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CSE 190 Lab 1 Report

Methodology:

In order to measure maximum transfer speed and thus bandwidth, we created separate sketches for a specialized transmitter device and receiver device. The receiver code is in the directory RadioTestReceiver, and the transmitter code is in RadioTestTransmitter. We aimed to maximize the speed by minimizing the complexity of each device's sketch and communications.

The transmitter simply broadcasts 100 packets as quickly as possible, with the data in each packet being the number of that packet (from 1 to 100). The receiver continually attempts to receive packets and for each packet received prints the total number of packets received, the received packet number, and time received. The duration of the communication in microseconds can be determined by subtracting the timestamp of the first packet from that of the last packet. This information together with the fact that a packet can contain up to 127*8 bits of data is sufficient to calculate bandwidth. The number (and percentage) of packets lost at a given distance is given by 100-packets_received, where the number of packets_received is observed directly from the total packets count displayed by the receiver on the last packet received.

Questions:

1. How will you measure bandwidth with reasonable accuracy?
Since each packet is received with a unique timestamp, the rate of data transfer could be measured by calculating the difference between the first and last timestamps. We know that each packet can contain a maximum of 127*8 bits of data, so multiplying that by the number of packets per second yields bandwidth in bits/second.

2. How will you determine whether a packet has been dropped?
Since the transmitting board always sends 100 packets, the number of dropped packets is equal to 100-packets_received. Also, the specific number of each dropped packet could be determined because the packet number of each received packet was printed by the receiver.

3. Do you think you can send data in both directions quickly?
No, sending data in both directions would be slower due to increased code complexity and more complex manipulation of the radio hardware. Sending data in a single direction is optimal because one device (receiver) can continually detect and process data which is continually sent by the other device (transmitter).

4. How do these measurements vary as the boards move further apart?

We observed that increasing the distance between transmitter and receiver increases the number of dropped packets, which essentially reduces the bandwidth (and reliability) of the connection.

Data:

	0m	**2m**	**5m**	**15m**	**25m**	**30m**	**40m (surface)**	**40m (raised)**
Packet loss (%)	0	0	0	0	1	51	100	30
Time (s)	3.473012	3.473016	3.473016	3.473020	3.463660	1.639492	N/A	2.466292
Bandwidth (Kb/s)	29.254	29.254	29.254	29.254	29.040	30365	N/A	28837

Difficulties/obstacles:

- Obstacle interferences: This was particularly relevant at 40 meters when the transmitter was on a flat cabinet surface about 1.5 meters high. When it was placed on the surface zero packets were received regardless of orientation. When the transmitter was raised a few inches off the surface, about seventy percent of the packets were received; this is significantly better than the results of the test 10m closer but on a surface. Similar issues were likely caused by other obstacles such as students standing in the signal path.
- As another team mentioned in class, there was a discrepancy in packet loss at about 30 meters; there was a larger percentage of packet loss than was expected, especially since there was a lower percentage of packet loss at 40 meters. This could be explained by the significant increase in obstacles when we increased the system distance
- We did not pay particularly close attention to the relative orientation of the transmitter and receiver in each range test, which could also account for some of the discrepancy between the 30m and 40m raised tests. However we did try several orientations on the 40m surface test and could not find any reception without raising the receiver off its surface.
- Our bandwidth measurements are less accurate if there is a significant error rate in that test because our method of measuring communication duration (last timestamp received - first timestamp received) will not account for any leading or trailing packets which are lost or contain errors.