Session 7: Multimedia Wireless Applications

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QoS Orchestration for Mobile Multimedia

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A Multi-Device Application Server

QoS Orchestration for Mobile Multimedia

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Sectioning

- Motivation
- The MASA Project
- The MASA Architecture
- The MASA Mobility Manager
- The MASA Media Manager
- Adaptation Strategies
- Applications
- Outlook

Motivation

Assumption (1):
Future Multimedia Communication will be performed in a very heterogeneous Environment:

Devices

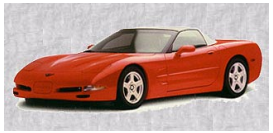
Screen Sizes, Processors, Memory, Power Supplies, Interfaces, etc.

Motivation

Network Access Technologies

Modem, ISDN, xDSL, Ethernet, ATM, GSM/GPRS, UMTS, etc.

Different characteristics for loss rate, bandwidth, etc.



Applications

Interactive/non-interactive, realtime/non-realtime, unicast/multicast etc.

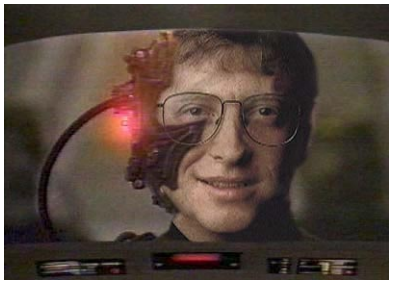
E.g. IP Telephony needs low delay, Video-on-Demand needs bandwidth

Users

Different technology background and QoS requirements

‚Normal User‘

likes to have an ‚on/off‘ button



‚Cyborg‘

wants to specify the importance of certain parameters

Motivation

Assumption (2):
In future networks,
Mobility will be essential

- **Terminal Mobility**

  supports to physically move the device and eventually to connect to a foreign network

- **User Mobility**

  supports to change the device and to have access on personal set of services in foreign networks

- **Session Mobility**

  supports to maintain ongoing multimedia sessions during user and terminal movements

The MASA Project

MASA

Mobility and Service Adaptation in Heterogeneous Mobile Networks

SIEMENS

Information and
Communication Networks
Communication On Air
ICN CA MS MA 1
Corporate Technology
ZT SE 2

University of Ulm
Department for Computer Science
Distributed Systems

NEC

NEC Europe Ltd.
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The MASA Project

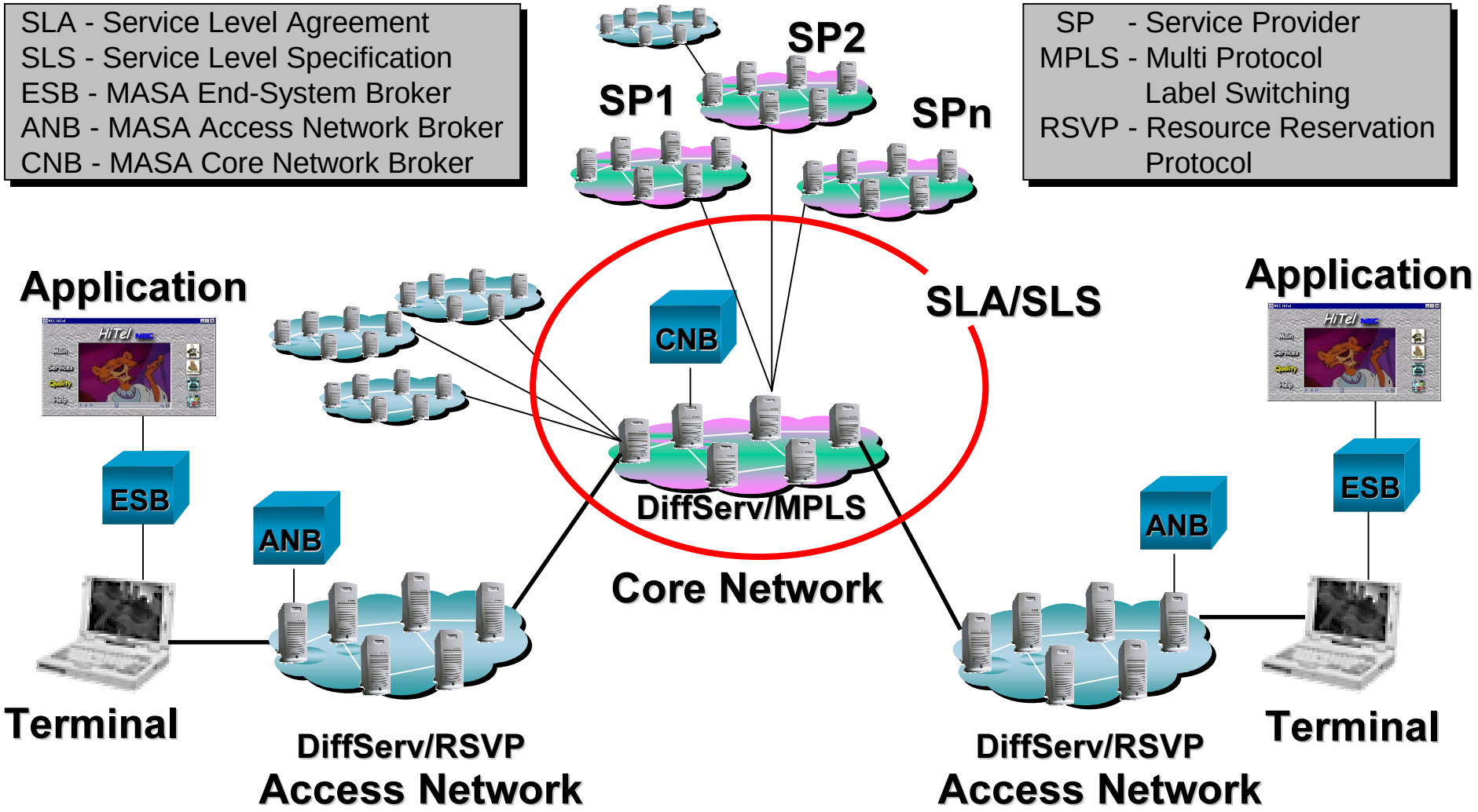
- MASA defines a comprehensive end-to-end QoS architecture to support QoS for adaptive real-time multimedia streaming applications in a heterogeneous mobile environment

- Application Separation
- Adaptive Multimedia
- Group Conferencing
- Using Network Layer QoS Mechanisms
- Open APIs
- User Profiles
- Intuitive User Interfaces
- Plugable-Components
- Design Principles
- Admission Control
- Charging/Billing/Accounting
- Fairness
- Operating System Independence
- Terminal/User/Session Mobility

The MASA Architecture

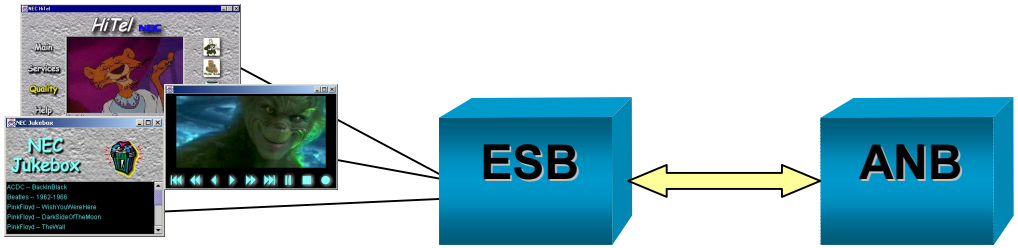
SLA - Service Level Agreement
SLS - Service Level Specification
ESB - MASA End-System Broker
ANB - MASA Access Network Broker
CNB - MASA Core Network Broker

SP - Service Provider
MPLS - Multi Protocol Label Switching
RSVP - Resource Reservation Protocol



The MASA Architecture

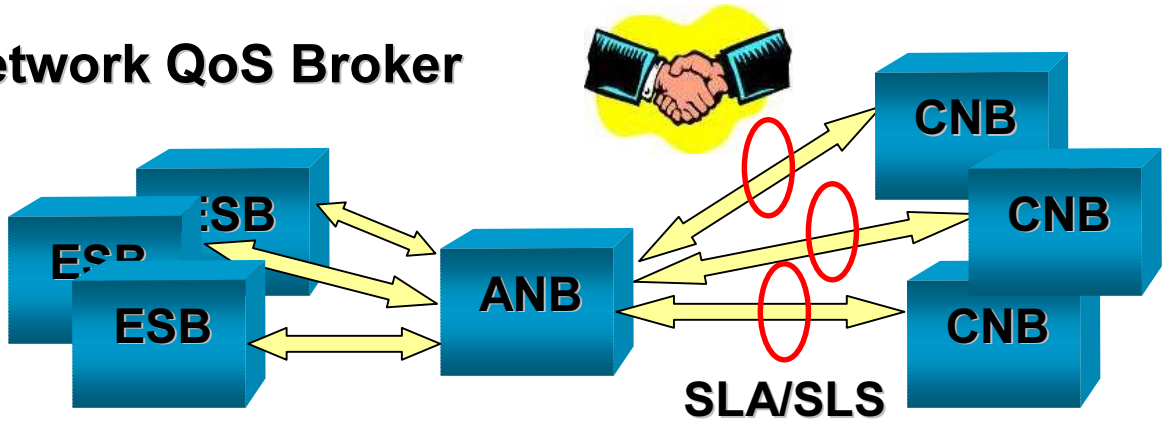
ESB – End-System QoS Broker



- Provision of QoS-enhanced streaming for multimedia applications
- Central Trading Intelligence (Adaptation)
- Local Resource Management (CPU, Memory, etc.)
- Analysis of Terminal Capabilities
- QoS Capability Exchange
- Policy Management (local QoS Profiles)
- DiffServ Marking, RSVP Reservation, etc.
- Communication with Access Network QoS Broker

The MASA Architecture

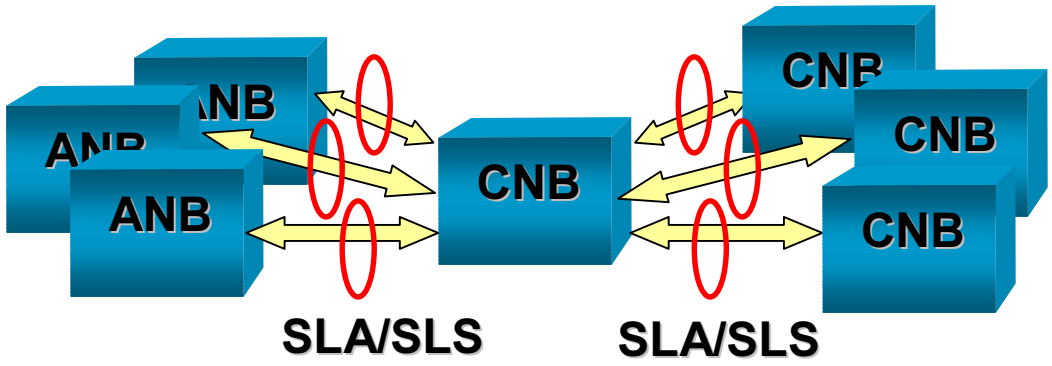
ANB – Access Network QoS Broker



- Local Resource Management
  (Router-Queues, DiffServ Management, QoS Routing, etc.)
- LAN Management Support
- Aggregation of Streams from Multiple Terminals
- Trading with Service Providers (SLA/SLS)
- Policy Management (IETF COPS/RSVP, COPS-PR)
- Using different Access Technologies
- Communication with End-System and Core Network QoS Broker

The MASA Architecture

CNB – Core Network QoS Broker



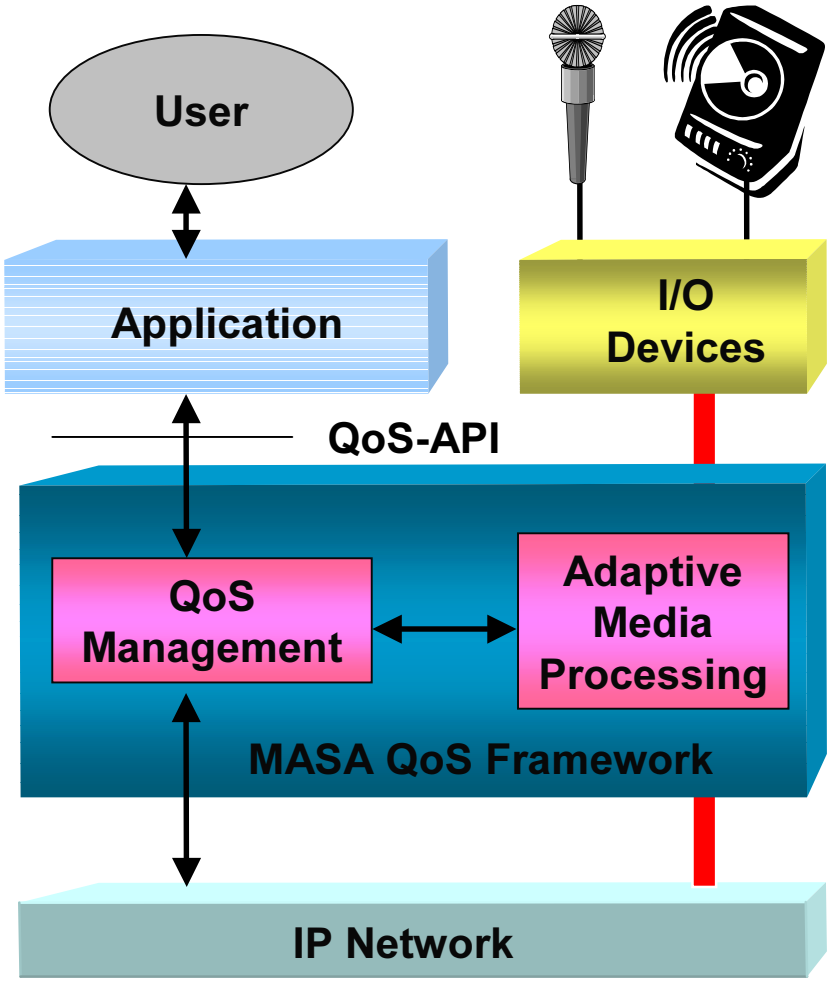
- Orchestration of Core Network Management
- DiffServ/MPLS Management
- QoS Mapping
- Interacting with several Provider Networks
- Traffic Engineering and Optimization
- QoS Routing
- Communication with Access and Core Network QoS Broker

The MASA Architecture

End-System Broker

Main Function:
Separation between media processing and applications allows for:

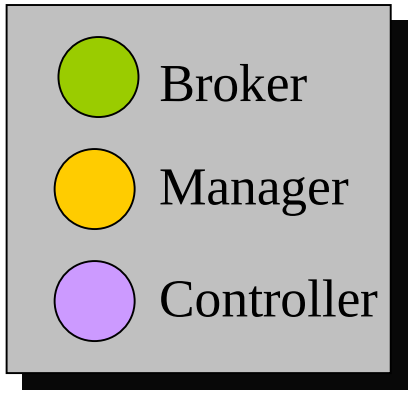
- ✓ Media-independent application development (GUI)
- ✓ Hiding complex media details by high-level QoS API
- ✓ Extendable Architecture through plug'n-play mechanisms
- ✓ Operating-System independent applications

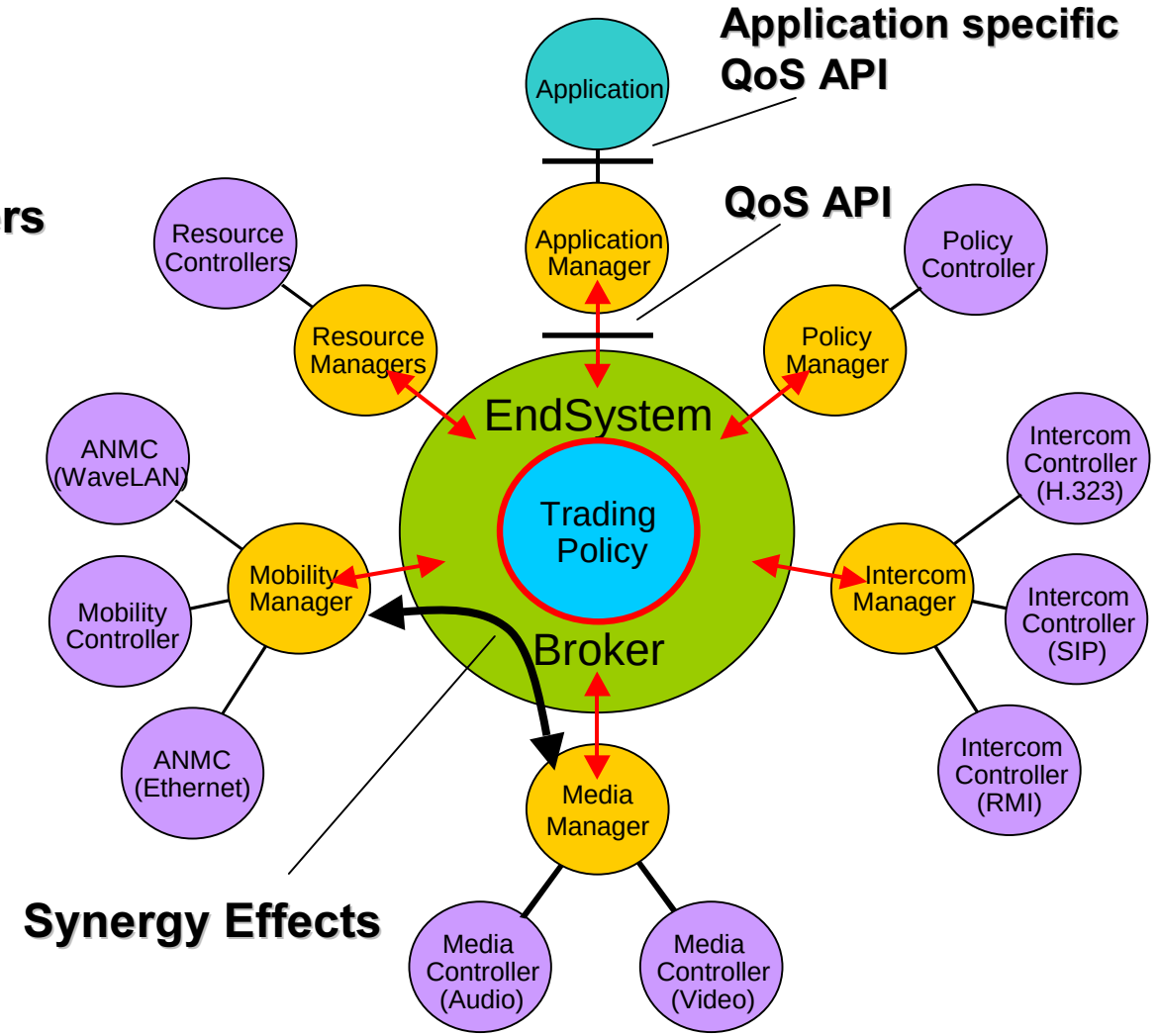


The MASA Architecture

Software Structure End-System Broker

- Broker and Managers are using event queues for monitoring results and commands

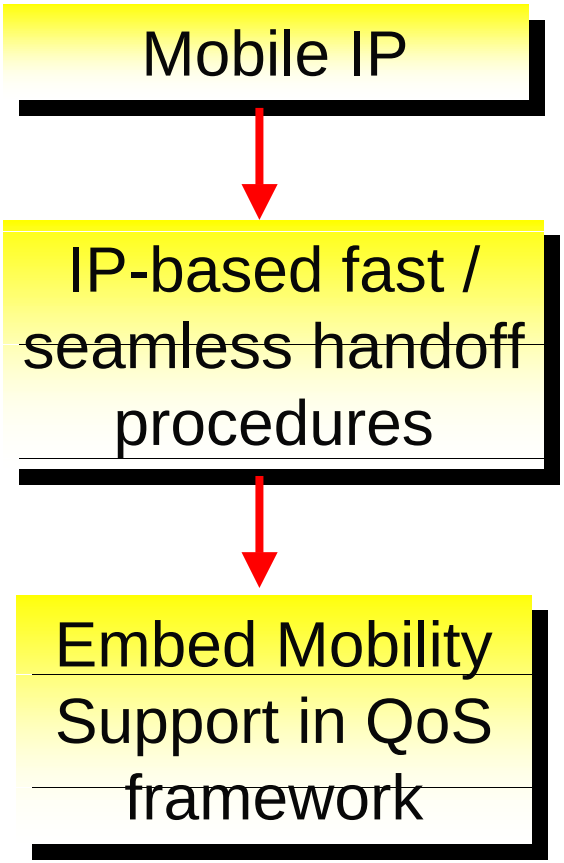




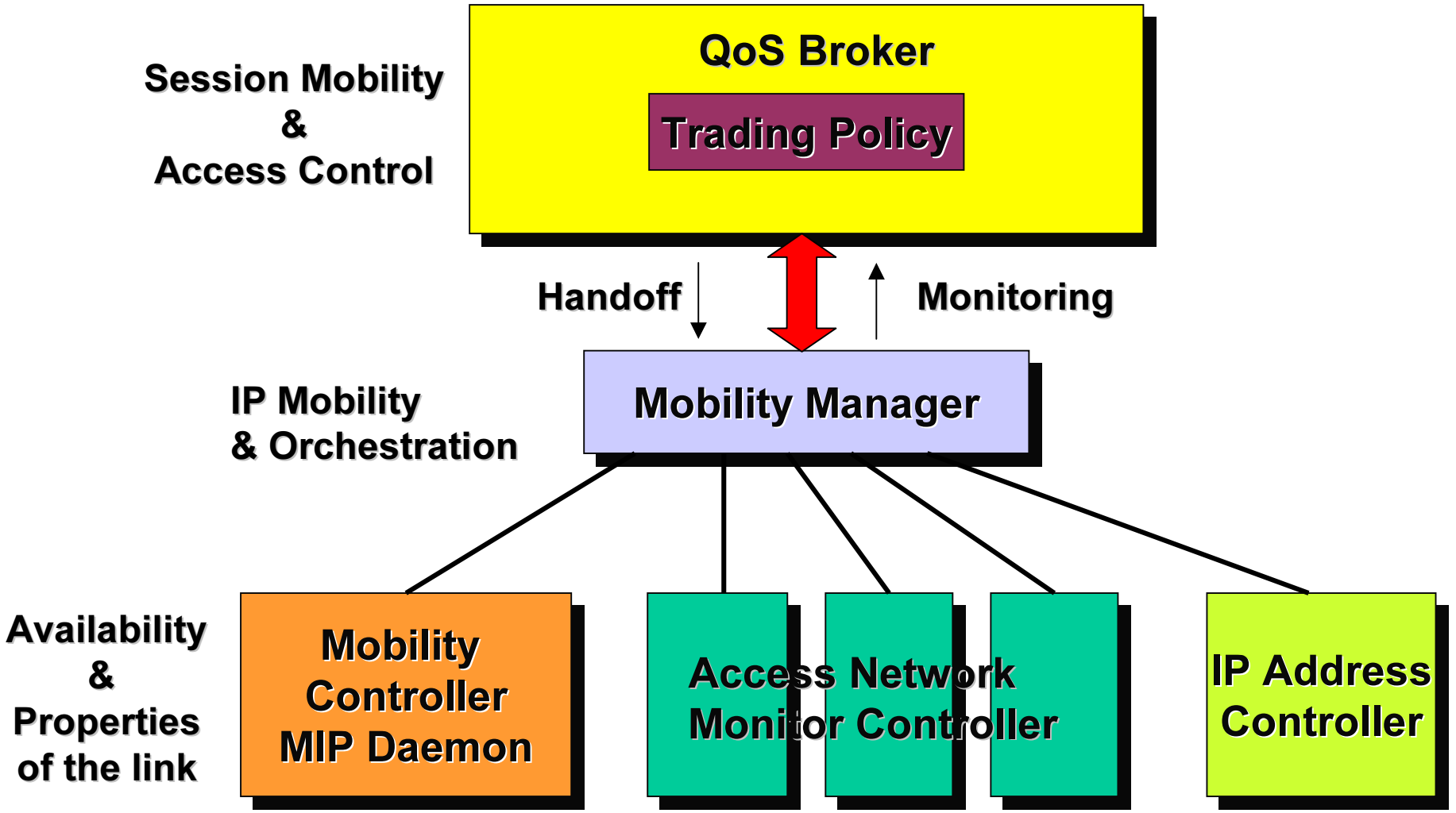
The MASA Mobility Manager

Motivation

- To enable *mobility of users / terminals between IP sub-networks* without manual reconfiguration of the terminals or the employed applications/services
- Uninterrupted packet delivery: "*seamless handoffs*"
- "*Always best connected*": Automatically choose *best* access network w.r.t. some user criterion or policy and *adapt media processing*.



The MASA Mobility Manager

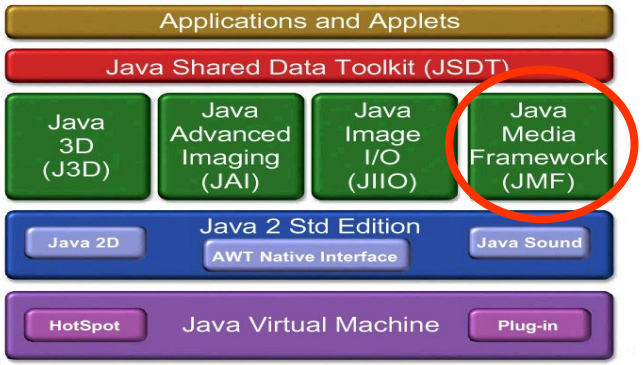


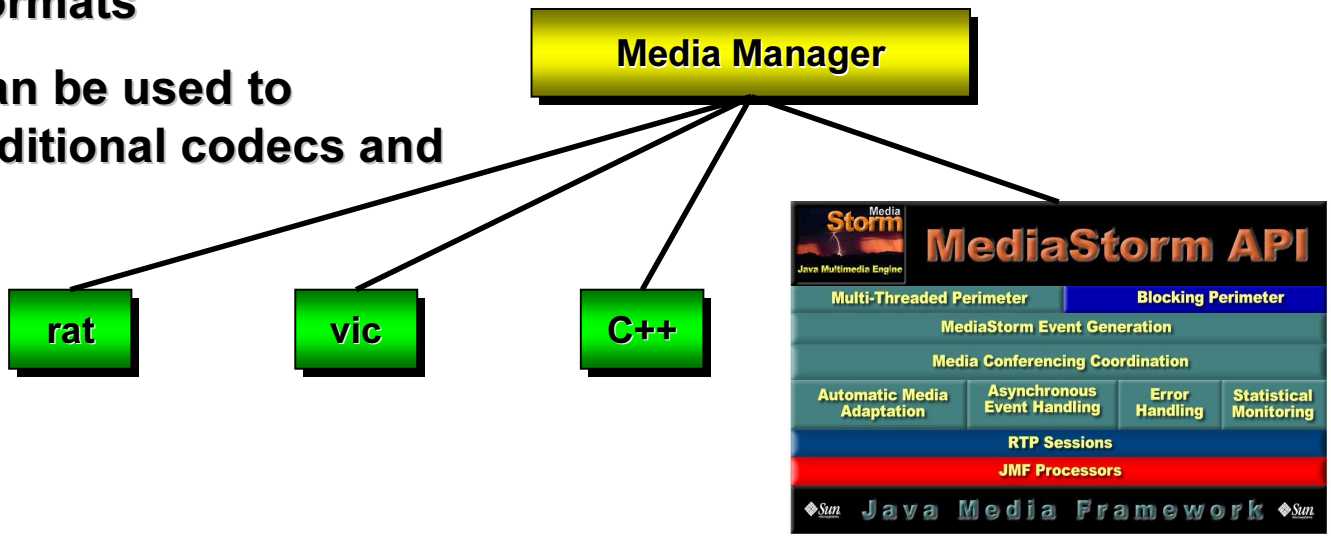
The MASA Media Manager

- **Media Manager** orchestrates the whole process
  - Administration of QoS hierarchy (User-Session-Stream-Flow)
  - Aggregation of monitoring parameters on all hierarchy levels
  - Broker support by hiding the Controller details
  - Media adaptation
  - Media synchronization
- **Media Controller** supports specific tasks
  - Processing and transmission of real-time multimedia data (RTP)
  - Instantiation of codecs, processors, effects, filters, etc.
  - Monitoring of transmission parameters (RTCP)
  - Monitoring of local performance

The MASA Media Manager

- Modular design of MASA allows for flexible implementations
  - MBone tools vic & rat (Siemens)
  - Proprietary C++ solutions (Uni Ulm)
  - Java Media Framework - JMF (NEC)
    - Java multimedia extension
    - JMF supports different audio- and video formats
    - Plug-ins can be used to integrate additional codecs and effects





Adaptation Strategies

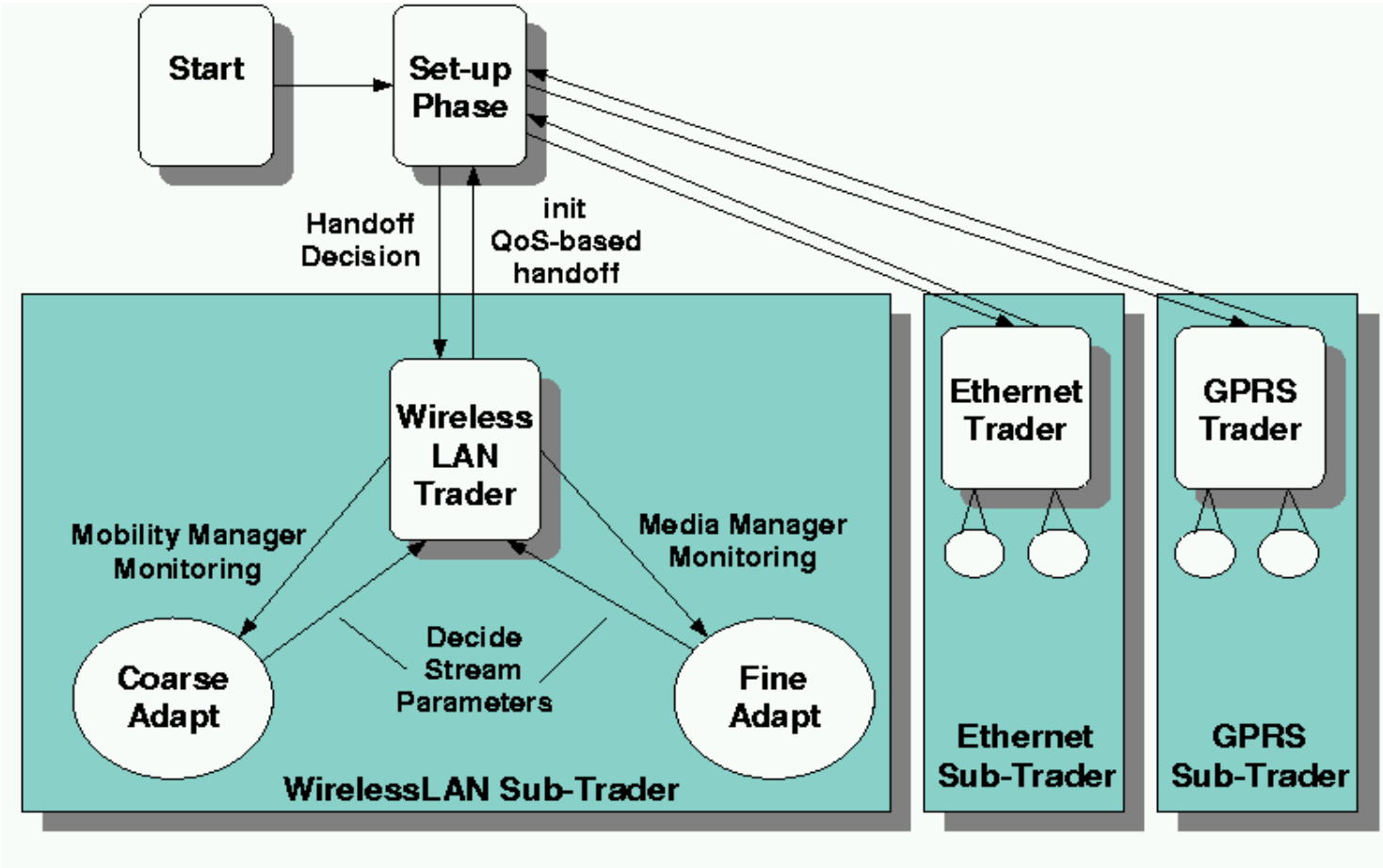
- **Interaction between Mobility and Media Management allows for synergy effects**
  - **Intelligent handoff decisions (intra or inter-domain handoffs, intra or inter-technology handoffs)**
  - ***Network Forced Handoffs*:**
    - **The interface (cable) was physically removed**
    - **The link quality has become very low**

    ⇨ **The Mobility Manager informs the QoS Broker, who performs the media adaptation with the help of the Media Manager**
  - ***QoS Forced Handoffs*:**
    - **Optimization based on QoS criterias, cost or access to certain services**

    ⇨ **The QoS Broker decides with the help of the local trader and issues a handoff request to the Mobility Manager**

Adaptation Strategies

- Hierarchical adaptation trader (exists for User, Session, Stream)



Adaptation Strategies

- Example: QoS Trader Interface for User (also for session and stream)

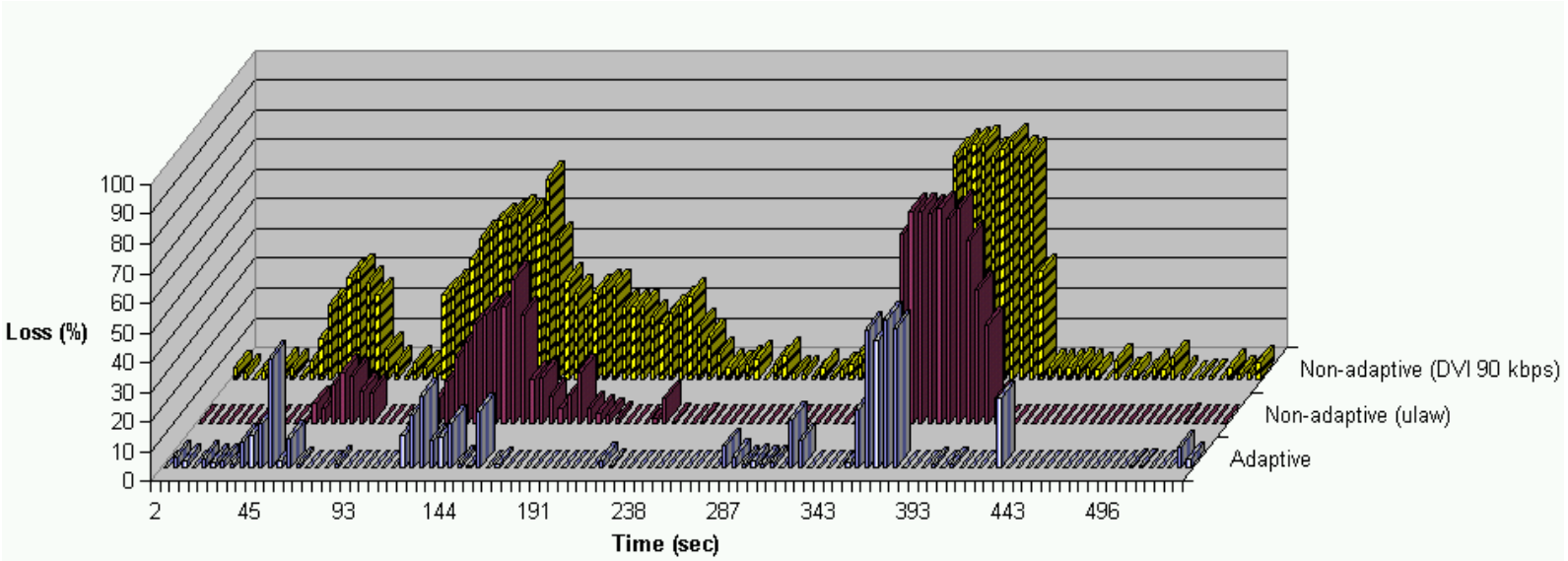
```
public QoSAnswerUser tradeUser(
                MasaUser user,
                MasaPolicy policy,
                MediaMonitorStatistics mediaMon,
                CPUMonitorStatistics cpuMon,
                MobilityMonitorStatistics mobMon,
                NetworkMonitorStatistics netMon,
                TradingRules rules,
                MediaFacility [ ] mediaFacilities,
                MobilityFacility [ ] mobFacilities
) ;
```

- Broker calls method on certain events
- Result is handled to all relevant Managers

Adaptation Strategies

- **Current Work focussed on media adaptation:**
  - **Syntactical WaveVideo filter based on packet priorities**
  - **Semantical WaveVideo filter for**

    - frame rate, frame size, color and space resolution & combi filter
  - **Audio/Video transcoding with JMF**
  - **Audio adaptation through codec changes based on RTCP reports with smoothed loss error rates**



Applications

Video Conferencing

Video on Demand (VoD)

Audio Jukebox

Radio Broadcasting

Outlook

- Reconfigurable Handoff Decisions sent to the Mobility Manager
- Access und Core Network QoS Broker
- Intuitiv GUI-Design for QoS Policy Controller
- Support of Group Communication
- Terminal und QoS Capacity Analysis and Agreement (SIP/HTTP/XML)
- SIP QoS Extensions
- DiffServ Support
- RSVP Integration
- Improved Adaptation Strategies
- Etc.

Any Questions?