Operating Systems Security

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Audio/video recordings of this lecture are available at:

http://www.cse.wustl.edu/~jain/cse571-07/

Overview

- Layers of Security
- 10 Immutable Laws of Security
- Malware
- Defenses
- Passwords
- Application Security: Email, Browsing

Layers of Security

Application Security

Network Security

OS Security

User Security

Physical Security

- *A lock is as strong as the weakest door.*

Common Operating Systems

- Windows (9x, XP, Vista)
- Windows Server (NT, 2000, 2003)
- Linux
- Linux Server
- Unix
- Solaris
- HPUX

Multiple books on security issues of each one.

Most malware exploits windows – due to popularity.
$\Rightarrow$ We will mostly concentrate on Windows
We cover only a very small subset

10 Immutable Laws of Security

1. *If a bad guy can persuade you to run his program on your computer, it's not your computer anymore*
2. *If a bad guy can alter the operating system on your computer, it's not your computer anymore*
3. *If a bad guy has unrestricted physical access to your computer, it's not your computer anymore*
4. *If you allow a bad guy to upload programs to your website, it's not your website any more*
5. *Weak passwords trump strong security*

Laws of Security (Cont)

6. *A computer is only as secure as the administrator is trustworthy*
7. *Encrypted data is only as secure as the decryption key*
8. *An out of date virus scanner is only marginally better than no virus scanner at all*
9. *Absolute anonymity isn't practical, in real life or on the Web*
10. *Technology is not a panacea*

Ref:http://www.microsoft.com/technet/archive/community/columns/security/essays/10imlaws.mspx?mfr=true

Where Malware Hides?

- Autoexec.bat or autoexec.nt can start malware before windows start
- Config.sys, config.nt
- Autorun.inf on CD-ROMs or even hard drives
- Boot.ini, bootsect.dos, command.com, dosstart.bat
- msdos.sys, io.sys
- Desktop.ini - Can be used to hide files and auto-launch programs when a folder is viewed
- Host, lmhost
- Manipulating SMTP server settings or the Host file and intercepting sent e-mail.

Malware (Cont)

- Nested archives (zip, rar, tar, cab)
  - detected only by recursive scanning
- Auto-run files in archives
- Embedded applications in Documents (word, PowerPoint, excel)
- Embedded macros in documents
  - Can secretly send a named doc to a remote sender
- OLE2 formatted documents can be executed
- Rasphone.pbk - Can modify dialup network setting including DNS and make long distance calls

Malware (Cont)

- Startup folder
- Web cache - malware dropped in by websites
- Path variable - illegitimate program will run then load legitimate program
- Trusted publishers - can execute programs w/o user approval
- Registry entries
- Embedded URLs in HTML Emails (can execute programs)

Malware Trends

- Moving from hobby to criminals
  $\Rightarrow$ more attempts to gain financial information
- Viruses are distributed through compromised websites
- Compromised clients are then directed to download more malware

Magnitude of the Problem

- Messagelabs.com:
  - 69% of all emails is spam. 1 in 43 contain virus
  - 70% of all spam is sent from addresses of innocent users
- Antiphishing.org:
  - Phishing email increasing 26% per month
  - 2% to 15% of the phishing is successful
- Dell.com:
  - Average PC has 50 to 70 spyware infections
- Secretservice.gov:
  - 29% of all successful intrusions by insiders

Defenses

- Don't give users Admin access
  ⇒ Windows Vista requires "run as administrator" for Privileged operations:
  - Install or uninstall programs
  - Configure windows system settings
  - View or change security permissions
  - Change networking configuration
  - Stop, start, load, or pause services
  - Modify drivers
  - Registry
  - etc.

Defenses (Cont)

- Update often
- Use Personal firewall
- Use antivirus software - keep updated
- Use anti-spam
- Use anti-spyware
- Boot-up password
- Boot only from primary hard drive - Can't load NTFS4DOS
- Password protect the bios

Defenses (Cont)

- Disable guest account
- Rename administrator account - unlimited retries
- Rename guest account to administrator - helps catch hackers
- Run services on non-default ports https://x.com:3809
- Install software on non-default folders
- Use encrypted file system (EFS)
- Disable LM and NTLM authentication
- Enable account lockout after a certain number of tries $\Rightarrow$ Potential DoS Attack

Defenses (Cont)

- Use two factor authentication - biometric, smart card, USB token, etc.
- Disable Simple File Sharing. SFS removes most NTFS permissions to close to Share. All connecting users come in as administrator or guests

Passwords

- Most people use only alphabets with dictionary words
  $\Rightarrow$ Easily broken
- Common passwords: password, admin, 12345, ...
- Often leave manufacturer defined password unchanged
- Most people use the same passwords for all accounts
  $\Rightarrow$ Get their password in a less secure environment and use it in a more secure environment

Windows Login Passwords

- Windows 2000 allows 127 character passwords with 64k possible characters $\Rightarrow 4.9\times10^{611}$ passwords
- System managers can set policies: Requiring minimum length and types of characters
  - Upper case alphabets
  - Lower case alphabets
  - Numerals
  - symbols
  - Unicode characters: Alt+nnnn 4 #s numeric keypad
- Most keyboards have 94 characters
  $\Rightarrow$ Most hackers will try 94 possibilities

Password Hashing

- Windows uses LAN Manager (LM) hashes or NT hashes.
- LM Hash is case insensitive and truncates password to 14 characters
- LM Has in not salted ⇒ Results in the same output if two accounts use the same password
- Salted ⇒ Random value is mathematically applied to the password before hashing
- Challenge-Response is used over the network

Password Attacks

- Password resetting - much easier than cracking
- Replace the Security Account Manager (SAM) files ⇒ Nordhi boot diskette
- Net use drive mapping
- Brute force password guessing ⇒ John the ripper exercise, Cain & Able, Brutus, TSGrinder (Terminal services and RDP connections)
- SQL Server authentication ⇒ ForceSQL, MSSqlPwd, Swlbf, Sqlbf-all, and SWL Auditing Tool

Password Attacks (Cont)

- Password capturing via key loggers,
- Hardware key logger - PS2 like between the keyboards and the PC. Used by FBI, CIA, Bank robbers, Customers
- Sniffing authentication traffic on the network
- Share Message Block (SMB)/NetBIOS attack tools: ScoopLM captures authentication exchanges, BeatLM then does off-line brute force cracking. Similarly, SMBRelay, SMBGrind, SMB Auditing tool, SMB Downgrade Attacker.
- Share password attacks - Share password cracker

Password Attacks (Cont)

- Kerberos Authentication
  - KerbSniff and KerbCrack
- Password Cache: 10 user credentials are cached
  - CacheDump
- Passwords saved with Remote Desktop Protocol (RDP) – cracked by Cain & Able
- Older IE (before IE6) sent authenticated credentials to all IIS servers

Password Authentication Mistakes

- Dell XP PCs (2005) had an hidden ad account with blank password,
- MS Word password can be blanked by opening the document in an editor

NetBIOS/SMB Services

- Commonly Attacked Window Services
- Enumerate NetBIOS name table of any machine: nbtstat -A <IP address>
- NetBIOS name table service can be disabled
- Anonymous logins

Application Security

- Peer-to-Peer (P2P) Sharing programs allow users to share files, directories, and drives
- Deny-by-default software policy in many enterprises

Email

- Phishing
- Attachments
- HTML content (autopreview)
- Spam: Spamming tools to introduce misspellings to avoid detection to harvest emails from web sites, usenet groups, chat channels
- Most email is plain text $\Rightarrow$ Can be read by any one
- Match the senders domain with IP address
- Set rate control on: Connections per client, emails per client, number of recipients per email
- Personal black and white lists

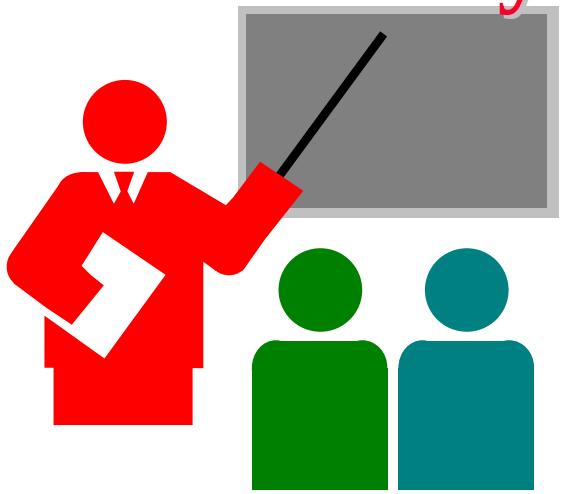
Browsing

- IE MIME type mismatch - Declare skin but send java script
- IE Plug-ins, Active X controls, Java scripts
- Password and form input saving in browsers and in-line auto complete
- Empty Temporary Internet Files folder when browser is closed

Web Servers

- Directory Traversal:
  - http://hostdomain/../../../../../../../windows/system32/cmd.exe?/c+dir+c
  - will be converted to c:\windows\system32\cmd.exe in unpatched versions of IIS 5.
  - Allows a command shell access to the hacker

Summary



- Need to secure systems against theft of data
  – bios password, boot password
- Passwords must be strong.
  Use two-factor authentication for critical applications.
- 10 Immutable Laws of Security
- Secure email and browsing

Reference

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Lab Homework 4

- This homework requires two computers with OpenSSH and telenet client and servers installed. You can use CSE571XPC client and CSE571XPS server or your own computers.
- Start ethereal (or wire shark) on the client machine.
- telnet to the server and login with your username and password. Logout.
- Ssh to the server and login with your username and password. Logout.
- Stop ethereal and read the trace.
  Note the difference in the two logins?

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 all preventive-control techniques, which safeguard any computer assets capable of being stolen, edited or deleted if OS security is compromised.