

Product	Development of RF and baseband	Development of protocol stack	Verification and conformance tests	Production and service	Network deployment and optimization
<b>Signal generation</b>					
R&S®SMW200A vector signal generator with optional fading simulator	FWA, eMBB, NB-IoT		FWA, eMBB, NB-IoT		
R&S®SGT100A SGMA vector RF source	NB-IoT		NB-IoT	NB-IoT	
<b>Signal and spectrum analysis</b>					
R&S®FSW signal and spectrum analyzer	FWA, eMBB, NB-IoT		FWA, eMBB, NB-IoT		
R&S®FS-K96 OFDM vector signal analysis	FWA		FWA		
R&S®VSE-K106 NB-IoT vector signal explorer software	NB-IoT		NB-IoT		
R&S®FSW-K18 amplifier measurements	FWA, eMBB		FWA, eMBB		
<b>Network analysis</b>					
R&S®ZNB/ZNBT/ZVA vector network analyzers	eMBB		eMBB		
<b>Power measurements</b>					
R&S®NRPM OTA power measurement solution	eMBB		eMBB	eMBB	
R&S®NRP power sensor family	eMBB, NB-IoT		eMBB, NB-IoT	eMBB, NB-IoT	
R&S®RT-ZVC04 multichannel power probe	NB-IoT			NB-IoT	
<b>Wireless communications testing</b>					
R&S®CMW500 wideband radio communication tester	NB-IoT	NB-IoT	NB-IoT		
R&S®CMWrun battery life measurements	NB-IoT				
R&S®CMW-KM052 IP connection security analysis for R&S®CMW500	URLLC				
R&S®TS8991 OTA performance test system	FWA, eMBB, NB-IoT		FWA, eMBB, NB-IoT		
R&S®AMS32 OTA measurement software	eMBB		eMBB		
<b>Mobile network testing</b>					
R&S®TSME ultra-compact drive test scanner					FWA
R&S®ROMES drive test software					FWA
<b>System components and shielded chambers</b>					
R&S®TS7124 RF shielded box	eMBB, NB-IoT		eMBB, NB-IoT	eMBB, NB-IoT	
R&S®DST200 RF diagnostic chamber	eMBB, NB-IoT		eMBB, NB-IoT		
R&S®ATS1000 antenna test system	eMBB		eMBB		
R&S®OSP open switch and control platform	FWA, eMBB		FWA, eMBB	FWA, eMBB	

## Service that adds value

- | Worldwide
- | Local and personalized
- | Customized and flexible
- | Uncompromising quality
- | Long-term dependability

## About Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, this independent company has an extensive sales and service network and is present in more than 70 countries. The electronics group is among the world market leaders in its established business fields. The company is headquartered in Munich, Germany. It also has regional headquarters in Singapore and Columbia, Maryland, USA, to manage its operations in these regions.

## Sustainable product design

- | Environmental compatibility and eco-footprint
- | Energy efficiency and low emissions
- | Longevity and optimized total cost of ownership

Certified Quality Management  
**ISO 9001**

Certified Environmental Management  
**ISO 14001**

## Rohde & Schwarz GmbH & Co. KG

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Be ahead in 5G.  
Turn visions  
into reality.

Test solutions  
for 5G



[www.rohde-schwarz.com/5G](http://www.rohde-schwarz.com/5G)

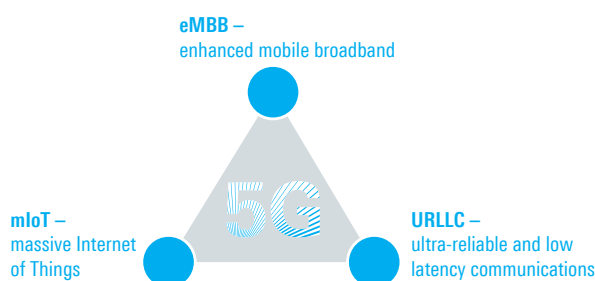


# Be ahead in 5G.

## Turn visions into reality.

**At Rohde & Schwarz, your test and measurement challenges are our motivation to provide solutions for your success.**

Up to now, concrete and confined use cases such as mobile voice for 2G and mobile data for 4G dominated the definition of cellular technologies. The next generation of mobile networks, 5G, introduces a paradigm change towards a user- and application-centric technology framework, aiming to flexibly support three important use case families:



eMBB focuses on the ever increasing end user data rate and system capacity support, while mIoT targets the cost-efficient connection of billions of devices without

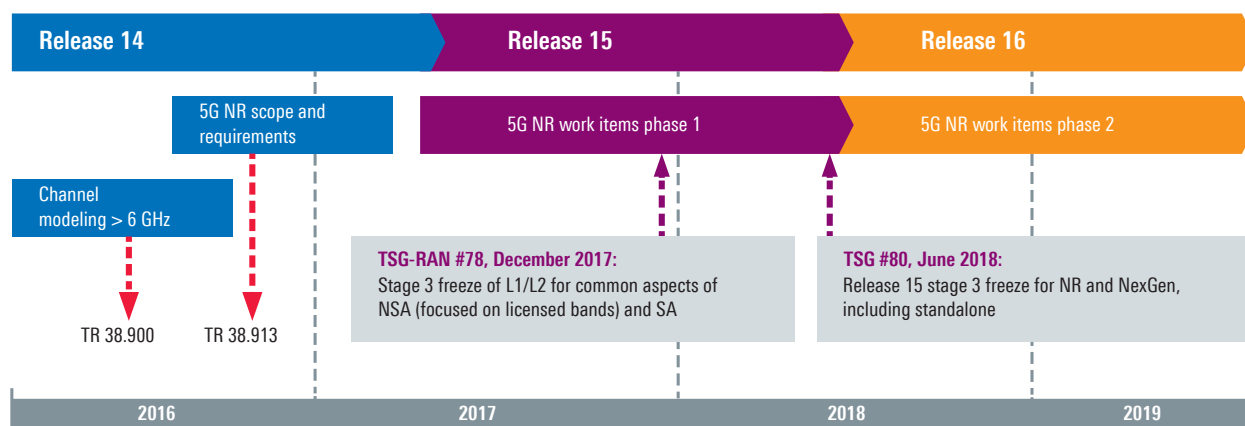
overloading the network. With URLLC, 5G opens up an entirely new use case family by supporting new requirements out of vertical industries such as autonomous driving for the automotive industry, remote surgery for eHealth and cloud robotics for Industry 4.0.

All three use case families require new technology components – from components and chipsets to assembled user devices and base stations – that challenge product development. The cellular network installation in the field also sets new demands. 3GPP, the responsible standardization body, will initially cover 5G specification work in two successive releases: 3GPP Release 15 and 16. Pre-5G systems are being implemented ahead of the 3GPP 5G specifications. These systems address specific scenarios such as fixed wireless access (FWA) for last mile connections of households and eMBB use cases to support mobility based on tightly coupled LTE interworking.

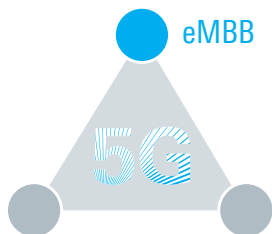
### Be ahead in 5G device and infrastructure equipment testing

Technological innovations combined with close and trustworthy customer relationships lead to innovative test and measurement solutions that allow customers to launch their products more quickly and safely. Rohde & Schwarz was one of the first to generate and analyze pre-5G signals that operate in the 28 GHz (or 39 GHz) frequency band and apply a cyclic prefix OFDM-based waveform with 75 kHz subcarrier spacing. Both the R&S®SMW200A and the R&S®FSW provide outstanding capabilities, achieving an EVM performance of 1 % over a 10 dB power range. Pre-5G coverage measurements are also available with R&S®ROMES and the R&S®TSME.

### 3GPP specifies two major architecture options: non-standalone (NSA) and standalone (SA) operation



# Be ahead in mobile broadband



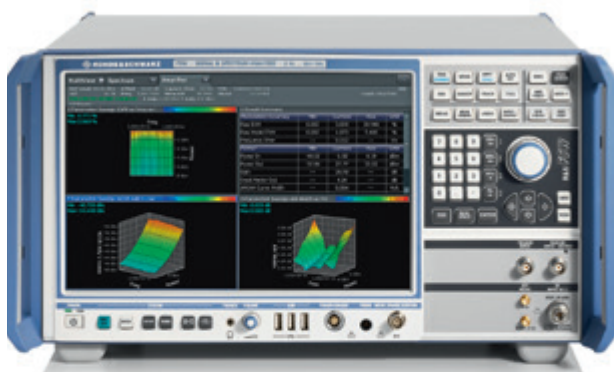
eMBB introduces two major technology enhancements: shifting the frequency spectrum to the cmWave and mmWave range for much higher bandwidth allocations and an advanced antenna system that includes tens or even hundreds of TX/RX antenna elements to enable massive MIMO.

## Efficient mmWave component testing

Far higher frequency bands with high bandwidth place challenging demands on components such as filters, mixers, power amplifiers and antennas that are used in mobile devices and infrastructure systems. To efficiently and reliably characterize these components, measurement systems must offer wide frequency coverage, high dynamic range, high output power, signal stability and signal quality with as little distortion and as few harmonics as possible.

The R&S®ZNB / ZNBT / ZVA vector network analyzers are ideal for demanding component characterization. To generate and analyze wideband signals, the R&S®SMW200A together with the R&S®SZU100A and the R&S®FSW are the instruments of choice. Power amplifiers are crucial to link performance, particularly in cmWave and mmWave frequency bands. The R&S®FSW-K18 uses CW and modulated stimuli to characterize power amplifiers (PA) in detail, efficiently determining amplifier KPIs such as EVM, AM/AM plus AM/PM conversion and gain compression from a single measurement.

Powerful solution to generate and analyze wideband signals for characterizing demanding components such as power amplifiers.



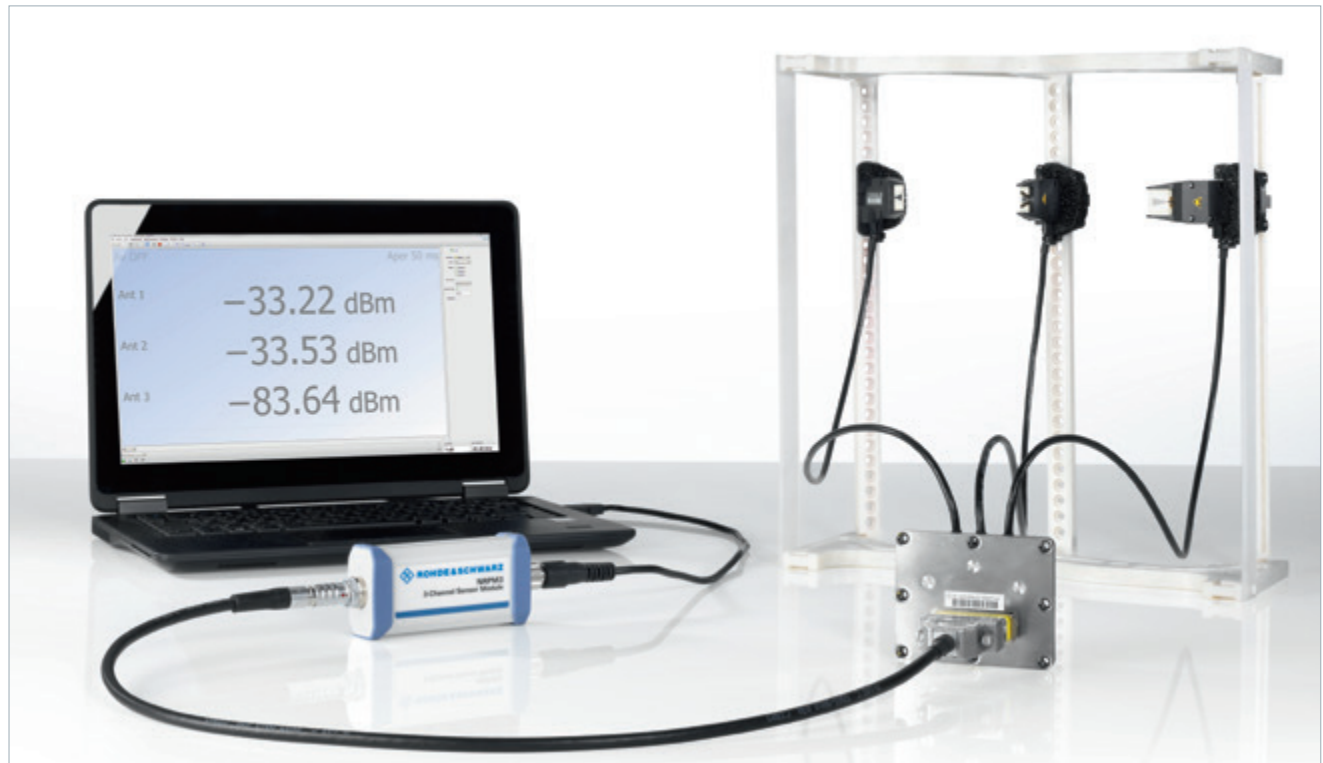
## Accurate antenna testing for massive MIMO

The two basic capabilities of massive MIMO are flexibly applied in real-world networks. Its high number of antenna elements with the associated amplifiers plus baseband and analog phase shifters support multiple spatial data streams as well as multiple and steerable beam patterns. Initially, massive MIMO is applied at base stations. Basic beamforming schemes can also be implemented in user devices in order to compensate for the high path loss in the cmWave and mmWave spectrum.

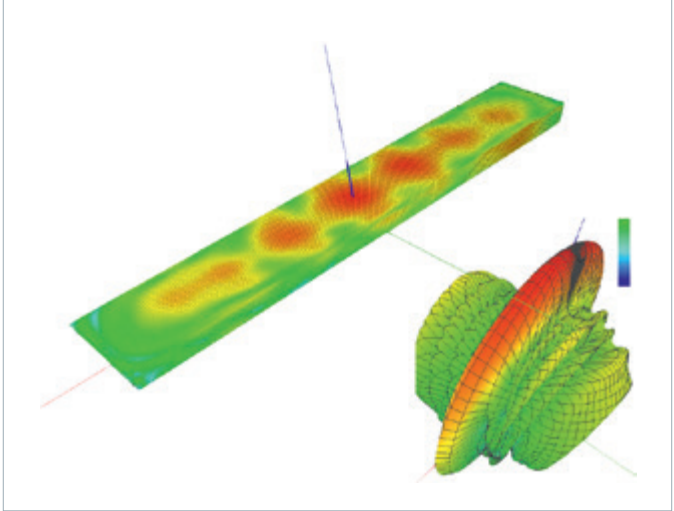
Testing massive MIMO requires a paradigm change since RF connectors are generally not available anymore. The test challenges include calibrating over the air (OTA) antenna elements, measuring mutual coupling between the elements and characterizing the desired beam pattern.

Rohde&Schwarz was the first to offer an over-the-air test solution with the R&S®TS8991 OTA performance test system for beam pattern measurements. Its capability to transform near-field to far-field considerably decreases the size of the shielding chambers for active antenna arrays (AAS). Designed for all mmWave systems operating in the 27.5 GHz to 75 GHz range, the R&S®NRPM OTA power measurement solution is ideal for performing fast and accurate realtime beam-steering and beam-tracking measurements in production environments.

Fast and accurate realtime OTA power measurements in production.

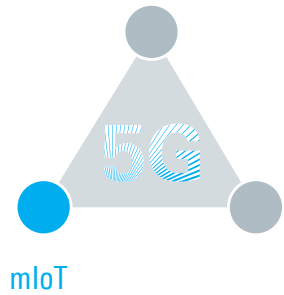


## Over-the-air antenna measurement



E-field visualization and accurate OTA beam pattern measurement for AAS.

# Be ahead in connecting everything



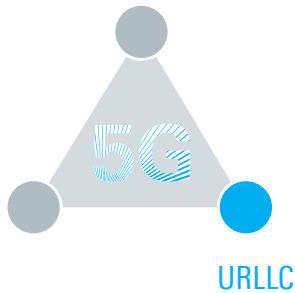
Wireless connectivity is a critical IoT success factor since expectations with respect to coverage, cost efficiency and longtime availability are extremely high. IoT applications requiring global coverage and mobility will focus on cellular technologies, especially on LTE-M and NB-IoT, and 5G in the future. IoT devices will also apply non-cellular technologies such as Bluetooth®, WLAN/Wi-Fi, ZigBee and Thread operating in the unlicensed frequency bands. Testing is essential in order to ensure proper functionality as well as lifetime quality and performance. Particularly the power consumption of IoT devices is critical since many IoT applications demand battery lifetimes of 10 years and more.

The R&S®SMx-K115 and R&S®SGT-K415 options together with the R&S®VSE-K106 software efficiently generate and analyze NB-IoT signals. Monitoring the impact of the application processor or the baseband chip on the total power consumption of an IoT device is also essential. The unique and cost-efficient solution consisting of the R&S®CMWrun software and the R&S®RT-ZVC04 power probe precisely measures power and current on IoT devices.



Precise power and current measurements on IoT devices.

# Be ahead in network and mobile endpoint security



URLLC use cases drive the need to improve latency, reliability, availability and security to enable, for example, industrial control and tactile Internet applications. Shorter latency or higher reliability and availability require intensified testing and verification processes. Especially security plays an important role in many scenarios.

Rohde&Schwarz is the first to offer a solution, and has integrated IP connection security analysis into its established R&S®CMW500 wideband mobile communication tester. This enables mobile communications and IoT device manufacturers for the first time to identify vulnerabilities in the IP connection security under controlled network conditions in the lab. Development engineers can now improve the IP connection security of their devices at an early stage of development.

This test functionality is based on the field-tested R&S®PACE2 software from Rohde&Schwarz Cybersecurity and detects and analyzes the IP data stream in realtime. The IT security solutions from Rohde&Schwarz Cybersecurity protect companies and public institutions worldwide against espionage and cyberattacks.

[www.cybersecurity.rohde-schwarz.com](http://www.cybersecurity.rohde-schwarz.com)

