REUTERS EVENTS™

In partnership with verizon

The Foundation of Next-Gen Connected Cars

5G & MEC for safety, security and monetization

Author
Susan Kuchinskas

Contents

3 A New Level of Safety

4 MEC and Autonomy

8 V2X and the Smart Community

10 The Car as Platform

11 Infrastructure: The Foundation for Innovation

15 Profiting from an Option-Rich Technical Infrastructure

17 Build the Infrastructure for Tomorrow Today

SECTION 1

A New Level of Safety

A pedestrian is about to dart into the street, but he's still hidden behind a building, so the driver can't see him. A potentially fatal accident is avoided, thanks to the car's connection to intelligent infrastructure.

Here's how it would work: A smart camera mounted in the intersection detects the approaching pedestrian. It relays this information via a software platform to a nearby edge node of a cellular network. The software precisely locates the pedestrian and sends an alert to the driver's vehicle.

All this happens in the blink of an eye, thanks to 5G cellular and mobile edge computing (MEC).

MEC is a network architecture model that brings computing resources and infrastructure closer to devices generating or consuming data, including cell phones, road sensors and connected vehicles. In this decentralized model, data is processed and stored in MEC within the radio access network (RAN) site, with only key information transmitted to more centralized data clouds.

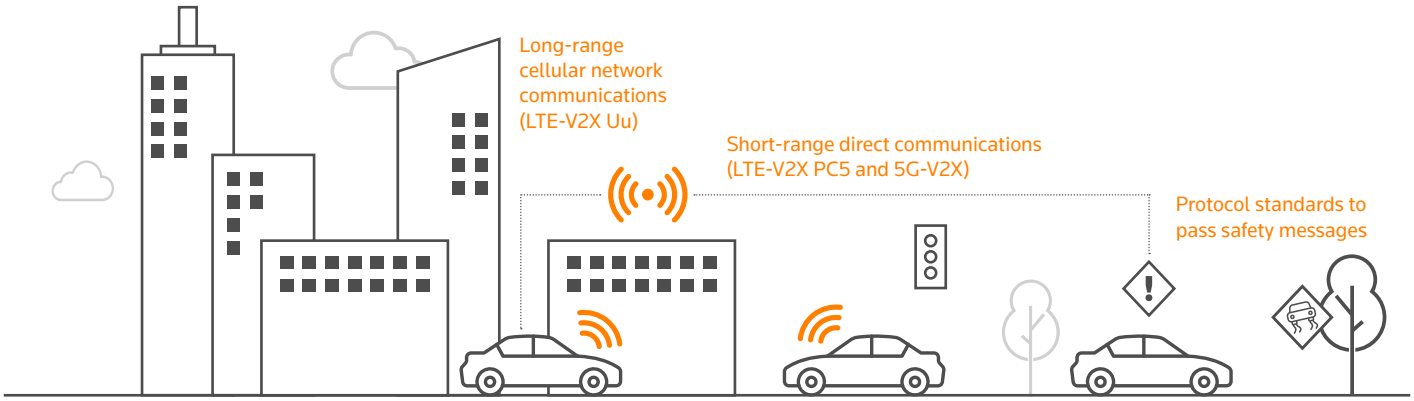
MEC leverages cellular networks and 5G as its primary connectivity. 5G could deliver data rates of gigabits per second with ultra-low latency.

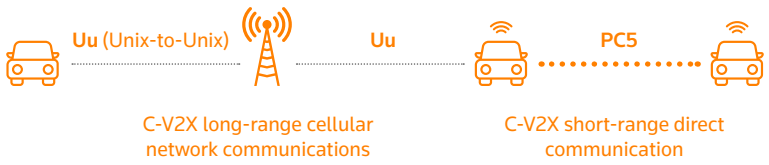
While this kind of pedestrian detection technology isn't available in production vehicles yet, it's been demonstrated by Honda and Verizon Wireless at the Mcity Test Facility at the University of Michigan.

SECTION 2

Enabled by MEC

Another test illustrates the potential of this technology. Nissan's Research and Advanced Engineering team used Verizon 5G Edge with AWS Wavelength to assist in processing sensor data , i.e. assisting the OBU/ECU of the car, from Nissan vehicles and infrastructure at the edge of Verizon's wireless network. Data was communicated back via the cellular network to vehicles in near real time. Then, Nissan's Intelligent Shared World platform notified drivers of oncoming vehicles obscured by larger vehicles, as well as hidden pedestrians.

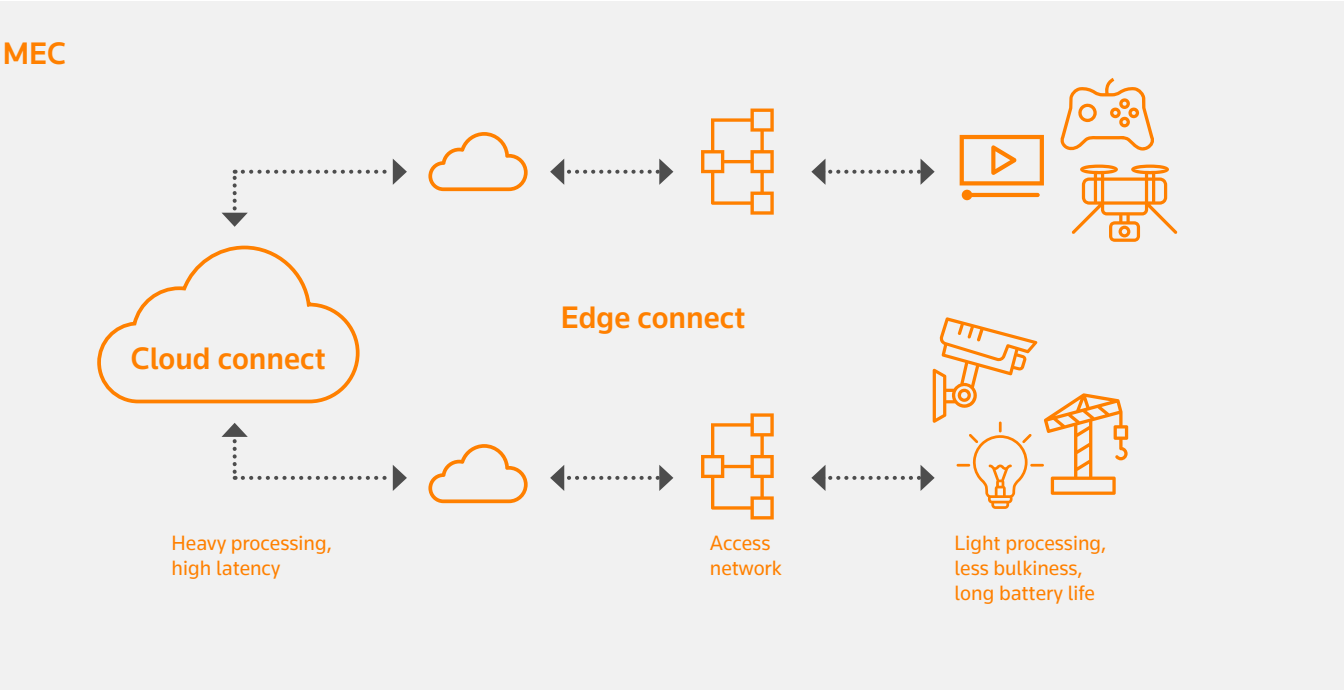




Cellular vehicle-to-infrastructure (C-V2X) applications like pedestrian and vehicle detection will help humans and autonomous vehicles drive safer.

But for these safety measures to work, the low latency offered by connections from the vehicle or infrastructure to a centralized cloud isn't good enough.

MEC can enable close to real-time transfers of data, while 5G provides a broadband pipe capable of carrying the immense amount of data that will be generated by autonomous vehicles, devices and infrastructure.



"5G connectivity will be the key to making sure the car can handle not only the technology of today, but also future technologies we may not be able to imagine now."

TJ Fox

MEC and 5G will let applications in the vehicle access local content and real-time information. There are plenty of examples of applications in addition to pedestrian detection.

- The navigation system could access local weather data to determine whether a particular route might be icy or flooded. It could connect to road sensor data to determine that traffic was moving slowly on what would normally be the optimum route.
- Vehicle-to-vehicle communication (V2V) would notify adjacent cars of their speed and heading, informing intelligent cruise control and helping to avoid sideswipes or collisions.
- Intelligent traffic information systems such as IRIS could use MEC to let departments of transportation monitor real-time information from roadway devices. Information on traffic accidents, road conditions and the flow of traffic helps them maximize road capacity and alert drivers to dangerous conditions or roadwork.
- Data from connected cars can be combined with vehicle-to-infrastructure (V2I) technologies to let connected traffic signals respond to actual traffic. A stoplight, for example, could remain green or yellow if no vehicles were approaching from the side.
- Connected, digital parking infrastructure could transmit locations of available parking via apps or navigation systems to reduce traffic congestion caused by cruising for spaces.

While it was once thought dedicated short-range communications would be the V2X enabler, the trend to use 5G cellular is clear. Cellular modems are already installed in new connected cars, and in the vehicle, it can support the same kinds of apps and services consumers enjoy via their phones. Cellular works over longer range with very high throughput and provides high-precision positioning. What's more, the cellular V2X (C-V2X) standard is globally compatible with 5G.[i]

For automakers, moving processing and other functions that reside within the car's systems to MEC devices could reduce the complexity and cost of in-vehicle hardware while providing connected vehicles with more advanced capabilities.

SECTION 3

MEC and autonomy

MEC and 5G will be even more crucial for unlocking the benefits of autonomous vehicles (AVs), which are expected to generate more than 300 terabytes of data each year.[ii] A study by the University of Michigan predicts autonomous vehicles will contribute to improvements in public health and safety, greater mobility, reduced energy and environmental impacts, and increased adoption of car sharing. The same study found that autonomous vehicles could reduce the number of fatal vehicle crashes by 90 percent just in the US, potentially saving approximately $190 billion per year.[iii]

Autonomous Vehicles can operate more safely with a cellular connection. Minimizing the amount of data to be downloaded can reduce the computational burden on the AV system.

High bandwidth and lower latency can reduce the need for high-powered computers onboard the vehicle. Instead, data can go to a MEC zone for processing, supporting rapid and automated decision-making in dynamic driving environments.

AVs will also need much more precise location data than GPS can provide. While GPS is accurate within three to nine meters, AVs must know their location within a few centimeters. Developments like Hyper Precise Location with Real Time Kinematics (RTK) can extend the capabilities of GPS. RTK will also support emerging technologies that depend on high level location accuracy – things like delivery drones and customer-approved location data for first responders during emergencies.

SECTION 4

V2X and the Smart Community

At the same time as it consumes data, the connected vehicle becomes a data source for applications that can be used by many other entities, including departments of transportation, city transportation managers and providers of emergency services.

Connected vehicles become a node in the internet of things, not only consuming data but contributing data to the network of connected devices. Combine data from connected vehicles with other connected infrastructure via V2X, and a wealth of new use cases emerge for the urban environment.

ABI Research forecasts the installed base of LiDAR sensors in smart cities to reach over 2.5 million by 2030. They'll help cities run more efficiently, leading to cost savings, and help contribute to decarbonization and resilience.

ABI identifies automated traffic management at intersections among the key sensor-based solutions and adds that sensor data monetization could provide new revenue for cities.[iv]

Lake Nona, Florida, is a real-world example of how 5G and MEC can inform city planning and infrastructure development. This 17-square-mile, planned community is gathering mobility data to inform its future planning and transportation strategies. With a mix of commercial, residential, retail and research facilities, the community has 5G infrastructure, a network of sensors and a fleet of autonomous shuttles. Hitachi Americas, which provides movement analytics, also accesses location data from personal smartphones.

Where a vehicle can communicate with the infrastructure, other vehicles and pedestrians around it, driver and pedestrian safety and traffic congestion could improve, and smart communities could get smarter. Traffic lights that automatically adjust their timing to the approach of a car could reduce traffic congestion and save a vehicle's fuel or battery charge by determining that there's no need for a car to stop at an empty intersection.

> When a vehicle can communicate with everything around it, driving gets safer, traffic improves and smart communities can get smarter"

SECTION 5

The Car as Platform

MEC and 5G are also foundational to the evolution of the car as a platform—a robust combination of hardware and software that provides a base for other processes and applications.

Cellular operators are already rolling out their 5G networks, offering higher speed, greater capacity and lower latency—a drop in latency as much as from 80 milliseconds to 22 milliseconds or less.[v] If consumer behavior in the car follows mobile phone behavior, this could lead to more consumption of services by drivers in the car: Open Signal found that 5G-smartphone users consumed between 1.7 and 2.7 times the data of those on 4G.[vi]

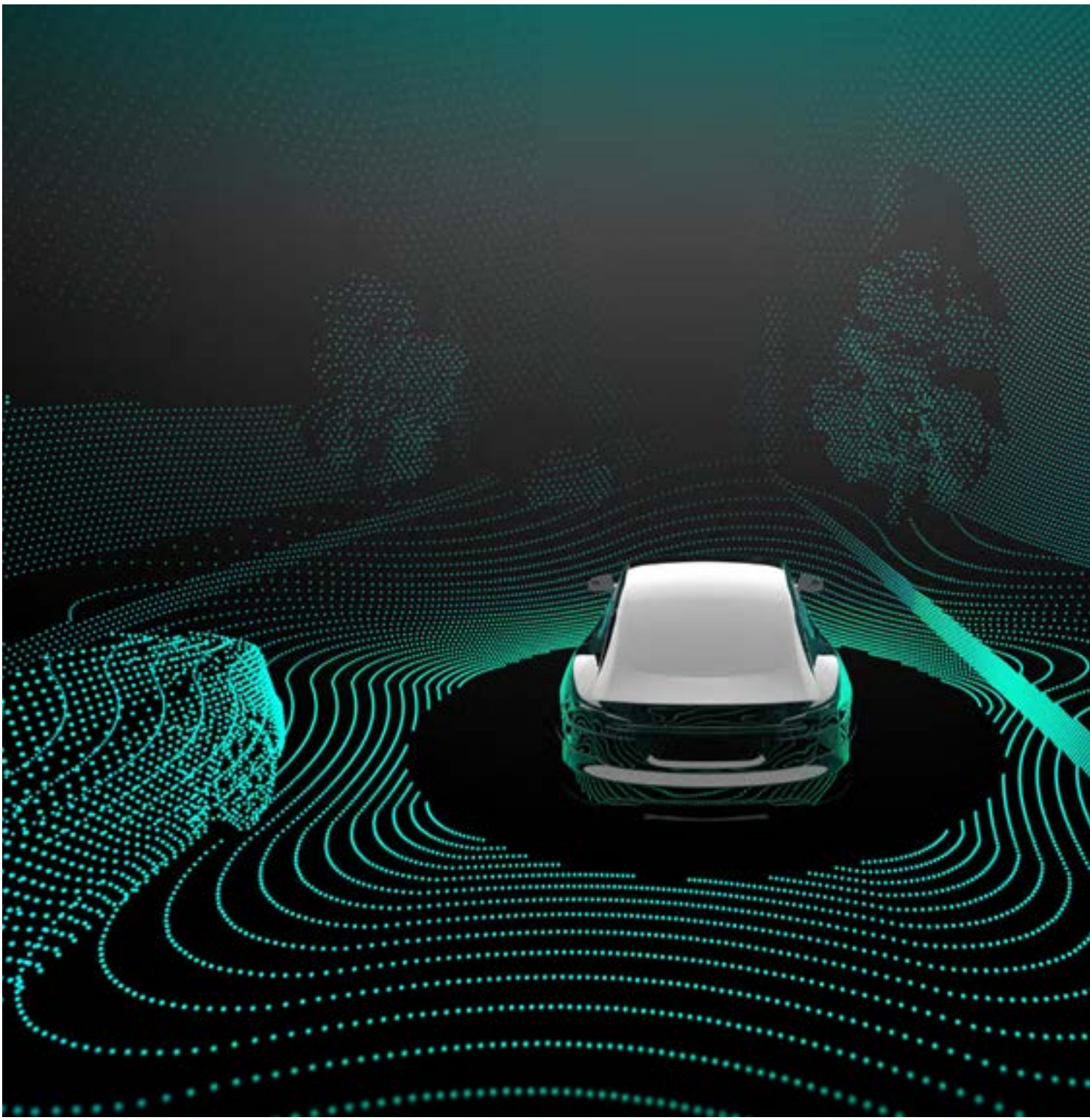
For OEMs offering desirable, monetizable applications and services, 5G may offer the same consumption boost. Faster, more attractive services can be a brand differentiator, as well. A 2020 McKinsey survey found that in some countries, including China, consumers would be willing to switch automotive brands for improved connectivity.[vii]

The car-as-platform has the potential to transform the driving experience while deepening and extending the relationship between consumer and brand. By offering enhanced safety, convenience and entertainment to the driver and/or passengers, this approach could provide monetization opportunities for OEMs and partners throughout its lifecycle.

The building blocks for this evolution are available now. The choices OEMs make today will determine how well positioned they are for the future.

SECTION 6

Infrastructure:
The Foundation for Innovation



To bring next-generation vehicles to market, OEMs will need an array of technologies that provide a foundation for innovations that will differentiate them. The same platform that will offer driver safety, cybersecurity, personalization and monetization in the near term will also put automakers on the road to full autonomy.

Frost & Sullivan warns that automakers may need to redesign their electrical and electronic architectures from the ground up to introduce the services and human/machine interface features that will be in demand by 2025 and later.[viii]

In addition to 5G connectivity with mobile edge computing (MEC), the future demands:

5G Ultra Wideband (5G UW)

5G UW (available in select areas) will provide the immersive vehicle experience in the connected car: entertainment, 3D mapping, and the ability for the OEM to quickly push out real time updates to the car.

End-to-end cybersecurity

Automakers must make sure that consumers' personal data remains protected and the vehicle is armored against attacks.

Upstream reports a total of 800 automotive cyber incidents, including a ransomware attack on a group of US dealerships.[ix] It also found vulnerabilities on a car rental management system and EVlink charging stations.

As in-car commerce becomes more prevalent, a new trove of personally identifiable transaction data will be generated, from paid streaming content to autopayment for fuelling to prepaid retail services. Add to that the kinds of data connected car makers already connect, including location and driving style, and hackers could have a field day.

Payment transactions themselves have, of course, been the subject of relentless attacks. The PCI DSS is a set of security requirements for any entity that processes or transmits credit card transactions. It's designed to help protect payment data from the point of purchase onward. The 2020 Verizon Payment Security Report found that only 27.9% of organizations it surveyed had achieved 100% compliance—and even those who had validated compliance struggled to maintain it.

When the point of purchase is a moving vehicle, securing transactions becomes more difficult as the vehicle may move from one access point to another.

Automakers themselves, as well as third-party service providers, should prepare to adopt the tenth release of the Payment Card Industry Data Security Standard (PCI DSS 4.0), expected in March 2022, which will be the most challenging yet.

There are four core security capabilities that every automaker must acquire for secure communications between the vehicle and everything:

- Enhanced visibility of risk to understand internal and external threats to assets, from proprietary databases to the factory to the individual vehicle.
- Secured infrastructure, assets and data from the cloud to mobile to IoT.
- Quick detection of and response to attacks.
- The ability to reduce the impact of attacks and quickly restore operations.

It's important to note security is central to the 5G standard, created by the 3rd Generation Partnership Project (3GPP). 5G enables Zero Trust, an architecture that precludes any component of the network to execute an action or transmit data without first being authenticated and authorized to do so.

The 5G standard includes comprehensive encryption standards and methodologies to secure and encrypt data in transit, so data is secured and encrypted in transit.[x]

Artificial intelligence

Artificial intelligence (AI) will play a major part in delivering the immersive in-vehicle experience.

It should be noted that edge computing enhances AI. Sensors can identify relevant and useful data, pass it along to AI analytics applications located at the edge. In urban areas where 5G MEC is fully deployed with C-band spectrum, AI analytics applications could sit at the sites of small cells.

AI algorithms will then be able to provide real-time inferencing and analytics—in theory, making decisions better and faster than a human could.

In the shorter term, AI in the cloud can add intelligence to an omnichannel contact center platform. By uncovering trends and revealing insights, AI can enhance customer engagement with information and promotions tailored to individuals.

Augmented reality

Augmented reality (AR) is already available as head-up displays (HUDs) in a few production cars, with other automakers planning to introduce it. In the HUD, AR can make driving safer by highlighting pedestrians, bicyclists, road hazards and providing visual lane-keeping assistance. It can make driving more convenient by projecting navigation information like street addresses onto the windshield view.

Then, there's advertising. AR connected to the cloud can overlay information about businesses, points of interest and other things on the road ahead. That overlay could include ads. While it's not clear that anyone would want a constant parade of popups offering fast-food discounts or motel prices, there are times—on a road trip, for example—where an overlay of this information could make it easier to choose a bed for the night.

It should be noted that hardware is only part of the AR equation for cars. Devices need to connect to a network with high bandwidth and ultra-low latency to support the huge and constant volume of data to be displayed. Edge computing capabilities could also help power AR applications by moving processing power closer to the user.

As shopping continues to shift to digital, AR on websites and mobile apps can let car buyers get a better sense of the exterior and interior of the car. They can compare different trims and even see how a car would look in their driveway. OEMs can help dealerships compete with direct-to-consumer car brands by offering enhanced retail experiences like these.

Personalized and contextual experiences in the car

The car is the last frontier for entertainment and marketing. There are two fronts: Shopping and entertainment for passengers via brought-in devices or personal screens can, with 5G connectivity, be as engaging to consumers—and as lucrative for OEMs and their partners—as the in-home experience. For drivers, safety and attention to the road must be paramount, but voice recognition and audio interfaces can let drivers safely order food, reserve a public charging station and a variety of other actions.

True personalization must be powered by the same technologies that target advertising on smart TVs, mobile devices and the desktop. That starts with a customer data platform to collect de-identified data about an individual's behavior and preferences. Combine that with the ability to bring in contextual information like weather and location to determine potentially interesting offers. Finally, this system must be able to constantly add behavioral information to those de-identified profiles.

The car of the future should also connect to personal media libraries. The same content delivered to the consumer's home should be available in the vehicle.

"For drivers, safety and attention to the road must be paramount, but voice recognition and audio interfaces can let drivers safely order food, reserve a public charging station and a variety of other action"

> Consumers are used to a rapid pace of innovation in their phones, devices and TVs. They'll expect the same level of innovation in the car of the future."

In an ideal world, someone should be able to pause playing an online game on the couch, get in the car, and resume the game in the back seat.

Stepping it up a level, OEMs can differentiate themselves with unique media experiences in the car.

As an example of the opportunities for in-car entertainment, Shark Experience runs on screens in golf carts.[xi] Golfers can view curated content from Yahoo Sports, Yahoo News and Yahoo Finance. They also have access to GPS yardages, hole flyovers, music via streaming radio or Bluetooth, real-time sports tickers, live and on-demand sports including the PGA TOUR and golfing tips.

Now, picture this for the car. A passenger could be offered a variety of media experiences based on their preferences and interests. A golfer could enjoy Shark Experience on a long drive, while an amateur chef could use the time to study Thai cooking. Or, the offered experience could be location-based. On a drive through Arizona, kids in the back could learn about the history of the Navajo Nation.

OEMs should collaborate with media brands and ad agencies to create this kind of audio entertainment for drivers and passengers that's on-brand, personalized and contextual. They should also partner with media owners to offer live-streamed content, including in-vehicle gaming.

New technology will be needed for server-side operations to smooth streaming content as the vehicle moves. Verizon's partnership with The Walt Disney Company illustrates how technology fires up the video experience. The companies have collaborated on a trial using Verizon's new Open Caching (OC) platform that caches content in network facilities closer to the customer.[xii] For in-home entertainment, this lets content start faster while reducing freezing, pausing or playback failures during streaming. OC could provide the same experience for people enjoying content on rear-seat screens as the car travels.

The various iterations of usage-based insurance (UBI) are another example of personalized services in the car. The UBI industry continues to grow, thanks to its delivery of better rates to safe drivers and reduced risk for insurers.

Automakers are rolling out dynamically priced insurance in partnership with insurers. Insurance plans could be personalized beyond the basics of how someone drives. Similar to features on demand, OEMs can offer contextualized plans available for a set period of time, say a vacation driving through the mountains, or let people temporarily add another driver.

While UBI policy rates are usually adjusted at policy renewal, OEMs could add gamification to more frequent updates. A driver who improved their score in three months could receive a congratulatory message—and a lower rate as an immediate reward. A consumer's ability to lower their rates as they go in a way that seems fun could be a differentiator.

A strong ecosystem of partners

As the lines of code and numbers of ECUs in the car grow, experts say that software will be key to future innovation. Volkswagen Chairman Herbert Dies went so far as to say software will contribute to 90 percent of innovation.[xiii]

While each OEM takes a different stance on the software build-or-buy question, every OEM knows that being able to scale is essential. Moreover, consumers are used to a rapid pace of innovation in their phones, devices and TVs. They'll expect the same level of innovation in the car of the future.

McKinsey identified the lack of an established ecosystem for scaling as one of the barriers to monetizing automotive data. It found that automakers too often expend resources building services that are beyond their core competencies—and that may already exist in the market. Instead, the consultancy advised them to focus on core competencies and things that differentiate the brand.

The list of potential revenue-generators McKinsey identified includes car commerce and automated payments, remote vehicle monitoring and services and targeted advertising.[xiv]

Software is certainly not the only area where OEMs need to identify the best partners. Chipmakers, cloud providers, research organizations and startups all have a role to play in building the car-as-platform.

SECTION 7

Profiting from an option-rich technical infrastructure

When the car becomes a platform for innovation, there are so many more options for innovation and monetization.

For example, one novel revenue stream that will be available in the near term is features on demand (FoD). While marketing may seem intrusive, FoD offers drivers a clear benefit exactly when they need it.

Volkswagen will trial FoD later this year. VW is considering navigation on-demand, as well as the ability for drivers to access travel assist, lane assist and adaptive cruise control. The idea is to make FoD offers contextual. If someone is in a traffic jam, they're a perfect customer for adaptive cruise control with stop and go. VW may offer this feature as a one-time purchase, try-to-buy or an ongoing subscription. While drivers may not understand the value of a driver-assistance feature, once they have the opportunity to use it when it matters, they see the benefit.

In order to offer FoD, OEMs must have an infrastructure of the future that includes high bandwidth, for the ability to turn on the feature immediately. They need secure OTA capabilities to update the vehicle on demand. They need a mobile payment infrastructure so that the driver doesn't need to recite a credit card number or fiddle with the infotainment screen to unlock the feature.

On the back end, OEMs need contextual awareness of how a vehicle is operating to determine whether an FoD offer might be welcome and what it should be. And they will need a customer data platform (CDP) that contains de-identified information not only about the make and model but also about usage, such as when and how much a car is driven. Rich, de-identified customer profiles in that CDP will also help OEMs finetune their communications so that they can personalize these communications and offers.

While there's a clear value case for many in-car services and apps—proactive repair alerts, enhanced navigation, voice-enabled commerce—OEMs need the technical flexibility and robustness to respond to the unknown future.

Because it's in this unknown realm of future services and apps that even more monetization opportunities will appear.

The vibrant autotech ecosystem enables not only steady advancement of autonomous technologies like computer vision and V2X, but also infotainment services. The consumer marketplace has shown, over and over, that it's difficult to predict the next hot thing. YouTube, consumer-generated review sites and TikTok are prime examples of things no one knew they wanted until they arrived.

At the same time, OEMs can strengthen relationships with their dealer networks and help position them for business success with an option-rich technical infrastructure.

Many dealerships have undergone their own digital transformations in response to consumer demand for online shopping and transactions. In cooperation with their dealer partners, OEMs can use data from the connected car to alert drivers when vehicle diagnostics show an issue and, using their personalization engines, not only direct the driver to the appropriate dealer but offer an incentive.

OEMs and dealers can improve lease renewal rates by proactively reaching out to leaseholders. Here, too, personalization can determine whether an upsell to a different model could seal the deal.

SECTION 8

Build the infrastructure for tomorrow today

Technical infrastructure is the foundation for innovation—but only if it's rich with options to address the safety and entertainment demands to come. Communications and services we can't imagine now may be table stakes ten years from now. The decisions OEMs make today will affect their ability to deliver on regulatory requirements for safety and consumer demand for exciting new experiences. An infrastructure primed for innovation will let OEMs take their place in an integrated ecosystem set to deliver the car of the future.

Verizon: your partner for the future

With an organization dedicated to partnering with automotive OEMs, Verizon can provide digital enablement to every part of an automaker's global organization.

- **Verizon 5G Edge, a mobile edge computing platform**
- **Verizon 5G Ultra Wideband**
- **Thousands of cloud-access radio networks (C-RAN), service-access point (SAP) sites and distribution switch locations that could run MEC services**
- **Partnerships with the top four chip manufacturers**
- **Partnerships with the top cloud providers**
- **Exclusive content thanks to partnerships with Walt Disney Co., Condé Nast, Sirius XM and BuzzFeed**
- **ThingSpace, a wholly owned IoT platform**
- **Proactive cybersecurity solutions**
- **An expanding suite of applications in the vehicle, such as network-coordinated firmware-over-the-air (FOTA) management; live streaming content via third parties; 3D mapping; and providing real-time operational information to autonomous vehicles**
- **Payment Card Advisory Services for secure in-car commerce**
- **Autonomous pilot programs with the University of Michigan's Mcity and Lake Nona, a 5G-powered, smart community**

Together, we can create a car of the future that's smart, able to learn and evolve, and rich with opportunities for OEMs and partners to earn more revenue by offering drivers what they want and need.

TJ Fox, SVP of Industrial IoT and Automotive, Verizon Business Group

As senior vice president of industrial IoT and automotive for Verizon Business Group, TJ Fox helps companies create best-in-class customer experiences through digital evolution and advancement into the 5G era.

He shares his insights on how to future-proof the car of today.

Keeping cars relevant

All the sensor data coming from the vehicle will make the customer experience more dynamic and relevant—even as the car continues to age.

The new generation of vehicles—especially EVs—may stay on the road for 1 million miles. Those vehicles will need to be relevant not just on the day they come off the factory floor or the dealer floor, but relevant ten years down the road.

5G connectivity will be the key to making sure the car can handle not only the technology of today, but also future technologies we may not be able to imagine now.

As soon as possible, new vehicles need to have 5G connectivity, open architectures and enough silicon and computing power onboard. As they get more and more data from the car, automakers can push experience or safety enhancements to make cars better, faster, and stronger. But you need low latency and high bandwidth for a better customer experience.

The right connectivity is crucial not only for the safety and the operation of the vehicle, but also for enhanced applications that will be updated on a daily, weekly or monthly basis.

As manufacturers bring new features and functions to market, they won't have to limit them to cars that are just coming off the line. Vehicles already on the road will be updateable on a daily basis, just like your computer and your phone.

Customer relationships

Auto manufacturers want an always-on relationship with their customers. Technologies like 5G and edge computing will be absolutely critical for maintaining that relationship not only with the first owner, but also with future owners, as the car is resold.

For the consumer, the automobile will be the ultimate mobile device. The vehicle will be very personalized in two major areas: infotainment and safety. Thanks to regular, over-the-air updates, the vehicle will get better, faster, stronger and safer.

EVs and autonomous driving

5G connectivity and edge computing are critical for improving autonomous driving. 5G can reduce latency in autonomous systems, which is important for safety. If you're driving at 50 miles per hour, and latency is 50 milliseconds, you'll drive a meter in that time. Edge computing on 5G allows for computing not only onboard, but also over the top. It could alert driving systems to an approaching danger in time to react.

For EVs, there will be new business opportunities at charging stations, as drivers spend an average of 18 minutes there. Automakers want consumers during that time to interact with the vehicle instead of the phone.

When the car is dynamic and constantly updated, there will be a new service model for manufacturers or dealers. Consumers can get new features and functions just by pressing a button, because the capability is already in the car.

References

i https://www.intechopen.com/chapters/77074

ii https://www.tuxera.com/blog/autonomous-cars-300-tb-of-data-per-year/

iii https://css.umich.edu/factsheets/autonomous-vehicles-factsheet

iv https://go.abiresearch.com/lp-70-technology-trends-that-will-and-wont-shape-2022

v These are target performance metrics; actual performance will vary and depends on device location, coverage quality and other factors.

vi https://www.opensignal.com/2020/10/21/5g-users-on-average-consume-up-to-27x-more-mobile-data-compared-to-4g-users

vii https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/unlocking-the-full-life-cycle-value-from-connected-car-data

viii https://www.frost.com/news/press-releases/marketplace-and-features-on-demand-to-revolutionize-the-european-oems-connected-services-and-hmi-market/

ix https://upstream.auto/research/automotive-cybersecurity/

x https://www.verizon.com/business/en-au/resources/articles/cybersecurity-5g-alex-schlager/

xi https://sharkexperience.com/

xii https://www.verizon.com/about/news/verizon-and-disney-stream

xiii https://spectrum.ieee.org/software-eating-car

xiv https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/unlocking-the-full-life-cycle-value-from-connected-car-data