5G NR MIMO SIGNAL ANALYSIS

An easy-to-setup test solution for high speed multichannel acquisition for 5G NR signals

Your task

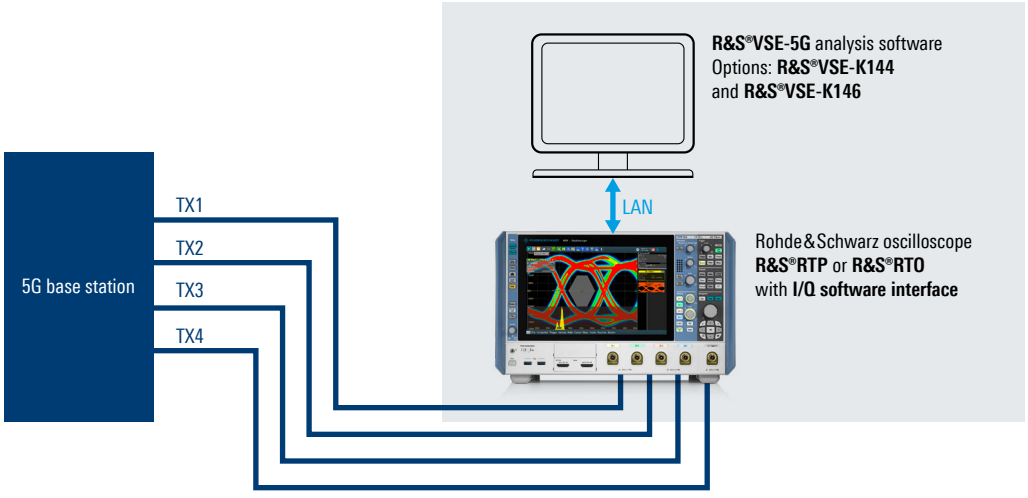
The 5G New Radio (NR) state-of-the-art mobile radio access technology focuses on enhanced mobile broadband communications (eMBB), ultra reliable low latency communications (URLLC) and massive IoT (mIoT) connectivity to serve the vertical industries. Massive multiple input multiple output (MIMO) antenna systems and beamforming are no doubt two of the compelling technologies facilitated by 5G NR. They are the key enablers and fundamental components of 5G deployment for improving the end-user experience, network capacity and coverage and ultimately contribute to high spectral efficiency. The advantage of deploying beamforming based on massive MIMO technology is that it boosts the power of beams for the target user in the desired direction while reducing the power of the beam for nearby unaddressed users.

This leads to another level of network efficiency improvement with respect to a higher link budget and improved avoidance and rejection of interference. To transmit the signal in a desired direction, beamforming is required. It is accomplished by generating the relative phase shift of each adjacent input signal stream. The introduced phase shift or phase difference should be kept constant so that the generated beam stably points in the wanted direction. Determination of the phase difference of the input signal on each MIMO layer is essential in order to benchmark the quality of the generated beamforming. The fundamental measurements of 5G transmitted signals, e.g. EVM, transmit power and ACLR, at each MIMO layer are essential. It is always beneficial to perform such measurements at different MIMO layers in a coherent manner to ensure correlated measurement results. Multichannel coherent acquisition of the 5G signal in parallel also increases measurement efficiency.

Rohde&Schwarz solution

An R&S®RTP or R&S®RTO oscilloscope together with the R&S®VSE vector signal explorer software is an easy-to-setup test solution for performing 5G NR MIMO signal analysis thanks to the high signal acquisition frontend and multichannel capability of R&S®RTP/R&S®RTO. The R&S®RTP is a high-end, four-channel oscilloscope. When equipped with the R&S®RTP-K11 I/Q software interface, it features downconverting and downsampling of the captured 5G MIMO FR1 signal. The high sampling capacity at a sampling rate of up to 40 Gsample/s generates a longer I/Q record length of up to 80 Msample.

Test solution with R&S®RTP/R&S®RTO and R&S®VSE



ROHDE&SCHWARZ
Make ideas real

The sampled output I/Q data from the R&S®RTP/R&S®RTO can be conveniently postprocessed by an off-the-shelf analysis tool provided by R&S®VSE equipped with the R&S®VSE-K144 and R&S®VSE-K146 options. The R&S®VSE-K144 and R&S®VSE-K146 measurement personalities for single channel and multichannel measurement, respectively, make it easy for the R&S®VSE software to deliver full RF parametric measurements, including the phase measurements of each MIMO layer. And a beamforming summary of each MIMO layer provides an excellent overview of the resource allocation of PBCH, PDSCH and CORESET, the associated antenna port (AP) and the corresponding phase measurements. The R&S®RTO with the R&S®RTO-K11 I/Q software interface provides an alternative cost-effective solution that covers the 5G frequency band up to sub6.

Application

The R&S®RTP-K11/R&S®RTO-K11 and R&S®VSE-K144 option combination covers the traditional 5G NR RF signal parametric measurements on a single channel, for instance EVM, frequency error, power spectrum, signal flatness and signal constellation.

Adding R&S®VSE-K146 to this combination enables the measurements in multichannel mode, which means that up to four MIMO layers can be simultaneously captured, downconverted and measured.

The R&S®VSE-K146 option supplements the R&S®VSE-K144 measurements with phase measurement, phase difference to the reference antenna and a beamforming summary as follows:

"RS Phase" measures the phase of the carriers occupied by various reference signals (PDSCH, PDCCH, etc.) on different APs.

"RS Phase Difference" measures the phase difference of different AP relative to a reference antenna port.

"Beamforming Summary" shows the phase characteristics for each allocation used by the UE-specific reference signals (PDSCH, CORESET, CSI-RS etc.) in numerical form.

The screenshot below shows an overview of the measurements included with R&S®VSE-K146.

Summary

R&S®RTP/R&S®RTO and R&S®VSE meet the need to verify 5G NR MIMO signals. Thanks to the high signal acquisition and multichannel capabilities of the R&S®RTP/R&S®RTO, MIMO layers and the signal characteristics of beamforming can be analyzed in a speedy and coherent manner.

R&S®VSE-K146 multichannel MIMO measurements

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5G NR MIMO signal analysis
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