NEXT-GENERATION AUTOMOTIVE INFOTAINMENT

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EXECUTIVE SUMMARY

In-car entertainment is a rapidly evolving space and systems have quickly progressed from simple car multimedia systems to more complex infotainment systems. During the upcoming years, ABI Research expects the following technological trends to define next-generation infotainment systems:

- **Connectivity-First Navigation**
- **Voice Assistants and Other AI Capabilities**
- **Increasing Hardware Complexity**

Aside from the technological trends described above, the infotainment market is also being influenced by the entry of new aggressive market entrants, including: Amazon, Google, Microsoft, and others.

Market incumbents have responded to the competitive threat of these new market entrants by introducing new innovative products and solutions to the market and/or by adjusting their focus on other value-add areas for OEMs.

Overall, the development of next-generation infotainment systems is being strongly influenced by both technological trends and changing ecosystem dynamics because of new market entrants. As a result, infotainment is evolving at a quickening pace from simple multimedia and navigation systems into complex systems consisting of multiple displays, voice assistants, connected services, and more. This has created both challenges and opportunities for existing market incumbents that must keep abreast of the technological trends, while also creating new openings for those entering the market.

INTRODUCTION

In-Vehicle Infotainment (IVI) or In-Car Entertainment (ICE) systems consist of a collection of hardware, software, and connected services that primarily provides multimedia (audio and video), navigation, and, increasingly, more connected services. Infotainment originated with simple car audio systems that consisted of radio and cassette/Compact Disc (CD) players that were controlled by a simple dashboard of dials and buttons. Today's more complex systems are provided through a wide range of interfaces, such as: touchscreens, steering wheel controls, and, increasingly, hands-free voice control. The main components of any modern-day infotainment systems consist of: navigation, multimedia, and a Human-Machine Interface (HMI), with cloud connected services that now provides additionally functionality as a subset of one of these categories.

This report explores how the core components in infotainment systems are developing and what the next generation of infotainment systems may consist of in terms of hardware, software, and connected services. This report provides an overview of the current and new players in the market and the partnerships they are forming, a qualitative analysis of some the technology trends, and forecasts for infotainment-related hardware and software.

THE SHIFT TOWARD "CONNECTED-FIRST" NAVIGATION

Historic automotive mapping business models revolved around offline-first navigation; however, business models are increasingly shifting toward connected-first business models. This, in part, is in response to failing strategies against bought-in navigation and Google's imminent entry into the market, but also to help create new monetizable opportunities for OEMs.

Connected-first solutions will bring about several key changes to navigation:

- **Livestreamed Maps:** Moving away from offline, survey-based mapping toward maps that are built in near-real time and continuously updated via livestreamed maps with smart caching. This will also mean that rather than providing large and infrequent whole map updates, normally on a quarterly or semi-annual basis, future maps will likely be near continuously updated.
- **More Connected** Services as Standard: With Google's market entry into embedded navigation, connected features, such as traffic services, will become standard. Companies like HERE are increasingly looking to incorporate traffic services as standard in their upcoming solutions.
- **New Connected Services:** In addition to current services, such as traffic, becoming standard, other connected services, such as smart parking, e-commerce, and location-based advertising, will become increasingly common in vehicle

NAVIGATION

EMBEDDED VERSUS BOUGHT-IN NAVIGATION

The rise of Google Maps and other free services, such as Waze and Apple Maps, has provided free navigation services to consumers that can be easily accessed through their handsets. Eventually, consumers started using these handsets in-vehicle to effectively provide free in-vehicle navigation via their Apple Maps, Waze, or Google Maps application via the use of an appropriate holder/handset stand. Furthermore, with CarPlay, Android Auto, and Baidu CarLife handset protocols, consumers can now also effectively project compatible mapping application to the in-vehicle displays.

As a result of bought-in handset devices, the personal navigation device market quickly became a market in decline and, equally, OEMs struggled to develop embedded solutions that would entice consumers away from using their handsets. Early embedded applications were costly and lacked the slick User Interface (UI), the OTA capabilities, and real-time information that Google and others could offer to consumers.

NEW STRATEGIES FOR EMBEDDED NAVIGATION

In order to compete, OEMs understand that they need to, at the very least, match what Google and others are offering to entice consumer away from their handsets for navigation.

Historical navigation development strategies were typically characterized by long design cycles (3+ years), complex supply chains, and models that center around offline-first, rather than connectivity- first. This led to two major problems:

- **Increased Costs:** As a result of an inefficient design process that does not recycle existing software components and focuses too heavily on OEM customization. These costs were eventually passed on to the consumer.
- **Lack of Functionality**: As a result of business models that focus on offline functionality, connected functions, such as traffic services, and frequent map updates that are standard on handset applications instead become costly extras for consumers in embedded applications.

The higher costs and consumer-perceived lack of functionality has critically limited the success of current embedded systems and OEMs are currently actively focusing on several key areas to help reduce costs, as well as simultaneously increase functionality:

- **Streamlining the Supply Chain:** By consolidating the supply chain, OEMs can significantly reduce development costs and reduce time-to-market.
- **Shifting to Connected-First Business Models:** By shifting to business models that revolve around OTA and connected services, items like real-time traffic information and frequent updates, which are default features of mapping applications outside of automotive, can also become standard features of embedded navigation systems in automotive.

OEMs have also realized that simply matching what Google and others offer on the handset and in-vehicle may not be a feasible strategy in the long term. Instead, newer strategies and approaches have revolved around better leveraging the in-vehicle data and hardware (such as digital clusters and sensors) that OEMs have access to, in order to build services and features that handset navigation simply cannot offer.

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NEW SERVICES AND FEATURES OF EMBEDDED NAVIGATION

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LEVERAGING THE INCREASING NUMBER OF IN-VEHICLE DISPLAYS

With the move toward larger head unit displays, digital clusters, and panoramic displays within the vehicle, the visual experience of navigation acts as a potential differentiator between bought-in navigation and embedded navigation. Bought-in handset devices, even with projection protocols, have no access to the digital cluster due to cybersecurity issues and the separation of safety-critical and non-safety-critical elements. OEMs, therefore, realize the extra digital cluster could serve as a key differentiator between their embedded navigation and third-party bought-in navigation.

Considering that the visual experience is a key part of navigation, by designing mapping applications that effectively leverage both the infotainment display and the digital cluster, OEMs will significantly advance the appeal of embedded navigation by offering something bought-in navigation cannot provide. The digital cluster and the central display together enable a customized and extended visual navigation experience that can be adjusted by a consumer depending on their preferences.

Figure 1: User-Customized Navigation UI Mercedes MBUX *(Source: Mercedes)*

HD MAPS

HD maps currently act as key enabler for advanced ADAS functions, such as advanced lane keeping systems, and steer-by-wire systems, such as advanced cruise control/traffic jam assist systems.

- **Cadillac Super Cruise/Ushr:** The Cadillac Super Cruise system available on the Cadillac CT6 uses HD mapping data provided by Ushr to provide an advanced cruise control system. It is the first consumer production vehicle to use HD mapping.
- **BMW/Mobileye/HERE:** BMW has been working with Mobileye to incorporate Mobileye's Road Experience Management (REM) crowdsourced mapping solution, providing rapidly updated HD maps that can power ADAS functions. To support the solution, anonymized data are passed to HERE to conduct real-time updates to the HERE HD Live Map.

Moving forward, ABI Research believes that HD map data could be used for providing infotainment functions

ABI Research believes that HD maps will be increasingly used to power Society of Automotive Engineers (SAE) Level 2 ADAS, as well as well as higher levels of autonomy, resulting in a higher number of vehicles using the data, which will also, in-turn, help increase the number of vehicles available for data collection. Currently, the overlap between HD map data used for ADAS and infotainment has remained largely untapped. However, ABI Research believes that moving forward the same HD map data could be used for providing infotainment functions such as lane level guidance, lane level traffic features, dynamic traffic flow data, speed profile data among other features.

Although, it is not clear how much HD map data Google has available, potentially through its subsidiary Waymo, HD navigation features could be key differentiators for market incumbents. ABI Research expects that an increasing number of OEMs could use HD mapping data that are already powering advanced ADAS to also provide advanced navigation features, such as lane-level navigation.

LIVE MAPS AND FREQUENT OTA

Historically, automotive mapping models relied on survey-based mapping, i.e., detecting changes, surveying changes, and then validating/updating through long data pipelines. New automotive mapping models will, however, revolve around models focusing on maps that are built in near real time through a livestreamed map with smart caching, rather than a complete offline map. This will also mean that instead of providing large and infrequent entire map updates, normally on a quarterly or semi-annual basis, future maps will likely be nearly continuously updated.

HD maps, such as those used for autonomous driving, will likely be updated via user-generated means, i.e., data crowdsourcing applications. This method will leverage suitable vehicles in the field equipped with on-board sensors to update maps without the need for dedicated mapping vehicles.

The use of live maps and more frequent map updates is clearly not something new to the wider navigation market, as all handset applications operate in this manner. However, it is something that is currently very novel in automotive, and it will significantly help bridge the functionality gap between bought-in navigation and embedded navigation.

LIVE TRAFFIC INFORMATION AS STANDARD

Traffic services is an extremely popular feature in connected navigation solutions, leveraging probe data, traffic incident reports, and devices in the field to feed specialized algorithms to build traffic flow profiles. This information then enables dynamic route guidance, which adjusts the user's route to provide the quickest route time.

Dynamic route guidance is a standard feature on handset applications like Google Maps and Apple Maps (powered by TomTom); however, the application of dynamic route guidance in embedded applications is much less frequent. Dynamic route guidance (powered by local traffic information) is normally a costly extra for consumers or is only provided on premium models.

HERE and other market incumbents are aiming to provide dynamic route guidance and traffic service as standard to OEMs in the upcoming years. Given that market incumbents like HERE and new market entrants like Google are increasingly likely to provide this live-traffic information/dynamic route guidance as standard to OEMs, it is likely that OEMs will opt to provide this service at a reduced rate/as standard to an increasing number of consumers, increasing its usage.

LOCATIONAL-BASED ADVERTISING AND E-COMMERCE

Location information can be gathered and analyzed via the use of AI to build user preferences and habits

Future embedded navigation systems will likely incorporate location-based advertising that will help drive new e-commerce opportunities for OEMs, merchants, and navigation providers (through potential revenue sharing models). Location information can be gathered and analyzed via the use of AI to build user preferences and habits. This, in turn, can power user-tailored and relevant e-commerce opportunities and locational-based advertising.

Any e-commerce/advertising solution will be suitably integrated into the mapping application and voice control HMI to provide this experience in a non-distracting, non-intrusive manner. Solutions from Telenav, such as the In-Car Digital Commerce (ICC) solution and the HERE Navigation On Demand concept are examples of how this may work. Navigation providers will have to work directly with merchants and a suitable payment processing partner to provide any suitable solution.

EMBEDDED NAVIGATION: THE CENTER OF NEXT-GEN INFOTAINMENT

With the new services and features now available for embedded navigation systems, coupled with the decreasing costs of these systems, ABI Research believes that embedded navigation will eventually become the de-facto option for consumers' navigation needs.

Embedded navigation will also be critical for opening new business models that are based on data, rather than product sales. Through connected navigation services and key location-based services, such as e-commerce, advertising, and other contextual experiences, OEMs will be able to unlock new revenue streams. The key to unlocking these services, however, is the ability to collect and interpret a user's location data.

NAVIGATION ON DEMAND

As discussed previously, OEMs face numerous challenges attempting to design a suitable navigation application and platforms. The push by Google into embedded navigation, along with its push into OS, connected services, and voice control, could result in market incumbents like HERE, Telenav, and TomTom losing significant market share. This is particularly the case at the lower end of the vehicle market, as OEMs struggle to develop their own navigation applications and infotainment platforms, due to the aforementioned challenges.

HERE is perhaps the best placed automotive navigation specialist to help counter the disruptive threat posed by Google. The company is owned by an OEM-led consortium, along with Tier One and Tier Two partners, which inherently provides it a large advantage over Google. Currently, four out of five in-car navigation systems in Europe and North America use HERE map data, resulting in more than 100 million vehicles globally using HERE Map data. The company also develops maps for autonomous vehicle applications and provides OTA services via HERE OTA Connect, which will form vital pillars of future navigation systems. Recently, the company announced its latest mapping product/solution : HERE Navigation On Demand.

HERE Navigation On Demand is a unique solution in the market that aims to combine the approach taken by mobile navigation providers like Google and the legacy approach taken by OEMs to embedded mapping navigation. The solution consists of several key components that help achieve this:

- **Core Map Content:** Mapping content is the area in which HERE specializes and, therefore, forms the backbone of the HERE Navigation On Demand solution. HERE Navigation On Demand will allow OEMs to choose between automotive-grade Standard Definition (SD) and HD map content.
- **Embedded Navigation Software:** The navigation core focuses on providing "off-the shelf" components that can be built upon by OEMs, enabling enough scope for OEM customization, e.g., providing a User Experience (UX) and map style that can be adjusted for OEM requirements. The solution additionally enables automotive optimized functions, such as search, card management, and voice guidance. Clearly, one clear differentiator between HERE and Google is that the embedded navigation software that HERE will provide much offers more flexibility (in terms of branding, UX, and map styles), as opposed to Google Map applications, which have a largely preset application style
- **Cloud-Provided Services:** HERE will provide additional cloud-based services that can be selected by OEMs, depending on required functionality and cost requirements. Furthermore, critically, HERE will provide a Software Development Kit (SDK) to allow third-party companies to also develop services for the HERE cloud platform marketplace. These services can also be chosen by OEMs. Allowing OEMs to pick and choose which HERE services they wish to integrate, as well as third-party services, provides OEMs with a huge scope for flexibility and customization

The key difference, however, between legacy OEM approaches and the HERE Navigation On Demand solution is the method for delivering the solution.

Firstly, the solution is a connectivity-first solution, rather than offline-first. Critically, this enables OEMs to upgrade and maintain up-to-date mapping solutions (map data, software, and UX) via OTA, as well as differentiate their product through connect services and the third-party service marketplace. This will help OEMs better align their products with consumer expectations.

Secondly, core navigation elements are not customized to each specific OEM; instead, the core navigation application focuses on providing "off-the shelf" components that can be built upon by OEMs, enabling just enough scope for OEM customization, while reducing time and costs for development. This will help OEMs reduce development costs and reduce design life cycles.

Table 2: Conventional Navigation versus HERE Navigation On Demand *(Source: HERE)*

	Conventional Navigation	HERE Navigation On Demand
Connectivity	Offline-first	Connected-first
OTA Update	Map updates (large disk size)	Streamed map w/ smart caching Features and services
Hardware Requirement	Given memory footprint Large disk size	Configurable memory footprint Configurable disk size
Upgradability	From Start of Production (SOP)	Anytime OTA
Map Format	Navigation Data Standard (NDS)	HERE Reality Index map Use case-optimized format
Remote Management	Custom entitlement of connected services	Software-as-a-Service (SaaS) dashboard Fleet management for feature deployment
Third-Party Ecosystem	OEM-specific, heavy customization/integration	Third-party service marketplace (available 4Q 2019)
Core Navigation	Customized per OEM	Off-the-shelf, extendable by OEM/3rd party
OS Support	Agnostic, heavy customization required	Agnostic, mostly off-the-shelf
Deployment Options	ENS	ENS, Display Audio and Mobile (CarPlay, SDL)

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