5G RAN Testing

CHALLENGE: CAPTURING THE PROMISES OF 5G-RAN

As 5G standards evolve, it is important to perform continuous standards conformance testing to accelerate innovation. Testing 5G devices, equipment, and networks with complete confidence requires careful planning, well thought-out test plans, a performance benchmarking strategy, test automation, and reporting. This will eliminate any surprises when accelerating the deployment of 5G-related products and services.

5G New Radio (NR) is the new technology specification for an OFDM-based physical air interface. 5G NR is not an evolution of 4G (LTE). It is required to achieve the extreme bandwidth, low latency, and massive scalability requirements of 5G. 5G NR is expected to make wireless broadband performance the same as wired – "Wireless Fiber" to deliver lower cost per bit.

Based on these drivers, here are a few key expectations placed on the next-generation of wireless networks:

1. Drastic decreases in latency (1ms on radio, <5ms end to end) and massive improvements in throughput (gigabit speeds per subscriber)
2. Drastic increases in density – one million devices per square kilometer
3. Support for higher-speed mobility – up to 500Km/h
4. Drastic decreases of energy consumption for terminals (for IoT devices, surviving up to 10 years on a couple of AA batteries)
5. Improvements to geolocation accuracy – less than 1 meter
6. Increases in network flexibility with more automation and programmability
7. Reducing OPEX costs to one-fifth of today's numbers

MORE AND FASTER

Unlike some prior, more incremental advances in wireless, 5G is not just about more and faster, but more and faster is part of the story. Enhanced mobile broadband (eMBB) captures much of the more and faster story, but it is here that the quantity of the more and faster bring about a completion of what started with earlier 4G deployments like WiMAX – wireless as a replacement for wired connections.

HIGHLIGHTS

- Validate 5G RAN functionality by assessing full protocol stack from Layer 1 to Layer 7
- Functional testing – layer by layer testing – up to 10 UEs
- Load testing of 5G-RAN – NSA and SA modes
- Compact footprint with potential to grow up to 4,000 UEs
- Test complex mobility scenarios
- Perform service quality validation with subscriber modeling, and multiplay voice, video, and data traffic generation
- 3GPP R15, FR1 (Sub6 GHz), up to 4xCC, up to 4x4 MIMO
- Flexible, modular, and scalable to support different split architecture of 5G-RAN

SOLUTION: 5G NR UE EMULATION FOR FUNCTIONAL LAYER-BY-LAYER TESTING AND LOAD/SCALE/PERFORMANCE TESTING

Keysight's XAir3 fixed chassis (appliance) provides 5G NR user equipment (UE) emulation that enables a powerful Layer 1 to 7 test solution. With complex UE modeling, it offers realistic and easily-configured traffic models and call patterns. Using IxLoad's real-world subscriber modeling, testers do not need to be protocol experts to develop test realism. From a single tool, users can perform capacity tests, detail a cell throughput, measure voice and video quality, and model a wide variety of mobility scenarios.
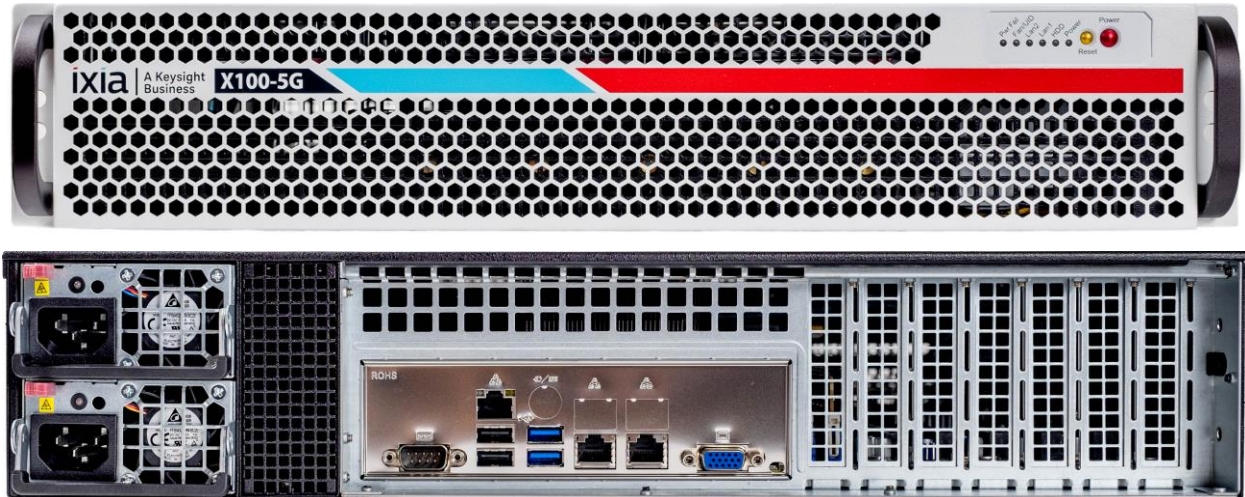

PRODUCT CAPABILITIES

- Full-featured 5G NR UE emulation within all FR1 Sub6 GHz bands with 100 MHz bandwidth

- Mobile application modeling with voice, video, and data traffic, including QoE (MOS, PESQ) and QoS measurements

- Non-standalone (NSA) – Option 3x with potential for 3, 3a, 4, and 7 as per 5G RAN architecture

- Standalone (SA) mode

- Designed for 5G

- Initially NSA, software upgradable to SA

- Uses current gen 4G UE emulation system as LTE anchor

- Baseband + lower MAC-layer functions

- Purpose-built for eMBB, mMTC, and URLLC

- Support for both sub 6GHz and mmWave

- Support for 100, 200, 400MHz bandwidth

- Support for 2x2, 4x4 MIMO

- 4 aggregated carriers, thousands of UEs

- 8xQSFP28 that are capable of eCPRI (10/25G)

- 8x25G links for data-plane IP traffic

XAIR3 PHYSICAL SPECIFICATIONS

| XAIR3 BASEBAND FIXED CHASSIS SYSTEM SPECIFICATIONS	
Fixed Chassis System Dimensions	• 30.3" (L) x 17.3" (W) x 3.46" (H) • 770mm (L) x 438.2mm (W) x 88mm (H)
Fixed Chassis System Weights	• Hardware only: 74.6 lbs. (33.84 kg) • Shipping: 94.5 lbs. (42.86 kg) [1] [1] Approximate (includes slides, power cords, sync cables and packaging)
Fixed Chassis System Electrical Power [2]	• Operates on 100-240VAC, 50/60Hz. • 200-240VAC is single phase. • Requires (3) power sources when running 100-120VAC, 9 Amps for each power supply. XAir3 fixed chassis is shipped with (3) 100-125VAC power cords. • Requires (2) power sources when running 200-240VAC, 7 Amps for each power supply. For 200-240VAC power cords, order part number 942-0110 from the Ordering Information section of this datasheet. The kit is provided at no charge with the purchase of a XAir3 fixed chassis when 200-240VAC is required. [2] Note: Power specifications are preliminary and are for reference for initial facility planning purposes.
Temperature	• Operating: 41°F to 95°F (5°C to 35°C) • Storage: 41°F to 122°F (5°C to 50°C)
Humidity	• Operating: 0% to 85%, non-condensing • Storage: 0% to 85%, non-condensing

X100-5G

- 2U appliance

- Intel 44 cores, 128GB RAM, 480GB SSD, 4 slots

- Runs Ubuntu OS

- 4 PCI Express Slots

- 25GE NICs (2-ports) – must be ordered separately

- 10GE NICs (2-ports) – must be ordered separately

10GE NIC

10GE NIC KEY FEATURES

- Dual SFP+ connectors
- Low-profile standard form factor
- PCI Express 2.0 (up to 5GT/s)
- Intel® QuickData technology
- VMDq, next-generation VMDq, and PC-SIG SR-IOV for virtualized environments
- Load balancing on multiple CPUs
- iSCSI remote boot support
- FCoE
- Support for most network operating systems (NOSs)
- Support both DAC twin axial and LC fiber-optic SR cables
- RoHS compliant 6/6
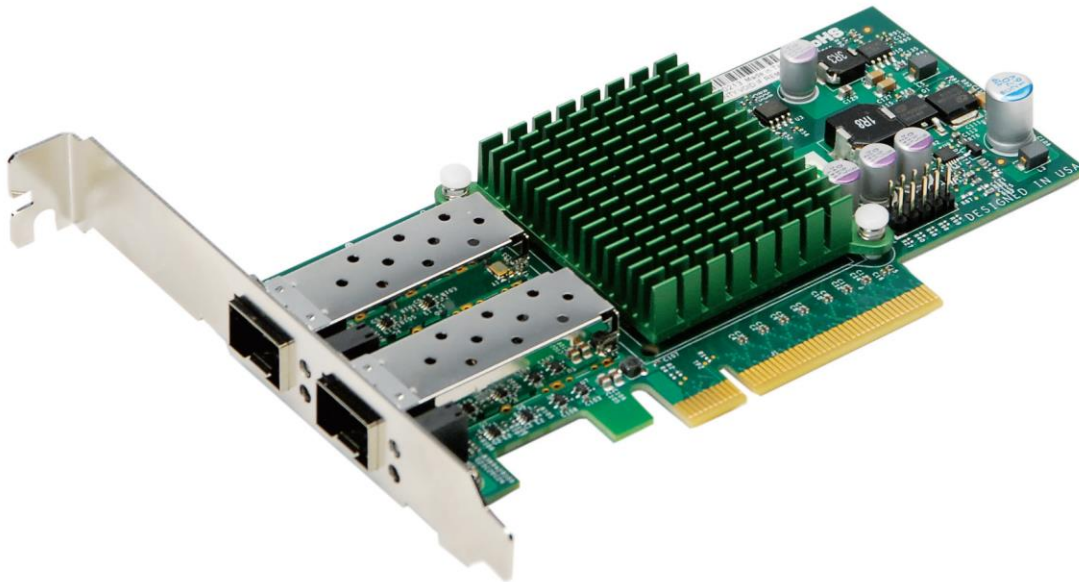
25GE NIC

25GE NIC KEY FEATURES

- Dual SPF28 connectors
- Low-profile, short length standard form factor
- PCI-E 3.0 x8
- Mellanox ConnectX®-4 Lx EN Ethernet Controller
- Asset management features with thermal sensor
- Hardware offloads for VXLAN, NVGRE, and GENEVE encapsulated traffic
- Low-latency RDMA over converged Ethernet (RoCE)
- PCI-SIG SR-IOV compliant
- Jumbo frames support up to 9.6KB
- PXE support
- Erasure coding offload
- NC-SI for IPMI support
- RoHS compliant 6/6

5G NR RADIOHEAD: RH 400-6000

The XAir3 Module is connected to the gNB device under test (DUT) through a radio frequency (RF) connection provided by the Ixia 6GHz Wideband Radio. The specifications for this radio are provided in the table below.

HIGHLIGHTS

- 400MHz to 6GHz frequency range
- FDD/TDD support
- 4x4 MIMO
- Class leading RF timing alignment for OTA test
- 100Mhz instantaneous bandwidth
- TX output power 0dBm (400-2700MHz)
- TX output power -10dBm (2700-5500MHz)
- TX output power -15dBm (5500-5925MHz)
- Support for CPRI V4.2
- CPRI line rates 1-8 supported
- Ambient temperature range 5-50 degree C
- RF connectors SMA
- Low power consumption typical < 80W
- Product Weight 12Kg

GENERAL SPECIFICATIONS

SPECIFICATION	VALUE
Bandwidth	100 MHz
Frequency ranges	400-6000MHz
Operating mode	FDD/TDD
Number of Tx/Rx paths	4x4 MIMO
Digital baseband I/F	CPRI V4.2
Clock reference	Recovered from CPRI line rate

Ambient Temperature range	5-50 C
Module RF connectors	SMA
Power meters	Tx and Rx power meters located at the antenna
Calibration	Continuous compensation of quadrature (IQ) imbalance
PSU Spec	100 – 240 VAC, 50-60 Hz; 80W Replaceable or resettable fuse Input: IEC-C14

FIBRE OPTIC INTERFACE SPECIFICATION

SPECIFICATION	VALUE
Fiber Optic Cable	Duplex LC Single Mode Fiber Wave Length: 1310nm Fiber Type: 9/125nm

PHYSICAL/ENVIRONMENTAL AND ELECTRICAL SPECIFICATIONS

SPECIFICATION	VALUE
Height	1U
Depth	Depth 630mm;
Weight/Mass	12kg including removable rails (but with no packaging)
19" Rack connection	Tool-less rack supplied with product. Rail Range: Min = 660mm ; Max = 800mm
Front Panel	8 x SMA RF connectors, female (4 x Rx, 4 x Tx) LED Panels: see Requirements section for details
Rear Panel	2 x SFP+ ports (bidirectional CPRI), 2x Ethernet Power Input: IEC-C14 Ground Lug with bolt/washer or equivalent 2 x SMA TDD pulse outputs
Cooling	Internal Fan cooling

ELECTRICAL SPECIFICATIONS (AT 25ºC UNLESS OTHERWISE SPECIFIED)

TRANSMIT SPECIFICATIONS	
SPECIFICATION	**VALUE**
Tx power (OFDM)	TX output power 0dBm (400MHz-2.7GHz) TX output power -10dBm (2.7-5.5GHz) TX output power -15dBm (5.5-5.925GHz)
Tx max. power (CW)	≥10dBm (400-2700MHz) 0dBm (2700-5500MHz) -5dBm (5500-5925MHz)
Tx power meter	Wideband power @ antenna
Tx gain range	>40dB
Tx gain accuracy	0.25dB
Tx spurious emissions	<-45 dBm
EVM	<1.2% 400MHz to 2.0GHz; <1.4% median and 2% peak 2.0GHz to 4.0GHz; <1.6% median and 3.5% peak 4.0 GHz to 6 GHz
Noise power density	<133dBc/Hz @ 10Mhz offset
Tx to Tx isolation	>50dB
Tx to Rx isolation	>60dB
DAC	16 bit
Gain Flatness (over full bandwidth)	0.8dB
Ripple (over full bandwidth)	0.6dB

RECEIVE SPECIFICATIONS	
SPECIFICATION	**VALUE**
Rx power max. (no damage)	30dBm
Rx power meter	Wideband power @ antenna
Rx gain range	60dB

Rx gain accuracy	0.25dB
Spurious emissions	<-45dBm
Pass band ripple	<±1dB
Demodulation Accuracy (in terms of EVM)	< 1.1% 400MHz to 2.0 GHz @ 256 QAM < 1.5% 2.0GHz to 4.0GHz @ 256 QAM < 1.5% median and 3.5% peak 4.0GHz to 6.0GHz @ 256 QAM

TIMING ALIGNMENT

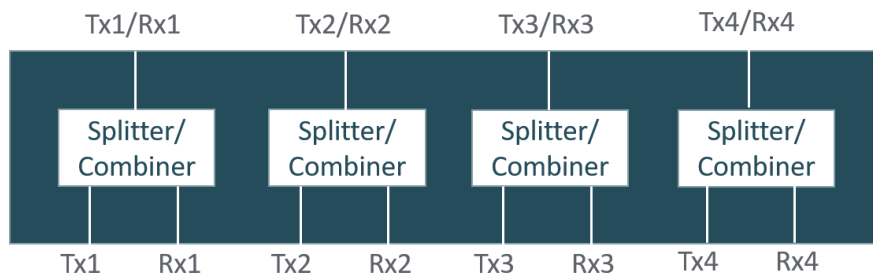| SPECIFICATION	VALUE
TX Delay Alignment (TX port to any TX port)	<=5nS
RX Delay Alignment (RX port to RX port same CPRI link)	<=5nS
RX Path Alignment (variation between antenna)	<=15nS
Delay adjustment	+/- 4nS
Delay reporting	T12,T2a ad Ta3 per the CPRI Spec

5G NR RADIO CONNECTION ENCLOSURE; SUB 6 GHZ: RCE 350-6000

The Radio Connection Enclosure (RCE 350-6000) simplifies cabling when attaching to DUTs that have a single port (combined Tx and Rx) per antenna. RCE 350-6000 is a passive device containing all the cabling and splitter/combiner parts required to transform the Radio Head antenna interface to combined Tx/Rx antenna ports. Connectors and internal parts are chosen to specifically match the full range of frequency and power supported by the Radio Head.

Block Diagram:

PHYSICAL/ENVIRONMENTAL AND ELECTRICAL SPECIFICATIONS

| SPECIFICATION	VALUE
Height	1.72 in [43.7 mm]
Width	19.00 in [482.6 mm]
Depth	15.11 in [383.8 mm]
Weight/Mass	6.7 lbs [3.1 kg]
19" Rack connection	Mounting holes (x4) on front panel
Front Panel	8 x SMA RF connectors, female (4 x Rx, 4 x Tx)
Rear Panel	4 x N RF connectors, female

ELECTRICAL SPECIFICATIONS (AT 25ºC UNLESS OTHERWISE SPECIFIED)

SPECIFICATION	VALUE
Port Count	4
Bandwidth	350 MHz to 6000 MHz
Isolation per port	17.1 dB

## PLATFORM OPTIONS FOR XAIR2 FOR 4G/LTE ANCHOR

VISIT KEYSIGHTCOM.COM FOR MORE INFORMATION ON IXLOAD PLATFORM OPTIONS	
Chassis	• XGS-12 HS/SD/HSL Chassis • XGS-2 HS/SD/HSL Chassis
Load Modules	• XAir2 • PerfectStorm
Radio Head	4G Radio Head: Supports all LTE bands with 5/10/15/20 MHz bandwidth
Radio Connection Enclosure	4G RCE: A passive device containing all the cabling and splitter/combiner parts required to transform the Radio Head antenna interface to combined Tx/Rx antenna ports

TEST TOPOLOGIES

NSA Mode – eNB and gNB wrap-around - Option 3x or real EPC.
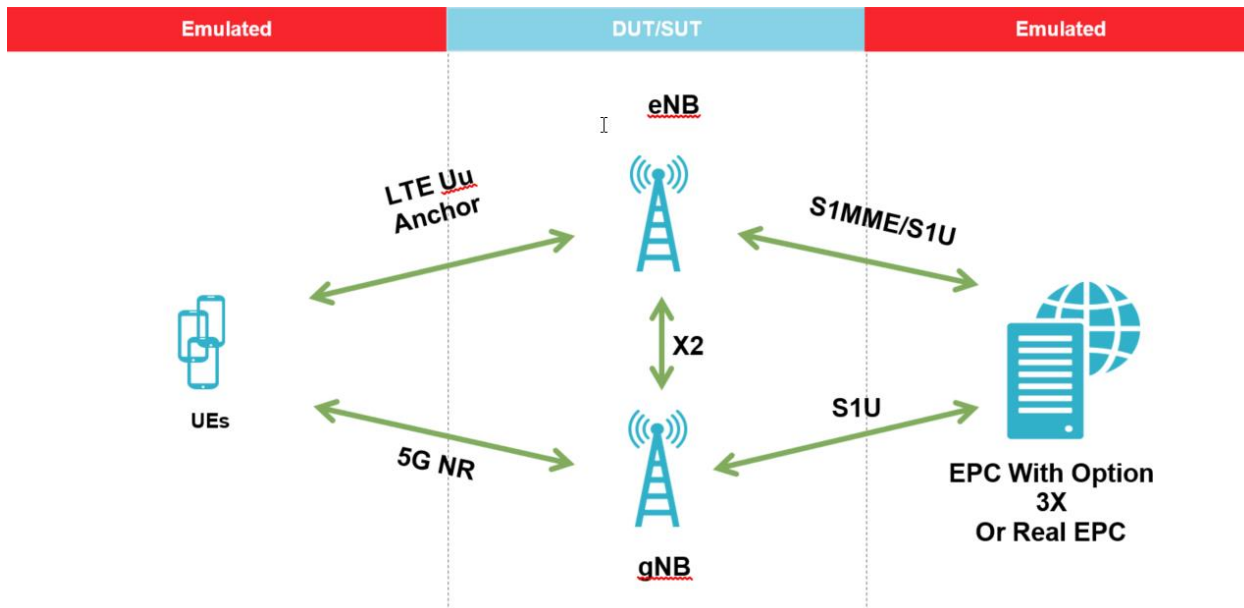
NSA Mode – eNB and gNB-CU wrap-around - Option 3x or real EPC.
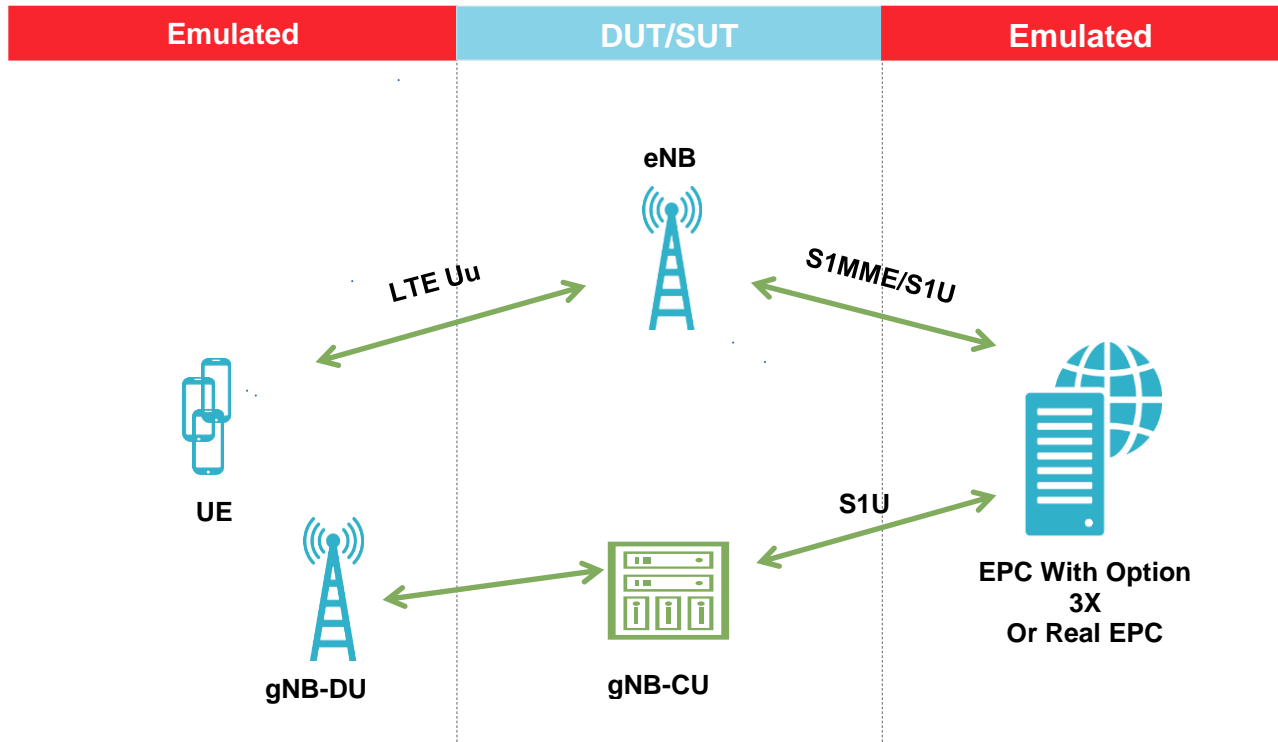
ORDERING INFORMATION

T8020S – Please contact your local Ixia sales team.

Learn more at: www.ixiacom.com

For more information on Ixia products, applications, or services,

please contact your local Ixia or Keysight Technologies office.

The complete list is available at: www.ixiacom.com/contact/info