RF 2016 TECHNOLOGY DAYS

NL HILVERSUM • 12-04-16

BE LEUVEN • 14-04-16

Smart test and certification of wireless IoT devices

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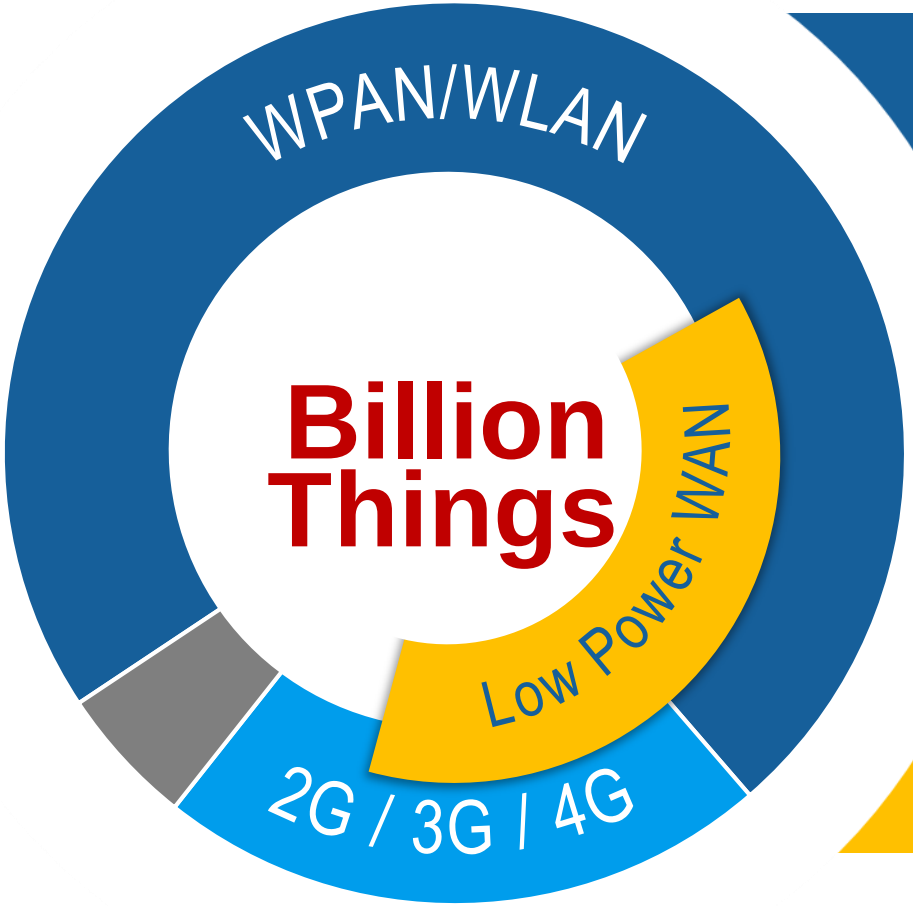
Connecting Billions of Devices to the Internet of Things (IoT)



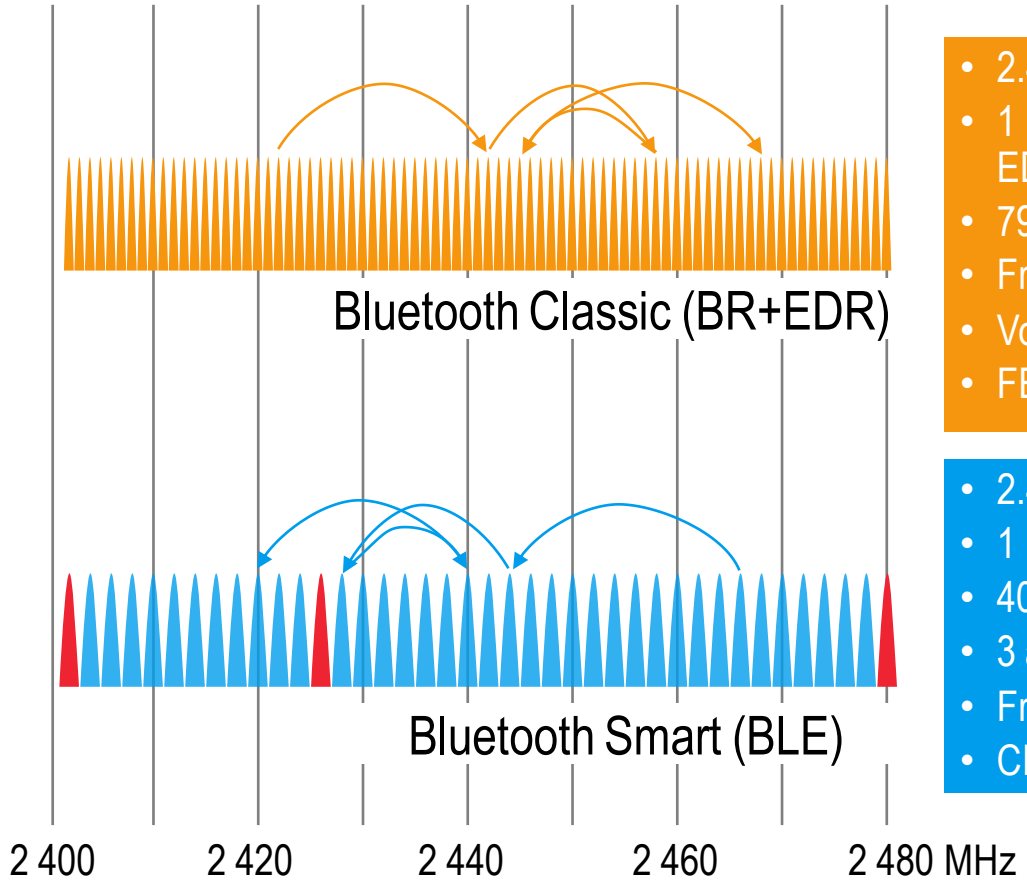
Wireless PAN/LAN
Bluetooth, Zigbee, Thread, WiFi

Wireless WAN (2G/3G/4G)
GSM, CDMA, UMTS, LTE

OTHER technologies
Satellite, DSL, Fiber, PLC

Low Power WAN
Sigfox, LoRa, Weightless, NB-IoT

Bluetooth Classic and Bluetooth Smart serving the wearable market



- 2.4 GHz ISM band
- 1 Msymbol/s using GFSK modulation
  EDR: Data modultation π/4-DQPSK / 8DPSK
- 79 Channels on 1 MHz spacing
- Frequency Hopping (1600 hops/s)
- Voice support
- FEC

- 2.4 GHz ISM band
- 1 Msymbol/s using GFSK modulation
- 40 Channels on 2 MHz spacing
- 3 advertising channel
- Frequency Hopping (37 channel)
- CRC

Bluetooth®

Bluetooth® SMART

Bluetooth SIG focuses 2016 on enhancements for the Internet of Things (IoT)

Mesh

building meshed network using relay nodes

Speed

100% improvement for low latency applications

Gateway

Connecting devices directly to the cloud

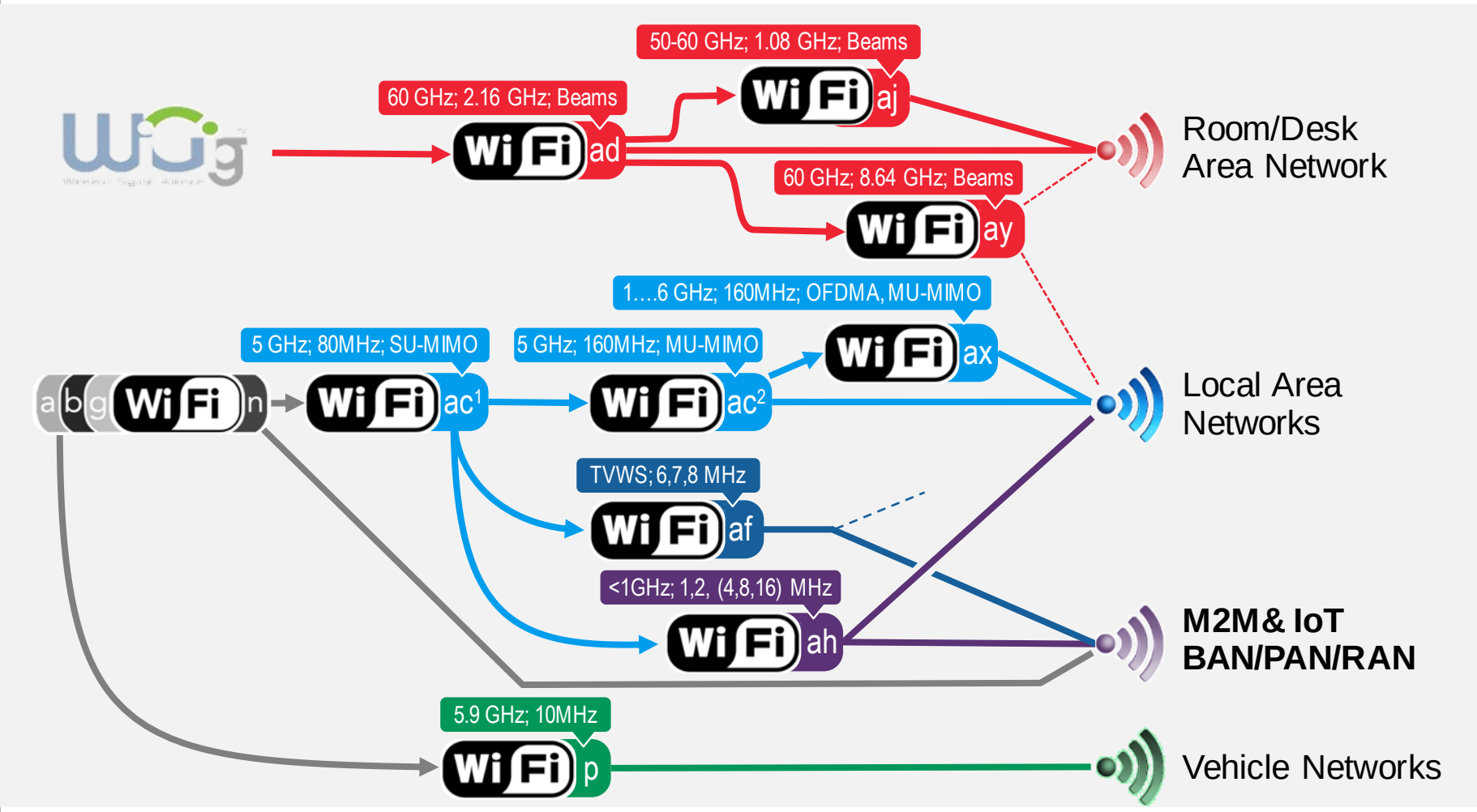
Range

4x range to cover a smart home or office

Direction

Extended capabilities of beacons for positioning

Wi-Fi adoption beyond Local Area Networks



802.15.4 – for smart home , smart buildings and more

ZigBee	THREAD / 6LoWPAN	ISA100	WirelessHART
ZigBee - Protocol	Protocol (e.g. CoAP)	ISA Protocol	HART: Protocol
ZigBee - Transport	UDP/TCP	UDP	HART: TCP like
ZigBee - Networking	6LoWPAN, DTLS, Distance Vector Routing	6LoWPAN	HART Addressing/Routing
802.15.4 MAC	802.15.4 MAC	Upper data link ISA100 802.15.4 MAC	HART TDMA - hoping
IEEE 802.15.4 2.4 GHz ◆ O-PQSK	**IEEE 802.15.4 2.4 GHz ◆ O-PQSK**	**IEEE 802.15.4 2.4 GHz ◆ O-PQSK**	**IEEE 802.15.4 2.4 GHz ◆ O-PQSK**

Sigfox Communication Principle (Europe) - 99% Uplink Traffic

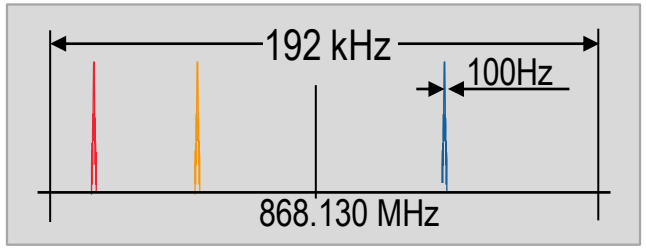
Uplink (Sensor ⇨ Cloud)

Rate: 100 bps (600 bps in the USA)
Modulation: (D)BPSK
Power: < 25mW

Downlink (Cloud ⇨ Sensor)

Rate: 600 bps
Modulation: 2GFSK
Power: < 500 mW

- Duty Cycle 1%
  ⇨ 36s transmission time per hour
- 12 Byte Payload + 13 Byte Control per message
- Each message send on 3 different channels (pseudo random hopping)
- 3 x 25 Byte x 8 Bit / 100 bps
  ⇨ 6 s air time per message
  ⇨ max 6 Messages per hour!



Object (Sensor)

~2sec ~2sec ~2sec

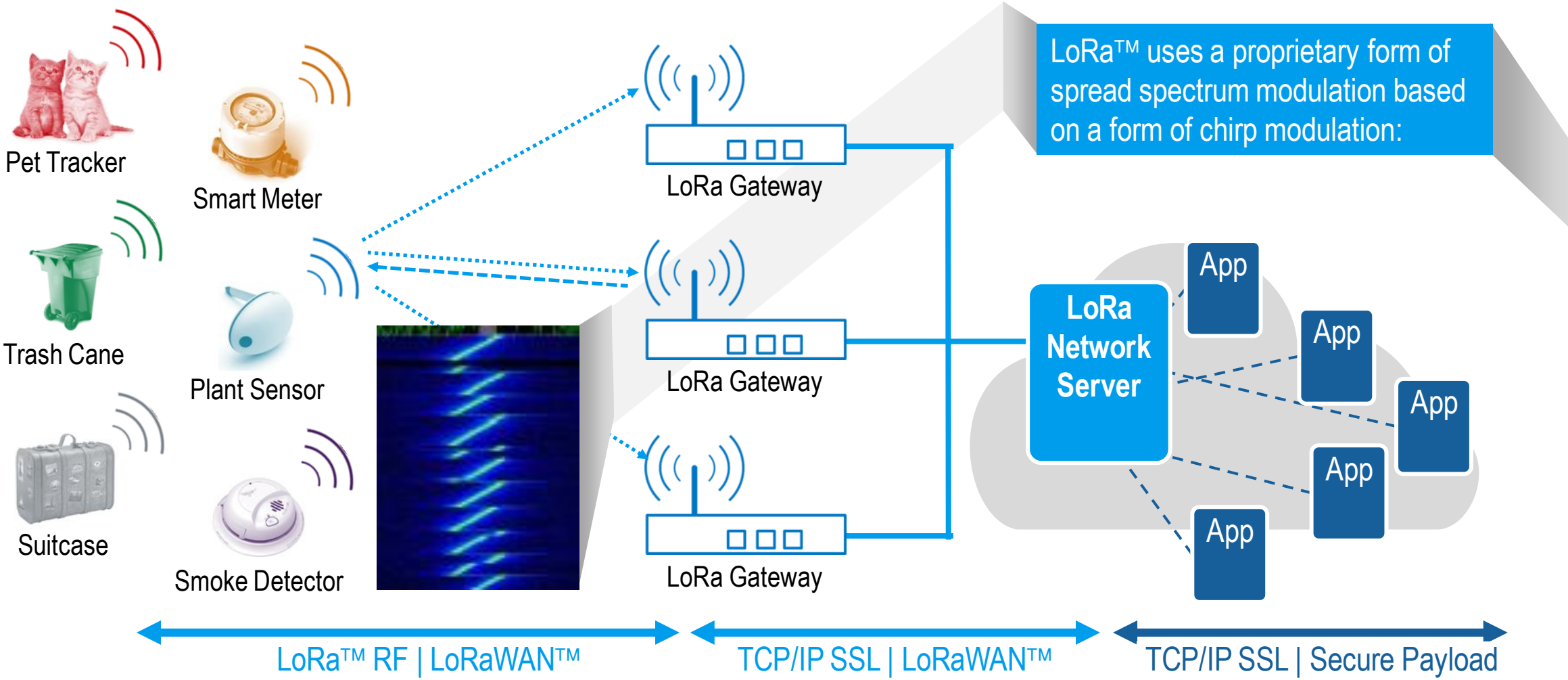
Base Station

Backend Server

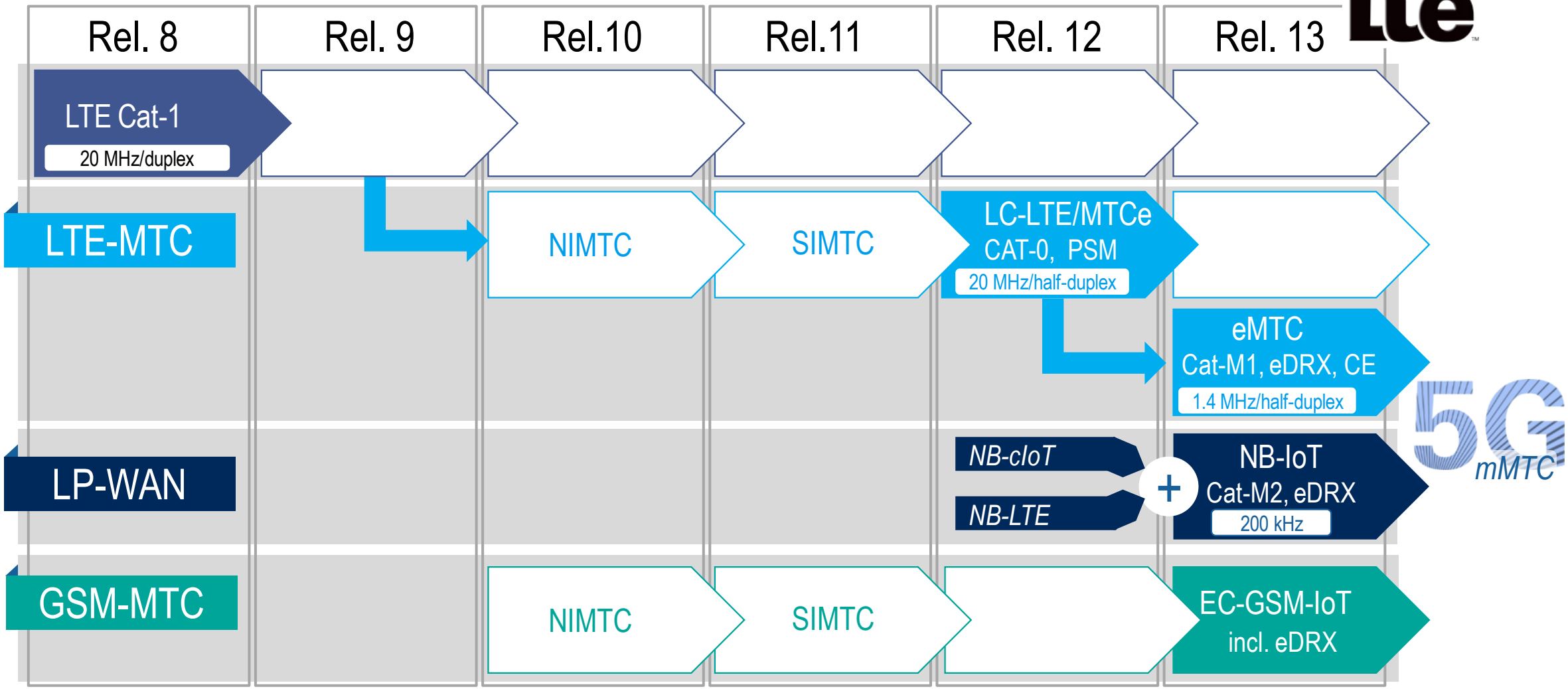
Tx Power:
< 25 mW (14 dBm)

Rx Sensitivity:
- 142 dBm

LoRaWAN™ Network architecture



3GPP IoT standardization on the way to 5G



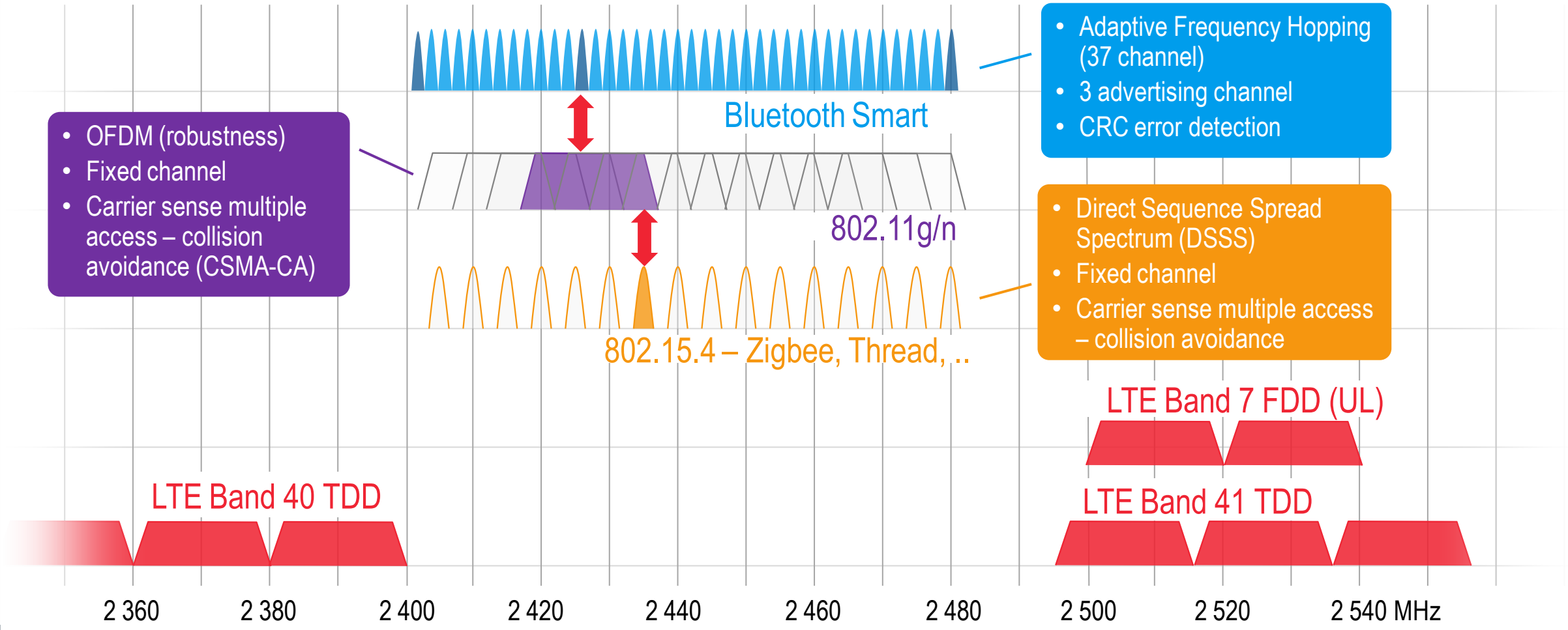
Testing in all phases of life cycle of IoT devices and networks

Research & Development	Design & Validation	Pre-Compliance & Compliance	Manufacturing	Deployment & Operation	Service & Repair
▌Digital and analog interface debug ▌Clock Analysis ▌EMI debug ▌Power Analysis	▌RF Parametrics ▌Co-existence ▌Functionality ▌Performance ▌Power analysis	▌Standard compliance ▌Regulator compliance ▌Carrier Acceptance	▌Calibration ▌Verification ▌Go / NoGo	▌Installation ▌Monitoring ▌Optimization	▌Fault Finding ▌Calibration ▌Verification

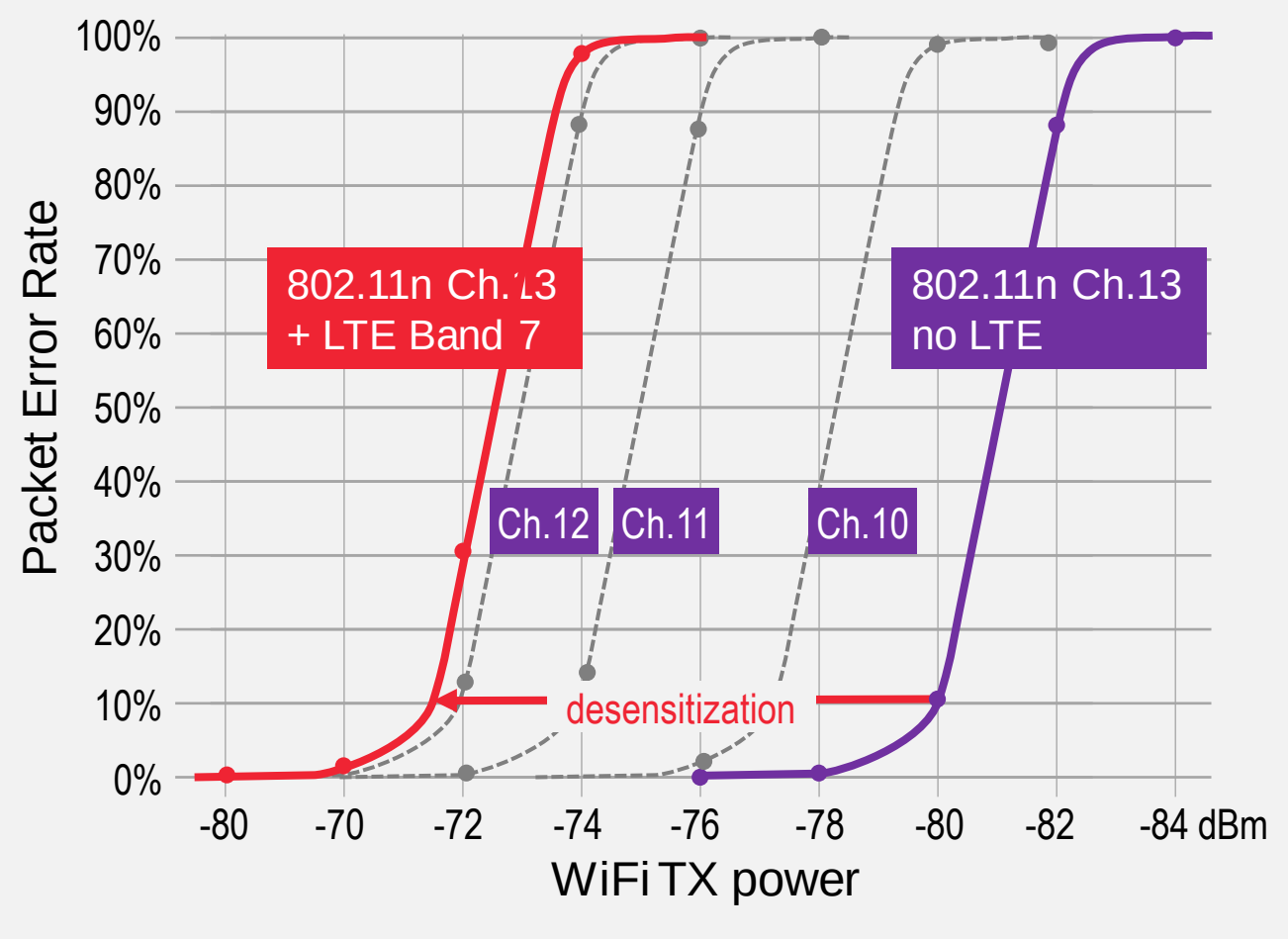


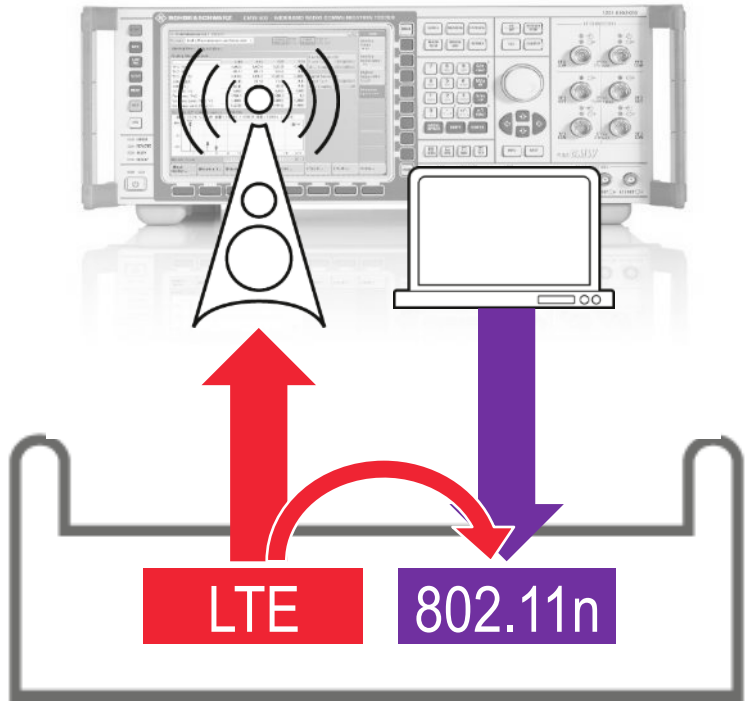



2.4 GHz ISM band – Home Environment (Home Gateway)

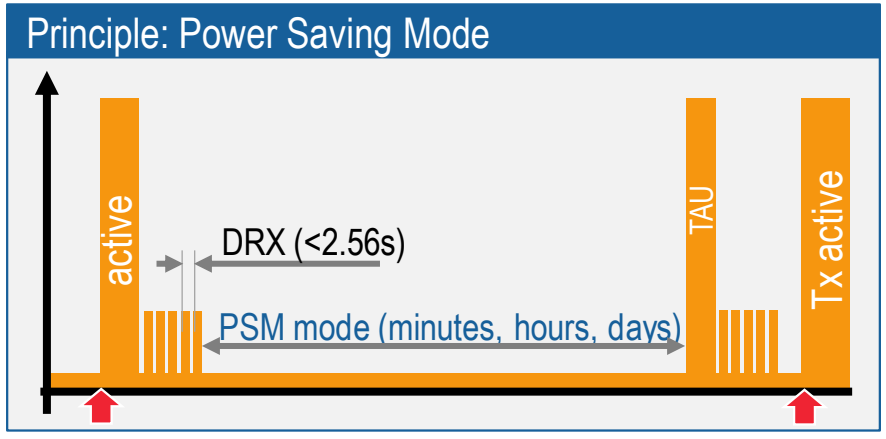


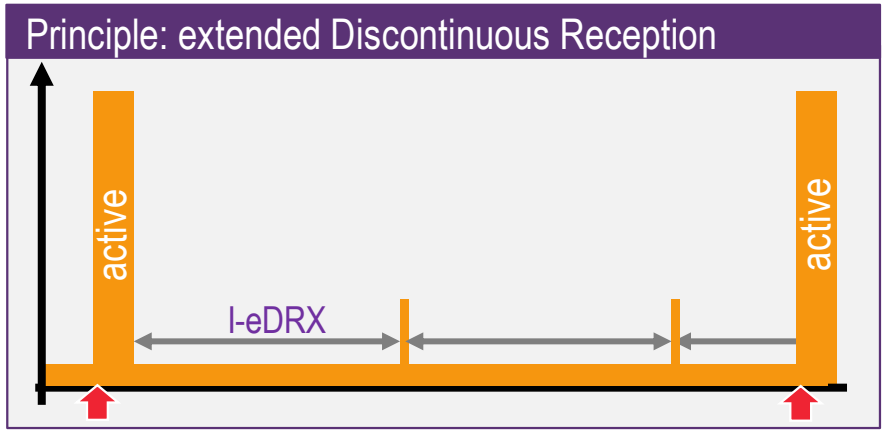
In-Device Interference measurements with R&S®CMW500

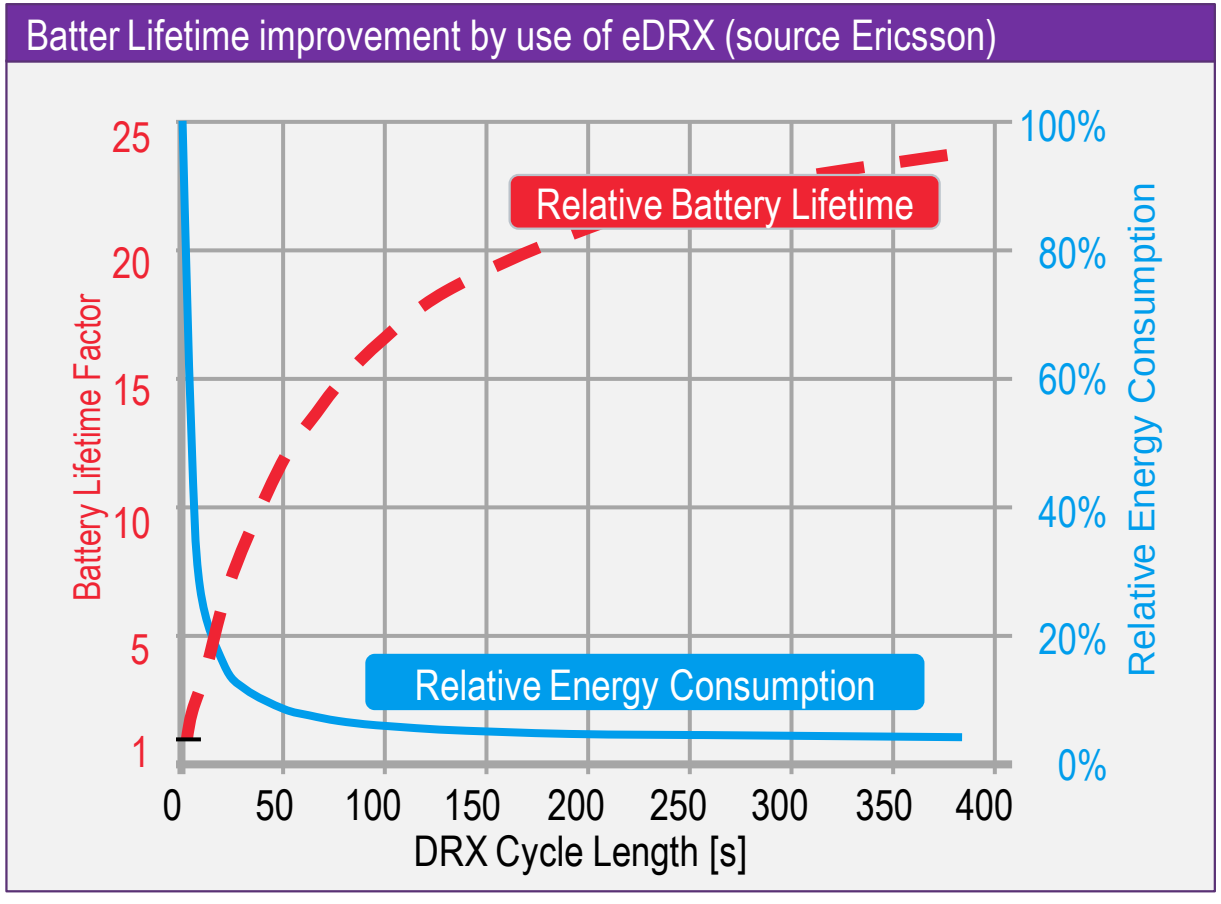




Two possible methods to save power:
Select the best one and define the optimal parameter!







End-to-end IoT Application Testing: Detailed view on all relevant aspects under reproducible network conditions

IoT Device

- IoT Application
- Comm. Module

Mobile Network

- Extended Access Barring
- Power Saving Mode
- Extended DRX cycle

IP Network

- Throughput
- Delay, Jitter
- Loss

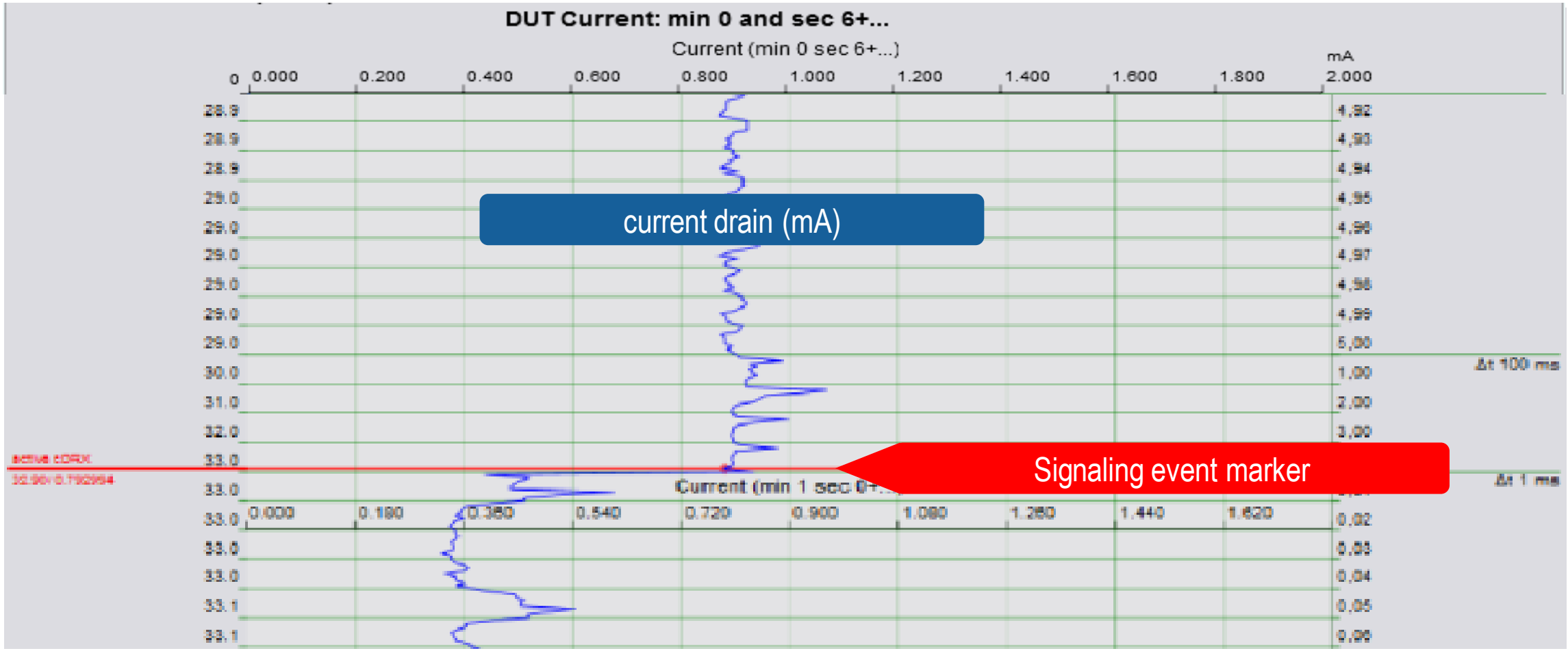
IoT Server

- IoT Application
- Service Platform

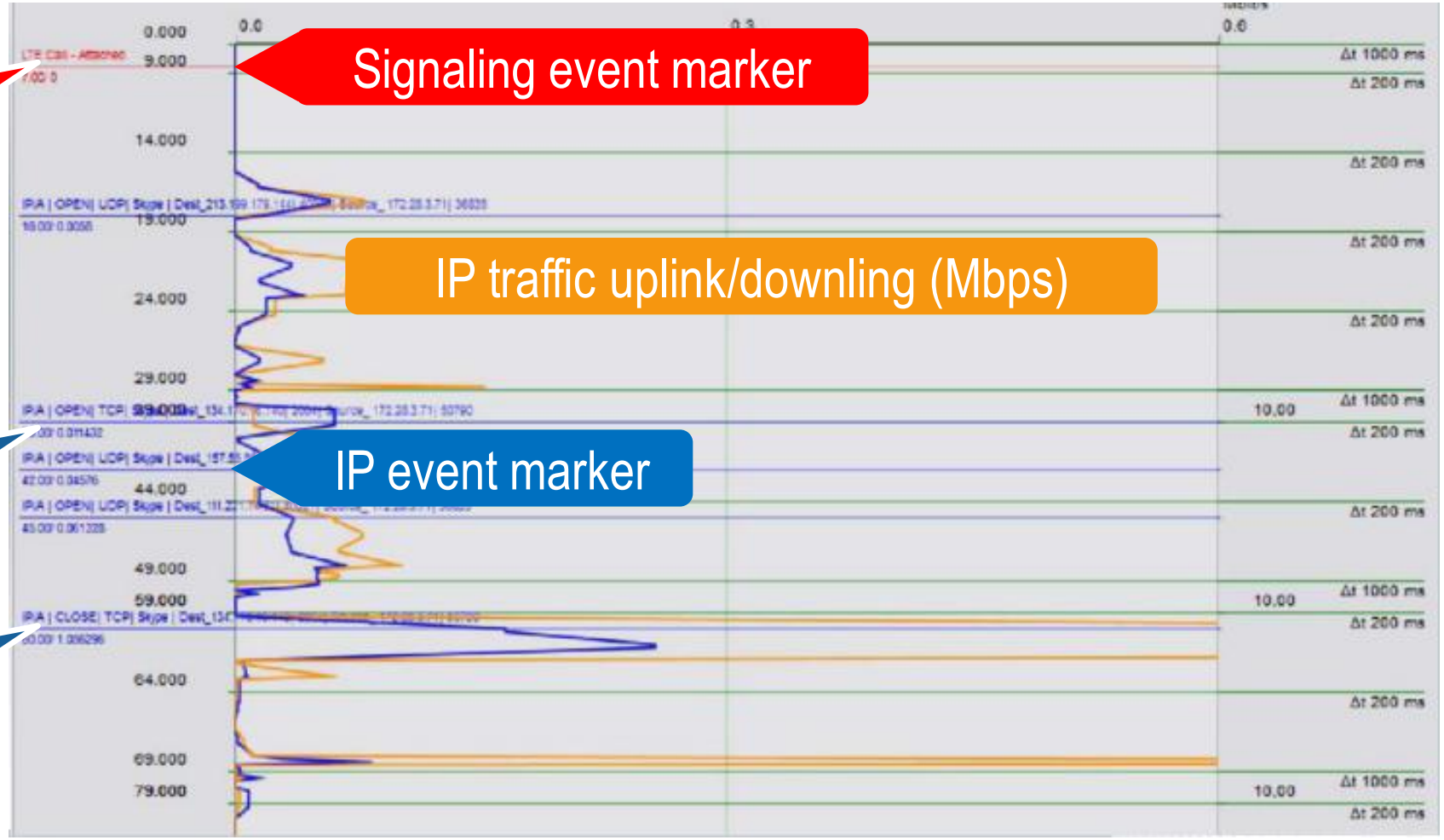
- Event initiated comm.
- Server initiated comm.
- Periodic communication

- Responsiveness
- Acknowledgement
- Protocol impact

R&S CMWrun – current drain monitoring



R&S CMWrun – IP Traffic Analysis



Your Partner in testing the Internet of Things

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