Conformance Test User Meeting 2024

R&S®CMX500 signaling test for 5G

All-in-one 5G signaling tester CMX500 OBT (RedCap, NTN, VoNR, Tput, Wi-Fi 7)

USA STUDY – NUMBER OF PEOPLE AND GROUPS NOT ABLE TO COMMUNICATE AS PART OF THEIR JOB OR ACTIVITIES

57 MILLION HIKERS
11 MILLION HUNTERS
60 MILLION ANGLERS
9 MILLION ACTIVE SKIERS & SNOWBOARDERS
100 MILLION THAT GO BOATING EACH YEAR
40 MILLION AMERICANS THAT GO RV CAMPING
10 MILLION SURVIVALISTS
869.000 AGRICULTURE WORKERS
32,300 FISHING AND HUNTING WORKERS
12,600 FORESTRY AND CONSERVATION WORKERS
14, 000 NATIONAL AND STATE PARK RANGERS
45,500 LOGGING WORKERS
710.800 FREIGHT AND CARGO TRANSPORT WORKERS
66.000 WATER CARGO WORKERS
18,500 ZOOLOGISTS & BIOLOGISTS
261,300 PARAMEDICS AND EMERGENCY MEDICAL WORKERS
OVER 1 MILLION POLICE AND FIREFIGHTERS
20.000 FEMA EMERGENCY MANAGERS
18,000 DISASTER RELIEF COORDINATORS
51,500 COASTGUARD PERSONNEL AND RESERVISTS

**Bullitt Group Market Study 2022*

NR-NTN

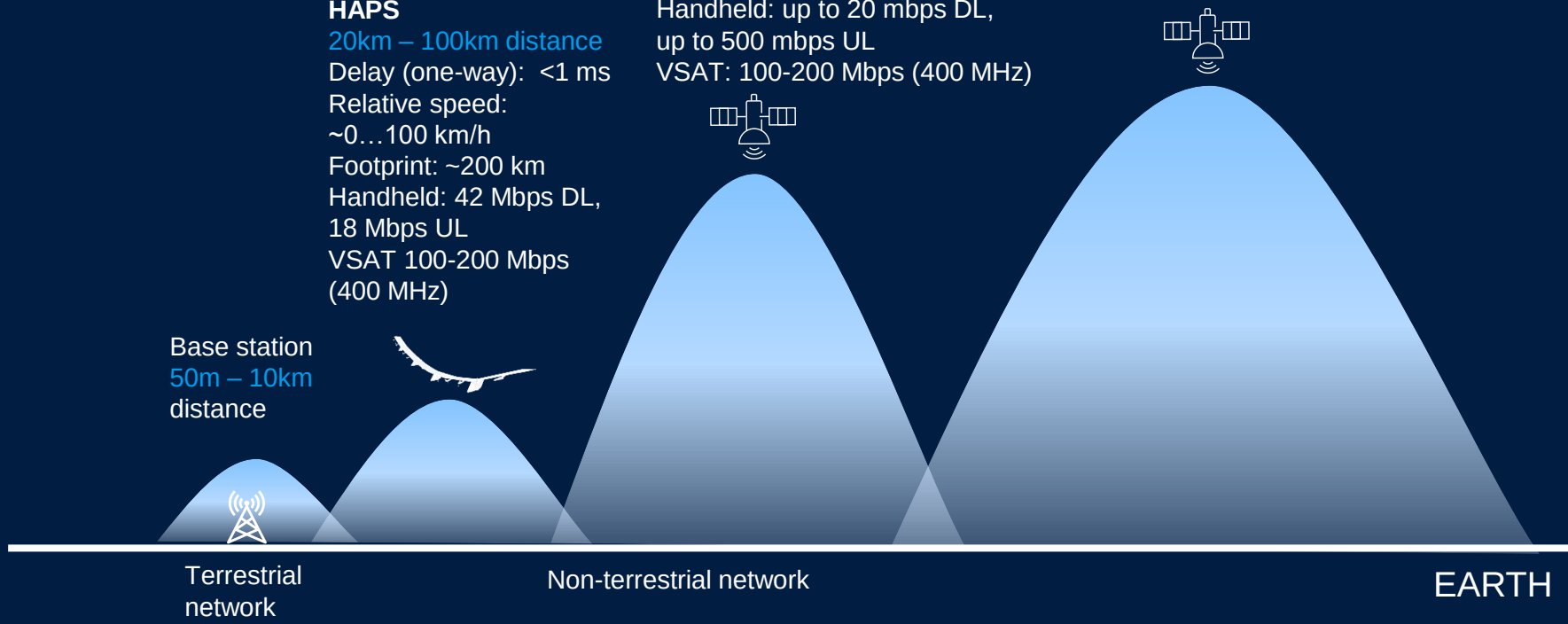
TR 38.811 (Release 17)

LEO
600km – 1900km distance
Delay (one-way): <6.4 ms
Relative speed: ~7.5 km/s
Footprint: <3000 km
S, L band in R17, Ka in R18
Up to 20 MHz bandwidth
Handheld: up to 20 mbps DL, up to 500 mbps UL
VSAT: 100-200 Mbps (400 MHz)

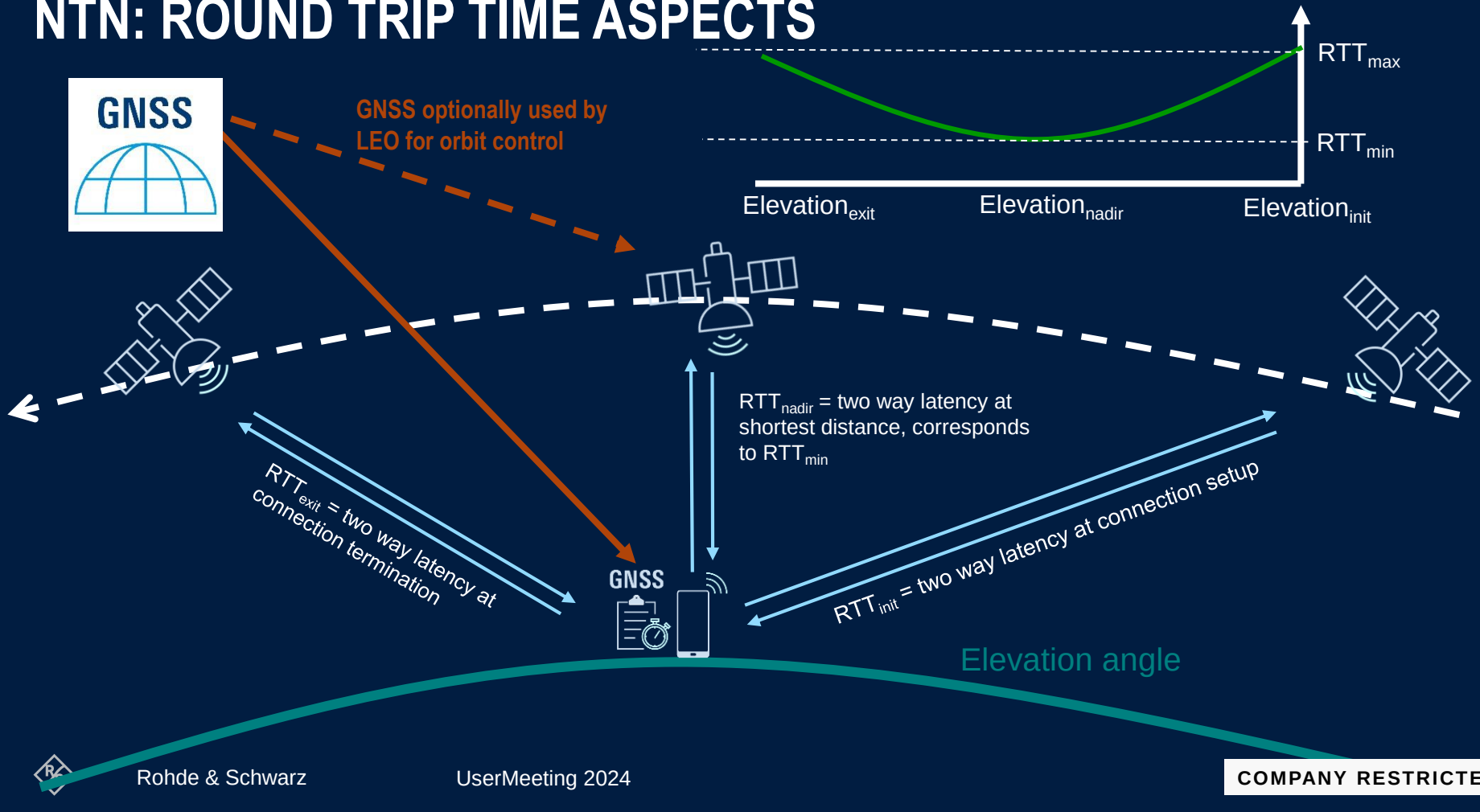
GEO
35000km – 40000km distance
Delay (one-way): 135.3 ms
Relative speed: ~0 m/s
Footprint: <10000
S, L band in R17, Ka in R18
Handheld LOW tpt IoT devices + VSAT

HAPS
20km – 100km distance
Delay (one-way): <1 ms
Relative speed: ~0…100 km/h
Footprint: ~200 km
Handheld: 42 Mbps DL, 18 Mbps UL
VSAT 100-200 Mbps (400 MHz)

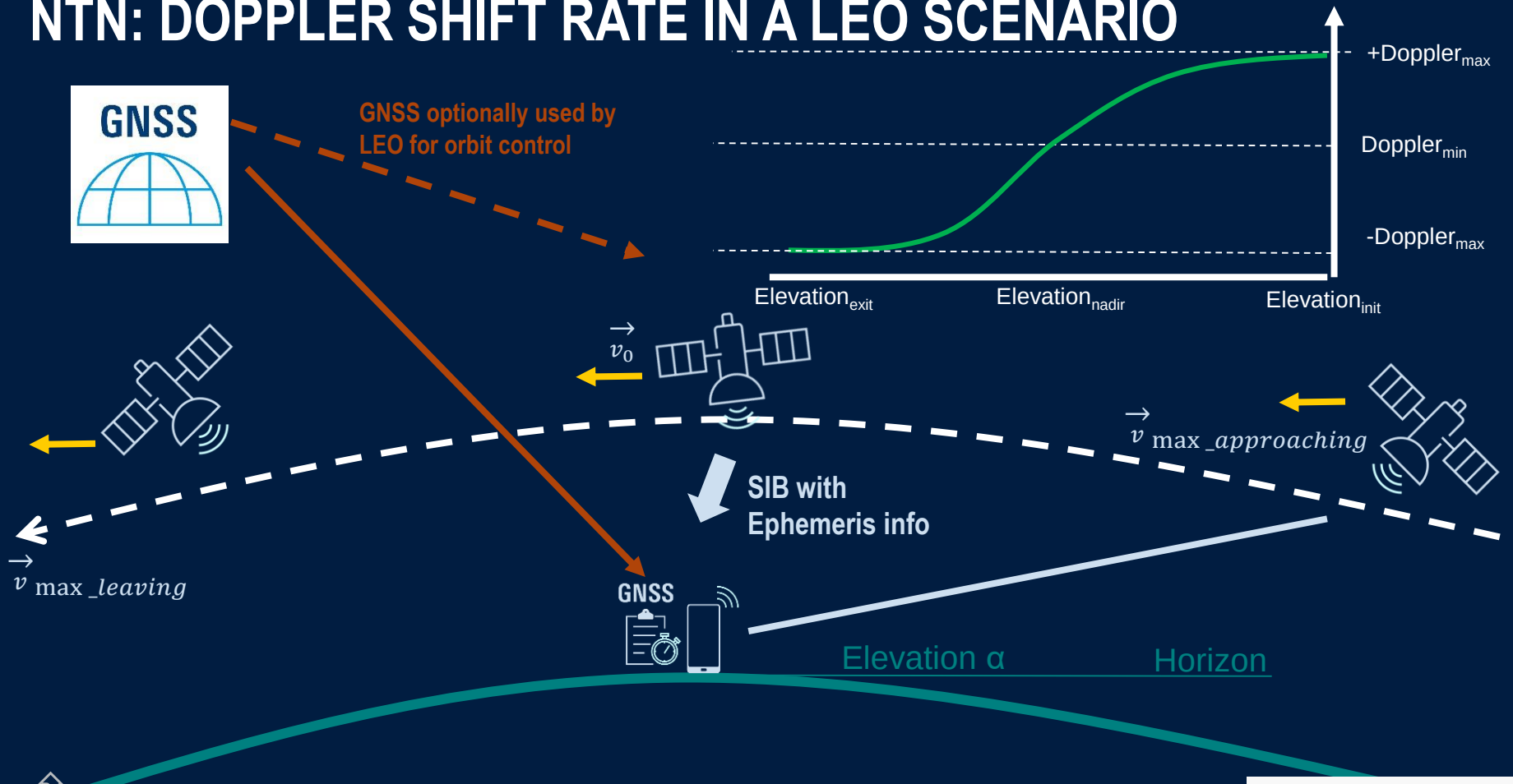
Base station
50m – 10km
distance



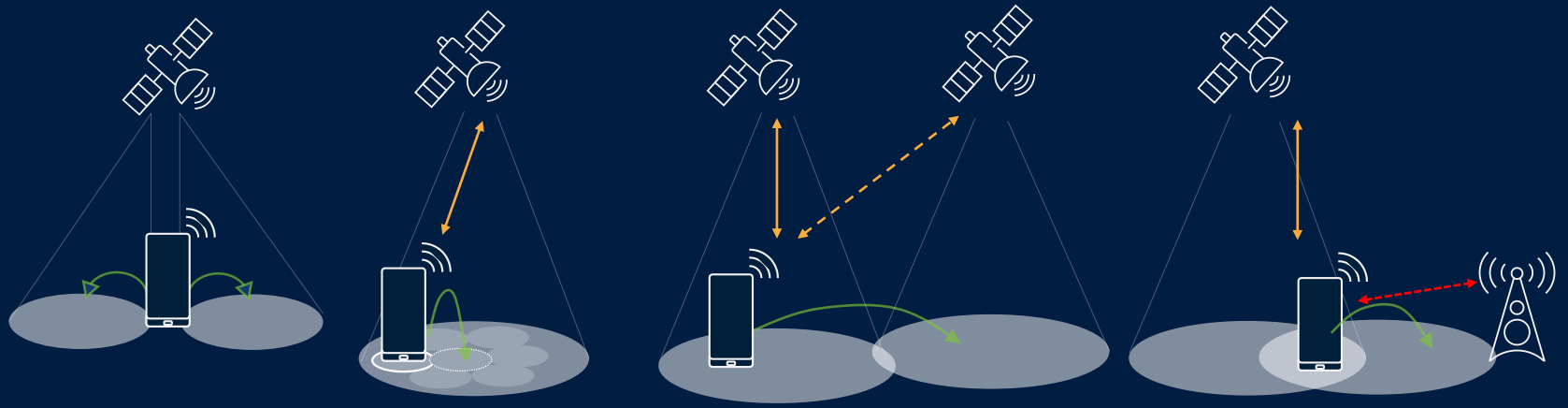
NTN: ROUND TRIP TIME ASPECTS



NTN: DOPPLER SHIFT RATE IN A LEO SCENARIO



NTN MOBILITY SCENARIOS



Cell selection/ cell reselection	Intra-satellite/ Inter beam handover	Inter-satellite handover/ Inter-satellite dual connectivity (DC)	NTN – terrestrial handover/DC

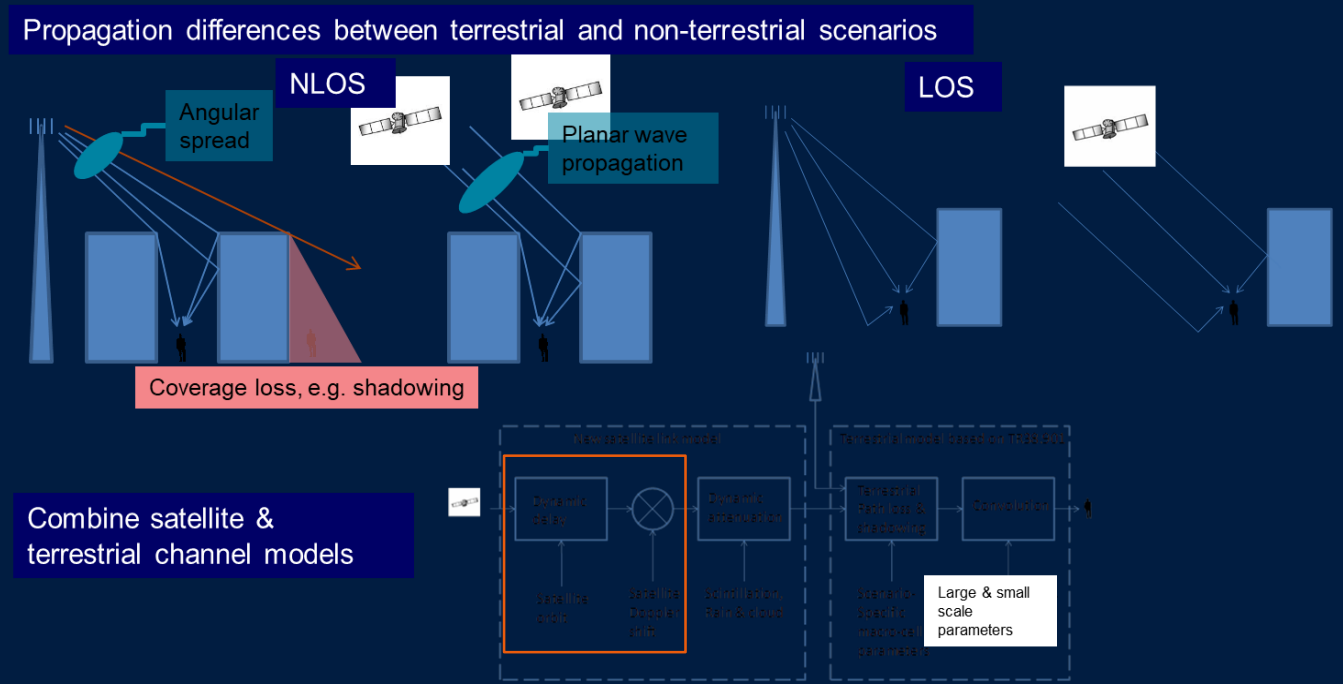
NR-NTN connection

Target or simultaneous dual connectivity NR-NTN connection

Target or simultaneous dual connectivity terrestrial connection

Channel simulation: Fading

- NOTE: Fading is optional for signaling tests, doppler + delay simulation is not!



INTERNAL CHANNEL SIMULATION IN CMX500

- Tight coupling between Signaling and Fading
  - Start channel emulation at specific system frame number
- Fading control and signaling control in the same API (GUI, xLAPI etc.)
- Power attenuation due to fading is automatically compensated
- Smaller HW footprint

Testing Solution

- Products:
  - **CMX500**
  - **SMBV100B** (required for GNSS)

EXPANDING COVERAGE WITH 5G NETWORKS
NTN-NR DEVICE TESTING / NTN-NR END2END

MWC 2024
Demos

CMX500 NTN-NR Callbox

- NTN-NR signaling
- RF measurements
- 3GPP conformance tests to follow
- Voice, Data Calls

- Internal fading
- LTE/5G & Wi-Fi in one box

CMX500 + TM500 NTN-NR-E2E test bed

- Application test over NTN-NR

⇨See the joint solution on the Viavi booth, Hall 5 Stand A18

Expanding coverage with 4G networks
NTN NB-IoT Device Test

MWC 2024
Demos

R&D, Bring-up / Integration

Just a SW upgrade to market leading One-box tester

- SAN Emulation
- Channel Emulation
- GNSS Simulation

R&S®CMW500/SMBV100

Conformance

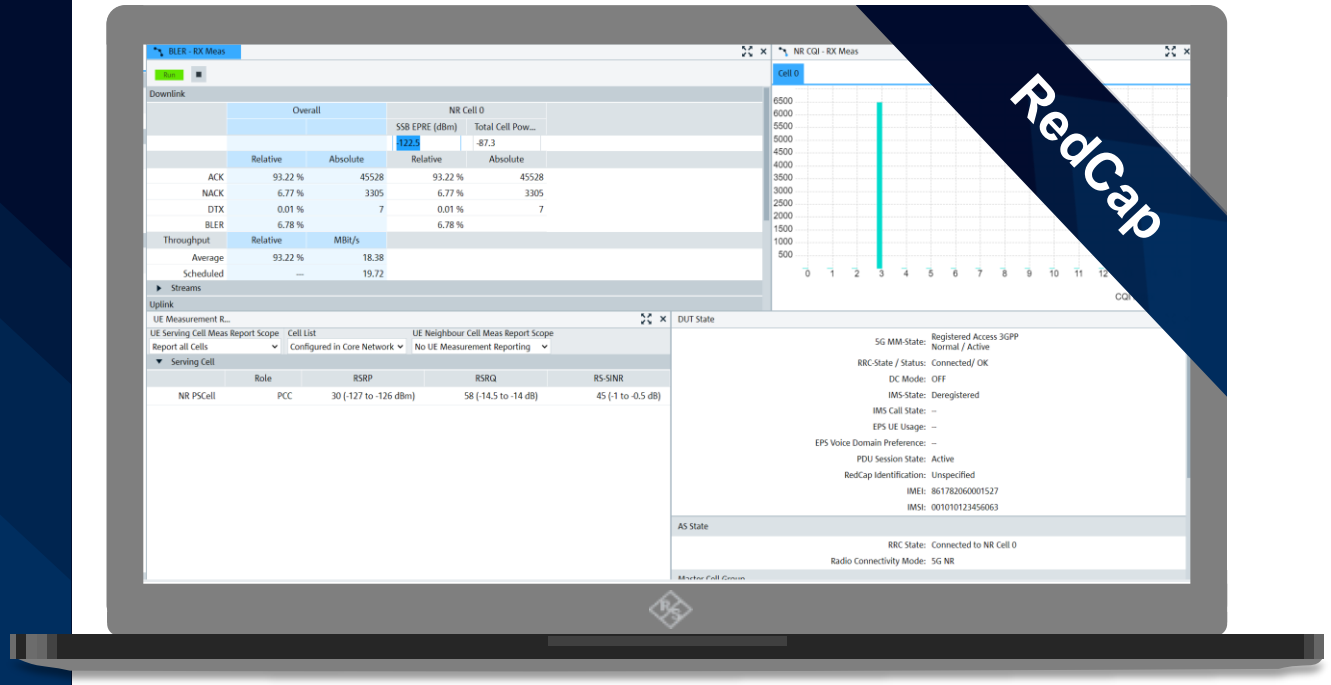
R&S activated GCF WI-333 in Jan ´24

- 3GPP TS36.523 protocol
- 3GPP TS36.521 RF/RRM
- 3GPP TS38.523 protocol
- 3GPP TS38.521-5 RF/RRM

CALLBOX
EXAMPLE USE CASES

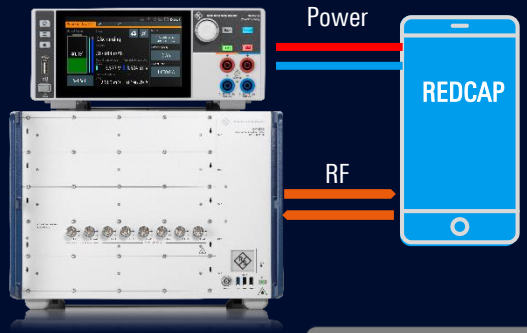
- Complete coverage of RedCap features

REDCAP



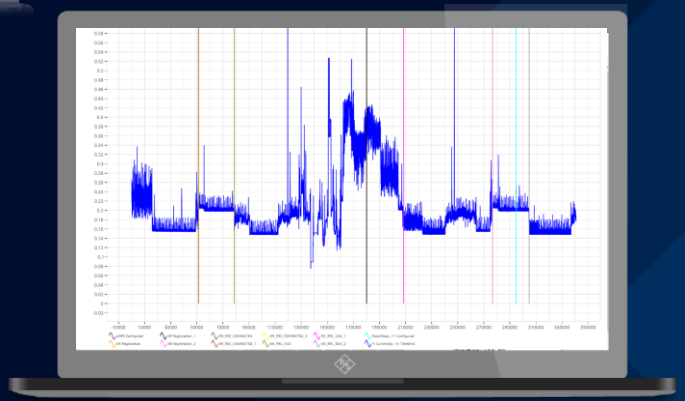
SEAMLESS IOT CONNECTIVITY
OPTIMIZING POWER CONSUMPTION W/ REDCAP FEATURES

MWC 2024
Demos



Power Consumption Measurements

- RedCap functionality with Rel.17 Power saving features
- E-DRX & Meas Relaxation
- NGM Power supply
- Power consumption curve with Signaling events – both offline and online



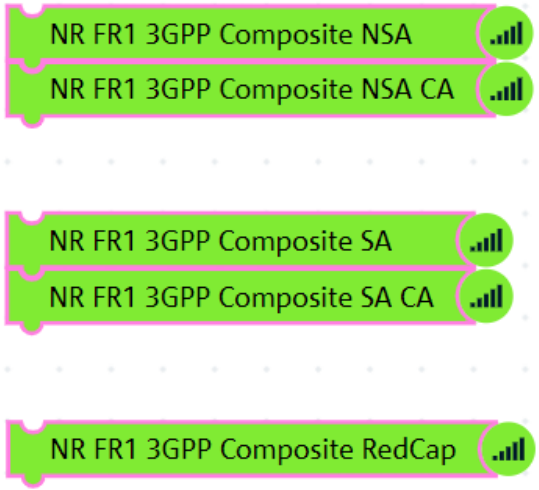
3GPP TC LIST

- 134 3GPP TCs supported
  - NSA: 36
  - SA: 74
  - **RedCap: 24**

NEW

- These licenses should be part of every callbox offer!

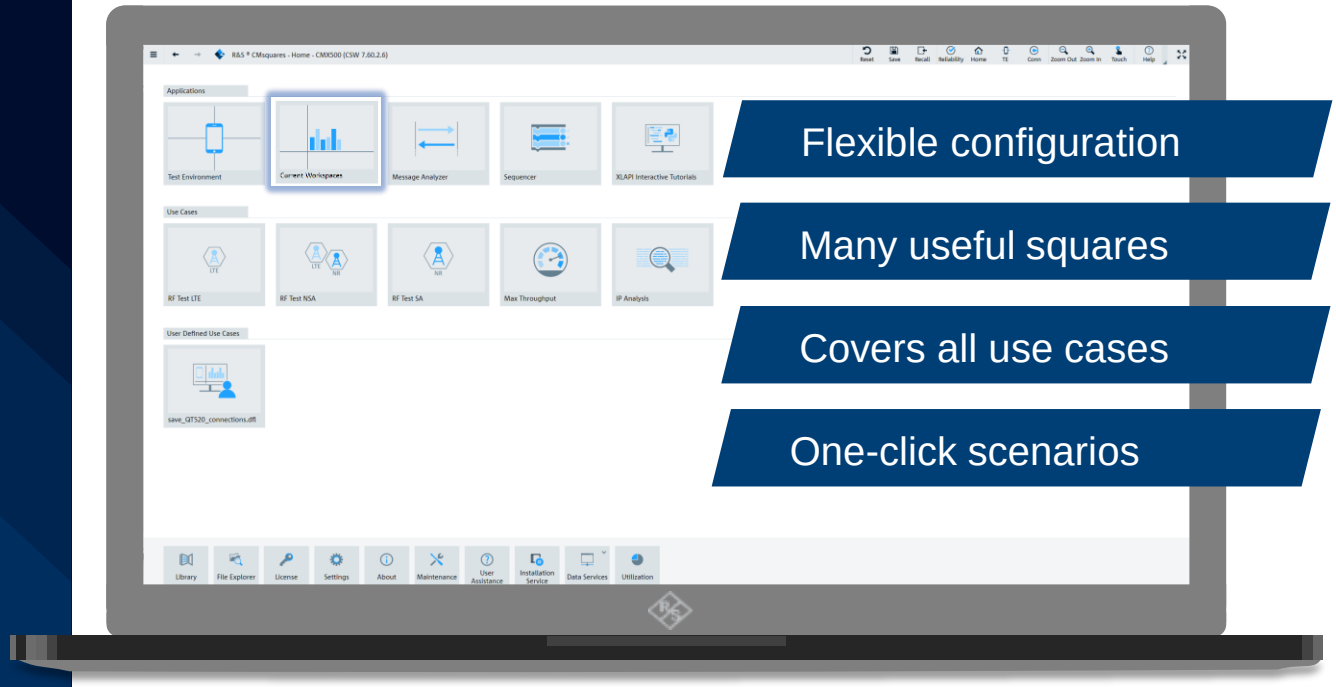
Sigle Box – CMX500 only!!



CMSQUARES
ALL TOOLS IN ONE PLACE

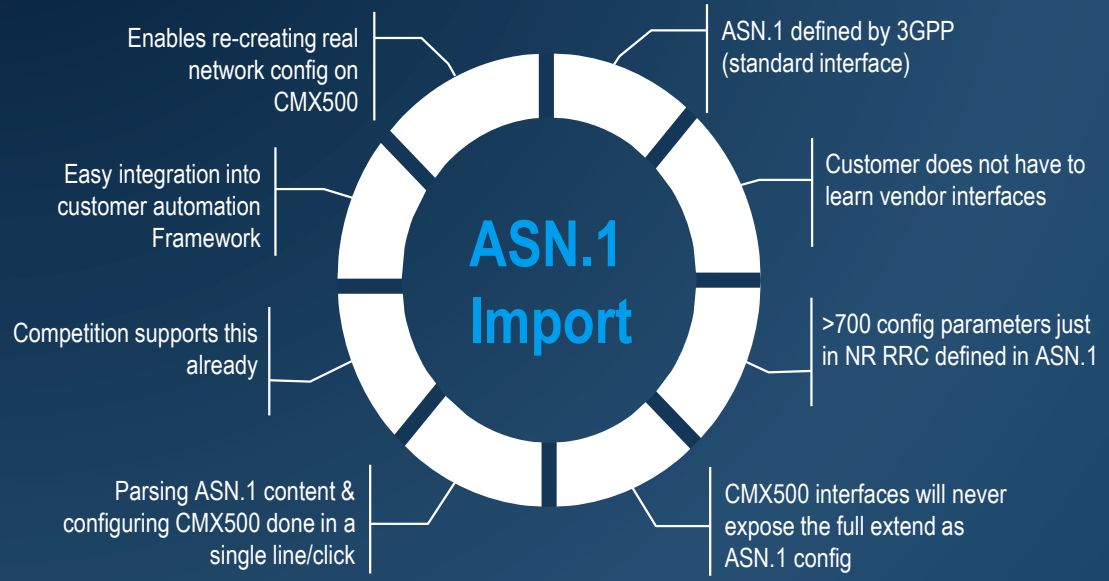
- Interactive Mode
  - Workspace
  - Use Cases

SUMMARY



- Flexible configuration
- Many useful squares
- Covers all use cases
- One-click scenarios

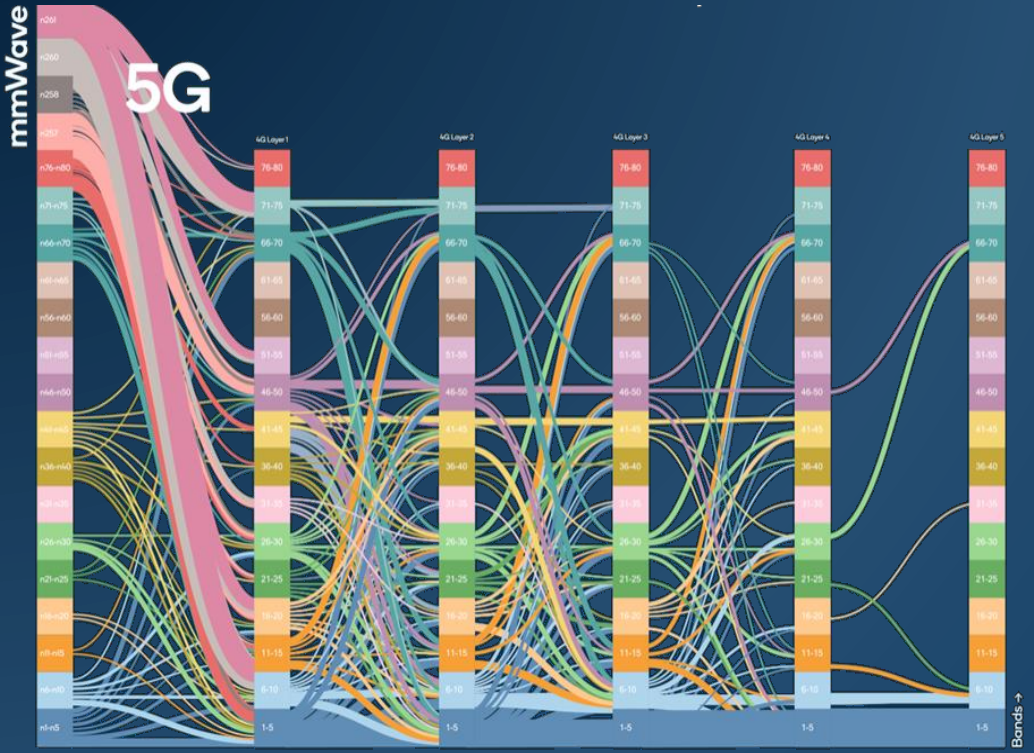
ASN.1 Import – Opens many possibilities

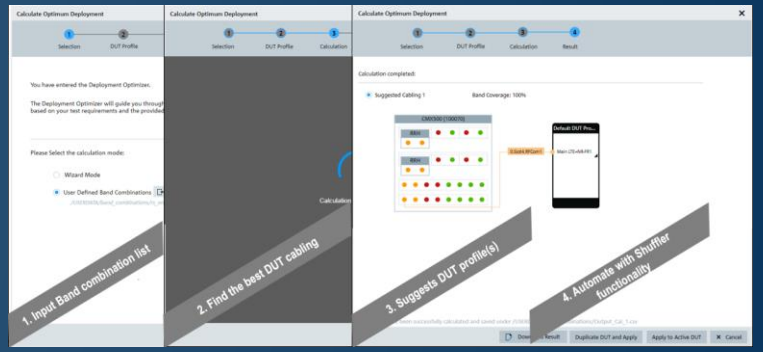


Loading 70%

Clients	Support
XLAPI	✓
SCPI	✓
CMsequencer	✓

E2E Tput testing without DUT re-cabling





- **Requirement**
  - Automated E2E Tput testing for all supported band combinations without re-cabling the DUT
- **Problem**
  - Dynamic Antenna switching in DUT
  - Complex cabling incl. lots of combiners
  - Difficult to figure out which band combinations can be supported on given OBT config

WIFI

THE FUTURE OF CONNECTIVITY: WI-FI 7 AND BEYOND

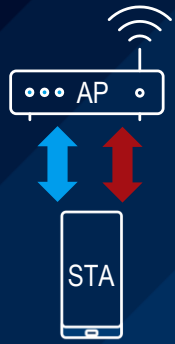
SIGNALING, OFFLOADING, NON-SIGNALING

MWC 2024
Demos

2024 Features

- STA/AP emulation
- All channels, all bands
- 4096 QAM Modulation
- OFDMA multi-user
- up to 8 GHz
- MLO: STR / EMLSR
- Voice over WLAN
- 5G/Wi-Fi offloading (3PDG/N3IWF)
- LTE/5G & Wi-Fi in one box

R&S®CMX500



INTERACTIVE
WORKSPACE

Offloading Result view:

- Visualize multiple RATs
- Sequencer Automation
- Measure the IP Throughput over different technologies
  - e.g. 5G & WLAN

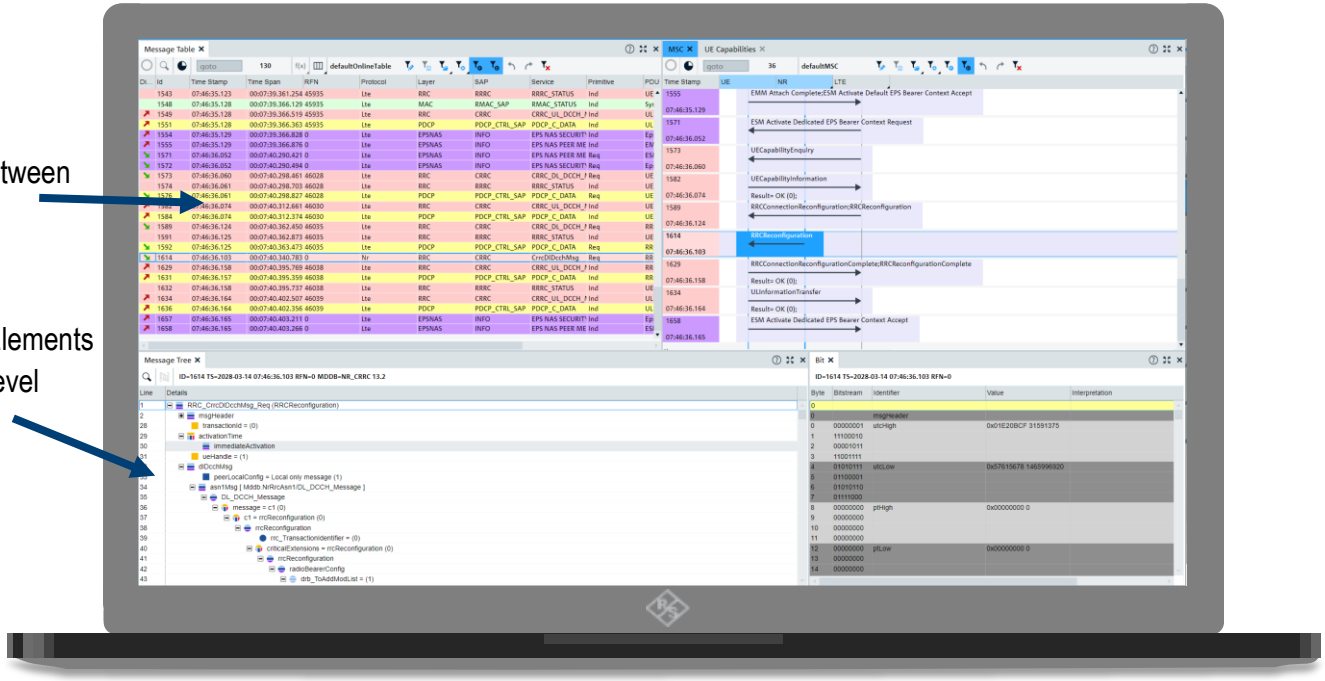
and more…

APPLICATION TESTING

WLAN OFFLOADING MESSAGE ANALYSIS

Message flow between UE and network

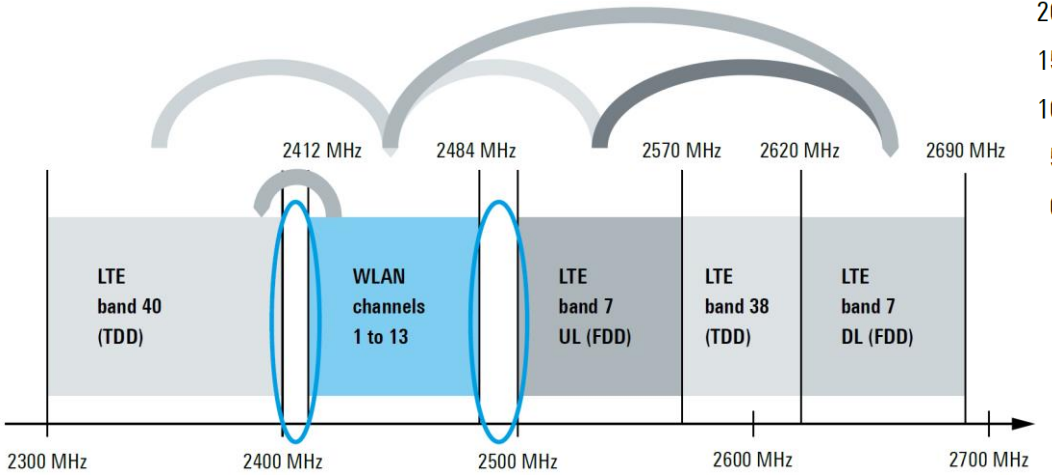
Inspect Information Elements on Layer 1 up to IP Level



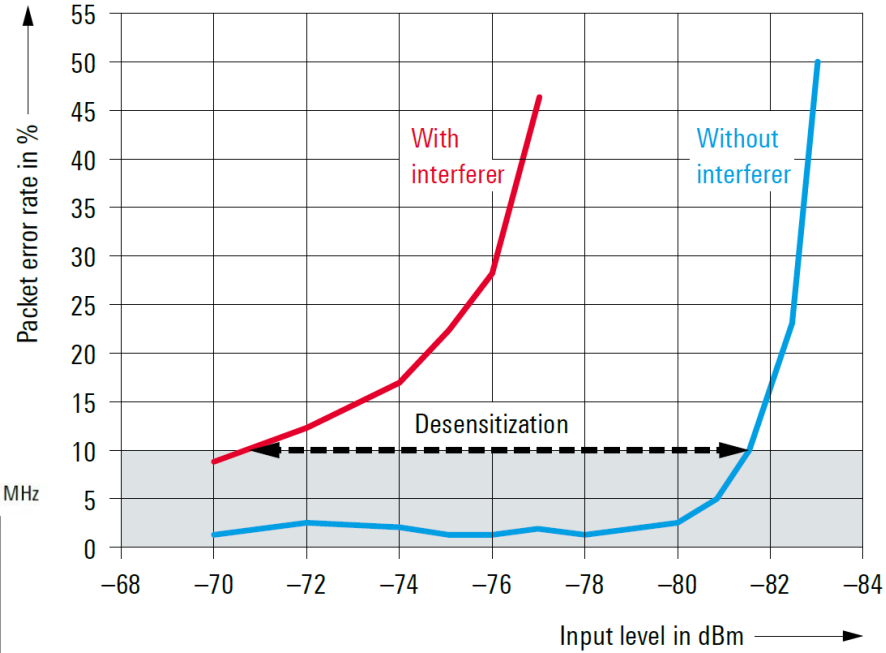
NARROW DOWN ROOT CAUSES AND QUICKLY RETRACE THE SIGNAL FLOW!

WIFI COEXISTENCE

In-Device Coexistence Interference Testing



In-device coexistence testing, RX sensitivity



CMX500
APPLICATON TEST

- Fully integrated IPv4/6 infrastructure
- Test of most common Internet Services and Protocols out of the box
- Extensive User Backend testing of OTT applications
- WLAN interworking with a single box solution
- Highest IP E2E Throughput rates
- Unique Tools:
  - Throughput Wizard, IP Tune, IP Analysis, integrates speech quality, Delay measurements, SMS Center …

Unique integrated solution – Simplify your test setup!

NETWORK SLICING – SLICELAND

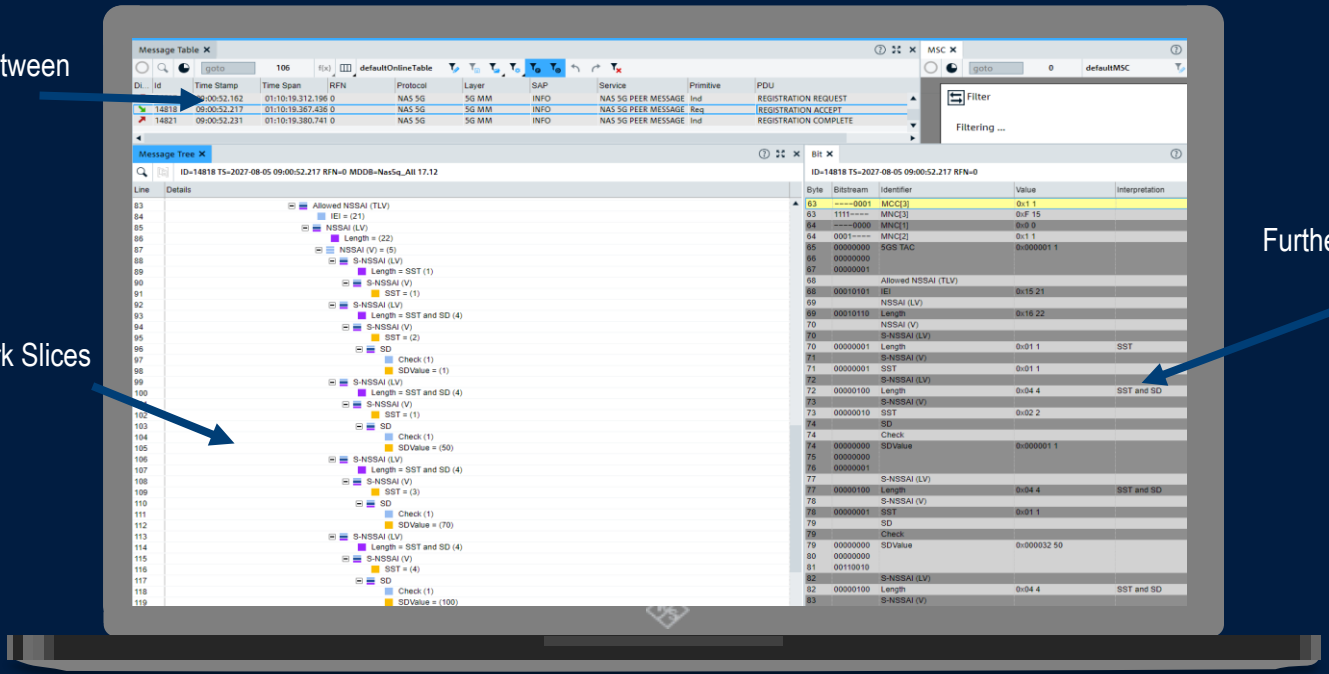
What is network slicing?

- Network slicing is an important feature of 5G for Operators.
- Creates multiple virtual networks on a single shared physical network.
- Each slice is like a private road on a shared highway.
- Dynamic allocation of resources enables flexibility & efficiency.
- Slices might cover various applications like autonomous vehicles, augmented reality, IoT and others.
- Each slice is tailored to specific application requirements (speed, capacity, security).
- With network slicing, the network adapts to the individual requirements of different use cases.

Network slicing Message Analysis

Message flow between UE and network

Signaled Network Slices



Further slice details

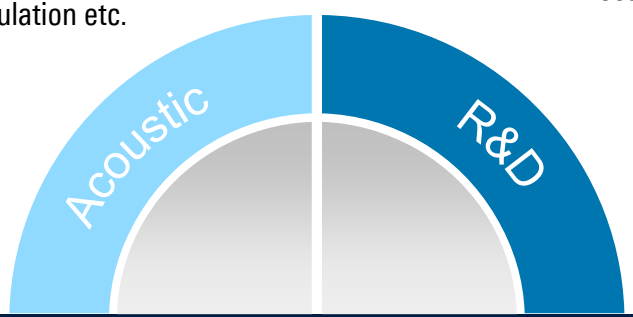
NARROW DOWN ROOT CAUSES AND QUICKLY RETRACE THE SIGNAL FLOW!

SPEECH QUAL-ROCK

5G - Voice over NR (VoNR) testing fields

Speech acoustic testing

- Performed in a chamber of the entire system incl. microphones & speaker
- Artificial HEAD is used
- Extensive testing e.g. Background noise simulation etc.
- Detailed analysis of the system components
- Standards:
  - P.11xx
  - UN R 144
  - (3GPP TS 26.131/132)

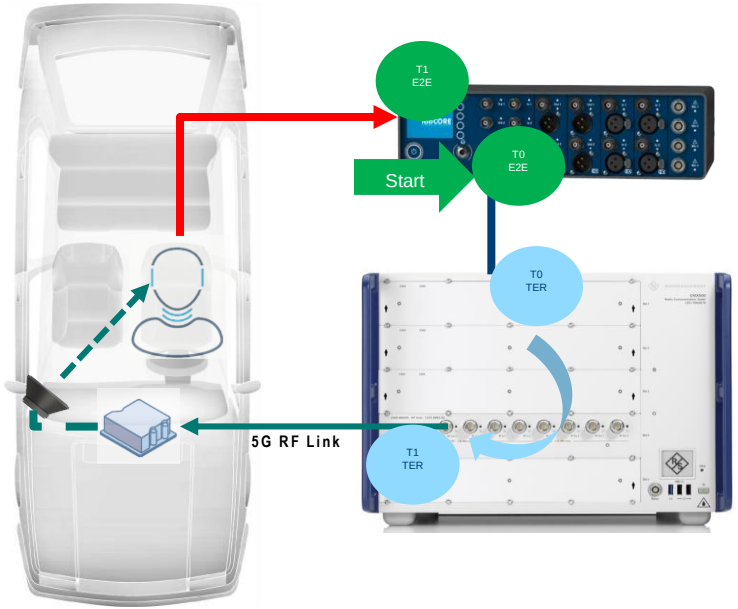


Speech performance and operator testing

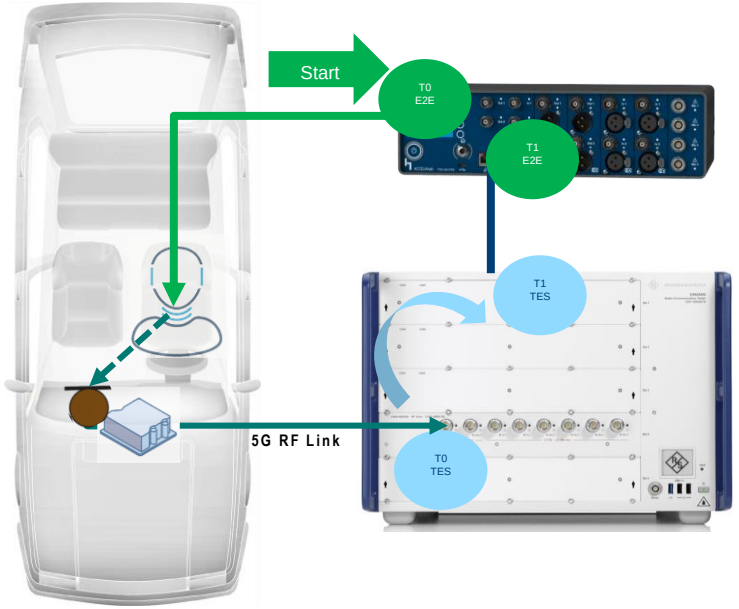
- Conducted testing without microphone and speaker
- Basic testing MOS e.g. with impairments or fading
- Focus R&D and operator test:
  - RF: voice quality vs. RF setting
    e.g. max Power FR1, multiple CC etc.
  - Protocol testing: voice quality vs. protocol
    SPS, RoHC, codecs and other IMS features etc.
  - Application testing: voice quality vs. IP traffic
- Software & hardware regression
- Performance & temperature test
- Operator Testing etc.

Precise delay measurements with CMX500 & HEAD acoustics labCORE

Downlink delay measurement (IP Forward)

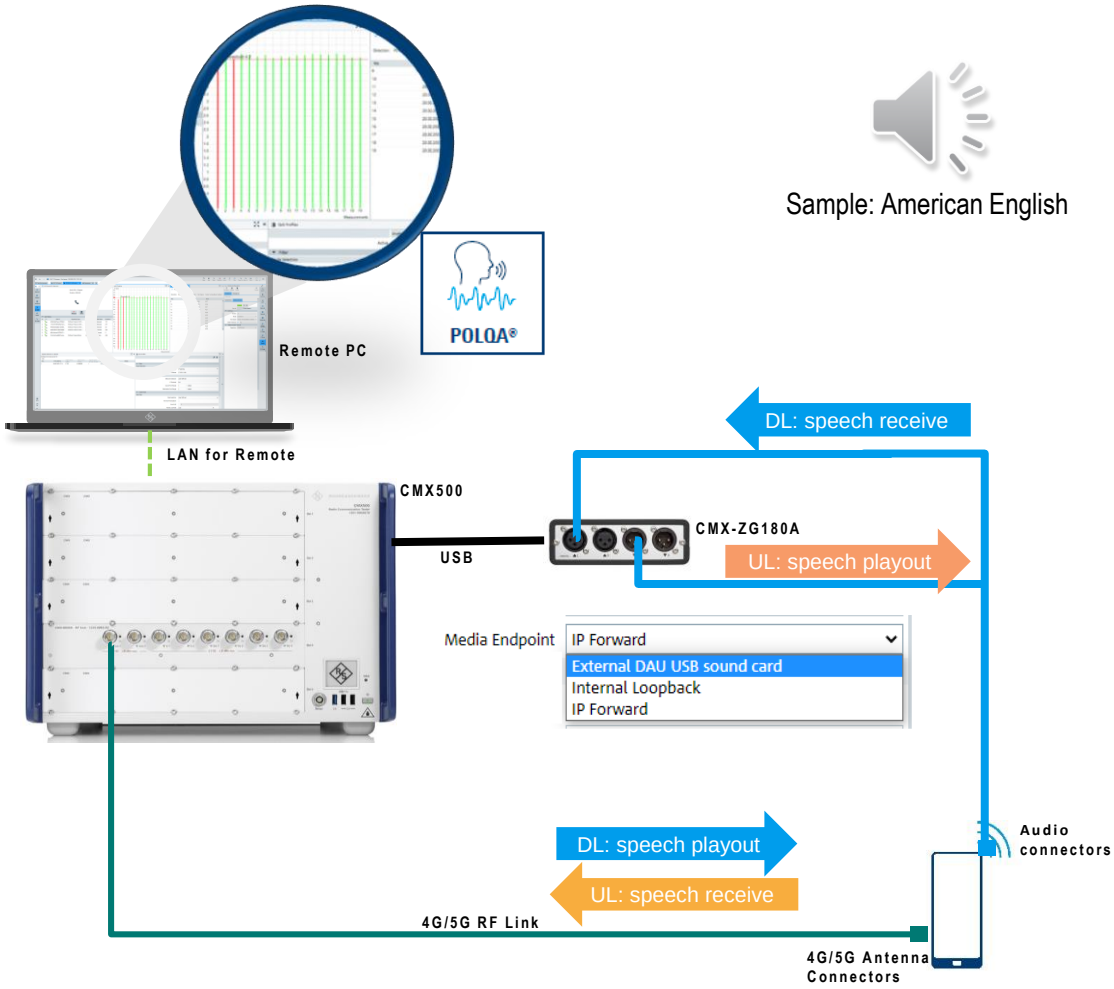


Uplink delay measurement (IP Forward)



CMX500 – Integrated Speech Quality Analysis

- One box for Audio Quality (Internal POLQA Analysis – no need for Audio Analyzer)
  - Golden Standard KPI for speech quality measurement
  - Evaluates the subjective speech quality
  - **IPRs: OPTICOM, SwissQual (R&S), TNO**
  - MOS (Mean Opinion Score):
    - 1 (worst) … 5 (best)
- VoWiFi, VoNR and VoLTE in the same box
- Support for AT&T VoNR Audio Quality test plan
- Speech samples files in multiple languages provided
  - ITU-T Rec. P.863 (2011)



NG ECALL – ROCKS‘

NGECALL
UPDATED MANDATE

- … this initiative updates standards for the transition of eCall to 4G and 5G networks.

Transition phase:

- Update: 14.02.2024 - IVS :
  - 1. With effect from 1 January 2025 it is allowed to implement NGeCall
  - 2. With effect from 1 January 2026 it's a must for all new vehicles
  - 3. With effect from 1 January 2027 older vehicle delivery might be stopped

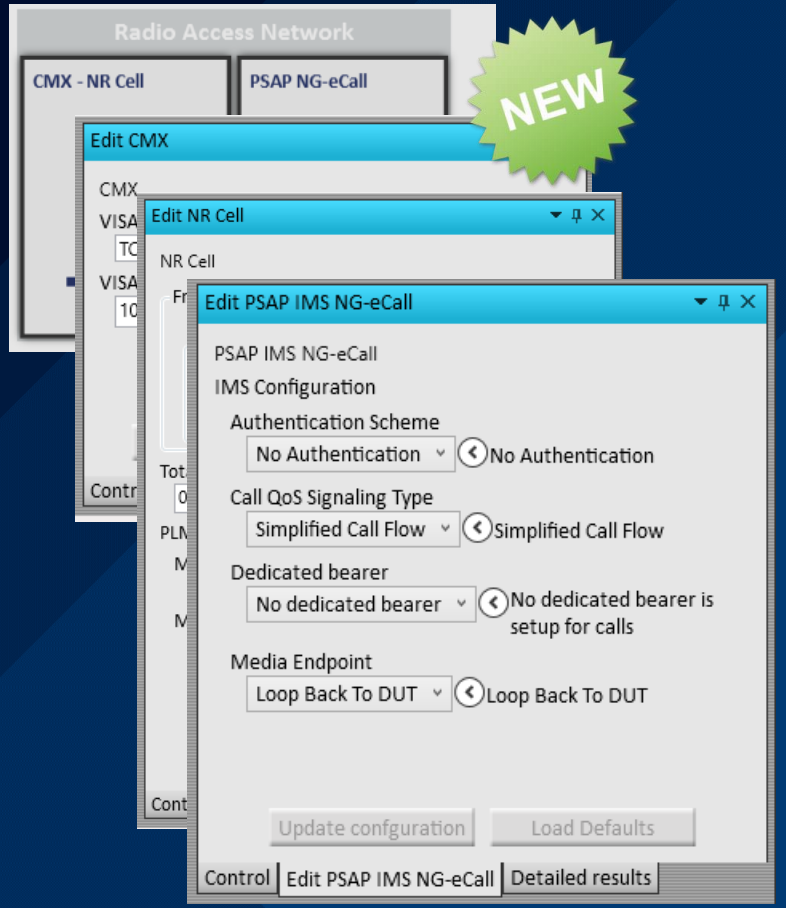
- Update: 06.02.2024 - PSAP:
  - PSAPs need to be updated till → 01.01.2026

See: link for IVS mandate
link for PSAP mandate

NGECALL
PSAP EMULATOR

5G PSAP enabler for NG eCall

- New option 5G NG eCall for CMW PC!
- Same software environment for all eCall variants (runs on PC)
- Same look & feel like NG eCall or legacy eCall with CMW
- Controls CMX500 for 5G easy swap to CMW for legacy
- Enables VoNR Voice Communication



CMX-KA098 5G NGeCall PSAP 1222.6639.02

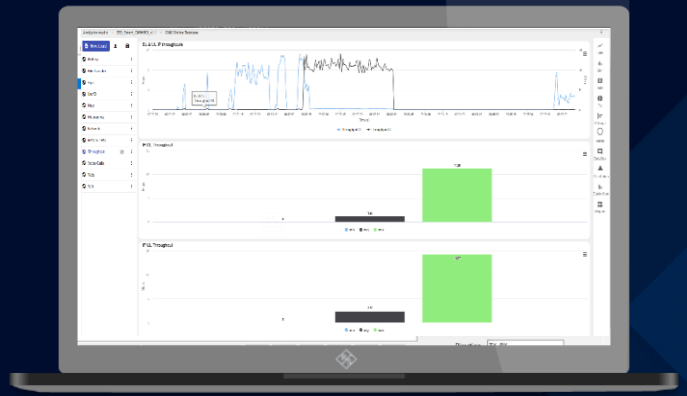
BATTERY-LIFELAND

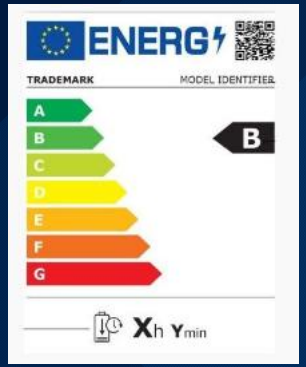
Energy efficiency and environmentalism
Verifying Eco Design and Energy Labeling

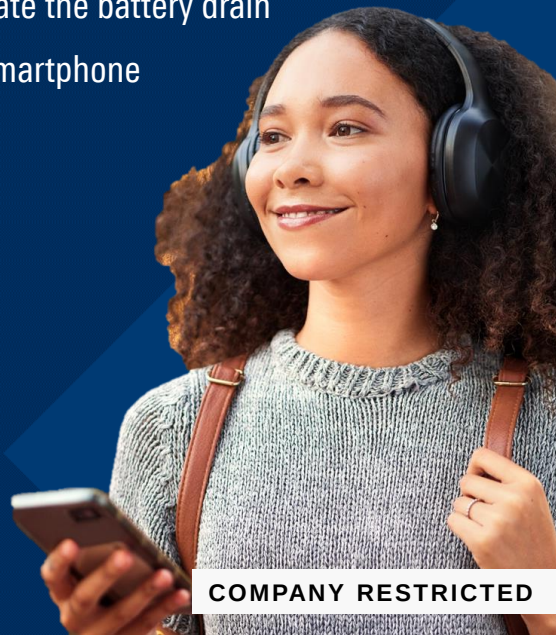
MWC 2024
Demos

Mobile device energy labeling

- Energy labeling mandatory in EU from 2025
- CMX500 emulates LTE or 5G network and SmartViser app runs pre-defined tests (call, streaming, …) and evaluate the battery drain
- Based on the drain, a rating is provided to Smartphone

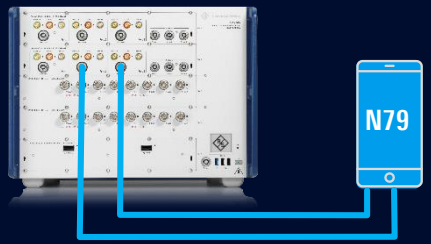






6G peninsular on the horizon

Towards 6G
New Spectrum with „FR3“ / FR2-0



CMX500 FR3 signaling

- Prototype implementation for early R&D

FSVA and SMW200A

- Different SCS settings
- Upto 1GHz Signal BW
- Optimized EMV for FR3
- IQ noise cancellation
- OTFS signal generation and analysis

6G Study items for WRC-27:
7.125-8GHz, 14.8-15.35 GHz

FCC:
12.2-12.7 GHz, 12.7-13.2 GHz

Candidate BW: 400 MHz