



STATMUXIP™

Overview

This white paper introduces StatmuxIP, the statistical multiplexing system developed by Modulus Video. This state of the art statistical multiplexing system is based on a closed loop methodology using an IP based signaling infrastructure. In combination with Modulus Video IP-centric multi-pass AVC encoders StatmuxIP delivers video at the lowest bitrates for multi-program transport stream (MPTS) applications such as direct to home satellite or distribution.

Statistical Multiplexing

MPEG-4 AVC is fundamentally similar to MPEG-2 and therefore stands to reap similar benefits from statistical multiplexing in MPTS applications. The principle of statistical multiplexing is that a group or “pool” of encoders share a fixed quantity of bandwidth. How that bandwidth is allocated is determined on a frame by frame basis such that the encoder with the most complex video borrows more bandwidth from the pool than those encoders with less complex video. The system must be designed such that the combined bit rate from the encoders never exceeds the pre-defined transport stream bandwidth. This principle has been well proven to provide better compression efficiency and to allow better video quality or more services to be included in the transport stream.

Closed Loop Statistical Multiplexing

It is important to appreciate the distinction between a closed loop and an open loop rate shaping statistical multiplexing application. In a closed loop system each encoder reports the complexity of the video to a control application that then computes and instructs the encoder an appropriate bit rate to use. In the open loop context, rate shaping multiplexers create a statistically multiplexed stream from pre-compressed streams, but, this “open loop” methodology is limited as to how much it can reduce the incoming stream bit rate. In contrast, a closed loop technique enables the encoders to aggressively flex the bit rate to optimally track complexity and hence deliver better efficiency.

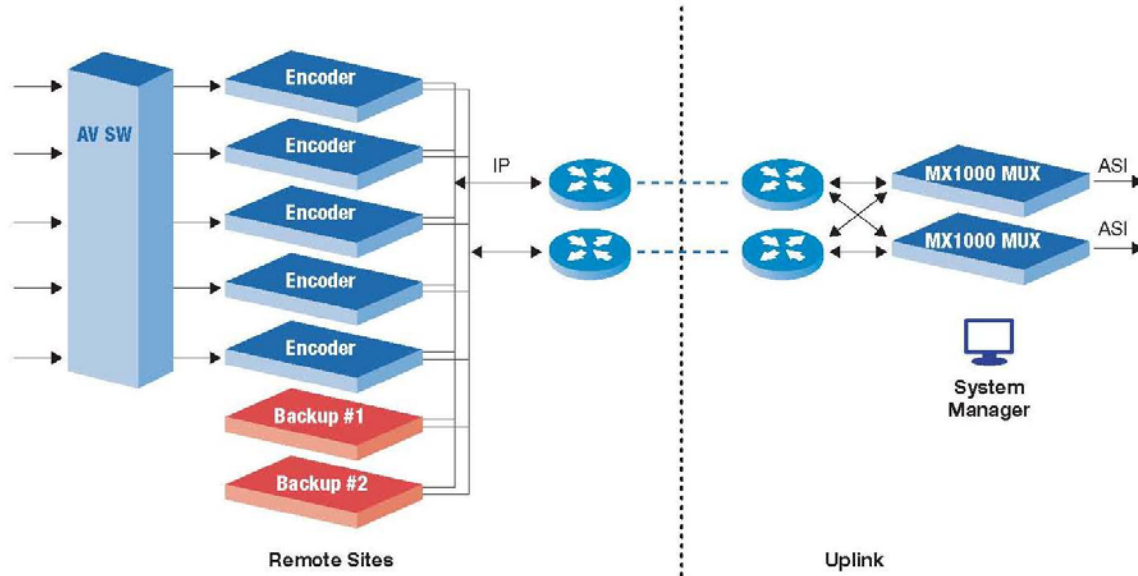
StatmuxIP Implementation

The system is controlled by the StatmuxIP control application running on the Modulus multiplexer. Each encoder performs a full AVC encode purely to accurately perform the bit rate analysis function. Frame by frame this function reports the immediate complexity statistics of the incoming video to the multiplexer. The multiplexer captures the statistics from all the encoders and then every frame sends a bit rate allocation grant to each encoder. The mechanisms are relatively simplistic; the foundation for good system efficiency is accurate complexity analysis followed by precisely timed bit rate allocation. The complexity and rate allocation messages are delivered over multicast UDP/IP (User Datagram Protocol over Internet Protocol) with NTP (Network Time Protocol) messages



White Paper StatmuxIP Over IP

which are used to allow the system to be resistant to imperfect IP networks and to be tolerant of up to 600ms of round trip time.



The diagram above indicates the basic architecture of a closed loop system. The network can be configured for Local area (LAN) or wide area (WAN) networked operations.

The architecture supports up to 80 encoders and is designed with provision for encoder and multiplexer redundancy. The encoder pool can consist of a mix of standard and high definition formats that do not need to be frame synchronized.

StatmuxIP Benefits

The IP-based architecture offers significant benefits compared to traditional statistical multiplexing solutions. StatmuxIP reduces cost by eliminating expensive ASI infrastructure and replacing it with low cost IT equipment.

A traditional ASI based system is constrained by its physical connections and ports. StatmuxIP increases flexibility reduces cost by eliminating the hard wired architecture. IP routing removes the physical constraints so that any feed can be routed to any multiplexer, thus simplifying system configuration. This makes it easier to move services between pools to attain optimized balance. Traditional closed loop statistical multiplexing has been limited to a group of co-located encoders. By sending the control messages over an IP network, StatmuxIP makes distributed architectures a reality. This application is



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White Paper

Statistical Multiplexing Over IP

ideal for local collection applications where remotely located encoders can compress content and still participate in a statistical multiplex pool where the final transport stream is assembled at a central location.

An IP infrastructure offers flexible redundancy options that produce cost savings. For example, operators can use a pool of redundant encoders to support the entire facility as opposed to one or more redundant encoders per multiplexer. IP networking can bring other benefits such as automatic path finding and route provisioning to further maximize service availability.

Performance

A number of factors contribute to the performance of a statistical multiplexing system. Most fundamental is the need for an efficient multi-pass encoder that uses the appropriate algorithmic tools and has the ability to accurately predict and apply the appropriate bit rate in a timely manner. Efficiency rises with pool size and distributed architectures allow more encoders per pool. StatmuxIP capitalizes on those facts by allowing huge pools per MPTS. This benefit comes in addition to the fundamental AVC efficiency advantage which will also drive pools size upwards. The net outcome is that StatmuxIP statistical multiplexing system will deliver exceptionally consistent video quality and deliver efficiency gains of around 40% when compared to a similar CBR application.

Summary

StatmuxIP is the statistical multiplexing application from Modulus Video. This state of the art IP based system is suitable for centralized and distributed architectures and delivers compression efficiency gains as well as cost savings and flexibility.

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