Poster Abstract: Wireless Sensor Network for Long Range UAV Swarm Communication

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***Abstract*—Unmanned aerial vehicle (UAV) swarms are useful for surveying large areas but face challenges communicating back to base stations at long ranges. Current wireless technologies often used for UAV swarm communication such as mesh networking or cellular data are costly and require devices not suitable for UAV power constraints. An emerging Low-Power Wide-Area Network (LPWAN), Sensor Network Over Whitespace (*SNOW*), is designed for distributed nodes requiring low-power, long-range communication but have a high developmental cost of integrating into existing systems. We propose a software architecture to exploit the benefits of *SNOW* while abstracting the implementation complexities and allowing external applications to interface with *SNOW* via a TCP/IP connection.**

I. Introduction

Unmanned aerial vehicle (UAV) swarms can be deployed to survey large areas such as for agriculture, environmental monitoring, and search-and-rescue missions. These areas often are thousands of acres making communication challenging [3]. Wireless technologies such as Wi-Fi do not provide the range required to cover such areas and are costly to setup mesh networks. Although licensed Low-Power Wide-Area Networks (LPWAN) such as LTE-M and 5G provide the required network coverage, they come with high deployment costs [2]. *SNOW* is an LPWAN with a range of several kilometers, operates in unlicensed TV whitespace and can be implemented within inexpensive, light-weight commercial off-the-shelf (COTS) devices making it suitable for low-cost deployments [2]. To achieve distributed, asynchronous communication, *SNOW* leverages Orthogonal Frequency Division Multiplexing (OFDM) by assigning each node a unique orthogonal frequency [1]. Orthogonal signals can be separated by applying the Fast Fourier Transformation (FFT) and then applying multithreaded decoding for each frequency bin [1].

II. Design

We opted to equip our UAVs with TI CC1312R1 Launchpads - a sub-1GHz MCU with a programmable PHY layer - and a Raspberry PI for the mission computer. The TI CC1312R1 has an upper limit bandwidth of 4.8 kbps and can output up to 15 dBm [5]. For the base station, we opted for the BladeRF 2.0 micro xA4, a software defined radio capable of bi-directional communication operating between 47MHz - 6GHz [5].

We propose a software architecture for leveraging the benefits of *SNOW* while abstracting the implementation complexities by interfacing with only a TCP/IP connection for ease of adoption in external applications. To make *SNOW* easy to adopt, we created an abstraction, called the middleware layers, that uses TCP/IP connections to interface between external applications and hardware to facilitate *SNOW* communication. Applications residing on the UAV mission computer can open a TCP/IP connection with the ***uav middleware*** application. The *uav-middleware* will relay TCP/IP messages over to the TI CC1312 via UART and initiate the transmission of the message over TV whitespace. Applications residing on the base station can also open a TCP/IP connection with the ***base station middleware*** application awaiting packets to be received and decoded.

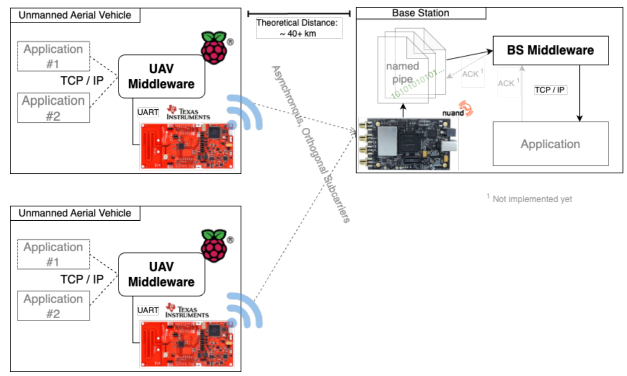

Fig. 1. System Architecture for UAV Swarm Communication using Sensor Network Over Whitespace (SNOW).

References

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