New Base station architecture and possible research themes

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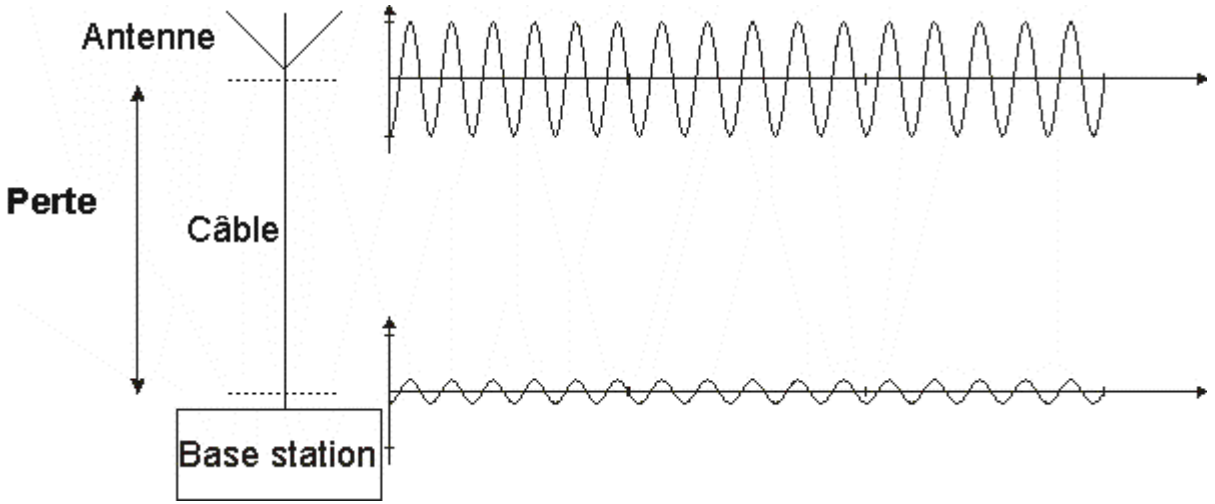
Evolutions of LTE

- Digital Radio Over the Fiber (technology independant)
- COMBO project
- Research ideas

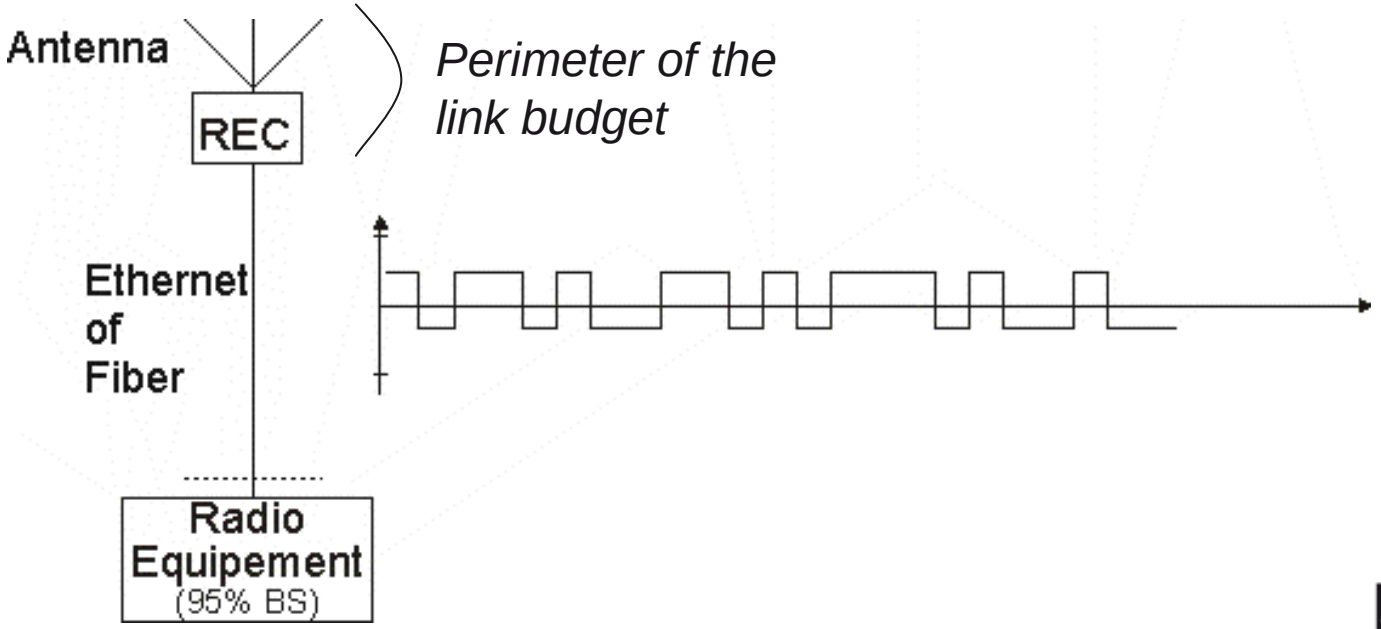
Classical Base station architecture

- The antenna is typically on roofs
- Demodulation, Detection, baseband management, control are made in the base station
- The base station cannot be close to the antenna: important losses in the cables => coverage reduction, energy inefficiency

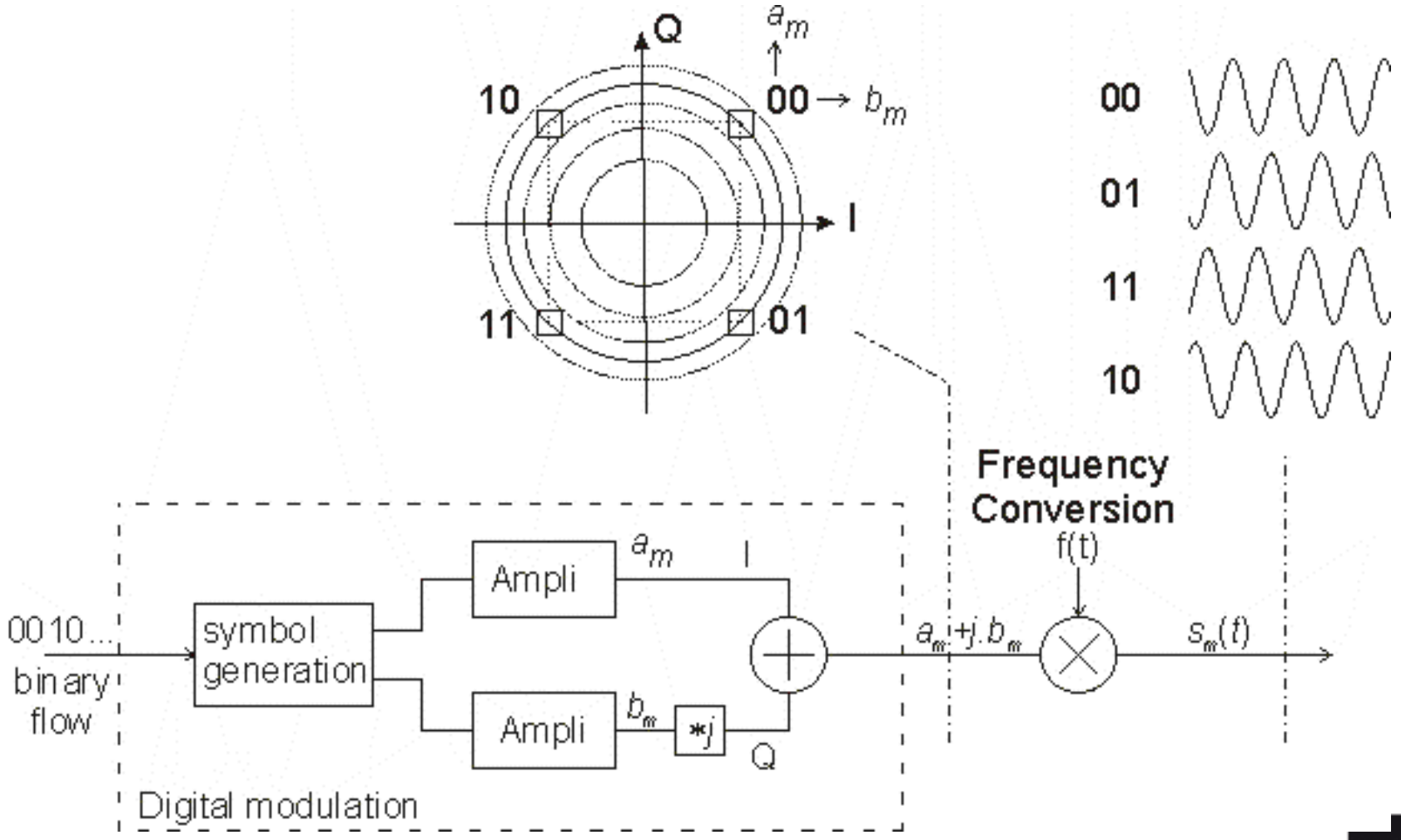


Main principles of remote radio heads

- **Remote Radio Head (RRH) (or Radio Equipement)**
  - antenna connector
  - frequency shifting, sampling, quantization of I and Q values
- **Base Band Unit (BBU) (or REC, Radio equipment control)**
  - detection, baseband management (error correction, interleaving



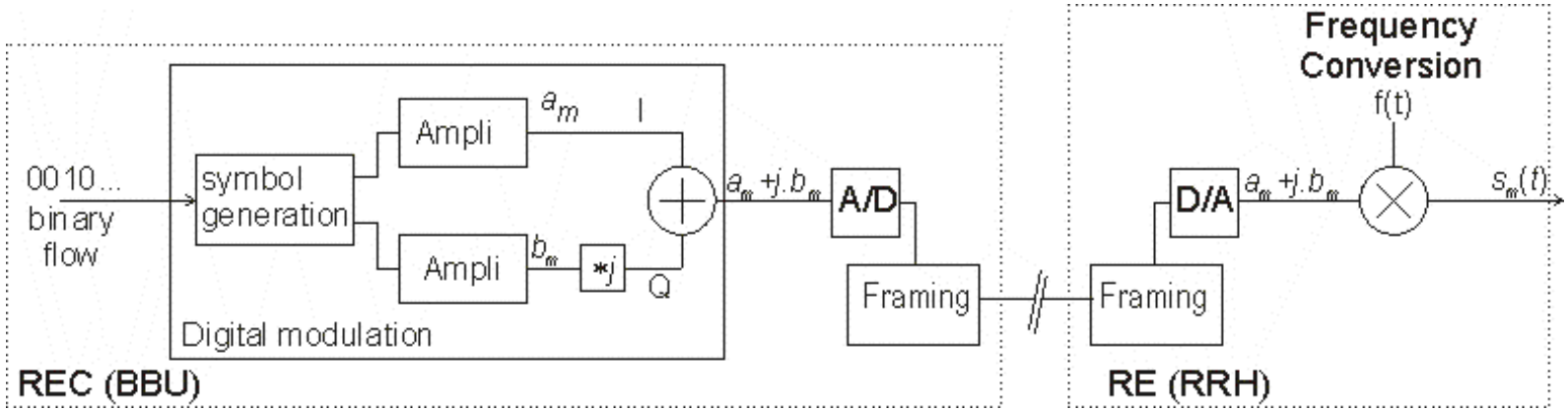
Digital modulation reminder



The CPRI initiative

- Common Public Radio Interface (CPRI)
- specification of the key internal interface of radio base stations between the Radio Equipment Control (REC) and the Radio Equipment (RE).
- forum of companies: Ericsson AB, Huawei Technologies Co. Ltd, NEC Corporation, Alcatel Lucent and Nokia Siemens Networks GmbH & Co. KG
- created on June 18 2003
- http://www.cpri.info/

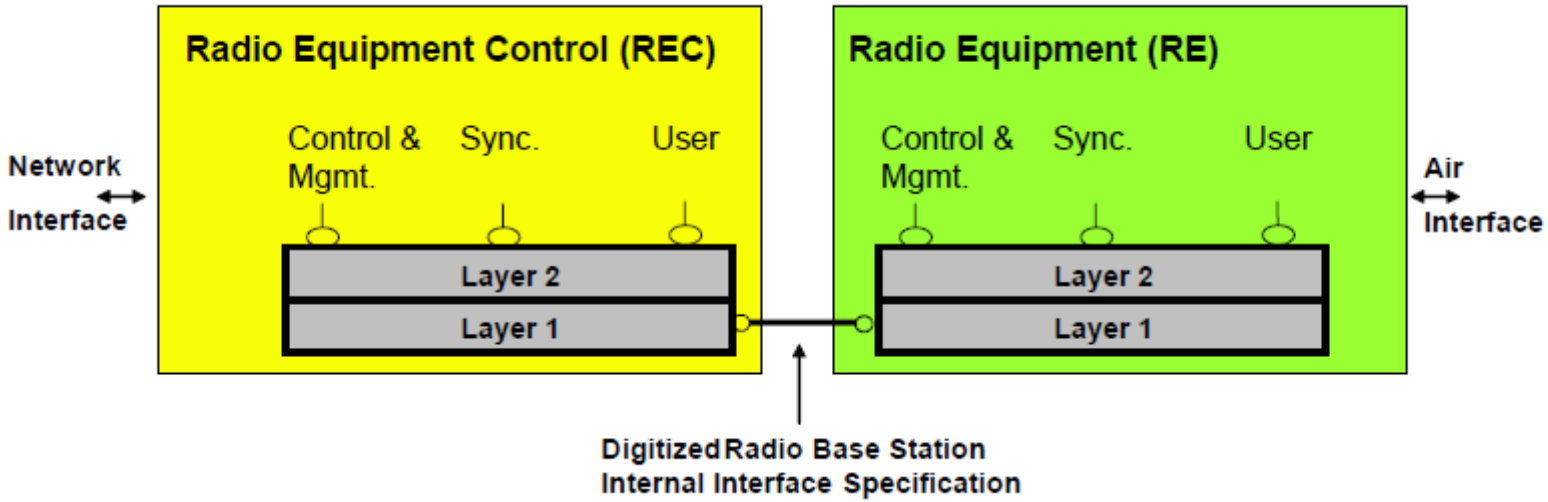
General principle of REC and RE (RRH) splitting



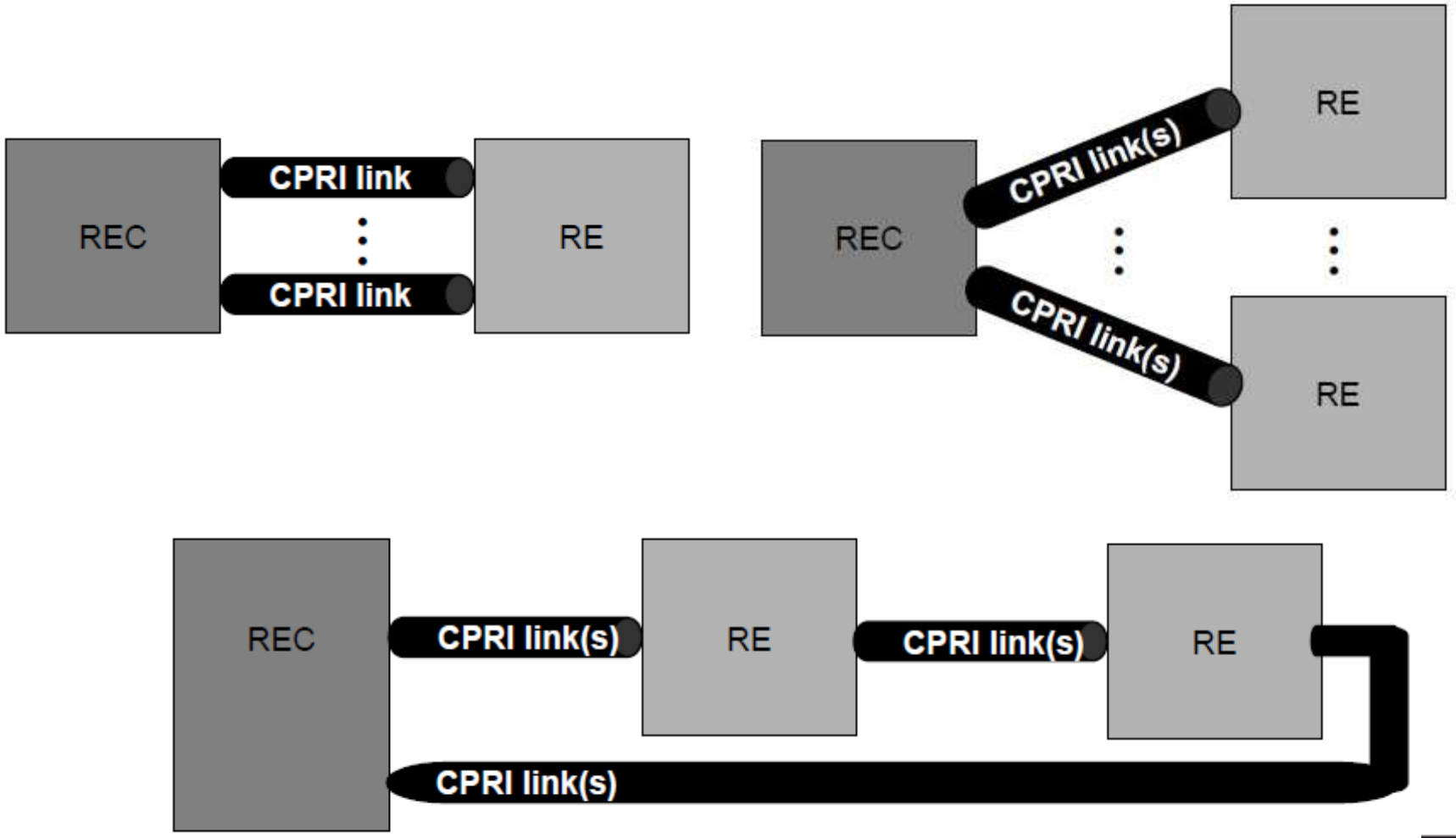
- **Quantization**
  - between 8 and 20 bits on the downlink (14 bits in OBSAI)
  - between 4 and 20 bits on the uplink (14 bits in OBSAI)
- **More than one sample for each chip or symbol**
  - between 1 and 2 samples on the downlink
  - between 2 and 4 samples on the uplink
- **for UMTS : 3,84 Mchip/s**
  - Two values (I and Q) for each chip
  - Minimal bit-rate requirement = 1*2*8*3,84 = 61,44 Mbit/s with 1 sample/chip and 8-bit samples

The CPRI Interface

- **Possible multi-hop architecture (REC-RE-RE-RE…)**
- **The cable length (between REC and RE) can be up to 10 km**
- **Possible technologies**
  - Gigabit Ethernet: (1000BASE-SX/LX)
  - 10 Gigabit Ethernet (10GBASE-LX4)
  - 10 Gigabit Ethernet (10GBASE-S/L/E)
  - Fibre channel (FC-PI) – Standard ISO/IEC 14165-115
  - Fibre channel (FC-PI-4) – INCITS (ANSI) Revision 8, T11/08-138v1
- **Specific Frame format**
- **Data Rates**
  - All rates are multiples of 614,4 Mbit/s = 160*3,84 Mbit/s
  - Rate up to 6144,0 Mbit/s



Some Possible Topologies



Cloud Radio Access Network

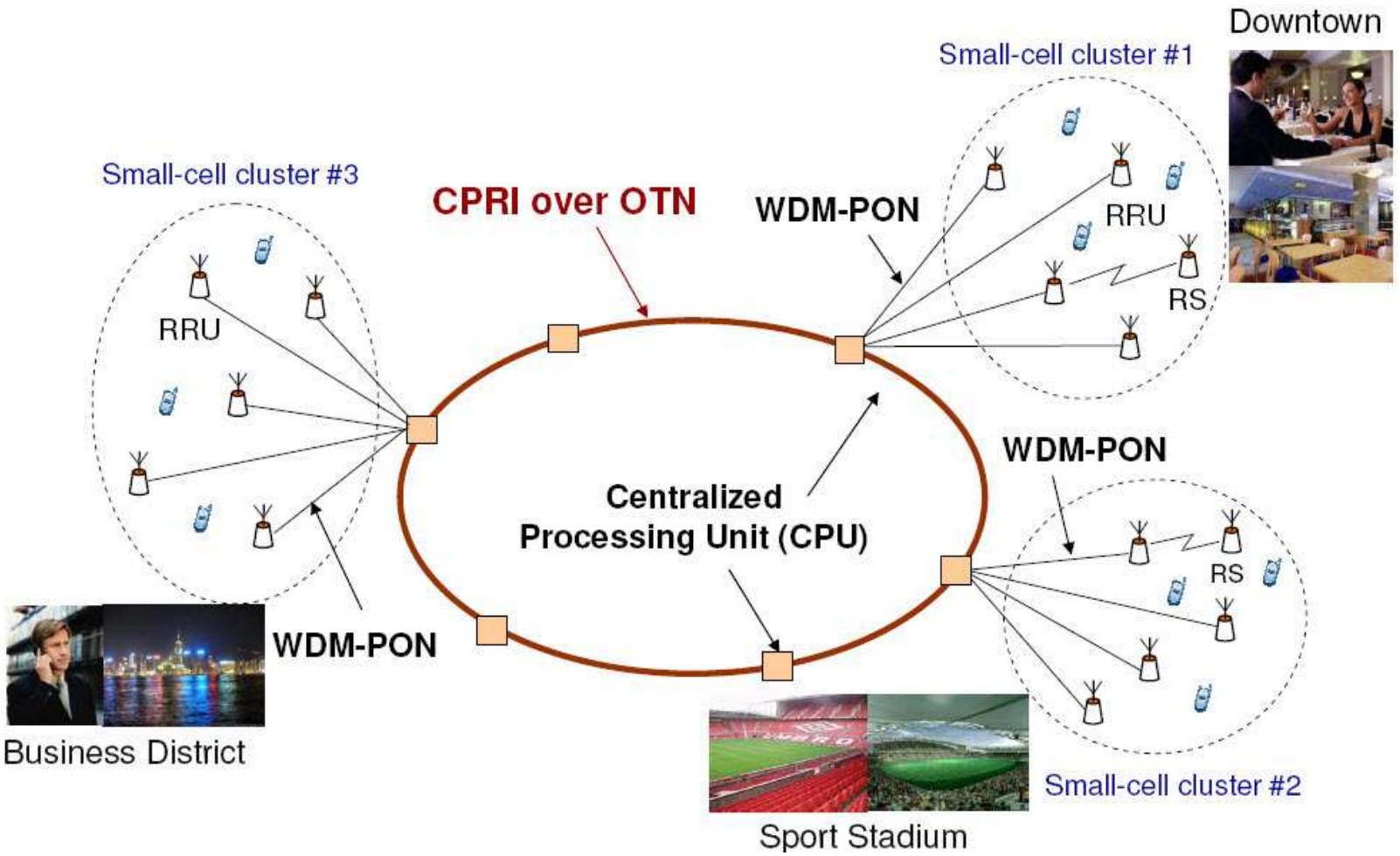
- **Objective of the Cloud RAN : lowers operating expenses, simplified deployment process**
- **Base Station Server**
  - Centralizing all the active electronics of multiple cell sites
    - Example : L1-handover is possible
  - Minimization of energy, real-estate and security costs
- **RRH, remote radio header**
  - mounted outdoor or indoor (on poles, sides of buildings,…)
  - anywhere a power and a broadband connection exist,
- **This new topology saves**
  - costs both during the installation
  - upgrading cost (hardware and software)
  - millions of dollars in CAPEX/OPEX ?
  - Cloud RAN makes possible the deployment of a very large number of small cells
- **Source : http://www.telecom-cloud.net/wp-content/uploads/2011/09/Cloud-RAN-Architecture.jpg**

The Combo project

- **COMBO = COnvergence of fixed and Mobile BrOadband access/aggregation networks**
- **FP7 ICT Call 8, Large-scale integrating project (IP) proposal**
- **17 partners, JCP, France Télécom,** Deutsche Telekom, Alcatel Lucent,
- **Télécom Bretagne : Philippe Gravey, Annie Gravey, Michel Morvan, XL**

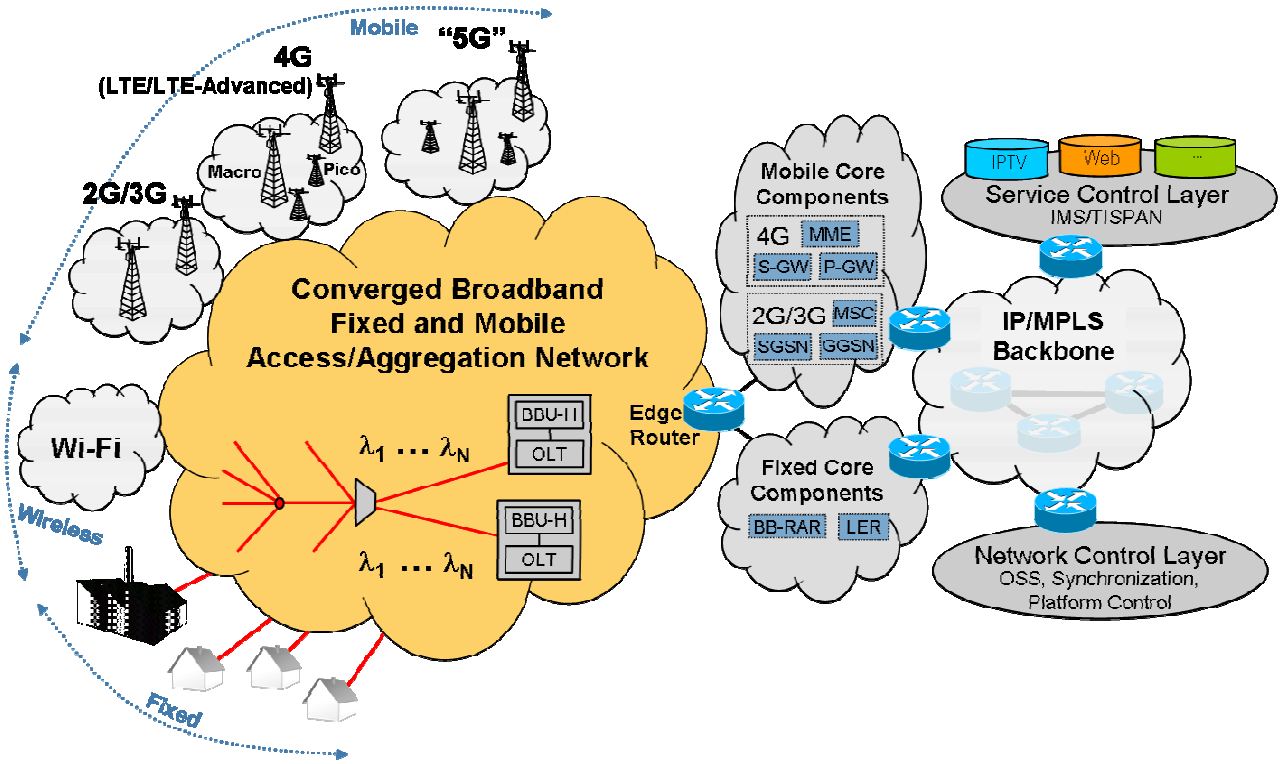
- **To propose and investigate new integrated approaches for Fixed /Mobile Converged (FMC) broadband access / aggregation networks for different scenarios (dense urban, urban, rural).**
- **COMBO architectures will be based on joint optimization of fixed and mobile access / aggregation networks around the innovative concept of Next Generation Point of Presence (NG-POP).**
  - Define optimised FMC network architectures, which will be quantitatively assessed and compared with respect to Key Performance Indicators such as cost, energy consumption, bitrate, delay, QoS;
  - Assess multi-operator FMC scenarios to ensure openness and flexibility for network operators and service providers;
  - Demonstrate experimentally FMC network features in lab and field tests to show the feasibility of proposed architectures;
  - Drive standardization bodies with respect to FMC architectures to boost COMBO concepts in coming standards and to foster large scale implementation of FMC networks.

The Cloud paradigm for Wireless Networks



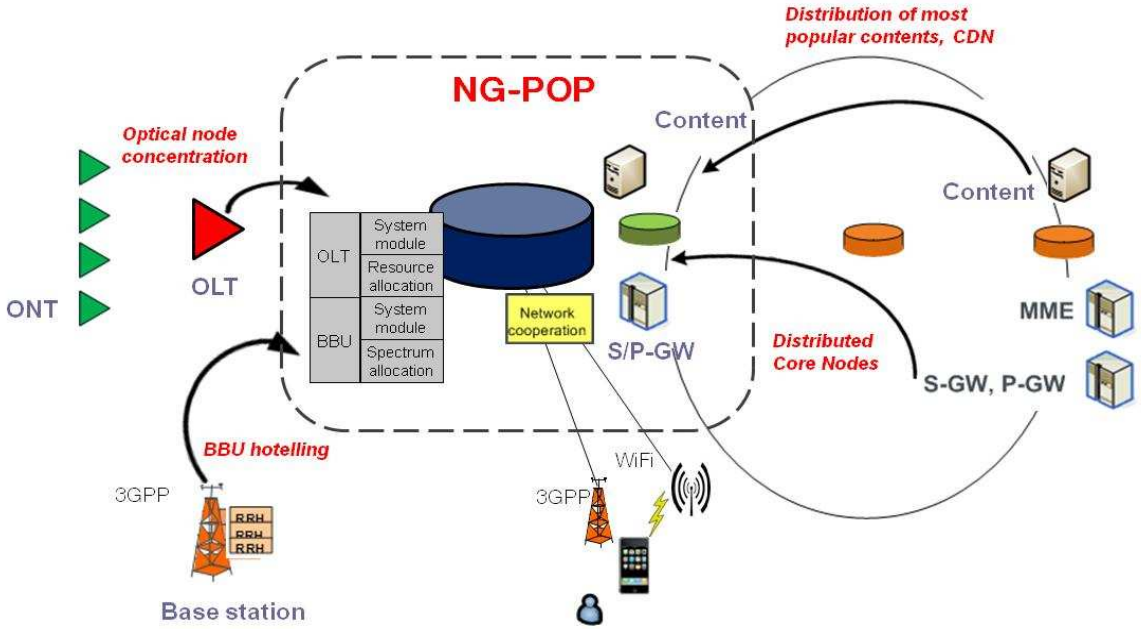
Source : http://www.telecom-cloud.net/wp-content/uploads/2011/09/Cloud-RAN-Architecture.jpgb

Scope of the COMBO project

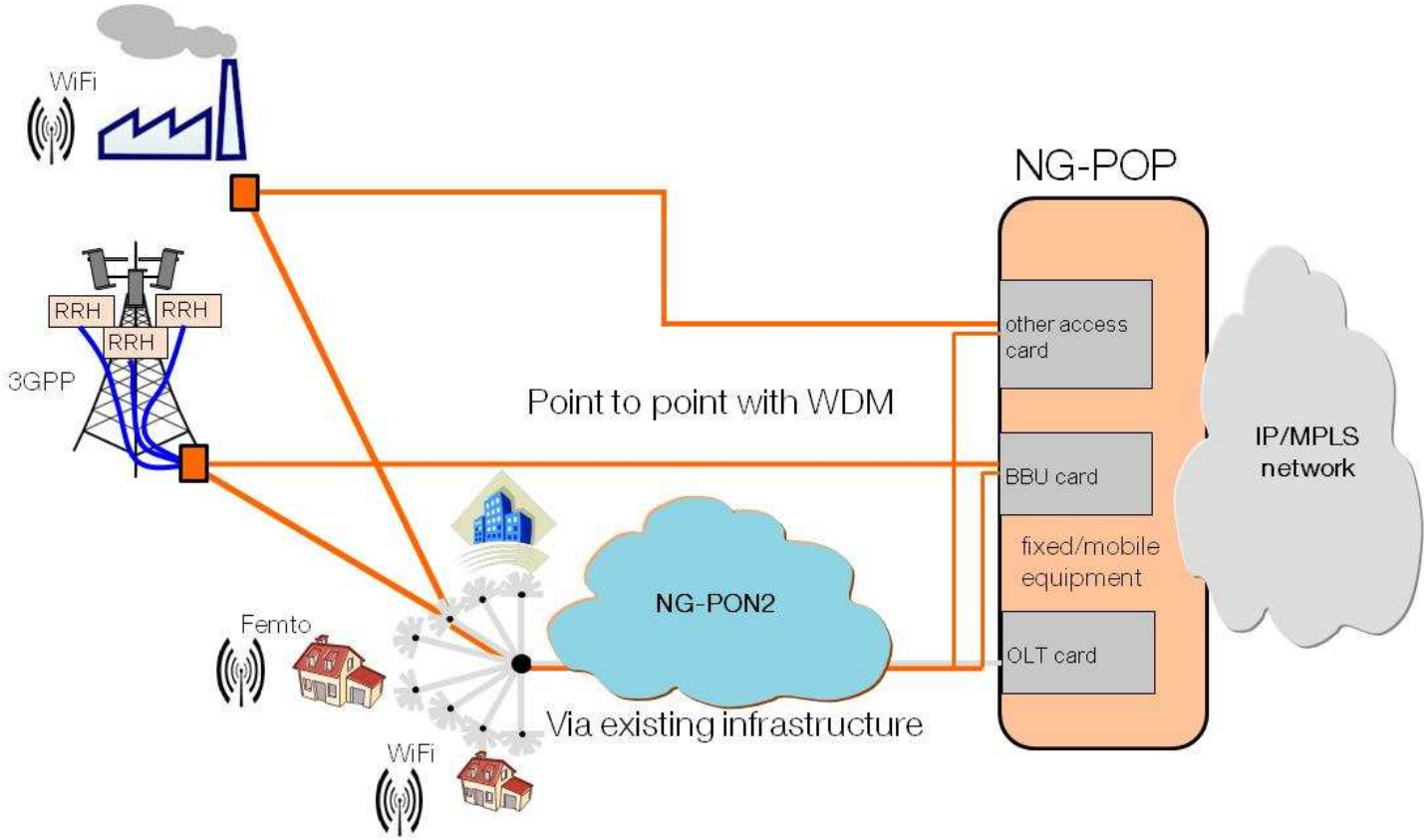


OLT, Optical Line Terminal
BBU, Base Band Unit - Hotelling

COMBO overall concept towards a Next generation Point of Presence



Convergence of fixed / mobile equipment and infrastructures towards NG-POP



Some ideas for next years

- **Try to use the new DRoF architecture**
  - Distributed base stations
  - Multi-cell scheduling
- **Box (WiFi Access Points, LTE femto base station)**
  - Fully virtualized (Box=Radio Header) ?
  - A real Router ?
  - Dynamic
- **Hierarchical cell structure with efficient wake up processes**
  - Multi-technology approach
  - Definition of Architecture
  - Fast handover process