

# Turn Visions into Reality

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# Industry activities and 3GPP

## The battle for



enhanced Mobile  
Broadband (eMBB)

A triangle of  
applications...



번호	제목	다운로드
1	5G201KT 5th Generation Radio Access: Physical layer	다운로드
2	5G211KT 5th Generation Radio Access: Physical channels and modulation	다운로드
3	5G212KT 5th Generation Radio Access	다운로드
4	5G213KT 5th Generation Radio Access	다운로드
5	5G214KT 5th Generation Radio Access	다운로드
6	5G215KT 5th Generation Radio Access	다운로드
7	5G216KT 5th Generation Radio Access	다운로드
8	5G217KT 5th Generation Radio Access	다운로드
9	5G218KT 5th Generation Radio Access	다운로드
10	5G219KT 5th Generation Radio Access	다운로드

### VERIZON 5G SPECIFICATIONS

- V5G.201 - VERIZON 5TH GENERATION RADIO ACCESS; OVERALL DESCRIPTION >
- V5G.212 - VERIZON 5TH GENERATION RADIO ACCESS; MULTIPLEXING AND CHANNEL CODING >
- V5G.300 - V25G ACCESS TECHNOLOGY OVERALL DESCRIPTION >
- V5G.322 - RLC (RADIO LINK CONTROL) LAYER PROCEDURES AND PROTOCOL >
- V5G.331 - RRC (RADIO RESOURCE CONTROL) LAYER PROCEDURES AND PROTOCOL >
- V5G.211 - VERIZON 5TH GENERATION RADIO ACCESS; PHYSICAL CHANNELS AND MODULATION >
- V5G.213 - VERIZON 5TH GENERATION RADIO ACCESS; PHYSICAL LAYER PROCEDURES >
- V5G.321 - MAC (MEDIUM ACCESS CONTROL) LAYER PROCEDURES AND PROTOCOL >
- V5G.323 - PDCP (PACKET DATA CONVERGENCE PROTOCOL) LAYER PROCEDURES AND PROTOCOL >
- AIR INTERFACE - TEST PLAN >

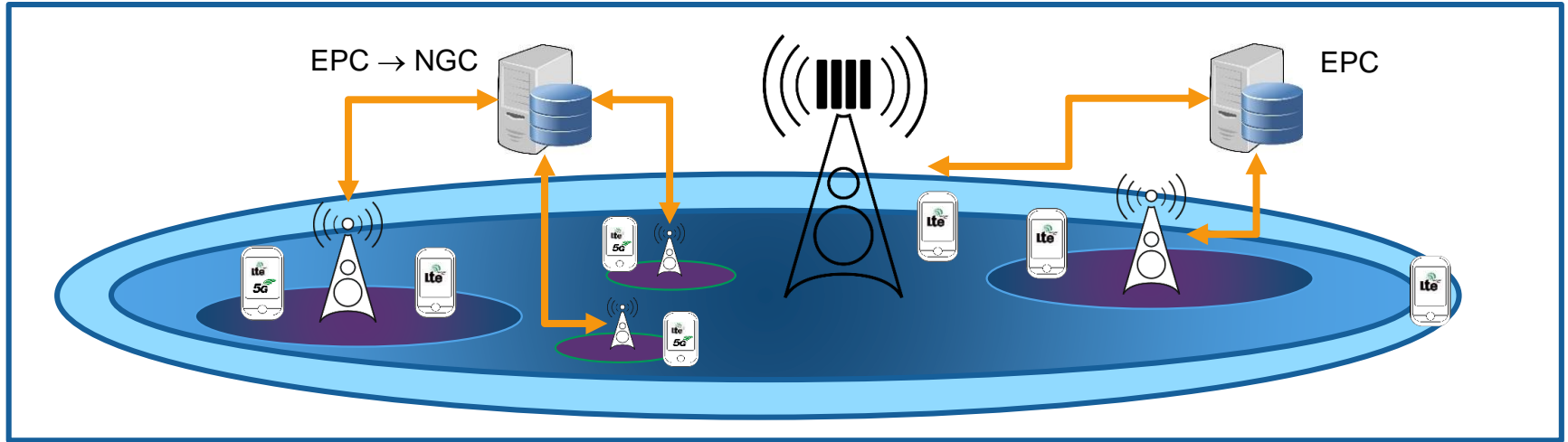
2 specific use cases:  
→ Fixed Wireless Access (FWA)  
→ eMBB for Olympics



massive Internet  
of Things (mIoT)

Ultra reliable &  
low Latency  
communication  
(URLLC)

# LTE provides the foundation on the way to 5G



FD MIMO	Carrier Aggregation	<b>eMBB (URLLC)</b>	<b>LTE-A Pro + NR &gt; 24 GHz</b>
Dual Connectivity	V2X	<b>eMBB / URLLC</b>	<b>LTE-A Pro + NR &lt; 6GHz</b>
Increased Coverage	Power Saving	<b>mIoT</b>	<b>NB-IoT &lt; 1GHz</b>
	Low Latency		

# 5G Challenges

## Massive MIMO Drives OTA Test Solution Development

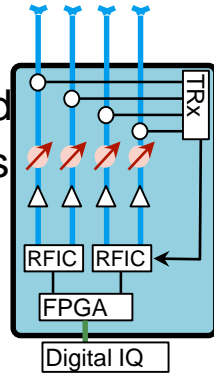
### Massive MIMO and/or cm/mm-wave

- High number of antenna elements each connected to phase shifters and PAs

- Limited test interfaces

- High integration in particular at cm- and mm-wave spectrum

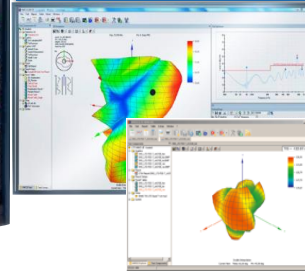
- No RF connectors



### Turn-key Systems



### AMS32 Software



### Wide Range of Chambers



### EMC and OTA Chambers



# ATS1000

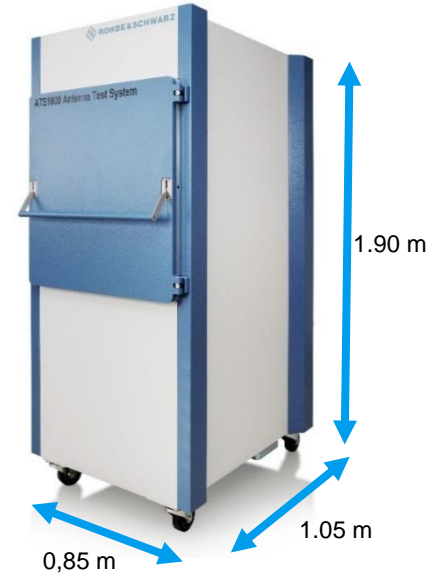
High reliability and compact  
solution for mmW UE / chipset testing



# System components

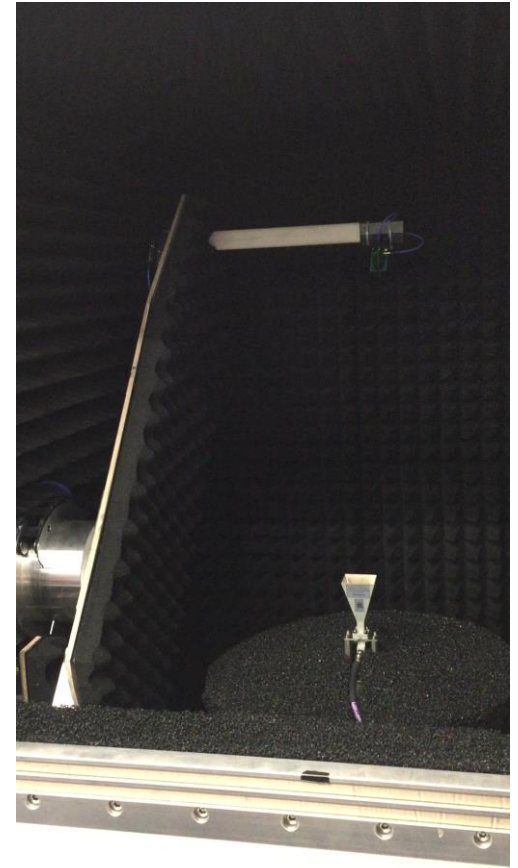
- Wheel-mounted movable chamber – goes through doors

Parameter	Value
Frequency range	10 - 90 GHz
Shielding effectiveness	>50 dB (over the complete frequency range)
Dimensions	Standard 0,85x1,05x1,9m (WxDxH)
Absorbers	High-quality Emerson absorbers layout
Interfaces	Multiple filtered feedthroughs
Weight	150Kg
Door	Robust shielded door with electrical open / close function



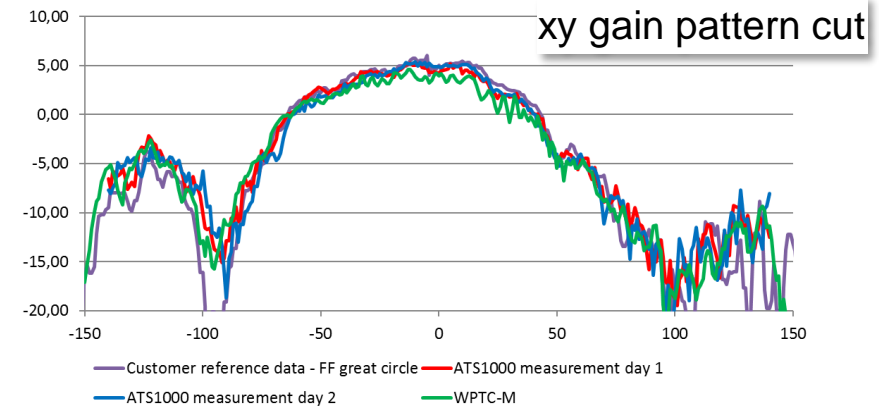
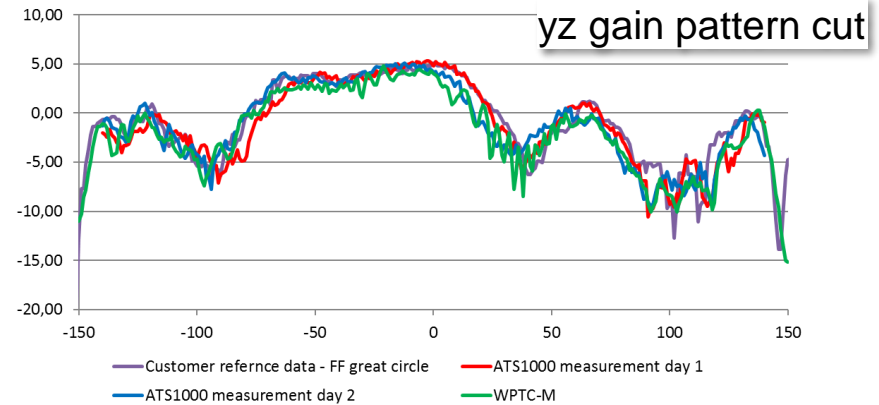
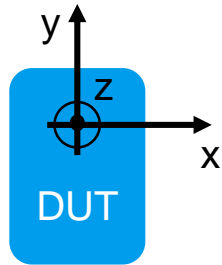
# Measurement time in ATS1000

- 9 minutes for full 3-D radiation patterns
  - 4 degree equidistant steps in AZ and EL
  - For 55 frequencies from 26.5 to 40 GHz



# Comparison on customer device

- 5G prototype at 28 GHz
- UE – mobile phone form factor, PCB-printed antenna
- Customer reference data measured with 6 m range length

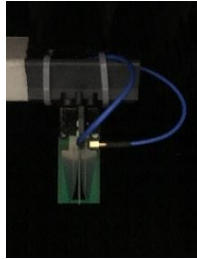




# 3D EVM measurement in beam peak with ATS1000 @ 28 GHz



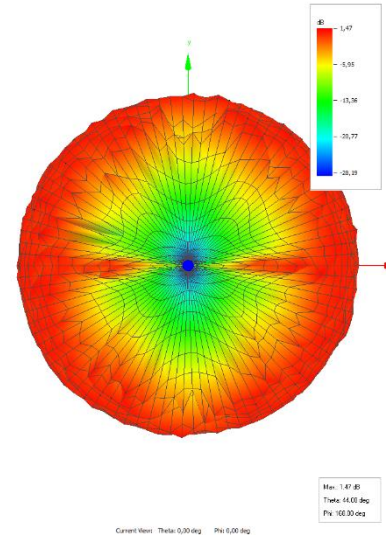
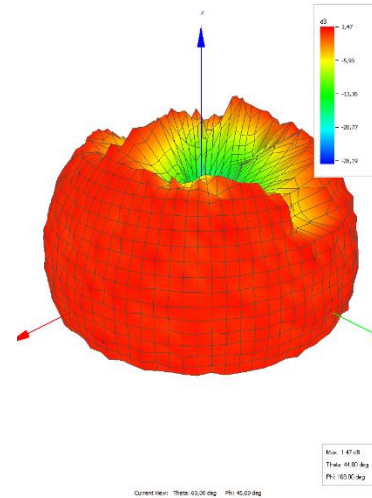
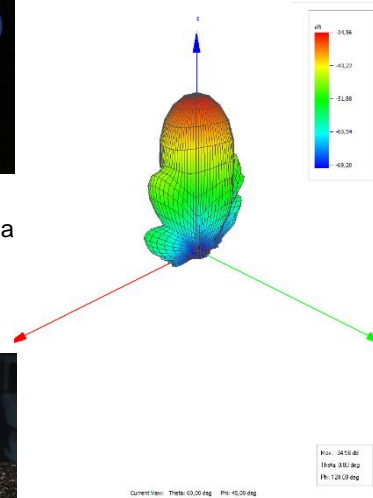
ATS setup incl. (from top)  
Positioner controller  
SMW200A (signal source)  
FSW for V-Pol EVM measurement  
FSW for H-Pol EVM measurement



2 Polarisation  
Trumpet Antenna

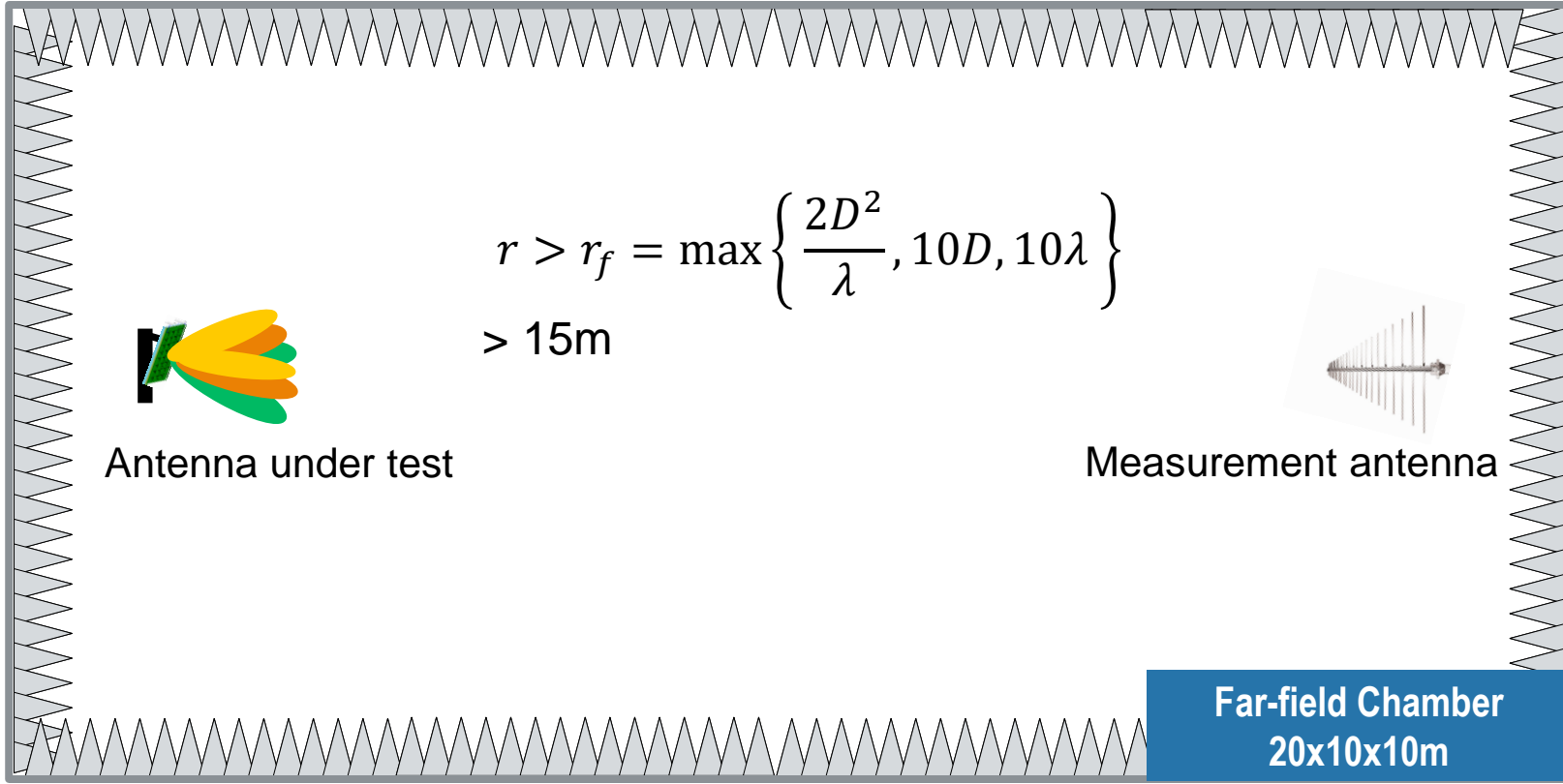


Standard Gain  
Horn Antenna



# Sub 6 GHz

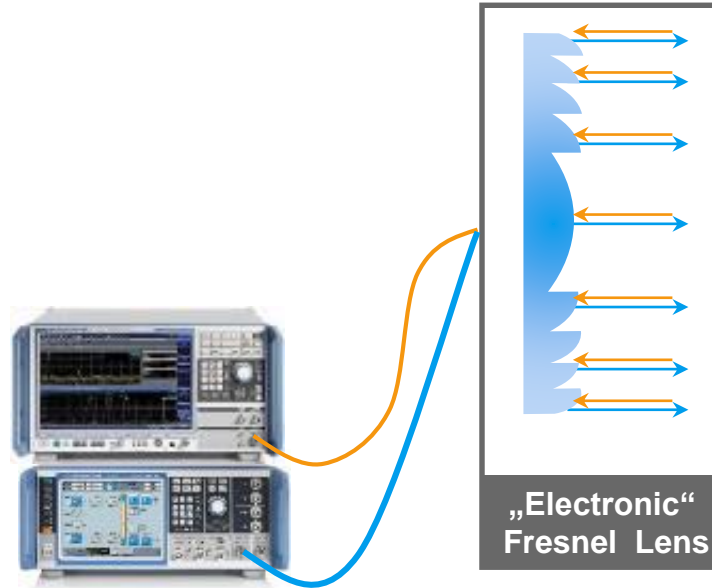
# Sub-6GHz eNB / gNB testing (DUT = 0.75x0.75m)



# PWS200: Plane Wave Synthesizer for sub 6 GHz (NR)



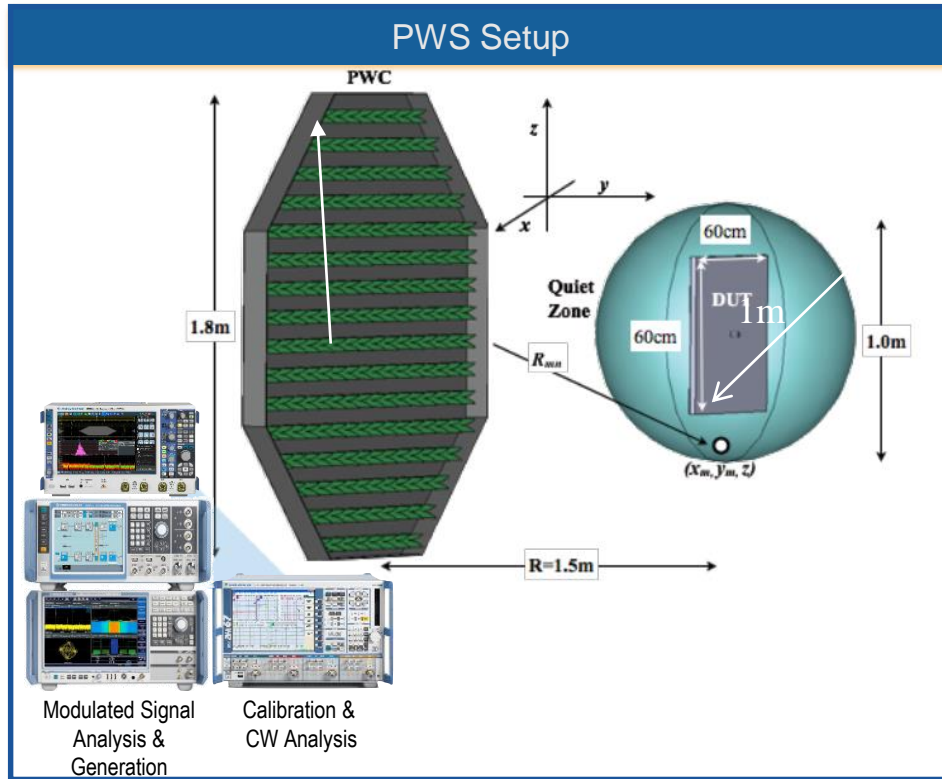
Fresnel Lens



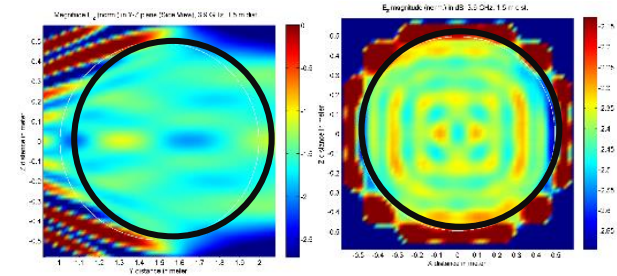
Adjustable elements



# PWS200: Plane Wave Synthesizer for sub 6 GHz (NR)

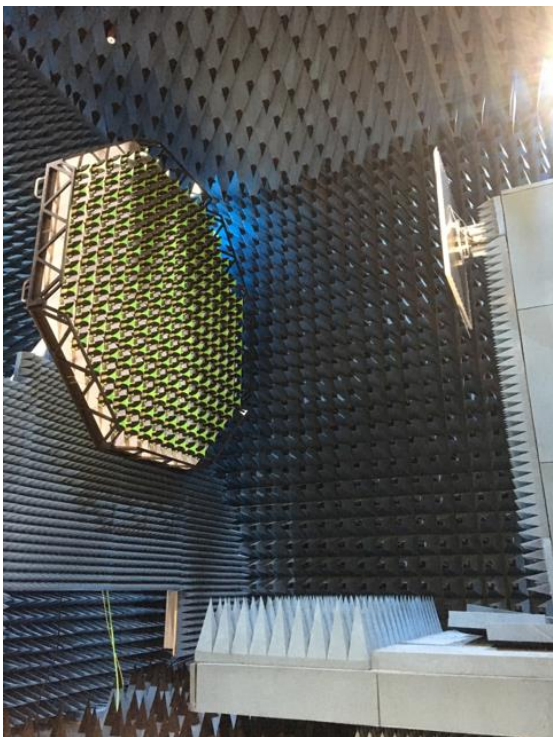


## Quiet Zone Magnitude

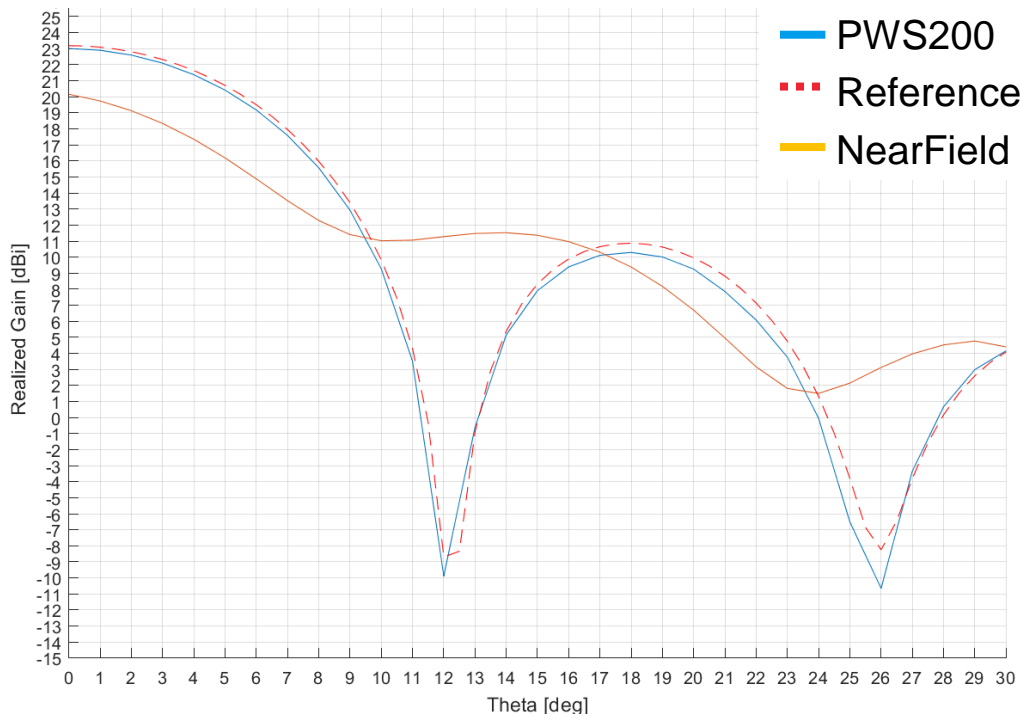


**Allows very fast measurements  
in relatively small chambers**

# R&S PWS200 first results

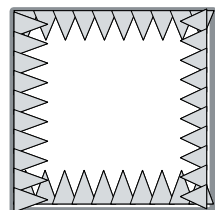


Commercial Product: Q2 2018



Far field measurement (reference) vs. PWS200  
vs. single antenna (Near Field)

# Sub-6GHz eNB / gNB testing (DUT = 0.75x0.75m)



**PWS200**  
2,5x2,5x2,5m

**Far-field Chamber**  
20x10x10m

# R&S is supporting NR in 3GPP

- R&S took over rapporteurship for NR specifications in RAN5 (including multiple work packages)
  - TS 38.521-y: RRM
  - TS 38.523-1: SIG
- R&S RAN4 NR contributions on various topics
  - FF criterion, RF baseline system, RRM baseline system, test interface, MU, ...
- ✓ With 19 delegates R&S shows its commitment to 3GPP in general and NR in particular.
- ✓ R&S ensures early monitoring of essential topics like NR in the core specification groups.
- ✓ In RAN4 and RAN5 R&S is a driving force for NR including contributions and taking over rapporteurship.







*“If you want to go fast, go alone.  
If you want to go far, go together!”*

*African proverb*

Thank you for your attention

