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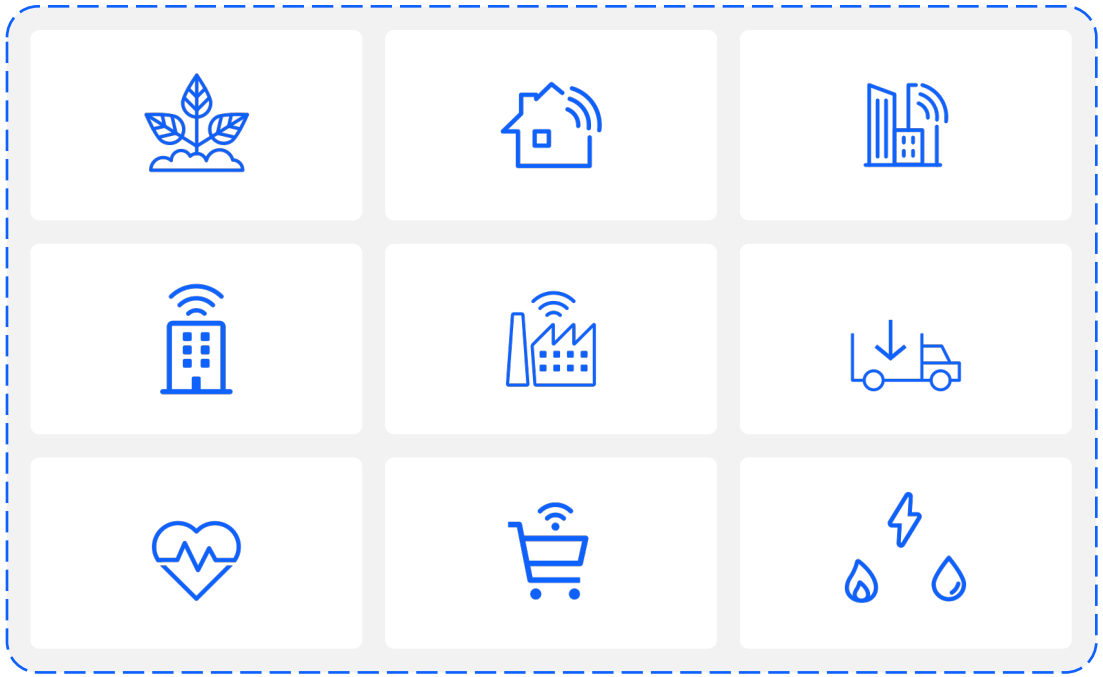
LPW-101

Connecting The Unconnected

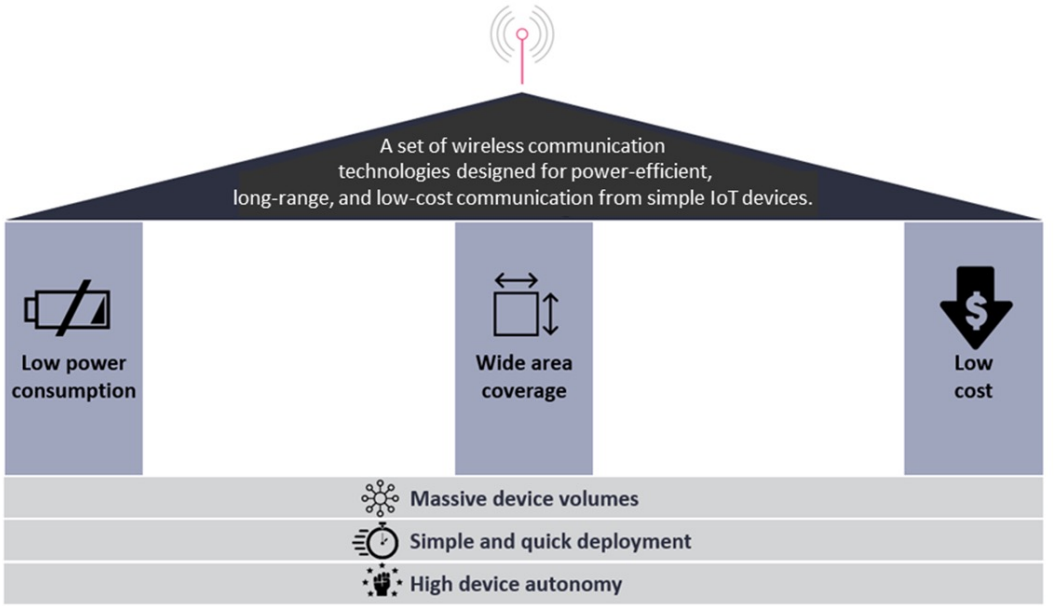
Abitzen Xavier | 2023

What is LPWAN and What applications are served by LPWANs



LPWAN Applications

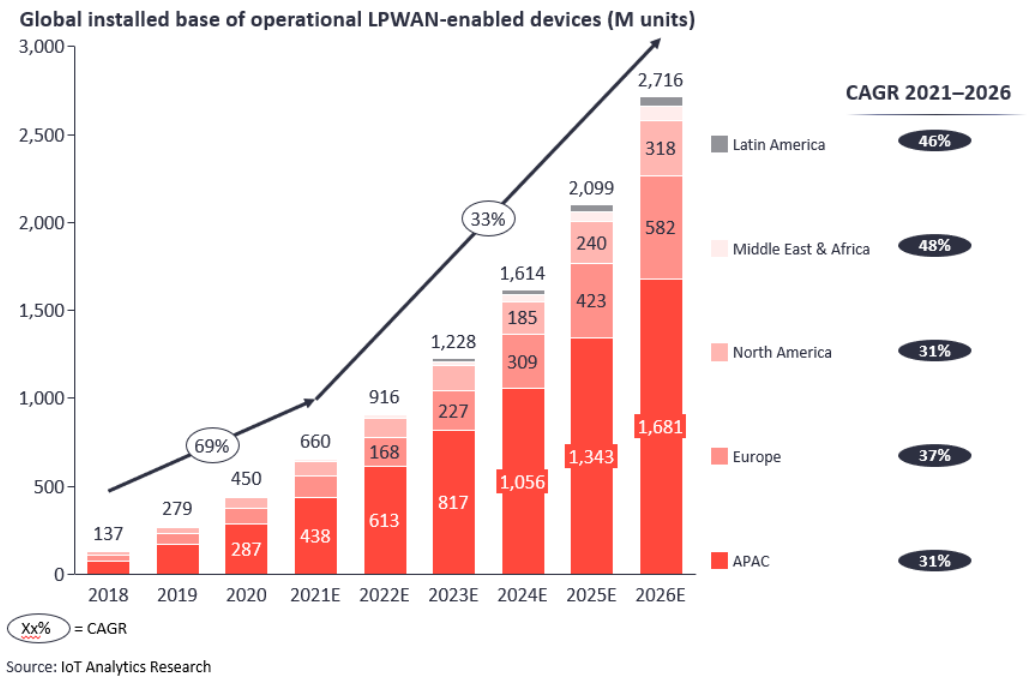
IoT applications that are often cost-sensitive and characterized by infrequent transmissions of small bursts of data, many devices often spread over wide areas, and the need for devices to operate autonomously for many years.

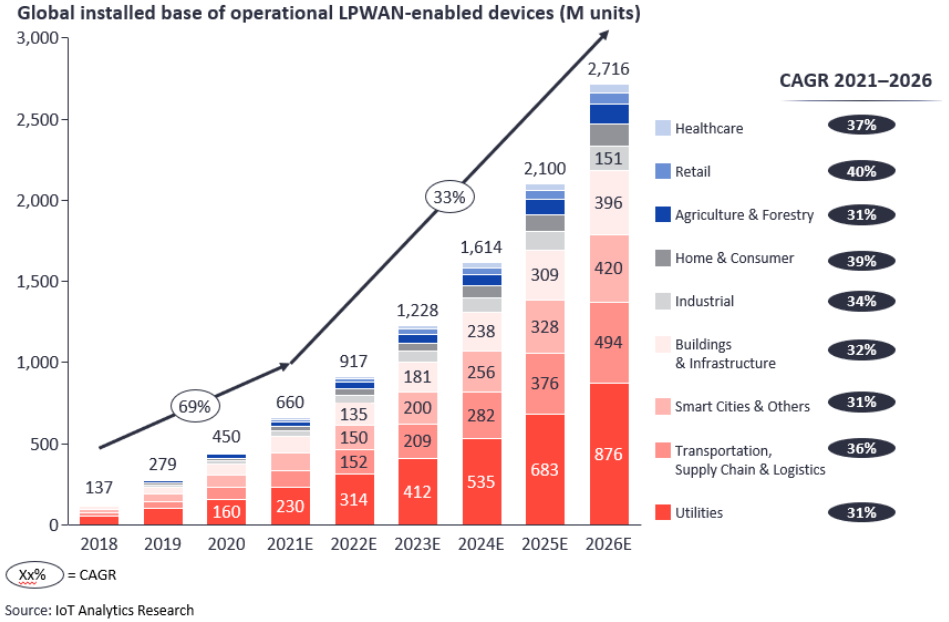


Definition

Low-power wide-area networks (LPWANs or LPWA networks) are a set of wireless communication technologies designed for power-efficient, long-range, and low-cost communication from simple IoT devices.

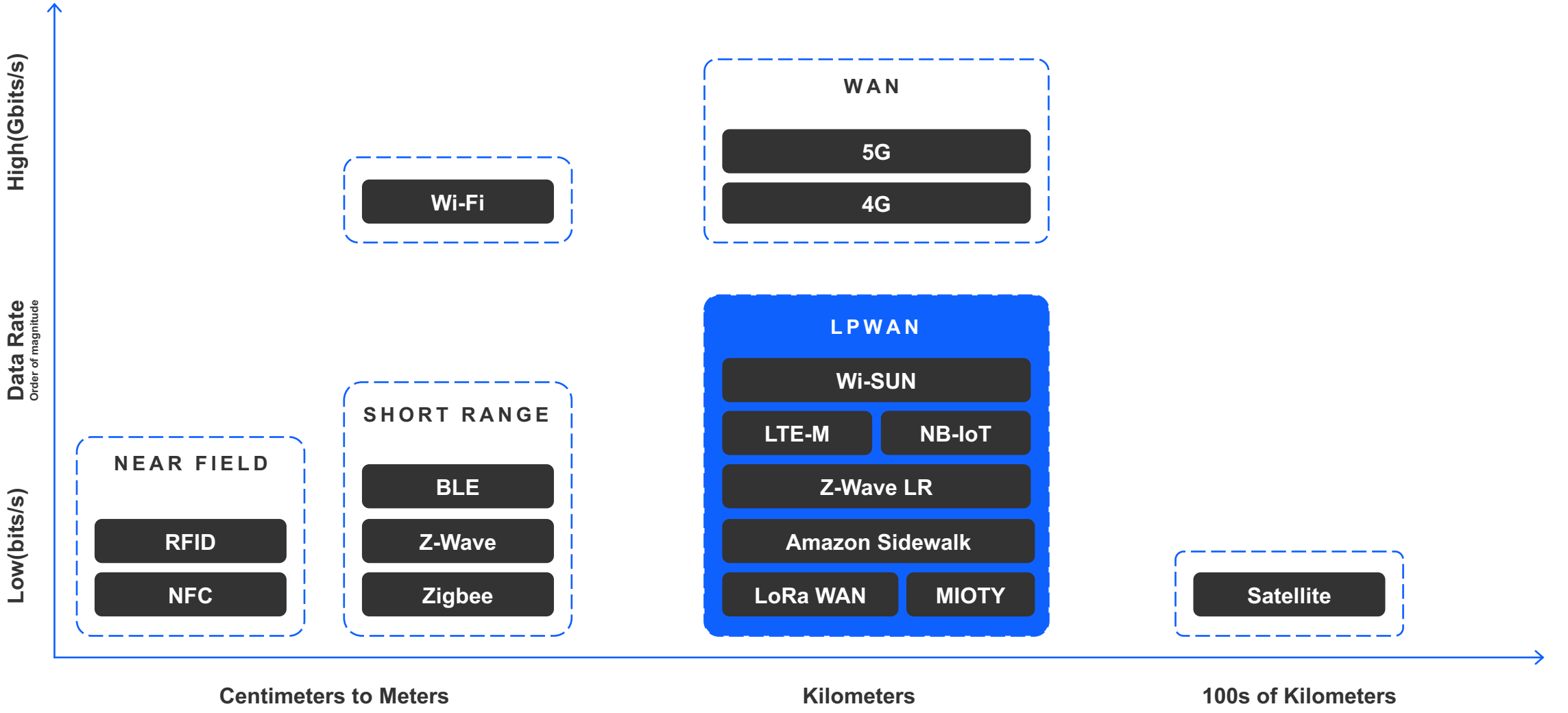
LPWAN Market Opportunity





Massive opportunity across multiple regions and verticals | 33% CAGR | 2.7B devices by 2026

LPWAN Positioning



LPWAN Technologies

- LPWAN is a highly fragmented space
  - Several protocols in use for major applications
  - Wide range of data rate needs
  - Regional and Segment differences
- Standards driving consolidation
  - Wi-SUN gaining traction in Electric Utilities and infrastructure
  - Cellular IoT targeted towards metering and asset tracking applications
  - LoRa WAN competing against cellular IoT for similar applications.

LPWAN Deployment Options

	LICENSED RADIO SPECTRUM	UNLICENSED RADIO SPECTRUM
	Exclusive spectrum access Guaranteed QoS and reliability No duty cycle limitations	Free spectrum access No guaranteed QoS and reliability Duty cycle limitations
PUBLIC NETWORKS Managed network No upfront costs Subscription fees	NB-IoT, LTE-M	LoRaWAN, sigfox, amazon sidewalk
PRIVATE NETWORKS Full network control High upfront costs No subscription fees	NB-IoT, LTE-M	Wi-SUN, Z-Wave PLUS LR, mioty, LoRaWAN

What is NB-IoT and LTE-M

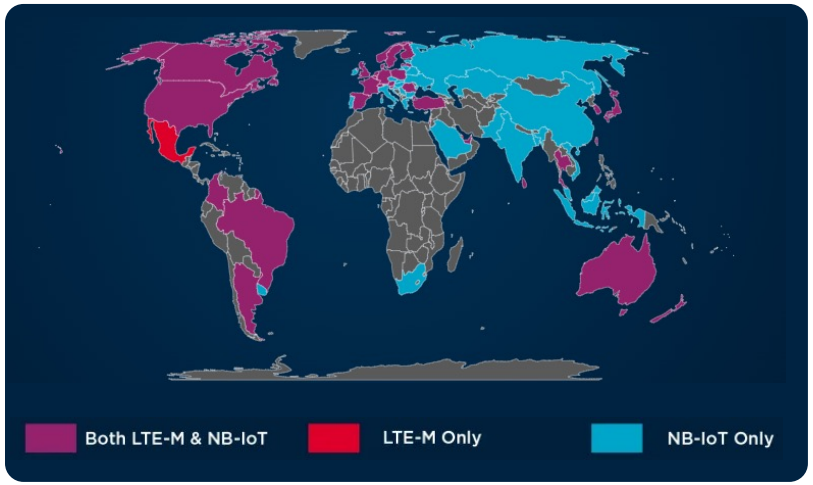
3GPP
Developed by

248
Mobile IoT Networks

GSMA
Alliance

136
NB-IoT

115
LTE-M Networks



Source - https://www.gsma.com/iot/deployment-map/ May 2023

Voice & Mobility
LTE-M: Yes
NB-IoT: No

Global Coverage
LTE-M: Americas
NB-IoT: Europe & Asia

Peak Data Rate
LTE-M : 1 Mbps
NB-IoT: 200 kbps

Power Consumption
LTE-M : Low
NB-IOT : Lower

Latency
LTE-M : ~100 ms
NB-IoT : 1 s

NB-IoT and LTE-M Technology

- Cellular technology using licensed spectrum
- Channel BW
  - LTE-M : 1.4 MHz, NB-IOT : 200 KHz
- Multiple access and modulation
  - LTE-M : OFDMA (DL)/SC-FDMA (UL) /16QAM
  - NB-IoT : OFDMA (DL)/SC-FDMA (UL) /QPSK
- Frequency deployment
  - LTE-M : LTE in-band, NB-IoT : Flexible
- End-to-end IP

Model

- **Network connectivity is provided by operators**
- **Subscription based**

What is Private 5G

5G

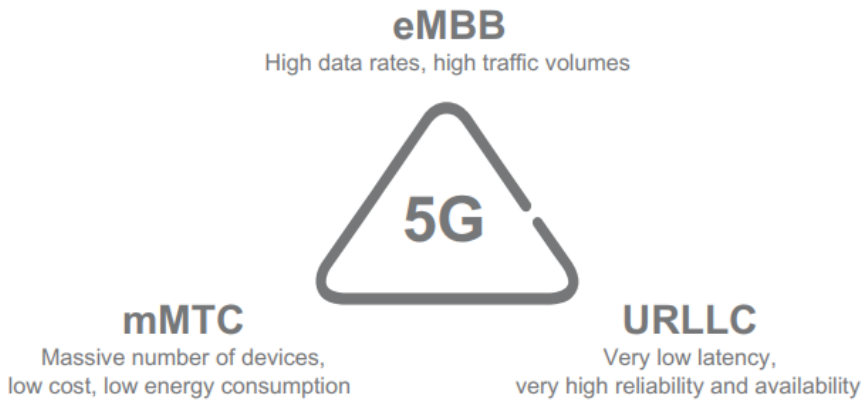
technology deployed on unlicensed or shared band

LTE-M/NB-IoT

in 5G New Radio (NR) & RedCap

3GPP

Release 15-17



Source - https://zeetta.com/

mMTC
1 million devices per square km

Pvt Spectrum
USA - CBRS

URLLC
1 ms Latency
99.99999% Reliability

Battery Life
10 years
200 bytes UL & 20 bytes DL / day

Coverage
164 dB with 160 bits/s

- **NB-IoT & LTE-M are 5G Technologies**
- **Public 5G networks are focusing on throughput**
- **Private 5G is the way to go for LPWAN devices**
- **Spectrum**
  - Industrial spectrum – Germany & Japan
  - Shared Spectrum – CBRS in USA
  - Public Spectrum – Verizon on-site-5G
  - Unlicensed Spectrum

Model

- **Private networks**
- **No subscription required**

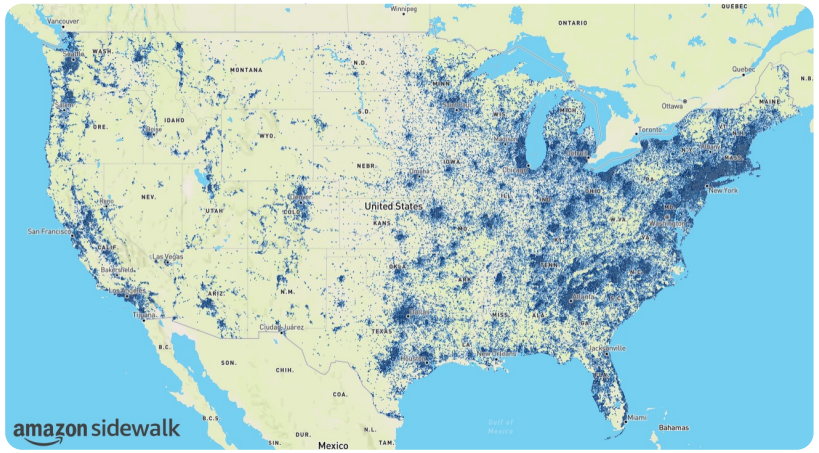
What is Private 5G

Nation Wide Coverage

Native support for AWS

Crowd Sourced Network

Operated by Amazon



Source – www.amazon.com

Topology
STAR

Coverage
Nationwide

Data Rate
Up to 50 kbps

Long Range
Link Budget ~150 dB

Mobility Support
Yes

Amazon Sidewalk Technology

- **Frequency Bands - License free ISM Bands**
  - 900 MHz Band in US
  - Frequency Hopping
- **Modulation**
  - BLE – Provisioning, OTA & short-range data
  - FSK – Reliable, Unicast & Synchronous
  - CSS – Unreliable, Broadcast & Asynchronous
- **Data Rate**
  - 1 Mbps (BLE), 50 Kbps (FSK), 2 Kbps (CSS)
- **Max Payload**
  - 255 Bytes (FSK), 64 Bytes (CSS)

Model

- **Private networks**
- **No subscription required**

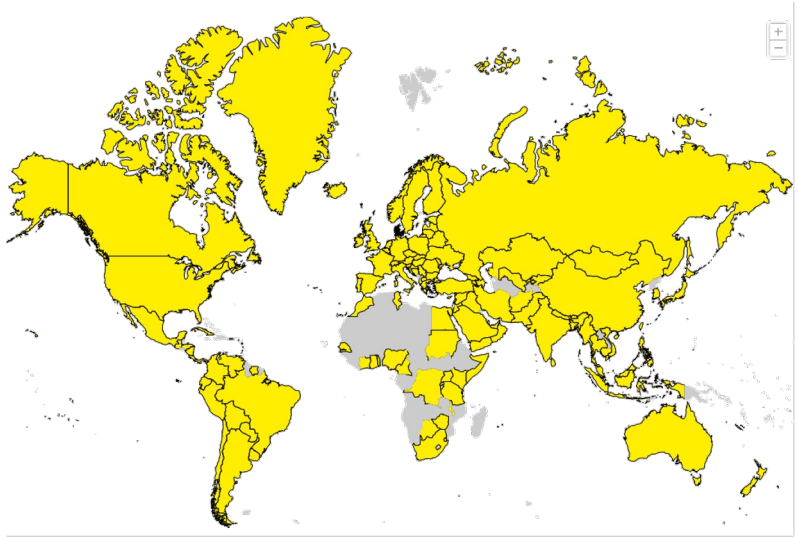
LoRa WAN

156+
Network Operators

LoRa
Developed by Semtech

170+
Countries

LoRaWAN
LoRA Alliance



Source – https://lora-alliance.org/
June 2022

Topology
Star

Global Coverage

LoRa Max Data Rate
12 kbps(UL)
21 kbps (DL)

Long Range
Link Budget 150+ dB

Native IP Support
No

LoRa®

LoRa Technology

- Frequency Bands - License free ISM Bands
- Bandwidth – 125/500 KHz
- Modulation - Chirp Spread Spectrum (CSS)
- Max Payload – 242 Bytes

Model

- Customers can use available public network
- Customers can deploy their own private network
- No subscription needed

What is Wi-SUN

300+
Members

100+
Million Devices

46
Countries

Wi-SUN Alliance

Source – https://wi-sun.org/

Topology
Mesh & STAR

Global Coverage

Data Rate
50 kbps – 2.4 Mbps

Battery Operation
Yes

IP to the end node
Yes

Wi-SUN Technology

- **IEEE 802.15.4g PHYs**
  - FSK & OFDM modulations, Multiple Data Rates
- **IEEE 80215.4e MAC**
  - Frequency Hopping and Mode switching
- **IPv6, UDP and TCP**
  - 6LoWPAN and RPL routing
- **Mandatory Security**
  - Public key infrastructure (PKI), AES, certificates

Model

- **Customers can deploy their own private network**
- **No subscription needed**

Z-Wave Long Range

Z-Wave Alliance

4000+
Certified Products

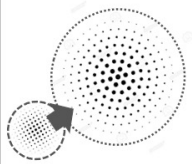
Largest sub-GHz ecosystem

100+
Million Devices

Coverage

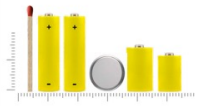
1 Mile Range

Scalability



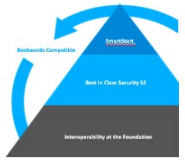
4000 Nodes

Coin Cell Operation



10 Years

Simple, Secure & Interoperable



Backward Compatible

Topology
Star

Global Coverage

Data Rate
100 Kbps

Battery Operation
Yes

Native IP Support
No

Z-Wave Long Range Technology

- DSSS-OQPSK Modulation
- 900 MHz and 800 MHz bands
- Up to 4000 nodes per Gateway
- Dynamic TX power control for longer battery life
- SmartSTART for easy commissioning
- S2 Security

Model

- Customers can deploy their own private network
- No subscription needed

High Level Comparison of LPWAN

	Wi SUN	Z-WAVE	LoRa	amazon sidewalk	5G Private NB-IoT/LTE-M
Native IP Support	Yes	No	No	No	Yes
Standard Based	Yes	Yes	LoRa – No LoRa WAN - Yes	No	Yes
Frequency Band	Sub-GHz & 2.4 GHz License Free ISM	Sub-GHz License Free ISM	Sub-GHz License Free ISM	Sub-GHz & 2.4 GHz License Free ISM	Licensed/Private
Max Throughput	2400 Kbps	100 Kbps	22 Kbps	50 Kbps	1000 Kbps
Network Topology	MESH	STAR	STAR	STAR	STAR

How do you select the right LPWAN

amazon sidewalk

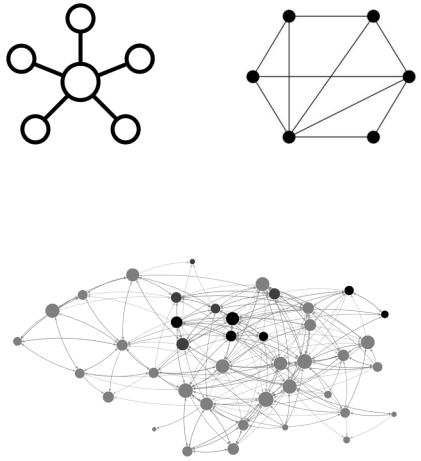
Z-WAVE PLUS LR

Wi SUN

LoRaWAN®

WHICH ECOSYSTEM YOU WANT TO PARTICIPATE ?

WHAT ARE YOUR APPLICATION REQUIREMENTS



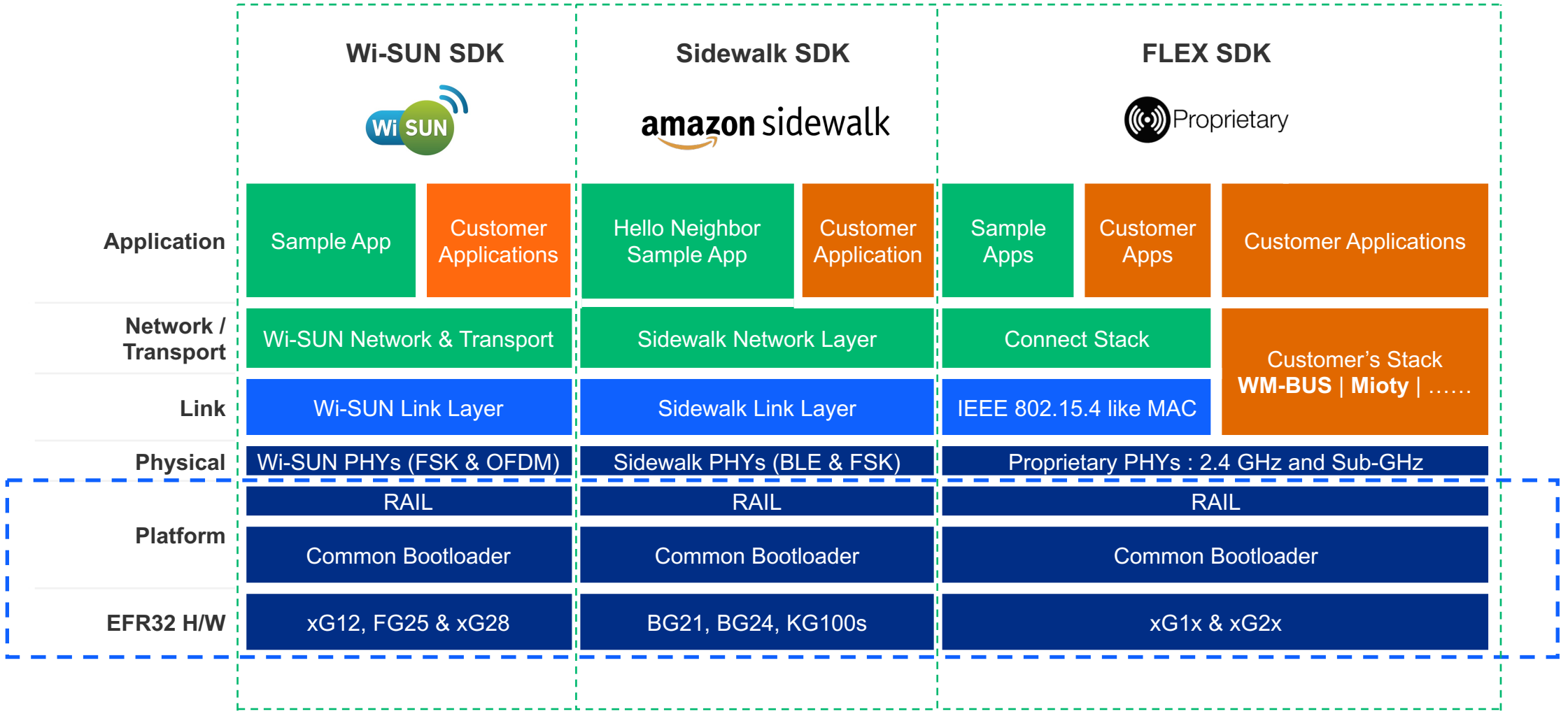
WHAT ARE YOUR NETWORK REQUIREMENTS ?

There is no silver bullet. Selection comes down to ecosystem, application, network and several other factors

Silicon Labs LPWAN Offerings

	Hardware	Stack/API	Partnership
Wi-SUN	Yes	Stack	N/A
Amazon Sidewalk	Yes	Stack	Amazon
Z-Wave Long Range	Yes	Yes	N/A
WM-BUS	Yes	Stack	Stackforce
MIOTY	Yes	No	MIOTY/Fraunhofer
Proprietary	Yes	FLEX SDK, CONNECT Stack	N/A

A Common Platform for all LPWAN solutions



Additional Resources

Wi-SUN	https://www.silabs.com/wireless/wi-sun
Amazon Sidewalk	https://www.silabs.com/ecosystems/extend-iot-device-range-with-amazon-sidewalk
Z-Wave Long Range	https://www.silabs.com/wireless/z-wave
Proprietary	https://www.silabs.com/wireless/proprietary

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Q&A