Internet Security

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General information

- Area: BKS – Hauptstudium Vertiefer
  - Integrated into a Module system of SECT and INET (see website)
- Time
  - Wednesday: 10:00 – 12:00
- Room
  - MA 43
- Language
  - English (questions can be asked in German!)
- Website
  - http://www.net.t-labs.tu-berlin.de/teaching/ss11/IS_lecture/
- Mailing list
  - via ISIS (link on the website)
General information

- Exam
  - For those that need it 😊
  - Oral or written exam after semester end (depends on # of participants)

- Prerequisite: some knowledge of
  - How the Internet works
  - How operating systems work
  - Little bit of undergraduate math for cryptography

- Additional contact persons:
  - Jan Böttger (INET) and Collin Mulliner (SECT)
What is this course about?

(Network security? Not quite!)

Focus:
- Security of networked **applications**
  - Security of Web browsers
- Protection of network **infrastructure**
  - Firewalls
  - Intrusion detection
Topics

 Basics of secure network protocol design
  ✔ Using cryptography (not a cryptography class!)
  ✔ The role of correct software

 Practical focus
  ✔ This is not a pure academic-style course
  ✔ You'll see real security holes
  ✔ A lot of (in)security is about doing the unexpected
  ✔ „Think sideways“
How to think about insecurity

- Bad guys don’t follow rules
- Need to understand what sort of attacks are possible to compromise a system
  - Prerequisite to understand what to protect in a system!
- This is not the same as actually launching them!
  - Taking a security class is not an excuse for hacking
  - Hacking is any form of unauthorized access, including exceeding authorized permissions
  - The fact that a file or computer is not properly protected is no excuse for unauthorized access
Reading

- Kaufman, Perlman, and Spencer. 
  Network Security: Private Communication in a Public World, 

- Cheswick, Bellovin, and Rubin. 
  Firewalls and Internet Security: Repelling the Wily Hacker, 

- Garfinkel, Spafford, and Schwartz. 
  Practical Unix & Internet Security, 
  O'Reilly Media, Inc.

- Matt Bishop. 
  Computer Security: Art and Science, 
  Addison-Wesley Professional 2002

- ... (see Web)

- Research papers (see Web)
Network security

Overview
Dichotomy: Hosts

- Is (or can be) well-controlled
- There are well-developed authentication and authorization models
- Strong notion
  - Of "privileged" state
  - What programs can use/do
Dichotomy: Networks

- None of the above
- Anyone can (and does) connect to the network
- Connectivity can only be controlled in very small, well-regulated environments, and maybe not even then
- Different OS have different – or no – notions of userIDs and privileges

=> notions of privilege is missing
Networking

- Networks interconnect
- Networks always interconnect
- Interconnections happen everywhere 😊 but mainly at the edges
Failures

- Benign failures
  - Most network failures are benign
  - The Internet allow for such failures
    - Data corruption
    - Timeouts
    - Dead hosts
    - Routing problems
    - ...

- Rule of thumb:
  - Anything that can happen by accident can happen malicious
    - -> much more dangerous!
Failures and Faults
Principle: Trust nothing

- A host can/should trust nothing that comes over the wire!
- Any desired protections have to be explicitly supplied
- There may be help from lower layers that supply protection
  - Yet those layers have to be based on the same principle!
  - Research on such lower layer protection is a very hot topic and far from being solved!
Attitude question

- Unproductive attitudes
  - „Why would anyone ever do that?“
  - „That attack is too complicated“
  - „No one knows how this system works, so they can’t attack it“

- Better attitudes
  - „Programming Satan’s Computer“ (Ross Anderson)
  - „Assume that serial number 1 of any device is delivered to the enemy“
  - „You hand your packets to the enemy to deliver; you receive all incoming packets from the enemy“
Network security tools

- Cryptography
- Network-based access control (firewalls and more)
- Monitoring

- Protocol analysis by formal verification

- Paranoid design!
Protocol design

- Heavy use of crypto and authentication
- Ensure that sensitive fields are protected
- Make authentication bilateral
- Figure out the proper authorization
- Defend against
  - Eavesdropping
  - Modification
  - Deletion
  - Replay
  - And combinations thereof
Buggy software

- Most network security holes are due to buggy code
- A buggy network-connected program is an insecure one 😞
- Correct coding counts for a lot!
Course overview

- Introduction
  - Attacks and threats, cryptography overview
  - Authentication (Kerberos, SSL)

- Applications
  - Web, browser, email, ssh

- Lower layer network security
  - NAT, (IPsec), firewalls

- Monitoring / information gathering
  - Intrusion detection, network scans

- Availability
  - Worms, denial of service, network infrastructure