Anritsu Advancing beyond

# LTE V2X Test Solution

LTE V2X PC5 Communication Software

MX725000A

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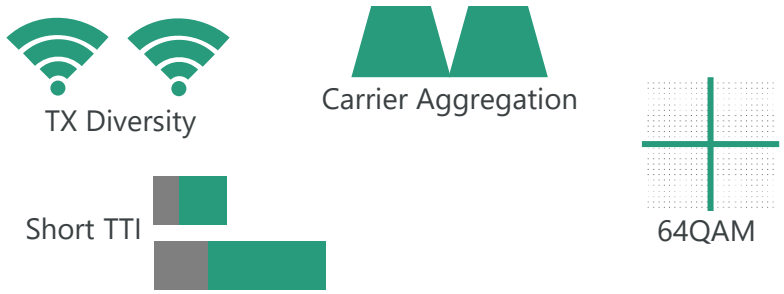
# Introduction

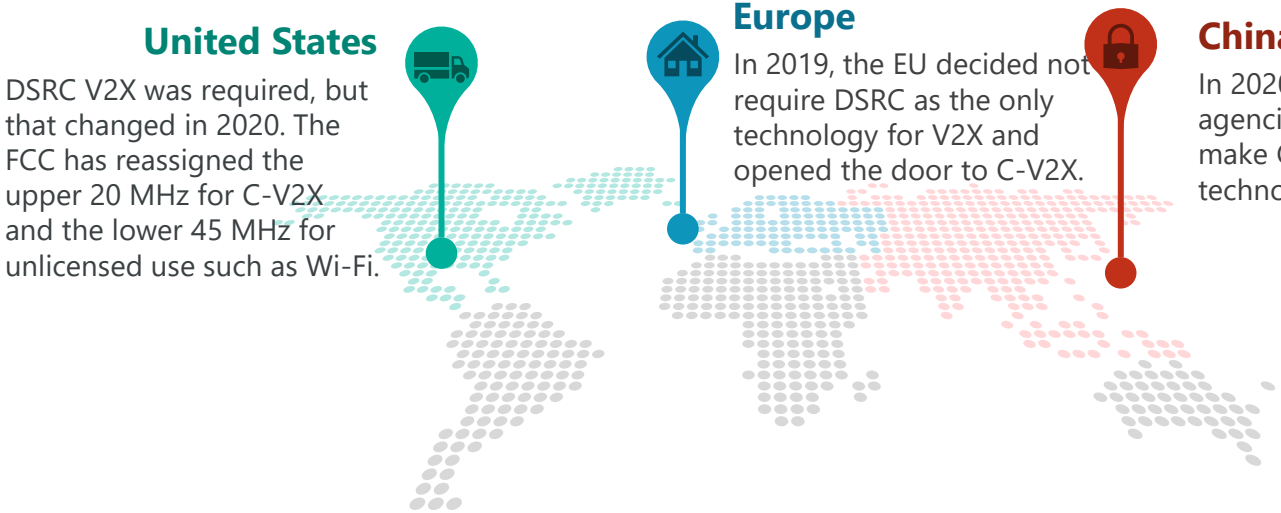
Since 2015, the first V2X network deployment based on DSRC 802.11p in Japan, V2X extends the 3GPP platform to the automotive industry by providing vehicle-to-everything supporting to vehicles, infra-structure(RSU). The V2X messages can be directly transferred over sidelink (also known as PC5 interface) although it is LTE base signal structure.

Cellular V2X was introduced to 3GPP in Release 14 by extending LTE to provide support for the automotive use case. Release-14 V2X supports basic road safety features by exchanging messages regarding position, speed and direction with the surrounding vehicles, infra-structure(RSU). The second phase of V2X in LTE Release-15 enhanced V2X by introducing features such as Carrier Aggregation on the sidelink interface, 64 QAM, Transmission Diversity and short TTI for the sidelink.

- 3GPP V2X phase 2 in R15 introduces a number of new features in sidelink.
  - Carrier aggregation,
  - High order modulation
  - Transmission diversity
  - Short TTI



# ITS Spectrum Allocation



### United States

DSRC V2X was required, but that changed in 2020. The FCC has reassigned the upper 20 MHz for C-V2X and the lower 45 MHz for unlicensed use such as Wi-Fi.

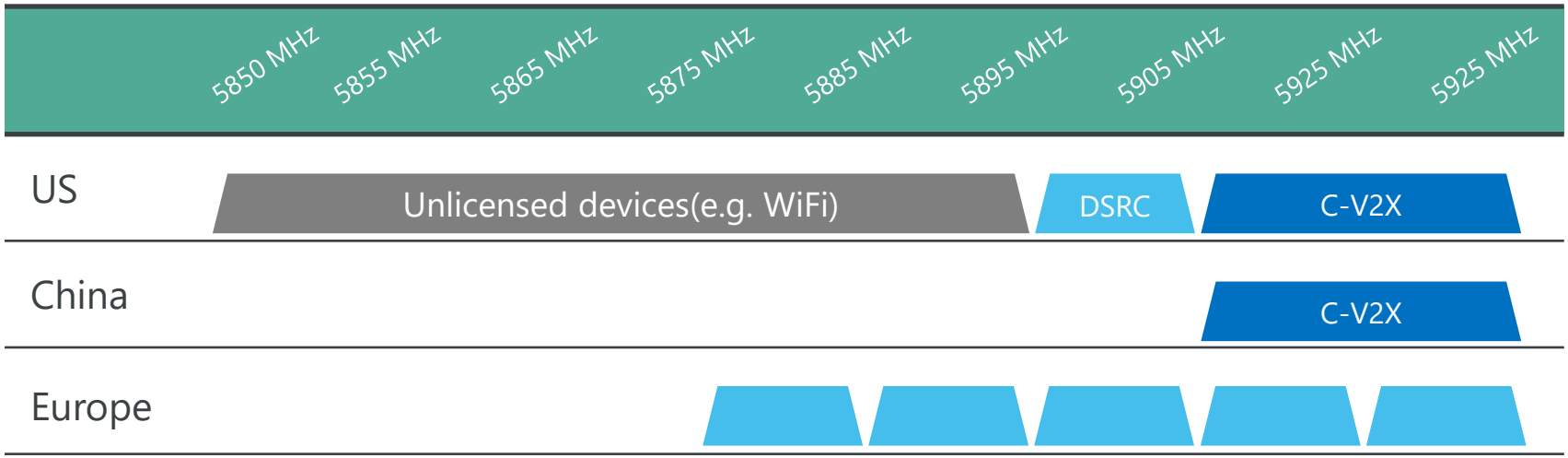
### Europe

In 2019, the EU decided not require DSRC as the only technology for V2X and opened the door to C-V2X.

### China

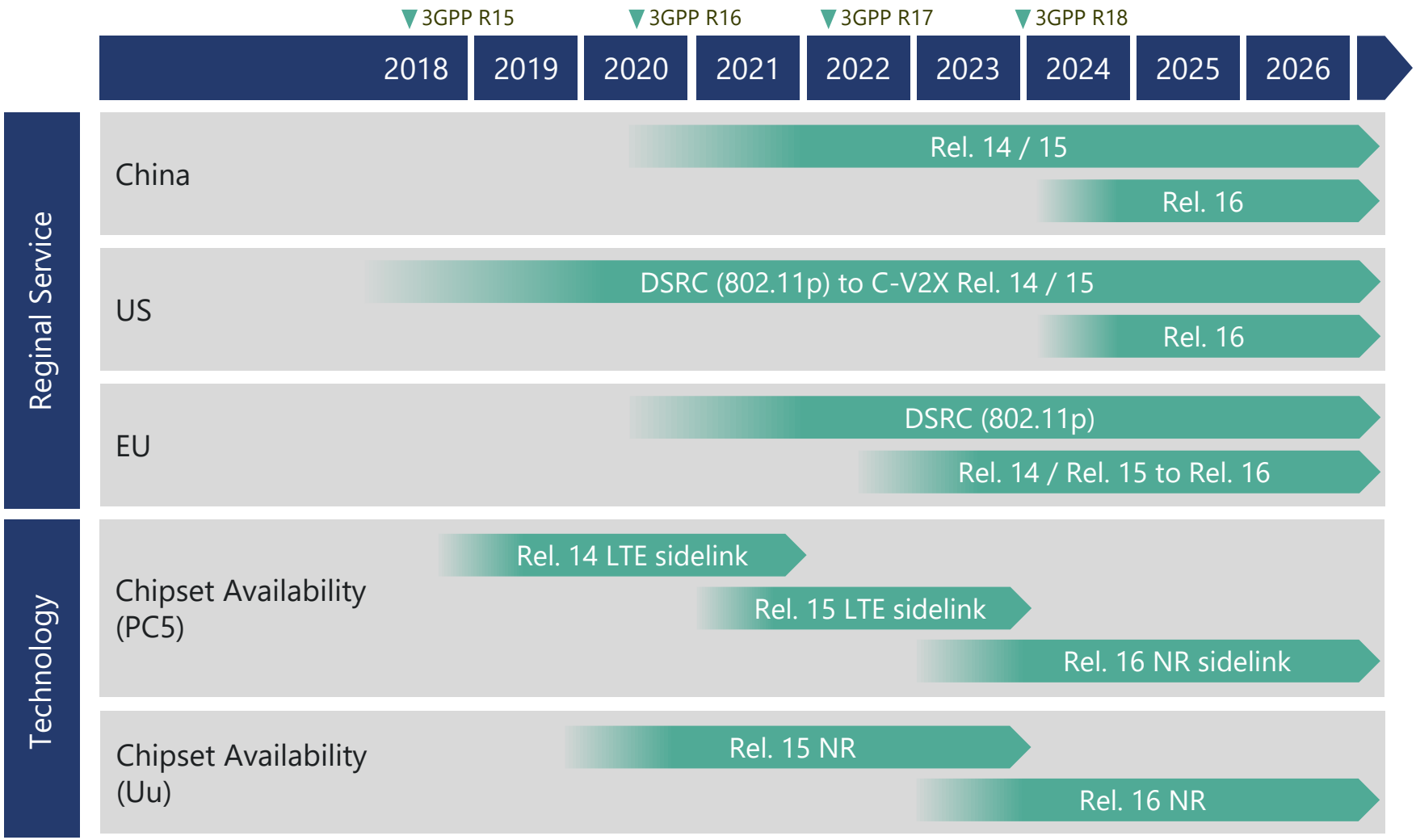
In 2020, related ministries and agencies in China agreed to make C-V2X the only IoV technology in China.

## 5.9 GHz ITS Spectrum




*5.9 GHz band for NR-V2X expects to be allocated in 2022 around.

# Timeline for C-V2X Deployment



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# Anritsu C-V2X Test Portfolio Overview

Scenario Base Emulation Software

Rel.14/15

## C-V2X Emulation

- Integrated with CAN Simulator
- Integrated with GNSS Simulator
- PC5 and Uu Interface
- Overall application test
- Sample traffic scenarios available

Wireless Test Set MT8870A

Rel.14/15

## C-V2X RF Performance Test

- Combination Test dedicated for the next generation Automotive devices including C-V2X/DSRC and LTE/5G.
- From R&D to Production
- TRX Parametric Test 3GPP
- Parallel Test with 32 RF Ports
- 160MHz Bandwidth


5G Simulator MT8000A

Up to Rel.16

## V2X & NR Combination Test

- Future Proof expandable for Ref.16 NR-V2X
- Call Connection base V2X RF test
- V2X functional & application test
- Rel.15 NR Uu (NSA & SA) ready now

**From Rel.14 up to Future Proof Rel.16**

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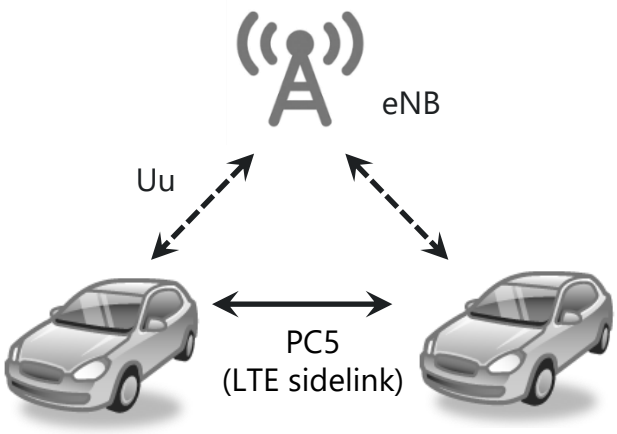
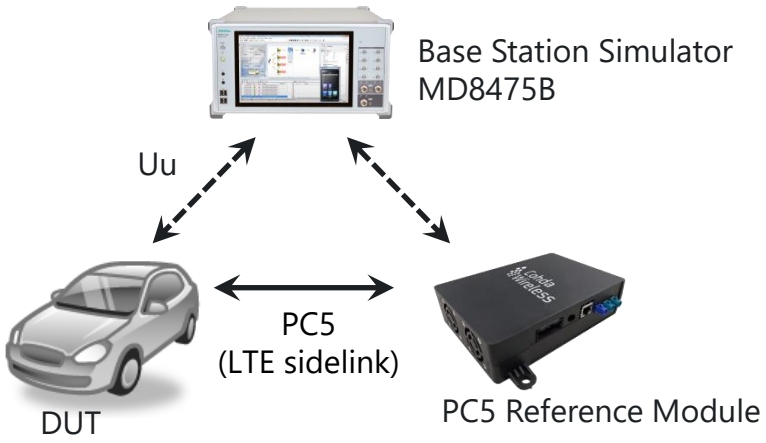
# Test Scope and Key Features

- Comprehensive test environment for hardware and software combination
- Pre-verification in ITS Message level
- Virtual simulation using PC5 RF signal
- Traffic scenario editor (V2X Use Case) to reproduce specific field issue
- Pre-installed sample scenario package
- Geographical condition customization using Google Map application
- Congestion test scenario supported with single PC5 reference module.

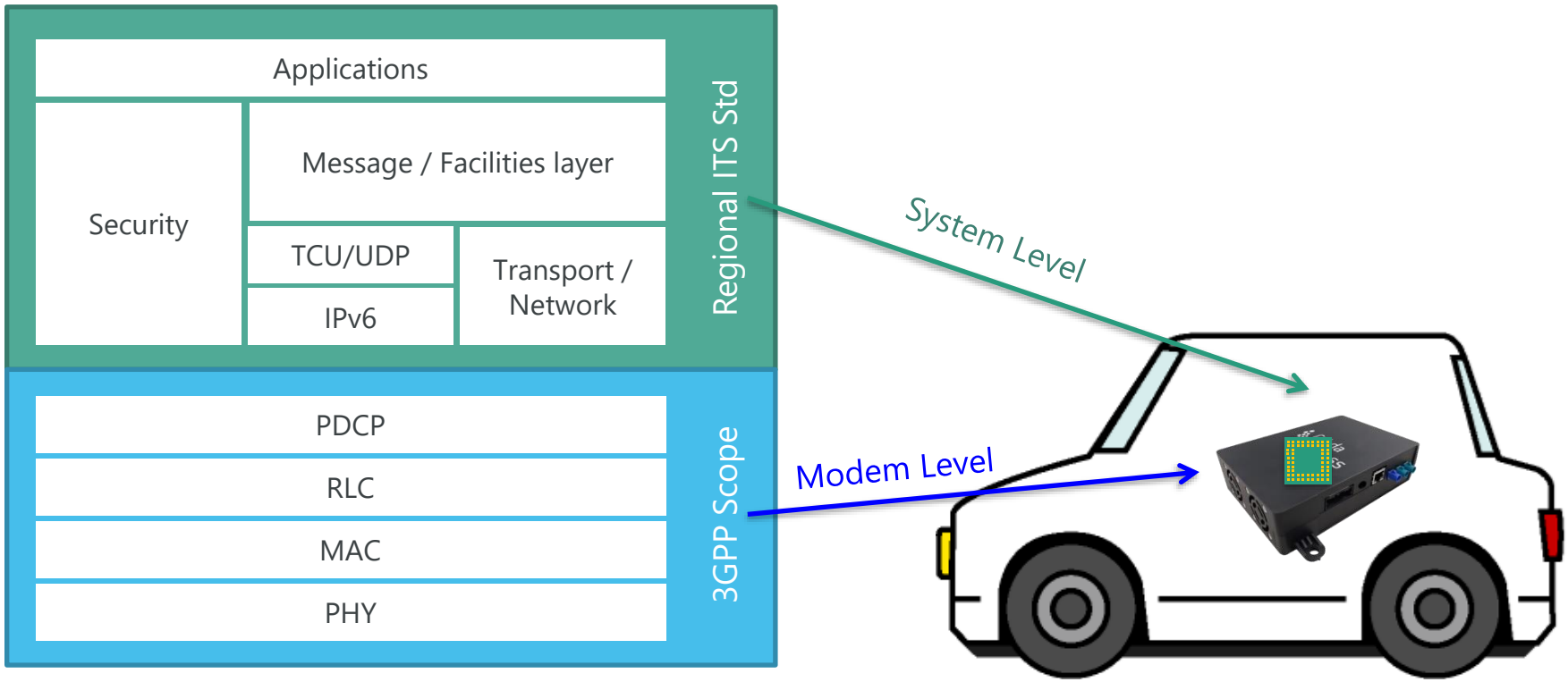



*MD8475B is not needed only for C-V2X PC5 testing,
but just behaves as a telematics interface.

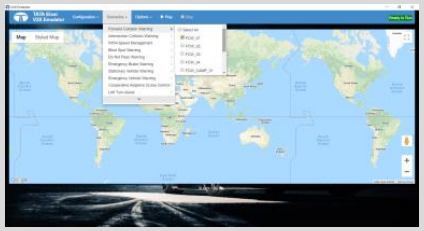
# Test Scope for System Level Approach

- C-V2X modem covering lower layer 3GPP features could be verified by modem level or NAD level.
- System level verification should be the first approach, which comprises the integration of the C-V2X modem together with other components, like application processor, security module and positioning device etc., which fulfil higher layer functions up to the application layer.

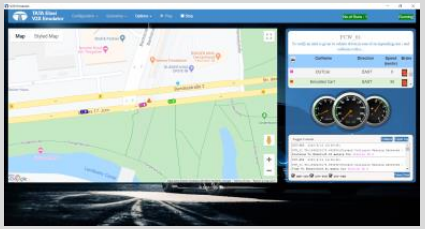


# Test Schematic & Test Procedure

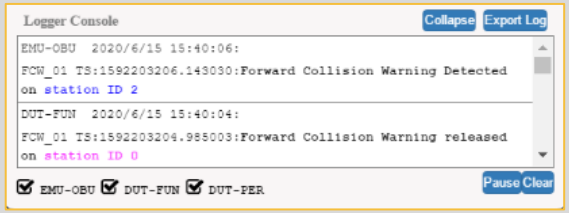
- Easy traffic scenario configuration
- Multiple emulated vehicles
- GNSS route definition
- Flexible parameter configuration , drive speed, signal strength etc
- Interpretation of ITS relevant protocols
- Map window for visualization of the scenario
- Log Trace for test process and DUT specific data
- The test solution allows CAN bus connectivity to analyze test results

Scenario Configuration



Play and Visualize



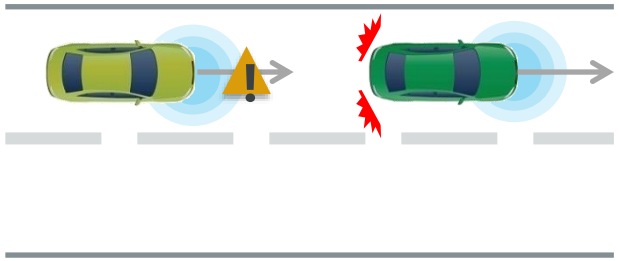

Log Trace

# Traffic Scenarios Available as a Turnkey Package

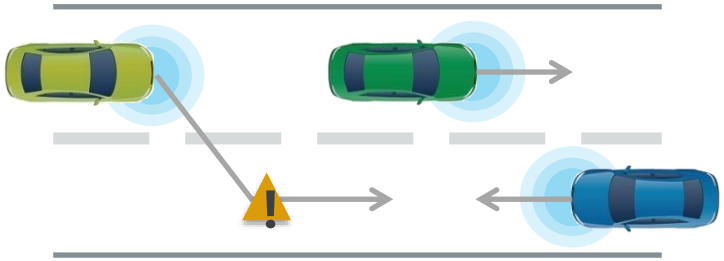
- Address the field testing challenges by creating real world conditions in a Lab and make the field test ready.
- Emulate the following specific use cases scenarios defined in 3GPP and regional ITS standards.

- Forward Collision Warning (FCW)
- Intersection Collision Warning (ICW)
- Hazardous Location Warning (HLN)
- Blind Spot Warning (BSW)
- Do Not Pass Warning (DNPW)
- Emergency Brake Warning (EBW)
- Speed Limit Warning (SLW)
- Stationary Vehicle Warning (SVW)
- Emergency Vehicle Warning (EVW)
- Cooperative Adaptive Cruise Control (CACC)
- Left Turn Assist (LTA)
- Abnormal Vehicle Warning (AVW)
- Control Loss Warning (CLW)
- Green light optimized speed advisory (GLOSA)

**e.g. Forward Collision Warning**



**e.g. Do Not Pass Warning**



# Reference Specification

## Protocol/Security

| Standard | Description |
|---|---|
| US Standard | • Access layer : 3GPPLTE-VR14<br>• Network layer : IEEE1609 Protocol Family<br>• Facilities layer : SAEJ2735<br>• Network security : IEEE1609.2 |
| China standard | • Please contact Anritsu sales |
| European standard | • Access layer : ETSI G5<br>• Network layer : ETSI BTP<br>• Facilities layer : ETSI CAM DENM<br>• Network security : ETSI TS103097 |

## Use Case

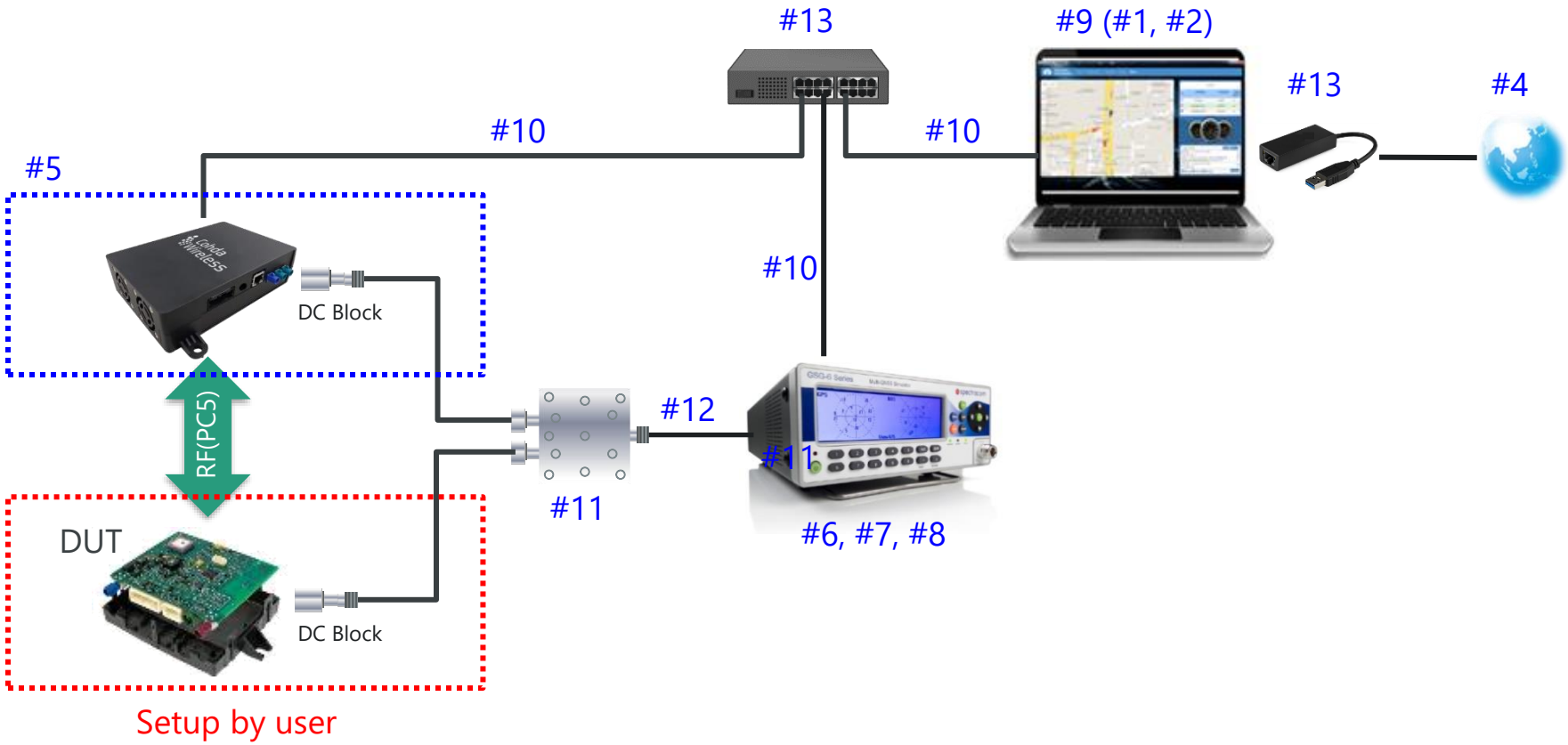
| Standard | Description |
|---|---|
| US Standard | • SAE J2945™/1 MAR2016 |
| China standard | • Please contact Anritsu sales |
| European standard | • ETSI EN302 637-2 CAM<br>• ETIS EN302-637-3 DEMM |

# Ordering Information

| Model | Description | Qty | Note |
|---|---|---|---|
| **Software** | | | |
| 1. MX725000A *1 | LTE V2X PC5 Communication Software | 1 | |
| 2. TATA-V2XE-ADV *2 | V2X Emulator | 1 | TATA Elxsi Software |
| 3. TATA-V2XE-ADV-AMC *2 | V2X Emulator 1 year support service | 1 | Annual support service. No contract required in the first year |
| 4. Google Maps Platform *3*5 | Directions API<br>Geocoding API<br>JavaScript API | 1 | Google Maps data contract.<br>Credit card for payment is required.<br>Internet connection is required. |
| **Reference Module** | | | |
| 5. MK6C EVK *3 | Reference Module | 1 | Cohda Wireless Reference Module |
| **GNSS Simulator** | | | |
| 6. GSG-62 *4 | GNSS Simulator | 1 | Orolia GNSS Simulator |
| 7. OPT-RSG *4 | RSG Option | 1 | |
| 8. OPT01/07 *4 | Passive GNSS Antenna | 1 | Required only for OTA connection |
| **Accessory** | | | |
| 9. Z2017B *1 | Standard PC | 1 | Dell Laptop PC |
| 10. J1440A *1 | LAN Cable | 3 | LAN Cable |
| 11. Z1858A *1 | Divider (2 way) | 1 | RF Divider |
| 12. J1795B *1 | Coaxial Cable (SMA(M)-SMA(M), 1.0 m) | 1 | |
| 13. StarTech/USB31000S *3 | USB 3.0 to LAN Adapter | 1 | Recommended model |
| 14. Mini-Circuits BLK-18-S+ *3 | SMA DC Block | 2 | (Recommended model)<br>Cuts DC in the signal from GNSS Simulator.<br>Connected to the Divider output. |
| 15. NETGEAR/GS105 *3 | 5 Gigabit Ports Switching Hub | 1 | Recommended model |

*1: For sale from Anritsu
*2: For sale from TATA Elxsi Ltd.
*3: Customer needs to purchase from vendors
*4: For sale from local distributers of Orolia
*5: Free service available of 200 USD every month with contract with Google.
It will not exceed 200 USD in use of about 5 hours a day,

# Ordering Information



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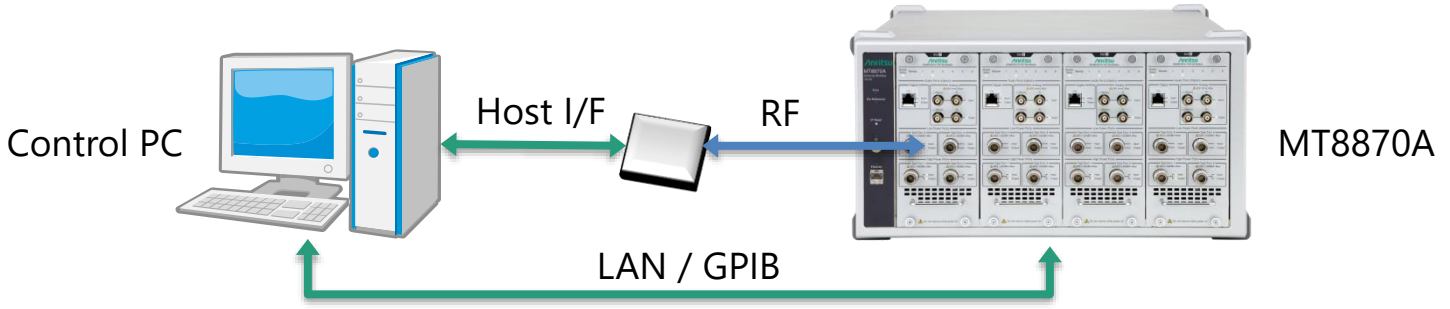
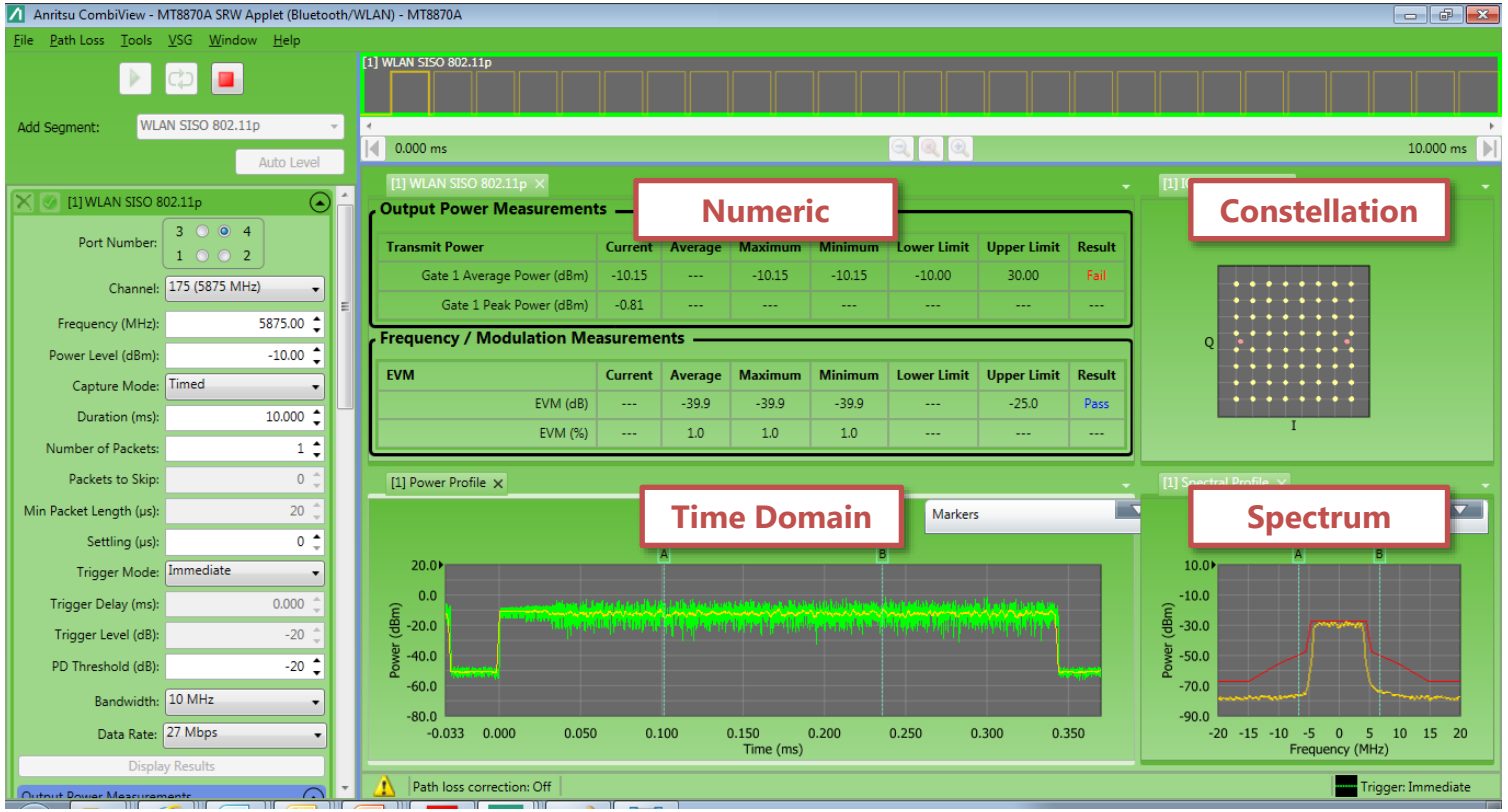
# C-V2X RF Test Solution



# C-V2X RF Test Solution

- Rel.14 LTE C-V2X PC5 RF TRX Test in Non-Signaling mode
- 3GPP TS36.521-1 V15.5.0

| Number | Description |
|---|---|
| 6.2.2G.1 | UE Maximum Output Power for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 6.2.2G.4 | UE Maximum Output Power for V2X Communication / Power class 2 |
| 6.2.3G.1.1 | Maximum Power Reduction (MPR) for V2X Communication / Power class 3 / Contiguous allocation of PSCCH and PSSCH / Non-concurrent with E-UTRA uplink transmission |
| 6.2.3G.1.2 | Maximum Power Reduction (MPR) for V2X Communication / Power class 3 / Non-Contiguous allocation of PSCCH and PSSCH / Non-concurrent with E-UTRA uplink transmission |
| 6.2.3G.2.1 | Maximum Power Reduction (MPR) for V2X Communication / Power class 2 / Contiguous allocation of PSCCH and PSSCH / Non-concurrent with E-UTRA uplink transmission |
| 6.2.3G.2.2 | Maximum Power Reduction (MPR) for V2X Communication / Power class 2 / Non-Contiguous allocation of PSCCH and PSSCH / Non-concurrent with E-UTRA uplink transmission |
| 6.2.4G.1 | Additional Maximum Power Reduction (A-MPR) for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 6.2.5G.1 | Configured UE transmitted Output Power for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 6.3.2G.1 | Minimum Output Power for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 6.3.3G.1 | UE Transmit OFF power for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 6.5.1G.1 | Frequency Error for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 6.5.2.1G.1 | Error Vector Magnitude (EVM) for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 6.5.2.2G.1 | Carrier leakage for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 6.5.2.3G.1 | In-band emissions for non allocated RB for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 6.5.2.4G.1 | EVM equalizer spectrum flatness for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 6.6.1G.1 | Occupied bandwidth for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 6.6.2.1G.1 | Spectrum Emission Mask for V2X Communication Non-concurrent with E-UTRA uplink transmission |
| 6.6.2.2G.1 | Additional Spectrum Emission Mask for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 6.6.2.3G.1 | Adjacent Channel Leakage power Ratio for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 7.3G.1 | Reference sensitivity level for V2X Communication / Non-concurrent with E-UTRA uplink transmission |
| 7.4G.1 | Maximum input level for V2X Communication / Non-concurrent with E-UTRA uplink transmission |

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