LR-101

Introduction to Long Range IoT Protocols

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LPWAN introduction

Low Power Wide Area Network are Wireless Technologies designed for:

- Low Power Usage
- Long Range Communication
- Low Data Rates
- Large-scale device connectivity

## Topologies

Typically, star, mesh or hybrid

Protocols

Standards based
(ex: WI-SUN)
or proprietary
(ex: Wirepas)

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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# Comparison between long range and short range IOT protocols
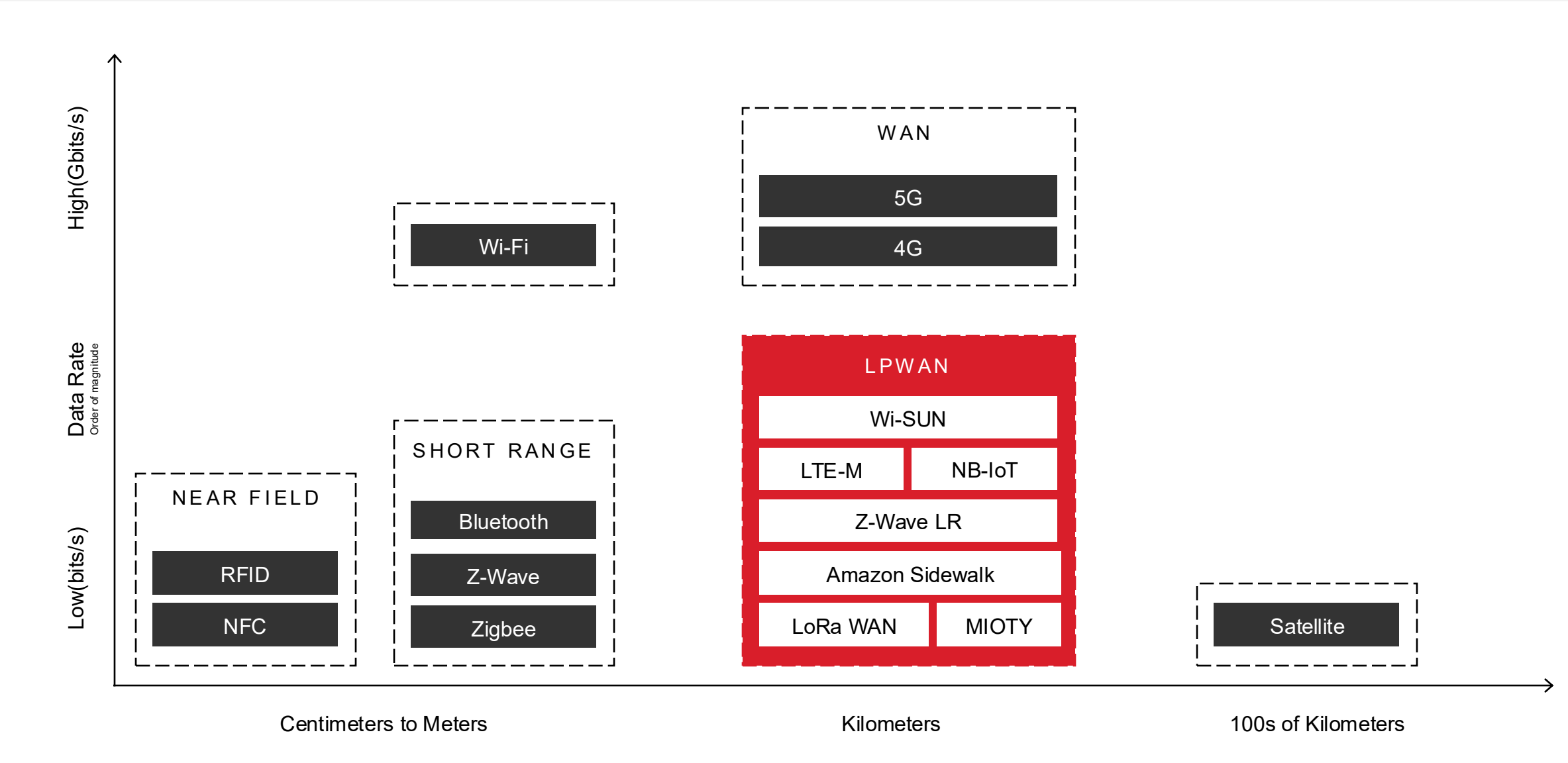
Mesh vs Star vs Hybrid Topology

STAR

- All devices communicate directly with a central hub (single-hop).
- Used in LoRaWAN and Z-Wave Long Range.
- Devices send data to a gateway, which forwards it to the cloud/server.
- Simple design enables:
  - Devices to wake → transmit/receive → sleep
  - Low power consumption
- Limitation: If a device is out of range or blocked, it cannot communicate—unless more gateways are added.

MESH
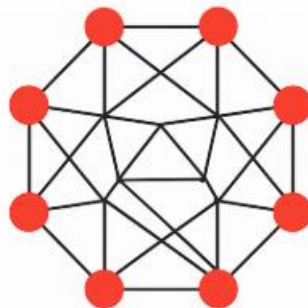
- Devices relay messages hop-by-hop; not all need direct hub access.
- Used in Zigbee, classic Z-Wave, Wirepas Sub-GHz RF Mesh, and Wi-SUN FAN.
- Advantages:
  - Extended range
  - Obstacle-tolerant routing
  - Self-healing: can reroute if a path fails
- Limitations:
  - Increased latency and complexity
  - Higher power consumption, as relay nodes remain active

HYBRID
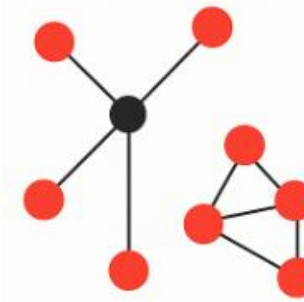
- Combines star and mesh to adapt to diverse environments.
- Example: Z-Wave Long Range (LR)
  - Indoor devices form a mesh
  - Distant devices (e.g., backyard sensors) use direct star connections
- Advantages:
  - Extended coverage
  - Optimized balance between reliability and efficiency

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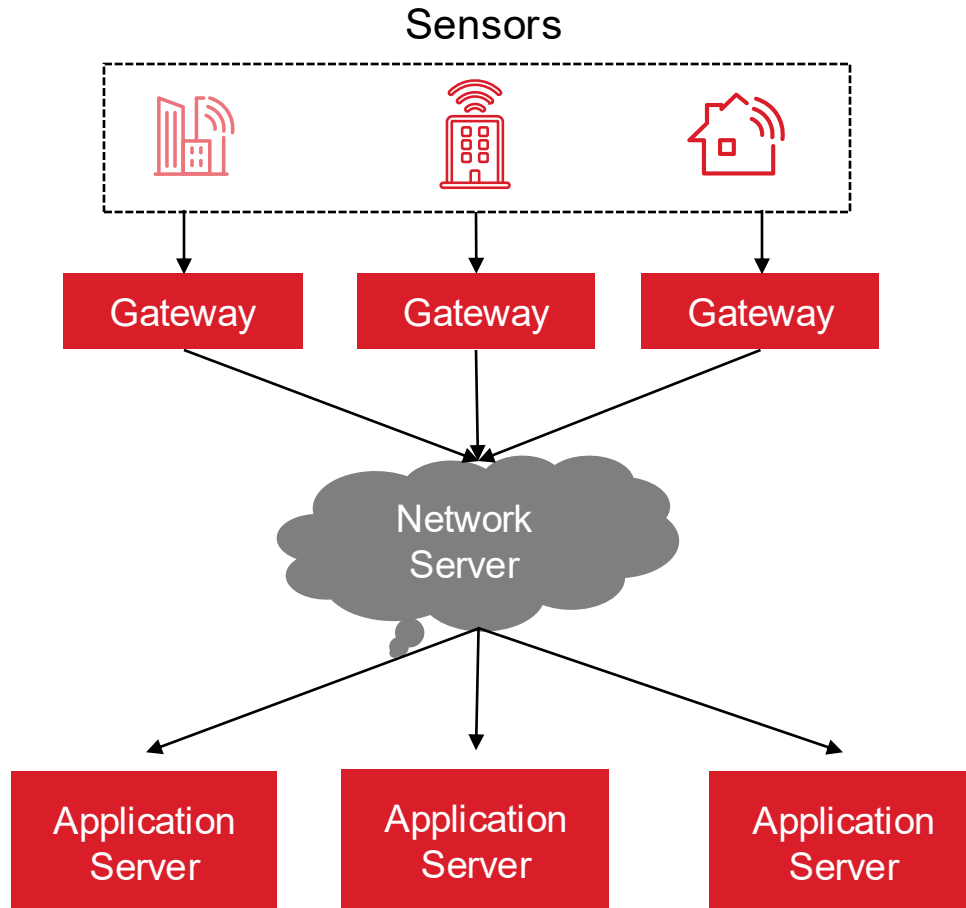
Standards vs Proprietary

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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Why does LPWAN Architecture matter?

Sensors

Gateway   Gateway   Gateway

Network Server

Application Server   Application Server   Application Server

Deployment Cost

- Considerations for individual node and infrastructure cost to deploy network
- Often the largest consideration with any network

Recurring Cost

- Costs for maintenance, scalability, and service contracts
- High recurring costs can limit network adoption and overall success

Future Proofing

- Ease of migration to new standard versions, OTA of nodes, and adaptability to changing security landscape
- Often overlooked due to emphasis on optimization for deployment or recurring costs

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Mioty: The Scalable, Future-Proof Alternative to LoRaWAN

Criteria	Mioty	LoRaWAN	Mioty Advantage
Deployment Cost	Telegram splitting and high interference immunity limit number of needed gateways	Protocol and memory limitations require more gateways to support same number of nodes	Improved scalability and lower barrier of entry for new deployments
Recurring Cost	Network efficiency lowers power consumption resulting in longer maintenance cycles	Longer transmit duty cycles and frequent retries limit device life cycles. Gateway inefficiency requires more WAN connections	Lower maintenance cost and fewer costly cellular connections
Future Proofing	Standardized solution with backward compatibility	Low data rate limits ability to update devices in field	Scalable, Interoperable, future ready design

Lower Deployment Costs
- Telegram splitting enables a single gateway to handle up to 3.5 million messages per day, drastically reducing the number of gateways needed-even in congested urban settings

Reduced Recurring Costs
- Resilience to interference dramatically reduces retransmissions lowering power consumption and maintenance requirements

Future-Proofs IoT Networks
- ETSI-standardized protocol ensures vendor-neutral interoperability and regulatory compliance across industries and regions

Silicon Labs Accelerates Time-to-Market
- Mioty PHY-layer validated SoCs supported by certified stacks and a vibrant partner ecosystem help customers go from design to deployment faster and more reliably

RF Mesh and Cellular: Hybrid LPWAN for Scalable IoT Connectivity

Cellular

Gateway

RF Mesh
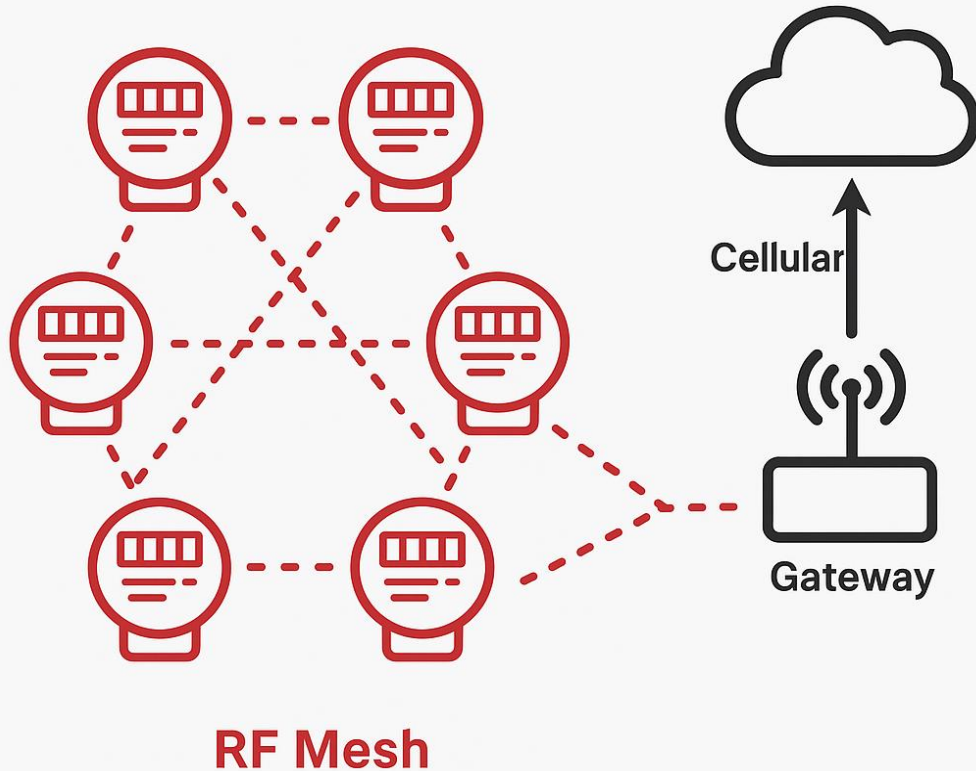
Hybrid Solution for IoT Connectivity

- Leverage strengths of both technologies to create easily deployable and maintainable solution

Cost Efficiency for IoT Deployments

- Lowers deployment and recurring cost by limiting number of costly cellular gateways and services

Scalable Flexibility for Diverse Environments

- Easily add nodes to an existing mesh network without worry of cellular coverage to every node
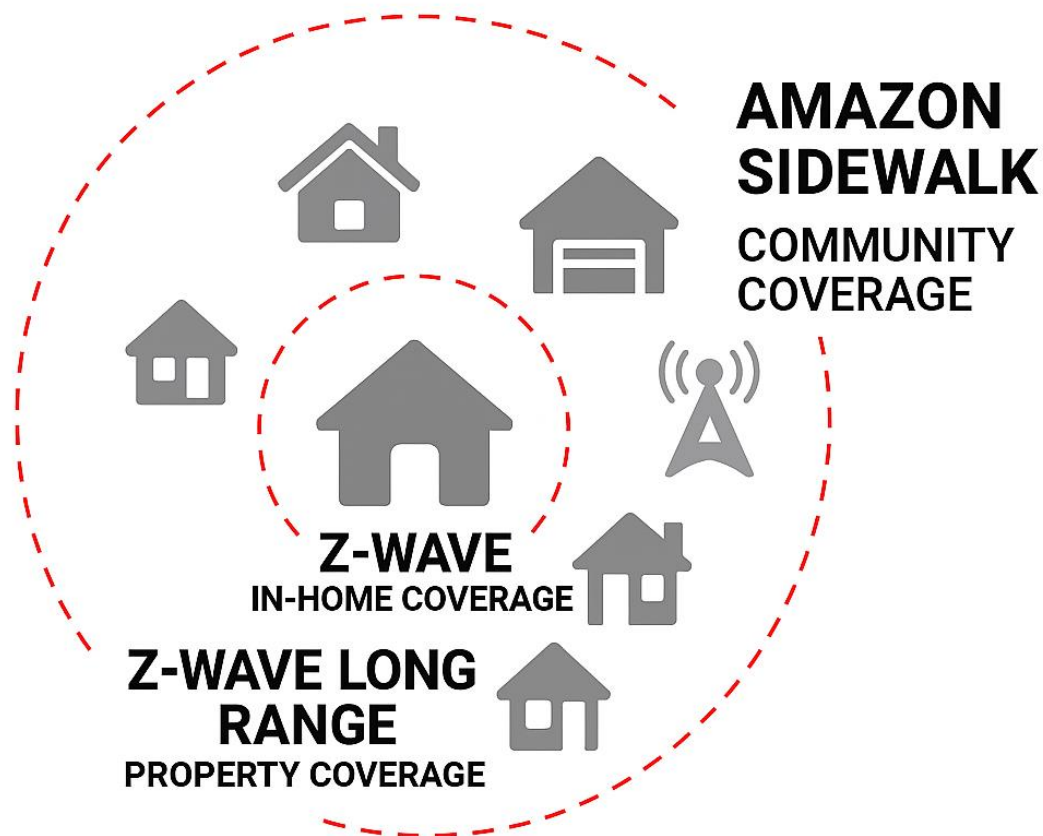
Future-Ready Design IoT Evolutions

- Provides a stable adaptable foundation, while ensuring cloud connectivity for future IoT advancements

Silicon Labs Simplifies RF mesh Network Design

- Support for existing and emerging mesh solutions ensures platform flexibility as networks evolve

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Amazon Sidewalk and Z-Wave LR for Smart Home Connectivity and Beyond

AMAZON SIDEWALK
COMMUNITY COVERAGE

Z-WAVE
IN-HOME COVERAGE

Z-WAVE LONG RANGE
PROPERTY COVERAGE

Expand use cases for IoT outside the home
- Provide users with better information from more sources to make homes and neighborhoods smarter

Seamless Connectivity for Diverse Needs
- Providing users with a seamless connectivity solution regardless of available network protocols

Silicon Labs: Your Partner for Both
- Optimized product families provide pin and firmware compatibility simplifying development cycles and speeding time to market

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Flexible LPWAN Platform: EFR32

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 Modulation

		xG22	xG23	FG23L	FG25	xG28
Supported Protocols	Amazon Sidewalk		✓ (FSK Only)			✓ (Bluetooth 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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Current Trends in LPWAN Deployments

Bridging the gap between smart home and smart city

- Integration of protocols like Matter alongside LPWAN networks allows for better visibility of entire system

Growing push for multi-vendor interoperability

- Creation of multi-use networks lowers overall cost for network uses and speeds time to market

Increasing need for edge intelligence

- Better real time decision making to improve efficiency and resource utilization

Multi-protocol gateways and devices simplify installation

- Simplify network architecture and device usage with more flexible protocol availability

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Summary and Takeaways

No silver bullet for LPWAN selection

- Developers need to consider how network topology, protocol selection, and chipset selection impact implementation

Silicon Labs EFR32 provides flexible platform for developers

- Broad support for Sub-GHz and 2.4GHz protocols along with common subsystems allow developers to focus on application development

Hybrid networks and implementations gaining traction across applications

- Optimize network architecture for environment rather than for specific protocol

Design for needs today while providing flexibility for tomorrow

- Devices and networks must be designed with flexibility and future needs in mind

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