5G测试新挑战及解决方案
5G testing challenge and solutions

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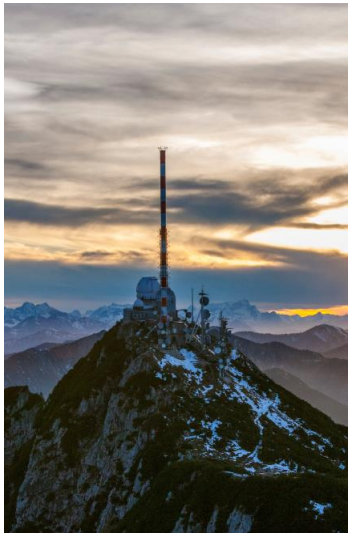
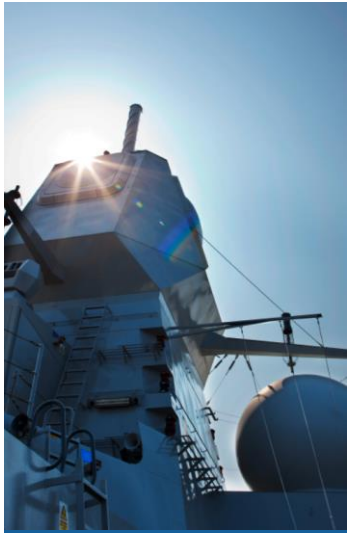
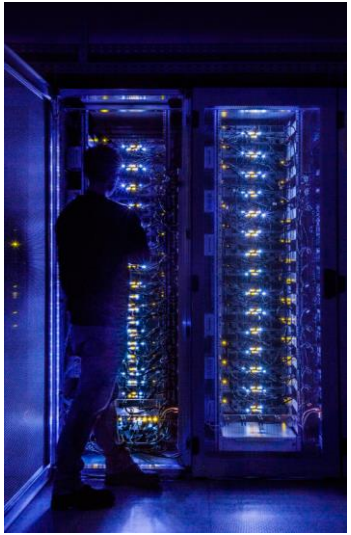
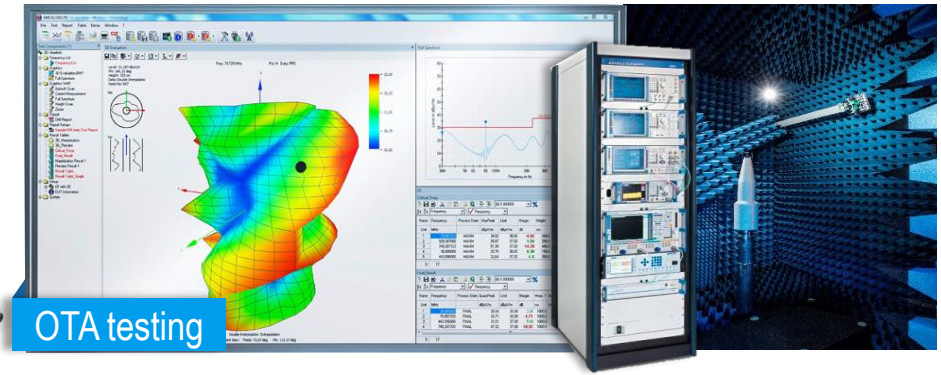
ROHDE&SCHWARZ

Rohde & Schwarz business fields

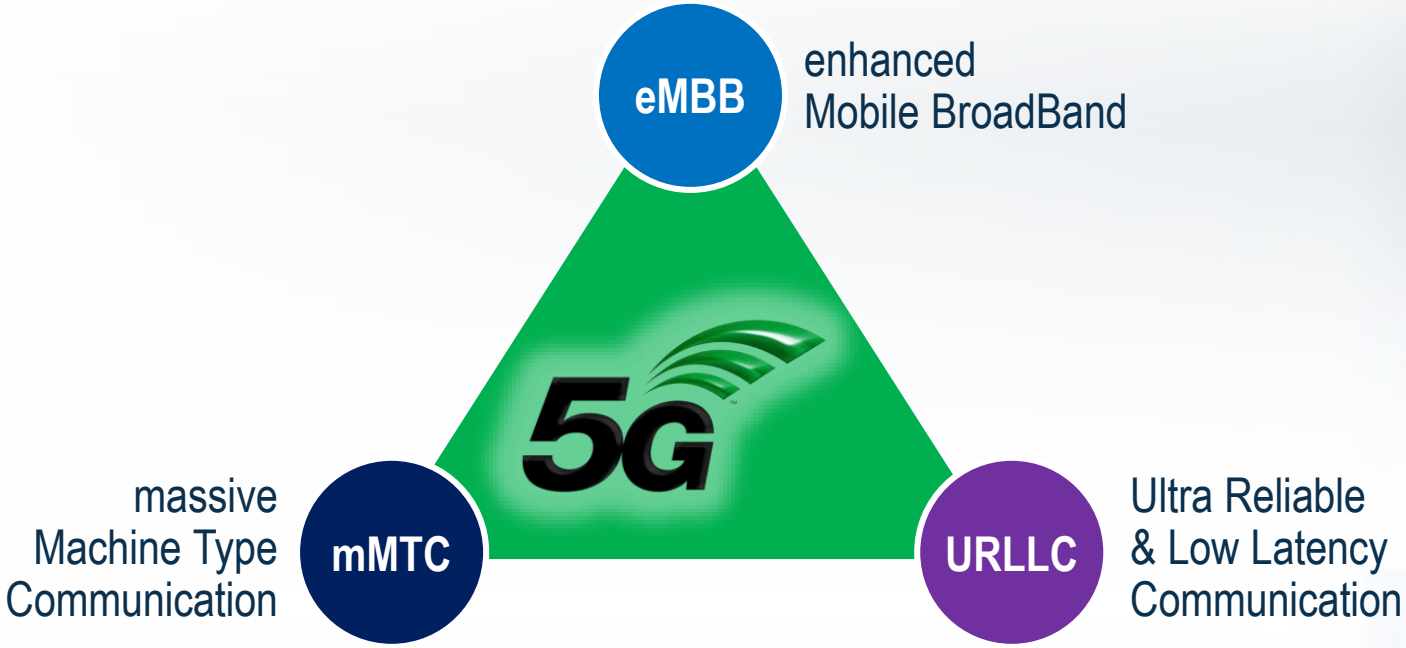
Test and Measurement	Broadcast and Media	Secure Communications	Cybersecurity	Monitoring and Network Testing
				

Service

Rohde & Schwarz competences & experiences in 5G



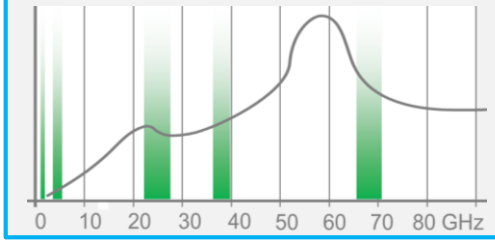
Test & Measurement challenges with 5G scenarios



5G Key Technology Components

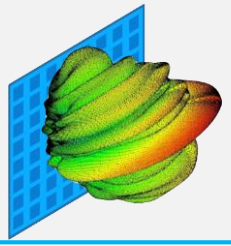
NR build on four main pillars

New Spectrum



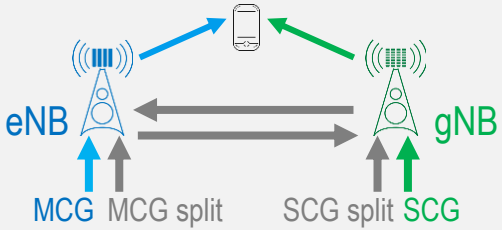
- < 1GHz
- ~ 3.5 GHz
- ~ 26/28/39 GHz

Massive MIMO & Beamforming



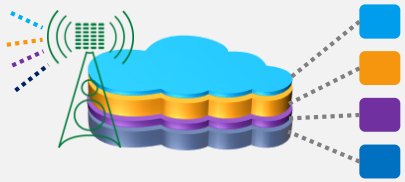
- Hybrid beamforming
- > 6GHz also UE is expected to apply beam steering

Multi-Connectivity



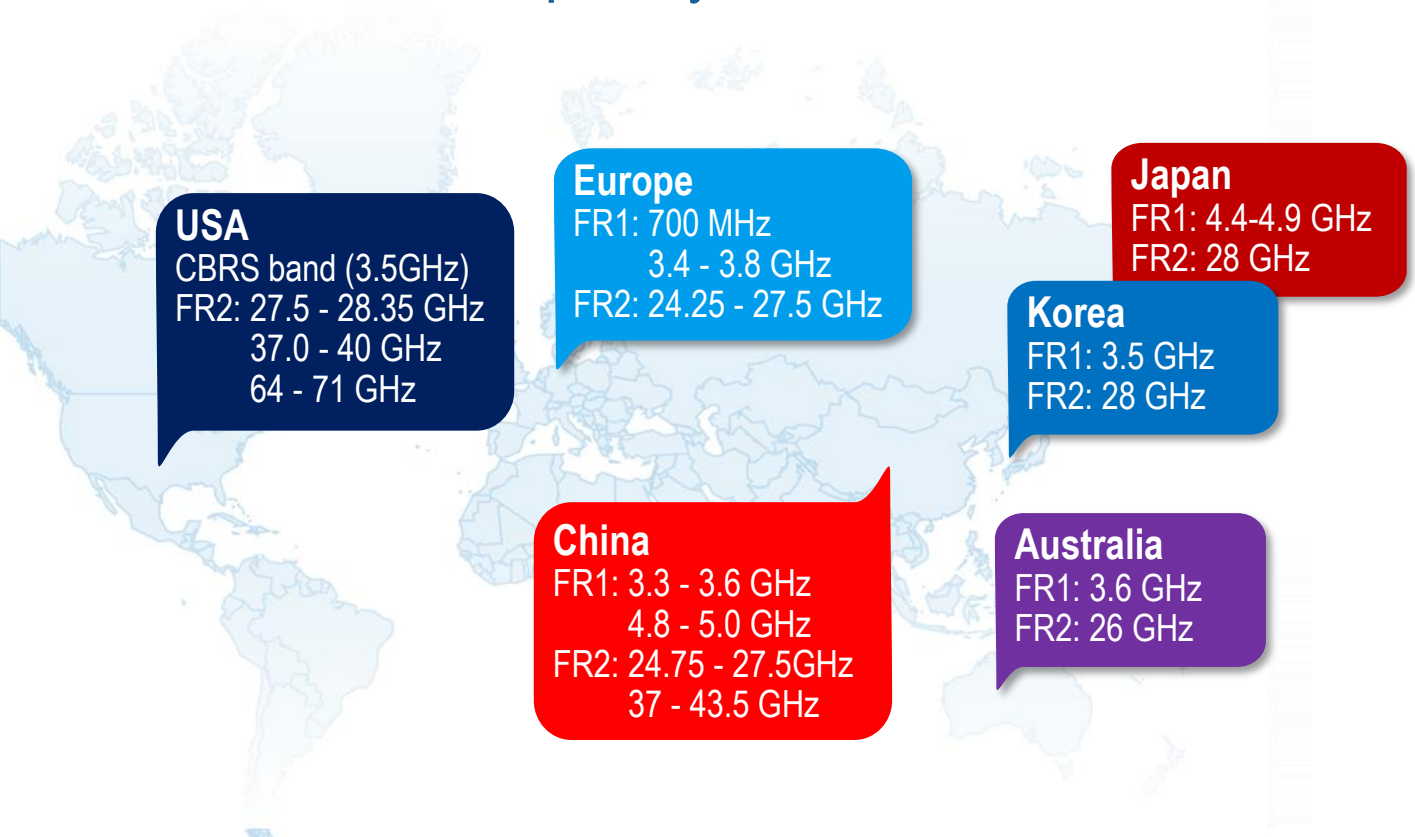
Initially based on Dual Connectivity with E-UTRA as master

Network flexibility - virtualization



- Flexible physical layer numerology
- Network Slicing
- NFV/SDN

Status 5G NR frequency allocation – actual status



NR frequency range 1 (FR1)
reserved numbers 65-256

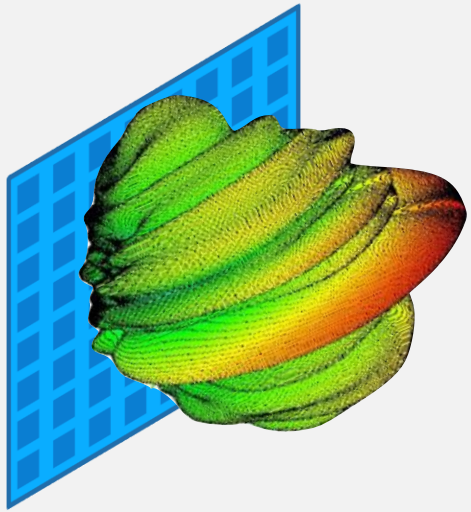
band	UL/DL
…	…
n77	3.3 – 4.2 GHz
n78	3.3 – 3.8 GHz
n79	4.4 – 5.0 GHz
…	…

NR frequency range 2 (FR2)
reserved numbers 257-512

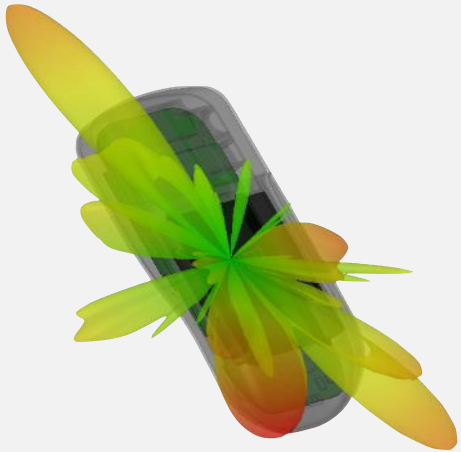
band	UL/DL
n257	26.5 – 29.5 GHz
n258	24.25 – 27.5 GHz
n259	n/a
n260	37 – 40 GHz

Two frequency ranges, one common challenge: Need for Over-the-Air testing in R&D and Production

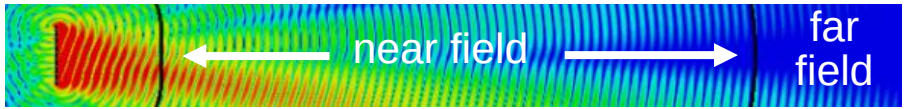
FR1: Sub-6 GHz – Massive MIMO



FR2: mmWave Beamforing



The obvious approach: Do measurements in far-field distance



3D Rotation of DUT

Single Measurement point

Dual-Polarized
High-Gain Antenna

DUT-MEAS Antenna Separation:
R > 2D²/λ (~18 meters for Massive MIMO)

Passive Measurements

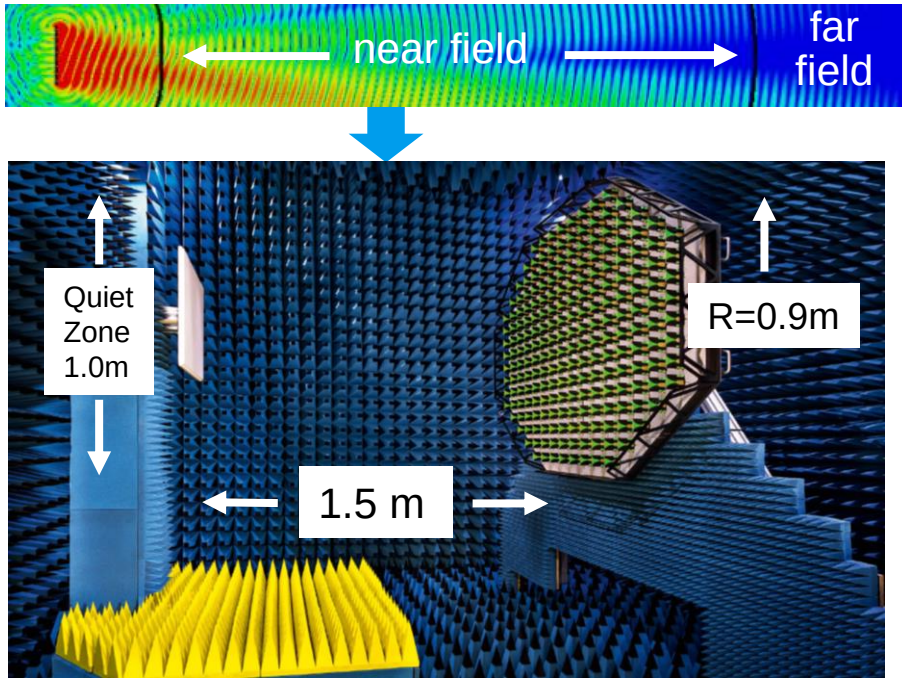
R&S®VNA

Active Measurements

R&S®Signal Generator

R&S®Signal Analyzer

The smart way: with R&S Plane Wave Converter in the near-field distance

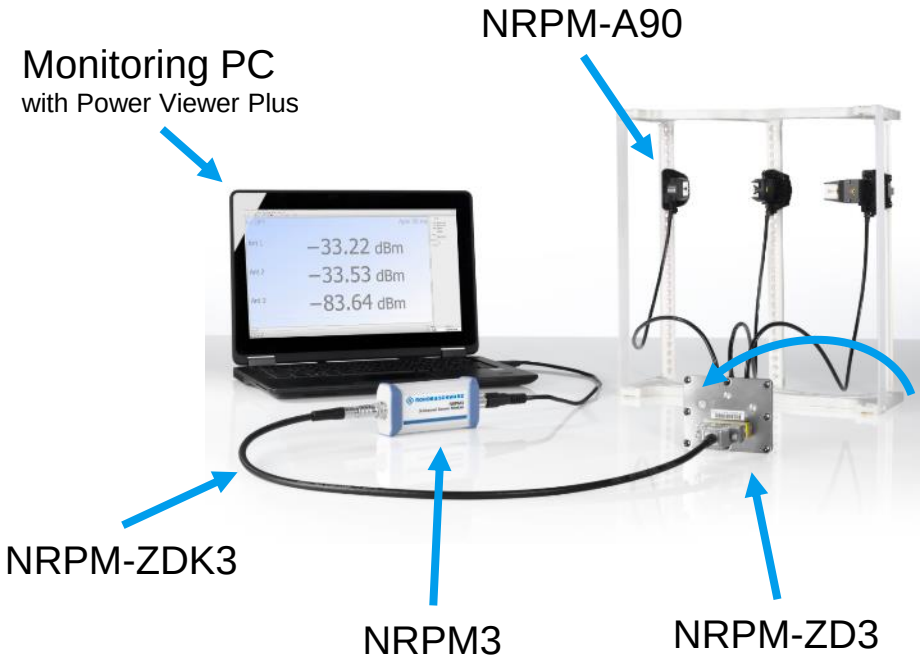


Parameters	Values
Signal Bandwidth	100-200 MHz (Modulated and CW)
Frequency Band	2.3 – 3.8 GHz (v1) & 2.3 – 6 GHz (v2)
Separation Distance	1.5 meters
Quiet Zone Size	1.0 meter diameter (0.75x0.75m DUT)
Speed (Far field EVM)	< 1 second
Measurement Capabilities	EVM, ACLR, SEM, EiRP, Gain
PWC Size	1.8 meter diameter (~2 times QZ size)
Polarization	Single Polarization (rotatable)

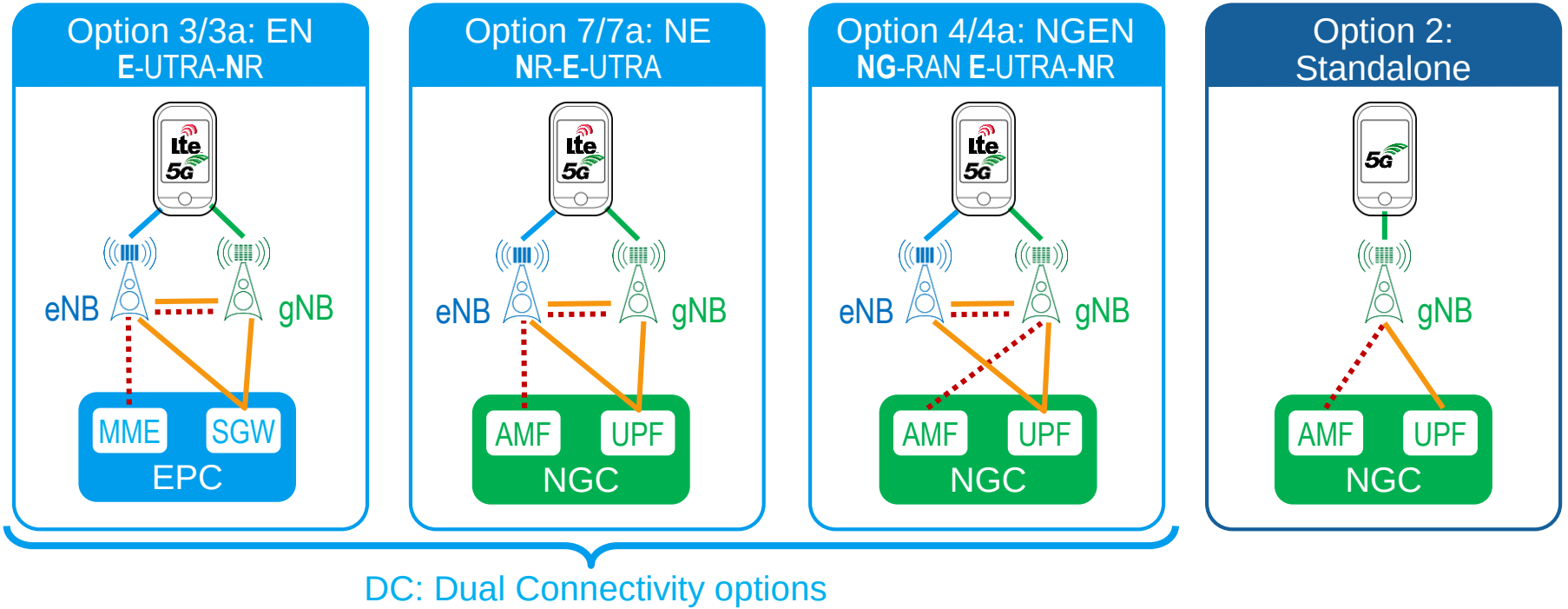
R&S most simple OTA test solution

NRPM - OTA power measurement system

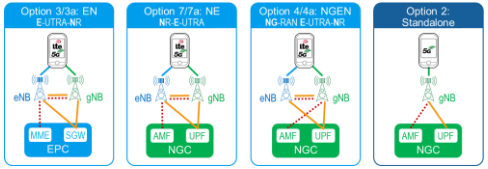
- Vivaldi antenna with integrated diode detector for power measurements directly on the antenna
- Absolute power measurement
- Frequency range: 20 – 90 GHz



5G Architecture Evolution
Deployment scenarios need 4G



R&S CMW gets new family members for 5G NR device testing

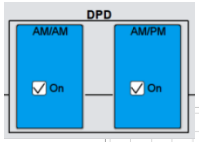


	LTE A Pro + Legacy technology /WiFi	5G NR sub6 (FR1)	5G NR mmW(FR2)
Non-Signaling (RF analyzer + generator)	 R&S®CMW100		 R&S®CMP200
Signaling (Network emulation)	 R&S®CMWflexx		 R&S® "HEAD30"  R&S®CMX500

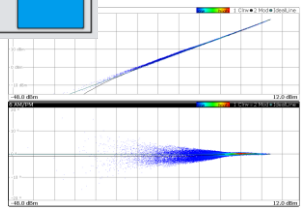
R&S test solutions to develop and implement 5G NR products

Component Characterization

PA characterization and calibration



R&S®SMW- K541
K544



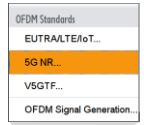
R&S®FSW
-K18D
-K544

R&S®ZVA

Network Analyzer

Direct measurements up to 110 GHz

RF development



R&S®SMW200A–K144

UP

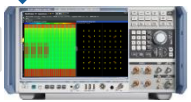
R&S®SMW200A

< 40 GHz

> 40 GHz

DUT

R&S®FSW85



R&S®FSW-K144/K145

- 40 GHz signal generation
- 90 GHz signal analysis
- 2 GHz bandwidth support

(FSW: 5GHz with RTO2064 and B5000)

5G NR Device Testing

Testing of 5G NR devices in non-signaling mode

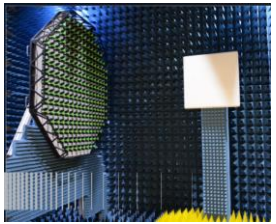
R&S®CMW100 (Sub6)

R&S®CMP200 (mmW)

Testing of 5G NR devices in signaling mode

OTA solutions

R&S®PWC200



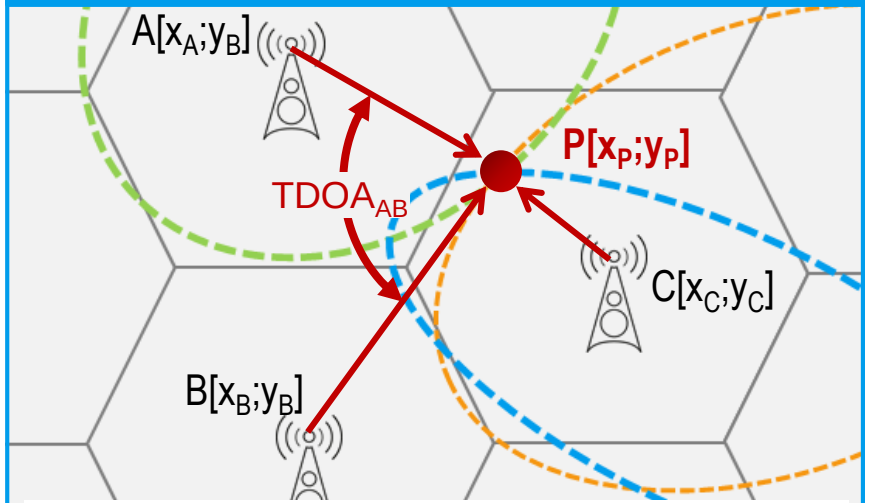
R&S®ATS1000

R&S®DST200

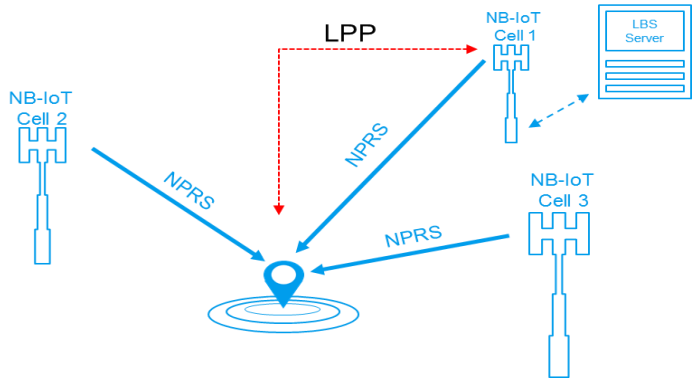
R&S®TS7124

Rel.14 NB-IoT/LTE-M offers enhanced positioning scenarios

Observed time difference of arrival



$$TDOA_{AB}\ c = \sqrt{(xA - xP)^2 + (y_A - y_P)^2} - \sqrt{(xB - xP)^2 + (yB - yP)^2}$$



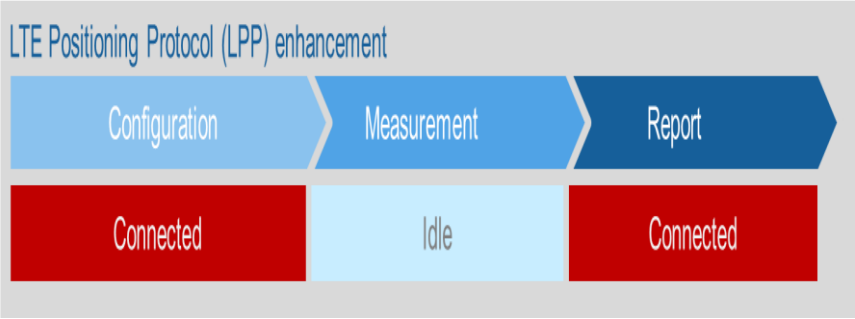
Positioning service impacts on power consumption
Additional test cases are necessary

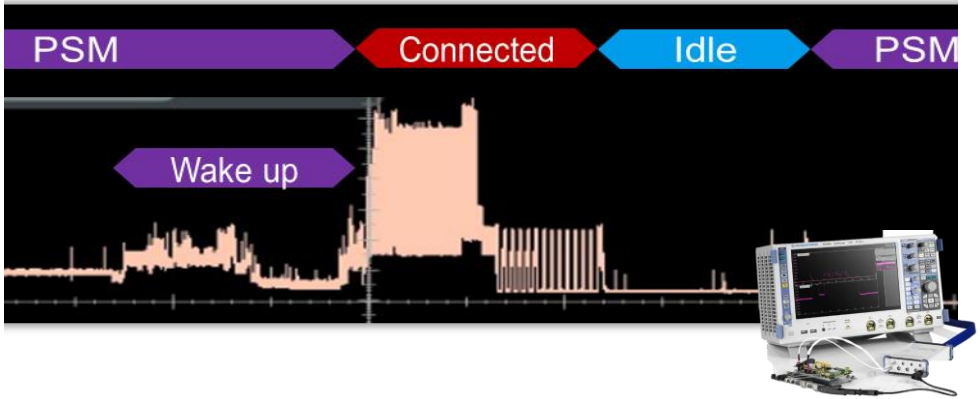
Challenge

- The battery consumption behaviour with positioning services need further study.

Solution

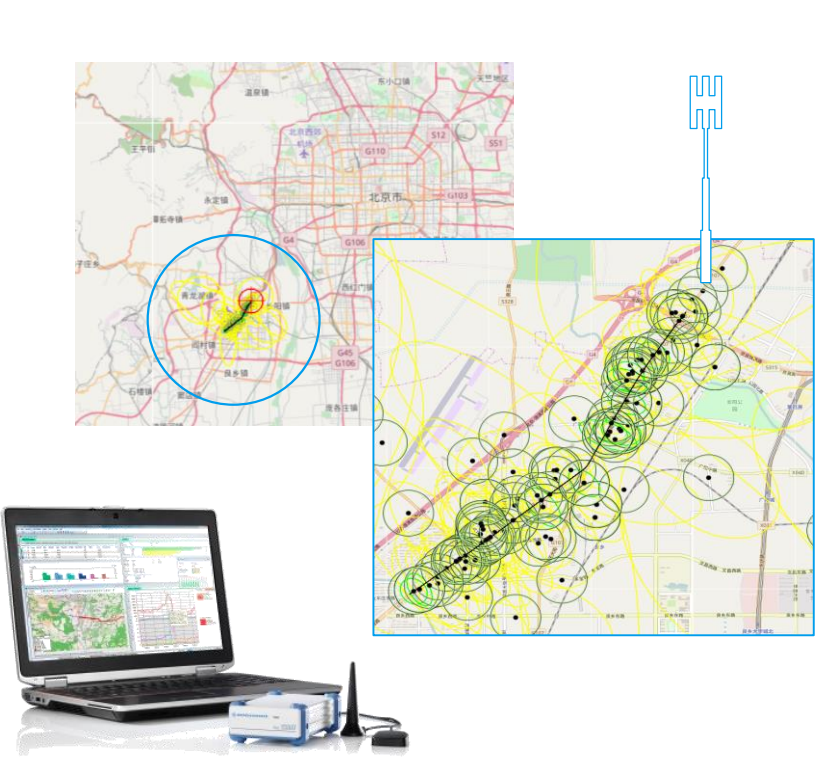
- Design the LBS test cases for power consumption requirements.

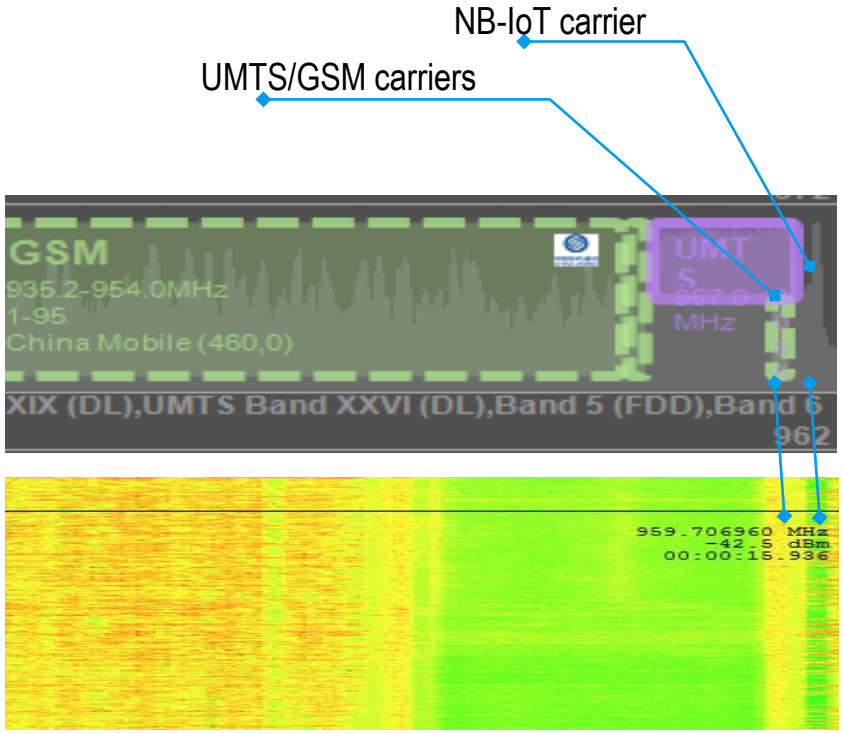




The real scenario example of NB-IoT network coverage

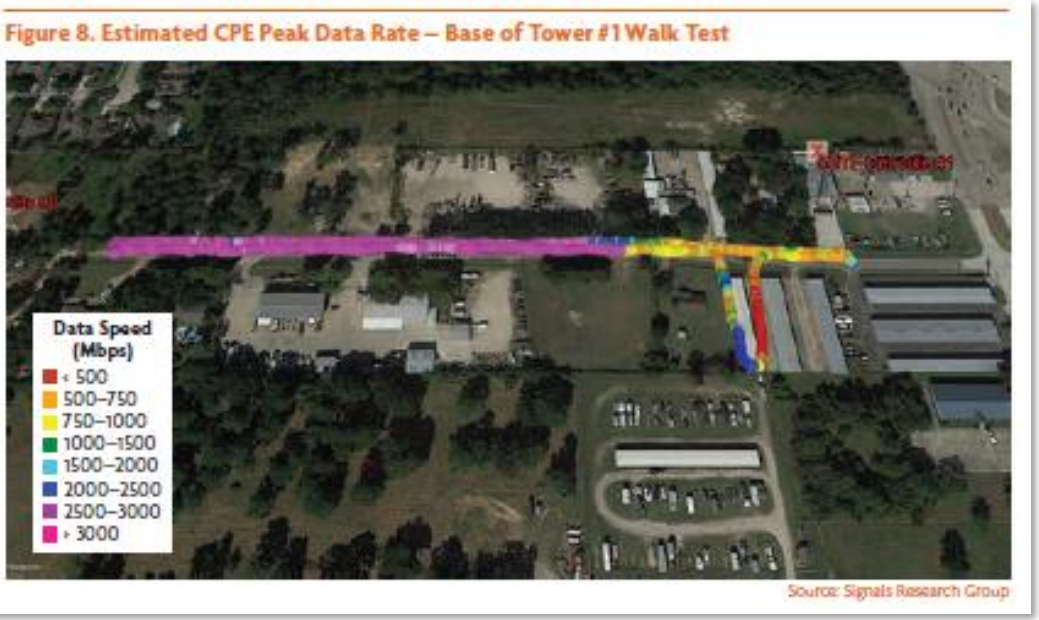
Stand-alone operation



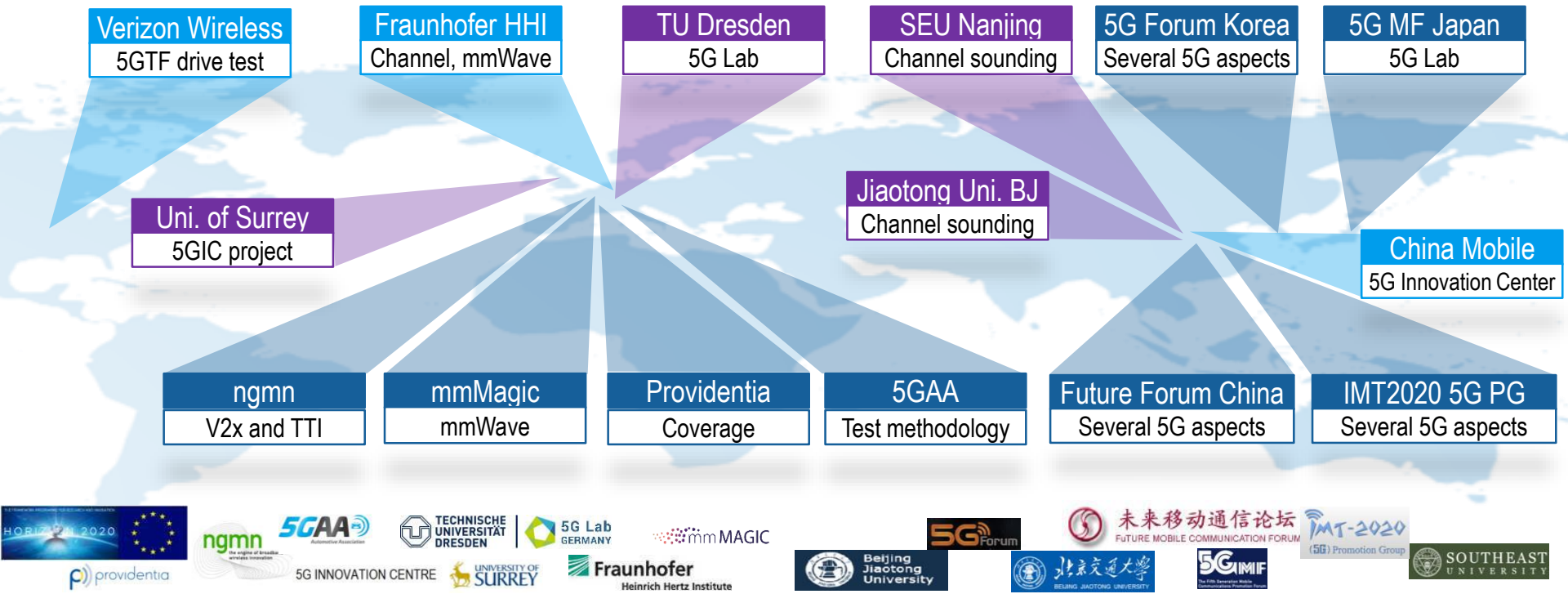


R&S RF Scanner TSMx / ROMES

5G Engineering demonstrator setup



R&S 5G engagement with other ecosystem partners & universities



Thanks for your attention!