FIELD OF STUDY

Network Security and Privacy

DISSERTATION TOPIC

"Towards Privacy-Preserving Services for Autonomous Vehicles (AVs)"

EXAMINING COMMITTEE

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ABSTRACT

The Autonomous Vehicles (AVs) have the potential to make major changes in the current transportation systems. Ride sharing can reduce the number of vehicles in the streets by increasing the occupancy of vehicles, which can facilitate traffic and reduce crashes. In AVs era, vehicles will be an on-demand service rather than an owned product, i.e., many passengers will rely on Autonomous Cabs (ACs) in their transportation. In order to guarantee the high quality of the AC service, the AC company needs to learn the geographic distribution of the potential service requests. However, the organization of shared rides and the management of ACs services require the passengers to disclose sensitive detailed information about their current and future locations which causes a serious location privacy issue.

We propose schemes to organize shared rides and manage the ACs services, while addressing the unique privacy issues. In our privacy-preserving ride sharing organization schemes, each user should represent his/her trip's data as binary vectors and submit the encryptions of the vectors along with a signature to a ride sharing organization server. The server can measure the similarity between the users' encrypted trips data without decrypting the ciphetexts or knowing any sensitive information. In our schemes, the ride sharing region is divided into cells and two different techniques have been used to represent the trip's data. In the first technique, each cell is represented by one bit in a binary vector that represents the whole region's cells, whereas in the second technique each cell has a unique identifier. Our schemes consider different cases of ride sharing and allow users to prescribe their requirements, such as transferable or non-transferable ride sharing, maximum distance between a trip's start/end location, a user's pick-up and drop-off locations, minimum number of cells, and minimum number of transfers between AVs. For ACs management, we propose a data aggregation scheme to preserve location privacy by providing the AC company with the total number of requests in each geographic area without accessing the individual user's data. The scheme can efficiently aggregate different types of data and enable the aggregators to detect data pollution attacks and learn partial information, e.g., to classify the ciphertexts based on the requested service, without knowing sensitive location information.

In order to verify our schemes, we analyze, evaluate, and implement the proposed schemes. Our analysis and evaluation results demonstrate that the proposed schemes can organize shared rides and collect the required location information for AC management efficiently and with privacy preservation.

BIOGRAPHICAL SKETCH

Ahmed Sherif received the B.Sc. degree in Computers and Systems Engineering from Al-Azhar University, Cairo, Egypt, in 2007 and M.Sc. degree in Computer Science and Engineering from Egypt-Japan University of Science and Technology (E-JUST) in 2014. Currently, he is a Ph.D. candidate in Electrical and Computer Engineering at Tennessee Tech University, Cookeville, Tennessee, USA.

His research interests include security and privacy preservation schemes in various networks and applications such as Autonomous Vehicles, Vehicular Ad-Hoc Networks, Smart Grid communication networks, Internet of Things applications and Mobile Ad-Hoc Networks. He aims to develop a suite of efficient, secure and privacy-preserving mechanisms and protocols.

EDUCATION

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The Department of

Electrical & Computer Engineering

Announces the Dissertation Defense

Of

Ahmed Bayoumi Sherif

In Partial Fulfillment of the Requirements

For the degree of

Doctor of Philosophy

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