ElectronicDesign
Connected Devices Bootcamp

The What, Where and Why of In-Vehicle Communication and Beyond!

By John Blyler, Contributing Editor

ABSTRACT

Vehicle-to-Vehicle (V2V) and Vehicle-to-Everything (V2X) communications platforms are needed for ADAS, infotainment systems and more. Here is a look at the developing need for high-speed, high-throughput, reliable and secure networks.

Communication within and outside of intelligent vehicles requires a high-speed, high-throughput, reliable and secure network. One leading candidate is the same hardware and software system that connects the Internet and the Internet-of-Things, namely, Ethernet. This familiar and mature technology is already being used within cars and is well on its way to serving as the framework for vehicle-to-vehicle (V2V) wireless communications.

V2V refers to data communication between vehicles to help prevent accidents through the transmission of position and speed data between cars. Automotive companies are pushing the US and European governments to develop mandates for the development and adoption of this technology. According to WiseGuyRerports.com, the V2V communication market is expected to grow with a compound annual growth rate (CAGR) of 45.8% during 2018-2025.

How does one design for both in-vehicle and V2V communication? The first steps are to understand the new requirements of these technologies.

What is Needed?

One of the hallmarks of today's in-vehicle and emerging V2V communication networks is high-data rate throughputs and very fast signal speeds. Both high-speed connectors and cables are needed to meet the transmission rates of 5 to 10 Gbps of data for infotainment and safety-related images and videos.

But handling data isn't enough. To cut down on system size and weight, hybrid connectors that handle both data and power are required.

Unfortunately, transmitting power near high-speed data lines tends to generate electro-magnetic interference (EMI). Mitigating these affects requires connectors and cables that are insulated and even shielded again EMI and signal crosstalk. One of the ways to handle these issues is with differential pair electronics like low-voltage differential signaling (LVDS) connections like those used in Ethernet systems.

In addition to connector and cable concerns, higher data rates and throughput from a multitude of different automotive sensors will require faster processors to perform calculations, data interpretation and potentially make life-saving decisions. To handle all the real-time data processing, sensor aggregators known as sensor fusion units are required. Software algorithms will be required to consider inputs from sensor aggregators and at least one other source before making decisions. For example, a video camera that captures an image might be compared with a light detection and ranging (LiDAR) unit that captures the same information via range-finding lasers. If the two sensor units "see" the same object or event, then the V2V communication system takes action.

Where is it Needed?

Modern vehicles are replacing error-prone human actions with advanced driver-assistance systems (ADAS) such as electronic stability controls, anti-lock brakes, lane departure warnings, adaptive cruise control, and traction control systems. These electronic vehicle components can reduce human error which greatly enhances safety.

ADAS technology relies on inputs from multiple data sources and sensor fusion units including video and imaging cameras, LiDAR, radar, and in-vehicle networking. Inputs from other vehicles – via V2V communications – and outside infrastructure systems may also be used.

Another area where high-speed data connector-cabling-modules are needed is In-Vehicle Infotainment (IVI) systems. IVI's are simply a collection of hardware and software in automobiles that provides audio or video entertainment. While cars of the past had only radios with cassette or CD players, today's automobiles include automotive GPS navigation systems, streaming video, USB and Bluetooth connectivity, internet, and WiFi. With these technologies, vehicle occupants can constantly access the latest news, entertainment, information and features from their phones while driving (hands-free, of course).

Two way-connectivity is the third area where high-speed data networks like Ethernet are needed. Perhaps the most common application for two-way connectivity is with Over-the-air (OTA) diagnostics systems which identify automotive maintenance issues and enable firmware or software updates. The most up-and-coming application for such connectivity will be in vehicle-to-everything (V2X) communications, which allow intelligent vehicles to query infrastructure stations along the road for increased driver safety.

How is it Designed and implemented?

The increasing complexity of interconnected electronic systems have caused vehicle designers to use a more systems engineering approach in which automotive electronic systems are partitioned into subsystems (sometimes called zones). These zones exist for engine control, infotainment systems, cabin area, front and rear electronics, etc. These subsystem partitions improve the design and efficiency of communication systems and data processing units.

In most cases, communications between in-vehicle zones can be handle efficiently with either wired or wireless Ethernet networks. External communications for wireless V2V and V2X communications must also be considered. Dedicated short range communication, or DSRC, is a global communications standard that links vehicles with stationary electronic units outside the vehicle. Outside communication is needed to monitor parameters such as traffic flow and weather conditions. It can also be used

for V2V communications. For example, if a vehicle is approaching another too quickly or from a blind spot, the vehicles could be directed to take evasive action.

DSRC communications are based on a particular type of Vehicle-to-Vehicle (V2V) technology that falls under the IEEE 802.11p Wi-Fi standard – often implemented with Ethernet. IEEE 802.11p includes data exchanges between high-speed vehicles and between the vehicles and the roadside infrastructure (so-called V2I communication).

But DSRC is not without its detractors. They point out that the original IEEE 802.11 standard—the basis for the 802.11p update—

was designed for relatively stationary Wi-Fi applications and not for millions of moving vehicles. Instead, these proponents are advocating that 5G next-generation cellular networks as a better choice for V2V and V2X communications.

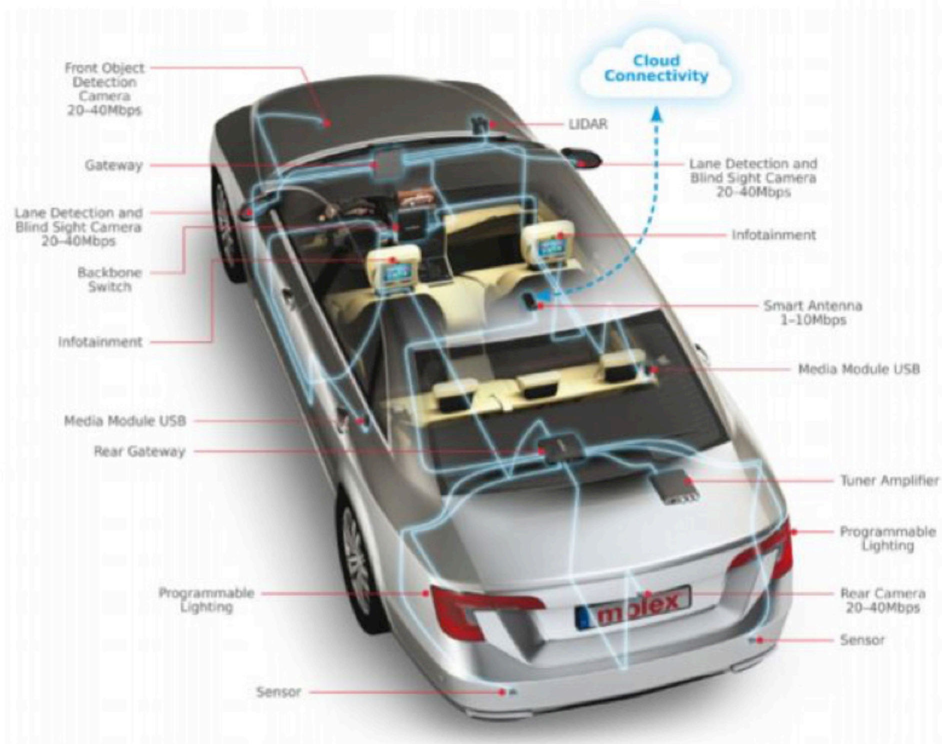
Regardless of which protocols are selected, V2V communications will be implemented to handle the higher data speeds and power demands of intelligent vehicles.

Picking the Right Solution

A good place to look for high-speed end-to-end communication solutions is at Molex. For example, Molex Gateway, part of their V2V offering, is a secure hub that gathers and processes data from all components, ADAS units and zones to integrate multiple hardware and software systems as well as legacy automotive protocols.

The In-vehicle processing power and connectivity systems needed for effective communication within an intelligent vehicle network are also offered by Molex. Further, they are developing infotainment solutions that reliably connect consumer devices to vehicle systems while providing rapid charging.

Overall connectivity challenges are met with Molex's existing and newer 10 Gbps Ethernet Automotive Network. Both provide complete data integration for a wide range of vehicles types and manufacturers. These networks allow for OTA updates, diagnostics, telematics and communication between the vehicle and the outside "cloud" (*see figure*).



Understanding the requirements, components and implementations of in-vehicle and outside of vehicle communication is a necessity for today's intelligent automobiles.