Network Architecture Testing

It is essential that all the nodes are able to communicate with each other over a long distance. To ensure that all the nodes will be communicating with each other through the XBees, the following tests can be done:

1. The first test that should be performed is a small scale test to ensure that the XBees are able to be configured through UART and send messages via the DigiMesh protocol. This test should be performed once the XBees are acquired.
    a. Acquire 4 XBees.
    b. Attach the 4 XBees to either Raspberry Pis or the Pixy Cam through UART. A mixture of Pis and Pixy Cams is preferred, as the Pixy Cam will be the MCU for the trail nodes, and the Pi will eventually act as the gateway node.
    c. Ensure the XBees can be configured through UART. If they are unable to be configured, then the XBee Development kit might need to be purchased in order to program the XBees.
    d. Ensure the XBees can send and receive messages from each other. If they are able to, then the XBee Development Kit is not needed.
    e. For this test, the XBees can be in close proximity with each other. Test 3 increases the distance.

Test 1 passed. After the XBees were configured, and the packet forming and parsing software was written, the XBees did exactly what was advertised. The programming was easy thanks to Digi's XCTU software. The XBees were able to send and receive messages to each other, as well as broadcast a message to all XBees.

2. The second test that should be performed is a test to see how far away the XBees are able to communicate with the selected antenna. This should be done once the previous test passes.

a. Create 2 nodes by connecting an XBee to either a Pi or a Pixy Cam through UART.
b. Make one node stationary, and take the other node and go as far away from the stationary node as possible before communication cuts out.
c. The biggest distance between two nodes on the trail is about 1.75 miles, so the XBees should be able to communicate with each other from at least 2 miles apart.
d. If this test fails, then a more powerful antenna needs to be purchased.
e. Preferably, the test should be performed on the trail itself, as that is where the nodes will eventually be placed.

Test 2 failed. It was done by connecting a stationary XBee to a power supply on campus, and another was connected via laptop and was walked around campus. Digi's XCTU software was running on it, and an XBee was connected via USB. The XCTU software could connect to the stationary XBee if it was in range. The maximum range on campus was only a couple hundred yards. The good news is this matches the XBee's documentation for urban or indoor environments. So in theory, when brought into an open environment such as the trail, the range should increase dramatically. If not, more powerful antennas are needed.

3. The final test is a small scale trail test. This is where a subset of the trail has nodes deployed to it. If this test passes, then it is probably safe to purchase more nodes and cover the entire trail. This test can be performed when the last test passes.
    a. Attach 4 XBees to either Raspberry-Pis or Pixy Cams.
    b. Deploy 4 nodes at positions 17, 2, 3, and 4 (referring to Figure 2). These four positions are the most spread apart spots on the trail.
    c. If all the nodes can communicate with each other, then the test passes, and it is probably safe to scale up to cover the whole trail.
    d. If the test fails, then some of the nodes might need a more powerful

antenna.

Since test 2 failed, this one was never performed.