modulus video

White Paper
Modulus Receiver Encoder

Modulus Receiver Encoder – MRE2000

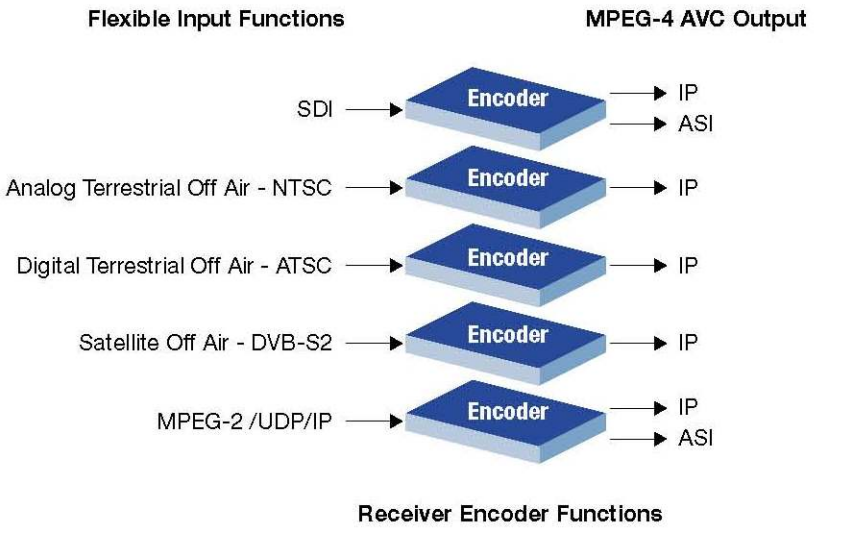
Overview

This white paper introduces the revolutionary Modulus Receiver Encoder (MRE) and describes how it dramatically streamlines television headend architectures. The MRE platform is based on proven internet protocol (IP) technology incorporating receiver, demodulation, decoding and MPEG-4 AVC encoding functionality into a single one rack unit platform. The MRE is SD or HD capable. It streamlines television headend architectures by reducing complexity, simplifying signal routing while enhancing reliability. The MRE is a flexible and robust technical solution enabling substantial reductions in both capital and operating expenses while improving the quality of television services. The MRE represents the future of how service providers will aggregate and distribute their most valuable video content.

Modulus Receiver Encoder Benefits

The MRE2000 family incorporates receiver functionality into a single one rack unit platform. This can eliminate the need for the external receivers and baseband processing equipment normally required at a headend. Integrating the receive functions into the encoder does more than reduce box count, it also simplifies the signal routing of the headend architecture. Enabling the ingesting MRE to simply re-tune to the desired feeds removes the requirement for an AV switch. The MRE also offers to receive compressed streams over UDP/IP. This configuration, based on virtual IP connections at both input and output of the MRE means that the encoder becomes an IP connected appliance and therefore simplifies installation, management and reconfiguration.

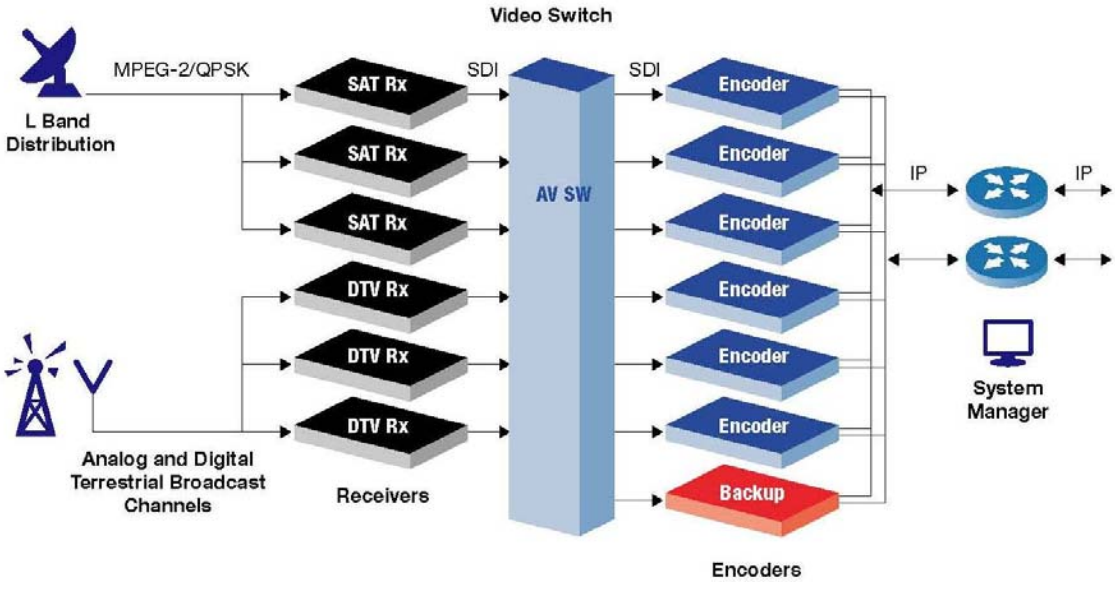
The following sections illustrate how the MRE can dramatically simplify architectures.



Applications - General

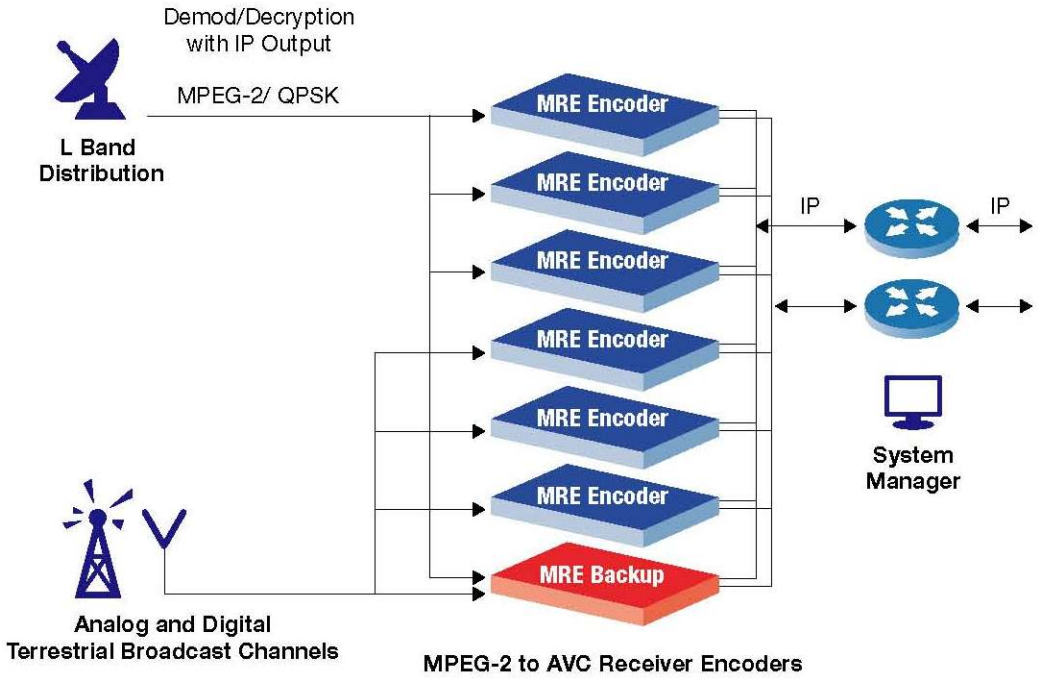
Consider a traditional headend architecture.

Traditional Architecture



The next diagram illustrates the principle of how the MRE simplifies the architecture by removing the receiver elements and the AV switch.

MRE Enhanced Architecture



The following sections expand on the application detail.

Applications – NTSC and ATSC Terrestrial Reception

The MRE **NTSC** receive functionality simplifies both US DTH and IPTV systems. In this application, an on board tuner will select an NTSC RF channel and the NTSC stereo audio and secondary (SAP) audio are separated along with the ancillary line 21 and XDS closed caption data.

This implementation incorporates a ghost cancellation features found only on the most high end receivers. When a GCR reference pulse is included in the signal the MRE can recognize multi path distortion and adaptively apply an inverse transform to deal with multi-path signal anomalies that typically cause ghosting effects.

In more detail, the MRE recognizes when the ghost cancellation reference (GCR) is present and can use this to compensate for multi path signal anomalies that are causing ghosting effects. The GCR reference is a multi frequency chirp signal (Bessel pulse chirp signal) that is broadcast in the US on vertical blanking line 19. This GCR signal reference is used in the receiver for calculating the adjustable weighting coefficients of a ghost-cancellation filter that is then applied to suppress the ghosts. The GCR signal is standardized by the ETSI standard ETS 300 732.

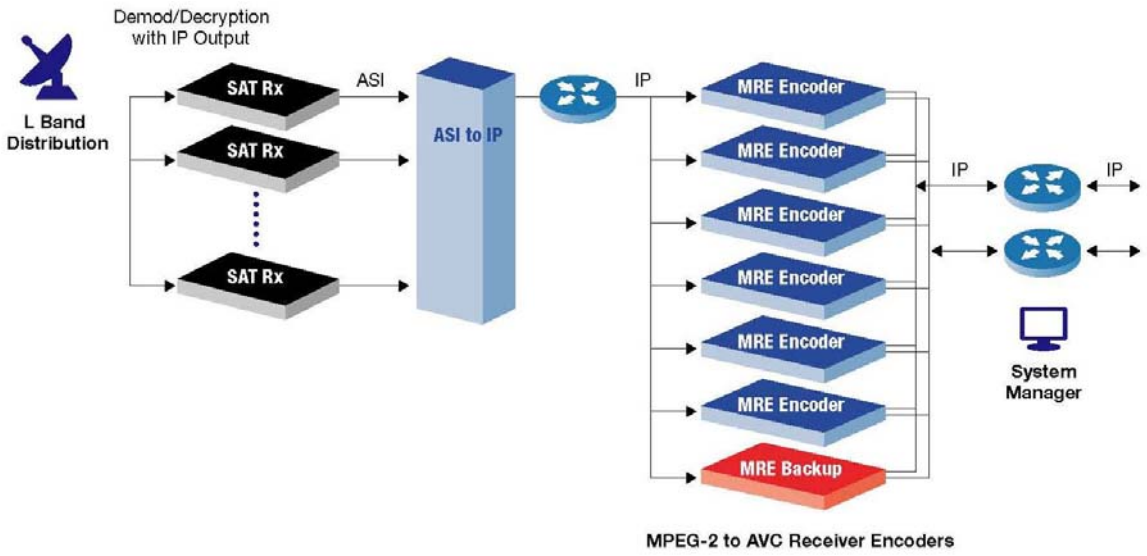
The same hardware that can receive **NTSC** can also receive ATSC digital terrestrial signal. In this application, the system tunes to the appropriate frequency and program number to select the HD or SD service. The MRE demodulates the signal and presents the compressed MPEG-2 stream to the processing core. The video signal is decoded and re-encoded into AVC. The audio signal components are passed through.

Applications – Satellite Reception

Direct reception of incoming satellite feed is complicated by the fact that in many places proprietary solutions are in place, therefore requiring deployment of corresponding proprietary descramblers. In DVB-S applications; however, the standardized DVB common interface conditional access module (CAM) modules can be deployed to decrypt the signal.

Satellite delivery in the U.S. almost exclusively uses proprietary scrambling solutions from three different suppliers. The following diagram illustrates how proprietary receivers can still be integrated in an IP-oriented headend. The MPEG-2 signal from a satellite transponder can be decrypted externally and presented via an ASI to IP aggregator then output over UDP/IP stream into the encoder. With a direct UDP/IP input, the input and output connections to the encoder becomes connectionless.

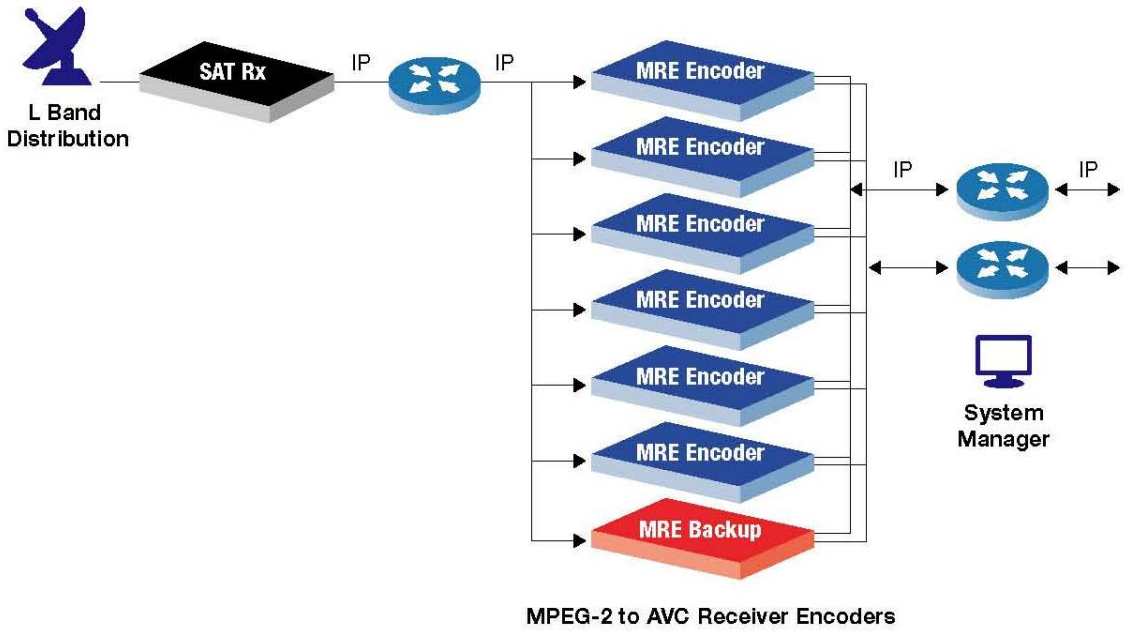
MRE Enhanced Satellite Architecture with Traditional Receivers



The encoder simply selects the desired service from the multi-program transport stream (MPTS) and delivers this compressed MPEG-2 transport stream (TS) into the AVC processing engine for decode and re-encode. Compressed audio will be treated as audio pass-through. The functionality includes the ability to deliver appropriate closed captioning and other peripheral signals.

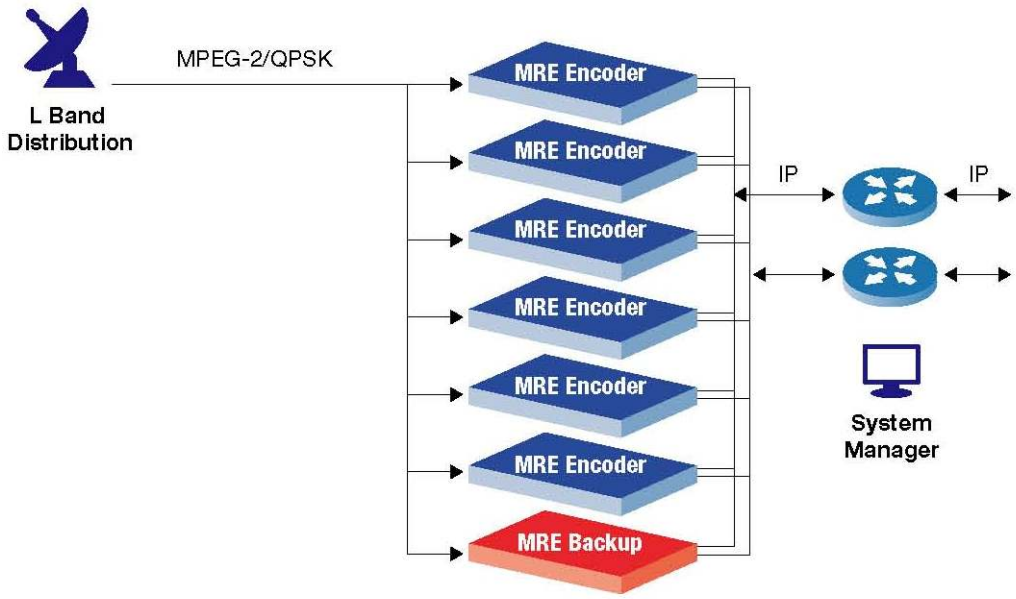
This approach can be extended if proprietary receivers are available that can decrypt the complete incoming transport stream as shown below.

MRE Enhanced Satellite Architecture with Bulk Descrambler



DVB satellite solutions with common interface (DVB-CI) interfaces offer the satellite inputs to be directly received into the MRE. The following diagram illustrates the standardized DVB-S with DVB-CI solution.

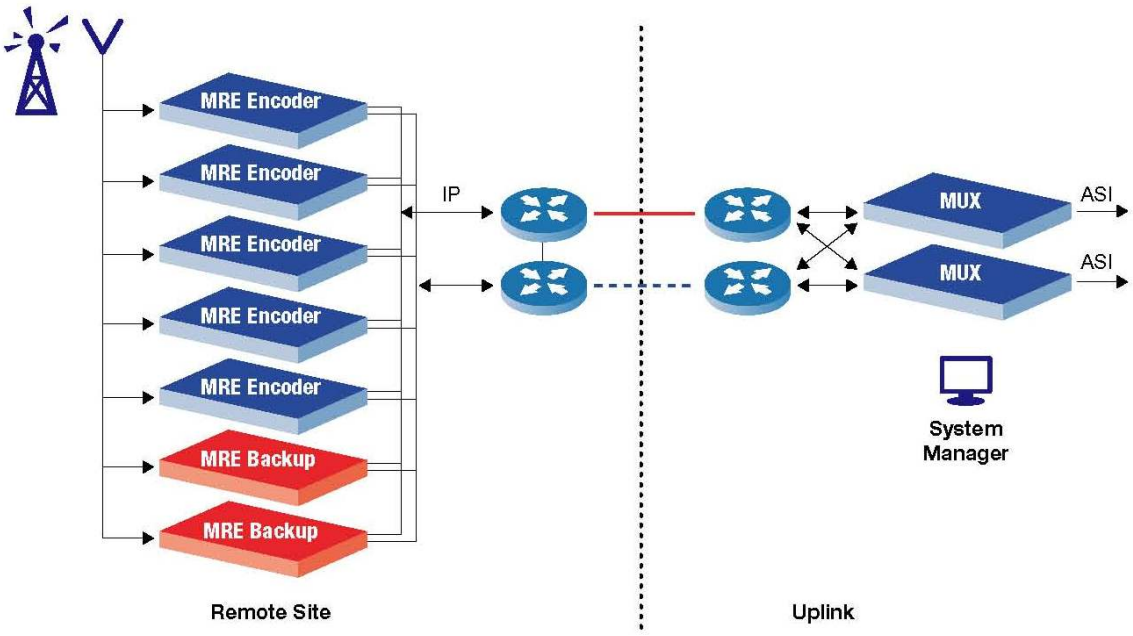
MRE DVB-S Satellite Architecture



MPEG-2 to AVC Receiver Encoders

Applications – Statistical Multiplexing

The MRE supports a closed loop statistical multiplexing implementation where the complexity analysis and rate allocation messaging is delivered over the IP network. The IP-based architecture offers significant benefits compared to traditional statistical multiplexing solutions including reduced cost by eliminating expensive ASI infrastructure and replacing it with low cost IT equipment.



Modulus Receiver Encoder Implementation

The MRE is based on the Modulus Video ME2000 second generation HD and SD encoder platform. Its IP-centric server architecture runs on a Linux operating system and combines powerful CPUs with programmable hardware, enabling it to support flexible input options and Modulus Video's custom algorithms that efficiently deliver high quality video services at very low bit rates.

Its state of the art HD and SD compression core has an excellent motion estimation foundation and is optimized to maximize support of the most valuable AVC tools. The implementation includes:

- Single slice processing to avoid any risk of visible partition boundaries
- Multi-pass (look ahead) encoding functionality
- IBBrBP with reference B frame support
- De-Blocking filter
- CABAC

Modulus Video continues to further adapt and extend the capabilities of its custom algorithms to further enhance the video quality at the lowest bit rates.

Modulus Receiver Encoder – Performance

There are a lot of misconceptions regarding the use of direct MPEG-2 to AVC transcodes. The case is the same for the alternate approach of decoding to baseband then re-encoding. Modulus Video strongly believes that the right approach is to utilize a decode re-encode methodology. While it is possible to adapt the syntax of an MPEG-2 stream to create an MPEG-4 AVC stream, this approach imposes severe restrictions that ultimately limit the performance and video quality.

Deriving AVC directly from an incoming MPEG-2 stream restricts the system to using the GOP structure and prediction methods of the incoming feed rather than using full flexibility that is available within the AVC syntax. AVC derives much of its efficiency advantage by extending the motion prediction referencing options to minimize residuals. AVC allows more B pictures, allows B pictures to be used as references and allows multiple reference pictures. All of these advances allow greater compression efficiency, which means with a fixed bit budget, better picture quality.

In addition, AVC allows for a wide variety of block sizes in motion estimation. This allows better tracking of complex motion. A key breakthrough in AVC is the use of weighted prediction. This capability was added to specifically address known weaknesses in MPEG-2: fades and cross-fades. Simply translating MPEG-2 syntax to AVC syntax may provide some savings in processing required, but doesn't allow use of powerful AVC tools that allow difficult video to be compressed with high video quality at low bit rates. The net effect of a MPEG-2-to-AVC "translator", when compared with decoder/re-encoder, is significant degradation on difficult sequences.

Deriving AVC directly from an incoming MPEG-2 stream will restrict the Motion Estimation (ME) resolution to ½ pixel ME rather than the ¼ pixel ME that would be achieved with basic decode/re-encode implementation.

Modulus Video has established itself by being early to market with high performance AVC encoding solutions that are able to deliver video at the lowest possible bit rates. Given the fundamental limitations associated with direct transcoding, Modulus Video maximizes video quality by mating decoding and high performance encoding technology and has extended the approach by integrating the decode functionality into the encoder. Further, by integrating the decoding function the encoder can extract and utilize incoming stream parameters to assist the encoder to make intelligent decisions with regards to the re-encode.

In summary, a decode/re-encode implementation with access to the full capabilities of MPEG-4 AVC will deliver better video quality, and this will be most evident with difficult sequences.

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Summary

The MRE is an integrated combination of receiver and high performance MPEG-4 AVC encoder for delivering HD and SD services. In addition to supporting baseband video the platform offers support for analog and digital terrestrial as well as MPEG-2 over IP as inputs to the compression core.

For satellite and IPTV applications: the feature set includes support for statistical multiplexing, capped VBR mode, low res proxy as well as advanced features such as ghost cancellation and audio level control for the NTSC feeds. With a compact form factor this platform offers to revolutionize head end architectures, reducing box count, simplifying signal routing and redundancy support.

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