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

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**Vol 8.0**

Editor-in-Chief: Kay Das, IEEE Life Member,

Systems Research Development and Innovation

**Vol 8.0: The Critical Importance, Key Benefits, and Market Opportunities of Cloud-Based AI.**

**Vol 7.0: COVID -19 and Connected Vehicle**

**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.

## THE CRITICAL IMPORTANCE, KEY BENEFITS, AND MARKET OPPORTUNITIES OF CLOUD-BASED ARTIFICIAL INTELLIGENCE

(free white paper from ABI Research: Cloud-Based AI In a Post-COVID19 World)

The demand for cloud-based services has never been greater. While nearly half of the world’s population is in partial or full lockdown, people are continuing their daily activities online. This has increased Internet traffic, with many communication service providers reporting a 30% to 40% spike in average traffic, but it has also led to a shift from many offline activities and transactions to online platforms.

As business continuity has become a vital challenge during COVID-19, fully scalable and flexible, yet secure cloud resources have become more important than ever. Despite some already having remote working arrangements and cloud processing capabilities in place, many organizations have yet to fully leverage the capabilities of cloud-based Artificial Intelligence (AI).

As the dust settles and the post-COVID-19 landscape takes shape, cloud AI adoption is set to accelerate key industries and domains across the globe.

**Strong Demand for Cloud AI chipsets**

At the moment, public and private data centers are experiencing record high workloads. The demands for cloud AI services will lead to more data center servers equipped with AI chipsets. These are servers that can host cloud-based AI workloads, such as conversational AI, search and recommendation systems, healthcare diagnostics and patient monitoring, and cybersecurity risk assessment and threat detection, thus shielding the cloud AI chipset market from
a market downturn. It is also important to note that the supply chain for semiconductors as a whole has not been as heavily disrupted as other industries. Fabrication factories in Singapore and Taiwan remain operational. While install- ing, commissioning, and deploying new AI servers may slow down due to movement restriction, the forecast for cloud AI chipsets is expected to experience only a slight drop in 2020, as compared to previous forecasts, before returning to close to normalcy in 2021. A quick rebound will ensue.

**New Connected Vehicle Shipments Will Drop By at Least 15%..... (from ABI Research)**

The COVID-19 outbreak has caused global new vehicle sales to contract by 19% in the first quarter of 2020 due to supply chain disruption, factory shutdowns, and the automotive vertical’s high dependence on brick and mortar retail sales. The lower sales are invariably driving down shipments of connected vehicles, and connected car platform subscription growth. According to **ABI Research**, a global tech market advisory firm, new connected vehicles will drop at least 15% globally in 2020. Furthermore, lower overall revenues will force OEMs and suppliers to reduce their expenditure on R&D, leading to industry consolidation and rationalization of investment.

“In the short term, a few OEMs may temporarily postpone immediate projects that add additional value to customers to concentrate their efforts on actions to reduce costs of ownership and to make their supply chain resilient and agile. However, investments and adoption of connectivity packages should remain constant due to standard fitment, such as eCall,” explains Maite Bezerra, Smart Mobility and Automotive Analyst at ABI Research.

OEMs with less liquidity will have to rationalize R&D investment and give preference to providers offering turnkey, low-cost solutions that fulfill basic regulatory requirements. On the other hand, larger OEMs with substantial investment in in-house solutions will be more willing to migrate to third party offerings and benefit from lower costs. Concerning infotainment, off-the-shelf solutions from providers like Google and Amazon are likely to benefit from the distress of OEMs, as they may be willing to lose control over their systems to decrease costs. OEMs will also be looking into leveraging partnerships and collaborative work, which is more cost-effective.

Connected car technologies have managed to enable various track and trace applications. Some OEMs, location service providers, and connected service platform vendors are using car connectivity to support countries fighting the COVID-19 pandemic. For instance, HERE, in partnership with ENEL X, is providing free estimation of movement, kilometers traveled, and main points of entry and exit within selected geographical areas in Italy. At the same time, Mojio is tracking the efficacy of social distance measures in the United States and Canada. And, TomTom has been tracing the lockdown efforts by analyzing traffic patterns. All companies use anonymized data from vehicles connected to their platform.

“With the decrease in new vehicle sales, which was already in decline before the COVID-19 outbreak, automakers will have to find strategies to decrease the churn rate of connected services and maximize revenue from registered vehicles. Meanwhile, service providers should increasingly invest in lower-cost turnkey solutions that meet the industry-standard requirements but allow some customization on top and further upgrades,” Bezerra advises.

These findings are from ABI Research’s [Connected Vehicles Quarterly Update](https://www.abiresearch.com/market-research/product/7778315-connected-vehicles-quarterly-update/) application analysis report. This report is part of the company’s [Smart Mobility & Automotive](http://bit.ly/2XYWdFr) research service, which includes research, data, and ABI Insights.  Based on extensive primary interviews, [Application Analysis](https://go.abiresearch.com/application-analysis-detail) reports present in-depth analysis on key market trends and factors for a specific technology.

**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

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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

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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

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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)