EMC / EME / Commercial / Wireless / Automotive

ELECTRO-MAGNETIC ENVIRONMENT TRAINING

FOR TAIWAN EMC DAY SEMINAR

Presenter: Daniel Loo

Date: 11th March eb 2021

ROHDE&SCHWARZ

Make ideas real

AGENDA

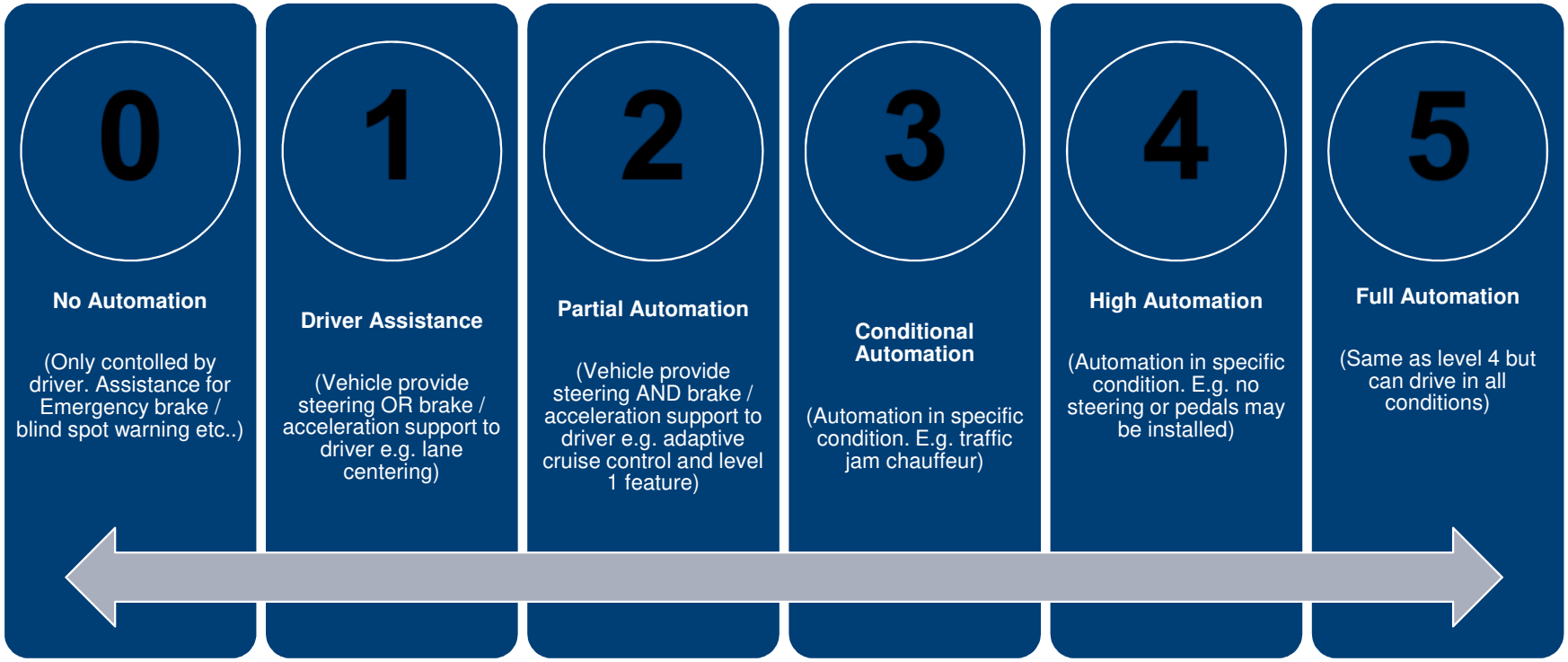
- Introduction - Technology
- Importance of EME
- EMC VS EME
- System Structure
- System Design
- System Features

Automotive

INTRODUCTION - TECHNOLOGY

SAE LEVEL OF AUTOMATION (LOA)

PROPOSED BY THE SOCIETY OF AUTOMOBILE ENGINEERS (SAE)



NEW INTEREST TOPICS WITHIN ISO AUTOMOTIVE WORKING GROUP

ADAS	C2X	EMC & ISO 26262	Automotive EMC Environment	Vehicle EMS	Virtual Testing
					
Human machine interface to provide assistance in driving	Communication from vehicle-to-everything	ISO 26262 addresses functional safety requirements for electrical & electronic systems	Specific conditions required for automotive EMC testing	Alternative vehicular test methods, e.g. Intentional EMI, Magnetic Field & Reverberating Chamber	Virtual testing for safety analysis
To study the ADAS functionality during immunity	To study C2X functionality during EMC testing	To study the functionality tests under EMC testing environments	To consider requirements specifically for testing in automotive EMC	Consideration of newer EMC test methods.	To consider future virtual testing for safety assessment

RISING UP TO THE CHALLENGE

EME

C-V2X

Advise

RDS

E-call

WHAT IS ELECTRO-MAGNETIC ENVIRONMENT (EME) TESTING

WHAT IS EME EFFECTS TEST ?

Electro-Magnetic Environment (EME) is evolution of EMC

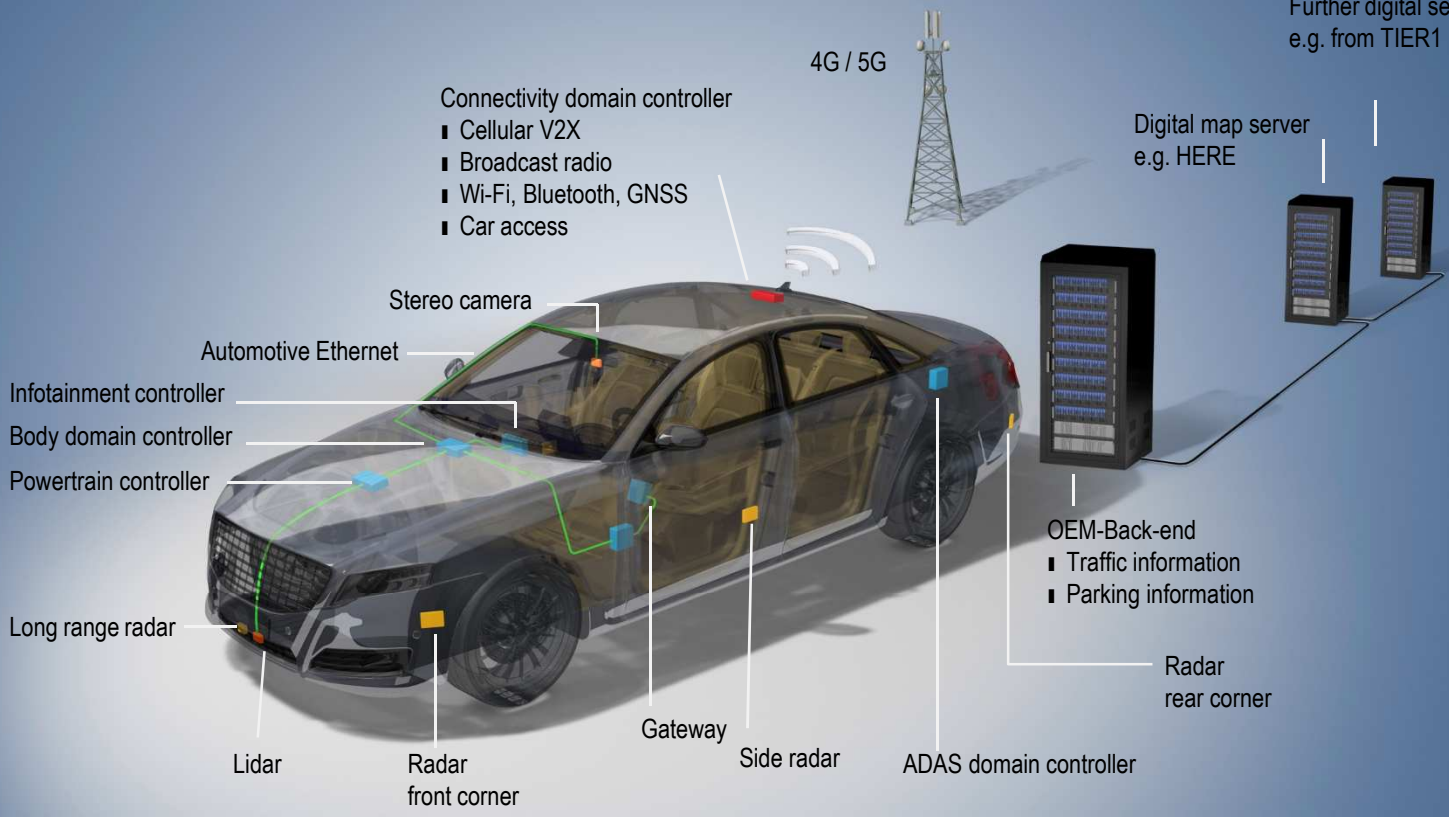
EME Effects test is putting the DUT/SUT under the sum of

- **EMC** tests which directly tests for safety and reliability of electrical & electronic devices;
- **Radio coexistence** which evaluates performance and functionality in the presence of known radio and wireless communication signals;
- **Scenarios** that introduce diverse operational environments;

in order to know the **Worst-case Effects** and evaluate the **Safety Integrity** of the DUT/SUT by advance analysis methods.

R&S Automotive at a Glance

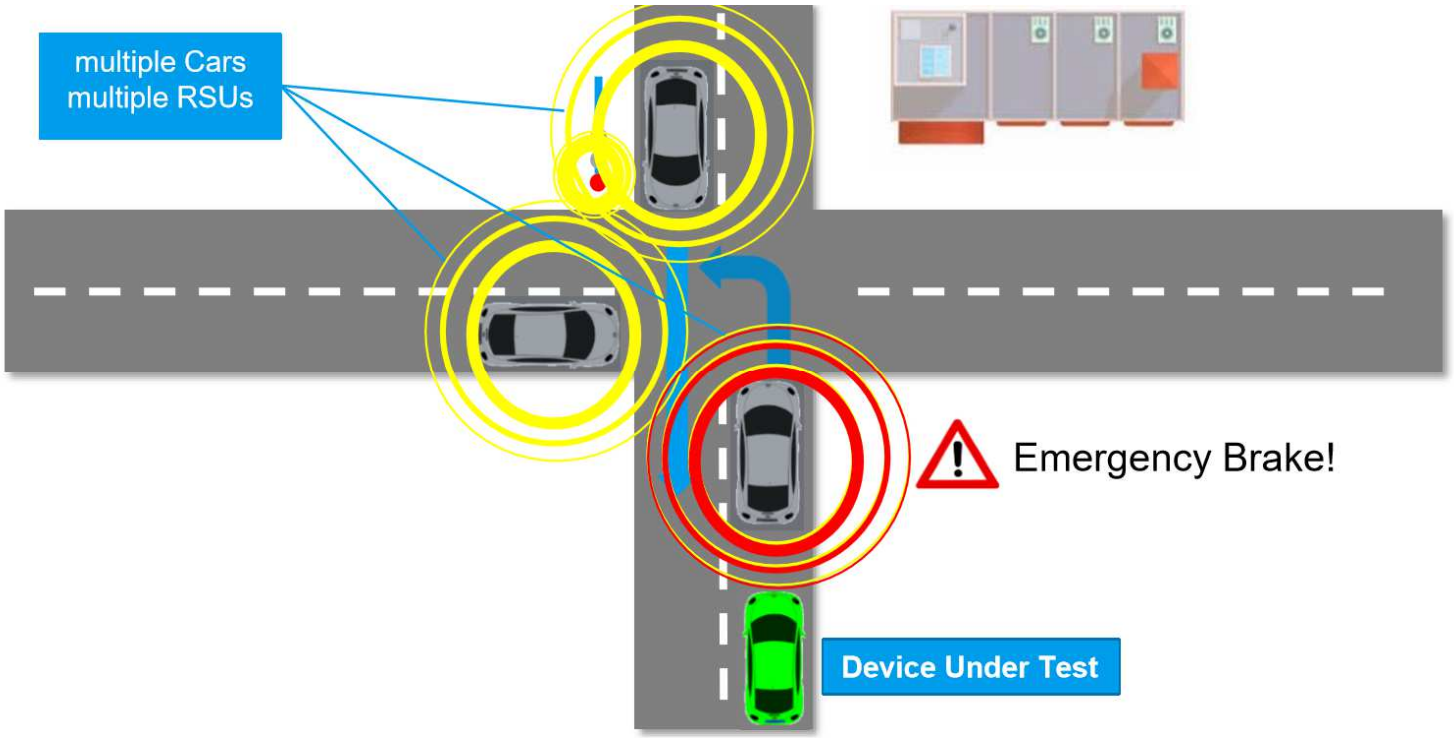
VEHICLE ARCHITECTURE WITH DOMAIN CONTROLLERS



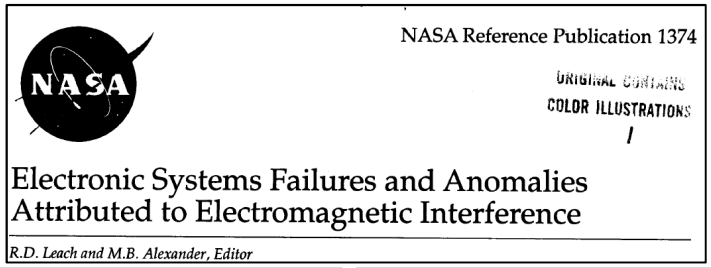
Rohde & Schwarz
Automotive Solutions

- Radar
- Connectivity
- Infotainment
- Ethernet
- EMC
- ECU Production Testing

MULTIPLE SIGNAL ON SIMILAR FREQUENCY BAND



NASA STUDIES



NASA Reference Publication 1374

ORIGINAL CONTAINS COLOR ILLUSTRATIONS

Electronic Systems Failures and Anomalies Attributed to Electromagnetic Interference

R.D. Leach and M.B. Alexander, Editor

2.1.1 Saturn Beat Frequency Case

During on-pad checkout at the Kennedy Space Center (KSC) prior to one of the early developmental test flights of the Saturn launch vehicle, the range safety receivers detected an extraneous signal. Because these receivers processed commands for engine cutoff, arm, and destruct, a thorough investigation was conducted to determine the cause of this unintended signal transmission. The problem appeared to be the production of spurious signals originating from the sum and difference combinations possible when signals frequencies are mixed. Although technically these spurious signals are not beat frequencies (associated with sound energy), this particular case is known within

2.2.5 NOAA–11 Phantom Commands

NOAA–11 is a weather satellite launched September 24, 1988, and operated by NASA for the National Oceanographic and Atmospheric Administration (NOAA). In September 1991, a series of phantom commands were observed and determined to be caused by EMI due to a noisy very high frequency (VHF) environment.[9]

2.3.1.15 Libyan Strike

In 1986 during the US air strike on Libya, several missiles failed to strike designated targets and an F–111 fighter crashed. Air Force officials blamed these incidents on EMI caused by U.S. aircraft transmissions interfering with each other.[16]

2.3.1.17 Mercedes-Benz Case

During the early years of ABS's, Mercedes-Benz automobiles equipped with ABS had severe braking problems along a certain stretch of the German autobahn. The brakes where affected by a near-by radio transmitter as drivers applied them on the curved section of highway. The near-term solution was to erect a mesh screen along the roadway to attenuate the EMI. This enabled the brakes to function properly when drivers applied them.

2.3.2 Aircraft Passenger Carry-On Devices Cases

Passenger carry-on devices provide another group of case histories. They show the increased susceptibility to external EMI sources that modern automated electronic systems aboard aircraft experience. This external EMI is generated by seemingly innocuous electronic devices, which include portable computers, AM-FM "walkman" cassette players, dictaphones, radios, heart monitors, and cellular phones.

2.3.3 Medical Equipment Cases

Modern medical equipment have experienced EMI problems. From 1979 to 1993, the FDA received over 90 reports concerning EMI problems in the field.[20] These reports are shown in table 2 by EMI categories defined by the Food and Drug Administration (FDA) and by equipment type.

NEWS

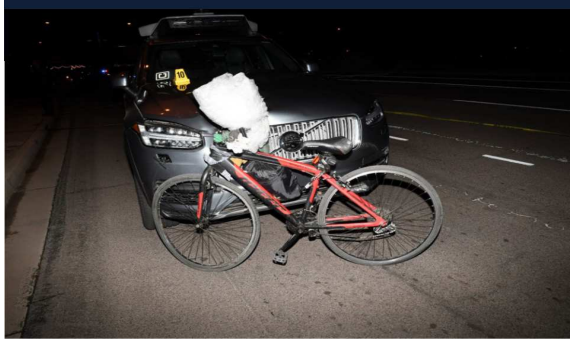
The autopilot sensors on the Model S failed to distinguish a white tractor-trailer crossing the highway against a bright sky

▲ Joshua Brown, the first person to die in a self-driving car accident. Photograph: Facebook

Against a bright spring sky, the car's sensors system failed to distinguish a large white 18-wheel truck and trailer crossing the highway, Tesla said. The **car attempted to drive full speed under the trailer**, "with the bottom of the trailer impacting the windshield of the Model S", Tesla said.- 2016

https://www.theguardian.com/technology/2016/jun/30/tesla-autopilot-death-self-driving-car-elon-musk

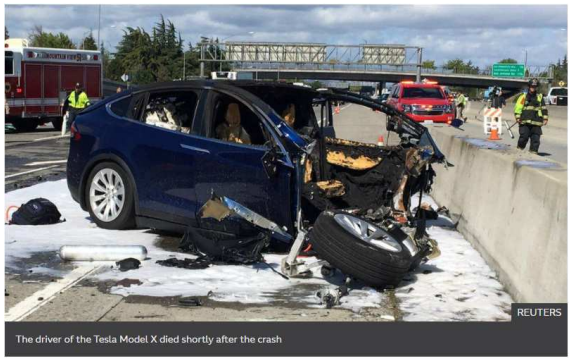
The automated car lacked "the capability to classify an object as a pedestrian unless that object was near a crosswalk," an NTSB report said.



A photo showing showing the bicycle matched up to the damaged areas on the Uber Volvo. National Transportation Safety Board

Because the car couldn't recognize Herzberg as a pedestrian or a person — instead alternating between classifications of "vehicle, bicycle, and an other" — it couldn't correctly predict her path and **concluded that it needed to brake just 1.3 seconds before it struck her** as she wheeled her bicycle across the street a little before 10 p.m. - 2018

https://www.nbcnews.com/tech/tech-news/self-driving-uber-car-hit-killed-woman-did-not-recognize-n1079281



REUTERS

The driver of the Tesla Model X died shortly after the crash

An Apple employee who died after his Tesla car hit a concrete barrier was playing a video game at the time of the crash, investigators believe.

The NTSB said:
The Tesla driver had not taken control of the car because he had been distracted by a smartphone video game
The Tesla's collision avoidance system was "**not designed to detect the crash [barrier]"**
Tesla's Autopilot system did not "provide an effective means of monitoring the driver's engagement – 2020

https://www.bbc.com/news/technology-51645566

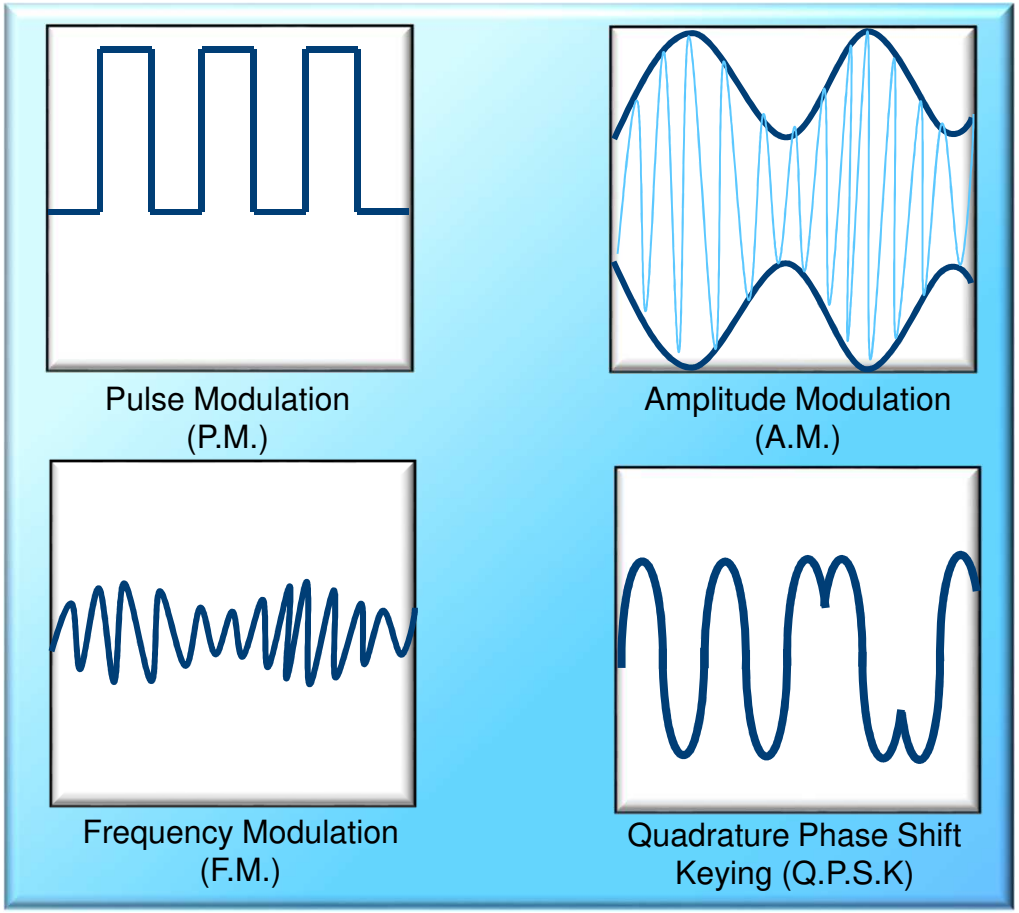
From **September 2016 to March 2018**, Uber's test vehicles were involved **in 37 crashes while driving autonomously**, but only two were the result of a car's failure to identify a roadway hazard. https://www.nbcnews.com/tech/tech-news/self-driving-uber-car-hit-killed-woman-did-not-recognize-n1079281

Automotive

EMC VS EME

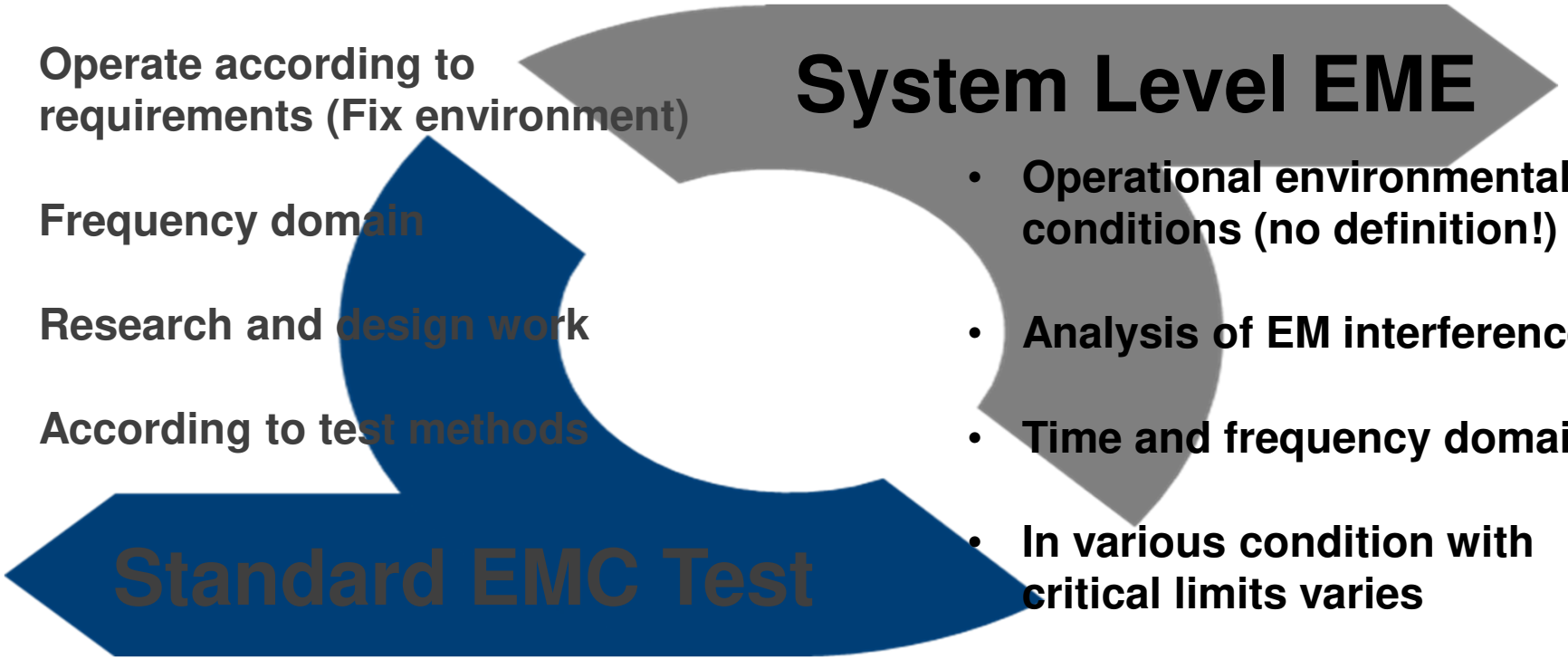
COMPANY RESTRICTED

FIXED MODULATION FOR CONVENTIONAL EMS



THE IMPORTANCE OF EME EFFECTS AND TESTING

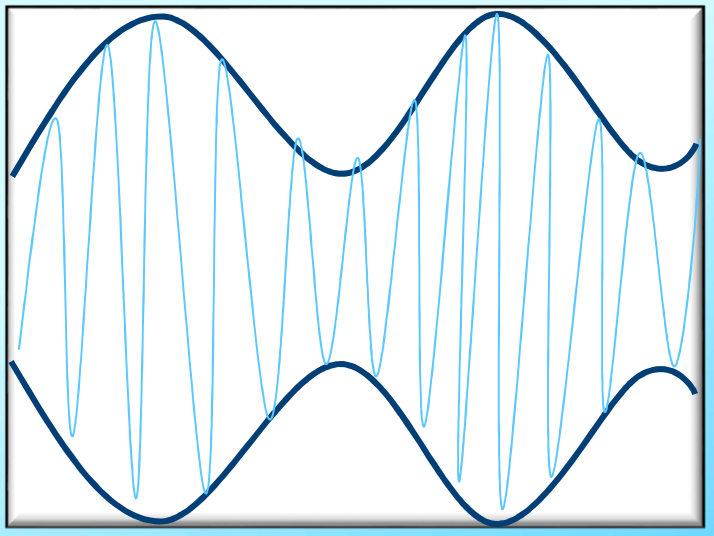
What are the differences ?



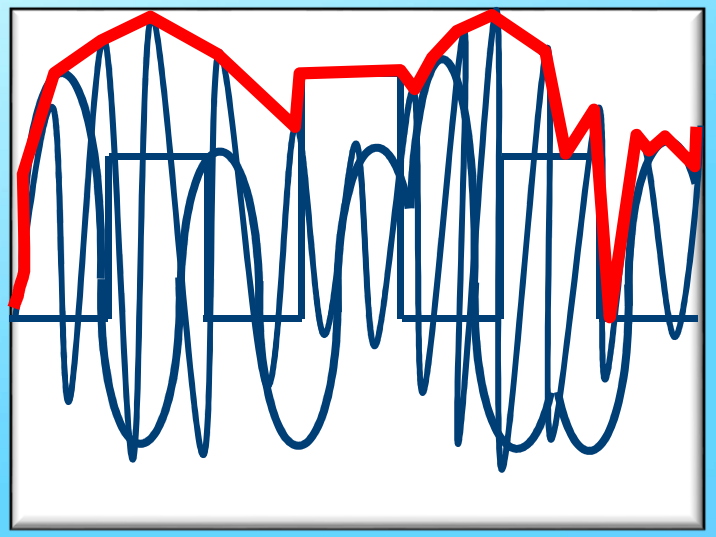
- Operate according to requirements (Fix environment)
- Frequency domain
- Research and design work
- According to test methods

- Operational environmental conditions (no definition!)
- Analysis of EM interference
- Time and frequency domain
- In various condition with critical limits varies

CONVENTIONAL EMS SIGNAL VS EME SIGNAL

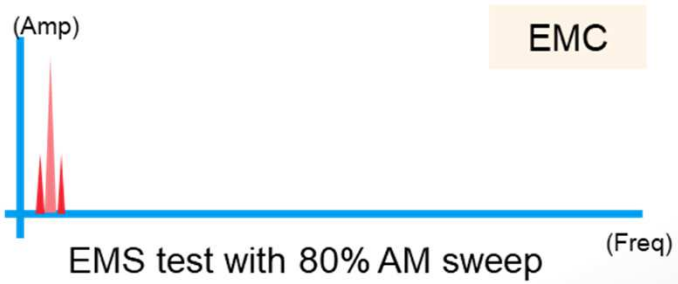


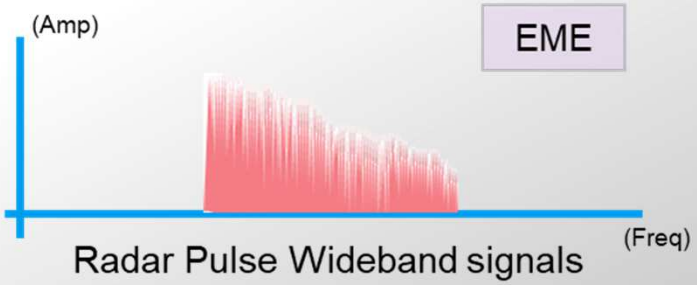
Amplitude Modulation
(A.M.)



Example of EME Signal

CONVENTIONAL EMS SIGNAL VS EME SIGNAL





- Military test method vs Pulse radar interferences
- EME test covers and focuses multi-domains of interference signals, which is closer to real-world environment during wartime
- It is Reliability, Adaptability and Safety Tests

EMC STANDARDS

► Different Electronic Equipment require compliance to different Standards

Commercial Equipment:

- ISM Equipment
- Consumer Electronics Equipment
- IT / Household Equipment
- Lighting Equipment

Applicable Standards:

- CISPR 11 - 35
- IEC61000-X-X series
- Product Specific Standards

Military Equipment:

- Aircraft Equipment
- Ship & Submarine Equipment
- Land Based Equipment

Applicable Standards:

- Mil-Std 461
- Mil-Std 464C
- GJB151A/152A-97

Automotive Equipment:

- Control Equipment
- Infotainment Equipment
- Communication Equipment

Applicable Standards:

- CISPR 12, 25
- ISO11451, ISO11452
- Product Specific Standards

TEST STANDARD DOCUMENTS

Electromagnetic Environment (EME) Effects Testing for System Level

CSAE 中国汽车工程学会标准 Standard of SAE-China

关注官方微信

中文名称：**道路车辆复杂电磁环境适应性要求和试验方法**

英文名称：Requirements and test methods of road vehicle’ s adaptability to complex electromagnetic environment

标准状态：**已发布**

提出单位	中国汽车工程学会汽车测试技术分会	**发布单位**	中国汽车工程学会

INCREASED INTERNATIONAL ATTENTION GIVEN TO COMPLEX EME

U.S. Department of Health and Human Services
Food and Drug Administration
Center for Devices and Radiological Health

Office of Science and Engineering Laboratories

Center for Biologics Evaluation and Research

*Abstract from **Radio Frequency Wireless Technology in Medical Devices "Guidance for Industry and Food and Drug Administration Staff**", U.S Department of Health and Human Services (FDA), 14 August 2013*

c. Wireless coexistence

A key factor affecting a wireless medical device's performance is the limited amount of RF spectrum available, which can result in potential competition among wireless technologies for simultaneous access to the same spectrum. Because conflicts among wireless signals can be expected, most wireless communication technologies incorporate methods to manage these conflicts and minimize disruptions in the shared wireless environment. The selection of RF wireless operating frequency and modulation should take into account other RF wireless technologies and users that might be expected to be in the vicinity of the wireless medical device system. These other wireless systems can pose risks that could result in medical device signal loss or delay that should be considered in the risk management process. To address this issue, FDA recommends that you address your device's environmental specifications and needs, including:

- Associated sources of EMD expected in specific known use environments, and
- Co-channel and adjacent channel interference from medical devices and other users of the RF band.

If the RF wireless medical device is expected to be used in proximity to other RF wireless in-band (i.e., the same or nearby RF frequency) sources, FDA recommends addressing such risks through testing for coexistence of the device wireless system in the presence of the number and type of in-band sources expected to be in proximity to the device. Depending upon the wireless medical device, this should also include multiple units of the subject device operating in the same vicinity, such as when patients are sitting adjacent to one another in a waiting room. Once failure modes and associated risks are identified, we recommend a justification of acceptable risk, or testing or other measures to demonstrate appropriate risk mitigation.

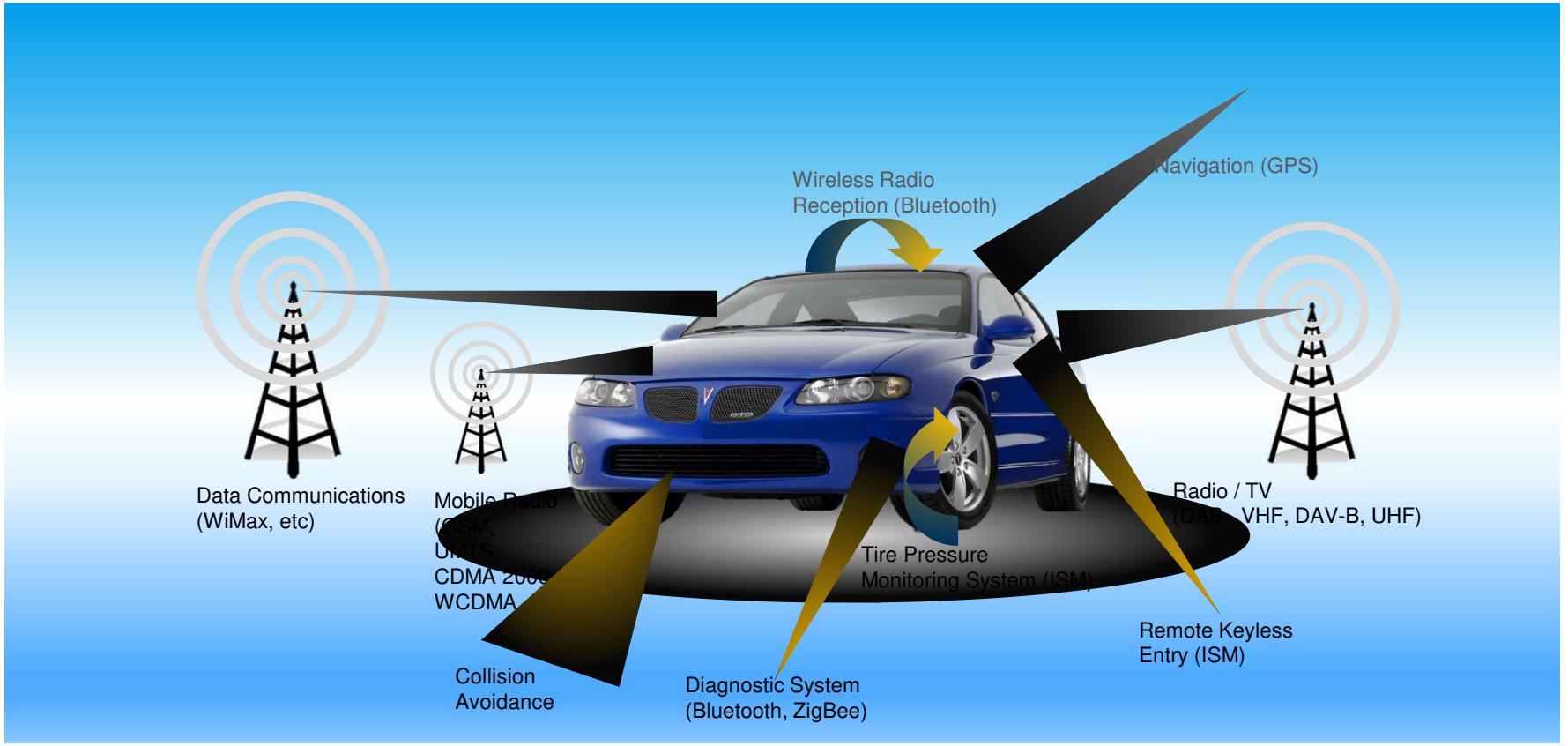
RELEVANT TEST STANDARD DOCUMENTS

Electromagnetic Environment (EME) Effects Testing for System Level

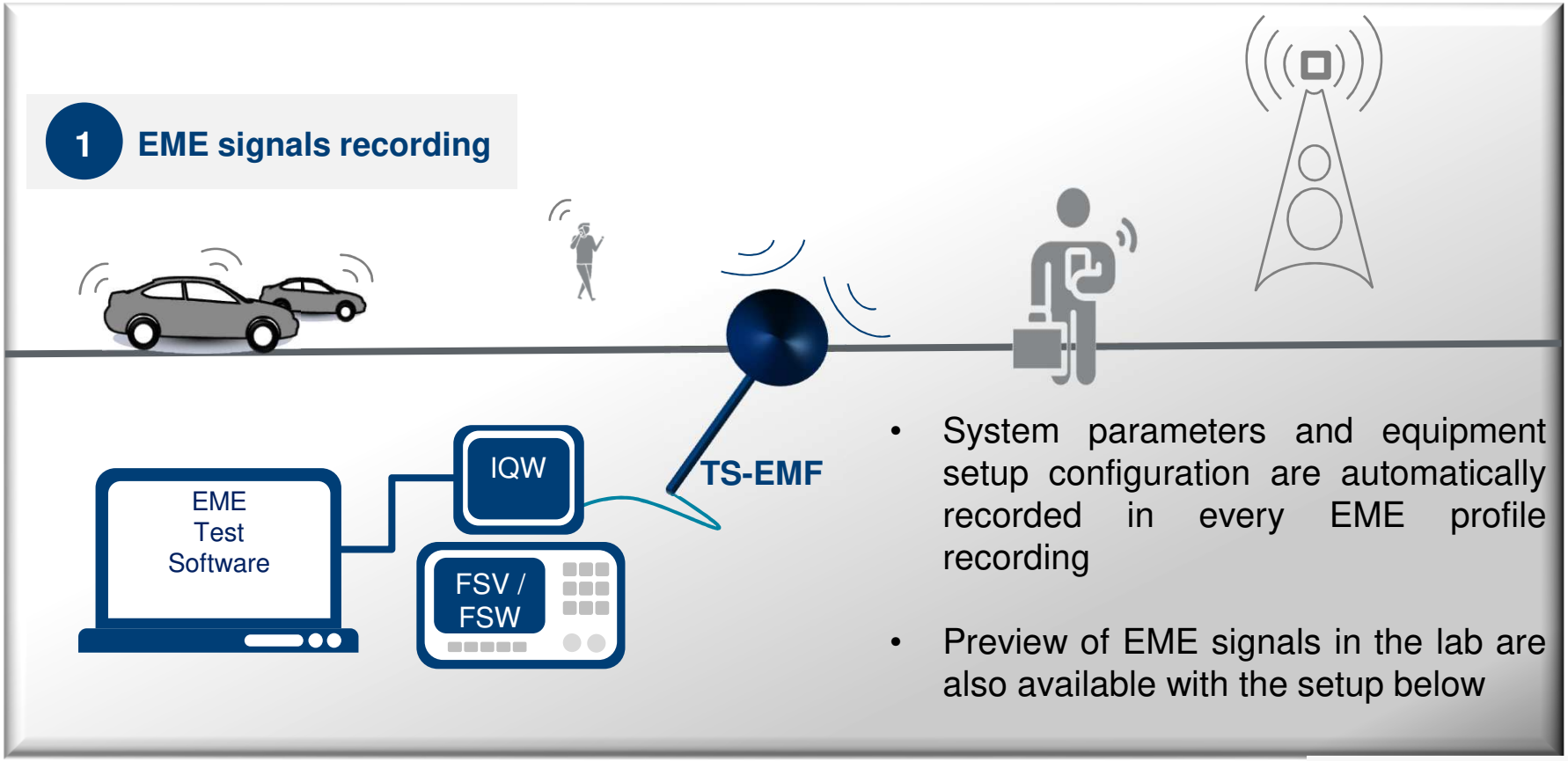
Automotive

EME SYSTEM STRUCTURE

EME SIGNAL COLLECTION AND RECORDING ON ROAD

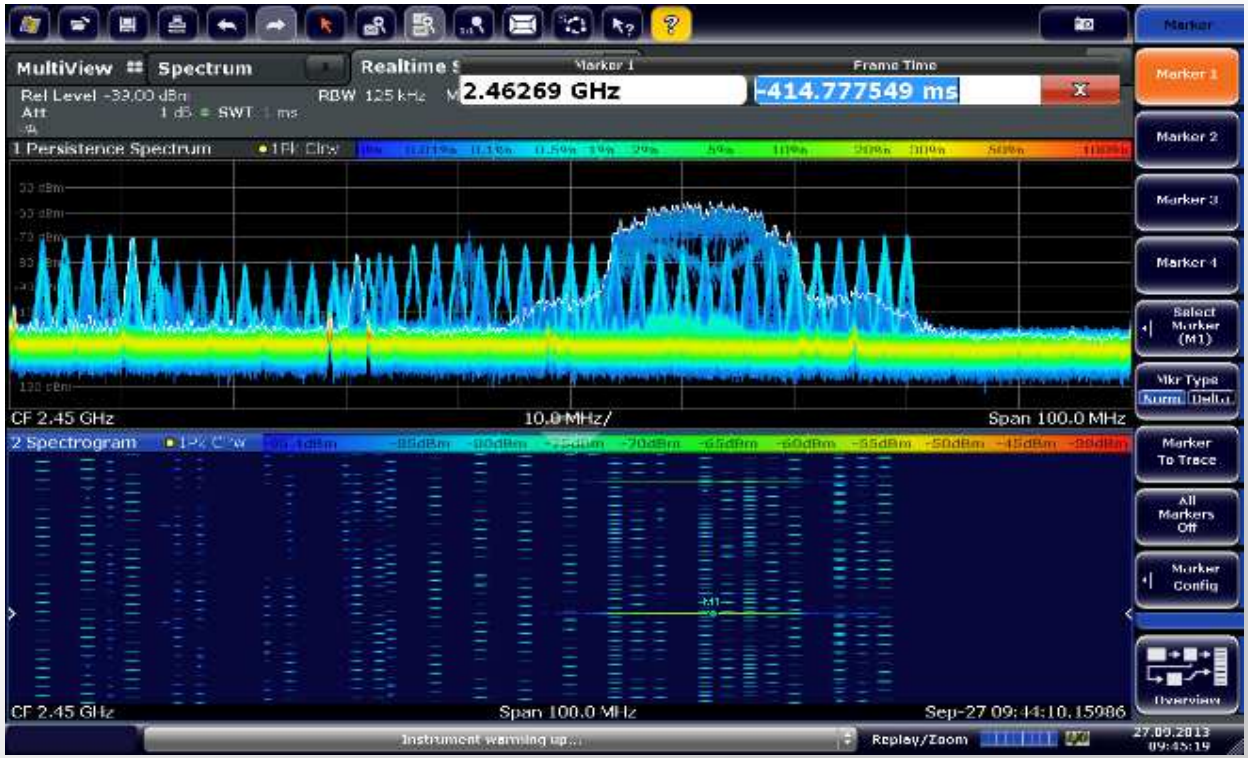


EME SIGNAL COLLECTION AND RECORDING ON ROAD

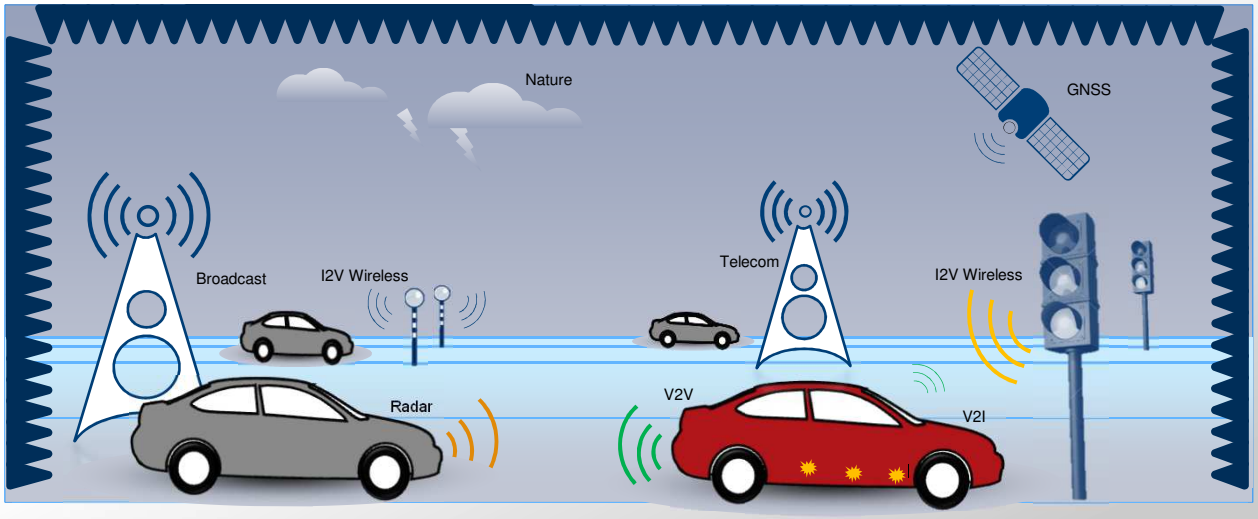


- System parameters and equipment setup configuration are automatically recorded in every EME profile recording
- Preview of EME signals in the lab are also available with the setup below

EME SIGNAL COLLECTION AND RECORDING ON ROAD



TESTING EME IN CHAMBER

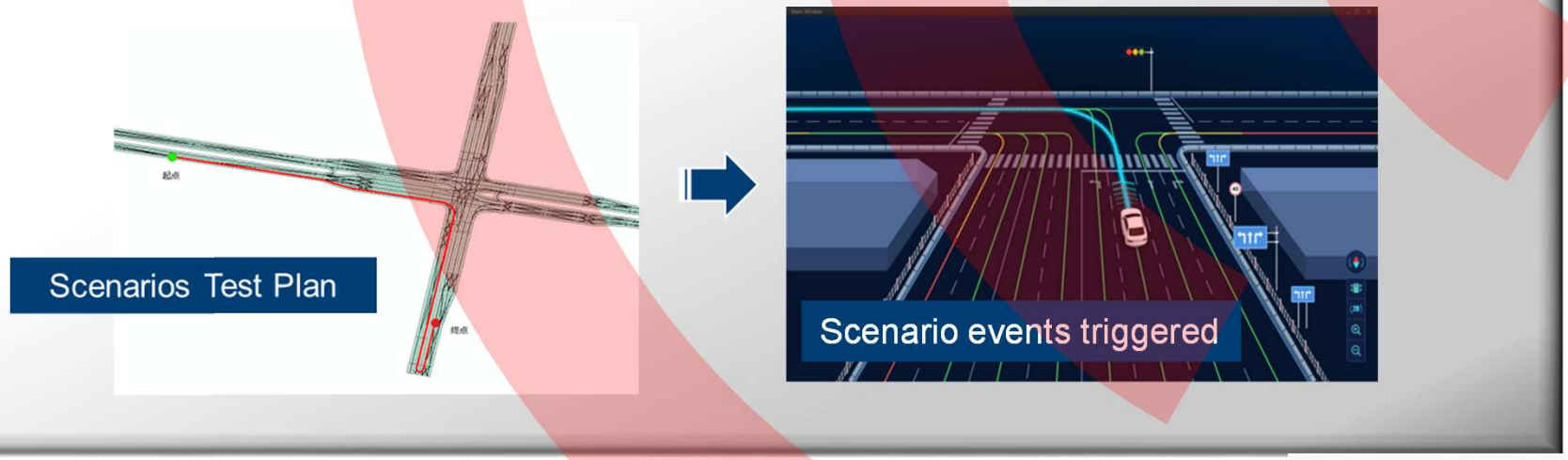


EMULATE COMPLEX EME SIGNALS

Enable the Road Electromagnetic Environment Testing

- **Radio coexistence** which evaluates performance and functionality in the presence of known radio and wireless communication signals;

- **Scenarios** that introduce diverse operational environments



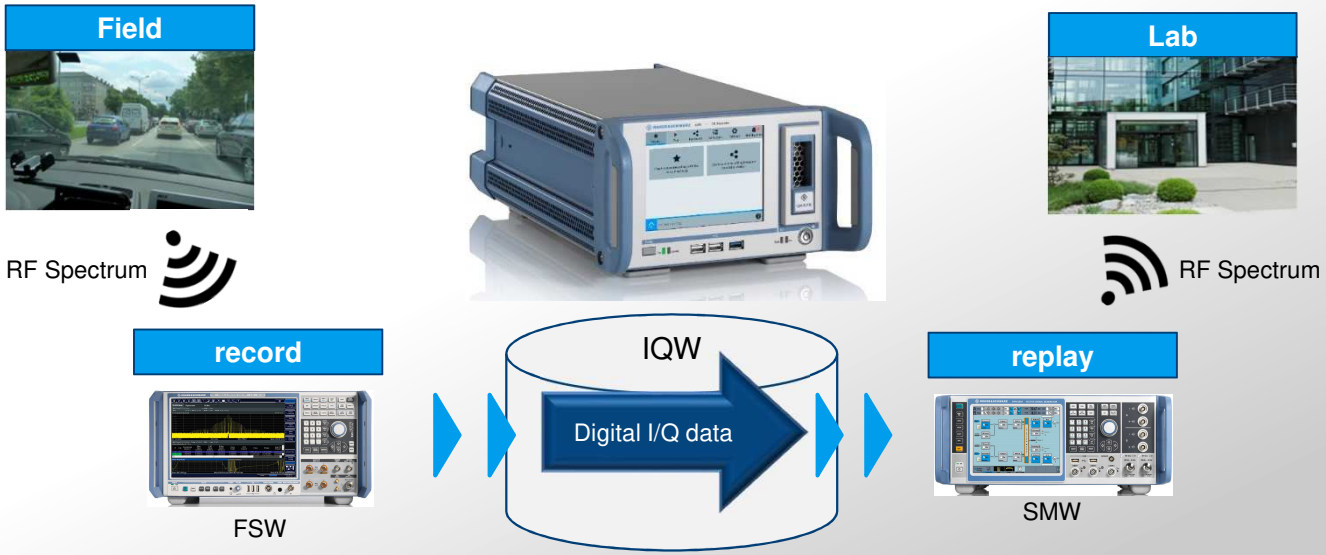
EMULATE COMPLEX EME SIGNALS

Enable the Military Electromagnetic Environment Testing

Automotive

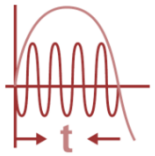
SYSTEM DESIGN AND FEATURES

BRING REAL-WORLD EME TO LAB



E.M.E FEATURES

Recommended Specification



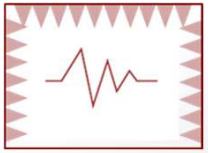
FREQUENCY AND BANDWIDTH

Carrier Frequency < 6 Ghz

Baseband BW 160Mhz

ARB BW 160 Mhz

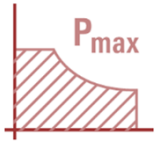
Analysis BW 40 MHz



FIDELITY & FIELDSTRENGTH

Subjected to recording and system calibration

Max-Pk field-strength may limited existing EMC system



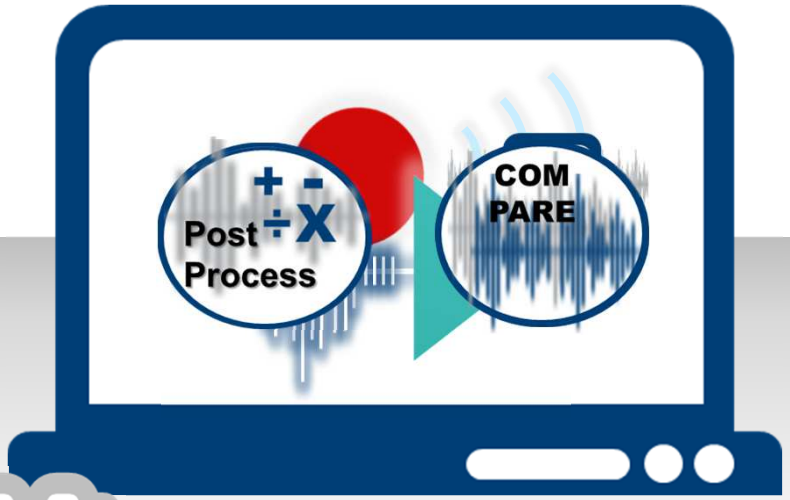
AMPLIFIER SPECIFICATION

Subjected to waveform characteristics and field strength levelling method

VALIDATION

TA-EME are designed according to CSAE recommended method and requirements

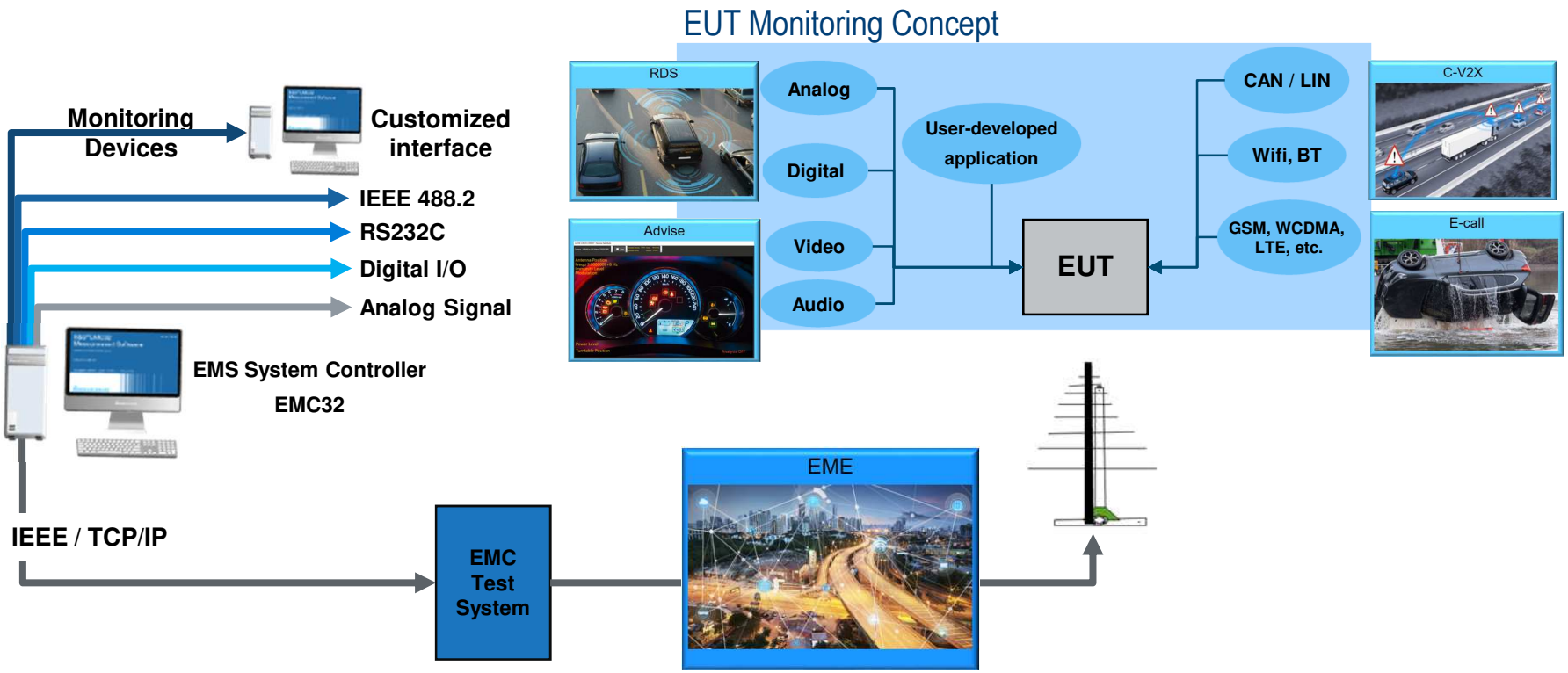
TAS-EME SOFTWARE FEATURES



From Field

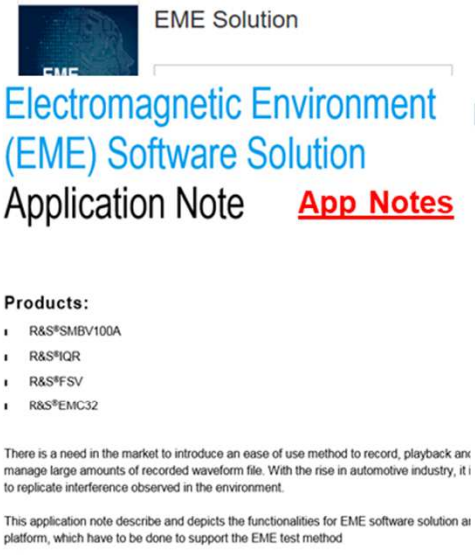
To Lab

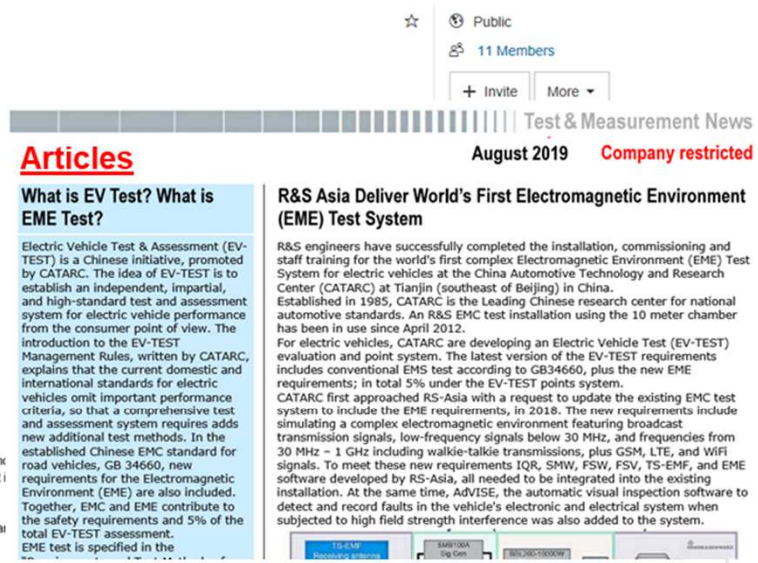
专为EMC领导者而打造的未来测试



VISIT EME SOLUTION

Collaborating and sharing ideas





4 Categories

- **Automotive**
- **Medical**
- **Military**
- **Wireless**

Scan Me

BUILT FOR THE FUTURE TESTING

8 subfolders in each category

App Notes → Brochures → Competitor → Events & Articles → Offer Templates → Powerpoint Slides → References

Automotive

DISCUSSION