



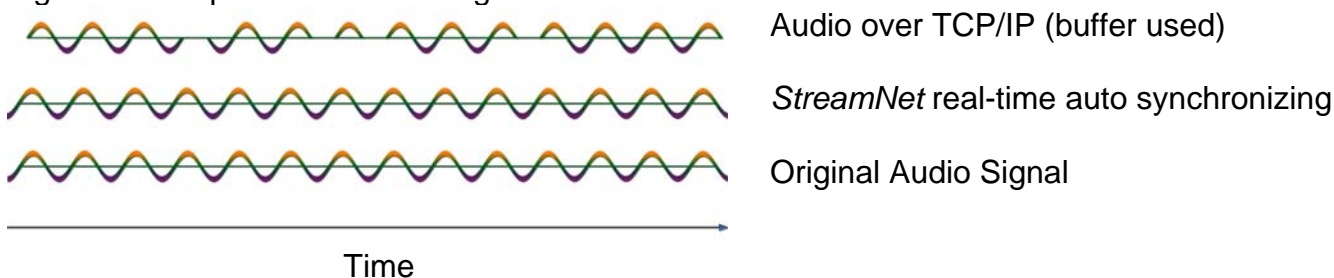
Introduction:

NetStreams' patent-pending StreamNet Technology encompasses several protocols, conventions, and technologies to insure the best quality audio and video distribution over TCP/IP. This whitepaper gives a good overview of StreamNet.

Automatic Synchronization of Streams (Time Sync)

One fundamental problem with using TCP/IP to distribute digital audio to multiple rooms in a home or workplace is the synchronization of playback. Without synchronization, audio can sputter, cut out, or have strong echo effects from room to room, sometimes playing several seconds apart. Simply incorporating a buffer to attempt to synchronize the audio is not enough, resulting in a 50 millisecond delay between any two speakers, which is audible. NetStreams' patent-pending StreamNet technology provides the solution, by removing the effect of network delays. A "master" is dynamically chosen to serve as the time reference, thereby allowing all devices to share the same concept of time. The sample rate is synchronized using a VCXO for low jitter. As a result, the maximum delay between any two speakers is reduced to 1 millisecond. StreamNet allows audio in any and all rooms to be synchronized when playing the same source throughout the house, solving the problem of distributing audio over TCP/IP packet-switched streams. Audio synchronization is done automatically, so the only thing you have to do is decide which song(s) you want to playback in which rooms of your home.

Figure 1: Comparison of Audio signals over TCP/IP:



Listen to Multiple Songs from a StreamNet-Connected Digital Music Server

Digital Music Servers are a great way to store, catalog, and listen to all of your music. Depending upon the size of the hard disc drive, you can store hours and hours of music on one server. However, with traditional multi-room audio systems you can only listen to one song at a time, depending upon the number of discrete output connections on the server. NetStreams has partnered with the leading Digital Music Server brands in the marketplace to incorporate StreamNet technology so you can listen to multiple songs* at the same time from one Digital Music Server over the DigiLinX Multi-Room Audio / Video and Control system. You can even listen to multiple instances of the same song at the same time.



*Depending on the model of the Digital Music Server.

Compatible with Traditional Audio Sources

DigiLinX Multi-Room Audio / Video and Control system is also compatible with more traditional audio sources (DVD/CD player, cassette player, XM Satellite Radio, AM/FM tuner, LP player). The *StreamNet* technology incorporated in the *NetStreams MediaLinX™* automatically converts the audio in real time so that it can be streamed over TCP/IP for playback in any room of your *DigiLinX* system and learns and packetized its IR commands to be sent over TCP/IP for easy control of the source.

Internet Protocol (IP-Based)

Intelligence and Unprecedented Scalability

The *DigiLinX* IP-Based Multi-Room Audio / Video and Control system leverages TCP/IP (the same language as the Internet) to deliver audio digitally. The *DigiLinX* system incorporates a state-of-the-art meshed network architecture in which each product on the network has its own IP address and network intelligence, eliminating the need for costly matrix switches and central controllers. In addition, audio streams are multicast to provide scalability. *DigiLinX* virtually has no limit on the number of sources or number of rooms you can have in the system, so no matter the size or scale of your home, *DigiLinX* can deliver the performance you require.

StreamNet's suite of communication capabilities enables easy system configuration & concrete network reliability:

StreamNet incorporates a suite of communications conventions which reduce the system configuration time required and increase the overall reliability of the network. This section covers Service Discovery, Message Routing, and Status Reporting.

Service Discovery

Every feature or function of the *NetStreams DigiLinX* IP-Based Multi-Room Audio / Video and Control system is provided by a "service." There are many types of services – audio renderers, audio sources, general purpose input & outputs (GPIO), user interface, media server proxy, just to name a few. These services 'advertise' their existence to the network, broadcasting their name, type, IP-Address(es) and other important information. When *StreamNet-Connected* devices are plugged into the network, they immediately advertise their capabilities, reducing the need to program the entire system from scratch.

Message Routing



ASCII messages provide the primary method of control and status reporting for *StreamNet*. Every service has a name and optionally belongs to a “room” and /or some number of “groups”. Messages may be addressed to the service name, room name or group name. Messages may be sent multicast (UDP) or unicast (UDP or TCP) to any or all *StreamNet-Connected* devices. If required, *StreamNet* devices will forward messages to ensure delivery to the service(s) addressed.

Status Reporting

StreamNet services output unsolicited reports of their state and changes in state. Reports are in a flexible format that resembles XML. Each report is a list of “variable=value” pairs. Status reports may be sent unicast or multicast. In addition, a TCP client may “register” for status from one or more services and the *StreamNet* device will aggregate the reports onto the one TCP connection.

High Quality, High Performance Audio

Choose Between Uncompressed, Full Bandwidth Audio and MP3

Your *DigiLinX* Multi-Room Audio / Video and Control system can handle a wide range of audio sources, from uncompressed, full bandwidth audio to MP3 songs compressed at any sample rate. It is important to note that compressed music (like MP3, WMA, and others) is significantly different from uncompressed music (.WAV - also known as PCM) in sound quality, mainly due to the compression algorithms used.

MP3 is short for MPEG2 Layer 3 — a fancy name for the MP3 audio file format. MP3 audio is a specially formatted and heavily compressed computer file. Depending on sample rate, the audio quality can sound close, but not equal to that of a CD. An uncompressed audio file of 1 minute consumes nearly 11.25 megabytes (MB) of disk space. An MP3 file uses only about 1 MB of disk space for the same minute of audio. This reduction in file size has revolutionized the delivery of music, because it is now easier to transmit music over the internet. A song that would have taken almost an hour to download, depending on the Internet connection, can now be downloaded in about 6 minutes using an MP3 or WMA file. In exchange for a smaller file size, the listener sacrifices 70% of the data that holds what some describe as the 3-D characteristics of the audio data necessary to create staging, imaging, and rich audio texture.

An uncompressed .WAV music file contains all of the data found in a CD, without any compression or loss of data. This offers the listener the highest quality audio available from a CD.

To sample the difference between a compressed (MP-3) music file or an uncompressed (.WAV) music file go to the demo section of our website (www.netstreams.com) and listen for yourself!

Figure 2: MP3 Audio Signal Resolution

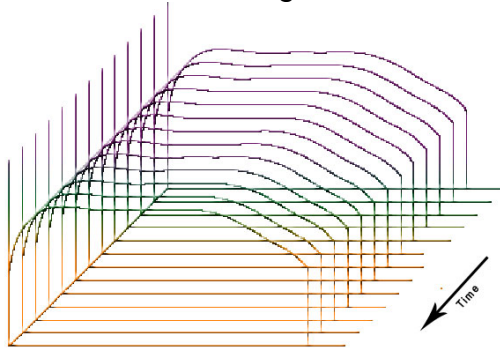
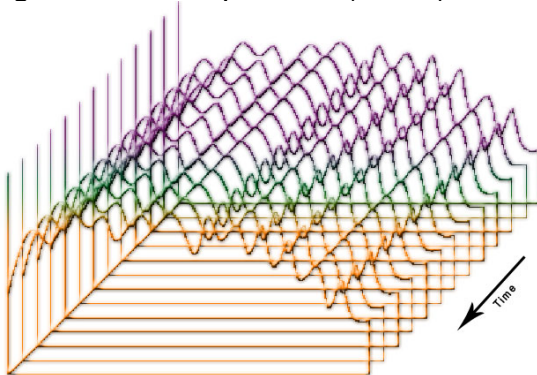


Figure 3: Uncompressed (.WAV) Audio Signal Resolution



Pure Digital Signal all the way to the Speakers

Digital Music provides the highest quality of audio since it's essentially a perfect copy of the digital tape from a recording studio. However, at the amplifier, the digital signal is converted to analog so it can be heard. A fundamental principle in audio is the longer the speaker wire, the more compromised the audio signal becomes, as losses can occur due to speaker wire resistance (regardless of the gauge). Besides losses due to cable resistance, longer cables begin to exhibit a significant reactive component of capacitance and inductance regardless of the wire gauge. When you do multi-room audio with longer cable lengths, the signal quality is compromised even more. The *DigiLinX* system maintains the quality of the signal by allowing the amplifiers to be located at the speaker or in the room, significantly reducing the length of the speaker wire required.

Figure 4: Pure Digital Signal all the way to the Speakers



High Quality Audio Components to Maximize Fidelity

The *DigiLinX* Multi-Room Audio / Video Control system incorporates high quality audio components to maximize sound quality. From Burr-Brown® 96kHz / 24-bit D/A and A/D converters to high quality Texas Instruments® and Apogee® Digital Amplifiers, you get the best audio performance possible from your source equipment.



WHITEPAPER

StreamNet™ Technology

INCLUDES
BB | Burr-Brown Products
from Texas Instruments

