KEYSIGHT TECHNOLOGIES

5G Device E2E Workflow Test Solutions

Business Development Manager / Keysight Technologies

Taehyun KIM

5G SUMMIT

5G Scenarios and Use Cases

NEW SERVICES AND CONNECTIVITY PARADIGMS

Courtesy of METIS: 2014

Amazingly Fast	Great Service In a Crowd	Best Experience Follows You	Real-Time & Reliable Communications	Ubiquitous Things Communicating

Mobile Broadband Access

- All data, all the time
- 2 billion people on social media

Massive Machine Communication

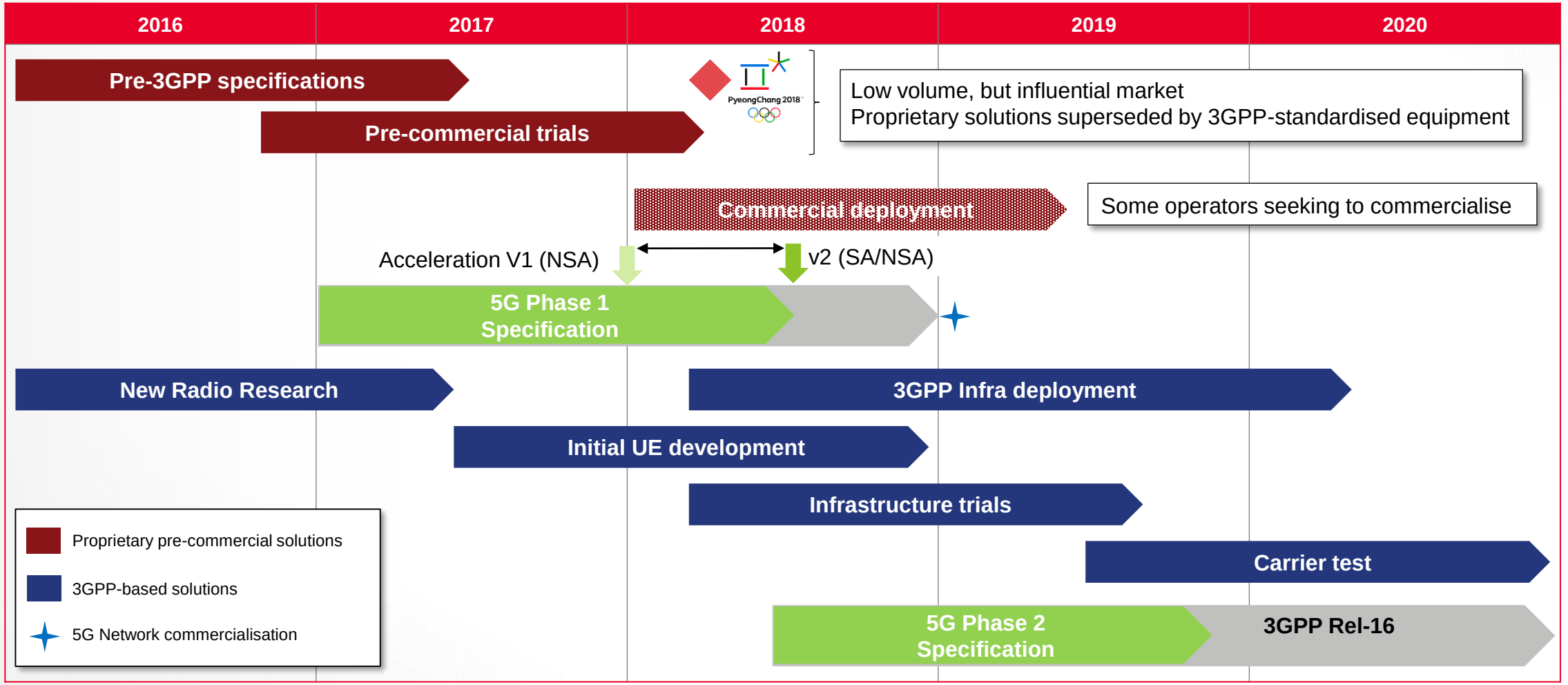
- 30 billion “things” connected
- Low cost, low energy

Mission-Critical Machine Communication

- Ultra high-reliability
- Ultra-low latency

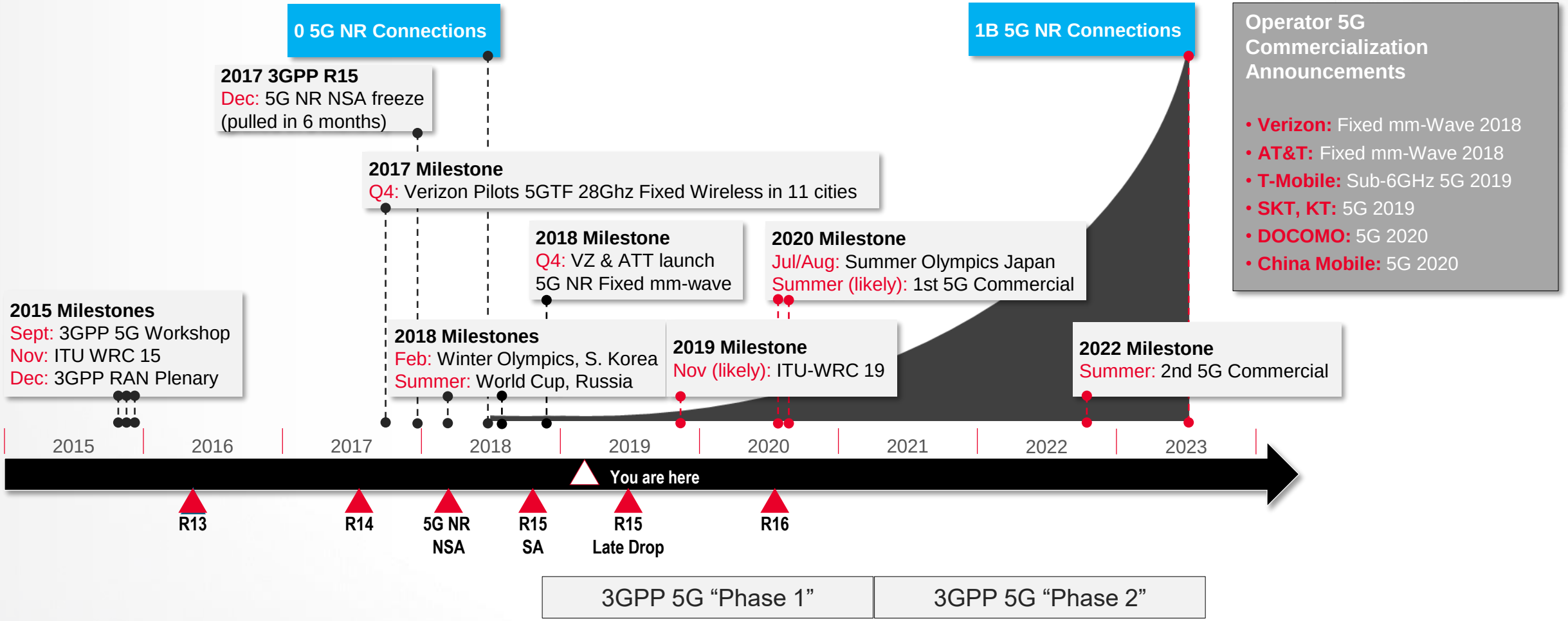
5G Market direction

TIMELINE



5G Timeline

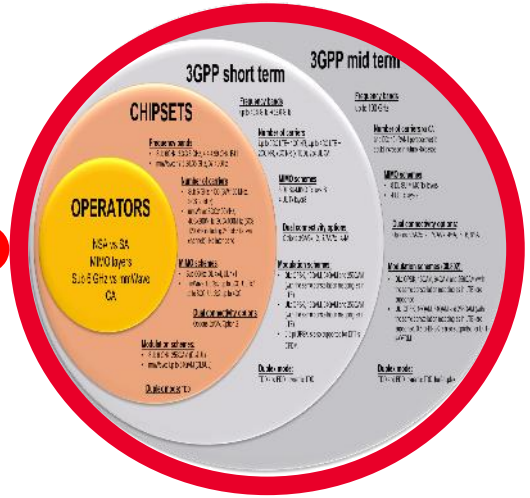
KEY MILESTONES AND CARDINAL DATES



Keysight in 5G

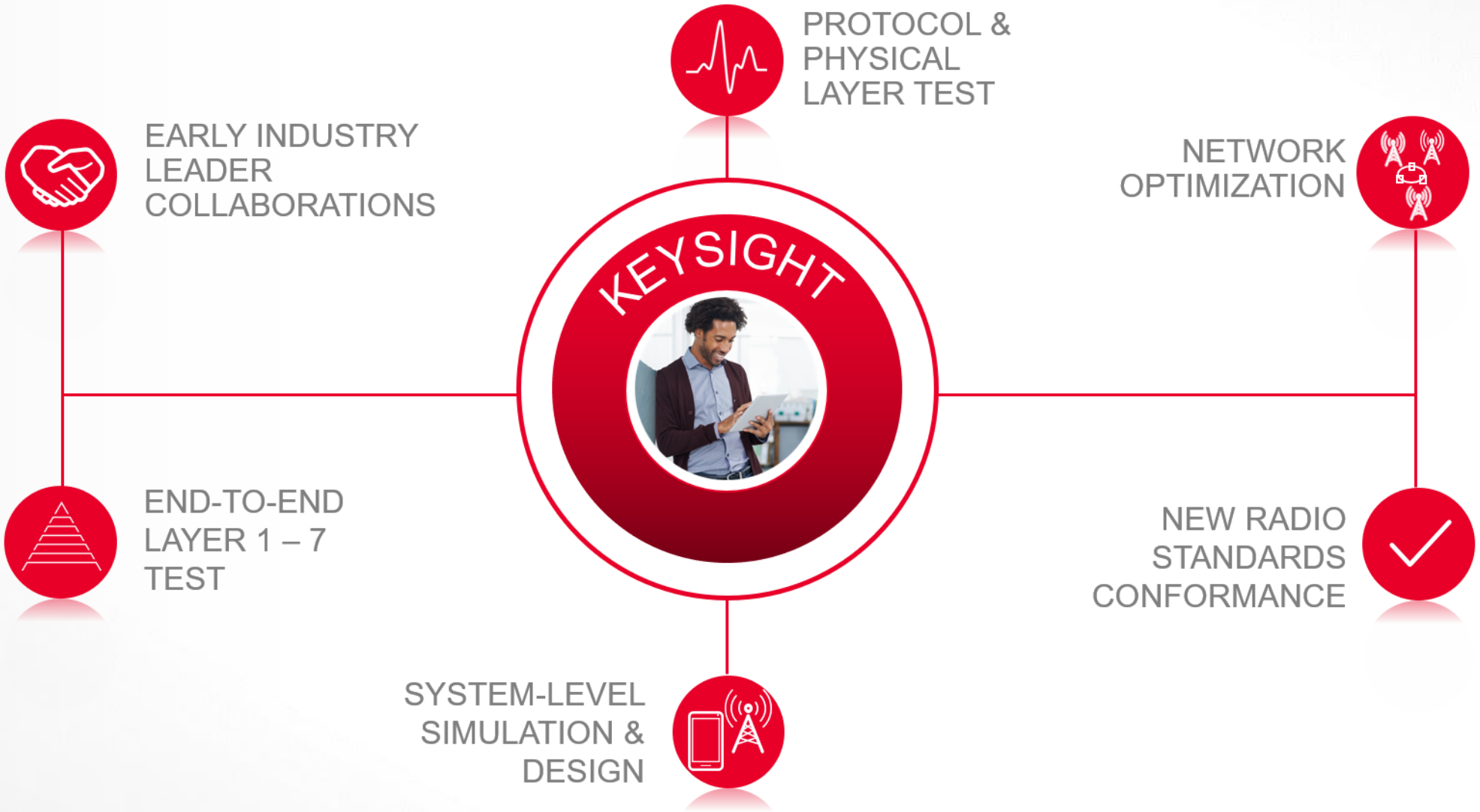
At heart of 5G revolution

Acquisitions



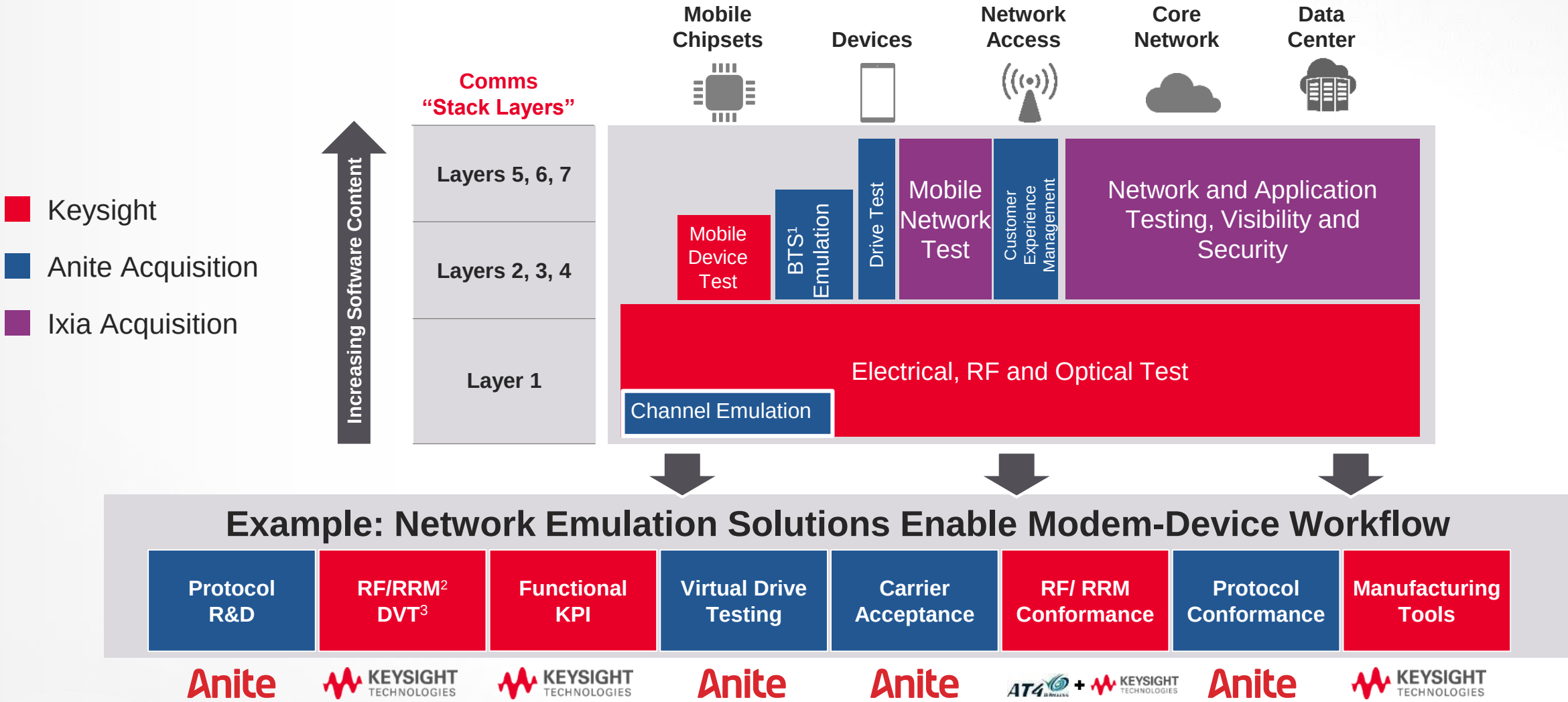
Ecosystem

We Are at the Heart of the 5G Revolution



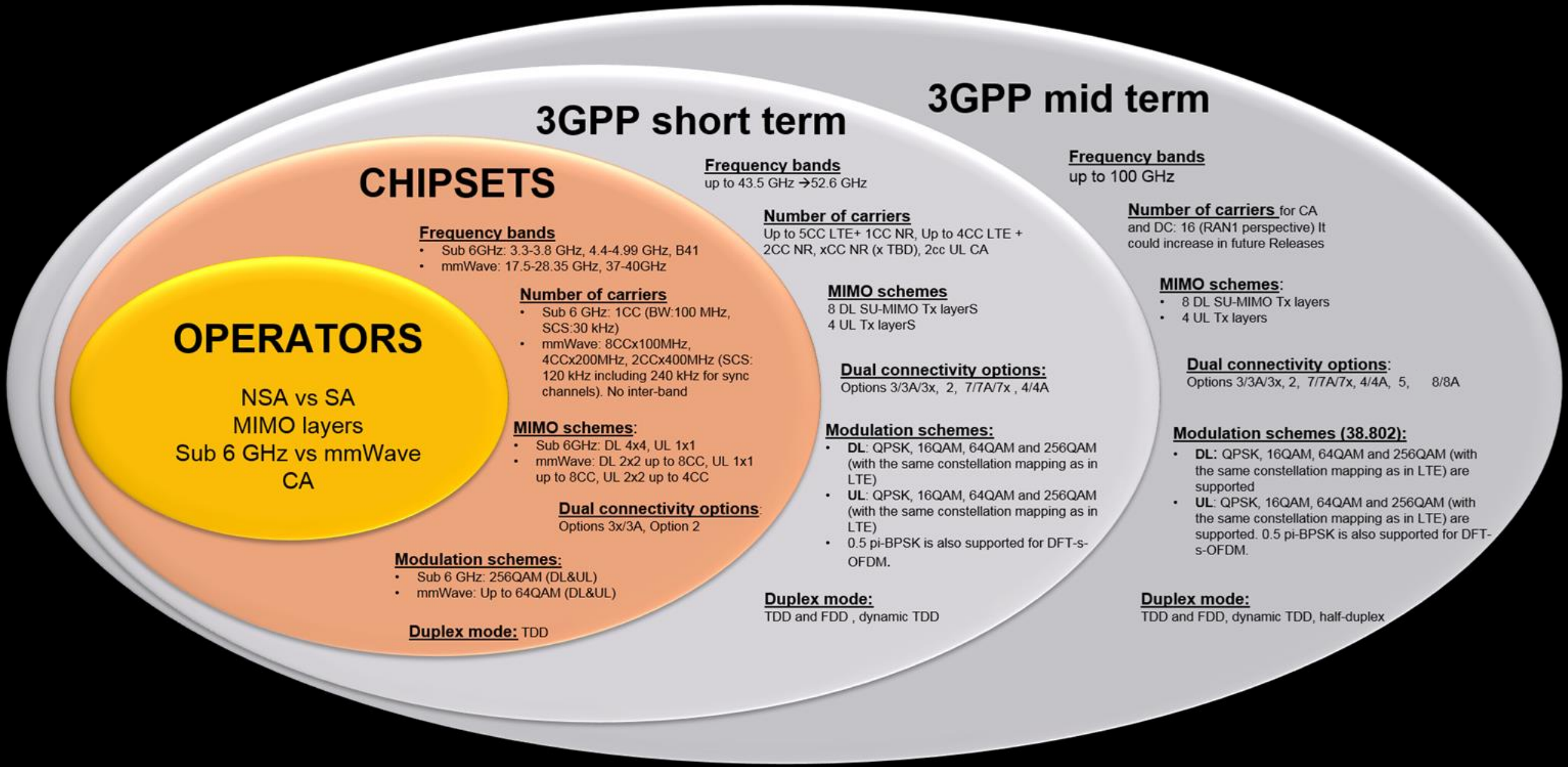
Keysight Strategic Acquisitions & Investments for 5G

FIRST TO MARKET WITH COMPLETE END-TO-END 5G SOLUTIONS



[1] Base transceiver station [2] Radio Frequency / Radio Resource Management [3] Design Validation Test

Ecosystem and features



CHIPSETS

Frequency band
up to 43.5 GHz →52

Number
Up to 5CC
2CC NR, x

Frequency bands
- Sub 6GHz: 3.3-3.8 GHz, 4.4-4.99 GHz, B41
- mmWave: 17.5-28.35 GHz, 37-40GHz

Number of carriers
- Sub 6 GHz: 1CC (BW:100 MHz, SCS:30 kHz)
- mmWave: 8CCx100MHz, 4CCx200MHz, 2CCx400MHz (SCS: 120 kHz including 240 kHz for sync channels). No inter-band

MIMO schemes:
- Sub 6GHz: DL 4x4, UL 1x1
- mmWave: DL 2x2 up to 8CC, UL 1x1 up to 8CC, UL 2x2 up to 4CC

Dual connectivity options:
Options 3x/3A, Option 2

Modulation schemes:
- Sub 6 GHz: 256QAM (DL&UL)
- mmWave: Up to 64QAM (DL&UL)

Duplex mode: TDD

Duplex
TDD and

OPERATORS

NSA vs SA
MIMO layers
Sub 6 GHz vs mmWave
CA

3GPP short term

ETS

cy bands
Hz: 3.3-3.8 GHz, 4.4-4.99 GHz, B41
e: 17.5-28.35 GHz, 37-40GHz

Number of carriers
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schemes:
256QAM (DL&UL)
p to 64QAM (DL&UL)

Frequency bands
up to 43.5 GHz →52.6 GHz

Number of carriers
Up to 5CC LTE+ 1CC NR, Up to 4CC LTE + 2CC NR, xCC NR (x TBD), 2cc UL CA

MIMO schemes
8 DL SU-MIMO Tx layerS
4 UL Tx layerS

Dual connectivity options:
Options 3/3A/3x, 2, 7/7A/7x , 4/4A

Modulation schemes:
- **DL**: QPSK, 16QAM, 64QAM and 256QAM (with the same constellation mapping as in LTE)
- **UL**: QPSK, 16QAM, 64QAM and 256QAM (with the same constellation mapping as in LTE)
- 0.5 pi-BPSK is also supported for DFT-s-OFDM.

Duplex mode:
TDD and FDD , dynamic TDD

Frequency ban
up to 100 GHz

Numbe
and DC: 1
could incr

MIM
- 8
- 4

M
-
-

Duple
TDD an

3GPP mid term

Frequency bands
up to 100 GHz

rriers
CC NR, Up to 4CC LTE +
(x TBD), 2cc UL CA

schemes
U-MIMO Tx layerS
layerS

l connectivity options:
ns 3/3A/3x, 2, 7/7A/7x , 4/4A

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DM.

namic TDD

Number of carriers for CA and DC: 16 (RAN1 perspective) It could increase in future Releases

MIMO schemes:
- 8 DL SU-MIMO Tx layers
- 4 UL Tx layers

Dual connectivity options:
Options 3/3A/3x, 2, 7/7A/7x, 4/4A, 5, 8/8A

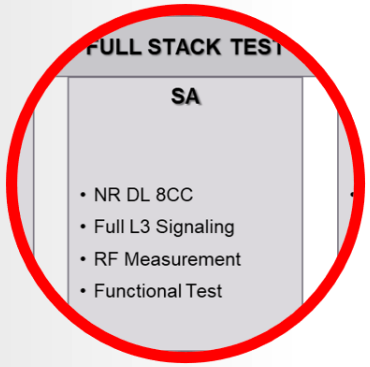
Modulation schemes (38.802):
- **DL**: QPSK, 16QAM, 64QAM and 256QAM (with the same constellation mapping as in LTE) are supported
- **UL**: QPSK, 16QAM, 64QAM and 256QAM (with the same constellation mapping as in LTE) are supported. 0.5 pi-BPSK is also supported for DFT-s-OFDM.

Duplex mode:
TDD and FDD, dynamic TDD, half-duplex

Proof of Concept

Use Cases

Modes of operation



L1 parametrization

Reference 5G network emulation

Protocol flexibility

KEYSIGHT TECHNOLOGIES

Reference 5G Network Emulation

UXM 5G (E7515B)

UXM 5G Wireless Test Platform (E7515B)

- <6GHz Frequency range
- Scalable bandwidth 8Tx/4Rx @800MHz, 4Tx/2Rx @1600MHz
- Integrated RFIO + Internal fading
- Support for RF, IF, Host and BBIQ interfaces (slow and full rate)
- Support for 10GbE connectivity

KEYSIGHT TECHNOLOGIES

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KEYSIGHT TECHNOLOGIES

Interactive Network Emulation

TEST APPLICATION FRAMEWORK

NR Cells Secondary Group

Displays basic cell settings and UE connection status (CONNECTED, IDLE, etc…)

Cells Status Bar

LTE Anchor

Navigate through Functions

Change Network Settings in real-time

Network Settings

Measurements

KEYSIGHT TECHNOLOGIES

Test Application Use Cases

NETWORK EMULATION
- 5G NonStandalone (NSA)
- 5G Standalone (SA)
- LTE Adv. Pro
- CIoT

WORKFLOW
- General purpose
- RCT / RRM building block
- RF Carrier Acceptance

FUNCTIONAL KPI
- E2E Data Throughput
- Voice / Video
- Battery Drain

MODES OF OPERATION
- L1 Test Mode
- Full Protocol Stack
- CW

RF PARAMETRIC
- Transmitter meas
- 3GPP alignment
- MIMO, Carrier Agg
- FR1, FR2

RECEIVER TEST
- BLER / HARQ
- Flexible scheduler
- AWGN
- Fading

Interactive Network Emulation

MODES OF OPERATION

CW

- Path loss calibration
- Any port in the System (UXM, CiU, RRH)
- Power, Frequency

L1 TEST

- Layer 1 test mode
- System information
- No L3 signalling established
- Rx measurements (BLER/Tput, HARQ)
- Tx measurements

FULL STACK TEST

NSA

- LTE DL 2CC (Anchor)
- NR DL 8CC
- Full L3 Signaling
- RF Measurement
- Functional Test

SA

- NR DL 8CC
- Full L3 Signaling
- RF Measurement
- Functional Test

Coming soon..

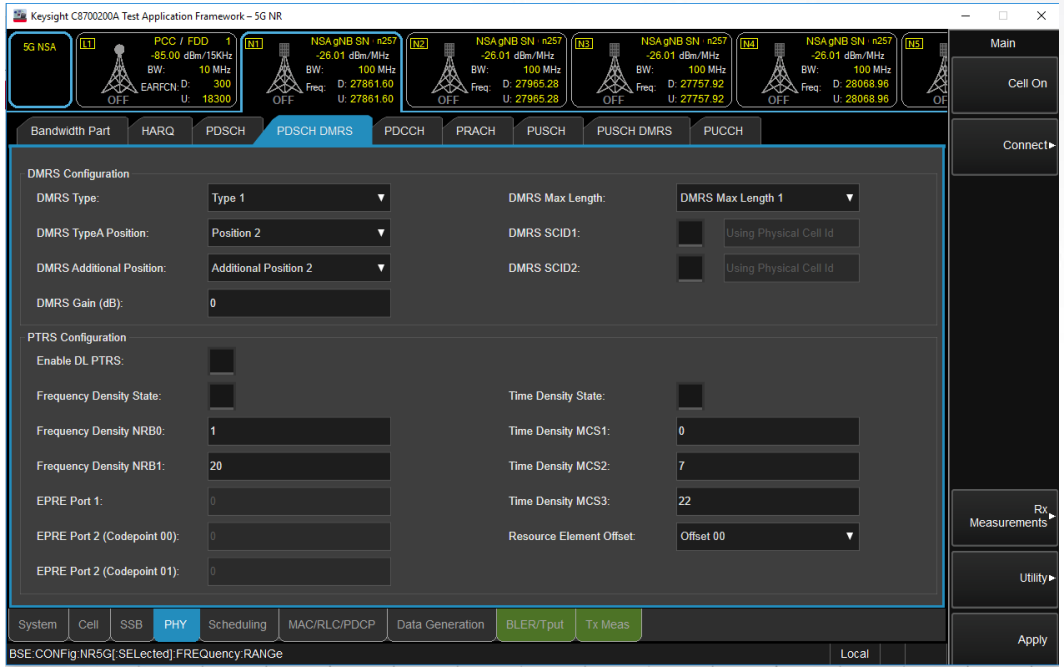
LTE

- LTE DL 8CC
- Full L3 Signaling
- RF Measurement
- Functional Test

Coming soon..

LTE AND NR WITHIN THE SAME NETWORK EMULATOR

Powerful L1 Parametrization



CELL SETTINGS

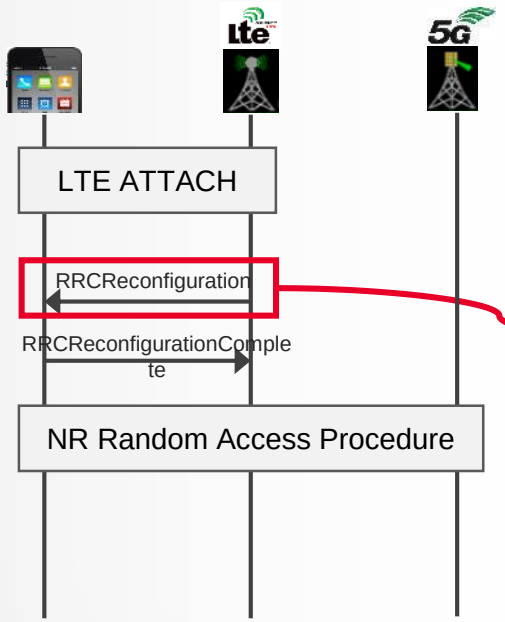
- FR1, FR2, IF, CUSTOM
- BW
- Power
- Subcarrier Spacing
- 2x2, 4x4 MIMO

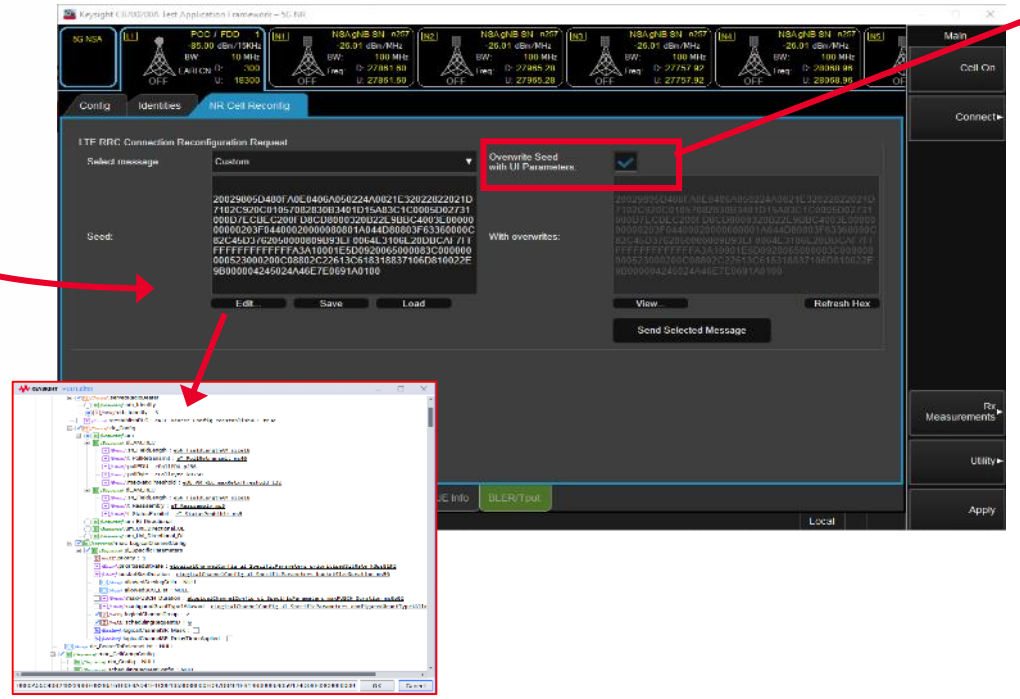
PHYSICAL CHANNELS

- BANDWIDTH PARTS
- SSB, PDCCH, PDSCH
- PRACH , PUSCH, PUCCH
- CSI RS
- HARQ

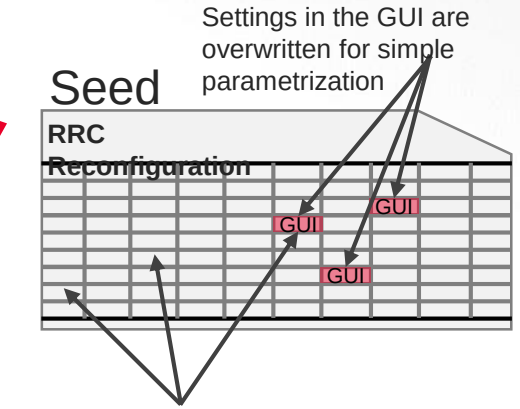
Protocol Flexibility

GO DEEPER IN FUNCTIONAL TEST





Integrated and easy to use ASN editor



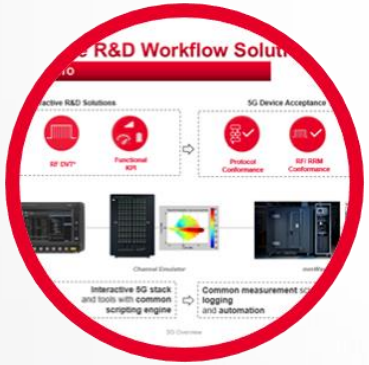
- Ease of use by PDU Editor in the Test App
- With PDU editor you get:
  - Modern look ASN1.0 editor, easy to use (no use of XML directly)
  - Create and further edit your customized protocol messages
  - Tune RRC settings to enable interoperability at early stages
  - Get access to any Information Element not exposed by the Test Application

Device Testing

HW components

R&D Protocol

R&D RF



Workflow Solutions

Functional

KEYSIGHT TECHNOLOGIES

First 5G NR Device R&D Workflow Solutions

END TO END PORTFOLIO

5G Interactive R&D Solutions

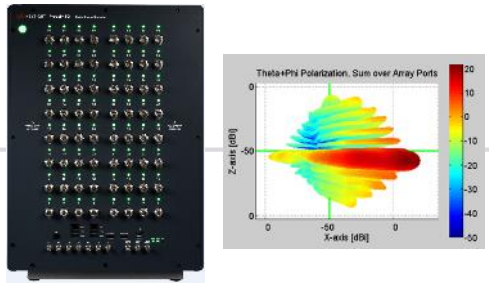
- Protocol R&D*
- RF DVT*
- Functional KPI

5G Device Acceptance Solutions

- Protocol Conformance
- RF/ RRM Conformance
- Carrier Acceptance

*available

Network Emulator



Channel Emulator

mmWave OTA Solutions

Interactive 5G stack and tools with **common scripting engine**

Common measurement science, **logging** and **automation**

5G NES Hardware Components

SCALABLE HARDWARE

FR1

- UXM 5G
- Add PC and 1GB Switch
- Measurements are conducted

FR2

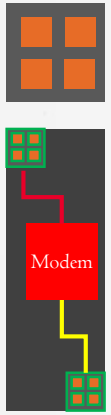
- Add CIU, RRH to FR1 setup
- CATR for emulated far field measurements
- Measurements are over the air

The cable is gone – solutions!

SOLUTIONS OPTIMIZED FOR THE WORKFLOW

CATR

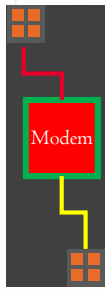
3GPP Approved



- Indirect Far Field
- Supports black box testing
- Use cases
  - RF Parameterics
  - Antenna Tests
  - TRP/TIS
  - Single AoA
  - Throughput tests

3GPP APPROVED

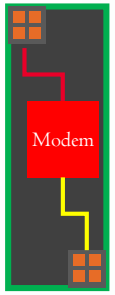
Rack Family – 2D MPAC, RMTC and Mini-RMTC



- Direct Far Field
- Cable replacement tests
- Use cases
  - Protocol Signalling Tests
  - Demod Tests
  - Array Calibration
  - UE CAL
  - Functional Tests

LIGHT WEIGHT

3D MPAC



- Direct Far Field
- Testing with faded environments
- Supports 38.901 based models w Propsim 5G

Use cases

- Throughput test
- HO Performance and NV-IOT
- Beam management

BASED ON SS-MPAC

5G R&D Protocol Toolset

KEY FEATURES

- Earliest availability of new 5G features
- Replicate desired network behavior whilst reducing test complexity with Built-in Protocol State Machine and Dynamic Control Points
- L1/L2 parameter change without programming
- Flexible automation and logging
- Results viewer

KEYSIGHT TECHNOLOGIES

Replicate network behaviour

5G PROTOCOL R&D TOOLSET

- Built-in Protocol State Machine and Dynamic Control Points simulates a “Live Network”
- Allows for interactive testing where the behaviour of a device can be investigated in an easy manner to facilitate debugging

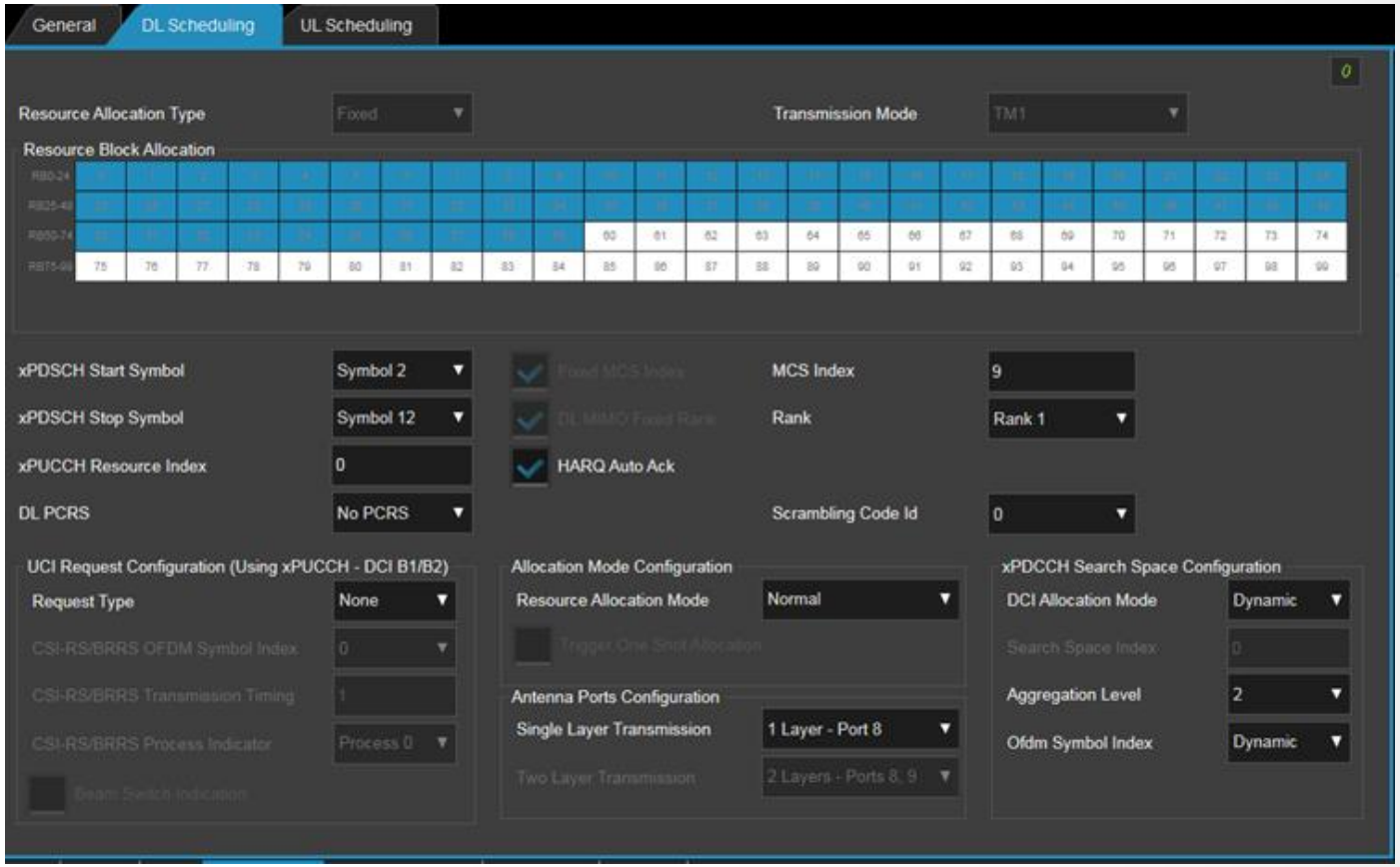
Script

Line	Time	Id	Direction	Details
1				Script Details [NR5G_LTE_PSCellAdd]
2				SIM Information [Explicitly defined]
3	00:00.00			5G User Prompt [Activate NR5G Cell]
4	00:00.00	NR-Cell A		Activate NR5G Cell [NR-Cell A :DL Power = -80 dBm/75kHz]
5	00:00.00	N-Cell A		5G DYNAMIC CONTROL POINT [Continue after User Action]
6	00:00.00			5G User Prompt [Start NR5GUEDemonstrator.exe]
7	00:05.00	E-Cell A		Activate LTE Cell
8	00:00.00	E-Cell A	SS --> MS	RRC Connection Reconfiguration
9	00:00.00			5G User Prompt [Wait, Press Ok to Exit]

Modify network behaviour easily

5G PROTOCOL R&D TOOLSET

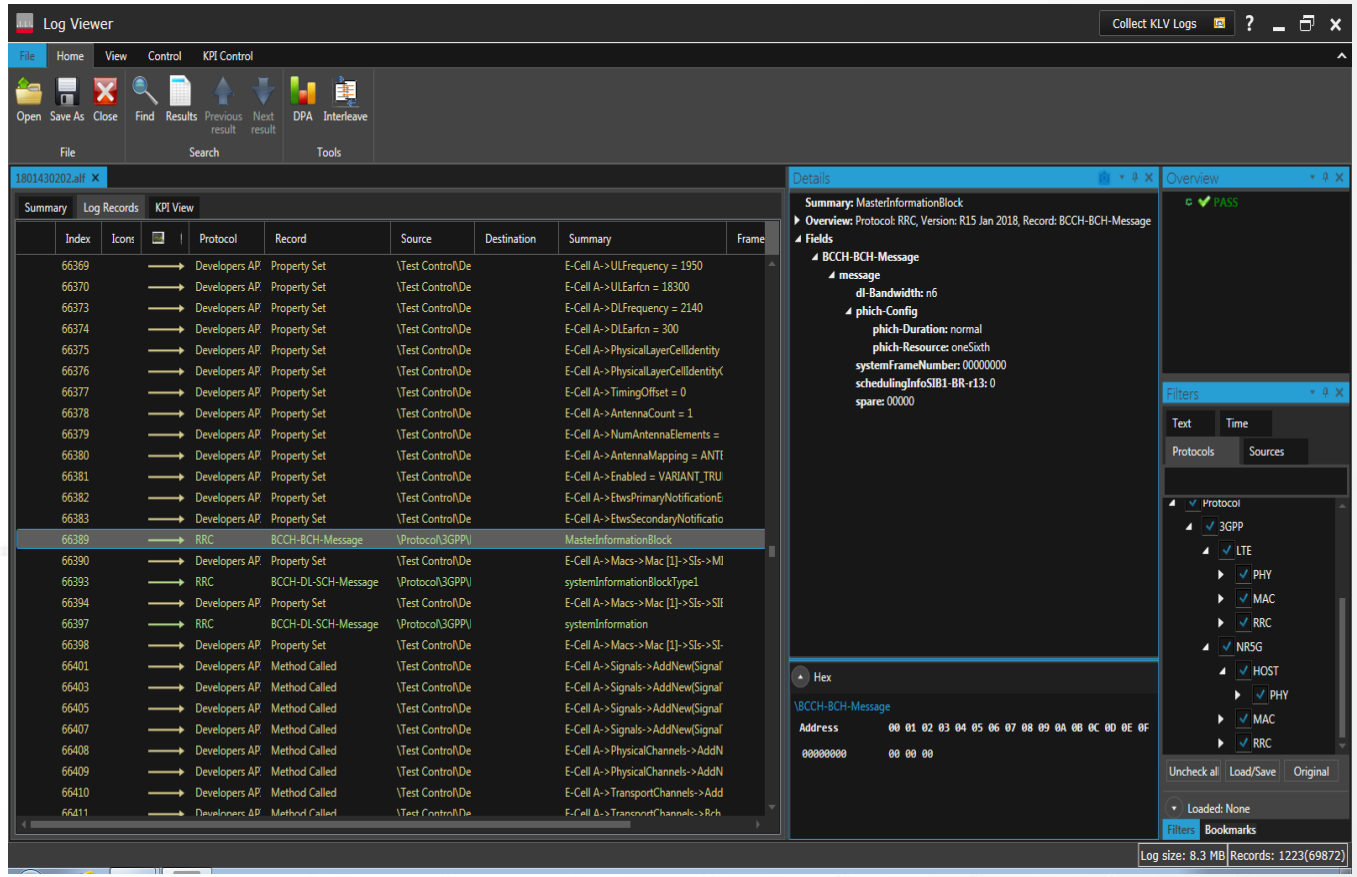
- Allow dynamic L1/L2 parameters changes without the need for programming
- Very useful in early development testing of prototypes



5G logging

5G PROTOCOL R&D TOOLSET

- Displays all layers of the protocol stack (PHY/MAC/RLC/RRC/PDCP)
- Filtering allows the user to view the data of interest
- Advanced search facilities and bookmarks make debugging easier
- User friendly as all information needed is available in one view



Dashboard viewer

5G PROTOCOL R&D TOOLSET

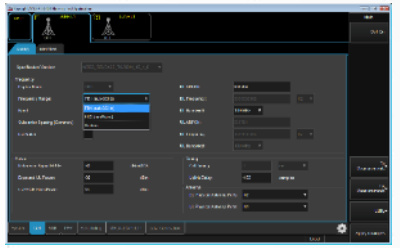
- Customised view with multiple graphs
- Enhanced debugging as relationship between various KPIs such as data rate and BLER can easily be seen graphically
- Link from graph to relevant location in the log to facilitate debugging
- Report generation to share results with other teams

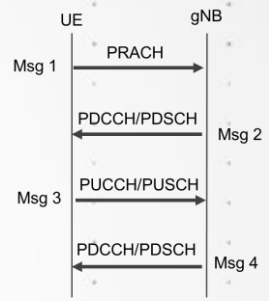
More RF bands, wider BW, BF

SIGNALING RF TEST

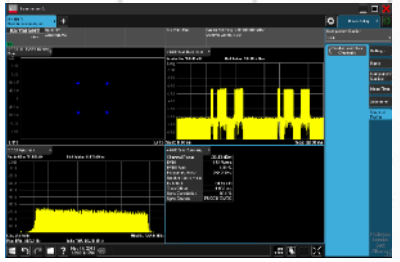
More RF bands, wider bandwidths, and beamforming

1. **Establish the 5G NR Call**
   - Configure; Cell, Beam, DL/UL channels and signals, scheduler
   - Complete PRACH





2. **Test Tx and Rx**
   - Transceiver; Channel Power, EVM, Freq Error, In-band emissions, ACLR, SEM, OBW
   - Receiver; BLER statistics



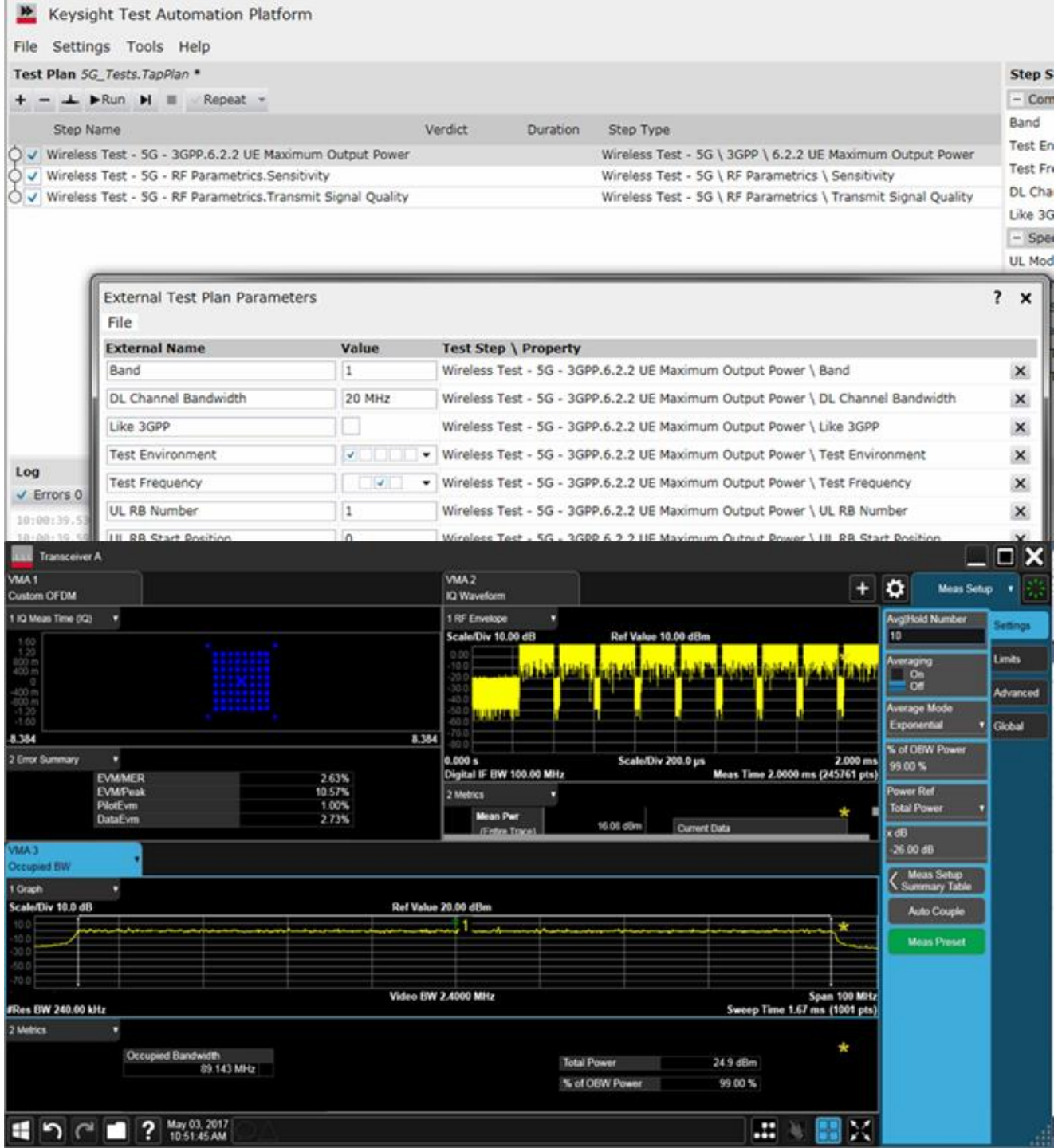
3. **Automate test for thorough verification**
   - Create Scripts using Keysight Measurement blocks
   - Test with power, frequency sweeps
   - Test Executive Environment

Sub-6 GHz and mmWave - Conducted and OTA

5G RF DVT Toolset

KEY FEATURES

- 5G NR support
- RF Test Application
- Automation & Scripting
- Pre-conformance ready
- Traceability to conformance

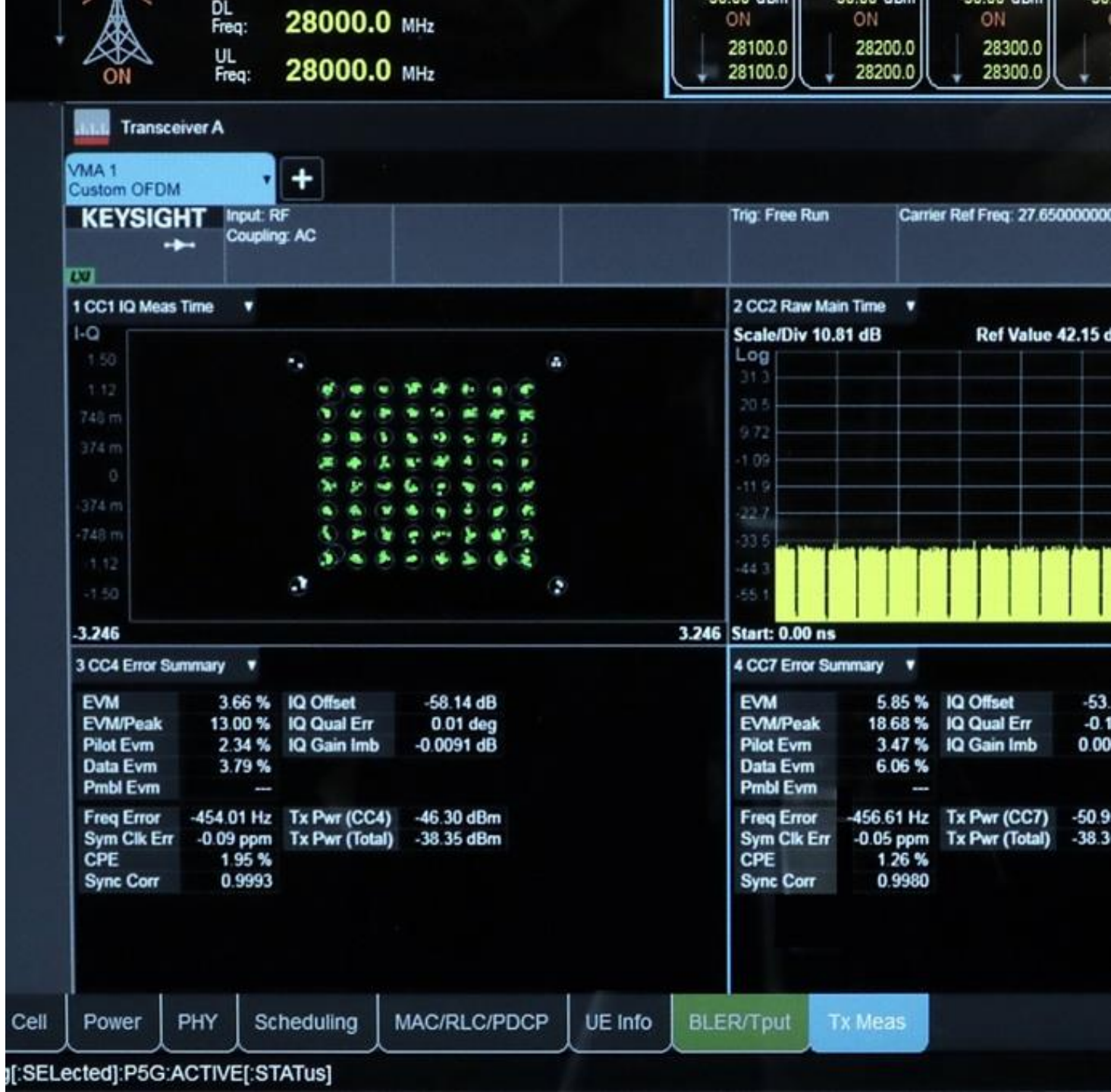


KEYSIGHT TECHNOLOGIES

RF Test Application

5G RF DVT TOOLSET

- Flexible manual testing
- On-a-call UL RF measurements
- Common Keysight measurement science through X-Apps
- Automate test set up Keysight 5G Interactive tools

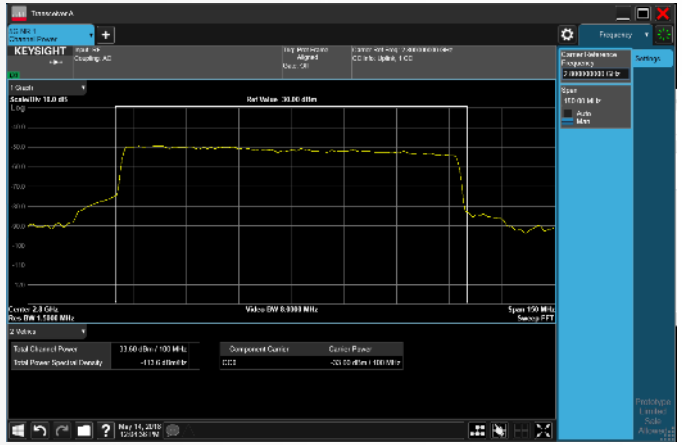


KEYSIGHT TECHNOLOGIES

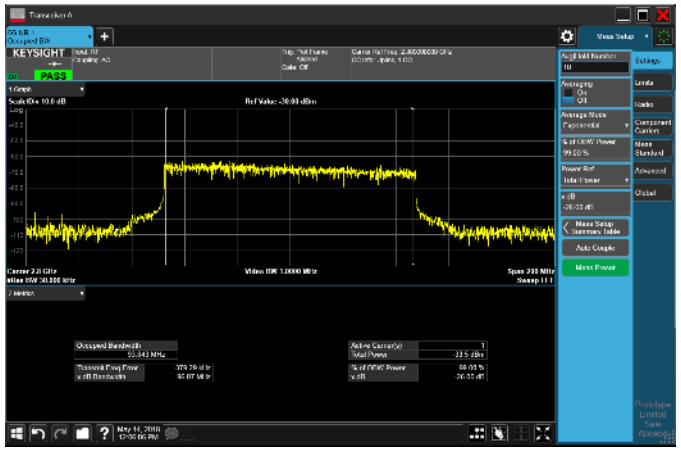
RF test on-a-call

TRANSMITTER

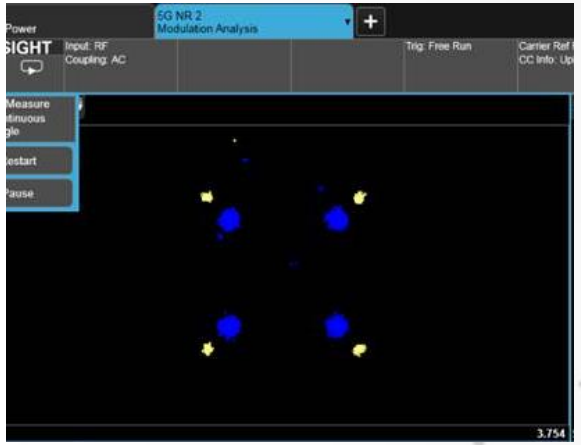
Channel Power



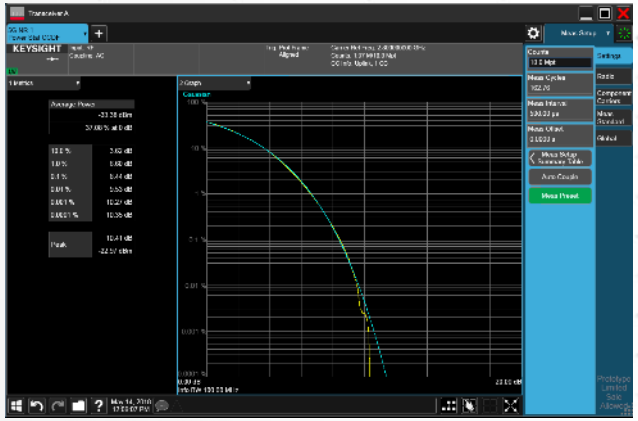
Occupied Bandwidth



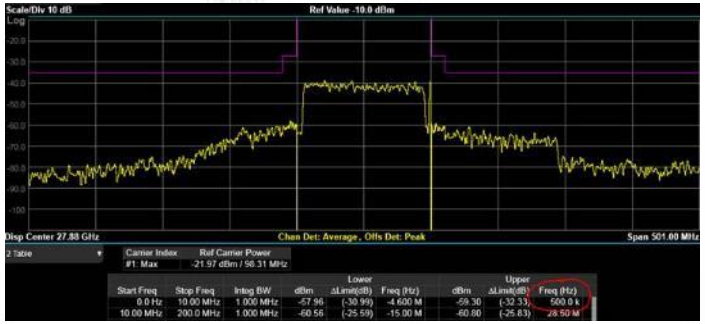
Modulation Parameters



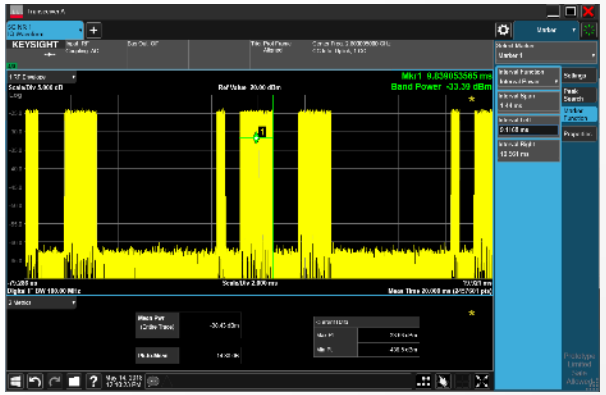
Power Statistics



Spectrum Emission Mask



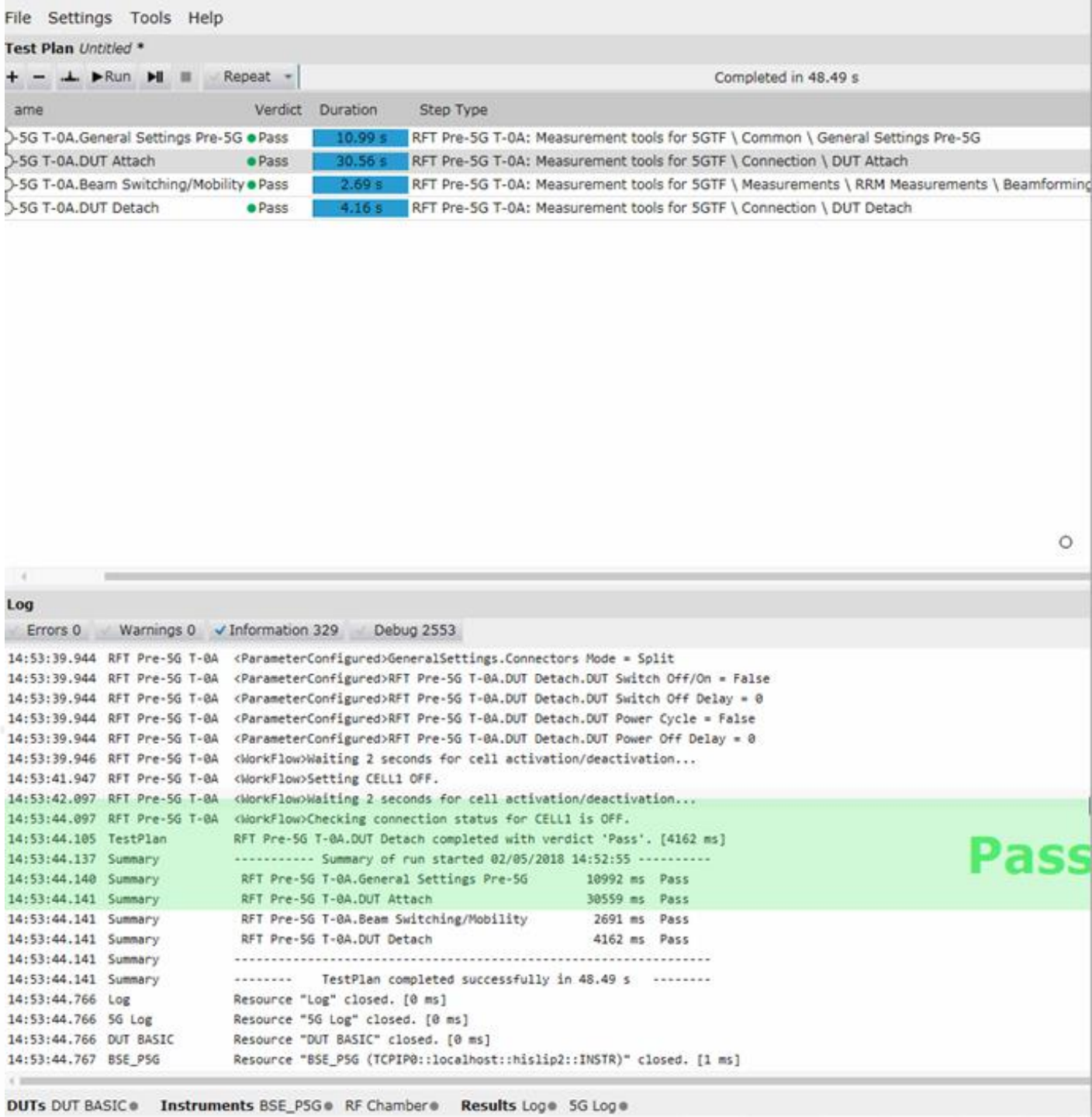
IQ Waveform



Automation & Scripting

5G RF DVT TOOLSET

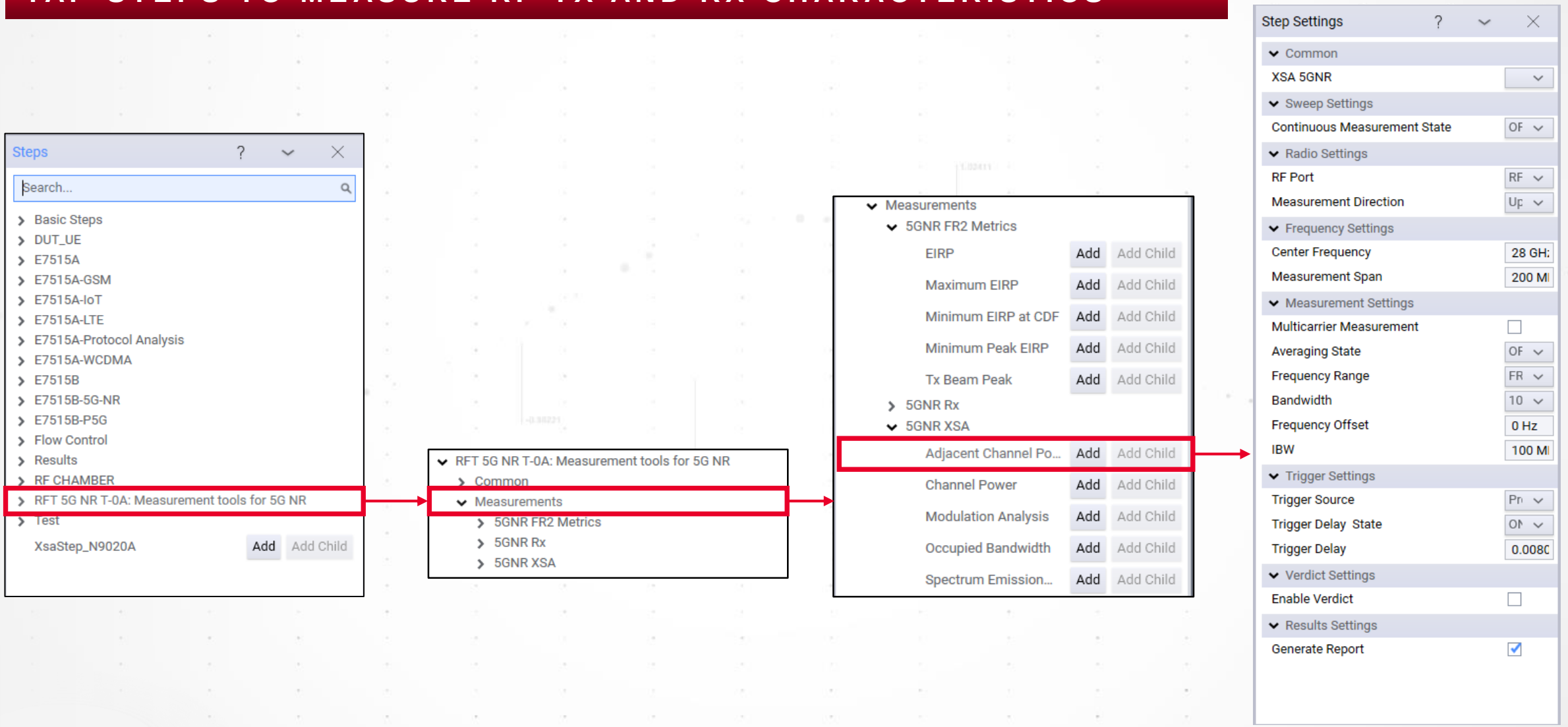
- Automate complete test set up include device and mmWave OTA measurements
- Test cases scripting with Keysight measurement tools or customized test steps
- Examples
  - Initial Access
  - Beam Management
  - Downlink Channels demodulation
  - UE reporting
  - Total Radiated Power (TRP)



KEYSIGHT TECHNOLOGIES

Automation & Scripting

TAP STEPS TO MEASURE RF TX AND RX CHARACTERISTICS



C870250AA RFT 5G NR T-0A: Measurement tools

TAP PLAN EXAMPLES

Test Plan *NSA_FR2_N260_5GNR_ErrorVectorMagnitude*

Step: Test Plan: Repeat — Completed in 0.00 s

Step Name	Verdict	Duration	Flow	Step Type
---- LTE cell configuration -----				Basic Steps \ Log Output
RFT 5G NR T-0A.LTE Cell Configuration - CELL1				RFT 5G NR T-0A: Measurement tools for 5G NR \ Common \ LTE Cell Configuration
RFT 5G NR T-0A.LTE DL Scheduler Configuration				RFT 5G NR T-0A: Measurement tools for 5G NR \ Common \ LTE DL Scheduler Configuration
RFT 5G NR T-0A.LTE UL Scheduler Configuration				RFT 5G NR T-0A: Measurement tools for 5G NR \ Common \ LTE UL Scheduler Configuration
---- NR cell configuration -----				Basic Steps \ Log Output
RFT 5G NR T-0A.NR Cell Configuration - CELL2				RFT 5G NR T-0A: Measurement tools for 5G NR \ Common \ NR Cell Configuration
---- Set UE State -----				Basic Steps \ Log Output
E7515B-5G-NR.LTE.NR Cell Reconfiguration with SgNB Addition				E7515B-5G-NR \ LTE BSE \ Cell Actions \ BSE Procedures \ NR Cell Reconfiguration with SgNB Addition
RFT 5G NR T-0A.NR Set UE State				RFT 5G NR T-0A: Measurement tools for 5G NR \ Common \ NR Set UE State
If Verdict (NR Cell Connected)				Flow Control \ If Verdict
---- Set Measurement Conditions -----				Basic Steps \ Log Output
RFT 5G NR T-0A.NR Set Measurement Conditions				RFT 5G NR T-0A: Measurement tools for 5G NR \ Common \ NR Set Measurement Conditions
---- Search TX Beam Peak -----				Basic Steps \ Log Output
RFT 5G NR T-0A.OTA Positioning: Spherical Sweep				RFT 5G NR T-0A: Measurement tools for 5G NR \ Common \ OTA Positioning
RFT 5G NR T-0A.Tx Beam Peak				RFT 5G NR T-0A: Measurement tools for 5G NR \ Measurements \ 5GNR FR2 Metrics \ Tx Beam Peak
---- Positioning and measurement -----				Basic Steps \ Log Output
RFT 5G NR T-0A.OTA Positioning : Direct Move				RFT 5G NR T-0A: Measurement tools for 5G NR \ Common \ OTA Positioning
---- Set UE State Disconnect -----				Basic Steps \ Log Output
RFT 5G NR T-0A.NR Set UE State IDLE				RFT 5G NR T-0A: Measurement tools for 5G NR \ Common \ NR Set UE State
RFT 5G NR T-0A.NR Set UE State IDLE				RFT 5G NR T-0A: Measurement tools for 5G NR \ Common \ NR Set UE State
E7515B-5G-NR.LTE.NR Cell Reconfiguration with SgNB Addition				E7515B-5G-NR \ LTE BSE \ Cell Actions \ BSE Procedures \ NR Cell Reconfiguration with SgNB Addition
E7515B-5G-NR.Activate Cells				E7515B-5G-NR \ General \ Cell Actions \ BSE Procedures \ Activate Cells
E7515B-5G-NR.Activate Cells				E7515B-5G-NR \ General \ Cell Actions \ BSE Procedures \ Activate Cells

NR NSA Connection

Measurements Conditions

Positioning

Measurement

5G NR Device Verification

TEST CHALLENGES

FLEXIBILITY

DIFFERENT BANDWIDTHS

MULTIPLE BWP

SUBCARRIER SPACINGS

RF PARAMETRIC

TX QUALITY

CARRIER AGGREGATION

mmW OTA

FUNCTIONAL

MAX DATA RATES

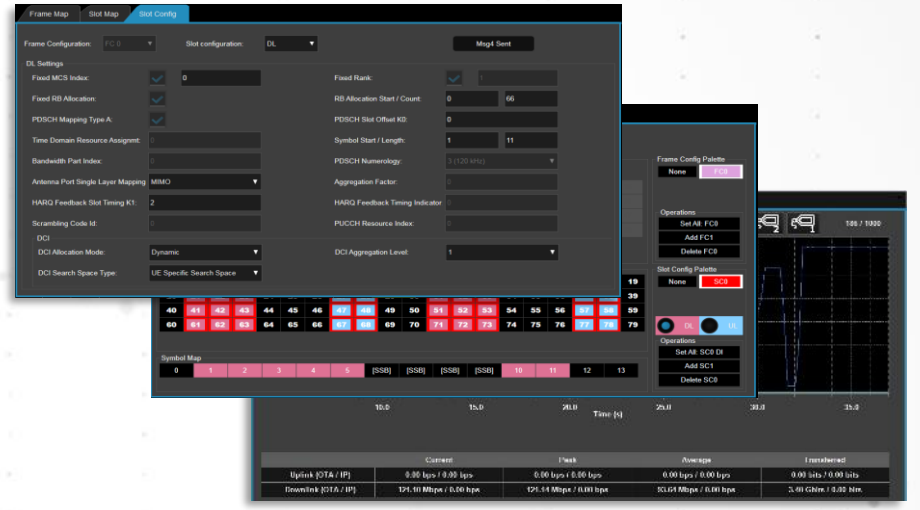
BATTERY DRAIN

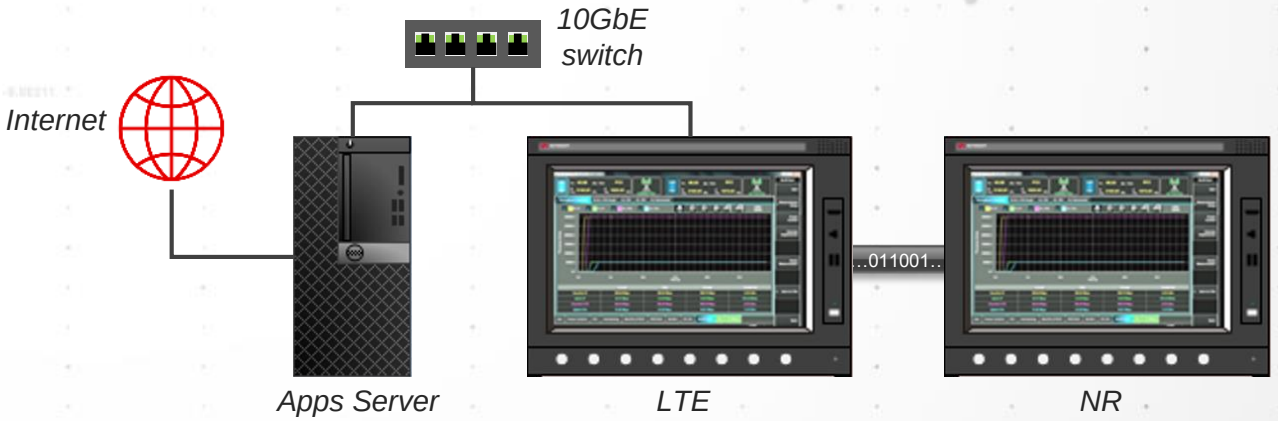
BEAM-MANAGEMENT

Data Throughput Performance

FUNCIONAL KPI TOOLS

- Benchmark 5G IP data throughput performance in a fully automated environment
- Make sure expected data rates are met in complex scenarios in both LTE and NR cells
- Verify end-to-end receiver performance for different MCS and RB
- Achieve sustained maximum data rate for most common transport protocols (FTP, TCP, UDP, ping)
- Connect to the Internet to test OTT applications
- Automation scripting tool via PathWave Test





Battery Life Evaluation

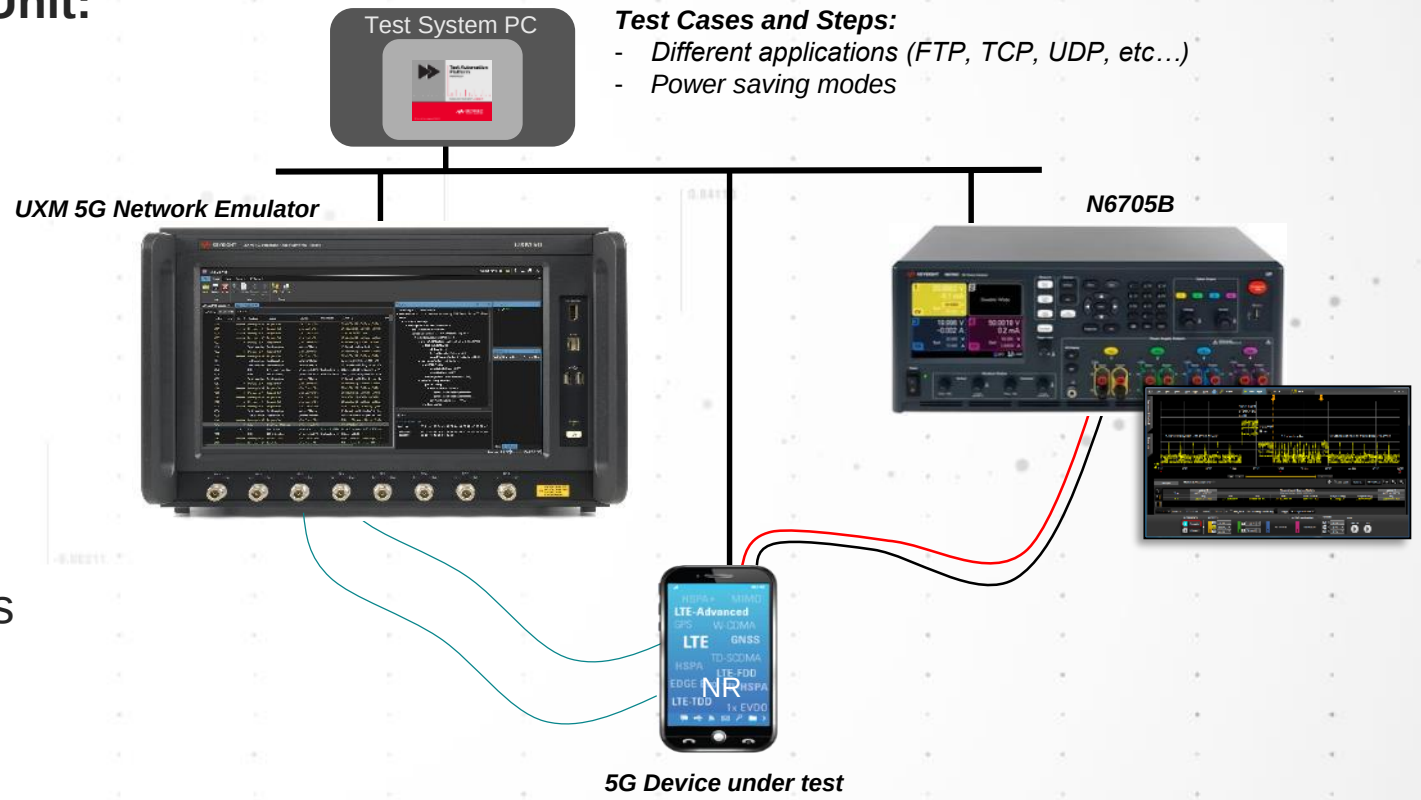
FUNCIONAL KPI TOOLS

Test steps to control Source Measurement Unit:

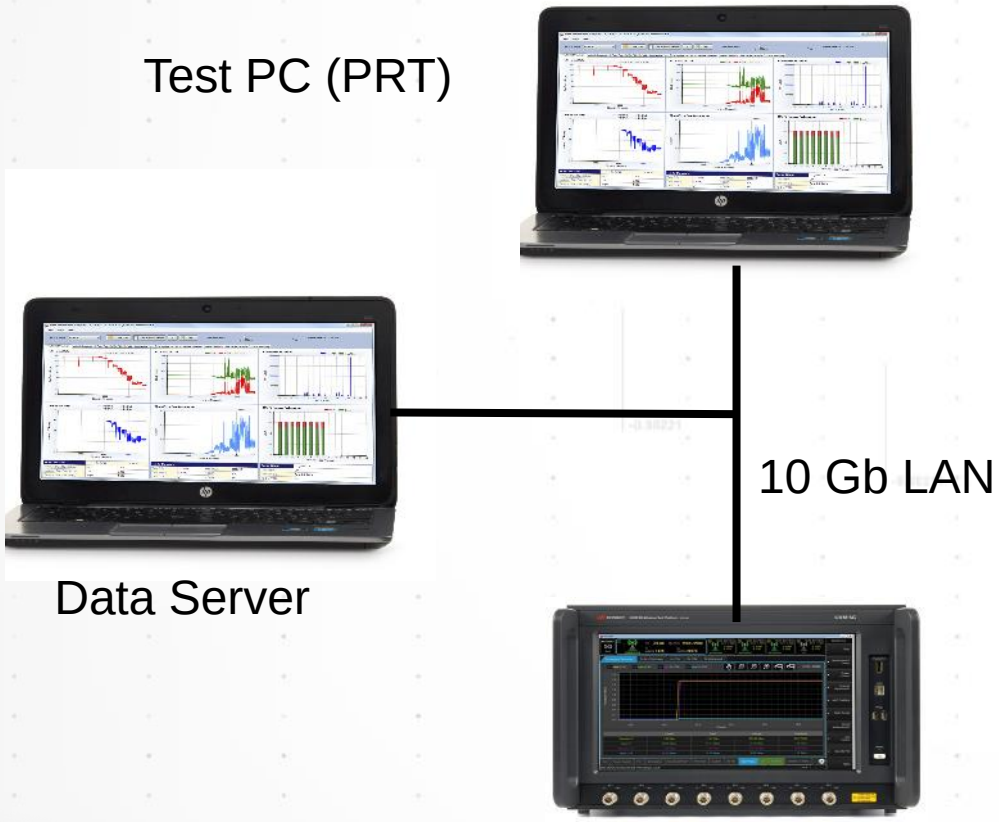
- Time resolution
- Capture duration
- Start / Stop

Keep the power drain controlled under:

- High data rates
- Mobility and beam-management scenarios
- File transfer
- Video streaming, www browsing
- Sleep and power saving modes



Data Throughput Testing

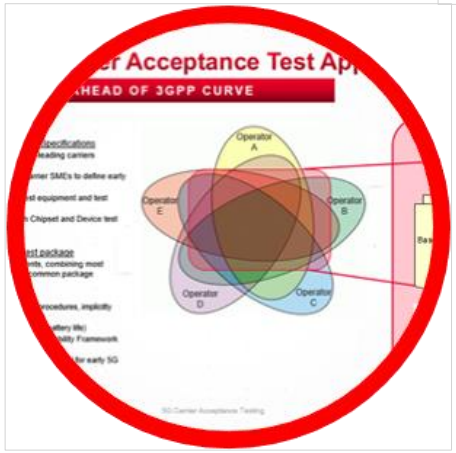


- Recommended setup for **maximum data rate**
- Lower rates (e.g. 600 Mbps) can be achieved without Data Throughput PC by running iPerf / FTP on the external PC
- 4.4 Gbps + proven using 5GTF Spec.
- Designed for 7.8 Gbps as per 3GPP
- Data Throughput PC will act as a slave to the PRT
- Customer has option to connect their **own data server**

Acceptance Solutions

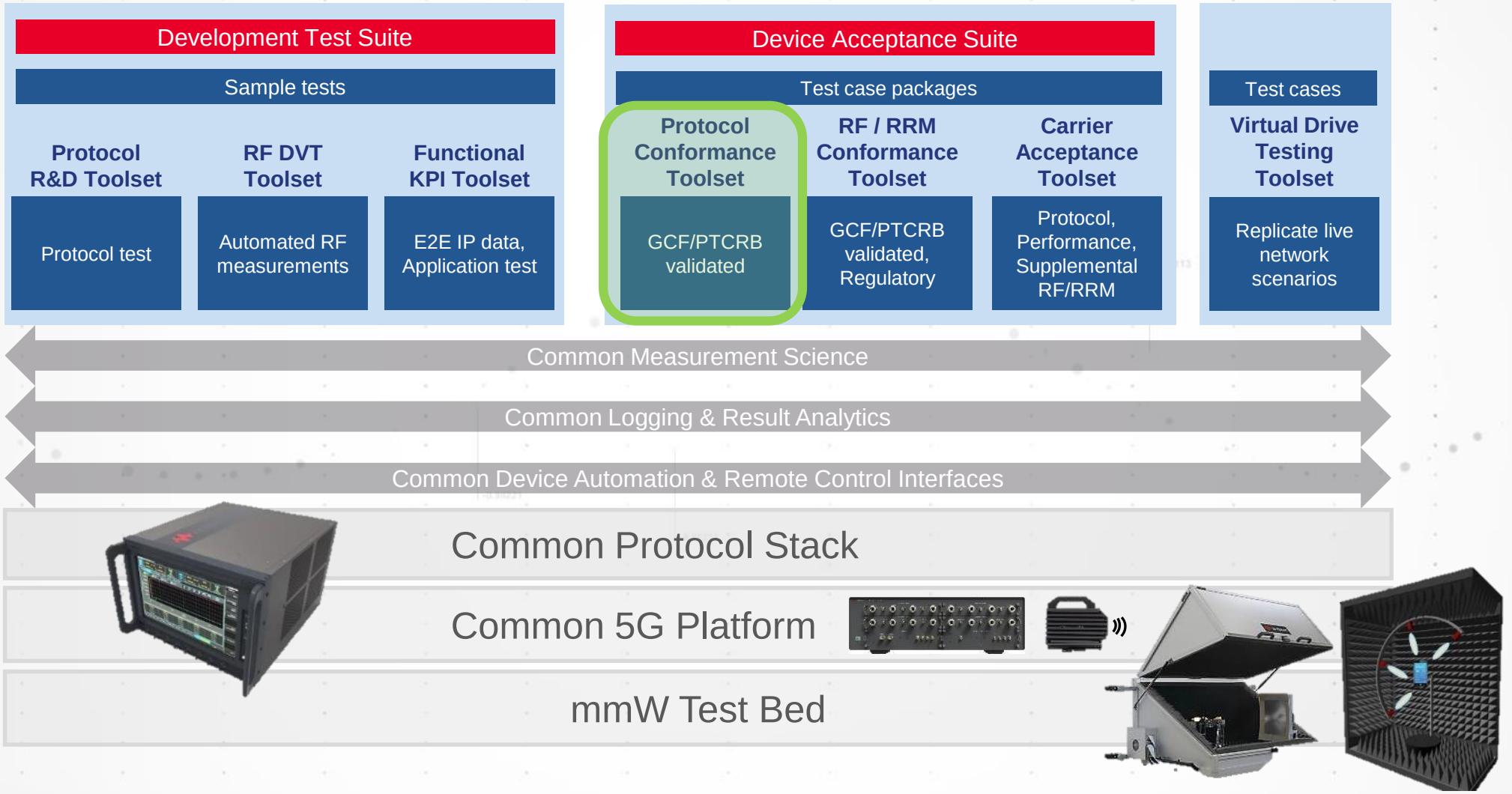
Protocol Conformance

Radio Conformance



Carrier Acceptance

Keysight 5G Network Emulation Solution Portfolio



5G Protocol Conformance Toolset

SUPPORTED HARDWARE CONFIGURATIONS

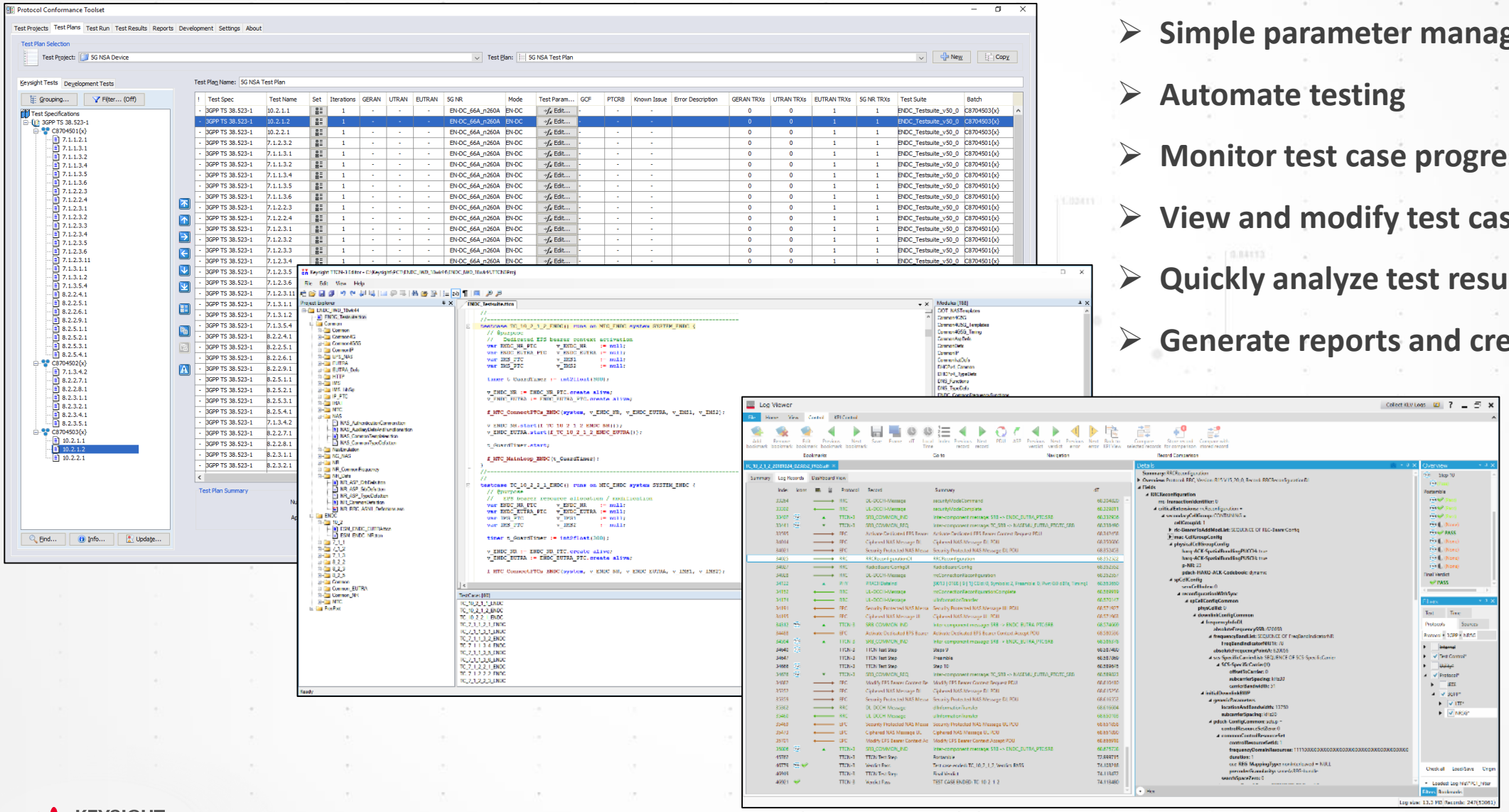
Network Emulators	Notes	5G frequency / test method		
		sub-6GHz / conducted	mmWave / conducted	mmWave / OTA
 UXM 5G	• Both 5G NR and LTE anchor on same UXM 5G • A single UXM 5G can support all 5G PCT test cases defined so far, with spare capacity for additional CCs if required in future	• RF cables from UXM 5G to DUT	+  • CIU upconverts 5G NR signal up to 12GHz IF • DUT's 5G antennas connected to CIU • DUT's LTE antennas connected to the UXM 5G or DA Combiner	+  +  • 28/39 GHz Remote Radio Heads
 +  UXM 5G A9000 Rev2.5	• Allows testing of legacy technologies and 5G • 5G test cases on UXM 5G (NR+LTE carriers for NSA) • 2G/3G/LTE test cases on A9000 Rev2.5 • Target for H1 2019	+  DA Combiner • Combines RF outputs from UXM 5G and A9000 • RF cables from DAC to DUT		+  • Rack-Mounted Test Chamber

4 RRHs required for mmWave interband test cases and band combinations

RMTC chamber approved for single cell test cases at RAN5#80. Decision on multi-cell test cases deferred.

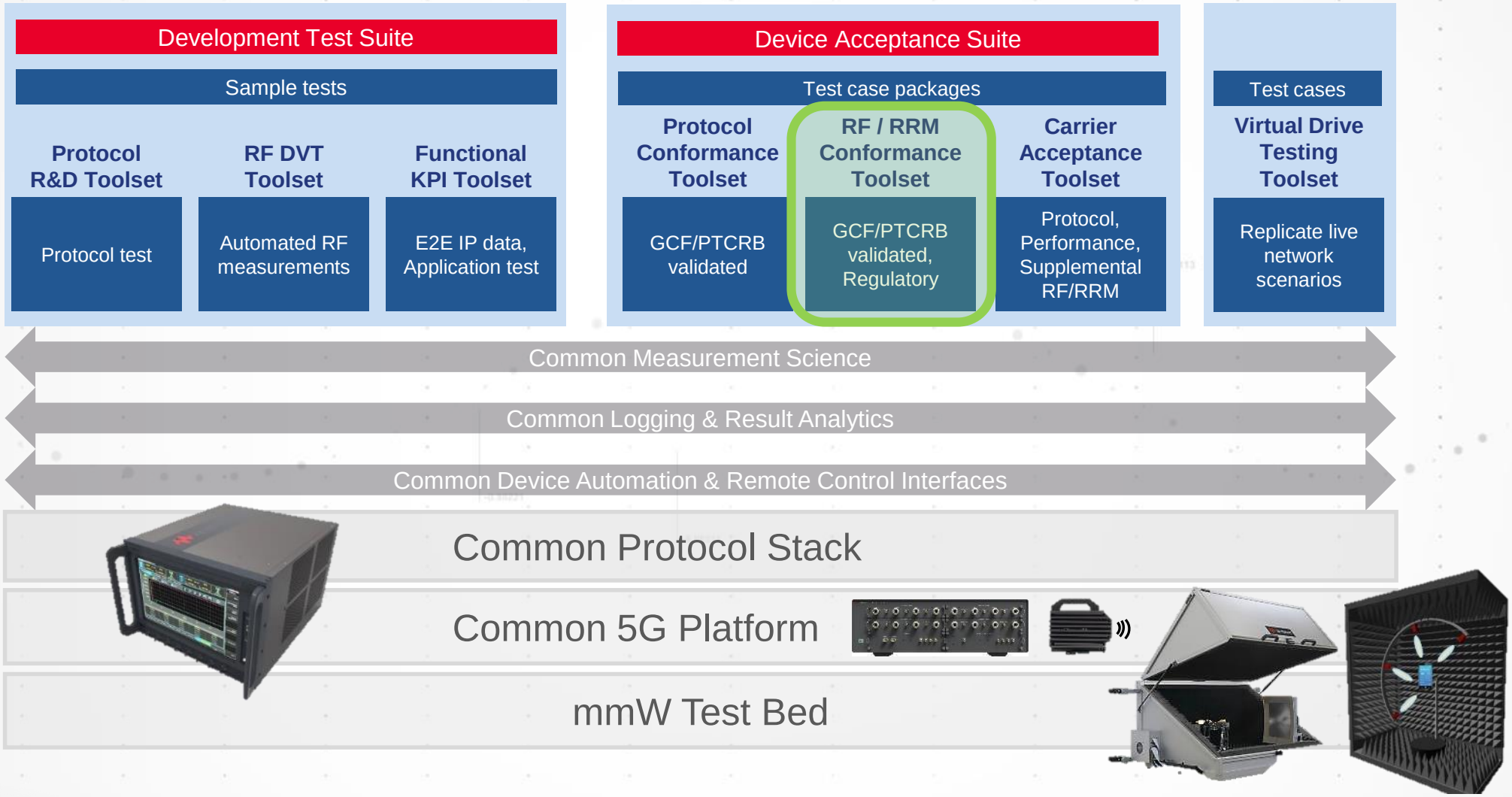
5G Protocol Conformance Toolset Solution

EASILY CONFIGURE AND EXECUTE CAMPAIGNS AND ANALYZE TEST RESULTS



- Simple parameter management
- Automate testing
- Monitor test case progress
- View and modify test case source code
- Quickly analyze test results
- Generate reports and create new test plans

Keysight 5G Network Emulation Solution Portfolio

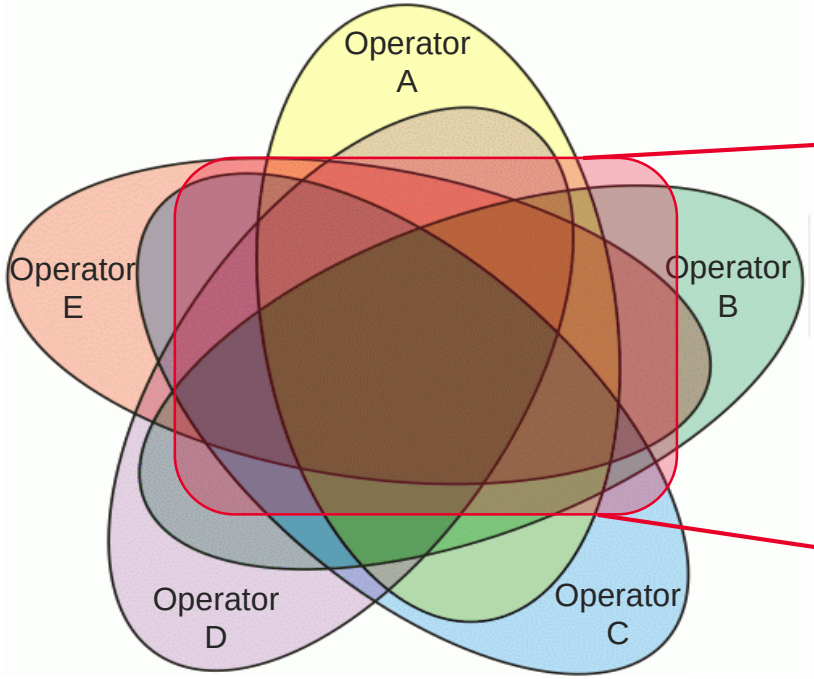


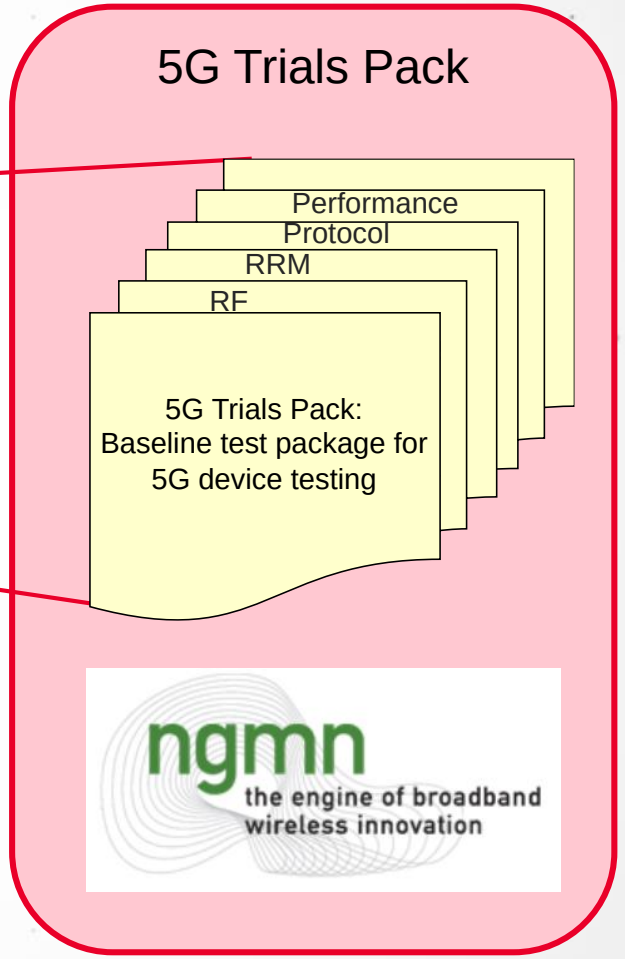
Keysight 5G Carrier Acceptance Test Approach

ENABLE 5G TESTING AHEAD OF 3GPP CURVE

1. Carrier-Specific Acceptance Test Specifications
   - Focused effort with the industry-leading carriers worldwide
   - Close collaboration with the carrier SMEs to define early 5G test plans
   - Provide early access to 5G test equipment and test cases
   - Maintain good alignment with Chipset and Device test plans

2. 5G Trials Pack: Baseline 5G test package
   - Predicts 3GPP test requirements, combining most relevant test scenarios into a common package
     - RF
     - RRM
     - Protocol (focused on layer 3 procedures, implicitly testing lower layers)
     - Performance (data throughput, battery life)
   - Implements the NGMN 5G Interoperability Framework test plan
   - Promoted as a pre-standard starting point for early 5G device testing





Keysight 5G MNO Engagement

- Keysight is strongly engaged with all of the leading 5G MNOs worldwide.
- Solutions and test cases have already been delivered to many of these MNOs.
- Keysight is also working with chipset vendors to verify these test cases.
- Actively consulting with a number of MNOs to assist in development of their formal 5G device acceptance test plans, which will be announced in 2019.
- 5G Trials pack being promoted to MNOs, to provide them with 5G test capability ahead of 3GPP test case availability.

Manufacturing Solutions

- Solution Portfolio
- mmW 5G Non-Signaling Solution
- 5G End to End Manufacturing Solution

5G Manufacturing Solution Portfolio

CHOOSE YOUR FREQUENCY RANGE

Sub-6 GHz

Sub-6 GHz and mmWave

mmWave

E6640A EXM

E6640A EXM, E7770A CIU, and M1740A RRH

E7760B, and M1740A RRH

mmWave 5G Non-Signaling Solution

E7760B WIDEBAND TRANSCEIVER AND M1740A MMWAVE TRANSCEIVER FOR 5G

Versatile Solution for mmWave 5G

- Verify performance over more than four 3GPP-defined mmWave bands in one RRH
- Cover IF and mmWave bands in a single solution
- Quickly characterize mmWave antennas with PAvT
- Test over the air with Keysight chambers, positioners and antennas and automate the entire solution with one software application
- Confidently test across the workflow with industry-proven measurement algorithms based on X-Series applications and simplify 5G measurements with integrated waveform and measurement application software
- Improve efficiency with a remote radio head that can be used with multiple Keysight platforms

5G Test Solutions

NON-SIGNALING TEST

Keysight has unique solutions for 5G test

- The only remote radio head covering more than four mmWave bands
- The only solution covering the 40 to 43.5GHz frequency range
- The only single solution combining IF and mmWave test
- Automation with PathWave Test
- Common 5G NR measurement algorithms used across all Keysight platforms

KEYSIGHT TECHNOLOGIES

5G End-To-End Manufacturing Solutions

PORTFOLIO

5G MFG Workflow

NPI
Define and develop test plans

Early MFG
Produce samples for evaluation

Transition to HVM
Optimize test plan for speed

HVM
Produce quantities for consumer use

5G MFG Solutions

Manufacturing

EXM Wireless Test Set

plus

CIU and Remote Radio Heads for mmWave

Efficient test plans with **sequencing** and, **no signaling**, **multiple ports**

Common measurement science and **automation, fast** and **repeatable**

Why Keysight?

WHY Keysight

- Matured and Stable 5G and mmW solution through early engagement
- First 5G NR Engagements with all WW Key chipset vendors
- First 5G NR Engagements with all WW Key Operators
- First 5G NR Engagements with all WW Device Makers
- Leading Activities at Standard body
- Leading position at RCT and PCT validation
- Proved and Verified mfg solution for 5G NR device


KEYSIGHT
TECHNOLOGIES