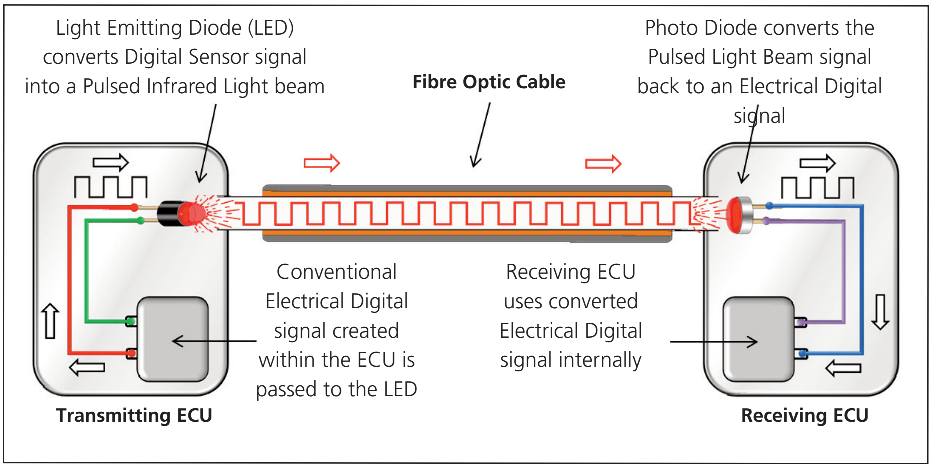
Vehicle networks - Byteflight

Byteflight networks were first used in early 2000's, and were primarily intended for safety systems, such as airbags. The Byteflight design dictated reliability, high fault tolerance and high data speed between ECUs.

Byteflight can also be used for other vehicle systems, such as seat adjustments and central locking. One feature of Byteflight is that signals passing between ECUs are light beams that pass through fibre optic cables. The pulsed light signals are not affected by interference from other electrical sources, which can occur in electrical wiring.

The Byteflight system has a star structure, with a master ECU and slave ECUs. On BMW safety systems, the slave ECUs have some control capability. On this system, the master ECU is referred to as a Safety Information Module (SIM) and the Slave ECUs are referred to as satellites. On the Byteflight networks, as well as the SIM transmitting signals to the satellites, the satellites can also transmit signals back to the SIM, so the signals can pass both ways through the fibre optic cables. The star structure used on Byteflight networks provides the safety benefit that if one of the satellite ECUs fail, then the other ECUs can still function.

In some versions of Byteflight, the SIM and the Gateway are separate modules, while in other systems the Gateway is physically located within the SIM. With both arrangements, the Gateway is a signal translator that enables the Byteflight network to receive or transmit data with other networks on the vehicle. There are variations of Byteflight for different vehicle applications; but the general principles of operation are the same across the different versions.



SIM

The first task of the SIM is to act as a central communications hub between all slave ECUs or satellites. Information from the satellites is passed back to the SIM, which can then re-distribute the information to the rest of the satellites when required. Some of the satellites contain crash sensors, and the information from these is passed to the SIM. The SIM can then pass the crash information to all the other satellites, so that all of the satellites have access to the same information relating to the forces produced in a crash.

A second task for the SIM is to provide an alarm signal back to all of the satellites when a crash is detected. At this stage, the SIM has yet to establish exactly where on the vehicle these high level forces will have any effect. The alarm signal provides a warning to the satellites so that they are ready to activate air bags or seat belt pre-tensioners, as may be required. When all of the information has been gathered from the crash sensors, the decision is then made as to which parts of the safety system should be activated to best protect the occupants.

Satellites and Crash Sensors

The crash sensors contained in some of the satellites are positioned at strategic locations around the vehicle. The sensors are usually acceleration sensors, accelerometers, that can detect left and right forces, as well as forward and backward forces. Note that each separate sensor may only detect forces in a single direction. Satellites with crash sensors can be located in the region of the doors and door pillars to monitor the forces acting on the side of the vehicle.

A centrally located satellite with a crash sensor, which can be located within the SIM assembly, is then usually fitted in the region of the interior centre console. This centrally located sensor provides an indication of the crash forces that are being applied to the whole vehicle. The satellite sensors in the doors or door pillars indicate which part of the vehicle the forces are acting against.

Other sensors detect which seatbelts are fastened, while pressure sensors detect if a seat is occupied. The information from these sensors is passed via a satellite ECU to the SIM, enabling it to decide which parts of the safety system should be activated. The SIM can also decide the activation timings of various components, such as airbags and pre-tensioners, dependent on vehicle speed. Some of the satellite ECUs are used to directly provide the trigger signal for activation of specific airbags or pre-tensioners, making it easier to be selective of which items are activated.

Light Beam Digital Signals

The digital signals used in the Byteflight networks are pulsed infrared light beams. The beams pass through fibre optic cables at around 10 million data bits per second (10 Mb/sec), which means that there can be 10 million individual signal pulses every second. This is 20 times faster than typical signals used in CAN-Bus networks that are used for powertrain systems.

A conventional electronic digital signal is created within the SIM or a satellite ECU, and the signal is converted into a pulsed infrared light beam, that is transmitted through fibre optic cables. When the beam reaches the satellite ECU or the SIM, it is converted back to an electronic digital signal for use internally. The signal can then be re-converted back to a light beam signal by the SIM for re-distribution to the other satellites as required. It is possible to have a physically damaged optic cable (bent, broken or kinked) that may prevent the signal from reaching it's destination.

This information is a small part of the full Learnguistics On-Line Vehicle Network Training course, available from Ryans Automotive. The information is provided by Peter Coombes, author of Learnguistics training courses.

Contact Ryans Automotive on 051-424-799 or at www.ryansautomotive.ie.

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