The right tool for the job

Instrumental fix for real-time test and validation challenges

By **Gordan Galic**, technical marketing director, Xylon

ADAS and AV embedded electronics systems are made of complex PCBs that challenge the laws of physics, chips that tick in the gigahertz range and interfaces that carry terabytes of data at blazing speeds through a vehicle's nervous system.

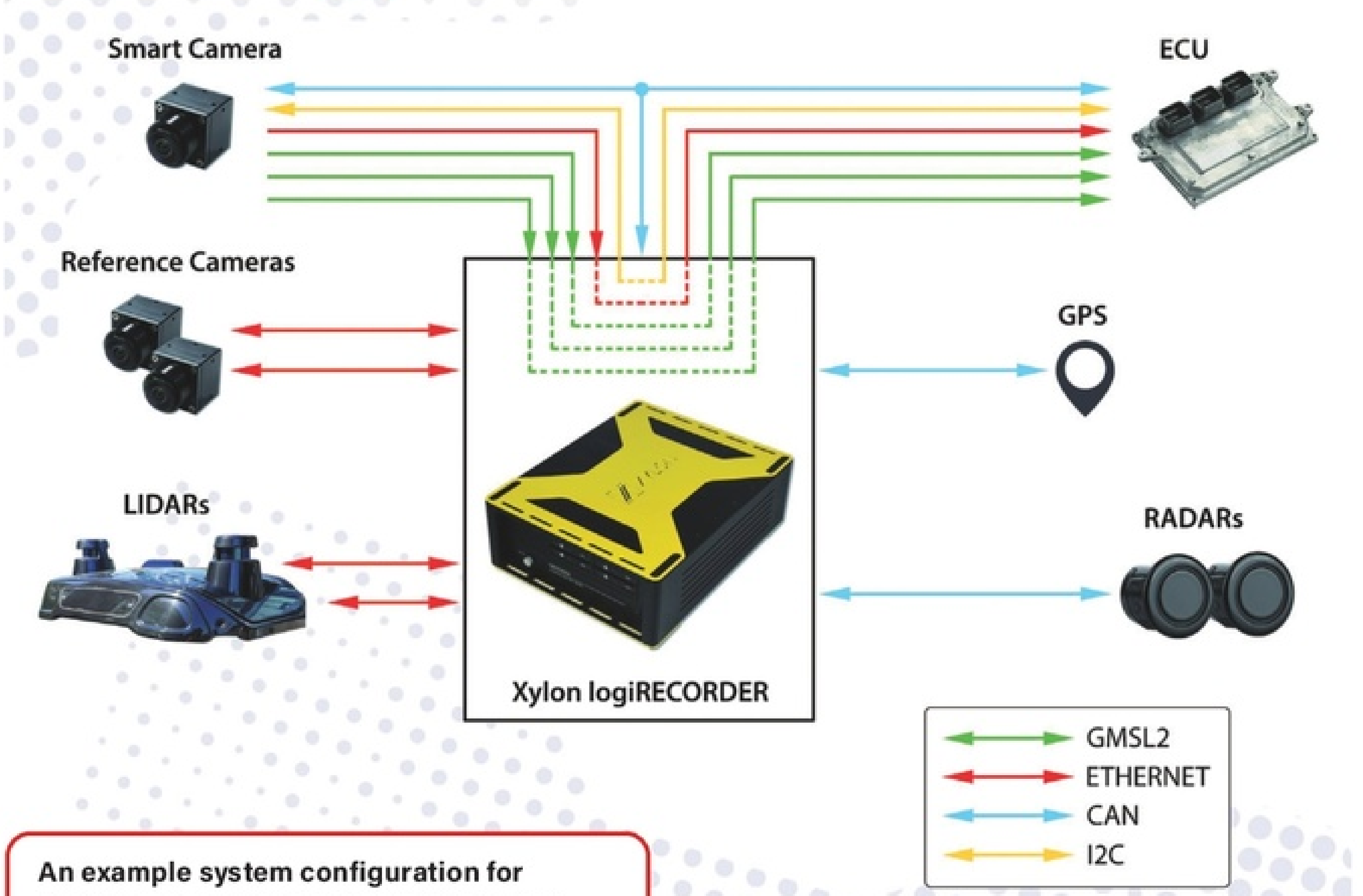
This makes non-intrusive datalogging of test and diagnostic data, as well as proper ECU stimulation in HIL research, extremely challenging. To ensure the coherence of the test and validation process, only minimal or no impact on the regular behavior of systems under test is permissible for test tools.

In most cases these tools use PC platforms and customized software, which quickly shows deficiencies at a real-time performance level, a lack of appropriate interfaces and a need for additional electronic boards to complete system integration. Such limitations can ultimately be overcome by fully customized hardware platforms, which often imply customization at the chip level. With production costs of customized chips reaching tens of millions of dollars, that hurdle seems too high.

Luckily there is a solution available at an immeasurably lower cost, and it comes in the form of programmable logic FPGA and SoC chips. FPGAs can be designed for specific functionality and manufactured within weeks or, at the latest, months.

Programmable FPGA chips form the basis of Xylon's logiRECORDER, a single-box device for datalogging and HIL simulations. The logiRECORDER integrates all automotive interfaces and, due to its ultimate hardware configurability, it can quickly be tuned for specific requirements.

To answer some of the latest field requirements, Xylon has just introduced a brand-new modular CPU acceleration card that enables not previously seen datalogging and HIL features, best described through an example test configuration.



An example system configuration for datalogging on the road and HIL testing in a lab. All sensors and ECUs are interconnected through a single logiRECORDER unit that enables not previously seen real-time data manipulation to ensure the coherence of the test and validation process

A forward-looking camera generates three GMSL2 video streams that route directly through the logiRECORDER, and connects to an ECU with minimal latency. The ECU controls the camera through a back-channel I2C bus tunneled through the logger.

Camera metadata and TAPI are delivered via Ethernet and analyzed in real time by the CPU card. FPGAs implement Ethernet TCP offloading engines (TOE) and the fastest possible Ethernet TAP, which make external routers unnecessary.

A CANbus connects additional sensors, such as radar and GPS, and carries various diagnostic data, and an acceleration card runs Universal Measurement and Calibration Protocol (XCP) to monitor and configure the ECU.

Reference cameras for datalogging monitoring are connected via a GigE Vision protocol supported by the card. FPGA accelerators eliminate timestamp jitter in compressed video streams and enable extraction of individual video frames.

FPGA TOEs can be configured in different ways, for example to demultiplex a 10GbE data link with all sensory data from a driving computer, and store data from each sensor in a separate MDF4 or ROS session.

A practically identical system can be used for a HIL simulation setup. The logiRECORDER's video routing, paired with I2C tunneling, enables the ECU to run production firmware and communicate with cameras without any stalling resulting from unanswered commands. At the same time, the logiRECORDER can inject stored and simulated videos instead of videos from cameras. FPGA accelerators enable real-time video manipulations, such as merging of real camera data with recordings, including fully synthetic video or camera error injections. Via the XCP protocol, the acceleration card can load calibration data into the ECU and monitor its internal states. ‹