Selenio™ Media Convergence Platform

Advanced Audio (including Loudness Management)

Application

It can be difficult in today's complex infrastructures to maintain a high-quality "sound" across the audio workflow, as broadcasters must juggle stereo and surround sound, as well as compressed and embedded audio. The issue of loudness management only adds to the complexity, and as the number of channels has increased, so too has the number of viewer complaints regarding volume levels. Whether it be channel-to-channel inconsistencies or program-to-advert transitions, large variations in perceived loudness have left many consumers shouting for change.

In an effort to address the loudness problem, the International Telecommunications Union devised the ITU-R Rec. BS.1770 recommendation for loudness measurement. With this recommendation, it is now possible to measure/control perceived loudness prior to transmission and provide consistent loudness between channels, programs and advertising breaks. Other recommendations and legislation are pending in various parts of the world.

As broadcasters work within this multiple-format world of audio, it is not just the loudness that needs to be managed, but the whole area of advanced audio. Ideally, broadcasters should be able to process any audio format associated with a video feed to meet the recommendations. From loudness control and Dolby® encoding and decoding to upmix, downmix and multimerge, solutions that address every aspect of advanced audio processing are best-suited to help broadcasters navigate the complex world of audio management – and ultimately, keep their viewers from switching the dial.

Business Challenge

In recent years, audio has become exponentially more complicated, from multiple-language versions to 2.0 and 5.1 surround sound. An integrated audio management solution is best, as loudness typically constitutes only a portion of the necessary audio processing requirements.

For broadcasters, the real challenge is to seamlessly integrate advanced audio and loudness control functionality into their existing workflow in as flexible, simple and cost-effective way as possible. However, as the number of channels increases, so too does the inherent complexity of an advanced audio and loudness solution. Key questions broadcasters are facing include: How do I move to 5.1 surround sound cost-effectively? At what point do we drive for loudness-corrected content? Do we accept that regardless of the source of the content it is the broadcaster's ultimate responsibility that the ITU recommendation is adhered to at the consumer interface? At what cost do we implement loudness management? Is the dynamic range of the content or how the audio has been engineered allowed to be modified or sacrificed to meet current standards?

With respect to advanced audio and loudness management, key goals of broadcasters include:

Drive Revenue Growth

In a market speeding toward total media convergence, generating incremental revenue by adding specialty side channels, mobile services, etc., is critical to survival for today's broadcaster. The challenge is in how to cost-effectively implement an infrastructure that will enable the rapid deployment of revenue-generating new services today, while also ensuring the infrastructure can support wherever the business is headed tomorrow. This also includes the implementation of recommendations, standards or directives that will influence the choice and deployment of infrastructure architectures. Loudness and advanced audio functions, such as Dolby processing, are relevant here as they must be implemented for both existing and new services.

Control Costs

The goal of any new technology is to allow implementation in as cost effective a way as possible. The infrastructure itself should be inherently future proofed, minimizing costs for future deployment of additional solutions or services.

Maintain On-Air Quality

Audio signals must be modified in order to meet current requirements. The real challenge is to correct the audio while maintaining the integrity of the audio mix created for the programming.

Enhance Flexibility

In today's environment, content can be created, managed and distributed in multiple formats. The associated audio can be encoded in multiple formats and mixed in different ways. Advanced audio processing and loudness management are best handled via a flexible platform that minimizes the workload in this dynamic environment.

Save Operator Time

Engineers are faced with headaches when dealing with upgrading old cards or updating firmware. Intelligent management of firmware is ideal, and broadcasters are best served via solutions in which the frame will, for example, automatically recognize and upgrade the cards.

Technology Solution

Imagine Communications developed the Selenio™ media convergence platform to simplify multi-distribution workflows, making it ideally suited to address the challenges faced by today's broadcasters for advanced audio processing and loudness management.

Selenio combines traditional baseband video and audio processing, compression and IP networking features — all in a single 3RU frame. By integrating many of the processes that would traditionally be done in a number of different AV processing cards, Selenio offers high levels of functionality and flexibility in an operational environment. With Selenio, up to 28 channels of high-density, baseband video processing, including up-, down- and cross-conversion and synchronization, can be hosted in one space-saving frame. Selenio conversion modules can create the desired output format regardless of the input video format, following AFD and other cues to manage aspect ratio in the process. These modules, in combination with the advanced audio processing options, offer a single or universal high-density video and audio processing solution.

As part of the baseband video processing modules available in Selenio, each card has an option for an advanced audio processing module. This processing module uses DSP technology to allow multiple, sequential audio processing functions to be carried out on the same module, including:

Dolby encoding/decoding

- Dolby E
- Dolby AC-3

DTS Neural Surround™ processing

- UpMix (2.0 -> 5.1/7.1)
- DownMix (5.1/7.1 -> 2.0)
- MultiMerge (2.0 or 5.1 -> 2.0 and 5.1)
- Loudness control (2.0/5.1)

By allowing the combination of many of the common audio processes together on a single module, Selenio enables:

1. A reduction in the number of physical processing cards required

   a. By allowing the integration of multiple advanced audio processes in a single module, the need for a multiple-card solution is reduced or eliminated.

   b. Each advanced audio module has 4x audio processing engines that allow multiple, sequential processing.

Advanced Audio Processing (AAP)	AAP1	AAP2
	AAP3	AAP4
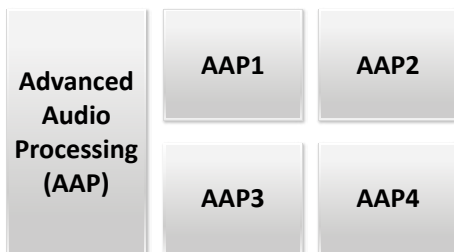
In this routing block, each block can be used to provide a different function or multiple advanced audio functions.

AAP1: Dolby E decoder

AAP2: DTS Neural Surround MultiMerge (5.1) + Loudness

AAP3: Dolby AC3 encoder

AAP4: Not required for this configuration

2. Simplified implementation of a loudness solution

   a. With a single-card solution, there is no need for wiring between cards.

   b. For high-density applications, prior to distribution to a head end, the embedded audio in the video services can be processed through a bank of Selenio cards to provide whatever processing is required.

3. Increased flexibility

   a. Requirements change, and via a Selenio advanced audio solution, the simple application of additional licenses allows the same hardware to be repurposed.

   b. A simple GUI allows intuitive configuration.

Business Value

By integrating multiple audio management processes together on a single module, Selenio provides a space-saving, energy-efficient solution that enables broadcasters to easily and cost-effectively support content from multiple sources and deliver it to multiple platforms.

Drive Revenue Growth

The Selenio platform enables customers to implement an infrastructure that will enable the rapid deployment of revenue-generating new services today, while also ensuring the infrastructure is adequately future-proofed to support emerging technology trends. With Selenio, loudness management and advanced audio functions, such as Dolby processing, can be quickly implemented for existing and new services.

Revenue growth is tied to the ongoing upgrade path from SD to HD. In today's traditional workflow, additional hardware is required to move from an SD to an HD service. In a Selenio environment, the migration from SD to HD only involves additional licensing or configuration for HD functionality.

Control Costs

Selenio enables significant cost savings throughout the product lifecycle. Unmatched density means fewer rack units and lower initial capital outlay. Less hardware and cabling means lower installation costs. Ultra-green technology means lower operating costs. Fewer modules mean lower maintenance costs. And software license options mean lower upgrade costs as business requirements change.

Maintain On-Air Quality

Selenio modules can be fitted with DTS Neural Surround™ MultiMerge audio processing technology, which provides a clean 5.1 channel audio mix for air, even when the source is dynamically switching among 5.1 and stereo.

Selenio audio processing modules are also available to monitor incoming audio and dynamically adjust loudness. With legislation pending requiring broadcasters to maintain signal loudness within certain specified bounds, Selenio provides a solid technical solution to remaining in compliance — regardless of the source audio in the programming or commercials.

Enhance Flexibility

With a full suite of integrated functionality, Selenio advanced audio processing modules offer the most compact, flexible processing solution in the broadcast industry today. In a single, dual-channel processing card, a single input source can be processed independently in each channel.
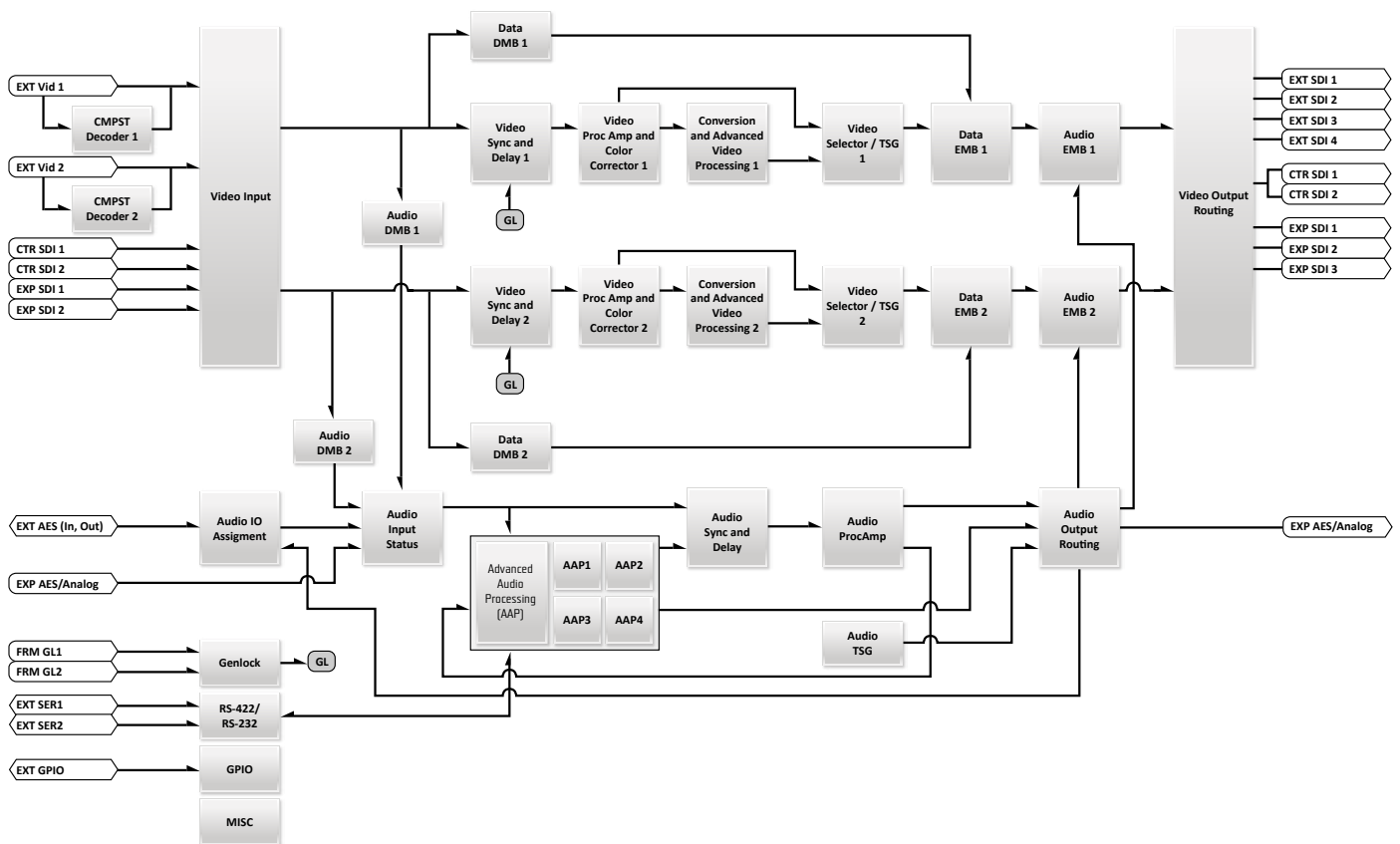
Save Operator Time

Intelligent management of firmware and configuration codes allows the Selenio solution to ease the burden on engineers to manage spares inventory and maintain the cards at the current or latest code releases. In the Selenio solution, the intelligence resides on the frame controller cards, which detect the replacement of a card in a frame and automatically upgrade both the operational code and configuration settings to match the failed or removed card — without any input from an operator.
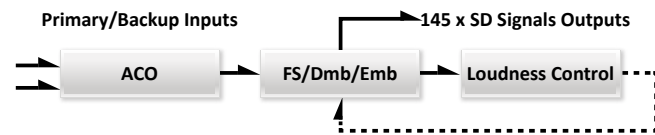
The Selenio Difference

When it comes to choosing advanced audio processing solutions in today's challenging market, reducing total cost of ownership is still top on the list of priorities. How does Selenio stack up in real-world terms?

In a typical, multichannel broadcast environment, there will be multiple channels that require a loudness solution. In the example below, we compare a traditional, modular solution vs. the Selenio solution. In this case, the customer is looking for a loudness solution for 145 SD channels with 2.0 embedded audio, and 20 HD channels with Dolby E 5.1 encoded channels, with signal protection on the front end (via automatic changeover). The diagram below illustrates the use of traditional modular blocks in creating a solution for both the SD and HD channels.

Typical Modular Solution

1- 145 channels SD + 2.0 Loudness Control

Primary/Backup Inputs   **145 x SD Signals Outputs**

ACO → FS/Dmb/Emb → Loudness Control

2- 20 channels HD + 5.1 Loudness Control

Primary/Backup Inputs   **20x HD Signals Outputs LC 2.0 and 5.1 mix and Dolby Dec/Enc**

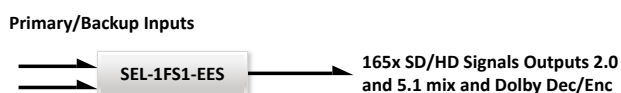ACO → FS/Dmb/Emb → Dolby Decoder → Loudness Control → Dolby Encoder

Each workflow in the diagram above uses a set of typical, modular cards to deliver the solution. For the HD solution, an ACO (automatic changeover) card provides protection on the input between a primary and backup signal. This is preceded by an audio de-embedder card, a Dolby decoder, a loudness control processer, and a Dolby encoder, which finally feeds an embedder to re-create the original signal after the loudness correction has been applied.

This is repeated for the SD channel (without the Dolby functionality).

In contrast, the Selenio solution eliminates the need for a multiple-card solution, as all of the required processing functionality is available in a single card.

Selenio Solution

Primary/Backup Inputs

SEL-1FS1-EES → **165x SD/HD Signals Outputs 2.0 and 5.1 mix and Dolby Dec/Enc**

The intelligent design of the Selenio processing modules allows a card (licensed for single-module operation) to provide ACO functionality on the inputs. All advanced audio functionality can be performed within the card.

The table below summarizes the costs and metrics for each (the traditional model and the Selenio solution).

Summary	Traditional	Selenio	% Saving
Size	102 RU	36 RU	64%
Cost	€1,800,000	€1,000,000	43%
Upgrade Cost	€12,000	€3,000	75%

Some key points to note regarding the Selenio design (which are not specifically highlighted or accounted for in the numbers) are:

1. Design costs — Selenio offers a very simple design model (one module licensed to do as required)

2. Commissioning costs — fewer modules mean fewer man hours required.

3. Upgrading a service from SD stereo loudness control to HD surround sound loudness control is very simple and cost-effective. Users wishing to replace an existing SD service with an HD service with surround sound will have to replace/add additional cards using the traditional design. With Selenio, it is just a simple case of adding licenses. As a simple illustration of this, observe the hardware difference between the SD and HD processing workflows on page 6. With the Selenio solution, it is only the configuration and licensing that define the SD/HD capability.

4. A built-in, intuitive Web-based interface — the first on the market to feature functional block diagrams — simplifies how operators set up connections by graphically mapping out each link and highlighting how signals are routed through the frame. Based on Microsoft® Silverlight® technology, the Selenio GUI enables operators to easily configure, monitor and manage the platform's advanced audio capabilities.

5. Spares inventory — fewer modules in the design mean less costs. Intelligent, integrated spares management reduces the burden on engineers to actively manage their inventory.

The following example further illustrates how combining Selenio video and advanced audio processing results in one of the most compact and powerful solutions available today:

Using a dual-channel HD Selenio conversion card, we can provide both an SD and HD output with different audio format requirements — in adherence to the ITU loudness recommendation.

Selenio XD Dual-Channel Card
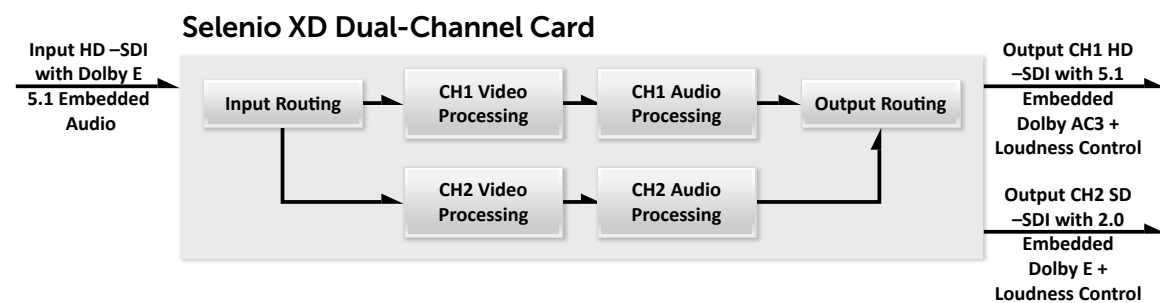
The diagram above shows the universal processing that Selenio offers for both video and advanced audio processing. In a traditional, modular environment, a solution for the above functionality would require a combination of the following cards to achieve the same result:

- Distribution amplifiers
- Downconverter
- Audio de-embedder
- Dolby decoders
- Dolby encoders
- DTS Neural Surround DownMix
- DTS Neural Loudness Control

And, all of these cards would need to be managed, installed and configured.

The unique, integrated architecture of Selenio allows all this processing to be performed from a single interface.

Summary

In summary, the Selenio media convergence platform delivers a true, universal processing tool for today's advanced audio and loudness management requirements — providing enormous savings in space, power, cabling and general operational complexity.

With Selenio, broadcasters can start small, and then easily and cost-effectively add services over time. Begin with a single-channel processing product. Simply add keys to add channels. And, as loudness standards and legislation become the norm, all that's needed is to purchase a license.

From Dolby encoding/decoding to upmix, downmix, multimerge and loudness control, the Selenio media convergence platform is designed to provide all of the tools necessary to meet today's advanced audio processing and loudness management demands — easily and cost-effectively.