EE/CprE/SE 491 WEEKLY REPORT 02
10/5/2019 – 10/11/2019

Group number: sdmay20-36

Project title: Open-Source Prototyping of 5G Wireless Systems for Unmanned Ground and Aerial Vehicles

Client &/Advisor: Hongwei Zhang

Team Members/Role:
Andrew Eschweiler – *Algorithm Dev.*
William Byers – *Algorithm Dev.*
Nathan Whitcome – *OAI Integration Dev.*
Samuel Stanek – *OAI Integration Dev.*
Ibrica Tutic – *Project Manager*
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o **Weekly Summary**

We have been continuing our work on getting the various simulators needed to test and develop the implementation of our algorithm. OAI has very specific hardware and software requirements, so we will need to work around that as a team, since it supports only Intel processors and specific version of a low latency Linux kernel. The algorithm development process has started, and we have team members dedicated to figuring out where in OAI the algorithm will be placed and how it will interface with the other modules in OAI.

We also found some potential issues with OAI when trying to simulator vehicle networks. The new version of OAI with the features necessary for 5G simulation no longer support SUMO, meaning we can't do very good simulations of these conditions. The older versions of OAI (LTE an below) support this, but in a very undocumented way. We will need to investigate of going a different route would be best to avoid the month or two needed to write the integration between SUMO and OAI-5G.

o **Summary of Weekly Advisor Meeting**

We talked more about our roadmap and developing attainable goals for the first phase of the project (getting simulators working and researching scheduling algorithms). We also talked more about the deliverables that we would like to have at the end of the project and how we can position ourselves know to make sure we are on schedule to deliver. Requirements were formalized and the initial work to get the software setup has been started along with the initial development of the scheduling algorithm itself.

- o **Past week accomplishments**
  - **Ibro:** Worked more on analyzing the PRKrt algorithm and how it would be implemented in OAI. Also looked some old version of OAI to find breaking changes across versions. Found that the newest version of OAI no longer support integration with SUMO. Also looked more into how the current scheduling algorithm is implemented in the enb-mac layer and if it can be extended to meet our requirements. Also found an alternative to OAI called ns3-mmWave. It is a fork of the ns3 network simulator project that has changes for 5G networks. Ns3 supports SUMO by default, so it would be extremely easy to begin development, assuming it has the features we need.
  - **Will:** Determined that the scheduling algorithm currently implemented in OAI is contained within the eNB MAC layer. Also located the directory openair2/LAYER2/MAC that seems to contain the source code for the eNB MAC Layer schedulers. Wrote out notes on several files to try and begin figuring out the source code's layout.
  - **Nathan:** Tried to get OAI on a virtual machine on personal PC but had some issues since it doesn't like to work with OAI. Did some research into SUMO and downloaded it to personal PC to do some testing. Talked to people with past experiences with OAI and communicating between two devices.
  - **Sam:** Learned more about SUMO and created simple test networks to hopefully be used with OAI if breaks between the two can be fixed. Studied and took notes on PRKt algorithm to begin to understand how to implement it in OAI. Studied current scheduling algorithm in MAC layer to figure out how to possibly implement PRKt instead.
  - **Drew:** Looked more into OAI and SUMO complications and looked more into the links provided by the professor as well as the scheduling alg. Still need to install SUMO.
  - **Nick:** Continued learning about 5G networks and started learning about open air interface and SUMO. Took notes on the wireless networking algorithms provided by faculty advisor in order to build knowledge on the subject.

- o **Pending issues**
  - Breaking changes across OAI versions
    - ▪ Do we need to use a specific version to meet some requirement?

o   **Individual contributions**

Name	Individual Contributions	Hours this period	Hours cumulative
Andrew Eschweiler	Research on 5G and algorithm analysis	3	33
William Byers	Determined implementation layer, located source code for eNB MAC layer	7	37
Nathan Whitcome	Tried to set up a virtual machine with OAI. Installed SUMO on my Windows PC.	6	36
Samuel Stanek	Created a few test networks in SUMO, studied PKRt and current OAI algorithm	7	37
Ibrica Tutic	PRKrt algorithm analysis, OAI breaking changes, ns3 simulator, remote computer	9	39
Nicholas Lorenz	Learned more on 5G, Installed SUMO on my PC	6	36

o   **Comments and Extended Discussion**

The new version of OAI no longer supports SUMO traffic data. This may be something that we will need to add if we would like to use SUMO and OAI in conjunction to simulate real-world scenarios. It seems that some other projects exist as well that directly support SUMO, so those could be an avenue to handle the simulation aspects.

The source code for the eNB MAC layer is quite extensive and does not appear to be thoroughly documented. It also seems there are several files for different schedulers and there is a config file which can be used to choose which one OAI runs with. There will need to be investigation into finding or creating documentation for the source code before the new algorithm is able to be implemented.

o   **Plans for the Upcoming Period**

- **All:** Get OAI and SUMO running on a computer. OAI is limited to specific processors (I.e. Intel) so we will need to track down a remote computer to install a low latency Linux kernel and OAI. Also, begin developing the initial algorithm prototype to prepare for the work in November and December.
- **Ibro:** Work more on investigating how to add the functionality to allow OAI to get positional data from SUMO again. Extremely old version of OAI supported this and the codebase is not documented well enough to find out how the code was written to get OAI to interface with SUMO. Also look at other scheduling algorithms and how they were incorporated into OAI to begin the initial algorithm development. Look for any other options to simulate with, (ns3-mmwave). Get a remote computer with Ubuntu 16.04 with a low latency kernel for simulation.
- **Will:** Find or create documentation for the eNB MAC layer in OAI. As part of documentation, investigate how the enb_config.c file is used. Focus on determining if we will be able to just write a .c and .h file for our algorithm and use enb_config.c file to run OAI with it. Examine how the round robin scheduler they are implementing has been developed as a basis for our algorithm.

- **Sam:** Continue testing with SUMO and learn more about creating more complex networks using SUMO website. Find out what was used previously for simulations in the CPS article. Study the MAC layer in OAI and how the current OAI algorithm is implemented.
- **Nathan:** Install SUMO on personal PC and run through some tutorials to get a general understanding of how it works by itself before trying to integrate it with OAI. Look into how previous groups tried to get SUMO working with OAI. Get a computer reserved for OAI through ETG and start setting it up to be compatible with OAI.
- **Drew:** Install SUMO and research PRKt algorithm. View tutorials for SUMO.
- **Nick:** Read up more on SUMO and the OAI and download it to my computer. In order to ensure the quality and performance of the system, a baseline for how it needs to work will be a need to know.