5G Fronthaul Transport Classes for 3GPP Splits

Discussion for the need of MAC – MAC split

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IEEE 1914
Next Generation Fronthaul Interface
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General 5G Fronthaul Transport Classes supporting 3GPP splits

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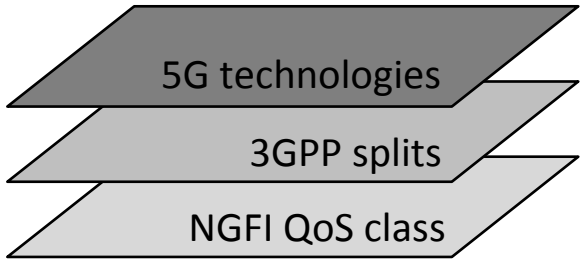
Introduction

- 5G needs technologies like mMIMO, cooperative techniques, massive bandwidth
- 3GPP will define functional splits between CU and DU to support various scenarios – NGFI need to analyze these

Recap of 1914.1 PAR

- **NGFI specifies classes of transport network to support various splits**

NGFI 1, 2, 3 ≠ 3GPP 1, …, 8



Agenda

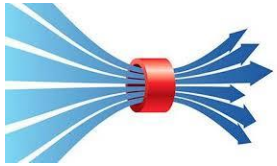
We need to define transport classes

- Generalizing 3GPP splits
- Supporting 5G techniques
- Supporting 5G scenarios
- Supporting different QoS classes on FH

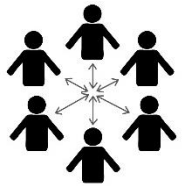
Proposal: We propose an NGFI interface in between current NGFI2 and NGFI3

GENERALIZING 3GPP SPLITS, SUPPORTING 5G TECHNIQUES

Technologies on the Frontline of 5G

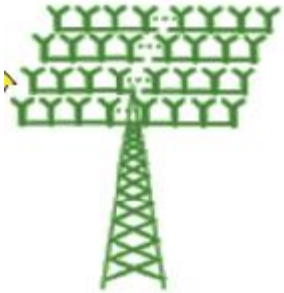


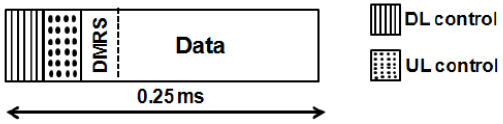
Bandwidth up to 1GHz



Multi-connectivity
UP/CP for LTE/NR
D2D

Massive MIMO Up to 256 antennas





TTI reduction
from 1ms to 0.2-0.25ms
In-resource signaling

Different levels of cooperation:
- Diversity above MAC layer
- Coordination at MAC layer
- Combination/Addition gains at PHY

Next Generation Fronthaul Interface

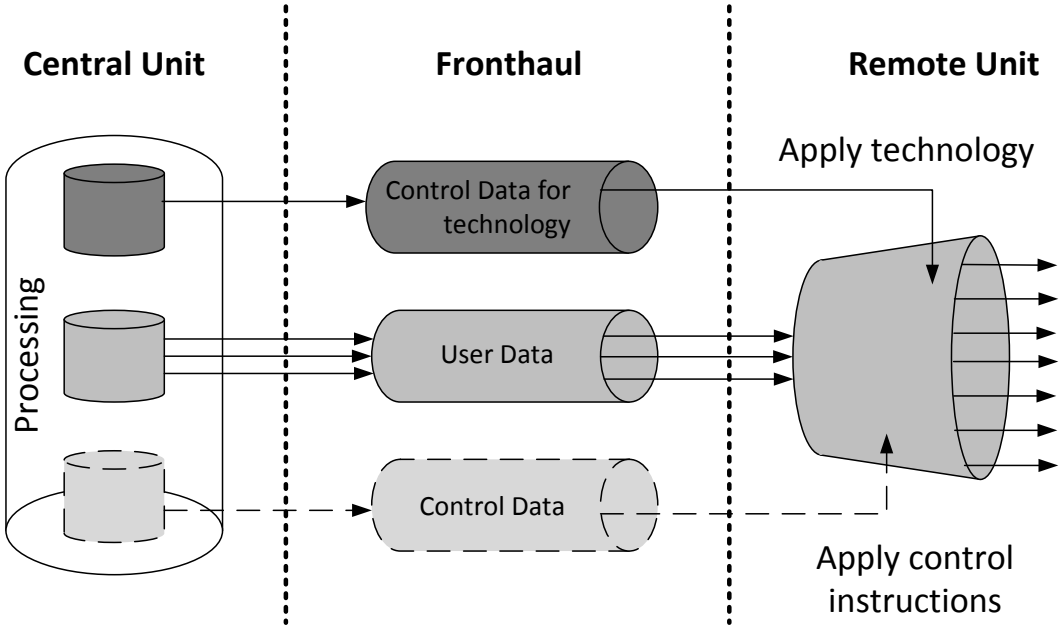
Issue: The current NGFI focus is only on analyzing most probable splits in LTE protocol stack

Instead we propose that:

NGFI focuses on the technologies to be supported between the RU and CU

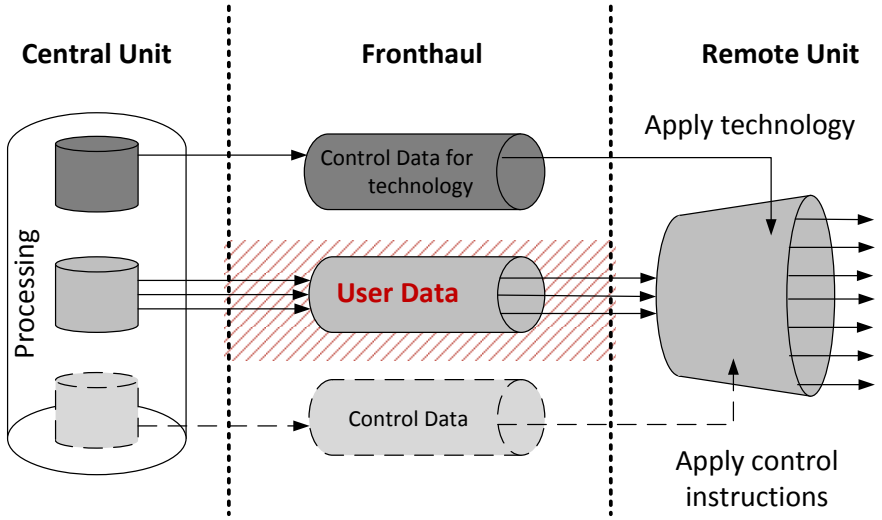
What is Fronthaul Transporting?

1. User data
2. Control data
3. Control data required for the technology



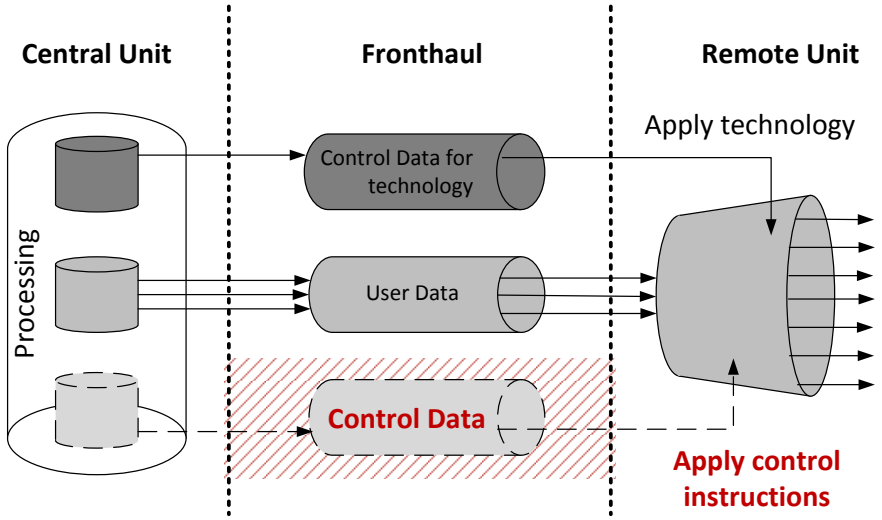
1. User Data

- **What are the properties of user data?**
  - Data format
    - Symbol based: IQ symbols
    - Slot based: user data per slot
    - Subframe based: user data per subframe
    - Bundling of subframes
  - Delay
  - Synchronization
  - Flow control



2. Control Data (Instructions)

- How the RU shall process the data flow (tech applied)
  - Modulation and Coding Scheme
  - Antenna mapping
  - Frequency/time allocation
- Format of information to be extracted and processed by RU
  - Format of Channel State
- **Properties of control data?**
  - Data format
  - Delay
  - Synchronization
  - Flow control



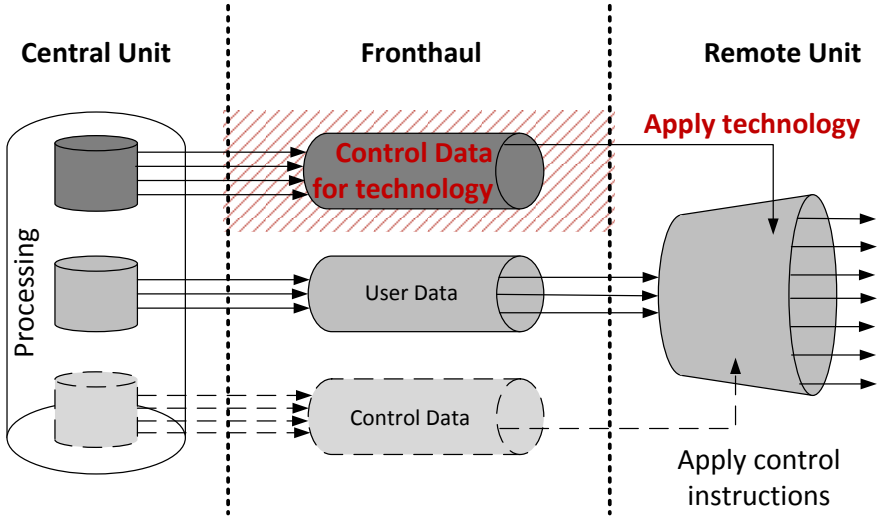
3. Control Data Related to the Technology

Separate technology from the split

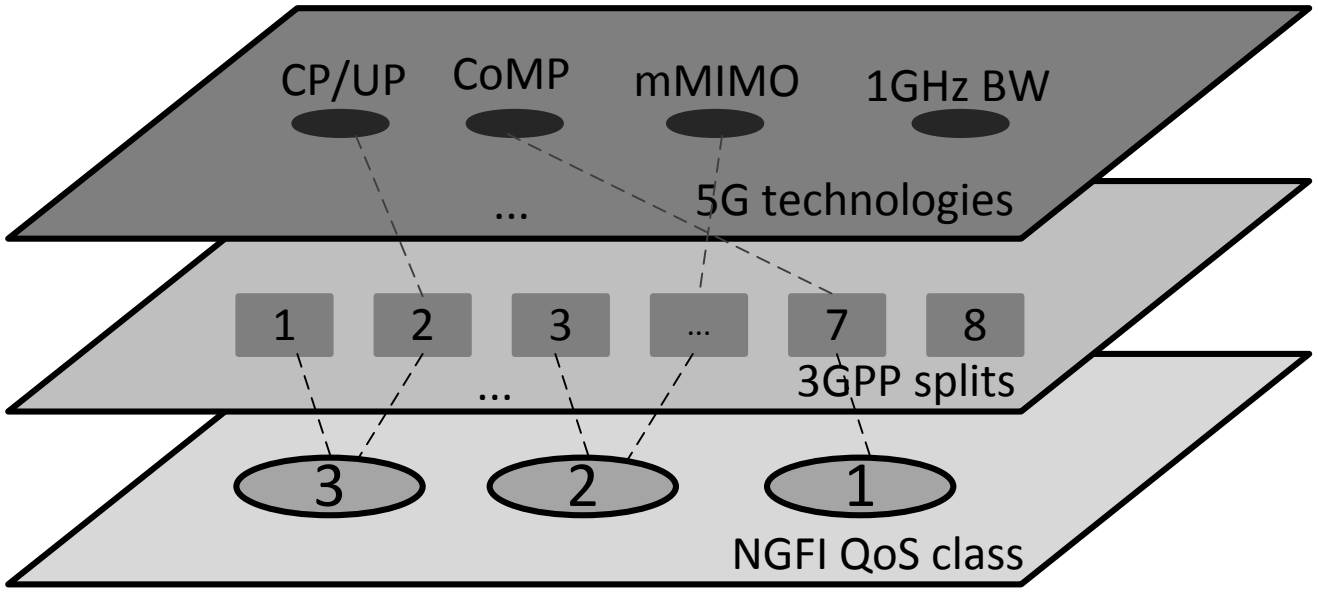
- MIMO & JR/JT: Separation of precoding weights (calculation point) and user data
- Format of CSI: Local estimation at RU or combat pilot contamination at CU

Centralize processing only when it is beneficial for the technology

- **Properties?**
  - Data format
  - Delay
  - Synchronization
  - Flow control



NGFI to Support Various Transport Classes



We propose that NGFI defines QoS transport class to support different 3GPP splits and 5G technologies

5G SCENARIOS

TR 38.913 - Analysis of Deployment Scenarios

3 categories of splits: PHY, MAC, PDCP/RLC

	Indoor Hotspot	Dense Urban	Rural	Urban macro	High Speed	Extreme rural	Urban coverage for MTC
Tech.	mMIMO, JR/JT	mMIMO, JT/JR	mMIMO	mMIMO	mMIMO	LTE	
Split	Split PHY	Split MAC Split PHY	Split MAC	Split PHY	Split MAC	No split	Split PDCP/RLC

Split MAC can support three scenarios

FH CLASSES OF SERVICE

Need for Medium Solution That Support C-RAN with Low Data Rates

Option	NGFI2	Our Proposal NGFI_N	NGFI3
C-RAN benefits	High	**Moderate to high**	Low
FH data rates	>10Tbps	**~30Gbps**	~30Gbps
Latency	<0.2ms	**~1ms**	>20ms

- **With a MAC-MAC split (Split 5) we can meet the basic 5G parameters in a C-RAN environment**
  - **C-RAN benefits on coordination and multiplexing gain**
  - **Low Fronthaul bit rate**
  - **Moderate Fronthaul latency requirement**

Proposal: Include NGFI_N into 1914 investigation

Our proposal: include 'medium' split to cover **3 transport categories**

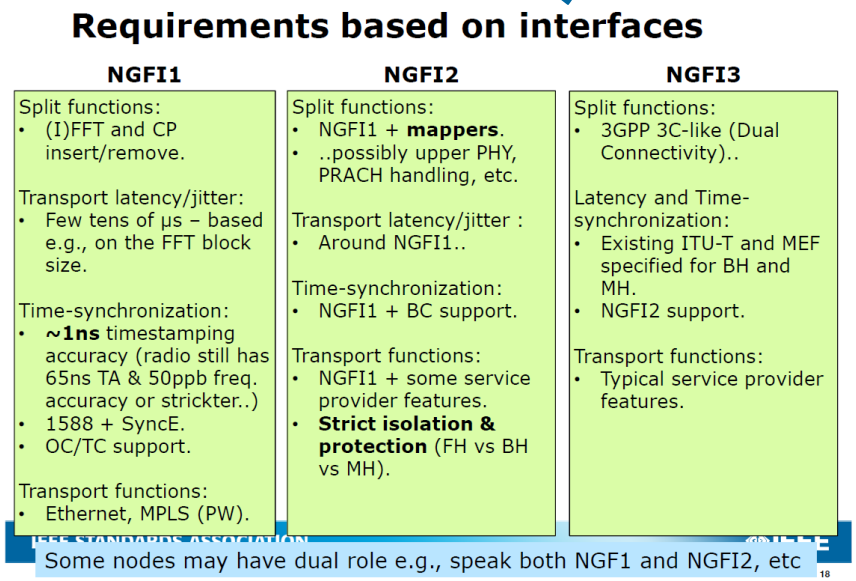
NGFI_N

Split functions:
- **Option 5-ish (MAC-MAC):** Centralized control, low data rate, moderate latency

Transport Latency/jitter:
- Few ms

Time synchronization
- 1588

Transport functions
- NGFI1 + some service provider features



J. Korhonen, "Practical approach to converged FH/BH network architecture and functional partitioning", 8/22-24/2016

Conclusions

- **We propose for NGFI to focus on the technologies to be supported between the RU and CU**
- **We propose 3 distinctive transport classes**
- **We propose to include split option 5 (MAC-MAC)**
- **This option provides C-RAN benefits at low Fronthaul bit rate an low latency**

Thank you for your attention

Q&A