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The Future of Data and Connected Vehicles

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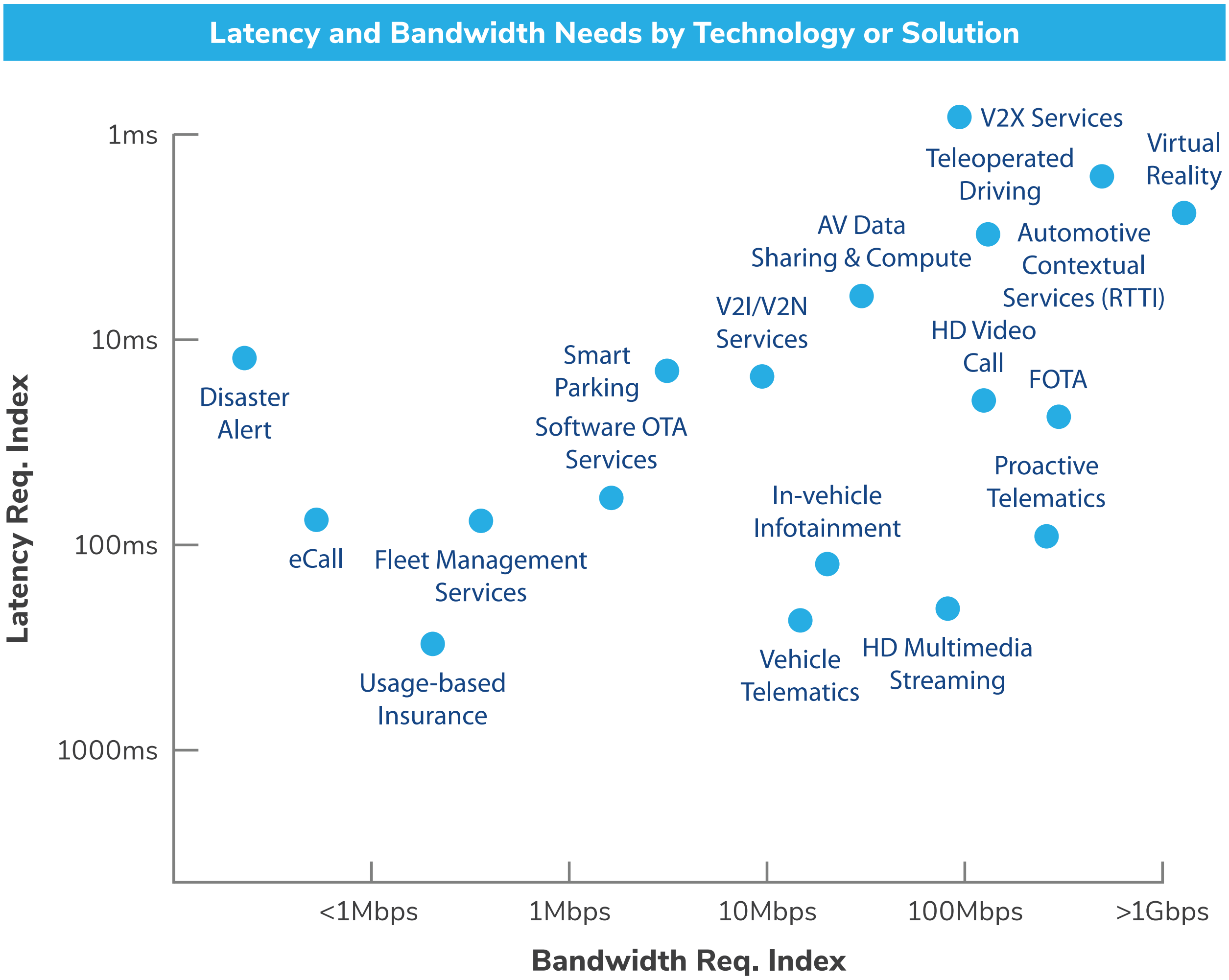
In the next few years, a more thorough connection between vehicles and the motorists who drive them will require a huge amount of data from numerous sources. Edge computing will enable data derived from vehicles, weather reports, road condition sensors, infrastructures, and other sources to be gathered, processed, and shared in real time with other vehicles and entities; collectively, the data will be used to determine insurance rates, track performance, and produce even more data for monetization across ecosystems. In fact, some experts predict that by 2025 each connected vehicle on the road will generate 100 gigabytes of data per hour, requiring cloud support.

Data will become even more vital as we move toward the reality of more autonomous vehicles on the road. Use of the cloud and edge analytics will increase, which will require massive bandwidth capabilities and expanded 5G network availability. As illustrated in the graphic below, all this data will enable exciting technological advancements in the automotive industry, including smart parking, teleoperated services, and autonomous vehicle data sharing and computing.

Figure 1: Exciting Technological Advances in the Automotive Industry—Connectivity Critical for New Features, Competitive Differentiation



Developing a Data Matrix across Systems

Effectively leveraging these huge quantities of data and offering more awareness and detailed information about what's going on around the vehicle will keep drivers and passengers safer. Predictive capabilities and sensors will help to reduce accidents and improve the driving experience. Yet, harnessing and effectively leveraging all the data generated by connected vehicles will be a mammoth task. Roger Berg, Director of the Automotive Edge Computing Consortium (AECC) and Vice President of DENSO International America, recently noted during the Frost & Sullivan webinar The Future of Data and Connected Vehicles that many questions still must be answered: "What kind of data is transferred between the sources and the users? How and where within the network and between these endpoints will the necessary processing be done? Will it need to stay in the vehicle? Will it need to be in the immediate regional cloud device or in an intermediate region edge device? Or will it all go back to the cloud?"

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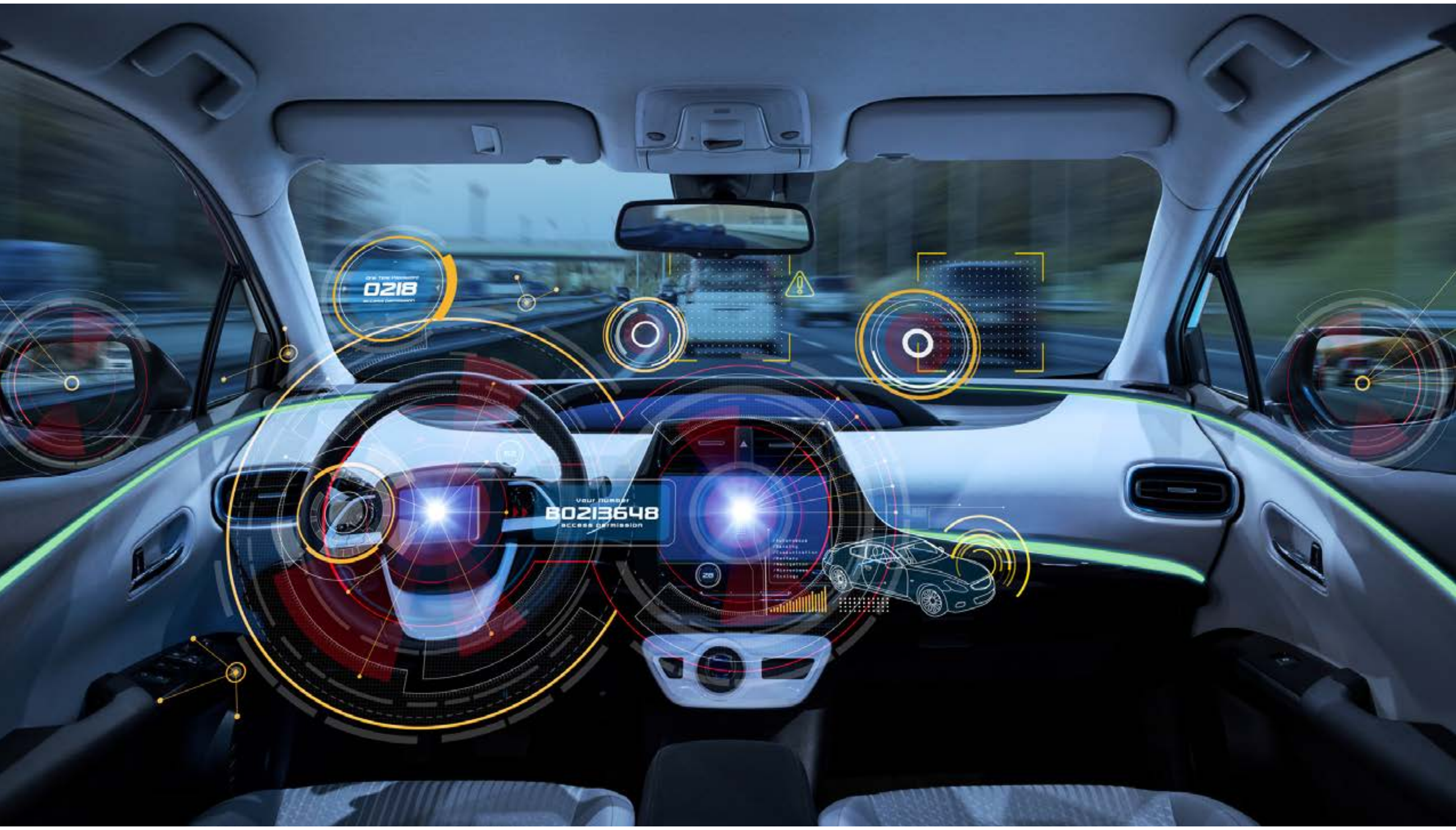
Industry players such as original equipment manufacturers (OEMs) and mobile network operators (MNOs) will have to come together to ensure that necessary calculations can be executed under average vehicle operating conditions. These and other value chain participants will have to address data availability and reliability, determine and configure the best sources for the data (e.g., a neighboring car versus a traffic intersection a mile ahead), and other considerations. As Roberta Gamble, Partner and Vice President of Frost & Sullivan, observed at the webinar, "A matrix of information across the ecosystem will need to be developed."

Edge Computing Will Drive Growth of the Connected Car Market

Frost & Sullivan analysis has determined that the global connected car market will be worth as much as $168 billion by 2025. Edge computing will play a big part in efficiently connecting and sharing data between cars and other systems. As Berg stated: “The amount of data that needs to be exchanged between the players in an intelligent, connected, highly automated vehicle system is really, really huge. … To put forth an architecture that will enable those kinds of services, the people at the AECC are developing a system of systems rather than a single ecosystem. It is unlikely that a single, universal architecture will be capable of achieving all goals, so there may be overlays of capability, perhaps from different cloud or edge service providers, in any given region.”

Edge computing presents numerous opportunities to generate revenue by creating new business/service models along the value chain. For example, city planners could analyze and share data about consistently poor road conditions to remedy traffic issues; sensor data could be shared with manufacturers or providers or sold as part of a service.



A Crucial Challenge: Designing a System of Systems

An architecture that supports high-mobility and low-latency requirements while providing access to networks that distribute all the data will be necessary. This overarching architecture will ideally include key performance indicators and predictive functions, making the driving experience safer and more efficient. Doing so will require collaboration among MNOs, OEMs, network vendors, cloud solution providers, and other stakeholders. All these players will need to come together to create a mix of safe, connected and less-connected vehicles on the road. Identifying and rectifying data, technology, and business gaps—and standardizing criteria and processes—will be crucial.

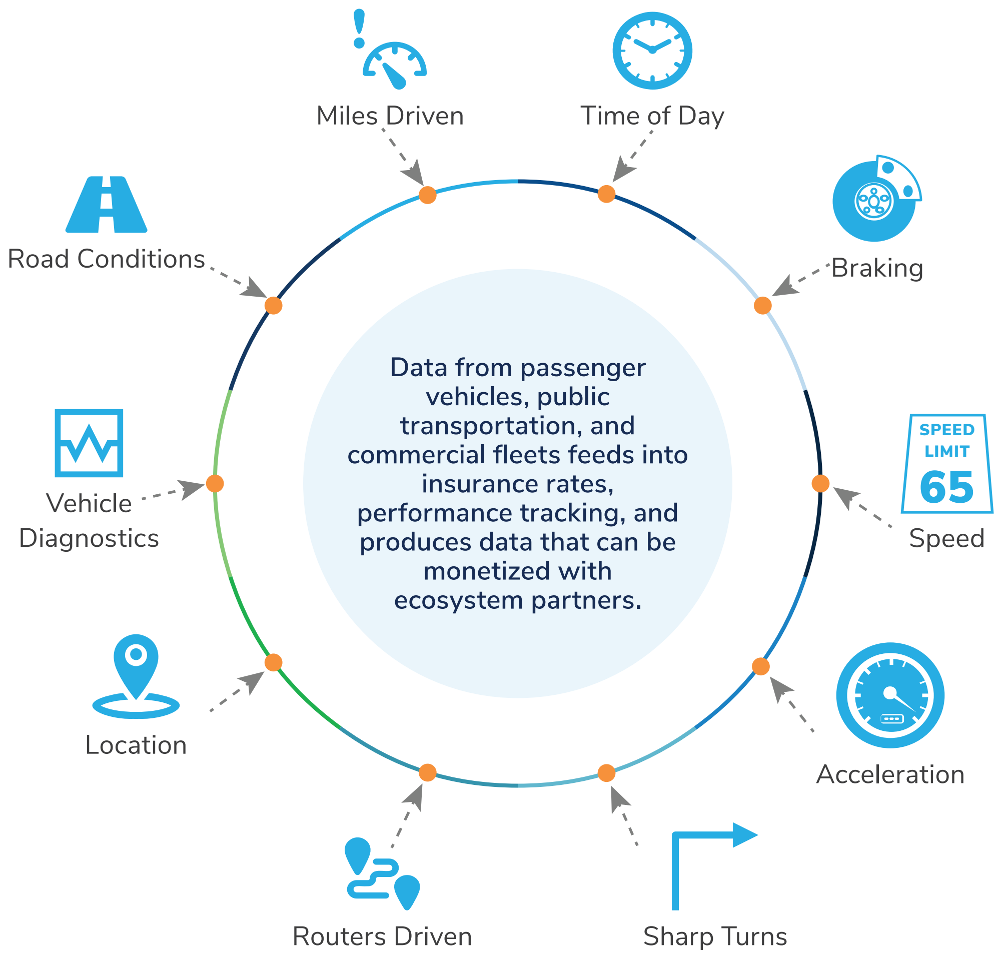
As Christer Boberg, Director of AECC and of Ericsson Internet of Things and Cloud Technology and Strategies, stated in the webinar: "There are certain functions and mechanisms that must be available and must be commonly accepted on a global scale. They should be, as much as possible, cross-vendor and provide diagnostics so that any player, any OEM, any application can use any infrastructure and any network from different vendors and service providers."

Connecting all this technology and making the processes provider-agnostic will be complex, multitiered undertaking. Trust and technical judgment will be essential in applying agreed-upon standards end to end among vendors, devices, and applications.

> **"The data from the connected vehicle running in London is not related to the data of the connected vehicle in New York City at all."**
>
> *—Ken-ichi Murata, President and Chairperson of AECC and Fellow at Connected Company at Toyota Motor Corporation*

Localized data also will be required. High volumes of data generated in one area may influence connected product design but not necessarily real-time data utilization. Ken-ichi Murata, President and Chairperson of AECC and Fellow at Connected Company at Toyota Motor Corporation, noted, "The data from the connected vehicle running in London is not related to the data of the connected vehicle in New York City at all. So the data collected in London should be consumed in London, and data collected in New York City should be consumed with the data of the other connected vehicles in New York City. That data could be compared or analyzed with other data from road sensors or climate information data locally." AECC's concept of distributed computing on localized networks is one way to handle this part of the process.

Figure 2: The Quantified Motorist—Data Streams In From The Vehicle, Driver, And Ecosystem Partners



Developing proofs of concept is a first step in designing the infrastructure and system of systems that will enable connected and autonomous cars. The more traditional top-down engineering approach to a proof of concept identifies the main requirements of a use case (e.g., technical requirements or user behaviors then documented by groups such as those at AECC). These specifications are used as guidelines for creating mechanisms or architectures that meet key performance requirements. A bottom-up approach typically leverages a solution that already exists, adapting it to solve technical issues or requirements. This approach often comes from an adjacent industry. Top-down and bottom-up approaches can be combined, ideally deriving the best aspects of each. “In the AECC’s vision … we would combine both these top-down and bottom-up implementations towards a comprehensive system that puts together an architecture and a portfolio of services that can be commercially deployed,” Berg said.

The AECC: Driving Best Practices and Global Solutions, Proof by Proof

The AECC is a consortium of cross-industry players that work together to evaluate technologies and use cases with the goal of finding solutions and driving best practices for vehicle and computing convergence—an area expected to grow by leaps and bounds in the coming years. The organization is particularly focused on edge computing in automobiles, testing new ways of creating value, use cases via streaming data, the Internet of Things, and analytics in distributed locations. Edge computing in combination with extensive 5G network capabilities will be essential to enabling connected and autonomous vehicles.

Eventually, improvements in latency and reliability driven by 5G and edge computing will harness, manage, and distribute data almost anywhere. Because automobiles generate arguably more data than most other machines, they are a primary use case for the untold new value, business models, and innovations these technological advancements bring. Yet, collaboration, standardization, addressing privacy concerns, and setting and adhering to best practices on a massive scale will be necessary to leverage these incredible technological capabilities safely and successfully.

To view the webinar and learn more, click here: www.frost.com/futureofdataconnectedvehicles

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