



CORRIDOR

Deployment Scenarios and Prototyping Platforms



Task 8 : Scenario Specification for Trials (T0+12 -> T0+18)

- Objectives

- defining the scenarios (T8.1) and prototype platform (T8.2) for trials in the railway context. The scenarios should take into account

- Tasks 4, 5, 6, and 7 output
- demonstration feasibility regarding the OpenAirInterface.org platform constraints as well as the constraints for installation on board the trains and along the railway lines

- Contributors

- IFSTTAR (1), IEMN(.7), TBretagne(1), EURECOM(5), UBO(1), SNCF (2), TCS (1)



Task 9 Platform Integration

(T0 + 18 -> T0 + 30)

- Objectives

- implementation of selected techniques from task 5, 6 and 7 on the existing OpenAirInterface.org radio equipment and emulation platform based on T8 output. (T9.1)
- integration and lab-testing of a multi-channel MODEM with broadband component carrier selection capabilities in UHF bands for testing in a reduced-scale RF demonstration environment comprising an on-board unit and two ground stations. (T9.2)
- On site testing (T9.3) and measurements

- Contributors

- IFSTTAR (13), IEMN(8), TBretagne(6), EURECOM(22), UBO(10), TCS (14)



Scenarios

- The goal of the tests is to validate a high throughput communication between a fixed equipment (eNodeB) and a mobile relay (or router) on a train.
 - The tests target a communication between fixed equipment (eNodeB/RRH) and a mobile relay (or router) on a train;
 - The speed of the train shall be at least 300 km/h (actual speed of the LGV);
 - The actual throughput is targeted to be high: it shall be compatible with the User needs;



Scenarios : Spectrum

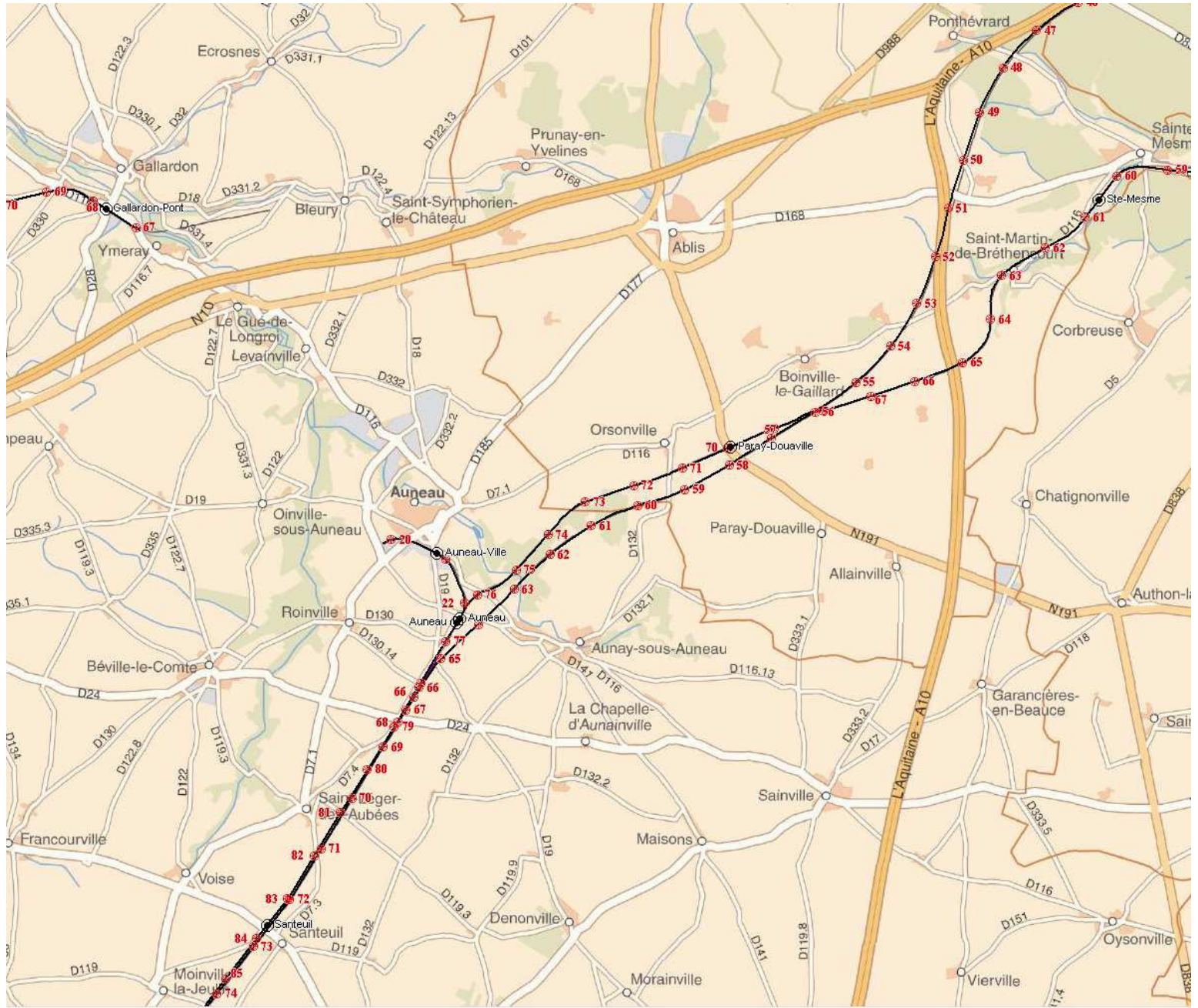
- The communication includes spectrum aggregation of at least 2 frequency bands, TVWS and 2.6 GHz are preferably targeted. The following bands were finally chosen:
 - CSA bands: 758-763 MHz (C = 760.5) and 769-774 MHz (C = 771.5), (2 times 5 MHz) => **bands to be auctioned in late 2015**
 - ARCEP band: 2580-2610 MHz chunk of 30 MHz; => **band used in SYSTUF (metro Parisien)**
- Considering the throughput, the number of frequency channels will be 4 (for spectrum aggregation), 2 times 5 MHz in the lower bands and 10 + 20 MHz in the higher band;
- The available bandwidth gives an aggregated bandwidth of 40 MHz.



Scenarios: Location

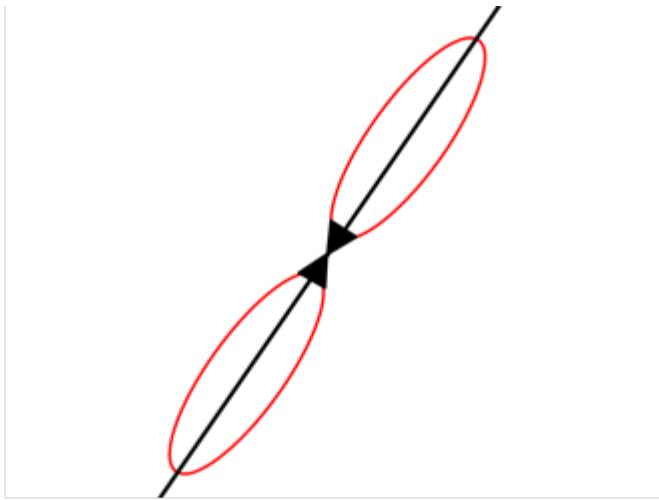
- SNCF has conducted a study on the issue of candidate sites (along the way) in terms of technical feasibility
 - near Chartres (Auneau) => Typical open rural area





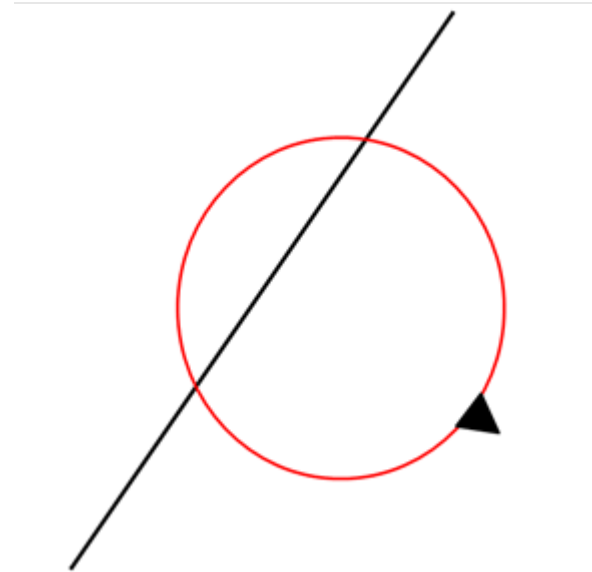
Scenarios: Deployment

Deployment scenario 1



Typically for control network for train operator

Deployment scenario 2

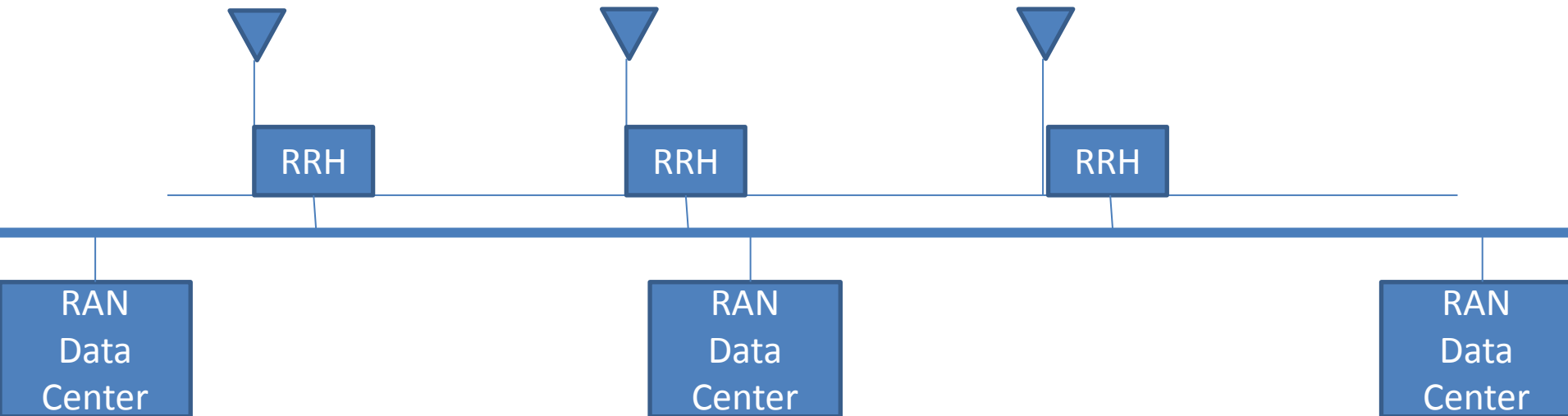


Typically for the Operator network



Some notes on Linear Deployment

- Linear deployment for control network
 - Highly directional antennas
 - Interconnected with railway operators optical network
 - Radio sites (RRH) interconnected via optical to mini data centers which run eNB processing and interconnect with railway operators EPC



Some notes on Cellular Deployment

- Cellular deployment
 - Targets 700 MHz/800 MHz/2.6 GHz aggregation
 - Would make use of beamforming techniques to guarantee high-quality coverage to train
 - Minimize impact on remainder of cell for normal users
 - Aim to employ multiple properly spaced receivers on train (for MIMO)
 - For Rel 13-> 5G Relay for high-frequency network inside train
 - Would also likely make use of common radio fibre from railway operator
 - Sharing of RAN data centers for railway control and cellular coverage (different radio sites)

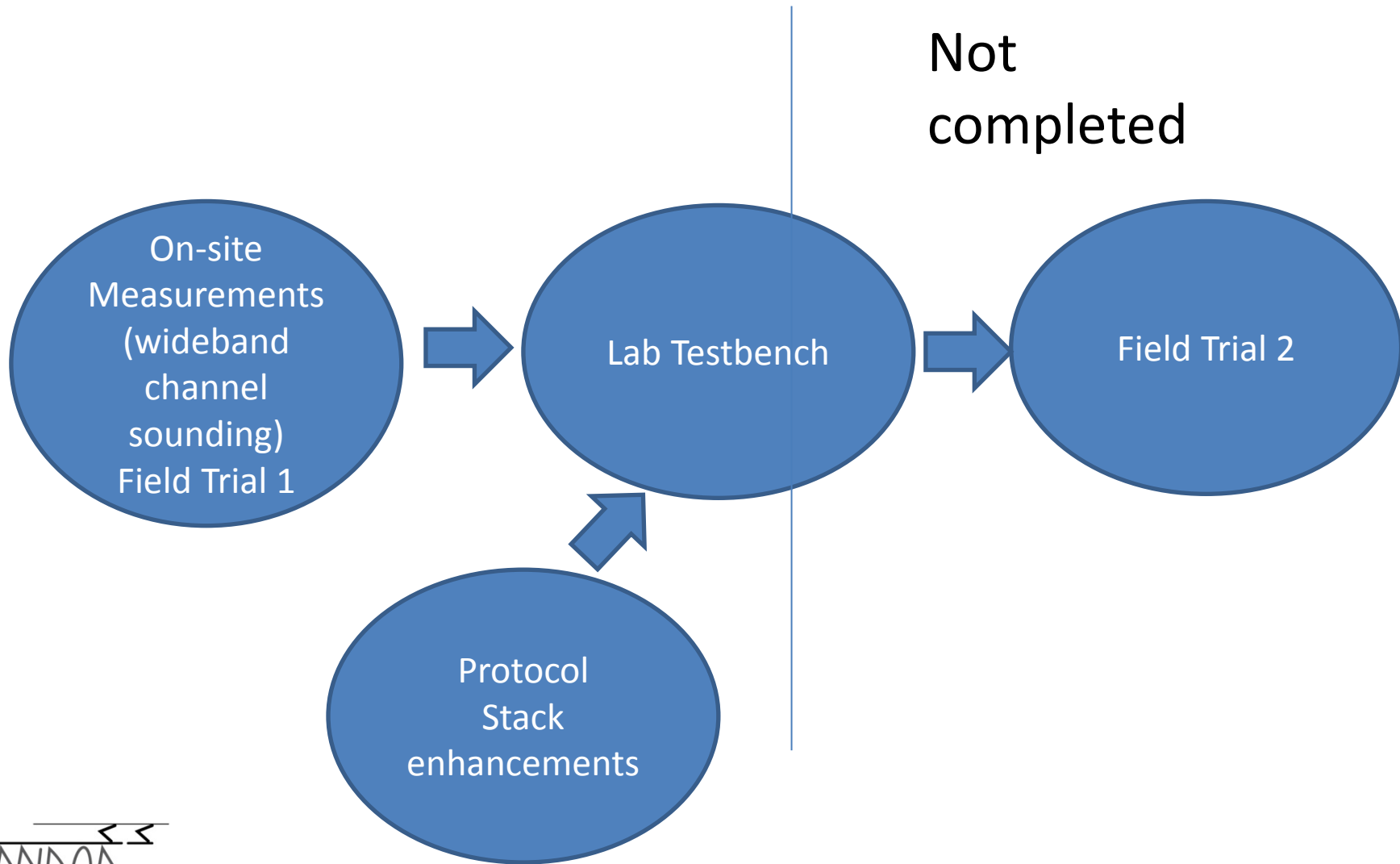


Platform

- Based on ExpressMIMO2 platforms from EURECOM
 - Maximum 4 20 MHz channels (MIMO or multi-channel) (4 ExpressMIMO2 in one PC) or 4 5MHz channels (one ExpressMIMO2)
 - UHF band TDD operation or 2.6 GHz TDD/FDD
 - Rel-8/10 TD-LTE MODEM (OFDMA/SC-FDMA)
 - Carrier aggregation or MIMO
- UE
 - 3 @ 800 MHz, 2 @ 2.6 GHz
 - Could have been 4 ...
- High-power front ends (40 dBm / antenna port)
- Lab testing environment
 - Mock network with high-end channel emulator
 - Availability of channel emulator was an issue
 - Use of channels emulation in OAI receiver as backup option (still incomplete)



Methodology



Openairinterface.org

- Opensource software-based implementation of 4G LTE (Rel 10)
 - Spanning the full protocol stack of 3GPP standard
 - E-UTRAN (eNB, partial UE)
 - EPC (MME, S+P-GW, HSS)
 - Realtime RF and scalable emulation platforms
- Objectives
 - Bring academia closer to complex real-world systems
 - Open-source tools to ensure a common R&D and prototyping framework for rapid proof-of-concept designs
- Playground
 - Commercial UE ↔ OAI eNB + Commercial EPC *
 - Commercial UE ↔ OAI eNB + OAI EPC *
 - Commercial UE ↔ Commercial eNB + OAI EPC *
 - OAI UE ↔ Commercial eNB + OAI EPC *
 - OAI UE ↔ Commercial eNB + Commercial EPC *
 - OAI UE ↔ OAI eNB + Commercial EPC
 - OAI UE ↔ OAI eNB + OAI EPC

*only Realtime RF



OpenAirInterface (2)

- Hardware = commodity equipment
 - ExpressMIMO2 (EURECOM)
 - National Instruments / Ettus USRP B210/X310
 - Nuand BladeRF
 - Soon NuTaq PicoSDR
 - Industry platforms (ALU, China Mobile, others)

