Bringing the MOST in interface controllers

By Clif Sanchez
Applications Engineer
SMSC

The original Media Oriented Systems Transport (MOST) network, used in many luxury European cars, is a powerful network architecture that utilizes a full software protocol stack to manage the network. Because MOST hardware ICs handle the low-level data-link layer operations, the external protocol stack is generally smaller than other network protocol stacks, while still being able to support many nodes with complex interactions.

These MOST systems, with a large number of nodes built by many suppliers, commonly have a system integrator that coordinates functions among all the suppliers of the system.

Integrated architecture

The latest generation of MOST chips, Intelligent Network Interface Controllers (INICs), have vastly simplified the network interface by integrating all the low-level, real-time network operations, including the network driver, on a chip. As a result, a stand-alone network node can handle all the housekeeping functions of the network autonomously. This architecture leaves only the highest layers of the protocol stack to be implemented off the chip, allowing the external processor to focus on the application and not on the underlying network.

Such integration requires only a minimum amount of external processor code. This simplification of the application code through the advanced INIC architecture supports a faster time-to-market and a more reliable system, so the user does not have to analyze and debug low-level network complexities.

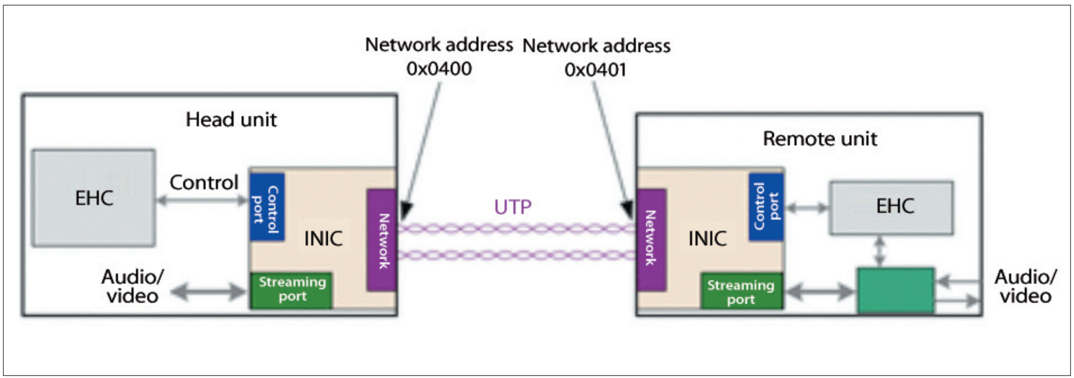

Figure 1: In this two-node network, the head unit contains an INIC configured as the timing-master for the network (at network physical address 0x0400) and a remote node (at physical address 0x0401).

While INICs support all the high-end features for full-blown in-car infotainment systems, they also provide a very lean way to implement simple setups like the connection between a radio and an amplifier. An example of an implementation using this newer INIC architecture is INIC eLITE, which leverages existing automotive-qualified MOST network chips, but simplifies the software model for a smaller, less complex network.

Due to the self-contained nature of INIC, no external network driver and only a few initialization commands are needed to manage such a simple network. The INIC eLITE architecture provides over 40Mbit/s of streaming A/V data along with a bi-directional control channel over unshielded twisted pair wire, with very little software overhead.

Because the streaming data is synchronous, QoS issues are eliminated. Assuming a network consists of two or three nodes, one node must be configured as the timing master, while the other nodes are timing slaves. The network-timing master provides the synchronization for the entire network. Although the choice of which node is configured as the timing master is arbitrary, it is generally located in the dashboard head unit.

Figure 1 illustrates the simplicity of managing a small network that consists of a few nodes and features transport of digital A/V channels, together with control.

The external processor or External Host Controller (EHC) on the timing-master node must only send one command to the INIC to start up the network. When the INIC receives this message, it performs all the operations necessary to get the network running on its own. Then it reports back to the EHC when the network is locked and ready. All the other nodes, where the INIC acts as the timing-slave, automatically start up independently of the EHC.

Because the network that the INICs form includes automatic discovery, each node has an assigned physical address that can be used to send data (control messages) between nodes. The timing master has the physical address 0x0400. The node that the timing master is transmitting to has the address 0x0401. The physical address keeps growing in increments to accommodate more nodes in the network. On all nodes, the INIC reports back to the EHC on how many total nodes exist in the network.

The INIC powers up in a protected state to maximize the network integrity. When the EHC has initialized and is ready for operation, the EHC must send an "attach" command to the INIC to allow the EHC to interact with the network. The INIC contains a couple of watchdog timers that periodically require the EHC's attention. Without this, the INIC will drop back into a protected state.

About MOST

Media Oriented Systems Transport (MOST) technology is a networking standard that enables the seamless transport of digital audio, video, and packet-based data, along with real-time control information, within the car. SMSC is a silicon provider of this IP and supports customers in their development tasks with MOST network management software and tools. SMSC's MOST-enabled INICs are being designed into automotive networks to transfer multimedia content quickly among devices such as radios, navigation systems, digital video displays, microphones, and CD players. With over 45 vehicle models on the road today, representing millions of vehicles with tens of millions of nodes, MOST is seeing rapid adoption in the automotive industry.

For nodes that want to source streaming data to the network, such as a CD player or FM radio, the EHC only needs to send a few commands to the INIC to place its source data onto the network. For example, such commands include:

- Open and configure the local hardware port
- Get the local data into INIC
- Get network bandwidth allocated
- Connect the local port data to the network bandwidth allocated

The EHC must wait until the INIC indicates that the network is locked before requesting network bandwidth.

The INIC responds to the network-bandwidth allocation command with information on where the data is located within a 40+ Mbit/s streaming section of the network. Once streaming data is allocated, any other node or multiple nodes can retrieve the data since the intelligent controller knows where the streaming data resides on the network. The source node can send a control message to the sink node, indicating the location of the source data. Then the sink node, such as an amplifier, sends a similar set of messages to the INIC indicating which data on the network to retrieve. The INIC then pulls the streaming data off the network and outputs the data locally in the specified format, such as I^2S (**Figure 2**).

If the network loses lock, then the streaming connections are automatically disconnected. This scenario can easily be managed in the EHC since the INIC automatically reports any change in network status. Once network lock is restored, the EHC just repeats the previous sequence to return the data onto, or off the network.

To send packet data or messages, termed control messages, to other nodes, the EHC adds the target node's physical network address to a message and loads the control message into the INIC. The intelligent controller will then manage the transmission of the message to the remote node in the network. This control message channel operates independently of the streaming data; therefore, heavy loading of the streaming bandwidth has no impact on the control message bandwidth.

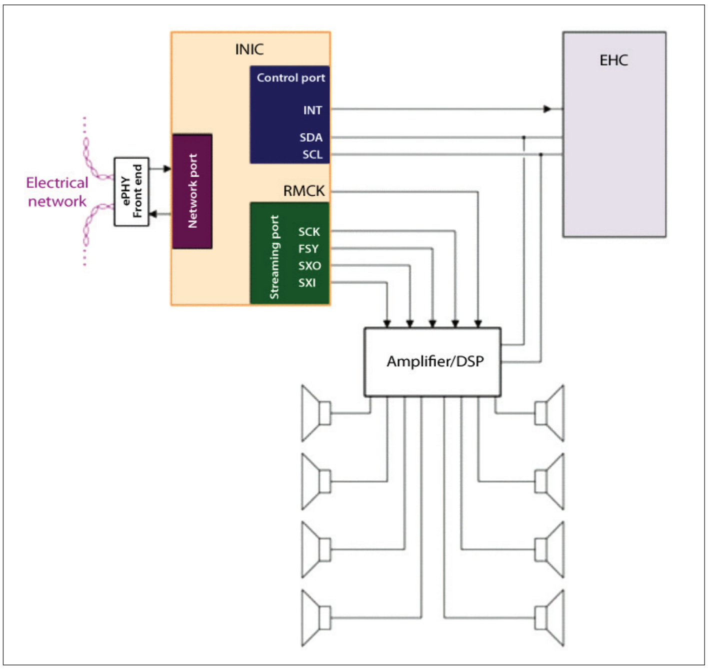

Figure 2: The EHC configures the streaming port by sending a few messages in through the control port. The EHC can also send messages to the other node on the network through the same control port. Synchronous data goes into INIC and comes out of INIC through the streaming port.

Overload

Although the control message channel supports over 1.5Mbit/s, there are times when the receiving node's EHC may not be able to read the received messages before the next message arrives. In this case, the INIC automatically retries control messages that fail to get transmitted properly. In systems using significant control message bandwidth, the number of retries can be programmed in the INIC to a higher value to offload the EHC from having to manage this task.

With this simplified interface to such a high-bandwidth multi-functional network, this architecture is a replacement for traditional "analog plus CAN" applications, where fewer wires, higher performance or more functionality are desired. The INIC architecture is also a natural solution for other applications outside of automotive applications. Because of the extremely small overhead needed in an EHC to manage the network, the overall system cost and complexity is reduced, making it excellent for applications such as a replacement for S/PDIF, high-end audio networking and mixing consoles, a multi-board serial data backbone, and other mobile networking applications that can be used in boats, airplanes, and buses.