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IEEE

IEEE 1914 NGFI (xhaul): efficient and scalable fronthaul transport for 5G

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Editor of IEEE 1914.1/MTI Radiocomp

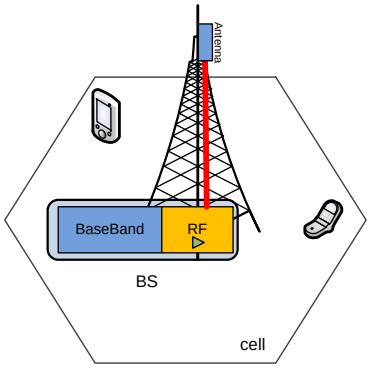
BackNets 2017

In conjunction with IEEE VTC Fall 2017

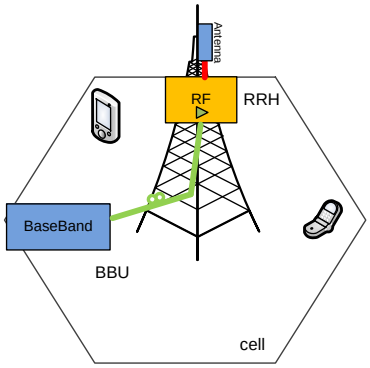
Toronto, Canada

September 24, 2017

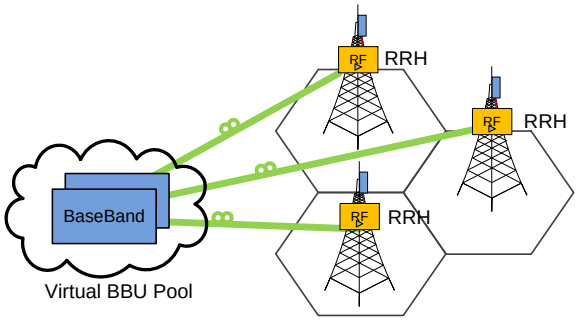
Base station architecture evolution towards supporting 5G



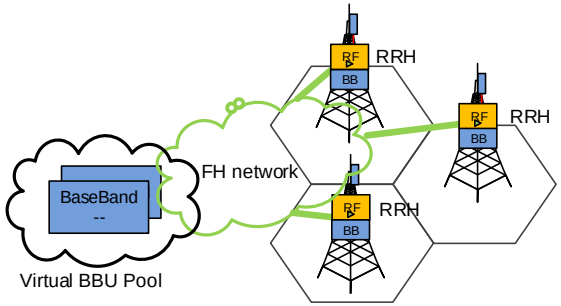
a) Traditional Macro BS



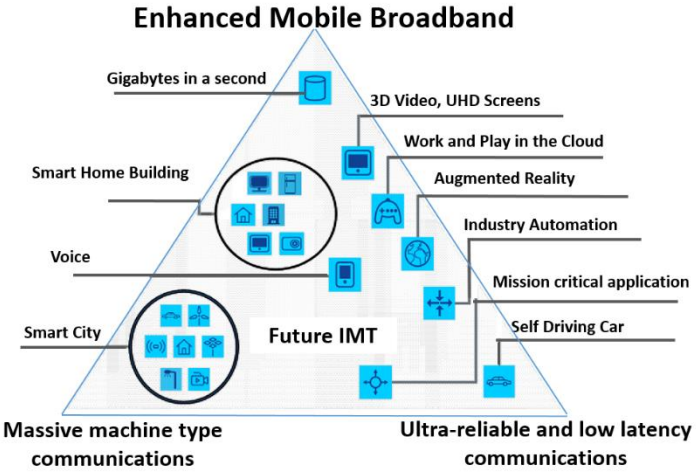
b) BS with RRH



c) C-RAN with RRHs

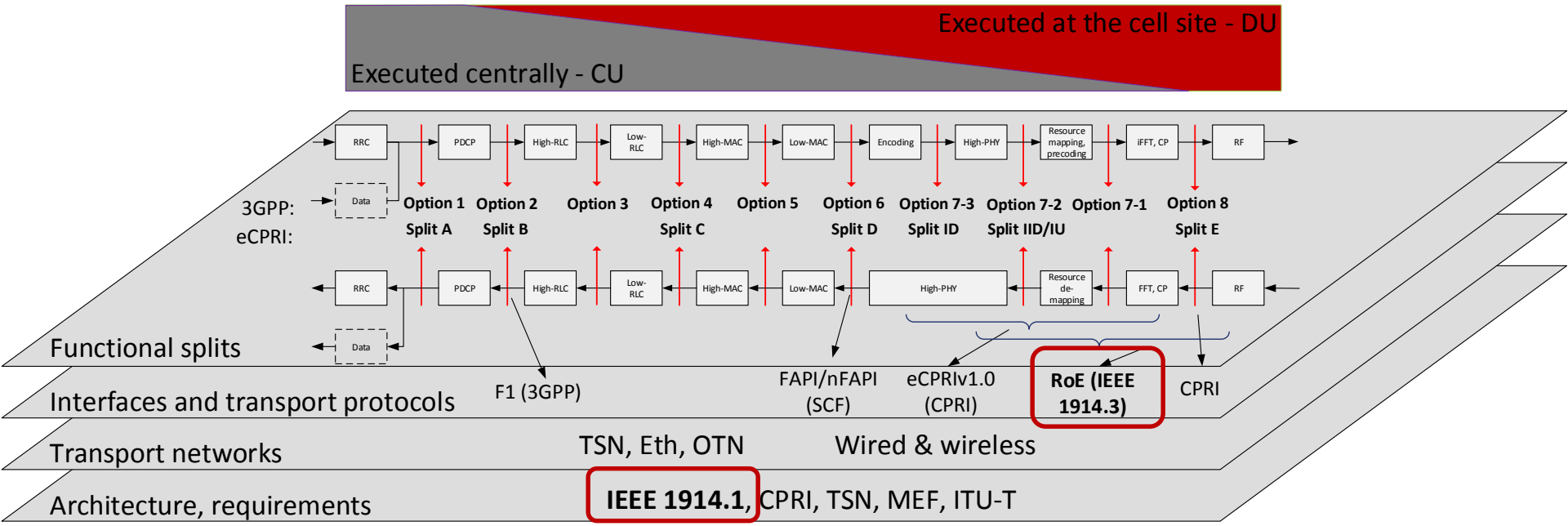


d) C-RAN with new function split between BBU and RRH



ITU-R IMT-2020

Standardization and industry solutions for 4.5G/5G base stations and XHAUL



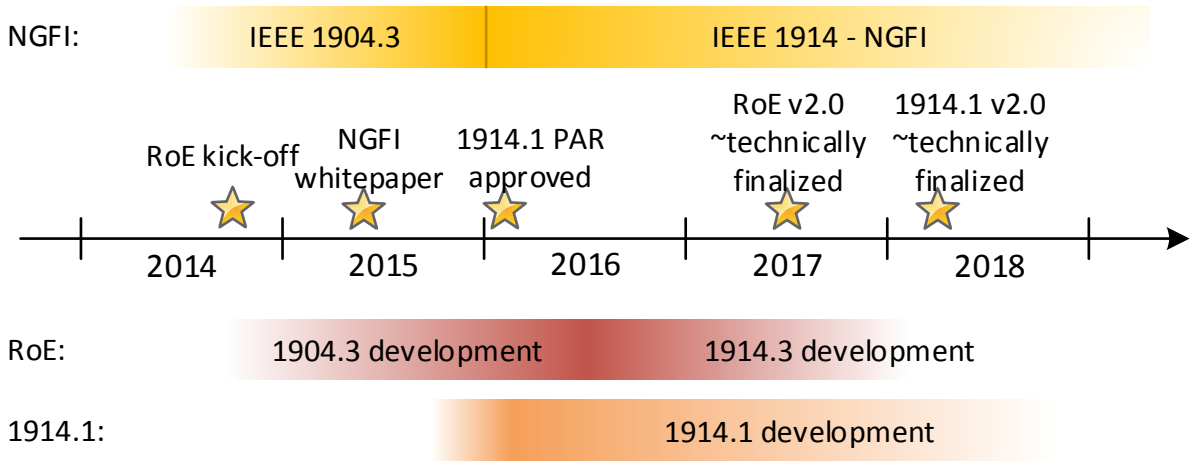
- Use cases and scenarios
- Architecture
- Requirements

Radio Over Ethernet Encapsulations and Mappings

Introduction to IEEE 1914 WG – NGFI (xhaul)

- NGFI: Next Generation Fronthaul Interface (xhaul)
- Approved by IEEE from Dec. 2014
- Target: efficient & scalable FH transport for 5G
- Website: http://sites.ieee.org/sagroups-1914/
- Extensive awareness with ~160 subscribers
- ~ 20 voting members, ~ 90 members

Participants from:
- operators
- chipset manufacturers
- telecom vendors
- academia



IEEE 1914 WG

P1914.1

- Standard for Packet-based Fronthaul Transport Networks
  - Use cases and scenarios
  - Architecture
  - Requirements

✓ Functional split analysis
× CU_DU functional split definition

P1914.3 (ex1904.3)

- Standard for Radio Over Ethernet Encapsulations and Mappings (RoE)
  - IQ (CPRI/native RoE) encapsulations and mapping
  - IQ in time and frequency domain

- Close relation with other SDOs

NGFI fundamentals

High scalability

- Enables C-RAN/V-RAN deployments
- Traffic-dependent

High resource utilization

- On air interface: Support of cooperative functions: CoMP, MIMO
- On transport interface: Support for **statistical multiplexing**

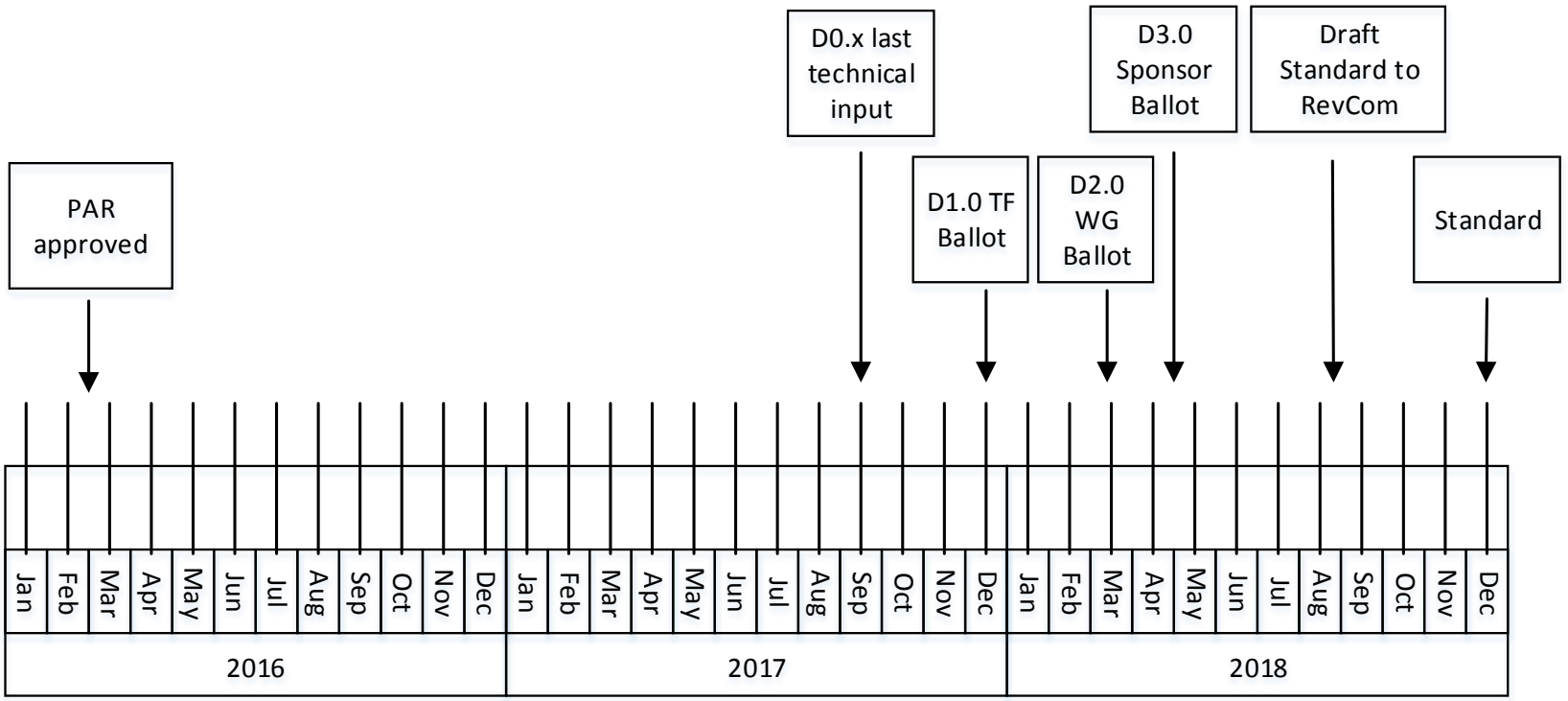
High flexibility

- Radio interface technological neutrality
- Enabling SW upgrades of mobile nodes

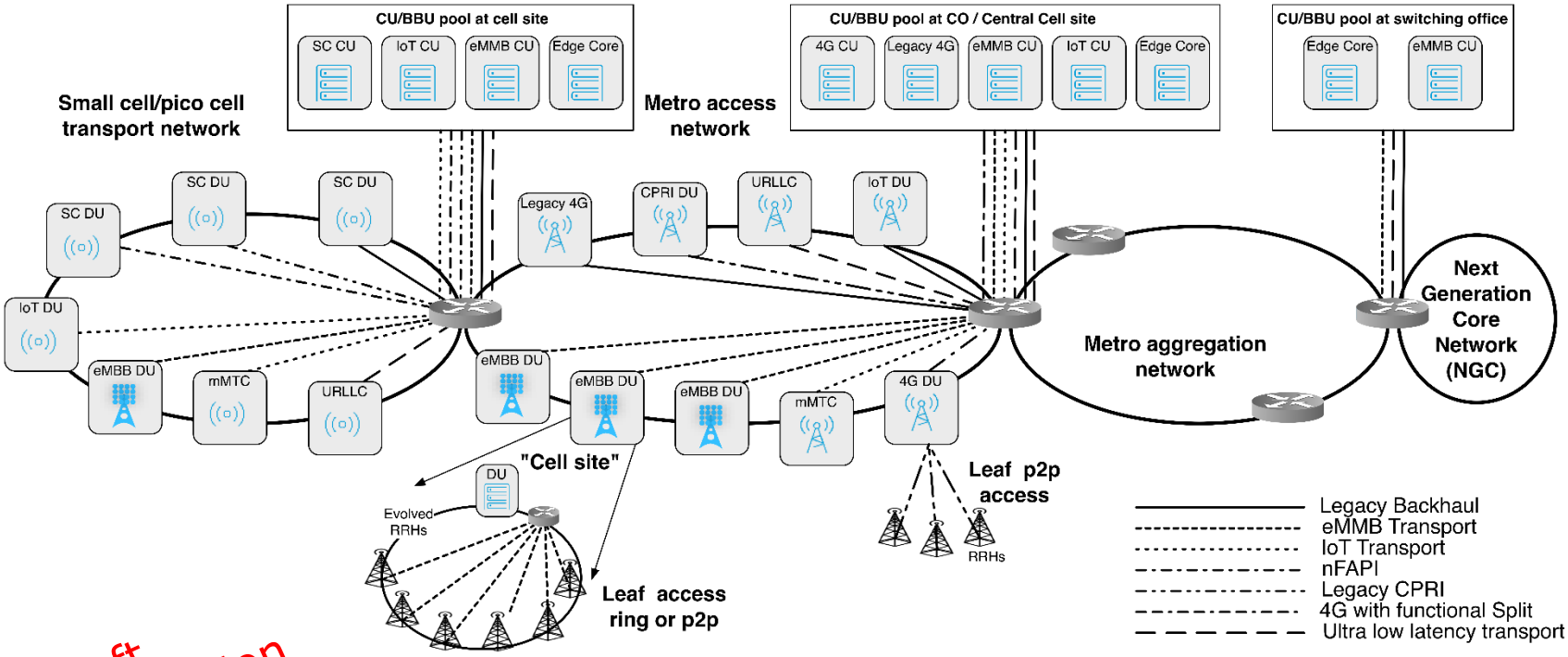
Low costs

- Leveraging mature **standard** transport solutions, e.g. **Ethernet-based**, IEEE 1588, SyncE, TSN
- Unified management and control solution, common networking protocols, and universal network elements

1914.1 Timeline



1914.1 Architecture supporting typical 5G and 4G use cases



Draft recommendation

Multiple functional splits are expected

Requirements – main areas

- Network
  - Transport classes of service – latency is a key factor
  - Throughput (informative)
  - Transport network slicing
  - Jitter
  - Synchronization
  - OAM
  - Security
- Node
  - Latency
  - Synchronization
  - OAM

Draft recommendation

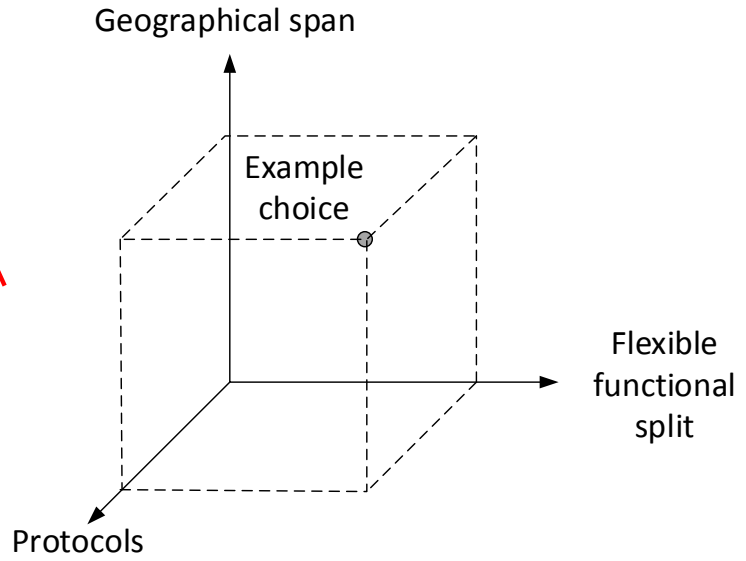
Transport classes of service

Draft recommendation

Class	Sub Class	Latency upper bound requirement	Priority Level	Informative
Control & Management	Synchronization	TBD	TBD	
	Low latency RAN control-plane	T_1	2	
	TBD			
Data-plane	Subclass 0	T_0	0	URLLC Application
	Subclass 1	T_1	1	3GPP Split Options 6, 7, 8
	Subclass 2	T_2	2	3GPP Split Options 2,3,4,5
	Subclass 3	T_3	3	Legacy backhaul
Transport network control & management	Transport NW control-plane	T_2	2	
Reserved				

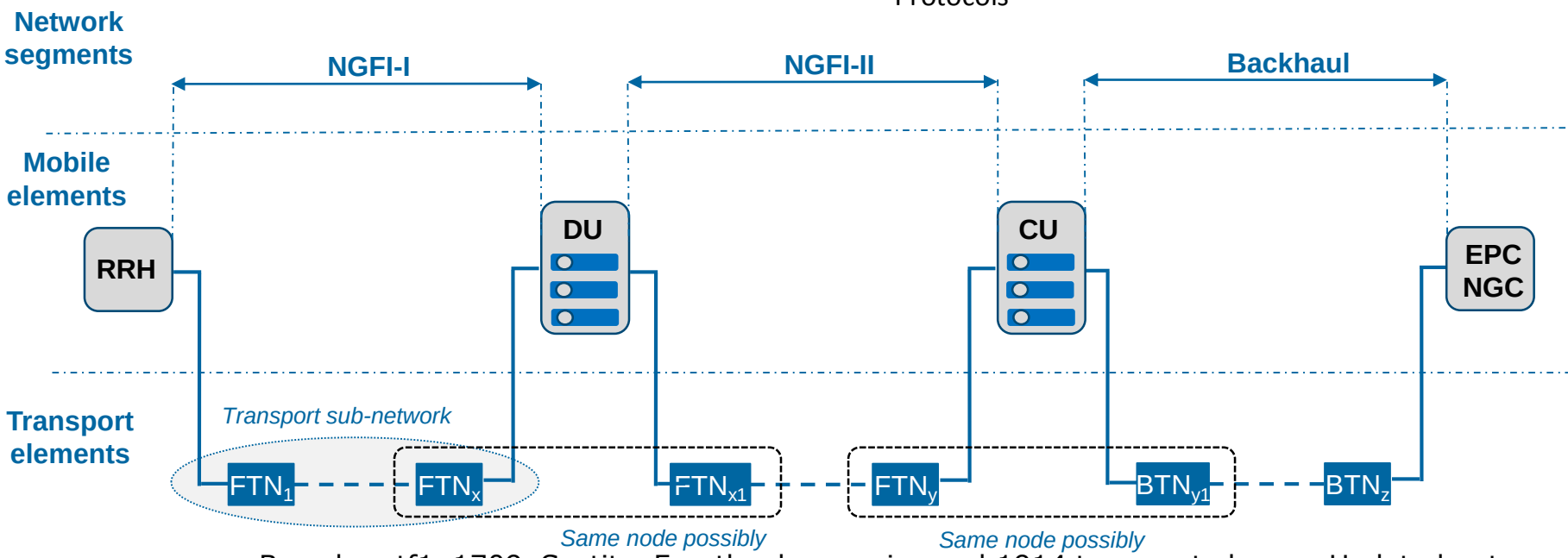
Latency symbol	**T_0**	**T_1**	**T_2**	**T_3**
One-way latency upper bound value	50μs	100μs	1ms	10ms

Deployment scenarios



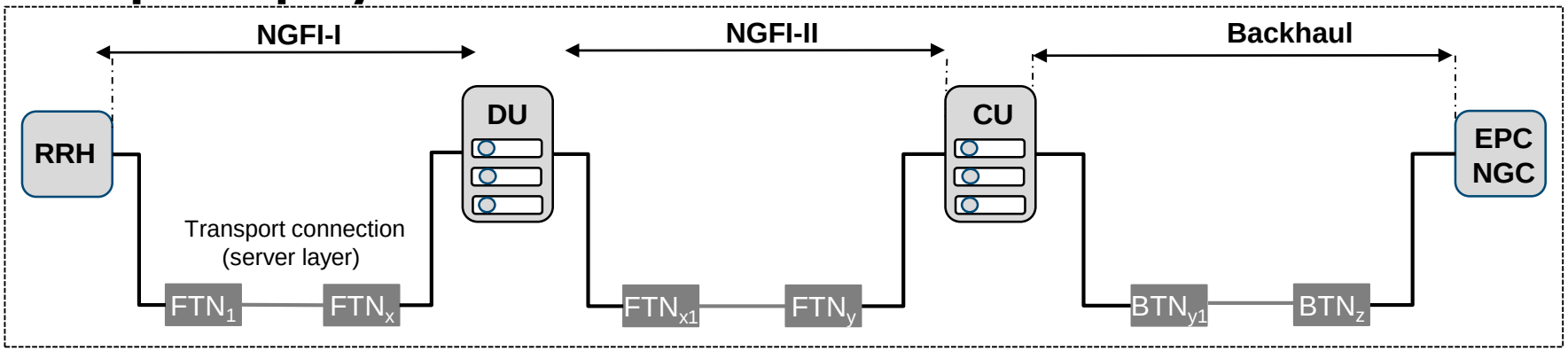
Draft recommendation

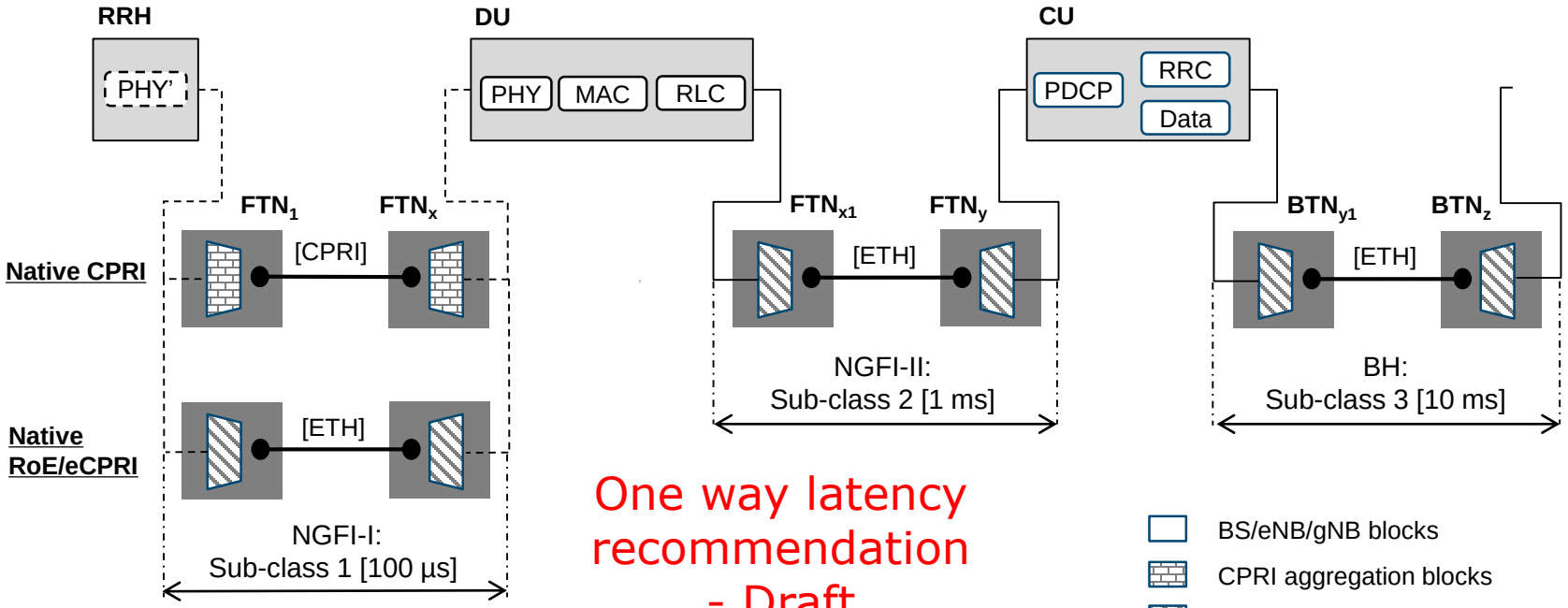
Generalized model



Based on tf1_1709_Sestito_Fronthaul scenarios and 1914 transport classes_Updated.pptx

Example deployment scenario





One way latency recommendation - Draft

BS/eNB/gNB blocks

CPRI aggregation blocks

ETH aggregation blocks

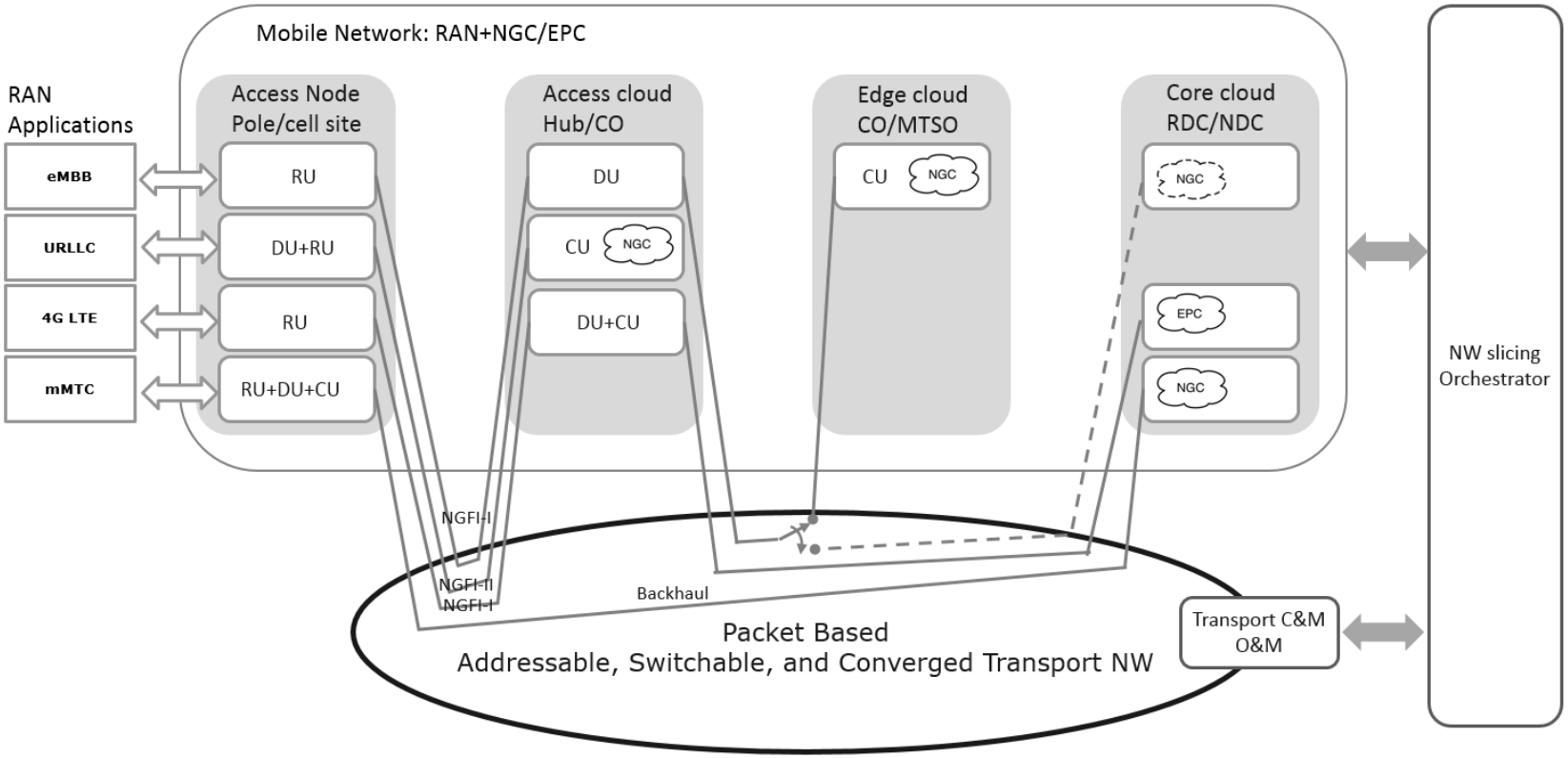
[...] Radio protocol carried

Transport connection (Lx-server layer, x=0, 1, 2)

Based on tf1_1709_Sestito_Fronthaul scenarios and 1914 transport classes_Updated_3.pptx

Network slicing

Draft recommendation

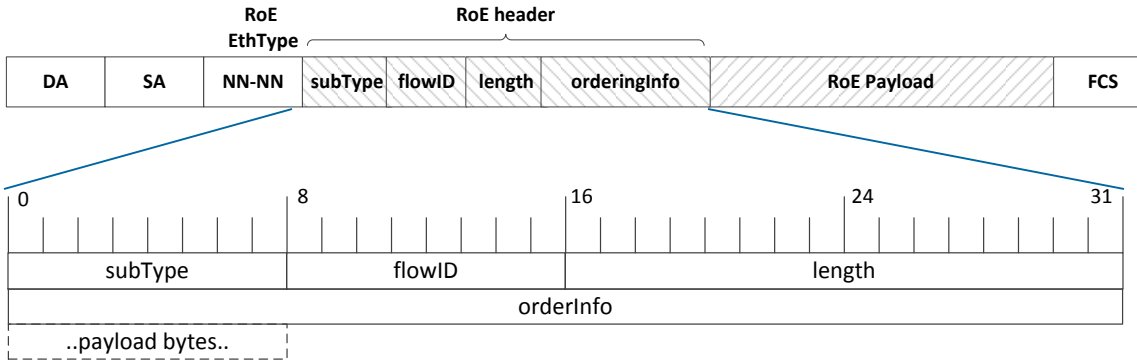


tf1_17_08_cai_tazi_RAN_node_definition_1.pdf

1914.3 overview

P1914.3 - Standard for Radio Over Ethernet Encapsulations and Mappings (RoE)

- Defines header and encapsulation of IQ data into Ethernet packets:
  - Structure-aware encapsulation (knowledge of higher layer, optimized for CPRI)
  - Structure-agnostic encapsulation (no knowledge of higher layer)
  - Native IQ (in time and frequency domain)
- Status: Draft v 2.X (~ technically complete)
- Target release: end of 2017

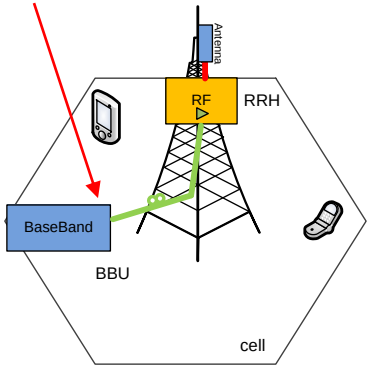


Conclusion: Where does 1914 fit?

1914.3 structure aware mapping of legacy CPRI to/from individually switchable component flows in an eNB for Ethernet-based eNBs

1914.3 structure agnostic mapping and aggregation of legacy CPRI flows over Ethernet transport network to non-ethernet eNBs.

1914.3 native RoE mapping utilizing e.g., Option 7.x splits and transport over Ethernet transport network.



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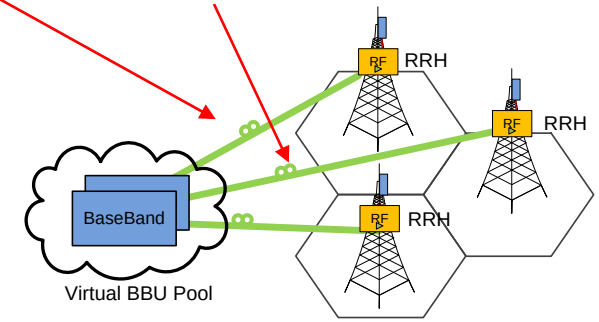
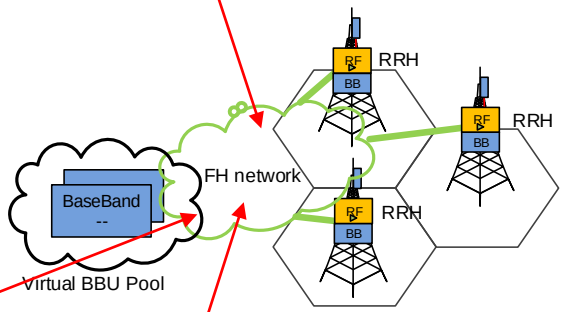


c) C-RAN with RRHs



d) C-RAN with new function split between BBU and RRH

1914.1 Node requirements
- Latency
- Synchronization
- OAM

1914.1 Network requirements
- Transport CoS – latency is a key factor
- Throughput (informative)
- Transport network slicing
- Jitter
- Synchronization
- OAM
- Security

Credit to: "IEEE 1914 NGFI (xhaul): building the transport foundation for 5G", Jouni Korhonen, Nordic Semiconductor; Aleksandra Checko, MTI Radiocomp

Contact information

- Website http://sites.ieee.org/sagroups-1914/
- Bi-weekly teleconferences

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  - stds-p1914-3@ieee.org
  - stds-1914-wg@ieee.org

Contributions are welcome

Thank you