Outline

2/4/02

Click here to start

Table of Contents

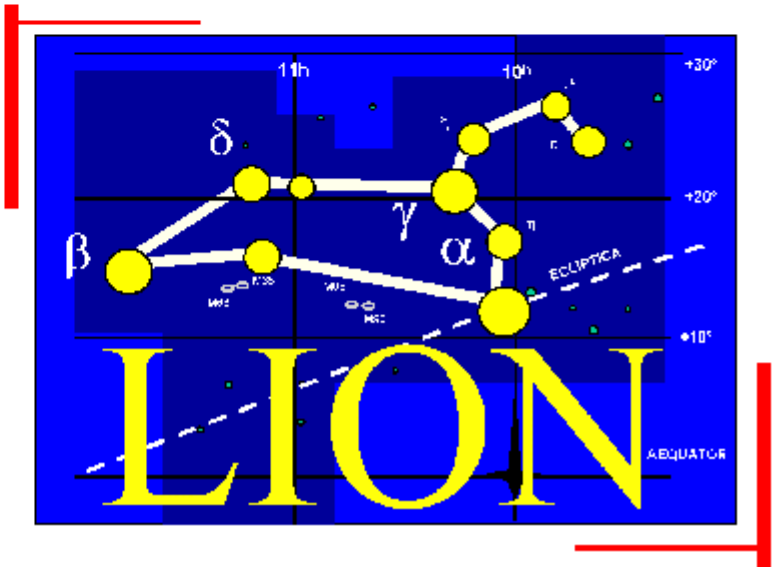
Author: Laptop

Email: Roberto.Sabatino@dante.org.uk

PPT Slide

For Further Contacts Project Leader of IST LION antonio.manzalini@tilab.com Phone: +39 011 2285 817

IST Project LION



Outline

- IST-project LION
  - Layers Interworking in Optical Networks
  - Overview – objectives
  - Testbed
- Progress: 2 examples
  - Recovery experiments on testbed
  - Design of survivable multilayer IP over Optical Network

IST Project LION

Telecom Italia Lab - *Prime Contractor*

Agilent Technologies Italia

NTT Nippon Telegraph and Telephone

Universitat Politecnica de Catalunya

National Technical University of Athens

Cisco Systems International

Sirti

T - NOVA - Deutsche Telekom

The University of Mining and Metallurgy

Interuniversity Microelectronics Centre

Telekomunikacja Polska

Siemens ICN

Tellium

IST Project LION

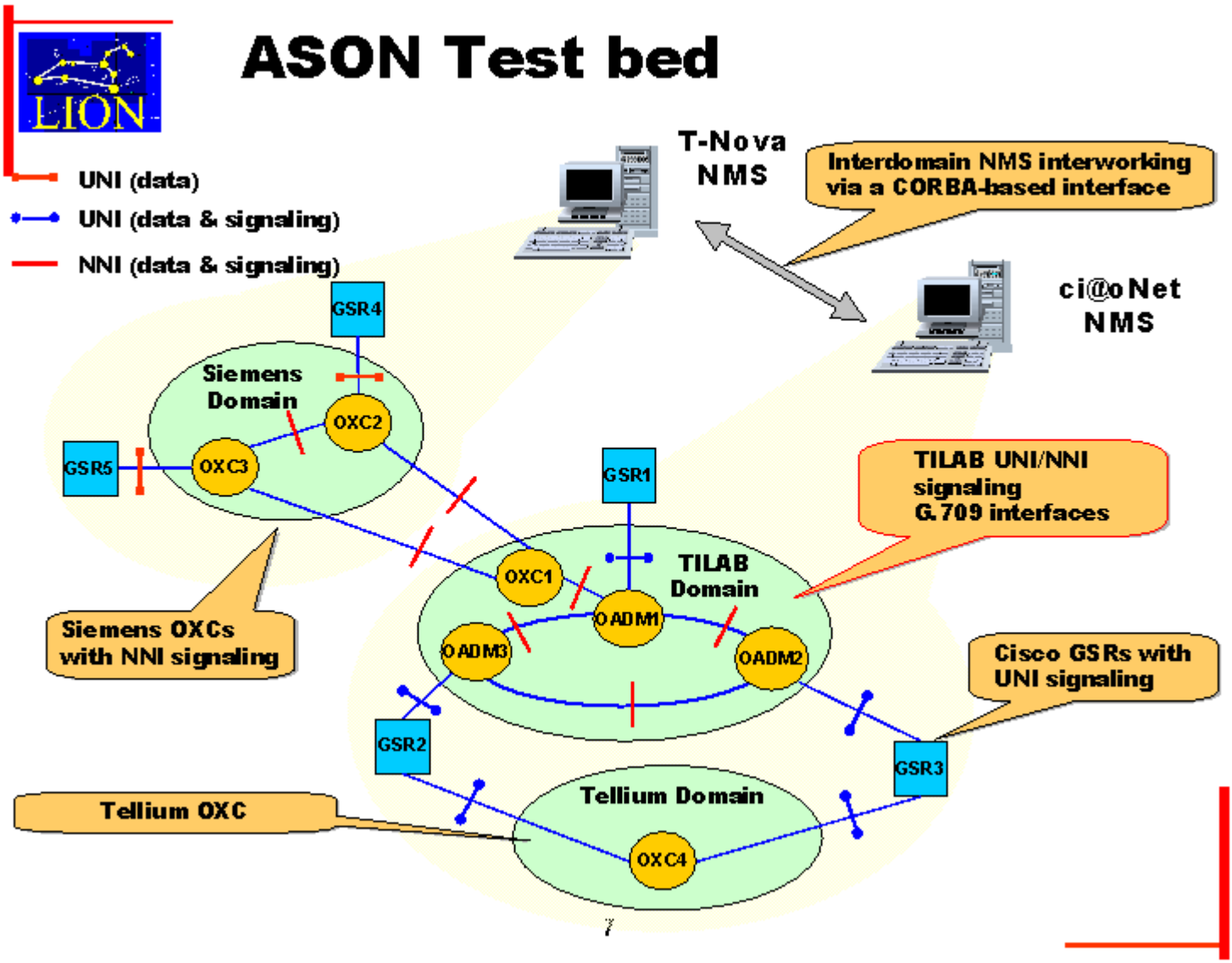
- Context
  - Evolution of current transport networks towards next generation optical networks
- Main Objective
  - Study, development and experimental assessment of an Automatic Switched Optical Network (ASON)
- Project Data
  - Starting date : Jan-2000
  - Duration : 36 *months*
  - Total Cost : 10,686,236 *EURO*
  - EC Contribution : 5,499,951 *EURO*

Objectives of the Project

- Definition of architecture and functional requirements for next generation optical networks (e.g. ASON and G-MPLS)
- Identification of resilience strategies for multi-layer networks
- Cost evalutation of IP over ASON solutions (case studies)
- Definition of a network management view for ASONs
- Design and implementation of two interworking Network Managers via a CORBA interface
- Design and implementation of UNI and NNI
- Design and implementation of Optical Control Planes
- Development of a test bed IP over ASON

Emerging Network Requirements

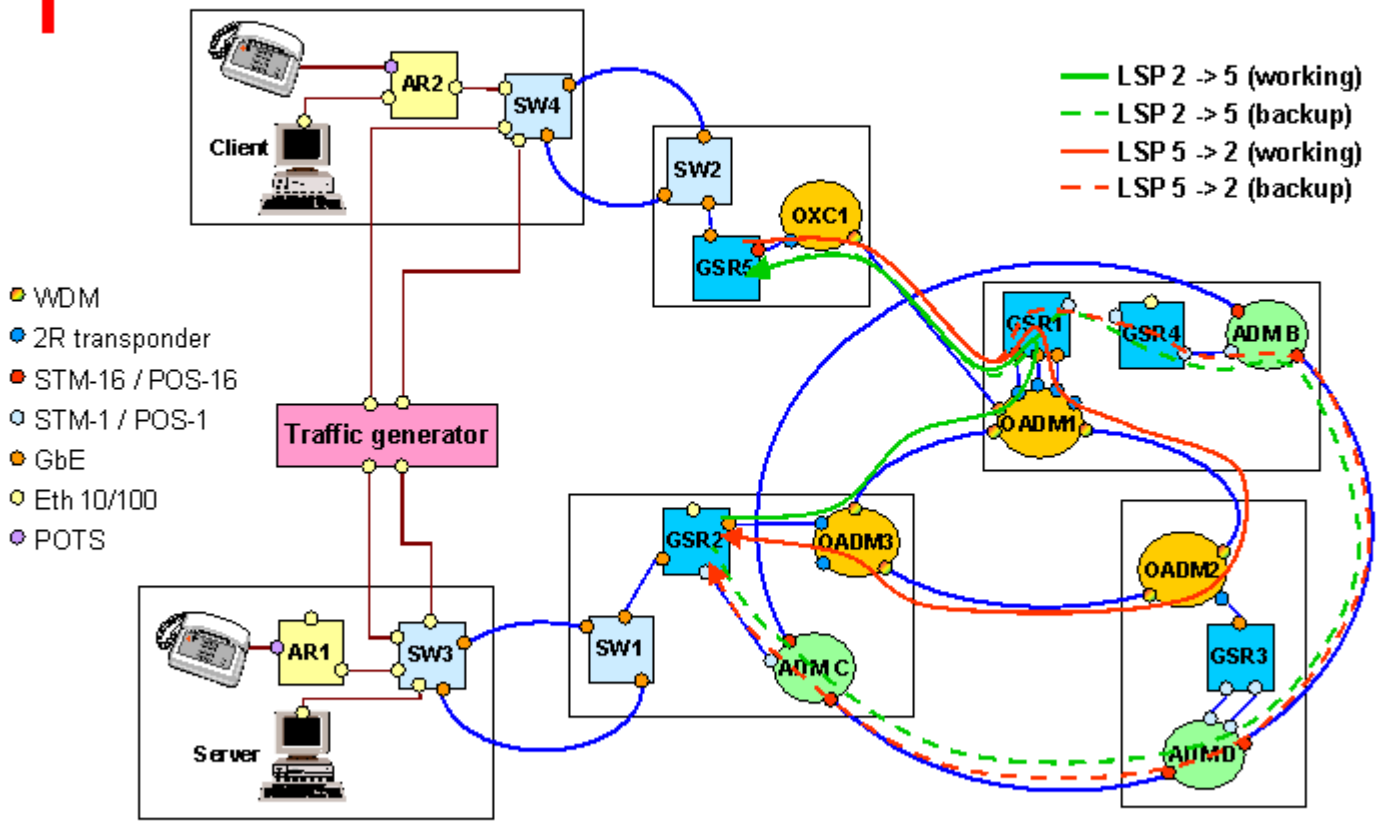
- Convergence of voice-video-data applications over the same infrastructure
- Reduced complexity and de-layering
- Higher penetration of opt. transport services
- Flexible and cost-effective end-to-end provisioning of optical connections
- Optical re-routing and restoration
- Support of multiple clients (metro)
- Multiple levels of QoS
- Optical Virtual Private Networks (OVPN)


ASON Test bed
LION
UNI (data)
UNI (data & signaling)
NNI (data & signaling)
T-Nova NMS
Interdomain NMS interworking via a CORBA-based interface
ci@oNet NMS
GSR4
Siemens Domain
OXC2
GSR5
OXC3
GSR1
TILAB UNI/NNI signaling G.709 interfaces
OXC1
TILAB Domain
OADM1
OADM3
OADM2
Siemens OXCs with NNI signaling
Cisco GSRs with UNI signaling
GSR2
GSR3
Tellium Domain
Tellium OXC
OXC4

Outline

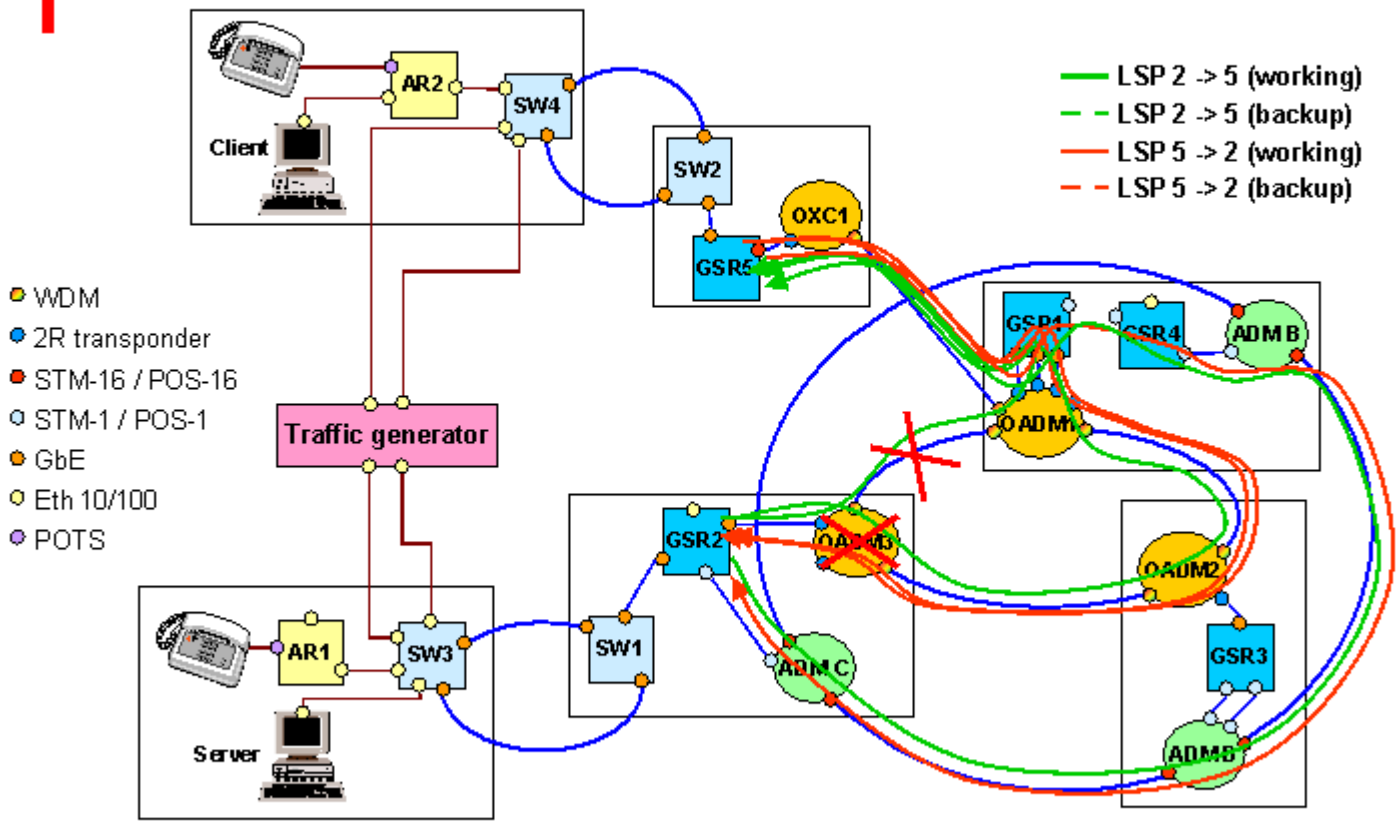
- IST-project LION
  - Layers Interworking in Optical Networks
  - Overview – objectives
  - Testbed
- Progress: 2 examples
  - Recovery experiments on testbed
  - Design of survivable multilayer IP over Optical Network

Measurements: MPLS rerouting



9

Measurements: Optical Protection



10

Packet Loss Measurement

	Optical protection			MPLS rerouting		
Lost Packets	min	ave	max	min	ave	max
GSR2 → GSR5 (250 Byte)	831	936	1140	375 152	711 490	1 796 002
GSR5 → GSR2 (250 Byte)	0	0	0	321 236	378 746	574 654
GSR2 → GSR5 (1500 Byte)	190	232	353	64 131	168 622	310 154
GSR5 → GSR2 (1500 Byte)	0	0	0	45 441	73 707	122 770

≈ 25 ms

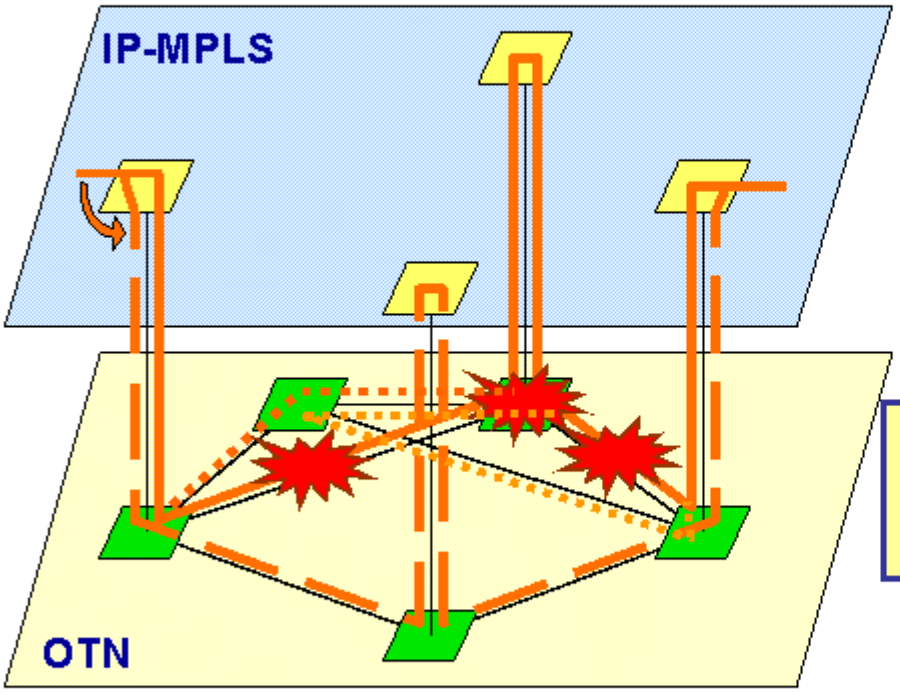
≈ 7 ÷ 39 s

GbE does not allow fast failure detection
--> HELLO detection scheme (+/- 40 sec)

Outline

- IST-project LION
  - Layers Interworking in Optical Networks
  - Overview – objectives
  - Testbed
- Progress: 2 examples
  - Recovery experiments on testbed
  - Design of survivable multilayer IP over Optical Network

Multilayer survivability: bottom-up strategy



MPLS LSP (working)

MPLS LSP (protected in OTN)

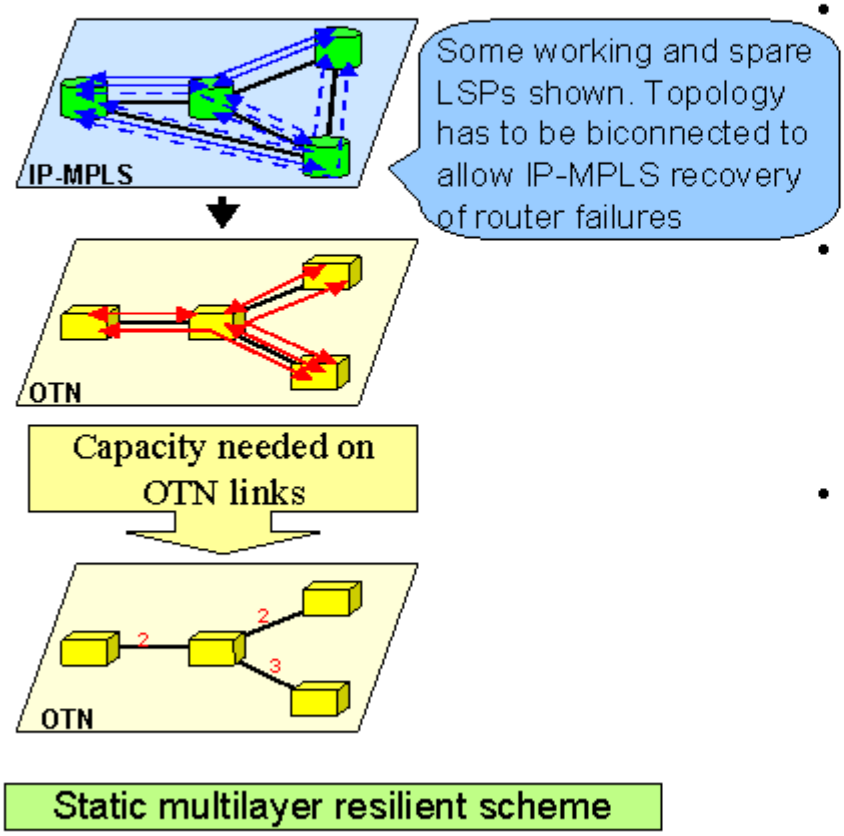
Backup MPLS LSP

Optical node failure → optical recovery can only restore transit lightpaths

Some actions at the IP-MPLS layer is needed.

13

Static recovery schemes

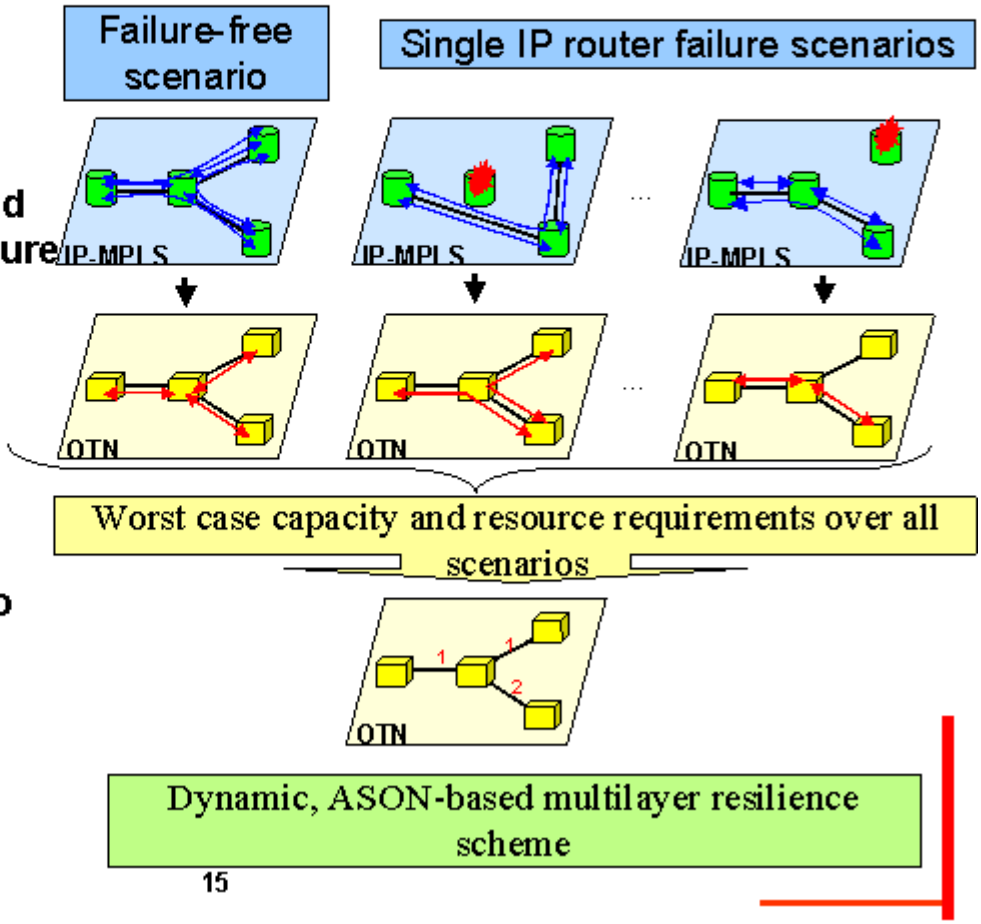


Static multilayer resilient scheme

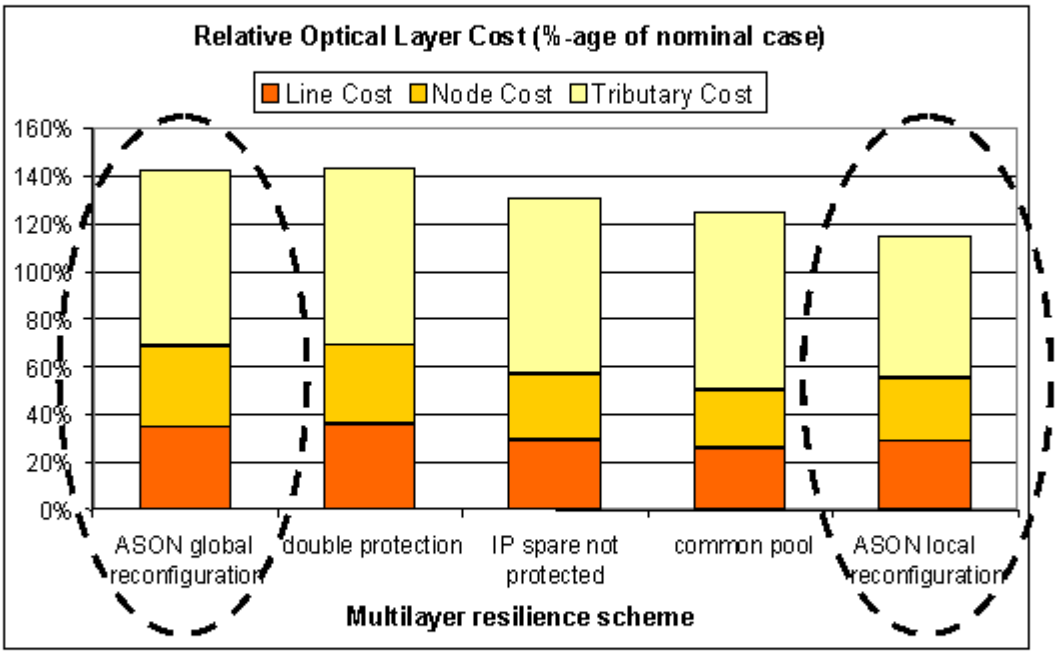
- **Recovery scheme at the IP-MPLS layer (MPLS rerouting, local protection,…) -> IP topology has to be biconnected**
  - **Assumption: MPLS rerouting**
- **Recovery scheme at the OTN layer (1+1 protection, link restoration,…)**
  - **Assumption: dedicated path protection**
- **Multilayer scheme**
  - **Options to support IP spare capacity**
    - double protection
    - IP spare not protected
    - common pool
  - **Assumption: bottom-up escalation strategy**

Dynamic ASON-based recovery schemes

- Dimensioning of multiple IP layer topologies
  - 1 for nominal (fault-free) scenario
  - 1 for each topology related with a single IP router failure
- Capacity needed in OTN is calculated for each dimensioning, taking into account capacity needed to recover from OTN failures (by means of 1+1 path protection)
- Resources needed in OTN to recover from all possible single IP or OTN failures are the worst case resource requirements of the OTN taken over the failure-free scenario and all IP failure scenarios



Cost comparison



- **ASON local reconfiguration needs fewest capacity**
- **ASON global reconfiguration ≈ double protection**

Note: ASON reconfiguration schemes have better fault coverage

16

For Further Contacts

Project Leader of IST LION

antonio.manzalini@tilab.com

Phone: +39 011 2285 817