

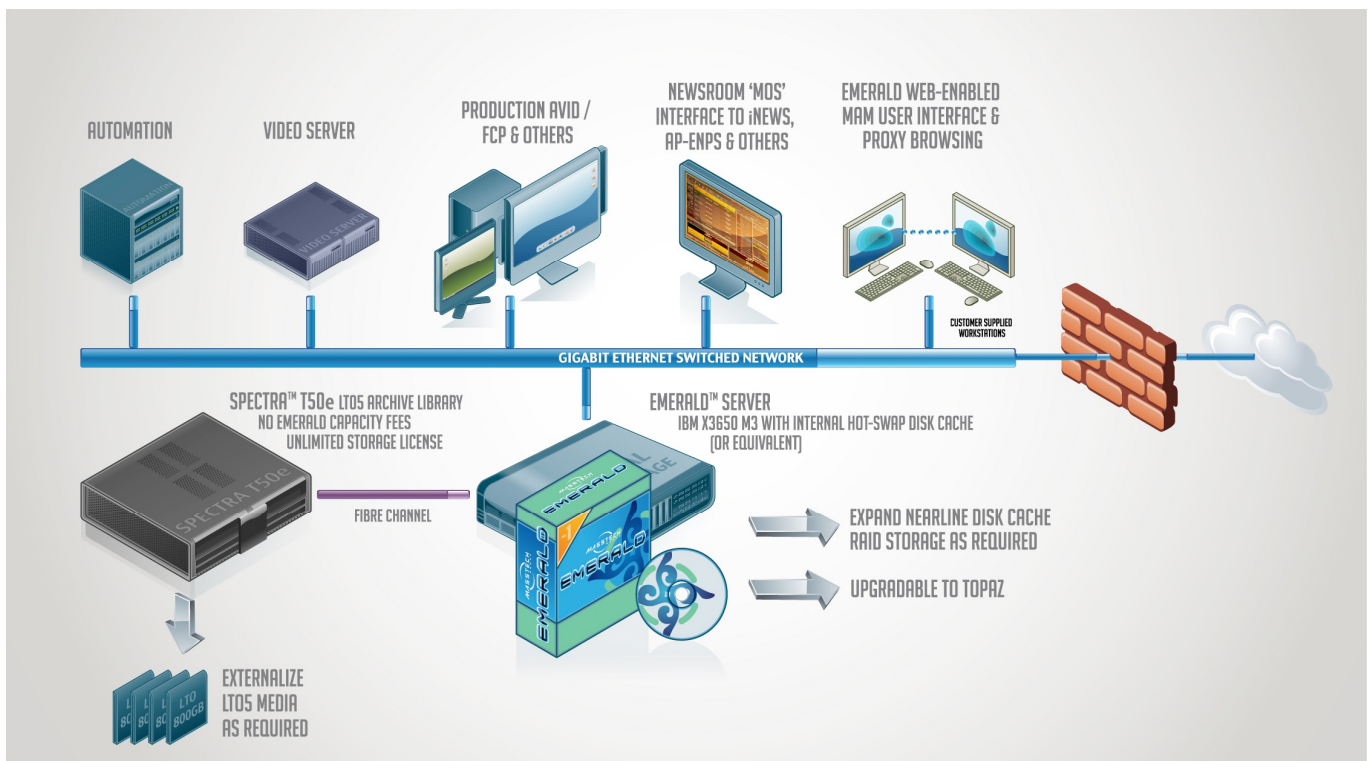
TRANSCODING HD CONTENT UP TO 6X REAL-TIME



**Abstract**

This paper is an in-depth review of the ways content can be captured, transformed to multiple file formats simultaneously and moved automatically to specified locations throughout the broadcast facility at speeds faster than real-time. Transcoding capabilities need to be 'transactional' within a broadcast ecosystem, automatically creating low resolution proxies, re-wrapping and transcoding content along the way to its final destination.

The Masstech in-house developed *HQS* (stands for *high quality speed*) transcode engine is able to transcode content in a single pass to speed up file delivery in workflows. This cutting edge product has set a new precedent in terms of minimum investment input for maximum transcoding output.



## Introduction

One of the banes of a broadcaster's life is transcoding content between different formats for video server playout or editing systems. It is needed for many reasons and it often needs many operations to deliver the file to the target device. Irrespective of anything else, the usefulness of any transcoder comes down to four essentials:

1. Speed of the transcode
2. Preservation of the metadata in the source file
3. Quality of the output
4. A minimum list of *-ilities*; the often overlooked and least mentioned system characteristics that directly influence the likelihood of a customer recommending the transcoder to anyone else.

Transcoding speed is expressed as multiples of the playout time of the source file – *real time, two times real time*. Transcoding is also described by the number of passes a file has to make through the transcoder – *one pass, two pass* and so on.

The broadcasting world is no longer a place where it is simply a matter of putting the signal on the air and the viewer's television passively displaying it. With the arrival of digital video and audio, the broadcaster is no longer in total control of viewer's experience. The viewer may have one of several types of different televisions in the house. Or even several different types of televisions scattered throughout the house. Each of these televisions may change the viewer's experience, irrespective of whether the signal arrives by a terrestrial broadcast antenna or by a set top box receiving a satellite or cable signal. An important characteristic of these televisions is that some of them can respond to Active Format Description (AFD) metadata carried in the signal to change the television's setup for the viewer's benefit. So it is essential for transcoded files to keep the metadata that is in the source file.

Preserving metadata is as difficult as achieving high transcoding speeds. Different transcoders take different approaches to preserving metadata, depending on their primary transcode objective.

As well as helping manage the viewer's experience, the metadata also carries information that, in some parts of the world, is a legal requirement. For example, V-chip information for all broadcast files and Closed Captions for categories of content or at least a percentage of the files broadcast.

The final judge of the quality of transcoded output is the broadcaster, because Peak Signal to Noise Ratio (PSNR) measurements and the like aside, only a human being can visually compare the source file with the output file, typically using high quality monitors. Only a human being can verify lip sync and audio quality. Unfortunately, some viewers will display broadcast content on the wrong size screen for the transmitted resolution or on screens that cannot autochange their aspect ratio. But if the broadcaster knows the transcoded file satisfied the station's quality standards, their duty of care to their viewers has been fulfilled. Canada's CTV has compared multiple transcode engines from the up-convert perspective. CTV and several other broadcasters consider Masstech's HQS engine to produce the best quality.

The list of *-ilities* that may apply to a transcoder can vary from person to person, but this review covers: usability, supportability, dependability, compatibility, configurability, customizability, scalability, operability, interoperability and manageability. It also considers modularity of transcoder design and performance.

## **Modularity**

Most vendors build transcoders using licensed components such as decoders, multiplexors, splitters, wrappers and so on. All the video transformation technologies can be licensed from someone. So the typical transcoder is a collection of independent software black boxes coupled by the vendor's software glue. The typical vendor transcoder is modular at the black box level.

A useful way to consider typical transcoder operation is to think of it as a factory floor.

The vendors who have licensed all their transformation technology have effectively leased out all of their factory floor to various independent companies. As the factory owner, the vendor has to manage the flow of the source file from the front door to the back door. But that is not as easy as it sounds. For example, the vendor has very little, if any, control over how the independent companies actually do their piece of the processing. Sometimes the source file will arrive at an independent company before that company has finished with the previous file and sometimes it will arrive too late to find that company metaphorically tapping its foot waiting to get on with its job.

But worst of all, the vendor has no direct control over how the independent companies compete for or use the CPU. So some of the vendor's total processing is determined by programmers working for companies other than the vendor. Unfortunately, the independent companies are unlikely to align themselves with the priorities and objectives of broadcasters in general and certainly not with any individual broadcaster. The sad part is that often, as soon as the vendor takes the file across the factory floor for one set of operations, it has to go around to the front door again for another set of operations. Sometimes the second pass is at the same independent company where a first pass operation was performed. HQS has changed that whole approach.

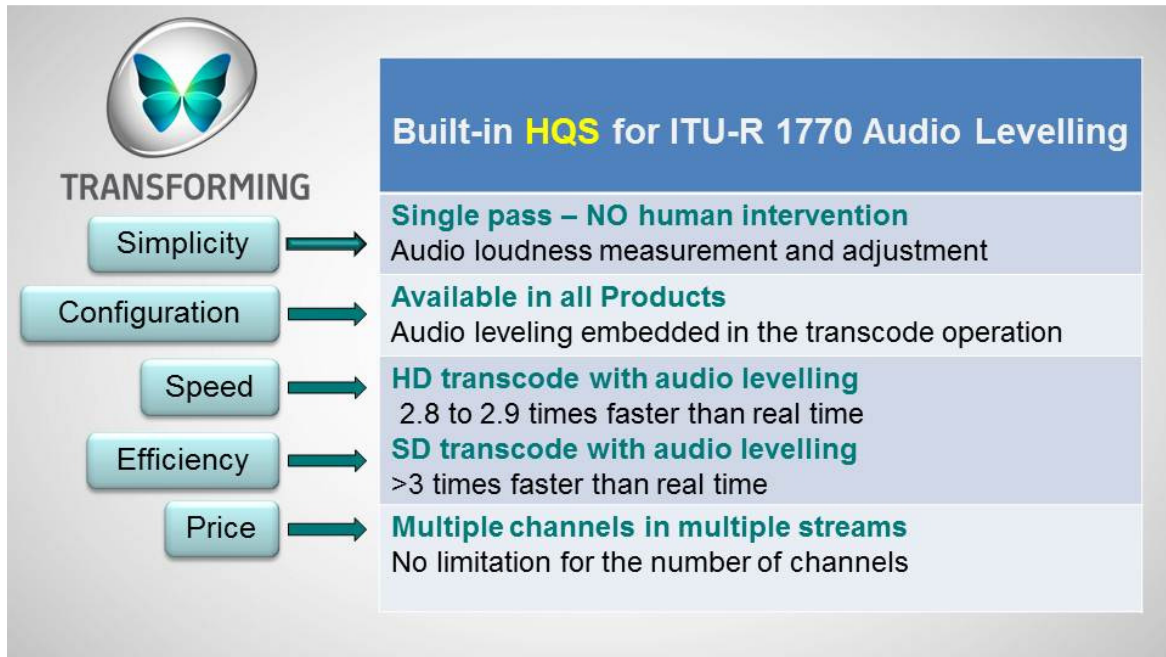
Masstech owns the whole factory and everything in it. From the front to the back, from the left to the right, from the top to the bottom. Virtually no part of the factory floor has been leased out. Instead of independent companies, Masstech has written its own *assembly unit* workbenches. HQS is modular at the workbench processing level.

With HQS as the factory owner, multipasses no longer exist. HQS knows everything about every operation for every part of the source file. That means different parts of the file can go to different workbenches and each assembly unit can be told to perform a set of operations in a particular order before passing on its part of the file.

The first assumption might be that total processing time will be the same because the system performs the same number of operations. But that is wrong. As the owner of the factory and everything in it, Masstech has written all the code and has a flexible manufacturing floor that can easily adapt on the fly to the task at hand. All the typical processing inefficiencies have been weeded out, designed out or minimized to the lowest level of impact. The result is an orderly progression of CPU processing without any metaphorical pushing or shoving or other physical claims for CPU time.

Having a scalable and flexible workbench means that it performs an optimized second set of operations only on parts of the files that require it, not on the whole original file. This is far superior than having to load the whole file again. Where is the technology elegance in that?

So not only can all the necessary operations be completed on one visit to a workbench, they are also completed significantly faster. Masstech clients report on average that their solution (their factory) operates 3 to sometimes 4 times faster on HD than any of their competitors and 15 times faster than real time for SD.



**Usability**

All the customer wants to do is put their source file on the right video server, in the shortest possible time, with a viewing quality that is not less than the quality of the source file. Most customers do not want to have to know, and indeed, in today’s cost cutting world, do not have the time to learn, about precisely which 10, 20 or 30 parameters should or should not be tweaked. Especially as transcoders that provide elaborate GUI’s to let an engineer manage down to the level of every single bit, are usually difficult to configure.

HQS is not a standalone tool that sits on the desktop. Nor does it have its own GUI. HQS comes inside a workflow package, like CatchBLUE, Emerald or Topaz. It is a server engine with an XML interface. The workflow package sends the XML requests to the transcode engine. Because Masstech has written its own target device interfaces, HQS knows about every parameter that needs to be tweaked for best output. Fine adjustments of HQS’s overall operation can also be made via its server configuration file.

**Supportability**

HQS is fully accessible to Masstech Support via a remote access interface. The customer fills in a Pre-installation form with their equipment addresses, their transcode sources, the version of software running on their target devices and even which interfaces Avid should use, and select their choice of workflow operations from a menu. After the customer installs the software, Masstech using remote access verifies the installation and the configuration file.

If something unexpected happens during HQS processing, Masstech Support can investigate by remote access, 24x7. Anywhere in the world.

### ***Dependability***

HQS has directly benefited from a long history of transcoder development at Masstech. Drawing from this experience, *Transcode* HQS has been developed specifically for the needs of television broadcasters. Other transcoder vendors may have more focus on Internet-based transcoding, but also try to deliver to broadcasting. For them, synchronization and metadata are less important.

Broadcast television is a real time world where black screens, poor lip sync and pixilation are not tolerated.

### ***Compatibility***

Transcoding covers a wide range of operations, such as remultiplexing, changing the bit rate, down-convert, up-convert, changing audio channel order, loudness measurement and adjustment and combining video from two different formats (such as MPEG and H264 files, changing their resolution and stitching them into a single MPEG output). HQS can also perform media operations such as format conversions (such as between PAL and NTSC) and Closed Caption operations such as between HD and SD, and writing to a file or TeleText or loading from a file. In addition, HQS knows about all the destination server formats, traffic systems and storage systems on a broadcaster's site.

Because Masstech owns the HQS code and interfaces, Masstech can easily add interfaces as needed and tweak interfaces in line with manufacturers' changes to device specifications. So the combination of workflow package and HQS is responsible for the compatibility of all its interfaces to a customer's broadcast equipment. It ensures that all the video servers and editors can exchange files. Including all the file's metadata.

Unlike other vendors, when Masstech decides to add new features to its products, they do not come with constraints nor do they unnecessarily impact performance or quality. Being the factory owner gives Masstech full control over where in the factory to place the new workbench and how to stitch it efficiently and effectively into the factory process.

### ***Scalability***

Transcode performance is really about the volume to process and the time it takes to process each file. HQS does not use any hardware accelerators. All its operations are optimized for working on commercial-off-the-shelf Intel or AMD based IT servers from IBM, Dell or HP, no extras needed. For example, a standard 2RU IBM server with a hyper-threaded, hex quad core provides the equivalent of 48 CPUs for HQS to manage.

Whichever size host server is used, if the site grows to more volume than the host server can handle in the available transcoding window, simply add another HQS host server.

### ***Configurability***

HQS can mix and match inputs to outputs, using available CPUs, as needed, for whichever set of jobs are currently being processed.

HQS is a dynamically reconfigurable transcode factory. It is not a preset, dedicated, limited video server transcoder. But here is the clever part – as HQS takes the source file from the queue, it can reconfigure whichever parts of the factory floor it needs for that file. It can specify the order of the work and it can specify which CPU or CPUs will do it. All in parallel, while processing other jobs already on the factory floor. HQS reconfigures on the fly without loss of quality and with all the metadata intact.

### ***Customizability***

If a customer wants to customize transcoder operation for the typical transcoder, there is usually a rather long delay. The request goes to the vendor and then, often, to one or more of the independent companies and so on.

As Masstech owns all the code, the interfaces and the configuration parameters for HQS, customization to any part of the workflow and transcoder can be made. Anywhere in the world.

### ***Interoperability***

HQS provides transcode interoperability between all the relevant equipment systems in a broadcast or production facility. Content arrives through one of several satellite feed, over the Internet, from various field cameras or NLE stations. The resulting file then needs to be delivered to one or more incompatible video servers, NLEs, or longer term storage subsystems. HQS enables this process to happen simultaneously.

For example, a complete transcode solution must pay attention to the end-to-end transcoding IO – from source location (typically disk), into local memory, to the CPU and out to the target location. Carefully analyzing and optimizing that end-to-end chain is an important ingredient when taking the total volume of processing into account.

### ***Operability***

Many Masstech customers have ten or more HQS engines. At sites where their area variety of video servers, the same source file has to be transcoded for each server type, HQS does that simultaneously, not sequentially. One HQS engine can handle all the different server types, but extra HQS engines can be added if the volume of content is too great for the transcode time available.

HQS also has an in-built priority mechanism so the customer can push the urgent files through ahead of the rest.

### ***Manageability***

Managing the HQS is also different. There is another management choice – employ the expertise to manage a typical vendor transcode farm or buy a technological solution that has all the expertise built into the box to make the optimization decisions, on the fly, for the selected transcode target. On the rare occasion a tweak is need to a particular output characteristic, it can be done immediately via remote access.

It is a matter of producing pictures with less worry about the technology.

### In conclusion

Content providers need to distribute content in multiple formats, resolutions, and bit rates, and the complexities of transforming content from one format another are not likely to get simpler over time. Moving content to various devices within a broadcast ecosystem will tremendously heighten the volume of content requiring transcoding. Key factors such as Speed of the transcode, Preservation of the metadata in the source file, Quality of the output along with the aforementioned accompanying characteristics will affect the customers' choice of the transcoder. Highly scalable transcoding solutions that are embedded into the full product offering (owning the whole factory and all the components in it) will help content providers address the complexities of this content delivery. This is now a mainstream, practical and necessary tool for virtually every station.

