





DLNA Overview and Vision Whitepaper 2007



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Executive Summary

Digital Living Network Alliance (DLNA) is a cross-industry organization of leading consumer electronics, computing industry and mobile device companies. We share a vision of a wired and wireless network of interoperable consumer electronics (CE), personal computers (PC) and mobile devices in the home and on the road, enabling a seamless environment for sharing and growing new digital media and content services. DLNA is focused on delivering interoperability guidelines based on open industry standards to complete the cross-industry digital convergence.

DLNA has published a common set of industry design guidelines that allow manufacturers to participate in a growing marketplace of networked devices, leading to more innovation, simplicity and value for consumers. The DLNA Networked Device Interoperability Guidelines are use case driven and specify the interoperable building blocks that are available to build platforms and software infrastructure. These guidelines also focus on interoperability between the devices for personal media uses involving imaging, audio and video.

In the DLNA digital home, it will be common for consumers to:

- Easily acquire, store and access digital music from almost anywhere in the home
- Effortlessly manage, view, print and share digital photos
- Carry favorite content anywhere to enjoy while on the road
- Enjoy distributed, multi-user content recording and playback

This white paper provides background on the issues consumers face and explains how DLNA addresses these issues, including an overview of the DLNA Networked Device Interoperability Guidelines. An overview on DLNA's work with Digital Rights Management and Link Protection is also be presented in the end of the white paper.

Introduction

Consumers are acquiring, viewing and managing an increasing amount of digital media on devices in the consumer electronics (CE), personal computer (PC) and mobile device domains within a networked environment. They want to enjoy this content easily and conveniently across different devices and locations in the home, regardless of the source. As shown in Figure 1, after the first and most obvious uses of a home network such as sharing broadband Internet or networked printers, the highest consumer need and interest for the use of a home network is for accessing and enjoying digital entertainment content from one device in the house to another.

The chart in Figure 2 further illustrates the consumers' preferred media types used with servers. As indicated in the chart, photographs and music collections currently represent the most common media types. It is possible that the preference to share LiveTV will increase in the future due to the availability of more sophisticated service enablers and mobileTV market penetration.

The trends illustrated in these two charts are fueled by the proliferation of digital media and IP networking and supported by several leading market indicators:

- Digital device sales: music players, cameras, camcorders, DVD players, multimedia mobile phones and personal video recorders.
- Broadband adoption: DSL and cable
- Home network adoption: wired and wireless; ad-hoc and infrastructure configurations

All of these indicators point in the direction of year-on-year growth and opportunity for CE, PC and mobile device manufacturers, software and application developers and content providers. In the new digital media world, CE, PC and mobile devices will seamlessly interact with each other to cooperatively enhance the consumer experience.

Figure 1. Interest in Networking Entertainment Content

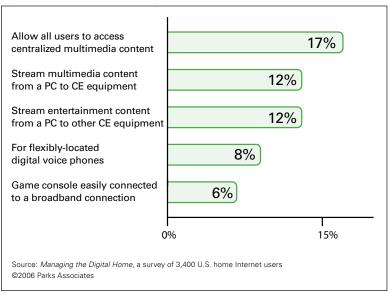
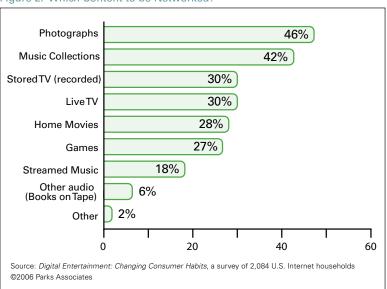


Figure 2. Which Content to be Networked?

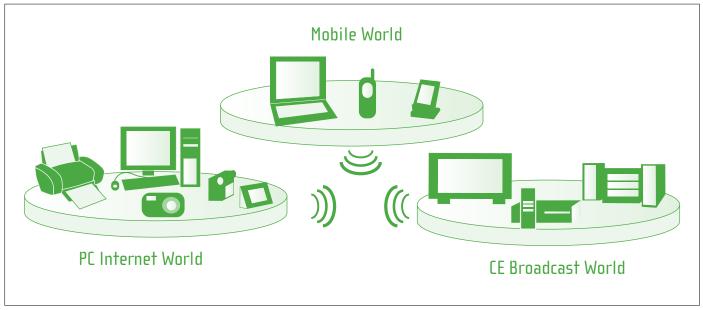


The Challenge

Today, three islands exist in the home (see Figure 3):

- The CE Broadcast World of set-top boxes and traditional consumer electronics.
- The PC Internet World where PC and PC peripherals communicate.
- The Mobile World of multimedia mobile phones, personal digital assistants, digital music
 players, laptop computers and similar devices provides unparalleled connectivity and freedom
 of movement into and out of the home environment.

Figure 3. PC, Mobile and CE Islands in the home



Consumers want devices in these three islands to work together in the home, but expectations have been largely unfulfilled.

In order to build in interoperability among these digital worlds and win customer confidence, industry leaders must address the following challenges cited by consumers and substantiated by research.

Consumer Challenges

- Products designed for the home should be easy to install, provide noticeable user value and be affordable.
- Products must interoperate with each other without requiring the consumer to undergo complex setup and configuration for connection between devices.
- Digital home products must interoperate with each other and with existing CE devices such as TVs and stereos.

Manufacturers must also recognize that the vision of convergence has not been realized in the mind of the consumer.

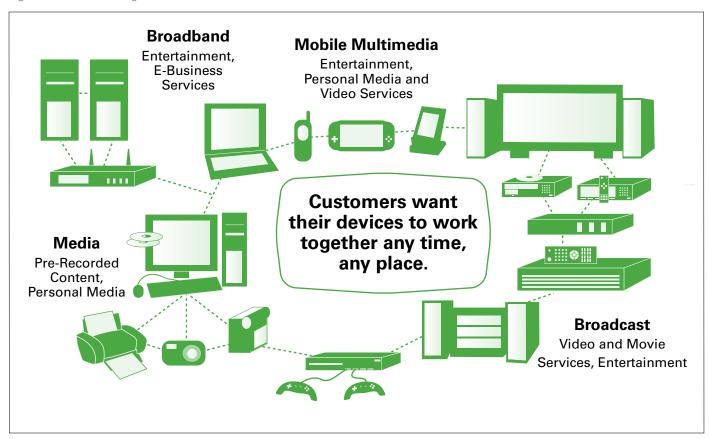
Product Developer's Dilemma

Current end-to-end solutions that are based on proprietary vertical implementations bring products to market early but have little impact on rapidly establishing a new category of products. Moreover, end users do not have the opportunity to select parts of a system from different manufacturers because there is no interoperability between those non-standard devices. Thus industry leaders must define guidelines to enable an interoperable network of CE, PC and mobile devices. This is where DLNA comes in.

Why DLNA?

DLNA has taken the initiative to answer the opportunities and challenges of the marketplace by delivering design guidelines developed in response to the most valuable use case scenarios. Wherever possible, the DLNA Networked Device Interoperability Guidelines refer to standards from established, open industry standards organizations and provide CE, PC and mobile device manufacturers with the information needed to build compelling, interoperable digital home platforms, devices and applications. DLNA evolving ecosystem of companies will offer a broad set of complementary products and services.

Figure 4. Content and Digital Home



The DLNA Vision

Members of the Digital Living Network Alliance (DLNA) share a vision of a wired and wireless interoperable network of consumer electronics (CE), personal computers (PC) and mobile devices in the home and on the road enabling a seamless environment for enjoying and growing new digital media and content services.

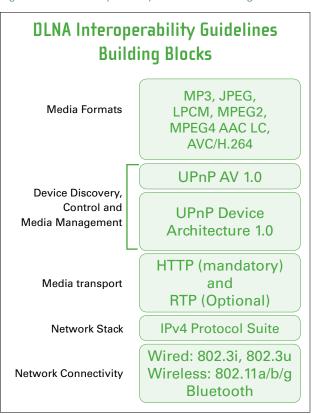
In the near future, digital homes will contain one or more intelligent platforms, such as an advanced set-top box or network-attached storage server device. These intelligent platforms will manage and distribute rich digital content to rendering devices such as televisions and wireless monitors from devices such as digital cameras, camcorders and multimedia mobile phones. Consumer experience will be further improved and enhanced because many mobile multimedia devices can also manage and distribute content to other devices.

The DLNA Scope and Strategy

Scope

In order to achieve the vision of digital interoperability in the home, DLNA has published a common set of industry design guidelines that allow manufacturers to participate in a growing marketplace of networked devices, leading to more innovation, simplicity and value for consumers. The DLNA Networked Device Interoperability Guidelines specify the interoperable building blocks that are available to build platforms and software infrastructure (see Figure 5). These Guidelines focus on interoperability between networked entertainment and media devices for personal media uses that involve images, audio and video. As new technology and standards become available, the Guidelines may broaden to cover other areas, such as home control, communications and advanced entertainment scenarios. Phased development of these Guidelines will take place to enable new user scenarios as they become important to consumers.

Figure 5. DLNA Interoperability Guidelines Building Blocks



This Figure 5 shows the technology ingredients covered by the DLNA Networked Device Interoperability Guidelines. For 2006 and beyond, the basic criteria for specific technology ingredients selected for these Guidelines include:

- Technology ingredients that should be based on standards from standards bodies, SIGs (Special Interest Groups) and industry forums, or be readily available and in relatively wide deployment on a variety of platforms in the marketplace. Intellectual Property should be available on reasonable and non-discriminatory terms for all manufacturers.
- In cases where multiple DLNA-approved technology ingredients are specified, it should be possible
 to bridge or translate (as required) between any two technology ingredients. For example, there
 should be a means to seamlessly bridge wired and wireless networking technologies.

Strategy

To deliver on the vision of interoperability in the digital home, DLNA has focused on three key elements:

- Industry collaboration
- Standards-based interoperability
- · Compelling products

The following is an overview of each of these elements.

Industry Collaboration

Aligning the key leaders in the CE, PC and mobile device industries on digital interoperability has been an essential first step for DLNA. However, industry collaboration has not been limited to just CE, PC and mobile device manufacturers—it has developed into an entire ecosystem of companies that together offer consumers a broad set of complementary products and services. This ecosystem includes contributors that are helping to bring all the necessary elements of the digital home to market and encompasses manufacturers, software and application developers, and service and content providers. In addition, the collaboration of industry leaders in DLNA has facilitated industry marketing and promotion while encouraging development, interoperability and support of home networked devices.

Standards-Based Interoperability

Under DLNA's leadership, the industry has cooperated in the development of workable guidelines for product design that define interoperable building blocks for devices and software infrastructure. It covers physical media, network transports, media formats, streaming protocols and digital rights management mechanisms. Standards for these areas are defined in many different forums and compliance with these standards has been an important first step. The DLNA Networked Device Interoperability Guidelines were created in a unique cross-industry effort that combined the efforts of over 200 CE, PC, and mobile device manufacturers and other DLNA member companies from around the world, working together with the aim of achieving the world's first substantial platform for true interoperability between consumer electronics, personal computer and mobile devices. Since technology and standards continually change and improve, these DLNA Guidelines will also evolve over time and ensure continued interoperability as new and old technologies are mixed together and addressed by DLNA.

Compelling Products

Finally, diverse and interoperable products are necessary to provide consumers with broad, compelling experiences and value throughout their homes. To this end, the DLNA Networked Device Interoperability Guidelines define a total of twelve Device Classes in three Device Categories. Since a Device Class is the certifiable entity in DLNA, a DLNA CERTIFIED™ product must embody the functionality of one or more of the Device Classes.

Figure 6. DLNA Device categories and device classes

Home Network Devices Digital Media Server (DMS) Digital Media Player (DMP) Digital Media Renderer (DMR) Digital Media Controller (DMC) Digital Media Printer (DMPr)

Mobile Handheld Devices Mobile Digital Media Server (M-DMS) Mobile Digital Media Player (M-DMP) Mobile Digital Media Downloader (M-DMD) Mobile Digital Media Uploader (M-DMU) Mobile Digital Media Controller (M-DMC)



The initial set of DLNA guidelines mostly covered use cases between media servers and players in a home network. DLNA Networked Device Interoperability Guidelines Expanded, March 2006, added two new device class categories: Mobile Handheld Devices and Home Interoperability Devices. These Expanded Guidelines also include additional device classes and new usage scenarios; for example, enabling consumers to use a third device (such as a PDA) to control content flow between two primary player and server devices, like a television and a media server.

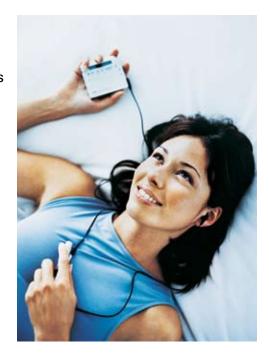
The **Home Network Device (HND)** category is made up of five Device Classes that share system usages in the home network with the same media format and network connectivity requirements.

 Digital Media Server (DMS) devices provide media acquisition, recording, storage, and sourcing capabilities, as well as content protection enforcement as required.
 DMS products will often include Digital Media Player (DMP) capabilities and may have intelligence, such as device and user services management, rich user interfaces and media management, aggregation and distribution functions.



Some examples of DMS devices include advanced set-top boxes, personal video recorders, PCs, stereo and home theaters with hard disk drives (for example, music servers), broadcast tuners, video and imaging capture devices such as cameras and camcorders, and multimedia mobile phones.

- Digital Media Player (DMP) devices find content exposed by a DMS or M-DMS and then pulls the selected content from the server to provide playback and rendering capabilities. Some examples of DMP devices include televisions, stereo and home theaters, personal digital assistants, multimedia mobile phones, wireless monitors and game consoles.
- Digital Media Renderer (DMR) devices play content received from a DMS or M-DMS after being setup by another Home Network Device (DMC or devices which include a DMC). Some examples of DMR devices include televisions, audio/video receivers, video displays and remote speakers for music.



- Digital Media Controller (DMC) devices find content exposed by a DMS and match it to the rendering capabilities of a DMR, setting up the connections between the DMS and DMR. An intelligent remote control is one example of a DMC device; a multifunction device such as a mobile multimedia phone may also include a DMC.
- Digital Media Printer (DMPr) devices provide printing services to the DLNA home network. Photo printing is the application DLNA prioritized, but other types of content can also be printed from a DMPr. When selected for media output, a DMPr combines images with an Extensible HyperText Markup Language (XHTML) template to create the printed page. DLNA provides several basic photo templates to assist new manufacturers in quickly adding photo printing to their DLNA devices. It is easy to add printing to device applications because the DMPr is based on the Universal Plug and Play (UPnP™) PrintEnhanced:1 Service and the W3C XHTML Print specification.

Some examples of DMPr devices include a networked photo printer and a networked all-in-one printer. Also, an application running on a PC may expose DMPr functionality to an ordinary USB-attached printer peripheral.

The **Mobile Handheld Device (MHD)** category is made up of five Device Classes that share the same system usages as the HND Device Category, but have different requirements for media format and network connectivity. The MHD category includes these Device Classes and functionalities:

- Mobile Digital Media Server (M-DMS) devices expose and distribute content. A mobile phone
 and a portable music player are examples of M-DMS devices.
- Mobile Digital Media Player (M-DMP) devices find content exposed by an M-DMS or DMS and play the content locally on the M-DMP. A media tablet designed for viewing multimedia content is an example of an M-DMP device.

- Mobile Digital Media Uploader (M-DMU) devices send content to an M-DMS or DMS with upload functionality. A digital camera and a camera phone are examples of M-DMU devices.
- Mobile Digital Media Downloader (M-DMD) devices find and download content exposed by an M-DMS or DMS and play the content locally on the M-DMD after download. A portable music player is an example of an M-DMD device.
- Mobile Digital Media Controller (M-DMC) devices find content exposed by an M-DMS or DMS and match it to the rendering capabilities of a DMR, setting up the connections between the server and renderer. A personal digital assistant (PDA) and an intelligent remote control are examples of M-DMC devices.

MHDs interoperate with stationary devices on the DLNA home network, permitting a variety of use cases. Some examples include:

- Push images and video taken from an MHD to a television
- Function as a remote control
- Upload images, music and video clips from an MHD to a media server
- Download images from an MHD to a server using server's controls

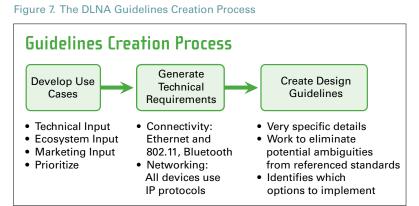
The Home Infrastructure Device (HID) category is comprised of two Device Classes:

- Mobile Network Connectivity Function (M-NCF) devices provide a bridging function between the MHD network connectivity and the HND network connectivity.
- Media Interoperability Unit (MIU) devices provide content transformation between required media formats for the HND Device Category and the MHD Device Category.

Use Cases and Usage Scenarios Drive Guidelines

DLNA realizes that a deep understanding of end users, their environments and current uses of technology is critical to success (see Figure 7). Equally important are a clear sense of the end users' attitudes to new capabilities and an understanding of the features that will ensure

the quick uptake and diffusion of products into the market. To document this knowledge, DLNA utilizes the established approach of use cases and usage scenarios. Only after refining, documenting and prioritizing these critical cases and scenarios can the process of creating detailed technical guidelines based on recognized industry standards move forward.



DLNA has prepared a separate white paper titled "DLNA Use Case Scenarios," which offers detailed information on the organization's evaluation of the most common, near-term consumer use cases for digital products. DLNA regards this companion white paper as an integral part of this DLNA vision and encourages readers of this document to also read through the "DLNA Use Case Scenarios" white paper.

Value Proposition

For digital interoperability to succeed, consumers, manufacturers, service providers and content providers must all see a strong value proposition in that interoperability. Consumers are unlikely to adopt and pay a premium for digital home products if those offerings do not deliver on their promise of performance, capabilities and simplicity. Likewise, CE, PC and mobile device manufacturers will have little motivation to develop interoperable products if the market does not provide clear business opportunities. The same applies to content and service providers who are looking for new venues and outlets to distribute their entertainment content and services.

The following is an examination of the value proposition for digital home products as it relates to consumers, content and service providers and manufacturers.



Consumers

The consumer will be able to purchase an abundance of products from a suite of home, mobile, and handheld device classes, including Digital Media Players, Servers, Renderers, Controllers, and Printers. As never before imagined, consumers will be able to communicate and collaborate with each other, enjoying simple and seamless access to content throughout their home. Consumers will benefit from greater convenience and ease of use and will have more flexibility in selecting a range of products from different manufacturers. Finally, the assurance of DLNA interoperability will instill confidence in consumers that the products they purchase will work well together and potentially to be more future-proof.

Content and Service Providers

The building blocks for digital interoperability provide content and service providers with technical solutions that eliminate barriers for secure end-to-end connectivity and high-quality media streaming, including commercial content. This interoperability allows content and services to be delivered to more end-points, increasing revenue opportunities for both content and service providers.

Manufacturers

As mature product lines slow and products become commodities, CE, PC and mobile device manufacturers continuously look for new ways to differentiate and expand existing product categories while increasing their function and capabilities. Consumer migration from VCR to DVD players is a good example of manufacturers transitioning existing applications into new and improved offerings. In another example, CE manufacturers have increased the value of the traditional television by incorporating brilliant flat panel screens, DVD players, game ports and high-definition capabilities. Another example is the growing adoption of multimedia—including audio, streaming video and imaging—as a standard feature in mobile devices.

The time-proven recipe described above yields increased value to consumers—value for which they are willing to pay a premium. Interoperable DLNA products also fit this model.

New business opportunities can also be strengthened by:

- Joint industry promotion of new CE, PC and mobile product categories
- Constructing an interdependent ecosystem of devices, software and services
- Fostering consumer/retailer confidence in reliable and high-quality DLNA devices

DLNA Networked Device Interoperability Guidelines

A collaborative effort of cross-industry member companies, the DLNA Interoperability Guidelines were formed from prioritized consumer usage scenarios and open and established CE, PC and mobile industry standards.

June 2004: Publication of the Home Networked Device Interoperability Guidelines just one year after DLNA was founded.

January 2005: Release of the Optional Media Format Addendum Guidelines. With support for more media formats common to many CE, PC and mobile devices, the value of devices based on DLNA guidelines is increased.

March 2006: Publication of the DLNA Networked Device Interoperability Guidelines Expanded, March 2006 adds significant functionality to the DLNA network. The introduction of mobile devices and printers allow information sharing among existing DLNA products and these new device categories, as well as the capabilities of media servers and players are extended.

October 2006: Publication of the DLNA Networked Device Interoperability Guidelines Expanded, October 2006 addresses vital link protection issues to provide the necessary environment that establishes secure streams for transmission of commercial premium content protected by copyrights.

DLNA CERTIFIED™ Products

Products designed to the DLNA Networked Device Interoperability Guidelines are granted use of the DLNA CERTIFIED™ Logo (see Figure 8) after meeting all DLNA certification and testing requirements. The first DLNA CERTIFIED™ products appeared on retail shelves in Q1 2006, enabling a better experience for consumers, building consumer confidence and adding value to the CE, PC and mobile device markets.

Figure 8. The DLNA CERTIFIED™ Logo



DLNA Member Companies

DLNA Member Companies represent a tremendous commitment of global brands and high-level executives. With twenty countries represented, DLNA is truly global in its origin. Total membership exceeds 200, with 21 companies serving as Promoter Members and the balance as Contributor Members. Rapid growth has characterized DLNA since its founding and continues to be spurred by significant interest in collaborating interoperability initiatives across all related industries. With this level of global commitment, DLNA has become a very effective digital networking organization whose members are enthusiastically and efficiently developing products to the DLNA Networked Device Interoperability Guidelines. Momentum for truly interoperable digital living is building rapidly through the efforts of DLNA and its Member Companies.

DLNA Architecture

The digital home consists of a network of CE, PC and mobile devices that cooperate transparently, delivering simple, seamless interoperability that enhances and enriches user experiences. This is the communications and control backbone for the home network and is based on IP networking UPnP™ and Internet Engineering Task Force technologies.

Interoperability is accomplished between devices when they can collaborate transparently on a particular service that they provide to the user. Typically, this includes the ability of devices to communicate with each other and exchange meaningful information. The building blocks needed to facilitate this interoperability are described below.

- Transparent connectivity between devices inside the digital home: This includes networking compatibility at the link layer (layer 2) for devices directly connected to each other. When devices of different layer 2 technologies need to communicate, appropriate layer 2 bridging and layer 3 routing must exist between these devices. The overall goal is to enable end-to-end connectivity between all devices exchanging information over the home network.
- Unified approach for device discovery, configuration and control: Any device on the home
 network must be able to discover the presence of other devices and services on the network
 and identify their function and associated capabilities. It also includes the ability to configure
 these devices and services, and control their operation with appropriate ease-of-use.
- Interoperable media formats and streaming protocols: Once devices can communicate with
 each other, they need to agree on a common streaming protocol in order to establish media
 streaming sessions. These devices also need to agree on the used media formats from those
 that they support to ensure that the media can be shared, consumed and rendered.
- Interoperable media management and control: Interoperable media management across all
 devices in the digital home enables the proper exchange of media information and control
 between devices provided by different manufacturers. It must include the ability to organize,
 browse, search, and select media items to be processed, in addition to the ability to control
 the operation of media streaming sessions.
- Compatible quality of service mechanisms: Quality of Service (QoS) for networking is essential when transferring high-definition media streams in the digital home, particularly in the presence of best effort traffic. For this to work, manufacturers must agree on how to address QoS in the digital home. Devices must still interoperate, even if there are no QoS mechanisms implemented.
- Compatible authentication and authorization mechanisms for users and devices: A number
 of authentication and authorization mechanisms are being considered by device manufacturers
 and application developers to provide appropriate security for access and control. It is imperative
 to settle on compatible authentication and authorization mechanisms that enable devices to
 request and/or grant access to particular devices and services in the home.

Key Technology Components

The following sections cover some of the key technology components for the DLNA Interoperability Guidelines.

Networking and Connectivity

The IPv4 family of protocols is the foundation for networking and connectivity in the digital home. Internet Protocol (IP) also provides underlying network communications for devices on the Internet. IP is based on industry standard specifications, implemented and supported in a wide range of devices with more than two decades of deployment in government, academic and commercial environments.

There are several advantages to using IP in the digital home:

- IP allows applications running over different media to communicate transparently. For example, a PC or an advanced set top box may stream media content to a television in the master bedroom through an Ethernet cable to an 802.11 Access Point and then wirelessly to the television. With IP, the media server and the television are unaware that the media content travels over two separate physical media. For direct peer-to-peer communications of a mobile device transmitting to a stationary device, IP provides the unifying framework to make applications independent of the actual transport technology.
- IP can connect every device in the home to the Internet. Since IP is the protocol of the Internet, any device in the digital home can be potentially connected to any other Internet-connected device in the world.
- IP connectivity is inexpensive. Because it is ubiquitous, economies of scale and competition combine to make physical media implementations of IP available at lower cost than other technologies.

Recognizing these advantages, the DLNA Networked Device Interoperability Guidelines are intended to facilitate simple, interoperable connectivity, while meeting the consumers' needs today and in the future.

The Internet Engineering Task Force is standardizing IPv6 as an improved version of IP and is actively pursuing a range of transition techniques for a smooth migration from IPv4 to IPv6. Many of these techniques will be applicable to home devices and residential gateways.

IPv6 provides built-in auto-configuration and enhanced support for mobility and security. IPv6 also provides a much larger network address space allowing more devices to be transparently interconnected. IPv6 is gaining acceptance in the CE, PC and mobile device industries as the long-term solution to the shortage of IPv4 addresses while maintaining end-to-end transparency.

In the near term, support of IPv4 is essential for interoperability of devices on the home network. In the longer term, IPv6 support will become more important. The future transition from IPv4 to IPv6 will be handled in the DLNA Networked Device Interoperability Guidelines in a manner that enables devices based either on IPv4 or IPv6 to work well together.

Device and Service Discovery and Control

Device and service discovery and control enables devices on the home network to automatically self configure networking properties (such as an IP address), discover the presence and capabilities of other devices on the network, and control and collaborate with these devices in a uniform and consistent manner. The UPnP™ Device Control Protocol Framework (DCP Framework), Version 1, addresses all of these needs to simplify device networking in the home and is the selected device discovery and control solution for digital home devices.

The UPnP Forum steering committee is currently looking at an improved version of the UPnP DCP Framework, Version 2 that integrates better with the emerging web services model. However, for the next several years Version 1 of the UPnP DCP Framework meets the needs of consumers and any migration to Version 2 will be handled in future DLNA Networked Device Interoperability Guidelines in a manner that enables devices based on either Version 1 or Version 2 to work well together.

Media Format and Transport Model

The DLNA media format model is intended to achieve a baseline for network interoperability while encouraging continued innovation in media codec technology. Improvements in media codec technology result in better network bandwidth utilization and media quality for a given bit rate. DLNA requirements on media format support apply to media content that passes over the home network from a DMS or M-DMS device to a DMP or M-DMP device. The DLNA media format model defines a set of required media formats and a set of optional media formats for each of the three classes of media and for both device categories: image, audio, and video with audio (AV). Table 1 and Table 2 show the current set of required formats and optional formats as defined in the DLNA guidelines. The network interoperability model for media formats is as follows:

- All DMS, DMP, DMR, DMC, and DMPr devices, and their counterpart MHD devices, must support all formats designated in Table 1 and Table 2 as required for any of the media classes and device category they support. In the addition, all DMS/M-DMS and DMP/M-DMP/M-DMD devices may support any additional formats designated as optional for any of the media classes they support.
- Any DMP, M-DMP, DMR, M-DMD and DMPr device must be able to receive content from any DMS or M-DMS device. A DMS or M-DMS device may stream content in its native format if the receiving device supports such native format. Otherwise, that DMS or M-DMS device should transcode the native format to one of the applicable required formats or to a format understood by the rendering device.

Table 1. DLNA Media formats for Home Devices

Media Formats	Required Formats Set	Optional Formats Set	
Imaging	JPEG	GIF, TIFF, PNG	
Audio	LPCM (2 channel)	MP3, WMA9, AC-3, AAC, ATRAC3plus	
Video	MPEG2	MPEG1, MPEG4, WMV9	

Table 2. DLNA Media formats for Mobile/Handheld Devices

Media Formats	Required Formats Set	Optional Formats Set
Imaging	JPEG	GIF, TIFF, PNG
Audio	MP3 and MPEG4 AAC LC	MPEG4 (HE AAC, AAC LTP, BSAC), AMR, ATRAC3plus, G.726, WMA, LPCM
Video	MPEG4 AVC (AAC LC Assoc Audio)	VC1, H.263, MPEG4 part 2, MPEG2, MPEG4 AVC (BSAC or other for Assoc. Audio)

LPCM represents a reasonable technical choice for a required audio format in HND devices, particularly in wired environments. Wireless networking is rapidly growing in importance for home networking and is expected to become an important means of distributing media in the home. For a wireless device, or a resource-constrained device such as a portable player with limited memory and power supply, compressed audio formats, such as MP3, AAC and WMA provide more efficient use of network bandwidth, battery power and storage. Therefore for the MHD device category, MPEG4 AAC LC and MP3 were selected as mandatory formats in audio media class and AAC LC with efficient AVC video for A/V media class. MPEG4 AVC is a new digital video codec standard noted for achieving very high data compression while maintaining good video quality at bit rates that are substantially lower (e.g., half or less) than what previous standards would need. Also, MPEG4 AVC may be applied to a very wide variety of applications.

Over time, new media formats may be added to the required or optional format sets. However, at all times, the required set shall only include formats that are open standards. The required and optional formats model brings the benefit of continued innovation in media codec technologies while assuring interoperability. Device manufacturers can differentiate their products by also including support for one or more of the optional media formats. This allows manufacturers to take advantage of better audio and video formats and, when possible, make more efficient use of available media storage and network bandwidth resources without sacrificing interoperability with devices that only implement the required format set.

The transfer scenarios that can be supported include:

- A transfer from a DMS or M-DMS device to a DMP or M-DMP device, even if there is no actual
 immediate rendering of the media content: This may occur for an intelligent DMS device that
 distributes or replicates media content on the home network.
- A transfer from a DMS device to another DMS device: Note that the intelligent DMS device
 would logically be acting as a DMP device in this scenario even if there is no immediate
 rendering of the media content. This may occur for an intelligent DMS device that aggregates,
 organizes, processes, and/or archives media content on the home network.

DLNA has defined the following three types of media transfer modes to deliver content from a Content Source to a Content Receiver:

 Streaming Transfer is used when either a content binary is being immediately rendered by DMP, M-DMP or DMR for a user and contains inherent timing that must be met or a content binary is being generated in real time at a fixed rate (such as a live broadcast stream), regardless of whether the item is being immediately rendered or stored for later use.

- Interactive Transfer is used when content that does not contain internal timing information is being transferred for the purpose of immediate user interaction with the content. For example, sending images that are to be displayed immediately to a user.
- Background Transfer is used for the case where the content binary is not being transferred for immediate rendering or where the user may be satisfied with a transfer executed at the lowest priority. It is typically reserved for the download or upload of content (by M-DMD or M-DMU) that is not being generated in real time by the Content Source.

Devices that source or render media content across the home network must support HTTP as the mandatory transport. Those devices may also support optional RTP.

Media Management, Distribution, and Control

Media management and control enables devices and applications to identify, manage, and distribute media content across the stationary home network, or to transfer it to mobile devices. UPnP Audio/Video (AV) technology addresses all of these needs for the home network and is the media management and control solution for devices developed according to the DLNA Networked Device Interoperability Guidelines.

UPnP AV specifications define the interaction model between UPnP AV devices and associated control point applications. The UPnP AV architecture allows devices to support entertainment content in any format and over any transfer protocol. UPnP AV specifications define the following four services hosted by Media Servers and Media Renderers.

- Content Directory Service: This enumerates the available content (e.g., videos, music and pictures).
- Connection Manager Service: This determines how the content can be transferred from Media Server to Media Renderer devices.
- AV Transport Service: This controls the flow of the content (e.g., play, stop, pause and seek).
- Rendering Control Service: This controls how the content is played (such as volume/mute and brightness).

In addition to the building blocks described, other issues need to be addressed for the digital home to work. The following are important capabilities that DLNA has also investigated.



Digital Rights Management / Content Protection

In order for commercial digital content to be made available for use with DLNA devices, content must be protected from unauthorized copying and use. Consumers acquire commercial content from different channels (cable, satellite, Internet, etc.) at different price points; the usage rights associated with content acquired through different channels are also typically different. For example, a movie ordered through pay-per-view on a cable set-top box has different usage rights from a video purchase from an Internet video download service. At the same time, consumers expect to be able to store, transport and use that content at any location and on any device on their wired or wireless home networks. Balancing the providers' need for protection from unauthorized use and copying, while providing interoperability between all networked devices that might handle the content, is a complex problem. Content protection methods must also be user friendly.

Today, there are several Digital Rights Management (DRM) technologies available to device designers and content providers. One or more of these solutions will typically be provided on DLNA devices to protect, administer and distribute stored content as one component of content protection in the digital home. However, commercial content cannot be shared across devices with different DRM technologies unless there is an interoperability mechanism for content to flow from the source device to the destination device. The interoperability mechanism must provide a technical DRM interoperability solution (ability to transform content protected using the source DRM to content protected using the destination DRM in a secure fashion) while respecting the usage rights and policy associated with the content. DLNA has identified DRM interoperability as the core charter of the content protection guidelines work within DLNA, recognizing that it is a key layer of interoperability that allows commercial content to be shared across all devices that belong to a consumer.

Given the complexity of DRM interoperability, the initial efforts of the content protection subcommittee in DLNA focused on link protection technologies to protect content in transit from a source (DMS, DMC or DMP) to a display device (DMR). The Content Protection Subcommittee completed its link protection guideline work in March 2006, resulting in the publication of the DLNA Networked Device Interoperability Guidelines Expanded, October 2006, which include link protection. The Content Protection Subcommittee is now focused on developing DLNA DRM interoperability guidelines.

When a DLNA device supports DLNA Link Protection, then the DLNA Networked Device Interoperability Guidelines Expanded, October 2006 mandates that the device must support DTCP-IP and may support WMDRM-ND. If an UPnP AV Media Server supports DLNA Link Protection, it must be capable of exposing and transferring at least one of the DLNA media format profiles with DTCP-IP link protection.

Other components of DRM that support additional user scenarios are being considered for development in standard organization and elsewhere in the industry.

How DRM Differs from Link Protection

The primary use case for link protection is that commercial content, which is stored on the DMS and protected by a DRM technology, is decrypted and re-encrypted using a link protection technology by the DMC (for example, mobile device) or DMP (for example, digital media player/DVR) before being sent to the DMR (such as a television). The DMR decrypts the content stream and then displays/outputs it.

Link protection thus enables view-only sharing of commercial content on all devices in the home network. DRM interoperability, the stated charter of DLNA Link Protection guidelines, enables true sharing of commercial content (copying as well as view/stream-only uses, subject to the usage rights and policy associated with the content) across all devices in the home network.

DLNA thus provides a useful venue for those who share the vision of device interoperability. Collaboratively, manufacturers can understand and document the range of technical and business requirements for achieving the required balance between protection, availability and usability. This work will aid device designers and content providers in implementing DRM methods today and in the future, to foster an integrated, user-friendly, and backward compatible system that meets the rights, needs and expectations of all stakeholders.

Manageability

Consumer adoption rates of digital products will depend largely on the overall quality of experience users have, not just when using these products for their intended purposes, but also when a problem arises involving one or more of them. The introduction of a variety of networked products into the home may make the resolution of issues by the consumer and support provider a difficult and expensive prospect.

The more management information that can be given to the consumer in a meaningful manner about the health and maintenance of their home network devices, the less likely they are to require support. Should a consumer require support for a device, they should know how to obtain such assistance and not be faced with the situation where they are passed on to another company without satisfactory resolution of their problem.

DLNA will provide a useful venue for interested members to discuss technical and business issues that illustrate how DLNA devices can be best managed and supported.

Liaison Relationships

DLNA liaises with other industry consortia and organizations to harmonize the introduction of relevant industry interoperability standards with development of the DLNA Networked Device Interoperability Guidelines. This collaboration is facilitated through a dedicated DLNA subcommittee that manages liaison relationships.

Examples of consortia and organizations from DLNA's liaison list:

- UPnP™ Implementers Corporation
- UPnP™ Forum
- Wi-Fi Alliance[®]
- Consumer Electronics Association (CEA®)
- Digital Video Broadcasting Project (DVB®)
- Home Gateway Initiative Project (HGI)
- Alliance for Telecommunications Industry Solutions (ATIS)

Formalizing Interoperability

Certification and Logo Programs

In September 2005, DLNA launched the Certification and Logo Program to validate interoperability between devices designed to be compliant to the DLNA Networked Device Interoperability Guidelines. When a DLNA member company's product passes certification testing, a licensing agreement may be signed issuing the DLNA CERTIFIED™ Logo to the qualified product, enabling consumers to identify it as DLNA compliant. DLNA CERTIFIED™ products enable verified connectivity and multimedia content sharing between CE, PC and mobile devices.

Plugfests

In an ongoing program, DLNA hosts compliance workshops (plugfests) worldwide and encourages DLNA member companies to attend with products currently in development. During a plugfest, products are tested in a DLNA compliant network with other products and by DLNA testing tools. This is a very effective way to prepare a product for DLNA certification testing and may even discover areas of development in the DLNA Guidelines. The member companies are committed to continuous development of the Guidelines along with close cross-industry collaboration within DLNA.

