

Commuter Tracking Sensor Network

High Risk Component: Network Architecture

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Network Architecture - Why High Risk?

- Without one, we have a bunch of Commuter Tracking Sensors.
- A reliable network is needed for accurate data
 - If one node goes down, incorrect or incomplete data will be recorded

Affected Needs

Need Number	Description
3	Modules will be part of a mesh network
4	A gateway module will allow the network to interface with the internet
5	Data gathered by the network will be stored via a cloud solution

Affected Engineering Specs

Item	Engineering Specification	Related Needs
3.a.i.1	The radio module must operate on a band that is open by the FCC	3
3.a.i.2	The radio module must be able to implement a mesh protocol	3
4.a.i.1	The radio module must be able to interface with an existing internet entryway such as 3g/4g or Wi-Fi	4
5.a.i	Cloud storage must be of a size that can hold the entirety of the data set that is collected	5
5.a.ii	Cloud storage must be accessible via a variety of interfaces and options	5

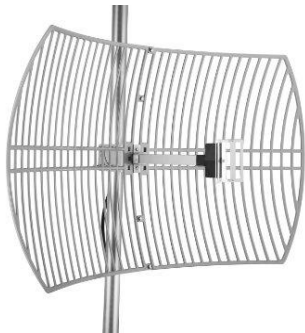
The Trail



Possible Ideas - Giant Wi-Fi Antenna

The Good:

- A couple antennas are cheaper than 17 radio modules
- Easily gets the distance required



The Bad:

- Usually designed for point-to-point
 - Point-to-multipoint communications are illegal for some directional antennas
- Unknown fan out for directional antennas
- Trail nodes still need some kind of antenna
- Not mesh networking

Possible Ideas - SMS

The Good:

- Unlimited Range, assuming signal
- Cheap chips - \$10-\$20 per chip
- Chips are designed for low-power devices.
- Legal!

The Bad:

- A lot of synchronization software needs to be written.
- Recurring cost
 - Eventually the cost of texts will exceed the price of ZigBees



The solution - Digi XBee 900 HP

The Good:

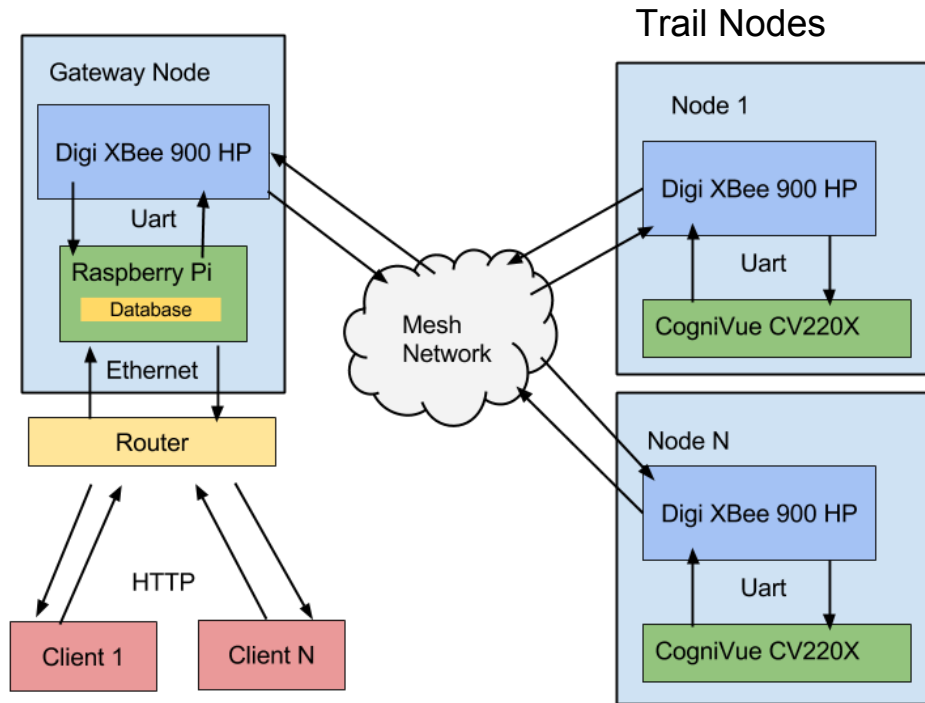
- Built in mesh networking
 - Digimesh protocol
- Range of 9 miles with antenna
- Runs in legal band (900 MHz)
- Uart interface
 - Compatible with MCU
- Built-in sleep mode
 - Saves power
- Documentation on how to legally use

The Bad:

- Expensive at \$42 per XBee
- Need to buy antennas too
- Possibly need a \$300 development kit
 - Unlikely needed based on research



How it works



- Trail nodes get data, and swap data with each other
- Trail nodes send data to gateway to write to database
- Raspberry Pi reads data from trail nodes over UART
- Data gets saved in Database
- Pi acts as web server as well
 - Provides web pages based on data in database

Parts List

Part Description	Quantity	Cost / piece	Real Cost / piece	Total Cost	Availability
Digi Xbee Pro 900HP	17	\$42.00	\$42.00	\$714.00	Digi Online Store
Raspberry Pi	1	\$35.00	\$0.00	\$0.00	Already have
Ethernet Cables	2	\$6.00	\$0.00	\$0.00	Already have
Wired Router	1	\$30.00	\$0.00	\$0.00	Already have
Antennas	17	\$8.00	\$8.00	\$136.00	SparkFun
			Total cost:	\$850.00	

- Digi Ships via FedEx ground, so it will probably take a week to ship.
- Unknown turn-around time.

Testing Strategy

- Small Scale Test
 - Buy 3-4 XBees
 - Connect to our groups Raspberry Pis through UART
 - Ensure all Pis can communicate with each other using the DigiMesh Protocol
 - If this passes, a dev kit is probably not needed.

Testing Strategy

- Distance Test
 - Take two XBees connected to the Pis, see how far they can go before cutting out
 - If they can go at least 2 miles, XBee and antenna are probably good enough
- Small scale trail test
 - Take all four test nodes out to the trail, and place at positions 2, 3, 4, and 17.
 - If they can all talk together, probably safe to ramp up

The Trail



Uncertainties

- Do we need the Dev kit?
- How far can these things actually go
 - Manual claims 9 miles

Thank you!

Any questions, comments, concerns,
queries, or threats?