New Project, New Features

I The all new Mercedes-Benz CLS is – besides the model SLK – one of the latest cars featuring MOST technology. (Source: Daimler)

MOST150´s new features in a series project

MOST is the de-facto standard for connecting infotainment systems in high-end vehicles. In Daimler AG vehicles, MOST25 with a speed grade of 25 Mbit/s has now been used for ten years. However, with the bandwidth of MOST25 almost fully occupied in current systems and with new system requirements for the next generation of infotainment systems, it was necessary to switch to a network with more bandwidth. Therefore, Daimler has decided to build its next generation of infotainment systems based on MOST150, as defined by the MOST Specification 3.0 [3].

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The bandwidth provided by MOST150 enables Daimler to realize new features, such as access to Internet services, as well as increased requirements for connectivity to consumer devices. In addition, Daimler has begun to stream video over MOST150, replacing separate dedicated video links. With the bandwidth provided by MOST150, it is possible to create a system where the available audio and video sources can be accessed independently from different seats.

In this paper the experiences with the networking and architectural aspects of the on-going development process at Daimler will be described.

Requirements of the next generation infotainment system

In current systems the head unit provides the user interface for the driver and optionally the co-driver. It interacts with different peripheral devices, for example a high-end audio amplifier or a country-specific digital radio, via the MOST bus. The MOST bus is used to transmit control information as well as the audio streams, including a digital 5.1 surround stream if a DVD is used as a audio source. Additionally, more and more data is transmitted over the asynchronous (packet) channel; for example, it provides metadata for music tracks or the data services for a digital broadcast system. The rear seat entertainment system is to a large extent still a standalone system and is not connected to the MOST bus.

The requirements that were the basis for the design of the next generation of infotainment systems can be summarized as follows:

- Independent access to audio and video sources from all seats.
- Access to Internet services and increased connectivity to customer devices.
- Increased bandwidth for new features.

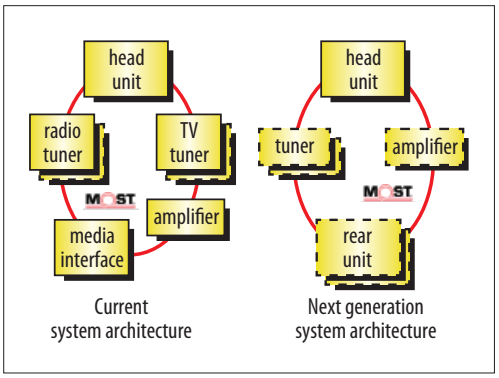

Figure 1. Comparison of the current and the next generation system architecture.

While the current system is basically a master/slave system with all controlling applications running on the head unit, in the next system the functions available for the rear seat passengers will be provided by rear units, which are connected to the head unit via MOST150. User interface and applications for the rear seat passengers will be executed on the rear units. A comparison for the current and the next system architecture is shown in **figure 1**. The challenges for the management mechanisms of a multi-seat system will be discussed in the next section.

The next Generation of Systems will provide access to Internet services and Web browsing for all seats. Therefore, IP traffic has to be transmitted efficiently over the MOST150 network, especially against the background of increasing data rates of mobile networks (e.g. LTE).

Finally, the bandwidth requirements for existing features have increased to a great extent. Reasons for this are, among others, the use of metadata (including cover art) for music tracks, the data services of digital broadcast radio (e.g. the weather information provided by the Sirius service in the USA [4]), accessing video files on storage media and the access to HTML-based information content provided by one device to the other devices in the system. All of these features have to be provided in a multi-seat context.

Management services for a multi-seat system

In a highly dynamic multi-seat system, robust management mechanisms, especially for the management of audio and video connections, are very important. In MOST150, management mechanisms are defined in the MOST Specification 3.0 [3] and have evolved from the well-proven mechanisms of MOST25. Therefore appropriate concepts, for example for error handling [2], can be re-used.

The MOST network management mechanisms enable a fast start-up of the system. They also provide mechanisms to deal with different error scenarios, such as an intelligent mute if the systems detects that an audio source is no longer active. With the MOST Specification 3.0, further mechanisms for failure detection and diagnosis have been added to improve the stability of the system, such as a detection of a sudden signal off caused by a device or an extended ring break diagnosis. With the sudden signal off detection, the system can determine the spontaneous failure of a certain device. Previously, this could only be detected through a special test setup and could not be diagnosed in a production system.

The mechanisms for connection handling are the basis for a multi-seat management that is able to handle a large number of sources and connections in parallel as well as the dynamic sequences that may occur, for example when audio sources are changed because of a traffic announcement. In the next system, the connection management will have to handle up to 20 entertainment audio sources and up to ten information audio sources. These sources can be played on four sinks in parallel (**figure 2**). In case of a source change, the connection handling will have to deal with the change of audio settings, the conflict handling and prioritisation, as well as the mixing, fading, and muting of audio sources dynamically and within certain timing constraints.

To reduce the high number of dedicated video links, which would otherwise have been necessary, the video sources of the head unit are transmitted as streaming connections via the MOST150 network. They use the isochronous streaming channels provided by MOST150, which were designed to transmit streaming data that does not have a fixed bit rate like compressed video or audio. Similar to MOST25, bandwidth can be allocated for streaming channels or for packet data.

MOST Ethernet channel and IP based protocols

One important new feature of MOST150 is the MOST Ethernet packet channel (MEP), which provides a channel compatible to Ethernet and is ideally suited for transmitting IP traffic. The MEP channel supports a 48 bit addressing mechanism and has a packet size similar to Ethernet, overcoming the restrictions of the old MAMAC mechanisms (Mobile Adaptive MAC).

The MEP channel is used to transmit IP traffic between the main units of the system (head units and rear units) to provide access to Internet services and the Internet itself. The MEP channel has proven to be an easy-to-use and efficient way to transmit IP data. **Figure 3** shows the net bandwidth that

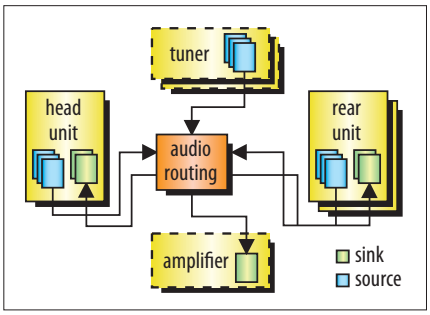

Figure 2. Functionality of audio routing in a multi-seat system.

can be achieved for a connection using the MEP channel in a MOST150 network with different settings of the boundary (i.e., the allocation of bandwidth between packet channels and streaming channels for the transmission of multimedia data). With the maximum bandwidth allocated for the packet channel a net bandwidth of over 107 Mbit/s was achieved during experiments at Daimler.

Besides transmitting IP traffic for Internet access, the MEP channel is used to transmit larger data sets, for example the contents of a music database, or to access HTML-based information

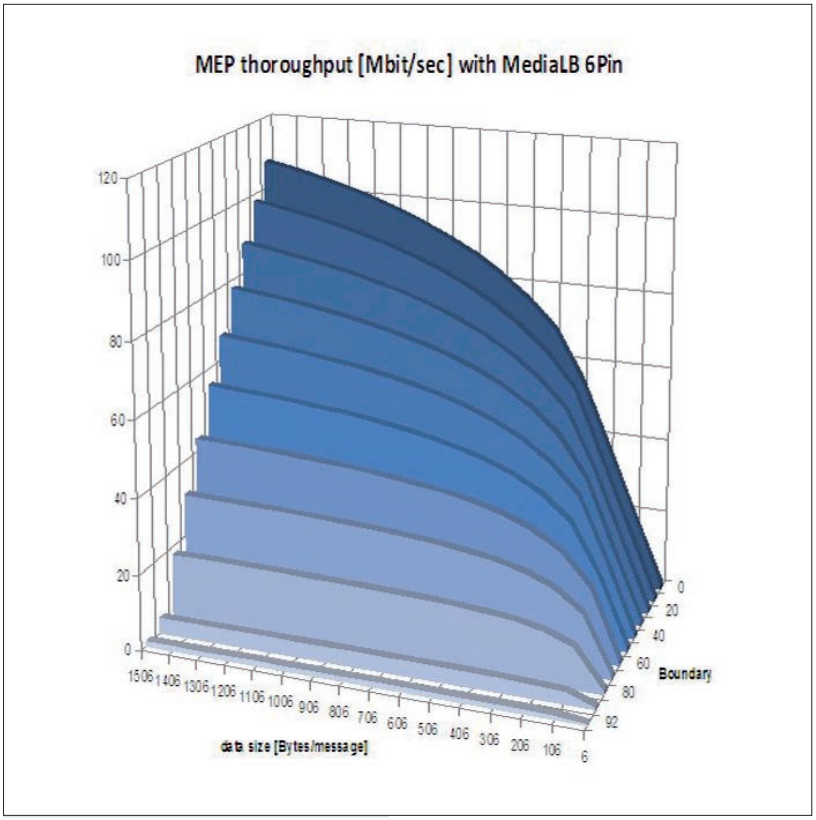

Figure 3. Net data throughput on the MEP channel of MOST150 for different settings of the boundary. (Source: Ontorix GmbH)

content. It was found that it is easy to realize such features by using standard IP based services and protocols such as a Web server and the Hypertext Transfer Protocol (HTTP).

Further direction of development

The decision for MOST150 has enabled Daimler to realize the new features of the next generation of infotainment systems while re-using the proven mechanism and application interfaces from current systems. The bandwidth of MOST150 is sufficient to create a multi-seat system, where it is possible to access every audio or video source from every seat.

While in the next system Daimler has begun to transmit certain video streams over the MOST150 network, a future goal is to extend this to video streams from slave devices (e.g. a TV tuner). Thus the number of connections will be further reduced and a more consistent system architecture will be achieved.

Besides supporting IP for Internet access, IP-based protocols and mechanisms have been successfully used for other use cases. The basis for this is the new MEP channel of MOST150, which provides an efficient and easy way to transmit IP data. Using further proven standards from the IT world will help to introduce new features earlier and easier. This is, for example, discussed in more detail in [1] and [5]. *sj*

Literature + Links

[1] *Leonhardi, A.; Gschwandtner, T.; Hauke, R.; Stümpfle, M.:* Using UPnP in a MOST Environment. Elektronik *automotive*, Special issue MOST, 2010.
[2] *Leonhardi, A.; Vallentin, A.; Pech, T.:* Error Handling Strategies for a MOST Application Framework. Proceedings of the 1st MOST Forum Conference and Exhibition, Stuttgart, Germany, 2008.
[3] MOST Specification, Rev. 3.0E2. 07/2010. www.mostcooperation.com
[4] www.sirius.com
[5] www.upnp.org

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