Connected cars

Getting ahead of the fast and furious flood of data

In association with

GSMA Intelligence

IBM

Experts on this topic

Colin Lee
V2X Group Owner/Manager,
Jaguar Land Rover
linkedin.com/in/leecolin/
clee13@jaguarlandrover.com

Colin is responsible for the V2X connected car technology and global roadmap for Jaguar Land Rover (JLR). Passionate about connected car technology, he works with ADAS, powertrain, infotainment, and assisted and autonomous driving teams to develop and implement solutions for JLR. Colin is also JLR's representative and board member on the 5G Automotive Association (5GAA), a cross-industry association developing end-to-end solutions for future mobility and transportation services. Colin participates in UK government initiatives to trial and test connected vehicle technologies.

Xian Li Tang
General Manager,
China Mobile Beijing
Tangxianli@bj.chinamobile.com

Xian Li is the General Manager of the China Mobile Beijing IT Department with more than 20 years of extensive experience in the telecommunications industry. She has taken various senior management roles (Chief Digital Officer, IT Director, and others) in China Mobile Beijing CO. She is a well-known data expert who has led China Mobile to establish a new data-driven operation mode and build a big data monetization platform based on operator data for the automobile, finance, and other industries.

Bill Lambertson
Vice President, IBM Technology, Global Telecommunications Industry
linkedin.com/in/bill-lambertson/
willlamb@us.ibm.com

Bill is an IBM Distinguished Industry Leader directing cloud, 5G, and edge solutions. Using his extensive experience, Bill engages with some of IBM's largest telecom and automotive clients worldwide. He is a respected champion and industry leader, driving IBM strategic initiatives in cloud, cloud-based networking, Internet of Things (IoT), and 5G edge solutions. Previously, Bill served as Chief Technology Officer for the IBM Systems and Technology Group, where he played a pivotal role in driving innovation and growth in the telecommunications and media industry.

Lory Thorpe
IBM Telecommunications Industry Partner, IBM Consulting
linkedin.com/in/lory-p-1ab3104/
lory.thorpe@ibm.com

In her role, Lory leads the global offering portfolio for 5G and telecom transformation. She has over 20 years of global experience in telecommunications and in enabling digital transformation across industries. As a technology and business executive with a strong innovation background across networks, IoT, security, quantum safe, and data/AI, working with leading global telecommunications vendors and operators, Lory has extensive experience in the definition and commercialization at scale of industry-impacting, cutting-edge capabilities. She is chair of the GSMA Post-Quantum Telco Network Task Force.

Priya Kurien
Global Telecommunications Leader, IBM Institute for Business Value
linkedin.com/in/priya-kurien/
Priya.kurien@ibm.com

Priya leads the telecom research area for the IBM Institute for Business Value. She is a telecommunication engineer by training and has worked with over a dozen telecom providers across four continents. She brings her deep and broad understanding of the telecom value chain, partnerships, competition, regulation, automation, and advanced technologies to help clients understand the business value of technology. Priya has special interests in 5G enterprise commercialization and is a member of the AI Expert Working Group for UKTIN and the GSMA IoT Forum.

Foreword

The equation is very simple: as the number of connected cars on the roads grows, so will the volume of high-stakes data being generated. The implication for telecommunications service providers, then, is clear. Their role as providers of high-bandwidth, low-latency, reliable, secure connectivity will only grow in importance.

As to whether or not operators can meet this challenge, I have no doubts. Operators are battle tested. They've proven they can meet skyrocketing data usage during the pandemic when abrupt work-from-home and virtual education orders stressed networks while also upending traditional traffic patterns. And looking ahead to future demands, telecoms are moving quickly to improve their 5G capabilities while pursuing new technologies like 5G-Advanced and 6G.

Connected cars, though, are about more than just connectivity. As the future of connected cars and the telecommunications industry plays out, the data generated will present new business opportunities to multiple industries, provided the necessary standards of trust and reliability are in place. At the same time, as the market develops, additional implications are worth noting:

- *Sustainability.* While telecoms are focused on their journey to net zero, their support for connected and autonomous cars also needs to be seen as a critical contribution to helping tackle climate change.
- *Drones and regulations.* Drones will doubtless play a role in supporting connected cars. But recent GSMA Intelligence research highlights that regulatory regimes need to be in place if the drone economy is to succeed in a given market, particularly around Beyond Visual Line of Sight (BVLOS) operations.
- *API exposure.* As the connected car ecosystem flourishes, potential partners for telecoms will grow at an incredible pace. Building one-on-one relationships that allow them all to tap into network capabilities will be difficult, making API exposure and monetization efforts such as those with the Linux Foundation's CAMARA telco global API alliance and the GSMA's Open Gateway particularly salient.

This Expert Insights report, "Connected cars," provides a succinct view into key issues for major stakeholders. GSMA Intelligence was honored to support the effort with data and insights stemming from our work with operators around the world.

Peter Jarich
Head of GSMA Intelligence

Key takeaways

As the connected car market continues to grow, telecoms have both a role in its success and the potential to profit.

- **Connectivity demands of next-gen vehicles command widespread, reliable network coverage.**
  Just as highway networks paved the way to success of automobiles in the early 20th century, network coverage is critical to the features and functions of connected vehicles.
- **Cross-industry collaboration is a must.**
  Telecoms, automakers, government policymakers, industry associations, developers of intelligent traffic systems, and cloud providers need to team to establish a secure, trusted technology infrastructure for data exchanges.
- **Telecoms should seize data monetization opportunities.**
  Telecoms can proactively define and pursue monetization opportunities around road infrastructure, traffic applications, and connected vehicle-generated data.

The data-driven applications and telematics in the modern vehicle depend on reliable, high-throughput, low-latency network connections.

Caution ahead! Why connected vehicles are poised to flood networks

Data is the new fuel powering modern cars, and networks are the pipelines. While fully autonomous vehicles may still be years away, cars are increasingly connected—exchanging data with external systems to provide infotainment, convenience, and automated safety features to drivers.

In fact, connected car sales overtook non-connected cars for the first time ever in 2022. The market is expected to grow at a CAGR of nearly 17% with the number of connected vehicles in service projected to reach 367 million globally by 2027.[1] That will add up to a *lot* of data.

Consider this scenario: if just 20% of the world's 1.5 billion cars become highly autonomous, meaning many driving functions are automated, they would generate around 300 zettabytes of data.[2]

Then factor in data from the surging electric vehicle market and its charging infrastructure connectivity needs, as well as the thriving connected car application market.[3] Just as drivers use apps on their mobile phones, they can use apps on their car to manage maintenance, find inexpensive fuel or available charging stations, log mileage, map routes, and choose music (see Figure 1).

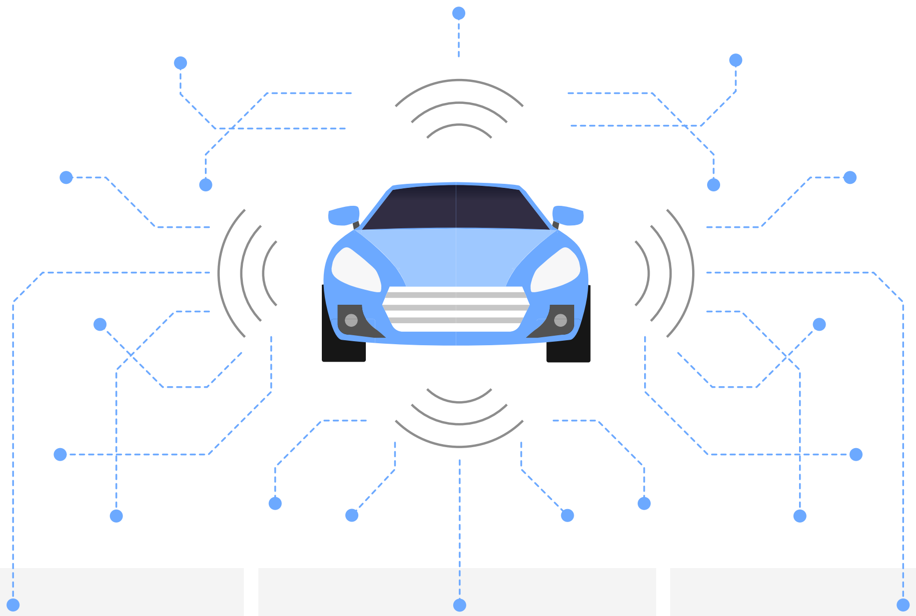
The resulting massive volumes of data will flood telecommunications networks. And as vehicles become increasingly autonomous, network performance and data reliability become a safety imperative as cars communicate with other cars, intelligent traffic systems, pedestrians, and more to navigate to their destinations unscathed.

The auto industry is forging ahead with a revolutionary digital transformation, leveraging connectivity solutions at every stage of the product lifecycle from design to disposal (see Perspective, "AI, automation, analytics demand connectivity"). The implications for telecoms are monumental—and underappreciated. Are network operators ready to handle the impending deluge of data from these vehicles? Are they prepared for the risks and responsibilities that will land on their doorstep? Are they anticipating and ready to take advantage of emerging business model opportunities that leverage the newfound connected car data?

What follows is a look under the hood at three key requirements for the telecom industry—coverage expansion, data trust, and collaborative partnerships—as the transition to more connected, complex vehicles accelerates. Automakers, government transportation planners, and road operators will play a role alongside telecoms in the future of connectivity for next-gen vehicles. The industry leaders of tomorrow will exploit opportunities for a potential competitive edge. Those who are caught by surprise will find themselves in the rearview mirror of their rivals.

FIGURE 1

Connected vehicles leverage advanced telematics and internet-based services to enhance the driving experience.



Driver convenience	Vehicle diagnostics	Safety
Infotainment (entertainment, navigation)	Over-the-air (OTA) updates	Tamper/stolen vehicle detection
Journey information services	EV battery health/charging status and notification	Over-speed alerts
Parking services	Available range	Hazard warnings
Electric vehicle (EV) charging services	Fuel/battery alerts	Emergency vehicle approach warnings
Keyless entry	Fuel economy	Vulnerable road user approach warnings
Emergency assistance	Low-tire pressure alert	Failure notifications
Vehicle preconditioning	Engine and chassis alerts	
Digital personal assistant	Real-time preventive function alerts	

AI, automation, analytics demand connectivity across the auto lifecycle

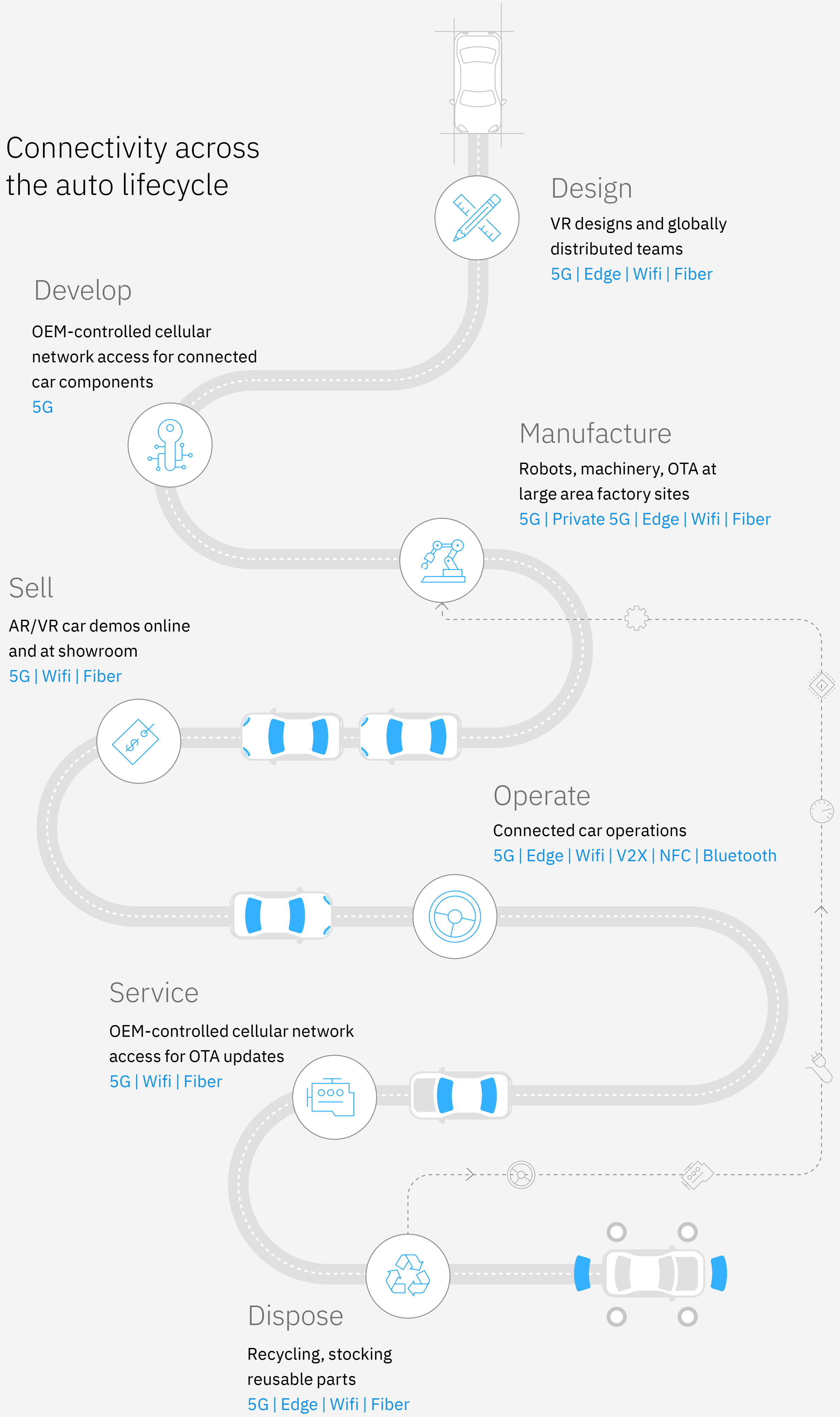
The auto industry is embracing data-driven processes across the vehicle lifecycle, leveraging virtually every kind of connectivity option. With the introduction of generative AI capabilities in some stages, the volume of data fueling processes—and the required network capacity—will only increase.

Design. Generative AI is expected to drastically impact the design process, according to recent MIT Sloan research. Generative AI models can help create new designs based on prompts from an experienced designer about viewpoints, colors, body type, and image. Then a predictive model can forecast what designs will have the most appeal to consumers.[4]

Manufacturing. Private 5G networks and edge computing solutions are the backbone for the modern factory where data supports vehicle assembly by robots, reveals issues along the line, and enables real-time quality monitoring. Pre-delivery over-the-air (OTA) software updates demand even greater network capacity than is possible now for some production goals to remain on track.

Operations and maintenance. Generative AI may also be the key to unlocking a truly autonomous vehicle future. By deploying algorithms to produce new content (such as images, videos, and text), generative AI can create virtual environments and simulate real-world scenarios to train autonomous vehicles in a safe and controlled environment. Cars could have a generative AI interface so drivers can converse with their vehicle in natural language instead of fixed commands.[5] And AI-based analytics of connected car data can enable predictive maintenance for faster, more targeted servicing and repairs.[6]

Connectivity across the auto lifecycle



Without adequate network coverage, there is no connected car.

Coverage: Essential for connected car advancements

Growing demand

The data-driven applications and telematics in the modern vehicle depend on reliable, high-throughput, low-latency network connections. Consider the developing continuum of autonomy that will require progressively greater capacity from telecom providers (see Perspective, "More autonomous, more important data"):

– *Warning systems.* These are the Advanced Driver Assist Systems (ADAS) most drivers are familiar with today. Based on an analysis of sensor data, the vehicle "taps the driver on the shoulder" to warn of an event or obstacle and the driver decides how to react.

– *Cooperative driving environments.* Vehicle-to-vehicle (V2V) technology allows vehicles to communicate with each other. Their sensors collect multiple inputs in real time from other vehicles. The vehicle parses the information and shares what's needed back to the other automated vehicles to jointly decide and perform a necessary maneuver based on road rules. These systems are expected within the next 10-15 years, and telecoms must plan accordingly.

– *Fully autonomous driving.* Vehicle-to-everything (V2X) technology connects a full ecosystem that consists of the vehicle, other vehicles it encounters, vulnerable roadside users (VRUs) such as pedestrians and bikers, and intelligent traffic systems. As the members of the ecosystem share path-planning data with each other, the vehicle navigates to its destination with little to no input from the driver. This will only be possible when most cars on the road are fully autonomous—well into the future.

Today's cellular network coverage across roads in most countries is not consistent enough to enable reliable connected services. More connected cars with more apps, implementation of V2X communications, advancements in intelligent traffic systems, the continued boom of Internet of Thing (IoT) devices, connected VRUs—combined, these compel widespread coverage and connectivity.

Filling the gaps in remote areas

Coverage gaps, particularly in more remote areas, means connections aren't always available. This poses a systemic risk in the fast-approaching, more connected transportation system of the future.

To satisfy the requirements, telecoms are shifting their strategy for network coverage. Rather than the traditional approach of basing coverage on population density, they consider traffic density. For example, where busy junctions exist in rural areas, vehicles will need connectivity to communicate with other cars or traffic assistance systems.

5G non-terrestrial networks (NTNs) are an essential piece of the connectivity puzzle, providing airborne coverage in regions unreachable or impractical for ground-based infrastructure.[7] Constellations of low Earth orbit (LEO) satellites—which fly closer to the planet than traditional geostationary satellites—are currently used in the defense sector, maritime communications, and with agriculture, but they show promise for providing the low-latency connectivity required by increasingly autonomous and connected vehicles. Telecoms are partnering with satellite providers to provide seamless coverage in the same way as roaming agreements work now. Apple and Globalstar, Skylo and Deutsche Telekom, Iridium and QualComm, BICS and Lynk Global, and more recently, Verizon and Amazon are teaming to deliver these new satellite-to-cellular services for cell phone users.[8]

Leading telecoms are also pursuing the use of unmanned aerial vehicles (UAVs), or drones, to extend NTN coverage. The technology has proven helpful for emergency responders in disaster recovery where communications networks are down.[9] While advantageous for solving coverage issues for connected cars, 5G NTN technology is currently costly and susceptible to disruption from terrain, weather, and atmospheric factors.[10] It needs improvements to be a viable solution.

Automakers are looking for a "magic pipe"—where the connectivity details are invisible, and the pipe simply provides the reliability, capacity, and speed required. It starts with coverage. Without that, OEMs will be forced to turn off certain use cases for connected cars, possibly stunting growth opportunities and decelerating their transformation.

Open questions

1. Connectivity infrastructure to support traffic density must be borne by stakeholders. Will this fall to government transportation departments as part of infrastructure development for the mid-21st century? What will their relationship be with telecoms?

2. Just as international roaming can be expensive, will OEMs/consumers be willing to pay for the increased costs to support better coverage requirements of the car when non-terrestrial networks are involved?

3. OEMs want a magic pipe, while telecoms want to monetize investments in each generation of cellular connectivity. How will this dynamic be resolved?

4. Will there be satellite companies that specialize in providing automotive coverage for more remote areas?

Perspective

More autonomous, more important data

Vehicles on the road today have varying degrees of autonomy, or automated driving features. As more cars are equipped with progressively more automated driving capabilities, smooth data exchanges and processing become even more critical. The Society of Automotive Engineers has defined the levels of autonomy as:

- *Level 0, no driving automation.* 100% manual but can include driver assistance features such as anti-lock braking, cruise control, and warnings for blind spots, frontal collision, and lane departures.
- *Level 1, driver assistance.* Driver drives and monitors the system, which, if activated, can perform acceleration, braking, and steering functions, such as adaptive cruise control or lane centering assistance.
- *Level 2, partial driving automation.* Driver is 100% engaged but these vehicles are equipped with ADAS, which provides continual assistance with accelerating, braking, and steering. Level 2 vehicles are the most widely available on the market.
- *Level 3, conditional driving automation.* Not as widely available; the driver allows the system to take over but must be ready to take control when necessary or requested.
- *Level 4, high driving automation.* The same as Level 3, but systems can intervene in the event of a malfunction without involving the driver. The driver can also still take control manually. These kinds of vehicles are regulated for use only in very specific, well-defined circumstances, with some countries (such as Norway and Scotland) being more ready to adopt than others.
- *Level 5, full driving automation.* Requires no human intervention and not even emergency manual intervention. These vehicles don't include pedals or steering wheels.[11]

In connected and increasingly autonomous cars, potentially life-and-death safety decisions depend on secure, verifiable data.

Trusted data: An imperative for driving safety

The future of connected and autonomous vehicles hinges on trust and credibility of data in real time. Why? Because potentially life-and-death safety decisions come down to secure, verifiable data.

While automakers are bullish on the safety promises of increasingly autonomous vehicles, consumers are wary. One survey found that only 29% of drivers said they would feel safe with their own autonomous vehicle.[12] Those OEMs that meet the secure, trusted data imperative can distinguish their brand from competitors. In the IBM Institute for Business Value (IBM IBV) Automotive 2030 survey, consumers cited safe autonomous driving as the top brand differentiator for on-demand mobility services.[13]

But as more data sources external to the vehicle's sensors are introduced, security risks escalate. Imagine the implications if cybercriminals hacked into a network supporting the data exchanges of a connected car, or even more dangerous, a group of vehicles of a certain make or model. They could steal or manipulate data, conduct unauthorized transactions, or take control of vehicle systems controlling a non-safety feature such as heat or critical safety systems such as brakes, steering, ADAS, or even the electronic control units (ECUs).[14] Protecting the data flowing in and out of the vehicles' systems begins with a secure network.

Securing data from network through the vehicle

Securing connected car data requires an end-to-end approach and falls to both network operators and OEMs. The attack surface is vast and complex, including endpoints from outside the vehicle as it communicates with systems in other cars, infotainment systems, intelligent traffic systems, charging infrastructure, or VRUs. Then there are the endpoints internal to the vehicle platform, including OEMs and their hardware and software suppliers.

Telecom operators need to take a holistic view of network security, understanding vulnerabilities in their products and processes, while OEMs must focus on securing the vehicle's software against cyber-attacks. Automakers begin with a secure-by-design approach, and they increasingly rely on OTAs—and the corresponding wireless connectivity—to roll out security patches along with other software updates.

To address the complexity of the vehicle's attack surfaces, OEMs are turning to Vehicle Security Operation Centers (V-SOCs), which provide real-time monitoring of a vehicle's use and allow security experts to intervene if they detect an attack. United Nations Economic Commission for Europe (UNECE)-mandated cybersecurity management systems require automakers to address cybersecurity from production and operation to disposal.[15]

OEMs don't like decisions based on "might's"

Data reliability is a hot topic across all industries, with leading Chief Data Officers citing it as their most pressing data management challenge in recent IBM IBV research.[16] The same can be said of OEMs. They don't like making decisions based on "might's," as in, this data *might* require the vehicle to take action. While open data sharing from third parties feeds future opportunities, automakers need absolute confidence that any external data fueling the vehicle's decision-making is accurate and reliable. A simple example: if a car is communicating with a parking lot about available spaces and receives wrong information repeatedly, the OEM will want to reject that data source. For safety scenarios, data trust is mandatory.

Data providers—from traffic signals to roadside operators to service providers to the brands of other vehicles—must prove themselves trustworthy over time. They each need to prioritize robust data management to help deliver high-quality data that earns the confidence of automakers.

OEMs are also considering ways to determine data confidence levels. One proposal is establishment of a real-time data quality monitoring system where third-party providers are given a confidence rating, say on a scale of 1 to 10. OEMs would choose to leverage data from the providers meeting a certain level and ignore the data from those that don't. They could then turn off the data from unreliable providers at the vehicle level.

Open questions

1. What standards and mediation will be required to ensure data is valuable and credible for automated driving decisions?
2. What lessons can automakers learn from telecoms around securing networks?
3. What role can telecoms play in helping automakers evaluate data reliability?

Telecoms alone cannot deliver the necessary connectivity solutions for the next generation of vehicles.

Collaboration: It takes an ecosystem to create connected car services

Just as highway networks paved the way to success of automobiles in the early 20th century, network coverage is critical to propelling connected vehicles. But telecoms alone cannot deliver the necessary connectivity solutions. It takes partnerships with governments, industry associations, developers of intelligent traffic systems and other connected road operations, and technology companies.

As an example, consider the role of governments and industry groups in establishing standards for V2X technology. Vehicle-to-everything can revolutionize road safety—and even life itself—by enabling vehicles to talk to each other and everything around them about road and traffic conditions, signal light timing, and lane closures. At some point, vehicles could even make all the arrangements for a trip, planning the route, parking, lodging, and more. But decades of standards changing, industry groups disagreeing, and government hesitancy have blocked V2X progress and left automakers in a quandary.

Today, industry associations and governments appear to be aligning on the Cellular V2X (C-V2X) communication protocol. GSMA, the global association for mobile operators, cites the worldwide availability of V2X—which leverages 4G and 5G networks—and the backing of over 130 leading mobile operators, vendors, automotive manufacturers, and suppliers as encouragement for government regulators to establish the regulatory framework needed to accelerate C-V2X development. In support, GSMA is working with the ecosystem of operators, OEMs, and regulatory bodies to develop a common approach to security, regulatory, and infrastructure solutions.[17]

Similarly, the 5G Automotive Association (5GAA), a global, cross-industry organization focused on future mobility solutions, cites regional developments that are having a positive impact on V2X deployment, including the launch of C-V2X vehicles by a large number of China-based OEMs.[18] In fact, China is the first to establish a national policy for an "Internet of Vehicles," adopting C-V2X as its standard and motivating further collaboration among the automotive, transportation, public security, and communications industries.[19]

Teaming with hyperscalers

With expertise in deploying and securing cloud, IoT, and edge computing solutions, hyperscalers also are key partners in building new connectivity solutions. For instance, cloud infrastructure helps bring IoT devices closer to the network for lower latency processing (see case study, "Travelping accelerates IoT device processing for connected cars").

Similarly, edge computing—combined with cloud and 5G—helps overcome challenges with bandwidth, latency, and speed whether in the manufacturing or operation of a connected vehicle. On the factory floor, edge is an important element of smart manufacturing models, enabling real-time data analysis that can help humans and robots make better, faster decisions.

For connected cars, edge helps process data quickly from external sensors such as traffic lights or pedestrians, and it can be used to deliver firmware updates to vehicles as well as convenience features such as real-time weather or traffic updates, recall notices, and other third-party services.[20] Placing artificial intelligence unit (AIU) chips—a system-on-chip designed to run and train deep learning models faster than a general-purpose CPU—in the next generation of vehicles will move the "edge" to the vehicle itself, further boosting data processing performance.[21]

While about half of telecoms in a recent GSMA survey report having edge solutions in trial phases, operators have been slow to develop them, citing lack of expertise and a limited vendor ecosystem as obstacles. But they can partner with hyperscalers to expand their capabilities and offerings and compete more effectively.[22]

Cars becoming an extension of home and work life creates opportunities for innovative new services.

Collaboration for monetization

5G connectivity enablement for connected vehicles alone represents a $3.6 billion opportunity for telecoms.[23] As cars become an extension of home and work life, consumers have shown a willingness to pay for value-added features, according to a recent IBV survey on electric vehicles:[24]

Autonomous driving/ driving assistance	**$172**/month
Remote diagnostics	**$116**/month
Premium entertainment or emergency services	**$37**/month
Security services	**$22**/month
Advanced mobility services	**$20**/month
Vehicle connectivity subscriptions	**$19**/month

Innovative services that monetize the data generated by connected cars also promise value. While issues around data ownership remain, telecoms need to proactively define and pursue their use cases (see Perspective, "Automated valet parking"). Examples include providing in-car infotainment usage data to application developers or advertisers, sharing location data with road operations or fleet management firms, supplying vehicle battery analyses with manufacturers, or offering traffic pattern data to government planners or retailers.

Some industry leaders are envisioning Economy of Things data-sharing platforms that capitalize on the proliferation of IoT devices, the data they are collecting, and the use of AI to uncover new value in that data.[25] For instance, Vodafone launched its Digital Asset Broker platform with an initial use case of a verified electric vehicle identifying and conducting transactions with charging points in Newbury, UK. The company plans to expand the capabilities into fleet capacity management.[26]

Open questions

1. Who leads the connected ecosystem of road operators, telecoms, and OEMs? Will it be driven by a municipality? The auto industry? Or a telecom operator?
2. With connected vehicles, whose customer is it? The automotive OEM? The network provider? The mobile device software providers?
3. What happens to the data generated by a connected car? What data will the auto industry choose to expose? Will telecoms continue to be the trusted mediator of data, as they are for current cellular data?

Case study

Travelping accelerates IoT device processing for connected cars[27]

Connected cars often experience latency issues that can affect safety-related insights. Network and communications software company Travelping GmbH needed to develop an IT infrastructure platform that could negotiate the challenges of cross-border data management regulations to make IoT networking more efficient. It knew the key was to get the network close to connected devices.

Using IBM public cloud infrastructure and a self-developed Kubernetes cluster, the company created a scalable, cloud-native packet gateway solution with containerized workloads that can be transported rapidly to auto manufacturers for real-time remote diagnosis or maintenance. IoT latency was reduced by more than 95%, accelerating real-time vehicle safety data insight.

Perspective

Automated valet parking offers glimpse into an autonomous future[28]

Technology leader Bosch, automaker Mercedes Benz, and parking garage operator APCOA have debuted automated, driverless parking in carparks in Germany. Bosch-provided infrastructure installed in the carpark interacts with the Mercedes-Benz technology in the car to enable autonomous driving.

The driver parks the vehicle in a handover zone at the garage entrance and then starts the driverless parking service through a mobile app. Stereo cameras in the garage detect free parking spaces as well as the driving corridor and any obstacles in the lane. Obstacles or pedestrians detected are processed on edge computers, enabling the vehicle to brake to a full stop when required. Because of the smart technology in the carpark, the technical requirements of the vehicle are minimized, facilitating easier scalability to additional car models. Germany is one of the few countries that has created the framework conditions for systems such as automated valet parking.

Action guide

The future of connectivity for the auto industry depends on cooperation across a cross-industry ecosystem. Following are key short-term initiatives to advance progress.

For telecom executives

Invest in expanding and upgrading network infrastructure to help ensure reliable connectivity for connected cars and V2X communications.

- Partner with cloud service providers to develop compelling 5G edge solutions for the auto industry.
- Aggressively implement 5G Standalone (5G SA)—a 5G core network with no dependency on 4G LTE network control functions—to unlock the advanced capabilities of 5G and enable innovative enterprise use cases.

Enhance service offerings by developing tailored solutions for connected car services and V2X applications that create new revenue streams and strengthen customer loyalty.

- Forge partnerships and alliances with automotive manufacturers and technology providers to drive innovation and accelerate adoption of connected car and V2X technologies.
- Evaluate connectivity solutions for fleet management, telematics, remote diagnostics, OTA updates, and advanced ADAS.
- Implement robust security and privacy measures to protect data and communications within connected car and V2X networks, including advanced encryption protocols, authentication mechanisms, and intrusion detection systems.

Participate in joint efforts with the auto industry to advance favorable regulations and standards for connected car and V2x deployments.

- Join discussions with regulatory bodies to advocate for policies that promote interoperability, security, privacy, and seamless connectivity across different vehicles and transportation systems.
- Actively engage in cross-industry organizations (such as 5GAA and GSMA) on the rollout of the C-V2X communication protocol.
- Establish clear data protection policies and manage compliance with relevant privacy regulations to help ensure the trust and confidence of consumers and businesses using connected car services.

Action guide

For auto industry executives

Exploit the network communications technology currently available in vehicles to enhance customer experiences.

- Embrace responsibility for cybersecurity and data privacy and prioritize capabilities that safeguard customers and their data.
- Engage with local wireless providers to manage compliance with data sovereignty and privacy laws.

Take a leap of faith on V2X technology and galvanize support to spur progress.

- Establish a long-term vision based on the capabilities of a V2X environment.
- Educate teams on capabilities available in a V2X environment and in an ADAS environment and explore how the two technologies can work together to enhance the driver's experience.
- Lobby government lawmakers to make V2X the standard communications protocol, in line with other countries such as China.

Evaluate opportunities to use AI and large language/generative AI models to enhance processes across the automotive lifecycle.

- Collaborate with telecoms and technology companies on data-monetization platforms and identify innovative use cases leveraging connected vehicle data.
- Explore ways AI can help improve vehicle safety as well as the in-vehicle experience—for example, through predictive maintenance.
- Investigate options for embedding AIU chips within vehicles, customized to auto industry needs, to move data processing to the vehicle.

For government policymakers and road infrastructure planners

Remove barriers blocking widespread adoption of the C-V2X communication protocol by offering a flexible, future-proof regulatory framework.

- Strongly influence specific technologies; allow stakeholders to select the most efficient and effective option to meet their needs.

Recognize that transportation infrastructure is as much about network connectivity as it is the roads themselves.

- Assign the appropriate representative(s) to take training on how to evaluate, procure, and implement standards-based intelligent transportation systems.
- Shore up data collection and management capabilities to improve data-based transportation management and position for development of transformative new applications for drivers.

About Expert Insights

Expert Insights represent the opinions of thought leaders on newsworthy business and related technology topics. They are based on conversations with leading subject-matter experts from around the globe. For more information, contact the IBM Institute for Business Value at iibv@us.ibm.com.

IBM Institute for Business Value

For two decades, the IBM Institute for Business Value has served as the thought leadership think tank for IBM. What inspires us is producing research-backed, technology-informed strategic insights that help leaders make smarter business decisions.

From our unique position at the intersection of business, technology, and society, we survey, interview, and engage with thousands of executives, consumers, and experts each year, synthesizing their perspectives into credible, inspiring, and actionable insights.

To stay connected and informed, sign up to receive the IBM IBV's email newsletter at ibm.com/ibv. You can also follow @IBMIBV on Twitter or find us on LinkedIn at https://ibm.co/ibv-linkedin.

About GSMA Intelligence

GSMA Intelligence is the definitive source of global mobile operator data, analysis, and forecasts, and publisher of authoritative industry reports and research. Our data covers every operator group, network, and mobile virtual network operator (MVNO) in every country worldwide—from Afghanistan to Zimbabwe. It is the most accurate and complete set of industry metrics available, comprising tens of millions of individual data points, updated daily. GSMA Intelligence is relied on by leading operators, vendors, regulators, financial institutions, and third-party industry players to support strategic decision-making and long-term investment planning. The data is used as an industry reference point and is frequently cited by the media and by the industry itself. Our team of analysts and experts produce regular thought-leading research reports across a range of industry topics.

Acknowledgments

We'd like to thank the following contributors for their essential guidance in the development of this report, including Noriko Suzuki, IBV Research Lead for the automotive industry; Mark Thirman, IBM Global Cloud Platform Leader; Michelle Diserio, Partner, Connected Solutions and Global Offering Lead; and Clarence Mitchell, Senior Partner and Global Leader, Enterprise Strategy for Communications. This paper also would not have been possible without the talents and creativity of Joanna Wilkins, Editorial Lead, and Kristin Biron, Design Lead.

The right partner for a changing world

At IBM, we collaborate with our clients, bringing together business insight, advanced research, and technology to give them a distinct advantage in today's rapidly changing environment.

Related reports

Telecoms move beyond connectivity

"Telecoms move beyond connectivity: Unlocking cross-industry value through IoT payment and data exchange platforms." IBM Institute for Business Value. February 2023. https://ibm.co/telecom-iot-payments

An on-ramp to sustainable mobility

"An on-ramp to sustainable mobility: Accelerating the shift to electric vehicles." IBM Institute for Business Value. February 2023. https://ibm.co/sustainable-mobility

Why organizations are betting on edge computing

"Why organizations are betting on edge computing: Insights from the edge." IBM Institute for Business Value. May 2020. https://www.ibm.com/thought-leadership/institute-business-value/en-us/report/edge-computing

Notes and sources

1. Siddiqui, Fahad. "Connected Car Sales Overtake Non-connected Cars in Q2 2022." Counterpoint. September 30, 2022. https://www.counterpointresearch.com/global-connected-car-market-q2-2022/; "Top 6 Companies Leading the Global Connected Car Market." Expert Market Research. October 16, 2022. https://www.expertmarketresearch.com/articles/top-connected-car-companies; "Connected vehicles to surpass 367 million globally by 2027, as 5G unlocks data-heavy use cases." Juniper Research. January 9, 2023. https://www.juniperresearch.com/press/connected-vehicles-to-surpass-367-million-globally
2. Götz, Florian. "The Data Deluge: What do we do with the data generated by AVs?" Siemens. January 22, 2021. https://blogs.sw.siemens.com/polarion/the-data-deluge-what-do-we-do-with-the-data-generated-by-avs/
3. Suzuki, Noriko, Mardan Kerimov, and Misuzu Nakanishi. "An on-ramp to sustainable mobility: Accelerating the shift to electric vehicles." IBM Institute for Business Value. February 2023. https://ibm.co/sustainable-mobility
4. Eastwood, Brian. "Artificial intelligence can help design more appealing cars." MIT Sloan. March 6, 2023. https://mitsloan.mit.edu/ideas-made-to-matter/artificial-intelligence-can-help-design-more-appealing-cars
5. Enderle, Rob. "The Automotive Market Pivots Hard to Generative AI and the Metaverse." Datanami. April 6, 2023. https://www.datanami.com/2023/04/06/the-automotive-market-pivots-hard-to-generative-ai-and-the-metaverse/
6. Curry, David. "Predictive Maintenance Coming to Connected Vehicles Through AI." RT Insights. April 13, 2023. https://www.rtinsights.com/predictive-maintenance-coming-to-connected-vehicles-through-ai/

7. “5G Non-Terrestrial Networks (NTN).” everything RF. April 20, 2023. https://www.everythingrf.com/community/5g-non-terrestrial-networks

8. Wallace, Bob. “How Emerging LEO Satellites are Impacting Wireless Networking.” Network Computing. March 30, 2023. https://www.networkcomputing.com/wireless-infrastructure/how-emerging-leo-satellites-are-impacting-wireless-networking; Flaherty, Nick. “European network for first satellite direct-to-mobile service.” eeNews Europe. September 6, 2022. https://www.eenewseurope.com/en/european-network-for-first-satellite-direct-to-mobile-service/; “Skylo Expands Deutsche Telekom’s Converged Cellular and Satellite Connectivity to IoT Applications.” Skylo newsroom. February 28, 2023. https://www.skylo.tech/newsroom/skylo-expands-deutsche-telekom-s-converged-cellular-and-satellite-connectivity-to-iot-applications

9. Hilson, Gary. “The expanding roles of emergency drones for disaster management.” Verizon. Accessed June 12, 2023. https://www.verizon.com/business/resources/articles/s/the-role-of-emergency-drones-in-disaster-management/

10. “5G Non-Terrestrial Networks (NTN). everything RF. April 20, 2023. https://www.everythingrf.com/community/5g-non-terrestrial-networks

11. “Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles.” Society of Automotive Engineers. Accessed June 14, 2023. https://www.sae.org/standards/content/j3016_202104/; “What are the 6 levels of autonomous vehicles?” Faist Group. January 11, 2023. https://www.faistgroup.com/news/autonomous-vehicles-levels/

12. Heller, Samuel. “Consumers don’t trust fully autonomous vehicle technology, new study finds.” Automotive News. March 8, 2022. https://www.autonews.com/mobility-report-newsletter/consumers-dont-trust-fully-autonomous-vehicle-technology-new-study-finds

13. “Automotive 2030: Racing toward a digital future.” IBM Institute for Business Value. November 2020. Unpublished data.

14. “Improving vehicle cybersecurity: ICT Industry Experience & Perspectives.” Alliance for Telecommunications Industry Solutions (ATIS). 2017. https://access.atis.org/apps/group_public/download.php/35648/ATIS-I-0000059.pdf

15. Windpassinger, Hans. “On the Way to a Software-defined Vehicle.” Springer Professional. August 2022. https://www.springerprofessional.de/on-the-way-to-a-software-defined-vehicle/23270660

16. “The C-suite Series: Turning data into value: How top Chief Data Officers deliver outsize results while spending less.” IBM Institute for Business Value. February 2023. https://ibm.co/c-suite-study-cdo

17. “Connecting vehicles to everything with C-V2X Today and in the 5G Era.” GSMA. Accessed June 12, 2023. https://www.gsma.com/iot/automotive/

18. “A visionary roadmap for advanced driving use cases, connectivity technologies, and radio spectrum needs.” 5G Automotive Association. November 2022. https://5gaa.org/5gaa-publishes-updated-2030-roadmap-for-advanced-driving-use-cases-connectivity-technologies-and-radio-spectrum-needs/

19. “C-V2X automotive tech brings enhanced safety and efficiency to China’s roads.” OnQ Blog. Qualcomm. March 1, 2021. https://www.qualcomm.com/news/onq/2021/03/c-v2x-brings-enhanced-safety-and-efficiency-chinas-roads; Stevens, Tim. “How V2V and V2X Technology Could Change the Auto World.” Motortrend. December 6, 2022. https://www.motortrend.com/features/what-is-v2v-v2x-technology/

20. “Edge computing for automotive.” IBM. Accessed June 22, 2023. https://www.ibm.com/resources/guides/edge-computing-industry-use-cases/#section-4

21. Burns, Jeffrey and Leland Change. “Meet the IBM Artificial Intelligence Unit.” IBM Research blog. October 18, 2022. https://research.ibm.com/blog/ibm-artificial-intelligence-unit-aiu

22. “The edge opportunity in the enterprise market: progress, challenges and future outlook.” GSMA. March 2022. https://data.gsmaintelligence.com/research/research/research-2022/the-edge-opportunity-in-the-enterprise-market-progress-challenges-and-future-outlook

23. “Connected vehicles to surpass 367 million globally by 2027, as 5G unlocks data-heavy use cases.” Juniper Research. January 9, 2023. https://www.juniperresearch.com/press/connected-vehicles-to-surpass-367-million-globally

24. Suzuki, Noriko, Mardan Kerimov, and Misuzu Nakanishi. “An on-ramp to sustainable mobility: Accelerating the shift to electric vehicles.” IBM Institute for Business Value. February 2023. https://ibm.co/sustainable-mobility

25. Katigbak, Raquel, David Palmer, Richard Cockle, and Dhana Cruickshank. “Telecoms move beyond connectivity: Unlocking cross-industry value through IoT payments and data exchange platforms.” IBM Institute for Business Value. February 2023. https://ibm.co/telecom-iot-payments

26. “Vodafone launches new Economy of Things platform—a world in which devices, vehicles and machines can buy and sell for us.” Vodafone news release. February 28, 2022. https://www.vodafone.com/news/technology/new-economy-of-things-platform

27. “Travelping GmbH.” IBM case study. Accessed June 13, 2023. https://www.ibm.com/case-studies/travelping-gmbh-cloud

28. Hammerschmidt, Christoph. “Bosch, APCOA start commercial roll-out of Automated Valet Parking.” eeNews. January 23, 2023. https://www.eenewseurope.com/en/bosch-drives-commercial-roll-out-of-automated-valet-parking-with-apcoa/

IBM Corporation
New Orchard Road
Armonk, NY 10504

Produced in the United States of America | July 2023

G3Y7VYN9-USEN-01

ibm.co/connected-cars-telecoms