The MASA Project

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The MASA Project

MASA =

Mobility and Service Adaptation in Heterogeneous Mobile Networks

http://masa.ccrle.nec.de

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

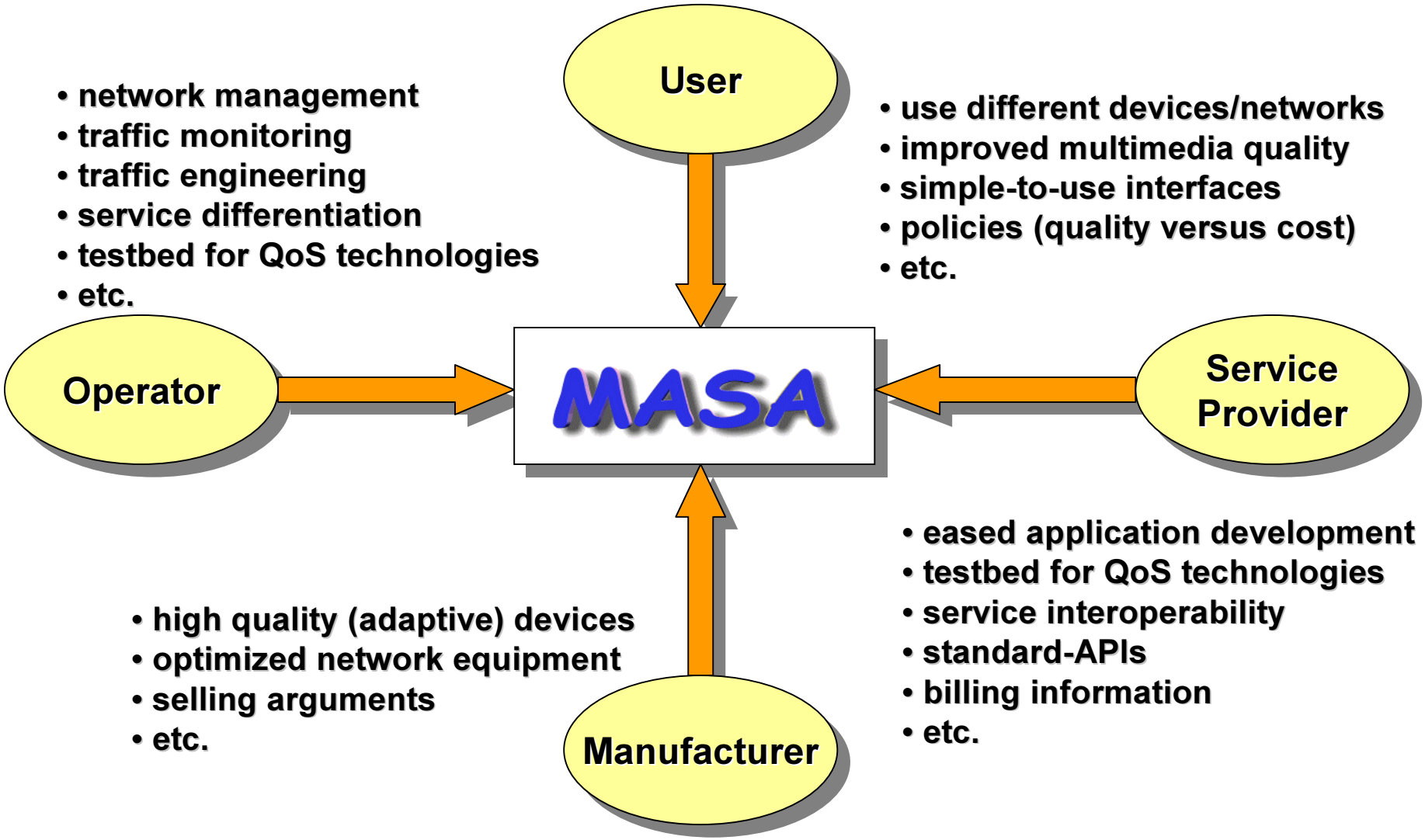
NEC

NEC Europe Ltd.
Network Laboratories
Heidelberg

Sectioning

- Motivation
- The MASA QoS Architecture
- Adaptation Strategies
- Applications
- Video Filtering
- The MASA Project Status and Plans

Motivation


User
• network management
• traffic monitoring
• traffic engineering
• service differentiation
• testbed for QoS technologies
• etc.
• use different devices/networks
• improved multimedia quality
• simple-to-use interfaces
• policies (quality versus cost)
• etc.
Operator
MASA
Service Provider
• high quality (adaptive) devices
• optimized network equipment
• selling arguments
• etc.
Manufacturer
• eased application development
• testbed for QoS technologies
• service interoperability
• standard-APIs
• billing information
• etc.

Motivation

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

Devices

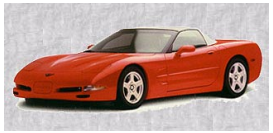
Screen Sizes, Processors, Memory, Power Supplies, Interfaces, etc.

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.

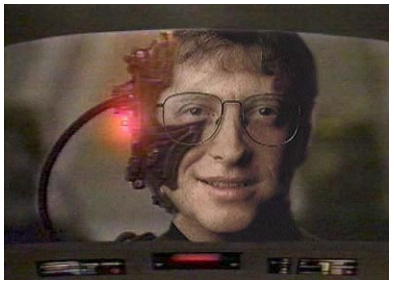
E.g. IP Telephony needs low delay, Video-on-Demand needs bandwidth

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 Architecture

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

• Mobility Management

- **to support seamless Handoffs in heterogeneous mobile environments**
- **to support different access technologies**

  (e.g. UMTS FDD, WirelessLAN, GSM/GPRS, Ethernet, etc.)

• QoS Management

- **to manage QoS end-to-end in a co-operative way**
- **to integrate and orchestrate resource management**
- **using network layer QoS**

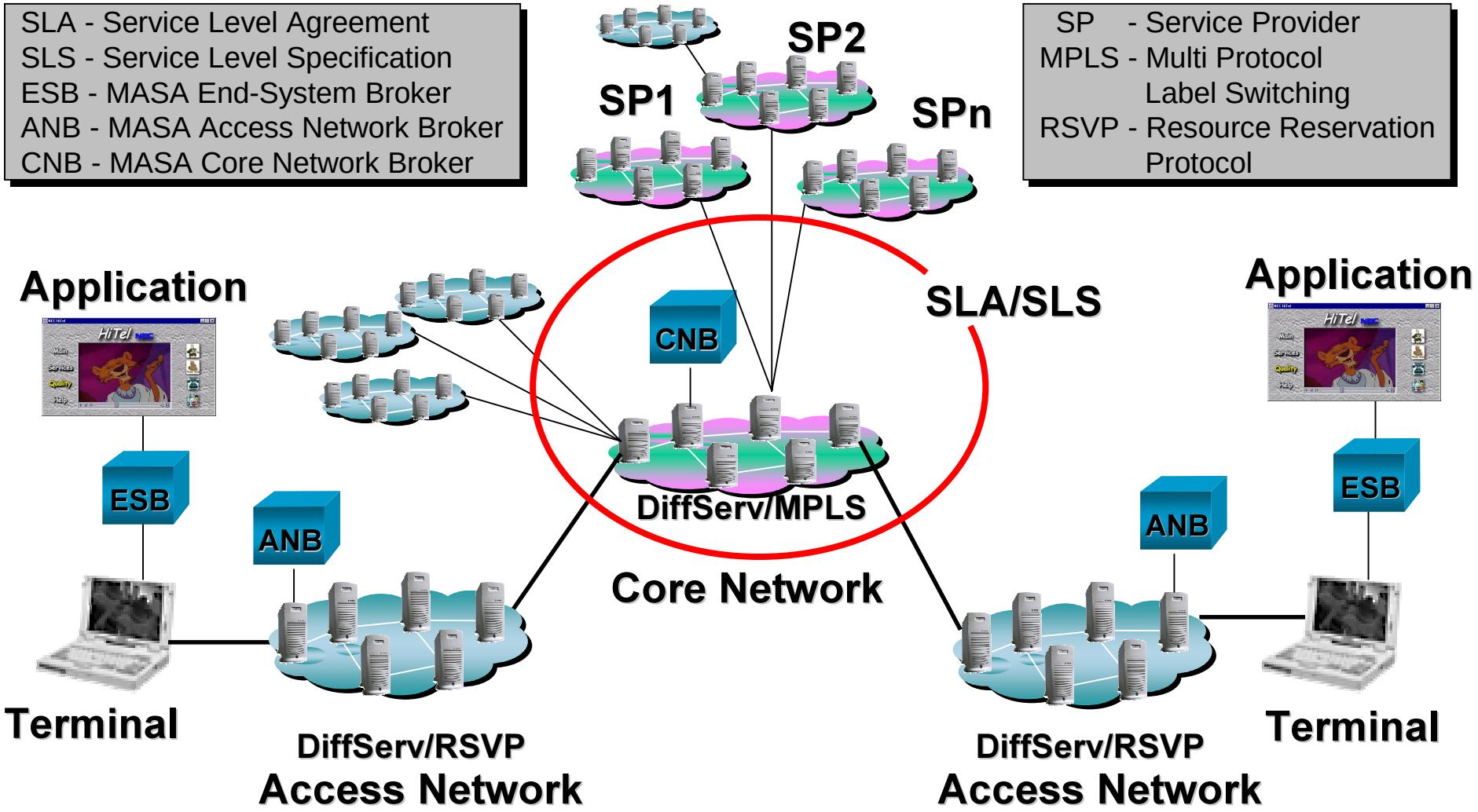
• Media Management

- **to support dynamic adaptable, high-quality, real-time media streaming**
- **to separate Media Management from the Application**
- **pure IP-solution**

The MASA Architecture

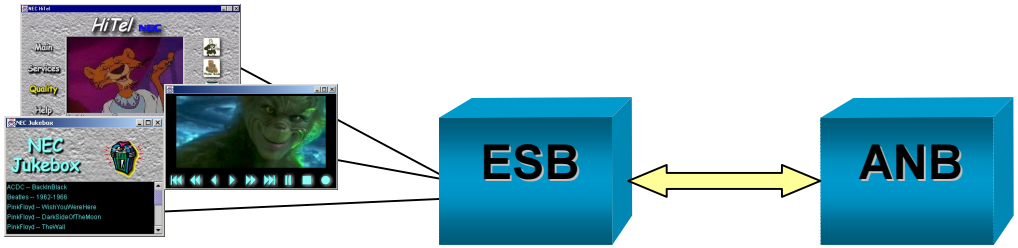
SLA - Service Level Agreement
SLS - Service Level Specification
ESB - MASA End-System Broker
ANB - MASA Access Network Broker
CNB - MASA Core Network Broker

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



The MASA Architecture

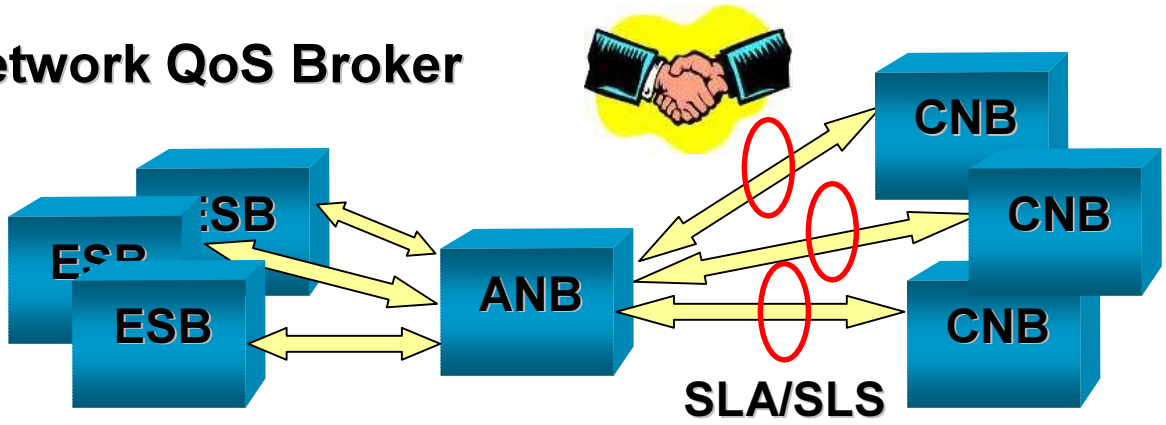
ESB – End-System QoS Broker



- 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

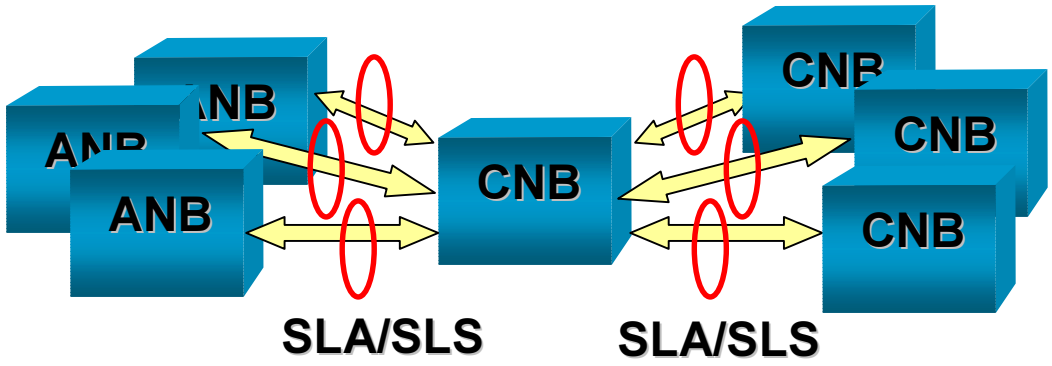
ANB – Access Network QoS Broker



- 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

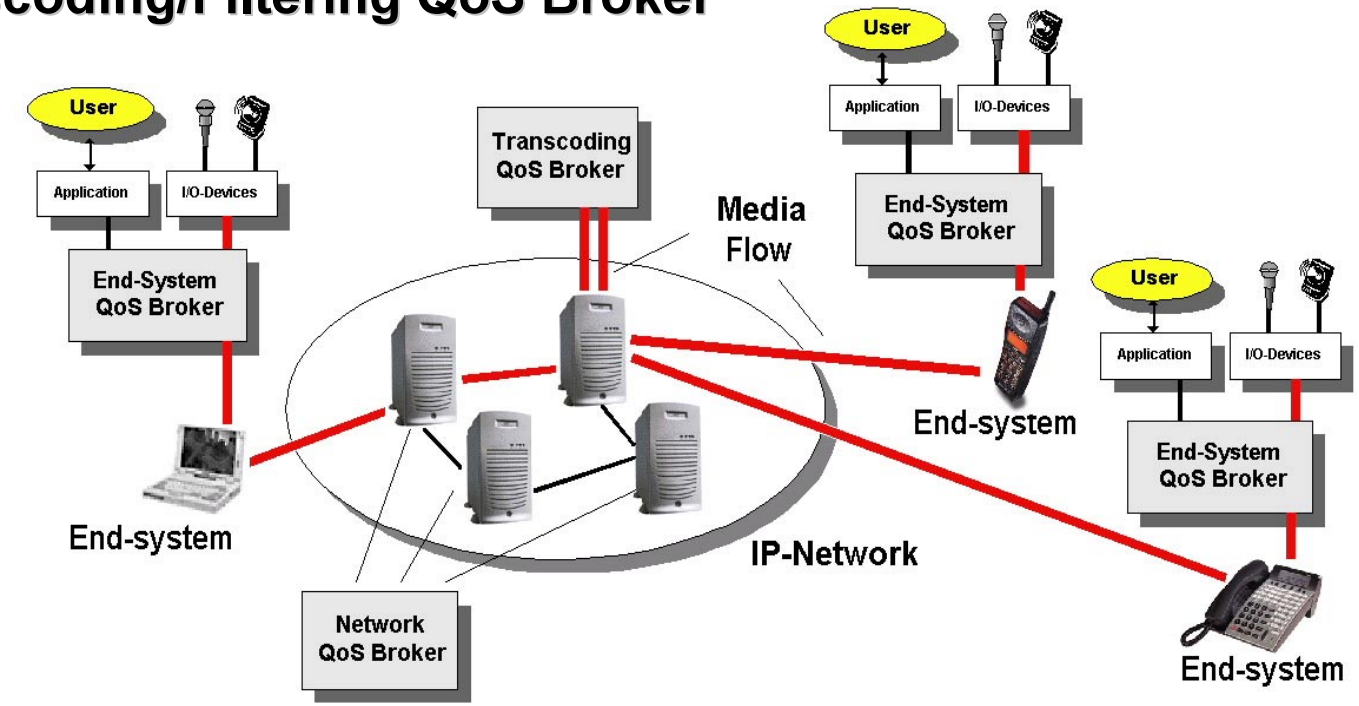
CNB – Core Network QoS Broker



- 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

Transcoding/Filtering QoS Broker



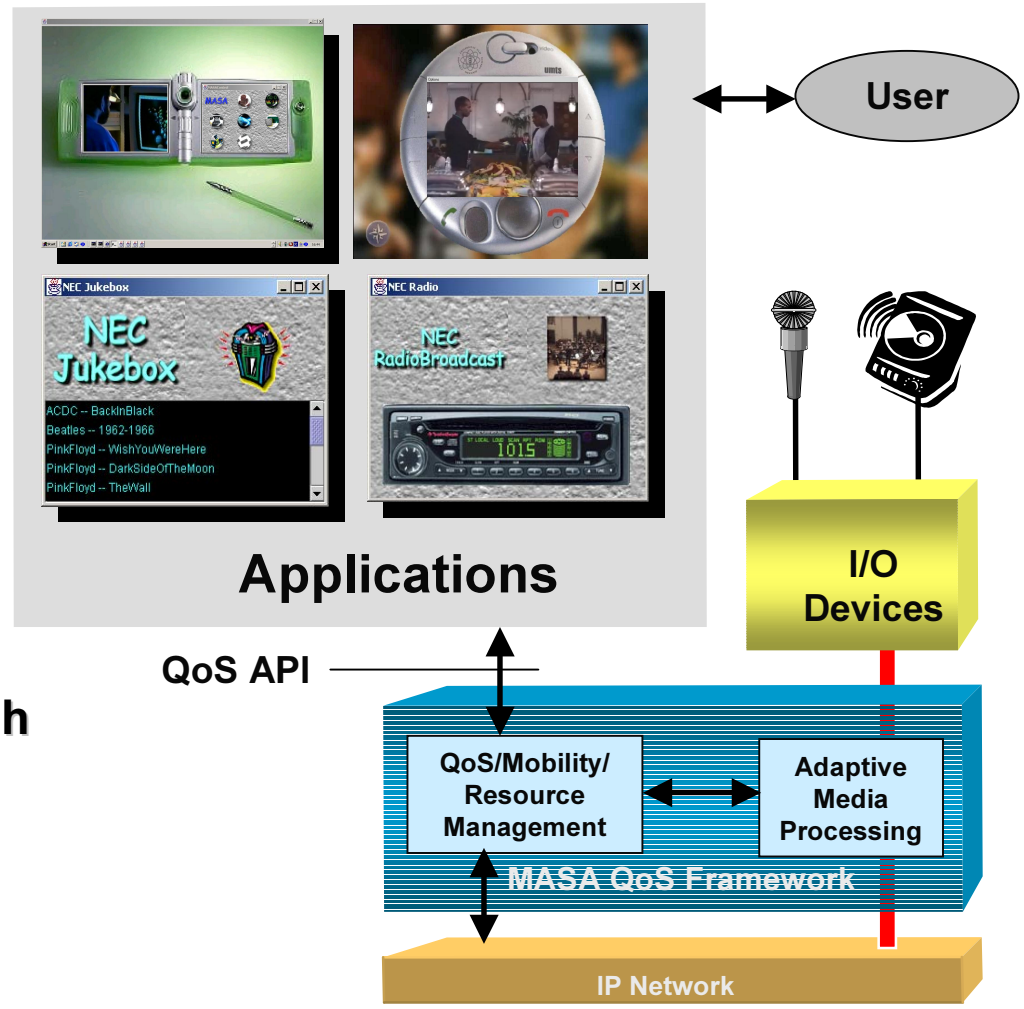
- Supporting heterogeneous devices by transcoding or filtering of media streams
- Placement should be optimized to avoid bandwidth wasting (probably near base stations e.g. UMTS or IEEE802.11)

The MASA Architecture

End-System Broker

Separation between media Processing and applications allows for:

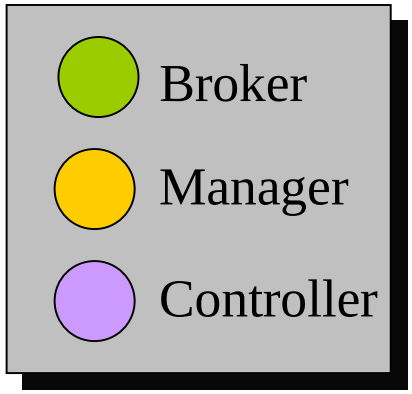
- ✓ **Media-independent application development (GUI)**
- ✓ **Hiding complex media details by high-level QoS API**
- ✓ **Extendable Architecture through plug'n-play mechanisms**
- ✓ **Operating-System independent applications**

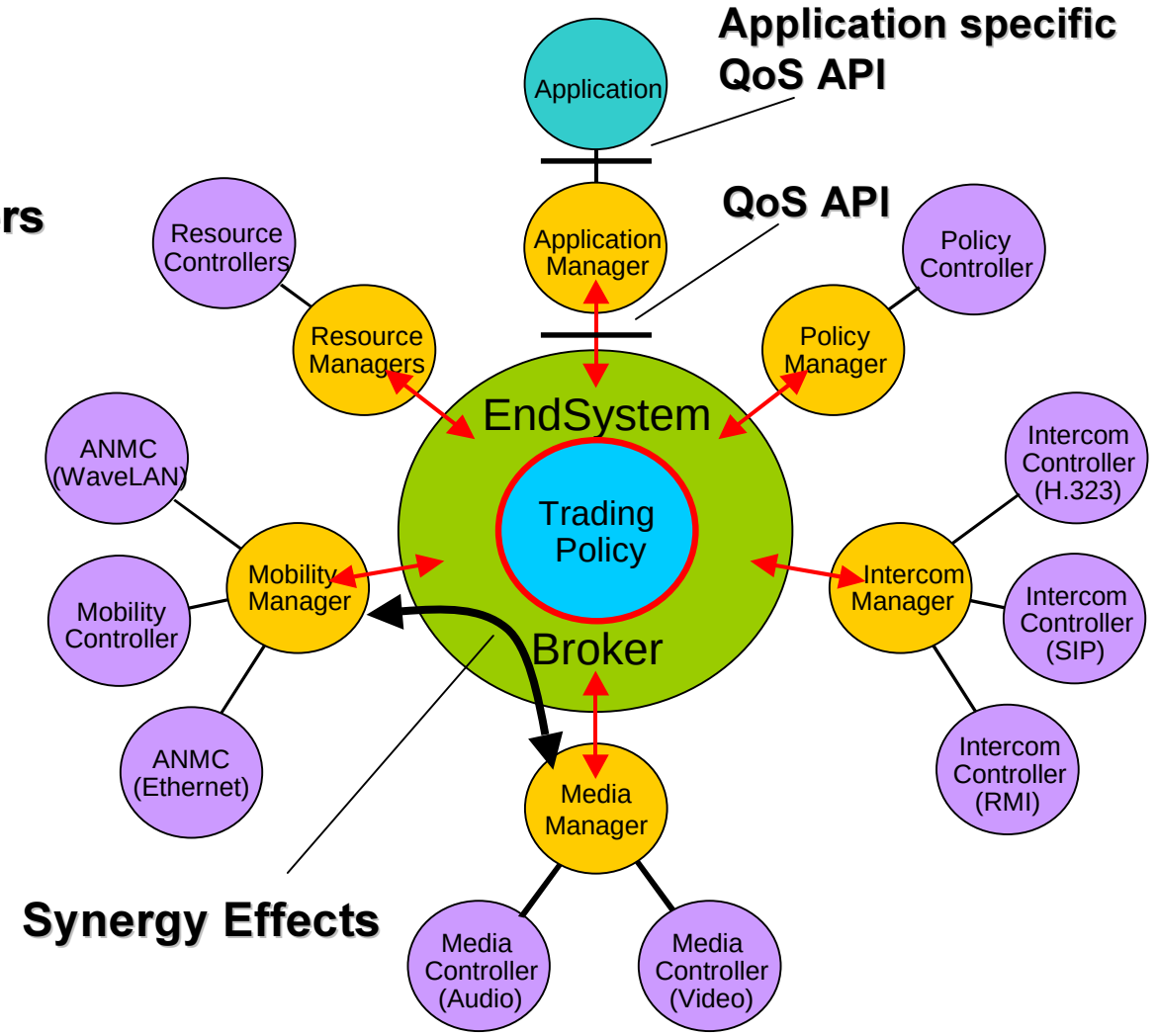


The MASA Architecture

Software Structure End-System Broker

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





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**

Applications

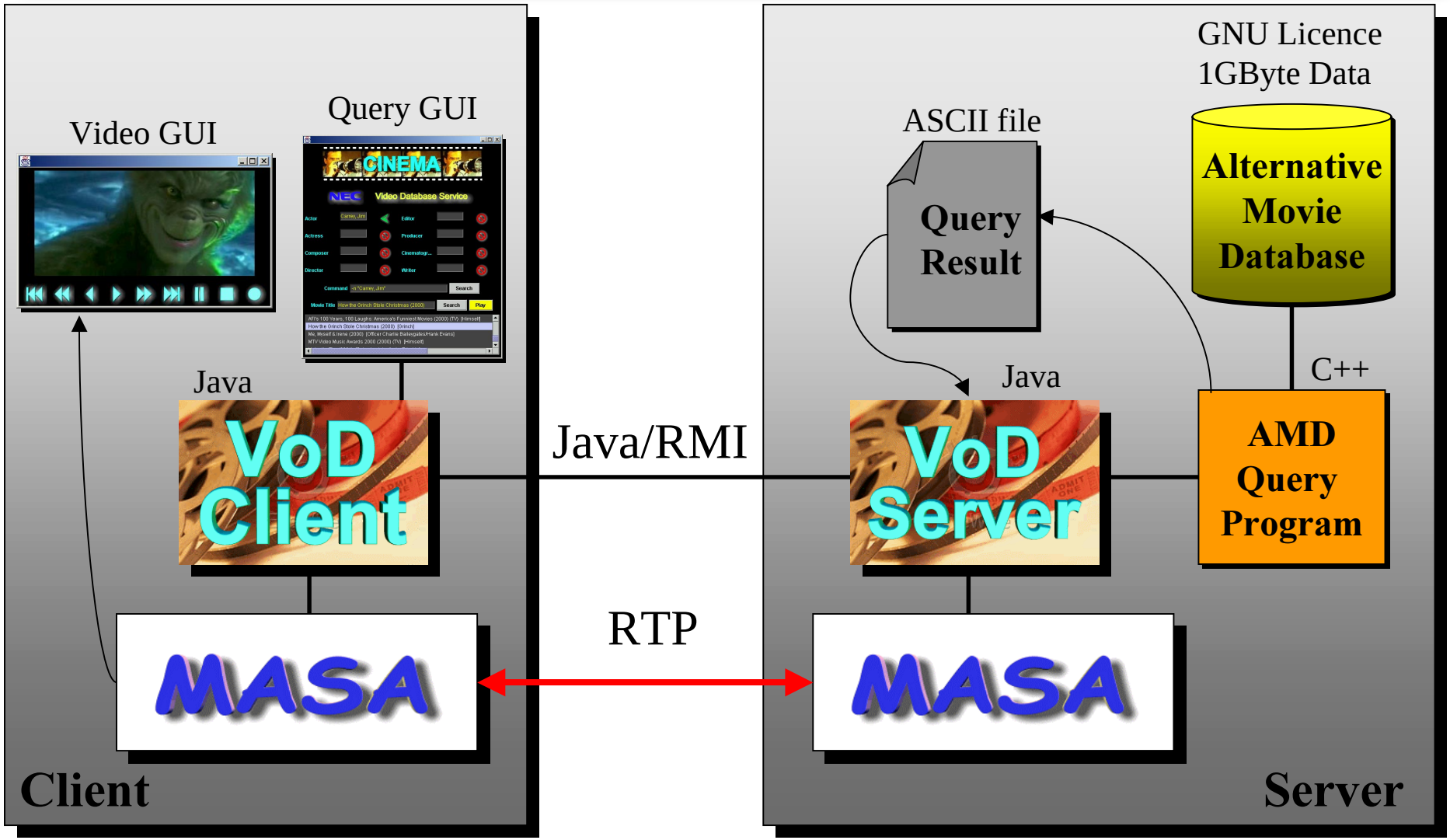
Video Conferencing

Video on Demand (VoD)

Audio Jukebox

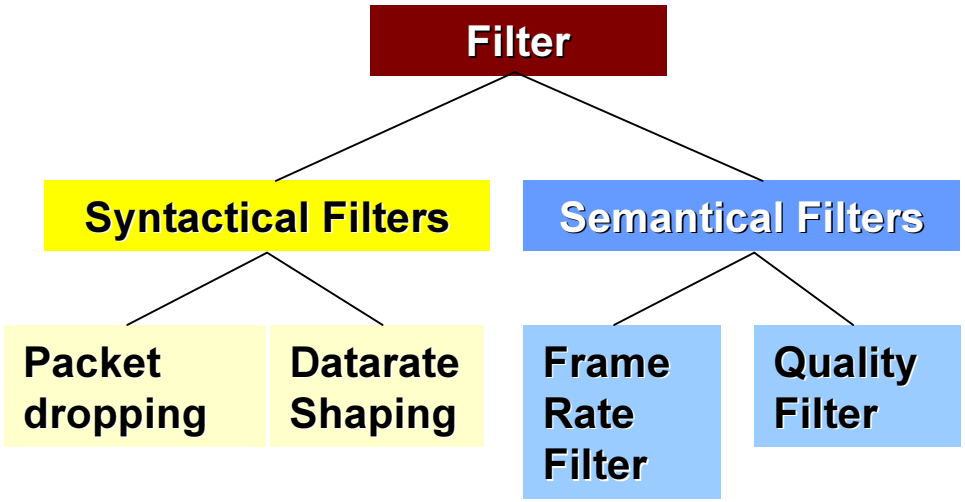
Radio Broadcasting

Video on Demand (VoD)



Video on Demand (VoD)

Video Filtering

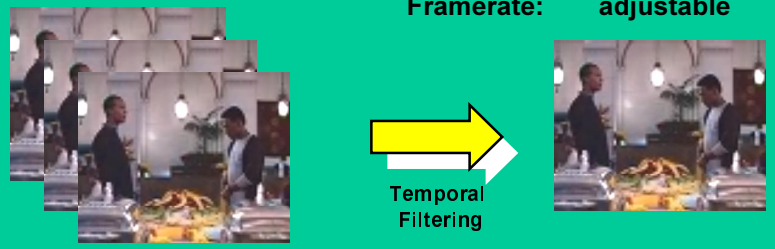


User QoS Policies

(Framerate vs. Color resolution)

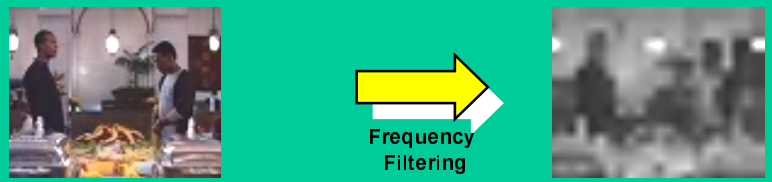
Framerate filter

Quality: constant
Bandwidth: varying
Framerate: adjustable



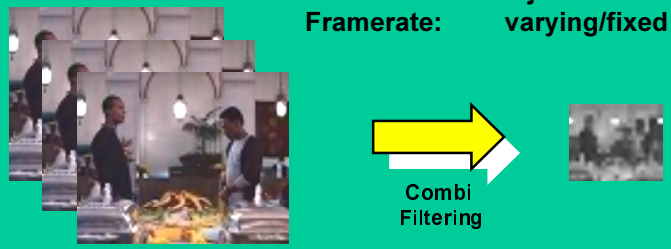
Quality filter

Quality: adjustable
Bandwidth: varying
Framerate: constant



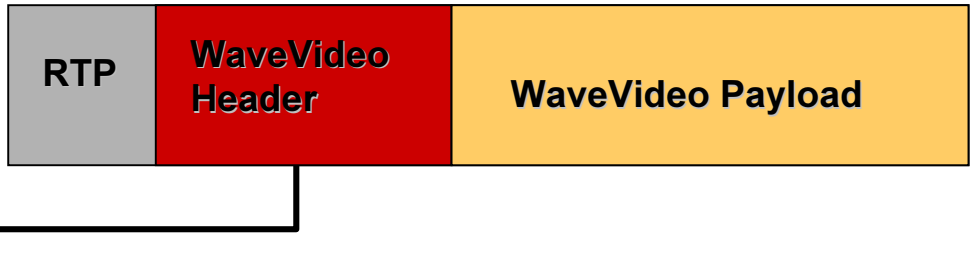
Bandwidth filter

Quality: varying
Bandwidth: adjustable
Framerate: varying/fixed



Video Filtering

Semantical Filters

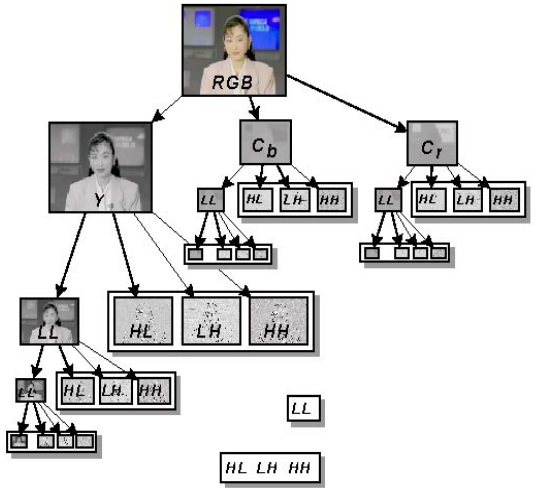


Tag contains information about:

- Quality Layer
- Colour Channel
- Recursion Depth
- Spatial Filtering

Combi Filter allows adaptation of:

- Frame rate
- Frame size
- Luminance quality
- Chrominance quality



Video Filtering

Syntactical Filter

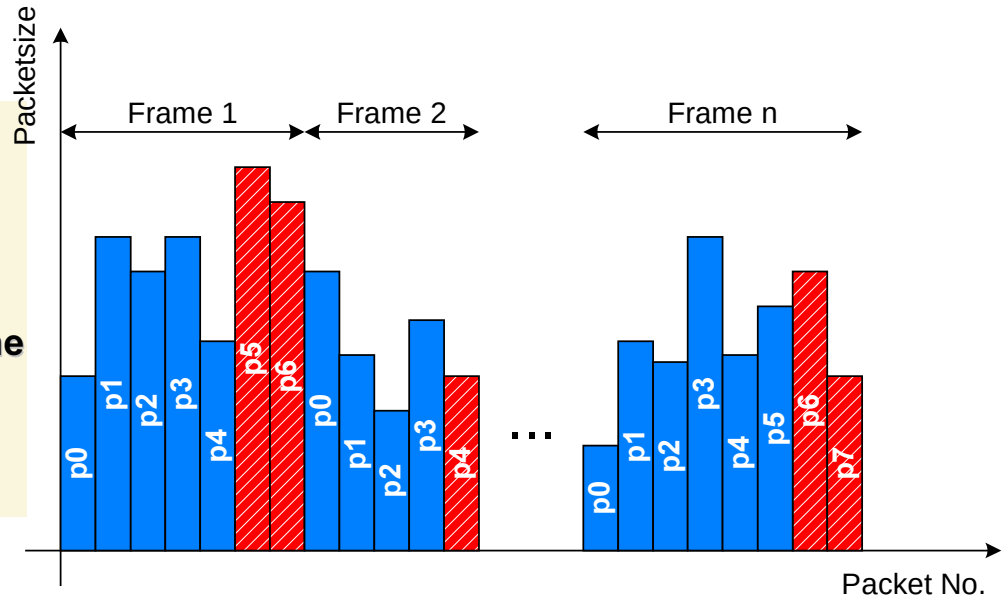
Priority Based Packet Dropping

$$m = trunc(n * q)$$

n: number of WaveVideo packets of input frame

m: number of WaveVideo packets for output

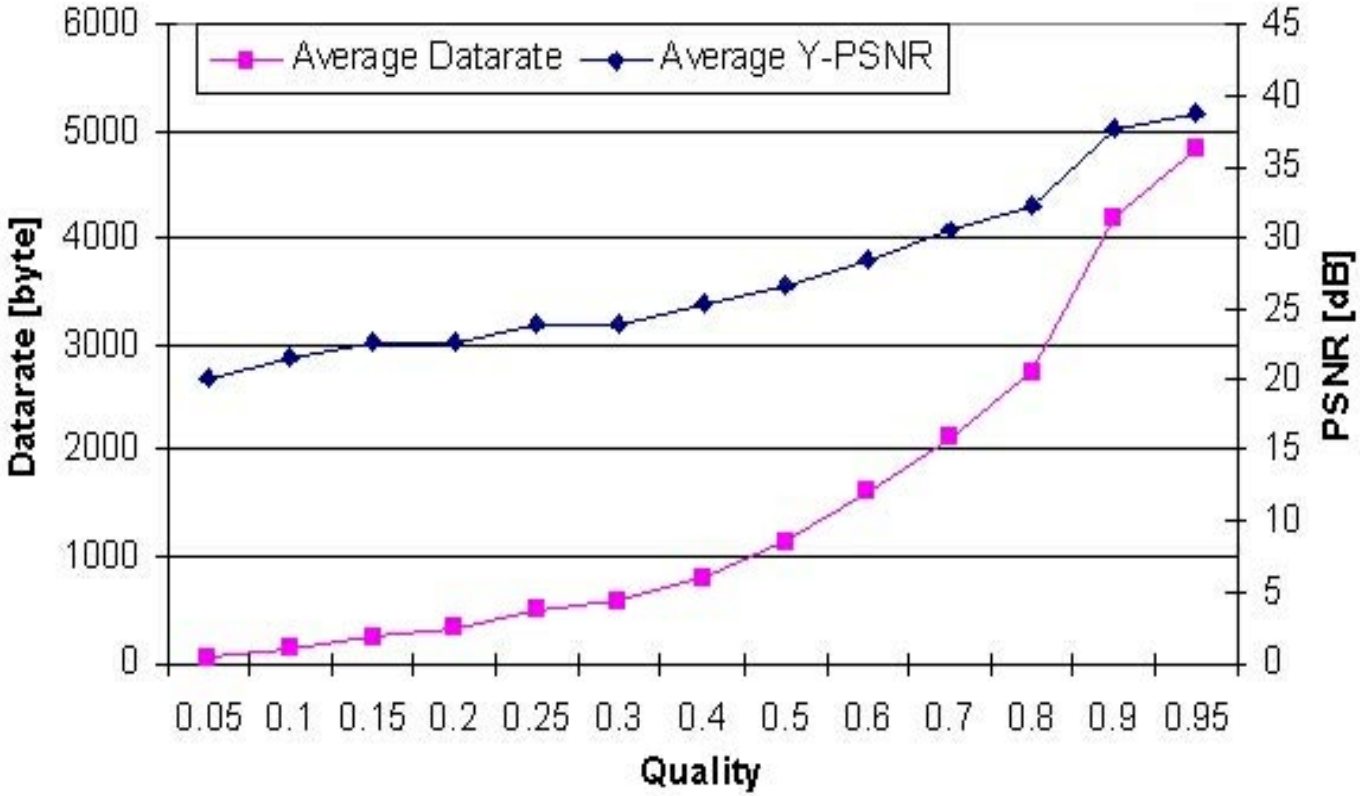
q: quality factor in [0,1], 1 is the best quality



- In congestion, routers start early to drop packets and to adapt to a lower bandwidth.
- Degradation of the quality of the picture, but the stream won‘t be lost and no anoying artefacts will be visible.
- Implemented as WaveVideo filter plug-in in JMF.

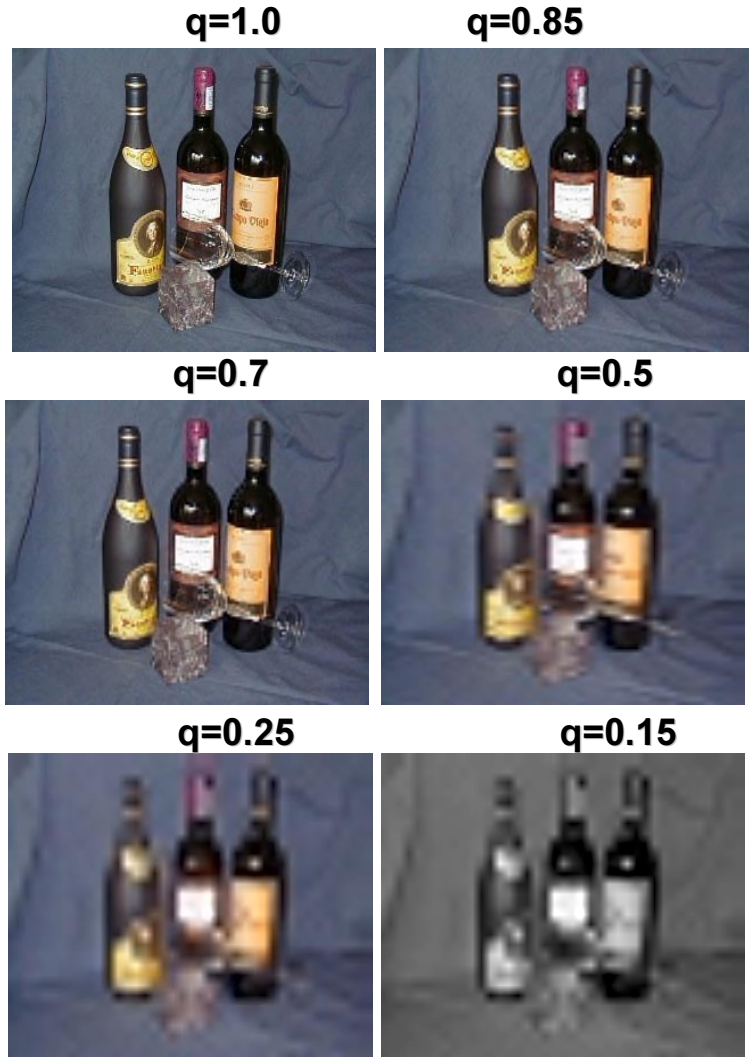
Video Filtering

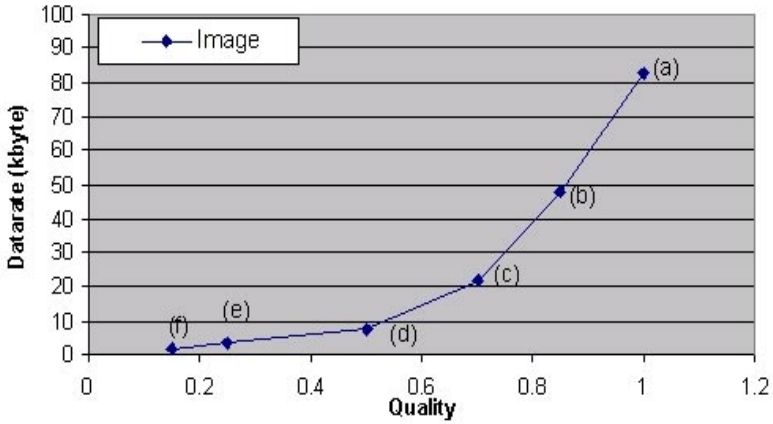
Measurements
Priority Packet Dropper



Video Filtering

Visual Quality





Q-factor	Datarate (byte)	Compression factor
1.0	82800	1:1
0.85	47959	1:2
0.7	21775	1:4
0.5	7697	1:11
0.25	3455	1:24
0.15	1583	1:52

Video Filtering

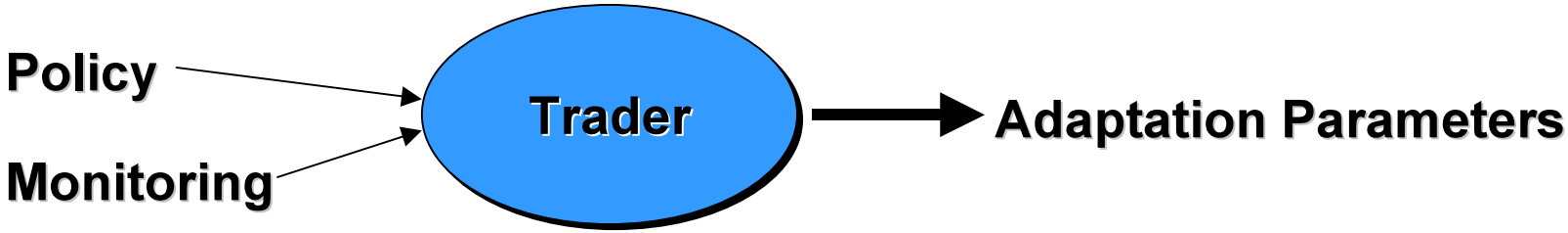
Video on Demand Scenario

Beverly Hills Cop Movie (Scene)
352 x 288 pixels
25 fps

User QoS Policy:

Data rate <= 10 Mbit/s, Frame rate <= 10 f/s

A: Frame rate is more important than Frame quality
B: Frame rate is of equal importance then Frame quality

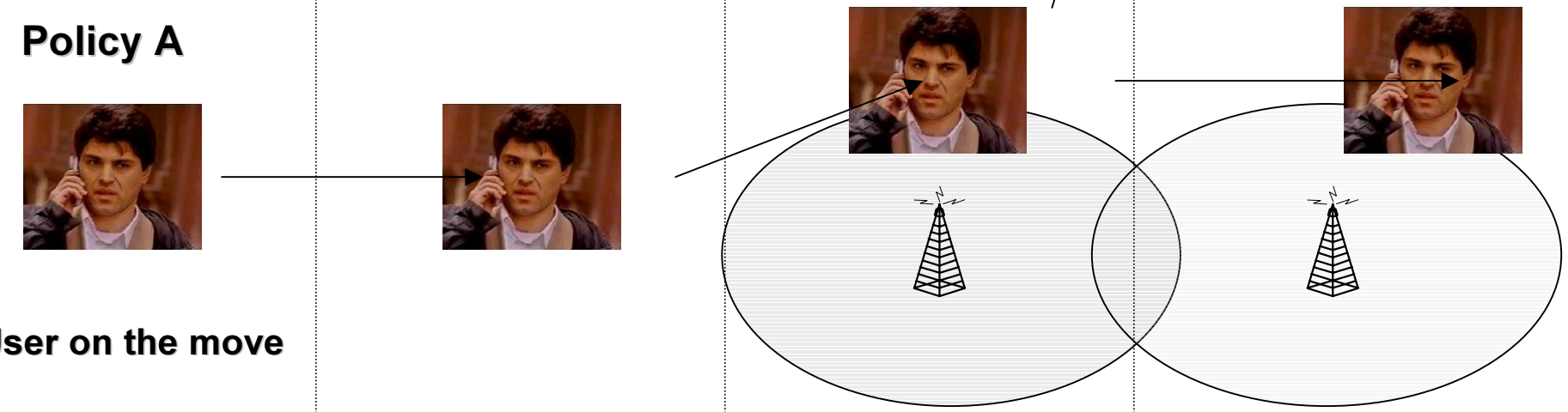


Video Filtering

<= 1 Mbit/s -> 10f/s, dropping only subbands of highest layer	<= 200 kbit/s -> 4 f/s, dropping a lot of subbands	<= 500 kbit/s -> 6 f/s, dropping less subbands
Ethernet	WaveLan 1 (bad Signal)	WaveLan 2 (better Signal)

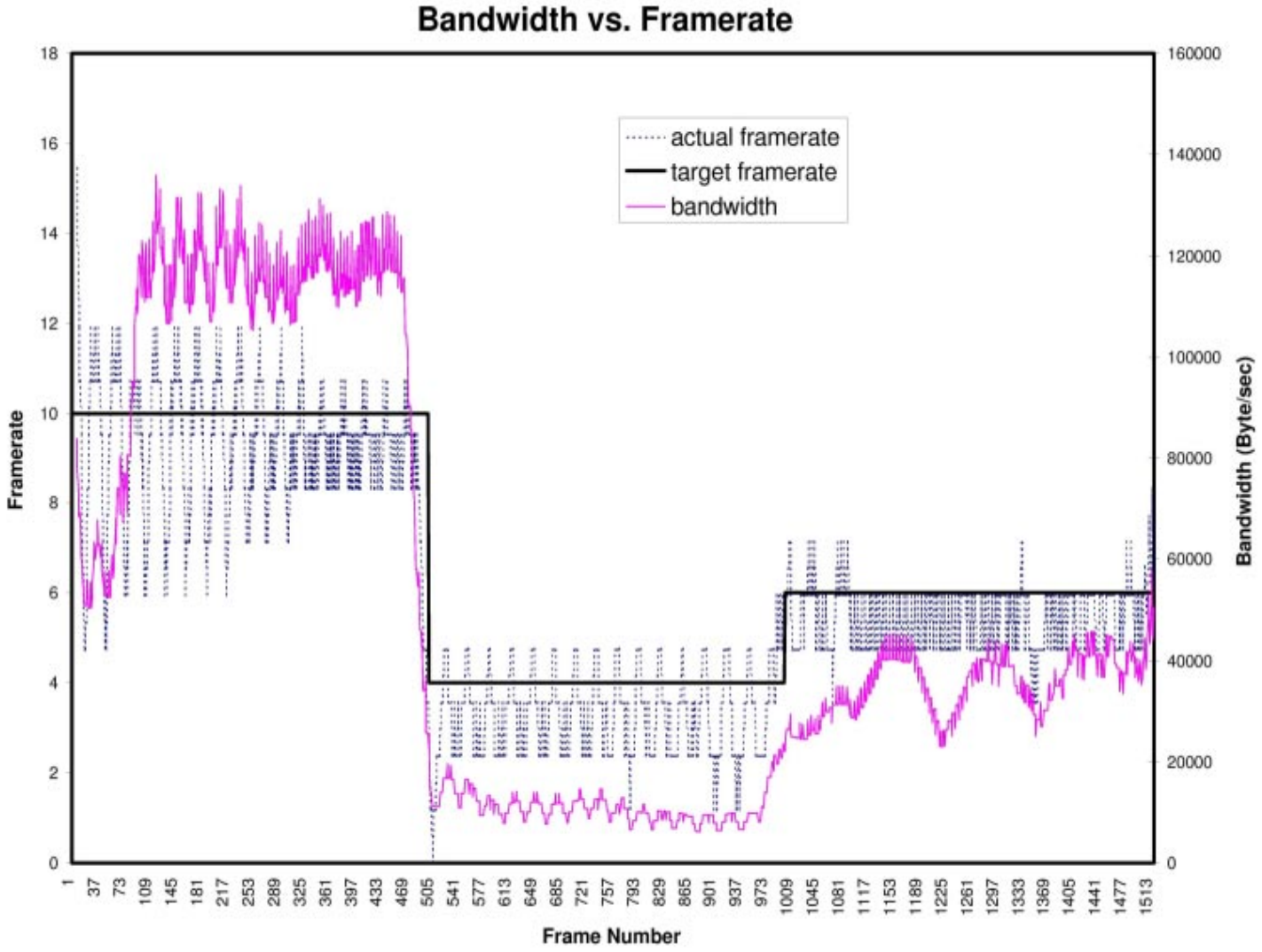
Policy A

Policy B



User on the move

Video Filtering



The MASA Project

Phase I (Oct 1999 – Sep 2000)

Design

- Broker Architecture
- Specification of a Mobility Management System
- Design of the Media Management System
- Definition of the inter-working between Mobility and Media

Implementation

- ESB with Mobility-, Media-, Policy-, CPU- and Intercom-Manager
- Sample applications (VoD, Internet Radio, etc.)
- Testbed (Mobile-IPv4, Linux/Windows) and Demonstration

Results

- MASA QoS Framework Design Document (ITR, 140 pages)
- Publications on International Conferences
  (IEEE SoftCOM'2000, GI KIVS'2001, IEEE ASW'2001, SSGRR'2001, QofIS'2001)

The MASA Project

Phase II (Oct 2001 – Mar 2003)

Design

- Overall Architecture with ESB, ANB, CNB and Transcoding Broker
- Interworking of all components (Interfaces + Protocols)
- Business Cases, Deployment Strategy, etc.

Implementation

- Complete Architecture
- Intelligent Trading and Resource Management Strategies
- Testbed and Demonstration

The MASA Project

Phase II (Oct 2001 – Mar 2003)

End-System Issues

- Synchronized audio/video streaming (JMF/RTP)
- RTP monitoring for group communication
- Interworking with Transcoder/Filter
- Downloadable codecs
- Receiver-driven adaptation strategies
- Enhanced local resource management
- QoS adaptation policies (Cost functions)
- Trading rules to optimize RSVP and DiffServ reservations
- Terminal capability analysis and exchange (SIP/HTTP/XML)
- NEC RTP Filter Router integration
- DiffServ marking on End-System?
- Focus on small end-devices (K-Java)

The MASA Project

Phase II (Oct 2001 – Mar 2003)

Access Network Broker

- Focus on policies for aggregated streams
- RSVP
- End-System Interworking

Core Network Broker

- Network Management (DiffServ, RSVP, MPLS, COPS, SNMP, etc.)
- Policies and SLS for aggregated inter-domain SLA
- Policy Management (IETF Framework)

Other QoS Projects at NEC

- Java Policy based Management System (DiffServ, MPLS)
- RTP Filter Router
- Alternatives to DiffServ (Olympic Model)
- QoS for SIP (Quality Agents)
- DiffServ Router Product
- etc.

Any Questions?