Network Security: Overview

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Audio/Video recordings of this lecture are available at:

http://www.cse.wustl.edu/~jain/cse571-17/

Overview

1. Security Components
2. Steps in Cracking a Network
3. Types of Malware
4. Types of Attacks
5. Security Mechanisms

Ref: C. Easttom, "Computer Security Fundamentals," 3rd Ed, Pearson, 2016, 432 pp., Safari Book.

Security Components

- **Confidentiality**: Need access control, Cryptography, Existence of data
- **Integrity**: No change, content, source, prevention mechanisms, detection mechanisms
- **Availability**: Denial of service attacks
  A=Availability, Authenticity or Accountability
- Confidentiality, Integrity and Availability (**CIA**)
- CIA Triangle

Steps in Cracking a Network

- **Information Gathering**: Public sources/tools.
- **Port Scanning**: Find open TCP ports.
- **Network Enumeration**: Map the network. Servers and workstations. Routers, switches, firewalls.
- **Gaining Access**: Keeping root/administrator access
- **Modifying**: Using access and modifying information
- **Leaving a backdoor**: To return at a later date.
- **Covering** tracks

Types of Malware

- **Viruses**: Code that *attaches* itself to programs, disks, or memory to propagate itself.
- **Worms**: Installs copies of itself on other machines on a network, e.g., by finding user names and passwords
- **Trojan horses**: Pretend to be a utility. Convince users to install on PC.
- **Rootkit**: Gets "root" (admin) privilege

Types of Malware (Cont)

- **Spyware**: Collect information. Legally used by employers.
- **Key Loggers**

- **Hoax**: Use emotion to propagate, e.g., child's last wish.
- **Trap Door**: Undocumented entry point for debugging purposes
- **Logic Bomb**: Instructions that trigger on some event in the future
- **Zombie**: Malicious instructions that can be triggered remotely. The attacks seem to come from other victims.

Ref: http://www.spywareguide.com/

Types of Viruses

- Boot sector virus: Floppy disks
- Macro virus: Office documents
- Email malware: Attachments
- Web site malware: JavaScripts

Types of Attacks

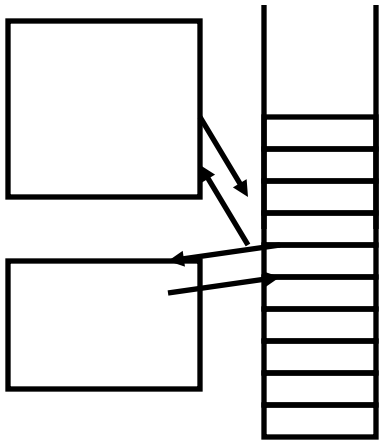
- **Malware**
- **Security Breach**: unauthorized access
- **Denial of Service (DoS):** Flooding with traffic/requests
- **Web attack**: SQL injection
- **Cross-Site Scripting**: Direct users to malicious sites using SQL injection
- **Session Hijacking**: Taking over an active session
- **DNS Poisoning**: Direct users to malicious sites
- **Brute Force**: Try all passwords.
- **Port Scanning** ⇒ Disable unnecessary services and close ports
- **Network Mapping**

Types of Attacks (Cont)

- **Cyber Stalking**: Harassing/threatening using Internet
- **Cyber Frauds**: Nigerian official wants to deposit large funds into your bank account
- **Identity Theft**: Get credit cards using your Social Security number
- **Phishing**: Email claiming to be from bank/employer/government

Buffer Overflows

- Return address are saved on the top of stack.
- Parameters are then saved on the stack.
- Writing data on stack causes stack overflow.
- Return the program control to a code segment written by the hacker.



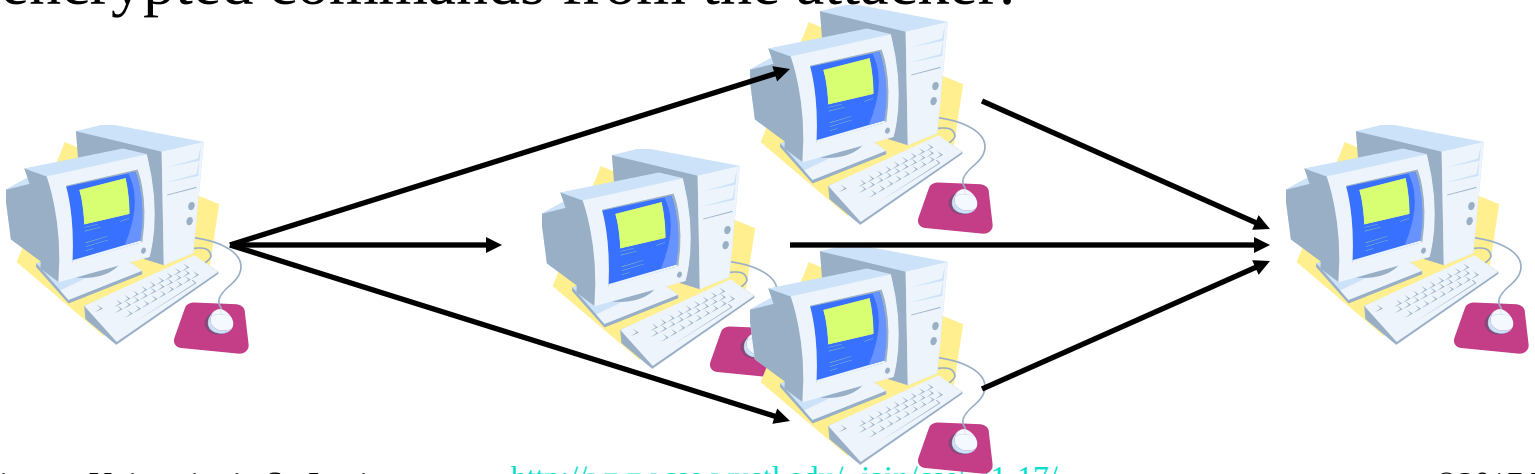
DoS Attack

- **ICMP Flood**: Lots of ping with large message sizes
  ping <adr> -l <buffer size> –w <timeout> -t (till stopped)
  ping 127.0.0.1 –l 65000 –w 0 -t
- **Syn Flood**: Lots of incomplete connections => Server runs out of resources
- **UDP Flood**: No application at destination port generates "Destination unreachable" response to *spoofed* source address.
- **Smurf Attack**: A broadcast ICMP packet is sent to broadcast address. Everyone responds to the spoofed source address
- **Ping of Death**: Ping with a very large packet can crash the destination
- **Low Orbit Ion Cannon**: Open Source DoS attack tool
- **High Orbit Ion Cannon**: Open source DoS attack tool written in Basic. Can attack 256 URLs at the same time.

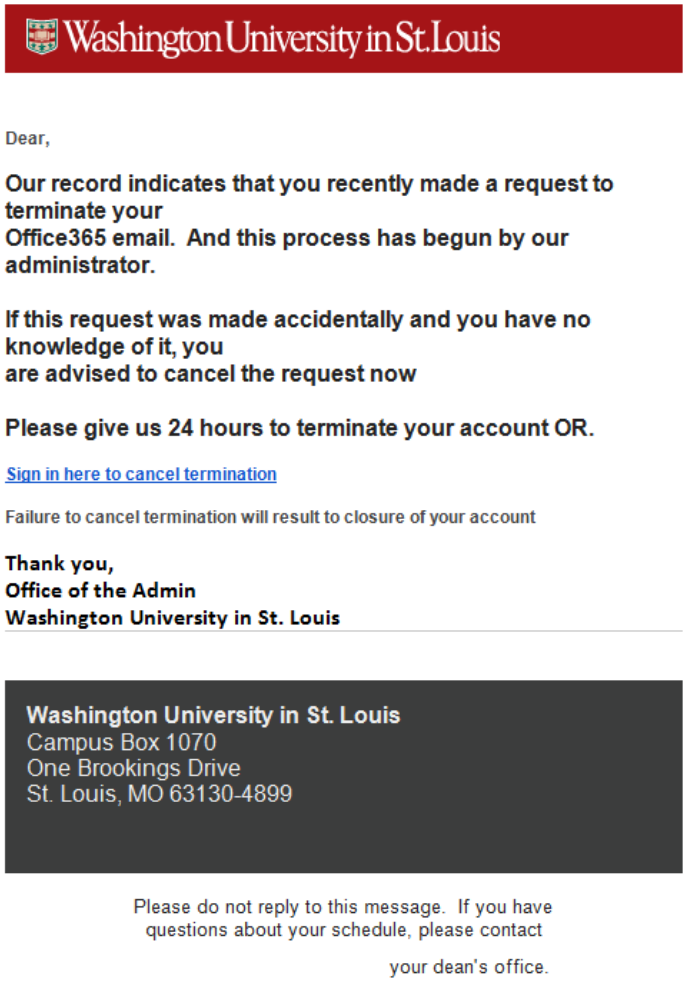
Ref: Low Orbit Ion Cannon, https://sourceforge.net/projects/loic/
https://en.wikipedia.org/wiki/Low_Orbit_Ion_Cannon

Distributed DoS Attacks

- **Tribe Flood Network** (TFN) clients are installed on compromised hosts.
- All clients start a simultaneous DoS attack on a victim on a trigger from the attacker.
- **Trinoo** attack works similarly. Use UDP packets. Trinoo client report to Trinoo master when the system comes up.
- **Stacheldraht** uses handlers on compromised hosts to receive encrypted commands from the attacker.



Phishing Example



Washington University in St.Louis

Dear,

Our record indicates that you recently made a request to terminate your Office365 email. And this process has begun by our administrator.

If this request was made accidentally and you have no knowledge of it, you are advised to cancel the request now

Please give us 24 hours to terminate your account OR.

Sign in here to cancel termination

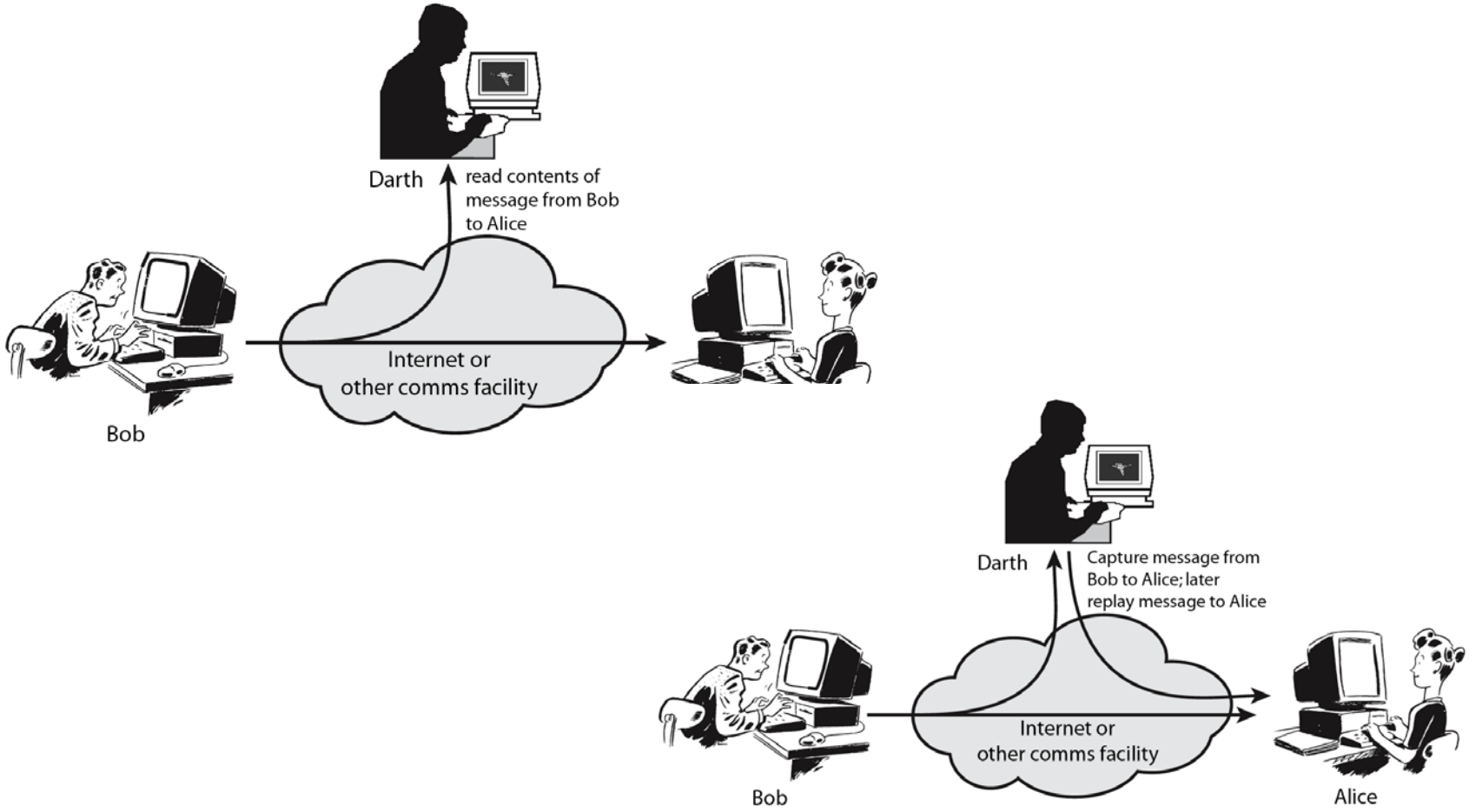
Failure to cancel termination will result to closure of your account

Thank you,
Office of the Admin
Washington University in St. Louis

Washington University in St. Louis
Campus Box 1070
One Brookings Drive
St. Louis, MO 63130-4899

Please do not reply to this message. If you have questions about your schedule, please contact your dean's office.

Passive vs. Active Attacks



Social Engineering

- **Reverse social engineering:** User is persuaded to ask Hacker for help.
- **Phone calls**:
  - Call from tech support to update the system.
  - High-level VP calling in emergency.
  - Requires employee training.
- Electronic Social Engineering (**Phishing**):
  - EBay transactions, PayPal Accounts, Bank Account, Nigerian 419 scams (Section 419 of Nigerian criminal code), Lottery.
  - Anti-phishing workgroup (antiphishing.org) found that 5% of the recipients respond compared to 1% for spam.

Security Mechanisms

- Encipherment
- Digital Signature
- Access Control
- Data Integrity
- Authentication Exchange
- Traffic Padding
- Routing Control
- Notarization
- Least Privilege: Each user/service should have minimum privilege to do the job

Honey Pots

- Trap set for a potential system cracker
- All the services are simulated
- Honey pot raises alert allowing administrator to investigate

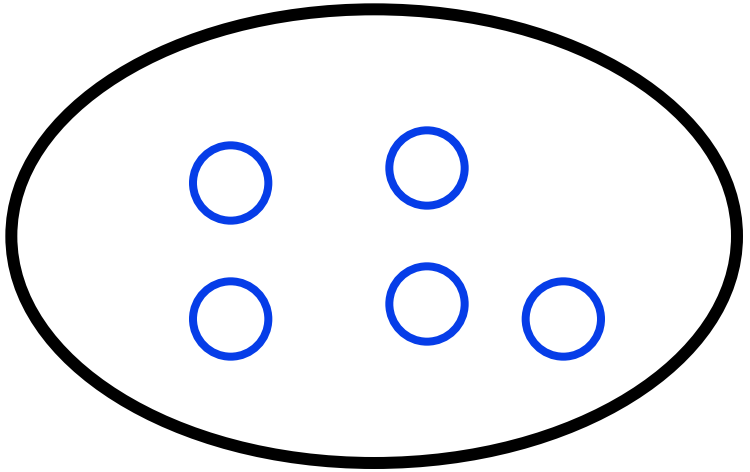
Hackers

- **White Hat Hackers**: Hackers that find vulnerabilities and inform the organization
- **Black Hat Hackers**: Hackers that exploit vulnerabilities
- **Red Team**: **Penetration testers** to find vulnerabilities
- **White Team**: Security protection personnel

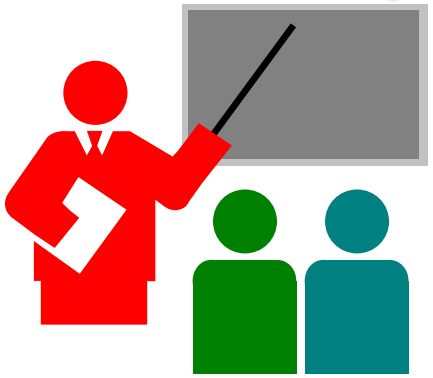


Perimeter vs. Layer Security

- **Perimeter Security**: Inspection at entry points
- **Layered Security**: Security in every segment inside as well as at the perimeter ⇒ All systems are not affected.



Summary



1. Confidentiality, Integrity, and Availability (CIA)
2. Malware: Viruses, worms, trojan horses, rootkit, spyware, trap door, logic bomb
3. Attacks: Malware, Security breach, DoS, Web Attack, Cross-site scripting, DNS poisoning, identity theft
4. DoS Attacks: ICMP/Syn/UDP flood
5. Security Mechanisms: Encryption, Signing, Authentication, honeypots

Lab 2

1. Download and read about the following tools
   a. **Wireshark**, network protocol analyzer, http://www.wireshark.org/download.html
   b. **Advanced Port Scanner**, network port scanner, http://www.scanwith.com/Advanced_Port_Scanner_download.htm
   c. **NMAP**, network mapping open source software, http://nmap.org/download.html
2. Use **advanced port scanner** to scan one to three hosts on your local net (e.g., CSE571XPS and CSE571XPC in the security lab) to find their open ports.
3. Use **nmap** to show the map of all hosts on your local net

Lab 2 (Cont)

4. Ping www.wustl.edu to find its address. Start Wireshark. Set capture filter option "IP Address" to capture all traffic to/from this address. Open a browser window and Open www.wustl.edu . Stop Wireshark. Submit a screen capture showing the packets seen.

Security Related Websites

- Computer Security Resource Center, http://csrc.nist.gov/
- Computer Emergency Response Team (CERT), http://www.cert.org/
- Computer and Network Security Reference Index, http://www.vtcif.telstra.com.au/info/security.html
- IETF Security area, https://datatracker.ietf.org/wg/
- Microsoft Security Advisor, https://technet.microsoft.com/en-us/security/bb291012
- Tom Dunigan's Security page, http://www.csm.ornl.gov/%7edunigan/security.html
- Security and Cryptography Forum, http://forums.devshed.com/security-and-cryptography-17/
- Cryptography Forum, http://www.topix.com/forum/science/cryptography

Security Related Websites (Cont)

- SANS Institute, http://www.sans.org
- Security Forum, http://www.windowsecurity.com/
- Google groups, http://groups.google.com
- LinkedIn Groups, http://www.linkedin.com

Acronyms

- AES Advanced Encryption System
- CERT Cyber Emergency Response Team
- DDoS Distributed DoS
- DES Data Encryption System
- DNS Domain Name System
- DoS Denial of Service
- ICMP IP Control Message Protocol
- ID Identifier
- IETF Internet Engineering Task Force
- IP Internet Protocol
- NIST National Institute of Standards and Technology
- PC Personal Computer
- RFC Request for Comments
- SANS Escal Institute of Advanced Technologies
- SQL Structured Query Language
- TCP Transmission Control Protocol

Acronyms (Cont)

- TFN Tribe Flood Network
- UDP User Datagram Protocol
- URL Universal Resource Locator
- VP Vice-President
- VPN Virtual Private Network

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http://rajjain.com

Related Modules

CSE571S: Network Security (Spring 2017),
http://www.cse.wustl.edu/~jain/cse571-17/index.html

CSE473S: Introduction to Computer Networks (Fall 2016),
http://www.cse.wustl.edu/~jain/cse473-16/index.html

Wireless and Mobile Networking (Spring 2016),
http://www.cse.wustl.edu/~jain/cse574-16/index.html

CSE571S: Network Security (Fall 2014),
http://www.cse.wustl.edu/~jain/cse571-14/index.html

Audio/Video Recordings and Podcasts of
Professor Raj Jain's Lectures,
https://www.youtube.com/channel/UCN4-5wzNP9-ruOzQMs-8NUw