

EU 5GPPP Project: 5G-Crosshaul **The 5G Integrated Fronthaul/Backhaul**

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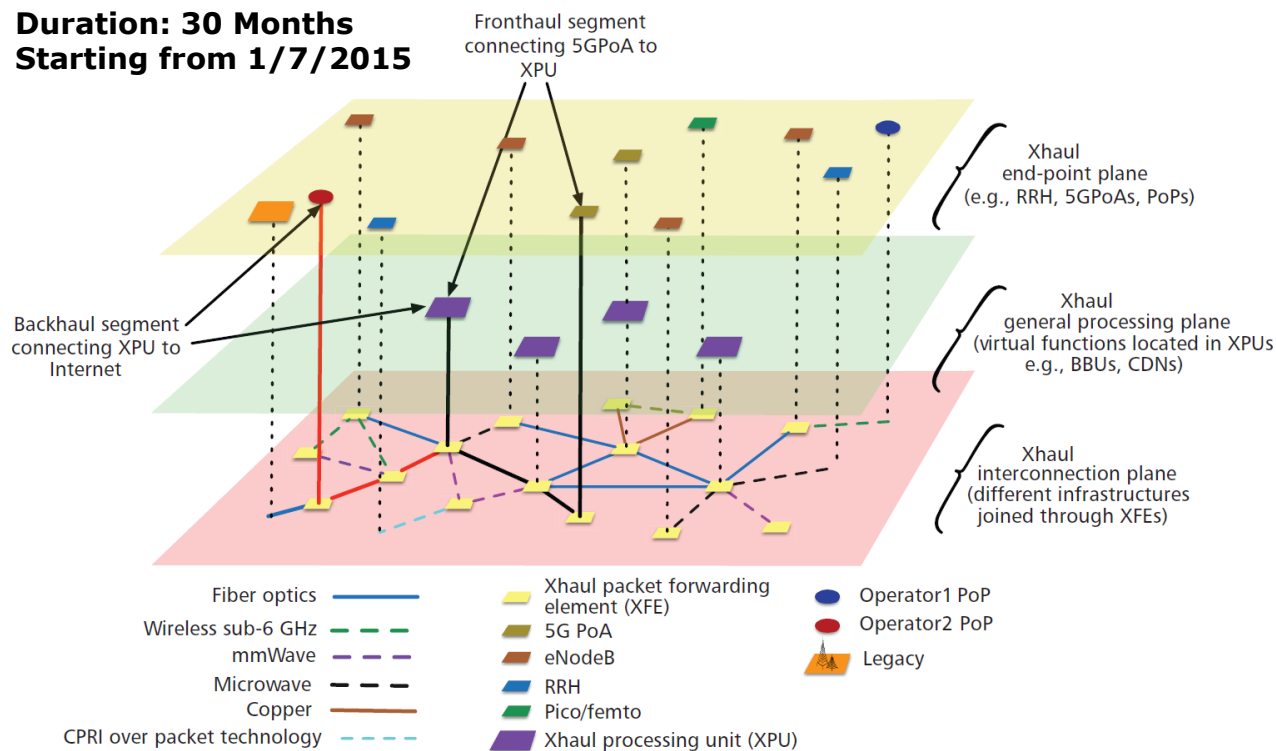
ITG 5.2.1 Workshop at NEC Laboratories, Heidelberg, Germany

Outline

- 5G-Crosshaul Overview
- 5G-Crosshaul Concept Design
- 5G-Crosshaul Architecture
- Example of Applications & Use Cases
- Summary and Next Steps

5G-Crosshaul Overview

Duration: 30 Months
Starting from 1/7/2015



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 transmission techs, e.g., mmWave, uWave, optical and copper

Use cases: Dense Urban Society, Multi-Tenancy, Media Distribution, MEC, Vehicular

Crosshaul 5G demonstration testbeds in Berlin, Madrid, Barcelona, Taiwan

5G-Crosshaul Concept Design

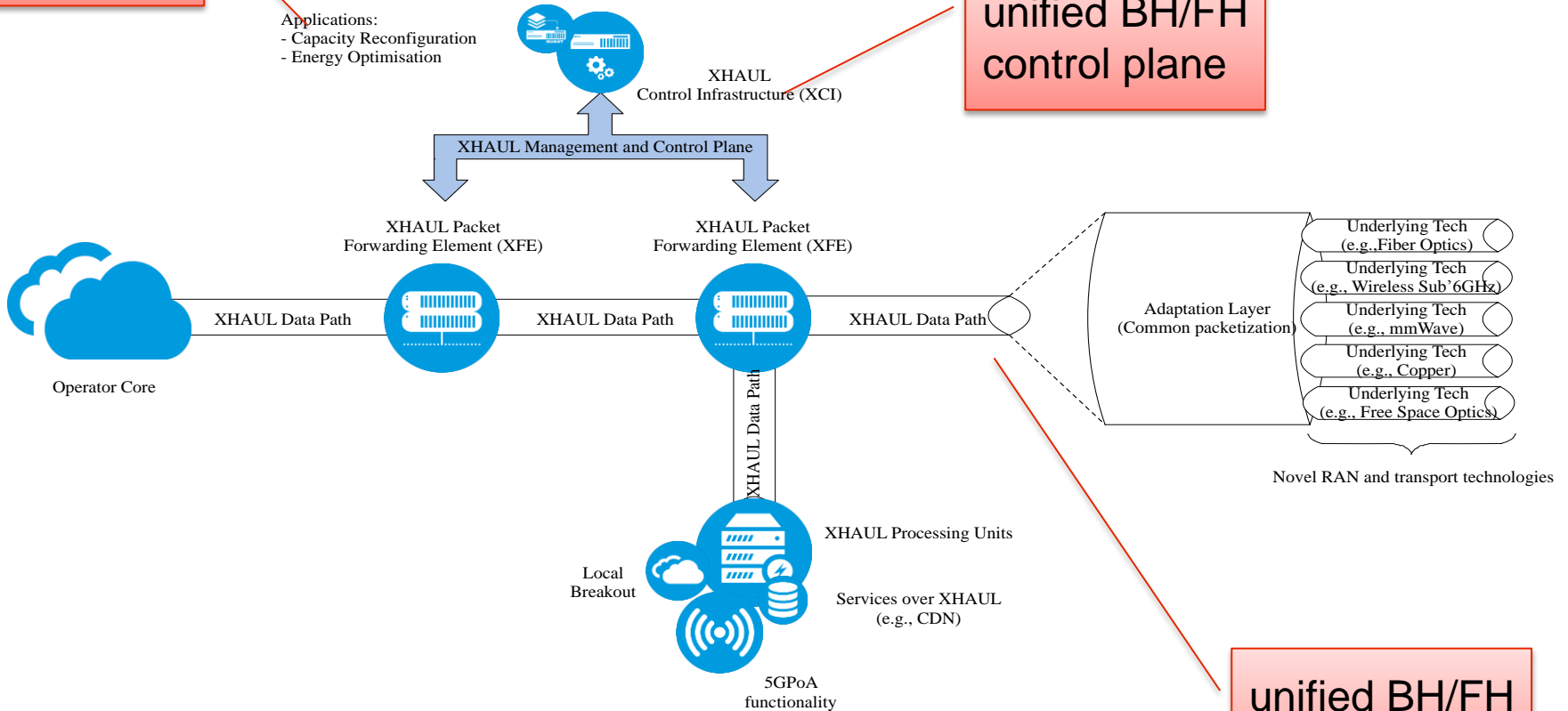
SDN/NFV-based control plane (XCI)

- NBI: interface to apps to program network
- SBI: provide technology abstraction

intelligence

Applications:
- Capacity Reconfiguration
- Energy Optimisation

unified BH/FH control plane



Data plane: define a versatile frame format and protocol suit to

- Carry FH and BH traffic on a common data path
- Support various fronthaul and backhaul technologies
- Support flexible functional split options

unified BH/FH data plane

5G-Crosshaul Functional Structure

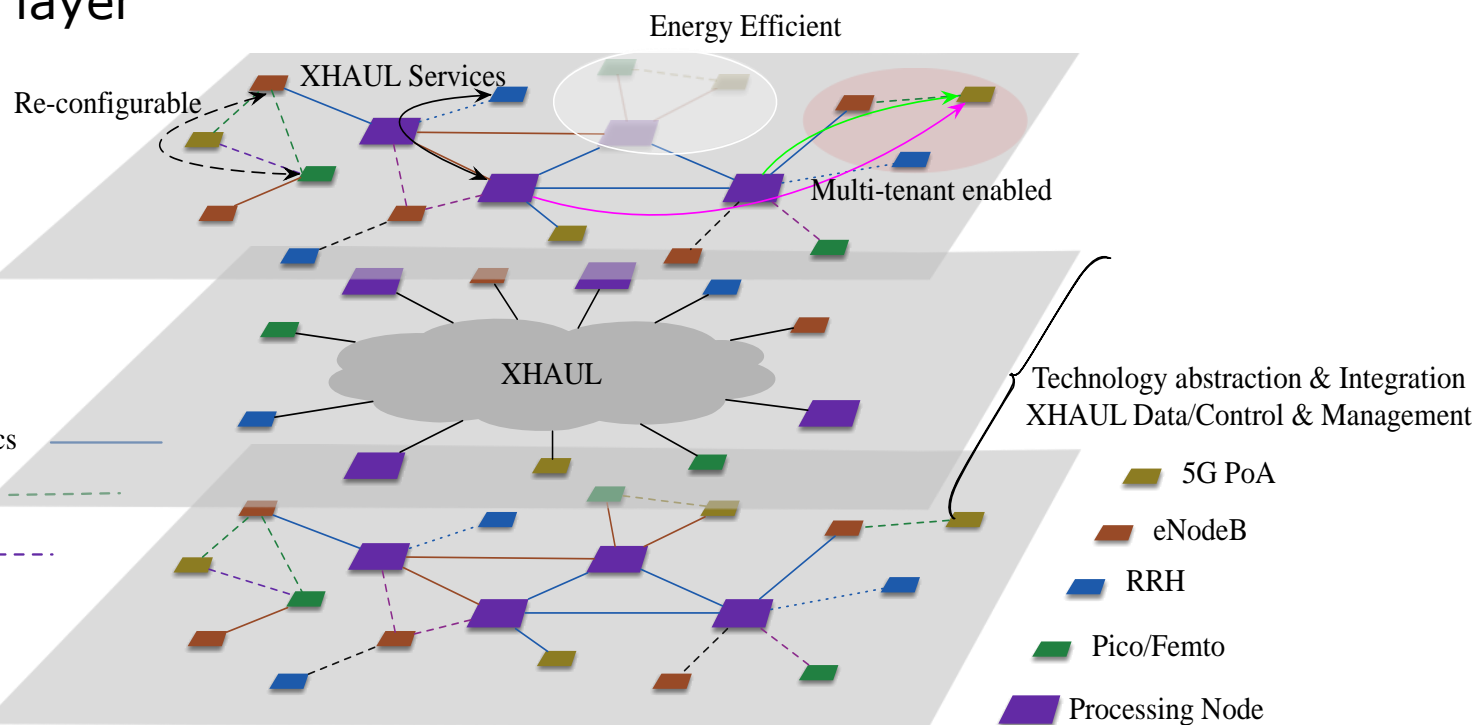
Application layer

- e.g. resource management, network re-configuration, energy efficiency, multi-tenancy

Network function layer

- Technology abstraction & integration
- Unified FH/BH data plane
- Unified FH/BH control plane

Infrastructure layer



5G-Crosshaul Architecture

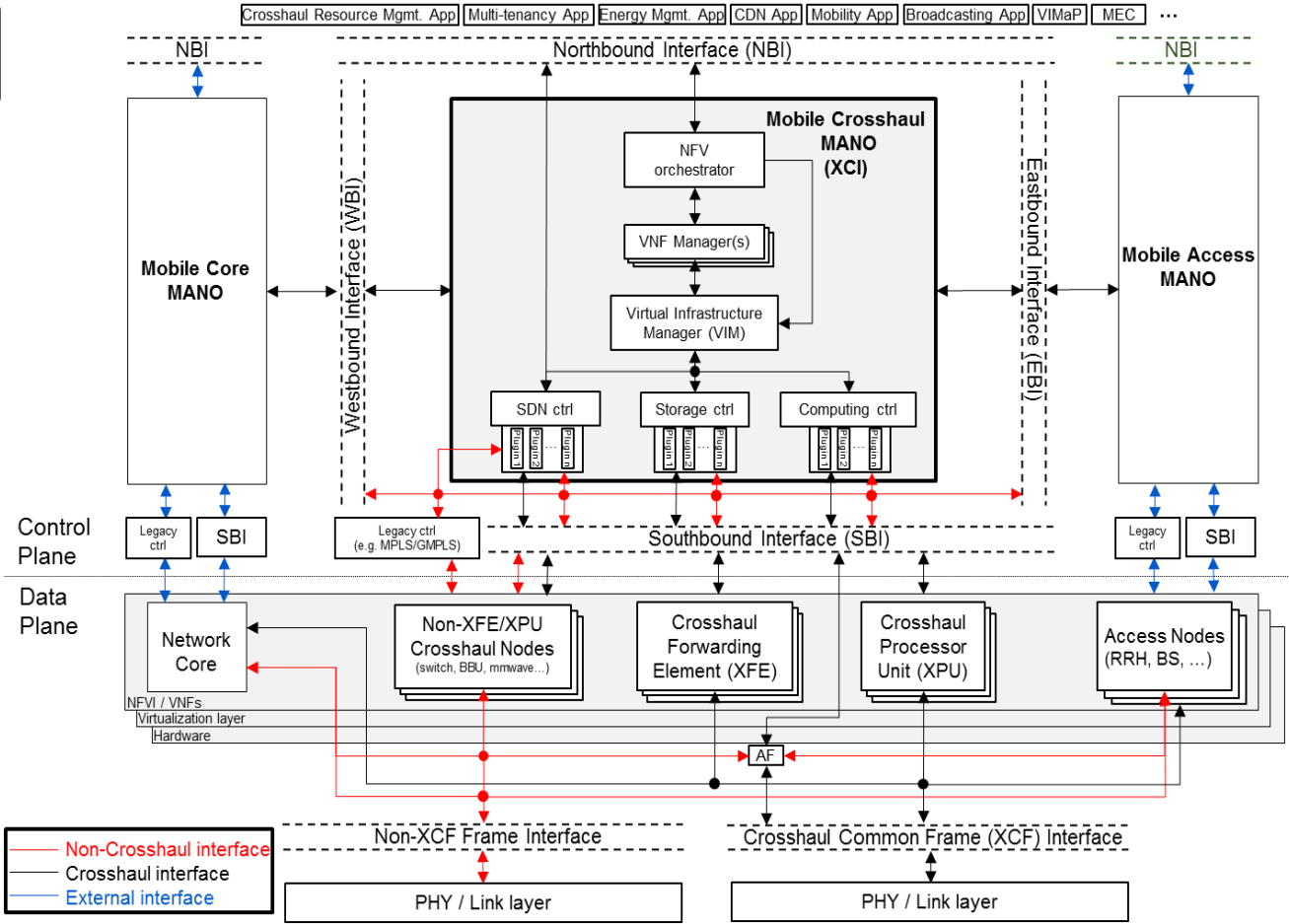
Innovative Network Applications
e.g. Multi-tenancy, Energy Management, Mobility

North Bound Interface

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

South Bound Interface

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



5G-Crosshaul Resource Management

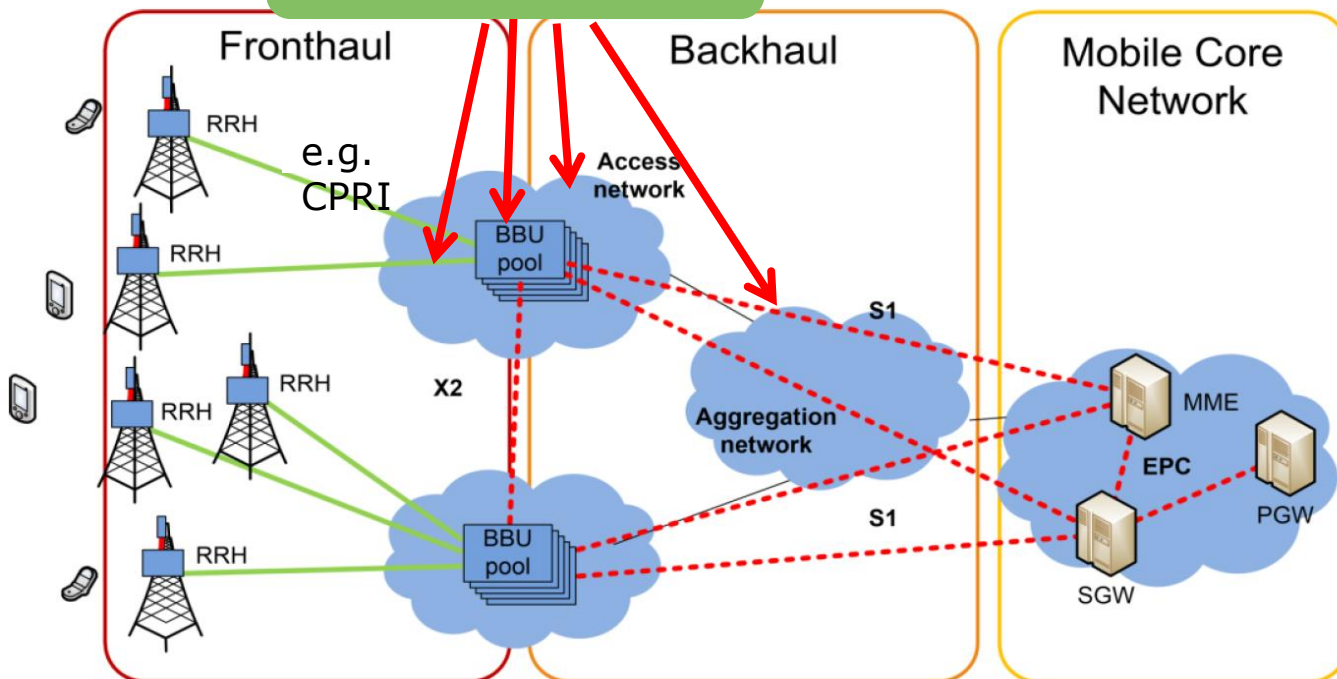
Multi-Tenancy

5G-Crosshaul Resource Management

Fronthaul: Dark fiber/DWDM, Wireless (e.g. mmWave, wireless optics), etc.

Backhaul: Optical fiber, wireless (Microwave), Carrier Ethernet, PON, etc.

Crosshaul Resource Management



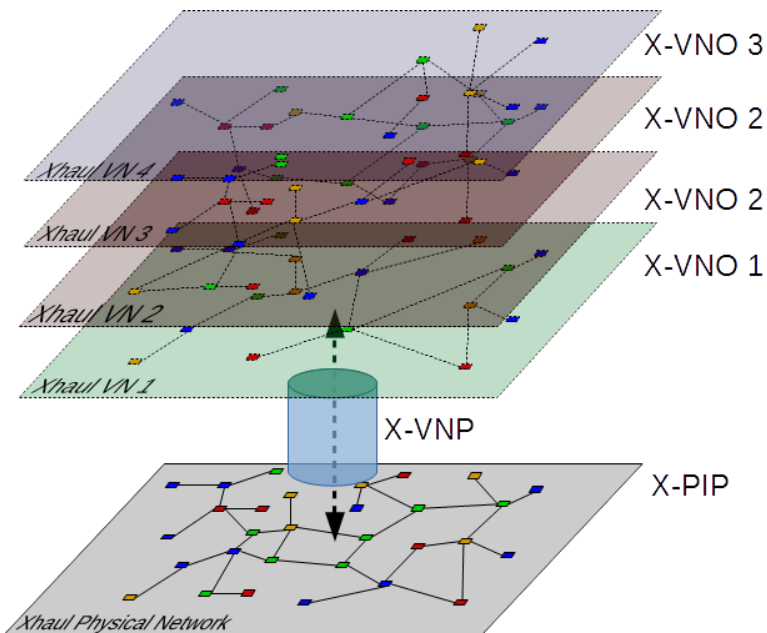
- Crosshaul-aware routing & load balancing
- RAN Functional split Function placement
- Schedulers, shapers, QoS management
- Power/modulation on wireless links
- Re-configuration upon events
 - Link failures
 - Load changes

Objectives:

- maximize overall (FH+BH) network utilization efficiency
- fulfill fronthaul and backhaul requirements
- fulfill service end-to-end QoS
- improve energy efficiency

Multi-Tenancy

- Flexible sharing of Crosshaul Networking + IT resources among network operators
- Tenants providing a slice of virtual resources are provided concurrently and seamlessly
- Virtual domains are isolated across tenants
 - Tenants may use their choice of network OS, SDN and IT controller, and even VIM (virtual infrastructure manager)
 - Tenants have their own virtual topology
- Virtual slices are allocated dynamically
 - Seamless scaling up (and down) to multiple tenants



X-PIP: Crosshaul Physical Infrastructure Provider

- Owns the physical substrate

X-VNP: Crosshaul Virtual Network Provider

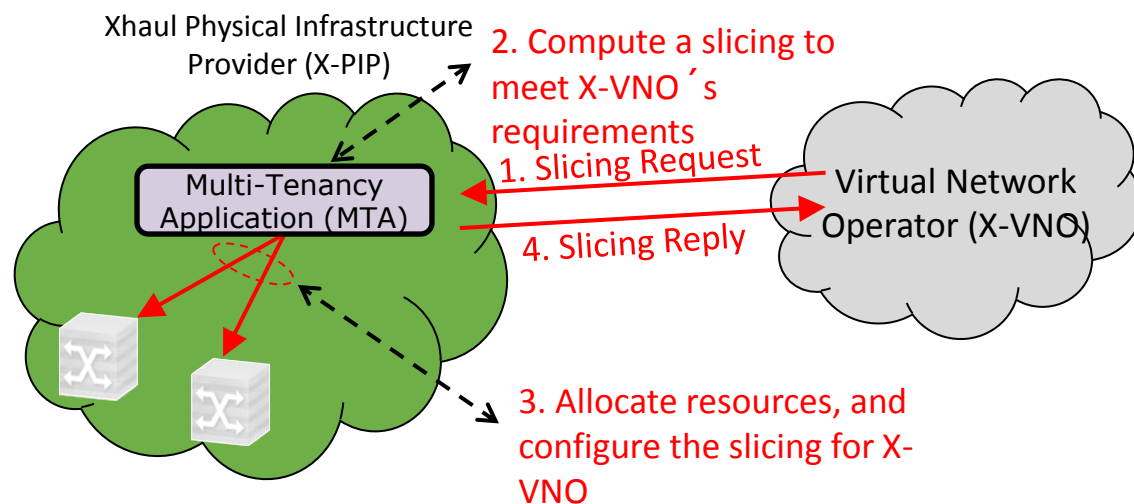
- Assemble physical resources from one or more X-PIPs to provide a virtual topology
- Provision and manage virtual networks for different operators and service providers

X-VNO: Crosshaul Virtual Network Operator

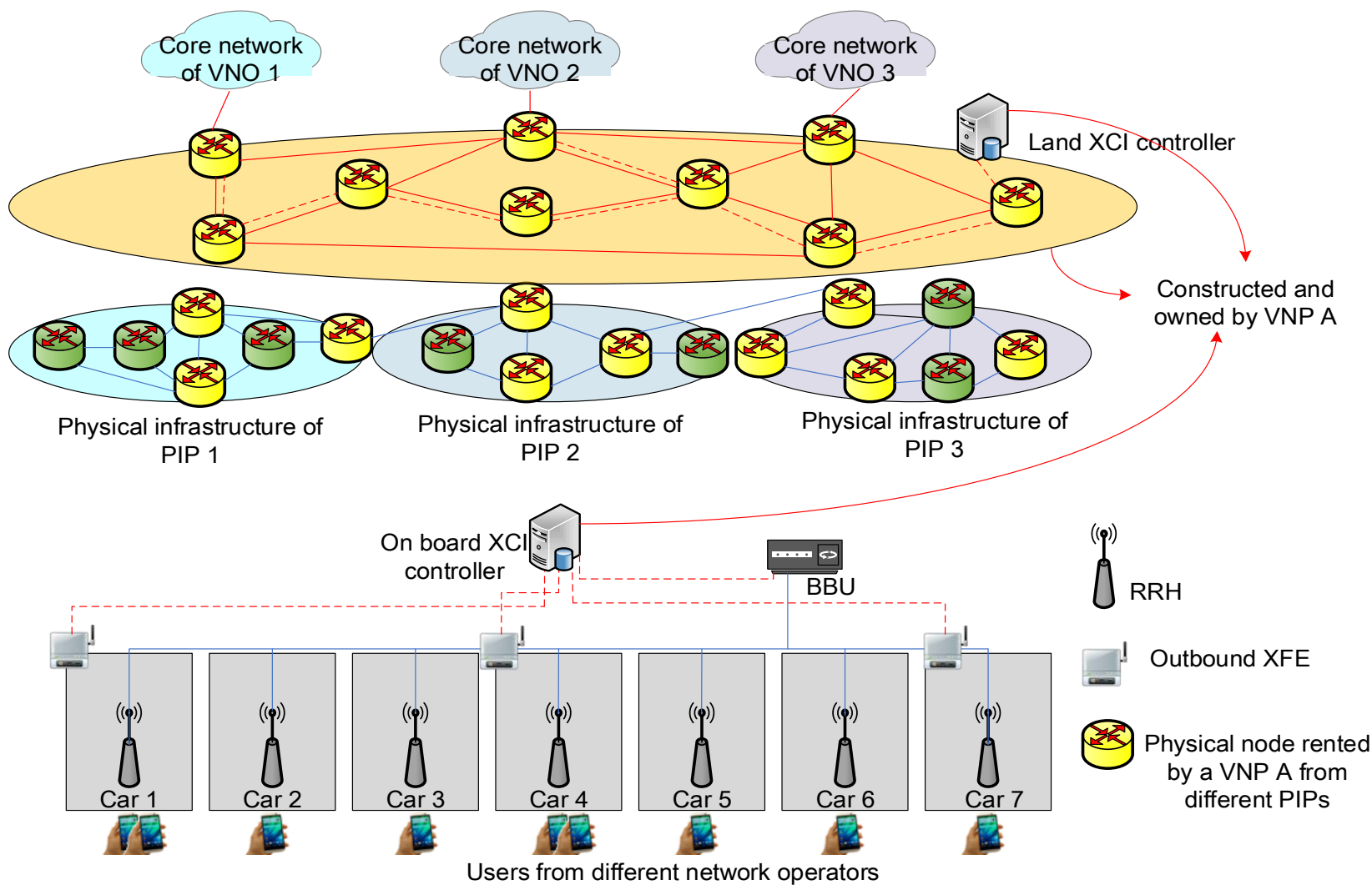
- Maintains and controls a virtual crosshaul network to support a Service Provider
- May use multiple virtual networks for different Service Providers

Dynamic provisioning and automated scaling of virtual Crosshaul network infrastructure for VNO

- A X-VNP can rent resources from one or multiple X-PIPs and assemble these physical resources into a virtual network infrastructure
- An X-VNO will send a request for a network slicing to X-VNP; the request contains the description about his Virtual Network (VN), e.g., topology
- The X-VNP computes and allocates the optimal slicing to meet X-VNO requirements
- The X-VNP configures/instantiates a slicing with appropriate resource for a VNO
- The X-VNP can update the slicing for a X-VNO on demand



Use Case: Infrastructure sharing in high speed train



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 Ethernet-based packet switching but also supports circuit-switching for extremely low latency use cases

Standardization roadmaps include relevant working groups in IEEE, ITU-T, 3GPP, IETF, ONF, and ETSI (amongst others)

A set of 5G-Crosshaul applications are being developed to support the 5G use cases and first proof-of-concept demonstrations are planned for 2016

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