January 2017

W3C CASE STUDY

Teamwork on Open Standards Development Speeds Industry Adoption

Like driving a long stretch of open road alone, standards development work can be a lonely endeavor. But with the right team of drivers on board, the road trip becomes fun and exciting. That's the situation that the GENIVI® Alliance and the World Wide Web Consortium (W3C) faced in early 2012. GENIVI and W3C, along with other interested parties, started a collaborative journey to explore the use of Web technologies in the automobile and support the adoption of those technologies in the connected car.

Those early discussions to define open standards for automotive Web APIs soon turned into a formal collaboration between GENIVI and W3C that has produced strong direction for developers of Web and automotive software, which is already being adopted by the industry.

Since its early days, GENIVI has successfully managed the balance between standards and the necessary freedom to allow competition and innovation in the open community. As a result, GENIVI has both produced standard application programming interfaces (APIs) and formed successful liaisons with a number of organizations to further open standards in the automotive industry. These active collaborations have the added benefit of bridging the automotive software ecosystem into digital living networks, navigation, smart home connectivity including Internet of Things, and most recently, in the smart city context.

Founded in 1994 as a member-driven consortium that supports open collaboration and open standards for a broad range of Web technology interests, W3C explored the impact of the Web as a platform for the automotive industry in a similar timeframe as GENIVI.

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With a common goal of bridging the Web and automotive contexts in place, the W3C formed the *Automotive and Web Platform Business Group* to accelerate the adoption of Web technologies in the automotive industry. It is now the seventh largest group out of 201 business and community groups in the W3C. After creating use cases for automotive specific areas, the GENIVI Korea Regional Expert Group presented their Vehicle Web API as input for the standardization of the vehicle's Web accessible programming interface. Based on that work and discussions in the business group, the first draft of the Vehicle Information API specification was published in 2014. This standard API allows for third party application development in a manner that is consistent across automakers. Fast forward one year later and the W3C launched the *Automotive Working Group*, to advance those draft specifications to full Web standards.

PROBLEMS AND CHALLENGES

Modern cars are loaded with sensors and actuators that continuously monitor the vehicle and allow control of its functions. Before the collaborative work between GENIVI and W3C, there was no standard for programmatically accessing the vehicle data generated by these sensors.

Automotive OEMs, and the industry at large, believe that hidden in this vast ocean of vehicle data is the key to value-added services, better connection with the driver, and in the end, better customer satisfaction. OEMs have developed proprietary approaches to mining this information and using it to develop new services and to benefit its customers. Some OEMs have published APIs that third-party applications can access. While this provides some competitive advantage, it again limits the return on investment for independent software developers to produce innovative software as their apps only work in a single OEM context. For other OEM contexts, they have to rewrite the app to mine data using a different API. This is a non-starter.

Further, even though some vehicle signals are organized in a standard way, OEMs chose different methods of exposing the signals, some with individual APIs to individual signals while others provide broader access to related signals. This again complicates programmatic access to the data across vehicle brands.

In the context of the GENIVI-W3C collaboration, GENIVI proposed a new approach to extend the Vehicle Web API draft standard, resulting in the elimination of some of these challenges introduced through multiple access methods to vehicle signals.

VEHICLE SIGNAL SPECIFICATION AND VEHICLE SIGNAL INTERFACE

GENIVI proposed a Vehicle Signal Specification (VSS) that provides a simple and extensible scheme for expressing and addressing vehicle signals in a standardized form. Signals are organized into a hierarchical tree with standard branches for signals that are common for any vehicle regardless of make or model such as speed, engine rpm, outside temperature, etc. Signals are addressed by a dotted notation that can easily be interpreted by human or machine, for example: Signal.Body.Lights.IsLowBeamOn, Signal.Drivetrain.FuelSystem.Range, etc. The GENIVI VSS repository on Github **(http://bit.ly/2hMMTmo)** currently defines close to 1,000 standard signals. Proprietary signals can easily be added to private branches of the specification. It is up to the originator of the signals to determine if they would like to contribute them to GENIVI for broader use. The specification suggests a common method of expressing the signal tree (YAML), but converters exist in the open community to convert this format to other well-used formats.

The GENIVI proposal also defined a Vehicle Signal Interface (VSI). In a vehicle, signals can originate from many different sources (a producer) and they can also be made use of by multiple subscribing targets (consumers). The Vehicle Signal Interface (VSI) allows for efficient distribution of signals from producers to consumers.

In only five months, GENIVI and W3C delivered a draft specification and after review by the broader W3C community, full standardization in the form of sample implementations and test frameworks is being finalized.

Readers can find the VSI source code with documentation and examples in the GENIVI Github repository at:

- **https://github.com/GENIVI/vehicle_signal_interface**

The First Public Working Draft of the Vehicle Signal Server Specification from the W3C Automotive Working Group is available at:

- **https://www.w3.org/TR/vehicle-information-service/**
- **https://www.w3.org/auto/wg/**

Speeding Auto Industry Adoption

The GENIVI-W3C collaboration is ongoing, but it has already produced useful approaches for standardizing both the access to and the structure of vehicle data information. At the application level, a standard Web API is now being considered for approval as a full Web standard. This standard releases developers to produce applications that work across multiple automotive brands and models, as long as the OEMs implement the standard. At the vehicle signal level, these applications now have a standard method for pulling individual or a collection of signals again simplifying application development.

The benefit to both the Web and automotive industries is more software, produced faster and at lower cost, delivering innovative solutions expected from this new wave of "big data" opportunities. Adopting these open standards unlock great value to the OEMs, their customers, and to other emerging stakeholders in the connected and autonomous vehicle ecosystems.

Other Joint Work on Improving Standard Interfaces

W3C has a rich history of working on location-based services with mobile phones. Recognizing the need to produce a standard interface for vehicle navigation, GENIVI approached W3C to explore the navigation API work done in the GENIVI Location Based Services (LBS) Expert Group. The GENIVI LBS APIs have been proven as mature through use in commercial products and are thus, a great starting point for the W3C standardization work. In order to support the collaboration with W3C, full access to relevant information such as requirements, code, and documentation is being granted on the GENIVI projects public wiki **(http://bit.ly/2hwal4k**) and the GitHub repository **(https://github.com/GENIVI/navigation)**.

The GENIVI LBS code is an integration of code coming from an open source project, Navit **(http://www.navit-project.org/)**, which exercises the various user interfaces. Proof of Concept implementations **(http://bit.ly/2ikDgZc)** that demonstrate the GENIVI LBS APIs for managing points of interest, traffic information and positioning are also available.

Additionally, GENIVI has active work in media management and cybersecurity, both of which are active threads of the automotive work in the W3C. Use cases and threat models will form the basis for ongoing collaboration in these two areas. More information on that work is available at: **https://lists.genivi.org/mailman/listinfo/genivi-ad-hoc-sec**.

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HOW TO GET INVOLVED

OEM and Tier One collaboration and contribution is not only welcomed, but encouraged. The greatest benefits to these jointly produced standards are realized when they are adopted across the industry, across multiple OEMs and Tier Ones, and available to independent software vendors who can develop innovative software once for many brands and platforms. GENIVI and W3C welcome anyone to explore the specifications and code (links provided above), provide feedback and suggest improvements. Through standards adoption and additional collaboration, the Web and automotive stakeholders will benefit from new and innovative software solutions.

To find out more information about GENIVI and to join, visit:

- **http://bit.ly/2iktwOv**
- **www.genivi.org/join**

To learn more about W3C's Web and Automotive work visit:

- **https://www.w3.org/auto/**
- To participate, email: **membership@w3.org**