

Flexible gateway solution for MOST in-car communication systems

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The development of modern automotive electronics – particularly in the infotainment sphere – must manage the tensions between demands for greater functionality, comfort, flexibility and safety on the one hand, and pressures for shorter development times and cost containment on the other.



For example, a luxury car in 1980 featured a radio with amplifiers. By 2005, the equivalent model boasted up to 12 different multimedia components, including a radio, CD / DVD player, telephone, navigation system and various TFT displays. In addition, modern vehicles have to satisfy strict safety and reliability criteria and meet market needs in many different countries.

The fast-moving nature of the industry has led to various measures designed to manage the competing pressures inherent in the development process. For example, hardware standardisation, such as the interfaces or bus systems in a vehicle, and the modularisation of components, have increasingly been used to simplify the design of varied configurations and enable production processes tailored to specific end uses and markets.

As the worlds of multimedia and automotive design have converged and as commercial and regulatory requirements have increased, a range of (sometimes competing) standards have emerged - such as I²S (Inter-IC Sound), I²C (Inter-IC), MediaLB (Media Local Bus), MOST (Media Oriented Systems Transport), 1394 Automotive, USB, Ethernet, CAN and FlexRay.

As a semiconductor manufacturer, Fujitsu supports all relevant hardware standards and increasingly offers relevant software and software support services. Its range includes integrated modules for all important interfaces, as well as gateway solutions between the various systems.

An in-car communication interface solution

The MB91F467M microcontroller (Figure 1) is a member of Fujitsu's MB91460 series and incorporates CAN, I²S, I²C and MediaLB interfaces specifically designed for in-car communications. Other microcontrollers in the MB91460 family can support up to six CAN, 12 LIN interfaces and/or FlexRay.

The MB91F467M enables the seamless connection of a car audio system to the MOST bus in the vehicle. Data can be transferred between the MOST bus and up to ten I²S interfaces; while control information can be exchanged between I²C and CAN, as well as with the MOST bus system.

In addition, this controller offers many other communication interfaces (LIN-USART), PPGs, ADCs and various timers for transferring other tasks in an infotainment system. The high-performance CPU architecture, comprising 1MB on-chip flash and 64KB RAM, ensures that all these tasks can run on a single chip.

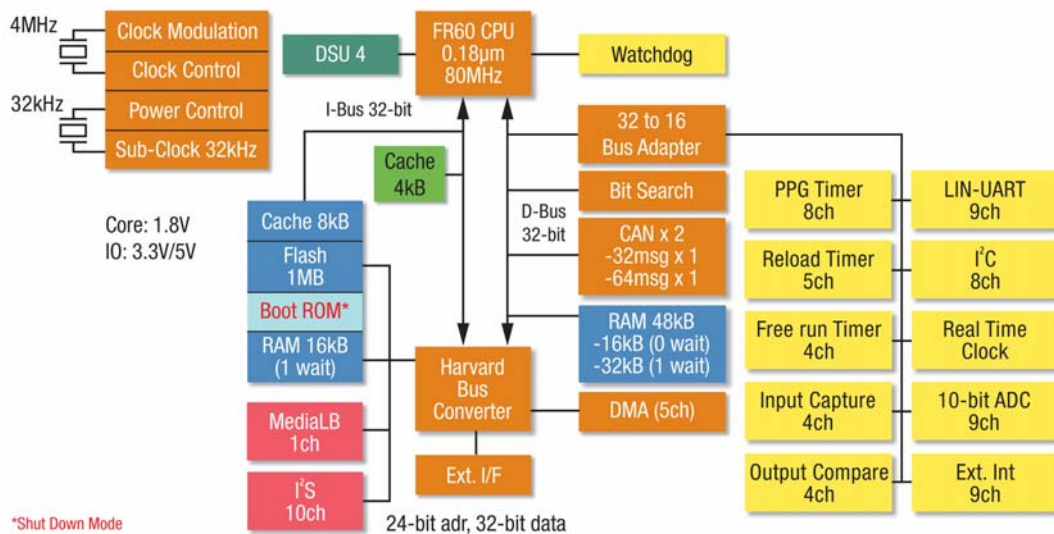


Figure 1: MB91F467M block diagram

Implementing MediaLB and the I²S interfaces onto the MB91F467M

The wide range of in-vehicle infotainment applications available, coupled with a growing demand for high broadband transfer of audio, video and control data has led to the introduction of a powerful 'infotainment backbone'. Today, MOST already assumes this task in over 50 vehicle models. Connecting an application to a MOST bus typically takes place as a 2-chip solution.

First, the physical connection to the MOST ring and the lowest level of communication (Low Level System Services, NetServices Layer 1) are implemented on an INIC

(Intelligent Network Interface Controller) produced by SMC. An external host controller, such as the MB91F467M, then processes the higher protocol layers (NetServices Layer 2, API).

Initially, communication between the host and INIC occurred via I²C and parallel interfaces. However, it is now expected that the MediaLB interface, together with the corresponding software API, will become standard.

MediaLB is simpler to port into any logic technology than a complete MOST interface. In addition, a certain level of long-term availability is achieved using the 2-chip solution. With the corresponding API, MediaLB should also guarantee access to all future versions of MOST and INICs.

MediaLB is a synchronous serial 3-wire bus. Defined by SMC, it is a further development of older standards, such as I²C, I²S and SPI. The bus master is normally the INIC. Various other components can be connected to a MediaLB system, which runs synchronously to the MOST network. It supports all MOST data transfer methods and enables operation with various transmission rates – currently up to 1024Fs. The MediaLB interface is made up of the following three connections:

- MLBCLK: clock signal generated by INIC synchronously to the MOST bus and which serves as a clock source for the entire MediaLB system
- MLBSIG: bi-directional line for transferring addresses, commands and status information
- MLBDAT: line for actual data transfer

Data transfer takes place in frames. Depending on transfer speed, a frame is made up of between 8 and 32 physical channels, which in turn are each 4 bytes long (called quadlets). Physical channels are assigned to logical channels via the channel address. Every channel defines a uni-directional transfer from a sender to one or more recipients. The data structure for each transfer is described in Figure 2.

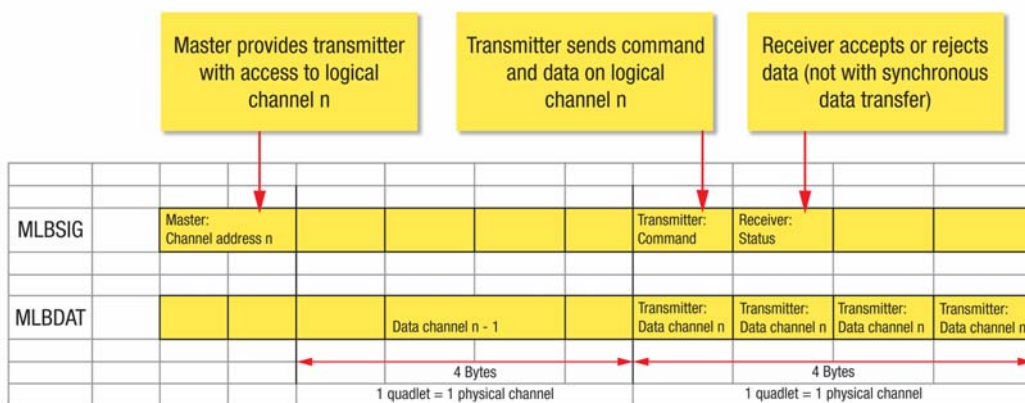


Figure 2: MediaLB data structure

When implementing a MediaLB interface on a microcontroller or processor, it is essential to take account of the number of channels and the transmission rates to be supported. The type and speed of the internal process then determines the number of internal buffers needed to prevent loss of data.

This ultimately determines the chip area and therefore the cost of such an interface. One variant is the support of 16 channels and 8KB local buffer, which is just as complex as a CAN interface with storage for 32 messages.

Synchronisation between the MLBCLK and the internal clock is also crucial.

The MediaLB interface implemented on the MB91F467M can handle synchronous data streams, asynchronous data packets and control data, and is made up of the following components:

- MediaLB function, supported by 15 channels with transmission rates of 256Fs and 512Fs and a local buffer of 2K words (32-bits)
- Clock generator
- Connections to two on-chip bus systems – to the CPU and directly to the I²S interfaces. A DMA module enables data transfer without impacting the CPU

The clock generator contains its own PLL, to enable generation of the higher clock pulse needed to process audio data independently of the CPU clock. For transmission rates of 512Fs, this clock pulse should be set to 64MHz or more. Circuitry to monitor the MLBCLK and signal malfunctions is also provided.

I²S

The I²S (Inter-IC Sound) standard was developed by Philips. This is a serial bus for uni-directional transmission of stereo audio data. The bus consists of three signals:

- SD: data rate depends on the application – with a CD it would be $44100 \times 16\text{bit} \times 2 = 1.4\text{Mbit/s}$ for example – and the capability of the sender and recipients
- SCK: clock as specified by the master
- WS: word select – to differentiate between the right and left channel

Control information must be transferred via other routes, such as I²C.

The MB91F467M includes 10 I²S interfaces which can work as sender or recipient. If necessary, the interfaces on the MB91F467M can also function as the I²S master, and then produce the transmission clock themselves. Data length is variable and can be between 3-bits and 16-bits. The MB91F467M also offers eight I²C modules for transferring control data.

On the MB91F467M there is also a direct connection between the MediaLB interface and the I²S interfaces which runs via a FIFO memory and can be operated in both directions by DMA – without CPU interaction. This direct connection is the decisive feature of the MB91F467M which enables operation as a gateway.

Using the MB91F467M as a gateway

Figure 3 illustrates the use of the MB91F467M as a gateway in an in-vehicle audio system.

The MB91F467M external bus can be used for more than simply expanding the internal memory. It also allows the connection and control of Fujitsu graphics controllers (GDC) - e.g. to represent graphically the information received via the MOST bus.

ECO system

Fujitsu offers both the hardware development environment (emulation system, starter kit) and the software development tools (IDE with compiler, linker etc) for the MB91F467M.

As for its other MB91460 MCUs, there are various software components (drivers, OS) for use with the MB91F467M and software examples from Fujitsu or Fujitsu partners. An evaluation board, together with sample software, is also available.

Outlook

As well as the MB91F467M, there are already other Fujitsu ICs with MediaLB interfaces, such as the MB86R01 ('Jade') graphic controller; and further components are in development.

As the next generation of technology comes on stream, it will enable even greater integration. For example, car audio functions and graphics could be built in together within a chip along with controllers and gateway functions. And then, as now, Fujitsu will provide the necessary development environment and a growing range of related software products and services.

More information from:

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Herr Mathias Bräuer (50) is Senior Manager Automotive Marketing of the Business Unit Automotive and Industrial of Fujitsu Microelectronics Europe GmbH in Langen. M. Bräuer studied computer sciences at the University of Dortmund. He began his career at Philips Semiconductors where he worked in ASIC development for 12 years. Since 11 years he is working with Fujitsu, currently responsible for marketing of Fujitsu automotive microcontrollers in Europe.

