Integrating Fronthaul and Backhaul

Xavier Costa Perez
Head of 5G Networks R&D Group
xavier.costa@neclab.eu

NEC Laboratories Europe
Heidelberg, Germany
NEC’s Network 2020 Vision

Mission Critical Service
- Medical Care
- Low Latency, Reliability

2020 Network
- Architecture Innovation
- RAT Evolution + New RAT
- Current Network
- FTTx
- Throughput, Capacity
- Energy-Efficiency, Coverage
- Entertainment
- Logistics

Social-Value Platform

Customers
- Open Innovation

Partners

Social-Value Creation
- Safer Cities & Public Services
- Quality of Life
- Industry Eco-System
- Safety
- Security
- Efficiency
- Equality

Massive MTC (Machine-Type Communication)
5G goes beyond an evolutionary approach
NEC’s 5G Architecture
5GPPP PROJECT ON 5G BH/FH INTEGRATION
5GPPP Project on 5G BH/FH Integration

- Project duration: 30 Months, project starts from 1\textsuperscript{st} of July 2015
- Xavier Costa, NEC, Technical Manager of the project

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Project Scope

- Develop novel physical and link layer technologies meeting 5G requirements

- Develop a unified data plane for backhaul and fronthaul
  - Supporting all RAN functional splits
  - Supporting required synchronization
  - With one versatile frame format
  - Requires new packet switch architectures

- Develop a unified control plane for backhaul and fronthaul based on SDN
  - Common network model
  - Common set of API functions
  - Resulting in abstraction layer for BH/FH

- Develop enabling and exploiting “SDN apps” on top of abstraction
  - Monitoring and prediction framework
  - Backhaul/fronthaul infrastructure planning and dimensioning
  - Context-aware resource management (RAN policies, routing, function placement)
  - Network-aware media distribution framework

- Evaluate the developed Xhaul technologies integrated on a 5G testbed in a real-world environment under realistic system constrains
Xhaul Concept and Approach

intelligent

Applications:
- Capacity Reconfiguration
- Energy Optimisation

XHAUL Packet Forwarding Element (XFE)
XHAUL Packet Forwarding Element (XFE)
XHAUL Data Path
XHAUL Data Path
XHAUL Data Path

XHAUL Management and Control Plane

Operator Core

Local Breakout

Services over XHAUL (e.g., CDN)

5G PoA functionality

Unified BH/FH Data Plane

Unified BH/FH Control Plane

Adaptation Layer (Common packetization)

Underlying Tech (e.g., Fiber Optics)
Underlying Tech (e.g., Wireless Sub’6GHz)
Underlying Tech (e.g., mmWave)
Underlying Tech (e.g., Copper)
Underlying Tech (e.g., Free Space Optics)

Novel RAN and transport technologies
Xhaul Concept and Approach
Work Packages

WP1: System Requirements, Scenarios and Economic Analysis
Define and prioritize the Xhaul requirements and use cases, design baseline architecture and assert the economic viability of the solutions for real-world deployment.

WP2: Physical and link layer of Xhaul
Investigate the applicability of different latest access, aggregation and transport technologies (at both physical and link layer) as well as develop network architecture for integration of different technologies to realize a novel integrated fronthaul and backhaul network, capable of meeting the tight 5G requirements in terms of synchronization, latency, jitter, etc.

WP3: Xhaul Control and Data Planes
- Design the Xhaul data plane to create a common transport network by designing a unfiled and versatile frame format and the corresponding protocol suit to support flexible split of radio and 5GPoA functionalities and to transport the fronthaul and backhaul traffic on the same physical link.
- Design a common control and management plane based on SDN approach, with a novel design of SDN controller and the corresponding southbound and northbound interface.

WP4: Enabled innovations through Xhaul
- Develop enabling methods including dimensioning and planning of the Xhaul infrastructure, end-to-end monitoring and prediction framework, Xhaul-aware media distribution framework.
- Develop context-aware Xhaul resource orchestration algorithms for joint optimization of RAN policies (e.g. scheduling, CoMP, shaping, handover), routing policies and RAN/Xhaul function placement (e.g. BBU, virtual IP edge, traffic offload).

WP5: Validation and proof of concept
Set up a 5G testbed to integrate the technology components and solutions developed in WP2, WP3 and WP4, to perform evaluation and experimentation of various PoC of key Xhaul technologies in a real-world environment under realistic system constrains.

WP6: Communication, Dissemination and Exploitation
Set up and execute viable plans for Xhaul communication, dissemination and exploitation activities with the aim to achieve high measurable impact of project results, leading to successful adoption of novel Xhaul technologies into future standards and innovation products.

WP7: Project Management
Project administrative, finical and legal management, technical innovation and quality management, and interaction with other projects of the H2020 5G PPP and other EU initiatives.
Xhaul FH/BH Integration Demonstration
Integrating Fronthaul and Backhaul

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