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Managing Digital Image Collections from your TV-Set: A State-of-Art Review

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Abstract — The problem of managing growing digital image collections is discussed in the context of a home user. The use of a conventional television set as both a viewing and management tool is discussed. The problem of linking digital cameras and other networked computer devices is outlined. A review of recent technological approaches to integrating the TV set with digital assets such as image collections is given. An overview of emerging TV-centric solutions is also given followed by a discussion of the potential merits of open standards for home networks and content based tools and services.

I. INTRODUCTION

Digital cameras continue to be one of the CE industry's recent success stories. However as many users switch from conventional to digital photography they find themselves with rapidly growing collections of digital images. Few consumers have the time and personal discipline to sit in front of a computer and manually catalog and organize their personal image collections. Thus there is a need to new approaches which ideally can combine the viewing and management of digital image collections.

The TV-set is probably the most ubiquitous home appliance. Despite the growth of home computers and the increasing availability of digital video content and services the TV-set remains as the heart of home entertainment and still serves as the gateway to news services for the majority of the world's population. From an objective viewpoint the TV-set is also an ideal mechanism for viewing digital images, yet it has never achieved much popularity in this regard. This is most likely due to the awkward nature of most TV viewing interfaces for digital content and the difficulties of setting up interface devices and accessing digital image collections.

II. TV INTERFACES TO DIGITAL MEDIA & CONTENT

Here we present an overview of various approaches to integrate the TV-set with digital media, with a particular emphasis on those interface devices or techniques which offer a means of viewing digital pictures on the TV-set.

A. Media Adapters

An important component of all USB based networking protocols, including PTP, is their Plug and Play functionality.

This is also a requirement of PTP/IP although its implementation is not discussed in the PTP/IP specifications. The TCP/IP protocol does not inherently support the necessary services for implementing the equivalent of an interrupt service to signal that a new device has joined the network, thus it was necessary to consider some of the extensions that have been employed by other TCP/IP based protocols and to investigate practical implementations.

1) TV Slideshow Adapters

The simplest way to get digital images and digital media displayed on a TV-set is to simply connect an A/V appliance with component video output to the TV. Many digital cameras feature direct A/V outputs and may even incorporate special "slideshow" features that cycle through stored images. However this requires the user to load the relevant images into a suitable camera. Other devices have appeared which connect to the TV set and display images directly from a memory card. Thus the user can keep several memory cards with favorite image collections and select between these by inserting the appropriate memory card. Although more flexible this is still an awkward access mechanism for the end-user. Most DVD players also feature slideshow capabilities, enabling users to use DVDs rather than memory cards, but again these appliances have never become very popular.

The major disadvantage of all such solutions is that they cannot quickly accommodate user requirements – image collections for viewing must be prepared in advance and the process of managing and organizing all of a user's images is separated from the viewing process itself.

2) Wireless and Ethernet Media Adapters

This is a category of device which connects the TV set to a computer network. Typically digital content such as images are kept on a home computer but are accessed via a proprietary user interface generated by the *Media Adapter* and displayed on the TV-set. A number of such devices have come and gone over the past 5 years. The device which has shown the more longevity is the *MediaMVP™* from Haupauge [28].

3) Smart Frames

A digital photo frame is a picture frame that displays digital photos without the need for printing them first. Frames are typically based on LCD display technology and feature interfaces for a range of memory cards. The widespread

adoption of digital cameras created a need for this new category of product because as little as 13% of digital photos are ever printed [1]. Some models can load pictures over the Internet from RSS feeds, photo-sharing sites and even by email.

Most digital photo frames display the photos as a slideshow, typically with adjustable time intervals and selectable slide transitions. Some frames can also play the movie clips recorded in the camera's "movie mode", or MPG files, and MP3 audio. These frames can also be connected to external A/V displays, such as a TV-set if a larger display is desired. Although digital photo frames appear to be a good idea they have not been hugely successful with consumers. Again, these devices lack the flexibility and ability to change content dynamically that most consumers associate with their TV-set.

4) Personal Storage Devices and Media Players

In their simplest form this is nothing more than a small portable hard drive which can be connected to a camera to offload images. More sophisticated devices which can also playback video or create a dynamic image slideshow have appeared on the market recently. Probably one of the best known such devices is the Video-iPod™.

Although such devices can store significant quantities of digital content they are stand-alone appliances and do not support sharing or provide mechanisms for multiple users to access a collection of digital content and assets.

B. Media Centers

A *media center* is a computer adapted for playing music, watching movies and viewing pictures stored on a local hard drive. It is typically connected to a TV set and used for watching and recording television broadcasts. Additional software modules support other tasks, such as finding news feed (RSS) from the Internet and slideshow viewing of digital image collections. Media centers are often operated with a remote control, connected to a television set for video output, and can often function as a normal personal computer.

As it is often connected to a home network a *media center* can be used for sharing content between multiple users and supports remote access to content with a suitable client device. Thus several users can access, display and manage content at the same time. Although media centers are often built using similar components to personal computers, they are often smaller and have hardware that is not usually seen in personal computers, such as receivers for remote controls, or television tuner cards.

1) Windows Media Center™ & Xbox 360™

Windows XP Media Center Edition™ (MCE) is distinguished from standard editions of *Windows XP™* by an exclusive pre-installed application which provides a large-font, remotely accessible interface for TV viewing on the computer as well as recording and playback, DVD playback, video playback, photo viewing, and music playback [2]. There is also support for Media Center Extenders - dedicated hardware devices that allow users to view the same content that is available on the MCE computer over wired or wireless Ethernet [3]. Up to 5 such Media Center Extenders are supported per MCE

computer/household. The Xbox 360 has Media Center Extender functionality out of the box, including HDTV support.

One disadvantage with the Media Center Extender technology is that it employs the *real-time transport protocol* (RTP) which is not optimized for standard wireless 802.11 networks. As a consequence many users of these devices have found them to be impractical for streaming video on wireless networks and have been forced to rely on wired network connections.

2) Apple TV™

This device has only recently been released to the market [4]. It builds on the success of the iPod™ and is supported by the iTunes™ Internet service which enables video downloads. Support for digital photos is included allowing the user to view photos that have been synced to the device, however it does not stream photos from other computers, although Apple has said they plan to add that feature and it relies on a user managing their image collection independently using a proprietary software application.

Although the *Apple TV™* is a competitively priced home appliance much of its support is for proprietary formats and applications. The company argues that this allows a better and more seamless user experience as they can ensure that all their computers and devices interoperate in a very effective manner. The Apple TV is currently closer to a *media adapter* than a true *media center*, although it is likely to evolve new functionality and capabilities over the next 12-18 months.

C. DIY Solutions

There are various active hobbyist groups who build or modify COTS computer components to create specialized home media centers. These are, in essence, desktop computers with embedded footprints and are often specially modified to reduce noise and to provide remote control interfaces using IR remote controls. Many solutions are close to the media center concept but some equivalents to the media adapter concept also exist. We now discuss some of the best known of these DIY approaches.

1) MythTV

MythTV is an open-source Linux application that enables a user to build the "mythical home media convergence box" [5]. The software architecture employed by MythTV is actually more sophisticated than a conventional *media center* as it separates the system functionality into a front-end client for content playback and a back-end server for content capture, storage and management [6]. Both front-end and back-end may reside on the same computer, but alternative configurations may include a single (master) back-end supporting multiple front-end clients which is analogous to the Microsoft *Media Center Extender* technology.

In addition to standard video, audio and picture viewers MythTV includes a flexible *plugin architecture* that simplifies the process of developing new functional modules/services to the core system software. Modules are available out of the box to provide support for web browsing, news feeds, weather, IP

telephony, gaming, music, creating DVDs and more [7]. As with any successful open-source projects a large community of users and developers has built up around MythTV and adetailed technical and HOWTO documentation is available [8].

2) Xbox Media Center (XBMC)

This is full media center software for the original Xbox game-console. XBMC can play music, videos and display images from the Xbox DVD drive, its internal hard-drive drive or a local network [9]. Other functions of XBMC include displaying weather forecasts and TV guides, watching YouTube videos, listening to Podcasts and streaming internet radio/video. XBMC software may be controlled using the Xbox gamepads, or alternatively from an Xbox remote control. The software is open-source.

XBMC handles all common digital picture/image formats with the options of panning/zooming and slideshows with "Ken Burns Effect" [10]. The original Xbox only provides ethernet connectivity for interfacing to a home network, however it is straightforward to add an 802.11 ethernet adapter [11], turning the Xbox into a wireless interface appliance for the TV-Set.

The XBMC source code software is licensed under the GPL by the developers, allowing anybody to redistribute XBMC. However, in order to compile the XBMC into executable form, it is currently necessary to use the Microsoft *Xbox Development Kit™* (XDK) which is only available to licensed developers and the resulting code may only be distributed by them. Accordingly, code compiled with an unauthorized copy of the XDK may not be distributed legally. A third-party project called OpenXDK is concerned with producing a replacement for the Microsoft XDK [12].

III. OPEN MEDIA STANDARDS

Most of the interface devices for TV-sets described in the previous section are based on proprietary software applications and content formats. However a number of industry groups are working to introduce open multimedia standards in an effort to create a more coherent market for new multimedia devices and associated network services.

A. Universal Plug and Play (UPnP)

This is a set of networking protocols promoted by the UPnP forum [13] that allows devices to interconnect seamlessly and allow for easy networking configuration, especially in a home network environment. UPnP provides standards for automatic networking configuration, automatic device discovery, service description, control, event notification and service presentation. It is integrated into the operating system of most desktop computers and providing a significant installed base.

UPnP A/V stands for "UPnP Audio & Video" [14], and is a grouping within the UPnP standards supervised by the *Digital Living Network Alliance* (DLNA), which is a forum of vendors and manufacturers who work in the home entertainment industry, and offer a certified branding for those products which follow their interoperability guidelines. The DLNA forum

members are focused on delivering an interoperability framework based on open industry standards [15].

UPnP A/V compatible *mediaservers* store and share digital media, such as photographs, movies, or music. Software-based *mediaservers* can be run on PCs (Personal-Computers), mainly on Microsoft Windows, Linux or Mac OS. Hardware-based *mediaservers* may run on any *network attached storage* (NAS) devices or any specific hardware for delivering media, such as PVRs.

B. Media Transfer Protocol (MTP)

The Media Transfer Protocol [24] is a set of custom extensions to the Picture Transfer Protocol [16]. These extensions were devised by Microsoft, to allow use of the PTP protocol to be extended to devices other than digital cameras. Examples include digital audio players and other portable media devices such as portable video players. Windows Vista offers support for MTP natively. The protocol is implemented for use across USB. The host connecting to an MTP device is called an MTP *initiator* whereas the device itself is an MTP *responder*.

The main purpose of the protocol is to transfer media files and associated metadata to/from devices, with optional support for remote control of the device, reading and setting of device parameters such as special DRM-related device parameters for restricted content. The device can also send events to the host.

A key reason for using MTP rather than for example the USB mass storage device class is that it allows the device to have some intrinsic file system, whereas USB mass storage always uses FAT. When a FAT file system is attached to a host computer the file system is "owned" by the host and thus the device itself cannot manipulate files during this time without risking corruption of the file system. MTP (or PTP) does not necessitate such device lock-down. It will also handle situations where a device is unplugged in the middle of a file transfer, whereas a FAT file system will immediately become corrupted. Additionally, the MTP allows MTP Initiators to identify the specific capabilities of devices with respect to file formats and functionality.

C. Picture Transfer Protocol over IP (PTP/IP)

With the wide adoption of new wireless technologies it was clear that sooner or latter the digital still camera will become a networking device. A new transport protocol, PTP/IP was adopted as a CIPA standard in 2005 [18]. The new transport is described in detail in [19] and it enables PTP [16], which could previously only be used with USB device connections [17], to be used with TCP/IP networks. The PTP/IP standard allows extension to a network environment without affecting applications that use PTP. It also enables multiple simultaneous connections among digital imaging devices, which was not possible with PTP over USB.

With PTP [20-22], digital cameras can exchange images with host computers, printers, other imaging and display devices. The interoperability resulting from the widespread adoption of PTP over USB transport has greatly reduces consumers' frustration at

the difficulty of transferring photos from camera to computer, printer, or kiosk, and contributed to the ongoing growth in sales of digital cameras and associated devices..

Some firmware modifications are required to the device firmware over and above the normal adaption of a USB communications stack to provide TCP/IP network connectivity for a PTP/IP device. These include the addition of (i) a device discovery mechanism and (ii) a device bonding mechanism. A detailed paper on the design of PTP/IP adapters for legacy cameras and printers was presented elsewhere [25-27].

IV. MTP/IP COMPLIANT TV INTERFACES

Here we are interested in creating an access and control means for networked PTP services via a TV-set. There are two principle scenarios. In the first case these services are actually implemented within the TV itself. This is actually a concept which will become very common as many state-of-art TVs begin to include computer-like functionality and support USB peripherals. The architecture of an MTP/IP adapter for such a TV-set is illustrated in *Fig 1* below.

In the second case these services originate from other networked appliances or services such as PTP/IP compatible printers, storage appliances, image post-processing, sharing and cataloging services. In this latter case the TV set only acts as a display for the user interface of the service router. Expanded details will be given in a forthcoming publication.

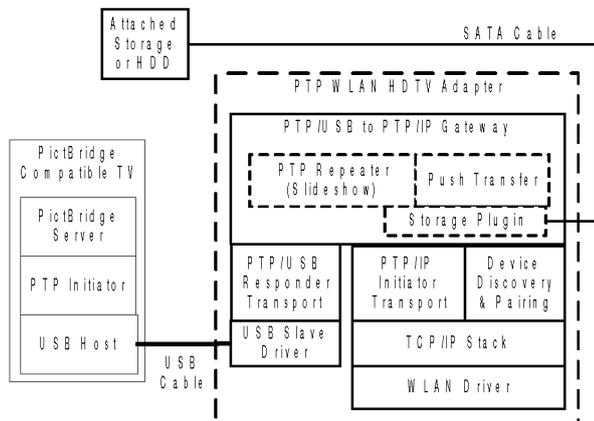


Fig 1: Architecture of PTP/IP Adapter for USB host TV

REFERENCES

[1] <http://www.itfacts.biz/index.php?id=P6866> , July 2006
 [2] <http://www.microsoft.com/windowsxp/mediacenter/default.msp>
 [3] <http://www.microsoft.com/windows/products/winfamily/mediacenter/default.msp>

[4] <http://www.apple.com/appletv/>
 [5] <http://www.mythtv.org/>
 [6] <http://www.mythtv.org/docs/mythtv-HOWTO-9.html>
 [7] <http://www.mythtv.org/wiki/index.php/Category:Plugins>
 [8] http://www.mythtv.org/wiki/index.php/Main_Page
 [9] <http://sourceforge.net/projects/xbmc>
 [10] http://en.wikipedia.org/wiki/Ken_burns_effect
 [11] <http://www.buffalo-technology.com/products/product-detail.php?productid=127&categoryid=28>
 [12] <http://www.openjdk.org/>
 [13] <http://www.upnp.org/>
 [14] <http://www.upnp.org/specs/av/default.asp>
 [15] <http://www.dlna.org/en/consumer/learn/roadmap/>
 [16] ISO 15740, "Picture transfer protocol (PTP) for digital still photography devices", Photography - Electronic still picture imaging, 2005
 [17] USB Implementer's Forum, "Universal Serial Bus Still Image Capture Device Definition Revision 1.0", July 2000, http://www.usb.org/developers/devclass_docs/usb_still_img10.pdf.
 [18] Camera & Imaging Products Association (CIPA), "PTP-IP Picture Transfer Protocol over IP version 1.0", Japan, 2005. <http://www.cipa.jp/hyoujunku/kikaku/pdf/DC-X005.pdf>,
 [19] P. Bigioi, G. Susanu, E. Steinberg, and P. Corcoran, "PTP/IP - a new transport specification for wireless photography", Consumer Electronics, IEEE Transactions, vol. 51, pp.240-244, Feb. 2005.
 [20] P. Bigioi, E. Steinberg, G. Susanu, and A. Pososion, "Picture Transfer Protocol - the answer to Digital Camera Connectivity", Proc. of the 9th Intl. Conference on Optimization of Electrical and Electronic Equipments, vol. 3, pp. 217 -226, May 2004.
 [21] P. Bigioi, G. Susanu, P. Corcoran, and I. Mocanu, "Digital camera connectivity solutions using the picture transfer protocol (PTP)", Consumer Electronics, IEEE Transactions vol. 48, Issue 3, pp. 417 - 427, Aug. 2002.
 [22] P. Bigioi, P. Corcoran, and G. Susanu, "Digital imaging services using PTP ", IEEE International Conference on Consumer Electronics, 2002. ICCE. 2002 Digest of Technical Papers, pp. 54-55, June 2002.
 [23] Camera & Imaging Products Association (CIPA), "CIPA-DC-001-2003, digital PhotoSolutions for Imaging Devices", <http://www.cipa.jp/english/pictbridge/>, Japan 2003.
 [24] MTP Media Transfer Protocol Specification, Microsoft website, http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnwm/html/mtp_spec.asp
 [25] P. Bigioi, I. Raducan, E.Steinberg, and P. Corcoran, "Enabling Legacy PTP Cameras and Printers as Networked PTP/IP Appliances", Consumer Electronics, 2007. ICCE. 2007 Digest of Technical Papers, pp. 54-55, Jan 2007.
 [26] P. Bigioi, I. Raducan, E.Steinberg, and P. Corcoran, "PTP Adapter Design and Connectivity Techniques for Legacy Imaging Applications", submitted to IEEE Trans. On Consumer Electronics, 2007. [expected publication in May 2007]
 [27] P. Bigioi, I. Raducan, E.Steinberg, and P. Corcoran, "Practical Network Interoperability for Imaging Appliances using PTP/IP" at RoEduNet 2006, Sibiu, Romania; Vol. 1, p326-331, 1st-3rd June 2006.
 [28] http://www.hauppauge.com/pages/products/data_mediamp.htmlG. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955.