Keysight Technologies
PROPSIM F64 5G Channel Emulation Solution - F8800A

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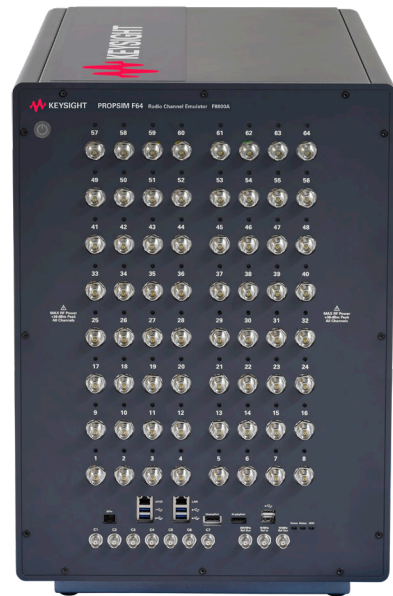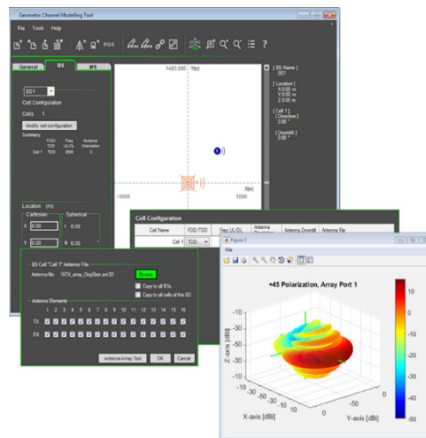
5G NR End-to-End Real-World Performance Testing at Sub 6 GHz and mmWave

5G NR is expected to deliver a superior and ubiquitous user experience, which will require higher data rates and pervasive cell coverage. To achieve higher data rates of up of to 20Gbps, 5G designers are adopting complex technologies such as wider signal bandwidths and massive MIMO with hybrid beamforming at mmWave frequencies, resulting in more effective use of the wireless propagation channel. This is leading to the need to validate the end-to-end performance of chipset, devices and base stations under real-world complex 3D fading and interference channel conditions.

The PROPSIM 5G Channel Emulation Solution is designed for end-to-end realistic and repeatable real-world performance testing of 5G multi-mode devices and base stations in the lab. The solution helps you to find the fastest path to 5G with superior user experience.

PROPSIM F64 5G Channel Emulation Solution

Versatile and scalable solution addresses diverse test needs in 5G, 4G and WLAN 802.11ax, including:

- Device and base station testing in the lab using real infrastructure, Keysight's UXM 5G network emulation or UE emulation solutions
- Sub 6 GHz MIMO and massive MIMO beamforming testing
- Device MIMO OTA testing
- mmWave massive MIMO OTA testing
- WLAN 802.11ax MU-MIMO and beamforming testing
- Field-to-lab virtual drive testing
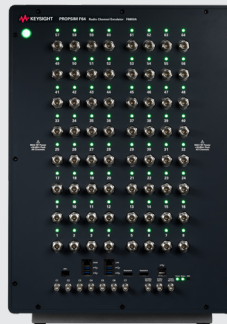
Emulates impairments of complex 3D real-world radio channel conditions including:

- Dynamic multipath propagation
- Range pathloss and blocking effects
- Doppler from mobility
- Noise and synchronous programmable interference (virtual cells, and users)

End-to-end performance validation across all 5G NR signal bandwidths and CA schemes

Wider carrier bandwidths

5G NR introduces wider carrier bandwidths up to 400 MHz. Since the performance of each bandwidth, from 5 MHz to 400 MHz, needs to be adequately verified, the PROPSIM 5G Solution natively supports, with high linearity, all 5G NR signal bandwidths up to 400 MHz.

Wider carrier aggregation bandwidths

5G NR supports up to 16CC Carrier Aggregation (CA) alongside contiguous CA above 1 GHz and non-contiguous on all 5G frequencies. The solution has native support for contiguous CA up to 1.2 GHz with high linearity.

The non-contiguous CA across fragmented frequency spectrum and scalable numerology needs to work with low network latency in 5G across a wide range of propagation conditions. Time- and phase-coherent channel emulation across all 5G deployment scenarios and CA schemes with different channel delays in end use scenarios enables comprehensive and reliable latency testing with PROPSIM 5G Solution.

Massive MIMO and mmWave frequency spectrum

Massive MIMO at sub 6 GHz and mmWave frequency spectrum rely on dynamic 3-dimensional (3D) beamforming technology to find multiple simultaneous independent propagation channels in line-of-sight (LOS) and non-line-of-sight (NLOS) conditions on the same frequency and time for single and multiple users. The higher number of independent propagation channels enables transmission of more data streams within a single cell on the same frequency and time versus non-3D beamforming systems with fewer independent propagation channels.

The use of multiple simultaneous channels means 5G base stations and devices need to leverage the time-variant complex 3D radio propagation channel dynamically. The PROPSIM 5G Channel Emulation Solution enables designers to verify the implementation of massive MIMO 3D beamforming capabilities at sub 6 GHz and mmWave frequencies in their base stations and devices. The solution supports both RF cabled and over-the-air (OTA) test setups.

# Realistic and effective performance assessment of 5G multi-mode devices and base stations

The PROPSIM 5G Channel Emulation Solution enables users to conduct realistic and effective performance assessment of 5G multi-mode devices and base stations under diverse and complex real-world channels in a laboratory environment, with automated tests running 24/7.

The PROPSIM 5G Channel Emulation Solution:
- Gives access to key performance indicator (KPI) results with excellent test coverage using reliable and repeatable testing methodology and tools.
- Allows users to validate new product releases and continuous implementation of new features to verify performance prior to delivery.
- Supports 3GPP and tier-1 mobile network operator test requirements.
- Offers seamless integration with hardware and software across sub 6 GHz and mmWave bands.

Where
$\Delta f = 2^\mu \times 15\ kHz$
Example: 15 kHz, 30 kHz, 60 kHz ... 480 kHz subcarrier spacing
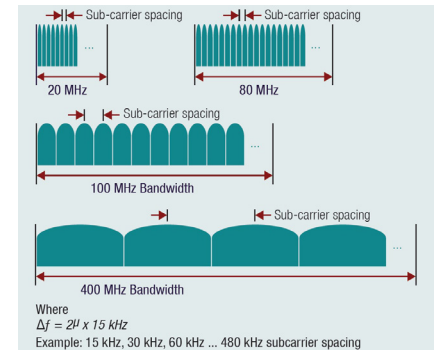
PROPSIM 5G Solution supports all 5G NR signal bandwidths and CA up to 1.2 GHz contiguous, 16CC non-contiguous.
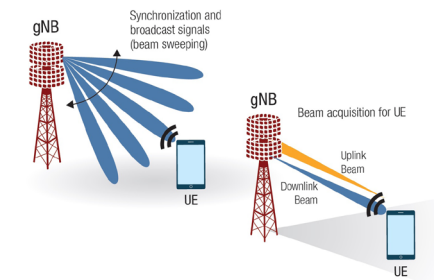

Advanced beamforming techniques require system-level end-to-end testing.

Full stack end-to-end RF performance testing

The PROPSIM 5G Channel Emulation Solution enables device and network equipment manufacturers to conduct full stack end-to-end protocol signaling and RF performance testing of the latest 4G and 5G base stations and multi-mode devices across sub 6 GHz and mmWave frequencies under uncompromised, coherent real-world complex 3D propagation channels.

The solution supports all 5G NR deployment scenarios with and without LTE anchor cells and coexistence of 3G and 2G cells. It also supports Wi-Fi offloading scenarios and addresses all technical requirements for testing 802.11ax capable access points and devices. Features include:

- Native bandwidths from 5 MHz up to 400 MHz instantaneous without external RF connection.
- 5G CA scenarios up to 16CC in a single instrument, with up to 1.2 GHz contiguous CA.
- Excellent linearity, exceeding 1024QAM modulation requirements.
- Integrated synchronous and programmable interference generators support efficient small cell testing.
- Single hardware instrument provides up to 64 TRX ports and (in 8 increments) up to 4096 MIMO channels.
- Sub 6 GHz RF cabled and OTA testing. MIMO multiple 2x2bi, 4x4bi, 8x8bi, and massive MIMO 16x16bi, 32x32bi with multi-unit 64x4bi, 64x8bi, 64x16bi, 128x8b, and /128x16bi.
- Clean and easy RF connections in lab with integrated RF band combining.
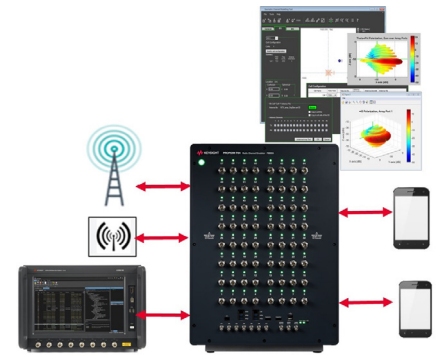
PROPSIM 5G Solution supports versatile 5G end-to-end testing needs with test platforms, live base stations, access points, and multi-mode devices.

Seamless integration with Keysight's 5G network emulation test portfolio for end-to-end insights across the workflow

The PROPSIM F64 platform seamlessly integrates with Keysight's end-to-end network emulation portfolio for full stack performance testing of multi-mode devices.

The versatile network and channel emulation solutions, combined with mmWave OTA test chambers, address the entire device workflow from R&D, design validation to manufacturing, enabling users to validate protocol layers and RF performance of a 5G NR device as well as gain quick access to KPIs for beam management, data throughput, and stability across both sub 6 GHz and mmWave bands.

PROPSIM GCM 5G test scenario building tool supports 3GPP TR 38.901

The PROPSIM GCM 5G tool is an industry-leading channel modeling tool that supports:
- User-defined 3D spatial scenarios and dynamic modeling of movement.
- Arbitrary and complex test scenarios.
- Multi-frequency and multi-RAT HetNet test scenarios.
- Device-to-Device (D2D) supporting IoT and V2X scenarios.
- Complex field to lab (e.g. high speed train test scenarios in CMCC VDT HST test plan.
- 3D/Massive MIMO test scenarios in tier-1 MNOs BTS test plans.
- 3D antenna beam pattern model embedding.
- Antenna library and antenna array tool for modeling arrays and beams.
- Available standard channel models 3GPP TR38.901, TR36.873 and SCME, IMT-Advanced, Winner, TGn/ac/ax.
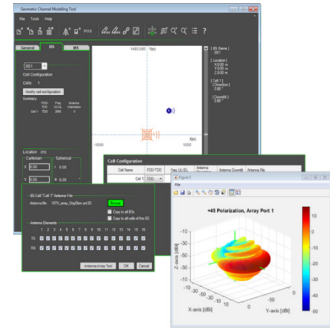

PROPSIM GCM 5G tool for scenario building.

KPI testing under TR38.901 channel models and beyond through:

- Massive MIMO beam management testing, beam acquisition metrics, mobility management, beam change, and handovers.
- Data throughput testing, peak/average, multi-user and stability.
- Latency testing across all 5G deployment scenarios, with dual connectivity, co-existence.
- Field-to-lab virtual drive testing.
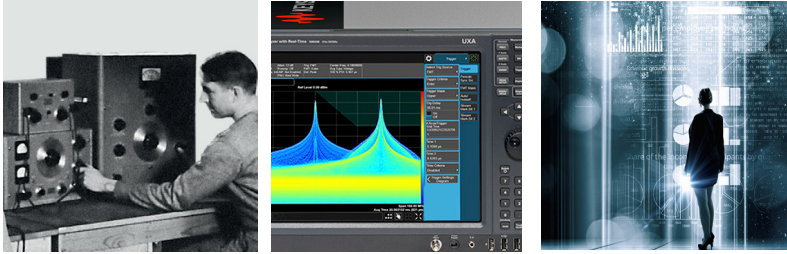- Device MIMO OTA testing.

Contact Keysight for more information, available configurations, and pricing.
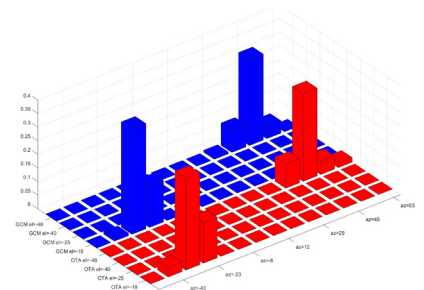
Beam management is important in 5G. One new KPI is beam acquisition metrics, which indicates how well your product can find/capture the beams under highly dynamic 3D real-world fading channel.

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