

# **Standardization Roadmap for the 5G Integrated Fronthaul and Backhaul**

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# Outline



- Part 1: Setting the scene – The fronthaul and backhaul in the 5G picture
- Part 2: Introducing 5G-Crosshaul – The 5G integrated Fronthaul/Backhaul
- Part 3: Standardization Roadmap – as captured so far by the 5G-Crosshaul



# Part 1: Setting the scene

## *The fronthaul and backhaul in the 5G picture*

# 5G-PPP Vision and KPIs



5G X Crosshaul

- Vision: A **unified programmable and shareable** infrastructure that can deliver **flexibly, speedily and efficiently all the 5G services** envisioned
- Key Performance Indicators (KPIs):



- 1,000 X in **mobile data volume** per geographical area reaching a target  $\geq 10$  Tb/s/km<sup>2</sup>
- 1,000 X in **number of connected devices** reaching a density  $\geq 1$ M terminals/km<sup>2</sup>



- 100 X in **user data rate** reaching a peak terminal data rate  $\geq 10$ Gb/s
- 1/10 X in **energy consumption** compared to 2010
- 1/5 X in **end-to-end latency** reaching 5 ms for e.g. tactile Internet and radio link latency reaching a target  $\leq 1$  ms for e.g. Vehicle to Vehicle communication
- 1/5 X in network management **OPEX**
- 1/1,000 X in **service deployment time** reaching a complete deployment in  $\leq 90$  minutes



# Mapping the 5G KPIs on the backhaul



5G Crosshaul

Capacity/  
Data rate

Need bigger pipes (Gbps optical and wireless) and ways to offload traffic to the edge where possible

Latency

Need fast and resilient forwarding, intelligent leveraging of edge infrastructure

Cost

Use less fibers (e.g. DWDM and/or wireless), away from specialized switching HW (embrace NFV), unify the management, use standardized OAM

Flexibility

Make it softwarized, bring SDN, make it virtualized, bring NFV, embrace the cloud

Efficiency

Enable access-aware resource optimization, switch on/off cells, support cooperative schemes

# Mapping the 5G KPIs on the fronthaul



5G X Crosshaul

Capacity/  
Data rate

Ways to reduce required fronthaul capacity, apply compression or consider new functional splits

Latency

Need fast and resilient (time sensitive) fronthaul networking, an intelligent use of the edge

Cost

Need to lower dependency on fiber and proprietary CPRI, use Ethernet-based where possible, use standardized OAM for fronthaul switches

Flexibility

Make it softwarized, bring SDN, support centralized and distributed clouds

Efficiency

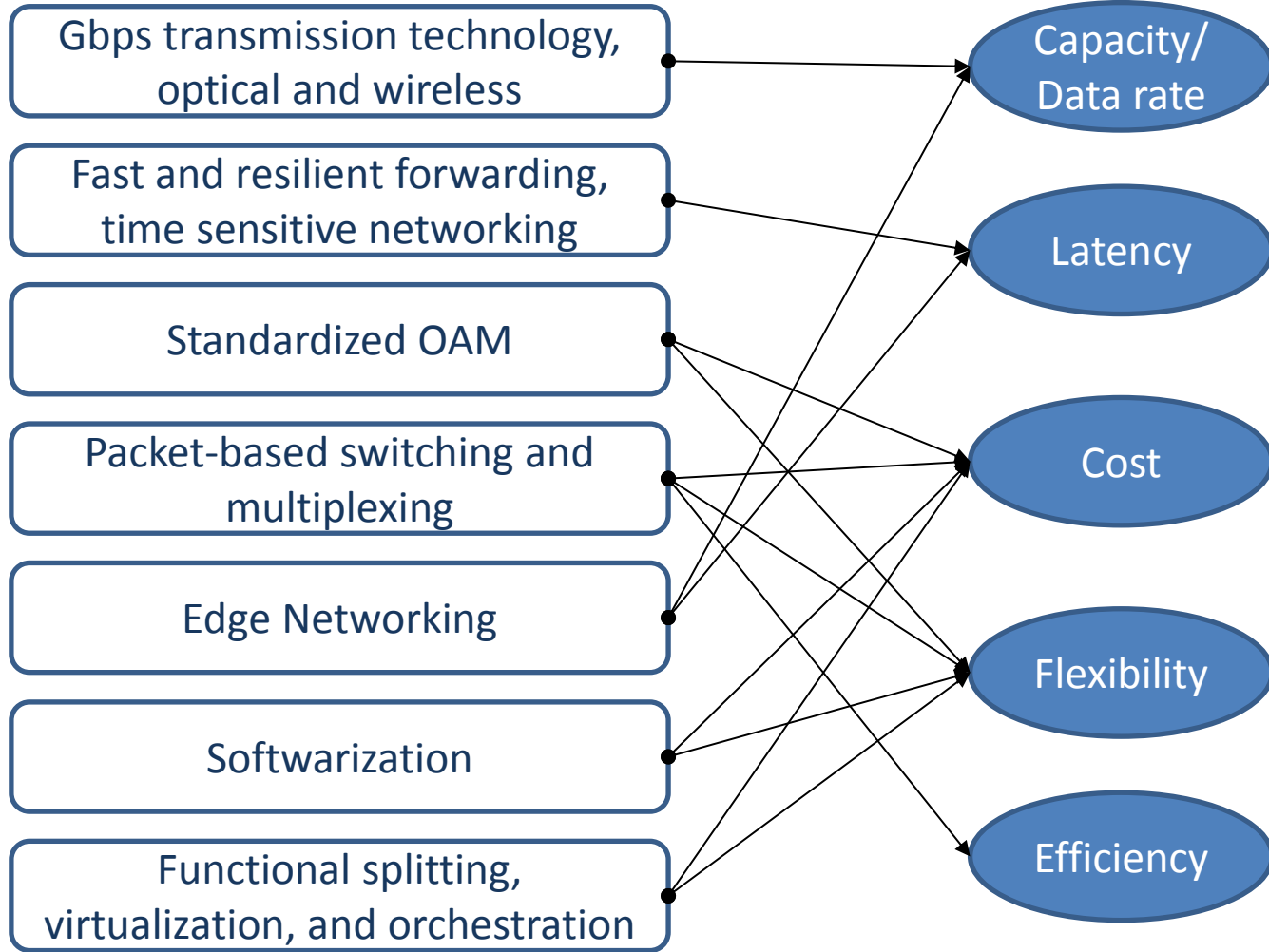
Move from dedicated CBR CPRI links to more shareable fronthaul networking (statistical mux)

# Enablers for 5G integrated FH and BH



5G X Crosshaul

## 5G integrated fronthaul and backhaul



# Part 2: Introducing 5G-Crosshaul

## *The 5G integrated fronthaul and backhaul*



# 5G-Crosshaul Project Elevator Pitch



5G X Crosshaul

**Unifying** the transport of existing and new **fronthaul and backhaul** traffic into a **5G crosshaul SDN/NFV-based** packet switching network, that supports **5G RAN architectures and KPIs**

*A high capacity low latency transport solution that lowers costs and guarantees flexibility and scalability*

The target for this tech: Telcos & Switch Vendors

# 5G-Crosshaul solution building blocks

A holistic approach for converged Fronthaul and Backhaul under common SDN/NFV-based control, capable of supporting new 5G RAN architectures (V-RAN) and performance requirements

## Main building blocks

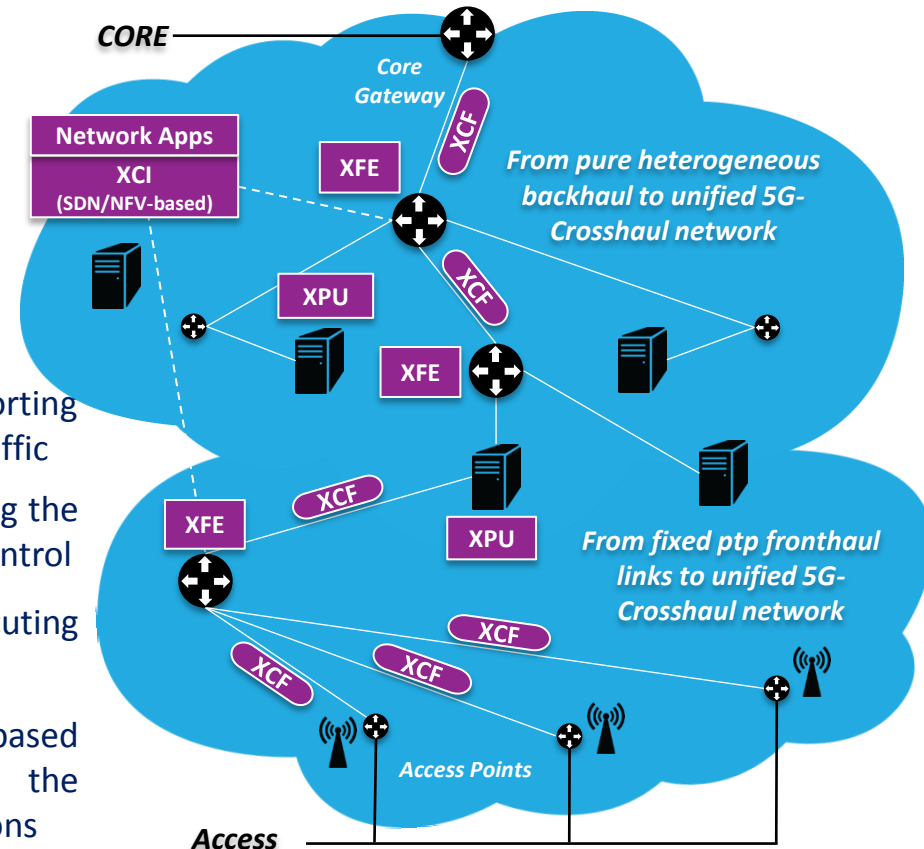
**XCF – Common Frame** capable of transporting the mixture of Fronthaul and backhaul traffic

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

**XPU – Processing Unit** for executing virtualized network functions (V-RAN)

**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



# Consortium and Project Traction



5G X Crosshaul

## Partners (21)

**Atos** **NEC** **NOKIA** **INTERDIGITAL EUROPE**

**NEXTWORKS** ENGINEERING FORWARD **Eblink** **TELECOM ITALIA**

**core network dynamics** **TELNET** **Telefonica**  
Redes Inteligentes **Telefonica I + D**

**10 years CREATE-NET** **Fraunhofer** **VISIONI**  
Heinrich Hertz Institute

**CTTC** **ITRI** **ERICSSON**  
Industrial Technology Research Institute



**Project Duration**  
Jul 2015 – Dec 2017

**EU Funding**  
7.95mio Euros

**Project Traction**

- Baseline architecture
- Common Frame Format
- First trials in Sep'16

[www.5g-crosshaul.eu](http://www.5g-crosshaul.eu)



# Part 3: Standardization Roadmap

## *As captured by 5G-Crosshaul*



# Standardization Roadmap (1/3)



- Use cases, gaps, requirements, architectures
  - NGMN, ITU-T 2020 FG, ITU-R WP5D, 3GPP, BBF, SCF
- Gbps transmission technology (wired/wireless)
  - Wired: ITU-T SG1x, GPON, FSAN, 100GE, CPRI
  - Wireless: ETSI mWT, IEEE 802.11ay
- Wireless access protocol functional splits
  - 3GPP, IEEE 802.11, SCF
- FH/BH traffic packetization (formatting)
  - Fronthaul: CPRI, NGFI (IEEE 1914.1 << 1904.3)
  - Backhaul: VLAN (IEEE 802.1Q), MPLS

# Standardization Roadmap (2/3)



- FH/BH traffic forwarding (switching protocols)
  - IEEE 802.1CM (Time Sensitive Networking), IETF DETNET (Deterministic Networking)
- SDN control
  - ONF (OpenFlow), OpenDayLight, ONOS, IRTF SDNRG, ITU-T SG1?
- NFV-based management and orchestration
  - ETSI NFV, OPNFV, IRTF NFVRG
- Network applications and APIs
  - OMA, ETSI MEC

# Standardization roadmap (3/3)



5GXCrosshaul

2016	2017	2018	2019	2020
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Identification of gaps, use cases, functional split profiles, initial requirements and architectures: **ITU-R/T, 3GPP, IEEE, NGMN, BBF, SCF**

Specification of Gbps transmission technologies (wired and wireless) supporting 5G traffic: **ETSI mWT, IEEE 802.11, XG Ethernet**

Specification of transport formats and forwarding protocols suitable for the envisioned traffic profiles: **IEEE 1914, CPRI, IEEE 802.1CM, IETF DETNET**

Extensions of SDN control framework (procedures, interfaces) for the support of mobile FH/BH: **ONF, ODL, ONOS, IRTF SDN**

Extensions for flexible support of distributed/centralized clouds: **ETSI ?**

Extensions for interworking with other domains: core and access: **3GPP?**

APIs for the support of various transport network applications: **OMA? ETSI?**



<http://5g-ppp.eu>



**Thank you for your attention!**

5G Infrastructure PPP

The European path towards global next generation communication networks

