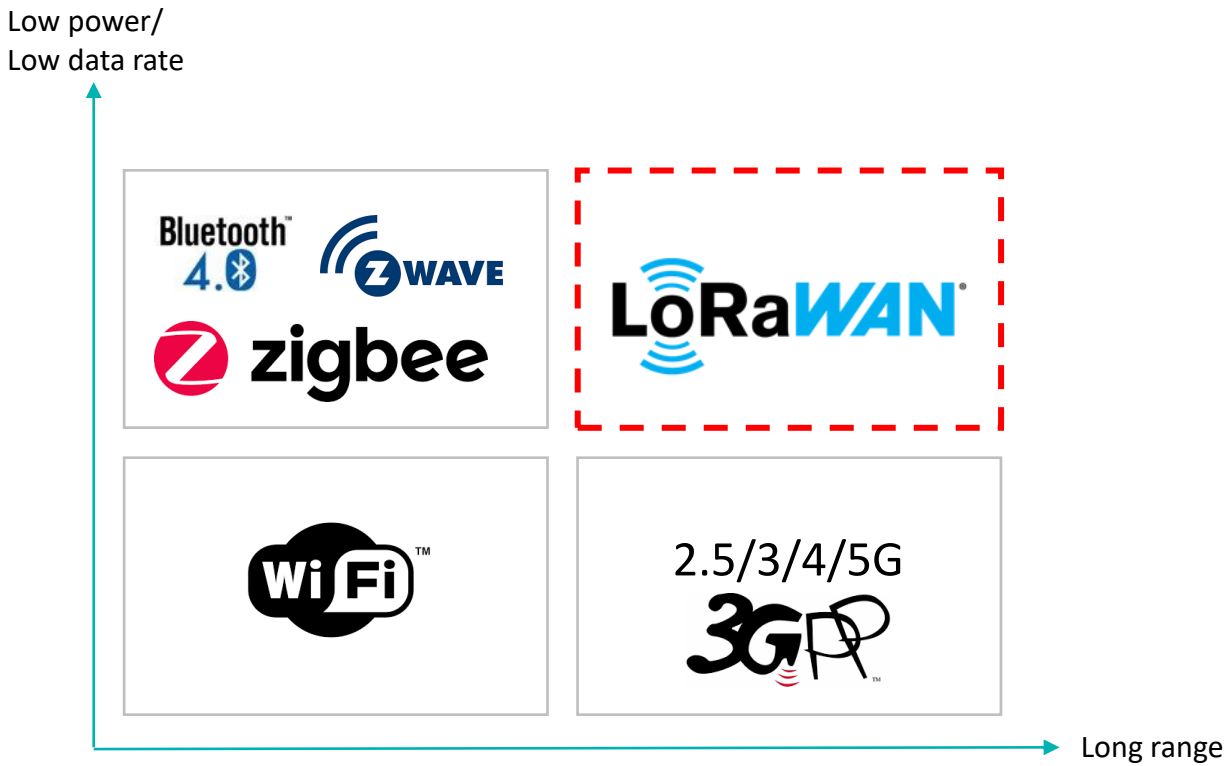
Actility
Connecting with intelligence

LoRaWAN®
Technical Features, Application Areas, New Developments

Alper Yegin
VP of Advanced Technology Development, Actility
Chair of Technical Committee, LoRa Alliance

Low-Power & Long-Range



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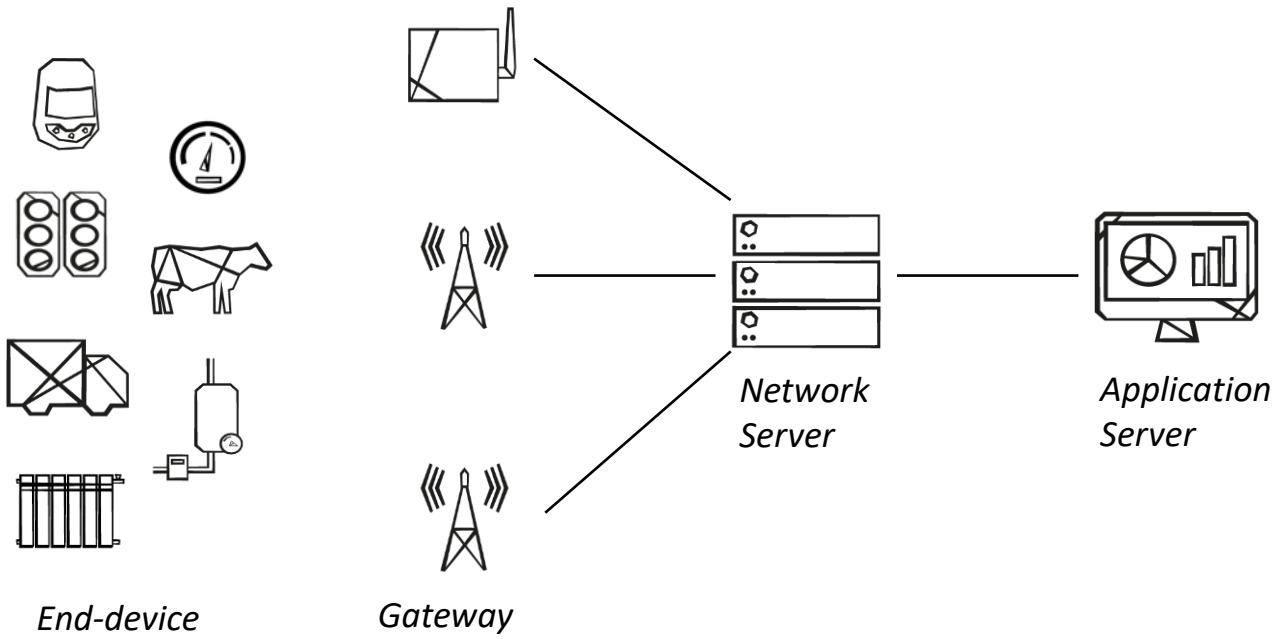
LoRaWAN

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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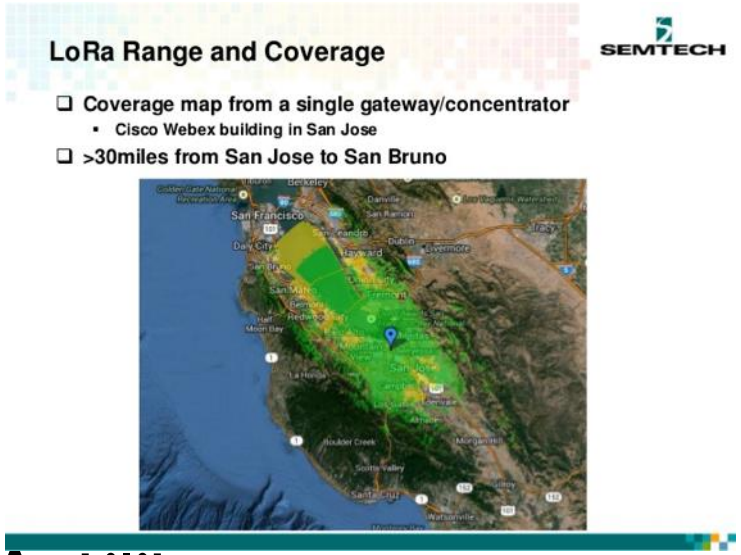
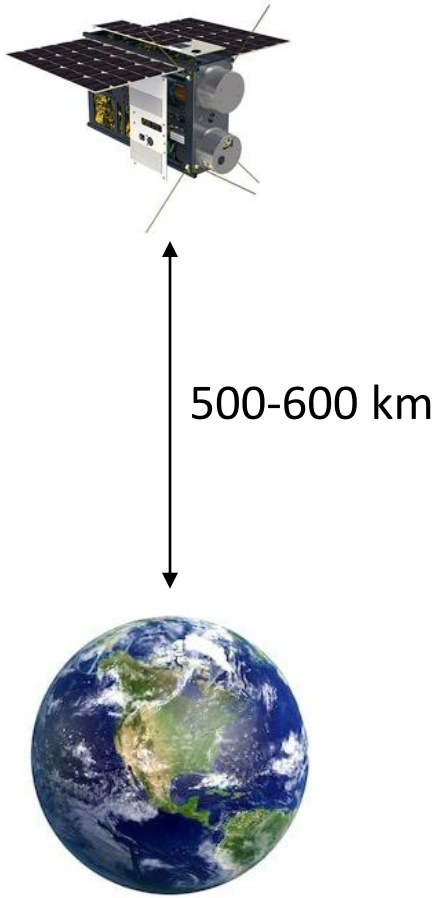
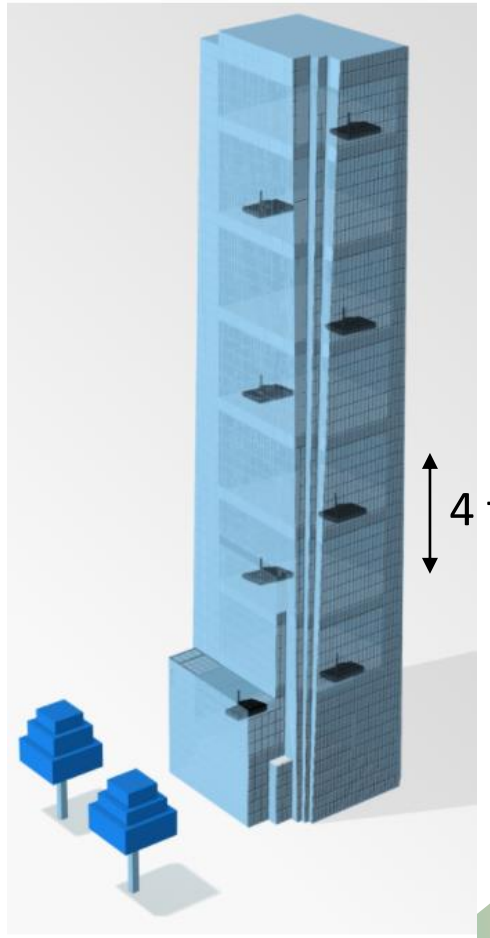
Range







Source: MachineQ

Actility

Power

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	51 – 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

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Gateways

Macro-cell

Pico-cell

Development kit

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

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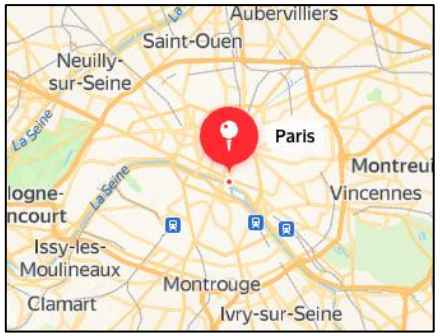
Organic Growth

Low-cost infra + Unlicensed band → Widespread deployments!

Home

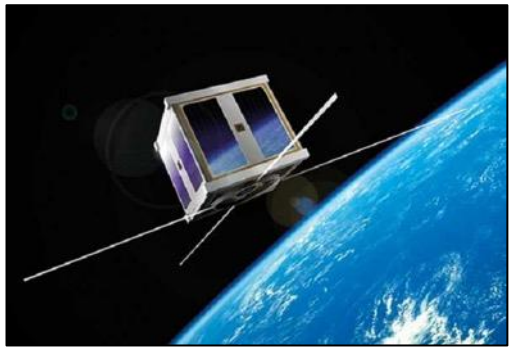
Commercial building

Campus



City

Country



Planet

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Operator Deployments

orange

bouygues TELECOM

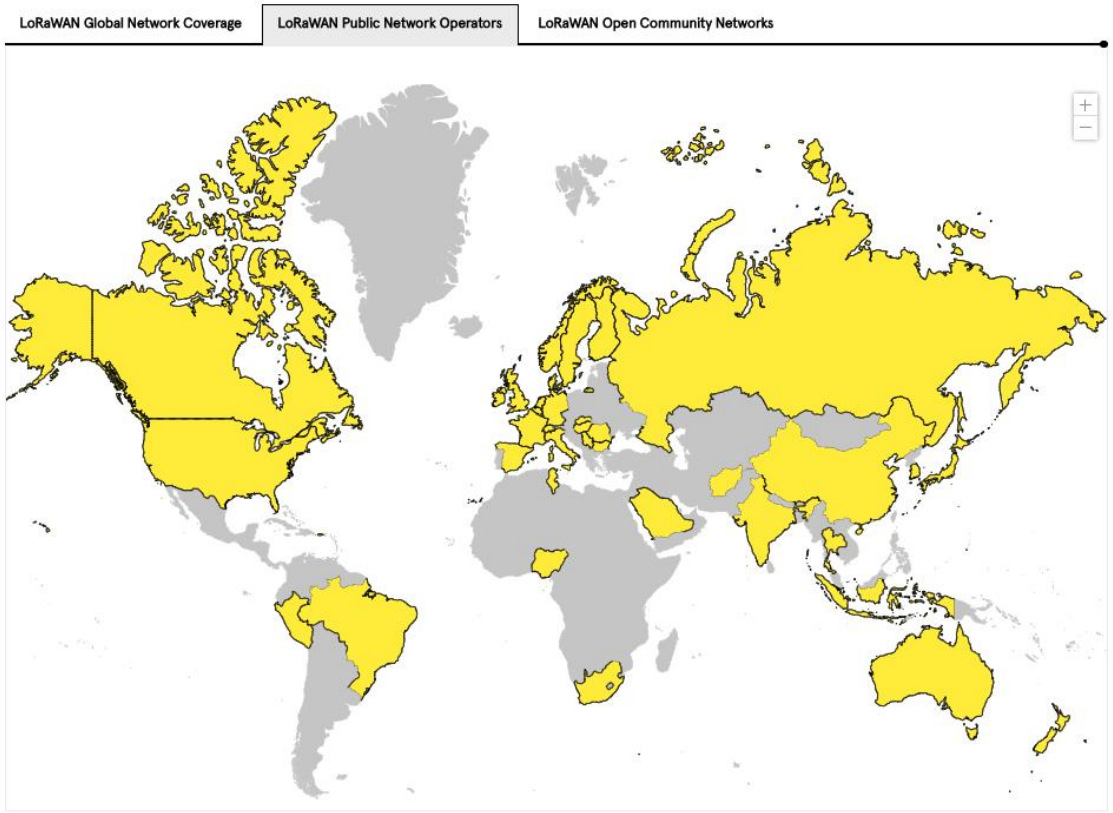
kpn

SK telecom

COMCAST

ЭНЮПТА

163 LoRaWAN Network Operators in **177** Countries



swisscom

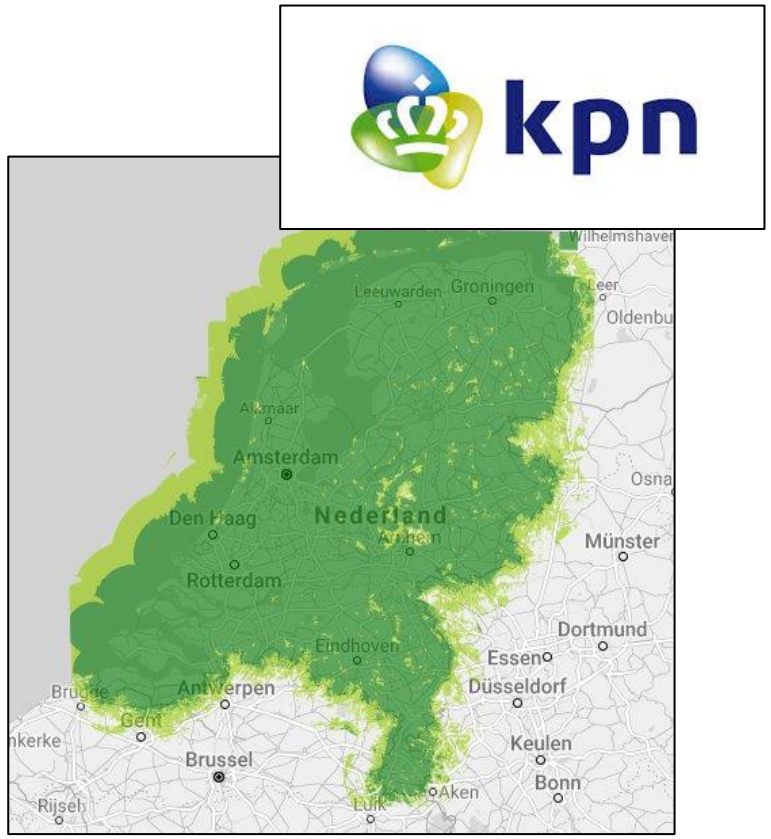
NTT WEST

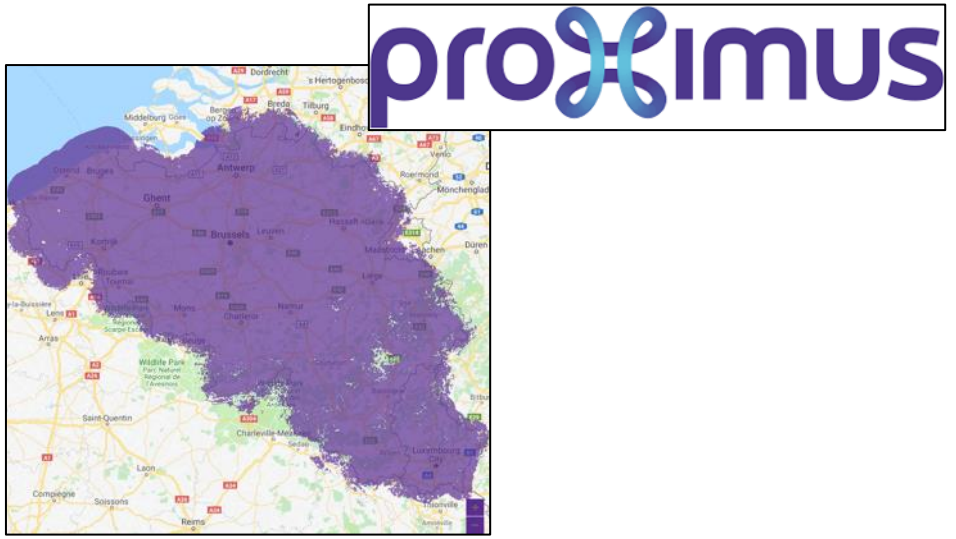
ZTE

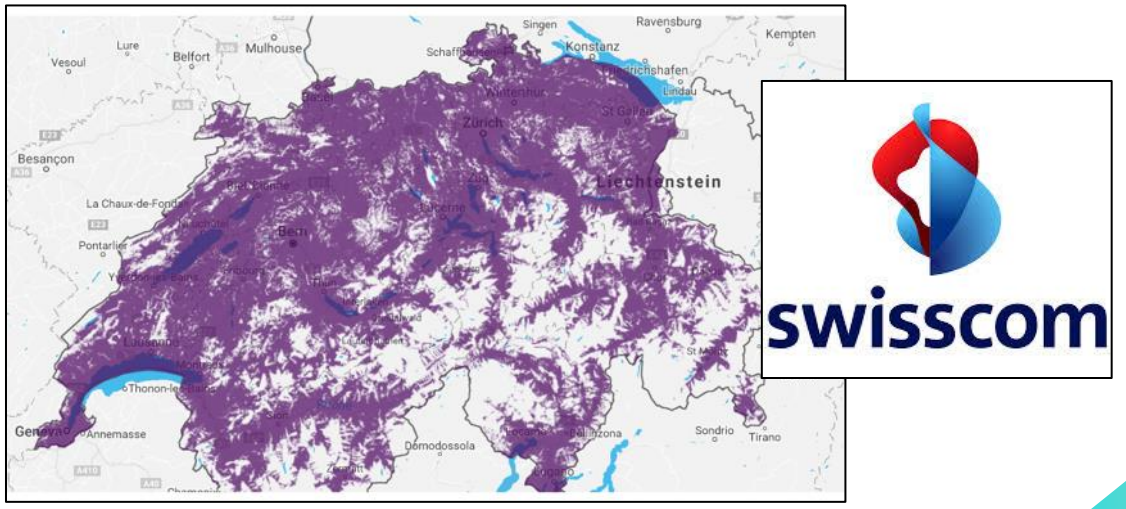
BT

TATA COMMUNICATIONS

Nationwide Coverage







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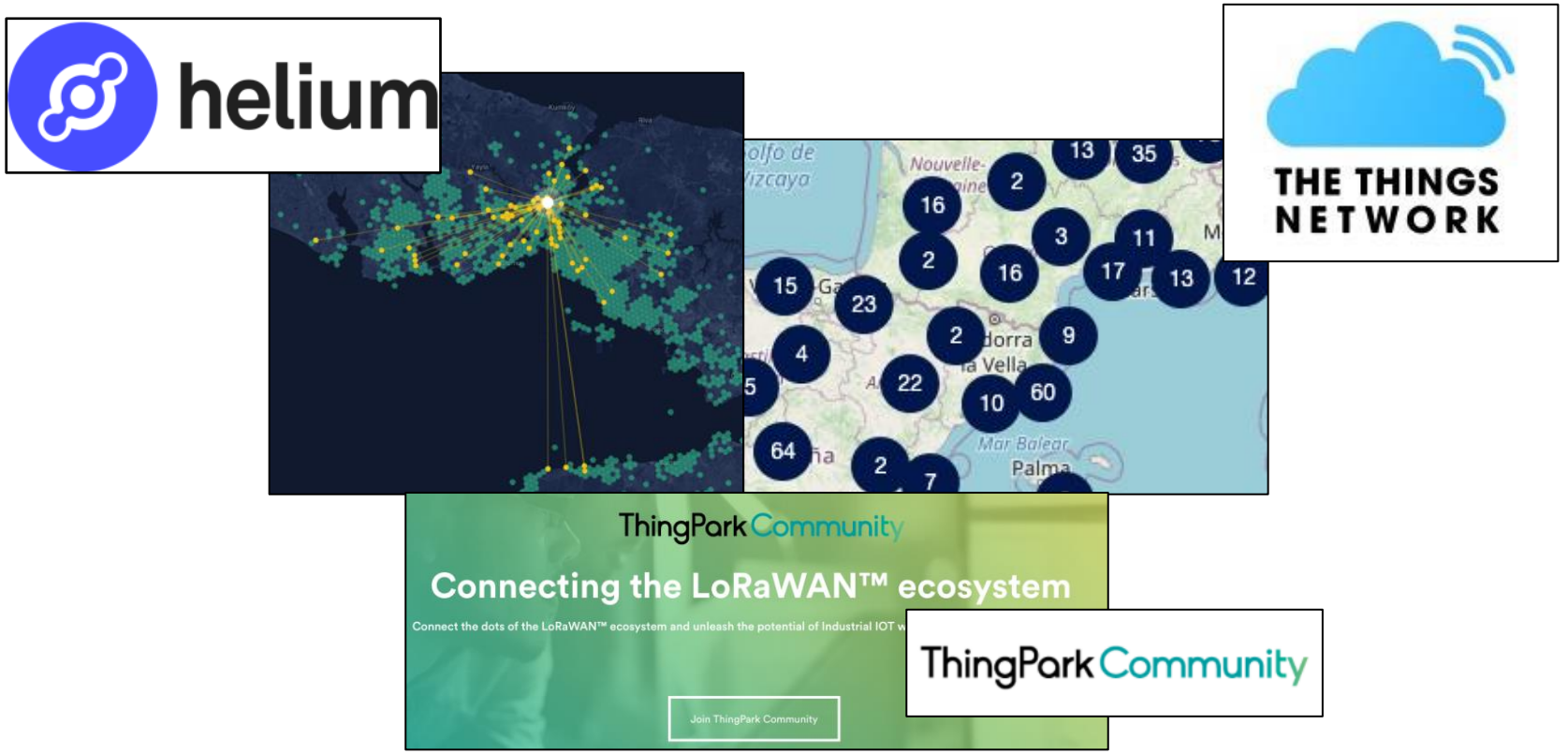
Community Networks



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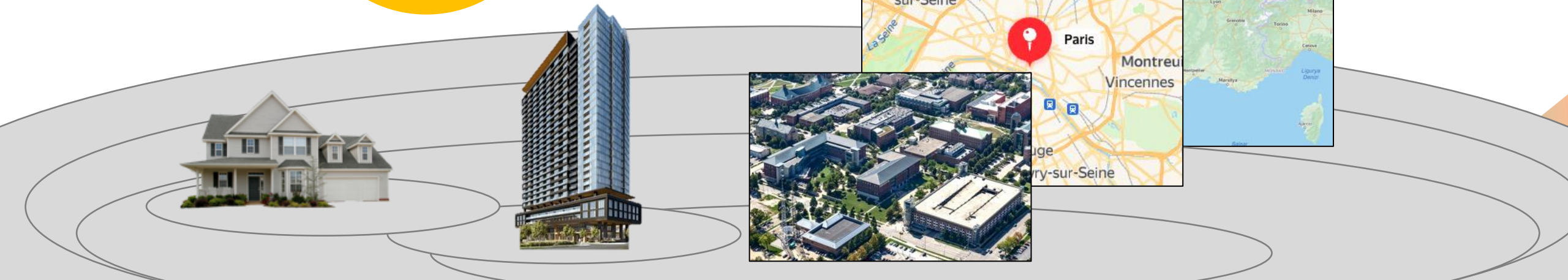
Integration via Roaming

Collaborative technology

LoRaWAN® Roaming

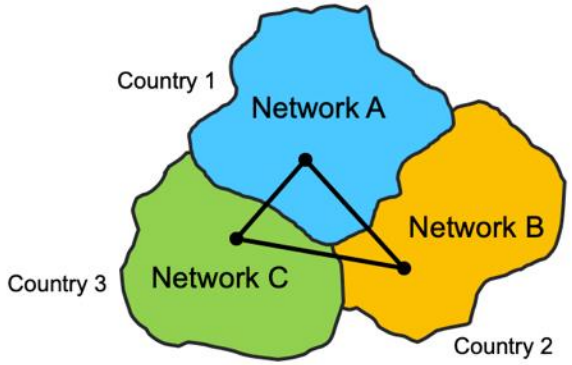
Collaborative ecosystem

Simple & scalable backend standard

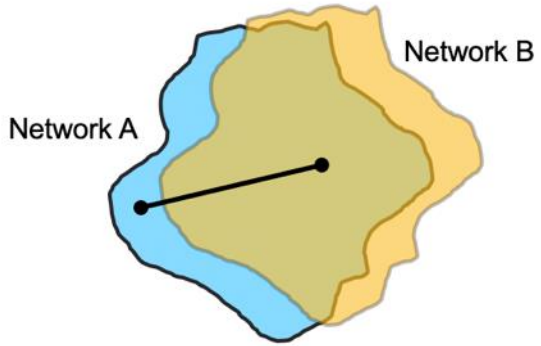


Roaming Flavors

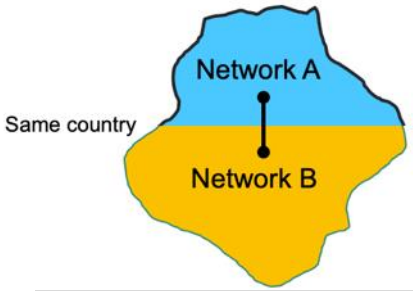
Coverage Types



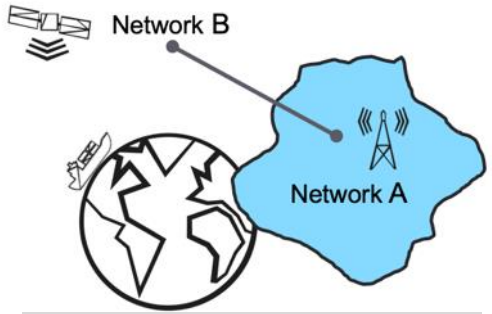
1. International complementary coverage (extension)



3. National overlapping coverage (densification)

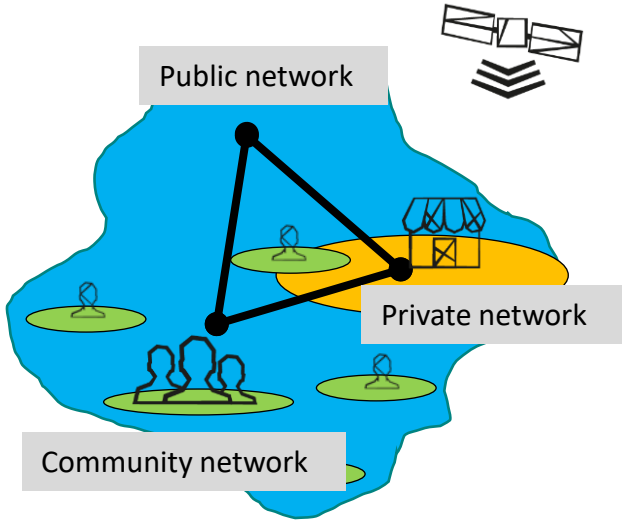


2. National complementary coverage (extension)



4. Satellite-terrestrial roaming

Network Types



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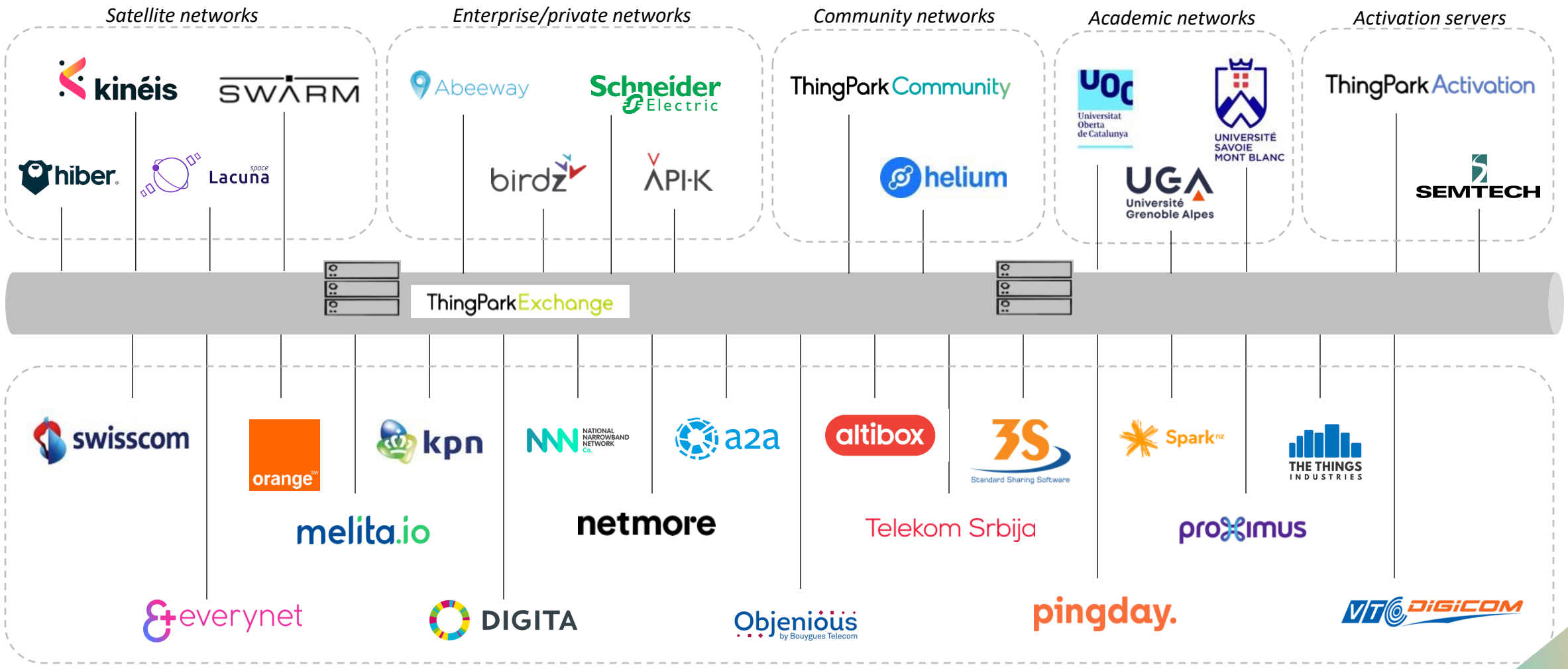
LPWAN Backbone



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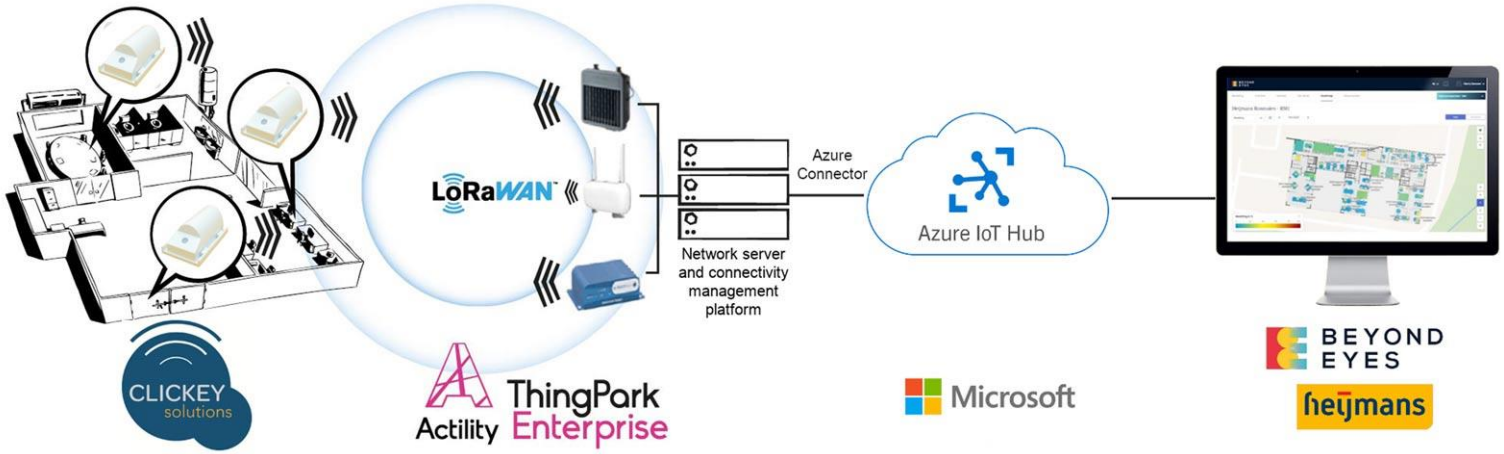
Buildings

Smart Buildings revolutionized with over 20,000 IoT sensors deployed at scale in the Netherlands on private LoRaWAN® network

Actility · heijmans · Microsoft · BEYOND EYES · CLICKEY solutions

- Desk Occupation Sensors
- Room Occupancy Sensors
- People Counters
- Energy Sensors
- Comfort Sensors
- Environmental Sensors



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Smart Grid

New Zealand electricity infrastructure gets real-time fault detection thanks to LoRaWAN®

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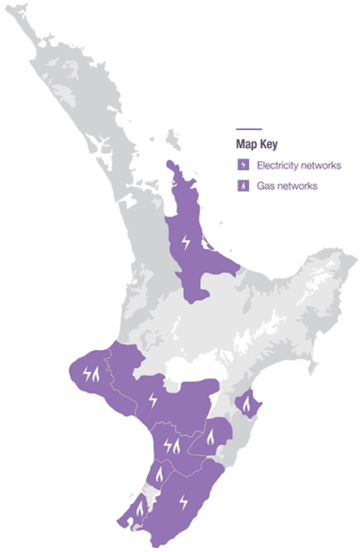
POWERCO



- Detect faults (power outage)
- Performance and metering information
- Identify underperforming assets
- Understand power demand

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Water Management

National LoRaWAN network deployed in Brunei for Smart Water use cases by Anian with IoThink Solutions and Actility

Actility ANIAN IoThink® Solutions

- Monitoring river water levels
- Flood warning
- Monitor wastewater pumping stations
- Monitor water quality

Construction

39,000 Abeeway LoRaWAN® Trackers deployed for Saudi Arabia's biggest hospitality project

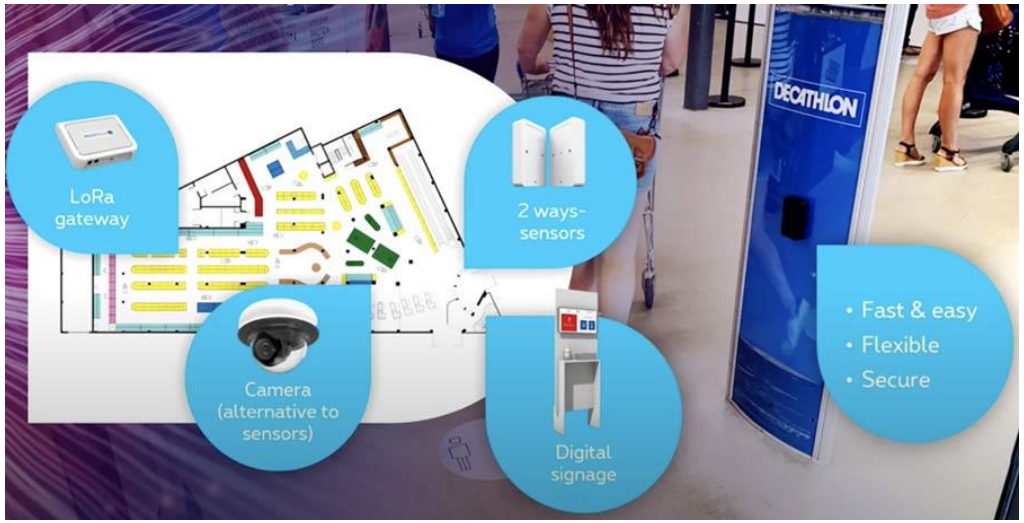
Actility · The Red Sea Development Company · Abeeway · machinestalk innovation frontier

- Site security
- Worker safety
- Access control
- Process efficiency

Retail Stores

Decathlon adapts to "new Covid normality" using IoT with Proximus and Actility

Actility DECATHLON proximus



Visitor counter and heat maps

Water Metering

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

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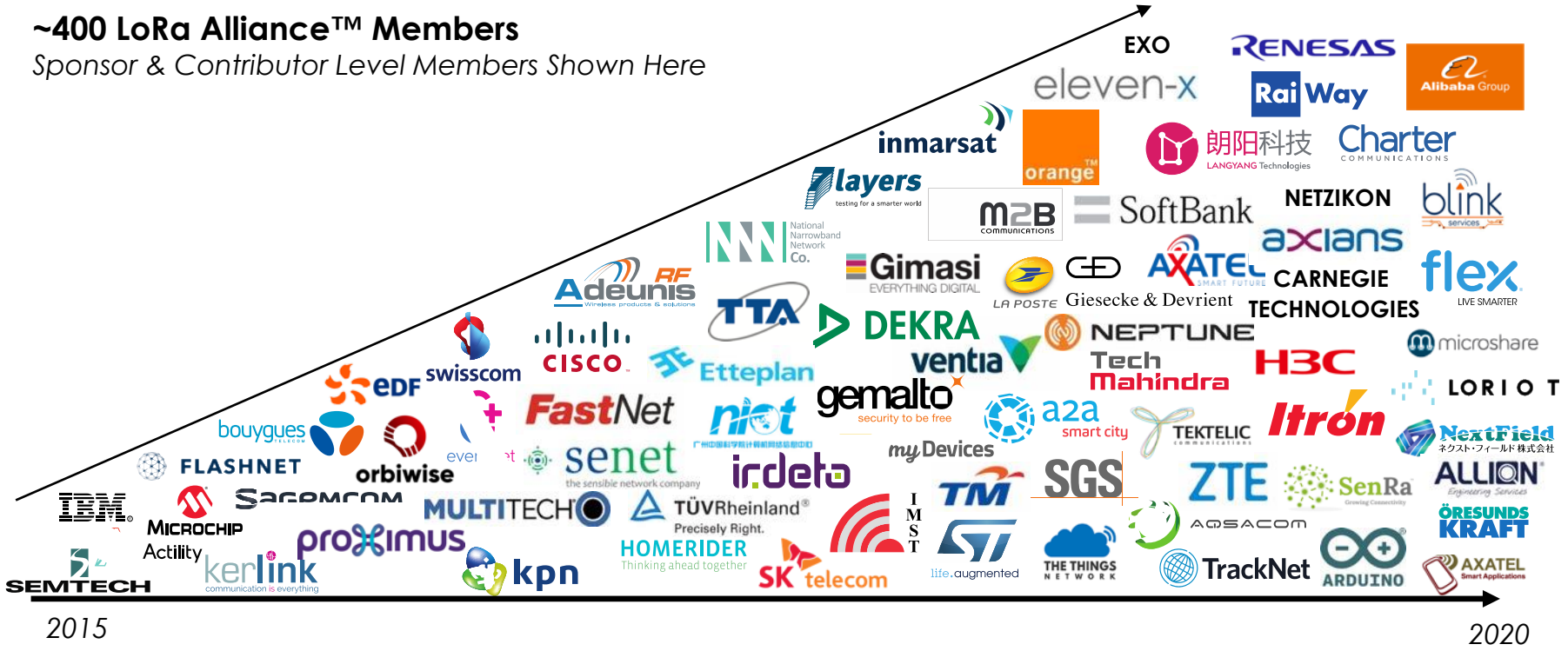
Industrial Zones

- Monitor gas usage
- Tracking vehicles and their transported goods
- Monitor health and production of machinery
- More to be added…

LoRa Alliance™

~400 LoRa Alliance™ Members

Sponsor & Contributor Level Members Shown Here



- Marketing Committee
- Certification Committee
- Technical Committee

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

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LoRaWAN® Recognized as ITU International Standard

- Recommendation ITU-T Y.4480 “Low power protocol for wide area wireless networks”
- Under Study Group 20 of the ITU Telecommunication Standardization Sector (ITU-T), ITU’s standardization expert group for “Internet of Things and smart cities and communities.”

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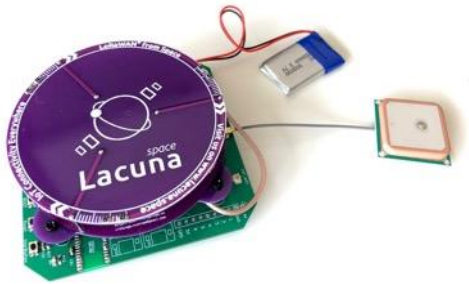
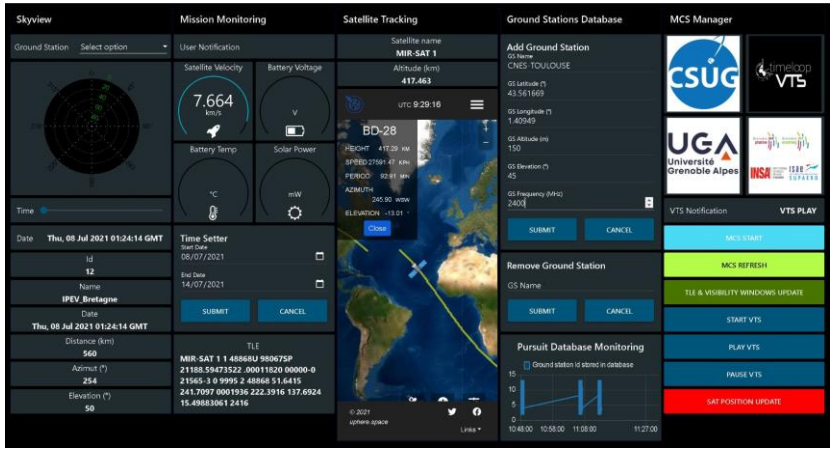
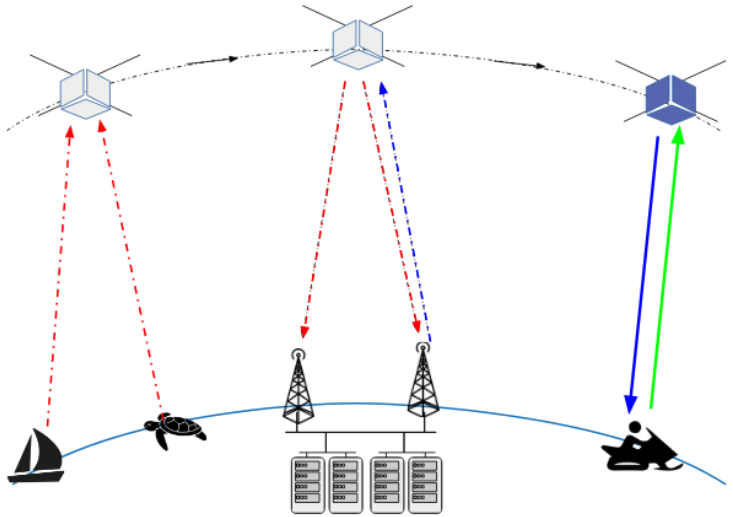
Satellite Networks



- Inmarsat
- Lacuna
- Eutelsat
- Kineis
- Echostar
- Wyld
- Fleet
- Hiber
- Swarm
- …





gricad-gitlab.univ-grenoble-alpes.fr/thingsat/public/-/blob/master/cubesat_mission/README.md#partners

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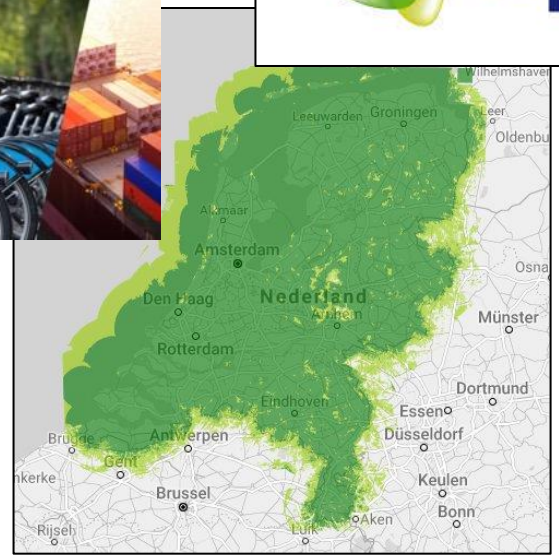
Nationwide Deployment of Class B

Millions of IoT devices in the Netherlands can now benefit from faster wireless control and firmware upgrades thanks to LoRaWAN® Class B

Actility

kpn



LoRaWAN World Expo

lora-alliance.org/event/lorawan-world-expo/

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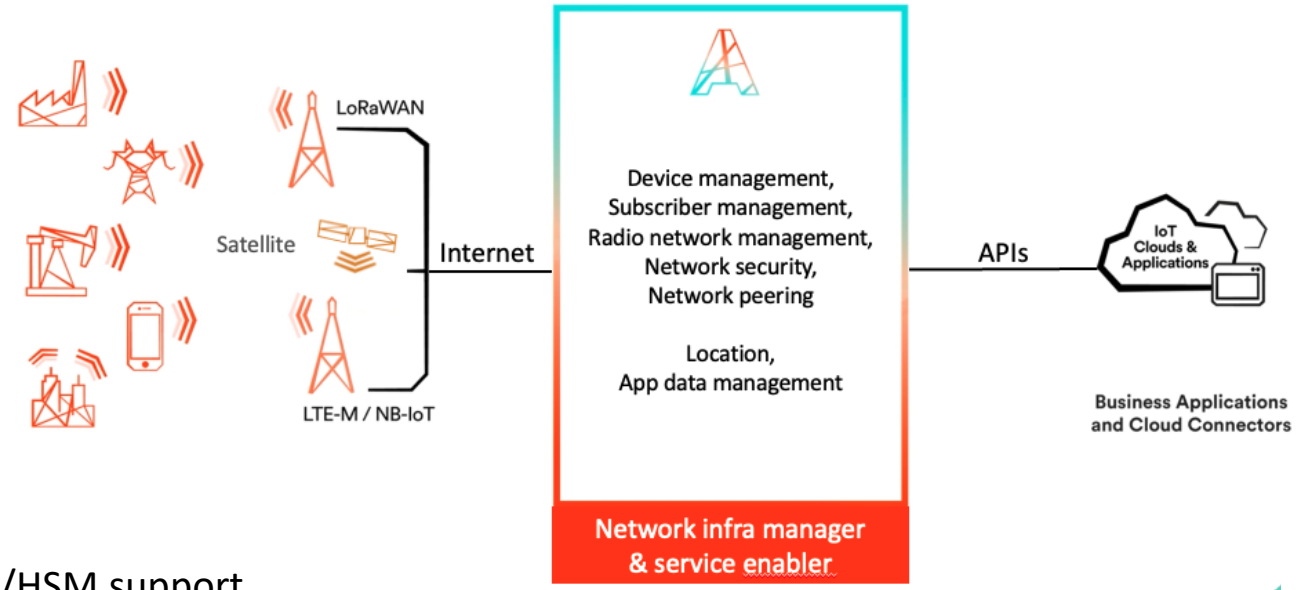
1 of the 3 companies authored the original LoRaWAN spec
Founding member of LoRa Alliance

50+ public operators and numerous enterprise customers

Backed by Orange, KPN, Swisscom, Cisco, Bosch, Foxconn, Inmarsat, Creadev, Ginko, Idinvest, Bpifrance



ISO9001-certified
Telco-grade,
multi-region
operational support

Public/private NS, JS, SE/HSM support,
OSS/BSS, LoRaWAN + cellular + satellite radio support, FUOTA server, roaming hub, location server, app data management, interop suite, B2B marketplace

Carrier-grade
commercial deployment by
majority of tier-1 nationwide LoRaWAN operators

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

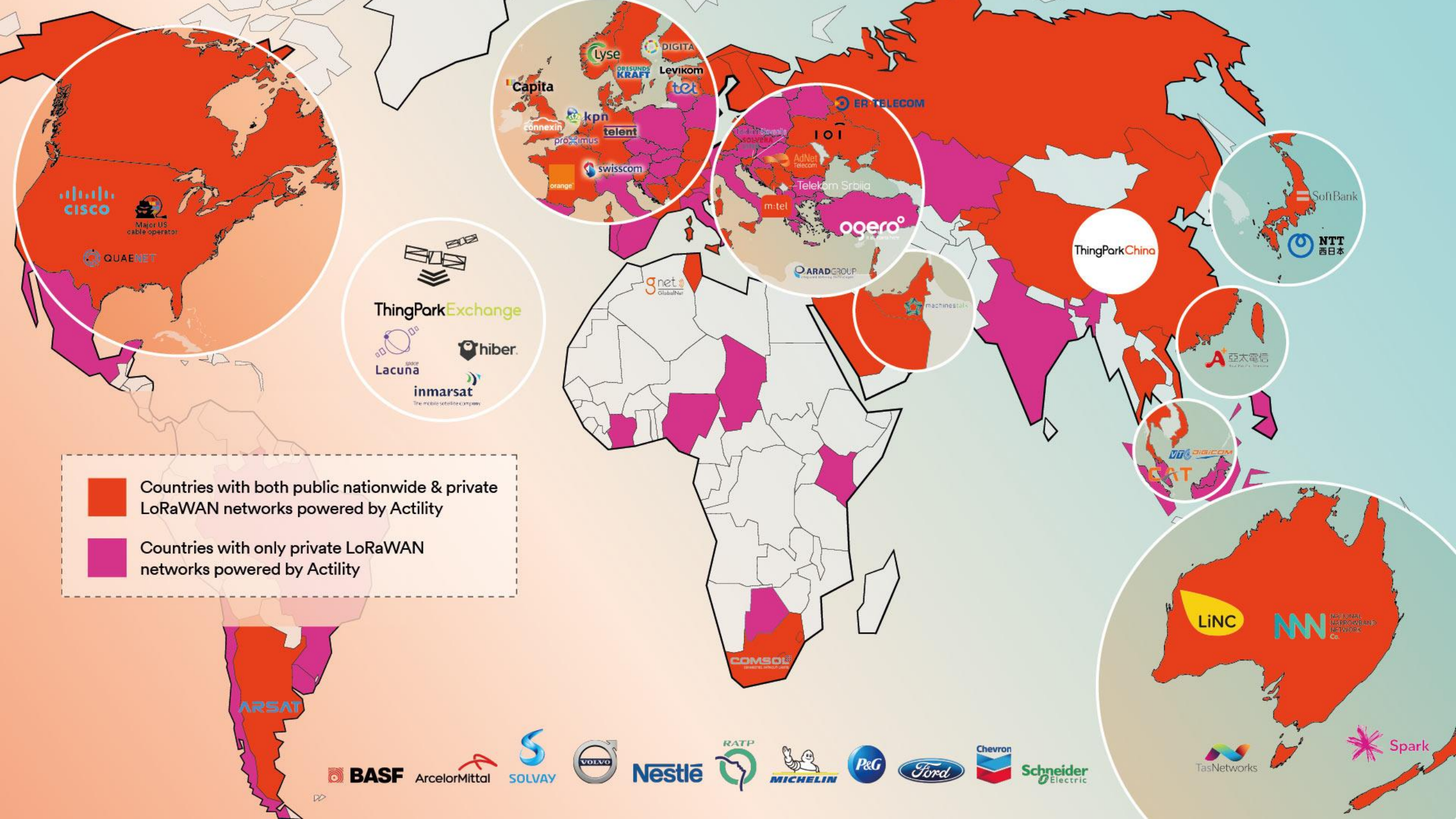
ThingParkWireless
LoRaWAN/LTE-M/NB-IoT network management
EPC Connector for 3GPP networks

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

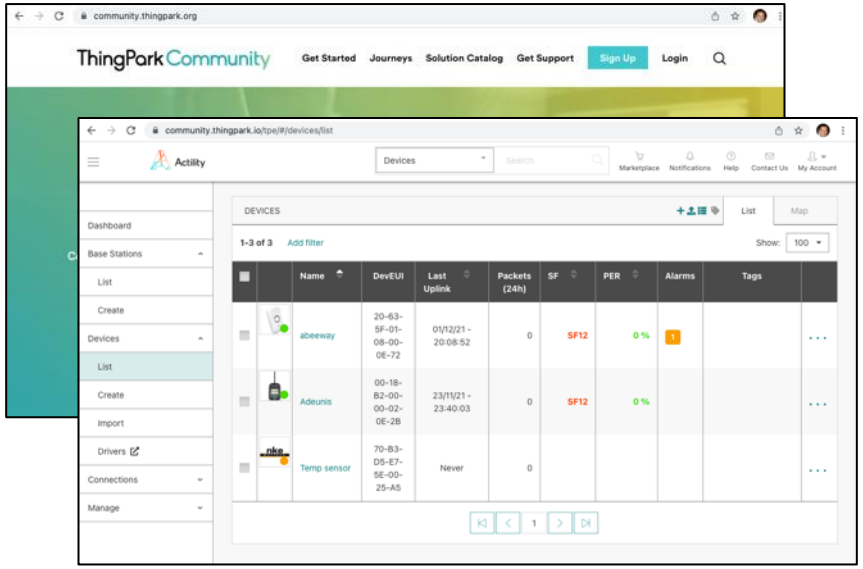
ThingParkEnterprise
LoRaWAN network management for dedicated/private enterprise IoT networks

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

Actility


Countries with both public nationwide & private LoRaWAN networks powered by Actility
Countries with only private LoRaWAN networks powered by Actility
cisco
Major US cable operator
QUAENET
Lyse
DIGITA
ØRESUNDS KRAFT
Lewikom
tet
Capita
kpn
connexin
telent
proximus
swisscom
orange
ER-TELECOM
101
AdNet Telecom
Telekom Srbija
m:tel
ogero
ARADGROUP
ThingParkExchange
Lacuna space
hiber
inmarsat
gnet GlobalNet
machinestalk
ThingParkChina
SoftBank
NTT 西日本
亞太電信
VTC DIGICOM
CAT
COMSOL
ARSAT
LiNC
NBN NATIONAL BROADBAND NETWORK Co.
TasNetworks
Spark
BASF
ArcelorMittal
SOLVAY
VOLVO
Nestlé
RATP
MICHELIN
P&G
Ford
Chevron
Schneider Electric

Try!



AWS IoT

Azure IoT Central

MQTT

ThingsBoard

thingworx®

+ several others

1

Buy a **device** on market.thingpark.com

2

Buy a **gateway** on market.thingpark.com (EU868, pre-configured for “ThingPark Community“

3

Create free account on **community.thingpark.org**, and access ThingPark Enterprise (**Network Server**)

4

Visualize data on an **application platform**

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www.actility.com/press-releases/ (past webinars)

https://www.actility.com/webinar-key-infra-features/

community.thingpark.org

Alper.Yegin@Actility.com

Q&A!

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APPENDIX

LoRaWAN vs NB-IoT

NB-IoT

Licensed bands
Public networks
Emerging deployments

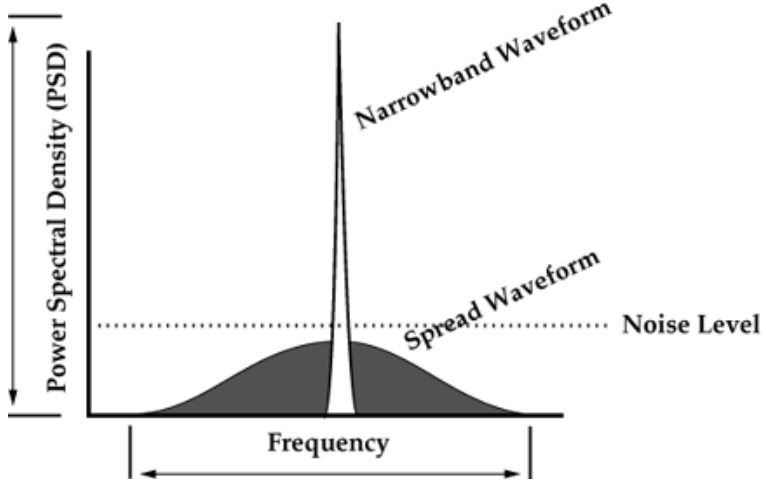
Real-time
Higher data-rate (250Kbps)
Marketing power (GSMA)

LoRaWAN™

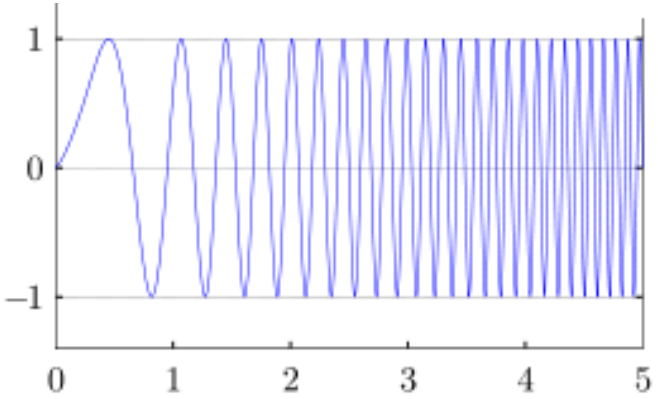
ISM (unlicensed band)
Public + private networks
Accelerating deployments
Low-power (1/5th! of NB-IoT)
Low-cost infra
Collaborative networking

Spread Spectrum

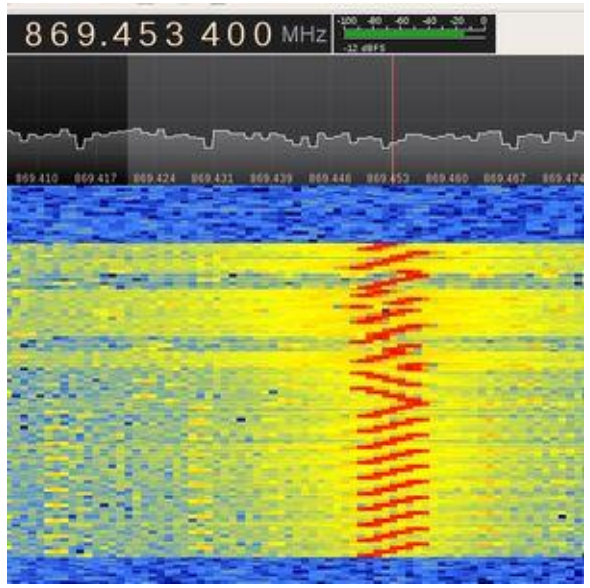
- Highly immune against interference and allows operating at very low SNR ranges (down to -20dB below the noise level)



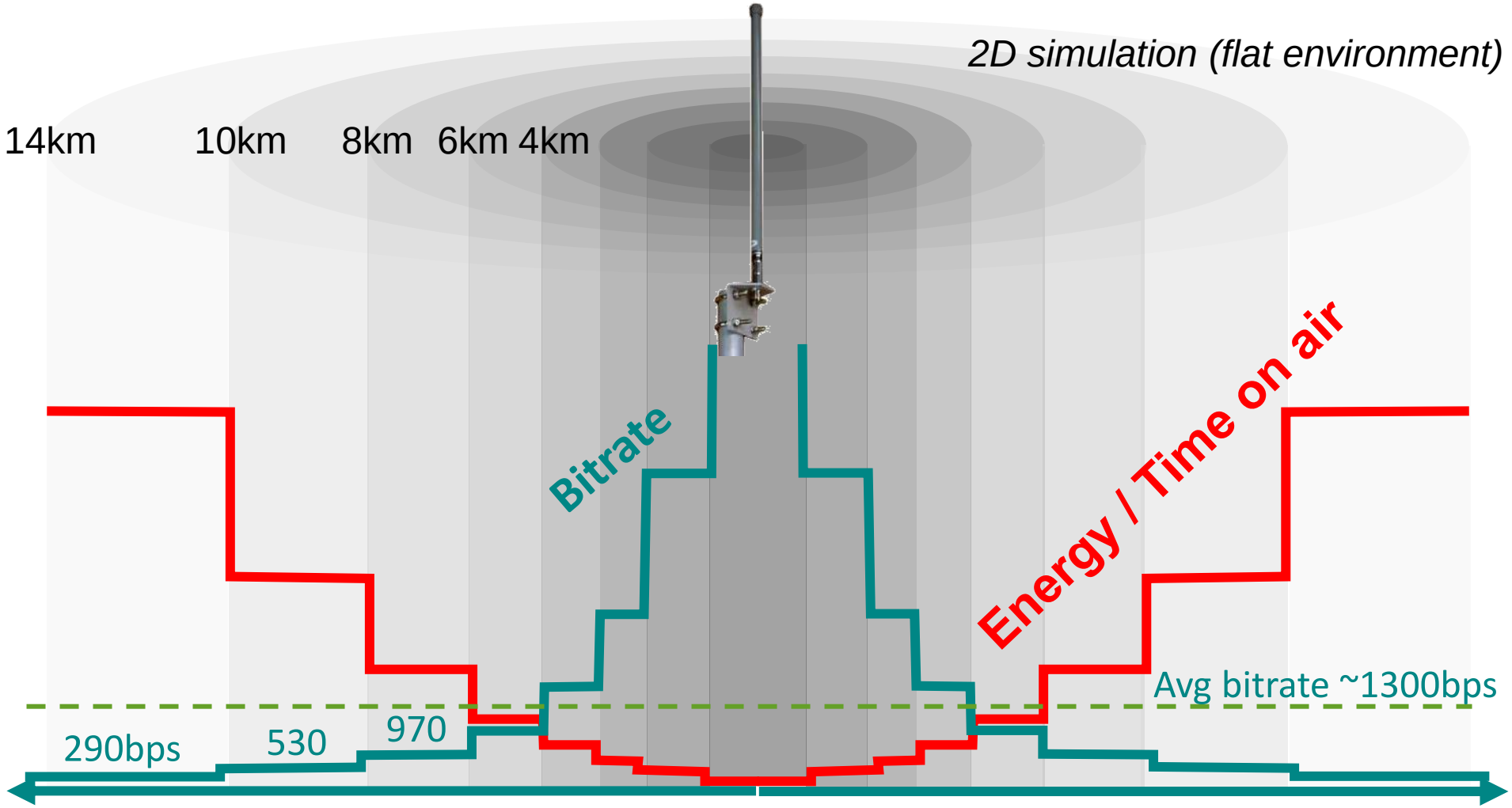
- Chirp Spread Spectrum (CSS) modulation
  - Spreading is achieved by generating a chirp signal where the frequency increases linearly over time.
  - When the maximum frequency of the band is reached, the frequency wraps around, and the increase in frequency starts again from the minimum frequency.



Chirp Signal



Adaptive Data Rates



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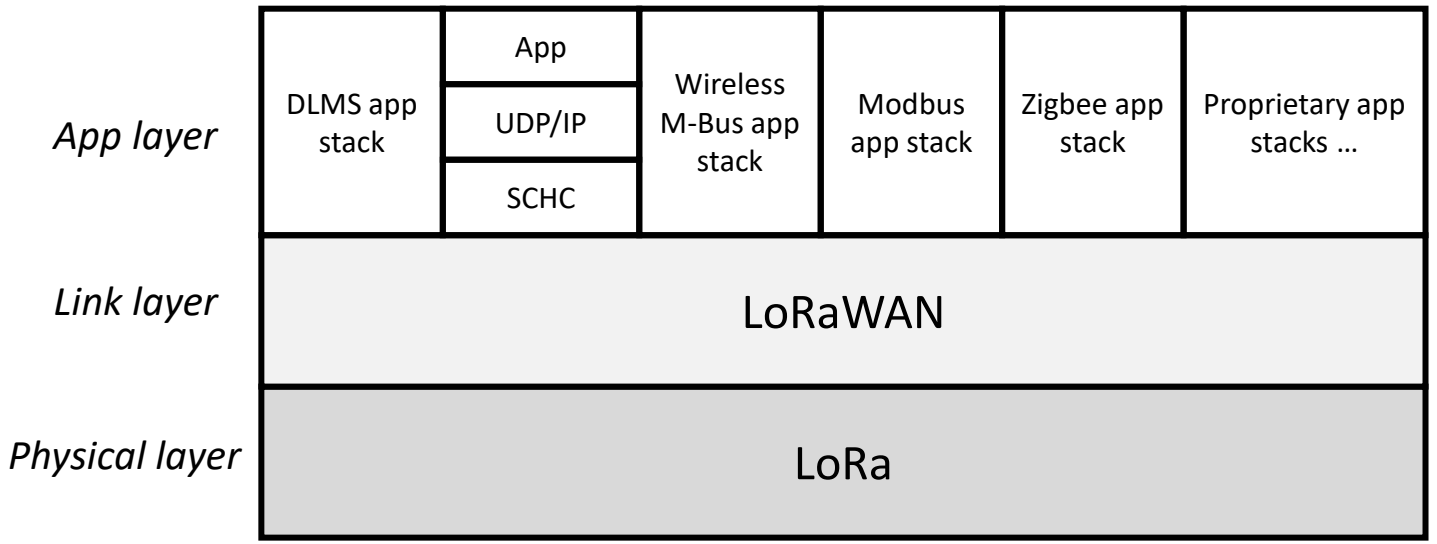
Detailed Characteristics

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	51 – 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

Network Stack



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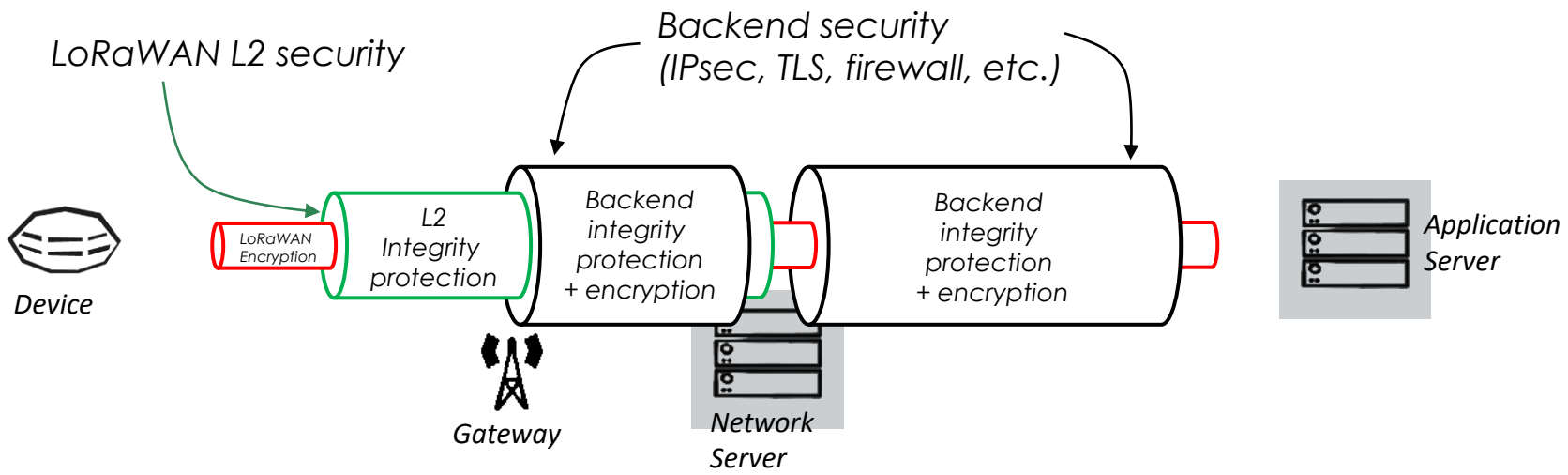
Interference Mitigation

- Chirp Spread Spectrum (CSS) modulation 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
- Macro-diversity
- FEC at app-layer

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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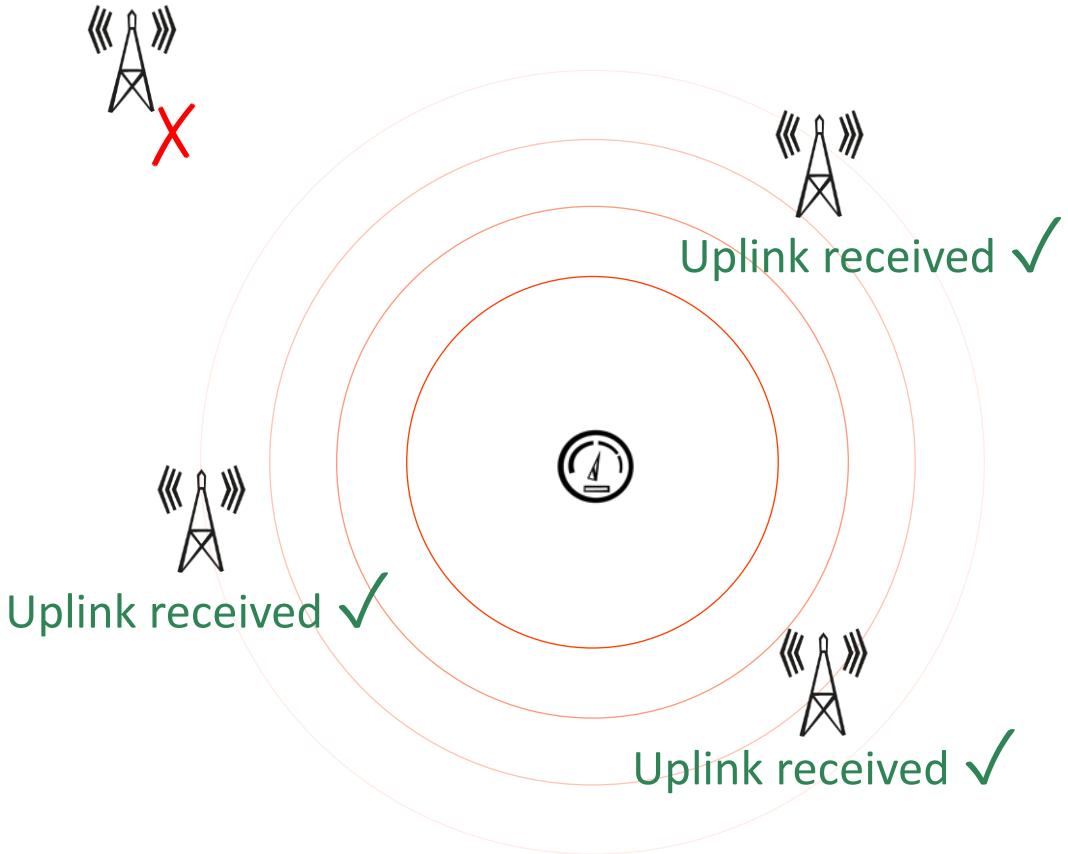
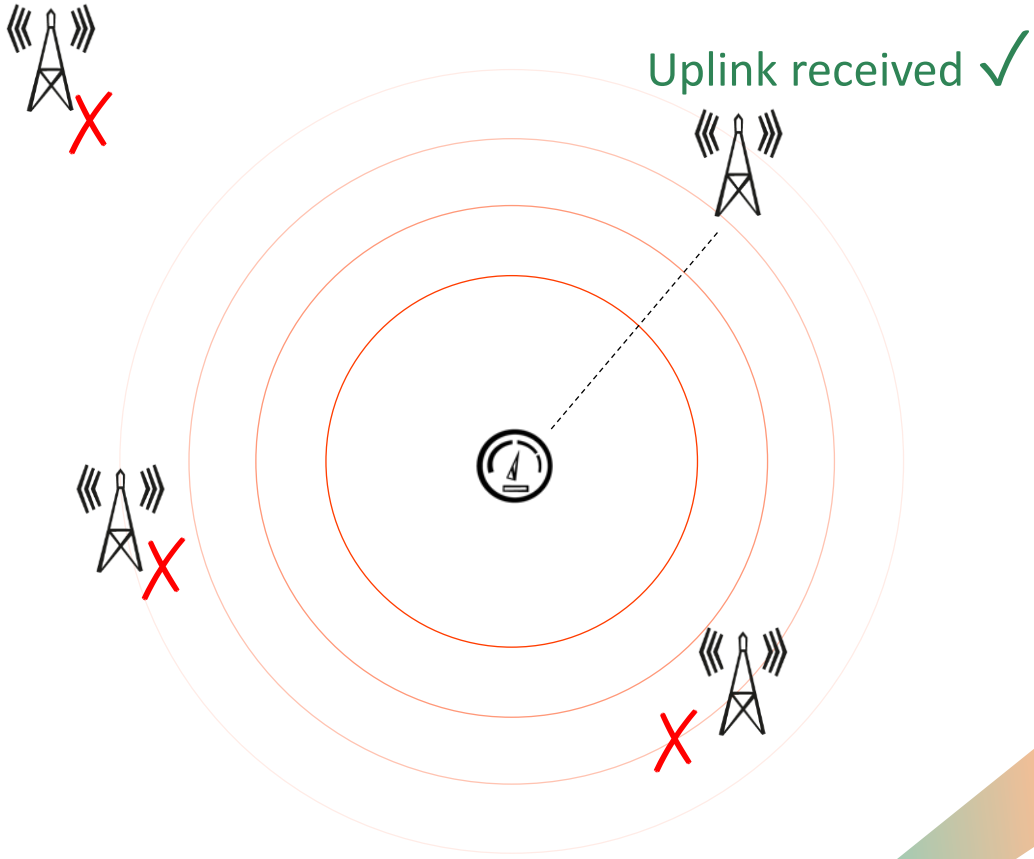
Collaborative Radio: Macro-Diversity



LoRaWAN®



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

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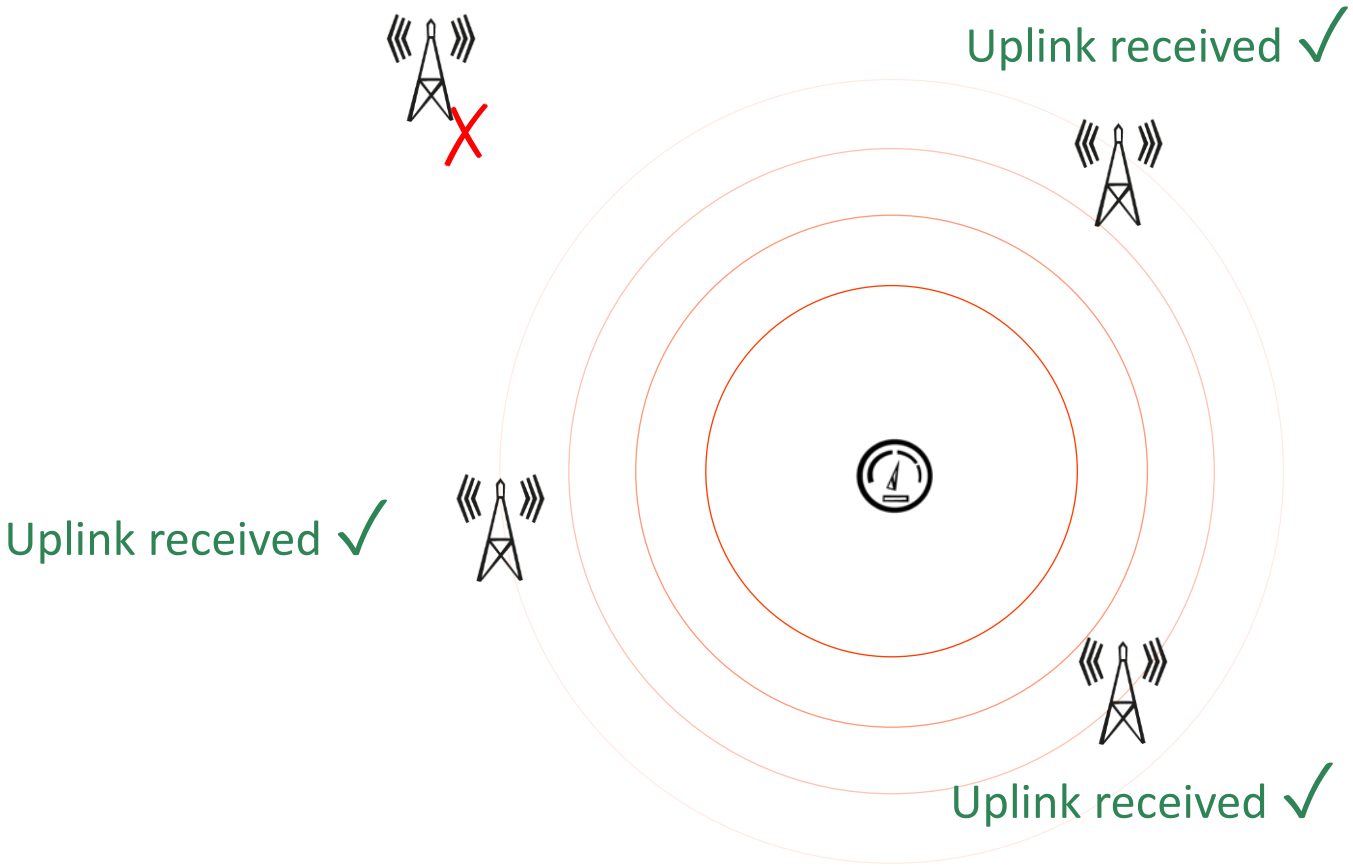
Geo-location



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

No extra hardware or processing cost on device

→ 20-100m accuracy

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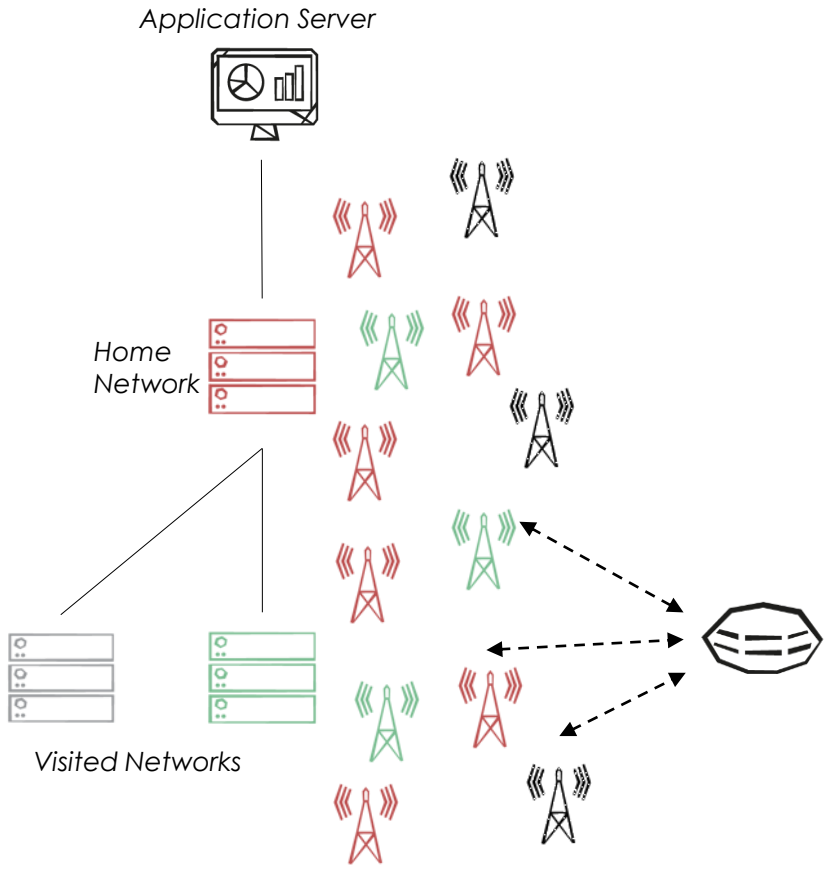
LoRaWAN® Passive (Transparent) Roaming

- Coverage extension → Necessity
- Coverage densification → Differentiation
  - Macro-diversity via Passive Roaming not possible with cellular IoT & Sigfox
    - Device battery consumption reduction
    - Interference reduction
    - Network capacity increase
    - Geolocation improvement



Actility