SITE TESTING AND TROUBLE-SHOOTING IN 5G MOBILE NETWORKS

Application Brochure
Version 01.01

ROHDE&SCHWARZ
Make ideas real

Commercial 5G rollout is happening now, and the rate of deployment of 5G non-standalone (NSA) sites is increasing every day.

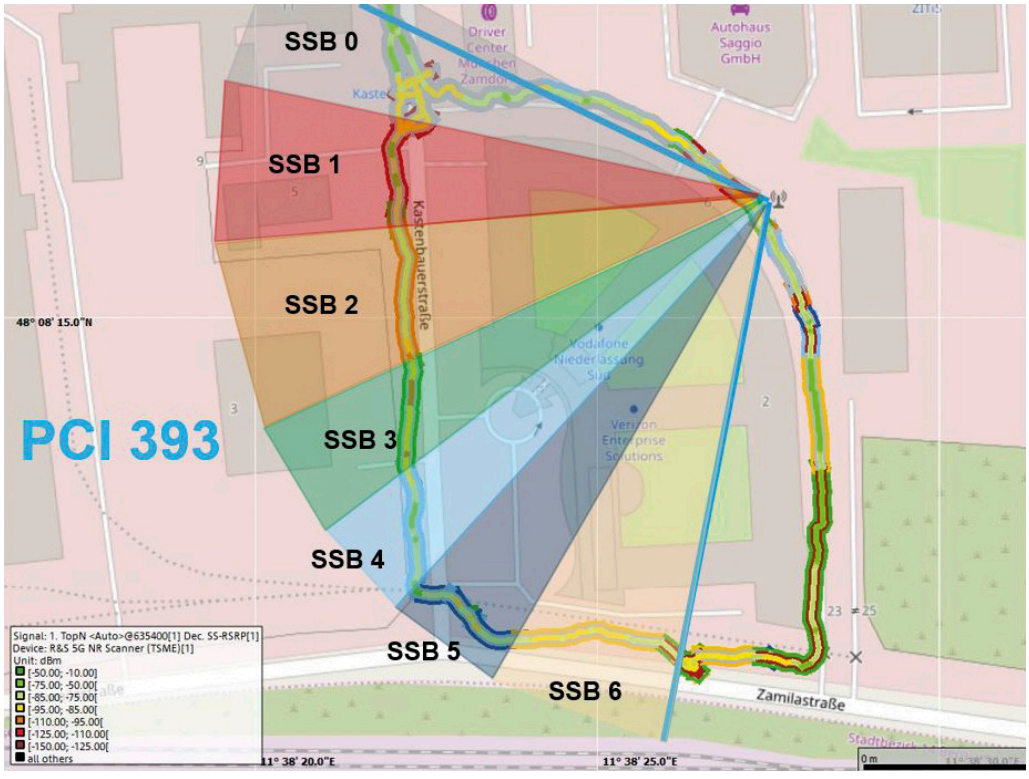
Each new installation needs to be verified to ensure correct network performance and the quality of service (QoS) delivered to end users over the 5G network.

For NSA mode, the link to the anchor site (usually low frequency LTE) needs to be checked in parallel. The deployment will happen in both the FR1 (sub 6 GHz) band and in the FR2 (microwave, usually 28 GHz and higher) band. The tests must also work in deployments where the radio interface is fully integrated (combined remote radio head and antenna) or split into RRH and antenna (connected by jumper cables). The LTE anchor cell can use the same antenna or another antenna – even one located on a different tower.

For previous generations of cellular technology, site measurements could be executed via dedicated test ports. This is no longer a valid reference point for 5G, active or MIMO antenna systems. Additionally, beam centric measurements can be only performed over the air in front of the cell site. Some of the traditional quality metrics such as EVM are no longer a reliable indicator of a proper working site when measured over the air. New test tools and procedures are necessary.

Site acceptance is by no means trivial. But with a well-defined test procedure and the correct test tools, a reliable and efficient process can be achieved. This document lists typical required RF tests, groups them into different deployment scenarios and itemizes the necessary test equipment.

Fig. 1: 5G NR FR1 site, three sectors (PCI), seven beams per sector



YOUR TASK

You have a newly installed 5G site and need to ensure the fundamental cell site performance, that all parameters are inside the specified range and that the additional 5G capacity is advertised in the related LTE anchor cells (SIB 2).

Installation

- Check VSWR reflections via OSS counters
- Ensure the PCI and beams are visible in the expected location (SS-RSRP, SS-SINR)
- Conduct power measurements on the allocated LTE anchor cell (RSRP, SINR, etc.)
- Run functional tests to ensure the correct integration of 5G cell into the network

Troubleshoot

- If reflection counters show problems, measure the reflection/DTF with a cable and antenna tester
- If beams/PCI are not visible, check and correct the 5G site configuration file
- Check cable and antenna
- If the 5G cell is not utilized or the throughput is too low, check if 5G cell is advertised on LTE-SIB 2
- If the SINR is not as expected, check for internal interference (e.g. sidelobes) and external interference

Depending on the deployment method, some of the tests may not be necessary or make no sense. Without a detached antenna, OSS can check reflections, but the reflections cannot be verified on site by a reflection/DTF test.

Especially in FR2, the beam distribution can be very complex. We have measured cells that distribute 64 beams and where changing from one beam to another was sometimes just one step.

Fig. 2: Beam distribution in a 5G FR2 site

SOLUTIONS

5G site testing solution

- Automatic channel detection
- SS/PS/PBCH/DM-RS -RSRP over PCI and beam
- RSSI over PCI and beam
- SS/PS/PBCH/DM-RS-SINR over PCI and beam
- SS/PS/PBCH/DM-RS-RSRQ over PCI and beam
- Parallel measurements for LTE and 5G NR
- FR1 and FR2 (FR2 via R&S®TSME30DC ultracompact downconverter)

Fig. 3: 5G site testing solution

5G QualiPoc Android smartphone

- Layer one parameters of anchor cell (LTE)
- Layer one parameters of secondary cell (5G)
- Scheduled and net throughput (LTE and 5G cell)
- Block error rate, BLER (LTE and 5G cell)
- Layer 3 signaling, MIB and SIB
- Functional tests (ping, data DL/UL)
- Dropbox transfer
- Facebook test
- Traceroute (UDP only)

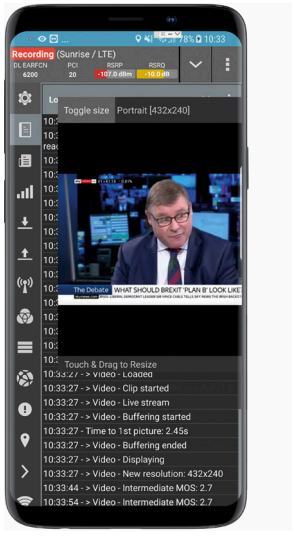


Fig. 4: 5G QualiPoc Android smartphone

R&S®Cable Rider ZPH cable and antenna analyzer

- Occupied bandwidth
- Spectrum emission mask
- ACLR
- Channel power
- Interference hunting
- VSWR
- Distance to fault
- Optional optical power measurement

Fig. 5: FR1: R&S®Cable Rider ZPH cable and antenna analyzer (FR2: R&S®Spectrum Rider FPH hand-held spectrum analyzer, 30 GHz without cable tests)

RESULTS

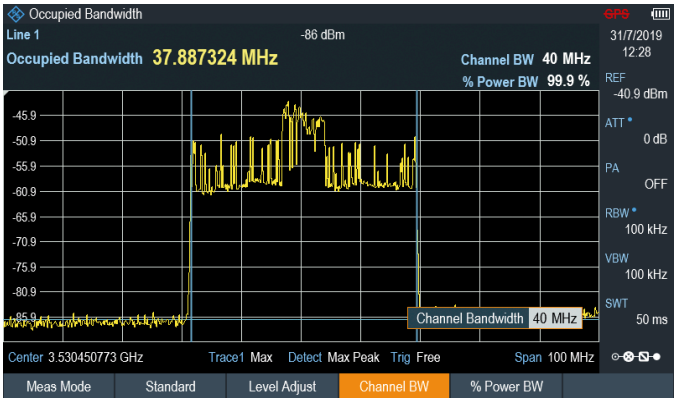


Fig. 6: Measured occupied bandwidth of a 40 MHz 5G NR signal

First indications if signals are present in the air can be found with a spectrum analyzer. The occupied bandwidth can be measured with the max. hold function by using a directional antenna and pointing to the sector antenna. The SSB section is visible in the middle of the spectrum.

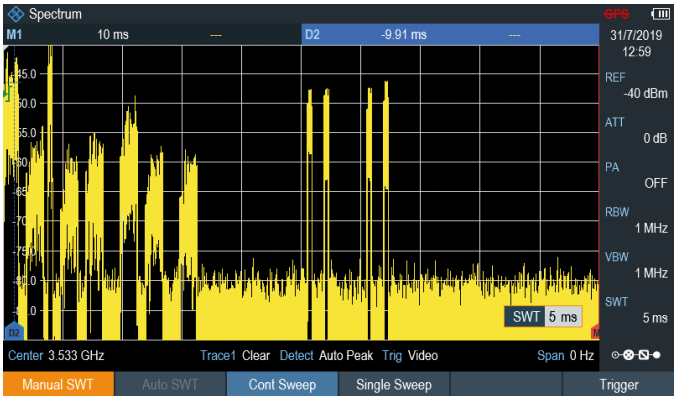


Fig. 7: SSB measured over the air in zero span with the R&S®Cable Rider ZPH cable and antenna analyzer (other shorter data/control signals are also visible)

Going into zero span and using the video trigger, the SSB can be seen in the time domain. In this example, seven repeatedly transmitted beams plus control data are visible. Since this is a spectrum measurement, no PCI or SSB indications are visible.

Fig. 8: Automated channel detection (ACD) showing bands 3, 20 and n78

Using the 5G site testing solution from Rohde&Schwarz, demodulation and decoding can be added to the spectrum measurements. With the automated channel detection, all LTE and 5G signals are displayed. It is not necessary to set the channel, frequency or SSB position. More information about the signal content can be obtained by reading relevant broadcasting data (MIB and SIB).

Fig. 9: Signals of interest sorted by highest value; LTE and 5G NR traces are displayed in parallel

By filtering, for example via band, PCI, MNC/MCC or SSB, the signal of interest can be selected and the availability of beams/PCIs, boundaries of beams/sectors, and sidelobes can be checked. The results are displayed in a Top N view (strongest signal in front) or as a graph in a value-over-time chart.

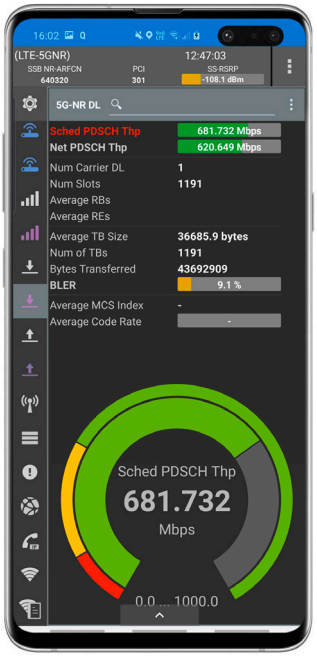


Fig. 10: Functional test conducted with a commercial 5G phone

By adding a smartphone to the 5G site testing solution, throughput measurements as well as functional tests such as data uplink and downlink can be performed. The layer 1 parameters and layer 3 signaling can be measured and recorded for further troubleshooting.

KEY FEATURES

- Automated setting of RF parameters via automated channel detection
- Highly sensitive scanner, fast and easy detection of signals even without a directional antenna
- Parallel measurement of LTE anchor cell and 5G cell, no switching time
- Extendable to functional tests via 5G phone attached to GUI
- Spectrum and cable tests with lightweight handheld analyzer
- Searching for external interferences by using the gated trigger of the handheld device

ORDERING INFORMATION

Designation	Type	Order No.
Autonomous mobile network scanner	R&S®TSMA6	4900.8005.02
Ultracompact downconverter, up to 30 GHz	R&S®TSME30DC	4901.1004.02
Smartphone based network optimizer	QualiPoc Android	
Handheld cable and antenna analyzer, combi model, 5 kHz to 3 GHz	R&S®Cable Rider ZPH	1321.1211.12
Handheld spectrum analyzer, 5 kHz to 26.5 GHz	R&S®Spectrum Rider FPH	1321.1111.26

MORE INFORMATION

For more information on the test and measurement solutions and products (such as the R&S®TSMA, R&S®TSME30DC, QualiPoc, R&S®Cable Rider ZPH and R&S®Spectrum Rider FPH) described in this document, please contact your local Rohde&Schwarz sales representative or visit www.rohde-schwarz.com/mnt

Service that adds value

- Worldwide
- Local und personalized
- Customized and flexibel
- Uncompromising quality
- Long-term dependability

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, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

www.rohde-schwarz.com

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 training

www.training.rohde-schwarz.com

Regional contact

- Europe, Africa, Middle East | +49 89 4129 12345
  customersupport@rohde-schwarz.com
- North America | 1 888 TEST RSA (1 888 837 87 72)
  customer.support@rsa.rohde-schwarz.com
- Latin America | +1 410 910 79 88
  customersupport.la@rohde-schwarz.com
- Asia Pacific | +65 65 13 04 88
  customersupport.asia@rohde-schwarz.com
- China | +86 800 810 82 28 | +86 400 650 58 96
  customersupport.china@rohde-schwarz.com

PD 3608.0862.92 | Version 01.01 | October 2019 (fi)

Site testing and trouble-shooting in 5G mobile networks
Data without tolerance limits is not binding | Subject to change

3608086292
3608.0862.92 01.01 PDP 1 en