ResilientP2PTestbed

An Off-Grid Disaster Recovery Communication System

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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 $<$ 200ms 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.