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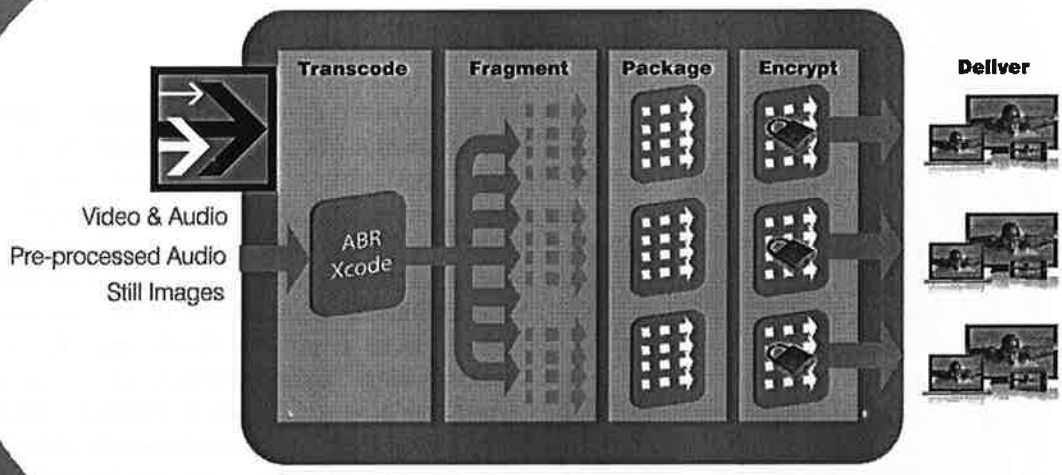
WHITE PAPER

Guide to Adaptive Bitrate Streaming

Adapting ABR in High-Volume Content Preparation Workflows

It's often said that change is disruptive, and that's certainly true for the most significant media distribution development in recent memory, which is the advent of new viewing devices for content delivery. With the extension of video viewing from standard TVs to smart phones, tablets, connected TVs, DVRs, and game consoles, today's media landscape is radically different from just a few years ago.



What used to be all but impossible—the delivery of consistently acceptable image and sound quality despite often uncertain and fluctuating bandwidth—is now taken for granted by viewers on these devices. Adaptive bit-rate (ABR) streaming is a key technology in making this work.

As with most new technologies, ABR streaming is a double-edged sword. Its benefits to end-users are obvious, but it brings with it some significant challenges for content owners and others who prepare media for distribution. Unless addressed carefully, those challenges can easily push content preparation infrastructure past its sweet spot, introducing inefficiencies that steeply increase labor requirements and processing time. This paper provides an overview of how ABR files differ from conventional streaming files, the implications of those differences for conventional media preparation processes, and how those processes may be successfully adapted to create highly-efficient, cost-effective ABR workflows.

Understanding ABR

In conventional streaming, once a connection is established between an end user and a media file, that file streams at a fixed bitrate and displays at its inherent resolution (e.g. 640 480). ABR streaming—whether Apple HTTP Adaptive Streaming, Microsoft Smooth Streaming, or Adobe Dynamic Streaming—instead tailors streams to the resolution of the playback device and the available bandwidth of the connection. Connect via a tablet over a strong Wi-Fi signal, and you'll get a larger picture and higher bitrate. Connect via a smart phone in your car and you'll get a smaller (lower resolution) picture at a lower bitrate. If your connection improves as you drive, the system will adapt on the fly to the changed conditions, increasing the bitrate at which the content is streamed.

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To enable this flexibility, an ABR file isn't really an individual file at all, but rather a package of files. An ABR package includes a manifest file, which holds the stream metadata, and set of multiple "layers," each made up of the media data for a different target bitrate. To enable switching between layers as conditions change during streaming, the content for each layer is fragmented into files of only a few seconds in duration.

Needless to say, one aspect of preparing an ABR package is to prepare the half-dozen or so streams corresponding to each of the package's layers. If transcoded on existing hardware, however, transcoding for an ABR package with a half-dozen layers will typically take about six times longer than transcoding a single fixed-bitrate file of the same content. Few facilities are currently equipped to increase production by a factor of six; attempting to do so without a significant investment in throughput will likely bring production to a standstill.

One approach to this problem would be to expand conventional capacity six-fold, investing in new machines to run the transcode processes, expanding data storage capacity, and adding all of the associated ongoing costs in areas such as cooling, energy, and real estate. But how would the costs associated with this expansion be recouped? ABR provides content owners with access to a new, fast-growing market, but it does not offer the multi-fold increase in revenues that would be needed to justify this massive expansion of capacity using existing models.

Clearly this aspect of an effective ABR solution requires a new approach to the transcoding software and hardware. At Telestream we've done that by developing an exclusive new technology called Lightspeed, that implements parallel processing and transcoding algorithms to accelerate video processing and H.264 encoding on parallel GPUs and also on multicore CPUs.The result is the highest possible image quality at the fastest possible speed. Solutions incorporating Lightspeed provide the boost in processing power required to address the ABR throughput dilemma, but they do so without a corresponding increase in hardware, operational, and maintenance costs.

ABR impacts not only the volume of material to be processed but also the media processing worklflow itself.

Media processing workflow

While highly-efficient transcoding technology is a big part of the ABR solution, it's far from the only factor to consider in planning for ABR. That's because ABR impacts not only the volume of material to be processed but also the media processing workflow itself, requiring a thorough rethinking of existing practices.

ABR's emergence coincides with the significant investment that content owners and distributors have made in recent years to extend media distribution beyond the confines of traditional broadcast and cable television. It would be a mistake to think of the content preparation side of that investment solely in terms of discrete devices for transcoding video into the correct format for various outlets. Instead, high-volume facilities have long realized that efficient content preparation demands a comprehensive approach that addresses the entire series of steps required to generate media in the appropriate form for its intended use.

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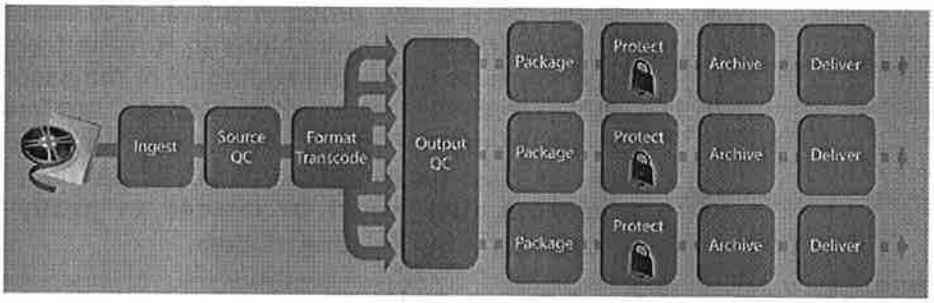
Here's a look at the capabilities required of an effective media preparation system for high-volume use:

- **Playlist processing**–Material for a given output clip is often drawn from multiple source clips (e.g. provider logo, main content, provider promo). A content preparation system should be able to automate this assembly process, working from a playlist that specifies the exact content (source files, offsets, durations, etc.) that goes into each finished clip.



Unified system workflow features regain efficiencies

- **Transcoding** — The most efficient use of resources is to access source materials just once, transcoding simultaneously into all of the different required variants (progressive download, TV/VOD distribution, etc.). Transcoding capabilities must include not only video but also audio and metadata to ensure compliant results in the destination format. Built-in analysis tools should be included to provide process feedback and a means of validating transcoding outcomes.
- **Content packaging**—Packaging requires assembly of compliant transcoded and externally provided components into packages that are themselves compliant with requirements for delivery to targeted platforms and destinations. Because requirements vary greatly depending on a host of factors including playback platform, region, and delivery channel, a content preparation system must be able to address the entire spectrum of practices and preferences. To avoid wasteful repetition of transcoding operations, these packaging variations must be handled with zero dependency on the transcoding sub-system.
- **Encryption and DRM** — Keeping content safe from unauthorized use is crucial not only for the final deliverable but throughout the distribution chain. For an efficient high-volume system, content protection should be integrated directly into the workflow.
- **Validation and tracking** (QC) — In addition to ensuring the best possible rendering of transcoded media in destination formats, a system should provide the means to track the progress of a given job through the workflow and also to verify the quality and compliance of the final result before the materials are handed off.

Intelligent automation can greatly boost efficiency.

- **Content delivery** — A true end-to-end solution delivers prepared media either to a destination such as a content delivery network (CDN) or to a hosted origin server, and it should be able to confirm that delivery has been successful.

With such a complex overall process it's evident that intelligent automation—with manual intervention limited to those aspects that can benefit from human judgment—can greatly boost efficiency.

Any task that can only be done manually, or that must be done more than once, is an obstacle to maximum productivity. So the imperative for vendors serving high-volume content providers has been to design these inefficiencies out of the picture, maximizing quality, throughput, and control while minimizing labor. Telestream's Vantage systems, which bring transcoding, media capture, metadata processing, and analysis together into a single managed process, are a prime example of this approach.

Using a unified system for both ABR and non-ABR output isn't just a nice idea, but a crucial requirement for any enterprise that intends to serve the ABR market without breaking the bank.

Integration vs. separation

Given the tasks required of a content preparation system, and the intelligent automation needed to operate such a system efficiently, two main options present themselves for adding large-scale ABR capabilities. One is to integrate ABR into existing systems. The other is to handle ABR as a separate process. Clearly the former makes far more sense than the latter:

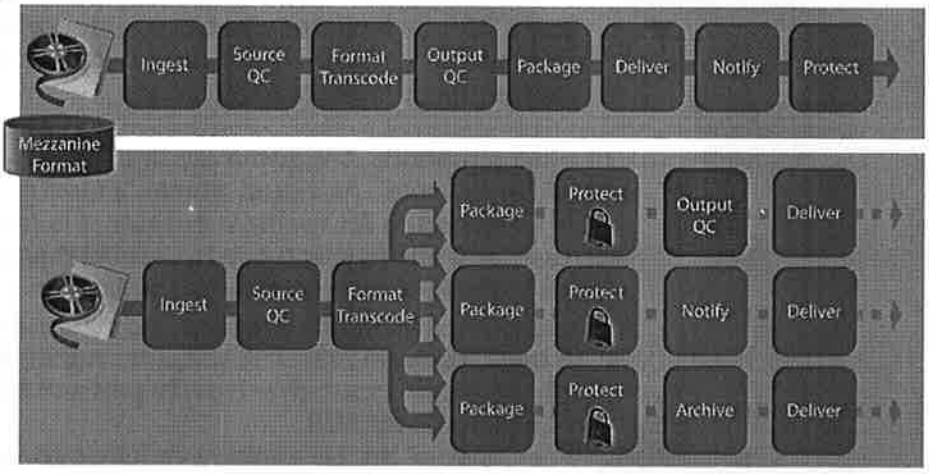
- In most situations, the same content will be processed into both ABR and non-ABR outputs. As noted above, industry experience has shown that when transcoding for multiple outputs it is faster to access a given source file just once and to transcode in parallel than to access the source multiple times to perform separate serial transcodes.
- Most of the other (non-transcoding) steps in the workflow will also apply to both ABR and non-ABR outputs. Again, it's more efficient to perform these steps once rather than to perform them for non-ABR deliverables and again for ABR.
- Most of the technology required to perform the needed tasks, to automate the workflow, and to track jobs through the process is the same for both ABR and non-ABR content. Purchasing, operating, and maintaining separate systems to handle these tasks for ABR is inherently less cost-effective than adapting existing systems and scaling them to meet combined ABR/non-ABR demand.

Based on the above, using a unified system for both ABR and non-ABR output isn't just a nice idea, but a crucial requirement for any enterprise that intends to serve the ABR market without breaking the bank.

But adapting a non-ABR system to accommodate ABR can be a tricky proposition on several levels. To make it work, a unified system must be built not only with the power to handle increased throughput but also with flexibility to handle the unique challenges posed by ABR packages.

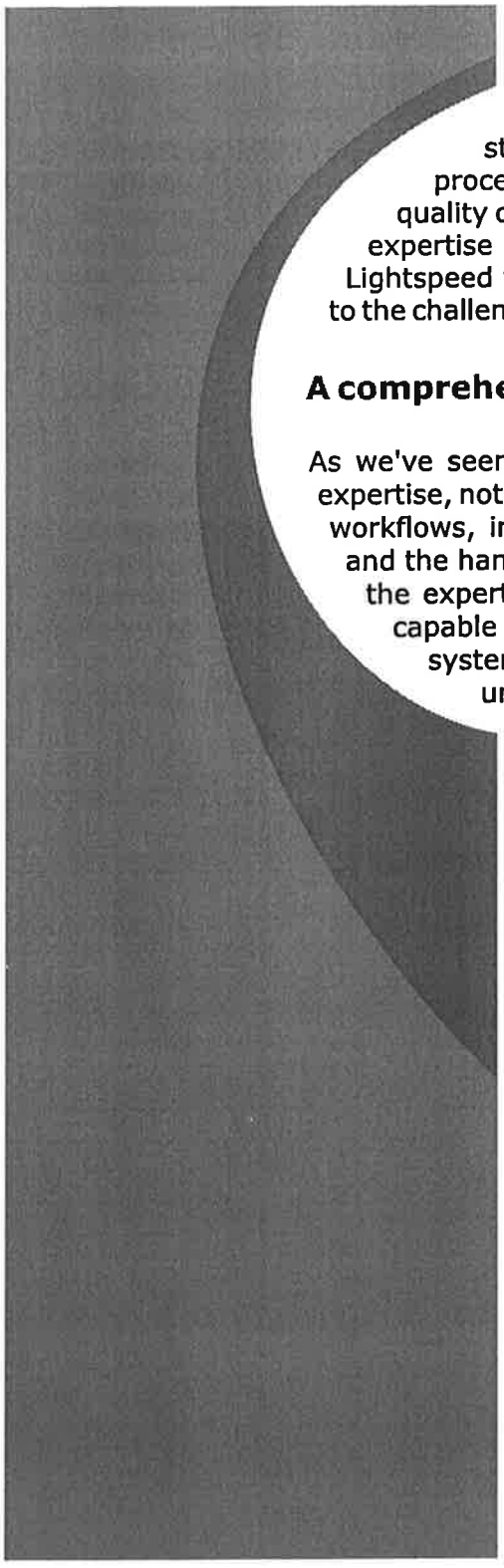
As we've seen, to make a unified system work effectively requires deep expertise, not simply in transcoding, but also in automated media production workflows.

That's because, as noted earlier, the structure of an ABR file is dramatically different from that of a fixed-bitrate file. And those differences can complicate several aspects of the overall file preparation workflow. Consider, for example, the task of handing off an ABR package to a content delivery network (CDN) using today's available delivery tools (FTP, file copy, etc.), which are all based on the assumption that each item of media content is represented by a single file. In a manual, step-by-step workflow, one could conceivably wrap the package's files into a .zip or .tar archive, FTP it to the CDN, and then rely on the CDN to properly extract the files and handle them such that they function as the intended ABR package. But when demand requires production and delivery of up to hundreds or thousands of files a week—the level at which effective process automation is a business necessity—the gross inefficiency of this approach becomes immediately obvious.



Mixed mode workflows

This same issue plays out in many other stages of ABR package preparation. Just as for non-ABR media, the material for a given output clip is often drawn from multiple source clips (e.g. provider logo, main content, provider promo). The transcoded files must be QCed. The components, both transcoded and externally provided, that make up the deliverable must be assembled into format-compliant packages for delivery to target destinations, in some cases with DRM or other encryption applied.



An effective unified solution must address each of these stages as part of a complete automated process, capitalizing on those areas where ABR and non-ABR processing can be the same while optimizing areas that must be different. Handling ABR with a system that does not support all of these needed capabilities is not a viable high-volume option.

Vantage combines both of these into a unified system that streamlines the entire process of source file decoding, video processing, parallelized H.264 encoding, packaging, encryption, quality control, and delivery. Combining Telestream's industry-leading expertise in workflow automation and management with the power of Lightspeed technology, Vantage is the ultimate high-throughput solution to the challenge of content delivery for multiple screens.

A comprehensive, unified system

As we've seen, to make a unified system work effectively requires deep expertise, not simply in transcoding, but also in automated media production workflows, including source-file playlists, job tracking, status reporting, and the handoff of output materials to external systems. That's precisely the expertise that Telestream has applied in developing its new ABR-capable Vantage solutions. We've taken our advanced field-proven systems, analyzed the impact of ABR on every step, and created unified solutions that maintain all the advantages of full-featured video transcoding, workflow automation, and system management while also being uniquely adept at simultaneously handling ABR and non-ABR outputs.

Vantage Transcode Multiscreen is optimized for ABR content preparation and workflows. Vantage Transcode is highly optimized for Web and VOD single-file production.

To learn more, visit www.telestream.net or call 1-530-470-1300.

