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IP transformation strategy for multiscreen video

The massive amount of content generated by over-the-top (OTT) video services and applications that is carried by broadband networks, essentially without charge, is a potential threat to the business of the traditional video service provider.

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This challenge is compounded by rising demand as increasing numbers of people use IP devices – such as smartphones, tablets, mobile-broadband enabled laptops and connected TVs – to watch video at home, at work and while on the move.

Meeting the challenge

In the short term, operator portfolios should include IP-based video services that meet the demands presented by changing consumer behavior. At the same time, operators need a repositioning strategy based on long-term IP transformation – a strategy that results in reduced operating expenses and increased revenue.

Digital natives (the generations that have grown up with broadband internet and the mobile phone) have discovered a wealth of video online – but not on their TV sets. Instead, they consume an increasing amount of video on their smartphones, tablets, and other portable media devices; they choose the best screen available to watch their programs and movies; they are pragmatic when it comes to where content originates, and show no obvious loyalty to any single video-content aggregator.

As the digital natives lead the way in the multiscreen television-viewing experience, other consumers in all demographic groups are following suit. Some of the developments fueling the move away from traditional TV behaviors are:

- the increasing reach and penetration of high-speed broadband, boosting download speeds and streaming quality;
- the dramatic increase in the use of broadband-connected devices, from gaming consoles to Blu-ray players to smartphones and tablets; and
- the growing volumes of premium content (including long-form content from major content providers) being made available online legally.

These developments are a threat to TV service providers, who have built up their businesses by delivering content to the TV set in the living room – a business model based on linear channels, PPV events, VoD movies, catch-up TV, and start-over TV. This model doesn't fit the IP-based multiscreen world, and traditional providers are facing revenue losses from declining subscription figures and the migration of advertisers to other media. Retaining viewer attention is key to preventing major content owners and brand names from turning to the internet to deliver content, marketing entertainment, movies and subscription-based content directly to consumers via websites and apps – bypassing the traditional provider entirely.

Online-video aggregators could become major competitors. Each time a subscriber views content from another source or on the screen of another device, there is a chance that they will take their business elsewhere entirely, eroding subscriptions and revenue.

TV service providers tend to have long-established relationships with content providers, and these relationships constitute valuable assets that allow them to offer premium content to subscribers. These content providers tend to be trusted and recognized household names that have long been in the enviable position of being the primary provider of TV services to the televisions in people's homes. TV service providers have plenty of advantages over new entrants into the business, and are in a good position to address the challenges presented by the IP world.

If keeping viewers entertained is a key ingredient to ensuring continued business, then a service-delivery system that can extend home-TV services over

BOX A Terms and abbreviations

AAC	Advanced Audio Coding
AC3	an audio format
API	application programming interface
AVC	advanced video coding
CMS	content management system
DASH	Dynamic Adaptive Streaming over HTTP
DOCSIS	Data Over Cable Service Interface Specification
DRM	digital rights management
DSL	digital subscriber line
HEVC	High Efficiency Video Coding
HTTP	Hypertext Transfer Protocol
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IPTV	Internet Protocol Television
ISO	International Organization for Standardization
LAN	local area network
LTE	Long Term Evolution
MPEG	Moving Picture Experts Group
OTT	over-the-top
PPV	pay-per-view
SCTE	Society of Cable Telecommunications Engineers
SDK	software development kit
VoD	video on demand

any network is a critical part of achieving that objective. TV services that can be provided over any network can be consumed almost anywhere on a wide variety of consumer-electronic products, while subscriber identity and user preferences are maintained across all devices. Such a service-delivery system provides a seamless, multiscreen experience that can be integrated with existing systems to preserve investments.

ConsumerLab research

To assess the behavior of people consuming TV and video, Ericsson ConsumerLab has carried out new research into TV habits[1]. An analysis of the findings has led to the conclusion that three key developments are driving the migration from traditional independent broadcasting to an integrated multiscreen experience:

- linear multiscreen TV;
- new devices; and
- quality, usability and accessibility.

Linear multiscreen TV

The ConsumerLab survey revealed that 85 percent of consumers watch broadcast TV several times a week (see **Figure 1**), indicating that a live experience continues to be essential. In fact, some respondents said live TV is becoming increasingly important in a world of connected devices, Twitter, news apps, and e-mail, where it is hard to record a major sports event for later viewing without learning the outcome before being able to watch the program. Social networking has made TV a shared experience, where the online space is becoming a virtual living room for many people to share.

Early multiscreen offerings were primarily focused on on-demand viewing, but consumers are now expressing a strong desire to watch broadcast TV on additional devices. Extending the experience from the television to other devices is referred to as linear multiscreen TV.

New devices

People are using many new devices to view TV, both in and outside the home. The bars in **Figure 2** show that, in terms of average viewing time per week (15 hours), traditional TV is still the most popular viewing method. The figures also show that consumption using other devices – averaging about 25 hours per week – is growing rapidly. Portable devices, such as laptops, smartphones and tablets, are increasingly being used outside the home, as people gain access through Wi-Fi hotspots and mobile-broadband networks. Tablet devices – the iPad in particular – have

FIGURE 1 Consumer TV and video viewing habits – times per week[1]

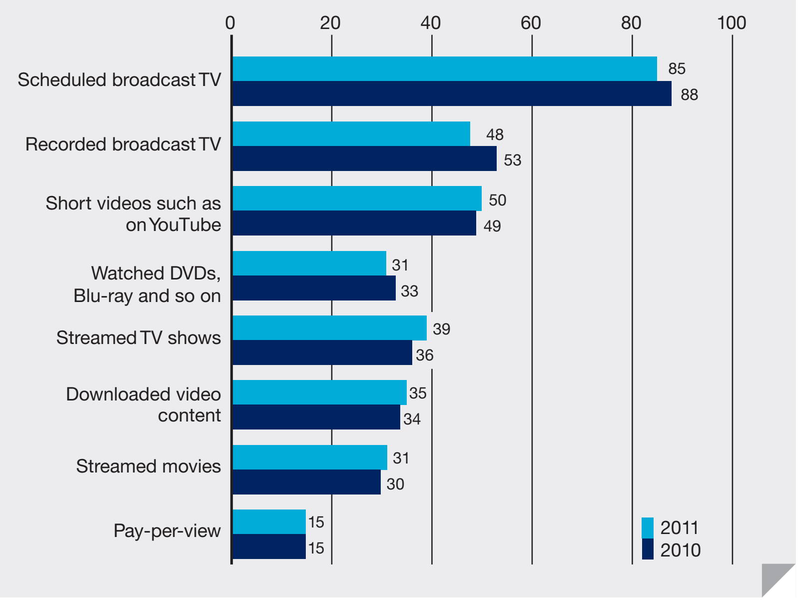


FIGURE 2 Average viewing hours per week per device[1]

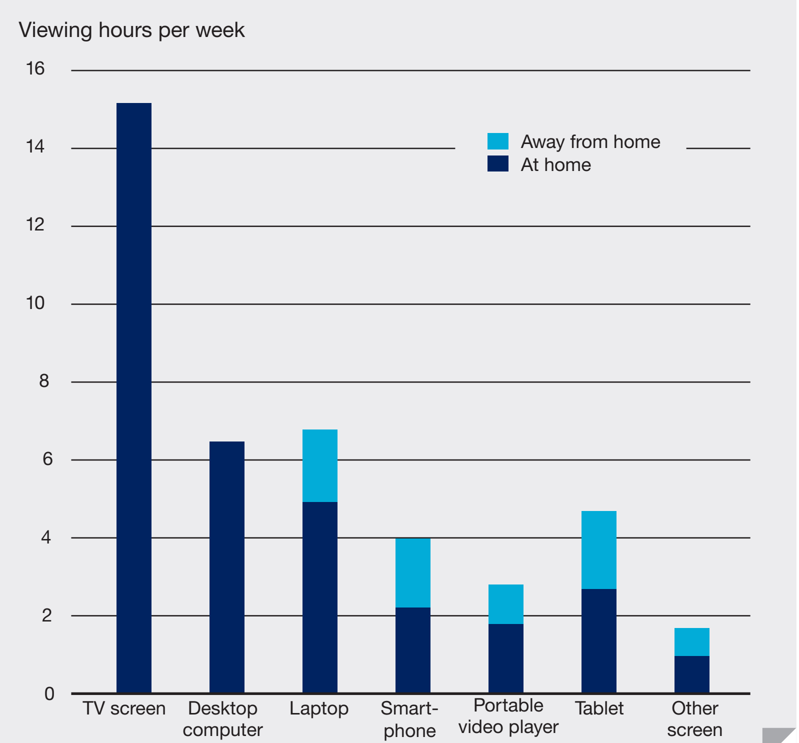
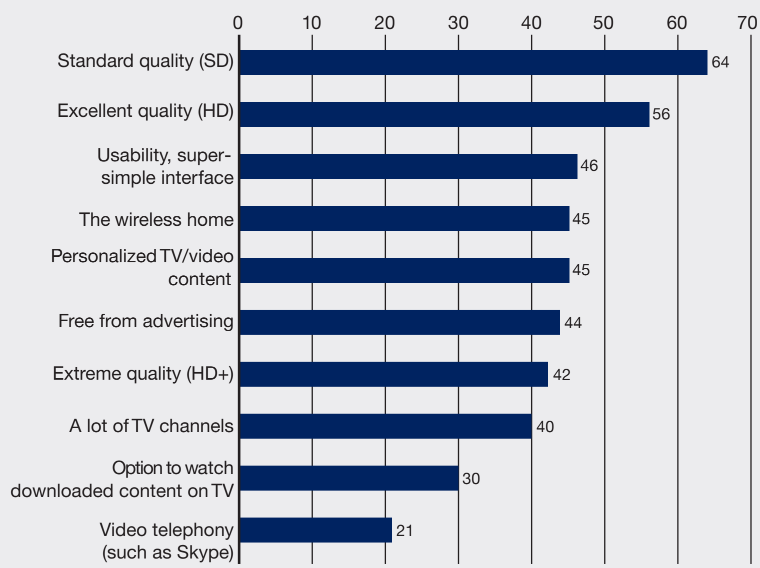


FIGURE 3 **Percentage ranking of TV video services in 2011**[1]



revolutionized online-video viewing, putting pressure on service providers to meet the need for broadcast and on-demand services to these devices.

Quality, usability, and accessibility

As shown in Figure 3, viewers ranked the most important features of TV services as quality, usability, and accessibility – the wireless home.

Quality – this is so important that it appears three times – standard, excellent and extreme. It is the one feature that consumers are clearly not willing to compromise on, and it is no coincidence that newer devices have high-resolution displays that allow people to benefit from higher-quality video.

Usability – a super-simple interface, this ranks as the next-most important feature after quality. As they switch from one device to another, people want to access content in the same way – they do not want to have to change the way they find their entertainment.

Accessibility – the wireless home is important because it allows the consumer to move the viewing experience easily from one room or place to another by using a portable device such as a tablet, or by session-shifting from one device to another, such as from a tablet to a big-screen TV.

Challenges

Changing consumer behavior has led video service providers to deliver services to new devices with the assured level of quality and usability their subscribers expect. New devices present a complex set of challenges:

- **the existing video-delivery infrastructure does not support the streaming media formats required;**
- **a high volume of content must be processed into multiple streaming media formats; and**
- **services must be implemented in an integrated manner to assure usability.**

Existing service delivery

The video-delivery networks of today were designed for managing and assuring bandwidth and user experience. New connected devices can access video content over IP on a home wireless network, a public Wi-Fi hotspot or a mobile-broadband network. However, these unmanaged networks generally do not provide guaranteed or consistent bandwidth. To support video delivery over such networks, HTTP adaptive streaming has therefore been developed (see Box B).

Today's video networks have been designed specifically to deliver the services they carry, and consequently they lack the flexibility to deliver multiscreen video services. Decoupling the service and application layers from the underlying subsystems that enable the actual delivery is an important part of creating service velocity – the flexibility to support rapid development and deployment of new services.

Processing

Some important elements of delivering video services to multiple screens are device-specific processing, content preparation, and metadata creation. To support the growing volumes of video streams and increasing diversity of device-specific formats, next-generation video-processing and preparation systems need to provide much greater scalability and flexibility. The requirements for video quality associated with multiscreen services will increase, and given that these services are an extension of the video service provider's brand, it is essential that delivery is reliable, with the highest possible quality assurance.

Usability

The video-viewing habits of today's consumer need to be satisfied to ensure that providers avoid losing revenue as people opt for OTT content – be it at home, on the move, at work – in fact anywhere users are likely to access content. A seamless multiscreen user experience, delivering uniform video services that offer functions such as preferences, bookmarking and favorites – across a user's complete range of devices – is clearly a requirement.

Addressing the challenges

Given all the challenges, the best solution for delivering multiscreen video services and associated content across all access networks is a unified open platform. By being open, a converged architecture platform (shown in Figure 4) enables rapid development and introduction of new services for all screens. The important functions are:

- **content processing – transcoding and packaging of video content into the necessary formats for all target devices;**
- **content management – processing of the metadata and organization of content processing required for video-service delivery to multiple screens and many devices; and**

- multiscreen user experience creation and service delivery – packaging and preparation of video-service offerings for consumers.

Content processing

The existing service-delivery infrastructure for broadcast services is well established. For IPTV, cable, satellite and terrestrial networks, each program is usually encoded twice – once for standard definition and once for high definition. However, content processing for multiscreen-service delivery is a much more computationally intensive function. Each channel must be encoded in several profiles and in multiple device-specific formats. Each class of device (for example, iOS, Android or Windows) can have different requirements in terms of format, resolution, and digital rights management (DRM), possibly requiring up to 10 different profiles (encoding rates) to support smooth transitions – a dramatic increase in the volume of real-time video processing.

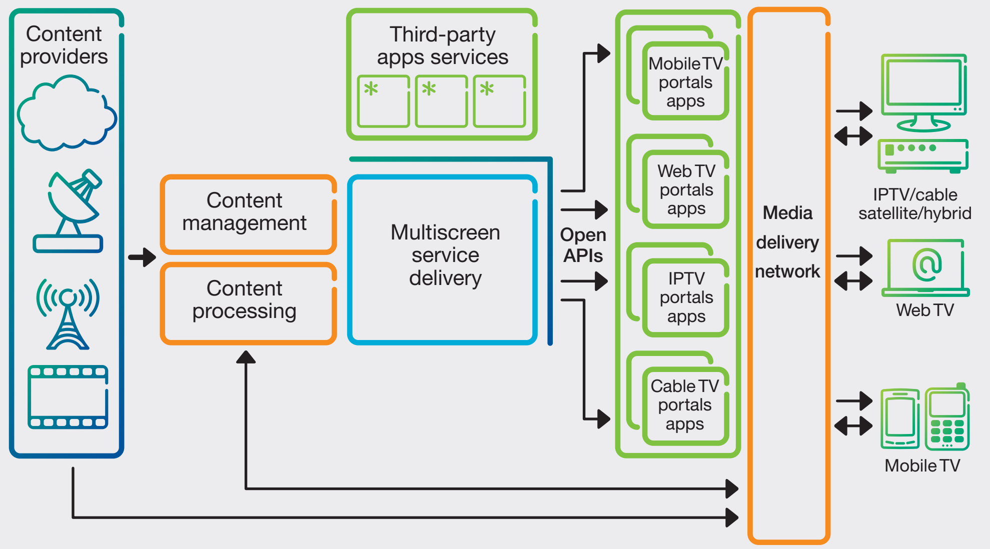
The content-processing parameters that impact user experience and ultimately operator brand reputation are resolution, picture quality and compression efficiency, all of which are equally significant for multiscreen and broadcast services.

- resolution – up to 720p60 meets the requirement for today's connected TVs; 1080p60 and higher will be required soon;
- picture quality – operator-supplied video can be differentiated from content delivered by OTT providers by applying the highest picture-quality transcoding; and
- compression efficiency – optimized file sizes make the best possible use of the available network bandwidth.

Relative to software transcoders, advances in hardware-based transcoding have improved picture quality, reduced power consumption, and increased density – providing a tenfold advantage in density over software implementations. Hardware-based solutions can be configured to treat different resolutions so that processing power can be applied to a mix of screen sizes and refresh rates in an optimal way.

For providers to scale their multiscreen TV services and offer a high-quality viewing experience, transcoding solutions must provide best-in-class adaptive streaming compression and segmentation. In this way, linear content can be delivered to any device with the density and flexibility required.

FIGURE 4 **Converged video-services architecture**



Content management

For multiscreen service delivery, content and metadata need to be processed for each network and for all supported devices, and delivered in multiple formats and profiles for each device type. The process for managing content is:

- a video asset is sent by the content provider in a given format (such as MPEG-2) to the video service provider – who usually has no control over the format of content received;
- an off-line transcoder generates copies of the asset in the required output »

FIGURE 5 **CMS in a typical network**

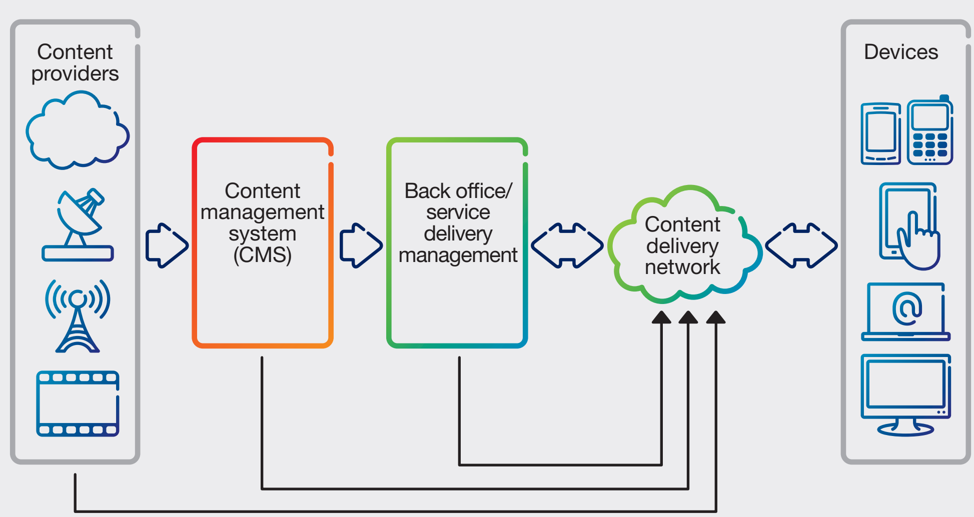
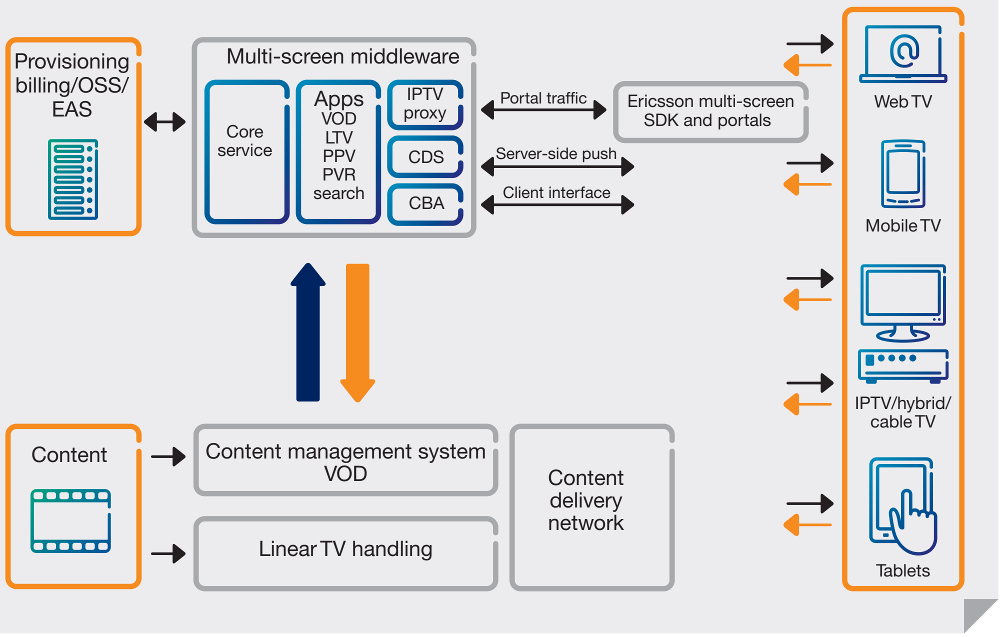


FIGURE 6 Multiscreen middleware



- formats at various resolutions, in a range of profiles, and in various containers – in line with services offered;
- the asset is placed into a content-delivery network; and
- metadata for the asset is processed, and catalogs are generated and published for delivery to navigation clients for all devices – so that subscribers can find the asset.

This process is repeated for hundreds of thousands of assets, which makes automation essential – manual operation on such a scale would be prohibitively slow, expensive, and prone to errors.

To manage delivery of content to multiple screens, devices, and networks effectively, a system that provides centralized management of metadata (in any format), customizable automation of content processing flows, and visibility of video assets throughout the entire content lifecycle is essential.

The Ericsson WatchPoint Content Management System and how it fits within a typical video service provider's network is illustrated in Figure 5.

Multiscreen service delivery

Many aspects of video services have little to do with the way in which services are delivered. For example, charging, subscription management, user preferences, parental control and ways of finding content are all part of a service but are independent of the delivery method. The software glue that binds video services together while remaining agnostic of the physical network is middleware, which creates an abstraction layer around video services and provides interfaces to the various service-delivery subsystems that fulfill them.

In a converged architecture, the middleware delivers video services to multiple screens on multiple devices, and links the user experience across those screens in an intuitive and seamless way. A subscriber may own several devices, each using different video formats and delivery protocols, and operating on different physical networks. Some examples of device setups are:

- a tablet may require MPEG-4 video with AAC audio delivered using HTTP live streaming over a Wi-Fi network;
- a traditional set-top may require MPEG-2 with AC3 audio encapsulated in an MPEG-2 transport stream, connected to a cable, broadcast or satellite network; and
- a mobile phone may require High Efficiency Video Coding (HEVC) with AAC audio delivered using MPEG DASH over an LTE network.

Ericsson's multiscreen middleware provides an integrated platform for deploying and managing video services across multiple networks to the ever-expanding universe of connected devices. At its core, it is an advanced service-delivery system, enabling a TV service provider to deploy and manage a broad array of TV services – not only via IPTV, cable, and satellite infrastructures, but also over broadband networks with a multiscreen experience. In addition to the services provided out-of-the-box, multiscreen middleware includes a complete set of software development kits (SDKs) and APIs, which allow the platform to be customized and extended to facilitate the rapid introduction of new services. The architecture is illustrated in Figure 6.

IP transformation

The adoption of an IP transformation strategy for multiscreen video should ultimately enable the video services provider to deliver all video over a single IP infrastructure. In the near term, such a strategy should support capping of investment in traditional platforms for video-service delivery, while allowing services delivered across old and new networks to be integrated with a converged control plane.

Operating and maintaining a single network infrastructure has clear long-term benefits, and as advances are made in optical and high-speed IP processing, networks can be upgraded continuously and independently of video-processing components. In addition, new services and applications can be added easily because they are independent of the underlying network.

In traditional video-service delivery networks, bandwidth is statically allocated according to service type. Spectrum in cable networks, for example, is statically allocated among broadcast, switched digital video, VoD, and DOCSIS channels. In a converged IP infrastructure, bandwidth can be assigned dynamically to video, high-speed-data and other services based on the traffic demand for a particular service at any given moment. As a result, the TV service provider can prioritize high-value services over lower-value ones – for example, by allocating more bandwidth to an ultra-high-definition television (UHDTV) PPV event than to a free-of-charge VoD program.

The adoption of HTTP adaptive streaming is becoming more widespread as the method of choice for video delivery to new devices over unmanaged networks – such as the internet – as well as over managed networks. Some of the operational advantages of HTTP adaptive streaming are:

- the ability to change video bit rate on the fly – the client can dynamically select the optimal profile according to display capabilities and network throughput;
- new profiles can be defined easily – taking advantage of next-generation coding such as HEVC or the addition of new resolutions such as 4K;
- only content that is actually viewed traverses the network;
- secure DRM based on content encryption is used rather than secure HTTP;
- a seamless mechanism for real-time ad insertion; and
- fast channel-change can be implemented by selecting low bit rate stream first.

Conclusion

A successful IP transformation strategy enables the video service provider to deliver video over a variety of physical networks using a common IP delivery ¬format. The service provider can deploy IP service delivery as an overlay extension to traditional video-service delivery mechanisms, such as MPEG-2 transport, and run both in parallel for as long as it makes economic sense to do so.

By introducing an abstraction layer across multiple service-delivery platforms in the form of converged multiscreen middleware, the migration to all-IP video services can be completed gradually, supporting a unified user experience across traditional set-top boxes and new IP devices. Linear multiscreen processing combined with CMS components is needed to support a wide variety of content formats, including HTTP adaptive streaming, to deliver content to all devices over both managed and unmanaged IP networks.

Such a strategy leaves service providers free to upgrade their networks continuously and independently of video-processing components as advances are made in optical transport and high-speed IP processing.

BOX B HTTP adaptive streaming

The experience of watching video over an unmanaged network is greatly improved when HTTP adaptive streaming is applied. This technique dynamically adapts the video bit rate to provide the best quality according to the bandwidth available to the client at any given moment. The source video is encoded at multiple bit rates – called profiles – and the client application requests the highest bit rate that the network can support, increasing or decreasing the rate as network conditions vary over time. By clipping video into segments that are aligned to, and commence with, corresponding I-frames, the client can play the video across bit-rate transitions in a seamless manner. The client determines the maximum bit rate it requests based on the device's processing power and screen resolution. HTTP adaptive streaming clients are becoming standard in PCs, tablets and smartphones.

Applications of HTTP adaptive streaming include:

- extending DSL reach – longer loops that do not have sufficiently high bit rates to carry full HD services can be used to support acceptable video quality;
- operation over wireless networks within and outside the home; and
- service delivery over the internet – extending the offering of the video services provider beyond the traditional area.

Three main competing and proprietary HTTP adaptive streaming protocols exist on the market today: Microsoft Smooth Streaming, Adobe Dynamic Streaming, and Apple HTTP Live Streaming. Recently, an effort was made to standardize a single approach – MPEG DASH – as an ISO standard and was ratified in December, 2011. MPEG DASH has the potential to unify the industry around a single standard, which promises to simplify the operations of IP video service providers – reducing the streams by a factor of three. Royalties have not been determined, and not all device manufacturers have committed to supporting it.

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