

OPTIMIX



Presentation at the 6th FP7
Networked Media concertation meeting



OPTIMIX in few words

- ICT FP7 (Call 1 project) over 3 years
 - » End of the project: 28/02/2011

- Goal: Enhanced video streaming in a point to multi-point context for wireless heterogeneous systems, based on end-to-end cross layer adaptation
 - » WP1: Requirements and exploitation
 - » WP2: Coding and modulation
 - » WP3: Transmission over the network
 - » WP4: System evaluation and demonstration



Partners and roles

THALES

- Project Coordinator
- WP2 leader: Coding and modulation
- Integrator of the joint simulator
- Integrator of real-time test-bed

SIEMENS

- WP1 leader: dissemination and exploitation
- MPEG standardization
- Realization of H264/SVC real-time codec



- WP3 leader: Transmission over the network

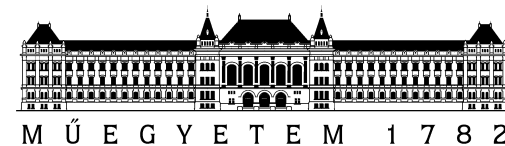


- WP4 leader: Real-time demonstration
- Realization of modified IEEE 802.11n boards

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Why is adaptation needed?

- Multimedia communication can be very bandwidth consuming
- Quality of the wireless communication is time-variable
 - » Varying modulation scheme and thus maximum throughput
 - » Varying loss and bit error rate
- Compression done at the application layer has to be coupled with redundancy inserted for error correction
 - » Need of dynamic selection of coding and protection parameters



Project approach

- Introduction of two separate controlling units:
 - » An Application Controller
 - » A BS Controller
- Design of signalling architecture allowing:
 - » The transfer of cross-layer information within network nodes and over different RATs
 - » The transfer of feedbacks and commands among different entities
 - From clients to controllers
 - Among controllers



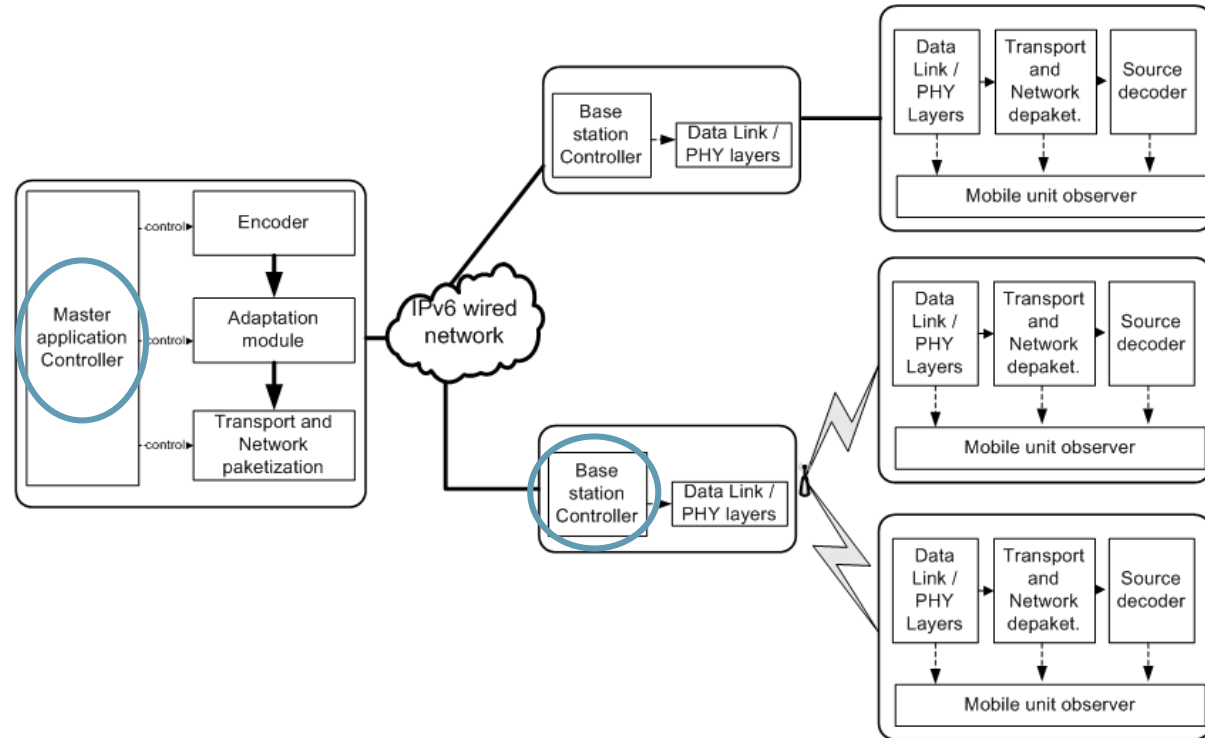
The architecture at a glance

» Application Controller:

- adapt in real-time the source coding parameters and the protection rates
- owned by a Service Provider

» Base Station Controller:

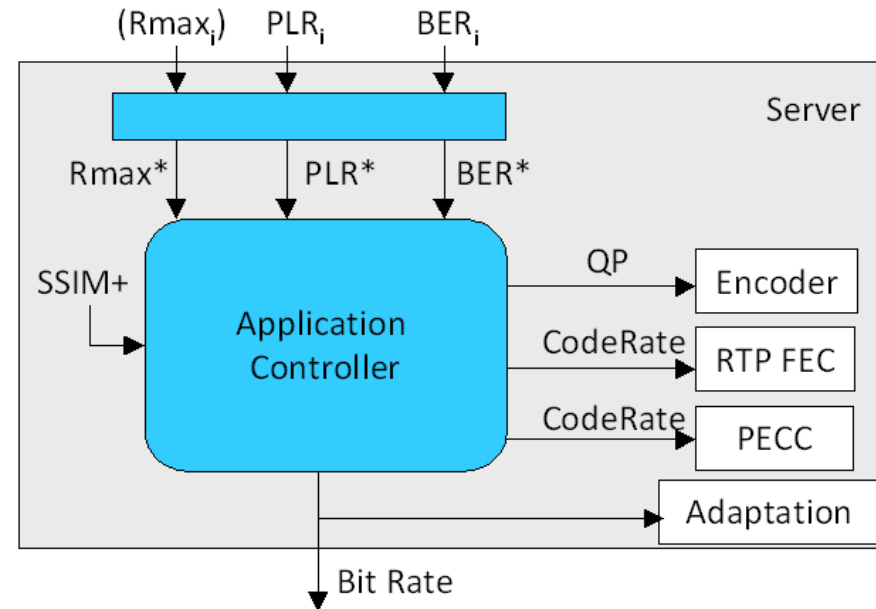
- allocate the shared radio resources among the users and the different kind of traffic





Application Controller

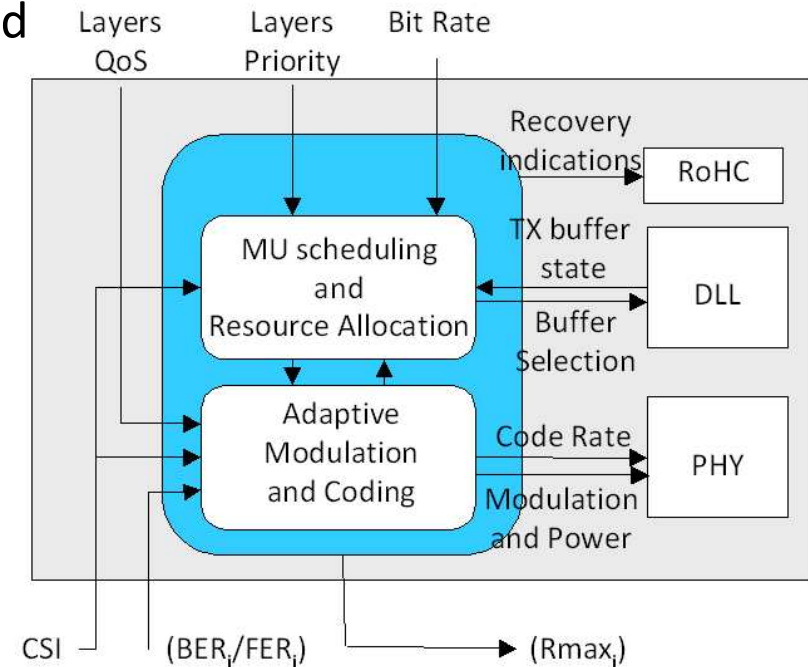
- Goal: control the compression and protection levels of video/audio streams based on the feedback information
- Inputs:
 - » maximum bit rate R_{\max}
 - » Packet Loss and Bit Error Rate
- Outputs:
 - » QP to video encoder
 - » code rate to RTP FEC
 - » bit rate, frame rate
 - » layers priority (in IP headers)
- Optimization timescale: every second
- Point-to-multipoint adaptation based on clustering of feedbacks from clients
 - » Definition of a target user for a non scalable video stream (H.264/AVC)
 - » Definition of C target users for a scalable video stream (H.264/SVC)
 - » Several cost function definitions





Base Station Controller

- Goal: schedule downlink transmissions and assign common resources to users
- Inputs:
 - » channel conditions
 - » multimedia stream characteristics
 - » QoS requirements specified by the Service Controller
- Optimization time-scale: ms to follow variability of radio channels
- MIMO OFDMA radio architecture with maximization problem subject to:
 - » total transmission power
 - » target data rate for the video stream
 - » amount of data in TX buffers coupled to the priorities signalled by Application Controller



- Adaptive modulation and coding schemes applied to satisfy BER/FER requirements for the different video priorities



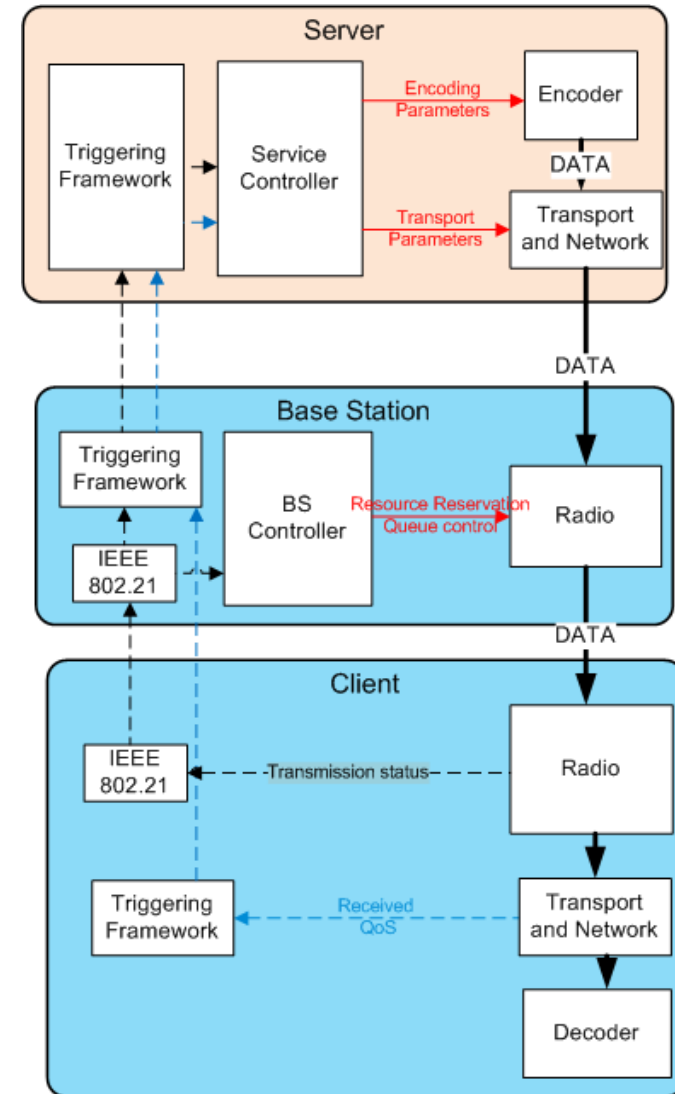
Cross/layer cross/node signalling

- Goal: transfer feedbacks and control information between layers and nodes
- Main features / elements:
 - » Cross-layer and end-to-end signalling
 - » IEEE 802.21 standard -based signalling
 - between Clients and Base Station to collect link and network information
 - IEEE 802.21 establishes the basis for heterogeneous handovers
 - Out of scope of IEEE 802.21:
 - Upper layer events (L3 and above)
 - End-to-end signalling for traffic control
 - » Triggering Engine (TRG)
 - between Clients and Server
 - for E2E cross-layer signaling



Triggering Framework

- » Present in all nodes
- » Trigger Format:
 - ID (Trigger identifier): e.g., Transport Layer Trigger
 - Type (Specific to the trigger identifier): e.g., Loss Rate
 - Value
- » Allow exchanging information between trigger sources and triggering consumers
 - List of possible triggers (IDs and Types)
 - Registration by trigger sources
 - Subscription by trigger consumers
 - for specific values (use of filters)
- » Trigger aggregation
- » Transport layer (L4) transmission
 - end-to-end transmission of Application and Base Station Controller triggers
 - end-to-end transmission of Radio node feedbacks (interface with 802.21)





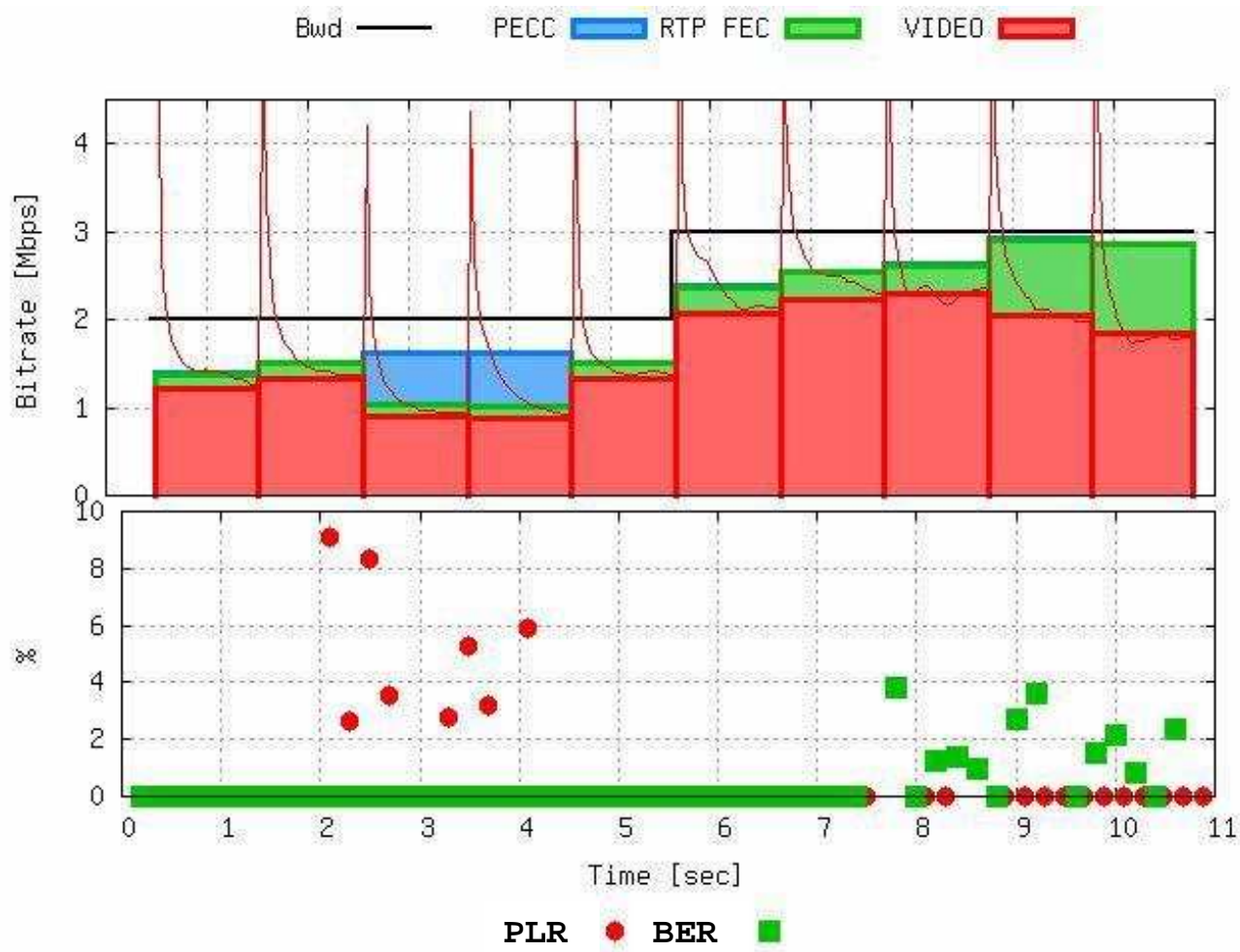
OPTIMIX system-level aggregation

- » Introduction of network-level aggregation for overhead reduction:
 - Introduction of Feedbacks Aggregation Servers (FASs)
 - Exploitation of IPv6 anycasting
- » Anycast IPv6 :
 - Packet delivery in IPv6 standard besides unicast and multicast
 - Definition of an anycast group
 - A packet addressed to an anycast address is delivered to the "closest" node according to a predefined metric (hop count, link state, server load, etc.)
- » In OPTIMIX signalling architecture:
 - Anycast group composed by the FASs and the Server itself
 - Feedback messages are addressed to the Feedback Anycast Address
 - Delivery to an aggregation server or directly to Application Controller
 - Aggregation servers collect feedbacks into common IP packets
 - Single packet with multiple values
 - No values aggregation to avoid decisions in FASs
 - IP packets are sent to the Application Controller by unicast



Example of OPTIMIX results

Application Controller behaviour in point to point transmissions





OPTIMIX simulator

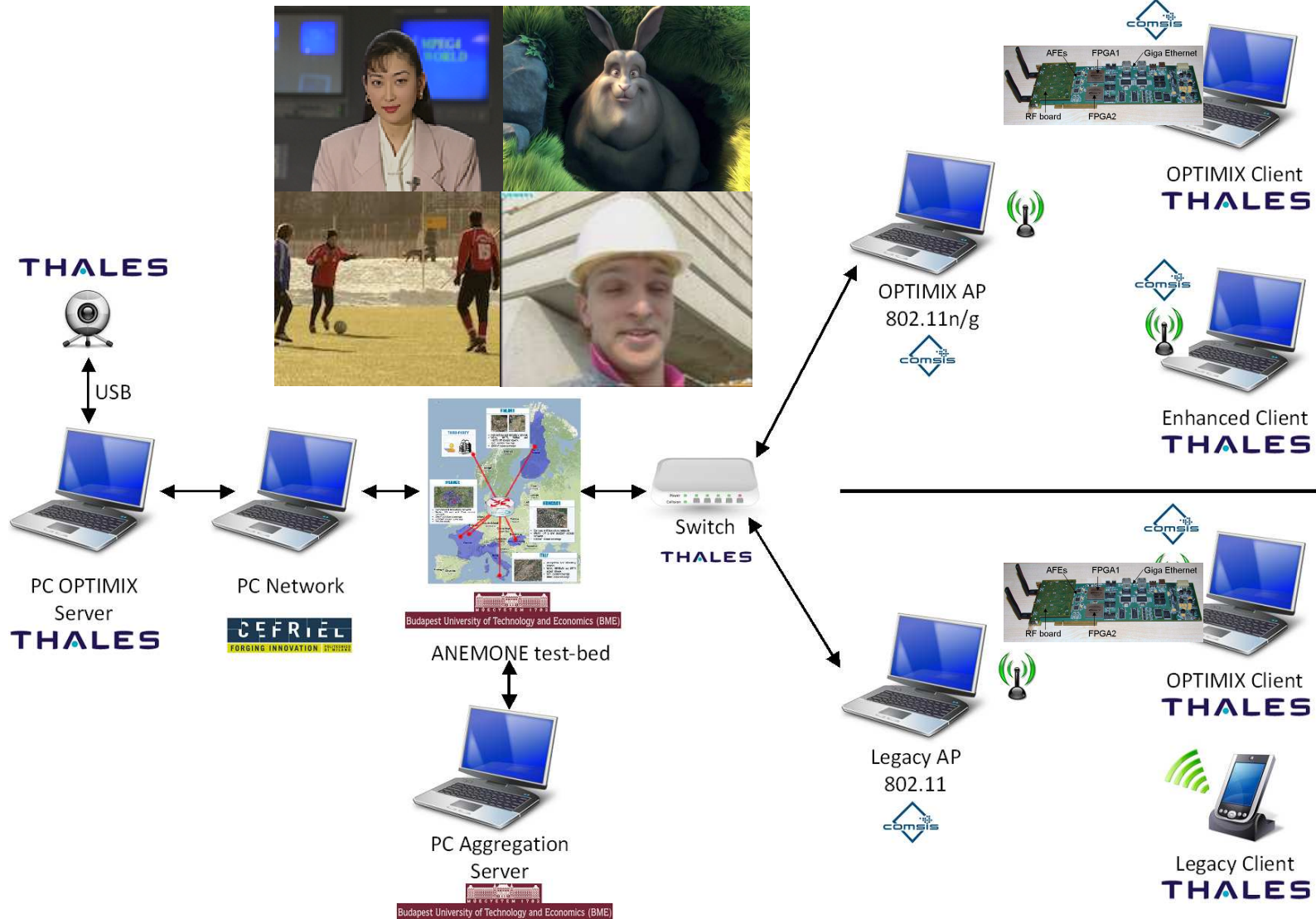
- Realization of a system simulator :
 - » Using OMNeT++ framework
 - » Based of collaborative work of most partners
 - » Implementing all layers (from application to physical)
 - » Transmitting real bits of information
 - » Modelling control information
 - » Including WP2 and WP3 solutions



- <http://www.ict-optimix.eu/index.php/OPTIMIXsim>



OPTIMIX test-bed





Conclusions

- Research WPs ended in Aug. 2010
 - » 6 patents
 - » More than 100 papers
- Current activity is final evaluation via:
 - » Simulations using the OPTIMIX tool
 - » Experiments on the real-time test-bed
- Both objective metrics as well as subjective video quality evaluation are addressed
- OPTIMIX results will be presented at the OPTIMIX workshop at VTC Spring 2011 in Budapest:
 - » <http://www.ieeevtc.org/vtc2011spring/Optimix.pdf>
 - » Deadline for submissions: 1st December



Thank you!