Drone Project Wireless Part Summary

The aim of the project is to build a fully automated system that can do simultaneous localization and mapping (SLAM) on a consumer quality UAV (AR Parrot Drone 2) while at the same time sensing the flying environment for channel state information (CSI) of IEEE 802.11n wireless signals. This information, paired with the specific points at which it was recorded can be used to build a comprehensive map of a particular environment like a building or a room, which can be used for applications ranging from intrusion detection to improving a building's wireless reception, or finding the source of disruptive interference.

The wireless sensing module had to be small, lightweight and energy efficient considering the limited load bearing and power capacity of the target UAV. The Intel Galileo generation 2 board was chosen considering all the requirements of the system and also because it ran a minimal version of Linux Kernel which could be modified to suit specific requirements. We tested two open source drivers which can collect CSI data. The first was the Atheros ath9k driver which can collect fast Fourier transform (FFT) data for each of the 56 bins of 802.11n signal. This approach was discarded because of the ambiguity of the collected data and the inability of the driver to perform actual data transmission while collecting CSI samples. The next approach was to try using the modified iwlwifi driver and firmware running on an Intel 5300 wireless card. This approach although suitable for our requirement cannot collect CSI information form an encrypted network. The latter approach was finalized as it was the most suitable and also freely available.

The task after finalizing the platform and approach was to actually port the tool intended to run on a full blown Linux distribution like Ubuntu to the minimal version of Linux the Galileo runs on. We first tried using the Intel provided Linux image based on Yocto and just use the modified driver as a kernel module. This method failed because of iwlwifi module depends on the connector driver which is not included in the standard Intel provided image. Hence we had to build a Yocto based Linux image for the board, while also using the patched version of the Linux kernel to enable CSI data collection. The task after this was to write a user space application which can automatically scan the 802.11 spectrum and collected CSI samples from detected access points. Our user space script will also create logs which can provide additional information about the CSI data collection process. The patch file to modify the Linux Kernel or more specifically the iwlwifi driver, instructions build the Linux image and it to a SD card, compile the user space tool and our script to automate CSI collection are available on this GitHub repository.