MLAN – time to pay attention

Despite an initial lukewarm reception the extension of FireWire has not gone away. Indeed recent developments have made mLAN a far more attractive proposition for serious audio production. TERRY HOLTON of Yamaha's R&D Centre explains.

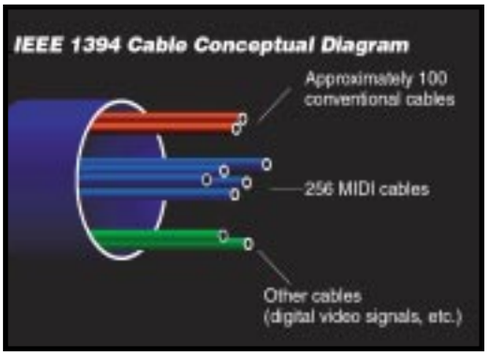
IN A TYPICAL PRO AUDIO environment, dozens of cables may be required to interconnect the various devices being used for audio production, processing and recording. Most often there will also be several different types of cable and connector required for each device depending on the type of audio or data being handled. Currently in such environments, the audio and control data signal flow is determined by the way the cables are connected, meaning that cables must be reconnected if you want to reconfigure the system. When making connections, attention must also be paid to the input/output direction of each jack, the left/right channel, and in some cases a consideration of impedance is also necessary. As systems become larger, all of these factors produce increasing complexity, expense and inflexibility.

Over the last few years, a new technology has been developed with the objective of dramatically simplifying system configuration and management and by allowing a very large number of digital audio and control data connections to be combined into a single, hot pluggable cable. The result of this very extensive research and development effort is a high-speed local area network for music and pro audio applications, known as mLAN. While much of the core development of mLAN has been handled by an engineering team inside Yamaha, mLAN has always been intended as an open standard to be used throughout the pro audio and music production industries.

mLAN uses and provides further extensions to the industry standard IEEE 1394 serial bus, which is based on the original FireWire technology developed by Apple. This standard allows for simple and low-cost connection of computers to consumer and professional electronic equipment, such as digital video cameras, audio equipment, electronic musical instruments, and hard disk drives. Having just one connector capable of interfacing to all these different types of device can obviously lead to much simpler cabling considerations in an audio production environment. And by using an interfacing standard common to the computer and consumer electronics industries, economies of scale will continually push prices down.

One key advantage of 1394 devices is that they are inherently hot pluggable. This allows cables to be freely connected and disconnected without the need to first power-down the devices in the network. Since IDs are assigned automatically as connections are made, the user does not need to make, or even be aware of, such settings. This allows the system to be used immediately after it has been configured.

Another important point is that there is no need to consider input and output designations of 1394 physical connectors, as every cable connection can handle transmission and reception. mLAN-compatible devices will typically have two or more 1394 ports to allow for easy linking of multiple devices. In addition, the flow of audio and control data signals between mLAN devices can be freely changed without physically reconnecting any cables. And, very importantly, such configurations can also be stored for future recall.



The isochronous data transfer and timestamp used by mLAN is a method that guarantees the right to transmit or receive data at fixed intervals. This makes it possible to transmit data with a guaranteed time of arrival, particularly essential for real-time video and audio applications. With the first generation mLAN data rate of 200Mbs, the 1394 bus is theoretically capable of transmitting up to 100 channels of CD-quality digital audio data. This is the maximum number of audio channels possible in a bus containing just a single transmitting device. The current 200Mbs bus is also capable of providing the equivalent of 256 MIDI cables (more than 4,000 MIDI channels) over a single 1394 cable at one time.

However, it is not so simple to specify the total number of channels possible with mLAN. For a device (referred to as a node) to transmit data, it must obtain bus access rights. The root node (specified automatically or manually by the user) arbitrates bus access rights and allows a single node to transmit data at any specific time. This process of bus arbitration consumes some of the available bandwidth, so with more transmitters active the total number of channels will be reduced.

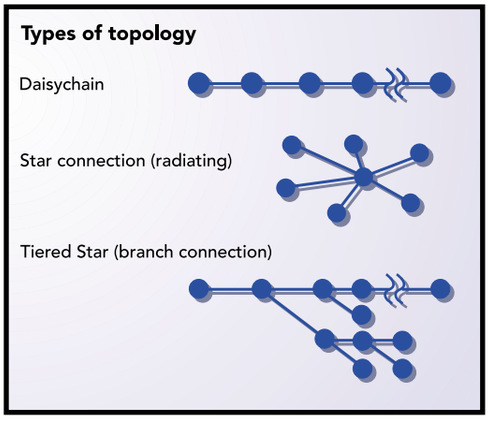
Second generation mLAN devices will be capable of 400Mbs data rates and equipment supporting this rate will be arriving on the market very soon. The mLAN bus capacity can be doubled when using devices supporting this higher data rate. Devices supporting different data rates can be simultaneously used on the same mLAN network, but in such cases the bus speed will be reduced to that of the slowest device on any particular branch of the network.

Another very attractive aspect of mLAN networks is the extremely low bus latency. Latency, in this context, refers to the delay caused by the process of sampling an audio stream, transmitting it, and then reconstructing it at the receiving nodes. In an mLAN network the default bus latency is set at a value of 0.354ms. This latency value can be reduced even further depending on system requirements. For example, if hot-plugging capability is not required the latency could be reduced to as low as 0.2ms. Of course, this figure does not include any A-D or D-A conversion latencies, nor does this figure refer to the latency of computer audio drivers.

For use in computer audio production systems, ASIO drivers are provided for Mac OS9 and Windows platforms, with WDM drivers also being developed for Windows. For Mac OS X, Yamaha and Apple have collaborated to provide extremely low latency drivers as an integral part of the operating system. Through the use of these drivers, mLAN is compatible with any sequencer or DAW that supports ASIO, WDM or Mac OS X Core Audio and Core MIDI.

In the vast majority of cases, configuration and connection of mLAN networks is very simple. If an mLAN system contains 16 or fewer nodes, a network can be constructed simply by connecting devices consecutively with no specialist knowledge required. Much larger systems are possible and a network can currently consist of a maximum of 63 devices. In the future, even larger systems of up to 63 x 1023 devices can be configured by using bridges.

mLAN networks can be very flexibly configured using a variety of different topologies including daisy-chain, star, or tiered star.



The distance between any two nodes is determined by a combination of the cable length and the number of hops. The standard 1394 copper cable length is normally up to 4.5m and the maximum number of hops between any two nodes is 16, resulting in a maximum distance of 72m between nodes. This is often fine for small to medium-sized studio installations, but for applications that require longer distances, 1394-compatible fibre optic interfaces and long haul repeaters can be employed.

Although most current mLAN devices use the

standard 1394 copper cable connections, it is also possible for mLAN devices to be designed to provide direct interfacing via fibre optic or CAT5 cabling. For example, with glass optical fibre interfacing distances of up to 500m at 400Mbs are possible, while CAT5 interfacing can allow up to 100m at 100Mbs.

To transfer real-time data, such as audio and MIDI, the clocks that are built into each device must be synchronised. The mLAN Fs Manager controls the master and slave relationship between each node's word clock. The word clock master setting can be configured manually by the user, or an Auto mode can be used. It is also possible for multiple word clock masters to exist on the same bus. This feature is particularly useful when it is necessary to work with different sample rates within one network.

Although multiple audio clock sources are allowed, a single node is required to control isochronous transmissions. This node is called the cycle master and the root node performs this function. If the power of the cycle master node is turned off, or if the cable is disconnected, it will no longer be possible to transfer data. If this occurs another node will be selected as the cycle master, and data transfer will resume. When a cable is connected or disconnected within a network, or when the power of a node is turned on or off, the bus will be initialised and the network will be automatically reconfigured. In many cases, depending on the position in the network of the device or cable that is removed, only a Short Bus Reset will be necessary and audio reception by other devices will not be interrupted.

The audio and MIDI data that flows over mLAN is transferred using virtual connectors called mLAN plugs. The logical routes that are established between these plugs are called mLAN connections. The mLAN Connection Manager is an important function possessed by all first generation mLAN devices. This is a module that manages the specified mLAN connections on each node in the network. In the original implementation of mLAN, software contained within each mLAN device is required to include complete connection management capability.

With second generation mLAN devices, such as the Yamaha 01X, a new connection management architecture is used to split the connection management function between a workstation (typically a Mac or Windows computer) and other mLAN devices. The high-level connection management and mLAN 'plug' abstraction capabilities reside on the workstation, while only a low-level connection management capability remains in other devices.

This new connection management architecture provides a couple of clear advantages. First, it reduces development costs and complexity for mLAN devices. Second, it allows for mLAN systems to be much more easily upgraded via the high-level connection management in the workstation.

The IEEE 1394 specification is widely used in DV connectors for digital video. Although DV includes an audio signal in addition to the video, it uses a different format from mLAN, and DV audio cannot be handled directly by an mLAN device. For an mLAN device to handle DV audio, a convertor device and/or computer software is required. However, DV video and audio signals can be carried along the same 1394 bus along with mLAN data. In many applications, this can provide a very convenient way to accommodate DV and mLAN signals simultaneously along a single cable.

The core technology behind mLAN is continually being enhanced and new chips are being developed to extend its capabilities and to provide more flexibility for product designers. One of the second-generation chips (PH2) provides increased channel capacity, 96kHz capability, and handles data at 400Mbps. Another new mLAN chip (NC1), also operating at 400Mbps, combines the functions of several previously required chips to allow more compact and cost-effective products to be developed.

One very significant difference between mLAN and other FireWire-based pro audio systems is that mLAN is an 'open' platform based on industry standards. For example, the protocols relating to the transmission of audio and music control data (e.g. MIDI) are defined within the IEC 61883-6 specification.

Working to establish industry standards is not necessarily the fastest way to develop and introduce new technologies and protocols. However, the benefits of this approach can be considerable, allowing for compatibility between many different manufacturers' hardware and software. mLAN is available through a royalty-free license and has already been licensed by more than 60 companies in the pro audio and music production industries.

An important potential benefit of this open platform approach is that alternative, but compatible products from various manufacturers will increasingly become available. This provides customers with a wide range of choices, while also contributing to lower costs through competition between manufacturers.

For any new technology to have a significantly positive impact, it is necessary for it to be effectively implemented in attractive and unique products. Although mLAN has been available for a few years now, the first products that fully exploit the benefits of the faster, more mature, and less expensive second generation mLAN technology will be arriving soon.

The recently announced 01X is the first significant product from Yamaha to be fundamentally designed around mLAN technology. The 01X uses mLAN to provide a totally integrated hardware/software solution for computer audio production. One of the most compelling features of the 01X is that it requires only a single cable to handle multiple channels of high-resolution digital audio plus MIDI control data between the digital mixer/controller and a Mac or PC computer. But perhaps more importantly, the 01X can be integrated with devices from other manufacturers as part of a flexible and open mLAN network. ■