Development of a Multimedia Product for HP Workstations

Providing multimedia capability on HP's workstations was an evolutionary process that was paced according to customer needs and the availability of quality multimedia hardware and software technology and low-cost workstations.

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Multimedia technology was a burgeoning market when HP's Workstation Group first looked at it in 1990. A lot of promise and exaggerated claims surrounded multimedia technology at the time. The question was how HP workstations could create a competitive advantage with the technology. The answer to this question resulted in HP MPower, a collection of multimedia tools and applications which are described in the articles in this issue beginning with an overview on page 10.

This paper will describe the development history of HP MPower and how it turned HP workstations from simply computational tools into media-rich information access and communication channels for business and industrial users.

The Start

Looking at the marketplace back in 1990 there were a number of application areas in which multimedia technology was being applied. Personal computers were being upgraded with CD-ROMs and sound cards, and typical multimedia application areas included presentations, computer-based training, and games. Workstations have difficulty competing with low-priced PCs for these markets. Since integrated networking capability was an advantage that workstations had over PCs at that time, we looked for markets that had distributed media requirements. We focused on two application segments: multimedia information management and real-time communication. The information-management market included document image management, work flow, and corporate training. The real-time communication market included workspace sharing, multimedia email, conference management, networked fax, telephone integration, and video teleconferencing.

We visited our customers to learn about challenges facing their businesses so that we could determine where we could offer solutions. A common theme we heard was that these companies needed to be more productive without significant increases in personnel. They were global companies that needed to align their teams on common objectives, and get them working together. Increasingly, they relied on distributed teams, alliances, and experts outside their company. The need for communication among these teams was critical to their success.

Communication between humans is more effective when it is natural. Media types such as recorded voice, pictures, and movies can add information to the communication that goes far beyond what traditional text can achieve. Facial expressions, body language, and tone of voice add cues to the meaning of the message. These cues help convey trust and understanding of what is being communicated. Multimedia computers can go far beyond traditional email in helping to facilitate communication, resulting in faster exchange and absorption of ideas. However, computer-assisted communication tools have to be easy to use and a natural part of the environment for them to be adopted by large numbers of people.

Although we wished that everyone owned an HP workstation, our customers did not have homogeneous HP environments. If the technologies we provided did not work with their existing equipment, then it would be difficult for them to deploy our products within their enterprises. Additionally, the importance of standards is very high in communication since they ensure that no one is excluded from a conversation because of the type of equipment they have.

We had three clear challenges for bringing multimedia to corporate offices. First, we had to deal with the limited networking capabilities of most existing environments. Second, the technology needed to be pervasive for people to use it. Finally, the technology needed to be very low-cost to be affordable for deployment within the enterprise.

End users were pulling the application developers into the multimedia arena. Thus, we needed to create desktop tools so users could immediately take advantage of multiple types of media without waiting for the applications to be developed. These tools also had to include examples of how to use the programming interfaces to the multimedia services so that application developers could immediately provide multimedia capability in their applications.

We wanted to leverage as much as possible the expertise within HP so we contacted numerous HP organizations. A PC-based collaborative multimedia project from HP Laboratories in Pinewood and Bristol, England was one of the pieces of research that helped guide us. Engineers in Bristol demonstrated that for distributed work groups trying to solve a range of tasks, a shared drawing space that allows multiple users to annotate a picture was very effective in improving productivity. Audio communication was considered the second most productive tool among these work groups. Surprisingly, seeing a video of the person they were

working with didn't improve productivity measurably. However, it is interesting that they perceived they were more productive when using video to show the object being discussed.

Our customer feedback was that although they all wanted to be able to do video conferencing from their desks, they did not have the network infrastructure in place. Also, when asked which media they would incorporate in their training and documentation, the answers were overwhelmingly in favor of images and audio. We felt that it was important to stage technologies for customer acceptance, and build up the capabilities over time. We decided to defer distributed digital video support until customers became comfortable with digital media over networks and implementations were cost-effective.

To keep the incremental costs for multimedia down we tried to implement as much as possible in software running on a PA-RISC CPU. This also allowed us to adapt our systems easily to new algorithms and standards, to provide access to our installed base, and to take advantage of new processor improvements.

1991—The Base Platform

Our customer feedback implied that the first technologies to be integrated should be image and audio. We asked customers about their imaging needs and found that while computers could display images, users typically had to run them through several conversion steps before their display program could put the image on the screen. Among graphics products there was a wide range of image formats and frame buffer pixel depths. This made image display inconsistent from machine to machine. Another problem was that the screen would turn funny colors when more than one image was displayed at a time because of the lack of color map sharing.

We addressed these problems with an image library and tried to make images as easy to use as text and graphics. We integrated image and audio libraries into the HP-UX* operating system so that applications would have an installed base for their functionality. There were no standards available for programming interfaces, so we modeled the interfaces to feel like X windows, which is a paradigm familiar to our application developers. Rather than creating HP file formats, common formats from the PC and Apple Macintosh worlds were used and conversion services were provided to import and export data from these platforms. We used algorithm expertise from HP Laboratories and the CPU power of our systems to include compression and decompression of images using the JPEG (Joint Photographic Expert Group) standard, which allows images to be useful on low-end machines with small disks. The image library was designed as an extensible pipeline architecture that would allow applications to add new file types or special operations.

Our approach to audio support was to integrate audio on the motherboard of our workstations. Instead of taking the traditional approach of providing a DSP (digital signal processor) for moving the audio to the CODEC (coder/decoder), we use the main processor. This not only saves the cost of the DSP but also the dedicated memory for the DSP and other support logic. The PA-RISC processor is much faster than commercial DSPs, and it allows more complex functions to be applied to media streams.

We felt it was important to develop small applications such as an audio editor that would provide end user tools so there would be market demand for the technologies. We also gave away the source code for these small applications so that developers would have working examples to start with when they developed their own applications.

The audio and image library were packaged with our X window sharing product HP SharedX, making up our first multimedia offering. The audio library, the image library, and HP SharedX are described on pages 62, 37, and 23 respectively.

1992—Media I/O

In 1992 we decided to make our existing technologies more useful and postponed digital video. We felt we could bring our customers more value by leveraging the strengths HP had in computer products and integrating those products with the base tools. We ported the HP ScanJet IIc from Microsoft® Windows to the X Window System to provide a way to get images into the workstation. We created a product called HP SharedPrint to allow a multitude of image formats to be printed on the wide range of PCL and PostScript™ printers available. We added fax technology so that users could have another way to communicate with images. This would also allow communication with people outside their normal networking environment. We collaborated with third-party vendors to provide hardware for video in a window and to allow users to capture digitized frames from the video. HP SharedPrint, HP MPower fax, and our first video offering are described on pages 44, 53, and 68 respectively.

We upgraded the audio that is built onto the CPU board to CD quality to anticipate low-cost speech recognition, text-to-speech capability, and computer-based training. The HP-UX elm mailer was integrated with the new media data types to handle compound document mail messages using the internet standard MIME (Multipurpose Internet Mail Extensions). To improve the usability of the system we did extensive up-front task analysis. We determined how the tools would be used to accomplish different tasks and worked to eliminate the number of steps users needed to succeed at those tasks. We made the user interfaces appear more consistent among the different tools. We used HP SharedX to replicate our graphical user interfaces and solicited feedback from the different HP organizations developing components for HP MPower and HP VUE (Visual User Environment) 2.0 customers. The HP VUE team worked closely with us to integrate the media and collaborative tools into the control panel of the HP VUE 3.0 control panel. We delivered this collaborative user environment to the market under the name HP MPower 1.0.

HP VUE 3.0 and the new elm editor are described on pages 20 and 71 respectively.

1993—Ready for Video

In 1993 we improved HP MPower in three dimensions by adding digital video, integrating telephony, and dramatically improving the flexibility for configuring the client/server

environment so that fax and print servers can reside on different machines. These features became HP MPower 2.0.

Digital Video in HP MPower

Recent advances in computer-processing speed and video-compression techniques have made it possible to combine full-motion video and synchronized audio into a form of computer data. This data, known as digital video, can be delivered over standard computer and telecommunication networks and can be integrated into multimedia applications such as computer-based training programs.

In the computer-based training market, there is typically a small number of authors and a large number of people who use this form of training. Our goal was to deliver cost-effective digital video playback for desktop computer-based training. We worked with HP Laboratories and the HP 9000 Model 712 team to integrate the video playback algorithms tightly into the PA-RISC 7100LC chip. The graphics team provided new blithering (dithering and visual blending) algorithms and media-oriented frame buffer access modes that greatly assist in the rendering performance, giving the appearance of a 24-bit system with the cost of an 8-bit system.

Standards-Based File Format. HP's digital video implementation supports the MPEG-1 (Moving Pictures Expert Group) file format. MPEG-1 is an internationally recognized standard for compressing synchronized audio and video data. MPEG-1 maintains a high-quality image (comparable to VHS tape) while supporting compression ratios up to 200:1.

Key Benefits. HP MPower users can play MPEG-1 movies on any HP 9000 Series 700 workstation without additional hardware. The new HP 9000 Model 712 workstation provides exceptional price/performance value for playing video because of instruction set enhancements to the Model 712's PA-RISC chip and enhancements to the graphics subsystem.

Since MPEG-1 movies are a form of digital data they can be transferred to other users via email or standard HP-UX commands such as `ftp` or `uucp`.

Digital Video Components. HP MPower 2.0 has two digital video software components: the video player and the video converter. The video player software plays MPEG-1 movie files with or without audio (see Fig. 1). The user can adjust the size of the window and adjust the audio and video qualities. Any frame in the video can be examined, and play forward or reverse capabilities are also available. Video frames can be captured and saved as TIFF, JFIF, Xbm, or Xwd images. Images can also be printed directly from the application.

The video conversion utility converts JPEG movie files to MPEG-1 format. JPEG (Joint Photographic Expert Group) is an internationally recognized standard that deals with the compression of still images.

Fig. 1. The digital video player playing an MPEG-1 movie file.

MPEG-1 movies can be obtained by capturing video data from an external source such as a video camera and storing it in JPEG movie files.† The JPEG files can then be converted to MPEG-1 format with the video conversion utility. Alternatively, customers can use a service bureau to convert their video material to MPEG-1 format.

Telephony

The integration of telephone functionality on a workstation provides users with a powerful communication tool that enhances the use of both the telephone and the computer. The telephone becomes easier to use because the computer can take care of the details of telephone use such as special function buttons, volume control, finding and dialing phone numbers, and tracking telephone use. The computer becomes a more effective communication and collaboration tool. Also, with telephone access, users can send faxes from their desktop, share their computer audio over the telephone, and get caller information from a database based on the caller identifier (e.g., telephone number).

HP's telephony product, or HP TeleShare, provides a two-line telephony card for HP's 9000 Model 712 workstation. The HP TeleShare card is an optional daughtercard, with two complete analog†† telephone line interfaces. Each telephone line has a digital signal processor to provide data and fax modem support and to handle audio mixing for voice mode use. Having two telephone lines provides the capability to place a telephone call using one line while setting up a data or fax connection on the other line.

HP TeleShare also includes a telephone application that provides users with access to various telephone functions from their workstations. For switching the mode of each telephone line between data modem, fax modem, and voice there is a small control application that controls the mode of each HP TeleShare line and reflects any changes in mode to the user. Fax functionality is provided through a single-user configuration of the HP MPower fax facility, while data modem functionality can be accessed through the user's favorite data communications package such as kermit or cu, provided they are configured to use the HP TeleShare card as a modem.

HP TeleShare has direct access to the HP MPower audio subsystem on the workstation, which is what makes it possible for a workstation with the audio headset to be used as a full-function telephone. This also makes it possible to share computer-generated audio over the telephone line and to record telephone conversations into computer audio files for later reference. Because telephone audio is low-quality, HP TeleShare provides services to deal with quality levels. The audio server automatically resamples the computer audio so that the user is not constrained by this restriction. This makes it possible to play CD-quality samples over the telephone line or to record from the telephone line into a CD-quality sample file.

Applications. Two OSF/Motif applications are provided with HP TeleShare. The first is called teleshare, which provides a graphical user interface to the telephone functions provided by the product. These functions include a telephone keypad, volume and hook controls, forwarding buttons, programmable speed dial keys, and a display area for incoming caller-identifier information.

The second application, called telctrl, provides control and status information on the media modes (fax, data, voice) for the HP TeleShare telephone lines (described below). There is also a helpful graphical setup and configuration program to help the system administrator configure the HP TeleShare product properly.

Fax and Data Modem Lines. HP TeleShare can function as a fax or data modem in addition to serving as a full-function telephone. The telctrl application allows control of the current mode of each of the HP TeleShare telephone lines, as well as reflecting any changes in the mode. The mode can also be changed automatically when a modem application opens a connection to the port supplied for interfacing to HP TeleShare's modem functionality. Only one line at a time can be used as a modem, but the other telephone line would be available for voice mode use.

A single-user configuration of the HP MPower fax product is shipped with HP TeleShare to provide support for fax functionality.

Conclusion

Enhancements or additions to the HP MPower product will be guided by our ability to leverage HP and external multimedia tools and technologies and integrate them into the product to reduce cost and to take advantage of HP's distributed computing and object-oriented design expertise. We will continue to listen to our customers' needs and provide frameworks that will allow tighter integration of the parts to improve usability. Our internal use of the collaborative tools for our own communications with remote experts and teams both inside and outside of HP will provide us with additional insight into communication needs for the future.

† A third-party video card must be used to capture JPEG movies.

†† Analog telephone line refers to the traditional, Plain-Old-Telephone-System (POTS) telephone lines, as opposed to ISDN (integrated-services digital network) or ISDN-like proprietary digital telephone systems.