

# The MASA Project

**A. Schrader, D. Carlson, J. Quittek**  
(NEC Europe Ltd.)

**C. Kappler, C. Niedermeier, R. Schmid, C. Meyer**  
(Siemens AG)

**A. Kassler, A. Schorr, L. Chen**  
(University of Ulm)



**SIEMENS**

Empowered by Innovation **NEC**

# Sectioning

- Motivation
- The MASA Project
- The MASA Architecture
- Adaptation Strategies
- Applications
- Outlook



**SIEMENS**

Empowered by Innovation

**NEC**

# Motivation

**Assumption (1):**

**Future Multimedia Communication will be performed  
in a very heterogeneous Environment:**



## Devices



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



**SIEMENS**

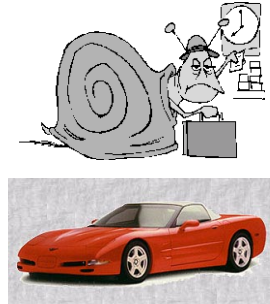
Empowered by Innovation

**NEC**

# Motivation

## Network Access Technologies

ISDN, xDSL, Ethernet, ATM, GSM/GPRS, UMTS, HIPERLAN 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

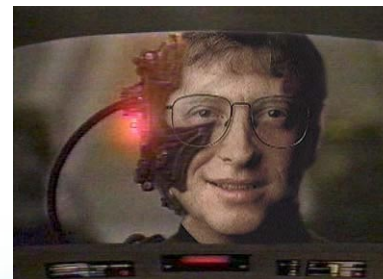
## Users

Different technology background and QoS requirements



**„Normal User“**

likes to have an  
„on/off“ button



**„Cyborg“**

wants to specify  
the importance of  
certain parameters



**SIEMENS**

Empowered by Innovation

**NEC**

# 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



**SIEMENS**

Empowered by Innovation

**NEC**



# MASA

## Mobility and Service Adaptation in Heterogeneous Mobile Networks

<http://masa.ccrle.nec.de>

**Phase I: 10/1999-9/2000 End-System Adaptation**

**Phase II: 10/2001-3/2003 Access and Core QoS Provision**

**SIEMENS**

Information and  
Communication Networks  
ICN CT SE Munich



University of Ulm  
Department for Computer Science  
Distributed Systems

**NEC**

NEC Europe Ltd.  
Network Laboratories  
Heidelberg

Empowered by Innovation

**NEC**

# 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
- ☐ Pluggable-Components
- ☐ Design Principles
- ☐ Admission Control
- ☐ Fairness
- ☐ Operating System Independence
- ☐ Terminal/User/Session Mobility

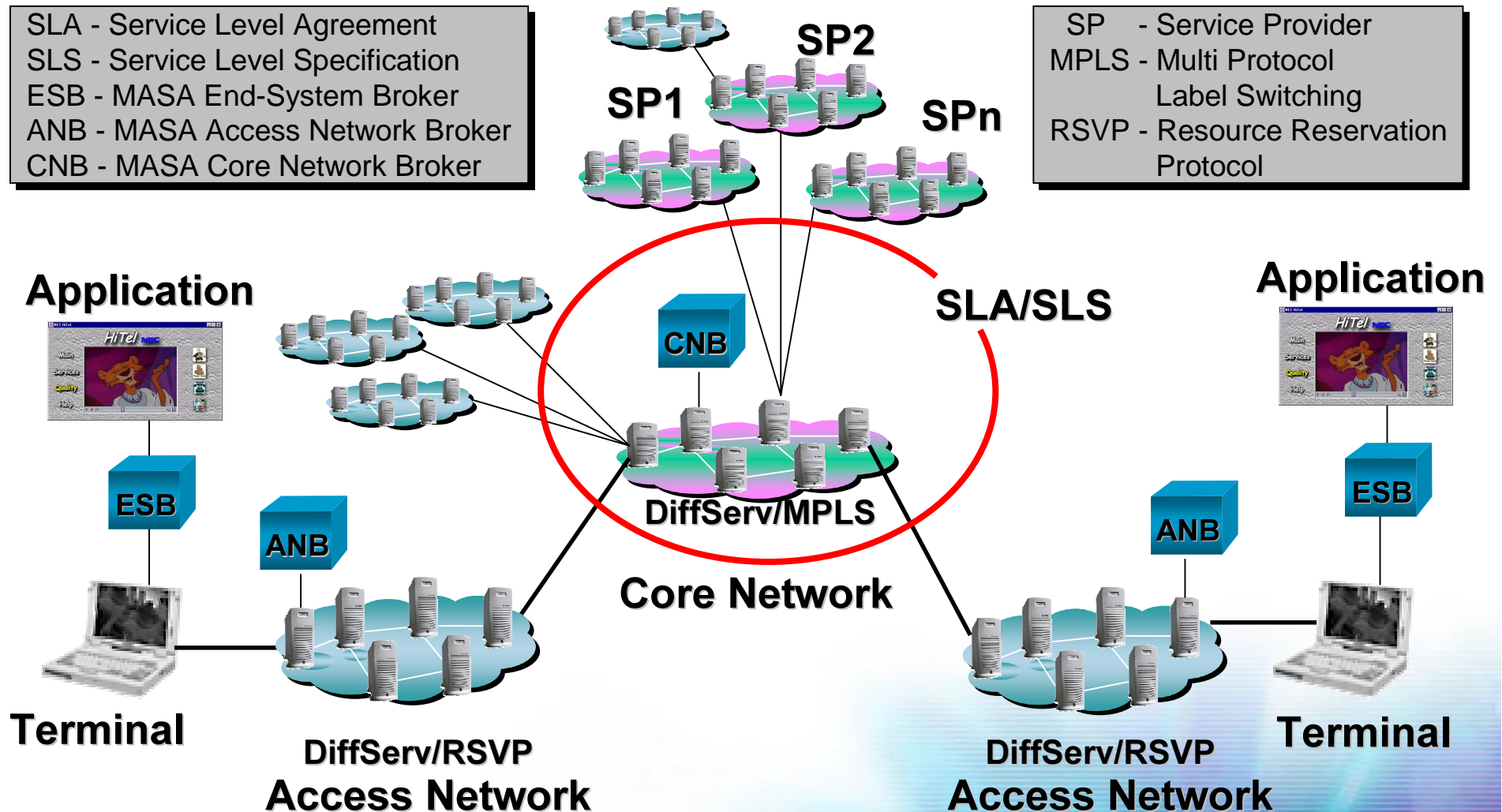


**SIEMENS**

Empowered by Innovation

**NEC**

# The MASA Architecture



SIEMENS

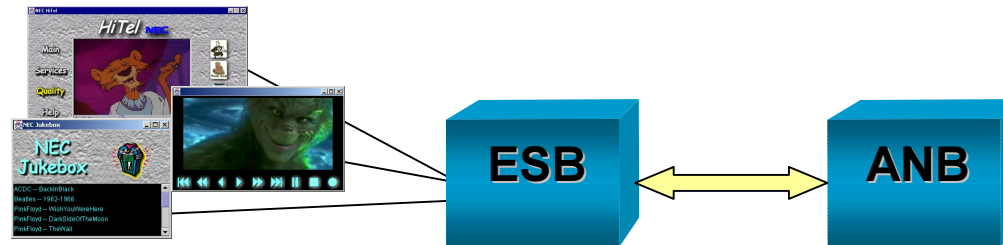
Empowered by Innovation

NEC



# 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



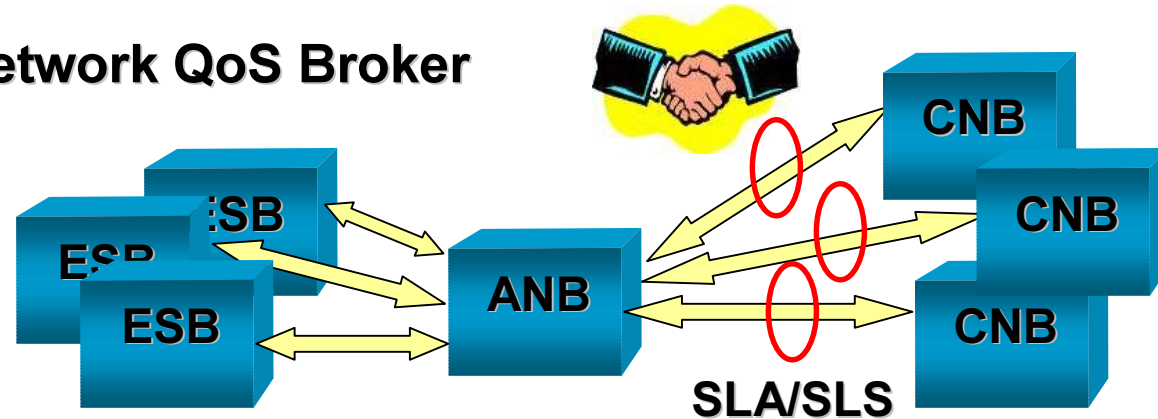
**SIEMENS**

Empowered by Innovation

**NEC**

# The MASA Architecture

## ANB – Access Network QoS Broker



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



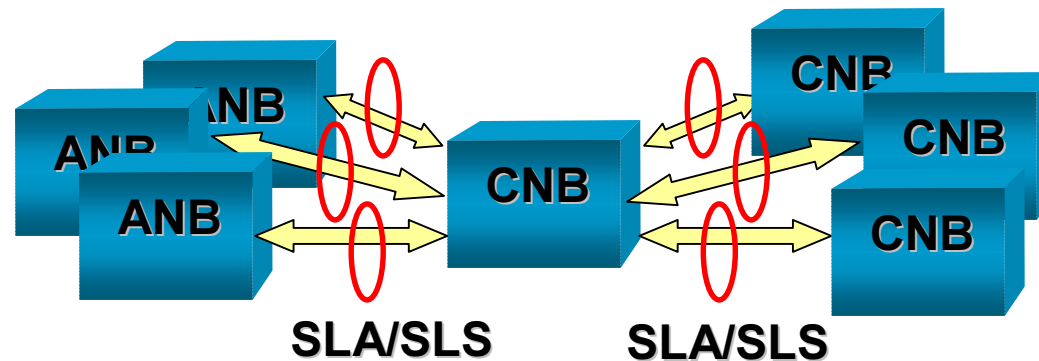
**SIEMENS**

Empowered by Innovation

**NEC**

# 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



**SIEMENS**

Empowered by Innovation

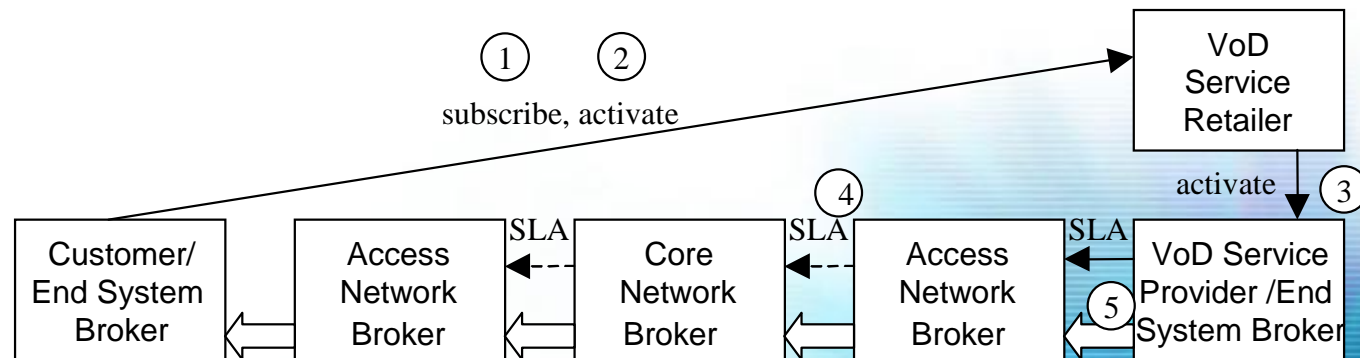
**NEC**

# SLA Negotiation between Brokers

■ ANBs and CNBs negotiate SLAs for establishing long-lived traffic trunks between access networks

- ❑ ANBs send flow aggregates through traffic trunks
- ❑ Traffic trunks are characterised by bandwidth and e.g. DiffServ class
- ❑ Traffic trunc built e.g. by bilateral agreements between adjacent Brokers, with intermediate Brokers acting on behalf of the Broker originating the trunc (Cascade Model)

■ When a customer subscribes to a service, e.g. VoD, the SLA for this session is also established via the Cascade Model



SIEMENS

Empowered by Innovation

NEC

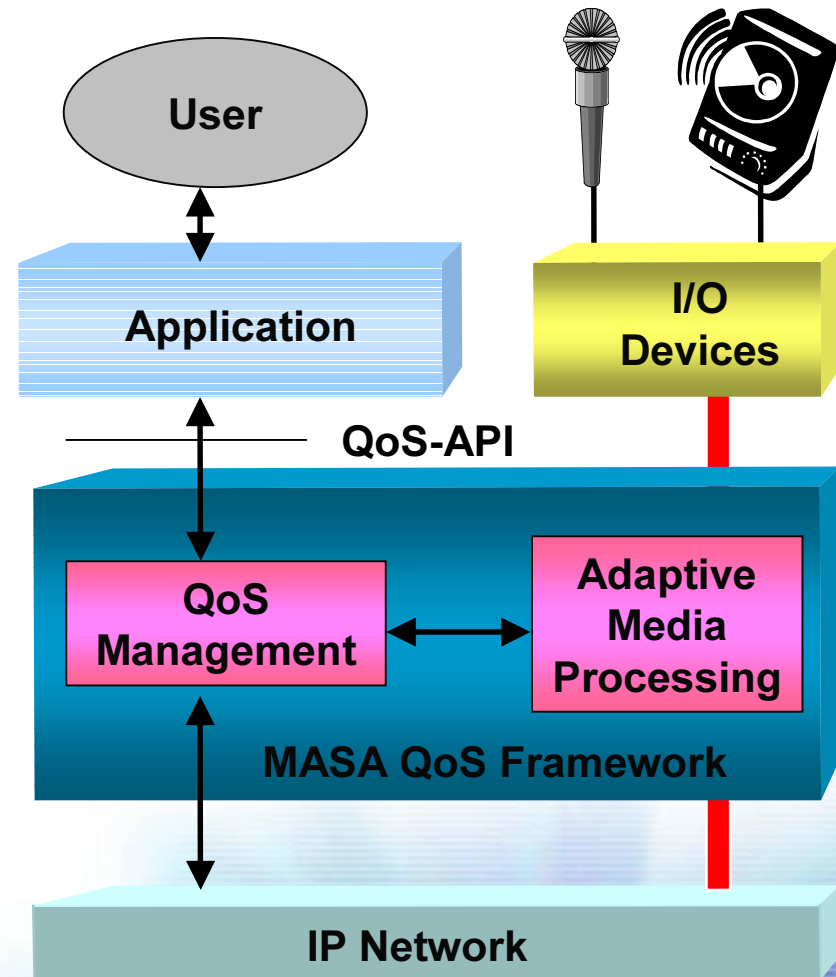
# The MASA Architecture

## 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



**SIEMENS**

Empowered by Innovation

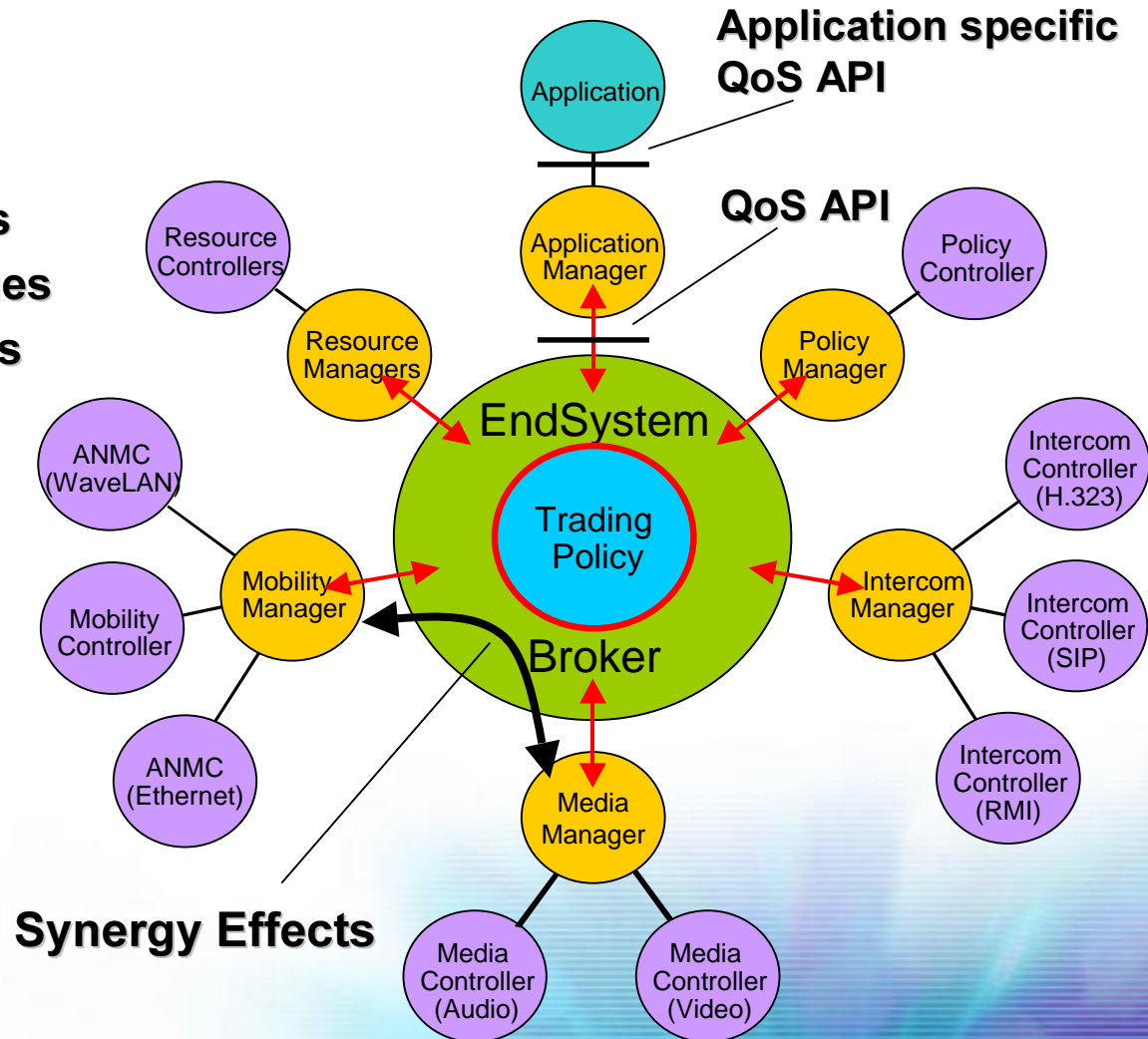
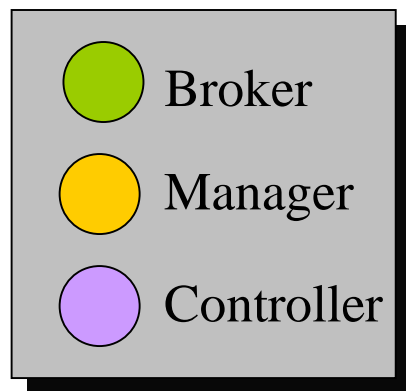
**NEC**



# The MASA Architecture

## Software Structure End-System Broker

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



SIEMENS

Empowered by Innovation

NEC

# The MASA Mobility Manager

## Motivation

- ☐ To enable *mobility of users / terminals between IP sub-network* without manual reconfiguration of the terminals or applications
- ☐ To support uninterrupted packet delivery: “*seamless handoffs*”
- ☐ To automatically choose *best* access network

## Technology

- ☐ Mobile-IP with simultaneous Bindings “*make before break*”
- ☐ Decide access network using *user policies* and *adapt media processing*
- ☐ Movement detection based on
  - on link layer rather than IP based (Access Network Monitoring)
  - monitoring of multiple stations per technology (e.g. WLAN)
  - monitoring of several types of Access Networks (multi-homing)

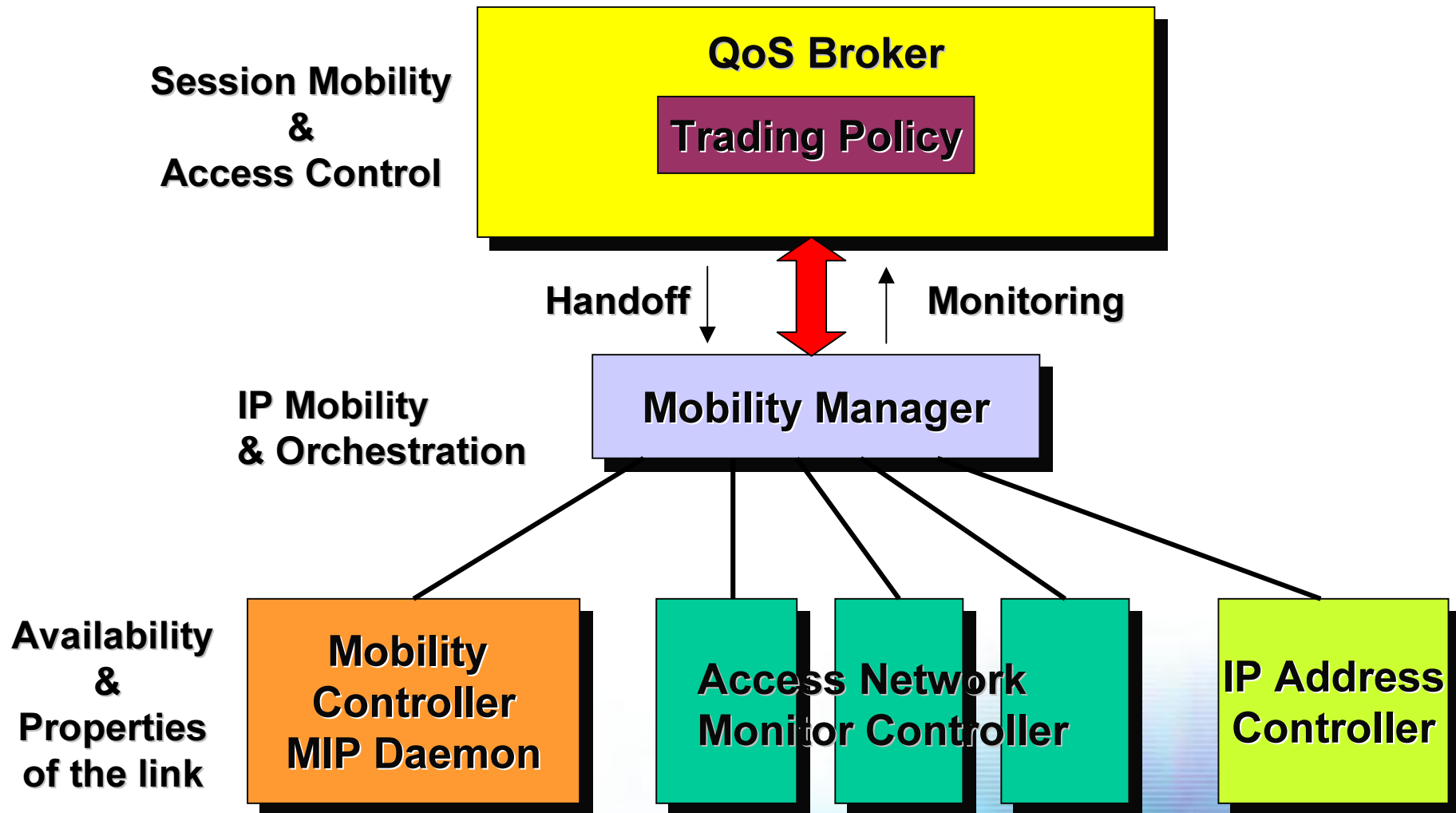


SIEMENS

Empowered by Innovation

NEC

# The MASA Mobility Manager



**SIEMENS**

Empowered by Innovation

**NEC**

# The MASA Media Manager

## **Media Manager** orchestrates the whole streaming 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



**SIEMENS**

Empowered by Innovation

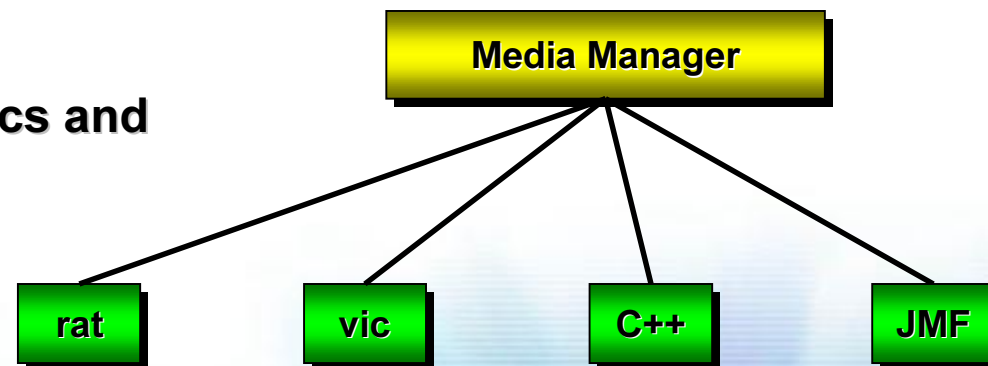
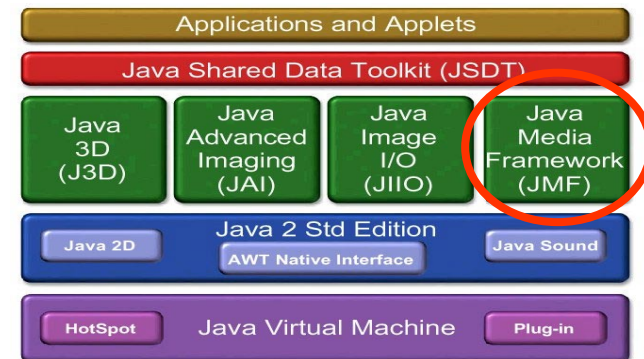
**NEC**

# 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



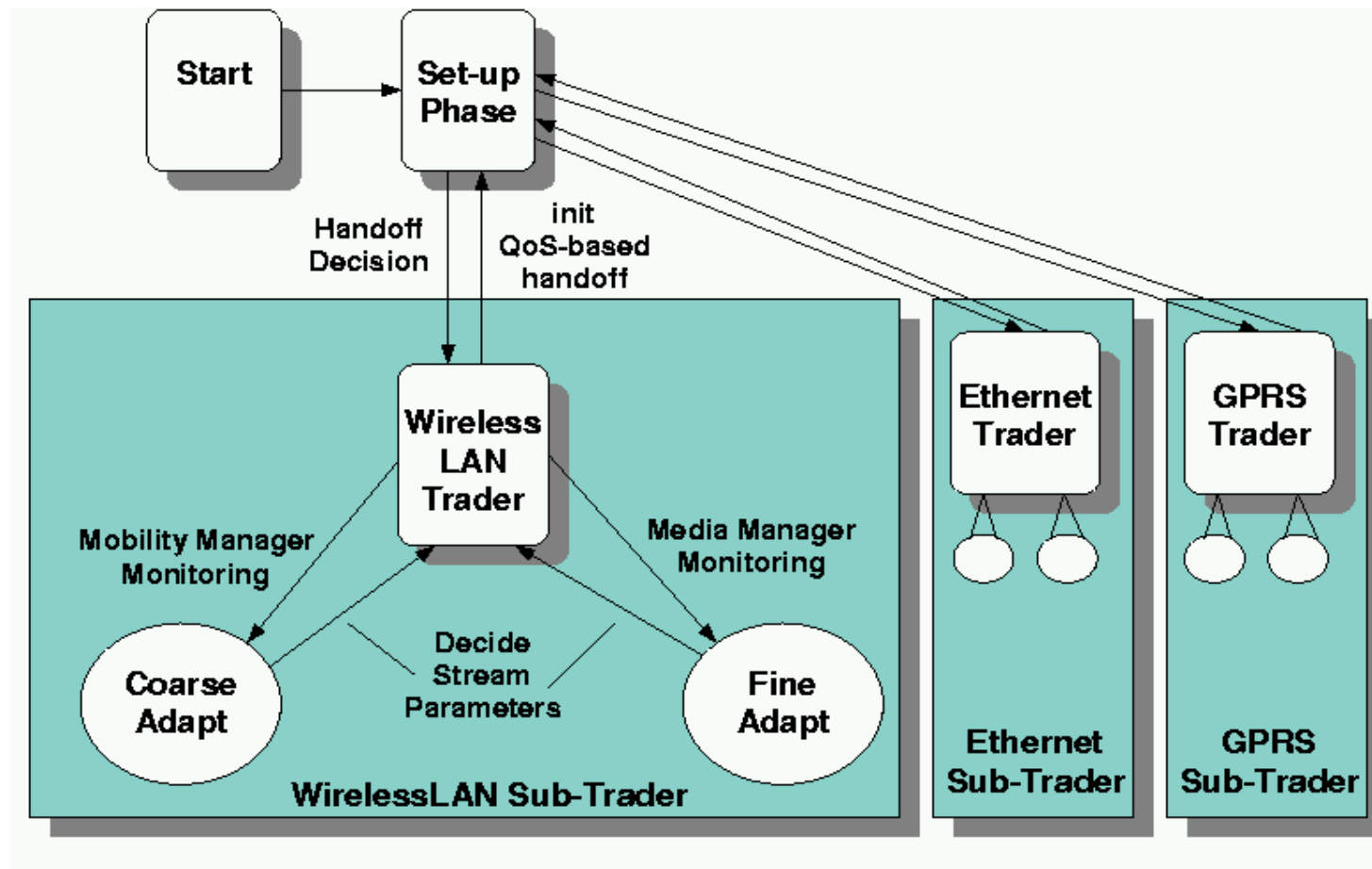
SIEMENS

Empowered by Innovation

NEC

# Adaptation Strategies

## ■ Hierarchical adaptation trader (exists for User, Session, Stream)



# Applications

## Video Conferencing



## Video on Demand (VoD)



## Audio Jukebox



## Radio Broadcasting



SIEMENS

Empowered by Innovation

NEC

# Results

## Specification of Architecture

## Prototype Implementation (Java / C++)

- Mobility Manager (Dynamics Mobile IP)
- Media Manager (Java / JMF, rat, vic, proprietary C++)
- Policy Manager (ASCII User Policy Description)
- CPU Manager (Windows NT)
- Intercom Manager (SIP, Java-RMI)
- Application Manager (VoD, Audio Broadcast etc.)

## Testbed equipped with Wavelan, GSM and Ethernet

## Simple Trader algorithms for audio and video

- Large set of codecs (MPEG, H.261/3, G.711, MP3, WaveVideo, etc.)

## Seamless Handoffs < 5 ms

## Publications on International Conferences

(IEEE SoftCOM'2000, GI KIVS'2001, IEEE ASW'2001, SSGRR'2001, QofIS'2001)



**SIEMENS**

Empowered by Innovation

**NEC**

# Current Activities

- 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 (SDPng)
- DiffServ Support, RSVP Integration
- Policies and SLS for aggregated inter-domain SLA
- Improved Adaptation Strategies
- Network Management (DiffServ, RSVP, MPLS, COPS, SNMP, etc.)
- Etc.



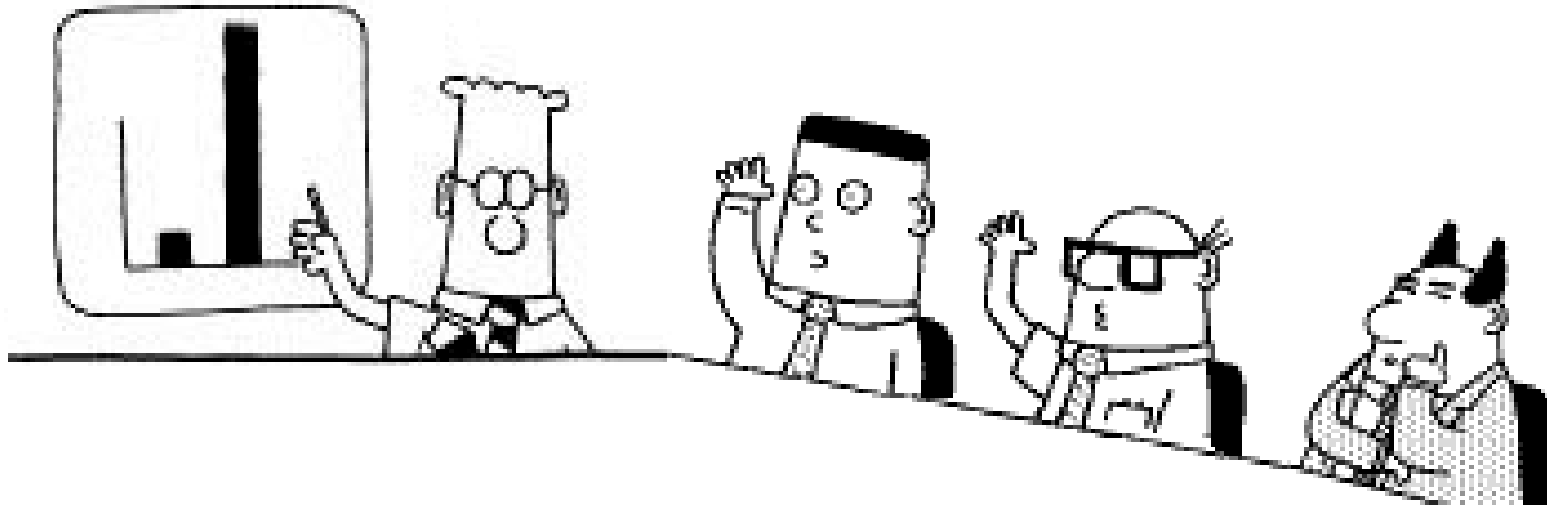
**SIEMENS**

Empowered by Innovation

**NEC**



# Any Questions?



Further Information can be found at  
<http://masa.ccrle.nec.de>



**SIEMENS**

Empowered by Innovation

**NEC**

Empowered by Innovation

**NEC**