Product Brief

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Product Highlights

- A wideband, real-time platform to replace existing narrow-band, non-real-time systems
- A full-featured platform for NG wireless evolution
- C/C++ programmable from the physical layer through to the Core Node (CN)
- Quick network onboarding and algorithm development in real-time networks
- Accelerated AI experimentation in wireless RAN workloads
- A pipeline for data collection, storage, and parsing using 3GPP schema for wireless communication.

Key Performance Indicators

The configuration and capabilities of ARC-OTA 1.3 are outlined in the following sections.

Number Antennas	4T4R
Number of Component Carriers	1x 100MHz carrier
Subcarrier Spacing (PDxCH; PUxCH, SSB)	30kHz
FFT Size	4096
MIMO layers	DL: 2 layers; UL: 1 layers
Duplex Mode	Release 15 SA TDD
Number of RRC connected UEs	16
Number of UEs/TTI	2
Frame structure and slot format	DDDDDDSUUU
	DDDSU
User plane latency (RRC connected mode)	< 10ms one way for DL and UL
Synchronization and Timing	IEEE 1588v2 PTP; SyncE; LLS-C3

Frequency Band	n78
Max Transmit Power	22dBM at RF connector
Peak Throughput KPI	DL: ~460Mbps; UL: ~112Mbps
Bi-directional UDP Traffic	> 4.0 hours exercised (Dell R750 + A100X)
	> 4.0 hours exercised (Gigabyte + A100 + CX6-DX)

Note

OTA test was performed with the following configuration: Samsung S22 + Gigabyte + DDDDDDSUUU.

Product Features

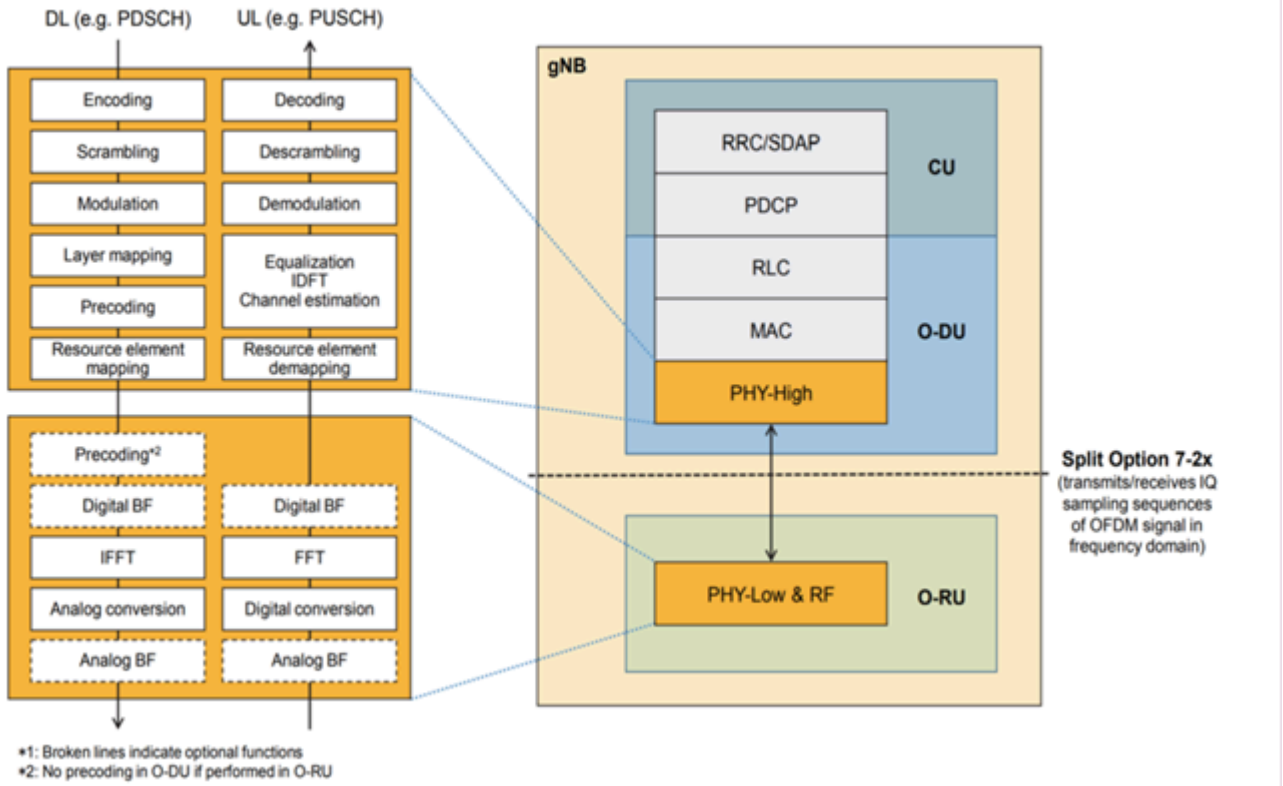
Feature	Description
Software Containers	A 3GPP Release 15 compliant and O-RAN 7.2 split 5G SA 4T4R wireless stack, with all network elements from Radio Access Network and 5G Core. Aerial CUDA-Accelerated RAN Layer 1 is integrated with Open Air Alliance (OAI) (https://openairinterface.org/) Distributed Unit (DU), Centralized Unit(CU), or a 5G NR gNB and 5G Core Node(CN) network elements.
Deployment Blueprint	A blueprint to ease developer onboarding, staging, and integration of all advanced 5G network components, including step-by-step verification through bi-directional UDP traffic with tutorials, FAQs, and troubleshooting tips to configure all the network components for a quick-turnaround live network. SDK Manager automation takes this a step further and automates developer environment setup.
Network Component Blueprint	Advanced 5G NR network component blueprint and NVIDIA lab integrated and OTA-qualified HW BOM manifest.
Source Code	Complete access to source code in C/C++, from Layer 1 through 5GC to jump start customizations and next-generation algorithm research

Access	
Service Management	The Kubernetes Service Management optional developer extension from Sterling provides two capabilities: Kubernetes Service Orchestration and Service Monitoring.

5G Fronthaul Features

RU Category	Category A
FH Split Compliance	7.2x with DL low-PHY to include Precoding, Digital BF, iFFT+CP and UL low-PHY to include FFT-CP, Digital BF
FH Ethernet Link	25Gbps x 1 lane
Transport encapsulation	Ethernet
Transport header	eCPRI
C Plane	Conformant to O-RAN-WG4.CUS.0-v02.00 7.2x split
U Plane	Conformant to O-RAN-WG4.CUS.0-v02.00 7.2x split
S Plane	Conformant to O-RAN-WG4.CUS.0-v02.00 7.2x split
M Plane	Conformant to O-RAN-WG4.CUS.0-v02.00 7.2x split
RU Beamforming Type	Code book based

5G NR gNB Features



Component	Capabilities
gNB PHY	Aerial CUDA-Accelerated RAN Layer 1 PHY (cuPHY) adheres to 3GPP Release 15 standard specifications to deliver the following capabilities. PHY capabilities include the following: • Error detection on the transport channel and indication to higher layers • FEC encoding/decoding of the transport channel • Hybrid ARQ soft combining • Rate matching of the coded transport channel to physical channels • Mapping of the coded transport channel onto physical channels • Power weighting of physical channels • Modulation and demodulation of physical channels including • Frequency and time synchronization • Radio characteristics measurements and indication to higher layers • Multiple Input Multiple Output (MIMO) antenna processing • Transmit Diversity (TX diversity) • Digital and Analog Beamforming • RF processing

	3GPP standards specifications that define the Layer 1 compliance are: • TS 38.211 (38.211 v15.8.0) numerologies, physical resources, modulation, sequence, signal generation • TS 38.212 (38.212 v15.8.0) Multiplexing and channel coding • TS 38.213 (38.213v15.8.0) Physical layer procedures for control • TS 38.214 (38.214v15.8.0) Physical layer procedures for data • TS 38.215 (38.215v15.8.0) Physical layer measurements • TS 38.104 (base station radio Tx and Rx) Base Station (BS) radio transmission and reception Aerial CUDA-Accelerated RAN complies with ORAN FH CUS specification version 3 (version 4 for power scaling) Aerial CUDA-Accelerated RAN complies with northbound interfaces adopted by industry based on Small Cells Forum for Layer 1 and Layer 2 (SCF FAPI).

gNB MAC	• MAC -> PHY configuration using NR FAPI P5 interface
	• MAC <-> PHY data interface using FAPI P7 interface for BCH PDU, DCI PDU, PDSCH PDU
	• Scheduler procedures for SIB1
	• Scheduler procedures for RA
	  ◦ Contention Free RA procedure
	  ◦ Contention Based RA procedure
	  ▪ Msg3 can transfer uplink CCCH, DTCH or DCCH messages
	  ▪ CBRA can be performed using MAC CE or C-RNTI
	• Scheduler procedures for CSI-RS
	• MAC downlink scheduler
	  ◦ phy-test scheduler (fixed allocation and usable also without UE)
	  ◦ regular scheduler with dynamic allocation
	  ◦ MCS adaptation from HARQ BLER
	• MAC header generation (including timing advance)
	• ACK / NACK handling and HARQ procedures for downlink
	• MAC uplink scheduler
	  ◦ phy-test scheduler (fixed allocation)
	  ◦ regular scheduler with dynamic allocation
	  ◦ HARQ procedures for uplink
	• Scheduler procedures for SRS reception
	  ◦ Periodic SRS reception
	  ◦ Channel rank computation up to 2x2 scenario
	  ◦ TPMI computation based on SRS up 4 antenna ports and 2 layers

	• MAC procedures to handle CSI measurement report
	  ◦ evaluation of RSRP report
	  ◦ evaluation of CQI report
	• MAC scheduling of SR reception
	• Bandwidth part (BWP) operation
	  ◦ Handle multiple dedicated BWPs
	  ◦ BWP switching through RRCReconfiguration method

gNB RLC	• Segmentation and reassembly procedures • RLC Acknowledged mode supporting PDU retransmissions • RLC Unacknowledged mode • DRBs and SRBs establishment/handling and association with RLC entities • Timers implementation • Interfaces with PDCP, MAC • Interfaces with gtp-u (data Tx/Rx over F1-U at the DU) • Send/Receive operations according to 38.322 Rel.16
gNB PDCP	• Integrity protection and ciphering procedures • Sequence number management, SDU discard and in-order delivery • Radio bearer establishment/handling and association with PDCP entities • Interfaces with RRC, RLC • Interfaces with gtp-u (data Tx/Rx over N3 and F1-U interfaces) • Send/Receive operations according to 38.323 Rel.16
gNB SDAP	• Establishment/Handling of SDAP entities. • Transfer of User Plane Data • Mapping between a QoS flow and a DRB for both DL and UL • Marking QoS flow ID in both DL and UL packets • Reflective QoS flow to DRB mapping for UL SDAP data PDUs • Send/Receive operations according to 37.324 Rel.15
gNB X2AP	• Integration of X2AP messages and procedures for the exchanges with the eNB over X2 interface according to 36.423 Rel. 15

gNB NGAP	• Integration of NGAP messages and procedures for the exchanges with the AMF over N2 interface according to 38.413 Rel. 15
	  ◦ NGAP Setup request/response
	  ◦ NGAP Initial UE message

	◦ NGAP Initial context setup request/response ◦ NGAP Downlink/Uplink NAS transfer ◦ NGAP UE context release request/complete ◦ NGAP UE radio capability info indication ◦ NGAP PDU session resource setup request/response • Interface with RRC
gNB F1AP	• Integration of F1AP messages and procedures for the control plane exchanges between the CU and DU entities according to 38.473 Rel. 16 ◦ F1 Setup request/response ◦ F1 DL/UL RRC message transfer ◦ F1 Initial UL RRC message transfer ◦ F1 UE Context setup request/response ◦ F1 gNB CU configuration update • Interface with RRC • Interface with gtp-u (tunnel creation/handling for F1-U interface)
gNB GTP-U	• New gtp-u implementation supporting both N3 and F1-U interfaces according to 29.281 Rel.15 ◦ Interfaces with RRC, F1AP for tunnel creation ◦ Interfaces with PDCP and RLC for data send/receive at the CU and DU respectively (F1-U interface) ◦ Interface with SDAP for data send/receive, capture of GTP-U Optional Header, GTP-U Extension Header and PDU Session Container.

5G Core Features

OAI CN	OAI CN supports AMF, AUSF, NRF, NSSF, SMF, UDM, UDR, UPF network functions of the 5GC