DESIGN AND IMPLEMENTATION OF CUSTOM MOST RING NETWORK PROTOTYPES

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Abstract

In this work, we have tested the feasibility of developing custom MOST (Media Oriented Systems Transport) devices and networks using two different approaches. First, we designed and manufactured a custom two-stage node with flexibility to be configured for transmission of different media in MOST networks, whose performance was tested in a two-node ring network to transmit a 5+1 encoded audio signal. Second, a MOST ring network was devised and implemented to remotely control a DVD player to reproduce movies and MP3 song files based on commercial prototypes from OASIS Inc. Our results show that it is possible to design simple custom MOST devices, but it can be very arduous to develop more complex devices which require high knowledge of Very Large Scale Integration (VLSI) electronic design. On the other hand, we found few commercial products in the market to implement custom MOST applications. Thus, the use of the standard MOST is not likely to outspread in the near future to domains other than the automobile, such as home or office networks.

1. Introduction

Polymer optical fibers (POFs) are a cost-efficient alternative to shielded electrical wires for automotive infotainment systems with high-speed audio and video transmission at data rates of more than a few megabits per second [1-4]. Since 2002, Media-Oriented System Transport (MOST) [4] is a standard for an optical infotainment data bus system in the automotive industry. In fact, many automobile companies (Volkswagen, BMW, DaimlerChrysler, etc) are installing MOST devices in their high rank car models. The MOST bus reduces the length of the connections and the number of cables needed, since each connection requires physically only a single fiber. When new components are added in a MOST network, it is enough to insert connections between two existing links. This fact entails a significant improving in the weight of the vehicles allowing the design of lighter cars. MOST technology also fulfills bandwidth needs: a video signal requires 4 Mbps, a channel of audio stereo 1.4 Mbps, a signal of DVD of optimal resolution requires about 10 Mbps, 1.4 Mbps for the signal of audio of one radio AM/FM, 4Mbps for a positioning system. Present generation MOST reaches up to 25 Mbps and a new controller version ready to be exploited has been extended up to 50 Mbps [5].

In this research line, we do not only analyze theoretically the standard MOST, but we also study its practical aspects. Here, we present the implementation of two simple applications that constitute the starting point for future works of greater spread. First, following a low level approach, we designed and implemented a custom two-stage node with flexibility to be configured for transmission of different media in MOST networks. The performance of these nodes was tested in a two-node ring network to transmit a 5+1 encoded audio signal. Second, we took a higher level approach to devise a MOST ring network to control remotely a DVD player to reproduce movies and MP3 files based on commercial prototypes from OASIS Inc. [6].

2. Low Level Approach: Custom boards to transmit S/PDIF sound

In this first approach to MOST technology, our focus was to get the basic node as the core for future projects, overlooking non-fundamental capabilities and functionalities. Following a modular structure, the basic node is divided in two parts: One more versatile centered on the transceiver MOST called Physical Layer Board (PLB), and the other one more application-dependent based on a microcontroller termed Application Firmware Board (AFB). Our aim was to make a final design of the PLB and thus, it was built with the sufficient versatility to allow any other MOST application to be based on this same design. Nevertheless, the AFB is application-dependent, which forces to develop a specific board for each application whose complexity depends on the programming to implement. Here, its functionality was simplified to the essential functions of feeding, boot configuration, node supervision and transmitted signal conditioning.

The system developed consists on the transmission of S/PDIF signals between two nodes. Each node is composed of two attached boards: a PLB and an AFB. Since MOST specification [5,7,8] impose the existence of a single master node in the network for even the most elementary topology, one of the nodes is configured as the master node and is connected to the computer, while the other one acts as a slave node and is connected to the speakers. The design of the AFB is independent of its master or slave configuration that can be easily selected by a switch. The separation between hardware/software is already clear at node level, and is reflected in our modular design: on the one hand, we wanted to incorporate the common functionalities to all node MOST to implement the most possible versatile board; on the other hand, we designed another board including the most specific aspects of the application like feeding, converters, and intelligence necessary to govern the node. The advantages of this scheme are that the transmitter and receiver have a common module which saves time and effort, allowing a design by components, simpler to develop and to test.

In Fig.1 the block diagram of our basic node is shown differentiating the two integrated boards: the PLB (left) and the AFB (right): The PLB includes the devices that perform the functions specific to the physical layer of the MOST system: The electro-optical module, denominated FOT-FOR, converts the signals in reception and transmission between the transceiver MOST and the optical ring, acting as physical connection to the fibre. It is based on a standard Cavity As Interface (CAI) emitter and receptor from Bigfoot (Infineon Tech. [9]) integrated on a connector from Furukawa, and a standard MOST transceiver OS8104 [6] from OASIS Inc. The design of the AFB for our particular application includes a low cost microcontroller OTP 97LPC764 from Phillips, and a data converter with low power consumption, as well as indicating actuators and LEDs to allow small operative changes. The feeding module is based on a regulator 7805 and depends on an outside source. Finally, the block converter adapts the Sony/Phillips Digital Interface Format (S/PDIF) data from external devices to the transceiver MOST OS8104.

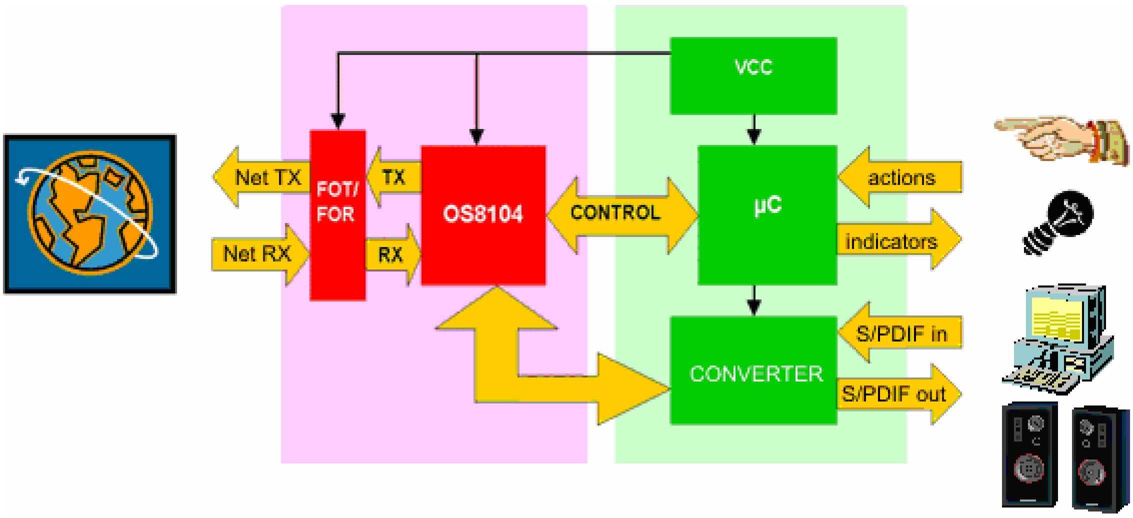

Fig. 1 a) Block diagram of the basic node with the Physical layer board (PLB) on the left and the application firmware board (AFB) on the right, showing their external connections and functions.

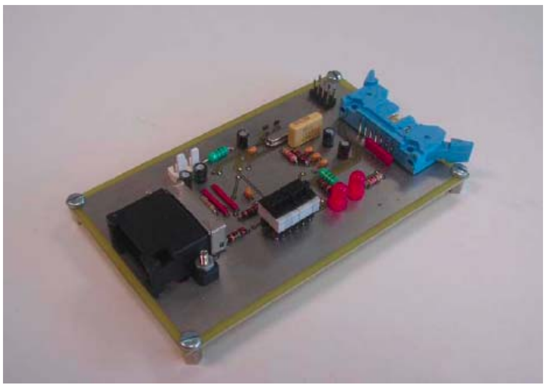

Fig. 1 b) Implementation of the PLB.

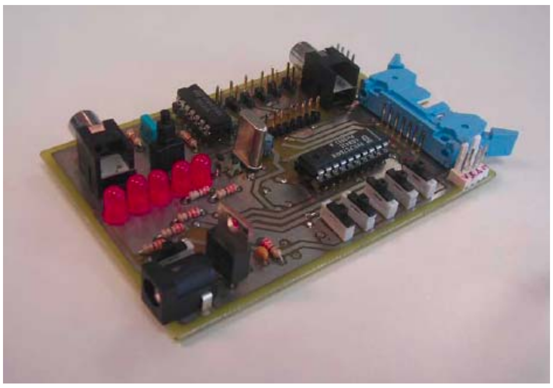

Fig. 1 c) Implementation of the AFB.

Once the correct operation of each node was verified separately, we implemented a point to point connection as a prototype to prove the correct communication between nodes. However, the final benefit of this approach is not the prototype itself, but the knowledge of the physical layer that it provides and its application in the design of more complex devices.

3. High Level Approach: Control of a DVD player in a ring MOST

In our high level approach we implemented the control of a DVD player in a MOST ring network based on commercial components from OASIS Inc., including a control node and two MOST devices: a DVD player and a Video decoder which is connected to a screen and to the speakers. The control node is an Intelligent Network Interface Controller (INIC) and acts as the network master node and receives commands from the computer to control the whole system. The INIC Evaluation Platform OS81050 is based on two boards whose functions are to be the physical layer interface and to communicate with the computer, respectively. The inner communication is performed by I^2C or 5-pin MediaLB standards. This two-board design has the same basis as our prototype described before.

The DVD player receives command messages and compresses the MPEG2 stream to be transmitted optically in the MOST ring network as a synchronous byte-flow. The DVD Player uses processor OS8805 from OASIS Inc. and offers a real-time interface to transmit MPEG2 streams for audio and video applications. It has the capability to scale the streams to change the compression rates to meet different quality demands. In addition, it accepts the commands to perform the common video player control.

The Video decoder is a multimedia device that converts the MPEG2 encoded data in standard analogical signal towards standard composite video and audio connectors plugged to a seven inches display and to the stereo speakers. It is also based on the OS8805 processor from OASIS Inc. and can be connected to other MPEG2 sources such as digital cameras, tuners, etc.

The configuration and initialization of the devices is made by the Optolyzer 4 MOST Professional software, which has a set of functions to control and to analyze the entire network.

The MPEG2 Transport Stream is transmitted in the MOST ring network in synchronous channels with high bit rates. The size of the transmitted stream and the compression ratio depend on the selected transmission speed. The video stream can be accommodated into either 4 or 8 of the 16 slots available in the MOST bus for synchronous transmission depending on the required quality. The remaining slots can be shared with other media sources that can be separately selected. In our experience, four slots are enough for an average video quality on a seven inches display, standard in automobile applications. Only a slight improvement is achieved with eight dedicated slots, which is more evident in rapid scene transitions. For audio reproduction, there is no quality improvement when increasing the number of dedicated slots beyond four slots. Therefore, this system has the capability to transport simultaneously four MPEG2 encoded video or MP3 audio streams with medium quality or two high quality video streams or any other combination.

Figure 2 (a) shows the scheme of the implemented network. Fig. 2 (b) is a picture of the demonstrative prototype and Fig 2 (c) depicts the specifically developed graphical interface performing as a remote control with the common functionalities for playing video such as pause, rewind, fast-forward, chapter-skip, etc. Each device on the network is remotely controlled by this interface, which can be integrated on a wireless handheld device.

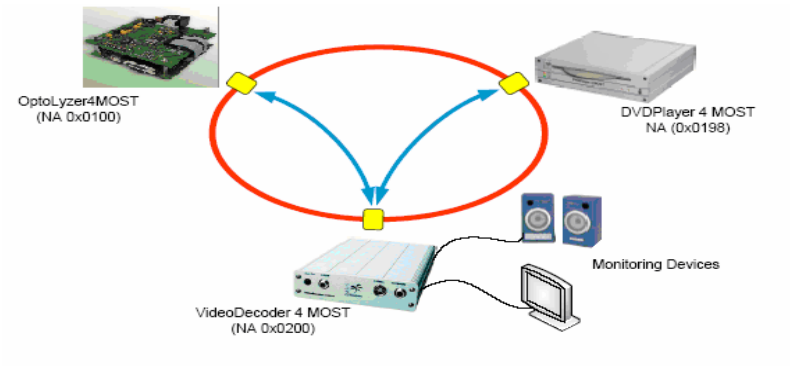

Fig. 2 a) Implemented ring network scheme.

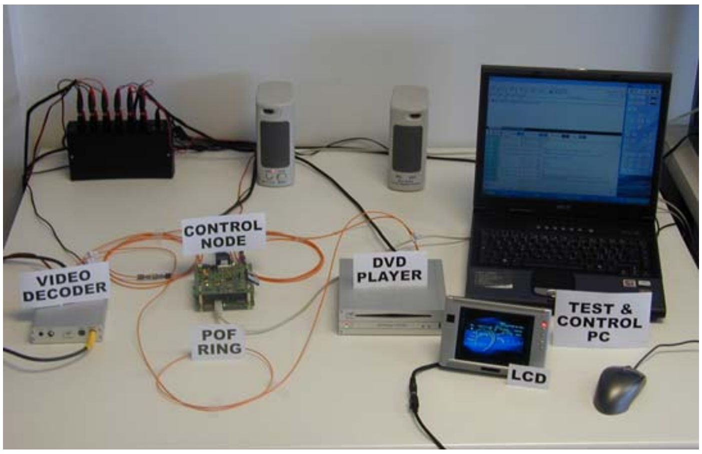

Fig. 2 b) Picture of the demonstrative set-up.

Fig. 2 c) Remote control.

This system is only a sample of all the possible applications that can be developed in a MOST network. However, the only devices that we have been able to include in this prototype have been provided by OASIS Inc. as they are the only available commercial source.

4. Conclusion

Here, we set out to develop MOST applications from two different approaches. First, in a low level approach, we built a two-board custom node that was tested in a ring network to transmit

S/PDIF audio. Second, the high level approach was based on integrating commercial devices to play multimedia content in a MOST ring network.

Our results show that it is possible to design simple custom MOST devices, but it can be very arduous to develop more complex devices which require high knowledge of Very Large Scale Integration (VLSI) electronic design. On the other hand, we found few commercial products in the market to implement custom MOST applications. Thus, the use of the standard MOST is not likely to outspread in the near future to domains other than the automobile, such as home or office networks.

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