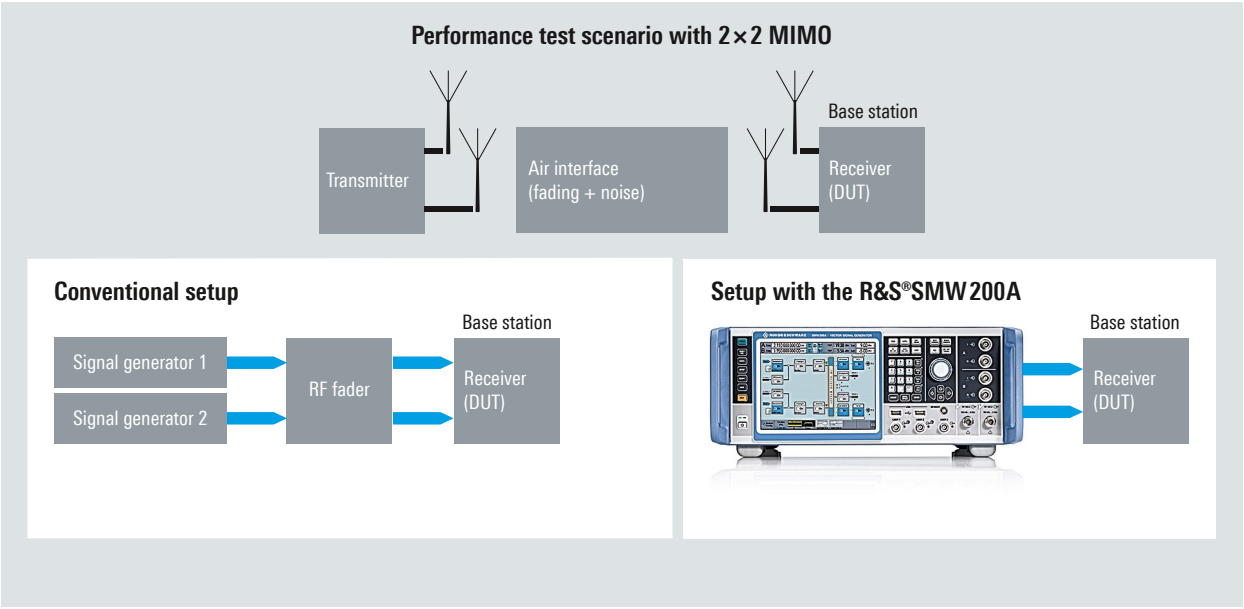
Performance tests on 5G NR base stations

The R&S®SMW200A vector signal generator with the optional integrated fading simulator is the industry benchmark for performance tests on LTE base stations. With the new R&S®SMW-B15 hardware option, the wideband version of the generator now also fades wideband millimeterwave signals in compliance with 5G NR Release 15.

The 3GPP 5G NR Release 15 set of standards was adopted in June 2018. The included specifications TS 38.141-1 and TS 38.141-2 are particularly relevant for base station manufacturers. They define general requirements for transmitters, receivers and base station performance. The requirements for transmitters and receivers target compliance with the spectrum usage conditions specified by the regulatory authorities. On the other hand, the performance requirements focus on data reception under real conditions, which makes simulation of propagation conditions necessary in the test setup.

The R&S®SMW200A vector signal generator with the optional R&S®SMW-B14 fading simulator was already the industry-leading single-box solution for performance tests on LTE base stations as well as on components for other standards, such as Wi-Fi. The sub-6 GHz requirements of 5G NR can also be easily addressed with this configuration. However, fading hardware with more bandwidth is needed for the 5G millimeterwave range with its large specified bandwidths. That is now available with the R&S®SMW-B15 option. The new fader can be installed in the wideband version of the R&S®SMW200A and meets the high demands of the test specifications for 5G NR Release 15 signal sources.

Comparison of setups



The R&S®SMW200A offers a compact, user-friendly setup for performance tests on base stations.

A new standard with new test requirements

Performance tests require highly precise transmit signals as well as simulation of propagation conditions. The physical layer features of the air interface standard dictate the nature of the transmitted signal. Unlike LTE, which only supports frequency bands up to 6 GHz, 5G NR extends into the millimeterwave range, placing new demands on signal generators. Furthermore, the maximum carrier bandwidth of 20 MHz per individual subscriber with LTE pales in comparison to the bandwidths of 100 MHz below 6 GHz and 400 MHz in the millimeterwave range foreseen with 5G NR. Channel models that ensure realistic simulation of propagation conditions over a much wider frequency range are also available for 5G NR. Together with higher carrier frequencies, larger signal bandwidths and higher-order MIMO (up to 8 × 8), they significantly increase the computational load on fading simulators compared to LTE.

Along with the usual conducted tests in the range below 6 GHz, the 5G NR performance tests introduce another innovation: over-the-air (OTA) tests at frequencies below 6 GHz and in the millimeterwave range. This makes test setups more complicated and imposes considerably higher requirements on the signal quality and RF output power of signal generators and fading simulators.

Key features of the R&S®SMW200A (standard and wideband versions)

- Frequency range: 100 kHz to 40 GHz (44 GHz pending)
- Output power: up to +18 dBm
- Optional integrated fading and AWGN generator
- MIMO, carrier aggregation, multistandard channel models and signal generation for 5G NR, LTE, Wi-Fi and many other common standards
- 8 × 4 MIMO with just one generator (below 6 GHz; additional R&S®SGT100A generators required for more than two RF signals)

Standard version with optional R&S®SMW-B10 (ARB generator) and R&S®SMW-B14 (fading) fading hardware

- Up to 160 MHz RF bandwidth
- Up to 160 MHz fading bandwidth

Wideband version with optional R&S®SMW-B9 (ARB generator) and R&S®SMW-B15 (fading) fading hardware

- Up to 2 GHz RF bandwidth
- Up to 200 MHz fading bandwidth

Compact and easy to operate

Compared to a conventional setup with separate signal generators and RF fading simulators, the R&S®SMW200A is more compact, easier to set up and to operate, and covers a much wider frequency range (see figure). It does not cause any signal conversion losses, which typically occur with RF faders. The generator produces extremely pure signals with high output power, and their levels can be set precisely without additional calibration effort. This is particularly beneficial for OTA tests.

R&S®SMW-B15 fading hardware for 5G NR

The R&S®SMW-B15 fading simulation hardware for the wideband version of the R&S®SMW200A is equipped with even more processing power. It currently offers a fading bandwidth of 200 MHz, which for example is necessary for 5G NR performance tests in the millimeterwave range conforming to Release 15, and in the future it will support even larger bandwidths in line with the evolution of the standard. The R&S®SMW-B15 can also be used in scenarios already covered by the R&S®SMW-B14, for example for MIMO fading and routing (initially up to 16 fading channels; soon up to 8 × 8 MIMO) or carrier aggregation. Furthermore, it supports the new 5G NR Release 15 channel model as well as many channel models also supported by the R&S®SMW-B14, including OTA MIMO fading.

Summary: The R&S®SMW-B15 hardware option equips the wideband version of the R&S®SMW200A vector signal generator with powerful fading simulation for performance tests on base stations in compliance with 5G NR Release 15 – with the same form factor and ease of use that have made it an industry standard.

Dr. Patrick Agyapong