Airborne WiFi Networks through Directional Antennae: An Experimental Study

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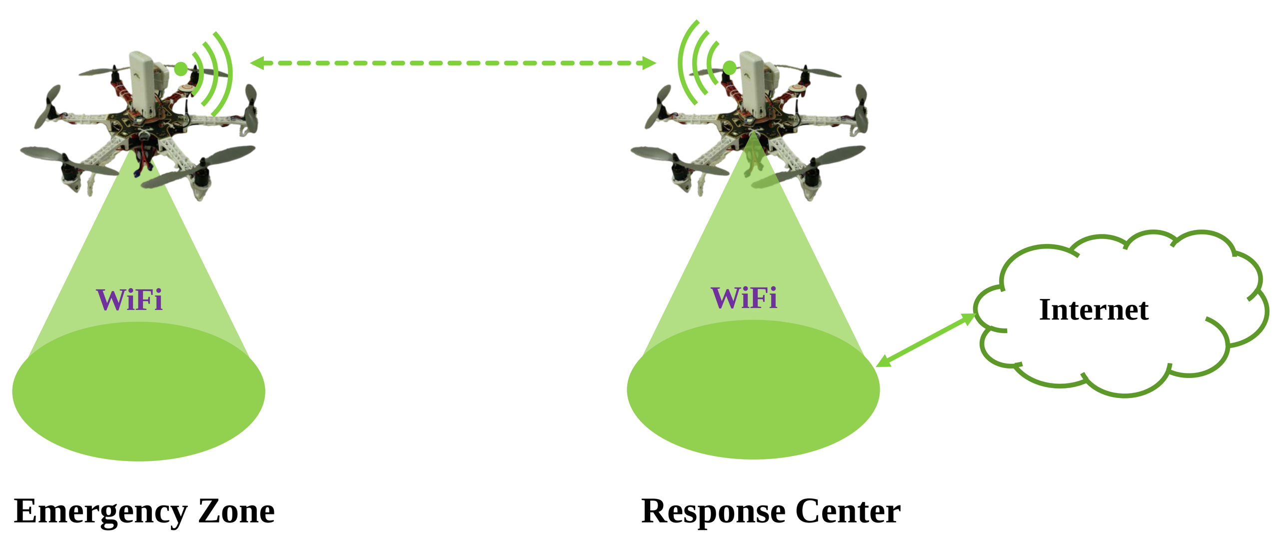
Introduction

In situations where information infrastructure is destroyed or not available, on-demand information infrastructure is pivotal for the success of rescue missions. In this project, we propose to develop a drone-carried on-demand information infrastructure for long-distance WiFi transmission, and pursue its practical use in the areas including emergency response, public event, and battlefield. The WiFi network can be connected to the Internet to extend WiFi access to areas where WiFi and other Internet infrastructures are not available.



As shown in the above system for emergency scenario, the drone-carried WiFi system will provide fast-developed high flexible communication infrastructure to enable activities such as real-time video transmission, rescue team coordination, and phone/email communications.

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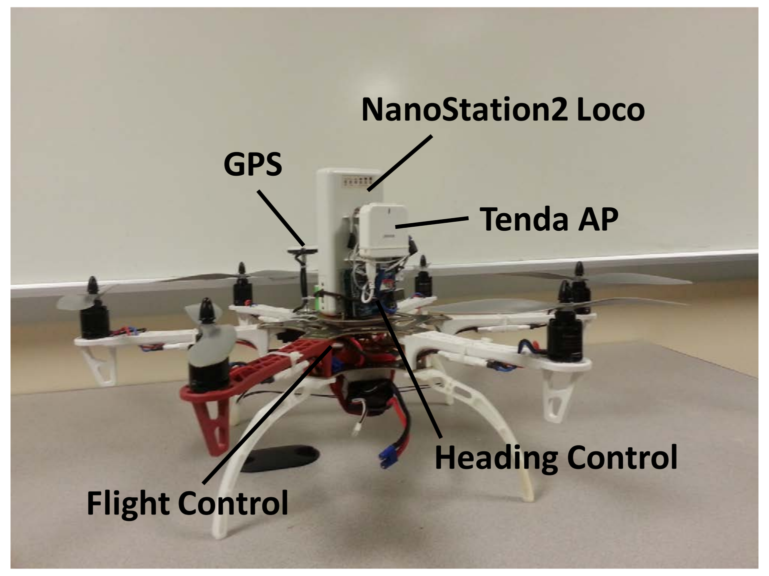
System Design

The DJI F550 hexacopter is adopted as the drone platform because of the higher stability comparing with fixed-wing UAVs and quadcopters. The arms of DJI F550 are made of ABS materials with a good balance between weight and strength. While the six motors consume more power than that of quadcopters, hexacopter provides stronger capability to maintain the flight attitude, especially with the wind disturbance.



We use ARDUINO Atmega256 chip and LSM303 E-compass sensor to guide the heading degree of the directional antenna. Also use XBEE to communicate with ground controller to indicate its height and get desired heading degree. The reading of the E-compass can offset the bias of the directional antenna so that the two antennas can face to each other precisely.

The total thrust with six propellers are 5.76Kg, which is more than twice of the total weight of the drone system (2.55Kg).

Experiment Results

Our experiments are conducted on 150m, 300m and 1Km. In the experiments, the two drones are maintained at the height of 10m manually. Each end connects a laptop on the ground by WiFi. The bandwidth test will be originated from CLIENT side towards SERVER side.

L_{dd}	Drones	Median(Mbps)	Average(Mbps)	STD(Mbps)
150m	Static	42.4	44.2	6.0
	Hover	40.1	36.2	11.9
300m	Static	36.1	35.9	5.7
	Hover	19.9	18.4	9.2
1000m	Static	12.4	13.4	7.0
	Hover	8.2	7.8	6.3

Conclusion

The performance of the WiFi link measured by throughput suggests the promising use of directional antennas to establish WiFi networks. As the link performance is highly dependent on the heading control, we will enhance the design of mechanical heading control in the future work. In addition, we will explore the capability of the drone-carried WiFi network in disaster response scenarios through working with collaborators in these domains.