Adaptive Wavelet Video Filtering

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Sectioning

- Introduction
- The MASA QoS Framework
- Adaptive Media Management
- Filtering Algorithms with Measurements
- Conclusions and Demonstration

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Motivation

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

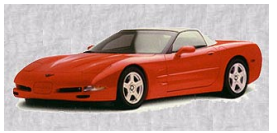
Devices

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

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.

Users wants to have on/off button, some other to specify certain parameters.

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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

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MASA QoS Framework

- **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**
- **Integrate and Orchestrate Resource Management**

• Media Management

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

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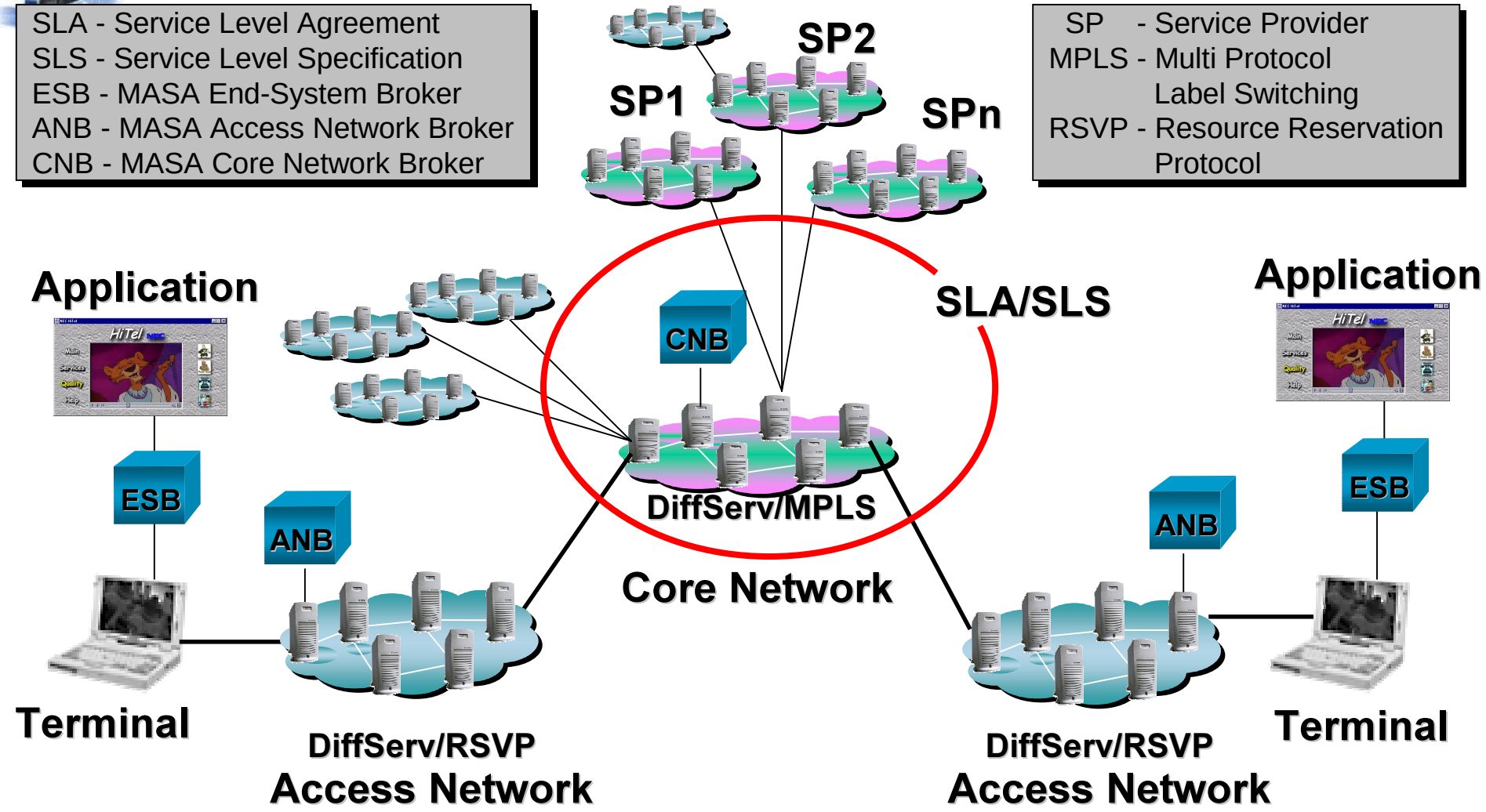
Overall Architecture

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



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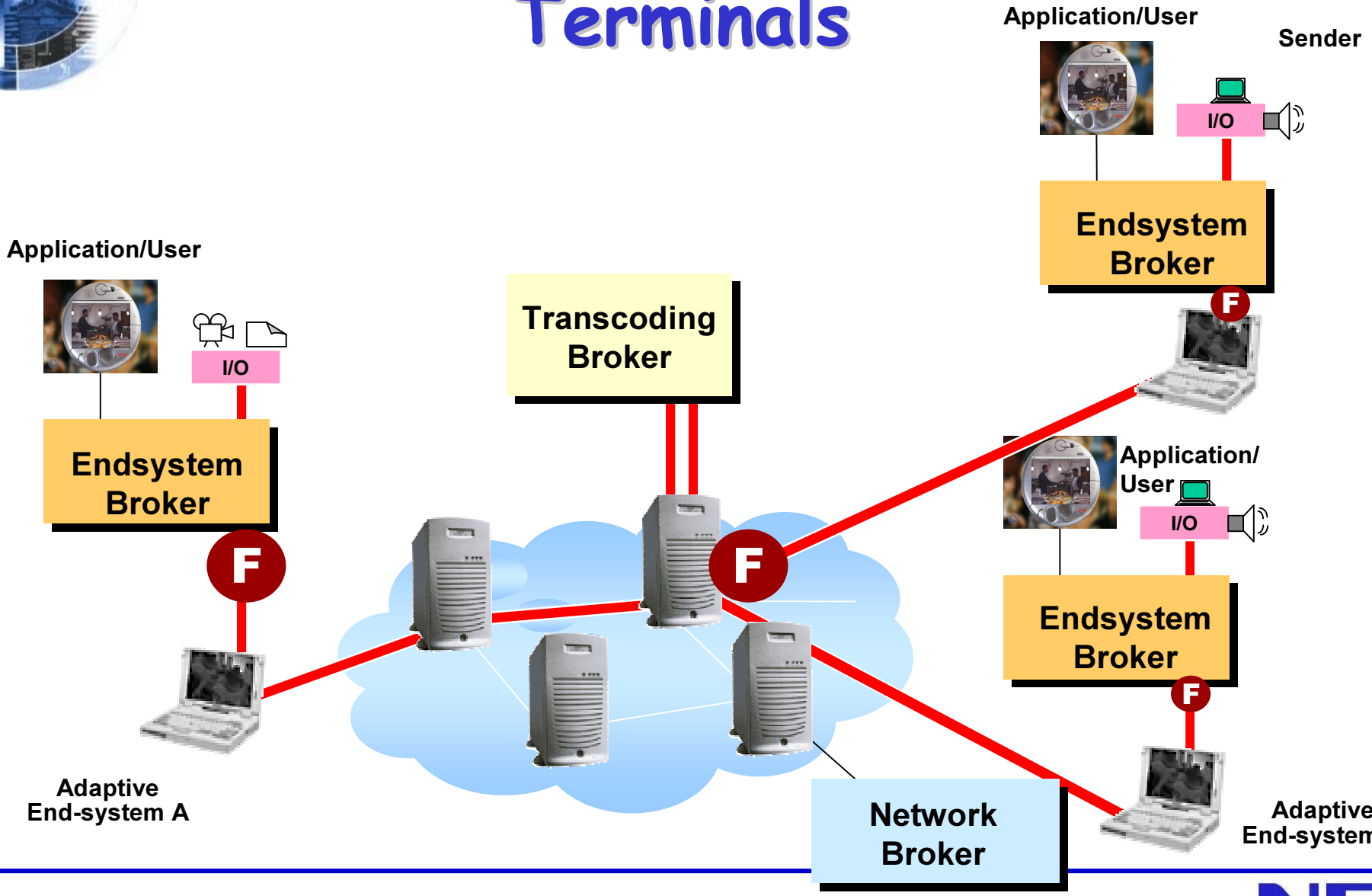
Support for Heterogeneous Terminals



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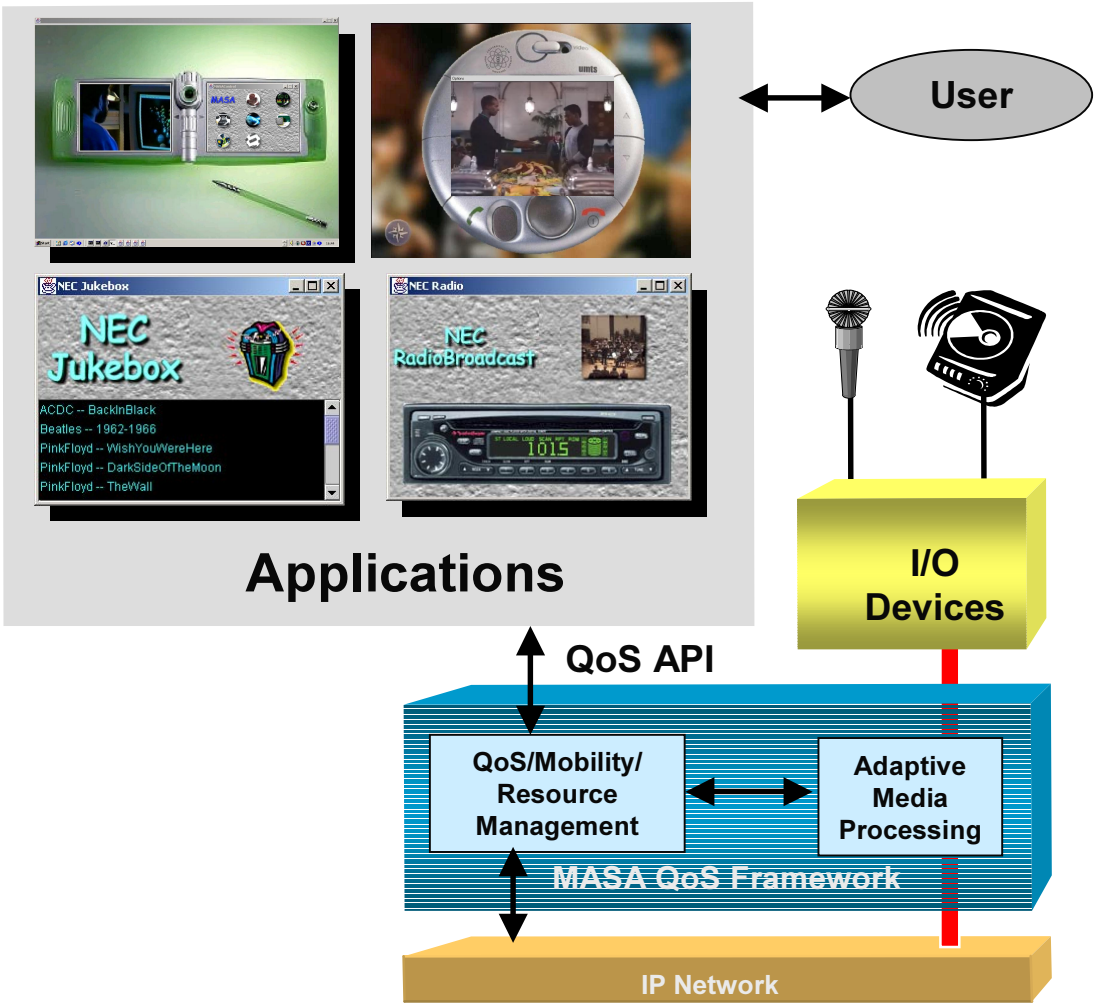
The Adaptive Endsystem Architecture

Separation of media processing and applications:

- ✓Media-independent application development
- ✓Hiding complex media details by high-level API
- ✓Future-proof technology
- ✓Dynamic downloading mechanisms
- ✓Operating-System independent applications
- ✓Generic QoS support



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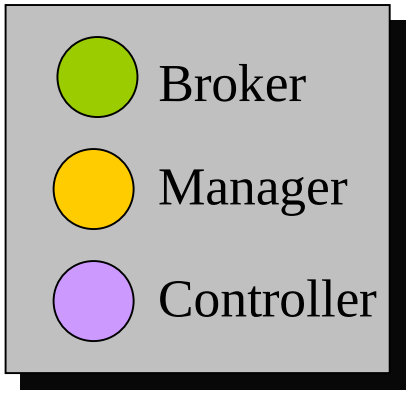
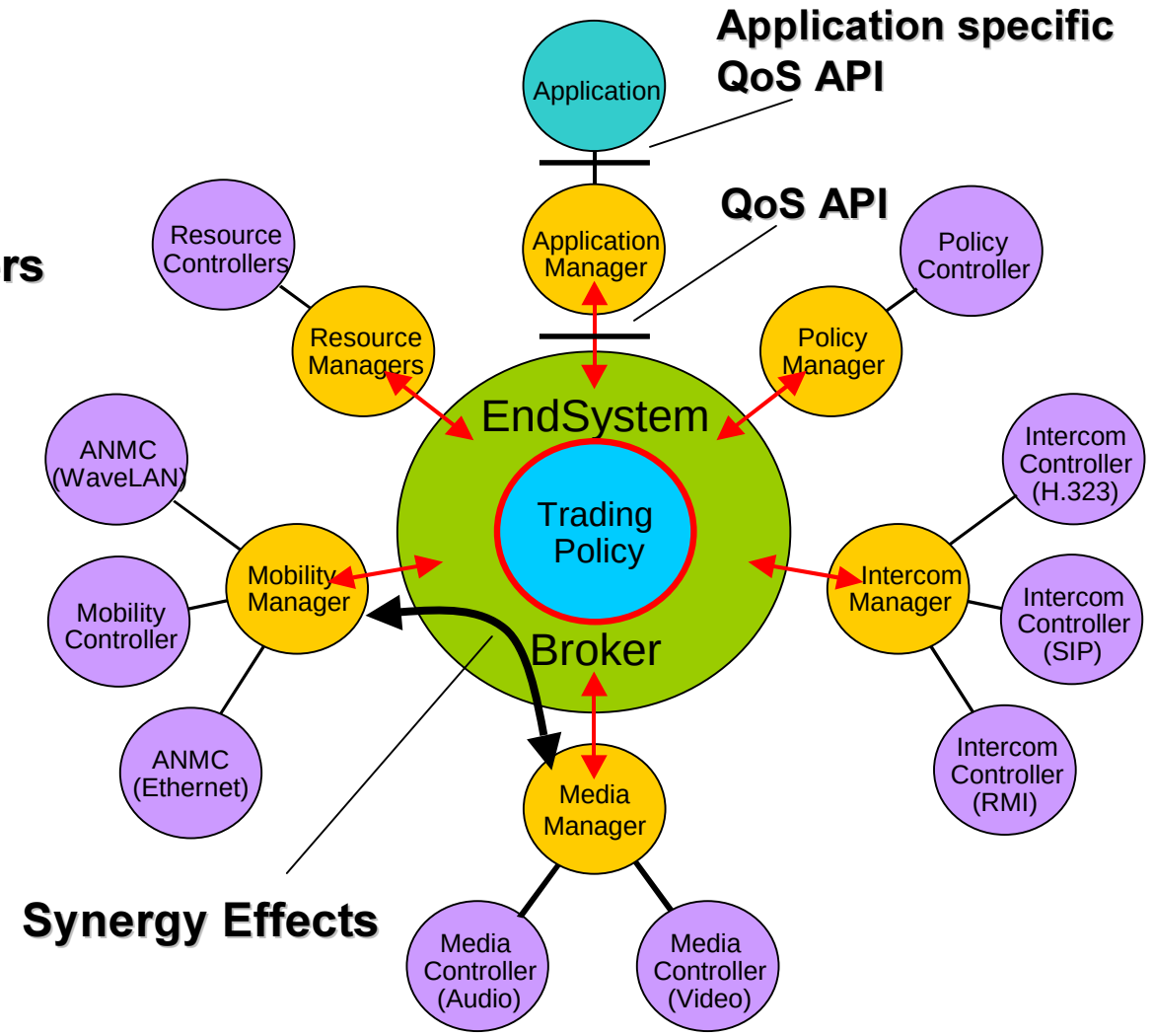
Generic Software Structure

- **Software Structure End-System Broker**
  - **Broker and Managers are using event queues for monitoring results and commands**





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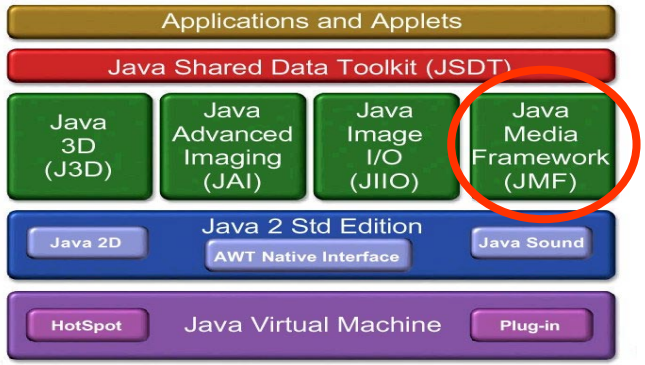
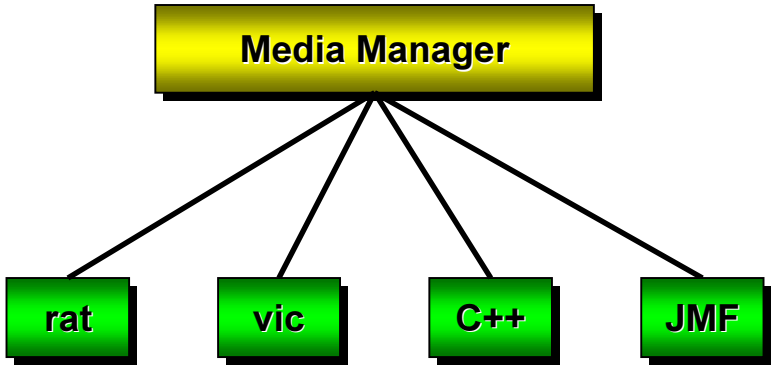
Media Controller

- 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





One technology inside the Media Management are filters !

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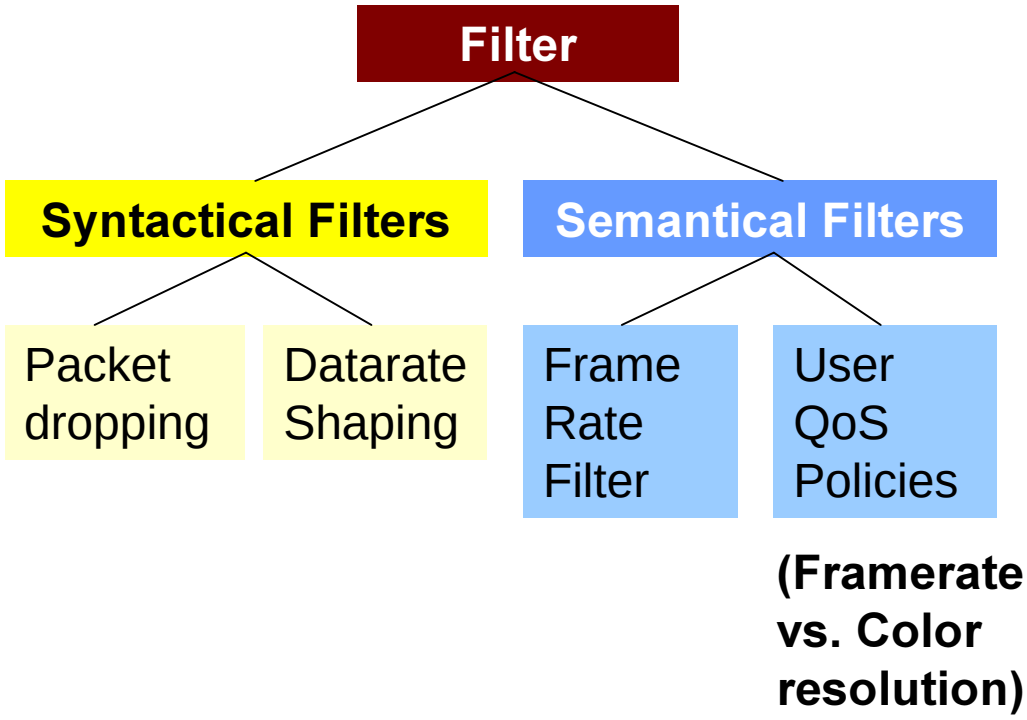
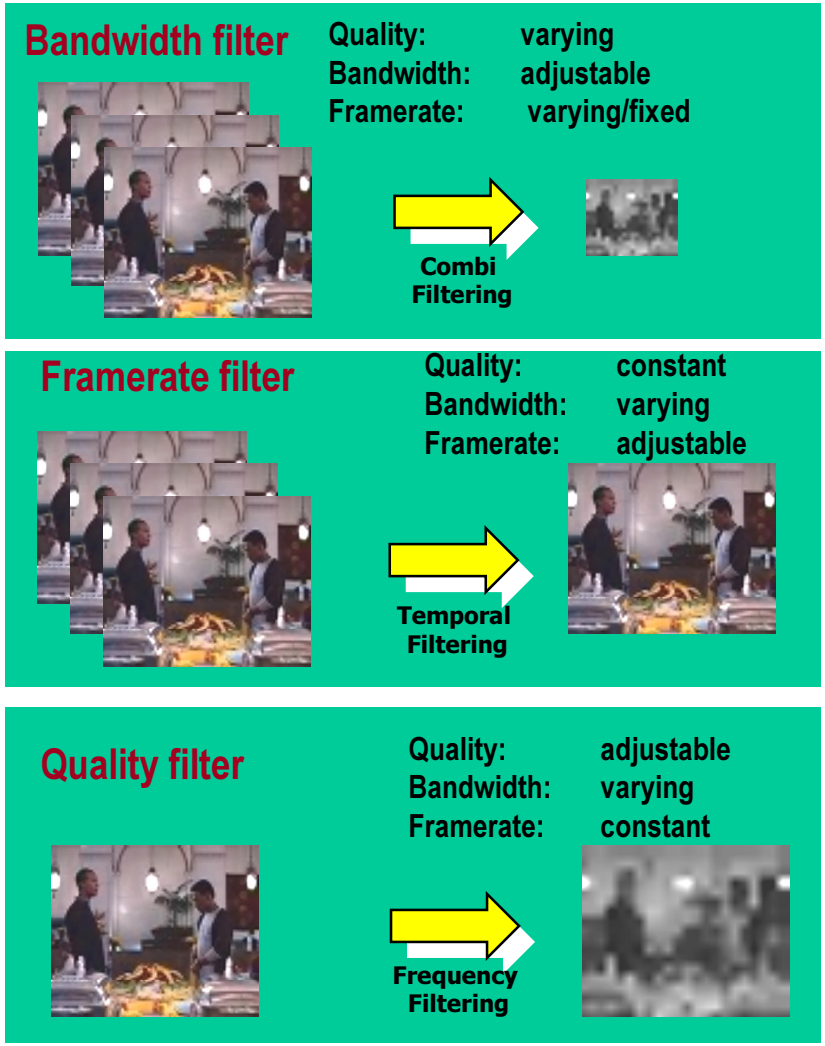
The QoS Filters





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Syntactical Filter

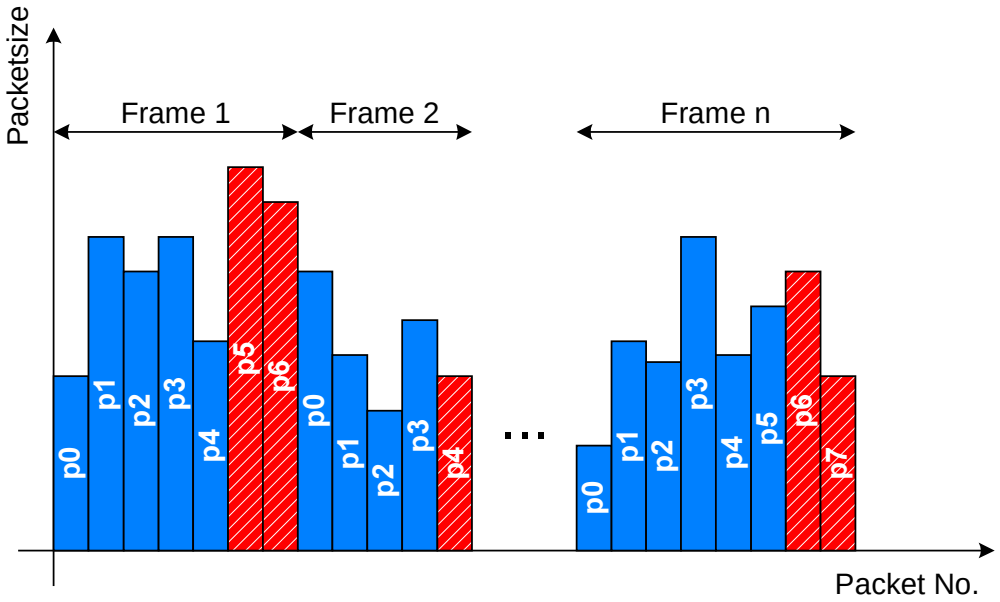
Priority Based Packet Dropping

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

n: number of WaveVideo packets of input frame

m: number of WaveVideo packets for output

q: quality factor in [0,1], whereas 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.

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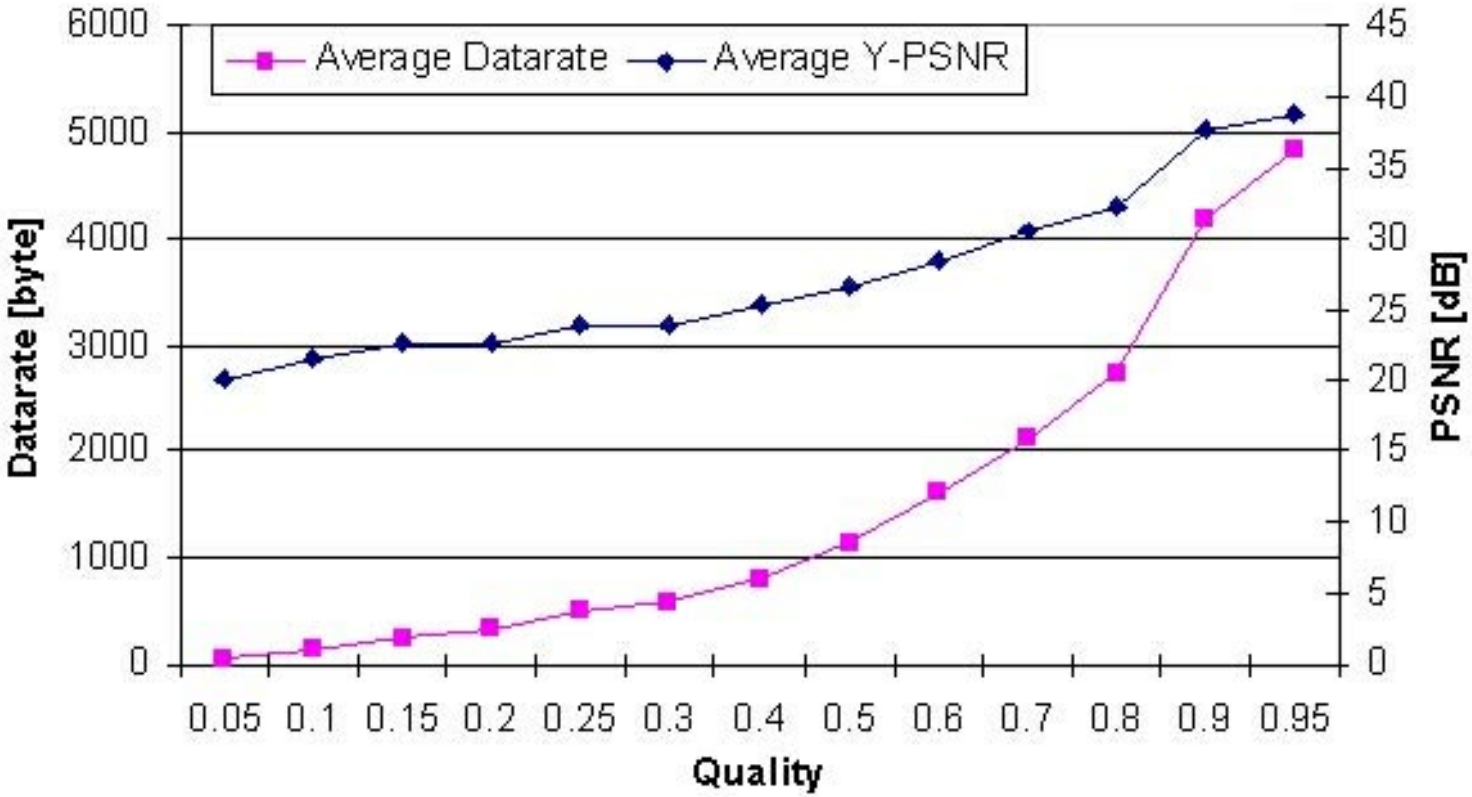
Measurements

Priority Packet Dropper



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Visual Quality

q=1.0

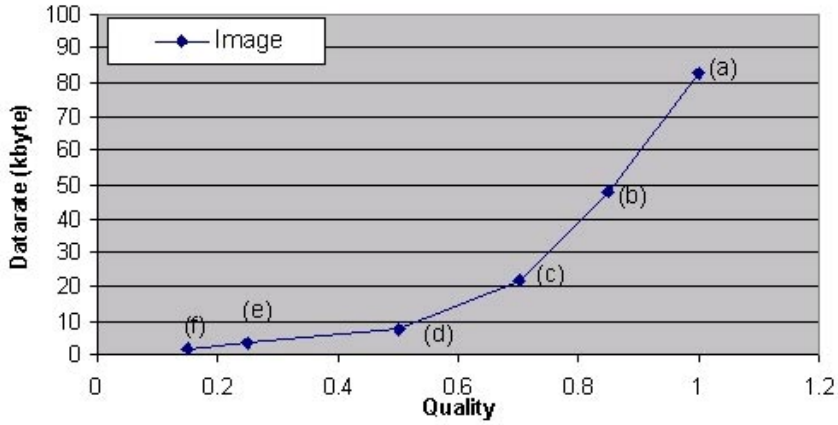
q=0.85

q=0.7

q=0.5

q=0.25

q=0.15



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

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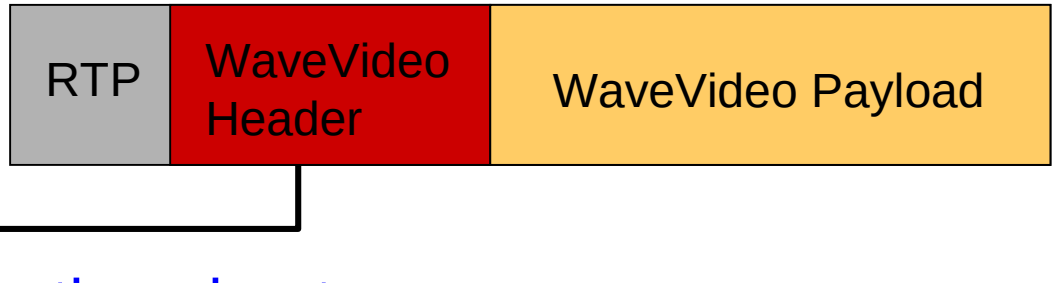
Semantical Filters

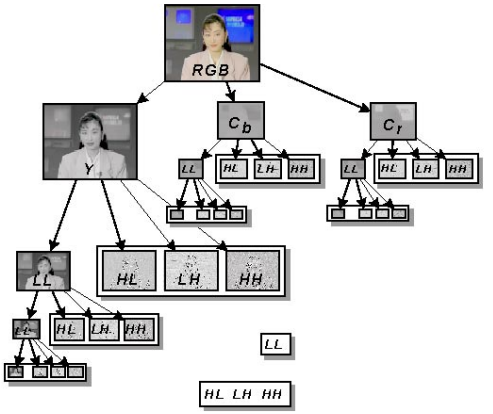


Tag contains information about:

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

Combi Filter allows adaptation of:

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



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Conclusions and Future Work

MASA is a comprehensive end-to-end QoS Framework:

- Flexible, object oriented hierarchical architecture.
- QoS policy controlled adaptive media adaptation.
- Syntactical and semantical WaveVideo based filters.

MASA will be continued in the MASA Network Project:

- Co-operation between NEC, Siemens and University of Ulm.
- Focus on interworking with Access and Core Network Management (DiffServ, RSVP, SIP, COPS, SNMP, etc.)

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Thank you

Thank You for your attention !

Now presenting: WaveVideo Filter Demo !

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