DEG
THE DIGITAL ENTERTAINMENT GROUP

TECHNOLOGY COMMITTEE
NETWORKED DOWNLOAD AND MANAGED COPY
WHITE PAPER

Section 1: Introduction

Historically the primary method for delivering commercial music and video content to the home has been packaged media formats such as CD, DVD-Video, HD DVD and Blu-ray Disc.

However in the quest for the new consumer paradigm of enjoying "anything, anytime, anywhere," it is becoming increasingly popular to access a variety of commercial video content from new service providers such as CinemaNow, Movielink, Vongo, etc. via the personal computer (PC). Once this commercial video content has been electronically downloaded, consumers typically want to move, copy or stream this content to multiple locations and devices within the home.

Electronic distribution of audio and video content is an area of rapid development that promises consumers more flexibility and convenience in how, when and where they choose to enjoy entertainment. Although broadband connectivity has become the norm in many consumer households, the bandwidth required for downloading even standard definition content can significantly impact download times (and therefore, consumer expectations).

The bandwidth requirements for high definition (HD) video content should make packaged media a more suitable method for mass distribution in the near term and help drive the demand for new packaged media formats like Blu-ray Disc and HD DVD. For that reason, both electronic distribution and traditional packaged media will co-exist as delivery methods for commercial video content for some time to come.

Regardless of how commercial video content is delivered to the home, consumers have come to expect new levels of flexibility and convenience. They also demand the ability to access their video anywhere within the home via a secure network; as well as outside the home using portable media devices.

There is also a growing desire for consumers to copy (or "rip") their commercial video content back to optical media (for backup and mobility reasons). In fact, both Blu-ray Disc and HD DVD include such capabilities as an integral part of their formats using a concept called "managed copy" (see reference to AACS). For example, this can electronically authorize copying content from packaged media to a secure portable device or a media server located within the home network. The variety of usage "scenarios" for securely moving, copying and streaming commercial content within the home are the focus of this report.

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For purposes of clarification, there are several areas this report does not cover.

- A discussion of Digital Rights Management (DRM) systems such as AACS which are critical for enabling various electronic distribution models, enforcing intellectual property rights, and managing content on home networks and secure portable devices(see DRM white paper previously issued by The DEG). This report assumes an appropriate DRM system is in place.

- The methods by which a consumer obtains packaged media or electronically distributed commercial content in their home, given that the methods for manufacturing and distributing packaged media, as well as those for electronically downloading commercial content to a PC or set-top box are already well known and documented.

- The assumption that the consumer has already legally obtained via purchase or rental a legitimate version of the commercial video content.

- The various so-called 'manufacture on demand' (MOD) approaches via enterprise solutions or retail kiosks which enable commercial video content to be written to recordable media and customized by consumers at the time of purchase.

- The many services that are available for music content, including wireless services that deliver content directly to mobile phones.

- Any form of traditional distribution service via broadcast, cable and satellite, including DVR (Digital Video Recorder) -based applications.

- Finally, this report does not discuss any technologies or back-end systems that are required for content delivery.

Section 2: Environment/Landscape

Growing Trend Toward Managed Recording

Several initiatives are under way to promote the new consumer paradigm of Anything, Anytime, Anywhere. Although leading technologists launched initiatives to bring the PC to the living room, (e.g. Microsoft's Media Center and Intel's Viiv), it is clear that for new distribution methods to become successful content needs to escape the PC. While the PC has many offerings, it is hardly the box to take "Anywhere."

The concept allowing content to go "Anywhere" is currently achieved through home networking. Although an important trend and an ideal way to roam with content around the house, it will take time before streaming HD video content over a home network with sufficient Quality of Service that is acceptable and intuitive to the consumer becomes "mainstream." Today, home network use for music content is just taking off.

A stronger trend to take content off the PC is the tethered device. The content on a portable media player is synchronized with the PC through a USB or FireWire cable. Apple's success with the iPod is clear proof that that this model has consumer appeal; although, video content on this type of platform is still in its infancy.

When it comes to moving video content to a large screen HDTV set, an optical media player is the natural source, because there is a standard definition DVD installed base of 82 million households in the United States alone. Next generation high definition formats are beginning to roll out this year and growth of HD players and media is expected over the next few years.

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While these are a few examples of addressing the Anything, Anytime, Anywhere paradigm, there are other trends currently in the industry that either influence or directly address this paradigm. The following section provides an overview of current and emerging trends and provides some examples of commercial services currently available to consumers. Each represent both unique benefits and some challenges for consumers.

Related Industry Trends

Multi-channel Publishing

From a content industry perspective, one of the most dominant trends is that content finds its way to consumers through different channels. The traditional distribution in theaters, packaged media and broadcast networks (and cable and satellite) are all popular. At the same time, new distribution channels are being added, including Internet downloading and mobile phone distribution.

Home Networking

From a consumer perspective, the trend of home networking is a mix of necessity and convenience.

In a scheduled broadcasting model, it is easy and well established to bring the signal to each display, i.e., TV set. In a packaged media model, inserting discs into players allows easy roaming around the house and beyond. However, with digital storage of content on hard disk based CE devices and computers becoming more and more popular, the problem facing consumers is how to enjoy this content in other rooms of the house or on other devices. The home network seems to be the most logical choice to allow digitally stored content to play throughout the house.

Once a home network is in place, the level of convenience can be dramatically increased if all media is stored on a device in the network and, can be selected from any screen in the house. This is not only relevant for new distribution models. The DVR is an example of such a device for broadcast content and is increasingly becoming networked devices. Traditional packaged media can play a role if its content can be copied to the networked device -- creating the 21st century equivalent of a jukebox. For the latter, discussions between technology and content companies are underway to determine content protection.

The home networking trend faces two major challenges. While home networking has gained significant momentum in the last several years, the driving force for such momentum has been the sharing the broadband Internet connection throughout the home, versus the networking of media content. Although many of the basic technologies are the same for a home network for entertainment use, special provisions are needed to allow video streaming, especially in HD quality over a home network. The second challenge is the setup of the home network, which, while improved, is still a daunting task for the average consumer.

Managed Copy

Whether managed copy is going to be a real trend remains to be seen. The only real motivation to rip a DVD to a PC or server type device is to provide access to a collection of DVDs through a home network because the unprocessed DVD content is not suitable for use on small screen portable devices. However, the widespread adoption of home networks for video streaming will have some technical hurdles. Although when consumers do want to access their DVDs over a home network, there are unauthorized tools readily available that support DVD ripping to a PC.

The real challenge here is not technical. Considering the above, will consumers pay a fee to unlock their DVD in order to allow it to be copied to a PC?

Mobile Devices

The significant effort that targets mobile devices with video content shows that the industry believes that watching video on a tiny display has consumer appeal. Similar to the Apple iPod for music,

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there is significant growth and investment being made in the ability to play video in portable devices, including mobile phones and dedicated Portable Media Players, or PMPs. (While a mobile phone is the target for entertainment content, video streamed or downloaded via the mobile carrier network is not the subject of this paper).

Virtually all mobile devices are loaded with content through the PC. A dedicated software application running on the PC allows copying content to the device. Some applications allow more elaborate management schemes, e.g. based on consumer preferences. The big challenge for mobile devices is interoperability of services and devices. A lthough Apple's iPod is likely so popular because of its tight integration with the iTunes software and the iTunes Store, in the end consumers will want a choice of services independent of the device they use.

Managed Recording

The available DVD catalog is some 60,000 titles strong. There is a surprisingly strong demand for *long-tail* content of complete seasons of TV shows as far back as the '60s. Soon, there will not be enough shelf space. This problem is further magnified by the advent of the next generation HD formats that also need shelf space.

But there is one major technical challenge to allow a PC or consumer device to burn a DVD, while maintaining content protection and still maintaining compatibility with the installed base of players. At the time of this report, DVD players are not allowed to play back today's recordable DVD formats with DVD content protected by CSS. A new Managed Recording format will likely require new recordable drives. However, several Hollywood studios and service providers are working to release major titles for PC downloads, such as CinemaNow and MovieLink, both of which have announced their intention to offer download-to-burn solutions.

Retail Kiosk Burning and Manufacturing on Demand

Also due to lack of shelf space, two other approaches are emerging. In the *retail kiosk burning,* a customer can select a title that is instantly burned to a DVD and then checked out at the cash register. In the manufacturing-on-demand model, a consumer can select and order a title online that is burned to a DVD and then shipped. Although these solutions share the same technical challenges of DVD player compatibility with managed recording, from a consumer perspective they are unrelated as the discs will be perceived to be equivalent with a title on a DVD-ROM disc.

Existing Services

iTunes Store

The Apple iTunes store recently started offering video content for *download-to-own* consisting of television shows and music videos. Most video content can be purchased for $1.99 each and is playable on up to five different computers and an unlimited number of video capable iPods indefinitely. However, purchased content can not be burned to a DVD. As with music, video content is available for both Windows and Apple Macintosh-based computers.

MovieBeam

MovieBeam is an on-demand movie *rental* service that automatically delivers movies to a television set-top box through television broadcast channels. Technology known as datacasting allows full-length standard definition movies to be delivered to the set-top box using the broadcast signals of local Public Broadcasting Service stations. The service does not require an Internet connection or a computer. However, an analog phone connection is required for billing purposes. The MovieBeam set-top box comes preloaded with about 100 movies, and up to 10 new movies are delivered to the box each week replacing older titles. In order to use the service, customers are required to purchase a MovieBeam set-top box (currently about $200) and pay only for the movies they view. Pricing is competitive with major rental chain pricing. Currently content from Twentieth Century Fox, Lionsgate, Paramount, Universal, Walt Disney, and Warner Bros. is available on the service.

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Movielink and CinemaNow

Movielink (founded by MGM, Warner Bros., Paramount, Sony Pictures and NBC Universal) and CinemaNow (owned by Twentieth Century Fox and Sony Pictures) started as online movie *rental* companies. The services offer a catalog of movies that can be downloaded to the PC in Windows Media DRM format for viewing in a limited time period. Movielink also allows part of the catalog to be downloaded in a format suitable for portable devices, equipped with the Windows Media DRM system.

Recently both services, in close cooperation with a few Hollywood studios, started to offer some major movie titles for download-to-own in the DVD sellthrough release window. Both have announced their intention to offer download-to-burn solutions as well.

Starz' Vongo

The Vongo service by Starz Entertainment Group is a subscription-based Internet video-on-demand service that allows consumers unlimited access to download full-length feature films in the Starz library with unlimited viewing on their PC if they are a current subscriber. Consumers do not need to subscribe to the Starz family of pay television channels in order to subscribe but an Internet feed of the Starz pay television channel is included in the Vongo subscription. The subscription fee is $9.99 per month. Alternate versions of many of the titles offered are also available in a lower resolution "portable definition" format for the next generation of Microsoft Portable Media Centers. Currently content is only available for Windows-based PCs as the downloaded content uses the WMV file format and WMDRM for content protection.

Section 3: Scenarios

Overview

After a consumer has legally acquired a form of commercial video content (herein referred to as the **original version of commercial content**), there are several "rights" the consumer *may* be granted by the rights holder of the content. In particular, this report outlines three such rights:

1. *Move*: The ability to move an **original version of commercial content** to another device or storage location;

2. *Copy*: The ability to make one or more **managed copies** of the of **original version of commercial content**, and

3. *Stream*: The ability to remotely access or stream the **original version of commercial content** or a **managed copy** over their home network.

The subsequent parts of this section describe each usage right in more detail, and highlight several scenarios and examples that demonstrate each applicable usage rights.

Rights

Each of the scenarios described below can be categorized based on the rights introduced above and are subject to permission to perform such action by the content owner or its licensing authority:

Move. To *move* commercial video content, in general, is to change the storage location of that content (and associated usage rights defined by the owner of the content) from one device to another. One may, for example, move their content from the hard disk drive of a desktop PC to a portable device. This action may be described as "*a spatial shifting* of the content." Once a move has been performed content can no longer be viewed from the original location. While it is possible that, independent of the content itself, just the license or right may be moved or transferred from licensee to another licensee, from one device to another device, or even from one system to another system, this scenario is not specifically discussed in this report. For purposes of this report, it is assumed that the rights associated with the content are moved with the content itself.

Copy. To *copy* commercial video content is to create a duplicate of the content at the same or a different location by using approved software. This action *may or may not* include the right to play the copied content or to create multiple copies of the original version of commercial content. The term *managed copy* refers to the *copy* of digital content, which has been created according to a particular authorization given by the content owner or its licensing authority. It is also worthwhile to note that the number of copies that may be made can be limited by the content owner or its licensing authority. For example, a consumer may be granted the right to make one copy only (a first generation copy), and subsequent copies are no longer allowed (wherein both the original version and managed copy are 'tagged' as copy no more). Assuming the associated right has been granted, the managed copy may also be moved or streamed, as further described in the appropriate sections.

Stream. To *stream* commercial video content is the ability to remotely access and view commercial content over a home network. However, the streamed content is not permanently stored by the remote player on the remote playback device. Streaming may apply to the original version, a moved version, or a managed copy, assuming the appropriate rights have been granted by the content owner or its licensing authority. Streaming content requires intelligence at both the server (the device streaming the content) and the client (the remote device viewing or rendering the content) to address network issues such as latency, as well as network throughput.

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Scenarios

The section describes several scenarios based on the applicable usage rights, i.e. move, copy and stream.

1. **Loading a Centralized Media Server** – These scenarios describe loading online library or commercial content onto a networked home media server so the commercial content can be accessed by any TV or PC in the house.

Usage Right	Scenario	Source	Target Device (Media)
Move	A movie is downloaded from an electronic download service to the office PC and then moved to the home media server. Once the movie has been moved, the downloaded version on the office PC can no longer be played, as the "right" to play the movie has been moved to the media server version.	Electronic download	Media server or NAS (hard drive)
Copy	Instead of moving the movie, a copy is made on the media server. The version on the office PC is still playable.	Electronic download	Media server or NAS (hard drive)
Copy	A DVD movie is purchased and an electronic copy is made by "ripping" the DVD. The ripped copy (Managed Copy) is placed on the media server with the associated usage rights for its usage.	Packaged media	Media server or NAS (hard drive)

2. **Distributed, In-Home Viewing** – These scenarios describe methods in which a consumer utilizes a home network to access and play commercial content over the network.

Usage Right	Scenario	Source	Target Device (Media)
Stream	A consumer has their only DVD player in the family room but desires to play the DVD from the bedroom (Stream from packaged media).	Optical disc (original version)	TV in bedroom
Stream	A consumer downloads an electronic version of a movie directly to the media server (original version). From the big screen TV in the living room, the consumer accesses the media server remotely and selects the downloaded movie from a variety of options from the media server (Stream from networked storage).	Local HDD or NAS	TV in entertainment room
Stream	An authorized copy (Managed Copy) of a DVD has been made and placed on the home media server. The family desires to watch this movie from the media server. Using a remote, the desired movie is selected from the media server and viewed on the TV in the entertainment room (Stream from networked storage).	Local HDD or NAS	TV in entertainment room
Stream	The youngest child in the family wants to watch cartoons which are on the media server, but her older sister is using the main entertainment area. The youngest	Local HDD or NAS	PC in kids room

	child goes to the PC in her bedroom and accesses the cartoons directly from the home media server (Stream from networked storage).		

3. **Portability & Mobility** – These scenarios describe methods in which a consumer can take copies of commercial content on the go for use outside the home network.

Usage Right	Scenario	Source	Target Device (Media)
Move	A consumer wants to move a high-resolution electronic download from the PC to a portable media player for use on the airplane with the kids. The electronic movie download on the PC is erased after the move.	Electronic download	Mobile device (SD, UMD, other)
Copy	A consumer wants to make a DVD-Video copy of their high definition disc to enable playback in the car DVD player (Packaged media to packaged media).	Packaged media	CE player, PC, game console (optical disc)
Copy	A consumer wants to make a copy of their high-resolution electronic download for use in portable media player to use on the airplane with the kids (Electronic download to volatile media).	Electronic download	Mobile device (SD, UMD, other)
Copy	A consumer wants to make a copy of their high-resolution electronic download for use on a player that is not connected to the home network (Electronic download to optical media).	Electronic download	CE player, PC, game console (optical disc)

4. **Remote Access** – These scenarios describe ways in which a consumer can access their commercial content from remote locations.

Usage Right	Scenario	Source	Target Device (Media)
Move	A consumer wants to remotely access their electronically downloaded movie at their second home. So the consumer moves the movie to an "online storage locker" so it can be downloaded over the Internet to a device in the second home. The original electronic movie download is no longer playable after the move to the online locker.	Electronic download	WAN/online server (hard drive or other mass storage device)
Copy	A consumer wants to remotely access their movie at their second home but doesn't want to bring a physical copy of the movie. So the consumer places an authorized copy of the DVD in an "online storage locker" so it can be downloaded over the Internet (Packaged media to online storage).	Packaged media	WAN/online server (hard drive or other mass storage device)
Stream	A business traveler who is on the road wants to watch a movie but the connection speed to his home network is slow. He logs into his online storage locker where he has placed an authorized copy, and	WAN or online server (hard drive or other	Mobile device

		mass storage device)	
Stream	A business traveler who is on the road wants to watch a movie from his home media server. He logs into his home network and streams the desired movie to his portable media player directly from his home media server (Stream from networked storage over Internet).	Local HDD or NAS (auth. copy)	Handheld/mobile device

5. **Backup/Archival** – These scenarios describe ways in which a consumer may desire to make an authorized backup or archival copy of their commercial content.

Usage Right	Scenario	Source	Target Device (Media)
Copy	A consumer wants to make a high-resolution backup/archival copy of their high definition disc to their local hard drive, which is then used to burn a backup onto optical media (Packaged media to local storage; back to packaged media).	Packaged media	CE player, PC, game console (optical disc)
Copy	A consumer wants to make a backup copy in case the kids scratch the discs, but instead of making an optical backup, the consumer wants to use their 500GB network attached backup HDD. Should they scratch the original disc sometime in the future, they can burn a complete replacement from this saved copy. However, the copy on the local hard drive is not playable directly; it is only for replacement burning (Packaged media to networked storage).	Packaged media	Media server/ NAS (hard drive)
Copy	A consumer wants to make a backup copy of an electronic download, but instead of making an optical backup or using a local HDD or NAS, the consumer uses an online storage locker (Electronic download to online storage).	Electronic download	WAN/online server (hard drive or other mass storage device)
Copy	A consumer wants to make a second copy of a movie they already purchased and placed on a SD memory card. The second copy is made from the first SD card and stored to a second SD memory card. (Volatile media to volatile media)	Volatile media (SD, UMD, other)	Mobile device (SD, UMD, other)

Section 4: Challenges

The scenarios described in the previous section introduce several technical challenges for widespread consumer success. This section is intended to identify these challenges that could impact and influence consumer adoption.

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Conversion

Based on the target device, a version of commercial video content may need to be "adapted" in order to successfully play on another target device. In other words, the video content in its original form may not be directly playable on another device in the home without some change to format, resolution, DRM or other.

The following are common conversion techniques often required to "adapt" video content from one device to another:

1. **Transcoding**: Transcoding is the process of converting from one type of audio/video format to another. This is often necessary as not every audio/video format is supported in every device, e.g. video content from a DVD may be MPEG2 at 720x480 resolution. However, to play a managed copy of the video content a portable media player may require the video to be in MPEG4 format at a significantly lower resolution (such as 320x240).

2. **Transrating**: While transcoding refers to the process of transforming the video for a target device, transrating refers to changing the bit rate of the video content. Both transcoding and transrating often occur at the same time. e.g., making an SD copy of HD video content requires not only a reduction in resolution, but a corresponding reduction in bit rate to create an SD-legal stream.

3. **Transcripting**: Transcripting is the process of converting from one type of DRM system to another, e.g., transcripting is required to create a DVD from an electronically downloaded video using the Microsoft Windows Media Format. In this example, the electronically downloaded video use the Microsoft WMDRM as its DRM system), however, DVD uses the Content Scrambling System as its security wrapper.

Each of the above conversion techniques can have a direct impact on the consumer experience. Of particular note is how transcoding and transrating can significantly impact video quality. While this report does not specifically describe the technical process for such conversion techniques, the reader should note the importance of investigating the robustness of these conversion techniques.

Performance

The process of downloading commercial content over the Internet as well as the process for "adapting" commercial content for playback on different devices (as described above) can be very time intensive. Therefore, process for optimizing performance and managing consumer perception is important during these processes.

Based on the scenarios described above, the primary influencers of performance include:

1. Download timeframes: Although broadband internet connectivity has become the norm, the available bandwidth is currently barely sufficient for the distribution of standard definition (SD) content due to lengthy download times. Performance is significantly worse for HD content, making electronic downloading of HD content beyond the reach of most consumer households. Managing consumer expectations for download times is critical to maximize the consumer experience. Potential techniques for optimizing the consumer experience include:

    a. Caching video content in advance of use or download: This improves the perceived download times since the content can be previously downloaded and cached. However, such an approach utilizes Internet bandwidth for video content that may not be played. This approach also requires management of available hard drive space.

    b. Play while download: This approach enables the consumer to play portions of the video while the download process continues in the background. This may not appease consumer expectations if the desire

is to place the video on another device like a PMP or burn to DVD (versus watch while downloading).

c. Optimized download formats: Another approach is to optimized file size (using various formats) for download to minimize download timeframes. Such approaches, however, potentially require conversion once downloaded, which can impact quality (as described above) or cause compatibility issues as (described below).

2. Conversion timeframes: Content conversation, especially transcoding, can be very resource intensive. The conversion process can take a significant amount of time, thereby directly impact the consumer experience. As most PCs do not have dedicated silicon for encoding (which is an essential part of the transcoding process), such conversion must happen in software. Even moving content can take a significant amount of time based on network throughput within the consumer home. Potential solutions for optimizing conversion timeframes include the following:

a. Optimized downloads: One approach is to optimize the format of the video prior to download. If the target device is an STB, then downloading in MPEG2 would potentially eliminate the need for re-encoding. However, such an approach could increase download times or impact other aspects of performance.

b. Dedicated hardware assist: Dedicated silicon for decode and encode can enable real-time conversation (and even potentially faster than real-time conversation). However, solutions based on dedicated silicon often add a significant amount of cost. Furthermore, software must be adapted to use such dedicated hardware.

c. GPU acceleration: Graphics process units (or GPUs) are starting to enable hardware accelerated functions such as encoding. GPU manufacturers including Intel, Nvidia, ATI and others are offering new interfaces for "offloading" aspects of the encode process to dramatically accelerate the conversion process. However, use of GPU acceleration requires specialized software that leverages such capability.

Compatibility

Due to the vast combination of formats, video codecs, DRM systems and devices, compatibility remains as one of the biggest challenges for implementing the above scenarios.

Some of the primary areas of incompatibility are described below:

1. DRM incompatibility: Today, certain devices only support certain DRM systems, resulting in a wide array of DRM incompatibility issues. For example, content using the WMDRM format will not work on an Apple iPod. Content using Apple's Fairplay DRM will not play on Windows Portable Media Center. Even Microsoft's own versions of Portable Media Center (v1 versus v2) have incompatibility issues due to the requirement to evolve DRM system to meet content owner requirements. Solutions for such DRM compatibility issues are the focus of industry bodies such as CORAL, HANA and DVB, as well as proprietary technologies like IBM's xCP and Microsoft's WMDRM. Depending on how these systems are adopted and deployed, the overall consumer experience may be affected by interoperability problems that can prevent video content acquired under one system from being utilized on another.

2. Format incompatibility: In addition to incompatibility between DRM systems, there are also format incompatibilities. As is the case with DRM, certain devices will only support certain video formats. Examples of this include: WMV is not supported on iPod, TiVo is incompatible with iPod. Thus, the need to convert

between formats as well as DRM systems is necessary to broadly support the scenarios described in this report.

Connectivity

While broadband Internet connections into the home are driving a boom in both wired and wireless home networking hardware, the ease with which to connect multiple devices within the home remains a difficult task even for networking experts. Device connectivity is a necessary building block in the success of the scenarios outlined in this paper.

Some of the primary issues of connectivity for home networking of video content are described below:

1. Device interoperability: The process by which one device (such as a PC) recognizes another device (such as a mobile handset or CE player) requires that the devices speak a common language. Several initiatives, such as UPnP and DLNA, are attempting to provide such a common language for inter-device communication. This problem gets more complex once the video content uses a DRM, as it is further required that the source device be able to "authenticate" the target device. This process is often called link protection, which ensures that one device can securely communicate with another device (this process can be independent of the actual encryption scheme used to protect the video content). DTCP is an example technology that implements link protection capabilities.

2. Video performance: The network throughput performance for streaming video across a home network is significantly higher than what is required for traditional data and audio. The size of the video content directly impacts streaming performance, and networks must be "tuned" to support the necessary sustained throughput to prevent drops or "hiccups" in performance. These performance issues can be more noticeable on wireless networks, especially those using legacy 8.02.11b or 8.02.11g technologies for SD-quality video. Several hardware manufacturers are developing optimized hardware for streaming video.

Corruption/Recovery

Whenever content is copied or transferred, there is a possibility that the content may become corrupt or lost. The following issues may require some form of recovery or preventative measures to ensure a successful consumer experience:

1. Disk drive failure: Once consumers are allowed to make copies of their commercial video content on hard disk drives (or other portable storage media), there enters the possibility that such storage devices may fail. In such a case, it may be desirable for the consumer to "recover" from such a failure by being able to regain access to the original version of content and/or rights originally granted the consumer. How such recovery situations are handled will vary from one content owner or licensing entity to another.

2. Corruption: Similar to the failure of a disk drive or other portable storage media, such storage devices may encounter corruption in portions of the storage. As in the case of disk drive failure, it may be desirable for the consumer to "recover" from such corruption by being able to regain access to the original version of content and/or rights originally granted the consumer.

Section 5: Home Consumer Details

This section describes the requirements and steps that are needed to make managed copies and enable viewing via the home network.

Move and Managed Copy

From a technical perspective, the concepts of *move* and *copy* are very similar in that they follow the same basic process, although the end result is different. With the move process the consumer is still left with just one viewable piece of content, unlike the copy process which leaves the consumer with one or more viewable copies of the commercial video content. Therefore, the move process will contain the additional step of removing or revoking the license or even the content from the original storage device or computer.

The primary steps in the *copy* process (for both packaged media and electronic download) are as follows:

1. Authentication – Identifying the original version as authorized to perform a copy
2. Authorization Transaction – The actual approval that a copy can be made, this can be free or monetary based
3. Transcode or Download – Conversion of the original version into a format suited for its intended use or alternatively, the correct (new) format is downloaded
4. Content Protection – Securing the copy so that additional unauthorized copies can not be made
5. Digital Rights Management – Defines the set of usage rights for the new copy
6. Managed Copy – The finished product that a is now ready to be viewed

For the *move* process the following step is required:

7. Voiding the Original – Either the license that allows the original file to be played and/or the file itself is removed from the original device

Assuming that the consumer has an original physical version of the content and it allows for a managed copy (or move) to be performed, the following requirements need to be in place in order for that consumer to successfully make a copy of the content:

Packaged Media
1. Hardware, to read the original physical version
2. Target Media or Device, to use the copy on
3. Client Software, to perform the copy

Electronic Download
1. Hardware, to read the original physical version
2. Broadband, to download the content
3. Target Media or Device, to use the copy on
4. Client Software, to perform the copy

Based on the service and business model, the requirements can vary greatly. The grid below shows what types of requirements are applicable to either packaged media or electronic download formats:

Requirement	Packaged Media	Electronic Download
Hardware	Consumer Electronics Player	Consumer Electronics Player

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	Personal Computer	Portable Video Player Mobile Cell phone Automotive Based Player Personal Computer
Broadband Connectivity	Dial-up Phone Line DSL Cable Modem Satellite	DSL Cable Modem Satellite Wireless
Target Media	Burn to Disc PC Hard Drive Removable Flash Memory	Burn to Disc PC Hard Drive Removable Flash Memory
Target Device(s)	Portable Video Player Mobile Cell phone Automotive Based Player Personal Computer	Portable Video Player Mobile Cell phone Automotive Based Player Personal Computer
Client Software	Firm Ware (CE Player) Software Player (PC)	Firm Ware (CE Player) Software Player (PC)

Authorized Streaming within the Home Network

Streaming allows a consumer to view content on a variety of devices within their home environment without the need to perform a move or a copy. Streaming is beneficial since the consumer does not have to move files around within their home environment, which depending on the file size can be a lengthy process. Rather, content is accessed remotely from another location within the home environment. Devices that can have content streamed to them include set top boxes, portable players, cell phones and computers.

The primary steps in the *move* process are as follows:
1. Registration – Devices are registered with the content server to become eligible to access the content
2. Request – When ready to view content, a request is made to the content server
3. Authentication – The requesting device identifies itself to the content server and the content server determines whether the device has been registered
4. Digital Rights Management – Defines a set of usage rights for the original copy and determines whether content can be streamed
5. Content Protection – Content stream can be encrypted to prevent interception of the stream
6. Content Stream – Content is streamed to the device either via a wired or wireless network

Assuming that the consumer has an original physical version of the content and it allows for streaming to be performed then the following requirements need to be in place in order for that consumer to successfully stream the content:

Packaged Media
1. Hardware, to read the original physical version
2. Target Device, to view the stream on
3. Client Software, to provide the stream
4. Network, to deliver the stream

Electronic Download
1. Hardware, to read the original physical version
2. Broadband, to download the content
3. Target Device, to view the stream on
4. Client Software, to provide the stream
5. Network, to deliver the stream

NETWORKED DOWNLOAD

Based on the service and business model the requirements can vary greatly. The below grid shows what types of requirements are applicable to either packaged media or electronic download formats:

Requirement	Packaged Media	Electronic Download
Hardware	Consumer Electronic Player Personal Computer	Consumer Electronic Player Portable Video Player Mobile Cell phone Automotive Based Player Personal Computer
Broadband Connectivity	Dial-up Phone Line DSL Cable Modem Satellite	DSL Cable Modem Satellite Wireless
Target Device(s)	Portable Video Player Mobile Cell phone Automotive Based Player Personal Computer	Portable Video Player Mobile Cell phone Automotive Based Player Personal Computer
Client Software	Firm Ware (CE Player) Software Player (PC)	Firm Ware (CE Player) Software Player (PC)
Network	Wired Network Wireless Network Radio Frequency Infrared	Wired Network Wireless Network Radio Frequency Infrared

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Section 6: Glossary

AACS: AACS stands for "*Advanced Access Content System.*" This is a specification for managing content stored on the next generation of pre-recorded and recorded optical media for consumer-use with PCs and CE devices. It has been adopted by the DVD Forum to protect HD-DVD content and by Blu-ray Disc Association to protect BD (Blu-ray Disc) content. *AACS Founders* consist of Disney, Intel, MEI, Microsoft, Warner Bros., IBM, Toshiba, and Sony. *AACS LA* (Licensing Administrator) licenses AACS. [Cf. http://www.aacsla.com/what/overview].

BD Content Management System: *Blu-ray Disc Content Management System* consists of AACS, "*BD+,*" and *ROM-Mark. BD+* is a content protection scheme that is based on the technology called *Self-Protecting Digital Content* (or SPDC) developed by a company called Cryptography Research Inc. *ROM-Mark* is a scheme to identify the *replication-stamper* for each pre-recorded BD disc; this scheme has been designed to prevent a mass production of pirated discs.

Certified Wireless USB: *Certified Wireless USB* (Universal Serial Bus) is the new wireless extension to USB that combines the speed and security of wired technology with the ease-of-use factor of wireless technology. This technology has been developed by the *Wireless USB Promoter Group* – Agere Systems, Hewlett Packard, Intel, Microsoft, NEC, Philips, and Samsung – aided by over 100 contributing companies. Certified Wireless USB will support robust high-speed wireless connectivity by utilizing the common *WiMedia MB-OFDM Ultra Wide-Band* (UWB) radio platform as developed by the WiMedia Alliance. It can deliver 480Mbps at 3 meters or 110Mbps at 10 meters. In addition, it has an efficient power management as well as a security mechanism using encryption and authentication during transmission. [Cf. http://www.usb.org/developers/wusb/]

CORAL: The Coral Consortium is a cross-industry group to promote interoperability between digital rights management (DRM) technologies used in the consumer media market. The Consortium's goal is to create a common technology framework for content, device, and service providers, regardless of the DRM technologies they use. This open technology framework will enable a simple and consistent digital entertainment experience for consumers.
[Cf. http://www.coral-interop.org/index.html]

CPCM: *CPCM* or *Content Protection and Copy Management* is an area of *DVB* standard that develops a system for protecting content after it has been transmitted to the client side. Such a system allows consumers to use recorded content within a home network but prevents it from being distributed on the Internet. CPCM specification has released the first three elements for informational purposes: 'Reference Model,' 'Usage State Information,' and 'Abbreviations, Definitions and Terms.'

CPPM/CPRM/CPSA: CPPM, CPRM, and CPSA stand for *Content Protection for Pre-recorded Media, Content Protection for Recordable Media*, and *Content Protection System Architecture,* respectively. All of these have been developed by "4C," a consortium consisting of Toshiba, MEI, Intel, and IBM. CPPM/CPRM are licensed by a company called "4C Entity, LLC." [Cf. http://www.4centity.com/tech/]

CPPM is a 'renewable' content protection system for pre-recorded media; it is currently applied for DVD-Audio format. *CPRM* is a 'renewable' content protection system for recordable media such as DVD-R, DVD-RW, DVD-RAM, SD Card, SD Audio, SD Video, and Portable ATA Storage. CPPM and CPRM use a *block cipher* encryption, authentication, media-binding, and a key-revocation mechanism.

NETWORKED DOWNLOAD

[Cf. http://www.4centity.com/tech/cprm/]

CPSA is a system architecture that defines a *comprehensive* and efficient framework that makes it possible to integrate major existing content protection technologies. CPSA depends on both technology and (security) policy and uses two key elements: encryption and watermarking.
[Cf. http://www.4centity.com/data/tech/cpsa/cpsa081.pdf]

CSS: CSS stands for "Content Scramble System." This is a content protection system developed primarily by Toshiba and MEI (Panasonic), which includes encryption, authentication, and region-coding mechanisms. 'DVD CCA' (DVD Copy Control Association) licenses CSS, and a subcommittee called *Content Protection Advisory Council* (CPAC) discusses and votes, among other functions, on proposed amendments to *CSS Procedural Specifications.* CSS Algorithm is considered as a trade secret; but it has been leaked, and its scheme has been compromised in several ways.

DLNA: DLNA stands for *Digital Living Network Alliance* and is a cross-industry organization of electronics industry, computing industry and mobile device companies, which share a vision of a wired and wireless interoperable network of PC, CE devices and mobile devices in the home and on the road, enabling a seamless environment for sharing, and promoting new digital media and content services.
[Cf. http://www.dlna.org/about]

DTCP: DTCP stands for *Digital Transmission Content Protection* and is a content protection system (or a specification) that works by securing links of home network devices via encryption and authentication mechanisms. For example, it has been used to protect interfaces such as *USB, MOST, Blue Tooth, IEEE 1394*, and digital links using *Internet Protocol* (IP). DTCP has been developed by five companies ("5C"): Toshiba, MEI, Intel, Hitachi, and Sony, and is licensed by DTLA (*Digital Transmission Licensing Administrator*). [Cf. http://www.dtcp.com/]

DVB: *DVB* or *Digital Video Broadcasting* is a series of open standards for digital television, where *DVB Project* is a consortium of 270 - 300 companies of broadcasters, manufacturers, network operators, software developers, regulatory bodies and others, to design standards for the global broadcasting of digital television and data services using *MPEG2-TS*. The specifications are *formally* standardized by *CENELEC* (Comité Européen de Normalisation ÉLECtrotechnique) or *ETSI* (European Telecommunications Standards Institute).

The areas of documentation are, for example, DVB-S (the digital satellite system), DVB-S2 (the second generation of DVB-S), DVB-C (the digital cable system), DVB-T (the digital terrestrial system), DVB-H (for battery-powered handheld receivers) , DVB-DATA (the cyclical data delivery system), DVB-SI (the service information system), and DVB-MHP (Multimedia Home Platform, middleware for interactive television). DVB-T has been launched or adopted mainly by European countries, where a separate organization *ATSC* (Advanced Television Systems Committee) has been launched in U.S. There is also an area defined by DVB-CA, which is a package of *conditional access* tools such as DVB-CSA (Common Scrambling Algorithm) and DVB-SIM (SimulCrypt). [Cf. http://www.dvb.org/]

EST: *EST* or *Electronic-Sell-Through* refers to a business model that sells media content over the Internet as opposed to selling the content in physical forms such as selling DVD at a store. EST allows the consumer to *own* the downloaded content by storing it indefinitely in the user's hard disk drive but *may* not allow the consumer to store it anywhere else. This is one-step up from *the download-to-rent* model, which a handful of Web sites such as *Movielink* and *CinemaNow* offer.

In April 2006, however, *Universal Pictures, Sony Pictures Entertainment, Warner Bros., Metro-Goldwyn-Mayer and Paramount Pictures* began offering download-to-own movies through Movielink's EST service. And in May 2006, *Buena Vista Home Entertainment* started to offer some of their content through CinemaNow's EST service, where the movies can be transferred to up to three additional devices including laptops and portable electronic devices.

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HANA: *HANA* stands for *High-definition Audio-video Network Alliance,* and its members include IT companies, CE companies, content providers and service providers. Its mission is to create standard-based solutions for secure and reliable end-to-end connected High Definition AV networks that advance commercial deployment of products and services and to enhance the consumer HD entertainment experience. HANA also interacts with other organizations such as CEA (Consumer Electronics Association), the 1394 Trade Association, CableLabs and MPAA (Motion Picture Association of America) to ensure that its solutions meet the needs of all stakeholders, including consumers. [Cf. http://www.hanaalliance.org/about.php]

HDCP: HDCP stands for *High-bandwidth Digital Content Protection* and is a content protection system (or a specification) developed by Intel Corporation to protect digital entertainment content across the *DVI/HDMI* interface. HDCP is licensed by Digital Content Protection, LLC. [Cf. http://www.digital-cp.com/home]

HomePNA: PNA stands for *Phoneline Networking Alliance*, and HomePNA is an incorporated, nonprofit association of industry-leading companies working together to help ensure adoption of a single, unified phoneline networking industry-standard and rapidly bring to market a range of interoperable home networking solutions.
[Cf. http://www.homepna.org/]

Managed Copy: *Managed Copy* refers to *a copy* of digital content, which has been created according to a particular authorization given by the content-provider or its licensing-entity. Sometimes, the term refers to the process of making such a copy. A specific system-architecture that provides such process or the technology that is used to create such copies can define this term more precisely. *AACS*, for example, defines this term as *a copy of the content that has been made subject to external authorization using the process defined in the AACS spec.*

Managed Recording: *Managed Recording* refers to *a process* of recording digital content onto (disc) media according to a particular authorization. The precise definition depends on a specific system-architecture or technology being used. As of today, however, this term is not widely spread among the consumers, as there is no system including AACS, which uses this terminology.

NAS: *NAS* or *Network-Attached Storage* is a system of storage devices accessible by a computer network (e.g., Ethernet, Fiber Channel, or even 802.11) as opposed to a system of storage devices directly attached to the computer via PC Bus or SCSI. NAS has advantages over *SAN* (*or Storage Area Network*), which is a separate network with storage devices attached, in that it is less costly and easier to operate. A NAS system supports NFS (Network File System), CIFS (Common Internet File System), FTP, TCP/IP, and SCP (Secure CoPy).

PMP: PMP or Portable Media Player is a handheld device that can store and playback audio/video files. PMP uses a hard disk or flash memory for storage (its size ranges from 64MB to 20GB or more) and supports some of multiple media formats such as MPEG, DivX, XviD (Open source MPEG-4), MP3, WMA, WAV, AAC, MIDI, Ogg Vorbis, BMP, JPEG, GIF, and so on. PMP often comes with an LCD or OLED screen and a memory card such as CF (Compact Flash), MS (Memory Stick), SD (Secure Digital), SDIO, miniSD, microSD, MMC (Multi Media Card), xD, and SM (SmartMedia).

Rendezvous: *Rendezvous,* developed by Apple as a *Zero-Configuration networking*, is an open, standards-based local-link networking technology that automatically connects electronic devices without any user-configuration, i.e., it automatically sets up IP networking configuration and provides dynamic service-discovery. Rendezvous is now used by iChat, iTunes, iPhoto, Safari, file sharing, printing, and most other software that does networking on a Mac, including *telnet*, *SSH*, and *FTP*. Apple has later introduced *Bonjour*, renamed after *Rendezvous 2*, which includes wide-area-service registration and browsing, inbound NAT traversal, new API for Java, and all of these features for Windows as well.

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UPnP: UPnP stands for *Universal Plug-'n'-Play* and is a series of network protocols standardized by *the UPnP Forum*, which is an industry initiative designed to enable simple and robust connectivity among stand-alone devices and PCs, where the members participate in designing schema-templates for their device-classes that they are interested in. The UPnP architecture is a distributed, open (*P2P*) networking architecture that uses TCP/IP and HTTP to enable seamless control and data-transfer among networking of *SOHO* devices such as PCs, peripheral devices, CE devices, intelligent appliances, and wireless devices. [Cf. http://www.upnp.org/]

ViiV: *ViiV* is a PC-technology developed by Intel to enhance digital entertainment experiences. For example, with a ViiV-based PC, you can watch DVDs, downloaded TV programs, and listen to CDs and MP3s; you can even rewind live TV and store all your shows with a TV-tuner-card and built-in DVR functionality. [Cf. http://www.intel.com/viiv/whatisit.htm]

WMDRM: WMDRM stands for *Windows Media Digital Rights Management* developed by Microsoft and is a *DRM* system, which is integrated into Windows Media Player to protect copyrights of multimedia content in PC environment. WMDRM has been adopted by *MovieLink* and *CinemaNow* to protect downloaded content. WMDRM has been extended for WMDRM for Portable Devices ("*WMDRM-PD*") in a form of SDK and WMDRM for Network Devices ("*WMDRM-ND*"), where the devices must support Windows Media *ASF*, encryption schemes including 128-bit *AES* and 2048-bit *RSA*, and *UPnP registration*. Recently, WMDRM-ND has been accepted by DVD CCA as an approved technology to protect CSS-protected content transmitted through links among network-devices.

xCP: *xCP* or *eXtensible Copy Protection* is a copy protection initiative developed by IBM that allows content owners to control over distributed content to home networks in order to prevent illegal use of commercial media. Its technology builds on IBM's existing CPRM and CPPM, which contains a *broadcast encryption* algorithm, a cryptographic key management technology for a one-way communication channel, where little or no Internet connectivity is needed for home network devices. The algorithm works by allowing all of the devices within a home network (*xCP Cluster*) to establish a common media key, where the system can modify the encoding of the media key in *KMB* (Key Management Block) so that one or more devices can be *revoked*. IBM has later developed an efficient broadcast encryption algorithm called *NNL* (named after *Naor*, *Naor*, and *Lotspiech*), which uses an optimized representation of the revocation information and rivals a *PKI certificate revocation list* in size. [Cf. http://www.almaden.ibm.com/software/projects/xcp/]

XCP: *XCP* or *eXtended Copy Protection* is a software package developed by the British company called *"First 4 Internet"* and is sold as a DRM scheme for CD distributed by *Sony BMG*, which prevents the user from making more than three backup copies. The version '*Aurora*' is used in Sony BMG CD discs, which will install a program when played by Window-PC, and will prevent other media players or ripping software from accessing the CD drive, preventing the user from burning the content more than being allowed to or transferring the content onto other portable devices. No uninstalling program has been available then for the user, and an attempt to remove the program would result in an inoperable CD drive due to the registry setting that the program has altered. After an uproar from various groups and consumers, Sony BMG has later announced that they will suspend manufacturing CDs using the XCP system, that they will recall the affected CD discs with the exchange, and that they have released a patch to remove the program.