Adaptive Resource Control for QoS
Using an IP-based Layered Architecture

GÉANT meets the Users
Brussels, May 22nd, 2002

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SIEMENS

http://www.ist-aquila.org/
Outline

- AQUILA Architecture
- Network Services
- Inter-domain QoS
- AQUILA and GÉANT
- Schedule for 2002
- Outlook and Wishes
Consortium

SIEMENS
Siemens, Germany
NTUA, Greece

Bertelsmann, Germany
Elisa Communications, Finland

Dresden Univ. of Technology, Germany
CoRiTeL, Italy

Salzburg Research, Austria
Q-Systems, Greece

T-Systems Nova, Germany
Telekom Austria, Austria

Polish Telecom, Poland
Warsaw Univ. of Technology, Poland
Architecture

Resource Control Layer

Resource Control

Admission Control

End-user Application Toolkit

QoS Request

QoS Request

Setting

QoS Request

Monitoring Probing Results

Architecture
Traffic Classes

The network operator offers the Network Services to the customer.

Network Services are mapped into traffic classes.

Network operator

DSCP, scheduling and queuing algorithms (e.g. WFQ, RED), router configuration, admission control rules.
AQUILA set of pre-defined network services

<table>
<thead>
<tr>
<th>Network service</th>
<th>Traffic type</th>
<th>Characteristic examples</th>
<th>Application example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premium CBR</td>
<td>constant</td>
<td>small packets, low loss</td>
<td>SIP VoIP</td>
</tr>
<tr>
<td>Premium VBR</td>
<td>variable</td>
<td>large packets, low loss</td>
<td>SIP Video</td>
</tr>
<tr>
<td>Premium MM</td>
<td>adaptive</td>
<td>moderate delay</td>
<td>Streaming Video</td>
</tr>
<tr>
<td>Premium MC</td>
<td>bursty</td>
<td>very low delay &amp; loss</td>
<td>online Game</td>
</tr>
<tr>
<td>Standard</td>
<td>best effort</td>
<td>classical</td>
<td>the rest</td>
</tr>
</tbody>
</table>

Goal: only a few network services to allow clear service differentiation
Why different **Network Services**?  
An application-oriented perspective…

**Applications**

- **With QoS assurances**
  - real-time
    - voice
    - video
  - non-real time
    - FTP, bulk data tr.
    - elastic streaming
    - transactional data

- **NO QoS assurances**
  - Best Effort
  - Best Effort

**PCBR**

**PVBR**

**PMM**

**PMC**

**FTP, bulk data tr. elastic streaming**

**Best Effort**
Why different Network Services? A traffic-oriented perspective…

Traffic

- **TCP flows**:
  - Greedy
  - NO QoS assurances
  - Best Effort

- **UDP flows**:
  - Stat-gain, large pkt
  - With QoS assurances
  - PMM

- **Non-greedy**:
  - NO QoS assurances
  - PMC

- **Greedy**:
  - Stat-gain, small pkt
  - PCBR

- **Best Effort**:
  - NO QoS assurances

PCBR

PVBR

PMM

PMC

Best Effort
Measurements

- E2E
- Host
- EAT
- Synthetic End to End Load

- Edge Device
- Core Router
- Core Router
- Edge Device

- Probe
- Probing
- Monitoring

- Resource Control
- Traffic Control
- Admission Control

- Measurement database

Results

- E2E
- Host

- test description
Current Work

- **Resource control in the 2nd trial (closed loop)**
  - Measurement Based Admission Control (MBAC)
  - Provisioning Control Loops (PCL)

- **Inter-domain resource allocation**
  - BGRP aggregates reservations along BGP sink trees
  - BGRP limits the number of active reservations at each node
Inter-domain QoS

Aggregated with other reservations to the same destination domain

Domain may use other QoS mechanisms than AQUILA

Domain may use other QoS mechanisms than AQUILA
QoS applications used in the 2\textsuperscript{nd} trial

- NetMeeting
- SIGMA (Sip-based IntelliGent Multimedia Application)
- Mediazine
  - IP based Internet / TV application
  - Different multimedia broadband services:
    - video / audio on demand
    - games
    - news
    - email
    - chat
    - e-commerce
Overall topology for 2\textsuperscript{nd} trial
AQUILA connects with SEQUIN / GÉANT

- Why do we use a tunnel (IP over IP)?

<table>
<thead>
<tr>
<th></th>
<th>AQUILA</th>
<th>SEQUIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network services</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Traffic classes</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>DSCP</td>
<td>Different</td>
<td>Different</td>
</tr>
<tr>
<td>AS</td>
<td>Private numbers</td>
<td>Official numbers</td>
</tr>
</tbody>
</table>
AQUILA connects with SEQUIN / GÉANT

- Four AQUILA traffic classes would be mapped into Premium IP
- DiffServ Code Points (DSCP) would be changed
- AQUILA traffic between Warsaw and Vienna must not be interfered during this trial
- In the future, Globally Well-Known Services (GWKS) may help
Schedule for 2002

- **April - June**
  - Global integration
  - Integration-meeting (last week of April 2002)
  - Remote configuration of the other trial sites

- **June - October**
  - 2nd trial

- **End of December**
  - Final Trial Report, Final Project Report
Interconnection activities

- **Mailing list**
  - pip-aquila@fokus.gmd.de

- **Establishing connectivity in two steps**
  - Step 1: Testbed connection to the NRENs
    - ATM 2.5 Mbit/s “TAA-testbed → AcoNet”
    - ATM 2.5 Mbit/s “TPS-testbed → POL-34”
  - Step 2: Tunnel configuration using GÉANT
    - Tunnel-termination at AQUILA testbeds
    - DSCP marking for Premium IP at ingress points of GÉANT
Experiences with GÉANT

- Establishment within one week from initial request (April 2002)
- SEQUIN / GÉANT network engineers very helpful
- Network fulfills the AQUILA requirements
  - Positively prooven using application like ftp, telnet, AQUILA QMTool, …
- AQUILA will now start it’s 2\textsuperscript{nd} trial using the NREN/GÉANT infrastructure
  - Test scenarios for inter-domain QoS provisioning
  - Evaluation of MBAC
  - Real user involvement in Warsaw, Vienna and Salzburg
Outlook and Wishlist

- **Enhancement of Standardization Activities**
  - Inter-domain QoS signalling: the BGRP+ architecture
    - draft-salsano-bgrpp-arch-00.txt (May 14, 2002)
      - requirements and scalability of inter-domain resource reservation
  - Standardized GWKS
  - Standardization of DiffServ usage (like port numbers e.g.)

- **Further availability of pan-European (and international) Research Network infrastructure**

- **Ease of administration overhead for researchers**
  - One contact point in order to avoid a series of negotiations with different network operators in the connectivity path
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Thank you for your attention!

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