A Generic API Regarding On-Demand QoS Support Over Heterogeneous Wireless Networks For QoS Aware Applications

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Agenda

- Introduction and Motivation
  - Application QoS Requirements, Network Provisioning of QoS and User Requirements

- Concept of Client-Based Generic QoS API
  - Client Architecture Requirements
  - QoS Aware Application Signalling

- Current Prototype Implementation
  - Based on Mobile IPv4
  - Problems of (Real-Time) Network Monitoring

- Outlook on Future Work
Motivation

- Heterogeneous Networks – The variety of different wireless access technologies (e.g. GSM, UMTS, Wireless LAN etc.) and their parallel existence – a highly dynamic environment!
  → Multimode Terminals
  → QoS Support to a certain degree

- Mobility Software enabling “Seamless Vertical Roaming” (e.g. Birdstep, Dynamics HUT etc.) based on Mobile IP (v4 now, v6 sometime in the future)

- QoS Provisioning: End-to-End provided by the network(s), hence for the service → QoS preceived by the User

- User Awareness on Cost and Billing but transparency to Application / Network Requirements

- Application programmers should not have to deal with specifics of a distinct access network and its implemented QoS features and supported protocols (Intserv/Diffserv, RSVP etc.).
Convergence of Application Needs and Network Capabilities

Application Requirements
- Bitrate, Delay, Jitter, BER, Availability

- Initialization
- Adaptation/Negotiation
- (Graceful) Termination

Generic QoS API

Variety of Access Networks and Supported QoS Features
- UMTS
- GSM/GPRS
- WLAN

Content Adaptation
Adaptative Playout
Intserv/Diffserv RSVP..
Resulting Client Architecture Requirements

- Access Network Management: Monitoring, Discovery and “Seamless” Switching – Vertical Handover
- Matching of QoS-Aware Application Requirements with current Access Network Available QoS.
- Network selection based on a fixed set parameters: Availability, Bandwidth, Bit Error Rate, Delay and Jitter
- Matching of Application QoS with Internet QoS (e.g. DiffServ)
- Security Support (e.g. VPN, IPSec)
- Standards where Applicable.
The Client Architecture based on Mobile IPv4

- **Shared Database** holds Network, Application and User Profiles
- Communication Provider sets up logical and physical connections → Matches between profiles → Communicates with Location Server
- Mobility Manager monitors network interfaces and updates routing table information
- Build upon the Dynamics Mobile IP Client
Signaling between Application and Communication-API

- The Communication-API allows a QoS Aware Application to specify/negotiate its QoS Requirements
- The Communication Provider Matches Application QoS Requirements with currently available Networks Registered in Network Profile
Signaling within the Client Architecture

- **Application Database (SD)**
  - **Application Profiles**
    - Prot.: HTTP
      - Service: BE
      - TP: a
      - D: b
      - DV: c
      - ER: d

- **User Profiles**

- **Network Profiles**
  - ID: 1
    - Type: UMTS
    - Av.: yes
    - Active: yes
    - QoS-Par.: TP, D, ...
  - ID: 2
    - Type: WLAN
    - Av.: no
    - Active: no
    - QoS-Par.: TP, D, ...

- **Connection Table**
  - Dest.: IP1
    - Port: 5005
    - QoS-F: 1111
    - QoS-P: TP1, ...
    - IF: 1
Signaling within the Client Architecture

**Communication Provider**

- **Application Profiles**
  - Prot.: HTTP
  - Service: BE
  - TP, D, DV, ER

- **User Profiles**

- **Network Profiles**
  - ID: 1
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- **Connection Table**
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  - QoS-F: 1111
  - QoS-P: TP1, ...
  - IF: 2

**APIs (Socket, QoS, RAS, ...)**

- **IP Layer**
  - UDP
  - TCP

**Mobility Manager (MIP / IPSec)**

- **Communication API**

- **App. 1 (RTP)**

**Driver (IF 1)**

- **Driver (IF 2)**

**Communication Provider**
Signaling within the Client Architecture

**Application Profiles**

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**User Profiles**

**Network Profiles**

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Current Prototype Implementation

- Modified Dynamics Mobile IP Client with Vertical Handover capability based on user specified priority (e.g. 1. WLAN, 2. GPRS/GSM, 3. UMTS)
- Only limited Monitoring of all QoS parameters on available Network Interfaces possible
- User can specify Network Selection Priority
Improvements to Current Prototype

- “Real Time” Monitoring of QoS Parameters
  - Candidate Network selection based on theoretical and statistically past measured QoS values of available access networks.
  - Additional use of Protocol header information (e.g. RTCP header in RTP protocol)

- Performance Optimization
  - Performance optimization of delays incurred in interface timeout, candidate network discovery and IP Tunnel re-establishment.
  - Use of Additional QoS Indicators e.g. Wireless Signal Strength
  - Home Agent Modification: IP Tunnel setup on Multiple Network Interfaces.
Summary and Conclusion

- There is Increasing User Mobility and Availability of Heterogeneous (Wireless) Networks
- Loads of Work Done on QoS Provisioning Middleware – Some Proprietary, Mostly In-Efficient Solutions – No Middleware provides total inter-operability
- QoS Handling in highly Dynamic Heterogeneous Network Environments Hard To Achieve, Hence End-To-End QoS Seamless Provisioning
- Cost Billing and User Perceived QoS a Must
- …Potential of Location Information?

...Thank you for your Attention! Questions?