Enhancing network capacity with IP and compression

by Oddbjørn Bergem, CEO, Nevion

Maximising network capacity is a critical goal for video network service providers. Video over IP offers the flexibility to scale bandwidth to provide just the right amount of throughput to deliver content. JPEG 2000 compression maximizes the capacity of any video network, but works best in an IP environment. JPEG 2000 and IP are a perfect match, providing flexibility and scalability while delivering the video quality that service providers and their broadcaster customers have come to expect from professional contribution transport.

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It's no secret that in today's climate, maximising network capacity is a - perhaps the - critical goal for video network service providers. More capacity brings the ability to transport more content, which brings more revenue. Capacity is the currency of today's video network. The more you have, the more valuable your network. Further, more efficient use of available bandwidth creates greater efficiencies and lowers costs. Simple enough, but increasing network capacity, especially under budget constraints, requires ingenuity, forethought and maximising the benefits that state-of-the-art technology can provide. Whether fine-tuning an existing network or implementing a new infrastructure, a network that maximises capacity requires not only careful consideration of the entire transport chain, but also the monitoring, control and management of that chain. Intelligently managed video networking can go a long way towards contributing to increased capacity. All in all, a worthwhile endeavour considering that the benefits of increased capacity - from more content transport to lower costs - translate directly to increased ROI.

The gifts of managed IP

IP's inherent properties bring several key advantages in terms of efficient capacity usage. Think of it as an environment of un-wasted space. Video over IP offers the flexibility to scale bandwidth to provide just the right amount of throughput to deliver content. IP is not limited by performing only at predefined speeds, where bandwidth is often unutilised because of the need to have extra bandwidth for peaks. Unlike SONET/SDH (*Synchronous Optical Networking/ Synchronous Digital Hierarchy*), the need for 160Mbps of bandwidth does not force the user to consume two OC-3 circuits (155Mbpsx2) potentially wasting 150Mbps of unused bandwidth. IP is a highly flexible environment of easily addressable direct connections, a significant departure from the manual setup of a traditional point-to-point broadcast network. However broadcasters, in particular, must have the confidence that IP can deliver consistently high-quality, and be assured that it comes with the essential reliability and performance that the industry expects. IP is standardised, highly flexible, and can deliver guaranteed quality of service, as well as low capital and operating expense when it is properly engineered and managed.

An IP video delivery chain entrusted with professional contribution video must deliver consistently excellent quality of service.

The rise of HD (*high-definition*) and increasingly 3G has also increased bandwidth requirements for broadcast contribution systems, highlighting the need for maximising capacity. Legacy infrastructures - satellite, SONET/SDH and ATM among them - are costly as they offer more limited scalability and flexibility for HD transport. IP offers broadcasters an easy and efficient way to avoid costly infrastructure overhauls while staying competitive and moving with the rising tide of HD adoption.

For those considering migrating to IP, modular solutions mitigate costs and often integrate with legacy infrastructures. Instead of complex, expensive installation of less ubiquitous, flexible and configurable equipment for video networks, IP solutions provide economies of scale in addition to bandwidth optimisation.

JPEG 2000 - the big squeeze

JPEG 2000 compression is a valuable tool for maximising capacity in any video network, but it's particularly valuable in an IP environment. In many ways, JPEG 2000 occupies a place in the industry similar to that of IP some years ago - known but not widely understood.

JPEG 2000's underlying structure is the key to its advantages. The highly flexible code stream obtained after compression of an image is scalable and can be decoded in a variety of ways. As a standard, JPEG 2000 allows for high bitrates - much higher in implementation than H.264. This is critical for high-quality transport, because certain infrastructure types impose bandwidth limits that are strict, but not severe. For example, HD will not fit into Gigabit Ethernet or OC-12 (622Mbps), but the entire pipe can be dedicated. So you can compress very lightly to fit into the pipe and achieve high-quality visually lossless compression. This also leverages the bandwidth scalability that is inherent in IP, where video can be transported at a desired rate with JPEG 2000, never consuming more bandwidth than is required.

JPEG2000 outperforms MPEG-2 Intra throughout the entire bit rate range, and can scale to higher rates than H.264. At the low end of the bit rate spectrum, H.264 outperforms JPEG 2000.

With the scalability of IP networks, the optimal amount of compression can be applied in order to use a minimum amount of bandwidth. Any two nodes can be connected in real-time, without the need to establish permanent circuits, thus providing extreme flexibility in bandwidth distribution. For these significant gains, JPEG 2000 and IP are a perfect match, complementing each other with flexibility and scalability while delivering the highest video quality that service providers and their broadcaster customers have come to expect from professional contribution transport.

JPEG 2000's low latency compression, and ability to maintain high video quality even after multiple encode/decode cycles, ensure that its advantages in network capacity are not outweighed by unacceptable disadvantages. Increased capacity without end-to-end quality is worthless. In a similar way, professional deployments of video over IP take full advantage of forward error correction (*FEC*) and buffering to ensure that when video arrives at its destination, its quality does not suffer due to packets that might have been delayed in transit.

Even with extreme compression, JPEG 2000 compressed images degrade with subtle blurring - not annoying blocking and tiling.

Video services management - increased capacity

Advanced video services management can enable more capacity through better resource management. In addition to efficient planning for capacity through inventory control and performance data, the most sophisticated management systems provide the ability to adapt to needs that can change in minutes.

A look at a recent IP-based HD video transport application for a high-profile European sports broadcasting organisation perfectly illustrates how smart video services management can reduce the infrastructure required in a video-over-IP network, thereby extending network capacity and saving costs.

Onside TV Production, the media production arm of the Swedish Football Association, the governing body of football in Sweden, receives content from small studios onsite at 16 different stadiums. Its programming is known as Klubb TV. Historically, these remote studios could only make file-based transfers to Onside TV's main production facility often more than 50km away. Through the installation of a JPEG 2000/IP transport compression solution and advanced management software at Onside TV, Klubb TV's local production sites are able to stream live content over a 100Mbps IP circuit. Perhaps even more significantly, the connection management function of the IP management platform now enables the primary production facility to use only three decoders to support the 16 different locations by dynamically shifting the connections to where they are needed - whether scheduled in advance or on an ad-hoc basis. Further, the on-site studios are now able to connect directly to the main facility and utilise web-based tools to manage their content. The management platform also provides key scheduling, provisioning and complete monitoring of all video-over-IP services.

By implementing a JPEG 2000/IP solution and advanced connection management, the Swedish Football Association's Klubb TV can stream live content to a primary production facility, where only three decoders are used to manage connections with 16 stadium-based studios.

The ability to link to multiple locations on an as-needed basis enables rapid and flexible content production and delivery. Even more significantly, installing hardware for nearly 20 dedicated connections would have been too costly for the production house. Technology and smart management combine to create multiple benefits. Perhaps nowhere is the proper management of live content more visible than in live sports broadcasting.

More capacity, more opportunities

There has never been a better time to take advantage of recent technological advances to improve network capacity, as well as the quality of the video we industry transport and manage. As always, getting the most from the latest technologies - from JPEG 2000 compression to video services management - requires specialised knowledge and the right choice of solutions. For example, nearly all JPEG 2000 implementations are based on the same chip technology. Each implementation's fine-tuning and optimisation will define its ability to meet and exceed expectations related to bandwidth maximisation, quality and latency. Likewise video over IP continues to evolve to provide greater security and deliver other benefits significant to professional broadcasters. The optimum combination of technologies can present service providers with game-changing new flexibility and efficiency. Maximising capacity to make bandwidth not just available, but attractive, to broadcasters at a price they can afford, is a goal that makes the required research and planning a very good investment, both for short-term gains and over the long haul. ●