Robert Leindl, Siemens AG, HL MC M, Robert.Leindl@hl.siemens.de, Fax: ++49 89 636-81895

The Controller Area Network
The evolution from Hard-Wired to Easy Wired networking

With the increasing number of distributed microcontrollers and intelligent peripherals used in todays electronic systems, such as vehicle controls, networking protocols between the units have become extremely important. A wide range of these applications are using CAN (Controller Area Network) for network communication.
Siemens Semiconductors has along experience with CAN 2.0B, with a range of stand-alone peripherals, automotive specific 8-bit controllers and the performance leading C167CR with complete CAN 2.0B Capability.

The CAN (Controller Area Network) is an ISO and SAE defined multi master serial communications bus that was originally developed during the late 1980´s for the automotive industry. Its basic design specification called for a high bit rate up to 1 Mbaud, high immunity to electrical interference and an ability to detect any errors produced.
The CAN protocol describes the method by which information is passed between devices. It conforms to the OSI model and defines the lowest two layers: the data link and the physical layer. The application layers are linked to the physical layer by various emerging protocols or a proprietary user defined scheme. Perhaps the best example of an industry-standard CAN protocol is Allen-Bradley’s DEVICEnet™.
Two varieties of CAN exists today,Basic CAN or a higher level FullCAN with „acceptance filtering“ hardware. In the basic CAN implementation all messages broadcast on the network have to be individually checked by the host controller. This results in the CPU often being „tied up“ checking messages rather than processing them. The introduction of an acceptance filter masks out irrelevant messages, using identifiers (ID´s) leaving the CPU to process only those messages that are of interest.
The CAN protocol allows for two identifier field lengths: part A specifies 11 bits, which allows 2032 different ID´s out of 2048, whilst extended CAN (part B) has 29 bits giving over 536 million unique identifiers

Today a wide range of applications use CAN for distributed networks. CAN 2.0B is now used in the powertrain of many midrange and high-end vehicles for communication between engine management, ABS, transmission control, ASR, active suspension and electronic throttle. This high speed bus with up to 500 kBaud transmission speed exchanges information such as motor RPM, vehicle speed and throttle control. In case of braking for instance this information can be used to automatically switch off the fuel injection to reduce the stopping distance. In a new car radio application for Mercedes Benz the volume control can automatically adjust by up to 10dB based on the speed information broadcast on the CAN bus or switch off. Those components like car radio, airbag, multifunctional display for satellite navigation, mobile phones or intelligent sensors are connected to a second CAN bus which uses 40 - 125kBaud transmission speed. The dashboard is the control panel which displays all relevant information and its instrumentation controller acts in many cases as the bridge between high- and low-speed buses.
This intensive use of CAN in the automotive industry together with rapidly decreasing pricing for CAN components attracted the attention of industrial users. Decisions in favor of CAN have being made not only by manufacturers of agricultural machinery and marine engineering equipment but also by manufacturers of medical equipment, textile machines and elevator monitoring systems.

Siemens Semiconductors has a long term experience with CAN 2.0B in the automotive area. Already the first products, the SAE 81C90/91 standalone peripherals, two customer specific 8-Bit controllers and the C167CR 16-Bit microcontroller offer integrated FullCAN 2.0B modules. Beginning of this year Siemens enhanced their portfolio with two low cost members of the C500 family - the C515C and the C505C. The C515C features low power consumption and optimized EMI behaviour and is iedal for car radio applications. The C505C features as well as Full CAN 2.0B with 15 messages buffers, 16-k ROM, 8-Bit AD converter and a PWM unit at a price of todays 2.0B stand-alone devices. By the end of this year, the CAN family will have been joined by the C164CI (16 Bit) and the SAF81C92 (Stand Alone). The C164CI is dedicated to the industrial market due to ist 6-ch PWM module for the DC brushless motor control units. The SAF81C92 is a new stand-alone CAN 2.0B peripheral ideal for either automotive or industrial control applications Until the end of this decade Siemens expects the CAN module on chip as a standard peripheral with a cost adder similar to standard serial interfaces today. The flexibility in the application will be enhanced via multiple CAN modules on-chip which can be used as a bridge between different bus speeds or on the same physical bus in order to enhance the message buffer size and further reduce the CPU load.