ARC - AI

AUTONOMOUS REGIONAL COGNITIVE ARTIFICIAL INTELLIGENCE

TEAM MESHMINDS

Abstract

ARC-AI introduces a novel paradigm for offline artificial intelligence systems through a decentralized, cognitive mesh network that operates independently of conventional internet infrastructure. The framework integrates edge computing, IoT communication technologies, and localized AI inference to enable intelligent, low-latency interactions in remote or disconnected regions.

The system architecture comprises a Main Hub—a central processing node equipped with local or hybrid AI models—and multiple Mini Hubs, distributed edge units that establish user connectivity via Wi-Fi and inter-hub communication through LoRa or extended-range wireless protocols. Each mini-hub performs data packet encoding, caching, and encryption using AES-GCM, while also supporting lightweight on-device inference through compact LLMs such as TinyLlama or Phi-1.

A core contribution of ARC-AI is its Knowledge Capsule System, a compact, cryptographically signed knowledge representation that enables autonomous inter-hub learning and data propagation. These capsules encapsulate question-answer pairs and their corresponding embeddings, allowing knowledge reuse and synchronization across nodes without requiring a centralized server. The result is a self-learning, adaptive AI mesh capable of improving over time through distributed reinforcement and caching mechanisms.

Experimental implementation in a simulated environment demonstrates the system's ability to process, cache, and relay AI responses entirely offline, with latency maintained within operational bounds for text-based query resolution. Future iterations of ARC-AI will integrate federated capsule learning, multilingual processing, and solar-powered resilience, advancing toward a sustainable and inclusive AI infrastructure for low-connectivity environments.

Keywords : Offline Artificial Intelligence, Edge Computing, IoT Mesh Network, LoRa Communication, Local LLMs, Knowledge Capsule System, AES-GCM Encryption, Distributed Learning, Federated Edge Intelligence, Cognitive Networking