MULTITECH®

Unlocking the potential of
the Internet of Things

LoRaWAN® 101

A Technology Introduction

INNOVATIVE COMMUNICATIONS

Design

Develop

Manufacture

Integrated & scalable **devices and services**

US Based Corporation with **Manufacturing HQ** in Minneapolis, MN

Wireless solutions across multiple **high-growth industries**

52+

years of experience

>120

million devices worldwide

125+

patents awarded

What is LPWA?

Low-Power, Wide-Area (LPWA)

Covers a group of technologies with the following key characteristics:

- Long battery life
  - 1-10 years
- Wide area connectivity
  - 2-10 miles range
- Lower cost chipsets and networks
- Lower data throughput capacity
  - Bitrates <100 kbps

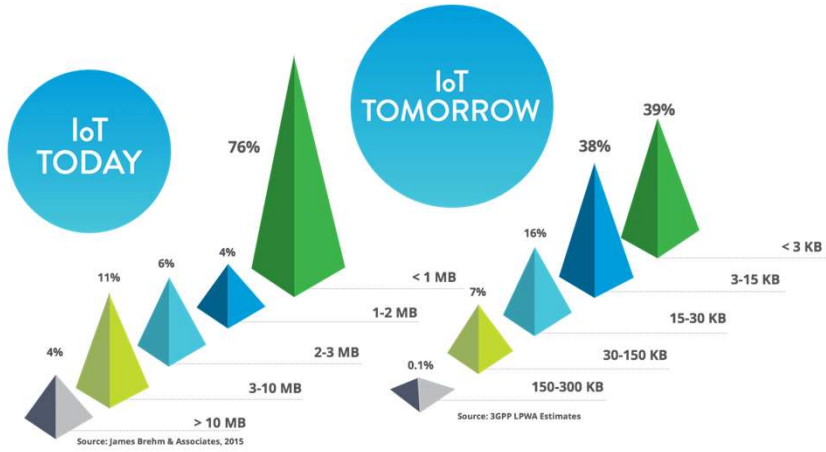
	Types of LPWA				LTE (Reference)
	Cellular LPWA		Non-cellular LPWA		LTE Cat.1
	LTE-M	NB-IoT	LoRa	sigfox	Lte
Frequency Band	Licensed band		Unlicensed band		Licensed band
Communication Range	10 km or more				5km
Data Transfer Rate	1Mb/s	<150kb/s	<10kb/s	100b/s	5Mb/s
Transmission Power	+23dBm	+23dBm	+20dBm*	+20dBm*	+23dBm
Battery Life	10 years or longer				-
Power Consumption	LOW		LOW		HIGH
Cost (at Deployment)	LOW		LOW		HIGH
Service Start Date	NOW				

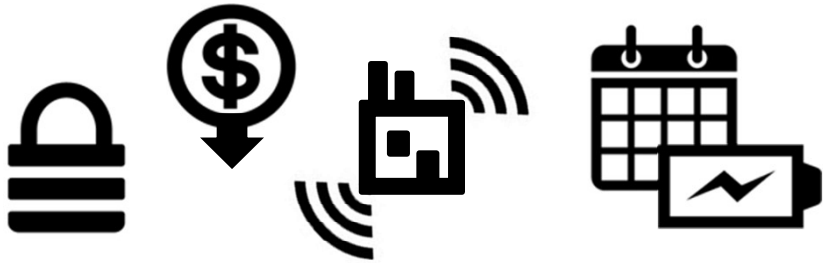
* +20 dBm is available in the U.S. only. EU and Asia use +14 dBm.

LPWA Target Requirements

Many of the next wave of devices to be connected will be fixed location sensors & constrained devices:

- Must operate on batteries for 7 to 10 years
- Will send less than 1,000 bytes of data a day
- Must be low cost to buy, deploy and operate
- Indoor units will need good building penetration
- Outdoor units will need exceptional range
- Must connect easily to sensors & assets
- Secured connection to networks & IoT app platforms





Introducing LoRa® (**Lo**ng **Ra**nge)

Long Range, Low Power, Lower Cost

- Physical silicon layer/wireless modulation
- Developed by Semtech
  - Based on Chirp Spread Spectrum Technology
  - 2-3 miles dense urban; >10 miles outdoors
- Low power = long battery life of up to 10 years

Robust & Secure Communications

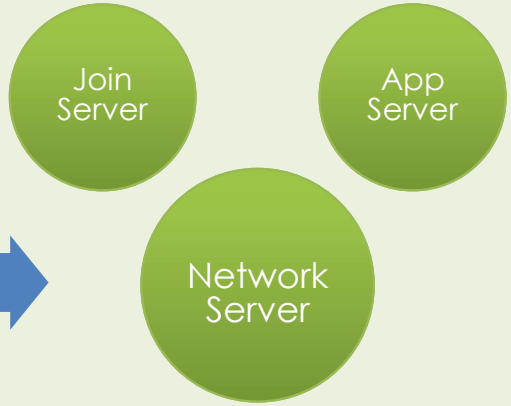
- Features end-to-end AES128 encryption, mutual authentication
- Not susceptible to interference from Wi-Fi, Bluetooth, Cellular
- Bi-directional communications

High Capacity & Interoperability

- Supports millions of messages per gateway/base station
- Device interoperability and availability of LoRaWAN® networks
- Supports geolocation

LoRaWAN® Protocol

Applications



LoRaWAN Network Server Software

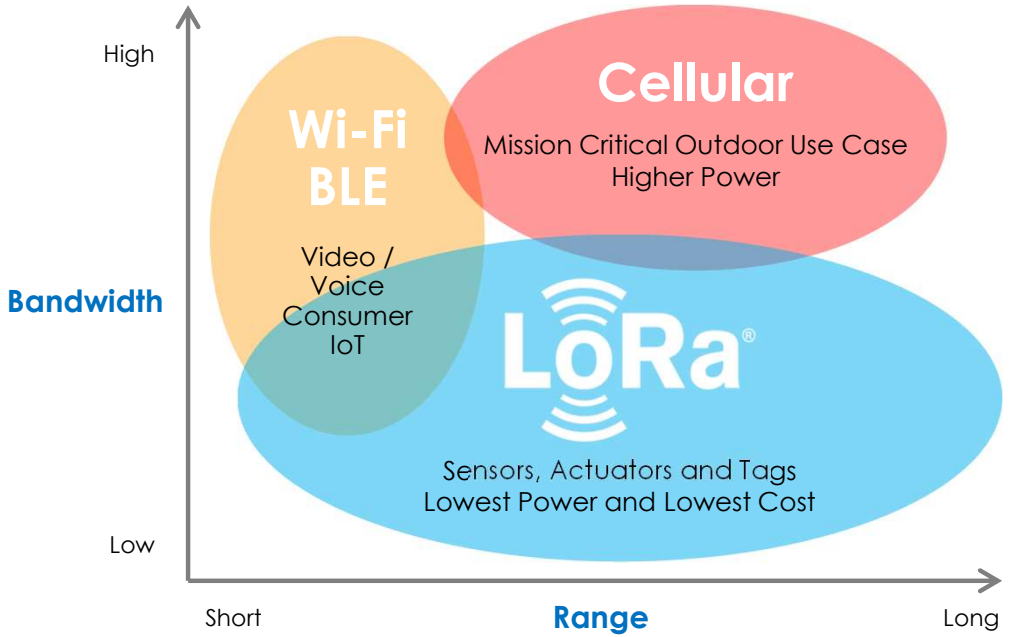
LoRa® is the wireless modulation used to Create the long-range communication link

LoRaWAN is the protocol and architecture used to transport the data to backend applications

LoRaWAN® Key Benefits

Unique ground-up features that make LoRa®/LoRaWAN® a strong value proposition for IoT

- Cost effective roll-out
- Ultra-low power
- Open private & public business models (license free)
- Long range
- Deep indoor penetration
- Geolocation
- Strong security
- Firmware updates over the air



Global LoRaWAN® Networks

171
Countries

166
LoRaWAN
Network Operators

1000s
LoRaWAN
Private Networks

Source: LoRa Alliance

Wireless Convergence Private Networks

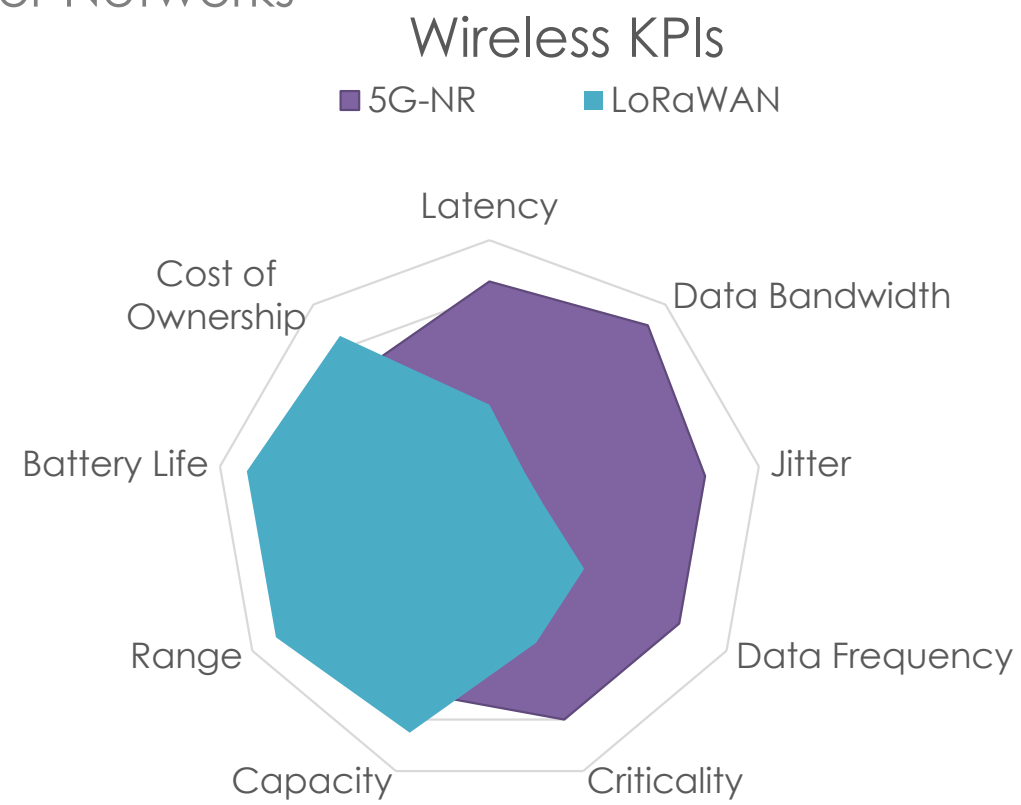
Voice + Broadband Data + Sensor Networks

Cellular 4G-LTE & 5G-NR

- All IP Secure Mobile Network
- Low Latency Broadband Data
- Spectrally Efficient
- Traffic Prioritization & Quality of Service
- Industry Standard Based Tech

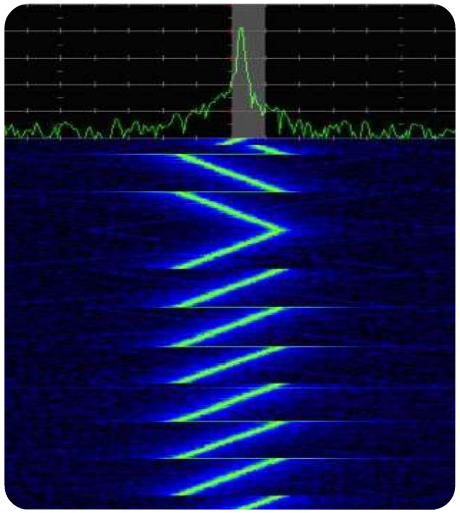
LoRaWAN®

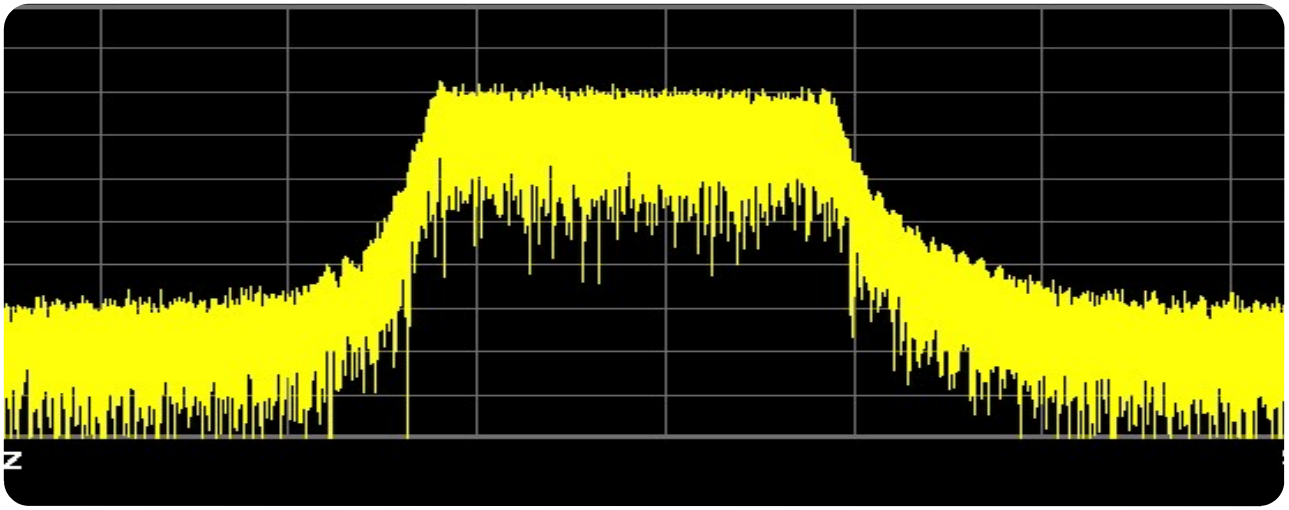
- Long Battery Life
- Wide Area Coverage
- High Noise Immunity
- High Density of Connected Assets
- Secure Open Standard



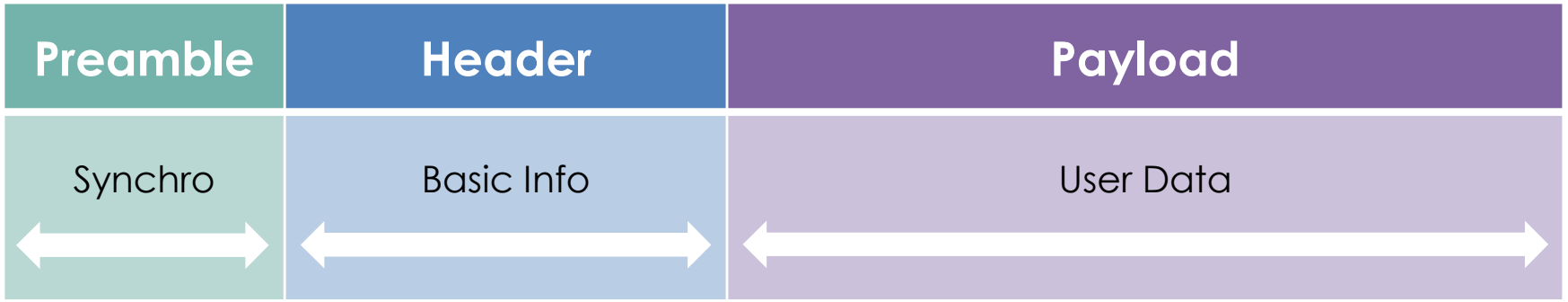
LoRa® a Spread Spectrum Technology

- Developed by Semtech Corporation (http://www.semtech.com/)
- Chirped-FM modulation, symbols of ramping frequency
- Processing gain = increased receive sensitivity
- Enables longer range at expense of lower data rate





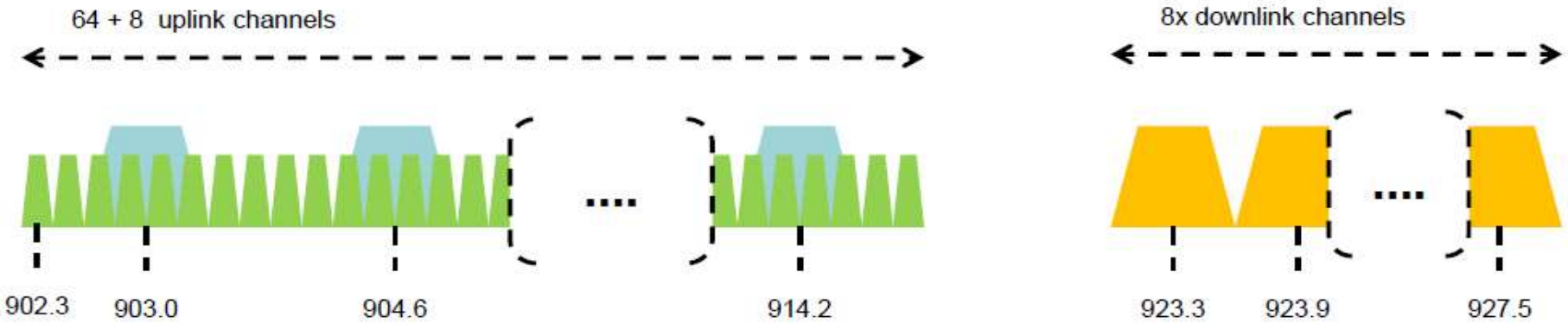
Protocol & Message Structure



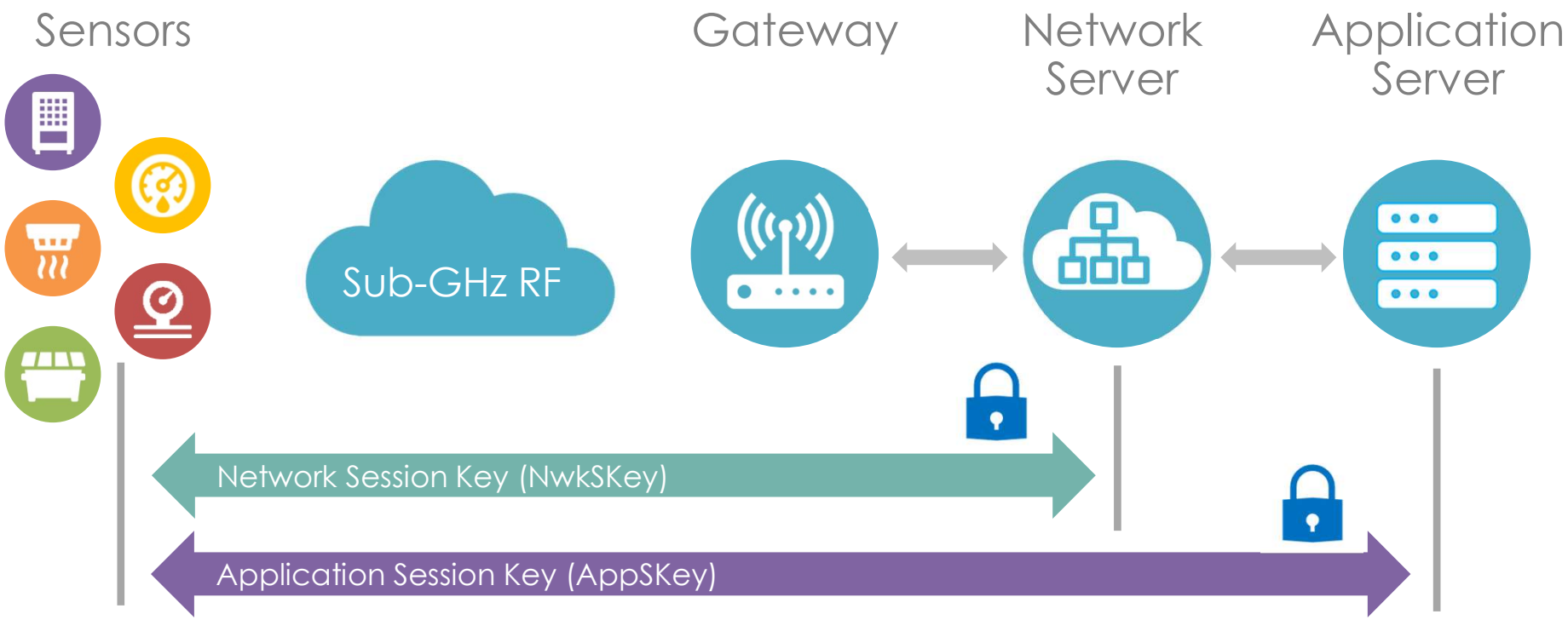
- **Chirp (chirp):** synchronization preamble to allow for recognition of message
- **Header:** basic information for message size and error correction
- **Payload (flexible):** user data ranging from 1 to 242 bytes

License free Sub-GHz Frequencies

- North America: 902-928 MHz Band (US915 Channel Plan)
- Upstream: 64 channels numbered 0 to 63, DR0 to DR3
- Upstream: 8 channels numbered 64 to 71, DR4
- Downstream: 8 channels numbered 0 to 7, DR8 to DR13

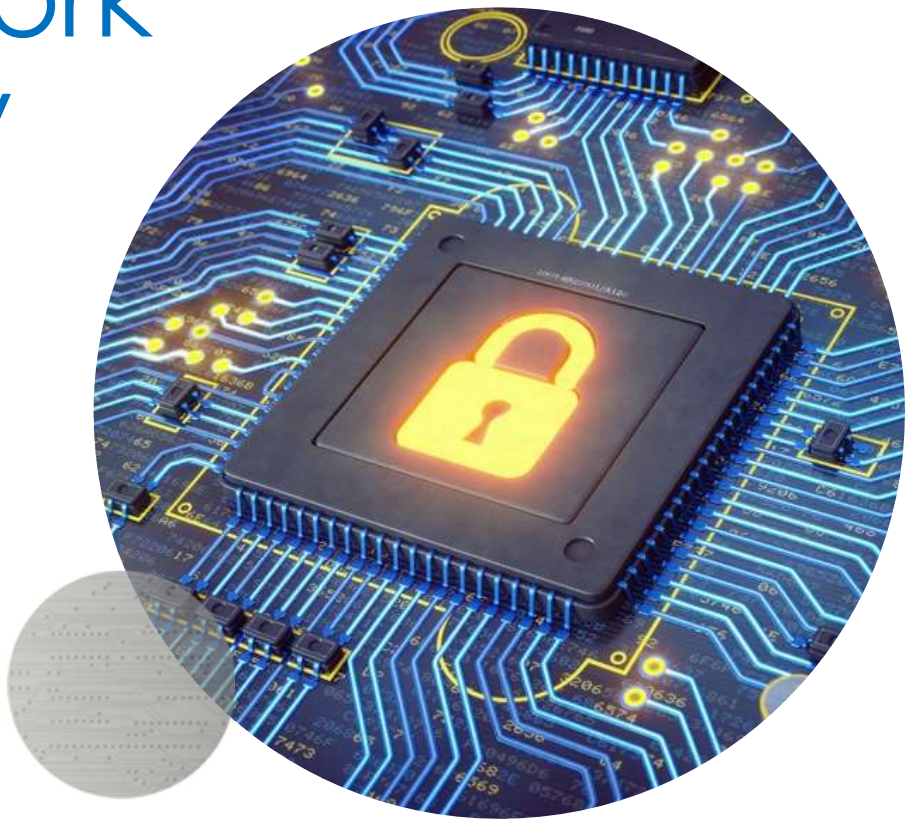


Logical Data Flow

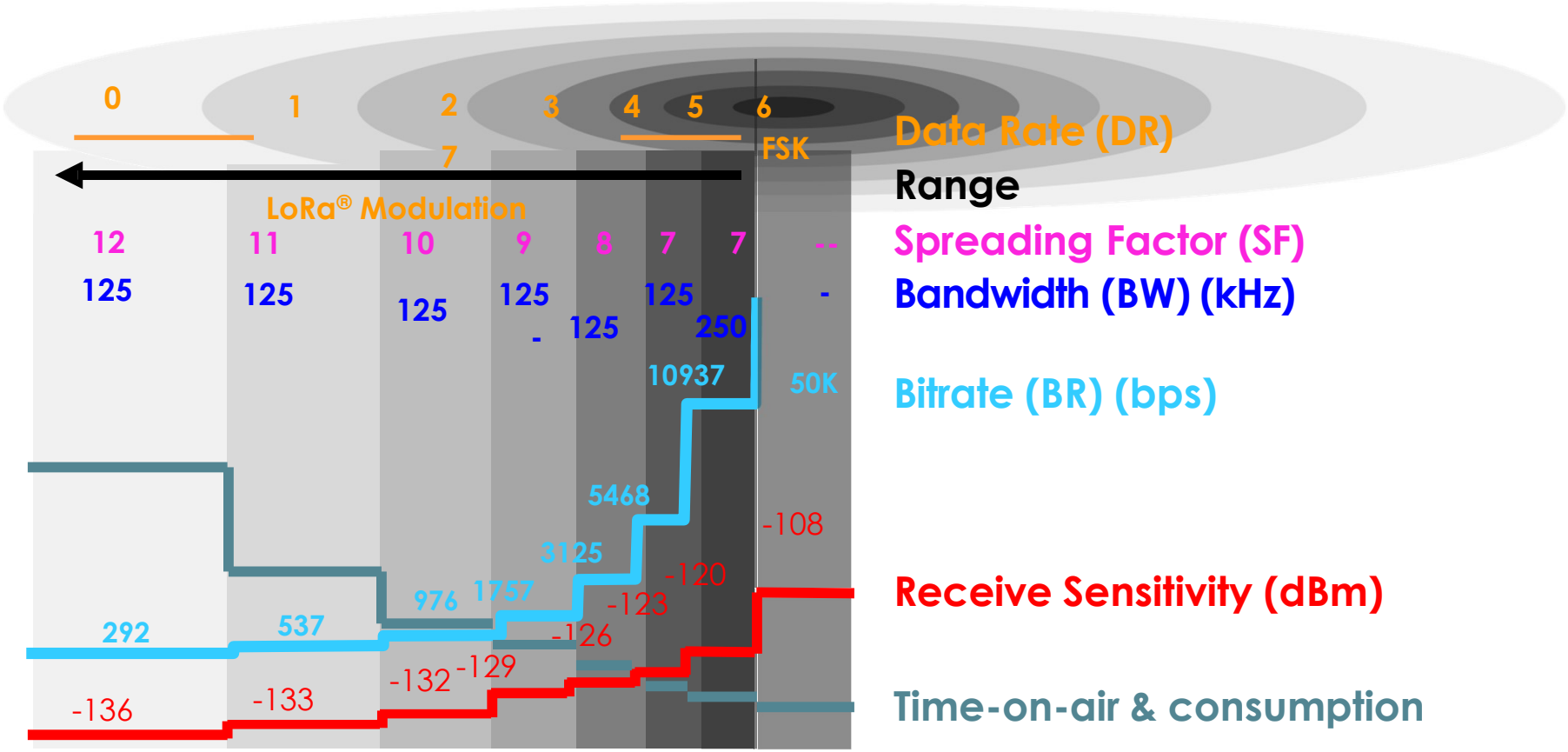


LoRaWAN® Network Protocol Security

- Based on 802.15.4 Security
- AES-128
- Enhancements:
  - Network Session Key (NwkSKey)
  - Application Session Key (AppSKey)



Data Rates & Spreading Factors



Data Rate (DR)

Range

Spreading Factor (SF)

Bandwidth (BW) (kHz)

Bitrate (BR) (bps)

Receive Sensitivity (dBm)

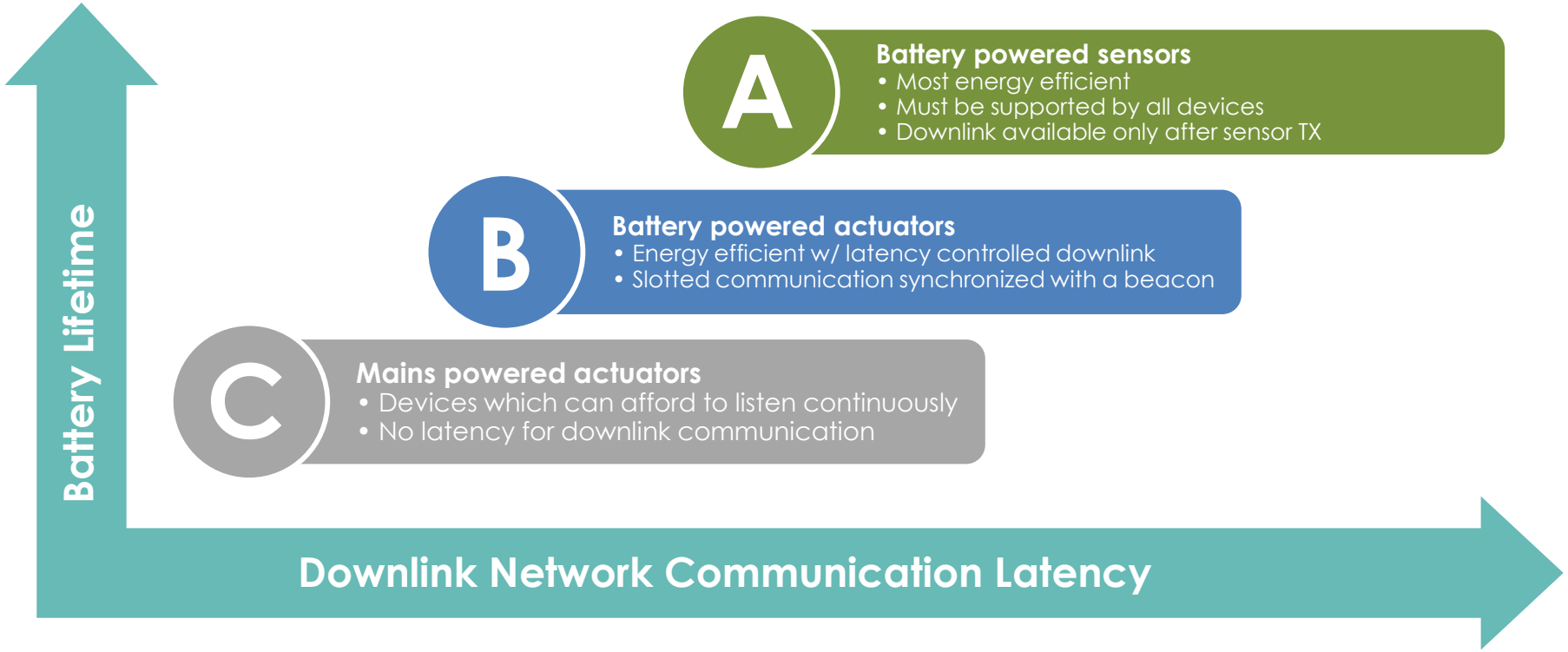
Time-on-air & consumption

ADR = Adaptive Data Rate

LoRaWAN® can auto-magically manage SF for each end-device:

- To optimize for fastest data rate versus range
- For maximize battery life, and
- Achieves maximum network capacity
- LoRaWAN specification requires ADR

LoRaWAN® Device Classes



Source: Semtech

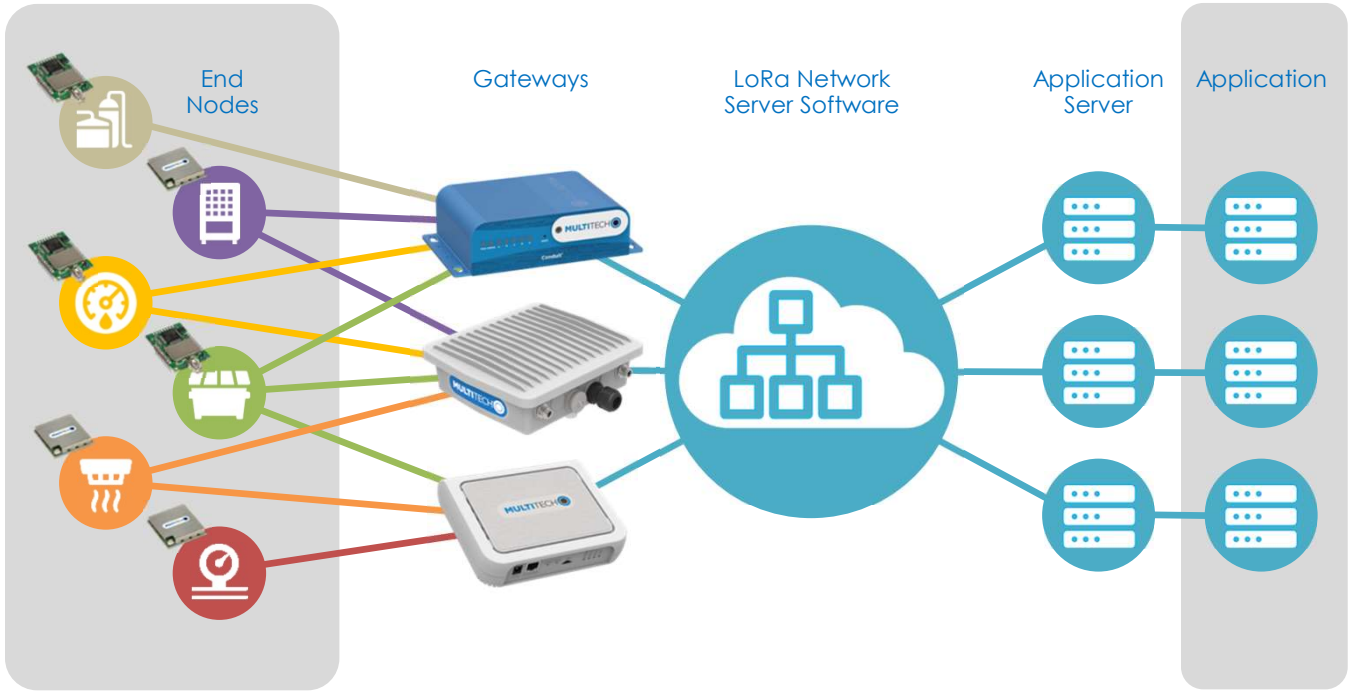
Agility of LoRaWAN® Network Architecture

The Basics:

- You supply end nodes
- You ingest data into your own:
  - Analytics Platform
  - Business System, ERP, etc.
  - Control System

Decisions:

- Sensor to Cloud
- Sensor to OnPrem control system
- Public Carrier or Private Network
- Centralized or Distributed Architecture



Types of Networks

Public

Subscription Based

Just like a cell phone

Well-established network providers

Good for:

- Low CapEx
- Mobility
- Speed of deployment

Not good for:

- Low OpEx – fees per sensor
- Network Management

Enterprise

Owner Operated

Mission-Critical System

Well established companies

Good for:

- Low OpEx – no fees
- Data Protection
- Network Management

Not good for:

- Low CapEx – build up costs
- Speed of deployment

Private

Single Site-based

Easy to Deploy

Targeted data and/or geographical needs

Good for:

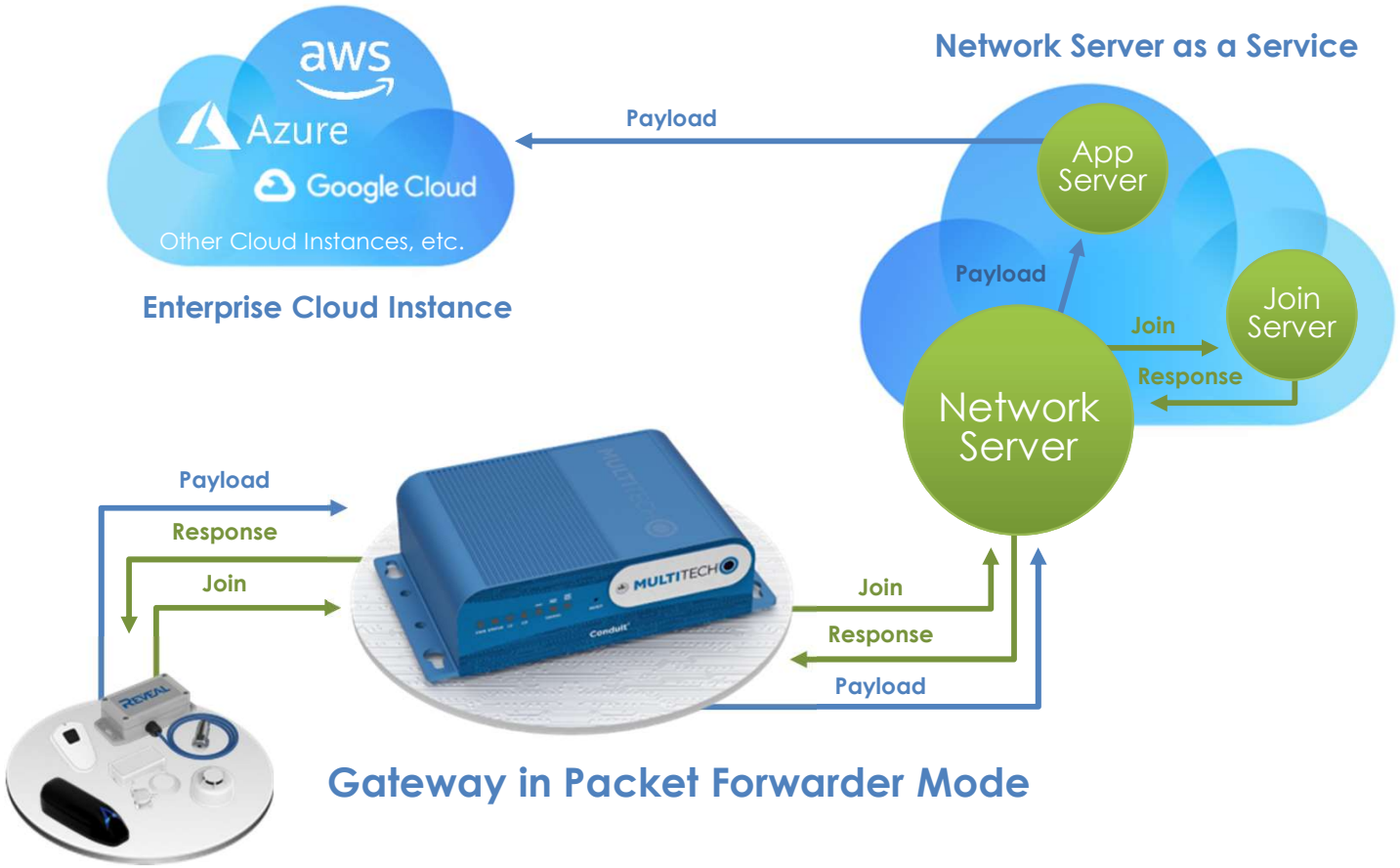
- Low OpEx – no fees
- Data Protection
- Speed of deployment

Not good for:

- Low CapEx
- Network Management

Lower Capital Expense → **Higher Capital Expense**

Centralized (Cloud) Network Server



Advantages

- Easy integration
- 3rd party network and device management
- No maintenance
- Fast onboarding of new Applications

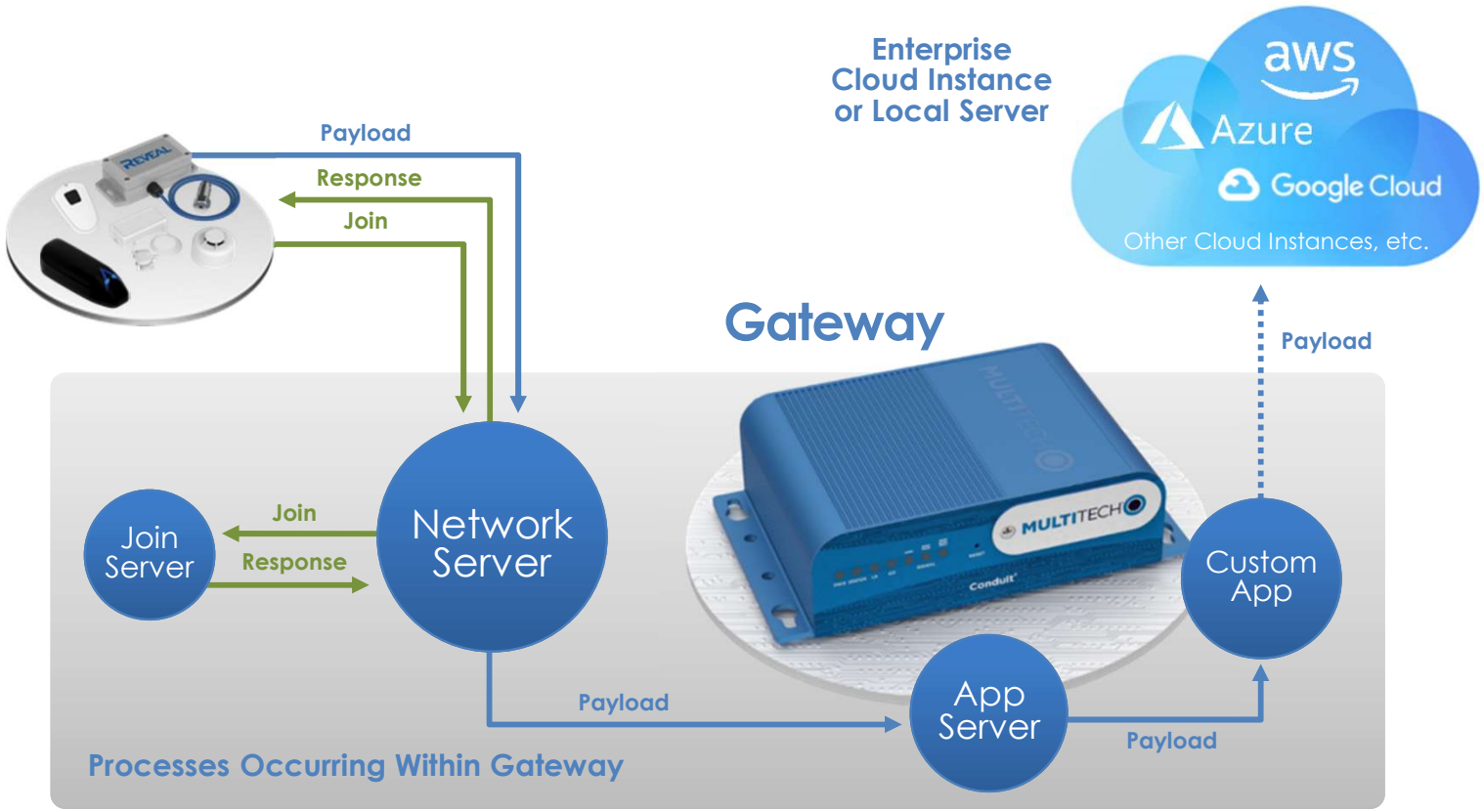
Disadvantages

- No intelligence & decision making on Gateway Edge
- Higher Opex Costs
- Increased WAN backhaul cost
- Shared network
- Lower resiliency to backhaul outages

Ideal For

- Wide Area Networks - Nationwide

Embedded Network Server



Advantages

- Easy out of the box set up
- Minimal WAN cost
- Low deterministic cost (Capex only)

Disadvantages

- Does not scale
- No centralized remote management, control & diagnostic analytics
- High touch when adding new devices and keys

Ideal For

- PoCs & Trials or a small, independent system

Distributed Network Server

Advantages

- Intelligence at the network edge – custom applications & AI
- Zero touch activation and provisioning
- Improved Resiliency, Privacy & Security
- Reduced WAN costs – only send to the cloud what is necessary
- Centralized management and analytics
- No intermediary for payload data
- Low Opex

Disadvantages

- User managed network

Ideal For

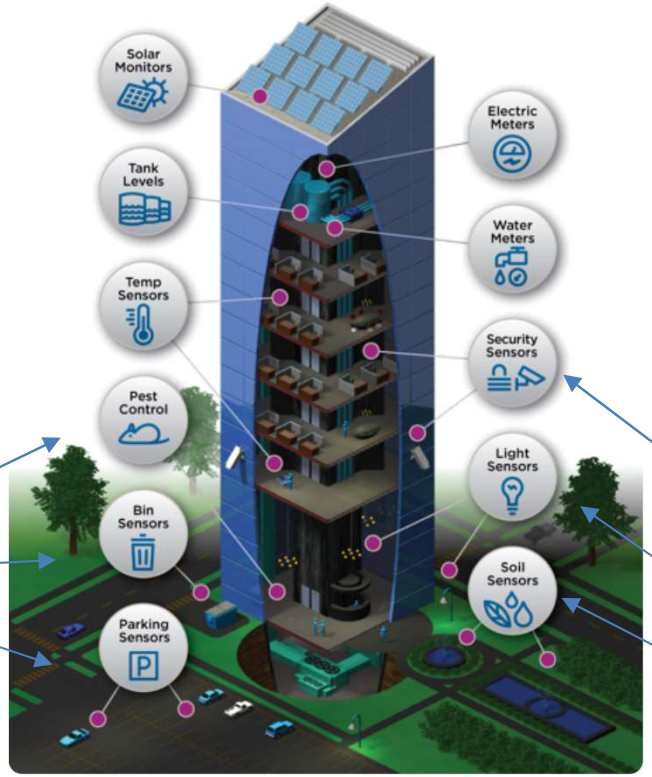
- Wide Area Networks - Nationwide

LoRaWAN® Applications

Smart City

Smart City Use Cases

Public Smart Building



Smart City Use Cases

Energy

Solar

AMR

DERs

Fleet EV Charging

Tank Monitoring

Aloxy valve positioning sensor

The Aloxy pulse characteristics:

- Sensor can be mounted on any type of manual valves, i.e. ball, gate, globe, gear operated valves
- Detects open, close and intermediate position (%)
- Ex certified and IP69
- Wireless communication trough LPWAN such as LoRaWAN protocol
- Battery lifetime is 5 year minimum
- Easy to install, no customized brackets

Valve position use cases:

- Process control to get real time feedback on operations
- Isolation valves to monitor proper isolation during maintenance
- Alarm / flag when critical valves are moved from their original position
- Choke valves to indicate the exact percentage of opening
- Emergency showers to alarm when used

Sushi Sensor

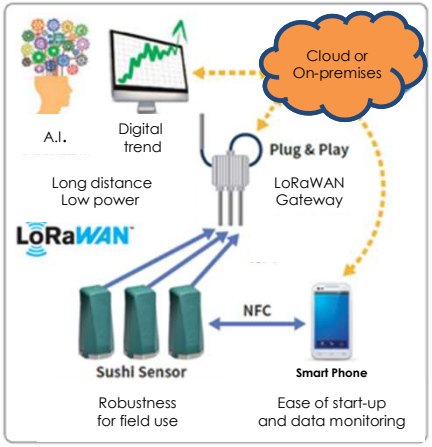
IIoT wireless sensor for field use

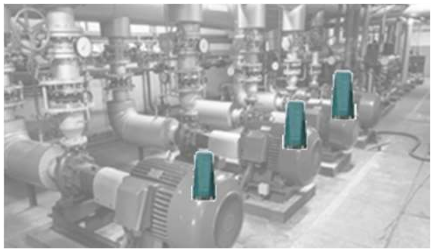
Monitor asset condition via wireless, digitize operator rounds

Sushi Sensor XS770A

Height: 3.96 in
Diameter : 1.88 in
Weight: 9.2 oz

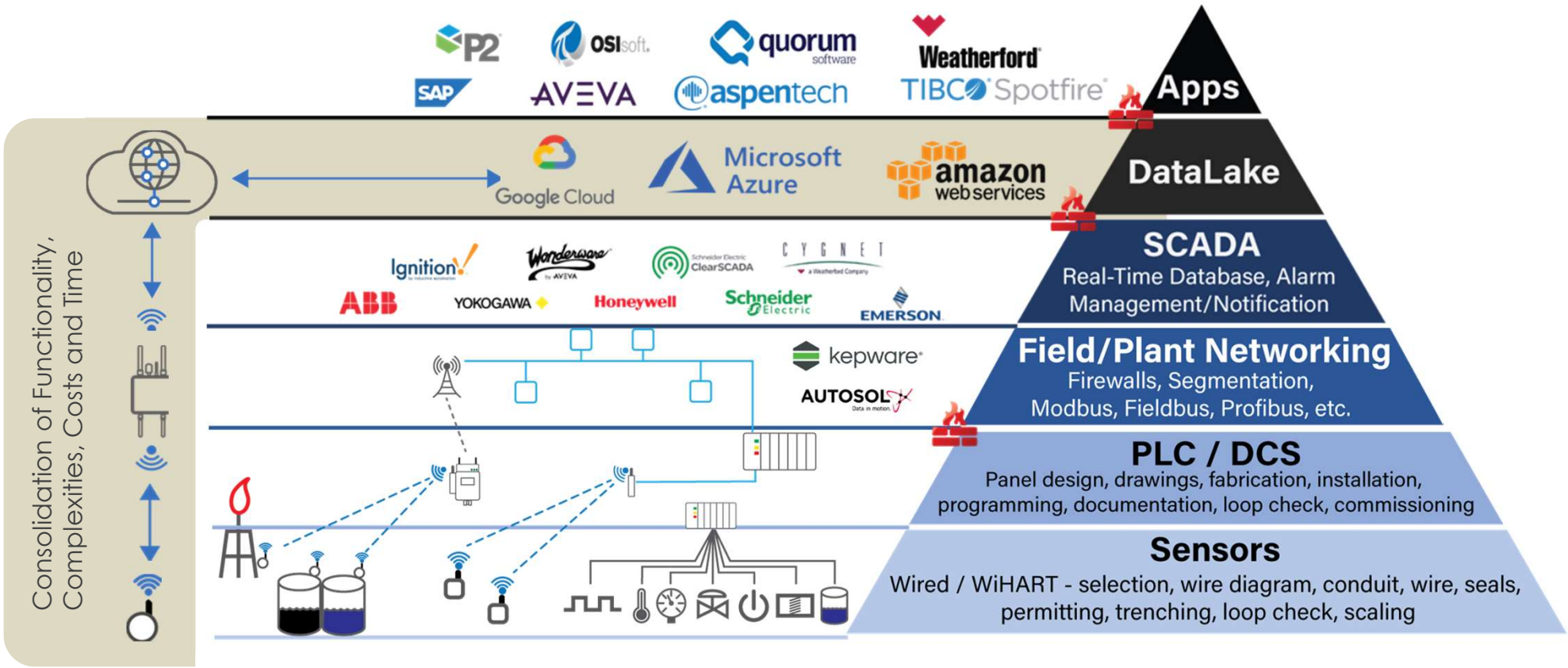
- **1st Vibration and surface temperature**
  - Monitor equipment across plant
    - ✓ Approx. 100 ~ 200 sensors per gateway
    - ✓ Transmission distance: approx. 3,300 ft (1000m)
  - Specs
    - ✓ 4-Year battery life @ 1hour interval
    - ✓ Frequency range: 10Hz ~ 1kHz (Peak, RMS)
    - ✓ Temperature range: -4 to 185 °F(-20 to 85 °C)
    - ✓ Fastest update interval: 1 minute
  - On Premise/ Cloud-based Solution
    - ✓ Configuration, data logging
    - ✓ Apply AI to enable Condition Based Monitoring
  - Use
    - ✓ Monitor equipment condition by vibration and
    - ✓ surface temperature trend data





Integration to Existing Control Systems

Enhanced with LoRaWAN®

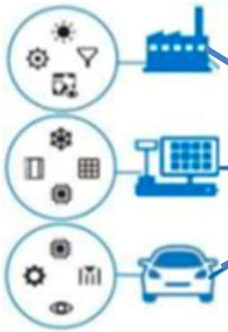


Integrated LoRaWAN® Solution

Gateway Management
Gateway management platform provided by MultiTech

DeviceHQ

LoRaWAN Sensors



Hazardous ATEX-C1Dx:
Aloxy, RadioBridge, Vega, VolleyBoast, Yokogawa

Gateway + Network Server

LoRaWAN

OnGo

MULTITECH

IoT Platform and IoT Analytics

aws

OSIsoft.

IBM Watson

Ignition! by inductive automation

Microsoft Azure

Enterprise Ethernet Network
MultiTech gateways are connected to the Ethernet, or Cellular networks

Lte

LoRa® Summary

- Long Range low bandwidth wireless technology
- License Free Spectrum
- Simple star topologies
- Bi-directional Data transmission
- Exceptional receiver sensitivity
- Provides three modes of operation Class A, B and C
- Adaptive Data Rate
- Long battery life up to ten years in Class A operation
- High level of Data security through encryption and authentication

MULTITECH®

Unlocking the potential of
the Internet of Things

Thank You

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