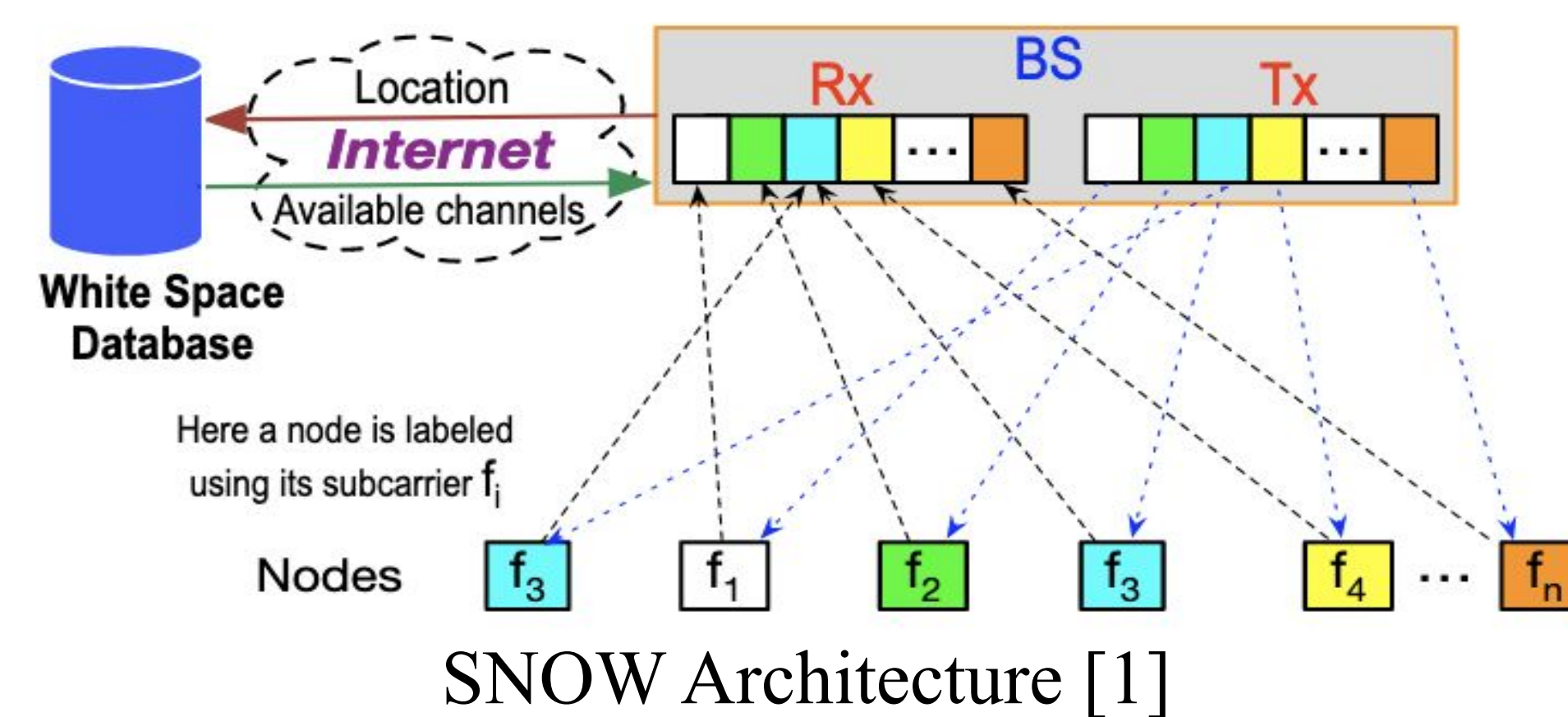


Wireless Sensor Network for Long Range UAV Swarm Communication



Introduction

- Unmanned Aerial Vehicle (UAV) swarms can be deployed to survey large areas such as for agriculture, environmental monitoring, and search-and-rescue missions.
- Current long range communication technologies are either not suitable for UAV swarms such as LoRa or are costly to deploy such as meshed Wi-Fi, LTE-M, or 5G.
- Sensor Network Over Whitespace (SNOW) is Low-Power Wide-Area Network (LPWAN) technology that freely operates on unallocated TV white space (470 - 698 MHz).
 - SNOW enables long range distributed, asynchronous communication from sensor nodes to the base station.
 - SNOW can be implemented within inexpensive COTS devices lowering deployment costs.

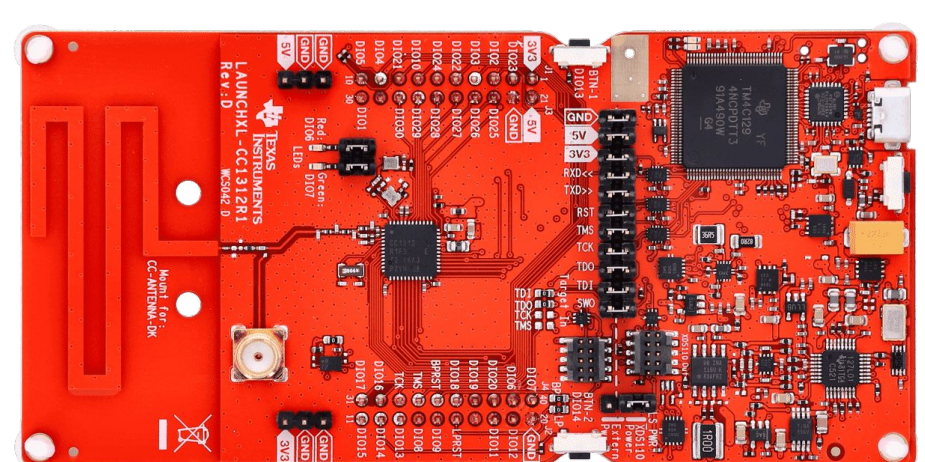


- Current implementations of SNOW are costly to adopt.
 - How can we **adopt** SNOW in current UAV systems with minimum cost?
 - How can we **deploy** a fully end-to-end communication pipeline using SNOW?

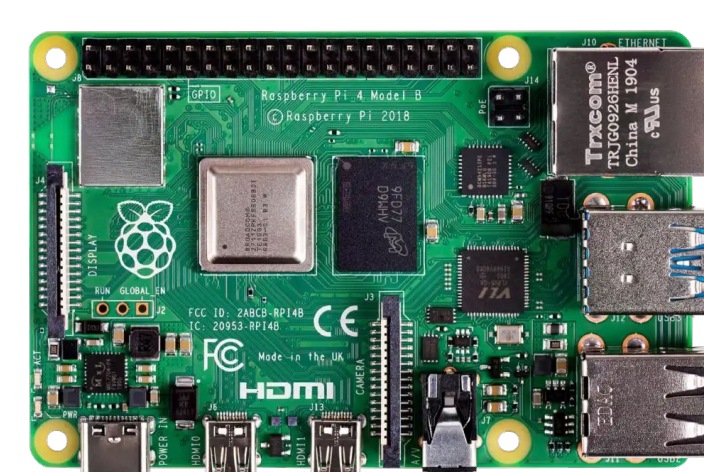
Hardware



SDR capable of operating on TV white space RF band
(Nuand BladeRF 2.0 Micro)



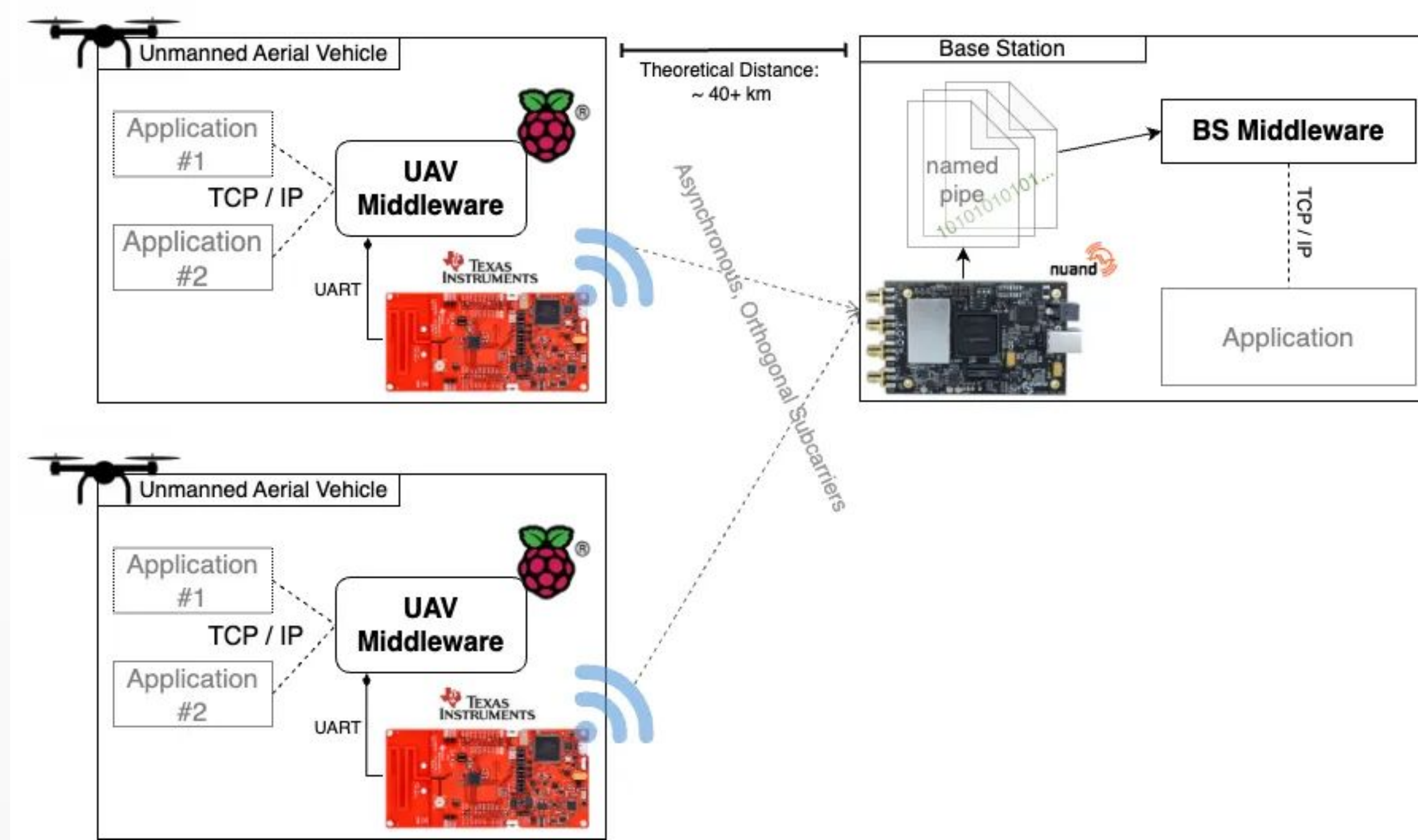
MCU with programmable RF PHY layer with support of UART communication
(TI CC 1312R1 LaunchPad)



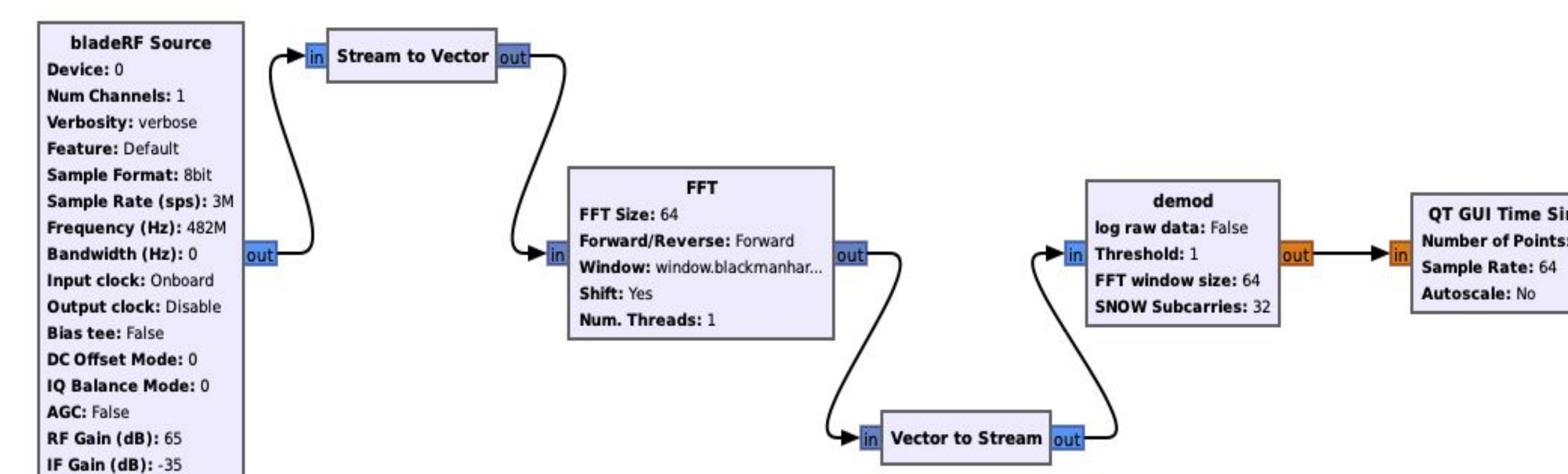
SBC for the UAV mission computer
(Raspberry PI 4 Model B)

Design

System Architecture



- Allows for external applications to send SNOW packets by connecting to a TCP/IP connection hosted by UAV or base station middleware applications.
 - TCP/IP is a wide-known communication protocol and easy to adopt in existing applications
- The base station leverages parallelized packet parsing for each subcarrier in the SNOW network.

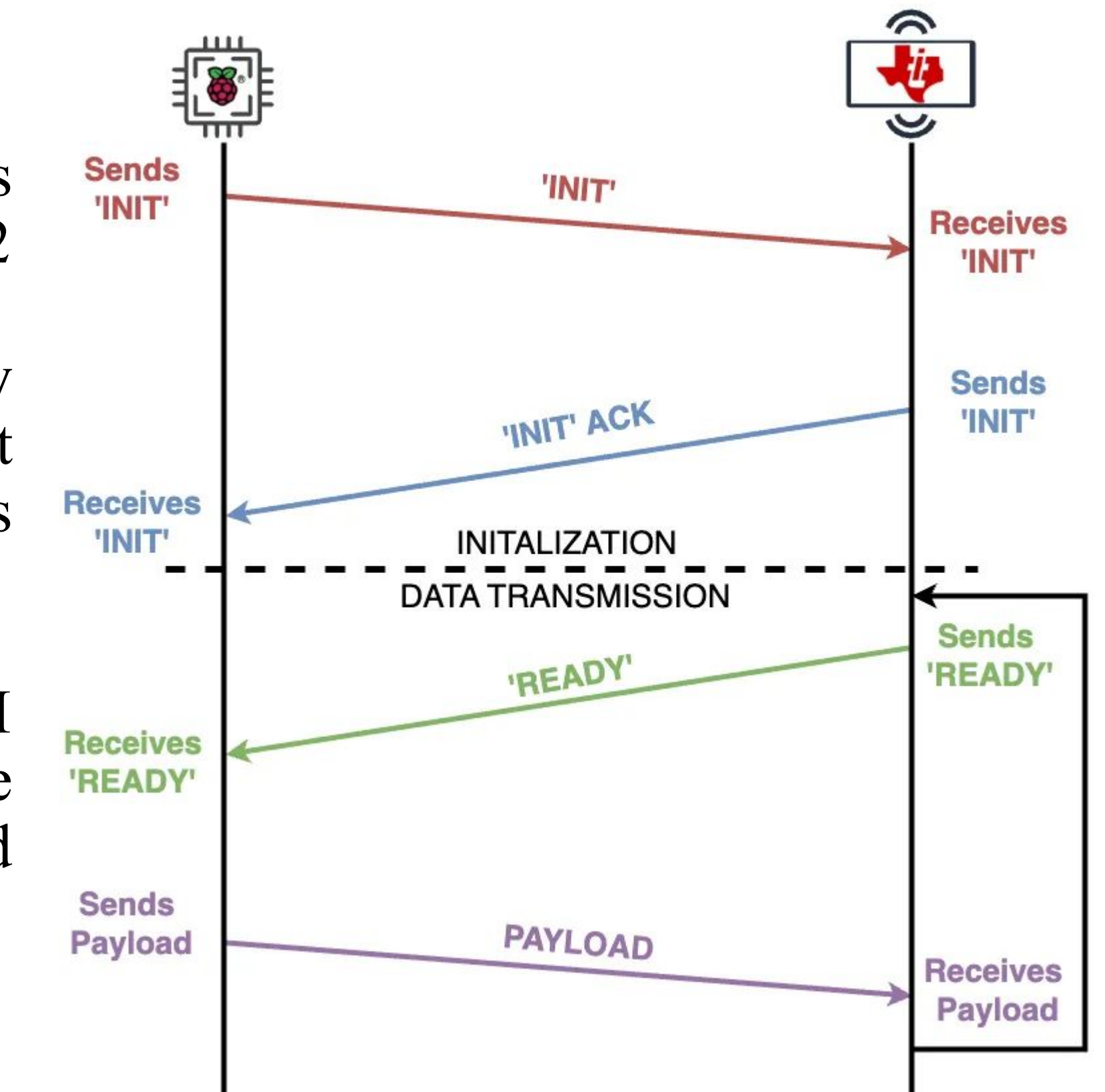


- We leverage the base GNU Radio implementation of SNOW (gr-snow) to handle DSP with the addition of writing to named pipes for IPC to the BS middleware.

Design

UAV Hardware Synchronization / Transmission

- Raspberry Pi supplies power to TI CC 1312
- TI CC 1312 is ready on boot up but Raspberry Pi requires initialization
- Raspberry Pi and TI CC 1312 handshake for initialization and packet transmission



Future Work

- Most of the work has been simulated within a lab environment. We plan on flight tests to simulate real-world deployments.
- To stick with the idea of low-cost deployments, we want to leverage Docker to simplify the deployment process of the BS middleware application.



References:

[1] M.Rahman, D.Ismail, V.P.Modekurthy, A.Saifullah. Implementation of lpwan over white spaces for practical deployment. In Proceedings of the International Conference on Internet of Things Design and Implementation (IoTDI '19), pages 178–189, 2019.