DATA ANALYTICS AND MACHINE LEARNING TO HANDLE HETEROGENEOUS DATA IN THE INTERNET OF VEHICLES

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CONTEXT

The Internet of Vehicles (IoV) is a convergence of the mobile Internet and the Internet of Things (IoT). The connection of vehicles to the Internet enables new applications, which bring new functionalities to the individuals thus making of transport easier and safer. In this context, the IoV concept represents future trends for smart transportation and mobility applications. Some Intelligent Transportation System (ITS) applications will require very low latency, much lower than is currently provided by existing communication networks.
At the same time, 5G networks are expected to offer very high data rates, extremely low latency, and significant improvement in users' different QoS requirements. The 5G networks will provide the foundational infrastructure for building smart IoV environment and supporting the functions of sensing, networking, computing and controlling.
The emerging new technologies in the 5G networks such as mobile edge computing (MEC), mobile cloud computing (MCC), network virtualization, network slicing, resources management and so on, may significantly facilitate and decouple network functions from dedicated hardware and meet various requirements of IoV networks. Thus, it can greatly improve the efficiencies in transportation infrastructures while reducing the traffic congestions, emergencies and accident.

OBJECTIVE

Connected vehicles are now formidable sensors platform, absorbing information from the environment (and from other vehicles) and feeding it to drivers and infrastructure to assist in safe navigation, pollution control, and traffic management. Vehicles are generating, collecting, storing, processing, and transmitting massive amounts of data used to make driving safer and more convenient. These rich sources of data will necessarily provide new dimensions and abundant opportunities to explore the design of reliable and efficient vehicular networks. However, traditional communication strategies are not meant to handle and exploit such rich information. Machine learning (ML), as a major branch of artificial intelligence, builds intelligent systems to operate in complex environments and provides efficient methods to analyse a huge amount of data by finding patterns and underlying structure. Moreover, ML provides a versatile set of tools to exploit and mine multiple sources of data generated in vehicular networks. This will help the system make more informed and data-driven decisions and alleviate communication challenges as well as provide unconventional services, such as location-based services, real-time traffic flow prediction and control, and autonomous driving.
Key to this, given the rich sources of data from various on-board sensors, roadside monitoring facilities, it is desirable to explore the massive amount of data and ease more

data-driven decision making to improve vehicular network performance. ML is an effective tool to serve such purposes. Another key enabler is the provision of adequate network resources that meets the proper functioning of IoV. Like other important instantiations of the Internet of Things (IoT), the IoV will have communication, storage, intelligence, and learning capabilities to anticipate the customers' intentions. Instantaneous Internet Cloud for vehicles is a concept for the IoV that will help providing all the services required by the connected vehicles. Specifically the research objectives are as follows:

1. Enable robust QoS aware pre-emptive service provision and corrective remediation of network edge resources to compensate for the volatility and heterogeneity of the vehicular environment.
2. Ensure resiliency of the access network given unreliable connectivity, highly transient links, density of nodes and complex radio environments.

METHOD

The network will employ a number of self-adaptive decision mechanisms to shift computing resources to the most appropriate location, optimising edge provisioning. Partial predictability of vehicle routes will be leveraged to allow the network to take pre-emptive action to compensate for vehicle dynamism by considering characteristics such as congestion, point of attractions, road topology etc. Further, the edge of the network will be extended to consider devices within the access network thereby creating a virtual edge network or vehicular micro-clouds. In this context, we propose research methods that will maintain the connectivity between vehicles and apply real-time intelligent management of network functions and resources with a specific focus on the following:

1. Creating knowledge from the network data collected in the context of heterogeneous technologies.
2. Exploiting the enhanced partial predictability of connected and autonomous vehicles for improved edge network provisioning.
3. Creating micro-clouds and virtual edge networks in the vehicles, to reduce load on the access network.
4. Handling fleets of UAVs by ensuring reliable low latency communications via hybrid communication networks.

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