AlexMesh Protocol v1.0

A Modern Layer 3 Alternative for Local and Decentralized Networking

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Abstract

AlexMesh is a novel Layer 3 protocol built entirely over Ethernet (Layer 2), designed for local, decentralized networks without requiring IP addressing, routers, or traditional TCP/UDP stacks. It introduces a self-contained, plug-and-play communication framework where nodes discover, route, and confirm delivery autonomously. This document argues the relevance, advantages, and unique value proposition of AlexMesh compared to the ubiquitous Internet Protocol (IP).

1 Introduction

The Internet Protocol (IP), despite its global dominance, was not designed for modern mesh or ad hoc networks. Its rigid structure, hierarchical addressing, dependency on centralized routers and configuration, and its general overhead make it inefficient or unnecessarily complex in many edge environments — such as IoT networks, private LANs, or secure isolated systems.

AlexMesh emerges as an alternative for those specific scenarios. By operating over Ethernet and bypassing IP entirely, AlexMesh enables a flexible, secure, and low-latency communication layer that is optimized for discovery, routing, and message exchange in local domains.

2 Design Goals and Architecture

2.1 Goals

- Zero configuration
- Fully decentralized peer-to-peer messaging
- Resilience to partial network partitions
- Stateless message routing with TTL
- Built-in delivery acknowledgment (ACK)

2.2 Architecture Overview

AlexMesh operates over Ethernet by defining a custom EtherType (`0x88B5`). Each message encapsulates:

- Source Node ID (6-byte MAC)
- Destination Node ID (6-byte MAC)
- Message Type (handshake, data, ACK, etc.)
- TTL (Time to live)
- Unique Message ID
- Payload

The protocol uses broadcast for discovery and supports store-and-forward logic for routing messages across non-adjacent nodes. All nodes are equal — there are no designated routers.

3 Comparison to IP

Feature	IP (v4/v6)	AlexMesh
Addressing	Requires static or DHCP	Self-derived from MAC
Routing	Centralized (routers)	Distributed, mesh-based
Setup/Discovery	Requires config play, broadcast handshake	Plug
Message Reliability	TCP or custom logic	Built-in ACK
Network Scope	Global + Local	Local only (LAN)
Protocol Overhead	High (IP+TCP headers)	Low (Ethernet + minimal)
Suitability for Mesh	Poor	Excellent
NAT/Firewall Issues	Common	None (layer 2 only)

4 Use Cases

- IoT networks where IP is overkill or unavailable
- Environments with isolated or air-gapped LANs
- Temporary or mobile mesh networks (e.g. disaster zones, military comms)
- Home automation systems requiring local-only secure comms
- Teaching and experimentation with Layer 2/3 concepts

5 Limitations

- No compatibility with IP-based internet traffic
- Not suited for wide-area or global-scale networks
- Security features such as encryption are not included in v1.0
- Requires raw socket access (root privileges)

6 Conclusion

AlexMesh rethinks what it means to communicate on a network. By discarding IP, it removes unnecessary layers for local and edge communication, offering a lean, direct, and robust solution for a modern class of decentralized, self-organizing systems. As IP continues to dominate the global internet, protocols like AlexMesh may be better suited to the intelligent, private, and local networks of the future.