A testbed of terabit IP routers running MPLS over DWDM

TF-NGN meeting
18-06-2001

http://www.alcatel.be/atrium
The objectives of the presentation

Present the Atrium project:
- objectives
- partners
- test bed deployment and access to the testbed
- research activities
- experiments

Present the Alcatel A7770 as Core Router
- used in the Atrium project

Look/discuss
- proposals to run experiments on the testbed
- interconnection of the European testbeds.
A testbed of terabit IP routers running MPLS over DWDM

- Life configuration of Core IP routers
- Focus on MPLS but also on native IP
- In an IP-MPLS DiffServ domain
  - Relation between QoS and MPLS
  - Traffic Engineering
- DWDM: Used as transport medium between POPs
- In POP
  - Test equipment: Smartbits, Router tester/QA robot, Adtech
  - Solaris and Linux stations
  - Alcatel PE, Juniper and Cisco routers
The Atrium Project

Duration: 30 months:

Objectives of the Project:
- Develop an advanced testbed for experiments and validation of an Advanced Terabit Router (ATR) : the A7770 RCP
- Research, Design and experiment with a set of traffic management algorithms and protocols
  - Allow the ATR to operate in a Diffserv capable, MPLS based AS.
  - Interconnect the AS with other AS with similar capabilities
- Test the final version of the ATR with very high demanding applications
## Atrium partners & roles

<table>
<thead>
<tr>
<th>Partner</th>
<th>Major Focal Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcatel</td>
<td><strong>Equipment (ATR routers)</strong>&lt;br&gt;<strong>Installation</strong>&lt;br&gt;<strong>Testing</strong>&lt;br&gt;<strong>Coordination</strong>&lt;br&gt;<strong>Demonstration</strong></td>
</tr>
<tr>
<td>FTR&amp;D – France Telecom Mobistar</td>
<td><strong>Network installation and maintenance</strong>&lt;br&gt;<strong>Testing</strong>&lt;br&gt;<strong>Research</strong>&lt;br&gt;<strong>Demonstration</strong></td>
</tr>
<tr>
<td>Universite de Liege</td>
<td><strong>Installation</strong>&lt;br&gt;<strong>Research</strong>&lt;br&gt;<strong>Testing</strong>&lt;br&gt;<strong>Demonstration</strong></td>
</tr>
<tr>
<td>Faculte Universitaires Notre Dame de la Paix Namur</td>
<td><strong>Research</strong>&lt;br&gt;<strong>Testing</strong>&lt;br&gt;<strong>Demonstration</strong></td>
</tr>
</tbody>
</table>
Structure of the Atrium Project

- Installation and Integration of the Network
- Test interoperability of MPLS in a diffserv AS
- Research intra domain TE
- Research inter domain TE
- Demonstration with real applications
- Exploitation & dissemination
- Project Management
Workpackage 0

- Project management and Coordination
  - Coordination of external Liaison, exploitation and dissemination
    - Coordinate visibility at international levels
    - Decide on agreements with third parties
    - Dissemination and exploitations of results
  - Interconnectivity to third party testbeds and experiments
    - M11 : Allow access
    - M14 : give access to 4 non atrium projects
    - M30 : access to minimum 15 projects
Workpackage 0: accommodation of other projects

- Methods to accommodate other projects
  - Collocate equipment with the ATR
  - Interconnect the Atrium project to other infrastructure
    - M7: VTHD: experimental network of FT R&D
    - M24: others
  - Coordination Committee
Workpackage 0: Projects contacted up to now

- Winman: interdomain management of IP and WDM
  - Corba Layer between IP network and IP NMS
- Moicane: constructs remote network islands based on IP QoS, characterised by different access technologies (Italy and Greece). Discussion ongoing to install an extra A7770 in Italy.
- Discussion ongoing to interconnect with Pioneer
  - Using ComNET transmission infrastructure - Germany.
- Interactions with students
- To be contacted: Plage, Garr, GRNET, see list of TN-NGN
Workpackage 1
Installation and integration of the Network

- Deploy 4 PoPs with the A7770 Routing Core Platform
  - Antwerp, Liege and Paris (2)
- Connect the A7770 RCPs to local network elements
  - test the IP forwarding capabilities
  - test the MPLS forwarding capabilities
- Interconnect the PoPs with OC-48 links
  - Isolated AS.
  - Validate the label edge router capabilities
  - Connect with GE ports to host other experiments
- Connect the testbed to external existing networks
Workpackage 1: phases

- Phase 1: stand alone (M1 - M9)
Workpackage 1: phases

- Phase 2: Connected autonomous system (M7)
Workpackage 1: phases

Phase 3: Autonomous system (M10)
Workpackage 1: phases

Phase 4: Connected autonomous system (M11)

AS #x: Renater

AS #y: Belnet

AS #2: VTHD
The A7770 RCP

- **Line cards with distributed forwarding** (slots 2 to 16)
- **Switching fabric** (slots 1 and 18)
- **Route server module** (slot 17)
- **Clock and synchronisation modules** (subassembly)
- **Management server modules** (subassembly)
- **DC powered NEBS, ETSI compliant**
- **Symmetrical dual shelf architecture**
- **Single 7 foot rack** 900 mm wide 700 mm deep

**Atrium**
The A7770 RCP

Easy and Effective Management
- Global management solution
- Cross-domain management
- SLA management
- Traffic engineering

Multiservice IP Platform
- Innovative IP services to generate new revenues

Service Management
- Flexible service deployment at reduced operating costs

Carrier Grade Operation
- High customer satisfaction to secure revenues

Optical IP Internetworking
- SONET, SDH, Ethernet, low cost
- 155 Mb/s up to 10 Gb/s
- 10 Gb/s per board
- Dynamic path allocation
- Co-ordinated multilayer restoration

Guaranteed Service Level Agreements
- Wire speed L2/L3 forwarding
- Flexible filtering, policing, ...
- OSPF, IS-IS, BGP, ...
- DiffServ+
- MPLS

High Performance and Scalability
- 640 Gb/s switching capacity
- Scalable switching technology
- IP Trunking
- Distributed forwarding
- Forwarding table distribution

Non-Stop Networking
- High density system
- Redundant equipment
- Variety of protection schemes
- Hot restart of applications
- On-line system upgrade

Optical IP Internetworking
- SONET, SDH, Ethernet, low cost
- 155 Mb/s up to 10 Gb/s
- 10 Gb/s per board
- Dynamic path allocation
- Co-ordinated multilayer restoration
WP2 : Conformance, Interoperability and Performance testing

- Definition of the testing tools and the systems to be tested
- Stand-alone test: Conformance and Performance of the A7770 & interoperability with selected network components like Alcatel PE, Cisco 12000, Juniper M160
- Isolated AS test: Performance of the 3 node network
  - Forwarding plane: throughput, delay, delay variation
  - Control plane: reactions on topology change
- Connected network tests: Inter-domain conformance, interoperability and the performance of the 2 AS network
- Validation of the network techniques developed by WP3/4
WP3: Intra-domain Traffic Engineering

- Propose and assess protocols and algorithms for intra-domain traffic engineering in MPLS networks.
  - Compute LSPs based on actual traffic profiles
    - Focus on TE-LSPs
    - Decentralized versus centralized schemes
    - Focus on on-line decentralized scheme based on bandwidth reservations and actual traffic
  - Fault tolerance by fast restoration of LSPs
    - Local versus edge-to-edge recovery
    - Precomputed/pre-established versus on demand backup LSPs
    - Performance requirements
      - Speed of repair, loss, delay variation, reordering
    - Scalability requirements (nb. of back-up LSPs)
    - QoS protection
WP3: Intra-domain Traffic Engineering

- Provisioning of QoS in MPLS/Diffserv networks
  - E-LSPs versus L-LSPs
  - E-LSP: more scalable, but less QoS differentiation

- Multicast support in MPLS/DiffServ networks
  - TE-multicast LSPs
  - Fast restoration of multicast LSPs
  - DiffServ QoS support
  - Study of the cost of multicast
  - Multicast transition scheme
WP4 : Inter-domain Traffic Engineering

-Extend traffic Engineering to be useable throughout the Internet (100000 IP subnets and 6500 AS)
  -Mechanism to establish inter-domain LSPs with QOS constraints and fast restoration constraints

-By means of:
  -Detailed analysis of the characteristics of inter-domain traffic via capturing of interdomain traces (M9)
  -Define protocols and mechanisms to support the framework
    -allow interdomain routing to distribute detailed information about link characteristics
  -Evaluate these protocols by simulations and tests.
WP5: Demonstration and Experiments

- Definition of tests to understand the behavior of a network model based on IETFs DiffServ model for QOS and MPLS traffic engineering
- Experiments based on results of WP3 and WP4.
- Identify and build
  - killer application and demonstration
  - Network experiments with platforms from European Projects
WP5: Proposals for Experiments

- data mirroring with high speed networks
- tele teaching between schools
- video conference
- multicast broadcasting
- grid computing
- database recovery and data replication
- distributed caching