Operational Databases-related Multi-Layer Network Modelling to Support Network Development at Magyar Telekom

Emil BABICS Magyar Telekom Telecommunications Plc., Hungary
Éva CSÁKÁNY Magyar Telekom Telecommunications Plc., Hungary
Tivadar JAKAB Budapest University of Technology and Economics, Hungary
Rozália KONKOLY Magyar Telekom Telecommunications Plc., Hungary
Lajos SZANDI Budapest University of Technology and Economics, Hungary

Magyar Telekom

MŰEGYETEM 1782

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Challenge for Service Providers

NEW SERVICES demanding guaranteed quality:

VoIP, IPTV, video services,

business data,

e-business etc.

PLANNING AIMS OF SERVICE PROVIDERS:

Providing services ensuring demanded quality requirements at competitive prices for the users

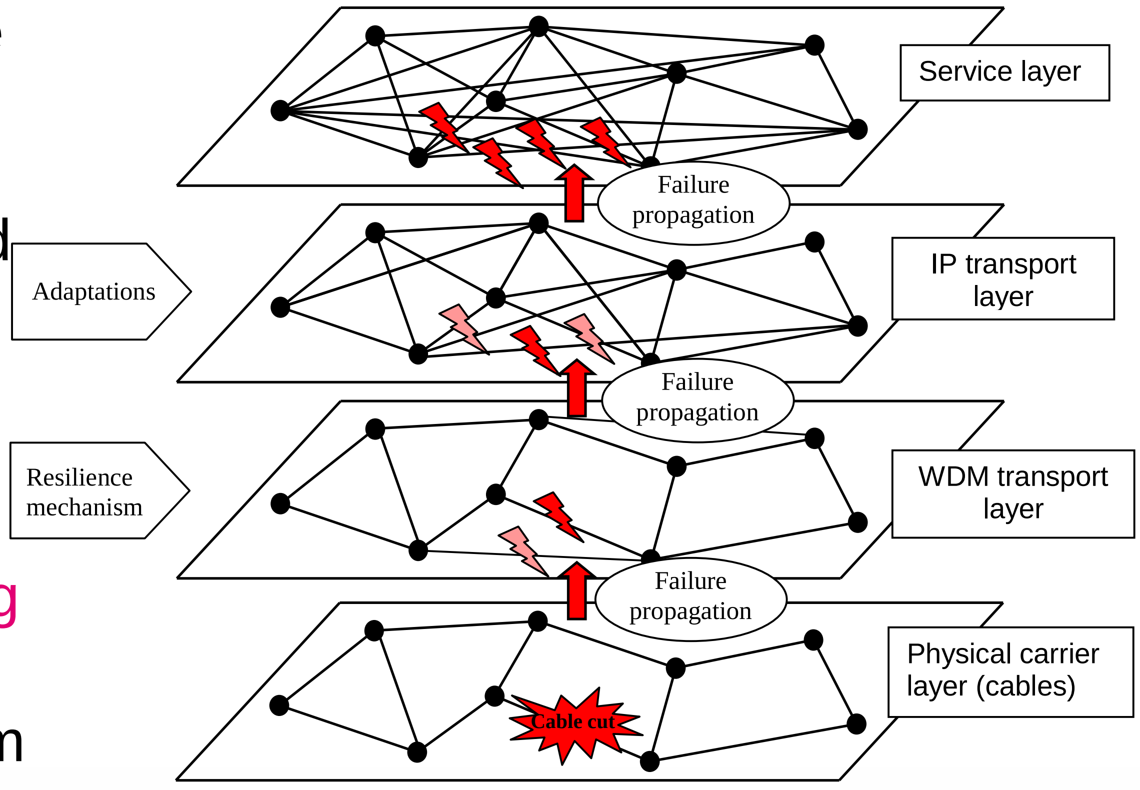
Network and service development:
- on cost-effective way
- using reliable and scalable network solutions
- building simple, converged network architecture (NGN)

High availability services
Quality of Service
(e.g. packet loss, jitter, delay)

- Thorough knowledge about network architecture, about logical and physical topologies
- Up-to-date and consistent data to support planning processes
- Appropriate network modelling, planning and analysis tool

Main targets of network modelling and planning

- To get a real picture about the network behaviour it is crucial for efficient and quick network-development decisions:
  - modelling the network in normal and in failure cases
  - calculate network load, packet-level performance (loss, delay, jitter), and reliability of Layer 1,2,3 connections (to determine the service availability in SLA)
  - Identify weak points of the network or incidental bottlenecks
  - modelling the multi-layered transport network (with client – server relationship between adjacent layers)



FlexPlanet

network planning and analysing sw. tool

(fitted highly to Magyar Telekom environment)

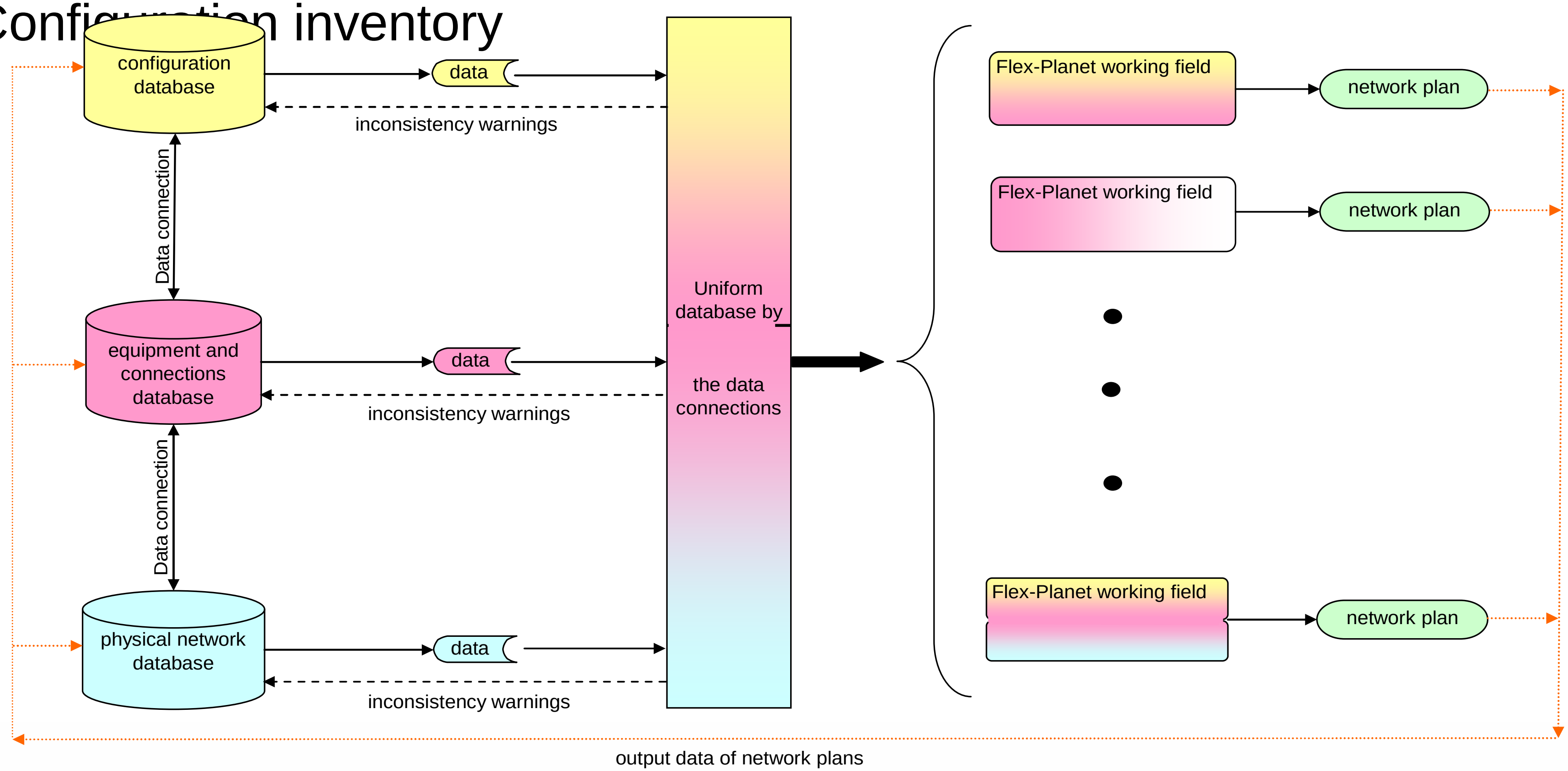
About FlexPlanet…

- The tool and the methodology was developed by BUTE – HT for the MT – PKI demands
- The tool works on real and consistent data originating from the operational databases
- Several1000 model elements – IP and WDM devices, interface cards, optical cable sections etc. – can be handled in the tool
- Containing equipment models, technologies and network structures, specially used at Magyar Telekom
- New procedures could be inserted easily, changes could be followed quickly
- Various planning and analysis methods:
  - Reliability analysis, Flow analysis, Failure analysis, QoS and TE planning, WDM – wavelength planning
- Practical planning and analysis tasks e.g.:
  - Traffic analysis of the IP/MPLS over DWDM network – link dimensioning
  - Network consolidation: DWDM to NG-DWDM migration
  - Planning SRLG disjoint Traffic Engineering tunnels
  - Integrated planning of IP/MPLS over NG-DWDM networks

Network databases and their use for making a unified data modell

Network databases have been realized on many platforms (the reason of this situation is partly historical, partly organizational):

- Physical network inventory
- Equipment and connection inventory
- Configuration inventory

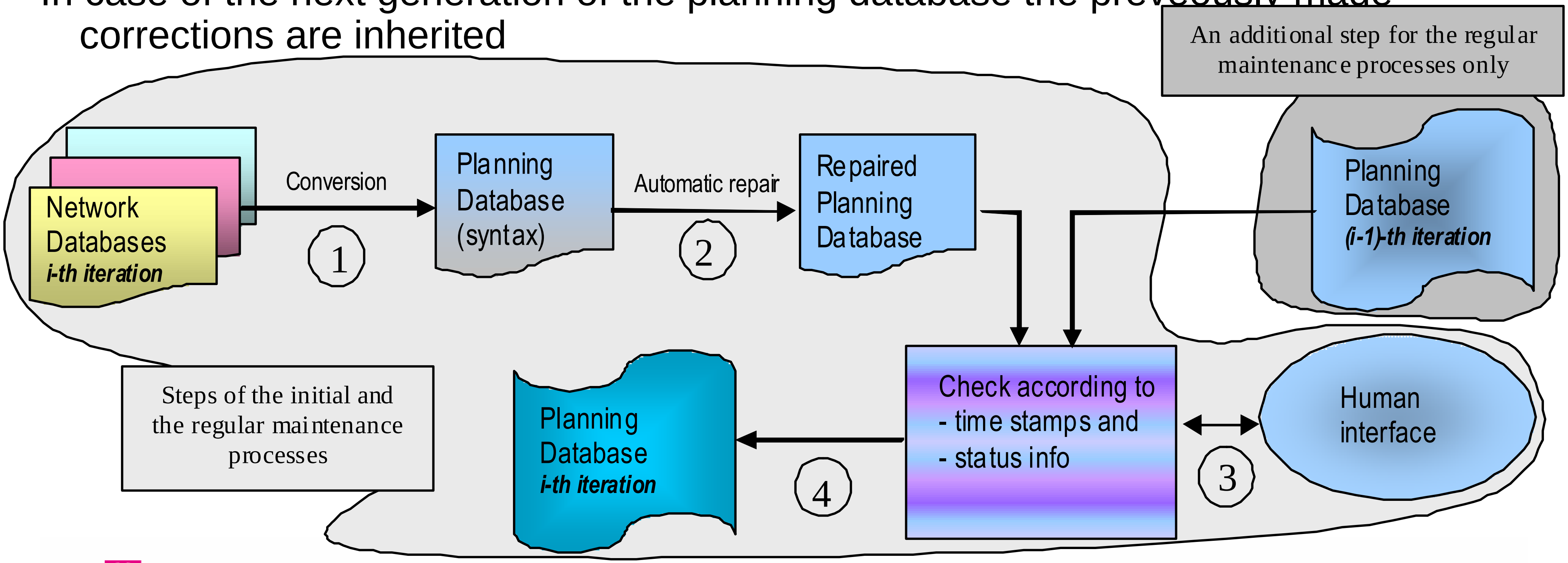


Process for creating an integrated planning database (network modell)

Main steps of the up-to-date planning database generation (performed regularly, e.g. monthly):

- Extracting relevant data in the suitable format from the network databases
- Automatic correction of most of the errors (errors can be originated from applying different syntaxes, human data input)
- Correction of the remaining errors via human interface
- Completing the planning database with timestamps and status information

In case of the next generation of the planning database the preveously made corrections are inherited



An application example: Improving service availability by using the integrated network model

Service provider

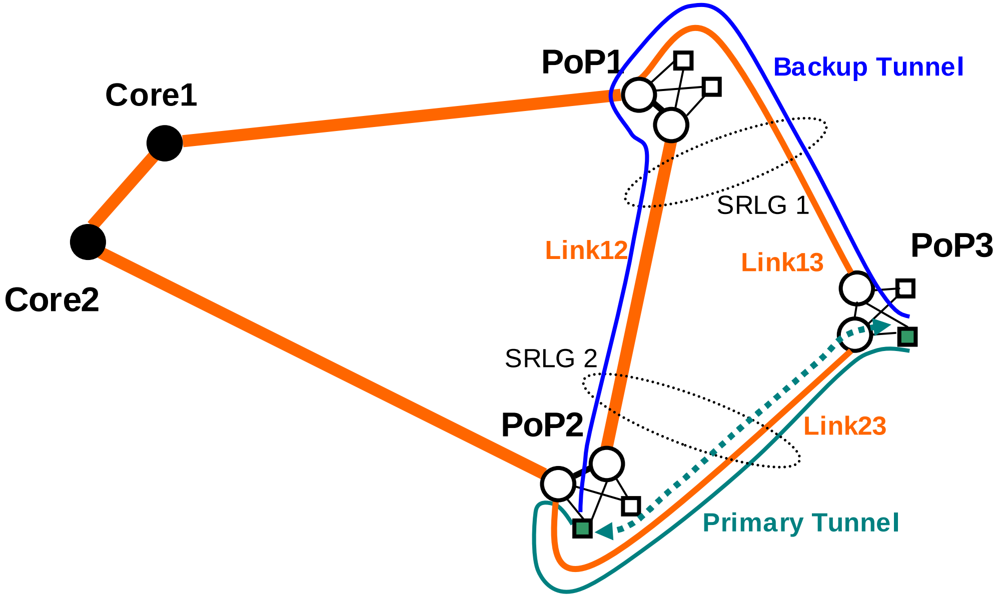
- has an IP network with redundancies in equipments and in topology (e.g. duplicated routers in PoPs, multiple reachability of PoPs, redundant functional elements in equipments)
- intends to provide fast restoration using path protected TE Tunnels in its IP/MPLS/DWDM network

Main target: to improve the joint availability of the Primary and Backup TE Tunnels examining different Backup TE Tunnel scenarios

- independence of the Primary and the Backup TE Tunnels has to be assured in all technological layers (e.g. paths planned disjoint in the IP layer happen to be not disjoint in the optical cable or WDM layer)
- This complex calculation needs consistent and integrated network description
- The joint availability of the Primary and the Backup Tunnels can be calculated on the basis of DTR (MTBF, MTTR) values of all layers components

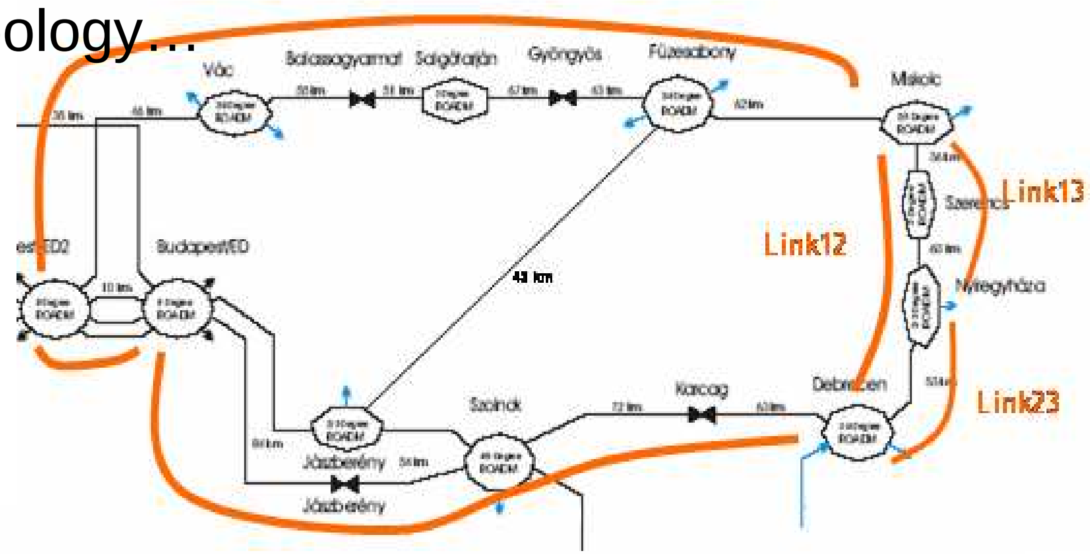
Scenario 1 (Base case)

If only the IP link level is considered…



- Primary Tunnel: minimal hop count path
- Backup Tunnel: minimal hop count path, disjoint from the Primary Tunnel in the IP link level

But, given the following physical topology…

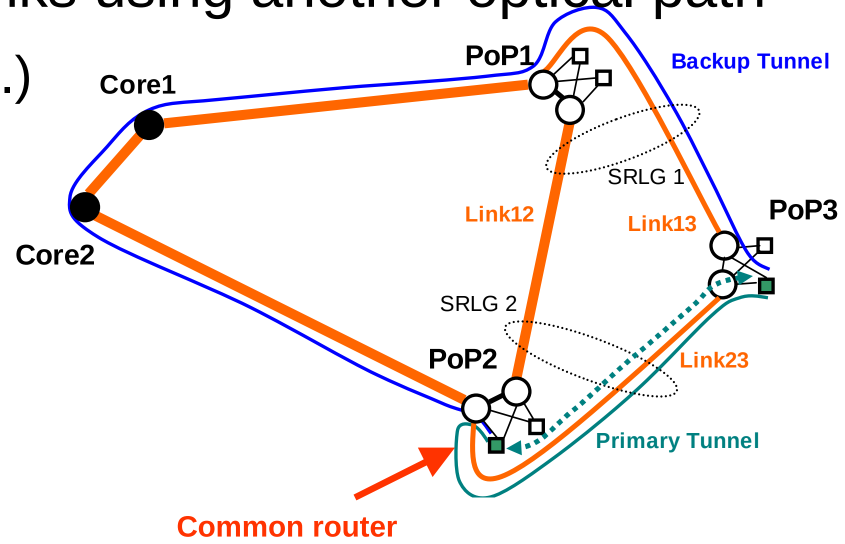


The problem is:
Primary and Backup Tunnels use the same optical path and WDM equipments, therefore fast restoration can not be realized in case of optical failure

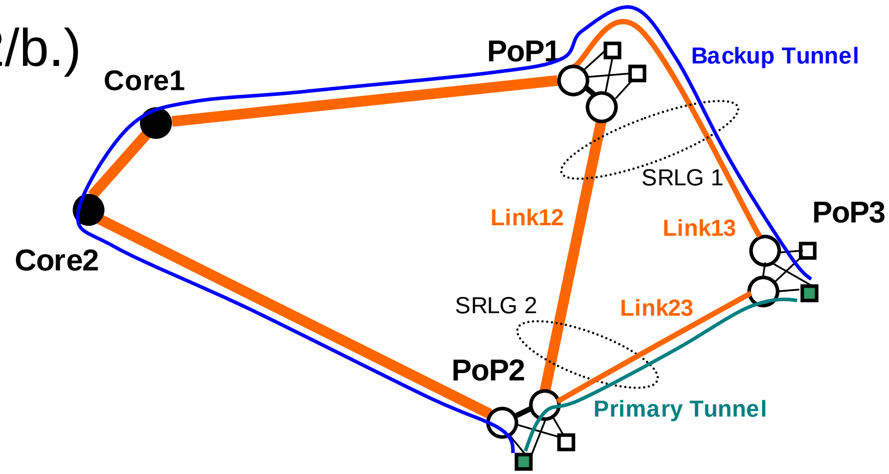
Scenario 2

If IP link level and also optical cable layer is considered…
Solution: Backup Tunnel - longer than minimal hop count - built on IP links using another optical path

2/a.)



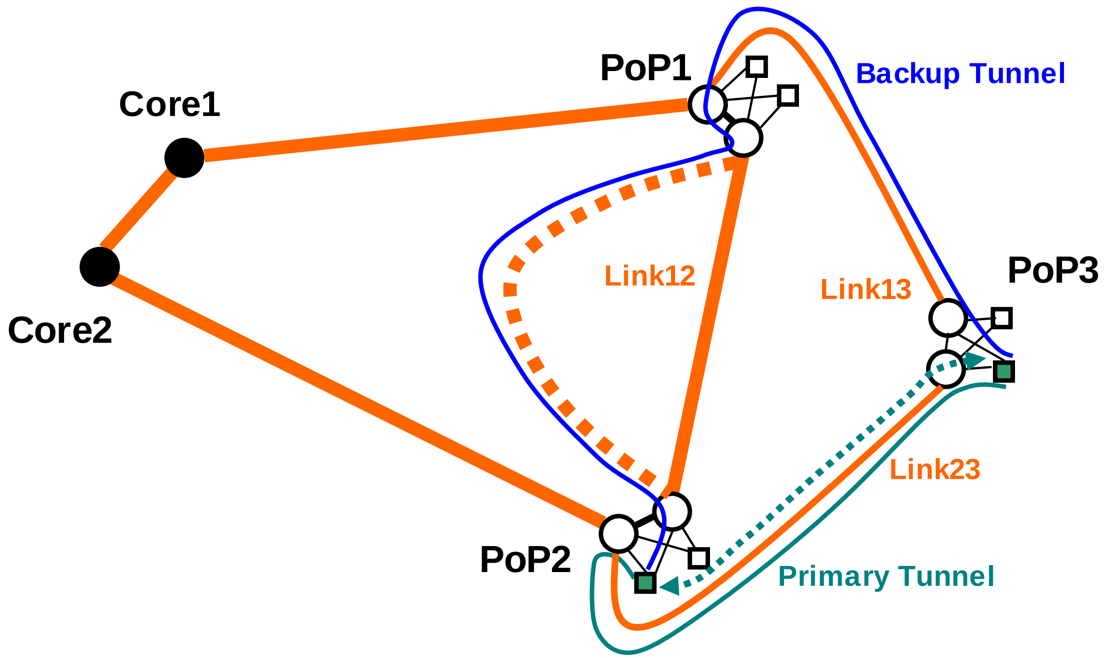
2/b.)



- Now Backup Tunnel is disjoint from the Primary Tunnel in optical cable level as well, that will improve joint availability
- but there is a common router in the 2 paths (in PoP2), that can decrease the joint availability
- Changing the termination of Link23 in PoP2, optical cable and router disjoint paths can be found

Scenario 3

If IP link level and also optical layer is considered…
Solution: Using protected optical channel between PoP1 and PoP2



Now Backup Tunnel is

- minimal hop count
- disjoint from the Primary Tunnel in optical cable level as well as in IP level

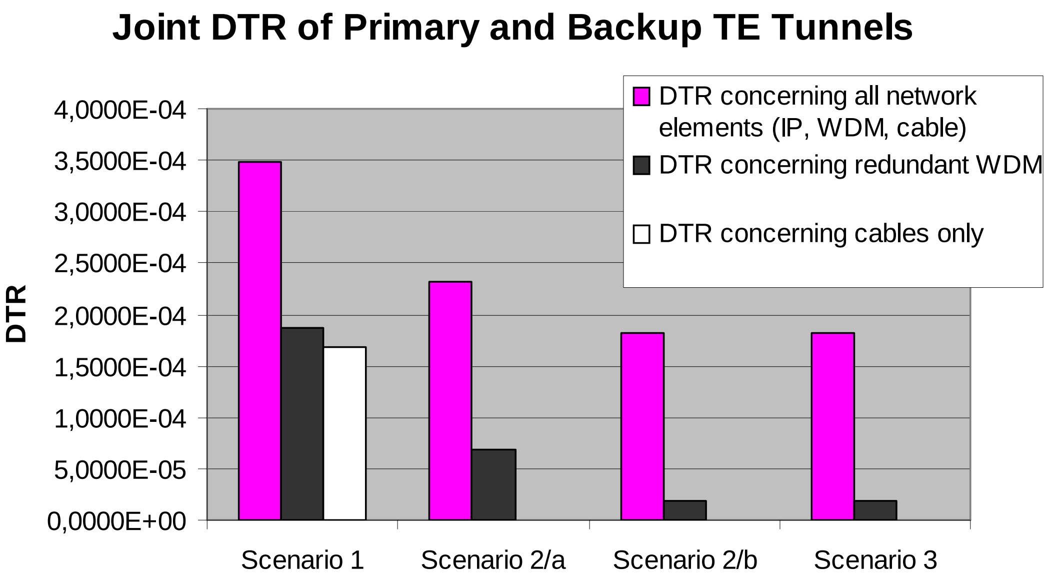
This solution can further improve joint availability, but it requires WDM development

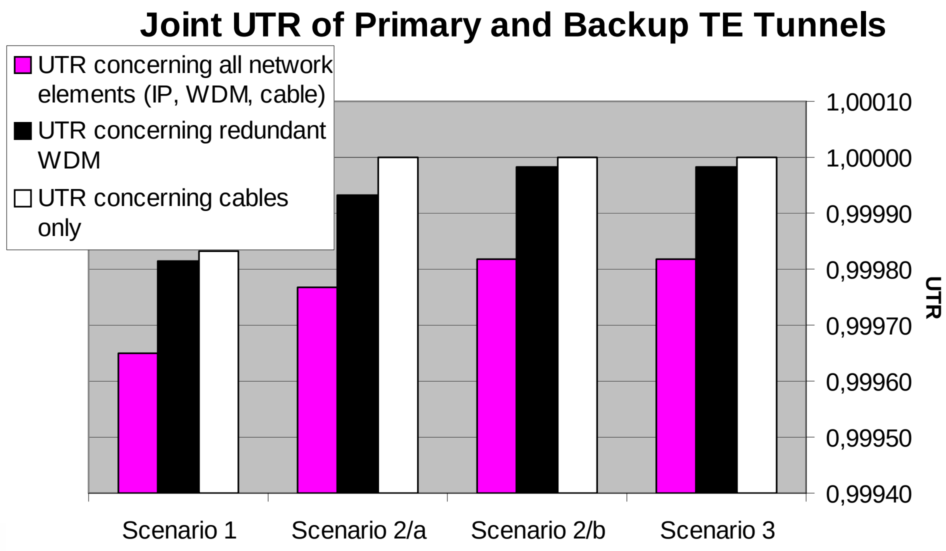
Comparison of results and consequences

- Small improvement achieved in DTR if considered all network elements – caused by not enough redundancy in WDM layer
- Duplicate WDM equipment in IP PoPs – an order of magnitude smaller DTR
- 5 x nines service availability needs dual-homing solution at the customer site

	DTR concerning all network elements (IP, WDM, cable)	DTR concerning redundant WDM	DTR concerning cables only
Scenario 1	3,4925E-04	1,8644E-04	1,6854E-04
Scenario 2/a	2,3117E-04	6,8138E-05	3,6540E-07
Scenario 2/b	1,8146E-04	1,8422E-05	3,6540E-07
Scenario 3	1,8128E-04	1,8242E-05	1,8583E-07

	UTR concerning all network elements (IP, WDM, cable)	UTR concerning redundant WDM	UTR concerning cables only
Scenario 1	0,99965	0,99981	0,9998315
Scenario 2/a	0,99977	0,99993	0,9999996
Scenario 2/b	0,99982	0,99998	0,9999996
Scenario 3	0,99982	0,99998	0,9999998





Summary

- An integrated network modell describing the multi-layer network operation has been developed
- Modell attributes are based on the information stored in the operational databases
- We eliminate inconsistencies occassionally found in the operational databases
- We maintain the planning database regularly, previous corrections inherited
- In each planning tasks we use only data relevant for the actual development task

Thank you for your attention,
and have a nice boat trip
this evening!