In a world where high-speed Internet access is taken for granted, consumers expect connectivity in airports, restaurants, campuses, and even public transit. Cars are no exception.

In 2015, auto manufacturers delivered approximately ten million vehicles - approximately 10% of all new vehicles - with embedded connectivity. As manufacturers continue to add new services such as in-car infotainment, stolen vehicle tracking or remote door lock/unlock, consumers expect more. Governments are also pushing for connected services such as eCall (in-vehicle emergency call) and stolen vehicle tracking.

Bringing vehicles into the Internet of Things (IoT) also opens up a new opportunity: the creation and implementation of new services that customers are willing to pay for. Car manufacturers can gather previously unavailable data to gain insights about customers and vehicle performance, and over time, create new streams of recurring revenue.

When bringing vehicles into the IoT, car manufacturers, integrators of telematics control units (TCU) and telematics service providers (TSPs) face challenges on many fronts, from deploying new features to vehicles in the field to maintaining compatibility with cellular technologies worldwide. As a trusted supplier delivering wireless solutions with MVNO (mobile virtual network operator) and MVNE (mobile virtual network enabler) capabilities, these issues and their solutions are familiar to Sierra Wireless.
Transforming the Relationship between Automakers and Drivers

Approximately 90 million new vehicles are produced and sold each year. Although embedded connectivity is available in only 10% of new cars sold today, this figure is expected to increase to 30% of 100 million new cars by 2020. By 2025, all cars sold in developed markets (EU, NAFTA, China, Japan, Korea and others) will include an embedded telematics solution.

Embedded connectivity fundamentally changes the way consumers use their cars. Services available today for the “Connected Car” include:

- **Safety**: Emergency call, breakdown call, crisis assist.
- **Security**: Stolen vehicle services, remote door lock/ unlock, personal security alert.
- **Preventive maintenance**: Remote diagnostics, maintenance alert/ support.
- **Navigation**: Route operator assistance, off-board navigation, vehicle finder, traffic information, speed camera information, parking space information, weather information, fuel price information, travel guides, satellite imagery, location sharing, last mile guidance.
- **Infotainment**: News and events, office/ communication tool, unlimited internet access, user reviews, location-based services, concierge services, web-based entertainment, social networking.
- **Usage-based insurance**: Pay As You Drive, Pay How You Drive.
- **Electric vehicle-specific**: Charging information, remote control/ monitoring.

Importantly for car manufacturers, embedded connectivity also transforms the relationship between automakers and drivers. To date, manufacturers have had limited insights into how their cars performed, how cars were driven, which features were used and how. Connected Cars are mediums that allow manufacturers to better understand vehicle owner needs and behaviour.

As part of the IoT, Connected Cars can provide valuable data to manufacturers about performance, maintenance, driver behavior and more. Knowing how drivers and passengers operate the various features in a vehicle will improve the usability in future generations of cars. Such data allows auto manufacturers to:

- Increase brand loyalty through deeper insights and stronger relationships with customers.
- Refine and improve vehicles to be more competitive.
- Gain a competitive edge by safely extending the Internet services that customers use in other areas of their lives to the time they spend on the road.

As more automakers adopt telematics and integrate “Big Data” generated by the IoT into their business, this shift will fuel new applications that create new revenue opportunities for the IoT-enabled ecosystem.
• Live data from the movement of windshield wipers combined with aggregated vehicle location data to make weather forecasts more accurate.

• Vehicle speed combined with aggregated location data to improve the accuracy of traffic forecasts.

• Data about rapid acceleration, sudden braking, and other forms of aggressive driving can provide driver behavior feedback to optimize insurance rates.

These examples highlight opportunities for enhancing the driving experience for the consumer and creating new, recurring revenue streams within the ecosystem.

![FIGURE 1: THE CONNECTED CAR APPLICATIONS](image)

**Challenges for the Connected Car**

The average lifetime of a car is 10 to 15 years. The automaker must make technology decisions today for a Connected Car that will not go into production for another two to four years. If the cellular solution selected is to remain relevant for 12 – 19 years from the time the decision is made, there are significant challenges that need to be addressed by car manufacturers as well as their TCU suppliers and TSPs, namely:

• Cellular solutions must be flexible enough to remain compatible with evolving network technologies over the vehicle lifetime.

• The chosen solution must deliver the most seamless, uninterrupted and simple coverage possible in all countries where the automaker has market presence.

• Solution developers must find scalable, cost-effective ways to develop reusable and upgradeable software that can be deployed across technologies independent of hardware and chipsets.

• Automakers must be able to manage software in the field simply, cost-effectively and securely – not just to apply fixes, but also to deliver upgrades and new functionality.
FLEXIBILITY TO SUPPORT EVOLVING NETWORKS

Major mobile network operators such as AT&T have announced they will shut down their 2G network in late 2016. This is a trend that will continue around the globe. The momentum of LTE deployments make it reasonable to assume that carriers will follow by shutting down 3G networks. If Connected Cars are to deliver continuous, seamless services to drivers and data to auto manufacturers, solutions must support changes to cellular network infrastructure.

Sierra Wireless recommends LTE as the most logical choice for any new telematics solution, since it is backwards-compatible with 2G/3G. LTE (with fallback to 2G/3G) offers the bandwidth needed to power data-heavy services such as infotainment and navigation.

UBIQUITOUS COVERAGE

Connected services are of use only when they maintain their connection to a service provider. Drivers of Connected Cars will expect service anywhere the road system takes them. Some connected services like infotainment systems require continuous, high-quality bandwidth. For automakers, this means any embedded solution must cover all available mobile technologies and frequency bands in a given region. It also means they must certify with the various network operators responsible for cellular coverage in those markets.

When it comes to providing the best possible user experience, Sierra Wireless recommends simplifying the process by a) adopting pre-certified LTE modules covering all bands in a given region and b) SIMs which hold multiple operator agreements on a single SIM and also support eUICC. Together these strategies offer economies of scale, access to more networks than any single roaming device, and the ability to switch networks without changing the SIM or even the embedded module.

To gain even more benefit, automakers should partner with a mobile virtual network operator (MVNO) instead of several MNOs. Not only would manufacturers benefit from the simplicity of managing connectivity from a single platform, but they would also have full control over selecting and switching between MNOs and MVNOs according to business model needs.

SCALABLE, COST-EFFECTIVE DEVELOPMENT

A new solution requires integrating processors, modems, and memory from a multitude of suppliers. When components for new in-vehicle applications aren’t compatible with existing features, solution providers and automakers must build dedicated services to support these new technologies. This increases the time and budget required to roll out new connected services.

Applications built for a specific hardware and chipset are not reusable from one platform or network technology to another; an application built for one TCU is unlikely to operate on the next-generation of TCUs. Furthermore, developing to a specific vendor’s technology potentially locks in the solution to a proprietary road map and pricing.
The demand for new, connected services that support a global market means that solution providers must find ways to reduce the complexity of dealing with the IoT, minimize development costs, and get services to market faster.

To reduce ongoing software development costs and avoid lock-in to proprietary technologies, Sierra Wireless recommends developing on a common open source application framework that supports multiple platforms. Software for connected services developed on such a framework can be reused for next generations of TCU, even if the TCU comes from a different supplier.

To reduce integration cost and complexity even more, select cellular modules which feature separate microprocessors for cellular connectivity and in-vehicle applications. Cellular solutions with pre-integrated open source OS and application framework allow solution providers to develop and deploy connected solutions much faster and at a much lower cost.

MANAGED SERVICES

The long lifetime of a vehicle means that the applications and devices in a Connected Car must work over the lifetime of the vehicle. For auto manufacturers, this means there must be an IoT-centric management solution for software and firmware in the field. This is essential not only for applying service updates such as new security protocols, but also to support delivery of new features; these could be features provided free-of-charge by the automaker or upgrades purchased by the car owner.

Unless this management component is part of the Connected Car’s ecosystem, automakers will not be able to capitalize on new business models built upon customer and vehicle relationship management.

Sierra Wireless recommends adopting a cloud-based approach to managing software and firmware for connected services. Cloud-based management platforms are scalable, cost-effective and enable better service to end customers. Ideally, look for fully-integrated device-to-cloud solutions that provide:

- End-to-end security
- Subscription management
- Secure over-the-air updates
- Operator-neutral SIM management
- Ability to manage operator agreements

Sierra Wireless Enables New Business Models for the Connected Car

Sierra Wireless offers car manufacturers, TCU solution providers, and TSPs a unique portfolio of solutions. As the number one automotive cellular module provider, we understand the challenges of embedding connected telematics applications in vehicles. Our integrated approach extends from modules and gateways to managed connectivity services, MVNE, and full MVNO capabilities.
Our automotive LTE modules are certified by major network providers, support eUICC for easy, over-the-air provisioning to switch network providers, and come pre-loaded with a Linux-based open source embedded platform that simplifies the development of connected applications.

Sierra Wireless is one of the few global MVNOs with our own redundant LTE-capable core network and IoT-specific smart SIM technology. As a global Mobile Core Network Infrastructure Operator (full-MVNO), Sierra Wireless is not tied to any particular MNO alliance. This puts us in a unique position to offer automotive customers truly global, operator-independent connectivity services. We can deliver an unbiased solution that helps automakers eliminate the need to source multiple MNOs, SIMs, connectivity agreements, and platforms. Automakers can deploy connected services with confidence, knowing they are future-proofed with the flexibility to select whichever connectivity options best support their business needs.

Whether it is seamless connectivity, application development, or over-the-air upgrades Sierra Wireless’ goal is to let solution providers and automakers focus on the customer driving experience, not the IoT infrastructure.

FIGURE 2: THE CONNECTED CAR DATA FLOW
Summary

In the past, once vehicles left the factory, auto manufacturers had no further visibility and no contact with them. There was little feedback about how vehicles were performing or being used except in cases where problems required a recall or a software update applied by a service dealer.

The Connected Car is changing all this by providing manufacturers with opportunities to establish a relationship with car owners and the car after the initial sale and beyond.

- In keeping up with consumer expectations, drivers of Connected Cars can receive the latest fixes and new upgrades immediately and remotely over the air.
- The ability to deliver software securely over the air offers opportunities for recurring revenue streams based on selling new services, functionality, or data.
- Manufacturers of Connected Cars can build closer relationships with customers by taking on the role of mobility provider, offering advice on the best route to get from point A to B – including routes that do not necessarily involve a car.
- Automakers can analyze Telematics data to derive information about vehicle usage, performance, usability of features, and other previously unavailable insights to benefit the design of future vehicles.
- Last but not least the Connected Car helps car manufacturers optimize product costs and sell more cars, thanks to improved customer relationships.

Auto manufacturers can move away from an inflexible situation where a TCU remains unchanged in a car over 10 to 15 years. Now they can update software and firmware remotely, and switch cellular networks to better support application requirements, reduce costs, or expand coverage.

Ultimately, this signals a move toward customer and vehicle relationship management. Business models for the automotive industry will expand to include data-driven opportunities for new products and services that can be sold proactively and delivered wirelessly.

For more information, visit sierrawireless.com/automotive.

About Sierra Wireless

Sierra Wireless is building the Internet of Things with intelligent wireless solutions that empower organizations to innovate in the connected world. We offer the industry’s most comprehensive portfolio of 2G, 3G, and 4G embedded modules and gateways, seamlessly integrated with our secure cloud and connectivity services. OEMs and enterprises worldwide trust our innovative solutions to get their connected products and services to market faster. Sierra Wireless has more than 950 employees globally and operates R&D centers in North America, Europe, and Asia.

For more information, visit www.sierrawireless.com.