Emerging communication technologies enabling the Internet of Things

IoT system design challenges and testing solutions

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Smart Testing
for a smart world

COMPANY RESTRICTED

Internet of things becomes reality in vertical industries

Wearables

Smart Homes

Smart Cities

Healthcare

Automotive

Smart Buildings

Asset Tracking

Retail

Agriculture

…..

Wireless technologies enabling the Internet of Things

Smart Cities

Wearables

Range

Sigfox
LoRa

eMTC/NB-IoT

Cellular
(2G/3G/4G/5G)

802.11 ah

WiFi
802.11 a/b/g/n/ac

ZigBee
Thread
Z-Wave
WI-SUN

ANT+

Bluetooth

802.11ad

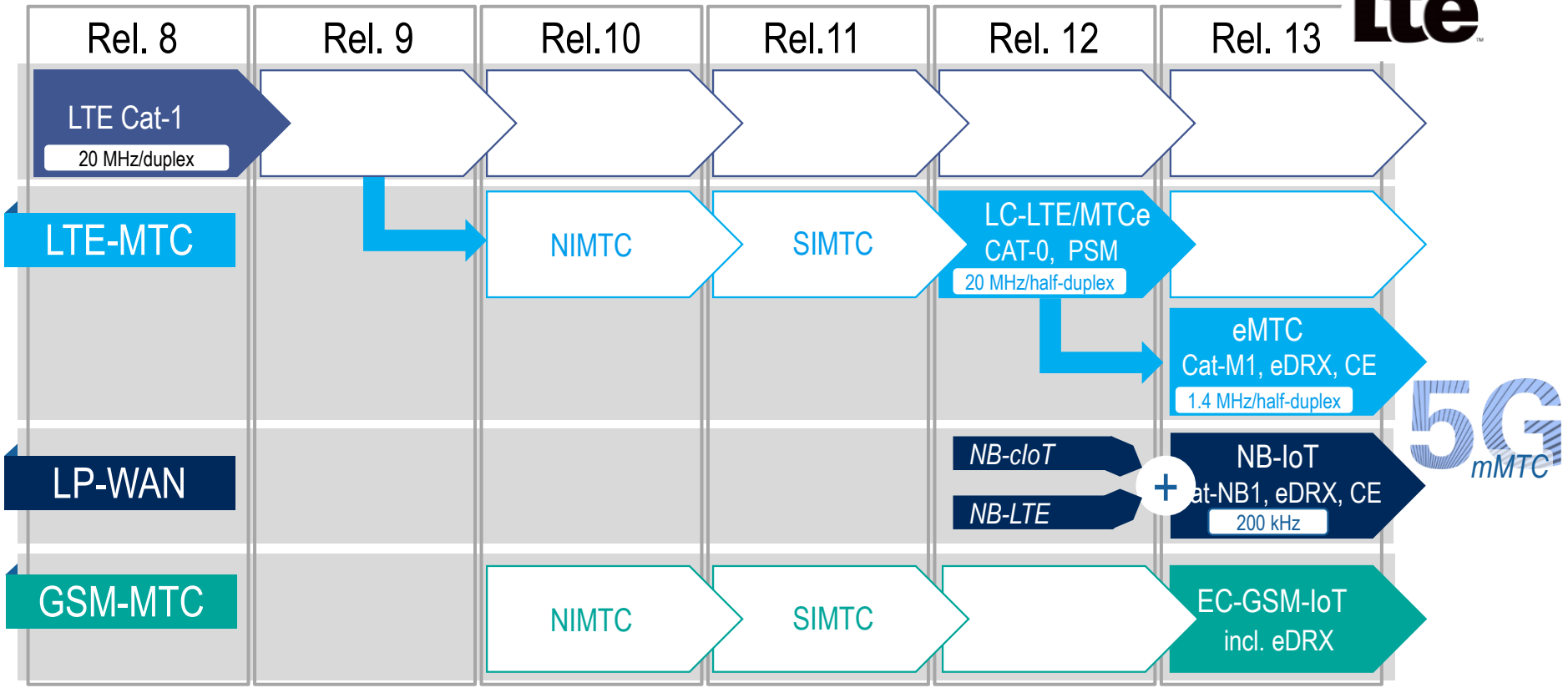
NFC

Data Rate

Smart Homes

Automotive

3GPP IoT standardization on the way to 5G



Bluetooth SIG focus on enhancements for the IoT

Mesh

building meshed network using relay nodes

Bluetooth 5

Speed

Support of 2 Mbps

Gateway

Connecting devices directly to the cloud

Range

4x range to cover a smart home or office

Bluetooth 5

Direction

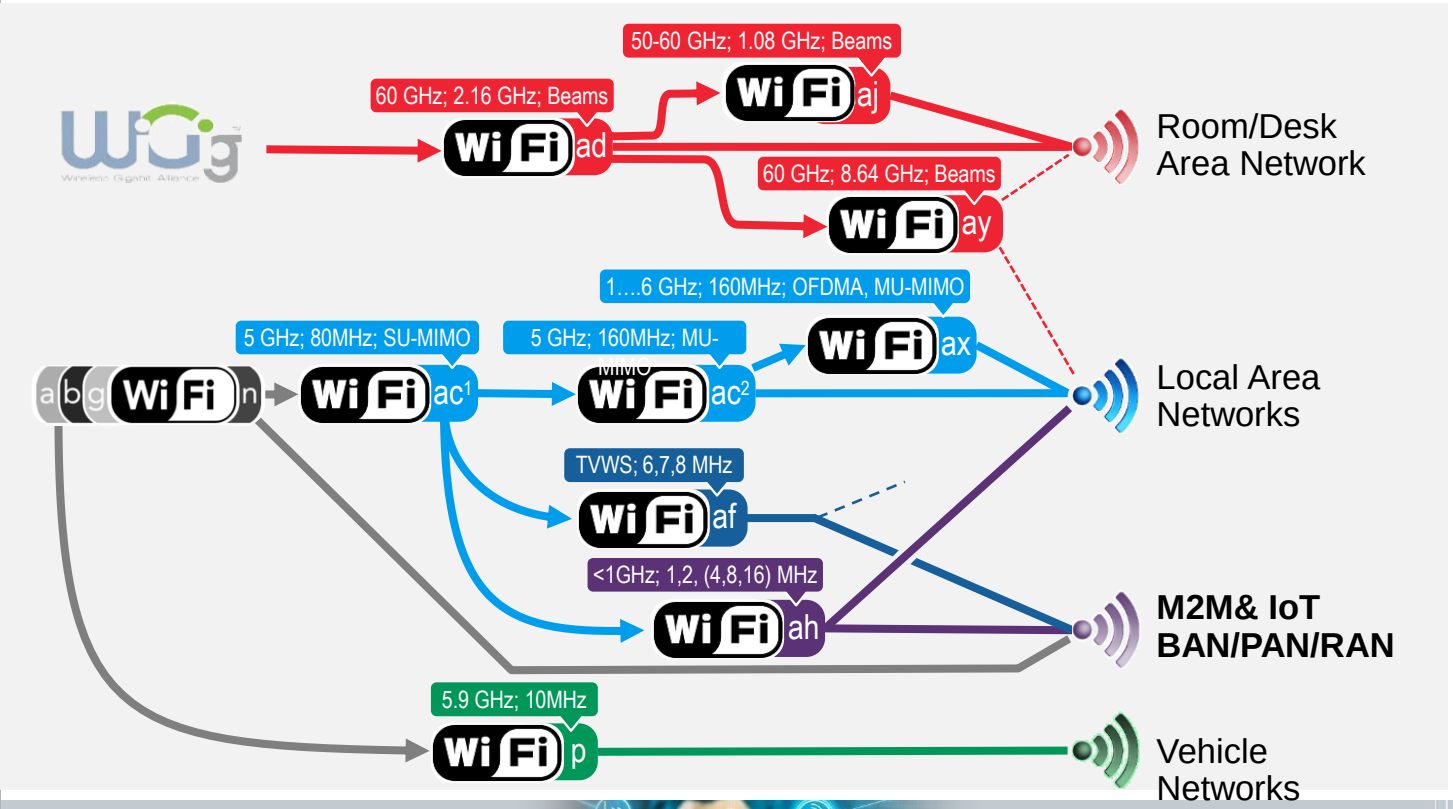
Extended broadcast capabilities of beacons

Bluetooth 5

"Bluetooth is on the threshold of being the enabling wireless technology for the IoT."

Bluetooth co-inventor Sven Mattisson

Wi-Fi adoption beyond Local Area Networks



LP-WAN technologies in ISM/SDR bands shaking the market

	sigfox	LoRaWAN	INGENU simply genius	WEIGHTLESS-N	WEIGHTLESS-W	WEIGHTLESS-P
Technique	Ultra Narrow Band (UNB)	Chirp Spread Spectrum	DSSS RPMA	Ultra Narrow Band (UNB)	DSSS	Narrow Band (NB)
Modulation	UL: DBPSK DL: GFSK	Frequency Chirps	UL:DBPSK DL:DBPSK	UL:DBPSK DL: -	16-QAM…. DBPSK	GMSK, QPSK
Channel BW (UpLink)	ETSI: 100 Hz FCC: 600 Hz	125 kHz 250 kHz 500 kHz	1 MHz	200 Hz	6/7/8 MHz	12.5 kHz
Band	ISM/SDR < 1 GHz	ISM/SDR < 1 GHz	ISM/SDR 2.4 GHz	ISM/SDR < 1 GHz	TV white space 470-790 MHz	ISM/SDR < 1 GHz
Driver	sigfox	SEMTECH	INGENU simply genius	nwave	neul	M2COMM

Testing in all phases of life cycle of IoT devices and networks

Research & Development

- Digital and analog interface debug
- Clock Analysis
- EMI debug
- Power Analysis

Design & Validation

- RF Parametrics
- Co-existence
- Functionality
- Performance
- Power analysis

Pre-Compliance & Compliance

- Standard compliance
- Regulator compliance
- Carrier Acceptance

Manufacturing

- Calibration
- Verification
- Go / NoGo

Deployment & Operation

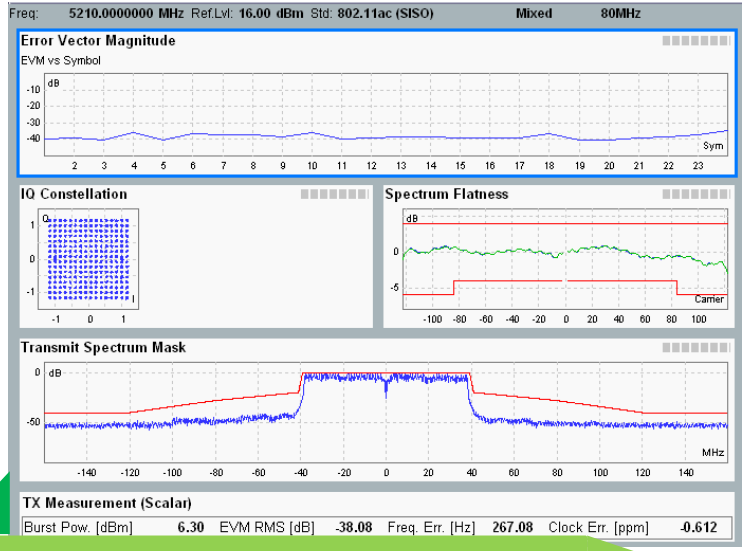
- Installation
- Monitoring
- Optimization

Service & Repair

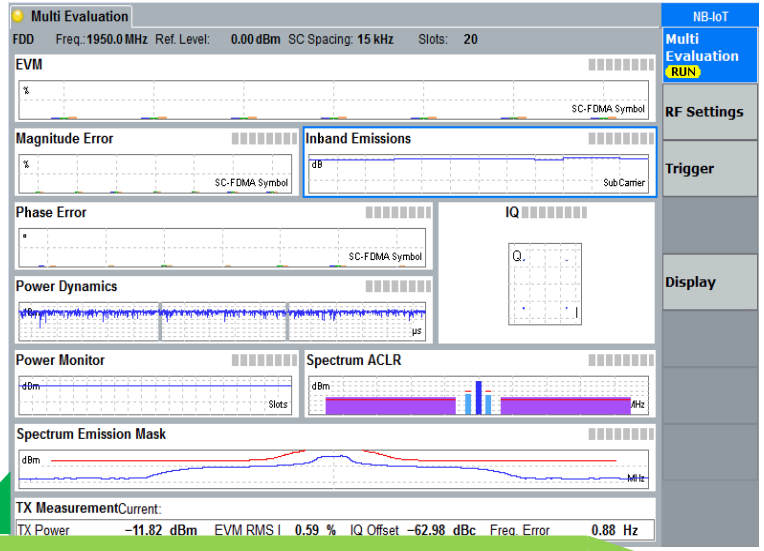
- Fault Finding
- Calibration
- Verification

RF accuracy/parametric is the essential challenges in wireless system design

Power | EVM | SEM | Frequency error | Constellation Diagram | …



802.11ac with 80MHz and 1024QAM



NB-IoT with 15Hz and QPSK

CMW500 the unique test solution platform for cellular Machine Type of Communication (MTC) and LAN/PAN connectivity

The all-in-one platform

Support of all major cellular and non cellular wireless technologies for non-signaling, signaling and protocol testing

Parametric RF tests

RF Transmitter / Receiver validation test in real-time base station emulation mode incl. channel impairments

Protocol tests

Protocol testing including IMS (VoLTE), MTC features (NIMTC, SIMTC, Cat 0, Cat M1), or LTE-U and operator acceptance tests

Wideband Radio Communication Tester R&S®CMW500

Location based services

Possibility to test location based services for satellite based (GNSS) and networks based positioning

Application Performance

Data application unit and advanced IP analysis as well as impairment features allow comprehensive e2e testing

GUI and Automation

CMWcards for easy test of complex scenarios and CMWrun for test automation from R&D to production

From physical layer to application layer: End-to-end IoT application testing

IoT device

- IoT application
- Communication module

Mobile network

- Extended access barring
- Power saving mode
- Extended DRX cycle

IP network

- Throughput
- Delay, jitter
- Loss

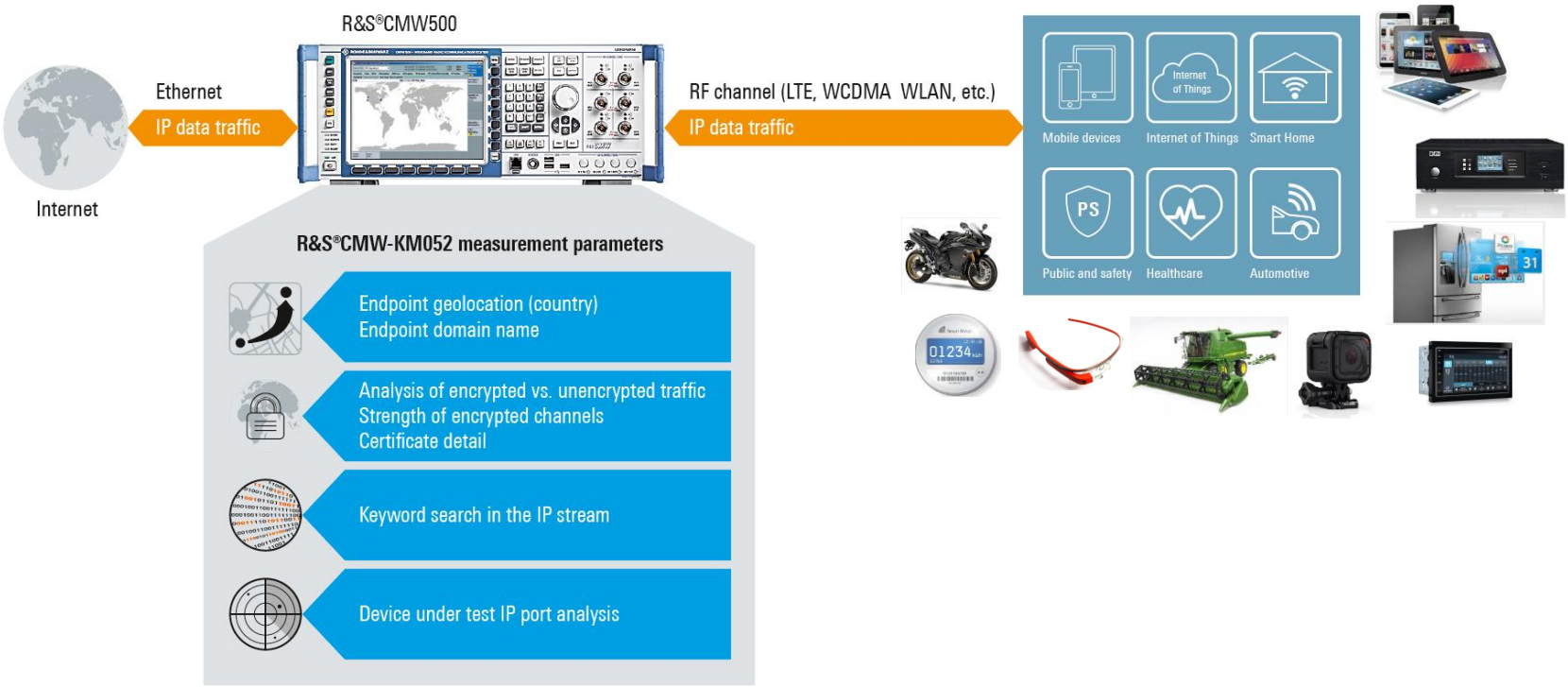
IoT server

- IoT application
- Service platform

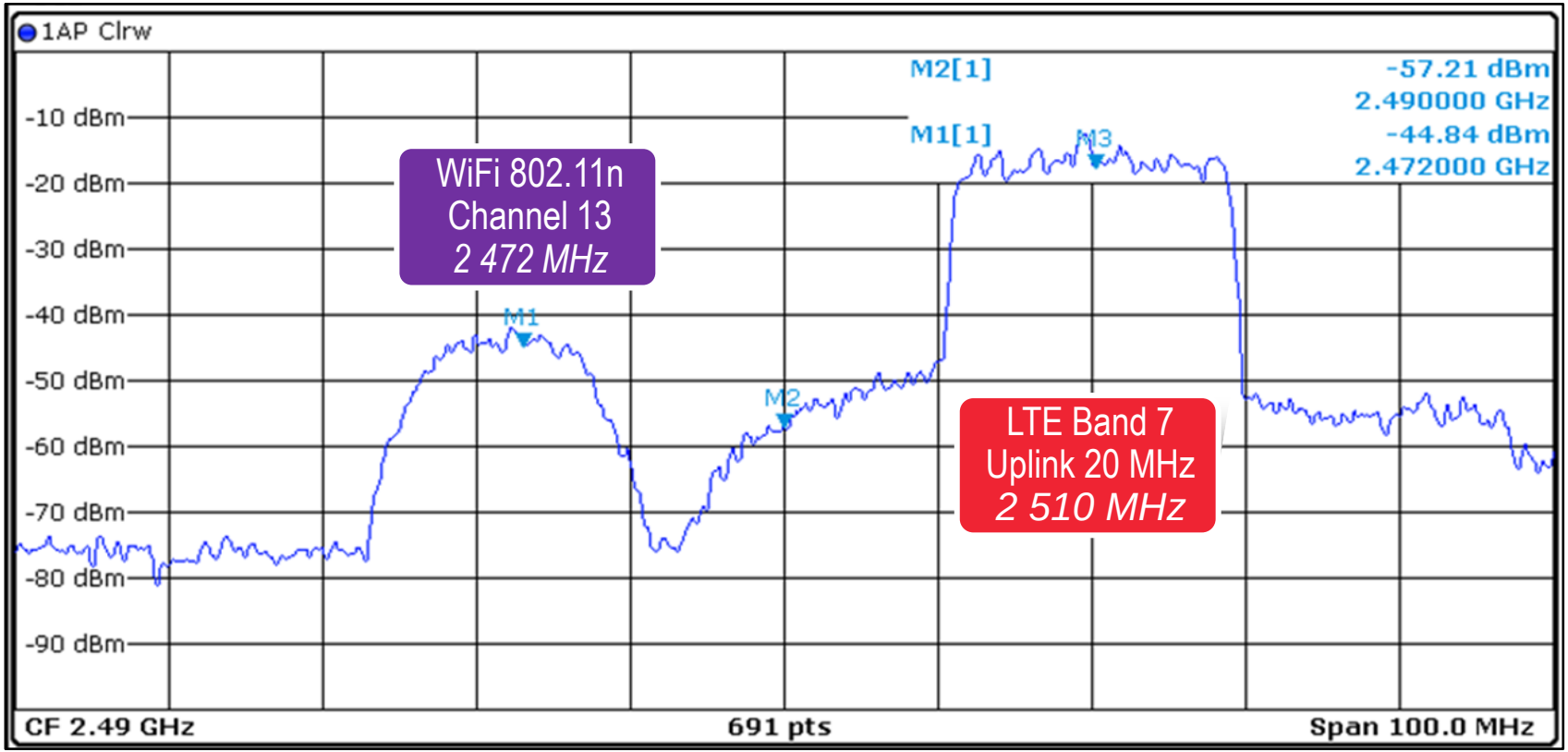
- Event initiated comm.
- Server initiated comm.
- Periodic communication

- Responsiveness
- Acknowledgement
- Protocol impact

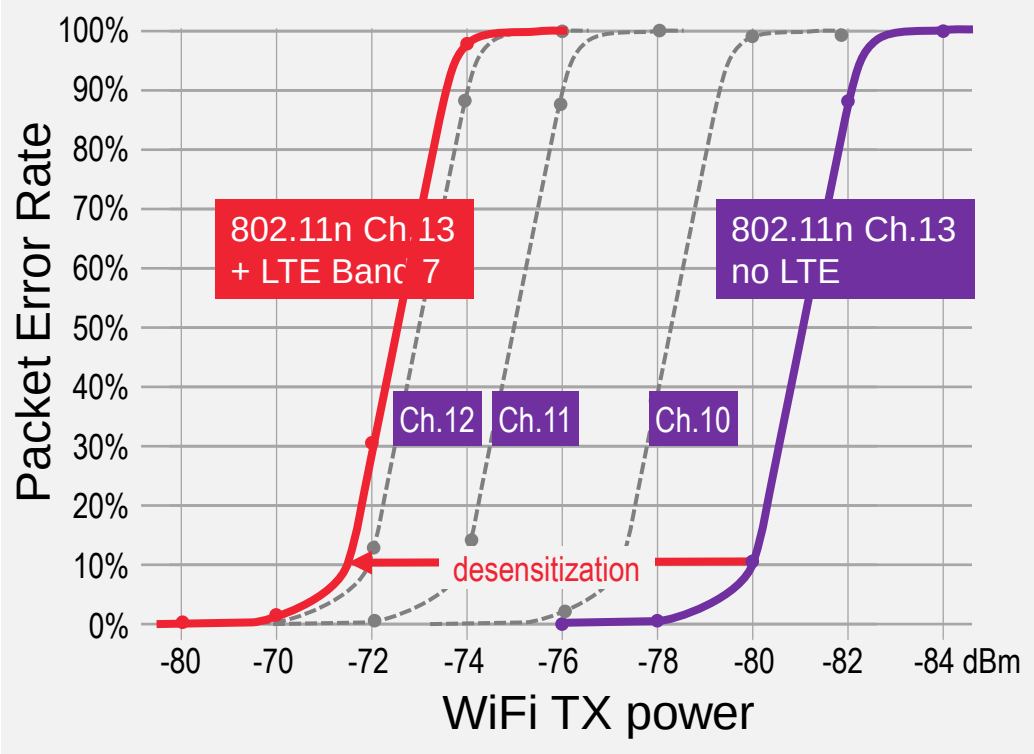
CMW-KM052 IP Connection Security Analysis
Test Solution

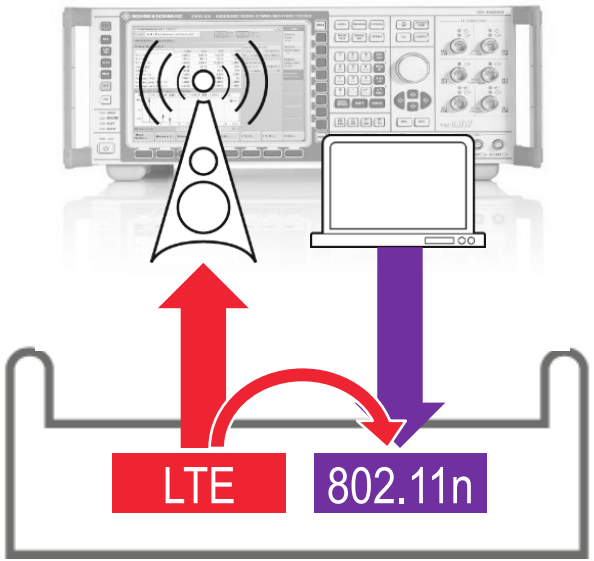


LTE/WiFi In-Device Coexistence: Spectrum View

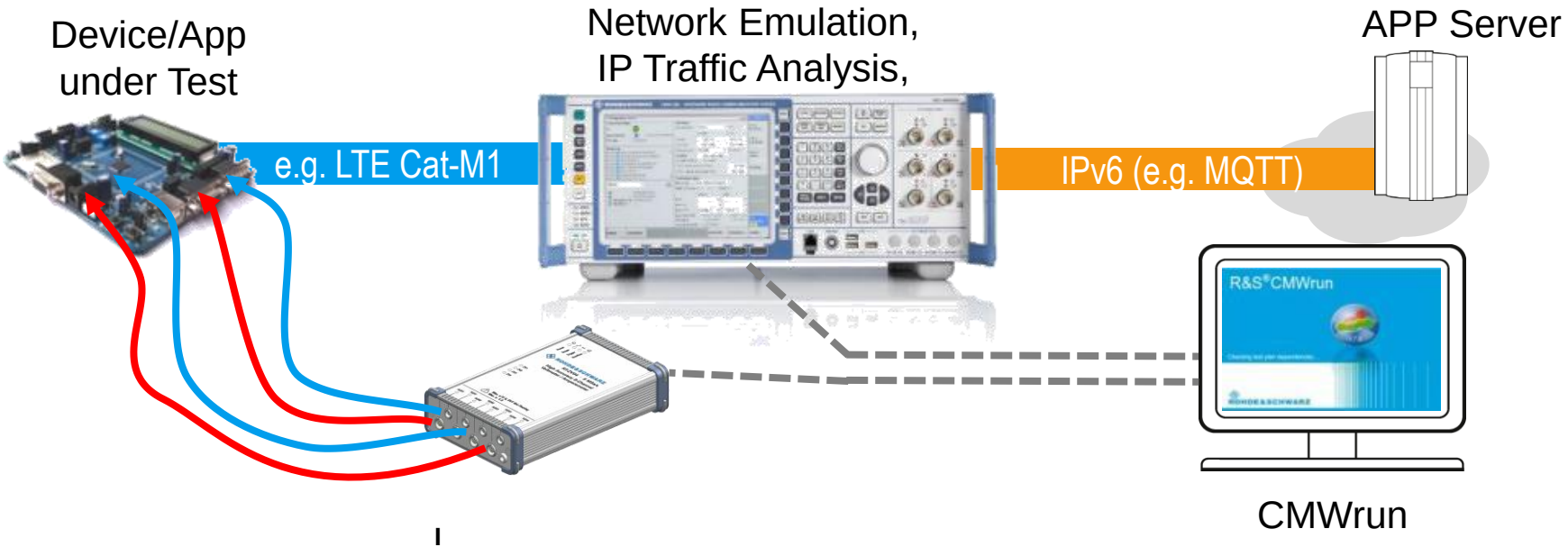


Prompt analysis of EMI problems starting in development





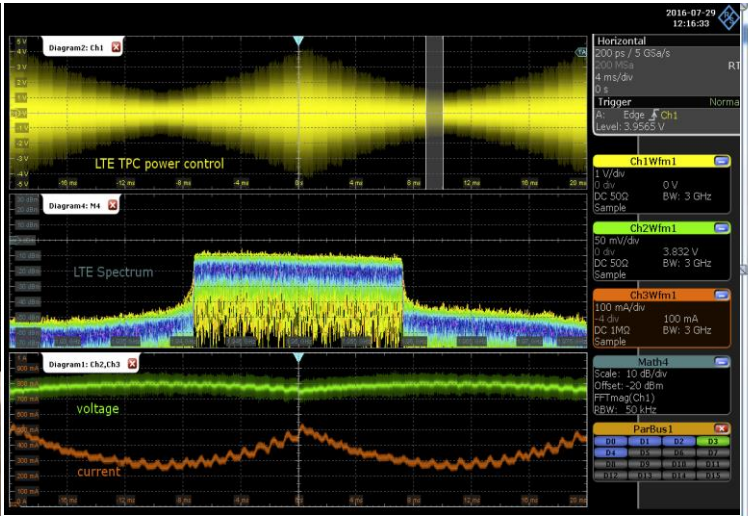
Analyzing/optimizing Power Consumption in e2e environment

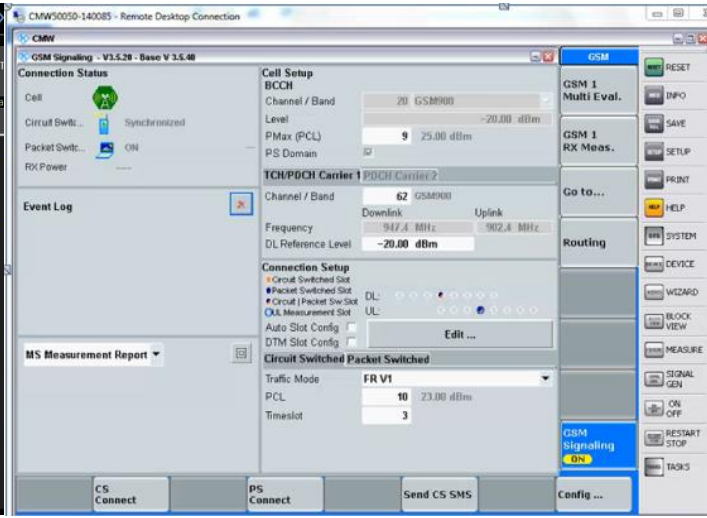


Multi-demo analysis under the ‘real’ network?

CMW + RTO setup is most powerful setup.

- CMW simulates the cat-m1 network envirment and measures the RF characters of the device.
- RTO offer the deep multi-demo analysis of the components of the boards.





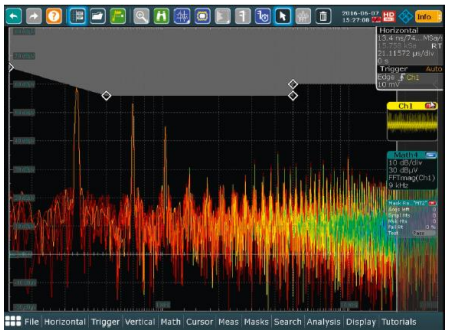
EMI is a serious problem for your design

RTO with the R&S®HZ-15 Probe set helps!

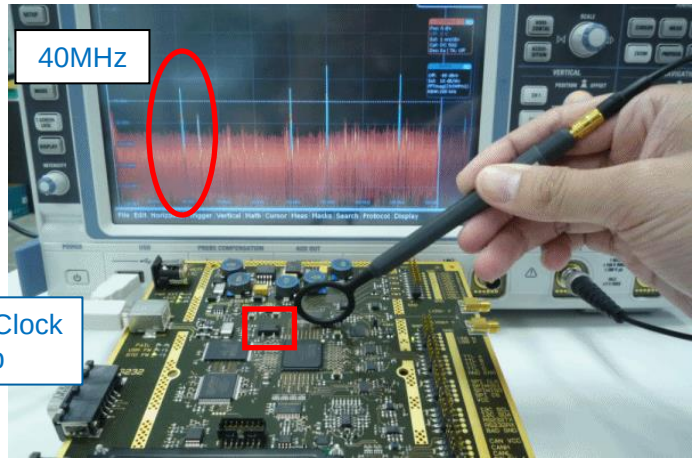
R&S®HZ-15 Probe set for E and H near-field emission measurements. 30 MHz to 3 GHz

Detection of EMI sources with the R&S®RTO Oscilloscope

- Fast and accurate measurements
- Multiple FFT traces
- Easy configuration of masks for EMC limit testing



Conducted emission test with a mask defined in the spectrum.



Conformance, Performance, Compliance and Network acceptance testing

RF & RRM Conformance Testing

Market-leading RF and RRM conformance test solutions for type approval and certification of mobile devices.

Products

Location Based Services (LBS) Testing

Comprehensive test solutions for network- and satellite-based location technology testing of wireless devices and chipsets.

Products

Protocol Conformance & Network Operator Acceptance IOT Testing

Future-ready protocol testing and performance quality analysis (PQA) solutions for certification and type approval testing as well as network operator acceptance testing (IOT).

Products

Audio / Video Testing

Reliable test solutions for audio and video interfaces and for in-depth audio measurements on wireless devices and consumer electronics.

Products

OTA: Over-the-Air Antenna Testing

Solutions for over-the-air antenna performance testing of wireless SISO and MIMO devices – from R&D to certification testing.

Products

Radiated Spurious Emissions, Regulatory & EMC Testing

Turnkey system solutions for automated radiated spurious emission (RSE) and EMI precompliance and compliance testing of wireless devices for all common technologies.

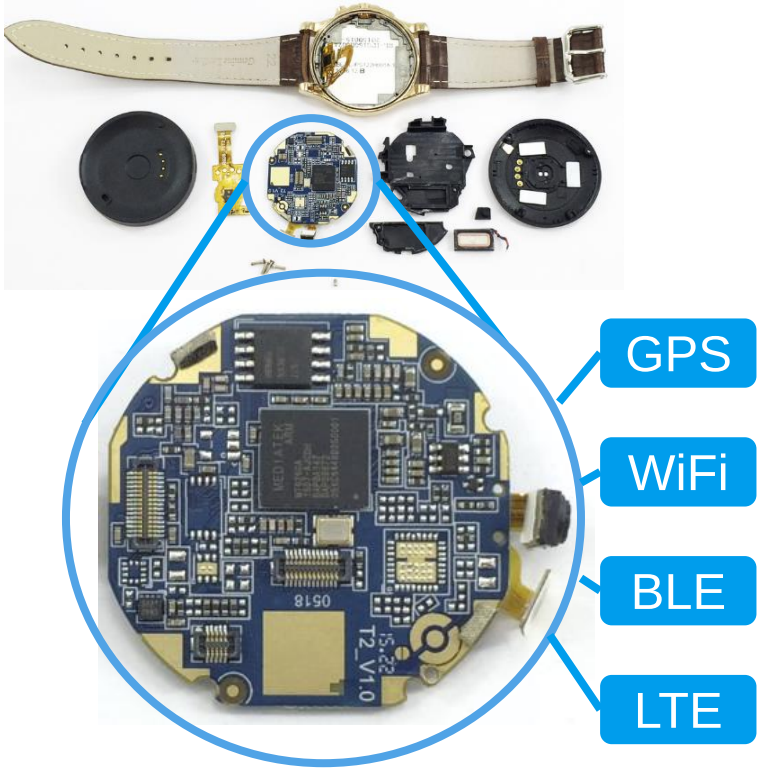
Products

Intelligent Transportation System (ITS) Testing

Integrated Test System for IEEE 802.11p Tests

Products

The effective of accurate measurements in production

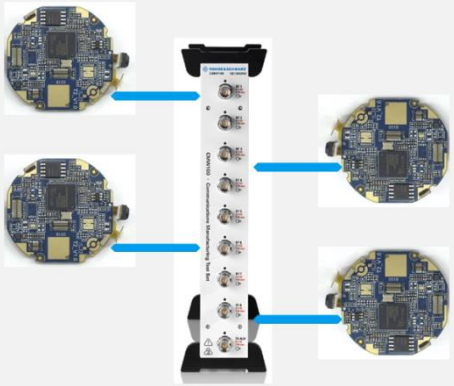


Calibration

- Frequency
- TX power
- RX RSSI

Verification

- Frequency offset
- TX power, EVM, SEM, ACLR
- RX sensitivity



Test & Measurement Solutions for the Internet of Things

- T&M solutions for most important wireless M2M technologies
- Support of 3GPP Machine type communication (MTC)
- Solutions for IoT application testing incl. eCall, or battery drain
- Solutions for testing location based services (GNSS, A-GNSS)
- Solutions for car-to-car communication testing

Your Partner in testing the Internet of Things

ROHDE&SCHWARZ