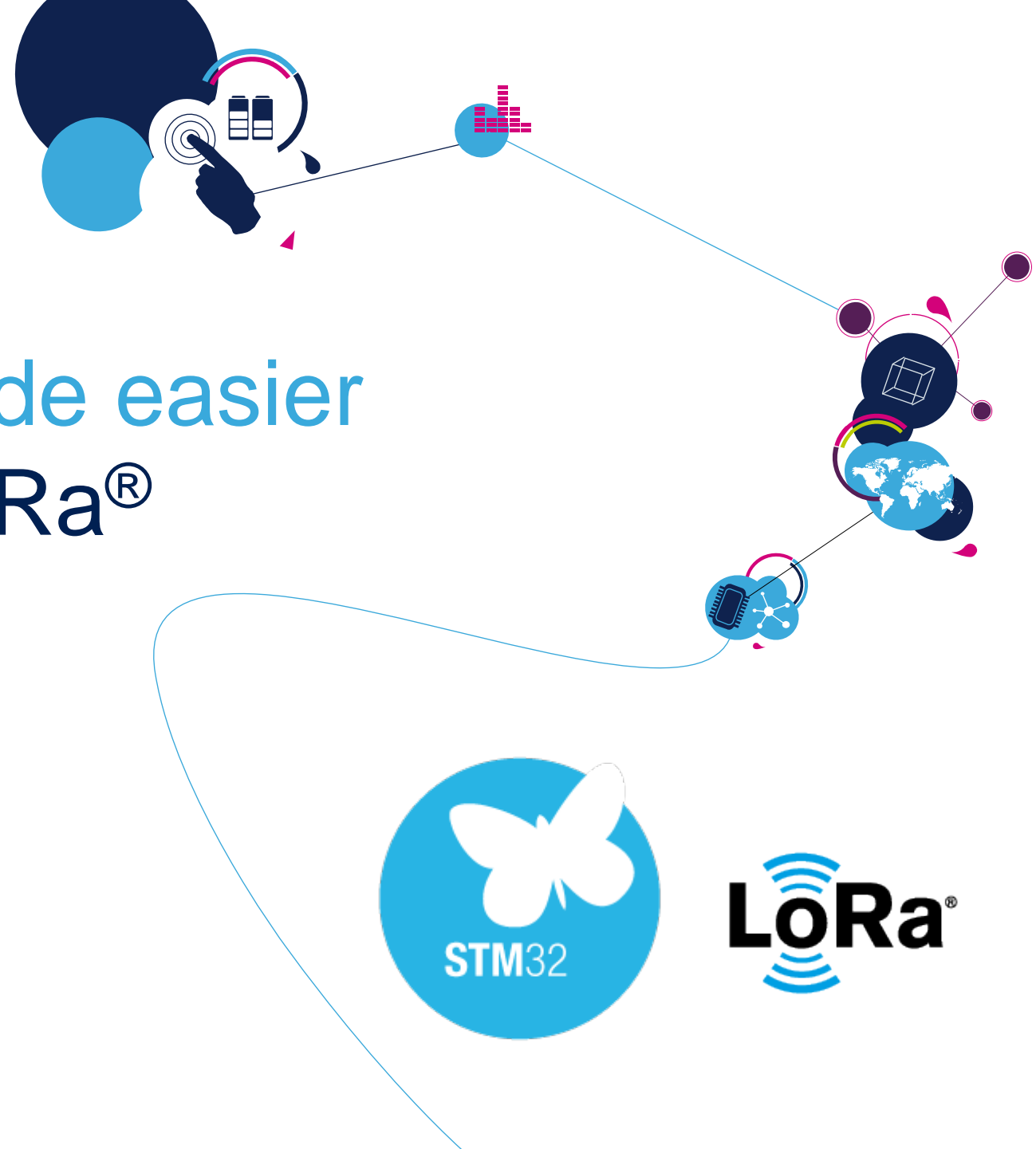


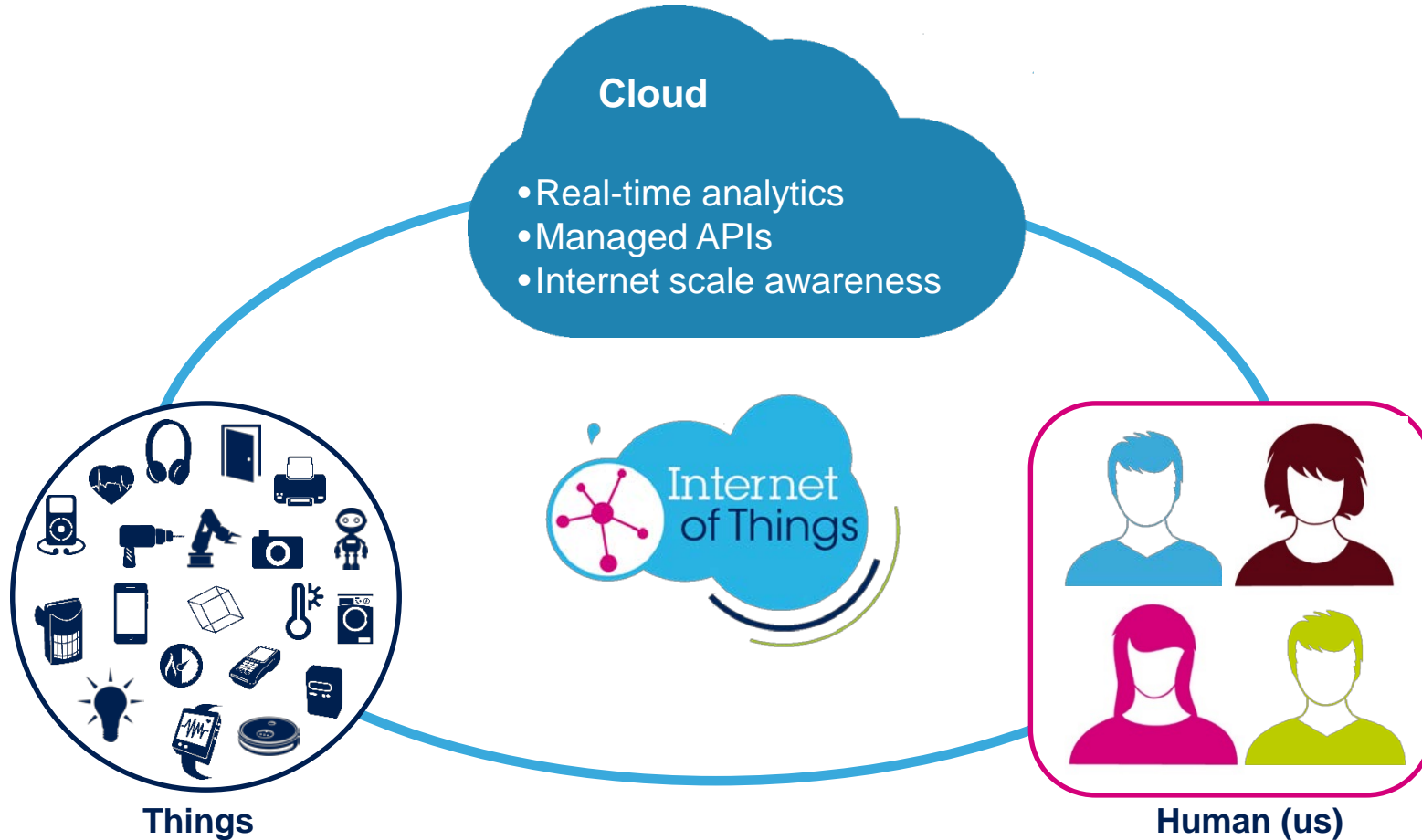
IoT connectivity made easier

STM32 MCUs & LoRa[®]



1. What is IoT ?
2. Communication technologies – Overview
3. LPWAN
4. LoRa® and LoRa Alliance
5. LoRa® technology modulation and LoRaWAN™ network protocol
6. STM32 boosting LoRa® (Roadmap, demos, competition, and schedule)

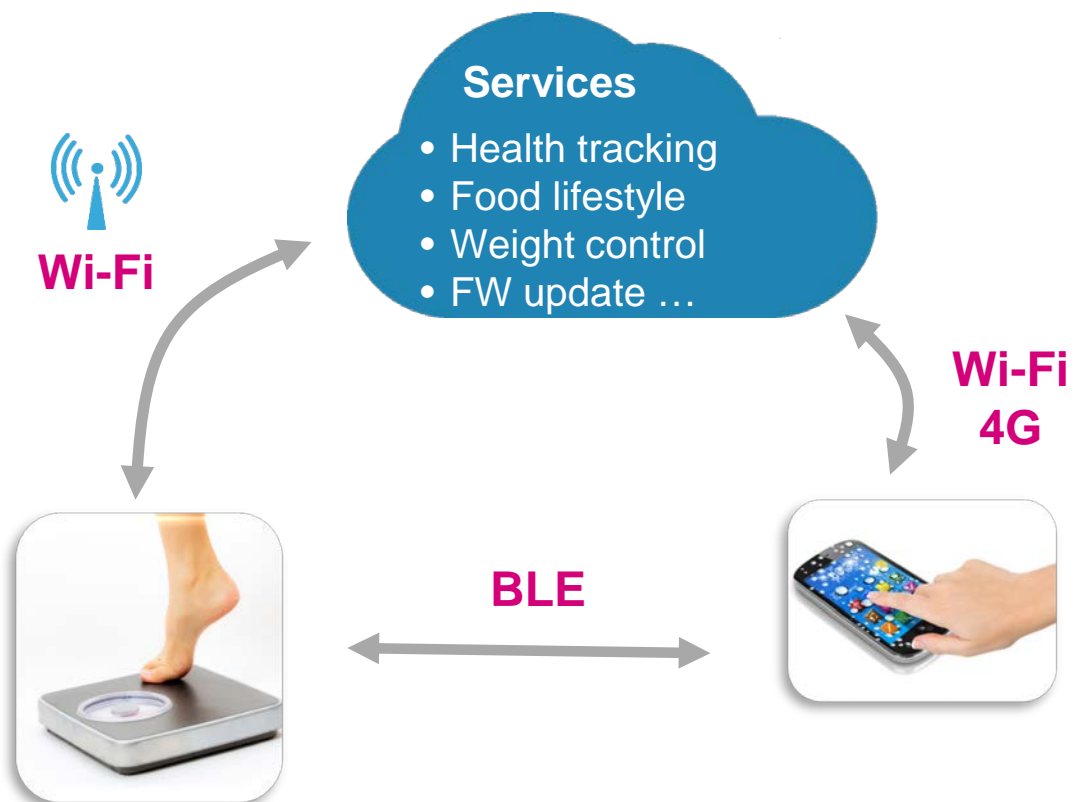
While M2M networks connect machines in closed systems, **IoT enhances the exiting networks** through an intelligent cloud.



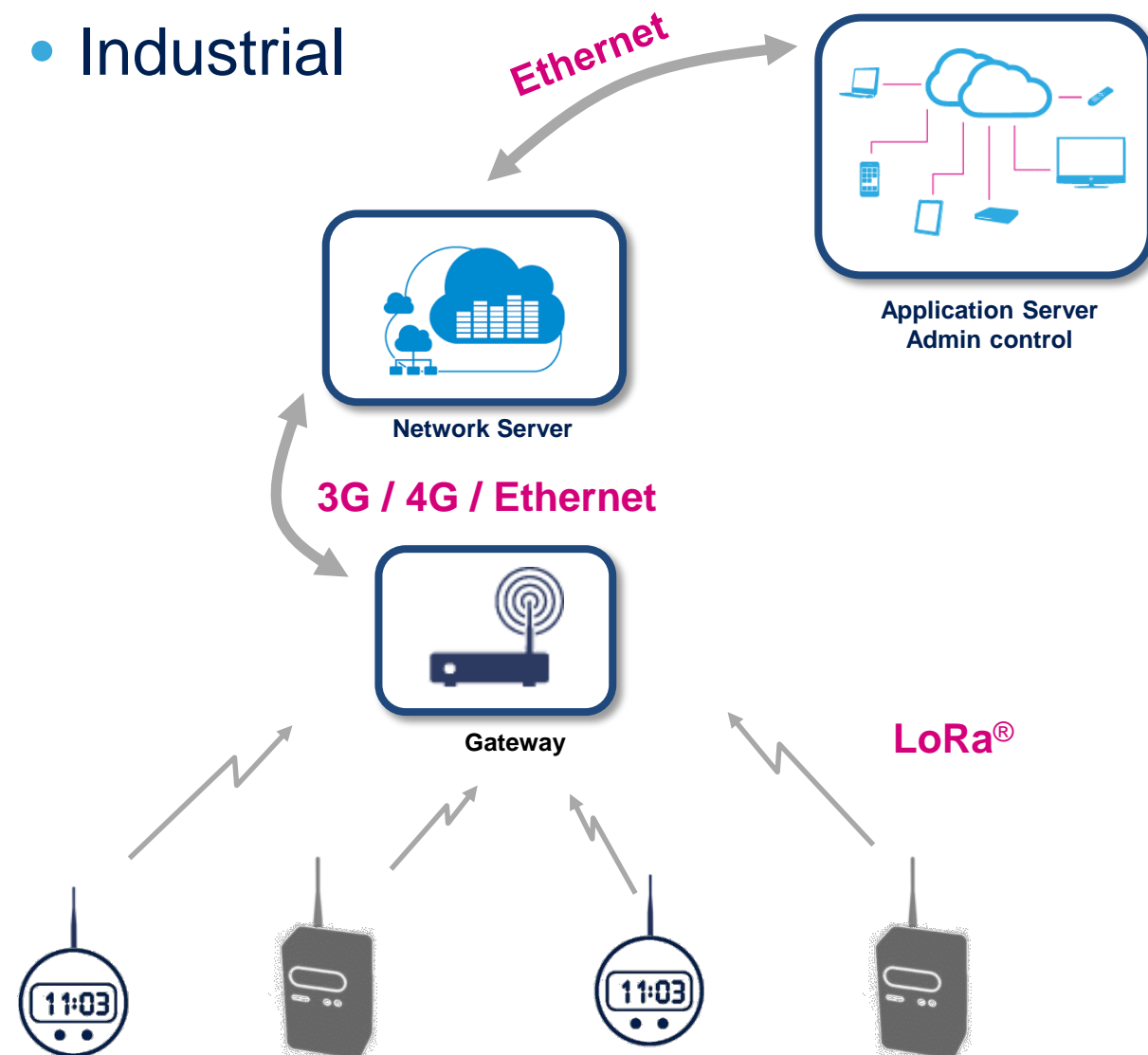
IoT use cases

4

• Consumer

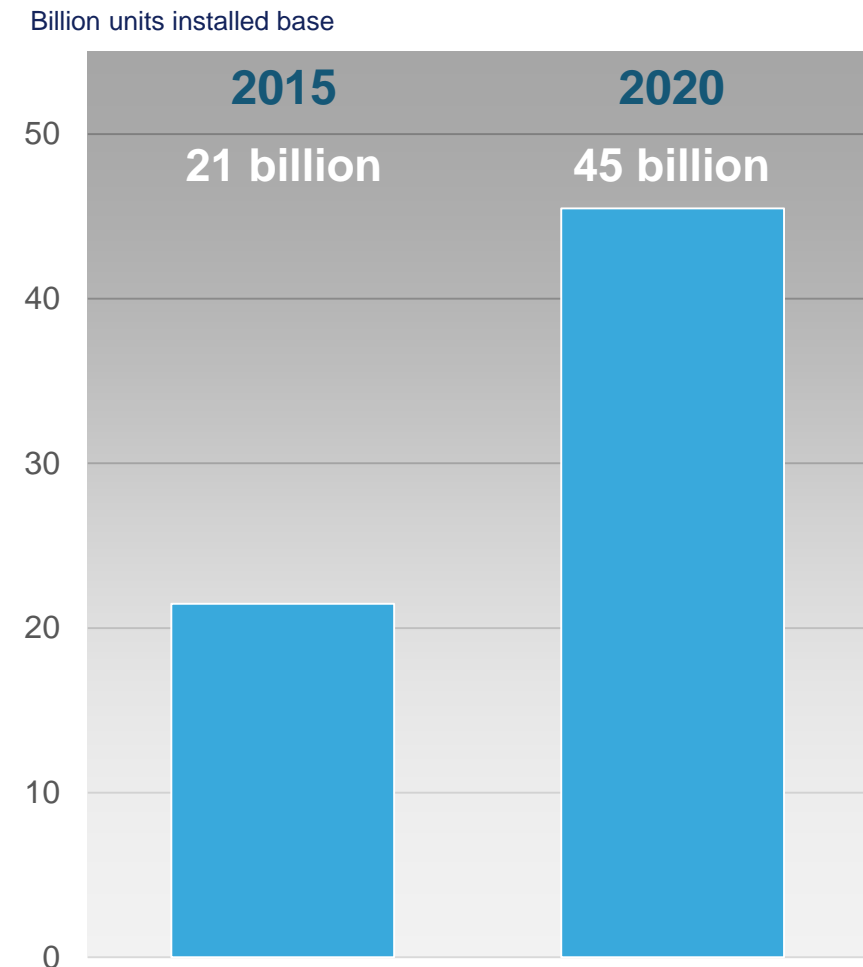
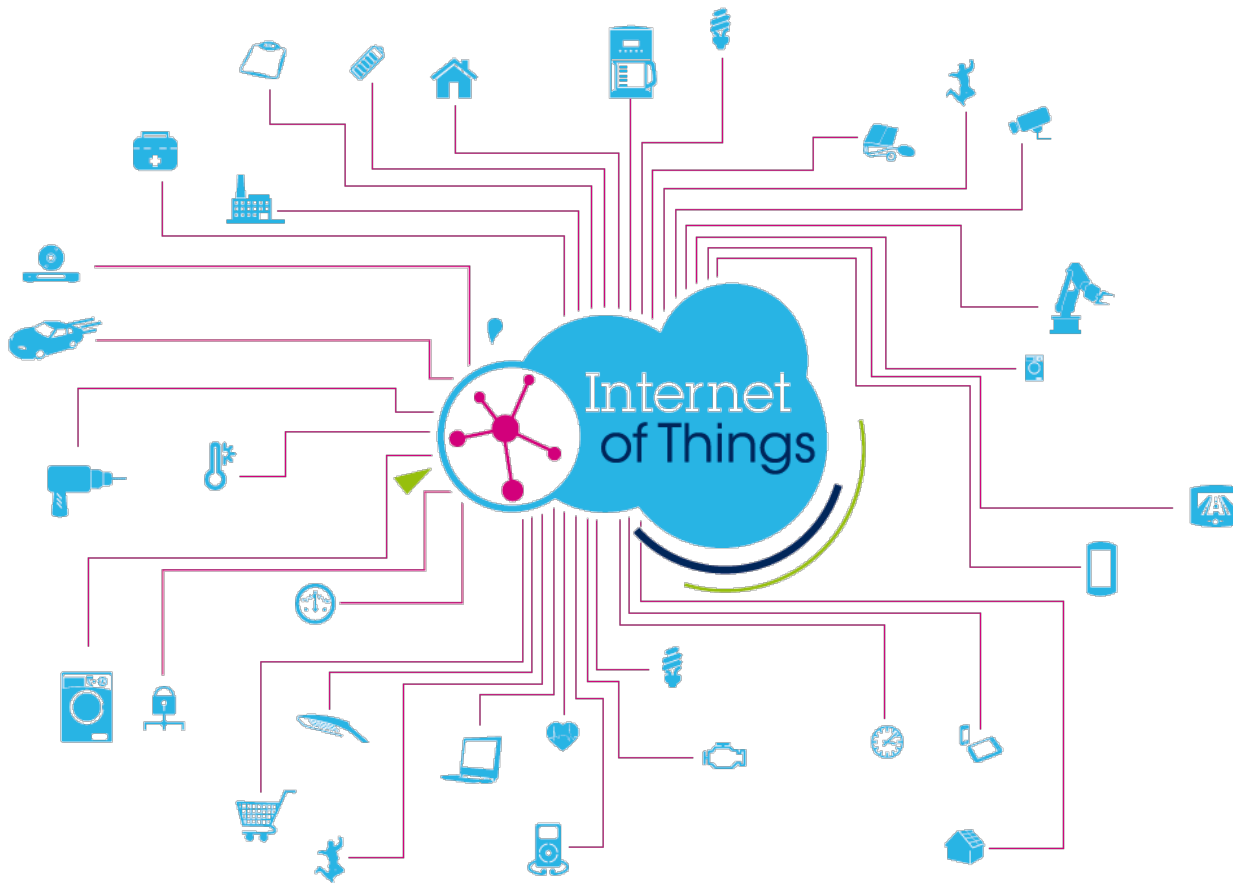


• Industrial



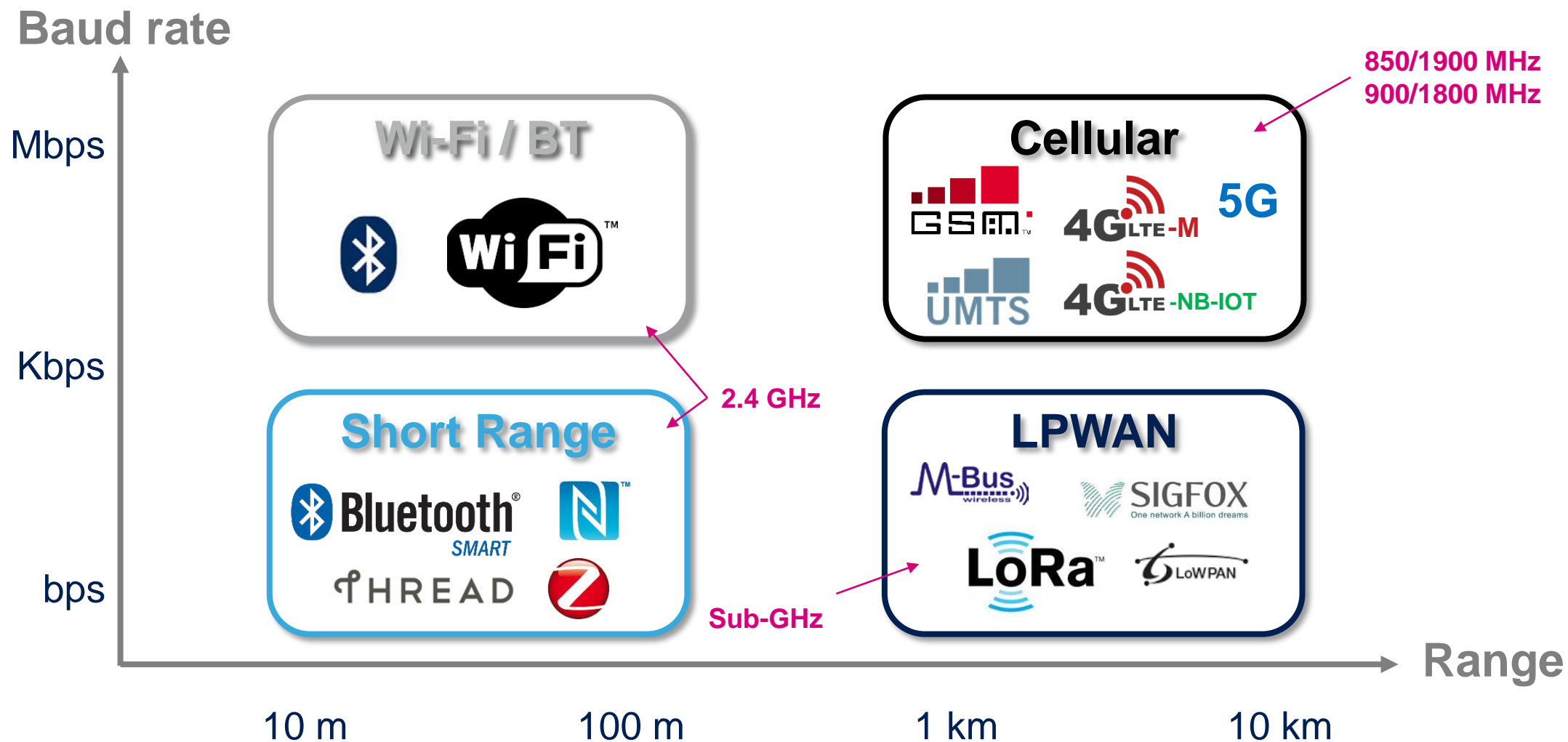
IoT - Driving the next semiconductor growth

45 billion connected devices are expected by 2020



Source : ABI, ST

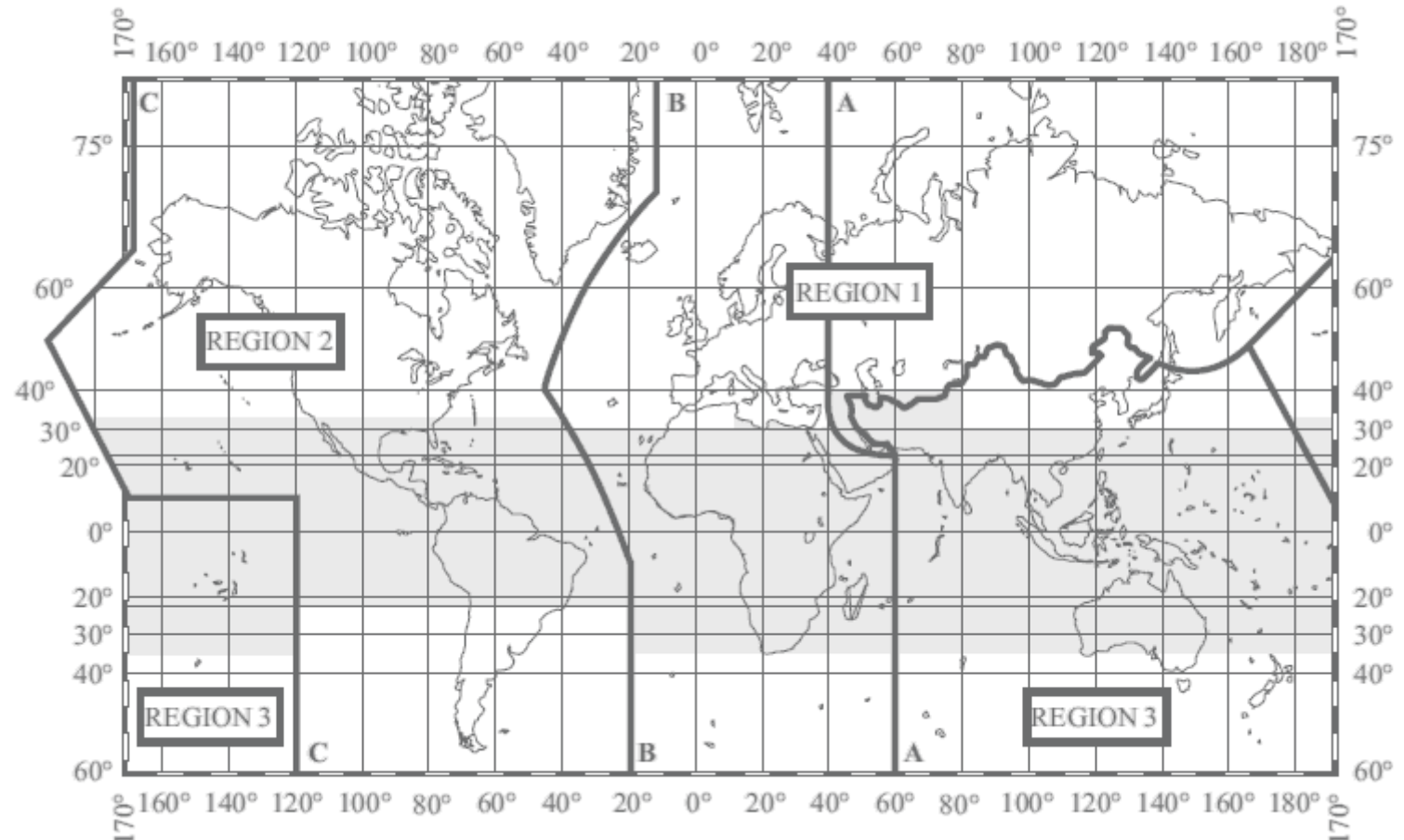
Communication Technologies - Overview



ISM worldwide regulation 7

Output Power vs Duty Cycle

Countries	Frequency band review	Max. output power
EU	868 MHz	14 dBm
USA	915 MHz	20 dBm
Korea	900 MHz	14 dBm
Japan	920 MHz	
Malaysia	862 to 875 MHz	20 dBm
Philippines	868 MHz	
Vietnam	920 to 925 MHz	
India	865 to 867 MHz	
Singapore	922 MHz	
Thailand	920 to 925 MHz	
Indonesia	922 MHz	
ANZ	915 to 928 MHz	
Taiwan	920 to 925 MHz	
China	470 to 510 MHz	17 dBm



The 2 solutions to address the IoT over LPWAN



- **Sub-GHz is a fragmented** segment with many dedicated protocols and solutions to address different needs
- An **initiative of standardization** is on-going with **LTE, LoRa®, Sigfox ...**
- **Standardization** will be an **enabler** for **industrial** applications (meters), **Smart Cities**

What is LoRa® ?

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1. A Sub-GHz wireless technology enabling low data rate communication over long distances
2. Targeting M2M and Internet of Things, IoT applications
3. LoRa® technology provides a WAN capability, using a MAC protocol named LoRaWAN



Long range

- Greater than cellular
- Deep indoor coverage
- Star topology



Max lifetime

- Low power optimized
- **10- to 20-year** lifetime
- >10x vs cellular M2M



Multi-usage

- High capacity
- Multi-tenant
- Public network



Low cost

- Minimal infrastructure
- Low-cost end-node
- Open software



True location

- Indoor and outdoor
- Accurate



Bidirectional

- Bidirectional
- Scalable capacity
- Broadcast



Global mobility

- True mobility
- Seamless
- Roaming



Security

- Unique ID
- Application
- Network

ST and the Alliance

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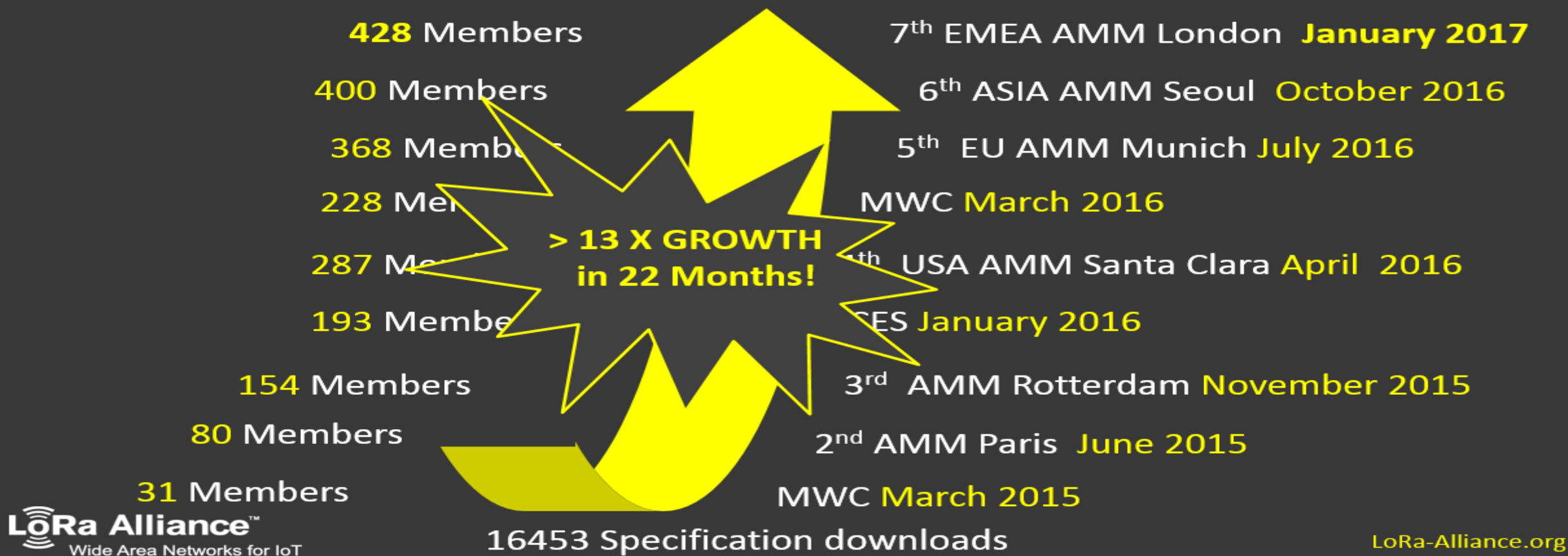
The Internet of Things era is now

ST is SPONSOR
and Board Member

 **LoRa® Alliance**
Wide Area Networks for IoT



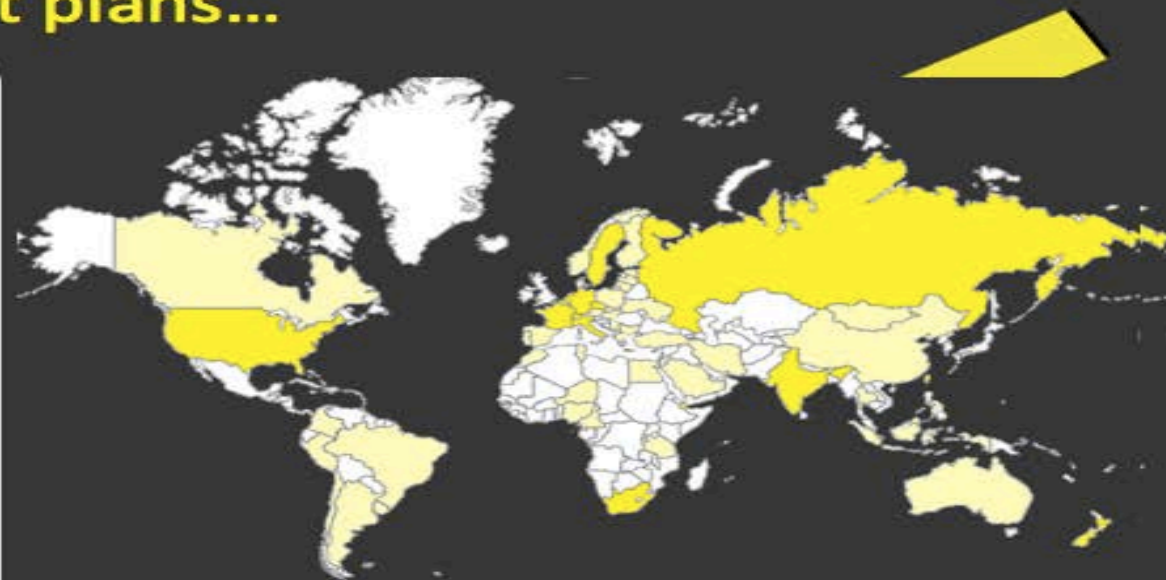
Membership Growth



The LoRa® Network Deployment

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LoRaWAN – National deployment plans...

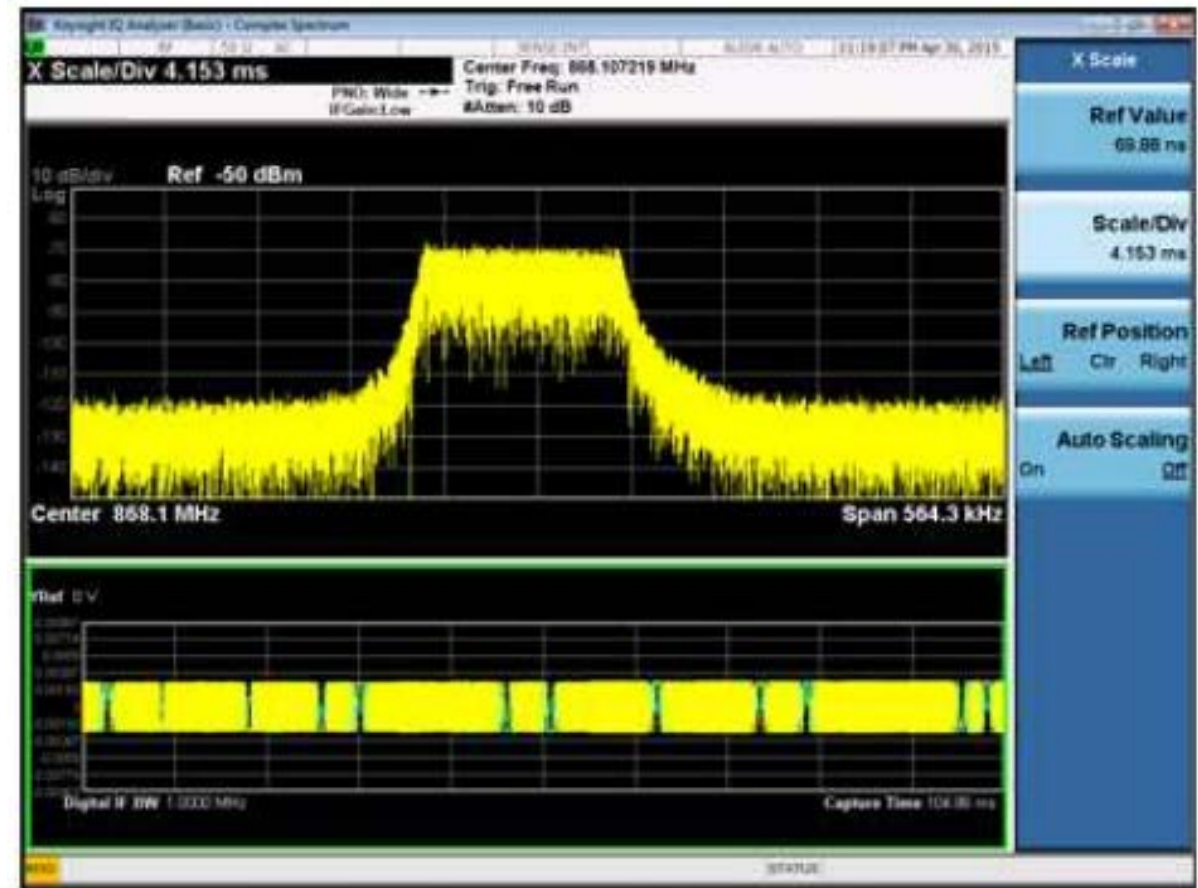


27 Announced national deployments
> 150 regional or city deployments

LoRa[®] technology modulation

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- LoRa[®] technology is based on the Spread Spectrum Technology
- It is a Chirped Frequency Modulation



Source: Semtech

LoRaWAN™ device classes

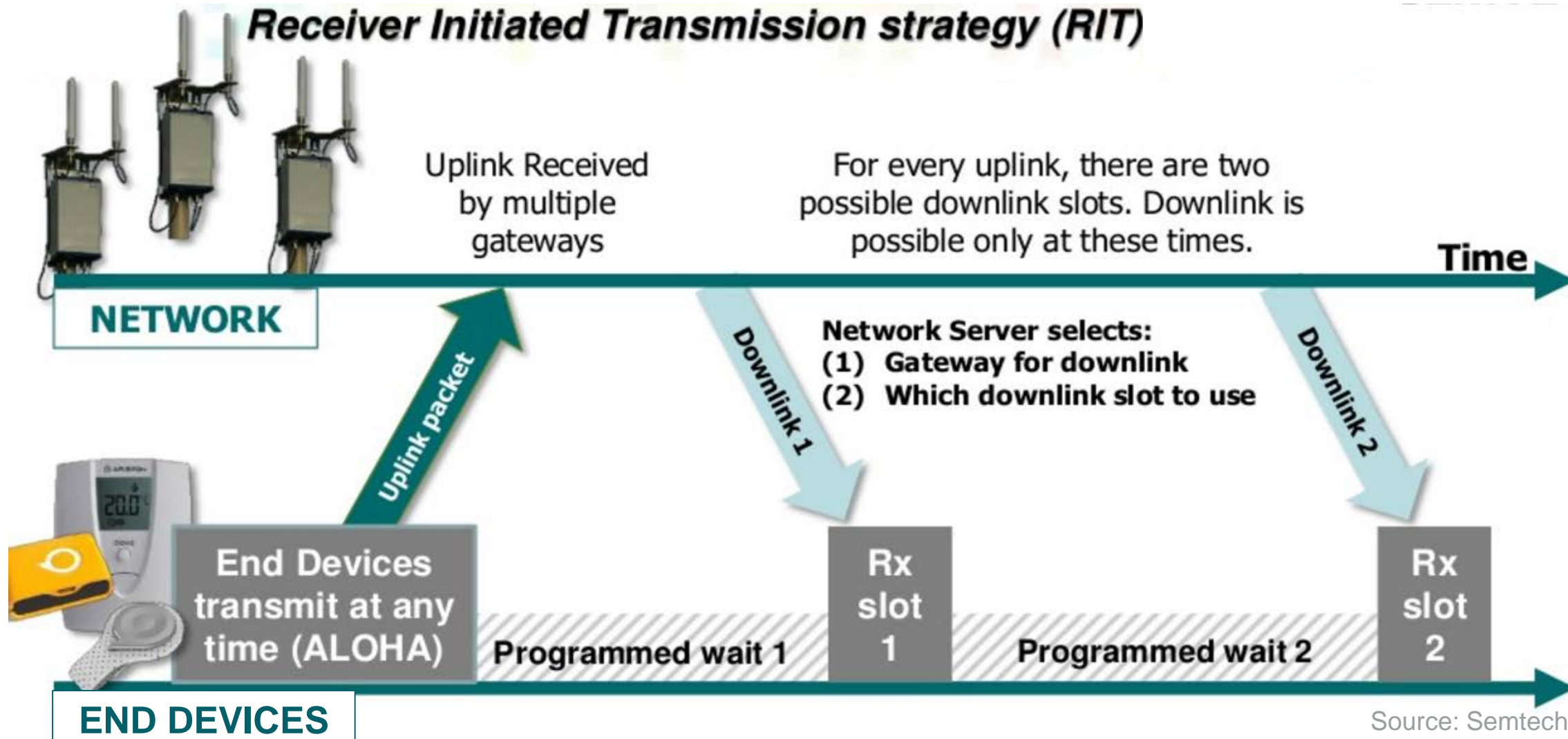
3 classes to cover all use cases

Class name	Intended usage	
A (“all”)	Battery powered sensors (or actuators with no latency constraint) Most energy efficient communication class. Must be supported by all devices.	<i>Mainly uplink with two potential downlink slots after each uplink</i>
B (“beacon”)	Battery powered actuators Energy efficient communication class for latency controlled downlink. Based on slotted communication synchronized with a network beacon.	<i>Programmed downlink slots to allow control within certain latency limits</i>
C (“continuous”)	Main powered actuators Devices which can afford to listen continuously. No latency for downlink communication.	<i>Lowest latency command and control for less power critical devices</i>

LoRaWAN™ device classes

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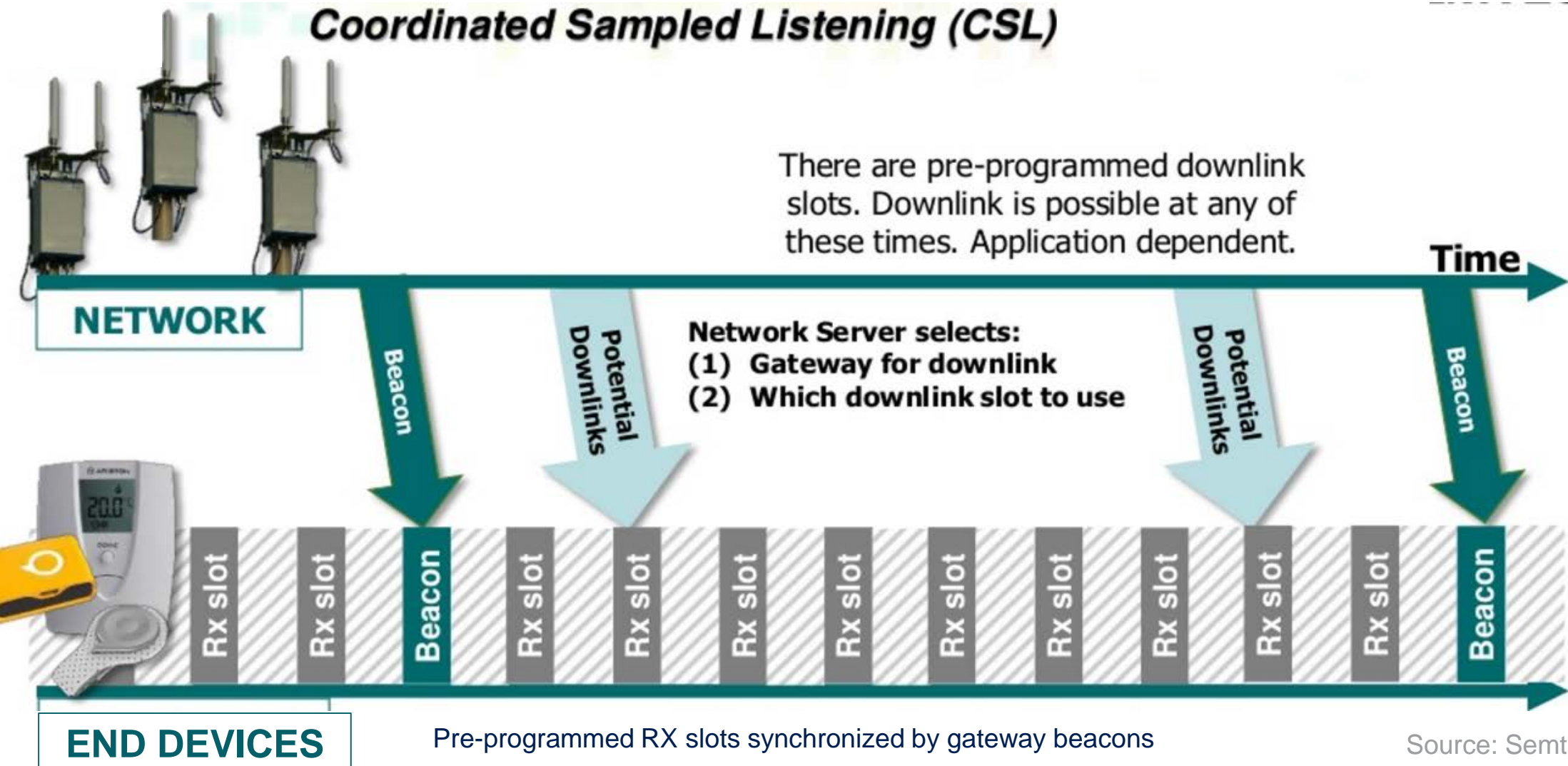
Class A – bidirectional communication



LoRaWAN™ device classes

Class B – Bidirectional Communication

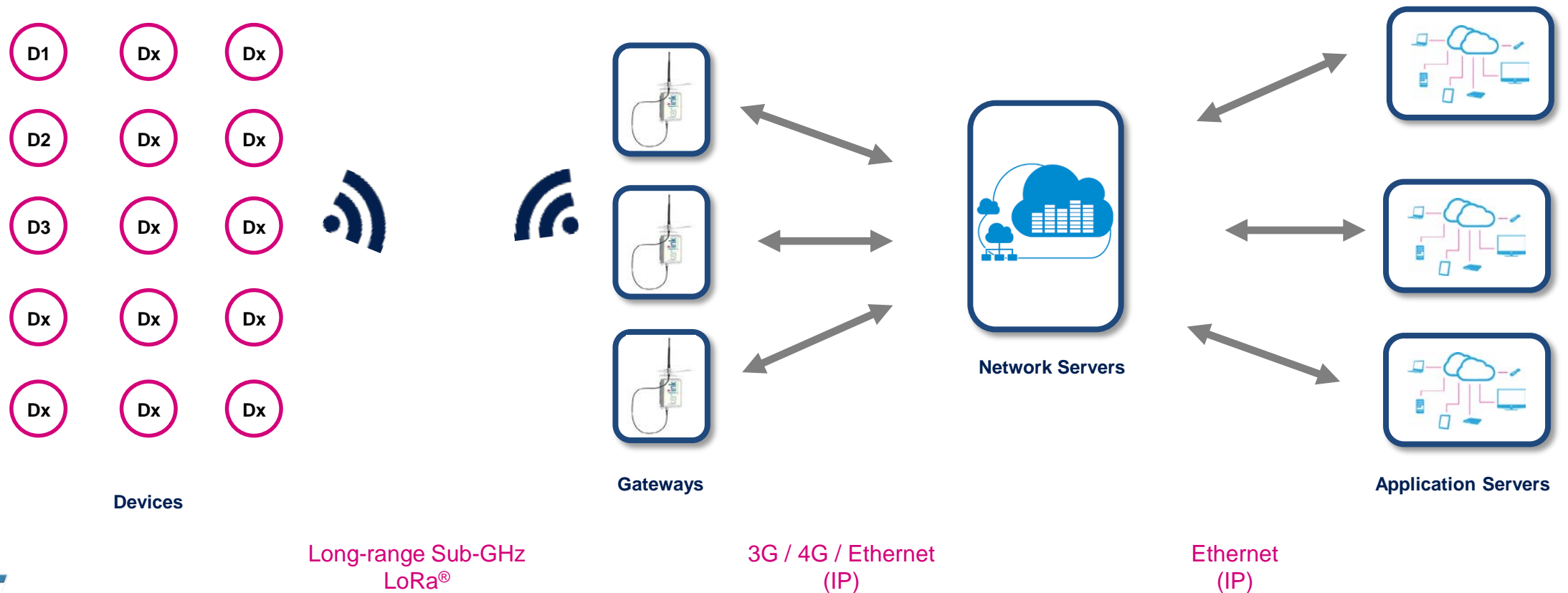
Coordinated Sampled Listening (CSL)



LoRa[®] network protocol

17

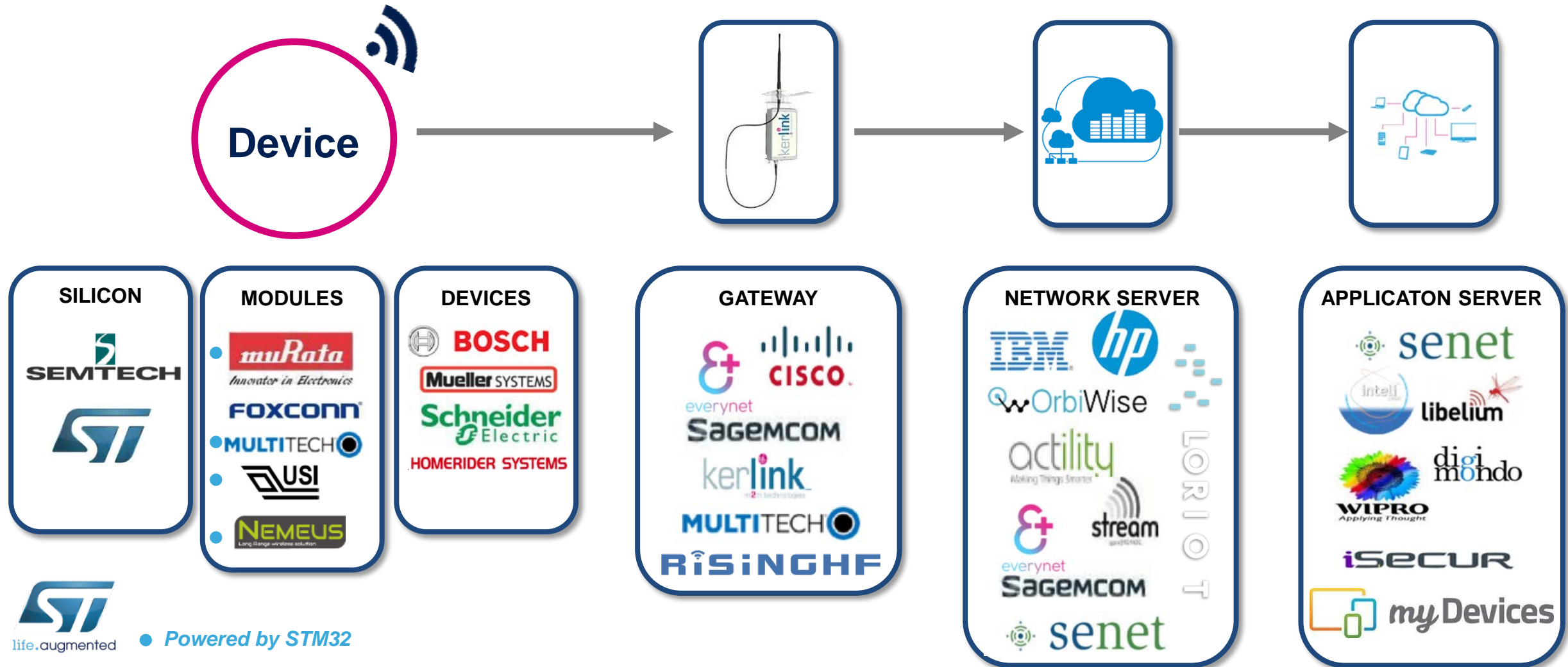
Network topology overview



LoRa[®] network protocol

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Solution providers



LoRaWAN™ - Security

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A native 128-bit AES security network protocol

- Device Address (DevAddr) is a 32-bit identifier
 - Unique within the network
 - Available in each data frame and shared between end-device, N.S and A.S
- Network Session Key (NwkSKey) is a 128-bit AES encryption key
 - Unique per end-device and shared between end-device and N.S
 - It allows message integrity communication between end-device and N.S
- Application Session Key (AppSKey) is a 128-bit AES encryption key
 - Unique per end-device and shared between end-device and A.S
 - It is used to encrypt / decrypt A.S server messages to the end-device
- To increase end-device authentication and security, a secure element can be added to the device

ST and Semtech LoRa® Agreement

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- Semtech Corporation and STMicroelectronics announce an **agreement on Semtech's LoRa®** long-range wireless RF technology
- Intended to **boost STM32 MCUs with LoRa®** technology to target internet of things deployments by mobile network operators and large-scale private networks

-> ST and Semtech partnership [press release](#)

LoRa® IoT Ecosystem



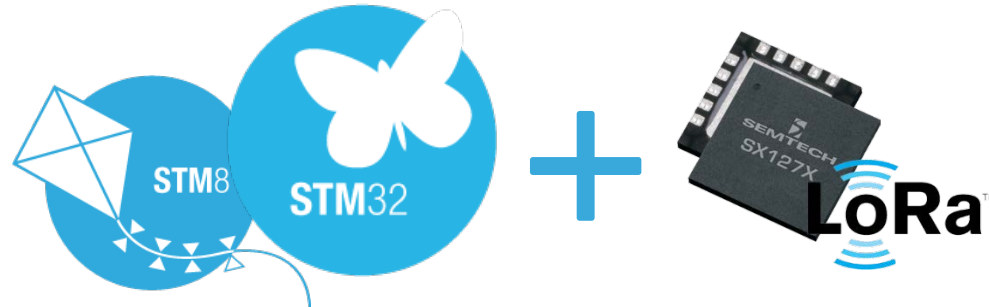
LoRa[®] powered by STM32[™]

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www.st.com/stm32-lrwan



USI[®] Module
AT command



Murata[®] Module
All-in-one Open

Cost-optimized
solution

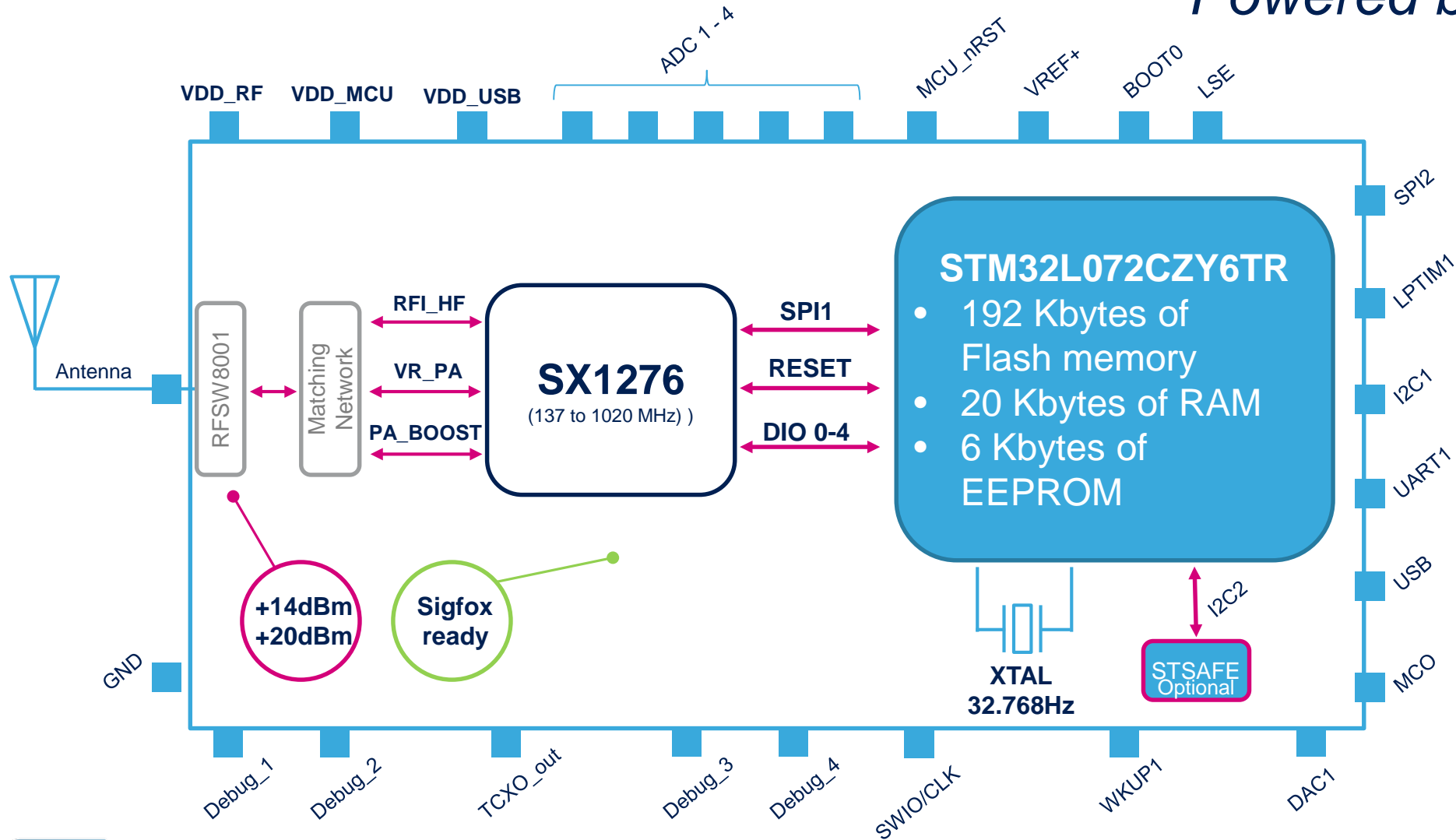
Flexible design architecture
More than **1000 STM8/STM32 part numbers**

All-in-one LPWAN

Open Murata® LoRa® module

Powered by STM32L0

22



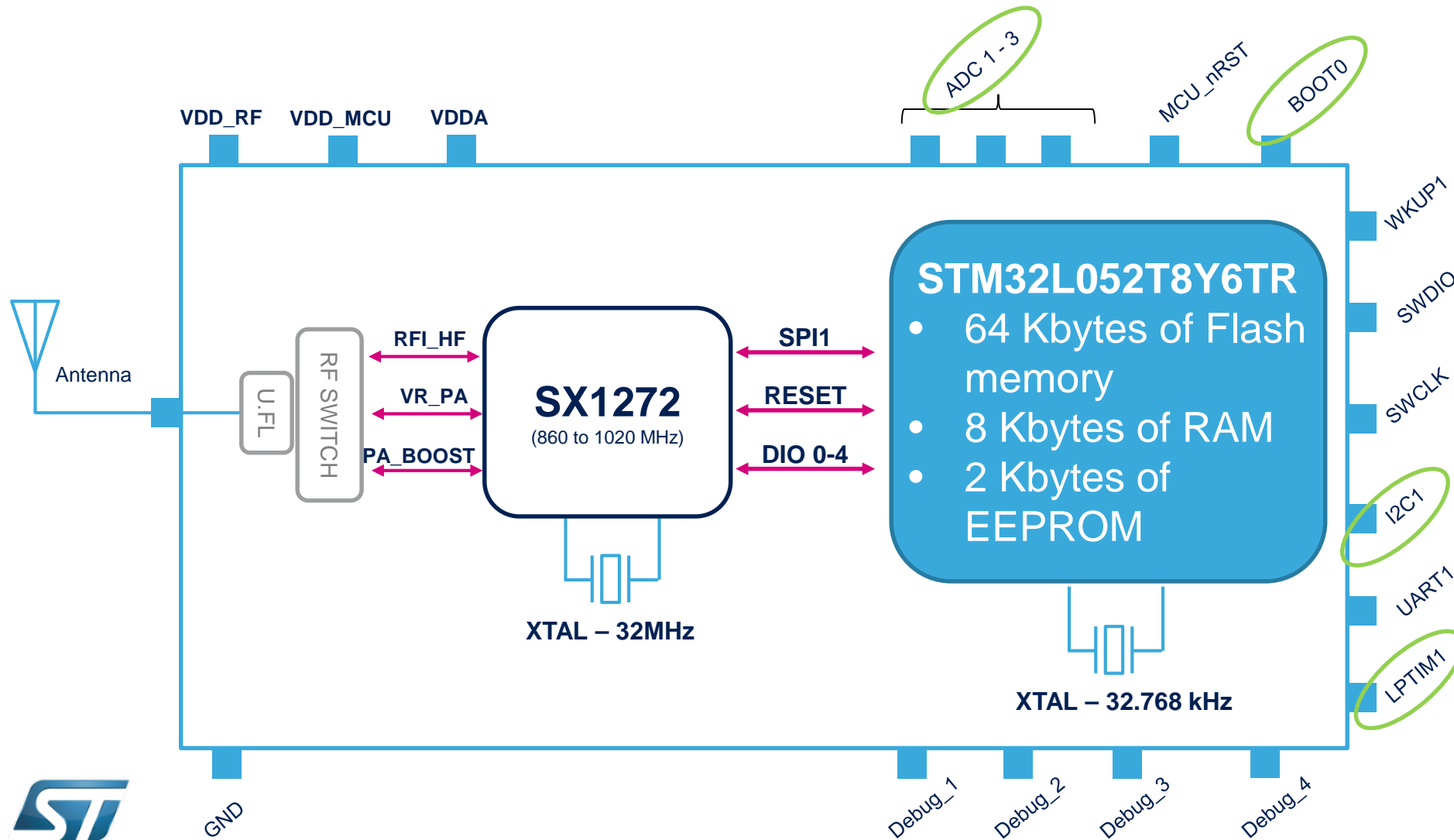
Open LPWAN
Module

muRata
INNOVATOR IN ELECTRONICS

USI[®] LoRa[®] module - AT command set

Powered by STM32L0

23



Cost optimized



Optional on open module version

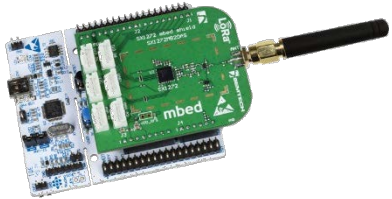
Let's get started

24

With a wide and existing ecosystem

(Click on the icon or link)

Hardware tools



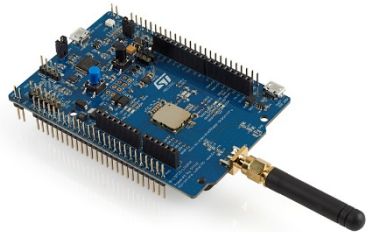
Nucleo pack

ST and Semtech
P/N: P-NUCLEO-LRWAN1



Expansion board

ST and USI®
P/N: I-NUCLEO-LRWAN1



Discovery kit

ST and Murata®
P/N: B-L072Z-LRWAN1



Dev tools

[STM32CubeMX](#)

[ST-Link Utility](#)

[Partners IDE](#)



System
Workbench
for STM32



LoRaWAN™ stack



life.augmented

[I-CUBE-LRWAN](#)

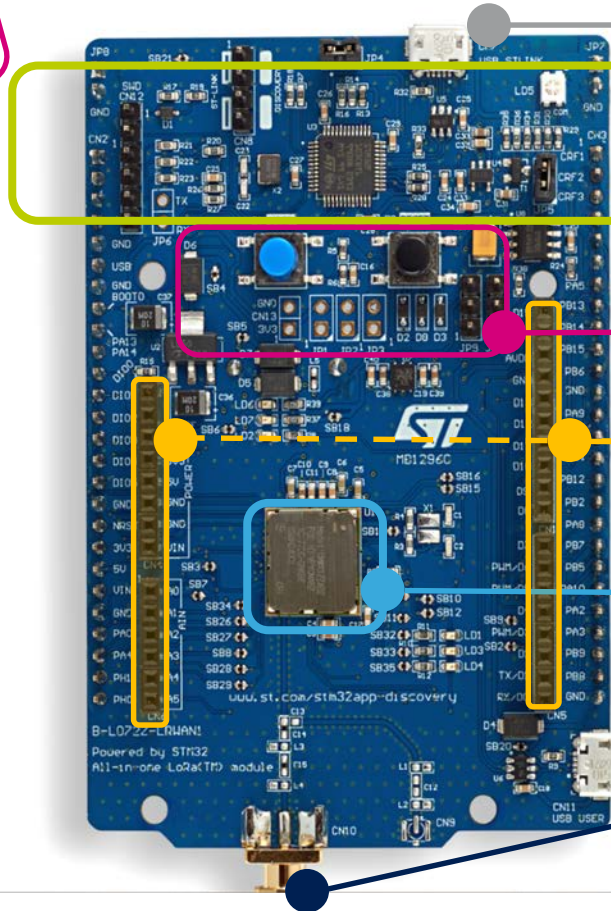
New hardware tool

25

B-L072Z-LRWAN1: Murata® STM32™ and LoRa® Discovery kit

Available now!

ARM
mbed
enabled



Flexible board power supply:
through USB or external source

Integrated ST-Link/V2-1:
mass storage device flash programming

2 push buttons, 2 color LEDs,
Jumper settings

Arduino™ extension connectors :
easy access to add-ons

Murata® module

SMA Antenna connector

Release your creativity with the STM32

27



www.st.com/stm32-lrwan