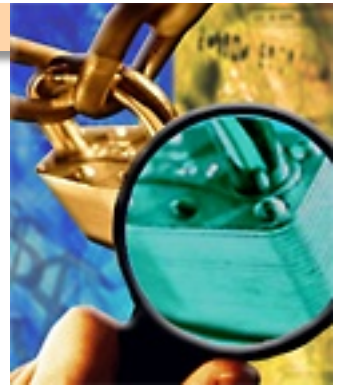

Security Best Practices

Vulnerability Assessment Course

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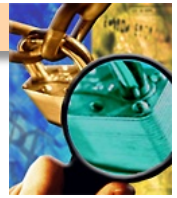

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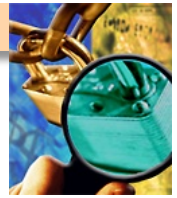
Agenda

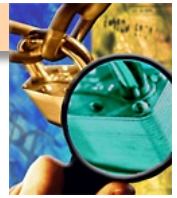
- Security Best Practices
- Assessment Lessons Learned



Best Practices

- Build security in from the beginning
- Establish an approach that protects high value systems from a sophisticated adversary
- Embrace the principles of Defense-in-Depth
- Establish a fault tolerant security model

Security in Design

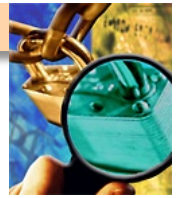


- Up-front design criteria for hosts, networks, applications and systems
- Difficult to retrofit information protection into an environment where none previously existed
- Protection designed into a system should be consistent with the threat to which it is likely to be exposed
- Major consideration should be given to the class of vulnerabilities that are likely to be present in a specific environment

Security in Design (cont.)

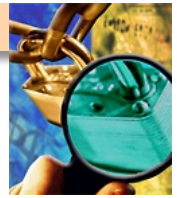
- **Common techniques:**
  - **Provide mechanisms for unique identification and authentication, auditing and discretionary access**
  - **Develop applications that do not require additional software that is not or cannot be secured**
  - **Ensure applications can function on an operating system that has been securely configured, consistent with best commercial and DOD guidelines**

Security Approach



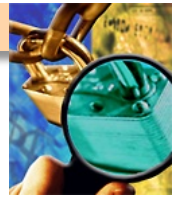
- Identify assets
- Identify potential threats
- Segment networks based on sensitivity and community of interest
- Implement Defense-in-Depth
- Continually re-assess security posture

Common Assets



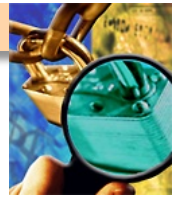
- Office information systems
- Public affairs web server
- Command and control information
- Logistics information
- Personnel information
- Financial information
- Communications infrastructure

Potential Threats



- Accidental loss of data
- Malicious users
- Hackers
- Terrorists
- Directed foreign intelligence collection
- Targeted information warfare attack
- Virus attacks
- Malicious code
- Denial of service

Defense-in-Depth

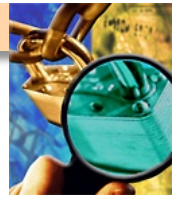


- Security configuration management
- Boundary protection
- Intrusion detection
- Incident response
- Vulnerability assessments
- Anti-virus
- Auditing

Security Configuration Management

- Underlying principle: Ensures individual systems can withstand an attack if perimeter defenses are breached
- Implementation: Individual systems configured such that they are relatively resistant to common attacks
- Common techniques
  - Utilize security configuration guidance (e.g., NSA, DISA, vendor, etc.)
  - Deactivate all network services that are not required for the function a particular system
  - Implement mechanisms for identification and authentication, auditing, and discretionary access
  - Require the use of secure protocols with strong I&A even on internal segments

Boundary Protection

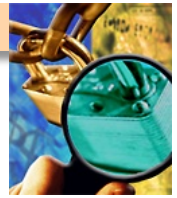


- **Underlying principle: Establishes a perimeter defense for the security domain**
  - **Should be defined based on organization's assets and potential threats to those assets.**
  - **Should be defined to providing a high degree of security while still maintaining the connectivity necessary to meet mission requirements**
  - **Should be defined to maintain the separation of systems based on the function of the system and the community of interest for the data residing on the system**

Boundary Protection (cont.)

- Implementation: Firewalls to provide real-time filtering and routing of authorized connections, unauthorized connections blocked
- Common techniques
  - Filtering/Routing (host by host, network service and protocol level)
  - Deny all policy – rule that denies any traffic that has not been explicitly allowed in or out of the network
  - DMZ for publicly accessible servers
  - Segment systems based on community of interest - e.g. critical C2 from OIS
  - Real-time alerting of malicious connection attempts

Boundary Protection (cont.)



- Implementation: Proxy servers to provide protection for internal web clients from malicious web sites
- Common techniques
  - Strip potentially malicious executable mobile content
  - Shield client IP address – prevents web sites from tracking individual clients
  - Block unauthorized sites – e.g. hacking sites

Anti-Virus

- Underlying principle: Defends individual hosts from infection from malicious code
- Implementation: Memory resident and on-demand scanners for workstations and servers
- Common techniques
  - Multi-level protection scheme: workstations, servers and email scanning
  - Filter capability – ability to filter emails based on subject name, attachments, etc.
  - In-bound and out-bound at gateway

Intrusion Detection

- Underlying principle: Provides the indications and warning that an attack is in progress
- Implementation: Sensors placed on the network and on individual hosts
- Common techniques
  - Multiple methods – one method may not identify all malicious traffic
  - Signature based, policy based, anomaly based
  - Real-time alerting of malicious connection attempts

Incident Response

- Underlying principle: Provides the plan of action for reacting to a successful attack
- Implementation: Procedures to isolate, contain and recover from unauthorized activity
- Common techniques
  - Have detailed plan
    - Evaluation - Determine validity, scope, and other relevant facts
    - Containment - Isolate system so trusted hosts can not be compromised
    - Notification
      - Preserve data required for criminal investigation
    - Eradication
      - Change passwords or re-install OS depending on the scope
    - Recovery - Fix the problem that caused the compromise
  - Exercise tactics and procedures

Vulnerability Assessments

- Underlying principle: Provides the opportunity to address weaknesses before an enemy can exploit them
- Implementation: Scanning tools that identify vulnerabilities in computer hardware, software, networks and operating systems
- Common techniques
  - Multiple packages – one package may not identify all vulnerabilities
  - Ability to identify backdoors behind the security perimeter, e.g. modems, VPNs, etc. – all potential vulnerabilities need to be assessed
  - Correction verification mechanism – ability to check if vulnerability has been eliminated

Auditing

- Underlying principle: Provides a record of actions taken within a system or network environment
- Implementation: Network and host level auditing programs
- Common techniques
  - Enable auditing/accounting
  - Review (system/application, web, firewall, etc.)
  - Centralized logging/analysis

Observations in Network Security

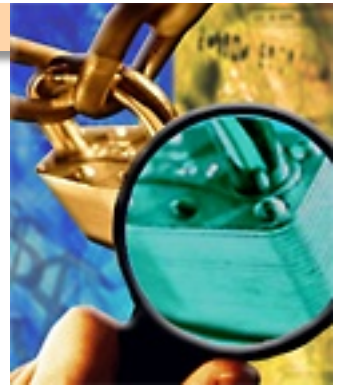
- Firewalls work well
  - The entire network security is dependent on the weakest link
  - Not all assets are behind the firewall
- Operational requirements always dictate some “holes” in the firewall security policy
- Intrusion detection must be used to monitor “holes”
  - If a VPN is used IDS cannot be done at the network perimeter
- Firewalls must be supplemented with host level scanning

Observations in Host Security

- Host security is highly dependent on specific operating system version and individual configuration
  - A constant “patch and wait” problem
  - Security patches often break other things or operational necessity can make applying patches impractical
  - Often patches are not released until after vulnerabilities are being widely exploited
  - Patches for some applications (i.e. IIS, MS SQL server, IE, etc.) are released at a rate which is unmanageable
- It is easier and more effective to block traffic to most hosts, then secure all internal hosts as time permits

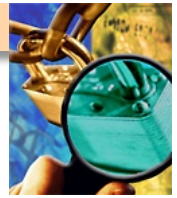
Challenges

- Multiple layers of security can make networks operations and troubleshooting very complex
- Too much dependence on vendors' products developed with rush to market as the goal
  - Security is often overlooked
- Applications developed with a goal of using latest technology instead of meeting the requirement
- Risk mitigations action increase complexity and cost
- Many security recommendations are dismissed because majority do not understand the threat

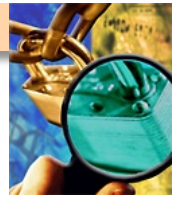


Assessment Lessons Learned

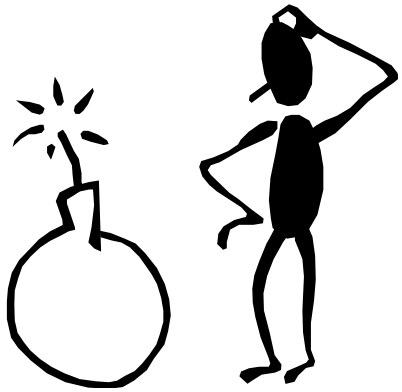
Assessment Process



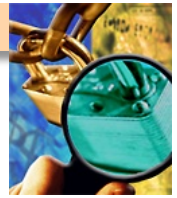
- Preparation Issues
  - Required notification process to organization
  - Organization approval for the assessment
  - Reporting templates useful to all concerned
  - Assessment objects available
  - Staff available to participate
  - Backing
- Preparation of the assessment plan
  - Use any organization specific assessment templates or guidance
  - Organization specific assessment plan
  - Organization approval of the assessment plan
  - Use organization approved tools or formats



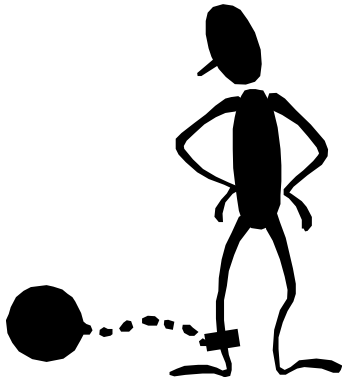
Obstacles



- The “Waiting Game”
- “I don’t understand”
- Scope is inaccurate
- Network diagram is inaccurate
- More systems than previously reported
- Unanticipated technology
- Documentation not availability
- Script outputs not provided
- Appropriate connectivity not provided
- Systems administrators lying, changing script outputs, or making corrections and re-running scripts
- Argumentative systems owners and administrators
- Asked to change finding
- Others...

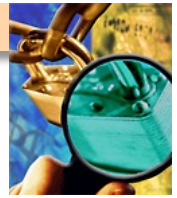


Pitfalls



- Poorly defined scope
- Coming in blind
- Not anticipating common delays
- Relying too heavily on tools
- Relying on a checklist
- Relying on a script
- Reporting false positives
- Not providing the impact of a finding
- Inaccurately characterizing the risk
- No network cable, power cord, other equipment
- Temptation to change a finding
- Arguing with a systems administrator
- *Others...*

Baseline Configuration

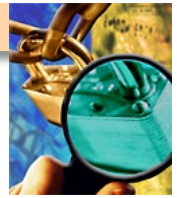


- Organization has not established its own baseline configurations
- Although NSA/DISA established a gold standard, may be too much for some installations and breaks applications
- Baseline configurations are a mandatory control under CM-2 of NIST SP 800-53

Configuration Management

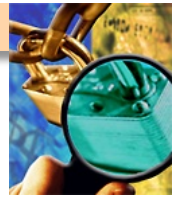
- Systems are inconsistently and improperly implemented- even within the same operational environment
- Many default configurations are still set (CM-6)
- ‘Least Privilege Principle’ is not appropriately implemented (AC-6)
- Unsecure protocols like (ftp, telnet)

Risk Management



- Security Risk Management (RM) needs to be considered right along with other project RM
- Most RM that takes place was for compliance rather than as a tool to help secure the system
- The Risk Assessments done now are of low quality and value – needs to correspond to impact level
- RM must be part of the overall project plan for the application/architecture
- Risk Assessment should be based on organization security policy

Application Security



- Applications remain vulnerable to many different types of attacks
  - Input is not validated
  - Improper session control (AC-11, AC-12)
  - Account Management is (AC-2) often weak and improper
  - Improper error handling messages
- Database application vulnerable to internal threat

Certification and Accreditation

- Many systems operating under an Interim Authority to Operate (IATO) for extended period (CA-6)
- Some systems did not have System Security Plans (PL-2) nor Risk Assessment (CA-2)
- Documents developed by organization to meet requirements, and not to solve issues (Contingency Plans)

Database Security

- Database Baselines are usually not implemented consistently
- Default accounts remain active (AC-2)
- Access management of database account is not secure
- Auditing logs are seldom enabled
- Accountability – confusion on where application DB programmer job ends and the maintainers begins has lead to implementation problems.

Access Control

- The ‘Principle of Least Privilege is seldom implemented correctly (AC-6)
- Systems have excessive ports and protocols enabled providing unnecessary access (CM-6)
- Excessive access were being granted into sensitive databases (AC-2)
- Administrator interfaces open directly to the Internet (AC-17)
- Developers often have full privileges into the production environment (AC-6/SA-8,10)
- Files often had world read, write and execute permissions (UNIX) (AC-4)

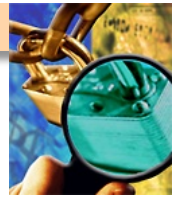
Operating Systems

- **Elements of Assessments**
  - Look at system partitioning
  - Centralized audit log important
  - Look for social engineering opportunities
  - Examine for defense in depth (or lack of)
  - Assessments confirm organization policies
- **Active Assessments**
  - Scan (ping sweep, port scans, OS Detection)
  - Enumerate (users, list file shares, identify applications)
  - Access (password "sniff", file share brute force, SAM DB, buffer overflows)
  - Escalate privileges (crack passwords, known exploits)
  - Pilfer (evaluate trusts)

Services

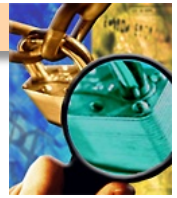
- There are critical security implications of improper DNS configuration
- Thorough evaluation of DNS must be completed
  - Automated tools provide a network view of the service (nessus, nmap, dig, dnswalk)
  - Automated tools will not tell you additional information such as improper ACL's, logging config, transfer hosts and other details
  - Manual review of named.conf or equivalent
- Assessor should have DNS references on hand during review if not familiar with DNS configuration settings

Common Findings



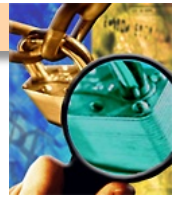
- **Windows Best Practices**
  - Patches and additional software
  - Minimize Network Services (e.g., IIS, AD)
  - Minimize Boot Services
  - Enhance Logging
  - File/Directory Permissions/Access
  - System Access, Authentication, and Authorization
  - User Accounts and Environment
  - System Partitioning
- **Follow best practice and configuration guides**
- **Always set complex passwords and change them often**
- **Perform periodic assessments**

Common Findings



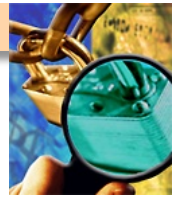
- **UNIX Best Practices**
  - Patches and additional software (e.g., OpenSSH, TCP Wrappers)
  - Minimize Network Services (e.g., inetd, sendmail)
  - Minimize Boot Services
  - Kernel Tuning
  - Enhance Logging
  - File/Directory Permissions/Access
  - System Access, Authentication, and Authorization
  - User Accounts and Environment

Common Findings



- Network Observations
  - Disable unneeded services and protocols
  - Encrypt routing updates with strongest algorithm available
- Poor ACL's
- Lack of Auditing
- Poor Configuration
- Operational requirements always dictate some "holes" in the firewall security policy
- Intrusion detection must be used to monitor "holes"
- Firewalls must be supplemented with host level scanning
- External recursion allowed

Conclusions



- **What have we learned from assessments?**
- The system owners have many controls which are not being addressed
- Need SLA in procurement phase
- The information systems security office has areas that can be improved upon, especially C&A, RA and CP.
- Embedding security into the SDLC is the best methodology NIST 800-64R2
- Accountability is important from the system owner, to OIS, to the vendor implementing the controls
- Standard reporting template would be useful
- Application security tools are not generally available (code analyzer)
- Databases behind firewalls are protected from external threats but still vulnerable to internal threats – focus on securing database application.
- Information security not part of technical architecture

Questions