

# 5G-Crosshaul Project Overview

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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

**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*

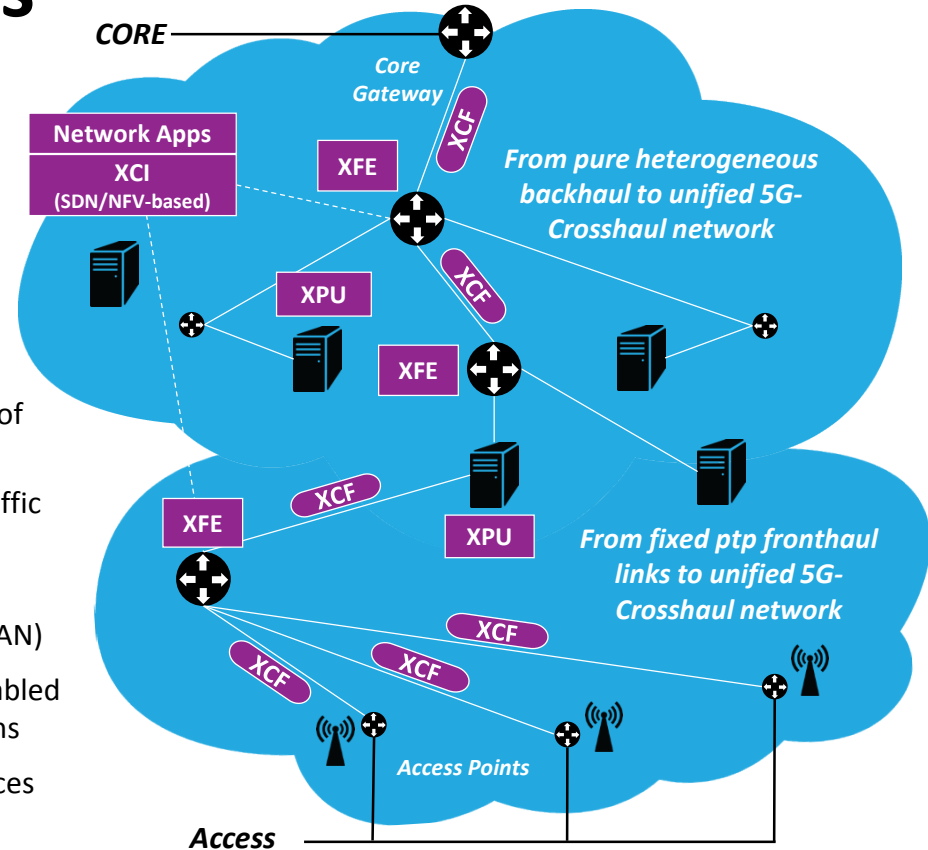
The target for this tech: Telcos & Switch Vendors

# 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

## Partners (21)



**Project Duration**  
Jul 2015 – Dec 2017

**EU Funding**  
7.95mio Euros

**Project Traction**  
Baseline architecture and  
Common Frame Format

# Baseline Architecture

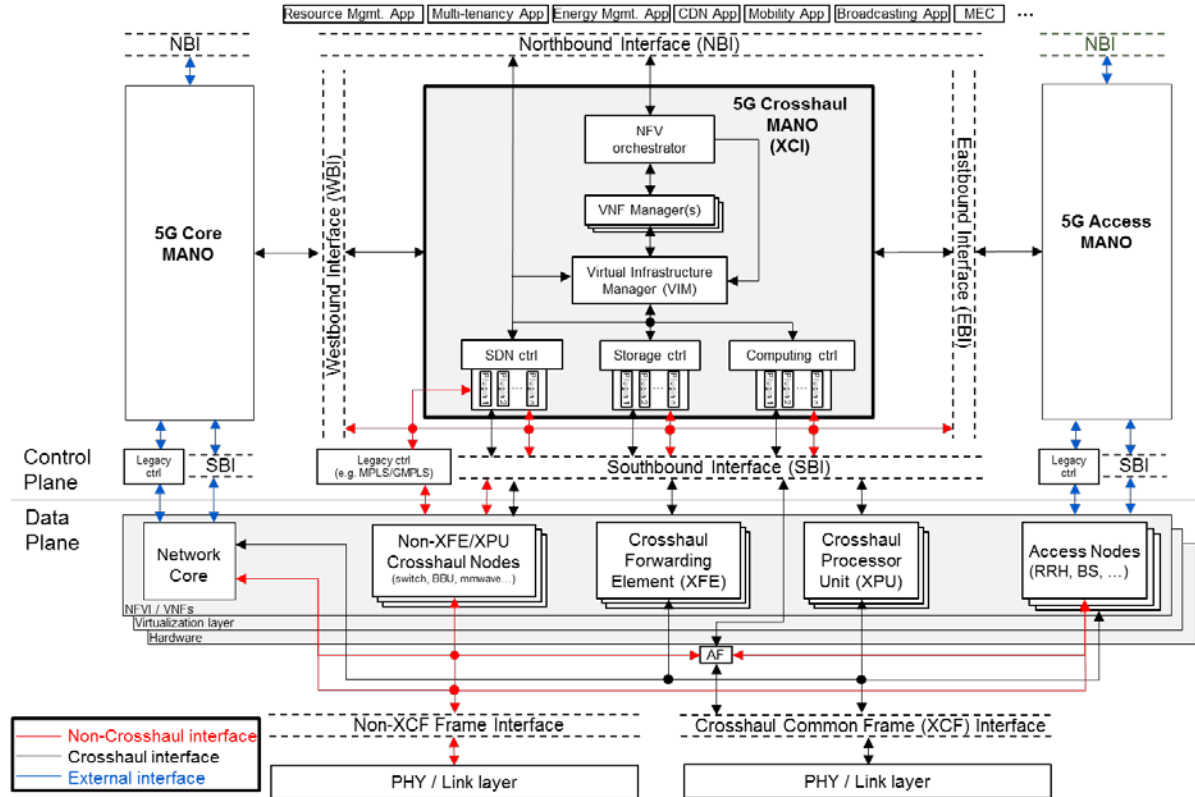
**Innovative Network Applications**  
e.g. Multi-tenancy, MEC, Mobility

North Bound Interface

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

South Bound Interface

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



# XCF Design Requirements

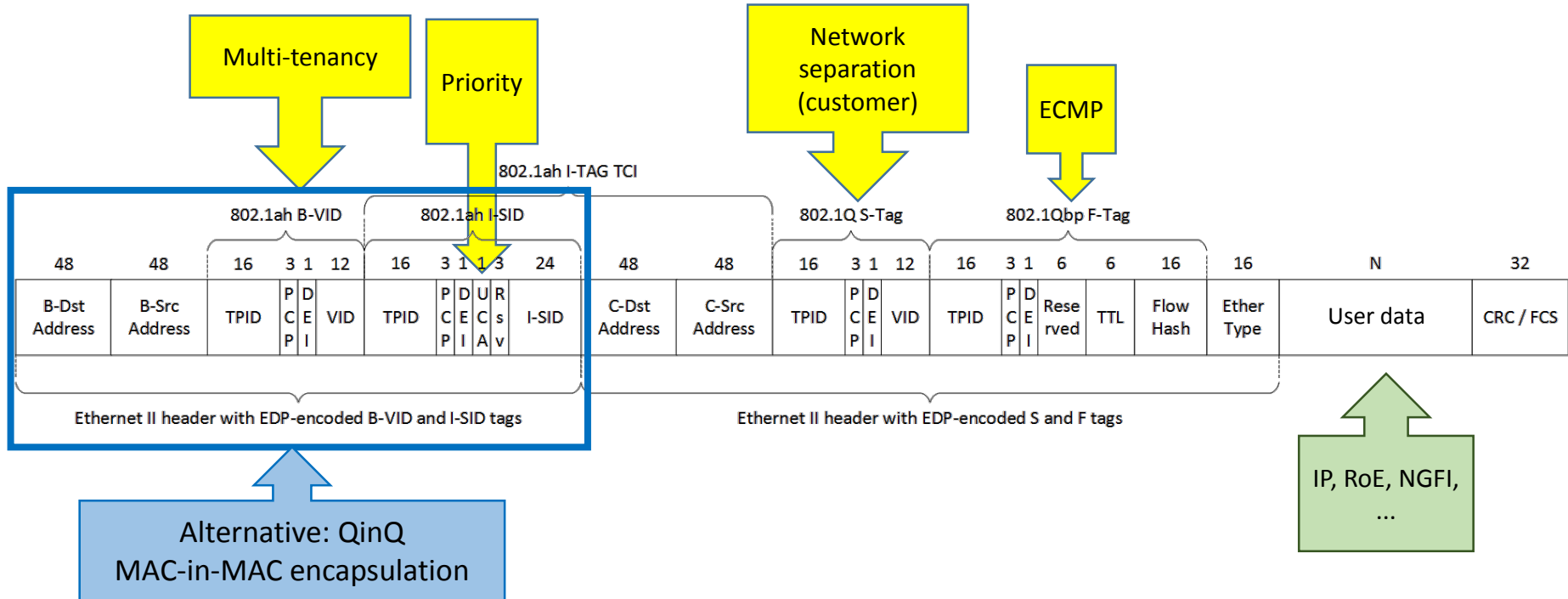
- Support multiple functional splits simultaneously
  - including Backhaul and CPRI-like Fronthaul
- Multi-tenancy
  - Isolate traffic (guaranteed QoS)
  - Separate traffic (tenant privacy)
  - Differentiation of forwarding behavior
  - Multiplexing gain
- Transport efficiency
  - Short overhead
  - 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

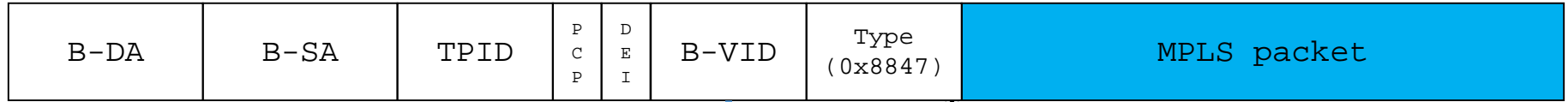


# MAC-in-MAC based XCF template



# MPLS-TP based XCF template

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



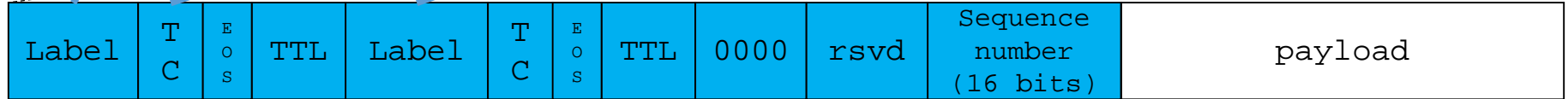
Service identification

Traffic Priority

Network separation (customer)

Multi-tenancy

0x8847 = MPLS label switched packet



LSP label (4 bytes)

PW label (4 bytes)

Control word (4 bytes)



# 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