CHAPTER 7

SECURITY

Security

- Security is about the well-being (*integrity*) of computer systems and data
- Computer security is the protection of data, networks and computing power.
- Computer security refers to techniques for ensuring that data stored in a computer cannot be read or compromised by any individuals without authorization.

Why do we need security?

- To protect vital information while still allowing access to those who need it
  - Trade secrets, medical records, etc.
- To provide authentication and access control for resources
- To guarantee availability of resources

  (99.999% reliability)

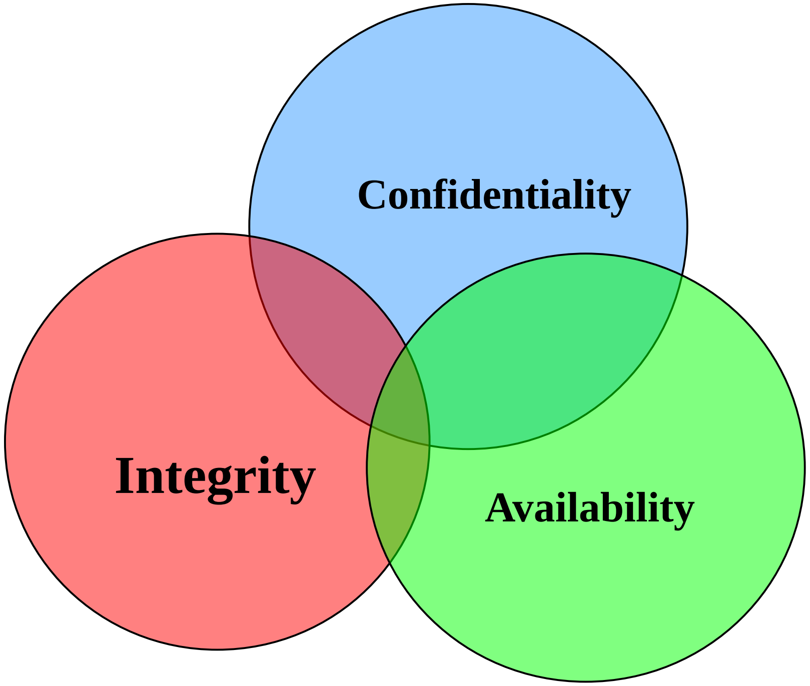
Who is vulnerable?

- Financial institutions and banks
- Internet service providers
- Pharmaceutical companies
- Government and defense agencies
- Contractors to various government agencies
- Multinational corporations
- **ANYONE ON THE NETWORK**

Computer Security Goals

Computer security addresses the goals:

- *Confidentiality*
- *Integrity*
- *Availability*



Confidentiality

- The requirement that information maintained by a computer system be accessible only by authorized individuals.
- Is the cover-up of information or resources.
- The need for keeping information secret arises from the use of computers in sensitive fields such as government and financial companies.

Integrity

- Refers to the trustworthiness of data or resources
- It is usually phrased in terms of preventing unauthorized change.
- Guarding against information modifications or destruction.
- Modification occurs when an unauthorized users not only gains access to but changes a resource such as data or the execution of a running process.

Availability

- Availability refers to the ability to use the computer system and information resources at desired times by authorized parties
- Availability is an important aspect of reliability
- Unavailable system is at least as bad as no system at all.
- Interruption occurs when an unauthorized party reduces the availability of or to a resource.

Computer Security

“The most secure computers are those not connected to the Internet and shielded from any interference”

Operating System Security

- OS security is the process of ensuring OS integrity, confidentiality and availability.
- OS security refers to specified steps or measures used to protect the OS from threats, viruses, worms, malware or remote hacker intrusions.
- OS security encompasses many different techniques and methods which ensure safety from threats and attacks.

Operating System Security

- OS security allows different applications and programs to perform required tasks and stop unauthorized interference.
- OS security may be approached in many ways:
    - Performing regular OS updates
    - Installing updated antivirus engines and software
    - Analyzing all incoming and outgoing network traffic through a firewall
    - Creating secure accounts with required privileges only (user management)

Security Threats

- A computer security threat is any person, act, or object that poses a danger to computer security
- A *threat* is a potential violation of security.
- The effects of threats can be an affect on the
    - Confidentiality of data
    - Integrity of data
    - Availability of a system.

Causes of Security Threats

- *Physical threats:*
  - weather, natural disaster, bombs, power failures, terrorism, etc.
- *Human threats:*
  - stealing, fraud, bribery, spying, sabotage, accidents.
- *Software threats:*
  - viruses, Trojan horses, denial of service.

Types of Security Threats/Attacks

- Fraud and Theft
- Loss of Physical and Infrastructure Support
- Intruders
- Malicious Software
- Threats to Personal Privacy
- Denial of Service (DoS)

Fraud and Theft

- An illegal taking of another’s physical, electronic, or intellectual property
- Insiders or outsiders can commit computer fraud and theft.
- Insiders (authorized users of a system) are responsible for the majority of fraud.

Loss of Physical and Infrastructure Support

- Power failures
    - Outages
    - Spikes
    - brownouts
- Disasters (natural and man-made)

Intruders

- Intruders are usually trying to gain access to a system, or to increased privileges to which they are not entitled, often by obtaining the password for a legitimate account.
- Hacking: is any attempt to intrude or gain unauthorized access to your system.
  - It can be via some operating system flaw or other means.
  - It may or may not be for malicious purposes.
- Cracking: is hacking conducted for malicious purposes

Malicious Software

- The most sophisticated threats to computer systems are through malicious software, sometimes called malware.
- Malware attempts to cause damage to, or consume the resources of a target system.

Malicious Software

- Malicious code can attack personal computers and other platforms.
- Malicious Software refers to
  - **Virus**
  - **Trojan Horse**
  - **Worm**
  - **Logic bomb**
  - **Trap door**
  - **Zombie**

Virus

- A small program that replicates and hides itself inside other programs usually without your knowledge
- A virus is a program that can ”infect” other programs by modification, as well as causing local damage. Such modification includes a copy of the virus, which can then spread further to other programs.
- The new copy of the virus is executed when a user executes the new host program.
  - Similar to biological virus: Replicates and Spreads

Worm

- Worm is an independent program that spreads via network connections, typically using either email, remote execution etc.
- Worm is an independent program that reproduces by copying itself from one computer to another and causes it to execute; no user intervention is required
- It can do as much harm as a virus
- It often creates denial of service (DoS)

Trojan Horse

- Secretly downloading a virus or some other type of mal-ware on to your computers.
- Consider as an example an editing program for a multi-user system. This program could be modified to randomly delete one of the users' files each time they perform a useful function (editing), but the deletions are unexpected and definitely undesired!
- Popular mechanism for hiding a virus or a worm

Spy-wares

- A software that literally spies on what you do on your computer.
- Example: Simple Cookies and Key Loggers

The effects of malicious software

- Corrupting the systems data
- Increasing file size
- Formatting the hard disk
- Slowing down the system
- Renaming all files with different name

Denial of Service Attack

DoS Attack:

- Is blocking access of legitimate users to a service.
- It aims to inhibit the normal use of communication facilities
- Make a network service unusable, usually by overloading the server or network

Threats to Personal Privacy

- **Personal Privacy**: The right of the individual to be protected against intrusion into his personal life or affairs, or those of his family, by direct physical means or by publication of information.
- Threat to individual privacy has arisen as a danger of the modern information age.

Why Computer Security?

Computer security is required because most organizations can be damaged by software or intruders.

The damages include:

- Damage of computer systems.
- Damage of internal data.
- Loss of sensitive information to hostile parties.
- Use of sensitive information to steal items of monetary value.
- Use of sensitive information against the organization's customers
- Damage to the reputation of an organization.
- Losing the ability to use the system

Security can be broken down into two distinct areas:

- **Physical security**
- **Logical security**

Physical security:

- refers to the issues related to the physical security of the equipment that comprises or is connected to the network.
  - Keeping rooms locked
  - Keeping computers locked
  - A combination of locks and alarms is an excellent theft prevention system for computer labs
  - Surge protectors and uninterruptable power supplies (UPS) are a low cost investment that can save very costly equipment damage.

Logical security

- Logical security is concerned with security of data stored on devices connected to the network.
- It involves
  - controlling passwords and password policies
  - controlling access to data on servers
  - controlling access to backup tapes
  - preventing sources outside the network from gaining access to the network

Security Solutions

There are a number of basic ways that a computer can be made more secure.

- Backups/disaster recovery
- Encryption
- Authentication
- Validation
- Data Protection
- Anti-Viruses
- Firewall
- Intrusion Detection System (IDS)

Backups (redundancy/disaster recovery)

- The purpose of a backup is to make a copy of data, which is unlikely to be lost or destroyed.
- If we want a backup to be protected from the some accidents that would destroy the data, we have to store it in a *different physical location*.
- Backups can be done on tapes, disks and at a different physical location by using network copying.

Backups

- Operating systems have different preferred ways of making backups, using different software and media.
- The key principle of backups is *redundancy*.
- Redundancy means making multiple copies of data, so that we always have something to fall back on

Backups

- We can have backups of data, but we can also have backup of services, in case we lose an important piece of hardware.
- Redundancy is like an insurance policy.
- making backups of every file is a time-consuming process, and it requires a lot of storage.

Backups

There are two kinds of backup

- **Full dump**: copies every file on a source medium to a backup medium.
- **Incremental or differential dump**: copies files according to the level of the dump.
    - A level 0 dump copies everything.
    - A level 1 dump copies everything, which has changed since the last level 0 dump.
    - A level 2 dump copies everything which has changed since the last level 1 dump or level 0 dump and so on.

Encryption

- Process of converting plaintext (readable data) into ciphertext (unreadable characters) to prevent unauthorized parties from viewing or modifying it.
- Encryption key specifies the transformation of plaintext into ciphertext, and vice versa for decryption algorithms

Encryption

- To read the data, the recipient must decrypt, or decipher the data
- The security of encryption lies in the ability of an algorithm to generate ciphertext that is not easily reverted to the original plaintext.

Authentication

- Authentication is the process of logging in, signing on in a manner that proves his or her identity using username and password to gain access to a system, network or web site.
- The username and password combination is often referred to as a person’s credentials and it is frequently sent over networks.
- Item that you must carry to gain access to computer or facility are called personal identification number (PIN)

Validation

- Validation describes the ability to provide assurance that a sender’s identity is true and that a message, document or file has not been modified.
- Encryption can be used to provide validation by making a digital fingerprint of the information contained within a message.
- A digital fingerprint is a code that uniquely identifies a file or a message by reflecting the content of the file with tremendous specificity.

Data Protection

- Data protection is widely used in the area of encryption.
- Encryption of files protects the data that is written to the hard disk on the computer in the event of theft if an attacker breaks in to the system.
- File encryption becomes more difficult to use and manage if the office has multiple employees. Because each employee needs the encryption key, protection of the key becomes a more difficult task.

Data Protection

- The more people who have access to encryption keys, the less effective encryption becomes. The risk of loss, theft or compromise of information rises as the number of users increases.
- Files that have been encrypted are also vulnerable to employees who leave the organization or who are dissatisfied and may want to cause the organization harm.

Antiviruses

To prevent viruses from entering a system there are two options.

- Isolate the machine
  - disconnect it from the Internet or any other network, not using floppy disks, CD-ROMs or any other removable disks.
  - This way one can be sure that no virus enters into the computer.

Antiviruses

- Install an Antivirus program
  - Antivirus programs are designed to keep a watch at all incoming files so that no malicious code can enter the computer.
  - Antivirus is a software utility, which searches the hard disk for viruses and removes which are found.

Antiviruses

- Most Antivirus programs include an auto-update feature that enables the program to download profiles of new viruses so that it can check for the new viruses as soon as they are discovered.
- AVG, Norton, Kaspersky, AVAST and McAfee are some of the examples of Antivirus programs.

Functions of anti-viruses

- Identification of known viruses
- Detection of suspected viruses
- Blocking of possible viruses
- Disinfection of infected objects
- Deletion and overwriting of infected objects

Firewall

- Security system consisting of hardware and/or software that prevents unauthorized network access
- A firewall is a network component that provides a security barrier between networks or network segments.
- Firewalls are generally set up to protect a particular network or network component from attack, or unauthorized penetration by outside invaders.

Firewall

- A firewall also may be set up to protect vital corporate or institutional data or resources from internal attacks or incompetence.
- Internal firewalls are generally placed between administrative, or security, domains in a corporate or institutional network.

Firewall

- All traffic to or from the protected network must go through the firewall; the firewall is designed to allow only authorized traffics
- If the firewall does its filtering job successfully, attacks will never even reach the protected network.
- If a received packet is legitimate, the firewall will pass on the traffic to the appropriate machine.

Firewalls

- They are configured with a table of destination’s IP addresses that characterize the packets they will, and will not, forward.
- It gives the IP address and TCP (or UDP) port number for both the source and destination.
- a firewall divides a network into a more-trusted zone internal to the firewall, and a less-trusted zone external to the firewall. These are
    - The internal network
    - The *DMZ (“demilitarized zone”)*
    - The rest of the Internet.

Personal firewall utility

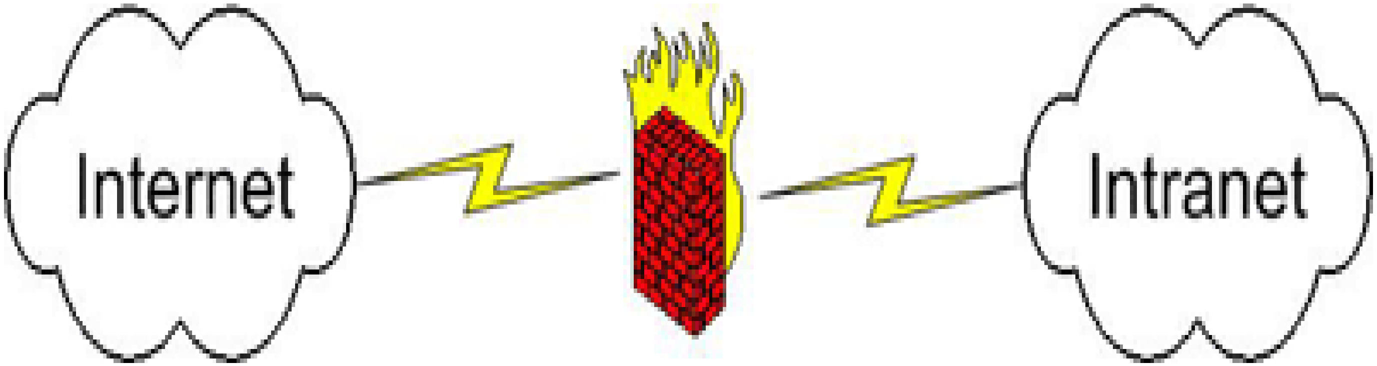
- Program that protects personal computer and its data from unauthorized intrusions
- Monitors transmissions to and from computer
- Informs you of attempted intrusion

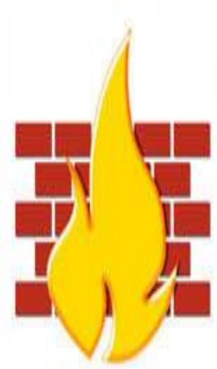
Firewall

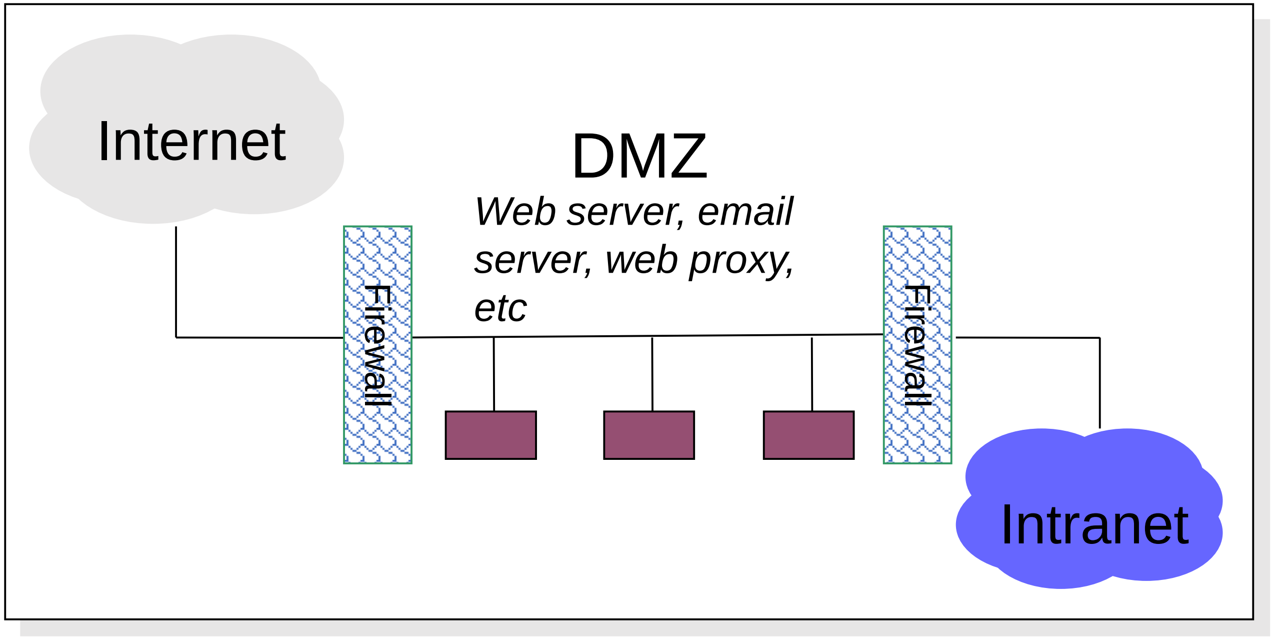
Three broad categories of firewall are distinguished

- *Packet-filtering*
  - pass or drop packets based on their source or destination addresses or ports.
- *Application filtering*
  - filters screen traffic involving specific applications or services (ftp, Http)
- *Circuit-level*
  - looks not only at source and destination addresses but also at the circuits that have been established for a connection.

Firewall

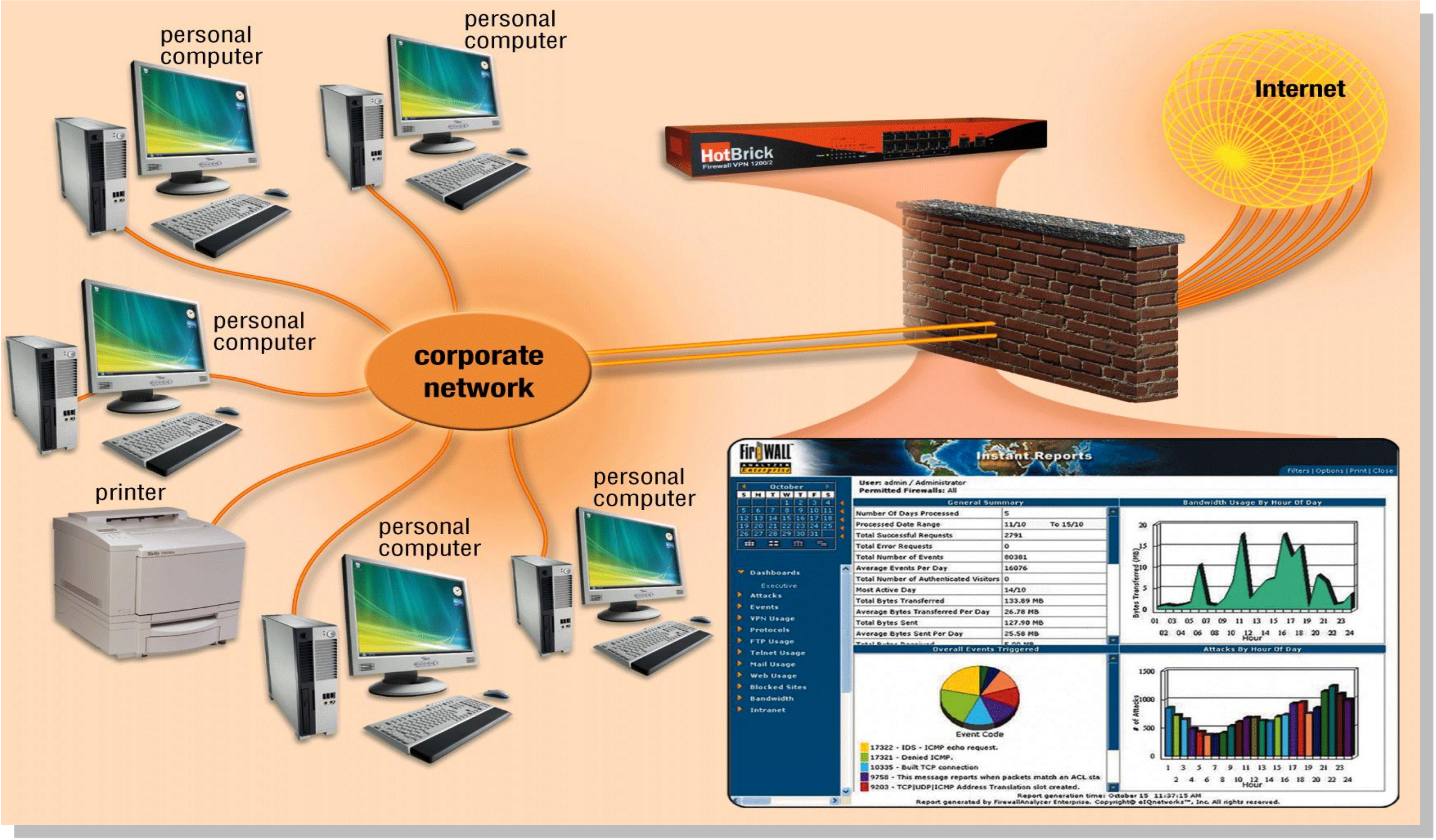






Web server, email server, web proxy, etc

Firewall



User: admin / Administrator
Permitted Firewalls: All

General Summary

Number Of Days Processed	5
Processed Date Range	11/10 To 15/10
Total Successful Requests	2791
Total Error Requests	0
Total Number of Events	80381
Average Events Per Day	16076
Total Number of Authenticated Visitors	0
Most Active Day	14/10
Total Bytes Transferred	133.89 MB
Average Bytes Transferred Per Day	26.78 MB
Total Bytes Sent	127.90 MB
Average Bytes Sent Per Day	25.58 MB

- 🟨 17322 - IDS - ICMP echo request.
- 🟩 17321 - Denied ICMP.
- 🟦 10335 - Built TCP connection
- 🟪 9758 - This message reports when packets match an ACL sta
- 🟥 9203 - TCP|UDP|ICMP Address Translation slot created.

Report generation time: October 15 11:37:15 AM
Report generated by FirewallAnalyzer Enterprise. Copyright© eIQnetworks™, Inc. All rights reserved.

Intrusion Detection System (IDS)

- An IDS gathers and analyzes information from various areas within a computer or a network to identify possible security breaches
- Used to monitor for "suspicious activity" on a network
- It detects both intrusions and misuse
- Freeware IDS exist e.g. snort (www.snort.org)

Intrusion Detection System (IDS)

Intrusion detection functions include

- Monitoring and analyzing both user and system activities
- Analyzing system configurations and vulnerabilities
- Assessing system and file integrity
- Ability to recognize patterns typical of attacks
- Analysis of abnormal activity patterns
- Tracking user policy violations

Network Security Tools

✓Nessus- vulnerability scanners
✓Wireshark-- packet sniffers
✓Snort (IDS- - intrusion detection system
✓Netcat-- Netcat)
✓Metasploit -Framework (vulnerability exploitation tools)
✓HPing2 -- packet crafting tools
✓Kismet -- wireless tools or packet sniffers
✓TCPDump --- packet sniffers
✓Cain and Abel (password crackers or packet sniffers)
✓John The Ripper (password crackers)