Dynamic Mesh Network for Telemetry Propagation and Communications in Coordinated Drone Swarms

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Objective

This project aims to ensure productive communications and data transfer between UAV's and/or to other devices outside the associated wireless ad hoc mesh network, such as a computer. This is will be built upon inspiration from existing protocols of network configuration and routing, such as B.A.T.M.A.N (Better Approach to Mobile Ad-Hoc Networks) Advanced, to create a configuration that is application specific to high mobility nodes, such as drones.

Milestone/Goals

Completed Tasks:
Weeks 1-2: Plan Project and Contact Advisor
Weeks 3-4: Get supplies and understand/configure hardware (Raspberry Pi's)
Week 5 : Configured BATMAN routing static mesh network and proved communication between edge node and CGS
Week 6-7: Research into more dynamic configurations and their respective metrics for efficiency and tolerance
Upcoming Tasks:

Week 8-10: Implementation of a multi-gateway static mesh network as a foundation towards creation of a dynamic version
Winter Quarter:
Weeks 1-2: Finish implementation of dynamic mesh network
Weeks 3-4: Implement on Drones & Conduct tests to ensure that the network meets the specifications and requirements
Weeks 5-6: If tests not passed, revise design and test again; if design works implement addition features
Weeks 7-10: Continue revising and testing design until finished for basic design and any completed complex addition

Background

HYDRA - Resilient Computation for Heterogeneous Autonomous Drone sYstems:
Project on real-time distributed task management in dynamic networks involving drones. Since drones have limited resources, drones need to offload computation tasks to outside nodes, such as a server. Hydra is the middleware that connects the interaction between drones to the algorithms used in the opportunistic task offloading software being produced.

Current Progress

Created a Mesh Network using 4 nodes and a gateway and configured the use of Proactive Mesh Routing Protocol B.A.T.M.A.N- adv. The gateway is physically wired with an ethernet cable to a network switch. Devices connected to the wireless network that the gateway is wired to can access the network and send and receive data. We have proven data transfer from an outside device to an edge node in the network. The effective range, tested in our network, between nodes is approximately 100 meters maximum. Currently, we are researching into how to configure and design a dynamic mesh network for high mobility nodes.

Diagram 1: Our Design

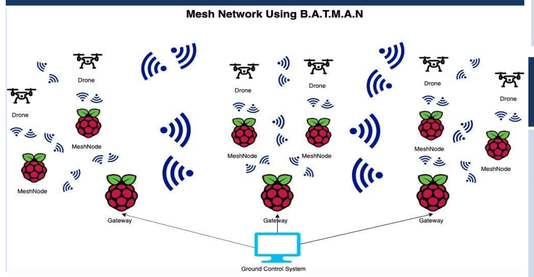


Diagram 2: Mesh Network

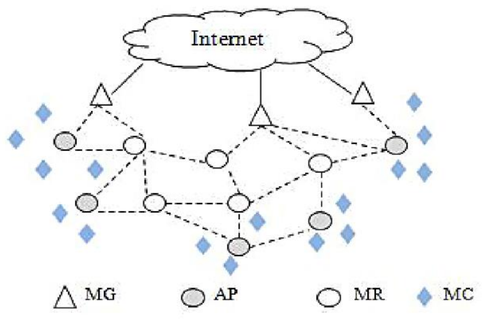
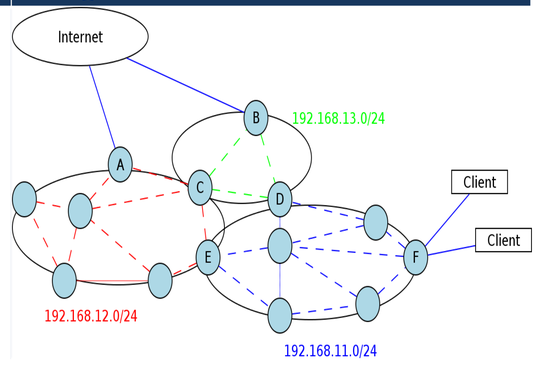


Diagram 3: B.A.T.M.A.N-adv



Hardware & Software

Raspberry Pi 3b
Ethernet Cable
UAVs - Drones
Router/Network Switch
Computers

Python 3.6.8
BATMAN-adv (Better Approach to Mobile Ad-Hoc Network)

Standards

IEEE 802.11: IEEE Standard for Information Technology--Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 10: Mesh Networking Wi-Fi
USB 2.0 / HDMI 2.0
TCP

References

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[3] M. Filho, M. Ribeiro, I. Silva, A. Santos, C. Oliveira, and R. Braga, "Performance Issues in a Low Cost Multi-Channel Multi-Interface Wireless Mesh Network," *Proc. - IEEE Symp. Comput. Commun.*, vol. 2018-June, pp. 792–795, 2018.

[4] S. Ferdoush and X. Li, "Wireless sensor network system design using Raspberry Pi and Arduino for environmental monitoring applications," *Procedia Comput. Sci.*, vol. 34, pp. 103–110, 2014.