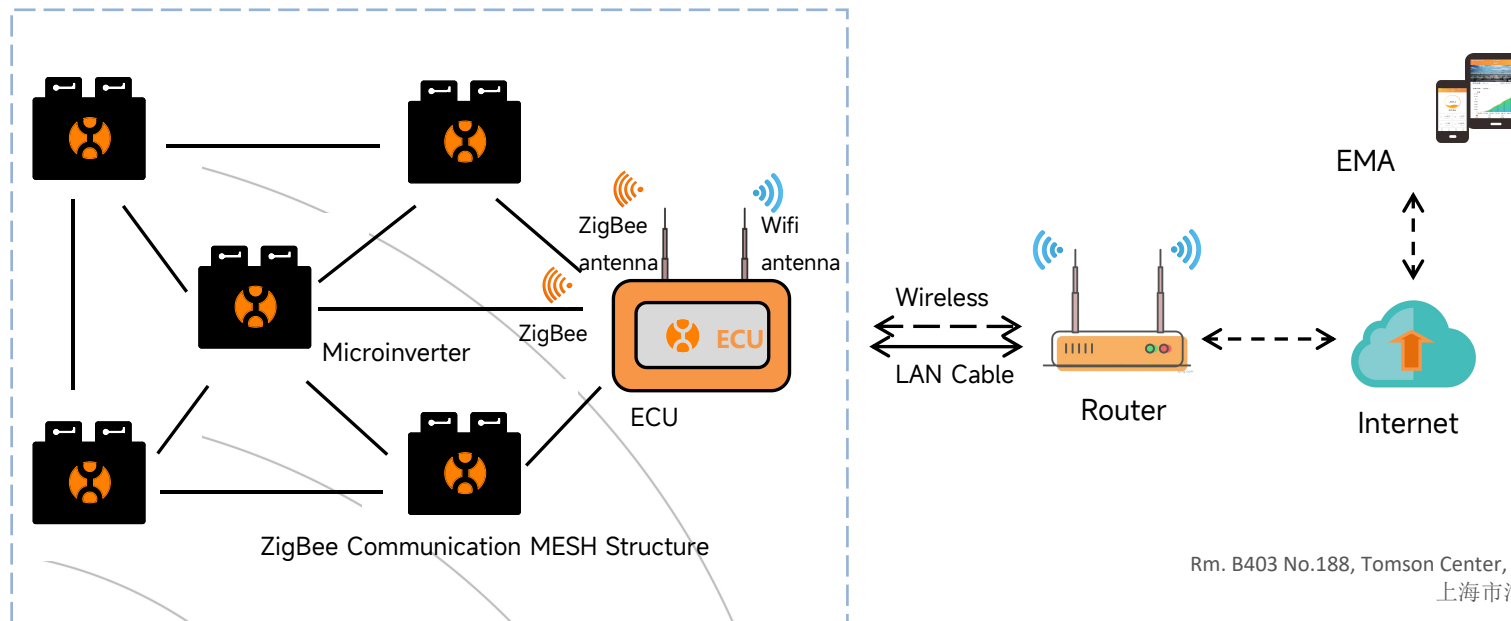# ZigBee Communication White Paper

APsystems Microinverter Communication Solution

APsystems microinverter applies the ZigBee wireless communication mode with the MESH structure. ECU collects the inverter power generation data and send remote control commands to the inverter via ZigBee wireless communication. Both ECU and microinverter have built-in ZigBee modules. Also, microinverter can not only directly communicate with the ECU, but also to each other, which can realize network self-healing, multi-level jump, optimize communication path, and make the whole system be formed into a MESH structure, as shown in the following figure. With the MESH communication network, ECU is connected to the Internet through a router or WIFI and upload the power generation data to the APsystems EMA.

ZigBee
antenna

Wifi
antenna

ZigBee

Microinverter

ZigBee

ECU

ECU

Wireless

LAN Cable

Router

EMA

Internet

ZigBee Communication MESH Structure

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MESH network topology is a very flexible communication mode. When a problem occurs in one inverter, data can be automatically transmitted along the other inverters or directly to ECU.

In addition, ZigBee uses the encryption algorithm is the AES encryption algorithm. AES (Advanced Encryption Standard) is a standard for encrypting electronic data formulated by the American National Institute of Standards and Technology. ZigBee communications use 128-bit keys to ensure the secure transmission of communications. In terms of anti-interference, DSSS in-line spread spectrum is adopted, which has strong anti-interference ability. Also, CSMA-CA mechanism is used, which can effectively avoid communication congestion and has strong system stability.

Comparison of typical communication method

	Wi-Fi	BLE	SUB1G	ZigBee	PLC
Communication Speed	High	Low	Low	Low	Low
Communication Node	Few	Few	Many	Many	Many
Communication security	High	High	User-defined	High	User-defined
Energy consumption	High	Fairly Low	Average	Low	Fairly Low
Features	With few communication nodes, the system can directly access the Internet.	With few communication nodes, the system can communicate with mobile phone.	Poor standardization, applicable to the scenario with many obstacles.	With many communication nodes, the system is applicable to large-scale data acquisition and control.	Poor standardization and limited by electric cable connections.

Application of ZigBee Communication in Microinverter System

The MESH structure ZigBee communication is characterized by multipath, multi-level jump. Therefore, if there are too many inverters (nodes) and the distance is too long, the system will keep conducting channel idle evaluation, path trial and multistage forwarding, which will lead to signal congestion and longer communication cycle.

In consideration of ZigBee communication quality, cycle and based on the actual project experience, it is recommended that 1 ECU monitors 80 microinverters, and with a maximum of 200 APsystems microinverters can be installed on 1 roof.