

DESIGN REVIEW

A4 - RESQ

Autonomous Indoor Search &
Temporary Communications

Ishaan Verma
Raghav Srinivasan
Mehaan Shah

Gemini was used to style slides, and
create the visual on this page



REQUIREMENTS

Use Case & Success Criteria

PRIMARY USE CASE: The rover autonomously navigates a controlled 100m² indoor environment and reports the location of one cooperating device to responders.

≥ 90%

Floor mapped

Within 10min,
100m²

≤ 0.5m

Map error

Walls & major
obstacles

0

Contacts

Across 10 runs

≥ 30min

Run time

On one charge

≥ 95%

Link availability

Max outage ≤ 5s

≤ 10s

Device detection

At least 9 out of 10
placements

≤ 1m

Device position error

At least 9 out of 10
placements

Use Case to Design Requirements

RESQ Rover

- ≤ 0.815 meters wide
- Carry ≥ 3 RESQUBES
- Connect to the mesh network hosted by the RESQUBES
- Localize own position to ≤ 0.5 meters error
- Traverse at ≥ 0.5 meters per second
- Robust hazard detection

RESQUBES

- Connect to ≥ 2 other RESQUBES
- Connect to either a firefighter tablet or a victim's device
- Detect and transmit the distance from it to a victim device (≤ 1 meter of error)

Autonomous Navigation & Mesh Network

RESQ Rover

- Deployed on arrival
- Autonomously navigates floor
- Gathers mapping & hazard data
- Dispenses communication RESQUBES

RESQUBES

- Deployed to locate victims
- Mesh network bypasses walls & obstacles
- Creates communication link: tablet to victim

Considerations

**Public
Health/Safety**

Economic

Verification & Testing Plan

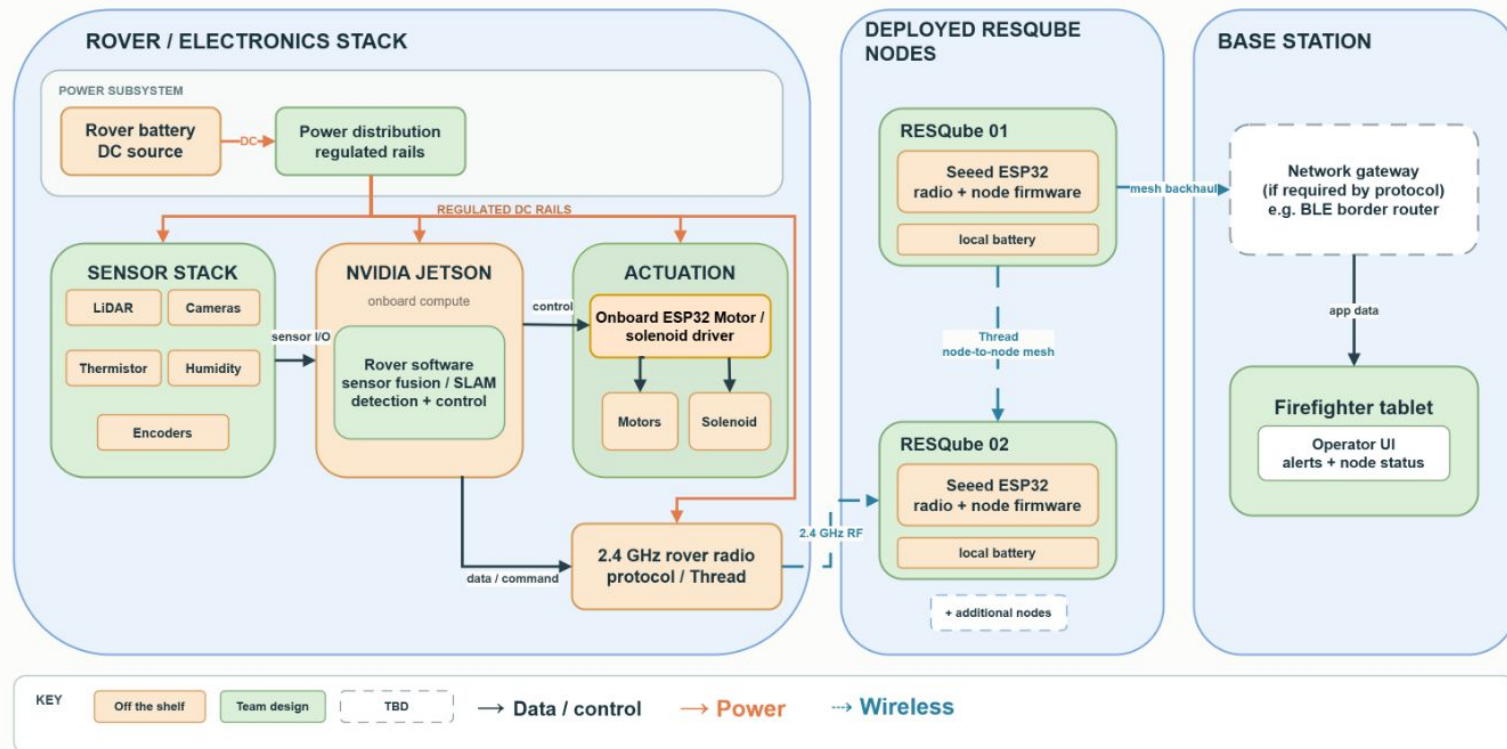
RESQ Rover

- 10 trial testing with varied wall layouts
- Measure object collision counts
- Evaluate floor coverage across 100 m² area
- Assess generated map accuracy vs. actual wall dimensions (use MSE to quantify error)

RESQUBES

- Positioning accuracy testing (3 nodes vs. ruler ground truth over 10 trials)
- Measure victim location error via distance formula
- Vary node spacing & wall count per trial
- Evaluate mesh integrity by monitoring dropped packet rates

System Architecture



Hardware Choices

RESQ Rover

- **Jetson Orin Nano:** High-speed sensor ingestion, computation & SLAM
- **Waveshare 6×4 Chassis:** Aluminum body with antenna & encoder motors
- **RPLiDAR:** SLAM mapping & obstacle detection
- **Wheel Encoders:** Precise odometry tracking
- **Camera:** Real-time operator telemetry

RESQUBES

- **SEEED Xiao ESP32C6:** Multi-mode connectivity (WiFi, BLE, Thread, Zigbee) & low power
- **3.7V 500mAh Battery:** Compact size, >30 min max-load runtime
- **3D Printed Chassis:** Minimal 2.4GHz signal attenuation

Software Decisions

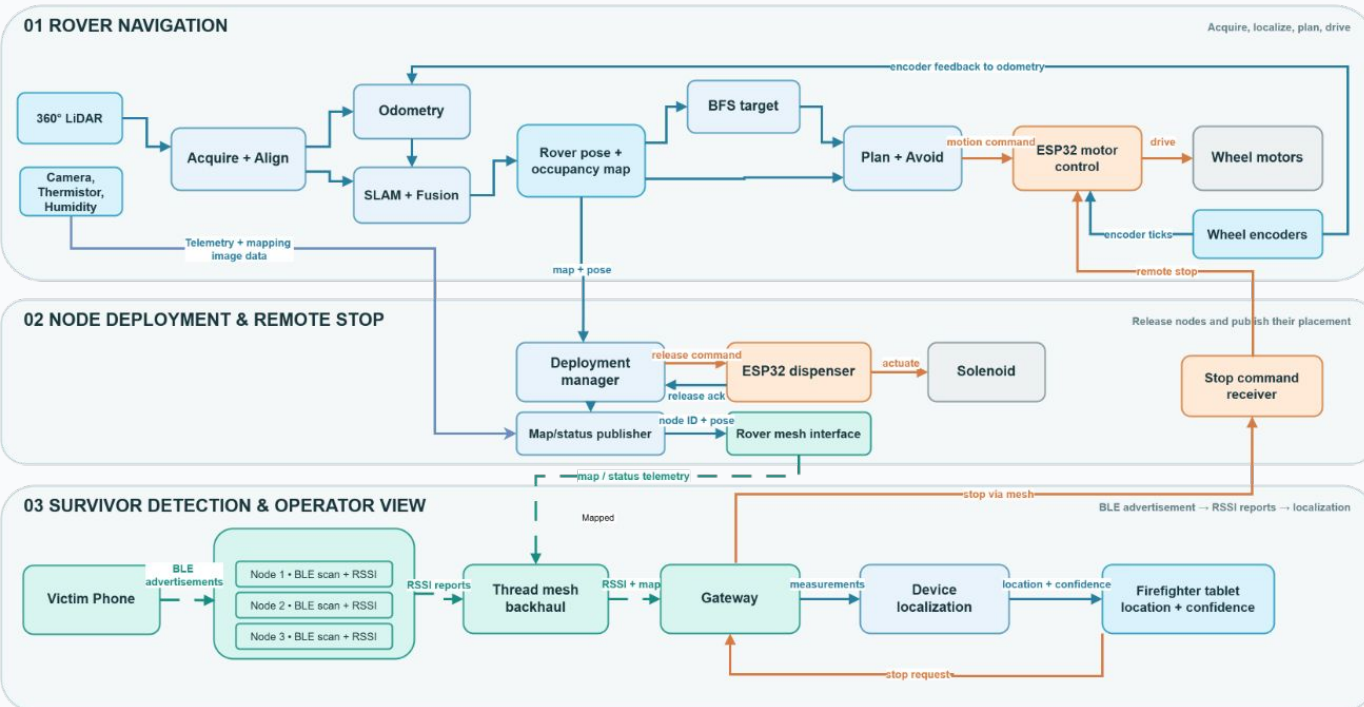
RESCUE ROVER / FUNCTIONAL FLOW

SENSING → NAVIGATION → DEPLOYMENT → SURVIVOR SIGNAL → OPERATOR RESPONSE

Sensor data

Commands

Wireless



Technical Risks & Mitigation

Phone Detection & Mesh

TARGET

$\leq 10s$ detection | $\geq 95\%$ link availability

MITIGATION

Optimize node spacing across coverage area

Indoor RF Location

TARGET

Position error $\leq 1m$ across layouts

MITIGATION

Add nodes & stronger antennas

Autonomous Navigation

TARGET

90% reach in ≤ 10 min | 0 contacts

MITIGATION

Increase clearance & reduce rover speed

Power Under Full Load

TARGET

≥ 30 min drive, map & comms

MITIGATION

Resize battery or reduce compute



RESQUBE Compute -
SEED XIAO ESP32C6



Premade Chassis w/ Motors &
ESP32 Motor Controller



Schedule & Ownership

