ORAMA-Net

Connecting deep all

ORAMA-Net is a pure LoRa™-based multi-hop LPWAN protocol that operates as a **mesh, gateway-free, and bi-directional network**.

Thanks to its Mesh topology, ORAMA-Net forms a genuine **Low-Power Wireless Sensor Network (LPWSN)** in which the endpoints (called **NODES**) dynamically build and maintain the network. Instead of relying on traditional gateways, the network uses an extremely lightweight Coordinator **(EDGE)** device whose hardware is very similar to a NODE. A simple platform such as an ESP32-based MCU combined with a Semtech SX1261/SX1262 LoRa transceiver is sufficient.

A single EDGE can support **up to 65,000 NODES within one cluster**. The EDGE only exchanges messages with the NODES registered in its cluster, eliminating the need for a traditional core network infrastructure. In particular, no dedicated Network Server (NS) is required between the network and the Application Server (AS), even when the AS is connected to multiple clusters.

If and when required, ORAMA-Net can also **seamlessly interoperate with legacy LoRaWAN™ deployments**. It supports encapsulation capabilities that allow interconnection with LoRaWAN Network Servers by transporting and meshing native LoRaWAN messages within the ORAMA-Net protocol, with only minimal overhead (i.e.: ORAMA-Net bypasses EU868 1% duty cycle limitation).

Regarding network formation, a NODE periodically listens for a beacon transmitted by the EDGE and relayed through intermediate NODES. Unlike conventional discovery mechanisms, ORAMA-Net NODES remain silent when they are outside any network coverage area. In practice, the network topology is limited to **9 hops** in order to control latency and network size, although this value can be configured between 5 and 15 hops depending on the set-up.

ORAMA-Net's **lean architecture** goes beyond advanced mesh setups **to enable breakthrough corridor LPWAN deployments** of 1,000 km+ (railways, highways, pipelines, energy grids).

Power consumption remains low. The **Wake-on-Radio (WoR)** mechanism consumes **around 25 µAh** typically, thus still enabling long-term autonomous operation.

Thanks to its **truly bi-directional communication**, NODES can be adressed anytime, no matter their status. To do so, ORAMA-Net implements **Listen-Before-Talk (LBT)**, also known as **Polite Spectrum Access (PSA)**, as defined in the ETSI standard. This is combined with an **Adaptive Frequency Agility (AFA)** algorithm that ensures pseudo-random and equiprobable access across all available channels in the operating band, while fulfilling the regulatory duty-cycle limitations associated with ISM bands.

ORAMA-Net provides **symmetrical uplink and downlink throughput**. Traffic arbitration between upstream and downstream communications which is managed through **Time Division Duplexing (TDD)**. In downstream communications, this mechanism guarantees a **maximum latency of approximately 20 seconds** between the transmission of a message by the EDGE and its reception by the NODE located at the outermost layer of the cluster (i.e. : up to 9 hops away, each one typically covering one kilometer or more).

From a security perspective, ORAMA-Net implements a **two-level security architecture**. First, **peer-to-peer (P2P) security** protects communications between the NODE and the EDGE. Each device encrypts, decrypts, signs, and verifies frames using a **Private Network Key (PNK)** unique to each cluster. Any NODE without the correct PNK cannot join the cluster and will be rejected by other NODES.

Second, ORAMA-Net supports optional **end-to-end (E2E) security** to protect communications between the NODE and the Application Server (AS).

ORAMA-Net is a patented Technology *from*

ORAMA-System

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