

TEST & MEASUREMENT IMPACT EVOLVING FROM 5G TO 6G

 **MOBILE TEST
SUMMIT 2025**
Virtual conference connecting the World

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ROHDE & SCHWARZ

Make ideas real



T&M SOLUTIONS FOR THE WIRELESS MARKET

As a global leader in RF and microwave testing, we support the entire product lifecycle of wireless communications devices and infrastructure components.

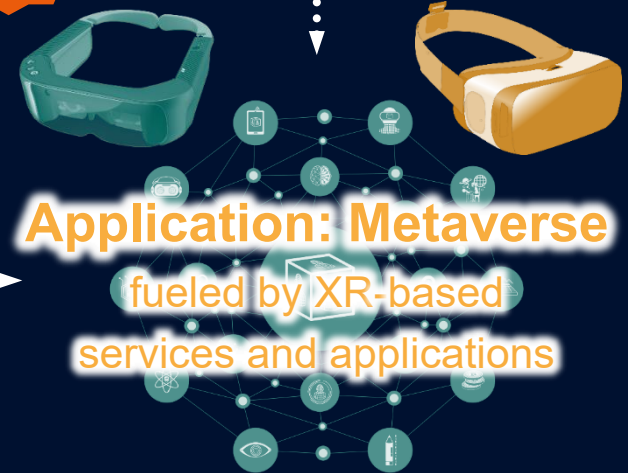


WHY DID 4G LTE SUCCEED WITH CONSUMERS?

HOW CAN 6G FOLLOW THE 4G LTE PLAYBOOK?



New device type...
combined with use
cases applications...
= Success!



Application: Metaverse
fueled by XR-based
services and applications

CARRIER-GRADE LAB-BASED TESTBED FOR EXTENDED REALITY (XR) FROM AN END-TO-END (E2E) PERSPECTIVE



R&S@CMX500
5G One Box Signaling Tester

R&S@ATS1800C
Compact 3GPP-compliant OTA chamber for 5G NR mmWave signals

¹⁾ [Link to CMsequencer brochure](https://www.ericsson.com/en/press-releases/6/2025/ericsson-t-mobile-and-qualcomm-begin-xr-trials-with-5g-advanced)
<https://www.ericsson.com/en/press-releases/6/2025/ericsson-t-mobile-and-qualcomm-begin-xr-trials-with-5g-advanced>

MOBILE WORLD CONGRESS 2025

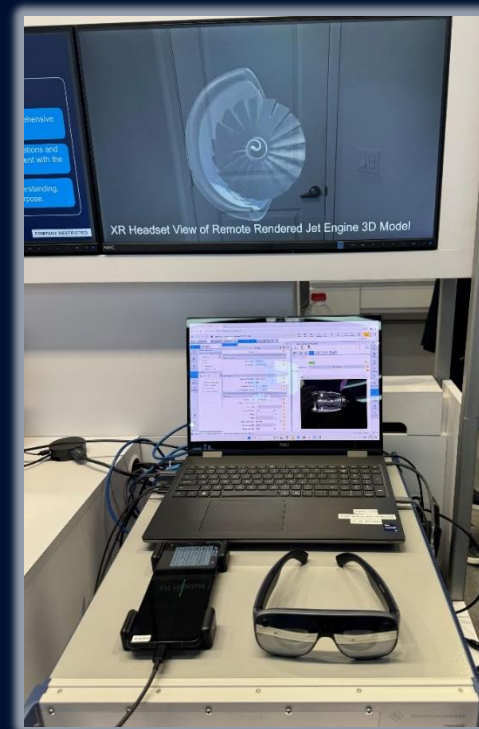
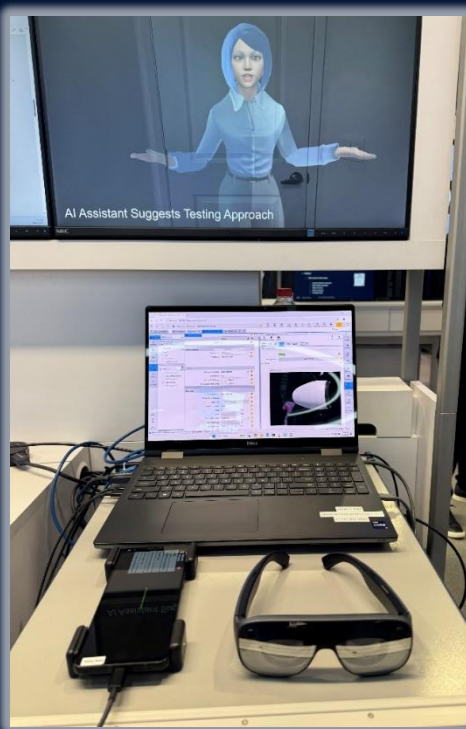
DEMO IMPRESSIONS

Demoed @

MWC
GSMA

BARCELONA
3 - 6 MARCH 2025

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ENSURE OPTIMUM QOS & QOE IN PRIVATE NETWORKS & CRITICAL INFRASTRUCTURES

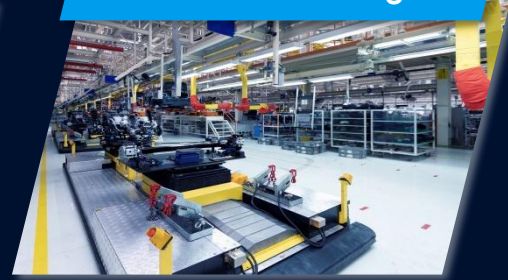
Airports



Energy utilities



Manufacturing



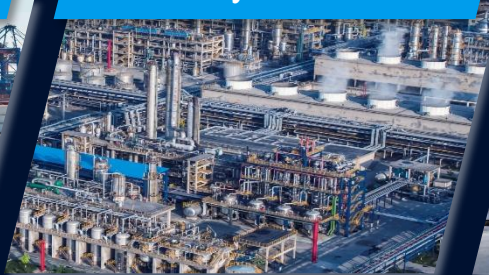
Mining



Ports



Refinery / Chemical



Warehouses



SOLUTION PORTFOLIO FOR PRIVATE NETWORKS

Research & Engineering



R&S®5G STS,
ROMES

**Rollout
preparation**

Spectrum clearance & interference hunting inside the factory, survey of surrounding networks

Acceptance

Passive RF & active tests. Tuning network performance to meet customer KPIs (acceptance report)

**Performance &
service level
verification**

Predictive maintenance by either regular performance verification or 24/7 autonomous monitoring with trend analysis

Troubleshooting

Detailed passive RF & active tests on site to identify root cause of network issues



R&S®FPH, R&S®5G STS

R&S®5G STS, LCM,
QualiPoc, SmartAnalytics
Mobile Test Summit 2025

QualiPoc, LCM,
SmartMonitor

R&S®PR200, R&S®5G STS,
QualiPoc, LCM, SmartAnalytics

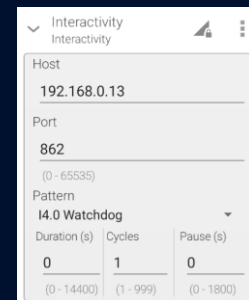
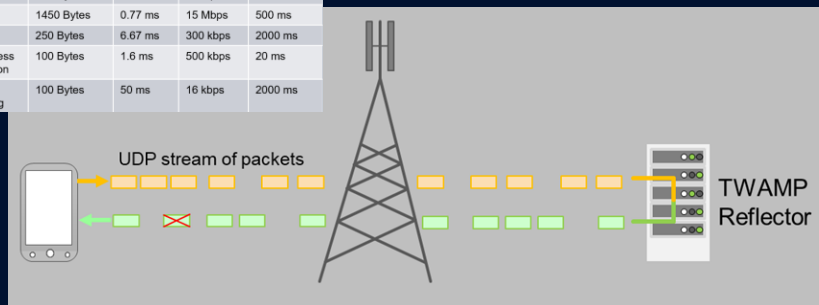
HOW TO MEASURE REAL-TIME CAPABILITY OF A MOBILE NETWORK?

Interactivity Test

- ▶ Client sends a load pattern in UL, server reflects to client
- ▶ **Packet size and rate can be varied based on a list of different traffic patterns (from 16kbps to 15Mbps)**
- ▶ KPIs: Latency (RTT), Jitter (packet delay variation) and packet loss

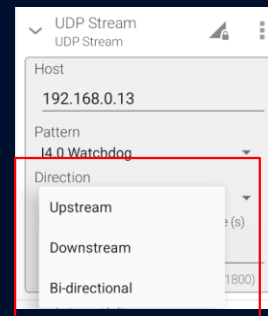
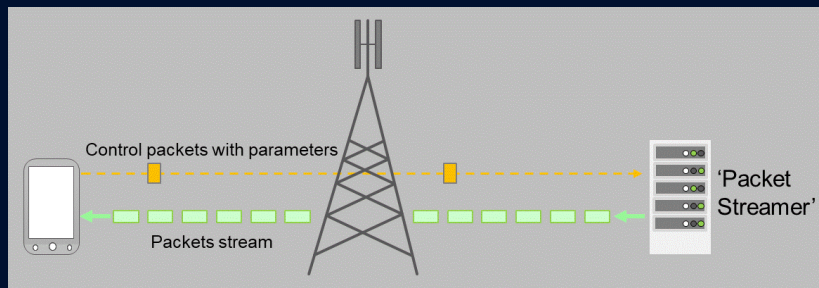
Data profile characteristics				
Profile	Packet size	Packet rate	Data rate	Delay Budget
Low	100 Bytes	8 ms	100 kbps	500 ms
Med	650 Bytes	5 ms	1 Mbps	500 ms
High	1450 Bytes	0.77 ms	15 Mbps	500 ms
Long	250 Bytes	6.67 ms	300 kbps	2000 ms
I4.0 process automation	100 Bytes	1.6 ms	500 kbps	20 ms
I4.0 Watchdog	100 Bytes	50 ms	16 kbps	2000 ms

TWAMP: Two-Way Active Measurement Protocol – specified by IETF (RFC 5357)



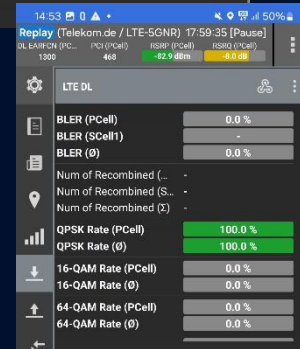
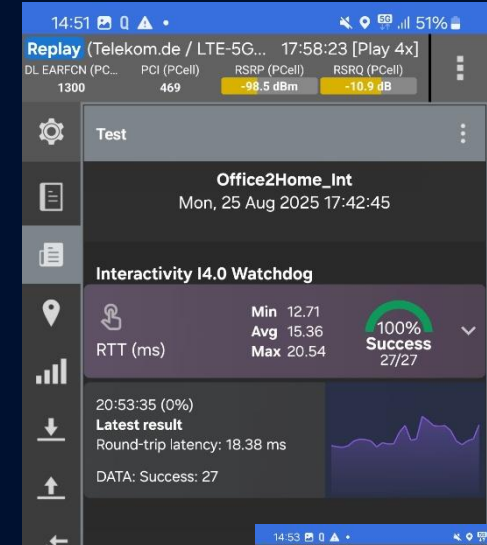
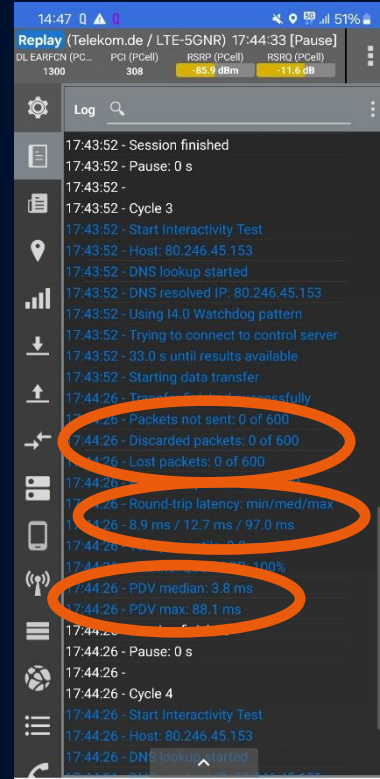
UDP Stream Test

- ▶ Server streams packets as defined by parameters; **independent** uplink and downlink traffic
- ▶ Allows to build more specific patterns (up to 50 Mbps)
- ▶ KPIs: Latency (RTT), Jitter (packet delay variation) and packet loss



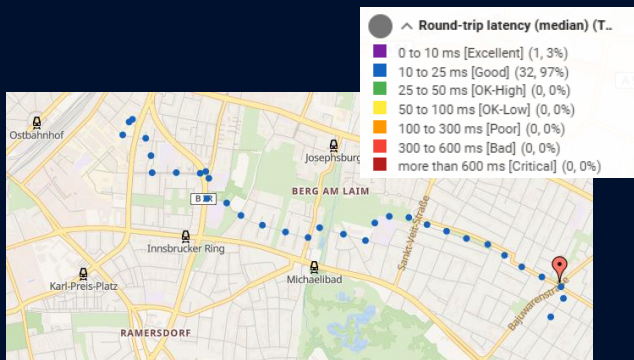
MEASUREMENTS IN PRACTICE

TEST SYSTEM: MTB = MEIKS TESTING BIKE

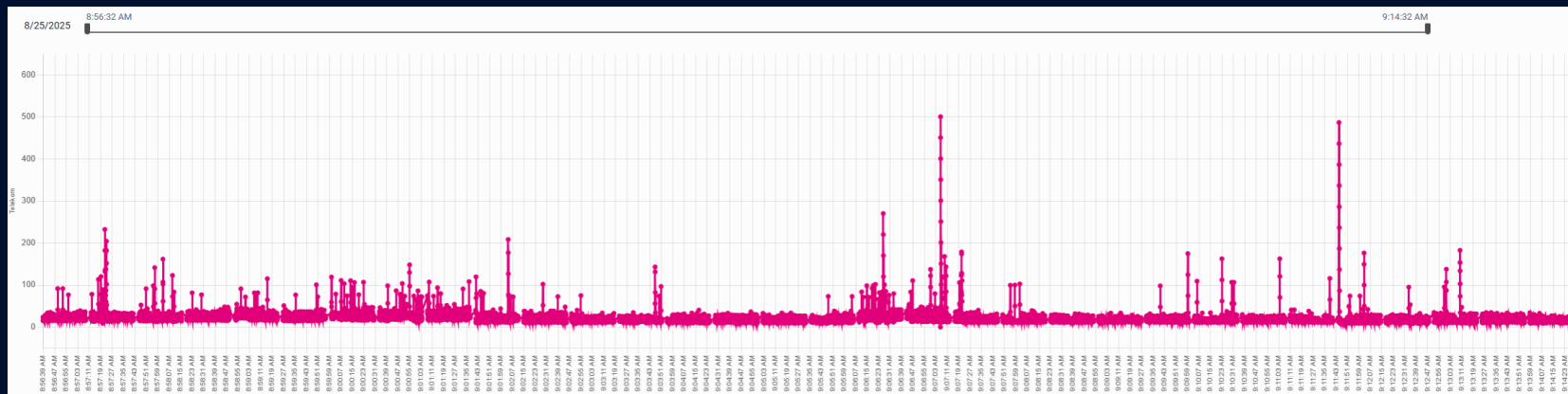
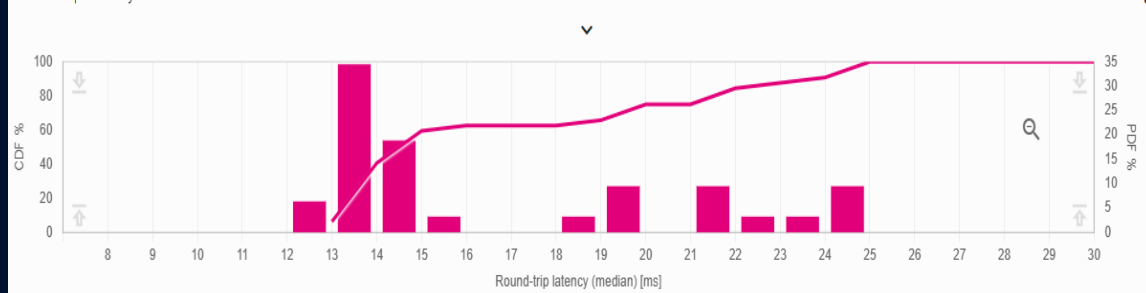


RESULTS

POST-PROCESSED WITH SMART ANALYTICS I40 WATCHDOG (16KBPS)



Round-Trip Latency Median Distribution



PRIVATE NETWORKS & CRITICAL INFRASTRUCTURES

THE IMPORTANCE OF A RELIABLE TEST DEVICE

Important to note:

- ▶ Smartphones don't represent the real-end user. Machines use modules, support e.g. more UL MIMO layers
- ▶ Android (QualiPoc) and Windows (ROMES) don't represent the real machine end-user performance

Solution:

- ▶ Non-smartphone, headless access device for mobile networks
- ▶ Based on a 4G/5G modem (M.2 Quectel RM520N-GL)
- ▶ Linux host computer

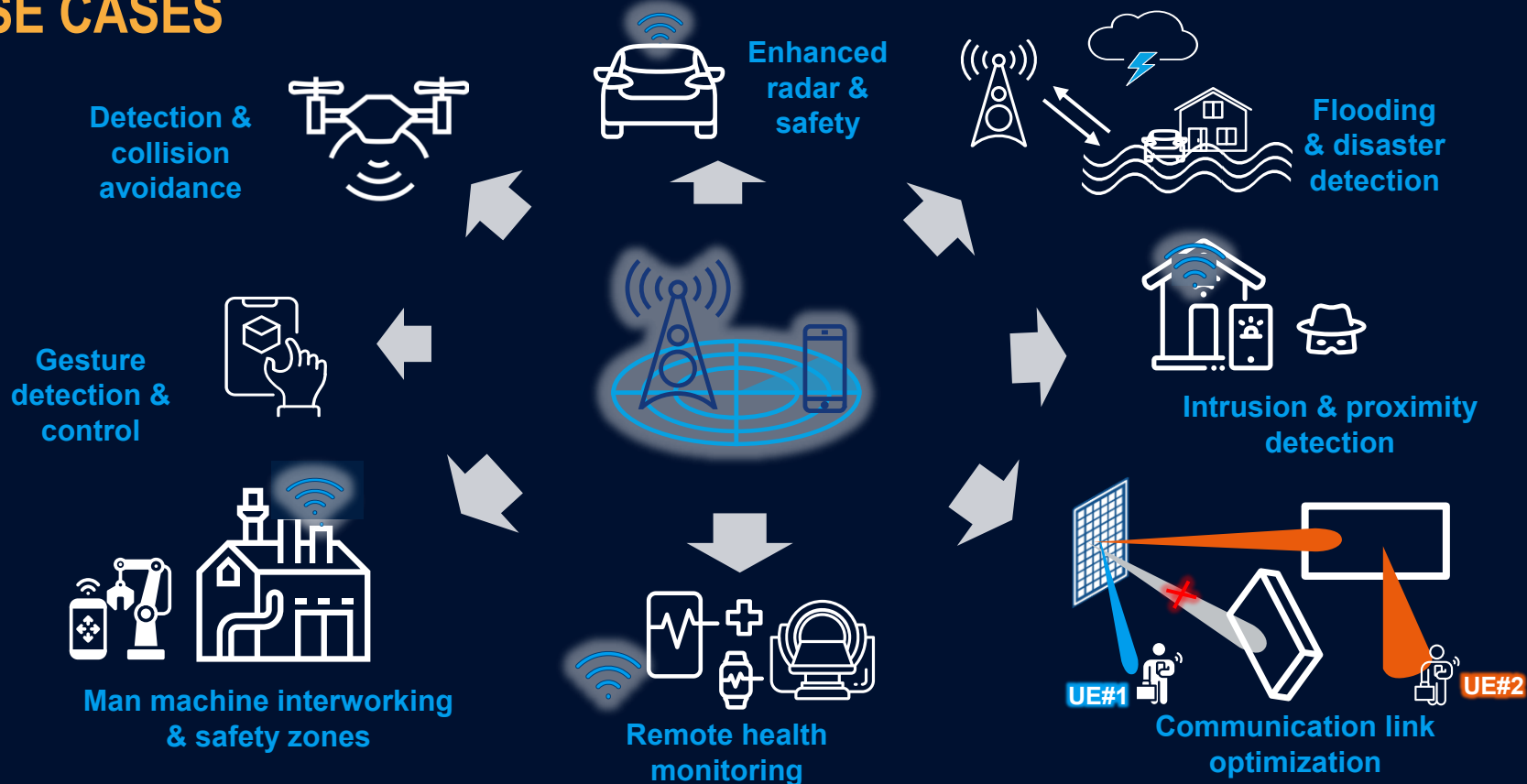


[R&S@QualiProbe](#) / [R&S@LCM](#)

Example results in a private (non-loaded) network

Device / Position	Traffic pattern	Cycle	RTT median	PDV median	RTT min	RTT max
LCM / P1	I40 Watchdog 16kbps	1	10,055 ms	3,952 ms	6,10 ms	24,842 ms
		2	9,301 ms	3,028 ms	6,27 ms	31,682 ms
		3	8,314 ms	1,741 ms	6,57 ms	31,362 ms
		4	7,557 ms	1,058 ms	6,50 ms	13,192 ms
		5	9,806 ms	3,106 ms	6,70 ms	13,269 ms
			9,01 ms	2,58 ms	6,1 ms	31,69 ms
	I40 process automation 500kbps	1	11,911 ms	5,857 ms	6,07 ms	25,193 ms
		2	11,749 ms	5,939 ms	5,85 ms	18,737 ms
		3	11,831 ms	5,881 ms	6,02 ms	21,407 ms
		4	11,959 ms	6,482 ms	5,48 ms	26,411 ms
		5	12,225 ms	6,281 ms	5,97 ms	28,243 ms
			11,94 ms	6,09 ms	5,48 ms	28,24 ms

INTEGRATED SENSING AND COMMUNICATION (ISAC) USE CASES



COMPLETED WORK IN 3GPP

REQUIREMENTS AND CHANNEL MODELLING

► Requirements (3GPP SA1):

- 5G wireless sensing service functional requirements (authorization, exposure, security and privacy, charging)
- 5G wireless sensing performance requirements (accuracy of positioning / velocity estimate, confidence level, sensing resolution, missed detection / false alarm probability, max sensing service latency, refreshing rate)

3GPP TS 22.137 V19.1.0 (2024-03)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group TSG SA;
Service requirements for Integrated Sensing and
Communication;
Stage 1
(Release 19)

► Channel modelling (3GPP RAN1)

- The focus of the work is to define channel modelling aspects to support object detection and/or tracking
- Aim at a common modelling framework capable of detecting and/or tracking the following example objects and to enable them to be distinguished from unintended objects:
 - UAVs
 - Humans indoors and outdoors
 - Automotive vehicles (at least outdoors)
 - Automated guided vehicles (e.g. in indoor factories)
- Objects creating hazards on roads/railways, with a minimum size dependent on frequency

ISAC CHANNEL MODELLING

TR 38.901

- Basic framework for the ISAC channel model:

$$H_{\text{ISAC}} = H_{\text{target}} + H_{\text{background}}$$

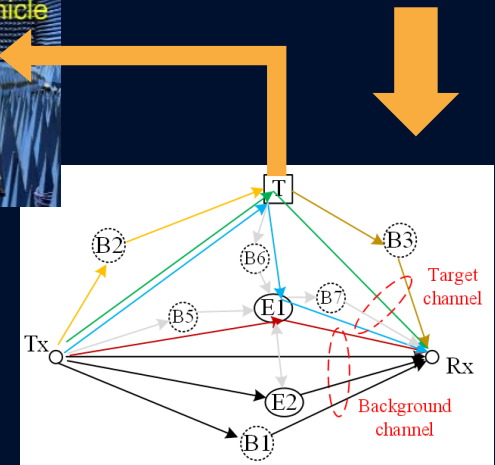
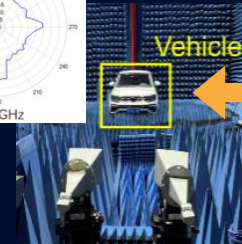
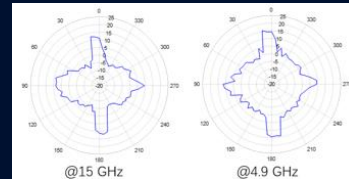
- **Target** channel contains **components impacted by the sensing target(s)**

- Target and all target interacting objects
- **Environmental Object (EO)**
 - EO – An object with a known position
 - Type 1: Dimension close to target's dimension
 - Type 2: Dimension much larger than target

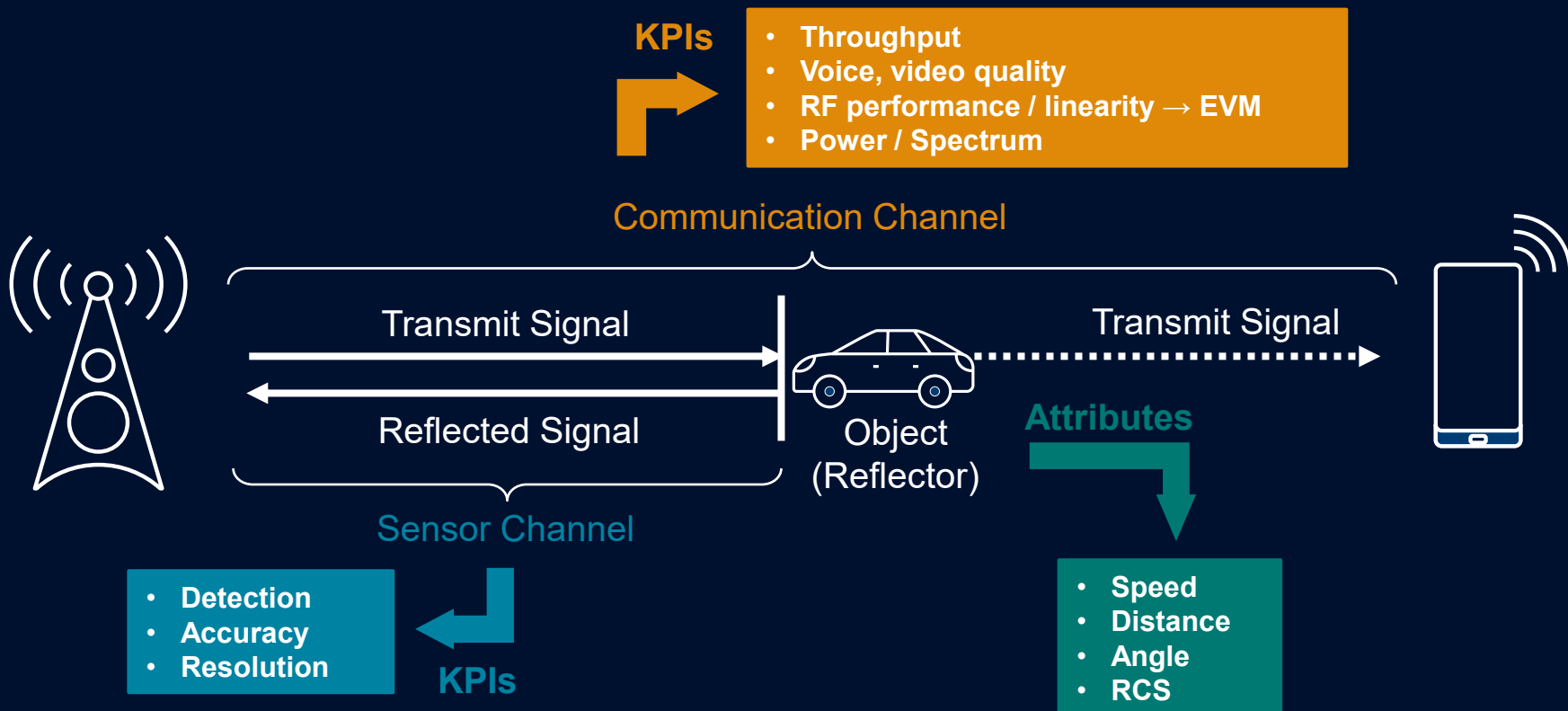
- **Added RCS modelling**

- Target Radar Cross Section

- **Background** channel are components **not impacted by the sensing target**



PRINCIPLES OF ISAC SENSING TESTING



ISAC TEST SOLUTION IN PRACTICE



MWC
Feb 2024

Berlin 6G Conference
July 2024



MWC
Feb 2025

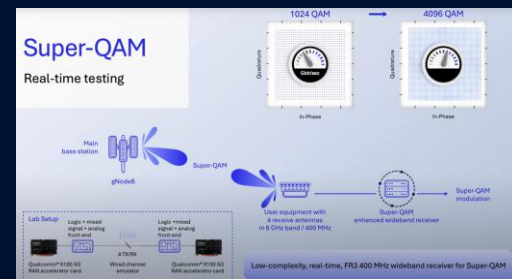


PHYSICAL LAYER TESTING ON THE WAY TO 6G

FOCUS IS ON FR3 (AND FR1)



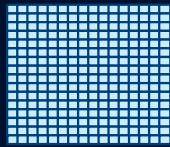
[Webinar: 6G spectrum and waveforms](#)



[Super-QAM Testbed \(Qualcomm\)](#)

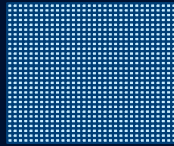
ADVANCED ANTENNA TECHNOLOGIES ARE REQUIRED

OTA MEASUREMENTS BECOME MORE DOMINANT



Giga MIMO

Same aperture size but
more antenna elements



FR3 coverage



f [GHz]	FSPL	Building penetration	
		Low-loss UMa/UMi (30% glass, 70% concrete)	High-loss UMa/UMi (70% IRR, 30% concrete)
3.5	Baseline	12.7 dB	26.9 dB
7	+6 dB	13.6 dB	31.4 dB
13	+11.4 dB	14.8 dB	33.5 dB

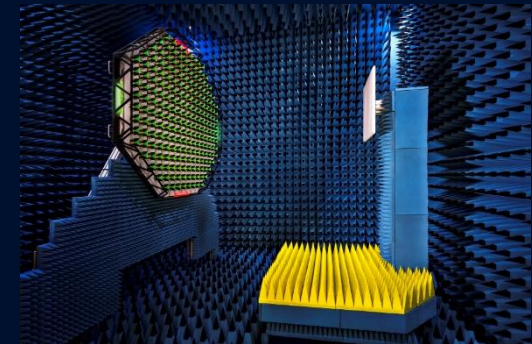
FR1 coverage

Source: <https://www.nokia.com/asset/213702>

R&S®ATS1800C



R&S®PWC200



NEXT GENERATION: SIGNAL & SPECTRUM ANALYSIS

MEASURE THE IMPOSSIBLE

[FSWX signal and spectrum analyzer](#)



MULTIPLE INPUT CHANNELS

- ▶ First signal analyzer with multiple input channels
 - Phase coherent measurements on multiple channels

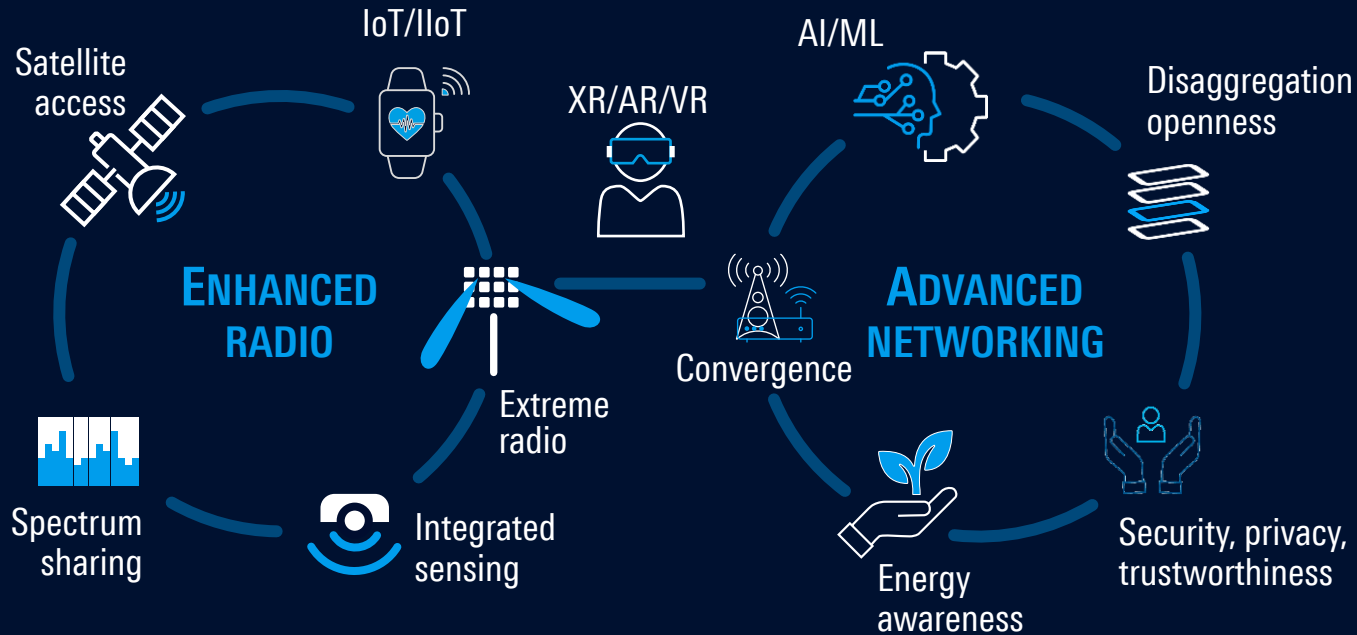
ENTIRE NEW MULTI-PATH INTERNAL ARCHITECTURE

- ▶ Cross correlation (high dynamic range for noise, phase noise and EVM measurements)
- ▶ Extended spurious free dynamic range
- ▶ New Measurement Science for optimal use of entirely new innovative design

ANALYSIS BANDWIDTH UP TO 8 GHz

- ▶ Widest bandwidth on the market

HEADING TOWARDS THE FUTURE OF WIRELESS TECHNOLOGY CORNERSTONES



TEST ♦ MEASURE ♦ INNOVATE

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**THANK YOU
VERY MUCH**

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