INTERACTIVE SESSION TECHNOLOGY

Talking Cars Make for Better Road Safety

Toward the end of 2015, Toyota, Japan's biggest manufacturer of small-sized vehicles, began to offer the Intelligent Transportation System (ITS) Connect safety package. ITS Connect overcomes the constraints of other similar systems that rely on line-of-sight limited sensors, such as poor function in extreme weather and blind spots, by enabling cars to talk to one another. The system allows a vehicle's onboard computer to perform vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) wireless communication continuously with other vehicles and with roadside infrastructure (lamp poles and traffic light poles).

ITS Connect allows effective communication within a radius of up to 300 meters at a frequency of 760 MHz, which was previously used in analog television broadcasting. Each V2V message contains basic data about the vehicle's position, speed, acceleration, type and size, and the timestamp, as well as free fields reserved for service expansion to be defined by individual applications such as the nearest intersection ahead. A vehicle with ITS Connect keeps broadcasting such messages and "listening to" these messages from other vehicles or infrastructure for analysis, and it responds accordingly long before a danger is visually perceived.

The ITS Connect system is designed to avoid collisions with other vehicles, pedestrians, and cyclists, by either changing the speed automatically (in case a vehicle ahead brakes abruptly) or by giving instant audio or visual safety information to the driver of any approaching vehicle from either side when passing through an intersection. By providing drivers with timely information and feedback, such as a reminder to give way to an approaching emergency vehicle or a countdown to a traffic signal change, the system can improve driving efficiency. The package also enables cooperative adaptive cruise control (CACC), which uses information obtained from V2V messages to automatically adjust the speed of an automobile to match that of the vehicle ahead.

Toyota and its allies began to promote Wi-Fi-based DSRC using the 5.9 GHz frequency band in the United States and European markets in 2017. Another standard of vehicular communication, cellular-vehicle-to-everything (C-V2X), appeared in 2018 and is trying to win different regional markets before DSRC becomes the mainstream. C-V2X consists of not only V2V and V2I but also vehicle-to-pedestrians (V2P) direct communications and vehicle-to-network (V2N) operations. V2P allows communications between vehicles and the mobile phones of non-vehicle road users, such as pedestrians and cyclists. V2N refers to exchange of traffic information, like the incidence of traffic jams, between vehicles and cloud-based data centers.

Since the two standards are adopted by different countries and regions and neither is mainstream, automotive parts manufacturing companies such as Continental AG and Autotalk have decided to let their products "speak" both "languages" by being compatible with both standards, thus giving flexibility to vehicle manufacturers and end users.

Regardless of standard, vehicular communications are expected to improve road safety by reducing 80 percent of traffic accidents, particularly collisions. In addition, V2X can increase efficiency in coordination of traffic flow through platooning and green waves. Platooning refers to a system in which multiple trucks drive together as a convoy, each at a consistent distance from the other, with the lead truck using a CACC application. This allows drivers on long-distance trips to take turns resting, and if the convoy is aerodynamic-optimal, fuel consumption is reduced as well. A green wave refers to a situation in which a series of traffic lights at several intersections turn green in perfect timing to allow continuous traffic flow in the same direction. The data collected in vehicular communication can be used to analyze patterns in traffic flow and in urban planning. Proper use of platooning and green waves could optimize mobility, improve congestion, save fuel, and reduce pollution.

These advances in vehicular communications are also paving the way toward the realization of the driverless automobile. In fact, Release 16 of 5G C-V2X, using a new radio-based sidelink, allows multicast communication to support advanced functions such as autonomous driving. The development of automatic driving is expected to provide further opportunities not only for the car-makers, telecommunication service providers, and chipset manufacturers but also for other sectors, such as shipment, logistics, insurance, and mobile healthcare.

However, regardless of standard, worries abound regarding data security and privacy issues. Vehicular

communications involve the transmittal of sensitive data, such as vehicle ID, and this data can be leaked. Malicious interception and alteration of transmitted messages could allow specific vehicles to be tracked, or false reports of misconduct to be generated.

Sources: Autotalks, auto-talks.com, accessed December 31, 2020; Continental AG, continental.com, accessed December 31, 2020; ITS Connect Promotion Consortium, itsconnect-pc.org, accessed December 31, 2020; Toyota Motor Corporation, global.toyota, accessed December 31, 2020; Jason Ellis and Shailesh Patil, "How NR-based Sidelink Expands 5G C-V2X to Support New Advanced Use Cases," qualcomm.com, March 31, 2020; K. Momota, "Connectivity Technologies Attracting Attention Due to Frequent Traffic Accidents," Furuno.com, May 31, 2019; Kristen Hall-Geisler, "In Japan, Priuses Can Talk to Other Priuses," TechCrunch, August 17, 2016.

CASE STUDY QUESTIONS

1. What are the pros and cons of the V2X technology?
2. What can be done to speed up the adoption of V2X technology among vehicle owners?
3. What other applications can you think of for the ITS Connect?

Case contributed by Joyce Chan, City University of Hong Kong

7-4 What are the principal technologies and standards for wireless networking, communication, and Internet access?

Welcome to the wireless revolution! Cell phones, smartphones, tablets, and wireless-enabled personal computers have morphed into portable media and computing platforms that let you perform many of the computing tasks you used to do at your desk, and a whole lot more. We introduced smartphones in our discussions of the mobile digital platform in Chapters 1 and 5. **Smartphones** such as the iPhone, Android phones, and BlackBerry combine the functionality of a cell phone with that of a mobile laptop computer with Wi-Fi capability. This makes it possible to combine music, video, Internet access, and telephone service in one device. A large part of the Internet is becoming a mobile, access-anywhere, broadband service for the delivery of video, music, and web search.

Cellular Systems

Worldwide, there are almost 4.9 billion mobile phone users, with over 3.1 billion using smartphones (eMarketer, 2020b, 2020). Mobile is now the leading digital platform, with total activity on smartphones and tablets accounting for two-thirds of digital media time spent (Anderson, 2019).

Digital cellular service uses several competing standards. In Europe and much of the rest of the world outside the United Sates, the standard is Global System for Mobile Communications (GSM). GSM's strength is its international roaming capability. There are GSM cell phone systems in the United States, including T-Mobile and AT&T.

A competing standard in the United States is Code Division Multiple Access (CDMA), which is the system Verizon and Sprint use. CDMA was developed by the military during World War II. It transmits over several frequencies, occupies the entire spectrum, and randomly assigns users to a range of frequencies over time, making it more efficient than GSM.