



Overview and Vision

White Paper

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DLNA
Digital Living Network Alliance

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A Scenario

Connor and Elysia enjoy all forms of home entertainment. They have amassed an impressive collection of home electronics, including a DVD changer, audio surround system and large screen TV for the family room, a bookshelf audio system for the office and a DVD player and TV for the bedroom. All of this is in addition to a DV camcorder, a digital camera, a multimedia mobile phone, and a PC for editing and sharing their digital content.

Connor loves taking movies of the children and editing them on the PC. Elysia enjoys taking digital pictures, then arranging them and using the PC to create collages.

Both Connor and Elysia like to watch their digital creations on the family room entertainment center. Connor copies his movies from the PC hard disk to the camcorder using 1394, then connects the camcorder to the family room TV with an analog cable. Elysia copies her digital pictures to a memory card and inserts it into the camera, then connects the digital camera to the TV with an analog cable. Of course, they just carry CD-R creations from room to room or to the car.

Both Connor and Elysia are happy that they can do these things, but they also feel that they should be able to have instant access to any content from any room, as soon as that content is created or brought into the house.

One day Connor went to the local computer store and purchased a wireless home network kit and another PC. He connected the new PC to the family room TV and to one of the wireless access points. He connected the other access point to the other PC where all the audio, movies, and pictures are stored.

At first Elysia was very enthusiastic about Connor's project – but then came demonstration time. Connor used shared folders to publish the audio, video, and pictures on their wireless home network. When he demonstrated how to play audio from the PC, Elysia noticed that sometimes the audio would break up. He then demonstrated going to the shared video folder and playing a home movie. At this point, both Connor and Elysia were surprised to find that the video was choppy and unsatisfying.

Elysia then asked how much the experiment cost and she didn't like the answer. "The old way may not be the most convenient, but at least it works," she said, and that's exactly what she returned to doing.

What Connor didn't know is that his personally designed end-to-end wireless solution did not account for the special needs of digital audio/video streaming. Connor's initial attempt at a home network remains in operation – when Connor is at the controls. But Connor continues to search for interoperable products and solutions that fulfill the promise of home entertainment networking.

Abstract

Members of the Digital Living Network Alliance (DLNA) share a vision of interoperable networked devices in the home that provide new value propositions and opportunities for consumers and product vendors. We are committed to providing a seamless interaction among consumer electronics (CE), mobile and PC devices and believe this is best accomplished through a collaborative industry effort focused on delivering an interoperability

framework for networked media devices. The DLNA will develop design guidelines that refer, as much as possible, to standards from established, open industry standards organizations. These design guidelines will provide CE, mobile and PC vendors with the information needed to build interoperable digital home platforms, devices, and applications. This paper gives an overview of the interoperability framework offered by the DLNA.

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 (see Figure 2) and supported by several leading market indicators.

- Digital device sales: music players, cameras, camcorders, DVD players, multimedia mobile phones and PVRs
- 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 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 co-operatively 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: Parks Associates, 2003

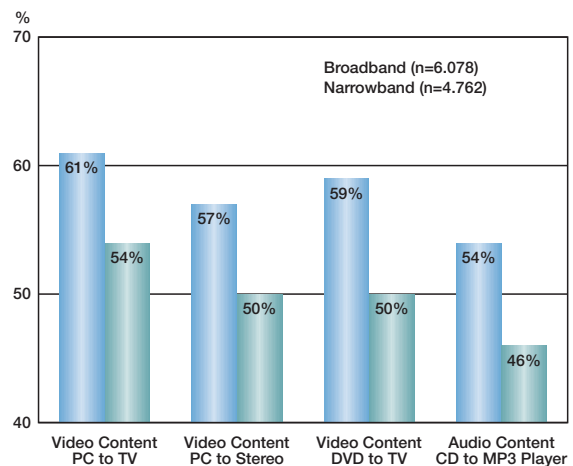
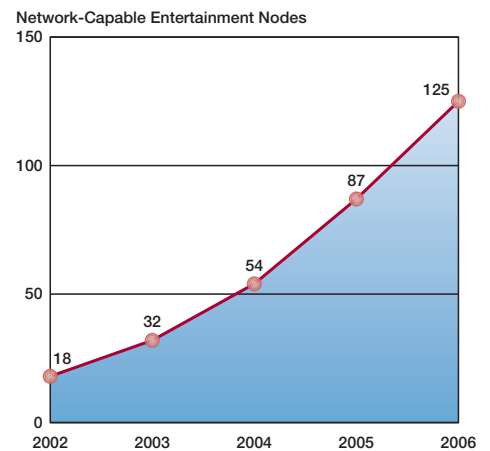


Figure 2. Growth in Entertainment-Centric Home Networks

Source: Networks in the Home: Analysis and Forecasts (Third Edition), © 2002 Parks Associates.

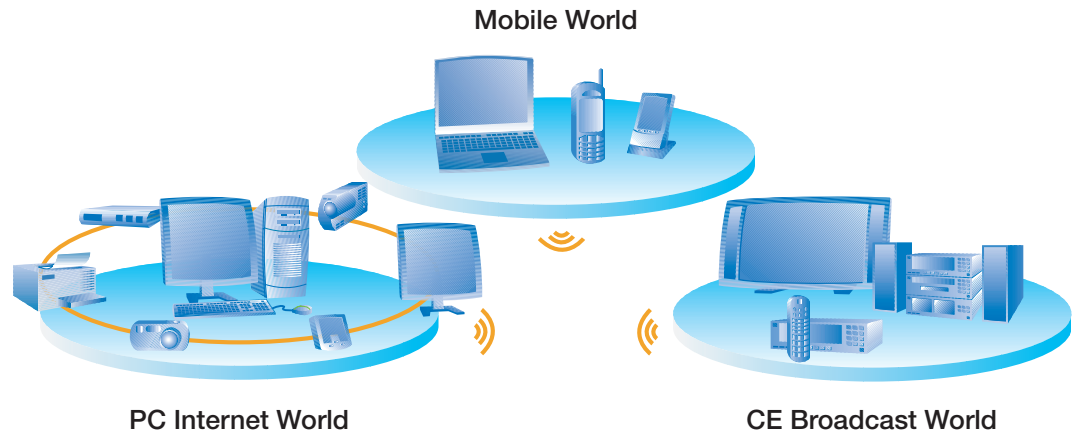


The Problem

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

- The PC Internet world where PC and PC peripherals communicate.
- The broadcast world of set-top boxes and traditional consumer electronics.
- The mobile world of multimedia phones, PDAs, 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 domains to work together in the home, but expectations have largely been unfulfilled.

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 consumer electronic 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, CE, mobile and PC industry leaders must define a framework to enable an interoperable home network. Products developed according to the DLNA's framework will enhance the distribution of digital media throughout the home.

The Vision

The DLNA vision integrates the Internet, mobile and broadcast islands through a seamless, interoperable network that will provide a unique opportunity for manufacturers and consumers alike.

In the near future, digital homes will contain one or more intelligent platforms, such as an advanced set-top box (STB) or a PC. These intelligent platforms will manage and distribute rich digital content to devices such as TVs and wireless monitors from devices such as digital stills cameras, camcorders and multimedia mobile phones.

Delivering interoperability in the digital home requires a common approach that focuses on three key elements.

- Industry collaboration
- Standards-based interoperability framework
- 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 is an important first step. Historically, these industries have delivered innovative consumer products side-by-side but not necessarily in concert. None of these industries has the means to drive digital interoperability alone. However, each industry offers unique capabilities and attributes.

CE and mobile device manufacturers have a history of creating new mass-market product categories, adding brand recognition, maintaining ease-of-use and hitting attractive price points. As a complement, PC manufacturers differentiate on hardware and software development and integration. In addition, PC makers are known for delivering new products to market quickly through the development and adoption of standards. The success of an interoperable network depends on creating new product categories and getting highly integrated devices to market quickly.

Industry collaboration is not limited to just CE, mobile and PC manufacturers. It is an entire ecosystem of companies that together offer consumers a broad set of complementary products and services. An ecosystem properly designed for digital interoperability must start with the consumer in mind and include contributors that can help bring all the necessary elements of the digital home to market. Industry collaboration must encompass manufacturers, software and application developers, and service and content providers.

A collaboration of industry leaders can also facilitate industry marketing and promotion while encouraging development, interoperability and support of home networked devices.

Standards-Based Interoperability Framework

While creating new product categories is important, industry leaders must first co-operate to develop an interoperability framework. This framework should define interoperable building blocks for devices and software infrastructure. It should cover 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 is an important first step. Ensuring device interoperability also requires the industry to come together to produce design guidelines so that the products of different vendors support a common baseline for the set of required standards. Since technology and standards continually change and improve, these design guidelines must also 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. These products will embody one or both of the two major functions discussed next (also see Figure 4 on the next page).

Figure 4. DLNA Product Categories

Digital Media Server (DMS) Devices provide media acquisition, recording, storage, and sourcing capabilities based on the DLNA Interoperability Model, 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.

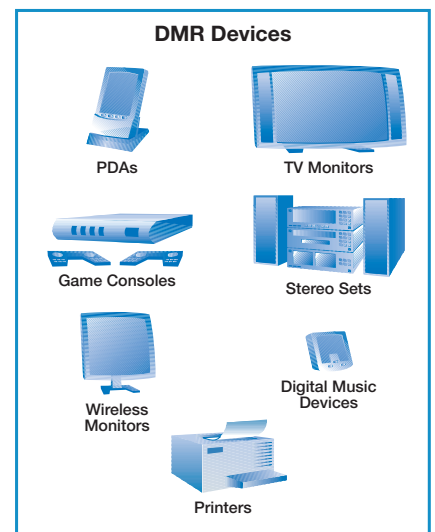
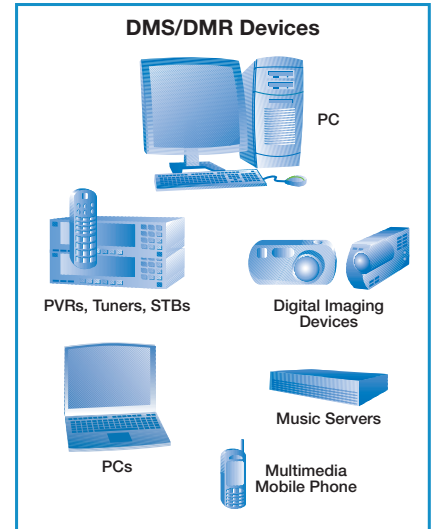
Some examples of these devices include:

- Advanced set-top boxes (STB)
- Personal video recorders (PVR)
- 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
- Multimedia mobile phones

Digital Media Player (DMP) Devices provide playback and rendering capabilities.

Some examples of these devices include:

- TV monitors
- Stereo and home theaters
- Printers
- PDAs
- Multimedia mobile phones
- Wireless monitors
- Game consoles



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 Digital Media Player/Server devices that communicate and collaborate with each other, allowing 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. Consumers can also store the same content in their multimedia mobile phones and enjoy it on the move. 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 streaming. This allows content and services to be delivered to more end-points in the home, 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 (see page 7).
- Fostering consumer/retailer confidence in reliable and high-quality interoperable DLNA devices.

Use Case Scenarios

While the goal is to provide consumers with new enjoyment in the interoperable home-networked environment, it is important for DLNA to address current and future use case scenarios and their role in developing design guidelines for interoperable products. DLNA therefore 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.

Interoperability Framework

The digital home will consist 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™ technology.

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 framework 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 and consumed.
- **Interoperable media management and control framework:** An interoperable media management framework 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 a compatible authentication and authorization framework to enable devices to request and/or grant access to particular devices and services in the home.

Additional Elements

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.. 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.

While the DLNA Home Networked Device Interoperability Guidelines v1.0 does 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.

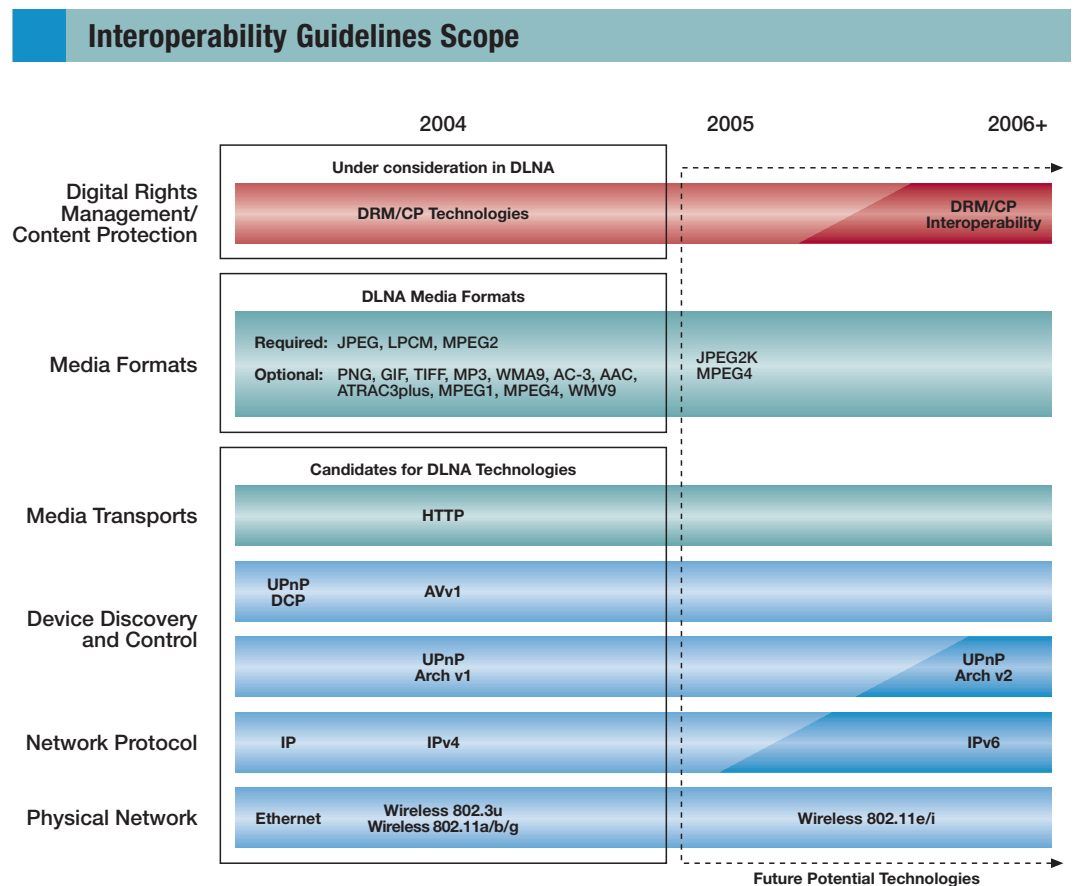
Manageability

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 who to call and not be faced with the situation where they are passed on to another company without satisfactory resolution of their problem.

The 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.

Figure 5. DLNA Interoperability Guidelines Technology and Standards Phasing



In order to deliver on digital interoperability in the home, a common set of industry design guidelines is required that allows vendors to participate in a growing marketplace, leading to more innovation, simplicity and value for consumers. The DLNA's Home Networked Device Interoperability Guidelines v1.0 specifies the interoperable building blocks that are available to build platforms and software infrastructure. Full implementation of an interoperability framework that meets the high-level requirements set forth in the preceding section will not be complete until after 2006 and will require phasing of interoperability guidelines as shown in Figure 5. The technologies noted for 2005–2006 under “Future Guidelines” in the figure are merely examples and should not be taken literally. For 2004, the DLNA Interoperability Guidelines v1.0 focuses 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.

Table 1. Preliminary Functional Components and Technology Ingredients for DLNA Interoperability Guidelines

Functional Components	Technology Ingredients
Networking and Connectivity	IP, Wired and Wireless Ethernet Media, and QoS Mechanisms
Device and Service Discovery and Control	UPnP v1 Architecture and Technology
Media Formats and Streaming Protocols	Media Format and Transport Model
Media Management, Distribution, and Control	UPnP AV v1.0
Authentication and Authorization	UPnP and other IP based security mechanisms

Table 1 shows the specific functional components and technology ingredients covered by DLNA Interoperability Guidelines v1.0. The basic criteria for specific technology ingredients selected for the DLNA Interoperability Guidelines for 2004 to 2005 and beyond include:

- Technology should be based on standards from standards bodies, SIGs 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 2004 and 2005.
- 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 between wired and wireless networking technologies.

The following sections cover some of the key technology ingredients 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 advanced STB 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 DLNA 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 v1.0 are intended to facilitate simple, interoperable connectivity, while meeting the consumers' needs today and in the future.

The Internet Engineering Task Force (IETF) 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 term, IPv6 support will become more important. The future transition from IPv4 to IPv6 will be handled in 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 3 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 and DMP 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 device 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 (May implement 1 or more)
Image	JPEG	PNG, GIF, TIFF
Audio	LPCM	AAC, AC-3, ATRAC3plus, MP3, WMA9
AV	MPEG2	MPEG1, MPEG4, WMV9

Interoperability for audio devices in the digital home is assured through the requirement to support the LPCM audio format. LPCM is an important, uncompressed audio format widely used today for the interchange of single and multi-channel premium-quality audio streams between digitally interconnected devices. Direct transmission of LPCM between devices is the means for assuring the highest fidelity of premium audio content. The technical requirements to create an LPCM stream from any source content and to transmit that stream are well within the capabilities of present day and future devices and digital interconnects. As a required format in the digital home, LPCM assures the broadest range of interoperability with the lowest possible cost and complexity.

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 in the optional format set provide more efficient use of network bandwidth, battery power and storage. Vendors whose products fall into these classes should seriously consider supporting one or more of the optional compressed audio formats.

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 requirement 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. 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, stills 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).

Putting It All Together

The DLNA offers significant new opportunities for the CE, mobile and PC industries. The vision articulated here for digital interoperability will require considerable effort to achieve. The industry needs to align, co-ordinate, and deliver at several levels:

- **Uses:** The CE, mobile and PC industries must define and align on a roadmap of uses that will drive consumer acceptance of a new category of interoperable digital home products. By necessity, this roadmap will be dynamic and must progressively reflect available technology and standards over time. Digital entertainment and media will most likely be the driving factor for early consumer adoption, while the availability of technology and standards dictates a planned evolution from personal to commercial media uses.
- **Interoperability Framework:** The CE, mobile and PC industries must: 1) align on the framework for digital interoperability, 2) continue to participate in key standards arenas, such as ISO, the UPnP Forum and CEA, to ensure future uses and capabilities are supported, and 3) translate the technology and standards into concrete design guidelines that can be used to build interoperable products. To support a dynamic uses roadmap, the design guidelines must progress over time.
- **Products:** To launch the digital home concept, adapters are needed that bridge the CE, mobile and PC worlds and support consumer's existing home devices. Such adapters can progressively support the expected, growing, mainstream market through increasing integration of common functions. To continue to grow the digital home category and fuel further demand, CE, mobile, and PC vendors must routinely deliver new and exciting products that meet consumer needs for functionality, reliability, performance, and simplicity.
- **Open Standards:** To assure rapid, broad adoption of the digital home concept, all of the mandatory elements in the design guidelines and interoperability framework will be based strictly on open industry standards. Standards bodies and industry groups such as ISO, the UPnP Forum, CEA, the 1394 Trade Association and others will continue to be the venue for development of technical specifications that service the digital home ecosystem. The DLNA is committed to establishing strong, complementary working relationships with these organizations in order to constructively reference their specifications, communicate appropriate feedback and jointly pursue new standards and design guidelines.

The DLNA has developed the DLNA Home Networked Device Interoperability Guidelines v1.0. and will continue to enhance these guidelines, to provide CE, mobile and PC manufacturers with the information needed to build interoperable platforms, devices and applications. This collaborative effort will result in the creation of a networked media products category for the home, providing new business opportunities for the industry and new experiences that benefit consumers.

Help make the digital home vision a reality – join the Digital Living Network Alliance!

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