Establishing a High Fidelity Communication Network among Multi-Rotor MAV's

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Drone formation flights is challenging and demand great precision of control. On top of a decentralized MPC implementation, the actual project developed a communication feature between quadcopters. This should allow to realize a formation flight relying on a Distributed MPC structure and permit to share horizon states among MAV's.

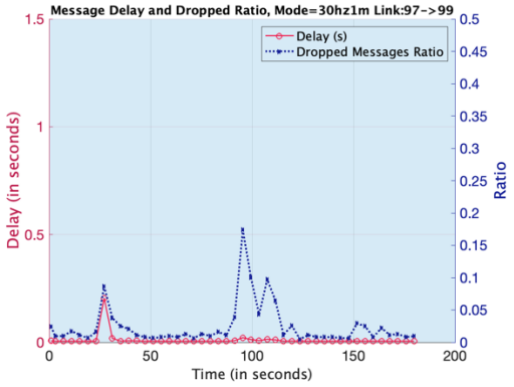
The communication was simulated using a multi-master ROS1 structure, with the help of the *fkie_multimaster* package. The latter manages the synchronization between multiple ROS masters, without needing major code adaptation: it simply requires launching two additional nodes at each master.

This architecture was then implemented among physical devices (Raspberry Pi 3b+). From a network point-of-view, they were able to communicate through an Access Point router, with static IP addresses defined in configuration files of hosts.

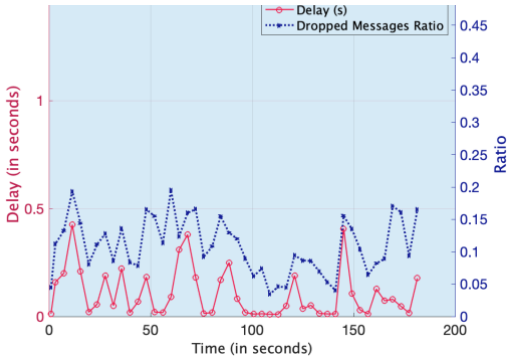
An additional ROS package was used to analyze network performances, such as delay of messages from sender to receiver, dropped messages ratio on link and throughout of devices' network interfaces. The *Advanced ROS Network Inspection* package extends the ROS topic */statistics* with another topic */statistics_host* to evaluate the inter-drone communication.

The content of these statistical topics was saved in bags using the package *rosbag* for latter analysis. Specific MATLAB scripts realize the extraction and analysis of those data and display results in meaningful plots.

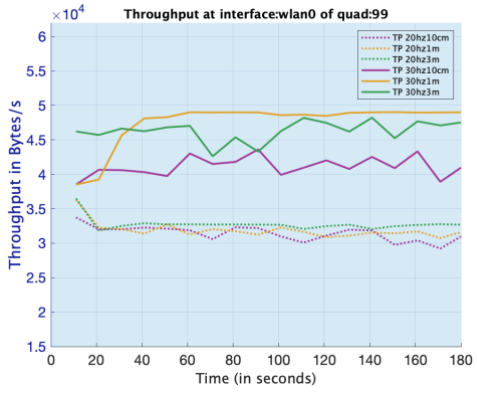
To determine the effect of Distances between the drones and Access point, and the defined ROS frequency, different experiments were run and analyzed. For instance, at 30Hz, the signal at 3m is less stable than at 1m. We also see that the Throughput is higher using a higher frequency (approximately 50% higher for a 50% raise in frequency).



1- Delay and Dropped Message Ration at 30Hz, 1m



2- Delay and Dropped Message Ratio at 30Hz, 3m



3- Throughput at network Interface of Quad 99