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Performing Ethernet Network Testing with Spirent OPEN and AVB Test Suites

Hyundai ensures their next-generation automobile conforms to IP and AVB standards

In the multifaceted automotive landscape, the success of establishing a new car label depends to a large extent on how manufacturers meet drivers' desires and needs regarding safety and convenience.

To guarantee flawless in-vehicle and V2X communication, compliance to standards developed by non-profit organizations such as OPEN Alliance SIG and Avnu are required for building a complete ecosystem of interoperable devices.

Background

Hyundai is marketing a state-of-the-art car with an impressive communications network system that hits new highs in safe, relaxed, and entertaining driving. High-quality networks require high-quality testing—Spirent was called upon to assist Hyundai in their efforts to determine the best Ethernet designs.

The Challenge

Today, car manufacturers like Hyundai face increasingly challenging requirements when constructing a network that demands predictability and absolute reliability. Although data networks in vehicles are commonplace today, manufacturers must ensure features such as infotainment, safety, and driver-assist technologies work together instantaneously. The Automotive industry has a long history in testing and retesting during development as consumers expect complete reliability in their vehicles.

What's new is that car manufacturers like Hyundai understand that stringent conformance testing of all connected features included in audio and video applications (e.g. cameras, sensors, and entertainment) is now indispensable. This includes the application for communication, the switch with implemented AVB/TSN functionality. To test these functionalities, a kind of rest-bus simulation is required for the communication layer. This is quite a challenge, especially for the tester, since they must simulate not only the expected communication, but also malfunctions in the network by simulating best- and worst-case scenarios.

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Hyundai needed a solution to test their new Ethernet network systems for compliance to international standards, including the Avnu Automotive AVB Profile and the OPEN Alliance SIG specifications. Furthermore, they intended to test their own specific IP and AVB profiles to be able to integrate additional communication feature sets. This can become a quite a challenge as systems are composed of devices from different vendors with various characteristics.

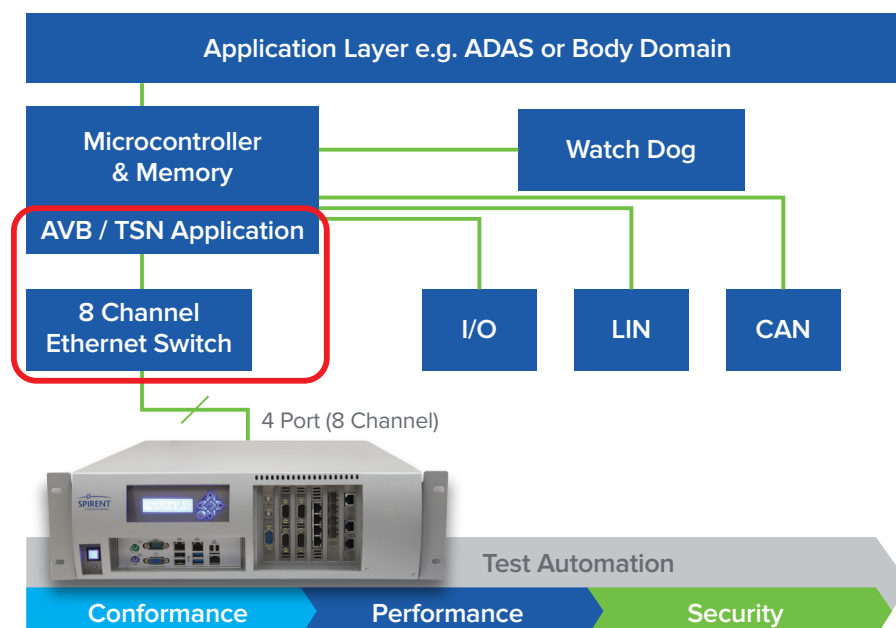
Depending on the development stage, the test process should also include a conformance check of implemented protocols as well as the validation of cyber security functions.

What is AVB?

Audio Video Bridging (AVB) is the layman's term for the set of open technical standards developed by The Institute of Electrical and Electronics Engineers (IEEE). Within these standards are guidelines that outline the maximum and minimum latency allowed, and these standards requirements must be met whenever an Audio/Video system is expected to deliver highly synchronized data which is why the IEEE Audio/Video Bridging Task Group expanded it to cover Time-Sensitive Networking (TSN).

AVB frames are forwarded with precedence over best-effort traffic (i.e. reserved AVB stream traffic traversing an AVB bridge has forwarding precedence over non-reserved traffic) and will be subjected to traffic shaping rules. The traffic shaping rules for bridges require that frames be distributed very evenly in time. This means that all the AVB/TSN traffic being transmitted out a particular port is distributed evenly in time. This has the effect of smoothing out the delivery times—preventing “bunching” of frames.

By controlling the queuing and data flow, an AVB/TSN system has the lowest possible latency. That latency is controlled and bounded by the rules of FQTSS. If a system has fewer switch hops then the designer can reduce the latency even further and be assured that the traffic will arrive correctly.



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The Solution

Utilizing Spirent TWorkbench automation platform allowed for the ease of customization and individual adaptation needed to fully meet Hyundai’s testing requirements. Additionally, Spirent’s software experts were able to develop the Hyundai-specific test cases in a timely manner. The test solution included a set of full-featured protocol conformance test suites used to verify the compliance to Avnu and OPEN Alliance SIG specifications.

AVB enables car manufacturers to develop industry “best practices” including:

- Support low-jitter media clocks and accurate synchronization of multiple audio/video or sensor streams
- Optimize network resources by allowing independent traffic classes
- Ensure timely packet deliveries using bounded latency traffic
- Ensure extreme reliability including redundant clock main and data traffic

Test Equipment

Hardware:	Spirent C50 Appliance with BroadR-Reach network interface cards
Advanced Software Kit:	RFC-2544, RFC-2889, IGMP/MLP Host IP/Multicast
	IEEE 1588v2, 802.1dx and DPG
	Automotive AVB Conformance Test Suite Pack
	OPEN Alliance SIG Conformance Test Suite Pack
	Spirent TWorkbench Professional



Next Steps

Spirent’s development and support team will continue to maintain existing specifications and assist with enhancements needed to optimize and modify test cases according to latest requirements and challenges. Spirent TWorkbench intuitive automation platform provides Hyundai’s design team the ability to develop test cases on their own, expanding their testing to include upcoming state-of-the-art features.

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About Spirent Communications

Spirent Communications (LSE: SPT) is a global leader with deep expertise and decades of experience in testing, assurance, analytics and security, serving developers, service providers, and enterprise networks.

We help bring clarity to increasingly complex technological and business challenges.

Spirent's customers have made a promise to their customers to deliver superior performance. Spirent assures that those promises are fulfilled.

For more information, visit:
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About Hyundai Motor Company

Hyundai Motor Company is a South Korean multinational automotive manufacturer headquartered in Seoul. Founded in 1967, the company is by now one of the largest automakers in the world. Due to their continuous focus on competitiveness, quality and innovative technologies, it remains a leader in the global Automotive industry. For more information please visit: <http://worldwide.hyundai.com/WW/Main/index.html>

Spirent pioneered testing of many of the technologies adopted by the Automotive industry, including Ethernet networks, mobile connectivity and service quality, or location-based services. Spirent is involved in standards initiatives and is an active member of AUTOSAR, Avnu, OmniAir Consortium, OPEN Alliance SIG, IEEE, and ETSI.

"The AVB/TSN core technologies of prioritization, reservation, traffic shaping, and universal timing allow the construction of networks with the demanding predictability and reliability requirements of the Automotive industry." –Avnu Alliance

Contact Us

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