QoS-Management as Closed Control Loop
Outline

- Motivation
- Objectives
- Integrated QoS-management
- QoS-management Building Blocks
  - Classification of Traffic and Marking
  - Topology Recognition
  - Network Planning
  - QoS-profile Provisioning
  - Call/Session Admission Control
  - QoS-/SLA-monitoring
- Outlook

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Motivation

- Enterprise Networks migrate to multi-service networks
- Network must accommodate Different Traffic Types
  - Real-time Voice over IP (VoIP), interactive video-conferences
  - Mission-critical Enterprise Resource Planning (ERP)
  - Guaranteed throughput, best effort
- Over provisioning of network resources economically not feasible (e.g. over WAN-links)
Objectives

- QoS-management Framework
  - Addresses Professional Service and Managed Service needs (cost-effective service offering)
  - Supports self-maintainers (ease-of-use, intuitive)
  - Automated as far as possible
  - Transparent
  - Future-proof
  - Integrated with umbrella management functions
    - Fault Management / Network Map
    - Performance Management
    - Configuration Management
Integrated QoS-management

- Call Admission Control (CAC)
- QoS-profile Provisioning
- Fault Management

- Traffic Classification and Marking
- Voice Quality determination
- Inventory / Topology Recognition

- QoS-monitoring
- SLA-management
- Network Map

- QoS-profile Provisioning
- SLA-management
- Fault Management

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QoS-management Building Blocks
Traffic Classification and Marking

Establishment of QoS-policy profile
- Corresponding Traffic Marking
  - IEEE802.1D, Differentiated Services
  - Preferably by endpoints (hosts)
  - In application-aware access switches on behalf of the endpoints
- Central, consistent QoS-profile provisioning in endpoints (IP-phones, soft-phones, access points and gateways)
- Application-layer classification
QoS-management Building Blocks

Topology Recognition

- Detect layer 2 and layer 3 topology
  - Routers, switches, hubs, and hosts
  - Connectivity and routing tables
- Explore properties of the links
  - Link capacities
  - Applied QoS-policies
- Create and maintain topology database
- Detection of topology changes via SNMP or OSPF
- Cope with the following problems:
  - Erroneous MIB-contents, VLAN detection

Detailled presentation by Marie Tromparent, TU Munich - LKN
Traffic Modeling
- Derive Service Rate ($r$) under given QoS-constraints according to established SLA
  - Includes max. delay boundary, packet loss
- Link Dimensioning
  - Acceptable bandwidth demand calculation for almost guaranteed QoS at given target outage probability
- Network Dimensioning
  - Import physical layer from Topology Recognition
  - Apply traffic matrix per service
QoS-management Building Blocks

Network Planning:
- Testing network readiness
- Link dimensioning
- Overall network dimensioning

Traffic Measurements:
- Modeling
- QoS-requirements

Traffic Mapping:
- NetworkTopology
- Traffic matrix
- Services (voice, video)
- QoS criteria

Input:
- NetworkTopology
- Traffic matrix
- Services (voice, video)
- QoS criteria

Software Tool

Network Model

Proposed Solution

Optimal Solution

Is the cost min?

Change topology?

Input:
- Cost model:
  - link capacity
  - # routers/switches
  - # ports/router
  - buffer size

Research Topics of ongoing PhD. Thesis
by Sanaa Sharafeddine TU Munich – LKN / Siemens AG, ICN EN
Jürgen Totzke, Siemens AG, Enterprise Networks
QoS-management Building Blocks

QoS-profile Provisioning

- Central QoS-parameter deployment services for
  - Complementary QoS-appliances
  - Workpoints and gateways
- Interface to IP-network vendor-specific Policy Management
QoS-Management Building Blocks

Call/Session Admission Control

- Complete call only if IP-network resources are available for the call with toll quality
  - Endpoints have to identify negotiated codec type, speech samples per packet
  - Central signaling entities (H.323 Gatekeeper, SIP-proxy) intercept call and query resource manager (bandwidth broker) for admission
- Option: Abstracted Network Topology focusing on over-provisioned zones and bottleneck link
- Option: Link-by-link reservation along the connection path
- Option: Static vs. adaptive (dynamic) approach
- Reapply reservations after network changes
QoS-management Building Blocks
QoS-/SLA-monitoring

- QoS-monitoring agents in work-points and access-points
  - Monitor received RTP/RTCP-stream
  - Check against provisioned thresholds
  - Send QoS-reports after time interval or at the end of the call/session for post processing
  - Issue SNMP-traps in case of threshold violations
- SLA-monitoring for WAN via QoS-appliances
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QoS-management Building Blocks
QoS-/SLA-monitoring

QoS-profile Provisioning
Element Manager

Soft-Clients
VolIP Network

IP-phones
QoS-monitoring Control Unit
Collection Evaluation / Thresholds

Switches

Gateways

Customer Fault Management

QoS Performance Monitoring Tool

Pull QoS Reports
Control Monitoring

Persistent Storage of QoS/reports

Push QoS Reports
Control Monitoring (SNMP) Traps

Administration of QoS Monitoring

Administration of VoIP Network

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Outlook

- Need for QoS-management is emerging
- Network vendors should move from proprietary CLI to emerging standard interfaces
- QoS-related interfaces should be protocol independent to be applicable for both H.323 and SIP
- Existing MIBs should be setup consistent and meaningful
- Customers should demand for and honor QoS-management functions
Disclaimer

The concept described in this presentation is a result of corresponding research in this area.

This presentation does not commit any realization of the presented concepts in corresponding products at this time or in future.
Backup
## QoS-profile

<table>
<thead>
<tr>
<th>Traffic Type</th>
<th>IEEE 802.1D Priority</th>
<th>DiffServ Code Point (DSCP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice Payload</td>
<td>5</td>
<td>EF (101110)</td>
</tr>
<tr>
<td>Fax Payload</td>
<td>5</td>
<td>EF (101110)</td>
</tr>
<tr>
<td>Video Payload</td>
<td>5</td>
<td>AF43 (100110)</td>
</tr>
<tr>
<td>Instant Messaging</td>
<td>3</td>
<td>AF21 (010010)</td>
</tr>
<tr>
<td>Signaling</td>
<td>3</td>
<td>AF31 (011010)</td>
</tr>
<tr>
<td>All Other Traffic</td>
<td>0</td>
<td>DE (000000)</td>
</tr>
</tbody>
</table>
Related Standards

- IEEE 802.1D
- IEEE 802.11e
- RSVP, DiffServ, MPLS
- COPS, SNMPConf
- RaQMom