MARAVEDIS RETHINK
Wireless Infrastructure Analysts

Experience Continuity:
The key enabler for the Connected Car?

Caroline Gabriel, Research Director, Maravedis-Rethink
Steven Hawley, Principal Analyst, Advanced Media Strategies

birdstep TECHNOLOGY

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Executive Summary

The Connected Car has transitioned rapidly from being an esoteric luxury to a mainstream option, especially in the United States. Connected Car equipment units are forecast to grow at a CAGR of over 27% between 2013 and 2018, topping 70m in the last year of that period.

However, as seen in other technologies which have been embraced enthusiastically by consumers, there is a challenge to turn all that volume and interest into revenues. Providers will have to balance the cost of connecting millions of cars with the potential fees they can charge to end users or ecosystem partners. And to ensure that initial consumer interest translates into sustained usage, expanding applications and rising revenues, several factors must be delivered – among them strong quality of experience, especially for video apps, and fully trusted security and privacy.

Three main groups of service providers are keen to meet these challenges and dominated the Connected Car sector – the mobile operators, the auto manufacturers, and the platform giants such as Google, Apple and Microsoft. Each group has different strengths and weaknesses in this space, and different commercial agendas. There are many emerging technologies to help them deliver strong services, including new Wi-Fi and cellular network standards, new operating systems and new in-car features.

However, the proliferation of different technologies, the varying business models of the main players, and the immaturity of the market create a significant risk that the Connected Car space will splinter between many different, and incompatible platforms. That would limit revenue potential and user experience, and the ability for the smart automobile to become part of the broader 'internet of things'.

Among the critical success factors, then, are to

- guarantee consistent and secure quality of experience.
- to support seamless usage across Wi-Fi, cellular and other connections, in order to provide unbroken continuity, and to optimize the costs for the provider.
- to provide abstraction layers that protects users and service providers from siloes and technology dead ends.

Platforms are emerging which address all three of these factors. Birdstep Technology is a pioneer in what it calls Experience Continuity, and this paper will examine how this approach can help providers to grasp the opportunities that arise when users' cars are connected to the Internet and to one another.

A recent study by Telefonica[1] found that a full 80% of consumers expect that, when they invest in a Connected Car, it will provide the same connected experience as they have on home, work and mobile systems. This means unifying handoff, QoS, user interfaces, available apps and content, often via the cloud.

According to the operators surveyed by Rethink, the most important services for which they are seeing consumer demand are security; uninterrupted service (both in the car and when moving beyond it, and especially for calls or video and music streaming); and high quality for in-car video.

As they look to layer added value on top of basic connectivity, to push revenues up, continuity, and overall quality, of experience will be an essential enabler, allowing the Connected Car's applications and connectivity to be integrated into the customer's broader wireless experience, thus generating additional value to the operator and other partners. Indeed, 59% of operators said that continuous experience with other networks and devices was 'essential' or 'very important' to their planned business model for consumers.

This paper will examine the key enablers which will enable providers from any of the three groups to help mitigate the risks of fragmentation, and deliver the critical elements of security, flexibility and quality of experience to support successful Connected Car services.

> "Attempts to promote one essentially proprietary ecosystem over others, made some sense for the handset market where consumers can effectively choose between them according to the smartphone they prefer, or the cellular service they subscribe to. But for the Connected Car it is a hindrance to service and market development because it duplicates development efforts by the automobile OEM and locks them into proprietary solutions while reducing choice for consumers. For the tethered connection a neutral model is required where a consumer could project and interact with a smartphone via their in-dash head end, regardless of the smartphone or OS.
>
> **Lonnie Schilling, CEO, Birdstep Technology**
>
> "

[1] *Telefonica, 'Connected Car Report 2014', https://m2m.telefonica.com/connected-car-report-2014.html*

Introduction

a) The Connected Car market gains scale

The Connected Car seems to have burst into the consumer mainstream out of nowhere. Suddenly, your center console plays host to your favorite apps. The latest car adverts on TV show a distracted driver surprised that the car took control, to avoid changing lanes. Mobile operators are starting to include cars in their mobile plans. But in reality, the road leading to the present has been under construction, incrementally, for more than a decade.

In the world's more advanced regions, our research confirms that the car companies have been working closely with telecommunications carriers, technology suppliers, systems integrators and regulators to transform a wide range of applications from concept to production reality.

Figure 1 indicates the scale of Connected Car growth by forecasting units shipped between 2013 and 2018. Volumes are expected to achieve a compound annual growth rate of 27.3% in the period, across the three main types of Connected Car systems – embedded, tethered and smartphone-based, which will be detailed in later sections. Total units are predicted to reach around 70m in 2018, and by then there will have been cumulative shipments of almost 280m.

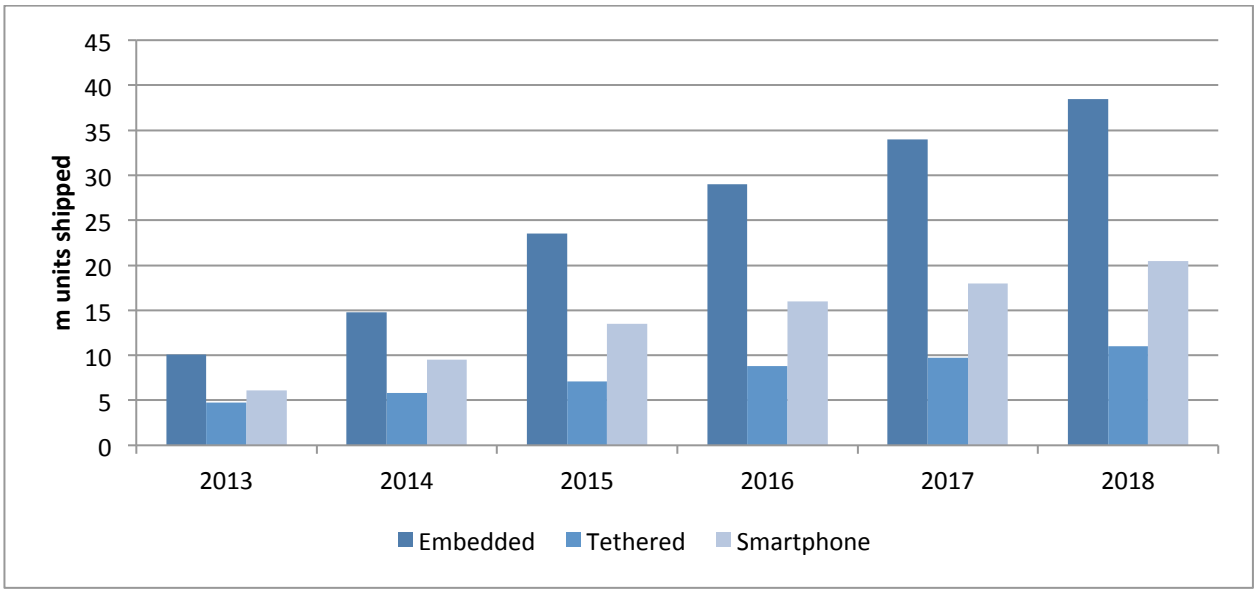

Figure 1. Rise in unit shipments of Connected Car systems of three main varieties. Source Rethink Technology Research service provider survey July 2014 plus consensus forecasts (GSMA, AnalysysMason, IHS).

Despite all this growth potential, however, there are significant challenges to turn huge numbers of Connected Cars into revenue streams for ecosystem players, and useful services for consumers. Essential to success will be the quality of experience, and the range of applications users can receive; the cost of those services; and fully trusted security and privacy. Service providers and car manufacturers will need to deliver those elements, with cost bases and revenue streams which justify the significant investment in networks and platforms. In this, an important enabler will be what Birdstep Technology labels Experience Continuity (see inset for definition).

b) The service providers

Continuity and consistent quality of service are vital for Internet users as they move between locations and networks, and this is no longer just about smartphones and PCs. Increasingly, it will be an important part of the service provider's business model for all connected devices, the Connected Car being a subset.

The Connected Car is just moving beyond a premium niche play and into the mainstream, especially in the United States. Users will be looking for a common, unbroken and high quality experience as they shift between connected screens (smartphones, cars, PCs, home devices and so on), which may be linked to different cellular and Wi-Fi networks at different times. This integration of different devices offers opportunities to deliver new kinds of applications and services to users, and also enables companies to amass a very detailed picture of consumers' activities and preferences across many locations, enhancing 'big data' business models.

Several types of companies may take advantage of these opportunities. Major auto manufacturers are partnering with Wi-Fi and cellular providers, but it is often unclear who is 'in control'. The auto OEMs themselves are the most influential stakeholders. Their main motivations are to extend the relationship with the consumer beyond the initial purchase and warranty service intervals as well as to improve vehicle safety. Connected services such as roadside assistance, emergency services – and now, content services - establish an ongoing billing relationship.

Meanwhile, the wireless service providers, whether mobile or over-the-top, are looking to establish their own role in the value chain. The US Mobile Network Operators (MNOs) have different approaches - Verizon emphasizes quality of data communications for B2B (business-to-business), while AT&T is more focused on cross-connecting its multiple consumer-facing Internet of Things (IoT) initiatives, such as the Digital Home and the Connected Car. The common denominator is to sell the virtues of their networks, and so continuous, high quality experience will be key, even when the user/car moves between cellular and Wi-Fi networks.

c) Continuity of experience in the Connected Car

In the end, the user will decide the fate of in-vehicle technologies that support consumer-facing features and applications, and that will depend in part on the user experience and its continuity with other areas of activity.

In order to drive revenues and new services, all players in the chain need to deliver a high quality experience to drive customer satisfaction and usage, and to position the Connected Car with other services such as home and mobile connectivity. Continuity of experience platforms will therefore be important to all the players focused on this emerging opportunity.

For the operator, there is the opportunity to optimise usage across all the capacity in the HetNet (heterogeneous network) made up of different technologies, such as Wi-Fi and cellular in different bands. As Ben Schwarz, industry expert and co-author of a recent Birdstep White Paper on OTT services and intelligent network selection [[2]] points out: "Operators differentiate with Experience Continuity by setting rules and priorities within their overall network to transfer customers between connections according to their application, Quality of Service (QoS) parameters, various business rules and location. In the White Paper we give some use real cases

[2] *'OTT services and intelligent network selection', Experience Continuity white paper by Birdstep, http://www.birdstep.com/english/white-paper-download_ec.aspx*

showing how service providers can improve customer satisfaction and retention by allowing the network to decide the best connection for a particular user and situation."

These capabilities have become increasingly important as mobile operators rely on offloading data to Wi-Fi, to increase capacity and reduce cost. However, the evolution of the true HetNet will take this model several steps further. Wi-Fi and 3G/4G networks will become more integrated and hand-off more seamless. Rather than being used mainly to offload low value traffic, Wi-Fi will often be the primary connection, offering the same quality of experience to users as cellular, and reducing operator costs.

This will be vital to the future viability of the mobile operator model. As more devices, including cars, join smartphones on the network, the need to expand 3G/4G capacity will be endless, and very costly, at a time when consumers constantly demand lower data tariffs. For both the consumer and the operator, costs are reduced when Wi-Fi is used actively – provided it can offer the same QoS. As Lonnie Schilling, CEO of Birdstep Technology, puts it: "Who's going to pay for all that cellular capacity and why pay for cellular when I can use my home Wi-Fi when the car is parked in the garage? Remember, in the US a car is parked for 92% of its life. Like a tablet, a car is nomadic in nature, so when parked, it may be more cost-effective to use Wi-Fi. As with any HetNet, strong Experience Continuity will ensure a positive customer experience."

This becomes even more significant when users find themselves moving not just between networks, but also between devices and locations. They then require a consistent experience across their smartphone, Connected Car, home screens and even their wearables. The best service availability from all those locations, regardless of network type must be sought and as continuous as possible QoS must be provided in the car, the home and outdoors.

What is Experience Continuity?

Experience Continuity (ExO), as defined by Birdstep Technology, not only enables users to move between different connections within a heterogeneous network (HetNet), such as Wi-Fi and cellular, seamlessly, but also ensures a continuous user experience while doing so. While the former element is enabled by standards such as HotSpot 2.0, the latter is supported by the Birdstep ExO platform. Key elements are:

- No user intervention or action required
- Calls, video streams and other activities are unbroken
- The user is unaware of the handover and is automatically transferred to the best available connection for his or her application and device

As well as transferring seamlessly between networks, ExO increasingly also includes seamless movement between different devices such as smartphones and car systems, with no new login required, and the same permissions, user interface and apps, the intention being that there is no perceived degradation in the user experience when moving from cellular to Wi-Fi and back again to cellular.

It is important for users to experience the same quality of service (QoS) levels on every network and every screen, adding up to an overall quality of experience. Consistent QoS, in a recent survey of over 100 mobile and Wi-Fi operators, was cited as the second most important factor in attracting and retaining subscribers, after pricing (Rethink Technology Research MNO survey May 2014).[1]

Since Connected Car standards and service models are still evolving, there will also be an important role for those platform providers which can provide an 'abstraction layer' that allows users to move between different types of in-car systems or connections seamlessly and with assured security. This will be important to encourage participation in a market where it would be so easy, for service providers or auto companies, to back the wrong horse in terms of standards or usage patterns. There are many uncertainties about how future wireless capacity will grow and which standards will be pre-eminent, with new Wi-Fi extensions like 802.11q on the horizon along with '5G' developments in cellular.

> Operators differentiate with Experience Continuity by setting rules and priorities within their overall network to transfer customers between connections according to their application, Quality of Service (QoS) parameters, various business rules and location
> **Ben Schwarz, industry expert**

Abstraction layers not only unify the user experience regardless of the underlying technologies, but also cushion players from the risk of having to choose a single platform. They can also allow providers to be flexible about how their services are used (by systems embedded in the car, or tethered handsets, for instance); and can provide an additional, and important, layer of security.

This paper will examine the particular opportunities that arise when users' cars are connected to the Internet, to one another and particularly when customers are seeking a common experience across their car, smartphone and other devices. Key opportunities lie in direct services revenues; improved customer attraction/retention through differentiated offerings and 'big data' analytics. These will be examined in terms of three primary segments – consumer, B2B and vehicle support – and from the viewpoint of different types of service providers.

1) Anatomy of the Connected Car and its markets

To help make sense of the overall Connected Car industry landscape, it is helpful to segment it into three different categories:

- Consumer-facing opportunities, including 'Connected Infotainment' applications from automotive manufacturers (OEMs), and from third party providers which present services and content through branded user experiences.
- Business-to-consumer (B2C), business-to-business (B2B) and Business-to-business-to-consumer (B2B2C) applications, for consumer services, vehicle fleet management, optimization of insurance coverage, and other applications that require wireless data telemetry'.
- Vehicle support, including in-vehicle, vehicle-to-vehicle (V2V), and vehicle-to-infrastructure (V2I) communications and networking.

This White Paper will look at these, one by one.

a) Connected Car stakeholders

Every decade has seen generational advances in technology. The 1980s was the decade of enterprise communications and the local area network. The World Wide Web became a consumer phenomenon during the 1990s. In the 2000s, IPTV led to multiscreen video delivery. Each of these saw a convergence of multiple enabling technologies – more each time. The 2010s are emerging as the decade of the Connected Car, and there are more stakeholders this time than ever before.

Business stakeholders in the Connected Car include:

- Automobile manufacturers (OEMs), which manufacture the vehicle and may act as the primary gate-keeper for software applications, connectivity, communications, and their underlying enabling technologies.
- Traditional automotive aftermarket suppliers that have focused primarily on car audio but have added connected conveniences and apps (Tier-1s supply the OEMs; Tier-2s supply the Tier-1s).
- Embedded software providers offering consumer-facing applications that reside in the center console, and the requisite supporting middleware and operating system software. Also software to manage in-vehicle electronic control units, in-car networks, sensors, WAN access and security.
- Connected application developers whose applications reside in external devices that complement the automotive experience, such as route-finding apps and 'electronic key fob' apps to help drivers locate, unlock and start the vehicle.
- Device suppliers that provide embedded mobile 3G/ 4G/LTE or Wi-Fi radios, mobile Wi-Fi hotspots, USB connectors and plug-in communication devices used to transmit vehicle data for insurance and fleet management applications.
- Content providers and advertisers with content that can be tied to location or travel.
- Integrators of software, devices, networking and communications infrastructure.
- Communications service providers that enable the above business stakeholders to access the vehicle and its associated applications, or partner with the OEM to provide mobile SIM cards.
- Radio access network suppliers that offer APIs for OEMs, suppliers and applications developers to access functionality in their networks that can optimize their applications.

Each of these groups has a particular place in the value chain.

A study by the GSM Association (GSMA Connected Car Forecast February 2013)[3] indicated that, in value terms, the Connected Car market would be worth €39bn ($52.4bn), up threefold since 2012, with €24.5bn of that coming from in-vehicle services, €6.9bn from hardware units, €4.5bn from telematics services and €4.1bn from the provision of connectivity. Both in-vehicle and telematics offerings will have the important revenue component of big data, which will also feed into broader analytics platforms.

[3] *GSM Association, February 2013, Connected Car Forecast http://www.gsma.com/connectedliving/wp-content/uploads/2013/06/cl_ma_forecast_06_13.pdf*

b) Implementing Connected Car services

There are several general approaches toward implementing Connected Car applications:

- Embedded by the OEM at time of manufacture.
- Embedded after manufacture by installing aftermarket audio and video systems, navigation systems and other products that add roadside assistance or emergency services to the vehicle; either replacing the OEM's solution or supplementing it.
- Tethered, to integrate the consumer device with the car's IVI system, to cross-connect and control device-resident apps and functions such as telephony from the car's user interface, such as controls on the steering wheel.
- Attached to a car's built-in on-board diagnostics (OBD-II) port, to access information about vehicle health and usage. Insurers are implementing applications through this port to help consumers minimize personal insurance expenses. There are even apps to expose this kind of information to friends via social media, One example is Dash,[4] by Dash Labs, which lets drivers compare their driving with friends. Another is Automatic,[5] which provides a simple interface to a host of automotive data and lets users connect with Automatic's user community.
- Connected to the outputs of consumer media players, smartphones or tablets, to the inputs of the IVI system for music or video playback.

c) Anatomy of the Connected Car

The Connected Car as a complex environment with many different kinds of systems and many stakeholders. Therefore, it's helpful to segment the Connected Car into functional domains.

Front Seat

From the consumer's point of view, the front seat is the car's business office. The information presented there is strictly intended for the purpose of driving.

Source: Tesla Motors

[4] *Dash: Smarter Driving Every Day*. Company Web site. Dash Labs. Accessed August 19, 2014. See: https://dash.by/

[5] Automatic, An Auto Accessory That Makes You A Smarter Driver. Company Web site. Automatic Labs Inc. Accessed August 19, 2014. See: https://www.automatic.com/

Driver's Side

The priority for the driver is to have up-to-the-millisecond information about the situation of the car – the car itself and the car in relation to its surroundings. Secondarily, the driver benefits from informational content that immediately serves the driving experience, such as mapping, driving directions, in-vehicle environmental control, and functions that minimize driver distraction such as voice control and synthesis.

Passenger's Side

The passenger seat is a hybrid environment. The passenger is in a position to assist the driver with the above, but is also in a position to do things that would distract the driver, such as searching for activities at a destination, taking the time to select the right music, or operating apps from a mobile device that is also playing music through the car's audio/IVI system.

Rear Seats

Rear seats are all about entertainment. It's commonplace for families to add seat-back screens for video.

Source: Nissan

Some car manufacturers and aftermarket suppliers offer slots for SD cards and USB storage, so they can transfer pictures to the in-car screens.

d) Systems in the Connected Car

The Connected Car is made up of a variety of interconnected subsystems, each of them managed by an Electronic Control Unit (ECU). These include the following:

In-vehicle Infotainment (IVI)

An IVI system is the modern incarnation of what was once the car stereo. It runs multiple functions, including:

- Apps for entertainment, information, navigation, vehicle status, car instrumentation, and safety.
- Access to environmental controls such as ventilation, air conditioning and heating.
- Inputs and outputs for screens and loudspeakers and for devices that consumers bring into the vehicle.

The head unit, which is the industry name for the system itself, contains the radio receiver and connectivity to antennas, an amplifier, memory, storage, a processor, a real-time operating system, device drivers, device-abstraction, and the other components that one would normally expect in a connected computer or even a TV set-top box. Modern vehicles also incorporate a network backbone (bus) to enable the interconnection of the Electronic Control Units (ECUs) in the vehicle.

Telematics Control Unit (TCU)

The TCU is the primary communications interface between the vehicle and the outside world for content delivery. The TCU helps deliver consumer-facing services located in the cloud, access content stored online or in the home, and send vehicle data telemetry to the manufacturer and to other business stakeholders.

TCUs can manage four areas of content delivery:

- Infotainment content: Radio (over IP or broadcast), video, images, and informational data content such as messaging.
- Location-oriented content: Reception of content used in mapping, traffic, route-finding, advertising, points of interest, parking lots, weather conditions, search and recommendation.
- Vehicle-centric service content: Roadside assistance, concierge, emergency calling, conveyance of vehicle status content for remote diagnostics.
- Content relating to vehicle monitoring for fleet management, insurance, or stolen vehicles.

Many use cases involve the exchange of multiple types of information simultaneously. For example, a collision might prompt the vehicle to automatically send information about the vehicle location, the status of door locks and to initiate an emergency telephone call.

Other Electronic Control Units

- Advanced Driver Assistance Systems (ADAS): Subsystems and devices that are interconnected with in-dash infotainment and body control systems, which include cameras, ultrasonic, or radar sensors mounted on or within the car and are the sensory system of the car. Applications include the adaptation of speed to traffic, parking assistance, collision avoidance, lane departure warnings, blind-spot detection, and even autonomous driving.
- Body Control Units: a type of ECU that controls the car's door locks, exterior lights, interior lighting, wipers, seat position and similar functions. Some cars have separate

airbag control units, door control units, seating control units and other specialized controllers that other cars incorporate within the BCU.

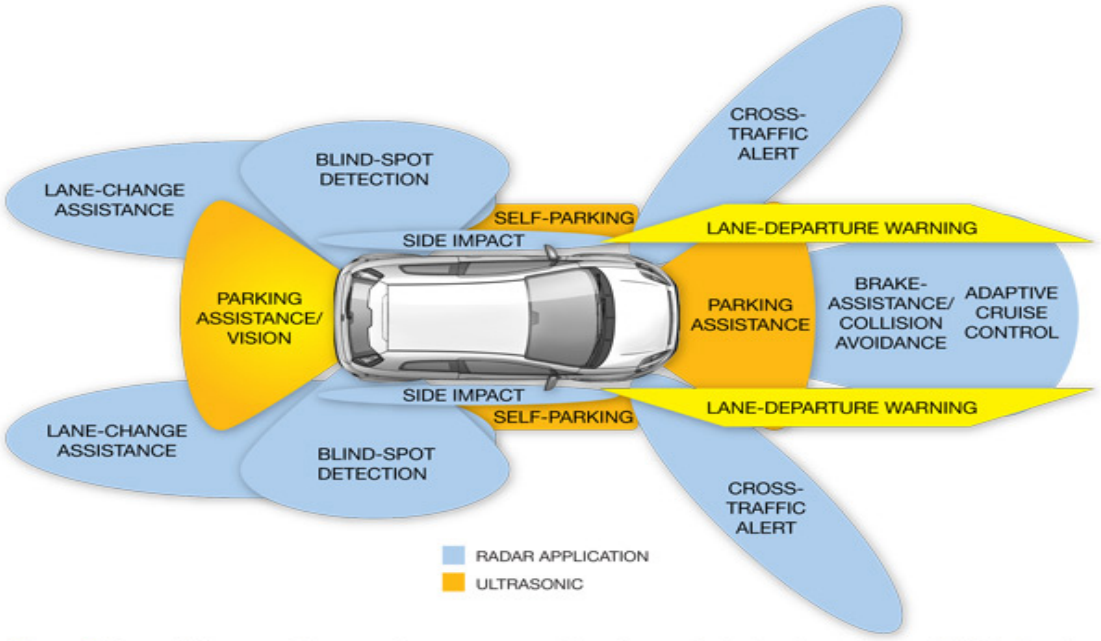

Figure 2. Types of Advanced Driver Assistance Systems (Source. Analogue Devices)

Autonomous driving is an advanced application of ADAS. Google has been developing driverless vehicles for several years, and in September 2012, California became the first state to allow self-driving cars on public highways.[6] Many car makers are in the process of developing and introducing assisted driving use-cases in production vehicles.

2) Car connectivity in the wireless business model

There are three main groups targeting the Connected Car –auto makers (as described in Chapter 2); mobile network operators (MNOs); device/over-the-top providers such as Google, which are also specialists in data aggregation for automotive applications. These may compete or cooperate, depending on the application and market. They will also work closely with other players in the chain, such as the wireless infrastructure providers, which are increasingly launching services such as cloud-based device management or big data services for the Connected Car.

The company that can provide that integration will have significant impact on the user experience and buying relationship to the car. However, the auto makers, as seen in the previous section, also aim to be the primary point of contact, using the customer's attachment to their car in the same way that Apple used its iPhone to push services and collect data effectively relegating the wireless connection itself beneath the bonnet, constraining it to the role of dumb data pipe.

Operators and mobile device/OS providers will both be aiming to offer a common platform which ties together multiple screens and connections under one brand, making the car just one aspect of an overall experience.

[6] *Brown signs bill regulating self-driving cars in California*. Article. September 25, 2012. The Los Angeles Times. Accessed May 20, 2013. See: http://articles.latimes.com/2012/sep/25/business/la-fi-mo-self-driving-car-law-20120925

All these competing and overlapping interests can lead to fragmentation and consumer confusion. It will be important that there are umbrella technologies, offering a consistent experience across whichever type of service consumers choose, allowing them to transfer easily between services led by auto makers, operators or platform providers.

a) Opportunities for the mobile operators

The MNOs see a significant opportunity in the Connected Car. Their control over their customer bases has been eroded by non-contract data plans, mobile number portability, open access and rising consumer awareness of the benefits of shopping around between operators. But as the first LTE cars come to market, some will be tied to a specific carrier, chosen by the auto firm, not the end user. Like utilities, and other groups which are embedding cellular connectivity into the devices that they sell to their end customers, they will sign deals with a single provider – deals which may come up for review every few years, but will have none of the unpredictability of consumer choice.

This is the dream outcome for the operators, and they are battling hard to make it a reality. Operators are already succeeding at this in the US where the first 4G cars are now coming to showrooms. They will carry a data plan like any other mobile device, but the user will not be able to choose which one. One example is General Motors' partnership with AT&T, which is further detailed below.

However, there is an alternative approach to the manufacturer-driven data plan. Some car makers are interested in becoming full MVNOs, embedding cellular connectivity so that the operator is invisible to the customer. The user might still be billed in a traditional way, or a certain level of data could be included in the cost of the car – a model pioneered by Amazon with its original 3G Kindle e-readers, and also adopted by some mobile PC makers and Japanese consumer electronics firms. However, the MNO's main weapon in negotiating this balance of power will lie in its ability to support a common experience, and shared data plans, across many devices, not just the car.

In Europe, the situation is looking less favourable to Telco's, since the LTE-enabled Audi S3 has appeared with a SIM card slot in the dashboard, so that the user can insert any carrier's SIM. BMW and Mercedes have similar initiatives (though they all have embedded models too, so the consumer will ultimately decide in this region). In addition, Audi has a Gemalto M2M module that supports many of the European spectrum bands. This reflects the long-standing difference between the European and US approaches to frequency and operator flexibility, via the almighty SIM card.

However, the SIM card is a double-edged sword. It keeps the carriers in the driving seat, but it also makes it hard for one single carrier to lock down users as the US operators are being allowed to do by the car sector. European counterparts will still have to fight for customers (though they will be able to get valuable behind-the-scenes contracts with carmakers for systems such as roadside assistance control). And in time, the SIM card could become an enemy in the machine-to-machine (M2M) space, which encompasses a vast range of items which connect to one another with no human intervention.

Figure 3 indicates the complex relationships of the different stakeholders, showing the different ways in which mobile operators expect to monetize the Connected Car – sometimes through standalone offerings, sometimes by providing enabling connectivity services to the car companies. Big data analytics are seen as one of the most important opportunities, placed in the

top two by over 20% of North American operators, though in the rest of the world, bundled cellular/Wi-Fi/car plans were in the lead. The primary monetization approaches vary between direct-to-consumer strategies like bundling; B2B services like big data and targeted advertising; and revenues from services which are embedded and billed by auto makers.

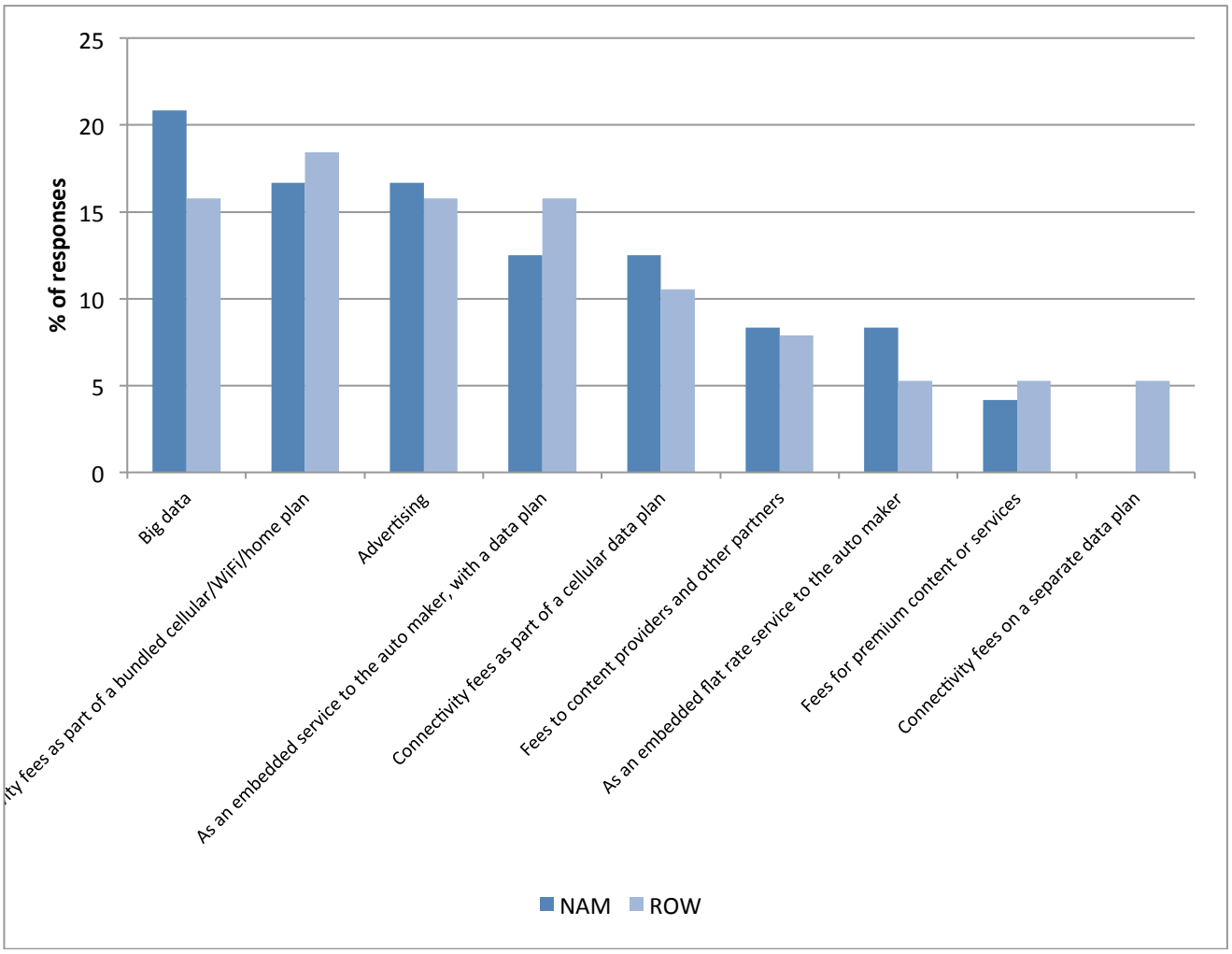

Figure 3. Main anticipated methods of monetizing Connected Car services (2 responses only per operator). Source: MaRe/Birdstep operator survey July 2014.

b) Managing the connections and achieving continuity

The opportunities available to the mobile, converged or Wi-Fi operators will, of course, depend partly on how the car is connected. Most commonly LTE is used to backhaul a Wi-Fi access point within the car, either through an embedded modem or tethered smartphone, turning the vehicle into a hotspot. However, there are other connectivity options emerging, such as the 802.11p extension to the Wi-Fi standards, which will underpin V2x communications in the US and elsewhere. 802.11p allows for long range secure transmissions between networks, so that cars can form huge mesh networks, talking to vehicles miles down the road and the highway and traffic systems around them.

The V2V systems currently alert drivers to possible dangers, and do not automatically operate any vehicle systems, such as braking or steering, but in the US, the NHTSA is "also considering future actions on active safety technologies that rely on on-board sensors, that are eventually expected to blend with the V2V technology.".

In other words, cellular and Wi-Fi technologies will increasingly be cooperating inside the car and for V2x communications of all kinds, making seamless hand-off an important enabler. It will also be important when users move between the car and other locations, to support unbroken activity as the device hands off from the in-car system to the macro-cellular network to the hotspot or in-home WLAN, and so on.

A recent study by Telefonica[7] found that a full 80% of consumers expect that, when they invest in a Connected Car, it will provide the same connected experience as they have on home, work and mobile systems. This means unifying handoff, QoS, user interfaces, available apps and content, often via the cloud. Figure 4 indicates where operators, in a survey of over 40 tier one MNOs conducted by Maravedis-Rethink in July 2014 - expect their Connected Car services to be running, and this shows a major shift towards cloud delivery, which raises its own challenges of consistent quality of access across different connections.

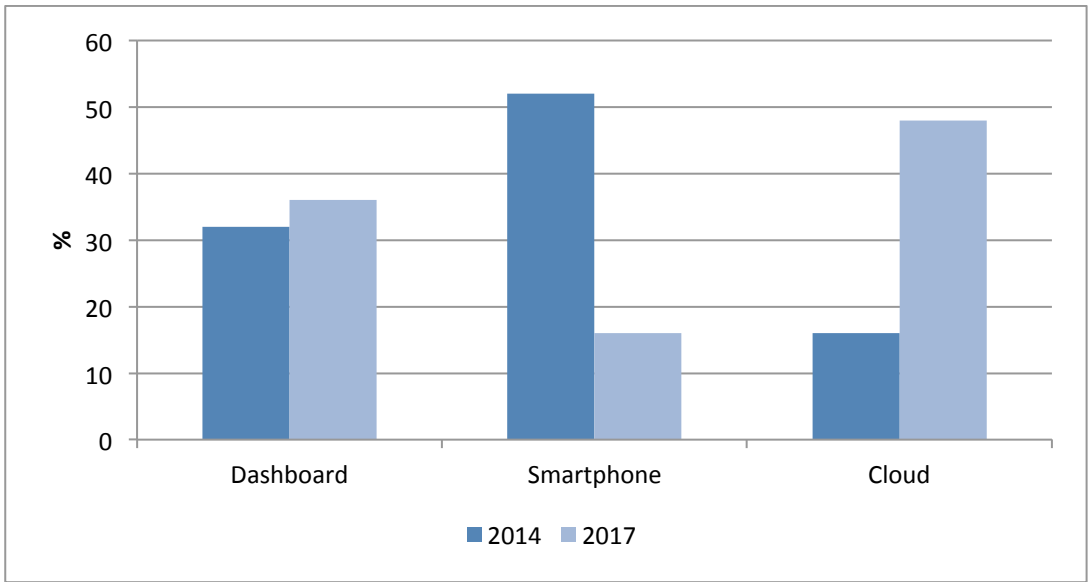

Figure 4. Percentage of MNO Connected Car services which will run in different locations (consensus of sample of over 40 tier one MNOs). Source: MaRe/Birdstep operator survey July 2014.

Another challenge will be to provide continuity of experience when users are accessing services and applications, which are located in different places, as well as from different screens. Over the coming three years, the consensus among the 40-plus MNOs surveyed by Rethink was that they would make a significant shift towards delivering services to cars from the cloud. By 2017, the number of applications accessed from the cloud by drivers and passengers is expected to rise from less than 20%, to almost half.

There may be an element of wishful thinking here - operators and their partners will gain competitive advantage if users can move freely from cloud-based to locally stored apps and content, and between different connected devices, without having to be aware of the locations themselves. This will also dilute the power of individual device makers, if the focus moves from the gadget itself to a unifying cloud, potentially improving the MNO's balance of power with Apple, in particular.

[7] *Telefonica, 'Connected Car Report 2014', https://m2m.telefonica.com/connected-car-report-2014.html*

The operator that can coordinate all these handovers, syncs and consistencies, delivering a strong experience to the customer, can claim a competitive advantage. While over-the-top providers like Amazon may be strong in delivering a synchronized cloud/local experience, the MNO can complement this with seamless connectivity on any network, increasing the amount of time when customers can be online with uninterrupted access to cloud services.

In some cases, the carrier will harness this to appeal directly to the consumer, attracting them with the promise of high QoS wherever they are connected. In others, it will use a strong customer experience story to secure deals with the auto makers, which embed the connectivity solutions in their cars and offer good QoS as a selling point for their vehicles, with the individual operator remaining invisible. And thirdly, they can partner with a cloud services provider to improve the latter's ability to deliver continuity of experience to subscribers.

c) Over-the-top and platform providers

The mobile web and device giants, led by Google and Apple, want to extend their user interfaces, applications and big data activities from smartphones to cars, expanding the situations where they can sell advertising and apps. They are building on their huge installed bases of developers, apps and loyal users. Google has created an Android-based implementation specifically for cars, Android Auto, as part of a broader effort to develop a common platform around its operating system, reaching into every kind of device and screen from handsets to smart home gadgets to wearables and cars.

The Mountain View behemoth has also set up the Open Automotive Alliance, a group of supporters which will support its platform and adhere to its rules. Android Auto allows users to plug handsets into cars to control both the vehicle and phone. They will then be able to navigate the phone using a combination of voice, touchscreen and physical knobs and buttons to minimize distraction when driving.

In Google's vision of the Connected Car, the vehicle is effectively empowered by the phone – acting as an extension of the user interface rather than a central intelligence. This device-centric approach can reduce the cost to auto OEMs of developing their own in-car systems, but also reduces their control over the experience and the services presented to drivers.

That, in turn, shifts the monetization opportunities from the car market to the software provider, at least for consumer apps. It's helpful not to lose track of Google's primary objective, which is to make the Connected Car an extension of Google's advertising ecosystem – after all, advertising makes up about 98% of Google's revenue. The native systems in the car, such as the radio and climate controls, are less likely to fall under the control of Apple and Google because the car needs to function even if the handset is not plugged in.

Android Auto should also support advanced services such as vehicle diagnostics and roadside assistance systems. And Google says it will help build scale for in-car applications, since it removes the need for developers to rework their software for each type of car system.

> Who's going to pay for all that cellular capacity and why pay for cellular when I can use my home Wi-Fi when the car is parked in the garage? Remember, in the US a car is parked for 92% of its life. Like a tablet, a car is nomadic in nature.
> **Lonnie Schilling, CEO, Birdstep Technology**

Meanwhile, Apple's CarPlay in-car interface allows iPhone users to access Apple services such as maps, iTunes and messaging via the vehicle's audio system (its own voice controls or Apple's Siri). The company also offers an embedded version of the iOS 7 operating system, with the Siri voice-activated personal assistant forming the backbone of user interaction in the car, to minimize distraction. Apple's objective remains to sell devices and the Continuity of Experiences and content. It is not currently focussed on advertising opportunities.

The carmakers which are supporting both Android Auto and Apple CarPlay include Audi, Chevrolet (GM), Ford, Honda, Hyundai and its 32.8% owned subsidiary Kia, Mitsubishi, Nissan, Opel (GM), Subaru, Suzuki and Volvo. Apple-only manufacturers are BMW, Peugeot and its subsidiary Citroen, Fiat group, Jaguar Land Rover, Mercedes Benz and Toyota.

The manufacturers which are currently Android-only are the Fiat Group brands that include Abarth, Ferrari, Fiat, Maserati and Alfa Romeo; the Chrysler group which is majority-held by the Fiat Group that includes Dodge, Jeep and Ram; Mazda, Renault, and the Volkswagen Group's Bentley, Seat and Skoda and Volkswagen itself; Acura (Honda) and lastly Infiniti (Nissan).

Other platforms include **BlackBerry**, with its QNX real time operating system, which currently claims around 50% of the IVI market. It has been used in over 200 car models, including vehicles from GM, Honda, and Hyundai and is regarded as a mature and stable platform, which could host Android apps too.

And there is **Microsoft**, with its Sync IVI system plus embedded Windows. And Windows Phone's Cortana (a competitor to Siri) may help the firm move up the value chain with its own voice-controlled handset option. Microsoft recently unveiled its Windows in the Car concept, which aims to put Windows Phone onto a screen in the car via MirrorLink, from the Car Connectivity Consortium. MirrorLink will essentially mirror the phone's screen on any display within the vehicle and will allow the car to use IVI apps on the handset.

For the consumer, it will be important that these different platforms can interoperate with one another, and with different in-car systems, to avoid lock-in. Birdstep's Schilling commented: "These attempts to promote one essentially proprietary ecosystem over others, made some sense for the handset market where consumers can effectively choose between them according to the smartphone they prefer, or the cellular service they subscribe to. But for the Connected Car it is a hindrance to service and market development because it duplicates development efforts by the automobile OEM and locks them into proprietary solutions while reducing choice for consumers."

He added: "For the tethered connection a neutral model is required where a consumer could project and interact with a smartphone via their in-dash head end, regardless of the smartphone or OS. This would likely be appreciated by the consumer who wants to use his Android phone in his newly purchased Mercedes sedan."

3) Business opportunities in the Connected Car

Once the cars are connected, a range of business opportunities opens up. As outlined above, these fall into three categories, each of which will be detailed in this section.

a) Consumer services

The first category of opportunities is for consumer-facing media and entertainment services, which the automotive industry refers to as 'infotainment.' Individual services include mobile audio (radio and music) and multimedia (web and video) services distributed using unicast, multicast or broadcast. The consumer usually consumes these services on a subscription basis.

Another set of services is based on location awareness and device presence. These include cellular-based services that can help consumers locate family members, and enable others to see whether or not a person (or a vehicle) is available over the network. Location awareness also enables applications that help users navigate and manage their driving experience through traffic. In network scenarios that don't have modern mobile IP networks in place, location is determined using GPS or Glonass satellite-based positioning.

Messaging services and email can also be extended into the car, and accessed through an in-vehicle touch screen, or through voice commands and speech synthesis. Voice is sure to be an important element of the overall human-machine interface (HMI) in the Connected Car.

b) Telematics services

The second major category of Connected Car opportunities relates to telematics-based business services; both business-to-business and business-to-consumer. Telematics is the auto industry's term for is the intersection of telecommunications, big data, in-vehicle technologies, and the physical infrastructure of roads and local authorities. B2C services include roadside assistance, breakdown calling and emergency services.

These telematics-based services may be captive to the auto manufacturer or offered by a third party. Examples of the former are GM's OnStar service and Volvo's Volvo On Call. Another is ARC Europe,[8] a joint venture of eight European automobile clubs in the UK, Germany, Italy, the Netherlands, Austria, Spain, Switzerland and Belgium. Its ARC Telematics[9] business unit provides stolen vehicle, roadside assistance and emergency call services. Stolen vehicle tracking, which is expected to be particularly popular in emerging countries where risk of theft may be higher.

Insurance is an area of interest both to consumers and to businesses, in which the usage of a car can be monitored and tracked remotely, including mileage, speed, fuel economy, collision detection, and other parameters that are useful in determining consumer insurance rates based on risk to the driver and the vehicle; and for usage-based insurance (pay-as-you-drive, pay-how-you-drive). In the United States, Progressive Insurance began offering its Snapshot®[10] monitoring device to consumers in 2012, and it has proven to be popular. Snapshot monitors[11] miles driven, acceleration and braking, and the time of day that the user drives.

Other B2B telematics services include in-car diagnostics and monitoring use-cases for roadside assistance, emergency response and insurance applications. Automotive and truck fleet owners and rental agencies can use global SIMs to locate vehicles and enable them to communicate with manufacturers or owners in distant locations, other countries, or across multiple transportation infrastructures.

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[8] ARC Europe. *Web site. Arc Europe SA. See: http://www.arceurope.com/*

[9] ARC Europe Telematics. *Web site. ARC Europe Telematics SA. See: http://www.arceuropetelematics.com/press*

[10] Snapshot® Monitoring Service. *Informational Web page. Progressive Insurance. See: http://www.progressive.com/auto/snapshot/*

[11] *Snapshot Privacy Statement*. Informational Web page. Progressive Insurance. See: http://www.progressive.com/auto/snapshot-privacy-statement/

c) Support for extra-vehicular communication

The third area of opportunity is for operators to offer data telemetry and data transport for vehicle-to-vehicle and vehicle-to-infrastructure communications, to enable a range of applications founded upon the relationships between a vehicle and its surroundings.

Rather than being an immediate opportunity, this opportunity will emerge over the next decade. Efforts are underway by governments, regulators and technology suppliers to enable intelligent metropolitan transportation systems, to help coordinate traffic based on density, signals and environmental conditions; and even enable toll collection.

Another set of opportunities arises around maintenance and operational optimization, including remote diagnostics and telemetry to collect data that can be used to fine-tune the operation of the car. These can be used as 'big data' to statistically aggregate and discern patterns that emerge across all vehicles in geographic regions, across entire automobile models or model years, or a number of other analytical criteria.

d) Big data

The big data aspects of the model are particularly interesting to many operators and over-the-top (OTT) players and these models are integral to all the individual use cases outlined above. Connected Car systems can collect valuable data about the user's habits within the car, but this will often be the preserve of the auto maker. Where operators and web providers can add value is by integrating that data with information about the same consumer, from other sources such as their handsets or smart home devices. They can, in this way, build up a picture of the user's behavior and preferences in many areas of life, provided they are able to 'follow' that individual regardless of how he or she is connected.

When analytics are applied to this kind of data, it can be used to:

- Improve services to the users themselves, by monitoring their quality of experience wherever they go.
- Enable third parties to offer personalized ads and promotions, such as targeted video content, or an insurance offer linked to driving habits.
- Feed anonymously into big data efforts such as traffic management planning or retail planning.

Since the average American spends 11 hours a week driving, in-car systems are clearly an important source for this kind of data. Each participant in the value chain will seek to control the big data goldmine, but the most powerful analytics will come from an open system in which information from all kinds of devices, networks and users can be consolidated. The resulting analytics will have high value for customers such as advertisers or marketers; and for the MNOs, car makers, parts manufacturers and other players, as they seek to deliver the most relevant and targeted services to drivers.

e) The operators' opportunities

The mobile operator's challenge is to identify which services, within the landscape outlined above, can deliver incremental revenue, directly or indirectly, and which the carrier has a realistic chance of controlling. Maravedis-Rethink's operator-based studies indicate that nearly all tier one and tier two mobile operators (92%) plan to offer Connected Car services by 2018 – 90% plan to offer connectivity, big data and other services to auto makers, and 84% to enterprises and verticals, and the same percentage direct to consumers (see Figure 5). Although for many, deals with the large auto companies are the first priority, as they can help achieve critical mass quickly, most operators see the Connected Car as an opportunity to extend their services in all their bases, including consumer and enterprise. At this early stage, most are keeping their options open and

targeting all three main markets, though over time, some are likely to become more specialized, especially those which fail to net the largest auto maker partnerships.

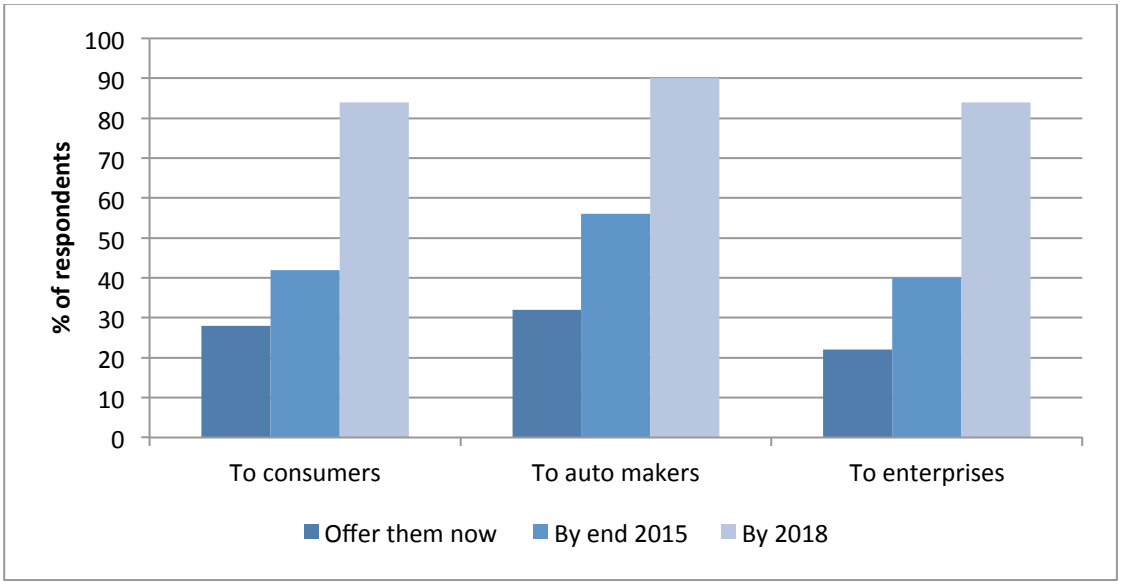

Figure 5. Percentage of mobile operators offering or planning Connected Car services in 2014 to 2018 (MaRe operator survey June 2014, over 100 respondents)

Rethink then conducted a specific survey of over 40 tier one mobile operators with an active interest in offering Connected Car services by 2018, in order to establish what this community sees as the most promising business models, and the key enablers.

For now the primary consumer interest is in highly car-specific services. Safety and security features currently appear to be the ones for which consumers, especially in the US, are most willing to pay, while – as with mobile services – it is more challenging to charge significant amounts for applications or content for in-car usage. According to Telefonica's second annual Connected Car report, published in July 2014[12], the features, which drivers considered most important – and for which they would be most likely to pay extra – are:

- Safety features such as roadside assistance and geo-fencing to monitor young drivers.
- Early warning systems.
- Smarter navigation systems.

Three-quarters of the respondents said safety and diagnostics were the most important features to them.

That is sure to change as consumers become more accustomed to the new generation of IVI systems, but it is important to consider how these will be monetized. Figure 6 indicates the primary services which operators expect to deploy for the Connected Car over the coming 3-4 years.

[12] *Telefonica, Connected Car Report 2014, https://m2m.telefonica.com/connected-car-report-2014.html*

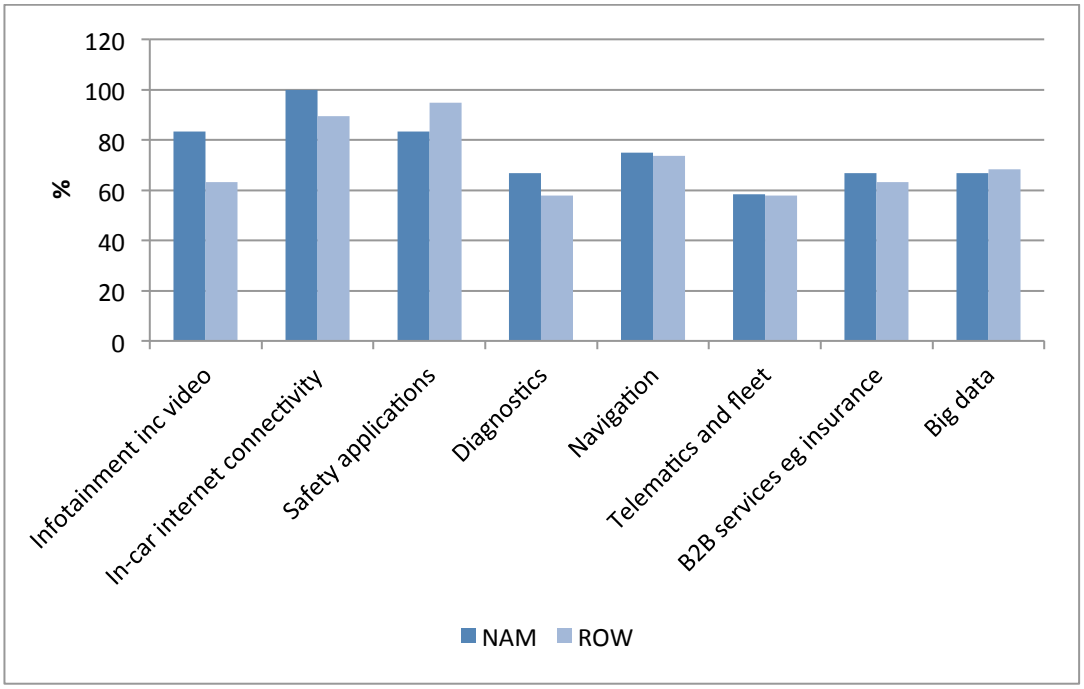

Figure 6. Of MNOs planning to provide Connected Car services, %, which aims to deploy each class of services by 2018 (split by North American operators and Rest of World operators. Source: MaRe/Birdstep operator survey July 2014.

There are some regional differences, including a greater focus in North America on infotainment and in-car connectivity revenues, while on other areas car safety remains the primary offering. Overall, the basics of safety and connectivity will be the table stakes for most operators, but other services which will be provided by more than 60% of MNOs by 2018 are infotainment, with a special focus on video; navigation; and big data/analytics.

f) Service provider case studies: AT&T and Verizon

AT&T

AT&T has a strategy of building new market initiatives from opportunities that are 'adjacent' to existing services, leveraging its network as the core enabling asset. In 2012, AT&T established four strategic initiatives: the Connected Car, AT&T Digital Life,[13] a home control and home security service, a mobile payments initiative as part of a joint venture with Verizon and T-Mobile called ISIS,[14] and a Mobile Premises solution that bridges LTE to the home via gateways.

General Motors has teamed with AT&T for communications support to its OnStar roadside assistance and emergency services business. Chevrolet is equipping a majority of its 2015 model-year vehicles with 4G LTE, which will support a multitude of applications, ranging from in vehicle infotainment to vehicle telematics, to mobile Wi-Fi connectivity.

AT&T's connected vehicle initiative[15] is intended to address the US market for vehicles with embedded connectivity. With 4G LTE, AT&T has positioned itself to expand upon OnStar, and address new opportunities in the passenger and rear seats of the car, including infotainment and

[13] AT&T Digital Life. *Informational Web site. AT&T. Accessed July 21, 2014. https://my-digitallife.att.com/learn/*

[14] *Our Ecosystem. Informational Web site. ISIS Web Site, JVL Ventures LLC. Accessed July 28, 2014. See: https://www.paywithisis.com/*

[15] Media Resources: The Future of the Connected Car. *Informational Web page. Accessed July 29, 2014. See: http://about.att.com/mediakit/connectedcar*

retail services. AT&T LTE subscribers can add their vehicles to their AT&T Mobile Share Value plan [16] for $10 per month. AT&T Mobile Share offers multiple tiers of voice, text, and data service plans for fixed prices. For example, a family with four mobile phones pays a fixed fee of $160 per month for unlimited talk and text, plus 10 GB of data over LTE.

AT&T's Connected Car efforts are designed not only to leverage the technologies embedded within its network platform, but also to interoperate and work together with other AT&T services. Consequently, AT&T can conceivably reposition its U-verse IPTV service to be a part of the consumer's 'personal entertainment cloud' that also happens to be accessible from the car.

To support the Connected Car and other strategic initiatives, AT&T runs Foundry facilities where developers can create applications that leverage AT&T's networks in areas that also include IPTV, the Connected Home, wearable technologies, near-field communications, mobile health, and software-defined networking. The purpose of the Foundry facilities is to help AT&T gain an edge over other network providers in emerging opportunities that leverage broadband IP.

In 2014, AT&T introduced a Connected Car developer platform called AT&T Drive, which exposes a set of APIs to Ericsson's Connected Vehicle Cloud.[17] Ericsson is one of AT&T's primary mobile network suppliers. The platform is supported by a lab facility in Atlanta called the AT&T Drive Studio.[18] AT&T also hosts its Network Ready Lab in Austin Texas,[19] where devices can be tested and certified by AT&T.

Verizon Communications

Verizon has taken a lower profile than AT&T in promoting Connected Car initiatives, but its interest in automotive communications is just as strong. Verizon is very active both in consumer-facing and infrastructure-oriented initiatives.

In mid-2012, in partnership with BMW, Honda, Hyundai, Kia and Toyota, Verizon established the 4G Venture Forum for Connected Cars.[20] This group was established to accelerate development of a 4G LTE service ecosystem across automotive OEMs, device suppliers, app developers and content publishers. Areas of focus include embedded cloud connectivity, mobility and safety use-cases.

Although AT&T has had more visibility with General Motors than has Verizon, Verizon Wireless and OnStar were early to demonstrate streaming content to a Chevrolet vehicle over LTE, at the 2012 CES conference. The same demonstration used controls on the car dashboard to control the lights and thermostat in a consumer home. A passenger streamed movies from a home PC to the car. From the rear seat, users played games, read the news and had video-chat sessions using screens embedded in the front-seat headrests. Each user was able to control their personal experience separately but simultaneously.

Also in 2012, Verizon acquired Hughes Telematics, whose systems and services are used to provide information, entertainment, navigation, stolen vehicle, vehicle diagnostics and safety

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[16] AT&T Mobile Share coming to your Connected Car. *Press Release. May 12, 2014. Accessed July 28, 2014. See: http://about.att.com/newsroom/att_mobile_share_coming_to_your_connected_car.html*

[17] Connected Vehicle Cloud. *Informational brochure. Published December 2012. Accessed July 28, 2014. See: http://archive.ericsson.net/service/internet/picov/get?DocNo=28701-EN/LZT1381044&Lang=EN&HighestFree=Y*

[18] AT&T Drive Studio. *Informational Web site. Accessed July 23, 2014. See: https://www.att.com/edo/chooseATT/chooseATT.jsp?primary=010000#/OurResources*

[19] AT&T Network Ready Lab. *Informational Web site. Accessed July 23, 2014. See: https://www.att.com/edo/chooseATT/chooseATT.jsp?primary=010000#/nrl*

[20] *Verizon Joins with Leading Global Auto Companies to Establish 4G Venture for Connected Cars.* Press Release. June 6, 2012. Verizon Communications. See: http://news.verizonwireless.com/news/2012/06/pr2012-06-05f.html

applications to the Connected Car.[21] Now called Verizon Telematics, its customers include Mercedes-Benz, Volkswagen, State Farm and General Electric. Mercedes-Benz uses Verizon Telematics to update onboard infotainment software in vehicles.

In addition, Automobile Club of America Club Partners (consisting of 10 AAA chapters in 20 states) partnered[22] with Verizon Telematics to offer Verizon's InDrive[23] solution, which utilizes a user-installed aftermarket device to provide hands-free voice calling, emergency services, and roadside assistance.

Verizon Wireless invites third party developers to take advantage of its Innovation Centers[24] in the San Francisco and Boston areas. The Innovation Centers have on-site labs with live 4G LTE facilities, technical subject-matter experts, and go-to-market programs for developers.

In 2013, Delphi introduced Delphi Connected Car, an OBD-II module which provides vehicle diagnostics (partnered with Verizon Wireless) to smartphone apps for access to vehicle status, alerts, trip logs, family-finder, and vehicle door-unlocking services.

5. The role of Experience Continuity in successful Connected Car models

Experience Continuity is becoming an important aspect our new digital lives as within of all kinds of wireless applications and content services. Operators increasingly highlight it for its value in:

- Increasing customer usage of services.
- Increasing customer loyalty.
- Increasing their overall share of an individual's spending on connectivity and media, even if individual items are under price pressure.
- Helping to protect security and privacy in a consistent way regardless of the device or connection.
- Delivering a comprehensive set of data about each customer across all their connections and screens, for deeper analytics and more accurate targeting of services and promotions. Continuity of experience solutions enable operators to analyze the customer experience right down to the device, when users are roaming between cellular and Wi-Fi.

Meanwhile, consumers indicate that the chief advantages of continuity of experience, when moving between networks, or between cars and other devices, are the greater productivity and enjoyment, which comes from unbroken communications and video streaming.
This has resulted in considerable investment in unified experiences in recent years. The most important elements are:

- Access to the same content and data from any device, including the in-car systems, which increasingly relies on cloud systems.
- The same user interface on all screens which the consumer uses, with their preferences and modifications preserved throughout, and the look and feel automatically modified for screen size and quality.

[21] Verizon Telematics: White Label Products. *Informational Web site. Verizon Telematics. Accessed May 23, 2013. See: http://www.hughestelematics.com/portfolio/white-label.php*

[22] AAA Club Partners Selects Hughes Telematics to Offer Connected Vehicle Services.

[23] Verizon Telematics: InDrive. *Web site. Verizon Telematics. Accessed May 22, 2013. See http://www.hughestelematics.com/portfolio/aftermarket.php*

[24] Innovation Centers. *Informational Web site. Verizon Communications. Accessed May 23, 2013. See: http://innovation.verizon.com/content/vic/en/innovation.html*

- Seamless connectivity as the user moves between devices and screens, with seamless hand-off to maintain voice and data sessions unbroken.

a) Key Connected Car services in operator plans

Within the broad categories of services outlined in the previous chapter, operators are engaging in detailed research into the differentiators, which would most attract drivers and consumers. These will be important whether the carrier is marketing directly to those people, or building a platform for automakers to deliver services to their customers.

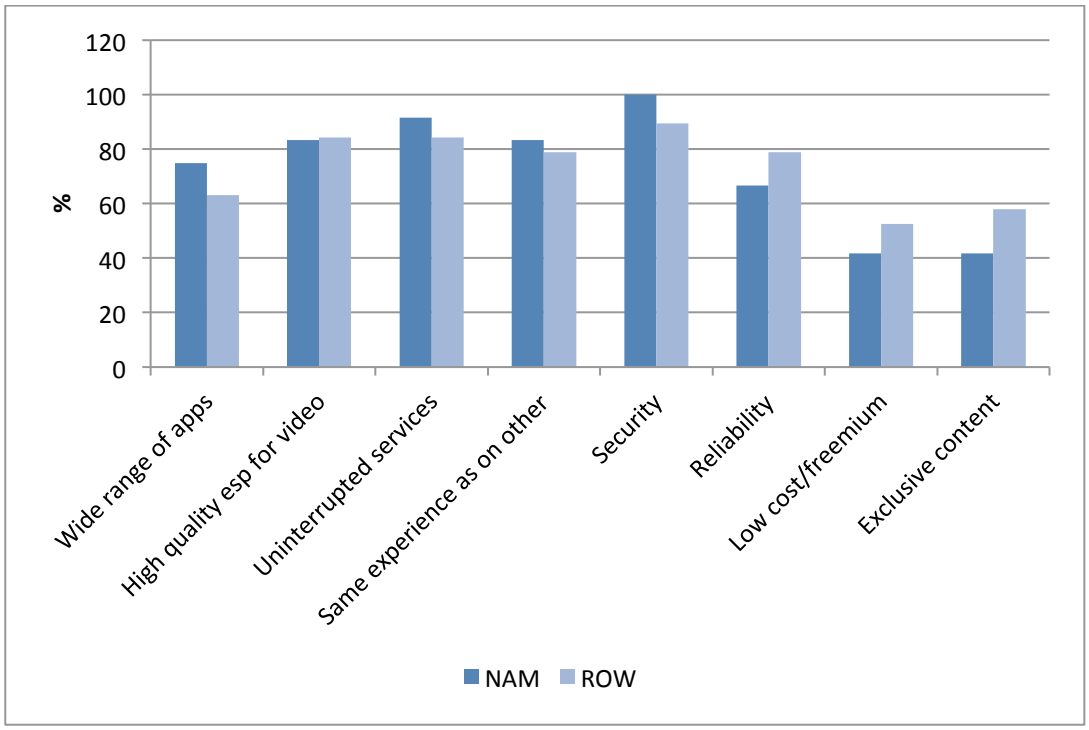

Figure 7. Features of a Connected Car service which consumers are demanding most, according to MNOs (MaRe/Birdstep operator survey July 2014)

According to the operators surveyed by Maravedis-Rethink, the most important services for which they are seeing consumer demand are security; uninterrupted service (both in the car and when moving beyond it, and especially for calls or video and music streaming); and high quality for in-car video (see Figure 7). These issues of security and quality of experience are significantly more important than availability of large numbers of applications and content items, or even cost issues (especially in north America). This pattern is somewhat contrasting with that on smartphones, where usage is often for shorter periods of time and differentiation is primarily seen in apps and content. However, the fourth most important consumer demand was to be delivered the same experience in the car as on other devices, in terms of interface, services and combined billing.

While some categories of Connected Car services will be essential just to enter the game at all - including connectivity, video streaming and safety applications - on top of those generic offerings, operators are looking for added value services to layer on top, with the hope of generating higher revenues and margins. For some of these, continuity of experience will be an essential enabler, allowing the Connected Car's applications and connectivity to be integrated

into the customer's broader wireless experience, thus generating additional value to the operator and other partners.

A high quality and unbroken experience also supports higher levels of overall usage of different services, and allows operators to create a far broader and deeper picture of the user's preferences and behaviour, to improve the ability to target them with ads or promotions, and to support big data business. The Connected Car Forum cites big data as one of the primary business opportunities for telematics providers.

b) Continuity of experience as an enabler

The importance of this issue is seen in Figure 8, indicating that 59% of operators said that continuity of experience with other networks and devices was 'essential' or 'very important' to their planned business model for consumers, and 48% said the same if they were targeting services at embedded auto systems.

However, whether the MNO, the automaker or the mobile platform provider is the main party monetizing the Connected Car, the same factors will apply as they seek to maximize usage and revenue from consumers and B2B partners.

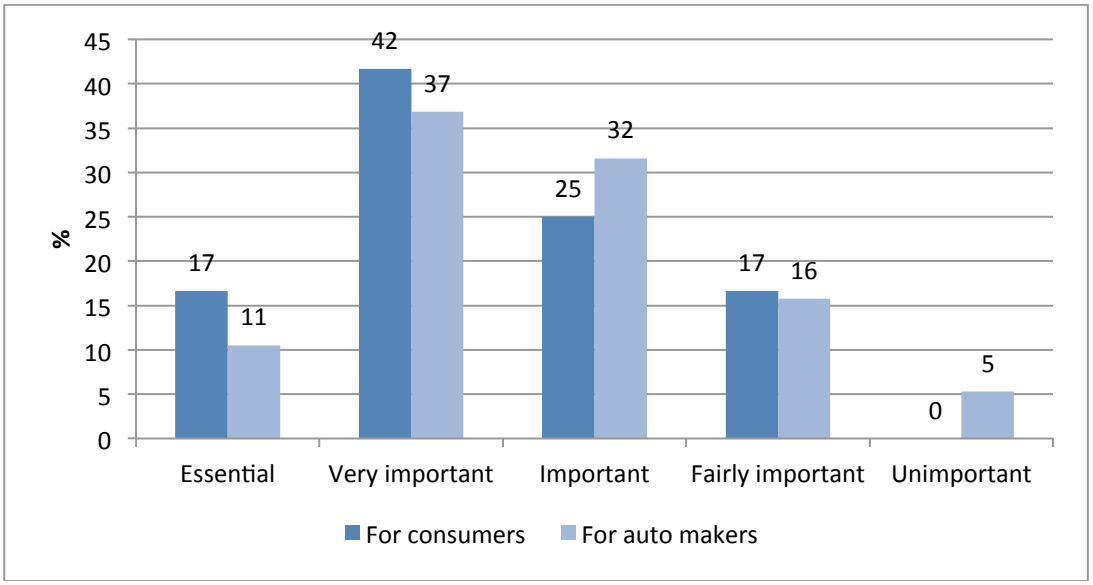

Figure 8. Importance of continuity of experience in enabling Connected Car business cases. Source MaRe/Birdstep operator survey July 2014.

The greater focus on continuity of experience for consumers is explained because it is so important in keeping customers loyal, and in increasing their usage, when operators are serving them directly. However, continuity is regarded as an important enabler of many aspects of the value chain.

Operators in North America see cloud-based media services and location awareness as the most important ways to add value to the Connected Car business model, and in both cases, it will be important to have uninterrupted service across different networks. While non-US operators have a greater interest in enhancing the model with new pricing and bundling approaches, there is global interest in big data services (see Figure 9).

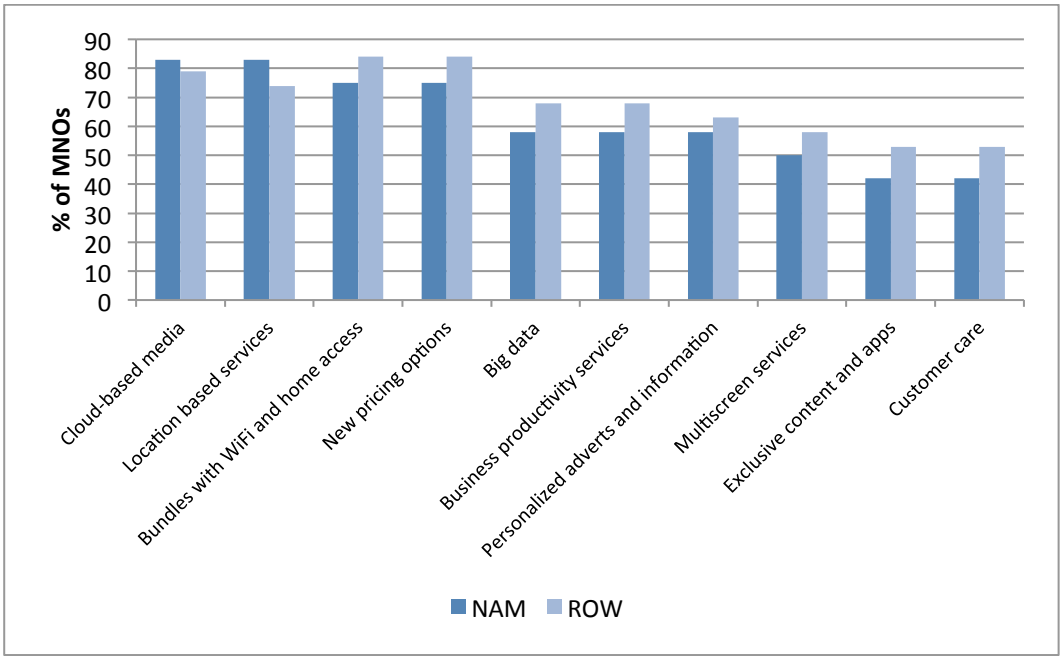

Figure 9. Added value services which operators plan to deploy between 2014 and 2017 to increase monetization of Connected Car customers. Source: MaRe/Birdstep operator survey July 2014.

As well as helping to enable some important aspects of monetization and added-value service for operators and automakers, continuity and QoS may also help to address some of the barriers that operators see in the Connected Car market.

As Figure 10 shows, the issues which dominate thinking in North America are led by security and privacy concerns, followed by pricing/monetization issues and by the ability to guarantee QoS.

Worldwide, the risks of hacking and misuse of private data are important barriers to acceptance of new services, including Connected Cars, and they are even more critical in the auto space, because they can also threaten vehicle and passenger safety. A platform which can increase the level of protection, regardless of which network a car is on, by embedding safeguards into the connectivity software, will be an important enabler of trust and uptake.

Another important barrier is doubt about consumer willingness to pay extra for in-car services. A continuity of experience platform can help with some of these challenges by enabling a more consistent and assured QoE, which in turn makes consumers happier to pay.

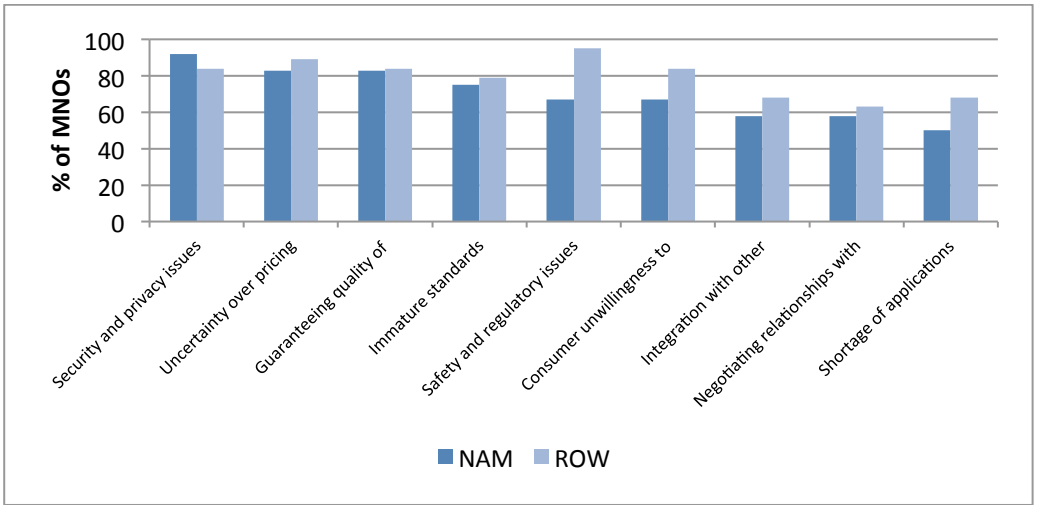

Figure 10. Barriers to deploying profitable Connected Car services. Source: MaRe/Birdstep operator survey July 2014.

Conclusion

The trends and findings outlined in this white paper indicate that there are significant opportunities in the Connected Car market, for mobile operators, over-the-top and platform providers, and auto makers themselves. In this immature segment, there will be a battle to be the primary gatekeeper, a role which vehicle suppliers and MNOs will struggle to keep out of the hands of Google and its rivals.

The need for a unifying layer to shield users from poor or inconsistent experience, and providers from technology siloes, is being addressed by Birdstep with its Experience Continuity platform. The complex requirements of the Connected Car, and the urgent need to avoid fragmentation, will open up new markets for such solutions, and will extend their remit well beyond Wi-Fi and HetNet connectivity, and into quality, security and continuity in every aspect of the user experience.

"Whichever group of stakeholders comes to lead the market, there will be a wide range of business models, and most of these will depend, for success and profitability, on several key factors – trusted security; seamless connectivity with consistent quality of experience; compatibility and continuity across different screens, apps and networks. These elements will be critical to deliver compelling services and drive usage and loyalty.

They all depend on users and providers being shielded from the mass of technologies which will go into the Connected Car, and providing a transparent, consistent layer which rides above different connection types, software platforms and embedded/standalone systems.

Caroline Gabriel, Research Director, Maravedis-Rethink

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About Rethink Technology Research:

Rethink Technology Research is a research firm and consultancy specializing in business models and technologies for mobile and wireless service providers. It carries out extensive surveys about the deployment plans, and business strategies, of mobile, fixed/mobile and Wi-Fi operators. It also works closely with the vendor community, regulators, standards bodies and investment companies to monitor the upcoming trends in wireless networks.

Its joint venture, Maravedis-Rethink, offers the leading research services focused specifically on mobile operators' infrastructure, from RAN to core to backhaul. These include MOSA (Mobile Operator Strategy Analysis). The company publishes news and analysis of mobile broadband issues on a weekly basis in its Wireless Watch product, as well as regular research notes to clients and financial analysts.

Rethink also engages regularly as a consultant with operators, suppliers, regulators and the financial community, usually advising on next generation wireless business models, and so has a deep insight into the real issues in the market, as opposed to the hype.

As well as collecting knowledge and intelligence through constant contact with the vendor, operator and financial communities, Rethink has a unique database of operators and service providers worldwide and collects data from them on a quarterly basis.

About Birdstep Technology:

Birdstep Technology is a leading provider of Smart Mobile Data and Secure Mobility for operators, enterprises and governmental organizations. We are committed to Experience Continuity and to combining the power of Wi-Fi with the coverage of mobile networks through "right loading". Drawing on extensive experience of successful customer projects and cooperation with operators, enterprise customers and OEM partners around the world, we deliver industry-leading solutions for wireless connectivity and service management.

Our Smart Mobile Data services offer advanced solutions for data offload & intelligent network selection, support automation and end user communication to network operators. Our Secure Mobility services offer solutions providing seamless and secure connectivity to business data for corporations and governmental organizations.

Birdstep Technology was founded in 1996 and has been listed on the Oslo Stock Exchange since 2002. The company is headquartered in Oslo, Norway, with competence centers in Sweden, Finland and the United States. For more information, visit www.birdstep.com and follow @BirdstepTech on Twitter.

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