

Simple Media Networks, Inc

SMeNet Background

Media networks come in many flavors, each with many pros and cons. At Simple Media Networks we work with a variety of network technologies in a variety of applications. This document describes our approach to solving the problem of audio and video networking specifically for embedded devices. In such devices addition of complex OS and networking stacks may significantly alter the viability of a project due to either hardware costs or development efforts required.

1 Media Networking Challenges

Audio and video media are unique in that they must be presented at the remote network device at a steady rate without interruptions or over-runs. For live data this means some combination of synchronization, buffering, error recovery, and/or resampling must be applied in order to retain data quality.

For the purpose of this discussion we will think of the network as a 3 layer model which includes the following:

A Physical Layer (PHY) which includes the core networking hardware: cabling, connectors, transmitter, receiver, and network interface hardware (transceiver, MAC, etc).

A Protocol Layer (Stack) which includes the network specific firmware for assembling data and passing it to the network in an appropriate way. On the receiving side this layer breaks the stream back out into specific data types and presents them to the application.

An Application Layer (App) which includes the actual application firmware.

2 Embedded System Requirements

For embedded systems the following requirements are generally critical:

- Ruggedness of Physical Layer
- Reliability of data transmission
- Compact and low cost hardware
- Minimization of development NRE due to firmware

The relative importance may be different between applications, but these factors are applicable to most embedded designs. These factors are of course in addition to the need to support audio or video streaming.

3 A PHY for Media Networks

One of our favorite solutions for an embedded PHY is the MOST network. The MOST network PHY features:

- Rugged locking connectors

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SMeNet Background.doc	1	1/4/2011 14:01:00 PM

Simple Media Networks, Inc

SMeNet Background

- Plastic Optical Fiber (POF) or Unshielded Twisted Pair (UTP or CAT5) for cabling
- Adaptive receivers in the UTP PHY which allow for very low power transmission with very low EMI/EMC
- Host interfacing based upon I2C or SPI
- Audio interfacing based upon I2S
- Lossless data transfer
- Inherent synchronization of all nodes
- Bufferless streaming for synchronous audio data
- Single chip TQFP44, QFN48 solution for audio
- Expansion chip for additional I/O and video

Integrated circuit solutions for the MOST network PHY are currently available from SMSC in 3 versions. These devices are called an Intelligent Network Interface Controller (INIC):

Name	INIC Chip	Speed	PHY Interface	Package
MOST25	OS81050	25Mbps	POF	TQFP44
MOST50	OS81092	50Mbps	UTP	QFN48
MOST150	OS81110	150Mbps	POF	QFN48

Fortunately, all three versions of the MOST INIC use a common interface method and share very similar API layers.

4 Challenges for MOST in embedded applications

4.1 INIC Control Interface

Because of the real time nature of the network, timing of message handling is critical to proper network operation. This generally results in a dedicated control interface between the INIC and the External Host Controller (EHC) with no other devices on it, and an interrupt based driver to ensure prompt responses to network activity. Response to INIC requests must be made within 10mS, and is generally implemented at 1-2ms. These requirements often lead to complications in integration with application software on the EHC.

4.2 The MOST Stack

While the MOST PHY is very compact and efficient, the MOST stack is very complex and bulky. The protocols have been developed by the MOST Cooperation to support major automotive OEM systems, and implemented in a

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SMeNet Background.doc	2	1/4/2011 14:01:00 PM

Simple Media Networks, Inc

SMeNet Background

stack library known as MOST Network Services (MNS). MNS supports many data types, and has substantial vertical integration. This vertical integration includes very high level functions, which do not really suit the needs of all systems. Master devices must have a detailed knowledge and understanding of the remote devices under their control, and that all devices are designed to a pre-defined set of functions. Each OEM has modified these instructions somewhat to suit their own system requirements, leading to limited interoperability of components between OEMs and systems. The resulting stack is large, complex, and requires substantial learning curve and development effort to integrate into existing projects. In addition, standardization at the higher levels is poor.

For Mastering devices a larger version of the stack is incorporated to implement the network management functions.

While this stack is viable for high volume automotive OEMS, it is prohibitive for most other uses.

5 Simplifying the Stack for embedded applications

Simple Media Networks has developed a simplified stack which operates with the MOST INIC/PHY to provide an efficient system solution for applications which do not require the complexities of the full Most Network Services stack. The SMeNet stack is ideal for point to point and low node count networks. The SMeNet stack is implemented in a small microcontroller so that the application EHC is isolated from the real time processing requirements of the INIC and the MOST network.

The SMeNet Stack provides the following features:

- Network Management
- Simple Configuration
- Tunneling of control messages between nodes
- Device identification
- Arbitrary extensions of data and parameters
- No real time constraints on the EHC
- Small memory profile

SMeNet provides a very simple API to the host processor, and provides functions for simple tunneling of I2S audio and I2C control messages between nodes.

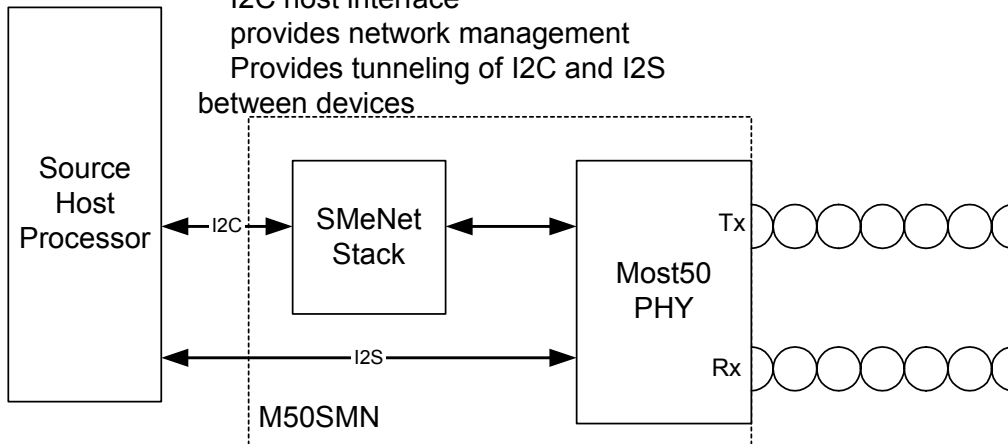
Example application using a SMeNet Interface:

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SMeNet Background.doc	3	1/4/2011 14:01:00 PM

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SMeNet Background

SMeNet Logical layer:
 provides simple API to host
 supports real-time requirements of PHY
 same for all nodes
 I2C host interface
 provides network management
 Provides tunneling of I2C and I2S
 between devices



MOST PHY

provides reliable data link
 optimized for low EMI/EMC
 same for all nodes
 provides 2 I2S data lines IN
 provides 2 I2S data lines OUT
 each data line can be TDM2, TDM4, or TDM8

Simple Media Networks, Inc

SMeNet Background

6 SMeNet Products

Simple Media networks has several small network interfaces in production and under development which are ideal for embedded A/V applications.



The following network cards all feature the SMeNet Stack and a MOST Phy. Cards are approximately 2x3" with a common connector to the EHC.

Card	INIC	PHY	Status	Recommended for/Key features	Size
M25I	OS81050	Tyco POF	Production	Audio applications	2"x3"
M50U	OS81092	UTP	Development	Applications where POF is undesirable	2"x3"
M50C	OS81092	CAT5	Development	Familiar CAT5 cabling	2"x3"
M150I	OS81110	Tyco POF	Development	Includes support for video	2.5"x3.5"
M150F	OS81110	Optolock POF	Development	Cut and clinch cabling, ideal for home, custom, and low volume installation	2"x3"

Please contact us for detailed information on these products.

7 Customization:

A variety of customizations are possible with SMeNet technology. For customers requiring higher integration, the SMeNet stack can be provided under license as

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SMeNet Background.doc	5	1/4/2011 14:01:00 PM

Simple Media Networks, Inc

SMeNet Background

a library linked into a customer EHC. Alternatively, application specific command sets can be developed and integrated into the stack to support 3rd party network devices. This has been done to successfully provide system controllers for OEM audio systems from B&O, ASK, Harman, etc. Please contact us to discuss the development of such solutions.

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SMeNet Background.doc	6	1/4/2011 14:01:00 PM