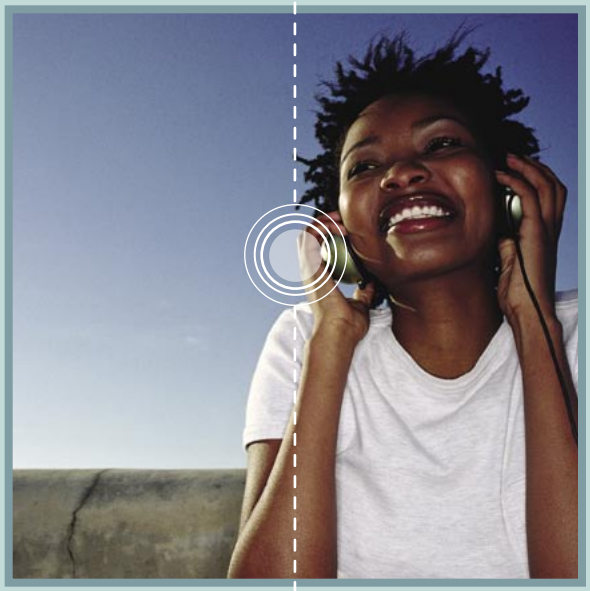

DLNA Overview and Vision Whitepaper 2006

dlna™

Digital Living Network Alliance

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Executive Summary

The 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 interoperable network of Personal Computers (PC), Consumer Electronics (CE) 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 vendors to participate in a growing marketplace of networked entertainment and mobile devices, leading to more innovation, simplicity and value for consumers. The DLNA Home Networked Device Interoperability Guidelines are use case driven and specify the interoperable building blocks that are available to build platforms and software infrastructure. They are focused 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
- Take favorite content anywhere to share with family and friends
- Enjoy distributed, multi-user content recording and playback

This paper gives an overview of the DLNA Interoperability Guidelines.

Introduction

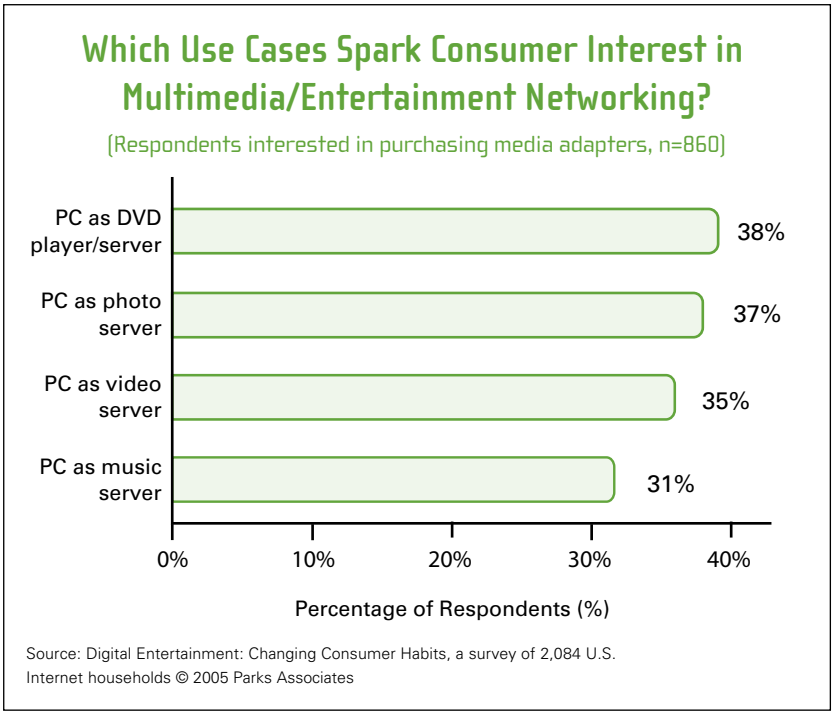
Consumers are acquiring, viewing and managing an increasing amount of digital media on devices in the CE, mobile and PC domains (see Figure 1). They want to enjoy this content easily and conveniently – regardless of the source – across different devices and locations in the home.

This trend is 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, mobile device and PC manufacturers, software and application developers and content providers. In the new digital media world, CE, mobile and PC devices will seamlessly interact with each other to cooperatively enhance the consumer experience. In the past, convergence has been the popular term used in the industry for the joining of these worlds. However, consumers generally don't want these devices to merge together in functionality – they just want them to work better together.

Figure 1. Interest in Networking Entertainment Content



Source: Digital Entertainment: Changing Consumer Habits, a survey of 2,084 U.S. Internet households © 2005 Parks Associates

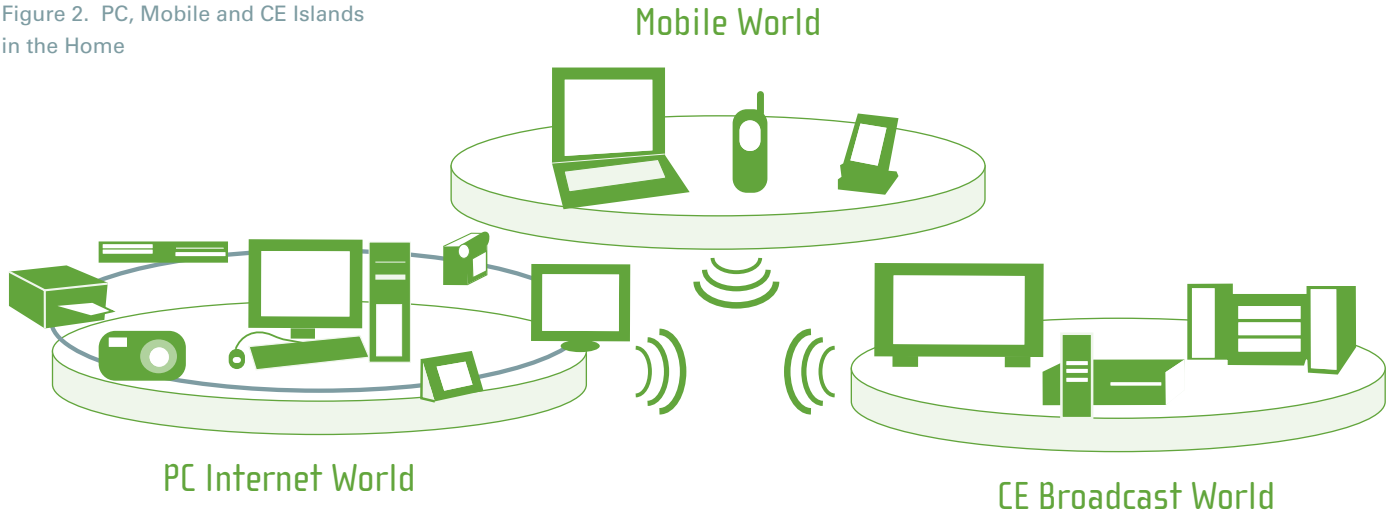
The Problem

Today, three islands exist in the home (see Figure 2).

- The PC Internet World where PC and PC peripherals communicate.
- The CE Broadcast World of set-top boxes and traditional consumer electronics.
- The Mobile World of multimedia mobile phones, personal digital assistants, MP3 players, laptop computers and similar devices provides unparalleled connectivity and freedom of movement into and out of the home environment.

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

Figure 2. PC, Mobile and CE Islands in the Home



In order to build in interoperability between 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 obvious user value and be affordable.
- 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

- Open industry standards are often too flexible – products built by different vendors all too often fail to interoperate well. Design choices should be narrowed through industry consensus to better achieve interoperability.
- Current end-to-end solutions based on proprietary vertical implementations bring products to market early but have little impact on rapidly establishing a new category of products.

In summary, industry leaders must define guidelines to enable an interoperable network of CE, mobile and PC devices. Products developed according to the DLNA guidelines will enhance the distribution of digital media throughout the home.

Why DLNA?

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

The DLNA Vision

Members of the Digital Living Network Alliance (DLNA) share a vision of a wired and wireless interoperable network of Personal Computers (PC), Consumer Electronics (CE) and mobile devices in the home and on the road enabling a seamless environment for sharing and growing new digital media and content services.

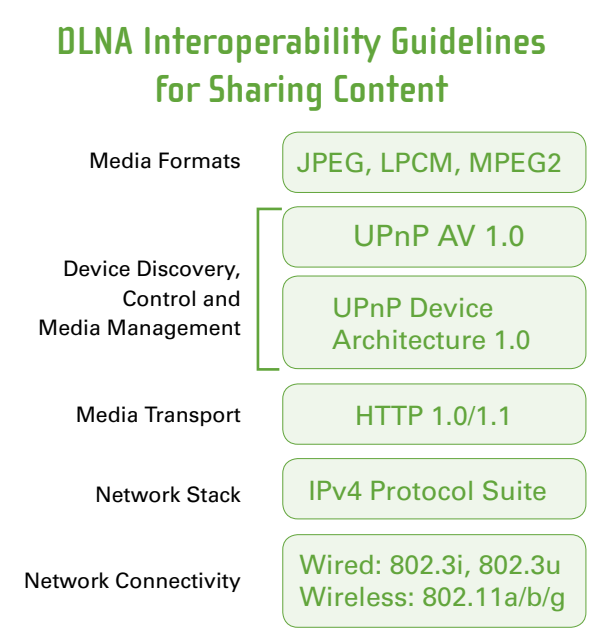
In the near future, digital homes will contain one or more intelligent platforms, such as an advanced set-top box or network-attached storage server device. These intelligent platforms will manage and distribute rich digital content to devices such as TVs and wireless monitors from devices such as digital cameras, camcorders and multimedia mobile phones.

The DLNA Scope and Strategy

Scope

In order to deliver on digital interoperability in the home, DLNA has published a common set of industry design guidelines that allow vendors to participate in a growing marketplace, leading to more innovation, simplicity and value for consumers. The DLNA Interoperability Guidelines specify the interoperable building blocks that are available to build platforms and software infrastructure. They have focused on interoperability between networked entertainment and media devices for personal media uses involving imaging, audio and video. Over time, 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 the

Figure 3. DLNA Interoperability Guidelines for Sharing Content



guidelines will take place to enable new user scenarios as they become important to consumers.

Table 1. DLNA Interoperability Guideline Functional Components & Technology Ingredients

Functional Components	Technology Ingredients
Connectivity	Ethernet, 802.11, and Bluetooth
Networking	IPv4 Suite
Device Discovery and Control	UPnP Device Architecture v1.0
Media Management and Control	UPnP AV v1 and UPnP Printer:1
Media Formats	Required and Optional Format Profiles
Media Transport	HTTP (Mandatory) and RTP (Optional)

Table 1 shows the specific functional components and technology ingredients covered by the DLNA Interoperability Guidelines. The basic criteria for specific technology ingredients selected for the DLNA Interoperability Guidelines for 2006 and beyond include:

- Technology 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 vendors.
- Technologies should enable interoperable products targeting particular uses to be brought to market in 2006 and 2007.
- In cases where multiple DLNA-approved technologies are specified, it should be possible to bridge or translate as required between any two technologies. For example, there should be a means to bridge seamlessly wired and wireless networking technologies.

Strategy

To deliver 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, mobile and PC industries on digital interoperability has been an essential first step for DLNA. But industry collaboration has not been limited to just CE, mobile and PC manufacturers—it has become an entire ecosystem of companies that together offer consumers a broad set of complementary products and services. This ecosystem includes contributors that are helping 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 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 them has been an important first step. The DLNA Interoperability Guidelines were created in a unique cross-industry effort that combined the efforts of over 100 CE, mobile and PC companies from around the world, working together with the aim of achieving the world's first substantial platform for true interoperability between personal computer, mobile and consumer electronic devices. Since technology and standards continually change and improve, the design guidelines will evolve over time and ensure continued interoperability as new and old technologies are mixed together in the Digital Living Network.

Compelling Products

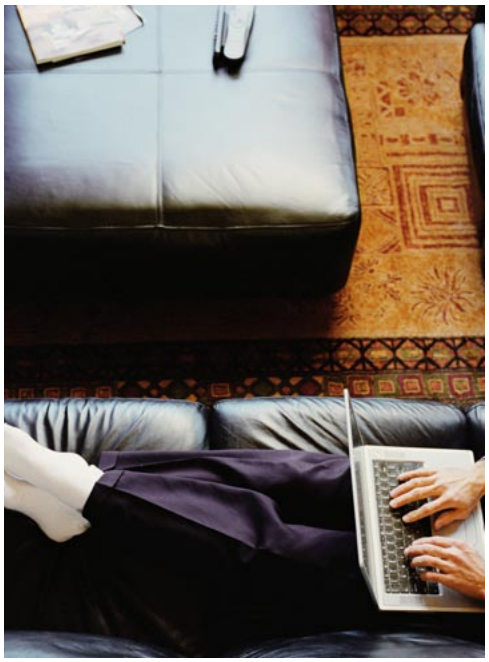
Finally, diverse, interoperable products are necessary to provide consumers with broad, compelling experiences and value throughout their home. To this end, the DLNA Interoperability Guidelines define a total of twelve Device Classes in three Device Categories. Since a Device Class is the certifiable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

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 described below 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 to provide playback and rendering capabilities. Some examples of DMP devices include TV monitors, stereo and home theaters, printers, personal digital assistants, multimedia mobile phones, wireless monitors and game consoles.
- **Digital Media Renderer (DMR) devices** play content they receive after being setup by another network entity. Some examples of DMR devices include an audio/video receiver, video monitor 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 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 more traditional applications may be written to support a DMPr. When selected for media output, a DMPr combines images with an XHTML template to create the printed page. DLNA provides several basic photo templates to assist new vendors in quickly adding photo printing to their DLNA device. It is extremely easy to add printing to device applications because the DMPr is based on the 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 a M-DMS and play the content locally on the M-DMP. A media tablet designed for viewing multimedia content is an example of a M-DMP device.
- **Mobile Digital Media Uploader (M-DMU) devices** send content to an M-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 and play the content locally on the M-DMD after download. A portable music player is an example of a M-DMD device.
- **Mobile Digital Media Controller (M-DMC) devices** find content exposed by an M-DMS and match it to the rendering capabilities of a DMR, setting up the connections between the server and renderer.
  A personal digital assistant 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. Here are just several examples:

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

The **Home Infrastructure Device (HID)** category is made up of two Device Classes.

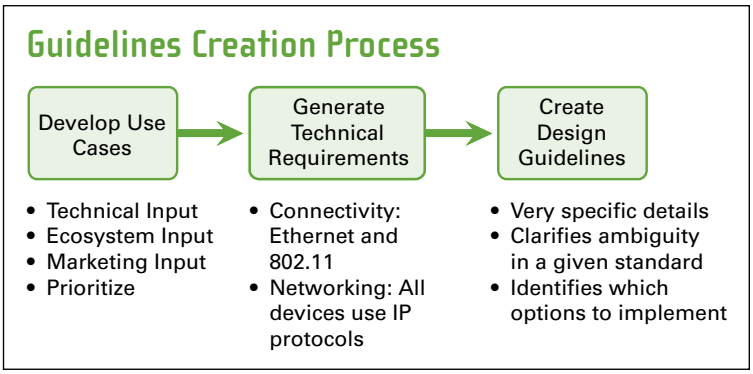
- **Mobile Network Connectivity Function (M NCF) devices** provide a bridging function between the MHD network connectivity and the HND network connectivity.
- **Media Interoperability Unit (MIU) devices** provide content transformation between required media formats for the HND Device Category and the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

The DLNA Process

Use Cases and Usage Scenarios Drive Guidelines

DLNA realizes that a deep understanding of end users, their environment and current use of technology is critical to success (see Figure 4). Equally important is a clear sense of the end users attitude to new capabilities and an understanding of the features that will ensure the quick uptake and diffusion of products into the market. DLNA decided to use the established approach of use cases to document this knowledge. Only after refining, documenting and prioritizing use cases and usage scenarios can the process of creating detailed technical guidelines based on recognized industry standards move forward.

Figure 4. The DLNA Guidelines Creation Process



DLNA has prepared a separate document called "DLNA Use Case Scenarios," which offers detailed information on the organization's evaluation of the most common, near-term consumer use models for digital products. DLNA regards the Use Case Scenarios white paper as an integral part of this DLNA vision and would like to encourage readers of this paper 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. Consumers are unlikely to adopt and pay a premium for digital home products if they do not deliver on their promise of performance, capabilities and simplicity. Likewise, CE, mobile and PC manufacturers will have little motivation to develop interoperable products if they do not provide clear business opportunities. The same applies to content and service providers who are looking for new venues and outlets to distribute entertainment 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 device classes, including Digital Media Players, Servers, Renderers, Controllers, and Printers. In the sphere of Mobile Handheld Devices (MHDs), the consumer will have the same wide product choice from an extensive group of device classes that parallel those just listed. 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 vendors. Finally, the assurance of DLNA interoperability will instill confidence in consumers that the products they purchase will work well together and be 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 steaming, including commercial content. This 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, mobile and PC manufacturers are continually looking 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 uses into new and improved uses. In another example, CE manufacturers have increased the value of the traditional TV 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 the consumer—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, mobile and PC product categories.
- Constructing an interdependent ecosystem of devices, software and services.
- Fostering consumer/retailer confidence in reliable and high-quality interoperable DLNA devices.

DLNA Achievements

DLNA 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, mobile and PC 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, mobile and PC devices, the value of devices based on DLNA guidelines is increased.

March 2006: Publication of the March, 2006 Home Networked Device Interoperability Guidelines 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. The capabilities of media servers and players are extended, and streaming of commercial content is allowed.

DLNA CERTIFIED™ Products

Products designed to the DLNA Interoperability Guidelines are granted use of the DLNA CERTIFIED™ Logo (see Figure 5) after meeting all DLNA certification and testing requirements. The first DLNA CERTIFIED™ products are expected to be on retail shelves by Q1 2006 and will enable a better experience for consumers, building consumer confidence and adding value to the CE, mobile and PC markets.

Figure 5. 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 280 and is made up of twenty-one Promoter Members with the balance 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 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, mobile and PC devices that co-operate 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 and 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 devises 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 media formats 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 vendors. 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, vendors 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. 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. IP will run over many different media without any awareness required by applications as to the underlying media. For example, a PC or an advanced set top box may stream media content to a TV in the master bedroom through an Ethernet cable to an 802.11 Access Point and then wirelessly to the TV. With IP, the media server and the TV 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 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, mobile and PC 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 tem, IPv6 support will become more important. The future transition from IPv4 to IPv6 will be handled in the DLNA 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 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 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 device to a 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: image, audio, and video with audio (AV). Table 2 shows an initial set of required formats and optional formats. 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 2 as required for any of the media classes they support. All DMS and DMP devices may support any additional formats designated as optional for any of the media classes they support.
- Any DMP, DMR, and DMPr devices, and their counterpart MHD devices, must be able to receive content from any DMS device. A DMS device may stream content in its native format if the receiving DMP device supports such native format. If the DMP device does not support the content's native format, the DMS device must transcode the native format to one of the applicable required formats or to a format understood by the rendering device. As long as the above network interoperability model is adhered to, native formats may include formats beyond those shown in Table 2.

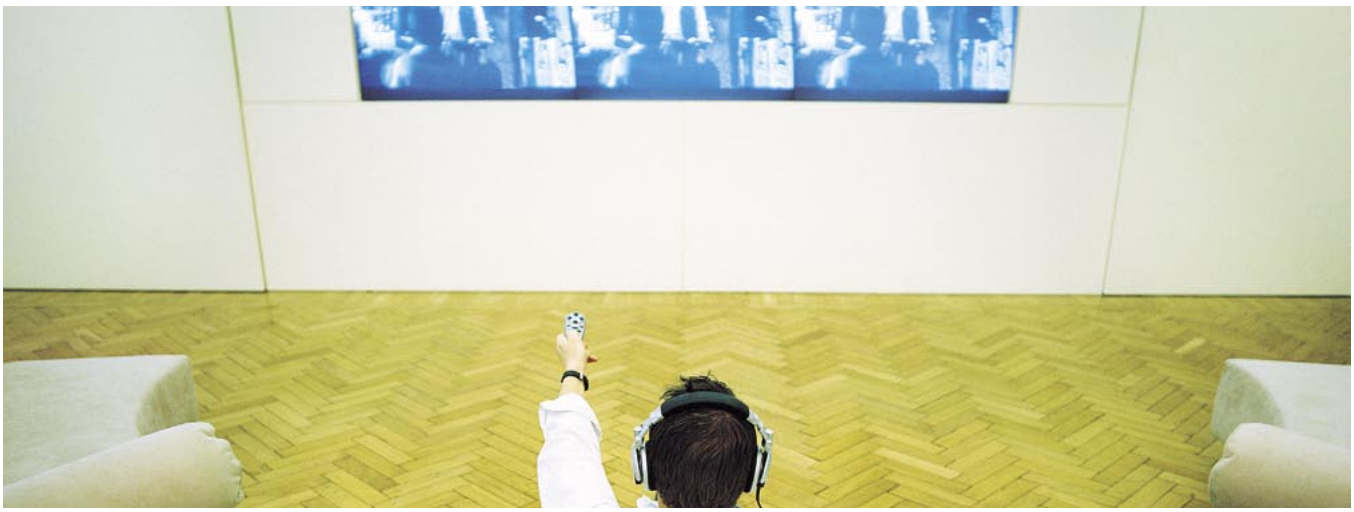
Table 2. DLNA Media Formats

Media Class	Required Format Set (must implement all)	Optional Format Set (must implement 1 or more)
Image	JPEG	PNG, GIF, TIFF
Audio	LPCM	AAC, AC-3, ATRAC 3plus, MP3, WMA9
AV	MPEG2	MPEG-1, MPEG-4*, AVC, WMV9

* MPEG-4 AVC is a ne
that are substantially lower (e.g., half or less) than what previous standards would need. Also, MPEG-4 AVC may be applied to a very wide variety of applications.

LPCM represents a reasonable technical choice for a required audio format, 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 in the optional format set provide more efficient use of network bandwidth, battery power and storage.

Over time, new media formats may be added to the required or optional format sets. 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. DMP and DMS device vendors can differentiate their products by including support for one or more of the optional media formats while maintaining interoperability with all DMP devices by adhering strictly to the requirements to transcode to one of the required, open standard formats. Alternatively, a DMS device may transcode from any format to one of the optional formats understood by a DMP device. This allows vendors to take advantage of better audio and video quality 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.



Home networked devices that source or render media content across the home network must also support a small set of baseline media streaming transports such as HTTP, which is mandatory, and RTP which is optional. The transfer scenarios that can be supported include:

- A transfer from a DMS device to a 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 an intelligent 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.

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 Interoperability Guidelines.

UPnP™ AV specifications define the interaction model between UPnP AV devices and associated control point applications. UPnP AV devices can include TVs, VCRs, CD/DVD players, set-top boxes, stereo systems, mobile devices, digital cameras, electronic picture frames and PCs. The UPnP AV architecture allows devices to support entertainment content in any format and over any transfer protocol. UPnP AV specifications define two types of logical device on the home network: Media Servers and Media Renderers. The specifications also define four services hosted by Media Servers and Media Renderers.

- **Content Directory Service:** This enumerates the available content (videos, music, pictures and so forth).
- **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 (play, stop, pause, seek, and so on).
- **Rendering Control Service:** This controls how the content is played (volume/mute, brightness, for example).

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 the DLNA will investigate further.

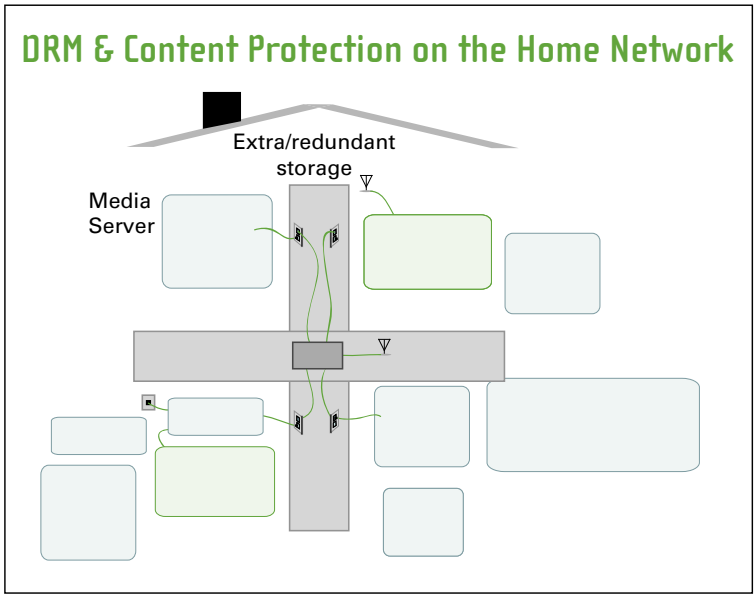
Digital Rights Management / Content Protection

In order for premium digital content to be made available for use with DLNA devices, content providers understandably insist that their content be protected from unauthorized copying and use. 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 network (see Figure 6). Balancing the providers' need for protection and the consumers' fair use rights and expectations 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. Other components of DRM that support additional user scenarios are being considered for development in the UPnP™ forum and elsewhere in the industry.

Figure 6. The Heterogeneous Home Network

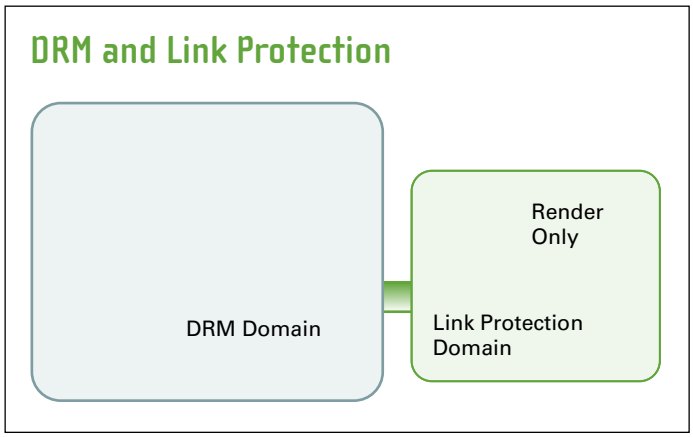


While the DLNA Interoperability Guidelines do not mandate specific DRM and content protection solutions, DLNA does provide a useful venue for those who share the vision of device interoperability. Collaboratively, vendors can understand and document the range of technical and business requirements for achieving the required balance between protection, availability and usability. This work will aid device designers and content providers in implementing Digital Rights Management methods today and in the future, to foster an integrated, user-friendly, and backward compatible system that meets the rights, the needs and the expectations of all stakeholders.

How DRM Differs from Link Protection

Link protection allows for secure play out of premium content hosted in a DRM system. For example, a link protection enabled DMP (player) can play DRM-protected content that is stored on a DMS (server). Figure 7 illustrates examples of devices that contain DRM and devices that only support link protection.

Figure 7. DRM and Link Protection



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 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 call 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 about 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 Interoperability Guidelines. This is facilitated through a dedicated subcommittee that manages liaison partnerships.

Some highlighted examples from the DLNA partnership's list.

- UPnP™ Implementers Corp.
- UPnP™ Forum
- Wi-Fi Alliance®
- Consumer Electronics Association

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 Interoperability Guidelines. When a 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 consumer electronics, AV products and home computers.

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 highlight weaknesses in the guidelines.