

# BRIDGING THE MESH

Connecting AREDN & Meshtastic for Oklahoma's Resilient Communications Future

Presented by - Roy Hooper "Hoop" KJ5IUL

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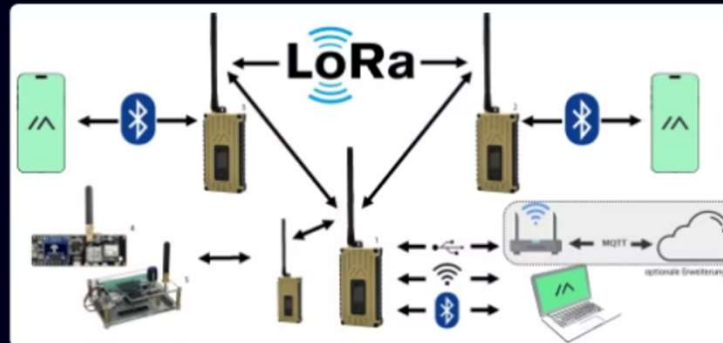
# AREDN and MESHTASTIC



## AREDN Mesh

A high-bandwidth, infrastructure-based network utilizing ham radio frequencies. Operates on microwave bands (2.4GHz, 5GHz) with directional antennas providing backbone connectivity across longer distances.

Perfect for bandwidth-intensive applications, web services, video streaming, and establishing reliable fixed network points during emergencies.



## Meshtastic

A low-bandwidth, highly mobile peer-to-peer network utilizing LoRa technology. Operates on ISM bands with compact, portable nodes that can cover surprising distances with minimal power.

Ideal for text messaging, GPS position sharing, sensor data, and rapidly deployable communications where infrastructure is unavailable or damaged.

# Both Networks Have Blind Spots

## AREDN Limitations

- Requires ham license and technical expertise
- High power consumption limits deployment options
- Fixed infrastructure vulnerable during disasters
- Complex setup creates adoption barriers

## Meshtastic Gaps

- Limited bandwidth restricts data-heavy applications
- No native web or IP-based services
- Isolated islands without broader connectivity
- Short range in urban environments

## Hybrid Solution

Combined networks leverage complementary strengths:

- AREDN's bandwidth with Meshtastic's mobility
- Fixed infrastructure plus rapid deployment capability
- Accessible entry points feeding robust backbone



# The Gaps Are Clear. The Time Is Right.



**AREDN mesh exists—but is underutilized**

Powerful backbone infrastructure  
with limited adoption across the state



**Meshtastic growing—but fragmented and isolated**

LoRa nodes popping up everywhere  
without coordination or integration



**We have the gear, the people, and the opportunity**

Oklahoma's ham community has  
everything needed to create  
something revolutionary

What we're proposing is a way to unify isolated infrastructure into a truly useful mesh—with edge devices, services, and real-world utility. It's time to connect it all into something meaningful.

# The Power of Adding Sensors to Meshtastic



## Sensor Expansion

Meshtastic nodes become powerful data collectors when paired with simple sensors. One node can monitor multiple environmental factors simultaneously.

Each sensor extends the network's utility beyond just communications.

## Environmental Monitoring

- Air quality, temperature, and humidity tracking
- Flood detection at low water crossings
- Smoke sensors for wildfire early warning

## Security & Safety

- Motion detection for remote properties
- GPS tracking for critical assets
- Entry detection for secure locations

Runs for weeks on a single battery. Solar-rechargeable options extend deployment indefinitely.





# AREDN Features and Tools

## MeshChat

Simple text relay system that works across the entire mesh, enabling communications without internet connectivity.

- Text-based messaging
- Works on any browser
- Low bandwidth requirements

## VOIP/SIP

Field-to-command voice routing creates reliable voice communications channels when traditional systems are down.

- Digital voice
- Point-to-point calling
- Intercom functionality

## Visualization & Processing

Node-RED and Grafana provide real-time visualization and event processing capabilities without external dependencies and could be ran on Raspberry Pi to support

- Data flow automation
- Custom dashboards
- Alert systems

AREDN isn't just routing—Anything you can run over IP you can run on AREDN. All of these tools are available right now, ready to be integrated into our hybrid mesh strategy.

# Two Networks. One Unified Flow.

## AREDN

Command & control layer that hosts dashboards and services. Provides the speed, bandwidth, and full IP stack needed for backbone operations.

- High-bandwidth data transport
- Reliable infrastructure backbone
- Supports web services and apps

## Meshtastic

Local, low-power mesh messaging and sensor data network. Excels with reach, accessibility, and off-grid strength.

- Long battery life
- Low cost of entry
- Growing adoption rate

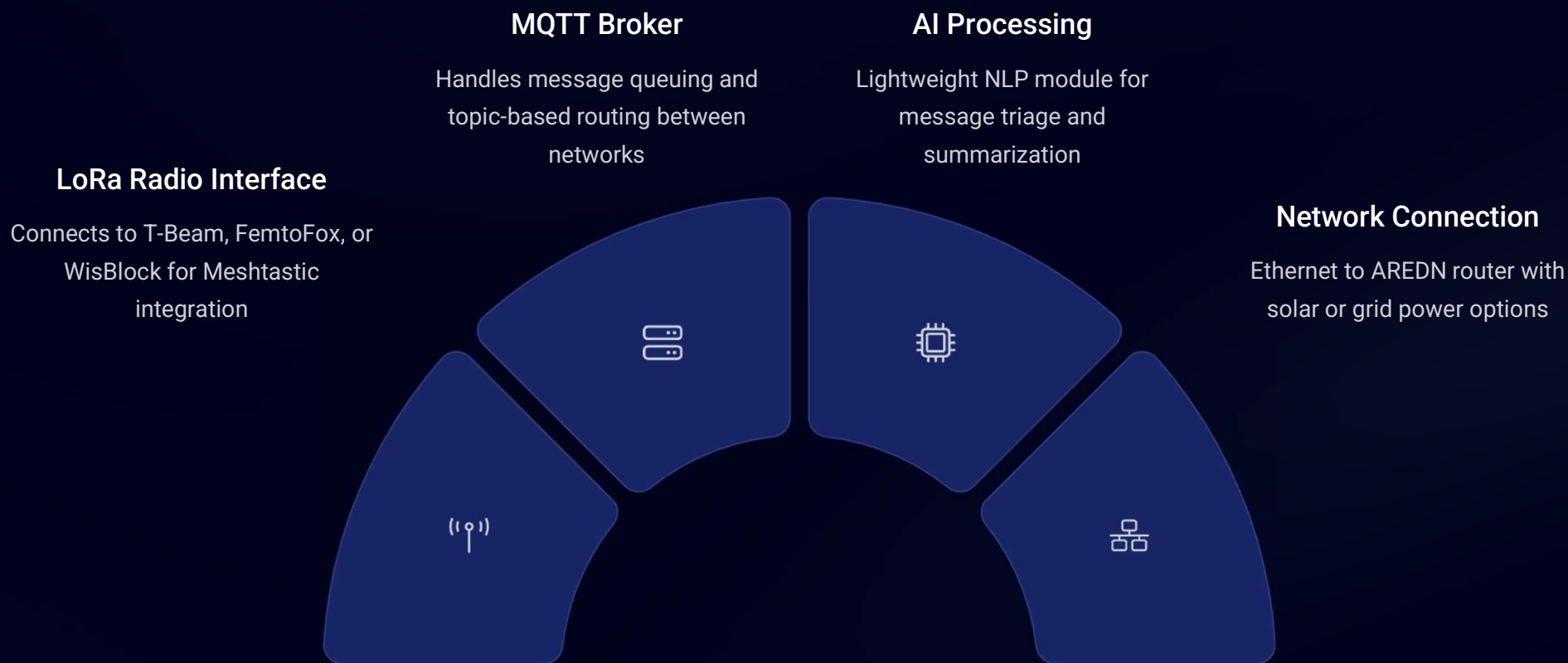
## The Bridge

Raspberry Pi Gateway connects both networks via MQTT, while AI/ML at the edge triages & summarizes data before rebroadcast.

- Protocol translation
- Smart message routing
- Efficient data handling

Example Flow: Flood sensor → LoRa message → Mesh Gateway → AREDN backbone → Emergency alert system

# The Raspberry Pi: Our Swiss Army Knife



The core idea is to use a Raspberry Pi gateway that links both networks using MQTT. But it's not just a bridge—it's also a brain. We're embedding local AI that listens to messages, classifies them, and decides what needs action



# How Messages Could Move through this Network

The bridge creates seamless communication between AREDN and Meshtastic networks through a simple Raspberry Pi and standardized protocols.



## AREDN to Meshtastic

- AREDN node sends HTTP POST to Pi
- Pi publishes to "from\_aredn" MQTT topic
- Subscriber forwards to Meshtastic API

## Meshtastic to AREDN

- LoRa device connects via serial connection
- Pi publishes to "from\_meshtastic" topic
- Delivered to MeshChat or Node-RED

## AI Enhancement Offline LLM

- Run TinyLLaMa/ Phi-2
- Flags critical messages automatically
- Summarizes reports and answers local queries
- No Cloud dependency

# MeshBridge Unit (MBU) - "The Experiment"

## 🧠 Edge Intelligence

reComputer R2130-12 (Raspberry Pi 5 + Hailo-8) runs local LLMs and Python automation.  
~\$249.00 Seeed Studio

## 📶 Dual Radio Connectivity

FemtoFox for LoRa (Meshtastic) + MikroTik/Ubiquiti for AREDN IP backbone

## 🔄 Bidirectional Message Flow

MQTT handles routing between LoRa and IP services (MeshChat, dashboards)

## ☀️ Off-Grid Ready

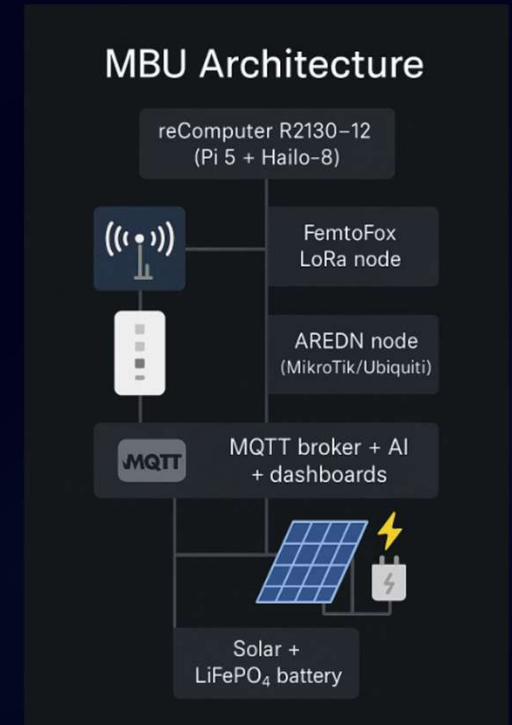
Powered by solar and LiFePO<sub>4</sub> batteries for field resilience

## 🏠 Node Services

Hosts MQTT broker, AI triage scripts, and local dashboards

## 🔓 Open Source and Modular

Easy to extend, replicate, and adapt for any field or rooftop deployment



At the heart of our MBU is the **Hailo-8 neural processor**—a low-power, high-performance AI accelerator that brings real-time decision-making to the edge, without needing cloud access. It's pronounced '**Hey-low**,' and it's built to run lightweight models like TinyLLaMA efficiently on-site.



# When It Counts: Rapid Coordination, Minimal Infrastructure



## Field Report

Meshtastic node sends "Building collapse, 2 trapped" from disaster site



## Smart Gateway

Pi Gateway triages message importance and publishes to AREDN MeshChat



## Command Center

EOC receives alert, coordinates response, sends back instructions



## Field Teams

Updated information rebroadcast to LoRa mesh keeps everyone informed

In a blackout or disaster, time is everything. With this setup, LoRa field messages reach the EOC via AREDN in seconds. Dashboards light up. A reply can be injected back into the local LoRa mesh—no internet needed. This creates a resilient communication backbone when traditional systems fail.



# The Mesh That Works Every Day

## Environmental Monitoring

Weather & air sensors feed data to AREDN dashboard for community access



## Community Information

Bulletins and local announcements pushed to Meshtastic users



## Knowledge Base

Queries to local wiki generate responses via MQTT without internet




## Group Communications

MeshChat threads from AREDN push important updates to field LoRa devices



This isn't a system that sleeps until disaster strikes. It works 24/7, providing community value through environmental monitoring, local information sharing, and offline-first communications that build familiarity and expertise among users.



# FIXING THE ENCRYPTION ISSUE



## Ham Channel with Published Key

Our preferred approach. Key available to all.



## Unencrypted Channel Option

Alternative for strict Part 97 compliance.



# FCC Part 97 Compliance: Mesh Network Encryption

Our hybrid AREDN/Meshtastic system ensures regulatory compliance while maintaining network integrity. Here's how:

- **Part 97 Challenge:** Amateur radio transmissions cannot use encryption that obscures meaning from regulatory authorities
- **Public Shared Key Solution:** Using a network-wide published key maintains regulatory transparency while protecting against casual interference
- **Unencrypted Channel Option:** Fully unencrypted communications remain available for maximum accessibility and compliance
- **Data Integrity Without Secrecy:** Our approach focuses on message integrity rather than secrecy—distinguishing between privacy and encryption
- **Community Compliance:** Documentation includes published keys and clear guidance for all operators to maintain Part 97 compliance

# Start Small. Build Big.

## Home Testing

Start with Pi + Meshtastic + AREDN tunnel at home to prove the concept and work out initial connectivity issues.

## Service Integration

Add Node-RED, MeshChat, and local MQTT broker to establish the service framework for information routing.

## Strategic Deployment

Deploy rooftop supernodes at Strata Tower (OKC), OU Physical Science (Norman), and the Grain Elevator (Edmond) to create the backbone.

## Community Expansion

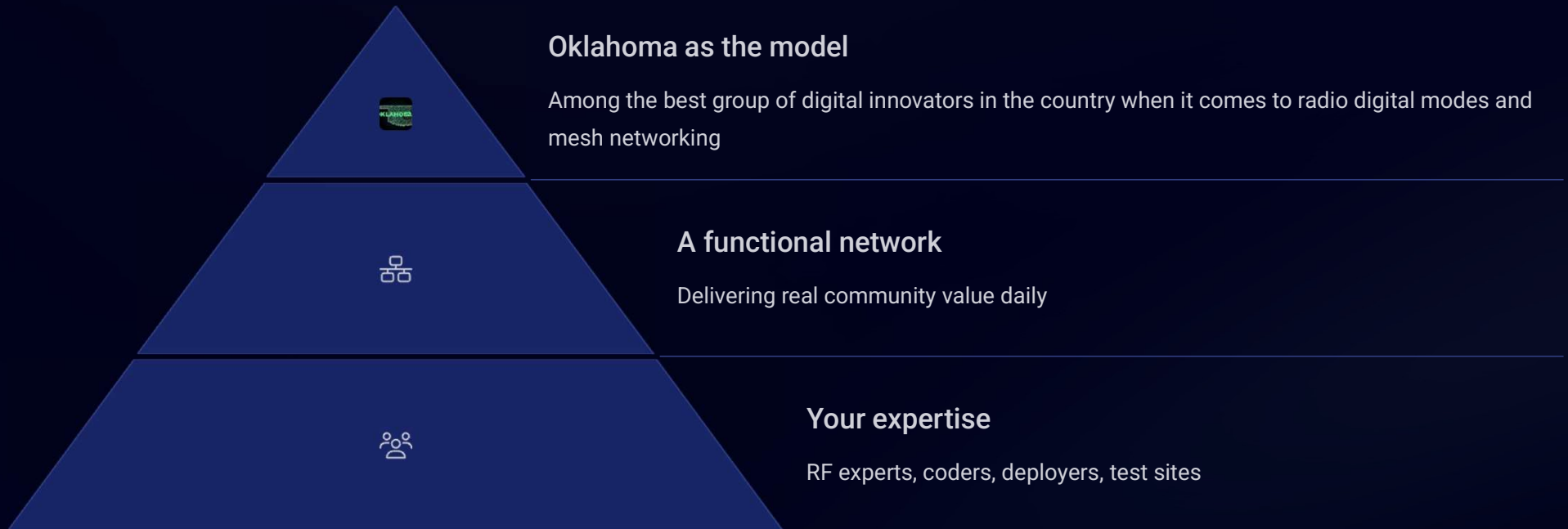
Recruit volunteers for edge coverage to fill in gaps and provide the mesh density needed for reliable operation.

## Iteration

Field test the network under various conditions, refine based on real-world performance, then scale to wider coverage.

First step is to prototype and develop the solution, then test and deploy. With your help, we can expand this quickly across the metro area. The goal is a living mesh spanning the metro area and beyond—with smart nodes and responsive services.

# This Is a Prototype. You Make It Real.



This is where I stop pitching and start recruiting. We need coders, scripters, network experts, and folks who just want to see this work. The building blocks are real and available now.

We've got the vision. We've got the gear. And with your help, we can make Oklahoma the epicenter of what amateur mesh networking can become. This isn't a tutorial—it's an invitation to revolution. Let's build something extraordinary together.

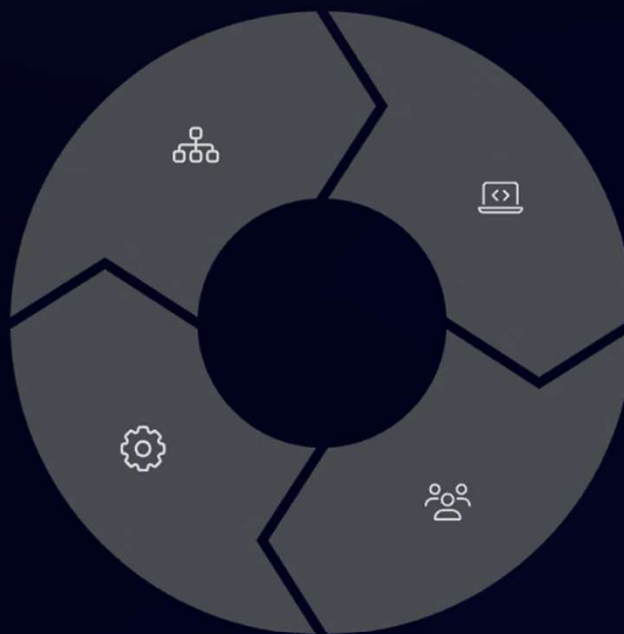
# WHERE WE NEED YOUR EXPERTISE

## Network Design

Planning wireless networks, understanding radio frequencies (e.g., LoRa, Wi-Fi), configuring mesh topologies, and optimizing signal range and reliability.

## Hardware

Installing and maintaining radio equipment (e.g., AREDN dishes, Meshtastic radios), wiring power systems (batteries, solar), and troubleshooting electronics



## Software Development

Writing Python scripts, working with MQTT and APIs, integrating AI models (e.g., via Hugging Face), and debugging code for real-time messaging

## Community

Organizing events, teaching others (e.g., ham radio basics), promoting the network, and recruiting volunteers to host nodes

# The Twist: Adding Voice Infrastructure to MeshBridge Units

- UHF DMR Repeater (BrandMeister)
- AllStar Analog Node
- AREDN Mesh Node

MeshBridge Units evolve from data relays into voice-capable command hubs.

These integrated systems share power and networking resources at strategic locations.





# Real-World Deployments: This Works Today



## AH6LE (Oregon)

AllStar nodes linked entirely over AREDN mesh with zero internet dependency, proving complete off-grid voice communications.



## N4TDX (Florida)

BrandMeister DMR repeaters using AREDN mesh as backhaul, enabling digital voice across expanded coverage areas.



## W2YMM (New York)

SHARI AllStar node with DVSwitch bridge creating seamless analog-to-DMR linking for cross-platform communications.

**The technology isn't theoretical — it's proven in the field right now.**



# Future Vision: Voice-Aware Mesh Networks

During disasters like tornados, our integrated mesh becomes a lifeline. Different modes work as one unified system.



## Meshtastic Sensors

Deploy sensors that monitor conditions and relay text updates through the mesh.



## DMR Field Reports

First responders use handheld radios to report incidents directly into the network.



## AllStar Voice Coordination

Command centers coordinate response efforts via voice channels across the mesh.



## AI Voice Transcription

"Help at 5th & Lincoln!" automatically becomes data, published via MQTT to MeshChat.

**Different modes, one network, smarter together.**

# Today's Youth = Tomorrow's Engineers

Join us in creating Oklahoma's resilient community mesh network. Learn real-world engineering while building something that matters.

- Master wireless networking and LoRa protocols
- Develop Python and Node-RED programming skills
- Design AI-powered local applications
- Build solar-powered field nodes
- Create infrastructure that works **without** the cloud

We're not just building networks. We're building the next generation of network builders.

