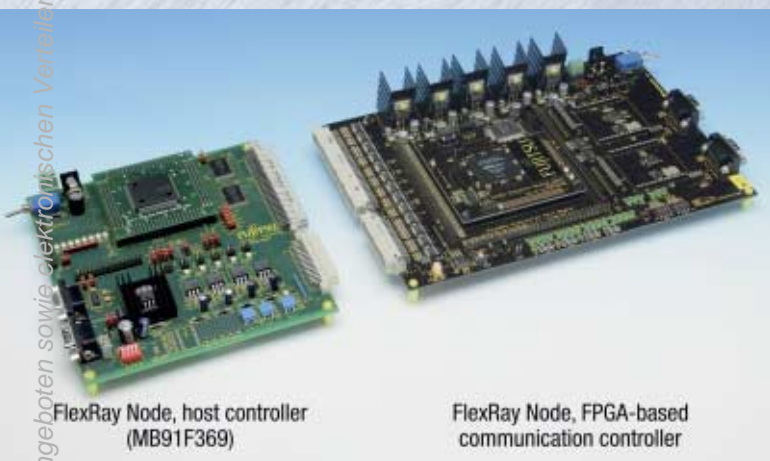


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FlexRay Node, host controller (MB91F369)

FlexRay Node, FPGA-based communication controller

Evaluation Kit:
FLEXRAY-
FPGA-KIT-369

Fujitsu's FlexRay Solutions

Fujitsu decided a year ago to provide development systems for applications with FlexRay and make these available in early 2005. Today these systems act as development platforms for applications and as the basis for the evaluation of first silicon for the protocol layer, which became available in September of the same year. Physical layer evaluations are also supported.

From the very start of its activities in the FlexRay area, Fujitsu focused on system solutions that provide both a ready to use hardware and a state of the art development environment including tools required for FlexRay project developments. With each step along the road map (Figure 1) Fujitsu offers software drivers and configuration tools that have been created in cooperation with third party partners.

Long before the most recent protocol specification 2.1 became available Fujitsu supplied first FPGA-based nodes easing the first steps for users into the new bus system. Even though devices for the physical layer are not part of Fujitsu's road map, transceivers have been included in the system support. Physical layer devices from Third Parties have been successfully tested in conjunction with all Fujitsu's development platforms. Different physical layer implementations, as well as protocol layer implementations from different vendors, have operated successfully side by side in the same network.

FlexRay Development Platforms

Today Fujitsu offers two development platforms. The first one, the FPGA-based FlexRay Evaluation Kit as shown above, is already in use by many suppliers to the automotive. The kit comprises a 32-bit MCU acting as host to the FlexRay communication controller (CC) featuring the ERAY core from Bosch. Along with a full set of software development tools included with the Softune workbench, driver software from DECOMSYS, and a configuration tool by TZM are included.

Like the numerous updates for the protocol layer implementation which made an FPGA approach inevitable, the physical layer is subject to changes. For this reason the FlexRay node contains sockets for optional modules from TZM carrying transceivers that meet the latest physical layer specifications. The designer is thus free to choose to equip these modules with the preferred type or vendor of transceiver devices.

All upcoming changes of the implementation of the protocol layer have been and will be made available to users of the evaluation kit quickly. Fujitsu provides updated bit streams for the FPGA and if necessary new driver versions for the FlexRay CC free of charge. The FPGA board itself also can be exchanged for an ASSP board with MB88121, a standalone FlexRay CC, which is now available. Thus the evaluation kit is a complete solution not only for today but it is prepared for future usage as well.

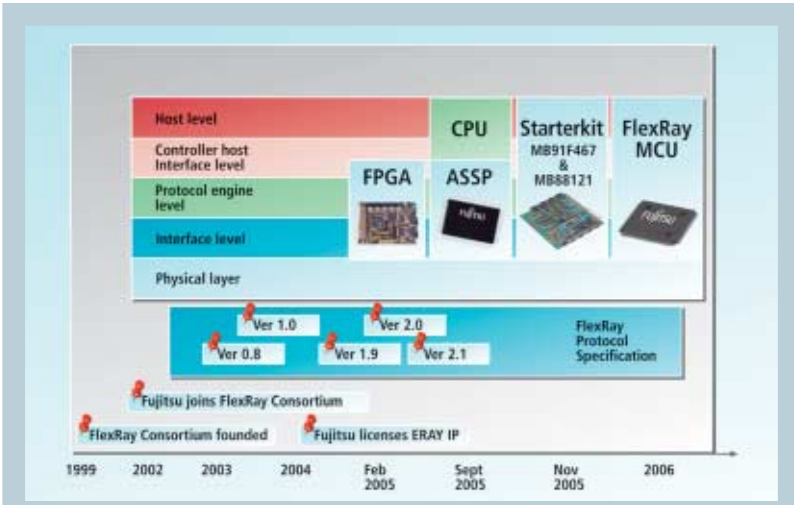


Figure 1: FlexRay road map

For the new microcontroller family MB91F460 Fujitsu designed a single board FlexRay development platform called SK-91F467-FLEXRAY. This platform is available now. The key features at a glance:

- 32-bit Flash microcontroller MB91F467D clocked 100 MHz
- 32 Mbit SRAM on-board memory
- Interfaces
- FlexRay interface MB88121 with onboard RS-485 and plug-in for PL-modules from TZM
- Three High-Speed CAN interfaces
- Three LIN UART-interfaces
- External bus interfaces support parallel bus I/F to MB88121 and plug-in of FPGA-based FlexRay CC

The SK-91F467-FLEXRAY is a multifunctional Starter Kit for the Fujitsu 32-bit Flash microcontroller MB91F467D series and Fujitsu FlexRay CC MB88121. The single board facilitates the autonomous development and test of software using Softune Workbench Monitor debugger. Alternatively, the Starter Kit provides a plug-in for an emulator for the MB91460 family. With sufficient CAN and LIN interfaces in addition to the dual channel FlexRay CC, four supply volt-ages, programmable push buttons, socket for LC-Display, and access to all resources of the MCU, the Starter Kit offers a platform that satisfies all the needs of a design project. The MB88121 connects via a 16-bit non-multiplexed parallel bus interface to the host processor. Like the FPGA-based evaluation kit, the Starter Kit is especially equipped for the analysis and use of the FlexRay bus system. The DECOMSYS::COMMSTACK driver library eliminates the need to design proprietary software driver for the CC. Furthermore, Fujitsu supplies pre-compiled examples that demonstrate the capabilities of the FlexRay bus system.

When challenging the initial application, a light version of the configuration tool *FlexConfig* from TZM supports the user to create its own communication matrix and generate the initialization code (CHI files) for the FlexRay CC. The Starter Kit enables designers to immediately start development of software for its application even before his own target system is available.

FlexRay CC MB88121

The MB88121 is a FlexRay communication controller that can be added to any host processor with an external parallel bus interface. The 64 pin device (QFP64 with 0.5 pin pitch) fully supports FlexRay protocol specification 2.1 and provides two channels each of which can be operated with 10 Mbps. Currently the device is used at JASPAR as an evaluation platform in a network with six nodes operating at 5 Mbps bus speed.

The MB88121 is operated from a single 5 Volt supply and an external quartz or square wave input. A PLL circuit provides the internal operating frequency of 80 MHz for the

ERAY core. Via mode selection pins several host interface modes can be invoked.

The ERAY core is completely encapsulated in the MB88121 while the physical layer components remain a separate circuitry. The host processor initializes the FlexRay CC via a parallel bus interface operated as fast as 32 MHz.

Independent of the topology, 2-chip or single chip solution, access to the message data requires special attention. At runtime the received messages and data for transmission is exchanged via output and input buffers of the ERAY core. Fujitsu implemented a suitable DMA support in order to relieve the host processor when retrieving or sending data

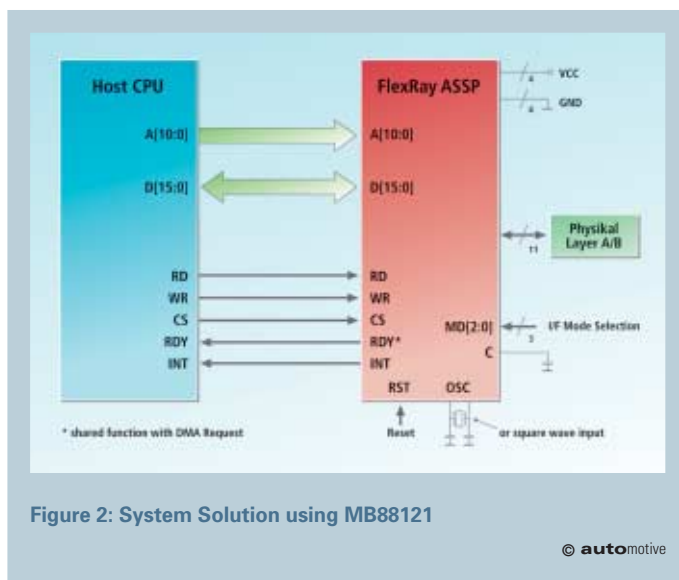


Figure 2: System Solution using MB88121

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to the message RAM providing more than 8 kbyte storage capacity for up to 128 different messages or 30 messages with maximum payload.

Outlook

Fujitsu currently provides development platforms and first silicon for FlexRay applications. These flexible hardware solutions are accompanied by state of the art tools for code generation as well as configuration tools and software drivers that enable users to start their FlexRay applications without delay. First silicon, the stand-alone protocol device MB88121, has been available since September 2005 and offers FlexRay connectivity to any host system featuring an external parallel bus interface (figure 2). This approach will soon be followed by solutions with FlexRay CC embedded into 32-bit FR cores i.e. MB91460 family to become available in 2006. Also other controllers based on Fujitsu's widely used 16-bit core are foreseen to be equipped with FlexRay interfaces.



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