ATRIUM

A Testbed of Terabit IP Routers running MPLS over DWDM

Abstract:

ATRIUM is validating high-speed network technologies to allow demanding end-user applications (including on-demand video streaming services, video conferencing, gaming and high-speed GRID computing). The ATRIUM advanced testbed supports QoS (Quality of Service), Multicast, IPv6 and fast restoration of link or node failures in order to demonstrate applications supporting collaborative activities and providing interactive access to information and resources in a way that is not possible in today's Internet.

Objectives:

The objectives of ATRIUM are to develop an advanced testbed to validate an Advanced Terabit Router (ATR) as both a core router and a border router using several highly demanding applications. Included in this is the development and assessment of a set of unified traffic management algorithms and protocols necessary to operate successfully an ATR in an MPLS-based and DiffServ-capable Autonomous System (AS) both intra- and inter-domain, and also the specification and testing of a Network Management System to operate and monitor IP QOS and MPLS enabled Core Networks. ATRIUM will also provide the research community with an advanced testbed containing the only current European-manufactured terabit router.

Technical Approach:

The overall work in the ATRIUM project has followed an incremental phasing:

- Installation of the ATRIUM testbed, creating connectivity between the sites of Alcatel, FranceTelecom R&D and the University of Liege.
- In 2002 the testbed was extended towards PSNC Poland and Telefonica I+D. This connectivity was accomplished using a virtual private network service offered by several NRNs (Renater, RedIris) and GEANT.
- In 2003 an additional site in INTEC Ghent was added to the testbed.
- A set of testing tools was defined and selected. These tools allow extensive interoperability and performance testing of the testbed in heterogeneous and distributed environments.
- Optimised traffic-engineering algorithms were developed. Examples are solutions for the dynamic calculation of LSPs (Labelled Switched Paths) on the basis of actual traffic profiles, fast restoration in case of failures, and for the provision of QoS and Multicast in DiffServ/MPLS networks.
- Development of protocols and mechanisms to support QoS and fast restoration across inter-domain boundaries in MPLS based networks.
- Exploitation of the testbed with a variety of experiments to better understand the behaviour of an operational terabit core network with the aim of proving that the type of backbone deployed in this project is recommended for the future.

Testbed:

The ATRIUM testbed is an IP/MPLS network based on Alcatel A7770 Core routers, interconnected via 2.5 Gigabit per second interfaces. Test equipment and routers of other vendors were used to perform the MPLS-QOS related interoperability tests. The testbed is interconnected to the France Telecom experimental network VTHD, the relevant NRENs (National Research and Educational Networks) such as BELNET, RedIris, Pol34 and Renater and the European backbone GEANT.

Experiments:

Experiments have been set up on the ATRIUM testbed in order to analyse and study the requirements and service availability (using Diffserv QOS, MPLS and network resilience) of a set of user applications and of Grid middleware. Performance degradation on distributed GRID middleware platforms interconnected via long distance network has also been studied. Due to the large distances of these platforms, the GRID middleware has to cope with significant delay and jitter.

Applications:

The testbed has been integrated with Multimedia terminals running advanced user applications like multi-party video and voice conference, video streaming and gaming. Grid middleware developed in other IST projects has been reused to measure the effect that a pan-European network has on the performance of this middleware.

Innovation:

The ATRIUM network is built on the ALCATEL 7770 RCP core router which comprises an innovative state-of-the-art hardware and software architecture designed to offer wire-speed performance, reliability, scalability and advanced features like non-stop networking, DiffServ IP, IPv6 and MPLS. The project proposes innovative mechanisms to compute LSPs dynamically according to the actual load of the network, rather than according to the reserved traffic profiles. This will improve the utilisation of the network and thereby increase the profit of the network provider, not only for best effort, but also for traffic profiles with associated QoS. Fast restoration of the data paths, multicast traffic and inter-domain traffic engineering are other key innovation topics.

Results:

The main results of ATRIUM have been

• Establishment of a non-stop, DiffServ-capable, MPLS and IPv6 based terabit core network, with intra and inter-domain and border router capability.

• The assessment of performance and interoperability on real size networks.

• A set of traffic engineering algorithms, providing QoS and Multicast in MPLS based networks and prototype implementations.

• Intra- and inter-domain protocols and mechanisms to support QoS and fast restoration in MPLS based networks.

• Proof of the major advantages of the testbed by means of multimedia applications and GRID middleware.

- A number of contributions to IETF for standards on inter-domain traffic engineering using BGP, MPLS-TE and QOS
- Deployment and testing of an inter-domain Layer 2 VPN to interconnect the Spanish and Polish testbed site to the core testbed. The layer 2 VPN uses inter-domain MPLS connections and is provisioned in the European IP backbone GEANT and the National Research networks Rediris and Renater. Successful demonstrations covering MPLS, QOS, Multicast and Ipv6 with live video streams at ECOC and IST conferences.
- Testing and evaluation of A7770 core routing technology with GEANT, National Research Networks, and PSNC with the goal of introducing the router in the core IP networks of these organisations.

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