

Webinar series: 5G Device Testing Journey

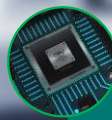
ONE TOOL FOR AUTOMATED DEVICE TESTING

Manish Chibba
Product Manager - Mobile Radio Testers

ROHDE & SCHWARZ

Make ideas real





4th May

Validation of digital design of next gen devices



11th May

Challenges to 5G mmWave component characterization



25th May

Simplifying 5G mobile device testing



1st June

ONE tool for automated device testing



8th June

Making lab testing more realistic with R&S®CM360°



15th June

Production test strategies and smart solutions

5G DEVICE TESTING JOURNEY

Webinar Series

TODAY'S WEBINAR

- ▶ 5G Automation needs
- ▶ ONE Solution for all needs
- ▶ Demo
- ▶ Key learnings



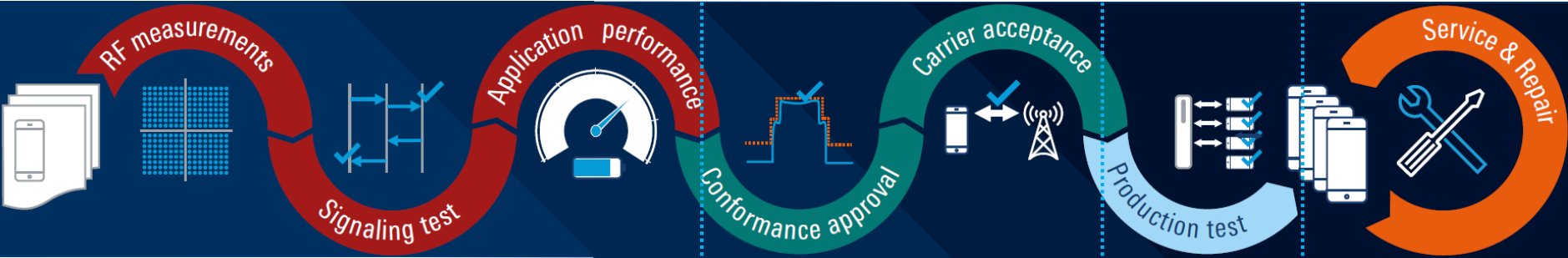
TESTING PHASES

R&D Testing

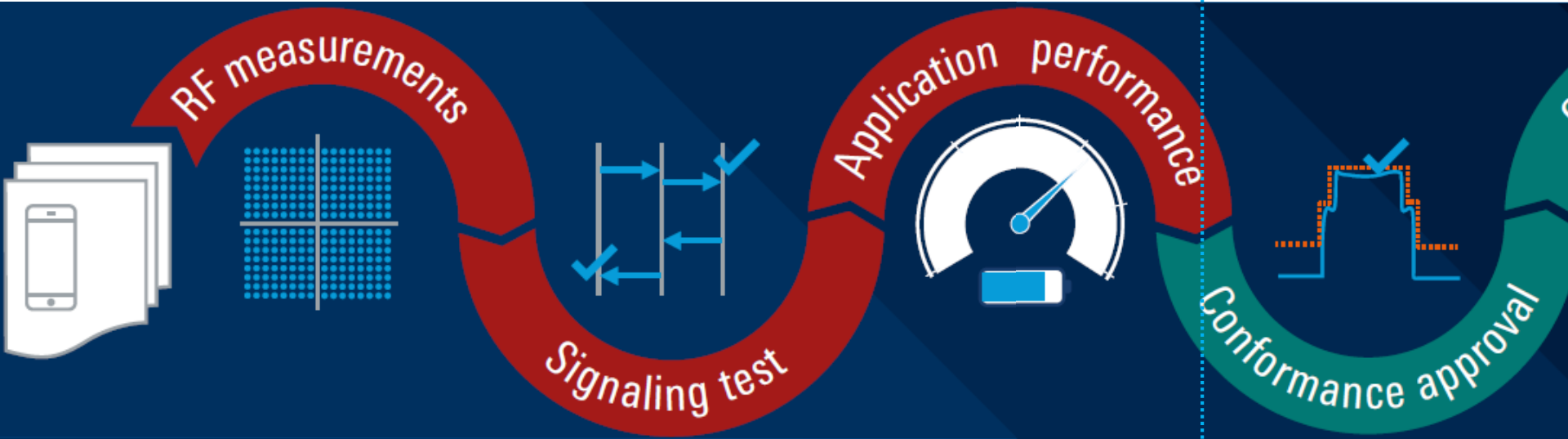
Conformance Testing

Non-Sig Testing

Go / NoGo Testing



FOCUS ON R&D TESTING



RF test team

- 3GPP Tx/Rx Pre-conf.
 - Multi-eval meas.
 - Min/Max Power meas.
 - BLER meas.
 - Rx Sensitivity meas.
 - FR2 Spherical meas.
-
- Reports & summary
 - Tables & Graphs
 - Time optimized

Functional test team

- L3 & NAS Sig.
procedure verification
 - Failure/Reject tests
 - Roaming tests
 - Throughput tests incl.
CA
-
- Report Signaling &
Failure events
 - Flexible configuration

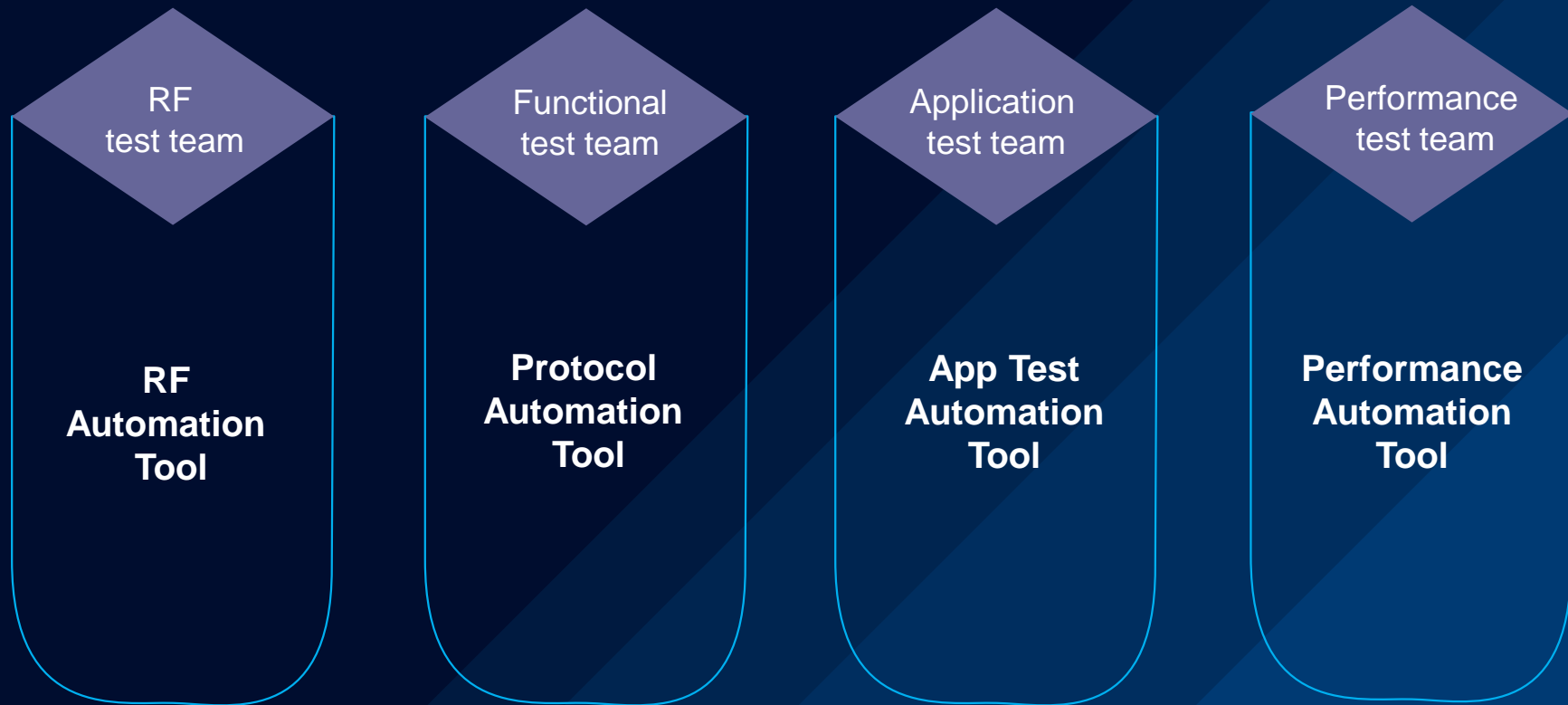
Application test team

- IP Throughput meas.
 - IMS tests incl. failures
 - VoLTE, VoNR, EPSFB
tests
 - Battery Life tests
-
- Power consumption
with events
 - Throughput charts

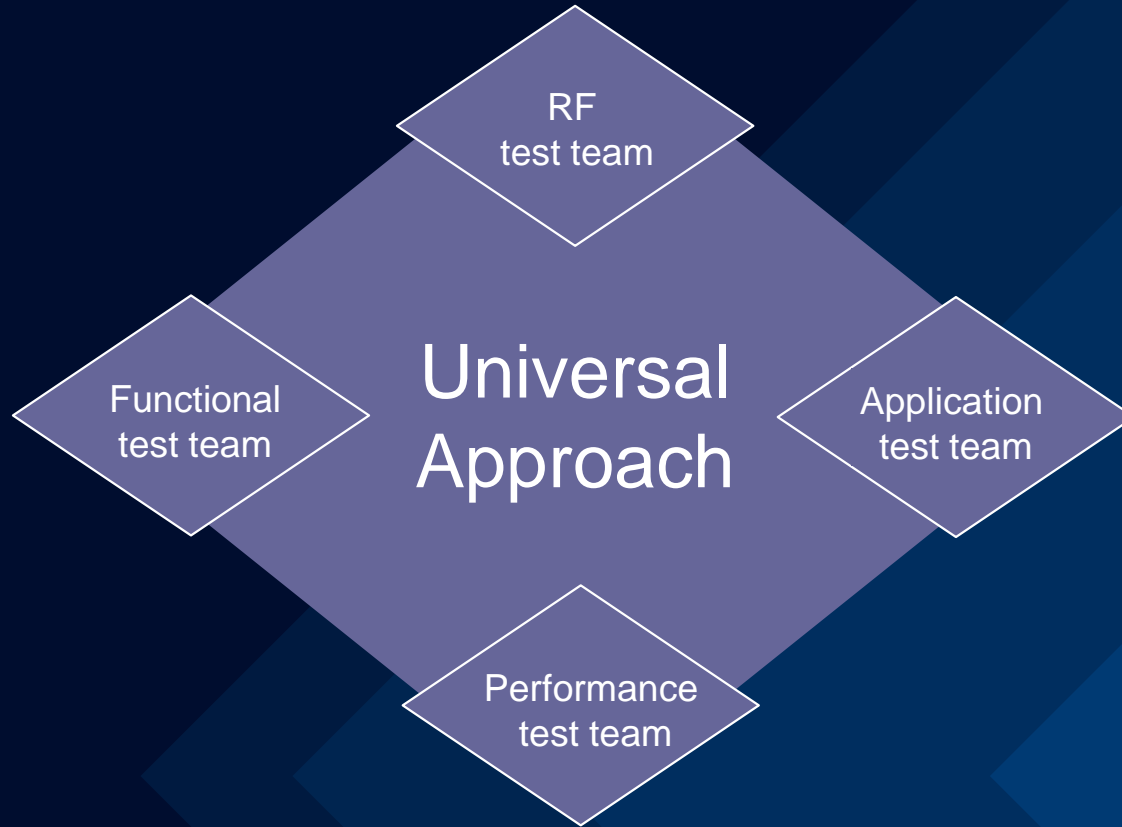
Performance test team

- 3GPP Fading profiles
 - Network impairments
 - Latency tests
 - Combine Functional &
Application tests
-
- Reports & Summary
 - Post-processing
results

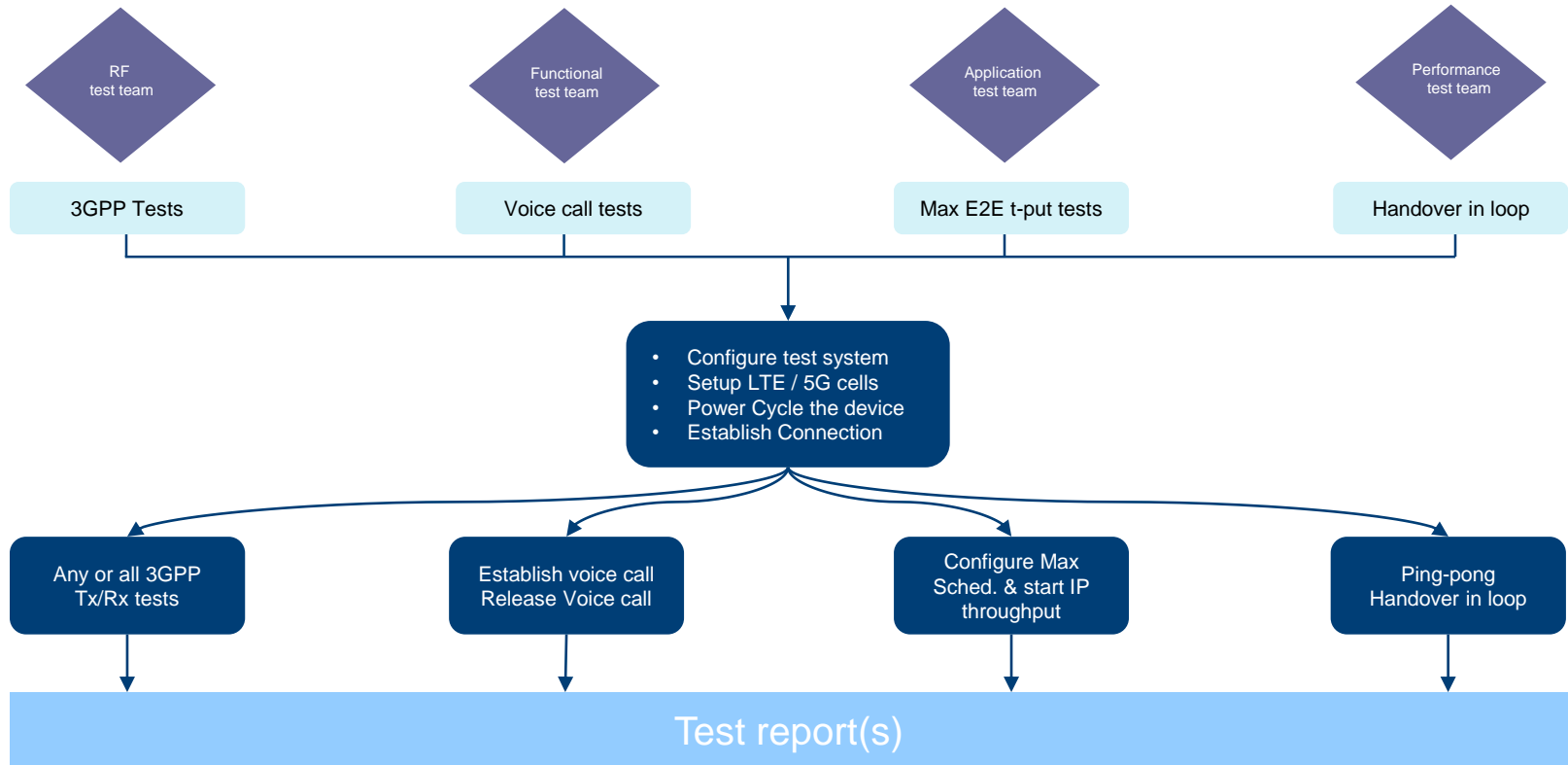
TYPICAL R&D DEVICE TESTING TEAMS



DETACHED APPROACH



TEST REQUIREMENTS ARE NOT ALL DETACHED



ADVANTAGES OF ONE TOOL APPROACH

Easy to learn
&
Easy to maintain

One
user automation
framework for all
testing teams

Uniform
reports and
results

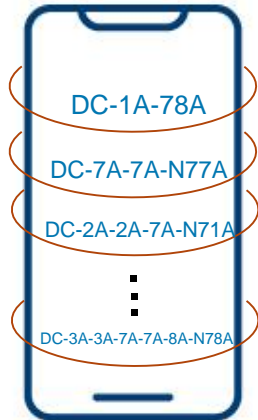
Amplify
device tests with
combining
RF, Signaling, E2E
into one test

Consistent information
exchange between testing
teams and higher mgmt

5G TESTING CHALLENGES

LTE-NR (MRDC) Band Combinations

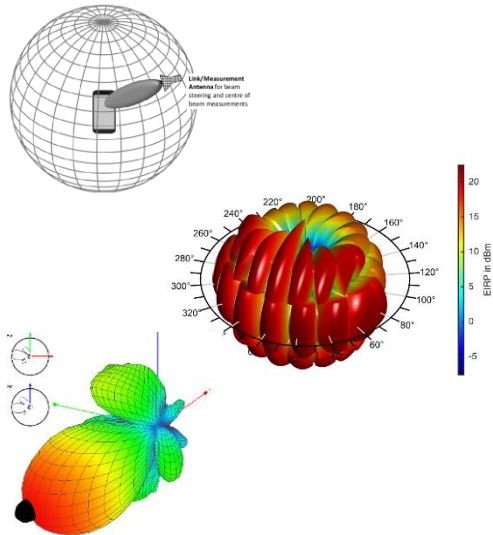
UE supported
LTE-NR Band combos



- ▶ Test every 5G feature for each and every MRDC band combination
 - Results in 100s of test scripts
 - Difficult to maintain
 - Process reports for every band combo test script
 - Difficult to summarize

5G TESTING CHALLENGES

Frequency Range 2 (FR2) tests



- ▶ Seamless support of OTA Chambers
- ▶ Finding Beam Peak (Main beam)
- ▶ Spherical Coverage
- ▶ Measurements across all test points
- ▶ Throughput tests
- ▶ FR1 + FR2 tests

5G TESTING CHALLENGES

Battery Life tests



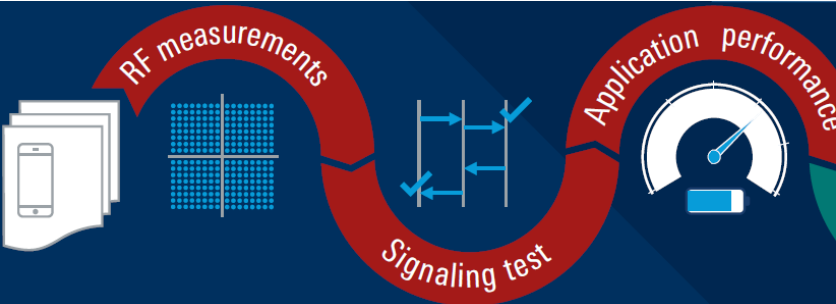
- ▶ Many Signaling features impact Battery performance
- ▶ Rel-16 has quite many new features for power saving
- ▶ How to re-use all the created and verified functional tests for battery life testing ?



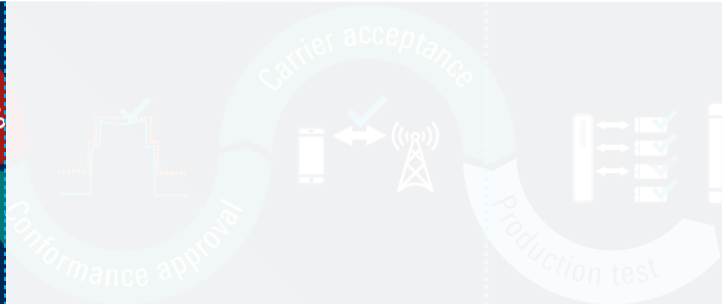
AUTOMATED TESTING MADE SIMPLE WITH CMSEQUENCER

TESTING PHASES

R&D Testing



Conformance Testing



Non-Sig Testing

Go / NoGo Testing





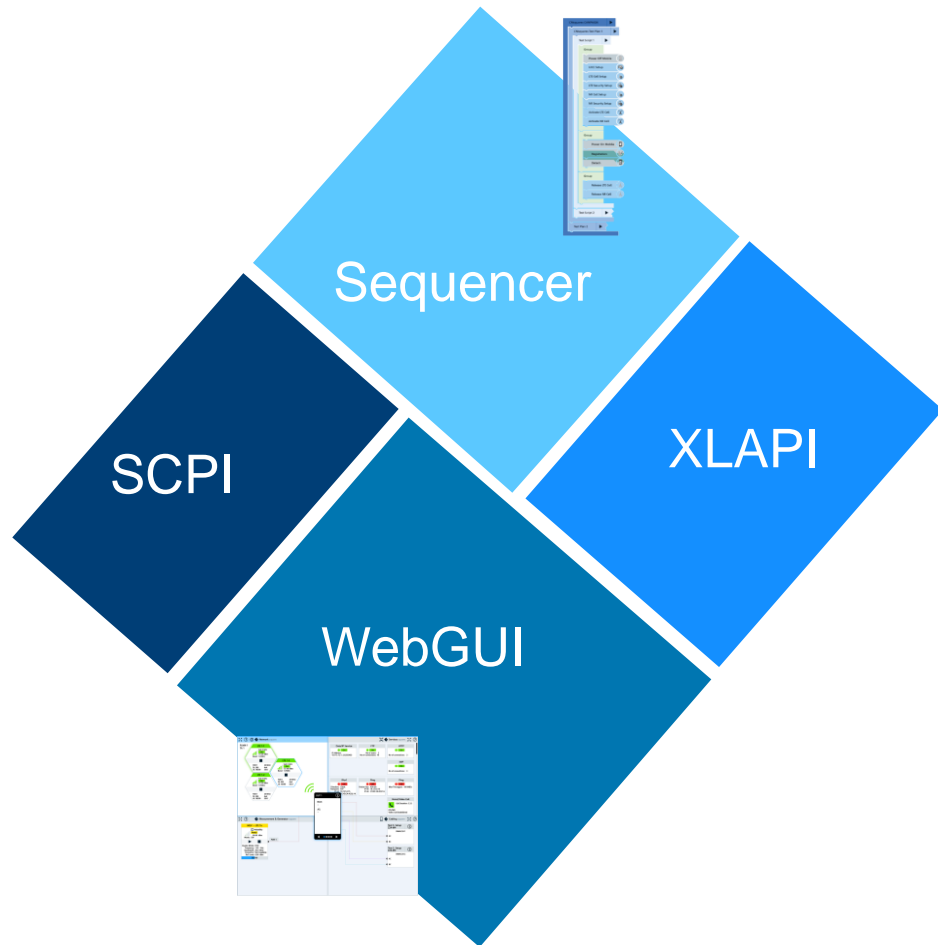
R&S® CMX500 & CMW500



R&S® CMQ500

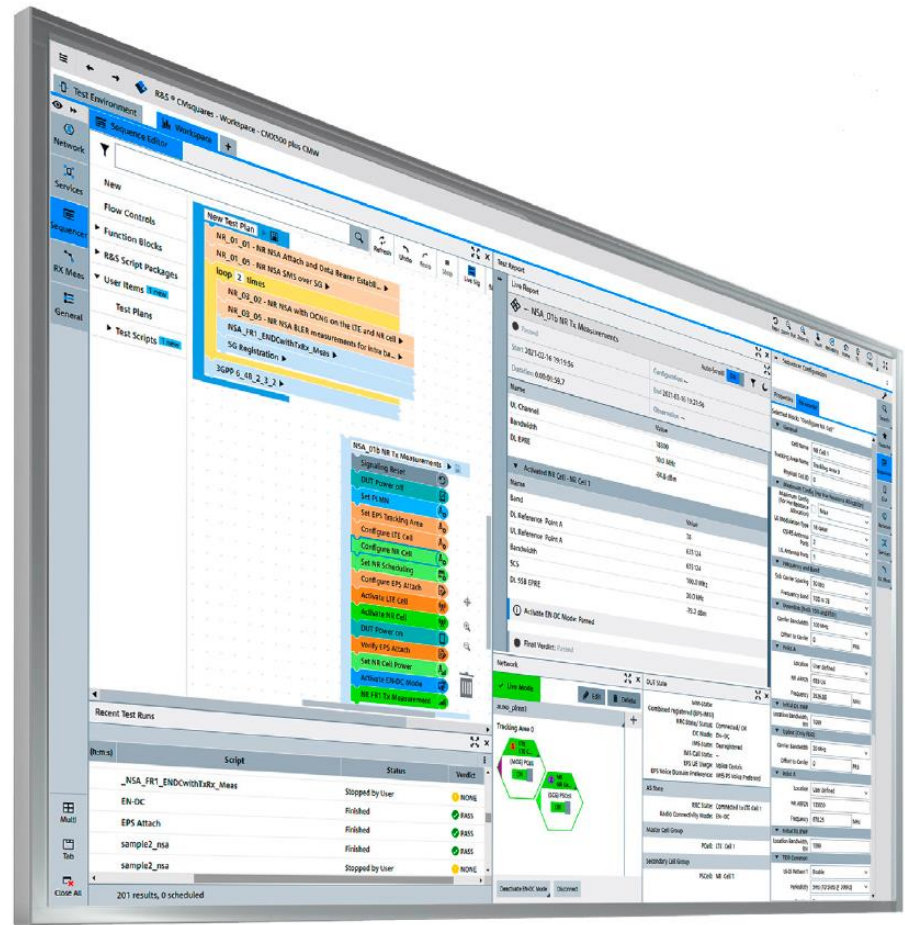


R&S® ATS800

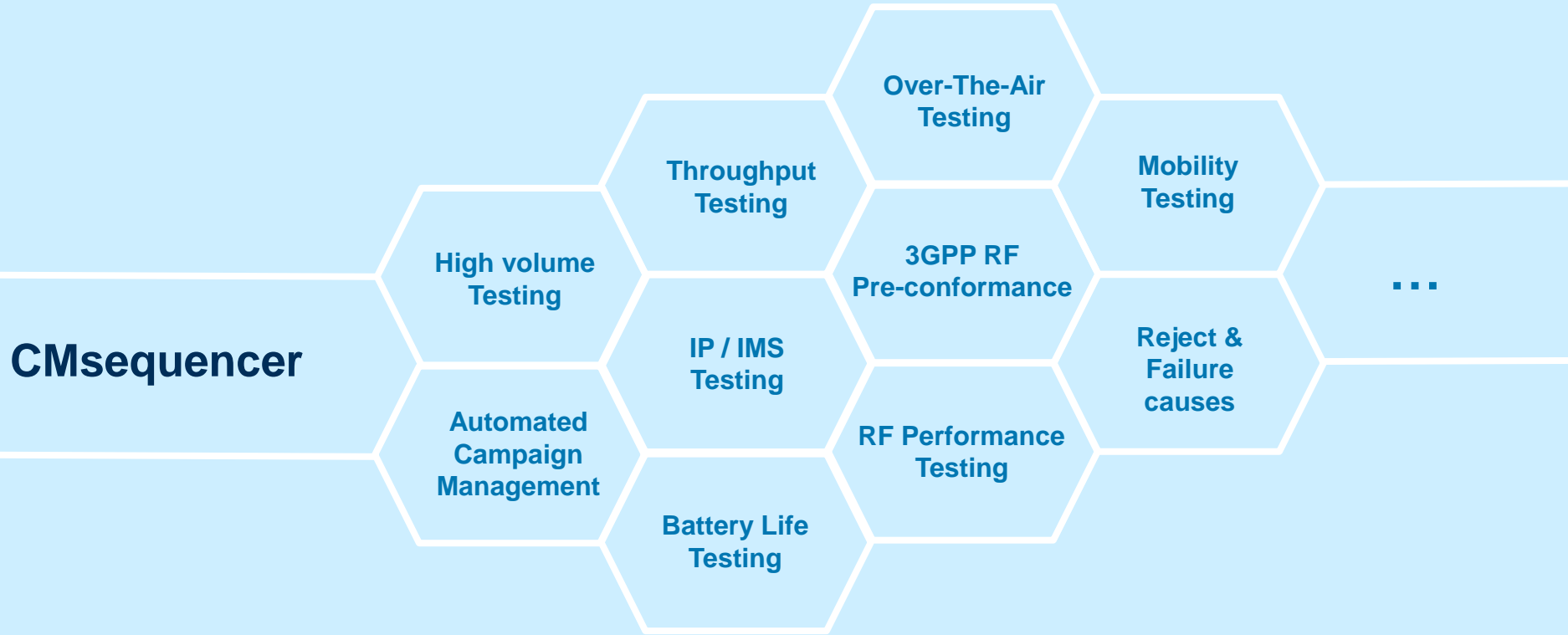


SEQUENCER

- ▶ Place of GUI scripting and automation
- ▶ Includes comprehensive campaign management
- ▶ State of the art, future proof software
- ▶ Complete Coverage of 5G NR R&D tests incl. 3GPP RF in one application
- ▶ Automatic band combination tests



COVERED USECASES



ALL TYPES OF R&D TESTS IN ONE TOOL



3GPP Pre-conformance tests

- 38.521 in-band Tx/Rx tests
- Easy to configure & speed optimized
- Flexi mode for extended testing



Protocol & Failure tests

- 5G features like ESFB, CA, CMAS/ETWS, Multi-numerology, ...
- Failures like Attach Reject, TAU Reject, Conn Reject, RLF, IMS Failures, ...
- SCPI and Python code extensions



RF & Functional tests

- Multi-Eval, BLER, Rx Sensitivity with live meas results incl. graphs
- Max Throughput E2E tests
- VoLTE / VoNR with Audio analysis
- Battery life tests



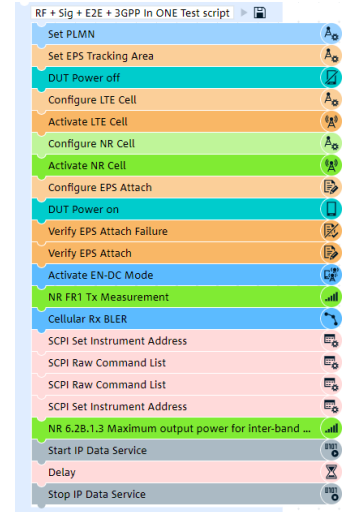
Automation Support

- Re-use of CMsquares automation framework
- Easy integration into external automation frameworks

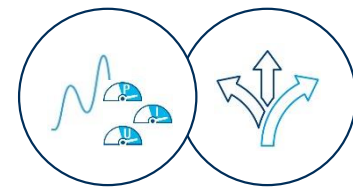
TAKING TESTING TO THE NEXT LEVEL



- ▶ Mix & match all types of testing
- ▶ Stress test devices
- ▶ Lean learning curve & easy maintenance
- ▶ Efficient exchange of tests and results across teams



RF + SIG + E2E IN ONE UI

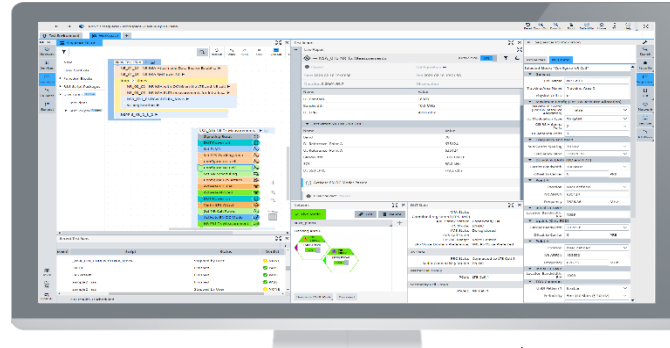


RF Meas

- LTE/NR Tx/Rx Meas
- Min/Max Power Meas
- Sensitivity Meas
- Channel/Band/BW sweeps
- Live Meas / graphs

Signaling Procedures incl. Failure

- Roaming, Tput, Scheduling
- ENDC, CA & other procedures
- Multi-cell & Mobility
- Reject, Failure, RLF
- UE capability sweep



Common & Control

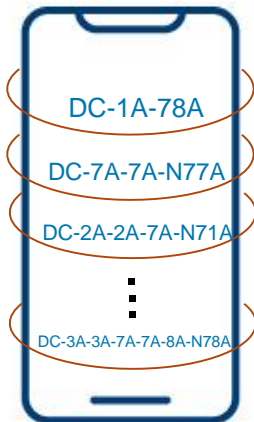
- DUT Control
- User prompts, Delays
- Simple loops / for loops
- If / else condition
- Input / Output parameters

IP Services incl. IMS

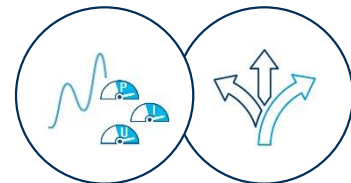
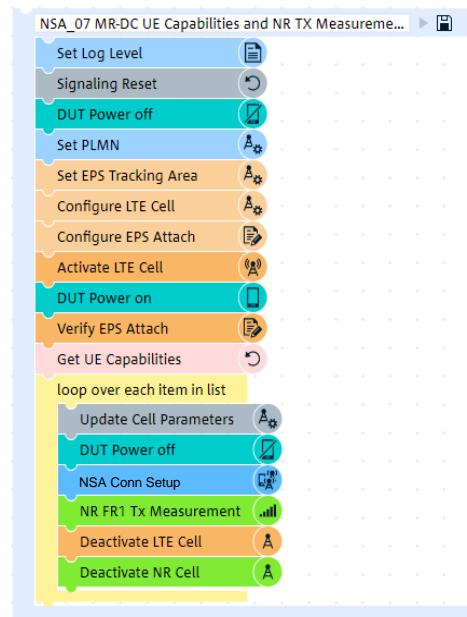
- IP Throughput services
- IP servers (DNS, FTP, ...)
- IMS, EPS-FB, VoLTE, VoNR
- Audio/Video testing

AUTOMATIC SHUFFLE THROUGH UE BAND COMBINATION

UE supported
LTE-NR Band combos



- ▶ **CMsequencer** offers an automatic way to sweep through all UE supported band combinations
- ▶ **Advantages**
 - One click solution
 - Verify RF meas, BLER meas & Throughput for all band combinations
 - One report summarizing results for all band combinations
 - Great way to check for health of a device



5G RF PRE-CONFORMANCE

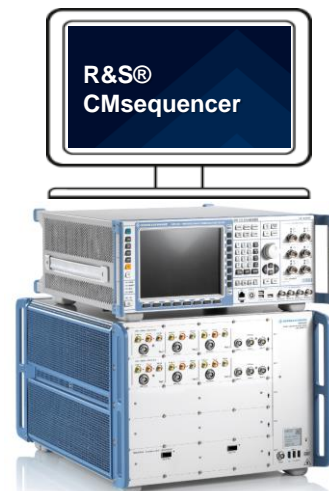
- ▶ Enables fast in-house RF Pre-conformance testing for in-band test cases
- ▶ Based on industry standard 3GPP conformance
- ▶ Allows combination of functional, parametric testing, BLER search routines and 3GPP pre-conf. testing
- ▶ No extra SW installation needed



FR1 Min Footprint

good for:

- NSA FR1: LTE 2x2, NR 2x2
- SA FR1: NR 4x4



FR2 Min Footprint

good for:

- NSA FR1: LTE 2x2, NR 2x2; FR2 8CC 2x2
- SA FR1: NR 4x4; FR2 8CC 2x2



3GPP TESTS - EASY & FLEXIBLE MODE



Easy

One block for configuring all 3GPP TCs incl. Band/BW/Channel configuration

3GPP NSA RF Tests

- Signaling Reset
- NSA Call Set Up
- 3GPP NSA Tests
- NSA Connection Release

Flexible

3GPP NSA FR1 Tx and Rx Tests

- Signaling Reset
- NSA Call Set Up
- NR 6.2B.1.3 Maximum output power for inter-band ...
- NR 6.2B.2.3 Maximum Output Power reduction for i...
- NR 6.3B.3.3 Tx ON/OFF time mask for inter-band E...
- NR 7.3B.2.3 Reference sensitivity for Inter-band...
- NR 7.4B.3 Maximum Input Level for Inter-band EN-...

Irrespective of mode, Uniform Measurement Report

Activated LTE Cell - LTE Cell 1

Activated NR Cell - NR Cell 1

Name	Value
Band	78
UL Reference Point A	620046
UL Reference Point A	620046
Bandwidth	10.0 MHz
SCS	30.0 kHz
DL SSB EPRE	-69.3 dBm

DUT Information

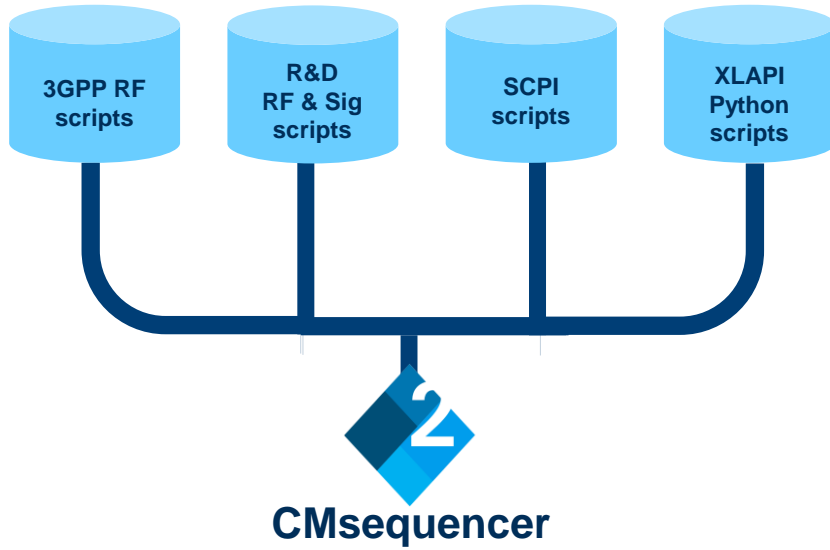
IMEI 351585110017012

Activate EN-DC Modc: Passed

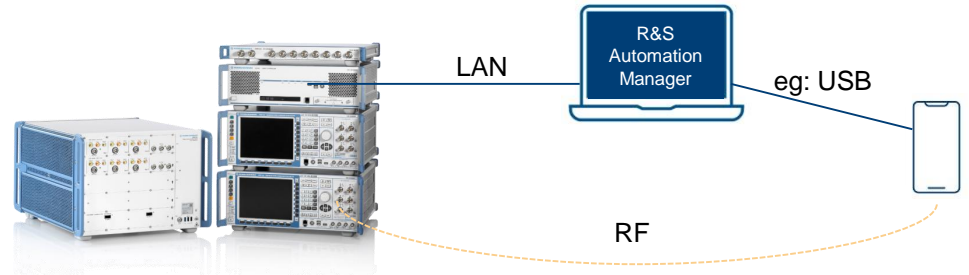
NR FR1 - 6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1 @ DC_TA_n78/15kHz [30kHz/5MHz] 10MHz

Test Item	Test Condition	Lower Limit	Upper Limit	Measured	Unit	Verdict
6.2B.2.1 UE Maximum Output Power reduction for Inter-Band EN DC within FR1	n78;620334;10MHz;10kHz;CP-OTDM QPSK;Inner_Full[1206];Pumaxpc3;ID:23	19.50	25.00	26.07	dbm	Failed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN DC within FR1	n78;620334;10MHz;10kHz;CP-OTDM QPSK;Edge_TRB_Left[1023];Pumaxpc3;ID:24	17.50	25.00	24.30	dbm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM QPSK;Edge_TRB_Right[1023];Pumaxpc3;ID:25	17.50	25.00	23.85	dbm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM QPSK;Outer_Full[2400];Pumaxpc3;ID:26	17.50	25.00	24.61	dbm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM 16 QAM;Inner_Full[1206];Pumaxpc3;ID:27	19.00	25.00	25.62	dbm	Failed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM 16 QAM;Edge_TRB_Left[1023];Pumaxpc3;ID:28	17.50	25.00	24.48	dbm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN DC within FR1	n78;620334;10MHz;10kHz;CP-OTDM 16 QAM;Edge_TRB_Right[1023];Pumaxpc3;ID:29	17.50	25.00	24.00	dbm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN DC within FR1	n78;620334;10MHz;10kHz;CP-OTDM 16 QAM;Outer_Full[2400];Pumaxpc3;ID:30	17.50	25.00	24.61	dbm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN DC within FR1	n78;620334;10MHz;10kHz;CP-OTDM 64 QAM;Edge_TRB_Left[1023];Pumaxpc3;ID:31	16.00	25.00	24.22	dbm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM 64 QAM;Edge_TRB_Right[1023];Pumaxpc3;ID:32	16.00	25.00	23.73	dbm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM 64 QAM;Outer_Full[2400];Pumaxpc3;ID:33	16.00	25.00	24.01	dbm	Passed

AUTOMATION FOR ALL 3GPP RF, R&D TEST SCRIPTS



Headless CMsequencer provides easy integration with user automation frameworks



SUMMARY

- ▶ Easy drag & drop blocks with color coding & parameterization
- ▶ Control structures like loops, if conditions & variable assignments
- ▶ Unlimited testing possibilities by mixing RF, protocol, application testing blocks
- ▶ Comprehensive reports with tables, charts & graphs
- ▶ Extension possibilities using SCPI & python
- ▶ Easy & flexible 3GPP Tx/Rx tests



DEMO



CMsquares - Home - CMX500 pl... CMsquares - Workspace - CMX50... localhost:5555

R&S CMsquares - Home - CMX500 plus CMW

Applications

- Test Environment
- Current Workspaces
- Message Analyzer
- Sequencer

Use Cases

- RF Test NSA
- RF Test 5A
- Max. Throughput
- IP Analysis

Library License 28 Settings About Maintenance Help Installation Manager Data Services

X90 UE - mu732454 - Remote Desktop Connection

Automation Manager - CAUsers\sa_tc_se_calibox\Documents\DUT_Files\MM_Profile\MM_MTK_Petru.xml

File Edit View Tools Help

Monitor Test Channel

Start Automation Stop

Pop [Er?] Delay [0] Test

Cmd: [ATD<CR><LF>

Forward Conversion | Reverse Conversion | Session Log

Listening for connections on Lshains for arm64

8:55

Phone on vibrate No service

Airplane mode Mobile data LTE Wi-Fi

Bluetooth Do Not Disturb Flashlight

11 (RQ01.210107.0...)

KEY LEARNINGS

- ▶ ONE automation tool is better than fragmented tool for different testing use cases
- ▶ R&S CMsequencer simplifies 5G testing and is a turn-key solution for ALL 5G R&D automation tests
- ▶ Thorough testing of 3GPP + RF + Protocol + E2E using ONE tool



THANK YOU

The background of the slide features a series of parallel diagonal stripes. The stripes alternate between a very dark navy blue and a slightly lighter, medium blue. The stripes run from the top-left towards the bottom-right, creating a sense of movement and depth.