High-Data Rate Communications for Drones, Balloons, and Other Platforms

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Project Goal: Determine the feasibility of using Wifi for high-data rate communications with High-Altitude Balloons, Drones, and other platforms. Research on user feedback shows 80dBm-82dBm signal strength is required for a stable connection.

Uses for long-range Wifi: High-Altitude Balloons have been used to provide internet service in remote locations and during emergency situations. Long-range Wifi could be used to receive data from High-Altitude Balloons at a reliable rate. This technology could also be used on drones by first-responders, especially fire services.

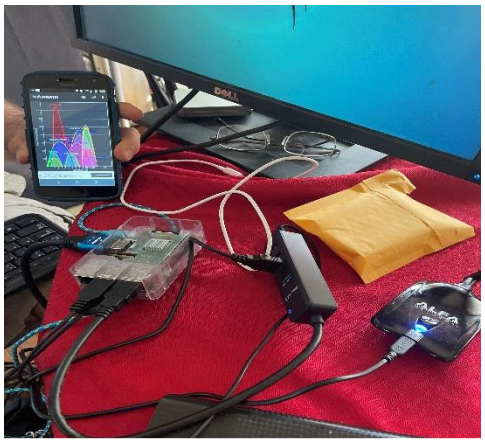

Figure1 shows a Raspberry Pi computer board set up to act as a Wifi access point

Method/Constraints/Equipment:

- Equipment List and Price: Raspberry Pi 3B, case, and memory card($75), AWU5036NH($40),USB and antenna connectors($10),Panel Antenna($40),Powered USB Hub($15)-Total($180); any laptop running Kali Linux. Further research requires an Az-el tracking mount, software to receive GPS coordinates via APRS to direct the antenna, and est. 40 hours of Python programming
- Method: Using the Raspberry Pi, AWUS036NHA, a panel antenna, a light portable battery, and a few miscellaneous USB cords, the team tested the feasibility of Wifi on High-Altitude Balloons, drones, etc. These materials were tested multiple times at different distances, the longest being 4 miles. The path loss formula was used to determine the distance that a Wifi connection could be established.
- Notable Constraints: Commercial-grade Wifi products are often heavy, Limited Power Levels for unlicensed operators, Panel Antenna has narrow 10-degree beamwidth that is difficult to aim when the target cannot be easily seen.
- Constraint Solutions: Used light 4-ounce Wifi modules, Amateur Radio Operators are legally allowed to use higher power on Wifi channels under 2430MHz, the target antenna is omnidirectional and transmits location periodically via Amateur packet radio(ARPS).

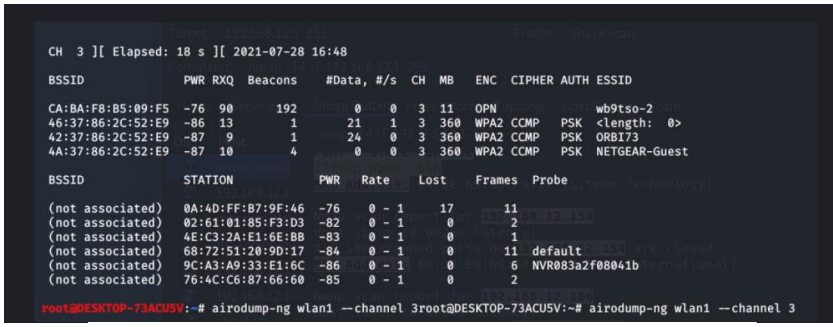

Figure 2 shows -76 dBm strength at 4 mile distance using panel antenna under ESSID "wb9tso-2"

Results:

- Connections were tested at four miles and achieved a signal strength of -76 dBm using the unaltered Wifi card.
- Altering the Wifi card to achieve 1W gives a projected strength of -66 dBm.
- Using the free-space path loss formula, it is observed that using this equipment, a signal strength of -78 dBm could be achieved at 16 miles away.

Expected Future Research:

- Testing on long-distance terrestrial +airborne platforms
- Testing at 10+ miles
- Integrate Azimuth and elevation tracking using Raspberry Pi to control the directional antenna
- Find min signal strength for acceptable data connection

Thank you to the MDSGC for the ability to conduct this research, gain hands-on experience, and further my academic studies.

Figure 3 shows panel antenna relative to laptop

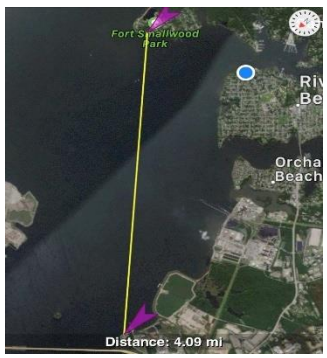

Figure 4 shows 4 mile distance between testing points.

Citations: *ARRL*. Frequency Allocations. (n.d.). http://www.arrl.org/frequency-allocations.
Free Space Path Loss Calculator https://www.pasternack.com/t-calculator-fspl.aspx