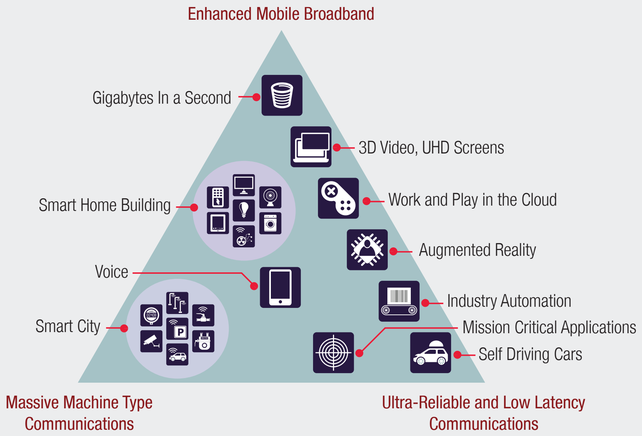
Seven Things You Need To Know About 5G New Radio

5G New Radio (NR), the next-generation wireless standard, requires new technologies and performance improvements that will challenge the way you design, test, and optimize.

The NR air interface can work in either standalone or non-standalone mode where an existing LTE network is used for control plane. Standalone mode and core network specifications are planned for June 2018.

NR is defined to support three emerging use cases: enhanced mobile broadband (eMBB), ultra-reliable low latency communications (URLLC) and massive machine type communications (mMTC). The first NR specification (3GPP Release 15) supports increased data throughput and greater capacity for eMBB. It also sets a foundation for support of URLLC mission-critical use cases such as autonomous automobiles.



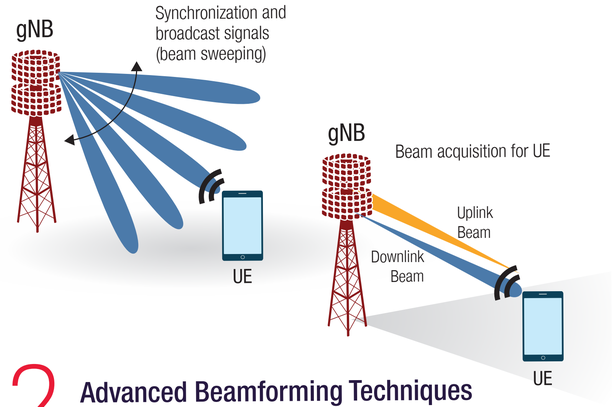
Source: ITU Recommendations 9/2015

1 New Spectrum and Bandwidth Impacts Signal Quality

To enable higher data throughput for applications like streaming HD video and to allow for more network capacity, 5G NR specifies new frequency ranges up to 52.6 GHz (Rel-15), and up to 100 GHz for future implementations, where there is more contiguous bandwidth available. Implementing air interfaces at millimeter wave (mmWave) frequencies with up to 1 GHz bandwidth means you'll need to correct for signal quality issues like path loss, flatness, phase noise, and linearity.

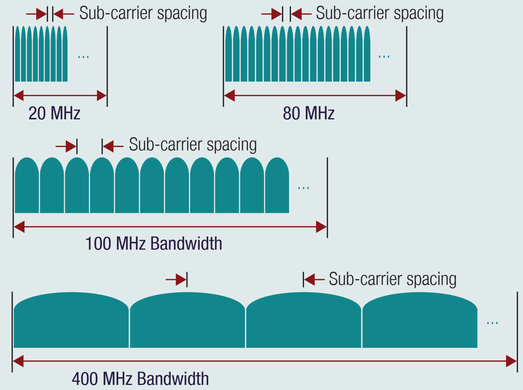
USA:	27.5 – 28.35 GHz and 37 – 40 GHz Pre-commercial deployments in 2018, 64-71 GHz future
South Korea:	26.5 – 29.5 GHz trials in 2018 Commercial deployments in 2019, 37.5 – 50 GHz future
Japan:	27.5 – 28.28 GHz trials planned from 2017 and potentially commercial deployments in 2020
China:	24.25 – 27.5 GHz and 37 – 43.5 GHz studies
Sweden:	26.5 – 27.5 GHz awarding trial licenses for use in 2018 and onwards
EU:	24.25 – 27.5 GHz for commercial deployments from 2020

Source: GSA Report Feb 2017



2 Advanced Beamforming Techniques Require System-Level Design

5G NR uses advanced beamforming to overcome the path loss and multi-path signal propagation issues that come with mmWave frequencies. The benefit of beamforming is that it can use steerable antenna arrays that deliver antenna gain and better SNIR to a specified UE. To make the most of the technology, however, new design and system-level test approaches are required.



Where
$\Delta f = 2^{\mu} \times 15\ kHz$
Example: 15 kHz, 30 kHz, 60 kHz ... 480 kHz subcarrier spacing

3 Waveform and Scalable Numerology Means PAPR Challenges

The 5G NR Rel-15 uses CP-OFDM waveform in DL and UL with scalable numerology. Scalable numerology allows for multiplexing of services with different quality and latency requirements and provides larger subcarrier spacing for mmWave carriers. The multiplexing of the multiple subcarrier spacing introduces PAPR (peak-to-average power ratio) and inter-subcarrier interference challenges since signals are not orthogonal. DFT-s-OFDM waveform can be used in UL to reduce the PAPR for UEs in power-limited scenarios where power efficiency is required.

4 Millimeter Wave Frequencies Require OTA Test

At mmWave frequencies, small-size antennas require testing to be conducted over-the-air (OTA) – a complex and expensive approach. A compact antenna test range (CATR) uses a parabolic reflector system and rotating positioner to eliminate the need for extremely large and expensive chambers.

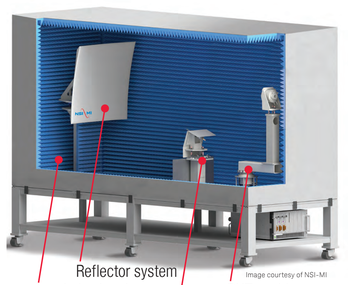
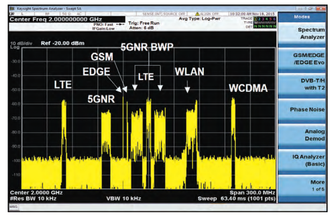
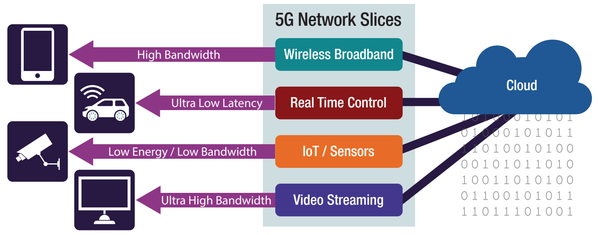


Image courtesy of NSI-MI

5 Multi-Waveform Coexistence Presents Interference Issues



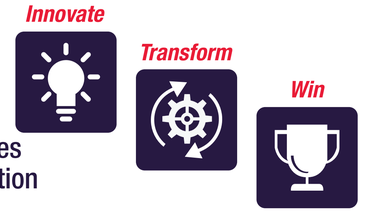
5G NR must coexist with the many already existing services and with new services that will be introduced to support 5G use cases. Different signals can be found in adjacent and in non-contiguous spectrum, making interference a big issue. To reduce adjacent spectrum interference, in-band and out-of-band emissions must be minimized.



6 Network Changes Are Inevitable

5G NR will drastically increase network traffic. To support the 5G NR use models and minimize cost, new network technologies are required. Network slicing makes the network more dynamic, enabling operators to allocate speed, capacity, and coverage. Cloud RAN moves baseband processing into the cloud, making mobile connections more efficient.

7 5G Requires Innovation



5G pushes the boundary of the wireless network, spawning new technologies to support new use cases. More antennas, mmWave technology, and higher speed all come at incremental costs. To be successful, you must innovate new designs and business models ahead of your competition.

Find out more: www.keysight.com/find/5G

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Accelerating Innovation Across the Wireless Ecosystem

To win in 5G, you need to think differently about how you simulate, design, validate, and optimize new products and services, from radio propagation and signal quality, to voice, data, and IoT traffic. Keysight partners with industry leaders to understand and master the complexities of 5G. See how our end-to-end insights and deep technical expertise can help you master the complexities so you can innovate, transform, and win in 5G.

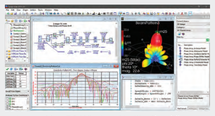

5G RF DVT Toolset

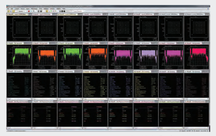

E7515B 5G UXM Wireless Test Platform


5G Protocol R&D Toolset

Emulate new 5G beamforming and mmWave spectrum protocols and speed time-to-market.


Infiniium Oscilloscope


SystemVue 5G Wireless Verification Library


Signal Studio and 89600A VSA Software


Wideband PXI Source and Analyzer Testbed


N9041B UXA Wideband Signal Analyzer

Develop and analyze 5G NR wide bandwidth waveforms from RF to mmWave with precision performance.

NEMO Outdoor


FieldFox Analyzer


IxLoad Performance Testing

Deploy and test 5G networks with precision field measurements and optimized network performance.

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