Patent Claims

➢ **Independent Claim (Main Claim)**

Claim 1 — Offline Self-Learning Artificial Intelligence Mesh Network

An autonomous offline artificial intelligence system, comprising:

(a) at least one **Main Hub** configured to execute artificial intelligence models locally and to generate structured knowledge responses in the absence of internet connectivity;

(b) a plurality of **Mini Hubs** configured to establish local wireless connections with end-user devices and to exchange encrypted data packets with the Main Hub through a long-range communication channel;

(c) a **Knowledge Capsule mechanism**, wherein each query–response pair generated by any hub is converted into a compact data unit containing a semantic embedding, source signature, and timestamp;

(d) a **distributed synchronization protocol** enabling the Mini Hubs to autonomously exchange, verify, and store Knowledge Capsules with neighboring hubs or the Main Hub;

(e) a **local inference module** within each Mini Hub configured to provide fallback AI responses using locally stored models and capsules during periods of disconnection; and

(f) a **secure communication layer** employing authenticated encryption and digital signatures to ensure data integrity, confidentiality, and capsule authenticity within the mesh network;

wherein the system collectively forms a self-sustaining, knowledge-sharing, offline AI network capable of continuous learning and autonomous operation independent of internet connectivity.

➢ **Dependent Claims**

Claim 2 — Capsule-Based Distributed Learning

The system of Claim 1, wherein the Knowledge Capsules are stored in a structured database on each hub, indexed using vector embeddings, and periodically exchanged between nodes based on similarity thresholds or synchronization intervals.

Claim 3 — Local AI Model Integration

The system of Claim 1, wherein each Mini Hub contains a quantized artificial intelligence model configured to perform local inference, generate approximate responses, and update local capsule repositories autonomously.

Claim 4 — Communication Infrastructure

The system of Claim 1, wherein the Main Hub and Mini Hubs communicate via a hybrid network comprising a short-range user access channel (Wi-Fi or BLE) and a long-range low-power link (LoRa or equivalent radio protocol), supporting encrypted packetized data transmission and acknowledgment-based retransmission.

Claim 5 — Capsule Verification and Trust Management

The system of Claim 1, wherein each Knowledge Capsule includes a digital signature generated using an asymmetric cryptographic keypair unique to its source node, and wherein receiving nodes verify said signature before ingestion into the local database.

Claim 6 — Autonomous Synchronization and Recovery

The system of Claim 1, further comprising an offline synchronization module configured to queue unsent queries and capsules during link failure, and to automatically reconcile and update capsule repositories when connectivity between hubs is re-established.

Claim 7 — Adaptive Power and Resource Management

The system of Claim 1, wherein each Mini Hub employs adaptive scheduling, solar or PoE power inputs, and low-power sleep cycles to enable continuous autonomous operation in remote or off-grid environments.

Claim 8 — Capsule Ranking and Validation Algorithm

The system of Claim 1, wherein a ranking algorithm assigns trust scores to Knowledge Capsules based on provenance, reuse frequency, and timestamp, allowing the network to filter outdated or low-confidence information autonomously.

Claim 9 — Multi-Language and Voice Interaction

The system of Claim 1, further comprising offline speech-to-text and text-to-speech modules supporting multiple regional languages, enabling users to interact with the network through voice commands without internet connectivity.

Claim 10 — Domain-Specific Capsule Modules

The system of Claim 1, wherein domain-specific capsule sets (including educational, agricultural, and medical datasets) can be integrated or updated locally to customize the network's knowledge base for sector-specific applications.

Claim 11 — Blockchain-Based Capsule Authentication (Optional Extension)

The system of Claim 1, optionally comprising a distributed ledger component for recording capsule identifiers, signatures, and timestamps to provide tamper-proof provenance and traceability across multiple clusters.