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Assessment of Mesh-Network Performance for Small Aerial Drones in Urban Environment

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Objective

Constant population growth and ongoing urbanization worldwide will shape the type of military operations that armies have to undertake. It is expected that the many future military operations will happen in urban environments. To conduct an effective and well-organized operation in urban areas, the ground warfighters require real-time situational awareness. Yet, one of the challenges that any army faces is delivering this information to those warfighters. This task is tremendously difficult as communication links are weakened by infrastructure in such environments, which reduces the transmission distance from kilometers to mere meters.

The research endeavor for this thesis was to apply a system architecture process approach to investigate the problem space and recommend a probable solution to this communication challenge. First, the concept of operation for the integrated system is defined and then the operational activities are outlined using a flow block diagram. Second, based on the concept of operation, the systems capabilities and requirements are identified to meet the operation needs. Finally, an architecture trade-off is conducted to discuss what the system is ready to give to get something else (i.e. extended endurance vs reduced payload) while keeping in mind the problem statement and system requirements.

Concept

The integrated system is designed and built by utilizing UAV and wireless mesh network technology to improve battlefield situation awareness for ground forces during operations. The primary mission for the integrated mission is to establish a battlefield network system for the command centre to transmit orders despite the forces potentially being a distance away and vice versa.

The integrated system aims to set up a mesh network within a battlefield to improve the ways of communication. For the system to be easily deployed, it needs to be portable, sustainable, and capable of smart navigation and automatic mesh network mapping for the operator.

Experiment Set-up

Hardware

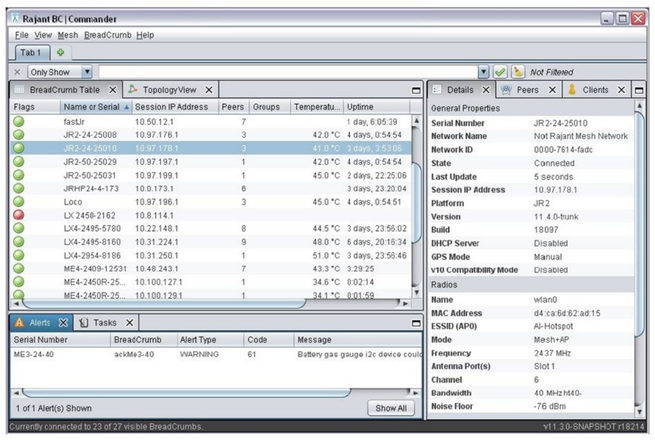
3DR Solo Drone is the principal mode of platform employed for the field-based effectiveness testing. The platform is a quadcopter design with four motor pods, compass, antenna, GPS, and electronic speed controllers and propellers. Furthermore, its mainboard computer has the capabilities to control navigation, attitude, and communication.

Rajant BreadCrumb DX2-50 is the communication network device used in this experiment. The device is a wireless mesh network device that provides reliable, superior connectivity and covers network reach and mobility. In addition, the wireless device provides Ethernet and Wi-Fi access point interfaces with high bandwidth to allow transmitting and receiving data, voice, and video communication

Software

Mission Planner is a ground control station software application used for configuration utility or as a dynamic control for unmanned systems. Moreover, the software is a full-featured control application for the ArduPilot open source autopilot.

BC|Commander is Rajant network management software which allows a user to configure, monitor, and manage the network node as a cluster or individual. The network management software is proficient as the application can provide users an overview of their mesh network through a friendly user-interface and offers several advanced capabilities that will be useful for deploying and managing large and intricate networks



Results

The detailed summarization of the collected data on noise floor, a wireless mesh network signal strength matrix table is generated. The signal strength matrix table shows the ideal configuration (i.e., altitude versus distance) to deploy the integrated system to achieve optimal signal strength.

Altitude (AGL)	Distance				
	100 m	200 m	300 m	400 m	500 m
30 m	G	G	G	G	A
60 m	G	G	G	A	A
120 m	G	G	G	A	W
Legends:	Weak (W)		Average (A)		Good (G)

Recommendation

The signal strength matrix can be integrated into the communication SOP to better support commanders in their communication planning for their operations. Such operations might include an army battalion tasked to capture an urban area with mainly low-rise buildings. The signal/communications officer is able to use the matrix table to determine the variables combination in which the integrated system should operate. Furthermore, the officer is also able to determine how many integrated systems should be deployed to form the wireless mesh network to provide constant communication.

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