A Call For The Home Media Network [1]

Gordon Bell and Jim Gemmell

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Microsoft Research

Microsoft Corporation

One Microsoft Way
Redmond, WA 98052

> "The best way to predict the future is to invent it." – Alan Kay
> "… or at least posit a vision for others to build" – the authors

1   Introduction

Home media acquisition, production, storage, and use is on the cusp of a radical change. The current home's hodge-podge of ad-hoc analog equipment will be replaced by all-digital, networked media equipment: the Home Media Network. There is no question that this change is coming; the question is "how soon"? The goal of this paper is to spur consumer and computer manufacturers to start delivering the Home Media Network *now*. We hope that this discussion of the issues, the advantages, and the breakthrough possibilities will convince manufacturers not to wait any longer.

Typical homes have a plethora of answering machines, boom boxes, cameras, computers stereos, telephones, and TV sets. This congeries is interconnected via at least four, independent networks carrying audio, data, telephony, and TV. Some homes add intercoms, home theatres, surveillance cameras, and home automation controllers. We talk about home audio-visual (A/V) systems, but applying the word "system" is generous to the extreme. For the typical consumer, it is difficult (or impossible) to interconnect all the possible devices. In the living room alone, the proliferation of remote controls demonstrates the lack of integration (Figure 1). True, the TV is usually connected to a cable, satellite and a VCR/DVD. The stereo also has a number of connected components. "High end" homes may even centralize audio sources and amplifiers and run speaker wires to every room, including providing a receiver and player for each family member. However, to truly integrate all home media requires a scary collection of special equipment, a sense of humor, trained operators, and a full-time maintenance/user consultant (the responsible person in the family).

Figure 1: Remote controls from one living room demonstrate the lack of integration in home A/V "systems".

The computer is starting to show how all media can be integrated. In essence, A/V content has been consumed by or "converged" into the computer. Consumer grade PCs can play CD-quality surround audio, play/rip/write CDs, and play/write DVDs. They can tune and record TV. They can also store and print digital photos, display art, and record phone messages. However, current PCs are not the answer, because they are not usually welcome in all rooms. They tend to be big, ugly, and noisy (just painting them black isn't the answer). They take too long to turn on. Also, the benefit of a PC's flexibility and extensibility comes at the price of management and maintenance, making few people

willing to maintain many of them. Their complexity is comparable to the multiple remote controls and the interconnected A/V equipment that occupies most listening/viewing stations.

We believe that a single, home network that connects a PC-based server (or servers) to specialized media appliances (and other devices) is likely to evolve. Smart speakers should connect directly to the network and just play the appropriate sounds served to them. Smart networked monitors should let us watch TV, surf the Web, and display our art, ambient environments, photos, and various video content. Microphones and cameras should connect to the network for communication, to allow telephony and videoconferencing.

Instead of needing to find the right remote control for the right device, any remote control should command the unified system (e.g. pressing pause on any remote control will pause the media in the room). However, current remote controls do not have a rich enough user interface (UI) for all the potential of the home media network. A wireless keyboard, or a 3D pointing devices such as the Gyropointer mouse allow richer UIs. Even better, a wireless tablet PC can support a very rich UI, and can also display and capture media (e.g. record audio). We believe the tablet PC will be the next generation universal remote. Farther in the future, you will be able to control the system by speaking to it, or gesturing with your hands.

To the technophile, a digital home media network is obvious and inevitable. There are technical and political problems (e.g. copyright protection) to be solved, but they appear solvable. Digital media has already invaded the home in CDs, DVDs, PVRs and portable digital music players – surely integration can't be that far away, can it? On the other hand, the average non-technical person asks, "why bother"? Why bother, indeed, when existing wiring doesn't do the trick, much of the content is still analog, and the desired gear is priced for the high-end buyer?

The remainder of this article provides motivations of why we should bother, how and what future content will be distributed and stored, what the hardware/wiring requirements are, and interim steps in the journey towards the all-digital future of the Home Media Network. One critical interim step is the development of "digital transformers" that connect existing analog equipment to the home media network. Of particular interest is the Digital Home Entertainment Center (DHEC) that would almost completely replace all components of the current home entertainment center.

2 Why bother?

To understand why we should bother with the digital home media network, we need to think beyond just wiring everything together and reducing the remote control count. The Home Media Network can take advantage of software creativity that computer platforms provide to enable breakthroughs in media usage.

To begin with, we enable content to go where it has never gone before. That big-screen display that is turned off right now is just a big, ugly, gray blob. What if it was a work of art? A slide show of your favorite photos? A fireplace? A passive or interactive aquarium? A window looking out on a tropical beach or at the scenery from the dining

car of the Orient Express? Imagine lying on your bed and hearing the sound of the wind on a beach, while peering at the stars on the bedroom wall or ceiling displays.

Perhaps you watch your favorite TV show, and it mentions a Web site. You click "bookmark" on your remote-control. After the show ends, a PC or the TV can bring up the TV bookmarks for web surfing. You watch a baseball game and "bookmark" some plays. Then email the bookmarks to a friend, who had the game recorded while working late. Coming home that night, she is able to watch the highlights you selected. The next morning in bed, you bring up the "Times" on the ceiling display. Then you watch a video-on-demand lecture while exercising. A camera and microphone co-located with a large monitor allow you to videoconference.

Integrating media with the world of computers doesn't just mean Web surfing. It means software that takes the "management" out of media-management. Lets take a moment imagine a world without arcane, nested menus; that doesn't force us to memorize channel numbers, song numbers, radio frequencies, or the special key-combination required to set the time (or record the message, or…). The software needs to learn the kind of music or programs we like. One can ask for songs selected by a favorite DJ, but when the DJ picks a song the system knows you don't like, it will skip it or play something you do like from your own library instead. Once a song is given the thumbs down, there is no reason to ever hear it again (at least not in *your* home). It will also learn what kind of photos and art you like. It will dig through the 99% of your photos that you will never bother to put in a photo album and bring them up to let you identify keepers.[2]

Imagining the possibilities is exciting. Some users have even wilder imaginations that us: a common feature request for UltimateTV is to be able to fast forward a real time broadcast channel! Rather than commenting on viewer intelligence, we'd like to point out the unlimited expectations in those requests.

But enough of being imaginative. Instead of us defending the motivation to switch to digital, lets put the champions of the status quo on the defensive. Why keep analog? It is not inherently cheaper. It is lower in quality. Let's face it, analog has reached the end of its useful life, and it is time to bury it. Lets not use HDTV, which will only prolong the life of analog (The MPEG format that HDTV uses is fine – we are referring to HDTV as a transmission scheme, and as a display standard). This means a complete change in every aspect of audio and TV distribution, display surfaces, controllers, networks, computers, and how all of these work together and are controlled. To achieve this goal requires effort, determination, new standards – and getting started!

3   Building the Home Media Network

Lets consider how the Home Media Network must be designed and built. Clearly it will be different from the streaming media aimed at enterprises and the Web. These environments are designed for many viewers. Startup latency is typically not a concern, and is traded-off against throughput. Quality is often low, since bandwidth restrictions don't allow the bit-rate required for improvement. The home is the opposite. There are

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[2] Companies such as Net Perceptions and Personify have built data mining tools that companies use to understand individual preferences for marketing purposes.

only a few streams to manage. Startup latency should be short (e.g. channel-flipping-type experience), and VHS/CDs define the low quality bar.

The home dictates another important difference – the "mainframe" architecture makes sense with "thin clients" or "network computers" and centralized configuration and maintenance services. This idea is unpopular with PC users who want the option to buy different computers for different applications to keep control. In WAN environments, bandwidth limitations are a barrier. Within the home, these difficulties disappear. Most of us want to maintain just one or two machines. Bandwidth in the home should be plentiful as we show below. Hence, the home is just fine for thin clients (including TV sets – we are already familiar with "head ends" for cable or satellite).

These thin clients are "smart" in that they are configurable, connect to the network, and can be updated. However, they are not meant to be an extensible, general purpose platform, like the PC, with many unbounded functions. Such flexibility leads to unexpected combinations that makes performance unpredictable and maintenance difficult.

In an ideal world, all media devices are completely digital and all transmission is via an Internet Protocol (IP) network. However, we foresee a very long interim that involves both legacy analog and digital for transmission and viewing. To cope with this mix, we envision each analog receiver or television set has a "digital transformer" that converts digital to the analog world of the amplifier/speakers and TV sets or monitors. For example, Voyetra's Audiotron also marketed as Gateway's Connected Music Player network device drives an amplifier with speakers and plays audio content from any server on an Ethernet/IP network. The next device we would expect in the genre is a Videotron, or Connected TV Player that plays TV content coming over an IP network. Similar digital media appliances will be forthcoming for cameras and microphones. Of course, there will also be combination units, like a speaker/mic combination as an IP phone. Figure 2 shows a home with media servers, digital transformers, and digital media appliances.

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