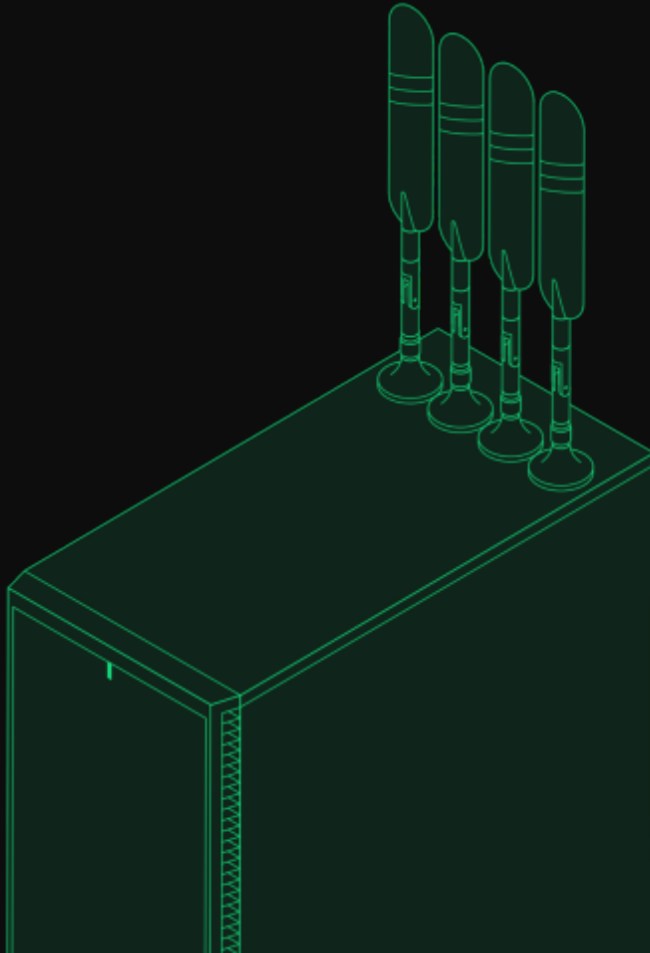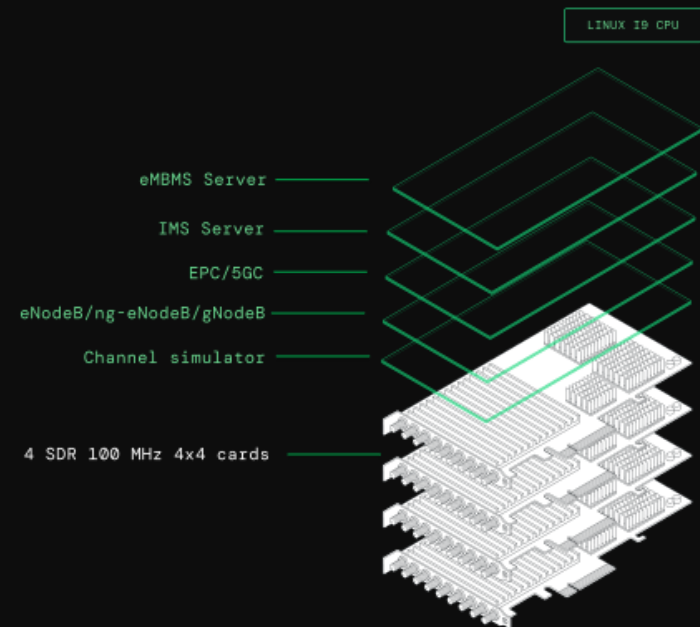# AMARI Callbox Ultimate

amarisoft

Overview

The AMARI Callbox stands out as the optimal solution for testing 5G NSA and SA, LTE, LTE-M, and NB-IoT devices. It operates as a 3GPP compliant eNB/gNB and EPC/5GC, facilitating both functional and performance testing. Powered by a carrier-grade software suite, it is among the three AMARI Callboxes specifically designed for 5G.

The Callbox offers four NR Cells at 100MHz MIMO 4x4. With the inclusion of an additional FR2 Package, the AMARI Callbox Ultimate can also deliver two cells at 100MHz MIMO 2x2 in mmWave (FR2).

LINUX I9 CPU

eMBMS Server

IMS Server

EPC/5GC

eNodeB/ng-eNodeB/gNodeB

Channel simulator

4 SDR 100 MHz 4x4 cards

In stock - Lead time 4 weeks - Contact us

Capabilities

5G

The callbox can act as a 5G standalone mode (SA) or 5G non-standalone mode (NSA) network. 5G Non Terrestrial Network (NTN) and 5G Reduced Capacity (RedCap) are also supported.

LTE

Even if it is designed for 5G, this callbox provides with the best of Amarisoft LTE technology.

LTE-M

The callbox supports LTE-M in both FDD and TDD to connect CAT-M1 devices.

NB-IOT

The callbox supports standalone, in-band and guard-band NB-IOT to connect NB1 and NB2 devices. It also supports Non Terrestrial Network (NTN) NB-IOT.

Up to 1000 UEs

Powered by a macro base station software, depending on the callbox model and configuration, it can handle up to 1000 concurrent active UEs.

6 Gbps - 2 Gbps

Depending on the callbox configuration and the UE capabilities, the callbox can deliver up 6 Gbps in downlink and 2 Gbps in uplink.

Handover

On a single callbox, intra eNB/gNB handover is supported. Inter eNB/gNB handover is supported using two callboxes.

Carrier aggregation

The callbox can aggregate multiple TDD and FDD LTE, NR FR1 and NR FR2 cells for high throughput testing.

VoLTE VoNR VoWiFi

The embedded IMS Server allows VoLTE, VioLTE, VoNR, VioNR, SMS and emergency call testing. The embedded N3IWF allows VoWiFi by connecting an external WiFi access point.

Highlighted features

Logging and Measurements

Selective logging and display of all layers of 3GPP LTE and NR stacks as well as useful graphs and analytic tools.

LOG EXAMPLE ↗

Automatic Test Setup and Scripting

Extensive WebSocket API allowing to send remote commands to eNodeB, ng-eNodeB, gNodeB, EPC and 5GC to ease test automation.

TUTORIAL ↗

Easy Configuration

Easy configuration thanks to JSON files with example configurations already included in each software release for eNodeB, ng-eNodeB, gNodeB, EPC and 5GC.

End to End Data Testing

Running on top of standard Linux in user space mode allowing easy integration with IP services.

Channel Simulation

Simulation of different DL channel types as per 3GPP models specified in 36.101 and 38.141 specifications.

TUTORIAL ↗

Feature testing

Test features to override the nominal protocol behavior in order to simulate error cases.

High Performance

Highly optimized software supporting multiple UEs and cells and high data rates in LTE and NR.

3GPP Features

Early access to 3GPP features for rapid validation of features under development.
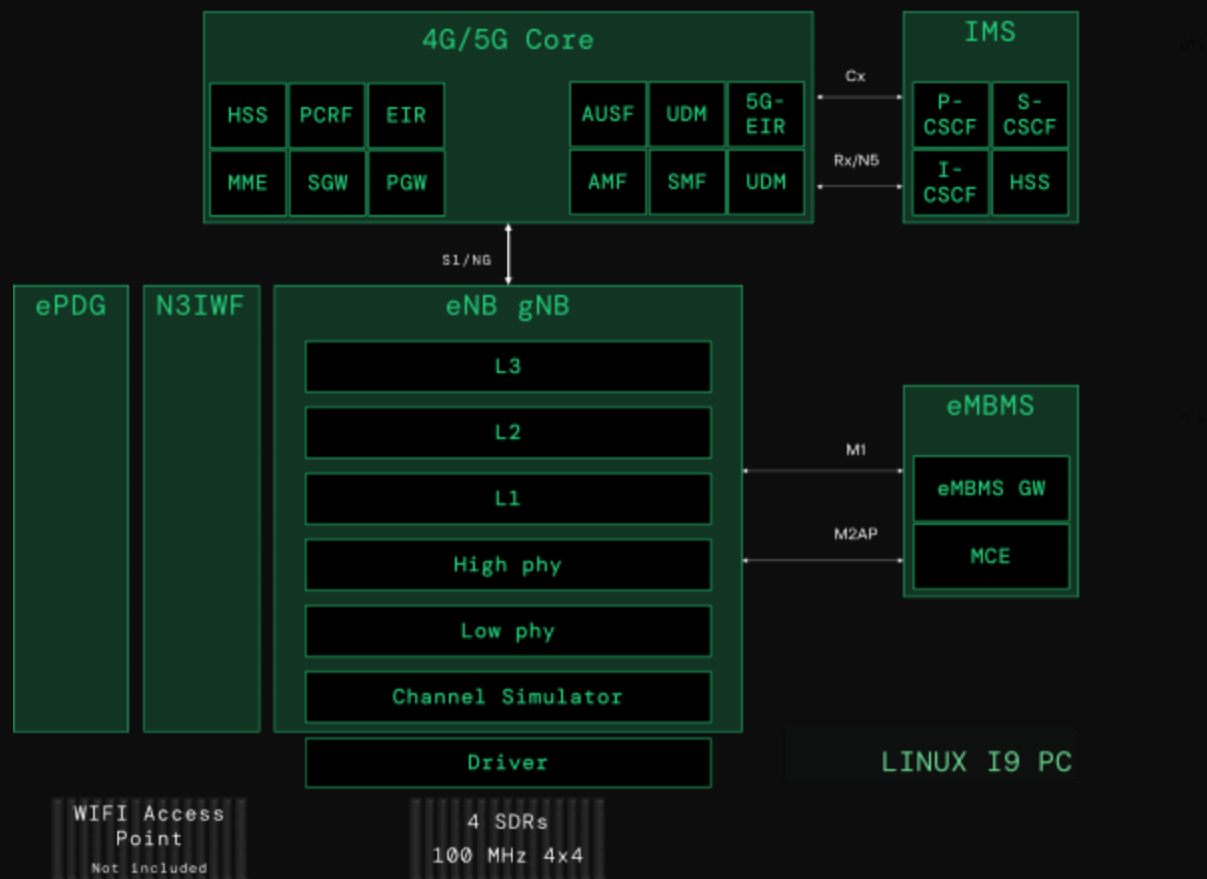
Frequency Agnostic

Support of a wide range of FDD and TDD frequency bands even nonstandard ones allowing to test in Sub-6GHz and mmWave. mmWave available on the AMARI Callbox Advanced, Ultimate and Extreme as an option.

TUTORIAL ↗

Architecture

4G/5G Core

| HSS | PCRF | EIR | | AUSF | UDM | 5G-EIR |
| MME | SGW | PGW | | AMF | SMF | UDM |

IMS

| P-CSCF | S-CSCF |
| I-CSCF | HSS |

Cx

Rx/N5

S1/NG

ePDG

N3IWF

eNB gNB

- L3
- L2
- L1
- High phy
- Low phy
- Channel Simulator

Driver

eMBMS

- eMBMS GW
- MCE

M1

M2AP

LINUX I9 PC

WIFI Access Point
Not included

4 SDRs
100 MHz 4x4

Possible RAN Configurations

The AMARI Ultimate RAN configuration is subject to constraints stemming from:
1- The characteristics and the number of Software Defined Radios (SDRs) it incorporates.
2- The CPU power, spcially for 5G FR2.

1- Constraints Arising from SDRs:
The Callbox integrates four SDR Cards, with each SDR capable of supporting two independant SISO or 2x2 MIMO 100 MHz channel or one 4x4 MIMO channel. This provides users with the follwing combinations:
Four 100 MHz 4x4 channels
Three 100 MHz 4x4 channels combined with two 100 MHz 2x2/SISO channels
Two 100 MHz 4x4 channels combined with four 100 MHz 2x2/SISO channels
One 100 MHz 4x4 channel combined with six 100 MHz 2x2/SISO channels
Eight 100 MHz 2x2/SISO channels
Each channel can support multiple contiguous cells, provided that the total bandwidth and MIMO layers of the channel are not exceeded.

2- Constraints Arising from CPU and Software License:
The limitations imposed by the software license restricts the total bandwidth of cells multiplied by the number of MIMO layers to 1600 MHz.
Only two cells 5G FR2 100MHz 2x2 cell are allowed

RAN Configuration examples

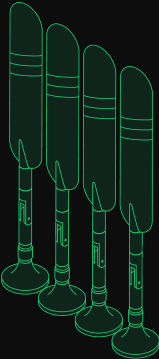|	
4G LTE	8 cells 20 MHz 2x2
	4 cells 20 MHz 4x4
5G NR SA Mode	8 FR1 cells 100 MHz 2x2
	4 FR1 cells 100 MHz 4x4
	2 FR1 cell 100 MHz 4x4 + 1 FR2 cell 100 MHz 2x2
5G NR NSA Mode	3 5G NR 100 MHz 4x4 + 1 LTE 20 MHz 4x4

	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
NB-IOT	8 NB-IoT standalone cells
	8 LTE cells with an in-band or guard-band NB-IoT cell each
LTE-M	8 LTE cells with CAT M1 support

Hardware components

Callbox and accesories

Callbox Specification

| Dimensions H × W × D	46.5 cm × 23.3 cm × 53.3 cm
Weight	14 kg
# AMARI PCIe SDR 100 4x4 Cards	4
Power supply voltage	100 - 240V AC
CPU	Intel i9

Accesories

4 antennas, 4 RF combiners and 32 RF cables SMA male to male RG405 are included.

5 programmable SIM Cards are included and already registred in the Callbox core user database.

AMARI PCIe SDR 100 4x4 Card

AMARI PCIe SDR 100 4x4 is a software defined radio (SDR) card based on AD9361 2x2 RF transceivers. It supports MIMO 4x4, FDD and TDD operations in any frequency between 500 MHz and 6GHz. It has an integrated GPS for accurate time and frequency synchronization. The cards can be easily chained thanks to a provided cable allowing clock and PPS propagation in between the cards. This will facilitate testing of higher MIMO layers and carrier aggregation. The total bandwidth of the card is 100 MHz, and its output power is around 12 dBm depending on the frequency used. The card requires at least gen 3 PCIe slot. This RF is used in AMARI Callbox Advanced, AMARI Callbox Ultimate, AMARI Callbox Extreme, AMARI UE Simbox E Series and AMARI UE Simbox MBS Series products.
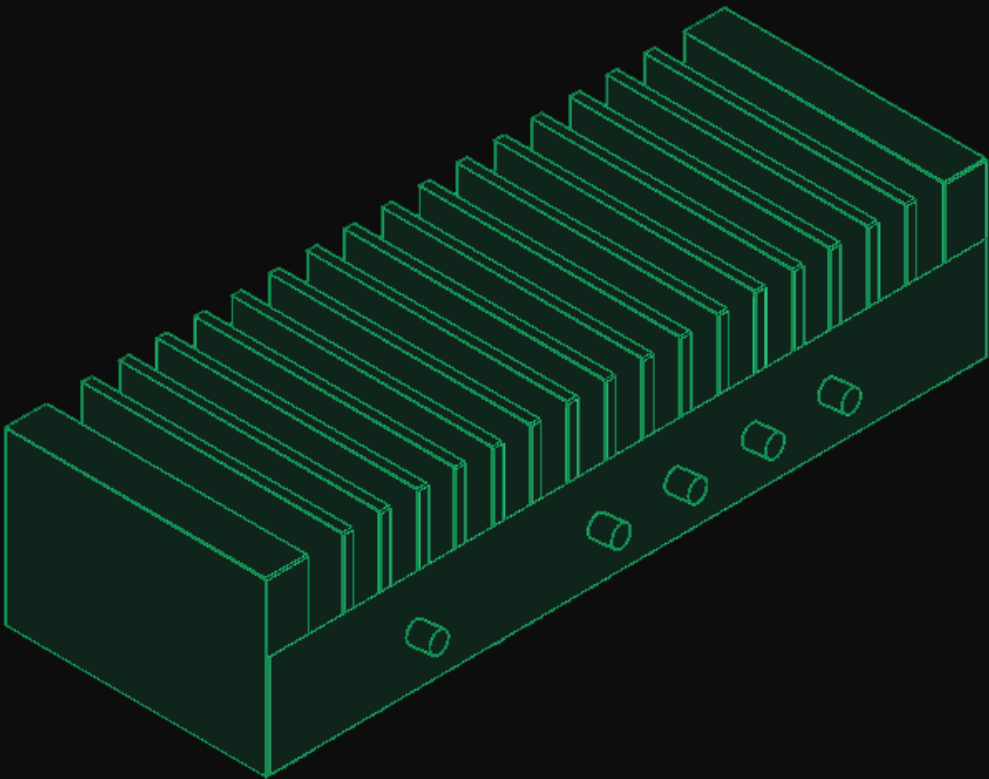
TECHNICAL DOC ↗
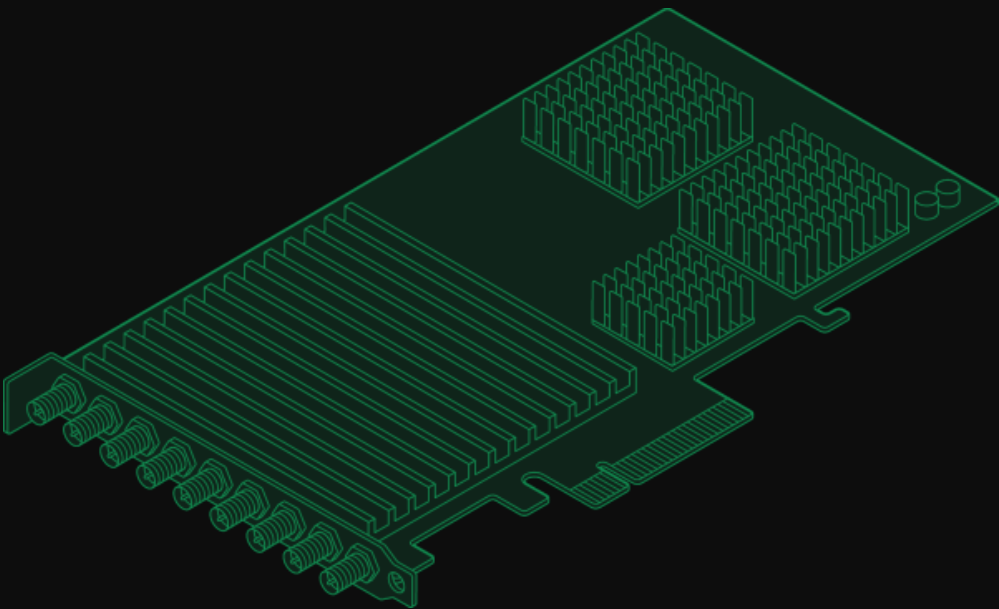
AMARI PCIe SDR 100 4x4 Card technical specification

Dimensions H × W × D	2 cm × 13 cm × 22 cm
Weight	0.2 kg
Frequency range	500 MHz to 6.0 GHz
RF bandwidth	1.4 MHz to 100 MHz
Power supply voltage	12 V DC input
Operation mode	FDD and TDD
MIMO	4x4
ADC/DAC sample rate	122.88 MS/s
ADC/DAC resolution	12 bits
Frequency accuracy	< 1 ppm
PCIe minimum requirements	8x / Gen 3
LTE 20MHz 64QAM EVM	<4% RMS (f<3.5 GHz) <2% RMS (f<2.6 GHz)
Synchronization	Internal clock , PPS signal, GPS , Reference external clock (LVDS)

AMARI FR2 Hardware Package

The AMARI FR2 HW Package enables mmWave technology on the AMARI Callbox Advanced, Ultimate, and Extreme and AMARI UE Simbox MBS models. It comprises a UDC (Up-Down Converter), RF cables, and horn antennas. The UDC serves to convert the sub6 signal from the AMARI PCIe SDR 100 4x4 Card into mmWave signal, and vice versa.

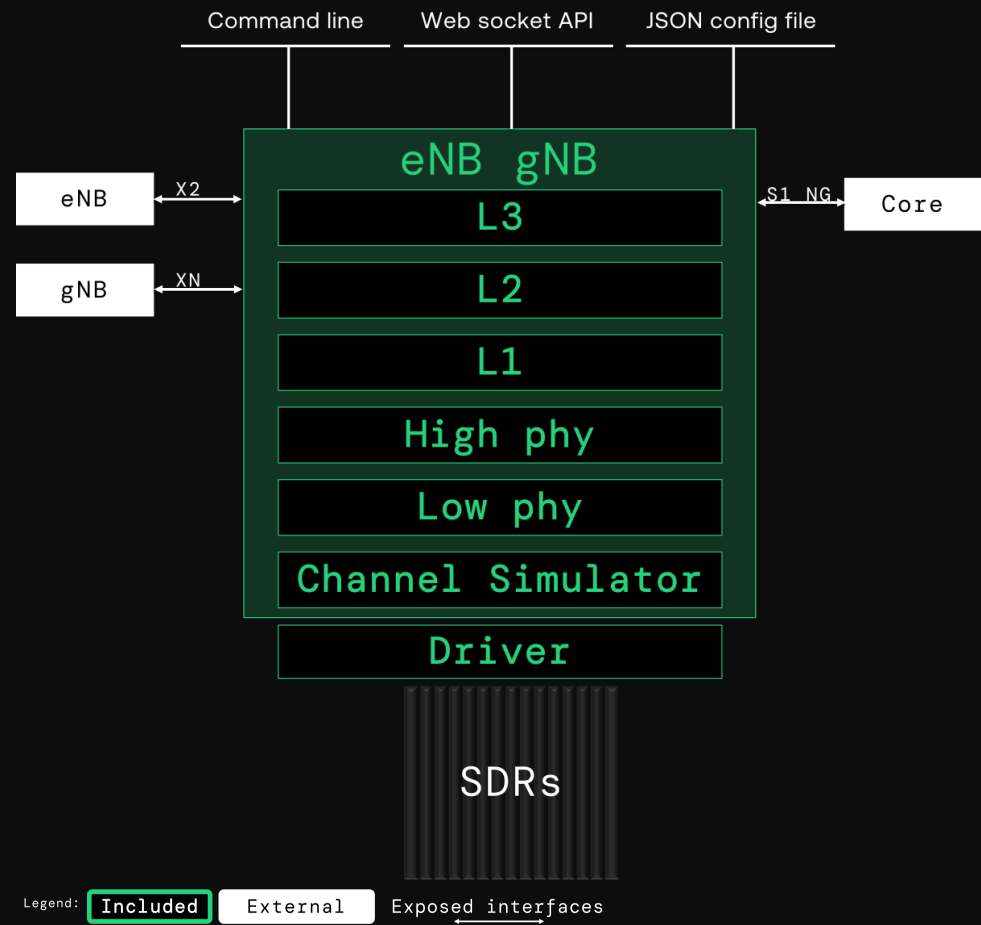| AMARI UDC technical specification	
Dimensions H × W × D	4 cm × 9.5 cm × 27.5 cm
Weight	0.2 kg
Frequency range	two SKUs: 24 to 30 GHz or 37 to 40 GHz
RF bandwidth	1 GHz
Power supply voltage	12 V DC input

Software components

vRAN eNodeB gNodeB

A release 18 full software eNodeB gNodeB including layer3, layer 2, layer1 and physical layer. It also includes a channel simulator. It connects to a split 8 or split 7.2 radio front end through an open API via a driver. It supports a standard S1/NG interface to connect a 4G or 5G core network. The eNodeB gNodeB is configurable through hundreds of parameters in a text file in JSON format. It has a WebSocket API for automation, and a command line interface.

DETAILED SPEC ↗

TECHNICAL DOC ↗

Command line   Web socket API   JSON config file

eNB gNB
- L3
- L2
- L1
- High phy
- Low phy
- Channel Simulator

Driver

SDRs

eNB — X2
gNB — XN

S1 NG → Core
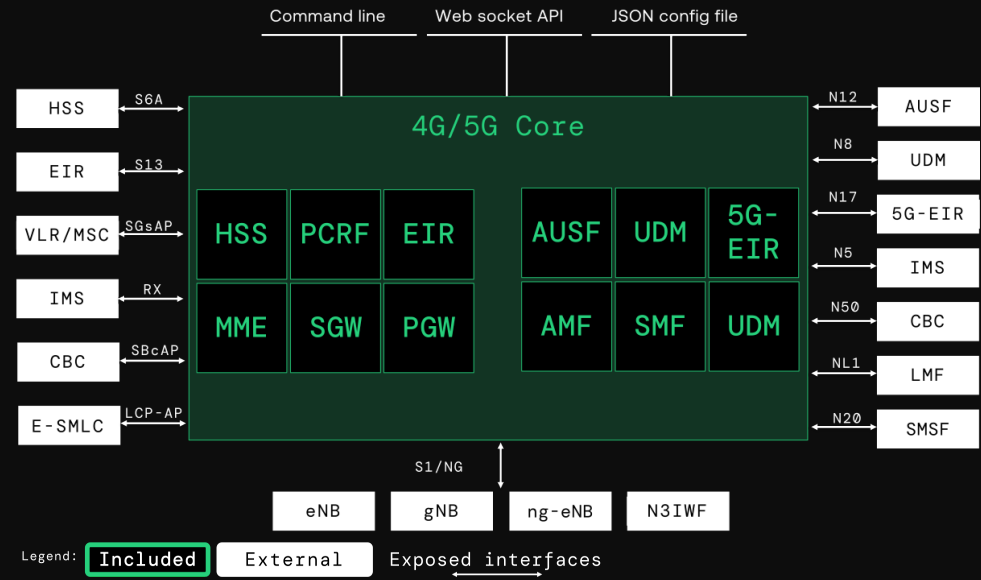
Legend: Included   External   Exposed interfaces

4G 5G CORE

A compact release 18 core network with built-in MME, SGW, PGW, PCRF, HSS, EIR, ePDG, AMF, AUSF, SMF, UPF, UDM and 5G-EIR.
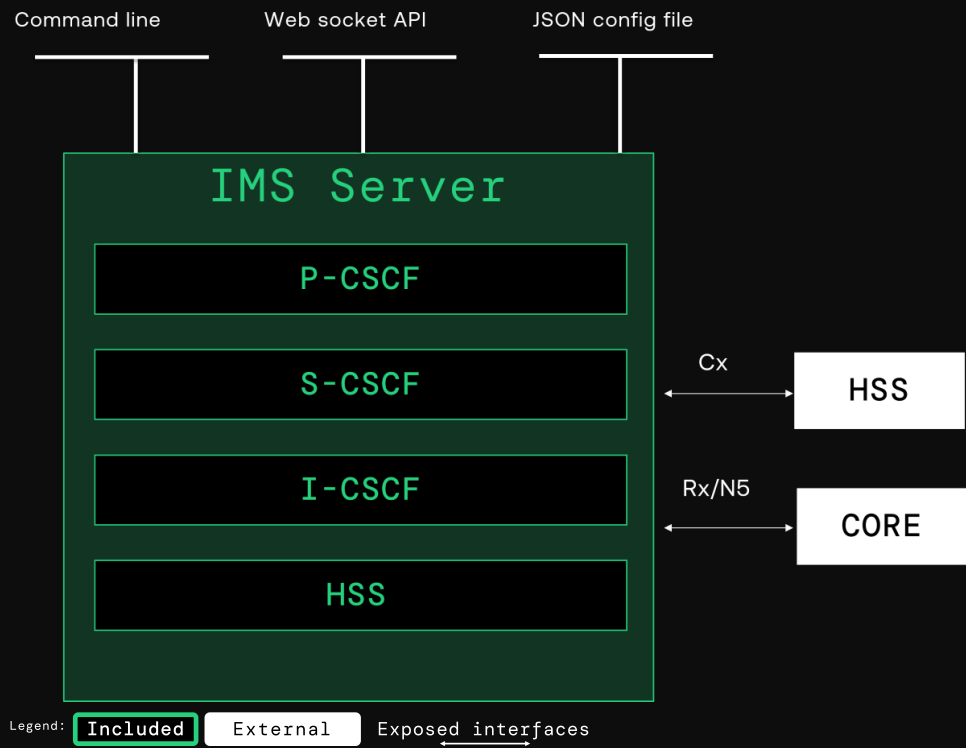
DETAILED SPEC ↗

TECHNICAL DOC ↗

IMS Server

An IMS standalone simple server. It has a built-in P-CSCF, I-CSCF, S-CSCF, HSS.

Command line   Web socket API   JSON config file

IMS Server

- P-CSCF
- S-CSCF
- I-CSCF
- HSS

Cx → HSS

Rx/N5 → CORE

Legend: `Included` `External` Exposed interfaces ↔

eMBMS Gateway

An LTE multimedia broadcast multicast services gateway with buit-in MCE.

Command line   Web socket API   JSON config file

eMBMS GW

- MCE
- eMBMS GW

M1 ↔ eNB

M2AP ↔

Legend: `Included` `External` Exposed interfaces ↔
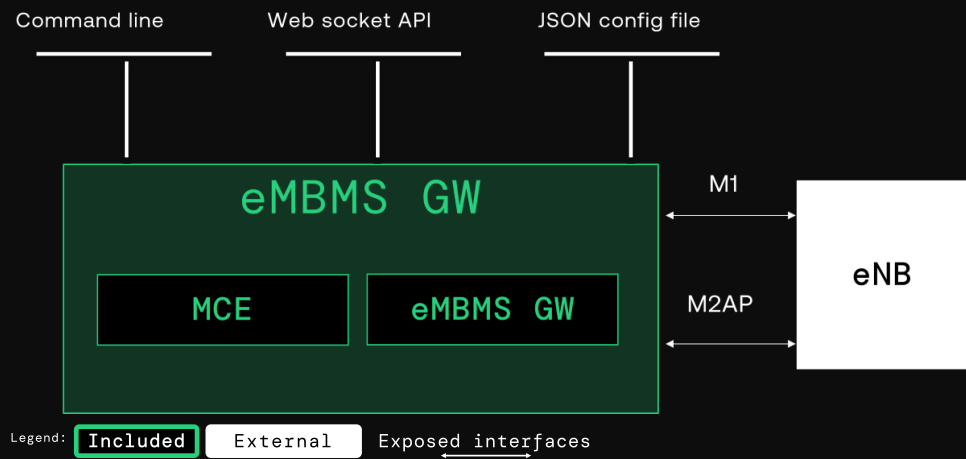
End to end device testing →

Specific feature device testing →

4G 5G network element testing →

Private network →

Operator conformance testing →

FTW gateway testing →

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Last updated : 2025-06-10T10:04:41+00:00