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It was possible to create a map with the route between the two campuses A 3D scenario was generated to correctly visualize the trajectories of the vehicles A virtual tool was created to compare the two vehicular communications protocols

Car to Car (C2C)

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Main Objetive

- Implement a V2V communication simulation environment applied to a real scenario in México City, integrating Wireless communication software tools though two different technologies, in order to obtain the best alternative in an effective communication

Specific Objectives

- SUMO modeling and 3D simulation in "Webots" of a vehicular route from campus CCM to CSF campus
- To have a software capable of simulating vehicular communications with the Protocol 802.11 p and with cellular technology on vehicles in SUMO and Omnet + + and to have an exportable version of the simulators of traffic and network in a virtual machine.
- Generate comparisons between protocols with respect to layer 1 and 2 of the OSI model on the raised scenario..

Methods

The project had three different stages of development, and an integration with the projects carried out during the last semester to have two final tools, one of visualization, and another of communications and traffic.

Traffic

Taking advantage of two open-source tools, SUMO and OpenStreetMaps, a map covering a large part of Mexico City, from the Santa Fe Campus, to the Mexico City Campus, was built from information collected by Internet users. In a route of 24.1 kilometers, buildings, bodies of water, and a tool capable of generating virtual vehicles that transit over any of the possible points on our map were built.

3D Simulation

Using another Open-source tool called Webots, a 3D scenario was built to be able to visualize vehicle paths while communicating wirelessly with any of the two protocols used.
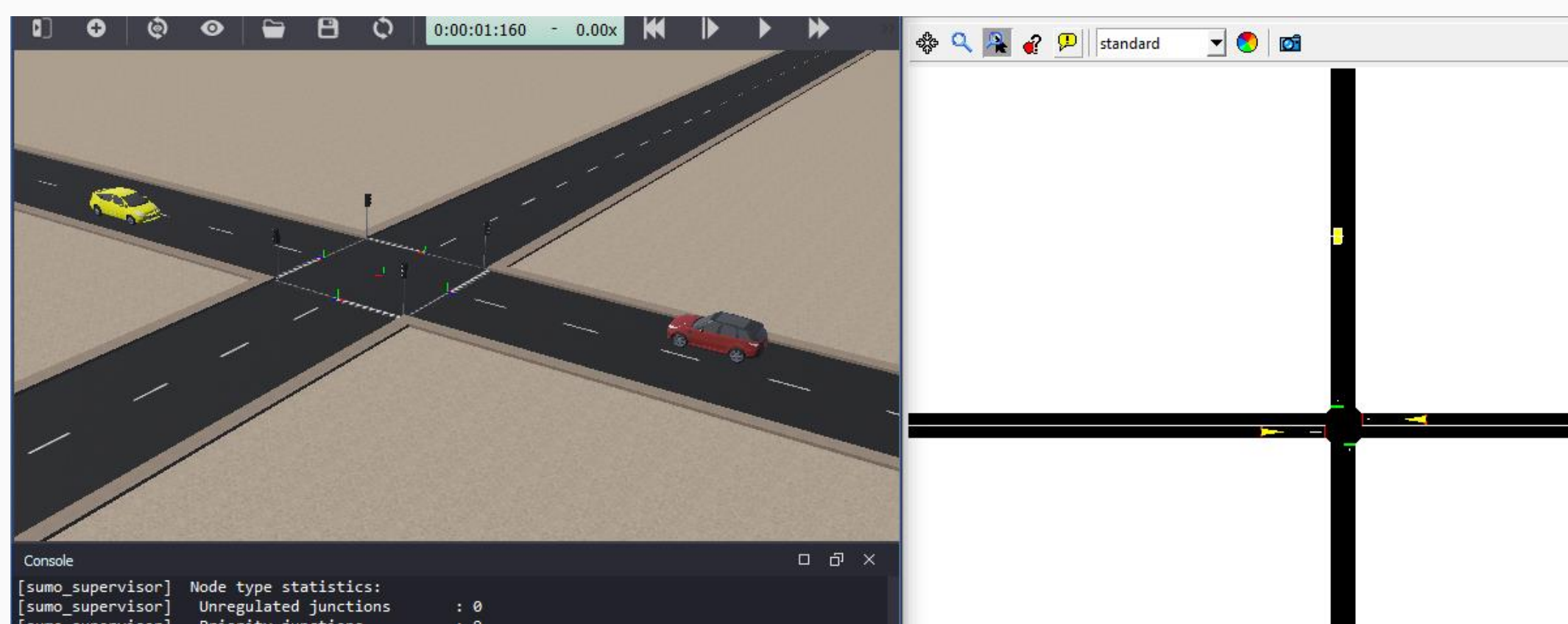
Vehicle communications Network

Integrating the first part of development, a virtual computer was generated through X free tools to be able to simulate wireless communications through 2 different protocols: 802.11 p and a hybrid between the features of 4G LTE and a 5G network. The tools used were:

- Ubuntu
- SUMO
- Omnet++
- Veins Framework
- Inet Framework
- SimuLTE Framework
- Libfox

Resultados

The development was successful in the three stages of the project. A map with the CCM-CSF route was generated in SUMO, a 3D virtual map of the whole campus was generated, where a complete vehicular journey can be appreciated, and a tool that compared both communication protocols in an environment was generated. checked.

3D Simulation

Complete simulation environment. A 3D view of CCM can be generated, where it is possible to visualize the entire route, through a given route


Simulation of Vehicular Networks

It was possible to realize a tool; in a single workspace it has the option of simulation in cellular network or vehicular network.
The 802.11p vs cellular protocols were compared in a smaller scenario, considering the presence of buildings and shadowing effects.
Communication was measured during the CCM-CSF journey with a total of 50 eNodeBs interacting with a vehicle.
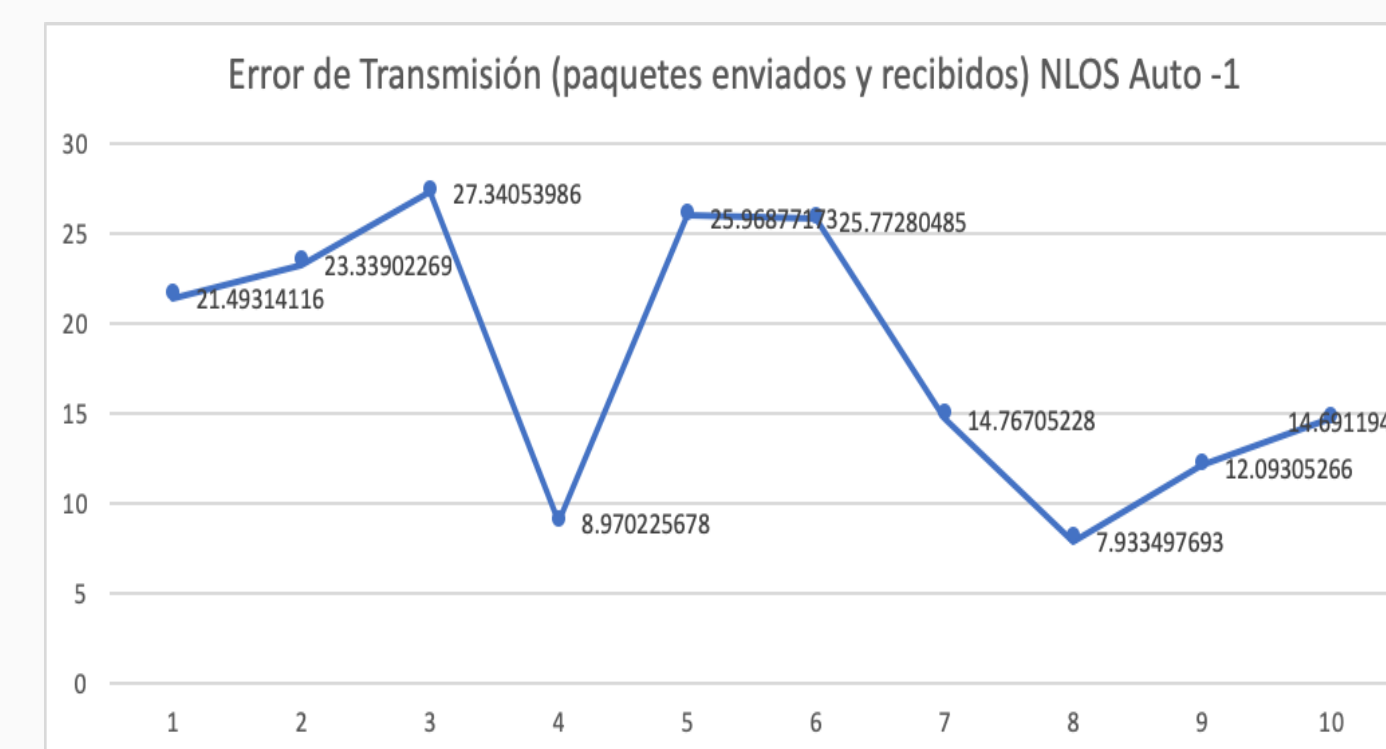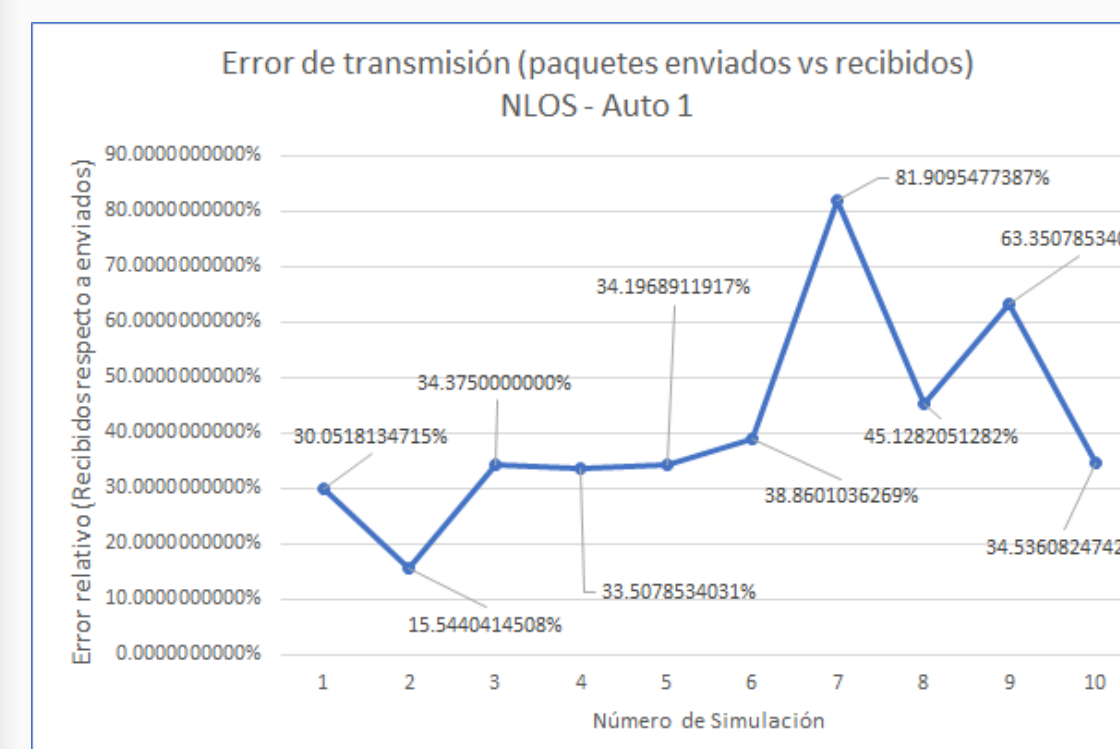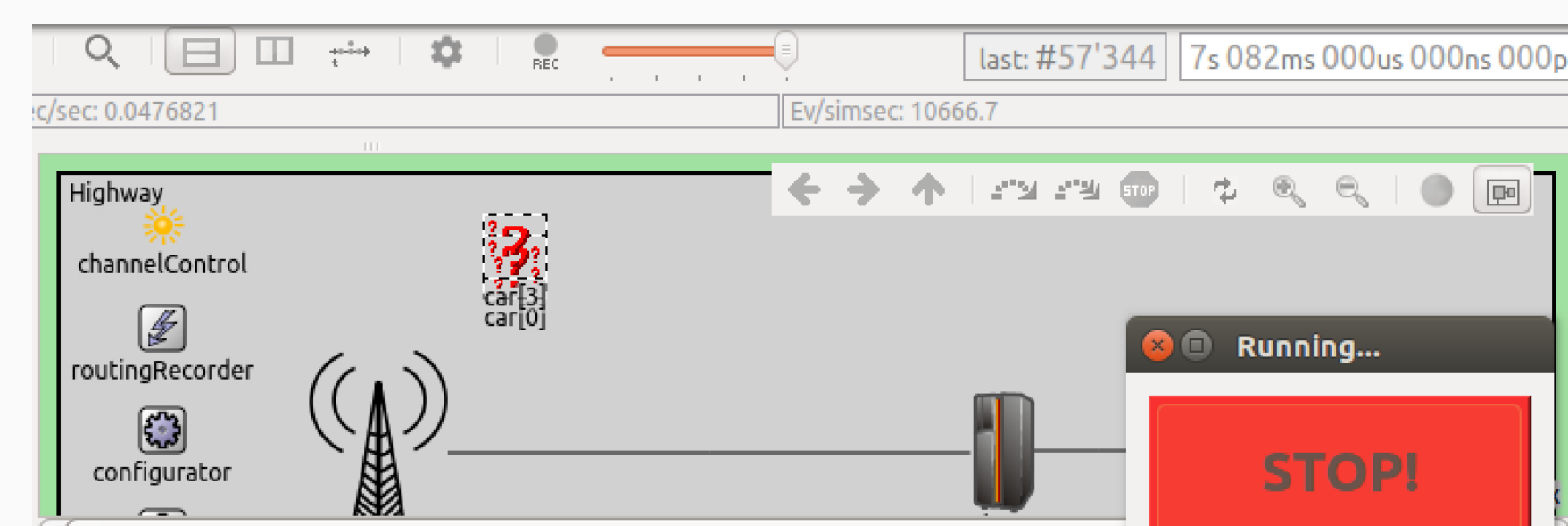

Future work

- Improve the design of the hybrid LTE protocol to completely migrate to the 5G protocol.
- Unify software so that everything is done in a single virtual machine exportable to any computer.
- Perform simulation analysis with greater complexity, involving more environmental factors, a level of higher level, etc.

Ethical dilemma

Violation of privacy by accessing user's location for as long as the vehicle is on. That is why several methods of protection have already been made to ensure the maximum communication for the applications V2V and V2X
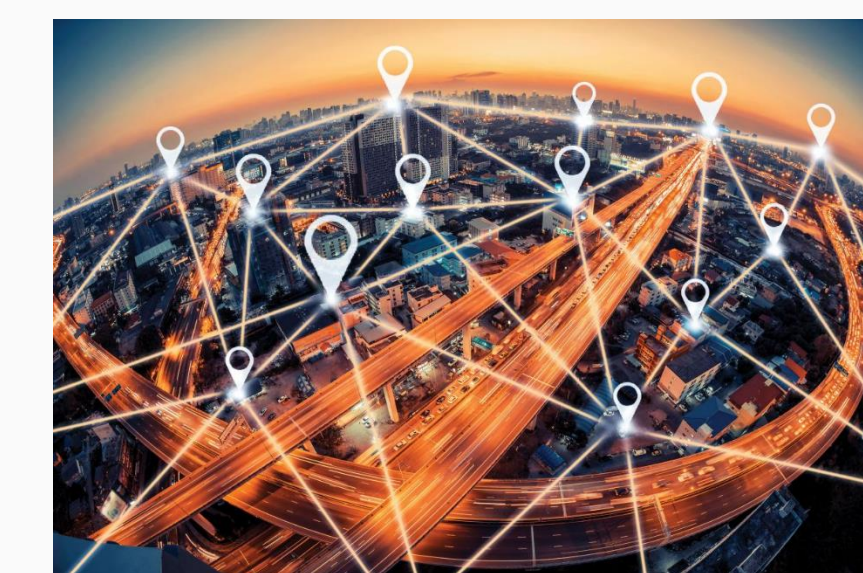
Conclusions

- It was possible to create a map with the route between the two campuses

- A 3D scenario was generated to correctly visualize the trajectories of the vehicles

- A virtual tool was created to compare the two vehicular communications protocols