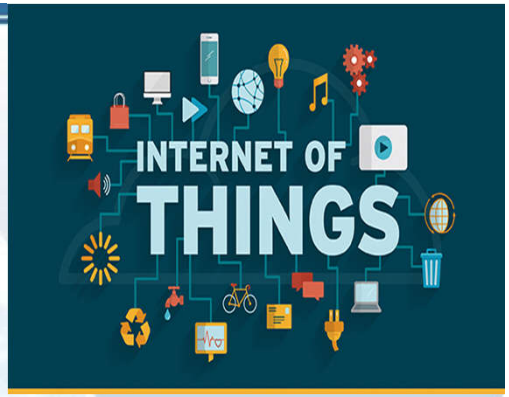


Getting Started in Internet of Things using LoRa

SEMTECH

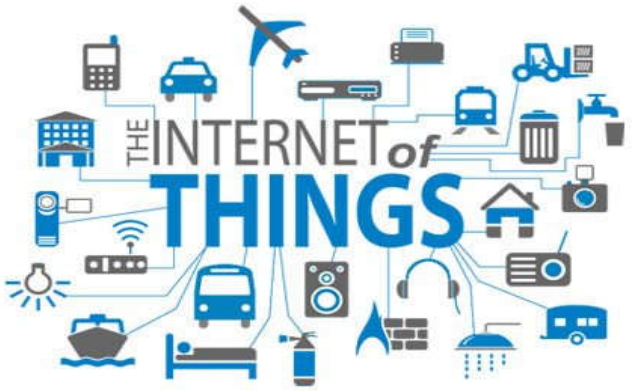
LoRa®

Rally Uminga

packetworx
TELCO FOR THINGS

Acsip

Why IoT is Important?



What is Internet of Things (IoT)?

- **inter-networking of physical devices**
- **embedded systems** with **electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data.**

Objectives of IoT.

- **allows objects to be sensed or controlled remotely across existing network infrastructure,**
- **resulting in improved efficiency, accuracy and economic benefit**
- **reduced human intervention.**

sensors and actuators - smart grids, smart power plants, smart homes, intelligent transportation and smart cities.

-IoT will consist of about **50 billion objects** by 2020.

Why IoT is important?

- **convergence of multiple technologies, including wireless communication, real-time analytics, machine learning, commodity sensors, and embedded systems.**
- **wireless sensor networks, control systems, automation** (including **home and building automation**).

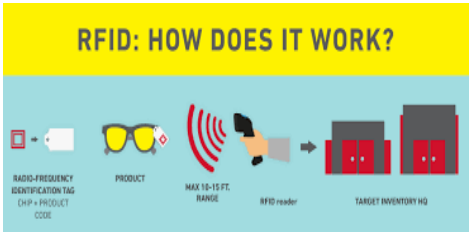
History of IoT

- **Coke machine** in **1982** at **Carnegie Mellon University** becoming the first Internet-connected appliance,
- able to **report its inventory** and whether **newly loaded drinks were cold.**

Coke Machine in 1982 – First IoT Device

History

- Became popular in 1999, through the Auto-ID Center at MIT
- Radio-frequency identification (RFID) was seen by **Kevin Ashton** as a prerequisite for the Internet of things at that point.



The term "the Internet of Things" was coined by Kevin Ashton of Procter & Gamble, later MIT's Auto-ID Center, in 1999.

What is LoRa

- **LoRa(Long Range)**
- **Digital wireless data communication developed by Cleo of Grenobie, France**
- **Acquire by Semtech in 2012**
- **Uses sub GHz license free RF bands (169MHz, 433MHz, 868MHz (Europe) and 915MHz (North America)**
- **Typically more than 10km with low power consumption**

What is LoRaWAN

- **Network layer protocol for managing communication between LPWAN gateways and end-node devices as routing protocol maintained by LoRa Alliance.**
- **Lora is the physical layer and Lorawan is the network/upper layers**

What is LoRaWAN

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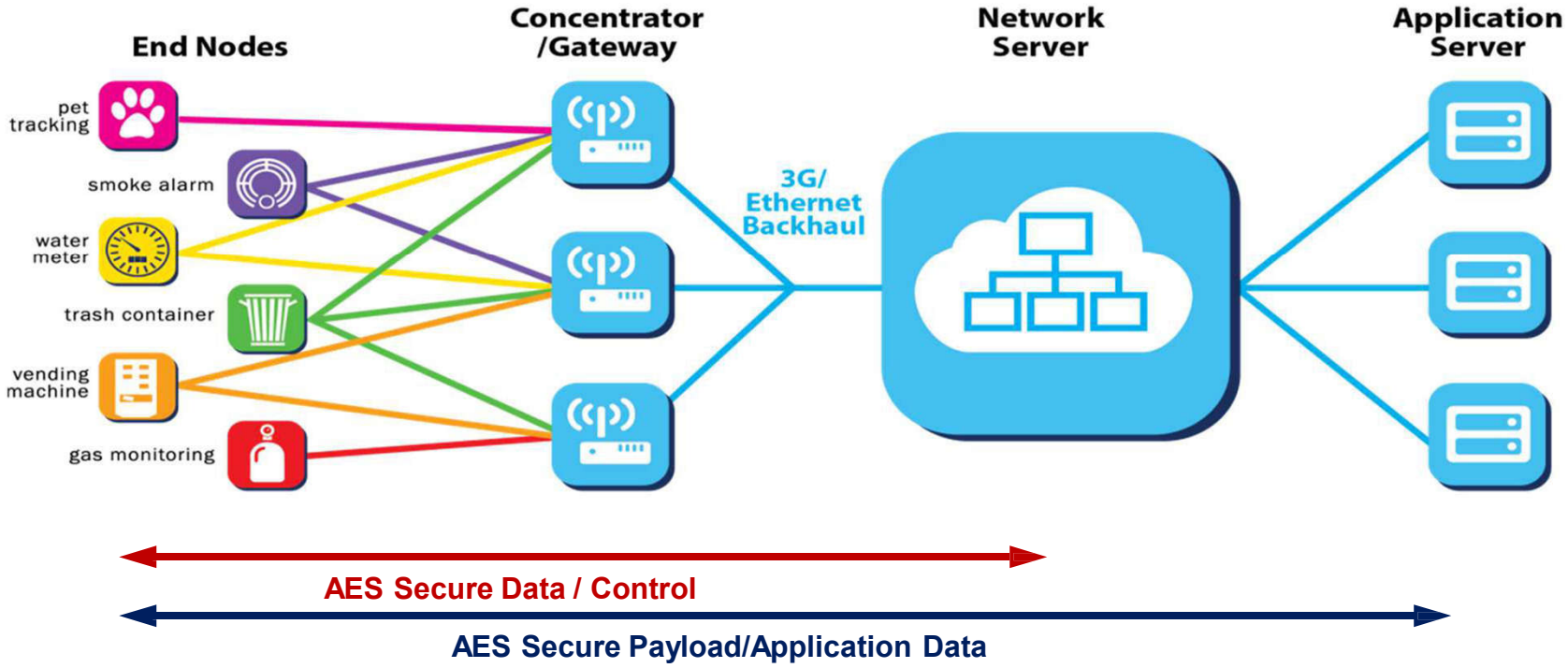
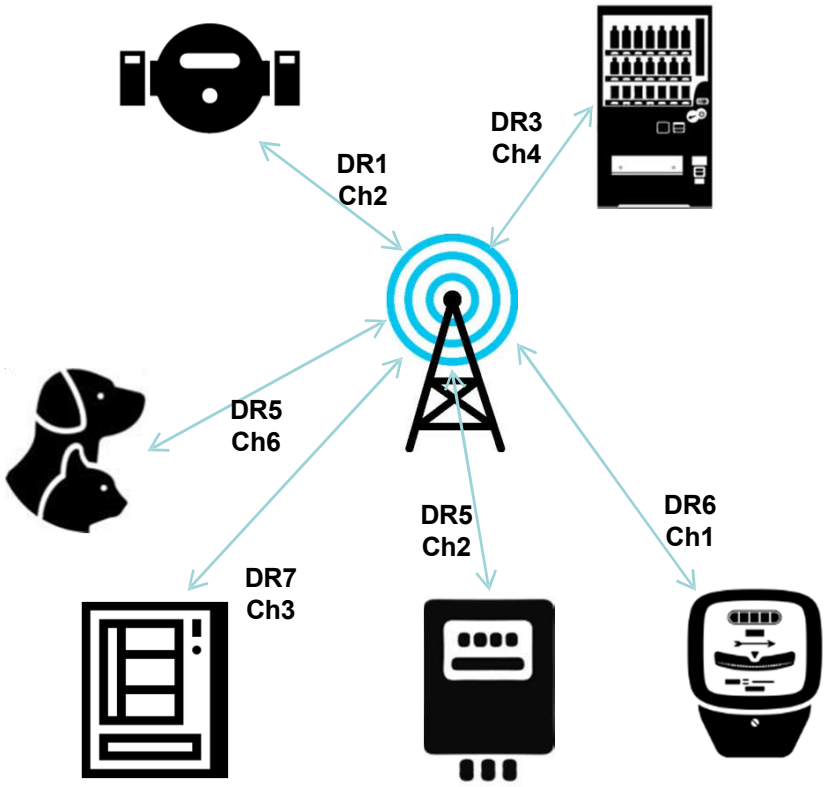
What is LoRaWAN

LoRaWAN™ Network



What is LoRaWAN

LoRaWAN™ Network



Multi-channel gateway

- Simultaneous reception of messages
- Scalable capacity
- Indoor or outdoor
- Adaptive data rate
- Supports geo-location

Fast time to market

- Commercial products available today
- Reference HW and MAC provided
- Reference design available

History

LoRa® - Brief history

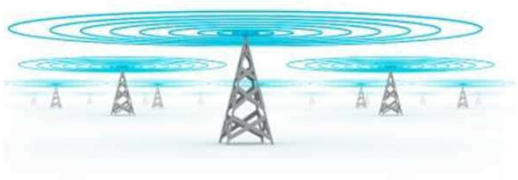
2013
- Launch of first LoRa radio by Semtech

2014
- First mobile network operator trials

2015
- Launch of LoRa Alliance: 130 members in 6 months
- Multiple sensors, gateways, modules available
- Public, private, viral network deployments worldwide

2016
- Over 400 LoRa Alliance members today
- Over 100 regions with deployments or trials
- Low power geolocation introduced
- Comcast announces US LoRaWAN network trial

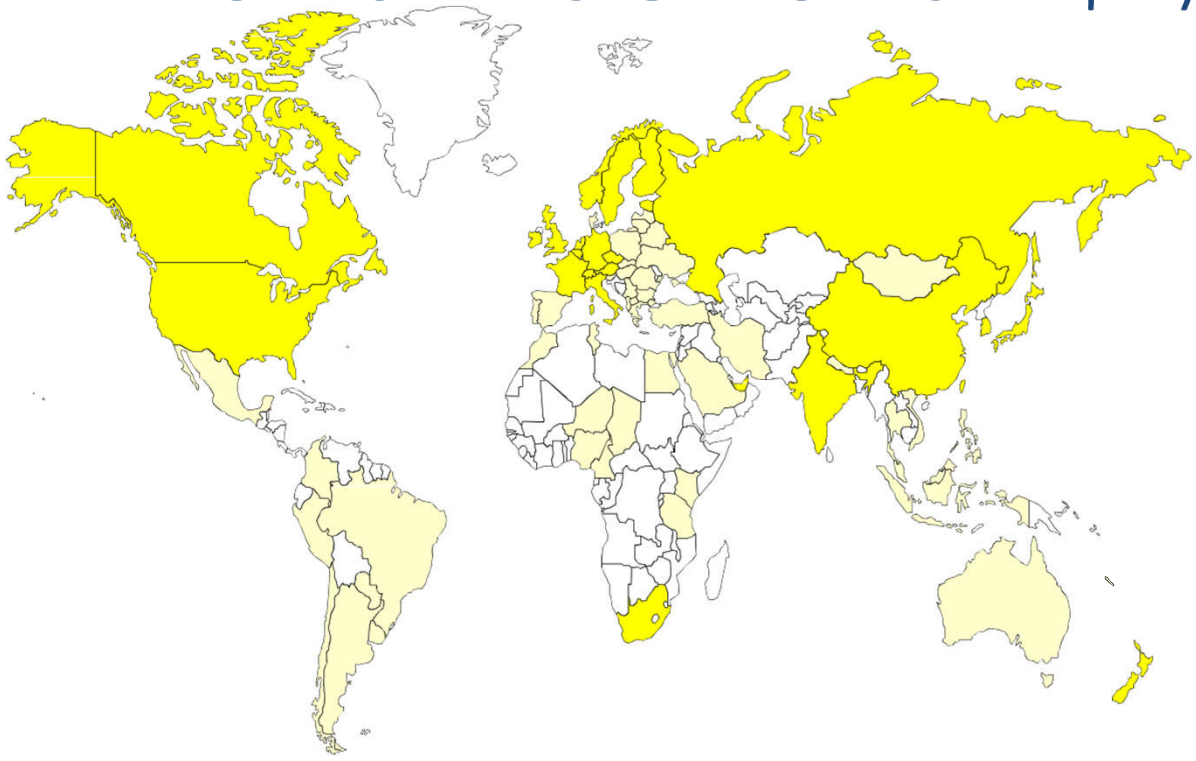
LoRa® Key Features



Long Range	Low Power	Multi Usage	Low Cost
15-30 miles outdoor	10-20yr lifetime	Scalable capacity	Minimal infrastructure
Deep indoor coverage	>10x vs cellular M2M	Multi-tenant	Low cost end-node
		Public or private	Open source software

LoRa® Key Features

Worldwide LoRa® Deployment



- 34 Publicly Announced Operators
- 150+ on-going trials & deployments
- 400+ members in the Alliance

Legend:

Publicly Announced

Other deployments

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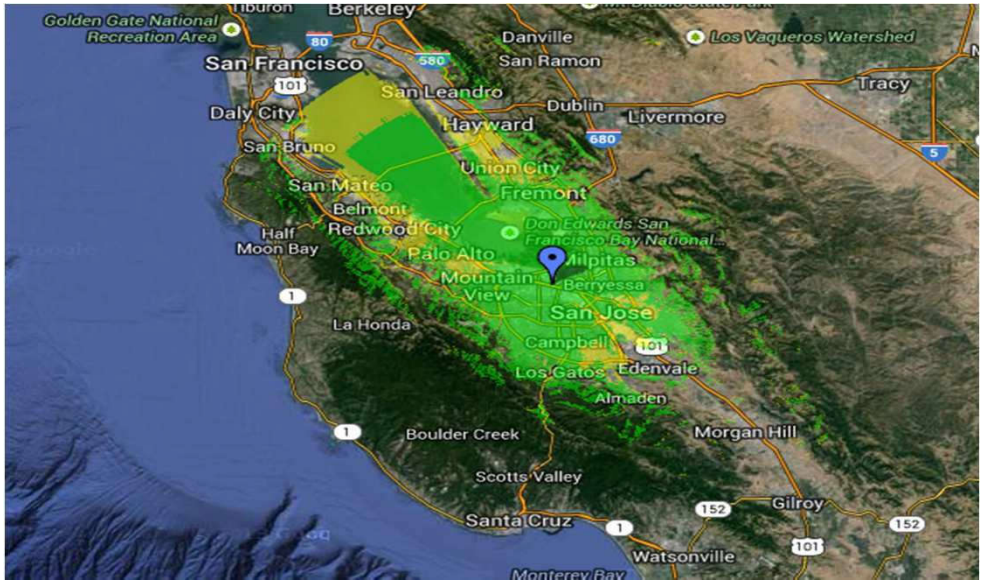
LoRa® Key Features

Coverage map from a single gateway

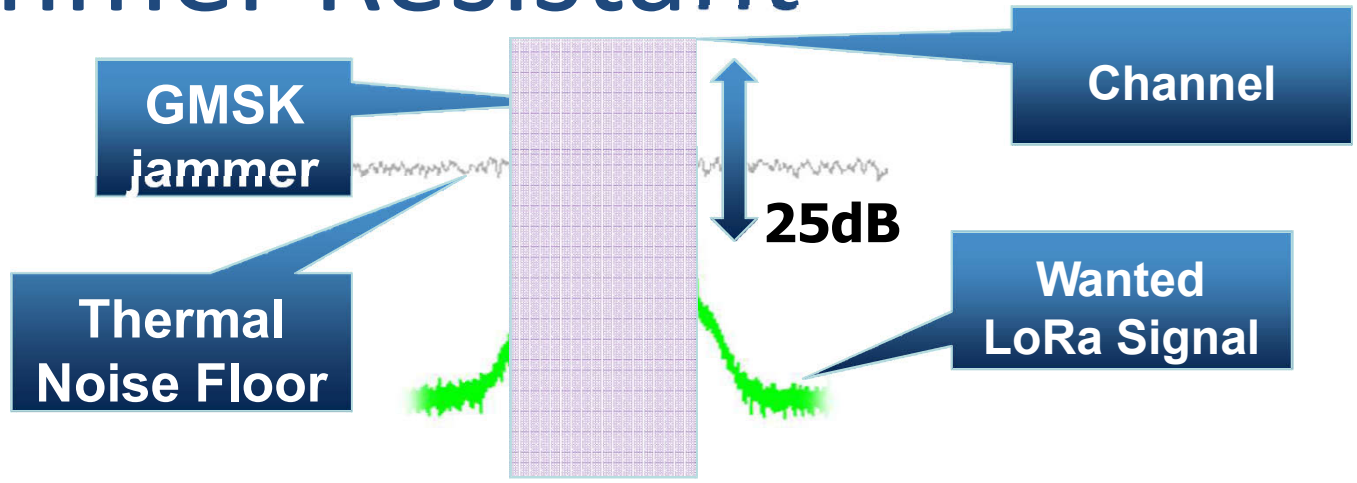
Cisco Webex building in San Jose

>20 miles (32Km) coverage from a single gateway



LoRa® Key Features

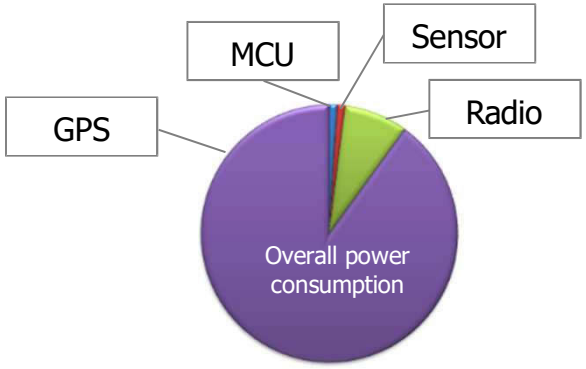
Jammer Resistant



Jammer type	LoRa Co-channel Signal to Interferer ratio	Existing FSK Co-channel Signal to Interferer
CW / FSK / GMSK	-25dB	+8 to 12dB
OFDM / AWGN	-21dB	+10 to 15dB
LoRa at different data rate	-25dB	

LoRa® Key Features

Geolocation with LoRaWAN™



Low Power

GPS free location

Optimize operations

- All base stations share a common timebase
- A LoRaWAN sensor transmits a packet
- Algorithms compare the time of arrival and other signal parameters

LoRa Use Cases

Agriculture with LoRa

- Animal health monitoring
- Crop yield
- Water conservation

Asset management with LoRa

- Utilization Of Resources
- Asset tracking and monitoring
- Energy and land use

LoRa Use Cases

Smart City with LoRa

- Energy conservation
- City or neighborhood coverage
- Operational efficiency

Smart Buildings with LoRa

- Deep indoor penetration
- Safety and security
- Operational efficiency

Thank you

- Any question or comment?