mAutomotive

2025 Every Car Connected: Forecasting the Growth and Opportunity

A whitepaper written by SBD for the GSMA

Executive summary

There are many reasons why connectivity in the car is likely to become ubiquitous over the next decade. However, for telecom operators, the ubiquitous future of connectivity is not on its own sufficient reason to celebrate. In-car connectivity can be enabled for a range of different applications and using various different technologies. Some of these applications and technologies could prove more or less profitable for the telecoms industry.

This whitepaper analyses not only how fast in-car connectivity will grow over the next 15 years, but also what type of connectivity will eventually become predominant. By doing this, a clearer picture emerges of the true opportunities (and risks) faced by the telecom industry.

Note. *This whitepaper and the associated forecasts focus only on passenger car telematics solutions that have been factory-fitted by OEMs. Aftermarket solutions for passenger cars or fleets are not analysed.*

Hypothesis: At some point in the future, every car will need to be connected to the outside world through a cellular network. The most user-friendly and secure way to enable this is by embedding a SIM card and a communication module inside the car. Therefore, the automotive market will naturally converge towards embedded telematics in the long term unless major barriers prevent this from occurring.

The major barriers that have prevented this hypothesis from becoming a reality in the past still exist today. Consumers are reluctant to pay the additional costs associated with embedded connectivity and instead view their smartphones as the solution to many of their in-car connectivity needs. In the short-term, these barriers will continue to exist, which is why vehicle manufacturers are justifiably turning to smartphone integration in an effort to satisfy consumer thirst for connectivity.

In the longer term, however, there are three disruptive **triggers** that could eliminate many of the barriers that have prevented embedded telematics from succeeding. These triggers include:

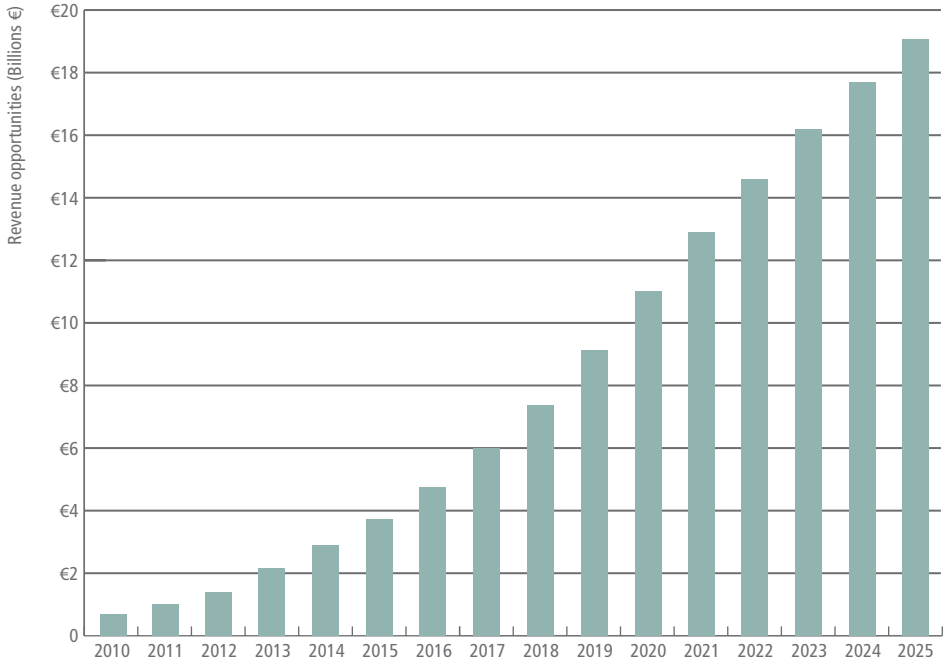
- **A growing number of telematics mandates** are being introduced by governments for services such as eCall or Stolen Vehicle Tracking. All of these mandates are expected to require (or strongly recommend) embedded telematics, which will in turn reduce the cost of hardware for consumers.

- **A revolution in pricing models** is becoming more likely within the telecom industry as the number of connected devices owned by each consumer grows. Solutions such as shared data plans, split billing and reprogrammable SIMs could lead to significantly more attractive pricing models for embedded telematics.

- **A decoupling of Apps from phones** may eventually become reality as more content and services are shifted to being hosted on the cloud rather than on native Apps. This could potentially reduce the motivation for smartphone integration in the longer-term and encourage the use of embedded telematics.

None of these disruptive factors are guaranteed to occur. Instead it is likely that each market will experience unique combinations of these triggers at different times over the next 15 years. But the impact of all three triggers occurring within a market is clear: a major growth in fitment rates and revenues for OE embedded telematics.

Figure 1. Forecast of Total Revenue Opportunities from Embedded Telematics



Source: SBD, 2012

Directly or indirectly, the telecom industry will benefit from the growth in connected cars. However, the size of the opportunity will depend on the type of connectivity that prevails in the car:

- **Smartphone integration and tethering** will lead to greater data consumption in the car, but will effectively restrict the value of telecom operators to selling more data.
- **Embedded telematics** provides telecom operators with a much broader opportunity to provide more advanced M2M support to vehicle manufacturers, including network security, billing, CRM and device management.

Telecom operators are often said to be nervous about being restricted to the role of data pipe providers. Within the automotive industry, there is an opportunity to become much more if embedded telematics becomes the long-term de-factor connectivity method.

The future of embedded connectivity in the car isn't completely in the hands of the telecom operators, but there is one area in which the telecom industry can support: enabling more flexible pricing models through solutions such as shared data plans.

Despite the challenges in implementing new pricing models, it is a key success factor for both the future of embedded telematics and consequently the future revenues for telecom operators within the connected car value chain.

We recommend that the telecom industry actively support a closer collaboration with vehicle manufacturers in order to find new billing solutions that reflect the increasingly connected world. Only then will the two industries be able to realize the vision of a safer, simpler and seamless connected car.

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2. What types of connectivity will become prevalent in the car?

2.1 Introduction to the different connectivity types

There are three ways for enabling cellular connectivity within the car, which vary based on whether the SIM, communication module and intelligence platform are **built-in** or **brought-in**. These solutions are summarized below and illustrated in Figure 2.

- **Embedded solutions** - All of the connectivity and intelligence is built into the car.
- **Tethered solutions** - The driver must use their phone as a modem (via wired, Bluetooth or WiFi) to enable connectivity.
- **Integrated solutions** - Smartphone Apps are integrated into the car to enable the driver to safely access features and services.

Figure 2. Summary of Connectivity Solutions

	Embedded	Tethered	Integrated
Components			
Communication module	Built-in	Brought-in	Brought-in
SIM	Built-in	Brought-in	Brought-in
Intelligence	Built-in	Built-in	Built-in
Services			
Safety	✓	▲	✗
Security	✓	✗	✗
Convenience	✓	▲	▲
Navigation	▲	✓	✓
Infotainment	✗	✓	✓
EV	✓	▲	▲
VRM	✓	▲	▲
PAYD	✓	✗	✗
Fleet Management	✓	✗	✗
Electronic Tolling	✓	✗	✗

Key
✓= Optimum solution ▲= Acceptable for some services ✗= Not possible or too difficult to implement

Source: SBD, 2012

The three connectivity solutions outlined above are not necessarily mutually exclusive. In fact, most vehicle manufacturers are developing strategies that rely on multiple connectivity solutions for different **segments** (e.g. embedded for premium models and tethered for low-end models) or for different **applications** (e.g. embedded for safety and integration for infotainment).

Although the most seamless and reliable option for connectivity is through an embedded solution, there are a number of barriers that have forced vehicle manufacturers to develop alternative solutions based on tethering or integration:

- **Barrier 1: High hardware costs -** The typical unit costs for embedding a Telematics Control Unit (TCU) into the car can vary between €50 and €200, depending on the required functionality of the TCU and the volume of systems sold. In comparison, tethered and integrated solutions are able to rely on the communication module and processing power that is already available within the user's mobile phone.

- **Barrier 2: High communication costs** - One of the hardest aspects of any telematics strategy is in predicting the likely usage and data requirements for different services. For some services (e.g. eCall), vehicle manufacturers have been able to hide the total lifetime communication costs into the upfront price of the system. However, for high-bandwidth and frequent-usage services such as navigation and infotainment, an additional subscription is often required from drivers. In almost all markets consumers have demonstrated a reluctance to pay an additional in-car communication contract on top of their existing mobile phone contracts.

- **Barrier 3: Consumer relationship with their smartphones** - Even without these additional costs, consumers still feel increasingly attached and dependent on their smartphones. This is mainly due to the various Apps that consumers have already downloaded onto their phones and the familiar HMI. Therefore, for many consumers have a greater interest in accessing their smartphone Apps through their in-car display rather than necessarily embedding new Apps into the car (particularly if there is an additional cost associated with in-car Apps).

The barriers highlighted above are most noticeable with two high-profile connected car services in particular: Navigation and infotainment. Although embedded connectivity would indeed provide the optimum end-user experience for these two services, many vehicle manufacturers have been unable to develop the necessary business models to enable this.

However, there are a number of important changes within the connected car market that could minimize the impact of the barriers that are currently preventing embedded telematics from becoming a truly mass-market solution.

2.2 Triggers for migration towards embedded connectivity

Although embedded connectivity has proved too costly for many telematics services so far, SBD believes that there are three future triggers that could improve the prospects for embedded solutions. These triggers are summarized below:

Figure 3. Triggers that could lead to Higher Growth for Embedded Telematics

Barriers to embedded telematics	Triggers for change	Impact of trigger on growth of each connectivity solution		
		Embedded	Tethered	Integrated
High hardware cost	Telematics mandates	**Higher** (mandate likely to require embedded telematics)	No impact	No impact
High communication cost	Shared data plans	**Higher** (More attractive billing models for driver as if there connectivity can be linked to phone bill)	**Lower** (less need for tethering is an embedded SIM in every car linked to driver's mobile bill	No impact
Smartphone/ customer relationship	Web-based Apps	**Higher** (lower barrier to embedded solutions as they only require a web browser)	No impact	**Lower** (app no longer tied to smartphone so less need for integration)

Source: SBD, 2012

2.2.1. Trigger 1: Government legislation reduces hardware costs

EU, Russia and Brazil have all announced plans to introduce telematics-related mandates for services such as eCall and SVT. Each of these governments has done so for unique reasons, but the overall effect is the same:

Mandated telematics typically leads to all cars being equipped with embedded TCUs.

Note. *Although the EU's mandate technically does not specify what type of connectivity should be used for eCall, the EC has already strongly spoken out against non-embedded systems such as Bluetooth-based eCall. The EC has highlighted concerns that the reliability of Bluetooth-based solutions would be compromised during a crash, or that the driver may not have connected the smartphone to the car before the crash.*

In other major markets there has yet to be any similar announcement of mandated telematics. However, SBD believes that within the next decade both China and India are highly likely to introduce similar laws. Although the public reasoning for these laws are likely to be related to safety (e.g. eCall), there will be a strong unspoken geopolitical justification too.

Russia, China and India are each deploying regional satellite positioning systems (GLONASS, Beidou and IRNSS respectively) in an effort to gain independence from the US-developed GPS service. In deploying these services, each country is aware that commercial success relies on creating a large market for low-cost receivers.

One of the key reasons for Russia's introduction of the ERA GLONASS eCall mandate was to boost the market for GLONASS receivers in the car in order to ensure that the Russia satellite positioning service can compete commercially against the US GPS service.

Although no similar plans have been announced by China and India (which are further away from launching their satellite positioning services), SBD believes there is a high probability that each government will adopt a similar approach for geopolitical reasons.

In addition to China and India, governments in other markets are also likely to find other reasons for mandating telematics in at least some vehicles, either to improve safety and security, or for other purposes such as Electronic Toll Collection (ETC).

Despite the strong push from governments in Brazil, EU and Russia to mandate telematics, the legislative process has suffered from continuous delays and uncertainties. We believe that these are only to be short-term delays to an inevitable future in which embedded telematics becomes mandated in a growing number of markets.

The immediate impact for the automotive industry will be painful, as OEMs are forced to absorb the additional cost of mandated TCUs and handle the on-going uncertainties relating to the evolving technical requirements. In the longer-term, however, the mandates will also enable OEMs to piggyback more connected services onto embedded TCUs and even reduce the cost of fitting embedded TCUs in markets without legislation. For this reason, the high cost of hardware may only be a short-term barrier to embedded telematics.

2.2.2. Trigger 2: Shared data plans reduce need for additional car subscription

According to a recent report published by Cisco, there are expected to be over 50 billion connected devices by 2020, which means that each person will own an average of 7 connected devices. As connectivity on various consumer devices such as laptops, tablets TVs and cars grows, telecom operators will be presented with new opportunities and challenges.

The key question is whether each of those connected devices will require customers to have a separate subscription or bill. If so, then consumers face a potentially daunting task of managing many subscription plans with multiple telecom operators for their growing number of connected devices. This will inevitably lead to a slower spread of connectivity across new devices.

However, telecom operators have already started to adapt to the new reality of multiple connected devices per user. Various telecom operators in USA and Europe have announced plans to develop more flexible shared data plans that would enable customers to pay a single bill and access the same data plan via multiple devices.

Telecom operators are also starting to promote split-billing SIMs to the automotive industry, which would enable the OEM to pay for vehicle-related connectivity in the car (e.g. remote diagnostics or eCall) and pass on the communication costs associated with infotainment or navigation services directly to the driver.

The current development of standards for remote provisioning of SIMs within GSMA seeks to provide additional flexibility and management capabilities for M2M connectivity contracts, helping to meet OEM demands.

There are many technical and business challenges associated with changing from a device-centric billing model to a customer-centric billing model, and it is unclear whether these solutions will emerge in certain markets such as China where consumers are more restricted in their choice of telecom operators. However, the customer demand for features such as shared data plans is expected to grow rapidly over the coming years, and in many markets telecom operators will soon need to be in a position to react.

For connected cars, this represents an opportunity to couple the data requirements for embedded connectivity to the existing mobile phone subscription that the driver already has, thereby potentially eliminating yet another barrier to embedded telematics. This would also, in turn, reduce the need for tethering-based solutions.

Note. *A long-term need for tethering has been envisioned by many as a way of overcoming the different lifecycles between automotive communication modules (which must last 10 years) and CE communication modules (which are replaced every 1-2 years). Within this vision, tethering could enable vehicles to continue using the latest network technologies available on the user's smartphone (e.g. 4G or potentially 5G from 2020 onwards) without having to upgrade the in-car TCU. Although SBD acknowledges this potential use case, we believe that longer-term applications that require faster connectivity throughput than is available on the embedded TCU will be enabled through smartphone integration rather than tethering. Additionally, OEMs such as Audi have already started to demonstrate modular hardware solutions that could potentially enable TCUs to be upgraded at a relatively low cost during the lifetime of the vehicle.*

2.2.3. Trigger 3: Web-based Apps reduce need for smartphone integration

Aside from hardware and communication costs, another barrier for embedded connectivity is the growing attachment that consumers have to their smartphones, which translates into a desire to safely access their smartphones whilst driving.

Vehicle manufacturers have capitalized on this desire by launching new and innovative integration solutions, enabling consumers to access their favourite smartphone Apps through the in-car HMI. However, the future need for smartphone integration in the car depends on whether Apps will continue to be hosted on the smartphone, or whether there will be a shift towards web-based Apps.

Already there is a major debate within the CE world about the impact of HTML5 on traditional native Apps, and whether the industry will experience a major shift towards web-based Apps. In addition to fundamentally transforming the app development community, this could also lead to Apps being decoupled from smartphones in such a way that reduces the need for smartphones to be integrated into the car.

Web-based Apps would make it easier for OEMs to seamlessly enable their customer's favourite content and services by simply implementing a browser within the car. This is a strategy already being pursued by various OEMs and suppliers, which also sees other developmental benefits associated with non-embedded Apps.

In reality, web-based Apps and native Apps are expected to co-exist for the foreseeable future. However, consumers are still likely to become increasingly accustomed to accessing their favourite content and services through HTML5 browsers, which will lessen the need for smartphone integration and strengthen the opportunities for embedded telematics.

2.3 Likelihood and timing for triggers in each market

The three triggers identified in the previous section are unlikely to all happen uniformly across all the various markets. In fact, in some markets there is a strong possibility that one or more of the triggers may never materialise. Figure 4 below summarises the estimation of the likelihood of each trigger occurring in different markets and the expected timing for the triggers.

Figure 4. Trigger Likelihood and Timing for Different Markets

Region/market	Trigger 1 Mandated telematics				Trigger 2 Shared data plans				Trigger 3 Web-based Apps			
	Likelihood of occuring	2010-15	2015-20	2020-25	Likelihood of occuring	2010-15	2015-20	2020-25	Likelihood of occuring	2010-15	2015-20	2020-25
EU	High	✓			High	✓			High	✓		
USA	Low				High	✓			High	✓		
Japan	Low				High	✓			High	✓		
China	Medium		✓		Medium		✓		High		✓	
Brazil	High	✓			Medium		✓		High		✓	
Russia	High	✓			Medium		✓		High		✓	
India	Medium		✓		Medium		✓		High		✓	
RoW	Medium				Medium		✓		High		✓	

Source: SBD, 2012

For mandates (Trigger 1), it has been assumed that mature markets like USA and Japan are less likely to introduce mandates based on the past legislative approaches adopted by the governments in each country. In markets like China and India, however, there is a stronger likelihood of telematics mandates due to the reasons outlined within 2.2.1.

For shared data plans (Trigger 2), it has been assumed that well-developed markets with competitive telecom industries (such as EU, USA and Japan) will be the first to experience a shift towards more flexible billing solutions. In other markets (such as China) where the telecom industry is more tightly regulated and does not enjoy as much competition, there may be less incentive for telecom operators to shift towards shared data plans.

For web-based Apps (Trigger 3), it has been assumed that the transition towards HTML5 will occur across all markets, although the timing will be faster for well-developed markets with more widespread 3G/4G coverage (enabling access to content/services from anywhere).

The precise timings for the three triggers are very hard to predict with certainty. Therefore a series of assumptions based on experience and extensive research across the automotive, telecom and CE industries in order to support the forecast model has been used. These assumptions (along with the accompanying forecast) will be updated regularly in order to take into account any changes in trends. The next Chapter provides the forecasts based on the current assumptions.

3. 2010-2025 Forecast

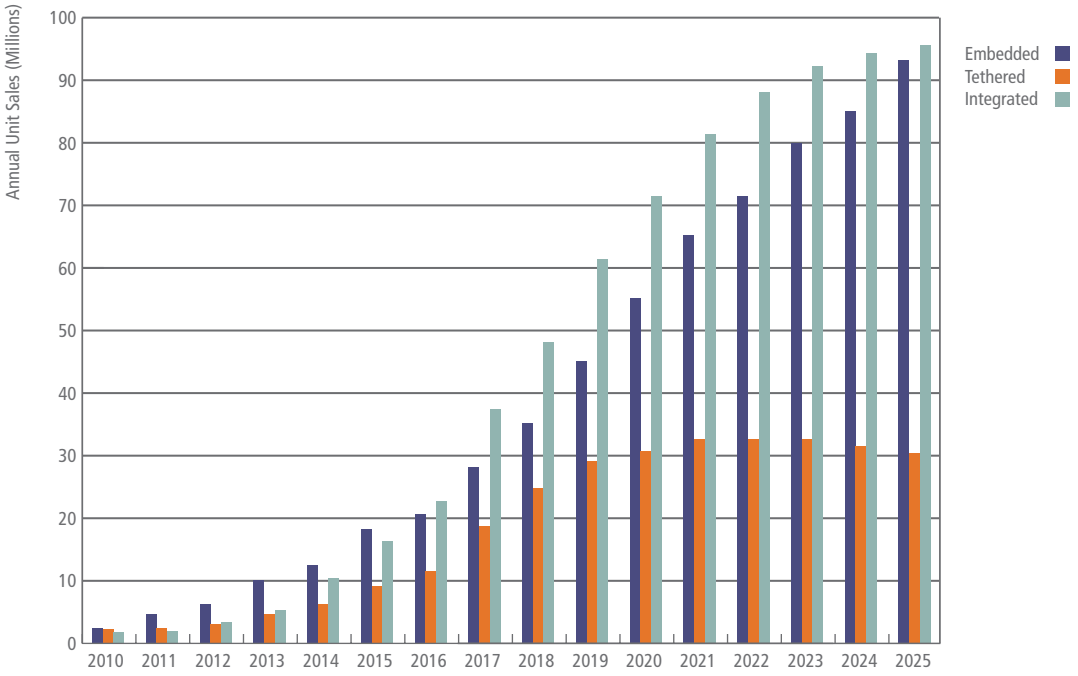
3.1 Overall growth of Embedded, Tethered and Integrated solutions

On a global scale, SBD forecasts that in addition to connectivity becoming ubiquitous by 2025, in actual fact many cars will continue to have multiple forms of connectivity during this period. This will occur even as embedded solutions become significantly more appealing and affordable.

However, not all of these connectivity solutions are destined to co-exist in the longer-term. In many markets, tethering will begin to decline in importance, giving way to a more user-friendly embedded solution. It is harder to foresee a similar decline in Integrated solutions in the car, although our forecasts for some markets do.

For embedded solutions, the short-term growth in many markets such as Europe, Brazil and Russia will be caused primarily by government legislation, whilst the other two triggers (shared data plans and web-based Apps) will play a strong role in ensuring that embedded solutions become ubiquitous in the long-term future. Figure 5 below provides the global annual sales of each of these connectivity solutions.

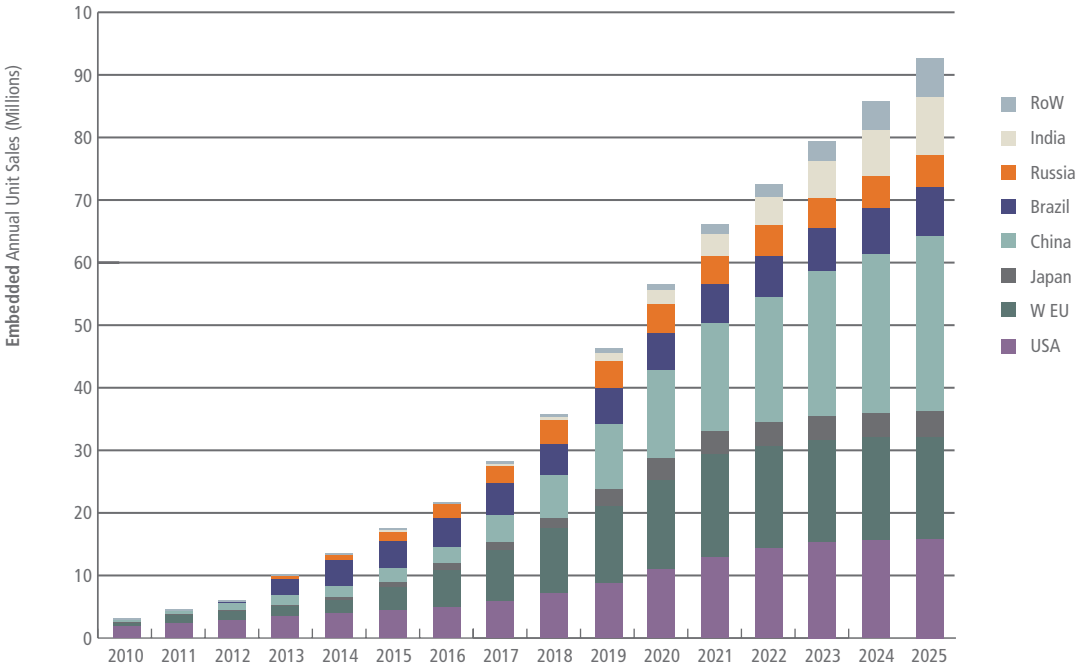
Figure 5. Global Sales Forecast of OE Connectivity Solutions in Passenger Cars (2010-2025)



Source: SBD, 2012

The sales figures below mask some major differences in how connectivity will evolve within different regions. The next page provides a region-by-region breakdown for the forecast.

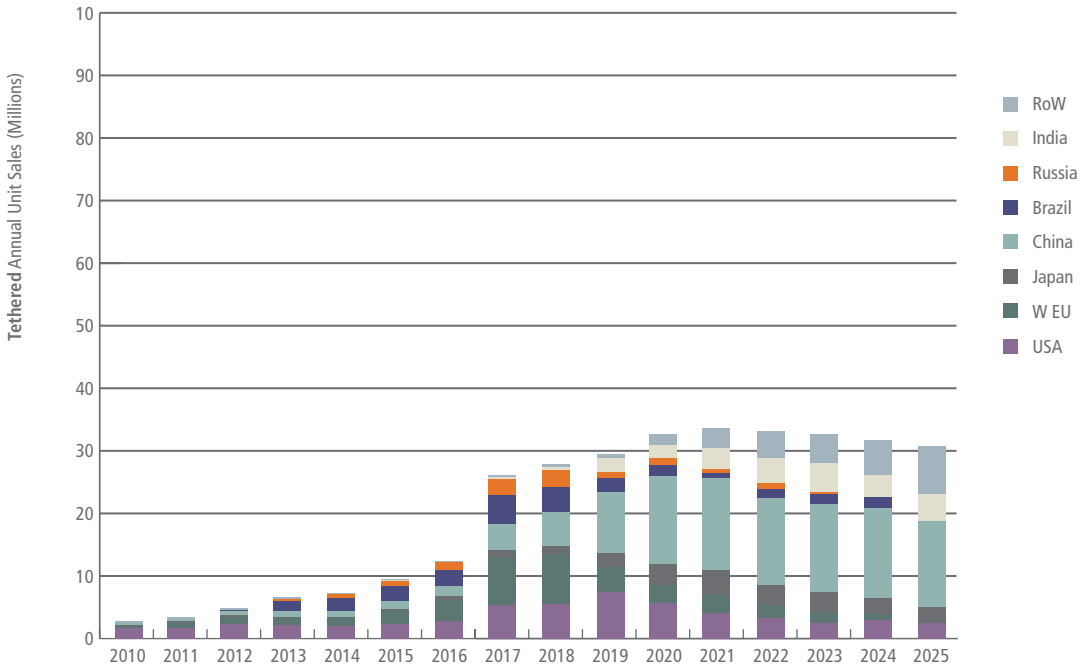
Figure 5.1 Embedded Global Sales Forecast of OE Connectivity in Passenger Cars (2010-2025)



Embedded Solutions

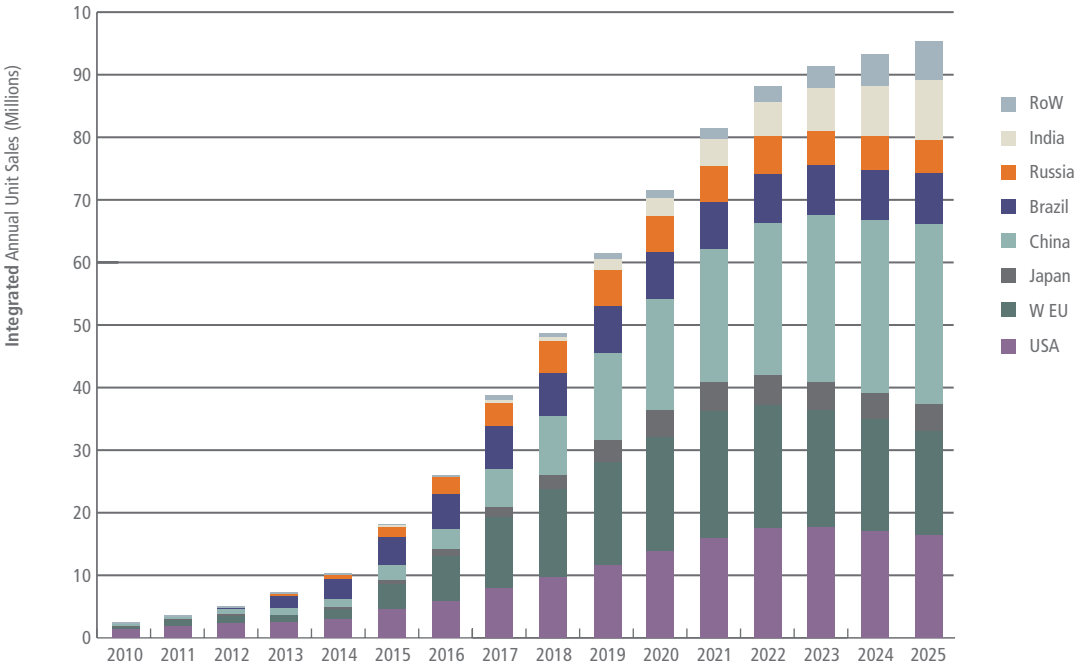
Embedded sales are currently dominated by the USA, where Onstar GM has built a successful (and relatively unique) model based on embedded connectivity. However, within 5 years the USA will only represent a fraction of the total market share, as Brazil, Russia and Europe all begin mandating the fitment of embedded telematics. In the longer-term, it is expected that China will introduce a similar mandate for telematics, which coupled with its rise in car sales will ensure that it becomes the number one market for embedded telematics globally. In other markets around the world, a mixture of market and government-led growth has been forecast .

Figure 5.2 Tethered Global Sales Forecast of OE Connectivity in Passenger Cars (2010-2025)



Tethered Solutions
Tethered solutions are forecast to grow more slowly and eventually peak in developed markets such as USA and Europe by the end of the decade. The main reason for this is that tethered solutions are seen as a short-term solution to consumers' unwillingness to pay for a second communication subscription (on top of their mobile phone bill). However, 'the' telecom operators will adapt to the growing number of connected devices by offering more flexible shared data plans that would eliminate the need for tethering. In markets such as China, however, the telecom operators may be slower to embrace these solutions, leading to a slower decline in tethering.

Figure 5.3 Integrated global sales forecast of OE connectivity in passenger cars (2010-2025)

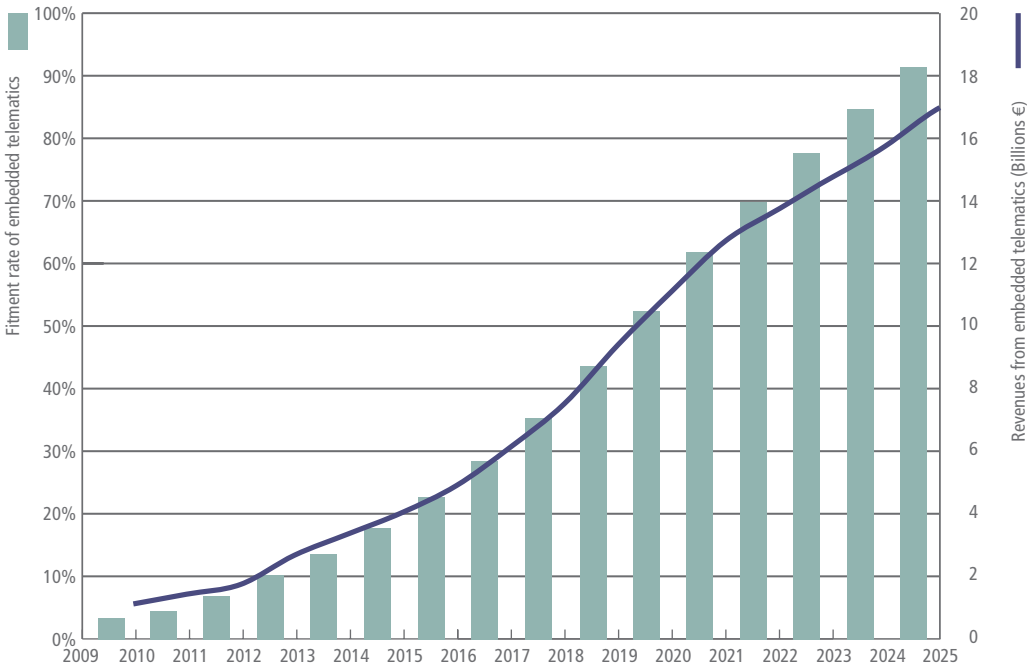


Integrated Solutions
Sales of Integrated solutions are forecast to grow rapidly over the next ten years as a reflection of the growing importance of smartphones and Apps. It is expected that within a decade the fitment of these solutions on new passenger cars will almost reach 100% by 2020 in markets such as USA and China. However, soon after becoming ubiquitous, the first "Cloud-only" cars will emerge that rely on web-based Apps to provide all of the functionality of smartphones without the need for integration. In markets such as USA and Europe, we will see the beginning of a slow decline for Integrated solutions from 2020 onwards.

3.2 Focusing on embedded solutions

Based on the forecasting assumptions outlined within the previous, SBD forecasts that globally the fitment rate of embedded telematics on new cars will rise rapidly from 2015 onwards, surpassing 50% by 2020 and 90% by 2025 - primarily driven by government mandates in new markets. By 2025, this will create a 19 billion Euro value chain dedicated to supplying TCUs, connectivity and content to the rapidly growing number of connected cars.

Figure 6. Global Growth Forecast for Embedded Telematics (2010-2025)



Source: SBD, 2012

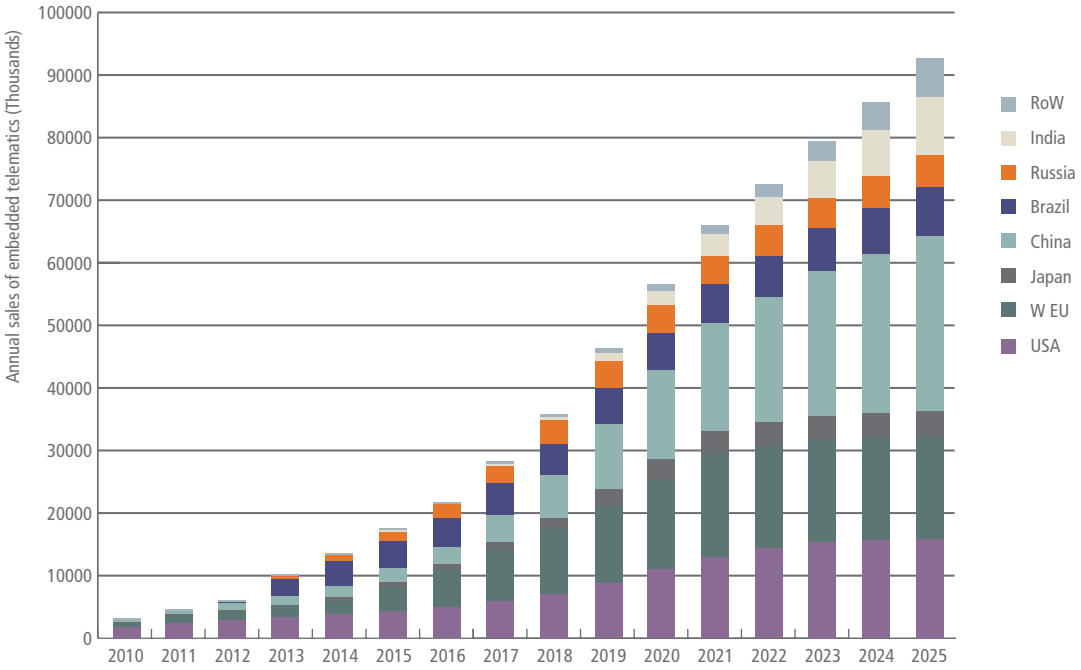
Note. *All of the forecasts included within the Chapter are exclusively for embedded telematics that have been factory-fitted by OEMs on passenger cars (i.e. not aftermarket solutions).*

3.2.1. Annual sales of passenger cars with embedded telematics

As shown in Figure 7 below, the annual sales of embedded telematics systems are currently dominated by USA (and in particular Onstar). However, with the upcoming mandates in Brazil, Russia and EU, this balance will change rapidly. In 2010 the USA accounted for over 70% of total sales for embedded telematics - by 2015 SBD estimates that this figure will have dropped to 25%.

By 2025, the biggest market for embedded telematics is forecast to be China, led by an overall intensive growth within the car market and an expected aggressive government strategy towards telematics in the car (see 2.2.1).

Figure 7. Growth Forecast for Annual Sales of Embedded Telematics by Region



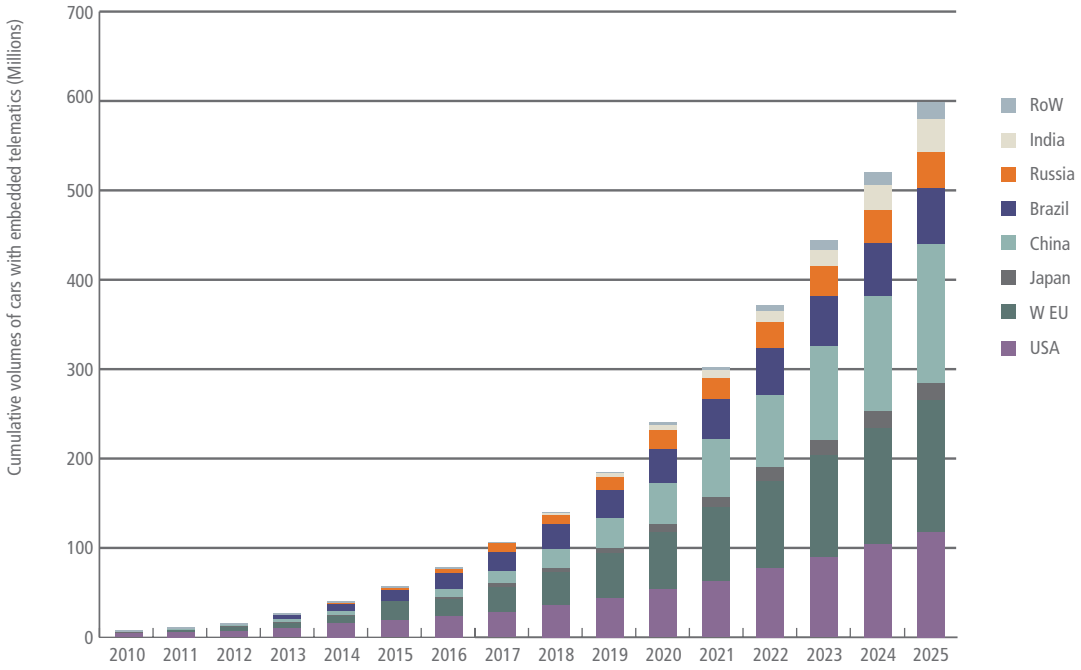
Source: SBD, 2012

Over 90 million new cars will be fitted with embedded telematics by 2025, representing a significant majority of total vehicles. This acceleration in growth will be enabled by the three Triggers identified identified in Figure 4, pg 9.

3.2.2. Cumulative volume of passenger cars with embedded telematics

The total size of the global car parc has recently surpassed 1 billion cars, and is forecast to exceed 1.7 billion cars by 2025. Within this car parc, SBD forecasts that 600 million cars on the road will be fitted with an embedded telematics system by 2025 (see Figure 8). Over 70% of these connected cars will be located in either USA, Europe or China, where embedded connectivity is expected to have the largest impact.

Figure 8. Growth Forecast for Cumulative Volume of Embedded Telematics by Region



Source: SBD, 2012

It is estimated that the accelerating growth in embedded in-car telematics over the next 15 years will lead to cars representing over 5% of all connected devices by 2025, compared with just 0.1% today.

3.2.3. Annual revenues from passenger cars with embedded telematics

Forecasting the revenue potential for embedded telematics requires a detailed assessment of hardware, connectivity and service cost trends:

- **Annual hardware sales** - Within this forecast, SBD has only included annual revenue assumptions for hardware that is directly required to enable connectivity. Therefore, whilst revenue opportunities from TCUs have been included, other peripheral hardware such as displays, processors or harnesses have not been included (as these are likely to be fitted anyway).

  The average unit cost of TCUs has been forecast based on the current price-range being quoted by tier-one suppliers, along with the expected price drop over time due to increasing volumes (with a faster price drop following the introduction of legislation).

- **Cumulative connectivity sales** - Connectivity sales revenues include any vehicle-related SIM services offered by telecom operators, such as the cost of data and SMS. Additionally, SBD has included within this forecast the cost of other specialist services relating to M2M, such as the provision of advanced security and SIM management services.

  SBD has not included within the forecast any revenues related to services that we believe would be accessed through a shared data plan (rather than a separate bill), such as infotainment. infotainment services are by far the most data-intensive services, and the growth of such services in the car would undoubtedly lead to a significant increase in data revenues for telecom operators.

  However, the major growth of infotainment services on embedded connectivity platforms can only occur if new pricing models (such as shared data plans) are introduced that enable the drivers to pass on associated connectivity costs to their existing mobile bill, rather than having to pay a separate bill. For this reason, it is assumed that connectivity revenues related to infotainment will be experienced through the driver's mobile phone bill, and will not be part of the automotive M2M revenues forecast within this report.

- **Cumulative content/services sales** - In addition to connectivity revenues, SBD has included the total expected revenues from 3rd party service and content providers, such as traffic information or provision of stolen vehicle tracking. In doing so, SBD has been cautious in estimating the Average Revenue Per Driver (ARPD) over the coming years.

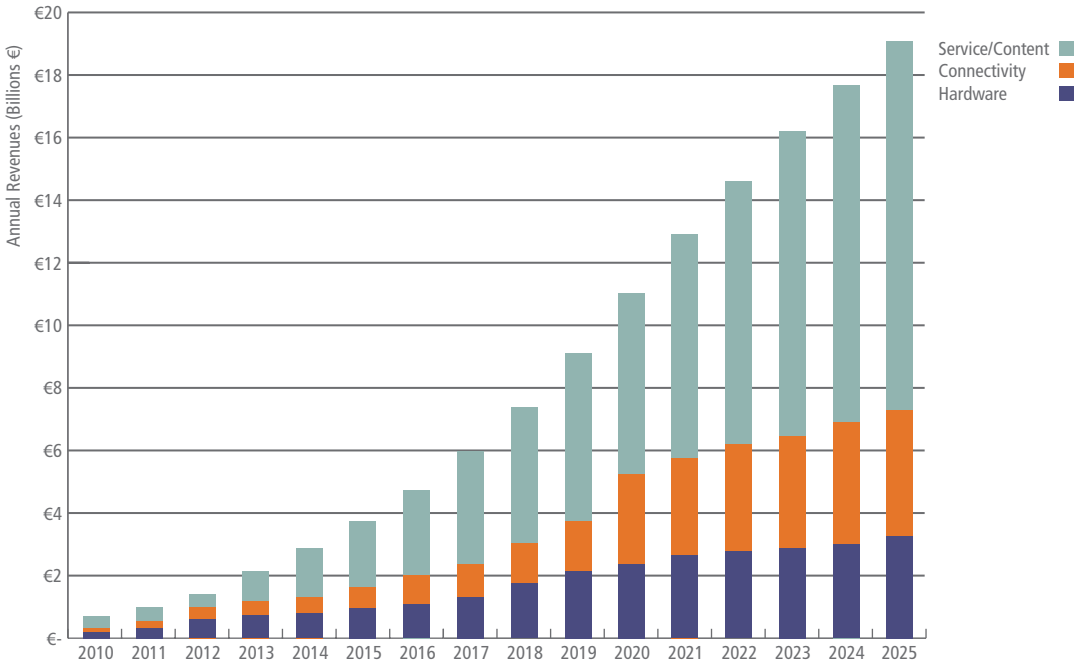
  Although the ARPD for current users of telematics services offered by OEMs like GM and BMW is relatively high (approximately €250 per year), these drivers will not represent a significant proportion of the 600 million drivers that are forecast to have an embedded connectivity solution in their cars by 2025. Most embedded connectivity units fitted by 2025 are expected to be used purely for low-cost applications that have been legislated by governments (e.g. eCall).

  Even as more drivers begin using premium navigation and infotainment services in the car, SBD believes that these will be funded through alternative business models such as advertising, rather than through the large subscription fees paid by a small proportion of telematics users today. This will particularly be the case in emerging markets, where demand for connectivity is high, but willingness to pay subscription fees is significantly lower than in developed markets.

Based on the above segmentations of revenue, SBD forecasts that the automotive embedded telematics market will grow at CAGR of 24.6% over the next 15 years to reach €20 billion by 2025 (see Figure 9).

The bulk of this revenue is expected to be from the sales of vehicle-related services and content. However, SBD also forecasts that connectivity revenues will increase to almost €4 billion by 2025 and that TCU hardware sales will grow to €3.25 billion.

Figure 9. Growth Forecast for Annual Revenues from Embedded Telematics by Revenue-Type

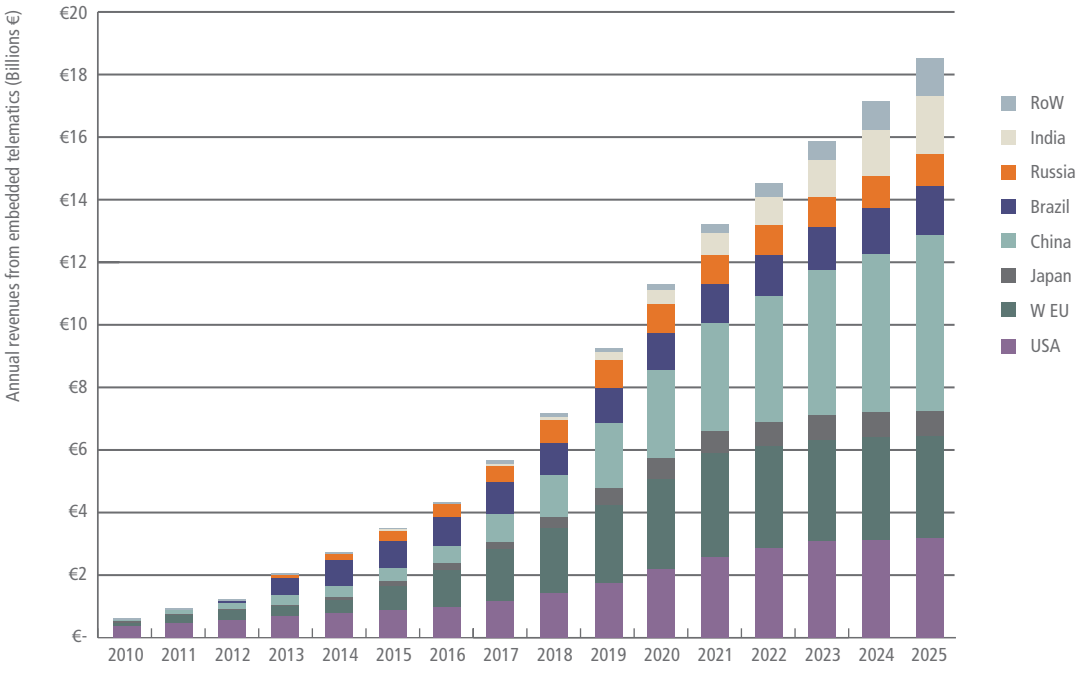


Source: SBD, 2012

Note. *Although the connectivity revenue forecast may seem conservative in comparison to forecasts made by other research companies, it is worth pointing out again that this figure is tied to the assumption that many of the data-intensive services (such as infotainment) will be delivered over a shared data plan. This assumption is one of the key triggers for the overall growth of embedded connectivity in the car.*

In terms of revenue-split by region, the USA is expected to present the strongest opportunities for service providers, telecom operators and suppliers throughout the next 15 years, although EU and China will become equally important from 2015 onwards. Figure 10 provides a breakdown of revenue growth by region.

Figure 10. Growth Forecast for Annual Revenues from Embedded Telematics by Region



Source: SBD, 2012

3.3 Alternative scenarios

Forecasting the future of connectivity in cars requires a detailed assessment of external factors beyond the automotive industry. Within this whitepaper SBD has highlighted three 'Triggers' that we believe could lead to embedded connectivity eventually becoming the predominant solution for in-car connectivity.

However, the precise dynamics and timings for each of these triggers will invariably change over the coming years, and it is likely that new triggers will emerge that may change the growth pattern for connectivity in the car.

For this reason, SBD is building a forecasting tool that will enable users to manipulate the triggers in order to understand how alternative scenarios to the one outlined within this whitepaper could emerge.

4. How can telecom operators maximize their opportunities?

The forecast presented within this report provides a vision in which over 600 million new passenger cars become connected to the outside world through OE embedded telematics systems, creating billions of Euros of new M2M revenue opportunities for the telecoms industry.

It is important to remember, however, that SBD's forecasts have been built on the assumption that vehicle manufacturers will naturally migrate towards embedded telematics solutions if the key barriers to embedding connectivity are overcome. Although SBD believes that these barriers are likely to be overcome in many of the major markets, this is not a foregone conclusion.

It is recommended that telecom operators become actively involved in supporting the success of embedded telematics in the car wherever possible.

Why should telecom operators become more involved?

Connected cars will become ubiquitous regardless of whether the barriers to embedded telematics are overcome. If the three triggers identified within this report (legislation, shared data plans and web-based Apps) fail to materialise, vehicle manufacturers will simply continue to rely on tethered or integration solutions for many of the most important connected car services.

Although any kind of connectivity is good for the telecoms industry, tethered and integrated connectivity will clearly provide a much narrower revenue opportunity for telecom operators, restricting them to the role of a data provider.

The future of embedded telematics, on the other hand, presents telecom operators with an opportunity to broaden their value. If fitment of embedded telematics grows as expected, operators will be in a strong position to support OEMs through advanced services such as:

- **Network security and user authentication** - The telecoms industry has been forced to implement extremely secure networks in order to avoid unauthorised access and fraud. In addition to protecting their network, telecom operators could also act as an additional firewall between the car and the outside world in order to block malware or unauthorised activities.

- **Billing** - Telecom operators have spent tens and sometimes hundreds of millions of Euros developing complex IT solutions to manage their billing requirements. These integrated billing solutions enable them to manage a wide range of post-paid and prepaid pricing plans. Additionally, in comparison to the relatively inflexible and static pricing models offered by vehicle manufacturers, telecom operators are able to rapidly react to changes in the market by launching new tariffs and discounts on a monthly basis.

- **CRM** - To compliment their billing solutions, telecom operators have also invested heavily in developing CRM systems that include advanced customer behaviour analysis, call centre automation and online marketing. These CRM systems could be extended to automotive telematics services in order to gain cost efficiencies, expand contact with customers and more quickly react to their concerns.

- **Device management** - Telecom operators play a critical role in managing software upgrades on mobile phones via their Device Management Interfaces. To achieve this, telecom operators have to successfully manage dozens of conflicting software versions across hundreds of different handsets.

  Although few vehicle manufacturers currently allow over-the-air software updates for their telematics systems, many are now planning more-easily upgradeable solutions that will require regular updating. Telecom operators could extend their Device Management Interfaces to also support connected car services.

- **App store support** - Since the successful launch of Apple's App stores, telecom operators have been keen to gain a share of the revenues derived from the sales of Apps. In 2010, the telecoms industry launched the Wholesale Applications Community (WAC) in order to develop a cross-platform app ecosystem. Mobile phone makers such as Sony Ericsson, Samsung and LG also support this initiative.

  Despite a great deal of early scepticism amongst industry insiders, the WAC initiative has continued to push forward and has launched new specifications that support HTML5, in-app billing and user authentication. WAC is also developing APIs that will allow App developers to more deeply integrate their Apps with the user's mobile phone.

Based on the above opportunities, it is therefore in the direct interest of telecom operators to ensure that all of the barriers currently facing embedded telematics are overcome so that embedded solutions become the de-facto solution of the future.

There is little that telecom operators can do to influence two of the three triggers identified within this report that would support the growth of embedded telematics: legislation and web-based Apps. However, the future of the third trigger (shared data plans) lies squarely in the hands of the telecoms industry.

It is not the objective of this whitepaper to analyse the challenges associated with shared data plans, although SBD recognises that telecom operators do face major business and technical hurdles in implementing such a change. Instead, the objective of this whitepaper is to demonstrate how much the telecom industry could gain from enabling a more flexible billing mechanism for embedded telematics. Based on the forecasts included within this report, SBD is therefore confident to recommend that the telecom industry work more closely alongside vehicle manufacturers in order to enable an embedded future for connected cars.

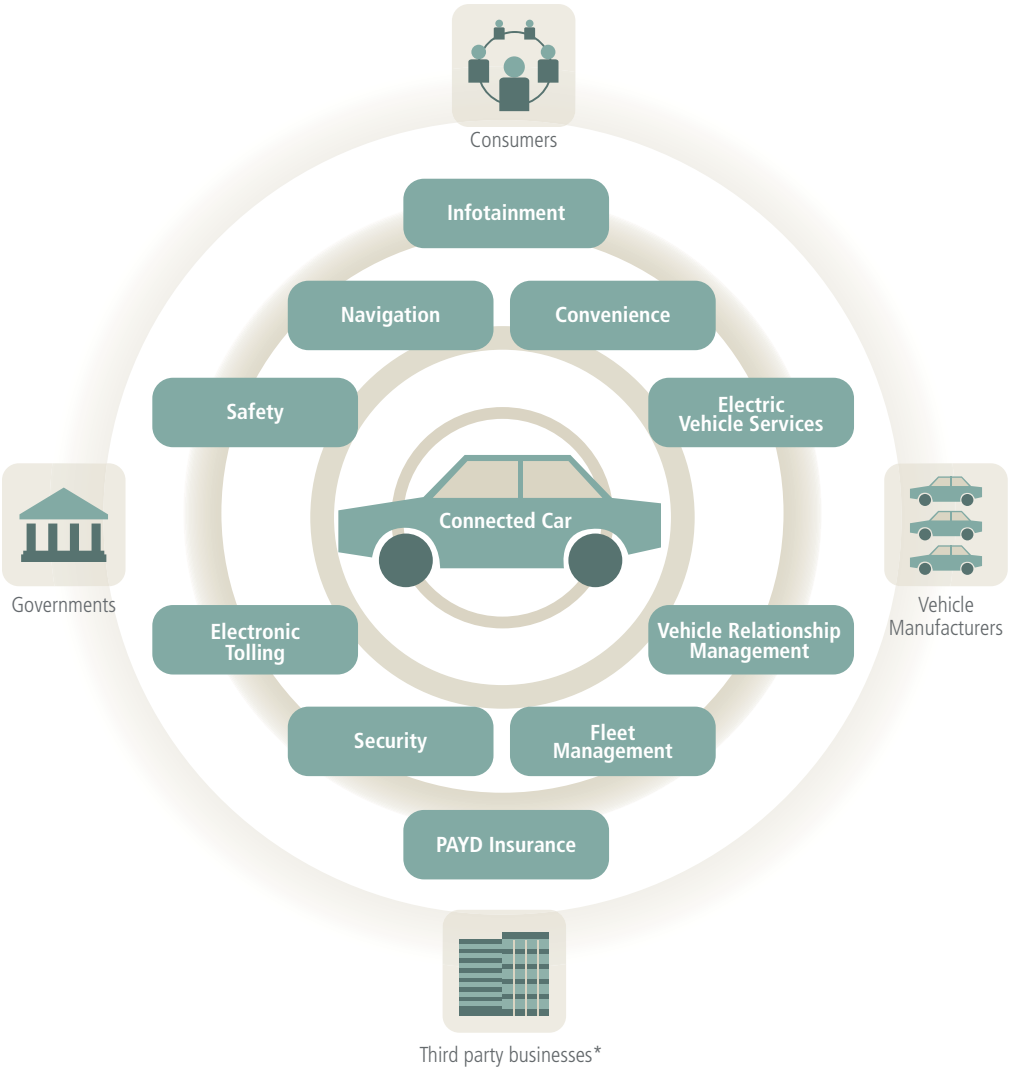
5. Understanding the use cases for connected cars

The number of use cases for connected cars has been steadily increasing over time, as consumers, vehicle manufacturers, governments and 3rd parties each begin to understand the value of connectivity. So far this whitepaper has focused on the specific solutions for enabling connectivity. This final Chapter takes a step back and analyses where the demand for connectivity is coming from and whether it will be strong enough to ensure that connectivity becomes ubiquitous on cars.

5.1 Current and future use cases for in-car connectivity

SBD categorises the use cases for in-car connectivity into the ten different groups outlined in Figure 12 below, each of which are experiencing growth due to demand from consumers, vehicle manufacturers, 3rd parties and/or governments.

Figure 11. Use Cases and Key Drivers of the Connected Car Ecosystem



*Third party businesses include: Insurance companies, Fleet management, Traffic concerns

Source: SBD, 2012

The rest of this section provides a brief summary of the future trends for each type of service.

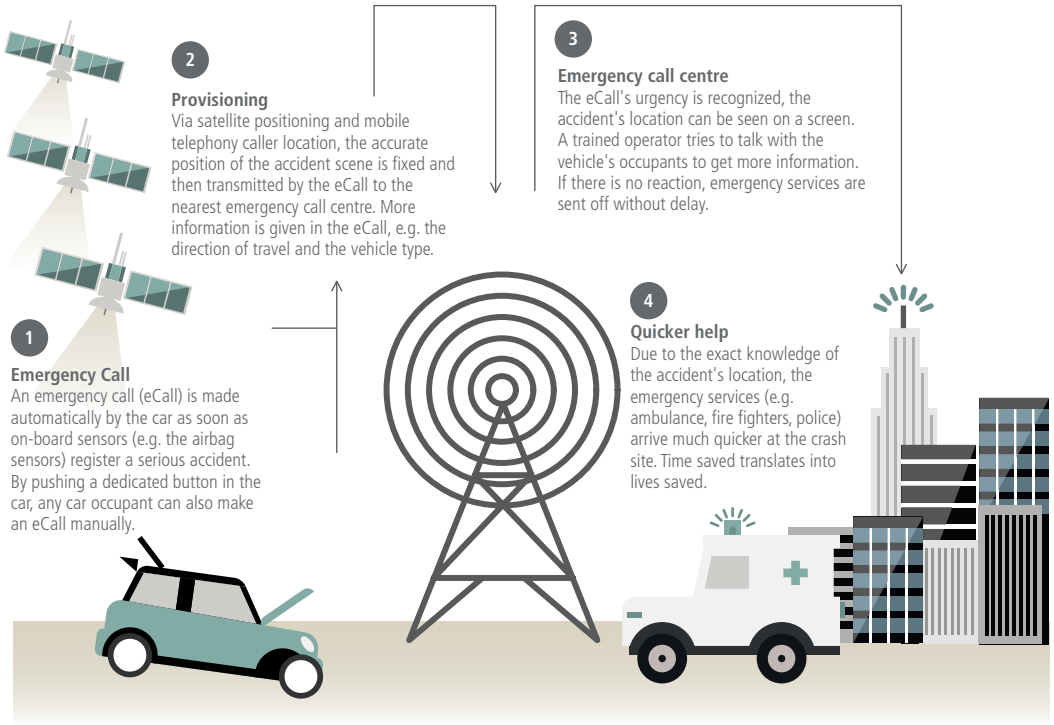
5.1.1. Safety

SBD has conducted over 30 end-user surveys across 10 key markets analysing the changing consumer attitudes towards different connected car services. Safety services such as Emergency Call (eCall) always rank relatively high for many consumers as it taps into their basic concerns about crashing in an isolated location. However, whilst eCall services have been available for many years, the high cost of hardware and services has so far deterred a significant proportion of drivers from opting for eCall in many markets.

This has started to change over the last few years, aided in part by the launch of ultra low-cost solutions such as PSA's €290 eCall solution in Europe. PSA recently announced the sale of its 1 millionth eCall-equipped vehicle, and has used eCall as a strong tool to improve its branding amongst safety-conscious drivers.

In the USA, consumers are believed to be more concerned about safety, and vehicle manufacturers such as GM and Ford have been able to capitalise on this in order to offer competitive safety and security services as standard on many models.

Figure 12. eCall: How It Works



Source: European Commission

However, even with competitively priced eCall, safety-based telematics is still suffering from a slower-than-usual growth cycle within the automotive industry. Under normal market conditions it would take another decade before services such as eCall could be considered truly mass market.

For this reason, a number of governments are starting to introduce legislation requiring vehicle manufacturers to fit eCall as standard on new vehicles. The EU has already announced plans for a mandate from 2015 on all new type-approved models, and Russia is expected to adopt a similar approach in order to improve safety and promote its GLONASS service.

Improving road safety is becoming a major government priority in various emerging markets such as China and India, and it is expected that other governments over the next decade to introduce similar mandates that require vehicle manufacturers to fit safety-based telematics as standard on their models.

5.1.2. Security

The market demand for security-based telematics services such as Stolen Vehicle Tracking (SVT) is heavily influenced by the insurance industry and any requirements or incentives they introduce for drivers of high-end cars. For example, there has traditionally been a significant demand for SVT within certain vehicle segments in markets such as UK and Italy because of insurance requirements. On the other hand, markets such as Germany have virtually no demand for SVT due to a lack of incentives.

> ***Note**. Most SVT solutions are aftermarket rather than factory-fit. This is mainly because vehicle manufacturers typically struggle to develop tamper-proof SVT solutions that are competitively priced.*

In certain emerging markets, such as Russia and China, the market for SVT has thrived without a strong incentive from he insurance industry due to higher theft rates and a greater concern amongst drivers about car theft.

High theft rates in Brazil has even led the government to introduce a mandate for SVT to be fitted as standard on all new vehicles in order to combat this growing problem (although the accompanying requirement to fit immobilisers is expected to have a greater impact on theft requirements at a fraction of the cost).

Insurance requirements in different markets change regularly, and it is possible that the recent upturn in theft trends due to the recession may lead to growth in demand in many markets. However, without legislation SVT will continue to remain a niche service for high-end vehicles. Governments in various emerging markets (where car theft is a major social problem) will be looking in interest at Brazil's effort to mandate SVT and may adopt a similar strategy if it proves successful.

5.1.3. Convenience

Connectivity strategies for vehicle manufacturers are increasingly focused on building a closer relationship between the customer and their car even when they are not driving. A major part of this is enabling convenience services such as:

- **Remote door unlock** (in case the driver forgets to lock their car)
- **Remote air-conditioning/heating activation** (for excessively cold or very hot days)
- **Remote vehicle monitoring** (if the driver wants to check the status of their vehicle)
- **Find my car** (when the driver forgets where they parked)

All of these services have been enabled by many vehicle manufacturers (including GM, BMW and Volvo) through Apps that can be downloaded onto the user's smartphone. Although they are rarely considered to be must-have features by drivers, they do help to build brand loyalty and help to play an important role in the overall justification for enabling connectivity with the car.

5.1.4. Navigation

Navigation services, and in particular traffic information, rank amongst the highest for most consumers in all of the surveys that have been conducted by SBD. Traffic information in particular is increasingly viewed as a must-have service. In a recent survey conducted by SBD, 86% of respondents in China and 60% of respondents in USA and Europe claimed to be interested or very interested in receiving reliable traffic information.

Although traditionally this information has been delivered over an analogue network (such as RDS TMC) these channels only support low-bandwidth services, reducing the quantity and quality of the traffic information that can be delivered. For this reason many vehicle manufacturers are starting to deploy traffic information services over cellular channels.

In Europe both Audi and BMW recently announced the launch of TPEG IP, a next generation of traffic information services delivered over a cellular channel. In the meantime, Ford and Toyota in the USA have also launched navigation systems that use traffic information delivered over a cellular network.

In reality RDS TMC is likely to continue in the 3-5 years as the de facto delivery channel in most markets for traffic information as it provides a very low-cost and scalable solution. However, as vehicle manufacturers aim to provide a richer experience and a greater number of navigation services, many will undoubtedly also offer an additional premium service using cellular networks.

5.1.5. Infotainment

Since the first introduction of cassette players during the 1970s, entertainment in the car has largely been an on-board experience, with drivers bringing in their media through cassettes or CDs. Even until recently, in-car entertainment mostly relied on connecting portable music players to the infotainment platform in order to play the driver's preferred music tracks. Outside of the car, the shift towards cloud-based content is changing the landscape of the entertainment industry and enabling consumers to access their media anywhere and anytime.

Inside of the car, vehicle manufacturers in the short-term are focusing on leveraging the user's smartphone in order to integrate popular cloud-based entertainment Apps such as Pandora or Facebook.

However, in the longer-term (2014 onwards) many vehicle manufacturers are also looking for ways to move beyond smartphone integration and connect the car directly to the cloud.

5.1.6. Electric Vehicles (EVs)

The global goal of reducing energy dependency and CO^2 emission continues to drive the significant investment into Electric Vehicles (EVs) and the related charging infrastructure. There is a general acceptance within the automotive industry that the launch of Electric Vehicles (EVs) will need to be accompanied by the deployment of connectivity infrastructure to enable communication with the driver, charging station and utility companies.

In the short-term, EV services are largely focused on Vehicle-to-Consumer (V2C) services that enable the driver to pre-condition the car and check the charging status of the battery. Vehicle manufacturers are also keen to enable remote diagnostics as a way to monitor the early deployment of new battery technologies.

In the medium-term, vehicle manufacturers are aiming to expand services Vehicle-to-Charging Point (V2CP) user cases, such as reservation and automated billing at local charging stations. In the longer-term, the utility industry is also keen to capitalize on connected EVs through Vehicle-to-Grid (V2G) applications that could enable them to remotely control charging schedules in order to improve the efficiency of their networks.

Forecasts for growth of EVs vary, but in general it is not expected that EVs will account for more than 5-10% of new car sales by 2025. Although telematics on EVs will come as standard, the low penetration of EVs means that it will not act as a major driver for telematics.

5.1.7. Vehicle Relationship Management (VRM)

Vehicle Relationship Management (VRM) is a lose term used to describe any maintenance or warranty-related services that vehicle manufacturers can use to better understand the status of their cars.

BMW was an early adopter of VRM through its TeleService telematics program. TeleService collects diagnostic data from the car and delivers this to dealerships, enabling them to know in advance whether vehicles require routine servicing or more advanced maintenance. In this way, BMW is able to minimise the downtime experienced by its customers.

GM has also embraced the benefits of VRM-based telematics services, and is able to collect diagnostic data from its 6 million Onstar subscribers in order to perform warranty analysis and detect trends relating to faulty components.

Improving VRM has always been a major attraction to vehicle manufacturers. However, VRM-based telematics requires significant organisational changes in order to bring together the various groups within an OEM that stand to benefit from collecting diagnostic data. Aside from a few noticeable exceptions, this is a challenge that many vehicle manufacturers have been unable to overcome, which has limited the internal VRM benefits that the automotive industry has been able to gain from telematics.

5.1.8. Usage-based insurance

Insurance premiums today are calculated mainly through risk algorithms for specific groups of drivers that insurance providers have perfected over many years. Over the last few years the insurance industry has begun undertaking major telematics trials of usage-based Insurance, in order to improve their risk algorithms by:

- Observing how specific customers drive
- Pricing their premiums based on the actual risk posed by drivers
- Detecting fraudulent claims made by customers
- Becoming the first to be alerted to accidents

Few of these trials have led to successful deployment of large-scale services, aside from in a small number of unique markets such as Italy. The main challenge so far has been the high cost of retrofitting hardware and the on-going communication costs. Linked to this is the difficulty that many insurers have faced in quantifying the value of data that has been extracted from cars.

Aside from the business model, the viability of usage-based insurance is also complicated by a large number of other country-specific factors, including regulatory restrictions, market competitiveness and consumer attitudes.

Despite the current challenges, the longer-term prospects are brighter as a greater number of cars come pre-fitted with embedded connectivity. This will enable insurers to piggy-back usage-based services using OE hardware instead of retrofitting their own hardware.

5.1.9. Fleet management

Traditional fleet management has a very different dynamic to any other application, as fleet operators are typically able to more clearly understand and quantify the financial benefits from tracking their vehicles:

- Fuel optimization
- Asset tracking
- Route productivity
- Driver behaviour management

With the increasing ability of telematics providers to demonstrate and quantify the benefits of fleet telematics, the proportion of traditional fleets being fitted with tracking solutions is growing healthily in most markets each year (in the USA the fleet telematics market is projected to double by 2016). Additionally, an increasing number of fleet operators are overcoming the challenge of driver acceptance by introducing incentives that support better driving habits.

Aside from traditional fleets, another source of growth within this segment in the long-term is expected to come from Car Sharing, as urbanisation leads to greater numbers of consumers renting cars for short periods rather than owning or leasing them. This alternative model presents additional market drivers for telematics in order to support the hire process and track vehicles in a more dynamic manner.

5.1.10. Electronic Toll Collection

Electronic Toll Collection (ETC) is viewed by many governments as a nirvana for taxing drivers based on how often they drive (rather than a flat-rate tax) and for managing congestion within urban areas. Small-scale ETC solutions have already been deployed across many countries. However, these mostly rely on expensive and restrictive roadside sensors (either RFID readers or Automatic Number Plate Recognition cameras).

A telematics-based solution that relies on GPS and a cellular connection would enable governments to provide national ETC services and to more precisely control how drivers are taxed.

The first of these GPS-based ETC services was launched (with a lot of difficulty) in Germany for HGVs travelling across the country. More recently, Singapore has started working with 4 different consortiums to test a hybrid GPS/DSRC ETC service for all vehicles that is expected to be launched in 2015/16. The Dutch government has also repeatedly announced plans to deploy GPS-based ETC.

> ***Note.*** *All of these existing and planned services rely on embedded connectivity being retrofitted to the existing car parc, and in some cases (e.g. Singapore) there would be no opportunity for vehicle manufacturers to develop OE factory-fit solutions. However, SBD believes that in the longer-term it is likely that ETC would become another function of an embedded OE solution.*

All of these activities have faced significant challenges associated with technologies (the accuracy and reliability of GPS) and business models (managing high costs of deployment).
In the future, any government aiming to introduce GPS-based ETC is also expected to face stiff opposition from an increasingly hostile public that is often suspicious of being tracked.

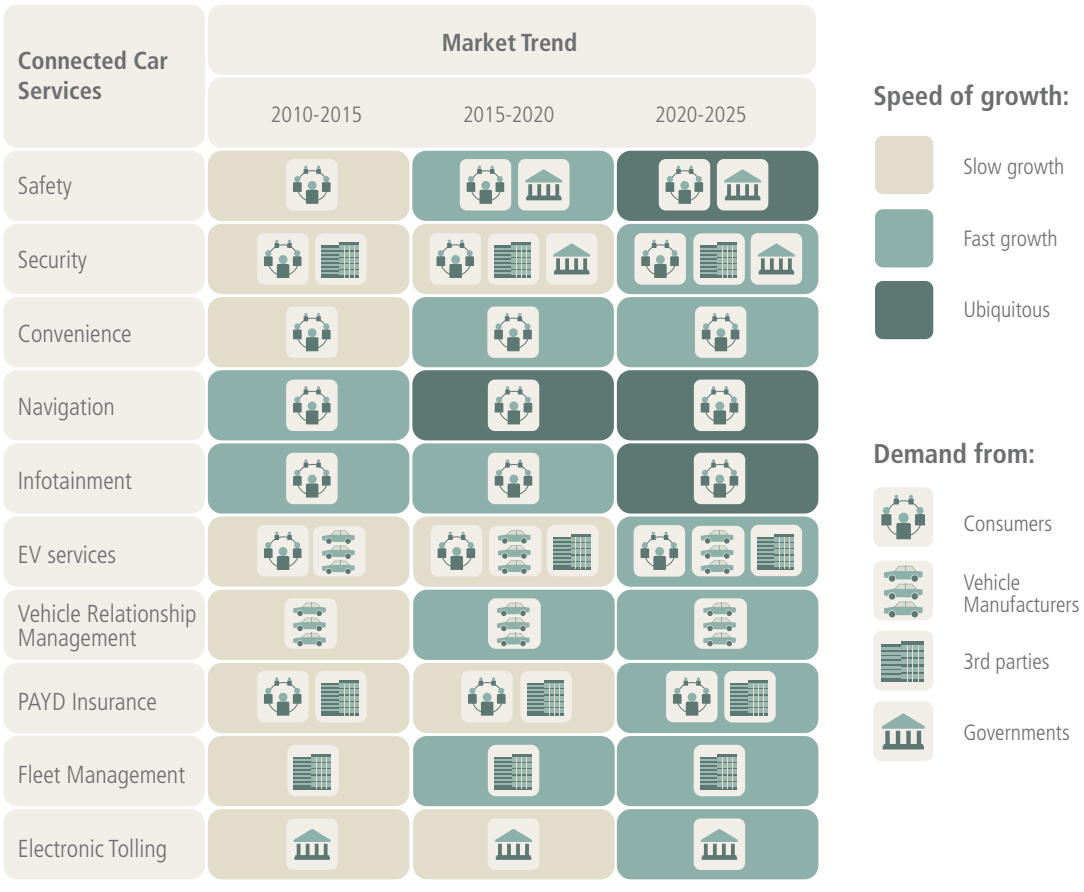
Despite these challenges, most governments view ETC (and in particular GPS-based ETC) as the only way to manage an increasingly crowded road network. SBD therefore expects more governments to launch ETC trials over the coming decade. However, due to a long realisation period (typically 10 years), only a small number of markets are expected to have launched live GPS-based ETC services before 2020.

5.2 Where will the key growth drivers be over the next 15 years?

Many of the applications shown are targeted towards segments that will remain relatively niche over the next decade in comparison to the entire passenger car market (e.g. EVs or Fleets). Conversely, other applications are likely to experience much faster growth across all segments due to external factors such as government legislation (e.g. eCall in Europe).

Figure 13 summarises the expected speed of growth for each of the connected car services, along with the key stakeholders that are promoting future growth.

Figure 13. Applications for In-Car Connectivity



Source: SBD, 2012

Although it is expected that all of these applications will grow over the coming years, some will clearly grow faster than others due to broader demand (e.g. navigation and infotainment) or legislative mandates (e.g. eCall in EU).

For telecom operators, in addition to understanding how fast each of these applications will grow, a critical question is what types of connectivity each of the applications will require.

This whitepaper has been commissioned by GSMA and written by SBD in order to highlight the future trends for connectivity in the car.

About GSMA
The GSMA represents the interests of mobile operators worldwide. Spanning more than 220 countries, we unite nearly 800 of the world's mobile operators, as well as more than 200 companies in the broader mobile ecosystem. The GSMA believes that the automotive industry has the opportunity to leverage existing mobile platforms and technology to provide innovative in-car services to a broad range of drivers through the provision of a consistent and standardized framework.

For the latest information on our mAutomotive programme please visit www.gsma.com.

About GSMA Connected Car Forum
GSMA Connected Car Forum, launched in 2011, enables automakers and operators to come together to reduce fragmentation and improve scale in in-car Apps development. Our current global priorities include defining specific requirements for remote management of operator credentials and use cases and business requirements for in-vehicle connectivity including both embedded solutions and tethered options. In Europe we are addressing eCall implementation issues.

To join the forum please email: mautomotive@gsm.org

About SBD
SBD is an independent automotive market research and consultancy firm specialising in the design and development of Connected Cars, Safe Cars and Secure Cars. From technical trends reports to conducting end user surveys, SBD has over 15 years' experience of providing strategic advice, insight and expertise to the automotive and associated industries globally.

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