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Connectivity in 2018
Fronthaul and Backhaul Challenges for 5G

Germany Connect Conference
Frankfurt –January 2016

Dr. Xavier Costa Perez

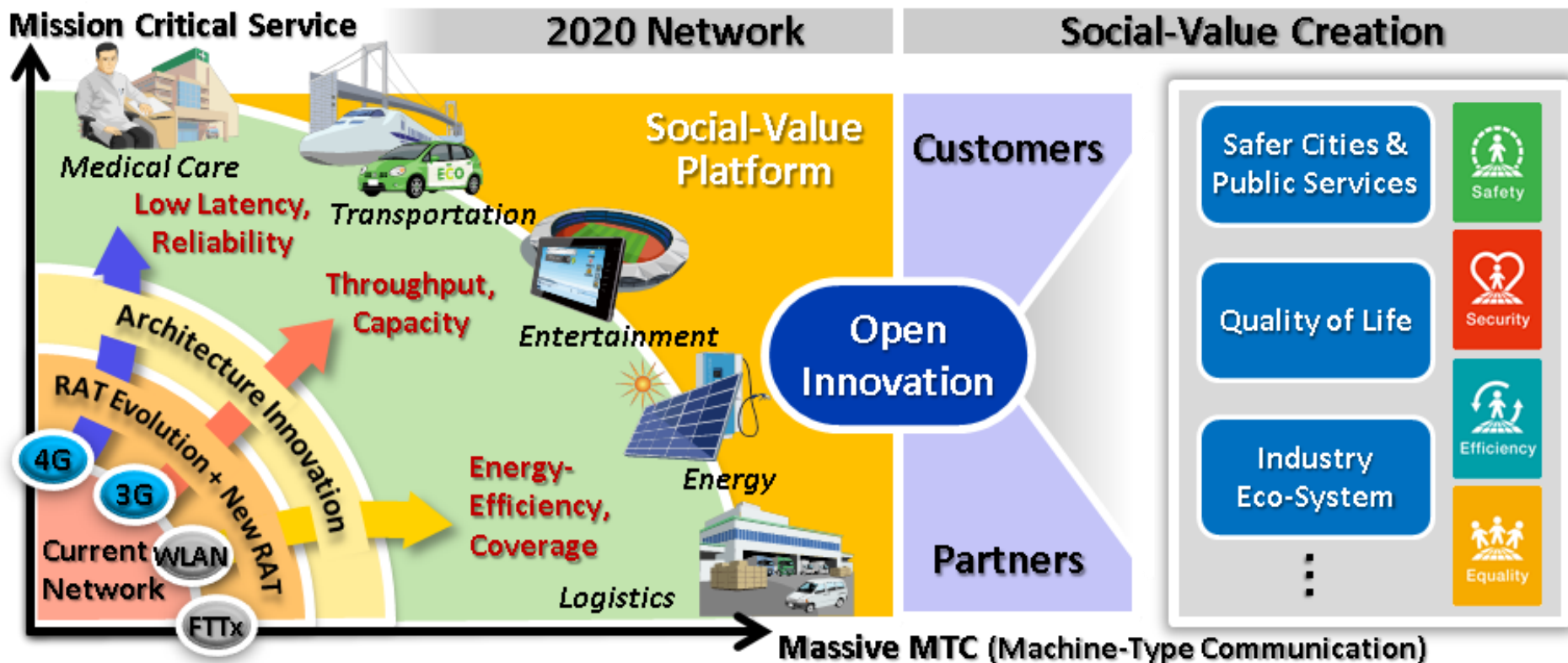Head of 5G Networks R&D

5G-Crosshaul Project Technical Manager (5GPPP)

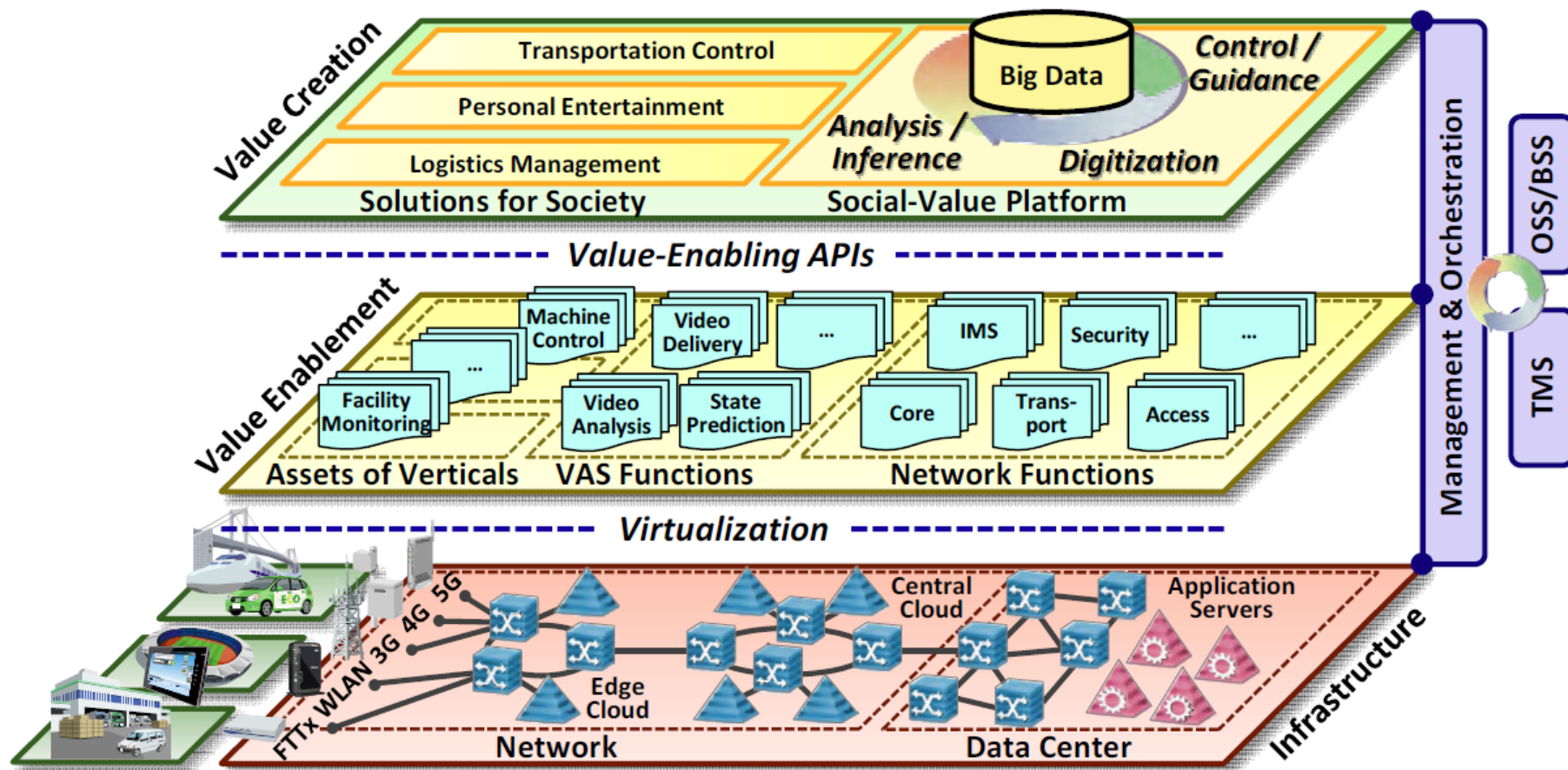**NEC Laboratories Europe**

**Heidelberg, Germany**

NEC's 5G Architecture

Network platform that fulfils the requirements for 2020 network

▎ High flexibility and rich functional. based on advanced network virtualization & programmability

▎ Independency between HW and SW that enables high expandability of the network functions

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Fronthaul Challenges towards 5G

Fronthaul is a major challenge for C-RAN deployment

中国移动
China Mobile
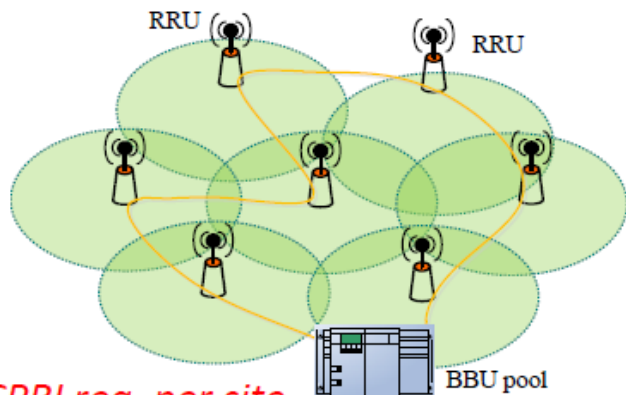
CPRI req. per site

Challenge by fronthaul b/w BBU and RRU
- Data rate b/w BBU and RRU using CPRI is **as high as 9.83Gbps** for 8-antenna TD-LTE, requiring **4** fibers for each carrier with 6G SFP
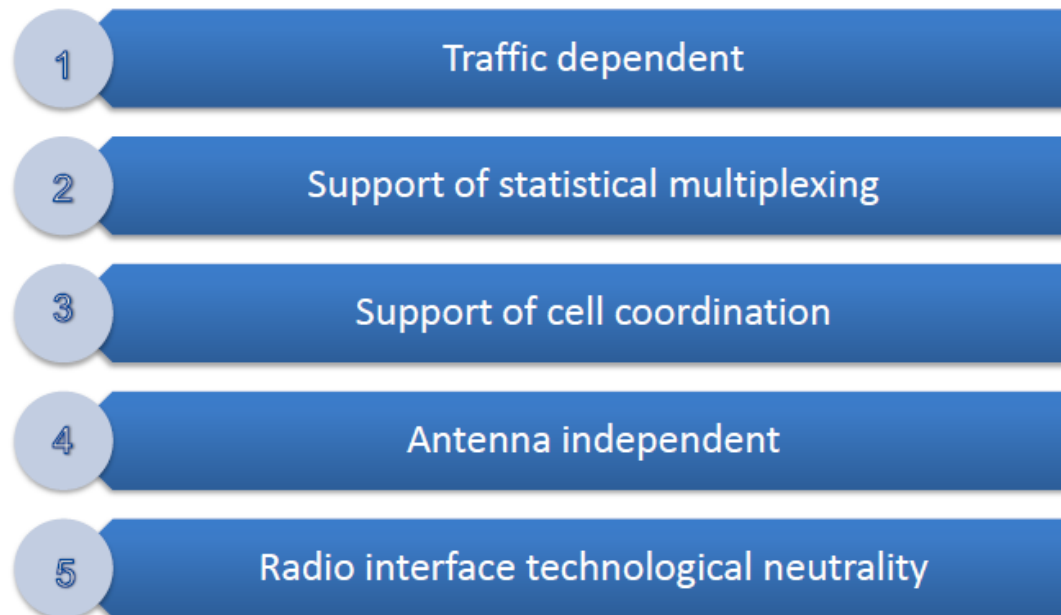
	Typical configuration	# of carriers	CPRI data rate per carrier	Total CPRI data rate before compression
GSM	3 RRU, S6/6/6	36	40Mbps	1.44Gbps
TD-S	3 RRU, S3/3/3	9	300Mbps	2.7Gbps
Current TD-LTE	3 RRU, S1/1/1	3	10Gbps	30Gbps
Medium term TD-LTE	S2/2/2	6	10Gbps	60Gbps
In addition, CPRI has critical requirements on synchronization and latency.				

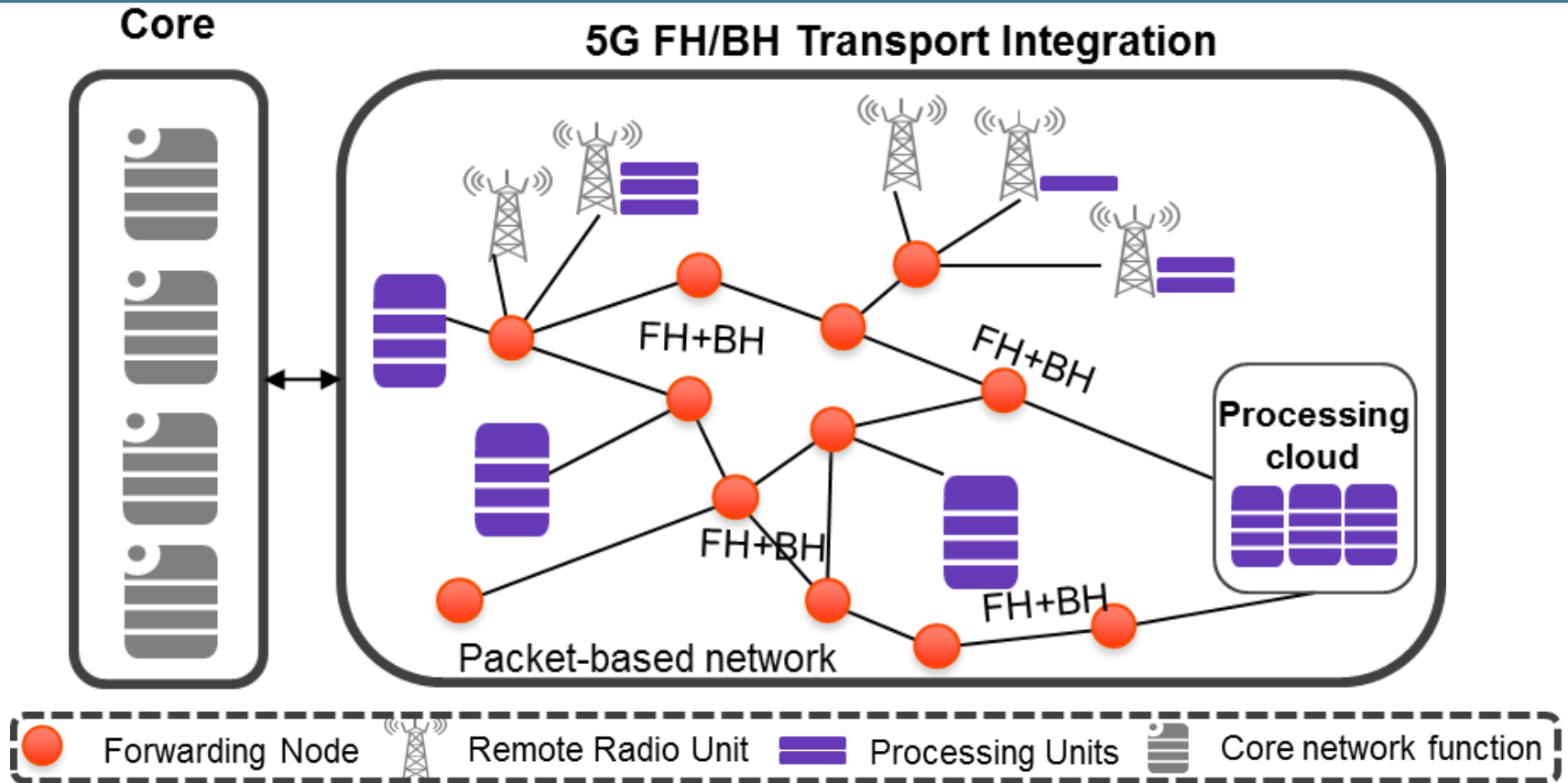Efficient fronthaul solution is required to enable C-RAN large-scale deployment

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Fronthaul Challenges towards 5G

Next Generation Fronthaul Interface (NGFI) for 5G

中国移动 China Mobile

1. Traffic dependent
2. Support of statistical multiplexing
3. Support of cell coordination
4. Antenna independent
5. Radio interface technological neutrality

- The key to achieve FH interface redesign lies in the function re-split b/w BBU and RRU
- The new NGFI will further lead to re-design of underlined transport networks with packet switching capability

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Integrating Fronthaul & Backhaul Transport in 5G Networks

Core

5G FH/BH Transport Integration

FH+BH

FH+BH

Processing cloud

FH+BH

FH+BH

Packet-based network

Legend:
- ● Forwarding Node
- Remote Radio Unit
- Processing Units
- Core network function

5G Mobile Transport Network

5G C-RAN will be transformed to a packet-based network (e.g. NGFI/IEEE 1904)

FH and BH will converge to an integrated transport network:

- BW usage dependent on user's load
  - Higher efficiency
- Enables path diversity – Packet-based Routing
  - Higher fault tolerance/Load balancing

- Unified management platform (FH + BH)
  - Lower management complexity and cost
- C-RAN Functional split and placement
  - Variable – Support of different functional splits
  - Dynamic – NFV-based 5G networks

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The 5G Integrated Fronthaul/Backhaul Tranport Network

▌EU 5GPPP Project

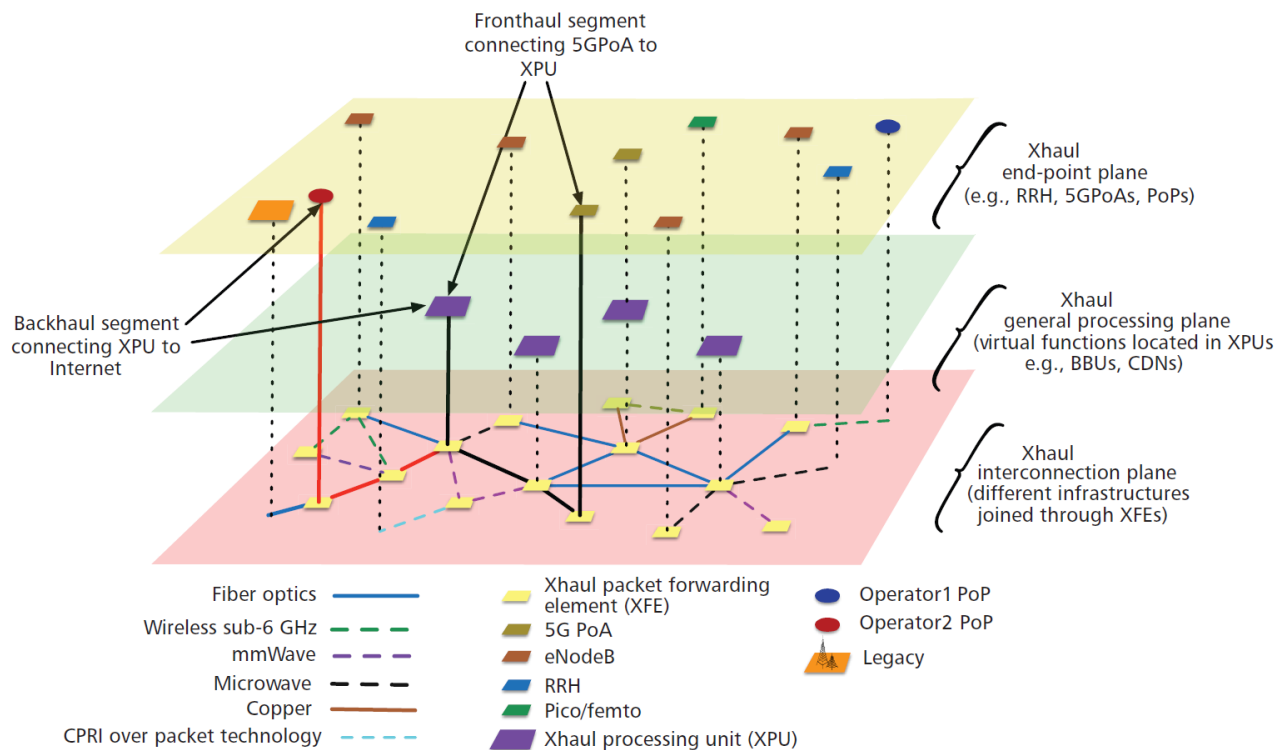▌Website: www.5g-crosshaul.eu

▌Project overview: 'Xhaul: Toward an integrated fronthaul backhaul architecture in 5G networks', IEEE Wireless Communications Magazine, Oct 2015 - link

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5G-Crosshaul Overview

Fronthaul segment connecting 5GPoA to XPU

Backhaul segment connecting XPU to Internet

Xhaul end-point plane (e.g., RRH, 5GPoAs, PoPs)

Xhaul general processing plane (virtual functions located in XPUs e.g., BBUs, CDNs)

Xhaul interconnection plane (different infrastructures joined through XFEs)

Fiber optics
Wireless sub-6 GHz
mmWave
Microwave
Copper
CPRI over packet technology

Xhaul packet forwarding element (XFE)
5G PoA
eNodeB
RRH
Pico/femto
Xhaul processing unit (XPU)

Operator1 PoP
Operator2 PoP
Legacy

Project Consortium

Operators

Orange, Telefonica, Telecom Italia

Vendors

ATOS, Ericsson, Interdigital, NEC, Nokia

Broadcaster/ Tech. Provider

Visiona, Telnet

SMEs

Eblink, Nextworks, CND,

R&D Centers

Create-net, CTTC, Fraunhofer HHI, ITRI

Universities

Univ. Carlos III, Univ. Lund, Pol.Torino

PM – Arturo Azcorra (UC3M)

TM - Xavier Costa (NEC)

R&D Areas

▌ Unified control plane for fronthaul/backhaul SDN/NFV-based (XCI)

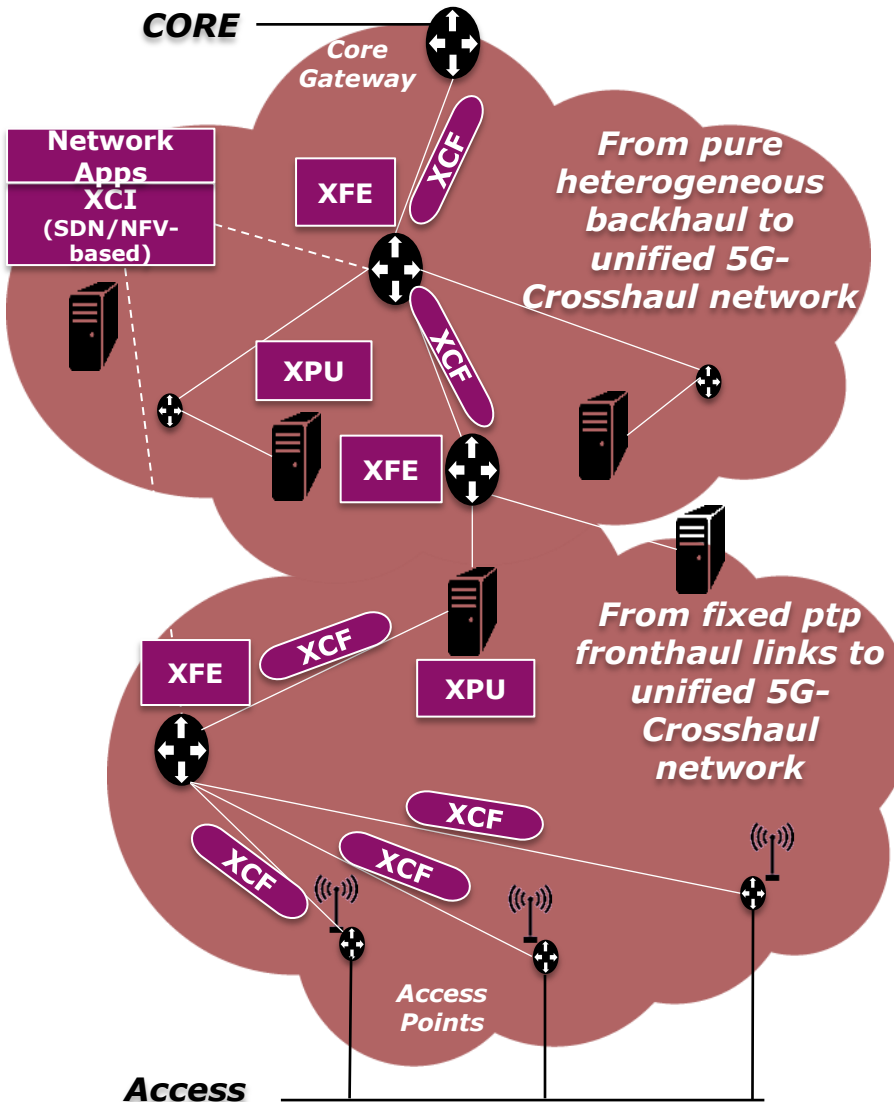▌ Unified data plane for fronthaul/backhaul technologies (XCF, XFE)

▌ 5G-enabling transm. techs, e.g., mmWave, uWave, optical and copper

▌ UCs: Dense Urban Society, Multi-Tenancy, Media Distr, MEC, Vehicular

▌ 5G-Crosshaul demonstration testbeds in Berlin, Madrid, Barcelona, Taiwan
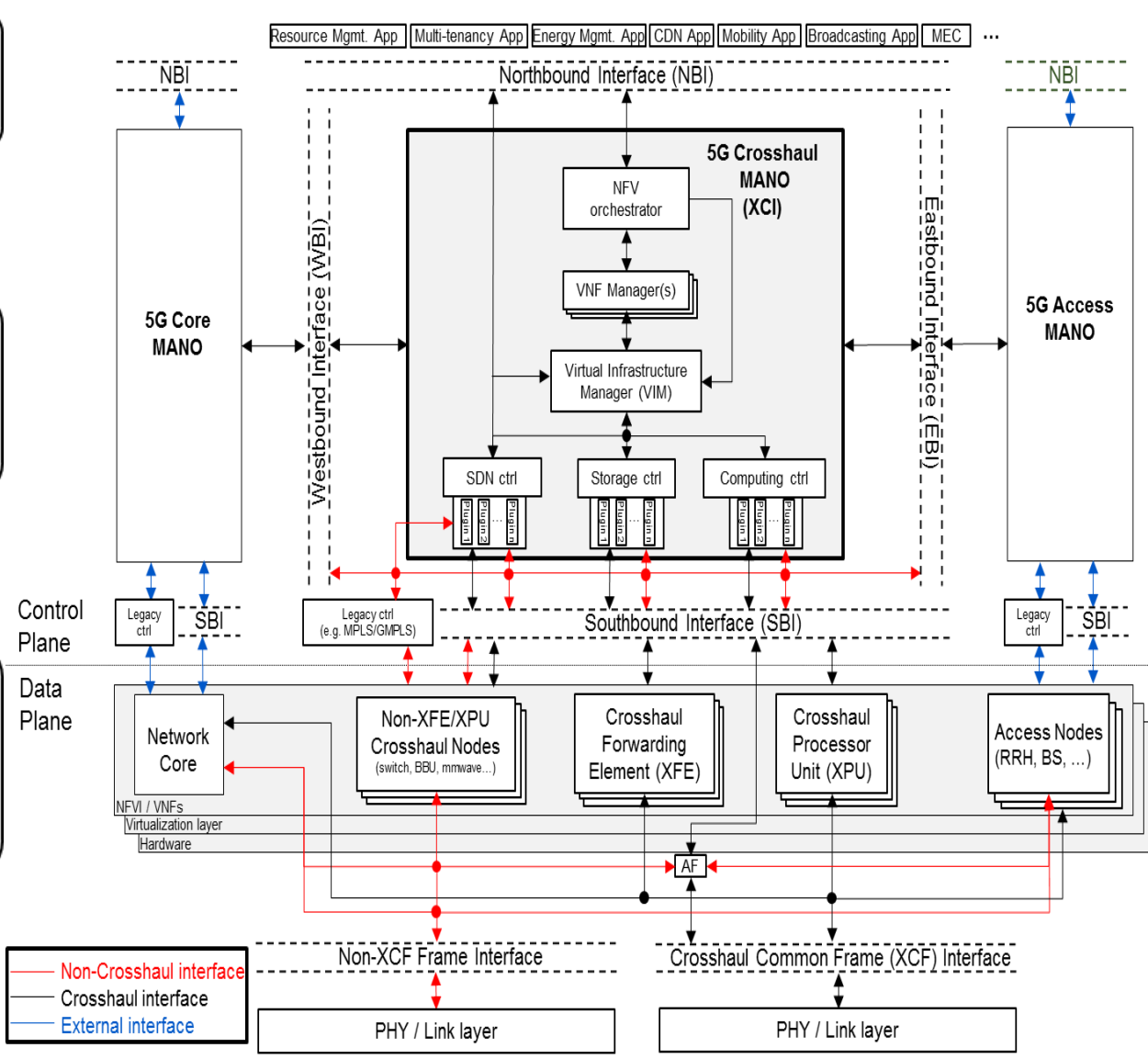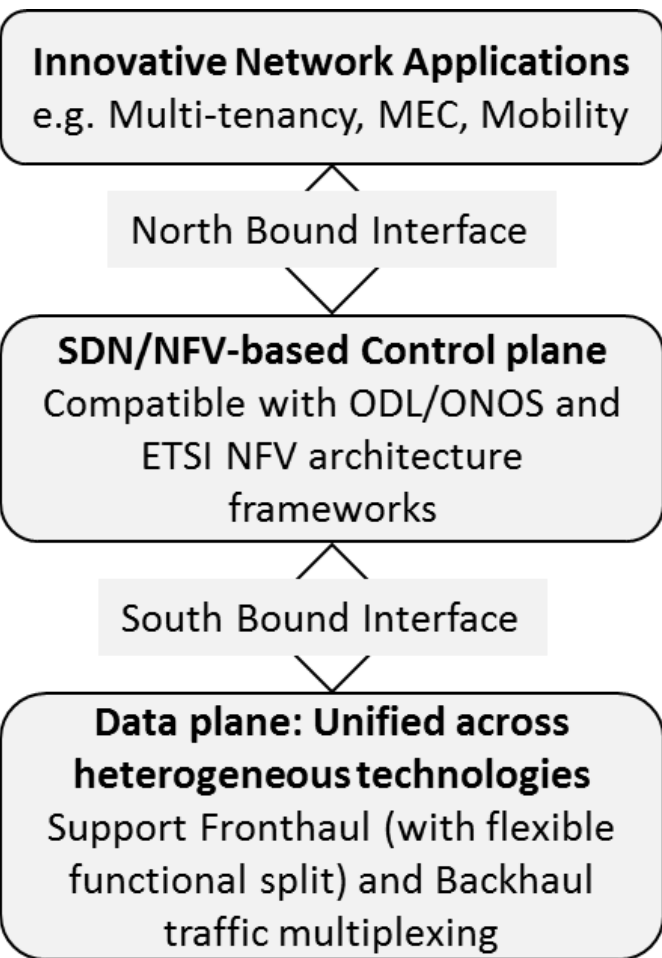
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A holistic approach for converged Fronthaul and Backhaul under common SDN/NFV-based control, capable of supporting new 5G RAN architectures (vRAN) and performance requirements

Main building blocks

- **XCF – Common Frame** capable of transporting the mixture of various Fronthaul and backhaul traffic

- **XFE – Forwarding Element** for forwarding the Crosshaul traffic in the XCF format under the XCI control

- **XPU – Processing Unit** for executing virtualized network functions and/or centralized access protocol functions (vRAN)

- **XCI – Control Infrastructure** that is SDN-based and NFV-enabled for executing the orchestrator's resource allocation decisions

- **Novel network apps** on top to achieve certain KPIs or services

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