Scuola Superiore Sant’Anna di Studi Universitari e di Perfezionamento

Software and Communication Platforms for High-Performance Collaborative Grid

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Italy-Tunisia Research Project
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1° year plenary meeting, Tunis, March 29, 2007

Outline

- Current status of the Pisa Lab & Research Unit
- Positioning of the Research Unit within the project
- Planned (already) ongoing activities and first year results
- Future activities

The Pisa group active on the project

- **Myself, Piero Castoldi,** Associate Professor, Head of Group
- **4 Researchers**
  - Luca Valcarenghi
  - Isabella Cerutti
  - Filippo Cugini, CNIT
  - Fabio Baroncelli, CNIT
  - Barbara Martini, CNIT
- **3 PhD Students**
  - Valerio Martini (2° year)
  - Nicola Sambo (2° year)
  - Ramzi Tka (1° year), PhD student at University Manouba, currently at Scuola Superiore Sant'Anna for 6 months

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Positioning of the Research Unit

WP1 – Hardware and software platforms

1 A) Infrastructure level: Next generation optical network

- 1.1 A) Traffic engineering and resilience in IP/MPLS networks over WDM networks
- 1.2 A) Control plane integration of IP/MPLS access/metro network with core WDM networks
- 1.3 A) End-to-end support of QoS

WP2 – Integration and assessment of solutions

2A) Infrastructure level: Assessment of networking solutions

WP3 - Joint experiments within the distributed laboratory

3.2) Remote measurements platforms

Planned (already on-going) activities

WP1

- Provisioning and resilience schemes for optical networks
- Path Computation Element and GMPLS protocol suite extensions (collaboration with Manouba)

WP2

- Service oriented network architectures

WP3

- International topology discovery and traffic measurements (collaboration with Manouba)

Dissemination

- International Master on Communication Engineering http://www.imcne.sssup.it
- Internal workshop every 3 months

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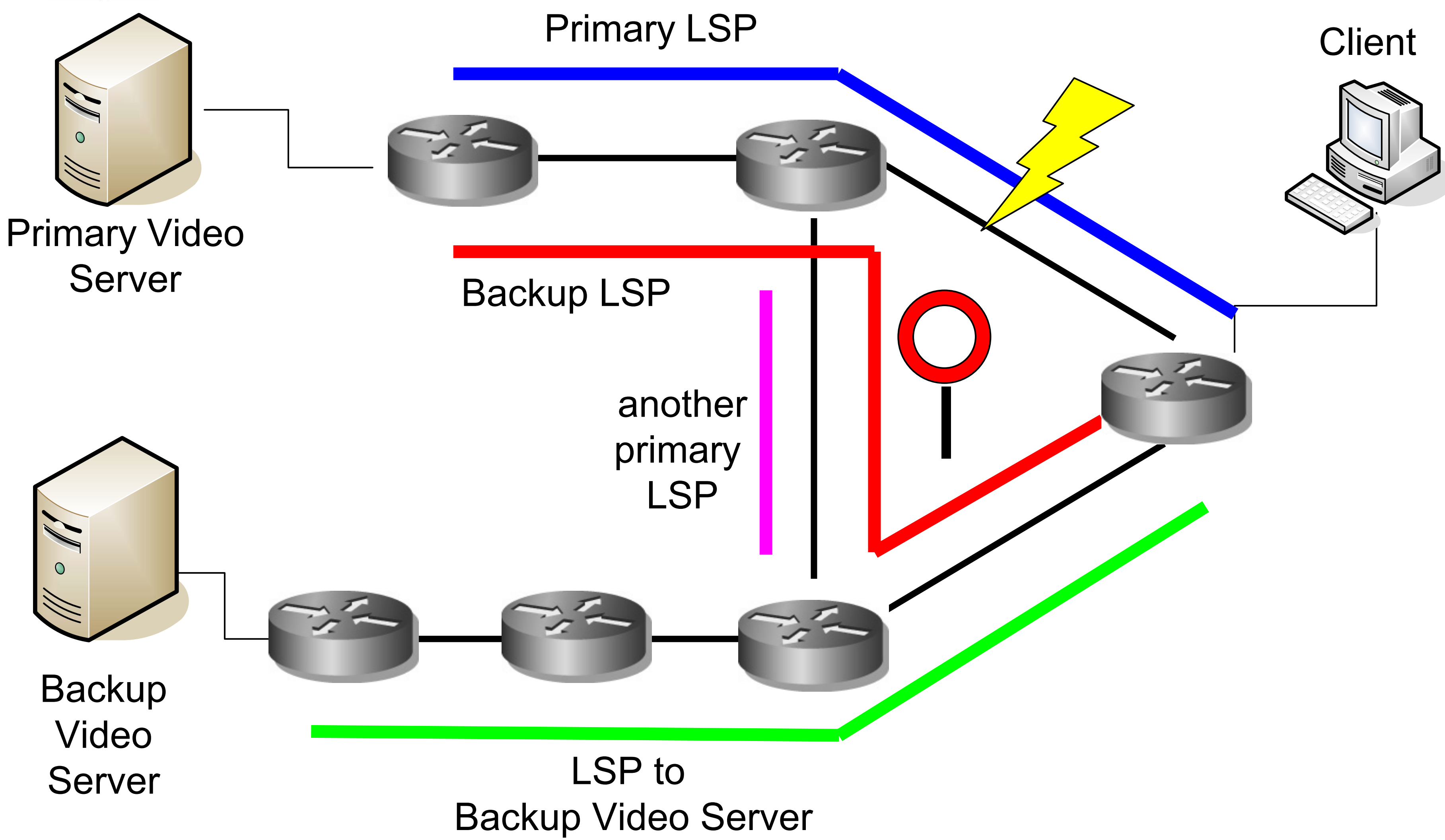
WP1 – Summary of results
Integrated network-application resilience schemes (1)



- Integrated Fault Tolerance Advantages: Path Restoration + Service Replication

WP1 – Summary of results

Integrated network-application resilience schemes (2)

Network dynamic restoration	Server migration	
	Network coordinated (Client–driven) (needs 2 LSPs, hence waste of resources)	**Network integrated (Agent based)** (requires additional functionality, but optimal resource utilization)
	Fault detection	
Connection tear down by transit router	Client buffers underflowing	Connection tear down by Ingress router
	Fault notification	
Notification to the ingress router	Automatic	Notification to Service Agent
	Fault recovery	
Connection rerouting	Client switches-over	• Service Agent setup a new connection from another server • Client switches-over

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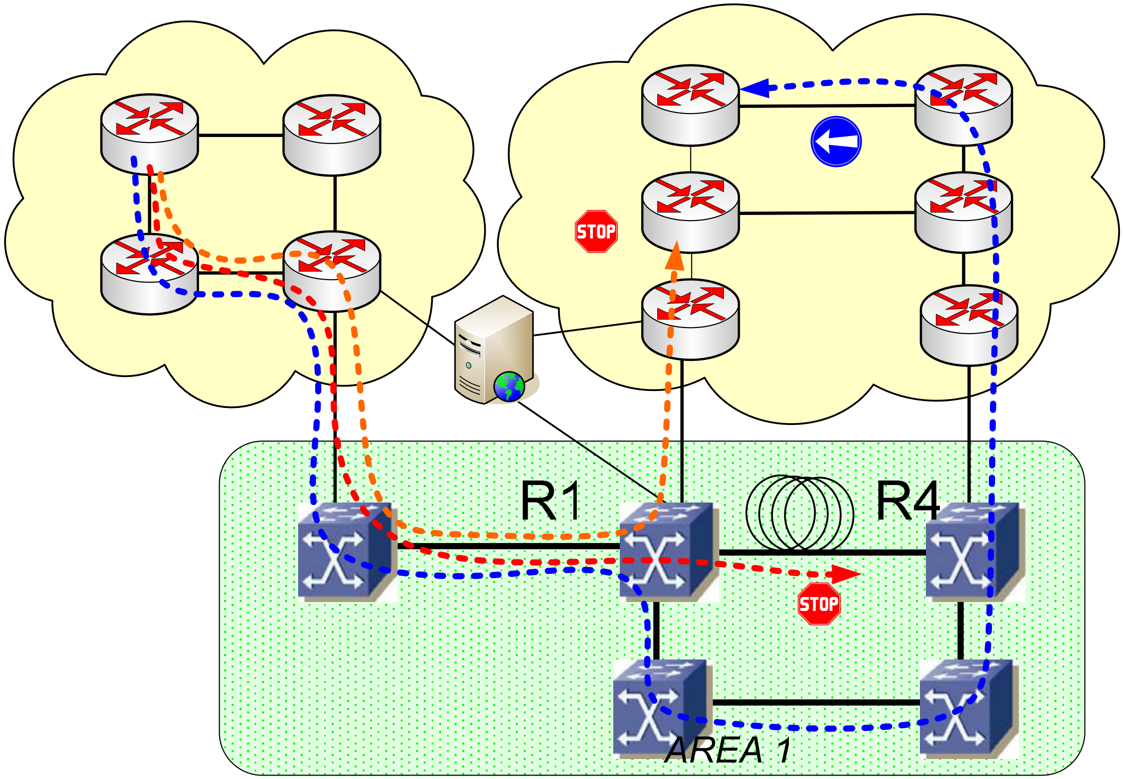
WP1 – Summary of results

Experimental validation of impairment-aware PCE



SCENARIO

- 2 OSPF Areas + Optical Layer (5 PXCs)
- LSP request R1-R8
- Link R9-R10 fully reserved
- Optical Gigabit Ethernet Link PXC2-PXC5 affected by high attenuation (> 20 km)

- Preliminary result: PCE reads topology file and traffic matrix requirements, elaborates TE solution and configures OXCs in less than 0.320 s (optical domain)
- Multi-layer configuration : OXC configuration + LSP setup time < 11 seconds.

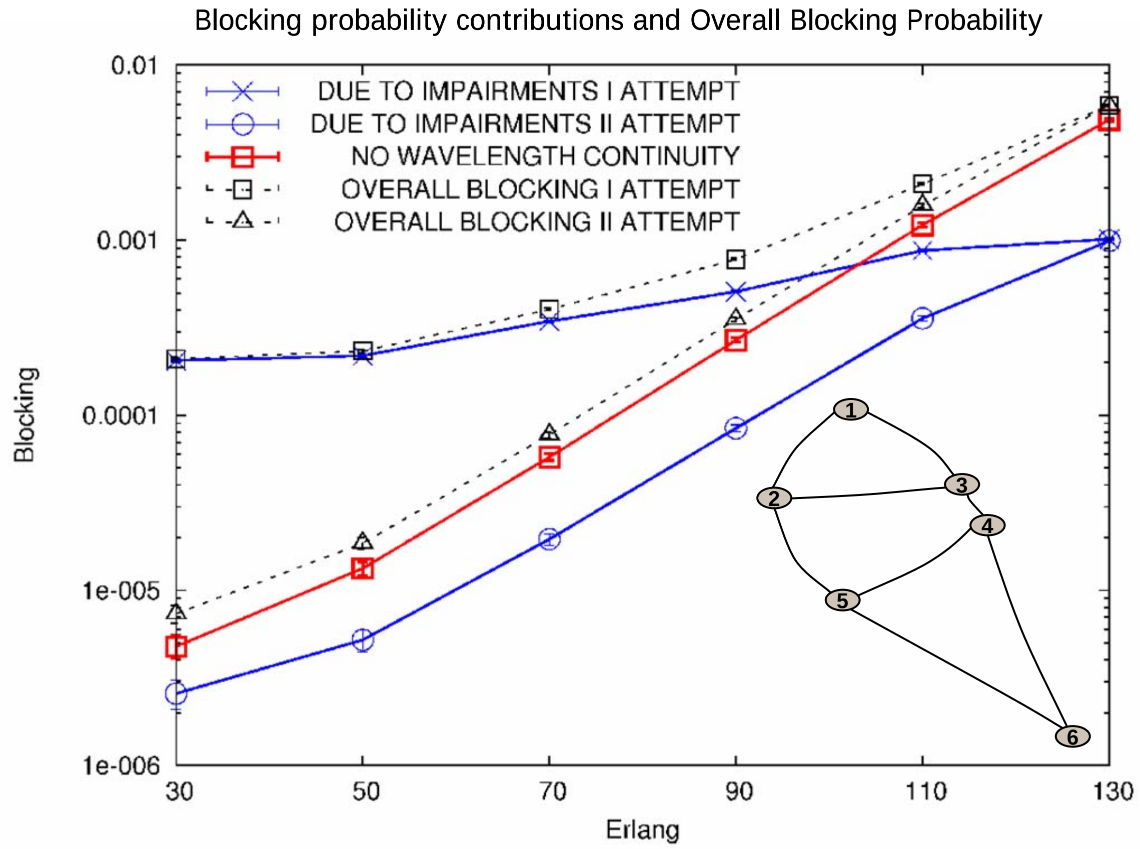
R2

R10

WP1 – Summary of results

Theoretical validation of impairment-aware GMPLS

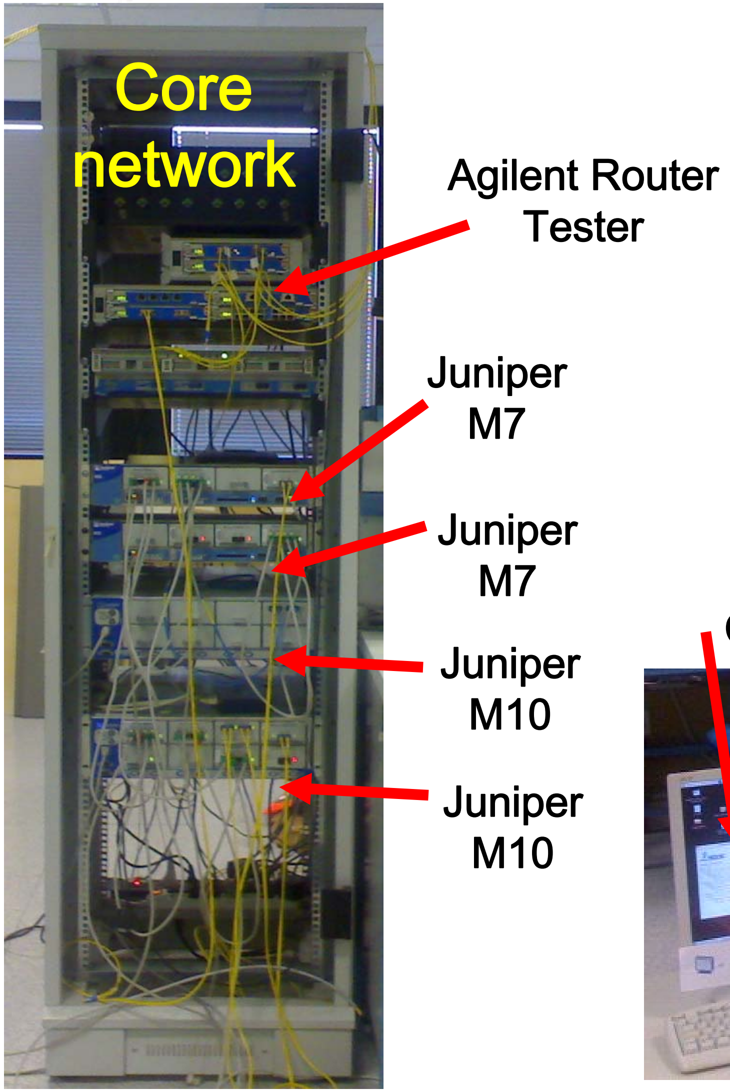
- Topology:
  - Nodes: add/drops, MeMs, Equalizers
  - Link Spans: SMF, DCF, Amplifiers, VOA, 32 channels
- Distributed routing with "global state information": shortest path (in terms of hop) preferred
- If no path satisfied Wavelength Continuity: lightpath is blocked
- 2 Attempts for Blocking due to physical impairments

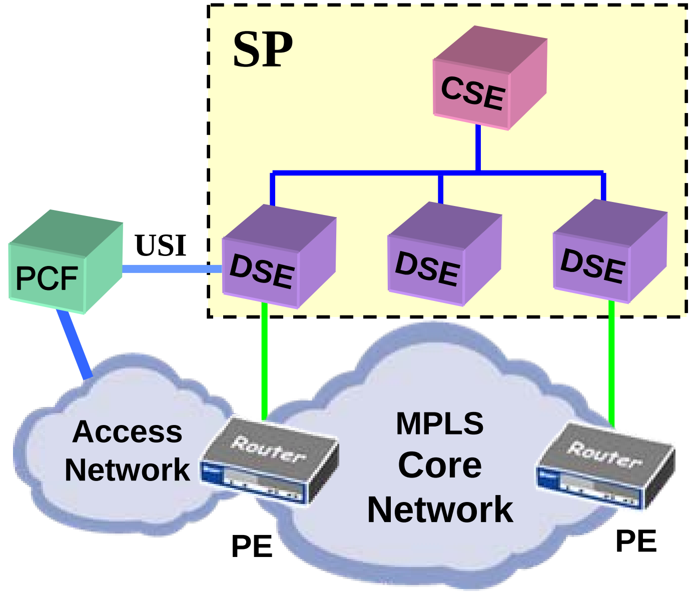


- Increasing Traffic Load: no shortest path available → other paths: longer than the shortest paths → excessive impairment accumulation
- II Attempt reduces blocking due to Impairments: need of presence of at least a Feasible Path

WP2 – Summary of results

Service-oriented network architectures (1)

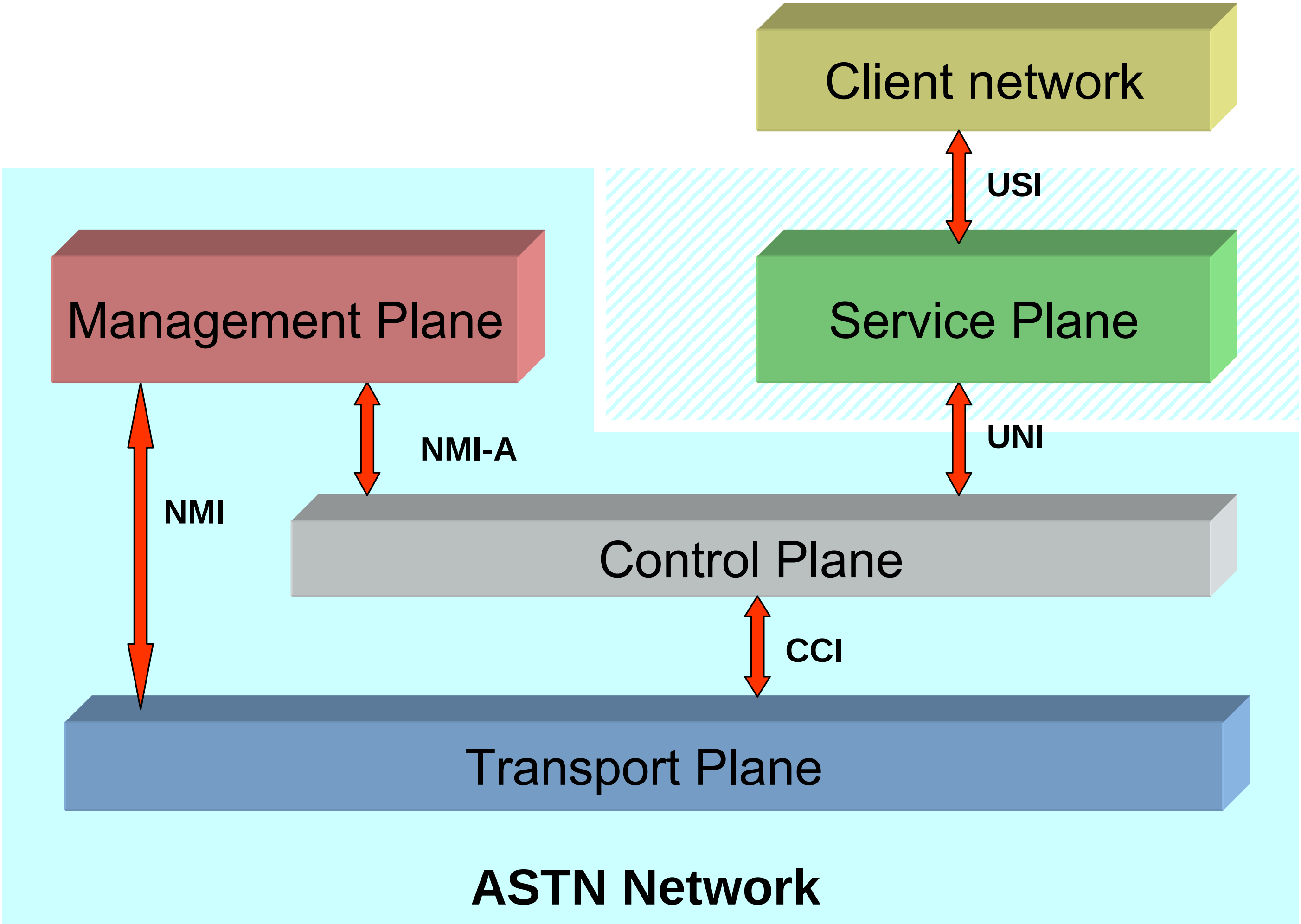




The testbed is used to provide audio/video services with end-to-end guaranteed QoS

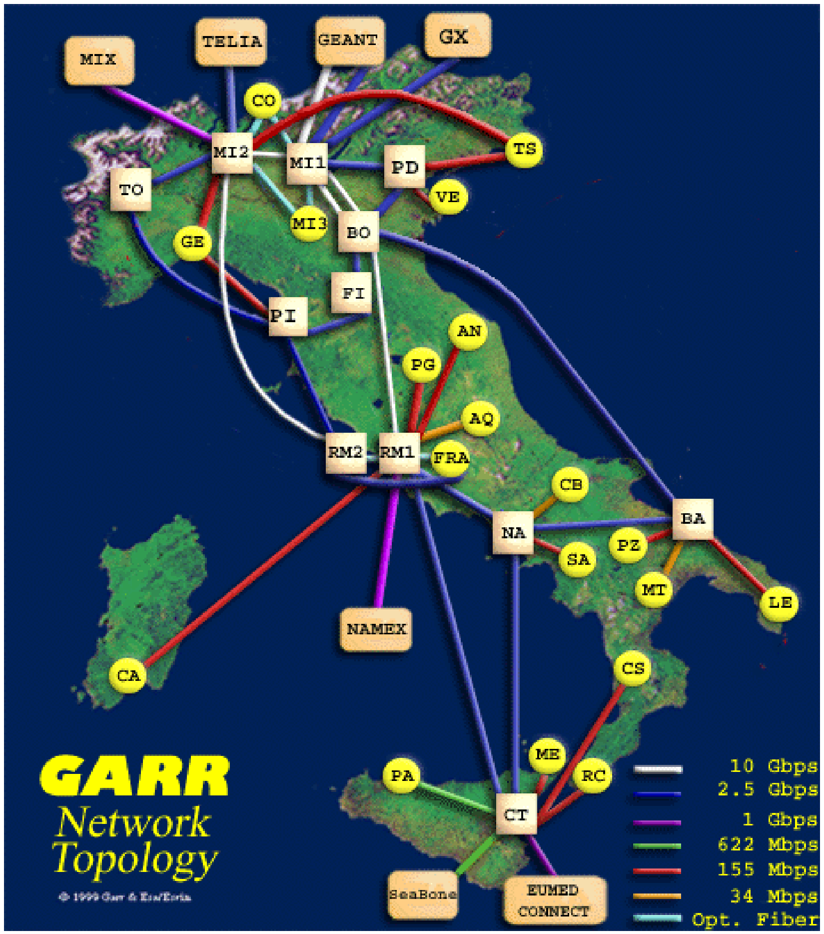
WP2 – Summary of results

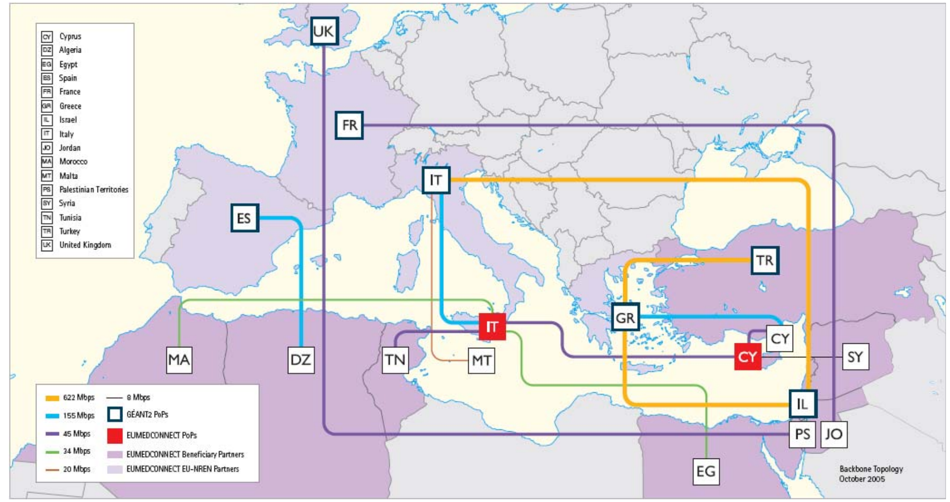
Service-oriented network architectures (1)

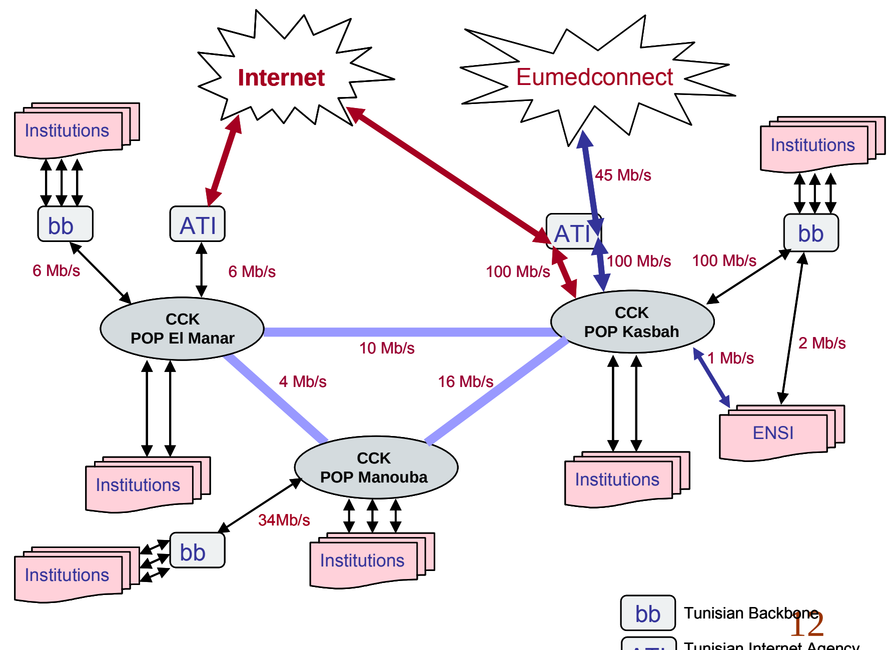


WP3 – Summary of results

Network measurements (1)







Tunisian Network – Apr 2006

WP3 – Summary of results
Network measurements (2)

- Network connection SSSUP-ENSI [thanks to Hela Boucetta]
  1. ENSI (Tn) – CCK POP Kasbah (Tn) (@ 1 Mbps)
  2. CCK POP Kasbah (Tn) – POP ATI Tunisi (Tn) (@100 Mbps)
  3. POP ATI Tunisi (Tn) (@100 Mbps) - POP Eumedconnect Catania (It) (@ 45 Mbps)
  4. POP Eumedconnect Catania (It) – POP Géant Milan (It) (@155 Mbps)
  5. POP Géant Milan (It) – POP Garr Milan1 (It) (@10 Gbps)
  6. POP Garr Milan1 (It) – POP Garr Milan2 (It) (@10 Gbps)
  7. POP Garr Milan2 (It) - POP Garr Torino (It) (@2.5 Gbps)
  8. POP Garr Torino (It) - POP Garr Pisa (It) (@2.5 Gbps)
  9. POP Garr Pisa(It) – SSSUP Central Office (Pisa, @100 Mbps)
  10. SSSUP Central Office (Pisa) – SSSUP Ircphonet (Pisa) (@1 Gbps)
- Network connection SSSUP-ESSTT [thanks to Heithem Abbes]
  - The reply to traceroute queries was not always returned
  - Identification and the analysis of the strict route is not permitted.
  - Route analysis from SSSUP to ESSTT performed in September 2006 and November 2006 determined different routes
  - Compared to the SSSUP-ENSI route, the two routes between SSSUP and ESSTT do not exploit academic and research backbone networks (e.g., GARR and EUMEDCONNECT). Indeed traffic packets flow through the backbone internet networks.
- Network connection ENSI-ESSTT
  - Traceroute analysis shows that the packets between the two considered Tunisian institutions flow through the backbone internet networks.
  - In general this route offers good throughput, but sometimes packets experience a very high delay.
  - Moreover, sometimes packet loss is experienced.
  - Results confirm that the bandwidth bottleneck is located in the access networks.

1° year complete list of publications
(with explicit acknowledgement to the project)

- L. Valcarenghi, F. Paolucci, L. Rossi, F. Cugini, P. Castoldi, “Integrated Multi-Layer Bandwidth Recovery for Multimedia Communications”, IEEE Workshop on High Performance Switching and Routing (HPSR 2006), 7-9 June 2006, Poznan, Poland

- F. Baroncelli, B. Martini, P. Castoldi, "A robust XML-based approach for network protocols implementation", Proc. of 2° Reliability issues in Next Generation Optical Networks (RONEXT) Workshop, colocated with ICTON '06, Nottingham, U.K., 18-22 June 2006 (Invited paper)

- F. Baroncelli, B. Martini, L. Valcarenghi and P. Castoldi "Service Composition in Automatically Switched Transport Networks", IEEE International Conference on Networking and Services (ICNS'06) July 16-18, 2006, Silicon Valley, USA

- F. Baroncelli B. Martini P. Castoldi, "Autonomic service provisioning for Automatically Switched Transport Network", Proc. of NGNCON 2006, Jeju, Korea, July 2-6, 2006

- B. Martini F. Baroncelli, V. Martini P. Castoldi "On-demand VPN service provisioning in application-controlled Transport Network", Proc. of NGNCON 2006, Jeju, Korea, July 2-6, 2006

- N. Sambo, A. Giorgetti, N. Andriolli, F. Cugini, L. Valcarenghi, P. Castoldi, "GMPLS Signalling Feedback for Encompassing Physical Impairments in Transparent Optical Networks", IEEE Globecom 2006 - Advanced Technologies and Protocols for Optical Networks, 27 Nov. - 1 Dec. 2006, S. Francisco, USA.

Future activities

Research

- Further pursue on-going activities
- Add new WP1 activity: wired-wireless (WiMAX/optical) network integration strategies
- Increase collaboration with partners
- Identify network infrastructure, reasonably ready at the beginning of the 3° year
- Further exchange of students/faculties

Dissemination

- Recommend an annual workshop for results exchange
- Joint Journal/conference publications