REAL-TIME BEAMFORMING VERIFICATION IN 5G NR FR1

During development of MU-MIMO antenna arrays, the beamforming algorithms undergo steady revision. Whether used in regression testing or verification of newly introduced features, fast beamforming verification helps to speed up R&D for beamforming antennas and improve performance of your product.

R&S®NRQ6 frequency selective power sensor

Your task

You are responsible for developing, verifying, or enhancing beamforming algorithms that are deployed in a real 5G NR device for sub-6 GHz frequency bands. The challenge is to enable real-time numerical and visual feedback, providing insight into the resulting beam patterns for the full antenna coverage range based on real measurements of the actual device frontend. Ideally, visualization should cover individual beams of different signals and channels down to distinct allocations in the resource grid.

Rohde & Schwarz solution

With the R&S®NRQ6, Rohde & Schwarz offers a small frequency selective power sensor with excellent dynamic range that also features I/Q recording up to 100 MHz of analysis bandwidth. Combining multiple R&S®NRQ6 power sensors, very accurate, phase-coherent recordings can be generated and used as a basis for determining the resulting antenna patterns for individual beam settings without the need for a full 3D OTA measurement.

Combine the R&S®VSE vector signal explorer software with the R&S®VSE-K146 5G MIMO measurements option for phase coherent I/Q recordings and extensive signal analysis. Identify phase differences across the modulated 5G NR waveform. Analog beamforming, digital beamforming and hybrid variants can be analyzed and verified, independent of the underlying technology. The relevant phase differences can be extracted from the software using the beamforming summary view.
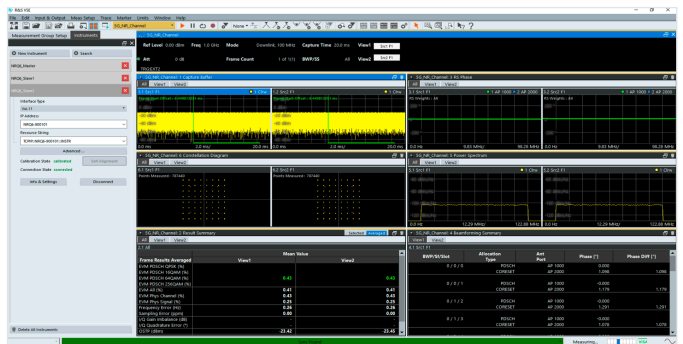

R&S®VSE-K146 5G MIMO measurements option

ROHDE & SCHWARZ

Make ideas real

Application

R&S®VSE-K146 enables parallel multi-channel analysis of 5G NR MIMO signals. Combined with multiple phase coherent R&S®NRQ6 devices, or alternatively a multiport oscilloscope, R&S®VSE-K146 provides analysis of reference signal phase, phase difference and a beamforming summary for UE-specific reference signals in PDSCH, CORESET and CSI-RS. Based on this data, the beamforming characteristics of antenna arrays can be calculated (see figure on the right). Simulations can be improved based on measurements, and beam pattern simulations can be created based on actual data from the measured RF and antenna frontend. Using Rohde & Schwarz power sensors and demodulation software, beamforming characteristics can be determined in real time, without the need for a full 3D scan. This enables 3D and 2D visualization of the resulting beam patterns, evaluation and verification of different beamforming settings, antenna element weightings, and beamforming algorithms. Algorithm performance can be verified based on actual measurements, taking the real antenna array hardware and RF frontend into account. This closes the gap between full beamforming simulation and a dedicated 3D OTA measurement.

SS/PBCH

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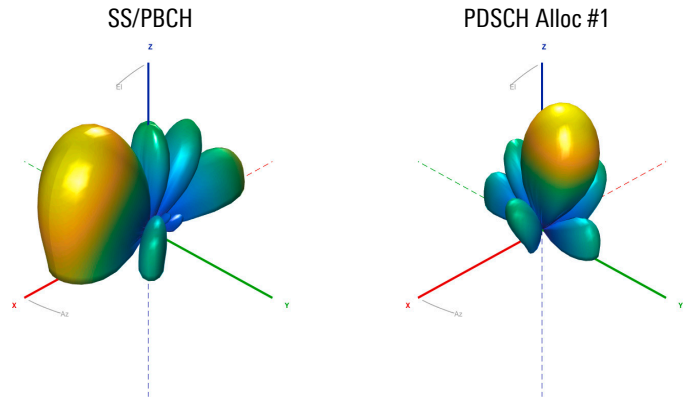
Beamforming visualization

For setups with a high number of simultaneously active antenna elements, an appropriately scaled switch matrix can be used to perform sequential measurements against a common reference port. Alternatively, the setup can be expanded by using more phase coherent power sensors, I/Q file recordings and post processing in the R&S®VSE software. To speed up data processing, the R&S®VSE enterprise edition is available for concurrent analysis of multiple measurements.
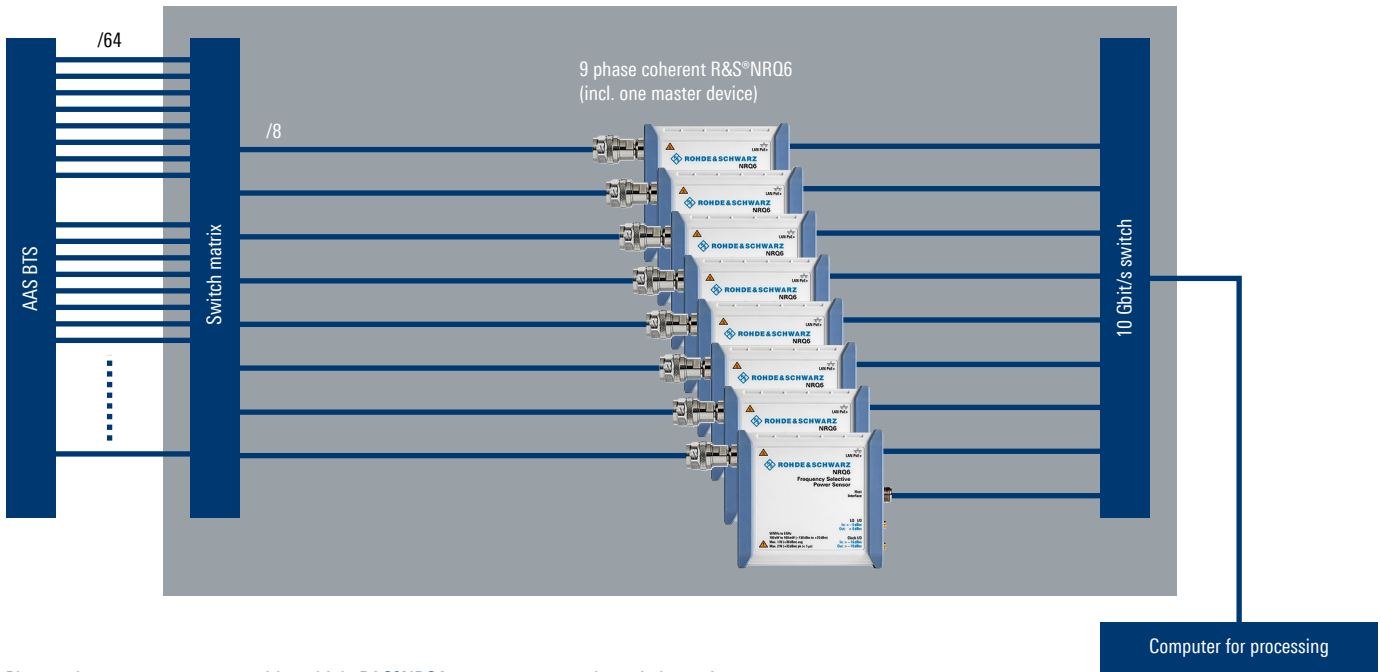
Phase coherent measurements with multiple R&S®NRQ6 power sensors and a switch matrix

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