Master Your V2X Design & Validation Challenges - DSRC、C-V2X、eCall

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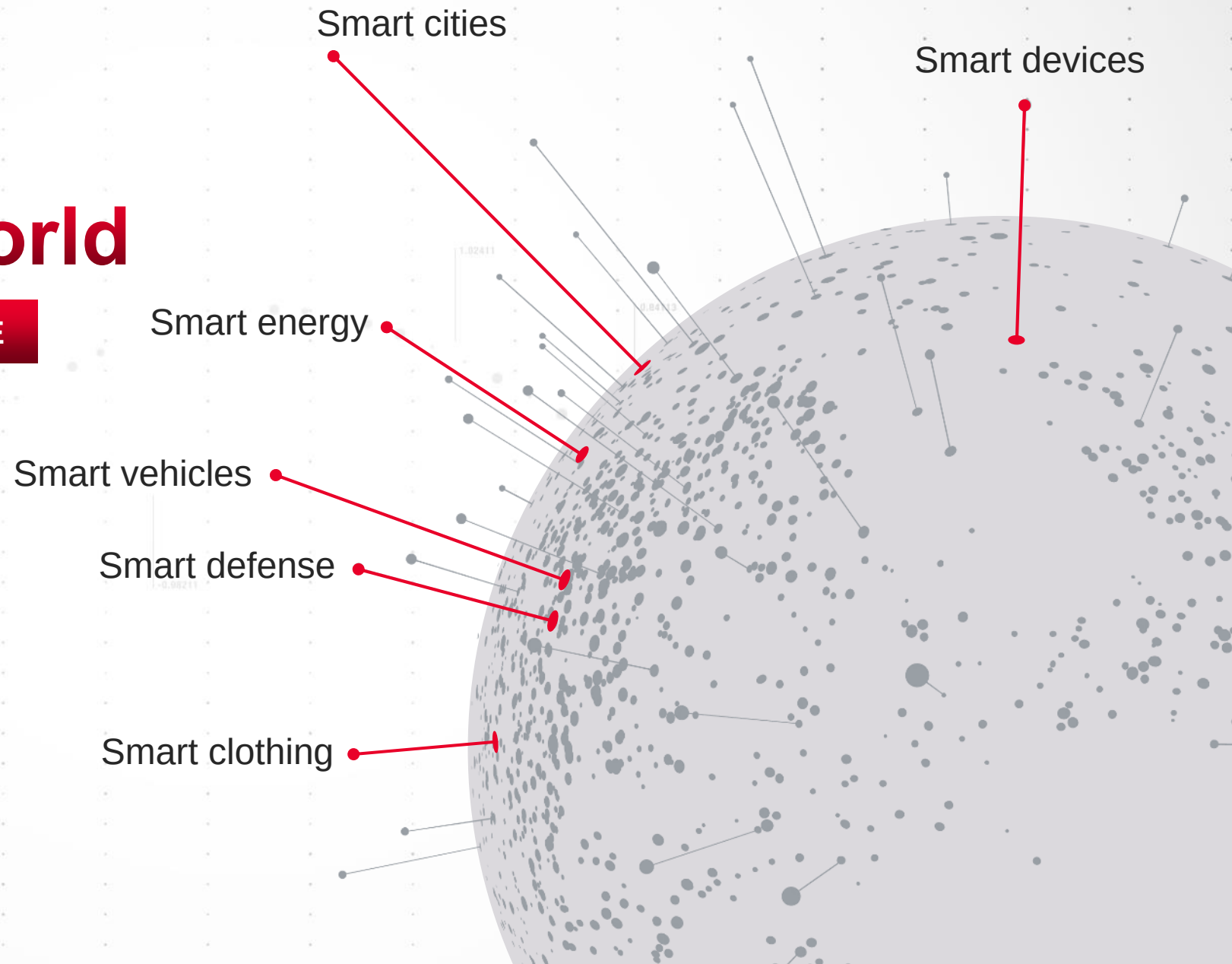
KEYSIGHT TECHNOLOGIES

Technology Connects the World

INNOVATION IS EVERYWHERE



KEYSIGHT TECHNOLOGIES

Technology Requirements Keep Advancing

MORE ELECTRONICS, MORE EFFICIENCY, MORE SENSORS

Electronics

- Better diagnostics
- Automotive Ethernet
- Infotainment

Batteries

- Longer range
- Higher densities
- More eco-friendly

Connectivity

- More information
- Better safety
- Easier navigation

Sensors

- Electro-mechanical
- Driver vision
- More autonomy

Evolution of Sensors in Vehicles

Mechanical Designs Starting in 1976

- Basic electronics
- Mostly mechanical
- No connectivity

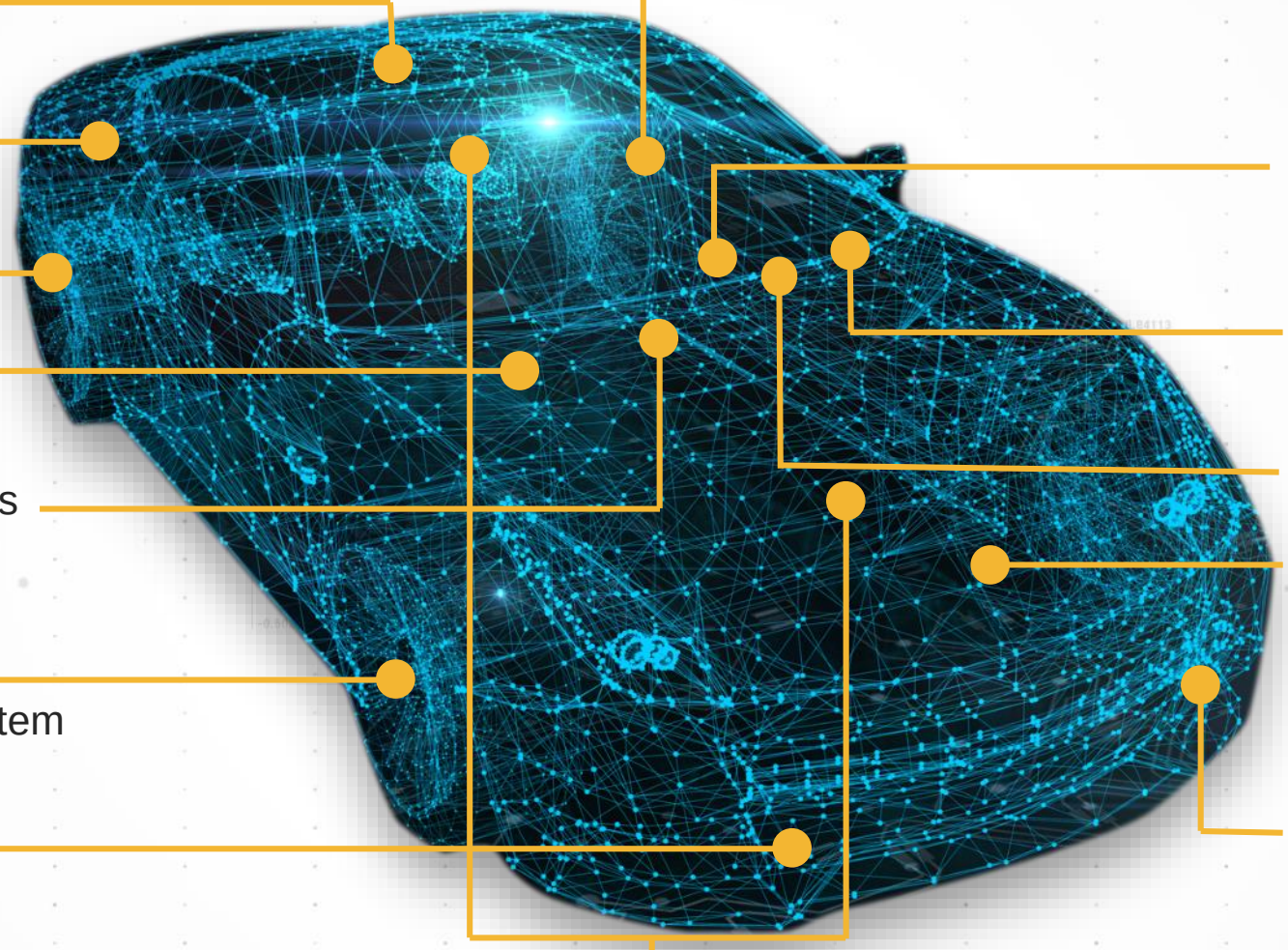
Assisted Driving Starting in 1997

- Electronic safety systems
- Integrated electronics
- Electric control units
- Infotainment

Autonomous Coming Next

- Sensor fusions
- Autonomous processing
- Auto-charging technologies
- Multi-connectivity

Innovations Through Multiple Technology Domains



V2X (V2V/V2I/V2P/V2N)

Radar Collision Avoidance

Electronic Stability Control Module

Climate Control System

Infotainment/Navigation Modules (DVD, eCalls, Hands Free Telephony, GPS)

Anti brake Locking system
Tire Pressure Monitoring system

Emission Control Module

Power Steering Control
Rear-view camera
Backup sensors
Power Seat Control

Personnel Occupancy Detection Systems (PODS) for Air Bag systems

Remote Keyless Entry

Instrument Clusters

Fuel Injection Module
Power Train &
Engine Management
(MiL, SiL, HiL)

Adaptive Lightning Control

Hybrid Electric Vehicle
(HEV) / Electric Vehicle (EV)

V2X – Enhanced Safety, Enabling Higher Levels of Automation

Forward Collision Warning

Motorist Advisories and Warnings

Red Light Violation Warning

Connection Protection

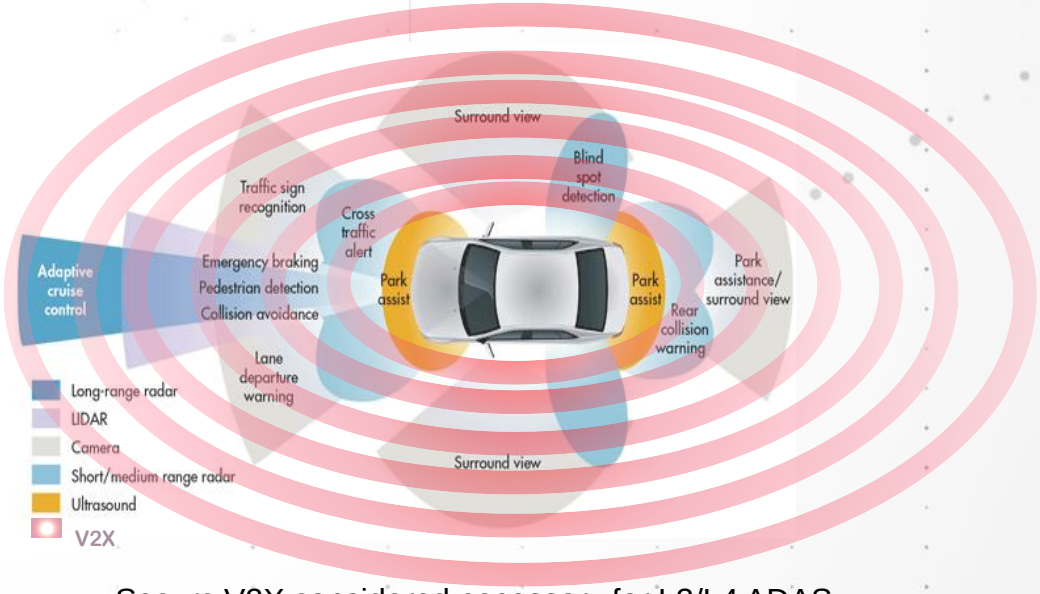
Eco-Traffic Signal Timing

V2V, V2I, V2P, V2N …

Technology to enhance driving experience, prevent accidents and collisions, assist traffic flow, enable higher levels of automated driving.

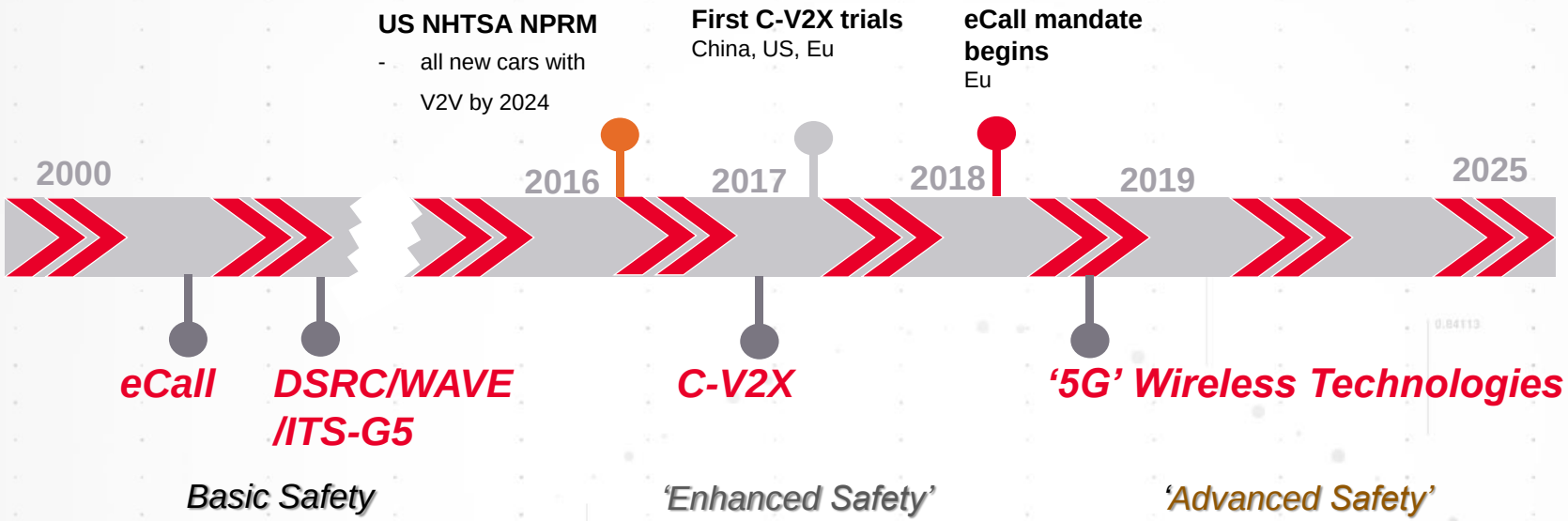
2 wireless technologies are currently being proposed -

- ❑ DSRC (based on IEEE 802.11p)
- ❑ C-V2X (based on 3GPP Rel-14 LTE-A Pro)



Secure V2X considered necessary for L3/L4 ADAS

V2X Technologies: Evolution



- DSRC - IEEE802.11p based
  - Based on 802.11a:
    - robust performance for short packets.
  - Products ready with actual deployments, extensive interop tests and field trials.(DOT/NHTSA)
  - Adopted or being considered by some regions.

- C-V2X – 3GPP LTE-based
  - Reuses LTE UL frame structure (Rel 14): require tight freq. & time sync.
  - Longer symbol and GI durations
  - Leveraging more recent PHY technologies: e.g. more advanced coding.
    - Improved air interface : Uplink: SC-FDM. Downlink: OFDM
    - Multi-antenna technology : Diversity, MIMO, Beam-forming
    - High spectrum flexibility : Flexible BW, FDD and TDD, new and existing bands
  - Still on going extensive field trials/testing.(more and more coming)
  - Qualcomm, Huawei and 5GAA are promoting heavily.

Test Challenges and Requirement for V2X (DSRC)

Wireless Communications System Lifecycle

WHERE DOES TESTING/MEASUREMENT CONTRIBUTE ?

- Simulation
- Channel Sounding & Modelling
- RF & modulation testing
- Channel Performance testing
- Base Station/ Network Emulation
- Congestion & Load testing
- Pilots/Trials
- Certification
  - Radio Conformance
  - Protocol Conformance
  - Interoperability
- Device Manufacturing Test & Calibration
- Infrastructure Coverage Planning
- Drive Test
- Virtual Drive Test

The bottleneck and test gap of this industry

KEY CHALLENGES OF V2X TESTING

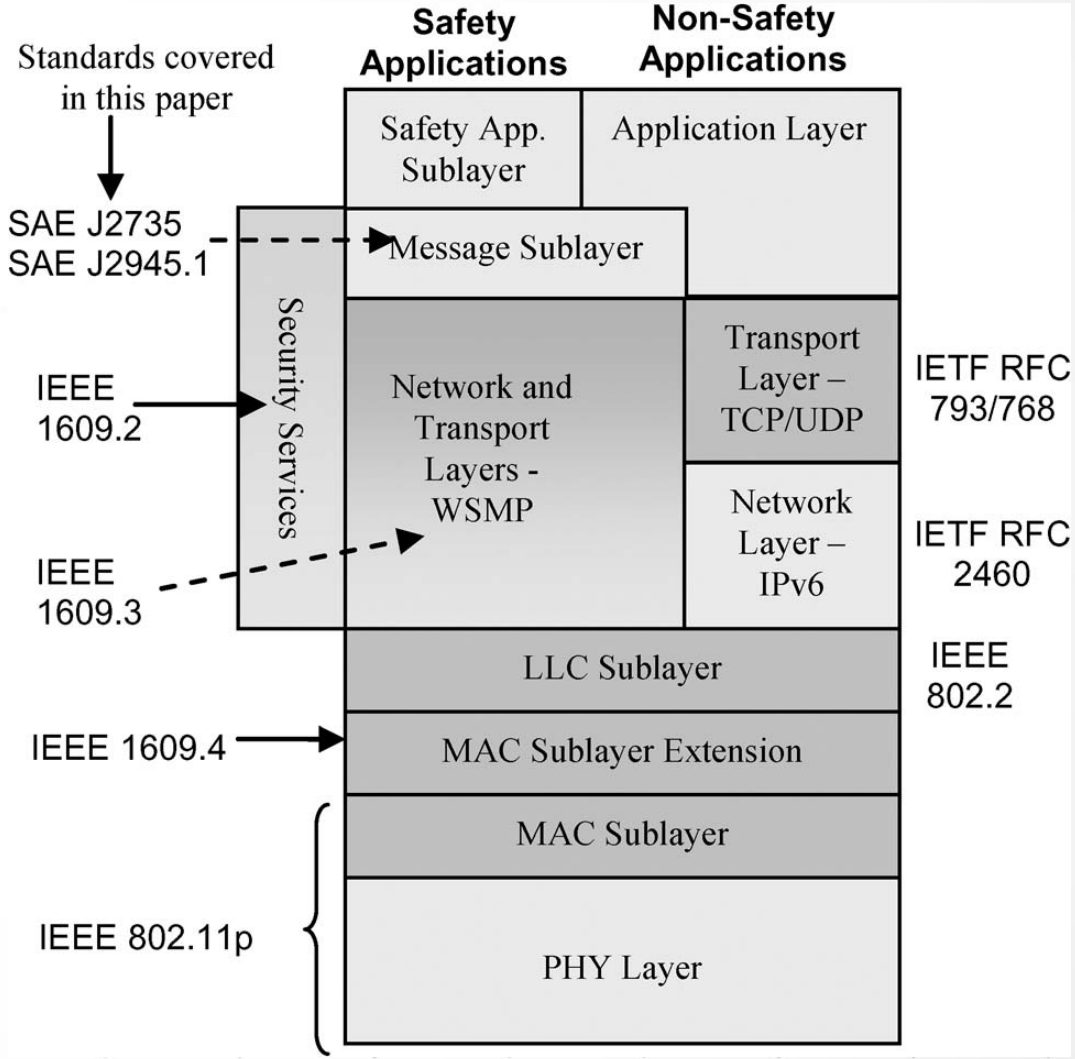
- System performance depends upon consistent implementation of Network Elements
  - Functional & Parametric Test of On Board & Roadside Units
  - Conformance Test : Device Certification
    - Multiple layers of standards : PHY layer to Protocol layer
  - Interoperability Testing
  - Assurance of functionality & performance of OBUs & RSUs through the manufacturing process
- System performance in real life conditions – pilots/trails
  - Field Testing
  - Loading, congestion handling

DSRC Operating Standards

COMMON VEHICLE LANGUAGE

- *SAE J2735 and J2945 define a standardized system of message sets for carrying information between vehicles.
- IEEE 802.11p is an approved amendment to the IEEE 802.11 standard to add wireless access in vehicular environments(WAVE).
- IEEE 1609 is a family of WAVE standards(P1609.0, P1609.1, P1609.2 etc) which supplement 802.11p with high layer messaging.

*SAE International is a U.S. based professional association and standards developing organization. SAE is an acronym for Society of Automotive Engineers. See www.sae.org



DSRC/WAVE

OmniAir CERTIFICATION PROGRAM

- Test OBUs & RSUs against PHY and Protocol Requirements
  - IEEE 802.11p Physical Layer
  - IEEE 1609.2 Security/Certificates
  - IEEE 1609.3 Network (including WSA)
  - IEEE 1609.4 Multi-Channel Operations
  - SAE J2945.1 V-V BSMs Minimum Performance and Message Interoperability

- 'Plugfests' bring OBU & RSU vendors together with Test Labs & Test Equipment providers to verify Interoperability and readiness for Certification, and provide opportunities for testing with SCMS & Field Testing

E6953A DSRC CoC Certification Test Solution

IEEE802.11p, 1609.3,1609.4, 1609.2, J2945/1Tests Cases supported

- Compact PXIe hardware
  - Keysight VXT : RF measurements + GPS source
  - DSRC Transceiver Module
    - CoC Test Cases require only 1 module
    - Configurable as fully functioning OBU/RSU
    - add modules for multiple simultaneous RF channels
  - Keysight PXIe Frame, Controller, Freq Ref

- Software
  - Certification Test Cases in Keysight Test Automation Platform
    - Test Case construction
    - Test Case sequencing
    - Pass/Fail
    - GUI
    - Controls Wave Channel Module & VXT
  - Single platform to be expanded for future V2X test needs

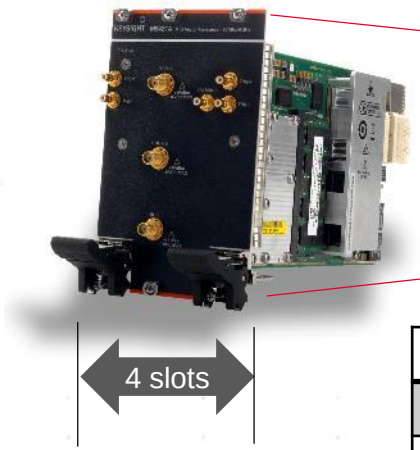
- Hardware & Software options covering
  - full CoC suite
  - RF only
  - Protocol only

Keysight V2X Test Platform

SIMPLIFYING RF TESTING

802.11p Test Cases
RF measurements

- using M9421A VXT hardware
  - Vector Signal Analyzer & Source
  - FPGA-Accelerated speed with high density & accuracy
  - Trusted X-Series software: industry tested algorithms, with code compatibility & bench top usability
    - N9077A measurement application
    - Graphical Vector Signal Analyzer
- N7617B Signal Studio
  - Arbitrary Waveform creation



Streamline Compliance Testing

Signal Studio

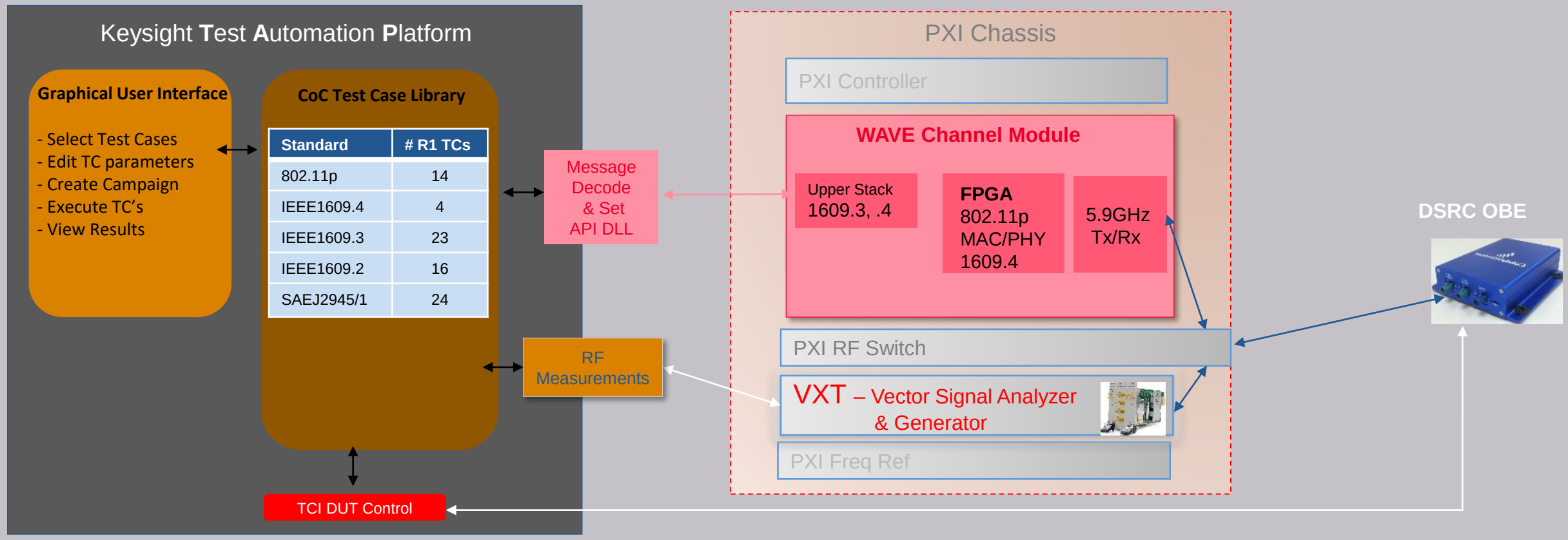
One-button X-Apps

M9421A VXT Key Features	
Frequency	60 MHz to 3.8 or 6 GHz
Bandwidth	40, 80 or 160 MHz
Modulated Output Power	+10 (HD) or +18 dBm
Memory depth	256 or 512 Msa
3 Ports	RF in & out, One Half Duplex (Optional)

Measurement integrity that ensures accurate, consistent results from R&D to Manufacturing

Keysight E6953A DSRC Certification Solution

Functional diagram



Keysight V2X Test Platform

Test Automation Platform

DSRC CoC Test Cases

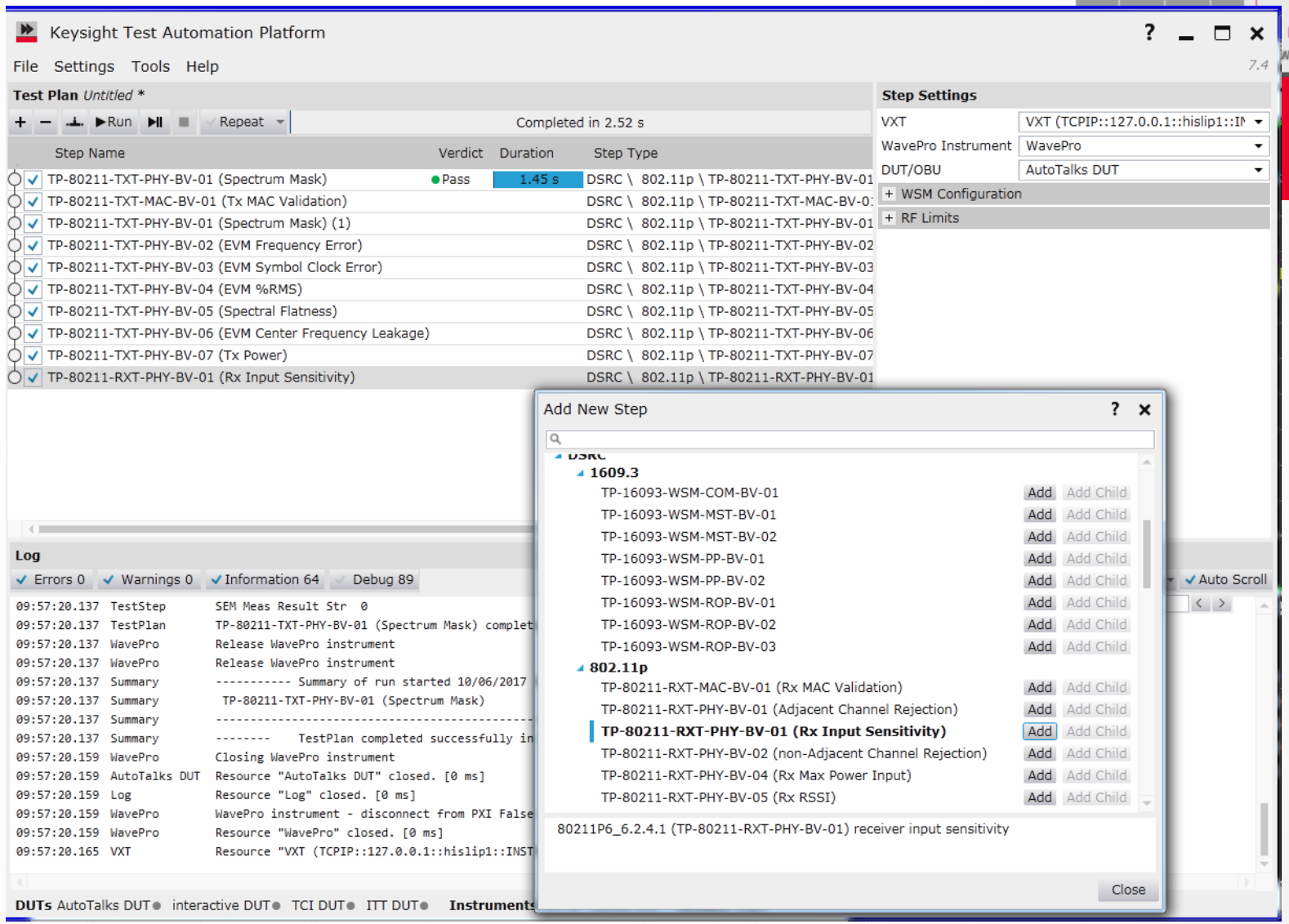
- 802.11p
- IEEE1609.3
- IEEE1609.4
- IEEE1609.2
- J2945/1

Test Plans

- Parameter Sweep Loop
  - e.g. Channel, Data Rate

Reporting

- Summary and each TC results
- Full ‘raw message’ data
- Detailed & graphical PHY results

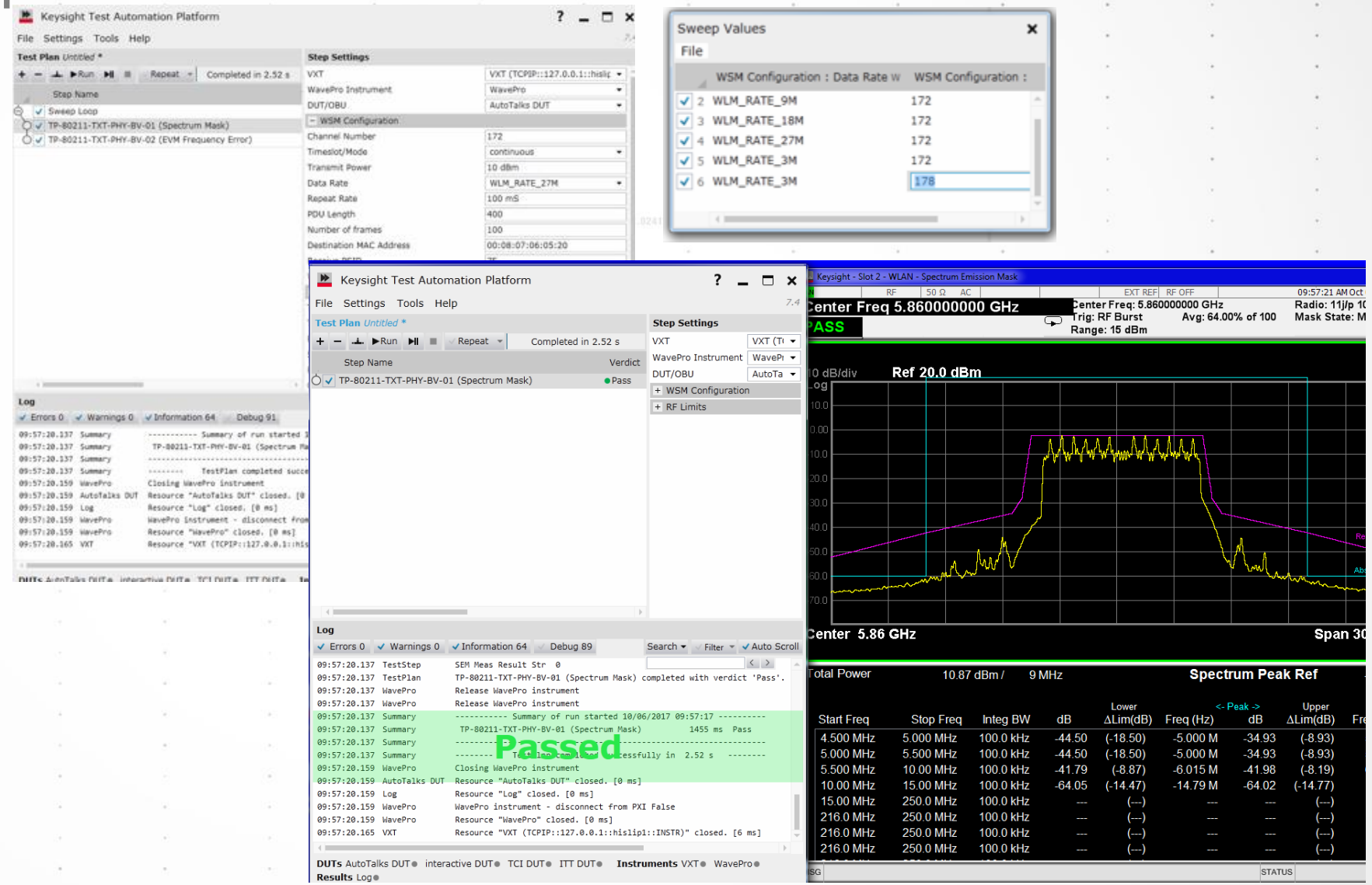


Keysight V2X Test Platform

Test Automation Platform

802.11p Test Cases

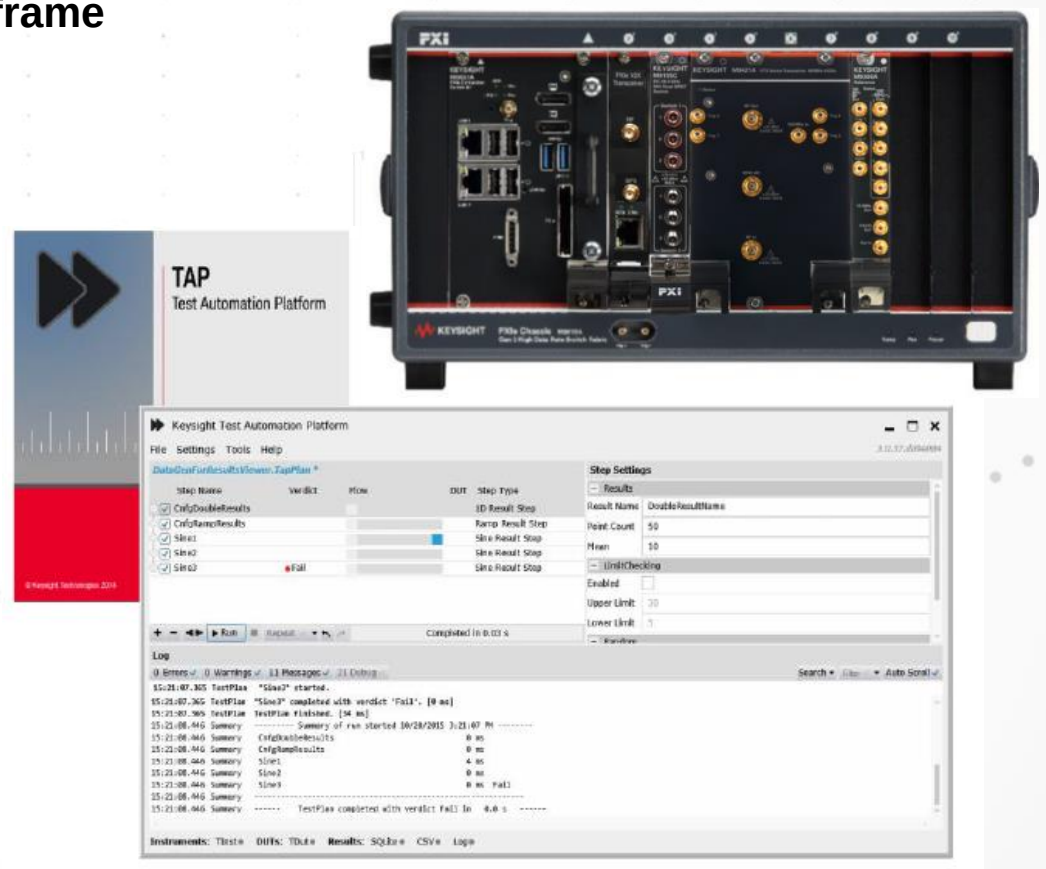
- RF Measurements
  - Test parameter setting, looping
  - Test Case Pass/Fail
  - Graphical VSA window
- Test Campaign Sequencing, Looping



E6953A Keysight DSRC CoC Certification Tester

Covers all CoC Test Cases in single , integrated PXI frame

- 802.11p
- IEEE1609.3
- IEEE1609.4
- IEEE1609.2
- J2945/1



Up next ……

- Pre-Certification and Design Verification solution
- Parameter flexibility to create new ‘TC’s & scenarios
- Loading, congestion, application testing
- ITS-G5 (optional 18GHz SA for EN 302 571 5.3.4)
- C-V2X

802.11NGV

- The IEEE 802.11 Next Generation V2X (NGV) Study Group is exploring ways to leverage more recent 802.11 technologies to address new applications of wireless access in vehicular environments, where new requirements for higher throughput, improved reliability and efficiency, and/or extended range are anticipated.
- "To support advancements in driverless car technology, car-to-car and car-to infrastructure connectivity, as well as to enable more robust vehicular infotainment offerings, a higher, more reliable and efficient throughput as compared to IEEE 802.11p is foreseeable," said Bo Sun, chair, IEEE 802.11 Next Generation V2X (NGV) Study Group.
- Backward compatibility with 802.11p can't be compromised
  - Physical layer enhancements should be applied in very specific scenarios for assuring the backward compatibility
- 802.11p has a minor specification gap (diversity)
- Multi-channel use-cases will expand

Test Challenges and Requirement for V2X (C-V2X)

C-V2X

- Proposed to 3GPP, driven by Huawei and Qualcomm
- Uses existing LTE infrastructure to deliver V2X services
  - Claims lower cost for both infrastructure and vehicle
  - LTE-D2D used for V2V
  - Plans being developed to improve latency (currently est ~100ms)
  - C-V2X capability expected in 3GPP R14, mid 2017
- Growing support including 5G AA

- Keysight supports and track LTE measurements, RF measurements likely similar to LTE/LTE-A

designlines AUTOMOTIVE

News & Analysis

Prelude to 5G: Qualcomm, Huawei Muscle into V2X

Connected Car Clash: 802.11p vs. LTE D2D

Junko Yoshida
10/15/2015 06:13 PM EDT
5 comments

NO RATINGS
LOGIN TO RATE

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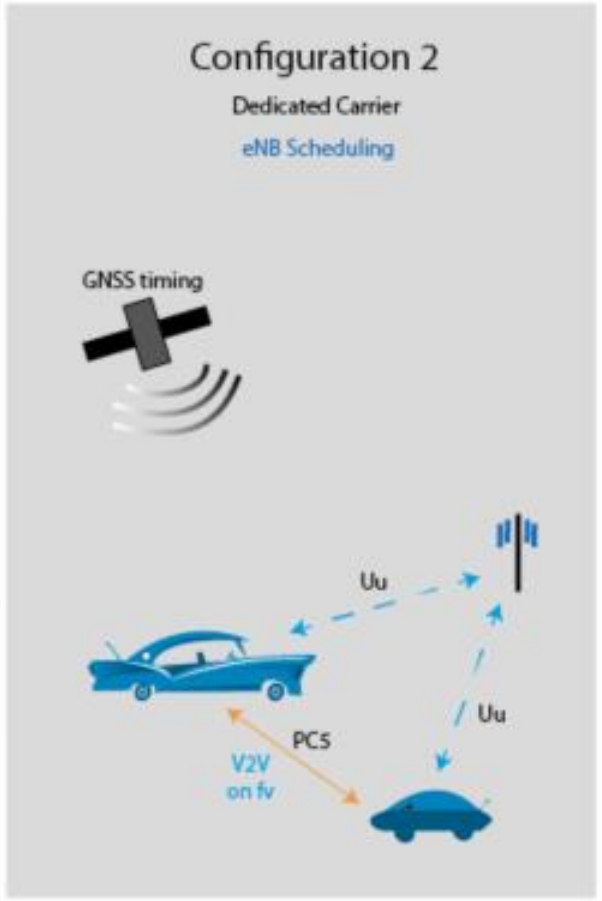
MADISON, Wis.—Huawei and Qualcomm, two cellular technolo giants, are muscling their way into the nascent vehicle-to-vehicle (V2V), vehicle-to-infrastructure communication market, often collectively titled V2X, by proposing a new LTE standard called "LTE V2X."

The move is at odds with incumbent automotive technology suppliers who have been working more than a decade to develo and test — and finally implement — a Dedica Short-Range Communications (DSRC) technology designed for V2V, V2I communications.

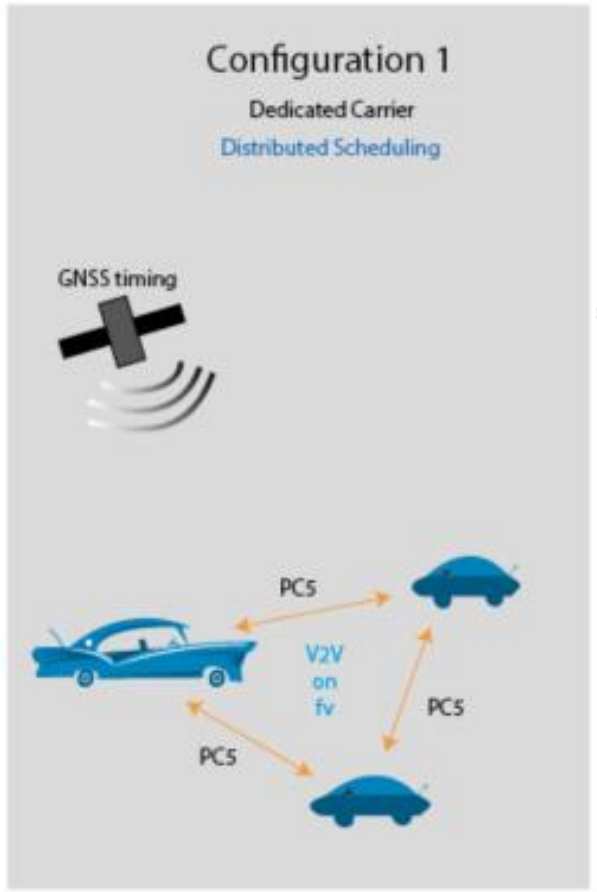
C-V2X Acronyms to Know

- UE- User Equipment
- E-UTRA – Network that the UE connects to
- Uu – Interface that allows for communication between a UE and the UTRA
- PC5 – Interface introduced under 3GPP Release 14 used specifically for C-V2X

C-V2X Mode 3 and Mode 4

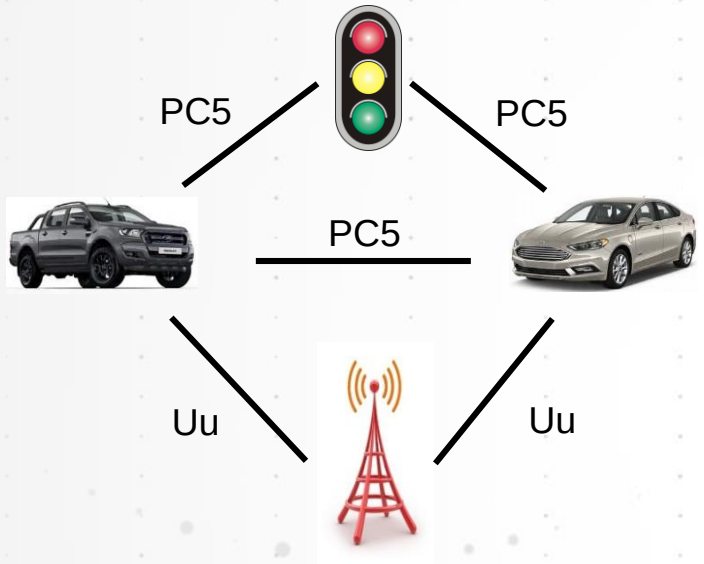


Mode 3

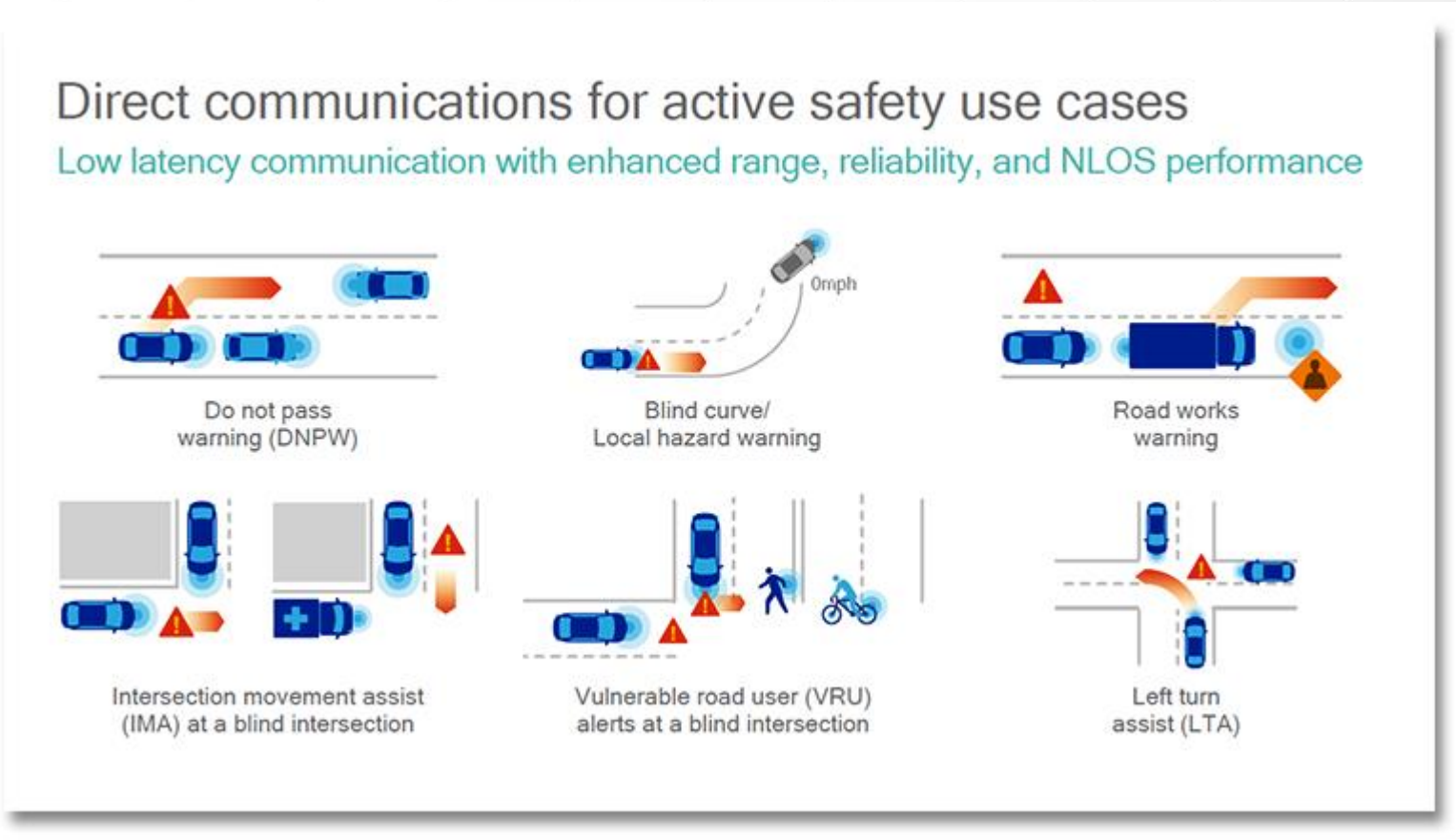


Mode 4

C-V2X Low Latency Communication

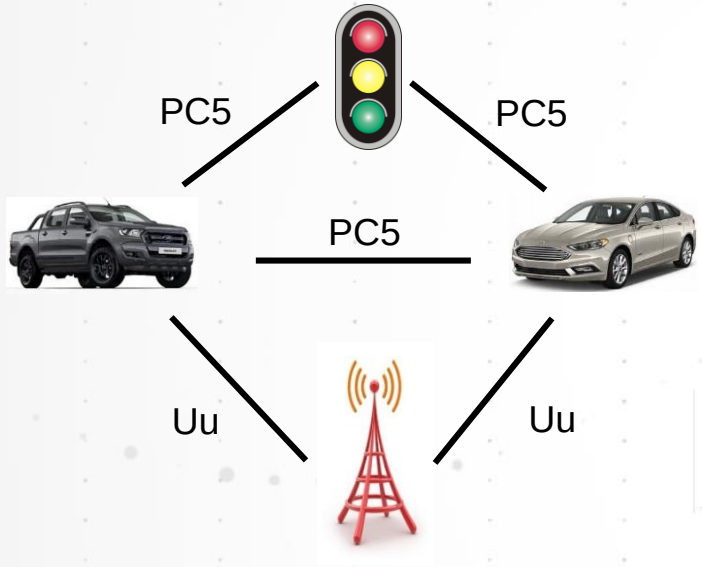


The PC5 interface was designed to make use of the 5.9 GHz band

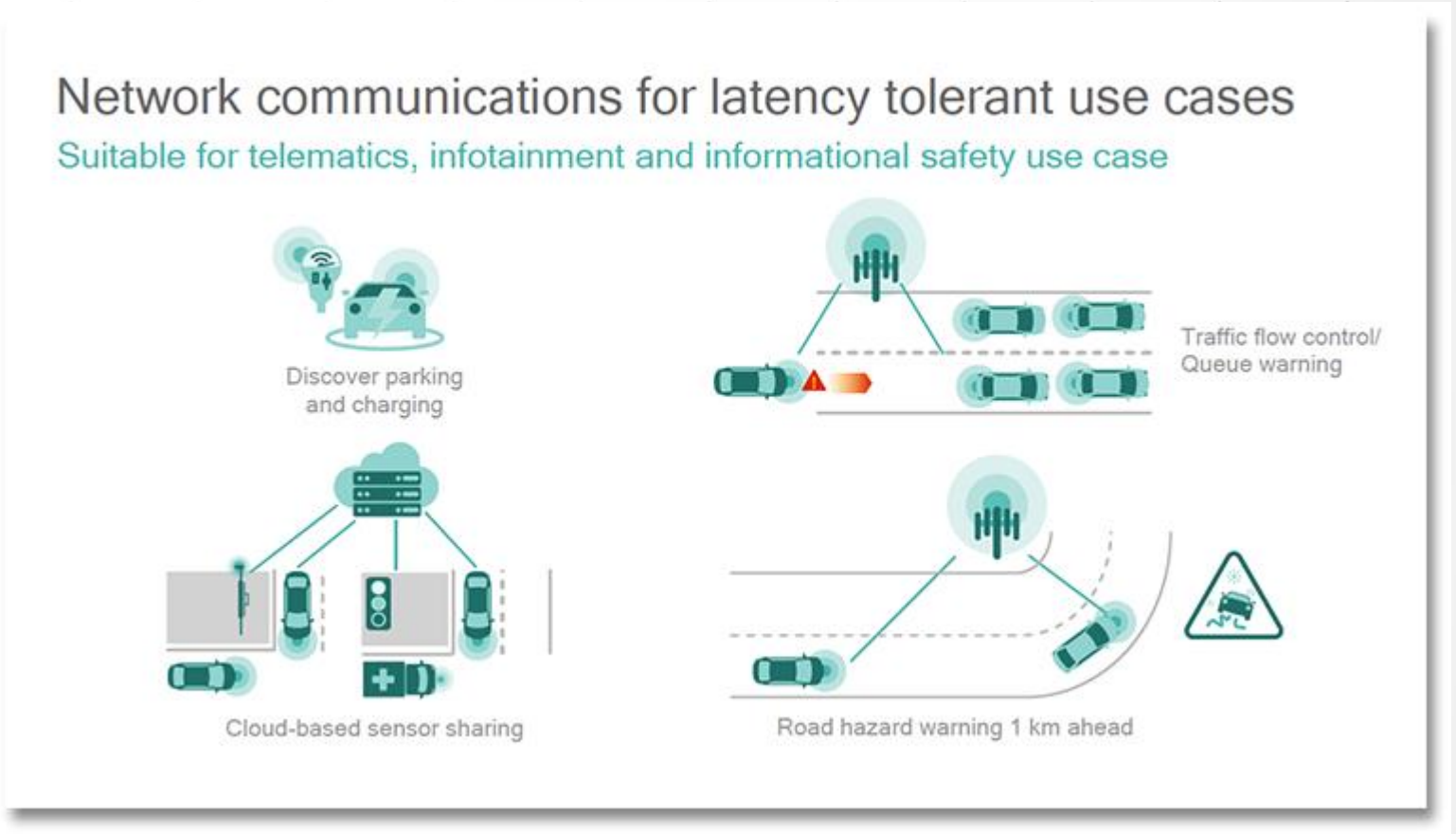


Credit: Qualcomm

C-V2X Latency Tolerant Communication



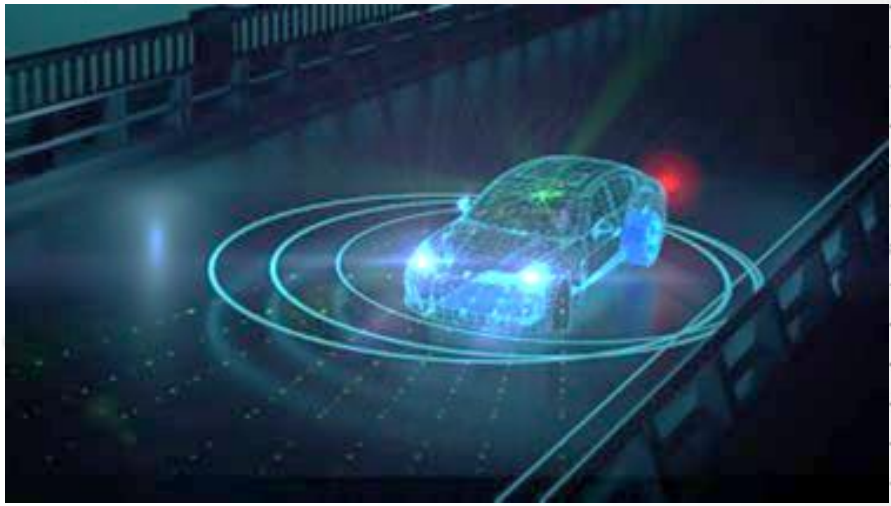
C-V2X is also capable of taking advantage of existing cellular networks to communicate when latency isn't an issue.



Credit: Qualcomm

C-V2X supports the vision for AVs

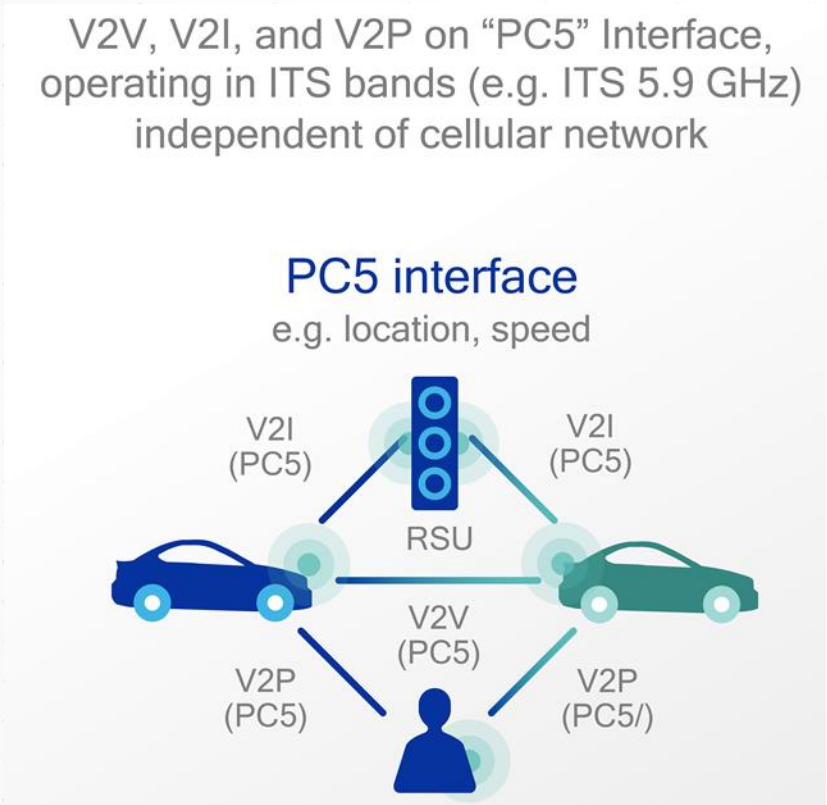
- **Vision**: Fewer accidents & greater road safety
- **Enabler**: Create greater on-board situational awareness
  - Observing
  - Foreseeing
  - Taking protective action
- **Foundation**: Dependable wireless technology
  - Superior range
  - Low latency
  - High-speed connectivity
- **Trend**: 5GAA membership ➔ momentum behind C-V2X
  - Evolving from *basic* to *enhanced* to *advanced*
  - Achieving full autonomy



C-V2X Transmission Modes

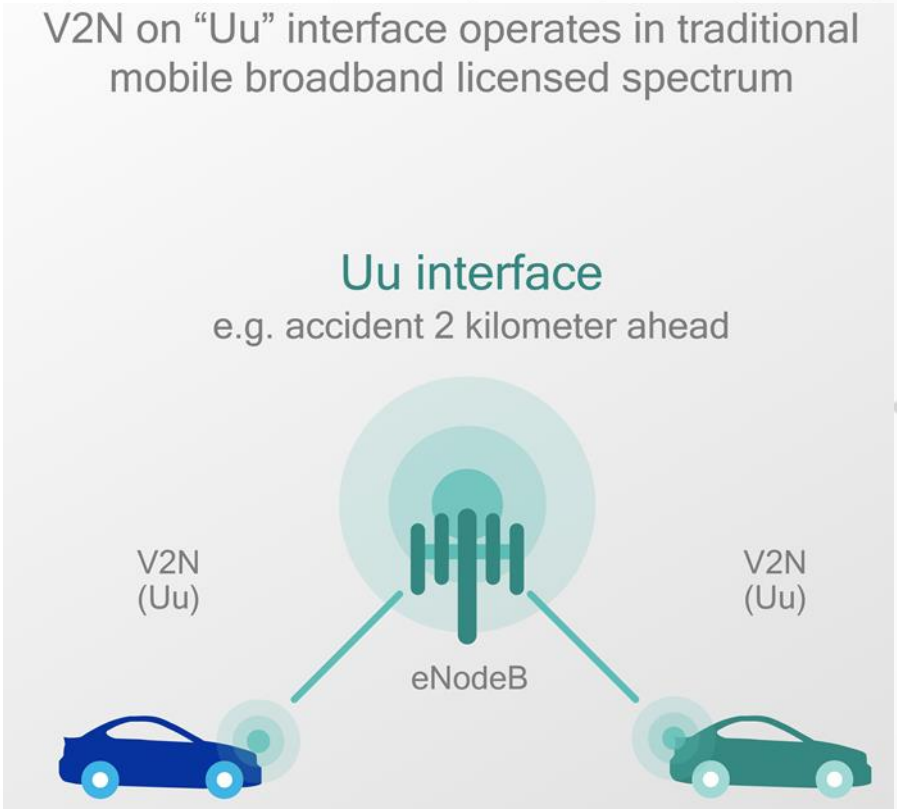
Direct Communications

V2V, V2I, and V2P on “PC5” Interface, operating in ITS bands (e.g. ITS 5.9 GHz) independent of cellular network



Network Communications

V2N on “Uu” interface operates in traditional mobile broadband licensed spectrum



Courtesy of Qualcomm

R14 C-V2X is the first step towards 5G NR V2X

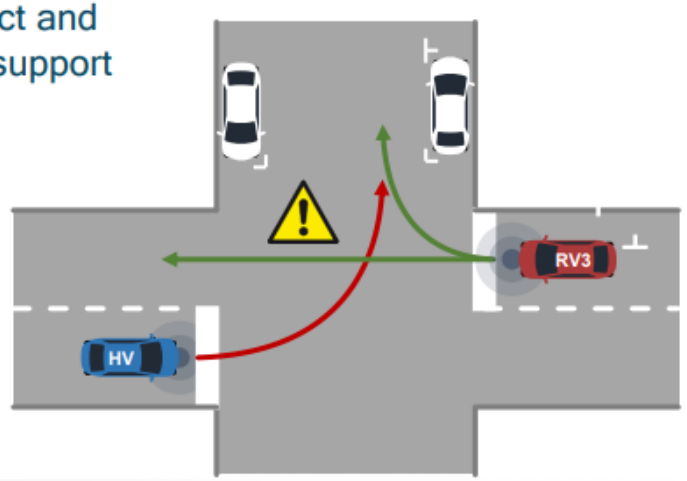
1H17 | 2H17 | 1H18 | 2H18 | 2H20

Rel14 — Rel15 — Rel16

Basic and enhanced safety

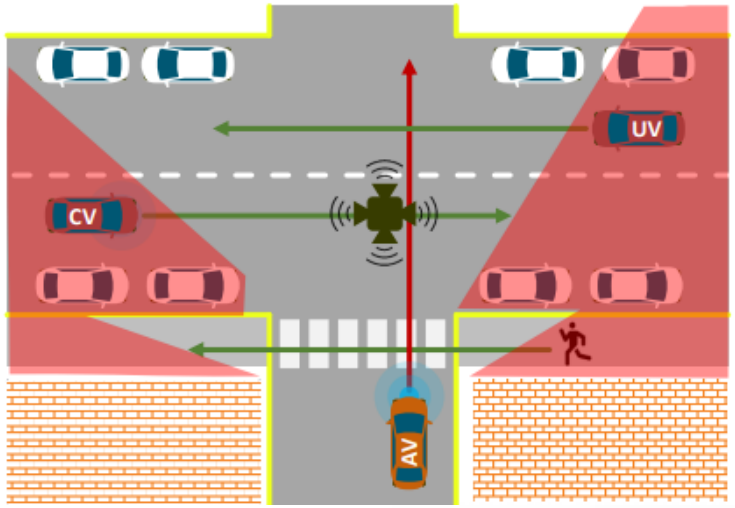
C-V2X R14/R15 with enhanced range and reliability

- Basic safety messaging
- Dual (direct and network) support



Autonomous driving / Automation

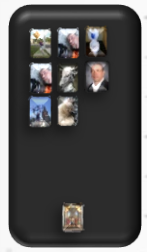
5G NR based C-V2X R16



- Backward compatible
- HD sensor and intent sharing

5G Changes the Entire Network

LTE ARCHITECTURE



UE
User Equipment

"Your Phone"

Air Interface

Mobile Operator Network

e-UTRAN

S1

ePC

SGi

e-UTRAN
Evolved Universal Terrestrial Radio Access Network

"The RAN"

e-PC
Evolved Packet Core

"The Core"

Servers PDN's

PDN
Packet Data Network

"The Rest of the World"

Increasing Possibilities
UE, CPE, AR, VR, any number of "things"

5G RAN
5G
Radio Access Network

NGC
Next Generation Core

5G Terms

5G Framework for Automotive

COMBINATION OF ALL THREE

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

Very High Data Rate In Congested Areas
Communications Optimized for Machines
High Reliability and Low Latency

5G & V2X Measurement Challenges

OVERALL AND C-V2X

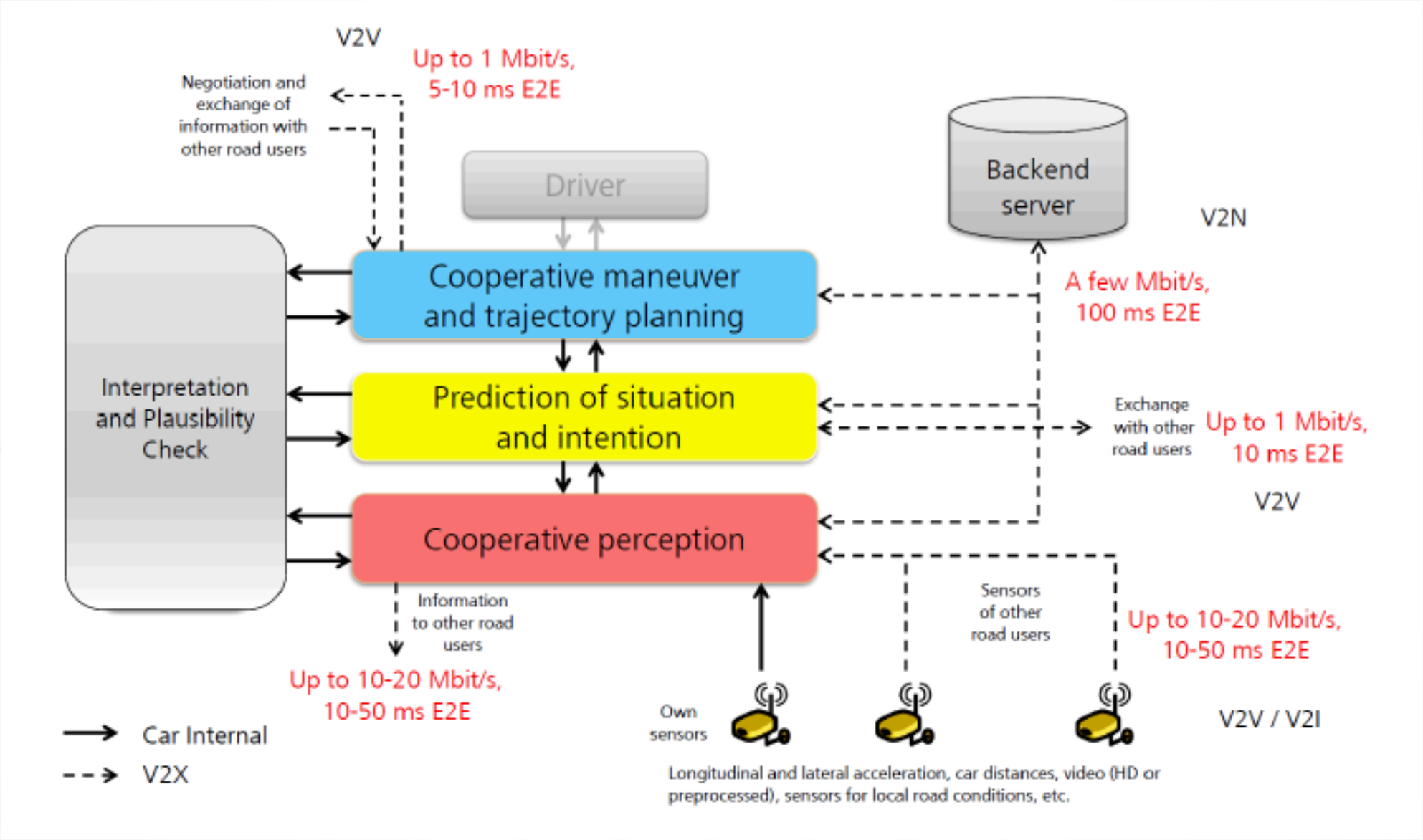
5G Overview

1. Measure, model, and emulate mmWave channels
2. Measure, model, and emulate wideband baseband
3. Measure and characterize chips & devices over-the-air
4. Emulate 5G network and device—characterize spectral efficiency gains
5. Simulate 5G NR signals, protocol stacks—prototype baseband and RF implementation effects to the system
6. Characterize phase, amplitude, and thermal effects of phased arrays
7. Emulate and evaluate end-to-end connections
8. Model, design, and troubleshoot mmWave components and subsystems
9. Characterize and troubleshoot high-speed digital interfaces in circuits and networks (from DigRF all the way to PAM4 and 400G)
10. Characterize interoperability/coexistence of wireless standards

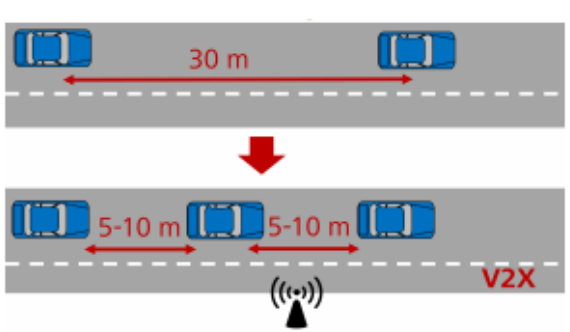
Key Measurements in V2x

- Latency
- Reliability (PER)
- Interference and Co-existence
- Range (Sensitivity)
- Congestion Control
- Maximum Relative Vehicle Speeds
- Dynamic Channel Impairments
- Data Throughput
- GNSS Accuracy
- Interoperability
- Certification Test (Dictated by Policy)
- Security
- Antenna Performance

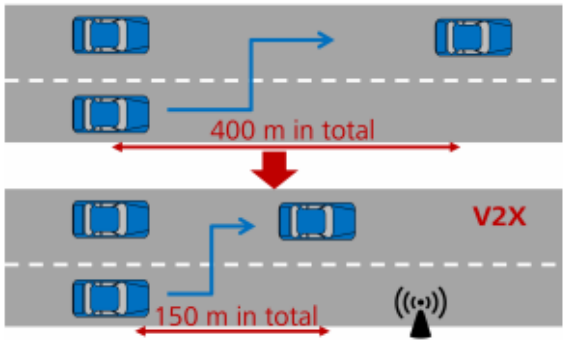
Connectivity Demands of Future Connected Vehicles



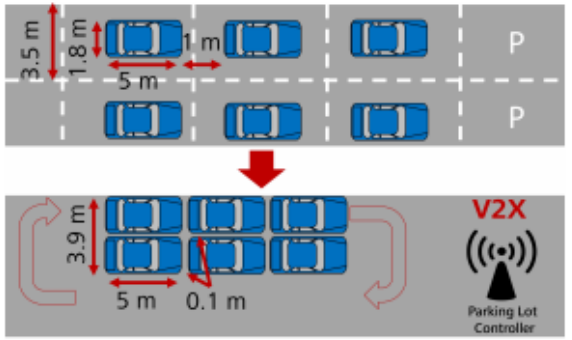
Examples of 5G Automotive Use Cases



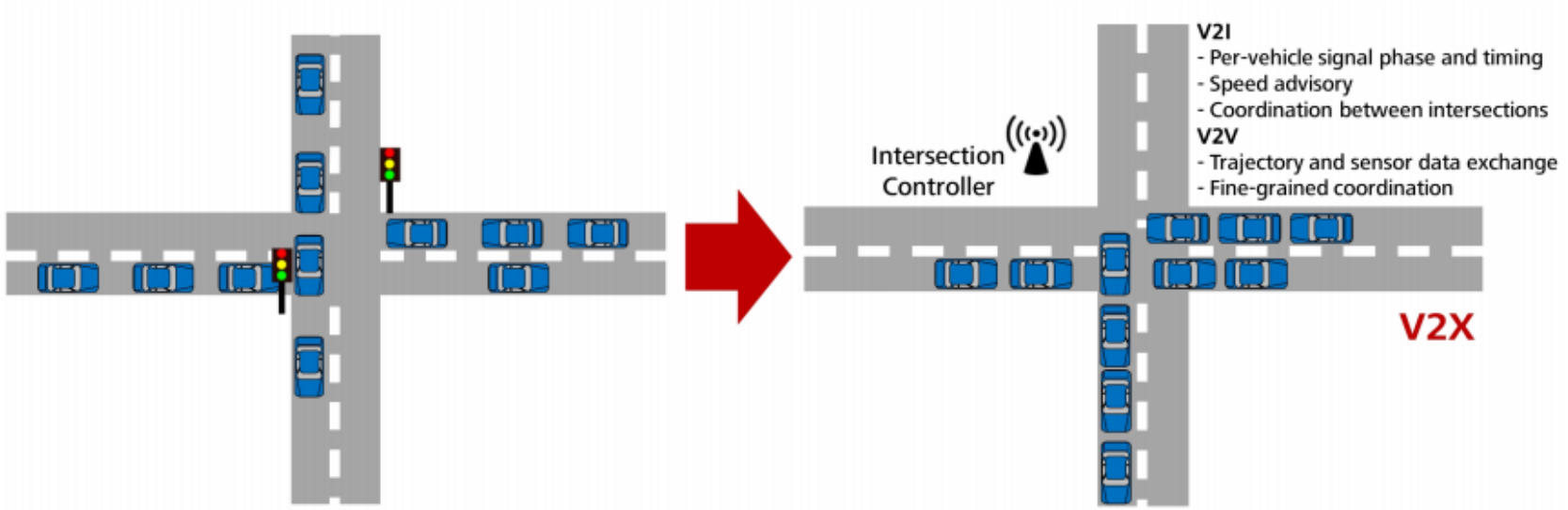
(a) Platooning/Cooperative Adaptive Cruise Control (CACC) [3].



(b) Lane (or Road) Merging [3].



(c) Connected Automated Parking [5].

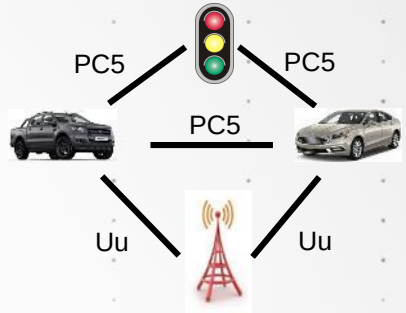


(d) Cooperative Intersection Control [3].

5G provides crucial capabilities

- **5G**: Reliable connectivity, fast data rates & ultra-low latency
- **Today**: C-V2X becomes key enabler of AV with 3GPP R15+
  - Stepping stone to Level 4 & Level 5 autonomy
  - Path to 5GAA *advanced* safety
- **Past**: LTE-Advanced Pro (4G)
  - Testers lack easy, cost-effective upgrades to 5G
  - Must replace to cover 5G R15, R16...
- **Implications**: Ignoring 5G increases costs, reduces opportunity
  - Limits ability to innovate & be first
  - Makes it harder to create strong differentiation

C-V2X Test System



UXM 5G Wireless Test Platform (E7515B)

- <6GHz Frequency range
- mmW Freq possible with remote radio heads

C-V2X Emulation via Test App

- Uu and PC5 interfaces
  - PSSS/SSSS (Synch), PSBCH (Broadcast), PSCCH (Control SCI), PSSCH (Data)
  - SIB21, RRC (Dedicated Msgs), DCI 5A
- Multiple UE emulation
- Functional & Protocol Test (L1/L2/L3) and modem bring-up
- RF Measurements: EVM, ACLR, OBW, SEM, Chan Power, Tx On/Off Mask
- GNSS via MXG (Optional)
- Pathwave Test Measurement Automation (Optional)

MXG GNSS Emulator (N5182B)

- 6GHz Freq Range
- Real-time creation of multi-satellite signals for GPS, GLONASS constellations (L1 with C/A code), Beidou (Compass), SBAS/QZSS with up to 40 channels, and Galileo (E1) with up to 16 channels for line-of-sight and multipath signals
- Add impairments such as multipath, pseudo-range error, and CW interference signals in real-time while the signal is playing

C-V2X Test Solution

Network and Vehicle emulation

Black = interface supported
Grey = interface not supported, functionality internal, subset to test modules

C-V2X Emulator

V2X Message Broadcast

V2X Control Function emulation – similar to ProSe

V2X Control Function

V2X App Server

IP

HSS

ePC SGW

PDN-GW

S5/S8

S11

S6a

S1-u

MME

S1-c

eNB

LTE Uu

Simulated devices inside UXM-B

ITS Stack

ITS

ITS

ITS

ITS

10MHz Ref

LTE Uu

PC5

R14 signalling enhancements for V2N/V2V

Sidelink RF meas

PC5 interface support

Device emulation

V2X Function

GNSS Synch

ITS Stack blue = Keysight ITS SW

V2X Function green = DUT App SW

V2X Control Function pink = Keysight App

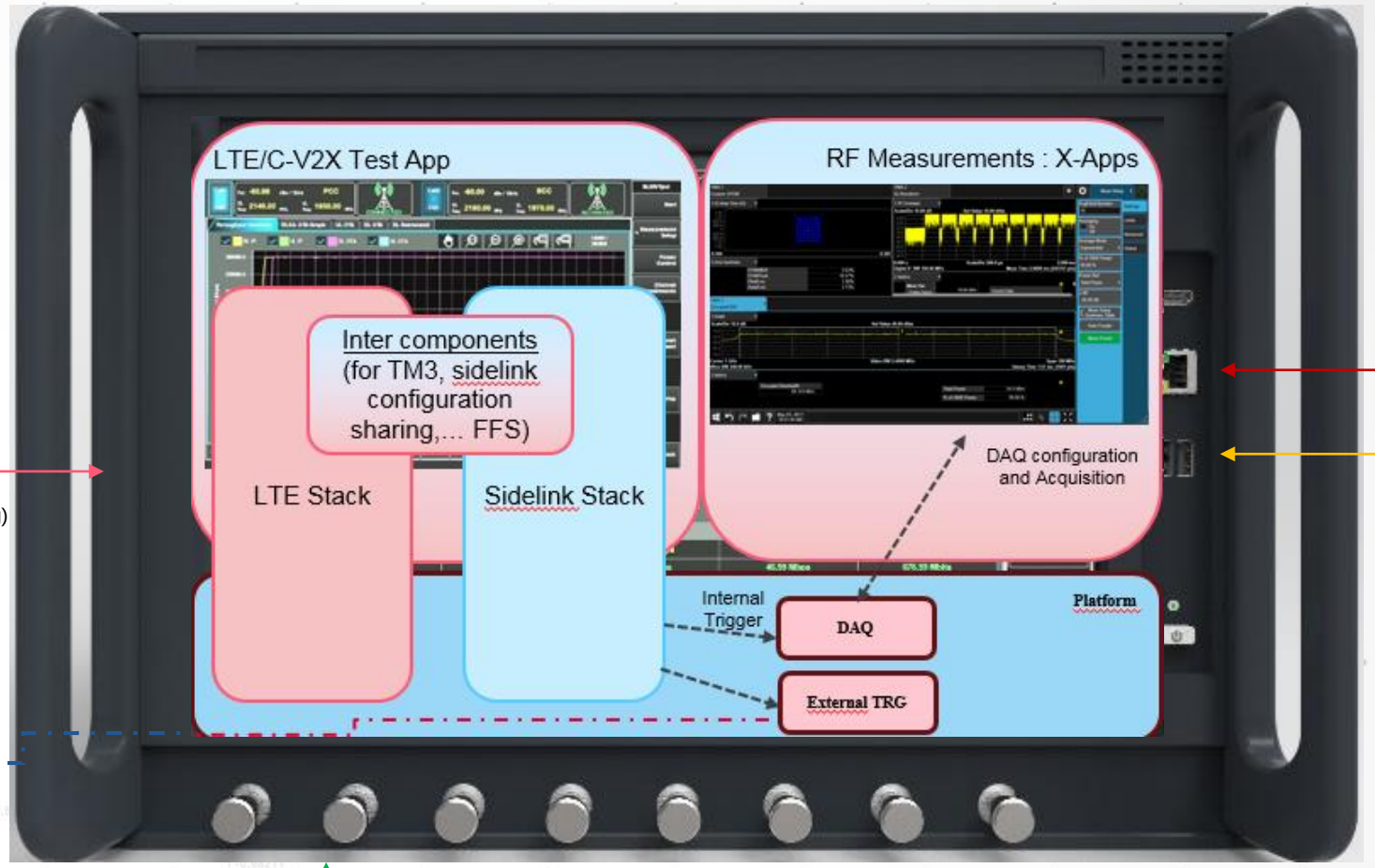
V2X App Server grey = Out of Scope

V2X App Server

V2X Control Function

ITS Stack

- Keysight Test Automation Software
  - Ready to use test sequences
  - Modern Interface
  - Complete Test report
  - And more..



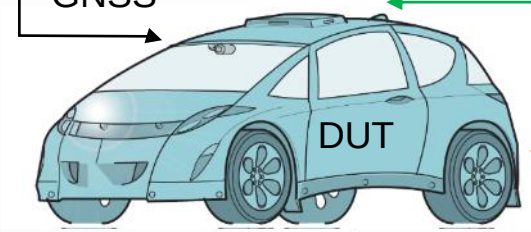
IP Conn.
(GNSS signal programming/loading)

GNSS

Trigger/Synch

GNSS -
Timing
Synchronisation
Position
Trajectory (dynamic)

GNSS



Uu

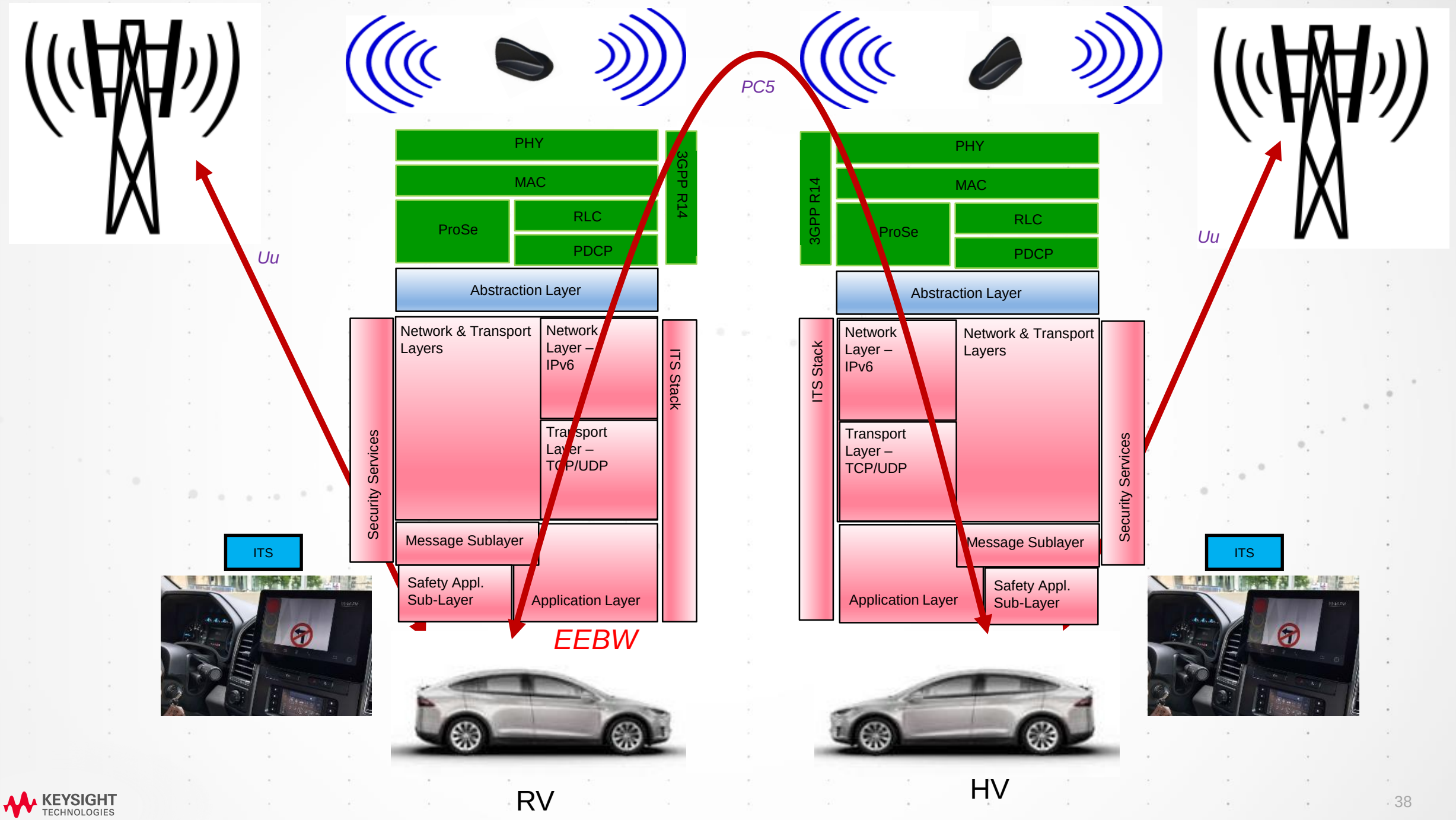
SIB 21
RRC (Dedicated Msgs)
DCI 5A
UL SPS (Multiple)

PC5

PSSS/SSSS (Synch)
PSBCH (Broadcast)
PSCCH (Control SCI)
PSSCH (Data)
DMRS

Serial conn. (AT commands)

IP conn. (custom DUT logs and control, traffic injection…)


PC5
Uu
Uu
PHY
MAC
ProSe
RLC
PDCP
3GPP R14
Abstraction Layer
Network & Transport Layers
Network Layer – IPv6
Transport Layer – TCP/UDP
Message Sublayer
Safety Appl. Sub-Layer
Application Layer
Security Services
ITS Stack
ITS
EEBW
RV
HV

Invest for the present & future

- **Keysight C-V2X Toolset**
  - Only solution tracking the evolving C-V2X standard
  - Platform will support future releases of 5G NR V2X
- **Protects your initial investment**
  - Serves as 5G measurement platform
  - Has roadmap to 5G NR V2X
  - Provides foundation for C-V2X conformance test
- **Accelerates deployment of advanced safety features**
  - Level 4: High Automation (constrained operation)
  - Level 5: Full Automation (unconstrained operation)

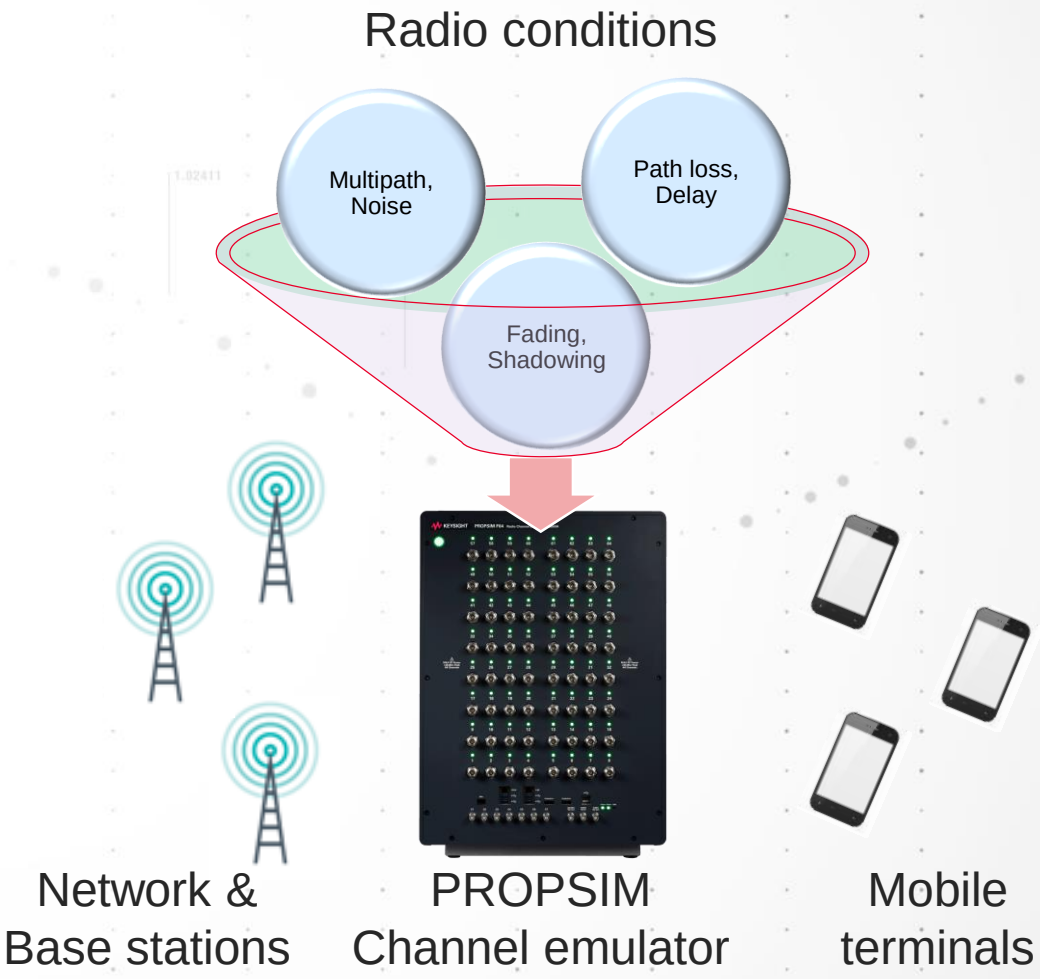
Address functional test, protocol test & RF

- **Supports RF, protocol & application-layer testing**
  - Covers both interfaces: User-to-UTRAN (Uu) & Direct Communication PHY sidelink (PC5)
  - Built on proven Keysight UXM 5G wireless test set
- **Simplifies C-V2X measurements with intuitive UI**
  - Addresses RF & protocol
  - Shortens learning curve
- **Includes GNSS emulator**
  - Uses Keysight N5182B MXG X-Series RF vector signal generator
- **Provides RF measurements of Tx & Rx characteristics**
  - *Tx*: power, error-vector magnitude (EVM), frequency accuracy, in-band emissions, adjacent channel leakage ratio (ACLR)
  - *Rx*: sensitivity, maximum input level, adjacent-channel selectivity

Introducing Channel Emulator

PROPSIM EMULATES COMPLEX REAL-WORLD RADIO CONDITION IN THE LAB

- Channel Emulator (CE) is a device which replaces wireless links with mathematical model of the radio conditions
  - Control the conditions over multiple test runs
  - Model extreme conditions
- Channel Emulator is used with real Radios
  - First prototypes can be already exposed to realistic field conditions



Virtual Drive testing

Challenges

Every car will be connected

Car manufacturer must meet end-user-experience in demanding field environments like congested highways and remote areas

OEMs cannot execute expensive field trials for every new model in numerous field network conditions.

Responsibility for interoperability between infotainment, emergency and other systems stays on manufacturer. Fixing issues in final drive test phase is unefficient and expensive

Drive testing in the field

Testing in real environment is labor intensive and time consuming. At the same time results are inconsistent.

Solutions

Virtual Drive Testing Toolset

Automated End to End performance testing process across the entire organization from test management to execution

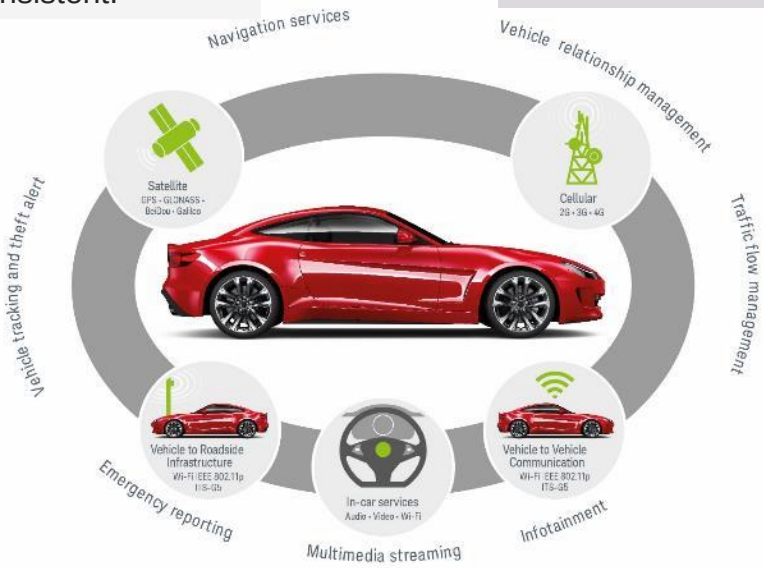
Test E2E Multi-cell mobility in realistic fading and interference conditions

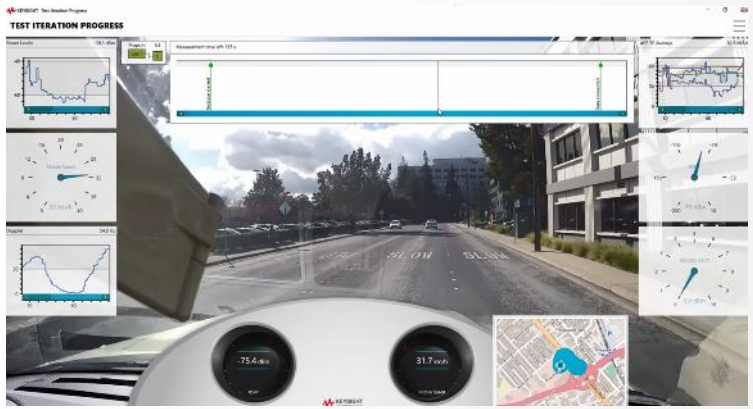
Integrated virtual drive & indoor test solution

Propsim RF channel emulation, Anite 9000 Network Simulation, GNSS simulation, Device controls, real-time diagnostics monitoring, test result logging, test data analysis and test reporting with Nemo drive test tools

Real world connected car use cases

Ready to run eCall test cases and user defined field to lab test scenarios. Build your drive test routes inside the lab to accelerate development cycles.





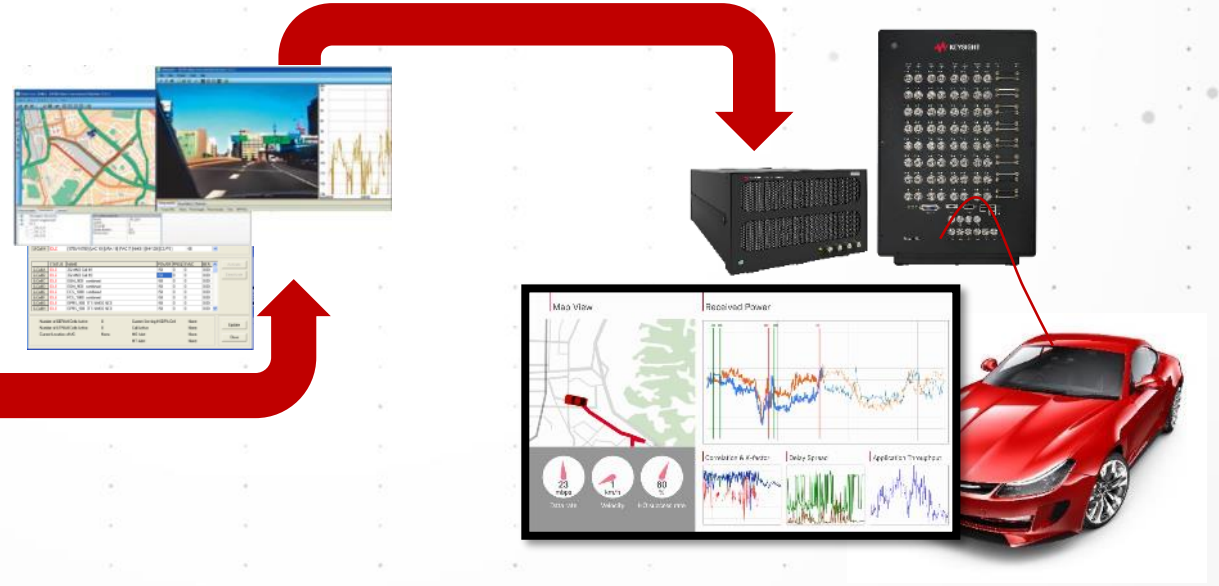
Keysight Virtual Drive testing Toolset

FROM FIELD TO LAB

Record network signalling and radio channel from live environment

Replicate the live network propagation, signalling and cell settings

Run test case with new VDT scenario

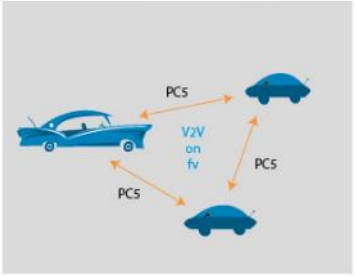


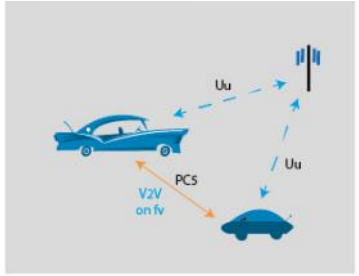
Summary

V2X CHANNEL SCENARIOS AND VIRTUAL DRIVE TESTING

V2X

- Propsim GCM tool
  - Supports V2V, V2P, V2I and V2N scenarios
- Test reliability of communications under speed, interference, high number of nodes w/wo cellular network precense





Virtual Drive Testing

- Automated End to End performance testing process across the entire organisation from test management to execution
- Integrated virtual drive & indoor test solution
- Ready to run eCall & ERA Glonass test cases and user defined field to lab test scenarios based on real world connected car use cases

Test Challenges and Requirement for V2X (eCall)

E6950A eCall/ERA-GLONASS Test Solution NG-eCall Update

The interoperable EU-wide eCall

MANDATE ECALL IN ALL NEW TYPES OF M1 AND N1 VEHICLES (PASSENGER CARS AND LIGHT DUTY VEHICLES).

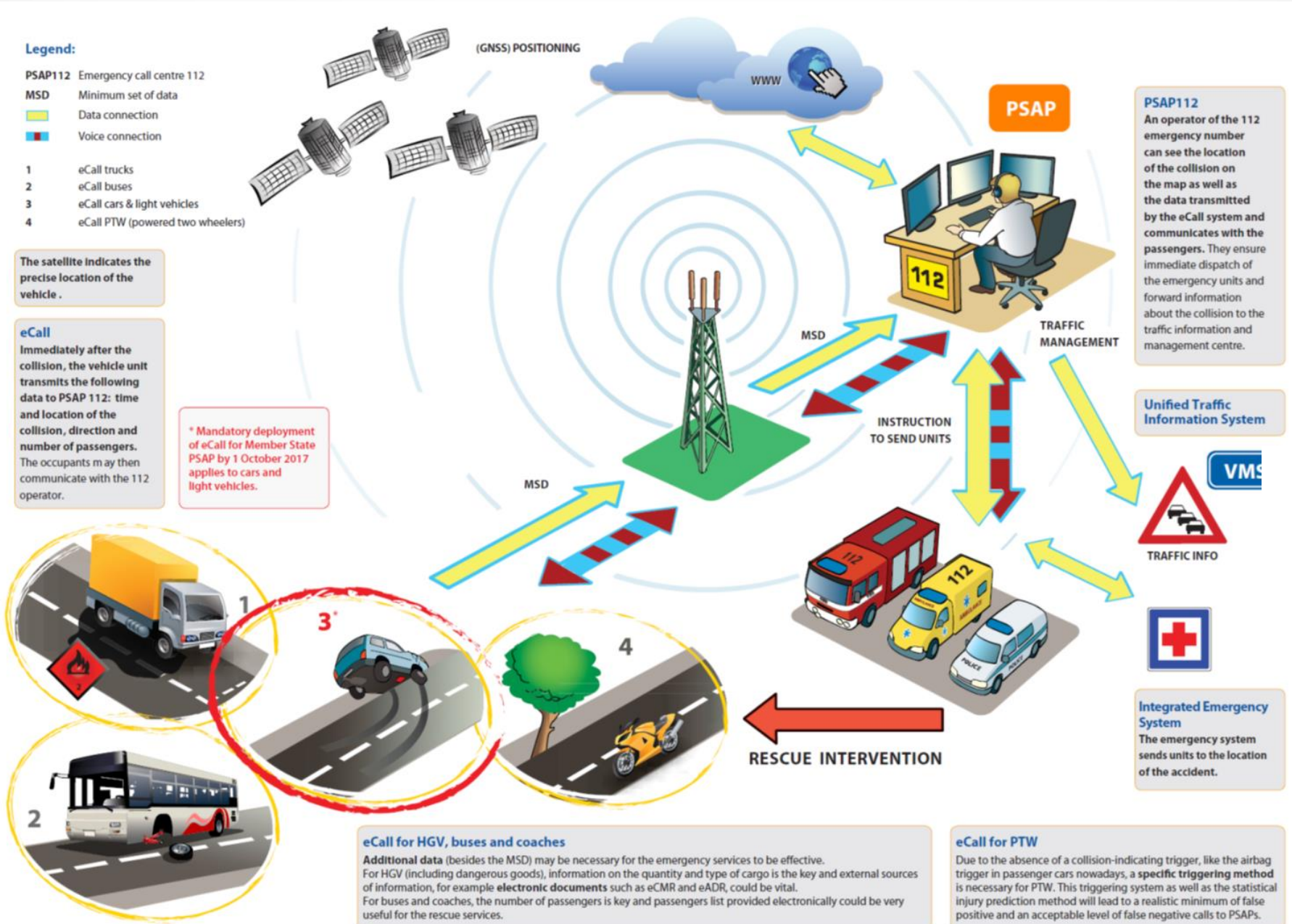
- **eCall 112-based emergency assistance from your vehicle**
  - eCall is a system used in vehicles across the EU which automatically makes a free 112 emergency call if your vehicle is involved in a serious road accident. You can also activate eCall manually by pushing a button.

From : https://europa.eu

- **More countries will benefit from reduced emergency response times for road traffic accidents.**
  - The United Nations (UN) also announced the UN Regulation on **A**ccident **E**mergency **C**all **S**ystems (AECS), effective June 2018. AECS aims to improve interoperability between existing emergency call systems, enabling the scaling-up of the technology.

  - AECS aligns the “ERA-GLONASS” emergency call system in use in the Russian Federation with the European Union’s “eCall”, which is set to become compulsory for all new cars sold in the EU from April 2018.

From : https://www.unece.org

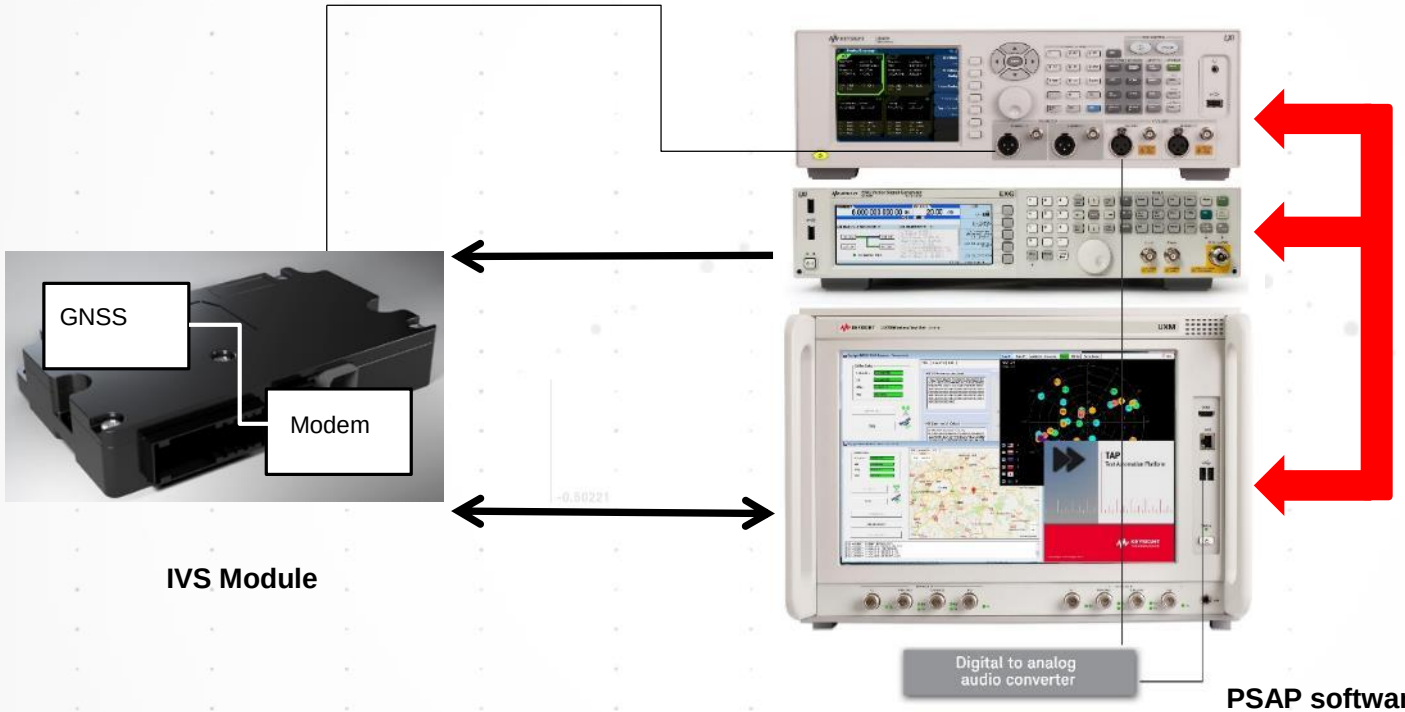


▲ I_HeERO architecture

From : http://www.heero-pilot.eu

Keysight E6950A eCall Conformance Test System

VERIFY IVS MODULE FUNCTIONALITY TODAY



IVS Module

U8903B Audio Analyzer – PESQ/POLQA Test

N5172B EXG GNSS Emulator

E7515A UXM Cellular Base Station Emulator

PSAP software running inside UXM (optionally on separate PC when using 8960)

What is NG-eCall?

OVERVIEW

- Next-Gen eCall moves from 2G/3G to 4G
  - Requires 3GPP Release 14 on UXM (available now!)
- Based on 3GPP Release 14, December 2016
- Current IETF draft RFC 8147
  - MSD transfers in INVITE and INFO SIP messages
  - In-Band MSD over VoLTE/RTP used if SIP MSD fails
  - CSFB used in the event where eCall over IMS is not supported
- PSAP interworks with Keysight IMS/Server (E6966B)
  - IMS Server terminates the VoLTE (Voice Over LTE) call and forwards the critical positioning information etc. to the PSAP.

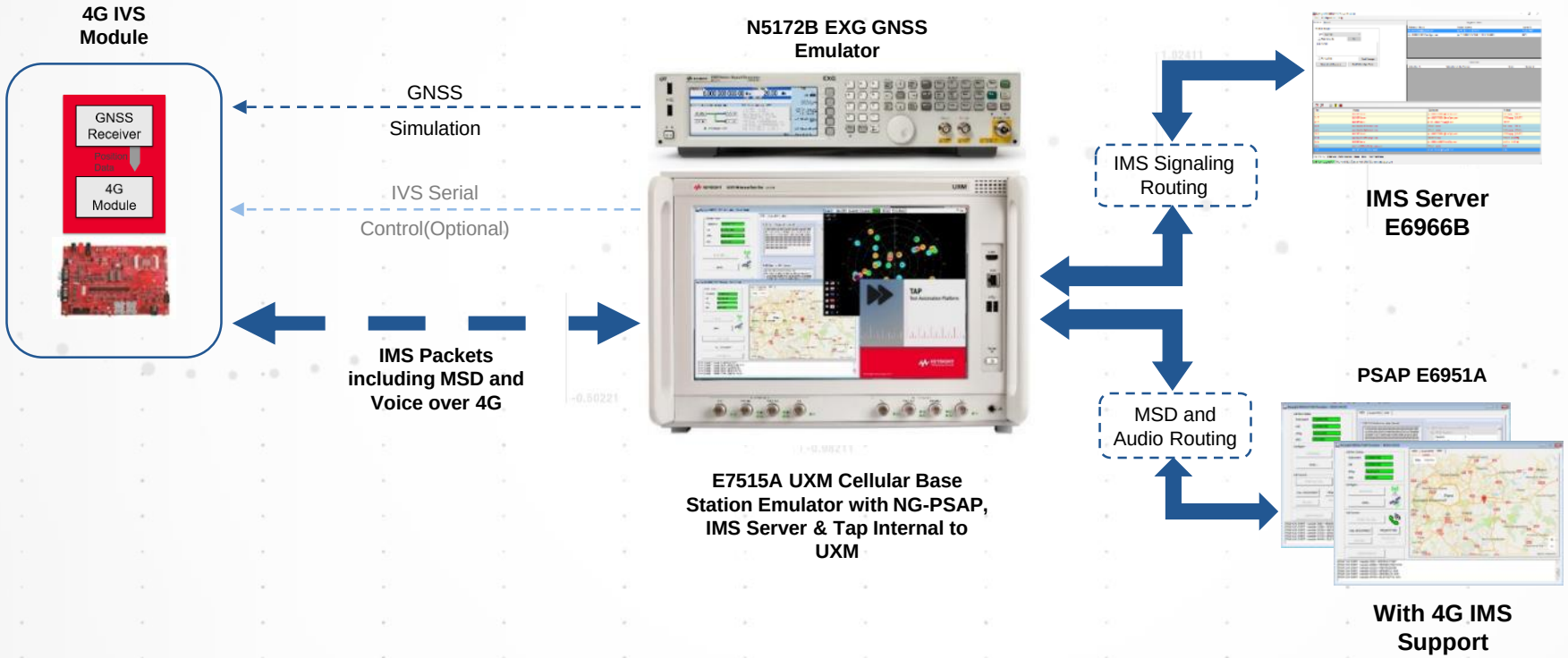
Why Next Generation eCall?

MAIN DIFFERENCE OF NG112 ECALL

eCall today	NG112 eCall
• Accident	• Accident
• IVS calls 112 centre via ***GSM***	• IVS calls 112 centre via VoIP (MSD is send with call setup message) • Emergency calls over ***LTE***
• Setup voice channel • Send MSD via in band modem	• Setup of voice channel
• Connect driver with 112 centre operator • Operator can talk driver and see MSD data.	• Connect driver with 112 centre operator • Operator can talk to driver ans see MSD data.

Keysight E6950A eCall Test Solution

VERIFY NG ECALL MODULE FUNCTIONALITY – UXM E7515A



NG eCall Solution configuration

CONFIG FOR ECALL/ERA-GLANASS/NG ECALL

* ***Required Option***

- UXM wireless test set, E7515A, Hardware

Option	Description
E7515A-504*	Frequency Range 300MHz to 3.8GHz
E7515A-RA1*	RF up-down converter A
E7515A-BA1*	Digital baseband transceiver A
E7515A-RB1	RF up-down converter B
E7515A-BB1	Digital baseband transceiver B
E7515A-L01	Protocol logging data source

Note: Testing of NGeCall with a E5515AC/E is not possible as it does not support LTE/4G connections.

- EXG, N5172B, GNSS Sig Gen

Option	Description
N5172B*	Vector Signal Generator
N5172B-503*	Frequency Range, 9 kHz to 3 GHz
N5172B-653*	ARB Baseband Generator (60 MHz RF bandwidth, 32 Msa)
N5172B-660*	Upgrade Baseband Generator with Real-Time Capability
N5172B-022*	Upgrade baseband generator memory from 32 Msa to 512 Msa
N7609EMBC-1FP*	Signal Studio for Global Navigation Satellite Systems, Node-locked perpetual license

- UXM wireless test set, Software

Option	Description
E7535A-1FP*	FDD/TDD TA suite, fixed perpetual license
E7530A-FFP-OP1*	IP data, fixed perpetual license
E7530A-FFP-OH1	Handover, fixed perpetual license

- IMS Server, E6966B

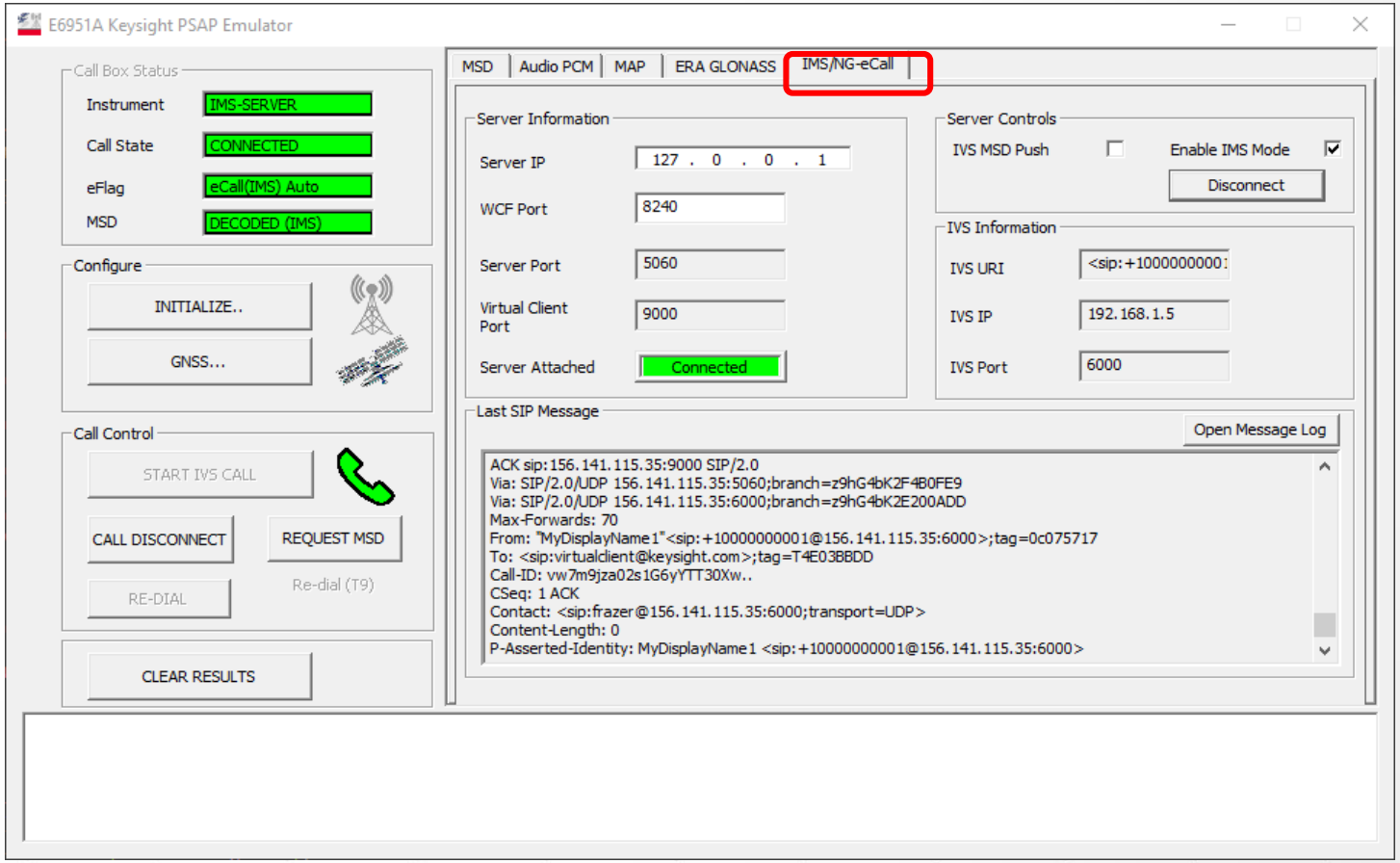
Option	Description
E6966B-1TP*	IMS-SIP server emulator, transportable, perpetual license*

- PSAP Software, E6951xA

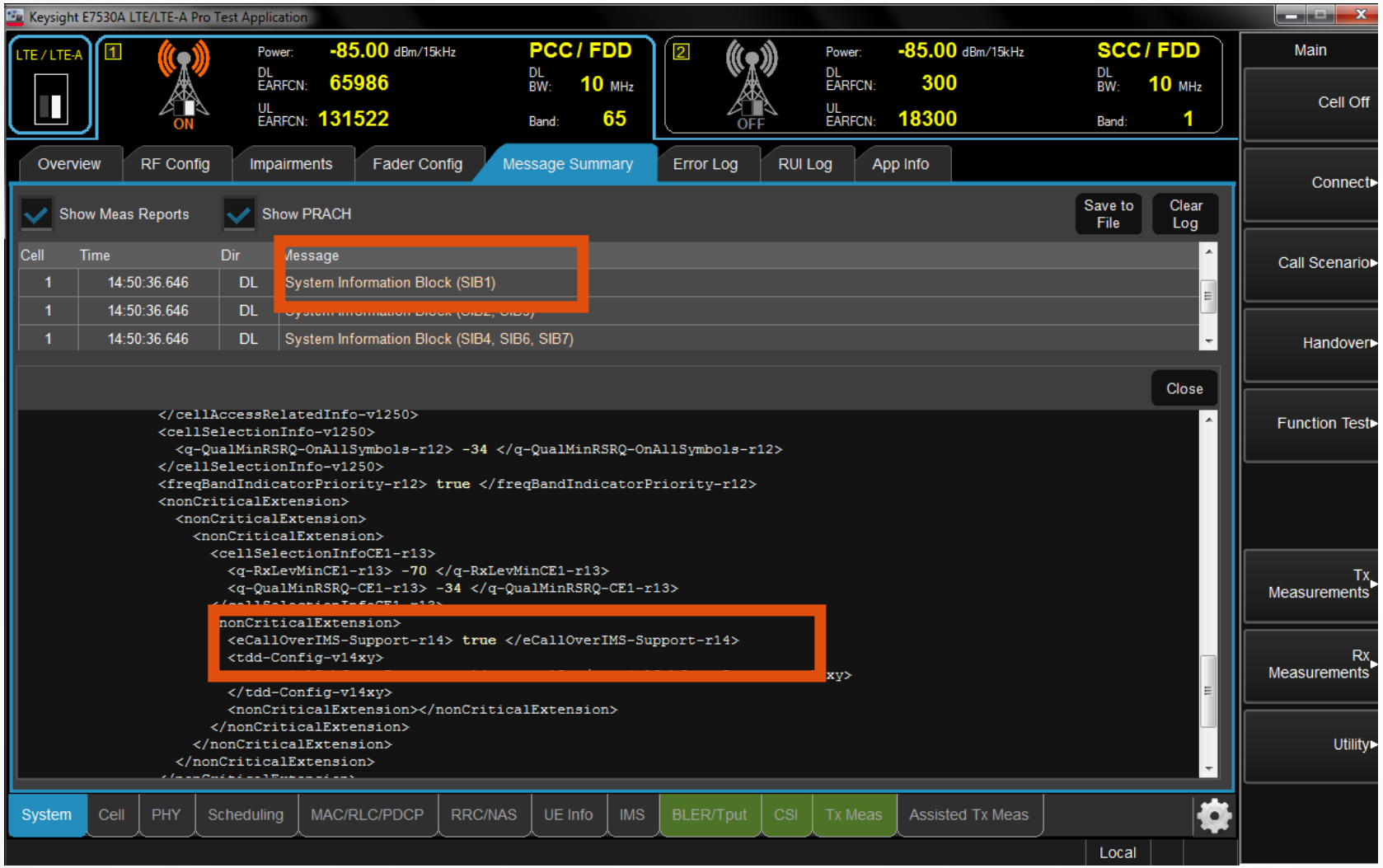
Option	Description
E69511A-1FP	PSAP software for eCall, node-locked, perpetual license
E69512A-1FP*	PSAP software for ERA-GLONASS, node-locked, perpetual license(including E69511A-1FP feature license)
E69513A-1FP	PSAP software for Live Network Mode, node-locked, perpetual license
E69514A-1FP*	PSAP software for Next Generation eCall, node-locked, perpetual license(Require E69512A)

PSAP IMS/NGeCall Mode

SUCCESSFUL CALL START THE IMS/NGECALL



Setting SIB1 on UXM Base Station Emulator



NG eCall standards

Base documents

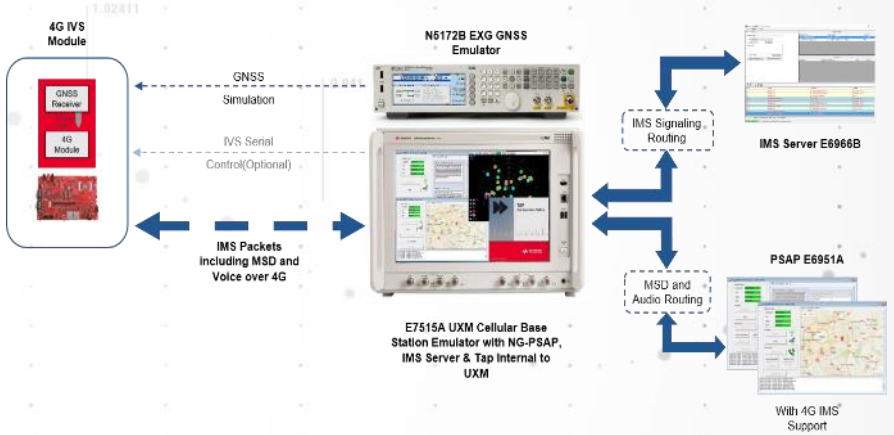
Documents	Title	Current Status
RFC8147	Next-Generation Pan-European eCall	Published
ETSI TS 123 167 V14.6.0 (2018-09)	IP Multimedia Subsystem (IMS) emergency sessions	Published
ETSI TS 124 229 V14.8.0 (2018-06)	IP Multimedia Subsystem (IMS) emergency sessions IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3	Published
CEN EN 16062	Intelligent transport systems - ESafety - eCall high level application requirements (HLAP) using GSM/UMTS circuit switched networks	Published
CEN EN 16072	Intelligent transport systems - ESafety - Pan-European eCall operating requirements	Published
ETSI TS 103 428 V1.1.1 (2016-06)	eCall HLAP Interoperability Testing	Published

Interop Testing - Proposal

SUGGESTED INTEROP TEST PROCEDURE

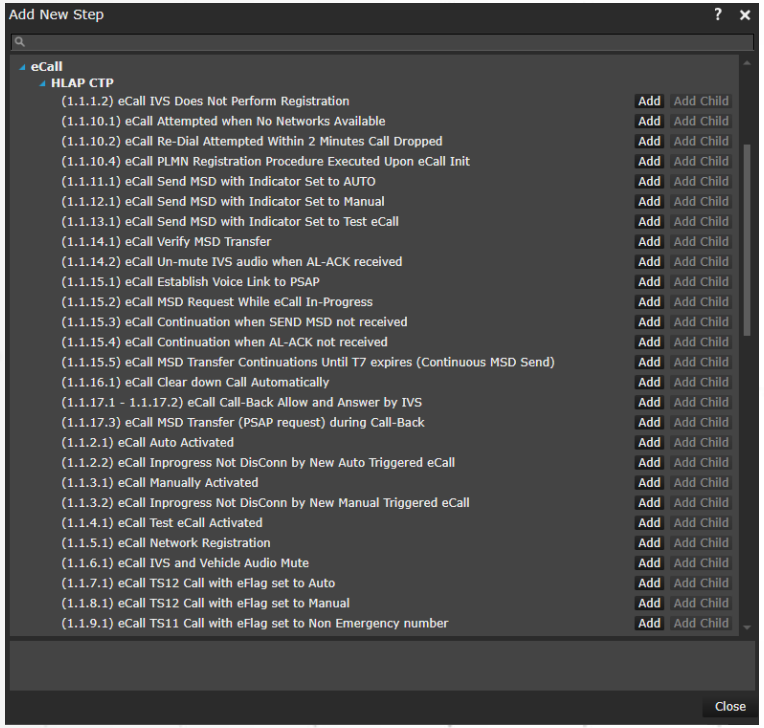
1. LTE Cell access – Test if NG-IVS recognizes SIB 1 (NGeCall capable cell)
2. IMS Emergency Registration should then occur
3. SIP Invite containing MSD from NG-IVS
   a. Check for eFlag via URN decode
      i. Auto/Manual/Test Number
   b. 200 OK eCall MIME body part
      i. ACK = TRUE/FALSE/Not Present
   c. After successful MSD decode - voice connection established and maintained
4. Assuming successful MSD decode and voice connection
   a. SIP Info request to update MSD (similar to Request MSD on 2G/3G)
      i. 200 OK/Timer tbd/Voice connection maintained
   b. End call
   c. Redial then SIP info procedure for MSD
5. Possible Failure Modes …
   a. If LTE Cell signals NG supported … but MSD fails 200 OK (NACK)
      i. MSD transferred over VoLTE (in band audio)
      ii. MSD resend/update – sent over audio
      iii. MSD resend/update using SIP Info

   b. If LTE Cell reports that NGeCall is not supported …then
      i. IVS module can reselect another LTE cell
         1. **(UXM HAS 2 CELLS SO THIS CAN BE TESTED)**
      ii. IVS may decide to opt for 2G/3G
         1. **CS FALLBACK**
         2. **IVS RESELECTION**

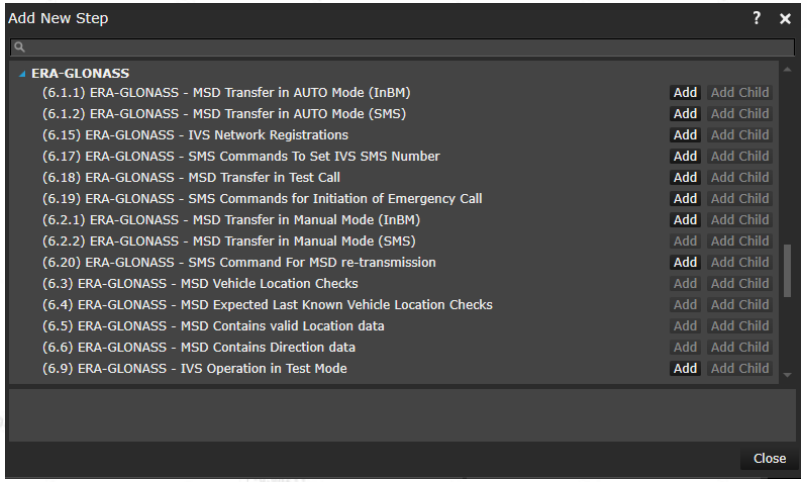


eCall/ERA-GLONASS Automated Test

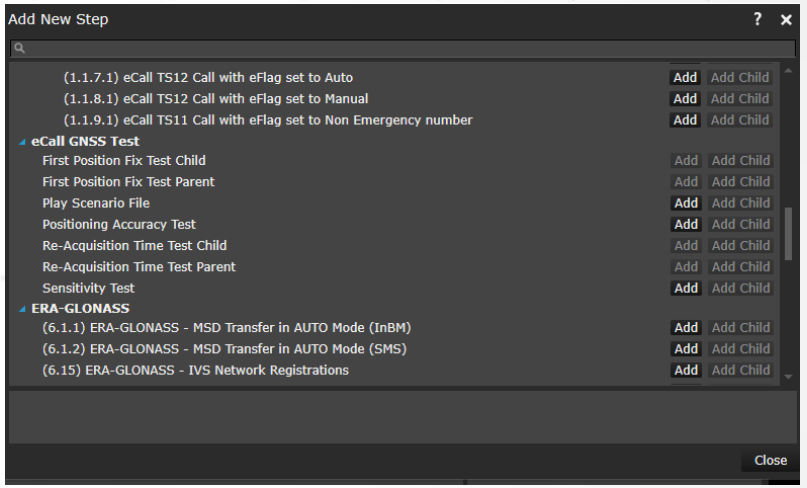
TAP AUTOMATION



eCall Test Cases
ETSI_TS 103 412



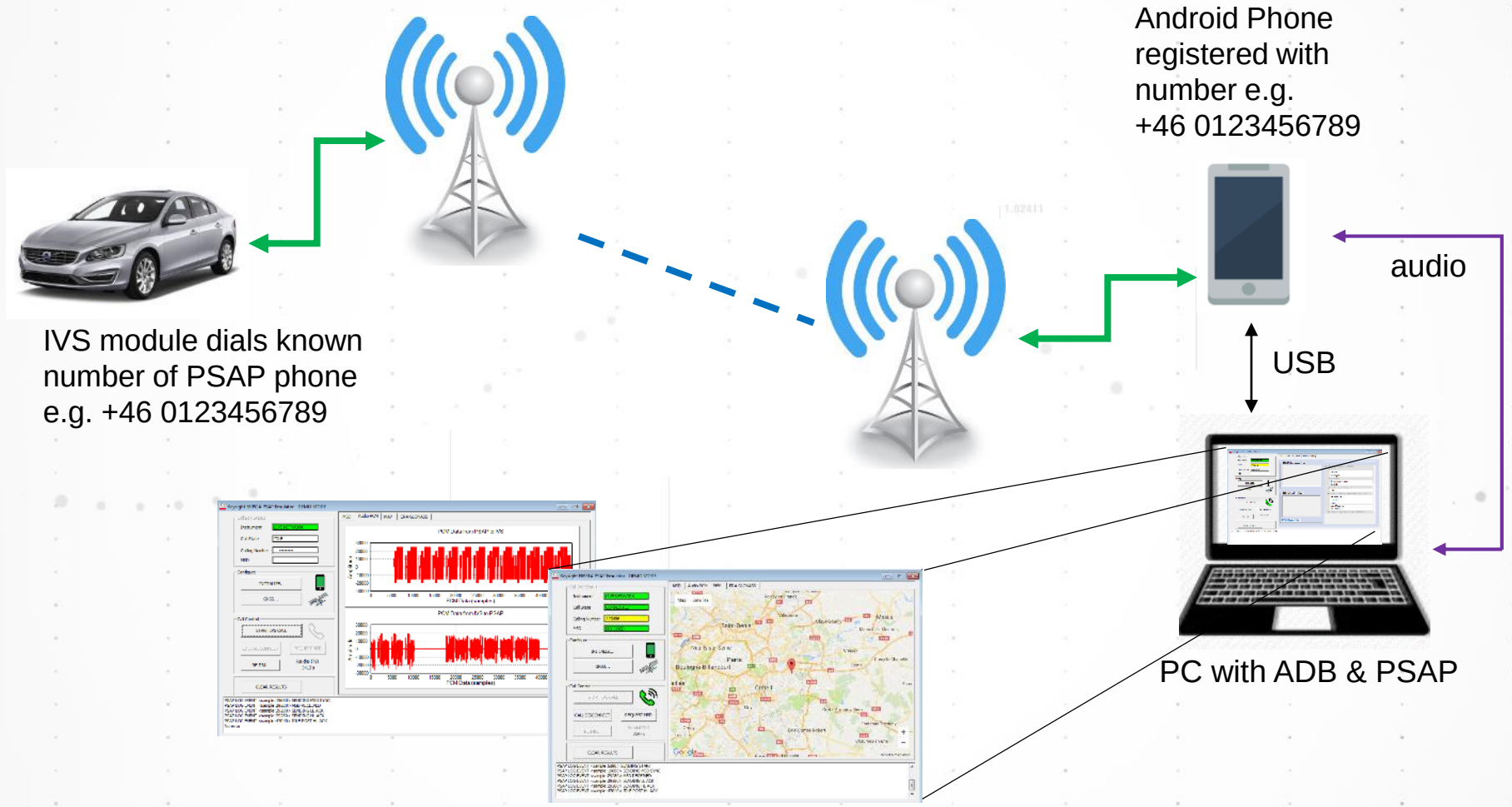
ERA-GLONASS Test Cases
GOST R 33467 ➔ (was R-55530)



eCall scenarios for GNSS testing (**ANNEX VI** of **EU 2017/79** regulation)

- 2.2.2. Assessment of positioning accuracy in autonomous static mode (static).
- 2.2.3. Assessment of positioning accuracy in autonomous dynamic mode (dynamic).
- 2.2.4. Movement in shadow areas, areas of intermittent reception of navigation signals and urban canyons (dynamic).
- 2.2.5. Cold Start time to first fix test (static)
- 2.2.6. Test of re-acquisition time of tracking signals after block out of 60 seconds (static)
- 2.2.7. Test of GNSS receiver sensitivity in cold start mode, tracking mode, and re-acquisition scenario (static).

eCall Live Network Test - PSAP and Android Phone



Test the Future, Today.

WHY CHOOSE KEYSIGHT?

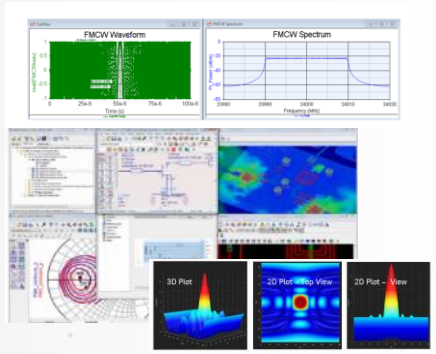
- **Summary**
  - Keysight support successful deployment of eCall.
    - Keysight **E7515A UXM** Wireless Test Set support **wide range of complex network operations**.
    - Achieve **greater confidence in RF performance**
    - Efficiently **verify performance of user equipment in an all-IP IMS-SIP test environment** using **E6966B IMS-SIP server**/client pair for testing voice, video, SMS and supplementary services on all-IP networks. Now with optional EVS Enhanced Voice Services Codec
    - Emulate realistic over-the-air (OTA) eCall parameters ***using PSAP Live Network Test mode.***
    - Automated test Cases for eCall and ERA-GLONASS
    - Keysight eCall PSAP software certified by NavCert*.
    - Keysight eCall/ERA-GLONASS test solution earned ERA-GLONASS certification from Rosstandart**.
  - ***Complete your certification and regression test using Keysight eCall conformance test solution.***

* NavCert is Notified Body (NB2603) for the European Electronic Toll System (EETS) based on EU-Directive 2004/52/EC (EETS).

** The Federal Agency for Technical Regulation and Metrology (Rosstandart) is a federal executive body providing government services and managing state property in the field of technical regulation and ensuring uniformity of measurements.

Keysight Wireless Solutions

OVER WHOLE DESIGN AND TEST LIFECYCLE

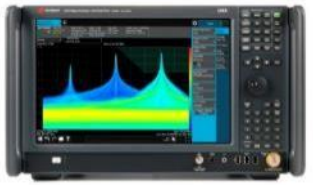


SystemVue Simulation SW

89600 VSA SW with WLAN option

MXA Signal Analyzer

PXA Signal Analyzer



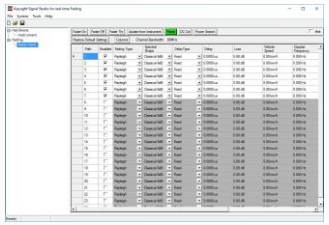
UXA Signal Analyzer

FieldFox N991xA

PXI VXT M9421A

Power Sensor and Meter

Architecture / Design | **Development** | Validation & Mfg.



N7605C SignalStudio for Real-time Fading

N5182B MXG Signal Generators

PROPSIM Channel Emulator

E6953A DSRC COC Certification Solution

E7515B UXM 5G

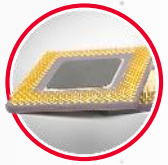
M9421A PXI VXT

E6640A EXM

From Design Simulation, Signal Generation & Analysis, R&D to Manufacturing Tests

Keysight Now Provides Insight Across the Entire Stack

Keysight Classic Ixia Anite



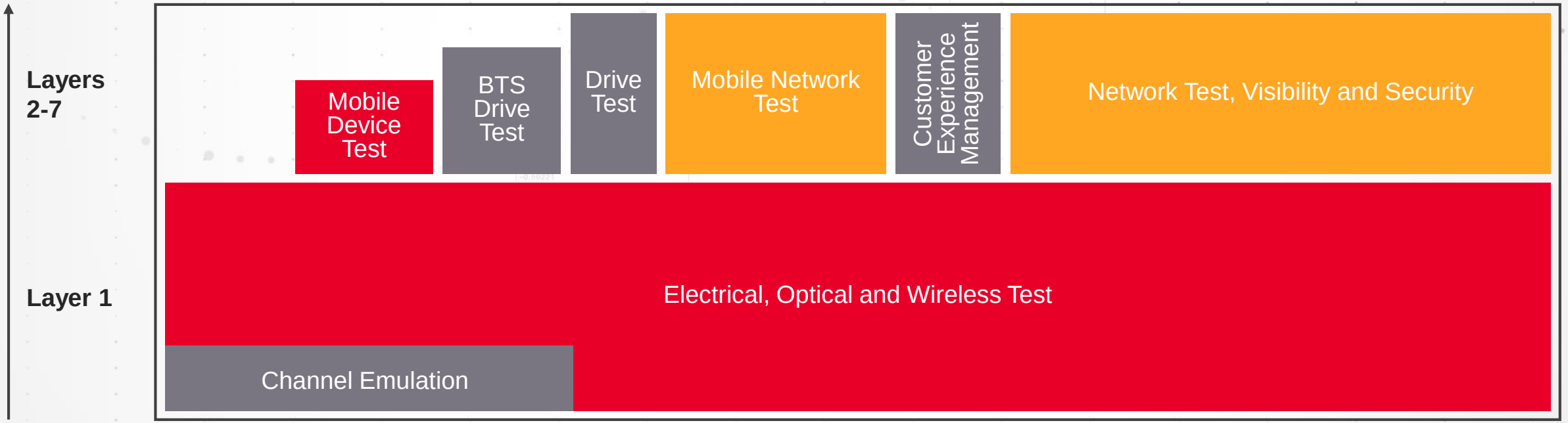
COMPONENTS & CHIPSETS

DEVICES

BASE STATIONS

HYPERSCALE AND DATA CENTERS

ENTERPRISE



LEADER IN AUTOMOTIVE & ENERGY

Collaborations

ETSI, 3GPP, 5GAA, IWPC, Autotech Council, Car 2 Car, and more

R&D Centers

in Germany, Detroit, , Bay Area, and Singapore

Over **50 Solutions** launched in 2017 alone

We Are at the Heart of the Revolution

Accelerating Innovation to Connect and Secure the World

WIRELESS

ENERGY

IOT

AUTOMOTIVE

AEROSPACE & DEFENSE

NETWORKING/ CLOUD