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Securing the Emerging Technologies of Autonomous and Connected Vehicles

Project 1915
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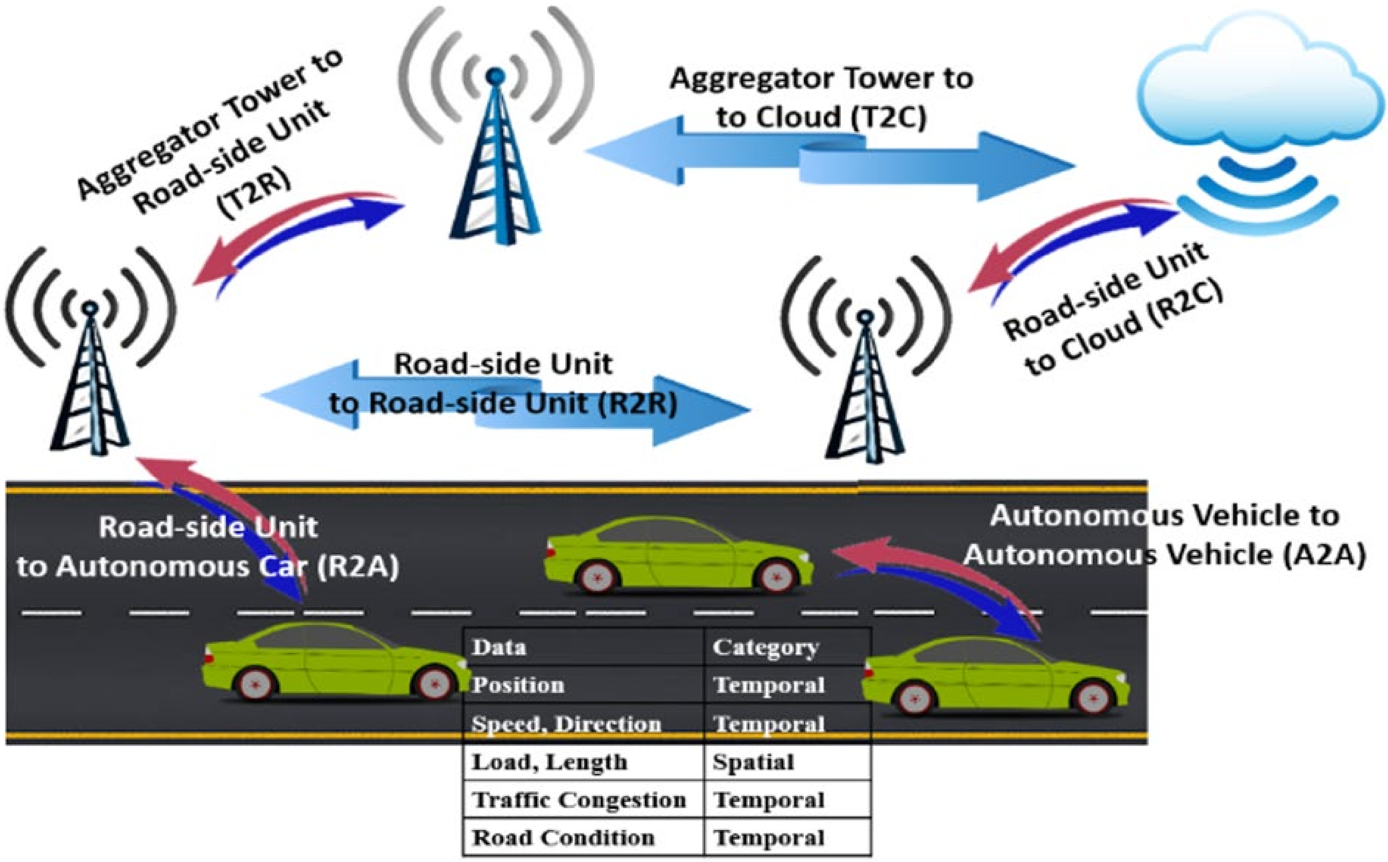

People around the world rely more heavily on technology every day. Visions of autonomous vehicles whizzing quickly and safely amongst towering, metallic skyscrapers have been imagined for decades. Researchers have already made headway on what a network of autonomous vehicles would look like, from protocols guiding vehicles' interactions with one another to the network's hierarchy of control. A network of vehicles so massive requires resources to be used as efficiently as possible. For practical application of the vehicular network, time and power consumption need to be optimized. Furthermore, the network needs to be secure to protect the public from vehicles going rogue due to external forces such as location hijacking.

Study Methods

With this project, researchers want to find a way to optimize resource usage when vehicles are communicating with one another in the network. For this study, researchers conducted three simulations, each with different densities of vehicles in the network. The scenario for the simulation was a four-way intersection, with 12 different possible paths for each vehicle to take. Researchers collected data on sending time of messages communicated between vehicles. Researchers also added precalculated overhead time to update the sending time to incorporate the use of security mechanisms. Next, the paths of message communication were modified by applying the minimum spanning tree (MST) algorithm, PRIM's. The time and power consumed under this method was then compared with the consumption when a broadcasting method was applied to the network instead. Finally, the data was then visualized and analyzed to demonstrate the massive savings in power and time.

By applying a minimum spanning tree algorithm to the vehicular network, time and power consumption are significantly reduced.

Findings

The use of an MST on the vehicular network is valuable and produces great reductions in power and time consumption. The savings in power was of magnitude 56.08; savings in time (for each simulation respectively) were of magnitude: 28.06, 44.56, and 53.88. The reductions for both power and time can be graphically represented as going from resources being consumed at a quadratic growth to consumption following a linear growth.

Policy Recommendations

Future researchers should consider both security and an MST algorithm. The effect they have on vehicular networks is both valuable and noticeable. This method addresses the aforementioned issue of limited resources, while also maintaining the security of vehicle communications. A layered security scheme should be considered for implementation in the network or to at least serve as a model for security of the vehicles and the public.

About the Principal Investigator

Dr. Shahab Tayeb is a faculty with the Department of Electrical and Computer Engineering in the Lyles College of Engineering at California State University, Fresno. Dr. Tayeb's research expertise and interests include network security and privacy, particularly in the context of the Internet of Vehicles. His research incorporates machine learning techniques and data analytics approaches to tackle the detection of zero-day attacks. Through funding from the Fresno State Transportation Institute, his research team has been working on the security of the network backbone for Connected and Autonomous Vehicles over the past year. He has also been the recipient of several scholarships and national awards including a US Congressional Commendation for STEM mentorship.

To Learn More

For more details about the study, download the full report at transweb.sjsu.edu/research/1915.

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