



Team Agreement

EC463/EC464 - Senior Design

Fall 2021 – Spring 2022

We, the members of team number 13, called “BehaV2X” have entered into a project titled “Misbehavior Detection System for Cellular Vehicle-to-Everything(C-V2X), for the customer, Professor David Starobinski, as part of Senior Design Project, ENG EC463/EC464.

The general objective of our project is to build a monitoring infrastructure to observe communication over a C-V2X network and detect potential anomalies. Communication between vehicles as well as network monitoring will be enabled using software-defined radios, based on NI USRP software-defined radios. The goal of the project is to demonstrate the ability of transmitting and receiving C-V2X messages, visualize resource usage via a friendly web-accessible API, implement attacks, and design and validate a misbehavior detection system to thwart such attacks.

We expect that our major project deliverables will include the following:

An implementation of communication between two SDRs using the C-V2X technology, with 90% reliability over 30 ft at least. A SDR capturing raw traffic coupled with a visualization software to monitor in real-time usage of channel resources in a C-V2X network. Demonstration of oblivious, smart, and cooperative DoS attacks on a C-V2X network. Thoroughly designed and tested framework to detect attacks (e.g., based on machine learning methods).

GENERAL CRITERIA FOR SUCCESS

We understand that evaluation of our work in Senior Design will depend on several factors. First is our team's success at meeting our proposed objectives, as described by our specifications, and providing our deliverables in working fashion, with the required documentation, by the course deadlines. Second is our demonstration of individual proficiency at design and at keeping adequate engineering records of our work. Third is our individual and collective team skill in listening, helping others to reach their goals, and negotiating technical and team problems. Finally, we understand the department policy for reimbursement of expenditures made in executing our project and agree that anything spent about the amount reimbursed by the department will be equally shared among all team members.

INDIVIDUAL LEADERSHIP

We understand that Senior Design teams shall be organized to give each member clear responsibility for one or more design areas. Several people may collaborate on a problem, but only one person should be the designated 'leader' for a design area. Each of us should be the leader of at least one design area so that we can clearly demonstrate our individual proficiency in design and in keeping professional engineering records (in our logbooks).

RESOLVING TEAM CONFLICTS

We understand that we need to work to resolve interpersonal and technical disputes within our team, in a professional and respectful manner. This will sometimes involve compromise, and we agree to be open to reasoned technical arguments about our individual areas and the team's collective efforts. We will seek faculty or mentor help when problems appear serious and are not resolved quickly by our efforts.

NON-PERFORMANCE OF DUTIES BY A TEAM MEMBER

We understand that each of us must pursue our design and team tasks in a professional and timely fashion to ensure our team's success. Should a team member fail to show diligence and concern for the team, a meeting of the team and the course faculty will be held to assess the situation and recommend specific short-term performance goals for the team member, and possibly the whole team. If these goals are not met, the course faculty may decide to remove the offending team member from the team. The student will then have to complete the course reporting directly to the faculty as a team of one. This is a serious step and suggests a significant failure on the part of the individual, and possibly the whole team. It should not be considered except as a last resort.

QUESTIONS

We understand that students and teams are welcome to approach the course faculty about this agreement at any time.

INDIVIDUAL TEAM MEMBER RESPONSIBILITIES

TEAM MEMBER ADDENDUM (submit one for each team member):

Team Member Name: Michael Aliberti

Team Number 13

Team Name: BehaV2X

I have read this entire document, including my teammates' descriptions of their 'leader' roles. I understand the document and agree with the descriptions of roles.

Team Member Signature:

A handwritten signature in black ink that reads "Michael Aliberti". The script is cursive and fluid, with the first name and last name clearly distinguishable.

Date: 11/29/2021

The following paragraph(s) describes the technical problem(s) for which I hold leader responsibility. (Please give technical details if possible. Broad topical claims will be difficult to assess.)

The crux of my current role is understanding the operation of Cellular Vehicle to Everything Communication as a protocol. This has enabled me in the past to serve as a consultant to team members working on hardware implementation, to outline testing metrics, and to run tests when needed. I have also been a primary contributor and editor for all written deliverables.

In the coming semester, I anticipate continuing to take the lead on written deliverables, and to help modify our C-V2X traffic generation code from the SrsRAN library in order to model the attacker behaviors outlined in our client's research. I will also likely be one of the primary contributors to the web-api for our data, though this task is subordinate to processing the data itself.

TEAM MEMBER ADDENDUM (submit one for each team member):

Team Member Name: Max Ellsworth

Team Number 13

Team Name: BehaV2X

I have read this entire document, including my teammates' descriptions of their 'leader' roles. I understand the document and agree with the descriptions of roles.

Team Member Signature:



Date: 30 November 2021

The following paragraph(s) describes the technical problem(s) for which I hold leader responsibility.

So far my main responsibilities are being an “infrastructure engineer” as well as being the point-of-contact to the Air Force Research Laboratory (AFRL). In the future, I expect my responsibilities to evolve, as setting up our infrastructure will soon no longer be an issue. Once we have a real dataset, I anticipate working more on analyzing and processing the data rather than generating it. With that being said, since we still need to collect the majority of our data, for now I will continue working on generating it and meeting any requests and requirements established by my other teammates for what data they need.

As an “infrastructure engineer,” I have set up workstations for our team which run the necessary software suite we need for doing our research. I have also worked extensively with our graduate student advisor, Stefan Gvozdenovic, on getting our Universal Software Radio Peripheral (USRP) devices to work. This involves setting up signal generators that provide pulse signals to the radios so that they can synchronize. I am also currently working with Samuel Krasnoff on receiving C-V2X signals (we are able to transmit them).

As the point-of-contact to the AFRL, I am responsible for communicating with the competition organizers and submitting deliverables to them. There have been three meetings with the AFRL so far which I have attended. I have also sent a number of emails to them as well. Having one point-of-contact with the AFRL simplifies communication between our team and the competition.

TEAM MEMBER ADDENDUM (submit one for each team member):

Team Member Name: Jason Inirio

Team Number 13

Team Name: BehaV2X

I have read this entire document, including my teammates' descriptions of their 'leader' roles. I understand the document and agree with the descriptions of roles.

Team Member Signature



Date: November 30, 2021

The following paragraph(s) describes the technical problem(s) for which I hold leader responsibility. (Please give technical details if possible. Broad topical claims will be difficult to assess.)

My responsibilities consisted of working with software simulations and programs that would aid with the infrastructure and hardware teams. Early on, I worked on traffic simulators using CV2X networks to help with data collection to speed up the process for machine learning. This process was halted to help shift progress with the hardware's firmware. I was tasked with the responsibility of signal analysis and used programs like URH, GQRX, etc. to measure and analyze CV2X and other radio signals on the 5GHz band. I use python to help with the networking analysis and data processing, and C/C++ for actual simulated network implementation (using prebuilt libraries like srsRAN, GNURadio, and others to help in this case). I help bridge the gap with software in the software defined radios (SDRs) and lay down the foundations for future software heavy tasks.

I work with Yixiu Zhu on signal analysis with the guidance from our student advisor, Stefan Gvozdenovic. Most of the hardware implementation and knowledge was gathered by Max Ellsworth and Samuel Krasnoff. My attempt of software simulations and hardware implementation uses analysis libraries like URH, GQRX compared to Michael Aliberti's approach with srsRAN research. The data collection will be given to Julia Zeng to confirm the usage of it for a machine learning model next semester.

TEAM MEMBER ADDENDUM (submit one for each team member):

Team Member Name: Samuel Krasnoff

Team Number 13

Team Name: BehaV2X

I have read this entire document, including my teammates' descriptions of their 'leader' roles. I understand the document and agree with the descriptions of roles.

Team Member Signature



Date: 11/30/21

Thus far, I have served primarily as a hardware engineer, focused on connecting our software defined radios with proper C-V2X packet communication. After Max Ellsworth had two desktops installed with DragonOS, a Lubuntu-based distro specializing in SDR software, I installed additional software and looked for proper functionality of the radios as simple receivers. The fine-tuning of each radios envelope, strength, and various other measurements was another important role. Signal generators and oscilloscopes were signed out for the purpose of proper synchronization and visualization of signals, respectively. I am now working with Max and Yixiu Zhu to create a V2X network, rather than just one way transmission and acknowledgment.

In the coming weeks and months, I will lead the collection of the data into an easily parsable format, which can then be handed off to my teammates for analysis through algorithmic processing and classification based machine learning models. I will also continue reading various papers and resources to cement the knowledge of the structure and transmission process of a V2X packet. This information will not only help with initial setup and troubleshooting, but also with the baseline data that we will use in our training sets. My current goal is to spearhead the collection of data, through both simulated and physical mediums, and into the hands of the analysis team.

TEAM MEMBER ADDENDUM (submit one for each team member):

Team Member Name: Julia Zeng

Team Number 13

Team Name: BehaV2X

I have read this entire document, including my teammates' descriptions of their 'leader' roles. I understand the document and agree with the descriptions of roles.

Team Member Signature



Date: 12/1/21

The following paragraph(s) describes the technical problem(s) for which I hold leader responsibility. (Please give technical details if possible. Broad topical claims will be difficult to assess.)

My primary responsibility is doing research on the C-V2X protocol and being one of the leads for writing the reports and deliverables for BU and AFRL. These responsibilities include reading any literature there is on C-V2X, which includes those assigned by our client, reviews of misbehavior detections systems, both those using machine learning and not, and providing a detailed and organized analysis of papers that will aid in the implementation of C-V2X on the SDRs. In the literature reviews my focus will be on, but is not limited to the physical-layer characteristics of C-V2X, like encoding, timing, bandwidth, frequency hopping choices, sidelink communication, and scheduling. The objective is to be a point of contact for any team member who needs to know more about a certain part of the protocol. When the implementation of C-V2X on the SDRs is finished, I will be on the machine learning team. At this point, my responsibilities will include data pre-processing for the machine learning algorithms, training multiple different models, and results analysis and fine-tuning.

TEAM MEMBER ADDENDUM (submit one for each team member):

Team Member Name: Yixiu Zhu

Team Number 13

Team Name: BehaV2X

I have read this entire document, including my teammates' descriptions of their 'leader' roles. I understand the document and agree with the descriptions of roles.

Team Member Signature: [Yixiu Zhu]

Date: 12/1/21

The following paragraph(s) describes the technical problem(s) for which I hold leader responsibility. (Please give technical details if possible. Broad topical claims will be difficult to assess.)

For our team, I'm acting as a hardware engineer in the starting phase and I will generally switch to the ML section as our team progresses. So far I have cooperated with Max Ellsworth from establishing our radio communication to understanding the URH and GQRX. From my understanding, it is initial to establish a solid understanding of our hardware performance and then proceed to the software section.

As we are proceeding to have our data generated and analyzed, I'm expecting my role to switch to data collection and analysis. I'm currently working with Jason Inirio on signal analysis with guidance from Stefan Gvozdenovic (our team grad student advisor). Our initial idea is to build a python wrapper to help data collection and analyzing and I'm currently finding ways to implement it. For the status of URH and GQRX, I'm still gonna enhance my understanding of how these tools could be connected with our self generated data.

I'm expecting my role to be switched to ML tuning in the later part of our project. Thus, I'm also preparing myself for this task. I'm actively testing our project related ML platforms and see if they could help our team in the final part. For example, I found a ML method of implementing cost-effective defensive strategy when experiencing potential attacks. I've got its source code running including its Duel Deep Q Learning networks(DQNs). It seems to be the "next step" after we finalized the detection system and we may not use it as we are still in the starting phase for ML. I'm thinking of if we could try to integrate it into our project for the next semester.