RAN WORLD
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Changes, Challenges and Case studies in the fronthaul network for C-RANs

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RAN world 2015

Session : working group “Fronthaul – Backhaul working group”

29th September, 2015, Cologne, Germany

orange™

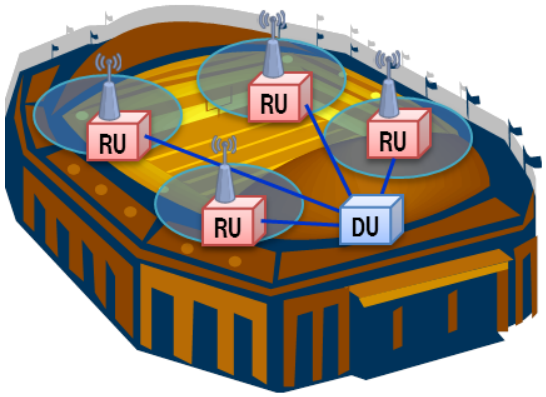
Contents

Different C-RAN architectures

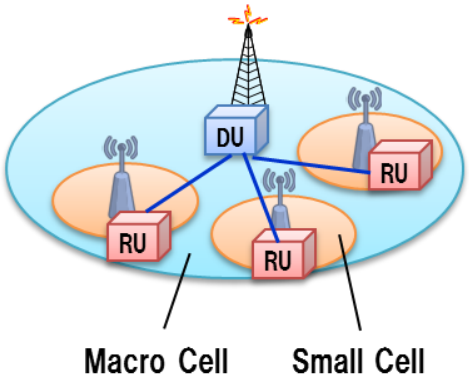
- Wide C-RAN
  - Macrocells + Hetnets

- Private and Local C-RAN
  - Micro or small cells
  - Outdoor: Local C-RAN
  - Indoor: Private C-RAN

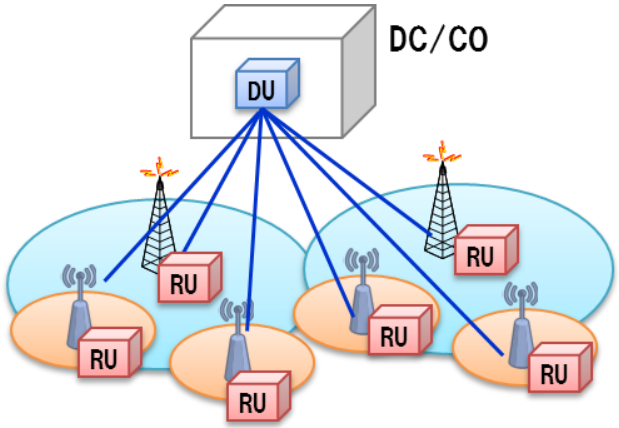
DC: Data Center
CO: Central Office



①Private C-RAN



②Local C-RAN
(Fronthaul Extension)



③Wide C-RAN
(CO-based C-RAN)

C-RAN drivers

- Interest coming from network operational teams: **site engineering solution** due to increased network rollout difficulties
- **Antenna site simplification:** footprint reduction, renting cost reduction, reduced time to install
- Contribute to RAN strategies on tower sharing
- **Better radio performances:** thanks to very low latency between BBUs:
  - Better performance in mobility
  - Improved uplink coverage
  - Higher capacity and improved cell edge performance with inter-site CoMP
- BBU **pooling and aggregation gains** possible across a number of sites
- **Energy efficiency**
- **Future proof** for **LTE-A** and beyond
- In case of **hetnets**: **improved interference control**
- BBUs are in a secured location: **no need for IPSec**

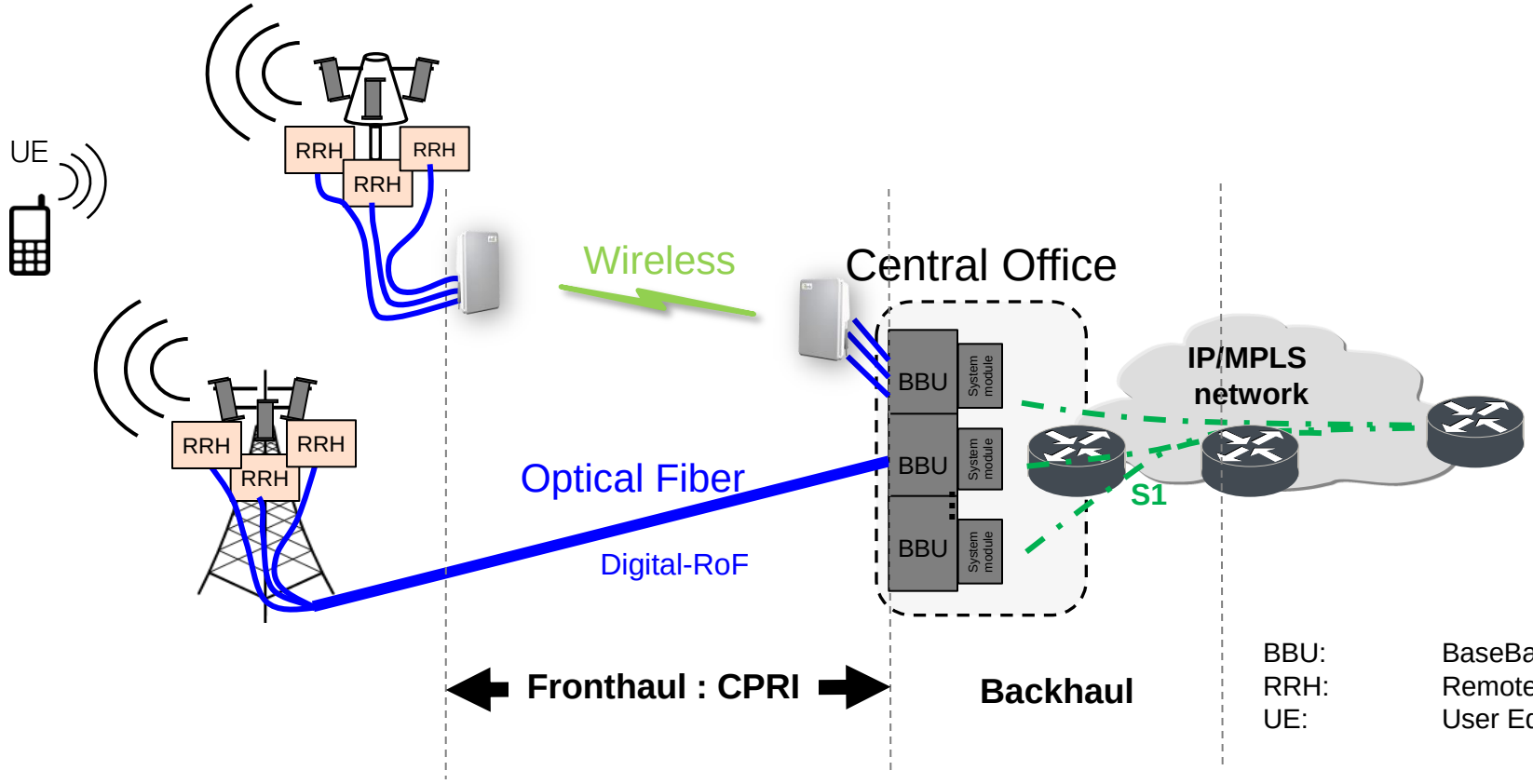
Drivers = cost reductions & ease of deployment

Fronthaul trials drivers

- Save or built new sites which are identified by operational teams, as **problematic in regular process** (Distributed RAN with backhaul)
- Be **compatible** for a full site fronthaul swap : **2G, 3G and 4G** (for all carriers) and **5G** tomorow
- Identify **OPEX** and **CAPEX** savings with existing Radio Access Technology equipment (2G, 3G, 4G)
- **Initialize the learning curve of fronthaul network segment production:** technologic choice, vendors pre-selection, installation process, Information System description, integration in the Operation Support System
- Measurements of **Energy consumption**
- Measurements, in a second step, of **Data traffic** impact (CoMP release)

Drivers = co-construction with operational teams

Fronthaul: a new segment that comes with Centralised Radio Access Network



Fronthaul interfaces: CPRI, OBSAI, ORI

Fronthaul media:

- Optical Fiber : Single Mode Fiber with or without color flavors
- Wireless : several RF bands possible with or without spectral efficiency

Contents

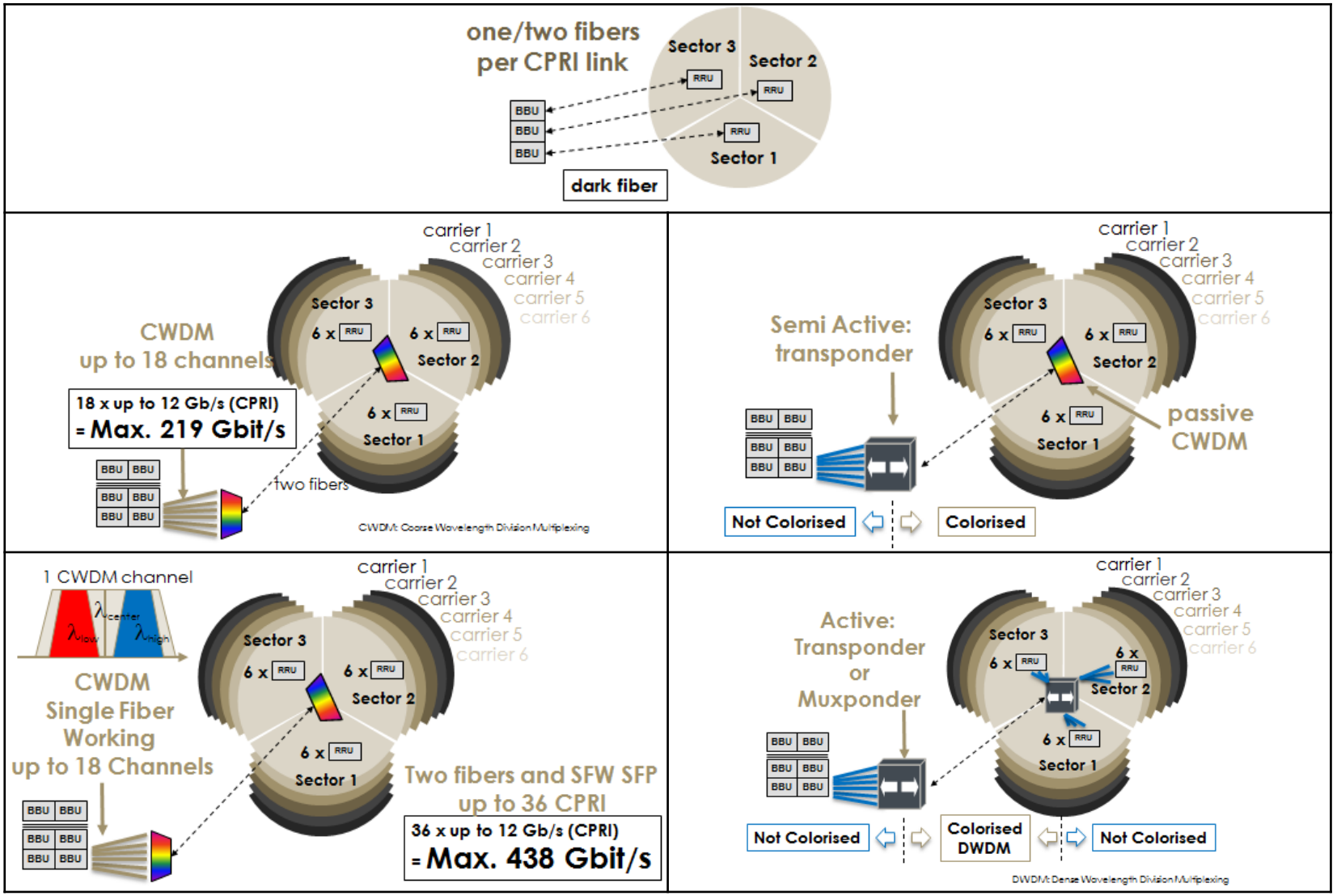
Optical fronthaul (CPRI)

Passive

Active & Semi Active

Fiber-rich network

to shared fiber



Optical fronthaul (CPRI)

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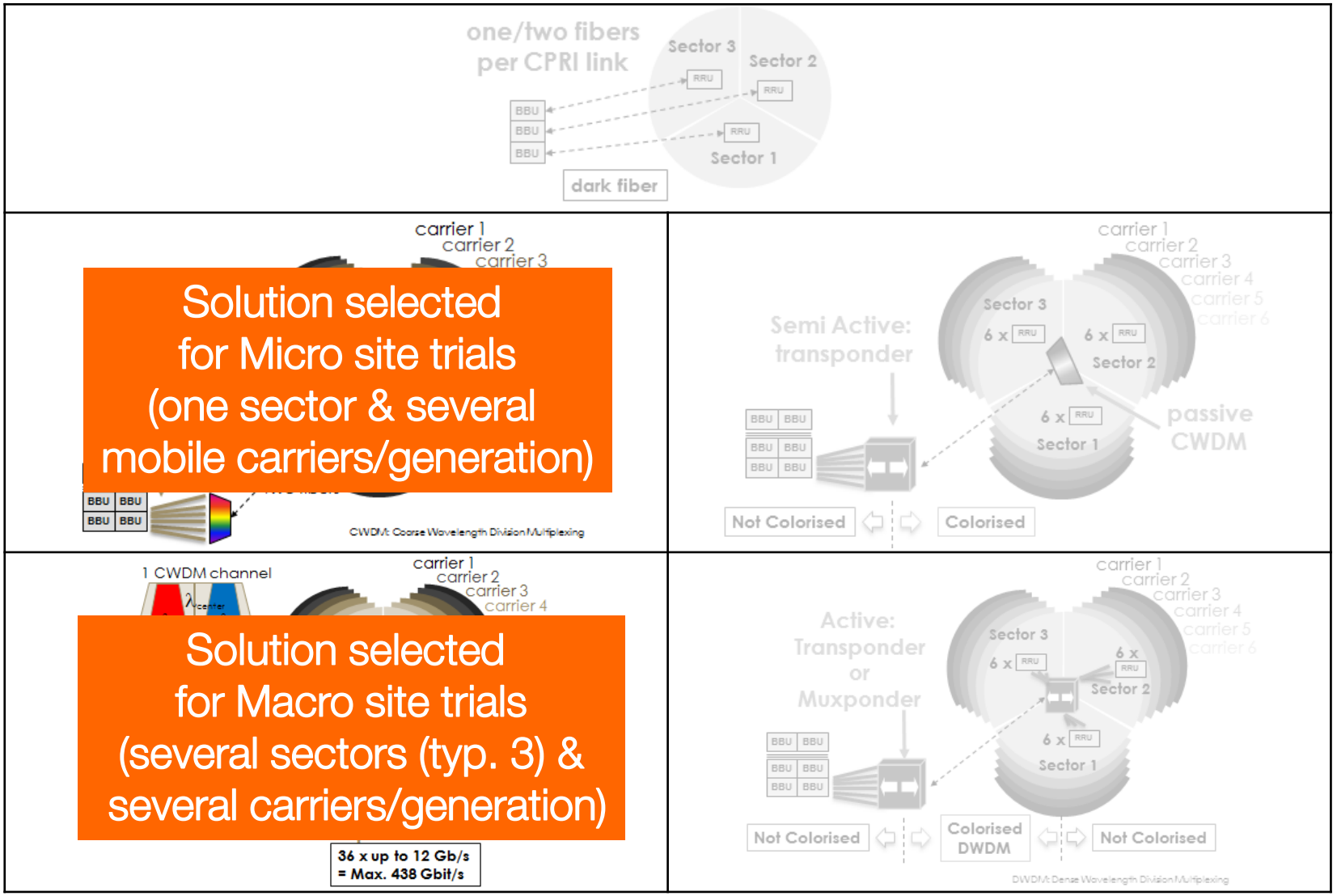


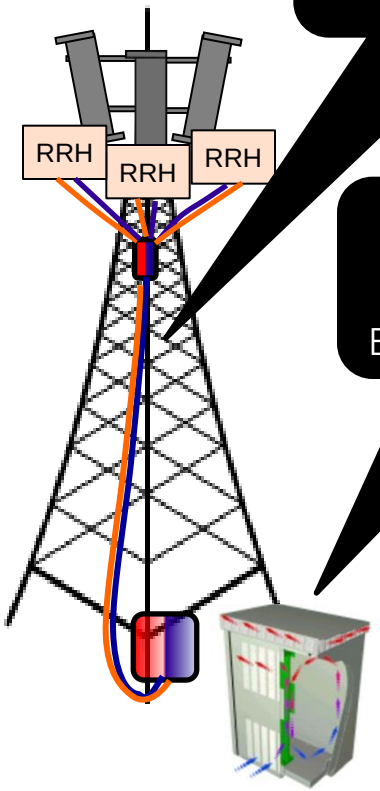
What is a passive optical fronthaul solution?

FTTA & PTTA
hybrid cable

BBU Hotel
Data center area
for a cells cluster

Backhaul

Hardware sharing



Low foot print
cabinet
Energy and passive fiber

Passive CWDM
MUX & DeMUX

BBU hotel
BBU 2G
BBU 3G
BBU 4G
interface fronthaul
interface backhaul

optical fiber

Radio configuration vs. fronthaul configuration

- **Micro** sites configuration (one sector)
  - 2G : 900 & 1800 MHz
  - 3G : 2100 & 900 MHz
  - 4G : 2600, 800, 1800 MHz
  - Total : maximum 7 CPRIs
  - Mux/DeMUX : 8 wavelength channels with two fibers
  - SFP : CWDM outdoor compatible CPRI3 (ready to CPRI5), two fibers
- **Macro** site configuration (three sectors or more)
  - three times more CPRI links :
    - Total : 21 CPRI links and 3 more with coming 700MHz
  - Mux/DeMUX : 16 wavelength channels with two fibers
  - SFP : CWDM outdoor compatible CPRI3 (ready also to CPRI5), single fiber working (SFW)
    - SFP SFW allows to support 32 links with 16 CWDM channel pairs

Contents

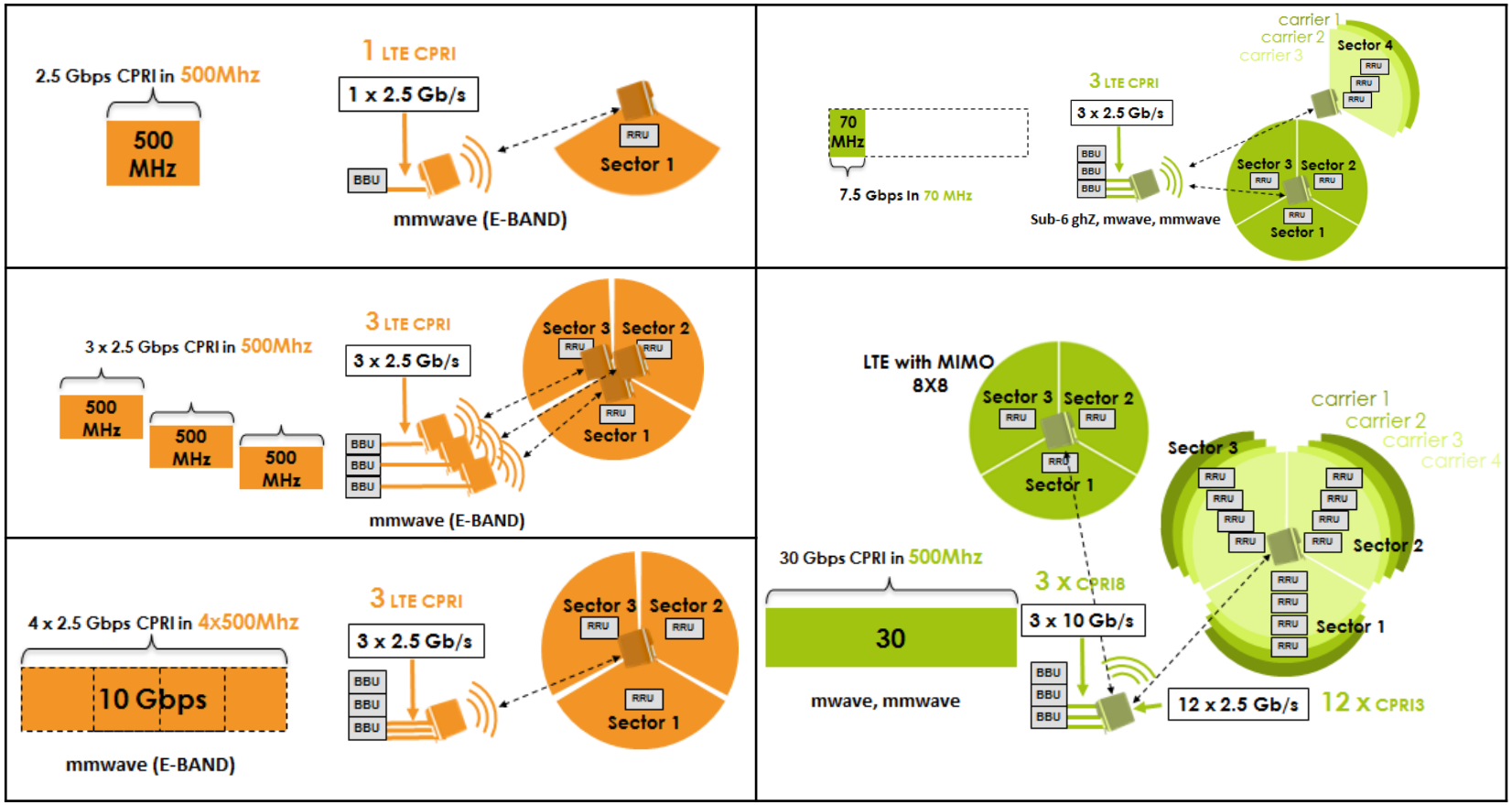
Wireless fronthaul (CPRI)

Native wireless

with spectral efficiency

From Small cell or 4th sector

to Macro cell



With wireless fronthaul, turn existing macro site into local C-RAN

Easier and faster deployment, same network architecture, better radio performance

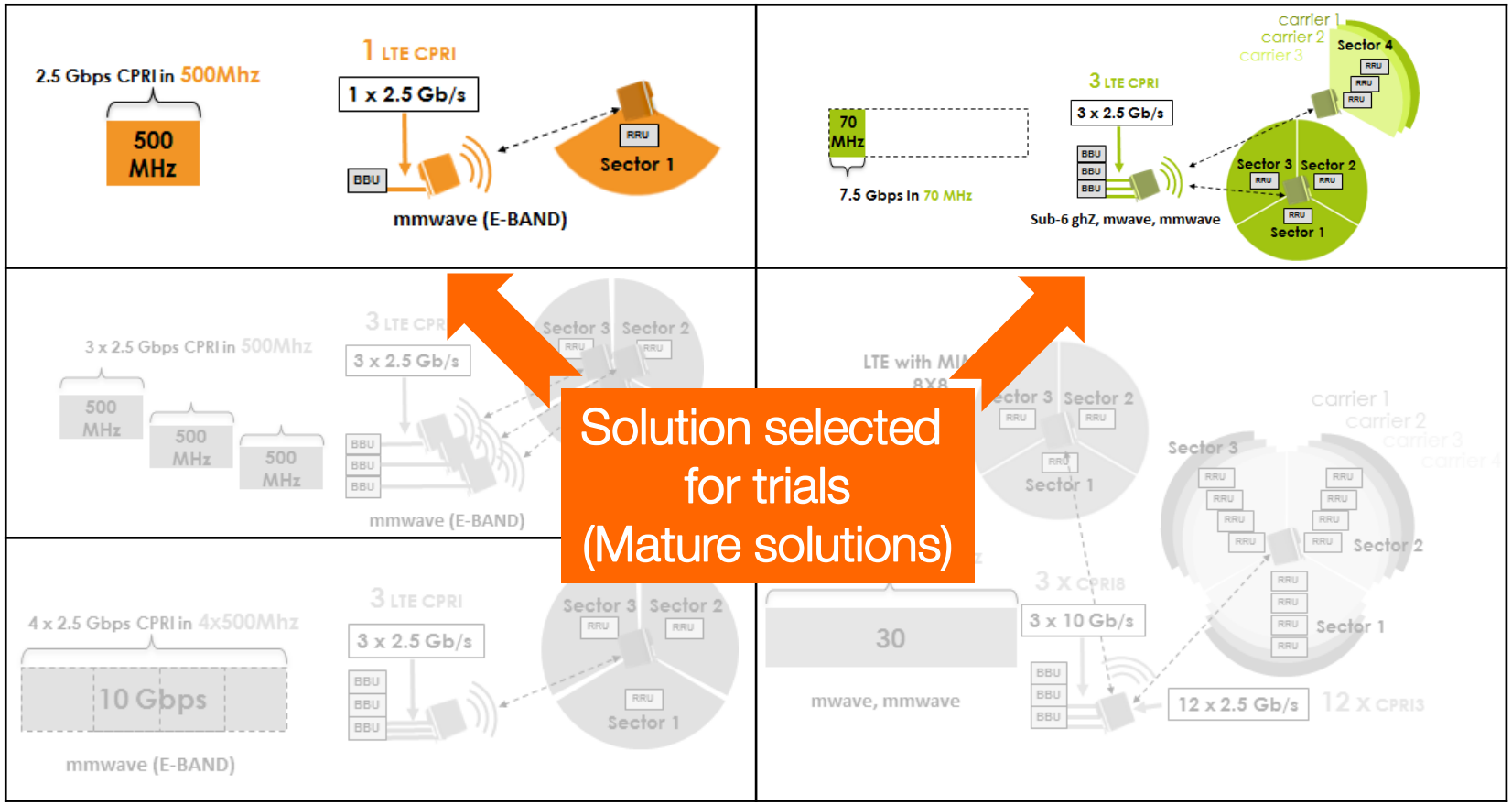
Wireless fronthaul (CPRI)

Native wireless

with spectral efficiency

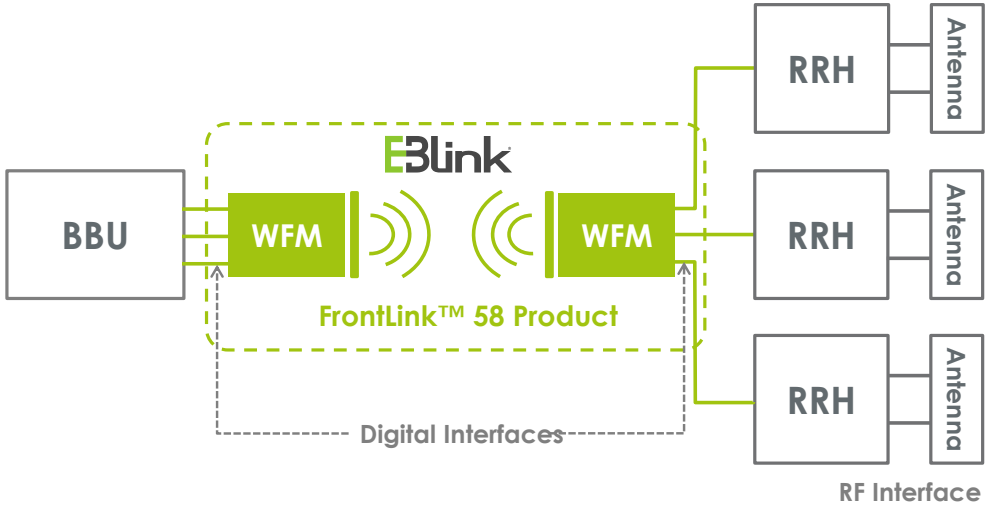
From Small cell or 4th sector

to Macro cell



Other country than France should have better business case for wireless fronthaul

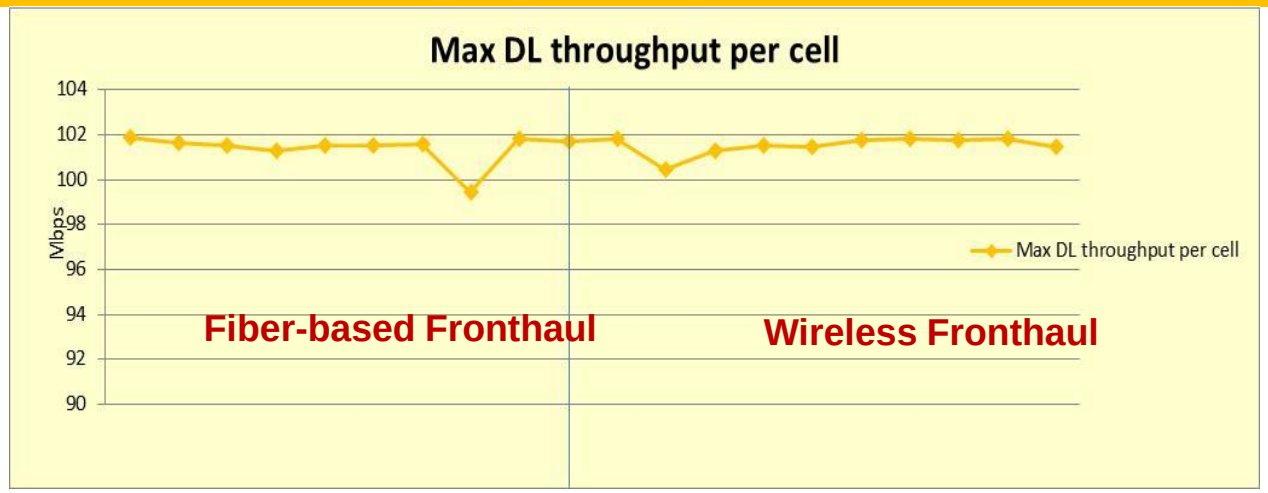
Wireless fronthaul: on Orange France network



Wireless fronthaul on Orange commercial network with FrontLink™ solution from EBlink

Three sectors LTE 2600 MIMO 2x2 → 3x2.457Gbit/s CPRI on a wireless fronthaul link

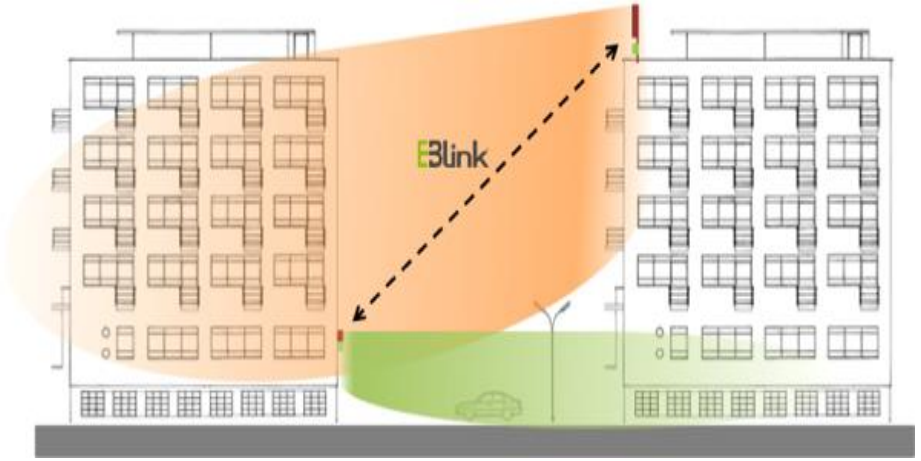
→ In less than 70 MHz bandwidth



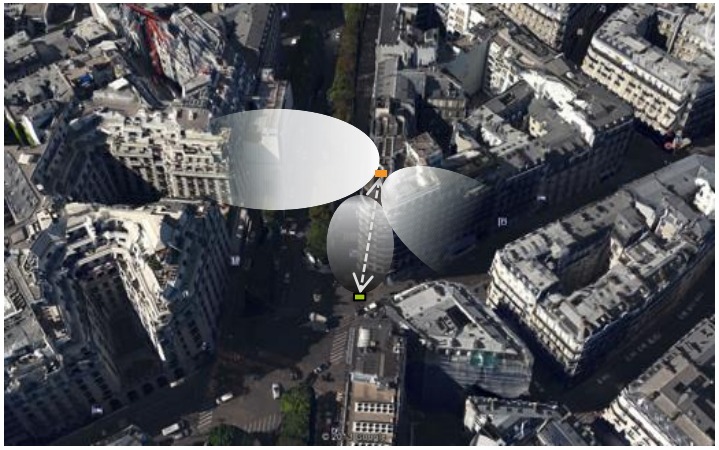
Some use cases of wireless fronthaul

Use Case :
Optimized coverage with a macro sector

Use Case :
Improved coverage in VIP zones / Indoors
Macro, Micro or Repetear



Use Case : Improved coverage in VIP zones / Indoors

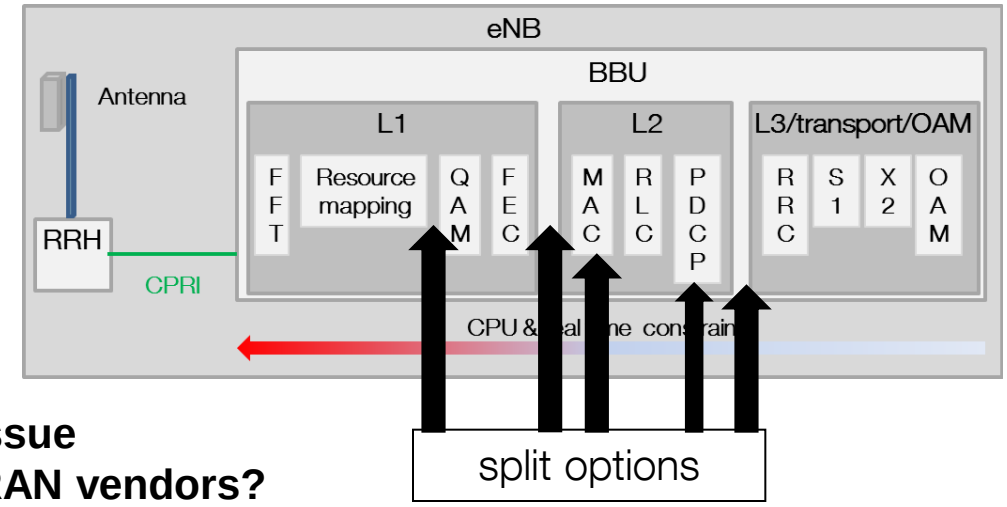


Conclusions and next steps (1/2)

C-RAN drivers and global perspective	- **Radio Site engineering solution & hardware sharing** - Radio performance improvements and future proof for LTE-A - Hybrid Fronthaul/Backhaul solution needed to address **HetNets** - C-RAN to co-exist with regular RAN architecture
Wireless Fronthaul	- Wireless fronthaul **commercially available today** for network densification and **local C-RAN** - Use of millimetric bands in future for **massive small cells**
Fiber Fronthaul	- **CWDM ready**: simple, passive, cost effective and future proof - **CWDM single fiber working:** increase fiber sharing and operational simplification - **Transponder** if wavelength management is an issue - Supervision and OAM of fronthaul by RAN
Fronthaul	- RAN OSS to support fronthaul link (Fiber and wireless)
CPRI redefinition if needed	- **CPRI transport: include natively the OAM of the medium** - **New functional split interface to reduce bandwidth?** - **Reference configuration including demarcation point** - **Sleep mode for energy efficiency?** - **Packetized fronthaul?** - **Why not Radio over Ethernet but do we want to include active transport equipment inside the RAN BBU-RRH links?**

Conclusions and next steps (2/2)

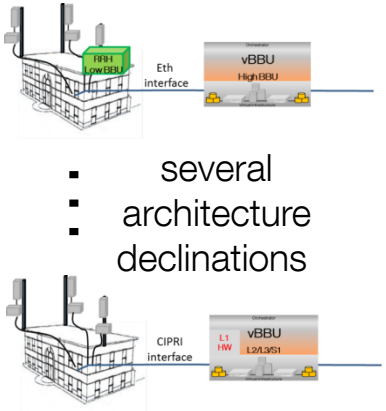
New functional split



- **Multi-criteria issue**
- **One split per RAN vendors?**
- **No consensus between RAN vendors and SDO**
- **The existing CPRI is slightly vendor dependent but constant transport requirement**

Architectures

- **New functional splits could introduce several transport networks architectures**
- **Re-used existing backhaul equipment (switch, router,…) is not obvious**
- **Several QoS need to be manage**
- **Operators needs a simple and single (compatible with all RAN vendors) fronthaul architecture**



Acknowledgements:

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감사합니다
ありがとうございました