

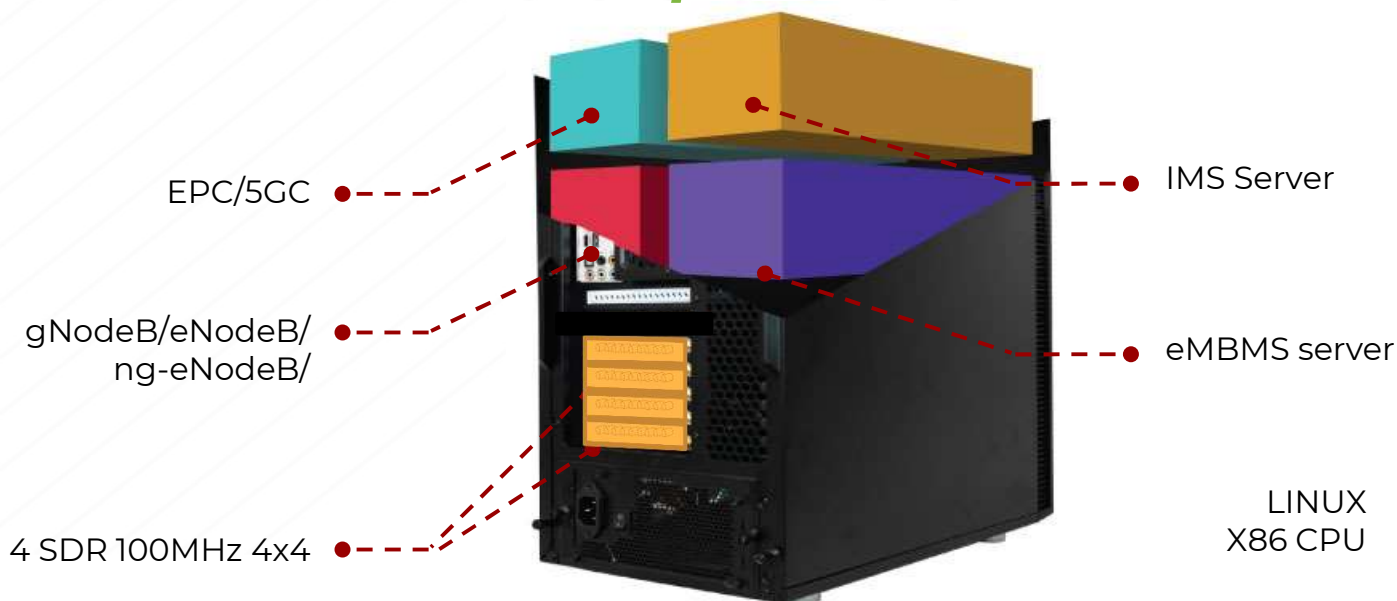
Packaged in a plug and play integrated PC, AMARI Callbox Ultimate is an ideal solution for LTE and NR testing of all types of user equipment with advanced configuration.

It acts as a 3GPP compliant eNodeB, ng-eNodeB, gNodeB, EPC and 5GC allowing functional and performance testing of NR, LTE, LTE-A, LTE-M and NB-IoT devices. The offer is completed by an integrated IMS server as well as an eMBMS gateway for VoLTE/VoNR and eMBMS testing.

The Callbox is powered by a deployment quality LTE and NR software suite offering the same level of baseband functionality as an indoor/outdoor network.



The Multi Gbps 4G/5G callbox



**Logging and Measurements**

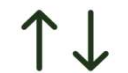
Selective logging and display of all layers of 3GPP LTE and NR stacks as well as useful graphs and analytic tools.

**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.

**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 and using of native Linux tools for throughput testing.

**Channel Simulation**

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

**Test Features**

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

**High Performance**

- Highly optimized software supporting multiple UEs and cells.
- High data rates in LTE and NR supporting downlink and uplink rates of 5 Gbps and 500 Mbps.

**Frequency Agnostic**

Support of a wide range of FDD and TDD frequency bands even non standard ones allowing to test in Sub-6GHz.

3GPP**3GPP Features**

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

PC Specifications

Dimensions H x W x D	46.5 cm x 23.3 cm x 53.3 cm
Weight	14 kg
Number of PCIe SDR Cards	4
Power supply voltage	100-240V AC
CPU	X86 architecture
Operating System	Linux Fedora

PCIe SDR Specifications

Dimensions H x W x D	2 cm x 11.5 cm x 21 cm
Weight	0.28 kg
Power supply voltage	12 V DC input
RF Coverage	500 MHz to 6.0 GHz
RF bandwidth	200 KHz to 100 MHz
Wireless range	10 meters
Operation mode	FDD and TDD
MIMO	DL 4x4

eNodeB/ng-eNodeB Technical Specifications

3GPP release	LTE release 16
Frequency bands	All FDD and TDD bands in sub-6GHz
Bandwidth	1.4, 3, 5, 10, 15 and 20 MHz in LTE 200 KHz for NB-IoT supporting all operation modes (in-band, guard band and standalone).
Number of active UEs	Up to 1000 UEs distributed within the configured cells
Transmission modes	1 (single antenna) to 10 (MIMO 4x4)
Carrier aggregation	Up to 8 carriers in DL and 3 in UL allowing mixed FDD/TDD combinations in DL
Modulation schemes	Up to 1024QAM in DL and 256QAM in UL
AS encryption and integrity protection	AES, SNOW3G, ZUC
Handover	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
ng-eNodeB network interfaces	NGAP and GTP-U to 5GC XnAP between ng-eNodeBs
IoT	LTE category 0 and 1 LTE-M cat M1 FDD, HD-FDD and TDD support NB-IoT single-tone and multi-tone cat NB1 and NB2
NB-IoT subcarrier spacing	15 kHz and 3.75 kHz

gNodeB Technical Specifications

3GPP release	Release 16
Frequency bands	FDD/TDD FR1 (< 6 Ghz)
Bandwidth	Up to 100 MHz
MIMO	Up to MIMO 4x4 in UL and DL
Subcarrier spacing	Data subcarrier spacing: 15, 30, 60 or 120 KHz SSB subcarrier spacing: 15, 30, 120 or 240 KHz
Modulation schemes	Up to 256QAM in DL and 256QAM in UL
Supported modes	NSA, SA
NR Split Bearer	3, 3a and 3x
Use case	eMBB
Network interfaces	NG interface (NGAP and GTP-U) to 5GC XnAP between gNodeBs
Carrier Aggregation	Up to 8 DL carriers in SA and NSA
Handover	Intra gNodeB, NG, Xn and 5GS to EPS handover support

Supported number of cells

Max number of LTE cells	8
Max number of 5G cells	8
Max total number of cells	8
$\sum(Bi*Li)$	1600

B_i is the bandwidth in MHz of cell i L_i is the number of dl MIMO layer for cell i

Configuration examples

LTE Only	8CC 20MHz 2x2, 4CC 20MHz 4x4
5G	NSA: 2 5G NR TDD 100MHz 4x4 FR1 + 2 LTE 20MHz 4x4 or 2 5G NR FDD 50 MHz 4x4 + 2 LTE 20MHz 4x4
NB-IoT	SA: 3 5G NR TDD 100MHz 4x4 or 2 5G NR FDD 50 MHz 4x4 8 NB-IoT standalone cells, 8 LTE cells with 8 in-band or guard-band NB-IoT cells
LTE-M	8 LTE cells with CAT M1 support

EPC Technical Specifications

Network elements	Mobility Management Entity (MME), Serving Gateway (SGW), Packet Data Network Gateway (PGW), Home Subscriber Server (HSS), Evolved Packet Data Gateway (ePDG), Policy and Charging Rules Function (PCRF) and Equipment Identity Register (EIR) all integrated within the same software component
3GPP release	Release 16
NAS encryption and integrity protection	AES, SNOW3G, ZUC
USIM authentication	XOR, Milenage, TUAKE
IP version	IPv4 and IPv6
QoS	Support of all LTE QCI as well TFT and dedicated bearers
Handover	Intra-MME and and EPS 5GS IRAT handover support
Network interfaces	SIAP and GTP-U to eNodeB Rx to external IMS server, S6a to external HSS S13 to external EIR, SGsAP to external VLR/MSC SBcAP to external CBC
RAT	NR, LTE, NB-IoT
CIoT features	control plane CIoT optimization, Non IP data delivery, Attach without PDN connectivity
Power saving features	PSM and extended DRX

IMS Server Technical Specifications

Network elements	Proxy-CSCF (P-CSCF), Interrogating-CSCF (I-CSCF), Serving-CSCF (S-CSCF), and Home Subscriber Server (HSS) all integrated within the same software component
ISIM authentication	XOR, Milenage, TUAKE
Security features	MD5, AKAv1 and AKAv2 for authentication and IPSec at transport level
Network interfaces	Rx interface for support of precondition and dedicated bearer Cx interface for external authentication
IP versions	IPv4 and IPv6
Services	Voice call, Video call, Voice echo test, Call hold, SMS over SIP and SMS over SG

eMBMS Gateway Technical Specifications

Network elements	LTE eMBMS Gateway (eMBMS-GW) and Multi-cell Coordination Entity (MCU)
Network interfaces	M1 interface to eNodeB for user plane M2AP interface to eNodeB for control plane

5G Core Technical Specifications

Network elements	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
3GPP release	Release 16
NAS encryption and integrity protection	AES, SNOW3G, ZUC
USIM authentication	XOR, Milenage, TUAK 5G-AKA
IP version	IPv4, IPv4v6, IPv6 and unstructured PDUs support
QoS	Configurable QoS flows
PDU	Multi PDU sessions support
Network interfaces	NG interface (NGAP and GTP-U protocols) to several gNodeBs, ng-eNodeBs or N3IWFs Rx to external IMS server, N12 to external AUSF N8 to external UDM, N17 to external 5G-EIR, N50 to external CBC
RAT	NR, LTE, NB-IoT and non-3GPP RAT
Handover	intra-AMF and 5GS EPS IRAT support

Web GUI interface for logging and analysis

The screenshot displays the AMARI Callbox Ultimate Web GUI interface for logging and analysis. The main window shows a log table with columns for Time, Diff, ENB, UE ID, Cell, SFN, RNTI, Info, and Message. A 'Statistics' window is open, displaying a graph of Throughput (PHY UL 1) over time. A 'Resource Block Allocation' window is also open, showing a spectrum plot. The main log table contains entries for PHY, RRC, NAS, and PUSCH, with details like format, n, seq, start, and end times.