mAutomotive

Connecting Cars:
Bring your own Device - Tethering Challenges



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Executive summary

Automakers and mobile operators are striving to make the connected car a reality on a large scale. These efforts to make consumer services seamless, using different connectivity options, pose many challenges. GSMA has been working closely with operators and automakers in overcoming existing barriers to embedded connectivity (built-in modem with a dedicated SIM).

While the challenges facing embedded technology are being addressed, tethered solutions (based upon IP sharing) are being considered by automakers. Tethering advocates note that tethering could help to seed the market for some connected services, increase consumer understanding and adoption, and hence create a strong foundation for making the shift to embedded connectivity in the future. Even advocates of tethering, however, recognise that it fits a specific purpose for certain services and remains inappropriate for others (such as remote control of vehicle environment and safety & security critical services).

This paper focuses on highlighting the existing tethering challenges and impacts of the existing barriers, in particular the risk of alienating the end user to connected services in general. The paper, importantly, also identifies potential opportunities for cross-industry action to overcome the challenges for tethered solutions, in the hopes of bringing connected car services a little closer to working out-of-the-box for consumers, whilst still making a positive contribution to the business of mobile operators.

Opportunities to technically improve tethering include:

- immediate opportunities (e.g. improved interoperability between handsets and head-units for Bluetooth PAN/DUN profiles; improved pairing process);
- building industry agreement on next generation tethering (including Wifi Direct).

Furthermore, a number of opportunities exist for operators to foster tethering. By enabling a win-win solution for all stakeholders, tethering could support the ultimate objective of more connected cars, services and eventually an embedded future.

Introduction

Smartphones and apps have created an expectation amongst consumers that they can stay connected to the Internet 24/7. Automakers believe that connectivity will help them sell more cars, learn more about their customers and gain insights into how their products are used. The difficult decision is how best to provide the connectivity (see the Annex for details on the trade-offs associated with different connectivity solutions). Figure 1 shows the key differences between embedded connectivity, tethered solutions and smartphone integration.

Figure 1: Distinctions between Connectivity Solutions

Connectivity Type	Embedded	Tethered (IP sharing)	Smartphone integration
Modem	Built-in	Brought-in	Brought-in
UICC ("SIM")	Built-in	Brought-in	Brought-in
Intelligence/ Applications	Built-in	Embedded	Brought-in
User Interface	Vehicle HMI	Vehicle HMI	In vehicle HMI OR Phone HMI

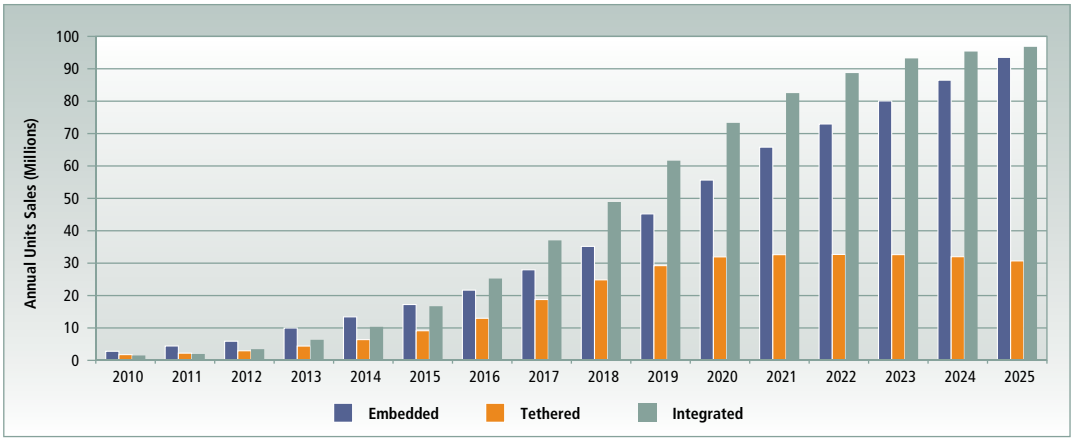
Source GSMA: Connected Cars: Business Model Innovation

Note. Tethering relates to using a wired (e.g. USB cable, USB key, OBD Dongle) or wireless connections (typically Bluetooth today, but also WiFi) to allow the phone's IP data connection to be shared with the car and should not be confused with other applications of Bluetooth in the car, such as hands-free voice calling. This paper focuses on the technical challenges associated to wireless tethering. Please refer to the Annex for detailed information on the different tethering methods.

What is the Outlook for Connectivity Solutions for In-Vehicle Services?

Despite limited connectivity in cars today, every car is likely to be connected in multiple ways by 2025 (see Figure 2).

Figure 2: Global Sales Forecast of Original Vehicle Manufacturer Connectivity Solutions in Passenger Cars



Source: GSMA / SBD 2025: Every Car Connected[1]

In the past, car connectivity involved only two options: connected or not. However, recent trends, as well as forecasts, suggest that connectivity solutions will become multiple: cars will increasingly have more than one type of connectivity solution deployed (each with its own benefits and challenges indicating its appropriateness to support different services), allowing the different solutions to complement one another:

- Automakers are likely to adopt embedded solutions to meet regulatory requirements and as a basis for the provision of vehicle-centric telematics services. However, widespread adoption will depend on overcoming embedded solutions' current limitations.
- While the challenges facing embedded technology are being addressed, tethered solutions (IP sharing) are likely to be employed as a mid-term "substitute" for embedded technology for certain services, especially infotainment, convenience and navigation services where the consumer actively initiates the service. Nonetheless, tethering remains inappropriate for some services due to:
  - No guarantee that the driver will employ the solution consistently enough to maintain service continuity (especially for those services, such as remote diagnostics, which should always be active in the background, but have no immediate "benefit" to the consumer);
  - The difficulty in physically securing tethered solutions for safety and security applications (such as eCall, where the phone could be damaged or thrown from the vehicle; or stolen vehicle tracking where the module must be inaccessible from thieves) etc.
- Nonetheless, tethered solutions allow automakers to leverage the customer's mobile contract, while still ensuring automaker control of service delivery and applications. This approach is particularly relevant for those geographies where an embedded solution is not required by regulation.
- Smartphone integration, where apps run on the phone and the human-machine interface (HMI) is transferred to the vehicle, is likely to be a long-term companion to embedded (and tethered) solutions to support the customer's preferred lifestyle apps (such as internet radio). However, smartphone integration is not considered further within this whitepaper because it is typically operator-agnostic and relies on the vehicle manufacturer ensuring compatibility with the customer's phone through its own apps, software development kits (SDKs) and application programming interfaces (APIs).

These connectivity considerations have important implications for the telematics and infotainment value chain's ability to optimise in-vehicle service experiences.

1 Tethering refers to IP sharing and Integrated refers to Smartphone Integration.

Primary Connectivity Challenges

A seamless in-vehicle experience for consumers will depend on overcoming existing barriers for both embedded and tethered connectivity. Please refer to the Annex (What are the specific drivers behind the different connectivity options and what roles do they each play?) for additional information on the strengths and weaknesses associated with each connectivity solution.

Embedded Challenges

Embedded connectivity currently presents a series of challenges relating to:

- Technical obstacles, including:
  - Initial hardware costs;
  - Existing difficulties in:
    - future proofing;
    - changing operators after production and during vehicle lifetime;
    - providing differential management of connectivity charges;
    - leveraging existing consumer mobile services in vehicle;
- Necessity to obtain a critical mass around the technology;
- Economic and business model barriers;
- Evolving value chains: Changing requirements and roles;
- Understanding different industrial contexts and drivers.

What Happens Now?

These challenges to embedded will take time to overcome. GSMA is working intensively with operators and automakers on many of these topics (please see the section on GSMA mAutomotive priorities for additional information).

In the meantime,

- Many automakers are relying upon tethering to provide connectivity for in-vehicle services;
- Many consumers are having their first taste of connected in-vehicle services via tethering solutions, despite their flaws.

Tethering Opportunity

The ability to leverage the user's existing connectivity contract together with the application intelligence in the vehicle is considered particularly attractive to many automakers because it:

- Requires less costly in-vehicle hardware than embedded solutions;
- Provides direct allocation of service connectivity costs to the end user;
- Provides a means to leverage external modems, which are likely to be more up-to-date than embedded technology, given the relatively quick renewal cycle of mobile devices.

Tethering Challenges

The challenges of tethering are multiple and include:

- technical difficulties;
- necessity of having appropriate business models and policies; and
- lack of clarity to consumers on the possibility to tether.

Technical

The technical challenges to tethering are multiple and depend upon the method employed for tethering for IP sharing. The GSMA's Connected Car Forum prioritised the most critical, urgent tethering technical challenges, requiring immediate cross-industry efforts. This work identified the necessity to focus first on interoperability of wireless tethering (in particular, Bluetooth DUN/PAN today and WiFi/USB for the future).

Wireless tethering for IP sharing has significant interoperability challenges, given the need to ensure that all the relevant devices (i.e. handsets and vehicles) have the:

- appropriate profiles (e.g. PAN/DUN), and
- same implementations of the profiles.

For this reason, the degree of compatibility varies greatly depending on the specific handset and vehicle – frequently, resulting in negative user experiences.

A key technical obstacle, which must be overcome if wireless tethering is to be a feasible connectivity solution, regards the initial pairing process between the handset and the head-unit. Consumers find the initial pairing process to be overly complicated and unreliable (i.e. successful completion is not guaranteed). Some experts have cited statistics that as high as 50% of vehicle owners never complete the initial pairing process.

Operator Business Models & Policies

Tethering generates a degree of alarm and uncertainty amongst the operator community. This is partly fuelled by the legacy of all-you-can-eat tariffs, which were designed by mobile operators to kick-start the mass adoption of smartphones. These models, successful in launching smartphones, however, also resulted in some anomalous cases where a minority of customers consumed vast quantities of data (by streaming file-sharing and video applications via a tethered connection to their PC) and generated network quality issues.

As a result, different operators have very different approaches to wireless tethering for IP sharing (with different tethering policies sometimes varying on the type of tethering, whether Bluetooth or Wifi), with some operators:

- Contractually prohibiting tethering;
- Permitting tethering as long as the customer pays an additional fee;
- Allowing tethering, without additional fees.

This fragmented approach to tethering reflects operators' difficulties in identifying a winning business model both of which is compatible with their handset consumer business models and which appropriately supports tethering on their networks (since network capacity is a finite resource for all). The recent market shift towards tiered data plans seemingly negates many operator concerns regarding anomalous uses, and arguably creates an environment where heavy users of tethering would generate incremental revenues for operators.

Japanese mobile operator SoftBank is a supporter of tethering. Through discussions with Toyota, Nissan and Honda, SoftBank identified an opportunity to offer a special low cost telematics-tethering option. This offer allows customers to use their existing data plan to enable connected services in the car for just 210 JPY (around €2) per month. As a result, SoftBank attracted new customers and increased its ARPU by encouraging a higher usage of connected car services.

Consumer Confusion on Tethering

The availability, usage policy and pricing of wireless tethering solutions for IP sharing varies considerably from operator to operator, handset to handset, technology to technology and even tariff to tariff, making it very difficult for consumers to easily understand the implications for them.

Consumer confusion in understanding if, how and at what cost they can enable tethering on their smartphones raises concerns for automakers trying to use this solution to stimulate and kick-start the market for connected services.

What is the Future of Tethering?

Tethering for IP sharing presents the connected vehicle community with a major dilemma. Advocates note that tethering could help to seed the market for selected connected services, increase consumer understanding and adoption, and hence create a strong foundation for making the shift to embedded connectivity, and hence M2M SIM-based solutions, in the future.

Massive deployments across the globe are being contemplated by automakers. Tethering service revenues for telematics and for telematics and infotainment (instead of and smart & vehicles) and vehicles are set to grow from currently negligible amounts to $909 million by 2016, according to Juniper research 2012[2].

Tethering could bring connected car services a little closer to working out-of-the-box for consumers, whilst still making a positive contribution to the business of mobile operators. By enabling a win-win solution for all stakeholders, tethering could support the ultimate objective of more connected cars, services and eventually an embedded future.

Nonetheless, the ultimate longer-term destiny for tethered connectivity is not clear. If tethering proves not to be successful as an intermediate step towards an embedded future, because the technical and business model challenges outlined above cannot be overcome, two clear risks exist where:

- Inconsistent/negative experiences with tethering make consumers wary of any kind of connected car services.
- Automakers rely on smartphone integration for connected services, thus limiting the range of services deployed and the value chain for these services.

2 http://www.juniperresearch.com/reports/telematics_&_smart_vehicles

What is the GSMA Doing to Address These Issues?

Automakers and mobile operators have come together in the GSMA's Connected Car Forum (CCF) to work on overcoming the challenges facing embedded connectivity for the mid-to long-term, as well as addressing immediate obstacles to wireless tethering (IP sharing). This twin-track approach aims to help support both the short-term and long-term deployment of telematics and infotainment services.

Concrete Steps Forward

The GSMA's mAutomotive initiative has taken some first steps towards addressing these concerns. These include:

- Mapping of primary technical obstacles for tethering;
- Verification and validation of the critical nature of the existing technical barriers to wireless tethering for IP sharing with the extended value chain (1st tier automotive suppliers, Bluetooth chipset manufacturers, operating systems providers, etc.):
- The joint prioritisation of Bluetooth PAN/DUN profile interoperability issues between handsets and head units.

These activities led to the publication of the GSMA Terminal Steering Group (TSG)'s Bluetooth® Interoperability Requirements for Mobile Terminals (TS.19) – see box.

The GSMA Connected Car Forum has co-operated with the GSMA Terminal Steering Group (TSG) to address Bluetooth (BT) interoperability, in cooperation with the Consumer Electronics for Automotive (CE4A) working group. The resulting Bluetooth® Interoperability Requirements for Mobile Terminals (TS.19) represent a significant step in realising genuine collaboration, in support of BT profiles, between automakers, handset manufacturers and mobile operators. Whilst handset manufacturers and operators have long been collaborating on this issue, the GSMA TSG has sought input from the car industry to enhance Bluetooth support and the end user experience for in-car connectivity.

This collaboration has produced tangible results. For example; handset vendors, whose design cycle is significantly shorter than the three years or so of the auto industry, had been looking to immediately remove support for BT DUN profiles, a common (and sometimes the sole) mechanism for providing tethering solutions with automakers. Through dialogue, a compromise has been achieved, in which handset vendors will support BT DUN until 2015.

To read the GSMA Bluetooth® Interoperability Requirements for Mobile Terminals, v1.0 (TS.19) please visit: http://www.gsma.com/newsroom/tsg-prd-ts-19-v1-0-bluetooth-interoperability-requirements-for-mobile-terminals/

Remaining Challenges for the Future

Technical challenges for wireless tethering for IP sharing remain. These include:

- How to improve the pairing process, potentially using Near Field Communications (NFC) technology, as a first-step to enabling service usage. Some possibilities for improving pairing include ways to achieve:
  - Automatic device discovery and selection;
  - Automatic pairing;
  - Automatic application start, mode selection etc
- Building industry agreement on a single technical solution for next generation tethering, for which WiFi Direct appears to be a front-runner.
- Potential means for operators to foster wireless tethering for IP sharing include:
  - Developing a single policy for tethering across all devices, technologies and tariffs;
  - Promoting their tethering policy to consumers so that it is easy for them to locate and understand;
  - Developing a tethering tariff that recognises the low data requirements of most in-vehicle connected services.

GSMA's mAutomotive Priorities

Looking further ahead, the main focus of the GSMA's mAutomotive project is to foster a positive outlook for embedded connectivity and additional opportunities for operators to provide value-added services. The project is currently addressing barriers to embedded connectivity by:

- Supporting automotive use cases for remotely provisionable SIMs;
- Demonstrating requirements and capabilities for split-charging and revenue management, as enablers for innovative business models for telematics and infotainment services;
- Supporting regulatory deployment for embedded module fitment. GSMA is working to support the evolution from policy to regulatory deployment of recent telematics mandates (including: European eCall; ERA-GLONASS; SIMRAV), as well as facilitating value-add opportunities for new service development where possible.

Potential future programme activities include business development opportunities, such as high bandwidth in-vehicle services and the role of big data for improving & developing in-vehicle services.

mAutomotive white papers published by the GSMA in 2012/13:

- **Connecting Cars: the Technology Roadmap,** which outlines primary automotive and mobile network operator industrial characteristics, available resources for service deployment and the requirements for these services, both with respect to the current context and likely future developments. The document also explores the existing barriers to wider deployment of telematics and infotainment services and the opportunities offered by greater cooperation between automakers and mobile network operators. The Connected Car Forum is using this information to assist in the selection of priority areas to pursue.
- **2025 Every Car Connected: Forecasting the Growth and Opportunity,** which analyses the potential growth in in-car connectivity between now and 2025, as well as the types of connectivity that will eventually become predominant.
- **Connected Cars: Business Model Innovation,** which examines the basic constructs of business models for telematics and infotainment services, highlights some of the emerging trends, and explores the unique role mobile operators can play in this value chain.
- **Split Charging & Revenue Management Capabilities for Connected Car Services,** which highlights the importance of these capabilities for the overall success of innovative business models. This white paper details the high level automaker requirements for charging and revenue management capabilities, their correspondence with the relevant operator capabilities, and the areas for future potential joint co-operation.

About the GSMA Connected Car Forum

The GSMA Connected Car Forum (CCF) is a platform for sharing information between the automotive sector and mobile network operators. It is designed to enable joint cooperation and foster activities that may not be possible through existing bilateral business discussions in a timely manner. The Forum is a response to the explicit need, expressed by both automakers and mobile operators, to remove current barriers and to improve the speed and take up of telematics and infotainment services.

To demonstrate their joint commitment towards achieving results, many GSMA CCF members are laying the groundwork for connected cars to become ubiquitous. Targets include:

- More than 20% of vehicles sold worldwide in 2015 to include embedded connectivity solutions;
- More than 50% of vehicles sold worldwide in 2015 to be connected (either by embedded, tethered or smartphone integration);
- Every new car to be connected in multiple ways by 2025.

In order to achieve these ambitious goals, the global GSMA Connected Car Forum addresses cross-industry initiatives of international relevance, focusing on:

- Enablers for telematics service deployment;
- Current operative deployment problems; and/or
- Strategic opportunities for the deployment of new services.

The global players participating in the GSMA Connected Car Forum are:

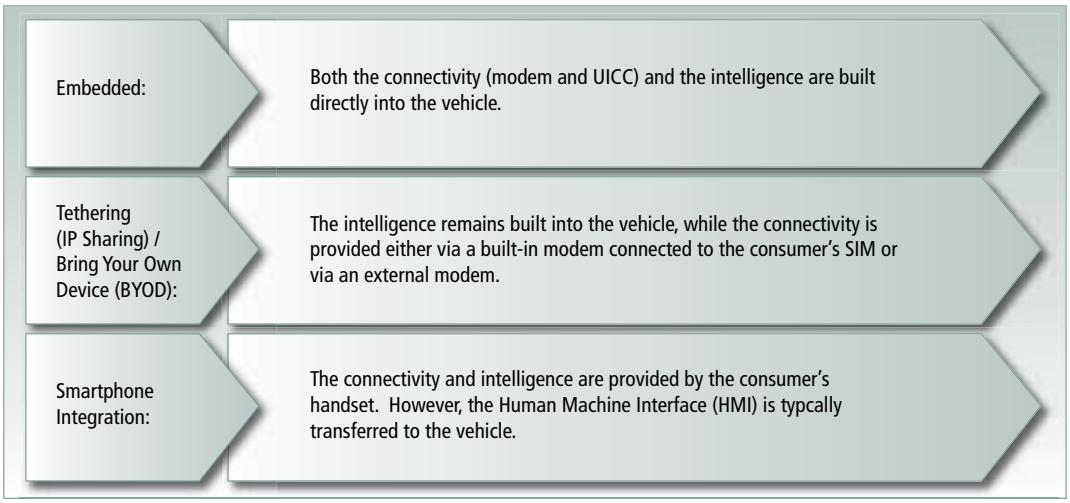
- Mobile operators: AT&T, Bell Canada, China Unicom, Deutsche Telecom, KDDI, KPN, KT, NTT Docomo, Orange, Rogers, Softbank, Telecom Italia, Telefonica, Telenor, Telstra, Turkcell, Verizon Wireless, Vodafone.
- Automakers: Audi, BMW, Chrysler, Fiat, Ford, GM, Honda, Hyundai, Jaguar Land Rover, Mazda, Nissan, Peugeot, Renault, Toyota, Volvo, VW.

Annex: Finding a Compass to Navigate Connectivity Solutions

How to Offer In-Vehicle Connectivity?

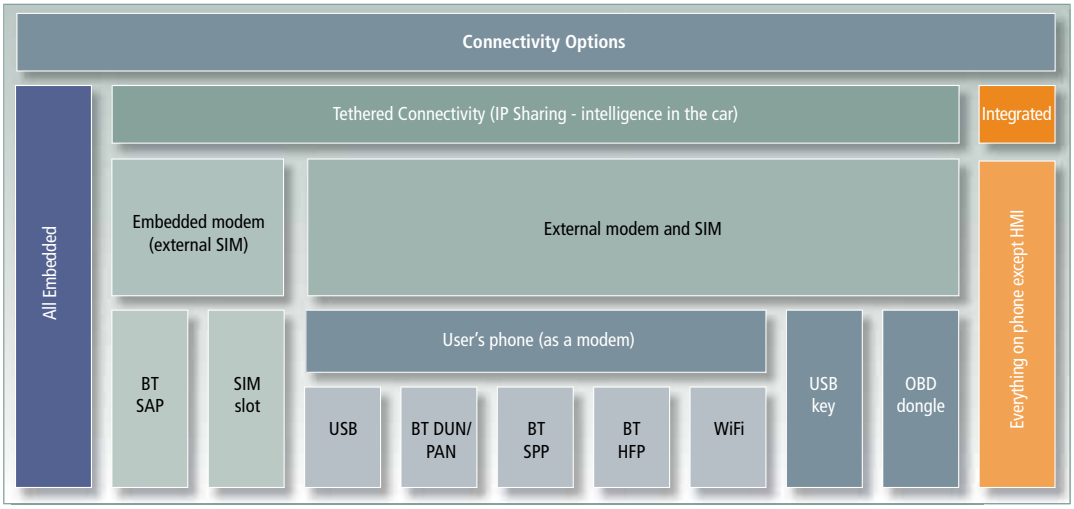
Figures 3 and 4 shows the three primary connectivity options for connected cars:

Figure 3: Connectivity Options for In-Vehicle Services



Source: GSMA 2013

Figure 4: Different Means to Enable Car Connectivity



Source: SBD 2011

General Connectivity Considerations

The different connectivity options are not mutually exclusive and can be used in tandem. Their use depends upon a number of factors, including:

- How can the automaker provide connected services which guarantee the service quality and user experience that its customers demand at the lowest possible cost?
- Which services are in the automakers' direct interest? Are the associated data costs predictable?
- Which services are highly unpredictable in terms of use and require high bandwidth?
- How can the automaker leverage the information and services that customers already enjoy on their phone?
- How does the automaker avoid recreating existing user services and applications?
- How does the automaker future-proof its solutions?

For automakers, the answers to these questions depend upon brand positioning and customer base, together with regional and cultural issues. Historically, embedded modules have typically been used to enable telematics and infotainment services with the automaker covering the costs of the connectivity using a subscription service model. This approach has been appropriate for those services requiring low-bandwidth connections, with stable usage and in which automakers have a direct interest in usage of the service i.e. remote diagnostics.

Today, the potential services are much broader and more diversified. In some cases, they are characterised by:

- High bandwidth requirements;
- potentially frequent use;
- Highly-elastic demand (i.e. unpredictable use and costs);
- Primarily of interest to the consumer (as opposed to the automaker).

As the range of services broadens, the question of how to manage connectivity costs has become quite critical for automakers.

What are the specific drivers behind the different connectivity options and what roles do they each play?

Embedded Connectivity

Embedded connectivity has the fundamental appeal of simplicity: It just works 'out-of-the-box' for consumers, encouraging service utilisation. Embedded solutions focus on vehicle-centric, high-reliability and high-availability apps. Embedded connectivity is a requirement for some services, such as stolen vehicle tracking and remote door unlock, and can enhance the performance of safety-based services, such as eCall.

Embedded solutions, which enable a broad range of services, have generally been limited to premium vehicles, with some notable exceptions:

- Some volume brand manufacturers, such as General Motors, Peugeot, Renault and Roewe, use embedded connectivity to offer a range of services from entry models upwards
- Some region-specific regulations require embedded solutions, such as eCall in Europe[3]. Legislators in a number of regions around the world are also planning to mandate the fitment of such systems.

Nonetheless, embedded connectivity isn't necessarily a one-size-fits all solution. There are a range of concerns, including:

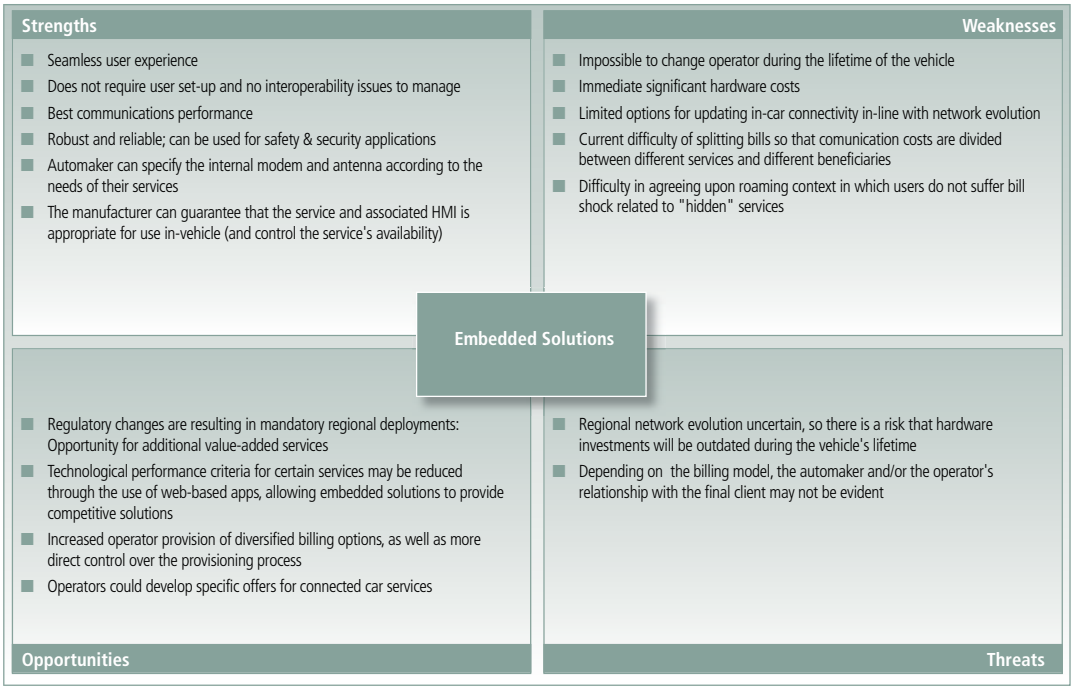
- Initial hardware costs;
- The need for connectivity solutions to be as future-proof as possible for the lifetime of the vehicle in a timely and cost-effective manner
- The need for split service-based/end-user charging and billing to support the expansion of services and associated business models for telematics and infotainment services, including the ability to differentiate service beneficiaries, manage multiple revenue streams, and enable bundled service and connectivity costs, etc.
- The need for broader service suites that directly encourage the car to be part of the universe of "everything connected". This kind of holistic approach may help overcome consumers' reluctance to pay for new contracts for additional devices.

3 Final type approval legislation is expected to confirm the requirement for embedded systems (draft legislation envisaged for early 2013).

The challenges facing embedded connectivity have led many automakers to consider other connectivity solutions, such as tethering and smartphone integration, alongside embedded solutions (even at the risk of impacting the overall customer experience).

Figure 5 shows the strengths, weaknesses, opportunities and threats associated with existing embedded solutions.

Figure 5: Strengths, Weaknesses, Opportunities and Threats for Embedded Connectivity Solutions



Source: GSMA 2012

Tethered/BYOD Connectivity (IP Sharing)

The so-called bring your own device (BYOD) approach leverages the user's connectivity contract. The intelligence remains embedded in the vehicle while the connectivity is provided through either an:

- Embedded Modem with a customer's SIM; or
- External Modem using the:
  - customer's phone via a USB cable or wireless connections through bluetooth profiles (DUN/PAN, SPP/HFP), or WiFi.[4]
  - USB key.
  - OBD Dongle.

4 USB cable – A wired solution that connects the phone to a USB connection in the car

BT DUN (Dial-Up Networking) – A Bluetooth profile that allows a device to use the phone to make a data connection.

BT PAN (Personal Area Networking) – A Bluetooth profile that allows one or more connected devices to share the phone's connection to the internet

BT SAP (SIM Access Profile) – A Bluetooth profile that makes a temporary copy of the SIM credentials from one device to another (e.g. copy the SIM from a handset to an embedded modem in a car).

BT SPP (Serial Port Profile) – A solution that uses compatible apps, on the phone and in the car, to by-pass tethering restrictions. Data is downloaded from the internet to the app on the phone, from where it is side-loaded to the car using SPP.

BT HFP (Hands Free Profile) – This profile is used to enable a voice call that the car can then use to transfer very small amounts of data using in-band modem technology (data-over-voice).

WiFi – The car is able to connect to the internet over WiFi if the phone is put into a portable hotspot mode.

Using the customer's phone to provide connectivity (accomplished today mostly by Bluetooth DUN/PAN, but likely to be WiFi/USB in the future) is attractive because it:

- Requires less costly hardware in-vehicle;
- Is more likely to benefit from up-to-date external modems, given the renewal cycle of mobile devices is faster than that for vehicles;
- Provides direct allocation of service connectivity costs to the end user.

However, tethering remains inappropriate for some services due to:

- No guarantee that the driver will employ the solution consistently enough to maintain service continuity (especially for those services, such as remote diagnostics, which should always be active in the background, but have no immediate "benefit" to the consumer);
- The difficulty in physically securing tethered solutions for safety and security applications (such as eCall, where the phone could be damaged or thrown from the vehicle; or stolen vehicle tracking where the module must be inaccessible from thieves) etc.
- The necessity to have remote connection to the vehicle by the user (i.e. remote control of vehicle environment requires an embedded solution).

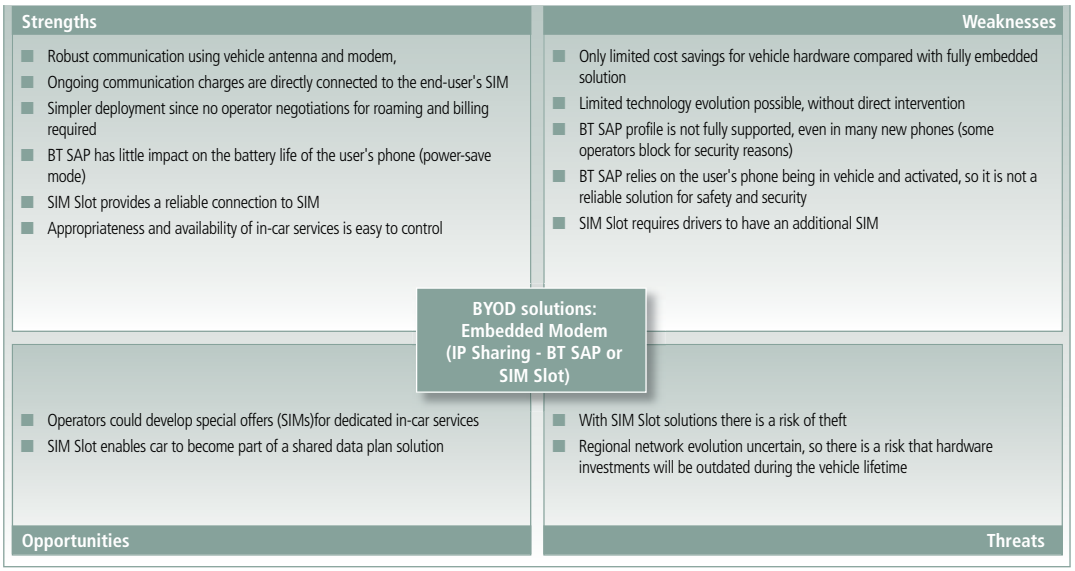
Today, tethered solutions typically focus on connected navigation and basic internet-based infotainment features. Tethering depends on the compatibility of profiles/protocols across the user's handset and the vehicle's head-unit. This compatibility requirement can be a stumbling block today for the viability of tethered connectivity.

If the compatibility issue can be addressed, tethering would provide the opportunity for consumers, en mass, to experience new and innovative in-car services quickly. Resolving the current tethering issues is an investment in the future for everyone. This is because:

- Tethering provides an entry-level solution for mass market connected in-vehicle services today;
- Tethering currently tends to focus on navigation/infotainment solutions which offer revenue opportunities for the whole value chain (and in particular for operators, when compared with vehicle-centric telematics) and, hence, a tangible incentive for all;
- If tethering is not seamless, consumers will not use the in-vehicle services, having a negative impact on:
  - Revenue generation, which has consequences for all value-chain players.
  - The future viability of in-vehicle services, regardless of connectivity type: Negative experiences with tethered in-vehicle services risk impacting consumers' perception of connected car services in general (regardless of the connectivity solution), which could reduce their appetite for future in-vehicle services, even those based on embedded versions (which do not have the same challenges for compatibility).

Figure 6 shows the strengths, weaknesses, threats and opportunities associated with existing tethered/BYOD solutions that make use of modem embedded in the vehicle.

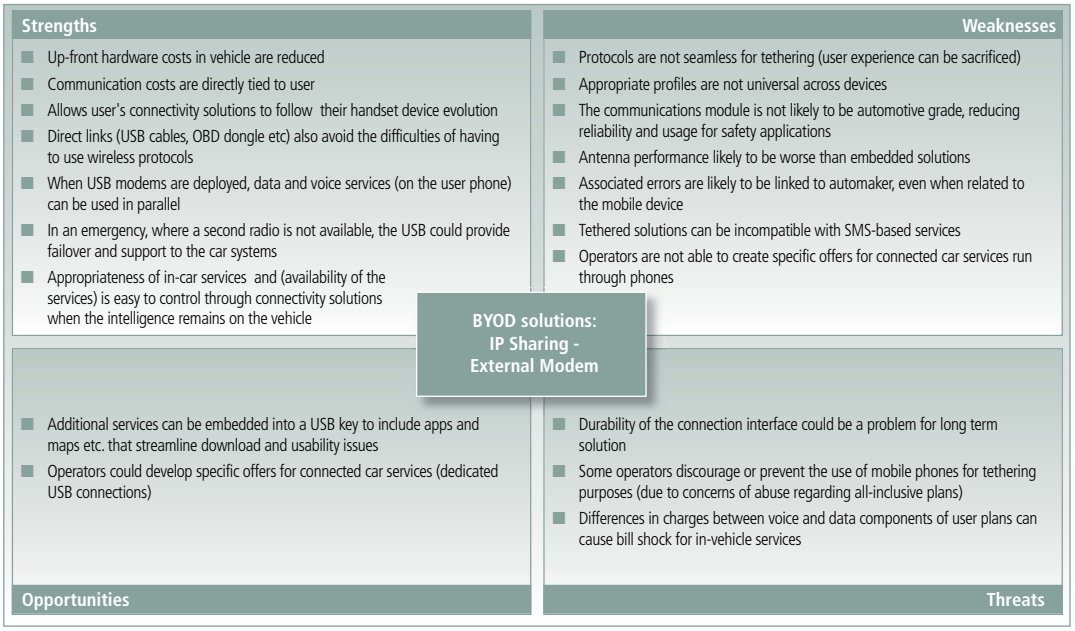
Figure 6: Strengths, Weaknesses, Opportunities and Threats for Tethered Connectivity Solutions (Embedded Modem with Intelligence in the Car)



Source: GSMA 2012

Figure 7 shows the strengths, weaknesses, threats and opportunities associated with existing tethered/BYOD solutions that make use of external modem provided by the user, such as a handset or a USB dongle.

Figure 7: Strengths, Weaknesses, Opportunities and Threats for Tethered Connectivity Solutions (External Modem and Intelligence in the Car)



Source: GSMA 2012

Smartphone Integration

Smartphone integration enables apps that run on mobile devices to be displayed and controlled via the vehicle's Human Machine Interface (HMI). Smartphone integration has the initial benefits of tethering, as it:

- Requires less costly hardware in-vehicle;
- Makes use of up-to-date external modem (due to the rapid renewal cycle of mobile devices);
- Enables direct allocation of service connectivity costs to the end user.
- Smartphone integration distinguishes itself from tethering in terms of:
- Relying upon the computing power of the smartphone;
- Supporting the customer's preferred apps;
- Targeting the existing base of app developers for the development/renewal of applications.

In addition to many of the limitations of tethering, smartphone integration suffers from significant concerns with regards to driver distraction, since these issues are difficult for automakers to manage or influence when external devices are used in the vehicle.

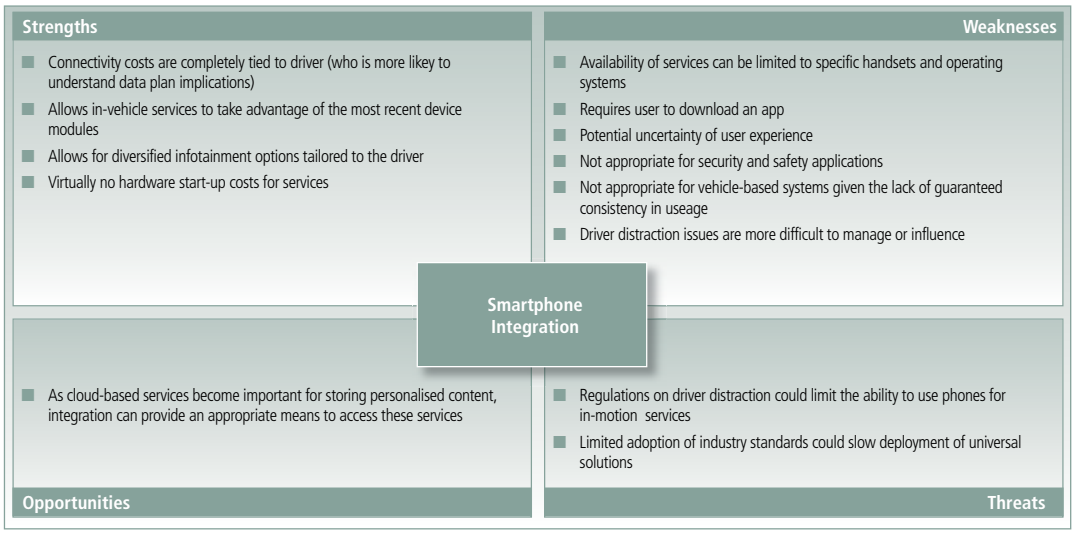
Integrated solutions tend to be used for higher bandwidth and personalised apps (such as on-demand music and social networking). Many consumers, especially in the US, are leveraging smartphone integration to utilise phone-based apps in the vehicle, in particular for internet radio and social networking.

Like tethering, smartphone integration remains inappropriate for some safety and security services for a variety of reasons, such as:

- There is no guarantee that the driver will employ the solution consistently enough to maintain service continuity (especially for those services, such as remote diagnostics, which should always be activate in the background, but have no immediate "benefit" to the consumer);
- The difficulty in physically securing tethered solutions for safety and security applications (such as eCall, where the phone could be damaged or thrown from the vehicle; or stolen vehicle tracking where the module must be inaccessible from thieves) etc.

Figure 8 shows the strengths, weaknesses, opportunities and threats related to smartphone integration solutions.

Figure 8: Strengths, Weaknesses, Opportunities and Threats for Smartphone Integration Connectivity Solutions (only HMI runs on the car, everything else is on the phone)



Source: GSMA 2012

Mapping of Connectivity Solutions to Services

The appropriateness of the different connectivity solution also varies by service:

- Infotainment services can be offered via each of the connectivity solutions.
  - However, embedded solutions' weaknesses, such as the higher hardware costs and a lack of flexible charging options, can impact the ability to deploy elastic-demand infotainment services. For automakers, these issues often overshadow an embedded solution's ability to provide a seamless user experience.
  - Tethering and smartphone integration offer lower-cost infotainment solutions with frequent technology upgrades (as handsets are replaced). These solutions enable in-vehicle services to take advantage of the expanding mobile broadband coverage, which is needed for high bandwidth infotainment services.
- Navigation services are easily provided by all connectivity options.
- Telematics (vehicle-centric services) are ideally provided by embedded solutions, but some can also be provided reasonably through tethering or smartphone integration. However, some services, such as stolen vehicle tracking, pay-as-you-drive insurance, fleet management, tolling or eCall, do not lend themselves readily to tethering or smartphone integration.

Figure 9 shows the suitability of each connectivity solution to specific telematics and infotainment services.

Figure 9: Mapping of Connectivity Solutions to Services (GSMA & SBD 2013)

Services		Connectivity Options: Embedded	Tethered	Smartphone Integration
Infotainment: High Bandwidth	Radio-Music, News: On-Demand Real Time Content	Barriers to address	Barriers to address	Ideal
	Video: On-demand and real-time content	Barriers to address	Barriers to address	Ideal
	Augmented reality points of interest	Barriers to address	Barriers to address	Ideal
	Other In-Vehicle Services enabled by Cloud Computing	Barriers to address	Barriers to address	Ideal
Infotainment: Lower Bandwidth	News, Stocks & sports	Ideal	Ideal	Ideal
	Email	Acceptable	Acceptable	Ideal
	Multimedia, internet services, social networking, etc.	Barriers to address	Ideal	Ideal
	Apps store	Ideal	Ideal	Barriers to address
Navigation	Navigation (point of interest, parking, fuel prices, weather)	Acceptable	Ideal	Ideal
	Traffic/journey times	Acceptable	Ideal	Ideal
	Travel and Traffic Assistance/ off-board route guidance	Acceptable	Ideal	Ideal
	Location based services	Acceptable	Ideal	Ideal
Telematics: Vehicle-Centric	Remote Control of Vehicle Environment/ Car Features	Ideal	Not appropriate	Not appropriate
	Remote Diagnostics	Ideal	Acceptable	Acceptable
	Breakdown Services (bCall)	Ideal	Acceptable	Acceptable
	General eCall (not EU specification)	Ideal	Not appropriate	Not appropriate
	Eco driving	Ideal	Acceptable	Acceptable
	Electrical Vehicle Use Cases: Battery Charge Monitoring/ Control	Ideal	Not appropriate	Not appropriate
Telematics: Other	Insurance Pay As You Drive	Ideal	Acceptable	Barriers to address
	Stolen Tracking	Ideal	Not appropriate	Not appropriate
	Fleet Management	Ideal	Not appropriate	Barriers to address
	Tolling	Ideal	Not appropriate	Not appropriate
	Payment (parking, etc.)	Ideal	Ideal	Ideal

Key: Ideal | Acceptable | Barriers to address | Not appropriate

Source: GSMA & SBD 2013)

About the Connected Living programme

Connected Living is a three year market development initiative whose mission is to help mobile operators accelerate the delivery of new connected devices and services. Our target is to assist in the creation of 700 million new mobile connections, whilst stimulating a number of service trials and launches in the Automotive, Education and Healthcare sectors. The Connected Living programme is also working with the city of Barcelona, the Mobile World Capital, to develop and showcase smart city services.

For more information visit: **www.gsma.com**
Email: **connectedliving@gsma.com**

GSMA Connected Living

mautomotive@gsma.com
www.gsma.com