Security Requirements for E-Commerce:

Authentication:

This is the ability to say that an electronic communication (whether via email or web) does genuinely come from who it purports to.Without face-to-face contact, passing oneself off as someone else is not difficult on the internet.

In online commerce the best defence against being misled by an imposter is provided by unforgeable digital certificates from a trusted authority (such as VeriSign). Although anyone can generate digital certificates for themselves, a trusted authority demands real-world proof of identity and checks its validity before issuing a digital certificate. Only certificates from trusted authorities will be automatically recognized and trusted by the major web browser and email client software.

Authentication can be provided in some situations by physical tokens (such as a drivers license), by a piece of information known only to the person involved (eg. a PIN), or by a physical property of a person (fingerprints or retina scans). Strong authentication requires at least two or more of these. A digital certificate provides strong authentication as it is a unique token and requires a password for its usage.

Privacy:

In online commerce, privacy is the ability to ensure that information is accessed and changed only by authorized parties. Typically this is achieved via encryption. Sensitive data (such as credit card details, health records, sales figures etc.) are encrypted before being transmitted across the open internet – via email or the web. Data which has been protected with strong 128bit encryption may be intercepted by hackers, but cannot be decrypted by them within a short time. Again, digital certificates are used here to encrypt email or establish a secure HTTPS connection with a web-server. For extra security, data can also be stored long-term in an encrypted format.

Authorization:

Authorization allows a person or computer system to determine if someone has the authority to request or approve an action or information. In the physical world, authentication is usually achieved by forms requiring signatures, or locks where only authorized individuals hold the keys.

Authorization is tied with *authentication*. If a system can securely verify that a request for information (such as a web page) or a service (such as a purchase requisition) has come from a known individual, the system can then check against its internal rules to see if that person has sufficient authority for the request to proceed.

In the online world, authorization can be achieved by a manager sending a digitally signed email. Such an email, once checked and verified by the recipient, is a legally binding request for a service. Similarly, if a web-server has a restricted access area, the server can request a digital certificate from the user‘s browser to identify the user and then determine if they should be given access to the information according to the server‘s permission rules.

Integrity:

Integrity of information means ensuring that a communication received has not been altered or tampered with. Traditionally, this problem has been dealt with by having tight control over access to paper documents and requiring authorized officers to initial all changes made – a system with obvious drawbacks and limitations. If someone is receiving sensitive information online, he not only wants to ensure that it is coming from who he expects it to (authentication), but also that it hasn‘t been intercepted by a hacker while in transit and its contents altered. The speed and distances involved in online communications requires a very different approach to this problem from traditional methods.

One solution is afforded by using digital certificates to digitally ―sign‖ messages. A travelling employee can send production orders with integrity to the central office by using their digital certificate to sign their email. The signature includes a hash of the original message – a brief numerical representation of the message content. When the recipient opens the message, his email software will automatically create a new hash of the message and compare it against the one included in the digital signature. If even a single character has been altered in the message, the two hashes will differ and the software will alert the recipient that the email has been tampered with during transit.

Non-repudiation:

Non-repudiation is the ability to guarantee that once someone has requested a service or approved an action. Non-repudiation allows one to legally prove that a person has sent a specific email or made a purchase approval from a website. Traditionally non-repudiation has been achieved by having parties sign contracts and then have the contracts notarized by trusted

third parties. Sending documents involved the use of registered mail, and postmarks and signatures to date-stamp and record the process of transmission and acceptance. In the realm of e-commerce, non repudiation is achieved by using digital signatures. Digital signatures which have been issued by a trusted authority (such as VeriSign) cannot be forged and their validity can be checked with any major email or web browser software. A digital signature is only installed in the personal computer of its owner, who is usually required to provide a password to make use of the digital signature to encrypt or digitally sign their communications. If a company receives a purchase order via email which has been digitally signed, it has the same legal assurances as on receipt of a physical signed contract.

3.16 Security policy for E-commerce:

The security policy may cover issues like:

- What service types (e.g., web, FTP, SMTP) users may have access to?
- What classes of information exist within the organization and which should be encrypted before being transmitted?
- What client data does the organization hold. How sensitive is it? How is it to be protected?
- What class of employees may have remote access to the corporate network?
- Roles and responsibilities of managers and employees in implementing the security policy.
- How security breaches are to be responded to?

The security policy should also consider physical aspects of network security. For example,

- Who has access to the corporate server?
- Is it in a locked environment or kept in an open office?
- What is the procedure for determining who should be given access? The security policy regulates the activities of employees just as much as it defines how IT infrastructure will be configured. The policy should include details on how it is to be enforced • How individual responsibilities are determined?

For it to be effective, the policy needs regular testing and review to judge the security measures. The review process needs to take into account any changes in technology or business practices which may have an influence upon security. Lastly, the policy itself needs to be regarded as a

living document which will be updated at set intervals to reflect the evolving ways in which the business, customers and technology interact. **Security Standards:**

There are various standards pertaining to the security aspects of enterprises. Some of them are

- ISO 17799 (Information technology – Code of practice for information security management).
- (ISO/IEC 2000).
- SSE-CMM (Systems security engineering – Capability maturity model).
- (SSE-CMM 2003).
- COBIT (Control objectives for information and related technology).
- (COBIT 2000).

ISO 17799 provides detailed guidelines on how a management framework for enterprise security should be implemented. It conceives ten security domains. Under each domain there are certain security objectives to be fulfilled. Each objective can be attained by a number of controls. The controls may prescribe management measures like guidelines and procedures, or some security infrastructure in the form of tools and techniques. It details various methods that can be followed by enterprises to meet security needs for e-commerce. It talks about the need for security policies, security infrastructure, and continuous testing in the same manner as has been detailed above.

The main objective of the COBIT is the development of clear policies and good practices for security and control in IT for worldwide endorsement by commercial, governmental and professional organizations. The SSE-CMM is a process reference model. It is focused upon the requirements for implementing security in a system or series of related systems that are in the Information Technology Security domain.

3.17 Firewall:

A firewall is a network security system that controls the incoming and outgoing network traffic based on an applied rule set. A firewall establishes a barrier between a trusted, secure internal network and another network (e.g., the Internet) that is assumed not to be secure and trusted. Firewalls exist both as software to run on general purpose hardware and as a hardware appliance. Many hardware-based firewalls also offer other functionality to the internal network they protect, such as acting as a DHCP server for that network.

Many personal computer operating systems include software-based firewalls to protect against threats from the public Internet. Many routers that pass data between networks contain firewall components and, conversely, many firewalls can perform basic routing functions.

Types of Firewall:

There are different types of firewalls depending on where the communication is taking place, where the communication is intercepted and the state that is being traced.

- Network layer Firewall
- Application layer firewall
- Proxy server
- Network address translation

➢ **Network layer Firewall:**

Network layer firewalls, also called packet filters, operate at a relatively low level of the TCP/IP protocol stack, not allowing packets to pass through the firewall unless they match the established rule set. The firewall administrator may define the rules; or default rules may apply.

Network layer firewalls generally fall into two sub-categories,

- Stateful Firewalls
- Stateless Firewalls

Stateful firewalls maintain context about active sessions, and use that "state information" to speed packet processing. Any existing network connection can be described by several properties, including source and destination IP address, UDP or TCP ports, and the current stage of the connection's lifetime (including session initiation, handshaking, data transfer, or completion connection). If a packet does not match an existing connection, it will be evaluated according to the rule set for new connections. If a packet matches an existing connection based on comparison with the firewall's state table, it will be allowed to pass without further processing.

Stateless firewalls require less memory, and can be faster for simple filters that require less time to filter than to look up a session. They may also be necessary for filtering stateless network protocols that have no concept of a session. However, they cannot make

more complex decisions based on what stage communications between hosts have reached.

- **Application Layer Firewall:**

Application-layer firewalls work on the application level of the TCP/IP stack (i.e., all browser traffic, or all telnet or ftp traffic), and may intercept all packets traveling to or from an application. They block other packets (usually dropping them without acknowledgment to the sender).

On inspecting all packets for improper content, firewalls can restrict or prevent outright the spread of networked computer worms and trojans. The additional inspection criteria can add extra latency to the forwarding of packets to their destination.

Application firewalls function by determining whether a process should accept any given connection. Application firewalls accomplish their function by hooking into socket calls to filter the connections between the application layer and the lower layers of the OSI model. Application firewalls that hook into socket calls are also referred to as socket filters. Application firewalls work much like a packet filter but application filters apply filtering rules (allow/block) on a per process basis instead of filtering connections on a per port basis. Generally, prompts are used to define rules for processes that have not yet received a connection. It is rare to find application firewalls not combined or used in conjunction with a packet filter.

Also, application firewalls further filter connections by examining the process ID of data packets against a ruleset for the local process involved in the data transmission. The extent of the filtering that occurs is defined by the provided ruleset. Given the variety of software that exists, application firewalls only have more complex rulesets for the standard services, such as sharing services. These per process rulesets have limited efficacy in filtering every possible association that may occur with other processes.

- **Proxy server:**

  A proxy server running either on dedicated hardware or as software on a general-purpose machine may act as a firewall by responding to input packets (connection requests, for example) in the manner of an application, while blocking other packets. A proxy server is a gateway from one network to another for a specific network application, in the sense that it functions as a proxy on behalf of the network user.

  Proxies make tampering with an internal system from the external network more difficult and misuse of one internal system would not necessarily cause a security breach exploitable from outside the firewall. Conversely, intruders may hijack a publicly reachable system and use it as a proxy for their own purposes; the proxy then masquerades as that system to other internal machines. While use of internal address spaces enhances security, crackers may still employ methods such as IP spoofing to attempt to pass packets to a target network.

- **Network Address Translation:**

  Firewalls often have network address translation (NAT) functionality, and the hosts protected behind a firewall commonly have addresses in the "private address range", as defined in RFC 1918.

  Firewalls often have such functionality to hide the true address of protected hosts. Originally, the NAT function was developed to address the limited number of IPv4 routable addresses that could be used or assigned to companies or individuals as well as reduce both the amount and therefore cost of obtaining enough public addresses for every computer in an organization. Hiding the addresses of protected devices has become an increasingly important defense against network reconnaissance.

3.18 Digital Signatures:

A digital signature is a mathematical scheme for demonstrating the authenticity of a digital message or document. A valid digital signature gives a recipient reason to believe that the

message was created by a known sender, such that the sender cannot deny having sent the message (authentication and non-repudiation) and that the message was not altered in transit (integrity). Digital signatures are commonly used for software distribution, financial transactions, and in other cases where it is important to detect forgery or tampering.

Digital signatures are often used to implement electronic signatures, a broader term that refers to any electronic data that carries the intent of a signature, but not all electronic signatures use digital signatures. In some countries, including the United States, India, Brazil, and members of the European Union, electronic signatures have legal significance.

A digital signature scheme typically consists of three algorithms;

- A key generation algorithm that selects a private key uniformly at random from a set of possible private keys. The algorithm outputs the private key and a corresponding public key.
- A signing algorithm that, given a message and a private key, produces a signature.
- A signature verifying algorithm that, given a message, public key and a signature, either accepts or rejects the message's claim to authenticity.

Applications of digital signatures:

Authentication:

Although messages may often include information about the entity sending a message, that information may not be accurate. Digital signatures can be used to authenticate the source of messages. When ownership of a digital signature secret key is bound to a specific user, a valid signature shows that the message was sent by that user. The importance of high confidence in sender authenticity is especially obvious in a financial context. For example, suppose a bank's branch office sends instructions to the central office requesting a change in the balance of an account. If the central office is not convinced that such a message is truly sent from an authorized source, acting on such a request could be a grave mistake.

Integrity:

In many scenarios, the sender and receiver of a message may have a need for confidence that the message has not been altered during transmission. Although encryption hides the contents

of a message, it may be possible to change an encrypted message without understanding it. (Some encryption algorithms, known as nonmalleable ones, prevent this, but others do not.) However, if a message is digitally signed, any change in the message after signature invalidates the signature. Furthermore, there is no efficient way to modify a message and its signature to produce a new message with a valid signature, because this is still considered to be computationally infeasible by most cryptographic hash functions (see collision resistance).

Non-repudiation:

Non-repudiation, or more specifically non-repudiation of origin, is an important aspect of digital signatures. By this property, an entity that has signed some information cannot at a later time deny having signed it. Similarly, access to the public key only does not enable a fraudulent party to fake a valid signature.

Some digital signature algorithms:

- RSA-based signature schemes, such as RSA-PSS
- DSA and its elliptic curve variant ECDSA
- ElGamal signature scheme as the predecessor to DSA, and variants Schnorr signature and
- Pointcheval–Stern signature algorithm
- Rabin signature algorithm
- Pairing-based schemes such as BLS
- Undeniable signatures

Aggregate signature - a signature scheme that supports aggregation: Given n signatures on n messages from n users, it is possible to aggregate all these signatures into a single signature whose size is constant in the number of users. This single signature will convince the verifier that the n users did indeed sign the n original messages.

- Signatures with efficient protocols - are signature schemes that facilitate efficient cryptographic protocols such as zero-knowledge proofs or secure computation.

3.19 Digital Certificate:

- It is an electronic document used to prove ownership of a public key. The certificate includes information about the key, information about its owner's identity, and the digital signature of an entity that has verified the certificate's contents are correct. If the signature is valid, and the person examining the certificate trusts the signer, then they know they can use that key to communicate with its owner.

- The most common use of a digital certificate is to verify that a user sending a message is who he or she claims to be, and to provide the receiver with the means to encode a reply. An individual wishing to send an encrypted message applies for a digital certificate from a Certificate Authority (CA). The CA issues an encrypted digital certificate containing the applicant's public key and a variety of other identification information. The CA makes its own public key readily available through print publicity or perhaps on the Internet.

- The recipient of an encrypted message uses the CA's public key to decode the digital certificate attached to the message, verifies it as issued by the CA and then obtains the sender's public key and identification information held within the certificate. With this information, the recipient can send an encrypted reply. • The most widely used standard for digital certificates is X.509.

Contents Of a Typical Digital Certificate:

Serial Number: Used to uniquely identify the certificate.
Subject: The person, or entity identified.
Signature Algorithm: The algorithm used to create the signature.
Signature: The actual signature to verify that it came from the issuer.
Issuer: The entity that verified the information and issued the certificate.
Valid-From: The date the certificate is first valid from.

- Valid-To: The expiration date.
- Key-Usage: Purpose of the public key (e.g. encipherment, signature, certificate signing...).
- Public Key: The public key.
- Thumbprint Algorithm: The algorithm used to hash the public key certificate.
- Thumbprint (also known as fingerprint): The hash itself, used as an abbreviated form of the public key certificate.