

GLIF Related Activities in the Czech Republic

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Presentation overview

- 1) CESNET introduction
- 2) Customer Empowered Networks Concept
- 3) Participation in GN2
- 4) GLIF related infrastructure
- 5) DWDM deployment in CESNET2+
- 6) CzechLight Amplifiers
- 7) Applications



CESNET, z.s.p.o.

CESNET (Czech Educational and Scientific Network)

- NREN in the Czech Republic

Established as legal entitie – not for profit

Association of Legal Entities (z.s.p.o.) in 1996

- 27 Universities

- Czech Academy of Sciences

54 staff members in Prague

More than 150 part-time universities and Academy of Sciences staff working on projects

Funding

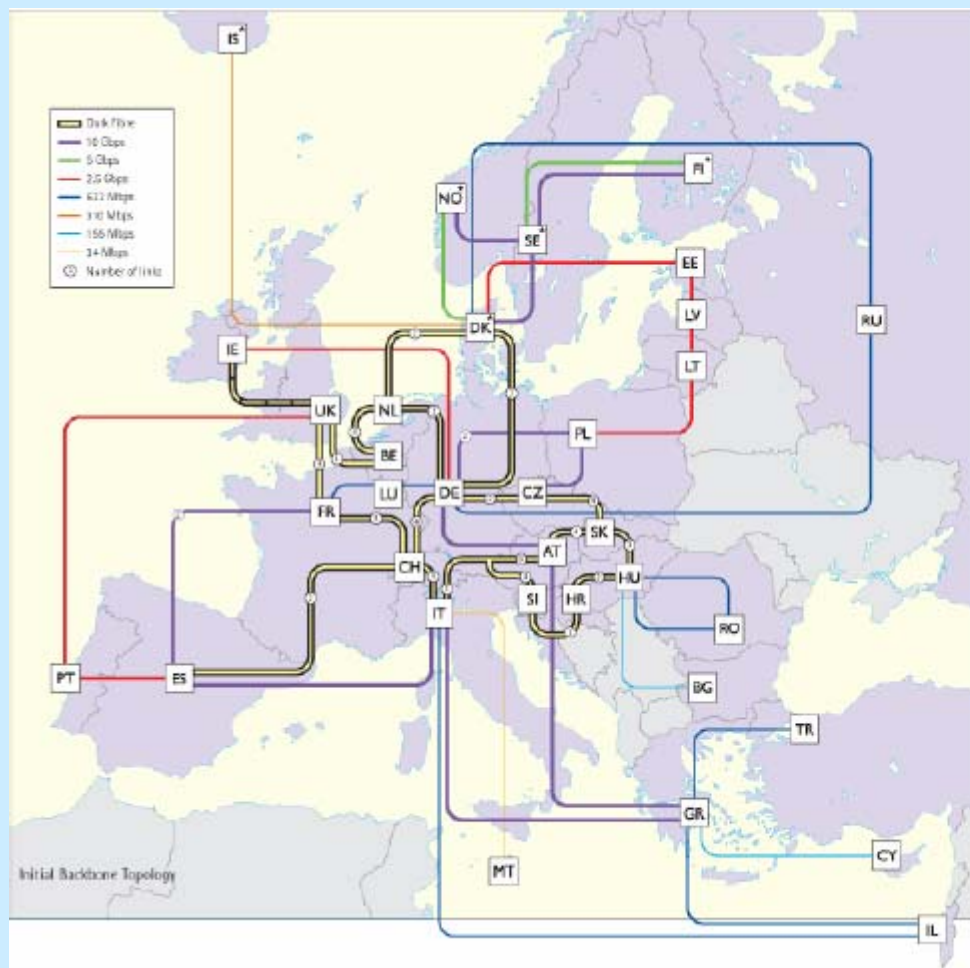
- Research plan: „Optical High Speed National Research Network and its New Applications“
- 2004 – 2010
- Funded by Ministry of Education, Youth and Sports of the Czech republic, association members and external sources (EU)
 - budgeted cca 13 Mil EUR/year

Research plan activities:

- CESNET2 backbone network development (V. Novák)
- Optical networks (S. Šíma)
- Programmable hardware (L.Lhotka)
- Network and traffic monitoring (T.Košňar)
- Performance monitoring and optimisation (S.Ubik)
- AAI and mobility (M.Sova)
- METACentre (L.Matyska)
- Virtual collaborative environments (E.Hladká)
- CESNET CSIRT (A.Kropáčová)
- Applications support (J.Navrátíl)

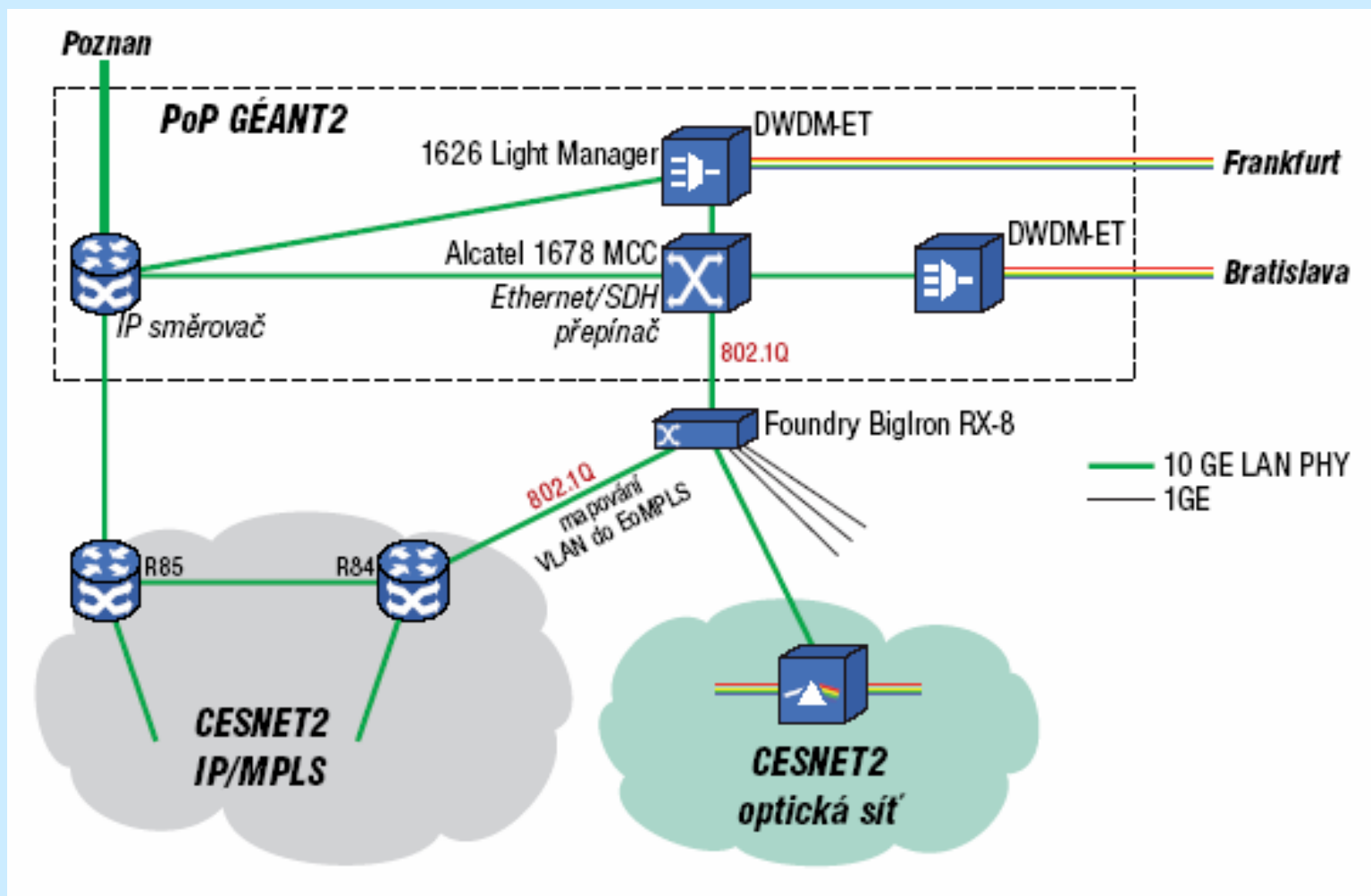
Customer Empowered Fibre Network Concept

- Utilization of dark fibres – CEF networks (the first DF line lighted in 2000, 2.5 Gbps PoS, 327 km)
- Now CESNET has 4951 km of leased dark fibres
- Cost effective deployment of multigigabit DF lines (N x 1 GE, N x 10 GE) with pluggable DWDM transceivers – GBIC, XENPAK
- Lack of cost-effective optical equipment suitable for NRENs
- Development of our own optical amplifiers (and other components)
- Repeaterless or Nothing-in-line (NIL) approach, where possible and practicable

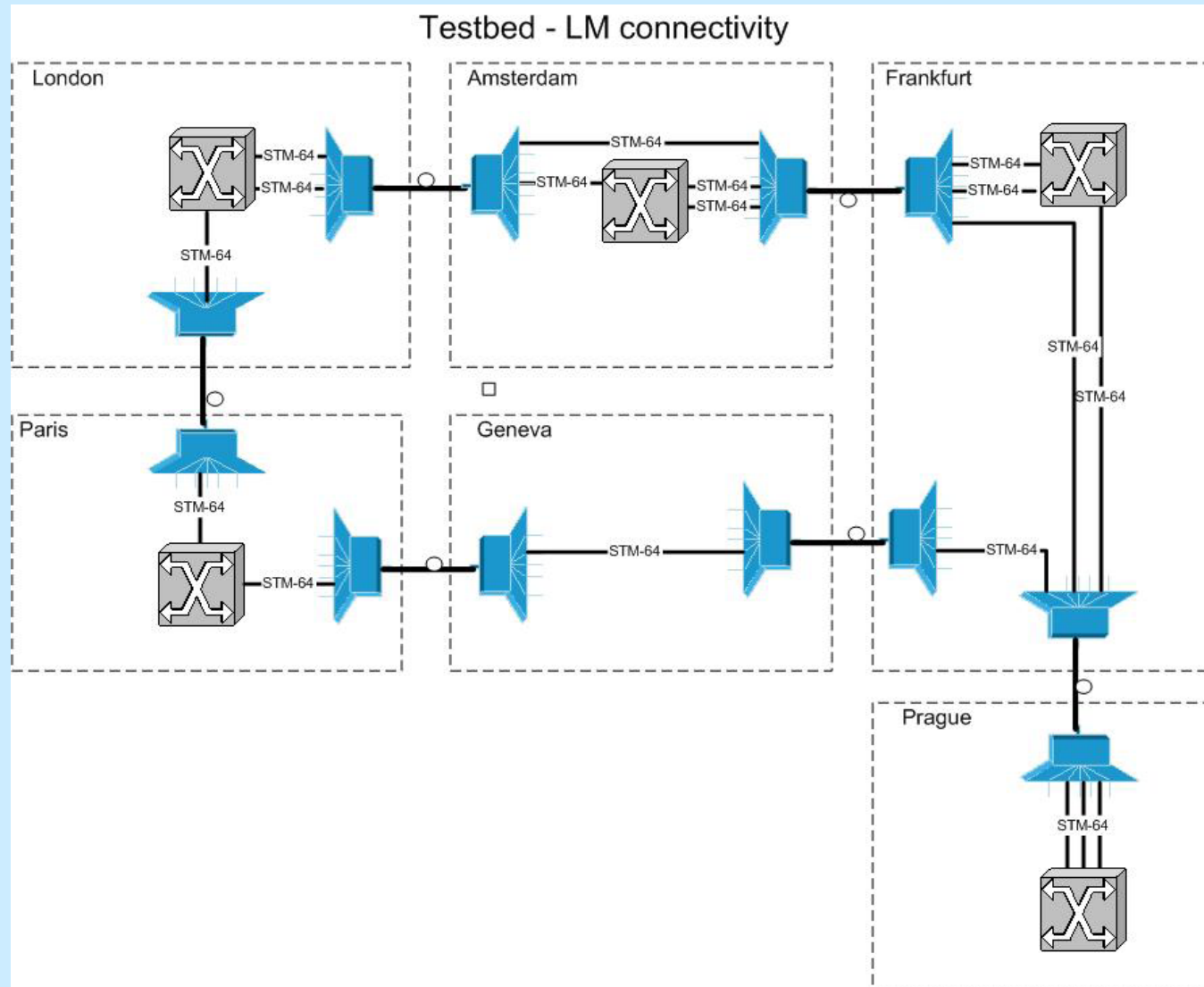


GÉANT2:

- 12,000 Km. of Dark Fibre
- 200 sites
- 18 Dark Fibre routes
- 26 Leased SDH circuits



GÉANT2+ PoP topology in Prague



Toolset element: The FlowMon probe

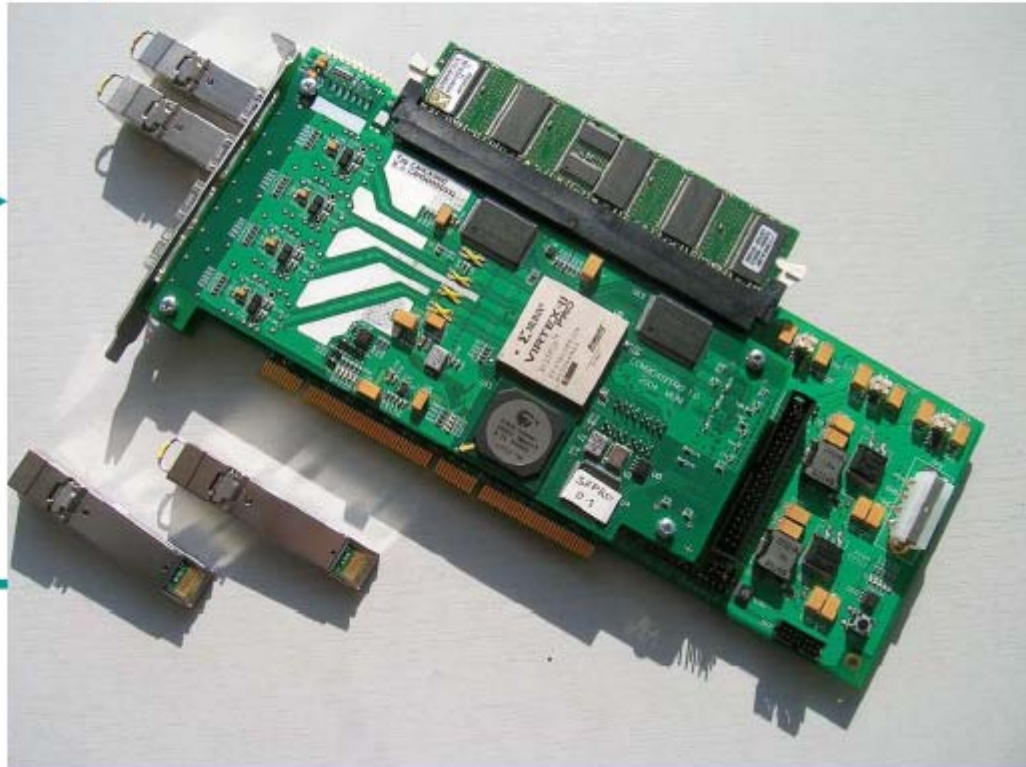


Connect. Communicate. Collaborate

IN:
Raw network traffic



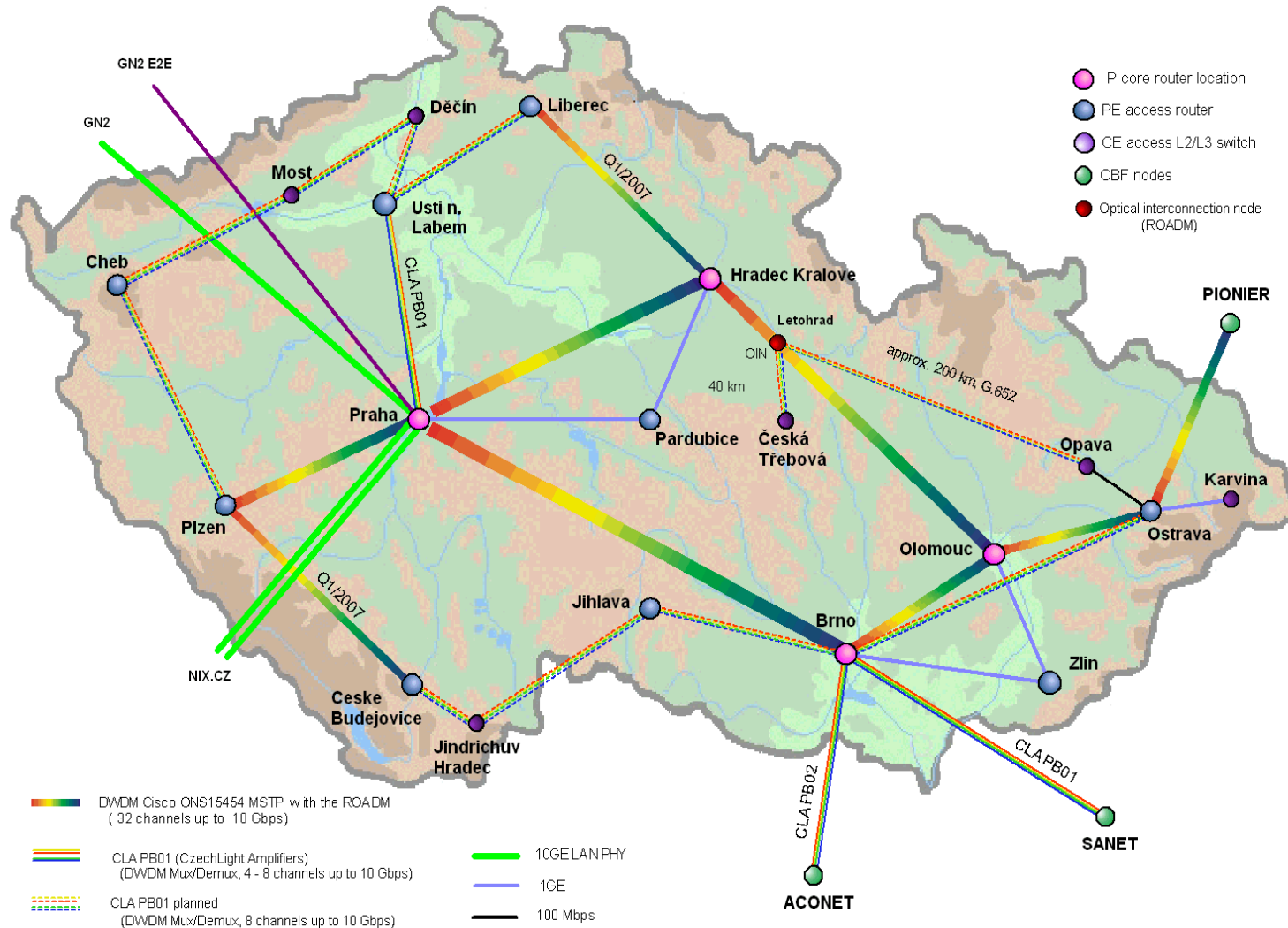
OUT:
netflow data



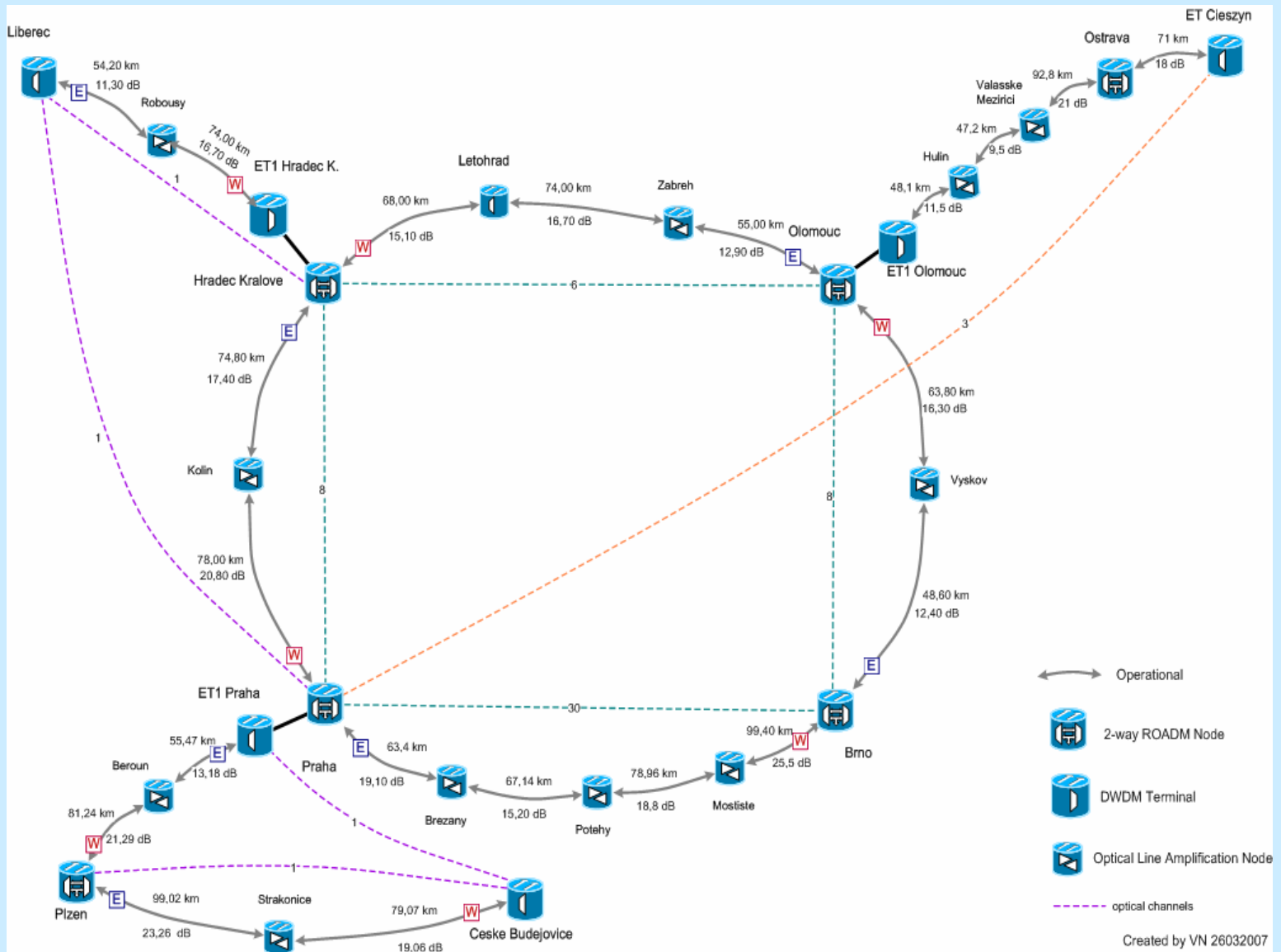
DWDM deployment in CESNET2+

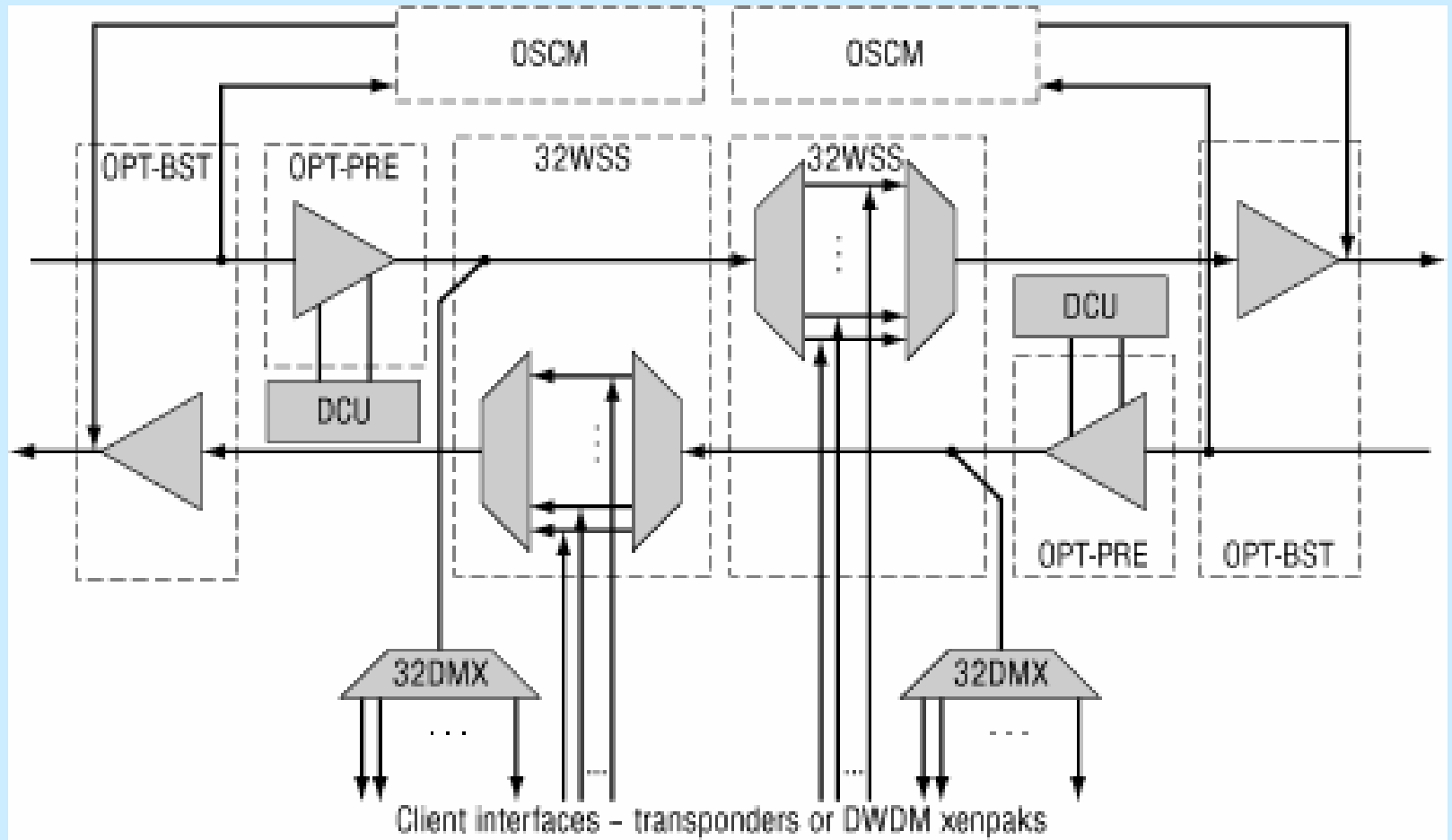
- commercially available equipment (CISCO ONS 15454 MSTP)
- equipment developed by CESNET – CzechLight amplifiers

CESNET2+ Optical Topology



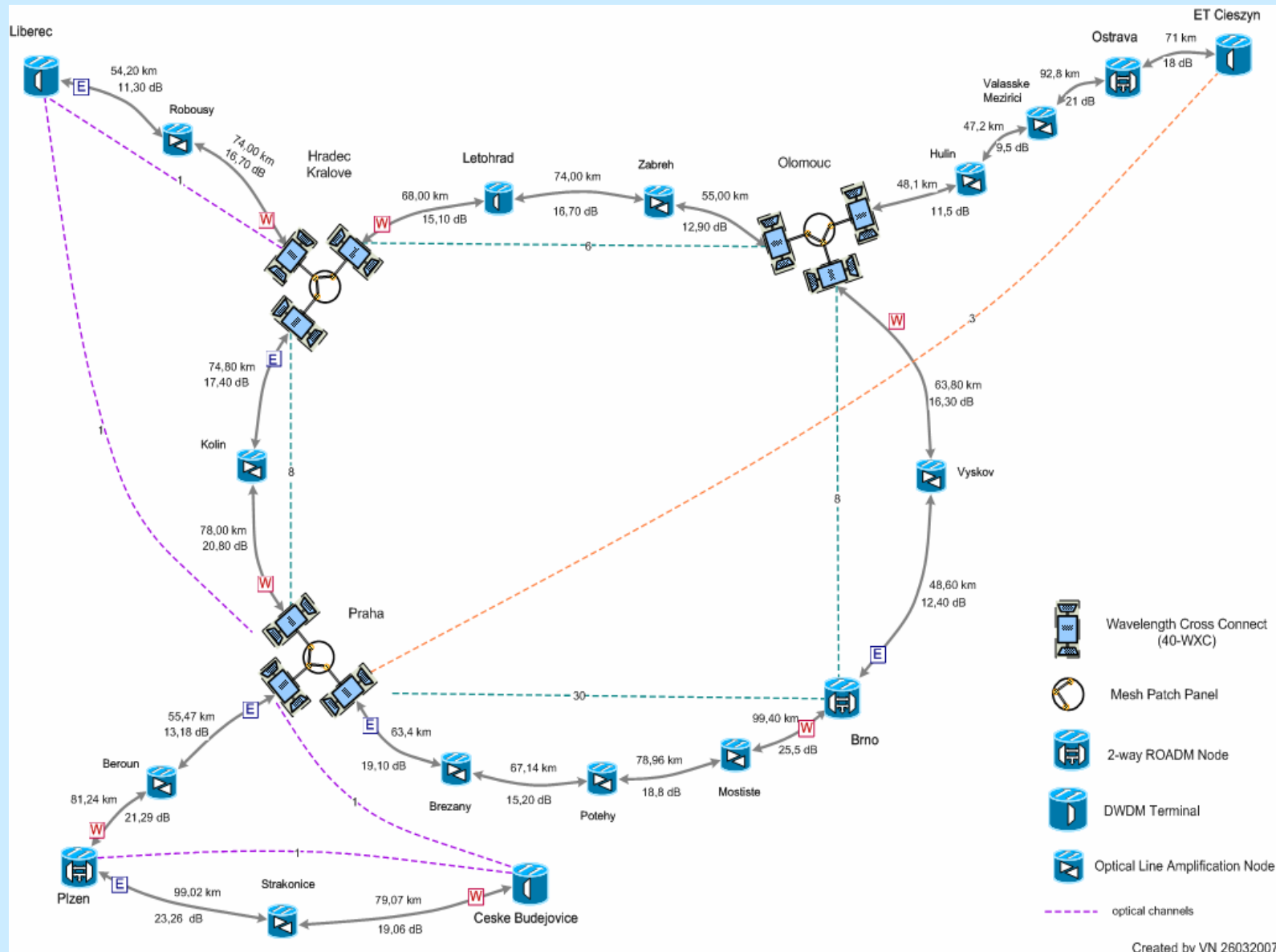
CESNET2+ Cisco based DWDM – April/2007



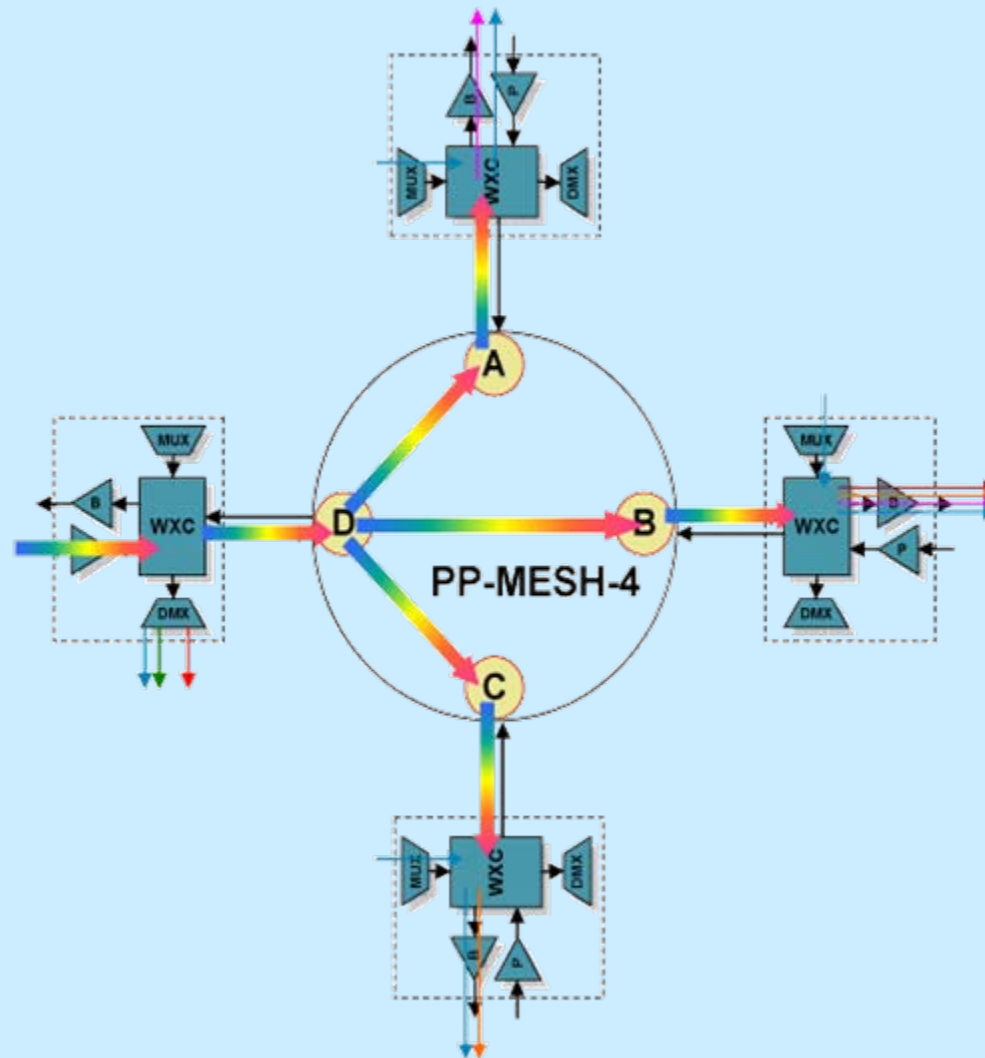


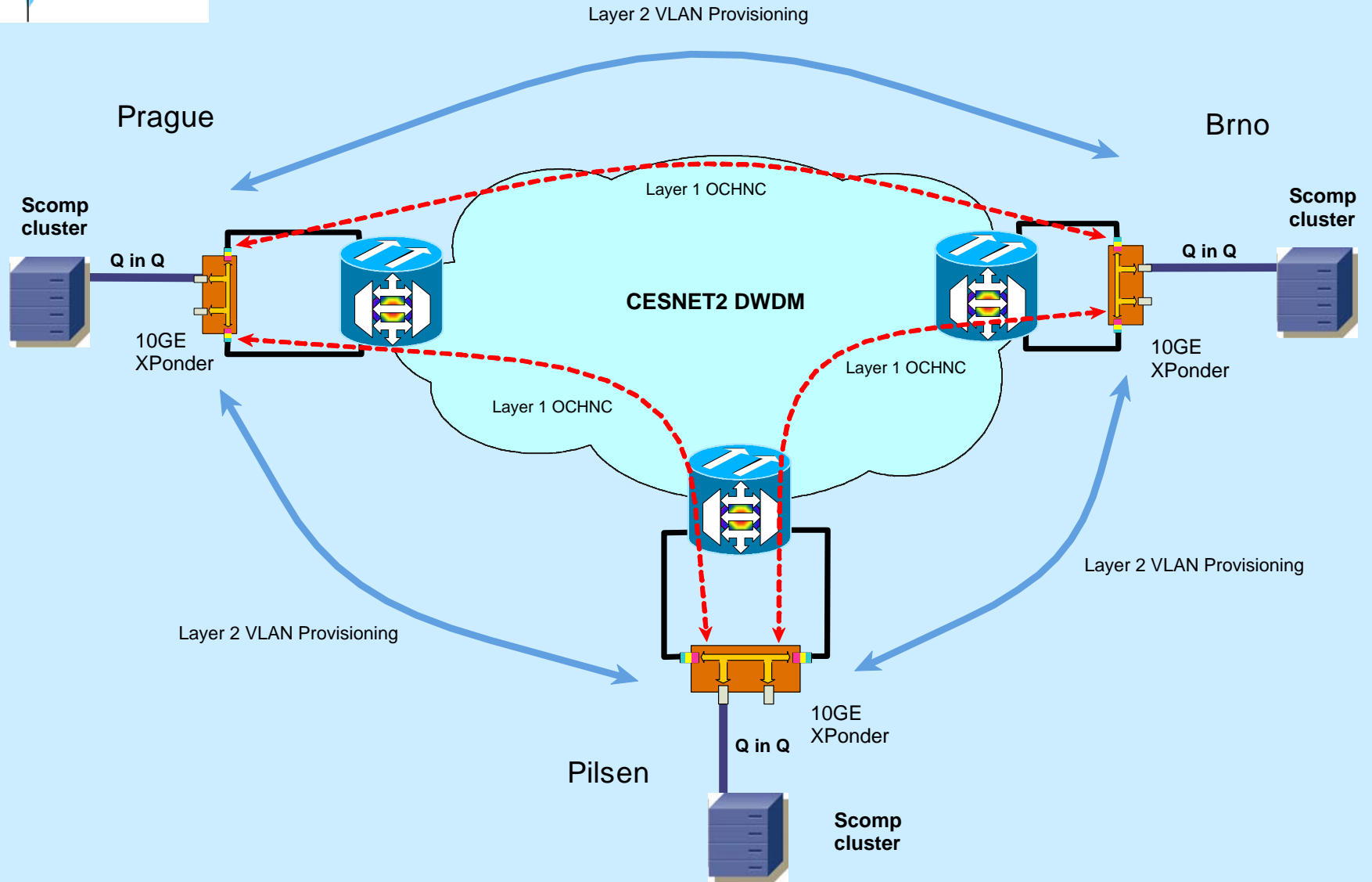
ROADM node block diagram

CESNET2+ Cisco based DWDM-plans for end 2007



Degree-4 ROADM Node Block Diagram



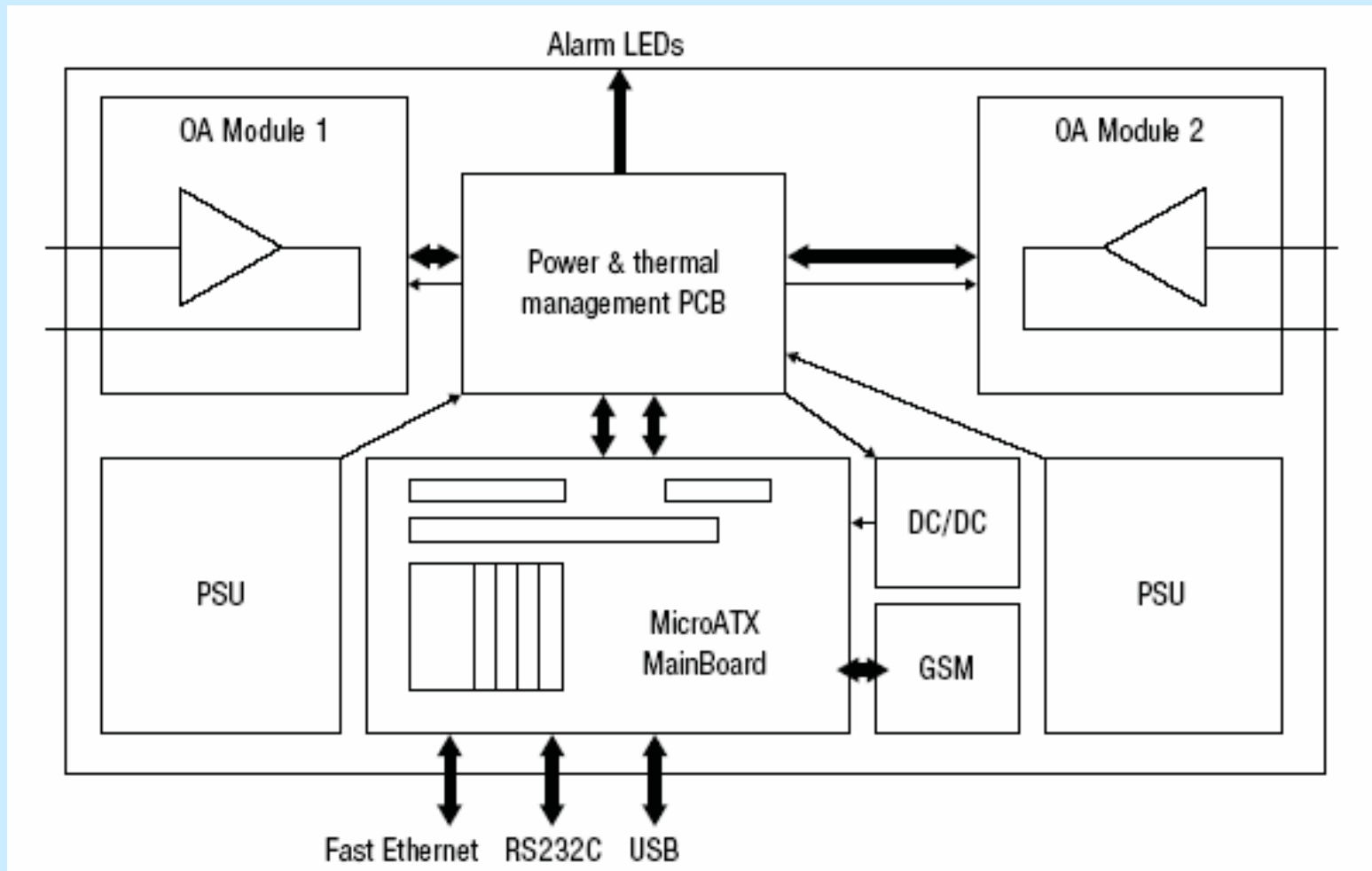


CzechLight Amplifiers

- An optical kit composed from commercially available up-to date optical elements
- Programmability, cost effectivity & reliability
- Possibilities of future development
- Customer based OFA modules – EDFA for 1550 nm, PDFFA for 1310 nm (*10 GE line cards for PC*), Raman modules
- High power boosters, low-noise preamps, in-line amps...
- Contract signed with two manufactures to produce and sell CzechLight amplifiers (CLAs)

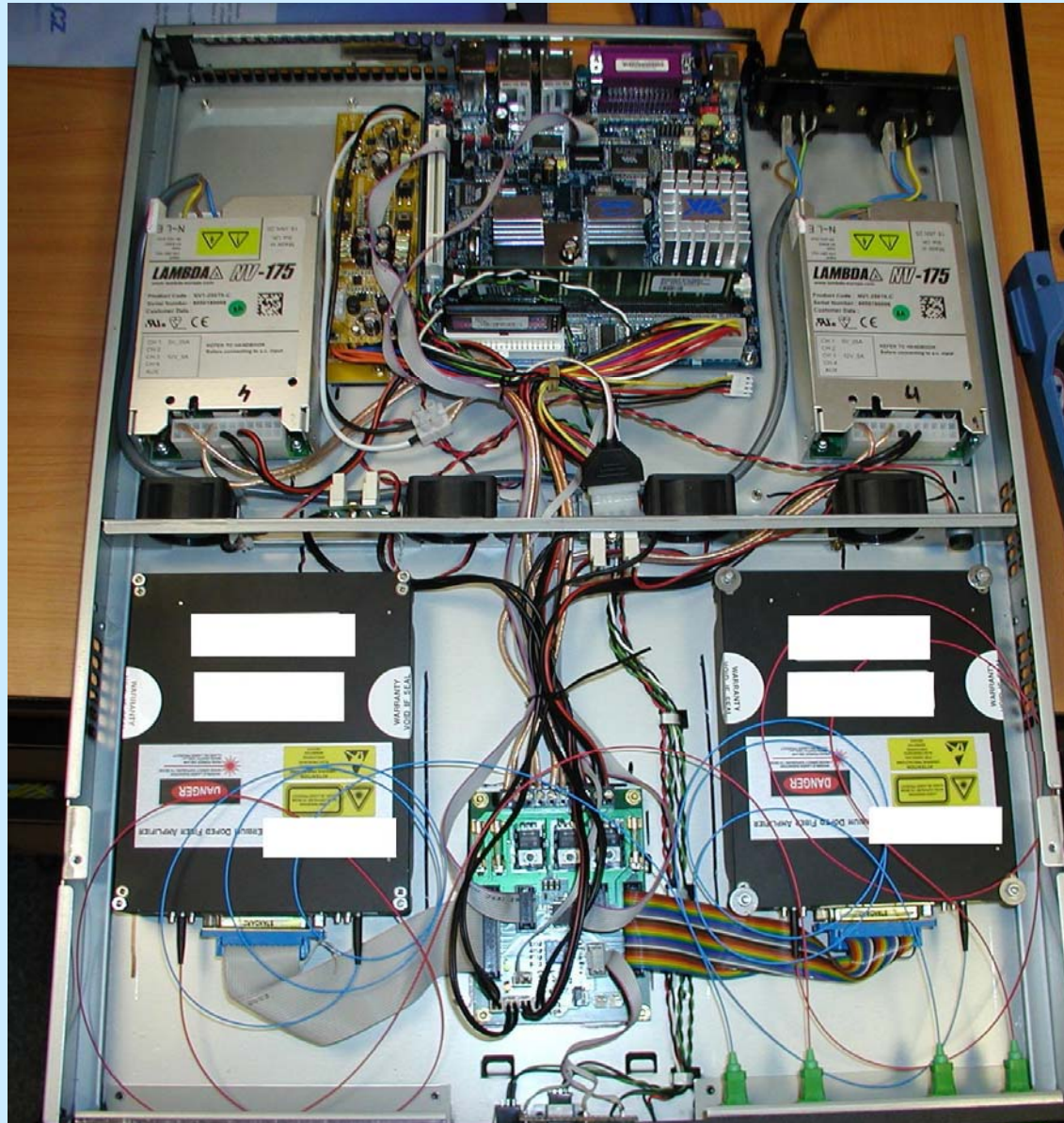
CLA (CzechLigh Amplifier) devices

- Up to 4 EDFAs (customer based) in one case
- Only 1U height rack case
- Dual PSUs (100-230VAC, 48VDC, ...)
- All important optical parameters are settable and under monitoring (control modes, gains, output powers, alarms,...)
- Remote monitoring of all other important operational parameters (DC voltages, fan speeds, temperature)
- **Many OOB management interfaces available** - (Ethernet, USB, GSM/GPRS/UMTS, Wi-Fi, BlueTooth,...)
- **„Open“ system based on Linux = programmability, possibilities of improvement, easy extendibility**



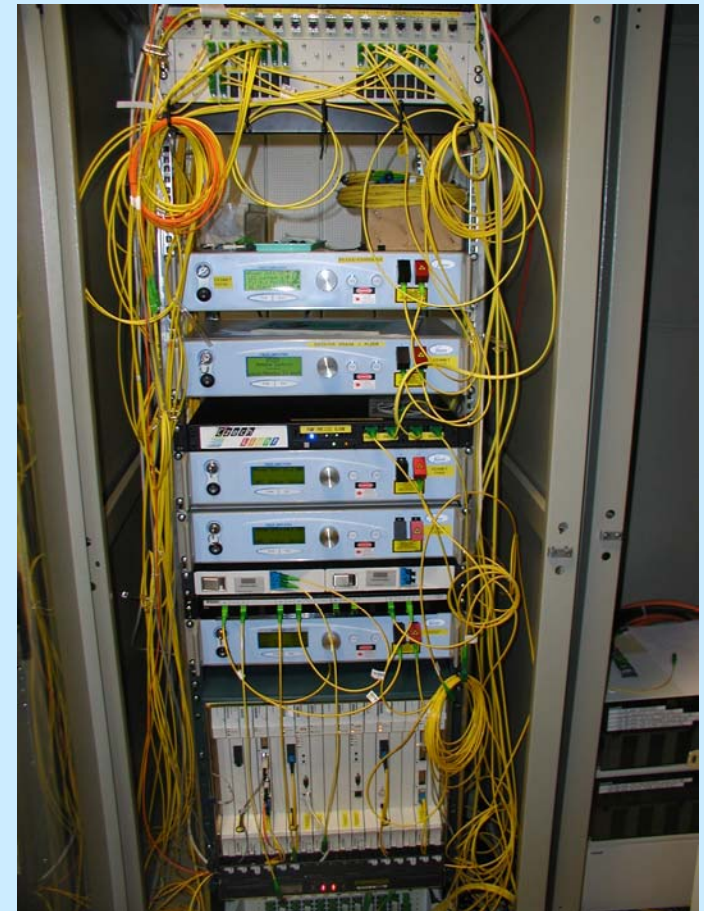
CzechLight amplifiers structure

Prototype Dual Inline DI01



CLAs Deployment

- Praha – Hradec Králové (CESNET2)



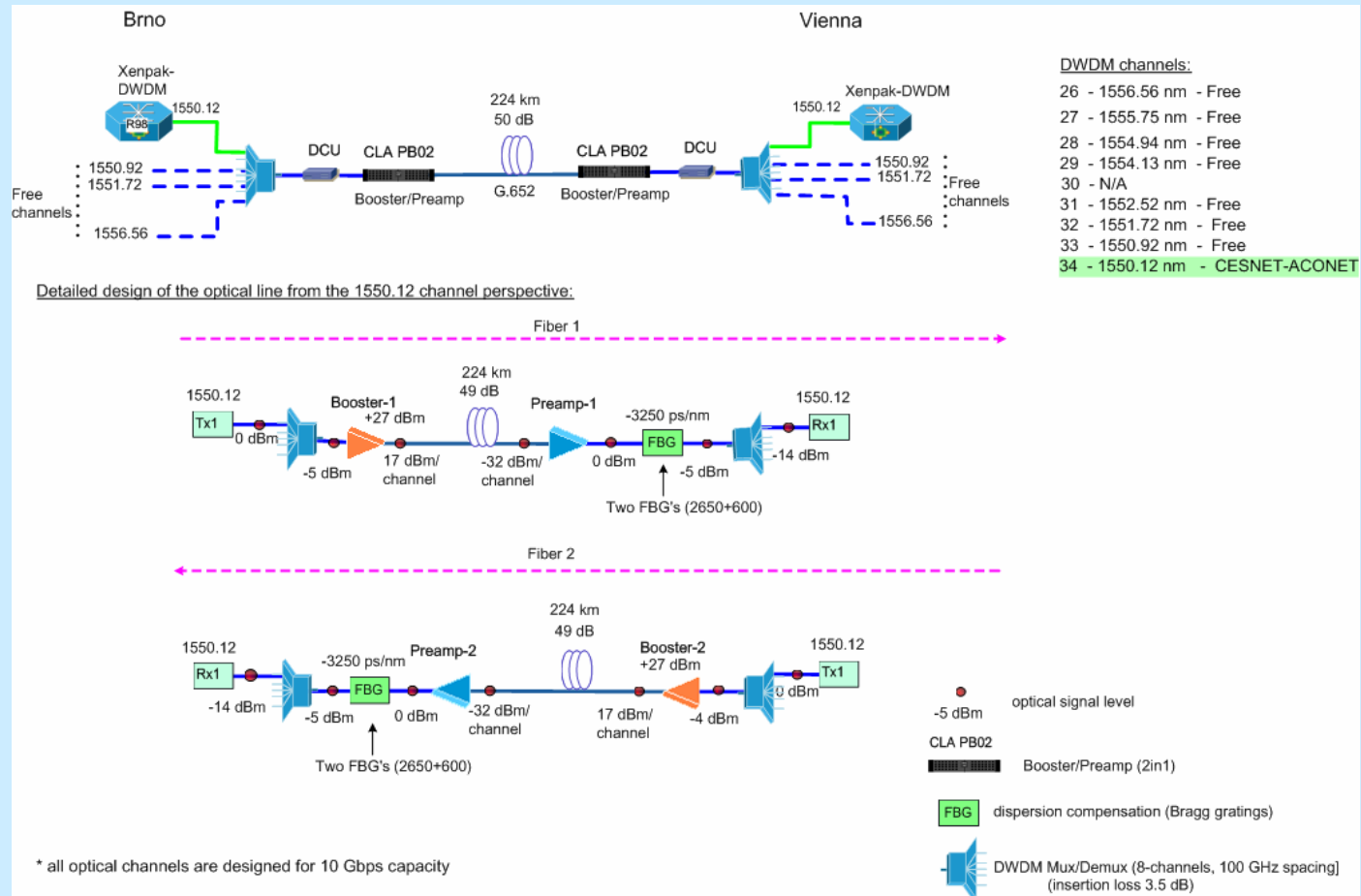
New CzechLight devices

- Tuneable compensators of chromatic dispersion
- Optical switches (simple patch pannels or with multicast capabilities)

CzechLight Compensators

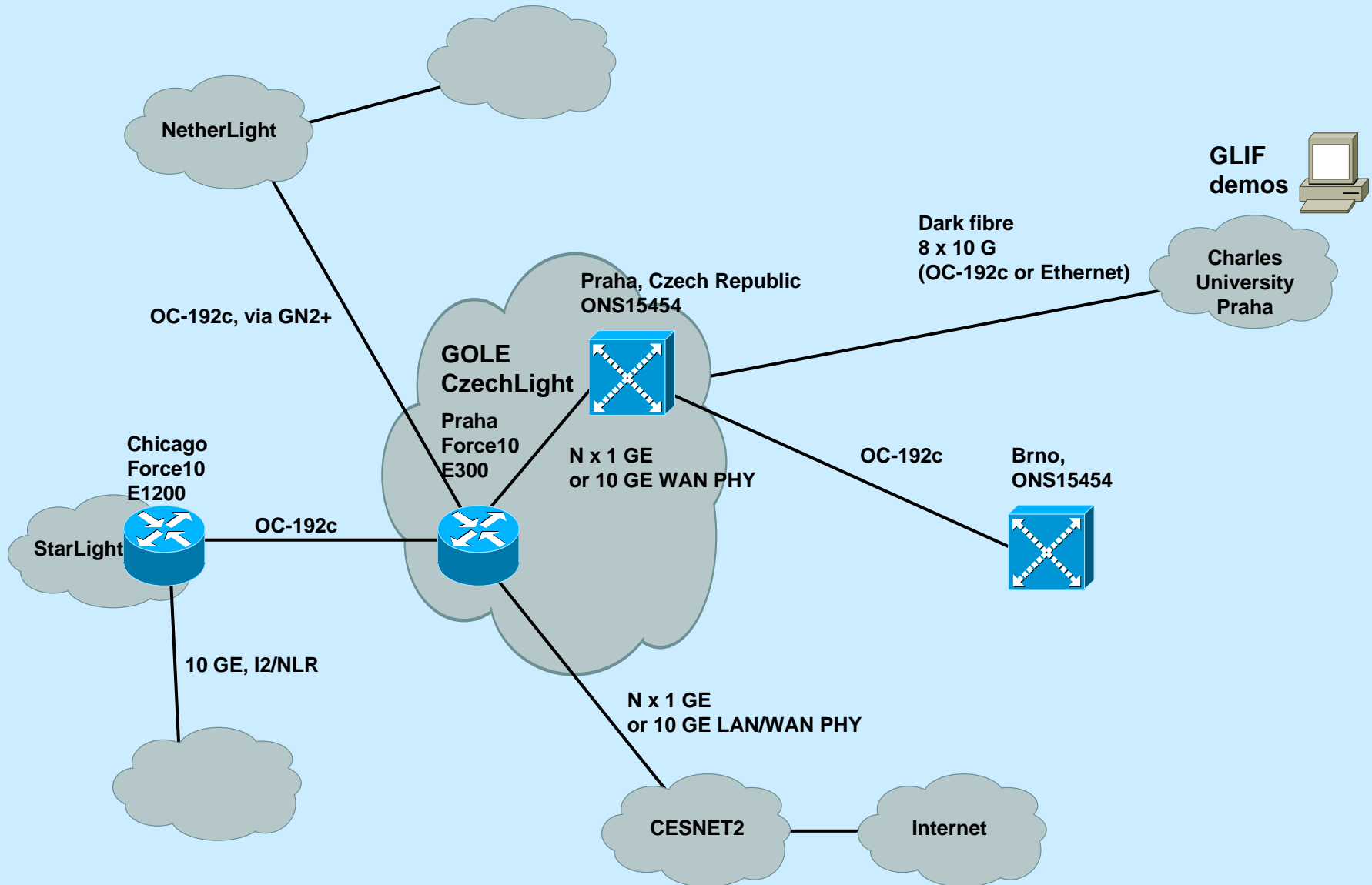
- To eliminate effects of Chromatic Dispersion
- A big issue for 10 G speeds (and beyond) in 1550 nm
- Dispersion compensation fibres – lossy, bulky and expensive
- Fibre Bragg Gratings – a relatively new element, DWDM laser is a must (narrow band), today FBGs can compensate for 51 DWDM channels
 - Signal filtering, spectrum shaping
- Cost effective solution
- Tuneable FBGs, not possible with DCFs (for e2e lightpaths, lambdas on demand)
- CLCs (a FBG plus management capabilities)

Optical CBF line Brno – Vienna





Infrastructure and Connectivity for the 7th Annual GLIF Meeting in Praha



GLIF connectivity upgrade

- In addition to two 10 Gbps GLIF related international links CESNET can extend GLIF to Austria, Poland and Slovakia
- Utilizing Cross Border Fibres from Brno to Wien, Cieszyn and Bratislava
- Links to Austria and Slovakia deployed with CzechLight equipment (amplifiers, compensators)
- Designed for 8 x 10 GE (or STM64/OC-192)
- A new DF link Brno – Cieszyn with CL equipment
 - One inline amplifier
 - For L0 (or higher) experiments
 - The local testbed for the Phosphorus project (<http://www.ist-phosphorus.eu/>)

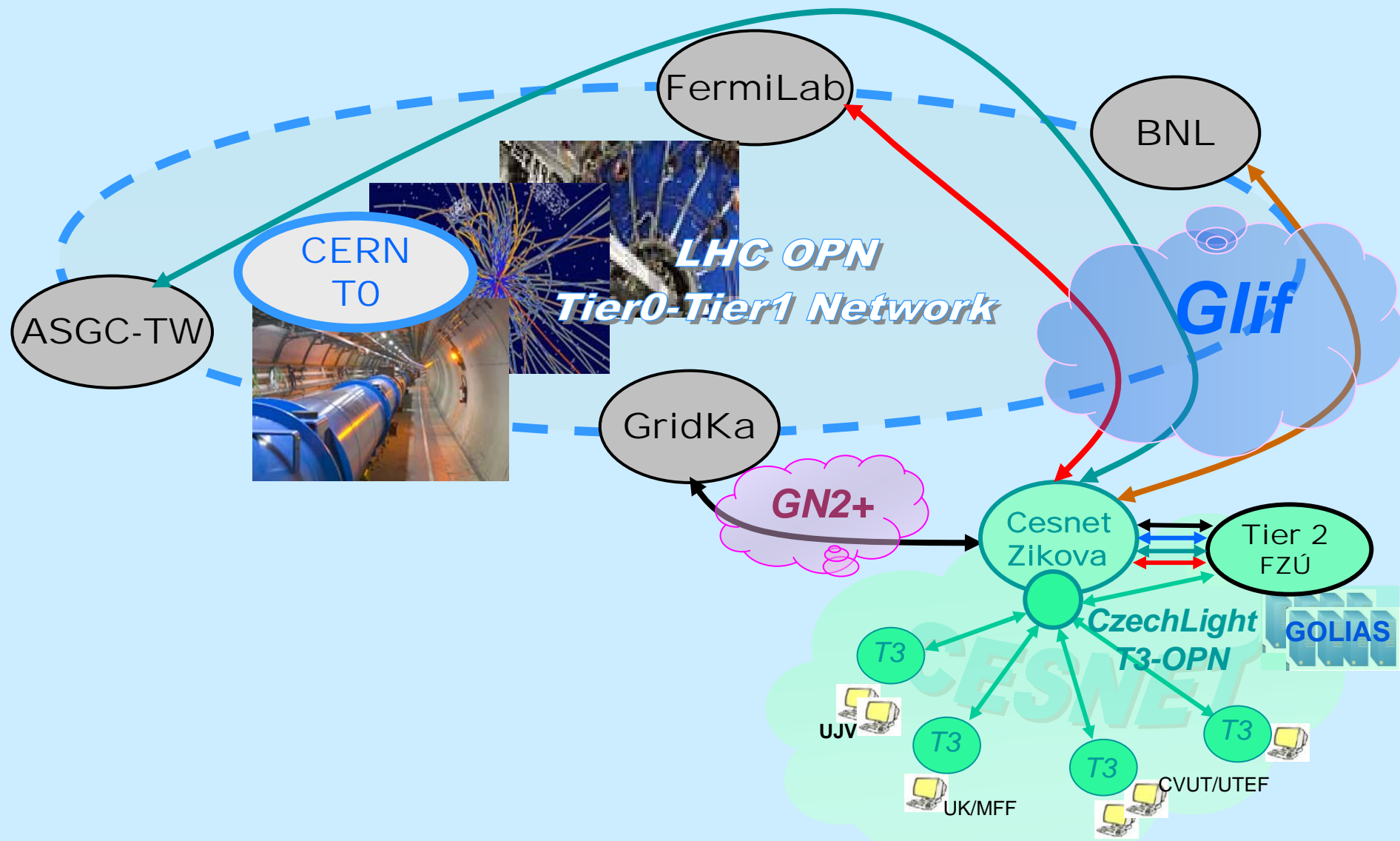
Applications areas

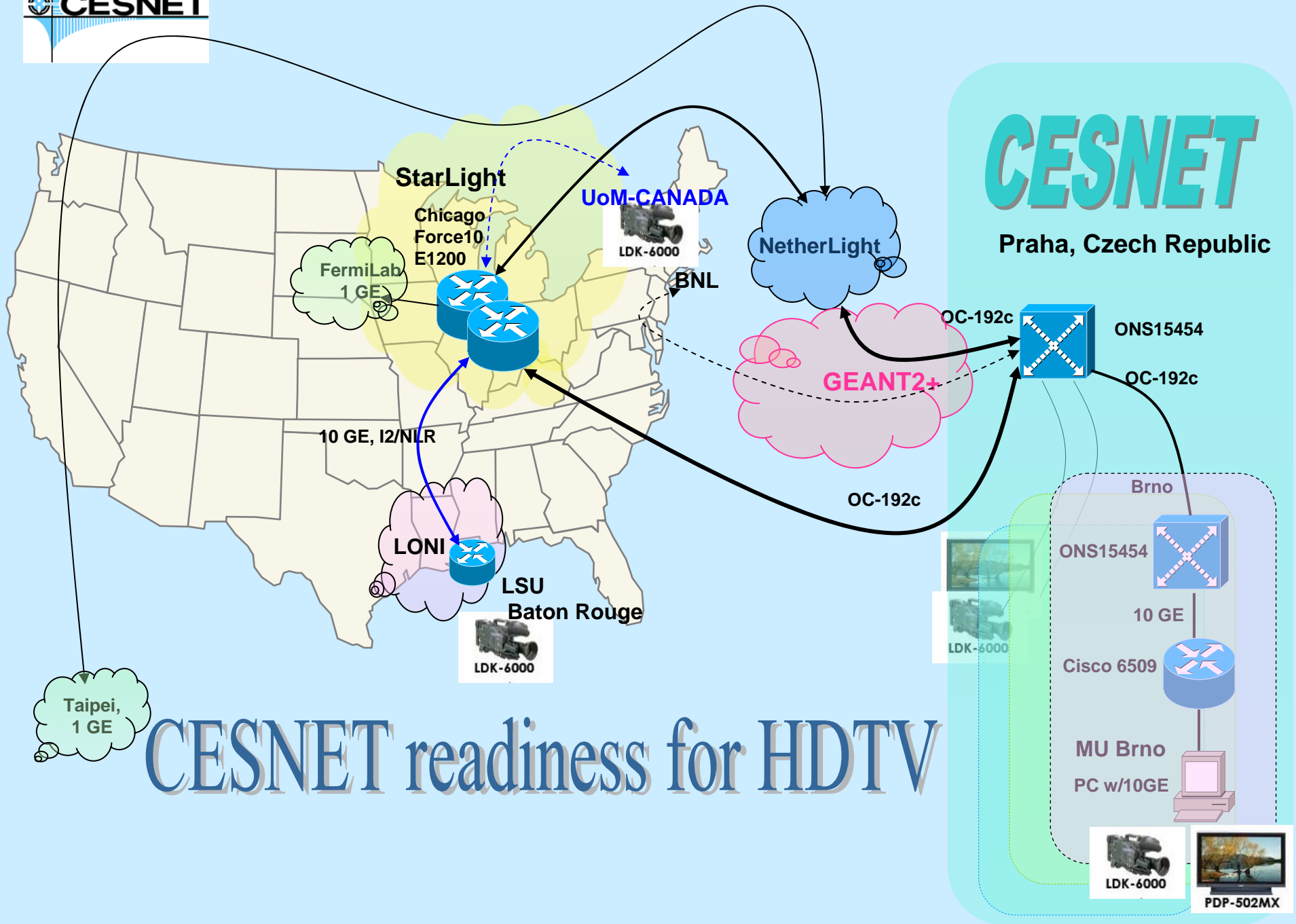
- High energy physics (HEP)
- Collaborative environment (HDVC)
- Medical area (image transference and storage)
- Entertainment industry (e.g. CineGrid)
- Distributed computing (Grids)
-
-

- Network for HEP in the Czech Republic
- Collaborators
 - FZK, Karlsruhe, Germany
 - Fermilab, Chicago, U.S.A.
 - BNL, Upton, U.S.A.
 - GCC Academica Sinica, Taipei, Taiwan
 - Institute of Physics AS CR, Czech Republic
 - Charles University in Prague, Czech Republic
 - Czech Technical University in Prague, Czech Republic
 - Nuclear Physics Institute AS CR, Czech Republic

Czech participation in LHC project

E2E paths to T1s and Czechlight T3-OPN







VINI

A virtual network infrastructure

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VINI

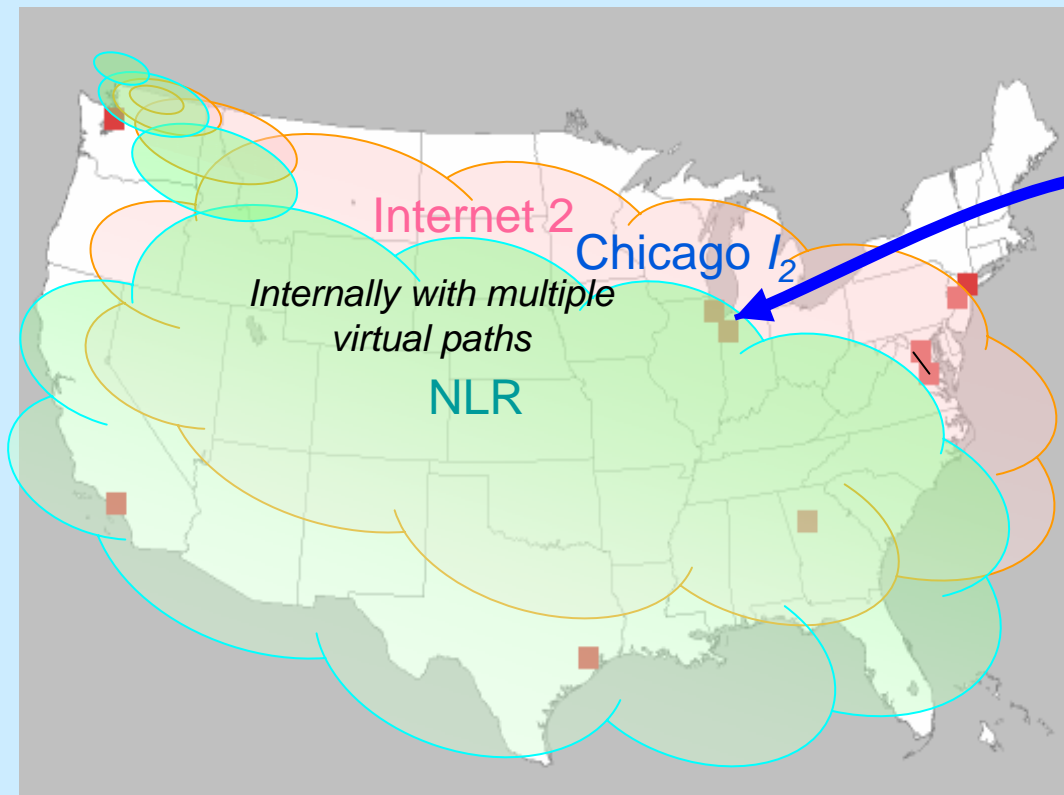
VINI is a virtual network infrastructure that allows network researchers to evaluate their protocols and services in a realistic environment that also provides a high degree of control over network conditions. VINI allows researchers to deploy and evaluate their ideas with real routing software, traffic loads, and network events. To provide researchers flexibility in designing their experiments, VINI supports simultaneous experiments with arbitrary network topologies on a shared physical infrastructure.

VINI currently consists of 24 **nodes** at 14 sites connected to the **National LambdaRail** and **Internet2**.

News

- Initial Deployment
- SIGCOMM 2006 Presentation

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One E2E optical path





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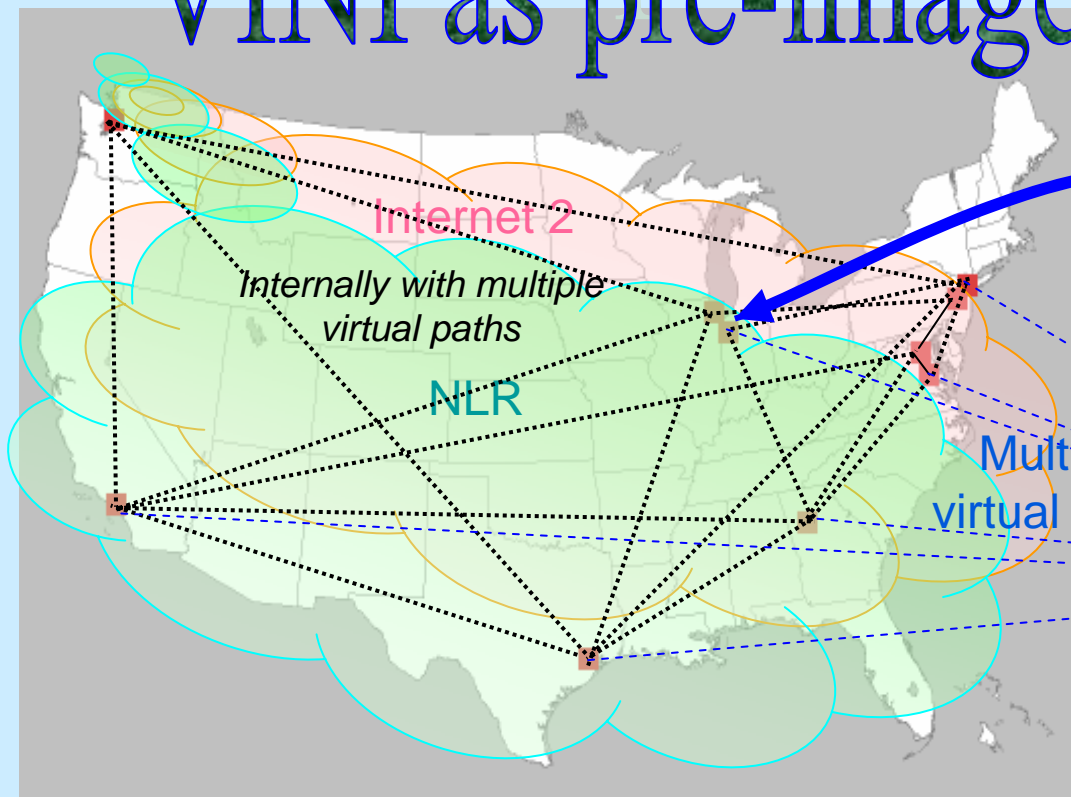
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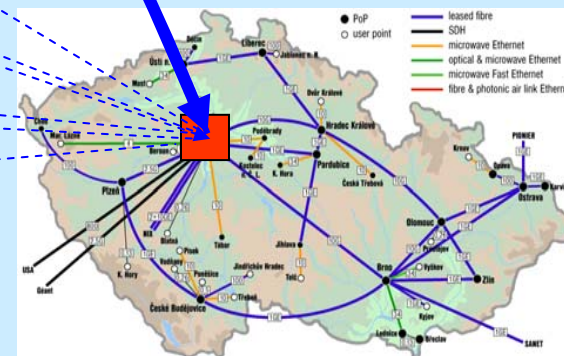
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VINI as pre-image of GENI



One E2E optical path

Multiple
virtual paths



Acknowledgement

To colleagues from CESNET - Lada Altmanová, Jiří Navrátil, Václav Novák, Jan Radil, Stanislav Šíma, Josef Vojtěch and others for their good work and contributing to this presentation.