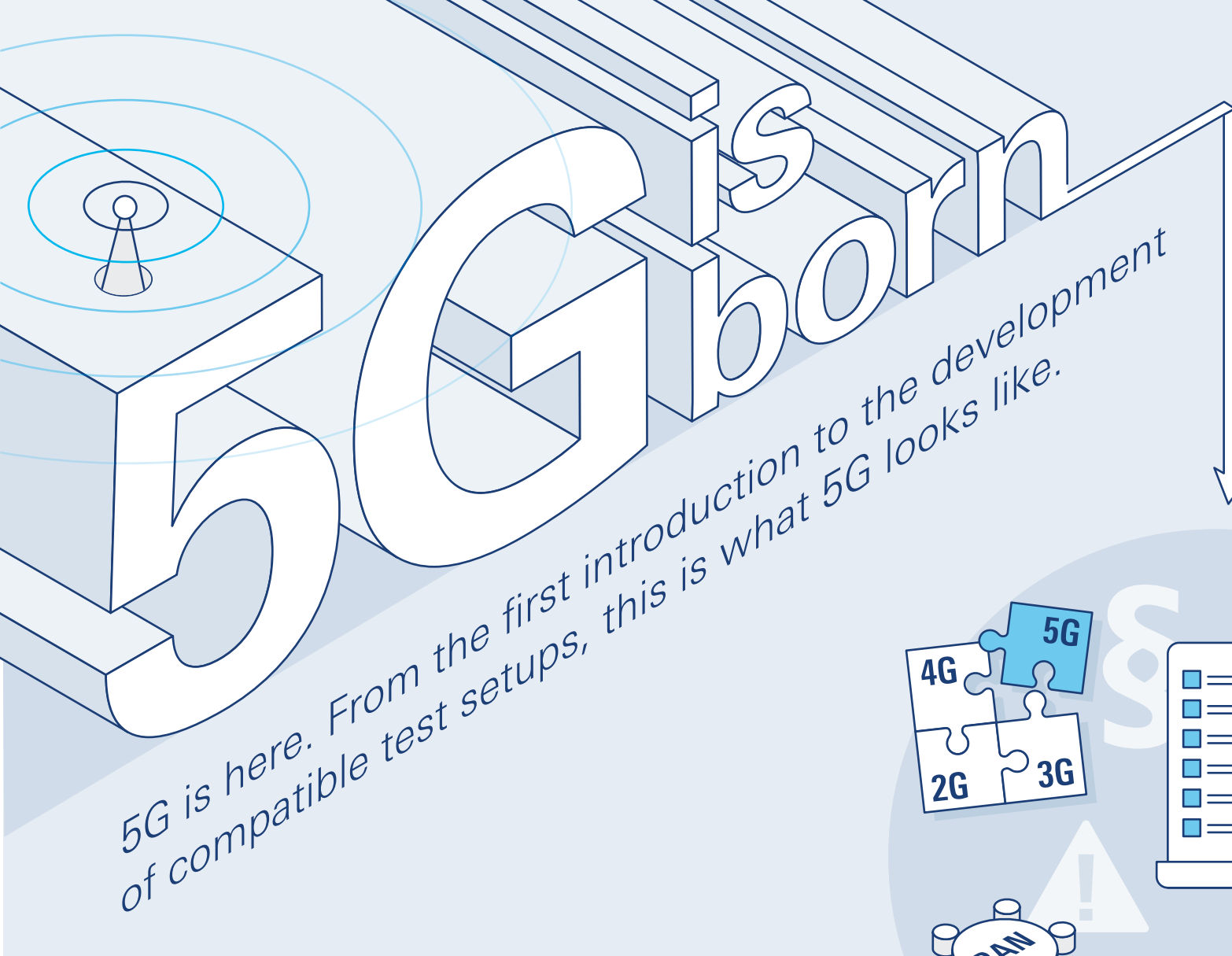
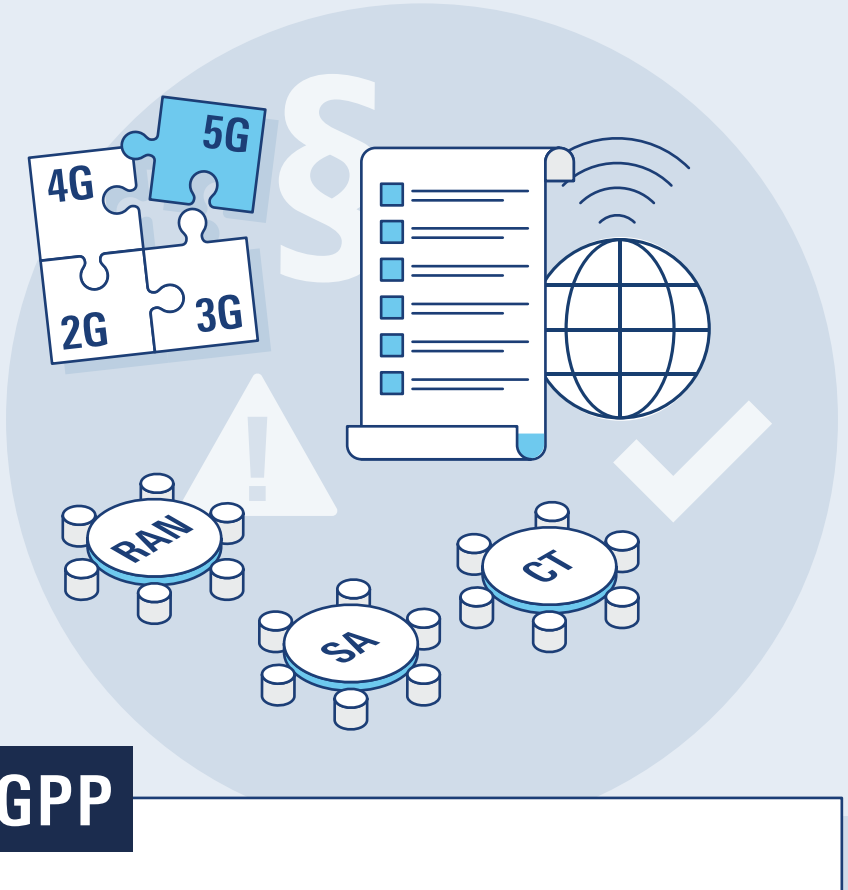


5G is here. From the first introduction to the development of compatible test setups, this is what 5G looks like.



3GPP Releases

3GPP uses a system of parallel releases to implement new features. 3GPP standardizes the GSM, UMTS, LTE and 5G NR radio access technologies. New features are introduced with new releases and co-exist with existing releases. You can find a complete list of releases since 1987 on the 3GPP portal.

3GPP

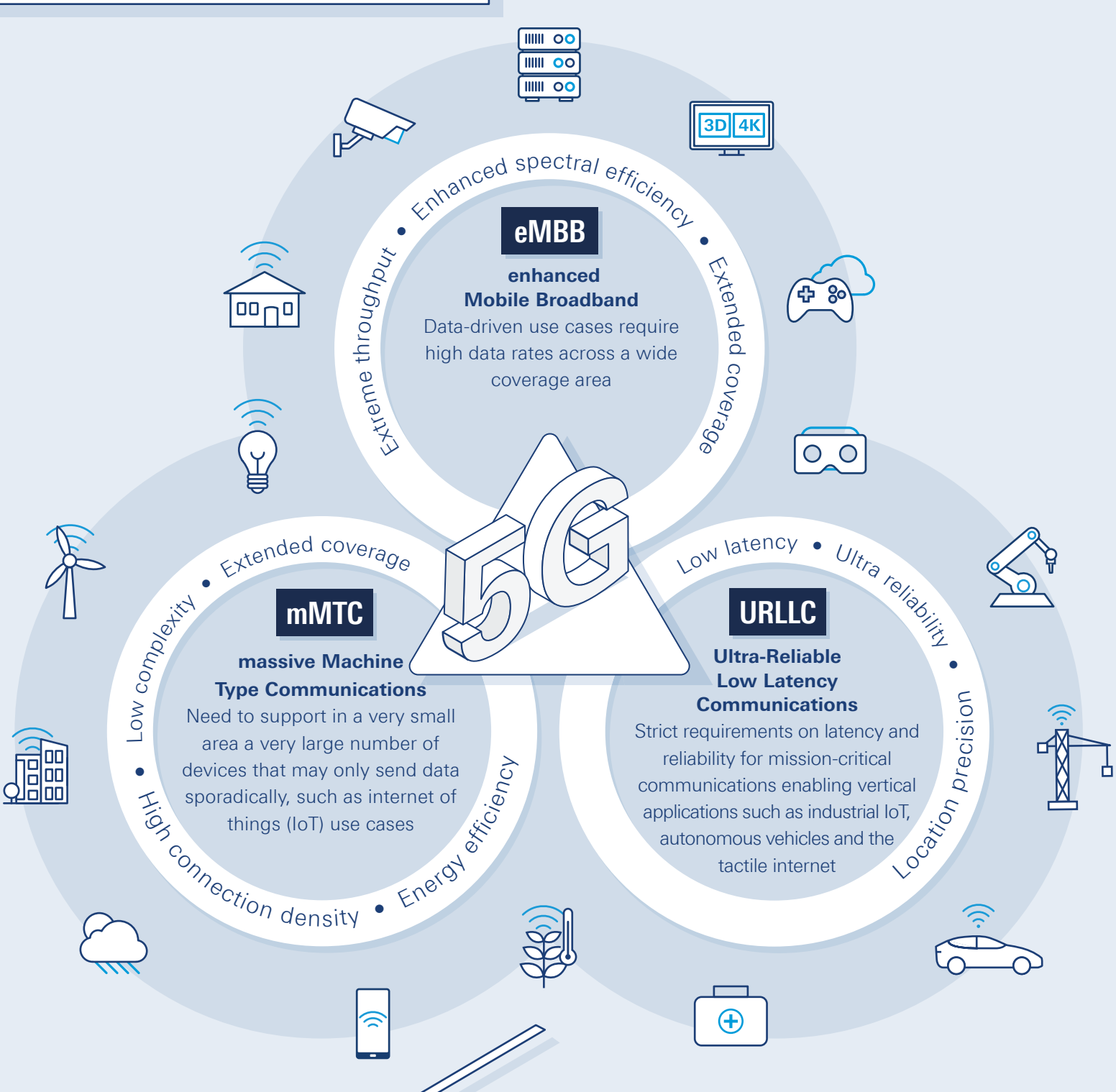
The 3rd Generation Partnership Project is a global initiative that provides its members with standardized protocols for implementing and maintaining new telecommunications technologies. To support the launch of 5G, 3GPP has developed a new radio access technology called 5G NR that is designed to become the global standard for 5G networks.

FIELDS OF APPLICATION FOR 5G

For the first time in wireless technology evolution, 5G started with the definition of use cases or verticals, ending in the famous triangle of services. This includes faster data services to end users (eMBB), quick and unlimited connection of various devices (mMTC) and reliable connections with low latency (URLLC). This will be essential for several different technologies such as autonomous driving, smart home and smart city solutions as well as virtual reality and the internet of things – including smart factories – and will enable new verticals for several industries.

5G in smart factories

5G brings smart factories to a new level. Now, machinery and products along the production line can interact in real time. Find out more about how Rohde & Schwarz is involved in smart factories in this infographic.



+ OPPORTUNITIES AND ! CHALLENGES FOR 5G DEVICES

	+ 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

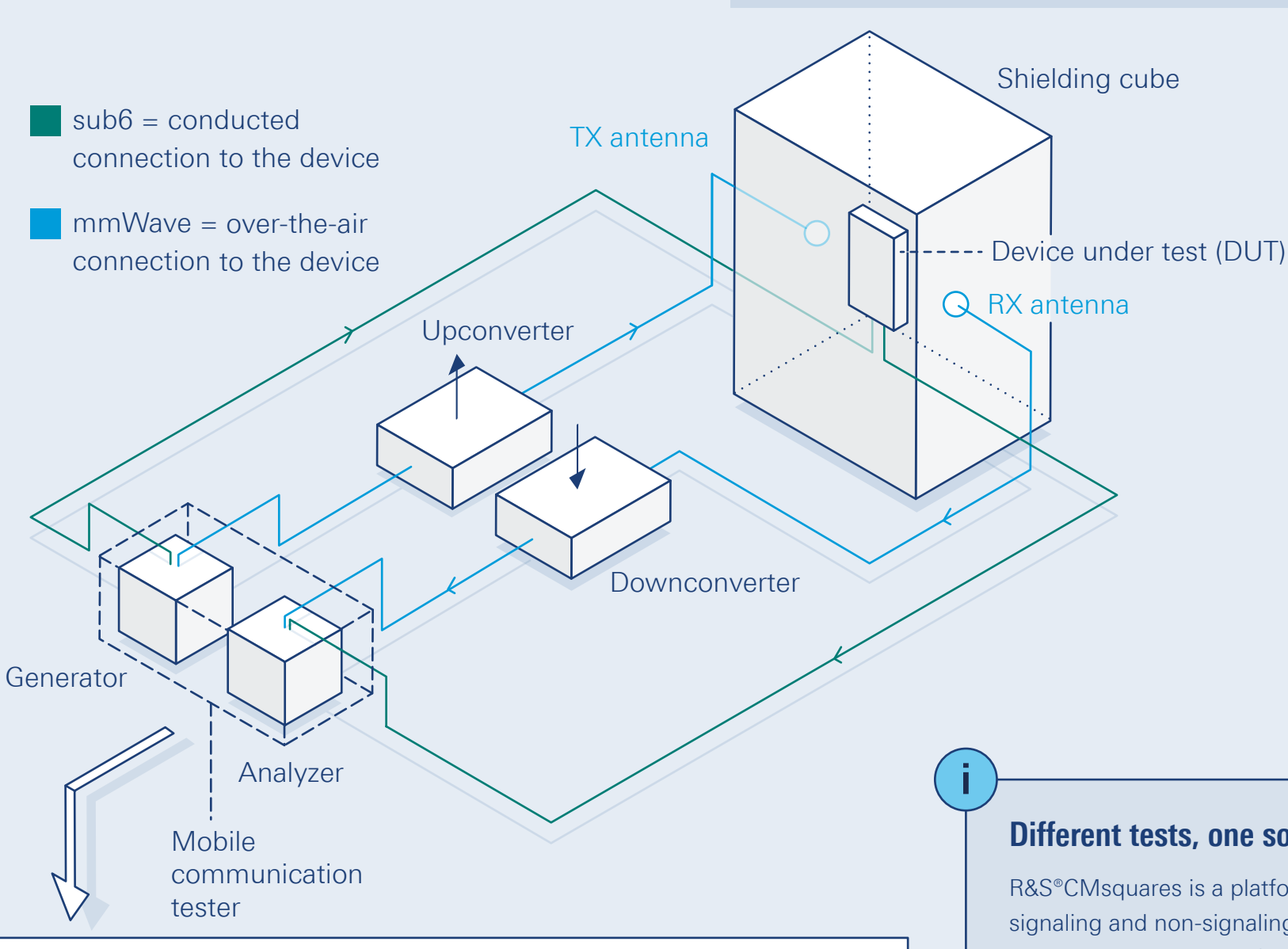
What is beamforming

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.

TESTING OF 5G DEVICES

1. RF measurements

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.

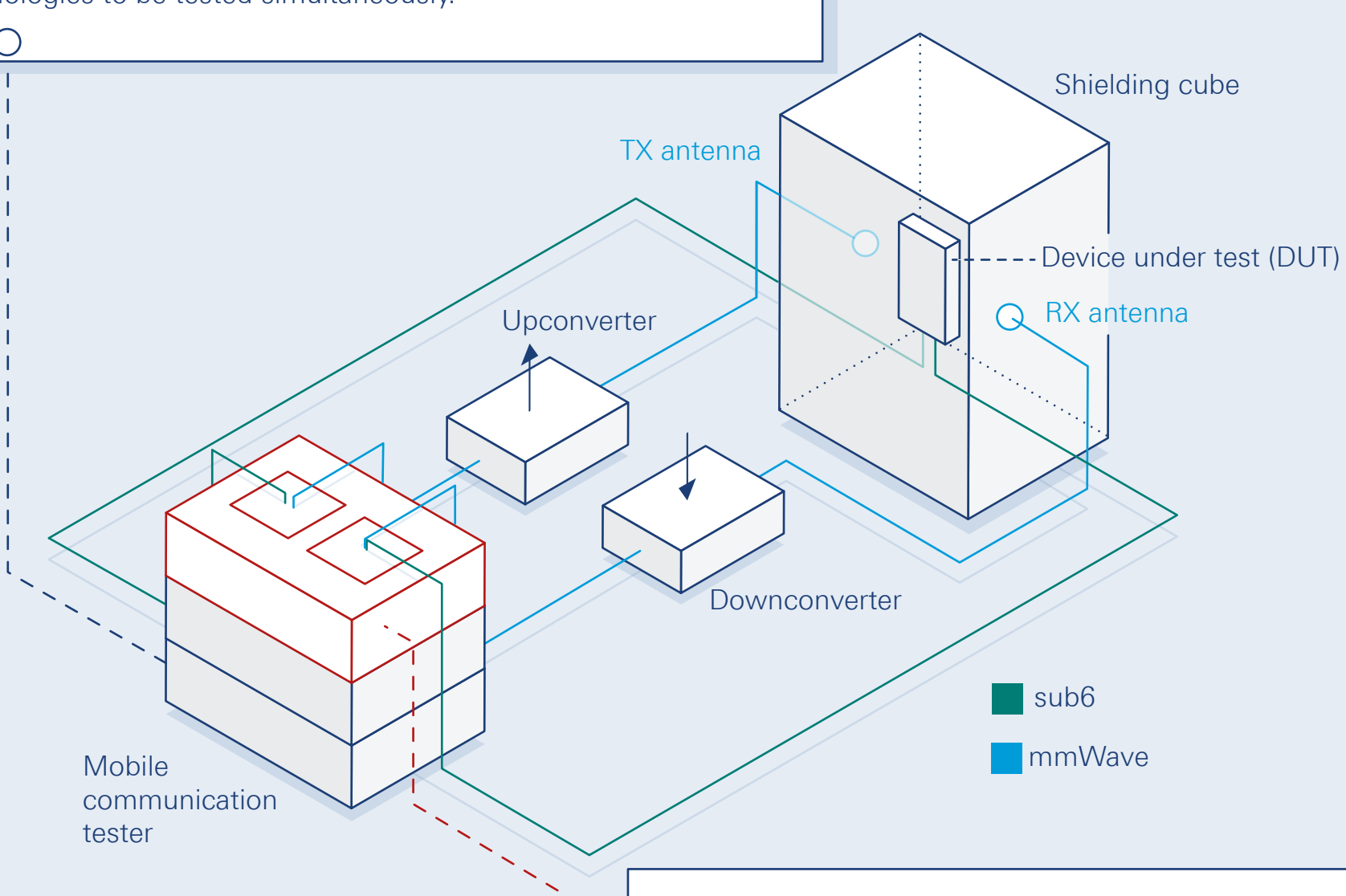


Different tests, one software

R&S®CMsquares is a platform for signaling and non-signaling tests, RF measurements, protocol verification and E2E testing.

2. Signaling tests

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 like e.g. handover. Depending on your test setup, you might need to run several mobile communication testers in parallel allowing multiple technologies to be tested simultaneously.

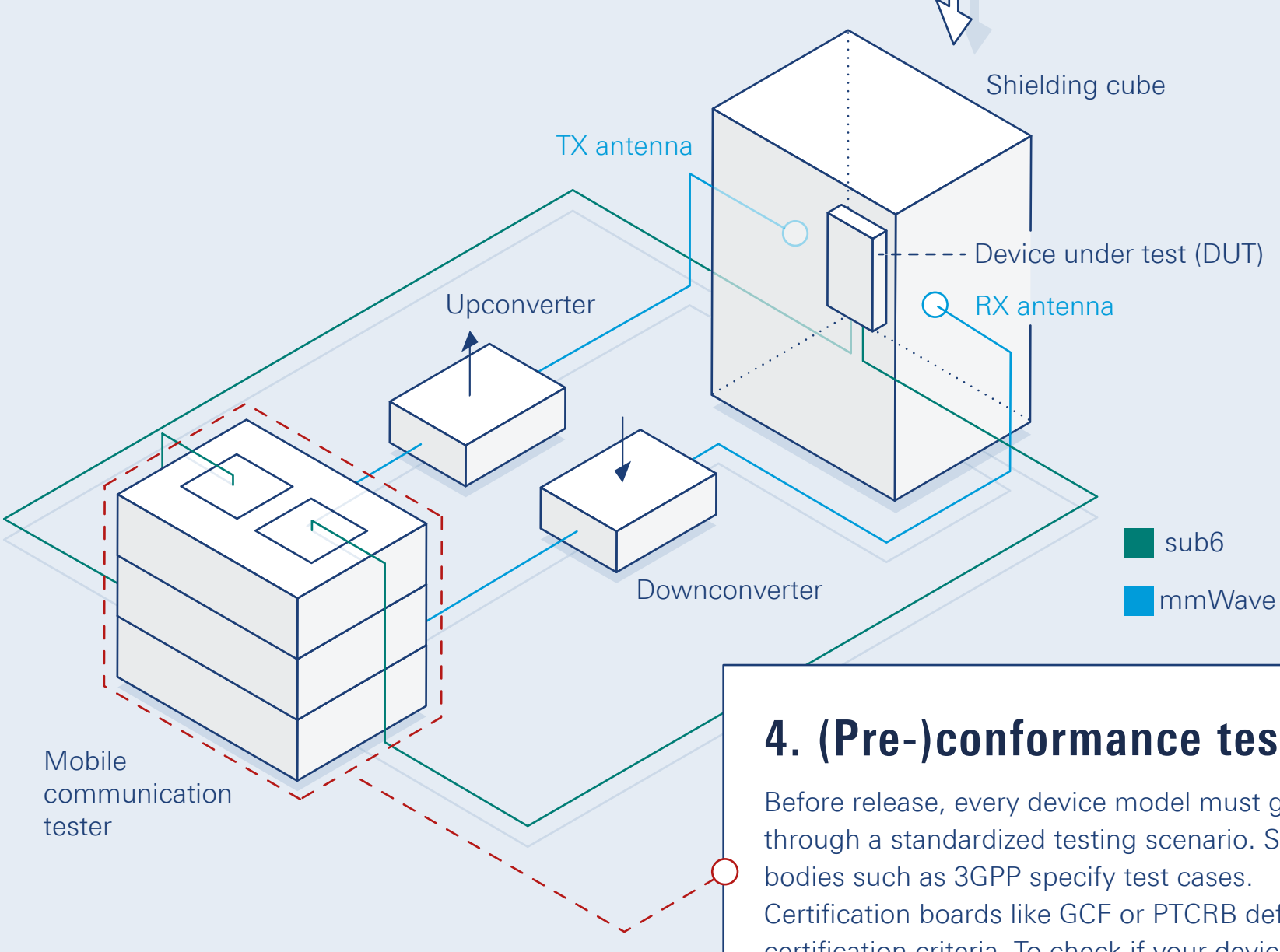


3. Application tests (E2E)

Another step that complements the signaling tests is 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 demand a different software interface than signaling tests but are performed with the same hardware setup.

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.



4. (Pre-)conformance tests

Before release, 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 test procedure. The full type approval system, which fulfills the test platform approval criteria, obviously offers highest accuracy and RF performance. Other important aspects are reliable and repeatable test results, modern analysis tools, and a upgradeable structure covering all mobile communication technologies from 2G to 5G. To enable space- and cost-saving systems, we offer a compact (pre-)conformance solution with modular structure that supports 2G to 5G mobile communication technologies.

BRINGING 5G DEVICES TO MARKET

1. Conformance approval

Before entering the market, the devices have to fulfill certification criteria defined by certification bodies such as GCF or PTCRB. Recognized test organizations execute these conformance test procedures.

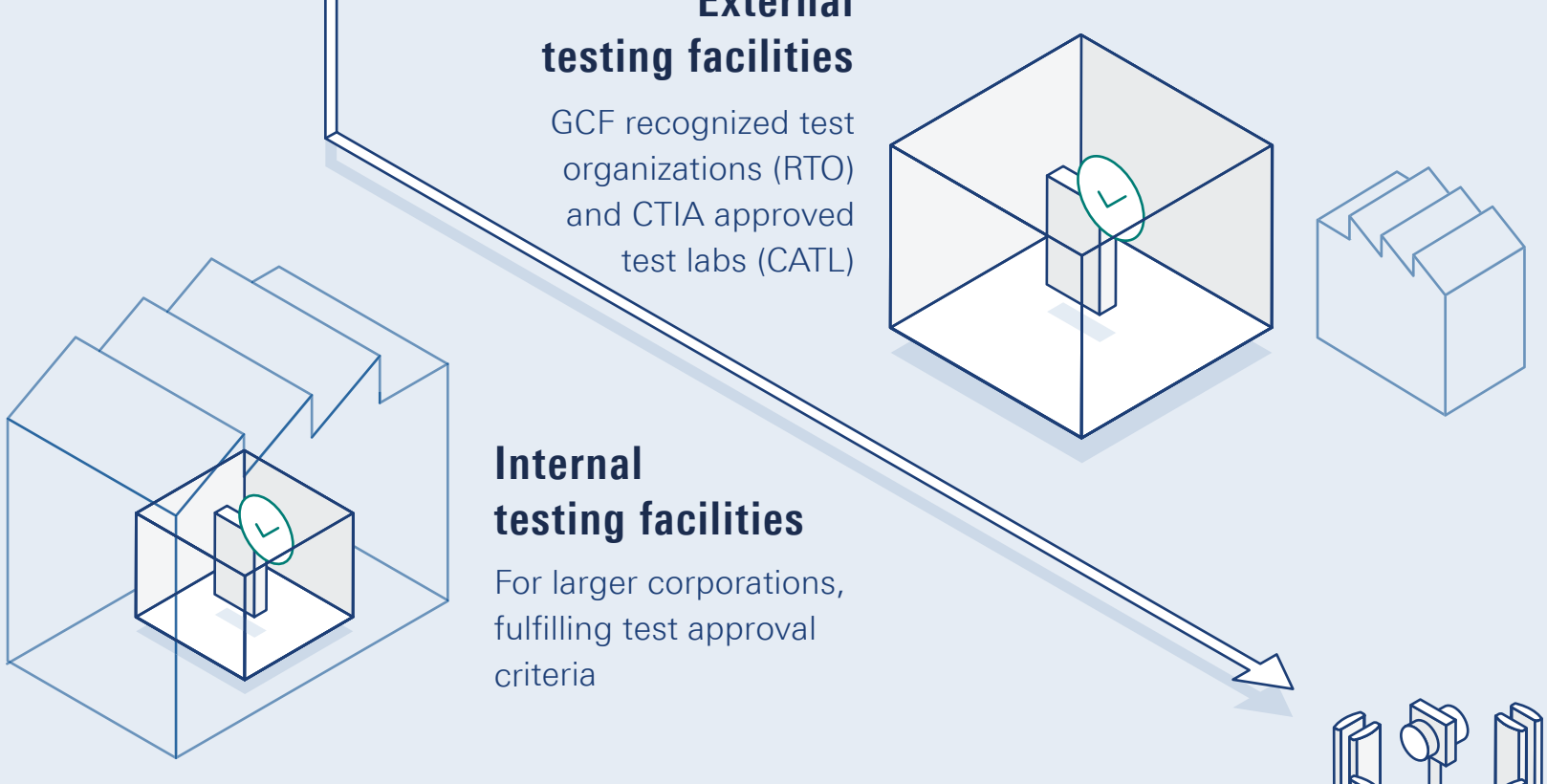
Longer time to market due to long-term resource limitation of testing facilities

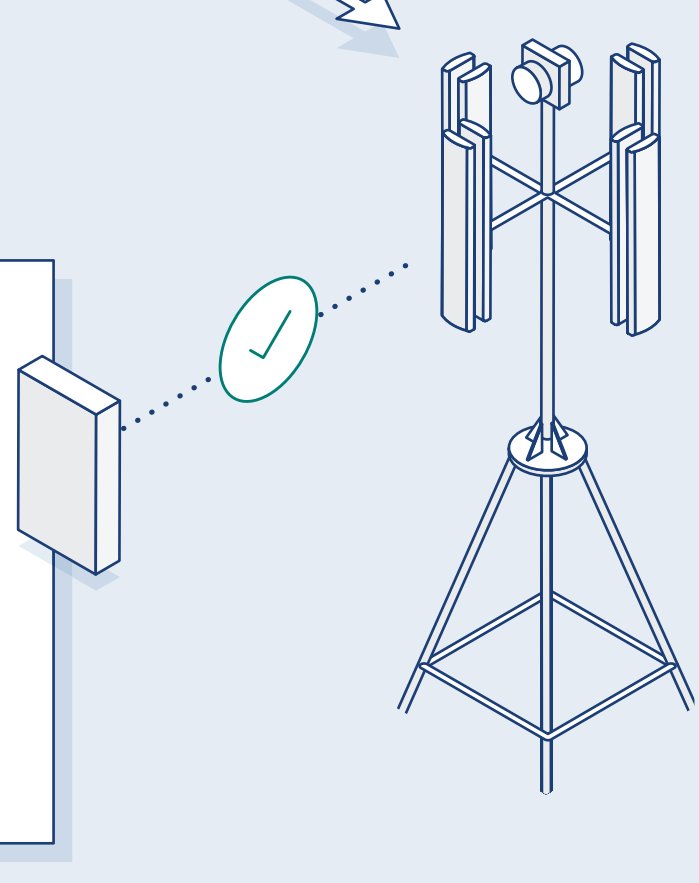
External testing facilities

GCF recognized test organizations (RTO) and CTIA approved test labs (CATL)

Internal testing facilities

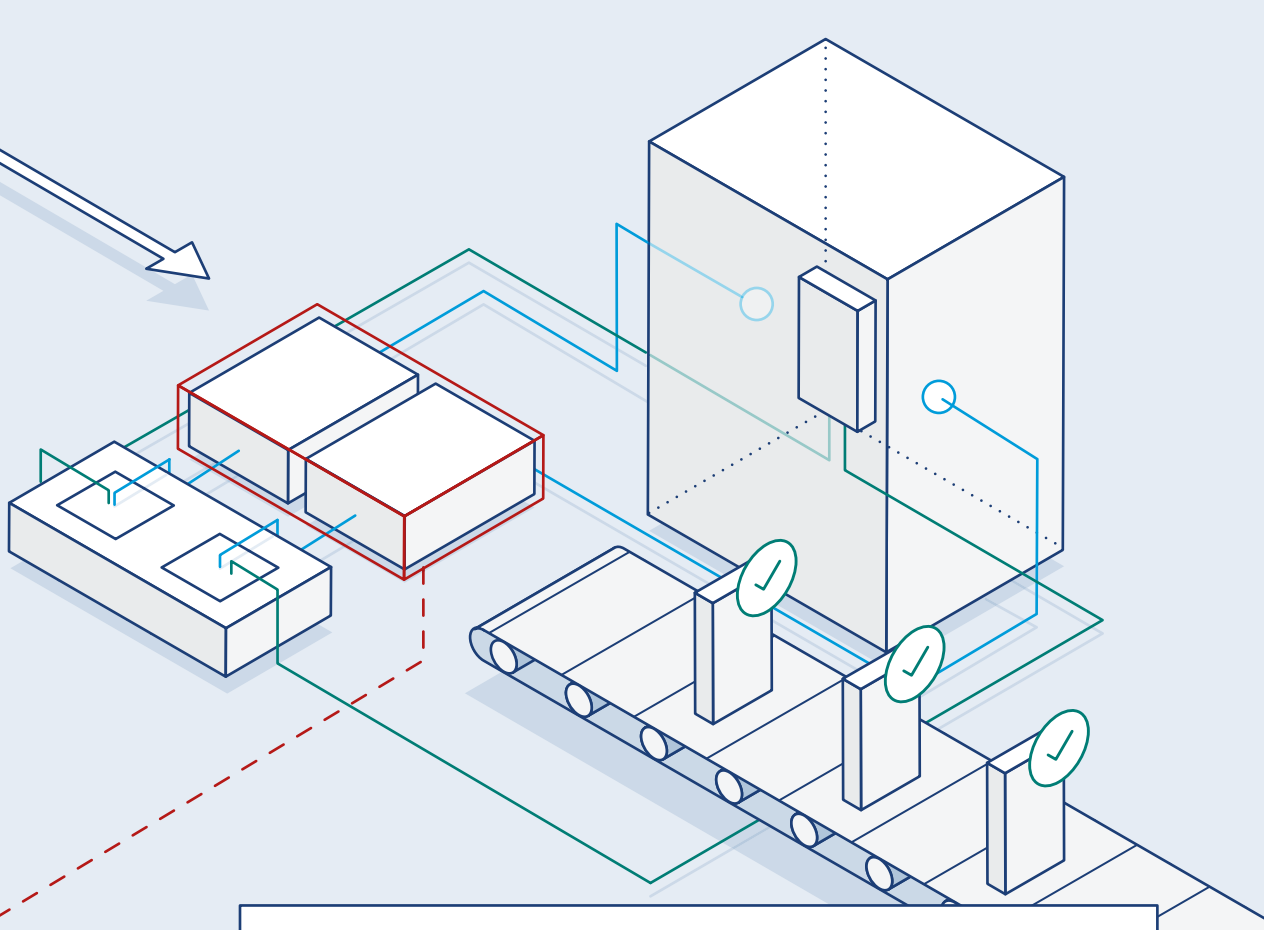
For larger corporations, fulfilling test approval criteria





2. Carrier acceptance tests

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.



Remote radio head with switch matrix

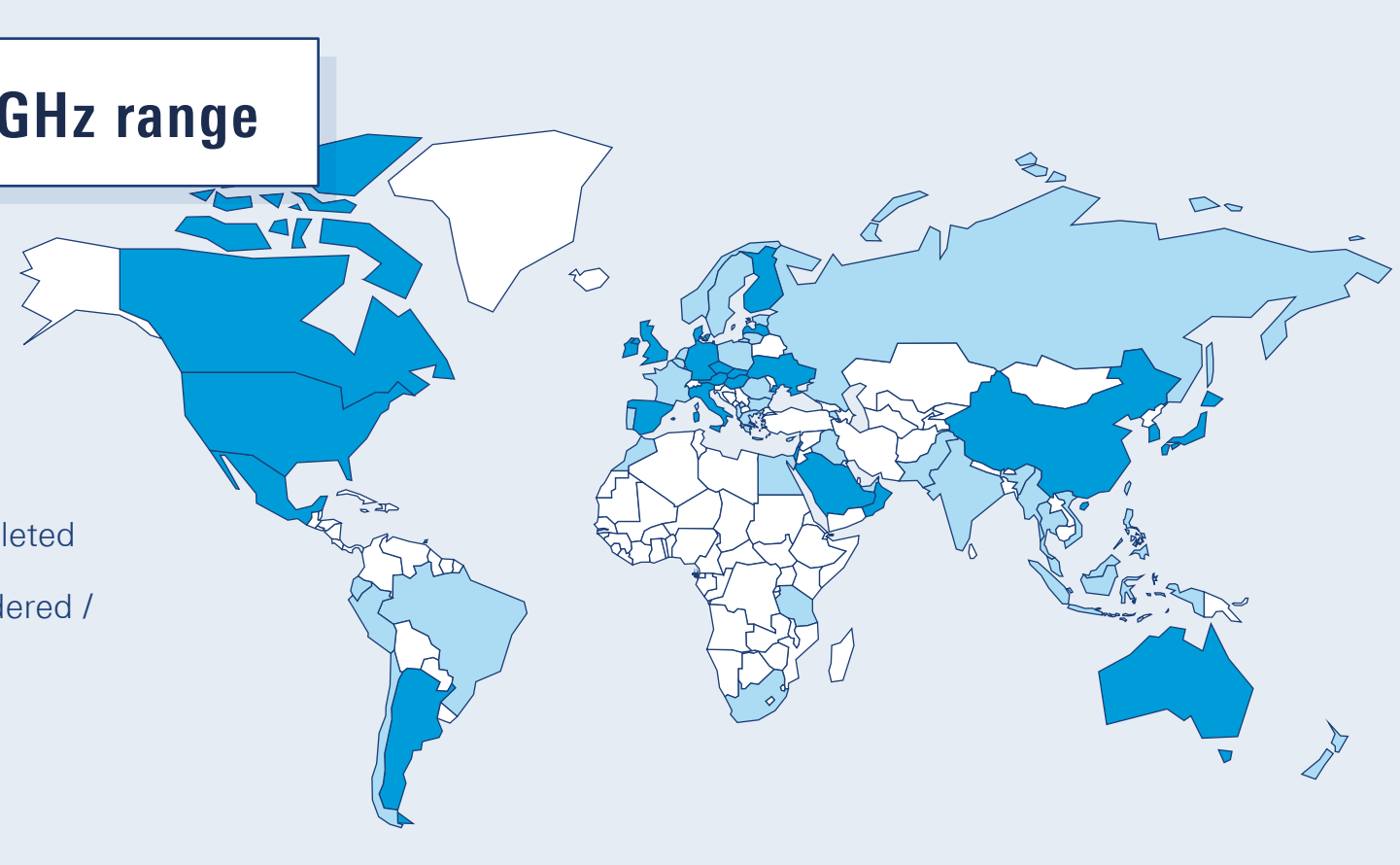
Simple radio heads can only be used for either horizontal or vertical measurements in one setup. However, there are also radio heads with a switch matrix. These are space-saving and increase efficiency, because one radio head can be used for both vertical and horizontal measurements.

3. Production tests

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. Our solutions allow simultaneous testing while being highly energy efficient and having the smallest footprint possible.

GLOBAL ALLOCATION OF 5G SPECTRUM*

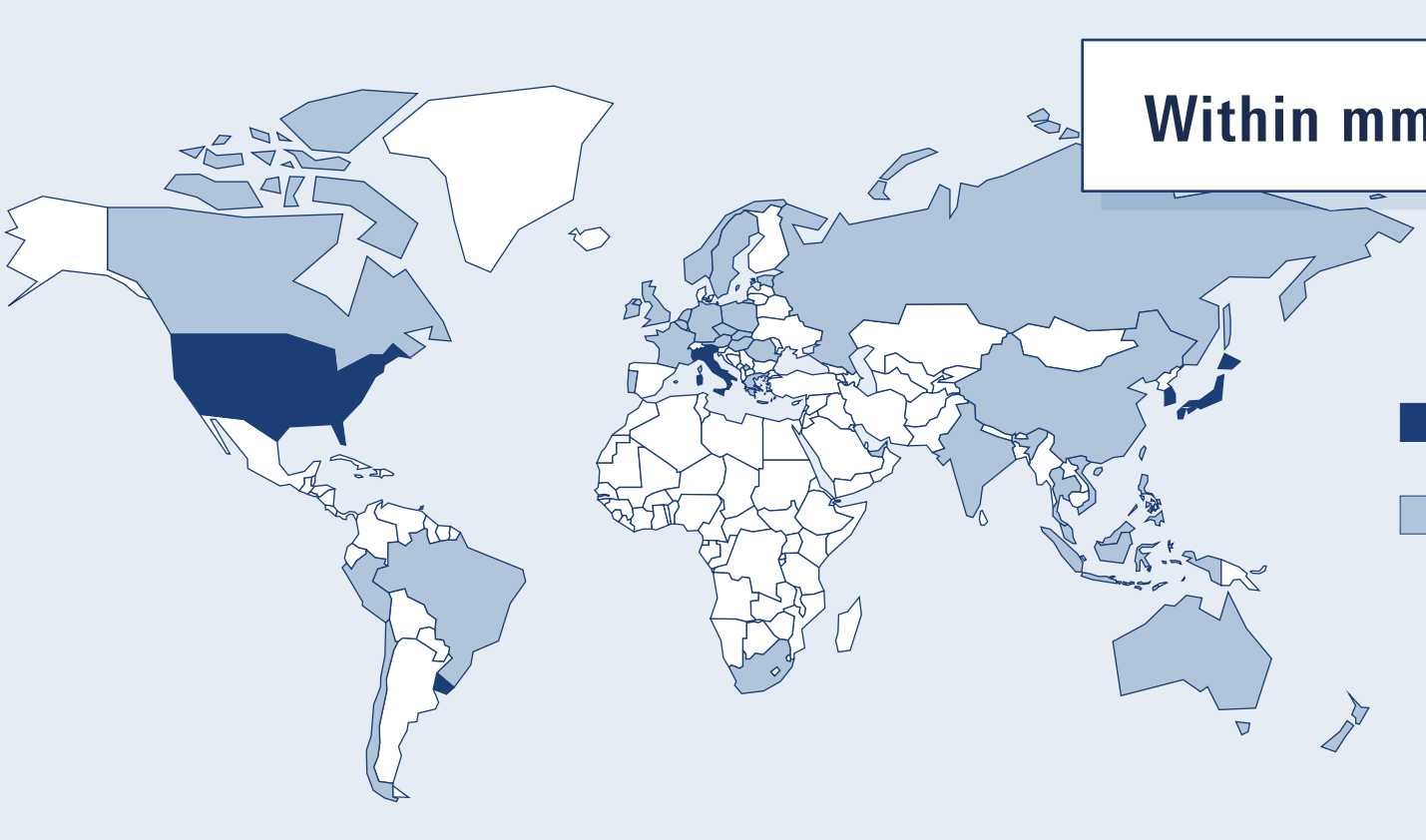
Within sub 6 GHz range



Ongoing / completed

Planned / considered / under review

Within mmWave range



Ongoing / completed

Planned / considered / under review

* Sources: Own analysis based on 2019-09 5G Spectrum Report – GSA
This graphic displays the current developments in frequency allocation – changes and further developments are highly probable.