CORRIDOR

Conclusions and Perspectives

Marion BERBINEAU
IFSTTAR
marion.berbineau@ifsttar.fr

Conclusion

CORRIDOR was a research project with 45 months duration

- A lot of new results have been obtained with a very good cooperation between partners:
  - Algorithms for Cognitive radio bricks
  - Measurements
  - Development of a specific antenna for spectrum sensing
- Difficulties related to the measurements in high speed context:
  - Long delay to obtain the frequency authorizations by ARCEP and CSA – Special thanks to M. IMART from CEREMA!
  - No chance to obtain a second slot with high speed train to perform measurements with the MIMOSA channel sounder of IEMN.
- The questions of reconfigurable communications is a key topic in the Shift2rail master Plan at EU level (IP2, TD2.1);
- Wireless communications for railways is part of the scientific road map of the IRT, Railenium, within the work program 4 (http://www.railenium.eu);
- Links have been establish with different COST actions dealing with Cognitive radio (TERRA, WINEMO, IC 9002…)
- A link should be established with the works on PMR and AGURRE (Association des Grands Utilisateurs de Réseaux Radio d'Exploitation).
- Link already established with ERA regarding the future of telecommunications for Railways

Publications during the project

- 2 PhD during the project duration and 2 other defenses planned in October (only one PhD financed directly by ANR)
- 19 published papers in well known international journals, 2 under review
- 18 presentations in international conferences, other to come very soon
- 6 official presentations of the project during international workshops or special sessions (GLOBCOM, ICC, TRA, *etc*.)
- Guest editor of two special sections in IEEE wireless communication magazine and IEEE vehicular technology magazine dealing with wireless communications for railways.

http://corridor.ifsttar.fr/dissemination.php

Results obtained

Intelligent Mobile Terminal

- 6 New Spectrum Sensing algorithms have been developed : SPET, WCV-T, WCV-S, MyrF, CCAV and RMT based Spectrum Sensing
  - The algorithms developed are blind, relatively low complexity compared to those present in the state of the art, more robust with respect to: the noise (particularly impulsive noise), the spatial correlation and fast varying channels
  - SPET and RMT based Spectrum Sensing algorithms have been tested and evaluate with success on LTE transmission data acquired during the on-board IRIS 320 measurements campaign
- New turbo receiver for interference cancellation due to Doppler effect
- New channel estimation algorithms dealing with high mobility
- New methodology based on characteristic modes theory for the design of metamaterial based antenna optimized for spectrum-sensing – Patent on going

Intelligent infrastructure

- Proxy based network mobility (P-NEMO)
- Diffserv based QoS architecture for multi-service mitigation
- Mobile router controlled FreezeTCP
- ns-3 simulation model (publicly available)

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THALES and SNCF point of views

Thales Communications & Security (TCS) activities and experience :

- THALES has an extended experience in areas related to fixed or mobile networks, mainly on the aspects of architecture and reconfiguration of networks.
- One of the THALES teams working on CORRIDOR project is part of the radio access team, with expertise for the definition, simulation and the implementation of PHY and MAC layers, for a wide range of frequencies.
- Reconfiguration is an aspect of interest for THALES, for long-term communication products: in same equipment, there is a need for several waveforms.
- Moreover, THALES is also a worldwide leader in railway signaling and transportation security, thus bringing its expertise for:
  - on-board systems,
  - new applications such as real-time video transmission on request,
  - next generation contextual passenger information, and
  - predictive maintenance applications.

Economical output for THALES

- **General Context:**
  - **Several teams** from THALES were involved in CORRIDOR project:
    - **A Radio Access Team** dealing with wireless standards and Cognitive Radio aspects and
    - **A Transportation Systems Team** in charge of the railway specific context interfaces.
  - This **collaboration** allowed the development of system needs, use cases and possible services.
- **Main Results:**
  - It has been also proved that current communication techniques and architecture design are not sufficient to provide efficiently a high speed connection;
  - Thanks to new system paradigms based on channel, environment and deployment characteristics, new communication techniques have been developed;
  - It has been proved that Cognitive Radio concepts are able to improve the efficiency of the radio spectrum use.
- **The outcomes of the CORRIDOR project can be used:**
  - to provide **inputs to standardization groups and regulation authorities**,
  - as **reinforcement to LTE** used in extreme scenarios for providing high speed connectivity,
  - for the development of future high-capacity wireless communications used for **5G networks**;
  - as **alternative for satellite communications** (more expensive, difficult to be deployed and lower expected user experience due to higher cell coverage).
  - for **emergency and crisis management scenarios**: temporary communications links have to be rapidly deployed in order to enable rescue teams to coordinate and combine their effort from the very first hours of intervention.
  - For **new applications for on-board systems** such as real-time video transmission on request, next generation contextual passenger information, and predictive maintenance applications, which represent **new business opportunities for THALES**.

SNCF contribution and benefits

- **Railway Context**

  In strong competitive environment, SNCF aims railway excellency for next decade.

  Improve quality, reliability and security for railway transportation are therefore strategic keys to guaranty best offers and services to passengers and clients and also improve railway operations and production.

  Develop and integrate new wireless communication technologies for high speed mobility is an essential technical brick for railway system.

- **Main contribution**
  - User definitions need (services description and technical performances)
  - Provide railway means for measurements and tests in high speed conditions (train and ground infrastructure)

- **Benefits**
  - Share vision of radio communication needs for high speed trains
  - Get technical translation of user needs
  - Evaluate potentiality of cognitive radio technology in high speed conditions
  - Have a better vision of:
    - Technical impacts of high speed mobility on radio communication system
    - Benefits of CORRIDOR architecture for high speed train communications
    - Alternative solution for train to ground communication

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Thank you for your attention
Questions?