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 variations, more options and higher complexity with a large impact on development, from early design phases to device manufacturing. 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 extending frequencies into the millimeterwave range to make more radio resources available.

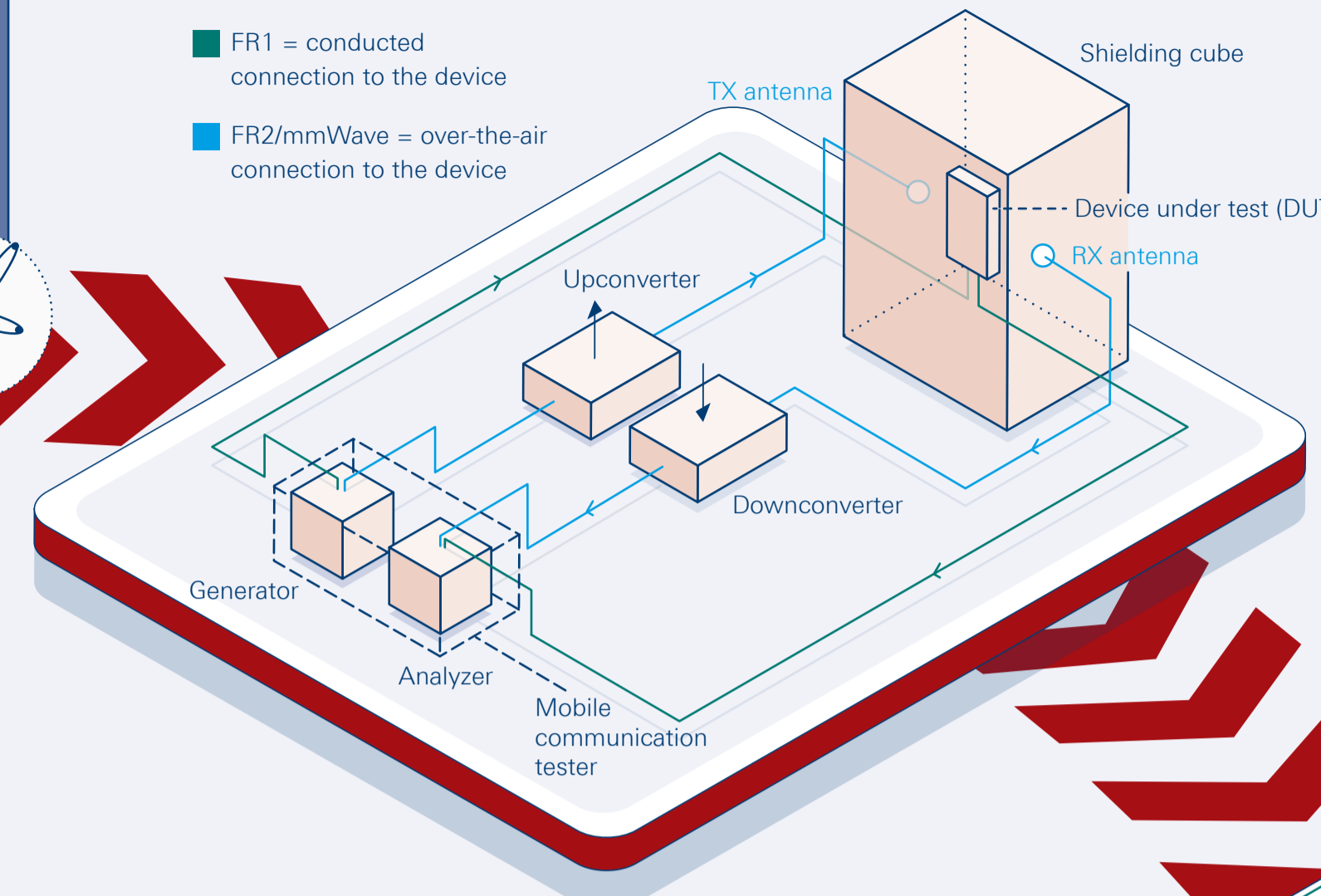|	⊕ Opportunities	! Challenges
mmWave	• Higher bandwidth → higher data rates	• Shorter distance / reduced coverage • Component complexity
Beamforming	• Better signal alignment → higher system efficiency • Antenna gain	• Construction of antenna arrays • OTA testing
Multi-connectivity	• Higher data rate • Redundancy	• Coexistence issues between multiple mobile communication connections
New use cases	• New verticals	• Performance tests • Cybersecurity

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

■ FR1 = conducted connection to the device

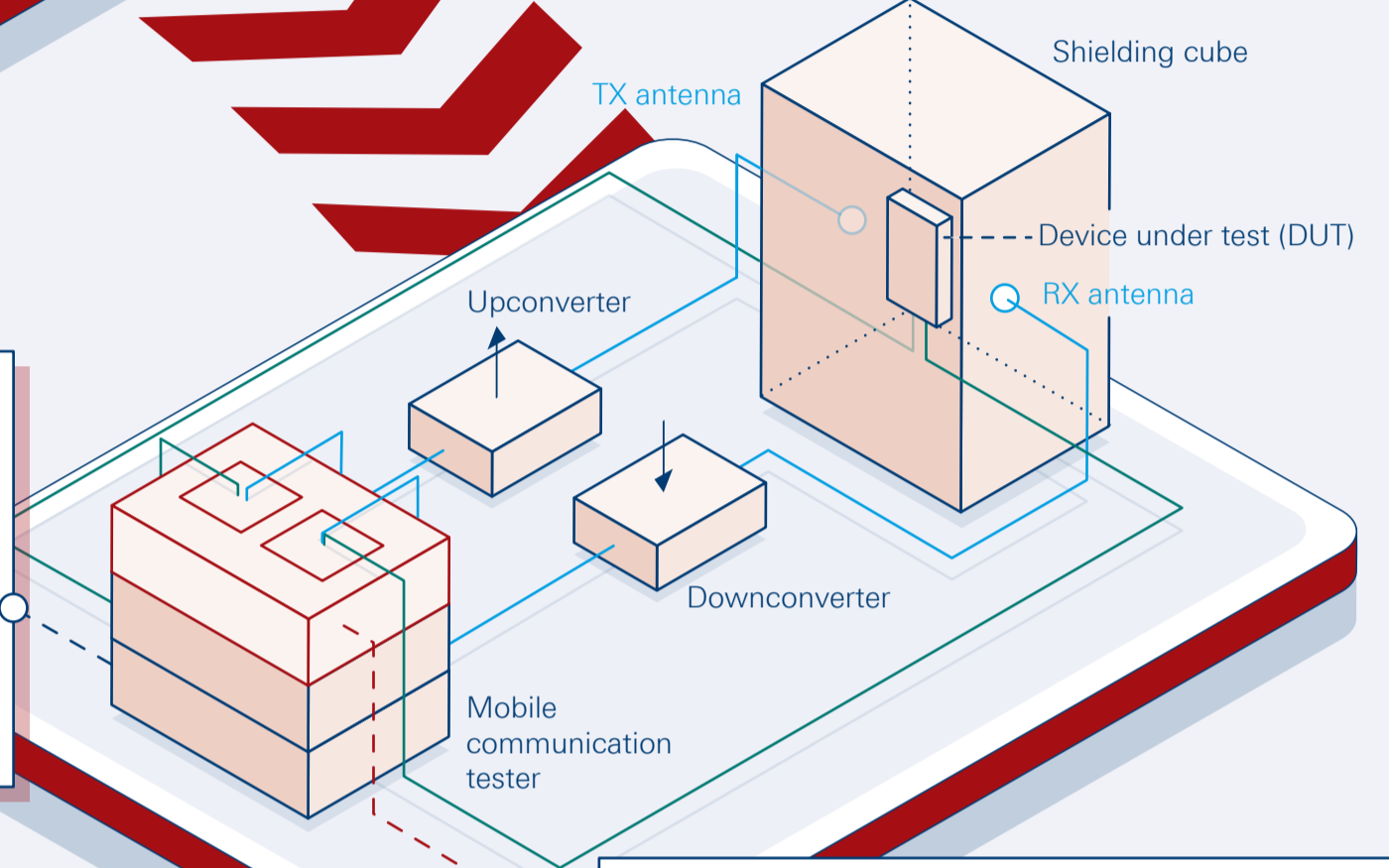■ FR2/mmWave = over-the-air connection to the device
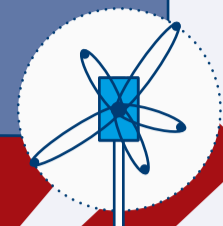
RF measurements 1
RF testing is the first step in the process. It ensures that the transmit and receive entity in the device under test (DUT) functions properly. In the test setup, a generator sends a standard compliant RF signal to the transmitting antenna. The device under test has to properly receive 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.

Labels: TX antenna, Shielding cube, Device under test (DUT), RX antenna, Upconverter, Downconverter, Generator, Analyzer, Mobile communication tester
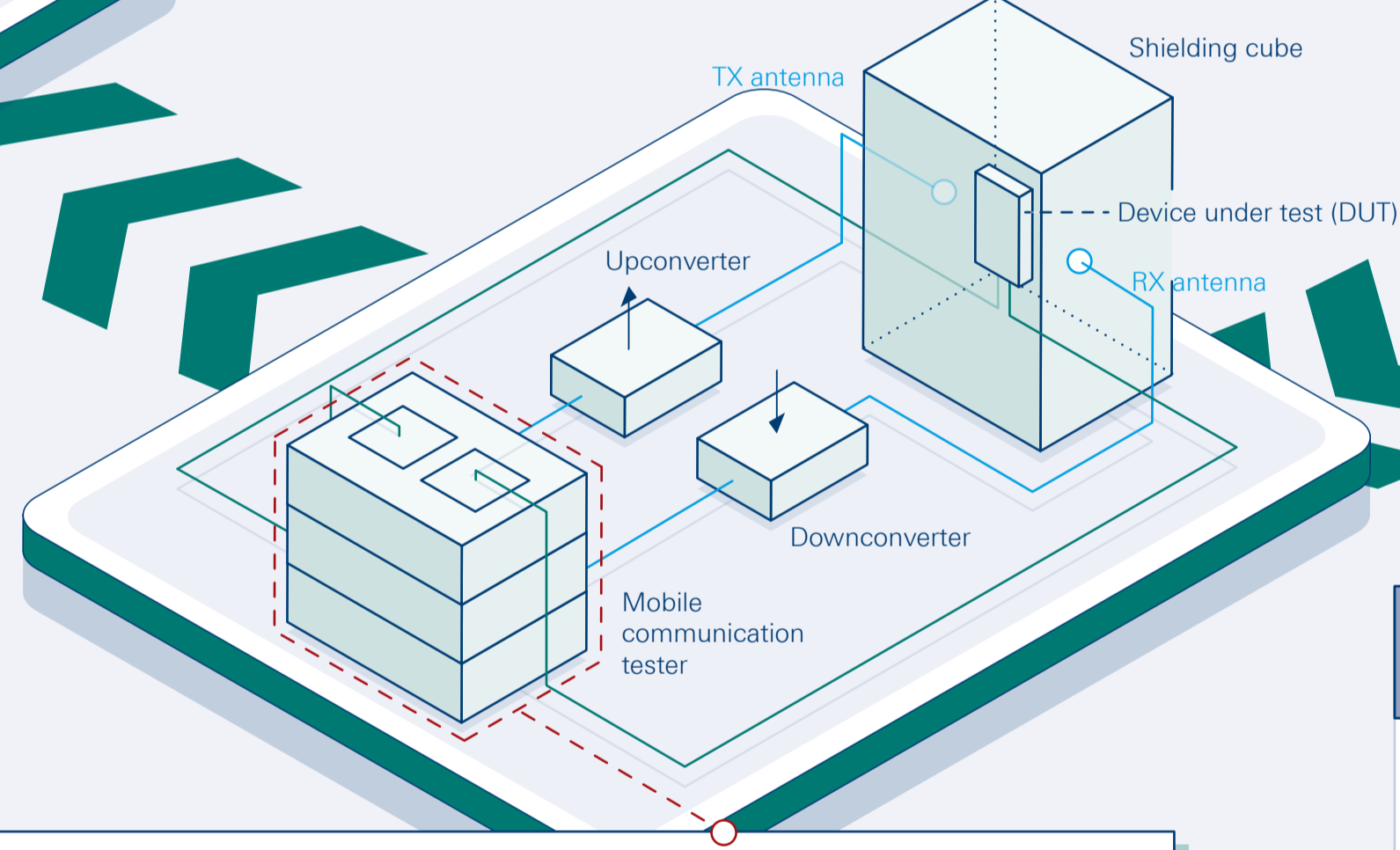
Signaling test 2
The next step in signaling testing is more complex. First the transmit and receive entities are combined and the DUT has to react properly. Functional tests are executed to verify the correct behavior of the protocol stack and even multiple mobile communications technologies can be analyzed. More complex scenarios allow testing of stress situations (interferer, fading), data applications or multi-technology signaling scenarios.

Labels: TX antenna, Shielding cube, Device under test (DUT), RX antenna, Upconverter, Downconverter, Mobile communication tester

Application performance 3
Application tests complement signaling tests. During this run, detailed tests are analyzed 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.

Production tests 6
Production testing includes non-signaling calibration and RF verification at the board/panel, module and final device levels. Automation, test time, accuracy and smooth integration into existing setups are critical. Parallel and fast multiple device testing increases production throughput while reducing power consumption and footprint.

Carrier acceptance tests 5
Some operators see the device as part of their network and make sure it functions properly. 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 sees the device from an end user perspective.

Remote radio head with switch matrix ℹ
Simple radio heads can only be used for either horizontal or vertical measurements in one setup. However, space-saving, highly efficient radio heads with a switch matrix mean one head can be used for both horizontal and vertical 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 efficient customer support for high customer satisfaction and loyalty. Ready-to-go test solutions with preset test plans make it simple to verify device behaviour. They let OEM/ODMs and repair companies perform functional tests and quick failure analysis for both cellular and non-cellular standards.

E2E ℹ
End-to-end testing is used to examine whether an application flows as expected from start to finish. The focus is on efficient customer support for high customer satisfaction and loyalty. The purpose of 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.

(Pre-)Conformance tests and Conformance approval 4
Before entering the market, every device model must undergo a standardized testing scenario. Standard bodies such as 3GPP specify test cases. Certification boards like GCF or PTCRB define certification criteria. To check if your device is ready for type approval, a fairly complex preconformance test procedure must be performed in the lab. Recognized test organizations execute conformance tests and provide type approval. Preconformance tests help eliminate divergences with specified requirements before a device is sent to a test house which saves time to market and costs.

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®CMP180 R&S®CMP200	R&S®SMW200A R&S®FSW	R&S®TS8980 and R&S®ATS1800C
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 8.3 GHz.	RF conformance, carrier acceptance and regulatory testing for 5G NR FR1/FR2 including a 3GPP-compliant CATR over-the-air (OTA) test system.

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