

Tutorial: Vehicular network systems in smart cities

1. Names and Affiliations of Speakers

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2. Abstract, objectives and motivation

The need for connectivity in motion has gained interest in vehicular network systems due to the services they can provide in the transformation of transport through the Internet of Things (IoT) application for a Smart City. The evolution of wireless network technology, protocols, and standards in a vehicular network aims to transform transport towards a more intelligent transport that meets users' needs. Thus, the implementation of a vehicular network, through smart vehicles and road infrastructure, allows vehicles or mobile nodes to communicate with each other to send information that provides society with numerous services ranging from decreased traffic up to the users' security. Therefore the wireless network in motion applied in the transport is unprecedented. Innovative applications focused on improving lifestyles through smart transportation are highlighted in this chapter. Besides, diverse literature in wireless networks is presented to enhance connectivity between moving vehicles and the development of future intelligent transport systems (ITS).

The motivation of this tutorial is the pursuit of research within the area of transport for smart cities employing vehicular networks. Smart transport has become highly important and relevant to meet the demand for services that society needs for a better lifestyle. The main objective of this tutorial is to highlight the need for the development and innovation of more intelligent transport systems that are capable of defining today's future across vehicular networks. The contributions of this tutorial are numerous—excellent literature aimed at the latest advances, challenges, and solutions in mobility in vehicular networks. In addition, the literature shows protocols, standards, and implementations to improve smart transport through different wireless technologies.

3. Keywords

Vehicular networks, IoT, smart cities, VANET, smart transport.

4. Intended Audience

The tutorial introduces the field for new attendees who have ideas for developing projects based on mobile networks. In this tutorial, algorithm codes are not presented; it is a survey about the development of vehicle networks in smart cities.

5. Content outline

The tutorial is organized as follows:

1. Introduction
2. Vehicular System Layered Architecture
3. Vehicular WSN and WDSN System
4. Vehicular communication
5. Network technologies for enabling vehicular communication in a Smart City
6. Security in vehicular networks
7. Vehicular Networking Applications
8. Challenges
9. Conclusions

6. Description

The tutorial objective is to show the importance of mobile communication, not only for vehicles but also for bicycles, where people can get information about their events. Smart mobility consists of public transport that defines an innovative infrastructure for traffic and transport that saves resources and is based on new technologies for maximum accessibility and efficiency for citizens.

Smart cities depend entirely on the network connection to offer user services, which requires features of today's networks. Vehicular networks have received growing attention from the transport industry, the academic community, and government because they have the potential to enable technologies for applications related to vehicles, vehicle traffic, drivers, passengers, and pedestrians. Some concerns are traffic congestion, inadequate urban infrastructure, and lack of real-time data exchange in developing countries. These challenging issues could be resolved by enhancing public transportations and keeping citizens more engaged and motivated to use technology to benefit from a smart system through networks and cloud technology. Some of the precision-based applications of smart cities mainly demand high-quality communication technologies because network latency can raise serious issues in the case of smart transportation. However, several solutions whose capabilities in terms of throughput and transmission range are minimal, such as Bluetooth, ZigBee, Wi-Fi, NFC, Z-Wave, LoRaWAN, and 6LoWPAN, are implemented. The advanced technologies, such as WiMAX and LTE, to name a few, are unsuitable due to their high energy consumption, as most of the connected devices in smart cities have battery constraints.

The first section shows the introduction to the Internet of Things and the IoT offerings proposed for transforming cities by improving infrastructure and enhancing the quality and performance of public services by being digitalized and smarter. Sect. 2 describes the vehicular system layered architecture by introducing vehicular network protocols and development environment. Sect. 3 presents a vehicular WSN and WDSN system. This section also shows VANETs and their characteristics. Sect. 4 introduces the dedicated protocols for vehicular communication such as IPv6, WAVE, and vehicular routing. Sect. 5 discusses the network technologies for enabling vehicular communication in a smart city. The interconnection of different technologies, short-range, and long-range used in the

implementation of vehicular networks is also discussed in this section. The security in vehicular networks is presented in Sect. 6. The Sect. 7 gathers research from relevant vehicular networking applications for smart cities. Constraints on critical infrastructure and resource availability limitations are discussed in Sect. 8. Finally, conclusions are showed in Sect. 9.

7. Teaching mode

Entirely virtual.

8. Materials

Slides with annotated bibliography. The tutorial will be presented entirely virtual due to travel restrictions and few resources. Therefore, the material that will be used is slides and will be shared when requested.

9. Bio-sketches

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Edna Iliana Tamariz-Flores received the B.Sc degree in Electronic Engineering from the Benemérita Universidad Autónoma de Puebla (BUAP), Mexico in 2004 and M.Sc. degree in Electronic and Telecommunications from CICESE research center in Ensenada B.C. Mexico in 2007. She is currently a full Professor-Researcher with the Faculty of Computational Sciences at the Benemérita Universidad Autónoma de Puebla. Her research interests include Wireless personal communications, Telecommunications, Networks, Wireless networks sensors, smart cities, and IoT.