# ResilientP2PTestbed

## An Off-Grid Disaster Recovery Communication System

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Date: December 10, 2025

# Outline

# Problem Statement

- **Scenario:** Natural disasters (earthquakes, floods) destroy critical infrastructure.
- **Impact:** "Golden Hour" rescue efforts are hampered by lack of communication.
- **Gap:** Satellite phones are scarce; existing consumer apps lack robust mesh routing.

# Proposed Solution

- **ResilientP2P**: Smartphone-based mesh network.
- **Core Tech**: Google Nearby Connections (Wi-Fi Direct + BLE).
- **Topology**: `P2P_CLUSTER` (Many-to-Many).
- **Features**:
  - Zero Infrastructure Required.
  - High Bandwidth (Voice + Data).
  - Self-Healing Routing.

# System Architecture Diagrams

The system design is captured in the following diagrams. Click to open.

- Class Diagram (PDF) - Core application structure.
- Use Case Diagram (PNG) - Survivor/Rescuer interactions.
- Sequence Diagram (PDF) - Connection establishment flow.
- Swimlane Diagram (PDF) - Component interaction and threading.
- Database Schema (PDF) - Room database ERD.

# Implementation Details

## Mesh Routing
Flooding protocol with TTL limits and Message ID caching to prevent broadcast loops.

## Zombie Detection
Heartbeats Sent every 5s. Peers disconnected after 30s inactivity.

## Audio
16kHz PCM Audio Chunks transmitted over Wi-Fi Direct.

# Performance Results

- **Range**: 40m (Indoors), 100m (Outdoors).
- **Latency**: Voice $< 200$ms per hop.
- **Stability**: Successfully maintains cluster of 4+ devices.

**Conclusion**: A functional, high-bandwidth off-grid mesh system running on standard Android hardware.
**Future Work**:

- End-to-End Encryption (ECDH).
- Optimized Routing (DSR/AODV).
- Integration with LoRaWAN gateways.

# Thank You!

We welcome your questions and feedback.