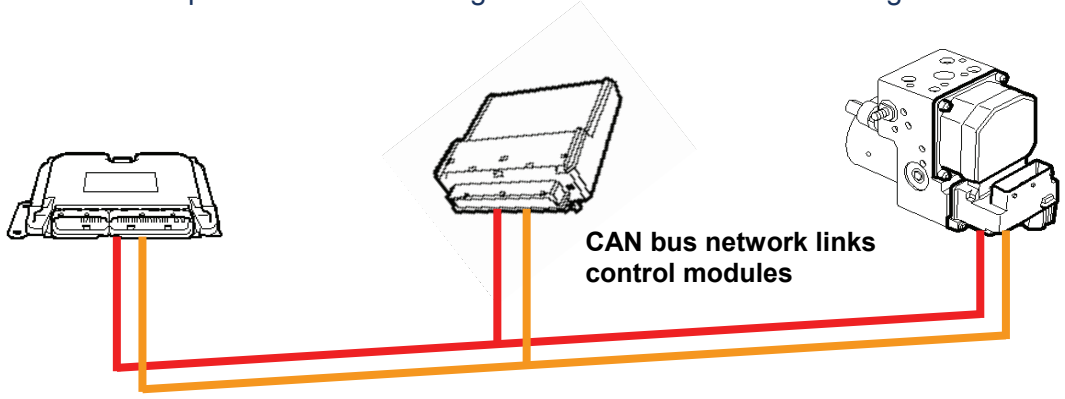
FlexRay

a technical appreciation
by AK Training

The ever increasing demand by consumers and motor manufacturers alike for enhanced functionality of vehicle electronic systems means that more and more information is being transmitted around the vehicle. The sheer volume of data as well as the speed and frequency with which data is required on some vehicles is now testing even the fasted automotive CAN bus networks towards the limits of their capability.

One of the latest developments in vehicle data bus communication systems technology is FlexRay. It is a further development of CAN bus which has now been around for over twenty five years. FlexRay has been conceived and developed over the last eight years by a consortium of vehicle manufacturers and semi conductor companies. The core members of the consortium currently include BMW, Daimler, Volkswagen, General Motors, Bosch, Freescale and NXP Semiconductors. A key feature of FlexRay is that it operates at a speed between ten and twenty times faster than CAN. To fully appreciate the concept of FlexRay, it is first necessary to have an insight into CAN bus.

The Controller Area Network (CAN) is a serial data communication protocol. It is a form of digital electronic language that allows the rapid transfer of signals and data to take place between control modules and is comparable to human language. However, instead of sentences, words and letters, the CAN protocol enables messages to be created and transmitted using just two voltage levels. Messages are transmitted over a pair of twisted wires that make up a bus network linking the various control modules together.



A CAN message is made up of a series of voltage pulses (otherwise referred to as ‘bits’) that are put together in a specific order to create the message. The maximum possible number of bits that can be transmitted per second over the bus network defines the speed of operation of the bus and is referred to as the baud rate. A high speed CAN bus is designated as having a baud rate of between 125 kilo bits and 1 Mega bits per second (ie between 125,000 and 1,000,000 voltage pulses per second). A powertrain bus for example typically operates at a speed of 500 kilo bits per second thereby enabling systems such as engine management, ABS and TCM to exchange critical information very rapidly.

FlexRay

a technical appreciation
by AK Training

The CAN protocol allows for a situation whereby several control modules may try to transmit messages at the same time. To prevent messages from clashing, the control modules go through a so called arbitration process to establish message priority. The control module whose message has the highest priority gets to go first and the other control modules have to wait their turn.

On the face of it, the operating speed of the average CAN bus network would seem to be more than adequate for the effective transfer of data around the vehicle. However, under certain conditions, the CAN arbitration process is one factor that potentially has a delaying effect upon the speed of critical data transmission, particularly in relation to suspension control, vehicle stability and occupant safety systems. This, along with the volume of information now presents the possibility of an overload of bus traffic occurring on the CAN bus, effectively causing a data traffic jam.

FlexRay operates over a two wire bus network, each wire physically separate from the other with a baud rate of up to 10 Mega bits per second on each wire (that is 10 million voltage pulses per second). The two wires are mainly used to provide fault tolerant message transmission. This means that if one wire fails, messages are transmitted successfully over the other wire. However, different messages can normally be transmitted over each wire which effectively doubles the rate of data transmission. Another key feature of FlexRay is that messages are allocated a pre determined time slot. The time slots are repeated in a fixed cycle, thereby enabling control modules connected to a FlexRay bus network to have exclusive access to the bus at certain times. This guarantees the reliable transmission of critical data. FlexRay is intended to be compatible with existing bus systems such as CAN, LIN and MOST fibre optics.

BMW is the first vehicle manufacturer to implement a FlexRay bus network on a production vehicle. The X5 Sports Activity Vehicle was introduced in 2007 and features an adaptive drive suspension system which makes limited use of FlexRay. The BMW X6 introduced in 2008 is the first production vehicle in the world to fully utilize a FlexRay system.

Nearly every motor manufacturer now utilizes data bus networks to a greater or lesser extent with many vehicles having multiple bus networks. For at least the last six years, CAN has been by far the most commonly used communication system. It is now also common to find powertrain and body bus networks going straight to the vehicle data link connector thereby enabling diagnostic communication to take place directly over the CAN bus. Such technology is no longer restricted to executive and premium brand vehicles. The development of FlexRay paves the way for further enhancements in vehicle data communication and electronic system functions.

Motor Industry Professional Training and Development