Software and Communication Platforms for High-Performance Collaborative Grid

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

Primary LSP

Backup LSP

another primary LSP

LSP to Backup Video Server

Client

Primary Video Server

Backup Video Server

• Integrated Fault Tolerance Advantages:
  Path Restoration + Service Replication
## WP1 – Summary of results
### Integrated network-application resilience schemes (2)

<table>
<thead>
<tr>
<th>Network dynamic restoration</th>
<th>Server migration</th>
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<tbody>
<tr>
<td></td>
<td><strong>Network coordinated</strong>&lt;br&gt;(Client-driven)&lt;br&gt;(needs 2 LSPs, hence waste of resources)</td>
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<tr>
<td><strong>Fault detection</strong></td>
<td></td>
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<tr>
<td>Connection tear down by transit router</td>
<td>Client buffers underflowing</td>
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<tr>
<td><strong>Fault notification</strong></td>
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<tr>
<td>Notification to the ingress router</td>
<td>Automatic</td>
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<tr>
<td><strong>Fault recovery</strong></td>
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<tr>
<td>Connection rerouting</td>
<td>Client switches-over</td>
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WP1 – Summary of results
Experimental validation of impairment-aware PCE

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.

Scenario:
- 2 OSPF Areas + Optical Layer (5 PXC)
- LSP request R1-R8
- Link R9-R10 fully reserved
- Optical Gigabit Ethernet Link PXC2-PXC5 affected by high attenuation (> 20 km)
**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
Service Plane Implementation

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)
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)


- 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


- 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

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