Firewall, VPN, IDS/IPS

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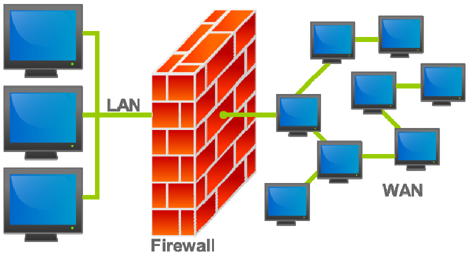
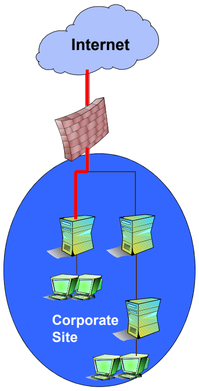
What is a Firewall?

- A firewall is hardware, software, or a combination of both that is used to prevent unauthorized programs or Internet users from accessing a private network and/or a single computer



What is a Firewall ?

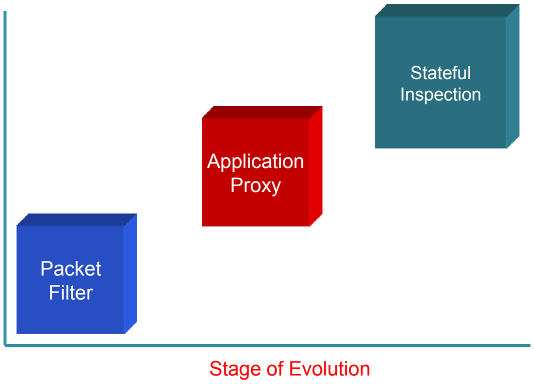
- A firewall :
  - Acts as a security gateway between two networks
  - Tracks and controls network communications
    - Decides whether to pass, reject, encrypt, or log communications (Access Control)



Hardware vs. Software Firewalls

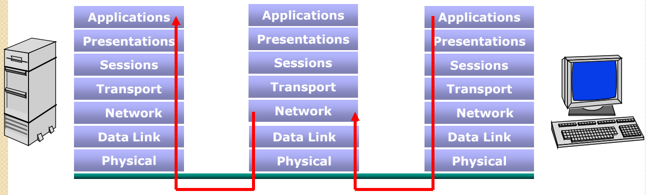
- Hardware Firewalls
  - Protect an entire network
  - Implemented on the router level
  - Usually more expensive, harder to configure
- Software Firewalls
  - Protect a single computer
  - Usually less expensive, easier to configure

Evolution of Firewalls



Packet Filter

- Packets examined at the network layer
- Useful “first line” of defense - commonly deployed on routers
- Simple accept or reject decision model
- No awareness of higher protocol layers



Packet Filter

- Simplest of components
- Uses transport-layer information only
  - IP Source Address, Destination Address
  - Protocol/Next Header (TCP, UDP, ICMP, etc)
  - TCP or UDP source & destination ports
  - TCP Flags (SYN, ACK, FIN, RST, PSH, etc)
  - ICMP message type
- Examples:
  - DNS uses port 53
    - No incoming port 53 packets except known trusted servers

How to Configure a Packet Filter

- Start with a security policy
- Specify allowable packets in terms of logical expressions on packet fields
- Rewrite expressions in syntax supported by your vendor
- General rules - least privilege
  - All that is not expressly permitted is prohibited
  - If you do not need it, eliminate it

Packet Filter Configuration - 1

Every ruleset is followed by an implicit rule reading like this.

action	src	port	dest	port	flags	comment
block	*	*	*	*	*	default

- Suppose we want to allow inbound mail (SMTP, port 25) but only to our gateway machine.
- Also suppose that mail from some particular site MORDOR is to be blocked.

Packet Filter Configuration - 2

action	src	port	dest	port	flags	comment
block	MORDOR	*	*	*	*	We don't trust these site
allow	*	*	OUR-GW	25	*	Connection to our SMTP port

- Now suppose that we want to implement the policy "any inside host can send mail to the outside".

Packet Filter Configuration - 3

action	src	port	dest	port	flags	comment
allow	*	*	*	25	*	Connection to outside SMTP port

- This solution allows calls from any port on an inside machine, and will direct them to port 25 on an outside machine.
- So why is it wrong?

Packet Filter Configuration - 4

- Our defined restriction is based solely on the destination's port number.
- With this rule, an enemy can access any internal machines on port 25 from an outside machine.
- What can be a better solution ?

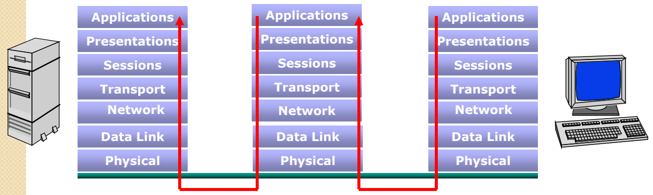
Packet Filter Configuration - 5

action	src	port	dest	por t	flags	comment
allow	{our hosts}	*	*	25	*	Connection to outside SMTP port
allow	*	25	*	*	ACK	SMTP replies

- The first rule restricts that only inside machines can access to outside machines on port 25.
- In second rule, the ACK signifies that the packet is part of an ongoing conversation.
  - Packets without ACK are connection establishment messages, which are only permited from internal hosts by the first rule.
  - With the second rule, outside hosts can send back packets to inside hosts on port 25.

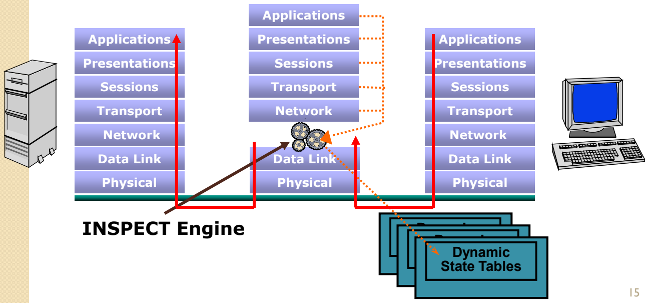
Application Gateway or Proxy

- Packets examined at the application layer
- Application/Content filtering possible - prevent FTP "put" commands, for example
- Modest performance
- Scalability limited

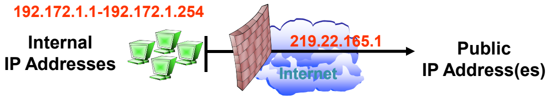


Stateful Inspection

- Packets Inspected between data link layer and network layer in the OS kernel
- State tables are created to maintain connection context
- Invented by Check Point



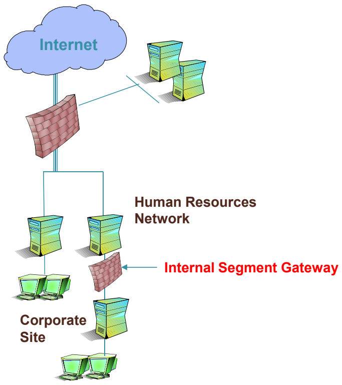
Network Address Translation (NAT)



- Converts a network's illegal IP addresses to legal or public IP addresses
  - Hides the true addresses of individual hosts, protecting them from attack
  - Allows more devices to be connected to the network

Firewall Deployment

- Corporate Network Gateway
- Internal Segment Gateway
  - Protect sensitive segments (Finance, HR, Product Development)
  - Provide second layer of defense
  - Ensure protection against internal attacks and misuse

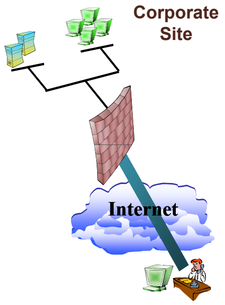


What is a VPN?

- A VPN is a private connection over an open network
- A VPN includes authentication and encryption to protect data integrity and confidentiality
- Types:
  - Remote Access VPN
  - Site-to-Site VPN
  - Extranet VPN
  - Client/Server VPN

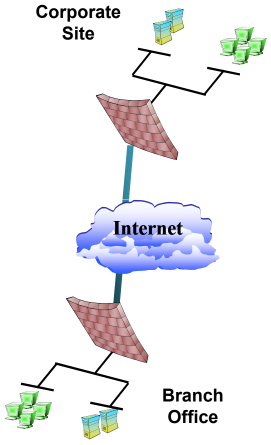
Types of VPNs

- Remote Access VPN
  - Provides access to internal corporate network over the Internet
  - Reduces long distance, modem bank, and technical support costs
  - PAP, CHAP, RADIUS



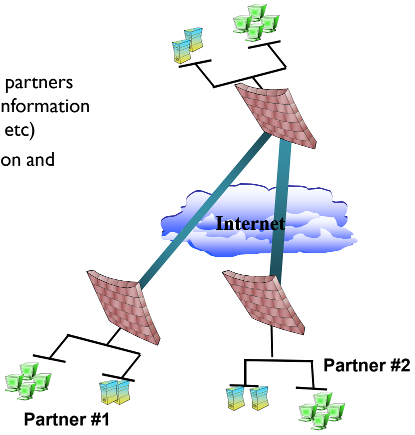
Types of VPNs

- Site-to-Site VPN
  - Connects multiple offices over Internet
  - Reduces dependencies on frame relay and leased lines



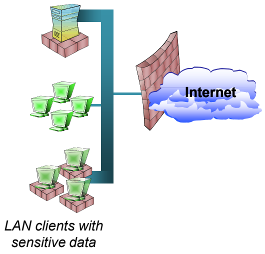
Types of VPNs

- Extranet VPN
  - Provides business partners access to critical information (leads, sales tools, etc)
  - Reduces transaction and operational costs



Types of VPNs

- Client/Server VPN
  - Protects sensitive internal communications



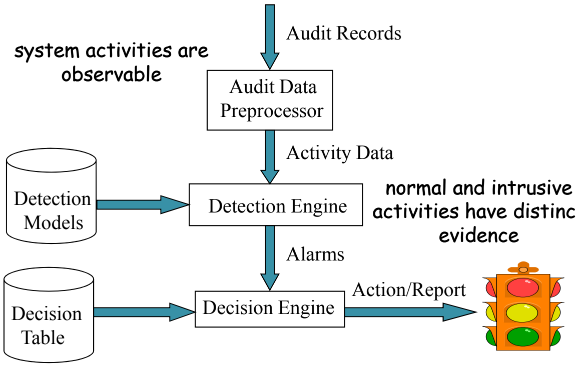
Overview of IDS/IPS

- Intrusion
  - A set of actions aimed at compromising the security goals (confidentiality, integrity, availability of a computing/networking resource)
- Intrusion detection
  - The process of identifying and responding to intrusion activities
- Intrusion prevention
  - The process of both detecting intrusion activities and managing responsive actions throughout the network.

Overview of IDS/IPS

- Intrusion detection system (IDS)
  - A system that performs automatically the process of intrusion detection.
- Intrusion prevention system (IPS)
  - A system that has an ambition to both detect intrusions and manage responsive actions.
  - Technically, an IPS contains an IDS and combines it with preventive measures (firewall, antivirus, vulnerability assessment) that are often implemented in hardware.

Components of Intrusion Detection System



Audit Records

Audit Data Preprocessor

Activity Data

Detection Models

Detection Engine

Alarms

Decision Table

Decision Engine

Action/Report

system activities are observable

normal and intrusive activities have distinct evidence

Intrusion Detection Approaches

- Modeling
  - Features: evidences extracted from audit data
  - Analysis approach: piecing the evidences together
    - Misuse detection (a.k.a. signature-based)
    - Anomaly detection (a.k.a. statistical-based)
- Deployment: Network-based or Host-based
  - Network based: monitor network traffic
  - Host based: monitor computer processes