



KEYSIGHT
WORLD 2019

5G gNB Testing With High-Performance User Equipment Simulation

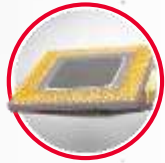
Solution Architecture/ ISG Keysight

Tony Wang



Keysight Provides Insight Across the Entire Stack

■ Keysight Classic ■ Ixia ■ Anite



**COMPONENTS &
CHIPSETS**



DEVICES



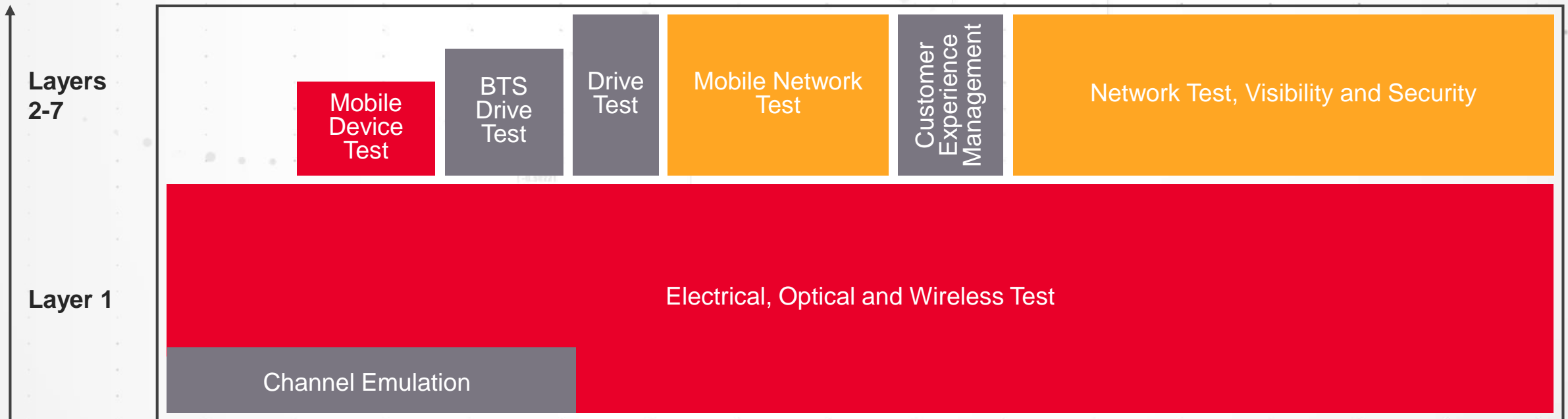
BASE STATIONS



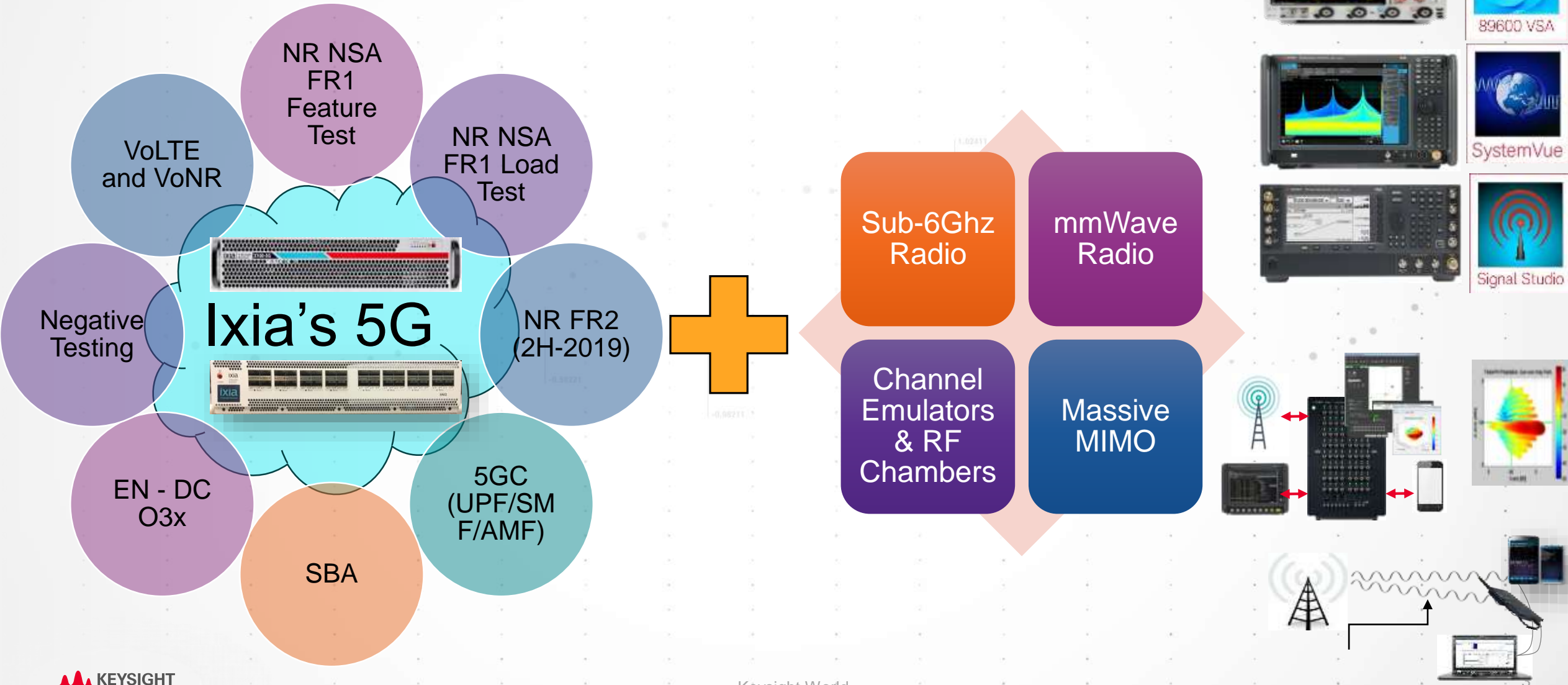
**HYPERSCALE AND
DATA CENTERS**



ENTERPRISE



5G - Keysight and Ixia : RF to Cloud One Stop Shop



UE Emulation Evolution

HW Available
Now

T600

- LTE
- Released 2009
- 400 UEs
- ATCA, Discrete FPGA, DSP, CPU
- 2 sectors in chassis

XAir

- LTE-A
- Released 2012
- 1,000 UEs
- 2 CA
- 6 Sectors in chassis

XAir2

- LTE-A Pro
- Released 2016
- 4,000 UEs
- GigLTE
- Cellular IoT
- LAA
- 4CA

XAir3 (2U fixed chassis)

- 5G NR
- NSA and SA
- Functional and Load Test
- FR1 and FR2(roadmap)
- Up to 100 MHz bandwidth
- Up to 4x4 MIMO

5G UE Emulator – H/W components

HARDWARE COMPONENTS

5G UE Emulator for FR1 and FR2

X100-5G
L2+Traffic



XAir3
Baseband



Radio Head
RCE



mmWave Head
(only for FR2)



- Hardware required for example solutions
- NSA requires additional XAir2 card for LTE Anchor
- RCEs include Circulators, Splitters

5G UE Emulator – 4 Carriers

X100-5G
L2+Traffic



XAir3
Baseband



RH 1
RCE 1



RH 2
RCE 2



RH 3
RCE 3



RH 4
RCE 4



mmWave Heads
(FR2)



5G UE Emulator H/W Components: XAir3

BASEBAND PROCESSING PLATFORM

- Industry-best processing power for UE Emulation
- Hosts the Baseband PHY channels
- Same hardware for
 - ✓ Single UE to 1000s of UEs
 - ✓ Sub 6GHz and mmWave
 - ✓ NSA or SA
- Software configurable for 100, 200, 400MHz bandwidths
- Support for X-RAN - CU/DU split architecture
- Support for 2x2, 4x4, 8x8 MIMO and Mu-MIMO
- Support for Baseband based fading



5G UE Emulator H/W Components: X100-5G

UPPER LAYER APPLICATION SERVER

- Multicore Intel Server with multiple 25G/10G Ethernet links
- Hosts 5G L2+ stacks = MAC, RLC, PDCP, RRC
- Hosts software test packages:
 - UE Functional Emulator: Few UEs, feature tests, layer level tests
 - IxLoad high scale traffic emulator: 1000s of UEs with realistic subscriber traffic profiles
- Same hardware for NSA or SA
- Connects to baseband over high speed (25G links) to provide 5G UE Emulator



5G UE Emulator HW Components: 5G Sub6GHz Radio Head

<6 GHZ RF TRANSCEIVER UNIT



- XAir3 sub-6GHz RF transceiver unit
- 4 receive and 4 transmit antenna connectors
- CPRI interface to XAir3 baseband (port card)

5G UE Emulator H/W Component: M1740A mmWave RH

- Supports all 3GPP specified 28 GHz, 39 GHz, and 40 GHz bands in FR2
- Compact, bi-directional
- Connect to XAir3/Sub6 RH for conversion to and from mmWave frequencies
- Remote radio head can be located near OTA chambers reducing test equipment footprint and loss
- Two RF ports
 - Test a single channel of two antennas without reconnection or external switching
 - Test two polarizations of a single channel without reconnection or external switching
 - Test Tx and Rx independently at the same or at different frequencies
 - Loop back Tx and Rx with one head and one E7770A



5G UE Emulator H/W Component: E7770A CIU (Common Interface Unit)

- Provides a bi-directional intermediate frequency (IF) interface to the gNB by up- or down-converting a sub-6GHz uplink or downlink RF signal into a 6 – 12 GHz IF signal.
- Provides control, power and local oscillator frequency input to the mmWave transceiver M1740A mmWave Radio Head
- Compact, 2U form factor
- Two duplex RF ports for testing multiple devices
- Supported in QDART
- supports the extension of the frequency coverage from sub-6GHz to high IF (6-12 GHz) and mmWave bands.



5G UE Emulator: Components (NSA Sub6)

IxLoad ^{VE}



5G NR EN-DC
UEs



XAir2

4G Radio Head

XAir3

5G Radio Head



Uu



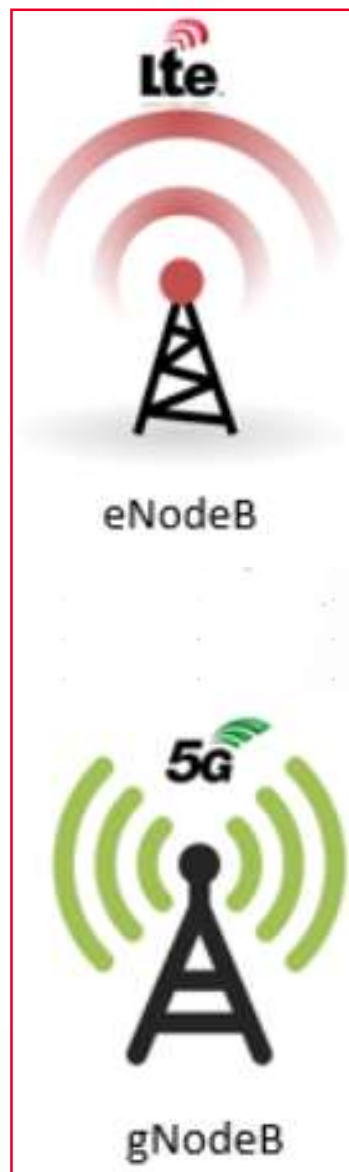
Cabled RF



NR



Cabled RF



25GE

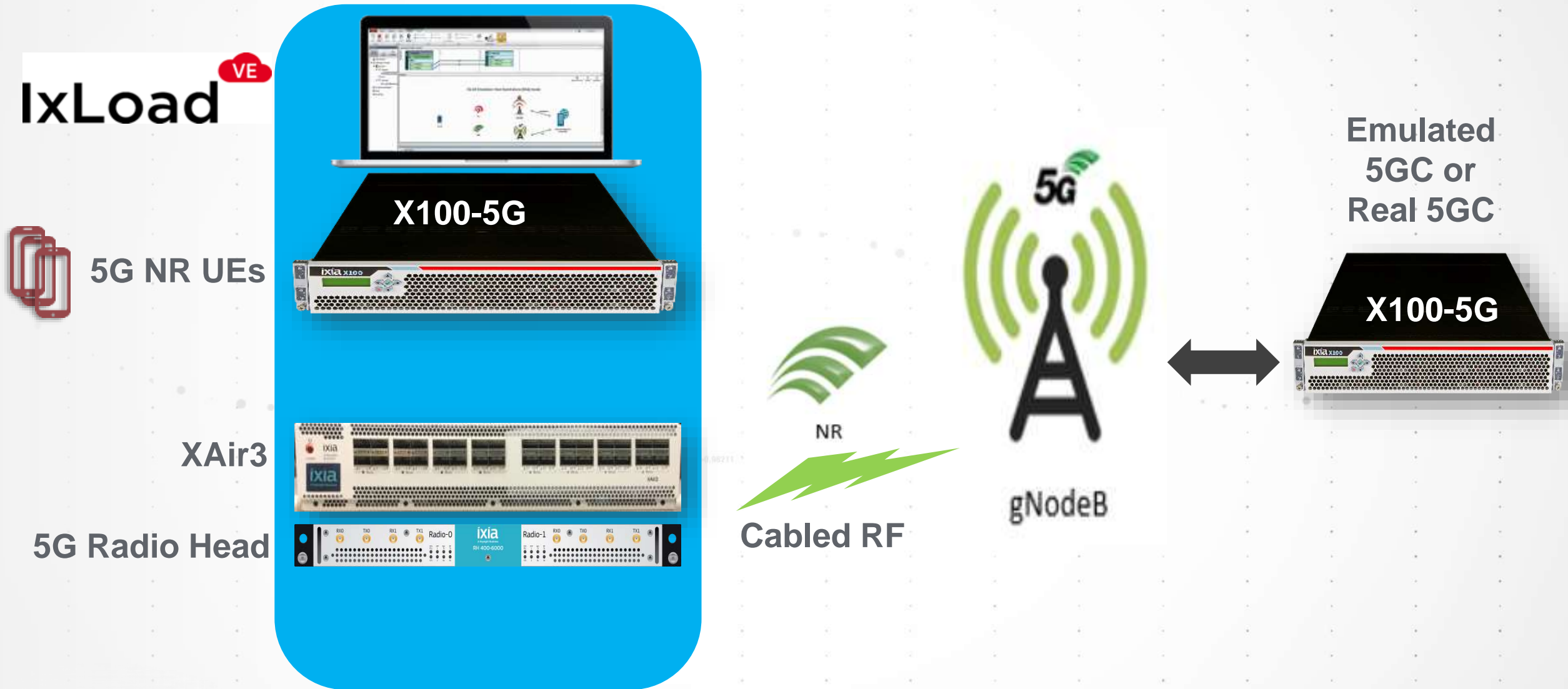


EPC-Sim

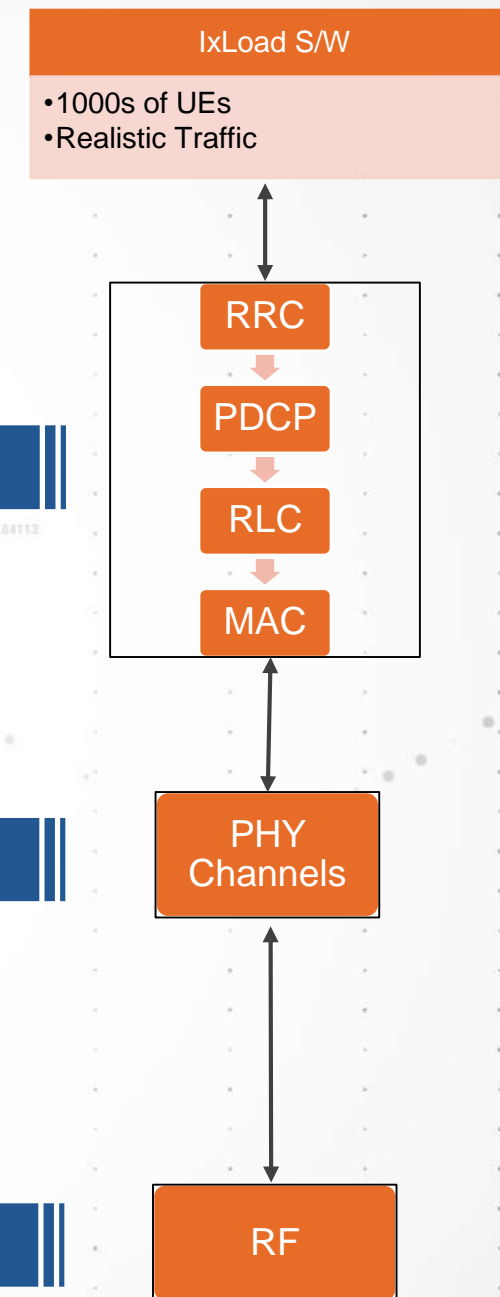
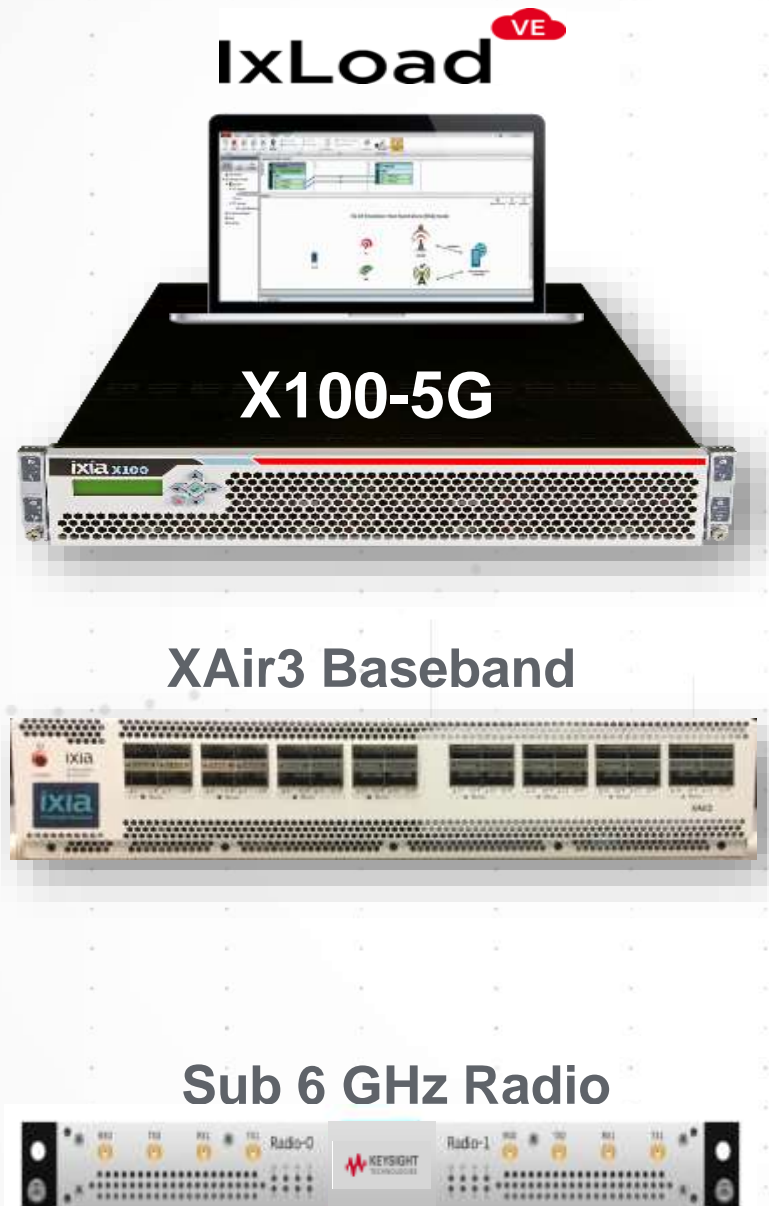
X100-5G



5G UE Emulator: Components (SA Sub6)

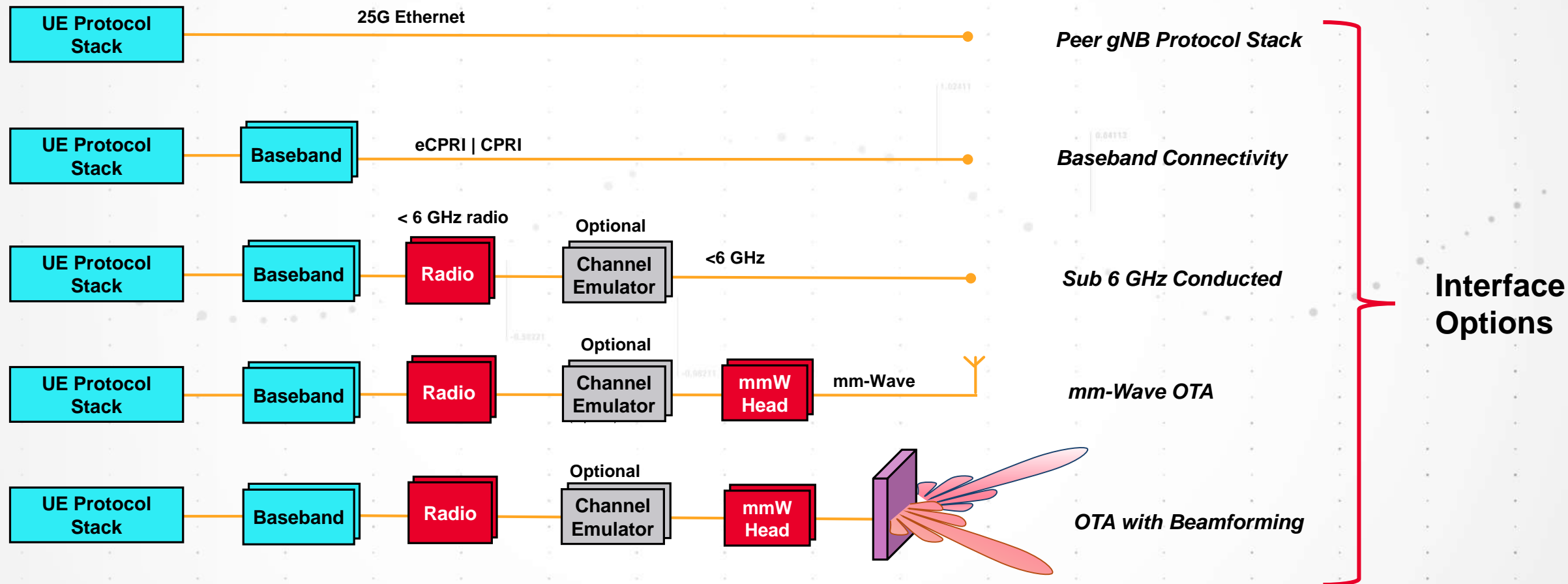


5G UE Emulator: Software Components



5G UE Emulator: Flexibility and scalability

LEVERAGING KEYSIGHT'S END-TO-END STRENGTHS



The only vendor can provide this flexibility

5G UE Emulator: Test Packages

KEY FEATURES

Two powerful test solution packages to match your needs

Functional/Feature Test

- Earliest availability of new 5G features
- Protocol verification
- Layer-by-Layer Test
- R&D, DVT, integration tools
- 1-10 Ues
- Stateless traffic

Load/Performance Test

- Verify complete base station functionality
- End-to-end full stack testing
- Realistic application traffic and usage scenarios
- Scale to 1000s of UEs

Keysight delivers automated tools to speed base station development



5G UE Emulator: Advantages

SOLVING THE CHALLENGES FOR EXISTING UEE PLATFORMS

- Cost-effective AND powerful platform
 - ✓ From one UE to thousands
 - ✓ Interface to DUTs however needed: Baseband, RF, OSS layers, EPC “wrap around” test
 - ✓ Scalable: Buy just the capability needed
 - ✓ Flexible: Modular ability to expand carriers, configuration easily
- Keysight end-to-end solution: “One-stop shop”
 - ✓ World-class baseband, channel emulation, RF and mm-wave capabilities
 - ✓ OTA, fronthaul measurement expertise
 - ✓ Complete range of test equipment for NEMS and Operators for entire life-cycle
 - ✓ Global field force with experts wherever YOU need them



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