# Selenio™ Media Convergence Platform

ATSC Head-End and Transmission Application

## Application

Today's ATSC broadcasters are in the midst of a significant transition, migrating from the traditional function of creating and distributing one version of one channel to one delivery system, to a new world of delivering multiple versions of multiple channels through many delivery systems. The simple days of a single analog channel are gone forever.

ATSC broadcasters do more today than meet the demand for direct, over-the-air viewership. The digital multiplex bit-stream they produce is also used by various service providers as the programming handoff mechanism for connecting the local station into their delivery platform. In addition, the emergence of ATSC Mobile Digital Television (DTV) is putting extra importance on the terrestrial broadcast footprint of the local market station, since the mobile DTV signal is uniquely received over the air.

Today, a typical ATSC broadcaster might have three programming channels that must be prepared for distribution: for example, two HD entertainment channels and one SD news/weather channel. Outputs are required for an ATSC terrestrial transmitter, local cable head-ends, an IP mobile feed for ATSC Mobile DTV and IP feeds for in-plant monitoring, as well as Internet distribution feeds. To complicate things further, various configurations of audio are required for the different feeds.

Breaking down the workflow details for each delivery platform in this example illustrates the complex requirements of a typical ATSC video head-end (VHE):

- **Signal Preparation** — Video signals from the plant arrive as HD-SDI. The video requires format and aspect ratio conversion for some delivery systems, as well as the associated reformatting of captions and other ancillary information in the video signal.

  Audio signals arrive as 5.1 or stereo only, depending on the source. Playout and Master Control use Dolby® E to facilitate the multichannel audio. At this end of the chain, the Dolby E must be decoded to PCM. A consistent 5.1 upmix of the audio and a stereo downmixed version are produced; these are subsequently loudness managed for CALM-act compliance. Visual Description Service (VDS) audio is also processed for each program.

- **Over-The-Air Transmitter Feed** — A heavily compressed statistical multiplex is used to fit the two HD and one SD signals into the ATSC modulator, while leaving room for a mobile service. The HD programs for the OTA transmission are cross-converted to 720p to optimize picture quality at this high-compression ratio. MPEG-2 encoding with Dolby® Digital audio is used.

- **Over-The-Air Mobile Transmission Feed** — To create the mobile feed, the source video is down-converted and the 5.1 audio is downmixed into stereo. CALM-compliant loudness control is applied on all audio signals in this transmission multiplex. This feed uses H.264 video encoding and AAC audio.

- **CATV Head-end Feed** — As delivery to the local cable operator is not constrained by the same bandwidth limitations as the OTA transmitter, many stations today create an alternative multiplex with a lower compression ratio. In our example, while the HD programming on the OTA channels is in 720p, the cable delivery is in 1080i format.

- **In-Plant Monitoring Feed** —Traditionally, an analog in-house CATV enabled everybody in the building to watch the air signals. Today, an IP version of the feed, suitable for decoding on desktop PCs, is another version to be generated from the TX room.

- **Internet Distribution Feed** — Increasingly, a live feed of the station is put online for online viewers. H.264 video with AAC audio also is used for this feed.
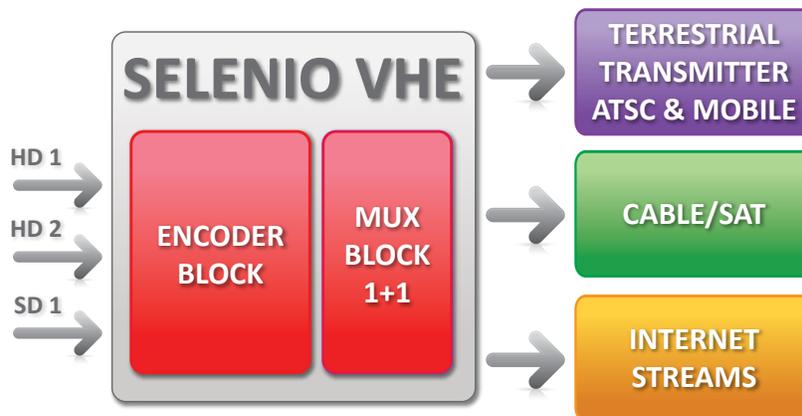


## Business Challenge

Today's viewers expect to receive their content over every delivery platform — appropriately branded, edited and conformed. Call it multiplatform or multiscreen delivery, today's broadcasters are challenged with having to provide more program feeds in more formats — as well as determining the best distribution techniques for each channel on each delivery system.

Following are some of the specific business challenges ATSC broadcasters face today:

**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.

**Control costs**
With increasingly competitive content and advertising models turning up the pressure on broadcast budgets, the ability to add new services without driving operating expenses through the ceiling is key.

**Maintain on-air quality**
In addition to the costs associated with producing secondary and tertiary channels, their existence puts additional performance strain on the transmission encoder to maintain picture quality, while simultaneously pushing more content down the chain than ever before. The constant pressure-point in planning changes to an ATSC transmission lineup is the trade-off between picture quality and the number of channels that can be transmitted in parallel.

**Avoid downtime**
The transmission air-chain is the lifeline between the content and the viewer, even when the viewer is ultimately viewing the signal over satellite, cable or IPTV. At the video head-end, the ATSC encoder/multiplexer equipment is a critical path item in the air-chain of the station. If the encoder or multiplexer is down, the station is off the air. If the air-chain is down, nothing else matters but getting the signal back on the air. Lost commercial revenue is never replaced.

# Technology Solution

Imagine Communications developed the Selenio™ media convergence platform to simplify multi-distribution workflows, making it ideally suited to address the challenges faced in today's ATSC head-end applications.

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 of the ATSC transmission chain into a unified, high-capacity platform, a single Selenio frame can handle the needs of an entire multichannel transmission path, including redundancy management.

Selenio brings numerous operational benefits to each process in the video head-end workflow:

### Signal Preparation

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.  In addition, virtually any advanced audio capability can be mixed and matched on a single module.

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 can also be fitted with DTS Surround Sound™ 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, stereo and mono inputs.

Selenio audio processing modules are also available to monitor incoming audio and dynamically reduce loudness.  With the CALM act now requiring U.S. 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.

### Encoding for Transmission

With Selenio, MPEG-2 and H.264 compression standards are supported from SD and HD to 3 Gb/s and mobile. Hybrid applications such as decoding an incoming compressed, contribution-quality stream, converting it to the required HD format and re-encoding it for consumer redistribution are easily managed all within a single Selenio platform.

With motion-compensated temporal filtering (MCTF) advanced video pre-processing and an integrated, closed-loop statistical multiplexing capability, Selenio encoders are engineered from the ground up to produce a superior ATSC bit-stream.

### Multiplexing for Transmission

The outputs of the various channel encoders are routed to the Selenio multiplexer module to prepare the final bit-stream for transmission.  Incoming programs can be readily repurposed into new programs; local content (commercials, news and more) can be easily added to existing programs; and new transport streams can be quickly generated.

The unique internal communication fabric in the Selenio platform enables content to be easily routed from a variety of sources, including MPEG-2 and H.264 encoder modules, various internal network interfaces such as DVB-ASI, and incoming transport streams from Gigabit Ethernet — with no external cabling required.

The multiplexer is in constant high-speed communication with each encoder, consolidating look-ahead information and planning the bitrate allocation within the channel.  This allows the system to steer the available bitrate to the programs that need it the most at any given time.

## Business Value

By converging compression, processing and networking technology into a single platform, Selenio provides a space-saving, energy-efficient solution that enables ATSC broadcasters to easily and cost-effectively support content from multiple sources and deliver it to multiple platforms.

### Drive new revenue

The Selenio platform's unique modular architecture enables ATSC broadcasters to rapidly deploy new capabilities and services as the business without replacing infrastructure. Seamlessly handling existing and hybrid applications, the high-performance, streamlined platform enables numerous revenue-generating possibilities — including HD, 3D, Internet, Mobile — with no disruption to the bottom line.

### 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

The evolution of the mobile service and the addition of side-channels both put pressure on the transmission encoder to deliver a great picture on several channels at the same time in the same constrained quantity of bandwidth to the home.

Selenio transmission encoders provide the latest in compression technology, ensuring exceptional picture quality at the low bitrates that enable multichannel broadcasting within the precious ATSC spectrum.

### Avoid downtime

Downtime is not only an embarrassment, but also a financial disaster. Viewers are fickle and quickly change channels, watching ads from a competing station.

With Selenio, every element of the air-chain can be backed up with N+1 redundancy. The platform provides integrated, seamless signal redundancy with full redundant configurations across processing, compression and routing for critical broadcast paths. In addition, a built-in, highly intuitive, Web-based interface enables operators to easily monitor and troubleshoot the entire system — significantly reducing the chance of error.

## WEAU-TV

During a major snow storm, the 2,000-foot tower for Gray station WEAU-TV, an NBC affiliate serving the greater Chippewa Valley in the central Wisconsin market, fell to the ground.

In a gesture of goodwill toward its broadcasting neighbor, local ABC affiliate WQOW-TV provided a slice of its over-the-air digital channel to return WEAU to the airwaves over a temporary transmission system. Imagine Communications supplied its new Selenio media convergence platform for the digital signal processing (MPEG encoding and statistical multiplexing) within the temporary system.

"Imagine Communications shipped us one of the first systems out of the factory," said Jim Ocon, vice president of technology for Gray Television. "The signal quality has been exceptional, and since we were broadcasting over WQOW's spectrum, they were actually getting calls about how much the video quality improved for both stations. It was an unusual way to test a new product, but in doing so we discovered something that works great."

Ocon added that the temporary transmission site looks "very professional," and the station is in the process of rebuilding its antenna and returning to its Channel 13 assignment from the temporary studio tower — with Selenio still part of the picture.

"We see many other benefits from using this in the workflow, including audio processing and loudness management, which is a big deal with the passage of the CALM Act, which requires the regulation of audio loudness in TV commercials," Ocon continued.

"Imagine Communications came to town and got us back on the air, but the slam dunk was getting Selenio installed."

## The Selenio Difference

While technical, operational and business objectives abound, when it comes to choosing video head-end infrastructure 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?

Let's take another look at our "typical" ATSC broadcaster: Using traditional broadcast equipment with at least a degree of redundancy, what kind of infrastructure investment would our broadcaster have to make to support his multichannel, multiplatform business?
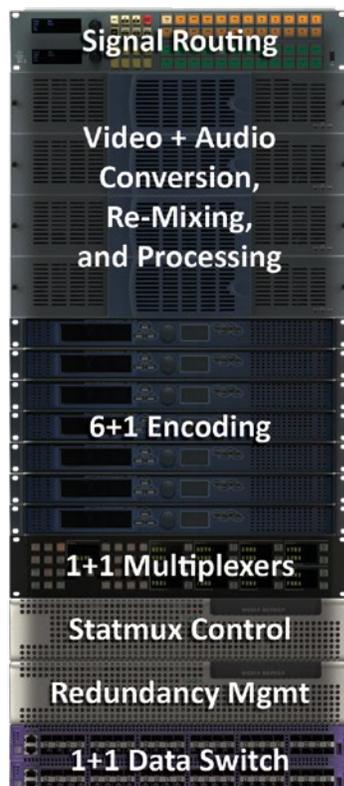
With traditional broadcast equipment:

- 45 separate functional items are required (including frame syncs, video format/aspect convertors, Dolby® E decoders, loudness processing, a variety of video and audio compression encoders and multiplexers, IP processors, Ethernet switches...)
- Power consumption is around 2500 watts
- Rack space required is a total of 25RU
- More than 130 cables connect the complex infrastructure
- Configuration, management and monitoring of all this equipment present an additional operational challenge

With Selenio:

- All 45 functions are consolidated into a single, high-density, integrated platform
- Power consumption is reduced from 2500 watts to 600
- Rack space is reduced from 25RU to 3RU
- Cables are reduced from 130 to 14
- A built-in, intuitive Web-based interface — the first on the market to feature functional block diagrams — enables operators to easily configure, monitor and manage the platform's advanced capabilities and simplifies the overall workflow.

Taking the functional convergence mindset of Selenio, all the video head-end functions (see Page 1) are consolidated into a high-density integration platform. Space, power, cabling and operational complexity are reduced by 75 percent. There is no reason to waste the equipment cost or real estate when a practical alternative is finally at hand.



**Signal Routing**

**Video + Audio Conversion, Re-Mixing, and Processing**

**6+1 Encoding**

**1+1 Multiplexers**

**Statmux Control**

**Redundancy Mgmt**

**1+1 Data Switch**

## 45 Functional Items

**Before**
25RU of Space
2500 Watts
131 Total Cables

**After**
3RU of Space
600 Watts
14 Total Cables

88% Less Space
75% Less Power
80% Less Wiring

## Summary

In summary, the media convergence platform is a true "anything in, anything out" tool for today's ATSC head-end — providing enormous savings in space, power, cabling and general operational complexity.

With Selenio, broadcasters can start small, then easily and cost-effectively add services over time.  Begin with a single-channel processing product.  Add keys to add channels.  Plug in different multiplexers.  Create transport screens.  The CALM act is suddenly in your lap? Just buy another license.  Want to try a mobile network?  No problem.  No new cabling, infrastructure or installation necessary.  And if the venture doesn't work, the initiative will not have broken the bank.

The Selenio media convergence platform is designed to be the next generation of infrastructure for the 22nd century video head-end.