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Virtual Personal Assistant

A Context sensitive User Experience for Automotive Infotainment & Driver Assist

Rajesh Biswal
Senior Architect, Automotive, Wipro Technologies

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Abstract

A recent Mercedes-Benz advertisement aired at the US Open 2012 illustrates a growing desire in the automotive fraternity to perfect the customizable and seamless in-vehicle infotainment user experience. The 'All From One Place' ad had a young man sitting in his car yet feeling like he is swinging between real life events – a match, party, storm, trading floor, and a date – an experience promised by telematics platform MBrace2. Today, every OEM is adding fresh dimensions to redefine the 'All' achievable by their smart telematics solution. Ford SYNC, for instance, is betting big on health facets via its In-car Health and Wellness solutions, while Toyota Sweden, Fiat and Renault believe eco-drive to be the unanimous voice of the future drive! Such a drift towards context-aware integration of content/services is making virtual personal assistant (vPA) platforms a necessity and a key opportunity for Tier I suppliers.

vPAs should exhibit context awareness of the driver, vehicle and vehicle environment. Further, it should have self-learning capability and with minimalist user intervention. For instance, if there is an incoming call when the driver is approaching a complex driving maneuver in the road, the vPA should be able to place the call on hold while playing back a prompt to the caller to ensure minimal driver distraction and "un-hold" the call after completion of the maneuver. Similarly, in case of a vehicle fault and display of corresponding tell-tale in the Instrument Cluster, the vPA may bring up the corresponding section of the user manual in the display on user prompt and provide expert guidance on the fault and corrective actions – e.g., a "limp-home" drive or immediate navigation guidance to a nearby service center.

Realization of such vPA systems requires an on-board device, with minimum user interaction and ubiquitous connectivity, and an off-board system, allowing intelligent integration and delivery of content/services in sync with the on-board device. Tier I suppliers having a strategic SI (system integration) partner can design and deliver these much-desired vPAs with ease.

Looking for an Opportunity Window

Where do Tier 1s stand in the infotainment landscape today? The advent of smartphones and related intelligent context-sensitive speech-based solutions like SIRI, Eyes Free and MirrorLink have encroached the in-vehicle Infotainment space – a traditional bastion for tier 1s. Most OEMs (like Ford and BMW with General Motors expected to follow) are moving human machine interface (HMI) development in-house, shrinking the HMI-led infotainment business for Tier 1s. Add to this the increasing affinity of OEMs (BMW, JLR, PSA, Toyota, and Nissan) towards Linux and GENIVI based platforms, the magnitude of the problems threatening Tier 1s increases manifold. Standardization and platform commoditization could well hamper the creation of new platforms in future – a core business for Tier-1s today.

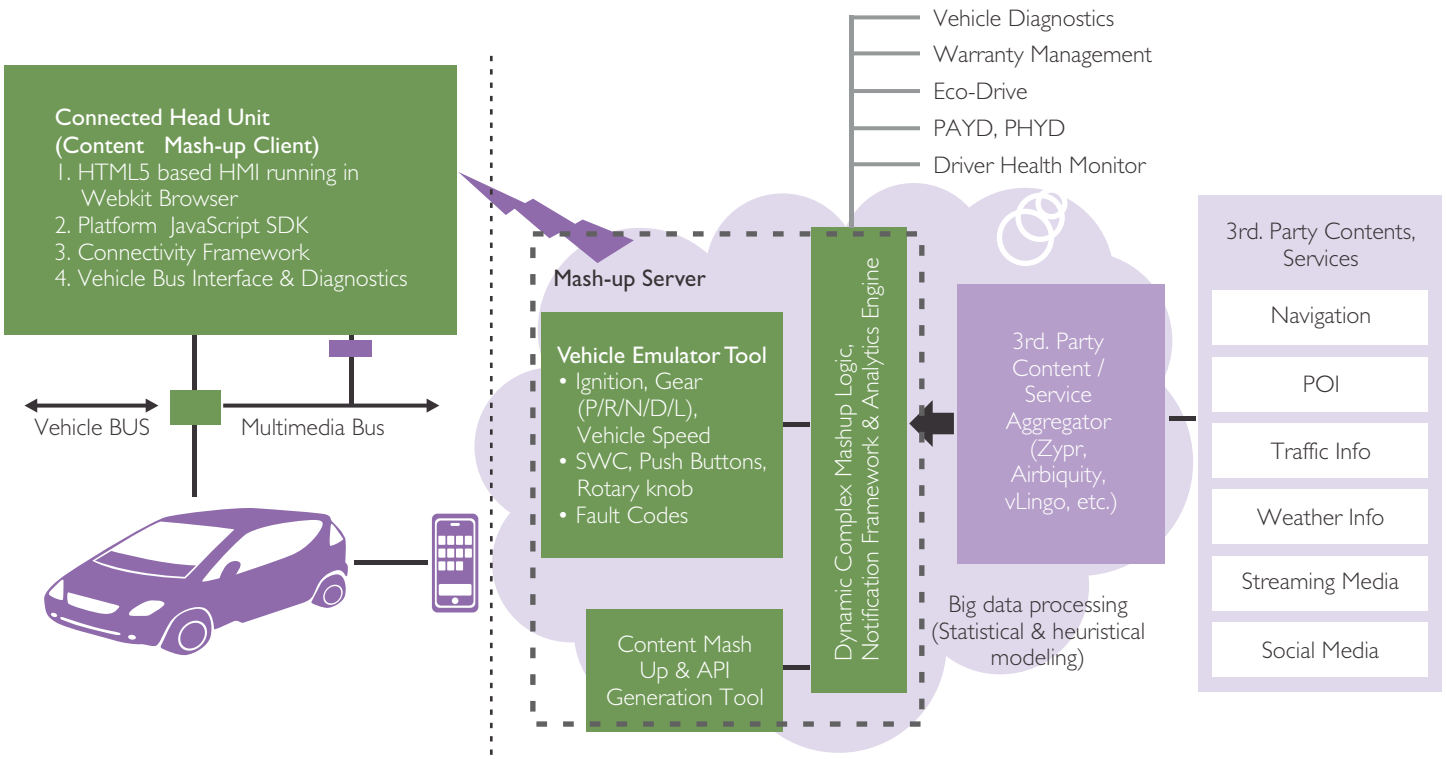
As a result, Tier 1s are looking for a new opportunity window to create value added services on top of traditional infotainment and vPAs could provide just that. Tier-1s, with support from OEMs, can provide an elevated driving experience to the end user by transforming Infotainment human interface (HU) into a Virtual Personal Assistant for the driver. They can outsmart the mobile world with vPAs, as unlike infotainment HUs (developed by Tier 1s) smartphone in-vehicle integration approach comes with limitations regarding access to vehicle bus and in-built sensors. Usage scenarios like accessing vehicle data to provide eco driving tips or driving suggestions for insurance discounts; leveraging driving pattern/preferences history on specific roads to adjust suspension controls, seating and air conditioning etc. would be hard to achieve for a smartphone based infotainment solution. Further, user interfaces of smartphones, primarily, not designed to be used while driving makes, smartphones unfit for vPAs.

Tier 1s can also consider creating a HTML5-Javascript based App SDK (software development kit) Framework to enables OEMs to create their own vPA applications capable of intelligently mixing off-board/on-board services to deliver the context-sensitive experience. This could also be extended to create of a sandboxed and secure application execution environment enabling safe and secure execution of downloadable applications.

Getting the vPA Right

Creation of a contextual integration (mash-up) of on-board and off-board services and delivery of vPA services through wireless connectivity and the HU Platform is no easy task. It involves multiple components working seamlessly with each other as shown in the diagram below.

Figure 1: vPA System Overview



Depending on the use case, the mashed content generation method needs to be carefully chosen. Mashed content can be generated through mashup logic built using JavaScript embedded in a HTML5 Web page on the mash-up client side. Such mashing will reduce overheads on the mashup server (allowing data to be retrieved directly from the content aggregator whenever applicable) and provide a more seamless user experience. The JavaScript code for such mashing could be a combination of HU platform JavaScript SDK, REST/JavaScript APIs from the mashup server referenced by web pages and/or JavaScript/REST based APIs of the content aggregator.

The alternative method is mashup logic implemented in the mashup server, especially, for complex scenarios requiring mashing of multiple disparate contents. The information on mashed-up contents can be then exposed through well-defined REST based APIs (or JavaScript APIs as wrappers on REST based APIs), which, in turn, can be used by mashup clients.

A further alternate can be creation of mash-ups using logics party resident in the Server and partly in the client (Head Unit)

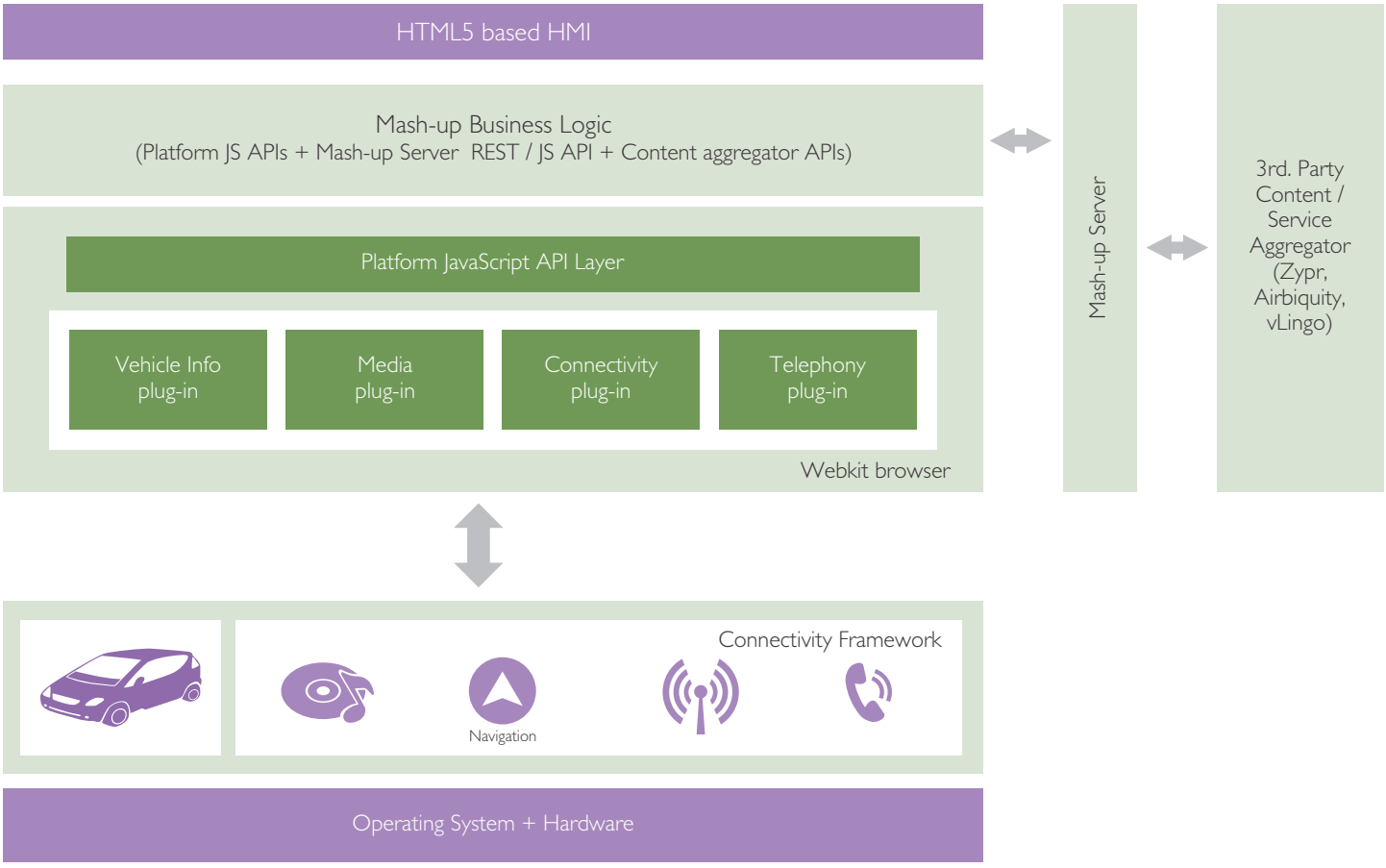
Mash-up Client

A typical Content Mash-up Client Architecture is shown below.

Mash-up Server

A robust Mash-up Server is essential for a foolproof vPA, more so, for scenarios where the mash-up logic / service is created in the server. Typical components of a Mashup server are - Content mash-up Rules Engine & API generation tool, Dynamic and complex mash-up logic, Analytics engine, vehicle emulator tool and a server-to-device notification framework as shown in Figure 1. The Content mash-up Rules Engine & API generation tool must help developers (OEM / Tier-1) create their own mash-up rules/logic and generate JavaScript APIs to access the mashed information. The dynamic and complex Mash-up Logic needs to perform complex queries on multiple-sourced data, thereby, requiring computations difficult to perform in the client's web browser, especially, when disparate contents are mashed up. The Analytics Engine carries out analytics on data received from multiple sources including the vehicle and its surroundings. It can expose results of analytics through JavaScript APIs that can be referenced by the client web page. The vehicle emulator tool emulates the actual vehicle behavior to the extent possible and can help test applications created using mashed up content in scenarios like unavailability or poor access of the target Vehicle HW/Platform. Lastly, the cloud to device notification framework will help push notifications to the client to wake up interested client applications and make them retrieve a message, data, update, etc. from the server as explained below.

Figure 2: Content Mash-up Client Architecture



Client-Server Communication and Event notifications

To realize proper mash-up functionality, it is imperative that off-board events are delivered asynchronously to the client, through an event notification mechanism. There are two possible approaches to realize this event notification – Push notification or Websockets. Push notification would involve using a SMS/custom 'Cloud to Device' notification framework to wake up the client (Head Unit). On Wake-up, the head unit would connect to the server and check for pending notifications. Websockets, on the other hand, would have the head unit and server communicate on a web socket connection. All events would be delivered by the server on the web socket connection.

Challenges

However, as it is with any distributed and cross-domain application, mashup developers and content / service aggregators would have to address security concerns around vPAs too. Content providers could employ authentication and authorization schemes (which require secure identity or securely identifiable attributes) in their APIs to enforce business models that involve paid subscriptions or sensitive data.

Sensitive data requires confidentiality (that is, encryption). While mashing sensitive data with contents that do not require such confidentiality, care needs to be taken to avoid putting confidential data at risk. Identity will also be crucial for auditing and regulatory compliance. Additionally, with data integration happening both on the server and client-side, identity and credential delegation from the user to the mashup service might become a requirement.

Conclusions

Instead of introducing multiple new but disjointed features in multimedia and connectivity, context-sensitive self-learning Virtual Personal Assistant like systems are more likely to make next generation Infotainment Systems succeed. This can be achieved through intelligent Content / Service mash-up of on-board vehicle services and Cloud based off-board services. However, with the technology involved being complex and the margin of error expectations next to nothing, one has to wait and see if this "yet-to-be-proven" concept of creating new driver experience through mashing contents and services succeed.

About the Author

Rajesh Biswal is a Senior Architect for Wipro's Automotive business. He comes with rich expertise in embedded software development and service integration for Automotive Infotainment and Telematics. He has also worked on delivering Connected Car Solutions to Automotive Tier1s and OEMs.

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