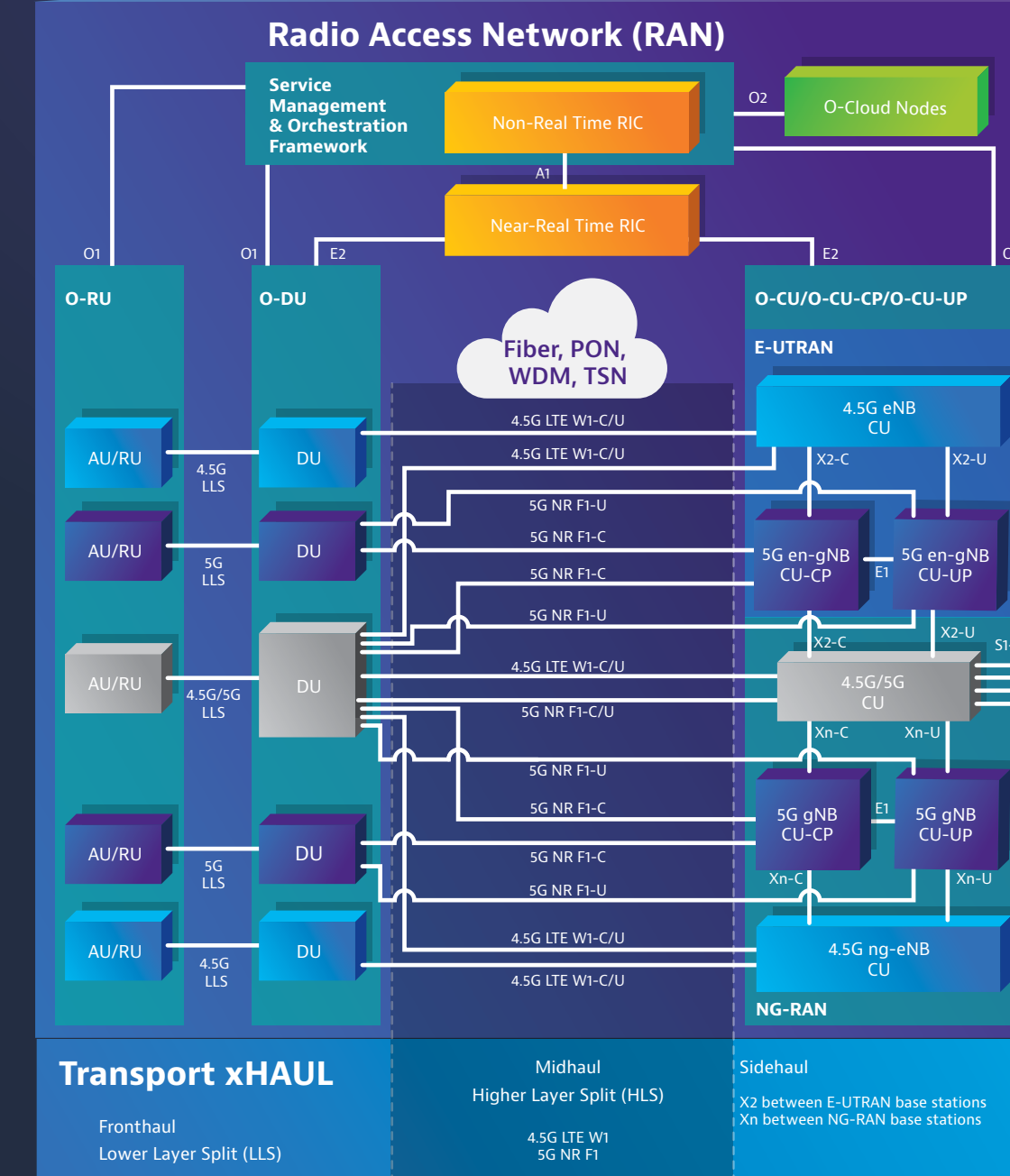


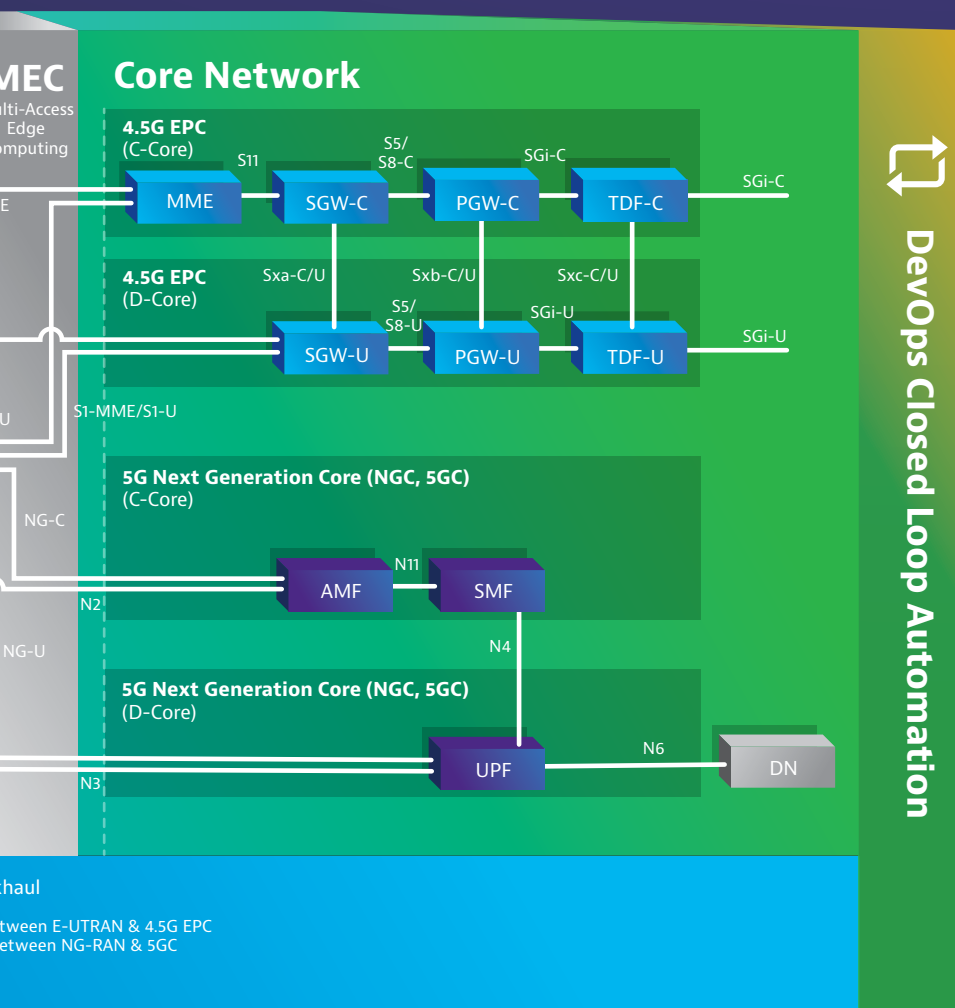
# 5G Architecture and Specifications



### VERTICALS, AUTONOMOUS DRIVING CELLULAR VEHICLE TO EVERYTHING C-V2X (V2I, V2N, V2V, V2P)

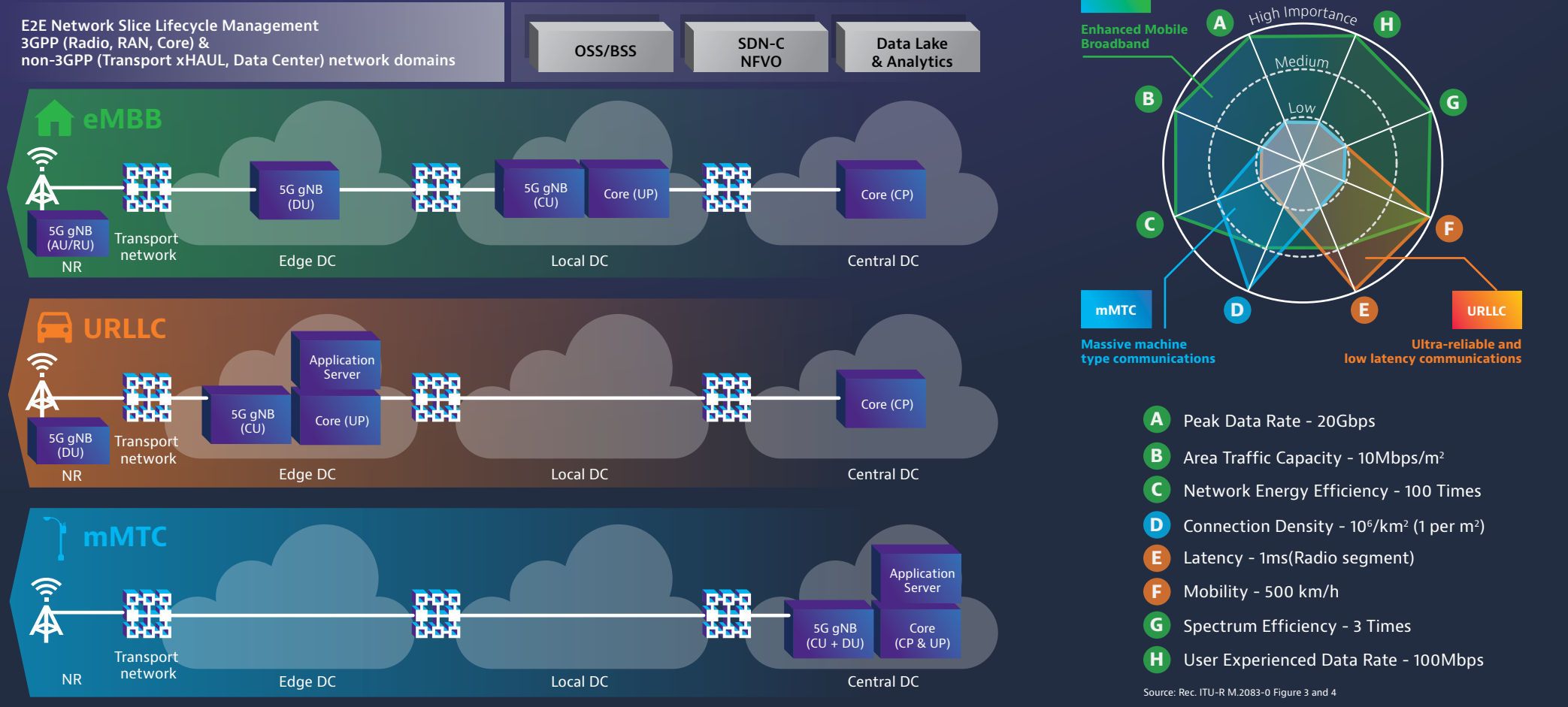


## 4G & 5G NEW RADIO (NR) END TO END (E2E) NETWORK ARCHITECTURE



## END TO END (E2E) NETWORK SLICING ARCHITECTURE

Examples of Service Adaptive Slices with Dynamic Deployments of Flexible Radio, RAN, Core functions and Transport, Data Centers resources

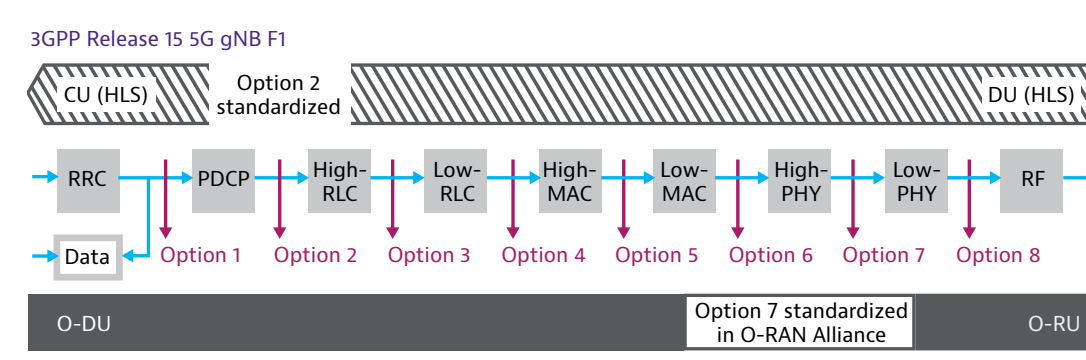


## viaivisolutions.com/5G

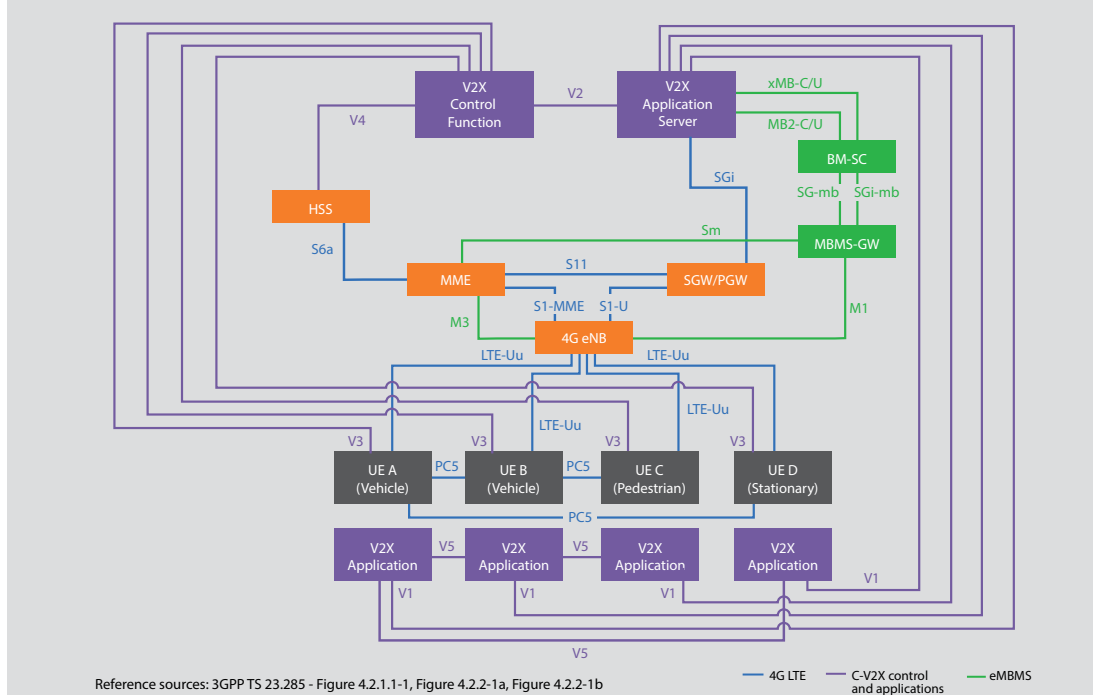
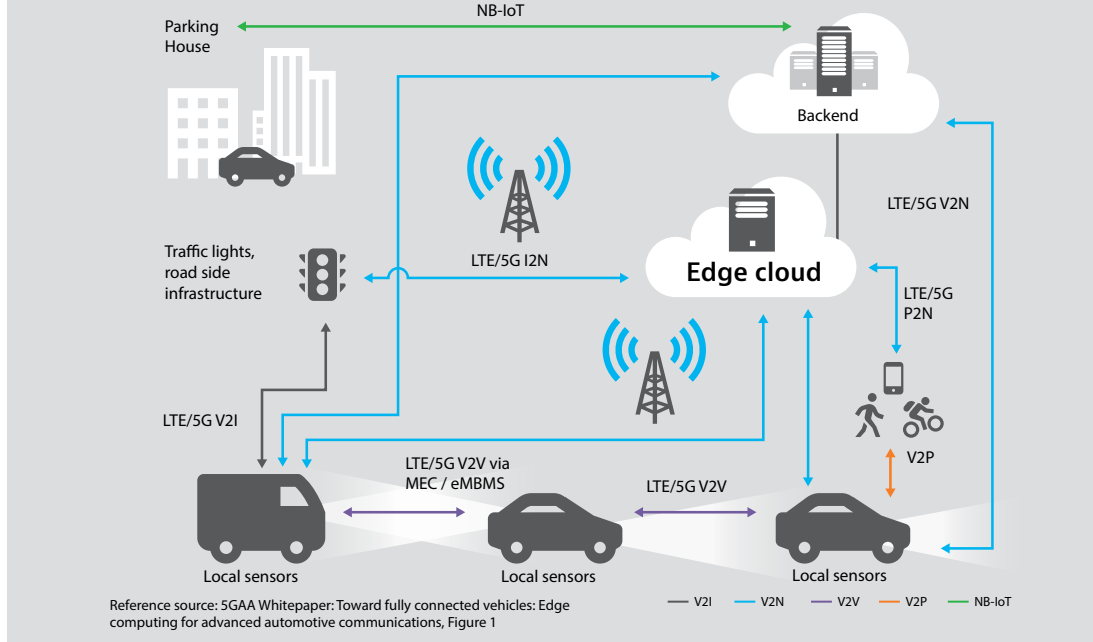
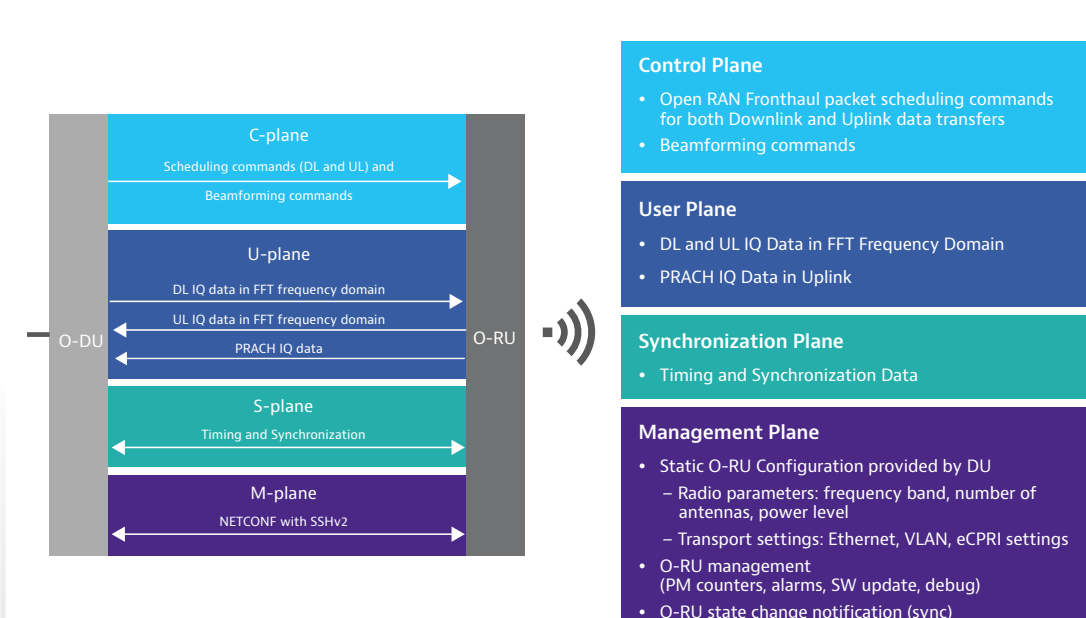
©2022 VIAMI Solutions Inc.  
Product specifications and descriptions in this document are subject to change without notice.  
30186386 928 0822 5G-top-10-use-cases

## XHAUL TRANSPORT

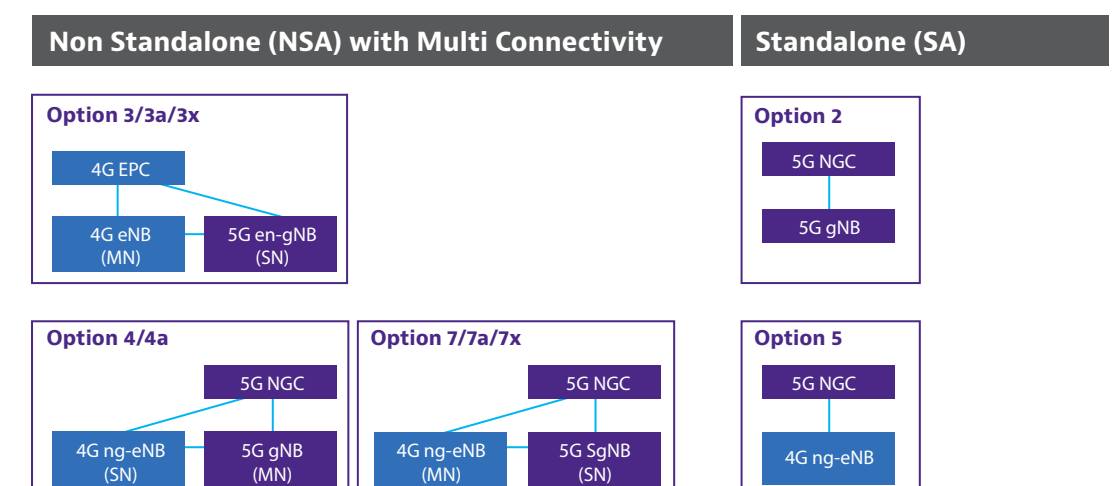
### 5G Disaggregated RAN Functional Split



### Protocol Stacks for Open Fronthaul (7-2x)

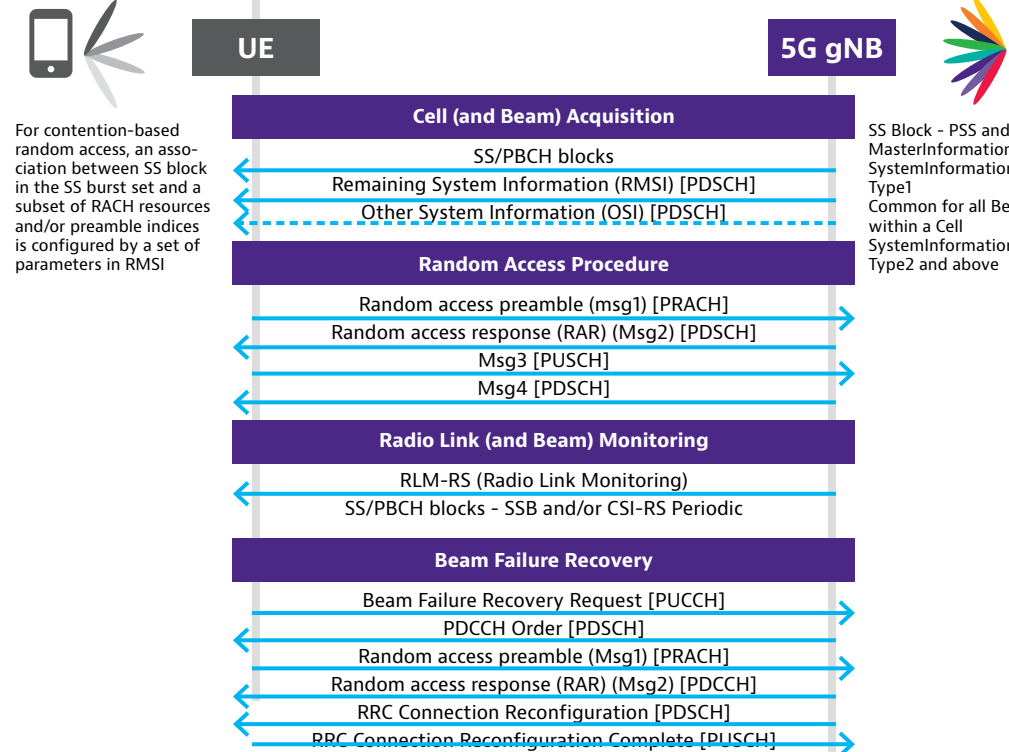


## 5G ARCHITECTURE OPTIONS

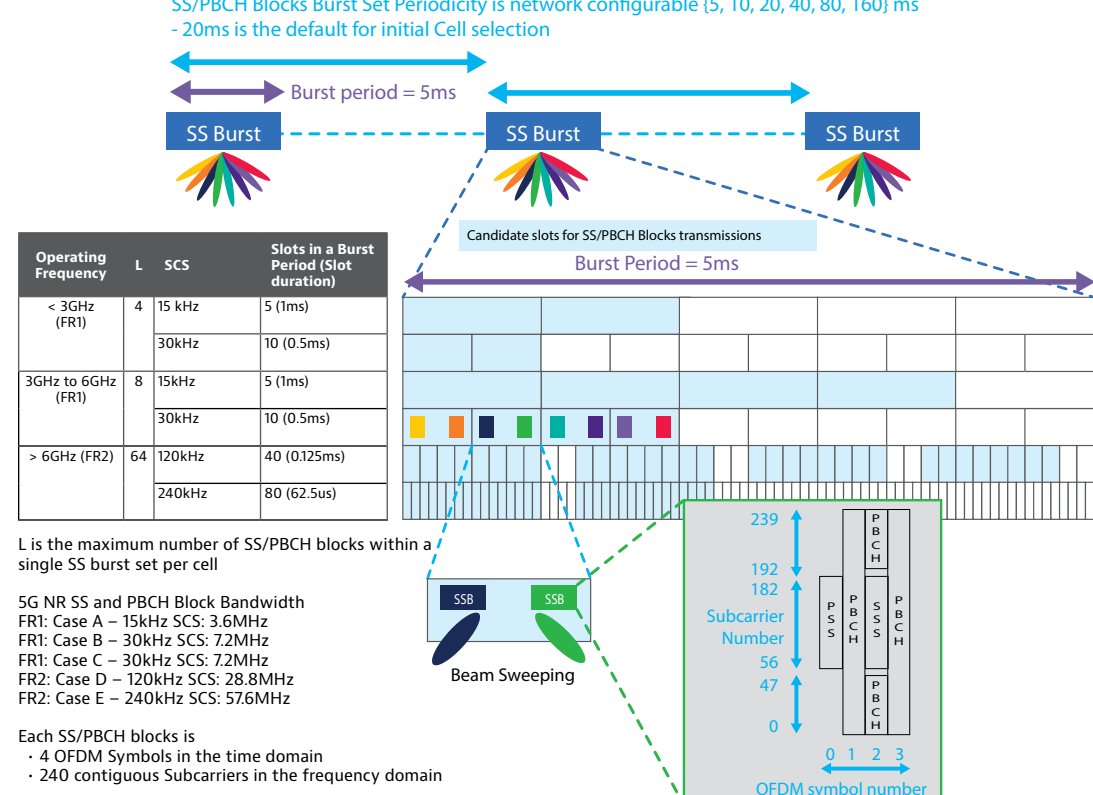


## 5G RADIO

### Massive MIMO Beam Forming & Management

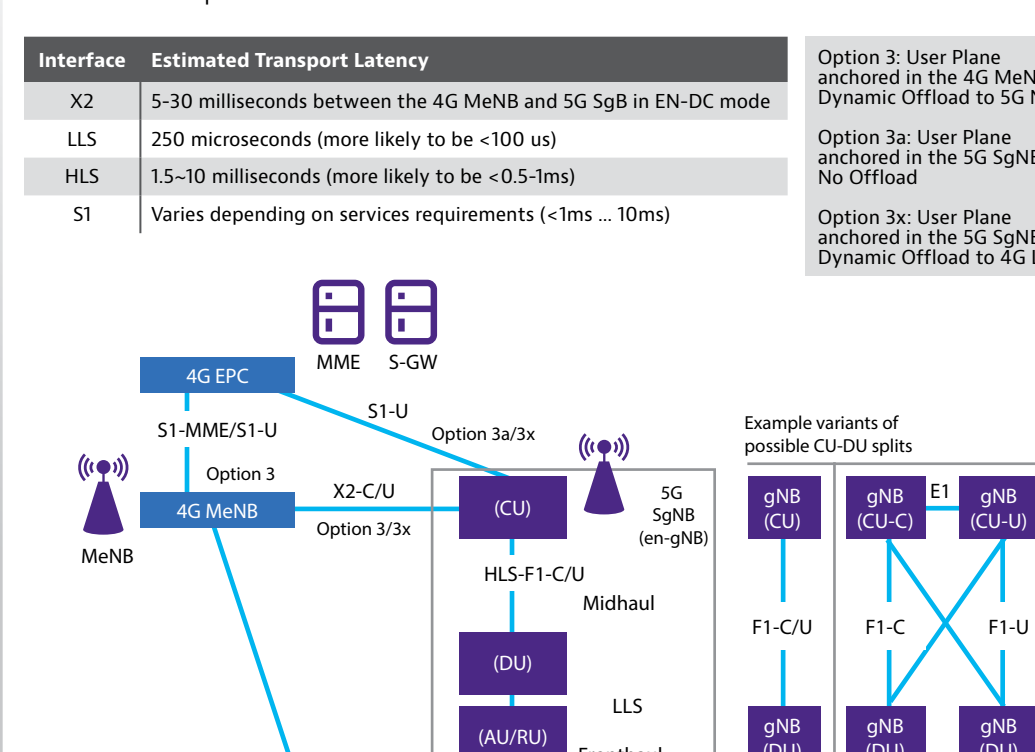


### SS and PBCH Block



## 5G RAN

### Non-Standalone (NSA) (EN-DC) Architecture with Disaggregated RAN Functional Split



## 5G 3GPP RELEASES HIGHLIGHTS

Release 15	Release 16	Release 17	Release 18: 5G-Advanced
Initial release of the 5G System - Phase 1	Enhancement for NR URLLC	NR MIMO NR sidelink enhancement	Under study and specification work (Only NR Item listed)
	NR based access to unlicensed spectrum	Dynamic Spectrum Sharing	MIMO evolution
	Integrated Access and Backhaul (IAB)	Industrial IoT / URLLC enhancement	NR RecCap UE
	NR V2X	IoT over Non-Terrestrial Network (NTN)	NR RelCap UE
	5G-XX with NR sidelink	NR Positioning enhancement	NR Network Energy Saving
	NR positioning support	NR Positioning enhancement	NR Network-controlled Repeaters
	Optimizations on UE radio capability signaling	Low-power wake-up signal and NR mobility enhancement	Multi-carrier enhancement
	Power Saving in NR	NR coverage enhancement	XR enhancement
	NR MIMO enhancement	NR sidelink relay enhancement	NR sidelink relay enhancement
	NR mobility enhancement	Multi-antenna MIMO enhancement	NR NTN enhancement
	2-stage RACH for NR	5G Multicast and Broadcast enhancement	NR NTN enhancement
	LTE-NR Dual Connectivity and NR Carrier Aggregation enhancement	Multi-SIM	NR Support for UAV
	LTE-based 5G terrestrial network	Integrated access and backhaul (IAB) enhancement	Dual NR/5G MIMO
	Cross Link Interference (CLI) handling and interference cancellation	NR Sidelink relay enhancement	In-Device Co-existence (IDC) enhancement
	Service Based Interface (SBI)	Mobile Relayed Small Data Transmission	NR Multicast and Broadcast service enhancement
	5G enablers for new verticals (IA, TSC, URLLC, NPN, CPE, V2X, etc.)	NR QoS enhancement	Mobile AB
		Network Automation for 5G - Phase 2	AIML for NG-RAN
		Edge Computing in 5G	NR QoS enhancement
		Proximity-based services	Network Automation for 5G - Phase 2
		Network Analytics enhancement	Edge Computing in 5G
		Network Slicing Phase 2	Proximity-based services
		Network Slicing enhancement	Network Analytics enhancement
		Advanced interactive services	Network Slicing Phase 2
		Access Traffic Steering, Switch and Splitting support in 5G architecture	Advanced interactive services
		Common API for 5G Core Network	Access Traffic Steering, Switch and Splitting support in 5G architecture
		Location Services enhancement	Common API for 5G Core Network
		Northbound APIs	Location Services enhancement

## Radio Protocols, Management & Procedures Specifications

4G LTE-Advanced Pro	5G New Radio (NR)
Service Data Adaptation Protocol	SDAP: 3GPP TS 37324
Radio Resource Control	RRR: 3GPP TS 38.331
Packet Data Convergence Protocol	PDCP: 3GPP TS 38.323
Radio Link Control	RLC: 3GPP TS 38.322
Medium Access Control	MAC: 3GPP TS 38.321
Physical Layer	PHY: NR-PHY
Physical channels and modulation	3GPP TS 38.211
Multiplexing and channel coding	3GPP TS 38.212
Physical layer procedures	3GPP TS 38.213 (control)
Physical layer Measurements	3GPP TS 38.215
User Equipment (UE) radio transmission and reception	3GPP TS 38.101-1: Part 1: Range 1 Standalone
Requirements for support of radio resource management	3GPP TS 38.101-2: Part 2: Range 2 Standalone
Physical layer, General description	3GPP TS 38.101-3: Part 3: Range 1 and Range 2 Interworking
Services provided by the physical layer	3GPP TS 38.101-4: Part 4: Performance requirements
User Equipment (UE) procedures in idle mode	3GPP TS 36.302
Multi-RAT Co-Existence	3GPP TR 37.872: Supplementary uplink (SUL) and LTE-NR co-existence

## Physical Channels & Signals

Downlink	5G New Radio (NR)
Channels	NR-PDSCH: Physical Downlink Shared Channel
Signals	NR-PSS: Primary Synchronization Signal
Uplink	NR-PUSCH: Physical Uplink Shared Channel
Channels	NR-PUSCH: Physical Uplink Shared Channel
Signals	NR-PSS: Primary Synchronization Signal

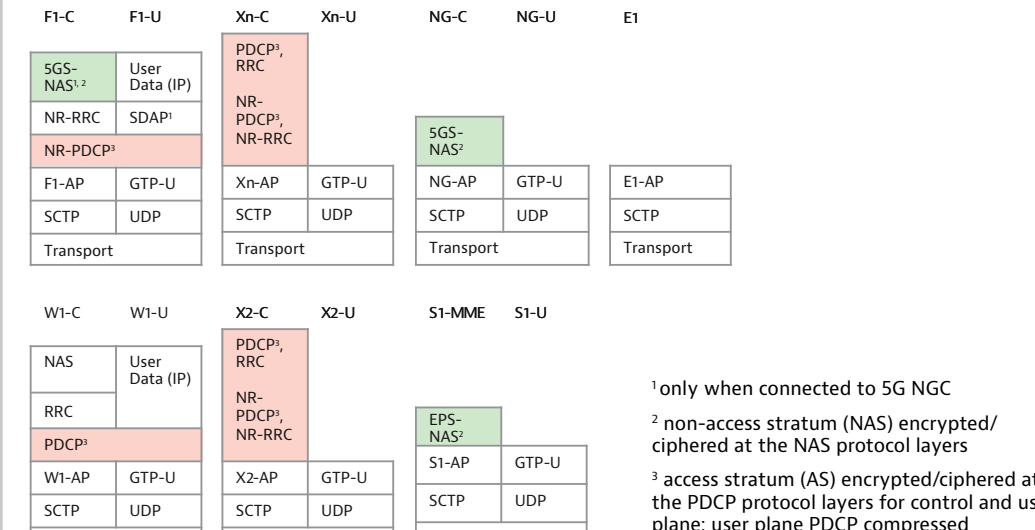
## Comparison of Key Radio Characteristics and Parameters

4G LTE-Advanced Pro	5G New Radio (NR)
Deployment mode	4G works independent of 5G
Frame Size, Subframe Size	10ms, 1ms
Waveform	OFDM
Multiplexing	FDD/TDD
Channel Modulation	Downlink: 1024QAM
Channel Coding	Data: Turbo Convolutional
Carrier Aggregation	Up to 32 CCs
Numerology	Static
Base Station (BS) radio transmission and reception	15kHz
Sub-carriers Spacing (SCS)	15kHz
Transmission Slot Duration	14 (7 per slot)
Slot Duration	0.5ms each slot
Slots per Subframe	2
Channel Bandwidth	Max. 20MHz
Bandwidth Part (BWP)	Not applicable
TTI	1ms

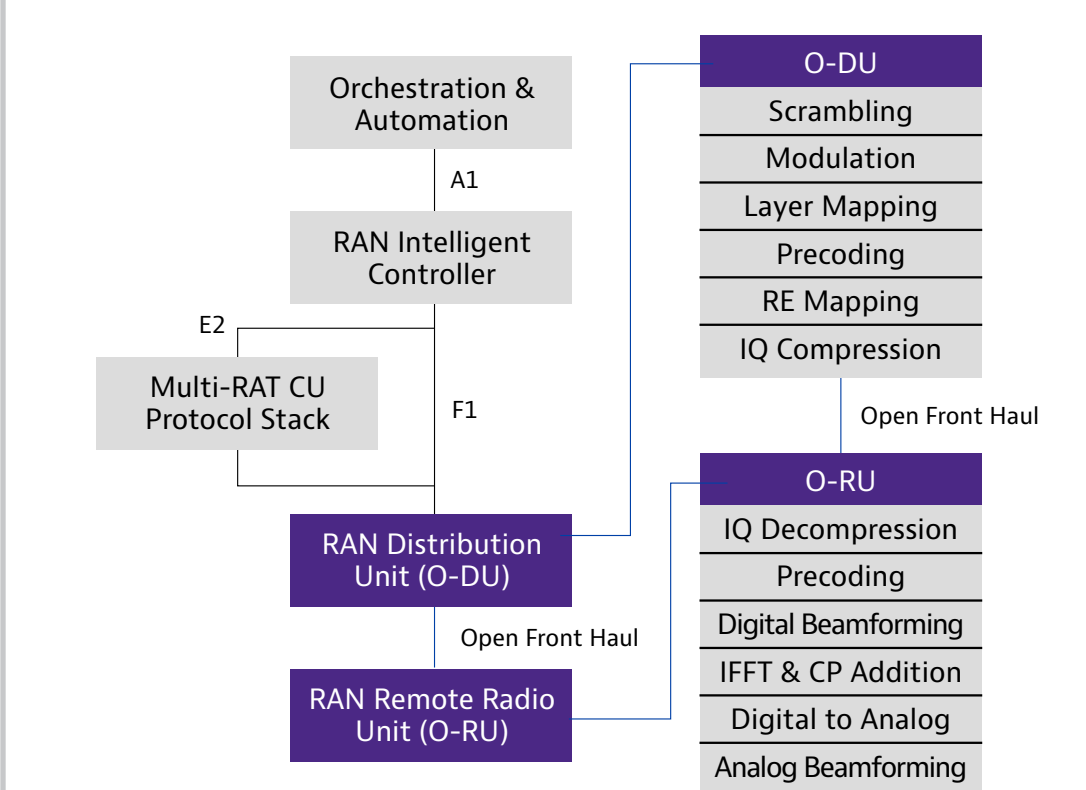
## Radio Access Network (RAN) Specifications

Interface	Protocols and Specifications	NE1	NE2
S1	S1-MME (S1-AP): 3GPP TS 36.413	MME	eNB
X2	X2-AP: 3GPP TS 36.423	eNB MNB	eNB-gNB/ SgNB
W1	W1-AP: 3GPP TS 37.473	eNB-CL	eNB-DU
NG	NG-C (NG-AP): 3GPP TS 38.413	NGC	NG-RAN
Xn	Xn-AP: 3GPP TS 38.423	gNB	gNB
F1	F1-AP: 3GPP TS 38.473	gNB-CU	gNB-DU
E1	E1-AP: 3GPP TS 38.463	gNB-CU-CP	gNB-CU-UP

## Radio Access Network (RAN) Protocol Stacks

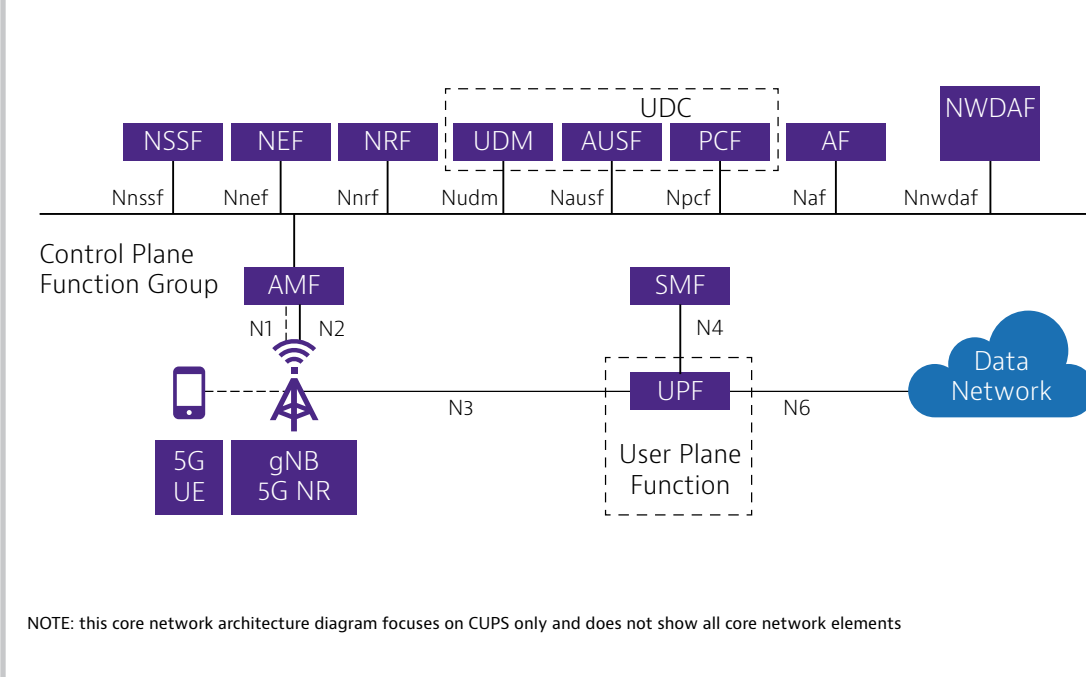


## Functional Split for Open Fronthaul (7-2x)



## 5G CORE

### Control and User Plane Separation with 5G Core Architecture



## 5G ARCHITECTURE SPECIFICATIONS

4G LTE-Advanced Pro	5G New Radio (NR)
System Architecture	3GPP TS 23.401: GPRS enhancements for E-UTRAN access
Policy and Charging Control	3GPP TS 23.501: Policy and charging control architecture
Security Architecture	3GPP TS 33.401: 3GPP SAE Security Architecture
RAN Overall Description	3GPP TS 38.300: E-UTRAN and E-UTRAN-NR Overall description, Stage 2
RAN Architecture	3GPP TS 38.401: E-UTRAN Architecture description
Multi-connectivity	3GPP TS 37.340: Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-connectivity, Stage 2
Control User Plane Separation	3GPP TS 23.214: Architecture enhancements for control and user plane separation of EPC nodes
CU DU RAN functions dis-aggregation	3GPP TS 37.470: W1 interface; General aspects and principles

## 5G NEW RADIO (NR) SPECIFICATIONS

Downlink	5G New Radio (NR)
Channels	NR-PDSCH: Physical Downlink Shared Channel
Signals	NR-PSS: Primary Synchronization Signal
Uplink	NR-PUSCH: Physical Uplink Shared Channel
Channels	NR-PUSCH: Physical Uplink Shared Channel
Signals	NR-PSS: Primary Synchronization Signal

## RANtoCore™ TRANSPORT, FIBER, METRO, AND RF TEST PRODUCTS



## SPECIFICATIONS

V4	V6	Specifications - Requirements & Architecture
V4 application is 1077956	V6 application is 1077956	TS 22.885: Study on LTE support for V2X services
Diameter	Diameter	TS 24.886: User Equipment (UE) to V2X Control Function Protocol aspects; Stage 3 SDP
SCIP	SCIP	TS 22.885: Service requirements for V2X services
Transport	Transport	TS 22.886: V2X Control Function to HSS aspects (V4); Stage 3

## ACRONYMS/ABBREVIATIONS

Acronym	Full Name	Acronym	Full Name
5G	5G Core Network	eMBB	Enhanced Mobile Broadband
SSG	5G System	NR	New Radio
AMF	Access and Mobility Management Function	NFVO	Network Function Virtualization Orchestrator
AS	Access Stratum	EPC	Evolved Packet Core
AUS	Authentication Server Function	EPS	Evolved Packet System
AU	Authentication User Plane Function	FR	Frequency Range
CU	Central Unit	FR1	Frequency Range 1
CUPS	Control and User Plane Separation	FR2	Frequency Range 2
DC	Data Center	GNSS	Global Navigation Satellite System
DN	Data Network	IPsec	Internet Protocol Security
DU	Distributed Unit	MME	Mobile Management Entity
eNB	Evolved NodeB	NAS	Non-Access Stratum
ENB	Evolved NodeB	SCS	Sub-carriers Spacing