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Session: Shiftier and Shiftier – My Videos, Your Videos, Our Videos!

Seamless Content Consumption Across Media Delivery Channels and Devices Using Media Bundles

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Abstract

Bundled services like Triple Play, the rise of Internet video, and the increasing number of intelligent consumer devices such as personal video recorders and video-enabled mobile phones, are radically changing the way video is delivered and consumed. Convergence of video and data will enable providers to offer many new services. We first examine what types of new services and functionalities consumers desire. We then introduce an approach called Seamless Content Consumption based on the concept of media bundles and outline how these requirements can be addressed using this approach.

Introduction

Many people would agree with the claim that the way video is delivered and consumed is undergoing a radical change. Analysis of the television and Internet video domains yields a complicated picture that seems to strongly suggest that the TV-Internet convergence, announced

to be around the corner many times before but which never materialized, is finally taking place. Popular TV shows like *Lost* are available for download on the Internet and programs like *Web Junk 20* bring user-generated Internet video content to broadcast TV. While an unprecedented number of viewers flock to Internet video sites such as YouTube, TV viewership is at an all-time high. On the provider side, cable companies have successfully started to bundle video, voice, and data services (commonly known as Triple Play), which goes a long way towards the convergence of the video and data media silos that were traditionally separate.

In this paper our goal is two-fold: First, we show why the traditional video content delivery paradigm, broadcast TV's centralized "one size fits all" approach is rapidly changing due to many disruptive forces. We briefly examine these disruptive forces and then discuss what sort of services will replace traditional delivery mechanisms to address changing user consumption patterns.

Our second goal is to describe an approach that we refer to as Seamless Content Consumption (SCC) that holds the promise to enable the next generation media consumption experience by letting users easily find and consume topically related content regardless of modality or the device used. SCC aims to blur the boundaries between traditional content delivery channels and across a user's set of devices. Specifically, we will examine two important questions and explain how the SCC approach can go a long way in solving them:

- How can cable operators offer diverse content that users desire, e.g., video on demand, Web pages, blogs, podcasts, and images, while making it easy for users to consume this content with minimum effort whenever and wherever they want?
- What are some of the new services that will be enabled by the convergence of video and data media silos? For example, how can the TV experience be made more social, both to share content among groups and to harness collective intelligence of users to select content.

We should also note that there also exist roadblocks on the path to convergence. Although some of these issues are technical, mostly they are business related. In addition, it has been noted that a cultural divide still separates the providers of TV and Internet media, especially in advertising in the two domains. Media planners who are accustomed to dealing with Nielsen ratings of how many households tune in for a certain TV show may have difficulty in translating complex statistics about click counts and downloads used to evaluate Internet advertisement models. Even in the current version of Triple Play bundled services, video and data silos are fairly separate. Nevertheless, we believe that the current trends driving the industry towards convergence are strong enough to overcome these obstacles.

TV and the Internet: Everything That Rises Must Converge

The End of the Traditional Video Delivery Paradigm?

In the traditional content delivery paradigm content is tightly bound to a specific delivery channel (cable, broadcast, DVB-H/T, Internet) and a specific target device (e.g., set-top-box/TV, PC, mobile phone). The related consumption model has the following characteristics:

- consumption experience is limited to the device at hand;
- users miss out on compelling and related content;
- content delivery channels are primarily push (e.g., broadcast) or pull (e.g., Internet);
- blanketed advertising targeting everyone;
- users have limited ability to personalize content.

There are powerful disruptive forces currently at work that make the above traditional content delivery approach no longer sustainable.

One of the most important of these disruptive forces is the rise of abundant niche video content easily available on the Internet. With broadband access becoming more widely available, users have begun to download videos with the ease they were downloading songs a few years earlier. However, consumers are being overwhelmed by the quantity of content available (more than 65,000 clips are being uploaded to YouTube daily), which is not easy to search due to insufficient metadata.

Another important development is the proliferation of portable devices on which users can consume video, e.g. video iPods® and mobile phones. More than 4 million video iPods have been sold since the product's debut on October 2005, along with more than 45 million TV shows through the iTunes® Music Store. This has fueled a consumer need to be able to easily device-shift content.

Personal video recorders (PVRs) have become more common, current market penetration is around 11% of US homes[1], enabling users to easily find, record, and watch shows among hundreds of cable channels that are available. PVRs have not only fragmented viewership even further but have also given viewers a simple way to skip TV commercials that led some analysts to herald the end of advertisement-funded broadcast TV.

Last, but certainly not the least important, is the fact that due to the convergence of video and voice/data channels, companies that used to be in separate industries, telephone operators, internet-service providers and cable companies, suddenly find themselves in the same business. Telecom companies have started to compete for video delivery through service bundles including IPTV.

When all the above factors are taken into consideration a complex picture emerges where it is not clear what the new video delivery paradigm will be. Yet one thing is clear: the traditional video delivery paradigm with neatly divided silos will not be able to cope with all the above challenges.

The Infinite Screen: Niche Video on the Internet

The standard TV broadcast model is designed to efficiently bring a show to millions of people but it cannot do the opposite – bring a million shows to each person. This is exactly where Internet video delivery excels. The amazing success of Internet video (see Figure 1) is directly

[1] ZDNetResearch, available online at blogs.zdnet.com
[1] "It's Not TV, It's Yahoo," *The New York Times*, September 24, 2005.

related to the Web 2.0 concept which prescribes practices that are for the most part the opposite of the traditional TV broadcast paradigm. Two such practices that are especially relevant to our discussion are

- *Let users create content*. Sites such as YouTube-Google Video, Yahoo Video, or Metacafe rely on their users to upload content, the more people there are who use the site and upload content, the richer the site gets. Coupled with the ease of capturing video content, this principle explains the variety and abundance of online video material.
- *Harness Collective Intelligence*. Personalization does not just mean narrowing down the broadcast stream so that it matches the user's interests, but creating new mechanisms to use the collective intelligence of users to provide better search results. This mechanism lets users easily explore the countless numbers of video clips in online video repositories. For example, the Metacafe video site uses 100,000 volunteers to filter the uploaded videos and mark the ones that seem to be more interesting.

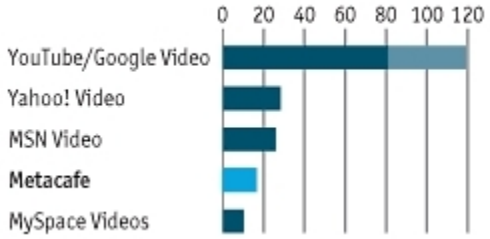

Figure 1. The number of unique visitors to major Internet video sites in September 2006 (in millions) [2]

Chris Anderson has coined the term "the long tail" to describe the seemingly infinite selection of niche content available in different media domains that account comparable consumption as the hits combined[3]. The availability of long tail content has changed how users choose content to consume, especially the young demographic. They do not distinguish between mainstream hits and underground niches, with commercial and amateur content competing equally for attention; they pick what they like.

News of Television's Death Greatly Exaggerated

Besieged from one side by viewers flocking to online sites such as YouTube to watch video content and by viewers armed with PVRs who skip commercials on the other, the death of advertisement-funded broadcast television might seem imminent. This is not the case, however. In 2005 the average American household watched TV for 8 hours, 11 minutes a day; almost 3% higher than the previous year and the highest level observed since television viewing was first measured by Nielsen Media Research in the 1950s. The number of TV households and the number of multichannel video programming distributor subscribers also increased in 2005. [4] The sales of high definition TV sets are increasing at an accelerating pace. In short, the place of TV as the central entertainment outlet in homes is firmly secured.

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[2] "We try harder," *The Economist*, p. 74, November 9, 2006
[3] Chris Anderson, *The Long Tail*, Hyperion Press, NY 2006
[4] Results of a study performed by six networks, available online at msnbc.msn.com/id/10071225/
[4] FCC Media Bureau's 12th Annual Video Competition Report to Congress, March 3, 2006.

The viewership patterns changed considerably, however, compared to previous decades. In the past, broadcast TV was hit-based and offered few alternatives. Almost 70% of all households with TVs tuned to *I Love Lucy* in 1950s while the same figure for Seinfeld was about 23%. Two of today's top TV shows, *CSI* and *Grey's Anatomy*, have both a viewership around 10%, a figure that would not have put them in the top ten 15 years ago[3]. Today TV viewers have many more alternatives; the average home now has about 100 cable channels serving niche interests. Finding shows of interest and recording them has also become much easier, thanks to PVRs, a factor that leads to an increase in time people watch TV[5].

The line between TV programming and content available on the Web is blurring. In the face of fragmented viewership of their shows, networks have been aggressive in exploring Internet options for distribution of their content. In his September keynote Steve Jobs told that the iTunes Store now has 220 shows from more than 40 networks, up from 5 shows available in October 2005. People have downloaded 45 million shows so far. On the other hand, niche Internet video content has started to appear on TV, e.g., *Web Junk 20* in which VH1® and iFilm® collaborate to highlight the twenty funniest and most interesting clips collected from the Internet that week.

Offering Internet video over TV is also being used as a competitive edge by service providers. Comcast launched a web site called Ziddio on November 7, 2006 for people to upload their homemade videos that will be rated by the users with the intention of making the winning videos available through a VOD channel. At the same time, Verizon is also reportedly in talks with YouTube to make Internet video content available on cell phones and as a VOD channel[6].

Recipe for the New Video Delivery Paradigm

It is safe to state that the way video is delivered and consumed is undergoing a radical change. In order to profit from and guide this change both cable companies and telecoms have started offering Converged Services, commonly referred to as Triple Play, where video, voice, and data services are offered as a bundle. Cable service providers have been very successful in offering Triple Play services, much of the increase in cable revenue, which is projected to grow 10.8% in 2005 to $66.5 billion,[4] comes from such services. However, even in these bundled services video and data remain isolated, which currently limits the possibility of introducing new services that tap the synergy between broadcast video and the Internet. The fact that users subscribe to a Triple Play service does not make it easier for them to watch a YouTube video on their TV or transfer a favorite TV show to their iPod. PVR-bundled services such as TivoToGo® have popped up to address this need.

Based on the discussion provided in the previous sections, we can summarize basic emerging user requirements for video consumption as follows:

- *Help me access the Long Tail*. Users like to watch niche content on the Internet but this content is mostly tied to PCs. Currently it is not trivial to watch such content on the TV or transfer it to a mobile phone. Viewers also want to easily search hundreds of cable channels they subscribe to in order to find programs of interest.

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[6] Yahoo finance, November 7, 2006, http://biz.yahoo.com/bizj/061107/1372537.html

- *Make video available anytime, anywhere*. Users demand to access any content from any device, whenever and wherever they want.
- *Connect me to my community*. Users desire to easily establish online communities that share videos and watch the same TV programs "together" from different locations.
- *Show me interesting commercials only*. The Internet model where advertisements are narrowly targeted to each user is more preferable to the blanketed advertisement model of broadcast TV.

Once video and data silo content really converge, a whole array of compelling applications will arise that will answer the above user requirements. We refer to this convergence as X-Play. X-Play will provide converged services through an ecosystem of consumer devices (retail and carrier provided), advanced home networking, unified software/applications, and content protection that provide new, feature-rich and easy-to-use experiences. X-Play promises traditional and new players the means to offer new services. Already 80% of telecom executives agree that it is essential to embrace convergence within the next three years[7]. For a discussion of technical issues in how X-Play services will be delivered to the home and managed, refer to the paper "Converged Services Framework: Tearing down the Silos" by Ulm and Weeks in SCTE Conference on Emerging Technologies 2007. In this paper we will focus on the types of applications possible using X-Play and how to enable them, which are discussed in the next sections.

The Seamless Content Consumption Paradigm

In this section we introduce an approach we refer to as Seamless Content Consumption (SCC) that addresses the emerging user requirements listed in the previous section. Powered by the joint video-data bundle offered by X-Play, SCC aims to blur the boundaries between traditional content delivery channels and across a user's set of devices for the user. The SCC approach is designed to address two important shortcomings of the current silo-based content delivery mechanism:

- *Following stories across media silos is difficult.* Consumers may view a news story on TV, go to a Web site to read related stories, and listen to a radio broadcast or a podcast for comments. There is currently no simple way to enable rich, personalized, and "story cycle" based browsing across media silos.
- *Simple media adaptation is only part of the solution.* Enabling a true device-shifting functionality in most cases requires more than transcoding the media; it requires providing a version of the content best suitable for the new device. For example, when consumers want to shift a sports game on TV to their radios, just playing the audio portion of the TV program is not the desired solution. A radio broadcast covering the same game needs to be found and played.

The new SCC-based experience relies on media association and representation technologies that facilitate intelligent content aggregation, delivery, and discovery across a variety of consumption devices in the home, in the car, and on the person.

[7] Special Report on the Future of Telecoms, *The Economist*, October 14th, 2006

The Media Bundle Concept

The basic premise driving the SCC approach is the notion that users have a desire to discover and consume topically related content. For example, users may want to follow how a news story developed over the course of days or they may simply want to watch all content related to a favorite actor. SCC enables this functionality by combining and describing related content as a relationship graph, which we refer to as *Media Bundles* (MBs). Note that MBs do not contain the actual media data, but only links to the data.

The nodes of a MB graph represent information about specific content contained in a media document, e.g., a video clip, web page, podcast, or image. We refer to these media items as *content entities* (CEs). A CE may be a whole program (e.g., an episode of Seinfeld) or it may designate part of a TV program (e.g., a particular news story within a newscast). Each CE is described using Uniform Resource Identifier (URI) string identifying the file that holds the actual content data as well as all the relevant metadata that describes this content, e.g., media source, media type, and the media creation date. Such descriptions will often be in the form of Extensible Markup Language (XML) files, where the metadata is contained using a multimedia content description standard such as MPEG-7 [8]. Thus, each node of the content relationship graph may be represented as an XML file with a unique URI. The metadata description for each CE may be obtained from the content provider, for example, for TV programs, information from the Electronic Programming Guide may be utilized. However, some content may have very limited or no metadata associated with it, which presents a problem. This lack of metadata problem can be alleviated to some extent by analyzing the linkage structure between the CEs.

The edges in the MB relationship graph represent different types of relationships between CEs. Since many types of relationships are possible between CEs, usually there will be more than one edge between two CEs in a MB. These edges may be described using a knowledge modeling language, such as the Resource Description Framework (RDF)[9]. It is this linkage structure that sets the MB approach apart from other approaches to multimedia syndication, e.g., the RSS and Atom standards. The complex linkage structure in the MB enables data mining algorithms to analyze relationships between CEs, cluster them, and determine which CE in the cluster is the dominant one. This analysis is similar to the algorithms used in analyzing the linkages between Web pages used by Internet search companies such as Google. By utilizing the linkage structure in the MB graph, such algorithms can cluster CEs even when some CEs have little or no metadata associated with them.

An example of a MB is shown in Figure 2 that illustrates a MB for a developing story about a recent political scandal containing six CEs from different sources. This simple Bundle has content in two modalities (video clips and web pages) but in practice Bundles will contain content from diverse modalities, including images, podcasts, and MP3 files. Note that this Bundle also contains the same video program in two different resolutions, the low resolution version targets small screen devices, such as mobile phones, while the higher resolution version is suitable for viewing on TVs. When a MB is received by a consumer device, it will be pruned based on the device profile so that only CEs suited for that device are available for display. The

[8] For an overview of the MPEG-7 standard, see http://www.chiariglione.org/mpeg/standards/mpeg-7/mpeg-7.htm
[9] RDF is a W3C specification, more information may be found at http://www.w3.org/RDF/

Bundle in Figure 2 contains four different types of CE relationships that are temporal (*predecessor*), semantic (*similar*), and other (*part of, summary of, higher resolution*).

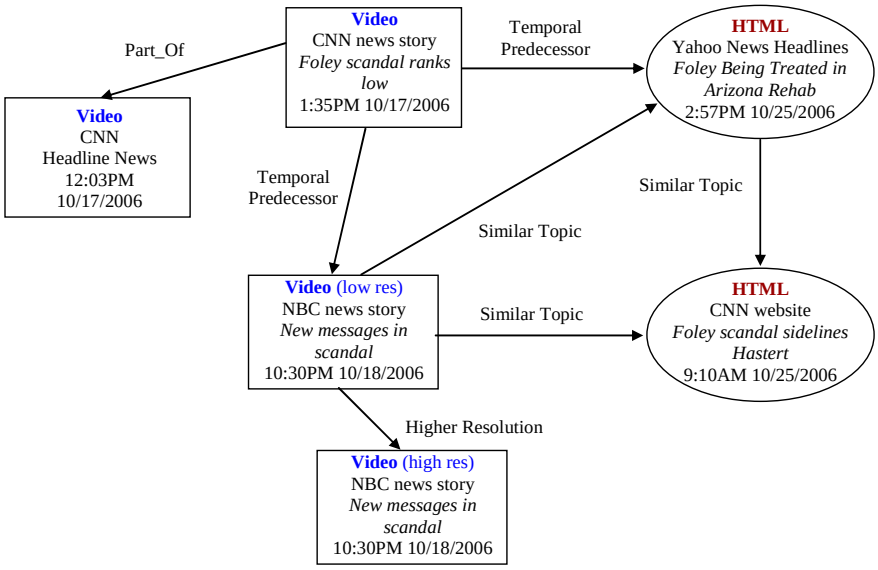


Figure 2. Example Media Bundle illustrating the relationships among six Content Entities.

In summary, the MB structure offers the following main advantages.

- *Small and compact*. MBs do not house the content itself but links to content. This way, digital rights management issues are also avoided, since this approach retains full control for the content provider.
- *Standard way to communicate metadata*. It provides a standard way for consumer devices to exchange metadata, thus overcoming the problem of metadata formats that is common for current consumer devices.
- *Enables link structure mining*. The links in the bundle opens up the possibility of analyzing the linkage structure using powerful data mining algorithms, similar to those used to analyze Web page linkage. These links not only enable users to follow the same story over time and across media silos, but also alleviate the problem of lack of metadata that is inevitable.

Media Bundle Creation and Services

There are two approaches to how MBs can be created and consumed by viewers, as explained below. These two types of MB creation mechanisms, which represent two ends of the content creation spectrum, gives providers great flexibility in offering both broadcast-like, pre-bundled content and personalized, niche content, depending on what the user desires.

User centric media bundle creation

In this approach MBs are created through media aggregation directly on the user's STB based on user intent and/or user profile. These MBs would cover niche content that is valuable to a small number of users. A user may read a news story of personal interest and initiate collection of content from the Internet and broadcast news related to that news story. The aggregated content

will then be used to create a MB on-the-fly that is personalized according to the interests of this one user.

Content provider centric media bundle creation
MBs can also be pre-constructed by content providers, service providers, or third parties and pushed to the user. These MBs would cover topics that interest a large number of viewers who sign up for such a service. An example of such a topic would be a sports team, e.g., Chicago Bulls. Bulls fans who sign up for the MB-based rich sports experience service receive MBs from the provider before games, containing player stats, video clips from previous games, selected web pages, player images and more.

MB services address many of the user needs outlined in the recipe for the new video delivery paradigm above. Furthermore, the MB approach also gives providers the opportunity to offer extra services and create additional revenue streams

On-The-Fly Media Bundle Creation with Media Aggregation

Automatic creation of MBs using media aggregation technology starts with capturing user interest for a particular topic. This information can be conveyed explicitly or implicitly. Explicit interest can be conveyed directly by creating a list of topics of interest. Implicit interest can be gathered by indicating interest while consuming a specific content item.

An example of how a user can trigger the automatic creation of a media bundle for a particular topic is illustrated in Figure 3. In this scenario the user, while reading a news story about the blues singer B.B. King on a mobile phone, indicates interest to know more on this topic. A message is then relayed to the user's X-Play service-enabled set-top box (STB) with the seed news text. The STB performs analysis on the seed news text to extract keywords and names, and uses this information to initiate a content capture process by exploiting a variety of connections such as cable, internet, and the home network, to search for content. Content from these sources is analyzed for relevance to the seed news story and relevant items are aggregated to form a MB of topically related content. This can be done in part by actively querying for web content, analyzing the electronic program guide (EPG) and cable content, and analyzing existing content metadata on the home network. The aggregation process can be performed over time to facilitate story tracking and story expansion. The content type can be a combination of video, image, audio, and text information.

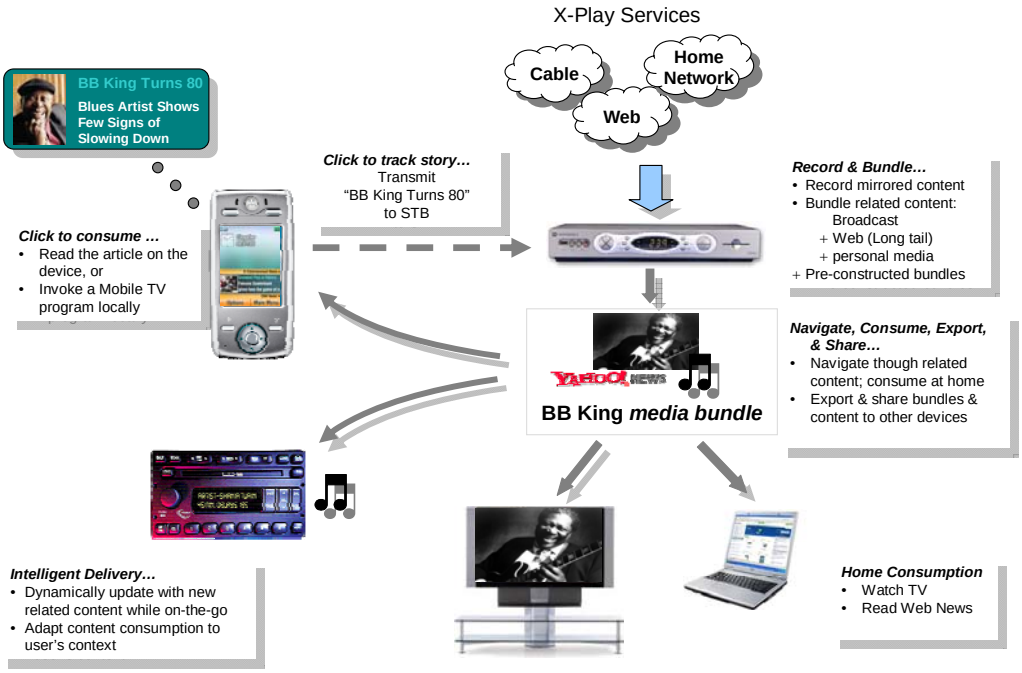


Figure 3. Example Seamless Content Consumption experience flow diagram

It is well known that automatic analysis of content is a hard problem that is not currently solved for unconstrained data domains. However, news content is generally highly structured and follows a number of established rules. For example, TV news programs frequently follow a pattern where each news story starts with an anchor shot. Similarly, news stories on the Internet usually have descriptive titles and topic sentences that summarize the news story. Such patterns make the automatic analysis of news media easier compared to other domains.

One problem in news content aggregation from TV news programs is that current EPGs do not contain information on the news story level, that is, EPGs typically list news programs with title only, e.g., *NBC News at 6*, without specifying what news stories are covered in the program. As seen in the MB given in Figure 2 one would like to determine the exact news story relevant for the bundle and have a link to that story. Since this information cannot be obtained from EPGs, it must be generated automatically by analyzing the video, audio, and closed caption information for the program. Simple ad hoc heuristic approaches to news segmentation, such as assuming that each news story starts with an anchor shot, lack the generality in handling diverse video sources with different features and production rules. However, a collection of such rules may be combined in a statistical algorithm to increase the accuracy in story segmentation.[10] A promising approach is to detect news clips that are shared by news programs from different sources, as shown in Figure 4. Video analysis algorithms exist that can perform this comparison many times

[10] W. Hsu, L. Kennedy, C.-W. Huang, S.-F. Chang, C.-Y. Lin, G. Iyengar, "News video story segmentation using fusion of multi-level multi-modal features in TRECVID 2003," *ICASSP 2004*, Montreal, Canada, May 2004.

faster than real time. The existence of such matches establishes the similarity of the news story and facilitates the creation of MBs.

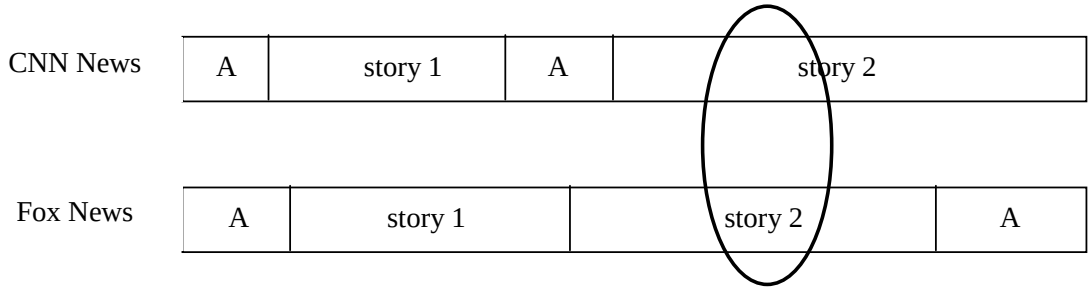


Figure 4. Matching of news clips across news programs from different sources. Shots labeled A are anchor shots. The location where the same news clip is found in the two programs is marked.

Pushing Pre-Constructed Media Bundles

Another way media bundles can be consumed is for them to be pre-constructed for topics that may be of interest to a large number of viewers and pushed to consumers who have signed up for a bundle update service. This would allow providers to offer a rich and immersive consumption experience that would be unprecedented.

Sports is a domain that is ideally suited for this kind or service since many fans are interested in all aspects of their teams, would like to track the performance of their favorite players, and also would like to track the performance of other teams. A content provider, such as ESPN, can pre-construct a media bundle for a sports team, e.g. Chicago Bulls, with links to clips from previous games, commentator blogs and podcasts, pages from the espn.com web site, together with radio content from local ESPN-affiliated radio stations. Links to buy Bulls merchandise and tickets to the next game can also be included in this bundle. The bundle can also contain content such as the funniest courtside picture from the previous game and clips where users can examine on their TV the view from the seat they want to purchase for the next game.

As such media bundles with rich content are constructed periodically, they are pushed through a cable operator to the STBs of users who have signed up for the *Bulls Rich Sports Experience* service.

What User Functionalities Do Media Bundles Enable?

The creation of these bundles blurs the boundary between the various delivery channels by aggregating content across delivery media. Once constructed, media bundles facilitate content discovery across the user's ecosystem devices, hence blurring the boundary between consumption devices to give a seamless content consumption experience.

Zero-effort consumption

Media bundles provide users with a zero-effort way of accessing and consuming interesting content and services regardless of content format and source, i.e., being able to dig deeper into a news item without getting off the sofa. Additionally, the rich relationships in the media bundle graph can be mined to facilitate discovery and hence consumption. Current solutions that address this problem require significant user effort and skill.

Seamless consumption on devices
Once a media bundle is pushed to a user's STB, it can then be sent to the set of devices in the user's ecosystem such as a car radio, mobile phone, and a personal computer. This allows for content discovery on any device and continuing the content consumption experience anywhere. Obviously, different devices have different capabilities some of which are overlapping and others that are not. Bundles may be appropriately filtered to allow discovery of content items that are matched with the capability of the playback device. As shown in Figure 3, after the media bundle about B. B. King is generated, it is filtered and pushed to the user's device ecosystem, including TV, PC, mobile handset, and car radio. The user can switch to different devices to consume different content included in the media bundle. For example, users can consume mobile-TV video formatted version of "B. B. King" content on their handsets, HD-version content at home, and listen to B. B. King music on their car radios.

What New Services Do Media Bundles Enable?

The Seamless Content Consumption paradigm based on media bundles provide players in the content and services area new ways to deliver content to customers. Specifically, the media bundle approach offers the following advantages to the providers.

Exposing Long Tail and related content to consumers
Media bundles offer the opportunity to provide customers with a rich package about a topic, which provides a very efficient way to address the user need for long tail and related content about the topic. For example, a bundle about an upcoming game of Chicago Bulls, a clip of an interesting part of the game with the same opponent 15 years ago may be included. Content providers with more than one media source can expose alternate media sources, e.g., ESPN including video from its network, pages from its web sites, and radio from affiliated local stations.

Targeted advertising
Since a media bundle is built around one concept, e.g. a news item or a sports team, focused advertisements related to this topic can be included in the bundle to draw more relevant eyeballs. Since users know beforehand that the advertisements are about a topic of interest they will be less inclined to skip them. The personalized views in the integrated presentation discussed in the previous section form an ideal mechanism for this type of advertising.

New services and revenue streams
Using media bundles gives providers the opportunity to guide the content consumption and discovery experience around specific topics and partnering content providers. Media bundles can be used to facilitate shopping related to the topic of the bundle; for example, they can contain links to buy team merchandise or tickets to an upcoming game. Another new and important revenue stream opportunity is for providers to partner with local and novelty content providers, they can showcase content from these partners in the bundles, similar to the prominent position partnering Web sites get in search engine results.

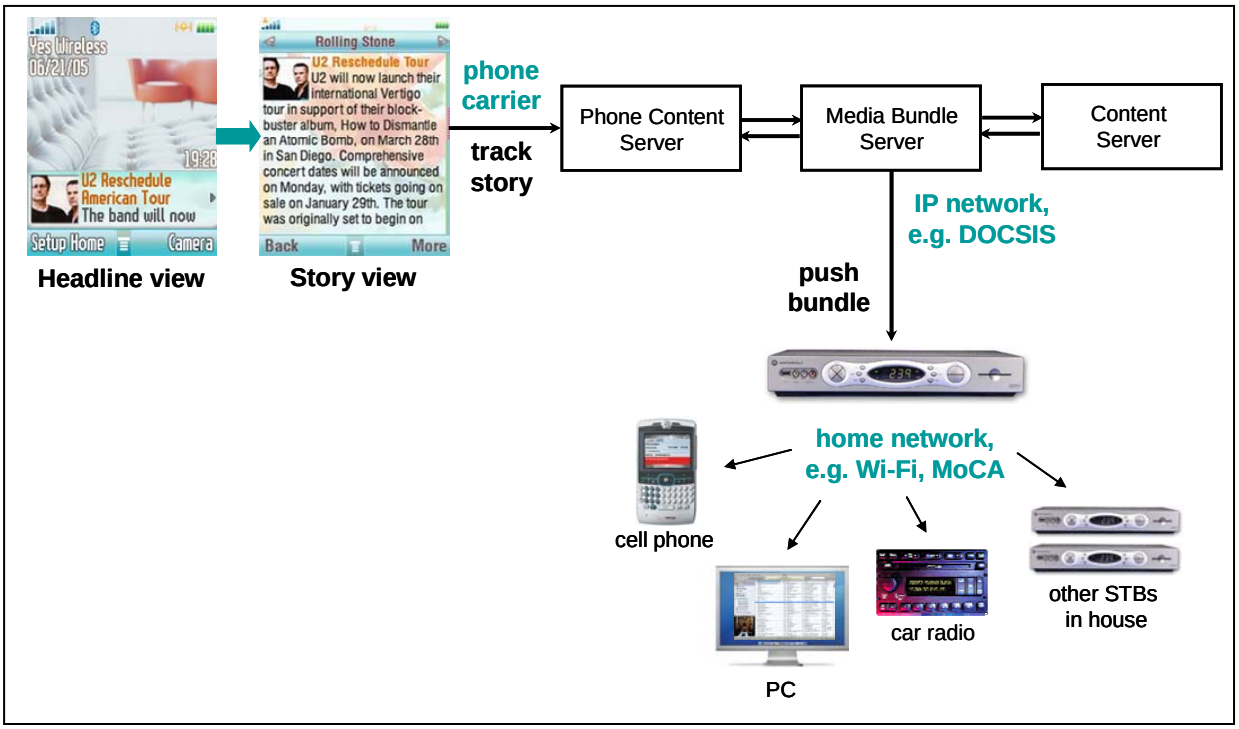
Practical Issues Related to Media Bundles

In previous sections we have outlined two different methods for MBs creation and different services and functionalities enabled by the MB approach. In this section we examine two important issues that need to be addressed for the MB- based approach to become practical.

How Will The Media Bundles Be Communicated Between Devices?

As explained above, MBs are essentially XML files with links to the CEs and expressing the relationships among CEs. Therefore, they are small in size and can readily be expressed in a binary format (e.g. using the binary format for metadata specified by MPEG-7) and compressed before transmission. In the content-provider-centric scenario, where MBs are pre-created and pushed to the user, both MBs and content can be sent over an IP network to the user's STB using technologies such as DOCSIS 3.0. The system shown in Figure 5 illustrates a scenario that is a combination of the two usage scenarios explained above. Here a user is interested in a story provided by a news service on his mobile phone and wants to track the story. This information need is transmitted to the MB server which then sends a pre-constructed bundle about the news story that the user is interested in to his STB. In order to make the STB client as light weight as possible, it is the job of the MB Server to determine the format specified by the MVPD operating the STB and convert the MB to this format.

In the system shown in Figure 5 the STB acts as the home MB gatekeeper and sends the MB to other devices in the user's ecosystem using an available in-home network which could either be wired (e.g., MoCA, HomePNA) or wireless (Wi-Fi®, Bluetooth) or a mixture of both. The availability of other devices may be determined using the Universal Plug and Play (UPnP) protocol. Once there is a common, centralized device within the home, it becomes much easier to remotely provision new services. Naturally there are still some challenges to move content between consumer devices; however, the formation of alliances such as the Digital Living



Network Alliance (DLNA) shows that there is a strong momentum in consumer electronics towards this goal.

Figure 5. A schematic diagram showing how a user interest in a news story triggers a pre-constructed media bundle covering that story to be sent a STB and there to other devices in the user ecosystem.

How Can Business Issues Related to Media Silos Be Addressed

One can argue that there are many business related challenges that need to be overcome in order to make the MB approach work. This argument states that the media silos are well-separated today not because of technical issues but predominantly due to business issues, that is, content providers would like to keep complete control over their well-defined media territories and want to keep other players out of this territory. By providing easy access to content across media silos, the MB-based paradigm seems to fly in the face of these silo-based businesses. How can we get these players, who have historically always operated on a silo-based mentality, to release their content for combination with other media as part of MBs?

There are two answers to this concern. First, as explained above, powerful market forces have recently emerged that has increased momentum for convergence across media silos. More than ever, users demand services and devices that aggregate, save, and personalize content from

different modalities, e.g., video, HTML, podcasts. Second, we have listed many advantages that MB-based content delivery offers for providers, including the ultimate goal in brand management: to be able to guide and keep the attention of users as they view content from different modalities, e.g., when a user switches from TV viewing to Internet surfing.

Conclusions

In this paper we have argued that the way video is delivered and consumed is undergoing a radical change. TV viewership patterns have changed considerably, compared with previous decades. Today's viewers demand easy and personalized access to media from a wide variety of sources and modalities. On the other hand, the Triple Play service provided by cable providers holds the promise of true convergence of video and data, enabling many new applications.

We have then outlined a new approach that we refer to as Seamless Content Consumption, which aims to address the new user content consumption requirements. Specifically, we have introduced the concept of a Media Bundle, which consists of links to content and their relationships, to show how this approach is implemented in practice.

Acronyms

Acronym	Definition
SCC	Seamless Content Consumption
DVB-H/T	Digital Video Broadcast –Handheld/Terrestrial
DLNA	Digital Living Network Alliance
RSS	Rich Site Summary or Really Simple Syndication
CE	Content Entity
MB	Media Bundle
URI	Uniform Resource Identifier
XML	eXtensible Markup Language
MPEG	Moving Picture Experts Group
MP3	MPEG 1 Layer 3
HTML	Hypertext Markup Language
STB	Set-Top Box
HD	High Definition
IP	Internet Protocol
DOCSIS	Data over Cable Service Interface Specifications
PVR	Personal Video Recorder
IPTV	Internet Protocol Television
MVPD	Multi-channel Video Programming Distributor
RDF	Resource Description Framework
EPG	Electronic Program Guide
MoCA	Multimedia over Coax Alliance
DOCSIS	Data Over Cable Service Interface Specification
HomePNA	Home Phoneline Networking Alliance
UPnP	Universal Plug and Play
VOD	Video on Demand
Wi-Fi	Wireless Fidelity