



5G

driving the future of connected vehicles

5G's capacity to re-shape automotive is profound.
Here's what to expect.

The connected car's future is here

For some, the software-defined, connected vehicle is the use case for 5G networks. It's no coincidence that some of Europe's fastest 5G networks are found in development centres renowned for automotive excellence. As autonomous vehicles, connectivity, electrification and shared mobility (ACES) continue to disrupt the industry, 5G is accelerating a move to the edge that will do for automotive what 4G did for financial services, streaming and e-commerce.

5G will disrupt many industries, but its capacity to re-shape automotive is profound: millions of vehicles globally already connect to mobile networks for everything from real-time navigation to infotainment. As 5G's footprint expands, vehicle-to-everything (V2X) and production at the pace of innovation are rapidly becoming realities: by 2027, it's projected to account for 23% of automotive cellular connections.¹ The vehicle is becoming an element of the network and will benefit from all of the information and applications that come with it.

This eBook takes a look at how 5G is accelerating connected car services – and what it means for the automotive industry.

¹ Juniper Research, *Connected vehicles to surpass 367 million globally by 2027 as 5G unlocks data-heavy use cases.*



Gartner forecasts that, by 2033, the automotive industry will become the largest opportunity for 5G IoT solutions – and the largest sector for IoT endpoints and use cases – representing 53% of the total market.

Supporting software-defined vehicles

For automakers, 5G is the tipping point accelerating journeys that began with electric vehicles (EVs) and advanced driver assistance systems (ADAS). Its capacity to deliver the resilience needed for premium mobility services and emerging new business models is just the beginning:

- **5G's cloud-native architecture** supports microservices and more open integration, providing enhanced scalability and interoperability.
- **Multi-access edge computing (MEC)** brings compute, storage and networking closer to users, applications and devices, providing the lower latency needed to open up dynamic new innovations and services. This will become even more important as more connected 5G devices generate more network traffic to manage, and data to measure.

Instantaneous, secure transmission of data between cars, humans and machines opens up a realm of use cases, each with their own unique set of possibilities, including:

Accelerated automation and safety features: Combined with multi-access edge computing (MEC), 5G provides the backbone for high-end, pre-emptive early warning and assistance systems, enhancing automated driving functionality while unlocking new opportunities and partnerships for connectivity and streaming services.

Autonomous vehicles and V2X: The secret sauce for V2X has arrived in the form of 5G and IoT. High throughput and low latency enable the kinds of connectivity needed to handle multiple sources of data, whether it's other vehicles, traffic lights or emergency services.

Transformation of the electric vehicle ecosystem: Development and production plants will benefit from enhanced insights and data, enabling improved production, better performance and availability of the infrastructure needed to genuinely transform deployment

and consumer uptake, such as battery level monitoring, charging stations and efficient route identification.

Mobility as a Service: 5G is the heart of the mobility revolution. As manufacturers and governments alike look to reduce carbon footprints, fleets of connected vehicles can ensure more efficient road usage, reduced fuel consumption and improved air quality as consumers share or use vehicles as a service. 5G makes this revolutionary ecosystem possible, enabling MaaS providers to run fleets of vehicles in concert with other transport systems, opening up new opportunities and value propositions for a younger generation for whom a shared use/ pay-as-you-go model will offer broad appeal.

Vehicle as a Platform for new services and partnerships: 5G's capacity to transmit data opens up significant downstream digital revenue opportunities that will extend the profitability of vehicles over their lifetime, beyond traditional value-add servicing/parts propositions. Branded marketplaces, content, entertainment streaming and real-time, customer-relevant opportunities all provide new frontiers for partnerships beyond traditional platforms.



Tech research firm ABI Research projects that 41 million 5G-connected cars will be on the road by 2030, rising to 83 million by 2035.

Big gains for speed and bandwidth

What's the difference?

Standalone vs Non-standalone 5G

Non-standalone 5G (NSA) deployments leverage existing 4G LTE core network for functions such as mobility management and user authentication. The 5G radio access network provides the enhanced data rates, lower latency and other benefits of 5G. Because it doesn't require a completely new core network, this deployment option allows for faster, more cost-effective implementation.

Standalone (SA) 5G networks operate completely independently of 4G LTE. They have their own core network to enable the full range of 5G capabilities and services.

2023 is expected to be the year in which 5G's true high-speed capabilities are unleashed. Since going live in 2019, momentum has been building: more core 5G launches were announced in 2022 than in 2021. The big change for 2023 is that all but one of the launches announced for 2023 are standalone (versus 75% non-standalone in 2022).² GSMA intelligence shows that 5G connections are set to double by 2025, with new 5G network deployments in more than 30 countries in 2023 alone.

The killer app is speed

2G was about digital voice, 3G brought web browsing and 4G opened the era of mobile broadband. 5G's 1Gbps download speeds and near-zero latency will enable almost immediate responsiveness, the ability to control devices in near-real time, and consistently high data rates, even when users or devices are moving around. Critically, 5G uses Radio Access Networks (RANs) that free connectivity from base station proximity, moving to the edge via small cells anchored to lampposts, traffic lights or buildings. With cloud-native microservices-based architecture and distributed edge computing, 5G will bring cloud resources close to vehicles.

The specification also includes Enhanced Mobile Broadband (eMBB) for high-bandwidth wireless connection, Ultra-reliable Low Latency Communications (URLLC) to ensure low latency, and mMTC (massive Machine-type Communications) to support the high connection density of online devices. Massive MIMO builds on existing MIMO technology to add a 'massive' number of antennae to improve throughput and energy efficiency.

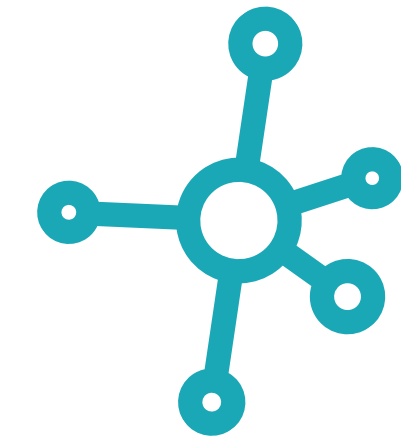
² New York Institute of Technology, *Will 2023 be 5G's year?*

³ *Connected Cars: how 5G and IoT will affect the auto industry*, ZDNET

5G on the road

From an automotive perspective, the ability of 5G-connected vehicles to stay in seamless communication with each other and the infrastructure around them while on the move could transform everything from road safety to traffic congestion and fuel optimization.

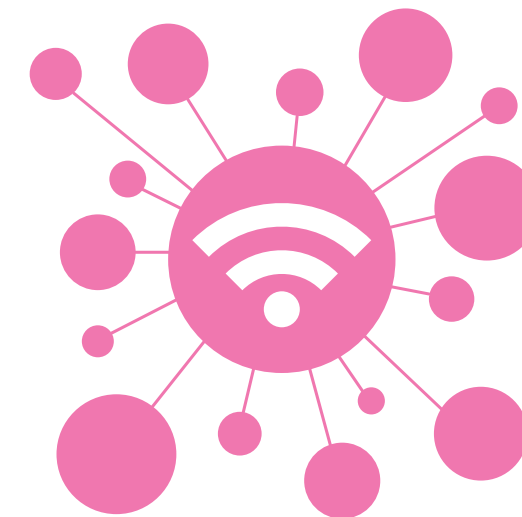
For automotive OEMs and transport providers, autonomous driving is an obvious destination. In the meantime, current and near-future services will be enhanced immediately: less congestion will enable buffer-free infotainment and streaming services, Over-the-Air (OTA) updates, fleet telematics and on-demand subscription-based services. On the factory floor, low-latency information exchange between equipment, sensors and analytics software will drive new insights, speed up production processes and enable custom-vehicle development. The share of 5G-connected cars that are actively connected to a 5G service is expected to reach 94% by 2028.³



As of
January 2023
there were 229
commercial
5G networks
globally

Source: GSMA

Going large: network splicing and slicing



**Network slicing,
in combination with
other capabilities, will aid
operators in addressing a
revenue opportunity worth
US\$300bn by 2025**

Source: GSMA

One of the most transformative aspects of 5G is its capacity to support millions of devices and multiple use cases over the same infrastructure. Network slicing is inherent in the standard, and allows for the dynamic allocation of dedicated resources for separate services. Different performance characteristics – including data speed, latency, security and mobility – can be tailored to different use cases. In other words: different areas of a network can be allocated based on need for quality of service, performance, security or latency.

What does this mean in real-world terms? Sensor-enabled parking, for example, is a static service, less bandwidth-intensive than mobile tracking in fleet management. Forecourt services involving e-payments and digital wallets demand a more robust and secure connection, whereas emergency services require guaranteed, priority connectivity. Predictive maintenance or over-the-air (OTA) software updates require high-quality, reliable connectivity. Network splicing allows the same network to be optimised for all of these use cases.

Mix ‘n’ match

Slices can be defined to support similar consumers with demand for high quality experience, or companies seeking to monitor vehicle users. Slices can also be mixed and matched, enabling cost-effective delivery of very different services. User Equipment Route Selection Policy (URSP) allows devices to connect to multiple slices simultaneously, based on their requirements.

In mission-critical use cases – for example, automated driving functionality – data can be transmitted using a high-quality slice, ensuring that even in congested situations where multiple services are consuming network resources, the critical service is always served with its required bandwidth. Sixty-four per cent of operators believe that rolling out 5G network slicing by 2025 is critical to competing successfully. Seventy-two per cent say it's the next 'game-changer in customer experience.'⁴

⁴ Amdocs 5G network slicing



Dealing with the data

The next generation of vehicles will provide up to 10,000 data points – from breakdown information to doors, windows, fuel, lights, navigation, warning systems and smartphone applications. ⁵

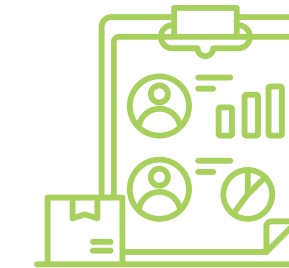
This constant stream of data means automakers are uniquely placed to have an always-on stream of user feedback and usage patterns – allowing them to constantly improve products and services. Data is the automakers’ opportunity to own the customer experience and the ecosystem behind it.

“Data not only represents an opportunity to extend the customer lifecycle far beyond the production line or showroom, it’s also an opportunity to refine the customer experience in ways that drive brand loyalty and differentiate against the mainstream tech players.”

Barry Napier, Cubic Telecom CEO

Car data monetization

As cars connect and ‘talk’ to everything in and around them they are producing ‘millions of miles’ of data. In today’s car industry, that ‘data exhaust’ not only aids continual improvements around areas like performance and predictive maintenance, it also opens up new revenue opportunities: McKinsey estimates car data monetization



may be worth up to up to US\$250-400bn globally by 2030. Some of the opportunities include:

Home-streaming and infotainment: If 30% per cent of the time people spend in cars will be devoted to interacting with content delivered through in-vehicle entertainment systems ⁶, connectivity will underpin almost every aspect of the user experience. High-quality connectivity on the road and home-streaming – the ability for users to experience content from their home country, regardless of which country they’re driving in – will play a significant role in underpinning user experience.

Performance-as-a-Service: As vehicles pivot towards becoming updateable devices, manufacturers like Volkswagen are building on the power of swarm data – using fleet data from other vehicles to upgrade vehicles over time. The ability to continuously modify, along with the need to interact with customers on software upgrades, is a huge step-change for OEMs. Stellantis CSO Yves Bonnefont said his company performed 7 million over-the-air updates in 2021, expecting to increase that to 100 million in 2026. Connectivity will play a critical role in driving this, literally underpinning the future of the car.

Premium mobility subscriptions and services: Subscription models are emerging in response to changed use patterns – McKinsey predicts that subscriptions will account for 20% of retail financing revenues in the European auto market by 2025. Premium infotainment, feature upgrades and enhancements, service unlocks, premium ADAS packages and advanced safety or navigation features are all part of an ecosystem of recurring interactions that will increase brand loyalty. The pivot towards a subscription model underlines the importance of adopting a lifecycle approach.

Car-as-wallet: A new generation of customers will expect to switch seamlessly from their smartphones to the car. Increasingly, that means in-car purchases and in-vehicle shopping, whether it’s paying for fuel/charging, tolls, ordering food or streaming content, customers will expect to be able to do it seamlessly.

⁵ Cap Gemini: *Monetizing vehicle data, how to fulfil the promise mdocs 5G network slicing*

⁶ Forbes magazine: *Meet the Swiss start-up bringing in-car gaming to BMW drivers* (2022).



5G: fuelling the data explosion

As 5G gains ground, in-vehicle consumer behaviour is likely to follow patterns we've already seen with smartphone use – research indicates that 5G smartphone users consume 1.7-2.7 times the data of 4G users.

For automakers, this is both a massive challenge and a game-changing opportunity: seamless connectivity and premium, highly monetizable services can become key brand differentiators. In a world here 37% of customers would switch car brands to gain improvements in vehicle connectivity, delivering high volume, low latency content has the potential to make or break a brand.

From updateable experience to long term relationship

It's not just about premium features and services: as over-the-air (OTA) updates become routine for manufacturers, the idea that a vehicle is the best it can ever be on the day of purchase is also set to change – and with it, the traditional customer lifecycle. OTA updates can transform the customer-OEM relationship, making it a lot more direct. And that direct relationship can extend far beyond the first owner of a vehicle. In a world where sustainable vehicles will spend a lot longer in circulation, that's a genuinely transformative development.

As James Towle of Jaguar Land Rover (JLR) told a recent *Financial Times Future of the Car* conference, OTA is moving away from solely being about “fixing problems”, into an opportunity for OEMs to have direct interaction with customers on an ongoing basis, while providing updateable experiences. “Rather than talking exclusively about subscriptions and driving revenue, we can actually provide a product and a service that can be direct to our customer base and improve that experience over time.”

With over 100 million lines of code in the average connected vehicle, the prospect of being able to deliver updates – and improvements – remotely, from the cloud, is revolutionising everything from development cycles to business models and customer relationships.

As they begin to collect and analyse it, many automakers are beginning to realise that they can re-use datasets to solve different problems and gain new insights into user needs and behaviours. As 5G moves towards the mainstream, automakers can look forward to a rich vein of data to fuel new insights, innovations and business models.



The automaker's dilemma

2022 marked the first time that connected vehicles outsold unconnected ones. ⁷ Gartner estimates that the share of 5G-enabled cars that are actively connected to a 5G service will reach 94% by 2028. ⁸

With these levels of scale, ownership of the in-car entertainment experience is already becoming a battleground where automakers compete or partner with media and consumer tech giants for a share of a US\$3.6 billion market. As Amazon, Apple, Google and other established tech giants expand further into the automotive space, with more likely to follow, this creates a dilemma for car manufacturers: do they let the tech companies in, or go it alone?

Partnering for success

As Cubic Telecom CTO Nick Power puts it, car makers are at a crossroads: on the one hand, the tech giants have significant expertise in building user-friendly operating systems. On the other, giving up ownership and control could result in reduced brand differentiation. "There's a fine line to walk between embracing tech partnerships and retaining ownership of the customer experience, without alienating them," he says.

Recent times have seen players like Stellantis partner with Amazon, while GM recently announced its plans to phase out Apple CarPlay and Android Auto in electric vehicles (it's partnering with Google to develop infotainment). CARIAD is working with HARMAN to create an open ecosystem of apps for a uniform, cross-brand store that combines exclusive, branded apps with in-car access to third-party content. For now, the partnership approach appears to be the favoured way forward.

Continuity – and connectivity - matter

Whichever route automakers take, continuity of experience will be key. For many customers, cars are becoming just another device

– but software failures in cars have the capacity to lead to a much more frustrating user experience than a bad update of a laptop or phone. Inconsistent user experience risks alienating users. Complexity can lead to significant issues if not carefully managed – system failures and crashes, incomplete or corrupted software installations, disruption of user preferences or loss of data can all overwhelm or frustrate users.

The pace of software updates means cars need fast, reliable connectivity with global reach. Automakers will need insights into how that connectivity is performing, so they can make better user experience decisions. Software-defined cars are enabled by software-defined connectivity. The concept of the vehicle as a 'third space' is evolving towards reality. As automakers pivot towards a market where the connected experience will matter as much as more traditional car features.



“Automakers are used to 3-7 year production cycles. Managing this in a world where technology becomes obsolete in a much shorter timeframe, where continual enhancement and updating of software is required...these are new challenges that automakers are working to solve. And that’s before we even begin to discuss keeping cars connected for their entire lifecycle.”

Nick Power, CTO Cubic Telecom

⁷ New York Institute of Technology, *Will 2023 be 5G's year?*

⁸ *Connected Cars: how 5G and IoT will affect the auto industry*, ZDNET



How Cubic helps

As 5G expands the commercial scope of the automotive industry, Cubic Telecom's technologies are helping some of the world's leading agriculture, automotive and transport brands to maximise the opportunities.

Our award-winning technologies are industry-proven, technology agnostic connectivity platforms designed specifically for automotive IoT use cases.

PLXOR

Our connectivity platform uniquely provides seamless integration with OEM IT business systems and enables remote device connectivity management, with minimal embedded SIM SKUs across the manufacturing supply chain. A unified solution, PACE enables car makers to extend their capabilities into the connected 5G ecosystem without having to invest in new skillsets, resources or technical architecture.

PACE

Cubic's PLXOR analytics platform enables global split-billing functionality, allowing vehicle manufacturers to tailor pricing strategies and offer personalised content packages. As splicing offers multiple connections simultaneously and mMTC enabling device density in small areas, network monitoring capabilities will be severely tested by 5G. PLXOR provides much-needed network visibility. Identifying, monitoring and controlling traffic at IP level, it provides automakers with a real-time view of network capacity and performance across a growing ecosystem of services. Alerts identify issues to drill into and troubleshoot by geography and timeframe, as well as vehicle and MNO.

INSIGHTS

Our Insights platform gives OEMs the connected intelligence they need to optimise customer experience, alerts and performance monitoring. In the complex world of 5G services, the ability to both categorise and analyse data traffic will be key for automakers looking to ensure operational efficiency locally as well as globally. Insight couples technical and quality of service data with behavioural analysis of end-users. Leveraging Cubic's cloud infrastructure to process insights allows carmakers to further distribute the compute load of processing vehicle and service data, reducing the need for hardware investment.

Think about it. We do.

To compete globally, automotive OEMs and device manufacturers must negotiate agreements with multiple operators in different geographies. They have to manage the complexities of connecting with different telecoms technologies while complying with regulatory and operational mandates in each country. Cubic completely cuts through that complexity, providing a single, global solution that enables any vehicle shipped anywhere in the world to have built-in compliance across local markets – from regulatory to tax requirements.

About



Cubic Telecom delivers innovative IoT connected software solutions to Automotive, Agriculture, and Transport manufacturers. Its ecosystem of revenue-generating services combines real-time analytics with global connectivity in 190 countries, always aligned to regional regulatory requirements.

Its global connected software platform PACE is used by leading companies around the world including Audi, Microsoft, Kymeta, Panasonic Automotive, Volkswagen, CNH Industrial, Skoda, e.GO Mobile and Arrival.

Headed by CEO Barry Napier, the company is privately held with over €110 million in funding by Audi Electronics Venture GmbH, Qualcomm, Valid, the European Investment Bank, Enterprise Ireland, and the Ireland Strategic Investment Fund, among others.



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