CAN Newsletter Online

IN-VEHICLE NETWORKS

Cooperation on timing measurements

Rohde & Schwarz and TSN Systems have successfully cooperated on precise timing measurements for in-vehicle networks using automotive Ethernet 100BASE-T1. Classical CAN and CAN FD also play a role.

The RTx-K35 software option for the RTO oscilloscope enables latency measurements (Source: Rohde & Schwarz)

With radar, lidar, and camera sensors present in automobiles, time sensitivity on networks becomes important, as vast amounts of sensor data need to be transferred and processed within a few milliseconds. The two companies cooperated on a solution. Moreover, they can perform precise timing measurements for all automotive serial bus protocols such Classical CAN CAN, CAN FD, LIN, and more.

Advanced driver assistance systems (ADAS) require high bandwidth and low latency communications. Automotive Ethernet can handle these requirements by offering higher data rates as well as time-sensitive network capabilities.

Together, Rohde & Schwarz and TSN Systems provide a test solution for engineers who need to perform precise timing measurements on in-vehicle networks with nanosecond accuracy for Layers 1 to 3. In the collaboration, Rohde & Schwarz (R&S) provides a tailored oscilloscope solution based on the R&S RTO, while TSN Systems contributes TSN Box, a hardware interface to the network and TSN Tools, a measurement and analysis software.

The test setup monitors an automotive Ethernet 100BASE-T1 communication link consisting of TSN Box 3.0 acting as talker, listener, and test access point (TAP) device. The TSN Box 3.0 TAP device provides information to a PC with TSN Tools based on Layers 2 and 3. The TAP introduced 2x PHY delay for 100BASE-T1 at around 1,5 µs ±10 ns. The RTO oscilloscope was used along with the R&S RTx-K35 bus measurements statistics option to measure and verify this timing accuracy in the physical layer of the automotive Ethernet signal (Layer 1). The mean time delay was measured to be 1,5 µs with a max deviation of ±10,2 ns. In addition, the Qbv traffic (IEEE802.1) was generated by the TSN Box 3.0 with 500 µs cycle time resulting in a jitter ranging from 8 ns to 20 ns, which was verified by both the TSN Tools and the RTO.

The combination of TSN Tools and TSN Box provides a range of functions to address validation and testing for time sensitive automotive Ethernet. While TSN Tools is a PC based analysis software performing visualization and deeo detail analysis, TSN Box serves as a interface to the link. Based on its configuration, it can act as a generic TSN Talker/Listener device with nanosecond precision. The TAP can transparently synchronize itself to the gPTP master in the network. This allows applications that need correlation between payload time stamps and TAP time.

The RTx-K35 software option for the RTO oscilloscope enables latency measurements, for example monitoring the communication between two devices for a long period, and provides statistics on error rates as well as frame timing on the packets. The RT-ZF7 test fixture acts as the link in the middle and allows the full monitoring between the transmitter and receiver device in both directions using the oscilloscope.

In combination with the suitable decoding option, the 100BASE-T1 time data can be measured frame-to-frame, and engineers can get full bus error statistics such as frame error rate and rate of consecutive errors. Moreover, they can perform precise timing measurements for all automotive serial bus protocols such Classical CAN CAN, CAN FD, LIN, and more.

Juergen Scheuring, Managing Director at TSN Systems, said, “The advent of time sensitive communication in next generation EE-Architectures raises some serious challenges for the test and validation teams at OEM (original equipment manufacturer) and Tier1. We are happy to cooperate with Rohde & Schwarz and to benefit from their class-leading products providing Layer 1 analysis and expert level knowledge on time sensitive networking.”

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