

CODENet by Team HackTampa

Covert On Demand Network



The Team

Bill Shaw: MeshNode Architect,
Networking, Prototype
Fabrication

Jon Adair: LeafNode Architect,
RF Guru, Prototype Fabrication

The Code

<https://github.com/TampaHackerspace/CODENet>

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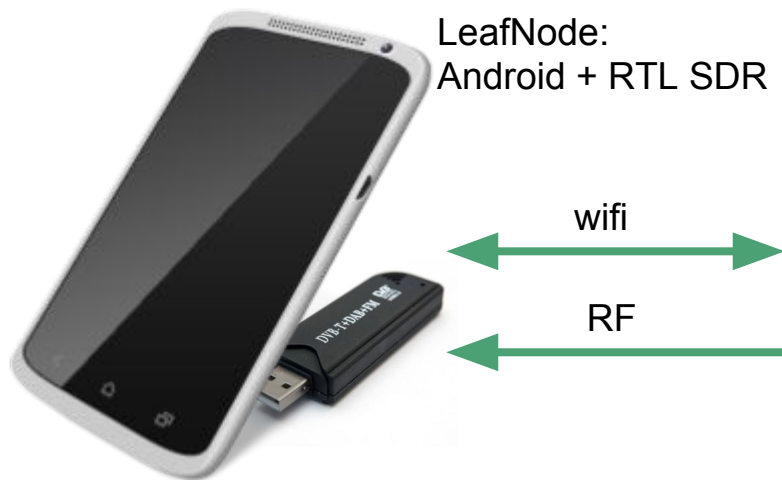
Version 3, 29 June 2007

Design Goals

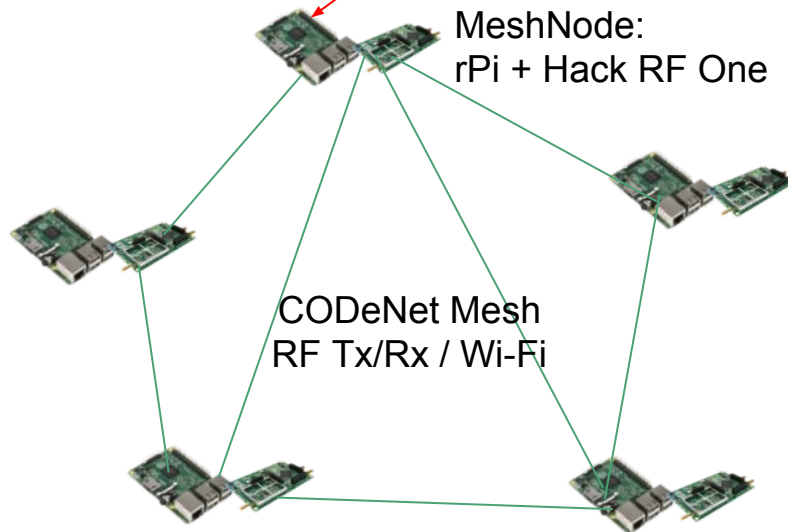
- ✓ Open Architecture
- ✓ Covert form factor
- ✓ Offline mapping
- ✓ Navigation
- ✓ SDR / Smartphone integration
- ✓ Two-way messaging
- ✓ Mesh infrastructure with global uplink capability



Architecture



CODeNet LeafNode
RF Rx / Wi-Fi



P2P Stack

- Raspberry Pi v3 + HackRF One SDR
- Babel Mesh Protocol
 - Used between MeshNodes
 - Currently via Wi-Fi
 - Planned via Hack RF One
- P2P over IPFS for data sharing
- Strengths
 - Robust and efficient on both wireless mesh networks and wired, structured networks
 - Support for double-stack (IPv4 and IPv6) networks
 - Support for source-specific routing for multi-homing
 - Small implementation, suitable for embedded systems
 - Fast convergence when topology changes
- Capable of multiple uplinks to global networks



MeshNode Deployment

- Geo-marking
 - Deployer marks location for later syncing
 - Embedded GPS
- Deployment options
 - Human (node requires power source for longevity)
 - RC Drone
 - Batteries to payload weight limit
 - Recoverable
 - Repositionable
 - Mobile (rechargeable via pedal generator)



Mobile MeshNode

Antenna

- Hide anywhere

- Most common form of transportation
- Nondescript
- Rechargeable system

MeshNode

Could also be:

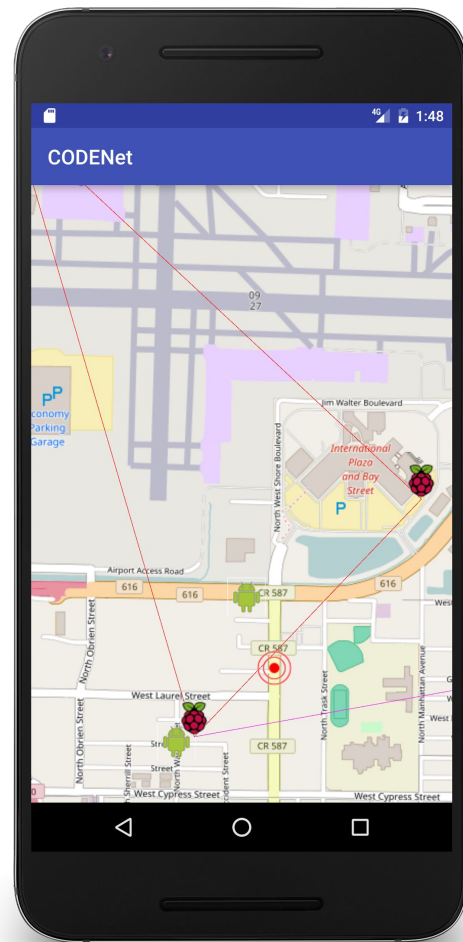
- Water bottle
- Basket

Battery pack with generator inside frame.



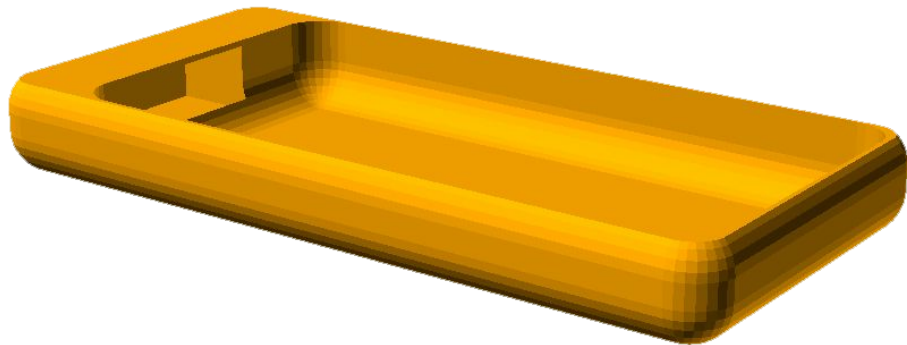
LeafNode - Mapping Application

- OpenStreetMap Foundation
- Locally cached mapping data
- Display markers for known MeshNodes
 - Heading and Distance from current location for navigation
- Display general position of other users from Recent Check Ins
- Can receive real-time updates through RF / SDR
 - New MeshNode deployed
 - Short text messages
 - Updated locations of other users

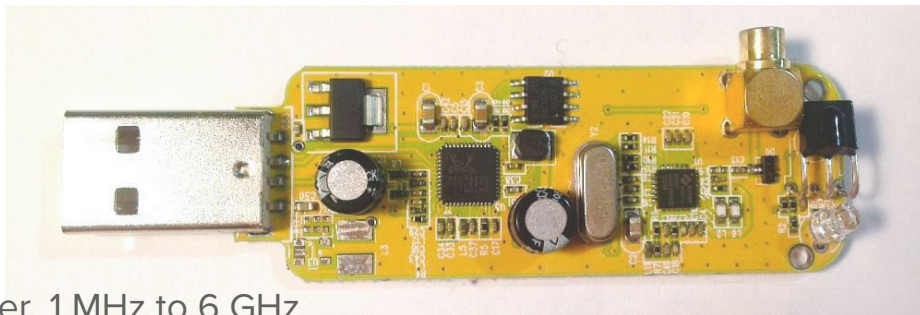


LeafNode - Android SDR Physical Integration

- 3D Printed false battery extender case
- Hidden OTG Cable, RTL2832U SDR Dongle, Antenna
- RF Service processing SDR samples
 - AFSK data on predetermined frequency
 - New MeshNodes appear on map in real time
 - Short text messages



RF / SDR Details



- MeshNode - Raspberry Pi
 - HackRF One - \$300, half-duplex transceiver, 1 MHz to 6 GHz
 - Transmit-only in our current use
 - GnuRadio
- LeafNode - Android Phone
 - RTL2832U SDR - \$20, 64 – 1700 MHz
 - Receive-only
 - Martin Marinov's rtl_tcp and libusb-1.0 port for Android
https://github.com/martinmarinov/rtl_tcp_andro-
- Initial implementation
 - 433MHz
 - Audio Frequency-Shift Keying over FM modulation

LeafNode Operation via RF / SDR

- Receives short messages
- New MeshNode deployed - location, wifi parameters, connectivity
- Location update for existing MeshNodes
- Location and status update for other users
- Short text messages



LeafNode Operation via wifi



- Two-way synchronization of data
- Any possibly missed messages - now can assure delivery / return receipt
- Rich, high-bandwidth, messages - images, files
- Update this LeafNode's location / last seen and share to other users

Future Directions

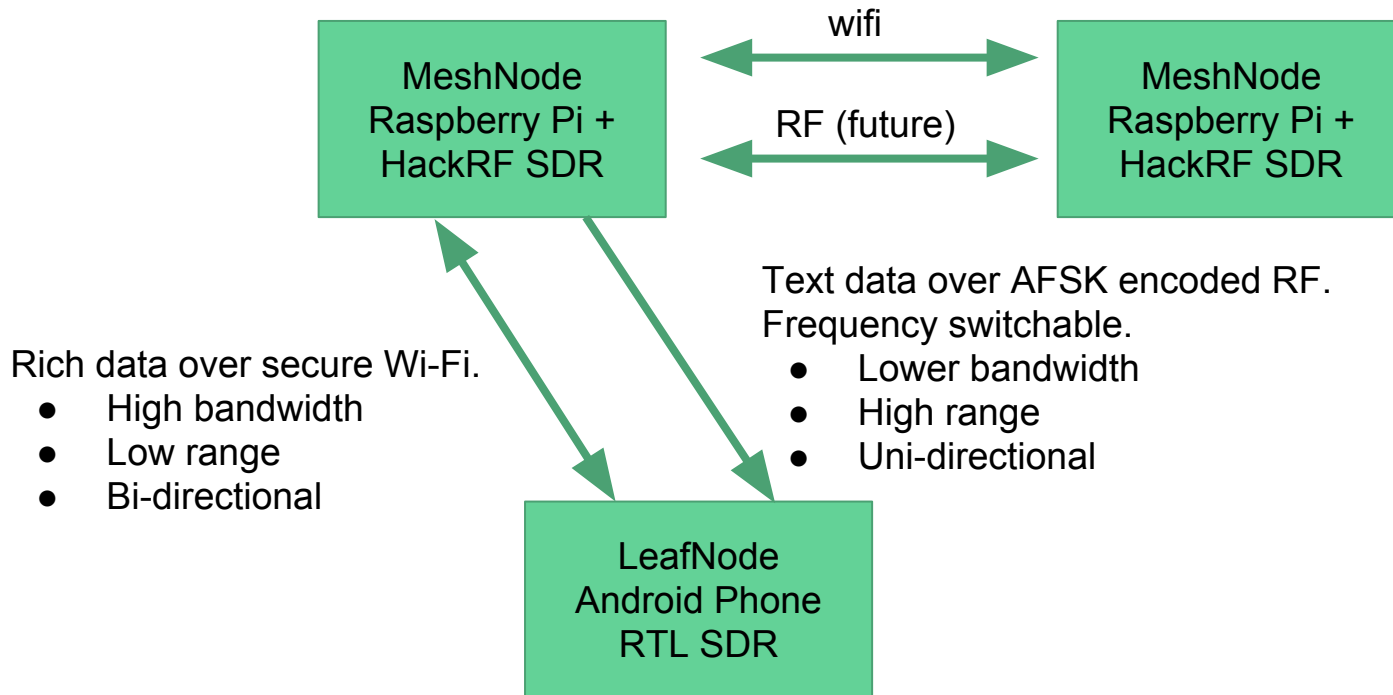
- Implement Mesh over multiple RF frequencies
 - Reduce jamming, environmental factors
 - Extend range of mesh
- Add phone package as mesh node
 - Improve position determination
 - Bi-directional communications at all times
- Enhanced security
 - Encrypt rPi-fs in case nodes are compromised
 - Encrypt comms to LeafNodes
 - Block compromised nodes
 - Rolling Wi-Fi SSID / passphrases
- Low power mode with scheduled power up/down

Challenges

- SDR Reception on Android
 - GNURadio port is still a work in progress
 - Lack of Android-ready Java libraries for decoding digital data modes
- Hardware on-hand
 - Only had access to one HackRF One due to other projects
- Communications
 - Need rf-lan drivers to implement picoTCP or similar stack over HackRF
 - IPFS poorly supported on Android
- Time

Questions

MeshNode & LeafNode Intercommunication



LeafNode

- Android phone with RTL SDR
- Phone comes in Wi-Fi range of MeshNodeMeshNode
 - Synchronize MeshNode and User locations
 - Retrieve user's stored messages (rich message formats)
 - Deliver new stored outgoing messages
 - Deliver any new MeshNode deployments
- CODENet Application
 - Mapping services via OpenStreetMap
 - Obtain cached tiles from MeshNodeMeshNode
 - Offline navigation
 - Integrated messaging