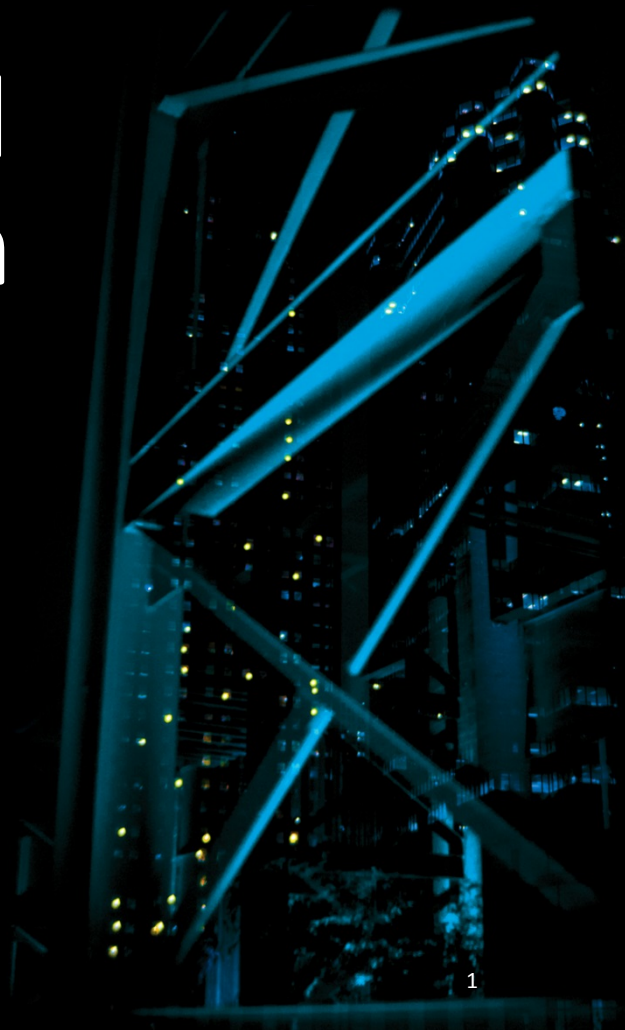
5G Roadmap to backhaul and fronthaul integration and 2016 Trial plans

Alain Mourad and Bekay Lim

April 27, 2016
IWPC Workshop – 5G Trials and Initiatives towards 2020, Seoul, South Korea



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Motivation

- @High Level: An ambitious set of **5G KPIs** (e.g. capacity, latency, efficiency) to deliver at a time network operators are looking into ways to **reduce costs** (TCO) and **expand the service** offer!
- @Fronthaul: Evolve from today's CPRI or CPRI-like to less-stringent (in terms of capacity, latency, jitter and cost) and scalable solutions that can cope with the high (small cells) densification and (massive) MIMO technologies foreseen in 5G: **Access Virtualization through flexible functional split between the RU and DU.**
- @Backhaul: Evolve from today's cascade of increasingly heterogeneous and independently managed technologies to a truly integrated transport that is flexible to adapt to various 5G requirements (capacity, latency): **Technology-abstract joint orchestration over common SDN-based control.**

Project Elevator Pitch

5GXCrosshaul

Unifying the transport of existing and new **fronthaul and backhaul** traffic into a **common-haul SDN/NFV-based** packet switching network, that supports **5G RAN** performance targets at **reduced costs**

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

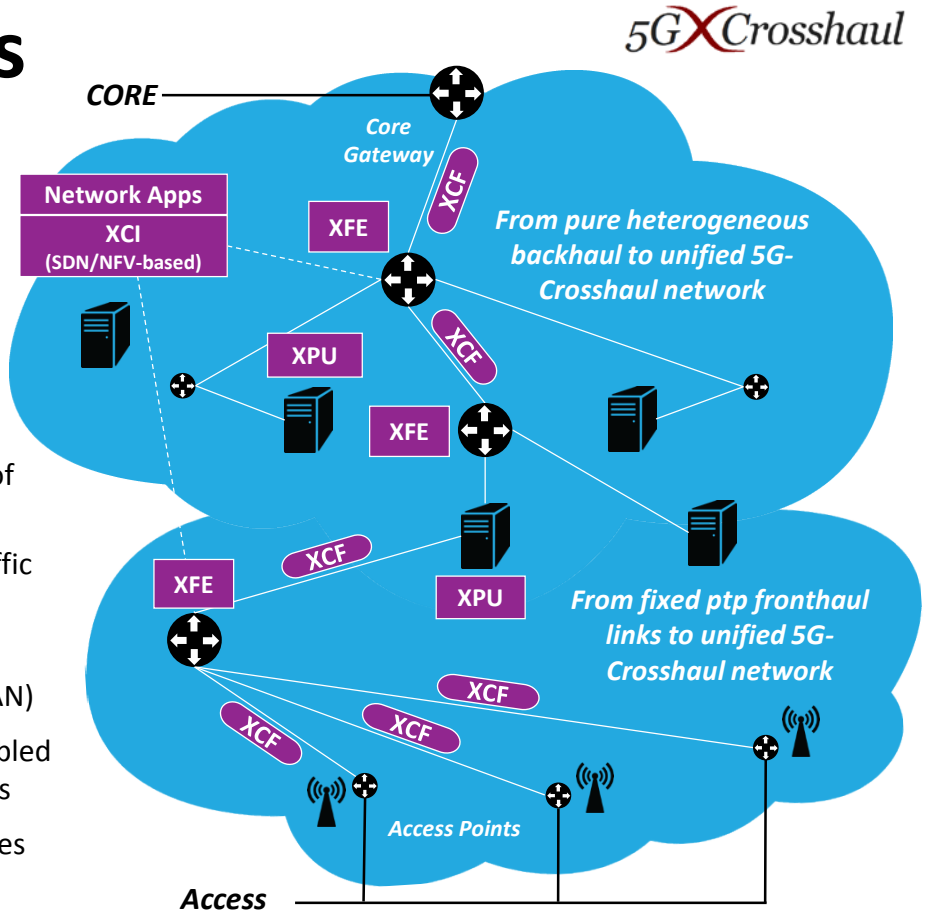
The target for this tech: Telcos & Switch Vendors

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 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 (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

5GXCrosshaul

Partners (21)

Atos, NEC, NOKIA, InterDigital Europe, Nextworks Engineering Forward, EBlink, Telecom Italia, cnd core network dynamics, Telnet Redes Inteligentes, Telefónica I+D, 10 years CREATE-NET, Fraunhofer Heinrich Hertz Institute, VISIONA, CTTC, ITRI Industrial Technology Research Institute, Ericsson, orange

Project Duration

Jul 2015 – Dec 2017

EU Funding

7.95mio Euros

Project Traction

Baseline architecture and Common Frame Format

www.5g-crosshaul.eu

InterDigital

Baseline Architecture

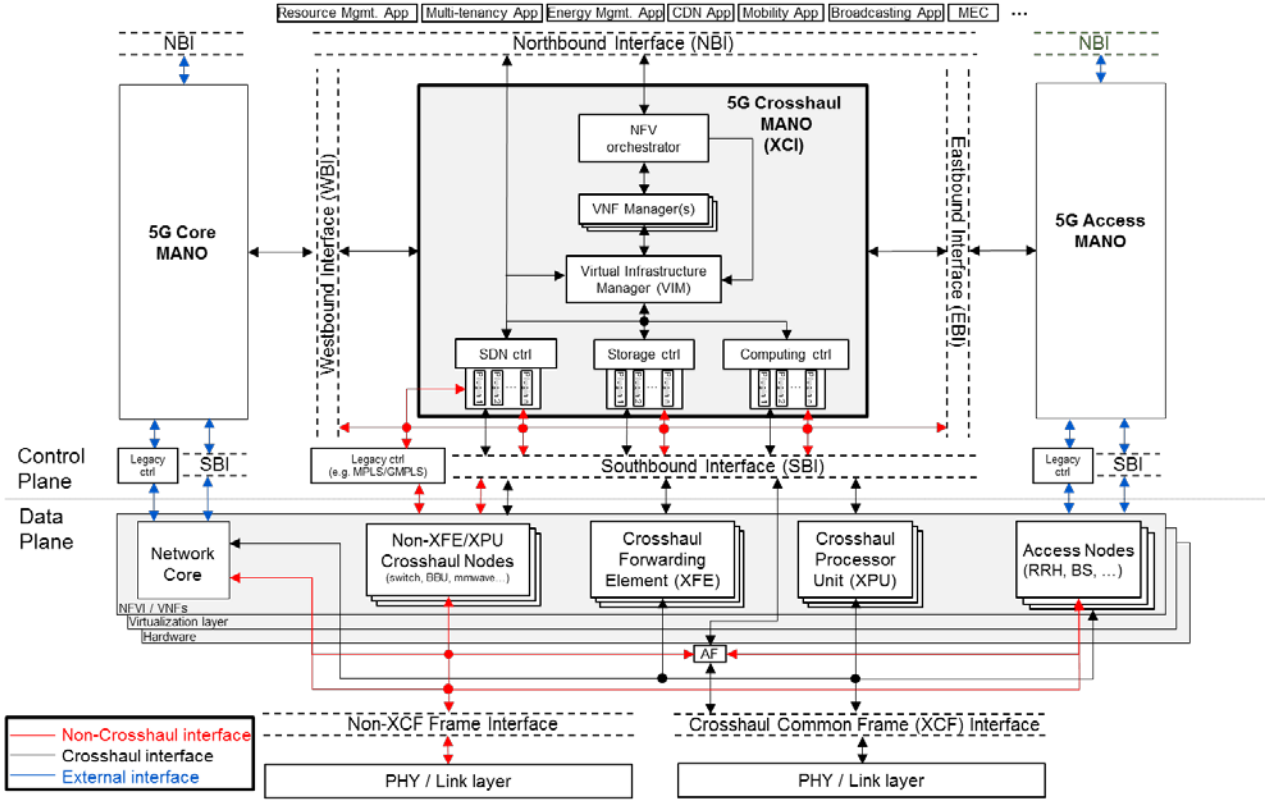
Innovative Network Applications
e.g. Multi-tenancy, MEC, Mobility

North Bound Interface

SDN/NFV-based Control plane
Compatible with ODL/ONOS and ETSI NFV architecture frameworks

South Bound Interface

Data plane: Unified across heteroegenous technologies
Support Fronthaul (with flexible functional split) and Backhaul traffic multiplexing



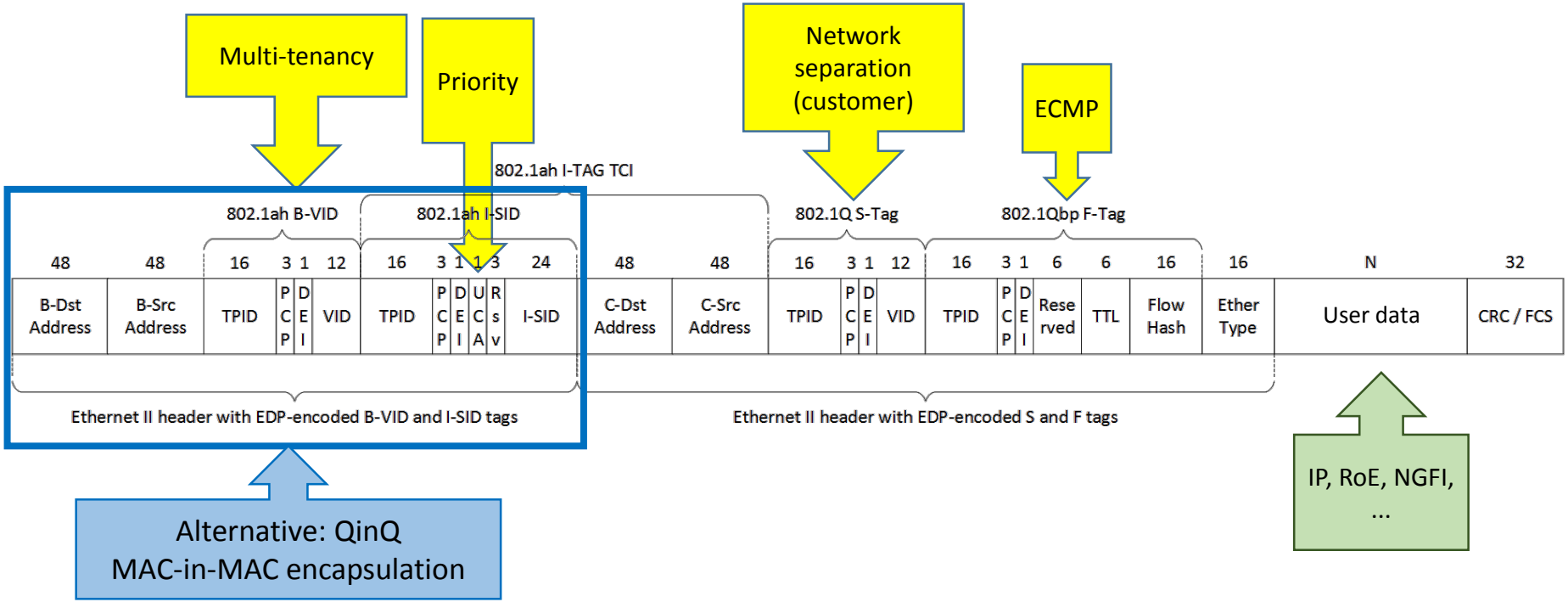
XCF Design Requirements

- Support multiple functional splits simultaneously
  - including Backhaul and CPRI-like Fronthaul
- Multi-tenancy
  - Isolate traffic (guaranteed QoS)
  - Separate traffic (tenant privacy)
  - Differentiation of forwarding behavior
  - Multiplexing gain
- Transport efficiency
  - Short overhead
  - Multi-path support
- In band control traffic (OAM info, …)
- Class of Service Differentiation
- Flow differentiation
- Energy usage proportional to handled traffic
  - Sleep mode, reduced rate, …
- Support of multiple data link technologies
  - IEEE 802.3, 802.11 (inc. mmWave), …
- Coexistence, Compatibility
  - Synchronisation: IEEE1588, IEEE802.1AS
  - Ethernet (same switching equipment, e.g. different ports, etc.)
  - Security support

XCF Baseline Format

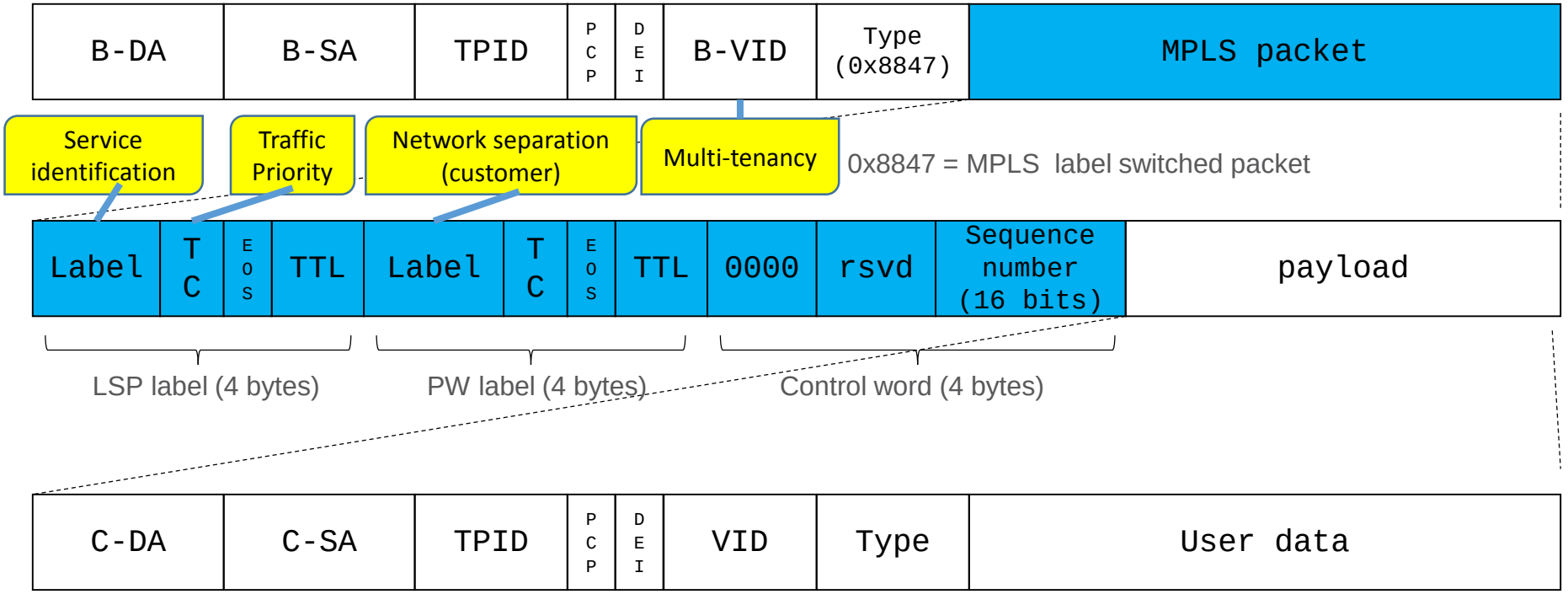
- Focus on Carrier grade Layer-2 switching for fronthaul and backhaul traffic
- Backwards compatibility with existing formats is prioritized
- Two existing formats are under consideration as XCF baseline templates:
  - Ethernet-based MAC-in-MAC (PBB-TE – Provider Backbone Bridge Traffic Engineering)
  - MPLS-TP (Transport Profile)
- **An instantiation of each of the above templates is under development to represent the XCF for enabling intelligent forwarding by new switches (XFE)**
  - Instantiation is developed through redefining some existing control information and eventually add new control information to optimize with the forwarding
- XCF design is planned for release in June 2016

MAC-in-MAC based XCF template



MPLS-TP based XCF template

Assuming Ethernet payload, and MPLS over Ethernet at the link layer



Summary and Next Steps

- 5G-Crosshaul project aims at **integrating Fronthaul and Backhaul** for envisioned **5G Virtualized RAN** architectures
- The integration is tackled in both the **control and data planes**
  - A common SDN/NFV-based control infrastructure (compatible with ODL/ONOS SDN and ETSI NFV architecture frameworks)
  - A unified data plane with common switching of FH and BH traffic across heterogeneous technologies
- The data plane focuses on **Carrier Grade Layer-2 packet switching (XCF)**
  - **Ethernet-based PBB-TE and MPLS-TP** as candidate **baseline templates** for support of legacy switches (backwards compatibility)
  - **New instantiation of the above templates for new switches (XFE)**
- **Standardization roadmaps** include relevant working groups in IEEE, ITU-T, 3GPP, IETF, ONF, and ETSI (amongst others)
- First **proof-of-concept demonstrations** are planned from Q2 2016