

Technical Note – Innovative WLAN Mesh Microinverter

1 Introduction

Microinverters grapple with communication hurdles. Wired PLC systems face grid quality and interference issues, risking data loss. Wireless options have flaws: ZigBee has latency and security gaps, while WiFi struggles with coverage and stability in large setups. Protocol mismatches and weak security further impede smart energy reliability. This context underscores the need for a better solution.

Traditional PLC, Sub 1G, or Zigbee: Need extra network gateway

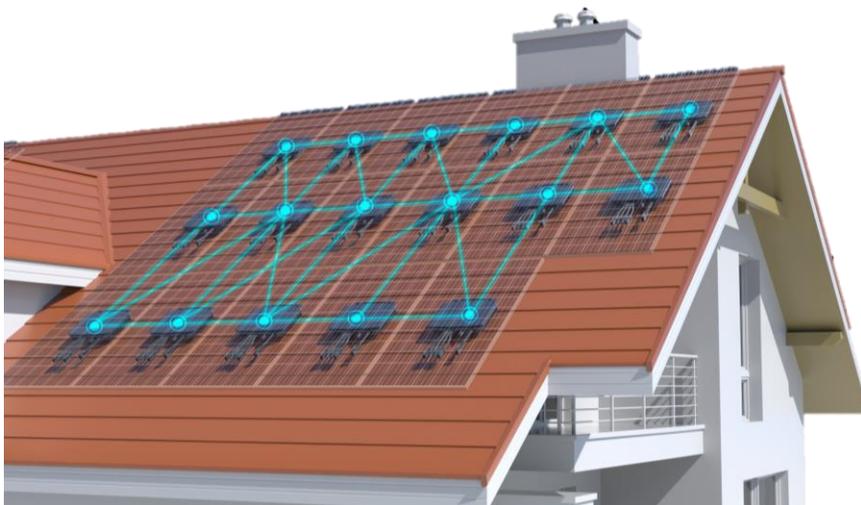
Most microinverters rely on PLC, Sub 1G, or Zigbee communication methods. However, these require specialized network gateways to convert signals that can be understood by routers. These network gateways come at a cost, typically priced from \$100 to \$500, significantly driving up expenses. Moreover, if a gateway malfunctions, the entire system grinds to a halt, highlighting the poor stability of such setups.

Traditional WiFi: Limited coverage and complex commissioning

2.4 GHz/5 GHz WiFi signal attenuation limits indoor coverage to ~30 meters, with >20 dB loss through concrete walls. More importantly, commissioning micro-inverters using this method involves complex manual WiFi connections for each device.

2 Sigenenergy WLAN Mesh Solution

Sigenenergy dares to be the first in the world. We are the first to apply the WLAN Mesh technology to the field of microinverters, and defining a communication protocol that is suitable for the microinverter business.



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This document addresses concerns regarding the communication reliability of WLAN mesh microinverters in distributed energy systems. It clarifies the wider wireless coverage, single-point commissioning, non-gateway system, self-healing topology of our WLAN Mesh microinverter architecture to ensure confidence in its convenience and robustness.

2.1 Expanded Wireless Coverage vs. Limited communication range

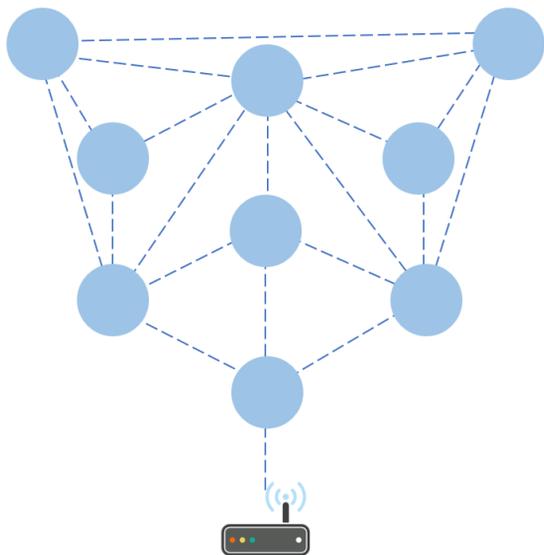
WLAN Mesh ≠ Traditional WiFi

Unlike Traditional WiFi's star-topology network, WLAN Mesh operates on a meshed-topology network.

With Traditional WLAN, each rooftop microinverter must be within direct communication range of the WiFi router, which limits microinverter layout flexibility and complicates router placement.

However, WLAN Mesh technology only requires at least one microinverter near the router to establish communication for the entire system. The WLAN Mesh microinverters act as bridges, relaying messages between each other, resulting in wider wireless coverage compared to Traditional WiFi microinverters.

Sigenenergy WLAN Mesh Mesh Networking, Wider Coverage



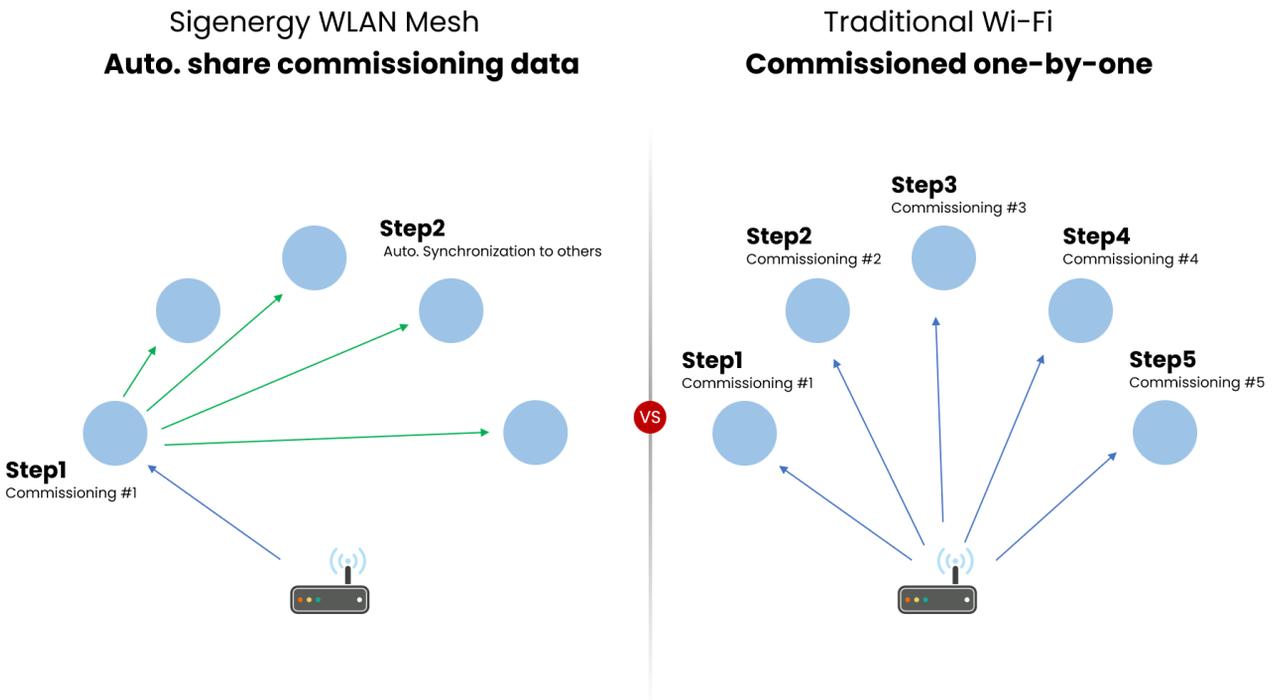
Traditional Wi-Fi Far from router, no signal



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2.2 Single-Point Commissioning vs. Commissioning One by One

With Traditional WiFi microinverters, each rooftop unit must be individually commissioned with the WiFi router, requiring significant manual effort. In contrast, WLAN Mesh microinverters can share commissioning data across the network, meaning only one microinverter needs to be commissioned—the rest synchronize automatically.

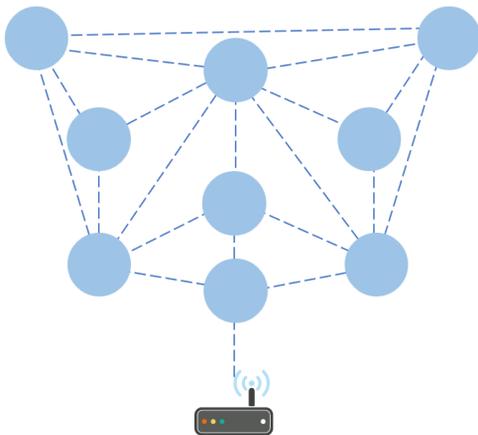


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2.3 Gateway-Free System vs. ZigBee/Sub-GHz/PLC Microinverters

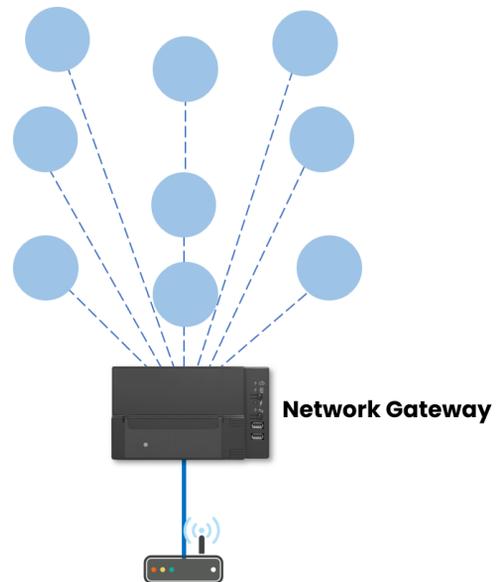
Traditional microinverters using ZigBee, Sub-GHz, or PLC require an external gateway, increasing system cost, installation complexity, and commissioning effort. In contrast, WLAN Mesh microinverters communicate directly with the WiFi router, eliminating the need for a gateway. This makes the system more convenient and cost-effective. Thanks to SigenMicro world-first EMS-inside microinverter technology, the gateway is completely removed from the system, further simplifying deployment.

Sigenenergy WLAN Mesh
Gateway-Free system



Traditional ZigBee/Sub-GHz/PLC
Extra gateway, extra CAPEX

VS



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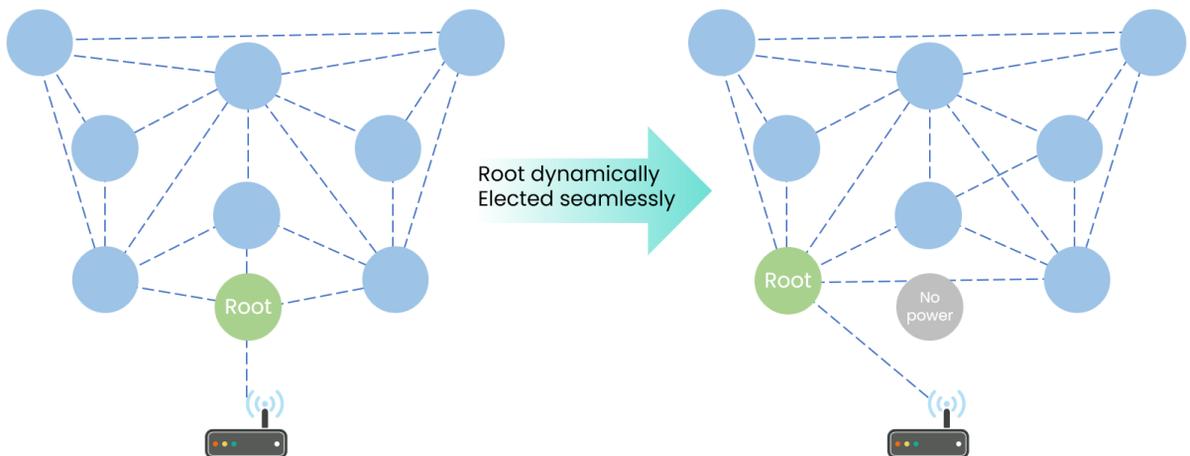
2.4 Self-Healing Mesh Topology

Dynamic routing:

Microinverters form a decentralized mesh network, dynamically selecting optimal communication paths. If a microinverter fails or off, traffic reroutes automatically via alternate microinverters.

Root node dynamic election:

The root microinverter (connects to WiFi router) is also dynamically elected, which ensures optimal communication between microinverters and WiFi router.



WLAN Mesh technology is already applied in home WLAN Mesh router products and industrial scenarios. Sigenergy thinks WLAN Mesh technology perfectly meets microinverter application and brings Capex value and convenience to home-owner and installer.

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3 Build a Stable Communication System

The stability of WLAN Mesh communication in microinverters can be guaranteed through three key mechanisms:

3.1 Extended Communication Range and Optimized Coverage

WLAN Mesh utilizes a multi-hop transmission architecture and dynamic path selection to overcome the physical limitations of traditional WiFi. For example, traditional WiFi typically covers up to 100 meters, but Mesh networks extend this range by allowing data to relay through intermediate nodes, forming a "honeycomb-like" topology. This is particularly advantageous in large-scale photovoltaic installations, such as rooftop solar arrays.

Practical Validation: In the case of SigenMicro Inverter, its integrated WLAN Mesh solution delivers a 1600% increase in coverage area compared to conventional WiFi, ensuring stable communication in large-scale solar power plant scenarios.

Signal Penetration: Nodes dynamically bypass obstructions (e.g., walls or solar panel shading) by selecting paths with optimal signal strength, enhancing reliability in complex environments.

3.2 Dynamic Self-Healing and Topology Optimization

WLAN Mesh networks exhibit intelligent fault tolerance:

Node Failure Recovery: If a microinverter fails due to shading or hardware issues, adjacent nodes automatically reroute data via alternative paths (e.g., shifting from A→B→C to A→D→C). This minimizes downtime with seamless recovery.

3.3 Multi-Layered Anti-Interference and Security Technologies

Sigenenergy WLAN Mesh technology integrates physical and protocol-layer innovations to ensure robustness. This product fully complies with all the stringent requirements of the **EN 18031 cybersecurity compliance**. It establishes a multi-layered protection mechanism covering the entire lifecycle of data transmission, storage, and access, fundamentally safeguarding data integrity, confidentiality, and availability, and effectively ensuring the security and compliance of system data. The relevant **certification number is 18032341 001**, which is verifiable and traceable via official channels.

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4 Why can Sigenergy do it

Sigenergy has become the first in the industry to apply WLAN Mesh technology to microinverters, primarily driven by the following innovative approaches:

4.1 Forward-Looking Technological Strategy

Sigenergy proactively identified the limitations of traditional wired communication solutions (e.g., PLC) in complex scenarios and introduced Mesh networking concepts. By leveraging multi-hop relay technology, they achieved stable signal coverage tailored to distributed energy systems, particularly addressing challenges in multi-node deployment.

4.2 Cutting-Edge R&D Capabilities in Hardware-Software Integration

The company assembled a top-tier R&D team with expertise in communications, internet technology, and AI. This interdisciplinary talent pool enabled the development of novel communication protocols and rigorous validation through extensive testing and simulation environments.

This breakthrough not only resolved long-standing industry issues like communication coverage gaps but also advanced distributed energy systems with intelligent, adaptive features, driving the sector toward higher efficiency and scalability.