Keysight's N9042B UXA Signal Analyzer

Joe Rickert

Vice President and General Manager of High Frequency Measurement R&D

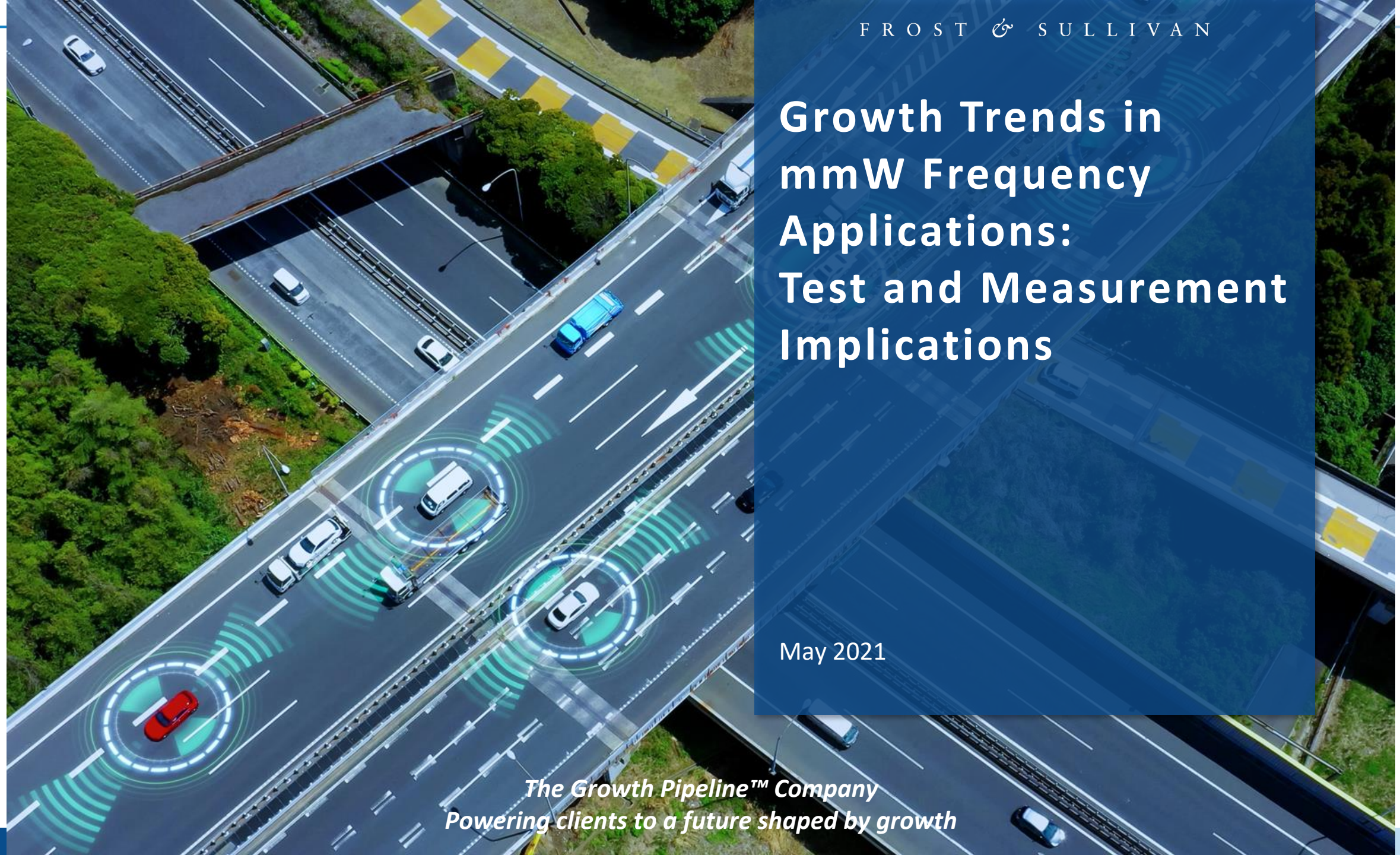
MAY 2021

KEYSIGHT TECHNOLOGIES

Agenda

- Kiran Unni, Vice President, industrial technologies practice, Frost & Sullivan
- Joe Rickert, Vice President and General Manager of high frequency measurement R&D for Keysight's communications solutions group
- Sean Lee, Business Development Manager for RF products at Keysight
- N9042B UXA Signal Analyzer Demonstration
- Q&A

KEYSIGHT TECHNOLOGIES



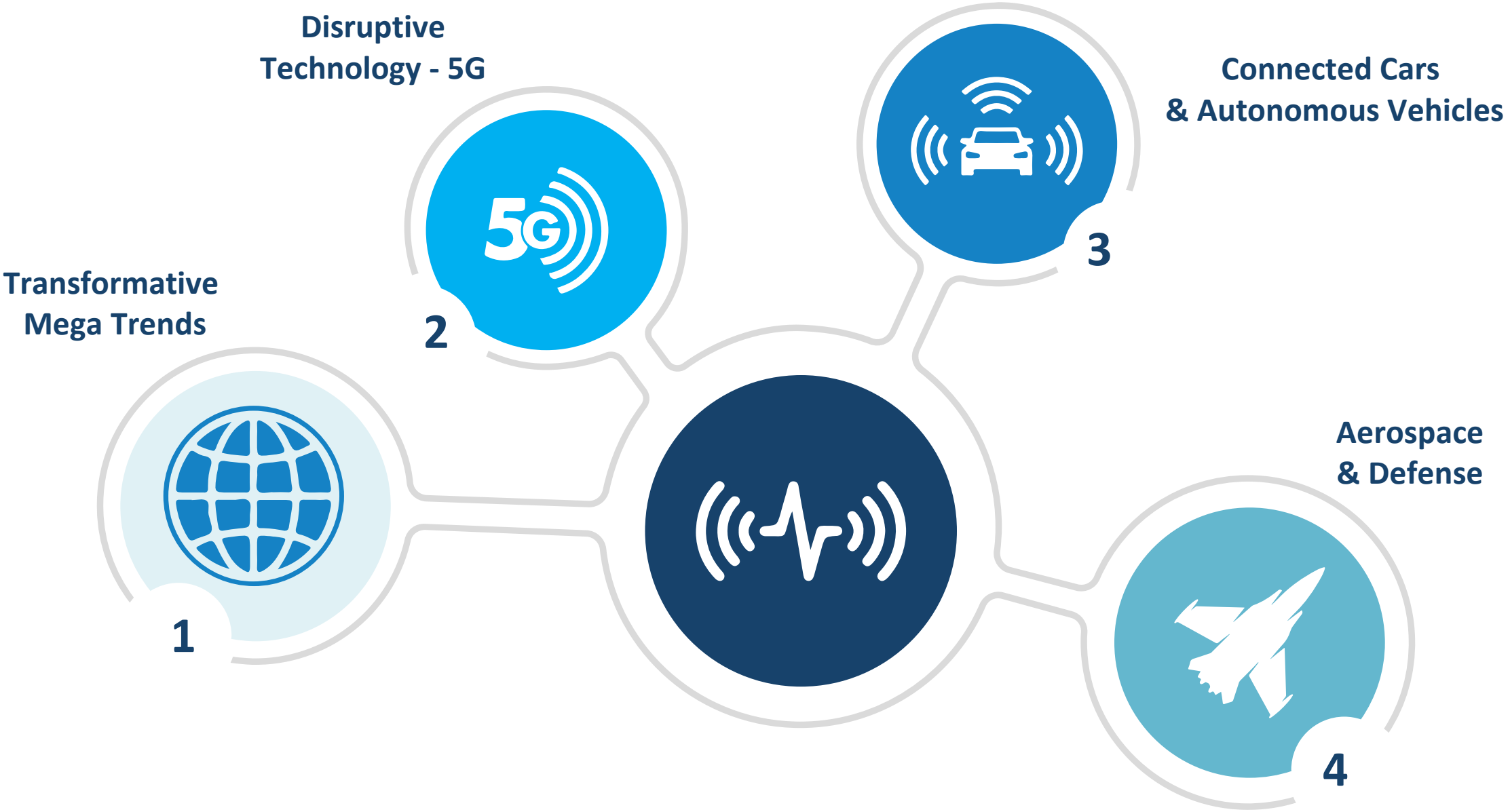
FROST & SULLIVAN

Growth Trends in mmW Frequency Applications: Test and Measurement Implications

May 2021

The Growth Pipeline™ Company
Powering clients to a future shaped by growth

DEMAND FOR HIGH FREQUENCY TECHNOLOGIES



Source: Frost & Sullivan

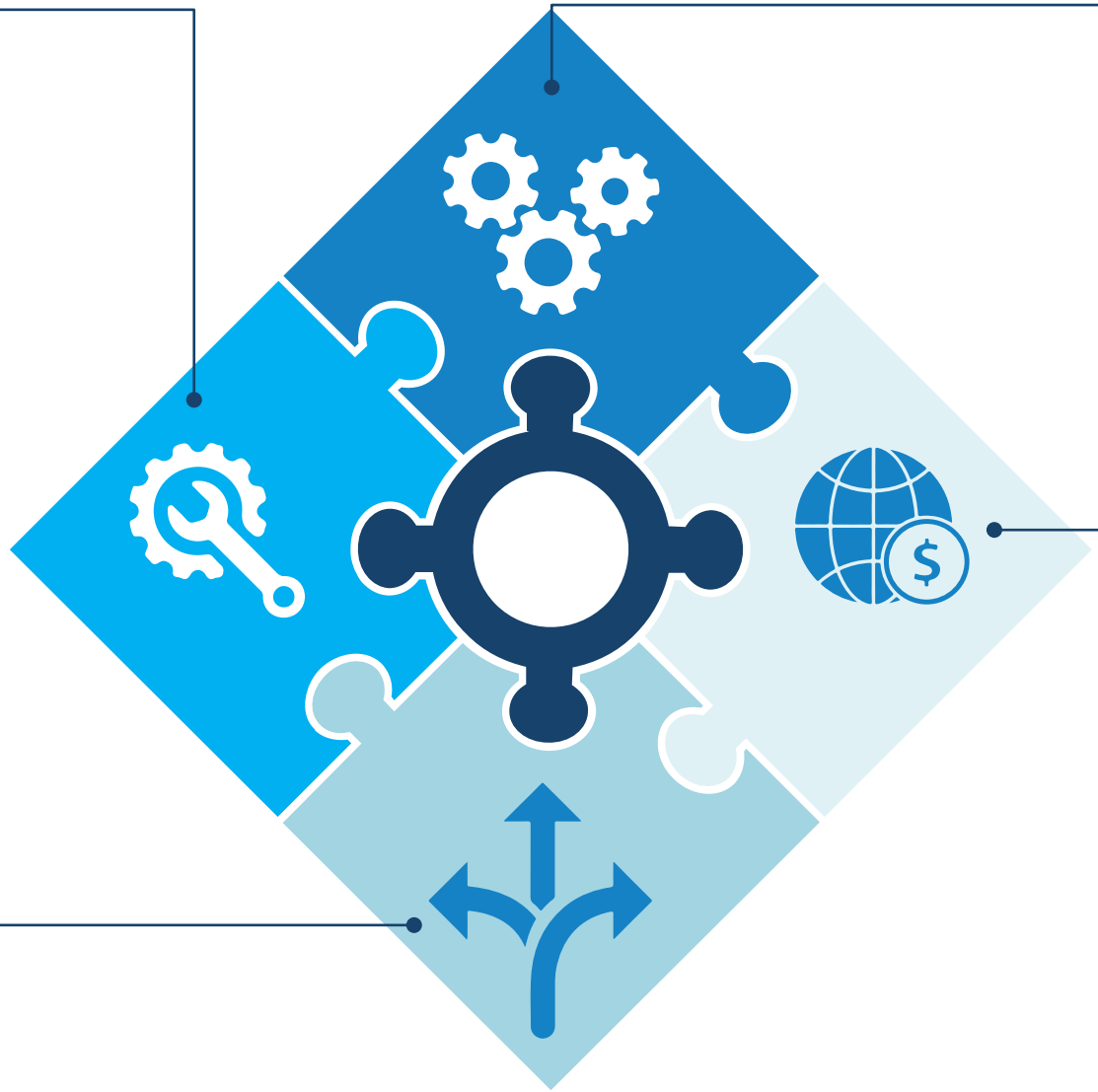
UNMET NEEDS & CHALLENGES OF MMWAVE TEST & MEASUREMENT

Technical

Wider bandwidth test instruments with higher accuracy and low noise performance

Commercial

Accelerating time-to-market



Flexibility

Ability to perform multiple tests in a single instrument

Return on Investment

Utilization rates of instruments in R&D applications

Source: Frost & Sullivan

END USER DYNAMICS IN COMMUNICATIONS VERTICAL

End user dynamics driving growth in T&M

5G networks are required support huge number of connected devices, thus needing high bandwidth and frequency networks

Frost & Sullivan's research indicates that **IoT device shipments** will reach 66 billion, growing at high CAGR (2019 – 2026) of 15.5%,

Demand Analysis from key 5G applications

Key Applications	Short-term demand rating (Scale 1 to 5)*	Mid and Long-term demand rating (Scale 1 to 5)*
Smartphones	5	5
Smart Homes	3	5
Augmented Reality	1	4
Gaming	1	4
Robotics	3	5
In-factory mobility and logistics	3	5
Autonomous cars	1	4

*(Scale 1 to 5) refers to level of adoption. Scale of 1 refer to weak adoption and 5 being stronger adoption

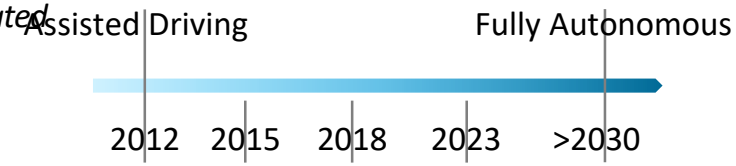
Source: Frost & Sullivan

END USER DYNAMICS IN AUTOMOTIVE VERTICAL

End user dynamics driving growth in T&M

Sensor Technology and Assisted Driving (AD) Levels, Global, 2012,2015, 2018, 2023, and >2030

Rise in level of autonomy has a large number of sensors incorporated

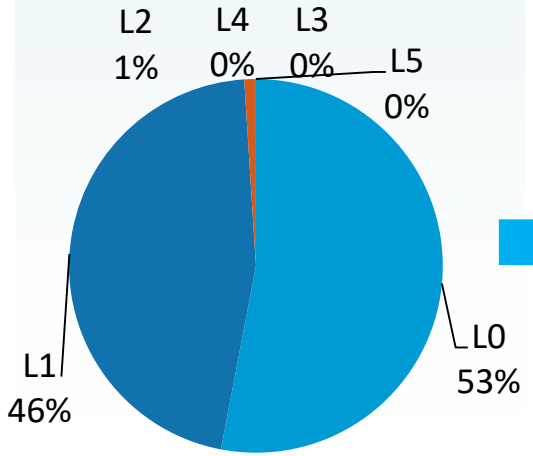


Sensor Technology \ AD Level	L1	L2	L3	L4	L5
Ultrasound	4	8	8	8	8-10
LRR	1	1	2	2	2
SRR	2	2-4	4	4	4
Camera	1	2-4			
Camera (LR)			2		2-3
Camera (Sur)			4	4	4
Camera (Stereo)			1	1	2
Camera (Trifocal)				2-3	
LiDAR	1		1	2-4	4
Total ASC*	**9**	**13-17**	**22**	**23-26**	**26-29**

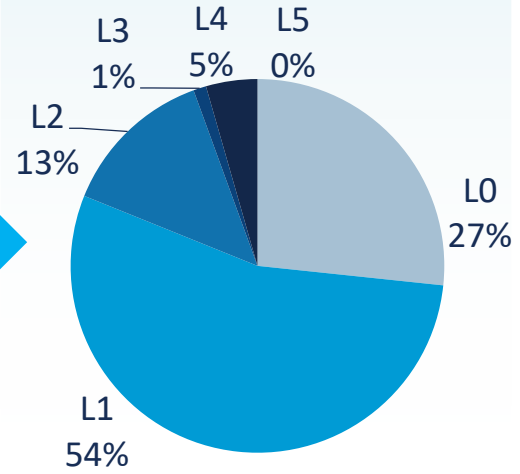
*ASC—Average Sensor Count

Among several applications that require high frequency testing, automotive radars in ADAS, operating at 77 to 79 GHz is an attractive double digit growth opportunity.

Autonomous Vehicles By Level of Autonomy, Percent Sales, Global, 2020



Autonomous Vehicles by Level of Autonomy, Percent Sales, Global, 2025



Source: Frost & Sullivan

END USER DYNAMICS IN A&D AND SPACE VERTICAL

End user dynamics driving growth in T&M

Aerospace & Defense

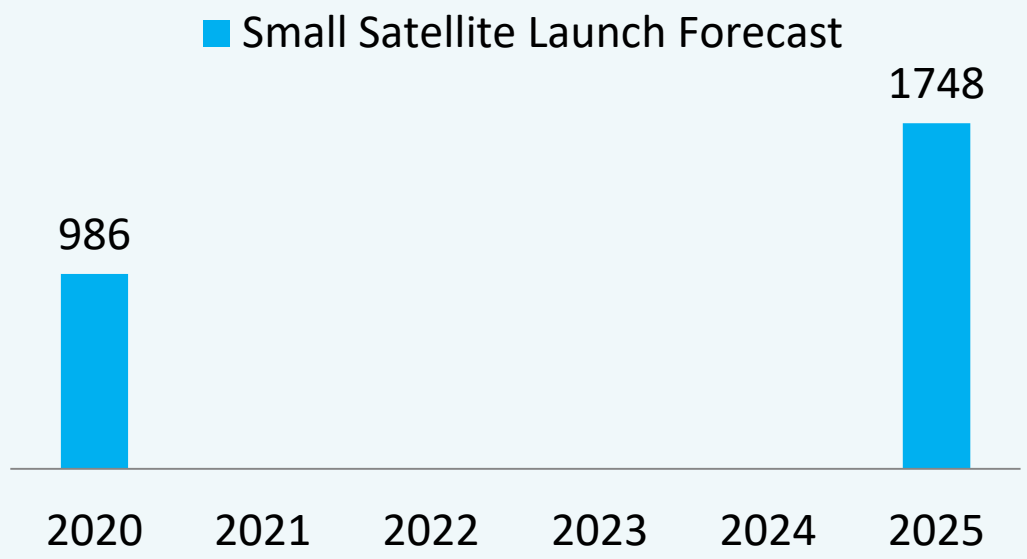
U.S. DoD Electronic Warfare spending is expected increase from $3.36 Billion in 2020 to $3.60 billion in 2025

Airborne radars are being actively upgraded to cater to the needs of next-generation fighters, upgrading legacy platforms, emergence of light combat trainer and proliferation of UAVs

Satellites

 # 136 vehicles launched in 2020

Small Satellite Launch Forecast



Source: Frost & Sullivan

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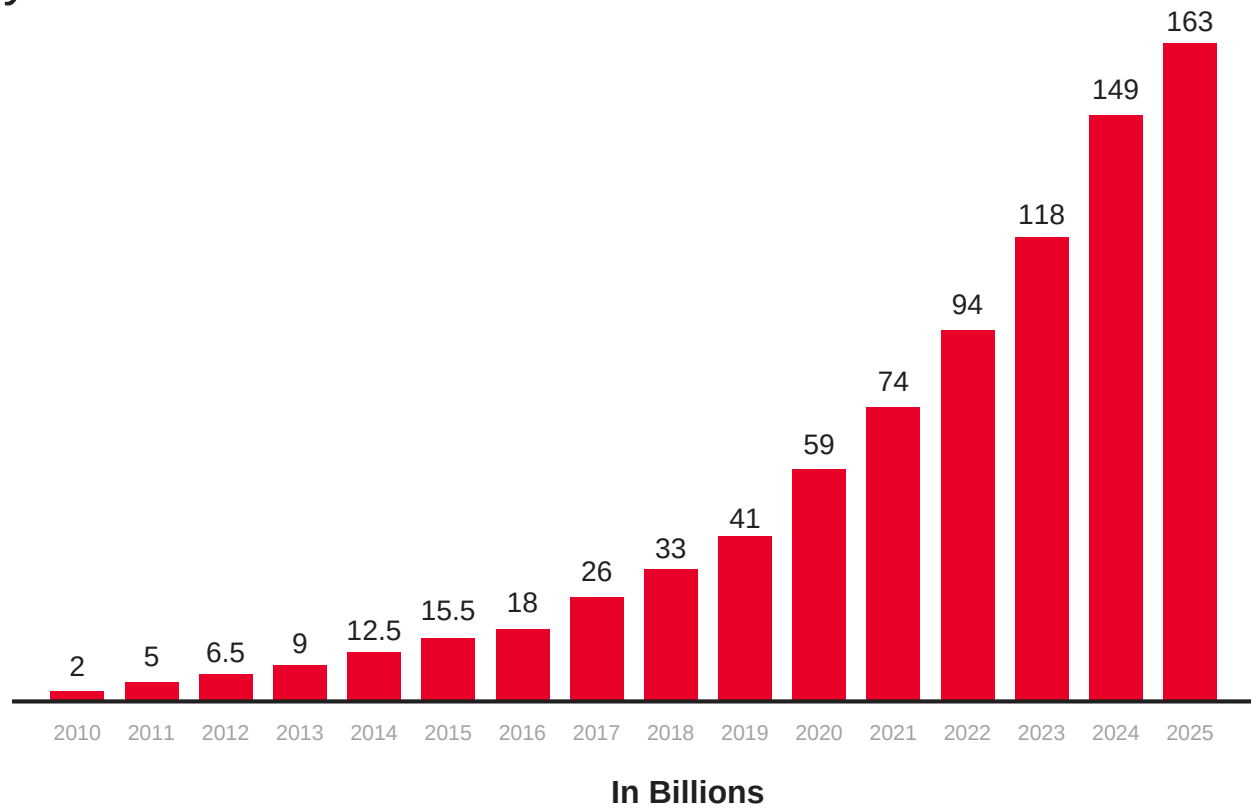
KEYSIGHT TECHNOLOGIES

Industry Trends

DATA - HIGH FREQUENCY - BANDWIDTH

- Greater than 5 billion mobile internet users by 2025
- 1.2 billion 5G subscribers by 2025
- Over 11,000 Communication LEO Satellites launched by 2030
- 163 billion terabytes of data by 2025
- 73 billion connected devices by 2025
  - 1 million connected devices per sq km
- 5G Release 16,17
- 6G Early Research



Keysight Capabilities

ACCELERATING INNOVATION TO CONNECT AND SECURE THE WORLD

- 150 locations
- Conducting business in more than 100 countries
- Decades of mmW expertise
- >4000 products and solutions
- R&D and production in 15 countries across the world
- 40 Service Centers
- ASIC design center and proprietary fabrication facility

TODAY'S SOLUTION INTRODUCTION

IMS 2021

A **hybrid** event:
- Atlanta June 7 – 10
- Virtual June 20 – 25

KEYSIGHT TECHNOLOGIES

Innovate Next in mmWave

DEMOS

- 5G mmWave Design Flow
- Radar System Design Flow
- Wideband Signal Analysis
- Frequency Converter Test
- Handheld 5G Field Test
- MIMO Wideband Testing
- Unlocking RF Design Data
- 6G Sub-THz Testbed
- mmWave Phase Noise Test
- Services is Now Strategic

Introducing the N9042B UXA + V3050A SA Frequency Extender

Sean Lee	MAY 2021
Business Development Manager for RF products	

Target Markets

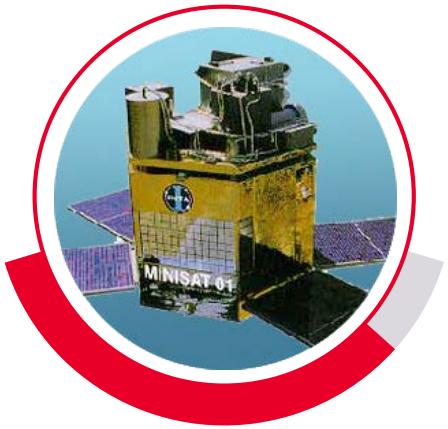
WHERE HIGHER FREQUENCY AND WIDER BW IS REQUIRED

Communications

- 5GNR + Early 6G
- 802.11ad / 802.11ay
- Point-to-Point Links
- Small Cell Backhaul

Aerospace & Defense

- Radar
- Electronic Warfare



Space

- Satellite
- New Space

Other

- Automotive Radar
- Component

Challenges

INDUSTRY TRENDS ARE CAUSING ISSUES

Higher Frequencies mean greater path loss and decreased SNR

Wider bandwidths mean more noise and decreased SNR …

Complex modulations require accuracy to resolve constellation points

Test solutions must have outstanding noise performance

N9042B UXA + V3050A SA Frequency Extender

KEYSIGHT'S SOLUTION TO THESE CHALLENGES

- Bandwidth + Frequency that Meets Customer Needs
- The Performance Customers Require
- Critical Accessories + Software

Wide Analysis Bandwidth

STAY AHEAD OF BANDWIDTH EXPLOSION

Increasing Bandwidth

Up to ~11 GHz BW

10 bits
External analysis bandwidth
Control & Calibration by N9042B

4 GHz BW

12 bits
16 GB capture memory

2 GHz BW

14 bits
16 GB capture memory
Also 1 GHz and 1.5 GHz

OPTION	ANALYSIS BW	FREQUENCY RANGE (CENTER)
R10	1.0 GHz	0.5 to 50 or 110 GHz
R15	1.5 GHz	0.7 to 50 or 110 GHz
R20	2.0 GHz	3.5 to 50 or 110 GHz
R40	4.0 GHz	10 to 50 or 110 GHz
CRW + EDC (External Digitizer)	Up to ~11 GHz	18 to 50 or 110 GHz

Frequency Range

2 Hz TO 1.5 THz

To 50 GHz

N9042B UXA

- 26.5, 44, 50 GHz
- Best-in-industry DANL
- Outstanding dynamic range
- Swept and wide BW demod

To 110 GHz

+ V3050A Freq Extenders

- 50 to 67, 90, or 110 GHz
- Swept with HW pre-selection
- Also IQ Demod
- Seamless SA experience

To 1.5 THz

+ VDI External Converter

- To 170, 220, … 1500 GHz
- Swept or IQ Demod
- Virginia Diodes external converter
- Contact Keysight; orderable as N9029A

V3050A Frequency Extenders

SEAMLESSLY EXTEND FREQUENCY TO 110 GHZ

- Continuous frequency coverage from 2 Hz to 110 GHz
- Preselected
- USB-powered and controlled
- Remote head form factor moves point-of-connection to device under test (DUT)
- Much more than just a mixer!

N9042B UXA + V3050A SA Frequency Extender

KEYSIGHT'S SOLUTION TO THESE CHALLENGES

Bandwidth + Frequency that Meets Customer Needs

The Performance Customers Require

Critical Accessories + Software

N9042B + V3050A

SUPERIOR PERFORMANCE

EVM

Industry leading EVM residuals and sensitivity

Enables accurate characterization of transmitters

SWEPT DANL

See small signals near noise

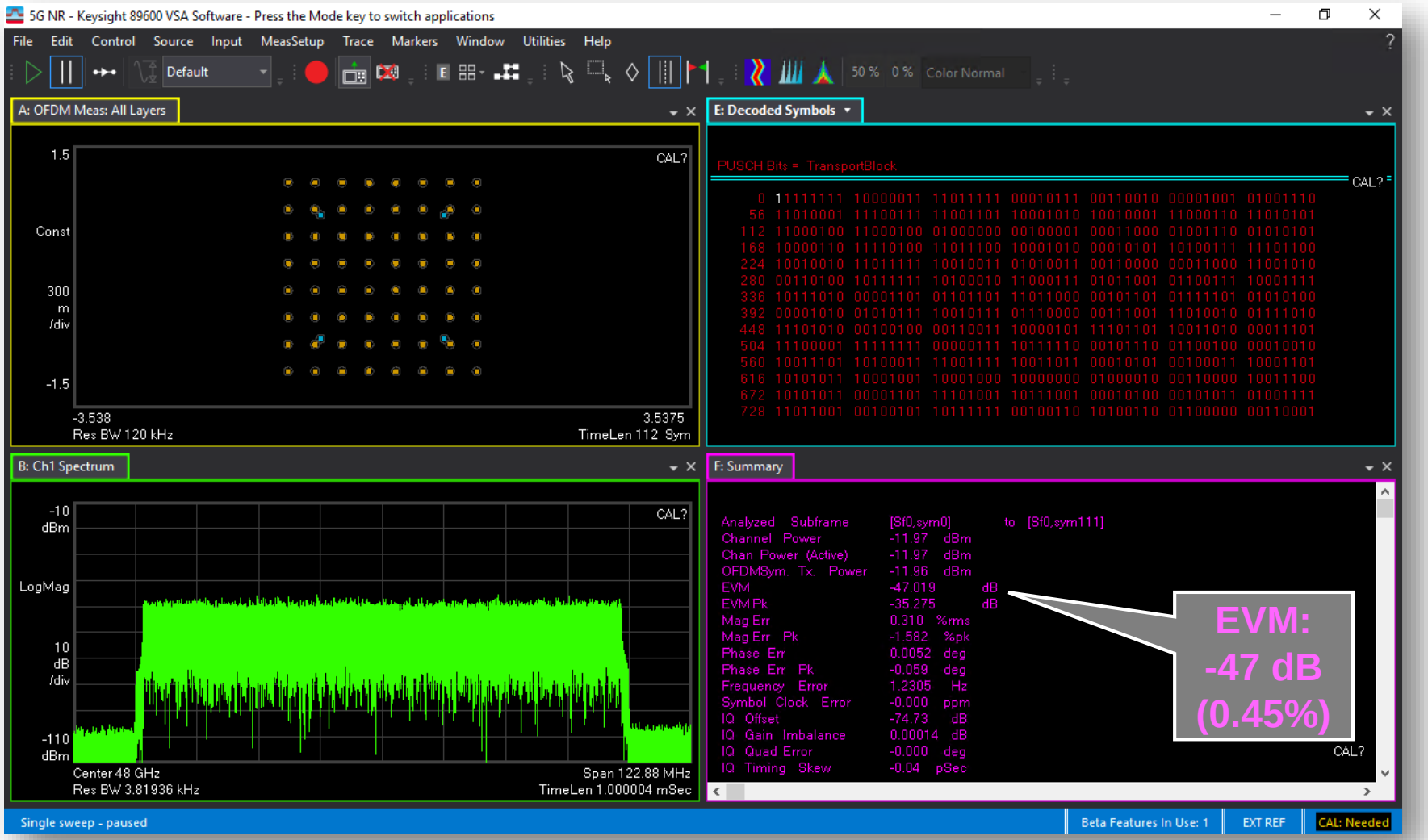
Quickly find spurs without having to narrow RBW and slow sweep speed

DYNAMIC RANGE

See small signals in the presence of large ones

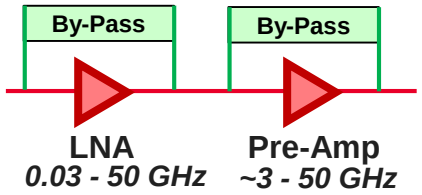
Industry Leading EVM

5GFR2 100 MHz AT 48 GHz



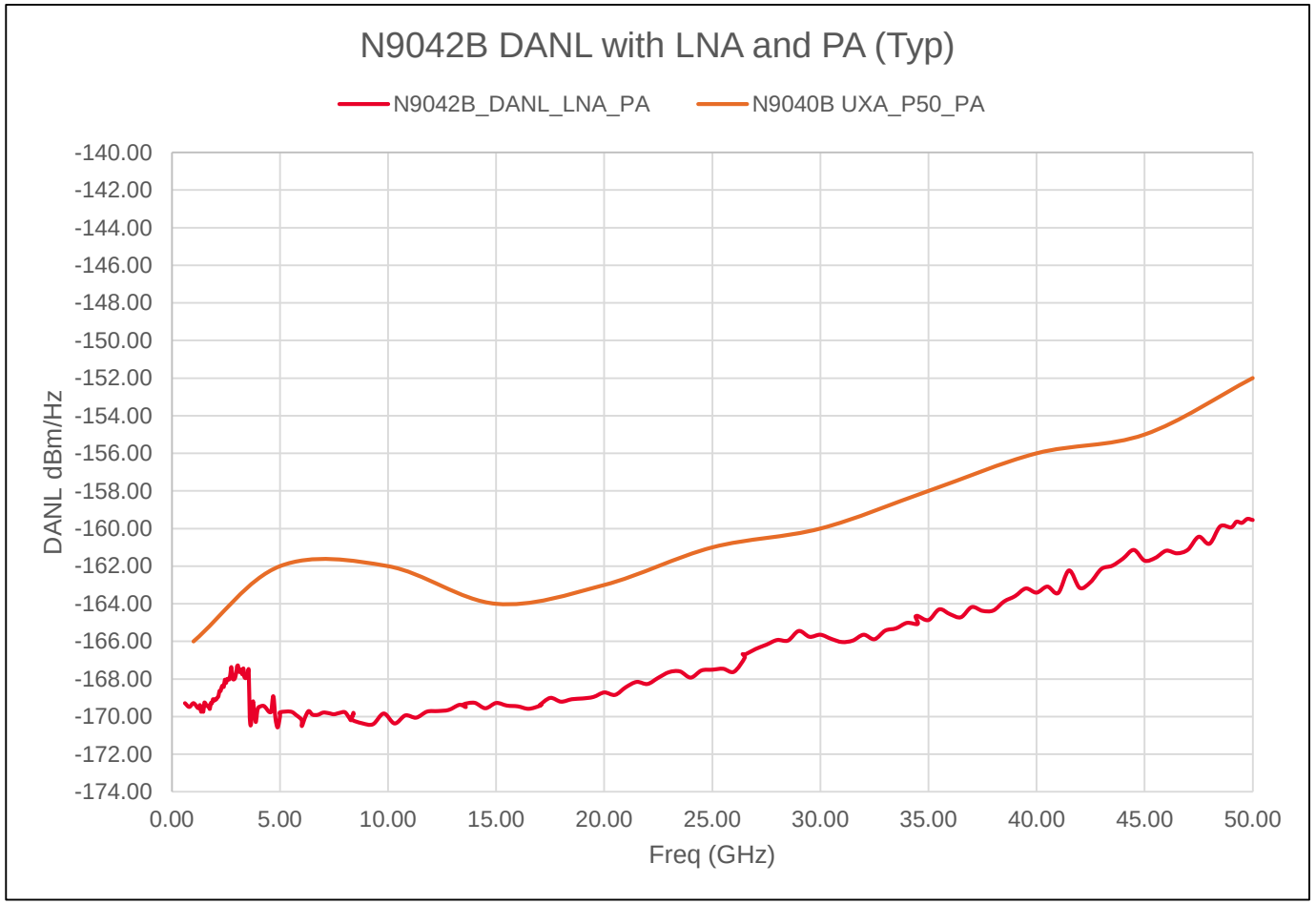
Low Swept DANL

FOR FAST SPUR SEARCH



New! LNA (Low Noise Amp) drives down noise. Two stages of gain gives greater flexibility to balance noise & distortion.

Both on for best Swept DANL (Sensitivity or Noise Figure), for low-level signals or spurs



N9042B UXA + V3050A SA Frequency Extender

KEYSIGHT'S SOLUTION TO THESE CHALLENGES

Bandwidth + Frequency that Meets Customer Needs

The Performance Customers Require

Critical Accessories + Software

4 GHz BW for Both Signal Analysis and Generation

SMART LINKAGE BETWEEN VXG & UXA STREAMLINES SET UP

- 4 GHz of corrected bandwidth for both analysis and generation
- Dual VXG channels aggregated into a single, coherently combined 4 GHz signal with channel bonding
- Auto-configure X-Series signal analyzer from VXG embedded 5G PathWave signal generation
- Automatic channel response correction and S-parameter de-embedding applied to VXG
- Smart linkage for automated VXG and MXG closed loop control in power amplifier test
- Characterize power amplifiers with DPD applied in RF and millimeter wave with simple and integrated user interface

What is the U9361 RCal?

CALIBRATE A TEST RECEIVER SYSTEM

- Improves test Rx system accuracy by an order of magnitude
- Seamlessly moves reference plane to the output of the DUT with easy-to-use, simple command structure and automation
- Models to 110 GHz
- Compact, palm-size, USB-powered and controlled
- Ultra-stable and repeatable with precision factory cal data inside
- Both magnitude and phase corrections with tunable, BPSK comb modulation
- US Patent for BPSK modulation calibrator

N9042B Software

SOFTWARE FOR ALL MEASUREMENT NEEDS

Now run up to **40% faster** with new CPU

N9085E 5G NR

(with 3GPP Rel. 16 support and improved “Optimize EVM”)

N9054E VMA Digital Demod and Custom OFDM

(QPSK/QAM/FSK/APSK, 2-segment support, DVB-S2X Presets)

N9055E PA (Power Amplifier) Test

(with VXG ‘Smart Link’ control & DPD support)

N9060E Swept SA, IQA and PowerSuite Measurements

N9080/82E 4G LTE-Adv-FDD/TDD, NB-IoT/eMTC/V2X

N9073E WCDMA/HSPA

N9068E Phase Noise

N9077E WLAN 802.11a/b/g/n/ac/ax

89600 VSA (Vector Signal Analyzer)

Follow-on Software Releases

- More V3050A Support
- More M8131A Support
- Segment Capture
- Streaming
- Pulse
- WLAN 802.11be
- Noise Figure
- RTSA with FMT

And more…

N9042B UXA + V3050A SA Frequency Extender

ADVANCED SIGNAL ANALYZER

- Industry leading **11 GHz** of analysis bandwidth
- Industry leading **4 GHz** of corrected bandwidth for **both analysis and generation** (with VXG)
- Keysight-exclusive signal analyzer frequency extenders – **unbanded and preselected up to 110 GHz**
- Superior performance **EVM, swept DANL, and dynamic range**
- Premier **measurement software** with X-Apps and VSA
- World's Only RCal receiver calibrator for an **order of magnitude improvements in amplitude accuracy**

https://www.youtube.com/watch?v=0BGghBVzJic

Keysight's N9042B UXA Signal Analyzer

DEMONSTRATION

Thank You!

QUESTIONS?