Network Infrastructures for Research – Where are NRENs today and where should NRENs go? - A view from DFN -

Vienna, 20th anniversary ACONET,
June 2010

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DFN organisation as an example for an NREN in Europe

DFN Facts

DFN organises the X-WiN communication infra-structure for the research community in Germany:

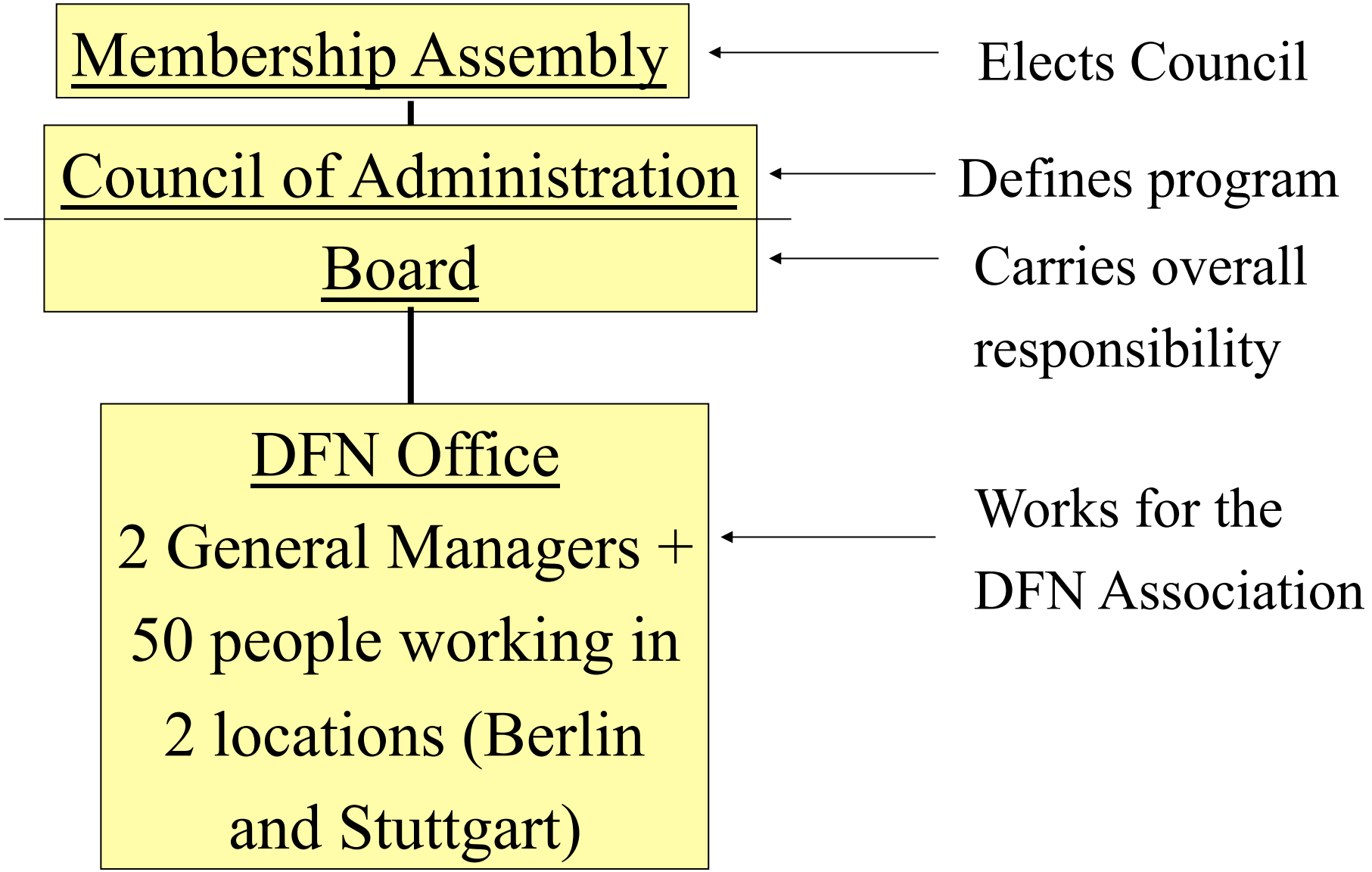
- More than **700 accesses** from universities, colleges and research institutions are connected to DFN‘s X-WiN.
- About **3 million students and researchers** use the network for their work.
- About **10.000 kilometer of dark fiber**
- DFN is not static but continuously developing services **driven by demands of the users**.
- **Demands** are: high bandwidth (up to 20 Gb/s), QoS (no packet losses), high reliability (100 %), high security, reasonable prices.

Organisational features

DFN: registered non-profit association with about 330 members:

- **founded** in **1984**
- only **institutional members** (universities, MPG, FhG, Helmholtz, Leibniz etc.)
- **Members govern DFN**
- **DFN represents** interests of the **German research community in Europe** and in Germany.
- **Yearly turnover ca. 40M€**

Organisational Structure of DFN



DFN‘s Services and Technology

X-WiN-Topology

Fibre Structure

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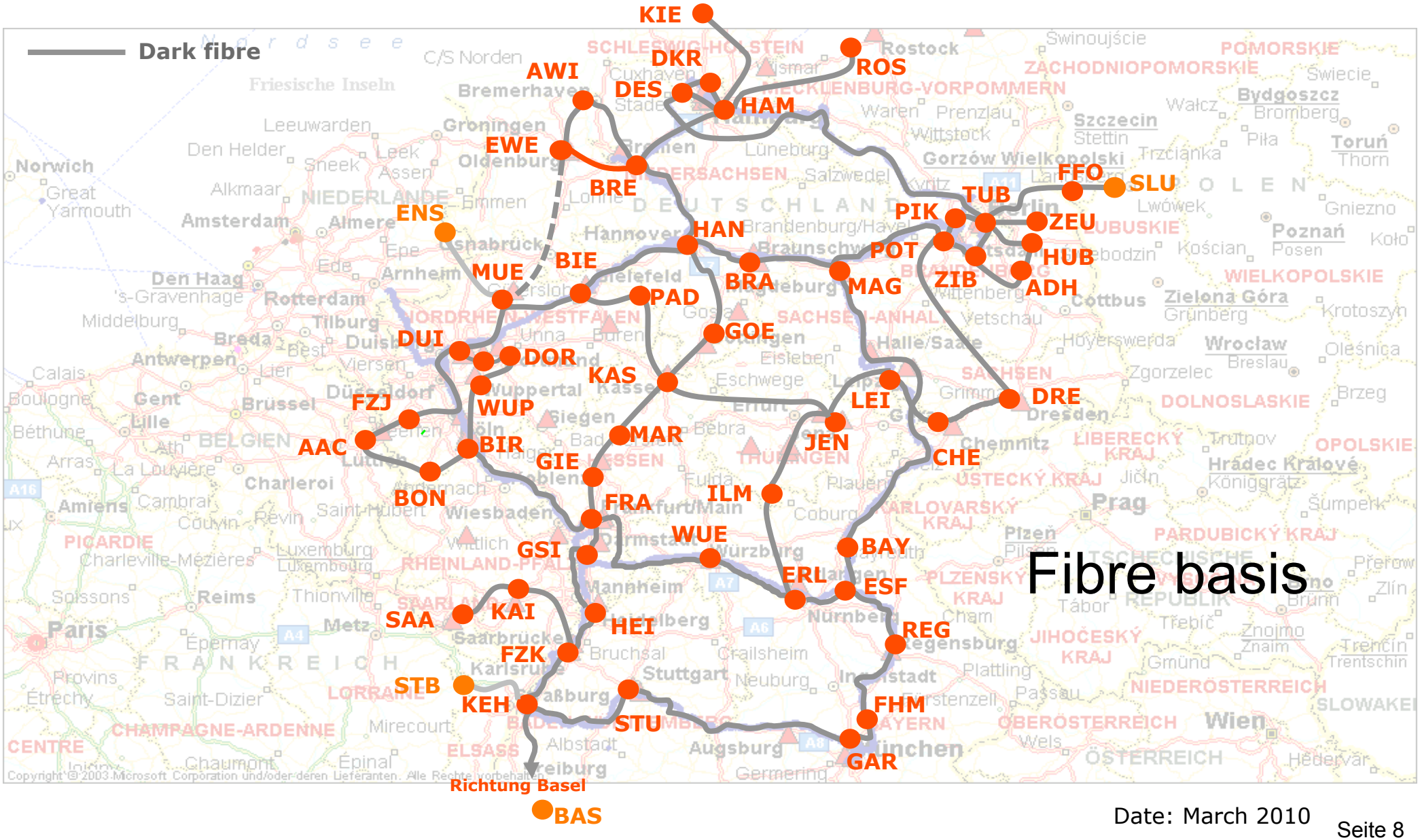

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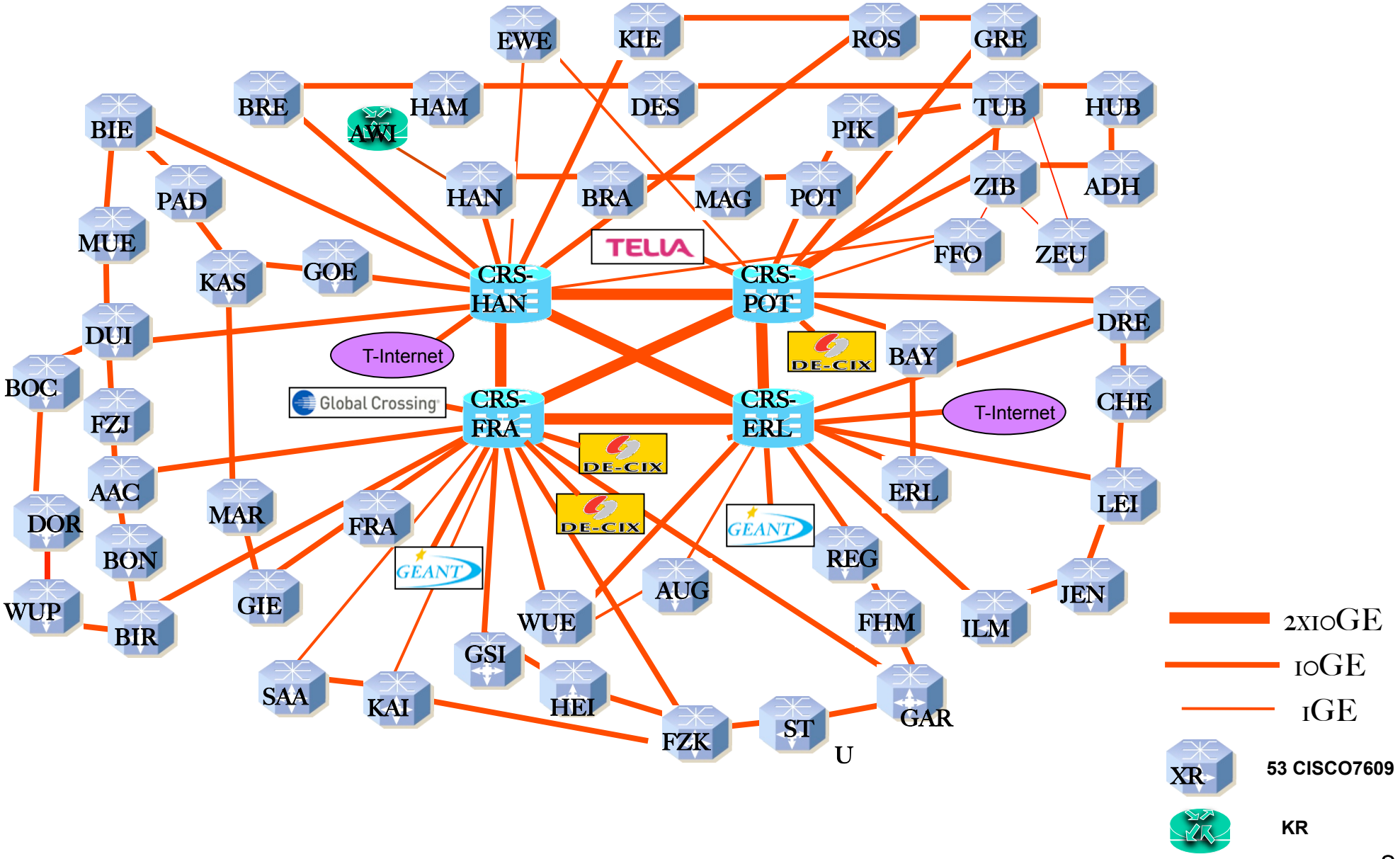
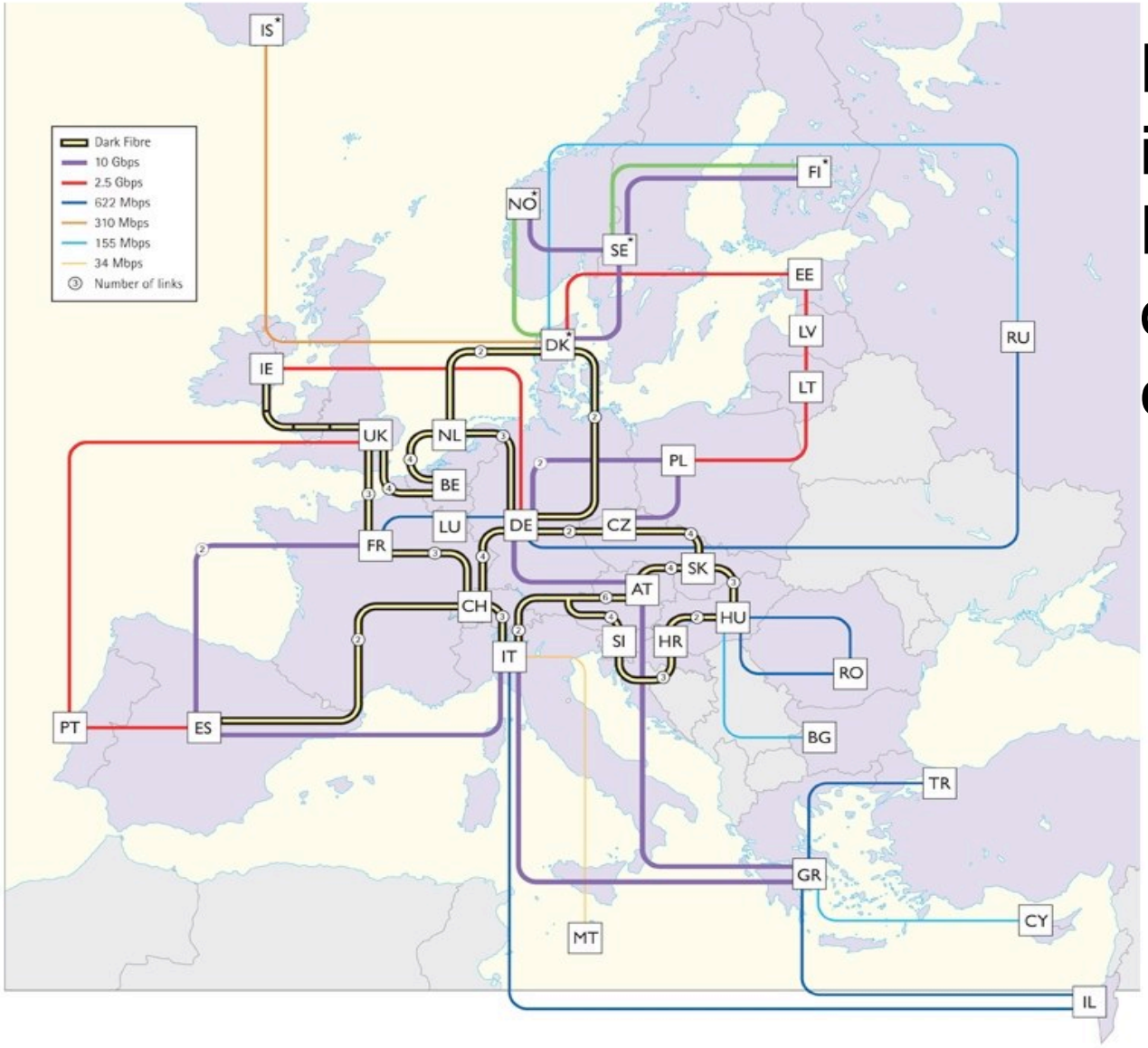
Date: March 2010

IP-Plattform: Juni 2010



Global connections



DFN has „outsourced“ intl. connectivity to DANTE in the context of the NREN consortium

Services

General aspects:

- all services conform with the demands of the community
- make life easier for the member institutions
- operate common service components centrally
  - very high expertise and skills
  - expensive equipment can be used by many
- member institutions can concentrate on local needs

Services - Examples (1)

DFN-CERT: Emergency Response Team

- prevention of security incidents (advisories, patches)
- incident handling - support when something has happened (telephone, email)
- automatic alert messages (if certain IP-numbers seem to be compromised)
- workshops and tutorials
- national and international cooperation
- Projects like DDoS detection

Services - Examples (2)

DFN-PKI: Public Key Infrastructure

- DFN-Policy Certification Authorithy (DFN-PCA)
- member institutions can outsource their own certification authorities (outsourcing because service provisioning needs highly skilled staff and expensive equipment)
- registration and identification are organised locally
- very well accepted

Services - Examples (3)

DFN-VC: Video Conferencing

- Video conferencing with many participant using a diversity of systems
- provision of several DFN Multipoint-Control-Units (MCUs)
- international connectivity based on GDS and worldwide gatekeeper structure
- easy to use interface
- telephone hotline and tutorials for administrators

Services – Example (4) IP reliability

- outages are identified on the basis of „service requests“ (...ITIL...) and evaluated
  - Automatically generated when failure occurs
  - Additional monthly (manual) reviews in the context of the permanent quality control
- Announced maintenance will be counted as outage, if it touches the availibility of the DFNInternet Service

Services – Example (4) IP reliability contd.

- Permanent quality control (fully transparent to users) of DFNInternet service
  - Offer „double access“ since 2009 (for the same price)
  - Main investment of DFN

- ca. 150 user institution have ordered double access

Services – Example (4) IP reliability contd.

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Access	Operation total [min]	outages [min]	Average Availability [%]	Average service disruption [min]
single	186.005.850	55.311	99,970	156
double	44.287.950	338	99,999	4
total	230.293.800	55.649	99,976	127

Services – Example (4) IP reliability contd.

Optical platform based services

- Toolbox for the provision of
  - DFNInternet (2Mbps to 10 GE)
  - VPN-Services based on optical links
  - services like DFNVC, DFNPKI, DFN-CERT, DFNRoaming, DFNNews etc. unchanged
- New cost structures for optical networks enable economic solutions for specialised services (Optical Private Networks / OPNs) i.e. Grids

The next (5 – 10) years

Big International Projects

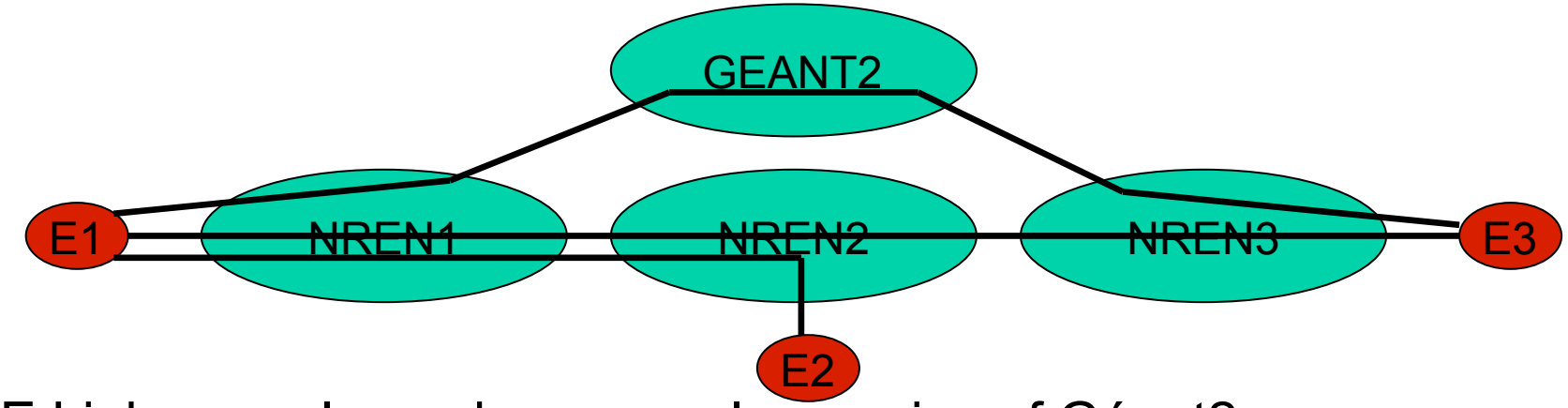
- Number of such projects will drastically increase
- Example is LHC (-> successful role of NRENs and Geant for LHCOPN)
- Increasing requirements:
- Large data volumes to be distributed to several sites in different countries

Technological Challenges

- Most of the big projects have the LHC characteristics: many organisations in many countries and high data transfer demands to be served via VPNs with reserved high bandwidth
- Multi domain technology is THE key for (our) success i.e.:
  - Rapid setup times of broadband links in a multi domain environment
  - Stable operation of such links with high availability (i.e. infrastructure!)

VPN Building Blocks: Model E2E Links

- E2E Links are dedicated optical multi-gigabit connections
- Essentially P2P links, usually using SDH/SONET or Ethernet



- E2E Links are planned as a regular service of Géant2:
  - Cooperation of several NRENs needed to operate E2E Links
  - Users need Single Point of Contact (SPOC)

⇒ E2E Link Coordination Unit (E2ECU) brings together Users and NRENs during operations

More refinement in workflow organisation needed!

Technological Forecast (1)

- **Bandwidth**:
  - Most accesses will be Ethernet based
  - GE access will be the standard for Internet access.
  - Big user sites will use 10GE access.
  - 40G/100G will be used in mainly in the core as a multiplex tool.
  - 100GE within the next 2 years in operation (several problems to be solved but no main technological problems on the optical layer)

Technological Forecast (2)

- **Bandwidth provisioning**: difficulty nr. 1 in the past but no major technical problem in the future. Systems for efficient provisioning of bandwidth in multi-domain environments including workflow management must be developed.
- **VPNs and classical Internet service**: VPNs will have an increasing importance This process will be evolutionary. The relevance of a generic IP service for research will be high in both national an European research communities.

Technological Forecast (3)

- **Grids/Clouds**: such systems will drive VPN technology. (Examples: LCG - VPN, DEISA, Jive, LOFAR...)
- **Monitoring**: no cross-domain VPN can be operated „in the dark“ – clear need to develop monitoring tools
- **Netaccess**: need for easy access to networks (key: Roaming and „federated access“) must be followed.
- **Security**: Security Tools and sites („CERTs“) must be continously developed further.

Organisational Challenges

- Typical demand is „one-stop-shopping“ in both technical and financial respect.
- Presently not very popular amongst NRENs
- DFN‘s prognosis is that unless consortium gets more flexible it will not always convince the users. And users are not forced to buy through NREN consortium!

The European Scenario

Why Research Networks and DANTE?

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- Science and Research have requirements for data communication, which are not met by the general (commercial) internet providers:
  - high data transfer requirements (qualitatively different from what the market can provide)
  - high volume
  - high percentage of international traffic
- In most countries, National Research and Education Networks (NREN) organise infrastructures for research and education
- NREN consortium and DANTE exist since a long time and deliver until now useful results