Internet Security

Prof. Anja Feldmann, Ph.D.
anja@net.t-labs.tu-berlin.de
http://www.net.t-labs.tu-berlin.de/

Prof. Dr. Jean-Pierre Seifert
jpseifert@sec.t-labs.tu-berlin.de
http://www.sec.t-labs.tu-berlin.de/

General information

- Area: BKS – Hauptstudium Vertiefer
  - Will be integrated into a Module system of SECT and INET
- Time
  - Thursday: 14:00 – 16:00
- Room
  - MA 043
- Language
  - English (questions can be asked in German!)
- Web site
    - http://www.net.t-labs.tu-berlin.de/teaching/ss09/is_ss09/
- Mailing list
  - see Web page

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:
  - Gregor Maier (INET) and Collin Mulliner (SECT)

3

What is this course about?

- Network security? Not quite!
- Focus:
  - Security of networked **applications**
    - Security of Web browsers
  - Protection of network **infrastructure**

4

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"

5

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

6

Reading

- Kaufman, Perlman, and Spencer.
  Network Security: Private Communication in a Public World,
  Second Edition, Prentice Hall, 2002
- Cheswick, Bellovin, and Rubin.
  Firewalls and Internet Security: Repelling the Wily Hacker,
  Second Edition, Addison-Wesley Professional 2003
- 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)

7

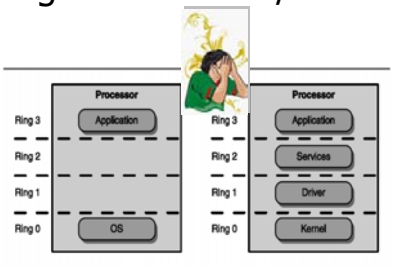
Network security

Overview

8

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



9

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

10

Networking

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

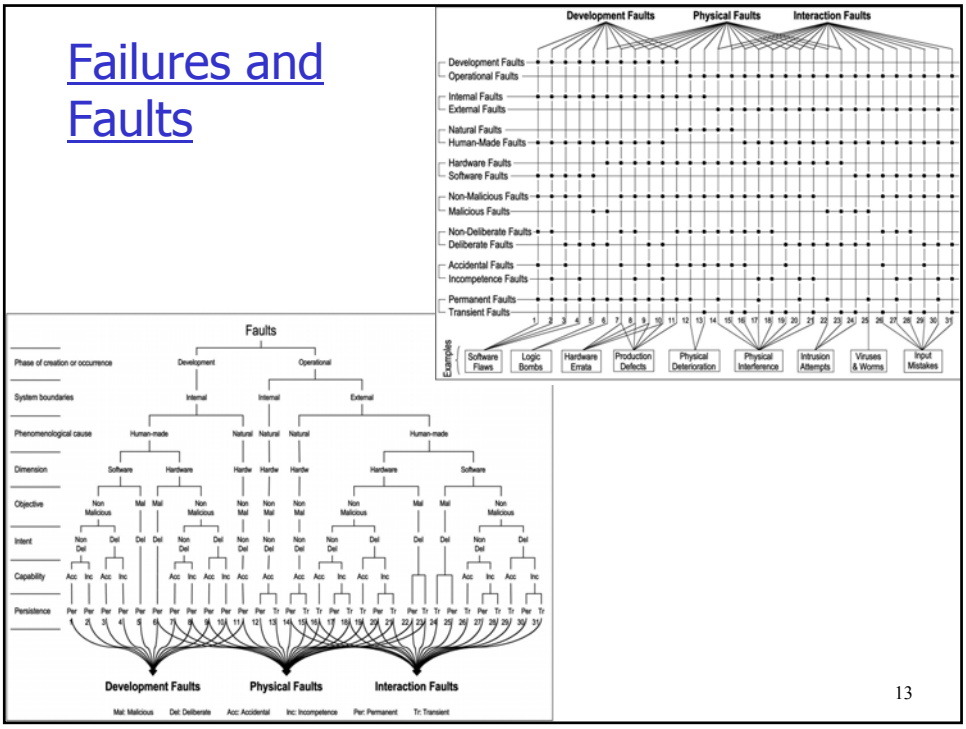
11

Failures

- Benign failures
  - Most network failures are benign
  - Programs 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!

12

Failures and Faults



13

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!

14

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"

15

Network security tools

- Cryptography
- Network-based access control (firewalls and more)
- Monitoring
- Protocol analysis by formal verification
- *Paranoid design!*

16

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

17

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!

18

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

19