BroadcastEngineering

European operators face close decisions over HD contribution encoding

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TVI's satellite truck is equipped with an ATEME MPEG HD encoder.

The announcement late January by Portuguese broadcaster Televisão Independente (TVI) that it is upgrading its SNG vehicles to H.264/MPEG-4-capable contribution encoding systems has set the agenda for other European broadcasters over the next two years. Many operators have to prepare for a world where most content is HD, which requires more efficient encoding than current MPEG-2 products working in an 8-bit profile.

Significantly, TVI has opted for a system from French encoding vendor ATEME that is capable of encoding in the H.264/MPEG-4 10-bit profile, even though it will be operating the product in MPEG-2 mode for now. The decision to start installing MPEG-4-capable encoders today in SNG vehicles used for HD coverage of soccer matches for worldwide satellite distribution by the EBU was made so the broadcaster ready when MPEG-4 10-bit contribution becomes more widely deployed in the broadcast community, according to TVI's chief technology officer José Nabais.

This raises an interesting point because not all broadcasters and operators will migrate to MPEG-4 encoding for contribution, even though they will use it for distribution at lower bit rates around 50Mb/s. There are other options for contribution, notably JPEG 2000, which is being promoted strongly in Europe by T-VIPS of Norway and Swedish media transport vendor Net Insight. The choice made will depend on several factors, including cost of bandwidth, the application and need for interoperability with other broadcasters or operators during the contribution cycle. The principal choices are doing nothing, migrating to MPEG-4 (either 8-bit or 10-bit profile), adopting a version of JPEG 2000 or going to completely uncompressed HD video.

The last option is the least common, and it seems surprising at first sight that any broadcaster or operator would take that path given that most of the industry is going for greater compression, not less. After all, raw HD generates 1.5Gb/s, and double that for the

1080p version that will be deployed in coming years. But given the falling cost of bandwidth across regional and global IP fiber-optic networks, it is sometimes worth trading that cost for the savings that can be made by reducing the need for skilled engineers on-site for external broadcast events, particularly soccer matches in Europe. Such remote operation requires the ability to transmit full uncompressed video over terrestrial links.

European telecommunications operator TeliaSonera, headquartered in Stockholm, already provides uncompressed HD video transport from soccer stadiums and horse racing tracks across Europe over its IP fiber backbone network, arguing that the extra bandwidth cost is usually more than repaid by being able to get rid of satellite vans and centralize production from the external sites to the studio.

“It also removes a layer of complexity and takes away a point of failure by avoiding compression,” said Per Lindgren, founder and vice president for business development at Net Insight, which supplies transmission systems to TeliaSonera.

In practice though, as Lindgren agrees, modern encoders hardly ever fail, so the main argument is economic. A reasonable question then is why operators would not adopt the recently developed, mathematically lossless version of JPEG 2000. This guarantees that no picture quality is lost during compression, even in theory, and even after repeated compression/decompression cycles, while reducing the bandwidth of HD streams down from 1.5Gb/s to around 500Mb/s, varying between 400Mb/s and 600Mb/s depending on the content. There is then some variation in the degree of compression, but the main reason for sending video uncompressed is timing. The JPEG 2000 compression process imposes a delay of about 100ms, which can be a problem for broadcasters using remote-controlled cameras with centralized production, which is precisely the application promoted by TeliaSonera.

But for the great majority of cases, contribution compression will continue to be required for years to come, with the focus being on making it effectively as near lossless as possible. This has given JPEG 2000 an edge because even without the mathematically lossless option, it is virtually lossless at bit rates down to 150Mb/s. It is only at bit rates below 70Mb/s when JPEG 2000 starts to break down, making it unsuitable for distribution.

However, there are two other factors. First, while it is true that MPEG-4 compression has until recently been inferior to JPEG 2000 for contribution, this has been in large part because it has been implemented in 8-bit profile. The profile refers to the number of bits used to encode video components for compression, and 10 bits are used at the production stage to produce SDI signals. The video then has to be downscaled to 8 bits and subsampled prior to encoding to use MPEG-4 8-bit profile encoders, causing degradations and artifacts such as color bleeding and smearing. Furthermore, these artifacts increase with each compression cycle.

These problems have been largely fixed, however, with the 10-bit profile version of MPEG-4. This avoids the downscaling after production, virtually eliminating progressive degradation during repeated compression cycles and making the encoding almost lossless at bit rates comparable to JPEG 2000. In fact, MPEG-4 allows profiles in the range of 8 bits to 14 bits, but research has found that while 10 bits yield a huge improvement in encoding efficiency over 8 bits, there is relatively little further gain at higher rates up to 14 bits.

It may be that JPEG2 000 is still marginally superior, but the use of MPEG-4 enables broadcasters to standardize on a single compression technology across the whole contribution/compression path. As a result, Net Insight's Lindgren predicts a close battle between JPEG 2000 and MPEG-4 over the coming year or two, even though he insists the former will yield slightly higher quality.

The second factor concerns standardization, where MPEG-4 wins out because of the long history of interoperability in the MPEG world. The JPEG 2000 world, on the other hand, is split between two camps. JPEG 2000 was actually conceived well before year 2000 and was far too complex for cost-effective deployment on the hardware of the day. But the standard proved its quality in a few military projects and was then adopted by Analog Devices, which developed a proprietary implementation on its chipset. By combining multiple chips, it became possible to encode video at much higher resolutions than with the main alternative, MPEG-2. Current JPEG 2000 products evolved from this version, but more recently, an alternative implementation emerged that takes advantage of contemporary Field-Programmable Gate Arrays (FPGAs). This gave a new generation of would-be compression vendors a potential leg up into the market.

This has led to the two camps to lock horns in various workgroups, and the eventual outcome is unclear. Yet the long-term success of JPEG 2000 depends on consensus emerging on a common standard, or else the MPEG-4 10-bit profile will most likely become the favored compression mechanism, especially in Europe. Still, the lack of standardization has not deterred many operators from deploying JPEG 2000, with T-VIPS and Net Insight enjoying considerable success.

Indeed, some operators are assuming the standards issues will be resolved and are adopting JPEG-2000 in the belief that this will deliver the best results at relatively high contribution bandwidths above 300Mb/s.

"Some customers, when planning their new contribution systems, look 10 years forward," said Johnny Dolvik, CEO of T-VIPS. "ORF in Austria selected IP network and JPEG 2000 compression to meet both current and future needs. Our JPEG solution gave them the option of SD, HD, 3G and 3D within the same unit."

It is true that most current adopters of JPEG 2000 are large operators with their own IP networks where the lack of interoperability between different vendors' transcoders does not matter so much. In such cases, JPEG 2000 does have one big undeniable advantage: It is only about half the price. But companies involved in the wider contribution ecosystem, backhauling video to affiliates who subsequently decode prior to distribution, are deterred from using JPEG 2000 because they cannot impose a single vendor's codec on their partners.

The future of the contribution compression scene, therefore, depends partly on the outcome of the JPEG 2000 standards battle, but either way, the MPEG-4 10-bit profile will be a major player. There will also be the option of totally uncompressed video for centralised production, but very few operators will be able to justify the cost of 1.5Gb/s or 3Gb/s per channel for sometime to come.