QoS Unterstützung in der neuen Generation von
Weitverkehrsnetzen und erste Erfahrungen im
europaweiten Einsatz

16. DFN-Arbeitstagung über Kommunikationsnetze
Düsseldorf 22. – 24. Mai 2002

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Fraunhofer
Institute for Open
Communication Systems

- General Project Information and Background
- GÉANT Premium IP Service
- QoS Trials in GÉANT
  - Preparatory Testing
  - H.323 Video Conferencing Experiments
  - User Group Trials
- Next Steps
GÉANT Pan-European NREN Backbone

GÉANT Interconnecting European NRENs in 27 countries

IST Project SEQUIN

Full Project Title

**Service Quality across Independently managed Networks**

Objectives

*to define and implement an end-to-end approach to QoS operating across multiple management domains*

Participants

• DANTE (Project Coordinator)

  • DFN (DE), GARR (IT), GRNET (GR), PSNC (PL), RENATER (FR), SWITCH (CH), UKERNA (UK)

Duration

November 2000 – April 2002

DFN Projekt: Quality of Service Architectures

Fraunhofer FOKUS & IND / RUS Uni Stuttgart
Premium IP Design Principles

• Replacement for ATM-based MBS service of TEN-155
  • comparable QoS guarantees
  • comparable operational effort and complexity
• Link Layer Independence: Using QoS mechanisms of IP layer
• Scalability: minimize additional complexity per node
• Modularity: adaptable to network evolution
  • NREN / Subnets to join when ready
• Pragmatic Approach
  • implementable with current hardware
  • matching current status of network topology

Premium IP Specification

• Based on Differentiated Services Architecture
• Using EF-PHB packet marking
• Rules for shaping, admission control, policing, scheduling
• Recommended values (buffer size, token bucket depth, ..)
• Initially only static service provisioning / no signalling (cp. MBS)
• Restrict Premium IP to 5% of link capacity [~ GEANT / TEN-155 ratio ]
  • prevent adverse effects on default Best Effort Service
  • protect against degradation from stream merging effects
Premium IP Example

- High priority scheduling for Premium IP packets on all nodes
- No policing on egress nodes
- No shaping in backbone
- Police on (NRENsrc, NRENdest)
- Aggregates on interdomain border nodes
- Policing optional when receiving from a trusted backbone
- Shape ONLY here
- Strict policing of capacity on (src, dst) IP prefix pair

Preparatory Testing

- Laboratory Testing at high data rates
  - Juniper M160 / Cisco12416 Engine3/4 Line Cards
  - rate limiting, marking, scheduling behavior (WRR / MDRR)
  - Smartbits Testing Equipment
  - STM-16 (2.5 Gbit/s) and STM-64 (10 Gbit/s)
  - QoS features validated / no impact on performance

- Testing between PSNC (POL) – Uni Bern (CH) over TEN-155
  - QoS Measurement Tools
  - Diffserv on Cisco 7200 platform
H.323 Video Conferencing – Objectives

- To implement Premium IP in production network
- To validate Premium IP Model under realistic conditions
- To select demonstration application with strong QoS requirements
- To select application with relevance to research community (user interviews)

H.323 Video Conferencing – Testbed Topology
H.323 Video Conferencing – Test Methods

- Subjective Conferencing QoS evaluation
- Objective QoS Parameters
  - QoS metrics:
    OWD (one-way-delay), ipdv, loss, available bandwidth
    (ITU-T / IETF RFC2330, IETF IPPM WG)
- QoS Measurement Methodology
  - active probes injection (RTT, ipdv, bandwidth)
    ping, rude/crude, netperf
  - passive packet capture (loss, OWD, ipdv)
    FOKUS Internet Measurement Platform
  - router MIB polling of counters (loss, bandwidth)

H.323 Video Conferencing – Measurement Examples

- Jitter Measurements RUS → GRNET
H.323 Video Conferencing – Achievements

• Validation of technical feasibility of service model on production network
• Realisation of Premium IP in a heterogenous environment over multiple management domains (dedicated link, ATM, overprovisioning)
• QoS Measurement Infrastructure for Premium IP

• other results:
  • was not a test for superiority of Premium over Best Effort
  • Difference in user perception of QoS and network performance
  • detection of specific packet re-ordering, ( metrics ?)
  • modified traceroute to report DSCP changes

Beta-Testing with User Groups

• IST AQUILA – Adaptive Resource Control for QoS
• IST MOCAINE – QoS for access technologies
• IST LONG – Collaborative Working Environments
• IST DATAGRID – GRID for Biomedical Applications
Beta-Testing with User Groups

• Wider Experience on Implementing Premium IP on other platforms
• Evaluate how Premium IP meets User Requirements
• Experience in service provisioning to user groups
  • Operational Procedures for service request, service configuration and inter-domain management NRENs ↔ GÉANT
  • QoS Monitoring Procedures for Fault Detection and SLA validation
• Disseminate expertise to other NRENs

Next Steps and Open Challenges

• Pilot Phase for Premium IP on GÉANT
  • to streamline provisioning process
• NRENs to support Premium IP provisioning
  • to dedicate resources for technical expertise and troubleshooting
• end-to-end performance aspects
  • install continuous performance monitoring across European NREN matrix
  • PERT (Performance Emergency and Response Team) to build expertise across different areas (NREN network, campus, high layer protocols, OS, ..)
• study of other IP QoS services (AF-based, ABE, LBE, scavenger, ..)
References

SEQUIN  www.dante.net/sequin
D2.1 Quality of Service Definition
D2.1 Add. 1: Implementation Architecture for the Premium IP Service
D3.1 Definition of the QoS Testbed
D5.1 Proof of Concept Testbed
D6.1 Report on User Group Trials

TF-NGN  www.dante.net/tf-ngn and www.terena.nl/task-forces/tf-ngn
D9.1 Specification and Implementation Plan for a Premium IP Service
D9.4 QoS Monitoring

DFN Quasar  www.ind.uni-stuttgart.de/Quasar

Internet2 QoS WG http://www.internet2.edu/qos/wg
Future Priorities for Internet2 QoS - Ben Teitelbaum

Premium IP Service Model

<table>
<thead>
<tr>
<th>Function</th>
<th>Location</th>
<th>Mechanism</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheduling</td>
<td>at all nodes</td>
<td>Highest priority queuing (PQ, WRR, ..)</td>
<td>to guarantee low delay, low jitter</td>
</tr>
<tr>
<td>Admission</td>
<td>Customer to NREN</td>
<td>Access Lists for (src, dest) prefix pair</td>
<td>to limit Premium IP traffic</td>
</tr>
<tr>
<td>Policing</td>
<td>Customer to NREN</td>
<td>strict on microflow (token bucket)</td>
<td>to enforce service contract</td>
</tr>
<tr>
<td></td>
<td>Inter-Domain</td>
<td>generous on aggregate increased bucket depth</td>
<td>to protect against abuse and misconfiguration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(AS src, AS dest)</td>
<td></td>
</tr>
<tr>
<td>Shaping</td>
<td>At endsystem only</td>
<td>Limit on max. sending rate</td>
<td>to avoid packet loss due to policing</td>
</tr>
<tr>
<td></td>
<td>Not done in Network</td>
<td></td>
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