Turn Visions into Reality

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Industry activities and 3GPP

The battle for

enhanced Mobile Broadband (eMBB)

massive Internet of Things (mIoT)

Ultra reliable & low Latency communication (URLLC)

2 specific use cases:
- Fixed Wireless Access (FWA)
- eMBB for Olympics
LTE provides the foundation on the way to 5G

- **LTE**: A Pro + NR > 24 GHz
- **eMBB (URLLC)**: LTE-A Pro + NR < 6GHz
- **mIoT**: NB-IoT < 1GHz

**Key Features**
- Carrier Aggregation
- Low Latency
- Dual Connectivity
- Power Saving
- Increased Coverage

**Diagram**
- EPC → NGC
- Carrier Aggregation
- V2X
- Power Saving
- Increased Coverage

**Notes**
- LTE provides the foundation for 5G
- 5G technologies build upon LTE
- EPC (Evolved Packet Core) transitions to NGC (Next Generation Core)

**Image**
- Diagram showing the evolution from LTE to 5G with different use cases and features.
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

Wide Range of Chambers

AMS32 Software

EMC and OTA Chambers
ATS1000

High reliability and compact solution for mmW UE / chipset testing
System components

- Wheel-mounted movable chamber – goes through doors

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

COMPANY RESTRICTED
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

![Diagram showing gain pattern cuts](image_url)
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

3D EIRP pattern

3D EVM pattern

Beam peak EVM view

Standard Gain Horn Antenna

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

\[ r > r_f = \max \left\{ \frac{2D^2}{\lambda}, 10D, 10\lambda \right\} \]

> 15m

Antenna under test

Measurement antenna

Far-field Chamber
20x10x10m
PWS200: Plane Wave Synthesizer for sub 6 GHz (NR)

Fresnel Lens

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

PWS Setup

Modulated Signal Analysis & Generation

Calibration & CW Analysis

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)
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