Connect. Communicate. Collaborate

The Future of Research Networking in Europe

- Technical and Organisational Challenges -

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Technical Challenges

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Some Definitions

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- VPN: **V**irtual **P**rivate **N**etwork - a „user-owned network“ which is built from a basic technical platform (IP / SDH / DWDM...)
- OPN: **O**ptical (Virtual) **P**rivate **N**etwork - a VPN based on optical technology
- Hybrid Network: Router based network using a VPN / OPN as a platform

Forecast (Communication Market)

- (1) liberalisation of the communication market in all European countries will continue and will decrease the „digital divide“ (or the economic conditions for that divide)

Example 1: X-WiN (typical NREN as of 06/06)

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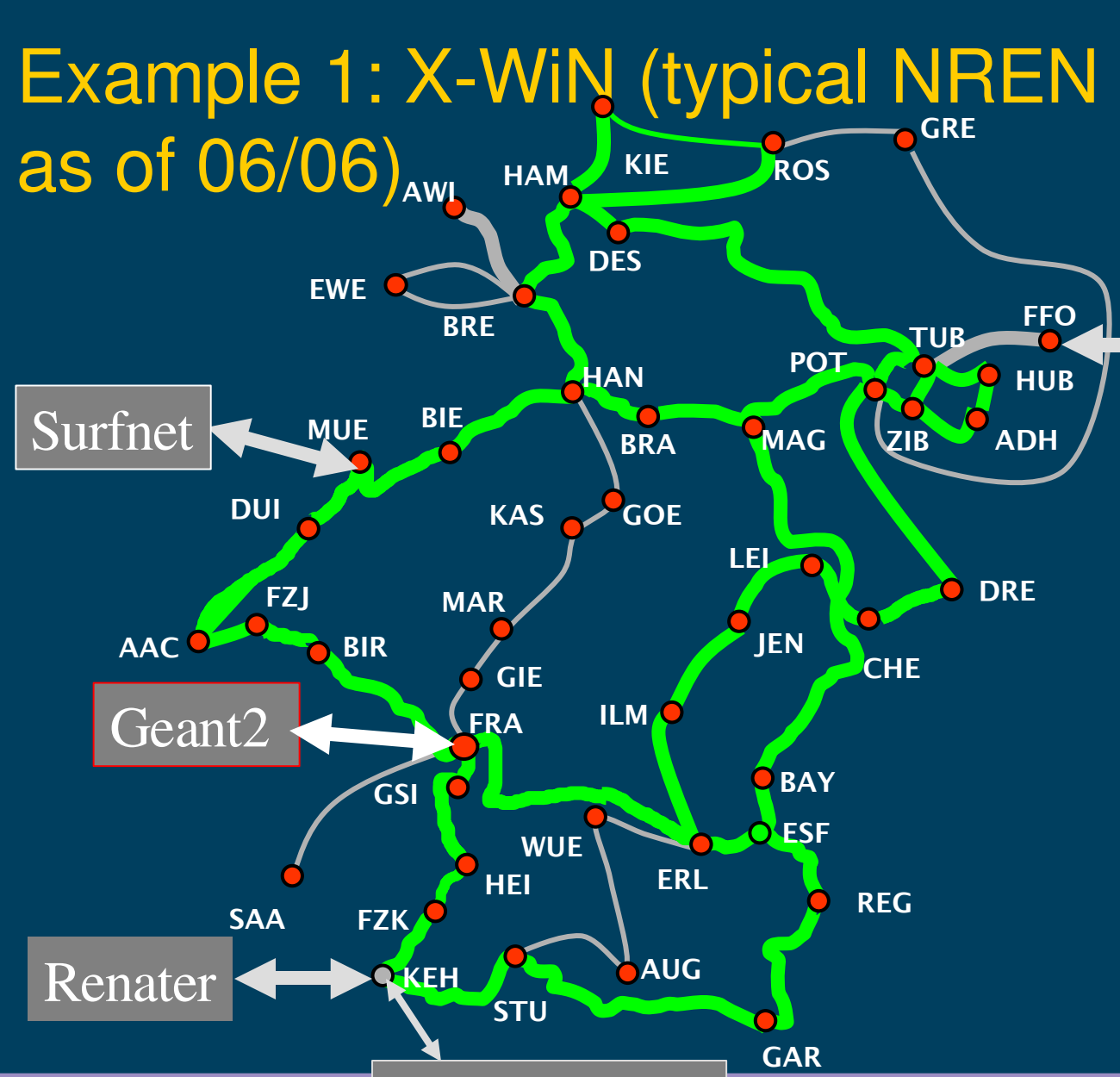

CBF
DFN PoP
Dark fibre
Wavelength

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Example 1: X-WiN as a hybrid network

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- Platform for a couple of national VPNs/OPNs and for the national part of intl. VPNs/OPNs
- Was possible due to lively fibre market in Germany
- Optical technology delivers ample bandwidth, i.e. 160*10G per link
- Costs per 10G link are relatively low (as in Geant2) - in the order of 30K€/a for 10G

Conclusion 1

Bandwidth, which has been the major problem for any research networking over the past decade will not be a major problem in the future

Forecasts (VPNs/OPNs)

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- (2) VPNs/OPNs will in a few years carry the bulk of scientific data in European networks (NRENs/Geant) and also worldwide

- (3) Migration to that scenario is an evolutionary (rather than a revolutionary) process defined by user group´s needs and available network technology

Forecasts (Role of Grids)

- (4) Grids will be a major driver for the VPN migration scenario process (example LCG-OPN... see special overhead)

- (5) Grid infrastructures have commonalities with network infrastructures but are different as well

Forecasts (Role of Grids contd.)

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- (6) Networking technology developments like network management (example: monitoring of VPNs/OPNs) or network security are still needed for serving „Grid infrastructures“

Example 2: LCG OPN in Europe

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- T1-T0 primary connection for „GN2 fibre cloud NRENs“ through Geant2; T1-T1 secondary connection on separate fibre paths through other fibre. Secondary connections provide resilience

- OPN approach; high data volume expected, Grid middleware driving this appraoch; „low“ prices (due to liberalized situation per country) makes it possible

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Geant2 topology as of 09/06

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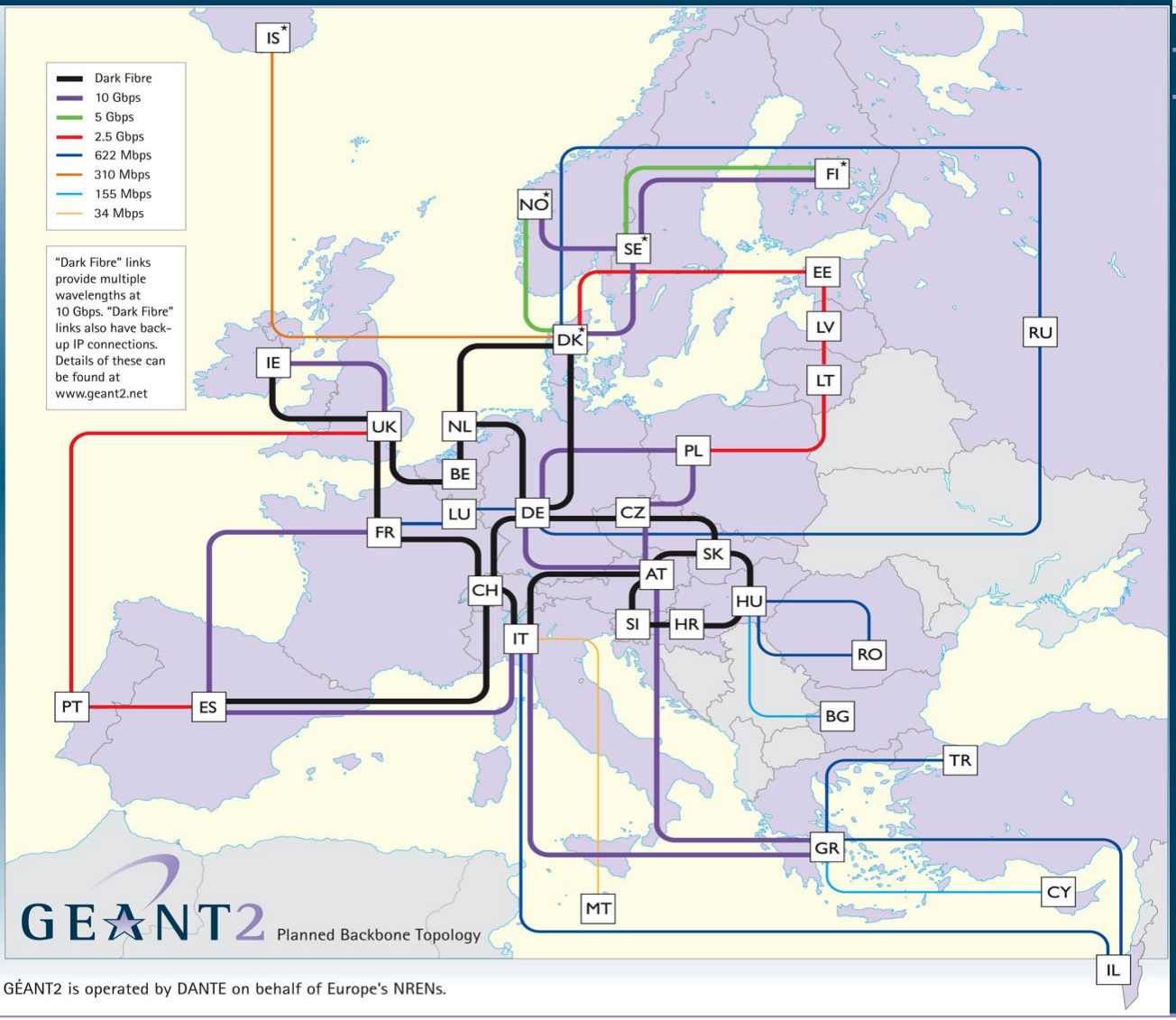

GÉANT2 is operated by DANTE on behalf of Europe's NRENs.

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LHC TIER*0* – TIER*1* OPN, scenario based on work by *R. Sabatino* DANTE

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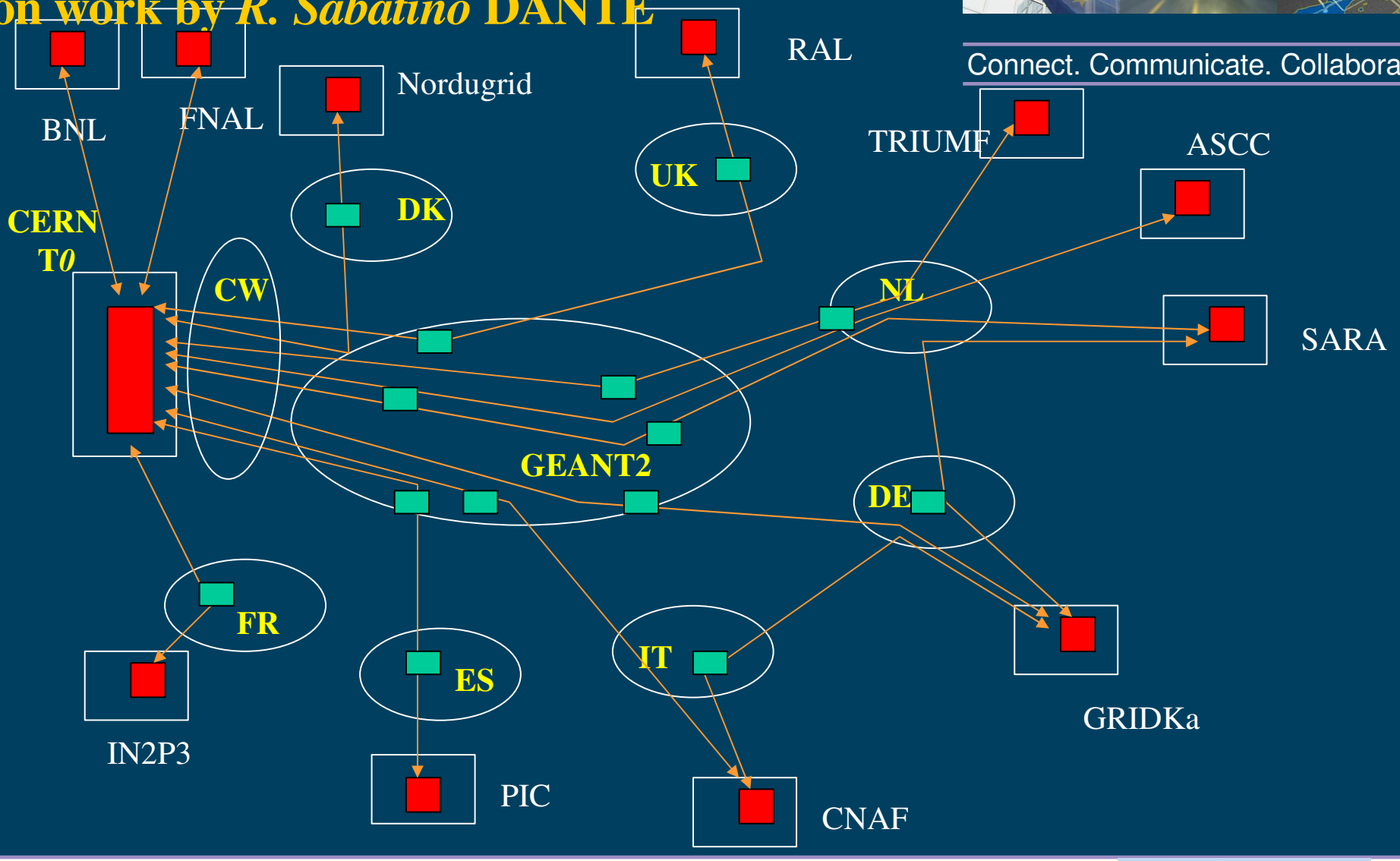

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Conclusion 2

- Developments for future network technology have to be done in close cooperation with advanced user groups, specifically those using Grid technology

Forecasts (transmission technology)

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- (6) On a per (user-) stream basis 10G will be the top-bandwidth to be used over the next 2-3 years perhaps even longer - the difficulty is to get data from / to sources / sinks at higher speeds than 10G
- (7) 40G or 100G per (user-) stream will follow.
- (8) 10G equipment will be very „cheap“

Forecasts (qualitative user demands)

- (9) The user (group) demand in the research area is in almost all cases „multi-domain / multi vendor“ in networking terms (--> see LCG example)

- (10) Users will require „intelligent networks“, i.e. network technology which adapts (at best dynamically) to their requirements

Conclusions 3, 4:

- One of the main future challenges for the developments of research networking is to further work out solutions for multi-domain environments for operational purposes

- Work started in GN2 („e2e“) but solutions have to be driven further according to developing demands for example from Grid communities

Conclusion 5:

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- Intelligent networks (i.e. „intelligent“ VPNs / OPNs adaptable more flexibly to user needs) have to be further developed in the future, i.e. VPNs „on demand“ or dynamic VPNs

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Organisational Challenges

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Governing Structure

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- Presently the NREN Policy Committee (NRENPC) is successfully governing the networking policy definition and always devised a flexible substructure (for example Exec) to adapt to management needs - the forecast is that this will be the case in the future as well

The NRENPC as of 09/06

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Austria	(ACOnet)
Belgium	(BELNET)
Bulgaria	(ISTF)
Croatia	(CARNet)
Czech Republic	(CESNET)
Cyprus	(CYNET)
Germany	(DFN)
Estonia	(EENet)
France	(RENATER)
Greece	(GRNET)
Hungary	(HUNGARNET)
Ireland	(HEANet)
Israel	(IUCC)
Italy	(GARR)
Latvia	(LATNET)
Lithuania	(LITNET)
Luxembourg	(RESTENA)
Malta	(UoM)
Netherlands	(SURFNET)
Nordic Countries – Denmark, Finland, Iceland, Norway, Sweden	(NORDUNET)
Poland	(PSNC)
Portugal	(FCCN)
Romania	(RoEduNet)
Russia	(JSCC)
Slovakia	(SANET)
Slovenia	(ARNES)
Spain	(RedIRIS)
Switzerland	(SWITCH)
Turkey	(ULAKBIM)
United Kingdom	(UKERNA)

PLUS NON-VOTING MEMBERS:
DANTE, TERENA
PERMANENT OBSERVERS: CERN, AMREJ, MARNET

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Conclusion 6: NRENPC

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- At this point in time there is no need to change that structure as it is working and flexible enough for its purpose.

Governing Structure for Grids

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- This is the **real organsational challenge** for the time to come to find an appropriate governing (?) / coordination structure for Grid computing in Europe
- Some similarities with NRENs (i.e. coordination), some non-comparable issues for example: missing central capability like Geant
- NRENs can bring in their experience for that process if needed.

Summary (1)

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- Bandwidth, which has been the major problem for any research networking in Europe over the past decade will be no longer a major problem
- Developments for future network technology have to be done in close cooperation with advanced user groups, specifically those using Grid technology

Summary (2)

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- Due to the user demands one of the main future challenges for the developments of research networking is to further work out solutions for multi-domain environments for operational purposes. Work started in GN2 („e2e“) but solutions have to be driven further according to developing demands for example from Grid communities

Summary (3)

- Intelligent networks (i.e. „intelligent“ VPNs / OPNs adaptable more flexibly to user needs) have to be further developed in the future, i.e. VPNs „on demand“ or dynamic VPNs
- Presently there is no need to change the governing structure as it is working and flexible enough for its purpose.