WELCOME TO LoRaWAN LIVE

TECHNICAL TRACK 2.00PM – 6.00PM

BERLIN, JUNE 13, 2019

LoRaWAN®

Creating Valuable IoT Connections

Take your LoRaWAN® project to the next level with LoRa devices from Bosch

Reiner Schmohl

Bosch Connected Devices and Solutions GmbH

LoRaWAN®

Creating Valuable IoT Connections

Agenda

1. Bosch Connected Devices and Solutions GmbH
2. Cross Domain Development Kit (XDK)
3. XDK LoRa-Extension
4. TRACI
5. Parking Lot Sensor (PLS)

1. Bosch Connected Devices and Solutions GmbH

About the company:

- IoT startup
- 4 domains (connected mobility, -logistics, industry 4.0 and cross domain)

Why we use LoRaWAN® technology:

- Wireless and secure
- Robust and over long distances communication solution
- Bandwidth adjustment and adaptive data rate
- Private and public networks can be joined

2. Cross Domain Development Kit (XDK)

Embark on the Journey to IoT Applications with Bosch as your Partner

XDK 110

Single box XDK, a universal IoT programming platform

XDK Node

Professional Bundle, box of 10 XDKs to implement small batch, cost-efficient applications

Solution Sets

Jump right into IoT use cases with Bosch and partner-made solution sets

Rapid Prototyping

Small Series Application

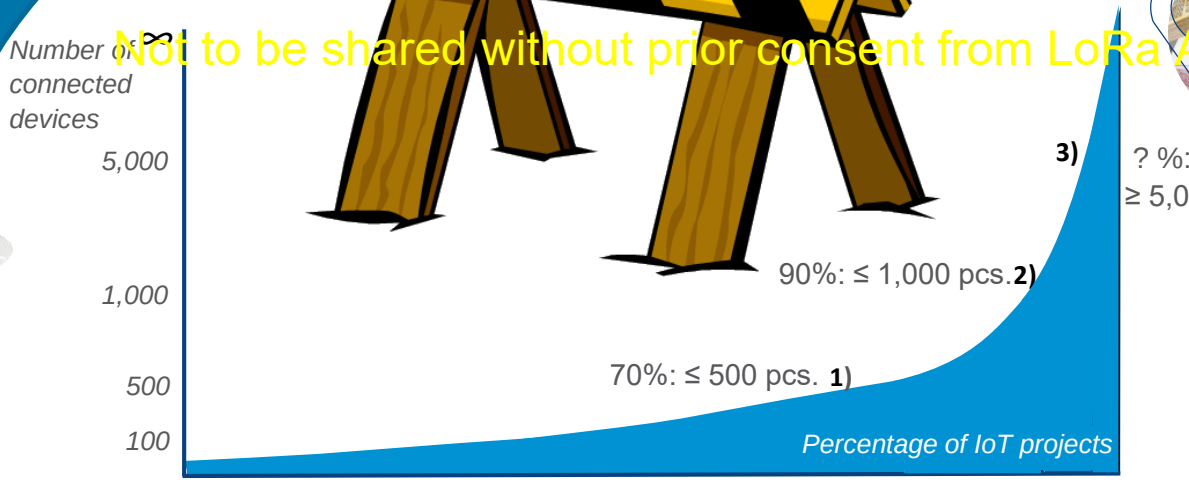
Ready-to-use scalable applications

2. Cross Domain Development Kit (XDK)
Strategy – IoT Customer Barrier

XDK based

Prototype

Derived Product Development Customer funded



2. Cross Domain Development Kit (XDK)

The universal, freely programmable smart sensor

- All in one sensor platform: hardware, software, community
- Connectivity via BLE and WiFi
- 32-bit microcontroller ARM Cortex M3
- Rapid prototyping, with Mita you don't need C-development skills
- No limitations thanks to extension board adapter

2. Cross Domain Development Kit (XDK)

The Swiss Army Knife of IoT sensoric

MEASURING RANGES

- Accelerometer: ±2 … ±16 g (programmable)
- Gyroscope: ±125 º/s … ±2000 º/s (programmable)
- Temperature: -20 ºC ... 60 °C
- Pressure: 300…1100 hPa
- Humidity: 10…90 %rH
- Magnetic field strength: ±1300 µT (X,Y-Axis); ±2500µT (Z-Axis)
- Light sensor: 0.045 lux … 188,000 lux ; 22-bit

SAMPLING RATES

- Accelerometer: BMA280 2000 Hz
- Gyroscope: BMG160 2000 Hz
- Magnetometer: BMM150 300 Hz
- Hum./press./temp.: BME280 182 Hz
- Inertial measuring unit : 1600 Hz (Accelerometer); BMI160 3200 Hz (Gyroscope)

- All-in-one sensor kit: No component selection, hardware assembly, or provision of a real-time operating system required
- Functional expandability through the included expansion board
- USA, CAN, AUS, MYS, MEX, SGP, BRA, PHL, CHN, THA, JPN, IDN, KO

2. Cross Domain Development Kit (XDK)
Potential use cases

Monitoring Motor Temperature:

- PT1000 + XDK Ext. board + XDK + PMP installed, to monitor temperature of motors
- Exchange motors during planned downtime predictively, if temperature is rising
- Improved OEE, Reduced labor cost, Avoidance of special freight, Reduced (TEB) cost per unit

Measure current with the LEM-Extension:

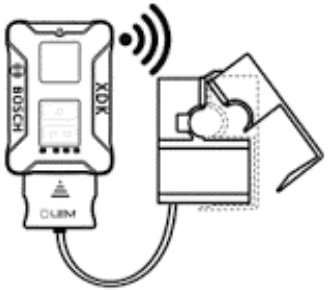
- Innovative, accurate, reliable, easy-to-install, non-intrusive current sensing
- for predictive maintenance applications in any use case
- Visualize the data via the Virtual XDK App

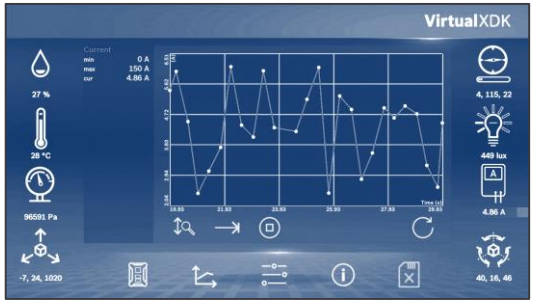
PT 1000 measuring temperature

XDK Extension Board
Temperature Sensor (ADC)

XDK

BOSCH PPM





3. XDK LoRaWAN® Extension
Sense – Think – Connect - Act

Connect your XDK to a LoRaWAN® Network
Public and Private LPWANs can be joined or created

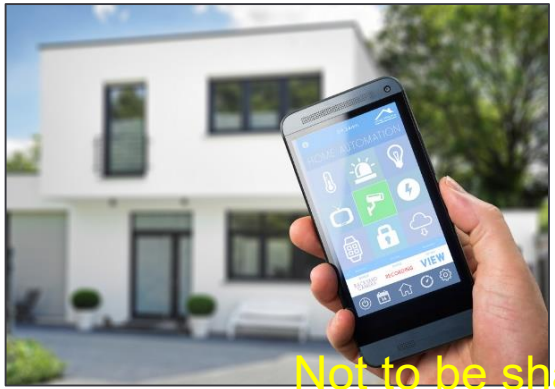
Exchange your data up to a range of several km, even through walls and buildings

Saves energy and ensures a long battery lifetime

Easy integration of all collected sensor-data from the XDK into your preferred backend, e.g. Cayenne, TTN

Pressure Sensor | Temperature Sensor | Acoustic Sensor | Humidity Sensor | Magneto-meter | Light Sensor | Gyroscope | Accelero-meter

3. XDK LoRaWAN® Extension
Potential use cases



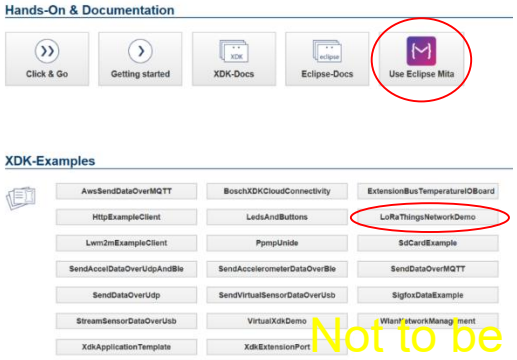
Home and building automation
Meeting room
21°C

Supply chain management
Spare part arrived

Industrial monitoring and control
Bearing experiencing excess wear

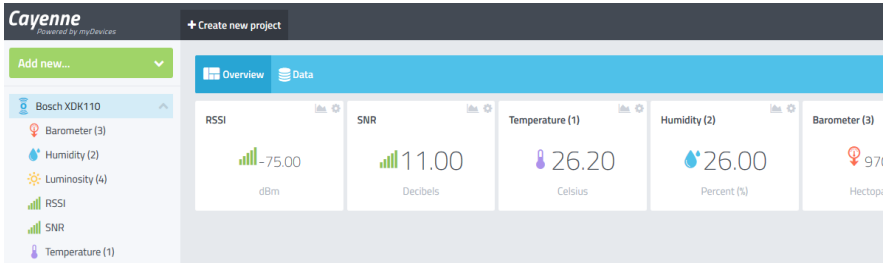
Smart city
Fine dust alert

3. XDK LoRaWAN® Extension
How to get started?



XDK workbench

- Flash XDK with LoRaThingsNetworkDemo
- Programmable with Mita



XDK sensors

- Address all 8 XDK sensors

Integration into backend

- Easy integration of all collected sensor-data from the XDK into your preferred backend, e.g. Cayenne, TTN
- Visualization of your data

4. TRACI
Tracking and monitoring in construction

Long Range Wide Area Network & Bluetooth

Very robust housing, designed for harsh environments : IP 69K

3-10 Years of battery life due to LoRaWAN® and smart algorithms

Alerts: Accident, maintenance, geofence, temperature

Equipment search time reduction
Operating Hour Counter
Lower costs, increase productivity

Shock

Magnetometer

Temperature

GPS

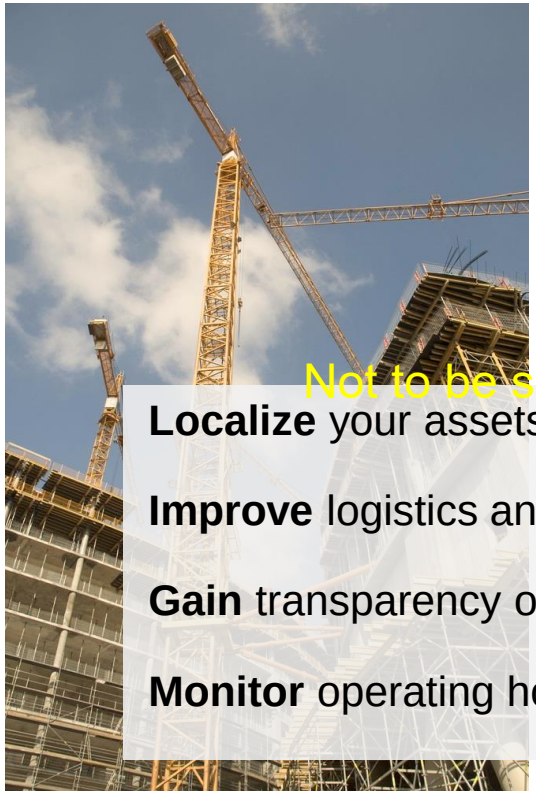
4. TRACI
Potential use cases

"We need to know where our assets are and if they are in use. This helps planning our daily work!"

"My fleet capacity is limited. I cannot afford having machines standing around unused!"

"Everybody is talking about digitalization but the topic stays really difficult to grasp for me!"

4. TRACI
Main advantages

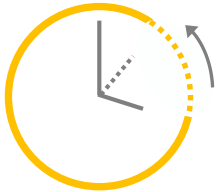


Localize your assets, equipment and vehicles

Improve logistics and processes in your daily work

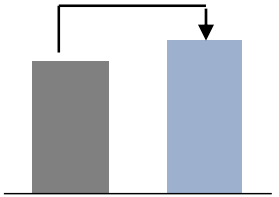
Gain transparency of asset usage and idle time

Monitor operating hours, vibration and temperature



"…equipment search time reduction >80%..."

"…avoiding permanent loss of implements & equipment..." (approx. 10% over time)



"… overall productivity increase of building process of up to 16% ..."

4. TRACI
How to get started?

- Mount the device on the asset, vehicle, machine, equipment or building material you want to monitor
- To activate TRACI simply remove the magnetic bar
- Multiple data access:
  - via mobile device apps
  - via web user interface
  - application interfaces to your ERP System
  - application interfaces to your software integrator

5. Parking Lot Sensor (PLS)

Bring your traffic concept to the next level

LoRaWAN® communication with gateway, range of up to several km

Enablement of new parking features such as searching, navigation and reservation

Detection and reporting of parking space occupancy

Battery life time up to 5 years

Magnetometer

Radar

5. Parking Lot Sensor (PLS)

Potential use cases

eCharging

Time between parking and un-parking events is calculated using sensor notifications, when a specific limit is reached illegal users can be charged

Autonomous car parking

System reserves and notifies the self-driven car for a free parking spot based on sensor data

Reducing congestion in the city

Mobile application like Google Maps could display the available parking spaces

Search time reduction

5. Parking Lot Sensor (PLS)

How to get started?

1. Prepare

2. Clean

3. Apply

4. Glue

- Request your PLS now
- Installation takes less than 2 min. per sensor
- No calibration needed at all, completely self calibrating

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@LoRaAlliance

linkedin.com/company/loraalliance/

marcom@lora-alliance.com

lora-alliance.org

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LoRaWAN® MODULE FOR MASSIVE INTEGRATION

LoRaWAN®

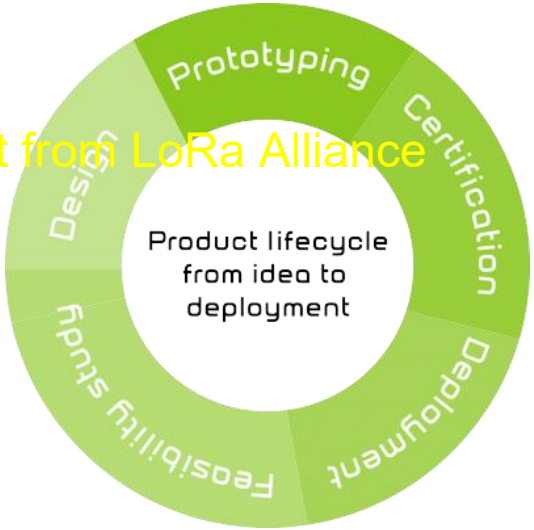
Creating Valuable IoT Connections

Agenda

- Embit, Who We Are
- IoT Everywhere
- IoT Everywhere Next Step: Massive Integration
- Massive IoT
- Develop your own LoRaWAN® IoMe solution
  - First Prototype
  - Design your LoRaWAN Solution
- Conclusion
- Q&A session!
  -

Embit, Who We Are

- Embit was born in Modena (Italy) in 2004
- Development of innovative ideas and Wireless Solutions
- Embedded Wireless Module
- Strong RF Know-How
- Microchip Partner
- LoRa Alliance™ Member since 2016



IoT Everywhere

Everything surround us will be smart and connected!

The Fridge will remember us

to buy the dinner

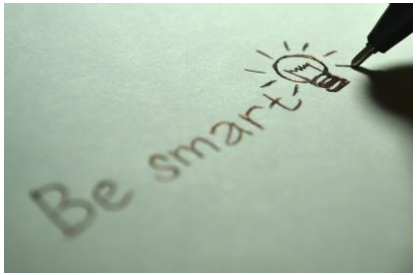
Our Plants will suggest us

the best moment

to water them

Lights will know

when staying On or Off



IoT Everywhere Next Step: Massive Integration

- IoT is going to be part of our lives
- IoT is going to be part of us!
- Massive Integration: from Internet of Things bringing people into **Internet of Me** [1]

IoT Everywhere Next Step: Massive Integration

- Massive Integration: **Internet of Me**[1]
- **People**-centered
- Changing **life**-style
- Improvement of the **Quality-of-Life** (**QoL**)
- Wearable Devices
  - Wrist-Fitness Tracker
  - Health-Care Monitoring
  - Wellness and Fashion

IoT Everywhere Next Step: Massive Integration

- Wearable IoT devices' technical challenges:
  - **Small form factor, size matters!**
  - **Wireless Connectivity**
  - Low power
  - Security

Massive IoT: Small Form Factor

- **Embit's purpose is to create the smallest LoRaWAN® module on the market**
- **Size today**: 11.5x11.5 mm, smaller than 1 cent
- Minimize size and routing while improving connectivity: U.FL
- Antenna tuning at 50 Ω
- 17 digital I/O

EMB-LR1276S

Massive IoT: Wireless Connectivity

- **The smallest LoRaWAN® module!**
- Full LoRaWAN Class A and Class C end-device protocols
- Full compatibility with TTI secure system
- Interoperability tested with:
  - ✓ A2A Smart City
  - ✓ Loriot
  - ✓ LoRaServer
  - ✓ The Things Network

Massive IoT: Low-power

- **The smallest LoRaWAN® module!**
- LDO supplier mode or switching mode to save power
- Extreme low power mode: 1μA

Massive IoT: Security

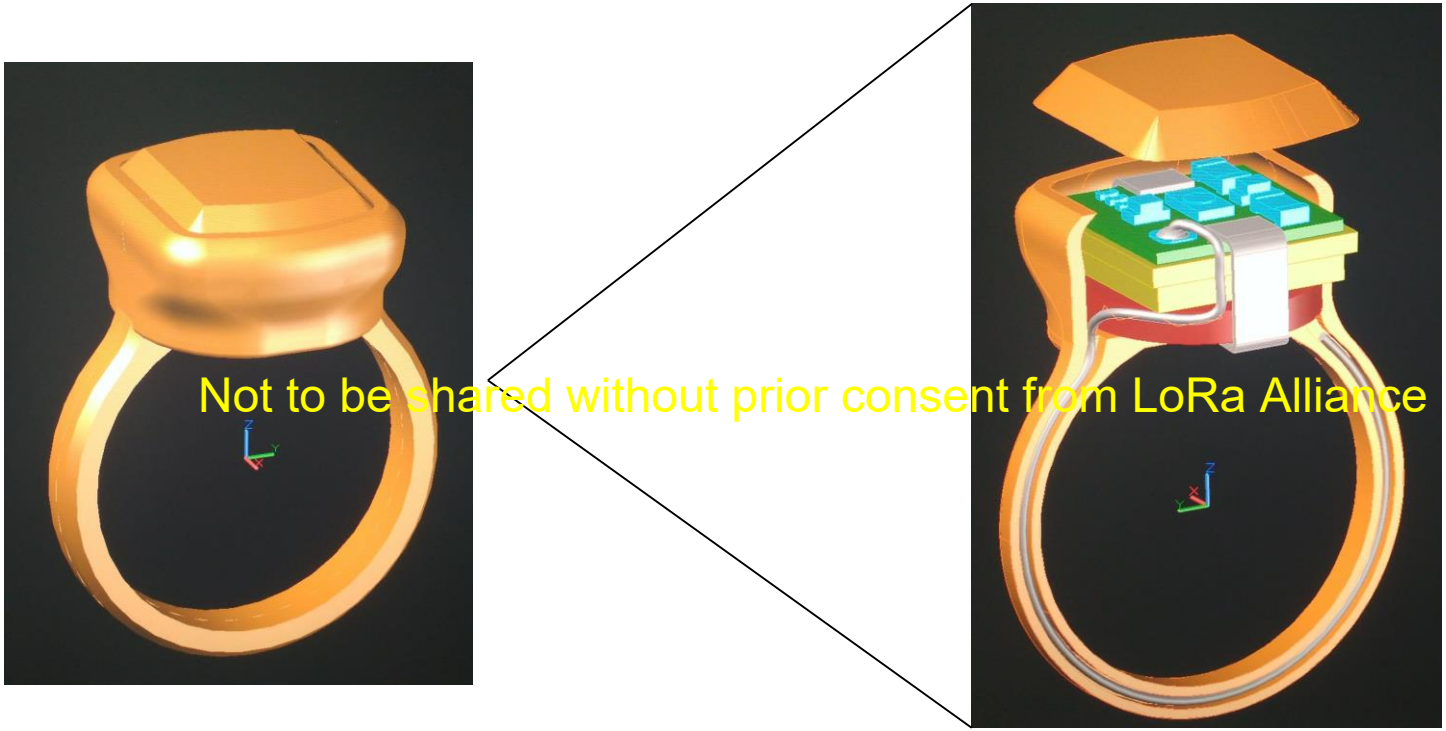
- **The smallest LoRaWAN® module!**
- Crypto Unit to protect communication (ATECC608A)
- The secure element can contain a secure identity, root keys compatible with LoRaWAN 1.0.x and 1.1

- Possibility to use open-software crypto, libraries integrated
- Authentication
- Provisioning

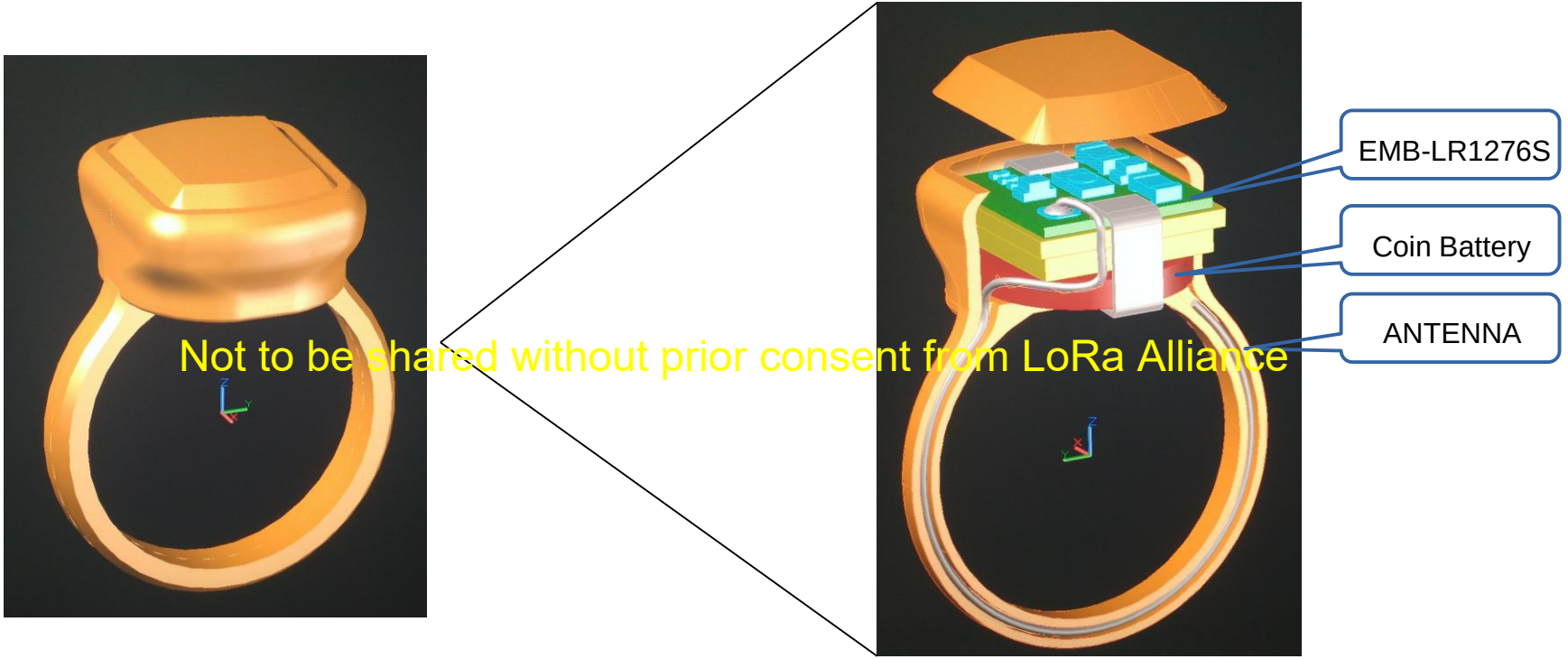
Massive IoT with EMB-LR1276S: Use Case

Massive IoT with EMB-LR1276S: Use Case

Massive IoT with EMB-LR1276S: Use Case



Massive IoT with EMB-LR1276S: Use Case



Develop your own LoRaWAN® IoMe solution

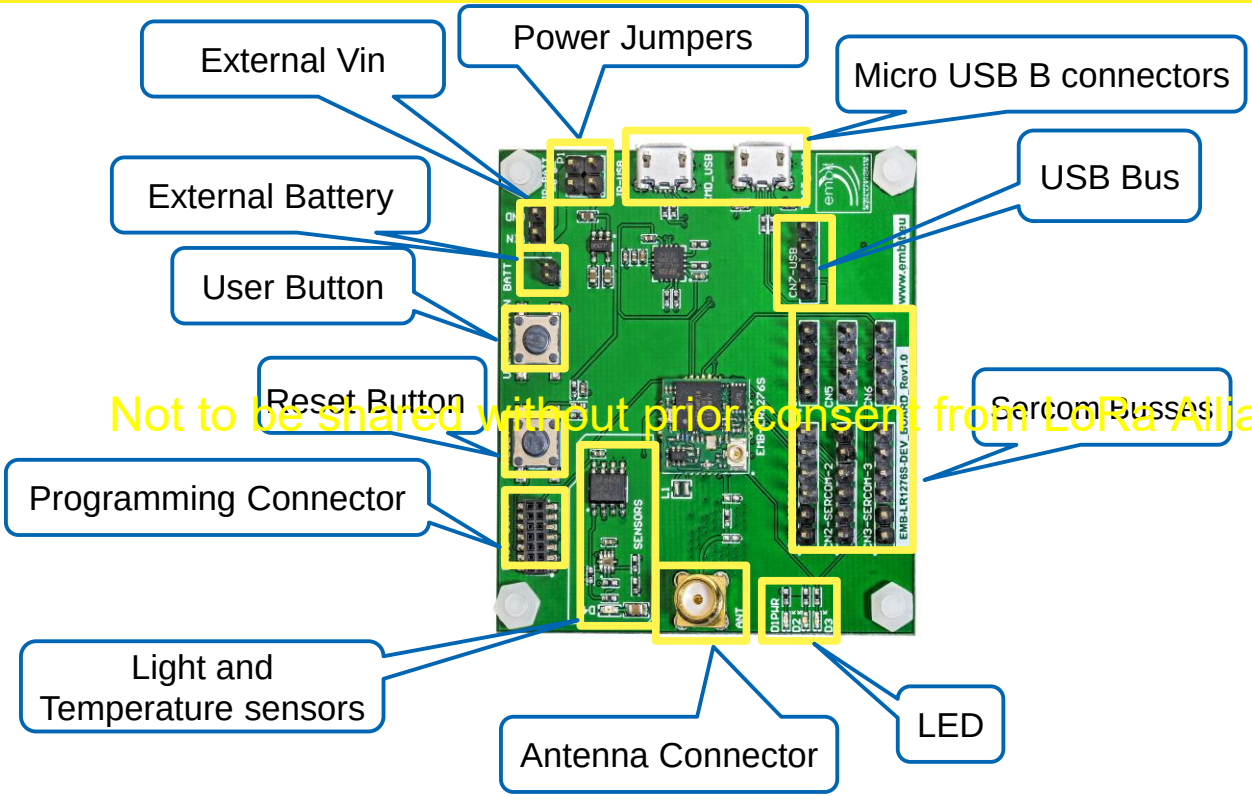
- EMB-LR1276S is small, LoRaWAN® ready, low-power and secure and can be adopted for a plethora of solutions.
- It reduces drastically time-to-market in IoMe projects: where small size is a requirement

- It is reliable for applications directly involving the person
- Creating a wide area network of micro LoRaWAN nodes, people-centered and life-style-changing

Develop your own LoRaWAN® IoMe solution

- Create a prototype using EMB-LR1276S
  - Dev Board 1276S
  - Nano LoRa Click
- Design your LoRaWAN® IoMe Node
  - Speed-up your RF design
  - Software Integration

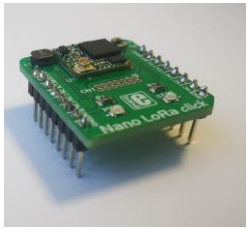
First Prototype: EMB-LR1276S Dev Board



EMB-LR1276S Dev Board

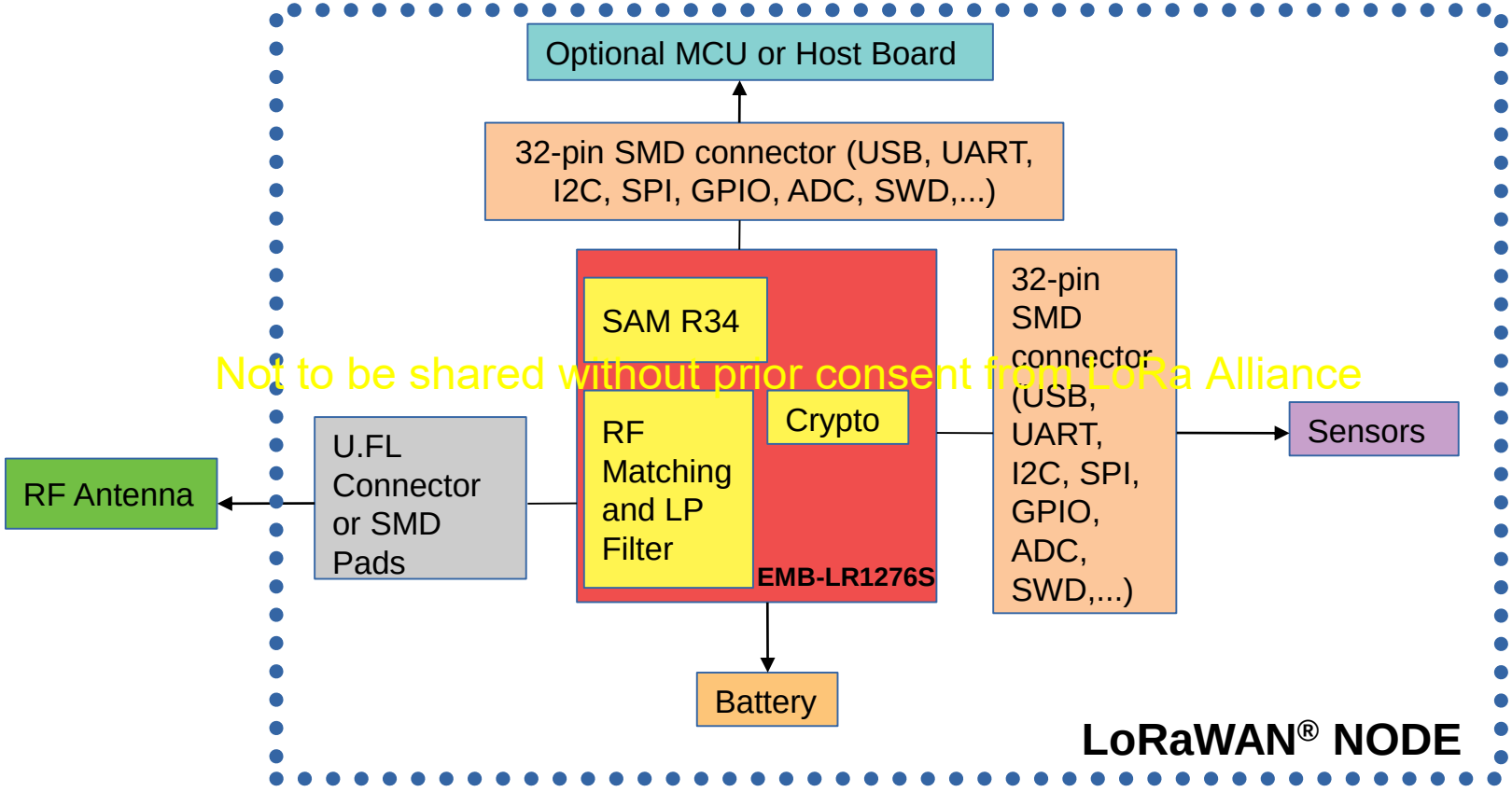
First Prototype: Nano Click

- Nano Click Board in collaboration with Mikroe
- Board compatible with mikroBUS™
- MikroBUS™ supplies LoRaWAN® board and enables data exchange through UART

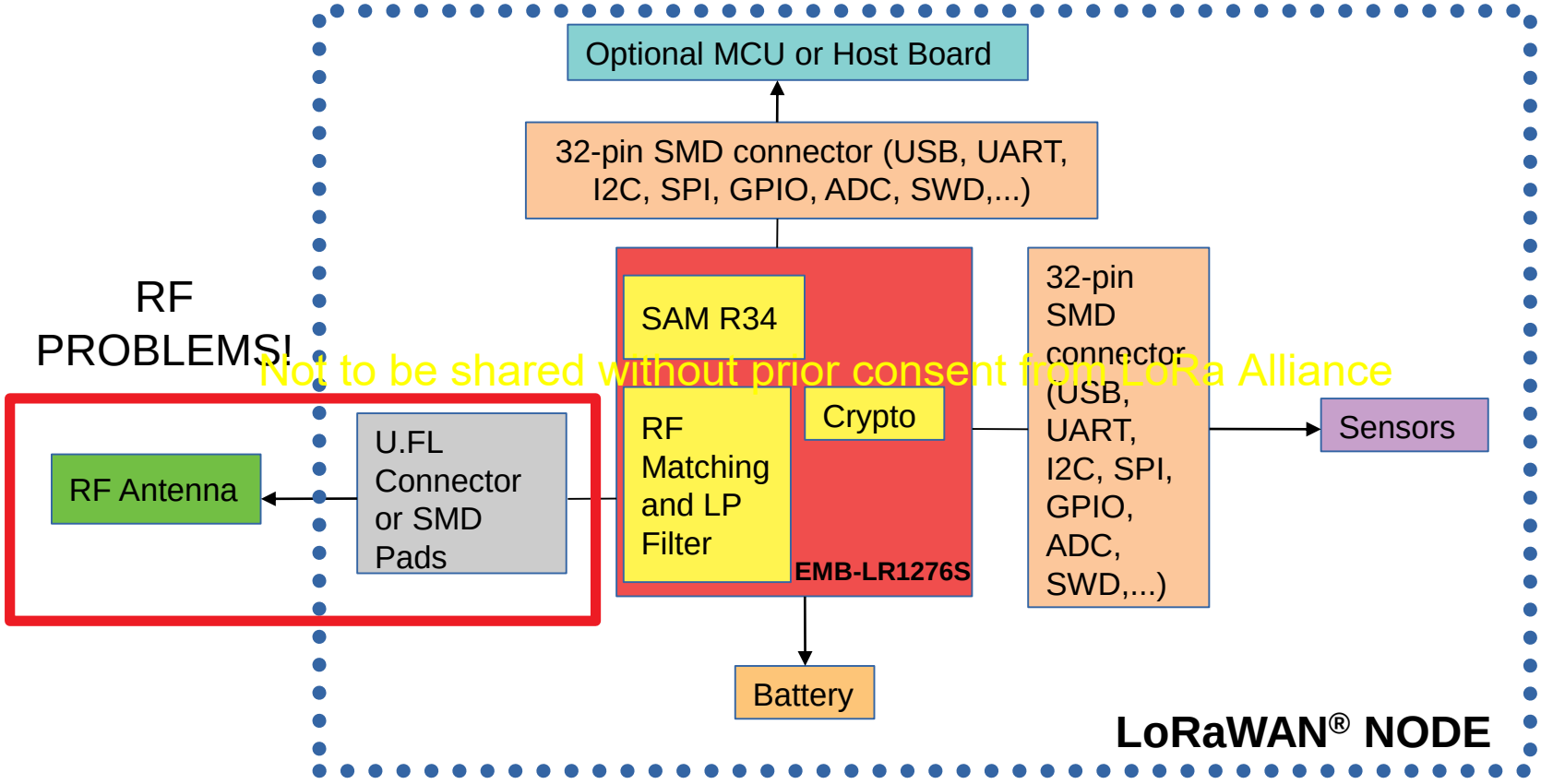


- Host sends EBI commands to Nano Click to make it join the LoRaWAN network for sending and receiving data
- Sensors can be plugged-in seamlessly

Design your LoRaWAN® IoMe Solution



Design your LoRaWAN® IoMe Solution

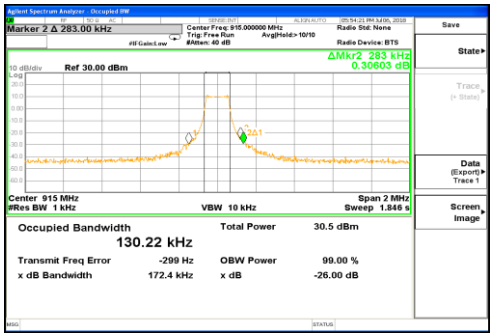


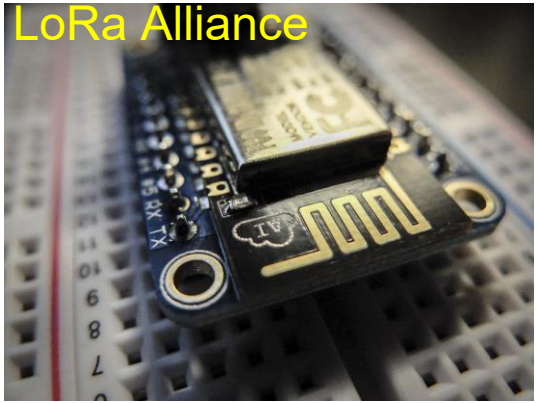
Speed-Up your RF Design

- Antenna size: Integrated Antenna or External Antenna
- Integrated Antenna available through Coplanar Waveguide with Lower Ground Plane (CPWG) design
- Integrated Antenna: PCB Antenna
  - Cheap, but
  - It needs ground plane
- Integrated Antenna: Chip Antenna
  - Small Size
  - Customizable, but
  - Easily to be detuned

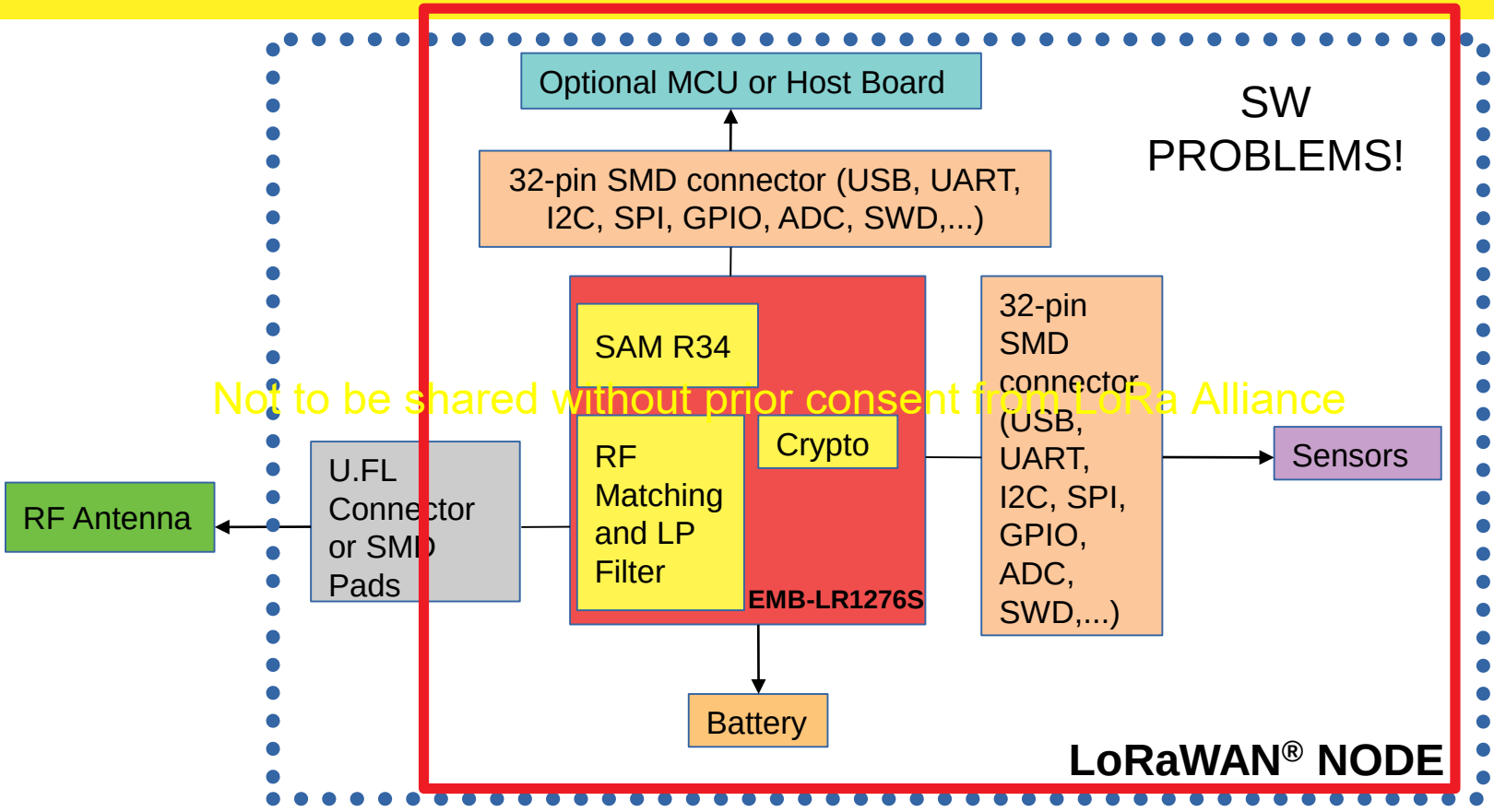
Speed-Up your RF Design

- Optional External Antenna Connection: 50 Ω single-ended U.FL connector
- Electro-Magnetic modelling
  - Challenge for small devices: Enclosure and Tuning
- Antenna Fabrication and Characterization





Software Integration



Software Integration

- Microchip SAMR34 System-In-Package
- Microchip LoRaWAN® Software Stack
- Integrated MCU + sub-GHz radio
- 256 KB Flash and 32 KB RAM

Software Integration

- Libraries to deal with LoRaWAN® functionality
- Implementing software state machines to manage all LoRaWAN chain, to send Join Packet, to send Data etc.
- USB, UART, I2C, SPI, ADC interfaces to connect your sensors
- Uploading sensors' driver in your code to fetch data
- Save space and energy embedding your application directly inside the module
- Atmel Studio 7 IDE
- Or use commands to control the transceiver (EBI Commands) with another MCU

To sum up...

- Find your IoMe use cases
- Choose the right sensor
- Make a prototype
- Layout and Antenna Design
- Software Integration
- Your LoRaWAN® IoMe Solution is ready!

Conclusion

- IoT Everywhere > The Internet of Me[1]
- LoRaWAN® Network penetration
- Massive Integration > small form factor devices/ specific tech challenges

- Develop your micro IoMe LoRaWAN Solution according to your use case

Q&A Session!

References

[1] 2015, The Developers Alliance, *Internet Of Things. Internet of Me: How wearable Tech is changing IoT*, https://www.developersalliance.org/internet-of-things/wearables

[2] 2017, Mordor Intelligence, *Global Smart Wearables Market* https://www.mordorintelligence.com/industry-reports/smart-wearables-market

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@LoRaAlliance

linkedin.com/company/loraalliance/

marcom@lora-alliance.com

lora-alliance.org

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LoRaWAN® The Power of Testing

Jörg Köpp
Market Segment Manager IoT - Rohde & Schwarz

LoRaWAN®

Creating Valuable IoT Connections

Rohde & Schwarz: Innovation is in our DNA

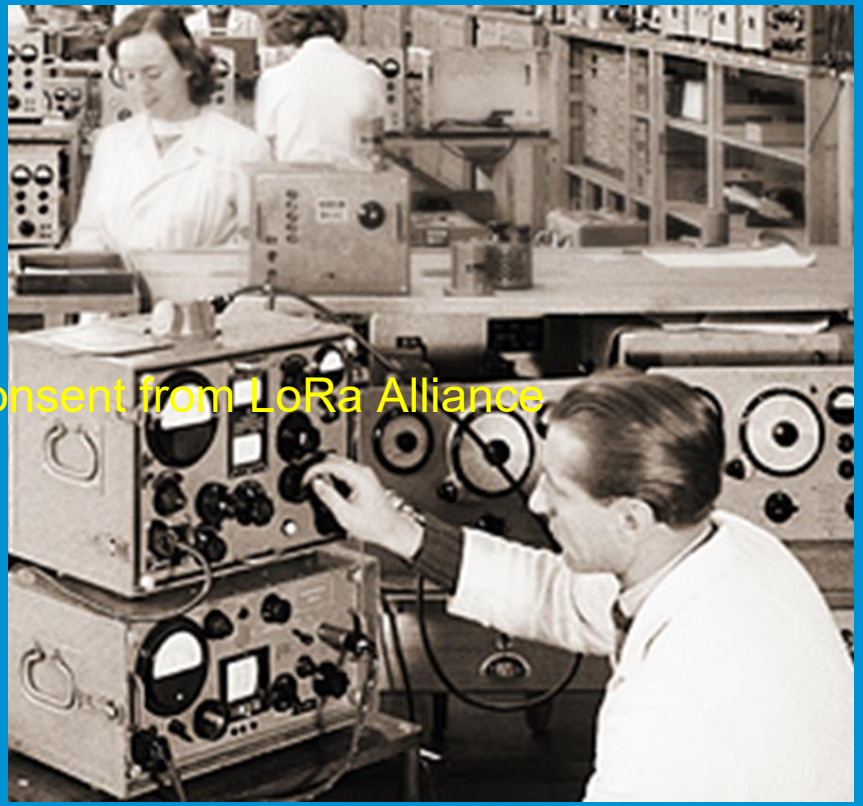
Rohde & Schwarz started as a two-man laboratory 85 years ago and grew into a global group of companies standing for innovation in the fields of **safe, secure and reliable communication**

11,000+
Employees worldwide

€ 2.0+ Bn
Annual revenue

70+
Global presence

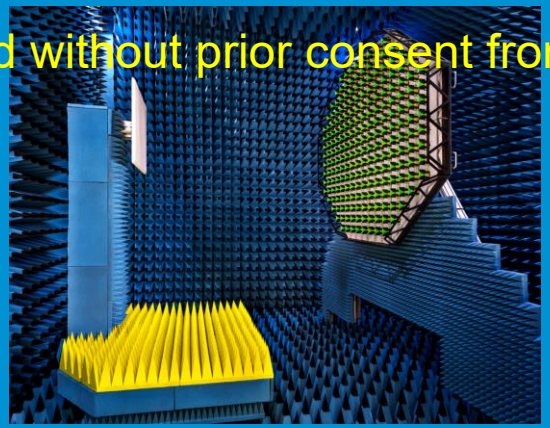
ROHDE&SCHWARZ



Rohde & Schwarz: some of our latest products

Quick Personnel Security Scanner
Extremely fast scans generate billions of data points analyzed by AI

Plane Wave Converter
Enable 5G network deployments by effective base station testing solution



Test and Measurement solutions from R&D to production for LoRaWAN®

LoRa Alliance™ Member

The Power of Testing

Challenges of our IoT customers

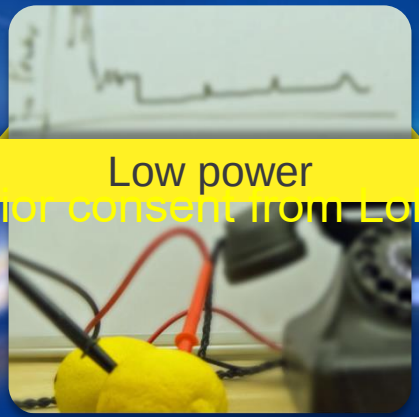
Technology choices

Design complexity

Myth of certification

Design challenges to meet specific IoT requirements

Quality & reliability

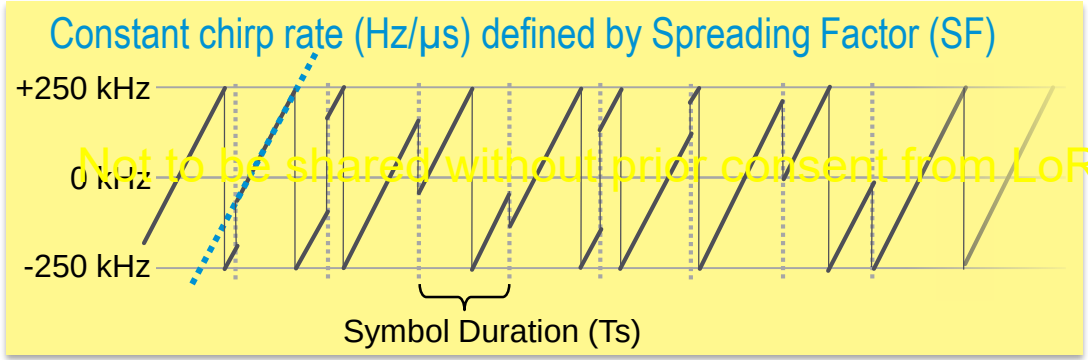


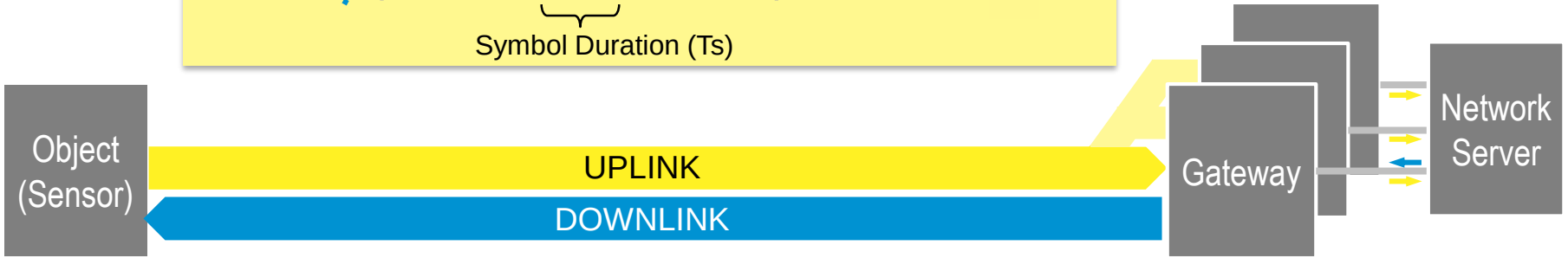
Low power

Deep coverage

LoRaWAN® in a nutshell

Chirped Spread Spectrum (125/250/500 kHz)	Multiple gateways simultaneously receiving	Pseudo–random frequency hopping (after each TX)	Data rate adaption (spreading factor/ bandwidth)	Different RX mode options (Class A/B/C)





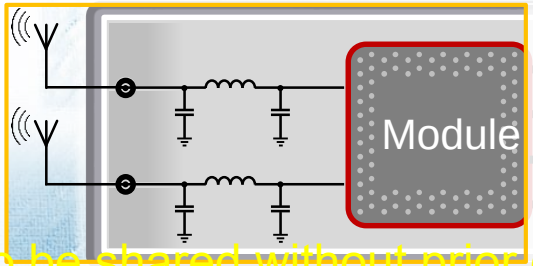
Don’t underestimate the basics of RF design

Matching | Ground plane | Housing | Interference

Bandwidth

Directivity

Gain



Power

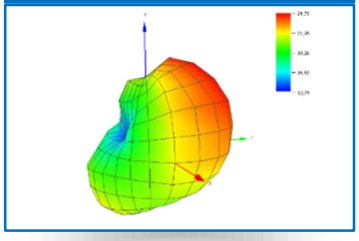
Clock

....

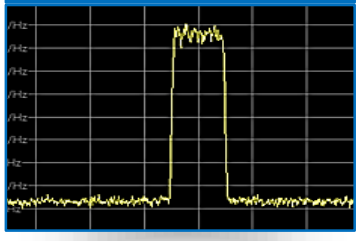
PCB

Return loss (S11)

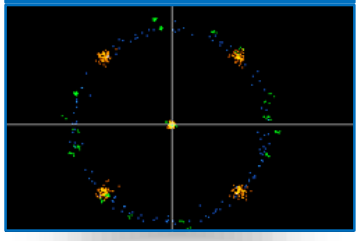
TRP/TIS



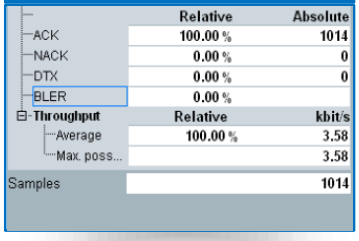
Tx Power / Spectrum



Error Vector Magnitude

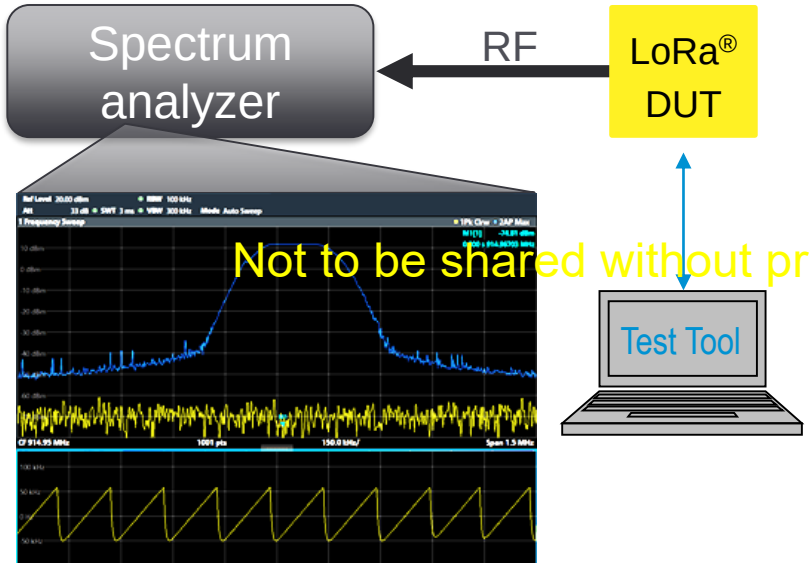


Receiver Sensitivity



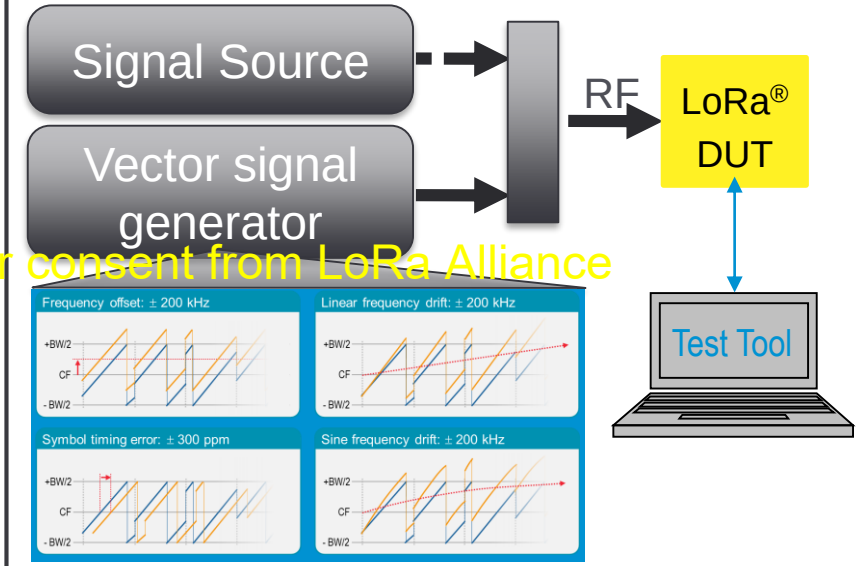
LoRaWAN® RF measurements for verification and regulatory conformance testing

RF Transmitter-Test



Tx bandwidth, Emission output power, Spectral density, FM Time Domain, etc.

RF Receiver-Test

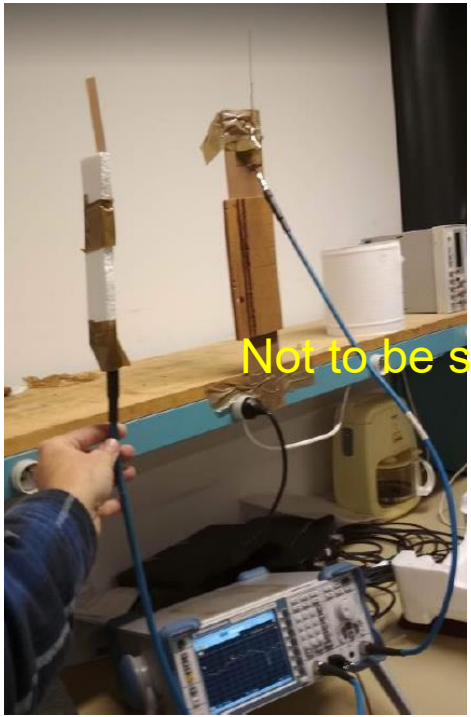


Measuring PER under different signal conditions (e.g. frequency drift, offset, timing errors, etc.)

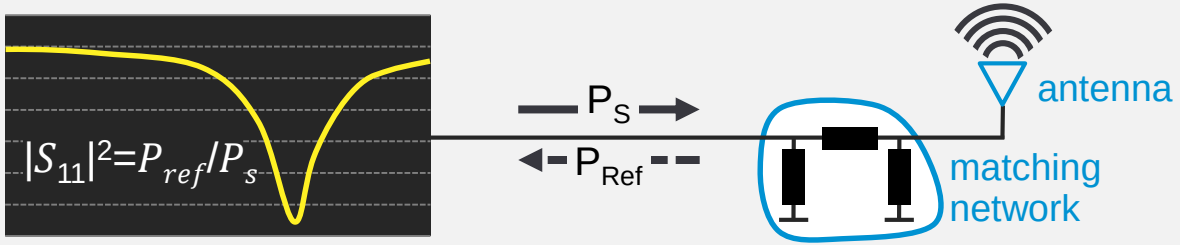
Regulatory Requirements for example ETSI & FCC

ETSI EN 300 220-1 Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz; Part 1: Technical characteristics and methods of measurement	FCC Title 47: Telecommunication PART 15—RADIO FREQUENCY DEVICES §15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
For example:	**e.g. for Systems employing Digital Modulation**
Effective radiated power	6 dB Tx bandwidth
Power spectrum density	Emission Output Power
Out of band emission	Power Spectral Density
Duty cycle	Emissions in Non-restricted bands

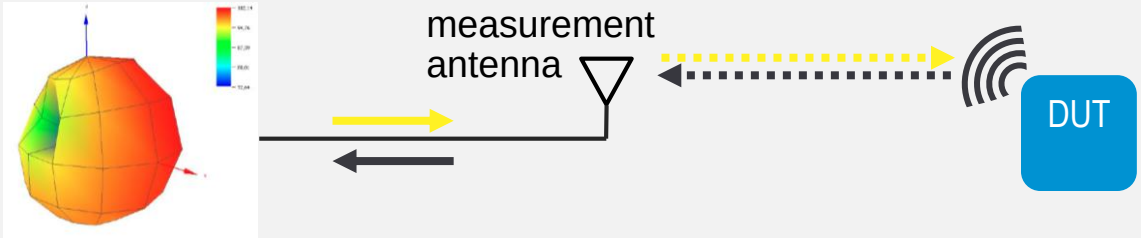
Antennas – often overlooked, but most critical in wireless design



Check antenna performance (gain, BW, frequency) and tune



Check overall RF performance of final design (TRP, TIS, directivity)



Source: Fabien Ferrero Antenna workshop at Things conference see Github

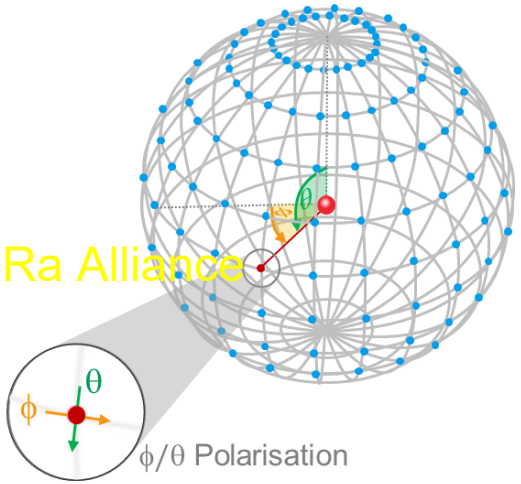
RF Performance evaluation procedure

- Requested by many LoRaWAN® Operators in order to ensure required/expected RF performance
- Created by the LoRa Alliance™ certification committee to have a harmonize approach to the measurement of **Transmit and Receive performance** of LoRaWAN® products
  - **Transmission performance** is measured as EIRP in a full 3D radiation power pattern with maximum segmentation of 10 degrees in both theta- and phi planes
  - **Received performance** is measured by detecting the point that the product reached a packet error rate of 10% (performed in RX1 & RX2)
- Requests to make these test MANDOTORY! So far manufactures are free to declare the results e.g. on the LoRa Alliance™ webpage

https://lora-alliance.org/lorawan-rf-certified-products

Example: TRP measured by the EIRP at several points around the sphere

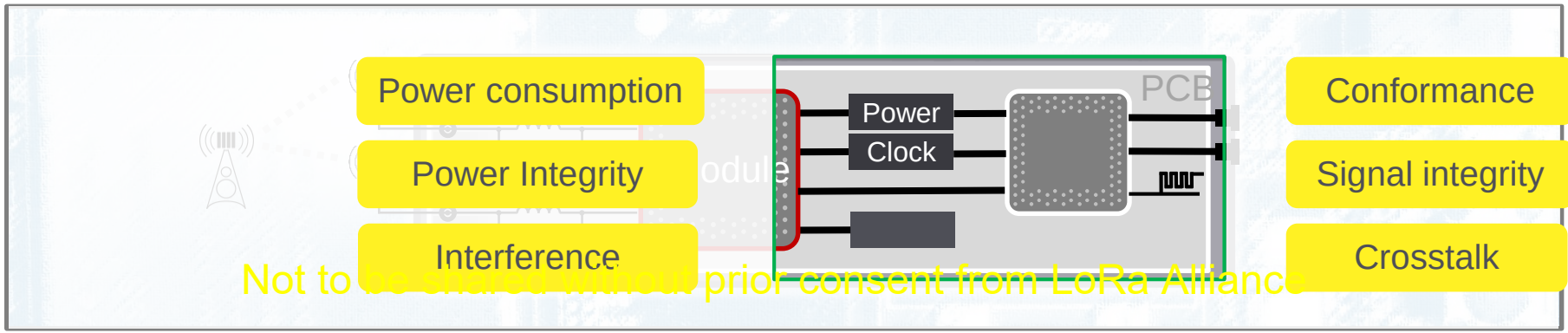
- Measured on one channel, in case of EU region at 863.1 MHz with a continuous wave (CW),
- In addition for the TIS calculation on 868.3 MHz (RX1 window) and 869.525 MHz (RX2 window)
- For the full 3D pattern the EIRP(ϕ, θ) is measured with both orthogonal polarizations for every direction of the sphere using a maximum segmentation of 10 degrees (264 points)
- The TRP corresponds to a spatial average of EIRP



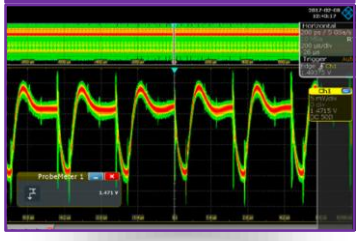
$$TRP = \frac{1}{4\pi}\oint\{EIRP_{\phi}(\Omega, f) + EIRP_{\theta}(\Omega, f)\}\, d\Omega$$

f – frequency; Ω - solid angle of direction, θ/ϕ - polarization

Verification of the electronic design



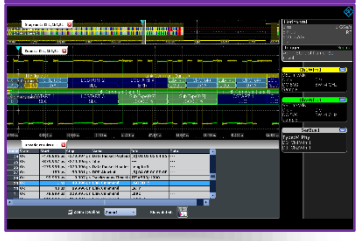
DC rail tolerance (Vpp)



Unwanted signals

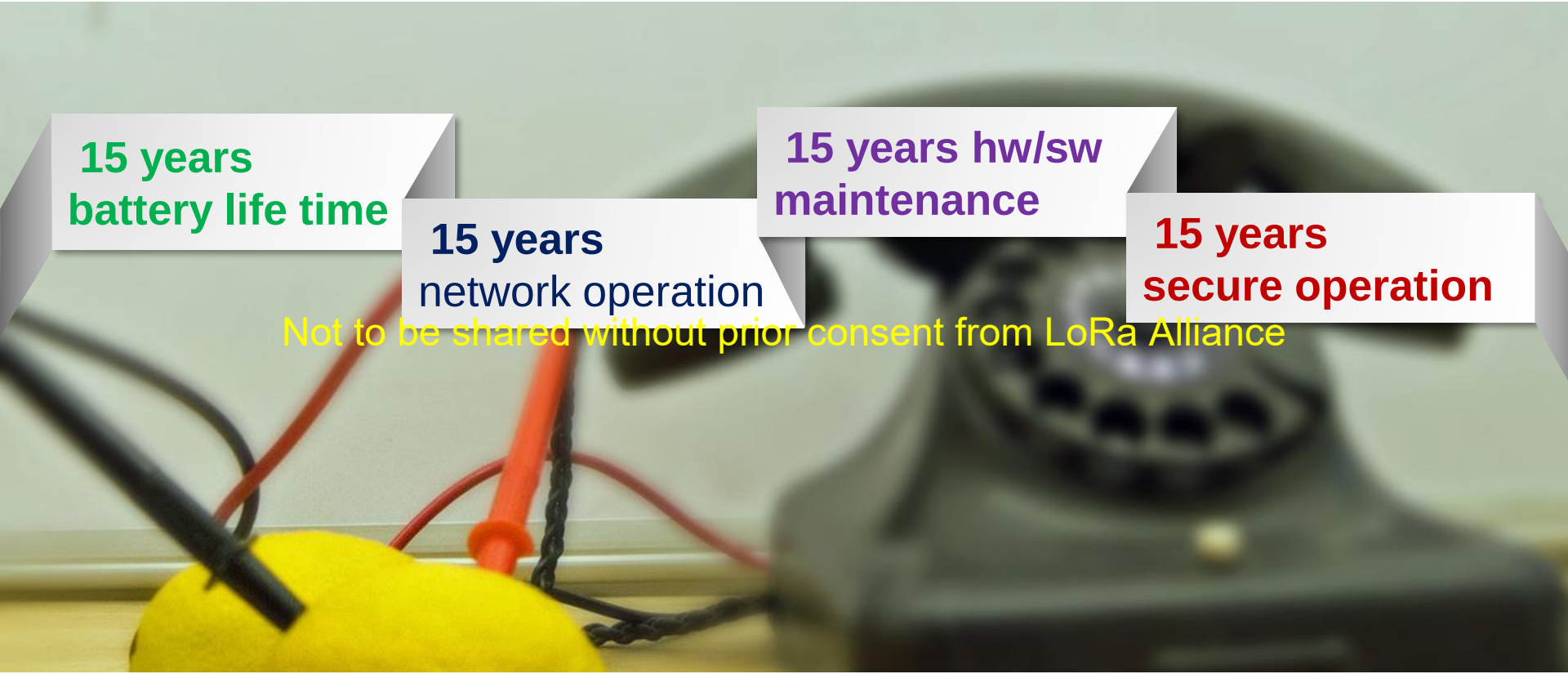
Power consumption

Digital channel analysis



Multi-domain analysis

Low power design is more than just using low power hardware and LPWAN technologies



LoRa Alliance™ certification focusing on interoperability and performance

All certification testing is performed by independent, LoRa Alliance member company laboratories for LoRa Alliance™ members only!

https://www.lora-alliance.org/certification-overview

Test items

LoRaWAN CERTIFIED

- Device activation
- Test application functionality
- Over the Air activation
- Packet Error Rate
- Cryptography
- Download window timing
- Frame sequence number
- MAC commands
- Confirmed packets
- Uplink transmission
- ***Optional OTA performance***

LoRa Alliance™ Authorized Test Houses

IMST · 7layers testing for a smarter world · TTA 한국정보통신기술협회 Telecommunications Technology Association · Element · TÜVRheinland · ALLION · DEKRA

European EU 863-870 MHz Region End Device Cert. (V1.5)

US + Canada US902-928 MHz Region End Device Cert. (V1.3)

Asia AS 923 MHz Region End Device Certification Requ. (V1.1)

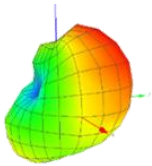
South Korea 920-923 MHz Region End Device Cert. Requ. (V1.2)

India 865-867 MHz Region End Device Cert. Requirements (V1.1)

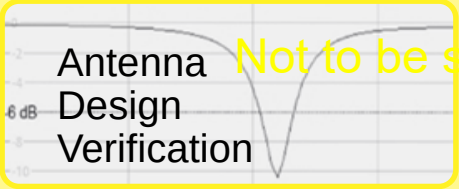
LoRaWAN® device and gateway testing needs

Design verification

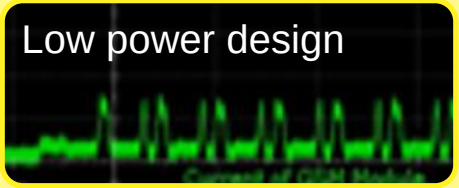
RF Performance testing



Antenna Design Verification



Low power design



Certification

MANDATORY

Certification

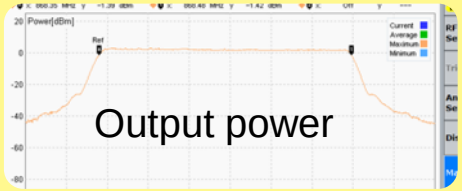
Being MANDATED

LoRaWAN CERTIFIED

Operator Certification

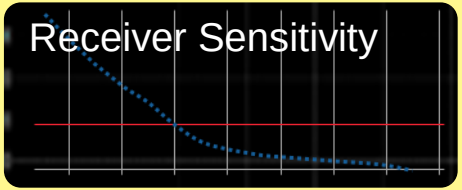
MANDATORY

End-of-line testing



Output power

Frequency



Receiver Sensitivity

LoRaWAN®

Creating Valuable IoT Connections

@LoRaAlliance

linkedin.com/company/loraalliance/

marcom@lora-alliance.com

lora-alliance.org

LoRa Alliance™

WELCOME TO LoRaWAN® LIVE

TECHNICAL TRACK 2.00PM – 6.00PM

BERLIN, JUNE 13, 2019

LoRaWAN®

Creating Valuable IoT Connections

TRUSTED OBJECTS

LoRaWAN® Security

EU Cybersecurity Act impact

LoRaWAN®

Creating Valuable IoT Connections

Agenda

- EU Cybersecurity Act : overview & key points
- Why EU Cybersecurity certification schemes?
- EU Cybersecurity: security assurance levels
  - Description of the 3 security grades
  - Characteristics of the EU cybersecurity certification schemes
  - Public and private initiatives
- EUROSMART IoT device security certification scheme
- LoRaWAN security positioning against Cybersecurity Act certifications
- Take away

Trusted Objects at a glance

Trusted Objects is a mission-driven company established **to change the face of IoT security** by enabling best practices security solutions to protect the whole IoT ecosystem.

- Independent company founded in 2014 by industry experts.
- Expertize in **cybersecurity technologies for Industrial IoT applications**, including secure embedded software & libraries, secure connectivity stacks, secure design services, personalization & provisioning solutions.
- Global footprint with presence in Europe, Asia (offices in Singapore and Bangalore).
- Solid technical and financial background.

Security is in the DNA of the company

EU Cybersecurity Act – Overview 1/2

- In April 2019, the European Parliament has approved a new cybersecurity regulation, the Cybersecurity Act.
- The Cybersecurity Act does cover networks security, information security and devices security (ICT products or services).
- Under the regulation, the Commission is empowered to adopt European cybersecurity certification schemes, including IoT devices.
- Unification of national certification schemes.

The European cybersecurity certification is completely separate and independent of the LoRaWAN® certification

EU Cybersecurity Act – Overview 2/2

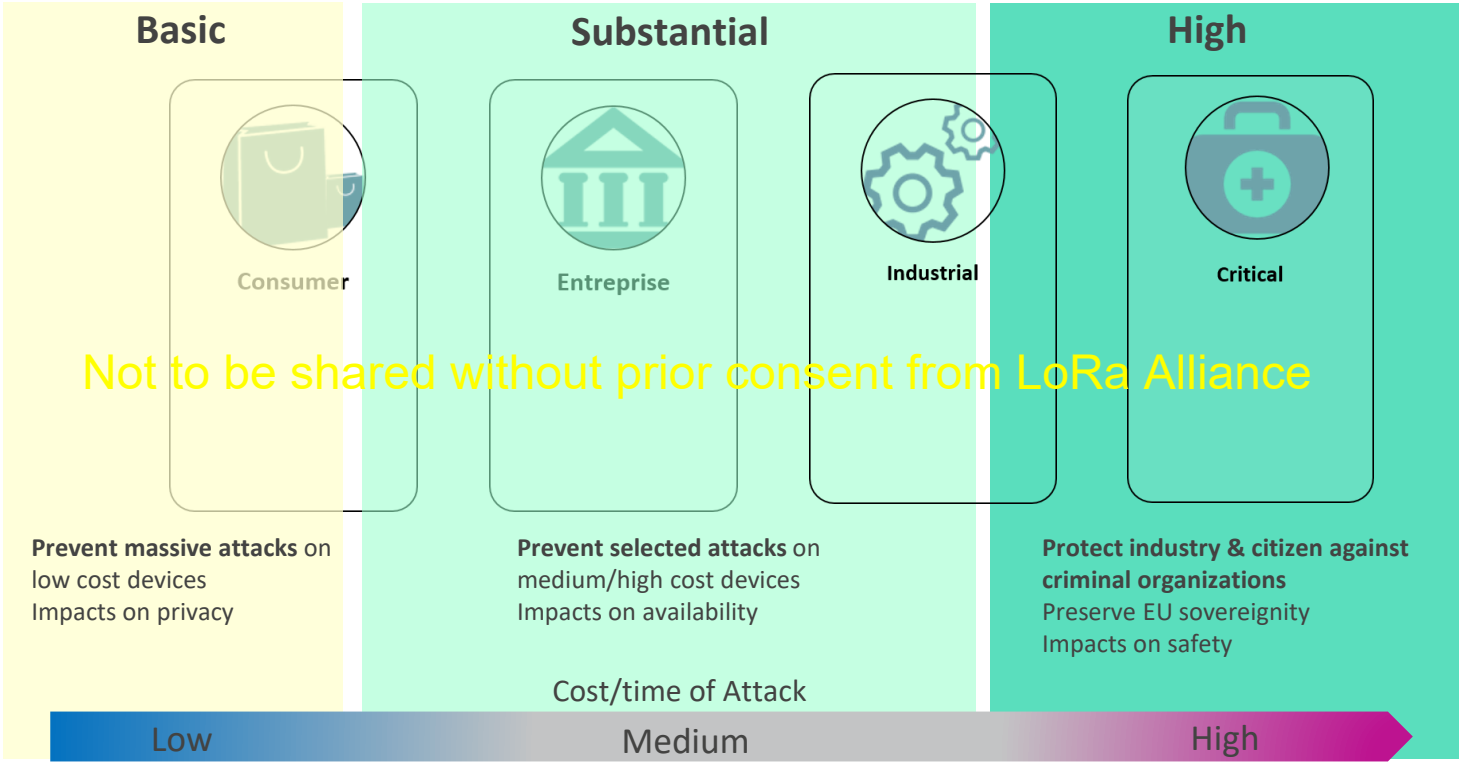
- Key elements of the cybersecurity certification schemes :
  - The new certification schemes will initially be voluntary.
  - The schemes and certification issued for products and services will specify 3 different assurance levels: basic, substantial and high.
  - “Security by design” approach at the heart of all projects.
  - EU Member states will establish penalties for infringing European cybersecurity certification schemes.

CERTIFICATION gives TRUST !

- "**TRUST** should be further **strengthened** by offering information in a **transparent** manner on the **level of security** of ICT products, ICT services and ICT processes..."
- "An **increase in trust** can be facilitated by **Union-wide CERTIFICATION** providing for **common cybersecurity requirements** and **evaluation criteria** across national markets and sectors."

Cybersecurity Act –Section (7)

EU Cybersecurity certification schemes: security assurance levels



Source: Eurosmart

Characteristics of the EU cybersecurity certification schemes

Assurance Level « Basic »
Objective: Inform

- Minimize **the known basic risks** of incidents and cyberattacks
- Security guidelines
- Self assessment

Assurance Level « Substantial »
Objective: Protect

- Minimize **the known cybersecurity risks** carried out with **limited skills and resources**
- Security schemes & Pentests
- Certification by CAB (*)

Assurance Level « High »
Objective: Prevent

- Minimize **the risk of state-of-the-art cyberattacks** carried out with **significant skills and resources**
- Security schemes & Pentests
- Certification by CAB (*)

(*): CAB: Conformance Assessment Body

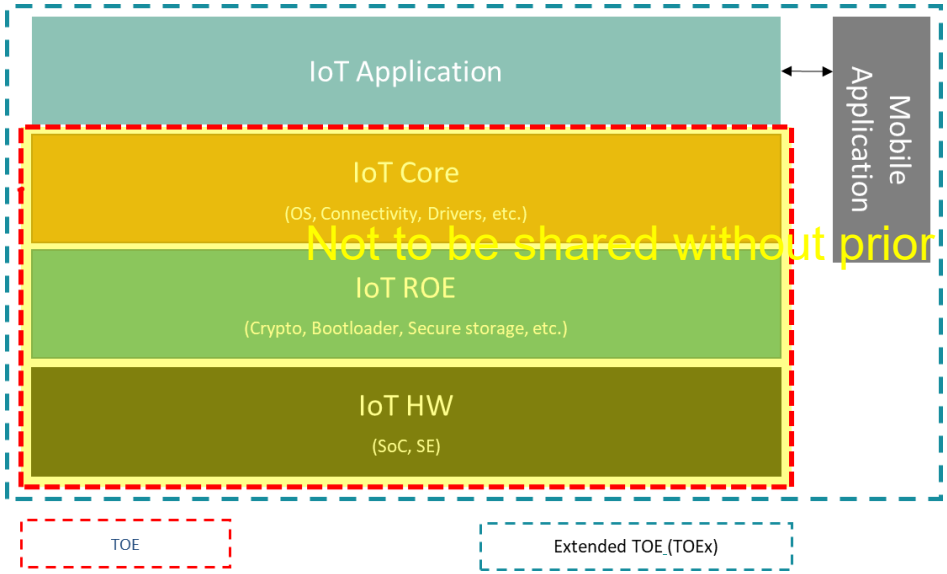
Certification schemes – Public and private initiatives

Scheme Name	Acronym	Key driver	Type of initiative	CSA Level
Eurosmart IoT Scheme		**Eurosmart**	**Private**	**Substantial**
IoT security Architecture		GlobalPlatform	Private	
Platform Security Architecture	PSA	ARM	Private	All
Secure Evaluation Scheme for IoT Platform	SESIP	NXP	Private	All
UL Cybersecuroty Assurance Programme	UL CAP	UL	Private	
Certification Sécuritaire de Premier Niveau	CSPN	ANSSI	Public	High, Substantial
Baseline Certification	BC	BSI	Public	Substantial
Commercial Product Assurance	CPA	CESG	Public	Substantial
Baseline Security Product Assessment	BSPA	NLNCS	Public	Substantial
SOG-IS for IoT		SOG-IS	Public	
LINCE		National Cryptologic Center	Public	High
ETSI TS103 655(Technical Specifications)	ETSI TS103 655	ETSI	ESO	Basic

EUROSMART – The Voice of the Digital Security Industry

EUROSMART - A certification scheme dedicated to IoT devices

Modular Target of Evaluation



Source: Eurosmart

- Not all products require the same level of certification.
- From a full hardware platform with an OS and cloud connectivity to individual components such as a Secure Element, MCU, or MPU.
- Secure evaluation scheme allows integrators to utilize the security testing on the Root-of-trust to enable less complex certification on their layer.

EUROSMART - IoT Device security certification scheme

Eurosmart scheme has been developed to **fulfill the requirements of the European Cybersecurity Certification framework** at the level “substantial”.

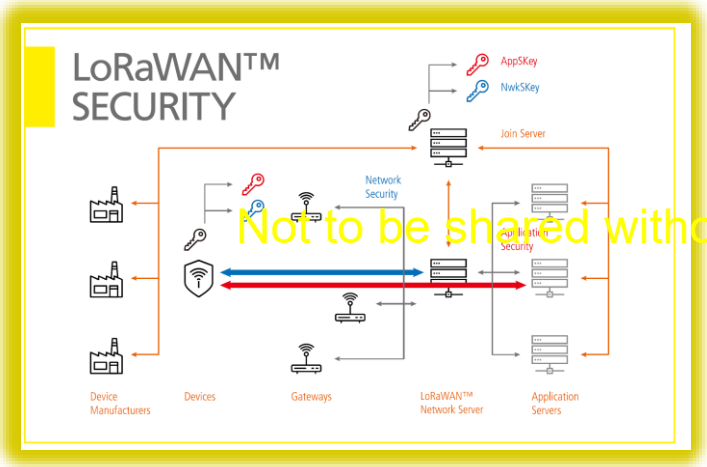
June 2019
Pilots certification phase start!

Certification duration is in days

Optimized cost

LoRaWAN® device security

®



Source: LoRa Alliance™

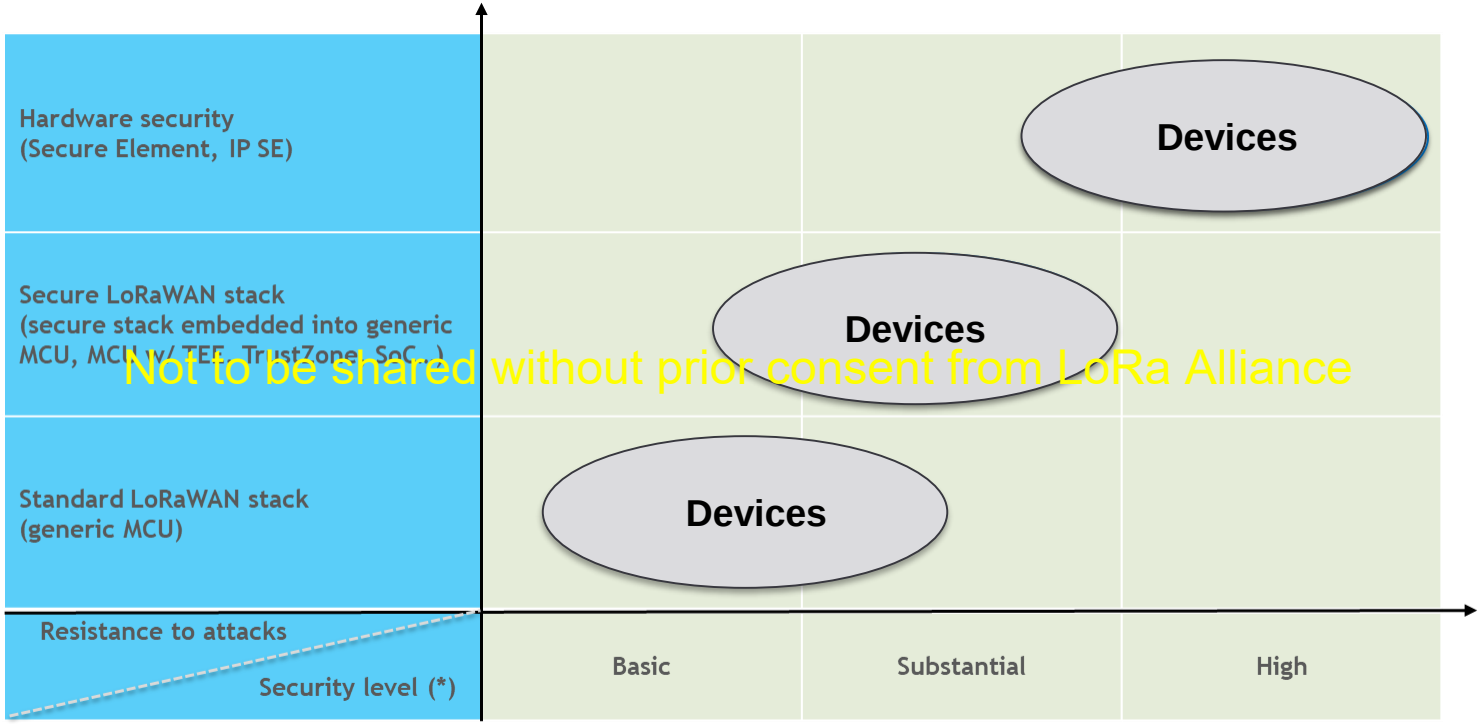
Physical Security of a LoRaWAN® Device

AppKey and the derived session keys are persistently stored on a LoRa Alliance™ device and their protection depends on the device physical security. If the device is subject to physical threats, keys can be protected in tamper resistant storage (a.k.a. Secure Element), where they will be extremely difficult to extract.

Source: LoRa Alliance™

Threats	Vulnerabilities	Risks
• Physical attacks (non invasive/ invasive): key extraction, replay attacks… • Logical attacks: malware injection, buffer overflows…	• Unprotected end node • Unsecured provisioning flow • Unsecured supply chain	• Data disclosure or data corrupted • Usurpation in sending fake commands • Cloning attacks

Device security against Cybersecurity Act Certification



(*): Cybersecurity Act –Security assurance levels

Take Away

- EU Cybersecurity Act will be the first step of IoT security regulation.
- Security certification to be categorized in 3 levels: basic, substantial, high.
- Substantial and high grades will include security evaluation by CAB, with pentests

- It could lead to achieve security certification for LoRaWAN® devices depending on use case and physical threats.
- We must be prepared based on security principles: secure by design, secure device, secure provisioning, end-to-end security……

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linkedin.com/company/loraalliance/

marcom@lora-alliance.com

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LoRa Alliance™

Technical Education as a necessary enabler for the social benefit of LoRaWAN®

Prof. Dr. Olga Willner
Hochschule für Technik und Wirtschaft Berlin

LoRaWAN®

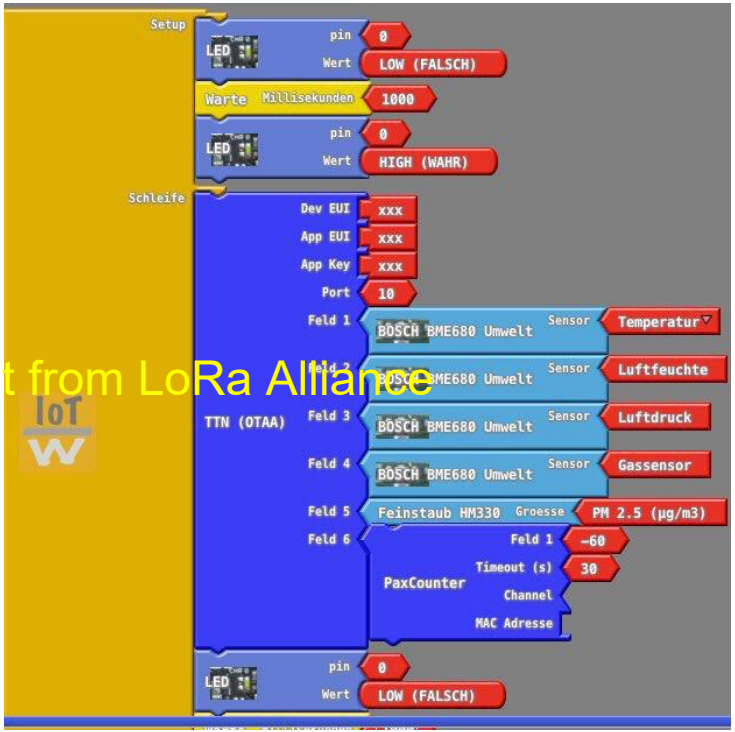
Creating Valuable IoT Connections

Introduction

- **Technical Education** is a **key prerequisite for leveraging** the **positive impact** of **LoRaWAN®** on **society.**
- **In Europe, LoRaWAN** was first adapted by the **maker community** and then the **corporations.**
- **Now** it is time to get the **citizens involved** and support them in **implementing** their **own use cases (Citizen Science).**
- Easily **accessible hardware** & **infrastructure** accompanied by **comprehensible manuals are** strong **enablers** for **citizen participation.**
- **Citizen participation** fosters the **implementation** of **use cases** that contribute to the **benefit** of **society**.

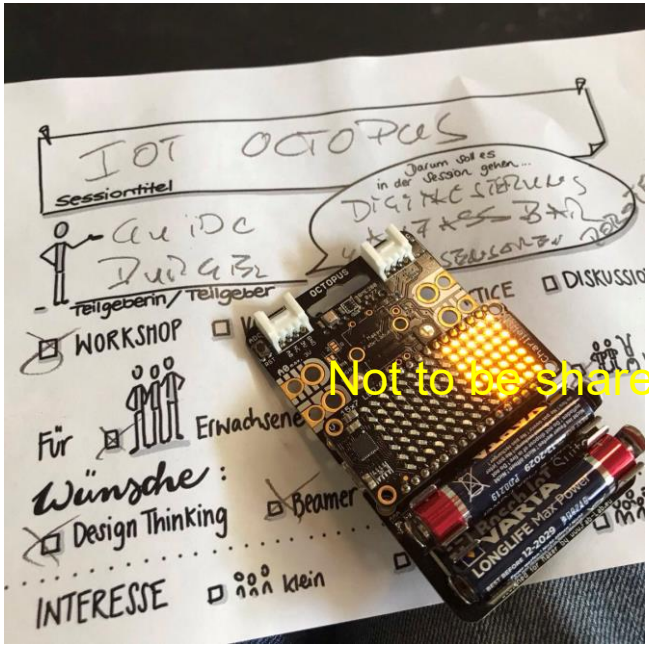
It’s about technical education – for students, adults & seniors…

IoT Octopus



Source: https://www.umwelt-campus.de/iot-werkstatt, Guido Burger

IoT Octopus



Pictures: Guido Burger

Technologiestiftung Berlin: The Hacking Box

What's inside the Hacking Box?

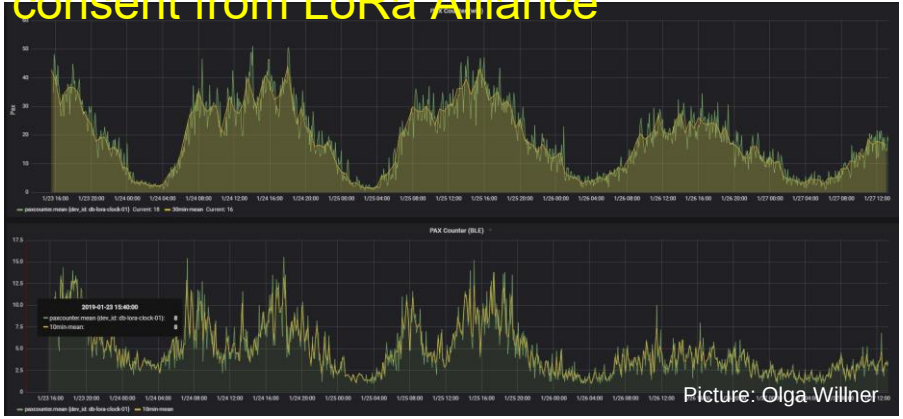
- > 130 **Arduinos**, **Calliope mini** and **Raspberry Pi 2&3**...
- Various **LoRaWAN®** shields
- > 20 **sensor** types, 70 **servos**, **displays**, LEDs…
- **Soldering irons**, **hot glue guns**…

Source: TSB

Deutsche Bahn PaxCounter Workshop at HTW Berlin

Picture: Klaus Wilting

Picture: Pycom



Picture: Olga Willner

Seniors Learning Online “SLO”

- LoRaWAN® as a facilitator for a self-determined life at home up to a high age
- Person of trust can monitor if
  - coffee maker is being used
  - light is switched on or off
  - house is left


Picture: Seniors Lernen Online


Picture: Seniors Lernen Online

Picture: Seniors Lernen Online

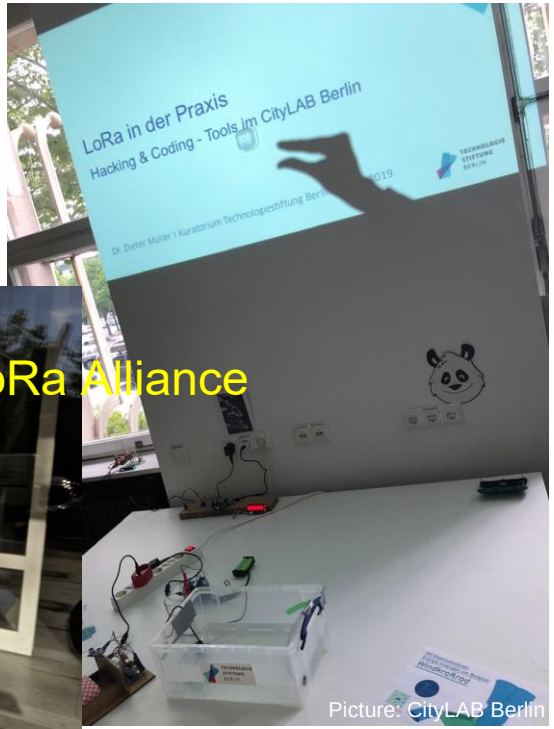
Source: Seniors Lernen Online

It’s also about our cities, their citizens and public administration…

City Lab Berlin

Picture: Olga Willner

Picture: CityLAB Berlin



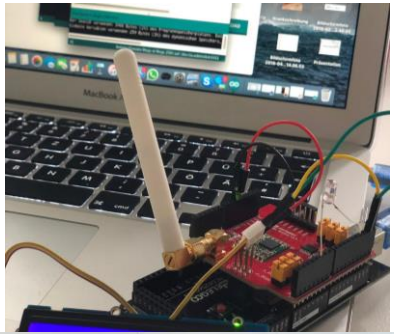
Picture: CityLAB Berlin

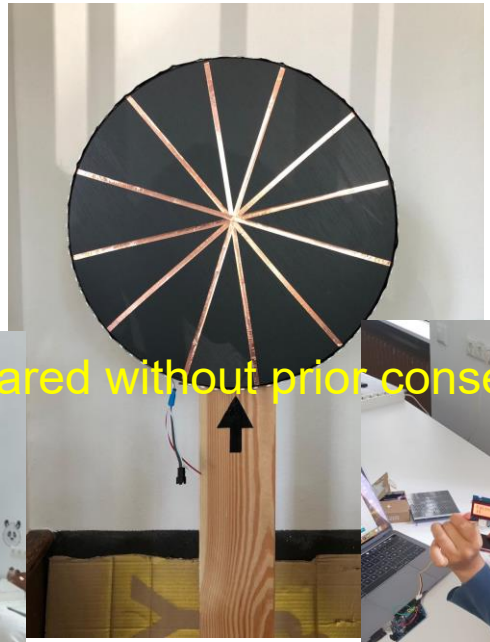
Upcoming LoRaWAN® projects in the CityLAB Berlin

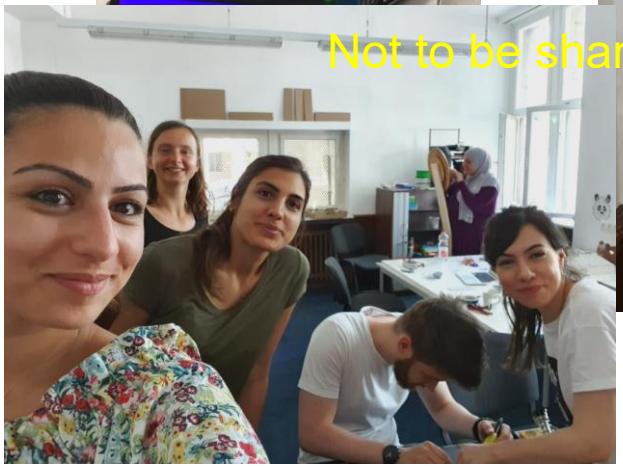
Internet of Trees

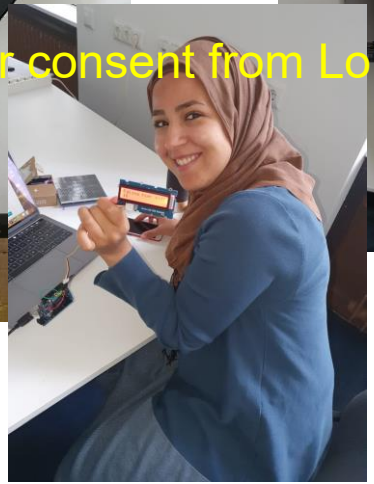
Wind Speed Measurements for Kite Flying

HTW Berlin students in the City Lab Berlin









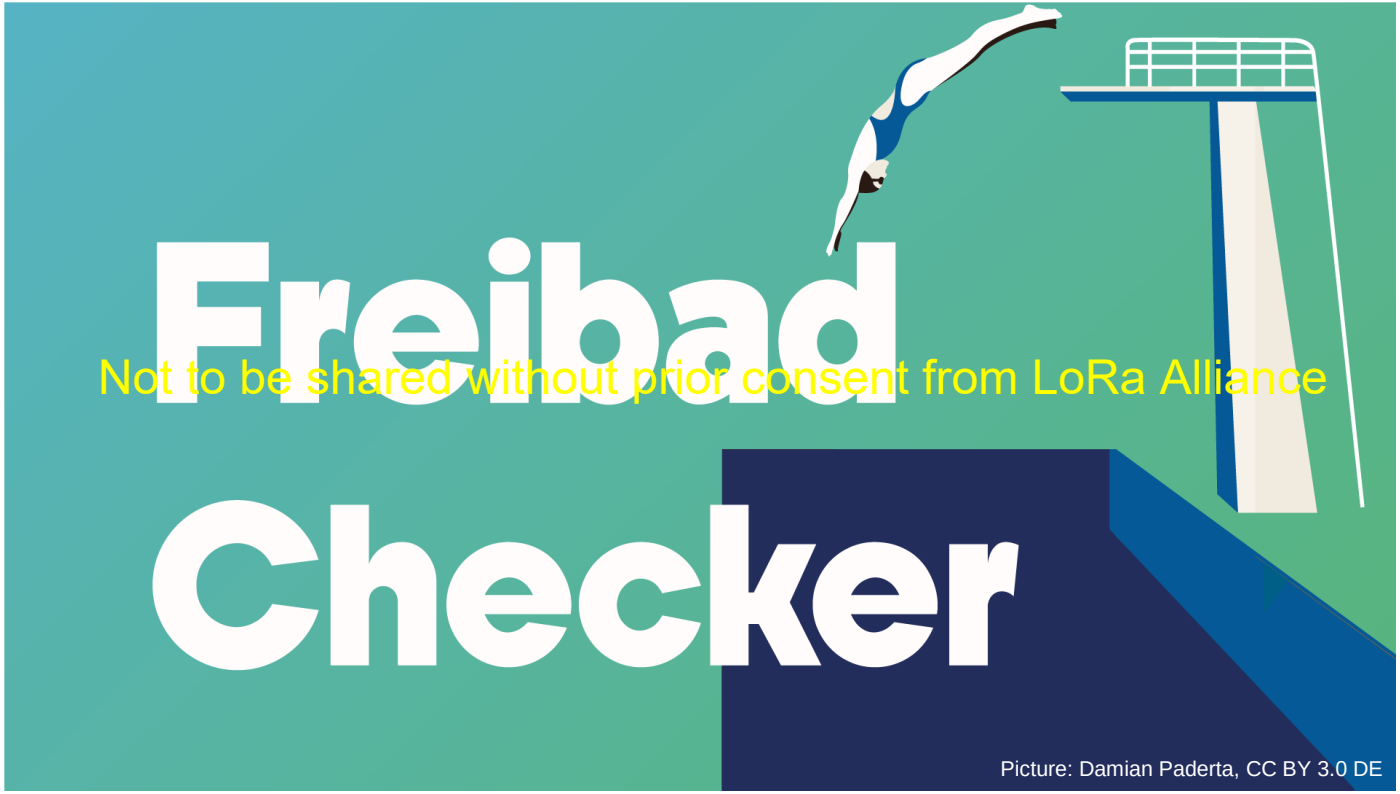
Pictures: CityLAB Berlin

Moers LoRaWAN® Hackday

Picture: Mario Wiedemann, CC BY 4.0

Picture: Caspar Armster

Moers LoRaWAN® Hackday – Outdoor Pool Monitor



Moers LoRaWAN® Hackday – FestivalTracker

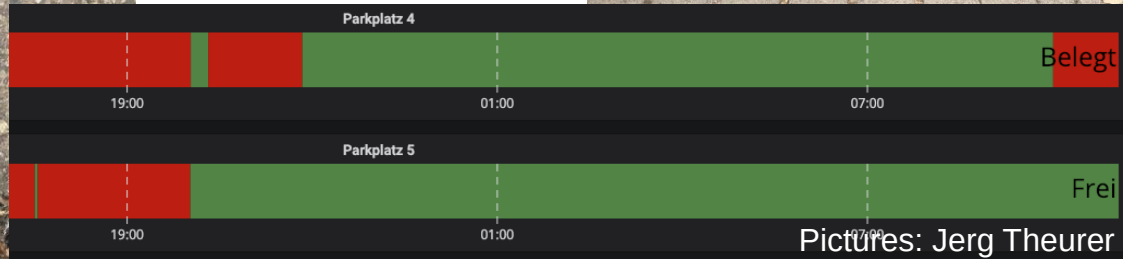
Moers LoRaWAN® Hackday – Obstacle Alerts

Picture: Damian Paderta, CC BY 3.0 DE

LoRaWAN® in the City of Herrenberg – Winter Service

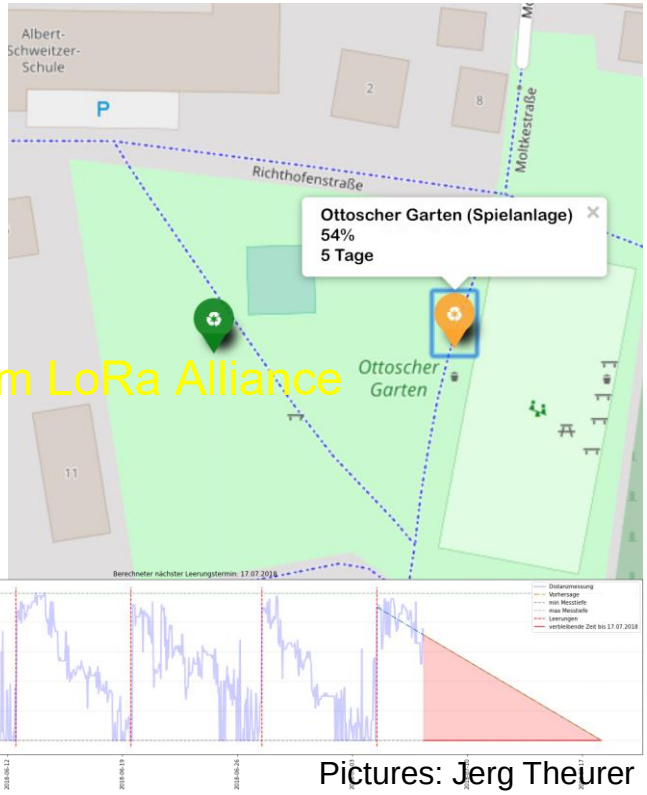
Pictures: Jerg Theurer

LoRaWAN® in the City of Herrenberg – Parking Sensors



Pictures: Jerg Theurer

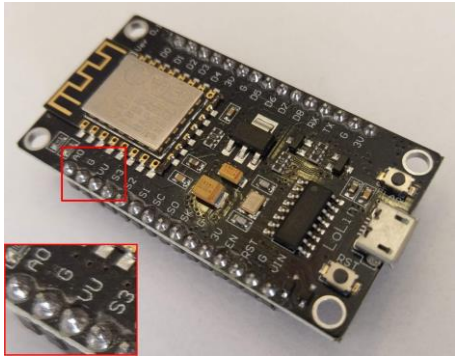
LoRaWAN® in the City of Herrenberg – Trash Can Monitoring



Pictures: Jerg Theurer

Finally, it’s about the environment…

Luftdaten.Info – Particle Matter Measurements with Citizen Science

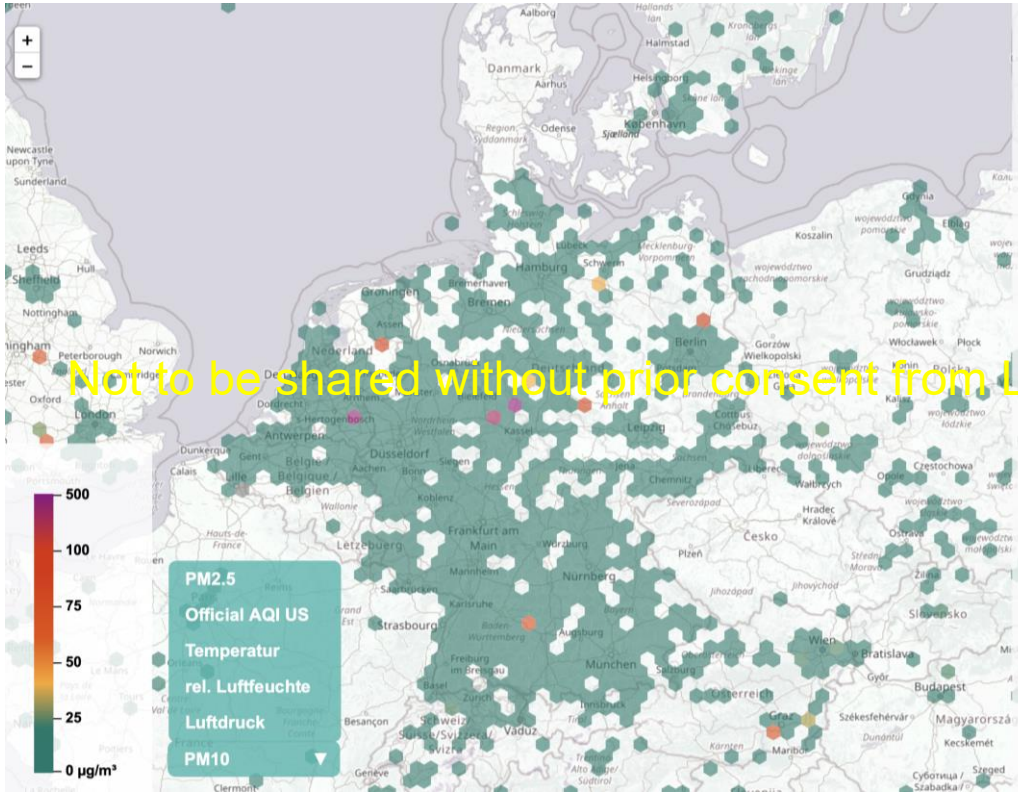


NodeMCU ESP8266,

SDS011, Particle Matter Sensor

Source: luftdaten.info

Particle Matter Measurements with Citizen Science



Sensor	PM10 µg/m³
Median 118 Sens.	7
(+) #283	6
(+) #347	14
(+) #593	9
(+) #1376	9
(+) #1465	28
(+) #2015	5
(+) #2057	7
(+) #2123	4
(+) #2125	4
(+) #2285	7
(+) #2287	12
(+) #2810	10
(+) #2848	7
(+) #3123	4
(+) #3287	13
(+) #3465	6
(+) #3491	7
(+) #3763	13
(+) #3937	6
(+) #4337	10
(+) #4440	8
(+) #4806	11
(+) #5149	8
(+) #5247	9
(+) #5666	9
(+) #5716	11
(+) #6537	6
(+) #6727	5
(+) #6733	11
(+) #6817	8
(+) #6856	7
(+) #6876	10
(+) #7051	4
(+) #7385	5
(+) #7787	10

Source: luftdaten.info/

Summary

- As we can see, many **impressive examples** for the **contribution** of **LoRaWAN®** to **society** are already out there.
- And they pretty much all **started** with a **combination** of **technical education** (e.g. workshops, hackathons) and **easily accessible hardware** & **infrastructure**.

- Making the **LoRaWAN®** technology available to **‘technical non-natives’** opens up an entire new **field** of **use cases**.
- And, many of these **use cases** do not solely contribute to the good of their initiator, but have a much **larger impact** on **cities**, **municipalities** and the **environment.**

LoRaWAN®

Creating Valuable IoT Connections

@LoRaAlliance

linkedin.com/company/loraalliance/

marcom@lora-alliance.com

lora-alliance.org

LoRa Alliance™

WELCOME TO LoRaWAN® LIVE

TECHNICAL TRACK 2.00PM – 6.00PM

BERLIN, JUNE 13, 2019

LoRaWAN®

Creating Valuable IoT Connections

LoRaWAN® Roaming

Alper Yegin, Actility

LoRa Alliance AMM, Berlin 2019

LoRaWAN®

Creating Valuable IoT Connections

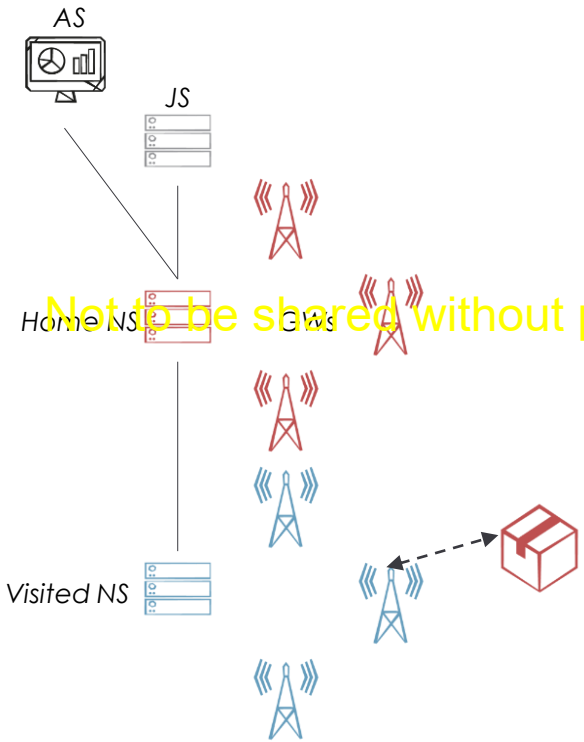
Why Roaming?

Coverage extension

Running core without radio network

Coverage densification

Coverage Extension

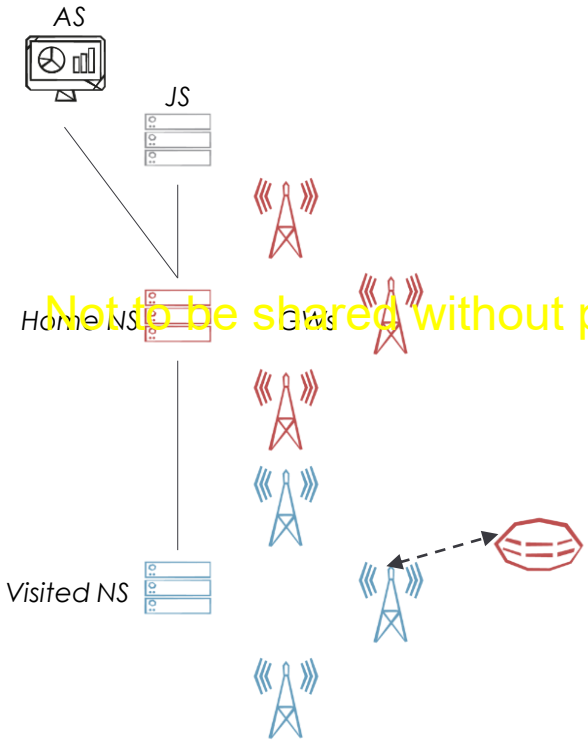


Public or private/enterprise networks

Geographically adjacent or disjoint

AS: Application Server
JS: Join Server
NS: Network Server
GW: Gateway

Coverage Extension

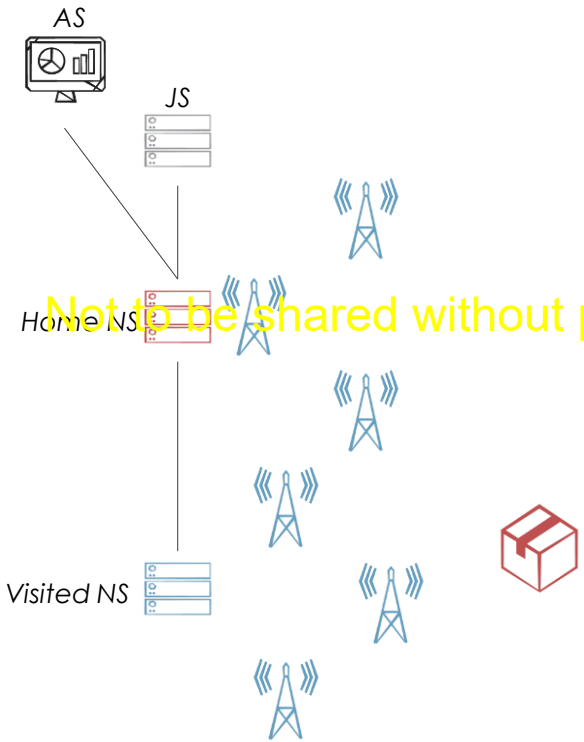


Public or private/enterprise networks

Geographically adjacent or disjoint

Always roaming

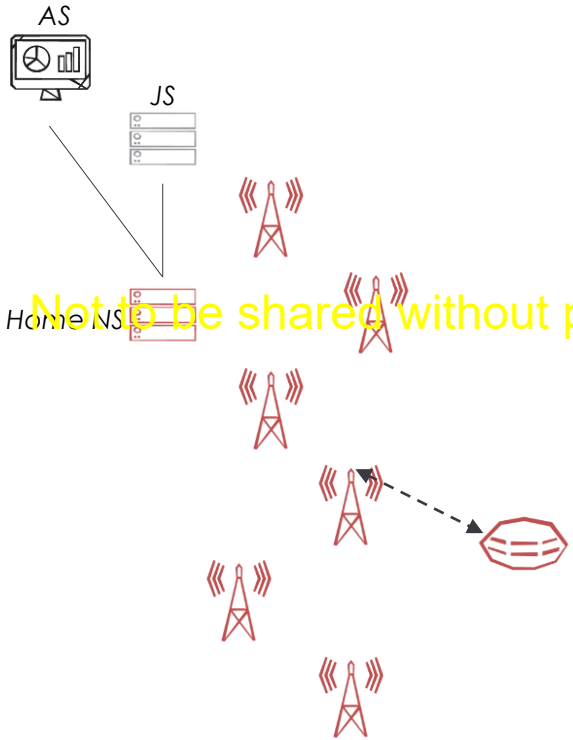
Core without Radio Network



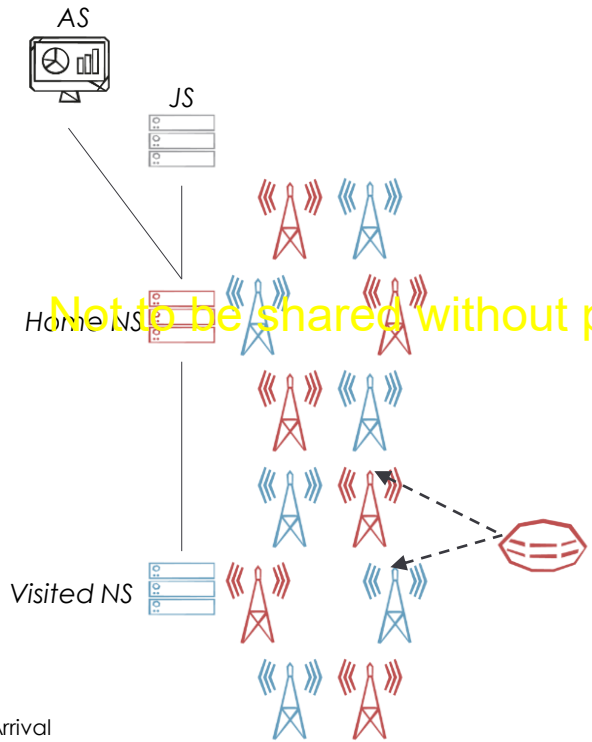
Enterprise networks can choose to have their own core network w/o building the radio networks

⇒ Feasible with LoRaWAN® due to low cost infra

Coverage Extension not Needed?



Coverage Densification



Macrodiversity! (several receivers)

⇒ Closer GWs

⇒ Higher data rate, lower power (ADR!)

⇒ Less interference (win-win)

⇒ Less packet error rate

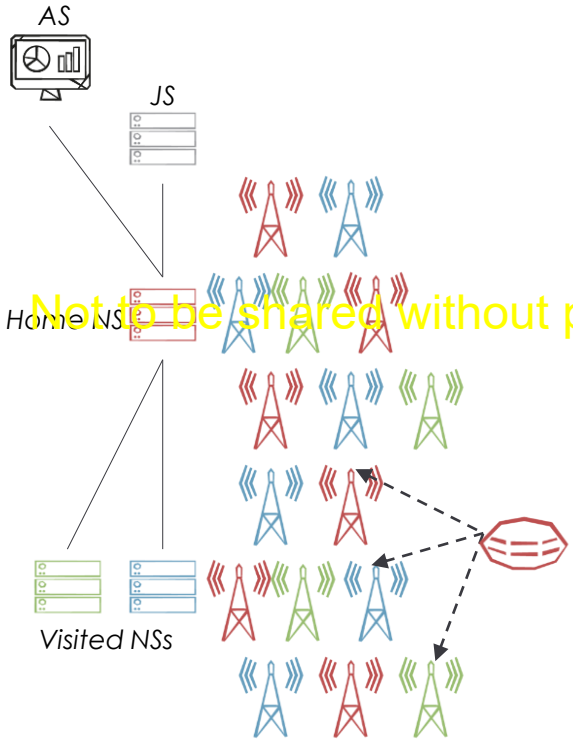
⇒ More battery life

⇒ More GWs

⇒ Better TDOA/RSSI geoloc accuracy

ADR: Adaptive Data Rate
TDOA: Time Difference of Arrival
RSSI: Received Signal Strength Indicator

Coverage Densification

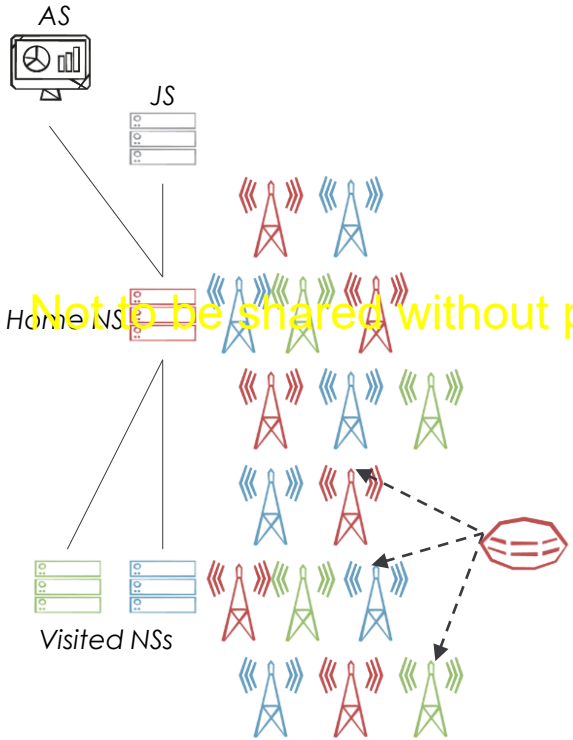


Simultaneous roaming with multiple networks

⇒ Even closer GWs

⇒ Even more GWs

Coverage Densification



Macrodiversity! (several receivers)

Device at home and roaming with multiple networks at the same time

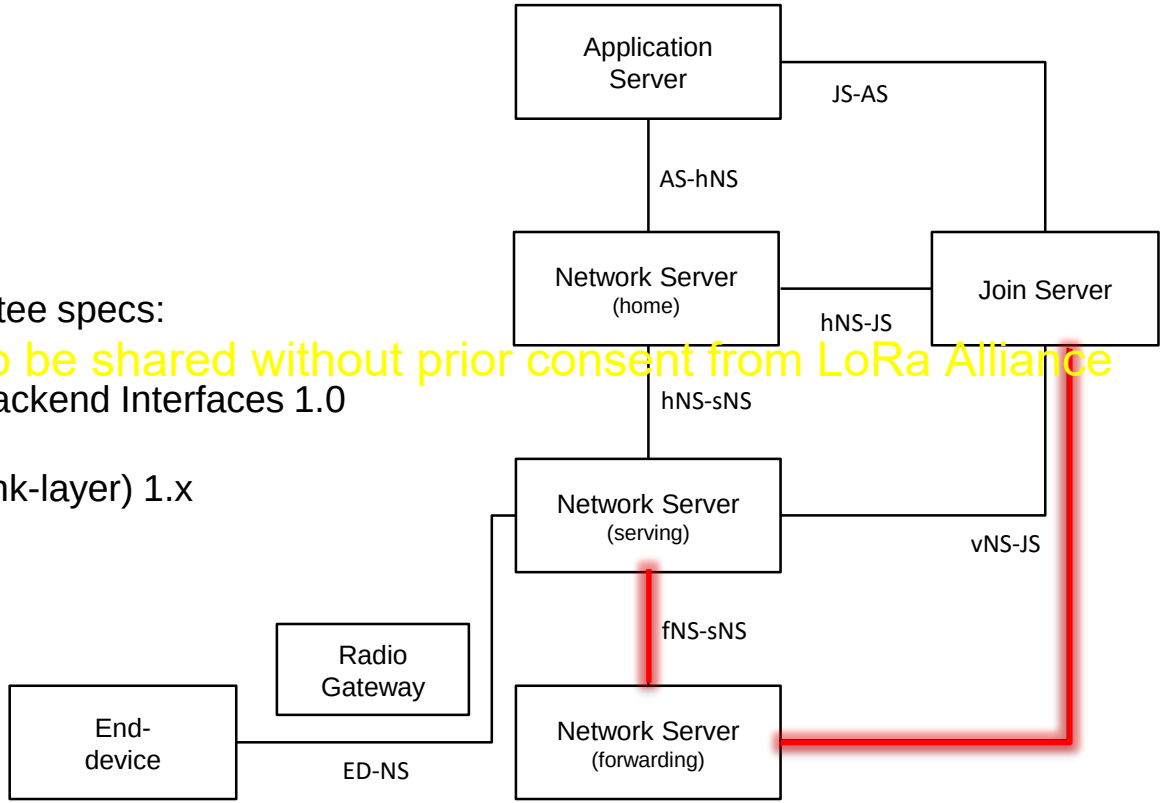
*Very **unique** mode of roaming!*

- *Not available to NB-IoT, Wi-SUN (tech limitation)*
- *Not available to SigFox (business model limitation)*

Step 1: Implement the Specs

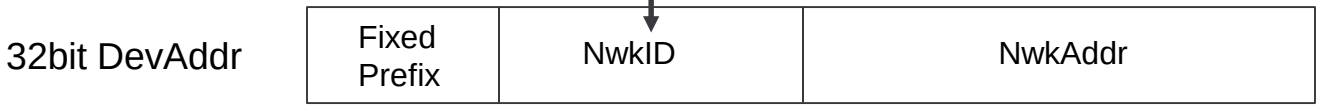
Technical Committee specs:

- LoRaWAN® Backend Interfaces 1.0
- LoRaWAN (Link-layer) 1.x



Step 2: Get a NetID

Identifies your network, when your devices send uplinks in visited networks



NwkID is a scarce resource (limited # of bits)

NwkID generated from NetID

NetIDs assigned to LoRa Alliance™ members

SpoAnsors *Contributors*

NetID Type	NwkAddr Size
0	25bit
3	17bit
6	10bit

Adopters/Institutionals

Avoid Mistakes

Identifies your network, when your devices send uplinks in visited networks

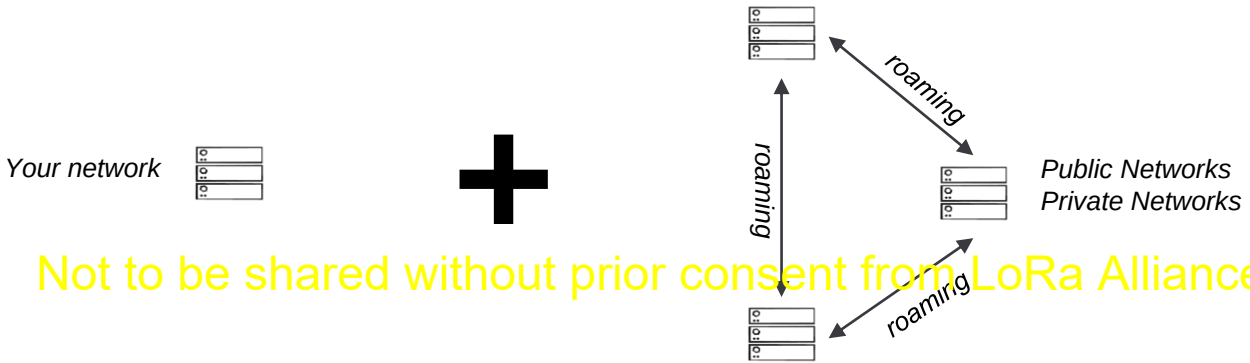
DevAddr

Join-request

Identifies Join Server, that helps visited network discover the home of an activating device

Random DevAddr or JoinEUI/AppEUI ⇒ Device loses home while roaming

Step 3: Partner up!



Not only a “necessity” but also a “strength” for LoRaWAN

Treat collaboration/roaming as ”default” choice

Step 4: Setup!

On your NS, configure Peer's:

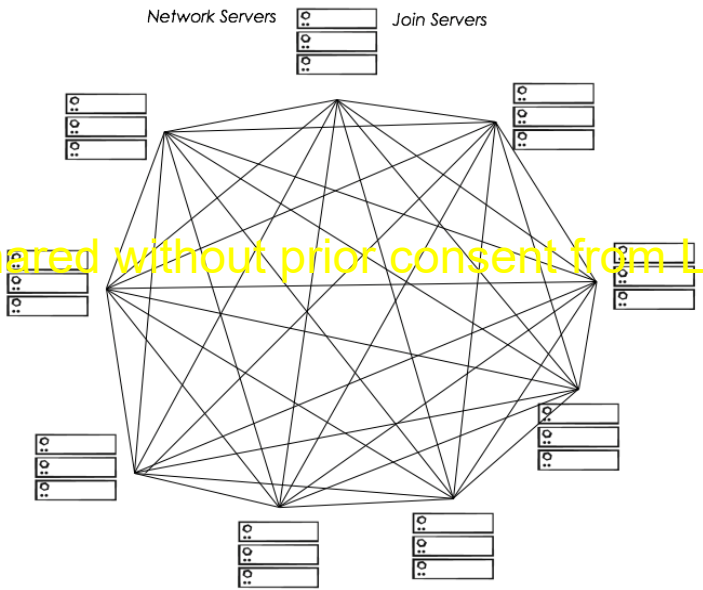
NetID(s)
Channel plan
fNS URL
sNS URL
NS IP address(es)
HTTP auth credentials
JS URL(s)
JS IP address(es)
JS HTTP auth credentials
And roaming policy (roam-in, roam-out, stateful/stateless)

On the JS(s) you are using, configure Peer's:

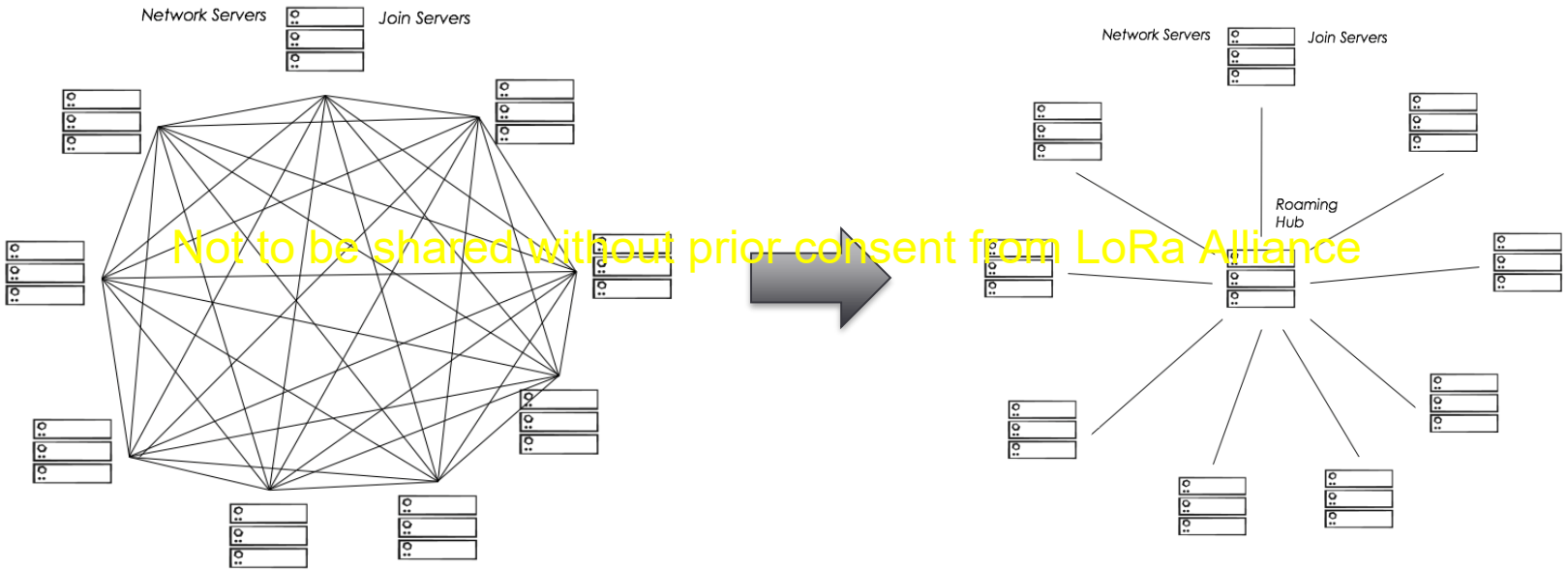
NetID(s)
fNS URL
NS IP address(es)
HTTP auth credentials

Mesh Interconnect

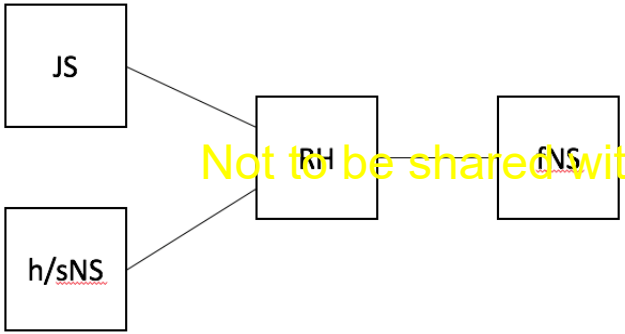
Configuration and management does not scale

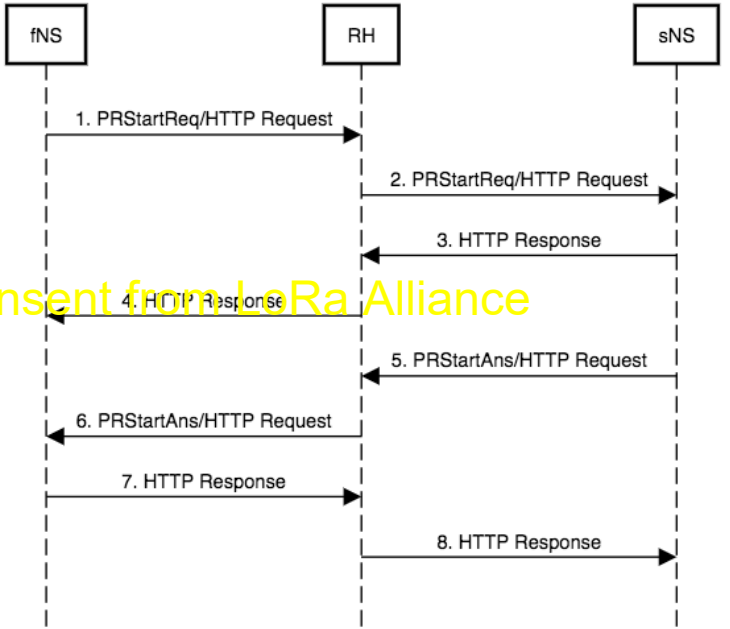


Star Interconnect



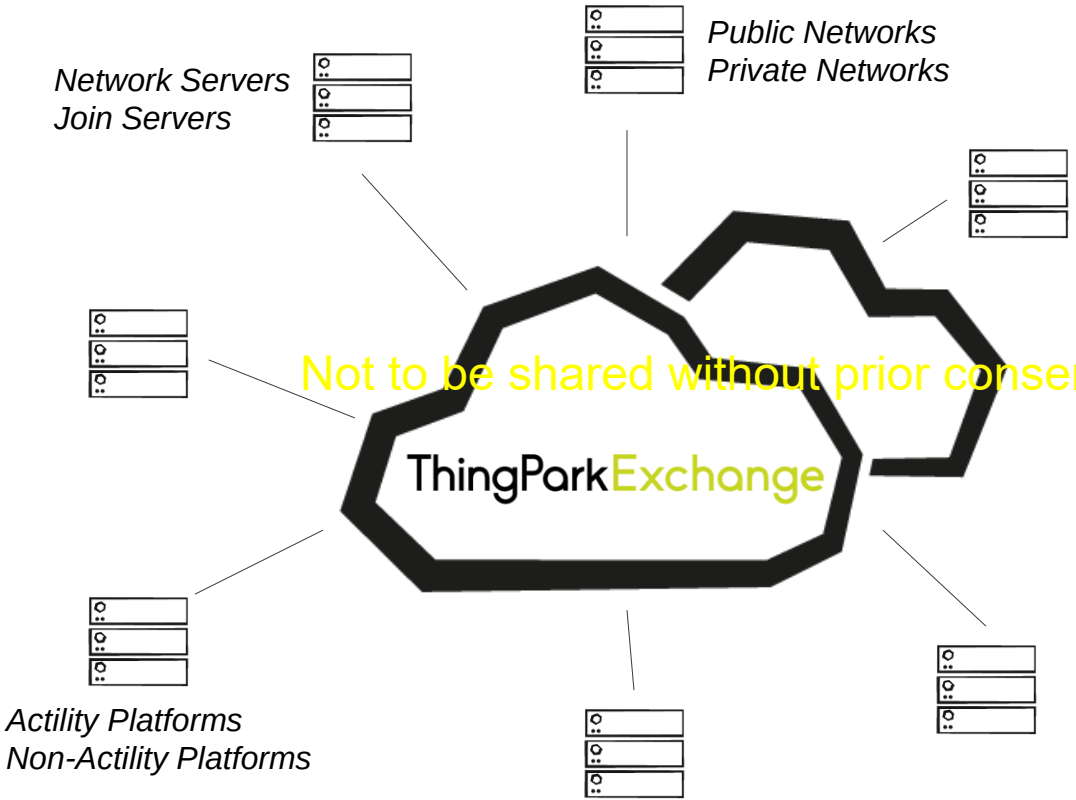
Hub Insertion





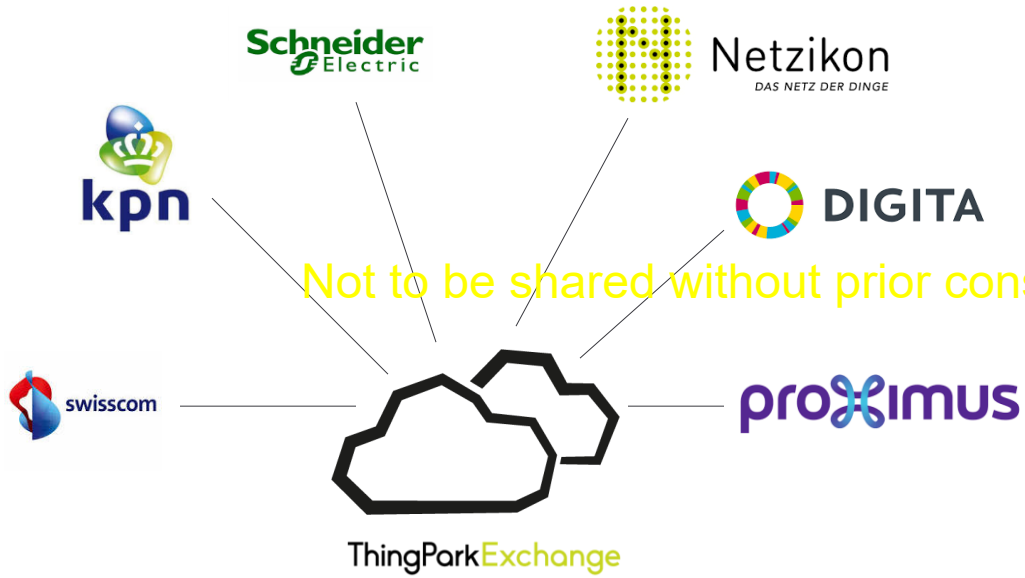
JS: Join Server
fNS: Forwarding Network Server
sNS: Serving Network Server
RH: Roaming Hub

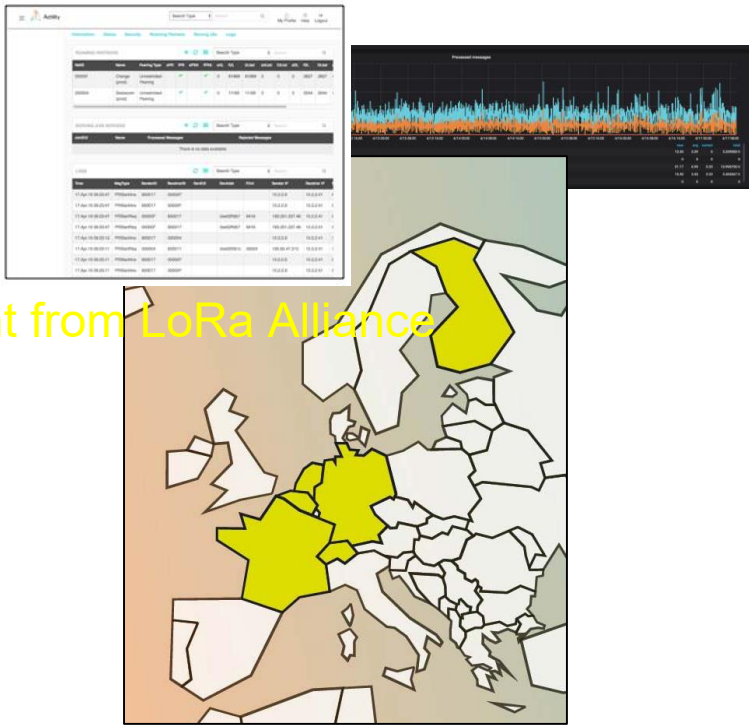
ThingPark Exchange: Peering hub



- Easy and scalable interconnections
  - Lower cost: **Interconnect your network ONCE, reach ANY network**
  - Faster network onboarding
  - Reaching a larger peering pool
    - Any size, any vendor, any geography
- Centralized and extensible policy control
- Security shield against NS/JS peering nodes
- Extensible business/peering models
- Unified and live visibility (web UI, UDRs, logs)

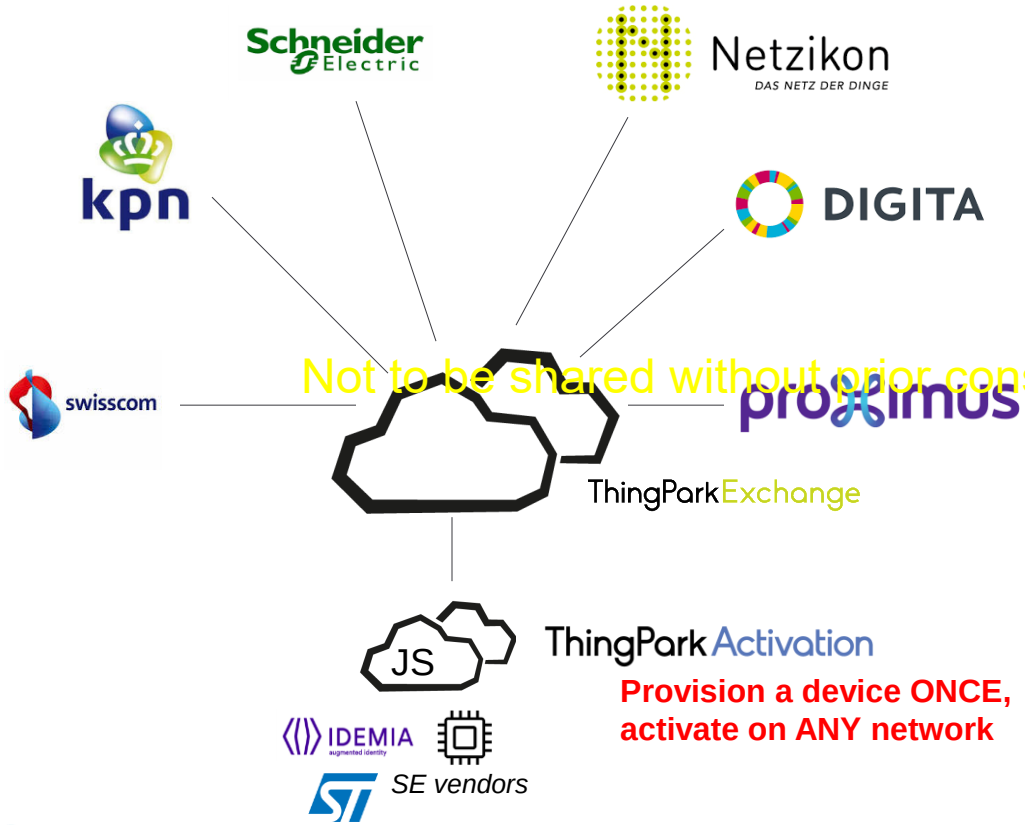
Interconnecting Networks for Roaming



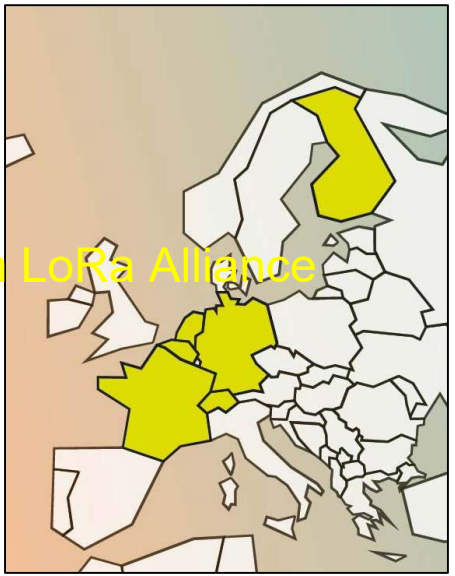


+ Levikom, Enforta (ERTH), …

Interconnecting Networks for Roaming & Activation



Provision a device ONCE, activate on ANY network



Roaming standard available

Implemented

Deployed

Welcome to join!

ThingParkExchange

LoRaWAN®

Creating Valuable IoT Connections

@LoRaAlliance

linkedin.com/company/loraalliance/

marcom@lora-alliance.com

lora-alliance.org

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WELCOME TO LoRaWAN® LIVE

TECHNICAL TRACK 2.00PM – 6.00PM

BERLIN, JUNE 13, 2019

LoRaWAN®

Creating Valuable IoT Connections

LoRa Alliance™ Certification update
LoRaWAN® Live

Derek Hunt – Certification Committee Chairman

LoRaWAN®

Creating Valuable IoT Connections

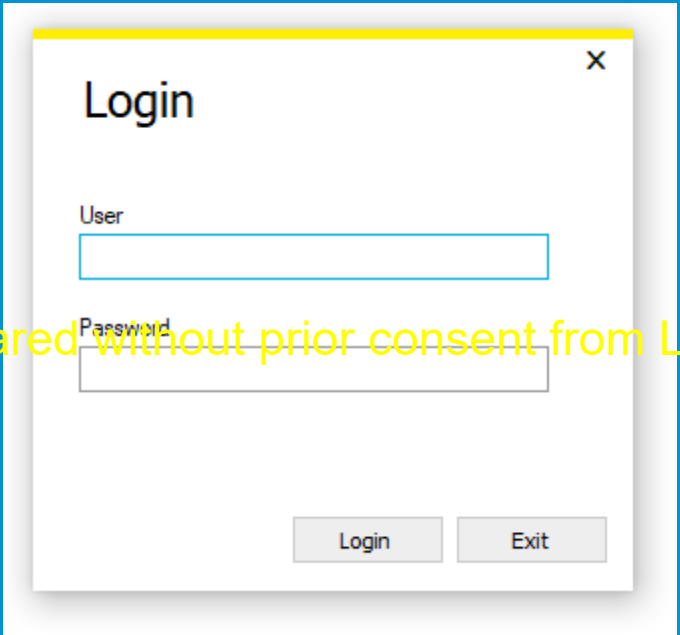
Topics

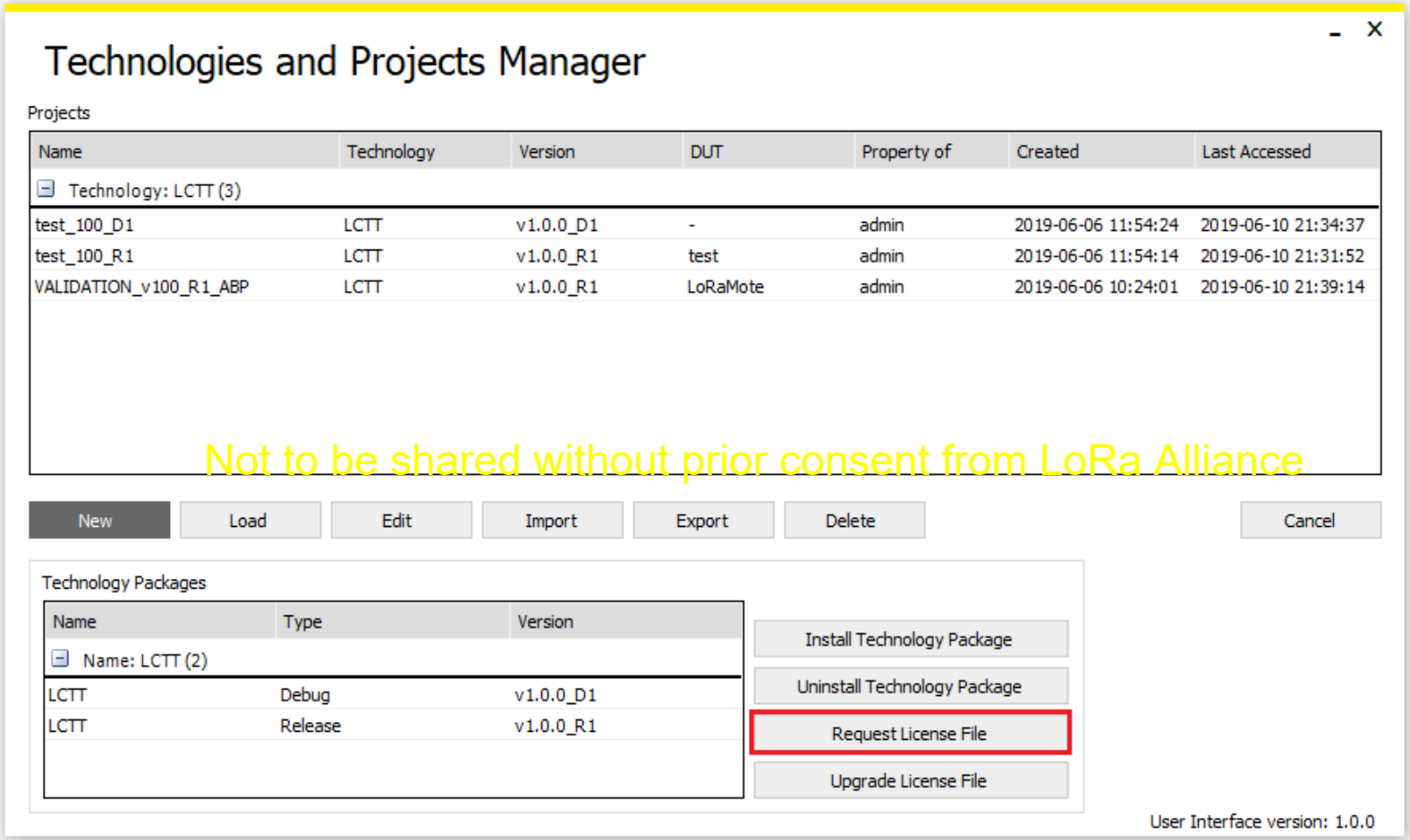
- LoRaWAN® Certification Test Tool Now Available (LCTT)
- Collective LoRaWAN® Device Qualification Program (CLDQP)
- Enhancements of Interoperability test
- Mandating RF testing
- New LoRaWAN1.0.4

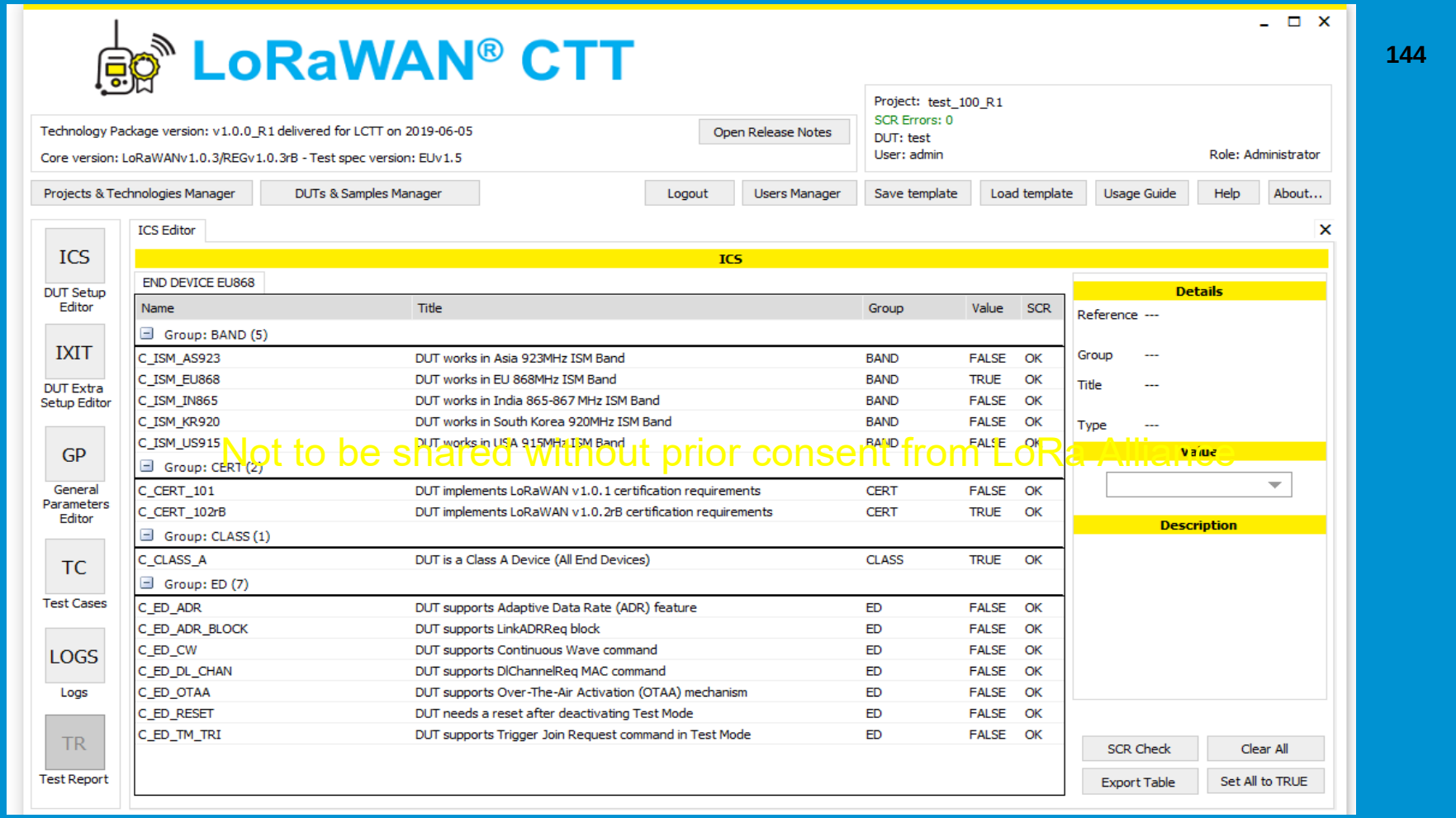
LoRaWAN® Certification Test Tool Now Available (LCTT)

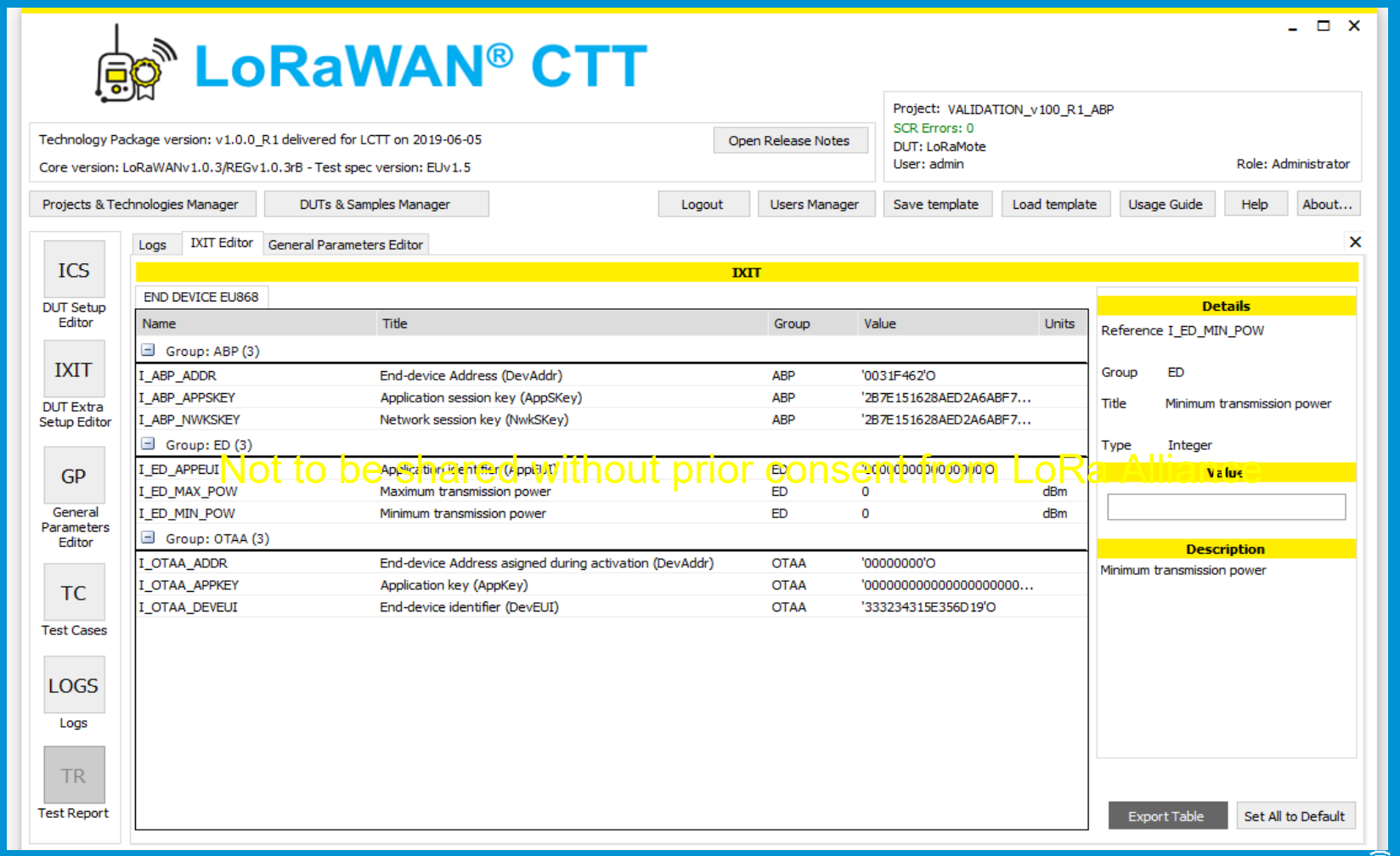
- LoRa Alliance™ is Developing the LCTT for all LoRa Alliance device manufactures to pre-test their device before sending it the Authorised test Houses (ATHs) for the LoRaWAN® Certification testing .
  - It will accelerate the certification process
  - Provide significant benefit to LoRa Alliance members
  - Will save time and money allowing devices to debug and design finalize prior to starting the formal certification process
- The LCTT is a precertification and regression testing tool
  - Used at a device manufacturer's own facility
  - Will enable manufactures to prove the design a device design before shipping it for formal certification testing.
  - The LCTT will have a precertification mode and a debug mode
  - Initial release this week for testing in specific regions,
  - With full global availability of LCTT and final release September 2019.
  - Test tool which will run on a local PC and LoRaWAN Gateway connection for Licence etc. via a central server
- The LCTT will also be made available to the ATHs if they wish to use it instead of their own test harness.
- DEKRA selected as vendor of LCTT and the tool is based on their LoRaWAN Certification test harness which is already approved for LoRaWAN Certifications.

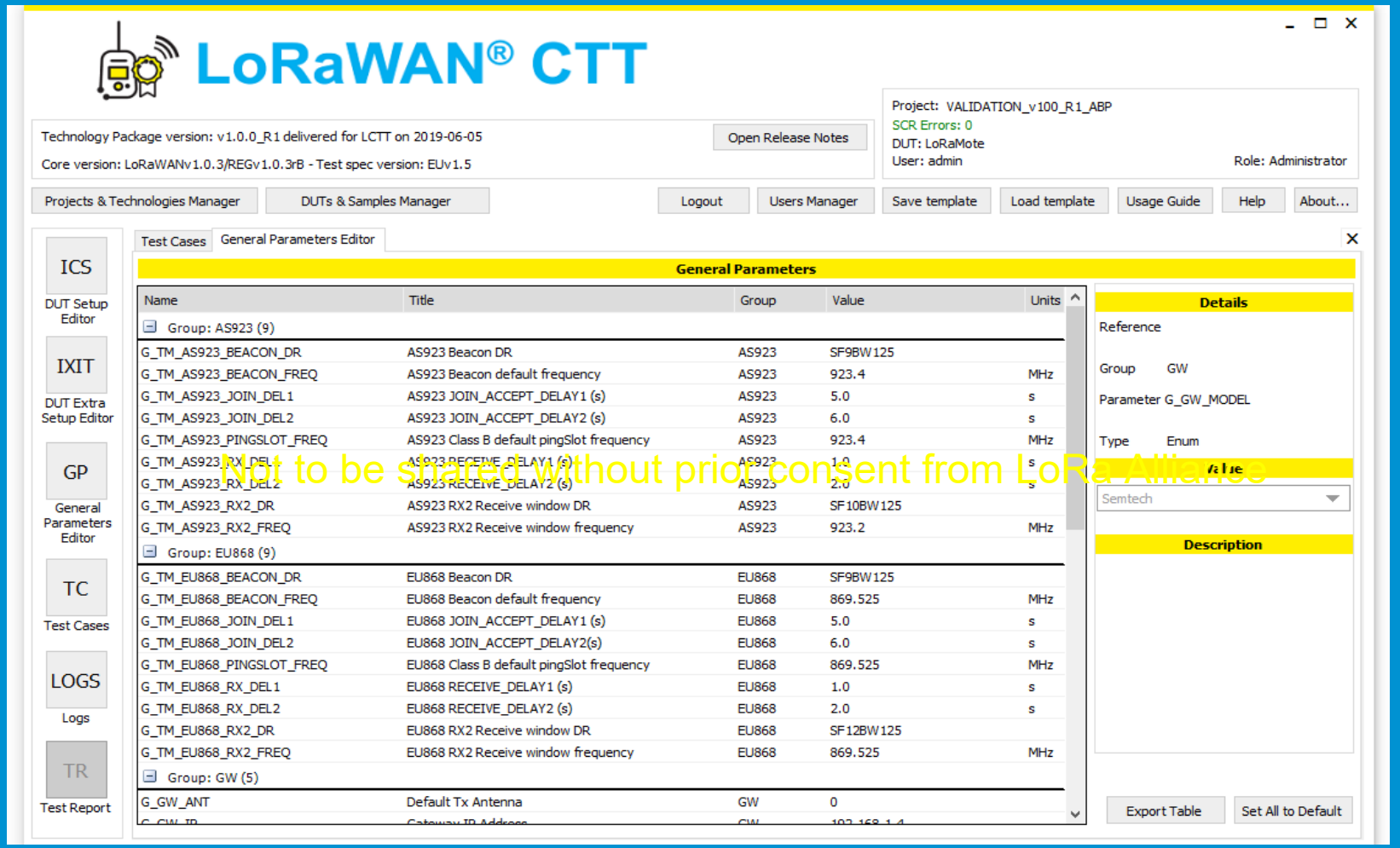
LCTT Screen shots

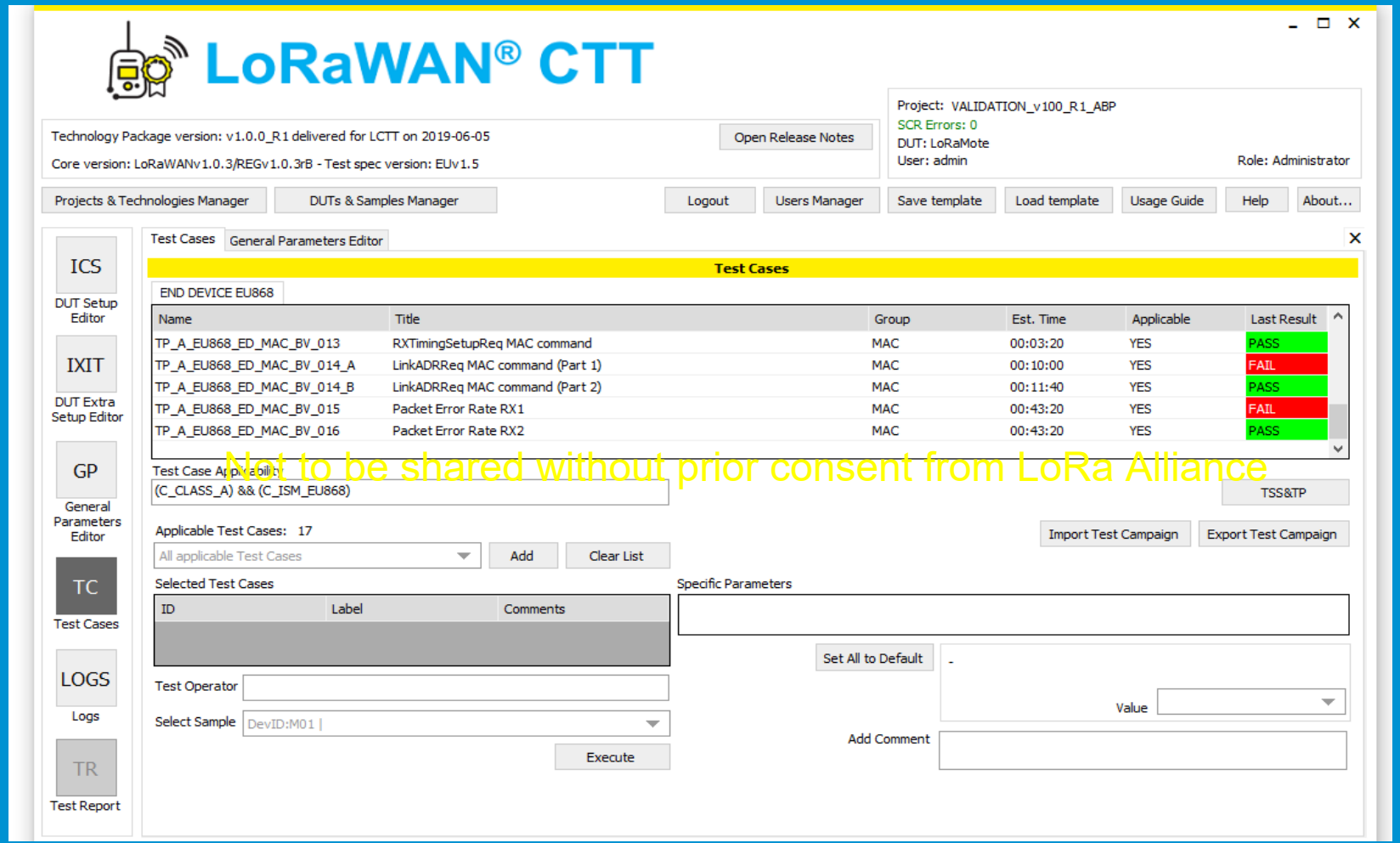


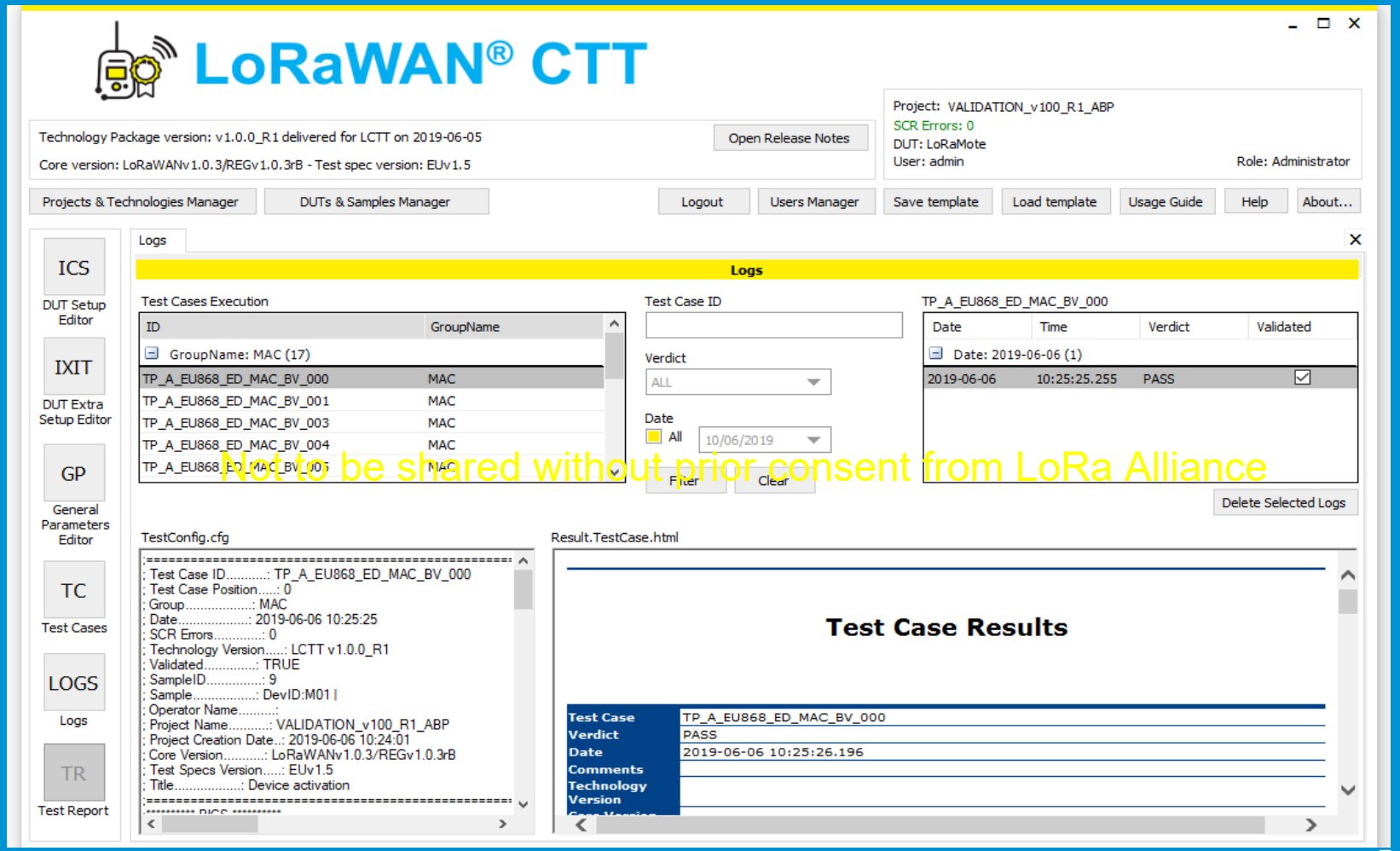

Technologies and Projects Manager
Projects
Name
Technology
Version
DUT
Property of
Created
Last Accessed
Technology: LCTT (3)
test_100_D1
LCTT
v1.0.0_D1
-
admin
2019-06-06 11:54:24
2019-06-10 21:34:37
test_100_R1
LCTT
v1.0.0_R1
test
admin
2019-06-06 11:54:14
2019-06-10 21:31:52
VALIDATION_v100_R1_ABP
LCTT
v1.0.0_R1
LoRaMote
admin
2019-06-06 10:24:01
2019-06-10 21:39:14
Not to be shared without prior consent from LoRa Alliance
New
Load
Edit
Import
Export
Delete
Cancel
Technology Packages
Name
Type
Version
Name: LCTT (2)
LCTT
Debug
v1.0.0_D1
LCTT
Release
v1.0.0_R1
Install Technology Package
Uninstall Technology Package
Request License File
Upgrade License File
User Interface version: 1.0.0











TP_A_EU868_ED_MAC_BV_000 Report

Generated
20190606 10:25:54 UTC+02:00
4 days 11 hours ago

Summary Information

Status:	All tests passed
Documentation:	TP_A_EU868_ED_MAC_BV_000 - Device activation Enter test mode
Start Time:	20190606 10:25:25.888
End Time:	20190606 10:25:54.778
Elapsed Time:	00:00:28.890
Log File:	log.html

Test Statistics

Total Statistics	Total	Pass	Fail	Elapsed	Pass / Fail
Critical Tests	3	3	0	00:00:27	
All Tests	3	3	0	00:00:27	

Statistics by Tag	Total	Pass	Fail	Elapsed	Pass / Fail
Step 01 - Device activation	1	1	0	00:00:00	
Step 02 - Test mode activation	1	1	0	00:00:17	
Step 03 - Test mode deactivation	1	1	0	00:00:11	

Statistics by Suite	Total	Pass	Fail	Elapsed	Pass / Fail
TP_A_EU868_ED_MAC_BV_000	3	3	0	00:00:29	

Test Details

Totals | Tags | Suites | Search

Type:
- ○ Critical Tests
- ○ All Tests

Statistics by Suite	Total	Pass	Fail	Elapsed	Pass / Fail
TP_A_EU868_ED_MAC_BV_000	3	3	0	00:00:29	

REPORT

Log level: INFO

Test Execution Log

SUITE TP_A_EU868_ED_MAC_BV_000 — 00:00:28.890

Full Name: TP_A_EU868_ED_MAC_BV_000

Documentation: TP_A_EU868_ED_MAC_BV_000 - Device activation

Enter test mode

Source: C:\Program Files (x86)\LoRaAlliance\LCTT\Technologies\LCTT\v1.0.0_R1\Content\tests\EU868\TP_A_EU868_ED_MAC_BV_000.robot

Start / End / Elapsed: 20190606 10:25:25.888 / 20190606 10:25:54.778 / 00:00:28.890

Status: 3 critical test, 3 passed, 0 failed
3 test total, 3 passed, 0 failed

- SETUP Setup. Test Suite Init — 00:00:01.112
- TEARDOWN Setup. Test Suite End — 00:00:00.010
- TEST Device activation — 00:00:00.065

Full Name: TP_A_EU868_ED_MAC_BV_000.Device activation

Documentation: Device activation process

Tags: Step 01 - Device activation

Timeout: 2 minutes

Start / End / Elapsed: 20190606 10:25:27.307 / 20190606 10:25:27.372 / 00:00:00.065

Status: PASS (critical)

- SETUP Setup. Test Step Init — 00:00:00.011
- KEYWORD DeviceActivation. DUT activation process — 00:00:00.036
- TEARDOWN Setup. Test Step End — 00:00:00.016

- TEST Test mode activation — 00:00:16.563
- TEST Test mode deactivation — 00:00:10.831

LCTT Tool

- The LCTT will be accessible to download via link on LoRa Alliance certification web page at :

https://lora-alliance.org/lorawan-certification

- Bugzilla tracking system being set up to record any issues with the tool.

Collective LoRaWAN® Device Qualification Program (CLDQP)

- A significant group of Public Network Operators have collaborated to roll-out the “Collective LoRaWAN® Device Qualification Program”
  - This will support manufacturers
  - Ensure that devices work as intended
  - Significantly simplify and speed up the process required to devices connected to their networks.

Collective LoRaWAN® Device Qualification Program (CLDQP)

- Why have they announced this?
  - Issues have been encountered with devices not complying to the LoRaWAN® protocols and with RF performance. Both are crucial for successful IoT deployments.
- What does it mean ?
  - Instead of each network operator having their own device testing, they have agreed to use a common qualification process to approve the installation of LoRaWAN® devices onto their networks

- What is the process ?
  - The network operators have mandated that for any device to be accepted onto their networks it must already be :
    - LoRaWAN Certified^{cm} through the LoRa Alliance certification program using a LoRaWAN version 1.0.1 or newer (test mode and continuous wave mode must be supported)
    - Interoperability tested using the actual functionality on the device during real network operation (using the App S/W)
    - RF Performance tested using the guidelines defined by the LoRa Alliance

Enhanced certification program to include Interoperability test

- Why enhance the certification program ?
  - Current LA Certification tests concentrates full protocol testing of the LoRaWAN® Specification (using the using the Certification Test Application S/W).
  - Operators have seen issues when the device is using the application software during real network operations that is not always picked up by the current Certification tests and this is the focus on the Interoperability tests that have been identified.
  - The operators do not want to do this additional interoperability testing of the devices before allowing them onto their networks.
  - Device manufactures will not need to wait for their device to be tested on every network before freezing their design.

- What going to change ?
  - Enhance the existing LA Certification tests to include the additional tests that the operators are currently doing so that they do not need to do them.
  - Include some Interoperability tests are going to be run using only the Device Application S/W.
  - The Certification Committee is currently incorporating the tests that are performed by the operators into the Certification program

New LoRa Alliance™ Certification test stages:

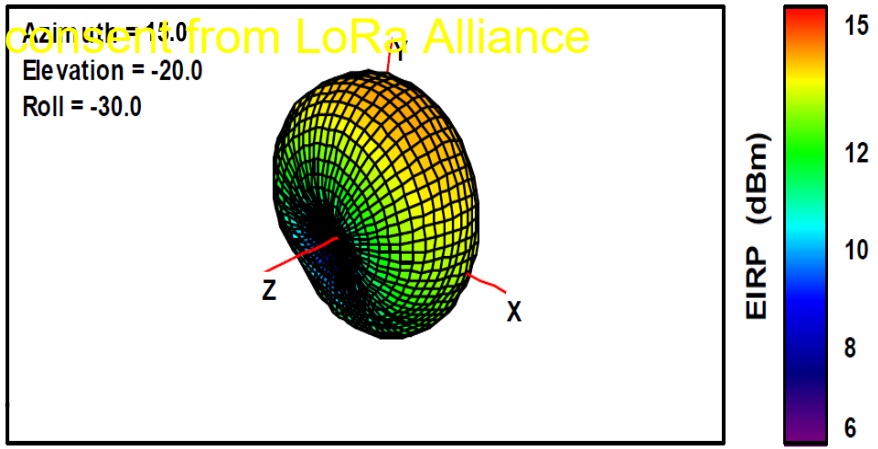
1. Pre-test by device Manufactures at their own locations using the LCTT.
2. Conformance tests Enhanced and run at Authorised test Houses (ATHs)
   - Full protocol testing (using the Certification Test Application S/W)
3. Interoperability tests run at ATH -
   - Testing functionality of the device during real network operation (using the App S/W)
   - New test plan based on what operators are currently using.
4. RF Performance tests.

Mandating RF testing

- Every device must be tested to ensure that it does not exceed the maximum regulatory requirements before being able to be used, but does not state what the actual output power and sensitivity are.
- The RF performance is crucial for successful deployments of IoT applications. Poor performance due to the antenna designs or sizes results in inadequate RF emission power and sensitivity. This leads to inefficient energy management in the device and causes network coverage issues as only the devices close to the gateway are usable.

Radiated RF Performance Evaluation Procedure

- Created by the Certification Committee to a harmonise approach to the measurement of the Transmit and Received performance of a LoRaWAN® Product.
- Used by the LoRa Alliance™ ATHs or other parties.
- Transmission Performance is measure as EIRP in a full 3D radiation power pattern
- Received performance is measured by detecting the point that the product reached a packet error rate (PER) of 10 percent
- Measurement performed on RX1 and RX2.
- The angle used for the test is from a region where the antenna gain is stable.
- Tested Devices displayed on the LoRa Alliance website (Manufactures may declare results or give contact details to obtain them.)
- RF Performance test Mandatory as part of the LoRa Alliance EU863-870 Certification from July 2019



LoRaWAN1.0.4

- Devices currently deployed (and earning revenue) are based on the LW1.0.x platform and this will continue for the foreseeable future, especially for those device/services that don't require handover roaming (passive roaming is supported on LW1.0.x).
- LW1.0.4 is an update to the L2 specification to clean up the LW1.0.x and resolve LoRaWAN® ambiguities.

In Scope

- Normative Cleanup
- Specification and Behavior Clarifications
  - ADR
  - JoinEUI vs AppEUI
  - Class B/C receive windows
  - CFList Error handling and restart behavior
  - 32 bit FCnt only
  - Retransmission behavior
  - MAC Command processing/response
  - ABP FCnt requirements (persistence required)
  - DevNonce increments

Out-of-Scope

- New MAC commands
- New key hierarchy
- New MIC calculation (split MIC)
- Handover Roaming features
- LW 1.1 protocol identifiers
- Issues that introduce compatibility problems

To be released soon with certified reference stack and the certification program

LoRaWAN®

Creating Valuable IoT Connections

@LoRaAlliance

linkedin.com/company/loraalliance/

marcom@lora-alliance.com

lora-alliance.org

LoRa Alliance™

WELCOME TO LoRaWAN® LIVE

TECHNICAL TRACK 2.00PM – 6.00PM

BERLIN, JUNE 13, 2019

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TECHNICAL Q&A

Thorsten Kramp, Co-Chair, LoRa Alliance Technical Committee

Alper Yegin, Co-Chair, LoRa Alliance™ Technical Committee

Derek Hunt, Chair, LoRa Alliance Certification Committee

Thank you for attending LoRaWAN® Live.

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