Communication Systems

Introduction and Organization

University of Freiburg
Computer Science
Computer Networks and Telematics
Prof. Christian Schindelhauer
General Information

- Winter course: 10/21/2008 - 02/13/2009
  - Prof. Dr. Christian Schindelhauer
  - Arne Vater
- Lecture
  - Tuesday, 11-13, 051-00-034
- Practical experiments
  - Wednesday, 11-13, 082-00-029
Course Information

- 6 credit points (ECTS)
- **Bachelor**: oral exam (by appointment)
  - Lecture in the area of specialization (advanced level)
- **Master**:
  - written exam (default)
  - oral exam (on demand)
  - Area of specialization: Communication and Databases
  Master/Diploma: mid level course
Sources

- Thanks to Prof. Gerhard Schneider
  - for the slides, the lecture and all resources to produce this lecture
- Find online lectures of last semester
  - http://electures.informatik.uni-freiburg.de/portal/web/guest/detail/-/moduldetail/view/206/4601/3701
Course Information

- Extends the Systems II lecture of the Bachelor program

- Sources of information
  - Past lectures: electures.informatik.uni-freiburg.de
  - Literature hints
  - Forum
Course Table

Computer Networking

- Networks I: Systeme II (summer)
- Network II: Communication Systems (winter)
- Specialization in Networks (summer)
  - Mobile Ad-Hoc Networks
  - P2P Networks
  - Internet Security
  - Telematik IV
- Team-Projects (winter)
- Seminars
Lecture Layout

- Interactive, online & experimental
  - In depth discussion of selected topics
  - Theory followed by hands-on experiments
  - Web-form
  - Hands on exercises
    - mandatory and experimental
Q&A

- Experience
  - „Systeme II“ attended?
  - Bachelor completed?
  - Other lectures in Networking?
  - Network operator of private/company LAN
  - Experienced in IP LAN configuration?
  - Linux experience?
  - Experience with virtualization?
Syllabus and Scope

- **3 Parts:**
  - I. Communication in IP networks
  - II. Security issues in networking
  - III. Digital telephony networks and voice over IP
- **Presentation of protocols and concepts**
  - with detailed experimentation of some of them
- **For timely and accurate details see forum**
First Part

- Introduction, simple IP networking
- Internet Protocol and Ethernets
- Ethernet and its Extensions like VLANs
- Address Resolution Protocol and its weaknesses
- PPP and PPPoE
- IP address assignment: Auto IP and DHCP
- Next Generation IP (IPv6)
- General IP routing
- Introduction into dynamic routing protocols
- Dynamic IP routing (IGP/EGP)
Second Part

Security

- Firewalls
- Quality of Service
- Deep Package Inspection
- DNS and weaknesses
  - Packet tunneling over DNS and other applications
- Secure tunnels on application level with SSH
- SSL/TLS (in)security
- IPsec, IKE
Third Part
VoIP

- GSM, UMTS
- Data connections
  - GPRS, EDGE, HSDPA, ...
- Voice digitization and quality of service
- SIP and H.323 and its challenges in more complex setups
Course Material

- All material available as download
  - slides, exercise sheets, packet sniffing examples, selected texts
- Web-page
  - http://cone.informatik.uni-freiburg.de/teaching/vorlesung/communication-systems-nw-ll-w09/
- Forum (capture: Schindelhauer)
  - Important announcements
- Reply on forum
Communication Systems

Introduction
Copyright Warning

- This lecture is already stolen
- If you copy it please ask the author
  - Prof. Dr. Gerhard Schneider
- like I did
Literature

- **Kurose & Ross**
  - Computer Networking
- **Douglas E. Comer**
  - Computer Networks and Internets
- **Andrew S. Tanenbaum**
  - Computer Networks
- **Patterson & Davie**
  - Computer Networks, A Systems Approach
- **R. Stevens**
  - TCP/IP Illustrated Vol. 1
Literature

- **Other texts**
  - RFC (request for comment)
    - documents on Internet standards
  - ACM and other journals articles on selected topics ...

- **Books**
  - E. Pehl, Digitale und analoge Datenübertragung
  - Flaig, Hoffmann, Langauf: Internet-Telefonie VoIP mit Asterisk und SER
  - Sinnreich, Johnston: Internet Communications using SIP
  - Hersent, Gurle, Petit: Beyond VOIP Protocols Kaaranen, Ahtiainen, Laitinen: UMTS Networks Architecture Mobility and Services

- **much more titles on VoIP, SIP, H323, ... available today**
What is the Internet

- **From**
  - a few networked machines at American university campuses
    - end of 60s, the D-ARPA
- **Ancestors**
  - Mailbox networks: Fido or Zerberos
  - Public data services
    - BTX in Germany
    - Minitel in France
    - Compuserve and AOL
- **Continuous tremendous growth**
  - scarcity of IP addresses
  - regular warnings on congestion of the backbone infrastructure
- **From**
  - few privileged senior scientists
- **over**
  - nearly every member of a university (within ten/fifteen years at least in developed countries)
- **to**
  - each person of this planet ?
- **onto**
  - each appliance ?
Participants of the Internet

- **From**
  - few host names and domains handled in a flat file
- **to**
  - multi-million top level domains like .com, .de
    - (second largest domain in the world with several million entries)
- **(Non)-profit services**
  - e.g. internic.net and denic.de

- **Participants**
  - (web/mail/…) servers
  - Workstations
  - Laptops, netbooks, tablet PCs
    - Multipurpose home and small offices router, gateway devices, NAS
    - Mobile phones
    - PDAs
    - Set-top boxes
    - Game consoles
    - Power switches and refrigerators, …
BelWue

- Our university’s outside connection
- Network connecting universities and colleges in south-west of Germany
  - Blue: 10GBit/s
  - Black 1Gbit/s Ethernet
  - Green (leased line): 2.4Gbit/s
  - Red 622Mbit/s
  - Purple 622Mbit/s backup links

You are here
DFN (B-Win)
2 Mbit/s Backbone (1996)

You are here
DFN
G-Win: successor

You are here
Exercise

- **Mandatory**
  - mini-groups will be in charge of supervising an exercise
  - Register today on the forum
  - and personally tomorrow

- **Please...**
  - read suggested literature
  - ask questions

- **Literature**
  - Any of the given textbooks – introductory chapters
  - Homepages of BelWue, DFN, GEANT(2)
  - On packet and circuit switching: Kurose/Ross
Homework

› Repeat:
  • protocols, protocol stacks
  • standards like ISO/OSI, TCP/IP models
  • end systems and network core

› Network taxonomy
  • Packet versus Circuit switching
  • Message switching

› Different Service Models
  • Client-server versus peer-to-peer networking

› Basic IP networking
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