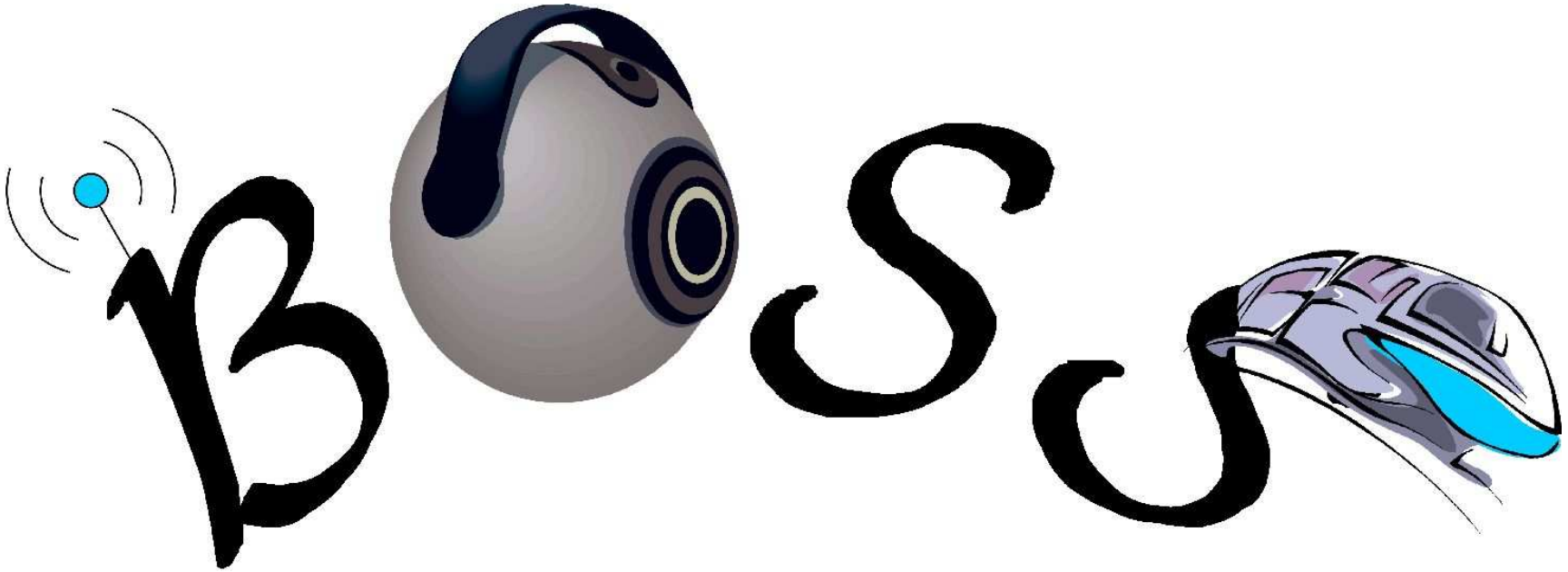


BOSS: On Board Wireless Secured Video Surveillance

Demonstration in RENFE carriage

April 23th, 2009

Madrid, Spain

EUREKA Σ! 3187

CELTIC Telecommunication Solutions

Overview

- BOSS project context
  - Consortium
  - Goals
  - Work strategy followed
- System architecture
  - Architecture design
  - Prototype
- Key technical improvements and advances
- Conclusions

BOSS project context

- Project type:
  - Celtic EUREKA project
  - European countries participating in order to work on research and technologies
  - Focus on telecommunications
- R&D project
  - Going for state-of-the art solutions and exploring the future
  - Proposing advances
  - Demonstrating the validity of the approach and confirming the choices made

BOSS project context

- Project aim : propose a reliable solution to increase the security of passengers inside commuter trains
  - Design of a technical solution allowing the deployment of a security solution for passengers against attacks/crisis, but also follow-up of maintenance issues for the rolling stock
  - Study and establishment of a high data-rate communication system between the trains and the wayside to allow a distant monitoring of passengers security but also preventive maintenance
- Project consortium – 12 partners in 4 European countries

BOSS project context

- User needs
  - Systems taking into account railway exploitation specificities
  - Easy to operate system: more autonomy, remote access to alarms & images as soon as possible is necessary
  - Plain data storage is very limited in practice

- User expectations
  - Improving reaction time will availability and reliability increase
  - Less operators needed, simplification of data handling
  - Easier adaptation to regulations (and their changes)

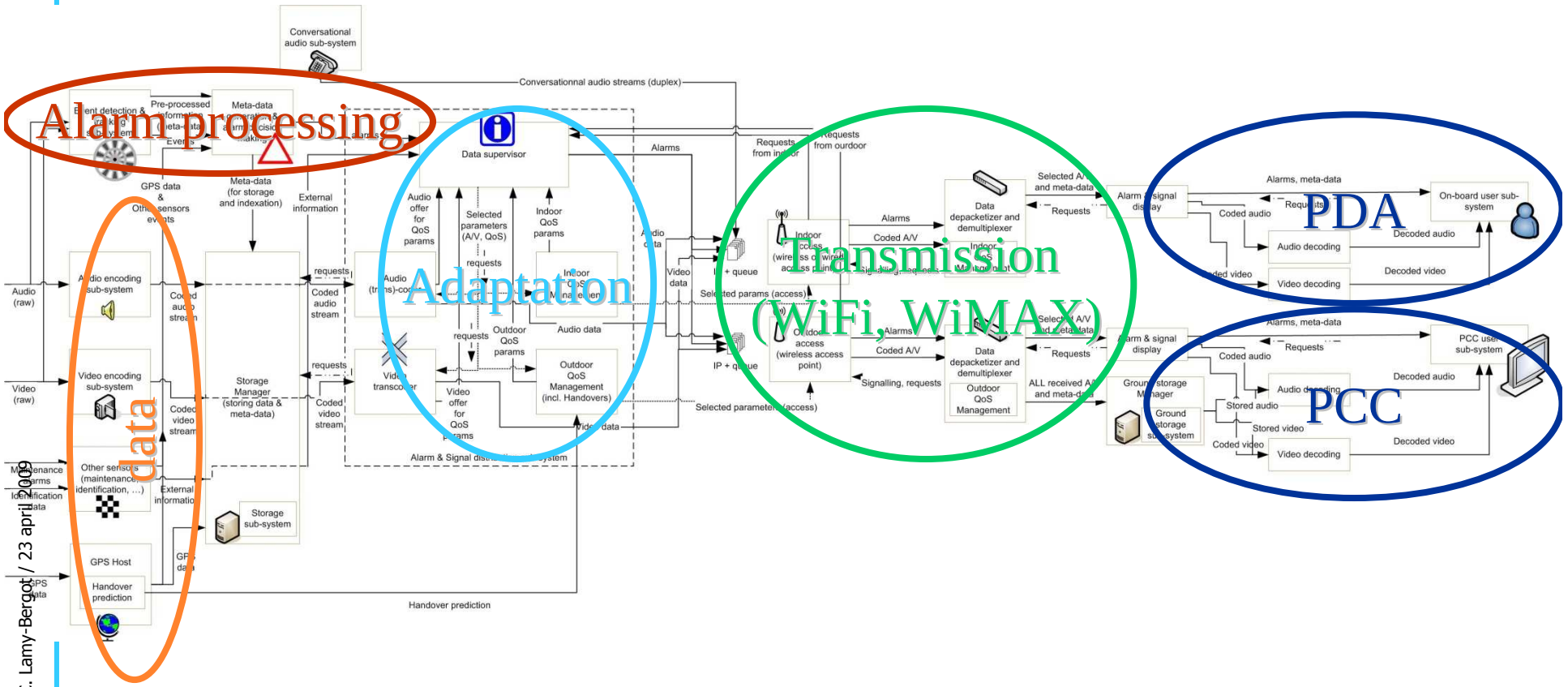
  ➔ Cost reductions and increased reactivity in case of problem (maintenance, attack)

BOSS project context

- Work strategy followed in the project: which research axes for what improvements?
  - User requirements collection and analysis
  - Data acquisition and event detection solutions development
    - Real-time solutions: audio, video, maintenance
    - Future advanced solutions (research)
  - Multimedia data processing and robustness enhancement
    - Real-time encoding over BARCO/THALES compression card
    - Software real-time advanced video decoder
    - Robustness of the video to errors and losses
  - Wireless link efficiency
    - Mobile dual connection system (UMTS/WiMAX) for coverage of lines
    - Future WiMAX-like MIMO solutions (research)
    - Handovers with by GPS aided prediction

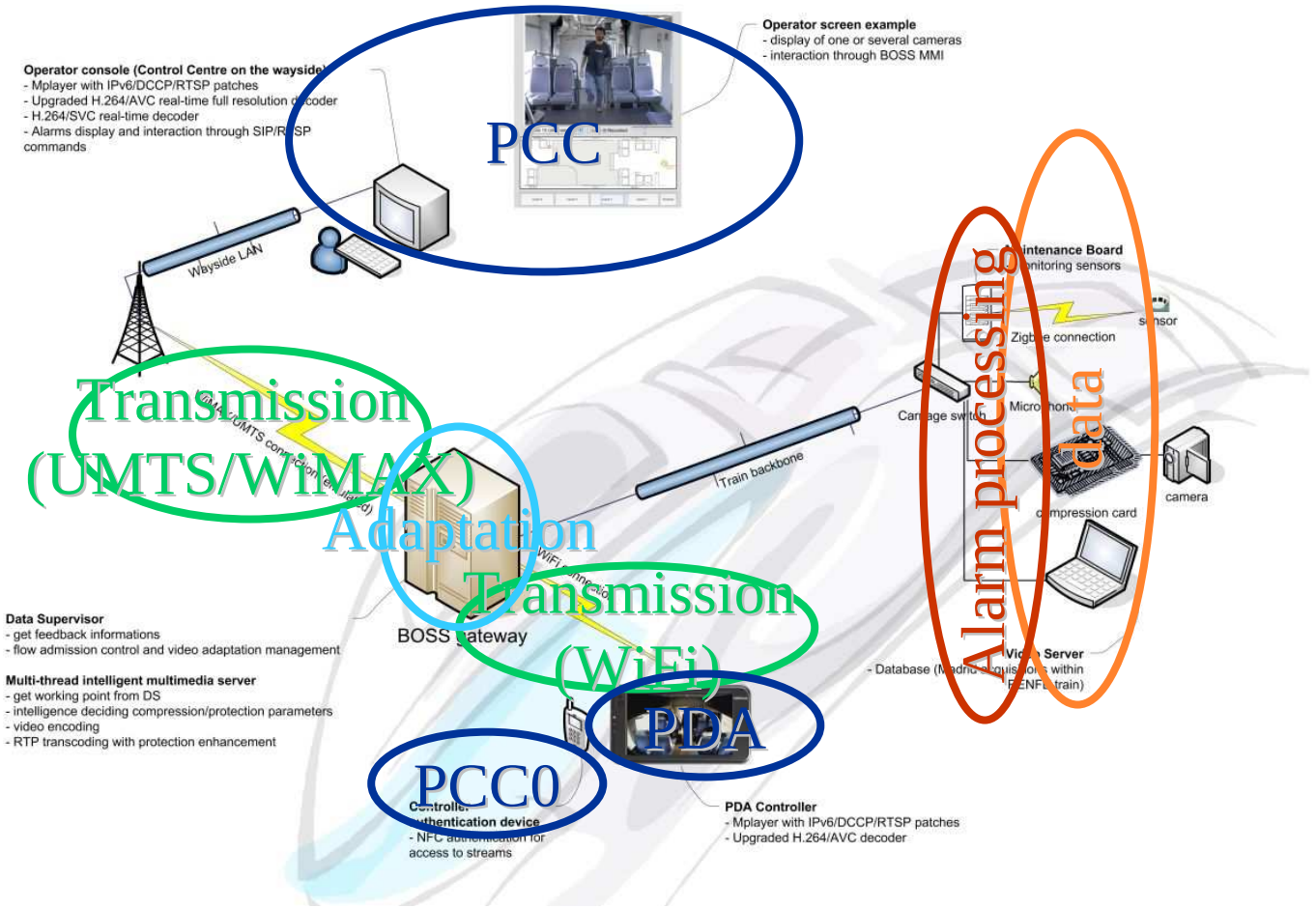
System architecture

- Functional approach



System architecture

- Declination into BOSS demonstrator architecture



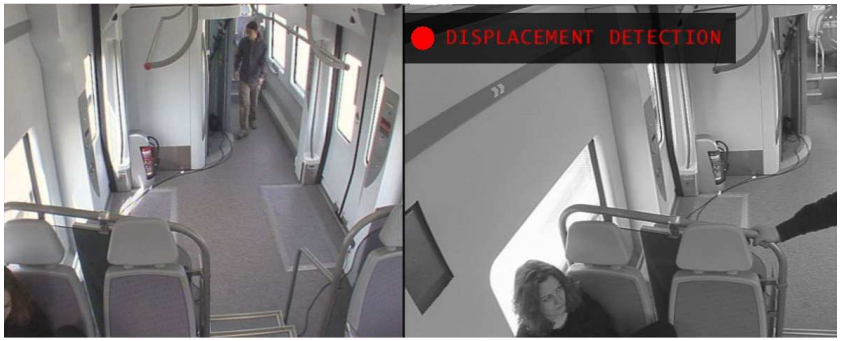
BOSS key bricks

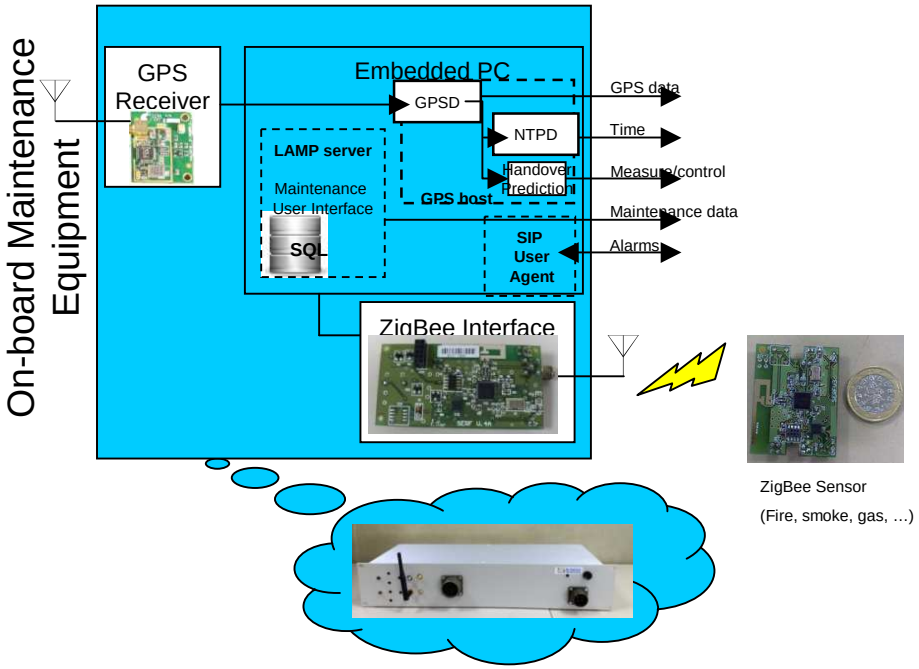
- BOSS has advanced under the principle of specifying and developing key bricks to
  - Ensure common interfaces/mode of operation
  - Propose improvements over standard solutions (better solutions and yet not too far from compatibility)

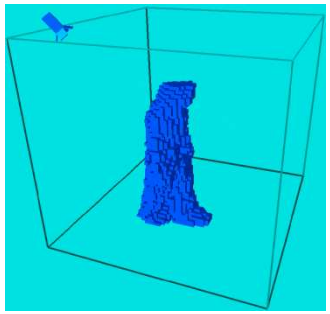
- This translates into:
  - Streaming of multimedia data (video, audio) ➔ RTSP over UDP
  - Messages exchanges in a large network ➔ SIP messages and SIP server and events detection (XML)
  - Wireless mobility with handovers (vertical & horizontal) management ➔ MIPv6, WiMAX (standard or evolved)
  - Advanced video coding ➔ H.264
  - Sensors connection and data retrieval ➔ Zigbee, 6LoWPAN
  - Advanced routing ➔ DCCP, QoS management

Key technical improvements

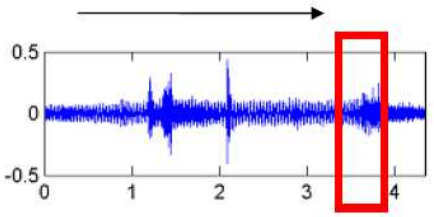
- Detection of abnormal events
  - Video
  - Audio
  - Maintenance







ZigBee Sensor
(Fire, smoke, gas, …)



Key technical improvements

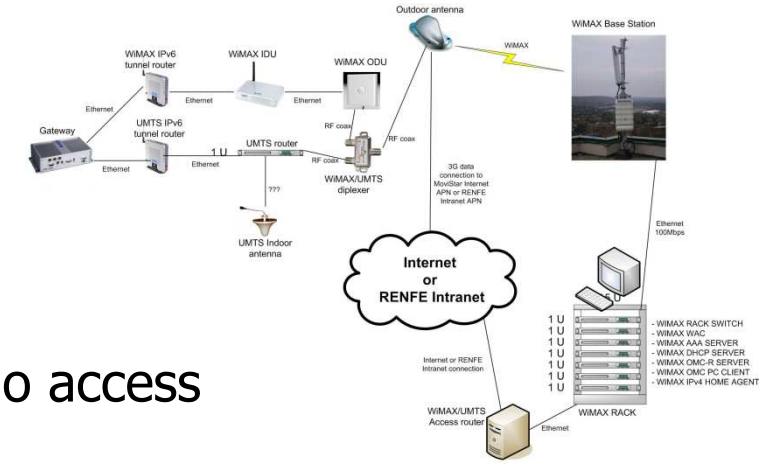
- Video compression and protection
  - Real-time software AVC and SVC codec
  - Real-time H.264/AVC encoding board Video robustness enhancement
  - Transcoding for video adaptation to transmission conditions
- Data supervision activity for streams admission and protection control
- Video encryption backward compatible with H.264
  - Authentication via NFC device

Visual result for BOSS 'Anomaly' sequence: embedding fixed protection is not enough

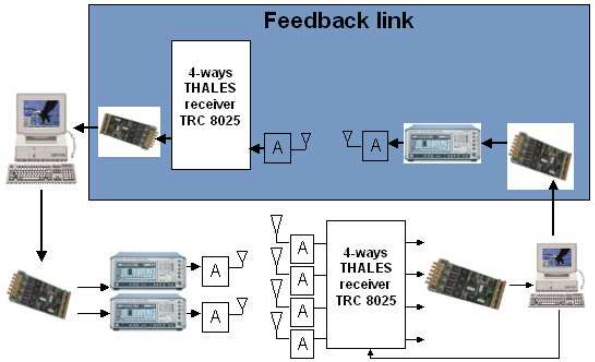
Configuration :
Video sequence CIF, 30Hz, BSC (4.10^{-4})
adapted RS(255,250), RS(128,120), RS(255,191) vs. with RS(128,120)

Key technical improvements

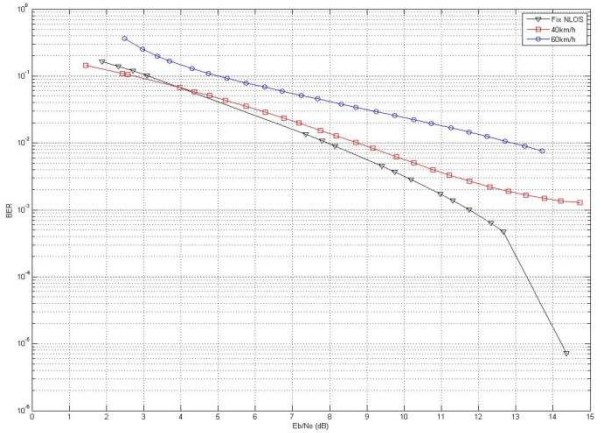
- "WiMAX" realisations
  - Dual WiMAX/UMTS outdoor link [load balancer and mobility support]



  - MIMO techniques for WiMAX-like radio access



Platform Architecture

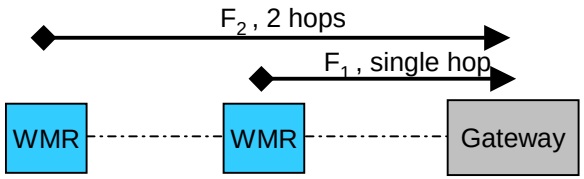


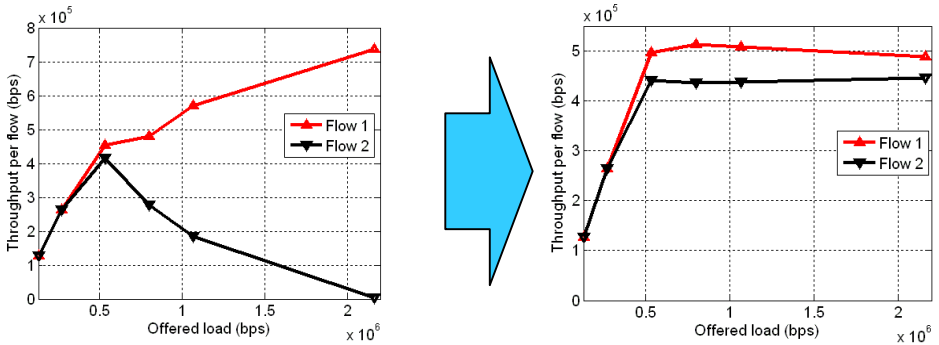
Mean BER vs. SNR for uplink communication and various mobile speed (fix, 40 km/h and 60km/h)

Configuration : MIMO2*2, Q-PSK, Alamouti coding, 0 or 40 or 60 km/h mobile speed, Sub urban area

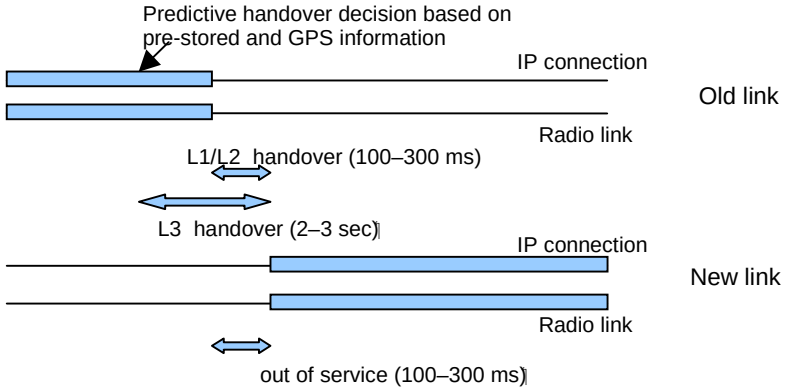
Key technical improvements (not integrated in demonstration)

- Advanced Wi-Fi mesh routing for connectivity over several carriages





- GPS-aided handover prediction
  - use of previously recorded access network properties to predict handovers based on the GPS information.



Preparing the demonstration

- Principle of the architecture has been validated in "lab" test-bed
  - Adaptation of streams is a good solution to fit with variable transmission conditions
  - Detection of events is a good way to help the operator to focus on potential problems and avoid sink into plethoric data)
  - Outdoor connection validation in static and car (WiMAX standard)

- Final step : integration of all elements together and in the train

Preparing the demonstration

- A first warning: integration in the train has encountered unexpected problems
  - UMTS coverage not available due to UMTS router burnt on Wednesday
  - ➔ WiMAX coverage around Pinto station alone is not sufficient to obtain a real outdoor link

- Realisation
  - Equipment placed in rack in technical cabin
  - Access in indoor through WiFI
  - Specific demonstration with wired connection for "PCC0"

Preparing the demonstration

- What will be shown
  - Controller interface : PDA for video and alarms
    - Issue of communication security (ciphering)
    - Transmission of videos from acquired sequences (due to non real-time ciphered compression)
    - Alarms display possible on PDA through web interface (example of maintenance)
  - Maintenance alarms
    - Two sensors types and technologies (Zigbee, 6LoWPAN)
    - Interface display for alarms rendering and sensors management

Preparing the demonstration

- What will be shown
  - Real-time compression from train cameras

    - Compression in H.264/AVC (latest digital TV standard)
    - Parallel placement of data in storage
    - Video alarms generation (live)

  - Real-time audio grabbing from microphone
    - Audio alarm generation (SIP messages sent to PCC - offline)
  - On-demand streaming of videos with adaptation to link capabilities (intelligent transcoding)
    - SIP based communication: client only asks for a given media, and SIP manages the correspondance and allows the RTSP communication to take place
  - PCC interface proposal (off-line)

Preparing the demonstration

- In practice we propose the following:
  - Going to Atocha-Renfe to take the equipped train
    - Train equipment presentation
  - Demonstration inside the train (going from Atocha-Renfe to Aranjuez and back):
    - "Controller" demonstrations
    - Sensors and alarms demonstration
    - Real-time video streaming of camera images to an observer
    - Real-time audio streaming
    - On-request video data adaptation
    - Visit in Pinto station: WiMAX equipment
  - Demonstration of PCC approach in RENFE PCC (in Atocha-Renfe)

We would like …

- To gratefully thank RENFE for having allowed us to access a carriage and perform tests inside, without having even been partner to the project

For more information

- Please do not hesitate to contact us
  - Project is ending in May/June but partners are willing to see the results disseminated and used by "real" users
  - NB: in particular, the GPS aided handover prediction is to be demonstrated this month to Hungarian authorities. Interested people can contact people from BME.

- Presentations, papers, publications are available on our web site: http://www.celtic-boss.org

- BOSS project has shown that the road to adaptive video surveillance was possible and could be followed. The next step is now to go from the R&D project to an actual product.