



Simnovus Network Emulator

**The Complete UE Validation
Solution**

INDEX

Table of Content

03

Introduction

04

Architecture

05

Key Features

06

New Features

07

The Options

11

SDR Cards

12

FR2 Package

13

RAN Spec

15

Core Spec

17

IMS and eMBMS GW Spec

SIMNOVUS NETWORK EMULATOR

Your Plug-and-Play Path to Faster UE Validation

The Simnovus Network Emulator is a one-stop solution for validating the performance and functionality of NR, LTE, LTE-A, LTE-M, and NB-IoT devices.

Our emulator acts as a 3GPP-compliant eNodeB, ng-eNodeB, gNodeB, EPC, and 5GC, supporting features like NTN, RedCap, VoLTE/VoNR, and eMBMS.

Powered by deployment-quality LTE and NR software, the Network Emulator offers the same functionalities as a real network, but with unmatched flexibility and cost savings.

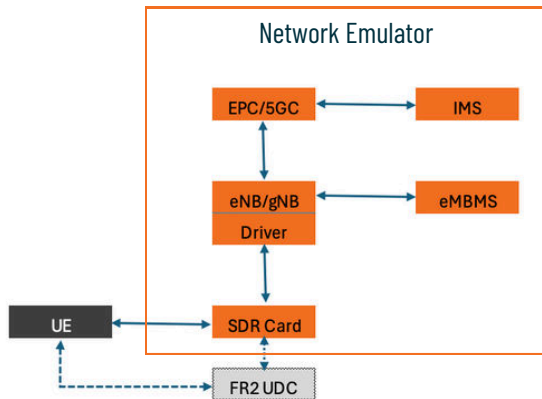


Here's what sets us apart:

- **Plug-and-Play Simplicity:** Get started quickly with minimal configuration.
- **Fast Isolation & Debugging:** Isolate issues and debug faster with in-depth data analysis.
- **Extensive Statistics & Correlation:** Gain valuable insights across protocol layers.
- **Reduced Capex:** Run multiple testbeds on standard servers with SDR cards.
- **Parallel Testing:** Save time and effort by running automated tests simultaneously.

ARCHITECTURE

Complete Network in a Box



The Simnovus Network Emulator offers a comprehensive testing environment within a single, convenient unit. It eliminates the need for complex network setups, functioning as a complete **network "in a box."**

The emulator contains all essential components for UE connectivity, including Radio Access Network (RAN) elements, 4G and 5G core networks, an IMS core for voice and messaging services, and an eMBMS Gateway for multimedia broadcast messaging. It can communicate with external public networks for internet services.

The Software Defined Radio (SDR) provides exceptional flexibility, enabling operation across any frequency band within the FR1 range. For scenarios requiring mmWave connectivity, an optional Up Down Converter (UDC), part of the FR2 package seamlessly expands the emulator's capabilities to support mmWave UE testing.

This comprehensive and adaptable solution empowers efficient and thorough device validation.

Key Features



Multi-RAT Support

Validates UEs supporting multiple radios 5G (SA/NSA) LTE, NB-IoT or Cat-M



Support of NTN and RedCap

Advance Release 17 feature support along with realistic satellite simulation to verify NTN capabilities.



Massive UE Support upto 1000

Scales to support up to 1,000 concurrent UEs (varies by model and configuration).



Handover

Supports intra-handovers (within a single emulator unit) and inter-handovers (between two units), Handover between VoWifi to VoNR/VoLTE.



Carrier Aggregation Supports carrier aggregation of multiple TDD/FDD LTE and NR FR1/FR2 cells.



VoNR/ViNR/VoWifi

Supports VoLTE, ViLTE, VoNR, ViNR, VoWifi, SMS, and emergency call testing with an integrated IMS server.



High-throughput testing (up to 9 Gbps DL/1 Gbps UL)

Achievable speeds depend on your emulator configuration and UE capabilities.



Realistic channel emulation

Supports various DL channel conditions based on 3GPP specifications (36.101 & 38.141)



Deep protocol insights Gain granular visibility into LTE and NR protocols with selective logging, layer-by-layer displays, and insightful graphs and analytics.



Streamlined automation

Extensive API simplifies test automation by enabling remote control of all nodes in the box.

New Features



Non Terrestrial Networks

- **Non-Terrestrial Network (NTN) Support (Release-17):** Validate NB-IoT and NR cell behavior in LEO, MEO, and GEO satellite configurations.
- **Advanced Satellite Channel Simulation:** Simulate large Round-Trip Time (RTT) delays, Doppler shift, and attenuation specific to NTN operation.
- **Flexible Ephemeris Configuration:** Configure satellite positions using industry-standard TLE or StateVector files, or define custom orbital elements.



Reduced Capability (RedCap)

- **UE Access Control:** Granular control over allowing 1 or 2 receiver User Equipment (UE) access within the cell.
- **Half Duplex Flexibility:** Enable or disable half duplex mode for the cell, catering to specific testing scenarios.
- **RedCap Configuration:** Define customized initial Downlink (DL) and Uplink (UL) Bandwidth Parts (BWPs) tailored for RedCap testing.

THE OPTIONS

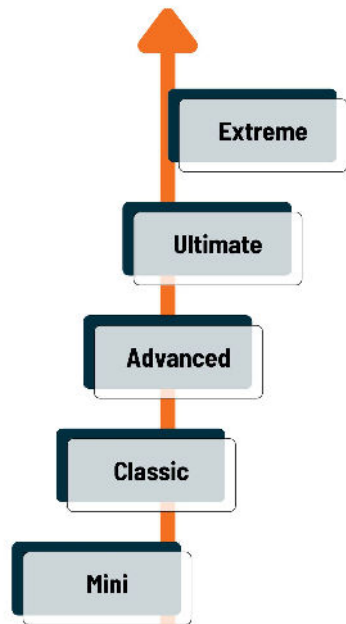
Flexible Network Emulator Options To Meet Your Validation Needs

Simnovus offers a range of Network Emulator configurations to perfectly match your User Equipment (UE) category and throughput requirements. All options leverage the same powerful software base, ensuring seamless operation and familiarity.

Select the ideal option for your current testing needs. Easily scale your setup up or down as your requirements evolve. With a simple license switch and the addition or removal of SDR cards, you can adapt your testing environment on the fly.

This flexible approach allows you to:

- **Optimize costs:** Pay only for the capabilities you need at any given time.
- **Future-proof your investment:** Easily adapt your setup for new testing demands.
- **Simplify upgrades:** Leverage the existing software base for a smooth transition.



"This network emulator is a lifesaver! Started small, easily scaled up with my needs. No more equipment headaches, just smooth sailing. Makes testing fun again!"

FEATURE MATRIX

Choose the Model that Fits Best

| Features | Mini | Classic | Advanced | Ultimate | Extreme |
|-------------------------------------|-----------------------------|------------------------------|--------------------------|--------------------------|--------------------------|
| LTE | Y | Y | Y | Y | Y |
| 5G NSA | N | Y | Y | Y | Y |
| 5G SA | Y | Y | Y | Y | Y |
| NB-IOT, Cat-M | Y | Y | Y | Y | Y |
| Support of FR1 | Y | Y | Y | Y | Y |
| Support of FR2 | N | N | Y | Y | Y |
| Max Channel BW (in MHz) per cell | 20 | 50 | 100 | 100 | 100 |
| Max SDR Cards | 1 x SDR50 | 3 x SDR50 | 2 x SDR100 | 4 x SDR100 | 6 x SDR100 |
| Max No of cells 2x2 MIMO or SISO | 1 | 3 | 4 | 8 | 12 |
| Max No of cells 4x4 MIMO | 0 | 1 | 2 | 4 | 6 |
| Max Concurrent UEs | 500 | 1000 | 1000 | 1000 | 1000 |
| Throughput (DL, UL) | DL :200 Mbps UL: 75 Mbps | DL :600 Mbps UL: 210 Mbps | DL :3 Gbps UL: 2 Gbps | DL :6 Gbps UL: 2 Gbps | DL :9 Gbps UL: 2 Gbps |

FEATURE MATRIX

Configuration Possibilities

| Mini | Classic |
|---|---|
| <p>4G LTE</p> <ul style="list-style-type: none">• 1 cell 20 MHz 2x2 <p>5G NR SA Mode</p> <ul style="list-style-type: none">• 1 cell 20 MHz 2x2 or 40 MHz SISO <p>NB-IOT</p> <ul style="list-style-type: none">• 1 NB-IoT cell in standalone, in-band or guard-band mode <p>LTE-M</p> <ul style="list-style-type: none">• 1 LTE cell with CAT M1 support | <p>4G LTE</p> <ul style="list-style-type: none">• 3 cells 20MHz 2x2• 1 cell 20 MHz 4x4 + 1 cell 20MHz 2x2 <p>5G NR SA Mode</p> <ul style="list-style-type: none">• 1 5G cell 50MHz 2x2• 3 cells 20MHz 2x2• 3 cells 40 MHz SISO <p>5G NR NSA Mode</p> <ul style="list-style-type: none">• 1 5G NR 50MHz 2x2 + 1 LTE 10MHz 2x2• 1 cell 5G NR 40 MHz 2x2 + 1 cell LTE 20 MHz 2x2• 1 cell 5G NR 40 MHz SISO + 2 cells LTE 20 MHz 2x2 <p>NB-IOT</p> <ul style="list-style-type: none">• 3 NB-IoT standalone cells• 3 LTE cells with an in-band or guard-band NB-IoT cell each <p>LTE-M</p> <ul style="list-style-type: none">• 3 LTE cells with CAT M1 support |

FEATURE MATRIX

Configuration Possibilities

| Advanced | Ultimate | Extreme |
|---|---|---|
| <p>4G LTE</p> <ul style="list-style-type: none">• 4 cells 20 MHz 2x2• 2 cells 20 MHz 4x4 <p>5G NR SA Mode</p> <ul style="list-style-type: none">• 4 FR1 cells 100 MHz 2x2• 2 FR1 cells 100 MHz 4x4• 1 FR1 cell 100 MHz 4x4 + 1 FR2 cell 100 MHz 2x2 <p>5G NR NSA Mode</p> <ul style="list-style-type: none">• 1 5G NR 100 MHz 4x4 + 1 LTE 20 MHz 4x4• 2 FR1 cells 5G NR 100 MHz 2x2 + 2 cells LTE 20 MHz 2x2• 1 FR2 cell 5G NR 100 MHz 2x2 + 1 cells LTE 20 MHz 4x4 <p>NB-IOT</p> <ul style="list-style-type: none">• 4 NB-IoT standalone cells• 4 LTE cells with an in-band or guard-band NB-IoT cell each <p>LTE-M</p> <ul style="list-style-type: none">• 4 LTE cells with CAT M1 support | <p>4G LTE</p> <ul style="list-style-type: none">• 8 cells 20 MHz 2x2• 4 cells 20 MHz 4x4 <p>5G NR SA Mode</p> <ul style="list-style-type: none">• 8 FR1 cells 100 MHz 2x2• 4 FR1 cells 100 MHz 4x4• 2 FR1 cell 100 MHz 4x4 + 1 FR2 cell 100 MHz 2x2 <p>5G NR NSA Mode</p> <ul style="list-style-type: none">• 3 5G NR 100 MHz 4x4 + 1 LTE 20 MHz 4x4• 4 FR1 cells 5G NR 100 MHz 2x2 + 4 cells LTE 20 MHz 2x2• 2 FR2 cell 5G NR 100 MHz 2x2 + 1 cells LTE 20 MHz 4x4 <p>NB-IOT</p> <ul style="list-style-type: none">• 8 NB-IoT standalone cells• 8 LTE cells with an in-band or guard-band NB-IoT cell each <p>LTE-M</p> <ul style="list-style-type: none">• 8 LTE cells with CAT M1 support | <p>4G LTE</p> <ul style="list-style-type: none">• 12 cells 20MHz 2x2• 6 cells 20 MHz 4x4 <p>5G NR SA Mode</p> <ul style="list-style-type: none">• 12 FR1 cells 100 MHz 2x2• 6 FR1 cells 100 MHz 4x4• 1 FR1 cell 100 MHz 4x4 + 10 FR2 cell 100 MHz 2x2 <p>5G NR NSA Mode</p> <ul style="list-style-type: none">• 5 FR1 cells 5G NR 100 MHz 4x4 + 1 cell LTE 20 MHz 4x4• 10 FR1 cells 5G NR 100 MHz 2x2 + 2 cells LTE 20 MHz 2x2• 10 FR2 cells 5G NR 100 MHz 2x2 + 1 cell LTE 20 MHz 4x4 <p>NB-IOT</p> <ul style="list-style-type: none">• 12 NB-IoT standalone cells• 12 LTE cells with an in-band or guard-band NB-IoT cell each <p>LTE-M</p> <ul style="list-style-type: none">• 12 LTE cells with CAT M1 support |

SDR Cards

Specification

| | SDR 50 | SDR 100 |
|-----------------------------|--|---|
| Dimensions H × W ×D | 2 cm × 11.5 cm × 12.8 cm | 2 cm × 13 cm × 22 cm |
| Weight | 0.1 kg | 0.2 kg |
| Frequency Range | 500 MHz to 6.0 GHz | 500 MHz to 6.0 GHz |
| RF Bandwidth | 200 KHz to 56 MHz | 1.4 MHz to 100 MHz |
| Power Supply Voltage | 12 V DC input | 12 V DC input |
| Operation Mode | FDD and TDD | FDD and TDD |
| MIMO | 2x2 | 4x4 |
| ADC/DAC Sample rate | 61.44 MS/s | 122.88 MS/s |
| ADC/DAC Resolution | 12 bits | 12 bits |
| Frequency Accuracy | 2 ppm | < 1 ppm |
| PCIe Requirement | 1x / Gen 2 | 8x / Gen 3 |
| LTE 20 MHz 64QAM EVM | <4% RMS (f<3.5 GHz) <2% RMS (f<2.6 GHz) | <4% RMS (f<3.5 GHz) <2% RMS (f<2.6 GHz) |
| Synchronization | Internal clock , PPS signal, GPS , Reference External clock (LVDS) | Internal clock , PPS signal, GPS, Reference external clock (LVDS) |

FR2 PACKAGE

Unlock mmWave Performance

About the Package

The FR2 package expands the capabilities of the Network Emulator by enabling mmWave technology. This package includes:

- **Up-Down Converter (UDC):**
Converts the sub6 signal from the 100 MHz SDR card to mmWave signals and vice versa.
- **RF Cables:** High-frequency cables for efficient signal transmission.
- **Horn Antennas:** Directional antennas optimized for mmWave frequencies.

Specification

| | |
|-------------------------|--|
| Dimensions H × W × D | 4 cm × 9.5 cm × 27.5 cm |
| Weight | 0.2 kg |
| Frequency Range | Two Variants - 24 to 30 GHz - 37 to 40 GHz |
| RF Bandwidth | 400 MHz |
| Power Supply Voltage | 12 V DC input |

The FR2 package is an optional add-on for the Advanced and Ultimate models.

PACKAGE COMPOSITION

RAN Specification

| Features | eNodeB | gNodeB |
|-------------------------------------|---|---|
| 3GPP Release | LTE release 17 | LTE release 17 - eMBB, RedCAP and NTN support |
| Frequency Bands | All FDD and TDD bands in sub-6GHz | All FDD and TDD bands in sub-6GHz + FR2 bands |
| Bandwidth | 1.4, 3, 5, 10, 15 and 20 MHz in LTE | Up to 100 MHz in LTE |
| | 200 KHz for NB-IoT supporting all operation modes (in-band, guard band and standalone). | Multi BWP support. |
| Subcarrier Spacing | Not Applicable | Data: 15, 30, 60 or 120 KHz |
| | | SSB: 15, 30, 120 or 240 KHz |
| Number of active UEs | Up to 1000 UEs | Up to 1000 |
| Carrier Aggregation | Up to 12 carriers in DL and 3 in UL allowing mixed FDD/TDD combinations in DL | Up to 12 carriers in DL and 3 in UL allowing mixed FDD/TDD combinations in DL |
| Transmission Modes or MIMO | 1 (single antenna) to 10 (MIMO 4x4) | Up to MIMO 4x4 in UL and DL |
| Modulation Schemes | Up to 1024QAM in DL and 256QAM in UL | Up to 1024QAM in DL and 256QAM in UL |
| Encryption and integrity protection | AES, SNOW3G, ZUC | AES, SNOW3G, ZUC |

PACKAGE COMPOSITION

RAN Specification – continued

| Features | eNodeB | gNodeB |
|------------------------------|---|--|
| Handover | Intra eNodeB, S1, X2 , Intra ng-eNodeB, NG, Xn and EPS to 5GS handover support | Intra eNodeB, S1, X2 , Intra ng-eNodeB, NG, Xn and EPS to 5GS handover support |
| eNodeB network interfaces | S1AP and GTP-U to EPC X2AP between eNodeBs M1 and M2 for eMBMS | S1AP and GTP-U to EPC X2AP between eNodeBs M1 and M2 for eMBMS |
| ng-eNodeB network interfaces | NGAP and GTP-U to 5GC XnAP between ng-eNodeBs | NGAP and GTP-U to 5GC XnAP between ng-eNodeBs |
| Other Capabilities | <p>LTE/LTE-M</p> <ul style="list-style-type: none">• Rel 16 compliant• LTE category 0 and 1• LTE-M cat M1 FDD, HD-FDD and TDD support• Group WUS support <p>NB-IOT</p> <ul style="list-style-type: none">• Rel 17 compliant• NTN support• NB-IoT single-tone and multi-tone cat NB1 and NB2• 15 kHz and 3.75 kHz subcarrier spacing• Support of two HARQ processes.• Group WUS support• CP CloT optimization | <p>Supported Modes: SA and NSA</p> <p>NR Split Bearer: 3, 3a and 3x</p> |

PACKAGE COMPOSITION

Core Specification

| Features | EPC | 5GC |
|---|---|---|
| 3GPP Release | LTE release 17 | NR release 17 |
| Network Functions | Mobility Management Entity (MME), Serving Gateway (SGW), Packet Data Network Gateway (PGW), Home Subscriber Server (HSS), Policy and Charging Rules Function (PCRF) and Equipment Identity Register (EIR) all integrated within the same software component | Access and Mobility Management Function (AMF), Authentication Server Function (AUSF), Session Management Function (SMF), User plane Function (UPF), UDM (Unified Data Management) and 5G-EIR (5G Equipment Identity Register) all integrated within the same software component |
| NAS Encryption and integrity protection | AES, SNOW3G, ZUC | AES, SNOW3G, ZUC |
| USIM Authentication | XOR, Milenage, TUAK | XOR, Milenage, TUAK , ECIES profile A and B, 5G AKA, EAP AKA Prime , EAP TLS |
| PDN or PDU Type | IPv4, IPv4v6, IPv6 and non-IP and Ethernet | IPv4, IPv4v6, IPv6 and non-IP and Ethernet |
| QoS | Support of all LTE QCI as well TFT and dedicated bearers | Support of all NR 5QIs as well TFT and dedicated bearers. Network Slicing |

Core Specification - continued

| Features | EPC | 5GC |
|-----------------------|--|--|
| Network Interfaces | S1AP and GTP-U to multiple eNodeBs | NG interface (NGAP and GTP-U protocols) to multiple gNodeBs, ng-eNodeBs |
| | Rx to external IMS server, S6a to external HSS | Rx and N5 interface to external IMS server, N12 to external AUSF, N8 and N13 to external UDM |
| | S13 to external EIR, SGsAP to external VLR/MSC | N17 to external 5G-EIR, N20 to external SMSF |
| | SBcAP to external CBC and LCS-AP to external E-SMLC | N50 to external CBC, NL1 interface to External LMF |
| Handover | Intra-MME and EPS 5GS IRAT handover support | intra-AMF and 5GS EPS IRAT support |
| RAT | LTE, NB-IoT, NR (Support of DCNR UEs) | NR, LTE, NB-IoT |
| IoT Features | <ul style="list-style-type: none">control plane CloT EPS optimizationNon-IP data delivery CloT featureAttach without PDN connectivityGroup WUS supportNTN NB-IoT Rel17 | <ul style="list-style-type: none">CloT 5GS optimizationNon-IP data delivery CloT featureRedCap support |
| Power saving features | PSM and eDRX | MICO, active time and eDRX |

IMS Core Specification

| | |
|----------------------------|---|
| Network Elements | S1AP and GTP-U to multiple eNodeBs Rx to external IMS server, S6a to external HSS S13 to external EIR, SGsAP to external VLR/MSC SBcAP to external CBC and LCS-AP to external E-SMLC |
| USIM Authentication | XOR, Milenage, TUAK , ECIES profile A and B, 5G AKA, EAP AKA Prime , EAP TLS |
| Security features | MD5, AKAv1 and AKAv2 for authentication and IPSec at transport level |
| Network interfaces | <ul style="list-style-type: none">• Rx interface for support of precondition and dedicated bearer• Cx interface for external authentication |
| IP Version | IPv4, IPv4v6, IPv6 |
| Services | <ul style="list-style-type: none">• Voice call,• Video call• Voice echo test• Call hold• SMS over SIP and SMS over SG |

eMBMS Gateway Specification

| | |
|---------------------------|--|
| Network Elements | LTE eMBMS Gateway (eMBMSGW) Multi cell Coordination Entity (MCE) |
| Network interfaces | <ul style="list-style-type: none">• M1 interface to eNodeB for user plane• M2AP interface to eNodeB for control plane |



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Thank You

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