Actility
Connecting with intelligence

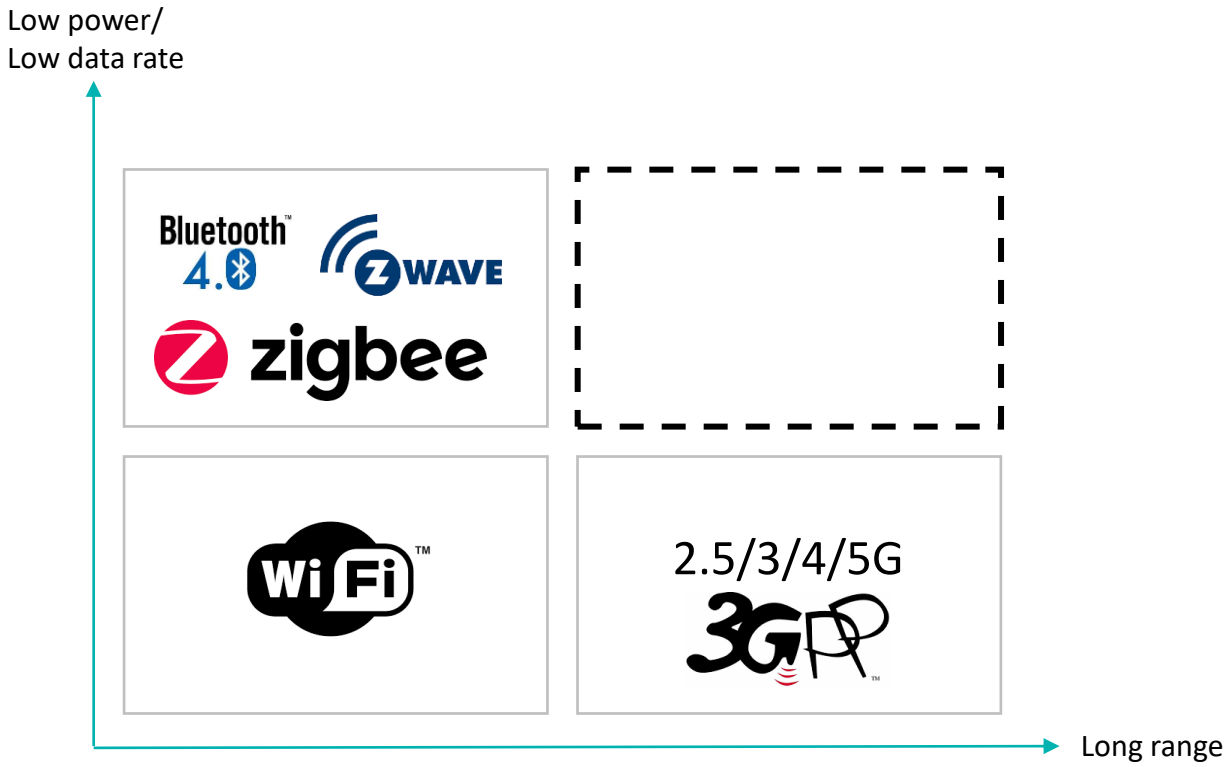
LoRaWAN: Building the Massive IoT

Alper Yegin

Sr. Director of Advanced Technology Development, Actility

Vice-Chair of BoD & Chair of Technical Committee, LoRa Alliance

Low-Power & Long-Range



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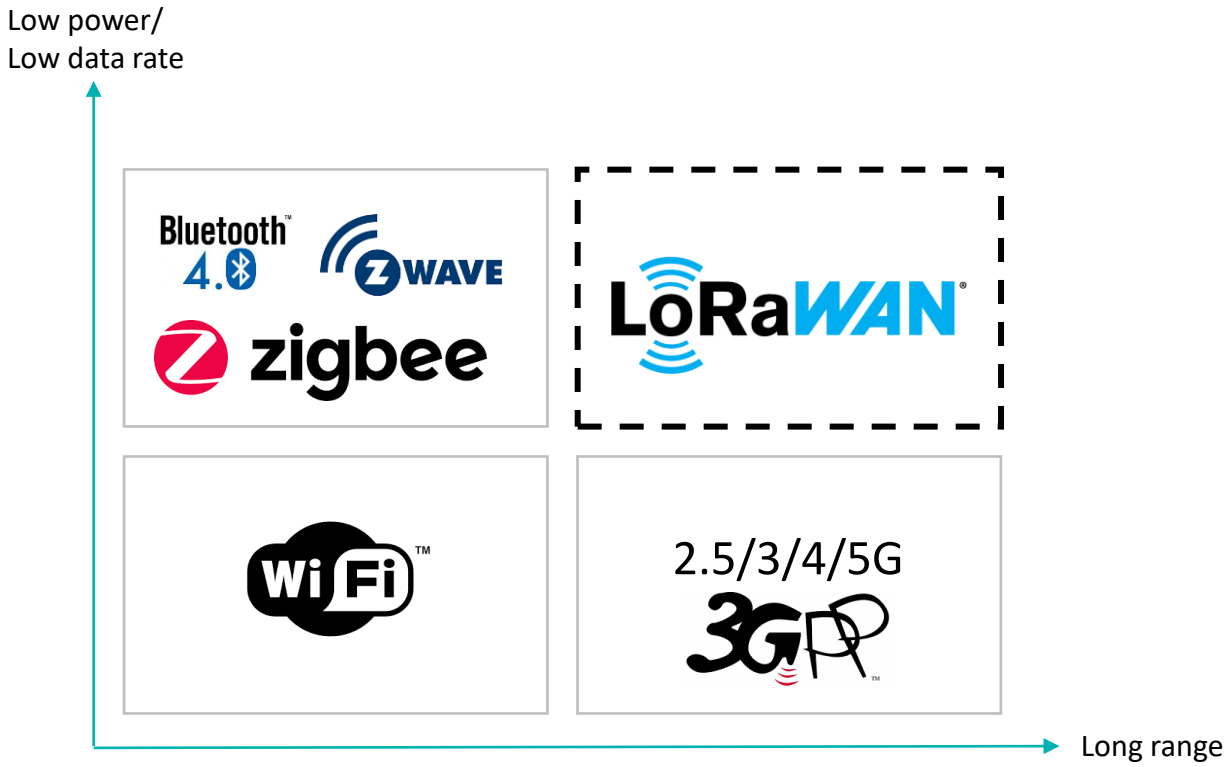
Low-Power & Long-Range



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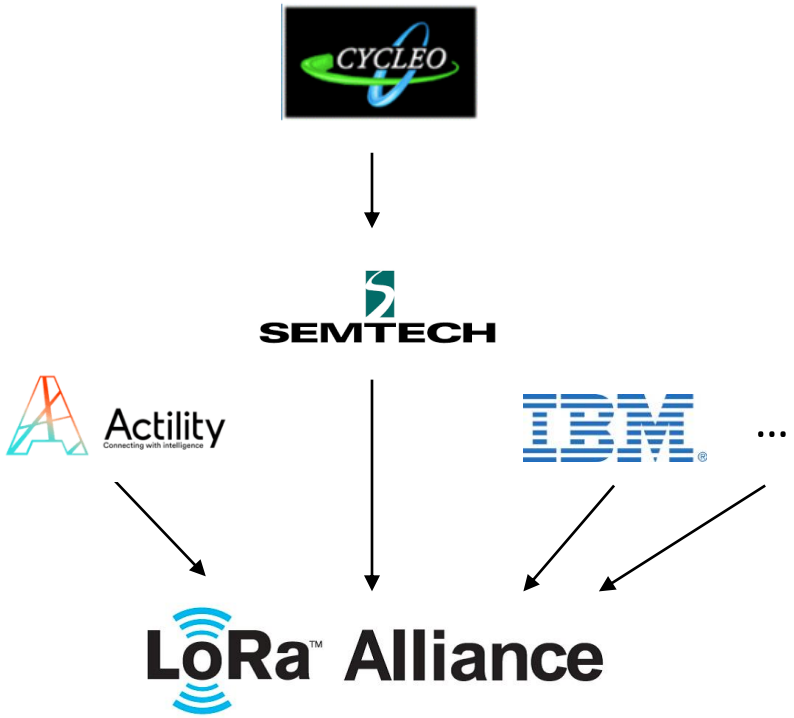
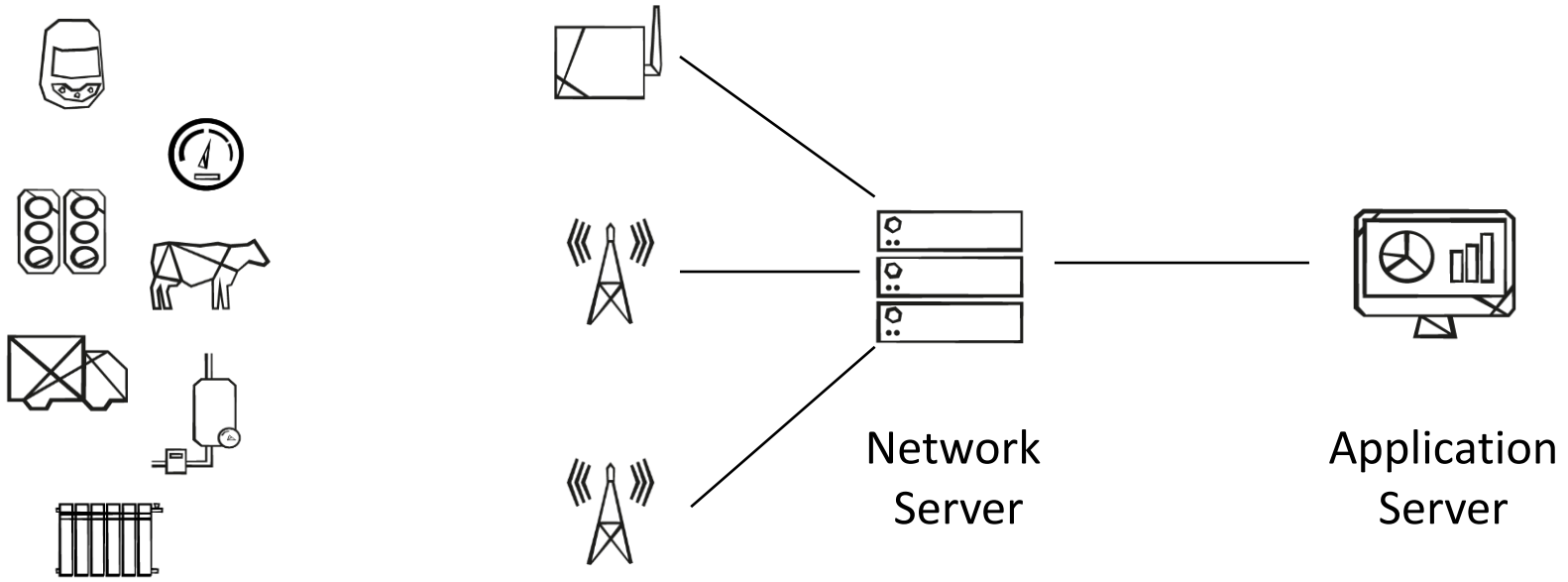
Low-Power & Long-Range



Architecture



End-devices
(sensors and actuators)

Gateways
(indoor and outdoor)

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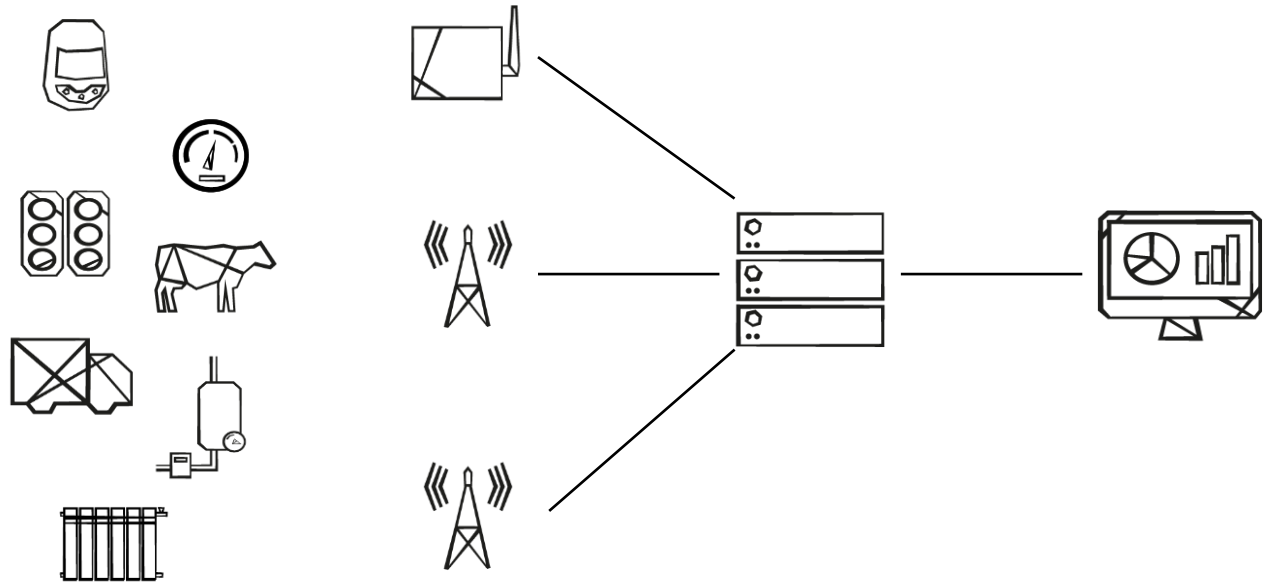
Characteristics

- Long-range (2 - 10+ km)
- Deep indoor coverage
- Low-power (10+ year)
- Strong security (AES128)



- Unlicensed band use
- Public/private networks
- Low-cost infra
- Open standards

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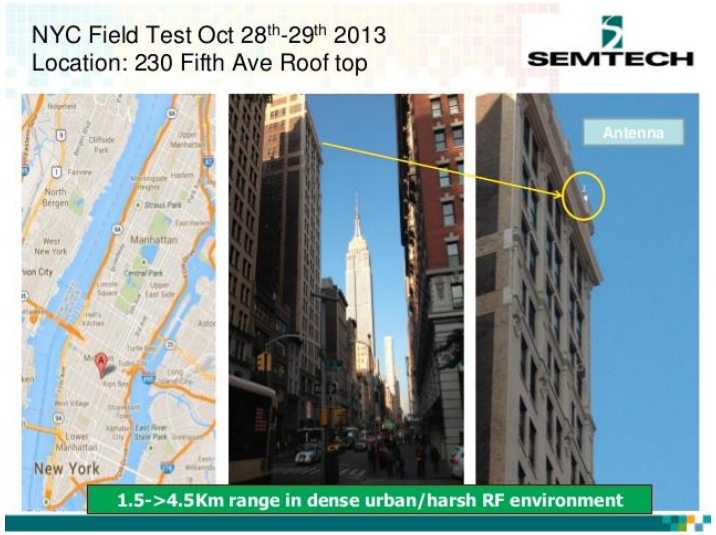
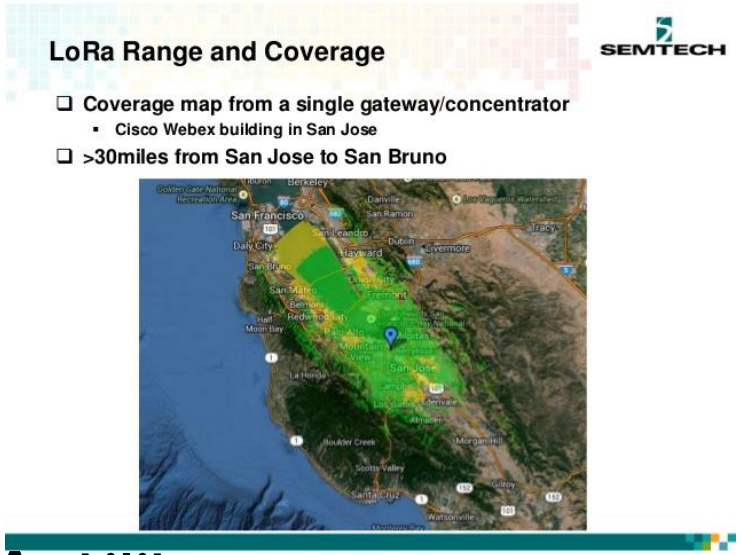
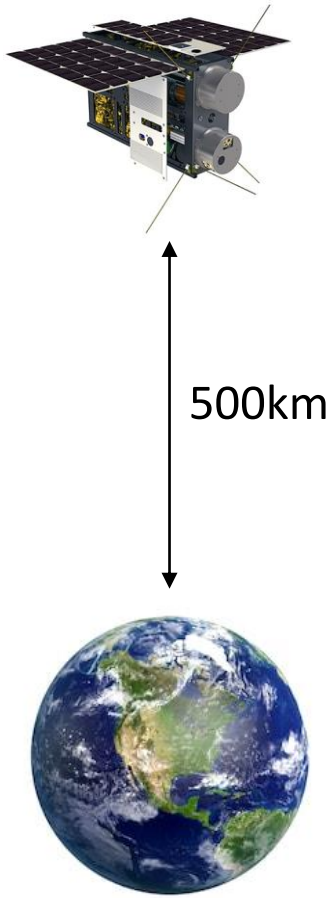
Detailed Characteristics

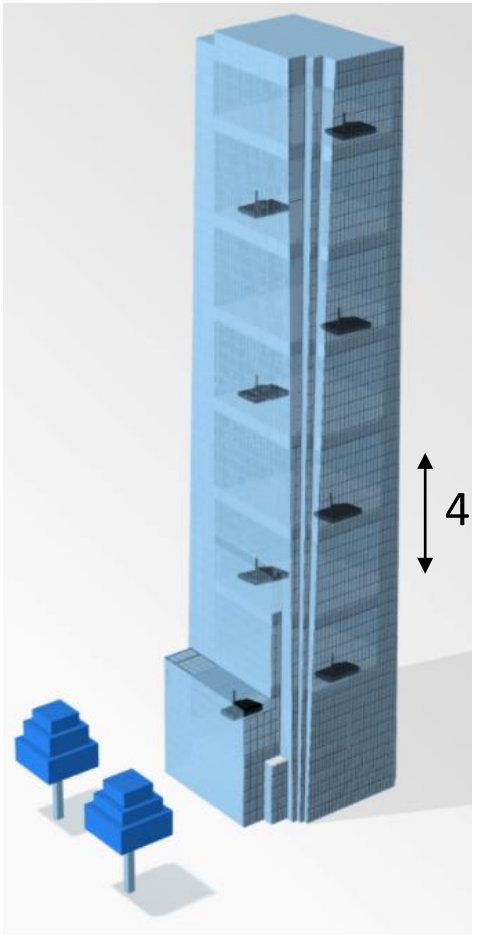
Modulation	LoRa (spread spectrum)
Frequency	Sub-GHz ISM (868/915Mhz)
Channel bandwidth	125-500 KHz
Data rate	300 bps – 50 kbps
Gateway sensitivity	-142 dBm/300bps
Range	10+ km, deep indoor coverage
Payload size	11 – 242 bytes (variable)
Battery consumption	10mA RX / 32mA (14dBm) TX -- 10+ year
Communication type	Bi-directional unicast, network multicast
Interference immunity	Spread-spectrum w/ Forward Error Correction
Scalability	Self-scaling network capability through Adaptive Data Rate
Mobility	Roaming, geo-location

Range









Source: MachineQ

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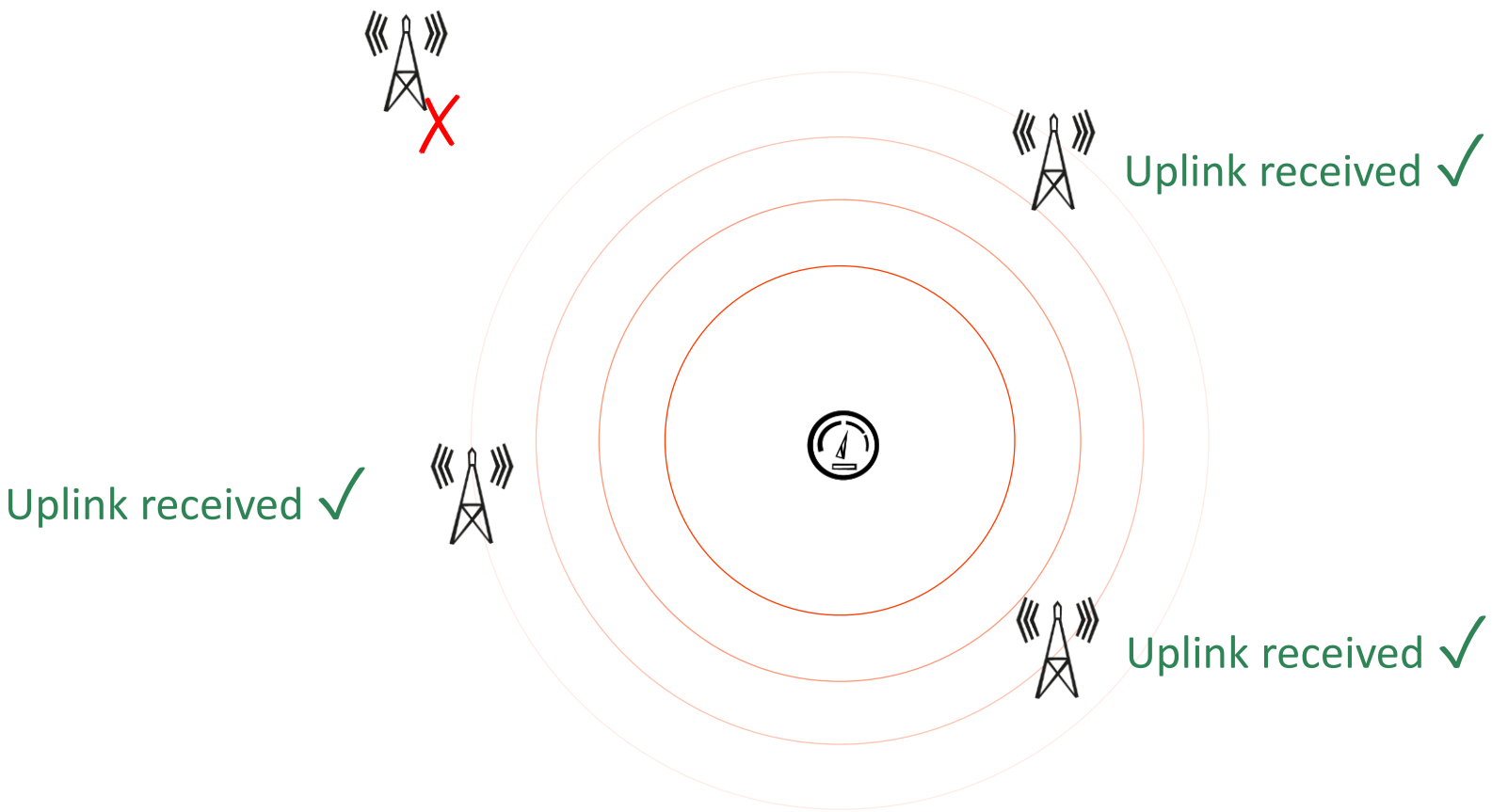
Macro-Diversity



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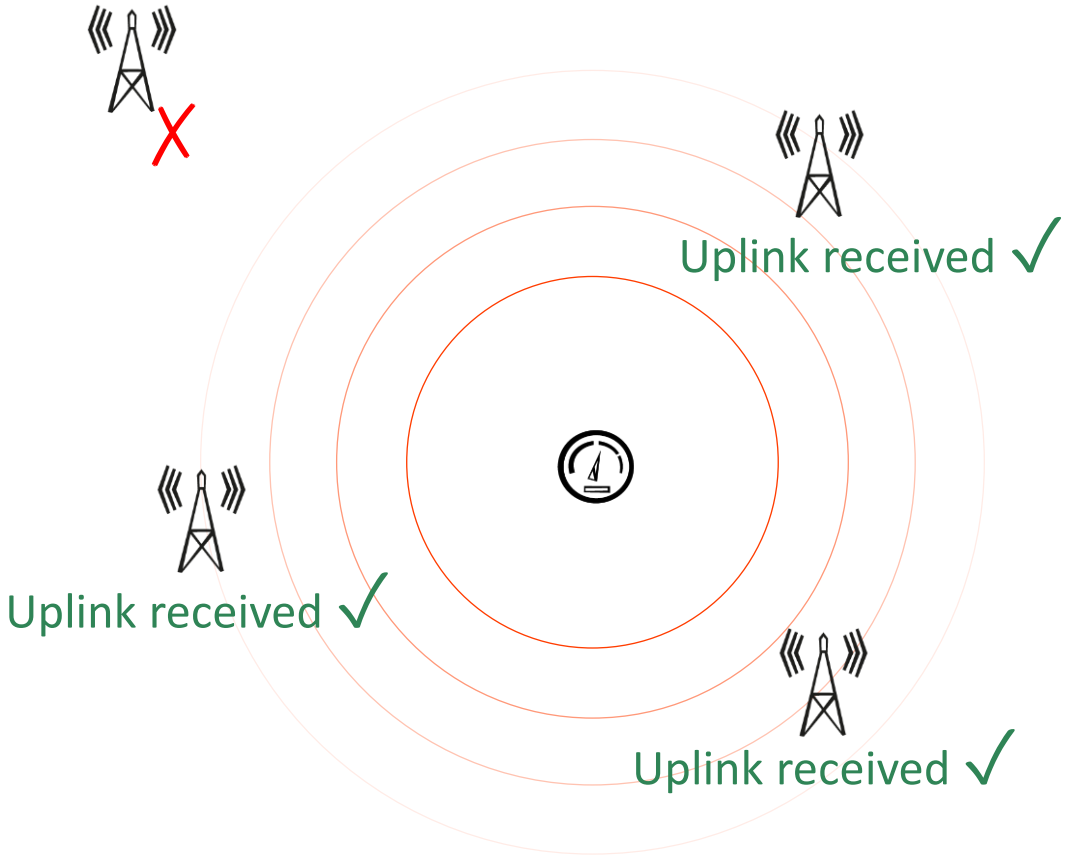
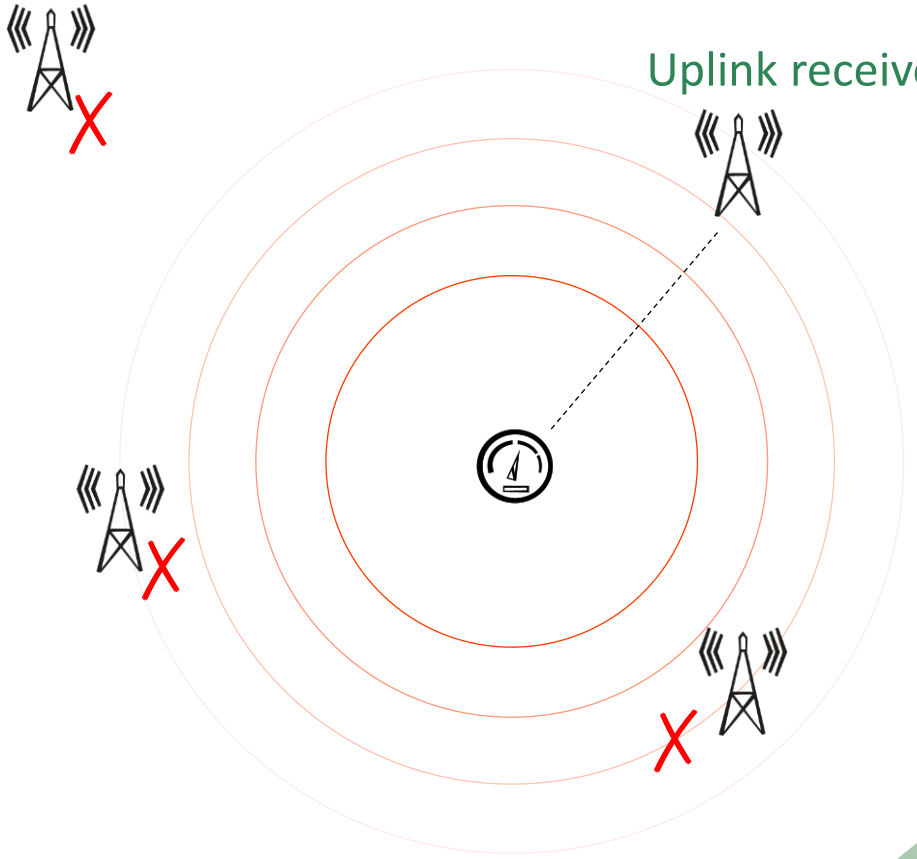
Macro-Diversity

LoRaWAN



NB-IoT/LTE-M/5G/WiFi



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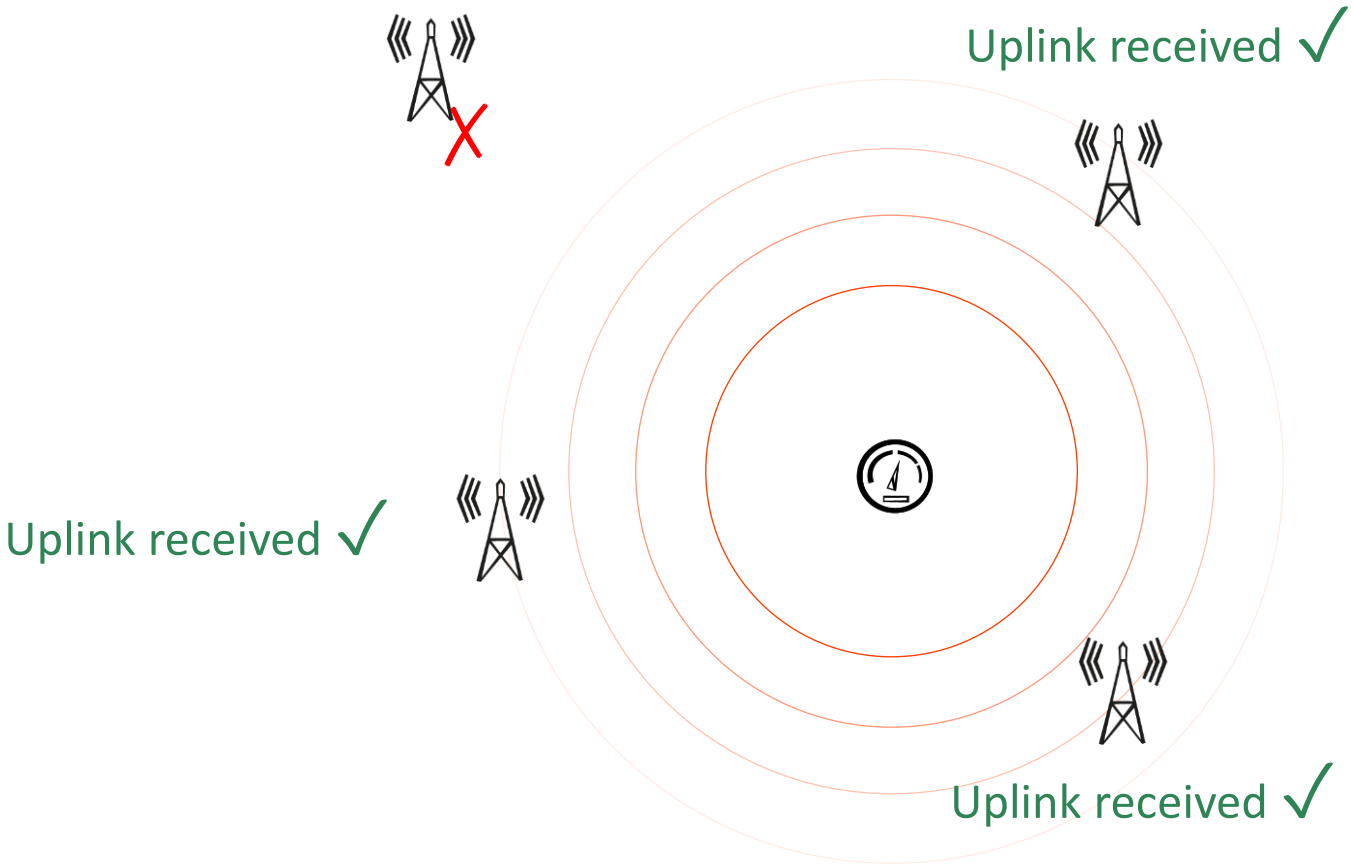
Geo-location



Physical broadcast + TDoA (Time Difference on Arrival -- nanosec)

No extra hardware or processing cost on device

→ 20-100m accuracy

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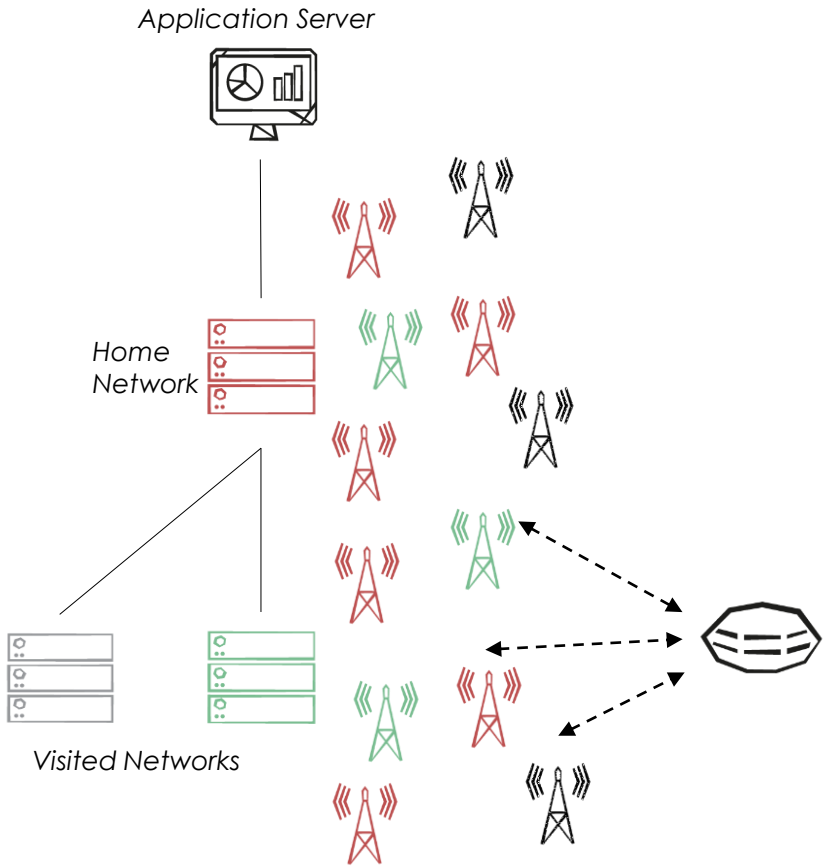
Roaming



- Collaborative reception
  - Enables higher data rates, lower power (ADR!)
    - Less interference
    - More network capacity
    - Longer battery life
  - Better TDOA/RSSI geoloc accuracy

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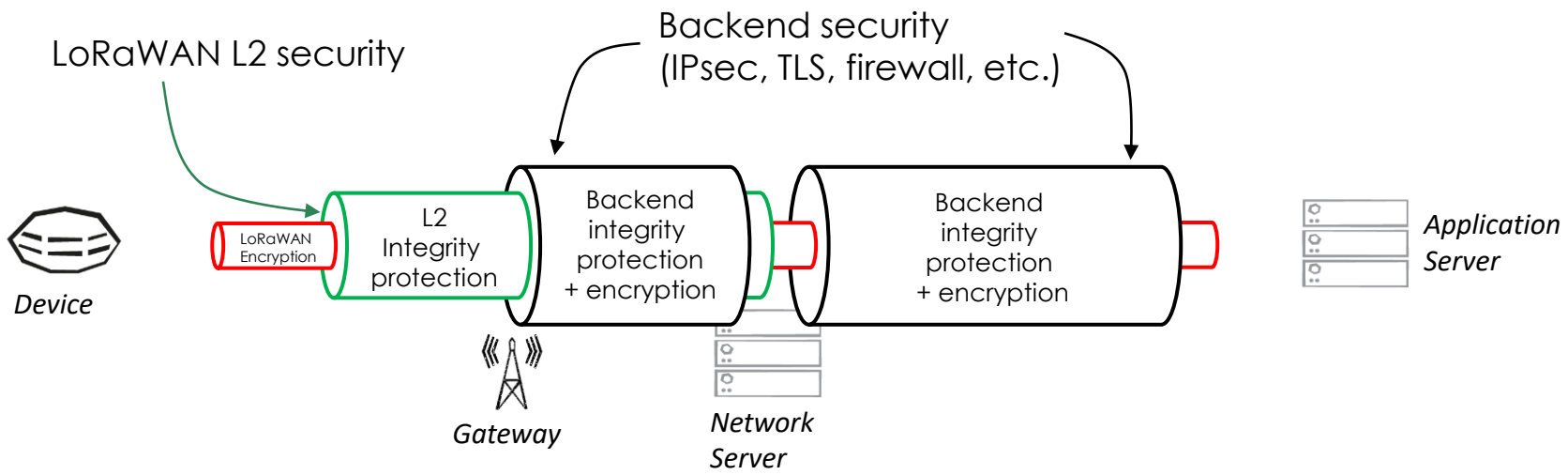
Security



Mutual end-point authentication
Data origin authentication
Integrity protection
Replay protection
Data encryption

…using **AES-128** keys and algorithms

\+

FUOTA
(Firmware Update Over-the-Air)

\+

Hardware-level security
(Secure Elements/ Hardware Security Modules)

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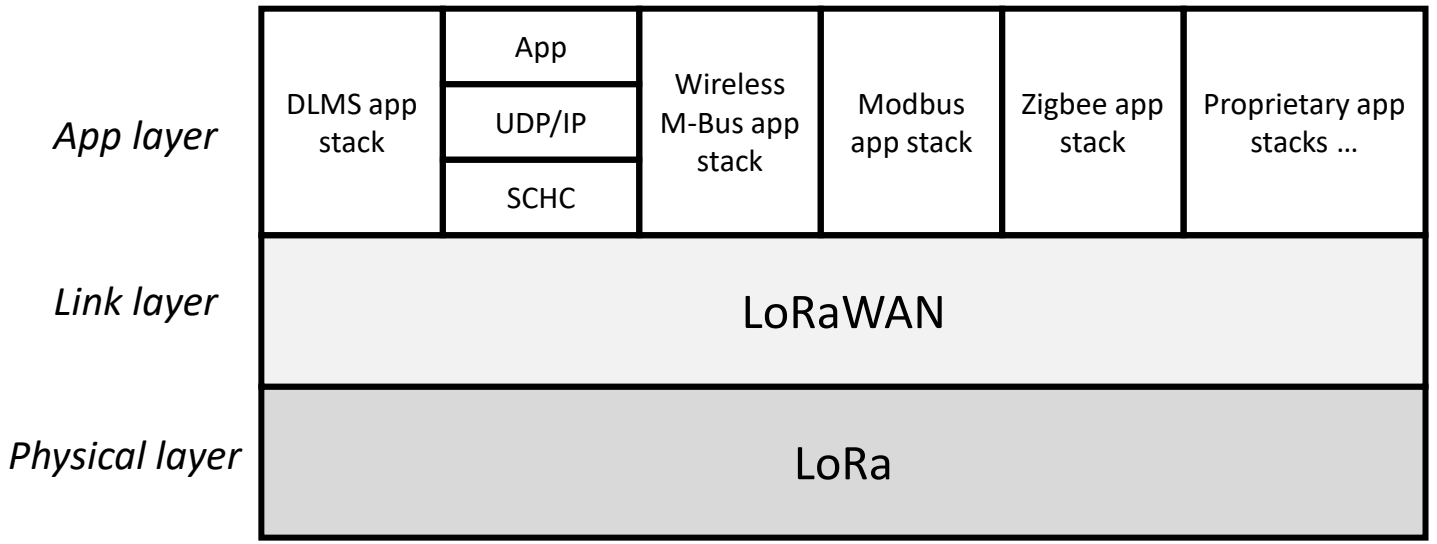
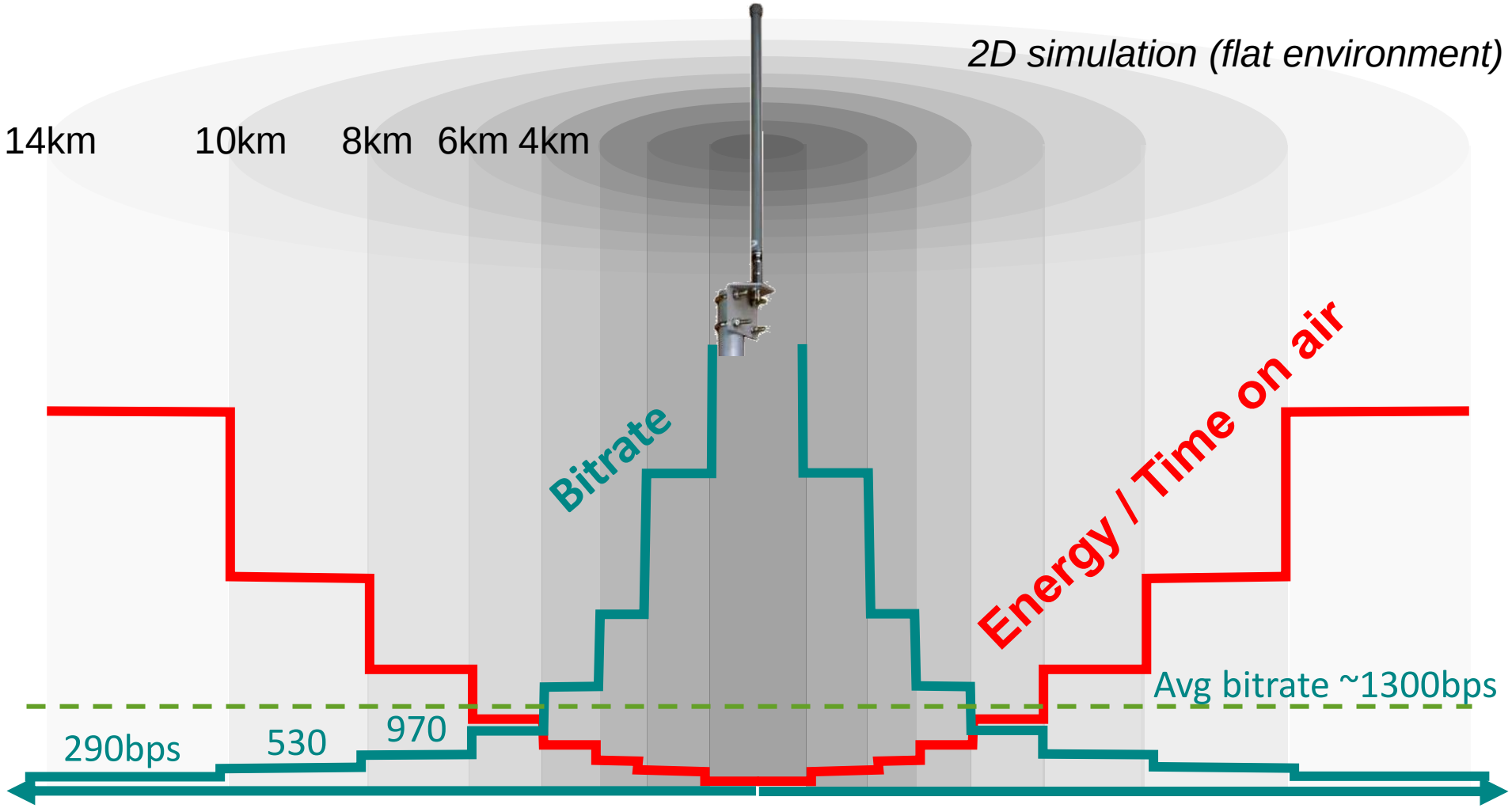
Network Stack



Adaptive Data Rates



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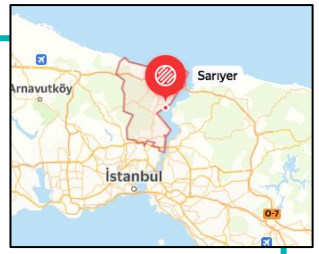
Deployment Types

Private Networks

Public Networks

House

Building



District

Campus

City

City

Country

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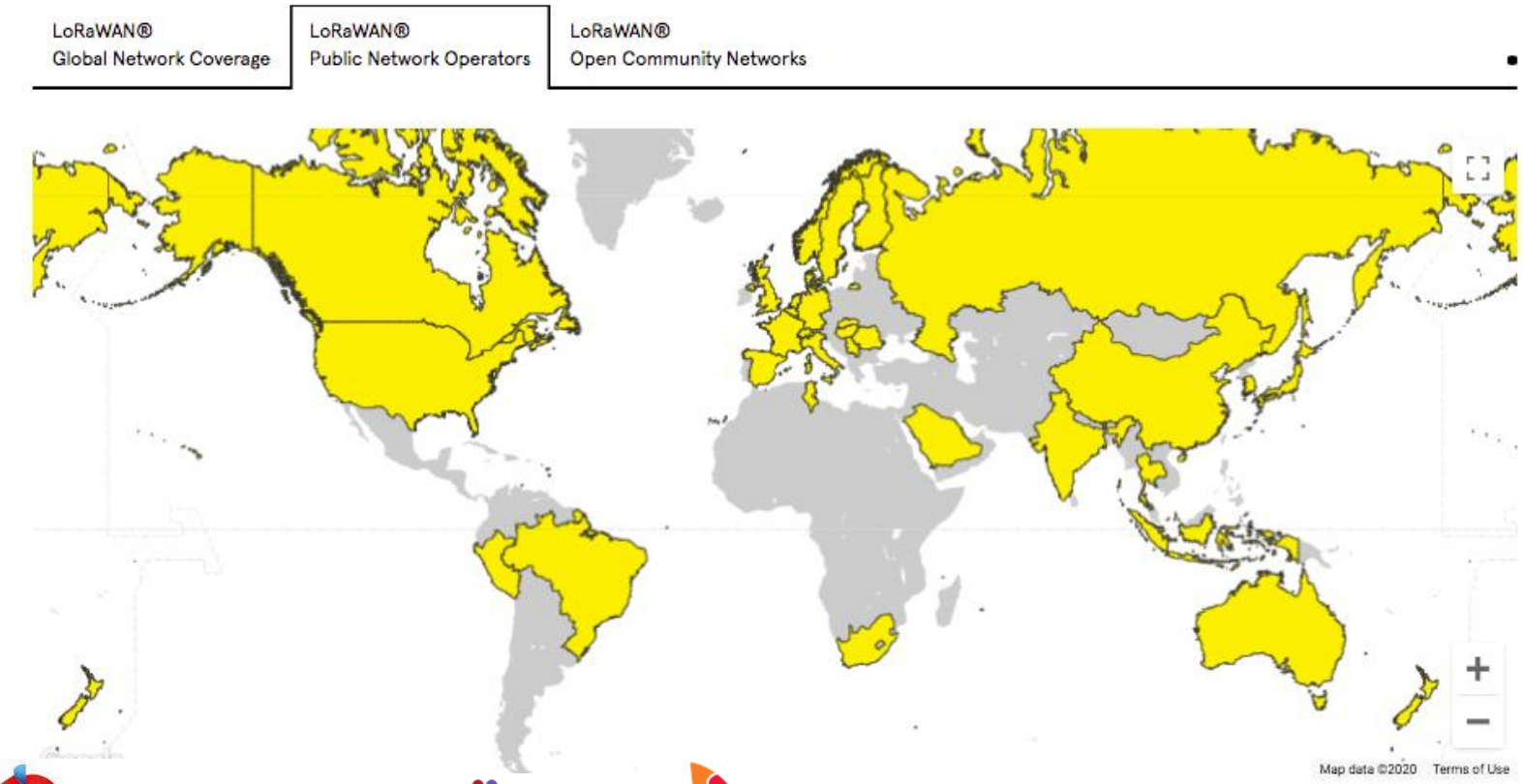
Global Deployments

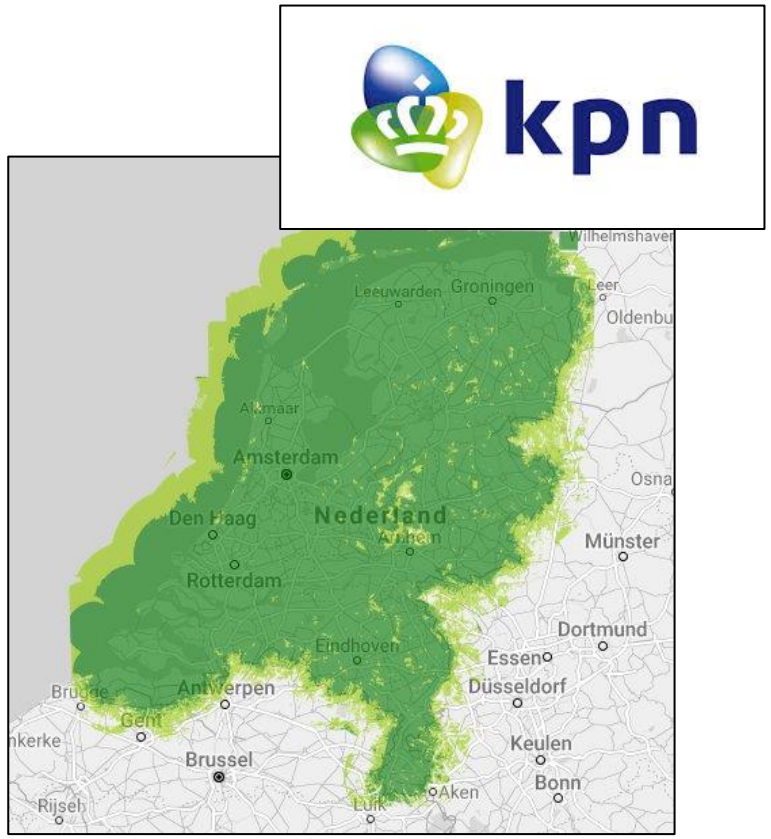
148 LoRaWAN® Network Operators in **162** Countries

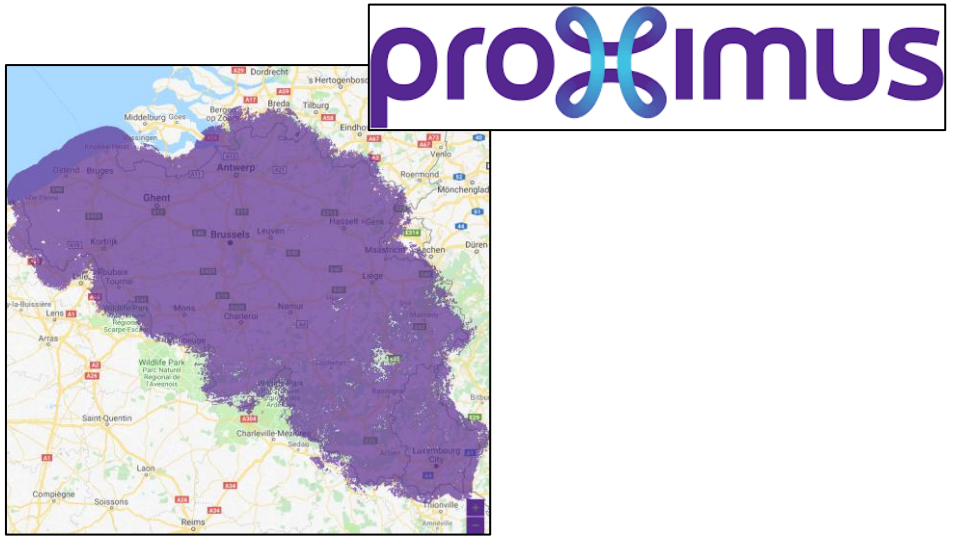


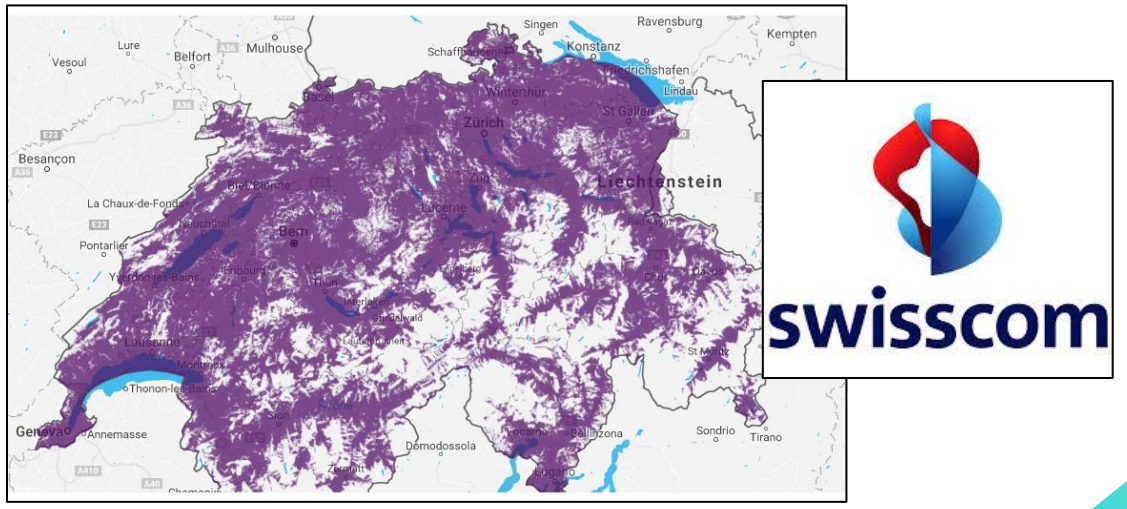
orange™ swisscom COMCAST SK telecom TATA COMMUNICATIONS BT

NTTWEST kpn bouygues TELECOM ZTE ЭНЮРТА

National Coverage







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Backbone & Peering

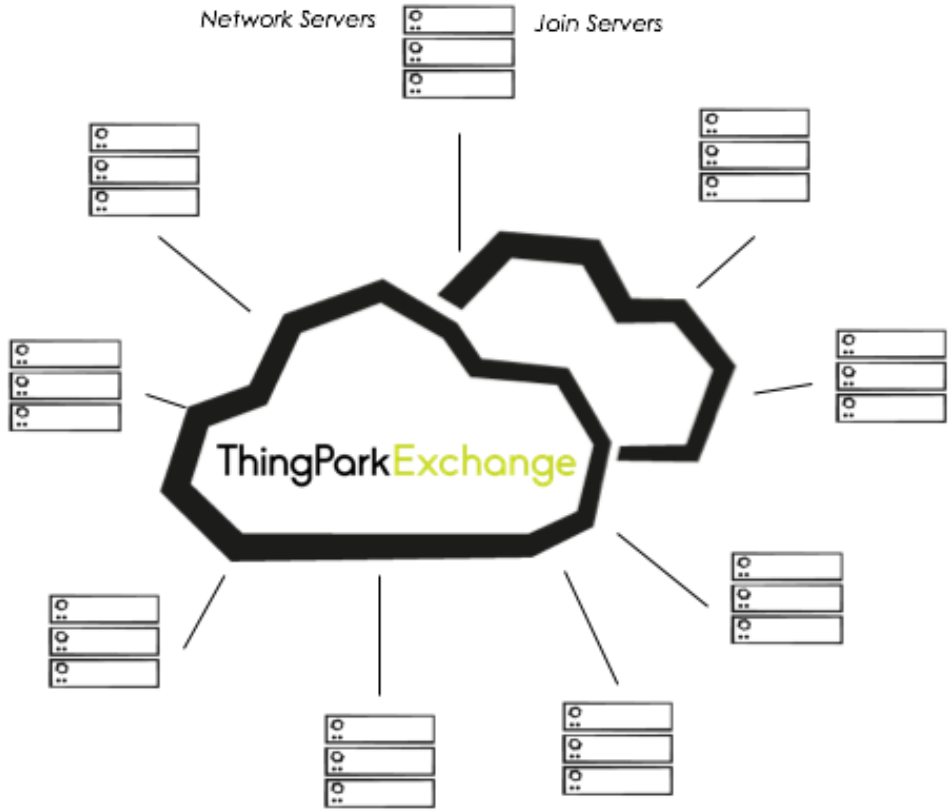
- TEX (peering hub) users
  - Swisscom
  - KPN
  - Proximus
  - Orange
  - Digita
  - Telent
  - Oresundskraft
  - ER Telecom (Enforta)
  - Everynet
  - NNNco
  - Objenious
  - Spark
  - VTC
  - A2A
  - Altibox
  - Schneider
  - Hiber
  - Lacuna
  - Semtech JS
  - ThingPark Activation

Public

Private

Satellite

JS



https://www.actility.com/lorawan-roaming-goes-global-thanks-to-actilitys-thingpark-exchange/

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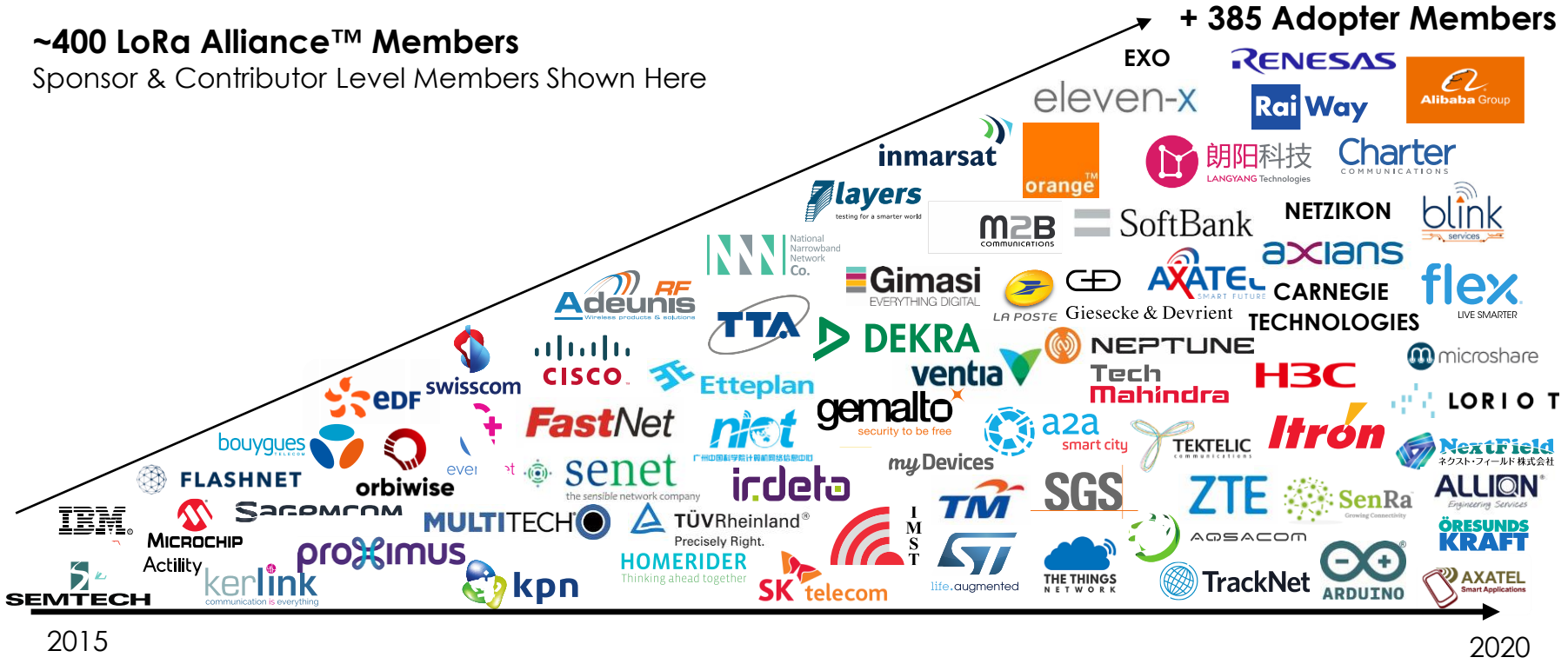
LoRa Alliance™

~400 LoRa Alliance™ Members
Sponsor & Contributor Level Members Shown Here

+ 385 Adopter Members



- Marketing Committee
- Certification Committee
- Technical Committee

Amazon, Cisco, Intel, Orange, SKT, BT, Tata, NTT, ZTE, Comcast, ARM, Sagemcom, NEC, Softbank, Alibaba, Tencent, Schneider, ST, …

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Gateways

Macro-cell

Pico-cell

Development kit

Cisco, Kerlink, Multitech, Tektelic, Ufispace, Gemtek, …

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Water Metering

VEOLIA

birdz

orange™

- Over 3 million water sensors in the next 3 years in France
- Additional water sensors to transition from pure metering to environmental services
- Unify all water sensors in a multiservice connectivity network

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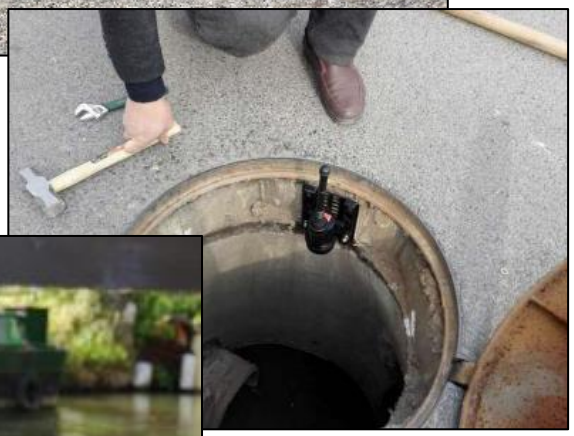
Smart City: Smoke, Parking, Manhole, Water Monitoring

- Shanghai
- Over 300,000 sensors
- Smoke detectors
- Acidity and oxygen sensors monitoring pollution/quality of water in rivers
- Parking space sensors
- Manhole cover detectors



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Asset Tracking

- 70 trucks produced per day
- Each moved several times per day for customization
- Abeeway industrial trackers are placed in the trucks

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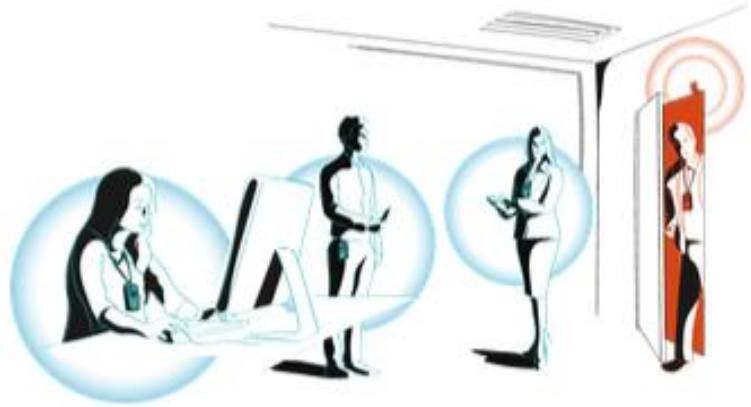
Tracker and Covid-19

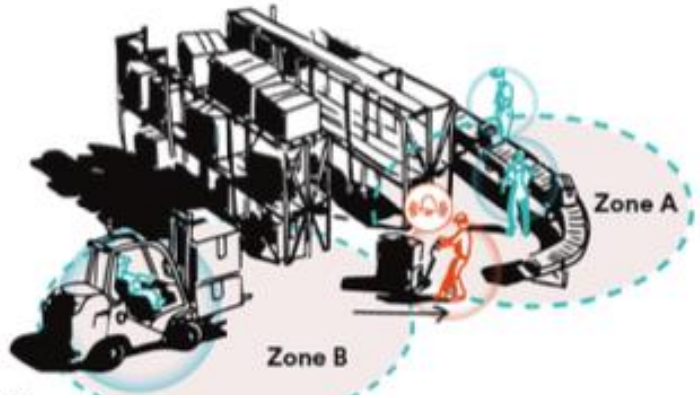
Abeeway
Improve your position

Proximity Alert & Monitoring

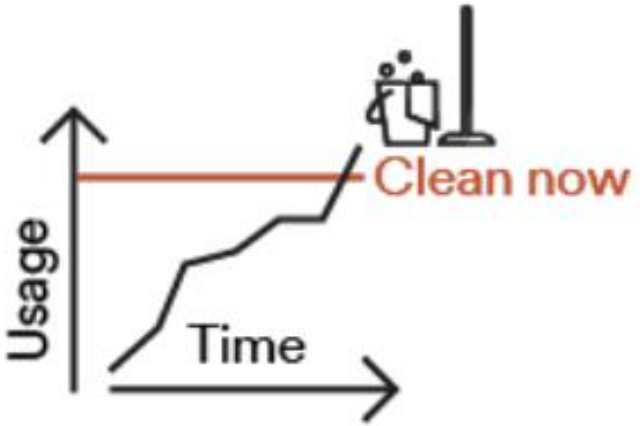
Density Enforcement



Zoning Enforcement



Disinfection scheduling



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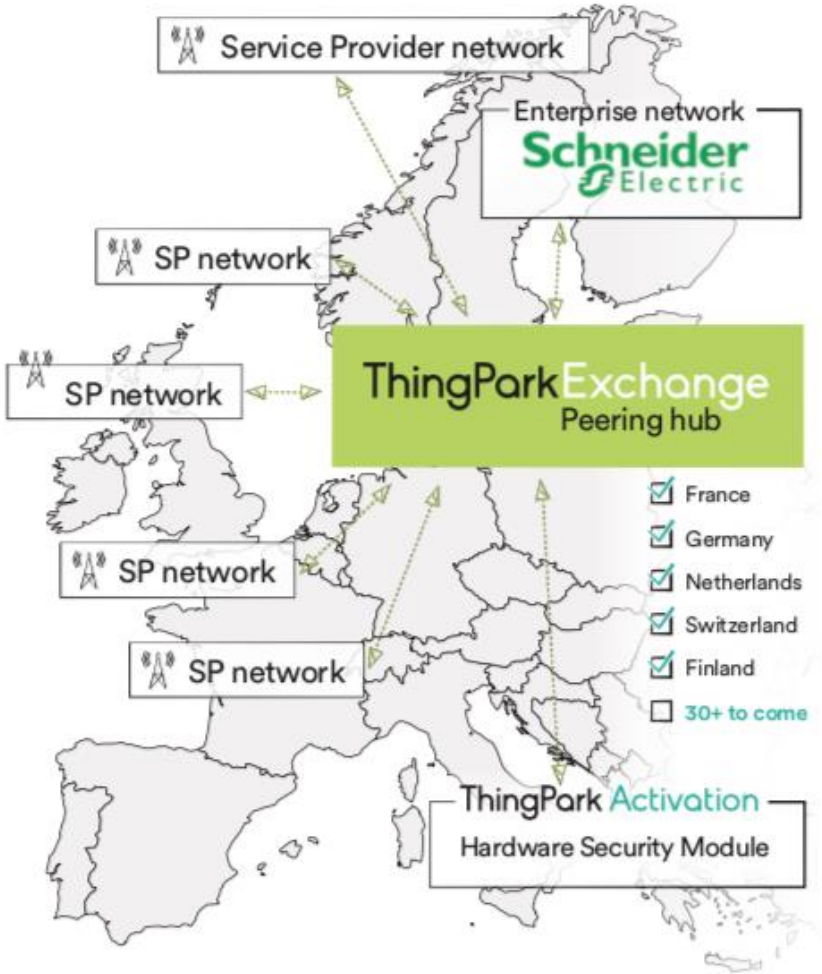
Industrial Monitoring

- Monitoring operating conditions of medium/low-voltage electric cabinets
- Unauthorized access
- Over-heating/fire
- Power loss



FACTORY SYSTEMES

ACTEMIUM

Wonderware by Schneider Electric

ATiM

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Building Management

- Occupancy, temperature, and air quality in buildings
- 15,000 sensors have already been deployed in smart buildings (Netherlands)

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LoRaWAN vs. NB-IoT

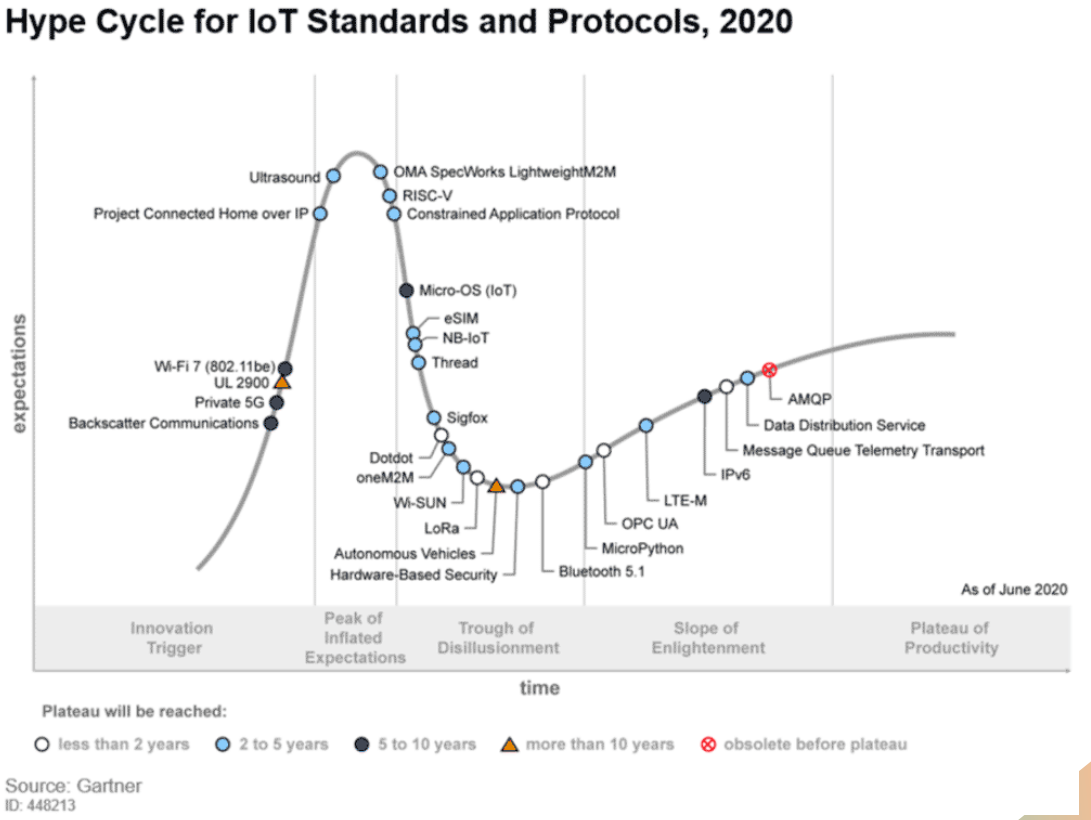
LoRaWAN™

ISM (unlicensed band)
Public + private networks
Accelerating deployments
Low-power (1/5th of NB-IoT)
Low-cost infra
Low-cost service
Collaborative networking

NB-IoT™

Licensed bands
Public networks
Emerging deployments

Real-time
Higher data-rate (250Kbps)
Marketing power (GSMA)



LoRaWAN and NB-IoT are complimentary (~ “3-5G and WiFi”)

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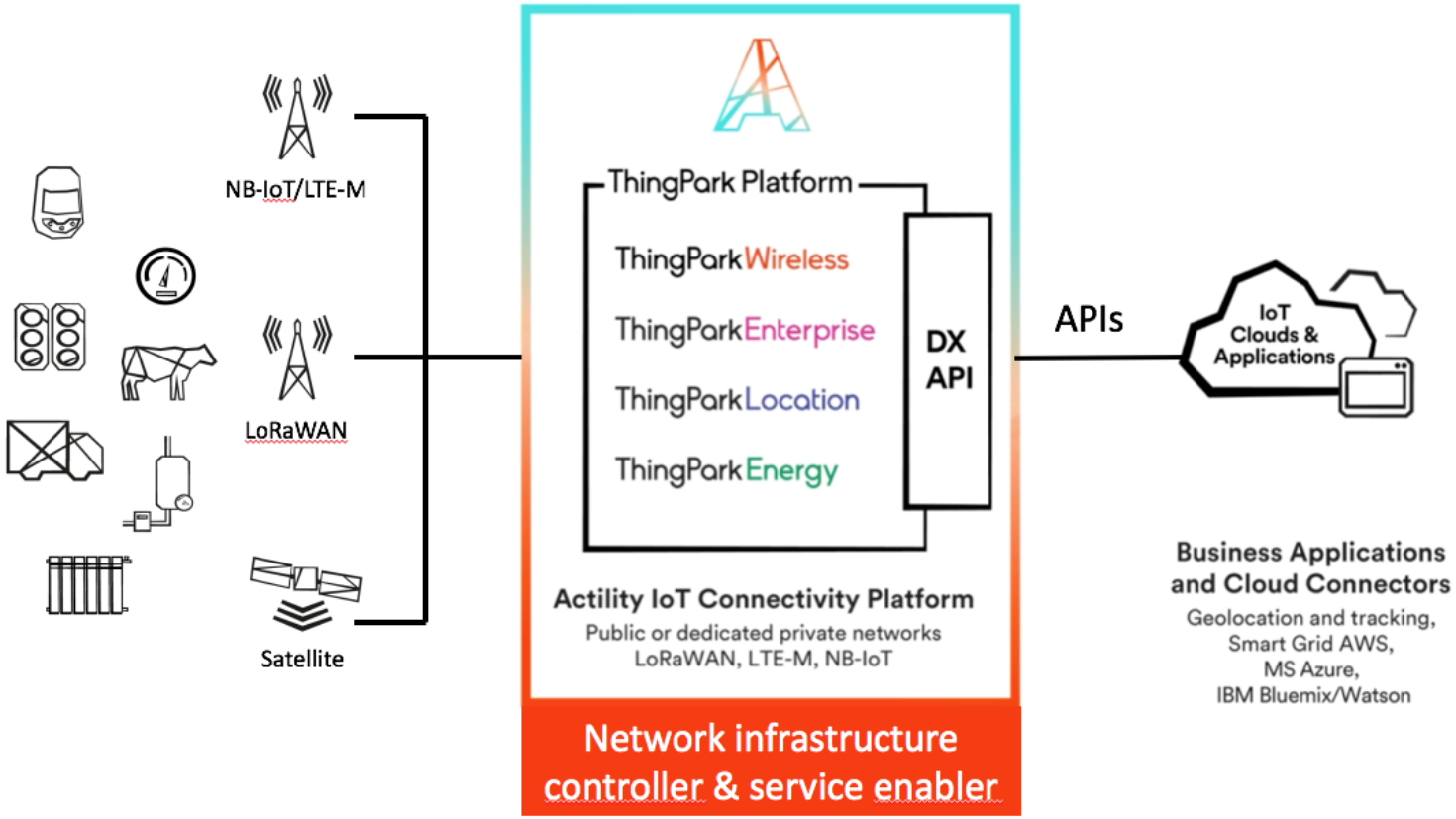

- Leading LoRaWAN system vendor
  - Almost half of national public networks globally powered by ThingPark platform
- Most comprehensive product/service portfolio
- LoRa Alliance leadership
  - Founding member, Alliance Vice-chair, Board Member, Technical Committee Chair, and active across all groups
- Developer network
  - 1000+ registered members
- B2B marketplace
  - 150+ sellers

Product Portfolio

Value

ThingPark X
Microservices for transforming, storing and exposing data to apps and cloud platforms

ThingPark Location
Multi-technology location engine combining GPS, AGPS, WIFI and LoRaWAN TDoA

Dataflow management and data enrichment tools

ThingPark Developer Portal
Self-service portal & developer network

Device Interop Engine
Device qualification & interoperability self test tool

Ecosystem development tools

Engagement

Scaleablility

ThingPark Activation
Secure large-scale device provisioning enablement tool

ThingPark FUOTA
Firmware Update over-the-Air for LoRaWAN devices

Device life cycle management tools

ThingPark Market
IoT device/app marketplace to accelerate ecosystem adoption

ThingPark Click&Go
End-to-end LoRaWAN packaged IoT solutions

Business enablers for low-touch sourcing and solution acceleration

Connectivity

ThingParkWireless
LoRaWAN/LTE-M/NB-IoT network management
EPC Connector for 3GPP networks

ThingParkExchange
Integrated roaming hub for multi-network/international LoRaWAN connectivity

ThingParkEnterprise
LoRaWAN network management for dedicated/private enterprise IoT networks

Tools to plan, deploy, operate and monetise LoRaWAN and LTE-M/NB-IoT networks

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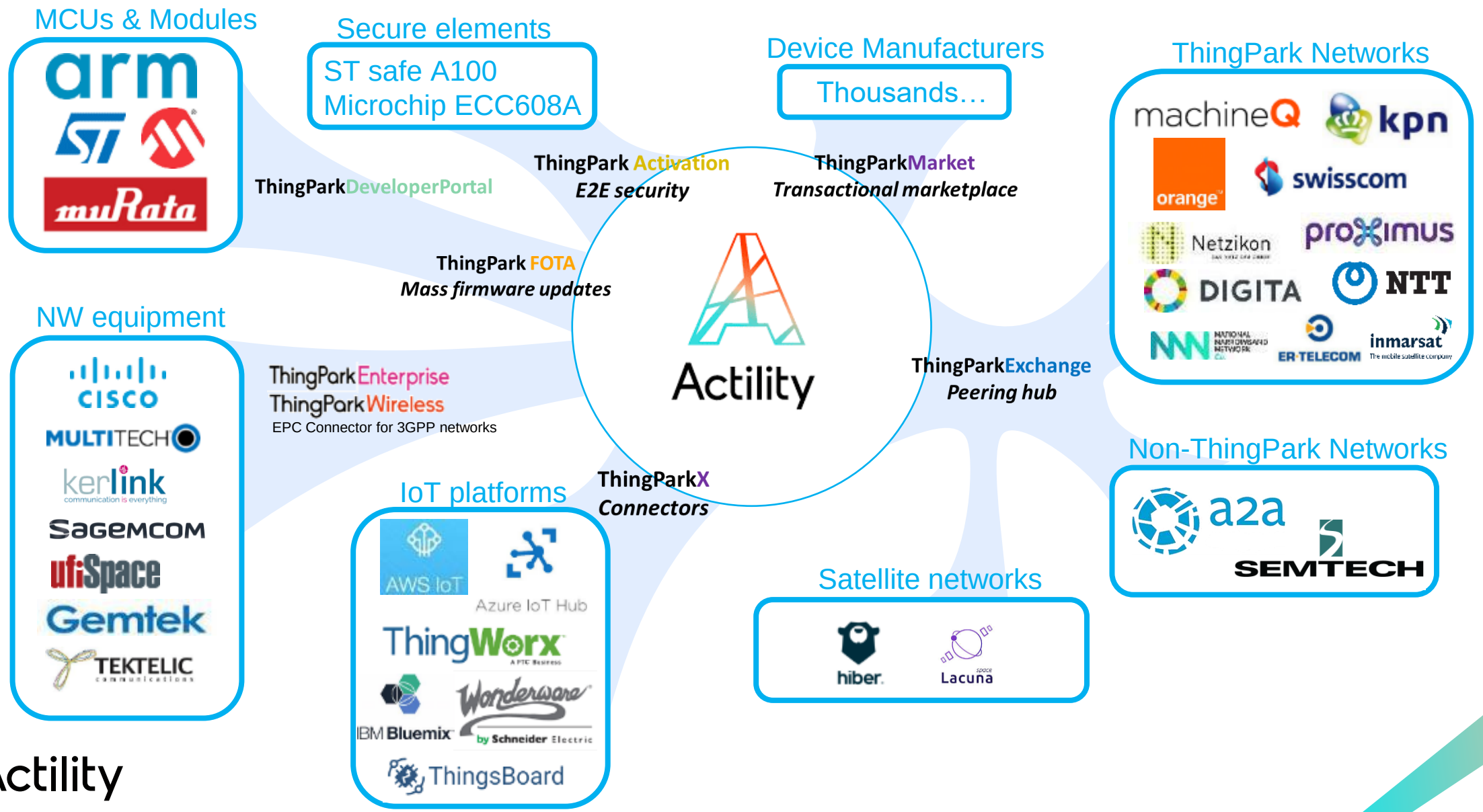
ThingPark Ecosystem



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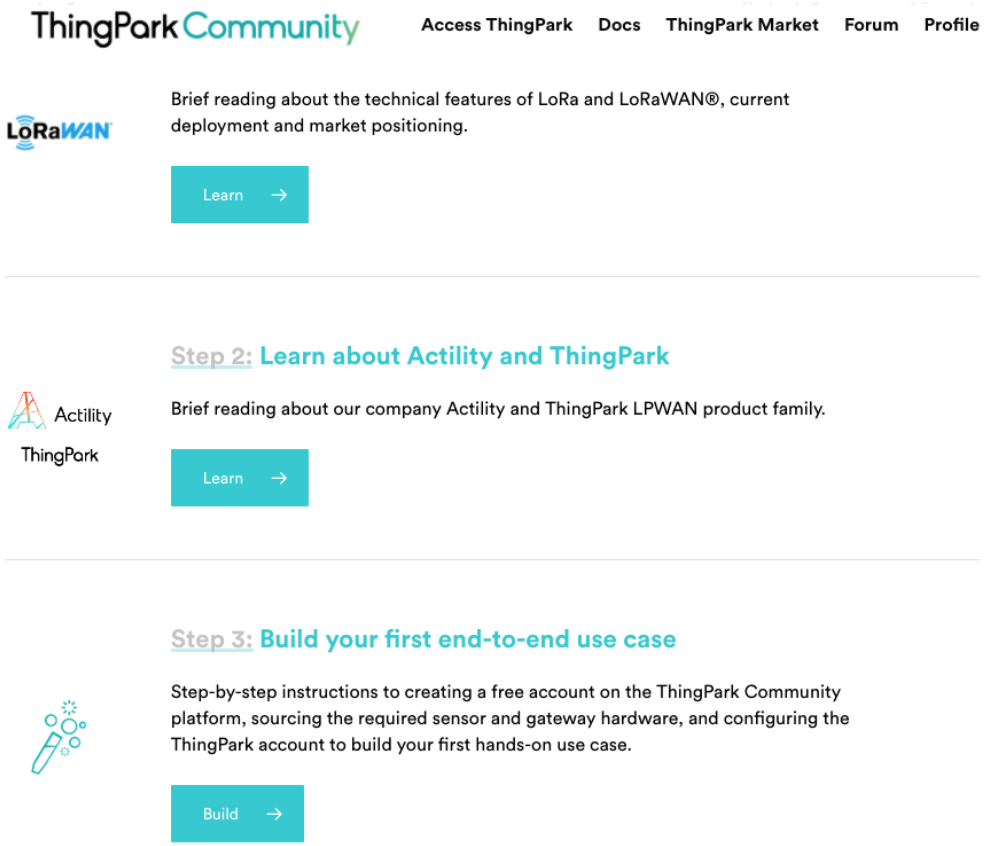
Want to Try?



- Create a free account on ThingPark Community Platform (NS) community.thingpark.org
- Follow step-by-step instructions
  - Including buying a device and gateway at market.thingpark.com
- Ask your questions on the Forum

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Q&A

actility.com
market.thingpark.com
community.thingpark.org

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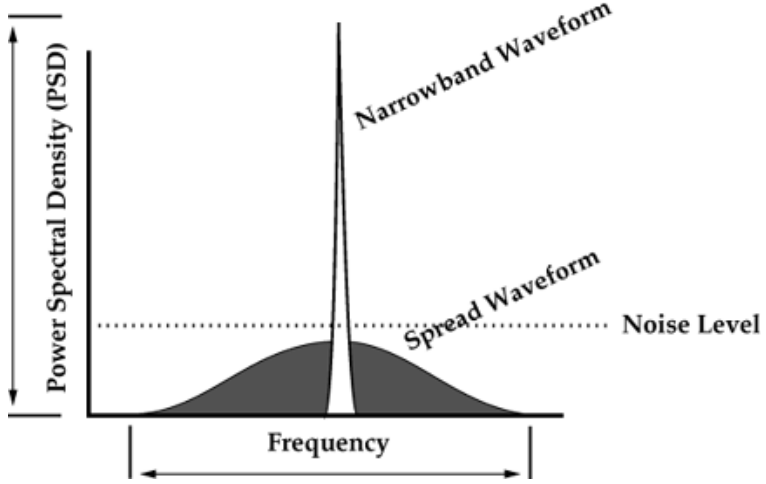
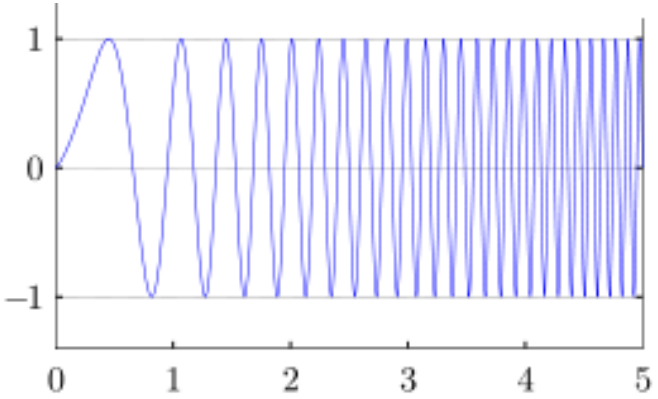
Spread Spectrum

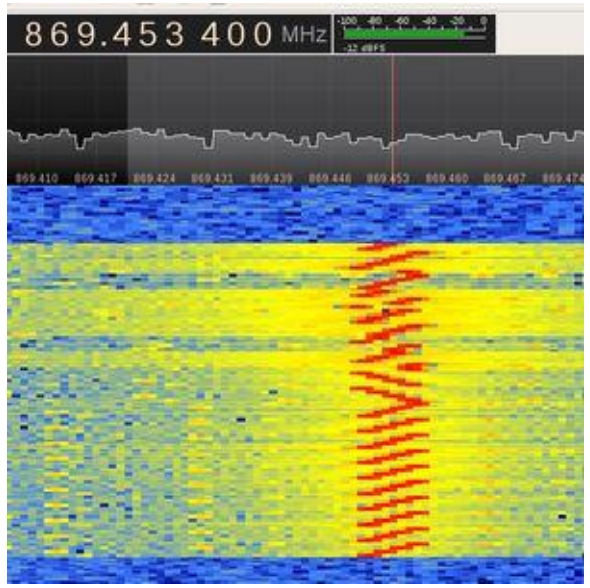
- Highly immune against interference and allows operating at very low SNR ranges (down to -20dB below the noise level)



- Chirp Spread Spectrum (CSS) modulation
  - Spreading is achieved by generating a chirp signal where the frequency increases linearly over time.
  - When the maximum frequency of the band is reached, the frequency wraps around, and the increase in frequency starts again from the minimum frequency.



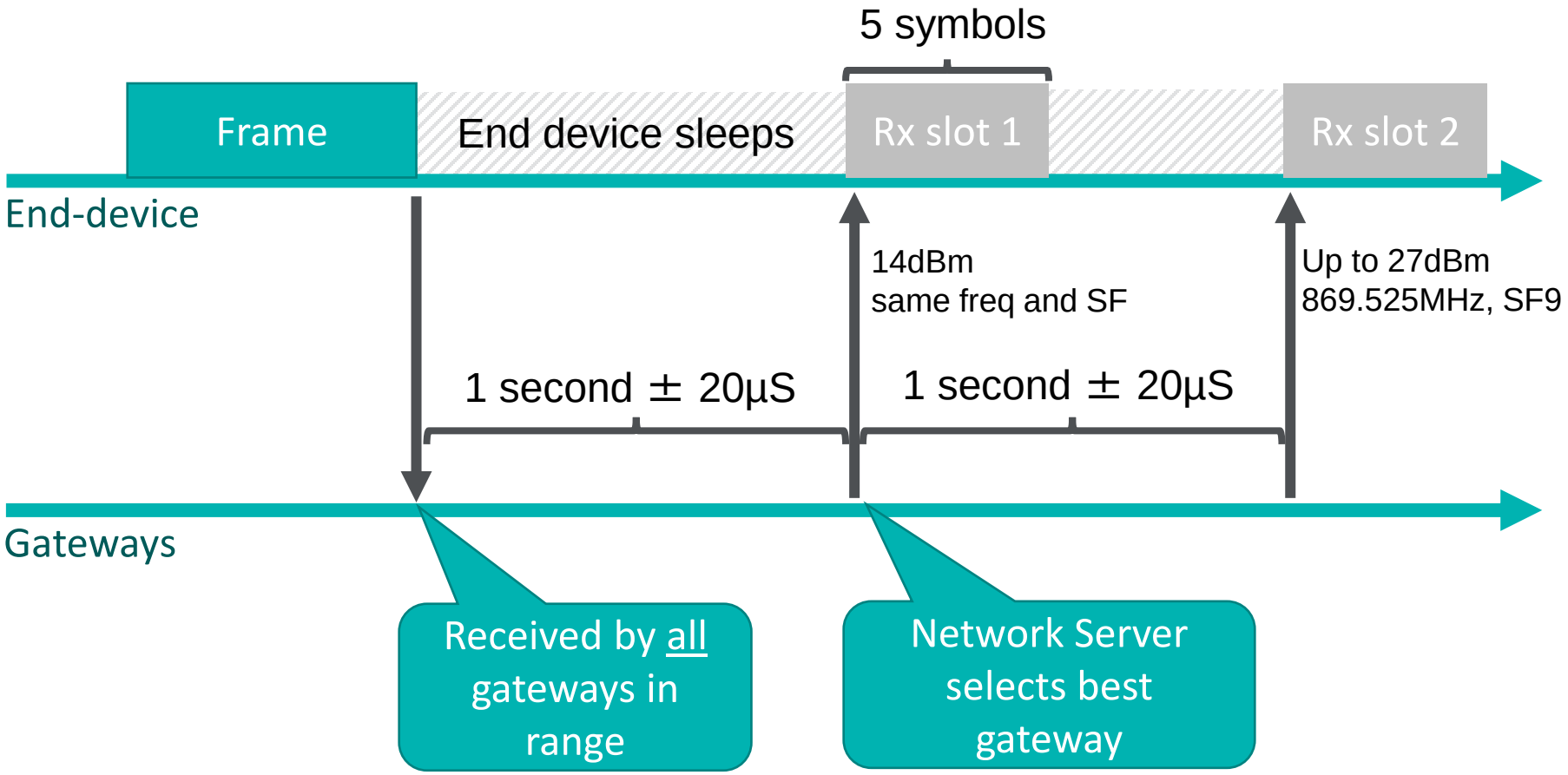
Chirp Signal



End-device Classes

Class name	Intended usage
A	**Battery powered sensors**, or actuators with no latency constraint
B	**Battery powered actuators** Slotted communication synchronized with the network beacon
C	**Mains powered actuators** Listen continuously

Class A



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LoRaWAN vs. SigFox

LoRaWAN™

Sub-Ghz ISM
Public + private networks
Open ecosystem
Flexible business models

Dynamic power management
Collaborative networking

sigfox

Sub-Ghz ISM
Public networks
Closed ecosystem
Single business model
Overly-constrained data traffic (*)

Early start

(*) 12 byte frame, 140 UL / 4 DL per day, 100bps

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Interference Mitigation

- Macro-diversity
- LoRa CSS modulation
  - Highly immune against interference
  - Uses FEC
  - Allows operating at very low SNR ranges (down to -20dB below the noise level)
- ISM band use limitations
  - Duty cycle, dwell time, LBT
- Multi-channel plans, channel hopping
- Demodulation of different SFs on the same channel
- ADR
  - Densified network → reduced TX power, increased DR → reduced collision
- Confirmed UL/DL
- FEC at app-layer

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Latest TC Publications

- LoRaWAN Link-layer Specification (TS1-1.0.4)
  - Clarifications/tightening/bug fixes, Class B and security improvements
  - Bundling w/ reference implementation, LCTT, and certification
- LoRaWAN Certification Protocol (TS9-1.0.0)
  - Protocol used for remote-controlling the device during certification testing
- LoRaWAN Regional Parameters (RP2-1.0.2)
  - LR-FHSS data rate (specifically for improving satellite and deep-indoor use cases), new countries: Senegal, Montserrat, Mali, Guinea, Syria and Vanuatu
- LoRaWAN Backend Interfaces Specification (TS2-1.1.0)
  - Geoloc for roaming; accounting, JS lookup, NS identification, and message flow enhancements
- LoRaWAN Device Identification QR Codes (TR5-1.0.0)
  - Device identification QR format to be used in automated device onboarding
- LoRaWAN DLMS End-Device Monitoring Guidelines (TR6-1.0.0)
  - List of end-device management and monitoring parameters for DLMS use cases