Open Thesis / Project

Leveraging Graph Neural Networks to Parametrize IoT Protocols

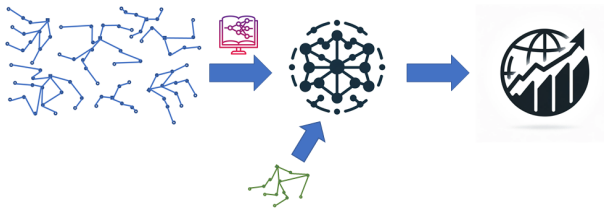
Thesis Type

Master Project / Master Thesis

Motivation

In the ever-growing realm of IoT, IoT protocols are vital, fueling a wide range of applications. Fine-tuning these protocols by means of selecting a good set of parameters is very important to ensure high performance. Typically, optimization of protocol parameters based on data collected using testbeds is preferred, as it reflects real-world uncertainties. However, the exhaustive testing of all possible parameter combinations is a time-intensive task that is exacerbated when a protocol should be tested with several network layouts and topologies. In such cases, exhaustive testing is unfeasible, and other techniques should be investigated.

Our goal is to employ graph neural networks (GNNs) and leverage their innate ability to utilize the graph-like data structures that wireless networks naturally form. GNNs are particularly suited, as they excel at unraveling the complex relationships and spatial dependencies inherent among the nodes. The strategy involves harnessing data derived from the parameterization of various network layouts for a given protocol to train a GNN model. This model shall parse this data and learn from it, enabling the prediction of the most effective protocol parameters for new, previously unseen network layouts. By adopting this method, we anticipate a significant reduction in the time required to optimize IoT protocol configurations for new layouts.



Goals and Tasks

Within this context, students can explore several directions and perform different tasks, such as:

- Getting familiar with state-of-the-art IoT protocols and measure their performance using real-world testbeds;
- Investigate and identify key features of wireless networks that influence protocol performance, focusing on parameters that are crucial for efficient operation;
- Explore effective methodologies for encoding network features, aiming to maximize their representational efficiency for model training;
- Utilize graph neural networks (GNNs) to model wireless network configurations, leveraging their ability to process complex network structures;
- Validate the GNN model's predictions against actual testbed results to assess accuracy and practical applicability.

Target Group

- Students of ICE/Telematics;
- Students of Computer Science;
- Students of Electrical Engineering.

Required Prior Knowledge

- Basic knowledge of machine learning;
- Solid skills in Python;
- Basic knowledge of networked systems.

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