

5G is now

RETHINK 5G DEVICE TESTING

Fifth generation mobile communications (5G) is the first communications standard designed to support a wide variety of consumer and industry applications. More flexibility typically means more variants, more options and higher complexity. This will have high impact on the development process from early design phases to device manufacturing. Especially advanced RF interfaces with antenna arrays operating in the mmWave range will make test setups and procedures even more challenging.



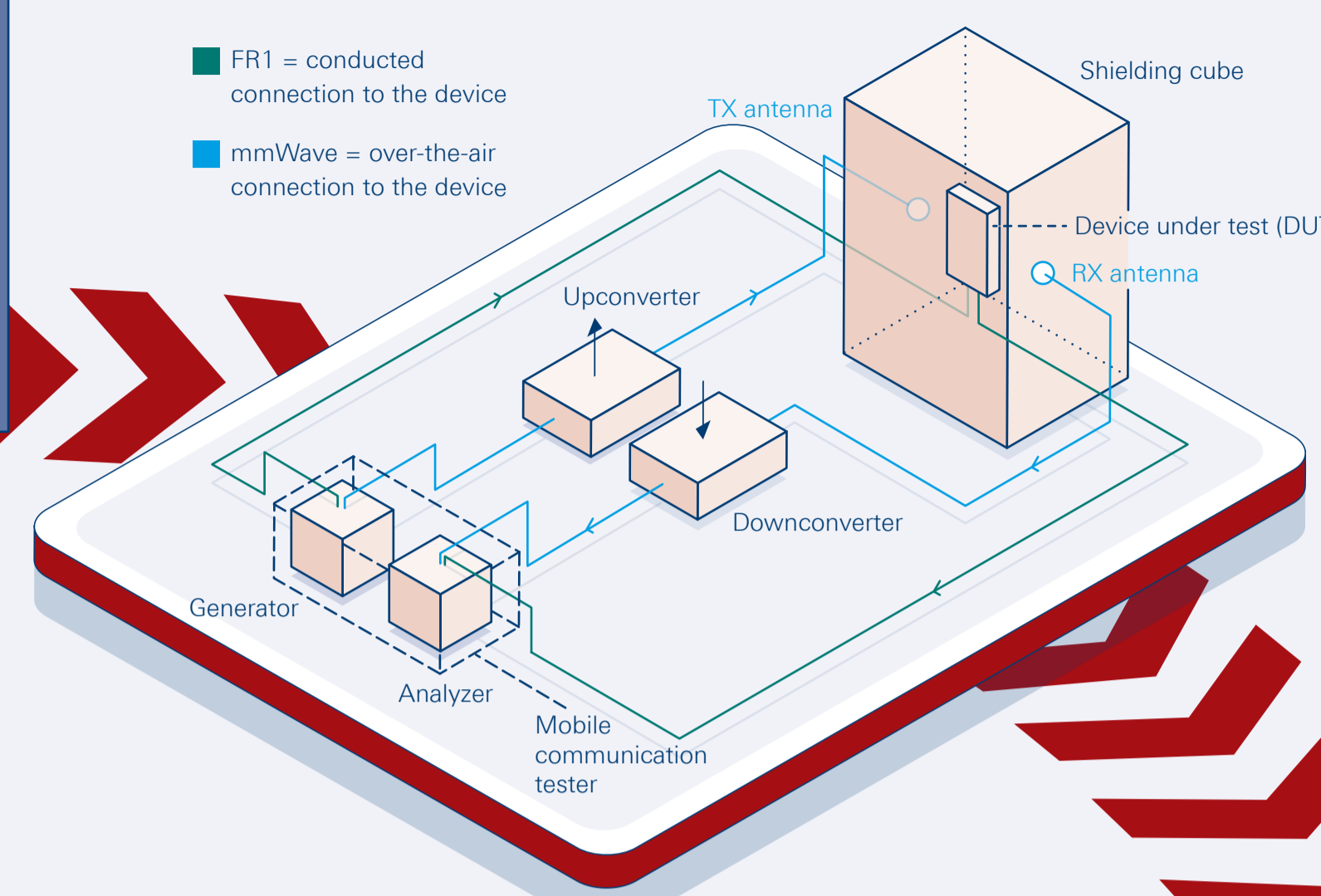
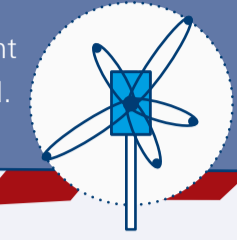
Learn more about mobile device testing:
<https://www.rohde-schwarz.com/mobile-device-testing>

Opportunities and Challenges for 5G technology: 3GPP Release 15 laid the foundation for 5G NR by introducing new, flexible numerology, advanced channel coding and modulation schemes to enable wider channel bandwidths and extended carrier aggregation schemes while also extending frequencies into the millimeterwave range to make more radio resources available.

	Opportunities	Challenges
mmWave	<ul style="list-style-type: none"> Higher bandwidth → higher data rates 	<ul style="list-style-type: none"> Shorter distance / reduced coverage Component complexity
Beamforming	<ul style="list-style-type: none"> Better signal alignment → higher system efficiency Antenna gain 	<ul style="list-style-type: none"> Construction of antenna arrays OTA testing
Multi-connectivity	<ul style="list-style-type: none"> Higher data rate Redundancy 	<ul style="list-style-type: none"> Coexistence issues between multiple mobile communication connections
New use cases	<ul style="list-style-type: none"> New verticals 	<ul style="list-style-type: none"> Performance tests Cybersecurity

What is beamforming

Beamforming describes an antenna technology that ensures highly focused antenna directivity and improves the overall system efficiency. Unlike before, signals are now sent out in the form of targeted beams that manage the transmission power based on the current user demand.



RF measurements 1

RF testing is the first step in the testing process. It ensures that the transmit and receive entity of the device under test functions properly. In the test setup, a generator sends a standard compliant RF signal to the transmitting antenna. The device under test has to properly receive this signal. Then the device transmits a signal through the RX antenna back to the analyzer, which verifies the RF signal quality by measuring parameters such as signal power, modulation quality and spectrum emission.

Production tests 6

Success in production tests is determined by three crucial factors: footprint (dimensions of the test instruments), testing speed and energy efficiency. Production usually calls for an abundance of different test instruments which allow simultaneous testing while being highly energy efficient and having the smallest footprint possible.

Signaling test 2

In the next step, the signaling tests, it gets a bit more complex. First we combine the transmit and receive entity, i.e. the device has to react accordingly. Functional tests are executed, verifying the correct behavior of the protocol stack and even multiple mobile communication technologies can be analyzed. More complex scenarios allow testing of stress situations (interferer, fading), data application or multi-technology signaling scenarios.

Carrier acceptance tests 5

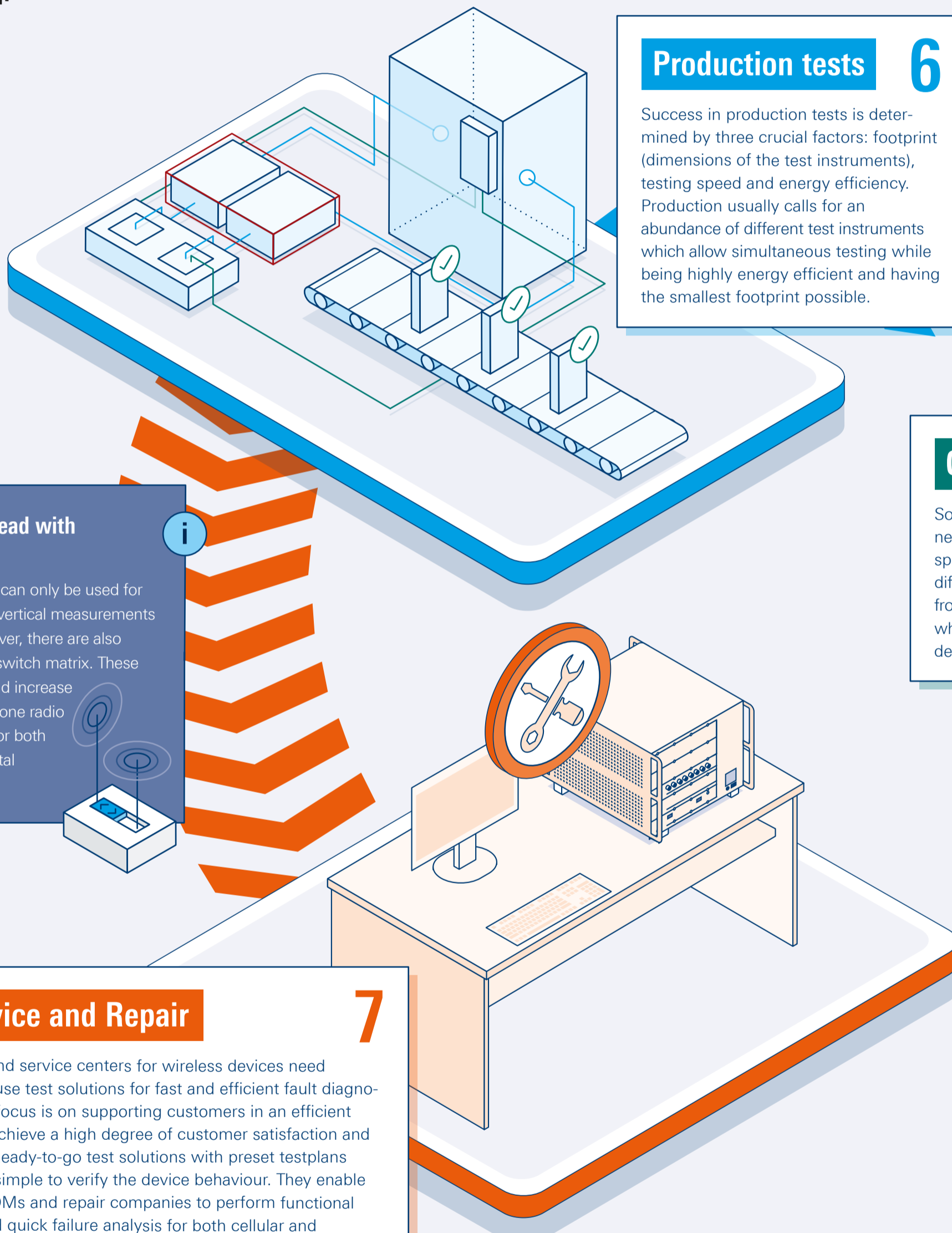
Some operators consider the device as part of their network and to ensure proper functioning, they have specified proprietary carrier acceptance tests. The difference is that GCF conformance testing analyzes from the perspective of proper standard implementation while carrier acceptance testing contemplates the device from an end user perspective.

(Pre-)Conformance tests and Conformance approval 4

Before entering the market, every device model must go through a standardized testing scenario. Standard bodies such as 3GPP specify test cases. Certification boards like GCF or PTCRB define the certification criteria. To check if your device is ready for type approval, you need to perform a rather complex (pre-)conformance test procedure in your lab. Recognized test organizations execute the conformance test procedures and provide type approval. Preconformance tests enable to eliminate divergences with the specified requirements before sending the device to a test house which saves time to market and costs.

Application performance 3

Another step that complements the signaling tests are the application tests. During this run, you will analyze detailed testing parameters to ensure that the applications within the device and network are functioning with the expected quality of experience (QoE). Application tests such as voice and IP throughput demand a different software interface than signaling tests but are performed with the same hardware setup.



Remote radio head with switch matrix

Simple radio heads can only be used for either horizontal or vertical measurements in one setup. However, there are also radio heads with a switch matrix. These are space-saving and increase efficiency, because one radio head can be used for both vertical and horizontal measurements.

Service and Repair 7

Repair and service centers for wireless devices need easy-to-use test solutions for fast and efficient fault diagnosis. The focus is on supporting customers in an efficient way to achieve a high degree of customer satisfaction and loyalty. Ready-to-go test solutions with preset testplans make it simple to verify the device behaviour. They enable OEM/ODMs and repair companies to perform functional tests and quick failure analysis for both cellular and non-cellular standards.

E2E

End-to-end testing is a technique used to test whether the flow of an application from start to finish is behaving as expected. The purpose of performing end-to-end testing is to identify system dependencies and to ensure that quality of experience and data integrity are maintained between various system components and systems.

5G one-box signaling tester	Non-signaling production testers	Vector signal generator and signal and spectrum analyzer	Conformance test system
R&S CMX500	R&S CMP200	R&S FSW	R&S TS8980 and R&S AT1800C
Extensive device testing including RF parametric, protocol and application testing from R&D to validation and pre-conformance.	Non-signaling testing for R&D and production to verify FR1 and FR2 TX/RX chains.	Accurate 5G NR FR1/FR2 signal generation with an internal modulation bandwidth of up to 2 GHz an analysis with an internal analysis bandwidth of up to 8 GHz.	RF conformance testing for 5G NR FR1/FR2 including a 3GPP-compliant CATR over-the-air (OTA) test system.

