WHITE PAPER

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TEXAS INSTRUMENTS

TI's vision for video infrastructure

Introduction

Any content on any screen, anytime, anywhere. It's one of the key challenges that station owners, networks and other video content providers, multichannel operators, advertisers and wireless carriers face as audiences expand their viewing across TVs, PCs and mobile phones.

That challenge is also an opportunity. For example, when a programmer or station owner can continue to serve an audience when they're away from the TV, that extended reach makes them a more attractive vehicle for advertisers.

The ability to deliver programming to PCs is key to meeting growing consumer expectations for on-demand content. Online video, as a form of video-on-demand (VoD), will be a powerful, effective way for programmers and other content providers to meet audience expectations. The catch is that programmers must assess how best to archive and distribute their content in order to provide the optimum viewing experience regardless of each user's connection speed and device capabilities.

Another emerging challenge is the industrywide migration toward H.264. Today, there are more than 50 million MPEG-2 set-top boxes (STBs) in deployment. However, several content providers, including HBO, ESPN and Scripps Networks, are among the growing number of programmers now sending H.264 content across the network.

In August 2008, DISH Network began transmitting all of its standard- and high-definition (SD and HD) programming in H.264. While the transition from MPEG-2 to H.264 will occur over time, it is clear that higher resolution content and the increasing ability of devices to support the more complex codec will spur the changeover.

The rise of H.264 highlights one of the few certainties in an uncertain market: Standards will always be emerging, evolving and fading away. As a result, it's critical that station owners and multichannel operators specify and deploy infrastructure and user devices that are flexible enough for field upgrades, high performance enough to deliver real-time content with no latency, and low power enough to comply with operational criteria.

This white paper summarizes these and other major trends in the video infrastructure market over the next decade. It discusses the challenges and opportunities that these trends create for station owners, networks and other video content providers, multichannel operators, advertisers and wireless carriers. This paper also looks at how those trends affect infrastructure and device vendors as they seek to anticipate and meet those companies' needs.

MPEG-4 and beyond

MPEG-4 (including MPEG-4 Part 10, also known as H.264 Advanced Video Coding [AVC]) is well on its way to becoming the dominant compression standard. That's because it frees up bandwidth – such as in cable plants and on satellite transponders – that can then be used to deliver additional programming, particularly HD (linear and VoD).

For HD, MPEG-4 is 30 to 50 percent more efficient than MPEG-2 and 30 to 40 percent more efficient when used with SD. At the very least, migrating from MPEG-2 to MPEG-4 reduces the need to add capacity, which is capital-intensive.

This migration is prompting major changes to infrastructure and user devices. For example, as networks deliver more programming in MPEG-4/H.264 AVC, headends have two choices. They can add the capability to support it and pass it along to customers, or they can convert it to MPEG-2, especially if they won't be migrating their installed base of MPEG-2 set-top boxes to hybrid units anytime soon.

Considering that there are more than 50 million MPEG-2 set-top boxes deployed and that they have a lifecycle of more than five years, the challenge of balancing the two technologies will continue for at least the rest of this decade.

Audiences increasingly expect to watch content on their terms: on demand and on devices such as PCs and mobile phones. Broadcasters and other content providers must address these preferences partly on the network side, such as in headends or near the edge of the cellular network.

Compression versus features will play a role in next-generation codecs – whether they are based on MPEG-4 or some other codec. As the need to conserve bandwidth is weighted against newer features and functionality within the codec, the direction of this market will be established.

PCs meet TVs

When it comes to PCs and TVs, "convergence" isn't hype; it's reality. Twenty-five percent of U.S. Internet users have watched a full-length TV program on their PC in the past three months, according to an October 2007 Nielsen Media Research survey.

Online viewing is even higher for some age groups. For example, 39 percent of respondents in the 18 to 34 age bracket had watched TV online. Among those in the 35 to 54 age bracket, it was 23 percent.

One reason why online viewership will continue to skyrocket over the next few years is that programmers are putting not only more content online, but highly desirable content. One example is CBSSports.com, whose NCAA March Madness on Demand service broadcast all 63 games of the 2008 NCAA Division I Men's Basketball Championship. Another is NBC Universal, which put thousands of hours of video from the 2008 Olympics online for viewing both live and on-demand.

In January 2008, NBC Universal said that NBC.com had served more than 500 million video streams in about 12 months. That level of viewership is a major reason why many programmers – such as MTV Networks – now structure their contracts with cable operators, satellite operators and telco TV providers so that they retain the right to distribute their content online. At the same time, growing online video usage helps cable operators and telco TV providers upsell their video-only subscribers on broadband.

One challenge is the wide variety of PCs and connections that audiences use to watch online video. Another challenge is that some programmers' contracts with multichannel operators limit the video's size (e.g., less than full screen) to reduce the chances that some audiences will watch shows entirely online, thus siphoning off advertising revenue from multichannel operators.

That's why ensuring a good viewing experience is an elusive goal for station owners and networks. One option – call it the "brute force" method – is to store their content in multiple ways and then deliver it in multiple standard formats in order to accommodate as many types of PCs and connections as possible.

A second option is to archive their content in only a few ways or even just one way and then transcode it on the fly to meet each viewer's requirements. This approach uses more finesse than force, and it's best executed using infrastructure based on digital signal processors (DSPs). That's because DSPs have the power necessary to handle processing-intensive tasks such as transcoding and compression in real time, with no noticeable impact on image quality.

DSPs are constantly advancing in terms of processing power and features, but some of today's DSP-based systems-on-chip (SoCs) already easily support a variety of HD video processing and multichannel applications, such as video transcoding. One example is simultaneous, multiformat HD encode, decode and transcoding up to H.264 HP@L4 (1080p 30 fps, 1080i 60 fps, 720p 60 fps).

This inherent DSP flexibility allows broadcasters, networks and other content providers to deliver video on myriad devices, from TVs to PCs to mobile phones, in formats that best match each device's capabilities. This flexibility also helps content providers monetize the long tail by transcoding their assets not only for the online distribution, but over mobile phones, too.

Using DSPs for real-time content transcoding has another key benefit to operators beyond the flexibility to address changing standards. DSPs – because of their architecture, use of acceleration and integration of CPUs, memory and I/O – deliver superior performance per watt of power consumed relative to other options.

In video systems, DSPs can consume as little as one-fifth the power of a general-purpose processor for similar video processing tasks. Ultimately, this sort of efficiency will help lower operational expenses associated with running the equipment. Moreover, as content providers migrate toward real-time transcoding solutions in favor of storing content in multiple formats on servers, DSP solutions can reduce demand for equipment and the electricity associated with running them, lowering costs and helping to keep our planet green.

Mobile video

In developed countries, most people never leave home without three things: their wallet or purse, their keys and their mobile phone. The latter creates opportunities for station owners, programmers and multichannel operators to serve audiences when they're away from their TVs or PCs.

For example, by leveraging wireless to extend their reach, station owners, programmers and multichannel operators create new revenue opportunities because advertisers now can use them to target audiences when they're on the go. Companies such as GoldSpot Media are already targeting this market with ad-insertion platforms and services for mobile video.

Mobile phones also are an effective way to reach certain demographics – such as teen-agers, young adults and business travelers – that aren't near a TV for most of their day. But mobile TV's appeal cuts across the board. In a February 2008 survey by CNN and Ericsson, 34 percent of respondents said TV is the application they most want on their mobile phones. Forty-four percent said that they plan to start using mobile video within the next two years. Of those already using it, 24 percent watch it daily, and more than half watch it at least once a week.

Figure 1: Summarizes on-line viewing across the major broadcast networks

Network	Videos viewed in millions	Minutes viewed in millions
ABC	47.3	28
CBS	33.8	104
NBC	25.3	62
FOX	1.4	2

Examples:

NBC: The Office: September 27, 2007
Season 4 premier, TV viewers = 9.7 million
On-line viewers = 2.7 million

CBS: Jericho February 12, 2008
Season 2 premier, TV viewers = 8.1 million
On-line viewers = 520,000

Figures are for December 2007 Source: comScore

The future of mobile video is tied partly to multichannel operators' quadruple plays (broadband, video, wireline voice, wireless voice). Over the next few years, multichannel operators will increasingly expand their mobile offerings beyond their wireless carrier partners' macrocellular networks. For example, today mobile subscribers can download or stream programs to their phones over their wireless carrier's outdoor cell sites. But many cable companies and telco TV operators are considering deploying STBs with built-in femtocells, which are mini cellular base stations designed to cover the inside of a home.

Femtocells may spur mobile video adoption if the femtocell service includes a flat-rate data plan that's cheaper than connecting to the macrocellular network. (For example, a subscriber might choose to download video content over the femtocell for viewing later rather than paying extra to stream it over the macrocellular network.)

Programmers, multichannel operators and station owners should keep an eye on STB femtocell deployment and adoption because it affects the market for video viewed on mobile phones.

Regardless of whether mobile video is delivered over macrocells or femtocells, one challenge is accommodating the diversity of mobile phones in terms of display size and resolution, processing power, memory, and battery life. As with PCs, programmers and station owners must decide whether to use the brute-force method of storing content in dozens of formats or archiving it one way and then transcoding it on the fly to match each device's capabilities and requirements.

For wireless carriers, more subscribers using mobile video generates more demand for capacity at each base station. Increasing capacity – whether it's by adding transceivers to existing base stations, splitting cells or both – isn't cheap in terms of capex or opex (e.g., backhaul). This dilemma highlights the value of compressing video as much as possible in order to reduce the network impact. Compression-related savings directly affect a wireless carrier's competitive position by improving their ability to price mobile video services competitively yet profitably.

Today, most mobile phone browsers lack the ability to display video from sites other than those operated by the subscriber's wireless carrier and/or its business partners. This walled garden approach eventually will fade, and when it does, wireless carriers must be prepared with infrastructure and mobile phones capable of working with a variety of video formats. Otherwise, they run the risk that subscribers will have problems. That could lead to churn or increased overhead costs as subscribers flood carrier call centers to get help.

Like other members of the mobile video ecosystem, wireless carriers also benefit from a DSP-based infrastructure, which can be programmed in the field to take advantage of new compression standards as they become available. DSP-based platforms are also capable of supporting all major air interfaces as well as multi-carrier systems within a single base station. This power-efficient approach ensures that video content can be delivered across disparate global networks.

DTV and beyond

The analog-sunset mandates in countries such as China and the United States are just the first step in the worldwide migration to DTV. That's because most of the HD studio cameras deployed today are capable of 1080p, as are roughly 80 percent of HDTVs sold thus far.

That installed base means that station owners and other content providers must be prepared to migrate from 720p and 1080i to 1080p. This migration is also driven by the growing amount of 1080p content available from operators such as DISH Network. That selection will increase consumer expectations about HD.

To meet those expectations, station owners and multichannel operators will need to use advanced compression to reduce the impact of 1080p on their infrastructure. DSPs directly address this need by providing the power necessary for real-time, processing-intensive tasks such as compression. DSPs also are programmable in the field, giving station owners, programmers or multichannel operators the ability to upgrade to more efficient compression standards as they become available.

Interactivity and user-generated content

Broadcasting no longer is a one-way medium. Today's audiences increasingly expect to be able to interact with content providers and their fellow viewers. For broadcasters, this means adding capabilities such as viewer-generated tickers, which display comments submitted via e-mail, instant message (IM) or short message service (SMS).

Advertisers, meanwhile, want new options for placing their messages, either across the bottom of the screen or embedded in tickers. Broadcasters and multichannel operators adding such capabilities will create new revenue opportunities.

Another trend is the popularity of user-generated content, which has rapidly expanded beyond mainstream sites such as YouTube to include niche plays such as GodTube. HD-capable cameras enable users to generate broadcast-quality content, which can then be distributed to a host of content providers. In fact, many recent disasters have been first reported by "citizen journalists," who captured video that was viewed on broadcast and Web networks worldwide.

Over the next few years, multichannel operators will launch videoconferencing services aimed at the consumer market. These will include telepresence, which uses HD video to make the conference seem more like an in-person meeting. Because it's HD-centric, telepresence will increase the need for advanced compression technologies in order to avoid overloading the network. And as with online video, videoconferencing and telepresence will require networks and endpoints with DSPs capable of handling a variety of compression standards in order to maintain quality.

Targeted advertising

Many multichannel operators have launched dynamic ad insertion, where commercials are selected based on information about a particular subscriber. For example, suppose that the STB reports to the network that it's often tuned to channels with children's programming during the day. In the evening, the network might insert commercials for an upcoming Disney on Ice event, based on the assumption that at that time of day, parents are watching TV and might be interested in ads for products and services for their kids.

Dynamic ad insertion is becoming increasingly common, as equipment sales show: In 2006, worldwide sales of ad-serving and -splicing equipment were $284 million, according to ABI Research. By 2011, that market will be worth about $1.8 billion.

This outlook is based largely on the many ways that targeted advertising can be delivered across VoD and linear programming. As ABI Research noted, “The increasing intelligence of ad servers will mean that providers can insert, for instance, localized ‘ticker’ ribbons across the bottom of a screen; they will also offer the ability to click onscreen links or objects to find related information on the Internet.”

Conclusion – flexibility and future-proofing (This revolution will be televised)

Technology changes are causing consumers to change their viewing habits and giving operators and content providers reason to re-think their strategies for video content capture, storage and distribution. The proliferation of HD content and growth of user-generated content; the growing number of networks across which that content is delivered; the evolution of compression standards; and the myriad end-user devices that need to be supported are among the market forces that are causing equipment manufacturers to turn DSPs as the basis for their platforms.

DSPs are ideal not only for today’s video applications, but for the demands of tomorrow’s, too. That’s because unlike rigid application-specific integrated circuits (ASICs), DSPs are flexible enough to be upgraded in the field to support new technologies and compression standards, such as the latest codecs. That flexibility is particularly important for equipment vendors and their customers at times when standards are still in flux, yet market conditions are propelling them toward the latest technology available.

Moreover, DSPs deliver very high video processing performance at a fraction of the power consumed by comparable ASICs and general-purpose machines, helping operators reduce operational expenses while leaving our planet in better shape. For these reasons, as the market moves forward, DSPs will be an important technology at the center of the video revolution.

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