



LINEAR ACOUSTIC

Multichannel Audio Processing
For Digital Broadcast

*StreamStacker*TM

Multichannel, Multiprogram Distribution System

Tim Carroll
Linear Acoustic Inc.
April 2005



The Linear Acoustic *StreamStacker*[™] system allows multiple audio versions of a single program to be transported and handled in a very cost effective and simple manner. Up to four 5.1 channel programs can be seamlessly transported over a single 20-bit AES pair¹ and passed straight to air by local stations with no need for re-encoding each program. A 16-bit AES pair can carry two 5.1 channel programs and two stereo programs. Local audio insertion and voiceover operations are supported via simple GPI contact closures or by RS485/422 remote control.

The *StreamStacker*[™] system is similar to the transport stream distribution model in place at the PBS and FOX networks, except it focuses solely on the audio portion, leaving the video to be sent at mezzanine compressed levels (i.e. around 45 Mbps). The system does not use any new audio coding schemes, but instead relies upon the well-established ATSC A/52 audio coding standard (commonly known as AC-3 or Dolby Digital). The process is based upon a very simple idea: AC-3 encode the audio and metadata once for each version of the program (i.e. one stream for English, one for Spanish, one for Visual Descriptive), then multiplex the streams together and distribute the composite stream to affiliate stations. The tricky part is handling the multiplexed stream once it arrives at the local station.

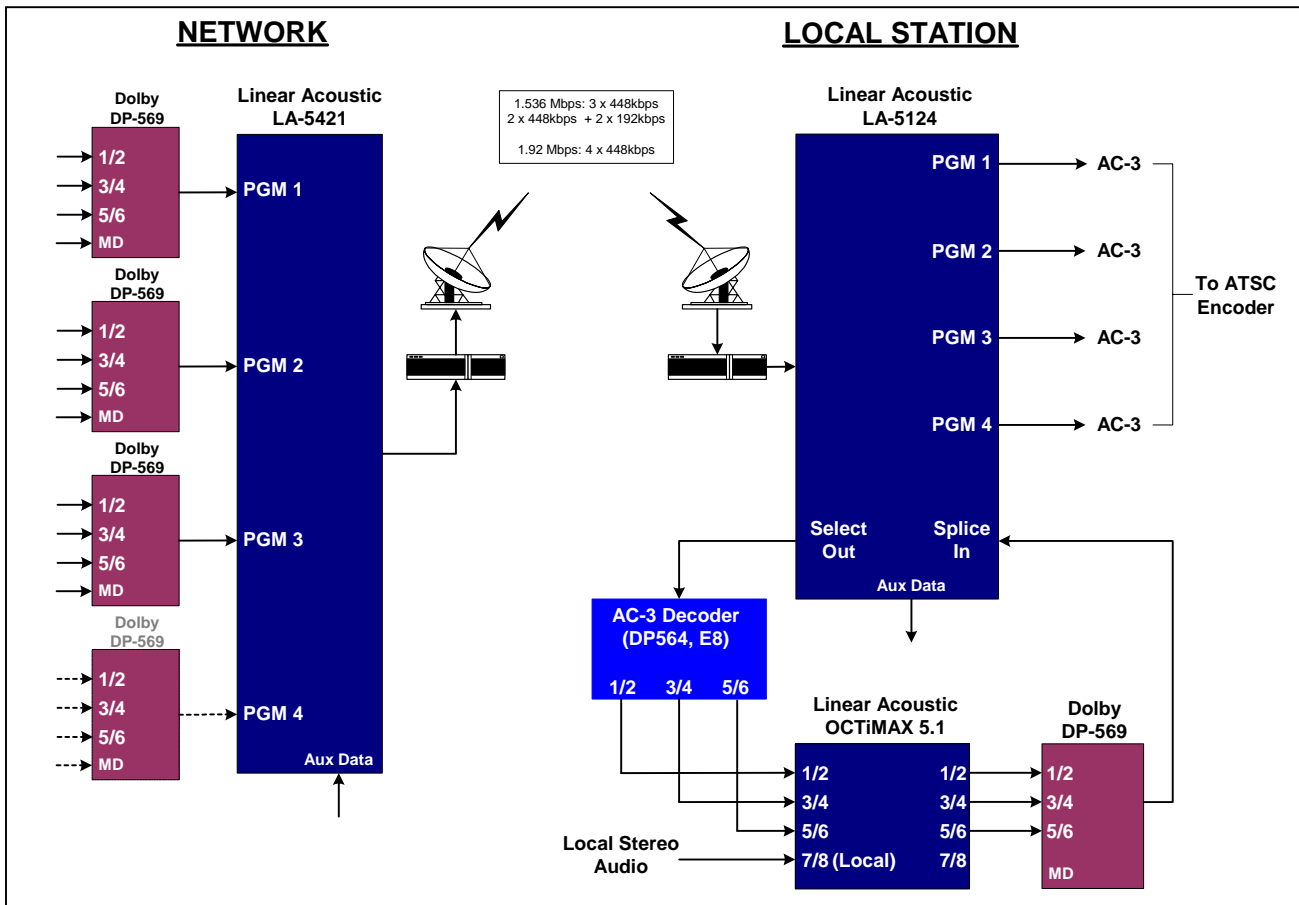


Figure 1 – *StreamStacker*[™] system block diagram showing network input on the left, and affiliate on the right.

Figure 1 is a simplified diagram of the *StreamStacker*[™] system, showing signal flow from a typical network through to the affiliate station. The classic approach has been to mezzanine encode the audio

¹ Any AES pair that conforms to SMPTE 320M (i.e. Dolby® E compliant) path will pass the *StreamStacker*[™] stream.

signals using a systems such as MPEG (in the case of NBC) or Dolby E (in the case of CBS), or even high-rate AC-3 (in the case of ABC). Each of these systems will accept multiple channels of PCM audio, and deliver them at a reduced rate to decoders, which are usually located at affiliate stations. In each of these systems, the audio must be decoded back to PCM before being passed on to the final AC-3 (Dolby Digital) encoder for transmission. There are several issues with this approach

The model LA-5124 is the first product developed for the *StreamStacker*[™] system and contains a de-multiplexer and a multi-input splicer. The unit accepts a multiplexed main input, two local AC-3 inputs, a DVB-ASI input, and produces up to four main program outputs. The LA-5124 will de-multiplex up to four incoming multiplexed AC-3 programs, frame synchronize them to the local reference, and output them via their corresponding program outputs. Any of the other inputs (Local A or Local B) can be silently spliced in place of any or all of the main programs. Future updates will allow any of the programs or local inputs to be inserted into any existing PID present in the input DVB-ASI stream, as well as for multiple programs to be mapped to multiple existing PIDs.

The next page shows the front and rear panels of the LA-5124. The unit has dual redundant power supplies (not generally field replaceable due to UL requirements), which are auto-ranging and support worldwide operation. Remote control is provided by simple GPI/O or via an RS232/485/422 serial connection.

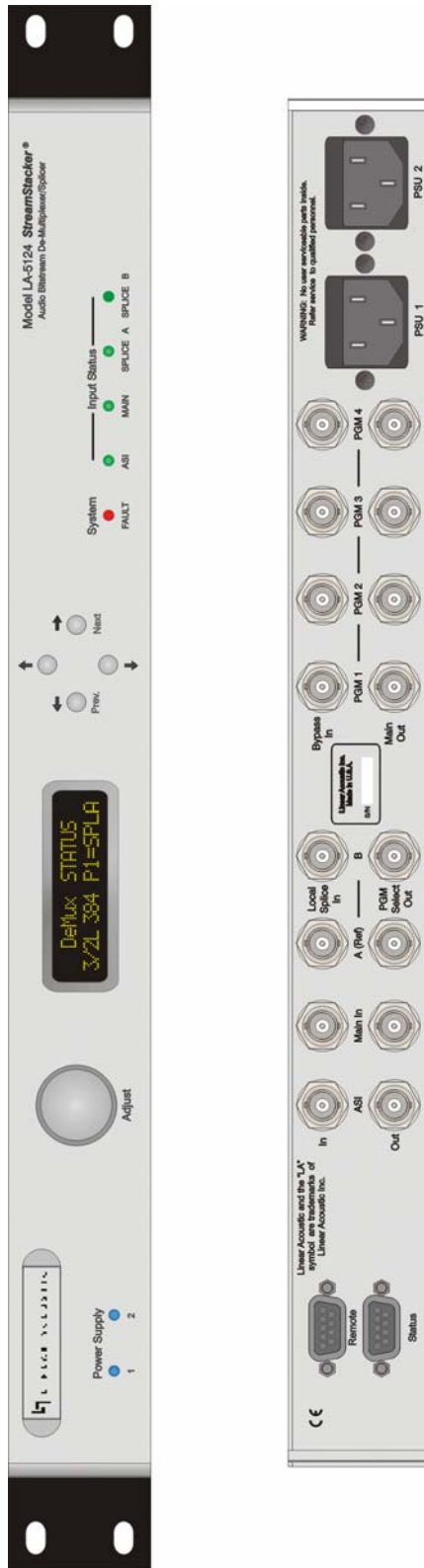


Figure 2 – Front and rear panel views of the Linear Acoustic StreamStacker™ LA-5124 De-multiplexer/Splicer.

Normal operations such as voiceover and local audio insertion need to be supported, and these operations need to be simple to execute. Any of the multiplexed AC-3 programs delivered from the network can be output from the LA-5124 via one of two Select Outputs, externally decoded, processed by a Linear Acoustic OCTiMAX 5.1, then Dolby Digital (AC-3) encoded and passed back into the system. The LA-5124 maintains proper timing and lip sync via internal adjustments.

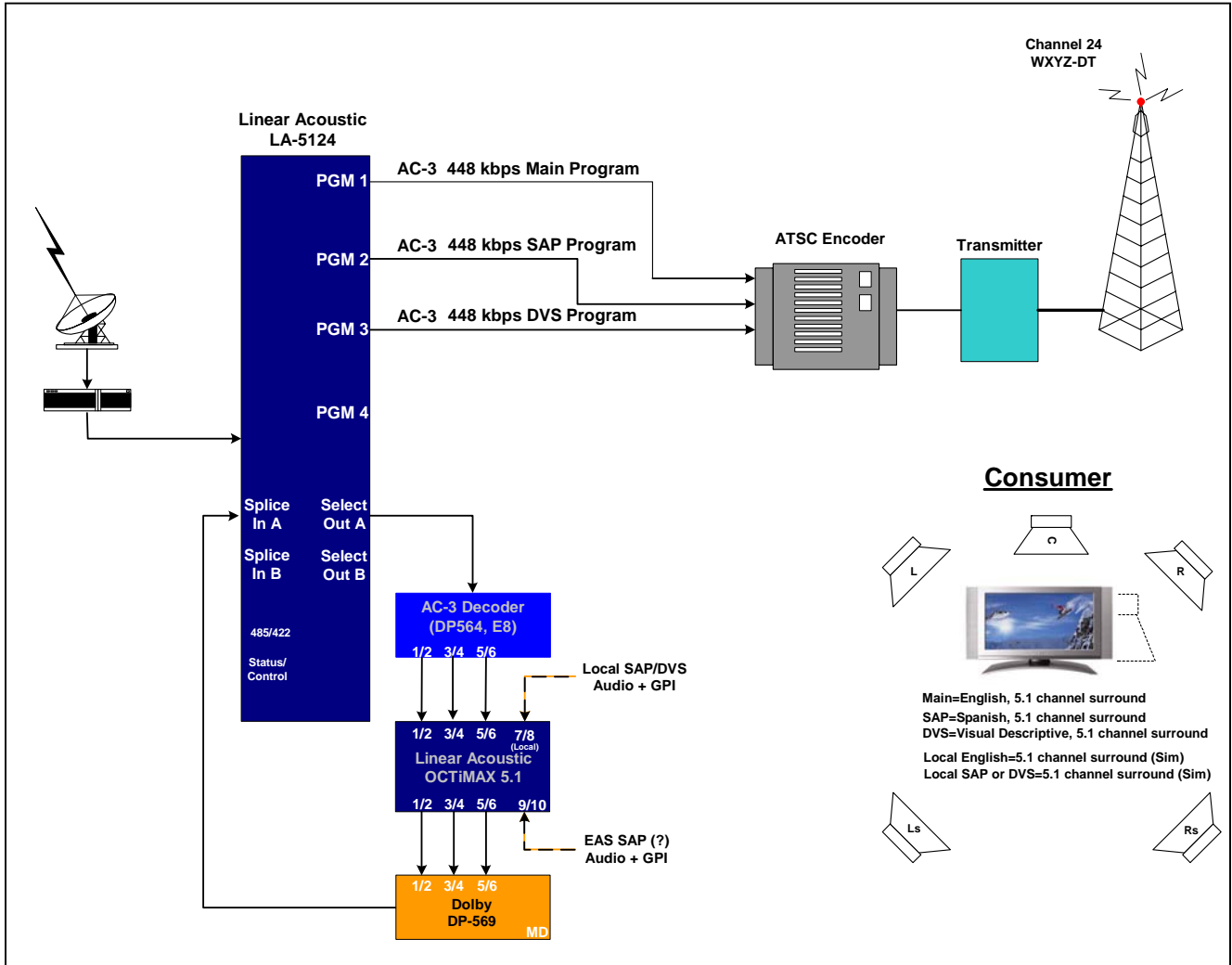


Figure 3 – Advanced implementation of the Linear Acoustic *StreamStacker*™ system.

Local audio is applied to the Linear Acoustic OCTiMAX 5.1 Digital Television Audio Processor to manage the short term loudness and metadata for local audio, and even allow the local audio to be used as a source for a network voiceover. This product also contains a selectable two-channel to 5.1-channel upmixer called upMAX which allows local stations to easily provide a top-quality audio experience for DTV viewers even when not carrying network programming. More information on the OCTiMAX 5.1 can be found at www.LinearAcoustic.com.

An additional important feature of the *StreamStacker*[™] system is its ability to create a signal that is fully compatible with standard AC-3 decoders. This allows any affiliate station that does not initially install the Linear Acoustic LA-5124 to get a 5.1 channel network program on the air. With some HD encoders and multiplexers, it is possible to apply both PCM and AC-3 streams to its inputs, internally encode the PCM to AC-3 and switch between the internal and external streams. Although transitions between local and network programming will be unpredictable and will very likely cause artifacts due to this asynchronous switching of streams, it will keep audio signals on-air until a station is able to add the proper equipment.

The *StreamStacker*[™] system has been deployed and is in regular use at the WB network. Any network that has the desire to distribute multichannel audio to their viewers can benefit from this technology. The system provides unprecedented economy at the local station level, especially as additional audio services are rolled out. Further, the level of complexity for the carriage of multiple multichannel audio programs has been reduced to a manageable minimum as metadata and individual audio channels need not ever be exposed to operators.

Many other advantages can be gained by working in the so-called compressed domain, and additional features and applications of the technology are forthcoming. As always, we are happy to hear suggestions and answer any questions. Please contact the author at tim@LinearAcoustic.com.