



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

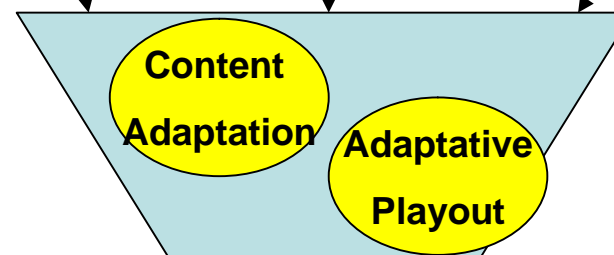
- Heterogeneous Networks – The variety of different wireless access technologies (e.g. GSM, UMTS, Wireless LAN etc.) and their parallel existence – a highly dynamic environment!
 - Multimode Terminals
 - QoS Support to a certain degree
- Mobility Software enabling “Seamless Vertical Roaming” (e.g. Birdstep, 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 perceived 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

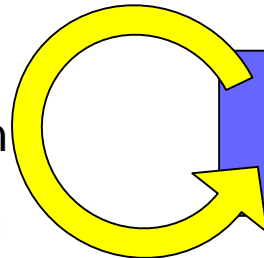
Application Requirements

Bitrate, Delay, Jitter, BER, Availability

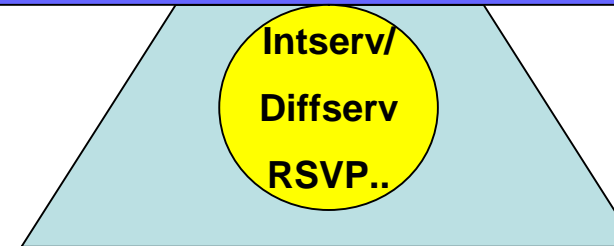
Email Video Streaming VoIP



Generic QoS API



- Initialization
- Adaptation/Negotiation
- (Graceful) Termination



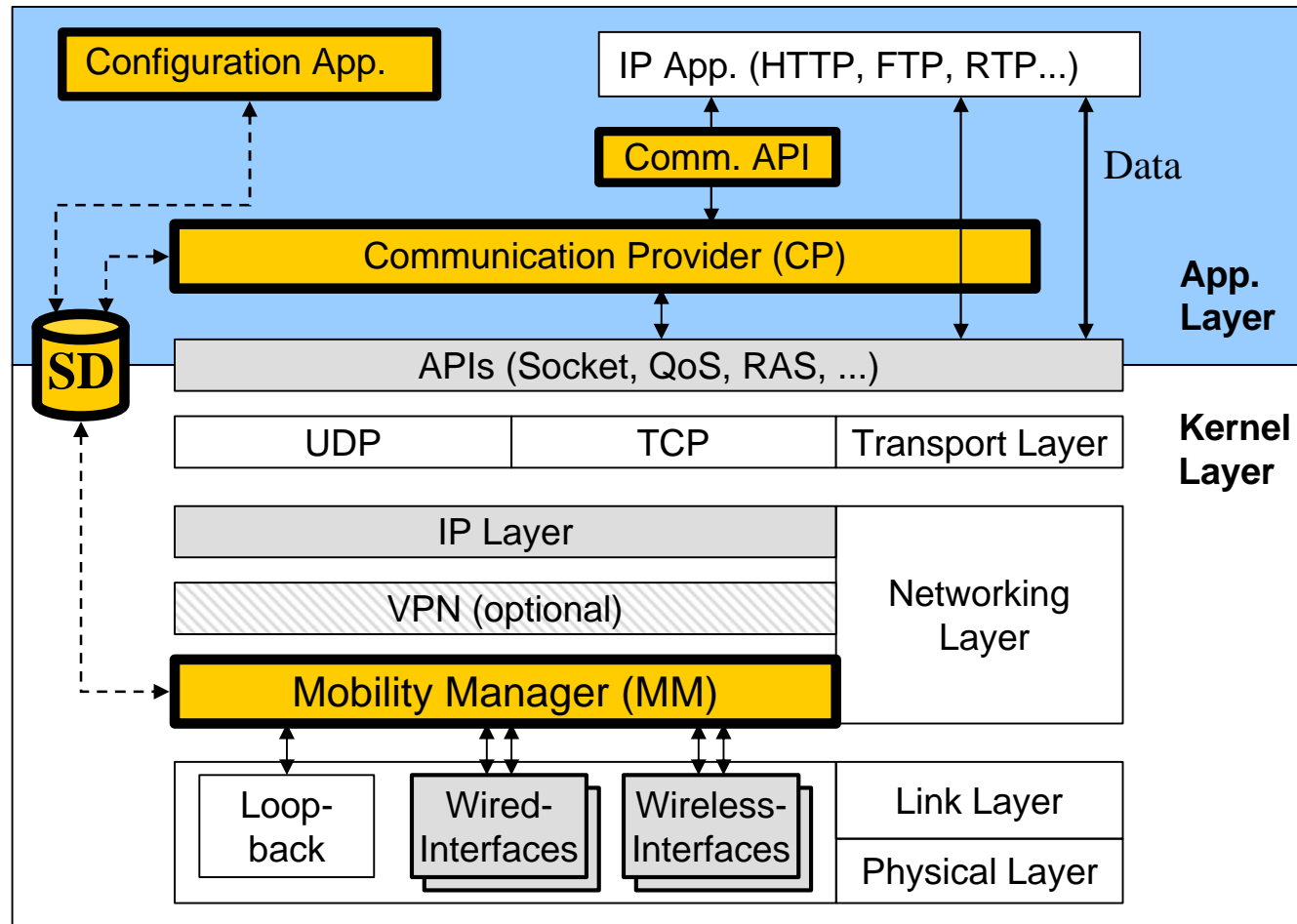
UMTS GSM/GPRS WLAN

Variety of Access Networks and Supported QoS Features

Resulting Client Architecture Requirements

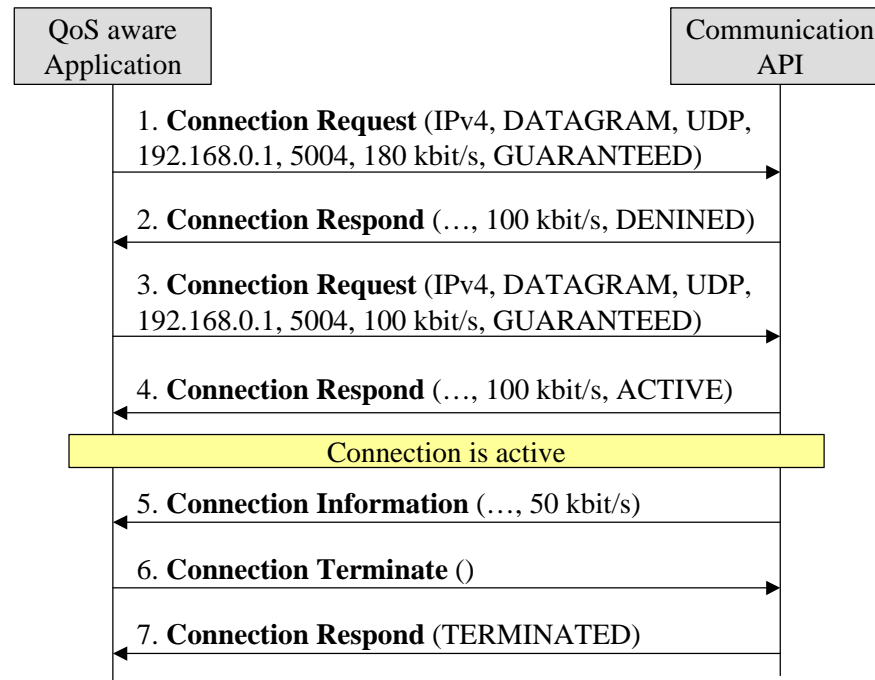
- Access Network Management: Monitoring, Discovery and “Seamless” Switching – Vertical Handover
- Matching of QoS-Aware Application Requirements with current Access Network Available QoS.
- Network selection based on a fixed set parameters: Availability, Bandwidth, Bit Error Rate, Delay and Jitter
- 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



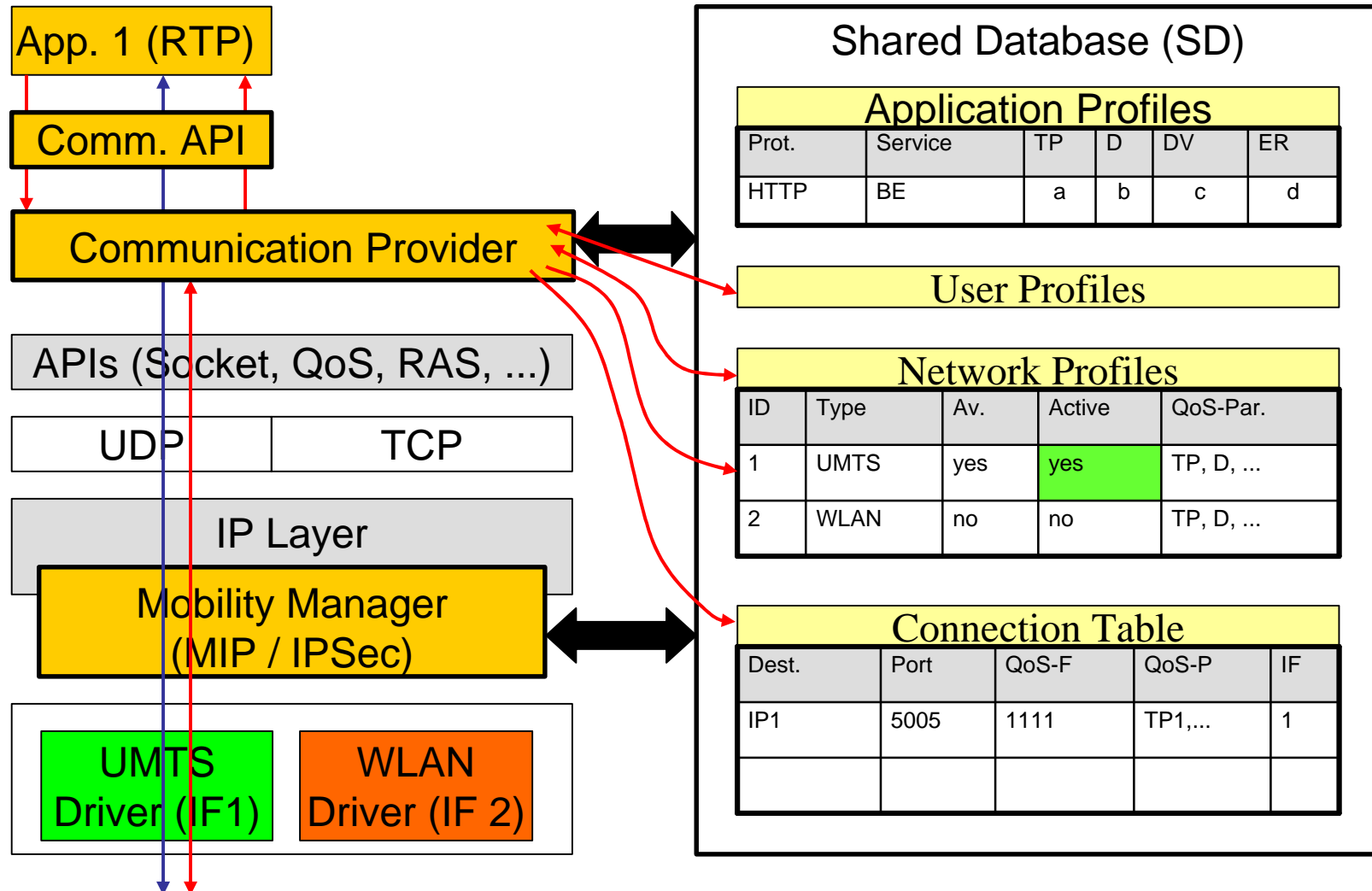
- Shared Database holds Network, Application and User Profiles
- Communication Provider sets up logical and physical connections
→ Matches between profiles
→ Communicates with Location Server
- Mobility Manager monitors network interfaces and updates routing table information
- Build upon the Dynamics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

Signaling between Application and Communication-API

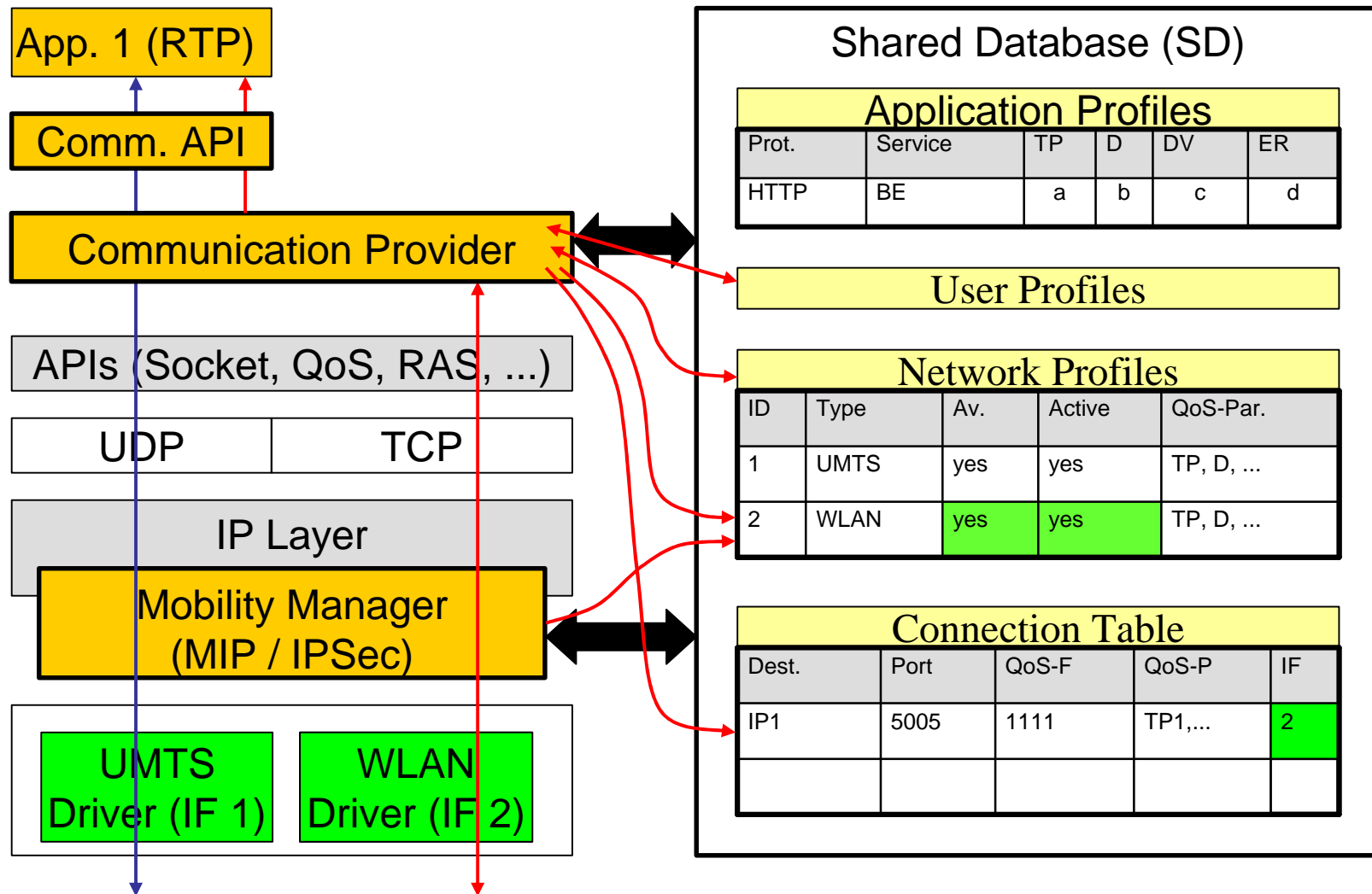


- The Communication-API allows a QoS Aware Application to specify/negotiate its QoS Requirements
- The Communication Provider Matches Application QoS Requirements with currently available Networks Registered in Network Profile

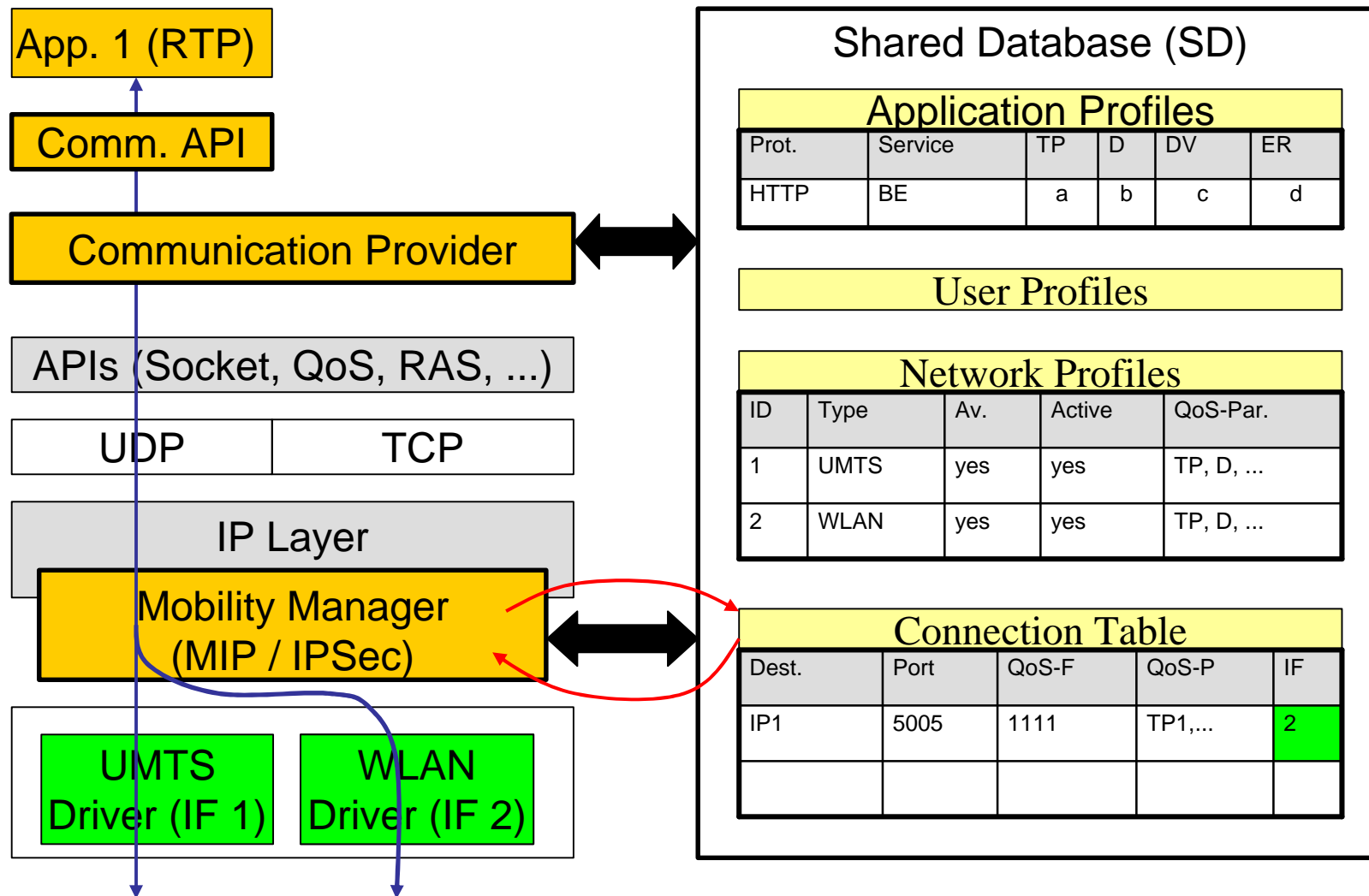
Signaling within the Client Architecture



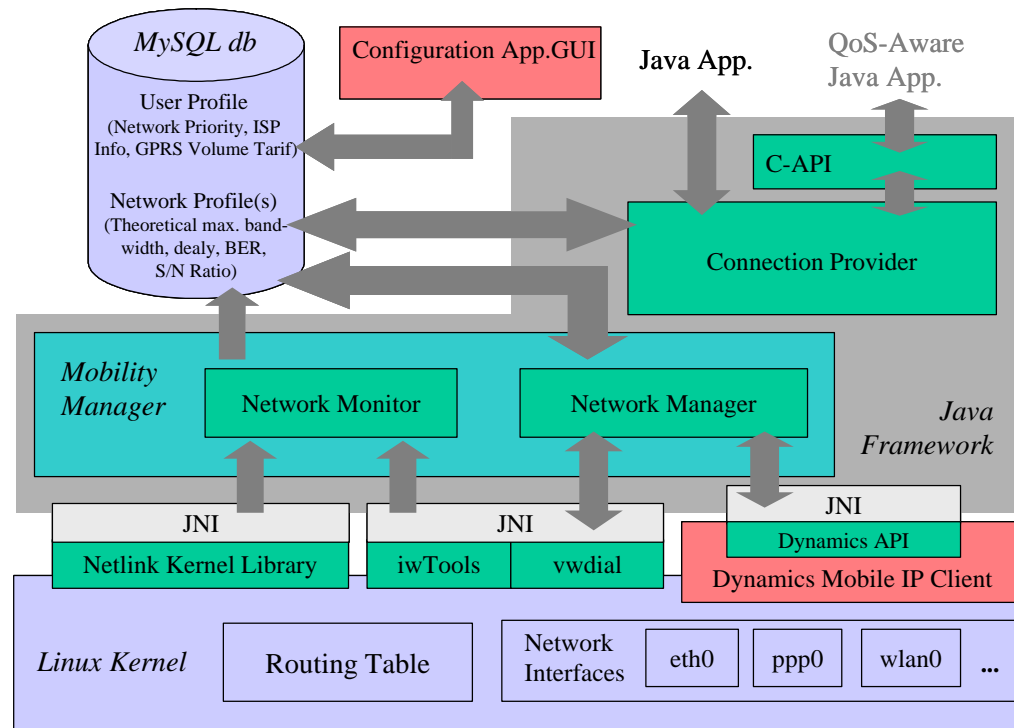
Signaling within the Client Architecture



Signaling within the Client Architecture



Current Prototype Implementation

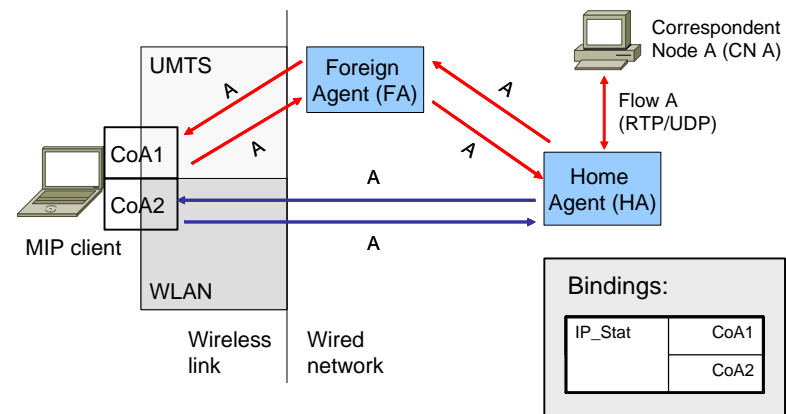


- Modified Dynamics Mobile IP Client with Vertical Handover capability based on user specified priority (e.g. 1. WLAN, 2. GPRS/GSM, 3. UMTS)
- Only limited Monitoring of all QoS parameters on available Network Interfaces possible
- User can specify Network Selection Priority

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?