LR101

Emerging Trends and Protocols in LPWAN

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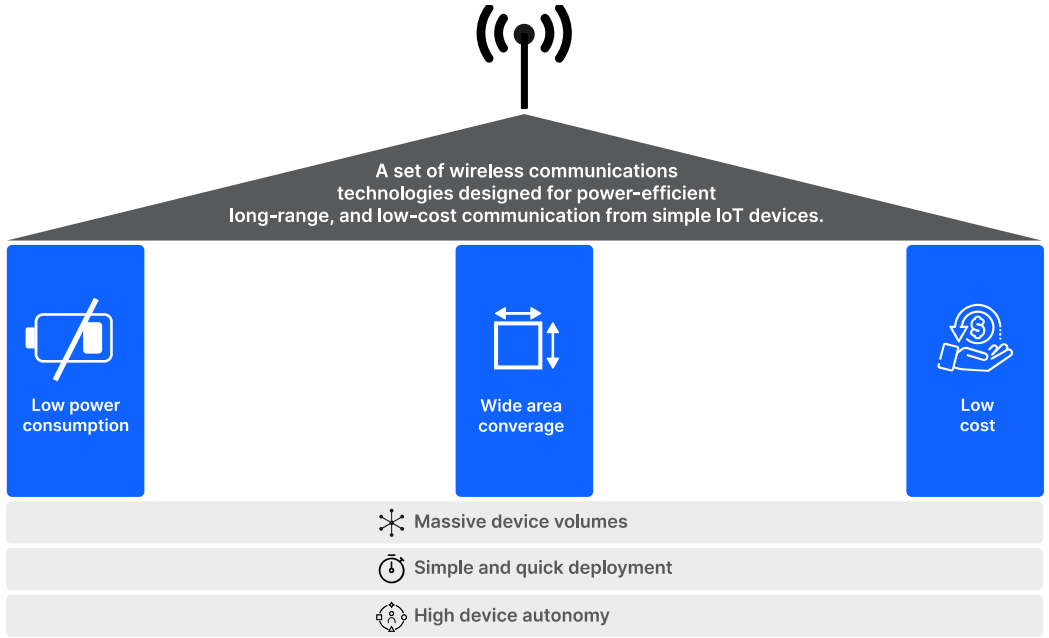
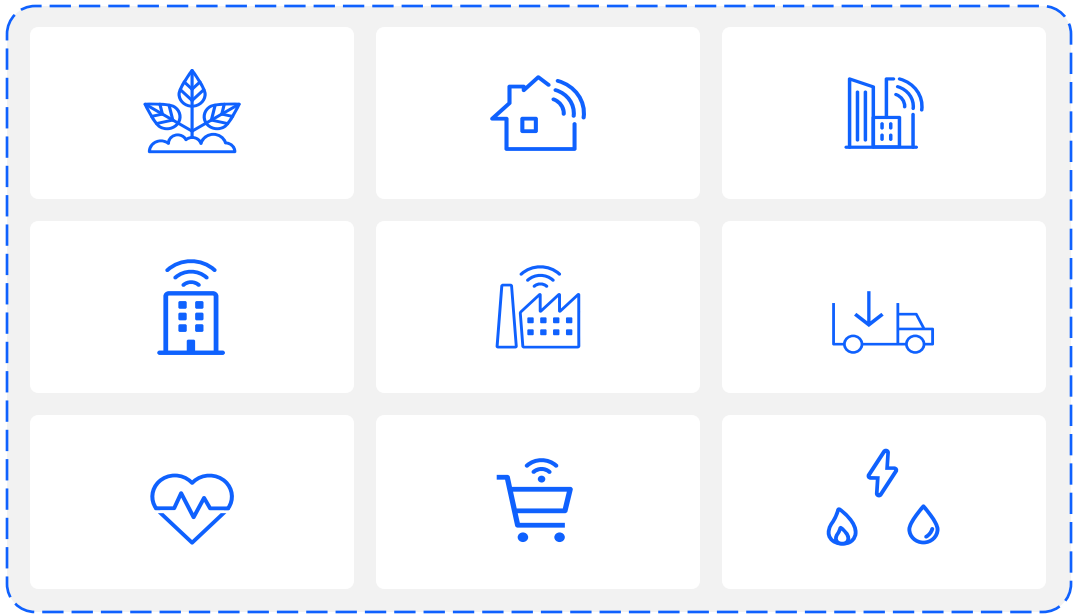
LPWAN Overview



Definition

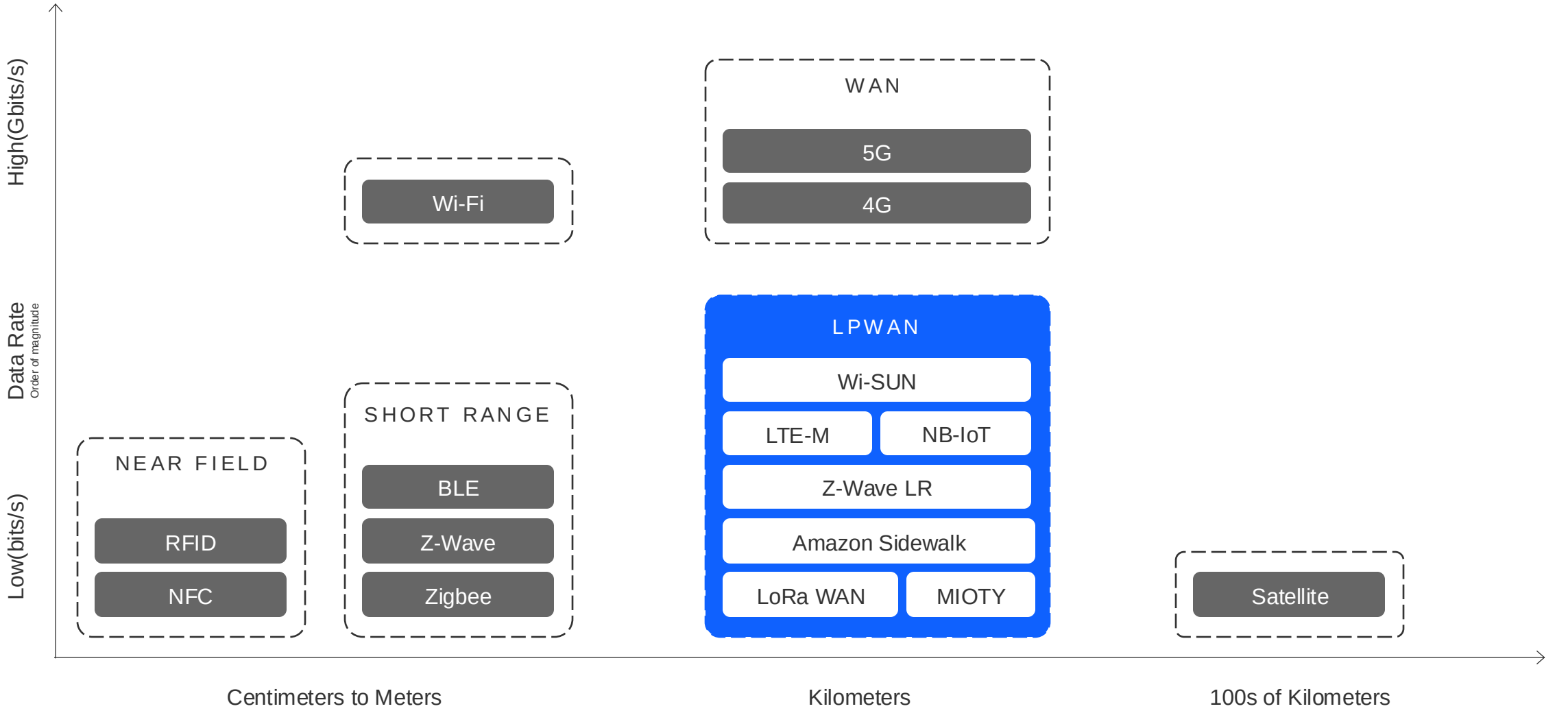
Low-power wide-area networks (LPWANs or LPWA networks) are a set of wireless communication technologies designed for power-efficient, long-range, and low-cost communication from simple IoT devices.



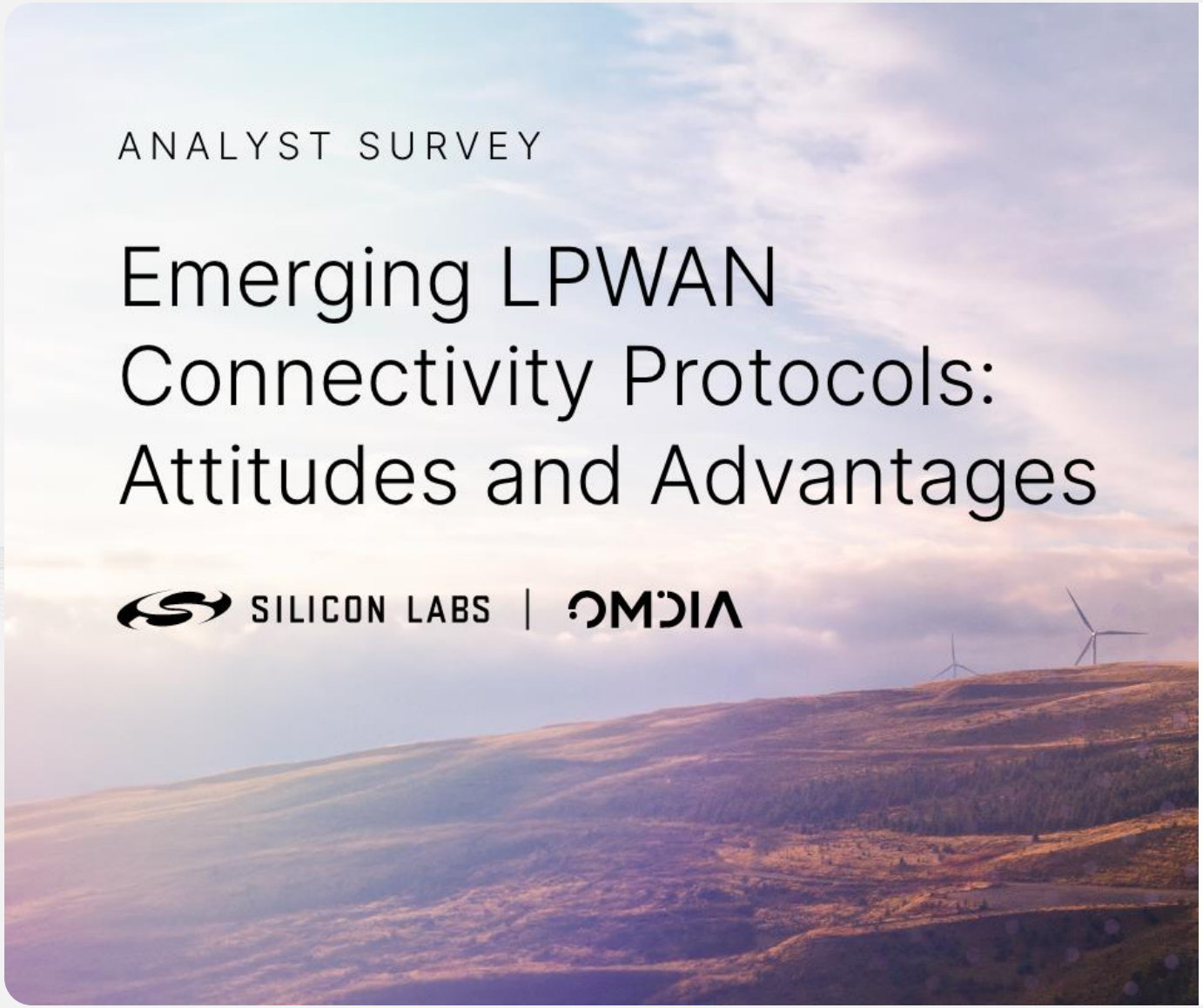
LPWAN Applications

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.

LPWAN Positioning



Omdia LPWAN Research



Silicon Labs coordinated with Omdia in 2023 for an LPWAN research report

- Globally focused with samples taken across multiple application areas

Focused on topics that are critical to LPWAN selection

- Networks being used
- Roadblocks in deployment
- Key considerations

Three main take aways:

- Picking right network is biggest concern of developers
- Security continues to be a concern across region and application
- Developer support is key consideration when selecting protocol and platform

How do you select the right LPWAN?

amazon sidewalk

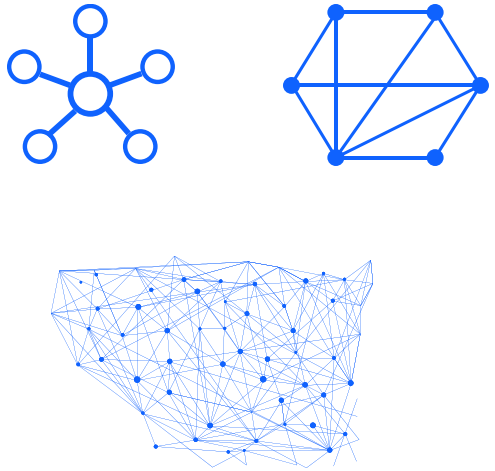
Z-WAVE PLUS LR

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

Standards Based vs Proprietary

Standards-Based LPWAN Solutions

Examples: Wi-SUN, Z-Wave, Cellular, LoRaWAN

Typically governed by alliances or member groups

- Interest in the growth of the solution and ensuring needs of key applications or markets are met

Ensure multi-vendor interoperability

- Typically done through certification programs

Great for large scale networks that need to serve many different applications

- Establish connectivity backbone and provide platform for expansion

Not always optimized for all applications

- Compromises need to be made for interoperability or other overriding concerns

Proprietary LPWAN Solutions

Example: Wirepas, Amazon Sidewalk

Usually managed and supported by a single entity

- May require licensing fee to get support and deploy

Typically optimized for single use case

- May have different stacks to support different applications

Interoperability limited depending on owner / developer of the protocol

- Can decided to keep things completely private or to open network to approved third parties

Can provide elevated levels of security

- Key network parameters can be kept private in order to maintain network and device level security

Growing needs for interoperability

Higher cost equipment is building out backbone of municipal LPWAN networks

- Streetlights, electric meters, and other line powered devices make up majority of existing LPWAN use cases

Allows for faster ROI for entities responsible for deployment of networks

- Looking to expand use cases and allow other devices on formerly private networks
- Allows for service fee model to help recoup costs by allowing third party devices on networks

Enabling expansion of LPWAN connectivity into lower cost and low power nodes

- Gas meters, water meters, and environmental sensors are most frequently brought up first

Multi-vendor interoperability is critical to this growth

- Network accessibility and reliability are now being added at SLA level to guarantee performance

Interoperability Models

Standards-Based LPWAN Solutions

Interoperability is greatly simplified

- Standard compliance ensures network level interoperability
- Application-level interoperability typically left up to developers

Certification process typically defines standard level of interoperability

- All solutions must function together at a minimum acceptable level

Can be changed as applications and standard evolves

- Changes can affect backward compatibility

Examples:

- Wi-SUN
  - Has standard certification process including certified test bed units for checks of stack and application
  - Ensures backward compatibility across versions of standard
- Cellular
  - Spectrum licensed by carriers who manage interoperability
  - Typically, older versions are sunset as newer versions emerge leading to potential orphaning of devices

Proprietary LPWAN Solutions

Interoperability can be limited depending on proprietary solution

- Some take “walled garden” approach only allowing single manufacturer networks while others work to ensure multi-vendor compatibility

Certification can be network dependent

- Networks like Amazon Sidewalk have very strict certification process while others may not have any

Examples:

- Wirepas
  - Stack ownership by Wirepas ensures compatibility between devices
- Amazon Sidewalk
  - Has very strict interoperability and certification program in place to ensure network “just works”
- Homegrown Standard
  - Can limit interoperability by design and be optimized for very specific applications or use models
  - Interoperability dependent on inclusion of partners into ecosystem

Evolving Security Landscape

Emergence of multi-vendor and mission critical applications is increasing visibility in LPWAN security

- Expansion of networks and inclusion of third parties raises potential security risks

Sub-GHz spectrum has some security advantages

- Network exploitation tools are not as readily available as they are for more prevalent technologies

Different network solutions take different approaches to solve the security issue

- Wi-SUN
  - Inclusion of standard IEEE 802.15.4 security along with certificate-based authentication
- Amazon Sidewalk
  - Very robust security built into network with public / private encryption used from device transmission to decryption at end destination
- Wirepas
  - Security at the heart of stack with the inclusion of secure device provisioning, network level security, and secure OTA

Protocol Overviews

Wi-SUN

Architecture:

- Centralized Routing Mesh

Support Model:

- Silicon Labs provided certified PHYs, stacks, and reference designs
- Certified Test Bed Units (FG25, FG28)

Security:

- Inclusion of standard IEEE 802.15.4 security along with certificate-based authentication

Supported EFR Families

- FG25
  - OFDM and FSK PHYs
  - Support for Concurrent Detection and Mode Switch
- FG28
  - FSK PHYs
  - Support for Mode Switch

What is Wi-SUN FAN 1.1?

FAN 1.1 is an extension of FAN 1.0 to address higher data rates and low power nodes

- Builds off features already established with FAN 1.0

Establishes different paths for certification with optional features depending on node type

- FAN 1.1 Core
  - Builds on FAN 1.0 and needed to support all FAN 1.1 devices
- FAN 1.1 High Performance
  - Adds SUN OFDM PHYs
  - Introduces Mode Switch Functionality
- FAN 1.1 Low Energy
  - Introduces Limited Function Nodes (LFN)

Wirepas

Architecture:

- Decentralized Mesh

Support Model:

- Hardware supported by Silicon Labs
- Software and Device Management support provided by Wirepas

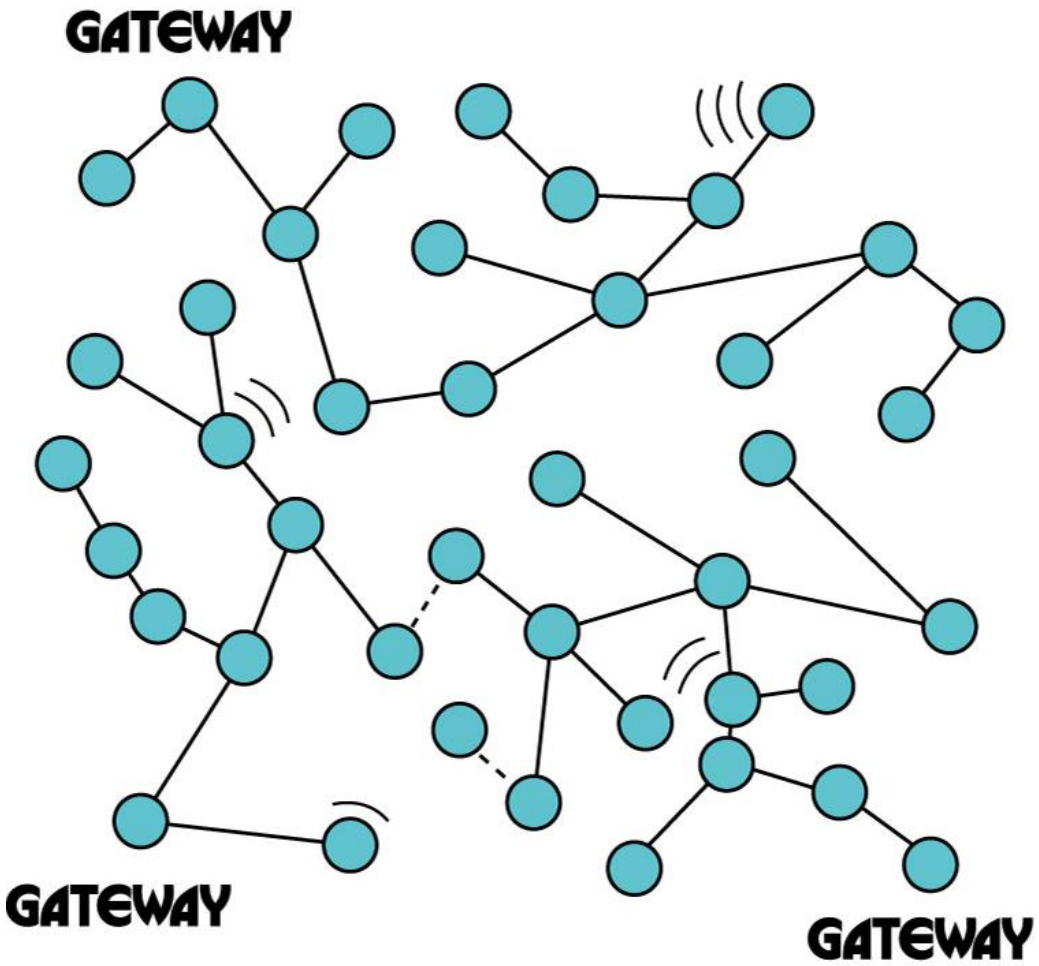
Security:

- AES128 Encryption with OMAC1 Integrity Verification

Supported EFR Families

- FG23
  - Sub-GHz stack only
- MG24
  - 2.4 GHz stack only

Wirepas - A Proprietary RF Mesh



Decentralized operation:

- Any device can be a router at any time

Short time on Air:

- Use high radio data rate to minimize time on air
- Enables less collisions for high density and high reliability

Locally synchronized point to point communication:

- Nodes connect via locally synchronized channels on a specific time slot(FDMA+TDMA)
- Best channel selection

Adaptive Transmit Power:

- Local and automatic power adjustment
- Maximize spectrum usage for high density

Z-Wave

Architecture:

- Centralized Routing Mesh with extended star for Z-Wave LR

Support Model:

- Silicon Labs provided certified PHYs, stacks, and reference designs
- Border Router reference designs and software
  - Unify Z-Wave controller
  - Unify Z-Wave to Matter bridge

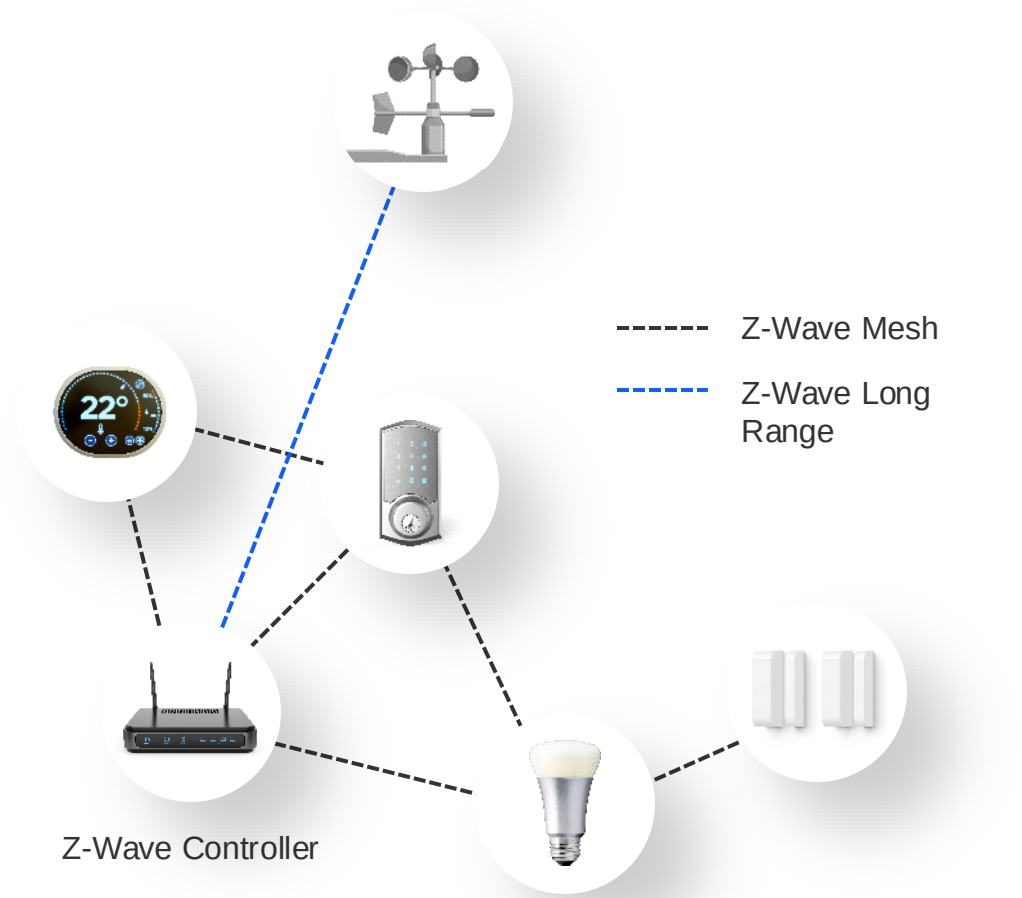
Security:

- Z-Wave S2 Security including SmartStart

Supported EFR Families

- ZG23
  - Including ZGM230S
- ZG28

Z-Wave 800 – Wireless Highlights



Mesh Network Topology

100 kbps
data rate
+0/14 dBm TX power

400 m
range (4 hops)
Coverage for the smart home and end of yard

200+ nodes
scalable
8-bit address space

Star Network Topology

100 kbps
data rate
Up to +30 dBm TX power

~1.5 Mile
range
Coverage for the whole home, yard, and beyond without a repeater

4000 nodes
highly scalable
12-bit address space

Amazon Sidewalk

Architecture:

- Distributed star network using Amazon devices as gateways

Support Model:

- Silicon Labs provided certified PHYs, stacks, and reference designs

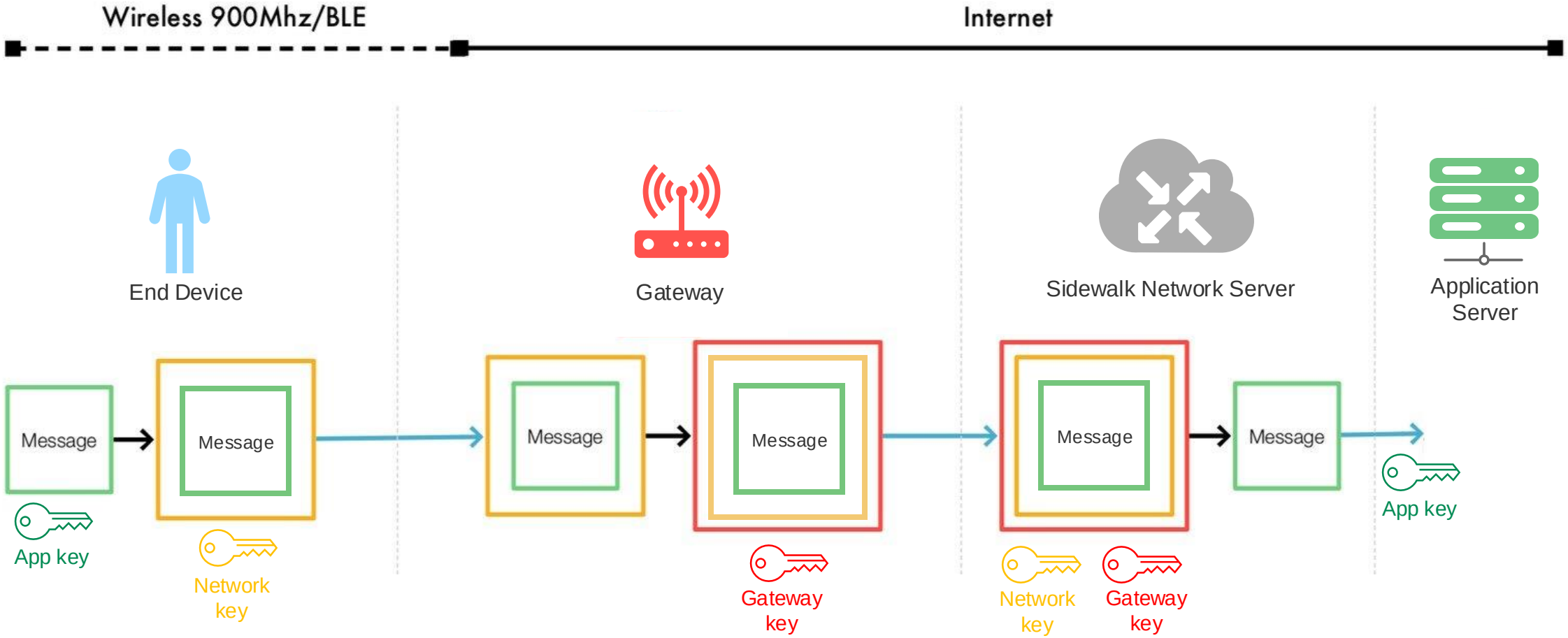
Security:

- Sidewalk specific security scheme involving public and private keys
- End to end encryption from device to cloud

Supported EFR Families

- SG23
  - FSK PHY Only
- SG28
  - FSK and Bluetooth LE PHYs

End-to-End Security



EFR32: Flexible Platform for LPWAN Applications

Chipset selection is crucial for protocol flexibility and future proofing

- Ability to select protocol at program or run time creates design flexibility

Multi-protocol use cases growing throughout IoT world

- Need to exist in multiple ecosystems or to create differentiated user experiences

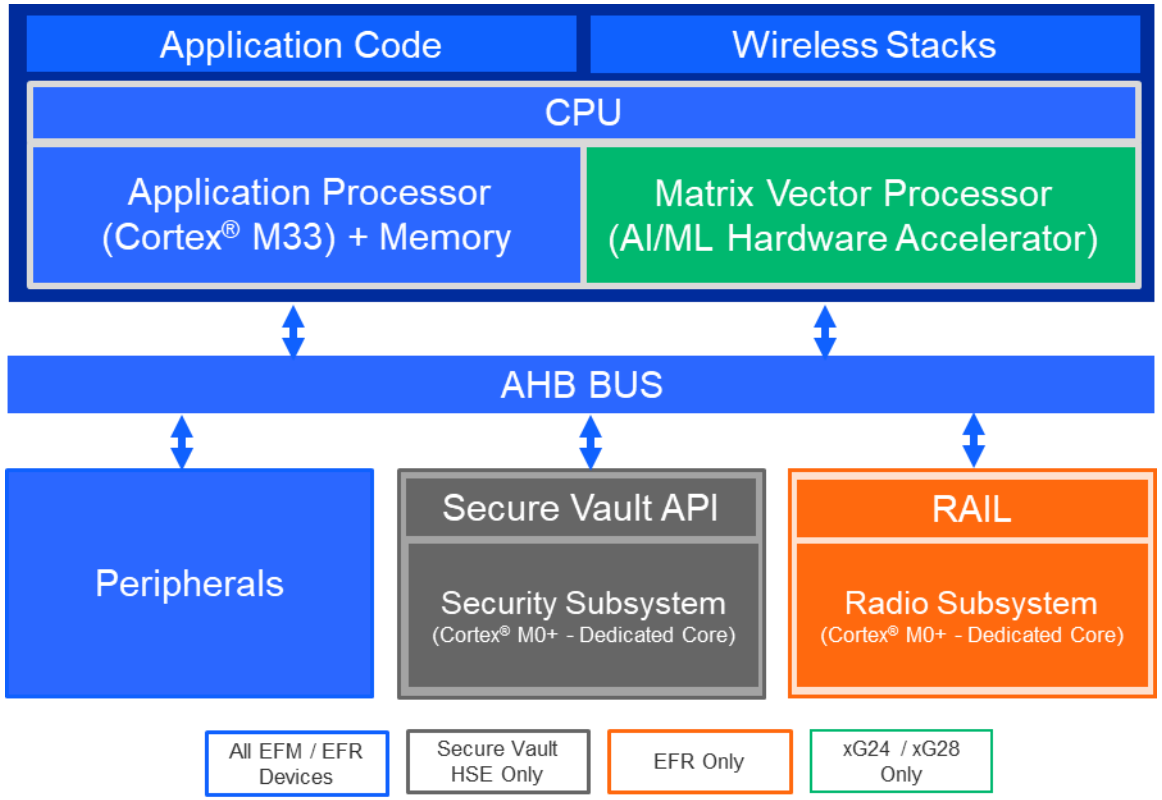
Growing need for development simplification

- Multiple code and footprint compatible options for Sub-GHz and 2.4GHz protocols

Common AI/ML and Security Subsystems simplify overall application development

- Can have leverage common algorithms or security schemes for reuse across product portfolio

Multi-Core, Low Power Architecture



1- EFR32 devices only 2- Secure Vault Hardware Secure Element (HSE) Only

Multi-core architecture gives design flexibility and optimization across EFM and EFR platforms

- Dedicated application, radio[1], and security[2] cores share system burden for better resource utilization

Common development platform for connected and non-connected products

- Simplicity Studio gives developers a common development platform for entire product portfolio

Footprint and firmware compatibility between EFM and EFR families

- Simplified SKU management and code base development lowers development cost and complexity

	BG	MG	FG	ZG	SG	PG
xG21	✓	✓				
xG22	✓	✓				✓
xG23			✓	✓	✓	✓
xG24	✓	✓				
xG25			✓			
xG26	✓	✓				✓
xG27	✓	✓				✓
xG28			✓	✓	✓	✓
	EFR Device Families					EFM

Supported Protocols and Modulations

		xG22	xG23	FG25	xG28
Supported Protocols	Amazon Sidewalk		✓ (FSK Only)		✓ (Bluetooth LE and FSK)
	Wi-SUN			✓	✓ (FSK Only)
	Proprietary	✓	✓	✓	✓
	Wireless M-BUS		✓		✓
	Bluetooth	✓			✓
	Wirepas		✓		
	Mioty		✓		✓
	Z-Wave		✓		✓
	CONNECT	✓	✓	✓	✓
Supported Modulations	MR-OFDM			✓	
	(DSSS)-OQPSK	✓	✓		✓
	(G)MSK	✓	✓	✓	✓
	2/4(G)FSK	✓	✓	✓	✓
	OOK/ASK		✓		✓
	MR-OQPSK			✓	

Standardization and Simplification for LPWAN Applications

No silver bullet solution for long range wireless

- Ecosystem, application, and network requirements help narrow down network selection

Interoperability is driving growth and application expansion

- Standardization of networks and management tools enables multi-vendor, multi-application networks

Security is becoming a growing concern for sub-GHz networks

- Addition of mission critical applications to previously private networks is raising profile of network security

Chipset and platform standardization can improve code re-use and shorten development cycles

- Firmware compatibility and common sub-system architecture simplifies development process

Q & A