Next Generation Network - - a PIONIER example

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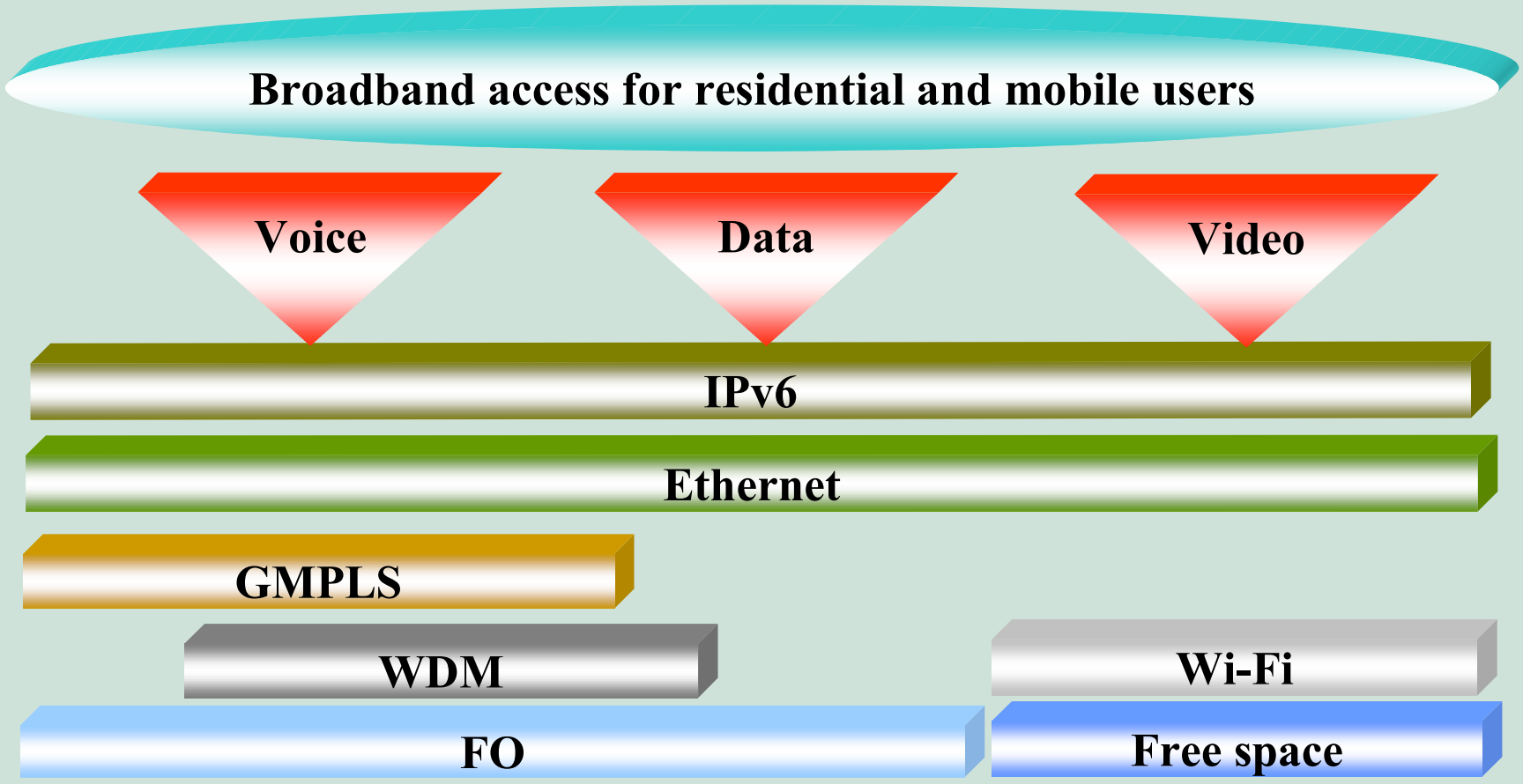
Fascination of fiber

- Used since 1990 in **buildings, campus** or **metro**
- Multi – technologies: Ethernet, ATM, POS, DWDM,...
- Cost efective solution
- Supports the advanced requirements of science
- Many implementations in academic community
  - **regional** networks: CalREN, NCNI, ...
  - **national** networks: CA*net 4, SWITCH, CESNET, PIONIER, ...

GOAL: TOWARDS ALL OPTICAL NETWORKS

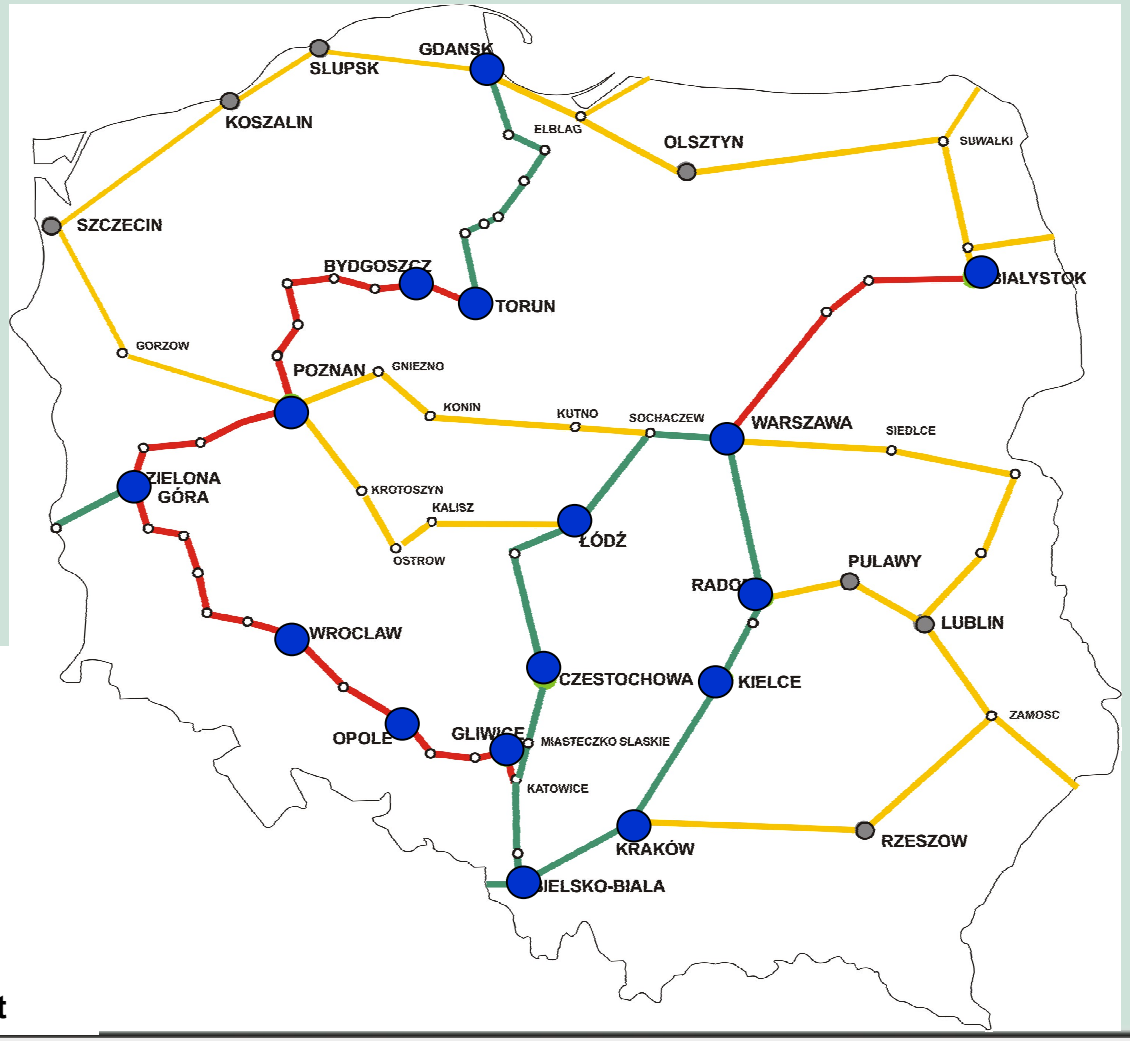
New, simple landscape for „All Optical Europe for Mobile Europeans”



PIONIER - an idea of „All Optical Network" - facts:

- 4Q1999 – proposal of program submited to KBN
- 2Q2000 – PIONIER testbed (DWDM, TNC 2001)
- 3Q2000 – project accepted (tender for co-operation, negotiations with Telcos)
- 4Q2001 – I Phase: ~10 mln Euro
  - contracts with Telbank and Szeptel (1434 km)
- 4Q2002 – II Phase: ~18.5 mln Euro
  - Contracts with Telbank, regional Power Grids Companies (1214 km)
  - Contract for equipment: 10GE&DWDM and IP router
- 2Q2003 – installation of 10GE with DWDM rep./amp.
  - 16 MANs connected and 2648 km of fibers installed
- **2004 – 21 MANs connected with 5200 km of fiber**

PIONIER fibre topology



Legend

- installed
- under construction
- planned 2003/2004
- nodes with PIONIER equipment

How we build fibers

- Co-investment with telco operators or self-investment (with right of way: power distribution, railways and public roads)
- Average of 16 fibers available (4xG.652 for national backbone, 8xG.652 for regional use, 4xG.655 for long haul transmission)
- Average span length 60km for national backbone (regeneration possible)
- Local loop contruction is sometimes difficult (urban area - average 6 months waiting time for permissions)

Community demands as a driving force

- Academic Internet
  - interational connections (2.5Gb/s now, 10Gb/s in October)
  - national connections between MANs (n x 622Gb/s now, 10Gb/s in June)
  - near future – n x 10Gb/s
- High Performance Computing Centers (FC, GE, 10GE)
  - Project PROGRESS - SUN cluster (3 sites x 1Gb/s)
  - Project SGI cluster (6 sites x 1Gb/s)
  - Projects in preparation
    - National Data Storage system (5 sites x 1Gb/s)
    - CLUSTERIX (12 sites x 1 Gb/s)
  - near future - n x 10, 40 Gb/s

Community demands as a driving force...

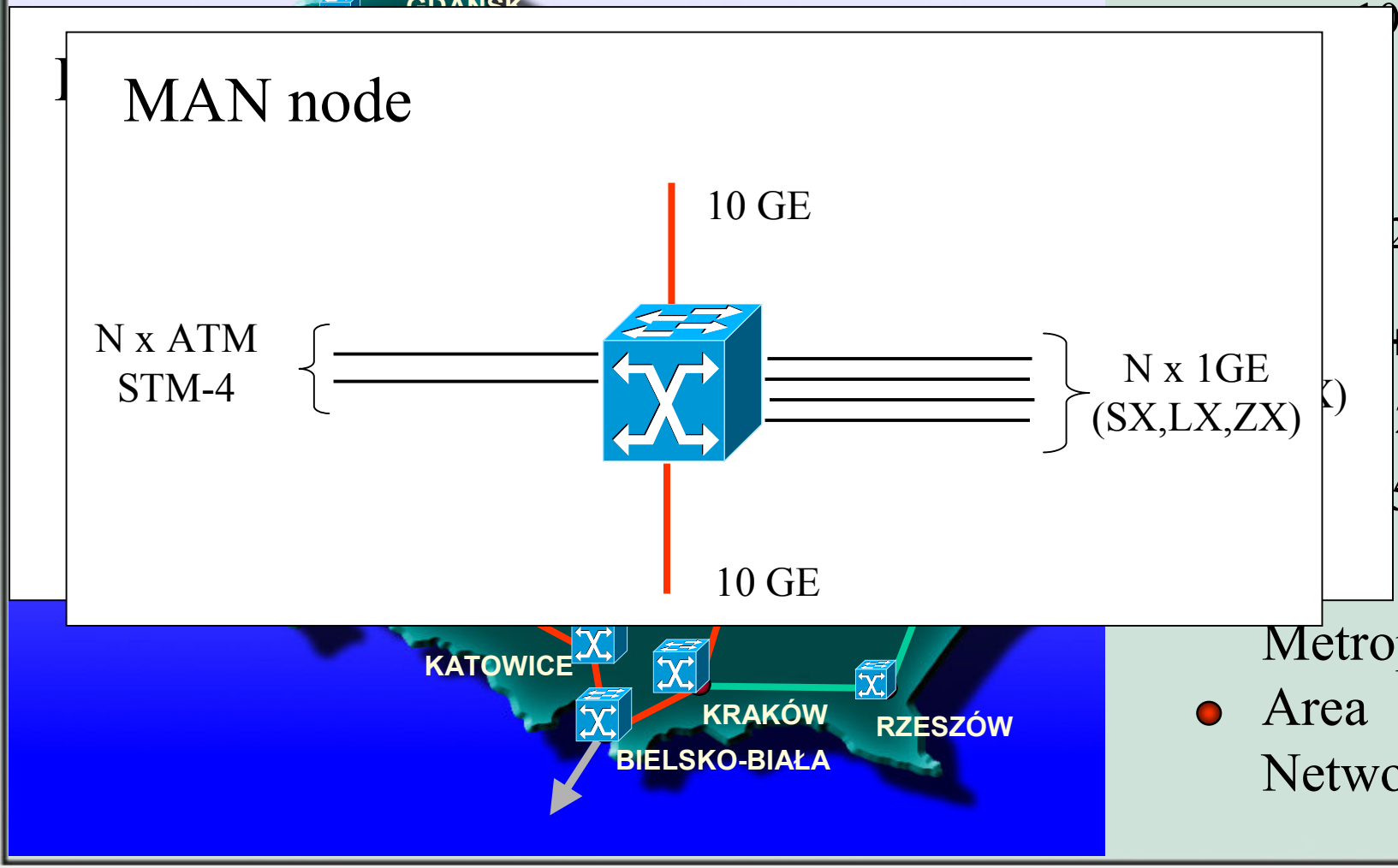
Dedicated Capacity for European Projects

- ATRIUM (622Mb/s)
- 6NET (155-622Mb/s)
- VLBI (2x1Gb/s dedicated)
- CERN-ATLAS (>1 Gb/s dedicated per site, 2 sites)
- near future – 6 FP IST

How PIONIER will adress them

- Start with 10GE over fiber as an intermediate stage (June 2003)
- DWDM System with 40Gb/s lambdas
- Optical switches with GMPLS
- Services: Optical VPN
  - Internet
  - HPC network
  - Goverment network
  - Dedicated networks for projects - ATLAS, VLBI, ...
- Access via optical MANs
- **near future: access via optical regional networks**

Intermediate stage - 10GE over fiber



OWN FIBERS

Gb/s

Gb/s

2.5 Gb/s

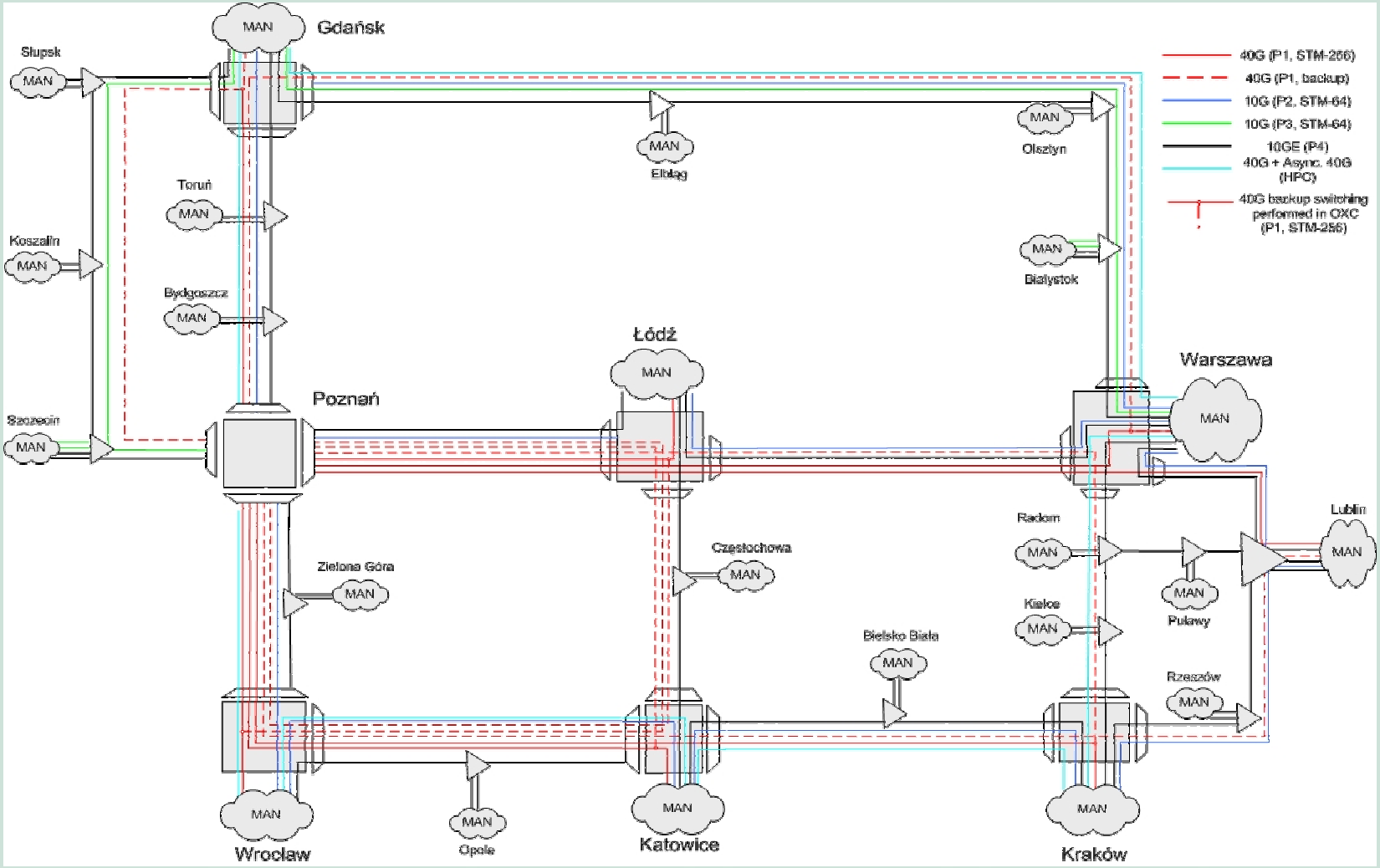
HANNELS

2 Mb/s

5 Mb/s

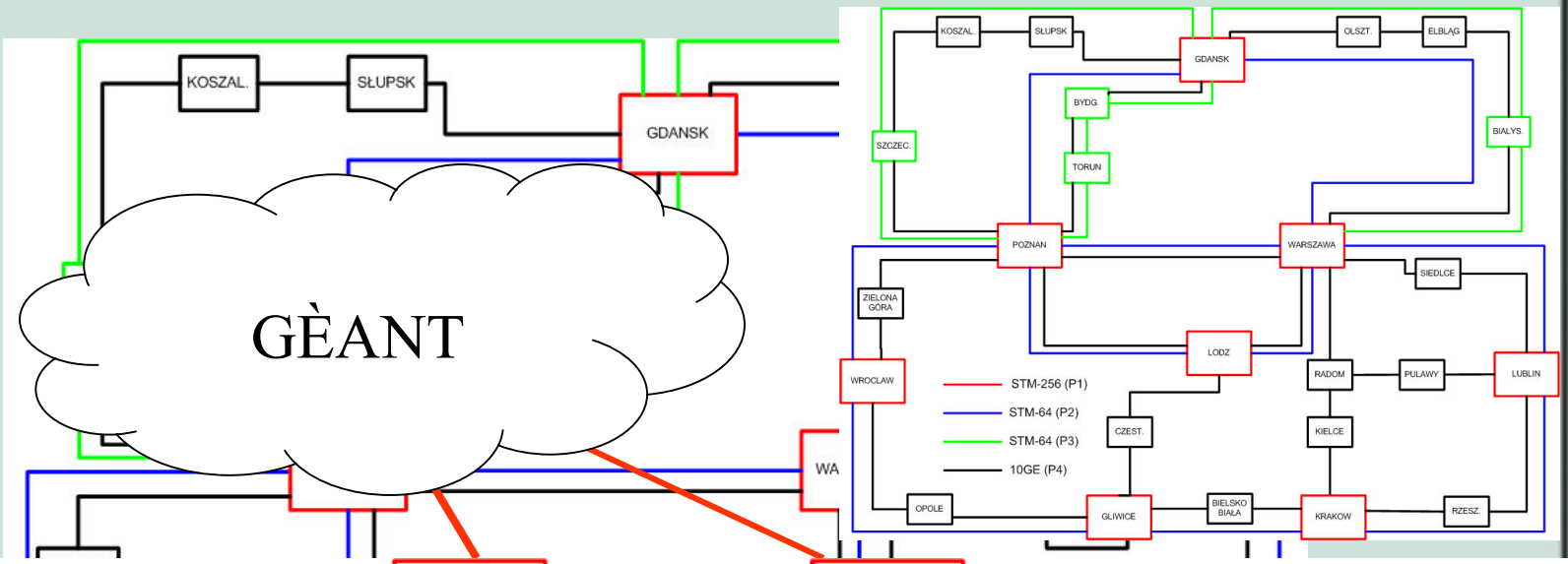
- Metropolitan Area Networks

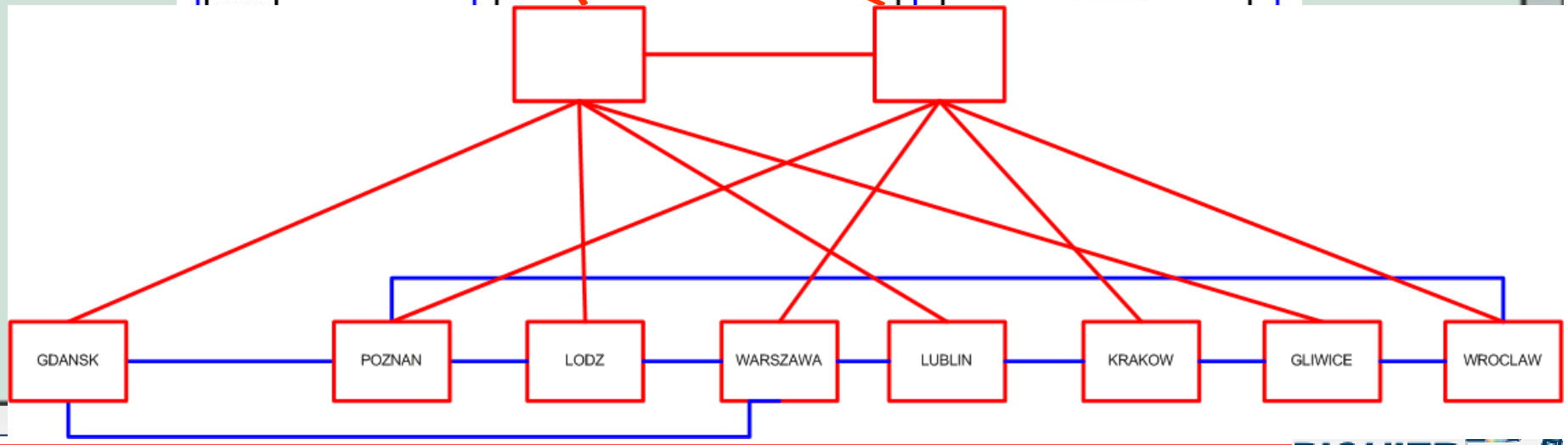
Target: multilambda network



PIONIER POLISH OPTICAL INTERNET

Academic Internet





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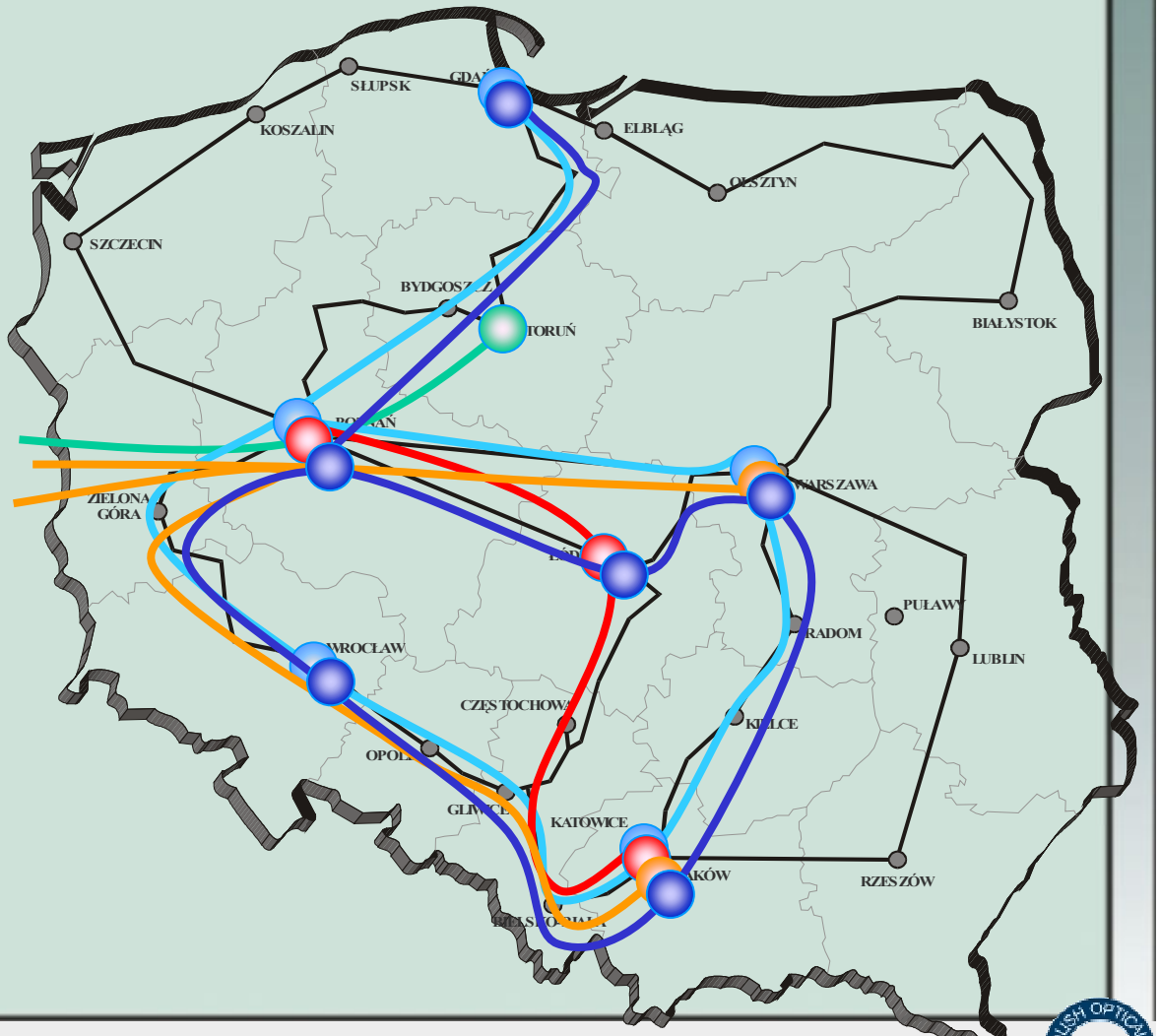
HPC and IST projects

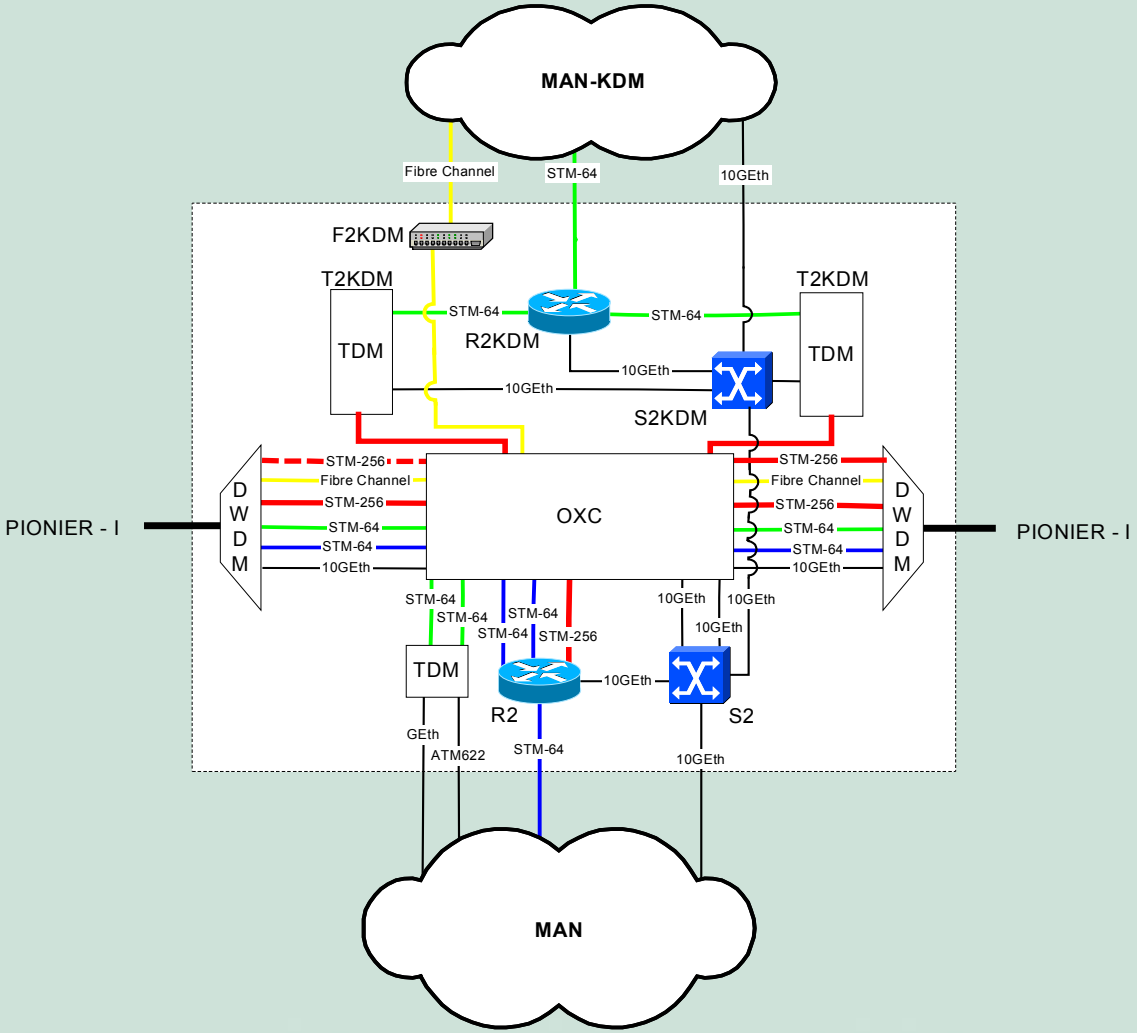
- HPC network
- PROGRESS
- VLBI
- ATLAS
- SGI (6)

OTHERS?



PIONIER POLISH OPTICAL INTERNET

PIONIER – sample lambda-PoP



PIONIER - the economy behind

Cost reduction via:

- simplified network architecture
  IP / ATM / SDH / DWDM → IP / GE / DWDM
- lower investment, lower depreciation
  ATM /SDH → GE
- simplified management

PIONIER - the economy behind...

Cost relation (connections between 21 MANs, per year):

- 622Mb/s channels from telco (real cost) : 4.8 MEuro
- 2.5Gb/s channels from telco (estimate) : 9.6 MEuro
- 10Gb/s channels from telco (estimate) : 19.2 MEuro

PIONIER costs (5200km of fibers, 10GE) : 55.0 MEuro

Annual PIONIER maintenance costs : 2.1 MEuro

Return on Investment in 3 years!

(calculations made only for 1 lambda used)

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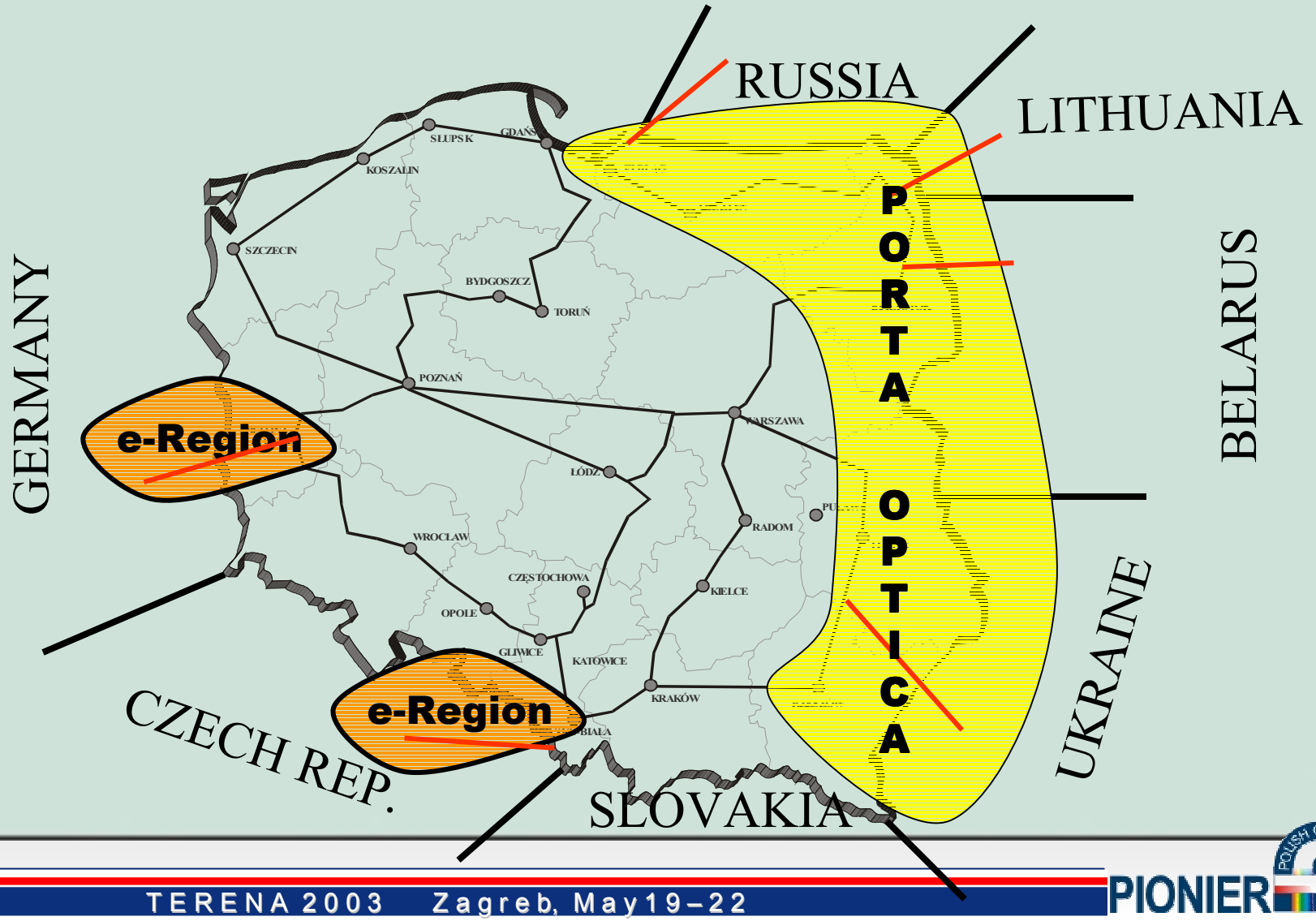
PIONIER – cooperation with neighbours



PIONIER

PIONIER – e-Region

Two e-Regions already defined:

- Cottbus – Zielona Gora (D-PL)
- Ostrava – Bielsko Biala (CZ-PL)

e-Region objectives:

1. *Creation of a rational base and possibility of integrated work between institutions across the border, as defined by e-Europe. (...) education, medicine, natural disasters, information bases, protection of environment.*
2. *Enchancing the abilities of co-operation by developing new generation of services and applications.*
3. *Promoting the region in the Europe (as a micro scale of e-Europe concept)*

PIONIER – „Porta Optica”

- „*PORTA OPTICA”* - a distributed optical gateway to eastern neigbours of Poland (project proposal)

- A chance for close cooperation in scientific projects, by the means of providing multichannel/multilambda Internet connections to the neighbouring countries.

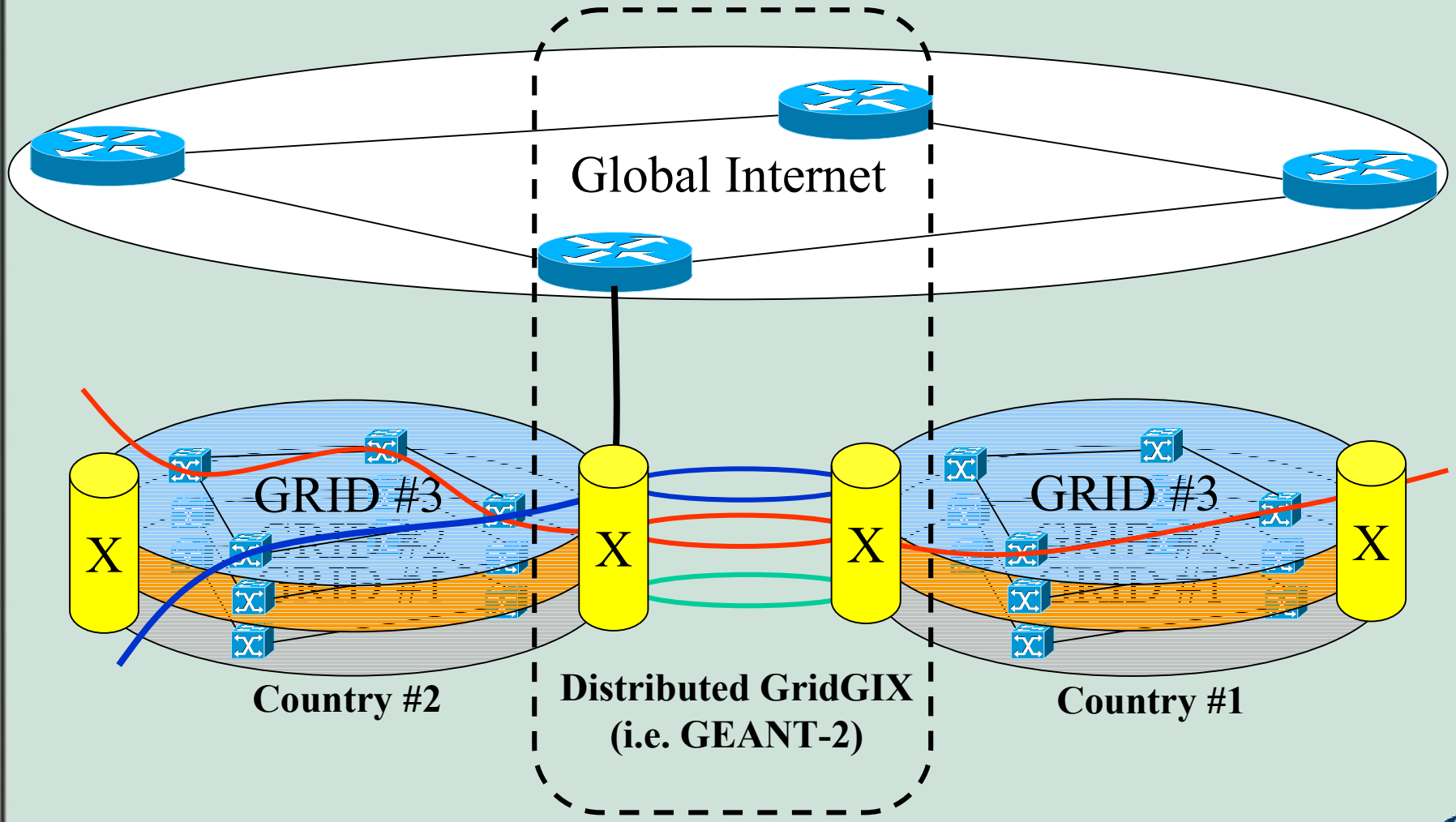
- An easy way to extend GEANT to Eastern European countries

European network for advanced services

- New generation of global value added services (GRIDs)
  - **resources all over the world**
  - **large bandwidth requirements (>1Gb/s)**
    - **dedicated core capacity**
    - **access via Internet or dedicated channel/lambda**
- Examples:
  - **TeraGRID computing and storage (TFlops & PB/s)**
  - **TV distribution GRID**
  - **xContent GRID**
- Global Internet
  - **dynamically created, n x λ between PoPs**
  - **broadband and mobile access (EFM, Wi-Fi)**

Problem: how to build networks supporting such services?

European network for advanced services



What we believe in?

1. **GEANT and NRENS should migrate to multilambda due to following facts:**
   - Emergence of Global Value Added Services (in form of specialized GRIDs)
   - Ethernet and Wi-Fi technologies will revolutionize global broadband access
2. **NRENs will embrace optical Regional and Metropolitan Area Networks – a move towards All Optical Network**
3. **Ethernet will be broadly used from first/last mile to WAN**
4. **IPv6 will be common platform for integrated multiservice (voice, data, video) network**