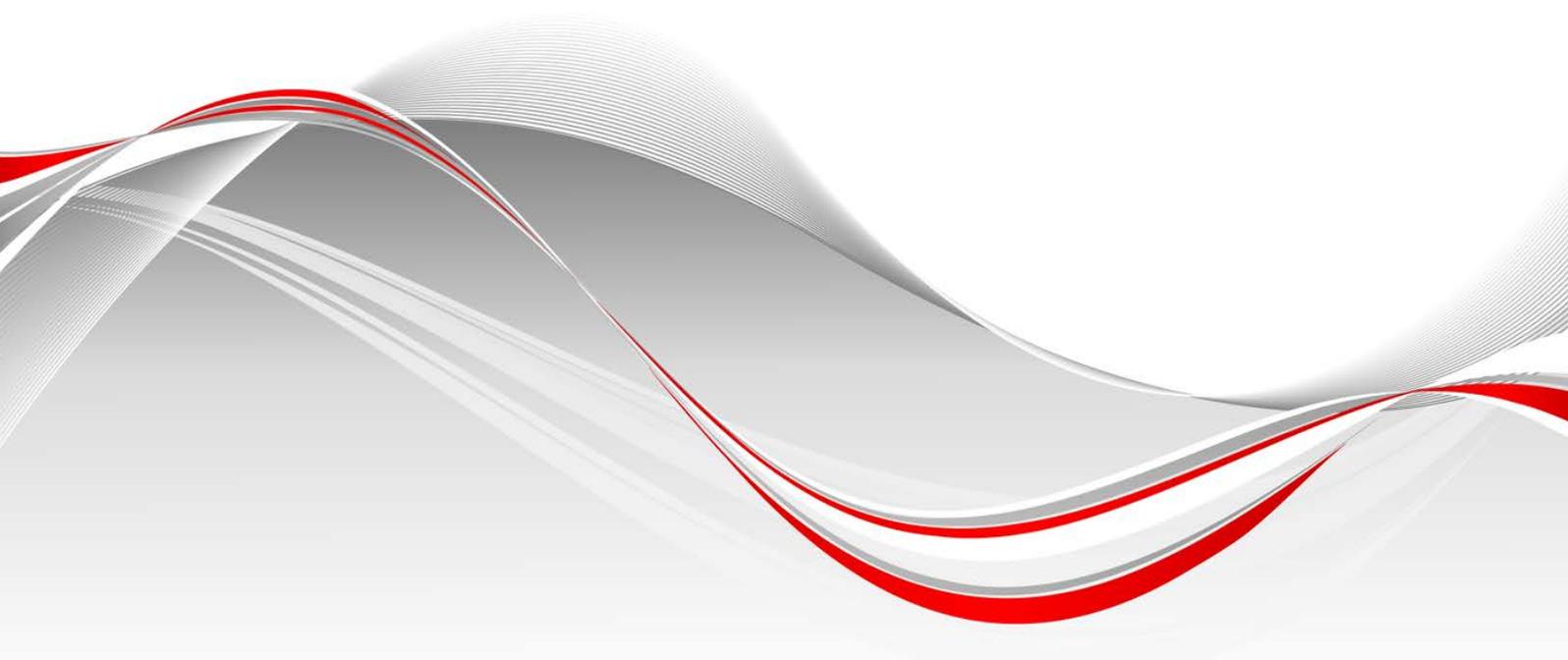# From the Connected Car to the Managed Car

White Paper

October 2013

Updated

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1 Introduction

The connected car is now a reality. According to Machina Research, by 2022 there will be 1.8 billion automotive M2M connections. 700 million of them will come from embedded wireless modules inside the car and 1.1 billion from wirelessly connected after-market devices that provide services including navigation and pay-as-you-drive (PAYD) insurance.
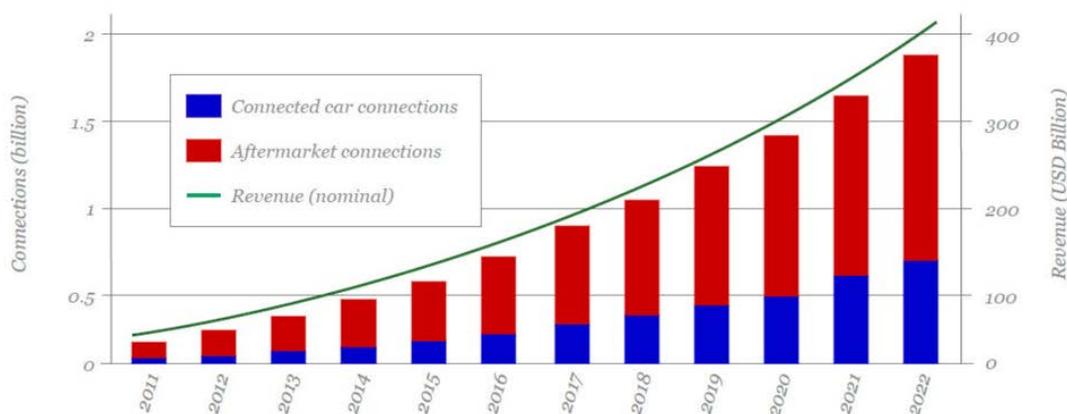

Figure 1: M2M Connections and Revenue in the Automotive Sector 2011-22

Central to the connected car is the in-vehicle infotainment (IVI) system, which brings together wireless connectivity, an IP-communication infrastructure, middleware and applications in a powerful, unified computing system. IVIs, with their combination of navigation and entertainment, have become one of the top features expected in new models.

At the same time, the computing power of other car systems is also increasing, including the number and the amount of software inside electronic control units (ECUs).

As a result of these two phenomena, the software experience inside the car is now considered a competitive advantage for OEMs.

GM Cadillac CUE and BMW ConnectedDrive are two examples. GM CUE delivers natural voice recognition and touch-screen technology for added driver safety. BMW ConnectedDrive offers rich entertainment services and driver assistance capabilities.

While sophisticated software features and car connectivity introduce opportunities to deliver new services for a better driving experience, they also introduce challenges associated with cost and manageability.

This white paper is intended for automotive OEMs, their suppliers and other software and hardware providers in the automotive ecosystem interested in using the connected car as a platform from which to deliver differentiated services that build lifelong brand loyalty and generate new revenue streams. The paper describes the new opportunities yet growing challenges created by car connectivity, and explains the management capabilities required by OEMs to service the increasing amount of car software. By moving beyond the connected car to the "managed car," the automotive industry can manage the car's software experience to become a key differentiator and strategic enabler.

2 The Opportunities Created from Car Connectivity

Historically, car manufacturers have satisfied their consumers with the right mix of design, power and functionality. But the new wave of Generation Y buyers changed the rules of the game. According to Deloitte's annual Gen Y survey, new car buyers want better fuel efficiency preferably from hybrids and in-dash technology that extends their digital lifestyle without compromising security.

The addition of wireless connectivity combined with consumer demand for better in-vehicle services are changing the automotive value chain and creating new business opportunities:

2.1 Consumer Relationships

Traditionally, independent dealerships have acted as proxies between the consumer and the car manufacturer. The relationship with the consumer is begun with the dealership during the car buying process and is maintained with the dealership through the warranty period. As a result, the consumer has almost no communication with the manufacturer unless there is a recall, resulting in a negative experience for the consumer and a weakened relationship with the manufacturer.

With always-connected cars, there is an opportunity to change this dynamic and create a strong relationship with the consumer rather than one based on repairs and, in the worst case, vehicle recalls. Car manufacturers can use the wireless channel into the car to maintain an ongoing positive relationship with their customers in the form of over-the-air (OTA) software updates that provide improved performance and new IVI features and applications. How this new relationship with the consumer is utilized can change the game for OEMs and how they monetize lifetime customer relationships.

2.2 Customer Experience

Today's vehicles can contain more than 100 electronic control units (ECUs) that are responsible for the car's operation, from managing the engine to controlling the air conditioning. When ECU software maintenance is required, consumers must bring their vehicle to the dealership or service center for reprogramming. These reflashing methods over the CAN bus can be time consuming, error prone and expensive.

The same wireless connectivity used for the infotainment system can be leveraged to remotely manage ECU software over the air, and can even reduce by half the time needed to reflash ECUs over the CAN bus. Whether over the air or over CAN, the consumer experience with routine car maintenance can be significantly improved with FOTA, firmware over the air updating.

In addition, car connectivity enables OEMs to obtain real-time performance data from the vehicle, including software behavior and application usage. This data can provide valuable insight to improve the next firmware version to prevent future maintenance, making the car experience continuously better throughout the ownership period.

2.3 Business Model

According to Reuters, U.S. commuters spend nearly a week of the year stuck in traffic. With multiple screens and connectivity to the outside world, there are abundant opportunities in the infotainment space to improve the driving experience and create tighter integration with the consumer's daily life. This connectivity also brings new business models. The deal between GM

and AT&T regarding 4G connectivity inside GM cars reveals some of these opportunities for car manufacturers to capture a portion of the data bill and ongoing services revenue.

Ford also monetizes the connectivity with an app store including Pandora and Wall Street Journal applications that are controlled by the voice recognition system. This is an example of how the automotive industry is learning from the mobile industry, which understands that the success of a software platform is generally proportional to the size of the application ecosystem. The ability to manage the software life-cycle of these applications will be a key differentiator for an OEM.

Opportunities to generate new revenue streams from car services can be expanded to other industries too. The new pay-as-you-drive (PAYD) business model for car insurance increases consumer choice and provides online car information to insurance companies that had no previous exposure to this information. Innovation will not just be in technology and the availability of Big Data, but also in creative new business models.

2.4 Regulation and Safety

The connected car is a platform to significantly increase road safety through fast access to emergency services, such as eCall in Europe, and someday, through autonomous driving. By transmitting vital information, such as the need to engage the breaks, either from one car to another (V2V) or to the communication infrastructure (V2X), accidents can be prevented.

These safety systems add new technologies and thus more software to vehicles, increasing the requirement for OTA software management, especially as regulations evolve and systems need to comply. However, these systems also add new safety requirements. Virtualization technology can be used to ensure separation when sharing computing resources between critical and non-critical systems, as well as protect the car's safety systems from open Internet connectivity.
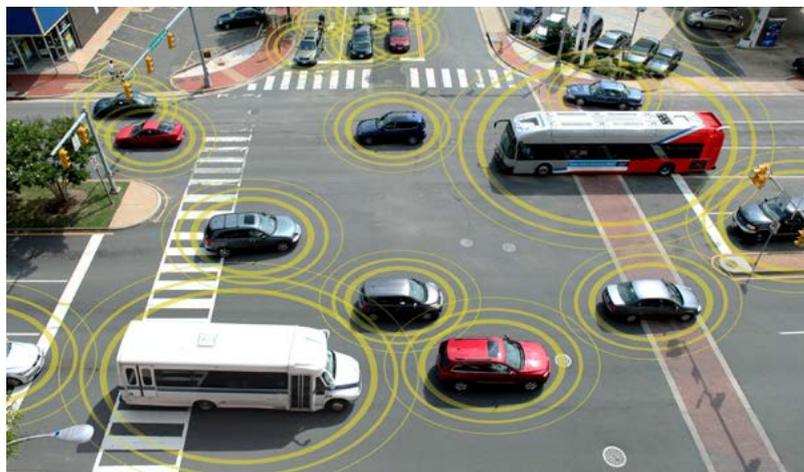

Figure 2: U.S. Dept. of Transportation, Intelligent Transportation System

2.5 Environmental Impact

One of the key components that will determine the success of electric vehicles (EVs) and hybrid cars and trucks is the ability to manage the vehicle's power resources. Beyond the typical navigation and entertainment features, the infotainment systems in EVs and hybrids also perform vital EV power monitoring and management.

To enable this next generation of EVs and hybrids, information technology and energy technology will converge in innovative ways to make it convenient and economical for the consumer to conserve energy and achieve greater distances on a single charge. As new charging stations become available and as the efficiency of batteries and engines improve, FOTA can keep the entire fleet operating at peak performance.

2.6 Software and Hardware Utilization

The connected car is utilizing hardware and software more efficiently while offering richer functionality. An example of sophisticated software utilization is the Advanced Driver Assistance System (ADAS), including lane departure warning systems, lane change assistance, adaptive cruise control and night vision, which is available for example in the 2014 Mercedes S class.

It is said that the 2014 S class is not "driven" but rather "operated" due to its advanced functions, such as the new Magic Body Control system. This system uses a stereoscopic camera located behind the rearview mirror to assess upcoming road conditions and proactively adjust the suspension in a fraction of a second ahead of time, rather than react to an existing situation only when it happens.

Figure 3: Mercedes-Benz Night View Plus System

Another example of better software and hardware utilization in the connected car is the infotainment system and the digital cluster. The requirements of a head unit are so diverse that no single OS can meet every need for functionality, performance, stability and security. Therefore, many car manufacturers are utilizing different operating systems for different car functions.

Virtualization technology enables the head unit to run both the general purpose operating system of the IVI and the real-time operating system of the digital cluster in separate virtual machines on the same shared hardware resource. The result of hardware consolidation is a lower BOM and greater fuel efficiency by reducing the weight of the vehicle. The key for the next-generation multiservice IVI system is to have a dedicated OS for driver-assistance services, another for infotainment and a third for consumer-downloaded applications. Virtualization can achieve this efficiently and reliably and without compromising security or performance.

3 From the Connected Car to the Managed Car

With more and more cars becoming connected through mobile and wireless technology, the next step for the automotive industry is to focus on how to manage the connected car and its software systems as a platform for delivering new services.

The "managed car" requires in-vehicle software management technology optimized for the unique environment of IVIs and ECUs, and a centralized back-end management system capable of managing any type of software—from applications to firmware, whether embedded or downloaded—at any point during the car's lifetime.
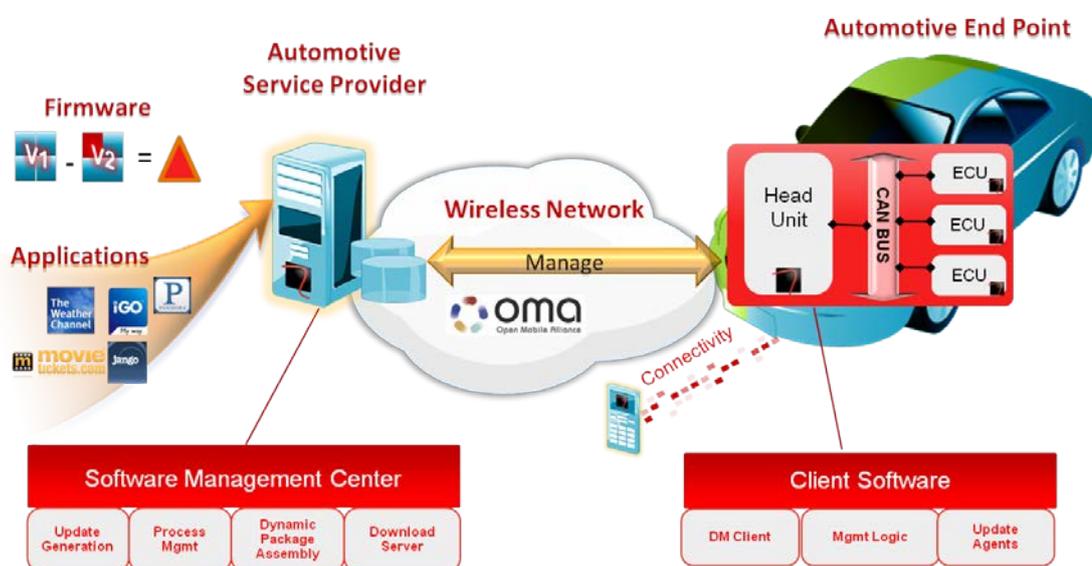

Figure 4: The Red Bend-Enabled™ Managed Car

Red Bend Software provides an end-to-end automotive software management solution that includes the following product components:

The Red Bend Software Management Center is a powerful standards-based, back-end management system that enables OEMs to centrally manage software, applications and firmware over the air. Through a Web-based console, car manufacturers can deploy, install, configure, update, activate, deactivate, analyze and remove software assets inside the vehicle. Standards-based device management protocols from the Open Mobile Alliance (OMA-DM) are used to ensure reliable and secure end-to-end communications with the vehicle.

The Red Bend Software Management Center uses patented algorithms to generate extremely compact software update packages. Intelligent policy management enables car manufacturers to configure the vehicle to use Wi-Fi at home for heavy data traffic and mobile networks for instant updates such as traffic information or location-based services. This ensures that bandwidth is used efficiently, costs are controlled and the customer gets an excellent experience when performing software updates.

The Software Management Center can be offered as a hosted solution or for installation on premises. The OEM can even allow car owners or third parties to configure and manage in-vehicle services, under the OEM's control.

Inside the vehicle, Red Bend's client software performs the management actions.

Red Bend's vRapid Mobile® client software updates automotive firmware over the air (FOTA). The vRapid Mobile standard Update Installer is used inside IVIs and Telematics systems, whereas the vRapid Mobile Fuse™ Update Installer is optimized for the extremely resource-constrained environments of ECUs. vRapid Mobile is

Red Bend's vDirect Mobile® device management client manages the communications between the vehicle and the back-end management center, including receiving software update packages and passing them to the Update Installer.

To isolate critical software from non-critical systems, **Red Bend's vLogix Mobile®** provides a Type-1 hypervisor that can run multiple operating systems in different virtual machines simultaneously, separately and securely on the same shared hardware platform. A failure or security compromise in one OS will not impact the other. This holds true from the smallest RTOS to the most feature-rich HLOS such as QNX, Android, Linux or GENIVI. By using virtualization, OEMs can increase hardware utilization while reducing costs.

4   Summary

The connected car is changing the automotive industry. As more cars become connected, the automotive value chain must ensure it has the management capabilities needed to enable the next generation of in-vehicle services, while keeping costs controlled and without sacrificing performance, security or time-to-market.

With an end-to-end system to manage automotive software over the air, OEMs can build a completely new relationship with customers based on managing the software experience and the application lifecycle. New software-driven business models are now possible.

5   About Red Bend Software

Red Bend® Software, the leader in Mobile Software Management (MSM) with more than 1.75 billion Red Bend-Enabled™ devices, makes mobile devices and services continuously better in a rapidly changing world. Red Bend is the only company that provides standards-based products and solutions for software management, device management, and mobile virtualization that work on any mobile phone and connected device uniformly, efficiently, and securely over the air. Red Bend enables its customers to stay competitive in a fast-moving market by helping them deliver high-value services on an increasing number of connected devices with growing software complexity. More than 80 leading device manufacturers, mobile operators, semiconductor vendors and automotive companies worldwide trust Red Bend with their most important assets—the mobile and connected devices their consumers depend on.

For more information, visit: www.redbend.com/automotive