VIIC Deployment Analysis and Policy Support
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Device Certification White Paper

December 14, 2010

Device Certification White Paper

Executive Summary

This paper provides information intended to help inform a policy determination regarding safety performance certification of motor vehicle cooperative safety systems devices that use 5.9 GHz dedicated short range communication (DSRC). Its primary purpose is identifying a set of key characteristics necessary for a robust certification framework. Relevant certification frameworks in use around the world are described and examined from a U.S. perspective for this purpose.

While this paper addresses certification of 5.9 GHz devices, it does not address the certification or other approval system that likely will be needed to assure the appropriateness and integrity of applications and services delivered by 5.9 GHz DSRC devices. These include non-safety applications that nonetheless may have safety implications (e.g., distraction). It should be noted that there may be a future need for a certification program that addresses applications and services made available by 5.9 GHz DSRC deployment (especially aftermarket applications and services), but this type of certification is beyond the scope of this paper. VIIC would like to participate in development of any future certification scheme for applications and services.

A critical objective for future IntellDrive^{SM} systems using 5.9 GHz DSRC is ensuring that the over-the-air vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications for safety purposes can be trusted. This requires that the devices that deliver the communications are properly designed and manufactured to provide true, accurate, timely and reliable communications in order to support safe performance and to support investment and deployment. Communications between vehicles and between vehicles and the infrastructure present a unique first-time challenge in motor vehicle cooperative active safety compared to autonomous active safety systems on vehicles today. For the first time, a broad scope of vehicles will be dependent on other vehicles, mobile devices, and on infrastructure for over-the-air communications that can enhance vehicle safety. That is why it is critical that the communications from all involved sources and devices can be trusted.

The decision has not been made yet regarding whether to follow a regulatory or non-regulatory path for 5.9 GHz DSRC cooperative safety communication system performance assurance. However, it is likely that some form of structured certification scheme will be necessary for a cooperative safety system. Certification is a recognized way to provide assurance that defined performance characteristics have been confirmed for proper and safe functioning of the system, its devices and equipment. Certification likely will be necessary for most or all parts of the system including vehicle, infrastructure and aftermarket components, devices and equipment.

It is possible that different certification systems could be implemented and coexist across the levels of certification anticipated for the 5.9 GHz DSRC system (i.e., component, device, equipment, vehicle, system, etc.). Different but well-established public sector certification frameworks already coexist for vehicle and vehicle equipment safety governance. This paper examines examples that include the U.S. self-certification system and the European type approval system, which also is used in some form widely throughout the world. These public sector frameworks entail government involvement. Certification systems also exist for many other consumer products, some with and some without government involvement. This paper also describes one example each of a public and a private sector certification system for non-motor vehicle consumer products.

Examination of these existing certification framework examples led to identifying key characteristics from them that are necessary for a robust certification system. The key characteristics are:

- Defined authority
- Clear accountability
- Performance-based standards to the extent possible
- Robust compliance certification practices
- Absence of bias or undue influence in certification process
- Certification to agreed standards for any 5.9 GHz DSRC safety device
- Assurance of continued compliance and conformity of production
- Compliance enforcement
- Known consequences of noncompliance

The VIIC recommends that these certification framework characteristics be incorporated in any future safety performance certification program for a 5.9 GHz DSRC cooperative communication system used for motor vehicle safety enhancement. Together these characteristics provide a reasonably stringent framework for an accepted level of safety device certification assurance.

A final recommendation for the purposes of this paper is one regarding the federal role in governance of V2V/V2I 5.9 GHz DSRC systems. The VIIC believes that federal governance is needed for most, if not all, aspects of a system deployed nationwide. These aspects include but are not limited to device certification, message integrity (validity, security, and enforcement), interoperability, rules of use and operations, privacy, harmonization, and cross border acceptance. Federal governance avoids the implementation of divergent and conflicting requirements at the state and/or local governance levels, which would make deployment of a 5.9 GHz DSRC system for cooperative safety impracticable for both system providers and users. Federal governance is necessary so that critical requirements can be applied and enforced uniformly across all U.S. jurisdictions. It also is needed to negotiate, implement, and enforce international agreements between countries. The governance structure also needs to be durable and reliable to support investment.

Existing federal entities already have authority over certain aspects of devices that would be used for IntelliDrive[SM]. For example, the NHTSA is responsible for overseeing the safety performance of motor vehicles and their equipment; the Federal Motor Carrier Safety Administration (FMCSA) is responsible for commercial motor vehicle safety; the Federal Highway Administration (FHWA) is responsible for roadway infrastructure, and the Federal Communications Commission (FCC) is responsible for the communication spectrum. Because this is a cooperative safety system that impacts across all of these agencies, new authority is likely to be needed to address shared responsibilities. Moreover, it is uncertain who has, or should have, governance responsibility for aftermarket devices. Therefore, some aspects of IntelliDrive[SM] are unique, and will require Congressional action to, at a minimum, expand and fill in any gaps in necessary governance structures.

Introduction

There are important objectives for performance assurance of future IntelliDrive[SM] communication systems, devices and equipment operating at 5.9 GHz. One key objective for motor vehicle cooperative safety systems using 5.9 GHz dedicated short range communication (DSRC) is that vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications for safety purposes can be trusted. Part of providing this level of trust involves assuring that the devices that enable communications are properly designed and manufactured and are capable

of delivering over-the-air communications that are true, accurate, timely, and reliable to support safe performance. Without that trust, performance could be compromised, and therefore investment in such a system would be unlikely. Cooperative V2V and V2I communications present a unique first-time challenge in motor vehicle cooperative active safety compared to autonomous active safety systems on vehicles today. For the first time, a broad scope of vehicles will be dependent on other vehicles, mobile devices, and on infrastructure for over-the-air communications that can enhance vehicle safety. That is why it is critical that the communications from all involved sources and devices can be trusted.

The path to achieve this objective, e.g., through regulatory or other means, remains undecided at this time. Much work remains in policy areas and there are still some technical issues to be resolved before properly-informed final decisions can be reached on whether, and if so how, to regulate safety performance of 5.9 GHz DSRC systems. This paper intends to provide information to help inform the policy side determination.

A possible non-regulatory path in the U.S. at the vehicle or vehicle equipment level could use the existing U.S. vehicle safety consumer information program known as the New Car Assessment Program (NCAP). This program, administered by the U.S. Department of Transportation's (DOT) National Highway Traffic Safety Administration (NHTSA), could be used to encourage, rather than mandate, the deployment of 5.9 GHz DSRC safety devices and applications through a rating or recognition system such as currently exists for certain passive and active safety systems and equipment on vehicles. The 2011 model year NCAP already includes a new feature that identifies if vehicles rated in the other portions of the NCAP are equipped with certain autonomous active safety technologies. Such a non-regulatory approach to the deployment of 5.9 GHz DSRC devices for safety would not guarantee universal, or even widespread, deployment of such devices, and may not adequately support state and national safety and mobility goals. Moreover, for 5.9 GHz DSRC cooperative safety applications, there would need to be infrastructure deployed to provide 'day 1' benefits to equipped vehicle owners, and possibly additional incentives to encourage retrofit in order to provide a measurable early benefit.

Regardless of the approach taken to introduce 5.9 GHz DSRC into the marketplace, a structured certification scheme likely will be required to provide the trust necessary for a cooperative safety system. Certification is a recognized way to provide assurance that defined performance characteristics have been confirmed (validated) for proper and safe functioning of the system, its devices and equipment. In the case of a 5.9 GHz DSRC system, this could include multiple levels of certification. The certification levels might be identified based on whether certification is required for the components, devices (original vehicle equipment, retrofit and aftermarket), roadside equipment, and/or vehicles (including light passenger vehicles, heavy trucks, specialty vehicles, and transit buses) that constitute the 5.9 GHz DSRC system.

Certification can have different meanings and purposes depending on specific objectives and applications. Different but well-established public sector certification systems already coexist for vehicle and vehicle equipment level safety governance; for example, self-certification in the U.S. and type approval in Europe and elsewhere around the world. These entail government involvement. Certification systems also exist for many other consumer products, some without government oversight. It is anticipated that different certification systems could be implemented and coexist across the levels of certification anticipated for the 5.9 GHz DSRC system (i.e., component, device, equipment, vehicle, system, etc.).

This paper primarily focuses on the possibility that the regulatory path with certification will be chosen in the U.S. It describes what certification means to the automobile manufacturers constituting the Vehicle Infrastructure Integration Consortium (VIIC) with respect to motor

vehicle integration for safety purposes of V2V/V2I 5.9 GHz DSRC applications. It discusses important features of the existing public sector self-certification system for motor vehicle safety governance in the U.S., including conformity of production. This paper also expands the scope of the more traditional perception of what "certification" means to include discussion of important elements that accompany and support a complete certification framework, including enforcement and consequences of noncompliance. Together, these additional elements also underscore the stringency of the U.S. motor vehicle safety governance. This level of stringency is likely to be necessary for any certification strategy ultimately adopted for 5.9 GHz DSRC safety devices and equipment.

Also described is another example of an existing public sector certification system for motor vehicle safety, called type approval, and third party public and private sector certification examples for non-motor vehicle products that also must provide safe performance in public use. These frameworks also exhibit stringencies important to an effective certification framework.

The paper concludes with recommendations regarding key characteristics of a certification framework and what these mean for an acceptable level of certification, conformity of production, etc., for all elements of the 5.9 GHz DSRC system, including aftermarket and infrastructure. A recommendation also is included for an ongoing federal role for reasons described herein and because nationwide coordination is necessary for a successful and effective implementation of the 5.9 GHz DSRC system.

Finally, the Annex identifies areas of potential system certification needing further study including applications, security, privacy, compatibility, and interoperability. The Annex also includes brief discussions of standards harmonization and product liability with regard to their relation to certification.

Certification Meaning and Purpose

Certification can have different meanings and purposes depending on specific objectives and applications. In simplified terms, certification is a process or methodology designed to provide a level of assurance, often including testing and/or documentation of compliance with defined applicable requirements (standards, regulations, etc.). What entity provides the certification or approval, what requirements must be met, and how it is done, are elements that can differ among different certification systems. However, accountability and authority are common elements of most certification systems. Certification also can provide a way to keep improperly performing products off the market. Accordingly, there is a level of reassurance consumers and the public perceive when a product is described as having been "certified."

This paper looks at certification with regard to safe performance of a product or system that is used by the public. The product(s) or system in the case of 5.9 GHz DSRC cooperative safety systems includes a motor vehicle and its equipment, as well as infrastructure equipment and aftermarket devices that deliver the cooperative communications. Certification then can be seen as a recognized way to provide a reasonable level of assurance necessary to substantiate a predefined, acceptable level of safe performance for the listed equipment, devices and vehicles. Although there is not a simple or singular definition of what "safe" performance is, often it is considered as performance that does not produce an unreasonable risk to safety. In the case of a cooperative safety device using 5.9 GHz DSRC, the ability to trust that the communications are delivered by a properly-designed and built device can be validated through

a proper certification process, which reduces the risk[1] that the communications are not accurate or true.

Motor Vehicle Safety Certification – U.S.

In the U.S., the National Traffic and Motor Vehicle Safety Act (law) of 1966, as amended, 49 U.S.C. Chapter 301 (Vehicle Safety Act), prescribes the U.S. governing structure implemented for motor vehicle safety. This is a public sector certification system because it is prescribed by public law and regulations and has government involvement. This law defines motor vehicle safety in § 30102 as:

> "…the performance of a motor vehicle or motor vehicle equipment in a way that protects the public against unreasonable risk of accidents occurring because of the design, construction, or performance of a motor vehicle, and against unreasonable risk of death or injury in an accident, and includes nonoperational safety of a motor vehicle."

The Vehicle Safety Act also prescribes the certification system, including accountability and authority (among other elements), for motor vehicle safety. The vehicle manufacturer's certification responsibility is stated in § 30115 of the Act:

> "A manufacturer or distributor of a motor vehicle or motor vehicle equipment shall certify to the distributor or dealer at delivery that the vehicle or equipment complies with applicable motor vehicle safety standards prescribed under this chapter [49 U.S.C. § 30101 et seq.]. A person may not issue the certificate if, in exercising reasonable care, the person has reason to know the certificate is false or misleading in a material respect. Certification of a vehicle must be shown by a label or tag permanently fixed to the vehicle. Certification of equipment may be shown by a label or tag on the equipment or on the outside of the container in which the equipment is delivered."

Under this system, the government has many responsibilities, including requiring and enforcing certification, but does not provide the actual certification or approval. The manufacturer has the responsibility to 'self certify' the conformity of its products with government-defined certification criteria. The manufacturer is not required to submit compliance or certification documentation to the government before it produces or offers its vehicles for sale, although after vehicles are offered for sale, manufacturers are responsible for producing such documentation upon request by the NHTSA. In short, a manufacturer needs to assure that its vehicles are compliant.

High-level essentials of self-certification responsibility for a vehicle manufacturer can be summarized as follows:

> (1) Assure (and document) compliance with all applicable Federal Motor Vehicle Safety Standards (FMVSS) and other regulations using the manufacturer's own (or contracted) testing, analysis and/or judgment,
> (2) Ensure compliance and certification are valid for *every* new vehicle produced for U.S. sale, and
> (3) Place a certification label on every new vehicle produced for U.S. sale attesting that the vehicle meets all applicable FMVSS and other regulations.

The NHTSA is the U.S. government agency responsible for implementing and enforcing the Vehicle Safety Act (and certain other laws related to vehicle safety). Major parts of NHTSA's

[1] To reduce the risk further, steps may be needed to also ensure that the applications delivered by such devices are appropriate and well-designed.

authority include issuing and enforcing FMVSS and other regulations that apply to motor vehicles and specified items of motor vehicle equipment. The agency has provided some clarification of what certification means for a vehicle manufacturer in its guidance document titled "Requirements for Manufacturers of Motor Vehicles and Motor Vehicle Equipment," revision date 4/2/2009:

> "The Vehicle Safety Act requires that motor vehicles and regulated items of motor vehicle equipment produced for sale in the United States be certified to comply with all applicable FMVSS. Type approval is not required for motor vehicles and motor vehicle equipment sold in the United States. NHTSA does not issue type approval certifications and does not certify any motor vehicles or motor vehicle equipment as complying with applicable FMVSS. Instead, in accordance with 49 U.S.C. 30115, we have in place a "self-certification" process, which imposes responsibility on the manufacturer to certify the vehicle or equipment item as complying with the applicable FMVSS. The Vehicle Safety Act requires the exercise of "reasonable care" in issuing a certification of compliance with safety standards.

An evident stringency of this self-certification system stems from the requirement that *every individual vehicle unit* must be certified, not just a model, design or "type."

Self–Certification by a Manufacturer – U.S.

The motor vehicle is a complex, high-volume product. This fact alone drives significant rigor into a vehicle manufacturer's quality processes. The evident stringency of the U.S. motor vehicle safety self-certification system imposes an additional rigorous duty on manufacturers to assure with reasonable care that *every* new motor vehicle unit produced for U.S. sale meets all applicable compliance requirements. This stringency necessitates that manufacturers implement careful and effective internal controls for FMVSS compliance and certification and ongoing conformity of production.

Individual vehicle manufacturers each have their own processes for assuring compliance and certification. This is permissible under the self-certification system. However, certain actions and characteristics indicative of a high degree of thoroughness and attention to detail are typical of these processes across all manufacturers. Such actions and characteristics include, but are not limited to:

- Implementing a common process with structure, definition, discipline, effective execution and accountability
- Identifying, communicating and comprehending all applicable FMVSS requirements
- Demonstrating/validating compliance with all applicable FMVSS requirements using
  - Common test procedures
    - If different than NHTSA test procedures, the manufacturer still must be able to assure compliance if test procedures specified in the FMVSS were to be used
  - Demonstrated engineering and computer analysis capabilities
  - Valid bases for engineering judgments
  - Compliance margins as necessary
- Comprehending design carryover and changes and the need to possibly retest and recertify due to these changes.
- Exhibiting technical credibility and consistency with established practice or state-of-the-art practice
- Implementing quality controls in all steps
- Completing FMVSS compliance/certification documentation

  - Including a document retention & retrieval system
- Assuring conformity of production and continued compliance (discussed below)

The nature of compliance requirements specified under the certification system also is significant to an effective certification process. Standards (or regulations) and certification are closely linked. It is premature and not within the scope of this paper to recommend specific standards or regulations for 5.9 GHz DSRC cooperative safety systems in motor vehicles. However, any such standards/regulations should be performance-based to the extent practicable. Requirements predicated on performance allow for design flexibility and product innovation. Design flexibility and innovation are acknowledged as especially important for continuing 5.9 GHz DSRC cooperative safety application development. Design-based standards or regulations often can limit product advancement, and therefore should be avoided when possible.

Conformity of Production and Continued Compliance – U.S.

Two related items from the above common certification process actions and characteristics warrant additional discussion because of their significance in U.S. motor vehicle safety self-certification: conformity of production and continued compliance. Their significance is evident, for example, in a "Compliance Testing Program" guidance document (revised August 18, 1998) issued by the NHTSA Office of Vehicle Safety Compliance (OVSC). The "Manufacturers' Responsibility" section of that document states, in part:

> "The manufacturer must not only be concerned with the initial certification, but should also monitor continued compliance of vehicles and/or items of motor vehicle equipment throughout the production run…"
>
> "The Office of Vehicle Safety Compliance (OVSC) does not specify the type of quality control program that a manufacturer should employ. That decision is left to the manufacturer."

Accordingly, although the initial certification of a new vehicle (or equipment) is necessary prior to introduction into commerce, the manufacturer must be certain that each individual vehicle unit produced and offered for sale complies, and each vehicle unit must have a certification label that attests to its compliance.

To have this assurance, a vehicle manufacturer must institute effective quality controls not only throughout a vehicle's initial phases (design, engineering, development and testing), but also in its production and assembly processes. These controls are crucial to assure continued compliance and conformity of production. The vehicle's inherent complexity, market and consumer demands, as well as certification needs are just some of the reasons that necessitate high quality. Well-established processes are implemented to identify, contain and correct errors as early as possible in and throughout the vehicle development and production processes[2]. This need for quality controls drives adoption of quality tools such as "Design for Six Sigma" and

[2] These include well-established quality processes such as: Auto Industry Action Group's (AIAG's) "Advanced Product Quality Planning (APQP) and Control Plan Reference Manual" issued in 1994; VDA "Quality Assurance of Supplies" edition 1998, VDA "Quality Assurance prior to Serial Application, Part 1" edition 1996; VDA "Quality Assurance before series production, Part 2" edition 1996; VDA "Quality Assurance prior to Serial Application, Part 3" edition 1998; and ISO/TS 16949 "Quality management systems - Particular requirements for the application of ISO 9001:2000 for automotive production and relevant service parts organizations" (2002-03-01)"

statistical process controls, among others. Many of these quality tools also are used to support FMVSS compliance and certification.

Compliance Enforcement – U.S.

One of the NHTSA's additional responsibilities is FMVSS compliance enforcement. Although the Vehicle Safety Act places sole responsibility for certification on the manufacturer, it also provides for what can be seen as a "trust, but verify" enforcement element that provides a "check and balance" in the self-certification framework. The Vehicle Safety Act permits NHTSA to acquire, investigate, inspect and test new saleable certified vehicles to determine if they comply with FMVSS and other regulations. The agency has a very active and well-funded compliance enforcement program. Each year, on a partly random basis, the agency selects, inspects and/or tests a fairly large cross section of new vehicles (and equipment) in this program. If, as a result of this enforcement activity, a determination of non-compliance is established, a manufacturer may need to recall and remedy that non-compliance (see discussion later in this paper). The NHTSA can also order a recall.

This NHTSA enforcement element provides an additional impetus for a manufacturer to assure every vehicle it produces for U.S. sale complies with applicable FMVSS and is properly certified.

Manufacturer Prohibitions in the Vehicle Safety Act – U.S.

While the NHTSA has an explicit compliance enforcement responsibility, manufacturers have what can be seen as an implied self-enforcement duty stemming from prohibitions specified in the Vehicle Safety Act. These prohibitions also underscore the stringency of the self-certification system for motor vehicle safety governance in the U.S.

The first prohibition is found in § 30112 of the Act which states, in part:

> "…a person may not manufacture for sale, sell, offer for sale, introduce or deliver for introduction in interstate commerce or import into the United States, any motor vehicle or motor vehicle equipment manufactured on or after the date an applicable motor vehicle safety standard prescribed under this chapter takes effect unless the vehicle or equipment complies with the standard and is covered by a certification issued under section 30115 of this title."

The second prohibition is from § 30115 of the Act which states, in part:

> "A person may not issue the certificate if, in exercising reasonable care, the person has reason to know the certificate is false or misleading in a material respect."

Accordingly, a manufacturer cannot certify, produce or deliver for sale, or sell a vehicle that it has learned or determined, in the exercise of reasonable care, does not comply with applicable FMVSS. A determination of non-compliance usually means the manufacturer faces some serious consequences as outlined below.

Recall and Remedy Responsibilities - U.S.

Further evidence of the stringency of the U.S. system of motor vehicle safety governance is related to the recall and remedy consequences a manufacturer faces following a determination of a non-compliance with a FMVSS.

While NHTSA can make an official determination of a non-compliance with an FMVSS, such determinations are made more often by the manufacturers themselves in the exercise of due care throughout their compliance, certification and production monitoring programs. Upon a manufacturer's official determination of a noncompliance to an FMVSS, the manufacturer must immediately stop producing the non-complying product and make a proper notification to the NHTSA within 5 days. Additionally, the manufacturer must develop and implement expediently a proper recall and remedy campaign and notify affected vehicle owners. An exception to the owner notification and recall/remedy campaign requirements is if the NHTSA agrees, upon evidence submitted in a petition by the manufacturer, that the non-compliance is inconsequential to motor vehicle safety. In that case, owner notification and recall/remedy actions are not required.

How the manufacturer can remedy the non-compliance is described in the Vehicle Safety Act, in part, as follows:

> "§ 30120. Remedies for defects and noncompliance
> (a) …Subject to subsections (b) and (c) of this section, the manufacturer shall remedy the defect or noncompliance in any of the following ways the manufacturer chooses:
> (A) if a vehicle--
> (i) by repairing the vehicle;
> (ii) by replacing the vehicle with an identical or reasonably equivalent vehicle; or
> (iii) by refunding the purchase price, less a reasonable allowance for depreciation.
> (B) if replacement equipment, by repairing the equipment or replacing the equipment with identical or reasonably equivalent equipment."

The NHTSA also has clarified that the manufacturer bears the expense of a recall and remedy campaign ("Requirements for Manufacturers …" guidance document previously referenced):

> "Regardless of whether the noncompliance with an FMVSS or a safety-related defect is determined to exist by the manufacturer or by NHTSA, the manufacturer must provide owners and dealers of the affected products with notification of the noncompliance or defect and must remedy the noncompliance or defect, usually without charge. The notification and remedy process is commonly referred to as a "safety recall campaign" or more simply as a "recall." NHTSA monitors the remedy program to ensure its successful completion. The agency is not authorized to expend its funds on recalls; the expense of notifying owners and providing a remedy must be borne by the fabricating manufacturer and/or importer of the products found to contain the noncompliance or defect."

The serious consequences associated with recall and remedy actions provide another reason for manufacturers to maintain a robust self-certification program.

Civil and Criminal Penalties and Actions – U.S.

In some circumstances, the Vehicle Safety Act (§ 30165) also allows the NHTSA to impose a monetary civil penalty on a vehicle or vehicle equipment manufacturer. The circumstances involve a finding by the NHTSA that the manufacturer violated its certification or other responsibilities under the Act. The penalties, which have been periodically adjusted upward for inflation, currently stand at a maximum of $6,000 (US) per violation (e.g., per each involved vehicle unit) or a maximum total penalty of $16,375,000 for a related series of violations (e.g., multiple vehicle units). There also is current active NHTSA rulemaking to adjust the maximum total penalty upward to $17,350,000, as well as proposed federal legislation that could increase this penalty substantially.

Additionally, the Act (§ 30170) allows for criminal penalties, including fines or imprisonment of up to 15 years, if there is a finding that a manufacturer falsified or withheld information under the reporting requirements of the Act (§ 30166) with the intention of misleading the agency regarding motor vehicle safety. Furthermore, the Act (§ 30163) allows a civil court action to be brought against a manufacturer for violating its certification or other responsibilities under the Act.

These penalties and actions historically have been used infrequently and normally only when there has been some evidence of a serious violation. However, individually and together they provide additional evidence of the strictness of the US. motor vehicle safety self-certification framework.

Summary - U.S. Self-Certification

The inherent stringency of U.S motor vehicle safety self-certification framework is evidenced by its defined federal authority and manufacturer accountability, enforcement and consequences of violations, etc., outlined in the preceding sections of this paper. These characteristics drive much of the necessary rigor an automobile manufacturer typically needs to implement for safety compliance and certification. Whether through regulatory certification or other means, comparable rigor is likely to be necessary to assure safe functioning of the 5.9 GHz DSRC devices, equipment and systems used for motor vehicle cooperative safety applications. This includes devices, equipment and systems provided by vehicle manufacturers, infrastructure providers and the aftermarket. Without such rigor, there may be questions on the ability to trust the information being transmitted. Without that trust, a 5.9 GHz DSRC safety application could be compromised or rendered unreliable. Such uncertainty would translate into excessive investment risk, thus impeding deployment. Recommendations are provided later in this paper regarding important elements of a certification framework that would support the proper rigor.

Other Certification Framework Examples – Public and Private Sectors

Type Approval – Europe

A second major public sector certification framework exists for motor vehicle safety governance. It is not a self-certification system. It operates differently than the U.S. certification framework, but also exhibits accountability, authority and evident stringency features that help assure an accepted level of motor vehicle safety. It is commonly called type approval. Components, systems and/or whole vehicles can be type approved.

The type approval system is used widely throughout the world, with Europe as the prime example. The European system has a similar purpose to that of the U.S. self-certification system, i.e., providing a reasonable level of assurance that the vehicle and its equipment perform safely (and meet environmental and anti-theft requirements). However, certain elements and features of the type approval system are notably different compared to the U.S. system.

One characteristic difference is that a governmental authority, for example a member country of the European Union (EU), has the primary responsibility for vehicle approval/certification. The government, through its designated type approval authorities, issues the approval/certification, not the manufacturer. A manufacturer must have European Economic Community (EEC) or (where contained in EU framework directive 2007/46/EC, Annex IV, Part II) Economic Commission for Europe (ECE) approvals to register and sell its products throughout the EU.

In the EU, legislation essentially is synonymous with regulation. The EU Parliament passes legislation in the form of a directive that is also the regulation. EU directives serve the same function as U.S. FMVSS. There also is a harmonization purpose in the EU motor vehicle safety governance framework. Based on a mutual recognition agreement among the EU member countries, once a vehicle is type approved by one member country, the vehicle manufacturer can market it throughout the EU. The applicable Framework Directive is the "Directive of the European Parliament and of the Council of 5 September 2007, establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles". It is commonly known as 2007/46/EC.

Type approval certification typically is demonstrated and documented through testing, inspection or submitted documentation with respect to defined compliance requirements in prescribed regulations. However, unlike the U.S. self-certification system, the testing and/or inspection is conducted in the presence of a type approval witness. This is a person representing the governmental authority or a representative of an officially-accredited test institute. The test will be conducted by that person on a test bench of the authority or the test institute, or it will be witnessed by that person at the manufacturer's test facility (or a contracted facility) for the compliance test or inspection. In addition, the type approval authority often provides specific direction on how the test or inspection is to be conducted and/or the type and format of documentation that is to be provided. This often involves specifying "worst-case" testing of a vehicle or item of equipment that combines a number of the most unfavorable features or test conditions with respect to the required level of performance to be achieved (ref. Type Approval Directive 2007/46/EC, Appendix 3, Paragraph 5).

In addition to the governmental responsibility for certification, the European type approval system exhibits an additional important difference compared to the U.S. self-certification system. The approval/certification is provided for the vehicle or equipment "type," not for individual production units. A simplified representation of what vehicle "type" means in this context is that the vehicles receiving the type approval have basically the same structure, equipment and performance as those intended for sale. The expectation is that all vehicle units within the vehicle type exhibit the same basic safety performance under the defined regulations because of the similarity in their design, construction and content.

The EU also has a conformity of production (COP) agreement (2007/46/EC, Articles 5 and 12, and Annex X). In addition to type approvals required for applicable technical regulations, COP clearance also must be given before a type approval authority can issue type approvals. In many cases, this can be achieved if the manufacturer demonstrates compliance with the International Organization for Standardization's (ISO) ISO 9001 industry quality management standard. That standard covers procedures for key processes in the business, monitoring processes to ensure their effectiveness, recordkeeping, checking for product defects with corrective actions as necessary and regular reviews and continuous improvement of processes and the quality system.

Once the type approvals are issued, a certification mark shall be affixed to the applicable vehicles (and equipment) and they can be offered for sale throughout the EU member markets. Member countries that wish to challenge compliance of a vehicle model with applicable regulations must take the matter up with the government that certified the vehicle. That government in turn works with the manufacturer to resolve the issue.

The Type Approval Directive 2007/46/EC includes a process (Chapter VIII Article 20 and 21) that permits exemptions for new technologies or new concepts. An approval can be granted, following application by the manufacturer, even if a vehicle incorporates a new technology (e.g. cameras replacing rearview mirrors) or new concept that conflicts with or is incompatible with

one or more mandatory EU Directives. The U.S. Vehicle Safety Act also has a less flexible exemption allowance.

An EU member state may grant a provisional approval (exemption) that will apply in its country. It first must inform the EU Commission and other member states and provide information describing (1) the reasons for the exemption, (2) the safety (and environmental) considerations involved and measures taken to address them, and (3) the tests and results demonstrating that at least an equivalent level of safety (and environmental) protection is ensured compared to the requirements for which the exemption is requested. After discussion with all other EU member states, the EU Commission can decide to grant an EC-type approval applicable throughout the EU.

When an exemption is given to a vehicle manufacturer, the EU Commission must take steps to amend the EU Directive, or propose to amend an involved UN-ECE regulation, to remove the conflict in the regulation. If the EU Commission does not authorize the exemption, the provisional approval will be revoked within six months after the decision. If the EU Commission does not amend the relevant legislation, the exemption may be extended to allow the sale of exempted vehicles to continue.

The EU also has a Directive on general product safety (2001/95/EC) that essentially serves a similar purpose to the notification, recall and remedy provisions of the U.S. Vehicle Safety Act. It describes the manufacturers' obligations with respect to general product safety of any product (not only automotive). The Directive requires that upon discovery of an unsafe condition in a product, a manufacturer must provide consumers with the necessary information regarding that condition, particularly when it is not obvious. A manufacturer also must, at its own expense, take the necessary actions to remove the unsafe condition, e.g., withdraw products from the market, inform consumers, recall products which have already been supplied to consumers, etc. Additionally, the manufacturer must notify the competent authorities and cooperate with them as necessary. The application of 2001/95/EC on type approved vehicles, their systems or components is described by the Safeguard Clauses in 2007/46/EC, Chapter XII.

Type Approval - Australia

A variation on the European type approval system is the type approval system for motor vehicle safety (and emissions) in Australia. Unlike the European system, the Australian government (the type approval authority) does not test or witness the certification testing. The manufacturer conducts the tests to ensure compliance with applicable regulations, called Australian Design Rules (ADR). The manufacturer then submits to the government authority (Vehicle Safety Standards (VSS) in the Department of Infrastructure and Transport) an application for certification approval. The manufacturer also must submit a summary of the compliance evidence to show that testing, etc., was done properly and that the vehicle met the requirements. If VSS agrees that the vehicle complies, it issues an approval document. That document allows the manufacturer to place compliance plates signifying certification on the specified make/model vehicles. The information the manufacturer submits is subject to government scrutiny. Such scrutiny also can include quality assurance audits of its manufacturing facilities and test facility inspections. As with European type approval, the expectation is that if the design is known to comply, and all of the production is built according to the design, then all the production vehicles also comply.

Type Approval - Japan

Another variation of the motor vehicle safety type approval system is the one used in Japan. In Japan, the government has its own facilities where overall compliance with standards is assessed. The government has the responsibility to assess performance through tests, inspections or other means using typical sample vehicles, to guarantee compliance with technical regulations, and to issue the approval certification. Detailed compliance with technical regulations is required, and inspections and evaluations are carried out by the government. Compliance is further guaranteed by means of inspection of vehicle manufacturer quality-control systems. Before approvals are provided, large amounts of vehicle test data and documents must be submitted by the manufacturer. That information then is reviewed by the government-run inspecting agency.

Third Party Certification

Another variety of certification framework can be categorized as third party certification. Third party certification is often used for consumer products. Two examples are discussed below. The first is a public sector third party conformity assessment framework that includes governmental oversight and authority. The second is a private sector third party certification structure that does not include governmental oversight and authority.

Consumer Product Safety Commission

The public sector example entails a third party conformity assessment regarding requirements specified by the U.S. Consumer Product Safety Commission (Commission), a U.S. federal government agency. The Commission has authority under the Consumer Product Safety Act (CPSA) to oversee a broad range of consumer product safety in the U.S.

Recently, a Commission Notice of Requirements was published pursuant to the CPSA and associated with conformity assessment of youth all-terrain vehicles ("Third Party Testing for Certain Children's Products; Youth All-Terrain Vehicles: Requirements for Accreditation of Third Party Conformity Assessment Bodies," Federal Register / Vol. 75, No. 166, August 27, 2010, p. 52616). The notice "…provides the criteria and process for Commission acceptance of accreditation of third party assessment bodies for testing of all-terrain vehicles (ATVs) designed and primarily intended for children 12 years of age or younger…"

In this case, an unbiased third party, not the government or the manufacturer, conducts the conformity assessment (testing, etc.). However, the Commission establishes the criteria and process for accreditation of the conformity assessment bodies. The criteria include requirements intended to limit undue influence on the third party assessment body's test results by the government, the manufacturer or any other person. The accreditation also must be registered with and accepted by the Commission, which also maintains an online accreditation listing system where interested persons can verify a product's accreditation status.

If the third-party assessment testing successfully demonstrates conformity with the applicable Commission regulations relating to ATVs, the assessment body issues a certificate of compliance. The manufacturer still has the responsibility for declaring its product is certified, but the certificate and test results from the third party assessment body can be used as the basis for certification. The notable characteristic of this certification example is the balance between some level of government oversight and the independence and established or presumed absence of bias generally attributed to third party assessment.

Underwriters Laboratory

The next example is a private sector example. The Underwriters Laboratories Inc. (UL) product certification programs cover a broad range of products, from consumer electronics and appliances to building materials and chemicals, among many others. The primary focus of UL's certification programs is to assure an acceptable level of safe performance of the products. The UL programs are accredited by the U.S. Occupational Safety & Health Administration (OSHA), the American National Standards Institute (ANSI), and the Standards Council of Canada (SCC). However, they do not involve government authority or oversight. UL operates as an independent, nongovernmental entity. Only UL reviews the results of all testing and evaluation and decides if a product is eligible for certification. UL has a long, well-established reputation as a respected certification source. As a result, a product with a UL mark is often viewed with confidence by consumers.

To establish certification, the product manufacturer submits samples of the product to UL for testing and evaluation. Testing and evaluation are conducted in UL's own laboratories or in facilities qualified by UL. UL also initiates a follow-up program by its field representatives involving periodic audits of the product at the manufacturer's production facility. This audit program is established as a part of the initial product evaluation. If the product meets applicable requirements, and the audit program is initiated, UL authorizes the manufacturer via certificate or notification to apply a UL certification mark to the production items represented by the samples that were submitted for evaluation. For some products, production samples are selected for retesting at UL. Certification continues until the manufacturer requests that it be ended, or the product or manufacturer cannot fulfill a requirement of the UL program. If a certified product is modified, UL requires that the modified product be reevaluated before that product is authorized to exhibit the UL certification mark. The notable characteristics of this third party certification structure are its independence and established and presumed absence of influence from a governmental authority or the manufacturer, and UL's world-wide recognition and reputation as a respected certification entity.

Summary and Recommendations

Key Characteristics of a Robust Certification Framework

The preceding discussion outlined what certification entails, including an expanded context of enforcement and consequences of noncompliance. Also discussed were existing certification frameworks for motor vehicle safety and examples of existing frameworks for safety certification of non-motor vehicle products. Public sector frameworks with governmental involvement and private sector examples were included. Key features and characteristics of the frameworks were identified.

The U.S. motor vehicle safety self-certification system has clear and important elements of authority, accountability and stringency, as do the vehicle safety type approval systems in Europe, Japan and Australia. Moreover, all have proven to be effective for many years at providing an accepted level of motor vehicle safety in the respective jurisdictions. Accordingly, because they provide a reasonable level of safety assurance, key characteristics from any of them could be helpful if a certification framework is determined to be required for 5.9 GHz DSRC cooperative safety systems, devices and equipment. Certification may be necessary, or at least preferred, to help assure that V2V and V2I cooperative safety communications can be trusted. Such trust is crucial to assure that 5.9 GHz DSRC devices comply with applicable requirements and are capable of delivering accurate and reliable applications/services. There also are useful characteristics of some third party certification frameworks that should be considered.

The VIIC recommends that the following certification framework characteristics be incorporated if it is decided that safety performance certification is necessary for any or all parts of a 5.9 GHz DSRC cooperative communication system used for motor vehicle safety enhancement. A brief rationale for each is included. The VIIC believes that together these characteristics provide a reasonably stringent framework for an accepted level of safety certification assurance.

- **Defined authority.** The entity, e.g., government, manufacturer or third party, which has the authority for certification and/or its enforcement, needs to be defined so that clear responsibilities are understood. Without defined authority, the certification process could become unreliable or uncontrolled and lead to a lack of confidence in the product. Moreover, in the case of 5.9 GHz DSRC systems for safety communications, those responsible for deploying them are unlikely to make the necessary investments without the assurance that rigorous certification requirements provide.

- **Clear accountability.** Accountability goes hand-in-hand with defined responsibilities. Accountability is important, for example, when questions of product performance are raised such is in a noncompliance investigation which might lead to a product recall.

- **Performance-based standards.** Specification whenever possible of performance-based standards, rather than design requirements, is important to allow for product design flexibility and innovation. This is especially important for continued 5.9 GHz DSRC development and innovation.

- **Robust compliance certification practices.** Among all of the key characteristics of an effective certification framework, this may be the most important. Robust certification practices, such as attention-to-detail, thoroughness and quality controls, (among others) are the real means to provide the technical assurance and basis for proper product performance.

- **Absence of bias or undue influence in certification process.** Reducing opportunities for undue influence on certification results or practices by any involved entity also helps maintain confidence in a product's performance.

- **Certification to agreed standards is needed for any 5.9 GHz DSRC safety device**. Initial certification of design and build quality needs to be demonstrated using testing, analysis and/or engineering judgment to provide true, accurate, timely and reliable communications in order to support safe performance.

- **Assurance of continued compliance and conformity of production.** This characteristic helps provide a level of confidence that every unit of the product produced complies with applicable requirements and that certification remains applicable to every new production unit.

- **Compliance enforcement.** This characteristic serves as a check-and-balance for the certification system and entails a "trust, but verify" philosophy that supports confidence in the certification.

- **Consequences of noncompliance.** Product recall and remedy consequences serve to protect the public from unsafe conditions that may occur in a product throughout its production and life. They provide an additional level of stringency supporting a robust certification framework.

Recommendation for an Ongoing Federal Role

A final recommendation for the purposes of this paper is one regarding the federal role in governance of V2V/V2I 5.9 GHz DSRC systems. The VIIC believes that federal governance is needed for most, if not all, aspects of a system deployed nationwide. These aspects include but are not limited to device certification, message integrity (validity, security, and enforcement), interoperability, rules of use and operations, privacy, harmonization, and cross border acceptance. Federal governance avoids the implementation of divergent and conflicting requirements at the state and/or local governance levels, which would make deployment of a 5.9 GHz DSRC system for cooperative safety impracticable for both system providers and users. Federal governance is needed so that necessary requirements can be applied and enforced across all U.S. jurisdictions. It is also necessary to negotiate, implement, and enforce international agreements between countries. The governance structure also needs to be durable and reliable to support investment.

Existing federal entities already have authority over certain aspects of IntelliDrive^{SM}. For example, the NHTSA is responsible for overseeing the safety performance of motor vehicles and their equipment, the Federal Motor Carrier Safety Administration (FMCSA) is responsible for commercial vehicle safety, the Federal Highway Administration (FHWA) is responsible for roadway infrastructure, and the Federal Communications Commission (FCC) is responsible for the communication spectrum. Because this is a cooperative safety system that impacts across all of these agencies, new authority is likely to be needed to address shared responsibilities. Moreover, it is uncertain who has, or should have, governance responsibility for aftermarket devices. Therefore, some aspects of IntelliDrive^{SM} are unique, and will require Congressional action to, at a minimum, expand and fill in any gaps in necessary governance structures.

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Annex

This Annex provides a brief discussion of three additional topics associated with certification. These topics will need to be addressed in the context of 5.9 GHz DSRC system certification. However, they are not yet developed to the point where a fuller discussion can be included at this time. The VIIC believes that further study and discussion of these items is warranted.

Areas of Potential System Certification Needing Further Study

The preceding paper focused on characteristics of a certification framework that could be useful for safety performance assurance of V2V and V2I 5.9 GHz DSRC cooperative safety systems. There may be other non-safety areas associated with these systems for which certification should be considered as a potential means to assure necessary levels of performance or capability. These areas include, but are not limited to, security, privacy, compatibility, and interoperability of the equipment and devices used in these cooperative communication systems. There is recognition by most 5.9 GHz DSRC stakeholders that these areas require further study and work already is underway to understand the needs in these areas.

It also should be noted that there may be a future need for a certification program that addresses aftermarket applications and services made available by 5.9 GHz DSRC deployment, but this type of certification is beyond the scope of this paper. VIIC would like to participate in development of any future certification scheme for aftermarket applications and services.

Standards Harmonization

Product certification complexity can increase if corresponding standards with the same or similar purpose are not harmonized globally across economies or jurisdictions where the product is intended to be sold. A simplified statement of the standards harmonization objective is “tested once, accepted everywhere.”

Standards harmonization already has been recognized as important to the development and rollout of intelligent transportation systems, including 5.9 GHz DSRC elements. Agreements and activity have been established and planned regarding harmonized cooperative safety system standards. These were recently outlined in an October 24, 2010 presentation by the U.S. DOT’s Research and Innovative Technology Administration at the 6th International Workshop on Vehicle Communications in Busan, South Korea (ref. “U.S. Perspectives on International Harmonization of Cooperative Systems Standards,” Bertini, Robert L.) This presentation also noted some of the potential benefits from harmonization specific to cooperative communication systems: reduced cost and accelerated implementation from reduced need for regionally different hardware/software; cooperation on applications and research, and expanded services for customers from interoperability.

Divergent standards can be disadvantageous to global vehicle development. In an already global vehicle market that is becoming even more global, automakers are producing more “world vehicles.” These are vehicles designed for sale in multiple markets around the world. For reasons of development and production cost reduction and vehicle affordability (among others), automakers look to increase economies of scale and to expand global sourcing for materials and production. Divergent standards among countries or jurisdictions increase vehicle development and production complexity. These complexities often add development and product costs that can reduce affordability without measurable increases in consumer benefits. They also can act as non-tariff barriers to automotive trade across economies.

A useful step to reduce conflicts from divergent standards (and regulations) would be for standards development entities to carefully analyze the purpose and objectives of their proposed standard(s). The goal of the analysis should be to determine if the national or regional objectives for which the standard is intended justify a standard different from a corresponding one already existing or proposed in another region or jurisdiction. A partial harmonization solution can exist even if there is a national or regional justification for a different performance level in a standard, e.g., a safety or environmental condition unique to a jurisdiction. A partial solution can be the use of a harmonized test procedure which would provide some beneficial reduction in product development complexity.

Even if harmonized standards cannot be established, mutual recognition and acceptance of standards or certifications among jurisdictions could be helpful. This could be especially important, for example, in the North American Free Trade Agreement (NAFTA) region. With the possible future rollout of 5.9 GHz DSRC applications in the U.S., considerations of cross-border certification recognition among U.S., Canada and Mexico needs to be addressed. To the extent that a determination can be made of the basic functional equivalence of corresponding standards or certifications from different jurisdictions, products from one jurisdiction could be accepted in another. This would eliminate the need for additional compliance certification testing and also provide the type of harmonization benefits previously noted. Functional equivalence could be declared if the standards or certification of another jurisdiction are determined to meet the needs and objectives of the home jurisdiction.

There may be a somewhat unique opportunity for standards harmonization regarding 5.9 GHz DSRC technology. The technology still is in relatively early stages of development. It is possible that harmonized standards development earlier rather than later in a technology's evolution may have a better chance of being realized, because differing national or regional standards have not had sufficient time to become established or entrenched. Accordingly, the standards development entities may be more willing and able to consider harmonization in their respective standards development processes. There is evidence that this is possible based on a real-world regulatory example: the harmonized Global Technical Regulation (GTR) established for safety performance of motor vehicle electronic stability control systems. The GTR was developed through the United Nations Economic Commission for Europe Working Party 29. It was adopted as a U.S. FMVSS and has been proposed for adoption as an ECE Regulation. The success of this harmonized regulation development was aided by two factors: (1) neither regulatory jurisdiction yet had a fully-established regulation for this purpose, and (2) a great deal of coordinated effort went into developing a strong scientific and engineering basis for the regulation.

The VIIC currently is developing a more complete set of recommendations regarding the need for harmonization and anticipates providing them in a subsequent paper.

Certification in Relation to Product Liability

As a general statement, product certification provides an important but only minimum level or baseline defense against possible product liability claims under U.S. law. Being certified does not exempt or remove a product from being subject to product liability lawsuits. Even if a manufacturer produces a product that complies with required standards or regulations, and the product is certified as such, the manufacturer still can be held liable under U.S. product liability laws. This has much to do with the fact that most compliance requirements, including the FMVSS, establish minimum standards. Most state laws require that a product remain safe for its intended use and for reasonably foreseeable misuse. Compliance requirements in minimum standards and regulations rarely cover all intended use or foreseeable misuse scenarios.

Plaintiffs often try to prove that the product is defective by arguing that there is an alternative, safer way to design the product.

There are other non-product liability considerations, e.g., those that a certification entity might face. These are beyond the scope of this paper. However, the following OmniAir[SM] Consortium paper provides a discussion of this subject: "5.9 GHz DSRC Device Certification Program: Liability Issues Regarding Certification," January 2008.