NOVELIC

CASE STUDY

Custom High-Speed Data Logger for ECU Validation

THE PROBLEM

The client is a leading Tier 1 automotive company that needed a reliable way to test its ECU for ultrasound sensors. They required a data logger that would log data from the ECU at a very high speed and provide an output to check data validity.

CHALLENGES

Time Synchronization

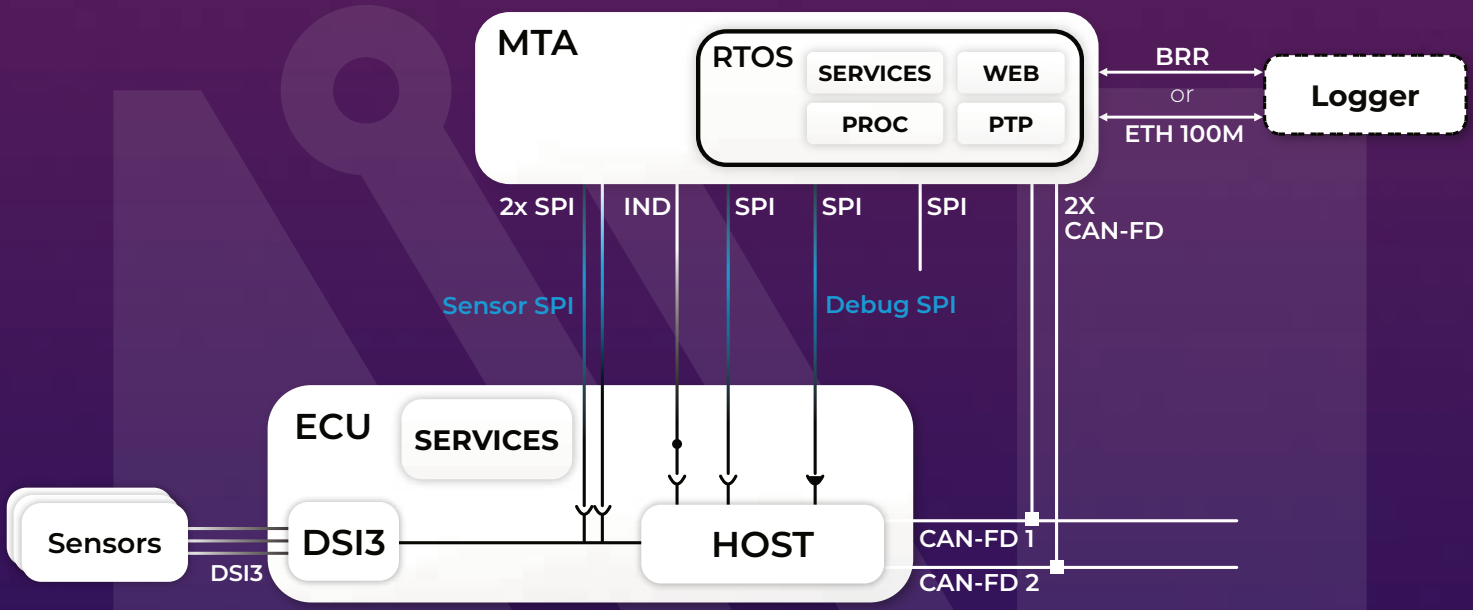
For the system to work properly, there had to be synchronization between the ECU and the data logger, as well as between the data logger and the PC. This was achieved by using Precision Time Protocol (PTP), an automotive-grade time synchronization protocol used to synchronize clocks throughout a computer network. Our team needed to choose the right hardware and software that would be able to support PTP.

Low-Latency

One of the greatest challenges was to enable low latency through the system. This required careful planning and optimization of hardware and software components to transfer data packets from the logger to the PC in the shortest possible amount of time.

THE SOLUTION

The project required full-circle product development including system design, hardware development, software development, integration, and production. As a result, our team developed a highly programmable and configurable platform that can be used to monitor and validate any kind of data from a device with a high throughput (camera, radar, lidar, and other types of sensors). While this solution was optimized to log raw data to a host device, it can also be customized to perform data analysis and preprocessing or to log raw data internally.



HOW IT WORKS

The purpose of the custom data logger is to enable ECU verification and validation by collecting the data it receives from the sensors and performing further analysis. The MTA data logger sniffs data packets exchanged between the ECU and ultrasonic sensors via SPI and CAN FD protocols. Each sniffed packet gets timestamped, which provides information on the time the packet arrives at the ECU and at the data logger.

The packets are sent to a PC, and a **CRC** (cyclic redundancy check) is performed to verify that the data is received correctly. There is a fully customizable, multi-port Ethernet switch with up to 6 outputs that enables switching between ETH PHY 100BASE-TX and BroadR-Reach 100BASE-T1. It is paramount for the data to be transferred from the data logger to the PC as quickly as possible. Our team managed to optimize both hardware and software and to have a time synchronization jitter at the scale of 10 nanoseconds. Once the data packets are stored on the PC, the user can perform further data analysis and processing, such as plotting the collected data to check for anomalies.

A custom-developed web server is used to configure the data logger and provide various statistics related to the data transfer and protocols (i.e. packet loss, packet arrived at a wrong destination). The web server has a custom PTP-oriented network adapter.

The logger can be remotely updated over an Ethernet/USB interface via Trivial File Transfer Protocol (TFTP). This allows for automatic updates and easy addition of new functionalities to the platform without any action required on the user's side.

This solution was developed to be highly customizable for different setups and use cases. The data logger supports a variety of interfaces (CAN, CAN FD, SPI, I2C, LIN, etc.) and can be ported to any RTOS. Since the logger can stream data from any type of sensor, it can be used as part of a sensor fusion system. The data collected from a sensor can also be used for sensor emulation. This is particularly useful for HIL (hardware-in-the-loop) testing where the collected data can be sent to the tested device in order to observe its behavior.

The logger can be further customized for multiple purposes:

- Custom ECU validation solution
- Packet sniffer for monitoring and validating streamed data
- Radar sensor data logging and preprocessing hardware

HIGHLIGHTS

- HIGH-SPEED, HIGH-THROUGHPUT DATA LOGGER
- SOFTWARE DEVELOPED IN COMPLIANCE WITH **AUTOSAR** STANDARDS
- BROADR-REACH AUTOMOTIVE ETHERNET STANDARD
- PTP AUTOMOTIVE-GRADE TIME SYNCHRONIZATION PROTOCOL
- REMOTE UPDATES VIA TFTP PROTOCOL
- CUSTOMIZABLE FOR HIL TESTING AND SENSOR FUSION

RESULTS

HIGH THROUGHPUT DATA EVENT LOGGING

LOW-LATENCY DATA STREAMING

TIME SYNC JITTER ~10NS

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