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# MOST 인터페이스를 갖는 차량용 미디어 서버 플랫폼에 대한 임베디드 시스템 설계

# Embedded System Design of Automotive Media Server Platform with the MOST Interface

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## 요 약

이동 차량에서도 멀티미디어 응용 서비스에 대한 요구가 급증함에 따라, MOST(Media Oriented Systems Transport) 프로토콜이 주목을 받게 되었다. MOST 프로토콜은 짧은 제어 메시지, 비동기 패킷, 그리고 예약형 동기 스트림 데이터와 같은 세가지 형태의 통신 모드를 지원한다. MOST는 다양한 전송모드를 지원하여 차량 내부의 네트워크에 응용하는 프로토콜로서 적합하다. 본 논문에서는 MOST 프로토콜을 장착한 AMS(Automotive Media Server) 플랫폼 기반의 임베디드 시스템을 구현하고 제어 포트와 소스포트의 동기 채널을 통한 네트워크 통신테스트를 동해 시스템을 검증한다. MOST POF(Plastic Optical Fiber) 네트워크 상에서 서로 멀티미디어 통신을 할 수 있는 프로토타입 임베디드 플랫폼을 구현하여 시스템의 동작 테스트를 위해 DivX 디코더를 연결하고 비디오 스트림과 제어 메시지를 MOST 네트워크를 통해 전송하여 동작을 확인하였다.

## Abstract

For growing need for the multimedia application in the vehicles, the MOST protocol has been focused on. The MOST protocol supports three kinds of communication modes; short control message, asynchronous packets, and reserved synchronous stream data. Because of a variety of transportation, the MOST is suitable for various applications in vehicle environment. In this paper, we implemented embedded system which is MOST-enabled AMS platform and tested the network communication operation through the control port and the synchronous channel of the source port. We implemented the prototype platforms which communicate each other on the MOST's POF network. Moreover we implemented the DivX decoder attached AMS platform and verified the operation by transferring the video stream and the control messages through the MOST network.

Key words : Automotive, MOST, ring network, in-vehicle network

## I. Introduction

The current vehicle consists of electronic devices as well as mechanical devices. Nowadays, the electronic devices connect each other by the standardized network protocol such as CAN(Controller Area Network) which is the predominant global standard for medium speed (ISO1519 class B: 10kpcs; 125kbps) and high-speed (ISO11898 class C: 125kpcs; 1Mbps) event-driven automotive communications networking, LIN(Local

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Interconnect Network) standardized in 1999 as a low-speed (class A: 20kbps) network, MOST(Media Oriented Systems Transport) which is intended for interconnecting multimedia components on an optical fiber bearer and whose bandwidth is approximately 23M baud, and so on[1],[2].

According to the increasing need for the multimedia service on a seat, amount of electronic devices such as a DVD player, a MP3 player, and a DMB receiver, which are installed in the vehicle, has been growing fast[3]. There are two legacy interconnecting network protocols described above, CAN and LIN. Both CAN and LIN are the protocols to control the body of a vehicle. They can support just low-bandwidth; maximum 1Mbps. The channel with 1Mbps bandwidth can not transfer the multimedia stream for example the DMB video stream, which requires 2Mbps bandwidth over[4]. Thus, for the multimedia service the need for the protocol offering the higher bandwidth emerged and the MOST could do it.

MOST is an communication network protocol for multimedia application with POF(Plastic Optical Fiber) media. It is developed by Audi, BMW, Daimler Chrysler, Becker Automotive, Oasis Silicon Systems, etc. Now the protocol supports 24.8Mbps frame rate, and later will be improved to support 150Mbps[5]-[7].

The AMS platform supports the fundamental functions such as GUI, networking, storage, and so on. Especially, the interface with the MOST transceiver and the common bus interface for sub-functional platforms were focused on in this paper. These design methods of the AMS was described and demonstrated. Finally, summary and future work were described.

## Ⅱ. Media Oriented Systems Transport(MOST)

The MOST technology was designed from the beginning to offer full inter-connectivity for audio, video, and data services over a plastic fiber optic network. The goal has been to make it easy for car-makers and manufacturers of multimedia systems to design components that can easily communicate with each other, so that intelligent vehicle systems can be deployed into the consumer marketplace.

Figure 1 shows the superframe structure. A superframe has 64 octets. The last 4-octet area is reserved for the control port and the remaining 60-octet area is for source port[7],[8].

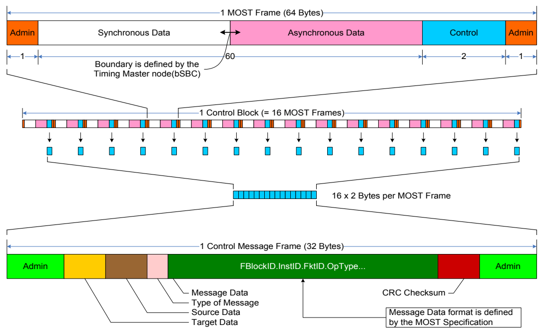


Figure 1. The MOST superframe structure.

## Ⅲ. Design of AMS Plaftorm

The AMS platform includes several functions, which include high performance MCU(micro-processor unit), in-vehicle NIC(network interface controller), graphic output device, touch-screen input device, audio output device, and hub system for external devices such as USB, etc. Although we prepared the multi-purposed platform for the in-vehicle devices, additional functions such as graphic output device or touch-screen input device are optional according to each application's specification. However, the MCU, the in-vehicle NIC for the in-vehicle backbone, and the relative software are mandatory for the in-vehicle devices.

### 3-1 Fundamental Components

SAMSUNG 32-bit RISC micro-processor, 2MB NOR flash memory, 256MB SDRAM, 128MB NAND flash memory, OASIS MOST transceiver, and its interface logic are fundamental components for our in-vehicle system. Moreover, the common bus controller logic is ready for an additional function, for example DivX decoder, Bluetooth communication, or DMB.

In addition to the above described components, 6.4 inch TFT LCD which has 640 x 480 resolution, 10Mbps Ethernet controller, USB 1.1 master and slave, touch screen, stereo audio, and so on. Figure 2 shows the block diagram of the AMS platform and the DivX sub-system.

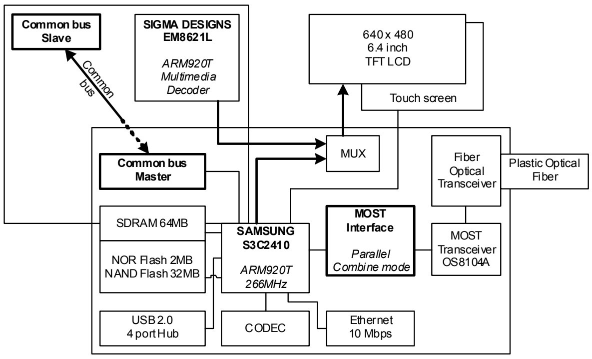


Figure 2. The hardware block diagram of the AMS.

## 3-2 The Common Bus Interface

The AMS platform introduced in this paper is for the template platform for various functions offering the fundamental components basically. For example, the AMS platform attaching a DMB receiver acts as the MOST-enabled DMB modem and the AMS platform attaching a DivX decoder is the MOST-enabled DivX player. We propose the common bus interface to link diverse sub-functional systems.

The common bus consists of a parallel interface, serial interface, and differential analog interface. The final system combing the AMS platform and sub-functional system have to include one or more interfaces according to the need of the own system.

For demonstration we interconnected the AMS platform and the DivX decoder sub-system with the parallel common bus interface. As soon as receiving the MPEG video stream and the control messages on the MOST network, the AMS platform transports the stream and control messages to the DivX decoder through the common bus. Figure 3 shows the common bus interface logic block diagram for the DivX sub-system.

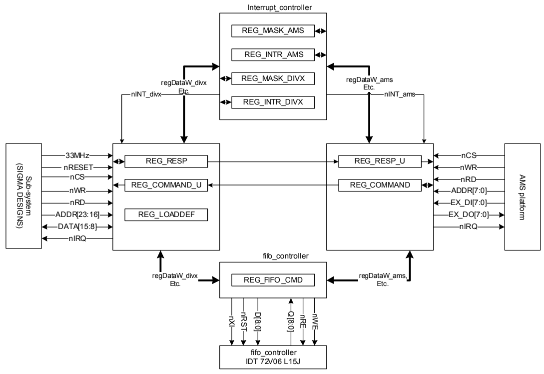


Figure 3. The common interface block diagram.

The figure 4 shows the MOST interface block diagram, which acts as a bridge between the CPU and the MOST transceiver OS8104A. The hardware bridge circuit replays control port (CP) messages and source port (SP) messages. Synchronous messages and asynchronous packets constitute the source port messages.

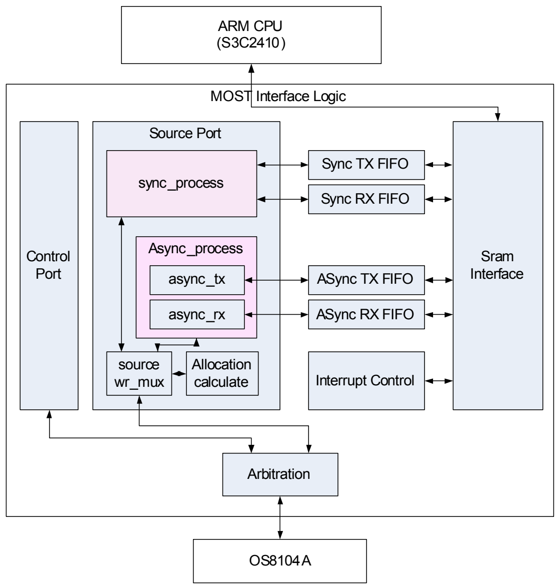


Figure 4. The MOST interface block diagram.

OS8104A provides three kind of interfacing method such as serial SP/serial CP, parallel SP/serial CP, and parallel SP/parallel CP. The parallel SP/parallel CP also consists of three kind of configurations such as parallel synchronous mode, parallel asynchronous mode, and combined mode.

We designed the hardware bridge circuit for parallel SP/parallel CP with combined mode. Therefore, the MOST application on the AMS can access all kind of the MOST data for example TCP/IP packets by asynchronous packets, video stream by synchronous data.

### 3-3 The software design

We determined that the software platform of the AMS should be the QNX. The micro-kernel architecture of the QNX is so reliable and fault-tolerable that the QNX-based system is suitable for the in-vehicle devices which request high reliability. Thus we should build device-drivers and applications on the QNX platform.

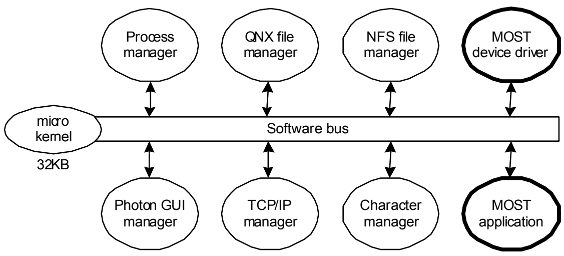


Figure 5. The software diagram.

The figure 5 shows the software architecture. The software modules including the MOST device driver except the MOST application, is the common software package for the AMS platform. Every MOST-enabled AMS platform has the MOST device driver, which exchanges data with the MOST transceiver; OS8104A. The MOST application just communicates with the MOST device driver by the IPC. The MOST device driver is similar in function to the NetService.

The MOST application of the DivX sub-system delivers video data from the video source or control messages from the remote controller to the DivX decoder by the MOST device driver. The MOST application uses the control port channel for the control messages such as play, stop, pause, etc. and makes use of the synchronous channel of the source port for the video stream for example MPEG2 stream.

## Ⅳ. Results

For demonstration, we built three systems. One was the MOST master, another was the AMS platform with the GUI, and the other system was the AMS platform attaching the DivX decoder sub-system. Three systems linked each other such as figure 6 and established the MOST network.

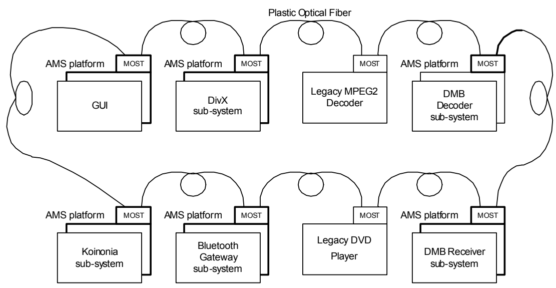


Figure 6. The test environment.

We implemented the parallel-combined mode MOST interface logic using the XILINX XC2V1000 FPGA device and the logic occupied 309,742 equivalent gates for the design. The common bus logic required 110 equivalent gates of the ALTERA EPM7512 and small relatively.

Figure 7. The AMS platform and the DivX sub-system prototype

The figure 7 shows the AMS platform prototype(left figure) and the DivX sub-system prototype(right figure). The MOST timing master, the AMS platform prototype board, and the AMS platform prototype board with the DivX sub-system prototype linked each other by the plastic optic fiber (POF) and constituted the MOST ring like the figure 8. For the compatibility test, we added the legacy DVD player which enabled the MOST.

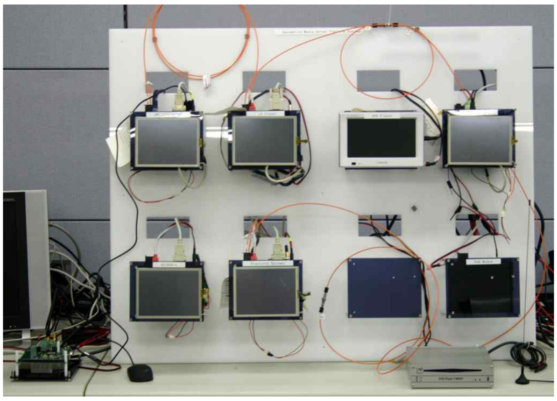

Figure 8. The actual testbed.

First of all, we demonstrated the control message communication with the control port. Touching a DivX button on the GUI with the touch screen, the AMS platform attaching the DivX decoder sub-system received the control message and then communicated with the attached DivX sub-system. Receiving the control message, the DivX sub-system operated correspondingly.

The MOST synchronous channel can contain minimum 24-octet and maximum 60-octet out of 64-octet; bandwidth from 9.3Mbps to 23.25Mbps. Each device can allocate the channel in terms of quadlets. Thus the AMS platform configured a quadlet for the synchronous channel and transmitted the video stream to the another AMS platform. We confirmed the reception of the data on the synchronous channel

## Ⅴ. Summary

The MOST protocol is appropriate to transport various kinds of data such as control data, internet packets, and multimedia data in the in-vehicle environment due to its superframe structure with three types of frame.

We proposed the automotive media server (AMS) platform with the MOST network interface controller and showed our MOST interface logic implemented in the FPGA. Moreover, we implemented the DivX decoder for demonstration of multimedia stream data transmission and the common interface logic for interconnecting the AMS with the DivX decoder sub-system.

The function of the control port and the source port was verified by exchanging the DivX control data and transporting the video stream on the plastic optical fiber (POF) ring network. Additionally the compatibility with the legacy MOST DVD device made by OASIS was verified

## Ⅵ. Future Work

We implemented the MOST-enabled AMS platform and tested the control port and the synchronous channel of the source port. Our future works are the verification of the asynchronous channel, the high bandwidth synchronous channel and the NetService implementation

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