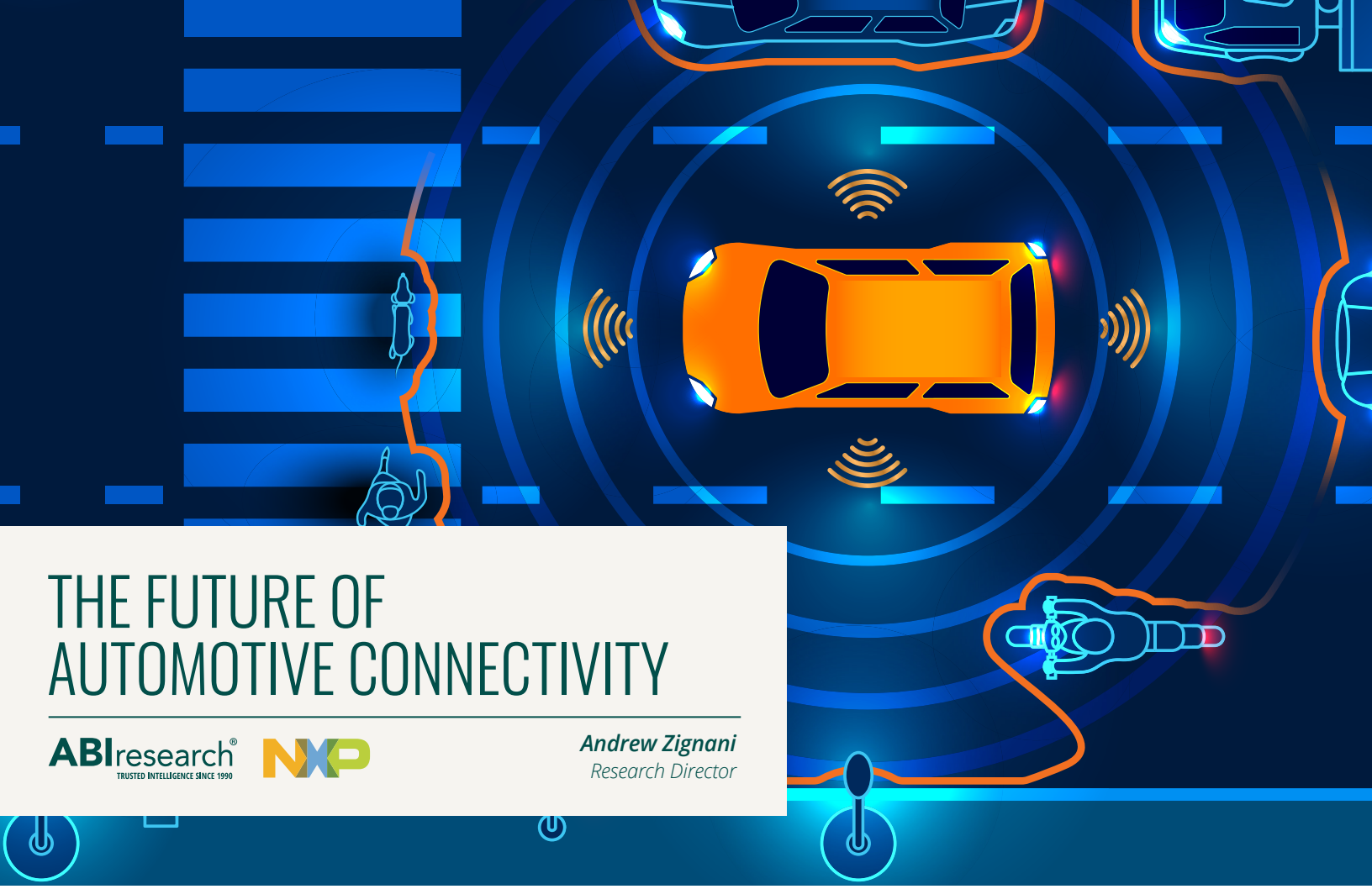

THE FUTURE OF AUTOMOTIVE CONNECTIVITY

ABIresearch® TRUSTED INTELLIGENCE SINCE 1990 NXP

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INTRODUCTION

The automotive industry is experiencing an unprecedented transformation as it takes on the transition to electric, increasingly autonomous, and connected vehicles. Among these automotive megatrends, automotive connectivity stands at the forefront of vehicle design decisions, thanks to its central role in enabling a wide range of innovative user experiences, value-added services, safety and security enhancements, and new features that are changing the way drivers interact with their vehicles. To make these new dimensions possible, cars will need to support a number of wireless technologies, including high-performance Wi-Fi, Bluetooth, Ultra-Wideband (UWB), Near Field Communication (NFC), IEEE 802.11p (DSRC), and cellular connectivity, in order to enable key use cases, such as advanced in-car infotainment and audio systems, secure vehicle access and sharing, intelligent vehicle data collection, over-the-air (OTA) updates, vehicle diagnostics and health management, tire pressure monitoring systems, vehicle-as-hotspot, and Vehicle-to-Everything (V2X) communications functionality, among others.

This white paper will highlight the future of the connected car and discuss how key wireless connectivity technologies will help to enable new innovative use cases within and around the vehicle. Discussion will focus on short-range wireless technologies such as Wi-Fi 6, Bluetooth, UWB, NFC, RAIN RFID, V2X, as well as on cellular technologies. The paper highlights the need to support multiple connectivity technologies within the vehicle to effectively address the existing and emerging use cases and applications. The discussion will centre upon four major areas, including vehicle-to-cloud connectivity and telematics, in-vehicle experiences, smart access and shared mobility, and V2X. In addition, it will highlight how new vehicle architectures will be fundamental in ensuring that vehicles of the future will be able to provide secure, robust connectivity that can maximize vehicle performance, create new services and business models, and enhance vehicle features once deployed.

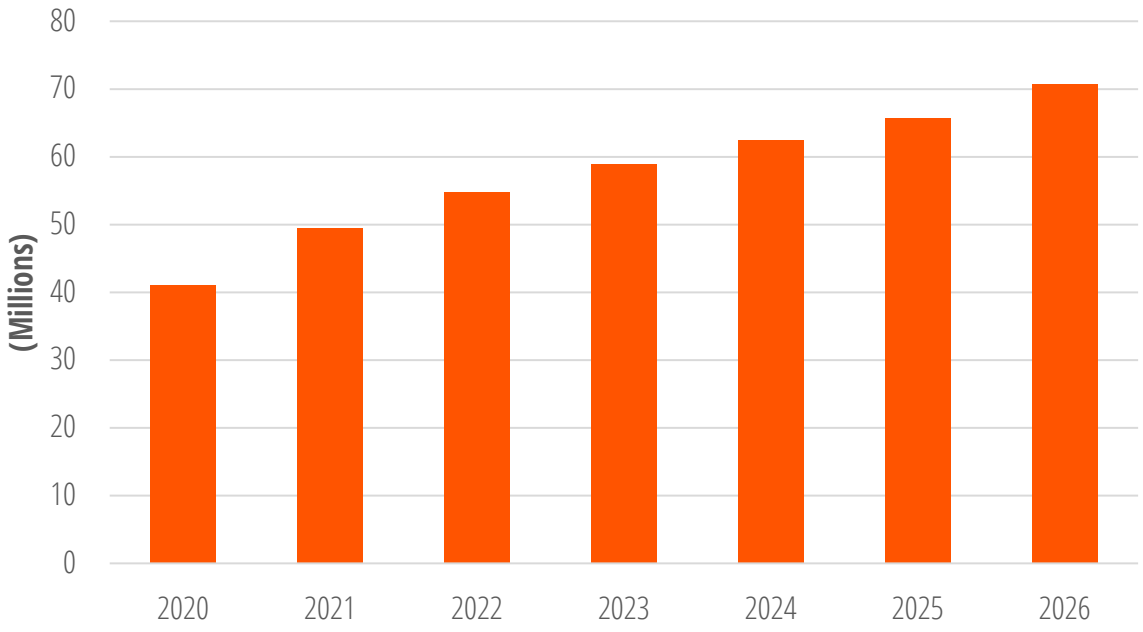
VEHICLE-TO-CLOUD CONNECTIVITY

The modern vehicle is evolving to become more electric, connected and increasingly autonomous. These enhancements are transforming vehicles into comprehensive IoT platforms, resulting in a shift away from hardware-centric devices of the past towards software defined vehicles that evolve over the course of their lifetimes to enable new features, provide greater security, enhance safety and efficiency, and create valuable new services and business models for consumers and OEMs alike. Recent advancements in computing, sensors, cloud platforms, and connectivity are enabling vehicles to evolve into rolling data platforms equipped with growing numbers of high-performance sensors. These have enabled more advanced safety systems and are building the path towards more automated vehicles. At the same time, end-user demands for better in-vehicle experiences regarding entertainment, comfort, and safety are leading to growing adoption of personalization via voice assistants, advanced digital cockpits with multiple displays, video streaming and gaming, and OTA updates, enabling new features within the realms of infotainment, autonomous driving, or comfort related functionalities. Unsurprisingly, this increasingly places vehicle-to-cloud connectivity at the forefront of vehicle design decisions.

As a result, both the number of connected vehicles and the amount of data being generated by vehicles is growing enormously. As Chart 1 demonstrates, by 2026, ABI Research forecasts that there will be over 70 million connected vehicles shipping annually, equating to 75% of all vehicles being shipped at that time. These vehicles will require high-speed, robust, Wi-Fi and cellular connectivity to the cloud in order to effectively transition to new software-defined and service-oriented approaches that can enable vehicles to quickly deploy new services and experiences while improving vehicle performance and intelligence over time.

Chart 1: Global Connected Car Shipments, 2020 to 2026

Source: ABI Research



CONNECTED VEHICLE USE CASES

Wireless connectivity is becoming a key differentiator and more vital component of the vehicle purchase decision. While historically, automotive OEMs have used connected car features as a way to differentiate in a competitive market, carmakers now see the growing business opportunity to monetize this connection and use connectivity to generate revenue via OTA updates, lifecycle management, new software and experiences, and the transmission of data from millions of connected vehicles to create valuable new services. Unlocking big vehicle data is an enormous opportunity which is being enabled by multiple converging trends, including vehicle compute and central gateways, automotive Ethernet, cloud computing and storage, and high-speed wireless connectivity via 5G and Wi-Fi 6.

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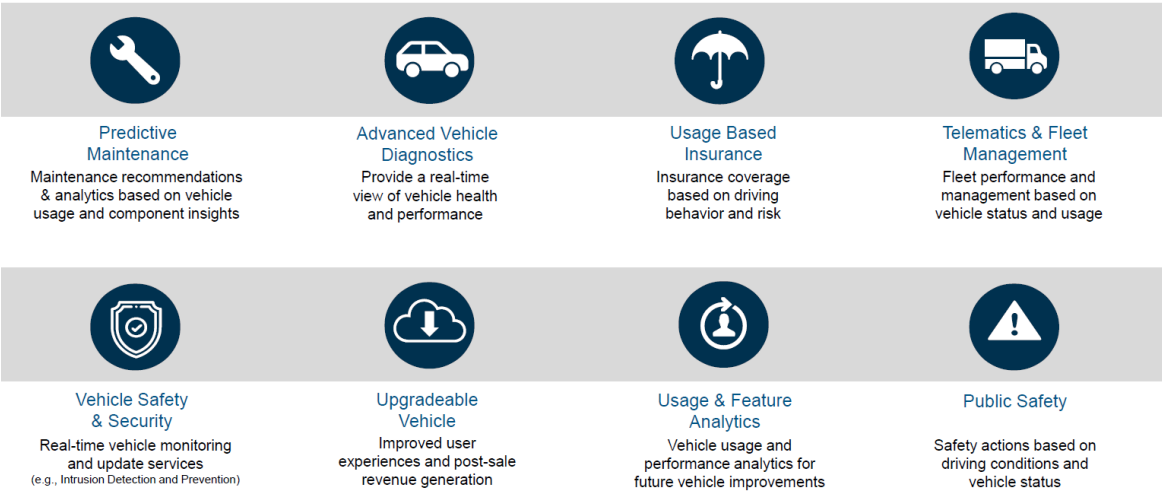
Figure 1 demonstrates some of the key connected vehicle use cases. While many connected vehicle use cases have historically focused on information sharing applications such as emergency calling, entertainment, and location-based services, there are growing activities in more advanced analytics and machine learning applications that will leverage the huge amounts of data generated by up to hundreds of vehicle sensors. This will enable use cases such as predictive maintenance, advanced vehicle diagnostics, performance and efficiency improvements, and feature expansions. As a result, vehicle manufacturers will be able to swiftly deploy new vehicle services, user experiences, and vehicle improvements, leading to additional revenue generation and closer relationships with customers throughout the vehicle's lifecycle.

Figure 1: Connected Vehicle Use Cases

Source: NXP



Today's vehicles are typically unable to adapt over time or provide new capabilities after the car is purchased. However, there is a strong interest among OEMs to enable an infrastructure where new features and services can be rapidly deployed. OTA updates are rapidly taking hold within the automotive market, with the Return on Investment (ROI) justified easily by the ability to generate revenue with new features and to correct software errors and apply cybersecurity patches without the need to physically service vehicles, improving the user experience and avoiding damage to brand reputations. As vehicle functions become increasingly software defined, the value proposition of OTA updates will grow over time. For example, OTA updates will deliver functional improvements to the vehicle after the POS (point of sale), making the vehicle upgradeable, a paradigm championed by Tesla and one that other OEMs also starting to explore and implement.

To enable these use cases, OEMs are increasingly adopting service-oriented gateways that support secure, vehicle-wide OTA updates that go beyond the capabilities of typical automotive microcontrollers. These gateways conduct operations outside of the traditionally risky infotainment realm, an area not known for secure OTA. For example, NXP's automotive-grade S32G processor has the performance and networking capabilities to rapidly deploy new use cases and enable upgradeable vehicles for global OEMs. This S32G family of processors are central to NXP's efforts in helping its partners monetize vehicle data, including its collaboration with Amazon Web Services (AWS) and its Vehicle edge-to-cloud compute solution which aims to enable new automotive industry revenue opportunities.

NXP's S32G also serves as a key component in NXP's collaboration with MOTER, an insurtech company that seeks to connect the insurance and automotive industries through a secure data platform, alongside the Fusion Project, an automotive industry collaboration aimed at defining a streamlined data lifecycle platform for connected vehicles.

These efforts at managing data are important as some industry estimates suggest that future autonomous vehicles will generate up to four terabytes of vehicle data each hour, while even modern vehicles today are esti-

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