5G SIGNALING DEVICE TEST WITH THE CMX500 ONE BOX TESTER (OBT)

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ROHDE&SCHWARZ
Make ideas real

Conformance

High Throughput

Performance

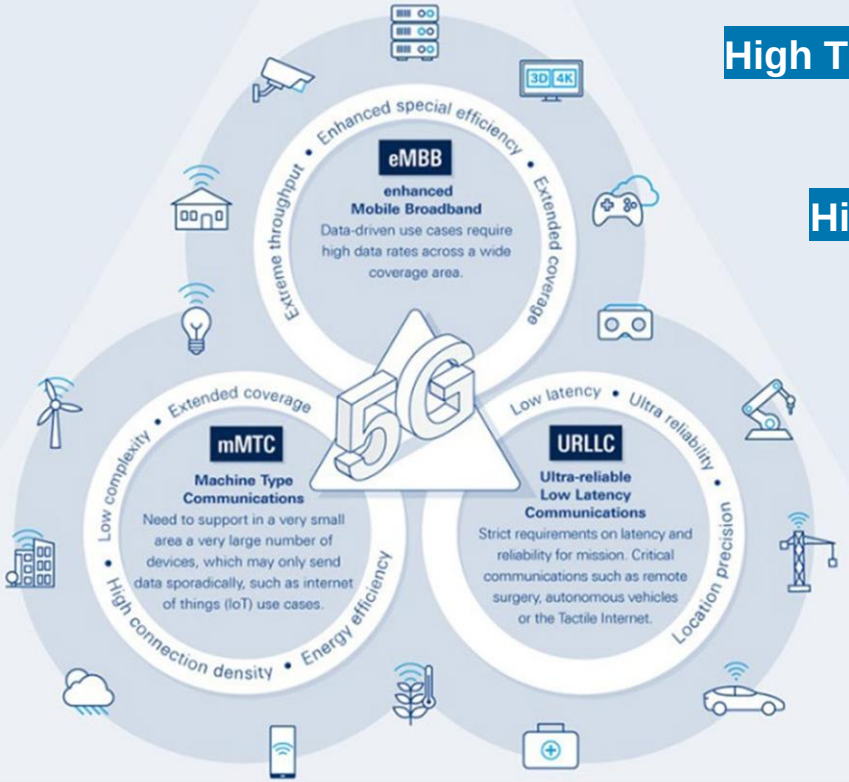
High Reliability

Security

New Applications

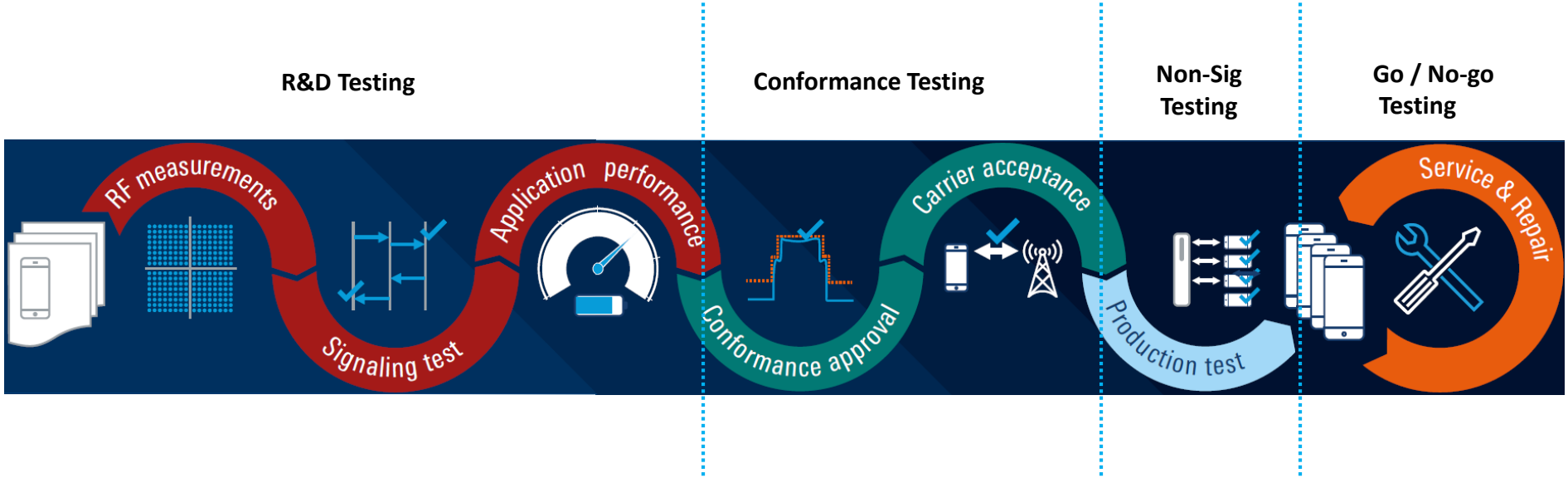
Energy efficiency

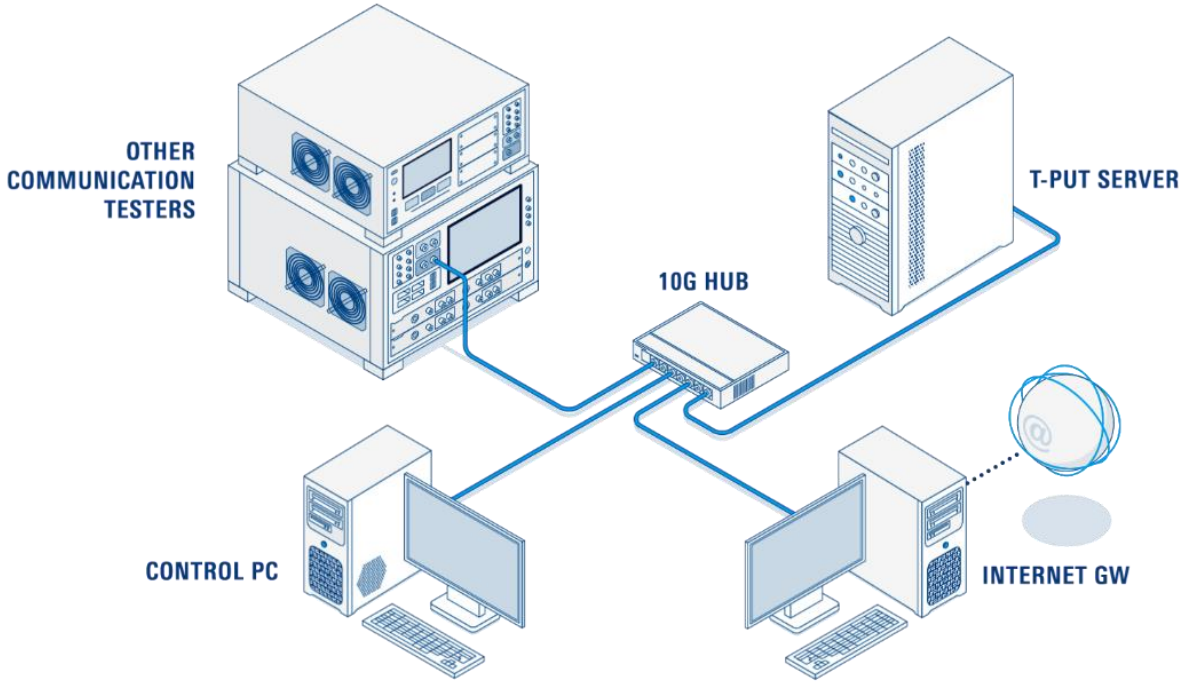
Low Latency



VERIFICATION OF 5G DEVICES IS A COMPLEX TASK

TESTING PHASES





TRADITIONAL SYSTEM SETUP TO ADDRESS 5G COMPLEXITY

AGENDA OF THIS SESSION

- CMX500 Hardware Overview
- User Interfaces
- Use Cases

- Summary

5G NR RADIO COMMUNICATION TESTER

CMX500 5G NR Signaling Tester

- Future proof 5G NR signaling test platform
- up to **64 FR1/FR2/LTE Layers** | **14 GHz** RF iBW
- Modular and scalable HW-Architecture
- LTE and FR1 multiband capabilities up to 8 Ghz
- FR2 Multiband Remote Radio Support (24 – 50GHz)
- 20 Gbps+ End-to-End IP Data Performance capability
- Single Web-based GUI for RF, Protocol and App Tests
- Extensive IP and Application Test feature set onboard
- Multiple Remote Interfaces including SCPI

FLEXIBLE & UPGRADEABLE CMX500 PLATFORM – FR1

OBT lite

- FR1/LTE 4x4 MIMO
- SA / NSA support
- **3GPP RF pre-conformance**
- **Application testing** (VoNR etc.)
- Signaling functional tests
- **Service and Repair**
- 3GPP Rel-17 **RedCap**

- 4 GHz RF DL iBW
- Sub8: 400 MHz - 8 GHz
- FR2 extendable

OBT

adds capabilities like:

- RF testing with **internal fading**
- FR1 CA over 2 GHz iBW
- Up to 32 NR Layers
- Up to 32 LTE Layers
- 48 layers on air simultaneously

- 8 GHz RF DL iBW
- Sub8: 400 MHz - 8 GHz
- FR2 extendable

OBT plus

adds capabilities like:

- Higher order CA **(massive band combos)**
- **High throughput testing**
- FR1 CA over 3 GHz iBW 4x4 DL MIMO
- Up to 16CC LTE/NR
- Up to 64 FR1/LTE layers on air

- 12 GHz RF DL iBW
- Sub8: 400 MHz - 8 GHz
- FR2 extendable

Q3/2023

OBT FR1 specialist

adds capabilities like:

- FR1 CA over 4 GHz iBW
- **Extensive Fading**
- Higher order CA testing **(all band combos)**

- 16 GHz RF DL iBW
- Sub8: 400 MHz - 8 GHz
- No FR2 upgrade

NEW

FLEXIBLE & UPGRADEABLE CMX500 PLATFORM – FR1 + FR2

OBT lite

OBT lite FR1 features +
FR2 capabilities like:

- Supports **FR2 SISO** + FR1

- 5 GHz RF DL iBW
- Sub8: 400 MHz - 8 GHz
- mmW: 22 … 50 GHz

OBT

OBT FR1 features + FR2 capabilities:

- Support for FR2 2x2 MIMO up to 8 CC
- CB RF test up 50 GHz and
  8CC FR2 2x2 + 4CC FR1 4x4
  8CC FR2 2x2 + 8CC LTE 4x4
- **10 Gbps Data Throughput**
- 3GPP pre-conformance tests

OBT plus

OBT plus FR1 features FR2 capabilities:

- Support for FR2 2x2 MIMO up to 8 CC
- CB RF test up 50 GHz and
  8CC FR2 2x2 + 4CC FR1 4x4
  8CC FR2 2x2 + 8CC LTE 4x4
- High order CA Testing (massive band combos) **FR1 combined with FR2**

Q3/2023

OBT FR2 specialist

capabilities like:

- FR2 10CC
- 4x4 AoA RRM testing

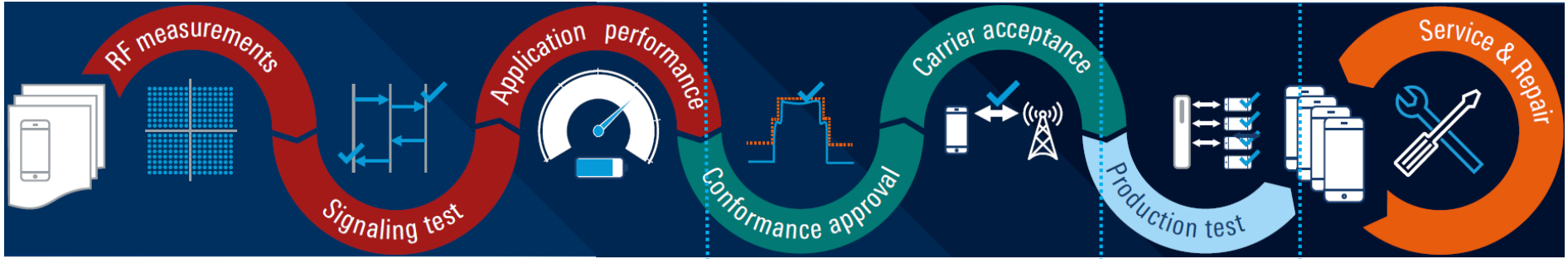
- High order CA testing (massive band combos) some FR1 combined with massive FR2

NEW

easy-to-use, web user interface

TESTING PHASES

R&D Testing | **Conformance Testing** | **Non-Sig Testing** | **Go / NoGo Testing**



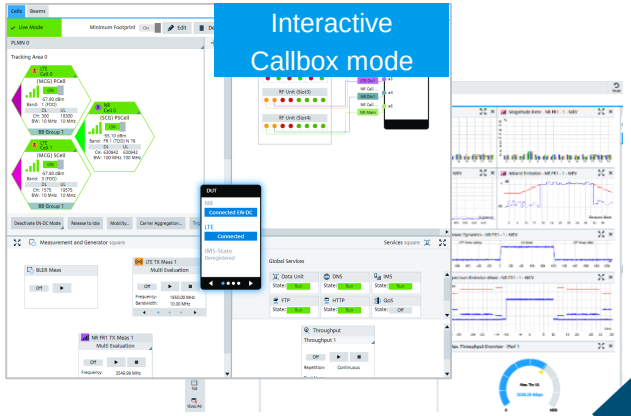
CMsquares

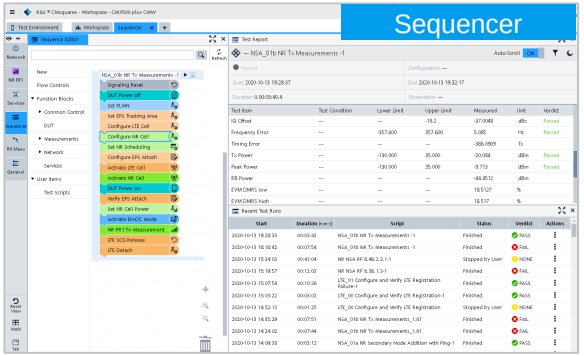
CMsequencer

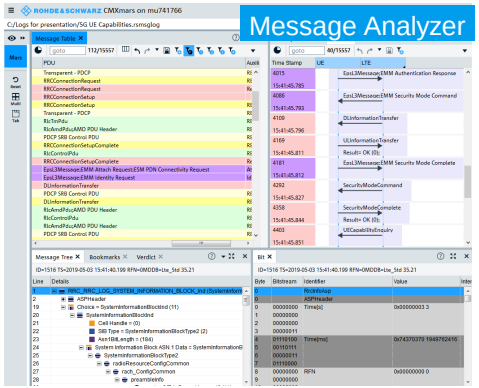
CONTEST

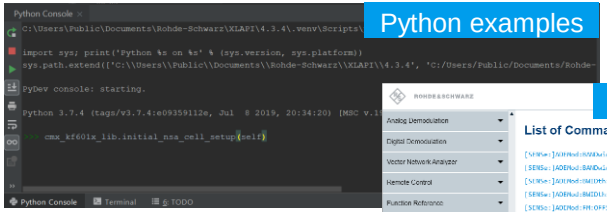
CMsequencer

MORE THAN JUST AN USER INTERFACE!







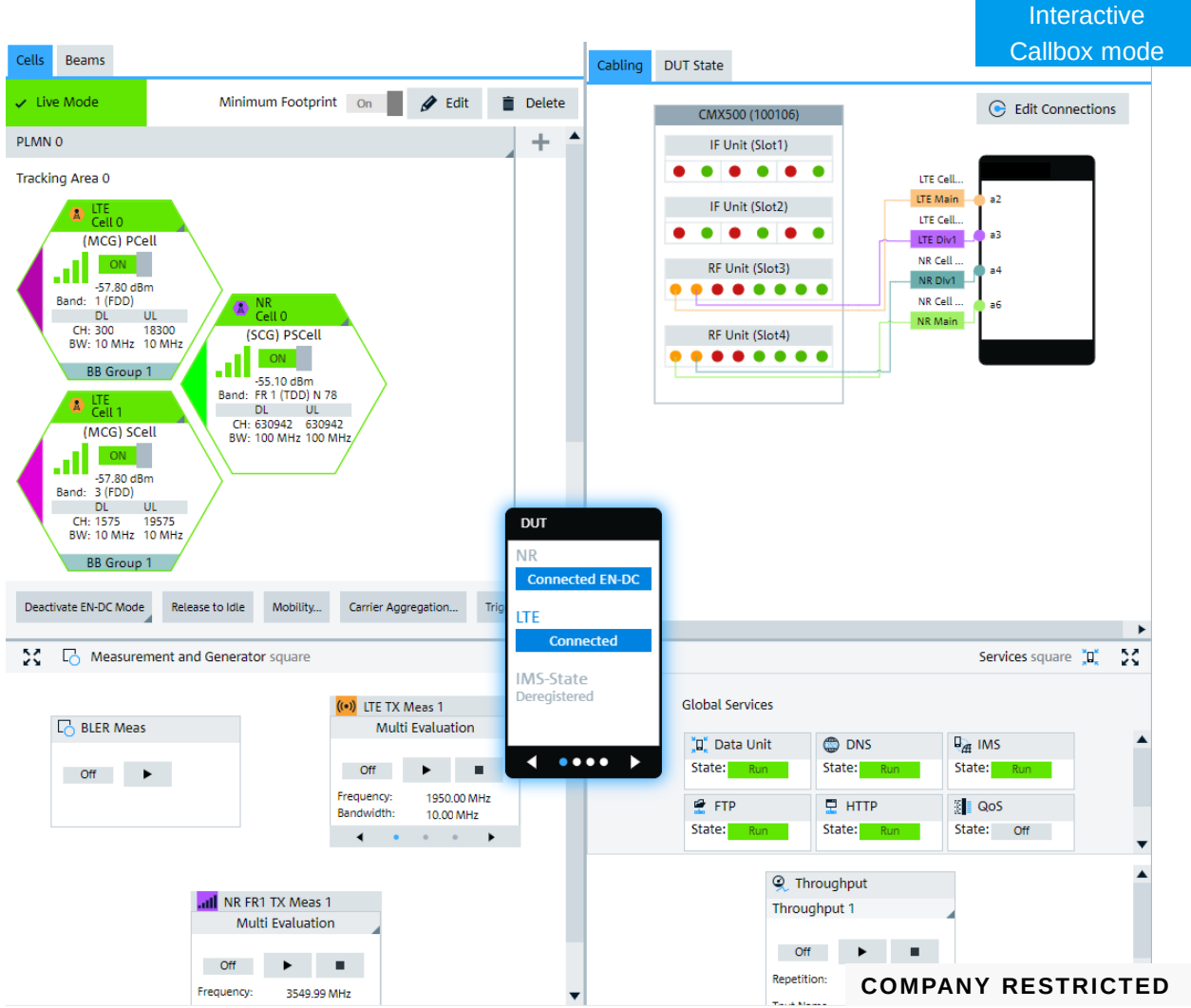


The all in one - User interface

THE TEST ENVIRONMENT

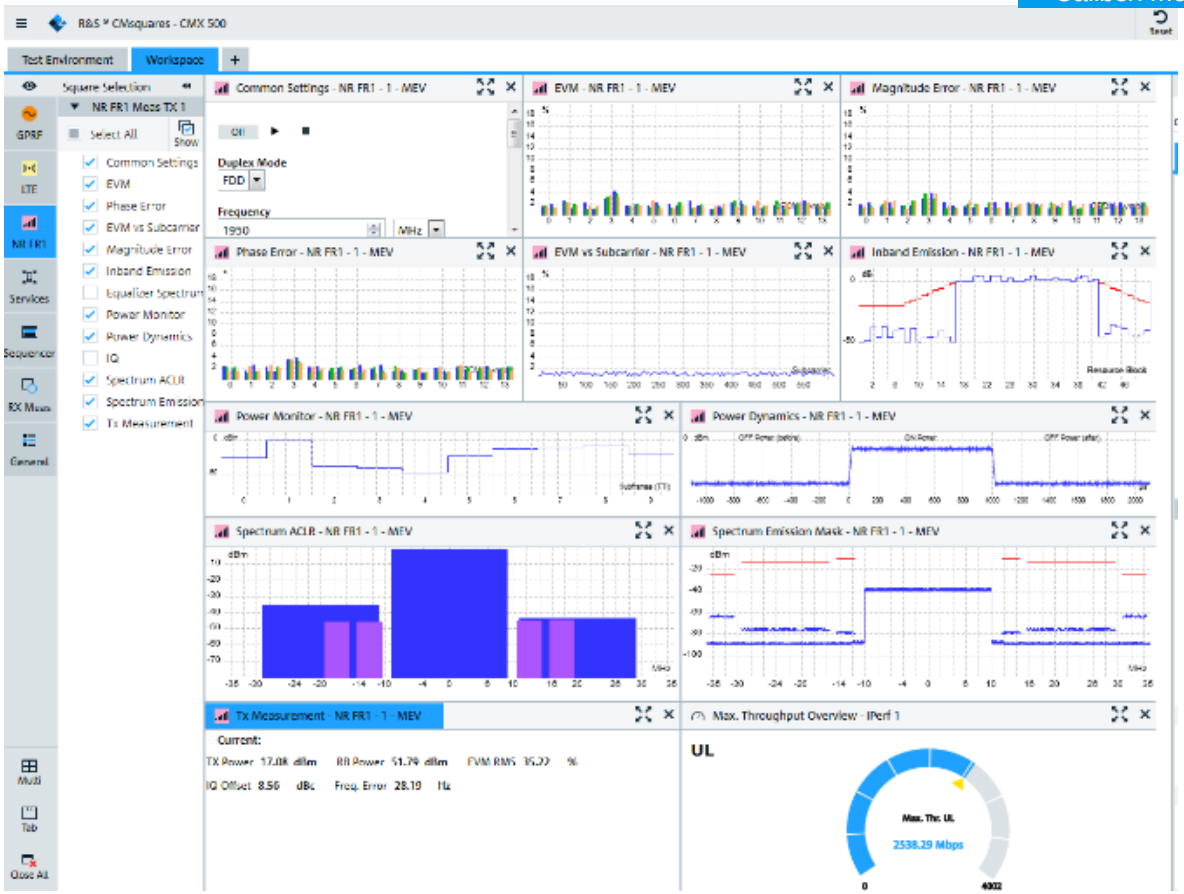
- Configure your test setup
  - Network & measurements
  - Cabling
  - IP services
  - DUT status
  - Prepare snippets
  - etc.

- DUT management
  - UE database
  - SIMprofile database
  - DUT connection management
  - etc.



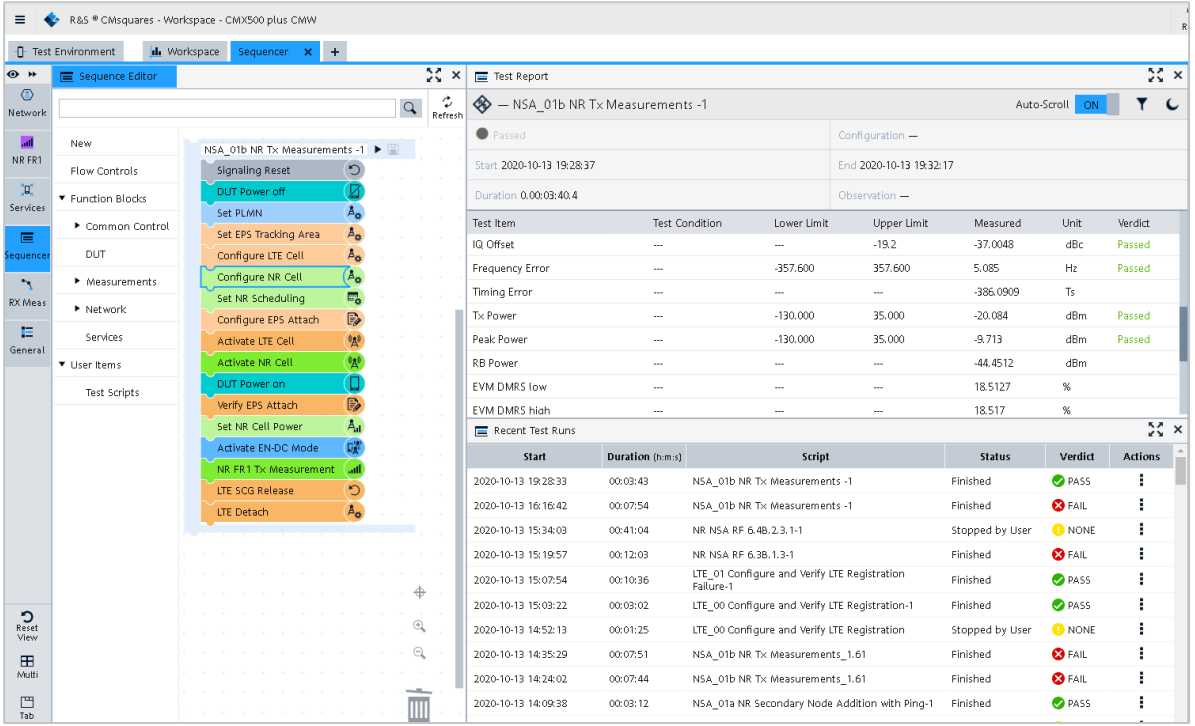
FLEXIBLE WORKSPACE

- Place of the measurements
- User defined configuration & easy mixing of all types of measurements
  - RF, IP or DUT status
- Real time results
- Compare LTE and 5G
- …or FR2
- …or end-to-end (IP)

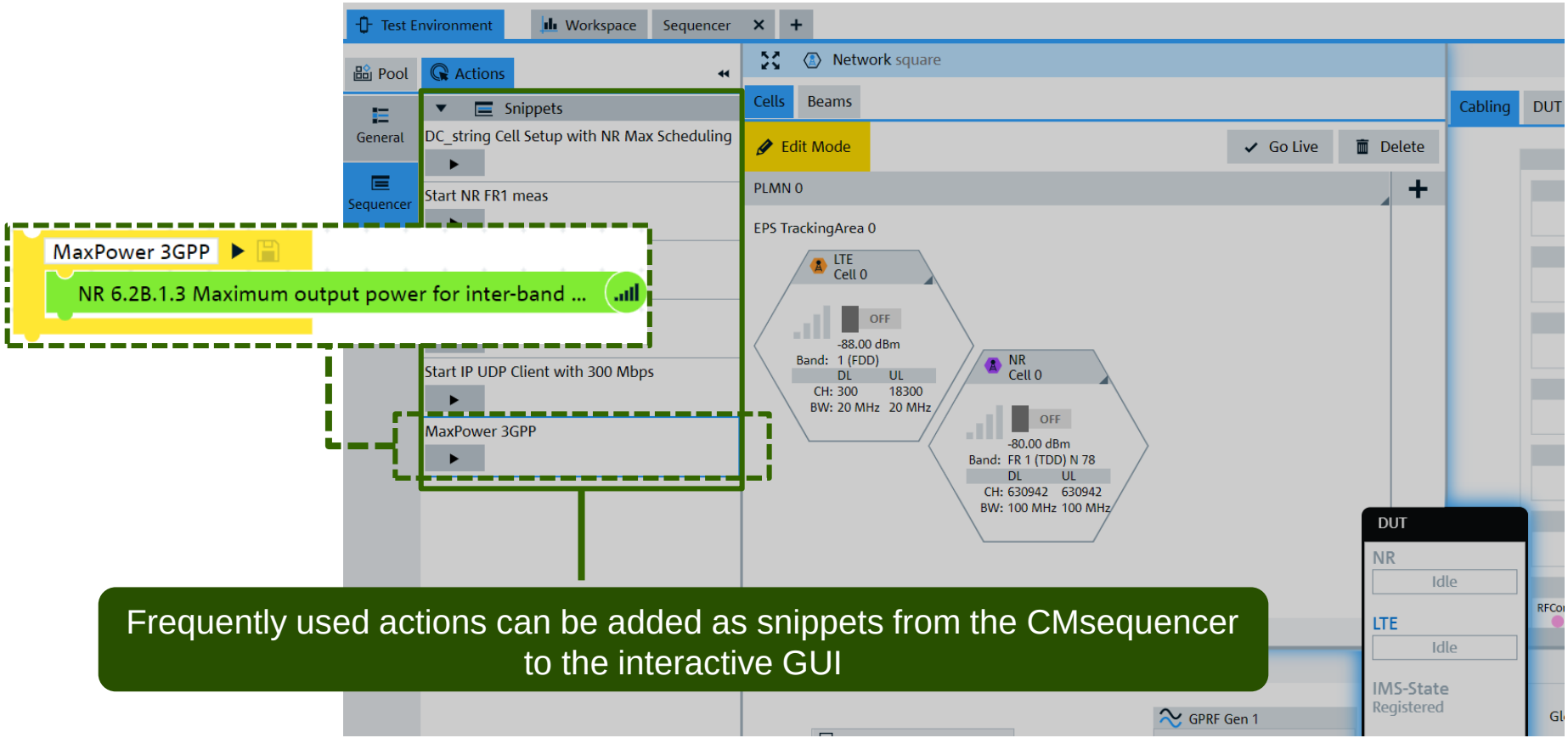


CMSEQUENCER

- Place for automation and scripting
- Includes comprehensive test sequence campaign management
- Complete Coverage of 5G NR R&D tests incl. 3GPP RF in one application
- Automatic band combination tests
- Reporting and test report generation



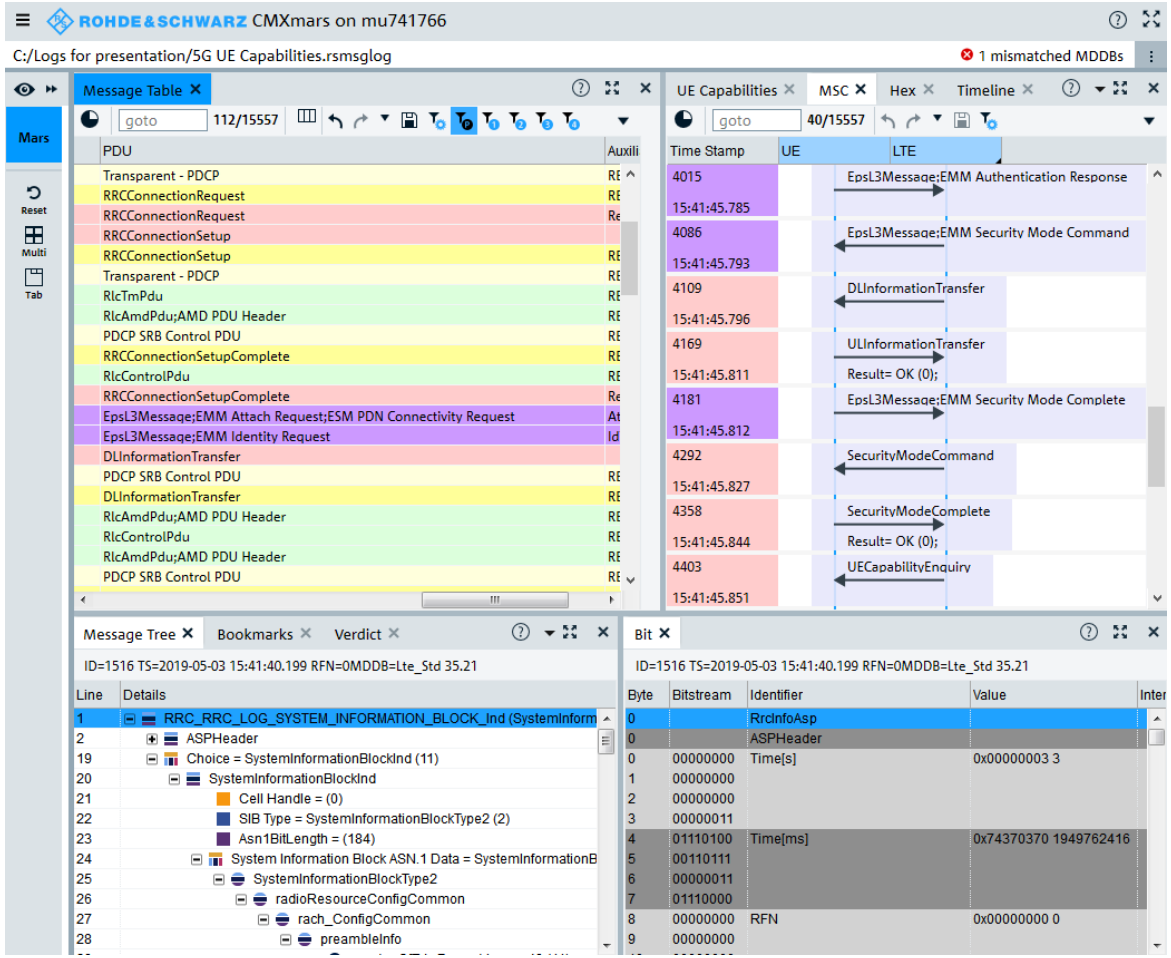
SNIPPETS - CREATE INFINITE SHORTCUTS IN WEBUI



Frequently used actions can be added as snippets from the CMsequencer to the interactive GUI

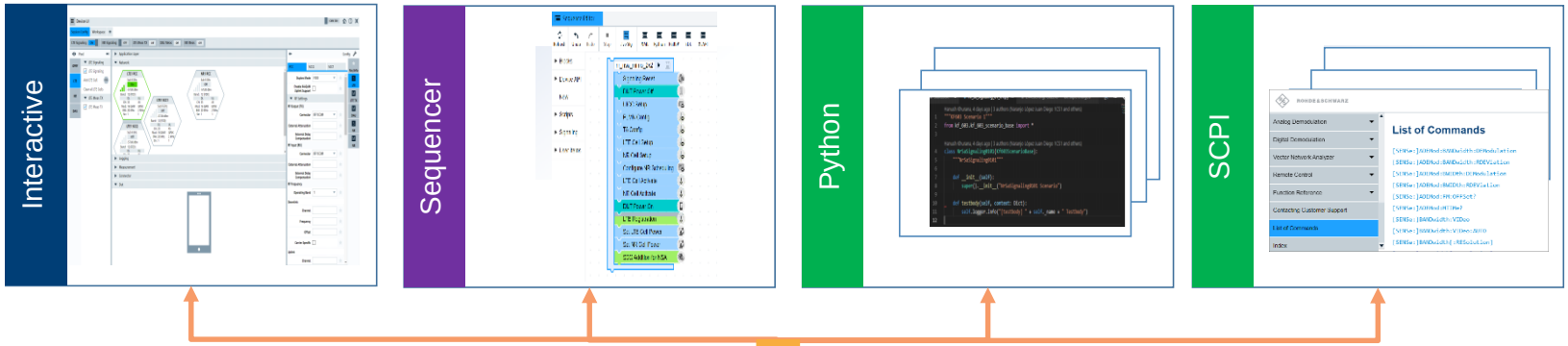
MESSAGE ANALYZER

- Place of real time tracing and post processing (online and offline)
- Evolution of well-established CMWmars
- Message tracing between network tester and UE from PHY to IP and IMS
- UE capabilities
- Message compare function



CUSTOMER INTERFACES

REMOTE CONTROL



CMX500 SUPPORTS MANY USE CASES

3GPP RF TESTING

MOBILITY, FAILURE & REJECT SCENARIOS

IMS AUDIO & VIDEO TESTING

IP THROUGHPUT TESTING inc. FR2

BATTERY LIFE TESTING

REDcap Rel.17

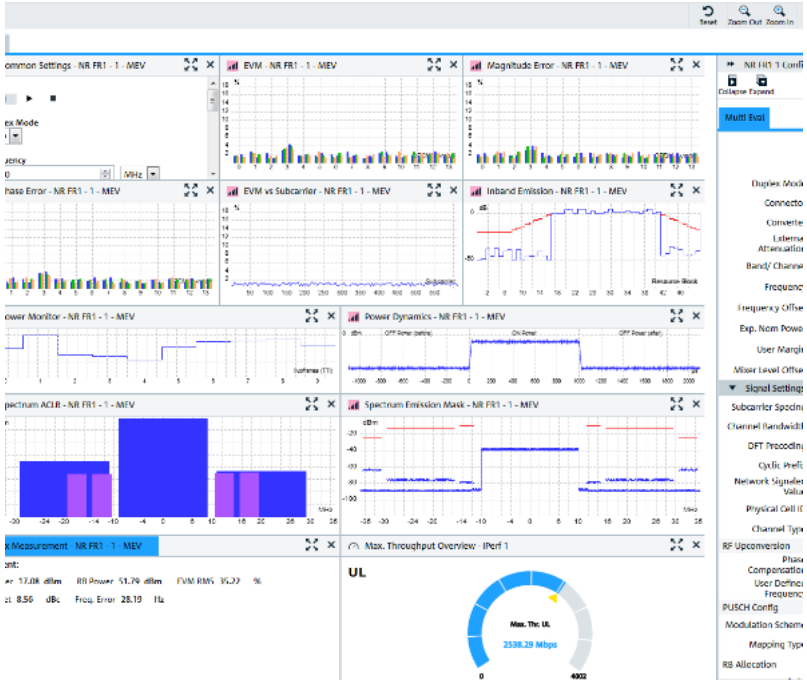
Security Analysis

Backend Service Test

WLAN Offloading

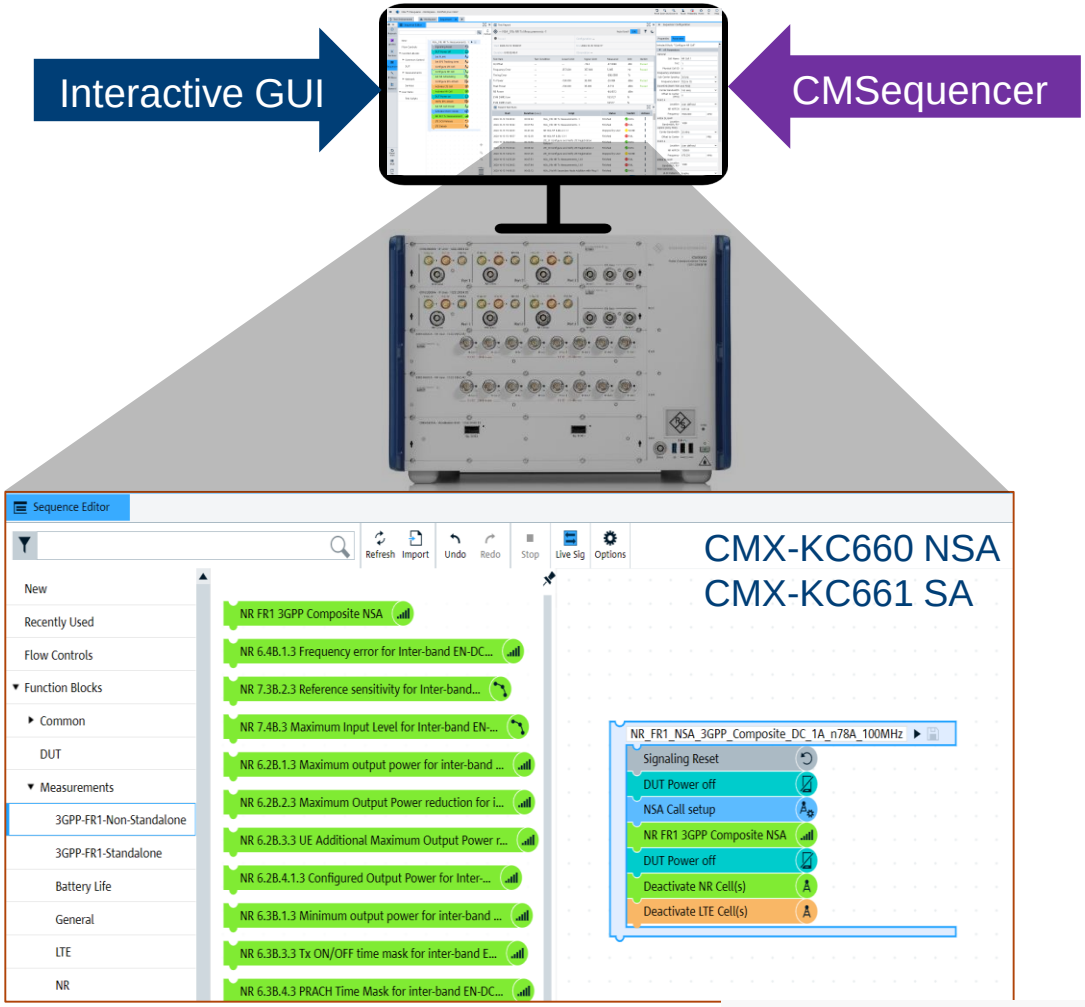
Many more…

3GPP RF PRE-CONFORMANCE TESTS



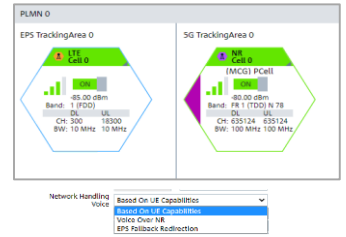
3GPP PRE-CONFORMANCE TESTS

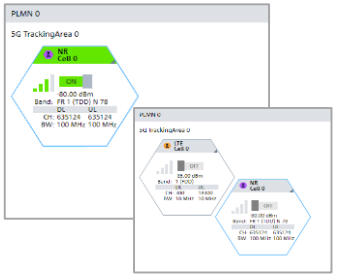
- 3GPP 38.521 Tx and Rx manual and automates tests for 5G FR1 NSA and SA
  - Interactive GUI
  - CMsequencer
- Pre-defined test scripts with allowed variations available
- Comprehensive test reports with measurement verdicts, tables and graphs
- Automated RF attenuation tuning for clean RF path
- And many more features

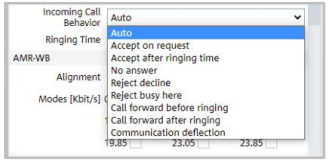


ALL FLAVORS OF MOBILITY & VOICE

- Intra & Inter RAT Handover
- Fast Frequency Change (FR1 & FR2)
- Idle mode mobility (cell selection / reselection)
- Radio Link Failure
- Redirection
- Roaming scenarios
- VoLTE / VoNR / EPS-FB
- Enhance mobility with fading too







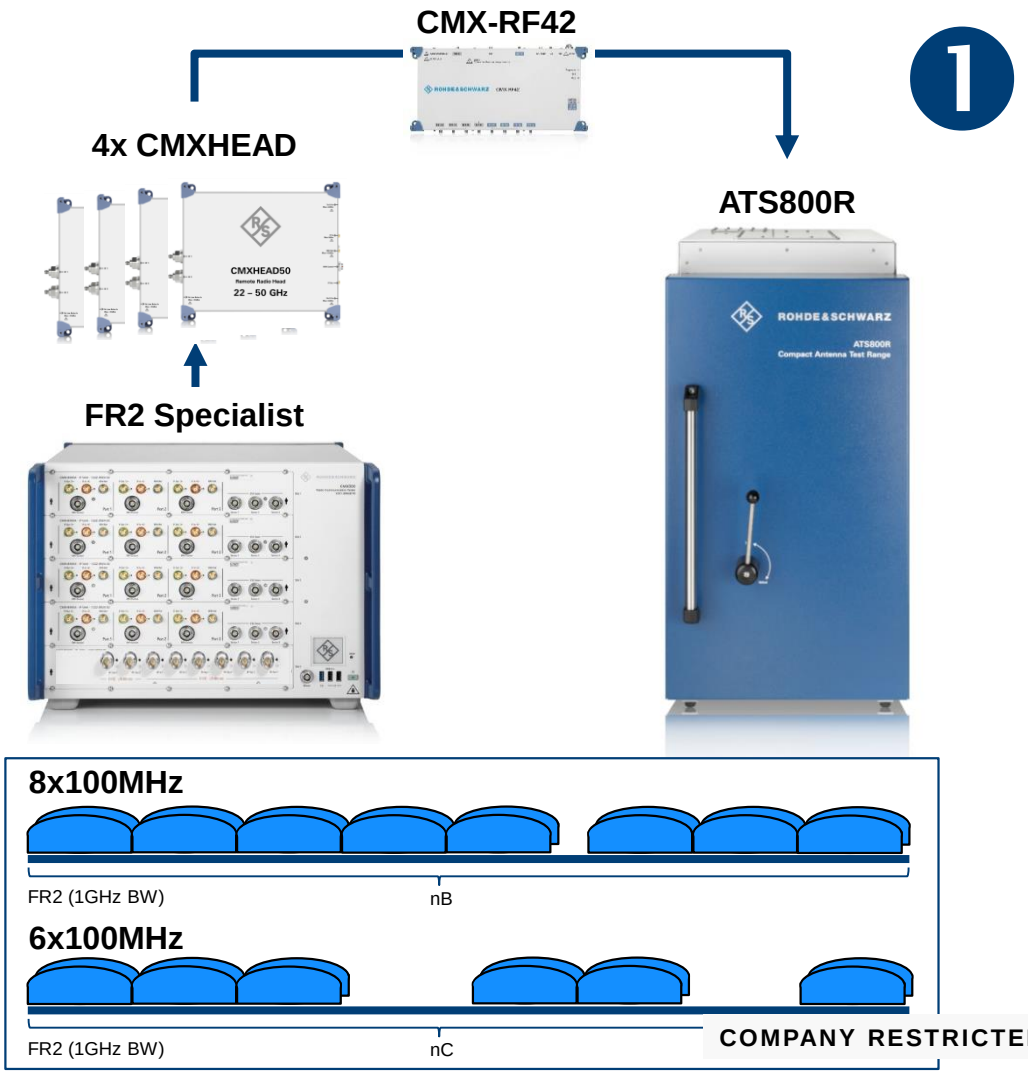
- Redirection
- Carrier Aggregation
- Handover
- Establish Call
- Radio Link Failure
- Enable Fading

- Configure NR Idle Mode
- Configure NR Neighbour Cell
- Modify NR Cell
- Set NR CDRX

- Configure LTE Idle Mode
- Configure LTE Neighbour Cell
- Modify LTE Cell
- Set LTE CDRX

NEW FR2 SPECIALIST

- **Advanced FR2 testing:**
  - **Up to 14 CC** FR2 with 2x2 + FR1
  - **>10 Gbps** E2E Data TP
- **Additional Use Cases**
  - Interband CA with 2x2 (e.g. 28 + 39 GHz)
  - Intraband CA with 2x2 (>1GHz)



R&S FR2 OTA CHAMBER SOLUTIONS OVERVIEW

	CMQ200	CMQ500	ATS800R	ATS1800C	ATS1800M
					
WxDxH [m]	0.45 x 0.7 x 0.6	0.45 x 0.7 x 0.6	0.6 x 1.2 x 2.0	0.9 x 1.5 x 2.0	~3.5 x 1.5 x 2.0
Application	R&D, production, 5G FR2 device/components	R&D, production, 5G FR1 & FR2 device/components LBS, NPT	R&D, pre-conformance (RF, LBS, Netop, PCT, PQA)	R&D, Conformance & pre-conformance (RF, LBS, Netop, PCT, PQA)	R&D, Conformance & pre-conformance RRM multiple AoA
Type	White box DFF/NF	DFF(FR2)/NF(FR1)	Black box CATR	Black box CATR	Black box CATR
Freq. Range	20 - 77 GHz	700 MHz - 77 GHz	20 - 50 GHz	(6) 23 - 90 GHz	(6) 23 - 90 GHz
Supported freq. Range	Full range	Full range	Full range	23 - 44 GHz (Feed antenna)	23 - 44 GHz (Feed antenna)
Quiet zone	Ø 2 cm @ 40GHz	Ø 2 cm @ 40GHz	Ø 20 cm	Ø 30 cm	4x Ø 30cm
Positioner	-	-	3D Az over El (opt.)	3D Az over El	3D Az over El
Shielding Eff.	> 60 dB	> 80 dB	>60dB (also FR1)	>90 dB	>70dB
Extreme Temp.	4/19/2023	-	1D	3D	

IP & APPLICATION TESTING

Unique integrated solution – Simplify your test setup!

USE CASE - VONR IMS SERVER

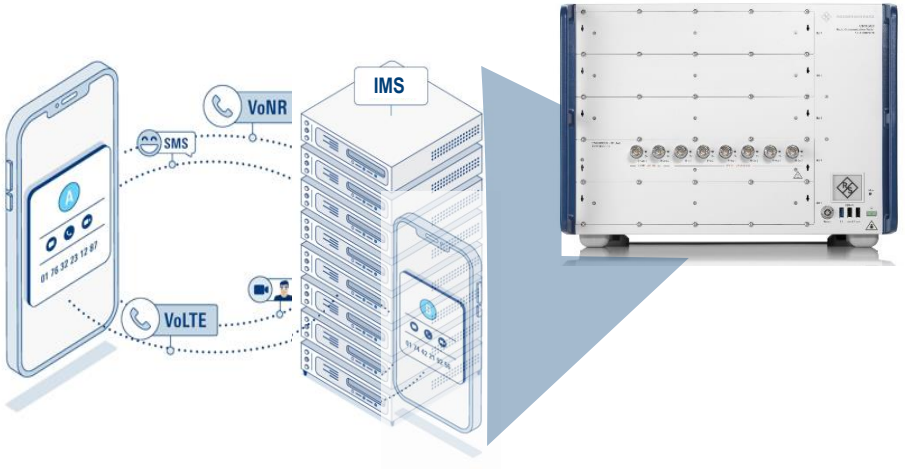
Key features:

- fully integrated server

Test capabilities:

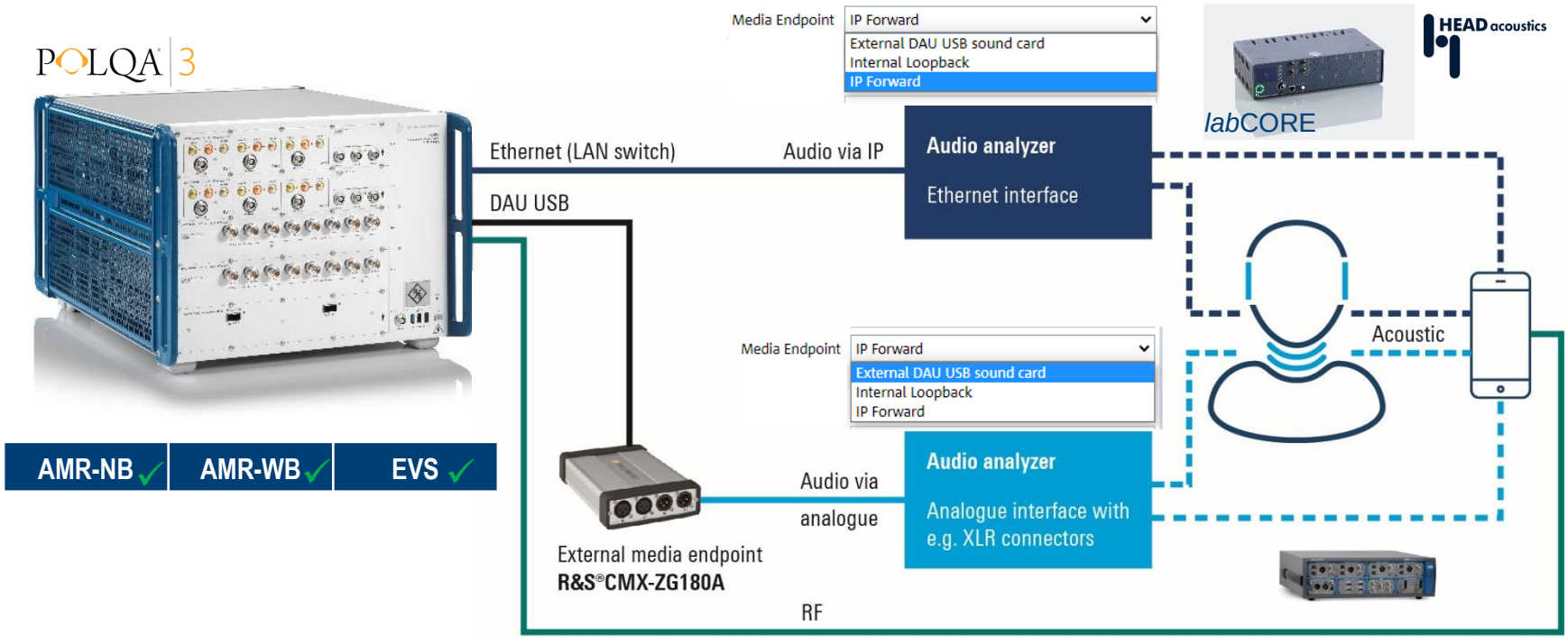
- IMS registration & call setup procedures
- VoLTE, VoNR and fallback or handover support
- Voice & Video audio testing
  - All audio codecs & code rates supported (AMR-NB/WB, EVS)
- IP Forward mode for HEAD acoustics labCORE
- Internal POLQA measurement scenarios
- SMS over IMS

… and many other features are supported



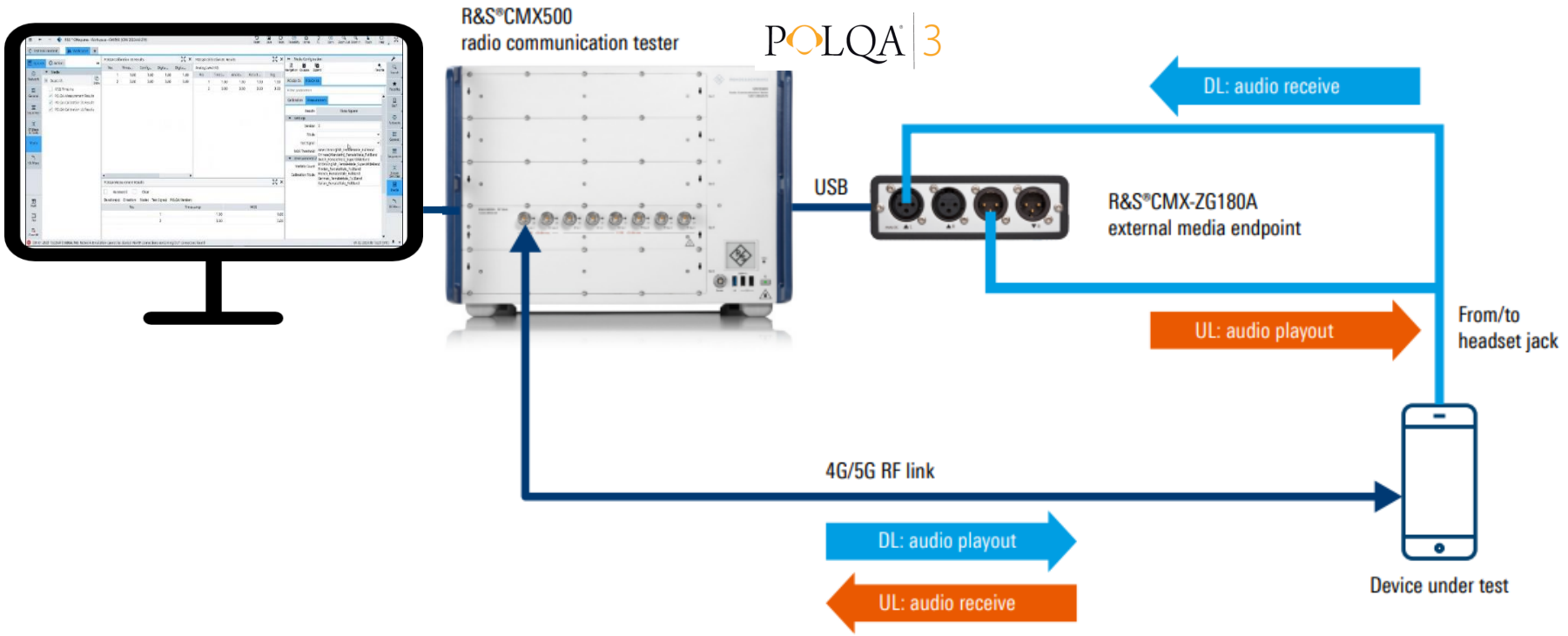
CMX500 comes with an internal IMS server for IMS, VoLTE & VoNR audio and video call testing

5G AUDIO QUALITY ANALYSIS
R&S CMX500 OFFERS MAXIMUM FLEXIBILITY

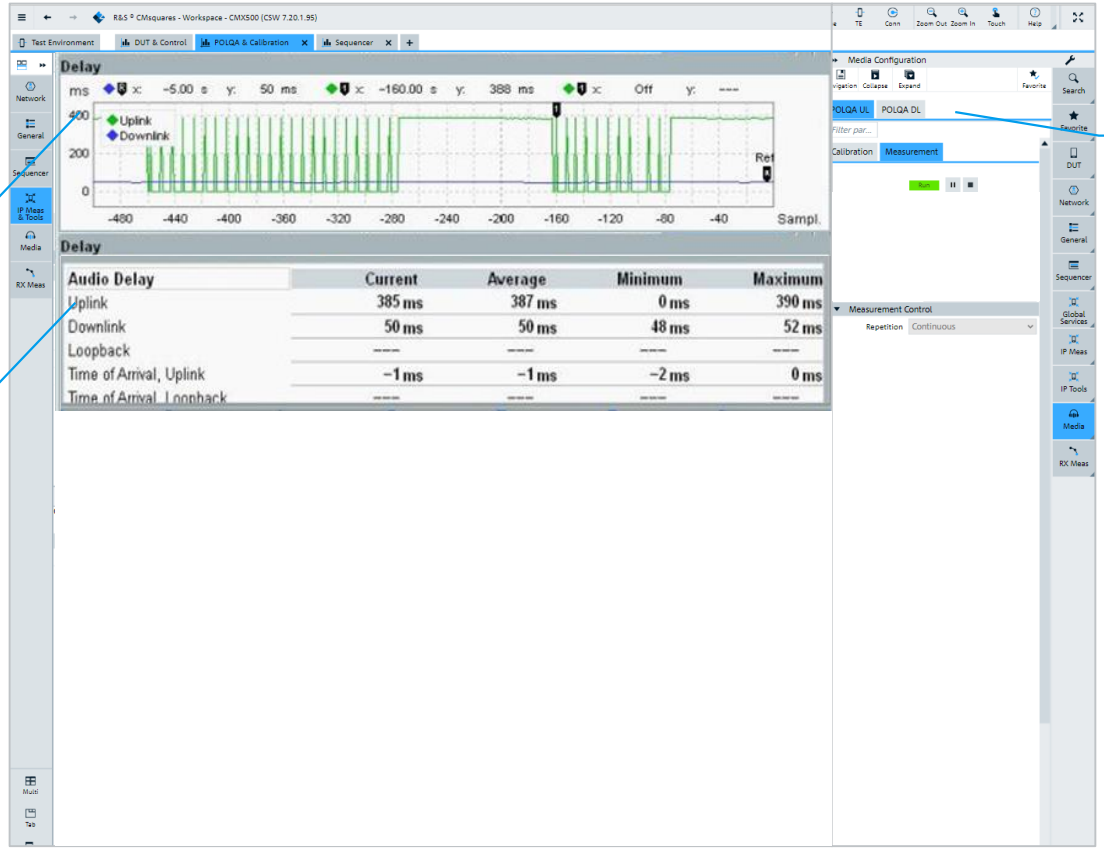


e.g. UPV, Audio Precision, customized solutions a.o.

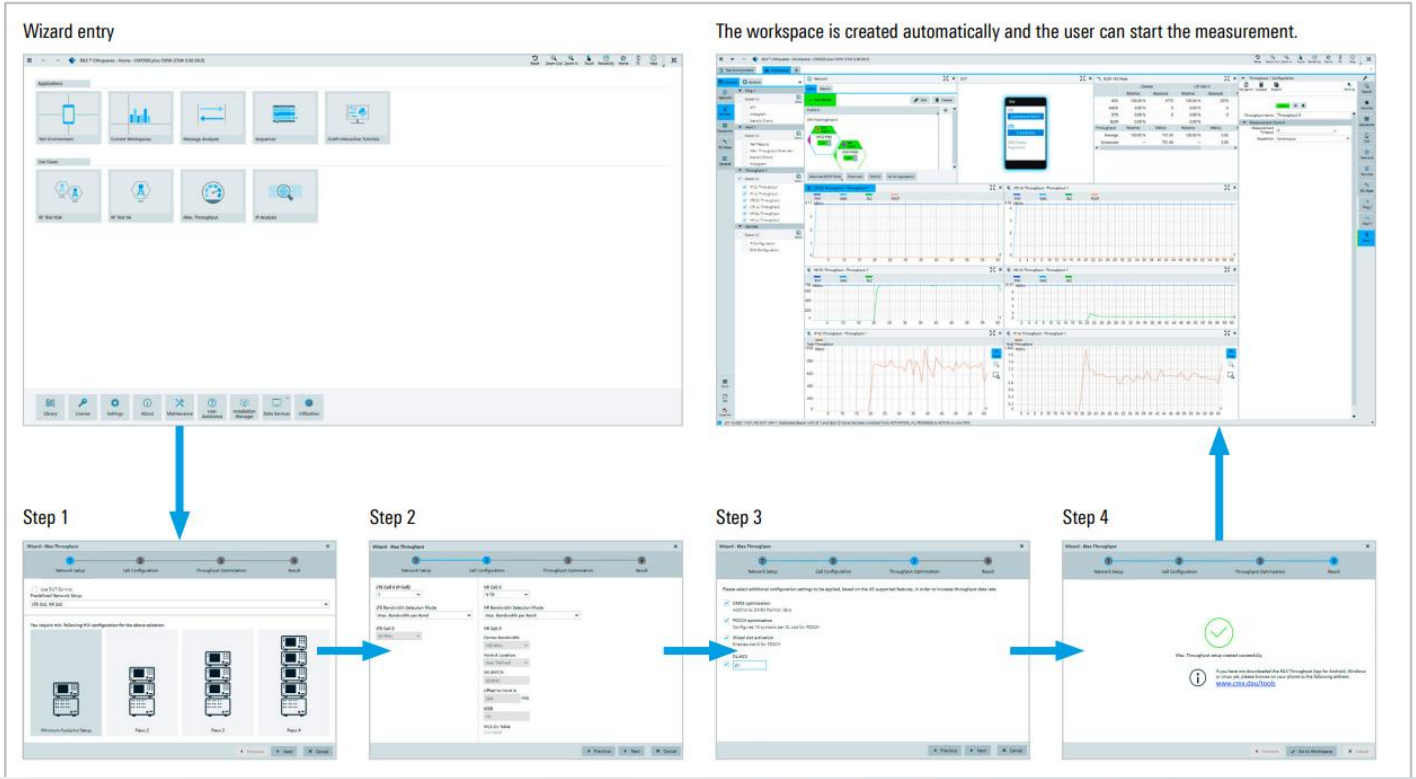
INTERNAL POLQA AUDIO QUALITY MEASUREMENT



AUDIO DELAY MEASUREMENT



USE CASE - MAXIMUM THROUGHPUT TESTING



Wizard (setup assistant) for network and workspace creation for the interactive GUI

IP-TUNE OVERVIEW

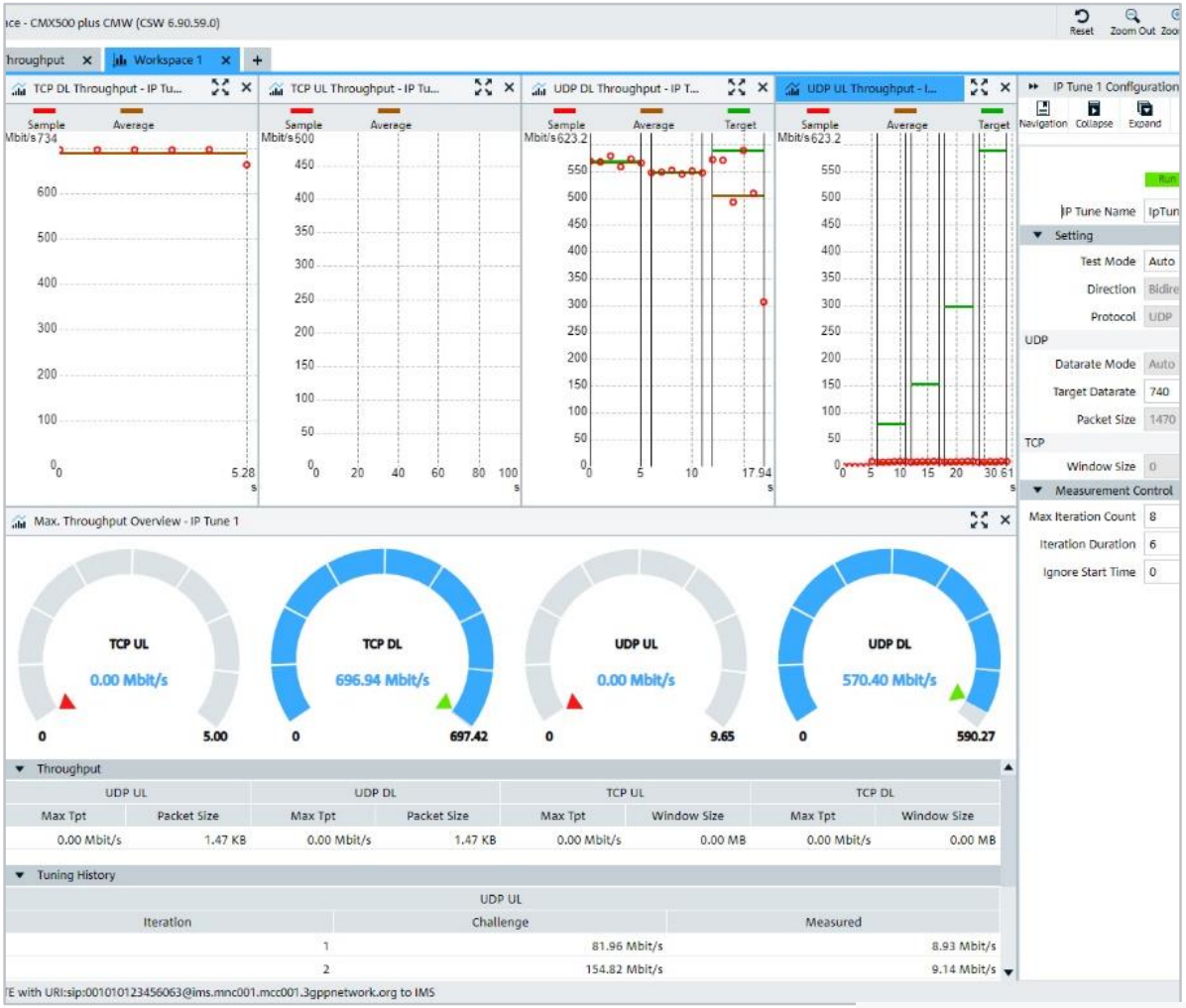
- Easy to use
- First impression on of the channel characteristics
- **Problem to solve:**
  - DUT with unclear capabilities
  - No overview on how to achieve high throughput

Throughput App 2

Automatic tuning of the IP throughput to the maximum

IP TUNE

- **Features:**
  - Channel Quality overview BLER vs. MCS
  - Step by step qualification of current channel UDP/TCP



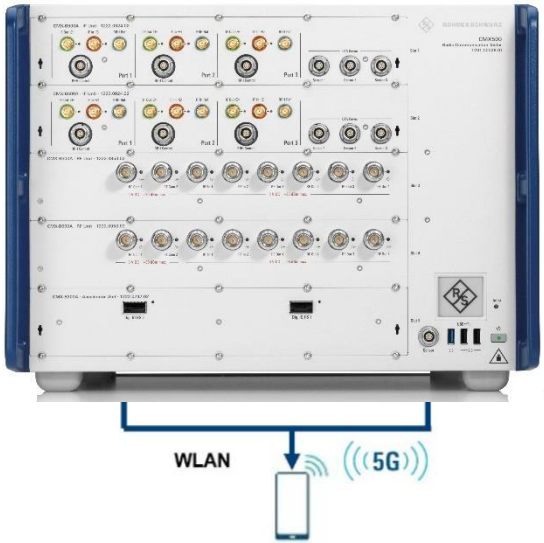
USE CASE: WLAN OFFLOADING / WLAN CALLING CMX500 WITH INTEGRATED ePDG INTERFACE

Procedure

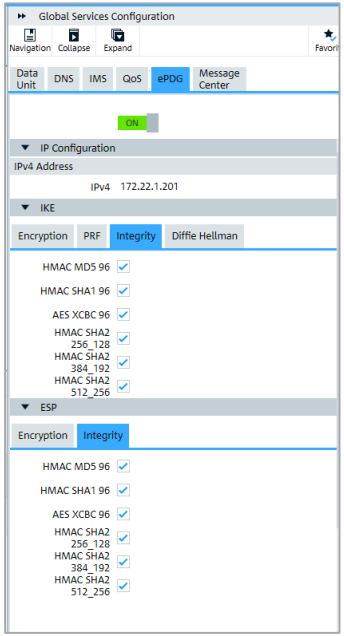
► NR <-> WLAN data offloading

► VoNR <-> WLAN calling

Test setup

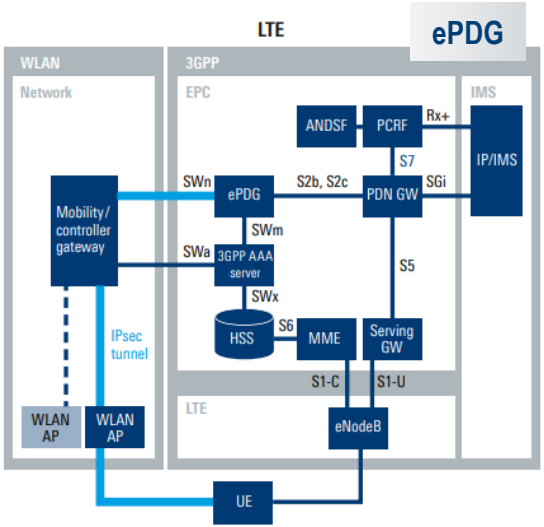


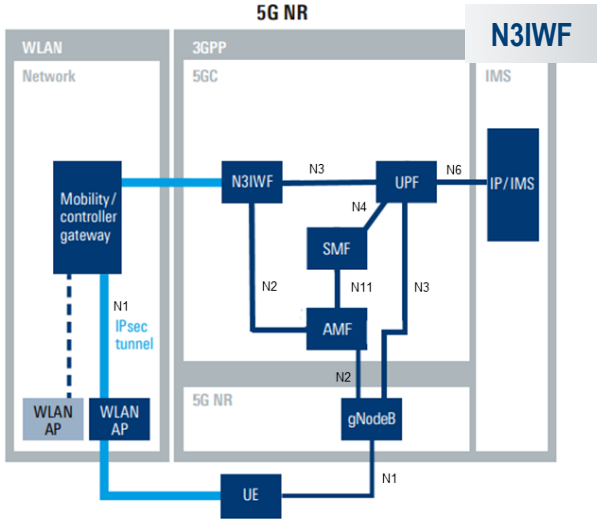
Configuration



N3IWF – NON-3GPP INTER WORKING FUNCTION

The evolution from LTE based ePDG to N3IWF for 5G-NR network



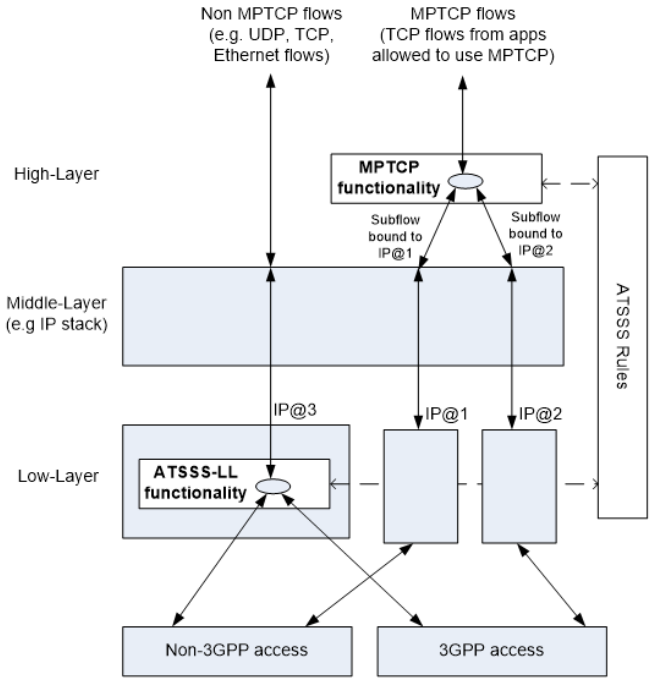


ATSSS – OVERVIEW

- **A**ccess **T**raffic **S**teering, **S**witching and **S**plitting (**ATSSS**)
- On top of N3IWF for 5G NR networks

- Two **steering functionalities**:
  - ATSSS-LL (operate on lower layer, e.g., IP)
  - MPTCP (use two TCP connections instead of one)

- Four **steering modes**:
  - smallest delay
  - active-standby
  - load balancing
  - priority based



UE POWER SAVING FEATURES – SUPPORTED ON CMX

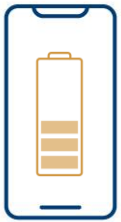
Rel-15

Rel-16

DRX

Wake-Up Signal

RRM measurement Relaxation



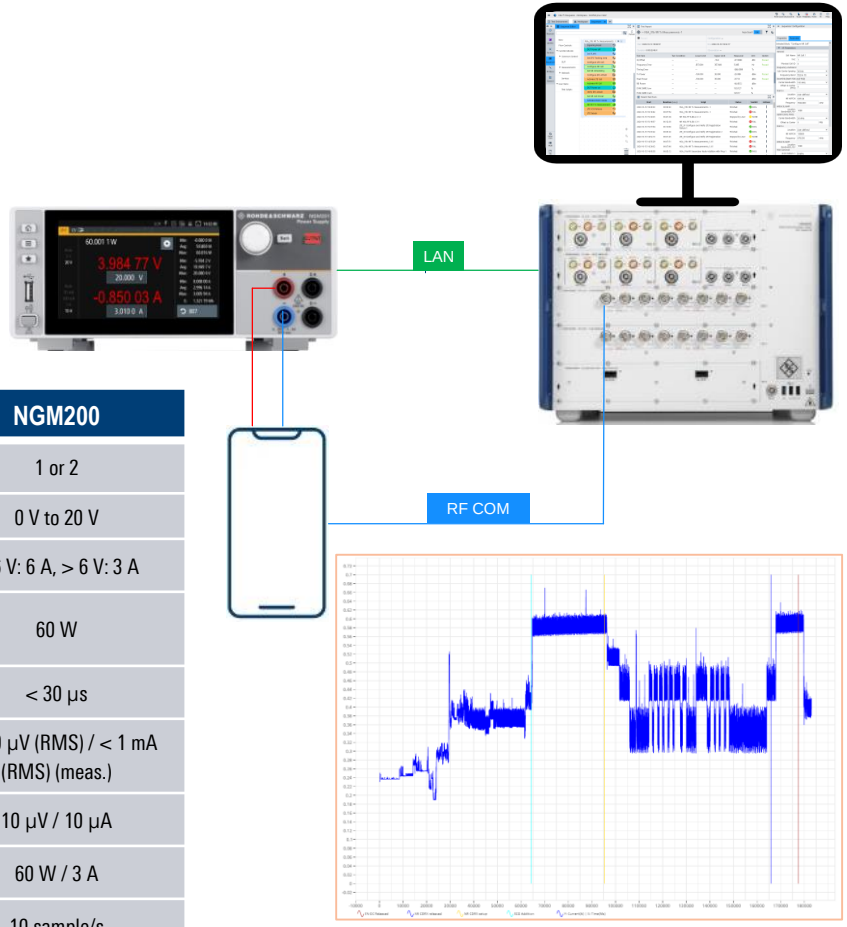
BWP Switching

UE assistance information

BATTERY LIFE MEASUREMENTS

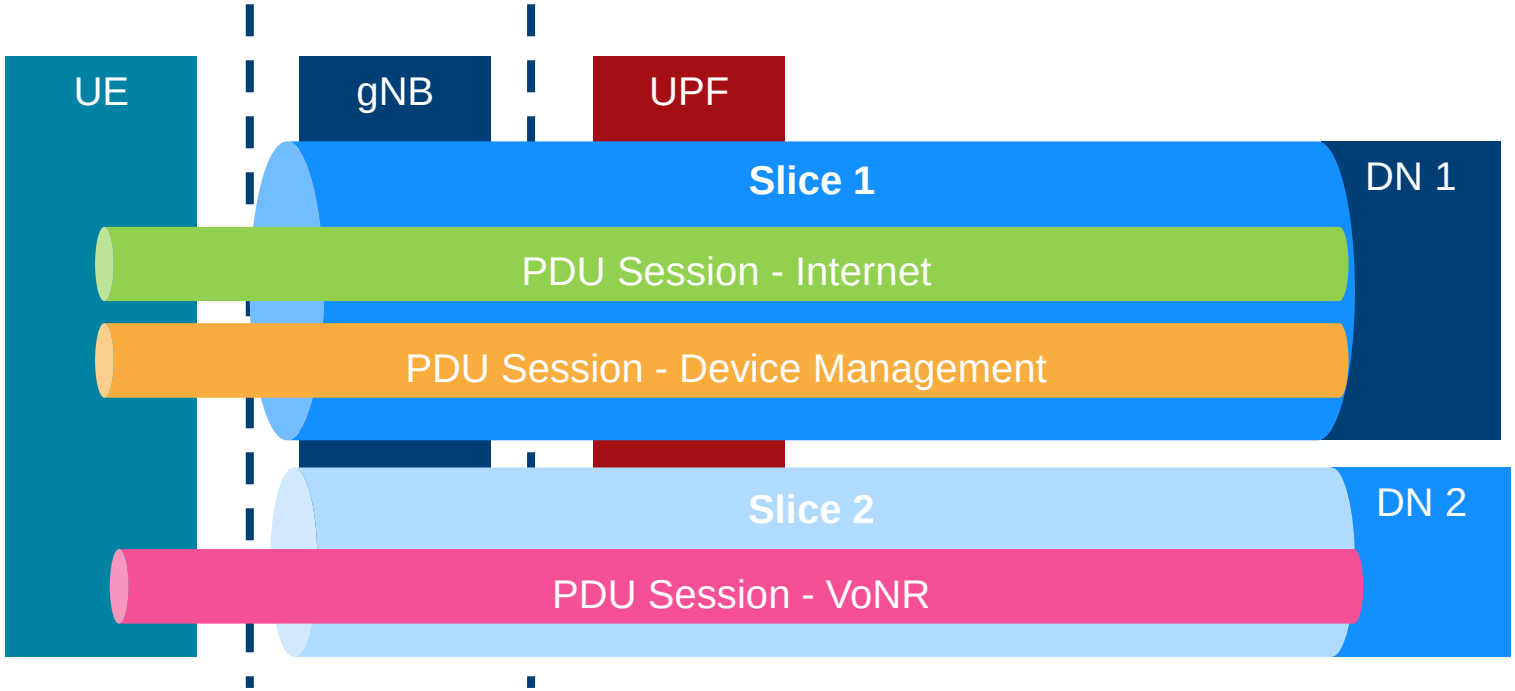
- DUT Power consumption measurements with CMX500 and NGM Power supply
- Up to 2-channel measurements of Voltage, Current and Power
- Rel.16 Power Saving features on CMX500
- CMX-KM110 option to enable measurements in Cmsquares
- Test script package for Battery life tests with CMsequencer

	NGM200
Number of channels	1 or 2
Voltage per channel	0 V to 20 V
Max. current per channel	≤ 6 V: 6 A, > 6 V: 3 A
Max. output power per channel	60 W
Load recovery time	< 30 µs
Ripple and noise	< 500 µV (RMS) / < 1 mA (RMS) (meas.)
Max. Readback resolution	10 µV / 10 µA
Electronic load	60 W / 3 A
Data Logging	10 sample/s



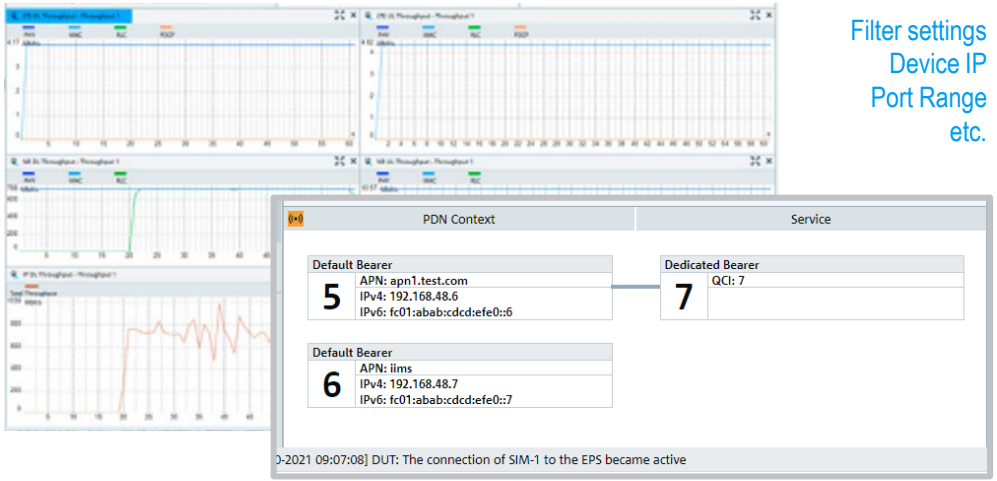
NETWORK SLICING

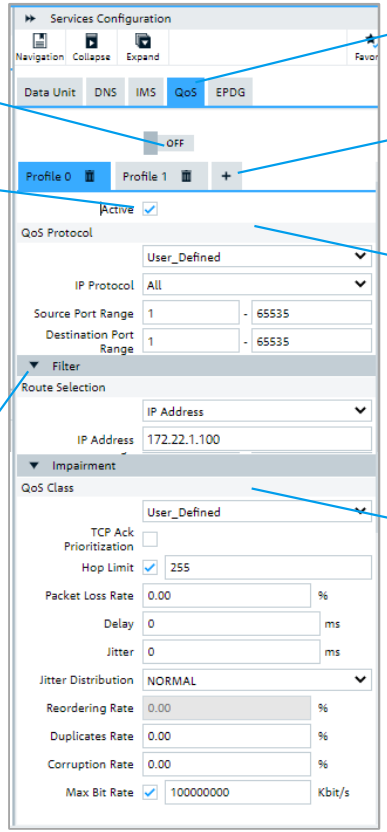
Example configuration



NETWORK SLICING

- Throughput per PDU session
- QoS per PDU session
- Overview of active slices and PDU sessions





Enable/Disable QoS

Enable/Disable QoS

Filter settings
Device IP
Port Range
etc.

QoS Tab in Service menu

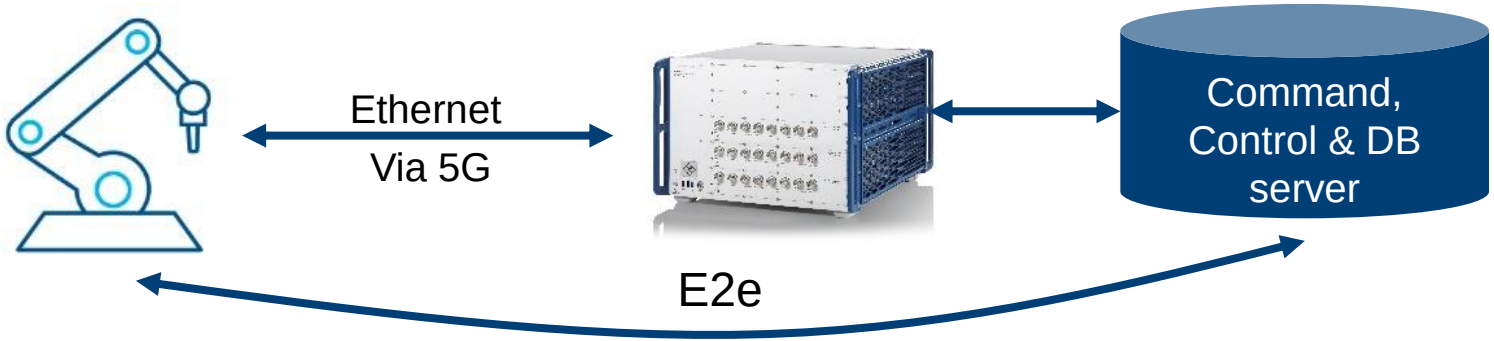
Add additional Profile settings

Protocol settings

Multiple impairment settings
Packet Loss rate
Delay
Jitter
etc.

USE CASE - INDUSTRIAL INTERNET OF THINGS

- Ethernet PDU support
- Delay & Throughput measurement



SUMMARY

- Future proof 5G NR device test platform
- Modular and scalable HW-architecture
- Super flexible software concept
- Many Use Cases supported
- **There is more to come!**

Thank You!