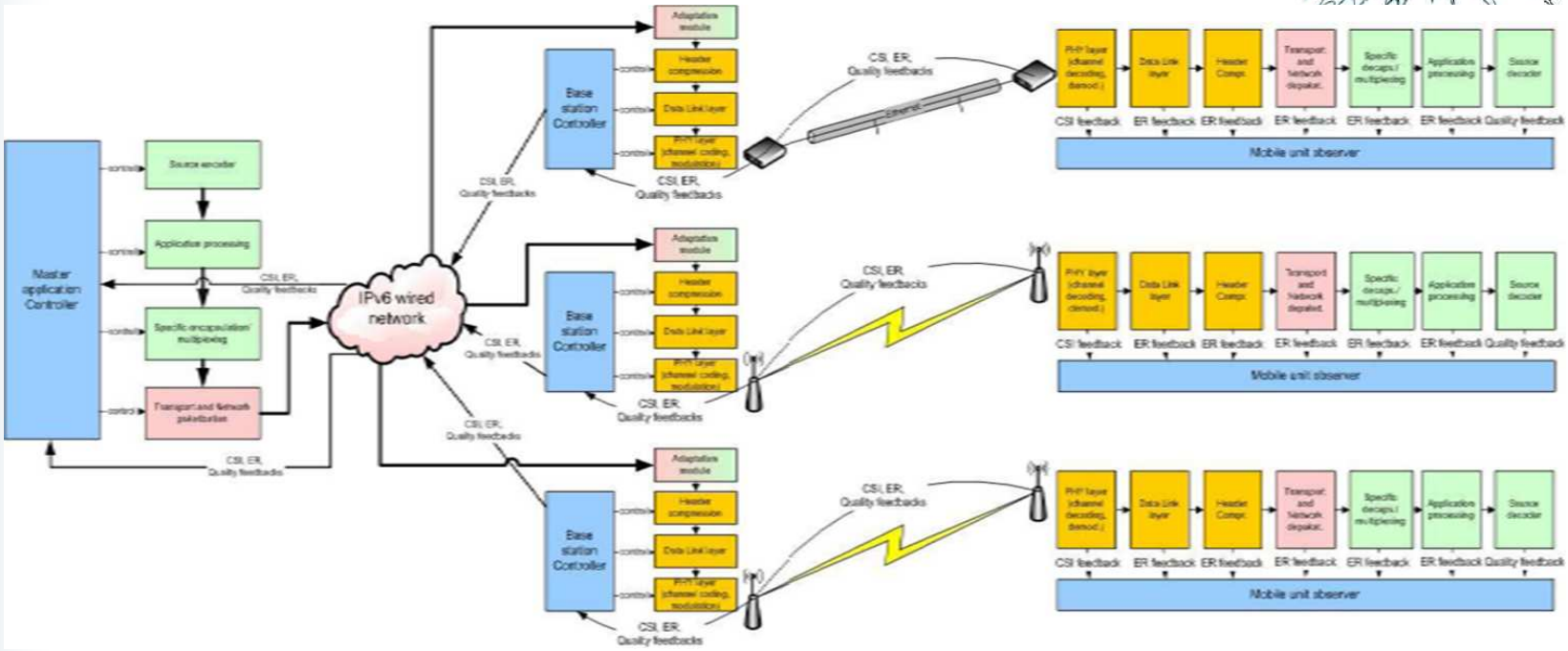
# OPTIMIX project


## Presentation for 4th FP7
## Networked Media concertation meeting

# The OPTIMIX project


- **The study:** innovative solutions enabling enhanced video streaming in a point to multi-point context for an IP based wireless heterogeneous system, based on cross layer adaptation off the whole transmission chain
- **The goal:** increasing PQoS for the end user in a point to multi-point multimedia transmission context
- **The approach:**
  - improve the efficiency of scalable video codecs in a wireless multi user environment
  - novel controlling strategies in the scope of P->MP scenarios, with aggregation of multiple feedbacks
  - cross-layer mechanisms to enable the communication between application world and transmission world

# OPTIMIX architecture overview




Application controller: selects source coding parameters (e.g. quantization parameters, frame rate,..) according to video source characteristics and the state of (wireless) network

Adaptation module: performs further adaptation of the stream to the wireless transmission. Used when the encoded stream does not fit the wireless channel conditions (e.g., because no available pre-coded stream responds to the criteria fixed by the application controller) or to adapt a scalable stream to the transmission quality of a particular wireless cell.

BS controller: schedules the radio transmissions and adaptively allocates available resources

Mobile Observer: collects cross-layer information from different layers of the system

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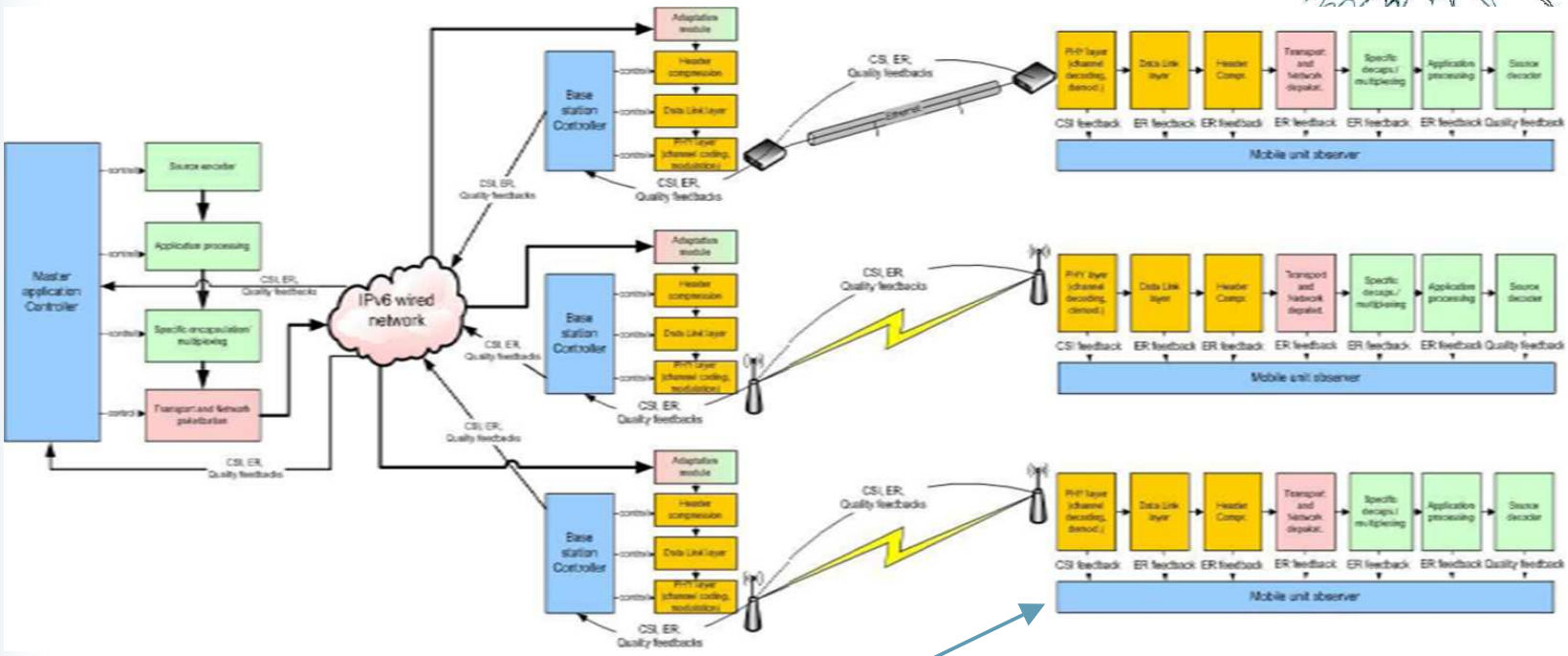


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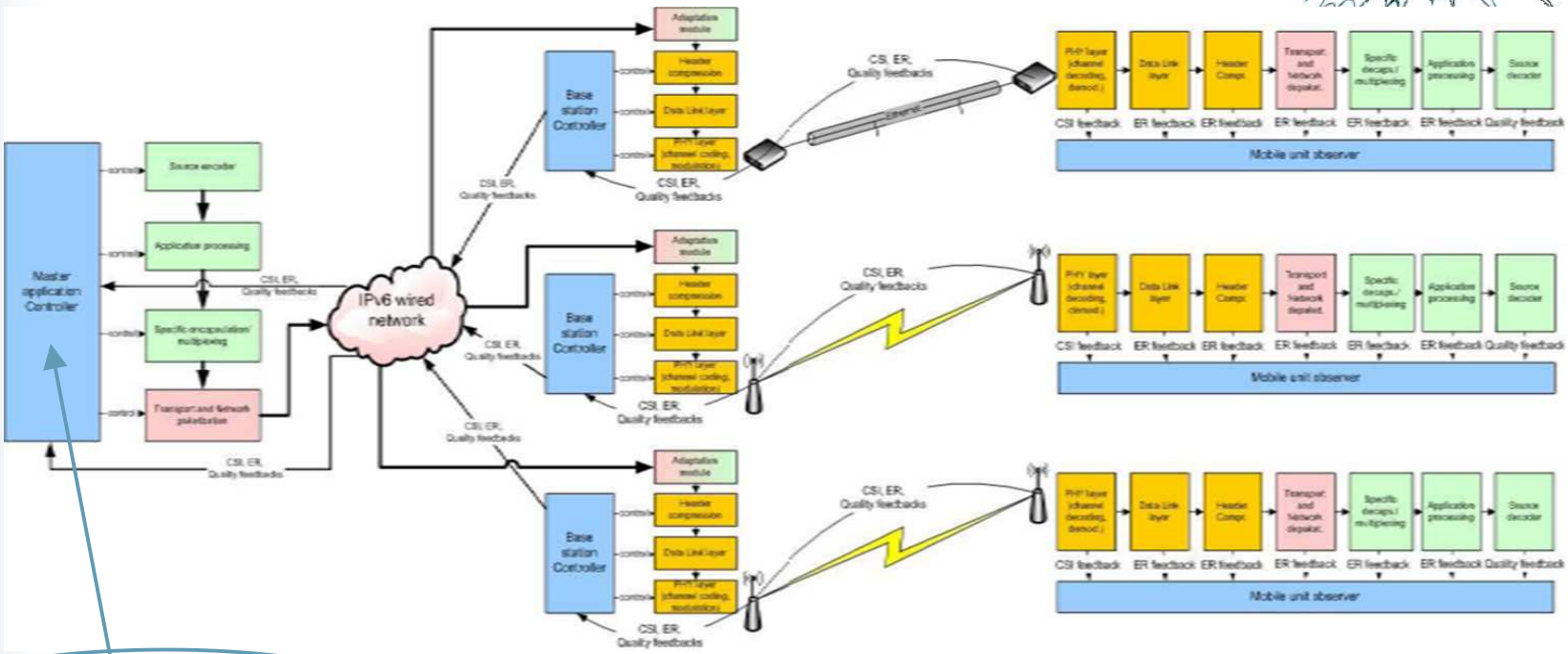


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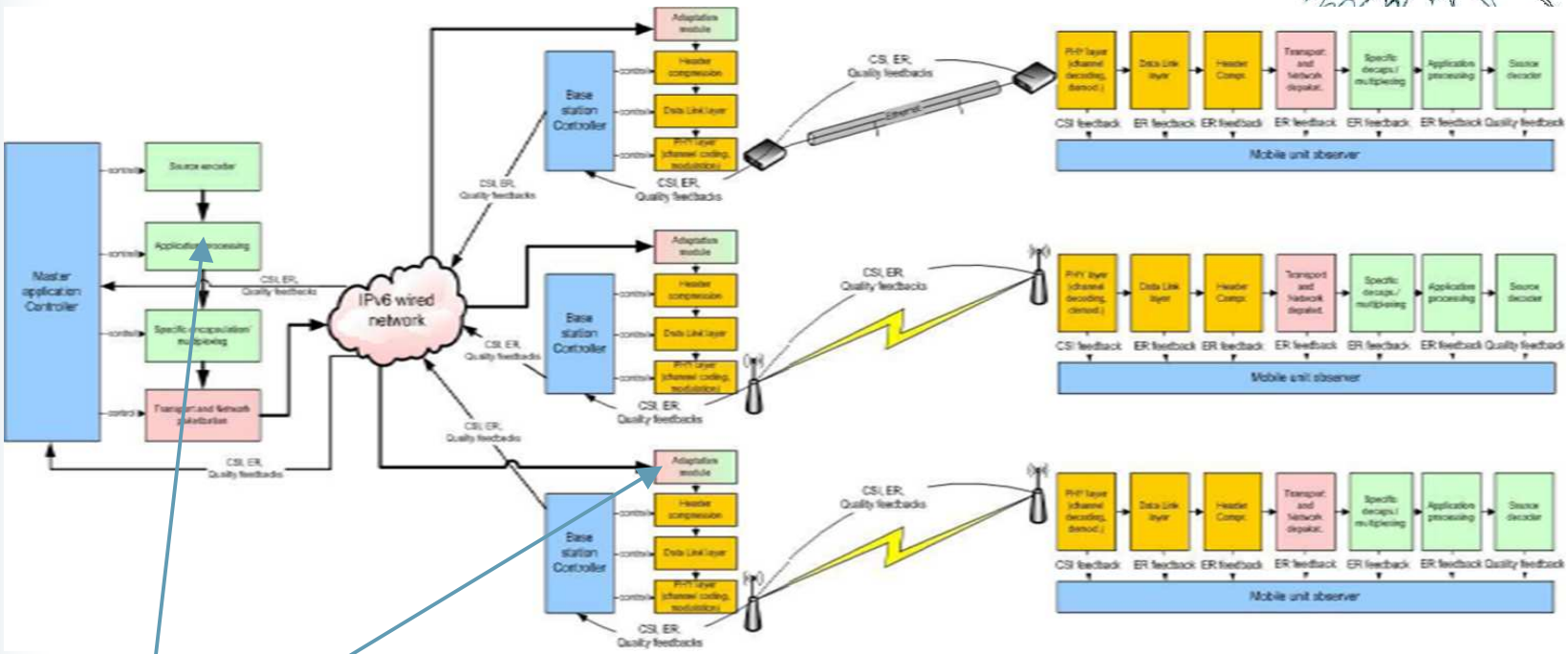


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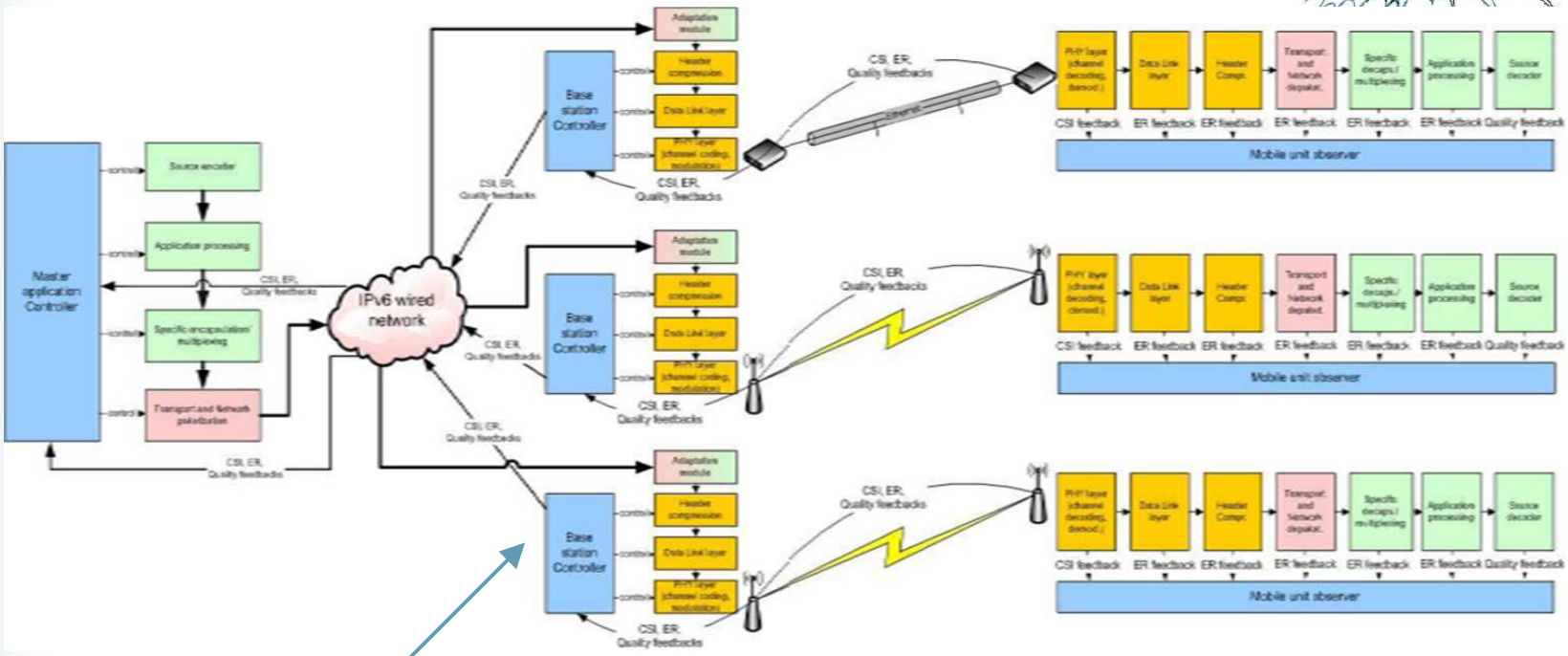


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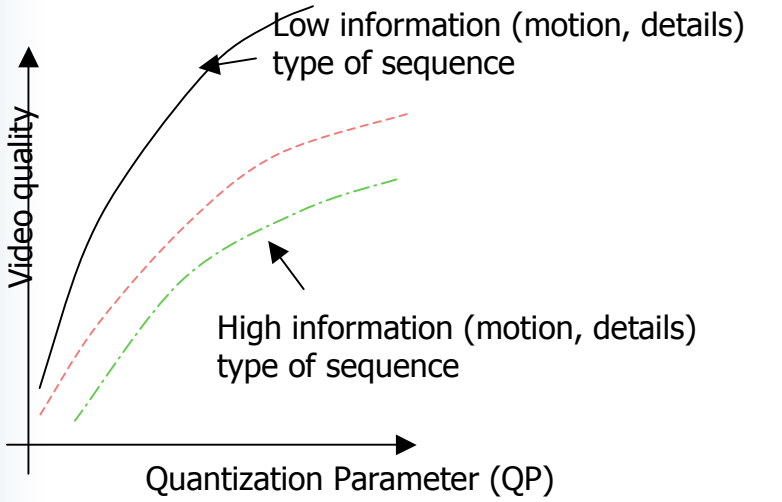
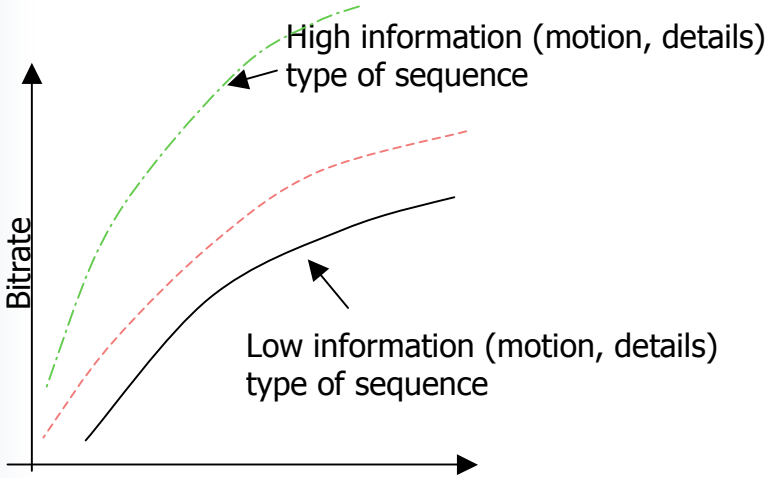
# The application controller


- Objective: controlling the compression and protection levels as well as the different modules in the transmission chain and adapt their parameters based on the feedback information it receives on transmission conditions
- Input: video and transmission quality metrics
- 3 operating mode considered:
  - "**Full**" mode: pre-coded streams
  - "**Partial & Trial**" mode
    - partial knowledge (from statistical information and previous steps). It uses a test & trial approach to reach its operating point. Mode realistic when considering streaming with limited delay constraints
  - "**Blind**" mode: video conference

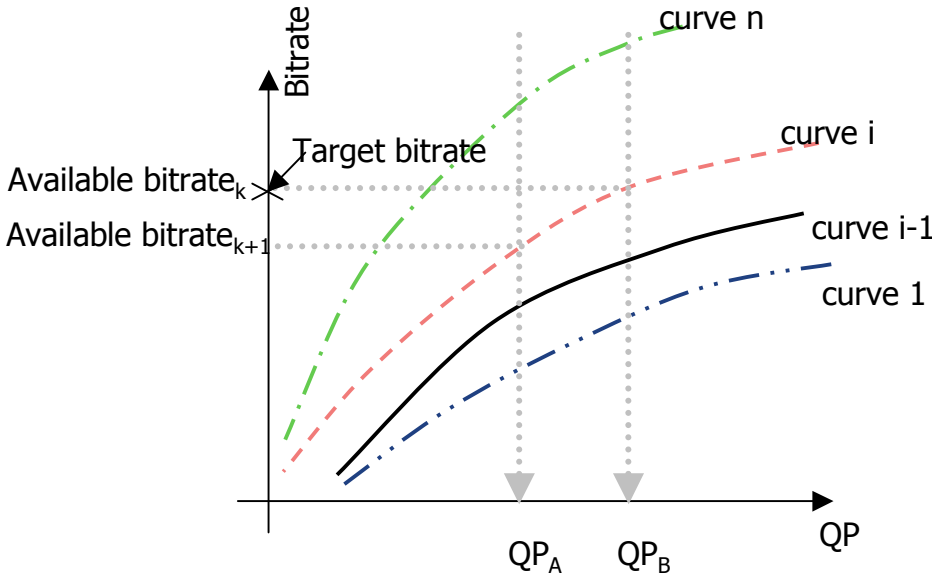
# Application controller adaptive prediction

- Abacus: video quality and Bit rate as a function of QP

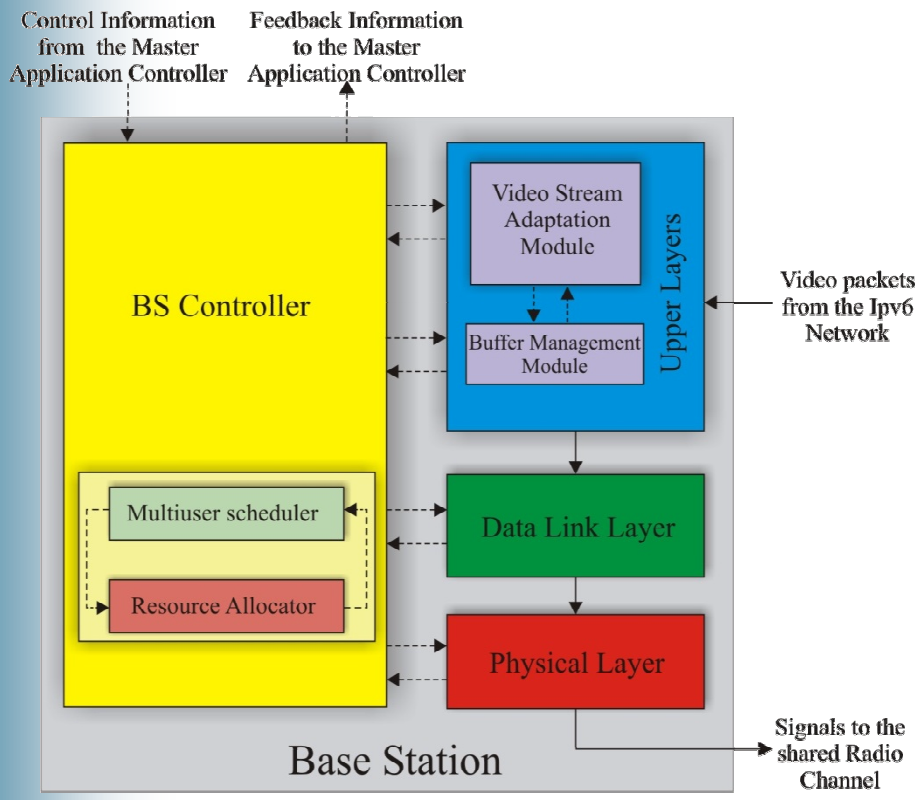



- Prediction of compression choice



# Base Station Controller

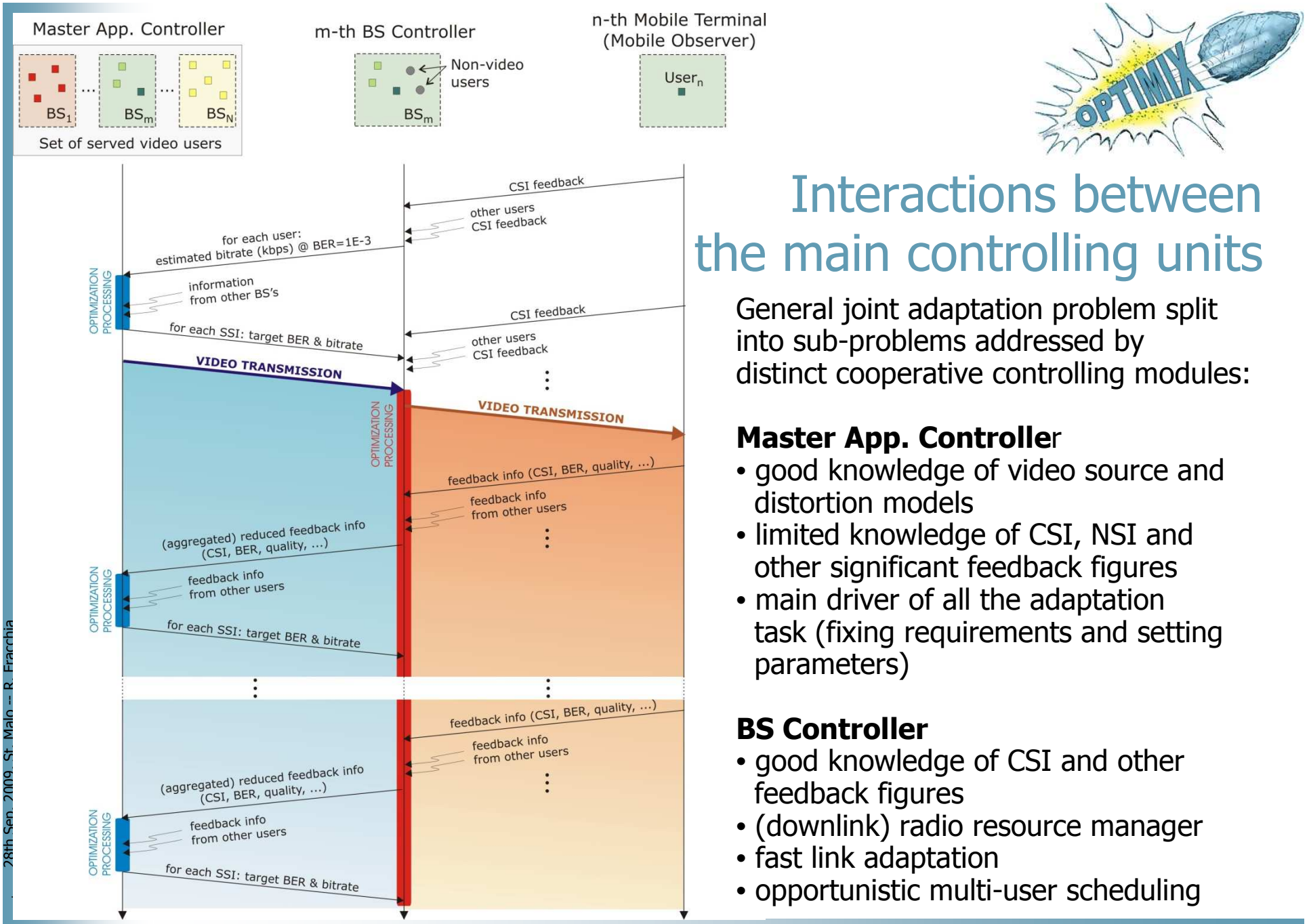



**BS Controller main tasks**:

- schedule the transmissions to the users across the shared channel
- allocate the radio resources
  - time (time-slots)
  - frequency (sub-carriers)
  - space (multi-antenna)
- satisfy the requirements specified by the Master App. Controller
- drive the video-stream adaptation module
- feedback (aggregated) reduced information to the Master App. Controller

According to the radio resources available, **several solutions have been envisaged** for the BS Controller and some preliminary opportunistic/adaptive algorithms have been developed, e.g.:

- sub-optimal and low-complexity solution based on iterative MU scheduler – Resource Allocator information exchange [D2.3a]
- sub-optimal dual Lagrange optimization, based on stochastic algorithms




# Interactions between the main controlling units

General joint adaptation problem split into sub-problems addressed by distinct cooperative controlling modules:

**Master App. Controller**

- good knowledge of video source and distortion models
- limited knowledge of CSI, NSI and other significant feedback figures
- main driver of all the adaptation task (fixing requirements and setting parameters)

**BS Controller**

- good knowledge of CSI and other feedback figures
- (downlink) radio resource manager
- fast link adaptation
- opportunistic multi-user scheduling

# Different ongoing works


- Specification of cross-layer information
- Definition of a cross-layer signaling framework (to transfer information from mobile nodes to the server)
- Optimization at all layers of the protocol stack: from application to physical layer
- Extension to multicast transmissions
- Traffic engineering with fault resilience capability
- Media Stream Ciphering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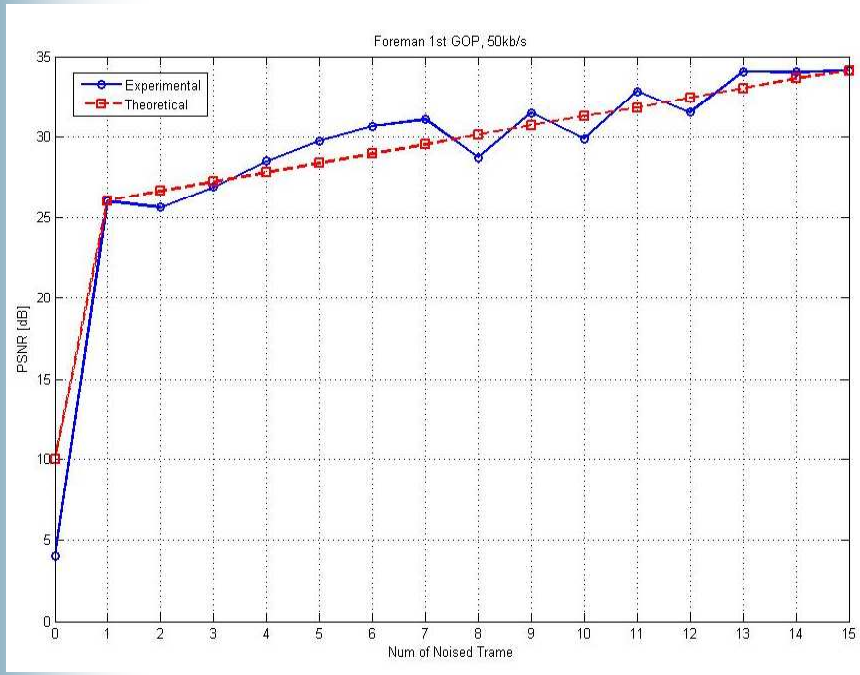
# Application controller adaptive prediction

- PSNR estimation: « Partial and Trial » prediction vs. Experimental (Foreman QCIF 15Hz, 1st GOP)




- Appl controller with RTP-FEC RCPC protection: PSNR evolution with time for « Partial & Trial » over varying channel (Foreman QCIF 15Hz, 17 first GOPs)