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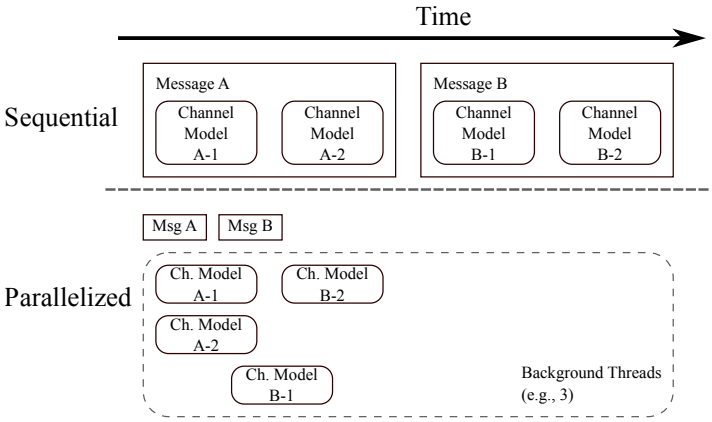
Bachelor / Master's Thesis

Future-based Acceleration of V2X Simulation

Simulation is a key tool for the development and research of V2X networks. V2X simulators evaluate various channel models to decide which messages reach which vehicles. However, these channel models require significant computation effort. This makes simulations take a lot of time and forces researchers and developers to wait for simulation results.
In the special case of real-time V2X simulations, the impact is even greater: As the computation time is limited to real-time, the size of the scenario, communication patterns, and selection of channel models are restricted.



The CCS group takes a leading role in the development of Veins[1], a state-of-the-art V2X simulator based on the OMNeT++ simulation framework. Veins is used in various research projects and provides a range of channel models which have seen constant improvements [1]. However, channel model evaluation is performed in a strictly serial fashion, due to the simulation architecture of OMNeT++. This limits the simulation process to only one CPU core. But most channel model results are not needed at the time they are computed, but at a slightly later simulation time. As wireless messages often reach more than one potential receiver, multiple messages and thus channel models have to be evaluated in this small simulation time window. This provides an easy opportunity to parallelize the channel model evaluation to speed up the overall simulation.

The concept of *Futures and Promises* was introduced into the *C++ 11* standard, and is supported by Veins. With this concept, computationally expensive operations can be moved into the background and processed by a separate thread. Instead of an immediate result, a placeholder (the future) is returned, which allows to access the actual result from the background thread, eventually (or actively wait for it). This seems like an excellent fit to parallelize and speed up Veins.

Goals of the thesis

The core goal of the thesis is a Future-based parallelized computation model for Veins. This model has first to be designed and implemented. A thorough validation is necessary to ensure that the new model yields the same results as the existing one. Finally, the performance improvements have to be evaluated under various conditions.

This theses can be pursued as a Bachelor or Master's thesis. For a Master's thesis, we would, e.g., expect a more thorough analysis and comparison of different parallelism techniques.

Keywords

V2X Simulation, C++, Parallelism, Futures and Promises

[1] F. Bronner and C. Sommer, "Efficient Multi-Channel Simulation of Wireless Communications," in *10th IEEE Vehicular Networking Conference (VNC 2018)*, Taipei, Taiwan: IEEE, Dec. 2018. DOI: 10.1109/VNC.2018.8628350.

[1] https://veins.car2x.org

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