



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

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

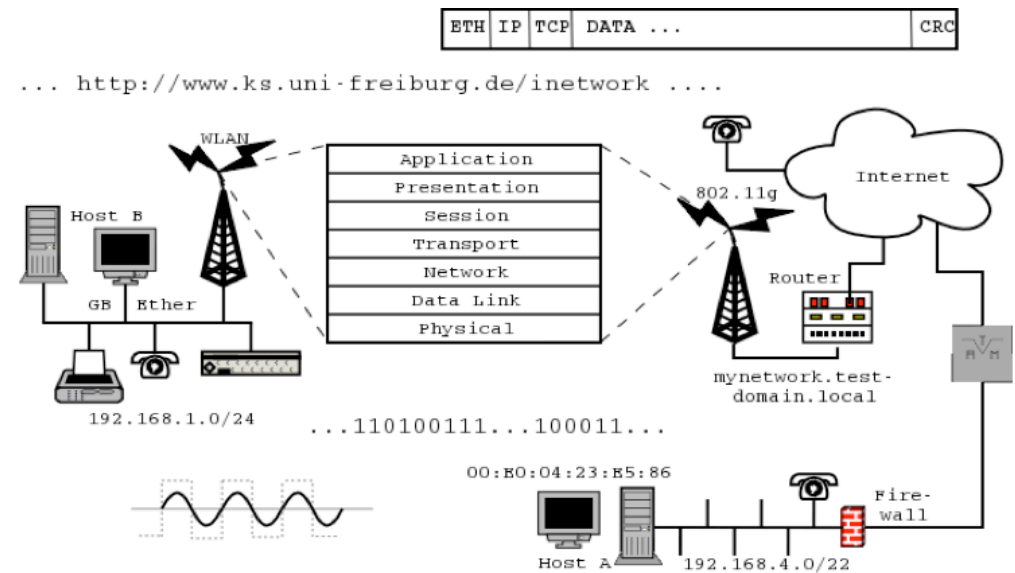
Course Information

- ▶ **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 DatabasesMaster/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>

Layout of the lecture



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
 - <http://cone.informatik.uni-freiburg.de/forum/viewforum.php?f=37>
 - 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-II-w09/>
- ▶ **Forum (capture: Schindelhauer)**
 - <http://cone.informatik.uni-freiburg.de/forum/viewforum.php?f=37>
 - Important announcements
- ▶ **Reply on forum**



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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

▶ to

- a nearly worldwide ubiquitous computer network

▶ 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

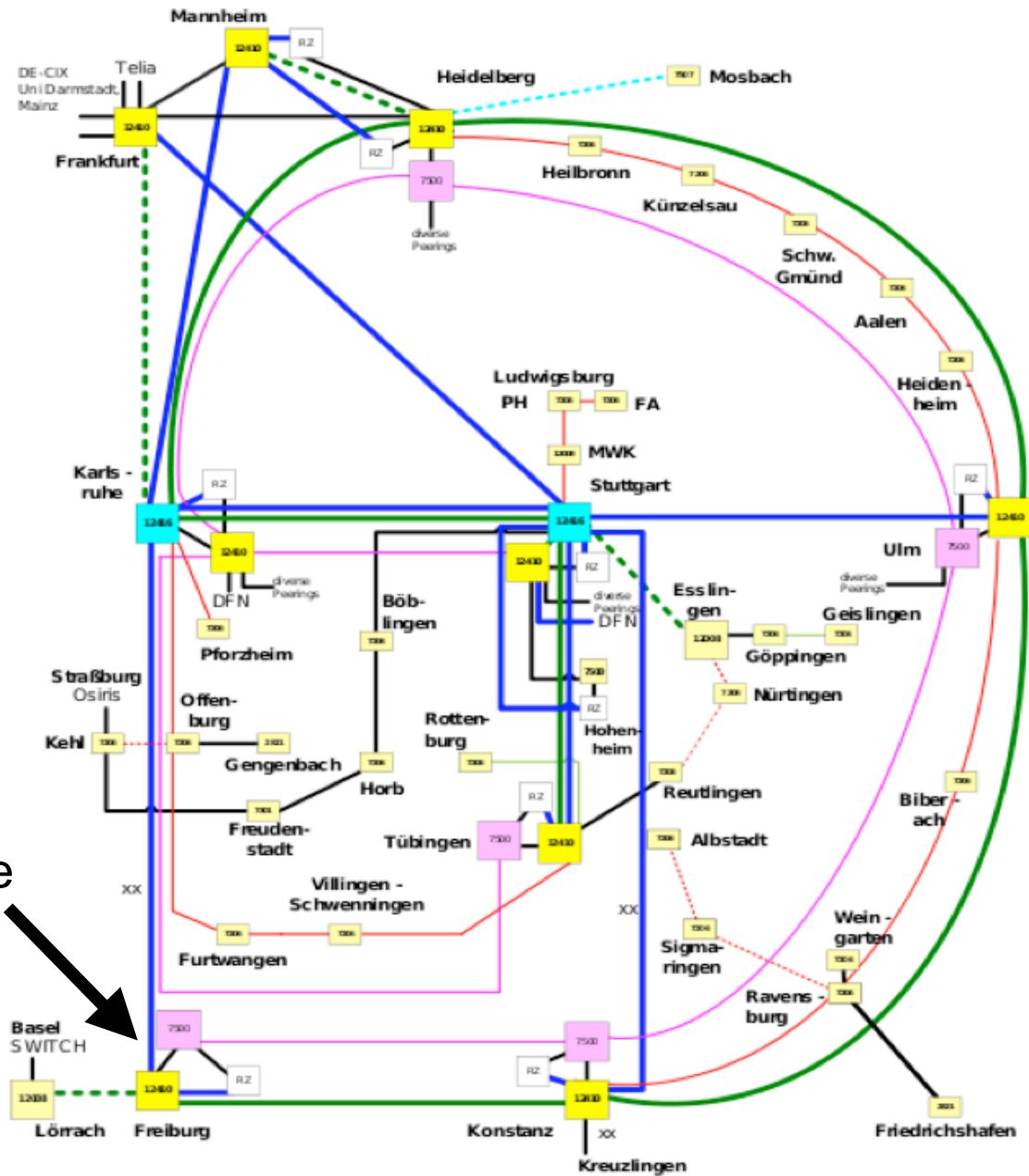
- (web/mail/...) servers
- Workstations
- Laptops, netbooks, tablet PCs
 - Multipurpose home and small offices router, gateway devices, NAS
 - Mobile phones
 - PDAs
 - Set-top boxes
 - Game consoles
 - Power switches and refridgerators, ...

BelWue

- ▶ Our university's outside connection
- ▶ Network connecting universities and colleges in south-west of Germany

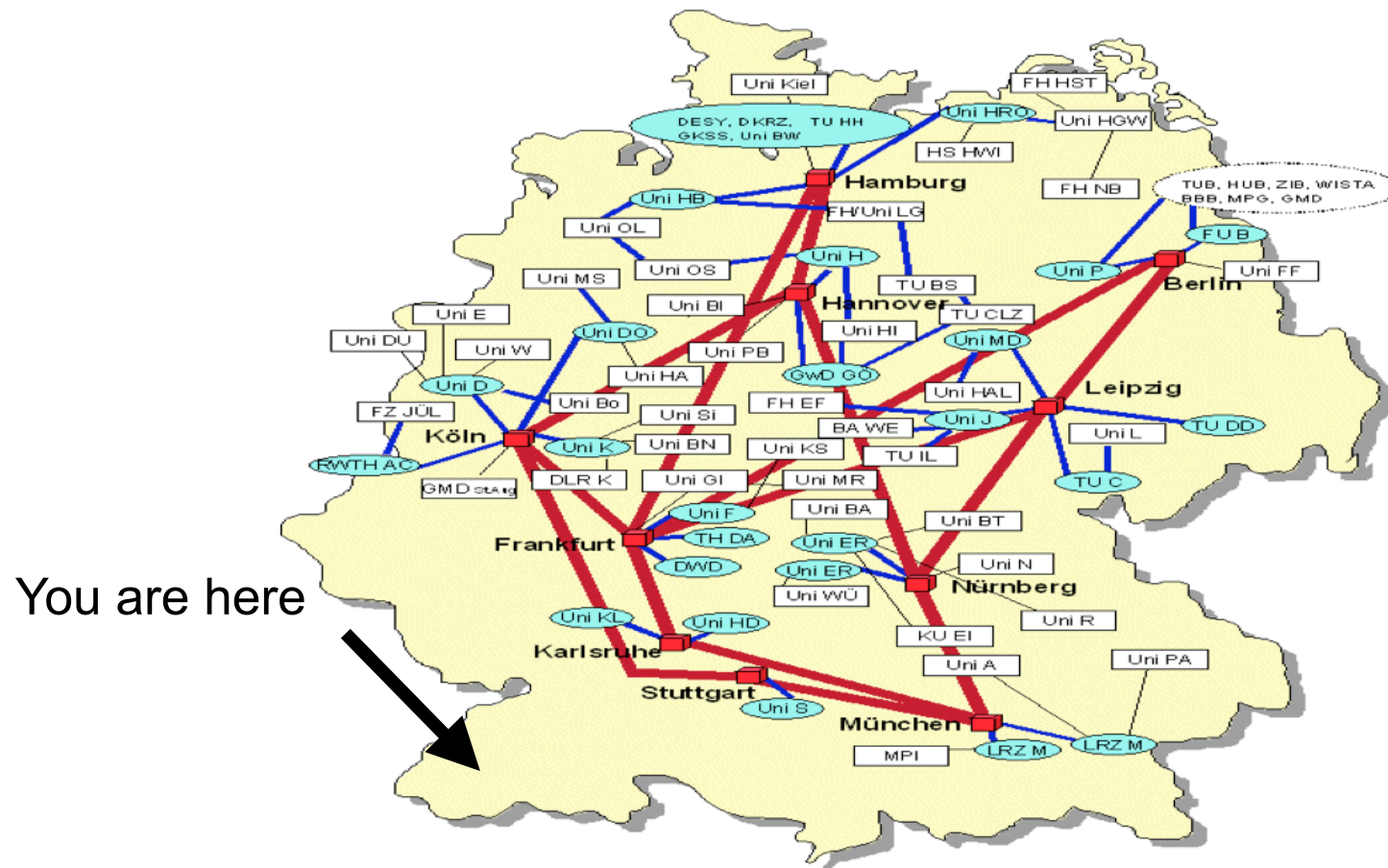
- Blue: 10Gbit/s
- Black 1Gbit/s Ethernet
- Green (leased line): 2.4Gbit/s
- Red 622Mbit/s
- Purple 622Mbit/s backup links

You are here



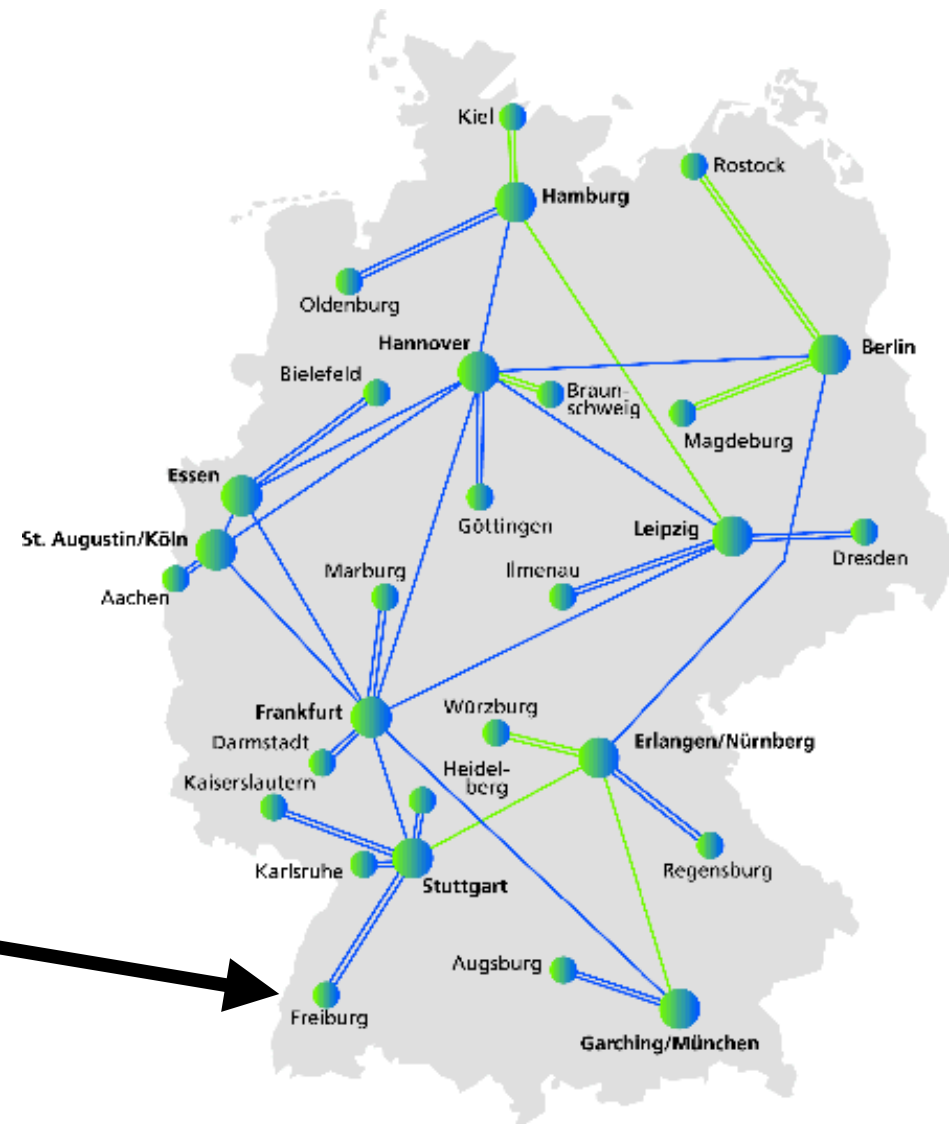
DFN (B-Win)



2 Mbit/s Backbone (1996)





DFN G-Win: successor

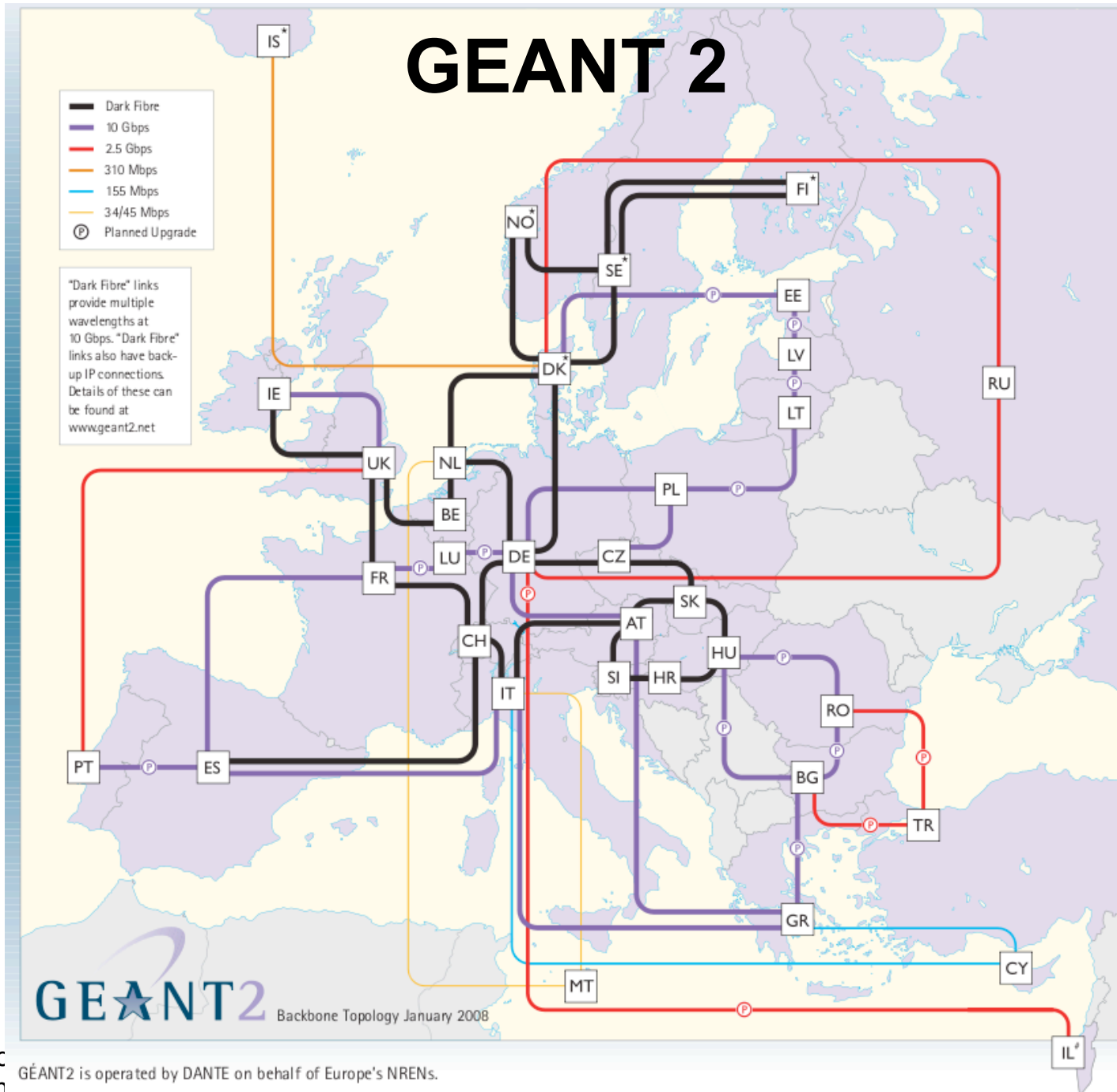
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-  Kernnetznoten mit aggregiertem Verkehr zugeordneter Kernnetznoten
-  Kernnetznoten

-  STM1-Verbindung
-  STM4c-Verbindung

GEANT 2



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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