Top-Down Network Design

Chapter Eight

Developing Network Security Strategies

Network Security Design The 12 Step Program

- Identify network assets
- Analyze security risks
- Analyze security requirements and tradeoffs
- Develop a security plan
- Define a security policy
- Develop procedures for applying security policies

The 12 Step Program (continued)

- Develop a technical implementation strategy
- Achieve buy-in from users, managers, and technical staff
- Train users, managers, and technical staff
- Implement the technical strategy and security procedures
- Test the security and update it if any problems are found
- Maintain security

Network Assets

- Hardware
- Software
- Applications
- Data
- Intellectual property
- Trade secrets
- Company’s reputation

Security Risks

- Hacked network devices
  - Data can be intercepted, analyzed, altered, or deleted
  - User passwords can be compromised
  - Device configurations can be changed
- Reconnaissance attacks
- Denial-of-service attacks

Security Tradeoffs

- Tradeoffs must be made between security goals and other goals:
  - Affordability
  - Usability
  - Performance
  - Availability
  - Manageability

A Security Plan

- High-level document that proposes what an organization is going to do to meet security requirements
- Specifies time, people, and other resources that will be required to develop a security policy and achieve implementation of the policy

A Security Policy

- Per RFC 2196, "The Site Security Handbook," a security policy is a
  - "Formal statement of the rules by which people who are given access to an organization's technology and information assets must abide."
- The policy should address
  - Access, accountability, authentication, privacy, and computer technology purchasing guidelines

Security Mechanisms

- Physical security
- Authentication
- Authorization
- Accounting (Auditing)
- Data encryption
- Packet filters
- Firewalls
- Intrusion Detection Systems (IDS)
- Intrusion Prevention Systems (IPS)

Encryption for Confidentiality and Integrity

Figure 8-1. Public/Private Key System for Ensuring Data Confidentiality

Figure 8-2. Public/Private Key System for Sending a Digital Signature

Modularizing Security Design

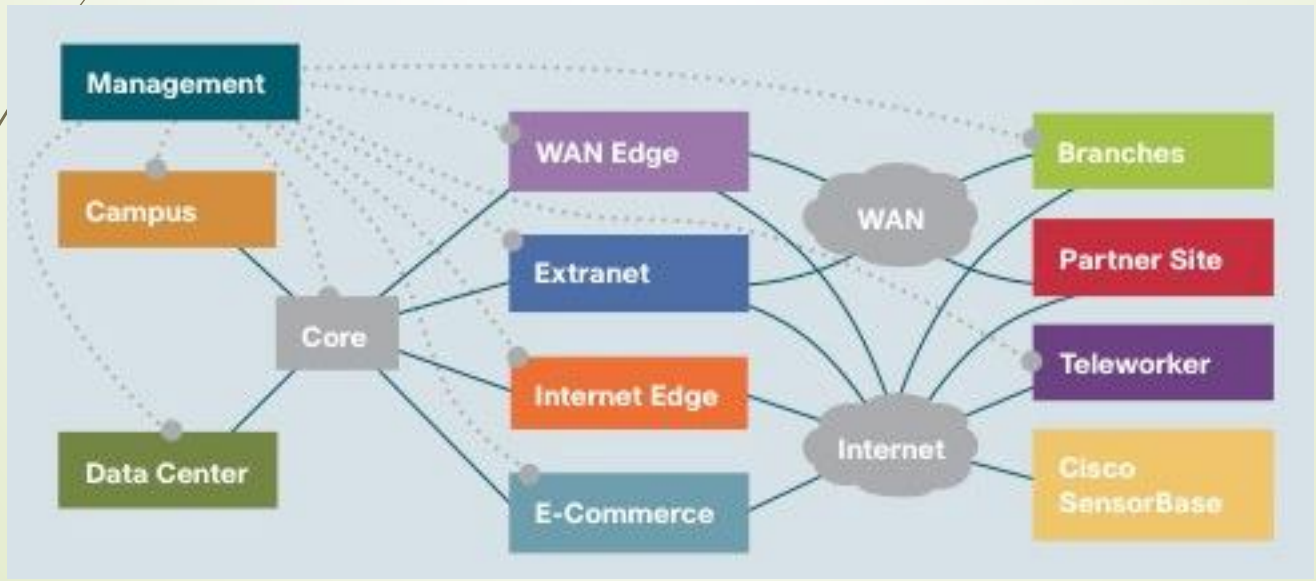
- Security defense in depth
  - Network security should be multilayered with many different techniques used to protect the network
- Belt-and-suspenders approach
  - Don’t get caught with your pants down

Modularizing Security Design

- Secure all components of a modular design:
  - Internet connections
  - Public servers and e-commerce servers
  - Remote access networks and VPNs
  - Network services and network management
  - Server farms
  - User services
  - Wireless networks

Cisco SAFE

- Cisco SAFE Security Reference Model addresses security in every module of a modular network architecture.



Securing Internet Connections

- Physical security
- Firewalls and packet filters
- Audit logs, authentication, authorization
- Well-defined exit and entry points
- Routing protocols that support authentication

Securing Public Servers

- Place servers in a DMZ that is protected via firewalls
- Run a firewall on the server itself
- Enable DoS protection
  - Limit the number of connections per timeframe
- Use reliable operating systems with the latest security patches
- Maintain modularity
  - Front-end Web server doesn’t also run other services

Securing Remote-Access and Virtual Private Networks

- Physical security
- Firewalls
- Authentication, authorization, and auditing
- Encryption
- One-time passwords
- Security protocols
  - CHAP
  - RADIUS
  - IPSec

Securing Network Services

- Treat each network device (routers, switches, and so on) as a high-value host and harden it against possible intrusions
- Require login IDs and passwords for accessing devices
  - Require extra authorization for risky configuration commands
- Use SSH rather than Telnet
- Change the welcome banner to be less welcoming

Securing Server Farms

- Deploy network and host IDSs to monitor server subnets and individual servers
- Configure filters that limit connectivity from the server in case the server is compromised
- Fix known security bugs in server operating systems
- Require authentication and authorization for server access and management
- Limit root password to a few people
- Avoid guest accounts

Securing User Services

- Specify which applications are allowed to run on networked PCs in the security policy
- Require personal firewalls and antivirus software on networked PCs
  - Implement written procedures that specify how the software is installed and kept current
- Encourage users to log out when leaving their desks
- Consider using 802.1X port-based security on switches

Securing Wireless Networks

- Place wireless LANs (WLANs) in their own subnet or VLAN
  - Simplifies addressing and makes it easier to configure packet filters
- Require all wireless (and wired) laptops to run personal firewall and antivirus software
- Disable beacons that broadcast the SSID, and require MAC address authentication
  - Except in cases where the WLAN is used by visitors

WLAN Security Options

- Wired Equivalent Privacy (WEP)
- IEEE 802.11i
- Wi-Fi Protected Access (WPA)
- IEEE 802.1X Extensible Authentication Protocol (EAP)
  - Lightweight EAP or LEAP (Cisco)
  - Protected EAP (PEAP)
- Virtual Private Networks (VPNs)
- Any other acronyms we can think of? :-)

Wired Equivalent Privacy (WEP)

- Defined by IEEE 802.11
- Users must possess the appropriate WEP key that is also configured on the access point
  - 64 or 128-bit key (or passphrase)
- WEP encrypts the data using the RC4 stream cipher method
- Infamous for being crackable

WEP Alternatives

- Vendor enhancements to WEP
- Temporal Key Integrity Protocol (TKIP)
  - Every frame has a new and unique WEP key
- Advanced Encryption Standard (AES)
- IEEE 802.11i
- Wi-Fi Protected Access (WPA) from the Wi-Fi Alliance

Extensible Authentication Protocol (EAP)

- With 802.1X and EAP, devices take on one of three roles:
  - The supplicant resides on the wireless LAN client
  - The authenticator resides on the access point
  - An authentication server resides on a RADIUS server

EAP (Continued)

- An EAP supplicant on the client obtains credentials from the user, which could be a user ID and password
- The credentials are passed by the authenticator to the server and a session key is developed
- Periodically the client must reauthenticate to maintain network connectivity
- Reauthentication generates a new, dynamic WEP key

Cisco's Lightweight EAP (LEAP)

- Standard EAP plus mutual authentication
  - The user and the access point must authenticate
- Used on Cisco and other vendors' products

Other EAPs

- EAP-Transport Layer Security (EAP-TLS) was developed by Microsoft
  - Requires certificates for clients and servers.
- Protected EAP (PEAP) is supported by Cisco, Microsoft, and RSA Security
  - Uses a certificate for the client to authenticate the RADIUS server
  - The server uses a username and password to authenticate the client
- EAP-MD5 has no key management features or dynamic key generation
  - Uses challenge text like basic WEP authentication
  - Authentication is handled by RADIUS server

VPN Software on Wireless Clients

- Safest way to do wireless networking for corporations
- Wireless client requires VPN software
- Connects to VPN concentrator at HQ
- Creates a tunnel for sending all traffic
- VPN security provides:
  - User authentication
  - Strong encryption of data
  - Data integrity

Summary

- Use a top-down approach
  - Chapter 2 talks about identifying assets and risks and developing security requirements
  - Chapter 5 talks about logical design for security (secure topologies)
  - Chapter 8 talks about the security plan, policy, and procedures
  - Chapter 8 also covers security mechanisms and selecting the right mechanisms for the different components of a modular network design

Review Questions

- How does a security plan differ from a security policy?
- Why is it important to achieve buy-in from users, managers, and technical staff for the security policy?
- What are some methods for keeping hackers from viewing and changing router and switch configuration information?
- How can a network manager secure a wireless network?