Presentation Will Begin Shortly

4:00

LPWAN

FEB 8TH | LPWAN 101 - A look at the Emerging LPWAN Solutions and the Applications They Serve

MAR 14TH | Wi-SUN FAN 1.1 Rollout

APR 18TH | Amazon Sidewalk – New Features and Market Applications
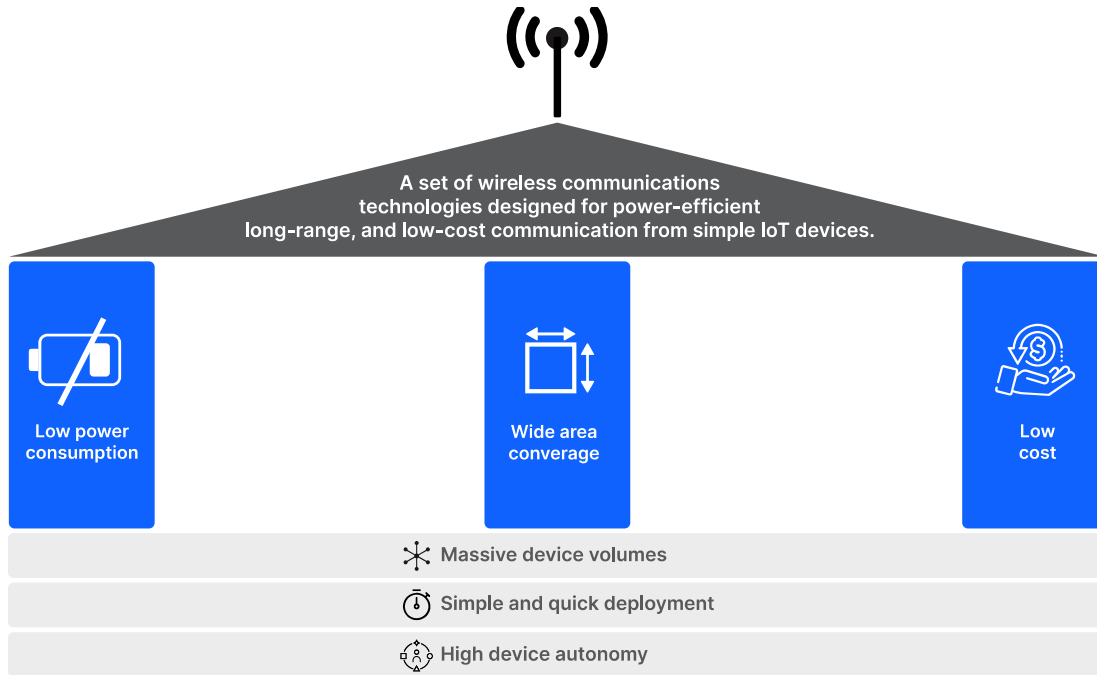
MAY 23RD | Why Sub-GHz?

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Agenda

8 Feb 2024

- **Introduction to LPWAN**
- **Omdia LPWAN Research**
  - Selecting the right LPWAN
  - Security
  - Support
- **Emerging LPWAN Applications**
  - Smart City Evolution
  - Building and Logistics Management
  - Smart Agriculture
- **Summary**

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What is LPWAN and What applications are served by LPWANs

A set of wireless communications technologies designed for power-efficient long-range, and low-cost communication from simple IoT devices.

Low power consumption

Wide area converage

Low cost

※ Massive device volumes

⏱ Simple and quick deployment
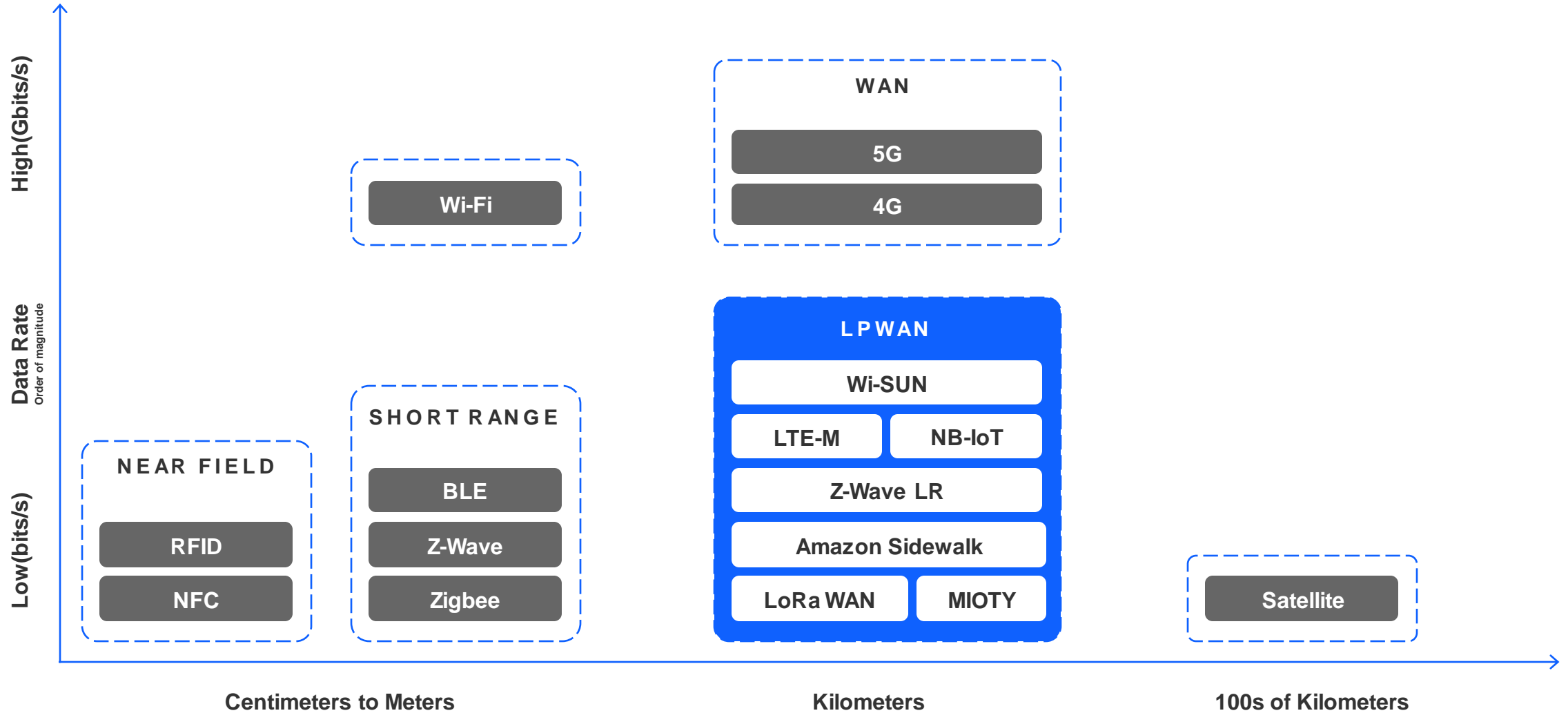
High device autonomy

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.
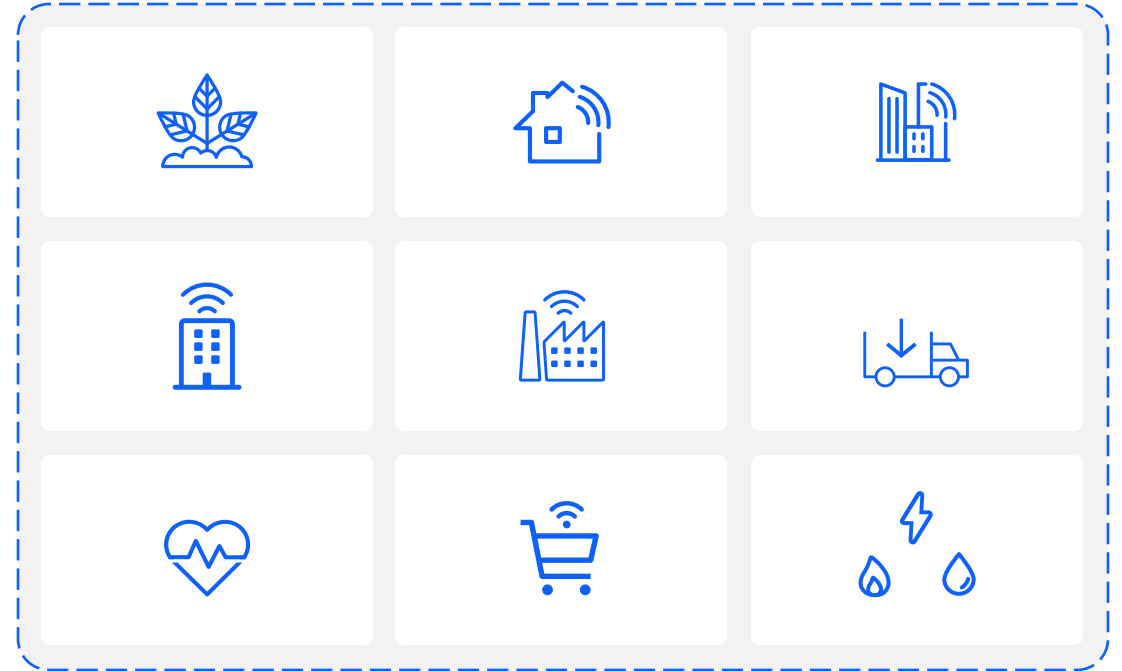
LPWAN Applications

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.

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LPWAN Positioning

Data Rate (Order of magnitude) — vertical axis: Low(bits/s) to High(Gbits/s)

Horizontal axis: Centimeters to Meters — Kilometers — 100s of Kilometers

WAN
- 5G
- 4G

Wi-Fi

LPWAN
- Wi-SUN
- LTE-M | NB-IoT
- Z-Wave LR
- Amazon Sidewalk
- LoRa WAN | MIOTY

NEAR FIELD
- RFID
- NFC

SHORT RANGE
- BLE
- Z-Wave
- Zigbee

Satellite

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Omdia LPWAN Research

ANALYST SURVEY

Emerging LPWAN Connectivity Protocols: Attitudes and Advantages

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- **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

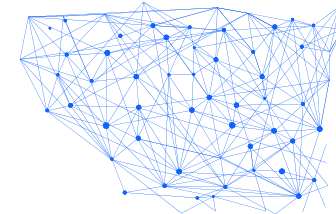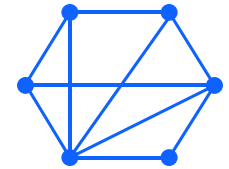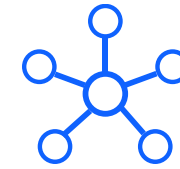SILICON LABS

How do you select the right LPWAN?

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

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Standards Based vs Proprietary

Standards-Based LPWAN Solutions

- **Examples: Wi-SUN, MIOTY, 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

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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

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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

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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

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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			✓	

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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
  - Proprietary
    - Truly proprietary networks can have security advantages due to private nature

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Support Models

- **Support models are different depending on network and chipset selection**
  - Structure can vary greatly from vendor to vendor or even within single vendor
  - Finding the best support model for you can be critical to the success of your development
- **Tools play a major part in overall support model**
  - Look for tools that simplify network evaluation and troubleshooting
  - Make sure you understand what is going to help simplify your overall development process
- **Code compatibility is critical to design success**
  - Allows you to focus on your application development and carry across multiple protocols and IC platforms

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Integrated Support vs Combined Support

Integrated Support

- **All aspects of IC and wireless design supported by chipset supplier**
  - Creates single path of support for any design challenges or issues
- **Creates tighter relationship between designer and support team**
  - Allows for deeper knowledge share between partners
- **Silicon Labs Example: Wi-SUN**
  - Silicon Labs provides stack, wireless SoC, and all design support
  - Complete hardware and software reference designs for multiple node types and platforms
  - Certified stack and PHYs along with certified test bed unit simplifies end device certification process

Combined Support

- **Support typically provided by both wireless stack provider and SoC supplier**
  - Wireless SoC supplier supports SoC and hardware design
  - Software and stack support provided by stack supplier
- **Relationship between stack provider and SoC supplier can be critical to success of engagement**
  - Lack of familiarity can create unnecessary complications or roadblocks for developers
- **Silicon Labs Example: Wirepas**
  - Wirepas provides customers with SDK that includes support for Silicon Labs devices
  - Silicon Labs works with developers for hardware or SoC specific issues
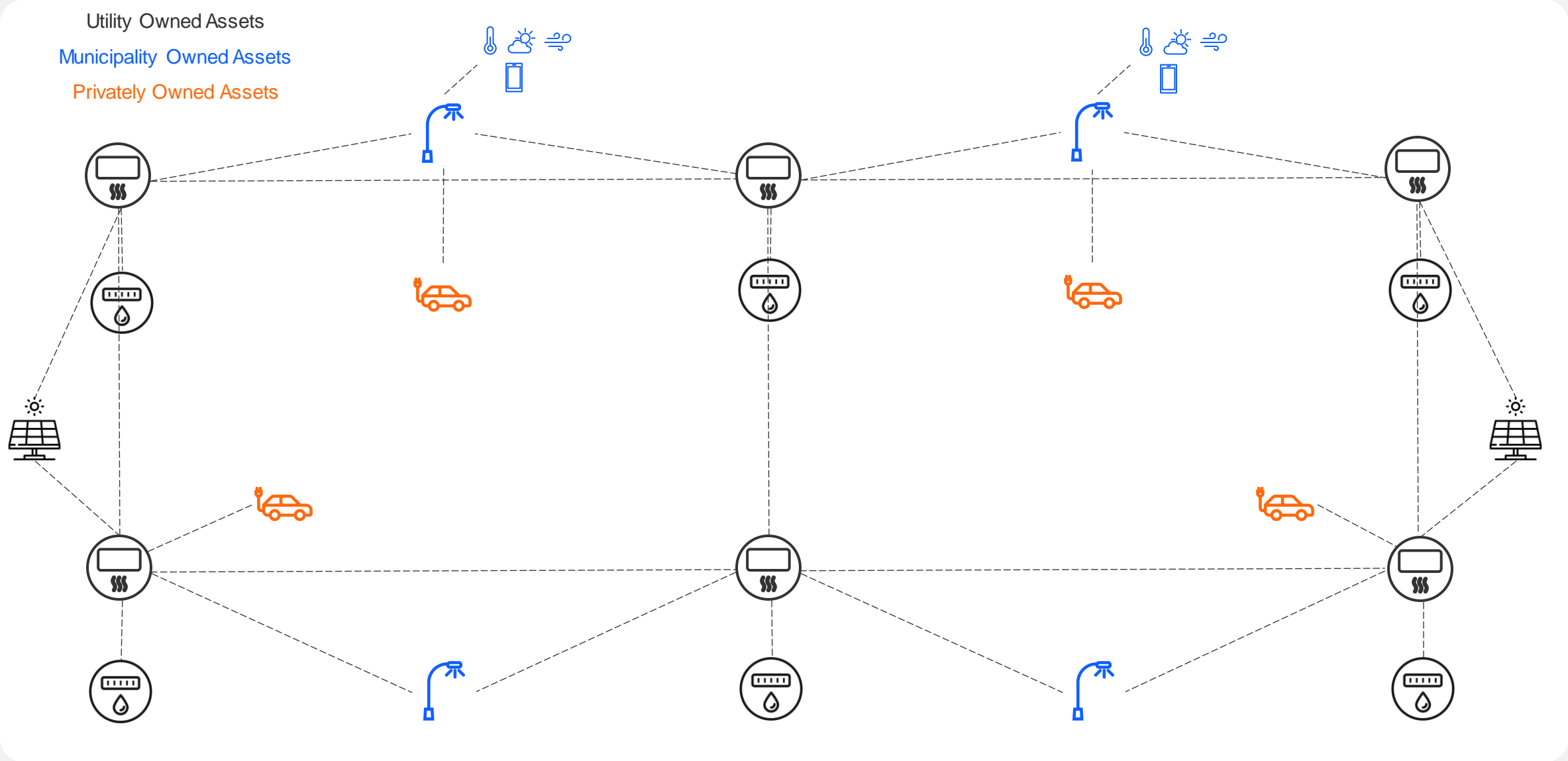 - Silicon Labs and Wirepas work to ensure reliability of Wirepas SDK and stack combination

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Q&A

LPWAN

LPWAN Applications

Smart City LPWAN Progression

Utility Owned Assets

Municipality Owned Assets

Privately Owned Assets

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Recommended Smart City Protocols

	Wi-SUN	Wirepas	Mioty	Proprietary
Architecture:	Centralized Routing Mesh	Distributed Mesh	Star only	User selected
Support Model:	Integrated	Combined (Wirepas)	Combined (Fraunhofer IIS)	Integrated
Security:	IEEE 802.15.4 + Certificates	Secure Provisioning Secure OTA	AES-128 for data protection and integrity check, bulk/per-device basis provisioning	User selected
Supported EFR Families:	FG25 (FSK + OFDM), FG28	FG23, MG24	FG23, FGM230S, FG28*	xG22, FG23, FG25, xG28
Value Proposition:	Alliance Governed	Small memory footprint	Very small memory footprint	Can be very application specific
	Backward Compatible	Sub-GHz and 2.4GHz support	Alliance Governed	High levels of security due to proprietary nature
	High throughput and low power use case support	Distributed mesh for simplified network infrastructure	Scalable and resilient to other sub-GHz communication	Multiple topology options
	Robust certification program	Great support for high density networks	Low data rate, low power, long range (deep indoor/hard to reach) applications	
	Network level interoperability	Low latency	Low network TCO	

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Logistics / Warehouse Management


```
EFR32FG2x
SoC
Battery →
    Customer
    Application        Garage
    Wireless           Door
    Stack              Controller
    RAIL
    Power Amp
    (PA)                    RF
    BALUN
```

DESIGN CONSIDERATIONS

- Robust Connectivity to meet SLA requirements
- Environmental Conditions
- Security
- Total System Cost
- Long Range
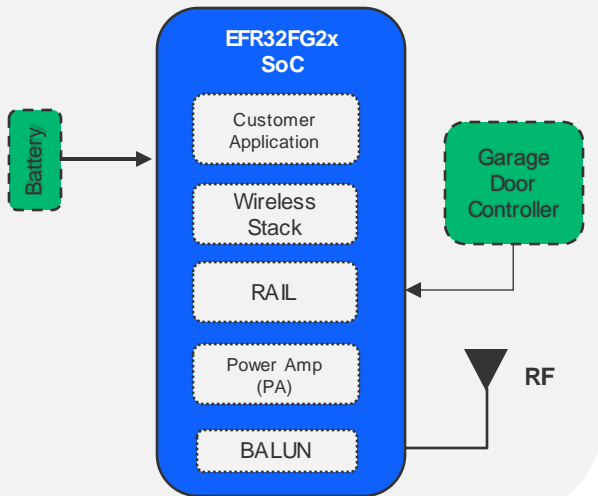- Scalability

HARDWARE SOLUTIONS

- **xG23**
  - Superior RF Performance (Link budget of ~146 dB)
  - Lower cost BOM with integrated DC/DC power supply, PA and BALUN
  - Low power consumption via Preamble Sense Mode, LESENSE
  - Can operate temperatures up to +125 °C
  - Secure Vault™ (certified PSA Level 3)
- **xG28**
  - High GPIO count (49)
  - Superior RF Performance (Link budget of ~146 dB)
  - AI/ML Accelerator for battery power consumption
  - Suitable for Wi-SUN battery-powered LFN nodes
  - Dual band support (Sub-GHz, 2.4GHz BLE)

1 – FG28 PHY certification scheduled to be completed in 23Q4

RECOMMENDED PROTOCOLS

- **Wi-SUN**
  - Low Energy Nodes added with FAN 1.1
  - Network Backbone provided by line powered devices
- **Amazon Sidewalk**
  - Easy to deploy and scale
  - Low maintenance cost
- **Wirepas**
  - High node density
 - Distributed mesh architecture limits gateway needs

SOFTWARE SOLUTIONS

- **Wi-SUN (FG28)**
  - Certified stack
  - Certified PHYs[1]
  - Complete integration into GSDK
  - Reference designs for all node types
- **Amazon Sidewalk**
  - Completely integrated Amazon Sidewalk SDK into GSDK
  - Optimized out of box experience for quick time to market
- **Wirepas**
  - Close relationship with Wirepas and proven reliability
  - Support on multiple wireless SoC platforms

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Legacy Wire Replacement
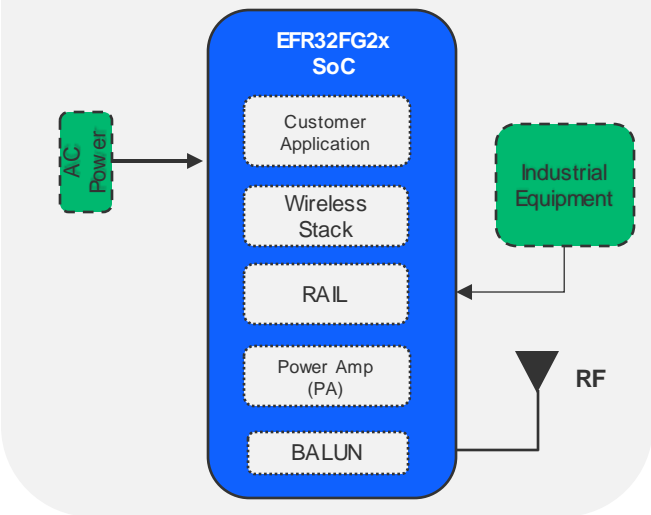
DESIGN CONSIDERATIONS

- Robust Connectivity to meet SLA requirements
- High Throughput
- Security
- Total System Cost
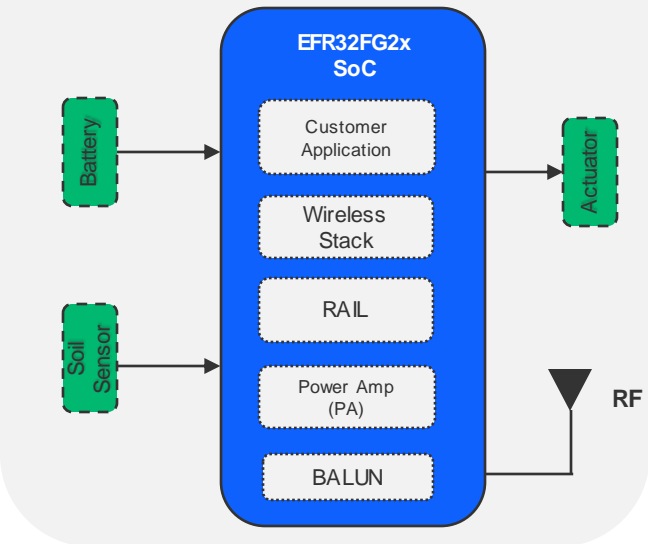- Scalability

RECOMMENDED PROTOCOLS

- **Proprietary**
  - Leverage standard PHYs for higher throughput
  - Close control over ecosystem to maintain IP and security

HARDWARE SOLUTIONS

- **FG25**
  - Superior RF Performance (Link budget of ~146 dB)
  - Lower cost BOM with integrated DC/DC power supply, PA and BALUN
  - Higher throughput with OFDM MCS7 support
  - Can operate temperatures up to +125 °C
  - Secure Vault™ (certified PSA Level 3)

SOFTWARE SOLUTIONS

- **Proprietary**
  - Support for complete PHY and protocol customization with CONNECT stack or RAIL implementations
  - Radio configurator and network analyzer tools to simplify network development and analysis
- **Silicon Labs CONNECT**
  - Simplified way to develop proprietary networks
  - Point to point, star and extended star configurations available
  - 15.4 based MAC layer in MAC mode
  - Lightweight and flexible stack up to the network layer

EFR32FG2x SoC

AC Power → Customer Application

Wireless Stack

RAIL

Power Amp (PA)

BALUN

Industrial Equipment

RF

1 – FG28 PHY certification scheduled to be completed in 23Q4

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Smart Irrigation and Soil Monitoring

EFR32FG2x SoC

- Battery
- Soil Sensor
- Customer Application
- Wireless Stack
- RAIL
- Power Amp (PA)
- BALUN
- Actuator
- RF

DESIGN CONSIDERATIONS

- Range
- Real time monitoring
- Battery Life
- AI / ML at the edge
- Environmental conditions
- Security

RECOMMENDED PROTOCOLS

- **Wi-SUN**
  - Self forming / Self healing mesh topology
  - Interoperability for integration of multiple systems
- **Mioty**
  - Very long point to point range
  - Low power modes to greatly extend battery life
- **Z-Wave Long Range**
  - Very long point to point range
  - Proven deployed ecosystem

HARDWARE SOLUTIONS

- **FG23 / FGM230S**
  - Superior RF Performance (Link budget of ~146 dB)
  - Lower cost BOM with integrated DC/DC power supply, PA and BALUN
  - Output power options to +20 dBm
  - Small form factor SiP module for 868 and 915MHz bands
- **FG28**
  - High GPIO count (49)
  - Superior RF Performance (Link budget of ~146 dB)
  - AI/ML Accelerator for battery power consumption
  - Suitable for Wi-SUN battery-powered LFN nodes
  - Dual band support (Sub-G, 2.4G BLE)

SOFTWARE SOLUTIONS

- **Wi-SUN (FG28)**
  - Certified stack
  - Certified PHYs
  - Integration into GSDK
  - Reference designs for all node types
- **Z-Wave (ZG28)**
  - Simplified development process with integrated SDKs
  - Certified SoCs and Modules
- **Mioty (FG23/FGM230S)**
  - Support for multiple device classes and communication profiles
  - Close partnership with Fraunhofer IIS for optimized combined support model

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Summary

- **LPWAN implementations are changing**
  - Market is seeing some key use cases moving from proprietary to standards-based solutions
  - Formerly closed ecosystems are opening to allow for inclusions of multiple vendors and expanded applications
- **No silver bullet LPWAN solution**
  - No LPWAN option can address all needs of the market today
  - Must make compromises depending on ecosystem, application, and network requirements
- **Chipset platform is critical to ensuring product flexibility**
  - Platforms with protocol flexibility can minimize risk to product success
  - Code reuse lowers overall product development burden and creates simplicity

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Q&A

LPWAN

Thank You

Watch ▶ON DEMAND