SILICON LABS
CONNECTED INTELLIGENCE

2026 tech talks
WEBINAR SERIES

扩展LPWAN部署：支持大规模与分段式微型网状网络

Wi-SUN

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Agenda

01 What Wi-SUN is

02 The Silicon Labs Wi-SUN platform

03 Why it matters for infrastructure IoT

04 Micro mesh vs. massive mesh

05 Choosing your architecture

06 Live Q&A with panelists

DEFINITION

Wi-SUN is an IPv6-based, self-forming, self-healing mesh.

IPv6-based architecture

IPv6, 6LoWPAN, and RPL routing — every node has a real internet address.

Self-forming, self-healing mesh

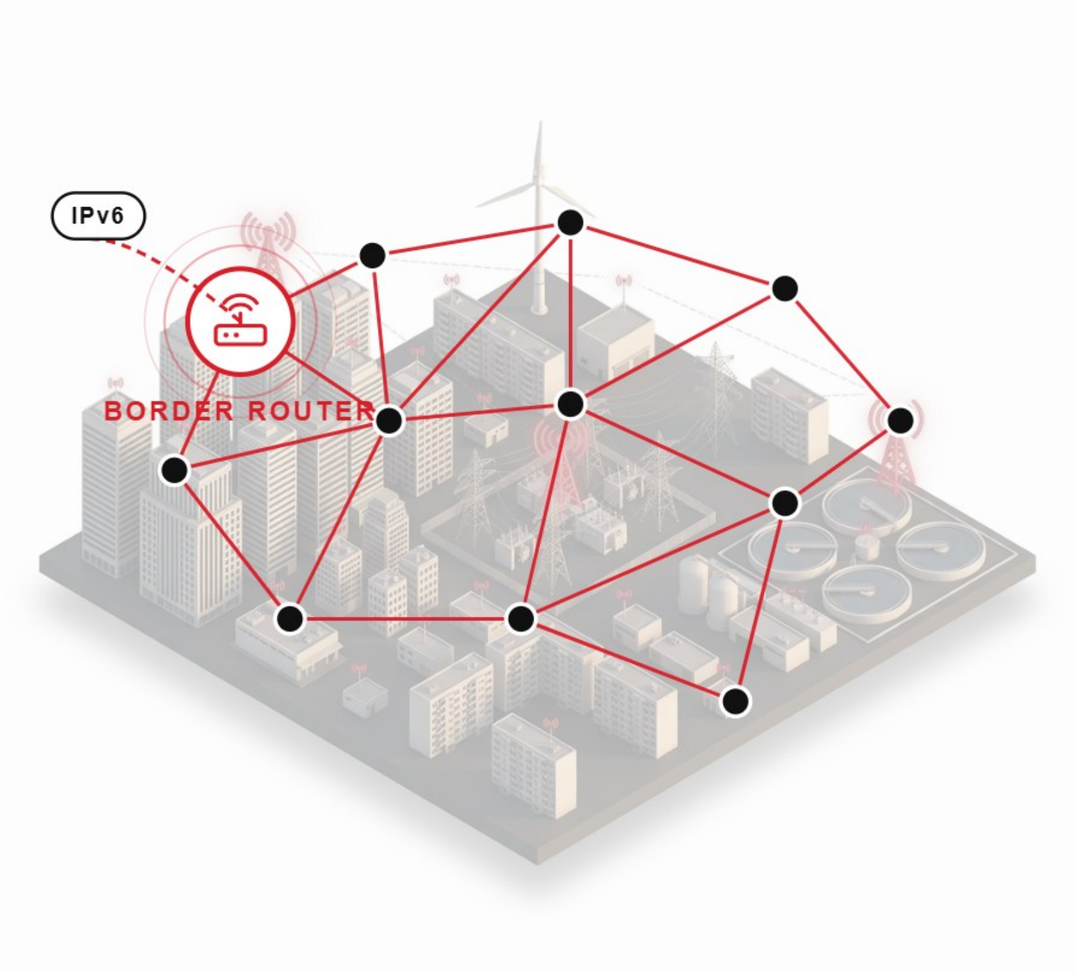
Multi-hop routing across large areas. Nodes find new paths automatically.

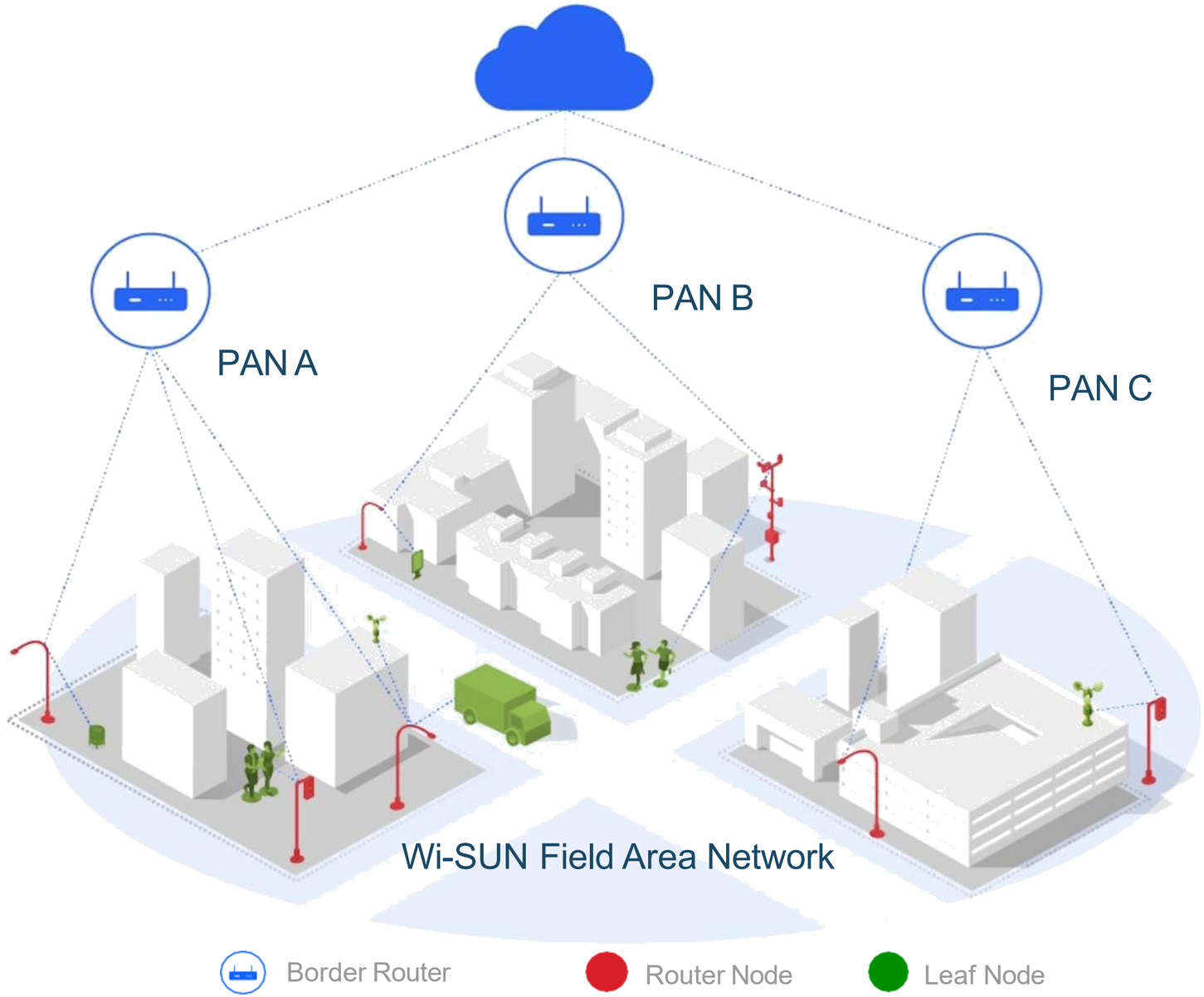
Standards-based and secure

IEEE 802.15.4g radio, certificate-based security, no vendor lock-in.

Multiple node types

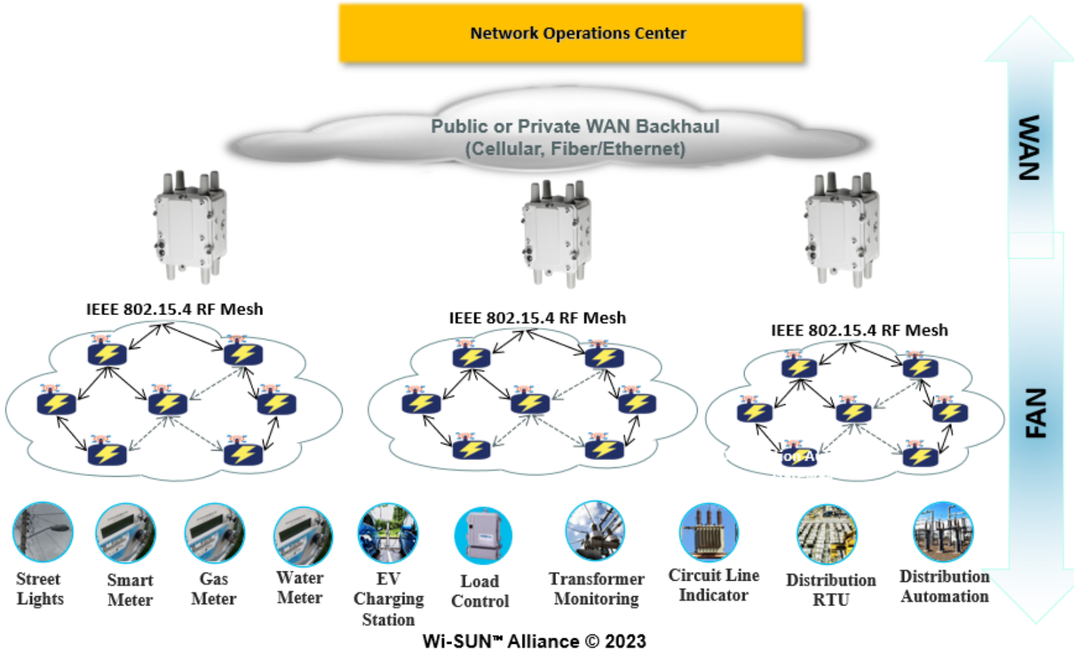
Border routers, full-function nodes, and low-power limited-function nodes.





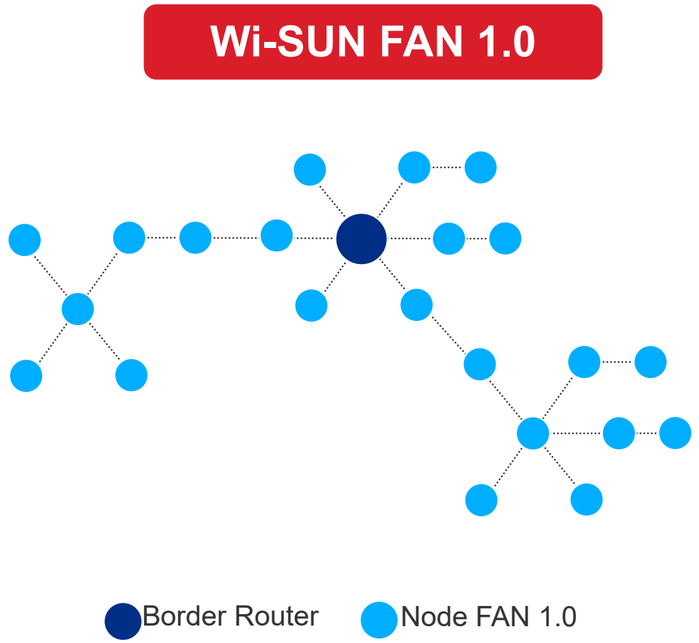
- **Border Router**
  - Provides WAN connectivity
  - Maintains source routing tables
  - Disseminates PAN-wide information such as broadcast schedules
- **Router Nodes (Full Function Nodes)**
  - Packet forwarding in a PAN
  - Services for relaying security and address management protocols
- **Leaf Nodes (Limited Function Nodes)**
  - Discover and join a PAN
  - Battery powered devices
  - Send/receive IPv6 packets

Wi-SUN适合的应用场景



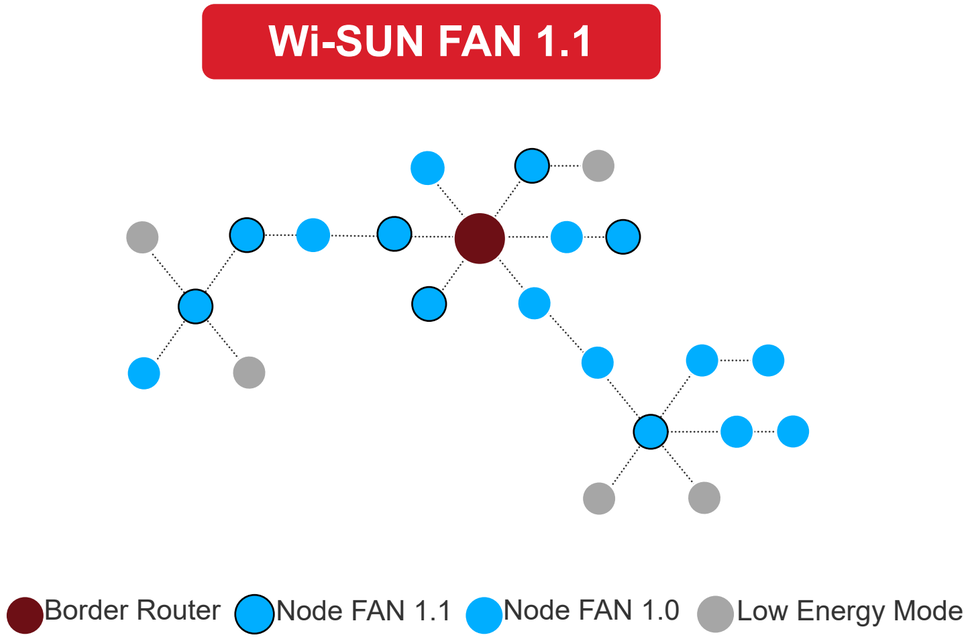
- **Smart Cities**
  - Smart Street Lighting
  - Infrastructure Management
  - Intelligent Transportation Systems
  - Parking Management
- **Utility Industry**
  - Advanced Metering Infrastructure (AMI)
  - Distribution Automation
  - Home Energy Management
  - Gas Meter, Water Meter
- **M2M**
  - Structural health: bridges, buildings etc
  - Agriculture
  - Monitoring and Asset Management
- **Home Automation:**
  - Smart Thermostats
  - Air Conditioning and Heat Controls
  - Energy Usage Information Displays

Wi-SUN FAN 1.0 回顾



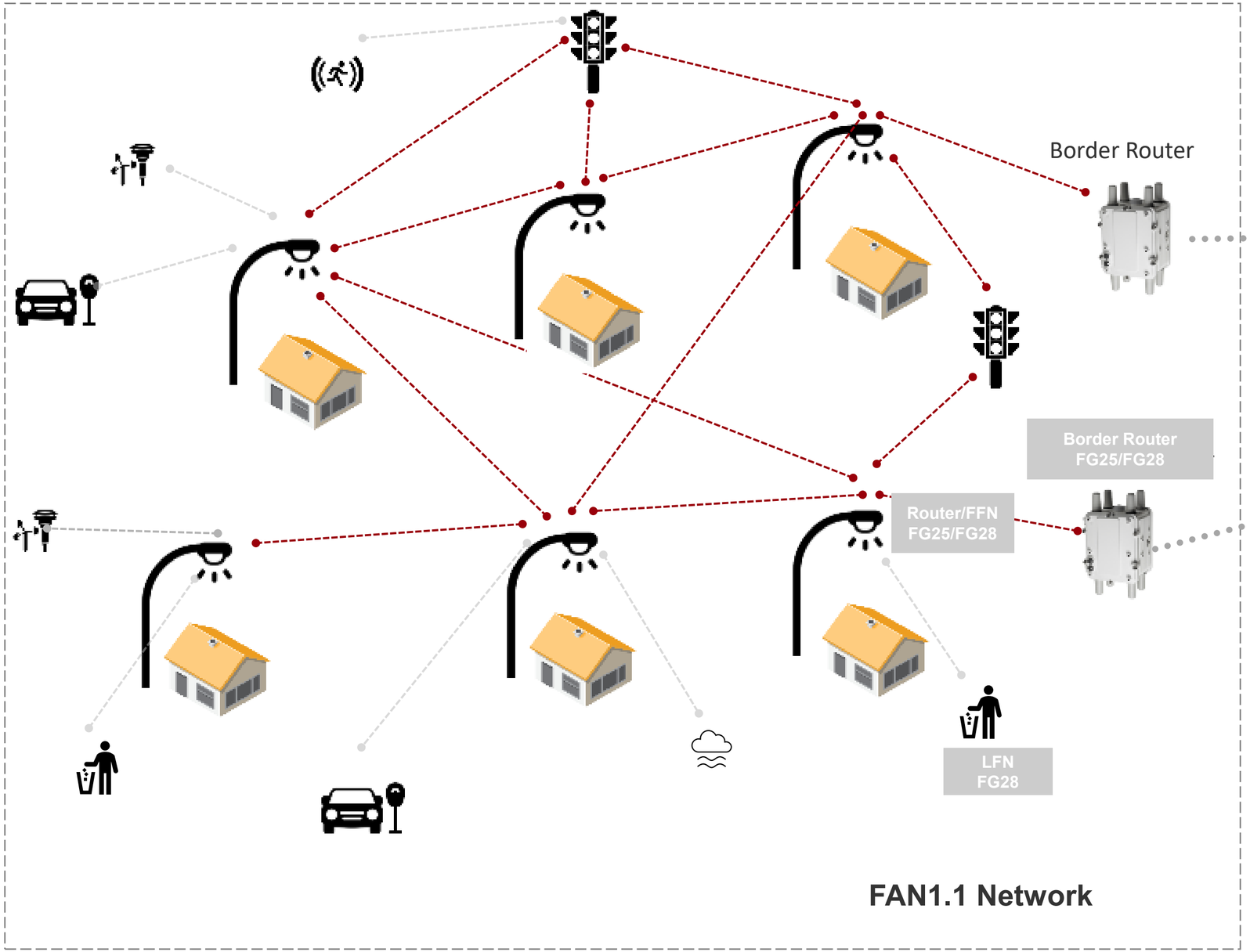
- **Wi-SUN Network Topology: Routing Mesh**
  - More like a tree than true mesh
  - All nodes are routing nodes and are always active
  - Border router maintains routing tables and ensures network backhaul
- **Primary Applications:**
  - Smart Cities
  - Smart Metering
  - Infrastructure
  - Energy Distribution
- **3 Types of Network Messages**
  - Unicast
    - From one node to another, communication flowing through neighbors
    - Routing with RPL (**R**outing **P**rotocol for **L**ow-Power and Lossy Networks)
  - Broadcast
    - Messages transmitted to all nodes within the range
    - Propagated with MPL (**M**ulticast **P**rotocol for **L**ow-Power and Lossy Networks)
  - Asynchronous messages
    - Messages transmitted to all nodes within the range
    - Mainly used for network discovery and configuration (PAN Advert, PAN config, …)
- **PHYs**
  - A single PHY is used for all messages (base PHY), i.e. all nodes talking the same language
  - Selection between 50, 100, 150, 200 & 300 kbps FSK
    - The PHY is selected upon the higher distance (range) between nodes and regional regulation
  - Frequency hopping is used

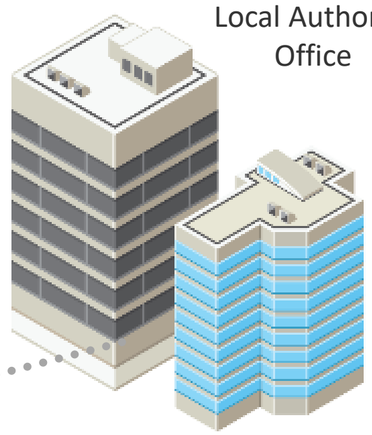
FAN 1.1 功能扩展



- **FAN 1.1 is an extension of FAN 1.0 to address higher bit rates and low power nodes**
  - Keeps the basis of FAN 1.0
- **Indeed, these new topics are optional in FAN 1.1 specification, so we get 3 pieces:**
  - FAN 1.1 Core (aka FAN 1.0+)
    - Only one feature added: PAN-wide Information Element
  - FAN 1.1 High Performance option (HP)
    - Introduces SUN-OFDM PHYs
    - Introduces mode switch
  - FAN 1.1 Low Energy option (LE)
    - Introduces Limited Function Nodes (LFN)

Wi-SUN FAN1.1 典型智能城市网络





Local Authority Office

Cellular, Fiber, Ethernet

LFN – Limited Function Node / Battery Powered
FFN – Full Function Node / Line Powered

High Data Rate [OFDM or FSK]
City wide MESH, Line Powered Routers / FFN, FG25/FG28

Low Data Rate [FSK]
Battery powered LFN Nodes (FG28) <> FFN (FG25/FG28)

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FAN 1.1 High Performance: OFDM

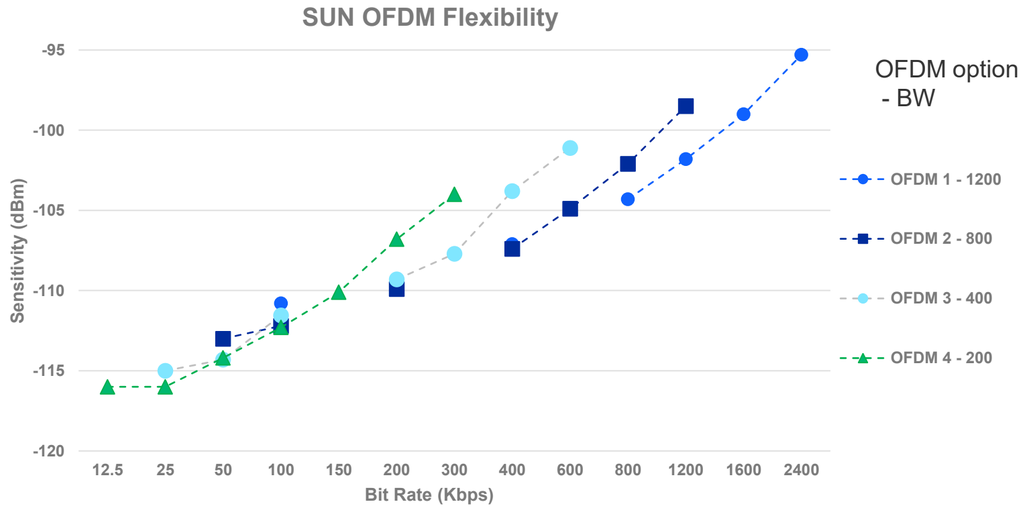
- **OFDM brings**
  - High bit rates, up to 2.4 Mbps
    - 3.6 Mbps w/ EFR32FG25 additional mode
  - Intrinsic flexibility on bit rates and performance levels
    - Sometimes referred to as MR-OFDM (multi-rate)
      - Packet-by-packet flexibility, within the same bandwidth
    - Each option has 7 Modulation and Coding Schemes
      - MCS0 (low bit rate) to MCS6, in-packet signaling
- **High bit rates bring**
  - Higher throughputs which are helpful for OTA
  - Shorter burst duration leading to
    - Better latency
    - Improved network performance & less congestion

bandwidth (KHz)	modulation	bit rate (kbps)	Tx duration (ms)
200	FSK 1b	50	241.92
	FSK 2a	100	120.96
	OFDM 4 MCS6	300	41.52
400	FSK 3	150	80.85333333
	FSK 4a	200	60.64
	OFDM 3 MCS6	600	21.48
600	FSK 5	300	40.74666667
800	OFDM 2 MCS6	1200	11.52
1200	OFDM 1 MCS6	2400	6.12

Example for 1500-Byte frame

OFDM high bit rates

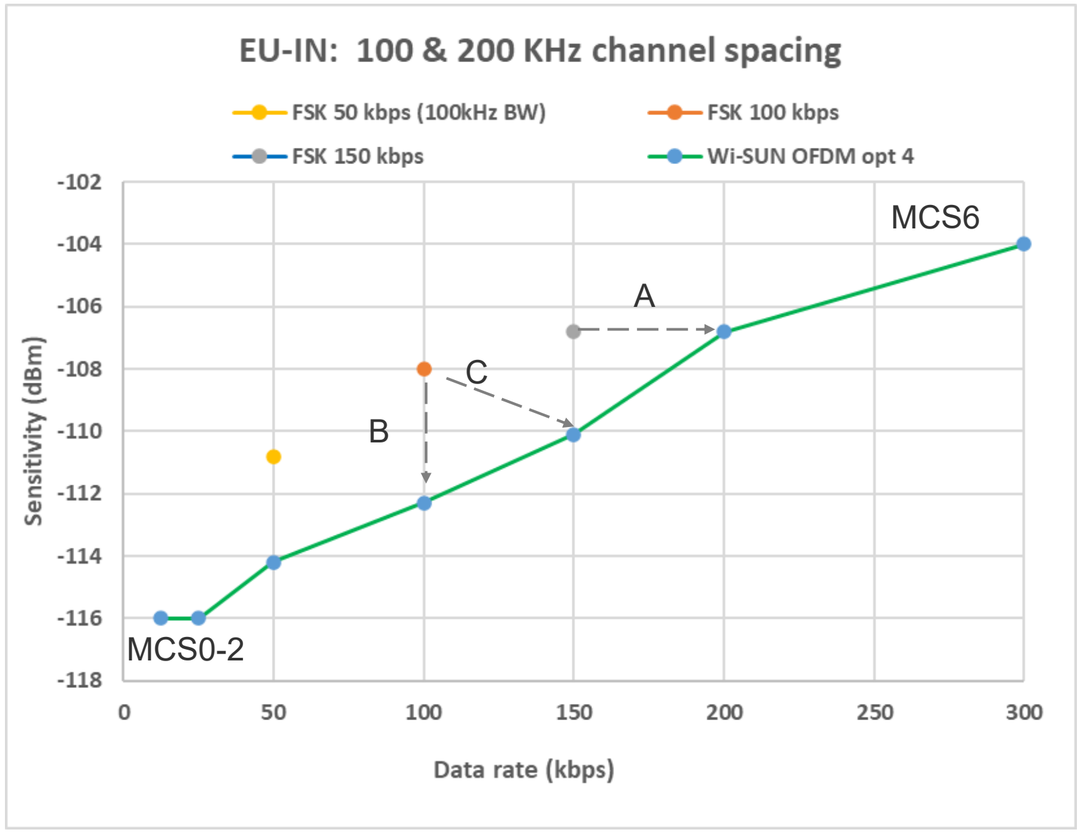
OFDM option	Bandwidth (kHz)	Main regions	Bit rates (kbps)	Sensitivity (dBm)
1	1200	NA, BZ	100 to 2400 (3600*)	-111 to -95
2	800	NA, BZ, JP	50 to 1200 (1800*)	-113 to -98
3	400	NA, BZ, JP	25 to 600 (900*)	-115 to -101
4	200	NA, BZ, JP, EU	12.5 to 300 (450*)	-116 to -104



NA: North America, BZ: Brazil, JP: Japan, EU: Europe

OFDM Performance compared to FSK: Europe – India case

- **Europe, India mainly use 200 kHz channel spacing**



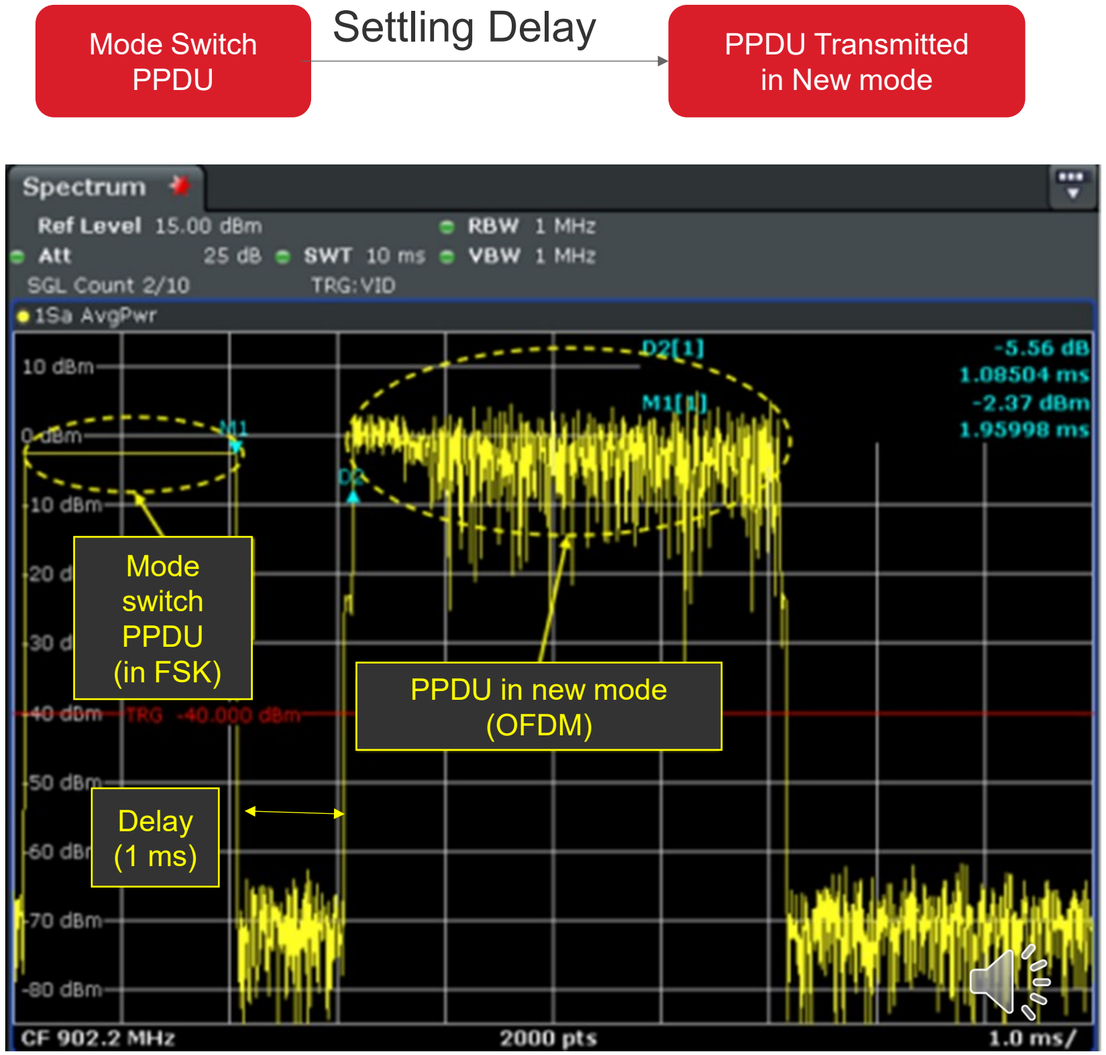
- **OFDM advantage vs FSK:**
  - A: increased bit rate for same range
    - +30 to 50%
    - + 200% from FSK 50kbps (100 KHz BW)
  - B: improved range for same bit rate
    - About 4 dB better sensitivity
  - C: can be a combination of both
    - +50% and 2 dB

- **Note: same comparison applies for other countries**
  - Europe & India are selected as the single channel bandwidth makes the comparison more fair

- **Intrinsic flexibility of OFDM allows**
  - To use low MCS to increase range
  - To use high MCS to increase throughput when conditions allow it

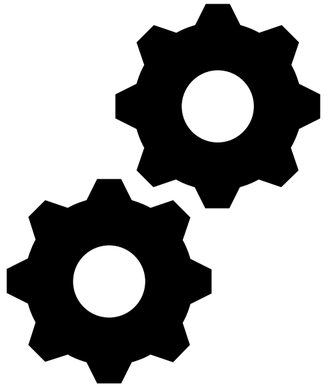
FAN 1.1 高性能– Mode Switch

- **Entire Wi-SUN network uses single base PHY**
  - Defined by border router for Broadcast, Unicast, and Asynchronous messages
- **Mode Switch allows for use of an alternate PHY for unicast messages**
  - Signaling packet sent on base PHY
- **Allows for switch between FSK PHYs or FSK to OFDM**
  - Enables higher bandwidths for short amount of time for use cases like OTA
- **Supported on both FG25 (FSK and OFDM) and FG28 (FSK only)**
  - Exists natively as part of Silicon Labs Wi-SUN stack



Mode Switch

- **Modulation and Data Rate (MDR) Switching**
  - Introduced in FAN1.1
- **Goal**
  - Temporarily switch from one MDR to another for one or more packets exchange
  - Switching can be used to take advantage of the channel conditions or to meet application requirements
- **Silicon Labs Implementation**
  - As per FAN1.1 spec
  - Provides PHY Mode Switch and MAC Mode Switch APIs



BENEFITS

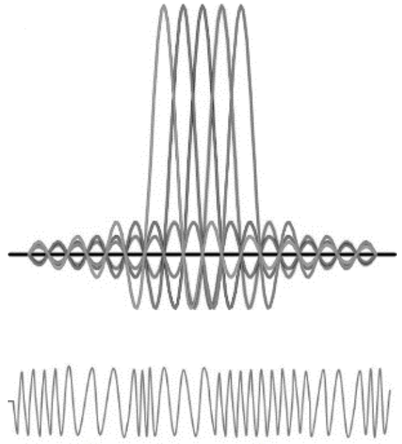
- Best modulation and data rate for a specific channel condition
  - Reduced burst size, then power consumption
- Best modulation and data rate for a specific use-case
- If channel condition allows select higher data rate for cases like OTA [OFDM or FSK]
- Best modulation and data rate based on device capabilities
  - Devices advertise on the modes they support

DRAWBACKS

- Need to transmit a Mode Switch PPDU
- Can be slow due to long CCA (160 micro-Sec) and settling delay (0.5 to 1.5ms as per spec.)
- Reduced co-existence performance in technologies with short CCA
  - For example, 802.11ah (40 micro-second)

Concurrent Detection

- **Concurrent detection of two different PHYs**
  - The device listens to both FSK and OFDM at the same time
  - The first incoming signal triggers reception, the other one is aborted
  - Behaves like mode switch, without the need for the signaling packet (Mode Switch PPDU)
    - Concurrent Mode can be considered as a super Mode Switch
- **Silicon Labs Implementation**
  - Supported on FG25 [FSK & OFDM]
  - Currently available concurrent detection PHY pairs:
    - OFDM_option1_FSK_50kbps_NA
    - OFDM_option3_FSK_100kbps_JP
    - OFDM_option4_FSK_50kbps_EU



BENEFITS

- Faster than Mode Switch
  - No additional signaling and settling time
- Better co-existence performance than Mode Switch
  - Mode Switch performance can degrade in the presence of technologies with faster CCA, for example 802.11ah
- Increase throughputs without the overhead of a signaling packet
- Allows hybrid networks
  - FSK for robustness and legacy, OFDM for high bit rates

DRAWBACKS

- Only one payload can be received at a given time
  - It is not a dual reception
- Limited to single FSK and OFDM PHY concurrently
  - Detection of 2 FSK or 2 OFDM is not possible
- Need pre-defined PHY pairs
  - Additional pairs can be implemented based on customer needs

Concurrent Detection is not specified in Wi-SUN, but a capability of EFR32FG25

FAN 1.1 LE: Limited Function Nodes (LFN)

- **LFN allows battery_powered_applications as nodes are sleeping most of the time**
- **The typical use case is a node transmitting 1-2 kB per day**
  - The goal is to reach a lifetime of 20 years with a typical LiMnO2 3.x volt / 2 AH battery
- **These nodes cannot be routers, so this is limited to leaf nodes**
  - Routers are referred to as Full Function Nodes (FFN)
- **The “LFN parenting” feature is required on a router to allow support of LFN children**
  - The FFN parent is managing LFN Broadcast and Unicast schedules
  - The FFN parent is buffering the message to be delivered to the LFN
- **LFN is available for**
  - EFR32**FG28** (FSK only)
  - EFR32**FG25** (FSK & OFDM)

COMPARED

How Wi-SUN compares to the alternatives.

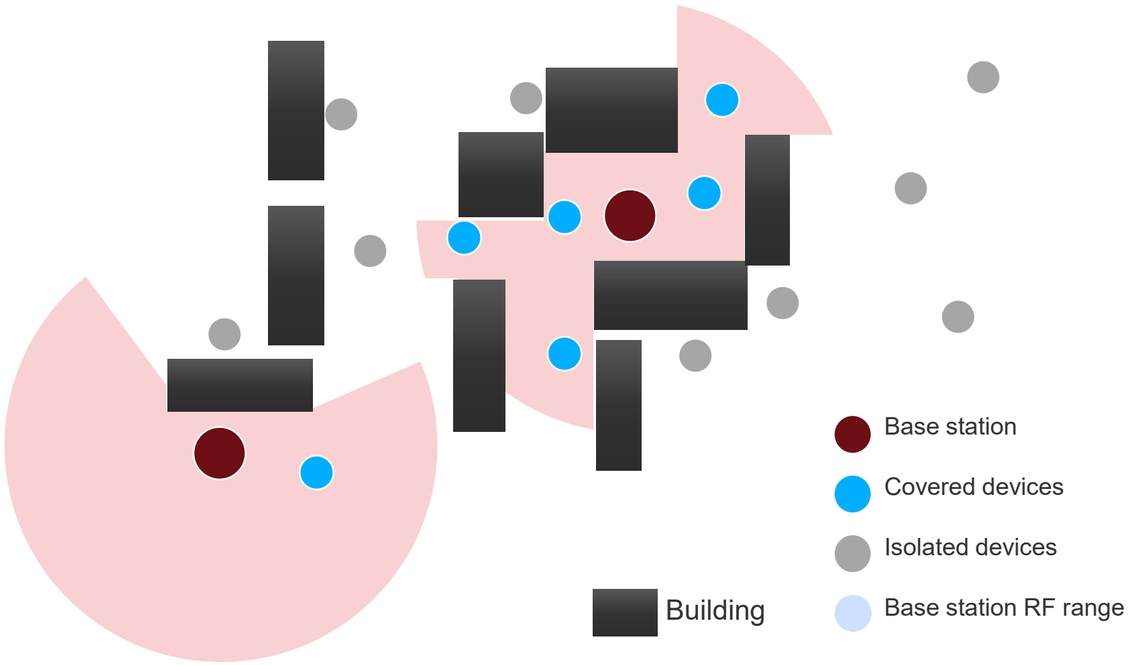
Three rows. Each is a place where infrastructure IoT typically breaks.

	WI-SUN IEEE 802.15.4G	PROPRIETARY MESH	CELLULAR NB-IOT / LTE-M	PROPRIETARY LPWAN
Multi-vendor interoperability	● Yes · standards-based	◐ Vendor-defined	◐ Carrier-based	◐ Vendor-defined
Network scale	● 100K+ nodes	◐ 100s to 1000s	● Millions (per carrier)	◐ 100s to 1000s
Operating cost (OPEX)	● Low · no carrier fees	● Low	○ High · ongoing carrier fees	● Low

Only Wi-SUN delivers all three at once. Standards-based interoperability, infrastructure-scale deployment, and long-term operating economics in a single architecture.

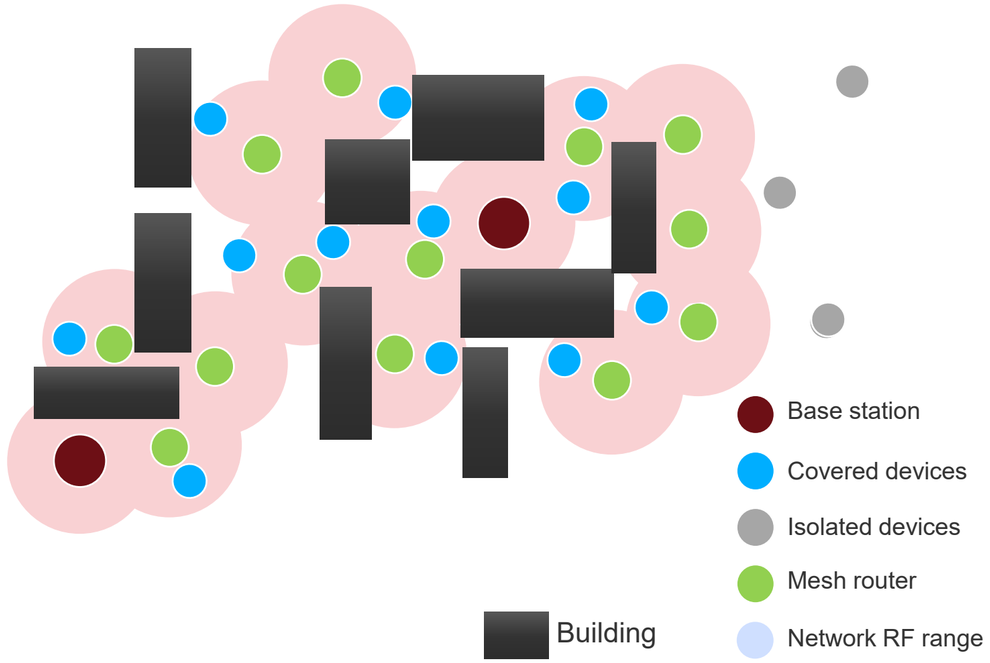
Wi-SUN Mesh在城市环境的优势

LONG-RANGE IOT PROTOCOL



- Star topology includes expensive base stations
  - More GW needed for coverage
- In an urban environment or RF challenging layout, deploying enough base stations to cover the entirety of an area is tedious.

MESH NETWORK PROTOCOL



- Mesh topology is more flexible
- Mesh routers can be deployed on grid powered devices (electric meters, streetlights…)
- Having a complete RF coverage of such an area becomes possible

THE PLATFORM

The Silicon Labs Wi-SUN platform.

From silicon to system — one platform, four layers, two SoCs.

L4 · APPLICATIONS Vertical use cases	Smart metering · Smart cities · Industrial IoT · EV charging · Building automation
L3 · WI-SUN STACK **FAN 1.1 certified**	IPv6 / 6LoWPAN · RPL routing · Self-forming & self-healing · PKI security
L2 · SDK & TOOLS Developer ecosystem	Wireless SDKs · Simplicity Studio · Analysis & profiling · Reference designs
L1 · SILICON Two purpose-built SoCs	EFR32FG25 (scale & performance) · EFR32FG28 (dual-band & edge)

EFR32FG25

Scale & performance. Built for large-scale Wi-SUN networks.

EFR32FG28

Flexibility & integration. Sub-GHz + BLE in one SoC.

为何选择芯科科技作为Wi-SUN解决方案供应商?

支持OFDM和FSK调变

- **Portfolio to support both OFDM and FSK modulations with FG25 and FG28**
  - Support for up to 2.4 Mbps data rates with OFDM on FG25
- **Optimized solution for LFN nodes with FSK support**
  - FG28 provides best in class RF and low power performance
- **Support for mode switch on FG25 for multi-use network optimization**
  - Simplifies mixed modulation network architecture

经认证的解决方案

- **PHY Certification on multiple devices**
  - FSK and OFDM certification with FG25
  - FSK certification on FG12 and FG28
- **Stack certification to cut down on development time and risk**
  - Tested and proven to work on all Silicon Labs devices
- **Certified Border Router reference design**
  - Customers passed certification using this design
- **Certified Test Bed Unit as part of Wi-SUN certification plan**

先进的功能特性

- **Concurrent Detection**
  - Eliminates needs for signaling packet within transmission
- **Support for OFDM data rates up to 3.6 Mbps**
  - Future proof for addition of MCS7 to Wi-SUN specification
- **Additional modulation support for longer range capability**
  - MR-OQPSK modulation improves link budget over FSK and OFDM
- **PHY Flexibility**
  - Tools to enable custom PHY creation to address additional network configurations

完善的参考设计和开发工具

- **Certified Reference Designs:**
  - Border Router (FG12, FG25)
- **Reference Designs:**
  - Router Node (FG12, FG25)
  - LFN Node (FG28)
- **Development Kits:**
  - Wi-SUN specific kit for FG25 Router Nodes (Wi-SUN-PK6015A and Wi-SUN-PK6016A
  - FG28 Pro Kit for LFN development (FG28-PK6025A)

SILICON LABS

SOC · EFR32FG25

EFR32FG25 — built for scale.

Memory headroom, advanced PHY, and infrastructure-grade security for the largest Wi-SUN networks.

MEMORY FOR SCALE

Up to 1920 kB Flash / 512 kB RAM

Supports large FAN 1.1 stacks and future OTA updates without sacrificing application headroom.

EFR32FG25 · IEEE 802.15.4g · Sub-GHz

ADVANCED PHY

OFDM · up to ~2.4 Mbps · mode-switch

Higher throughput and lower latency than legacy FSK-only radios — multi-Mbps OFDM for large-mesh routing nodes.

NETWORK EFFICIENCY

Concurrent OFDM + FSK detection

Improves channel access in dense, congested RF environments — fewer collisions, better throughput.

INFRASTRUCTURE SECURITY

Secure Vault™ High

Hardware root-of-trust and key management — designed for 10–20+ year deployments.

TAKEAWAY Your network is only as scalable as your node architecture. FG25 is the architecture choice for scale.

SOC · EFR32FG28

EFR32FG28 — dual-band edge.

Sub-GHz networking and BLE local access in a single SoC, for devices that need to talk to both the mesh and the user.

DUAL-BAND INTEGRATION

Sub-GHz + BLE in one SoC

Long-range mesh networking and local Bluetooth connectivity without two-chip designs.

EFR32FG28 · Wi-SUN + Bluetooth LE

SIMPLIFIED ARCHITECTURE

Eliminates dual-chip designs

Reduces BOM, board space, power budget, and development complexity.

USER EXPERIENCE

Mobile commissioning & control

Setup, maintenance, and user interaction over BLE from any phone or tablet.

SYSTEM FLEXIBILITY

Ready for evolving protocols

Scales features and connectivity as use cases and standards grow over time.

TAKEAWAY Not every Wi-SUN device is just a network node. FG28 covers the user-facing edge.

Wi-SUN例程

EFR32FG25 902-928 MHz 16 dBm Radio Board (BRD4270B Rev A06)

OVERVIEW | EXAMPLE PROJECTS & DEMOS

SDK Simplicity SDK Suite v2026.6.0

Filter on keywords

Demos

Example Projects

Solution Examples

What are Demo and Example Projects?

Wireless Technology CLEAR

- Connect (7)
- RAIL (14)
- Wi-SUN (15)

Device Type CLEAR

- NCP (6)
- RCP (1)
- SoC (97)

MCU CLEAR

- 32-bit MCU (68)
- Bootloader (14)

Project Difficulty CLEAR

- Advanced (55)
- Beginner (48)

15 Items Found

Wi-SUN - SoC Border Router Empty

Production

The Wi-SUN Border Router Empty sample application is a bare-bones application. It can be used as a template to develop a Wi-SUN border router application with custom application logics.

CREATE

View Project Documentation

Wi-SUN - SoC Border Router In-Meter Gateway

Production

The Wi-SUN Border Router In-Meter Gateway sample application is a meter application running on the border router SoC.

CREATE

View Project Documentation

Wi-SUN - SoC CoAP Collector

Production

The Wi-SUN CoAP Collector sample application demonstrates the use of the CoAP (Constrained Application Protocol) to emulate a metering-like application. The CoAP Collector purpose is to retrieve measurements from the devices running the Wi-SUN More...

CREATE

View Project Documentation

Wi-SUN - SoC CoAP Meter

Production

The Wi-SUN CoAP Meter sample application demonstrates the use of the CoAP (Constrained Application Protocol) protocol to emulate a metering-like application. The CoAP Meter purpose is to send sensor measurements to a CoAP Collector device More...

CREATE

View Project Documentation

Wi-SUN - SoC DC CIU

Experimental

Wi-SUN Direct Connect Control Interface Unit. Simple button-driven interface for DC client operations.

CREATE

View Project Documentation

Wi-SUN - SoC Empty

Production

The Wi-SUN Empty sample application is a bare-bones application. This application can be used as a template to develop a Wi-SUN application.

CREATE

View Project Documentation

Wi-SUN - SoC Network Measurement

Production

The Wi-SUN Network Measurement application provides a performance measurement solution based on the ping mechanism.

CREATE

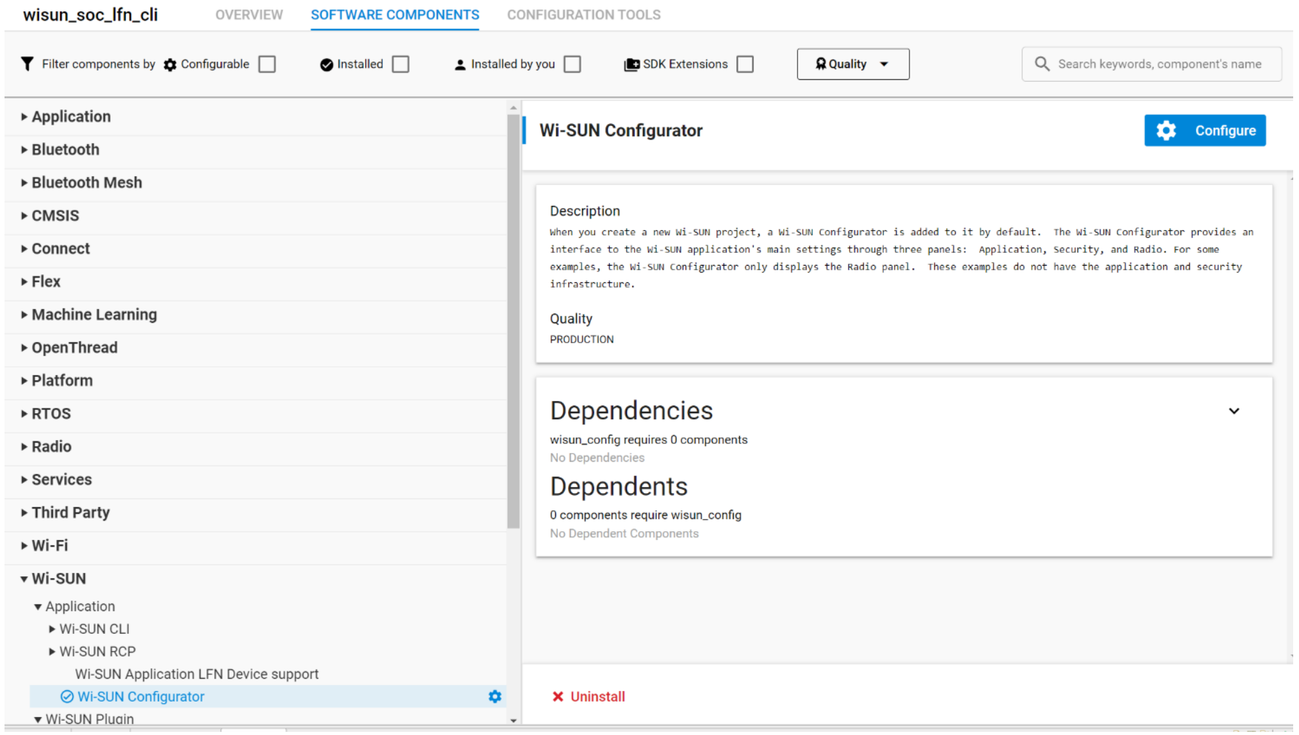
Wi-SUN - SoC Ping

Production

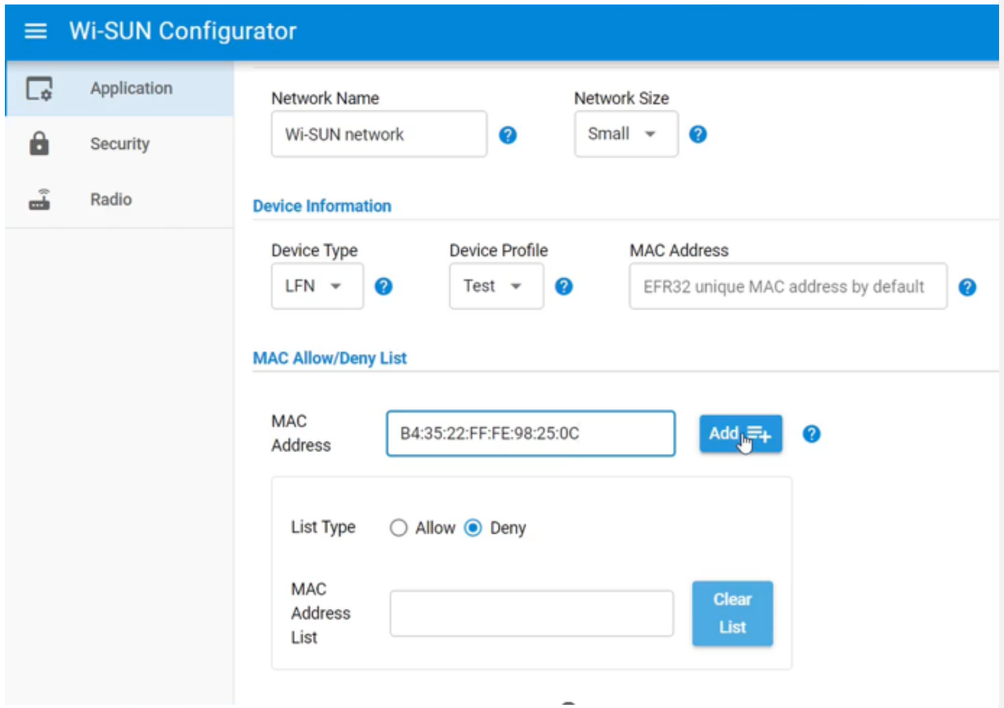
The Wi-SUN Ping sample application demonstrates how to use the Wi-SUN application framework and the POSIX-like socket API to implement a basic ping application.

CREATE

Wi-SUN可视化配置工具

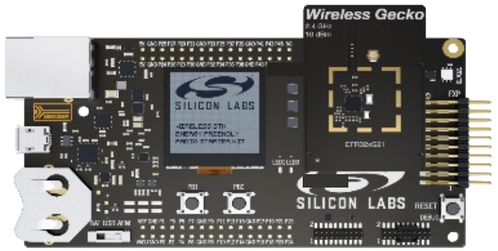


软件组件配置



Wi-SUN应用配置

Wi-SUN硬件开发板

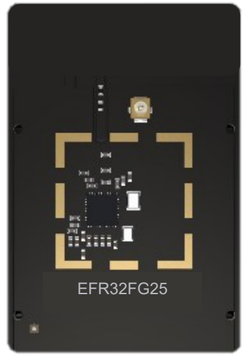


EFR32FG25/FG28 and Wi-SUN Pro Kits

套件包含

FG28 Pro Kits
1x BRD4002A Mainboard
1x FG28-RB440xB Radio Board
1x 868 / 915 MHz antenna
1x 2xAA Battery Holder

FG25 Pro Kits
1x BRD4002A WSTK main boards
1x FG25 +16 dBm
1x BRD8016 Expansion board
1x Antenna



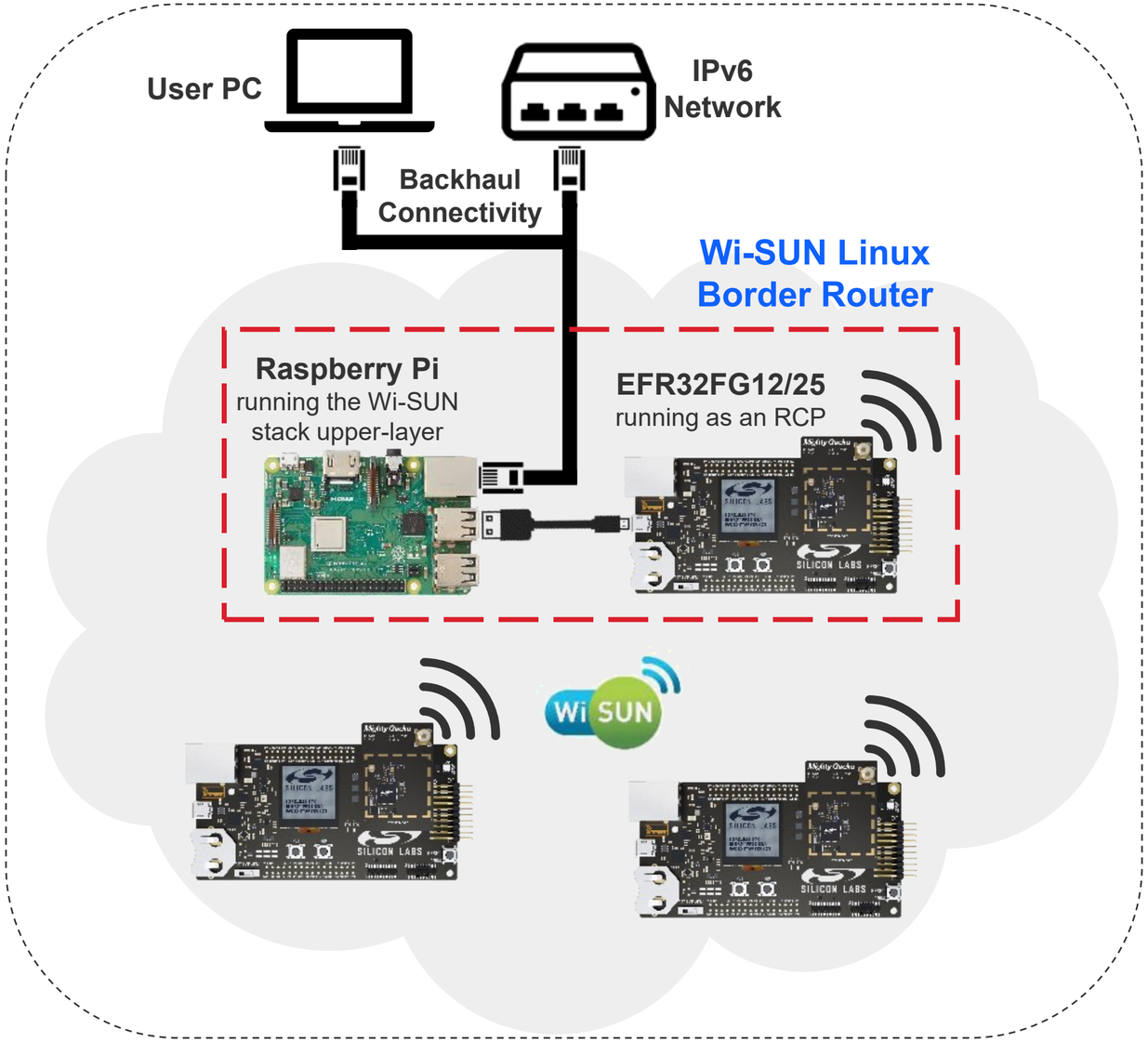
可选择的射频板

FG25-RB4272A – 470MHz +16 dBm
FG25-RB4271A – 868MHz +16 dBm
FG25-RB4270B – 915MHz +16 dBm

xG28-RB4400C (+14 dBm)
xG28-RB4401C (+20 dBm)

开发套件可用于开发路由节点、边界路由器和LFN

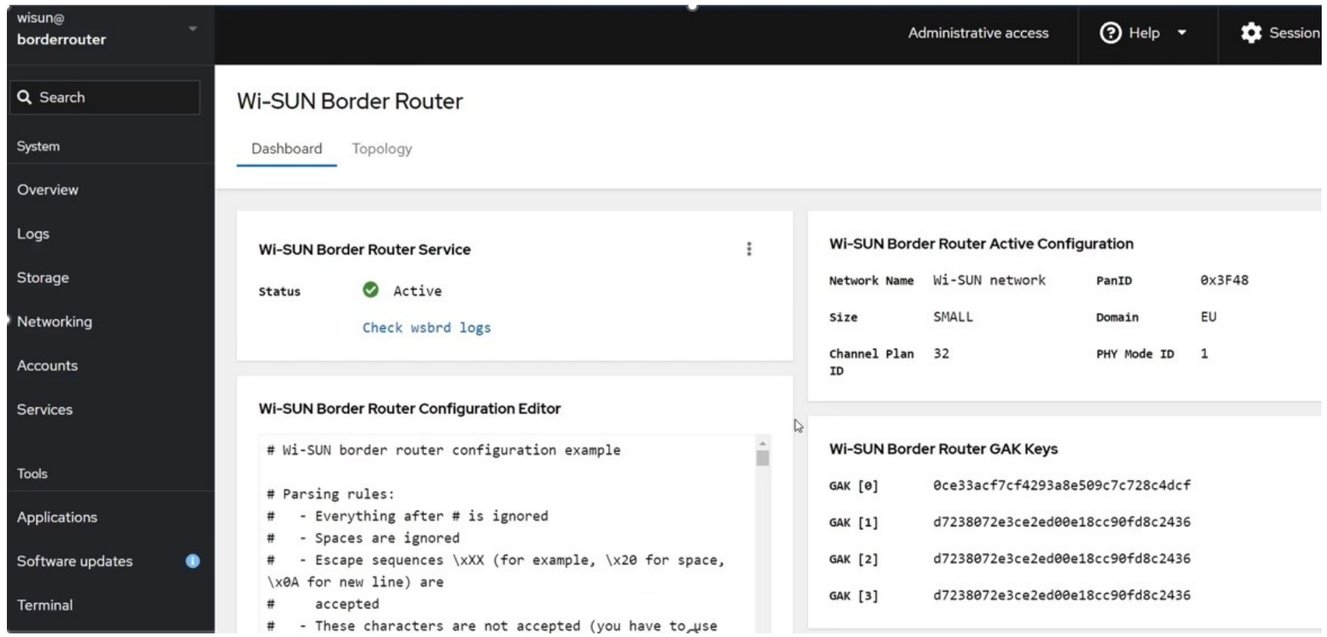
Wi-SUN 边界路由器参考设计



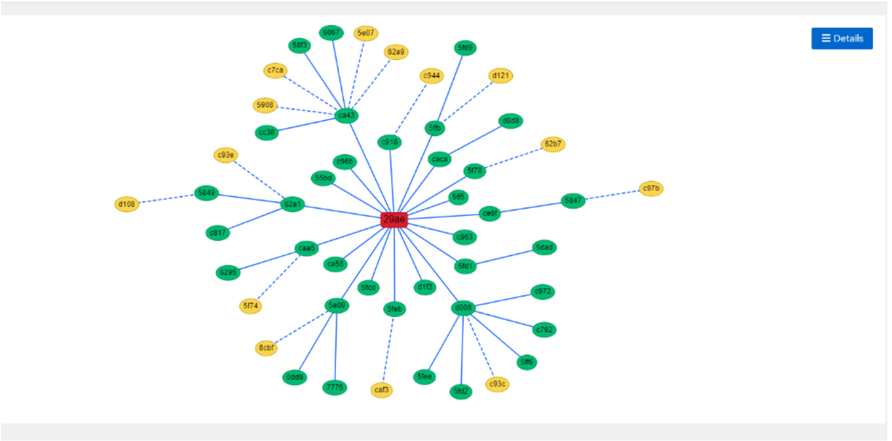
- **Host API**
  - Based on Spinel & extended to Wi-SUN needs.
- **Border Router Configuration & Visualization**
  - Web GUI for configuration & network visualization
- **Wi-SUN Network Layer**
  - Provided as source code
  - Implemented in C
  - Easily portable to any Linux distribution
- **Wi-SUN Link Layer**
  - Wi-SUN RCP Binary (PHY/MAC)
- **Documentation**
  - Readme, configuration guidelines, application note
- **Wi-SUN Tools**
  - Direct Connect
  - Dynamic Data Provisionin

Border Router Source Code -
https://github.com/SiliconLabs/wisun-br-linux

边界路由器可视化配置工具



BR可视化管理界面



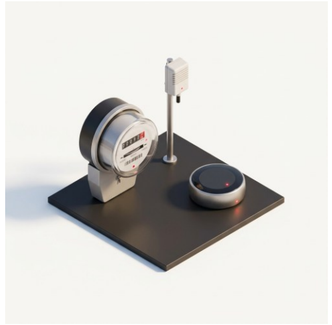
可视化网络拓扑和节点信息

THE SHIFT

IoT is moving from connecting devices to operating networks.

Three tiers, three sets of requirements. The third is what Wi-SUN is built for.

TIER 1 · DEVICES



A few

connected devices

Direct connections. Star topologies. The world before mesh.

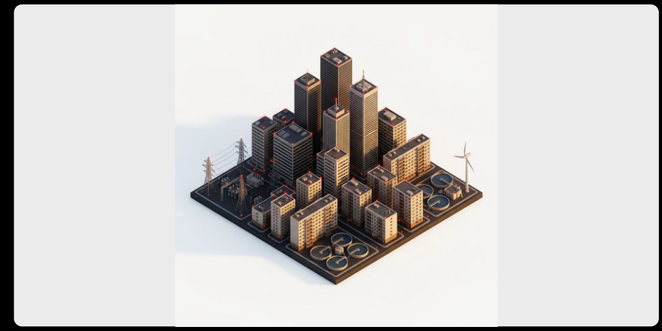
TIER 2 · LOCAL MESH

10s–100s

nodes per network

Localized coverage. Buildings, campuses, sites.

TIER 3 · MASSIVE MESH



1000s–100K+

nodes per network

Infrastructure-scale IoT. Cities, utilities, regional grids.

TAKEAWAY Wi-SUN is designed for networks that scale across all three tiers—and stay reliable at the top.

WHY IT MATTERS

Three things infrastructure IoT needs at once.

No single alternative delivers all three. Wi-SUN does.

01 · Interoperability

Multi-vendor by design

Standards-based IEEE 802.15.4g + IPv6 stack. Procure across vendors and avoid lock-in for the 20-year life of the network.

IEEE 802.15.4g

open standard

02 · Scale

Hundreds to 100K+ nodes

Mesh topology with distributed routing scales horizontally—add nodes and border routers without re-architecting.

100,000+

nodes per network

03 · Longevity

Built for 10–20+ years

OTA-friendly memory headroom, multi-rate PHYs, and certificate-based security designed to outlast the deployment.

10–20+ years

deployment lifecycle

TWO ARCHITECTURES

Same protocol. Different architecture.

MICRO MESH

Local. Flexible. Application-focused.

Scale	10s – 100s of nodes
Coverage	Localized · buildings, campuses, sites
Routers	A single border router is usually enough

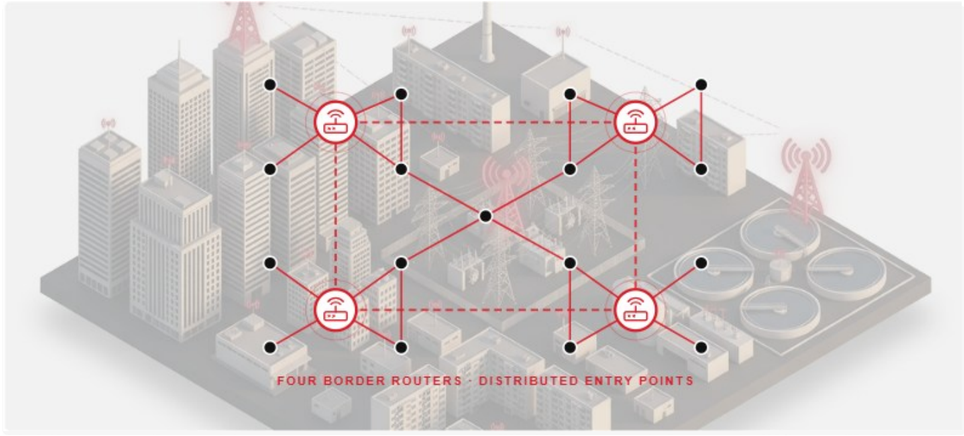
SCALE

LIFECYCLE

INTEROP.

MASSIVE MESH

Wide-area. Resilient. Built for infrastructure.

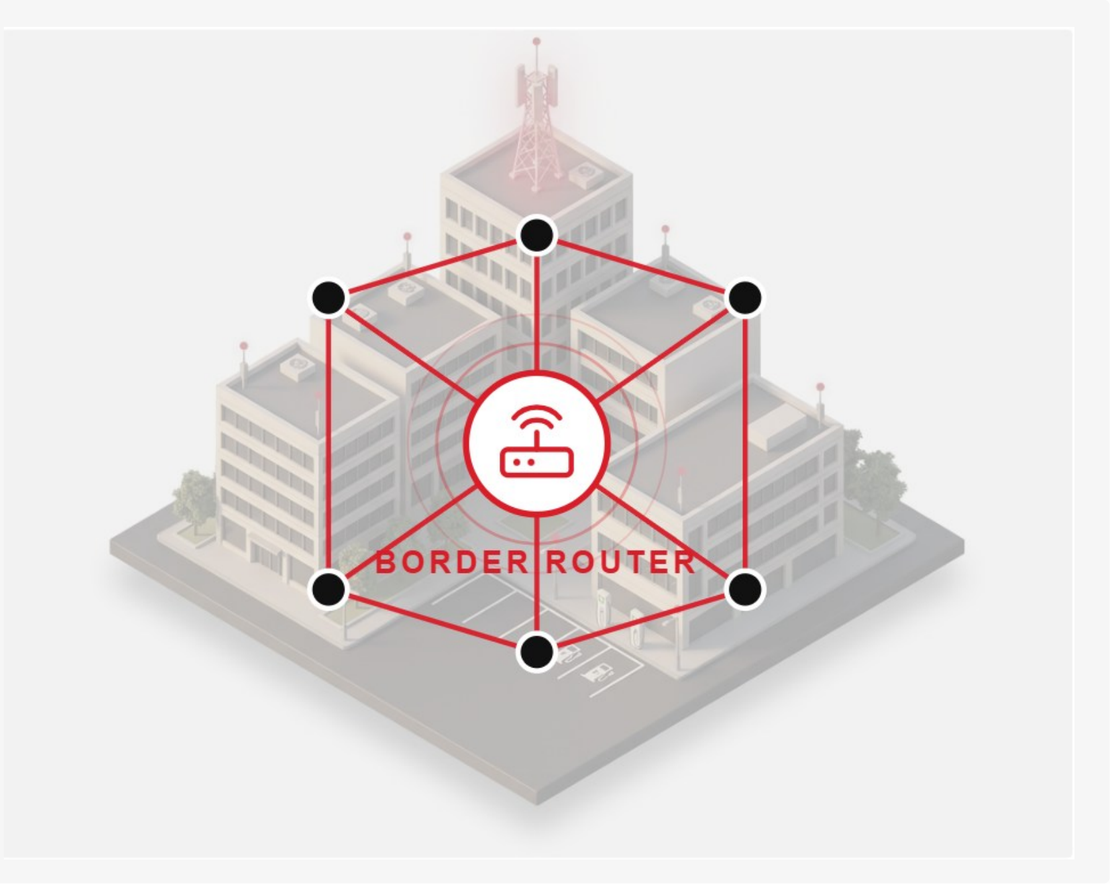


Scale	1,000s – 100K+ nodes
Coverage	Wide-area infrastructure · cities, utilities
Routers	Multiple border routers · redundant entry points

ARCHITECTURE · MICRO MESH

Wi-SUN micro mesh.

Standards-based connectivity, simplified infrastructure, sized for localized deployments.



10s – 100s of nodes

Sized for a single building, campus, or site.

Single border router

One simple gateway typically connects and manages the whole network.

Standards-based interoperability

Mix vendors freely from day one; scale up later without re-architecting.

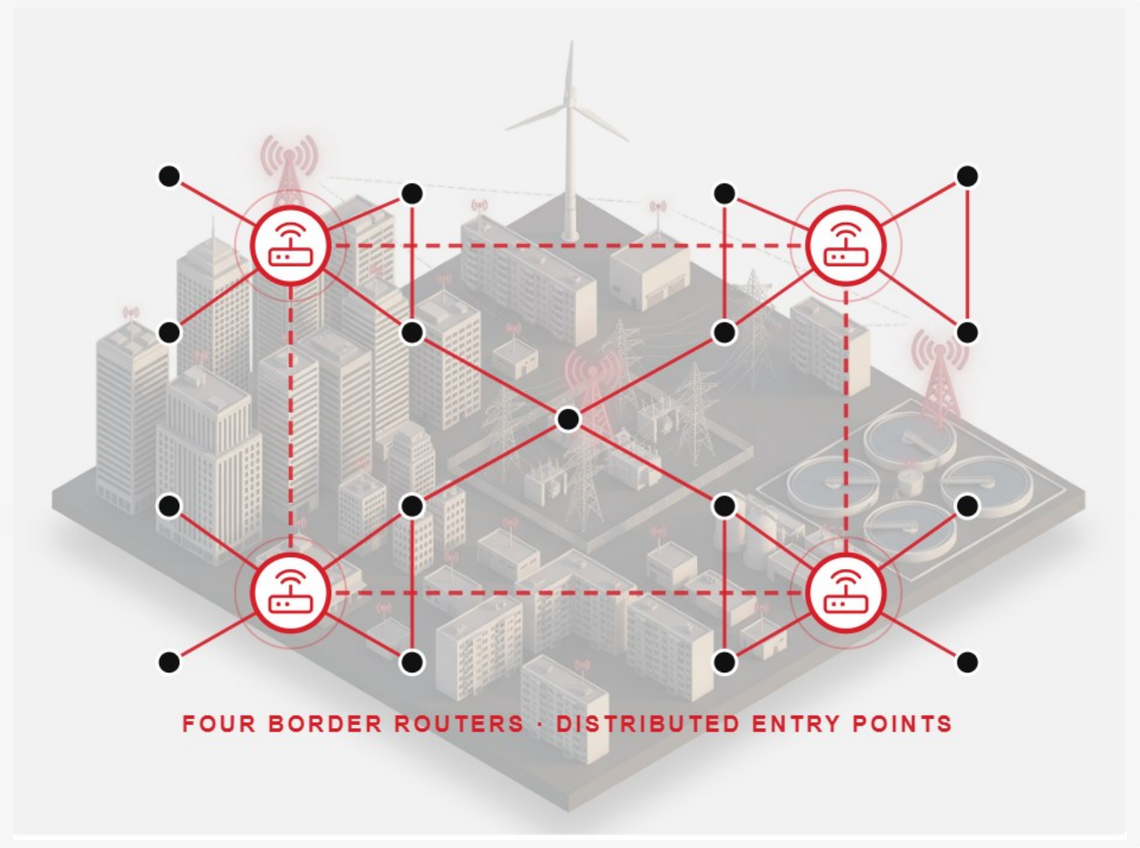
WHERE MICRO MESH FITS

- Commercial buildings
- Campus infrastructure
- EV charging clusters
- Industrial sites

ARCHITECTURE · MASSIVE MESH

Wi-SUN massive mesh.

Distributed infrastructure for thousands to tens of thousands of nodes — engineered for 10–20+ year lifecycles.



1,000s to 100K+ nodes

Proven in 1,000+ node deployments; designed to scale to tens of thousands in a single coordinated mesh.

Wide-area infrastructure

Designed for geographic coverage — cities, utility grids, public networks.

Multiple border routers

Distributed entry points provide capacity, redundancy, and resilience.

Long-lifecycle, mission-critical

Engineered for 10–20+ year deployments with infrastructure-grade reliability.

ARCHITECTURE CHOICE

Choosing your Wi-SUN architecture.

Same protocol underneath. The right architecture — and the right SoC — depends on scale and intent.

WHEN MICRO MESH

Local deployments where simplicity wins.

- 10s – 100s of nodes inside a building, campus, or site
- A single border router is sufficient
- You want flexibility and standards-based interoperability today, room to grow tomorrow

WHEN MASSIVE MESH

Infrastructure-scale deployments built to last decades.

- 1,000s – 100K+ nodes across a city, utility, or region
- Distributed border routers for capacity and redundancy
- Mission-critical, 10–20+ year lifecycles with security and OTA headroom

TOGETHER FG25 + FG28 cover the full Wi-SUN spectrum — from the user-facing edge to the infrastructure backbone.

KEY TAKEAWAYS

What to remember from today.

01 Wi-SUN isn't just a protocol — it's a scalable network architecture.

02 Only Wi-SUN combines interoperability, scale, and longevity in one stack.

03 The same protocol covers micro mesh and massive mesh — same skills, different deployment.

04 EFR32FG25 + FG28 give you the silicon range for both ends of the spectrum.

CLOSING Interoperability is the foundation of long-term IoT success.