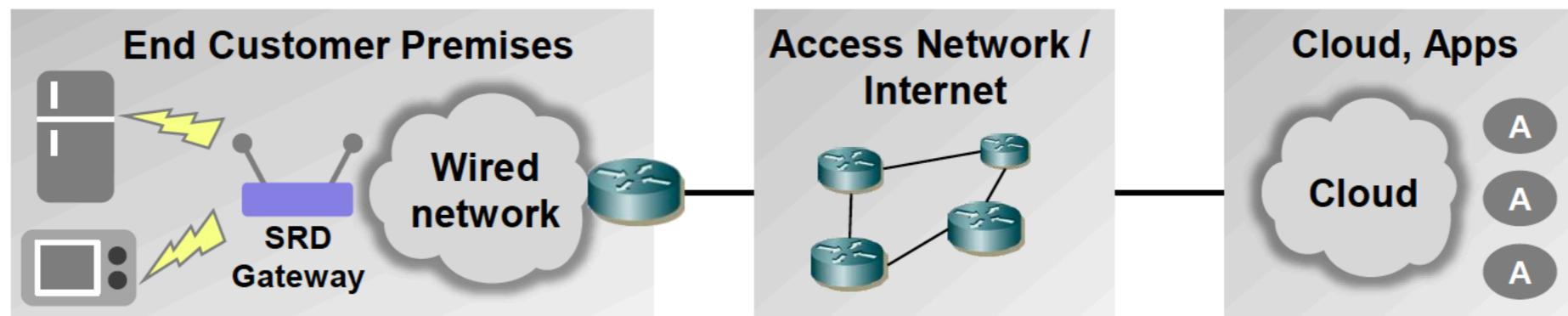


ICN/LoRa

Dirk Kutscher

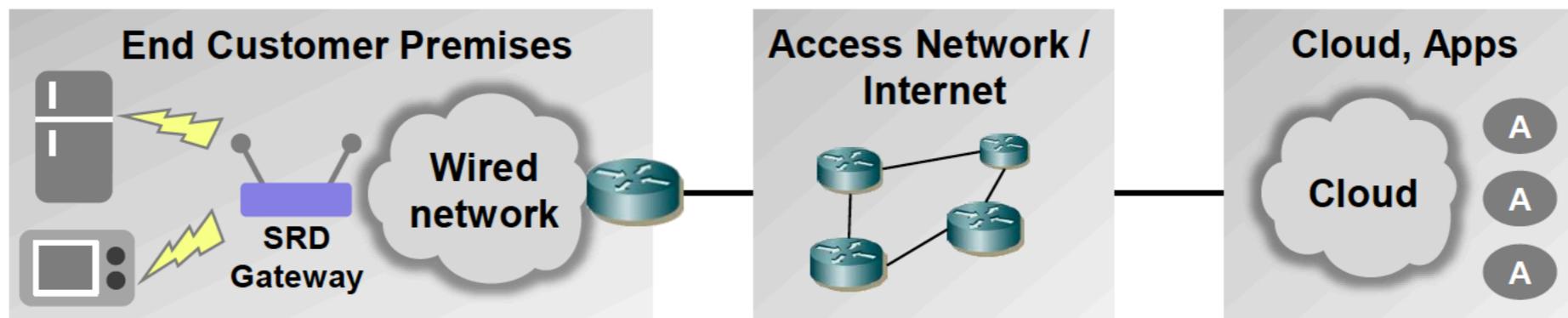
LPWAN Compared to LowPAN

- Low-Power, local/personal Area (802.15.4 etc.)

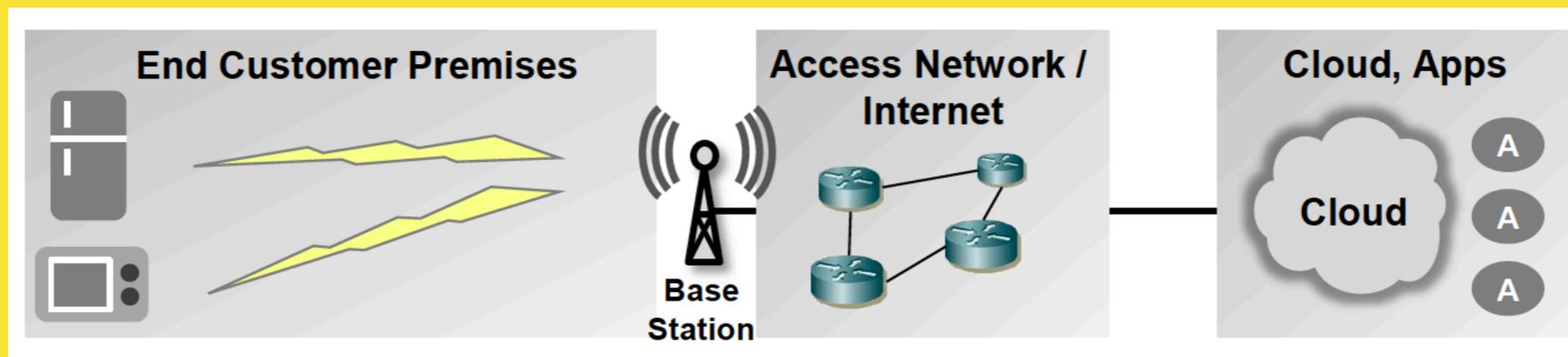


LPWAN Compared to LowPAN

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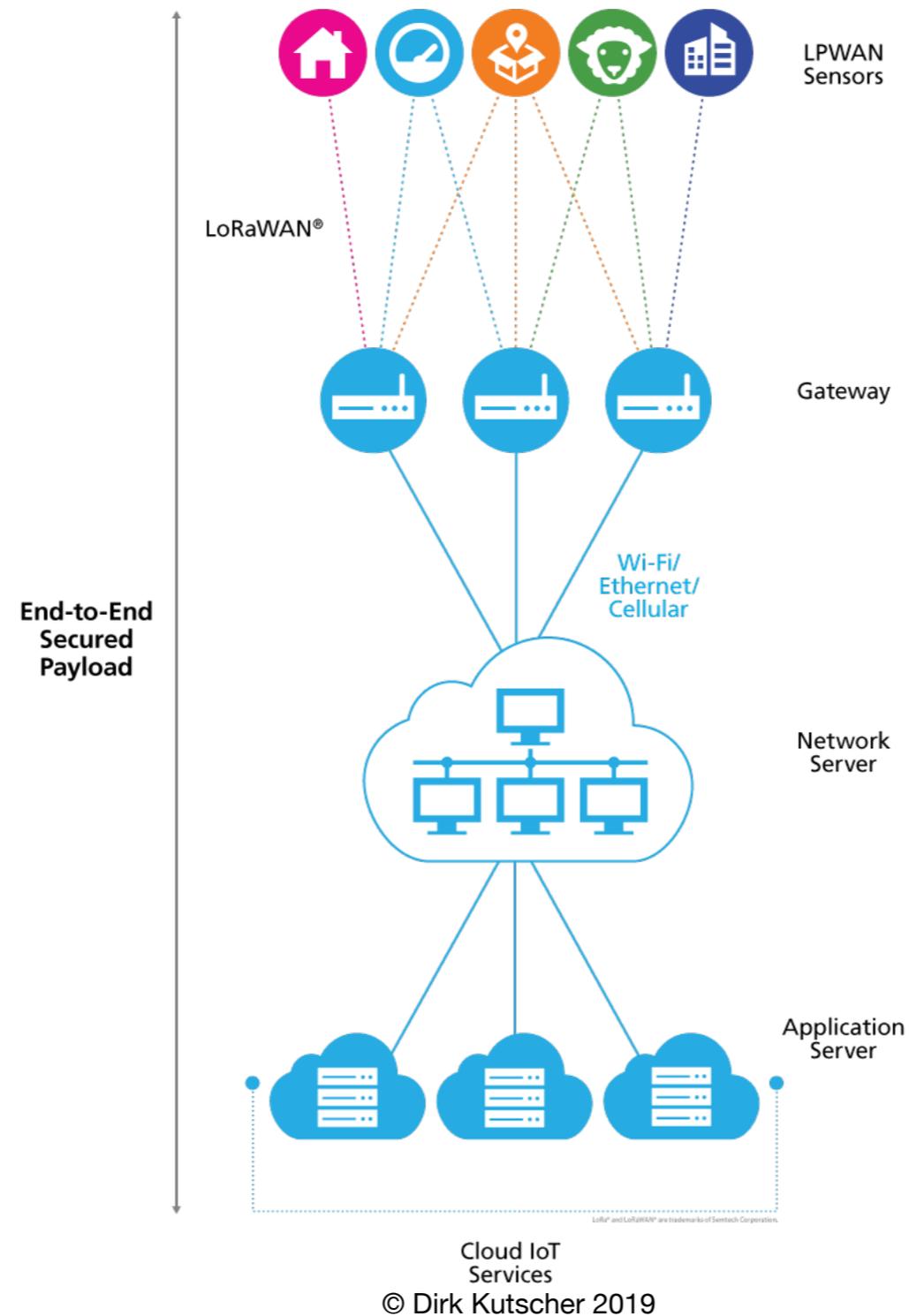


- Low-Power Wide Area





LoRa (Long-Range)

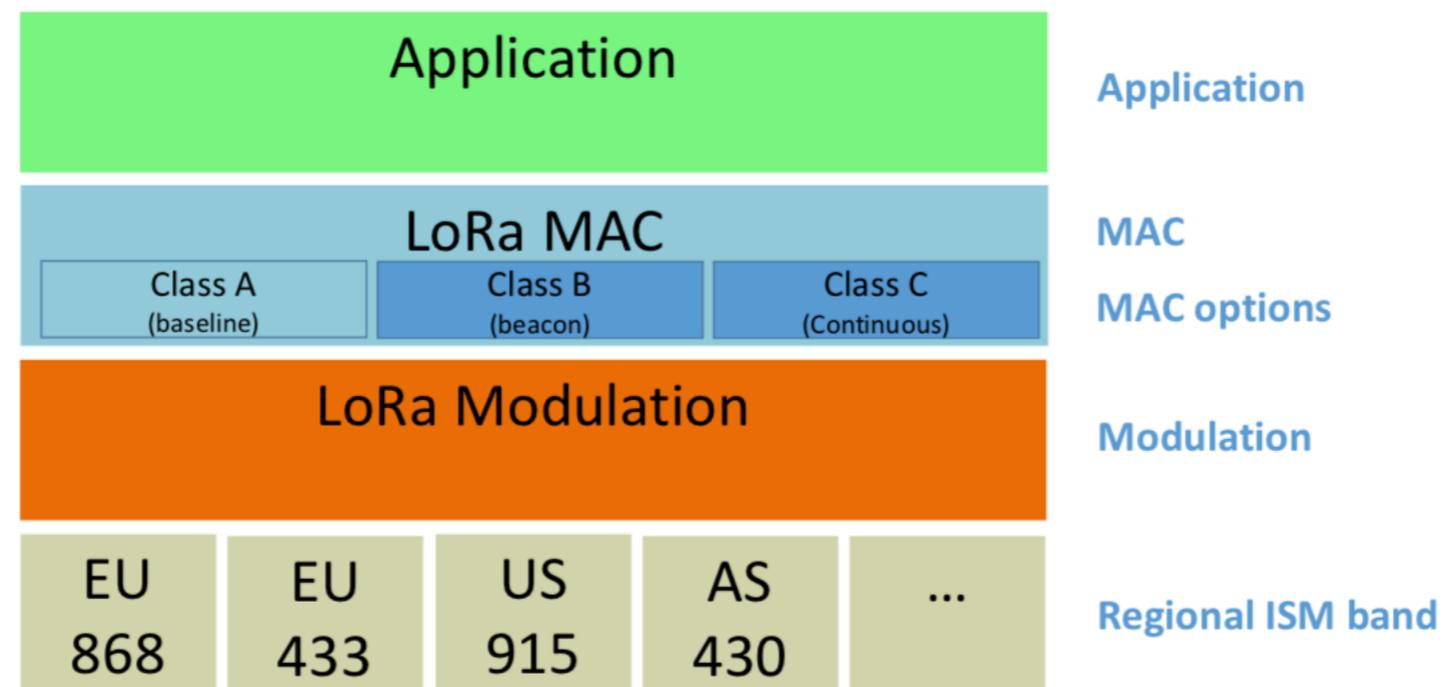




LoRa: Long Range

- Technology and protocol engineered by SEMTECH (www.semtech.com)
- LoRa Alliance: >200 members
 - 2 successive versions of the protocol, LoRAMAC & LoRAWAN 1.0 (release January 2015)
 - 3 classes of devices LoRAWan: A, B, C*
 - Classe A: **Bi-directional end-devices**
 - Classe B: **Bi-directional end-devices with scheduled receive slots**
 - Classe C: **Bi-directional end-devices with maximal receive slots**
 - Chipsets exist in unidirectional (860 – 1020 MHz band) or bidirectional (High Band – 860-960MHz & Low Band – 169-510MHz) and for the moment are provided only by Semtech.
 - End devices identification: IEEE EUI64 format

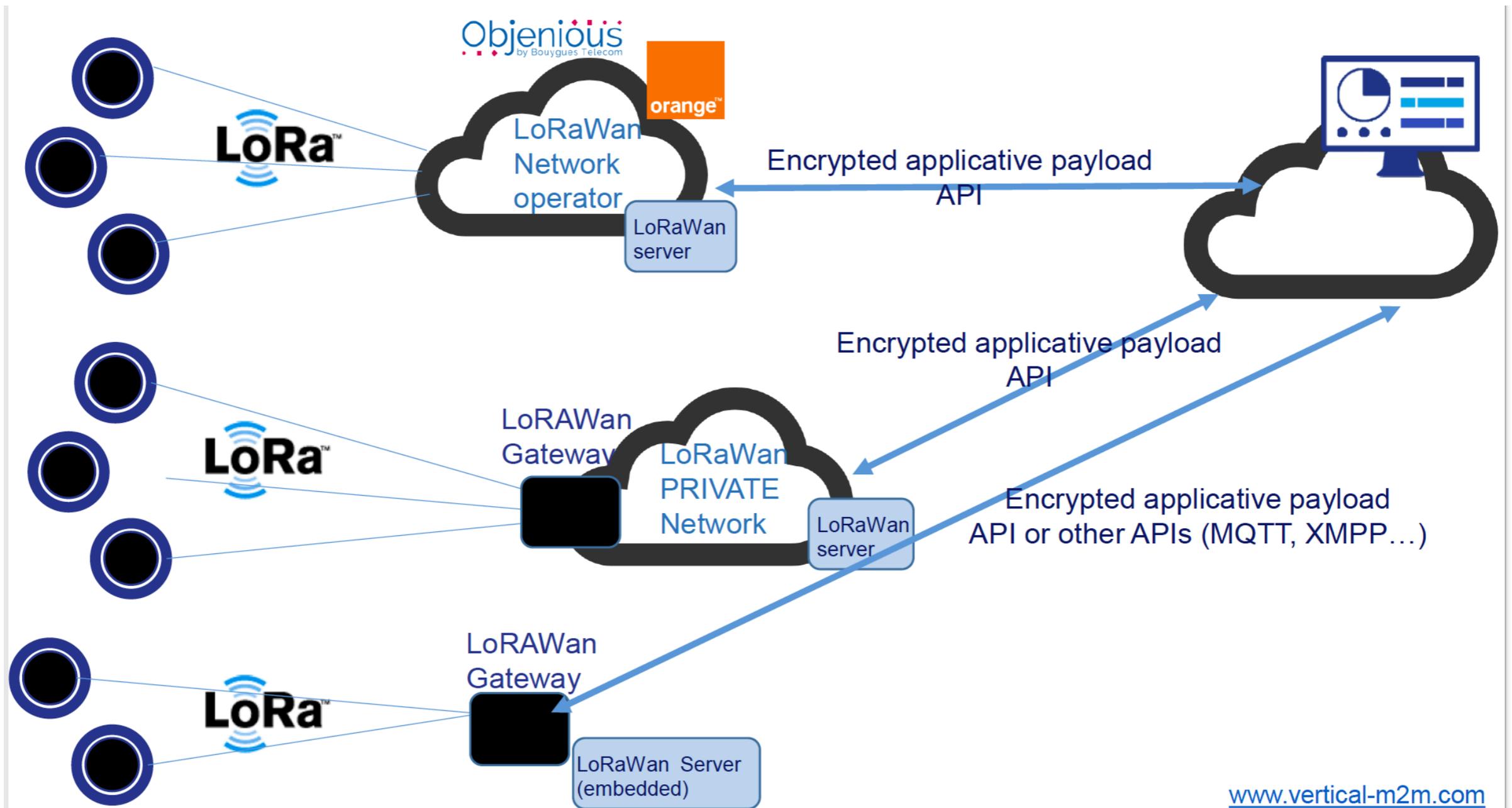
LoRa Classes



- Class A: bi-directional communications whereby each end-device's uplink transmission is followed by two short downlink receive windows.
- Class B: extra scheduled receive slots
- Class C: continuously open receive slots (only closed when transmitting)



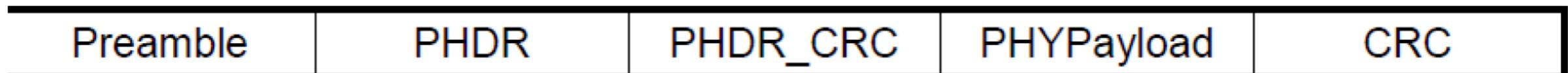
LoRa Architecture





LoRaWAN Specification-1.0

- Datarate of 0,3 to 50 Kb/s
- Encryption AES128 device – server & end-node – user app
- Stars of stars architecture
- 3 classes of devices (bidirectionnal communication)
 - A Class
 - B Class (beacon)
 - C Class (continuous)
- Uplink messages format



- Downlink messages format





LoRa Networks

The screenshot shows the Semtech LoRa Ecosystem website. The main navigation includes SEMTECH, LoRa®, PRODUCTS, APPLICATIONS, TECHNOLOGY, DESIGN SUPPORT, QUALITY, and BLOG. A search bar is located in the top right. The page title is "LoRa Ecosystem" with a sub-navigation menu: OVERVIEW, WHAT IS LoRa?, WHY LoRa?, APPLICATIONS, ECOSYSTEM, PRODUCTS, and RESOURCES. The main content area is titled "Network Providers" and contains a paragraph about LoRa-enabled devices and a "SEARCH IN CATALOG" button. On the right, there is a "LoRa Ecosystem" sidebar with links to Ecosystem Overview, LoRa Alliance, Featured Sensor Use Cases, Gateways, Software, Networks, and Industry Alliances. Below this, there are two promotional boxes: "Developer Kits" with a "DEVELOPER PORTAL" button and "LoRa Developer Portal" with a "VISIT THE PORTAL" button.

SEMTECH
LoRa® PRODUCTS APPLICATIONS TECHNOLOGY DESIGN SUPPORT QUALITY BLOG

SEARCH: semtech.com
LoRa DEVELOPERS INVESTORS COMPANY CAREERS

LoRa Ecosystem
OVERVIEW WHAT IS LoRa? WHY LoRa? APPLICATIONS ECOSYSTEM PRODUCTS RESOURCES

Network Providers

LoRa®-enabled devices communicate over the LoRaWAN® open protocol, a low power wide area network (LPWAN) specification built on LoRa Technology and developed by the LoRa Alliance®. The LoRaWAN network facilitates interoperability of connected devices, helping to accelerate the Internet of Things (IoT) revolution. LoRaWAN networks can be public, shared, private, or enterprise deployments, enabling freedom of innovation by network providers worldwide. Explore a [global coverage map of network operators from the LoRa Alliance](#). Highlights of deployed network providers are featured below. Find even more in Semtech's catalog of LoRa-based products and services.

[SEARCH IN CATALOG »](#)

A2A Smart City
A2A Smart City develops and manages the enabling technological infrastructures for integrated and networked digital services. The competence of A2A Smart City and the integration with the territory guarantee the rapid implementation of the most innovative projects, able to improve the quality of life in the cities. A2A Smart City is a company of the A2A Group, the largest Italian multi-utility company, at the top of the energy, environment, heat, networks and smart cities sectors.

[Visit A2A Smart City Website »](#)
[News: A2A Smart City Initiative »](#)

Alibaba Cloud

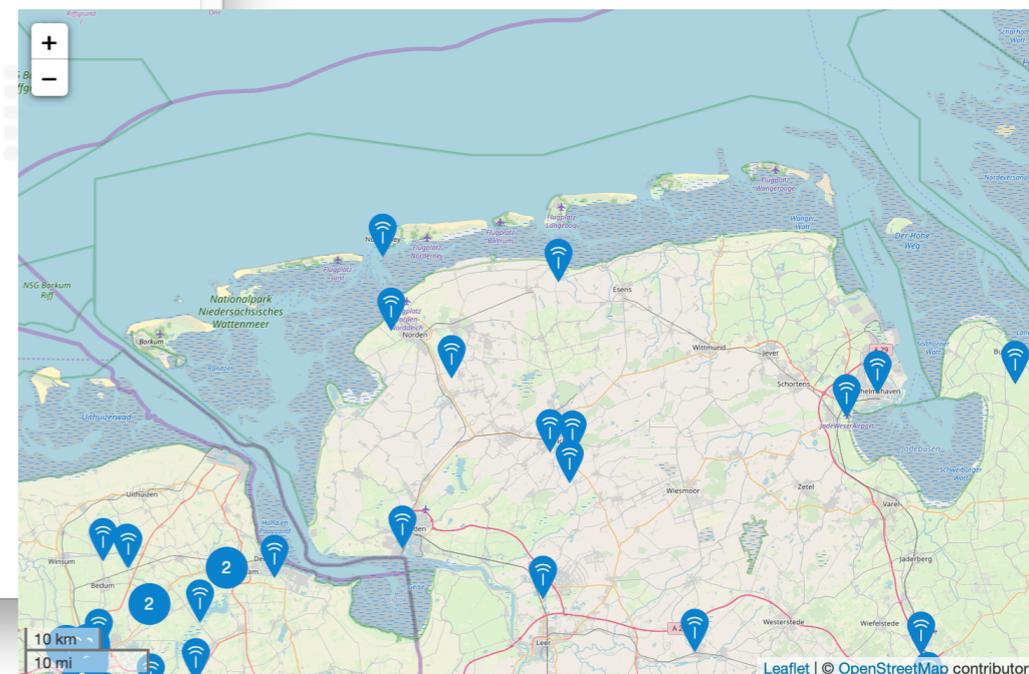
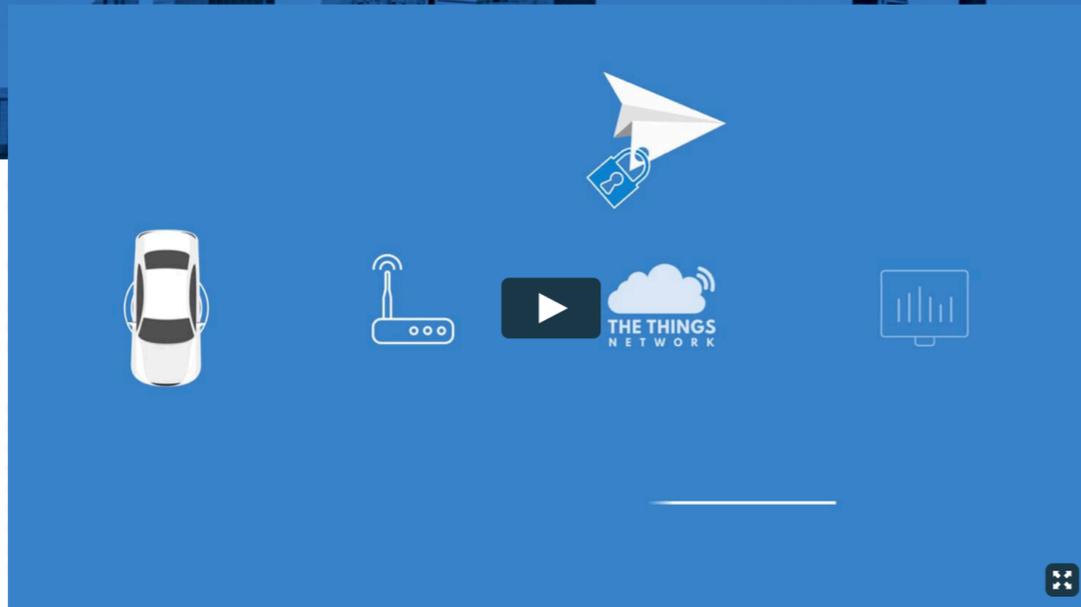
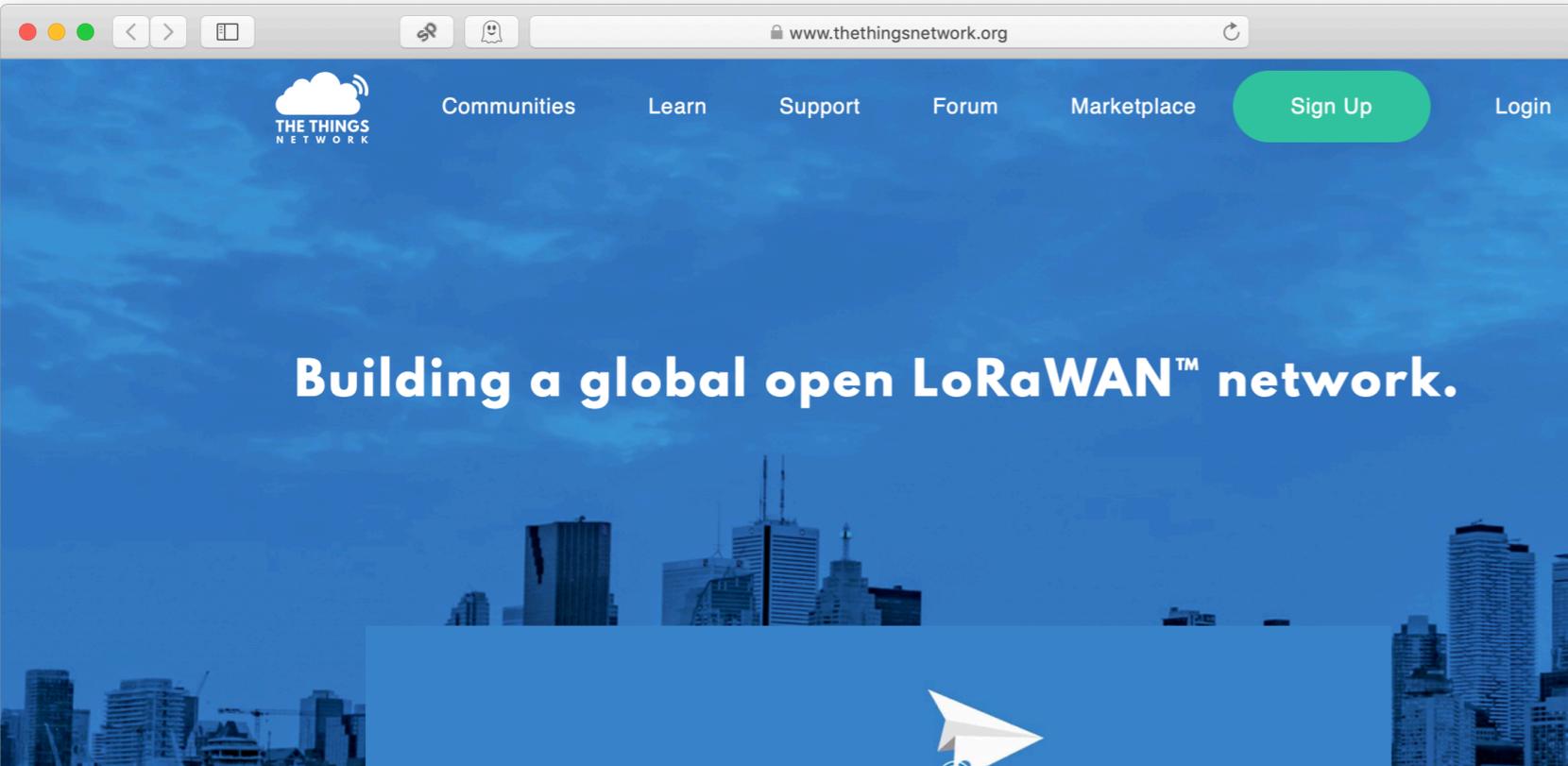
LoRa Ecosystem
[Ecosystem Overview](#)
[LoRa Alliance](#)
[Featured Sensor Use Cases](#)
[Gateways](#)
[Software](#)
[Networks](#)
[Industry Alliances](#)

Developer Kits
Find Reference & Development Kits for LoRa-based solutions.
[DEVELOPER PORTAL »](#)

LoRa Developer Portal
connect. learn. share.
[VISIT THE PORTAL »](#)



Example: The Things Network



Supporting 84312 developers in building
industrial grade LoRaWAN™ solutions



LoRaWAN Messages

MType	Description
000	Join-request
001	Join-accept
010	Unconfirmed Data Up
011	Unconfirmed Data Down
100	Confirmed Data Up
101	Confirmed Data Down
110	Rejoin-request
111	Proprietary

Opportunities for ICN

