation on the presentation of physical evidence by forensics experts. When criminal cases rely on testimonial and circumstantial evidence, do jury members feel that something is amiss? Is there a possibility that jurists might acquit when forensics evidence is not presented during a trial, but substantial circumstantial and testimonial evidence exists? If these changes are being perceived by attorneys as genuine, have lawyers reacted to changes in jurors by adjusting trial preparation and the presentation of evidence at trial? Additionally, are attorneys questioning jurors' viewing habits to either strike or attempt to retain avid viewers of forensics crime dramas?

Detection and recovery is the heart of computer forensics. This is the aspect which matters in the legal presentation of a cybercrime case in the court. The goal of detection and recovery is to recognize the digital objects that may contain information about the incident and document them. "Acquisition" is to copy and preserve the state of data that could be evidence. By "forensic acquisition of media" we mean the process of making a bit-for-bit copy, or image file, of a piece of media, where image files are frequently used in civil or criminal court proceeding. Therefore, completeness and accuracy of acquisition process is required. In addition, the source of evidence must remain and not get altered by attackers or by normal processes innocently.

Technical persons involved in digital forensics/computer forensics need simple technical skills such as understanding the various kinds of file systems (e.g., the FAT), system software, data organization and specific OS – Windows, Mac and Linux/Unix being the main operating systems in the market today. For the hand-held digital mobile devices there are operating systems such as the Symbian, the Palm OS, file systems and evidence recovery, etc. The legal professionals need to understand the working of court system, the legislations, laws (for cybercrime), and the investigative process and the evidential value of the electronic artifacts recovered/seized as potential evidences to be presented in the court while putting up the case.

Data of digital nature can be very easily deleted or altered; for example, by turning ON the computer or by simply opening/viewing a file or by password protecting files or even by saving data to another platform. Information may be available in areas that necessitate the use of special tools and techniques to identify and review. If data is not properly recovered and analyzed, it may not be admissible and/or credible in a court of law. Therefore, forensics investigators need to be careful in the matter of capturing the "perceived" evidence. They should understand that before they seize a computer or other electronic hardware they must consider whether they require a search warrant. They should be aware that if they wish to access stored electronic communications, they will need to comply with the Privacy Act/Privacy Law if applicable in their country. In order to conduct real-time electronic surveillance, they will need to obtain a wiretap order from a judge.

If access to digital evidence does not come through from an confiscation agency, court orders may become necessary to obtain the data as well as use of the extraction tools to determine whether protocols had been appropriately applied. Conversely, a prosecution or defense team may wish to suppress evidence from discovery, if they believe it could be damaging to the case. This is where the time-consuming aspects of the forensics examination may occur. In general, it is difficult to perform a comprehensive decomposition and logging of all materials (such as the contents of every sector of a terabyte hard drive, or thousands of hours of digital video from a surveillance camera), so a "scratch-and-sniff" approach might be used to yield promising information. Even though cost-effective, tactical decisions to proceed with only a partial investigation may be regretted in hindsight if a post-mortem comprehensive analysis shows that an alternative outcome might have prevailed.

Box 7.18 Beware – Forensics Acts and Laws!

It is said that forensics is a territory of dilemmas! The foremost dilemma with the study of electronic law is that it is very complicated to confine its study within simple parameters; Internet and electronic commerce do not define a distinct area of law as with contract and tort law. Electronic law crosses many legal disciplines, each of which can be studied individually. Cybercriminals abound – there will always be those in the world who wish to gain some benefit without actually paying for it. As a result, the electronic law will also cross-over certain aspects of criminal law.

In Chapter 1, many forms of cybercrimes are mentioned. Whether it is racial or sexual harassment, stalking, bullying at work or neighbors from hell, harassment is a form of discrimination that is generally prohibited by legislation. Harassment in the workplace is something employers must not tolerate, and includes any form of unwelcome, unsolicited, or unreciprocated behavior that a reasonable person would consider offensive, humiliating or intimidating. Chapters 1 and 2 mention about cyberstalking. Cyberstalking is the distribution of malicious communication through E-Mail and the Internet. Although based on new technology, it is in principle precisely the same as many other form of malicious communication and can be dealt with through the usual civil and criminal law methods. The distribution of offensive E-Mail through the Internet and such communication will also constitute an offense under a variety of statutes (such as the Malicious Communication Act in the UK).

Chapter 1 mentioned Children's Online Privacy Protection Act (COPPA). Pornography is a big business on the Internet and has even been seen by some as its foundation. In the US, pornography is protected as speech under the First Amendment of the Constitution. Obscenity, on the other hand, is not protected. Obscenity may be legally possessed in an individual's private home, but generally its distribution is illegal.

In much of the common law world, law enforcement needs to obtain a legal authorization in order to search and seize evidence. Generally, this power is granted through a request for a search warrant that states the grounds for the application, including the law that has been broken. In the US, the requirements demand that the application describe the specific premises need to be searched, as well as the items being sought. In the physical world, there is a real limit on the length of time during which a search can be conducted. This rule does not impose much of a limit on electronic searches. As investigators make a copy of the digital evidence (such as a hard drive), they are able to continue to search those files for "string," which are beyond the scope of the original warrant, and do so at their leisure. According to the Fourth Amendment rule, an investigator executing a warrant is able to look in any place listed on the warrant where evidence might conceivably be concealed. Text of the Fourth Amendment states the following:

"The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized."

As per traditional practices, an investigator was precluded from looking into any location beyond the area of the evidence he/she wishes to seize. Electronic evidence, however, may be stored anywhere. The result is that in an investigator can electronically look anywhere in search of digital evidence. For more details on the Fourth Amendment in the cyberspace, refer to the link mentioned

Box 7.18 Beware – Forensics . . . (Continued)

at the end of this box. Chapter 6 mentions about “evidence.” The Indian IT Act impacts the Indian Penal Code 1860, the Indian Evidence Act 1872, The Bankers’ Books Evidence Act 1891, The Reserve Bank of India Act 1934 (see Chapter 6) to make them in tune with the provisions of the IT Act. Electronic evidence in law is the legal recognition and evidential value in litigation of evidence in digital format. An Anton Piller order is a civil court order providing for the right to search premises and seize evidence without prior warning. In the US, the Business Software Alliance has used those orders as a remedy when they are attempting to stop illegal software use (termed software piracy) and copyright infringement to achieve the recovery of property.

Refer to the following URL mentioned for a complete presentation on the Fourth Amendment:
<http://law.uoregon.edu/faculty/shoar/docs/cc10/2010-fourthamendment.ppt> (7 September 2010).
Also see the link in Ref. #6, Video Clips, Further Reading.

7.17 Special Tools and Techniques

We present in this section ready reckoner of forensics tools as well as some special techniques such as “data mining.” Forensics tools have also been mentioned in various sections of this chapter so far – for example “file carving” is mentioned in Box 7.10. Most of the “file carvers” tools operate by first looking for file headers and/or footers and then by “carving out” the blocks between these two boundaries. Outlook files with extension “jpeg” and MS Word files are fragmented and, therefore, appear corrupted or missing to a user using traditional data carving. “Disk duplication” equipments were mentioned in Section 7.11. Embedded memories inside the computer were mentioned in Section 7.7.2. Recall that Computer Online Forensics Evidence Extractor (COFEE) was mentioned in Box 7.1. Helix is another well-known tool for digital forensics investigation. Helix is a tool specially tailored for incident response, system investigation and analysis, data recovery and security auditing. It is attuned to experienced users and system administrators working in small-to-medium, mixed environments, where threats of data loss and security breach are high. Helix has two modes – pure Linux bootable live CD and the Windows mode, where it can be used *in vivo* on top of a desktop running Windows OS. Helix is available for download by E-Mail registration. For further technical details on Helix, visit <http://www.dedoimedo.com/computers/helix.html> (10 February 2010).

The list of carving tools is presented in Table 7.9. The list of reviewed tools is presented in Table 7.11. Cyberforensics expert Peter Stephenson, when asked, about how important tools are in digital forensics, responded by saying “... *Essentially, incident management is a forensics problem. That challenge demands a serious toolkit of computer forensic, network-enabled forensic, network forensics and analytical tools.*” In the words of another well-known forensics analyst Steve Hailey, “*If the tools being used are the mechanism to find evidence on a computing device, and several different tools can replicate the process, then it doesn't matter what tools were used.*”

Most tools have the same underlying principles:

1. Creating forensics quality or sector-by-sector images of media;
2. locating deleted/old partitions;
3. ascertaining date/time stamp information;
4. obtaining data from slack space;
5. recovering or “undeleting” files and directories, “carving” or recovering data based on file headers/file footers;
6. performing keyword searches;
7. recovering Internet history information.

7.17.1 Digital Forensics Tools Ready Reckoner

The list of “carving” tools presented in Table 7.9 is divided in three main categories (a) data recovery (b) partition recovery and (c) carving. The associated websites are also mentioned for more information on these tools. Readers may like to re-visit Box 7.10.

Table 7.9 | List of carving tools

| Sr. No. | Name of the Tool | Brief Description |
|----------------------------|-----------------------|---|
| Data Recovery Tools | | |
| 1. | Norton Disk Edit | The master boot record is required to boot your computer. Having a current backup of your master boot record is an excellent way to ensure that, in the event of a virus or hardware failure, you will be able to recover your system in the shortest amount of time possible. |
| 2. | HD Doctor Suite | It is a set of professional tools used to fix firmware problem. To know more on this, visit http://www.salvationdata.com/data-recovery-equipment/hd-doctor.htm |
| 3. | SalvationDATA | This tool claims to have a program that can read the “bad blocks” of Maxtor drives with proprietary commands. To know more on this, visit http://www.salvationdata.com/ |
| 4. | BringBack | The tool offers easy to use, inexpensive and highly successful data recovery for Windows and Linux (ext2) operating systems and digital images stored on memory cards, etc. To know more on this, visit http://www.toolsthatwork.com/bringback.htm |
| 5. | RAID Reconstructor | Recall the RAID levels explained in Box 7.11. Runtime Software’s RAID Reconstructor will reconstruct RAID Level 0 (Striping) and RAID Level 5 drives. To know more on this, visit http://www.runtime.org/raid.htm |
| 6. | e-ROL | e-ROL allows you to recover through the Internet files erased by mistake. Recover your files online for free. To know more on this, visit http://www.e-rol.com/en/ |
| 7. | Recuva | Recuva is a freeware Windows tool that recovers accidentally deleted files. To know more on this, visit http://www.piriform.com/recuva |
| 8. | Restoration | Restoration is a freeware Windows software that will allow you to recover deleted files. To know more on this, visit http://www.snapfiles.com/get/restoration.html |
| 9. | Undelete Plus | Undelete Plus is a free deleted file recovery tool that works for all versions of Windows (95-Vista), FAT12/16/32, NTFS and NTFS5 filesystems and can perform recovery on various solid state devices. To know more on this, visit http://www.undelete-plus.com/ |
| 10. | R-Studio | R-Studio is a data recovery software suite that can recover files from FAT(12-32), NTFS, NTFS 5, HFS/HFS+, FFS, UFS/UFS2 (*BSD, Solaris), Ext2/Ext3 (Linux) and so on. To know more on this, visit http://www.data-recovery-software.net/ |
| 11. | Stellar Phoenix | Data recovery software services and tools to recover lost data from hard drive. Visit http://www.stellarinfo.com/ |
| 12. | DeepSpar Disk Imager | It is a dedicated disk imaging device built to handle disk-level problems and to recover bad sectors on a hard drive. To know more on this, visit http://www.deepspar.com/ |
| 13. | Adroit Photo Recovery | This is a photo recovery tool that uses validated carving and is able to recover fragmented photos. Adroit Photo Recovery is able to recover high definition RAW images from Canon, Nikon, etc. To know more on this, visit http://photo-recovery.info/ |

(Continued)

Table 7.9 | (Continued)

| <i>Sr. No.</i> | <i>Name of the Tool</i> | <i>Brief Description</i> |
|---------------------------------|----------------------------------|---|
| Partition Recovery Tools | | |
| 1. | Partition Table Doctor | It helps recover deleted or lost partitions (FAT16/FAT32/NTFS/NTFS5/EXT2/EXT3/SWAP). To know more on this, visit http://www.ptdd.com/index.htm |
| 2. | NTFS Recovery | DiskInternals NTFS Recovery is a fully automatic utility that recovers data from damaged or formatted disks. To know more on this, visit http://www.diskinternals.com/ntfs-recovery/ |
| 3. | gpart | Gpart is a tool which tries to guess the primary partition table of a PC-type hard disk in case the primary partition table in sector 0 is damaged, incorrect or deleted. To know more on this, visit http://www.stud.uni-hannover.de/user/76201/gpart/ (restricted permission) |
| 4. | TestDisk | This is an OSS tool (open-source software) and is licensed under the GNU Public License (GPL). To know more on this, visit http://www.cgsecurity.org/wiki/TestDisk |
| 5. | Partition Recover Software | Partition Recovery software for NTFS and FAT system that examines lost windows partition of damaged and corrupted hard drive. To know more on this, visit http://www.stellarinfo.com/partition-recovery.htm |
| File Carving Tools | | |
| 1. | DataLifter® - File Extractor Pro | Data carving runs on multiple threads to make use of modern processors. Visit http://www.datalifter.com/products.htm |
| 2. | Simple Carver Suite | This is a collection of unique tools designed for a number of purposes including data recovery, forensics computing and E-Discovery. The suite was originally designed for data recovery and has since expanded to include unique file decoding, file identification and file classification. Visit http://www.simplecarver.com/ |
| 3. | Foremost | Foremost is a console program to recover files based on their headers, footers and internal data structures. Visit http://foremost.sourceforge.net/ |
| 4. | Scalpel | Scalpel is a fast file carver that reads a database of header and footer definitions and extracts matching files from a set of image files or raw device files. Scalpel is filesystem-independent and will carve files from FATx, NTFS, ext2/3, or raw partitions. Visit http://www.digitalforensicsolutions.com/Scalpel/ |
| 5. | CarvFs | A virtual file system (fuse) implementation that can provide carving tools with the possibility to do recursive multi-tool zero-storage carving (also called in-place carving). Patches and scripts for scalpel and foremost are provided. Works on raw and EnCase images. For more information, visit http://www.forensicswiki.org/wiki/CarvFs |
| 6. | LibCarvPath | A shared library that allows carving tools to use zero-storage carving on carvFs virtual files. For more information, visit http://www.forensicswiki.org/wiki/LibCarvPath |
| 7. | PhotoRec | This is file data recovery software designed to recover lost files including video, documents and archives from hard disks and CDROM and lost pictures (thus, its "Photo Recovery" name) from digital camera memory. Visit http://www.cgsecurity.org/wiki/PhotoRec |

(Continued)

Table 7.9 | (Continued)

| <i>Sr. No.</i> | <i>Name of the Tool</i> | <i>Brief Description</i> |
|--------------------|-----------------------------|--|
| 8. | PhotoRescue | Datarescue PhotoRescue Advanced is picture and photo data recovery solution made by the creators of IDA Pro. PhotoRescue will undelete, unerase and recover pictures and files lost on corrupted, erased or damaged compact flash (CF) cards, SD Cards, Memory Sticks, SmartMedia and XD cards. For more information, visit http://www.datarescue.com/photorescue/ |
| 9. | RevIt | RevIt (Revive It) is an experimental carving tool, initially developed for the DFRWS 2006 carving challenge. It uses “file structure-based carving.” Note that RevIt currently is a work in progress. For more information, visit https://www.uitwisselplatform.nl/projects/revit |
| 10. | Magic Rescue | Magic Rescue is a file carving tool that uses “magic bytes” in a file contents to recover data. For more information, visit http://www.student.dtu.dk/~s042078/magicrescue/ |
| 11. | FTK | FTK2 includes some file carvers. <i>Note:</i> see Table 7.11 |
| 12. | SmartCarving | SmartCarving is a file carving technique to recover fragmented files. SmartCarving utilizes a combination of structure-based validation along with validation of each file’s unique content. |
| 13. | GuidedCarving | This is a technique to recover fragmented files introduced in <i>Adroit Photo Forensics</i> . GuidedCarving allows a user to attempt to recover a fragmented file that failed to fully recover using SmartCarving. |
| 14. | Adroit Photo Forensics | Adroit Photo Forensics supports data carving of popular image formats. Also supports fragmented carving using <i>SmartCarving</i> and <i>GuidedCarving</i> . |

Note: The term “Data Recovery” is frequently used to mean forensics recovery, but the term really should be used for recovering data from damaged media.

The information in Table 7.10 is based on Dr. Peter Stephenson’s in-depth review of forensics tools conducted in year 2006. The survey by Dr. Stephenson is considered to be one of the best known among similar other surveys. Links for other survey are mentioned after the table.

Prices indicated are “as at point in time” that is the exact prices should be found out at the time of purchase. Versions indicated are as per testing done in 2006 – for more information, refer to website www.scmagazine.com

Links to other surveys/reviews about forensics tools are provided below:

1. *Best Forensics Tools – 2007 Edition* can be accessed at the following link: <http://www.dragoslungu.com/2007/04/17/best-forensics-tools-2007-edition/> (4 April 2010).
2. *EnCase Forensic 6 – Review* is available at the following link: <http://whereismydata.wordpress.com/2008/08/31/enckease-forensic-6-review/> (3 April 2010).
3. The following link will take you to *Computer Forensics Tool Testing (CFTT) Survey*: <http://blogs.sans.org/computer-forensics/2010/03/04/computer-forensics-tool-testing-cftt-survey/> (1 April 2010). Table 7.11 provides information about the tools compared in Table 7.10. Reference websites are also provided.

Table 7.10 | Forensics tools features comparison at a glance

| <i>Product Name</i> | <i>Coroner's Toolkit</i> | <i>Encase Forensics Toolkit</i> | <i>i2 Analyst's Notebook</i> | <i>LogLogic LX2000 First Response</i> | <i>Mandiant Net Witness</i> | <i>ProDiscover Incident Response</i> | <i>Slurp Kit/Autopsy Browser</i> |
|--|--------------------------|---------------------------------|------------------------------|---------------------------------------|-----------------------------|--------------------------------------|----------------------------------|
| Supplier | Open source | Guidance software | Access data | i2Inc. | LogLogic | Mandiant | Man Tech Int'l. |
| UNIX/Linux platform | Yes | No | No | Yes | No | Yes | No |
| Windows Platform Analyzes W – Windows U – UNIX/Linux | No U | Yes W, U | Yes — | No W | Yes — | No W, U | No W, U |
| Remote Capture GUI | No | No | — | Yes | Yes | — | Yes |
| Requires Remote Agent | No | Yes | Yes | Yes | Yes | No | No |
| Preforensics Audit | No | Yes | No | Yes | No | Yes | No |

Table 7.11 | Top tools in digital forensics

| <i>Name of the Tool</i> | <i>Brief Information</i> |
|--|---|
| The Coroner's Toolkit (TCT) Version 1.16 Visit www.porcupine.org | <ul style="list-style-type: none"> • OSS tool (open-source software) • No cost – OSS • Not a GUI-based product • Used with UNIX platform – it is a collection of command line tools • Written by Dan Farmer and Wietse Venema • Deep UNIX knowledge is the prerequisite to use TCT because it is a UNIX-only tool • Documentation is not detailed • Support to this tool is not much available – like most OSS tools, users are expected to fend for themselves |
| EnCase Forensics Version 5.0 Visit www.guidancesoftware.com | <ul style="list-style-type: none"> • GUI-based • Expensive • Adequate documentation • Simple to operate and use • Can acquire many different media • Plenty of web support • Costs around \$3000 Targeted at large organizations |
| Forensics Toolkit (FTK) Version 1.61 Visit www.accessdata.com | <ul style="list-style-type: none"> • Comprehensive with many features but not simple to use • Overwhelming program interface • Good documentation • Comes with a USB-pluggable hardware device • Costs around \$1100 |
| i2 Analyst's Noted Version 6.0.55 Visit www.i2inc.com | <ul style="list-style-type: none"> • Very different type of forensics analysis tool • Can import metadata from EnCase • Data can be imported from spreadsheet using CSV file • Has the ability to analyze complex crimes • Help system is very good • People-based support is expensive (online support and phone support is also available) • Costs around \$3700 |
| LogLogic's LX 2000 Visit www.loglogic.com | <ul style="list-style-type: none"> • Highly expensive – costs around \$50000 • Excellent tool for log analysis – analyzes logs in real-time mode • Mature and useful product • High functionality but complex to set up • Excellent interface but high learning curve (many hidden features to be understood) • Adequate documentation |
| Mandiant First Response Version 1.1 Visit www.mandiant.com | <ul style="list-style-type: none"> • No cost – freeware forensics audit tool with strong audit features • Not easy to use – awkward interface • Useful features once understood • Gathers forensics information in an organized and simple-to-read fashion • Limited support and limited documentation • Deploys agents across network computers to gather a snapshot before evidence is gathered |

(Continued)

Table 7.11 | (Continued)

| <i>Name of the Tool</i> | <i>Brief Information</i> |
|--|---|
| NetWitness Version 6.0 Visit www.netwitness.com | <ul style="list-style-type: none"> • Network traffic security analyzer and works as a security intelligence tool. Helps automate IDS analysis process • Good user interface • Set up is easy due to installation wizard • Good user interface • Low scalability • Inadequate documentation • Web-based support and E-Mail-based support for registered users • Costs \$30,000 • Not suitable for large enterprises |
| ProDiscover Incident Response Version 4.55 Visit www.techpathways.com | <ul style="list-style-type: none"> • Complete IT forensics tool can access computer over the network • Fairly easy to use • Supports remote analysis of running processes, open files, open port and services running on open ports • Not for first time users – experience in forensics required • Well laid-out documentation • Full disk imaging capability, ability to find hidden data, file metadata information, hash keeping as well as across network data gathering • Costs \$8000 |
| Sleuth Kit and Autopsy Browser Visit www.sleuthkit.org | <ul style="list-style-type: none"> • No cost – it is a freeware • Good documentation • Good support • Straightforward to use for those familiar with UNIX environment but difficult to use by those not familiar with UNIX • Can use Non-UNIX file systems too • The browser can run on any HTML environment • Adequate documentation • Support is much better as compared to many other OSS – E-Mail-based support is available and many active user forums are available |

7.17.2 Special Technique: Data Mining used in Cyberforensics

Data mining is a very vast topic; full treatment of this topic is beyond scope of the chapter. In this section, we are only going to explain how data mining techniques are applied in cyberforensics. Chapter 1 presents the various categories of cybercrimes. A criminal act can encompass a wide range of activities, from civil infractions such as illegal parking to internationally organized mass murder such as the 9/11 attacks in New York, US and 26/11 attacks in Mumbai, India. Law enforcement agencies across the world compile crime statistics. Depending on the type of cybercrimes, the impact and the impacted parties can vary. Some examples of impact and impacted parties are national security and government, financial impacts and individuals, brand image and organizations. More on this is presented in Chapter 9.

Traditional data mining techniques such as association analysis, classification and prediction, cluster analysis, and outlier analysis identify patterns in structured data. To know more on these analyses, visit <http://www.theairling.com/glossary.htm>. Newer techniques identify patterns from both structured and unstructured data. Literature^[28] shows that as with other forms of data mining, crime data mining raises privacy concerns. Automated data mining techniques are being researched for both local law enforcement and national security applications. A brief explanation of some of the data mining techniques is as follows:

1. **Entity extraction:** This technique is used to identify particular patterns from data such as text, images or audio materials. It has been used to automatically identify persons, addresses, vehicles and personal characteristics from police narrative reports.^[29] In computer forensics, the extraction of software information such as the data structure, program flow, organization and quantity of comments, and use of variable names, can facilitate further investigation by grouping similar programs written by hackers and tracing their behavior. Entity extraction technique provides basic information for crime analysis, but its performance depends greatly on the availability of extensive amounts of clean input data.
2. **Clustering techniques:** This involves grouping data items into classes with similar characteristics to maximize or minimize intraclass similarity. For example, in order to identify suspects who conduct crimes using similar methods or to distinguish among groups that belong to different gangs. These techniques are not featured with a set of predefined classes for assigning items. The statistics-based *concept space algorithm* is used to automatically associate different objects such as persons, organizations and vehicles in crime records.^[30] The Financial Crimes Enforcement Network AI System (AI is the branch of computer science, known as “Artificial Intelligence”)^[31] uses link analysis techniques (to identify transactions’ patterns) to exploit Bank Secrecy Act data to support the detection and analysis of money laundering and other financial crimes. The technique of “clustering” crime incidents can automate a major part of crime analysis but is limited by the high computational intensity typically required.
3. **Association rule mining:** This technique discovers frequently occurring item sets in a database and presents the patterns as rules. This technique has been applied to detect network intrusion and to derive association rules from users’ interaction history. Investigators can also apply this technique to network intruders’ profiles to help detect potential future network attacks.^[32]

Automated techniques to analyze different types of crimes need a unifying framework describing how to apply them. In particular, there is a need for understanding the relationship between analysis capability and crime type characteristics. This understanding can help investigators more effectively to use those techniques to identify trends and patterns, address problem areas and even predict crimes. After having completed a brief overview of data mining techniques in cyberforensics, we now discuss forensics auditing.

7.18 Forensics Auditing



“Forensics auditing” is also known as “forensics accounting.”

Forensic auditing includes the steps needed to detect and deter fraud. Forensics auditors make use of the latest technology to examine financial documents and investigate white-collar crimes like such as frauds, identity theft, funds embezzlement, securities fraud, insider trading, etc. Forensics accounting is a specialized form of accounting; it uses accounting, auditing and investigative techniques. Forensics accounting professionals are assigned specialty tasks, such as analyzing and tracking evidence of economic transactions. In some cases, they are asked to present this evidence to a court of law. Forensics auditors are responsible for detecting fraud, identifying individuals involved, collecting evidence, presenting the evidence in criminal proceedings, etc. From career perspective, forensics auditors can work in both large and small organizations like insurance companies, banks, courts, government agencies and law firms. Cybersecurity Careers are addressed in Chapter 12.

There is almost always some legal/evidential angle in forensics auditing. Consider as an example of forensics auditing, the investigation of a fraud or presumptive fraud with the objective of gathering evidence that could be presented in a court of law. There is an increasing use of auditing skills to prevent fraud by identifying and rectifying situations that could lead to frauds being perpetrated (i.e., risks). It might be useful, therefore, to categorize forensics auditing as being either "reactive" or "proactive."

"Insider trading" needs some explanation. According to the American Heritage Dictionary, "insider trading" is the illegal buying or selling of securities on the basis of information that is unavailable to the public. It involves trading of a corporation's stock or other securities (e.g., bonds or stock options) by individuals with potential access to non-public information about the company.

"Insider trading"^[33] refers to two separate financial transactions – one being perfectly legal and the other being subject to massive civil fines and possible prison time. There is a legal form of insider trading – it involves the sale of securities or stocks by officers of a company or stockholders who own more than 10% of the company. In many countries, trading by corporate insiders, for example, officers, key employees, directors and large shareholders, etc., may be considered legal if this trading is done in a way that does not take advantage of non-public information. However, the term is frequently used to refer to a practice in which an insider or a related party trades based on non-public information obtained during the performance of the insider's duties at the corporation, or otherwise in breach of a fiduciary or other relationship of trust and confidence or where the non-public information was misappropriated from the company.

Recall the discussion about regulatory perspective for forensics (Section 7.15.1). Government departments/agencies can possibly use the techniques of forensics auditing to assess compliance with regulations governing payments of grants/subsidies. Compliance auditors could also use these techniques while auditing such governmental programs. We have mentioned about "steganography" in Section 7.12. Antiforensics tools can hide data with cryptography or steganography. "Antiforensics" is addressed in the next section. Although steganography has not yet come either under the direct scope of IT Audits or under cyberforensics investigation, because it is not yet considered a direct threat by auditors and cyberforensics investigators, it is the one that needs to be considered and understood for possible future occurrences.

Box 7.19 Auditing vis-à-vis Cyberforensics Investigation

For many people, both the terms auditing and cyberforensics investigation are the same but actually they are not. Typically, an "audit" involves examination of information and operations for accuracy, legality and propriety. Internal audits are meant to report risks and to make recommendations to promote sound-operating practices. Audit examinations typically involve documents, records, reports, internal control systems, accounting procedures and actual operations. On the other hand, "cyberforensics investigation" is the process of extracting information and data from computer storage media and guaranteeing its accuracy and reliability (typically in an evidential context).

Box 7.19 Auditing vis-à-vis . . . (Continued)

Objective of an "audit" is to determine whether all transactions are properly recorded in the accounts, and appropriately reflected in the organization's statement and reports. The objective of a "cyberforensics investigation," on the other hand, is to identify "digital evidence" using scientifically derived and proven methods that can be used to facilitate or to help reconstruct events in an investigation. The secondary objective is to identify the responsible person and seriousness of the misconduct.

Auditing and cyberforensics investigation vary in their "scope" too. Scope of an audit typically includes – audit objectives, risk assessment, nature and extend of controls testing (compliance testing or substantive testing) and the extent of auditing procedures to be performed, reliance on previous audits. The scope of cyberforensics investigation involves scientific methods to identify, collect, analyze, validate, interpret, preserve, document and present electronic evidence derived from digital sources.

Results of audit are generally communicated via written report to management. On the other hand, report of a cyberforensics investigation is submitted to the investigator, prosecutor, law enforcement, organizational management and others. The impacts differ too. An audit is conducted in a non-confrontational manner, with generally helpful cooperation by the auditee whereas a cyberforensics investigation may be adversarial. Each investigation is independent and unique in itself.

Recall the discussion in Section 7.5.1 The Rules of Evidence – "secure, auditable digital date/time stamps" will have the following attributes:

1. **Accuracy:** The time presented is from an authoritative source and is accurate precision required by the transaction, whether day/hour/millisecond.
2. **Authentication:** The source of time is authenticated to a suitable timing laboratory so that a third party can verify the precision and accuracy.
3. **Integrity:** The time should be secured and not subjected to corruption during "handling." If it is corrupted, either inadvertently or deliberately, the corruption will be apparent to a third party.
4. **Non-repudiation:** An event or document should be bound to its time so that association between event or document and the time cannot be later denied.
5. **Accountability:** The process of acquiring time, adding authentication and binding it to the subject event should be accountable, so that a third party can be assured that due process was applied and that no corruption transpired.

"Digital Evidence Collection" is a game of patience. The potential for fraud, unintended errors can be eliminated by adding secure and auditable time to digital evidence. The use of secure date/time stamps can not only improve the integrity digital evidence, but also provide higher assurance required for digital chain of evidence. Using secure and auditable time helps to ensure that any important electronic time stamp that cannot be corrupted has an evidentiary trail of authenticity. The secure issuance of timestamps for digital evidence has some critical components associated with them:

1. First, it must be remembered that digital data needs binding of time. Such binding of time with digital data must occur within a trusted computing environment to assure the "efficacy of the time stamping process."
2. Next, it is important to consider the accuracy of the clock used as the source for time stamping. The clock used should be appropriate for the application. For example, the accuracy of a timestamp

indicating access to a secure facility through the use of a card access or biometric device of 30 seconds may be reasonable. However, the time stamp on an electronic stock transaction or money transfer may warrant a finer resolution.

3. When a local trusted clock is used as the source for time stamping, its calibration and audit must be routine, continuous and traceable. Furthermore, to make the audits reliable, the audit of such clocks must be performed by a trusted, disinterested third party.
4. Finally, the issuer must verify the validation of the resulting timestamps. The verification/validation records ought to be made available to any party that has the need to evaluate the accuracy, validity, trustworthiness or traceability of a timestamp.

7.19 Antiforensics

“Antiforensics” is the application of scientific method to digital media to invalidate factual information for judicial review. There are four categories of antiforensics: (a) *Data destruction*; (b) *data hiding*; (c) *data encryption* and (d) *data contraception*. Antiforensics is a combination of people, process and tools. There are several counter-forensics commercial software tools available in the market. They are designed to eliminate specific records and files but leave system otherwise functional, that is, overwrite deleted data to thwart recovery and cope with system files, like the Registry. Counter-forensics tools are increasingly reported as important factors in legal action. Organizations must seek to understand the mindset, skill set and capabilities of those employing antiforensics techniques. By way of a situational context, this is like trying to understand from cyberattackers’ perspective so that threats posed to the information systems can be understood. Cybercriminals exploit the fact that forensics takes time. Recall “Locard Exchange Principle” (Box 7.5) – conventional wisdom tell us that an attacker will attempt to leave as little evidence as possible. From another angle, however, there are significant advantages to an attacker for creating extraneous evidence. The first is the time factor mentioned earlier; forensics investigation takes time and time is money! Multisystem compromises against enterprise networks resulting in non-linear increase in the amount of effort that goes in accurate analysis of suspect system. In situations where an extraordinarily large number of computers are under suspicion, businesses can rarely perform a full forensics analysis of all the computers.

Recall the discussion in Section 7.16.2. In that context, here is another point on forensics from “privacy” perspective: Modern OS and applications that run on the OS generate a high amount of data about users’ activities. Current trends in computer use raise concerns about recovering “privacy-sensitive” data from computer systems, especially given the mobile computing trends and “remote working” trends. The line between “home” and “office” is getting thinner as work takes place round the clock in a “work anywhere” and “any time” mode. Employees use company computers (desktops, laptops, etc.) for personal E-Mails, banking, shopping, listening to music, watching video, etc. (although some organizations have strict rules and guidelines on allowed usage and security restrictions on sites to be visited using company computers). Refer to Chapter 9 and Appendix C.

When companies provide employees with laptops to work from home,^[34] other family members may also use these computers. In such a scenario, company computers often may contain “sensitive personal information” (along with business confidential information) which individuals want to keep private. The laptops may also contain records that companies would like to protect and examine. Users are getting increasingly aware of their “privacy exposure” from these records and the “digital artifacts” that linger even after files are “deleted” on the computer they use. As a result of this, a range of “counter-forensic” privacy tools have emerged. These tools are nothing but software designed to irretrievably eliminate records of

computer system usage and other “sensitive data.” Following are some of the lists of well-known tools with “counter-forensics features”:

1. Windows Washer;
2. Windows and Internet Cleaner;
3. CyberScrub Pro;
4. Evidence Eliminator;
5. Acronis Privacy Expert;
6. SecureClean.

A table^[35] showing feature comparison of 1, 2, 3 and 4 is available in a link in References. However, those are not the only antiforensics tools available in the market place today. More are described in the next paragraph.

Metasploit antiforensics investigation arsenal includes tools such as (a) *timestomp*,^[36] (b) *Slacker*, (c) *transmogrify* and (d) *Sam Juicer*. Let us first understand how “timestomp” acts as an antiforensics tool. Timestomp uses Windows system calls *NtQueryInformationFile()* and *NtSetInformationFile()*. However it does not use the call *SetFileTime()*. Timestomp features include display and set MACE attributes to mess up with EnCase and MS Anti-Spyware. Timestomp leverages a series of Win32 system calls to modify the Last Modified (M), Last Accessed (A), Creation Date (C) and Entry Modified (E), together referred to as “MACE.” During a forensics analysis, the examiner will use these values to attempt to piece together a timeline of event. If an attacker is able to undetectably modify these entries then the examiner can no longer rely on timestamps to create a timeline for the crime committed. By performing a series of standard Win32 function calls, an attacker can place data at the end of a cluster. A subsequent series of function calls allows an attacker to retrieve the stored data. Timestomp allows the techie criminal to hide information on a system that may not be immediately distinguished from other random slack space information. Little can be done to examine hidden slack space information that has been properly obfuscated or encrypted. This explains how “timestomp” may permit an attacker to subvert file time stamps to corrupt a forensics analysis; however, it can also be used to validate various forensics tools for reliability. Thus, it works like a double-edged sword!

“Transmogrify” is a simple search and replace engine that allows for the file signatures to be changed between various types. An attacker might change a JPG file to show up as a Windows Executable. Most popular forensics tools only perform the most basic pattern matching and file extension examination to identify file type. Therefore, an investigator relying on these tools is most likely to misidentify the file type and allow it to go as unexamined! The only way to tell if a file is a JPG would be to open it, and the only way to determine if a file is an EXE would be to execute it. This is because a JPG hidden as an EXE would never run and an EXE hidden as a JPG would never display!

Timestomp and *transmogrify*, mentioned in the previous paragraphs, are tools that focus on changing, hiding or planting misleading evidence. “Sam Juicer” is designed to help advanced attackers to prevent evidence from ever being created. As a result, no evidence will ever come to disk and, therefore, a postmortem forensics analysis of the disk will not reveal any clues as to how the compromise occurred. The analysis will not even throw light about the extent of control the attacker had on the computer system. There is no easy solution (as at the time of writing this) available to prevent Sam Juicer from running once the machine has been compromised.

A well-known tool, which is used for data hiding, is called *Slacker*^[37] – it is part of the Metasploit framework mentioned earlier in the section. Slacker can hide data within the slack space of FAT or New Technology File System (NTFS) file system. Slacker breaks a file into pieces and places each piece of that file into the

slack space of other files, thereby hiding it from the forensics examination software. At the beginning of this section, we mentioned that there are four categories of antiforensics – data hiding is one of those categories. Data hiding technique involves the use of bad sectors. When performing this technique, the user changes a particular sector from good to bad and then data is placed onto that particular cluster. It is a common belief that forensics examination tools will see these clusters as bad and continue without any examination of their contents.

Forensics tools “Sleuth Kit” and “EnCase” are mentioned in Section 7.10 and Sections 7.7.2 and 7.10.2, and Tables 7.10 and 7.11 describe their features. EnCase relies on the Windows API to perform timestamp translation. However, a glitch in the Windows API results in a blank value being displayed when the time stamp values are set below a certain threshold. Thus, we need to appreciate

that computer forensics tools are neither panacea nor magic; after all, they are only complex software tools that like all software may be subject to certain attacks. Although these tools play such a critical role in our legal system, it is important that they be as accurate, reliable and secure against tampering as possible. Vulnerabilities would not only question the admissibility of forensics images, but could also create a risk that if undetected tampering occurs, courts may come to wrong decisions in cases that affect lives and property. Antiforensics is more than a technology. This approach to criminal hacking can be summed as follows: *Make it hard for them to find you and impossible for them to prove they found you*. If an attacker succeeds in making a cyberforensics investigation extremely costly, then he/she can actually create a business case against in-depth forensics analysis!

SUMMARY

The field of digital forensics/computer forensics has grown rapidly in the 21st century, most notably due to the increased trend in mobile devices found at technical, non-technical and violent crime scenes and the rise in mobile workforce in the global economy. Mobile computing/remote working, etc. are some of the emerging patterns of work. In this chapter, fundamentals of cyberforensics and its associated aspects were presented. Cyberforensics has become an important domain given the kind of world in which we live now and the way businesses now operate. Cybersecurity has become a mission-critical component in modern times. When security threats are not analyzed effectively, the result can be unpredictable catastrophes. The emergence of information forensics comes from the incidence of criminal, illegal and inappropriate behaviors. We are living in the knowledge age where information and knowledge are the most sought after commodities. Criminals, competitors and even employees exploit loopholes in current security architectures and control structures; use antiforensics techniques and tools to hide their

traces; and apply forensics tools and techniques to obtain the required information to commit cybercrimes. Steganography is a dynamic tool with a long history and the capability to adapt to new levels of technology. As steganographic tools reach the stage of advanced technological features, the steganalyst and the tools they use must also advance. In reference to steganography used by cybercriminals, we also explained about rootkits, which is a set of software tools inserted by an intruder into a computer in order to allow that intruder to enter the computer again at a later date and use it for malicious purposes without being detected. These purposes include (a) collecting data about computers (including other computers on a network) and their users (such as passwords and financial information), (b) causing such computers to malfunction and (c) creating or relaying Spam. Like any tool, steganography (and steganalysis) is neither inherently good nor evil; it is the manner in which it is used which will determine whether it is a benefit or a detriment to our society.

Security has become a major concern on social networks. It is very important that we find the right solutions to tackle the different security problems on the social networking sites today. The chain of evidence and accuracy of digital evidence is very important in cyberforensics investigation. Experienced human investigators can often analyze crime trends precisely, but as the incidence and complexity of crime increases, human errors occur, analysis time increases and criminals have more time to destroy

evidence and escape arrest. By increasing efficiency and reducing errors, crime data mining techniques can facilitate police and enable investigators to allocate their time to other valuable tasks. Attackers' objective is to make forensics investigation difficult. They aim at foiling the investigations. Antiforensics behaviors, tools and technologies are, therefore, an area of concern when they do not get caught, as discussed in the chapter.

REVIEW QUESTIONS

1. Is there a difference between computer security and computer forensics? Explain.
2. Can a cybercrime investigation be done without involving a forensics expert? Explain with reasons.
3. Explain how the “chain of custody” concept applies in computer/digital forensics.
4. Explain the importance of strong documentation in cyberforensics profession.
5. Is there a difference between “digital forensics” vis-à-vis “computer forensics”? Explain.
6. Explain the role of digital forensics. What do you think is the reaction of traditional legal communities about role of “digital evidence” in crime? Prepare a debate note by considering your own view as well as by talking to the legal community professionals and/or the professors in the institute where you are studying.
7. Explain the importance of “chain of custody” concept. Provide illustrations to support your answer.
8. Do you think the *Indian Evidence Act* is adequate to handle digital evidence? Explain your answer with supporting illustrations.
9. Explain some of the best practices in handling digital evidence. Explain what “rules of evidence” are.
10. Explain how an E-Mail can be traced for forensics purpose. Outline the various key steps involved.
11. What are the various phases and activities involved in the life cycle of a forensics investigation process? Support your answer through various relevant examples.
12. What are the different types of digital analysis that can be performed on the captured forensics evidence?
13. What are the typical elements of a digital forensics investigation report?
14. What would be the nature of evidence collected for network forensics?
15. What role does an “expert witness” play in a cyberforensic/digital forensics case?
16. What precautions should be taken while collecting electronic evidence? What are the things to be avoided during a cyberforensic/digital forensics investigation? Support your answers with examples. What are the things that *cannot* be avoided?
17. Explain why the NDA (non-disclosure agreement) is important in a forensics investigation. What do you think are the risks that may arise if an NDA is not signed before commencing the investigation?
18. Highlight the key steps to be performed in solving a computer forensics case.
19. Explain what is required in setting up a computer forensics laboratory. What tools are required on hardware and software side?
20. What steps do the network hackers execute, as explained in this chapter?
21. What is a “social networking” site? What are the security threats that can emanate from social networking sites?

22. What are “rootkits.” Why are they dangerous? How do rootkits help cyberattackers?
23. What are the major international regulations (the “Big 4 Laws”) as mentioned in this chapter that impact forensics?
24. Explain the “complexity” and “quantity” problems faced in digital forensics investigation.
25. Explain the “data privacy” challenge in cyberforensics. Support your point with suitable illustrative examples.
26. Do you think that using “counter-forensics privacy tools” is a good idea? Why? Explain with examples.
27. Provide an overview of how “data mining” techniques can be applied in cyberforensics.
28. Highlight some of the key differences between an “audit” and a “cyberforensics investigation.”
29. What, do you think, has led to antiforensics behaviors and tools? Elaborate your answer with suitable examples. Explain how the criminals exploit the situations.

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