



# LoRa-Enabled Smart Sensing Solutions

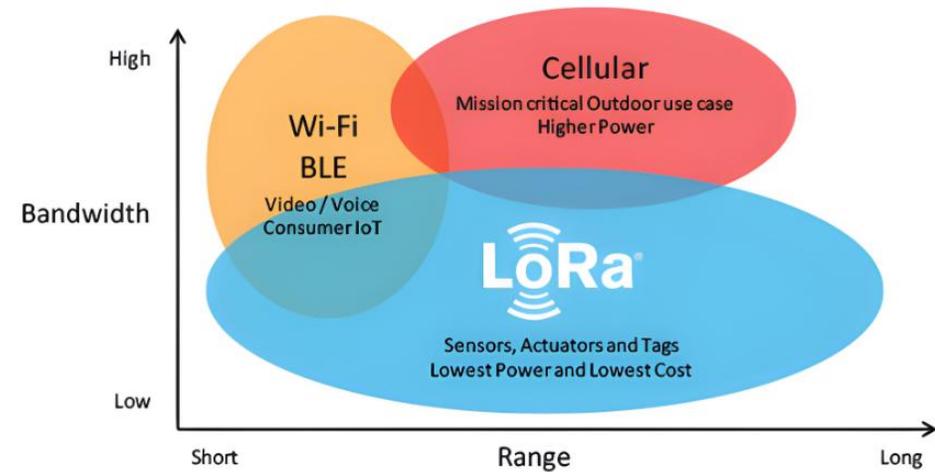


# Background of LoRa:

- Semtech owns the underlying LoRa technology, which it acquired from the French company **Cycleo in 2012**. The LoRaWAN standard is managed by the LoRa Alliance
- **LoRa technology**: This is the physical layer and modem technology that enables long-range, low-power wireless communication. It is owned and trademarked by Semtech.

# Why LoRa?

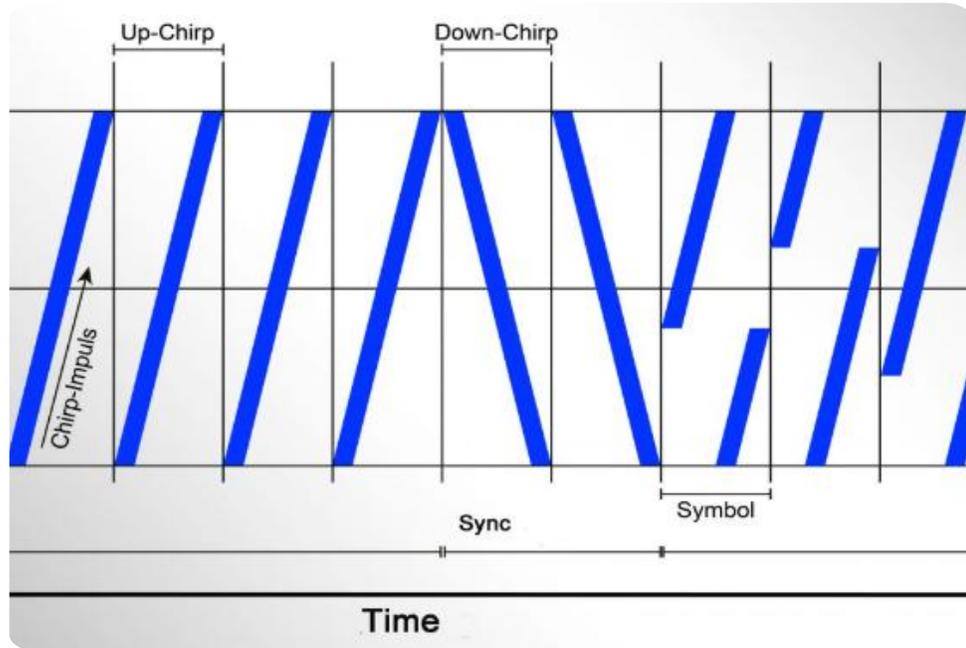
LoRa Cloud™ software solutions, and the LoRaWAN standard offer an efficient, flexible and economical solution to real-world problems in rural and indoor use cases, where Cellular, Wi-Fi and Bluetooth Low Energy (BLE) networks are ineffective.



# Why LoRa?



- **Extremely Low Power Consumption:** LoRa devices can run 5 – 10 years on a small battery. LoRa radios “sleep” efficiently and transmit small packets infrequently.
- **Very Low Cost:** LoRa modules are inexpensive ( $\approx$  \$2–\$5). No SIM cards. No monthly subscription fees
- **Long Range at Low Data Rate:** 2–5 km in urban areas, 10–15 km in rural areas, Up to >50 km line-of-sight
- **Works Where Cellular Coverage Is Weak:** Farms, Mines, Offshore facilities, Rural areas, Inside buildings or basements etc.
- **Scalability: LoRaWAN** Gateways can handle thousands of devices with small payloads efficiently.



## Chirp Spread Spectrum (CSS) modulation for LoRa:

It uses a patented spread spectrum modulation called Chirp Spread Spectrum (CSS). This process involves a "chirp," or a signal that sweeps across a range of frequencies, making the signal more resilient to interference and allowing it to be recovered even below the noise floor.

- LoRa (Long Range) is a proprietary spread spectrum modulation technique derived **from Chirp Spread Spectrum (CSS) technology**. It is a long-range, low-power wireless platform commonly used in Internet of Things (IoT) applications.
- LoRa works in the ISM frequency bands (433 MHz, 868 MHz, and 915 MHz), and the radiated transmission power is limited. In order to have a larger radio range than conventional modulation types, such as FSK (Frequency Shift Keying), the receiver sensitivity has been significantly improved with LoRa.

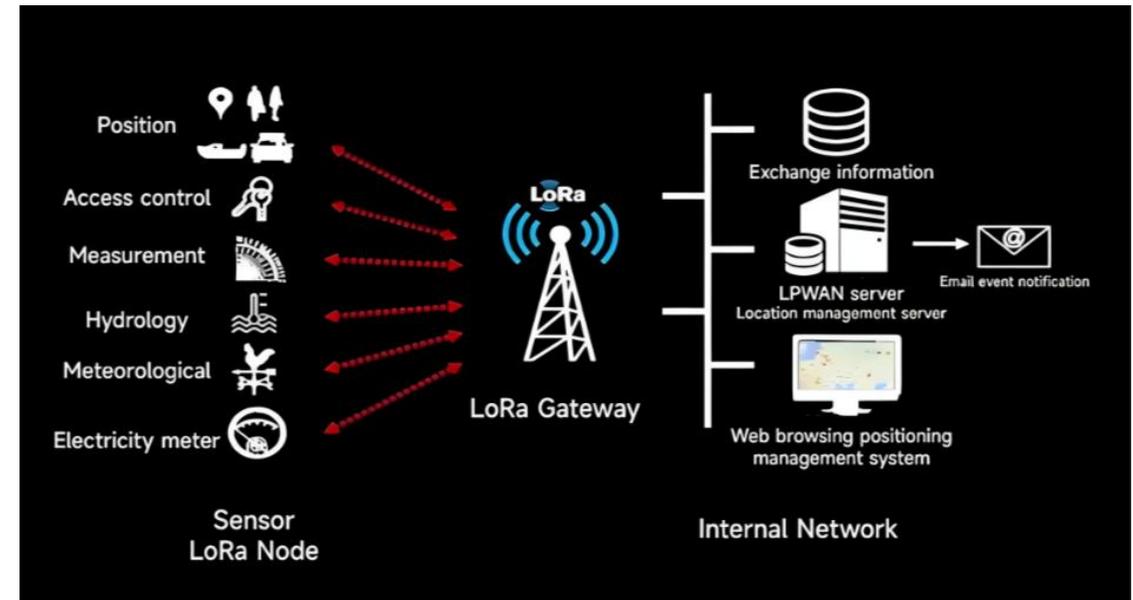
# LoRa Components:

## A LoRa network consists of:

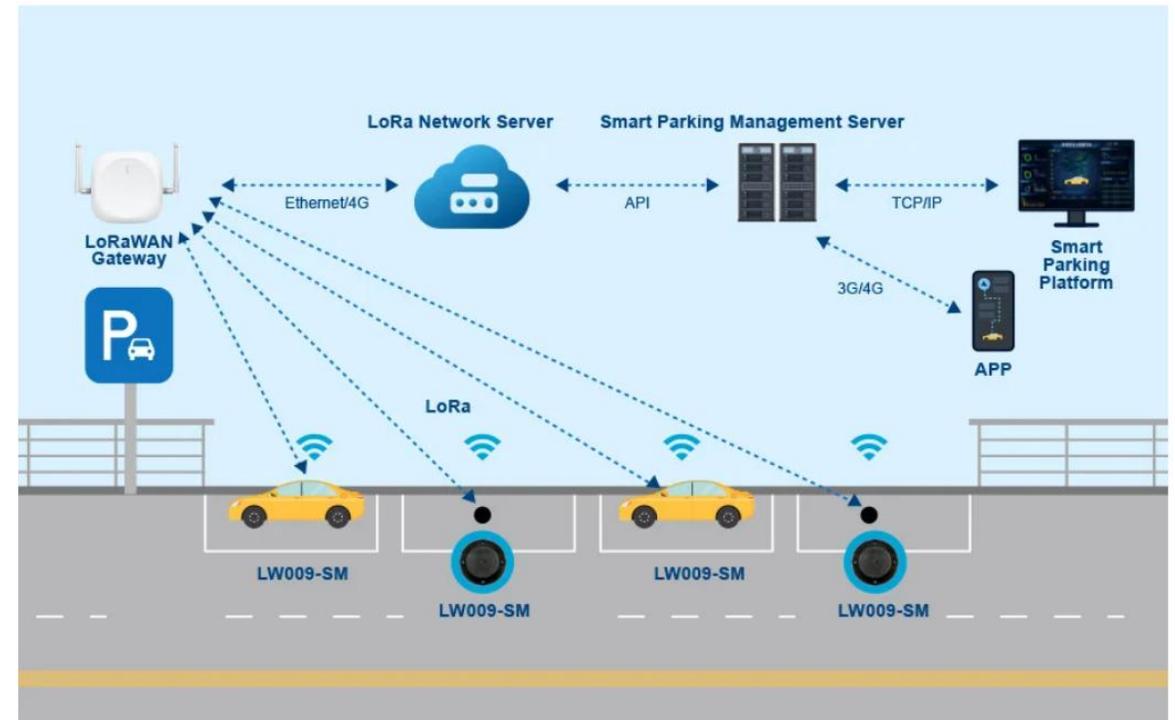
- **Nodes:** Sensors or devices that collect data and use LoRa to transmit it wirelessly.
- **Gateways:** Devices that receive data from many nodes and forward it to the internet via a standard IP connection (like Wi-Fi or cellular).
- **Cloud Server:** A server that receives and processes data from the gateways and can send commands back down to the nodes.

## •Communication:

Data travels from nodes to gateways (uplink) and can also be sent from the server to nodes via the gateway (downlink).



# Example of Smart Sensors Communicating with Smart parking Platform.





# Example of Smart Sensors & Gateways:



## The Things Indoor Gateway - Setup

Push & hold SETUP button for 10 seconds.



connect to configuration AP.



MiniHub-XXXXXX

**3** Open Configuration Webpage <http://192.168.4.1> and setup your WiFi network.



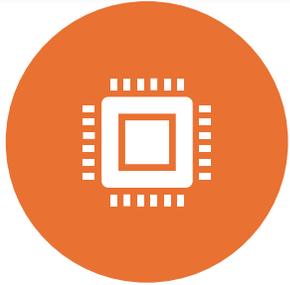
**4** Expect solid green status LED upon completed reboot.



# Technology Comparison:

Dimension	LoRa (LoRa/LoRaWAN)	NTN (Non-Terrestrial Networks)	Cellular (4G/5G/NB-IoT)	Bluetooth (Classic/BLE)
Spectrum	Sub-GHz ISM bands	Satellite bands (L/S/Ku/Ka)	Licensed bands (700MHz-3.8GHz+)	2.4GHz ISM
Range	Urban: 1-3mi; LoS: 10-15+mi	Global coverage via satellites	Kilometers (macro), hundreds of meters (small cells)	10-100m
Data Rate	bps to kbps; FLRC up to 2.6Mbps	Low to moderate	kbps (NB-IoT) to multi-Gbps (5G)	Up to ~3Mbps
Latency	Seconds	High (satellite propagation)	Low (ms for 5G)	Low (ms)
Power	Excellent (10-20 years)	Good for bursts	Moderate to poor (except LPWA)	Good (BLE optimized)
Topology	Star-of-stars	Satellite links + ground segment	Cellular RAN → Core	Point-to-point / Mesh
Cost	Low device & infra	High service cost	High infra & spectrum cost	Very low device cost
Use Cases	Smart cities, utilities, asset tracking	Remote assets, disaster recovery	Mobile broadband, massive IoT	Wearables, peripherals

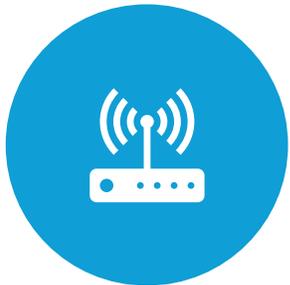
# Future of LoRa:



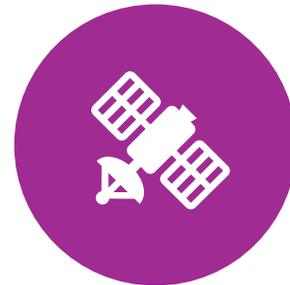
The most important upcoming advancement could be LoRa technology working together with Cellular Technology.



Cellular integration with LoRa aims to have a cellular SIM card inserted in the Gateway.



This will help as a back-up plan for the connectivity for the Gateways if the primary internet connectivity fails. Aside there are many rural areas where there is no Internet connectivity on Fiber.



Another aspect is when NTN merges with LoRa. A gateway can be placed on Satellite & multiple sensors on ground can communicate with it seamlessly. Maritime area will be hugely benefited with this advancement.

# Implementing LoRa (Use Case):

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## Background:

- In our office, we do have multiple Lab Rooms, Server Rooms, UPS rooms.
- These rooms hold very high importance in our office's daily functioning .
- The infrastructure, servers we have in these rooms holds high business values & has applications those directly interact & impact our esteemed customers.
- So for the smooth running of these infrastructures Temperature, Humidity in the room is utmost important.

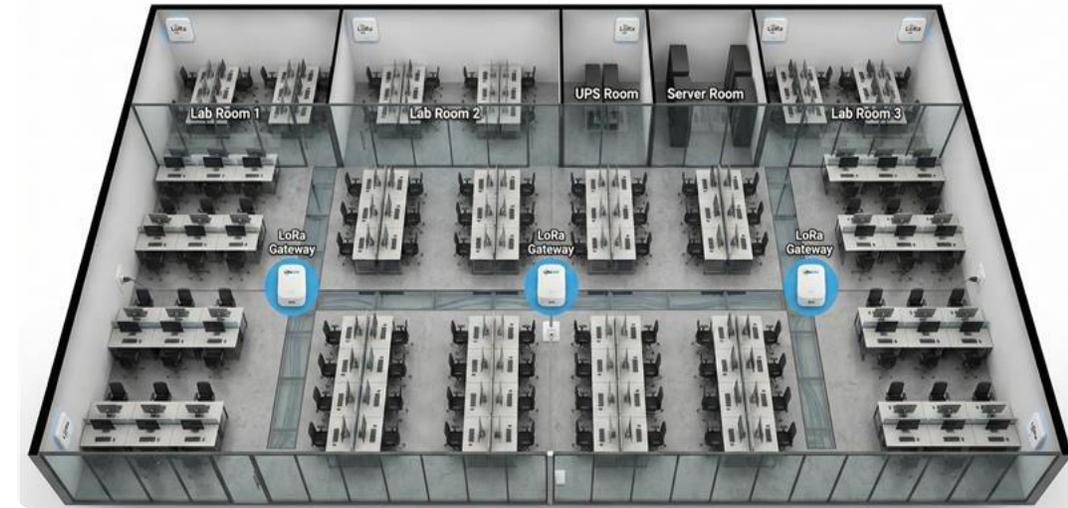


# Problem Statement:

These Server/Lab rooms are behind highly dense concrete walls, and cellular signal strength is found to be very low in these rooms when tested.

# Solution Design:

- To monitor these rooms, we used LoRa Smart Sensing as a solution.
- We placed different sensors in different rooms for purposes like Humidity Sensing, Temperature Sensing & Human Motion Sensing.
- Unauthorized human presence or Human movement was also configured in Smart Sensors.
- We placed the Gateways almost equally spaced from each other to cover the maximum office floor area with overlapping coverage for redundancy.
- We configured web apps to notify the IT team if the configured threshold for Temperature, Humidity & Human Presence is breached.



## Results & Performance:

- The result of this implementation was very impressive. Our Infrastructure team & IT team are getting all notifications if any configured threshold is breached for any Sensors.
- This has helped us in quickly resolving any issue with Infrastructure team in real time. This has helped us in saving in terms of Cost for Infrastructure monitoring & it has really saved us time in long term maintenance of the Sensors, gateways, the Subscription.

# Challenges & Lessons :

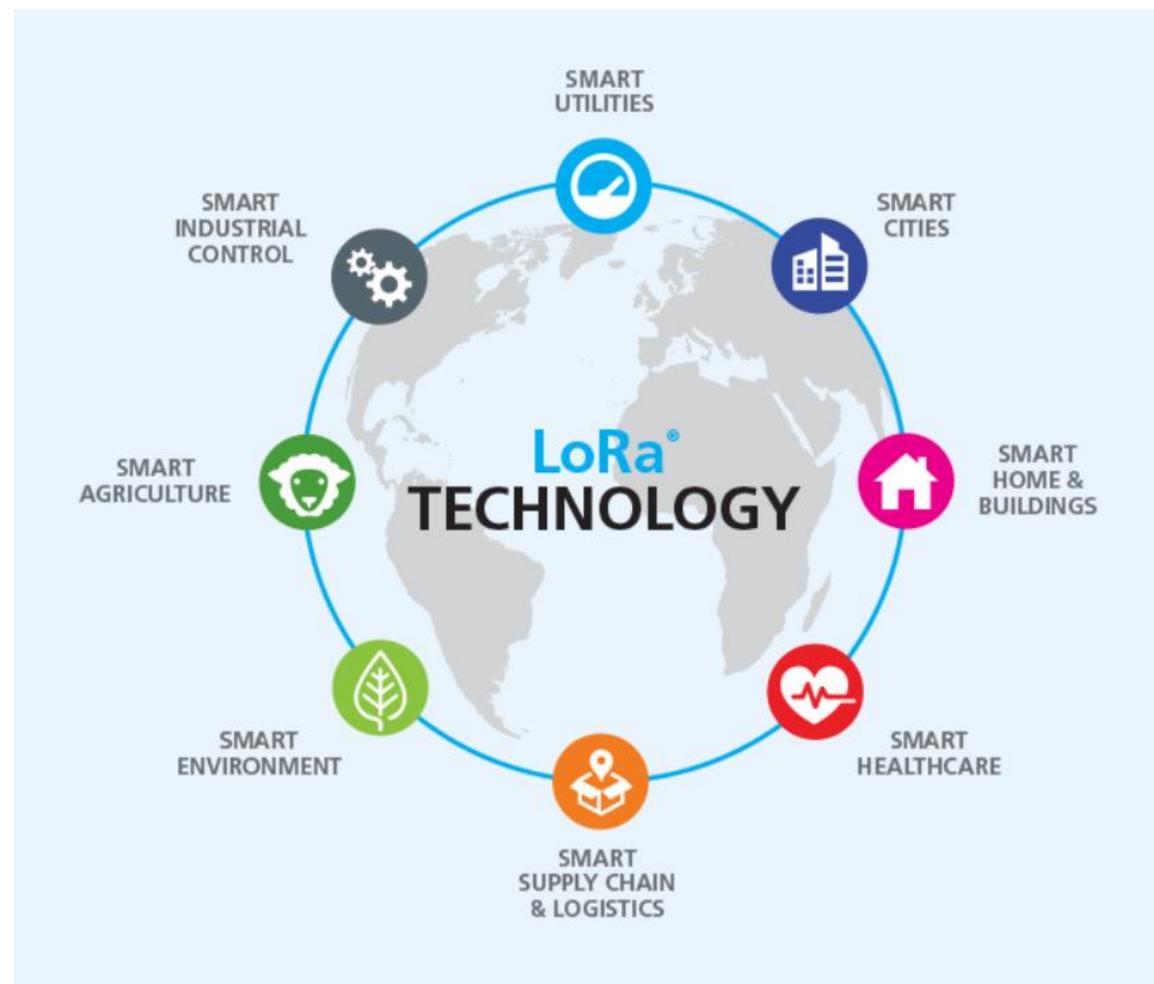
- We discovered an important lesson while configuring Human Presence Sensing sensors in our lab.
- The initial setup failed to detect people entering because the sensor was positioned to monitor only one door, while the entry actually split into two directions (left and right).
- This created a blind spot where people entering through the unmonitored path weren't detected. By locking one of the split doors and forcing all traffic through a single monitored entry point, the sensor began working perfectly.
- This experience taught us that successful sensor deployment requires more than just proper configuration—strategic placement that accounts for all possible entry paths and traffic patterns is equally critical for accurate detection and alerts.

# On-Boarding LoRa enabled Smart Sensors & Gateways :

- Our Solution used Brownen Gateways & Tectelic Sensors.
- All LoRa Gateways & Sensors have a unique Claim ID.
- This unique claim ID is defined in the Web servers of LoRaWAN Service Provider.
- So when we onboarded the sensors/gateways, we claimed the Sensors/Gateways through WebGUI.
- This is helpful for anyone who is planning to implement the LoRa Solution, as it is very easy to onboard the devices by the customer themselves, as per their convenience.
- Aside the choice of Smart Sensing Gateways & Sensors (From Different Vendors) is welcomed. Because the On-Boarding Platform & the technology support many vendors.

# LoRa Use-Cases :

LoRa devices and the LoRaWAN standard enable countless use cases in a number of key markets including smart agriculture, buildings, cities, environment, healthcare, homes, industrial control, supply chain and logistics, utilities, and more.



# Core Value LoRa Brings to Smart Sensing Technology :



1. Ultra-Low Power  
→ Multi-Year  
Battery Life



2. Long-Range  
Coverage →  
Kilometers, Not  
Meters



3. Low Cost:  
Devices + Network  
+ Operation



4. Small Data  
Efficiency → Ideal  
for Sensors

# Business value of LoRa in Smart Sensing:

## 1. Massive-Scale Deployments:

Cities, utilities, and industries can deploy tens of thousands of sensors without, Contracting with carriers, Adding SIMs, Paying data plans like cellular networks.

### Examples:

- Water utilities: Smart metering, Leak detection
- Smart cities: Parking, Lighting, Waste bins
- Agriculture: Irrigation, Soil
- Industry: Predictive maintenance

# Business value of LoRa in Smart Sensing:

## 2. Remote & Offline Operation

We can build private LoRa networks:

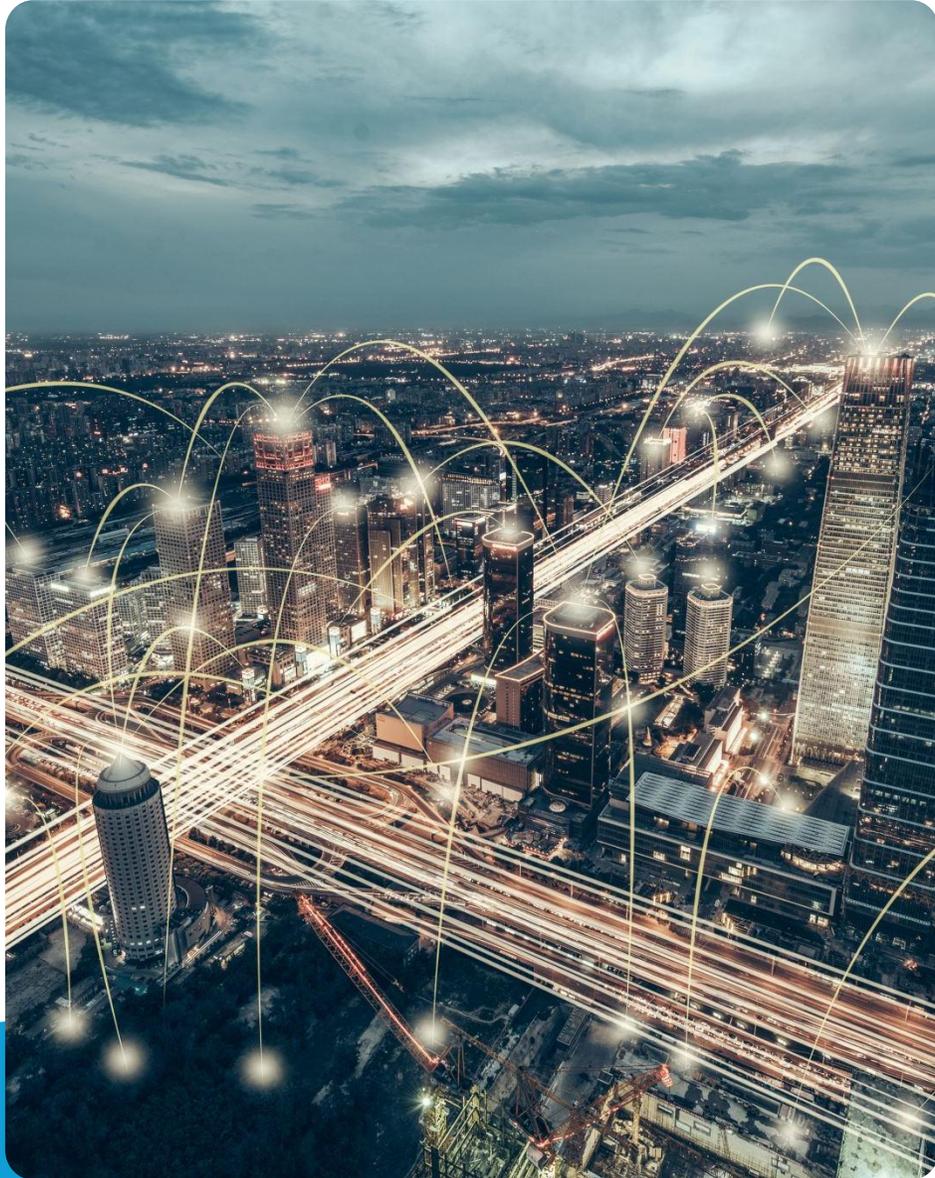
- Farms without cellular coverage
- Mines and factories where phones don't work
- Disaster zones

### Value Addition:

Sensors still operate even if no telecom network exists .

## 3. Minimal Maintenance → Lower Total Cost

- The highest cost in IoT is not the sensors themselves - it's the maintenance.
- LoRa's multi-year batteries + long range offers lower cost per year of operation than almost any other wireless technology in the current market..



# Conclusion:

- LoRa enables long-range, low-power connectivity that allows millions of devices to operate reliably for years with **minimal infrastructure**.
- This makes it ideal for **large-scale IoT deployments** across smart cities, industry, agriculture, and environmental monitoring.
- By **reducing energy consumption** and **operational costs** while maintaining reliable communication, LoRa turns ambitious digital transformation goals into practical, scalable solutions.
- As connectivity needs continue to expand, LoRa provides a **proven and sustainable foundation** for the next generation of **intelligent systems**.

**Thank You**

