CAN we fix it?

Technicians today are faced with very sophisticated vehicle electronics. John Challen and Richard McLaughlin explain the networks that connect multiple ECUs to manage everything from engine performance to braking and stability – and the role of diagnostics transfer, without electronics or energy consumption

Recent years have seen an explosion in the number of digital electronic systems and subsystems embedded in all types of commercial vehicles – driven by market demands for efficiency, operational cost and safety improvements, as well as stricter legislation around emissions etc, and the fact of enabling technologies. As a result, truck, bus, coach and van electronic architectures now involve multiple ECUs (electronic control units), and several computer networks and types.

That's both good and bad. On the one hand, quite apart from the sophisticated functionality resulting from computer assistance with the vast majority of vehicle systems, these developments have led to a reduction in wiring and hence also lower vehicle weight, as well as increased levels of reliability. The latter is, in turn, partly due to the requirement for fewer electrical connections, which would otherwise be the cause of time-consuming problems, or technicians, particularly as vehicles age. However, on the other hand, technicians now need to deal with vehicles that depend at least as much on computer networks as they do upon mechanical engineering.

The most widely used in-vehicle network technology is CAN (Controller Area Network), which enables vehicle ECUs, whatever their role and function, to be connected and to 'talk' to one another. In a CAN network, ECUs are connected by one wire – or bus – so must contend for the use of

that wire to communicate with other ECUs. So, if an ECU needs to transfer data onto the bus, it must first sense that the bus is not already in use by another ECU. If the bus is busy, then that ECU needs to hold its CAN data frame until it's no longer engaged and then transmit – achieved using the well-established CSMA/CD (carrier sense multiple access, collision detect) procedure.

The collision detect element comes into play when two or more ECUs sense that the bus is clear and transmit their data at precisely the same moment. In this scenario, the data might collide and cause corruption. So the CANbus routine essentially sees the problem and only allows the highest priority information (for example, wheel speed data) to consume the bandwidth, while lower priority data, such as engine temperature, is infinitesimally delayed.

Optimising the CAN network architecture is, in part, about avoiding too many collisions cluttering up the bandwidth and potentially delaying time-critical data exchange, which might impact some aspect of vehicle performance. And hence the arrangement of multiple CANbus networks, some dedicated to high priority data exchange, others to low priority, not requiring time-critical responses. Low-priority buses are connected to the bigger picture via what's termed a gateway. This acts as a filter that controls data passing, for example, from the body control CANbus to the powertrain control CANbus, and vice versa.

CAN diagnostic data

Workshop technicians will be familiar with connecting their diagnostic tools to the CANbus, a process typically handled via the vehicle's OBD (on board diagnostic) connector. Most off-the-shelf diagnostic tools, otherwise called fault code readers, connect to the vehicle CANbus by this means and collect information from the vehicle systems, looking for DTCs (diagnostic trouble codes) set in any of the ECUs. These are CAN data frames generated by the ECUs concerned and, depending on the sophistication of the commercial fault code reader used, can guide technicians to the possible root cause of the problem(s).

While there are many diagnostic tools on the market, and most are very capable devices, vehicle technicians are warned of their limiting factors. The key concern is that, while they do make a huge difference by indicating a fault code that, in turn, points to a likely problem, it's not difficult to jump to an incorrect diagnosis. Why? Because the diagnostic tool is likely to see multiple DTCs set in one or more ECUs, actually indicating a cascade of problems that are related to the original cause, but effectively masking it.

So how then do you overcome that limitation? Sometimes it is necessary for specialist technicians to use more sophisticated CAN data collection tools that enable them to look more closely at the underlying data and determine the root cause.

We're not talking about standard commercial DTC readers, but CANbus analysers that are able to examine all the CAN signals involved in real-time monitoring and control of the vehicle, and interpret the underlying data. These tools have data logging capabilities and are primed to trigger on suspect events to establish the originating fault. Think of them as CAN bus oscilloscopes – the next level down from a standard fault code reader, allowing technicians to focus in on the detail where system faults resist conventional troubleshooting. TE

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Pullman invests for the future

To support the technicians in dealing with the increasing number and complexity of electronic systems encountered on its vehicles, Pullman Fleet Services has embarked on a programme of rolling out modern diagnostic systems throughout its operations.

Eclipse Automotive Technology has been selected to supply Jaltest truck and trailer diagnostic tools to handle the ever-changing world of CAN (Controller Area Network) and LIN (Local Interconnect Network) xdigital electronic technology. Pullman says it's about cutting downtime and preventing recalcitrant vehicle faults from escalating by improving preventive maintenance via provision of appropriate technician tools.

"With modern vehicle systems, faults will manifest in one area of the vehicle and, through CAN and LIN technology, they will appear in another system seemingly completely unrelated. We have seen faults with the suspension, night heaters, horns and interior lights on a vehicle, yet the problem [may] originate from a hazard warning light switch," comments Maurizio Romano, operations director at Pullman fleet services.

"As the CAN system [links] signals from one component to something quite different, the only way to quickly and decisively diagnose the fault is to use the latest diagnostics equipment. We found the Jaltest diagnostic package to get to the root of the problem very quickly and easily, cutting down vehicle off-the-road times," he adds.

Romano makes the point that CAN and LIN network connect many vehicle systems together, so it's imperative that technicians can 'see' information for what it is. That's why Pullman has chosen to run its new diagnostic systems on portable workstations – enabling this essential equipment to be ready wherever it's needed to display everything from fault codes to wiring diagrams, voltages, resistances, pressures etc.