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Dissertation Defense
Doctor of Philosophy in Computer Science

"**IoT-Driven Scheduling of Residential HVAC and Virtual Bus Lanes for Energy Savings**"
by **Daniel Petrov**

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Abstract:
IoT is a great vehicle for enabling solutions of problems in the connected environment that surrounds us (i.e., smart homes and smart cities), but only recently have the use of sensors and IoT has been proposed to address issues related to energy efficiency. Our hypothesis is that data processing and decision making needs to be carried out at the network edge, specifically as close to the physical system as possible, where data are generated and used, in order to produce results in real time and make sure the data is not exposed to privacy and security risks. To this end, we propose to leverage scheduling principles and statistical techniques in the context of two applications, namely aiming to reduce duty cycle of HVAC systems in smart homes and to mitigate road congestion in a smart cities. The common goal in these two aims is the reduction of energy consumption and reduction of atmospheric pollution.

To achieve our first aim, we propose intelligent scheduling of the duty cycles of HVAC systems in residential buildings. Our solution combines linear and polynomial regression enabled estimator that drives the calculations about the amounts of time thermally conditioned air should be supplied to each room. The output from our estimator is fed into our scheduler based on integer linear programming to decrease the duty cycle of the home's HVAC systems. We evaluate the effectiveness and efficiency of our HVAC solution with a dataset collected from several residential houses in the state of Pennsylvania.

To achieve the second aim, we propose the concept of virtual bus lanes, that combines on demand creation of bus lanes in conjunction with dynamic control of traffic lights. Moreover, we propose to guide drivers through less congested routes using bulletin boards that provide them information in real time for such routes. Our methods are anchored to priority scheduling, incremental windowed-based aggregation and shortest path first Dijkstra's algorithm. We evaluate the effectiveness and efficiency of our virtual bus lanes solution with a real dataset from the city of Beijing, China and a twenty four hours traffic scenario from the city of Luxembourg.