The European project TEQUILA organised a workshop on quality of service (QoS) and service level agreements (SLAs) in IP networks and the Internet. The main question is how voice over IP and, more generally, multimedia can be deployed over the Internet. The focus of the workshop was on QoS guarantees for value-added IP services and the modeling of service level specifications (SLS), the technical part of an SLA. The workshop was held in Amsterdam on 25-26 January 2001.

The TEQUILA Project and Premium IP Research in Europe

The acronym TEQUILA (IST-1999-11253) stands for Traffic Engineering for Quality of Service in the Internet, at Large Scale. TEQUILA’s main objective is to study, specify, implement, and validate service definition and traffic engineering tools for the Internet. The TEQUILA system should provide both quantitative and qualitative service guarantees through planning, dimensioning, and dynamic control of traffic management techniques based on DiffServ. The project addresses the following technical areas: (a) specification of static and dynamic, intra- and interdomain SLSs; (b) protocols and mechanisms for negotiating, monitoring, and enforcing SLSs; (c) intra- and interdomain traffic engineering schemes to ensure that the network can cope with the contracted SLSs within domains and in the Internet at large.

TEQUILA constitutes, together with the AQUIA and CADENUS projects, the European IST project cluster Premium IP, which deals with the deployment of value-added IP services over the Internet. These projects were well presented at the workshop, resulting in fruitful discussions and exchange of ideas (see the box “Workshop Speakers and Program”).

The Challenge: QoS over the Internet

Today’s Internet applies best effort IP forwarding. The network attempts to deliver all traffic as soon as possible within the limits of its abilities, but without any guarantees related to throughput, delay, delay variation (jitter), and packet loss. It is up to the end systems to cope with network transport impairments. The best-effort forwarding model works fine so far because most applications running on IP are low-priority and low-bandwidth data applications with high tolerance for delay and delay variations. The deployment of QoS-based value-added IP services over the Internet is one of the most exciting challenges that service providers currently try to address. Internet service providers (ISPs) are seeking to generate new revenues beyond the low- or zero-income best effort paradigm. Telecom deregulation and emerging voice over IP (VoIP) technology open up new markets and potential business. Traditionally, telephone providers (telcos), on the other hand, fear the competition of these ISPs and are moving toward an integrated data-voice networking solution aimed at cost optimization and new service offerings.

SLS and Standardization Efforts at the IETF

Members of the TEQUILA project introduced a first Internet draft (“SLS — Contents, Parameters, and Semantics”) on the SLS topic in June 2000. Currently a second version of this draft and a proposal for a service level usage and specification framework are available at the IETF Webpage:

http://www.ietf.org/internet-drafts/draft-tequila-sls-00.txt

These drafts, together with two other proposals of AT&T and the IST-AQUIA project, are currently discussed on a public mailing list: sls@ist-tequila.org.

To subscribe to the list send an email to majordomo@ist-tequila.org with the sentence:

subscribe sls@ist-tequila.org in the body and nothing in the subject line.

Workshop Speakers and Program

- Next-Generation Networks in the European IST Program (Paulo De Sousa, IST Project Officer)
- Users, Pricing and Resource Reservation — Managing Expectations (Jon Crowcroft, UCL, M3I Project)
- Negotiating, Subscribing and Invoking Value-Added IP Services (Danny Goderis, Alcatel, TEQUILA Project)
- Service Creation in SLA Networks (Michael Smirnov, GMD Focus, Cadenus project)
- SLA/SLS in Service Creation for Premium IP (Giovanni Cortese, Cadenus project)
- QoS Monitoring and SLS Auditing (Victor Reijis, Heanet/Surfnet, TERENA TF-NGN)
- Service Specification and TE for the Qbone (Ben Teitelbaum, Internet2)
- Providing QoS through Policy-Driven Traffic Engineering (George Pavlou, Unisys TEQUILA project)
- Traffic Engineering Aspects of the VTHD Network (Dominique Delisle, France Telecom R&D)
- Adaptive Resource Control for QoS Using an IP-Based Layered Architecture (Bert Koch, Siemens, AQUIA project)
- On QoS & Traffic Engineering and SLS-Related Work (Christophe Diot, Sprint Labs)
- The Statistical Nature of Traffic and Its Impact on the Realizability of QoS Guarantees (James Roberts, France Telecom)
- Inter-Operator Management Framework for QoS-Enabled IP Services (Istvan Cselenyi, Telia-Eurecom EQUIP Project)

Demand: Service Level Specifications for the Internet

The workshop focused on two related topics: first, the technical modeling and monitoring of customer demands through SLSs; second, the QoS technologies required to meet these demands, including the provisioning, management, and traffic engineering (TE) of IP networks. Since value-added IP services are likely to be provided over the whole Internet, their corresponding QoS will be based on a set of technical parameters on which both customers and service providers will have to agree. Such agreements, and especially the negotiations preceding them, will be greatly simplified in the presence of an unambiguous set of technical SLS parameters. After signing the agreements and specifying the SLSs, it is further the task of the service provider to meet customer demands through network management and traffic engineering. The customer expects certain performance from the network, but the operator also attempts to satisfy

(Continued on page 4)
TEQUILA WORKSHOP (Continued from page 2)
these expectations in a cost-effective manner. Therefore, traffic engineering is a basic tool for the operator to accommodate as many as possible of the traffic requests by optimally using the available network resources.

Network Monitoring and Internet Adaptive Control
Several speakers and attendees stressed the importance of the following recent trends in industry and research:

- Monitoring and measurement architectures are becoming increasingly important for providing QoS and service assurance. First, the operator needs to verify whether the QoS performance guarantees committed in SLAs are in fact being met in its network. This requires an in-service verification of throughput, delay, and packet loss characteristics. Second, monitoring may be extremely helpful for proactive control of the network. Monitoring the actual traffic enables operators to refine the reservation over time and drop the level of overprovisioning needed to offer the promised statistical guarantees.
- A relatively new research topic is concerned with Internet adaptive control as an extra hook for providing end-to-end QoS. Mentioned topics include RTCP rate adaptive sources, adaptive multimedia applications, resource control, and policy.

Main Workshop Conclusion
The deployment of voice and multimedia over IP definitely requires premium IP and QoS. Although major parts of the relevant technologies (e.g., IP differentiated and integrated services) have been developed, the current “Internet IP QoS chaos” still remains, and research activities at the European and international levels remain necessary. Resolving Internet IP QoS requires refoosing and clearly specifying the following:

- Determine the relevant business model. There is a clear business driver for IP QoS and multimedia over the Internet. However, the business scenario heavily depends on the type of customer (enterprise, residential, content providers, other service providers) and the type of service (retail, composite, multimedia, virtual private network).
- Analyse the current state and upgrade lifecycle of the ISP network infrastructure and technology. Providing QoS can be done in several ways, such as overprovisioning of the whole network (no control of individual flows), overprovisioning of multimedia services only (“loose control”), or strict admission and resource reservation (“tight control”). The preferred strategy of a service provider heavily depends on its current technologies and type of network (tier 1, metropolitan, access, etc).
- Clearly specify the service type and interface. The customer-provider interface may have significant influence, such as retail (ISP-customer) or wholesale (ISP peering). The IP value-added service must be clearly specified through SLAs/SLAs, including the service guarantees for each service (topology), the traffic characteristics, and the means of controlling the service contract (service assurance, i.e., SLA-monitoring and measurement).

All speakers and attendees stressed the importance of interproject exchange of achievements and ideas. Therefore, an important conclusion for the organization of European research is that similar workshop meetings and the recent NGN project cluster initiative should be further developed.

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NEXT GENERATION NETWORKS (Continued from page 3)
to take the next generation networks where no other networks have gone before, preparing for the coming tidal wave of next generation applications in the Internet, the mobile wireless segment, in the always-on applications and in the formation of appliances, promoting new technologies on a world-wide basis sharing knowledge, experience and interoperability and creating common and solid grounds for the Next Networks,” according to its mission statement.

For more details on the NGN initiative, please visit the NGNI Website: http://WWW.NGNU.org or http://WWW.NGNInitiative.com

ENHANCED MEMBERSHIP PROGRAMS (Continued from page 1)
developments. Limited funding is provided upon submission of annual proposals. The budget of the Chapters Support program has been sharply increasing in recent years, from US$22,000 in 1999 to US$55,000 in 2000 and to US$100,000 in 2001, in accordance with the increase of Chapters’ activity levels. Chapter Chairs are strongly encouraged to take advantage of this program for the promotion of the Chapter activities.

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