Multi-RAT and Network/Terminal Function Virtualization

Virtual RAN towards 5G

Arnaud de Lannoy

Orange Labs Network /RNM
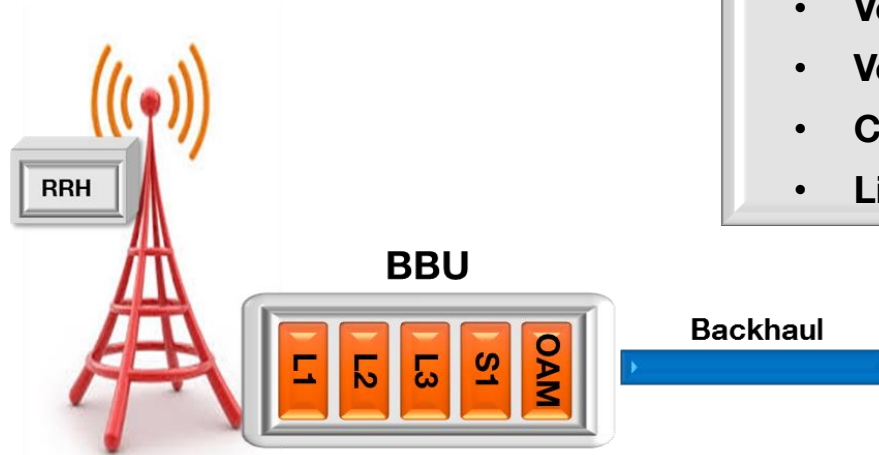
February 2017

vRAN Project

orange™

The RAN virtualization, illusion or reality

- **RAN Characteristics**
  - **Very high CAPEX**
  - **Very high OPEX**
  - **Critical for wireless KPI**
  - **Linked to the backhaul**

Not eligible to the virtualization

RRH

BBU

L1 L2 L3 S1 OAM

Backhaul

Eligible to the virtualization
but
With CPU & Real time constraints

The virtualized RAN architecture

Today No virtualization

Step 1 Partial virtualization

Step 2 Full virtualization

Virtualization of higher layers in a central location on an Orange virtualized infrastructure

Virtualization of lower layers at the radio site

Cost efficient

Best KPI

5G Ready

Why the RAN virtualization ?

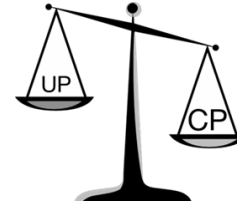~~CAPEX~~   ~~OPEX~~

4G/5G Dual Connectivity

- Offer the best of 4G/5G networks to ensure 5G KPI from day 1

Latency

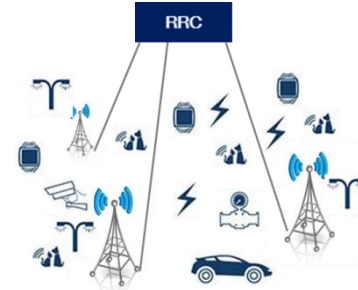**Transport efficiency**

Pooling
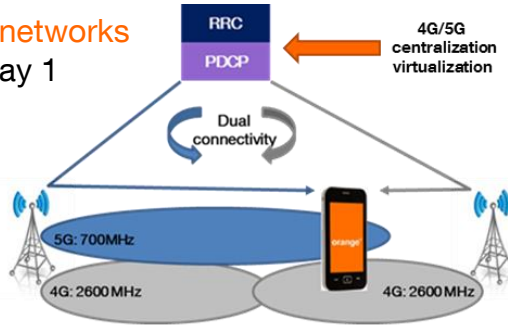
IoT management

- IoT UE induce a high signalization vs traffic
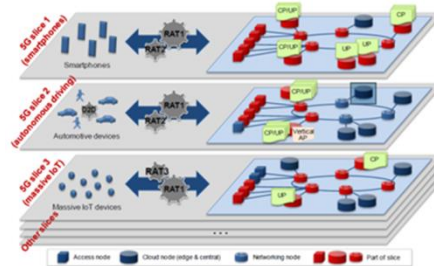
Pooling

Scaling

5G Slicing

- "dynamic" deployment of end to end network components, allowing fast deployments of new services

The virtualization is the key enabler
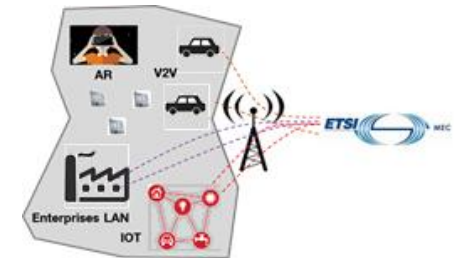
Without RAN slicing, no E2E slicing

Multiple Access Edge Computing

- Reduce the latency between the UE and contents
- Establish a link between the RAN and contents

The virtualization is a key enabler

The latency reduction is essential to the QoE


4

Virtualized RAN trial in Poland principles

vRAN field trial objectives

- Confront the vRAN architecture to the field
  - Transport architecture
  - LTE features
  - LTE performances
- Evaluate impacts of the virtualization on operations
  - Upgrades
  - Maintenances
  - Green
- Investigate QoE enablers linked to MEC

vRAN trial architecture

- A virtualized infrastructure designed by Orange
- A vBBU and iRRH designed by Altiostar
  - 2 indoor small cells
  - 2 outdoor eNB
- A full integration into the Orange Poland network
  - Commercial transport
  - Commercial EPC
  - Handover between vRAN and legacy RAN

vRAN – Trial Architecture
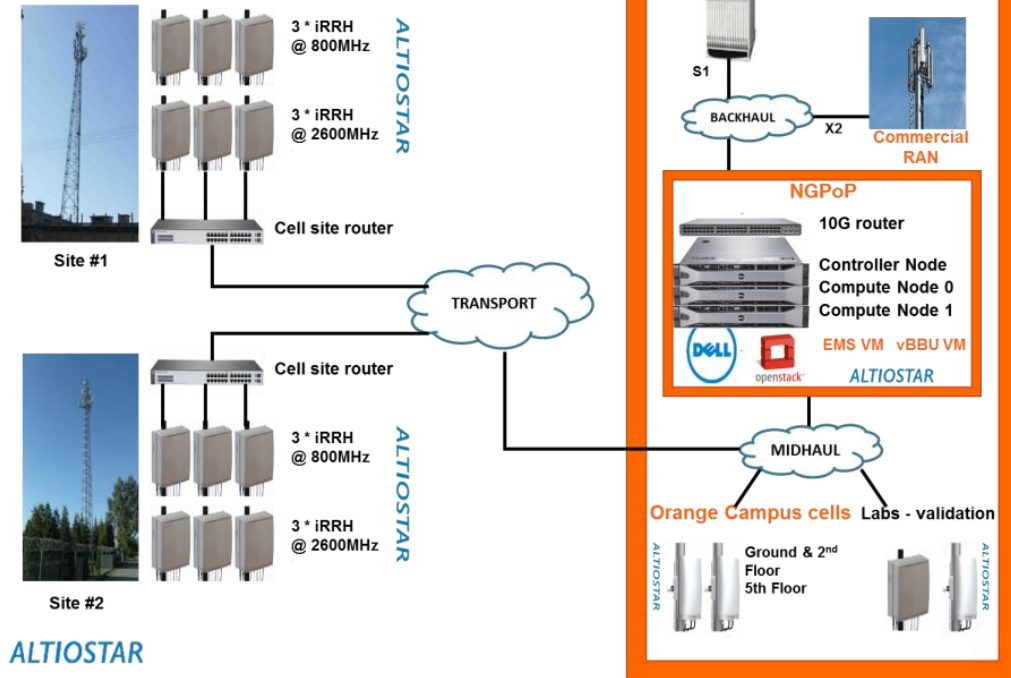
Commercial traffic

Virtualized RAN trial in Poland results

vRAN architecture

- The vRAN architecture is compatible with a Metropolitan NGPoP deployment
  - The maximum latency between the radio site and the Metropolitan NGPoP is validated
  - The Midhaul interface is robust enough for a commercial deployment, but the latency shall be guaranteed through a new transport solution
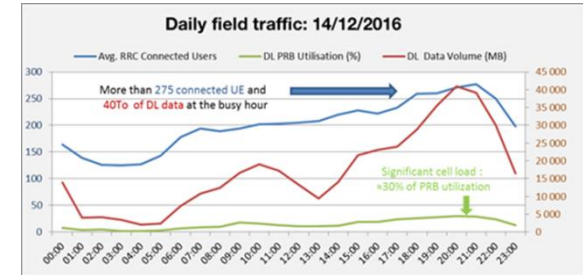
vRAN on a NGPoP

- 26 days of live traffic in the field; 48 days in the Orange campus

High Traffic

Very good KPI

Compatible with LTE Advanced features

Daily field traffic: 14/12/2016

More than 275 connected UE and 40To of DL data at the busy hour

Significant cell load : ≈30% of PRB utilization

The virtualization challenge

- OpenStack and the vRAN design is still a challenge
  - The installation and operations of OpenStack are not yet at a telco carrier grade level
  - The design of a vRAN network in a NGPoP induces a full redesign of the RAN

Orange shall develop virtualization skills

Multiple Access Edge Computing

- MEC features proposed by Altiostar provide QoE gains
  - The TCP optimization feature is functionally available
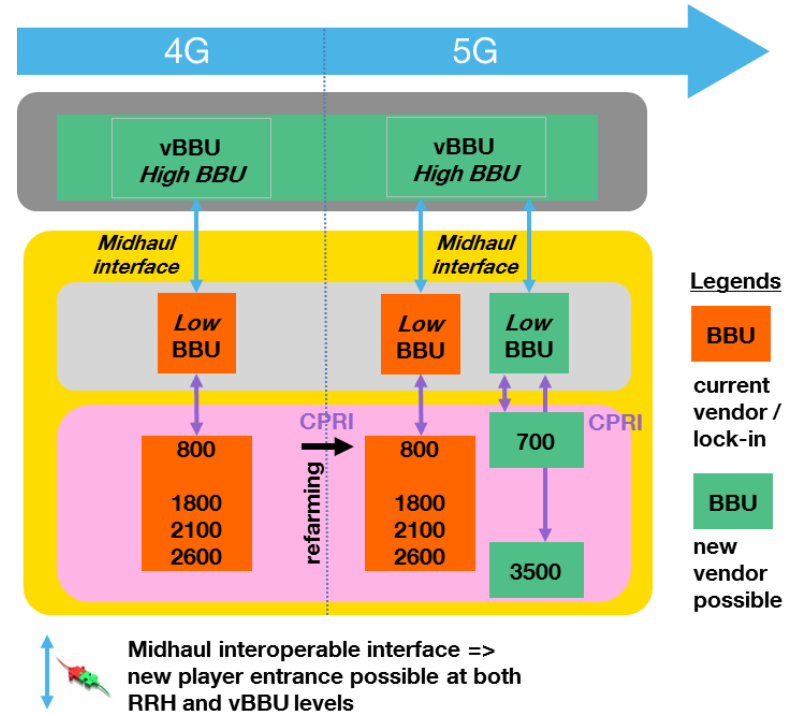

RF aware TCP Optimizer

www

  - The transparent caching provide significant gains

The virtualized RAN or the flexible RAN

Orange is pushing the Midhaul standardization at the 3GPP for 4G and 5G RAN

Benefits of the Midhaul standardization

- OPEX reduction by simplifying the tool chain

- Supplier flexibility
  - A standardized Midhaul interface is the tool to unlock the low BBU and the vBBU
  - This will offer the possibility to connect a low BBU from vendor A to a vBBU from vendor B

4G	5G

vBBU *High BBU* — **vBBU** *High BBU*

Midhaul interface

Low BBU — **Low BBU** — **Low BBU**

CPRI   refarming   CPRI

800 / 1800 2100 2600   →   800 / 1800 2100 2600   700   3500

Legends

BBU current vendor / lock-in

BBU new vendor possible

Midhaul interoperable interface => new player entrance possible at both RRH and vBBU levels

Conclusions

- The 4G & 5G RAN virtualization is now feasible and will be deployed in the context of the 5G deployment

    5G KPI   QoE   Slicing

        IoT   Flexibility

- A full carrier grade vRAN network is now feasible as demonstrated by Altiostar, but the full network integration is still a challenge

    Security   Orchestrator   Transport

- The RAN virtualization induce huge impacts on skills, tools, process and supplier relationships

    Training   Organization   Contracts