

O-RU SIMULATOR

Data Sheet

OVERVIEW

The O-RAN architecture is based on hardware and software disaggregation and using RAN applications as cloud-native functions. Validation strategies for O-RAN require a completely new approach based on software simulators vs. the traditional proprietary hardware.

The Simnovus software solution is designed for this new architecture.

Validate 5G Combined O-DU and O-CU Using Software

The Simnovus O-RU Simulator offers a comprehensive solution to validate the functionality and performance of the combined O-DU (O-RAN distributed unit) and O-CU (O-RAN central unit) over eCPRI-based 7.2x split fronthaul interface. The Simnovus solution simulates multiple O-RUs and hundreds of UEs generating realistic traffic models.

Our highly intuitive, web-based user interface provides superior user experience enabling quick ramp-up. It runs on commercial off-the-shelf (COTS) hardware enabling parallel test beds in a cost-effective manner.

Eliminate Analog Issues

With our solution, the need to procure and configure an O-RU goes away. With the traditional validation products, a lot of time is lost in making sure the analog parameters like gain, power, attenuation, carrier frequency offsets are calibrated between the UE Simulator and the O-RU.

Our solution not only completely removes the need for these but also makes it easy to configure scenarios like signal fading, channel modeling, and handover use cases.

All-Inclusive Subscriptions

Our solution is sold as an all-inclusive annual subscription. Simply choose the number of UEs to select the subscription needed. This modern subscription model enables customers to create parallel test beds without large upfront Capex.



Scale Easily

Multiple licenses of the O-RU Simulator can be combined to validate higher capacity and performance. This model allows for the maximum flexibility throughout the validation life cycle as both functional and performance validation can be achieved using the same product.

No-Script Automation

Automation is built into our solution to accelerate Continuous Integration/Continuous Development (CI/CD). Our solution includes a rich set of pre-packaged automation libraries ready for integration into your automation framework. Scripts are auto-generated with our powerful and flexible web-based UI, allowing for CI/CD and eliminating the need to write your own scripts. Simply choose from our comprehensive list of RESTful APIs to control the test and obtain test results.



Validation of combined O-DU, O-CU



FEATURE SUMMARY

Software on COTS	Simulates multiple O-RUs and hundreds of UEs; scales up horizontally, quickly and efficiently
All Digital Interfaces	Abstracts radio interface with O-RU emulation
Multi-Purpose	Enables functional, interoperability, and performance testing of the combined O-DU and O-CU
Multi-Topology	Enables validation of combined O-DU and O-CU in wrap around or end-to-end (E2E) configuration
Realistic Scenarios	Generates realistic traffic patterns towards the combined O-DU and O-CU
Advanced Troubleshooting	Provides multi-layer logging and multi-level statistics with correlation

KEY BENEFITS

Enables Parallel Testbeds	Software on COTS enables parallel test beds to accelerate validation
Simplifies Test Setup	Digital interfaces remove lab setup complexities by eliminating need for radio equipment
No Expensive Capex	Flexible subscription enables broad coverage without millions in Capex
Quick Ramp-up	Packaged tests and intuitive workflows ensure fast and robust validation
100% Automation on Day 1	Packaged scripts and RESTful APIs enable out-of- the-box automation and CI/CD acceleration
2x Faster Troubleshooting	Comprehensive multi-layer logging and multi-level statistics ensure faster problem isolation



O-RU SIMULATOR SPECIFICATIONS

WG4 ORAN Specifications	O-RAN Fronthaul Control, User and Synchronization Plane specification v7.0 O-RAN Open Fronthaul Management Plane specification v7.0 – (Hierarchical model) O-RAN Fronthaul Interoperability Test specification (IOT) v6.0
Simulated UEs	Up to 256
eCPRI Specifications	v2.0
Fronthaul Split	7.2a
Test Configuration	Cat-A O-RU Frequency Range 1 FDD and TDD 100 MHz Sub Carrier Spacing: 15, 30 and 60 KHz Number of antennas: up to 4 x 4 MIMO
3GPP Release	Rel.16
M-Plane	Hierarchical model • JSON-based static configuration
S-Plane	Transport Synchronization configurations: LLS-C1, LLS-C2, LLS-C3 PTP telecom profiles: ITU-T G.8275.1 & ITU-T G.8275.2
C & U-Plane	Section type 0, 1 and 3 Programmable static-bit-width fixed point IQ (16 bits) Block-floating point compression Static configuration of U-Plane IQ format and compression header eCPRI with concatenation Application layer fragmentation and reassembly L2: Ethernet with support of jumbo frames QoS over fronthaul
CUS-Plane IoT Profile	A. 2.1.1 NR TDD IOT Profile 1 -NR-TDD-FR1-CAT-A-NoBF



O-RU Simulator Specifications cont.

UE Categories	5G
5G Deployment Modes	SA
Handovers	Inter/intra-frequency, inter-duplex,
QAM	QPSK, 16 QAM, 64 QAM, and 256 QAM
Channel Emulation	AWGN, 3GPP channel models (AWGN, EPA, EVA, ETU, TDL: A/B/C)
Power Control	UL Power Control, PHR, TPC
Dual Stack UE	Supported
Volte/Vonr	Supported with per-UE MOS calculation
Other Application Traffic	Fixed payload UDP and TCP data, FTP, ICMP PING
Automation	RESTful APIs
Statistics	Comprehensive counters and KPI's as per the specification Statistics at different levels Global, per RU, per Antenna, per UE Separate counters for UL and DL for C and U plane
Logging	UE Logs: All layers (L1, L2 and L3), SIP Fronthaul Logs: C-plane, U-plane, and M-plane
Miscellaneous	 VLAN Support Data flow separation based on VLAN ID Data flow separation based on MAC addresses Uplink Traffic Management using C-Plane



FUNCTIONAL OVERVIEW

	Cell	Subscriber	User Plane		Traffic	Mobility	Settings	
RAT Type 5G	i: SA	Carrier Aggregation	No	Mobil	ity No			
Cell #1			_					Advanced Settings
Cell Type *	5G 🔨	> SCS (KHz) *(i)	30	~	DL Antennas *	2 ~	PDCCH Decode Opt	Disable ~
BS ID *	1	Bandwidth (MHz) *	100	~	UL Antennas *	2 ~		
Duplex Mode *	TDD	PRACH ()	0		Tx Gain (dB)	40 40		
Band *	n78 🔨	· .			Rx Gain (dB)	40 40		
DL-NR-ARFCN *()	623484				Global Timing Advance			
SSB NR-ARFCN *	620736				Rx to Tx Latency ()	2		
					RII Category *	CATEGORY A		
						-0+2-24-8-(17		
					Source MAC *	a2:D3:34:TD:61:e7		
					Destination MAC *	b4:96:91:a3:12:70		
					Fronthaul			
	RAT Type 56 Cell #1 Cell Type * BS ID * Duplex Mode * Band * DL-NR-ARFCN *① SSB NR-ARFCN *	Cell #1 Cell #1 Cel	Cell Subscriber RAT Type Sc: SA Carrier Aggregation Cell 81 Cell 7ype* SG SCS (KH2) *0 Bs ID* 1 SG Bandwidth (MH2) *0 Duplex Mode* TDD PRACH(-) Band* n78 PRACH(-) BsB N*-ARFCN* 620736 SSB NR-ARFCN*	Cell Subscriber User Plane RAT Type 56: SA Carrier Aggregation No No Cell #1 Cell #1 SCS (KHz) *① 30 SE Cell Type * 56 SCS (KHz) *① 30 SE Bs ID * 1 SB advirtin (MHz) *① 100 SE Duplex Mode * TDD PRACH① 0 SE DL-NR-ARFCN *① 623484 SSB NR-ARFCN * 620736	Coll Subscriber User Plane RAT Type 56: SA Carrier Aggregation No Mobil Cell 91 Cell 7ype* 56 SCS (KHz) *① 30 ✓ BS ID* 1 SB andwidth (MHz) *① 100 ✓ Duplex Mode* TDD ✓ PRACH① 0 Band* n78 ✓ SSB NR-ARFCN * 620736	Cell Subscriber User Plane Traffic RAT Type 50: SA Carrier Aggregation No Mobility No Cell #1 50: SA Carrier Aggregation No Mobility No Cell #1 56: SA SCS (KHz)*① 30 DL Antennas* Data 1 SG SCS (KHz)*① 100 UL Antennas* Bs ID* 1 Sandwidth (MHz)*① 100 UL Antennas* Duplex Mode* TDD PRACH① 0 Tx Gain (d8) Band* n78 S23484 S23484 S23484 SSB NR-ARFCN* 620736 Rx to Tx Latency① Rt to Tx Latency① Rt to Tx Latency① Rt to Tx Latency① Rt Category* Source MAC* Luncharter Luncharter Extension MAC* Extension MAC* Luncharter Luncharter Foothball Foothball	Cell Subscriber User Plane Traffic Mobility RAT Type S6: SA Carrier Aggregation No Mobility No Cell 37 Carrier Aggregation No Mobility No No Mobility No Cell 70pe* 56 S55 (KHz)*① 30 DL Antennes* 2 ~ Bs D* 1 Pandwidth (MHz)*① 100 UL Antennes* 2 ~ Duplex Mode* TDD PRACH① 0 Tx Gain (dB) 40 40 Bsnd* n78 Rx Gain (dB) 40 40 40 40 StantARFCN* 620726 Rt Type Rt Category* Category. 2 Rt Gain (dB) 40.40 40 No KD Type Ed20726 Rt Gain (dB) 40.40 50	Cell Subscriber Der Plane Taffe Mobility Settings RAT Type Sc: SA Carrier Aggregation No Mobility No Cell Type* S6 SCS (64t) *0 30 U. Antennas* 2 PDCCH Decode Opt SB ID* 1 Bandwidth (MH2) *0 100 U. Antennas* 2 V Duplex Mode* TDD PRACH 0 TX Gain (89) 40 40 Band* n78 V FX Gain (89) 40 40 Band* n78 V V FX Gain (89) 40 40 Band* n78 V V FX Gain (89) 40 40 Band* n78 V V FX Gain (89) 40 40 Band* n78 V V FX Gain (80) 40 40 Band* n78 V V FX Gain (80) 40 40 Band* n78 V V FX Gain (80) 40 40 Band* n78 V V FX Gain (80) 40 40 Band* n78 V V FX Gain (80) 40 40 Band* n78 V FX Gain (80) 40 40 40 Band* n78 V FX Gain (80) 40 40 40 Band* n78 V FX Gain (80) 40 40 40 Band* n78 V FX Gain (80) 40 40 40 Band* N <

Generate complex test profiles in minutes with our step-by-step-test creation wizard.

Intuitive Web Interface

With Simnovus's web graphical user interface (GUI), there is no need to install any client software to use our solution. Plus, once you upgrade the server, all users will have direct access to the latest software by simply logging in on their browser.

Simplified Test Configurations

Our solution has an intuitive step-by-step workflow to walk users through the generation of even the most complex test profiles in just a few minutes. For more customized validations, users can easily edit our library of prepackaged tests. A variety of configurations are readily available, including multi-UE test cases with mobility scenarios and channel models.



Extensive Statistics

Simnovus provides a wide range of key performance indicators (KPIs) at the global scale and allows users to drill down to per O-RU instance, percell, and per-UE levels. Examine current values and data over time for trend analysis.



Examine trends with global statistics.

Compare various uplink and downlink statistics for visual analysis and troubleshooting.



Drill down to per-cell and per-UE level statistics.

In addition, users have access to various message counters at the protocol level, including NAS and RRC messages.

definition result definition definitio	. 64 64 64 64 66 66 1022 64 66 66 66 66 66 66 66 66 66 66 66 66	110 540 520 500 60 40 40 20					
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Access layer-by-layer message counters.



Drill down to per-O-RU and per-eAxC level statistics.

Detailed Logging and Troubleshooting

To help users analyze base station behavior, our solution provides advanced logging and troubleshooting capabilities.

Key logging capabilities include:

UE and cell level

- View detailed logging of all layers (PHY, MAC, RLC, PDCP, RRC, NAS)
- Selectively enable or disable logging of a layer
- Choose log level for each layer of the stack
- Filter logs for a particular UE or cell
- Switch from detailed decoding of NAS and RRC messages to logs of all PHY layers
- Save logs in text or graphical format for offline analysis

 Detailed C Plane logs for Extended Antenna-Carrier (eAxC) configured, both uplink and downlink

t Case List /1Cell_1UE_a /	Logger							🔲 (niles 🕕	Live Log
JE. Corru		sti = 1	28.2				× 0)		
Time	RU ID	Cell ID	eAxC ID	SEN	Message Type	Dir	Message		
01/20/1970 15:23:28.820	0	0	0	128.2	C-Plane	DL.	C-Plane Type = 1(Most channels)ID = 17(all PRBs)		
01/20/1970 15:23:28:820	0	0	1	128.2	C-Plane	OL.	C Plane Type = 1(Most channels)ID = 17(all PRBs)		
01/20/1970 15:23:28.822	0	0	0	128.2	CiPlane	DL.	C-Plane Type = 1(Most channels)ID = 17(all PRBs)		
01/20/1970 15:23:28:822	0	0	1	128.2	C-Plane	OL.	C-Plane Type = 1(Most channels)ID = 17(all PRBs)		
01/20/1970 15:23:28:825	0	0	1	128.2	C.Plane	DL.	C Plane Type = 1(Most channels)(D = 17(all PRBs)		
essage									
Name Type = 1(Most channels)(D = 1	7(all PREs)								
Issage: O Hate 3 PRI Message: (
PRI Message: ECPRILRT.CONTROL	DATA.								
PRI Payload: 20,									
arC_identifier: (
LPortJD: 0.									
ndSector_ID: 0,									
CJD: 0,									
LPort_ID: 1									
ownee ID: 2.									
bsequence ID: 0.									
91.1									
dio Application Message: C-Plane M	fessage: {								
ction Type: 1.									
Plane Common Header Fields: (
taDirection 0(UL) 1(DL): 1,									
erindes: 0.									
meld: 128,									
bframeld: 1,									
eld: 0,									
artSymbolid: 0,									
mberOfsections: 1,									
CompHdr: (
AgW6dth: 16.									
Parameter A									

O-RU			Q, B	ter Display Fi	iter					0
Time	DIFF	Layer	Dir	UE ID	Cell ID	HFN	SFN	RINTI	Info	Message
02/19/2023 00:20:39.708	0	PHY	UL.	23	0	0	234.19	0x42be	PUCCH	format=2 prb=100:10 symb=12:1 sr=0 osi=1001111
02/19/2023 00:20:39.708	0	PHY	UL.	39	0	0	234.19	0x4635	PUCCH	format=2 prb=110:10 symb=12:1 sr=0 csi=1001111
02/19/2023 00:20:39.712	+0.004	PHY	DL.	45	0	0	235.4	0x45bb	PDOCH	ss.,id=0.coe,index=27.al=1.doi=0,1.k2=4
02/19/2023 00:20:39.713	+0.001	MAC		45	0					periodio 85R triggered
02/19/2023 00:20:39 713	0	PHY	UL.	24	0	0	235.8	0x44e3	PUCCH	format=2 prb=100:10 symb=12:1 sr=0 csi=1001111
02/19/2023 00:20:39.713	a	PHY	UL.	-40	0	0	235.8	0x4b84	PUICH	format=2 prb=110:10 symb=12:1 ar=0 csi=1001111
02/19/2023 00:20:39.713	0	PHY	UL.	45	0	0	235.8	0x45bb	PUSCH	harq=4 prb=0.10 symb=0.11 CW0: tb.Jen=185 mod=4 rv.jdx=2 cr=0.85 reto=1
02/19/2023 00:20:39.713	0	PHY	UL.	25	0	0	235.9	0x44e4	PUCCH	format=2 prb=100:10 symb=12:1 sr=0 osi=1001111
02/19/2023 00:20:39.713	0	PHY	UL.	41	0	0	235.9	0x4885	PUICH	format=2 prb=110:10 symb=12:1 sr=0 csi=1001111
02/19/2023 00:20:29.718	+0.005	PHY	UL.	25	0	D	235.18	0x493a	PUOCH	format=2 prb=100:10 symb=12:1 ar=0 csi=1001111
02/19/2023 00:20:39.718	0	PHY	UL.	42	0	0	235.18	0x4886	PUDCH	format=2 prb=110:10 symb=12:1 sr=0 osi=1001111
02/19/2023 00:20:39.718	0	PHY	UL.	27	0	0	235.19	0x47ac	PUCCH	format=2 prb=100:10 symb=12:1 sr=0 csi=1001111
02/19/2023 00:20:39.718	a	PHY	UL.	43	0	0	235.19	0x4998	PUCCH	format=2 prb=110:10 symb=12:1 ar=0 csi=1001111
02/19/2023 00:20:39.720	+0.002	PHY	DL.	45	0	0	235.1	0x7111	PDOCH	ss_id+1 cce_index+0 al+4 dbi+1_0
02/19/2023 00:20:39 722	+0.002	PHY	DL.	45	0	0	235.4	0x45bb	PDOCH	ss_id+3 coe_index+27 al+1 doi+0_1 k2+4
02/19/2023 00:20:39 722	0	PHY	DL.	45	0	0	235.5	0x45bb	PDOCH	ss.jd+3 cce.jndes+26 al+1 dci+0_1 k2+4
02/19/2023 00:20:39.722	0	MAG	UL.	45	0					SBSR: kg=0 ba+0 FAD: ker+182
02/19/2023 00:20:39 723	+0.001	PHY	UL.	45	0	0	235.8	0x45bb	PUSCH	harq=4 prb=0.10 symb=0.11 CWI: tb,Jen=185 mad=4 rv,Jdx=3 cr=0.35 retx=2
02/19/2023 00:20:39 223	0	PHY	UI.	45	0	0	235.9	0x45bb	PLISCH	haror5 orb=0.10 events=0.11 CWD: th: lenv185 mod=2 rv: ide=0.cr=0.66 reto=0

Detailed layer logging.

OFH C-plane logging in JSON format.



SYSTEM REQUIREMENTS

The Simnovus solution runs on COTS hardware and comprises of the following components:

Manager: GUI and controller node

O-RU Simulator: simulating UEs and O-RUs

It requires one or more multi 25GbE Ethernet Network Adaptor PCIe cards for connectivity on the fronthaul.

Recommended card:

Broadcom57504 Quad Port 10/25GbE, SFP28, OCP NIC 3.0

Intel® Ethernet Converged Network Adapter XXV710-DA2-25G 52000 **App Server:** Application server for terminating user plane traffic.

SYSTEM SPECIFICATIONS

O-RU Simulator	Manager	App Server
Dell R750/R760 (2 socket)	Virtual Machine	Virtual Machine
CPU: Intel Xeon Gold/ Platinum	CPU: Intel i5 or Xeon	CPU: Intel i5 or Xeon
Clock speed: Max turbo frequency above 3.4 GHz	Clock frequency: 2.6 GHz or higher	Clock frequency: 2.6 GHz or higher
Core Count: 32 per CPU	Number of cores: 4 or more	Number of cores: 4 or more
RAM: 8 x 8GB DDR4	RAM: 16 GB or higher	RAM: 16 GB or higher
OS: Ubuntu 20.04	OS: Ubuntu 20.04 or higher	OS: Ubuntu 20.04 or higher
Disk space: 1TB	Disk space: 500GB or more	SDD: 500GB or more
Intel® Ethernet Network Adapter XXV710-DA2	NIC port: 1 x 1GbE	NIC ports: • 1 x 10GbE for traffic • 1 x 1GbE for management
PCIe Gen 3 slots: 2		



ORDERING INFORMATION

The Simnovus flexible all-inclusive software subscription provides simplified ordering:

Simply Choose

Number of UEs (1, 16, 32, 64, 128, or 256).

App server software is also included.

Get started today! Contact **sales@simnovus.com**.

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