**Top Level Newsletter:** **Connected Vehicle**

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**Vol 6.0**

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Systems Research Development and Innovation

**Vol 6.0 progress: Featuring three articles from Proceedings of the IEEE, February 2020, Special Issue on Internet of Vehicles,**

**Vol 5.1 progress: Feature on Co-operative Automated Driving added**

**Vol 4.0 progress: An important paper reviewing current sensor technology added**

This publication is intended to provide the IEEE member with a top level briefing of the subject under review. There is a change from previous issues as the size of the newsletter has been increasing. Instead of a cumulative approach, as adopted previously, the newsletter will now only feature new content. For previous content, please access previous voliumes.

The objective is to provide a platform for fast learning and quick overview so that the reader may be guided to the next levels of detail and gain insight into correlations between the entries to enable growth of the technology. Intended audiences are those that desire a quick introduction to the subject and who may wish to take it further and deepen their knowledge. This includes those in industry, academia or government and the public at large. Descriptions will include a range of flavors from technical detail to broad industry and administrative issues. A (soft) limit of 200 to 300 words is usually set for each topic, but not rigorously exercised. As descriptions are not exhaustive, hyperlinks are occasionally provided to give the reader a first means of delving into the next level of detail. However, it is not the intent to make this a forest of hyperlinks. The reader is encouraged to develop a first level understanding of the topic in view. The emphasis is on brief, clear and contained text. There will be no diagrams in order to keep the publication concise. Related topics in the case of Connected Vehicle technology, such as 5G cellular and the Internet of Things will be included. The publication will be updated periodically. Articles from other published sources than IEEE that add to the information value will occasionally be included.

This newsletter forms part of the regional Advanced Technology Initiative (ATI) of which connected vehicles form a constituent part. Technical articles solely from IEEE journals/magazines are referred to by their Digital Object Identifier (DOI). Those readers who wish to delve further to the complete paper and have access to IEEE Explore ([www.ieeexplore.ieee.org](http://www.ieeexplore.ieee.org)) may download a complete article of interest directly by inserting the DOI. Those who subscribe to the relevant IEEE society and receive the journal may already have physical or electronic copies in their possession. In case of difficulty please contact the editor at kaydas@mac.com. The objective is to provide top level guidance on the subject of interest. As this is a collection of summaries of already published articles and serves to further widen audiences for the benefit of each publication, no copyright issues are foreseen.

Readers are encouraged to develop their own onward sources of information, discover and draw inferences, join the dots, and further develop the technology. Reading the full articles summarized here is recommended.

**Internet of Vehicles [Scanning the Issue],**

**Proceedings of the IEEE (Volume: 108, Issue 2, Feb. 2020)**

Xuemin Shen , Romano Fantacci, Shanzhi Chen

**Page(s):**242 - 245

**DOI:**[10.1109/JPROC.2020.2964107](https://doi.org/10.1109/JPROC.2020.2964107)

Vehicular communication networks have emerged to enable numerous vehicular data services and applications. Conventional vehicular ad hoc networks (VANETs) are often operated in the ad hoc mode and mainly focus on road safety applications based on the connection between vehicles and roadside units (RSUs). To support vehicular communications, dedicated shortrange communication (DSRC) and car-to-car communication consortium (C2C-CC) have been initiated in the United States and Europe, respectively. With the new era of the Internet of Things (IoT), the conventional VANETs have evolved to the Internet of Vehicles (IoV). In IoV, each vehicle is envisioned as an intelligent object, equipped with sensing platforms, computing facilities, control units, and storages and is connected to any entity (other vehicles, RSUs, charging/gas stations, cloud, and so on) via vehicle-to-everything (V2X) communications. Intelligent vehicles can take different roles, i.e., being both a client and a server, taking and providing big data services, leading to numerous new IoV applications, from assisted/autonomous driving and platooning, secure information sharing and learning to traffic control and optimization. (168 words)

# Mobile Edge Intelligence and Computing for the Internet of Vehicles

Jun Zhang, Khaled B. Letaief

Page(s): 246 - 261

**DOI:**[10.1109/JPROC.2019.2947490](https://doi.org/10.1109/JPROC.2019.2947490)

The Internet of Vehicles (IoV) is an emerging paradigm that is driven by recent advancements in vehicular communications and networking. Meanwhile, the capability and intelligence of vehicles are being rapidly enhanced, and this will have the potential of supporting a plethora of new exciting applications that will integrate fully autonomous vehicles, the Internet of Things (IoT), and the environment. These trends will bring about an era of intelligent IoV, which will heavily depend on communications, computing, and data analytics technologies. To store and process the massive amount of data generated by intelligent IoV, onboard processing and cloud computing will not be sufficient due to resource/power constraints and communication overhead/latency, respectively. By deploying storage and computing resources at the wireless network edge, e.g., radio access points, the edge information system (EIS), including edge caching, edge computing, and edge AI, will play a key role in the future intelligent IoV. EIS will provide not only low-latency content delivery and computation services but also localized data acquisition, aggregation, and processing. This article surveys the latest development in EIS for intelligent IoV. Key design issues, methodologies, and hardware platforms are introduced. In particular, typical use cases for intelligent vehicles are illustrated, including edge-assisted perception, mapping, and localization. In addition, various open-research problems are identified. (210 words)

# Evolutionary V2X Technologies Toward the Internet of Vehicles: Challenges and Opportunities

Haibo Zhou, Wenchao Xu, Jiacheng Chen, Wei Wang

Page(s): 308 - 323

**DOI:**[10.1109/JPROC.2019.2961937](https://doi.org/10.1109/JPROC.2019.2961937)

To enable large-scale and ubiquitous automotive network access, traditional vehicle-to-everything (V2X) technologies are evolving to the Internet of Vehicles (IoV) for increasing demands on emerging advanced vehicular applications, such as intelligent transportation systems (ITS) and autonomous vehicles. In recent years, IoV technologies have been developed and achieved significant progress. However, it is still unclear what is the evolution path and what are the challenges and opportunities brought by IoV. For the aforementioned considerations, this article provides a thorough survey on the historical process and status quo of V2X technologies, as well as demonstration of emerging technology developing directions toward IoV. We first review the early stage when the dedicated short-range communications (DSRC) was issued as an important initial beginning and compared the cellular V2X with IEEE 802.11 V2X communications in terms of both the pros and cons. In addition, considering the advent of big data and cloud-edge regime, we highlight the key technical challenges and pinpoint the opportunities toward the big data-driven IoV and cloud-based IoV, respectively. We believe our comprehensive survey on evolutionary V2X technologies toward IoV can provide beneficial insights and inspirations for both academia and the IoV industry.

1. We provide a thorough survey of V2X communication technologies evolution. Looking back at the historical process of V2X technologies development, it has been 20 years since the first licensed spectrum was allocated for DSRC in 1999. This review can provide beneficial guidance in the direction of V2X evolution toward IoV.
2. We conduct an in-depth technical comparison between 802.11 V2X and cellular V2X, in terms of both pros and cons. We conclude that cellular V2X will be a strong competitive technology against 802.11 V2X, which integrates cellular communications and device-to-device (D2D) CT.
3. We highlight key technical challenges and pinpoint opportunities toward future directions of IoV. We investigate two promising future trends of IoV technologies, i.e., big data-driven IoV and CIoV, which can provide insights and inspirations for both IoV academia and industry developments.

It has been 20 years since FCC has allocated DSRC with 75-MHz spectrum for vehicular communication applications in 1999. Looking back at the historical process of V2X development, we have elaborated the history and technological development of DSRC. To further study and understand the key technologies of V2X, we have investigated the development roadmap of 802.11 V2X and cellular V2X technologies, respectively, and compared the pros and cons of two mainstream V2X technologies as well. Finally, we have proposed two important development trends of vehicular communication technologies for IoV. Last but not least, we have highlighted the key technical challenges and pointed out the opportunities toward the big data-driven IoV and CIoV. We believe that this study will shed light on the vehicular communication technologies and promote the technology advance and development of IoV.

(460 words)