ITU: Session on ICT products – Gateways to Digital Transformation
Conformance and Interoperability Challenges for developing countries

# Ensuring reliable and secure communication in a hyper-connected world

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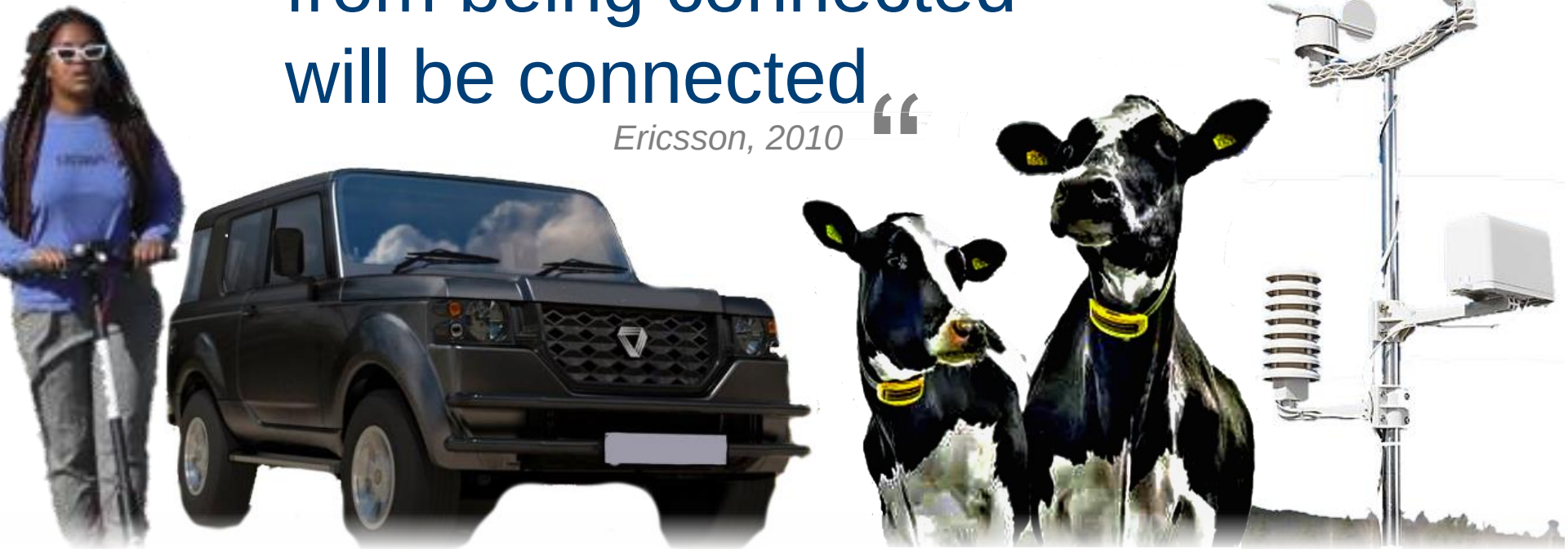
Make ideas real

# “Everything that will be benefit from being connected will be connected”

*Ericsson, 2010*



# IoT enabling applications in developing countries

Real-time data for Immunization


GSM powered water monitoring


Remote solar power solution w/ IoT

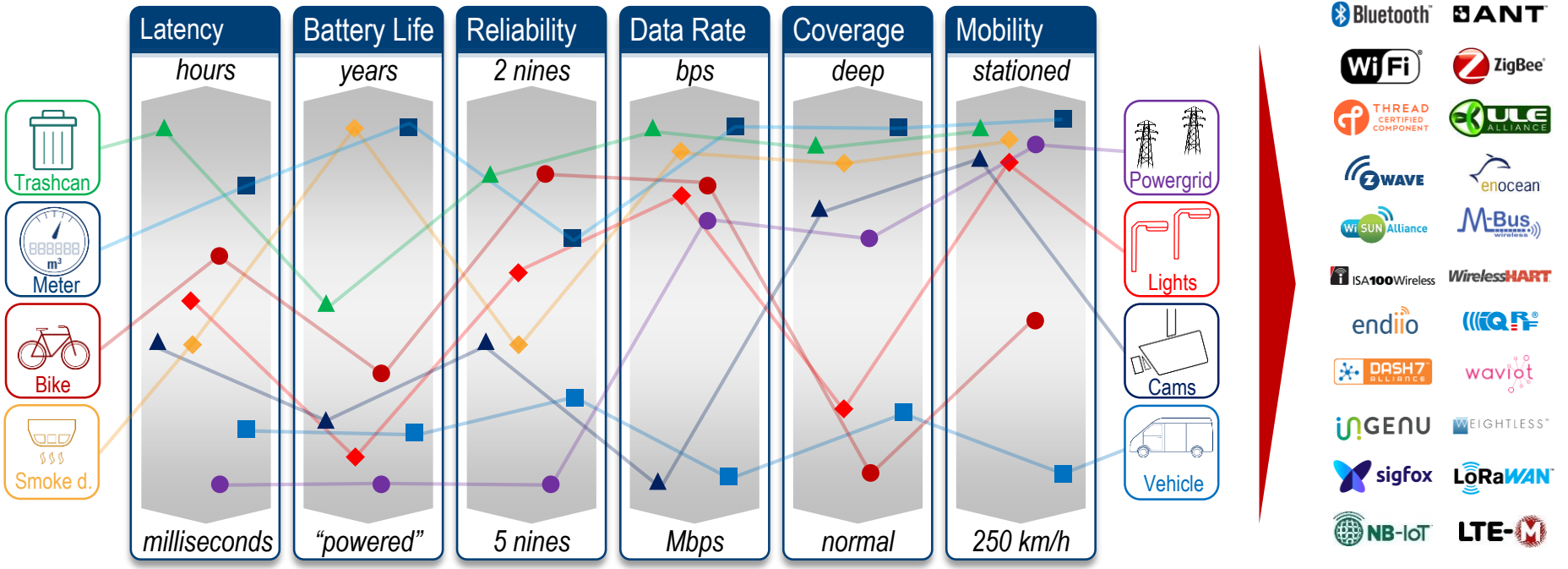

Cattle tracking and monitoring


requiring cost-efficient, reliable and secure wireless communication

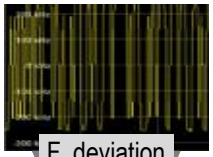
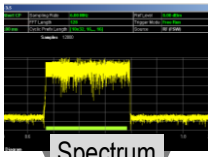
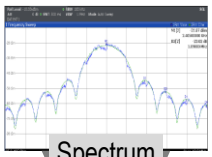
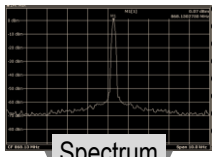
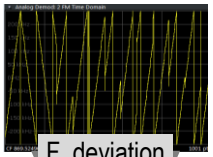
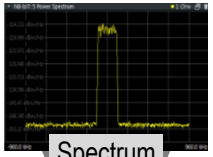
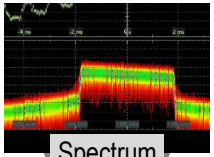
# Challenges in wireless IoT design



# Different requirements have led to a large variety of technologies

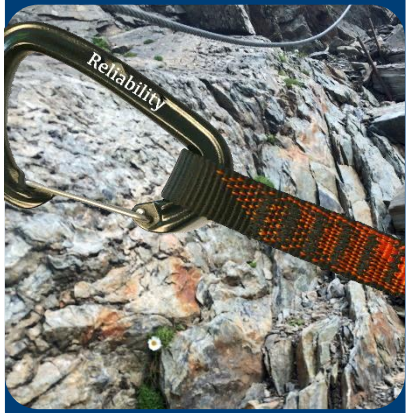


# Selection of wireless technologies most relevant for IoT

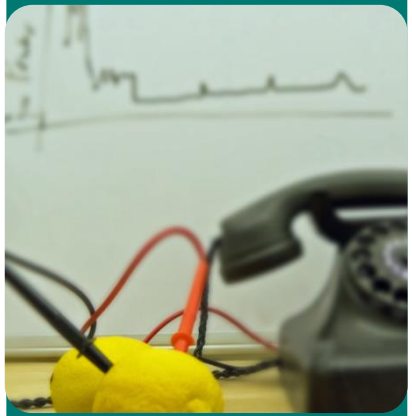
| | Bluetooth Low Energy | Wi Fi ax | ZigBee THREAD | sigfox | LoRaWAN | NB-IoT | LTE-M |
|---|---|---|---|---|---|---|---|
| **Technique** | FHSS | OFDMA | DSSS | UNB | CSS | OFDMA | OFDMA |
| **Modulation** | GFSK | BPSK<br>QPSK | O-QPSK | UL: DBPSK<br>DL: GFSK | Frequency Chirps | BPSK<br>QPSK | QPSK<br>16QAM |
| **Bandwidth** | 2 MHz | 20 …<br>160 MHz | 2 MHz | 100 Hz (ETSI)<br>600 Hz (FCC) | 125, 250,<br>500 kHz | 3.75,15 kHz<br>180 kHz | 1.4 MHz (M1)<br>5 MHz (M2) |
| **Spectrum** | 2.4 GHz<br>ISM | 1.. 6 GHz<br>ISM | 2.4 GHz<br>ISM | Sub-GHz<br>ISM | Sub-GHz<br>ISM | < 6 GHz<br>3GPP | < 6 GHz<br>3GPP |
| **Characteristics** |  F. deviation |  Spectrum |  Spectrum |  Spectrum |  F. deviation |  Spectrum |  Spectrum |

# Embedded design challenges to meet specific IoT requirements

Quality & reliability

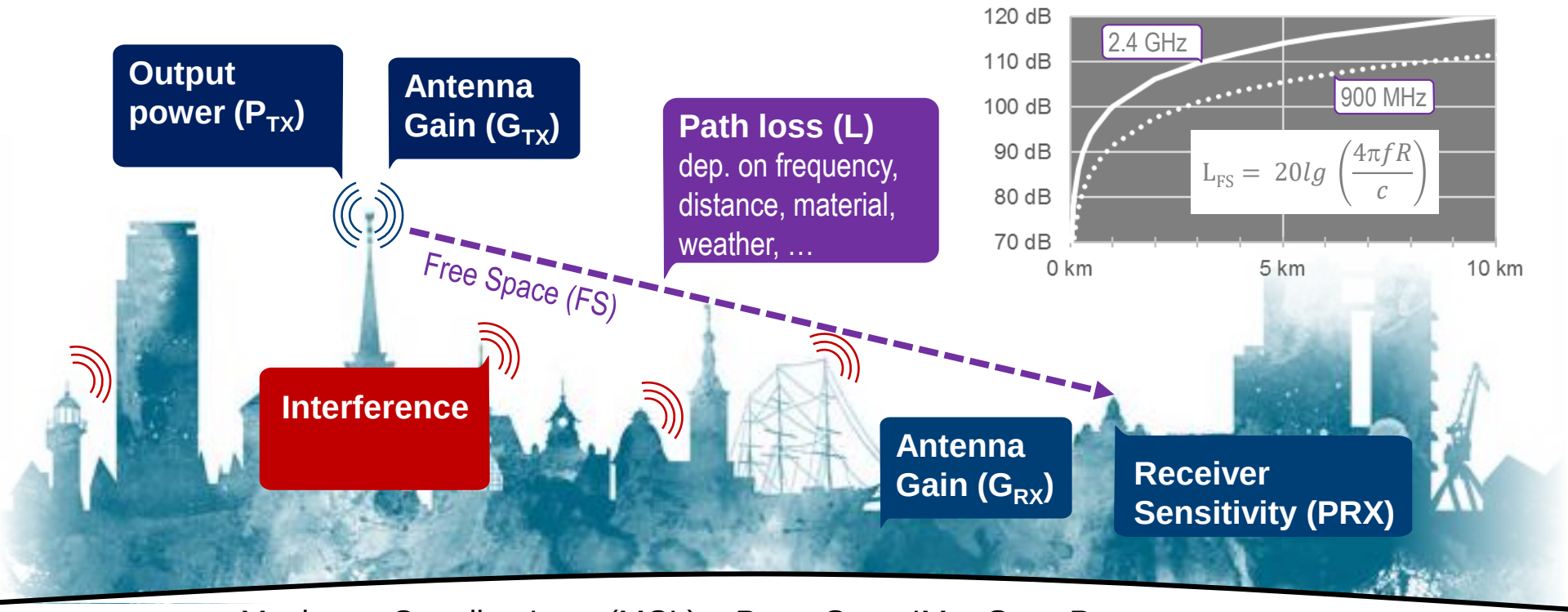



Low power



Deep coverage

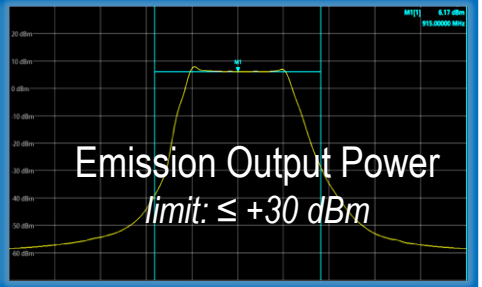
# Wireless communication - a wonder, but essentially just physics

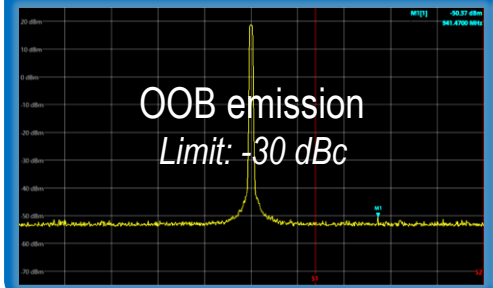



Maximum Coupling Loss (MCL) = $P_{TX} + G_{TX} - IM + G_{RX} - P_{RX}$

# Example LoRa Certification – Tx measurements

## FCC 15.247 for Systems Employing Digital Modulation

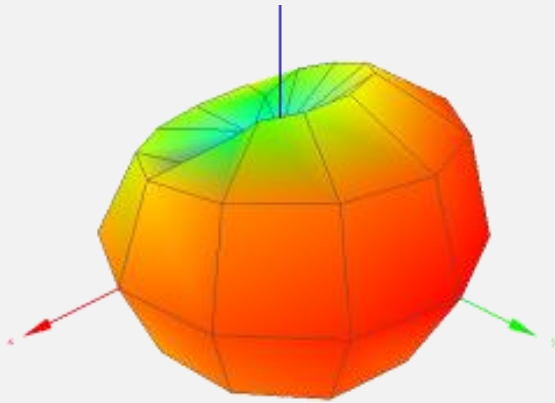





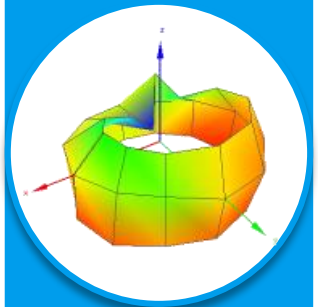
## LoRa Alliance RF performance guideline

$$TRP = \frac{1}{4\pi}\oint[(EIRP_{\phi}(\Omega, f) + (EIRP_{\theta}(\Omega, f)]\ d\Omega$$



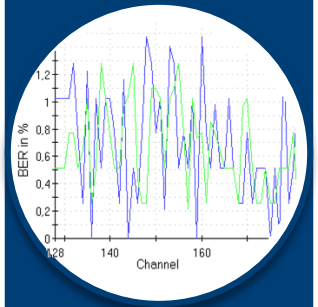
# OTA measurements, that help to ensure the desired performance and compliance with regulation

## Performance



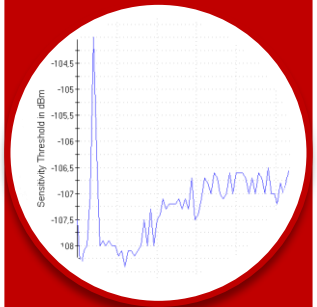
*Measurement of radiated RF power (TRP) and receiver sensitivity (TIS/TRS)*

## Coexistence



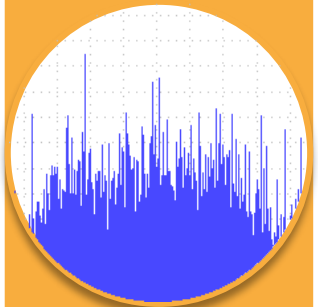

*Assessment of the interference of one wireless technology on another*

## Desense



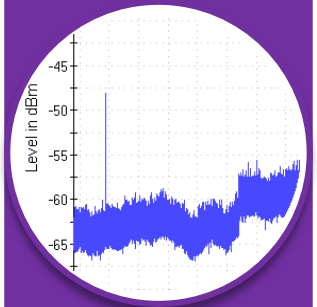

*Self-interference test by measuring error rates with an active potential interferer*

## EMI



*Detection of EMI sources with a receiver performing a frequency sweep*

## Spurios Em.




*Measurement of radiated spurious emissions (RSE) in- & out-of-band*

OTA performance verification in R&D, Integration, Production and Service/Repair

# Heavy use of ISM bands by different technologies asks for regulation e.g. by ETSI and FCC

Different technologies

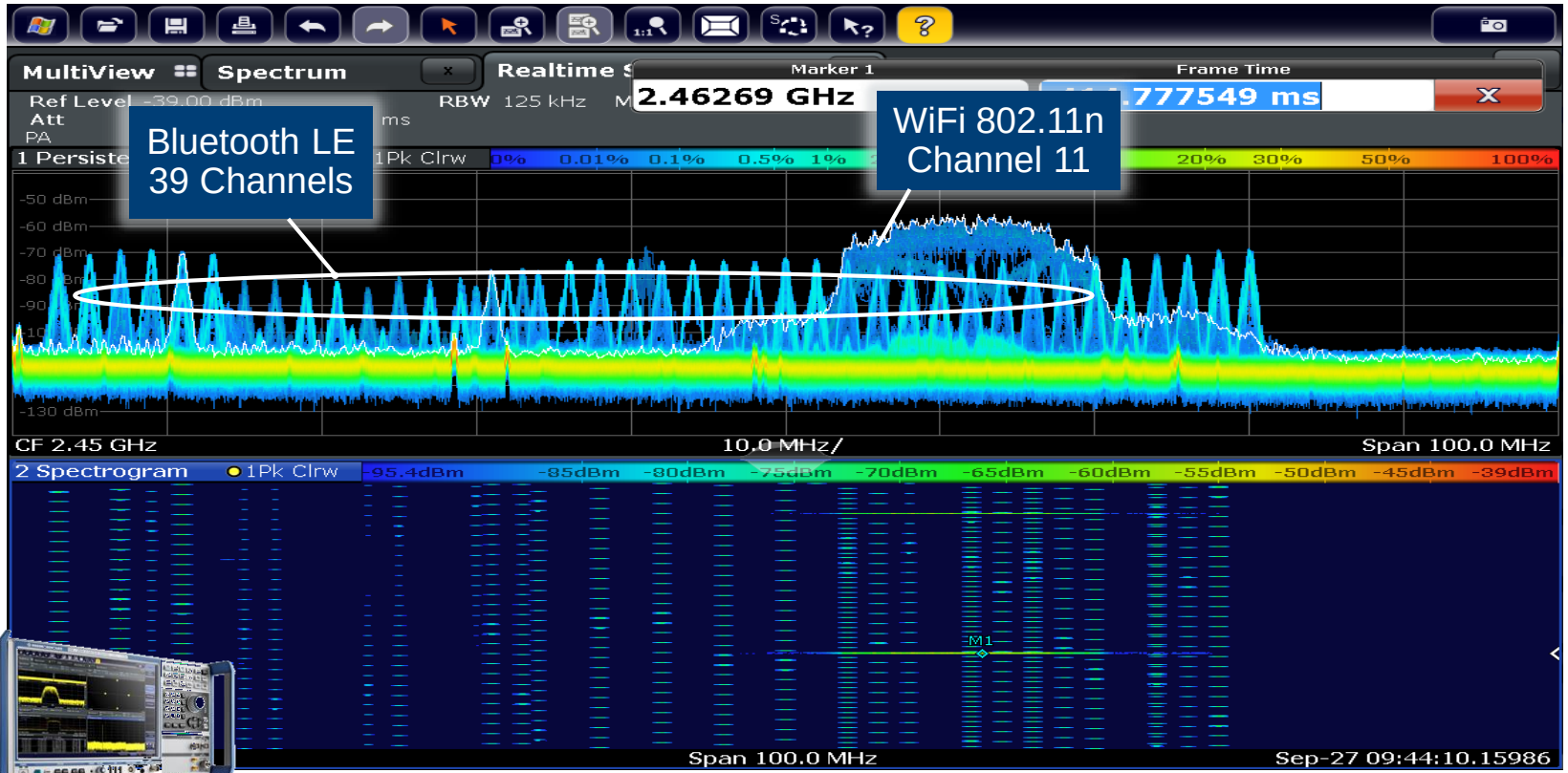

Density of networks

No network control

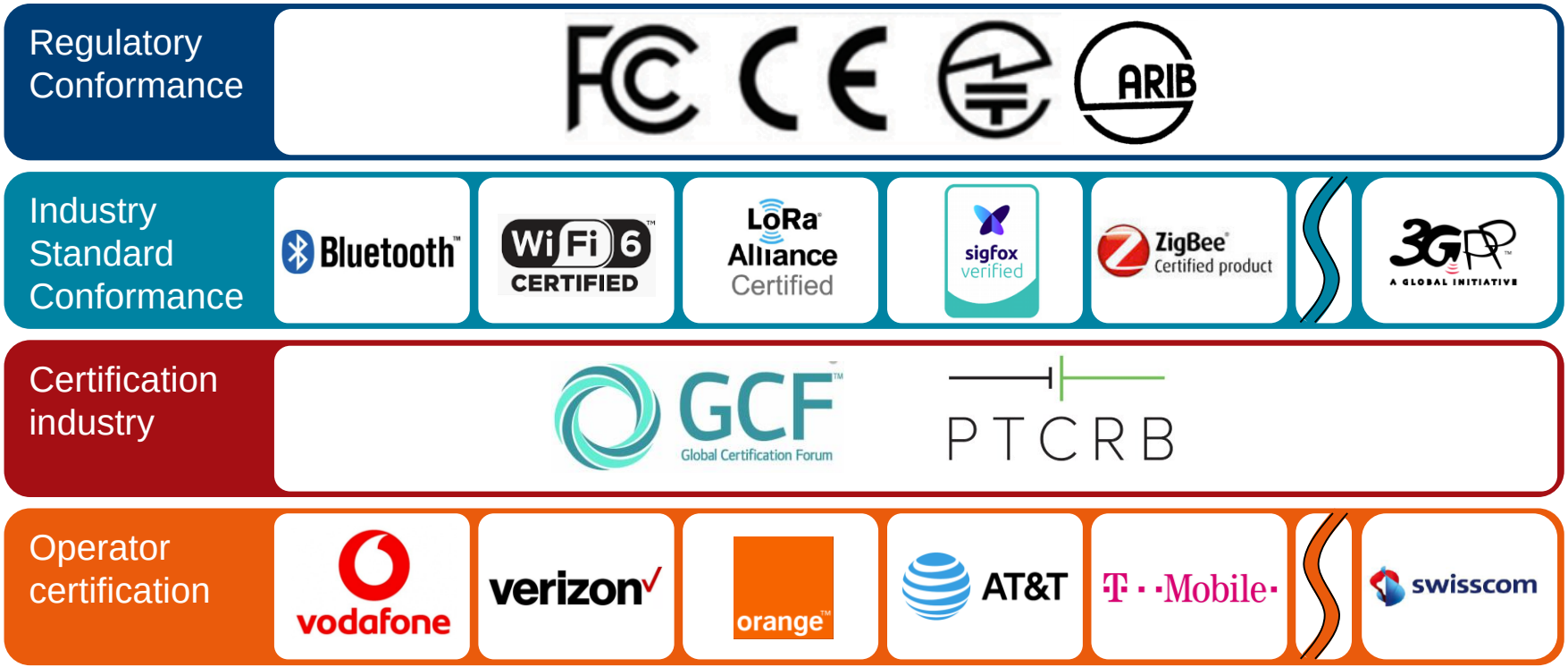
Ensure coexistence of different services/technologies operating in the same frequency band

ETSI EN 300 328 V1.8.1/ V1.9.1 (2.4 GHz) and ETSI EN 301 893 V1.7.1/ V1.8.1 8 (5GHz)
FCC §15.247 (2.4 GHz & 5.8 GHz) and FCC $15.407

# Real-time spectrum analysis to analyze interference issues



# IoT certification landscape



# Industrial Internet of Things creates a magic triangle

**New applications**


Need for new or adapted certification schemes

# The impacts of ‘unsecure’ IoT devices could be devastating

Impacts on IoT devices and services

*Impacts on IoT services und users*

- Take over control
- Steal information
- Ransom demand
- Disrupt IoT services
- …

Use of hijacked devices

*Impacts on critical infrastructure*

- Distributed denial of service attacks
- Distributed cyber-physical attacks
- …

**Need for security certification?**

# Together, we shape the future of security and communications to enable a safer and connected world