

HP MPower: A Collaborative Multimedia Environment

Multimedia capability on a workstation enables users to interact with their applications and communicate with others in a variety of formats (textual and nontextual). HP MPower provides an environment in which users have easy access to the multimedia facilities at their workstations, and application developers can easily add new multimedia tools.

by William R. Yoder

Imagine being able to have a project team meeting in which the participants are widely dispersed but are able to collaborate from their desktop workstations as if they were all in the same room. To carry out such an electronic meeting, the participating workstations must provide the facilities that allow users to create, manipulate, and share textual and nontextual information such as audio, image, and video data over a network.

HP MPower provides workstation conferencing and the collaborative sharing capabilities mentioned above. Unlike video teleconferencing, which requires a significant hardware and networking investment, HP MPower is a low-cost software product that works with today's workstations and networks. HP MPower offers a full range of multimedia types such as audio, image, graphics, video, and text (Fig. 1), with five ways of sharing information: print, mail, fax, whiteboard,

and real-time application sharing. HP MPower offers access to this set of multimedia tools through the HP VUE 3.0 graphical user interface.

HP MPower is currently supported on the HP 9000 Series 700 and 800 workstations and HP X stations.

The Media-Equipped Knowledge Worker

A typical knowledge worker uses a workstation to process information in the form of documents, spreadsheets, graphics presentations, and so on. In addition to these items, the media-equipped knowledge worker has access to sound clips, video frames, scanned images, faxes, and other media objects. Whether among a local team or among colleagues who are scattered geographically, the media-equipped knowledge worker benefits by sharing high-fidelity information at a high bandwidth.



Fig. 1. A typical HP MPower display showing windows open for whiteboard, images, and video.

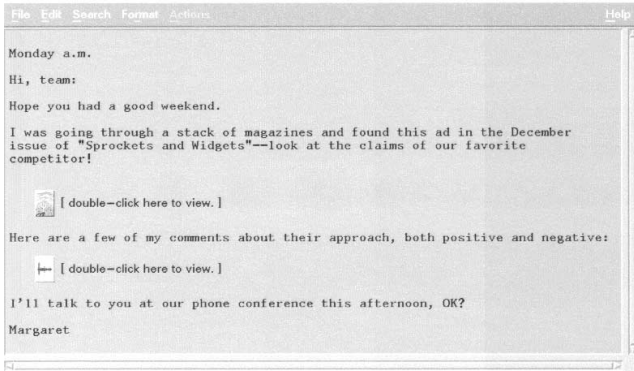


Fig. 2. Multimedia mail composing.

Workstations and PCs capable of providing multimedia access have until recently existed as islands of technology, only good for standalone applications. A developer logs into such a workstation and creates, say, a training module that end users can access only at the isolated workstation. By combining the power of media technology with networked systems running the HP-UX* operating system, HP MPower enables users to collaborate effectively via a workstation medium.

For example, suppose Margaret wants to send her colleagues a document consisting of text, a scanned image of a competitor's magazine ad, and a voice clip commenting on the article. She presses the mail button on the HP VUE front panel shown in Fig. 1 to compose the mail message shown in Fig. 2, presses the scanner button on her HP MPower media panel to scan in the ad, and then presses the audio button to record her comments. Finally, she drags and drops the scanned image and voice clip into her mail message and sends it on its way.

As another example of using this media-equipped workstation, consider Jeffrey who wants to work on a CAD drawing with his colleagues in Colorado and Washington. From the HP VUE file manager, he drops the drawing into a whiteboard window on his workstation, calls his colleagues on the telephone, and uses the whiteboard window to interact and collaborate with his colleagues. The whiteboard and the software for sharing windows are discussed in the article on page 23.

The HP MPower System

On a fully-equipped HP MPower-enabled workstation the following services are available to the user:

- Faxing
- Online Documentation
- Scanning
- Image Viewing
- Audio Recording and Playback
- Video-in-a-Window
- Window Capture
- Whiteboard Collaboration
- Application Sharing
- Color Graphics and PostScript™ Printing.

Many of the services listed above are accessible from the HP MPower media panel shown in Fig. 3. Some of the other HP MPower features accessible from the front panel include:

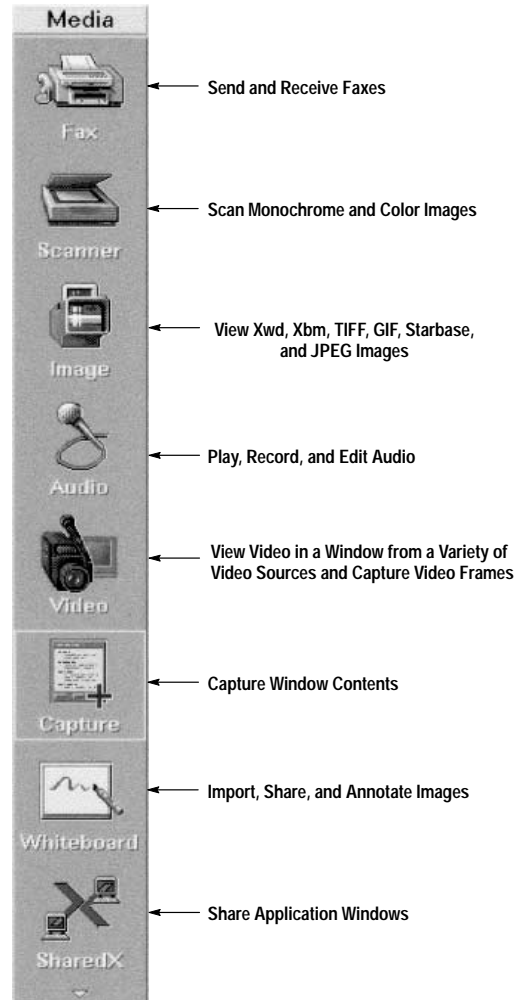


Fig. 3. HP MPower media panel.

- Audio control for adjusting global audio output devices
- Help control for accessing system-wide online documentation
- Print control for printing text and graphics, managing print requests, and administering printers
- Mail control for reading and composing plain text and media-embedded mail messages.

Hardware Components. The basic HP MPower workstation consists of a high-resolution display, a keyboard, and a mouse. For a fully-equipped HP MPower multimedia workstation the other hardware components include:

- Built-in 8-bit or 16-bit audio with speaker or plug-in headset
- External scanner with SCSI interface
- External fax modem (or modems) with serial interface
- EISA-based video card
- A variety of serial and parallel printers.

Software Components. HP MPower software consists of a number of tightly integrated media tools coupled to the HP VUE 3.0 user environment with interprocess communication mechanisms for distributed processing. HP VUE 3.0 and HP MPower are peers in the software hierarchy (see Fig. 4). When the user selects an HP MPower media object (e.g., audio file) from the HP VUE 3.0 display, HP VUE hands control over to HP MPower to take the appropriate action on the object.

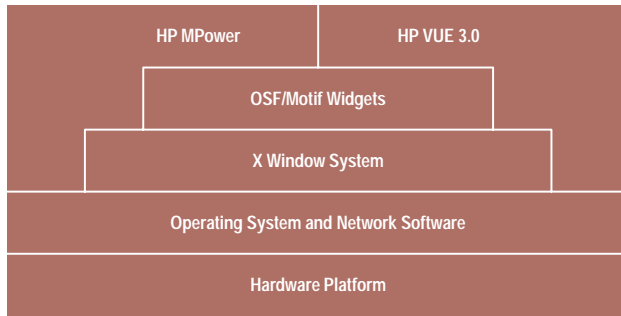


Fig. 4. The software hierarchical relationship between HP VUE 3.0 and HP MPower. HP VUE 3.0 provides user interface and desktop services for the look and style of HP MPower media objects, and HP MPower provides the actions associated with a particular media object.

A typical media tool consists of an OSF/Motif-based client application, its run-time libraries, a backend server process, and the appropriate device drivers (see Fig. 5). At the lowest level, the device drivers control the hardware. For example, the VideoLive card uses an X-server extension to access the frame buffer. This X-server extension enables direct hardware access to the frame buffer, so that the VideoLive client can manipulate 24-bit 640-by-480-pixel images within the context of an 8-bit root window. Media server components are described in more detail later in this article, and the VideoLive card is described in the article on page 68.

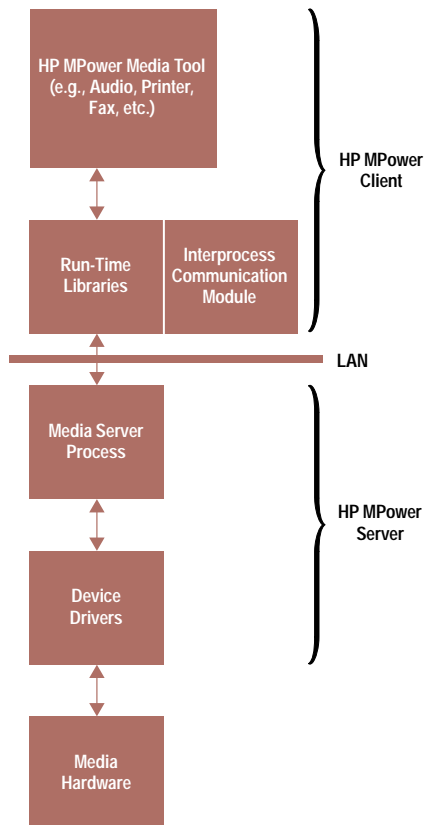


Fig. 5. The architecture for a distributed multimedia application.

Important HP MPower run-time libraries include the image and audio libraries, which are described in the articles on pages 37 and 62, respectively.

The User Interface

From a user's point of view, the HP MPower workstation consists of an integrated set of tools and their associated media objects. HP MPower provides facilities that enable the user to:

- Create media objects like a video frame sequence
- Browse objects such as an incoming fax
- Edit objects such as an audio track
- Share objects such as a workstation window.

The appearance and behavior of HP MPower are derived from the OSF/Motif style guide and from the HP VUE desktop. For example:

- Users can double-click to invoke actions, as in playing an audio file
- Users can drag and drop media objects on HP MPower tools, as in dragging and dropping an image file on the fax composer.

HP MPower tools are mouse-driven with pushbuttons, pull-down menus, and dialog boxes.

The HP VUE 3.0 interface is described on page 20.

Objects and Actions

The file-typing mechanism used by HP VUE is extended to media objects. For example, PostScript files are denoted by a .ps suffix appended to the base file name (e.g., Article.ps). The HP MPower media tools such as the audio editor ensure that files are created with the appropriate suffix.

Each media object has certain allowable actions or methods. For example, for audio files appropriate actions include Play, Edit, and Mail, and for image files appropriate actions include View, Print, Mail, and Fax. Table I lists the objects and actions supported in HP MPower 1.0. These HP MPower actions extend the predefined HP VUE 3.0 objects and actions.

Online Documentation

Extensive online documentation is provided with the HP MPower system. Built on the HP VUE 3.0 help system, HP MPower online documentation includes component level documentation (e.g., help on the fax composer) and system level documentation (e.g., the "Welcome to HP MPower" chapter).

Top level indexes provide users with easy access to all the help volumes on their system. The many hyperlinks† among topics allow users to browse hundreds of pages of task-oriented and reference material, which may or may not be related to the task they are performing. Another type of help called item help enables users to find answers as they use the media tools in the context of the task they are performing.

With the exception of a minimal set of introductory online documentation, all help text is installed on the HP MPower server to conserve client disk space. More about HP MPower help is covered in the articles on pages 79 and 90.

† Hyperlinks are navigation pointers to related pieces of information. The online help article on page 90 provides more information about hyperlinks.

Table I HP MPower Objects and Actions		
Object	File Suffix	Appropriate Actions in HP MPower
SUNFILE	.au	Create, Edit, Mail, Play
NEXTFILE	.snd	Create, Edit, Mail, Play
WAVFILE	.wav	Create, Edit, Mail, Play
L16FILE	.l16	Create, Edit, Mail, Play
L8FILE	.l8	Create, Edit, Mail, Play
Lo8FILE	.lo8	Create, Edit, Mail, Play
ALFILE	.al	Create, Edit, Mail, Play
UFILE	.u	Create, Edit, Mail, Play
PS	.ps	View, Print, Mail, Fax
EPS	.eps	View, Print, Mail, Fax
TIFF	.tif, .tiff	View, Print, Create, Mail, Fax
GIF	.gif	View, Print, Mail, Fax
JPG	.jpg, .jpeg	View, Print, Create, Mail, Fax
BMF	.bmf	View, Print, Mail, Fax
BM	.xbm, .bm	View, Print, Create, Edit, Mail, Fax
PM	.xpm, .pm	View, Print, Create, Edit, Mail, Fax
XWD	.xwd, .wd	View, Print, Create, Mail, Fax
MIME	.mim	View, Print, Create, Edit, Mail, Fax
Unknown	.unk	Create, Mail
Data/Text	(any)	View, Print, Create, Edit, Mail, Fax

Client/Server Architecture

HP MPower is shipped in a client/server configuration, allowing applications and data to be distributed across a networked computing environment. In a client/server architecture, programs and data are split across the network according to each machine's capabilities. The term server refers to a program offering a service such as faxing or printing. The term client refers to a program requesting a service, such as the fax composer or the HP SharedPrint client.

In today's client/server world, many services are typically concentrated on a powerful central system, which is termed a server system. For example, the HP MPower server offers built-in fax, mail, font, help, print, and HP VUE services. The functionality available locally on the user's desktop is collected on what we call the HP MPower client.

Advantages of the HP MPower client/server architecture include:

- Distributed processing
- Maximum performance measured by interactive response times and load balancing
- Minimum cost-per-seat realized by RAM and disk savings
- Scalability in that when new clients are added, the system administrator can either add new servers or simply add RAM and disk to existing servers.

Fig. 6 shows a typical HP MPower client/server configuration. In this configuration a client can fax a document via an HP MPower server to another client (see ① in Fig. 6). Likewise

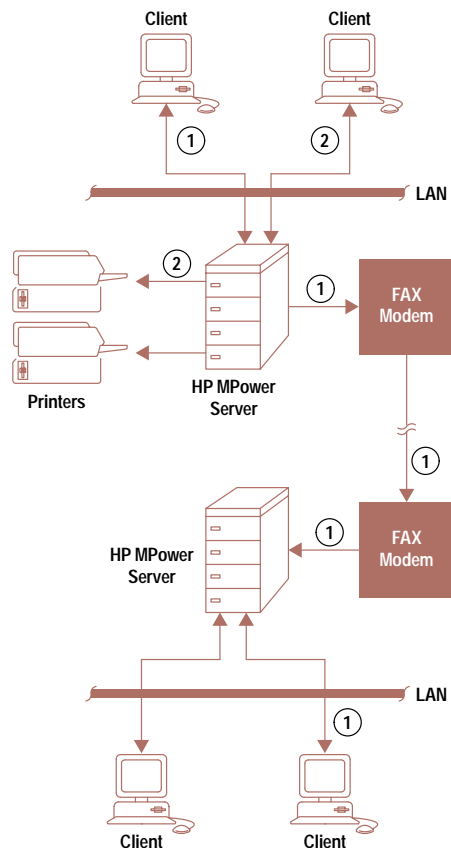


Fig. 6. Faxing a document between two clients connected to different HP MPower servers.

a client can send a document to an HP MPower server (provided it offers print services) to be printed on a specific printer (② in Fig. 6). Typically, an HP MPower server provides fax, printer, font, online help, and user interface services. The HP MPower client provides local image processing, audio, video, and display services. Applications, such as spreadsheets, can run on the server, on the client, or on dedicated application servers.

HP MPower services can be split among a variety of machines in extremely flexible configurations. For example, HP SharedPrint servers are installed on whatever machines have printers physically connected, the fax server can run on a machine different from the HP MPower server, and there can be two or more HP VUE servers providing login, file, and window management services for a large group of users. However, in arranging services in such a manner an extra burden is put on the system installer and network administrator.

For simplicity, the HP MPower server by default runs all the HP MPower services. The HP MPower client on the user's desktop runs whatever productivity, multimedia, or user interface applications it can offload from the HP MPower server.

Server Processes

HP MPower server processes include the device drivers and the interprocess communication software shown in Fig. 5.

The server processes in the HP MPower 1.0 network include:

- An X11R5 display server with HP SharedX and video extensions

- An audio server that manages local audio hardware
- A font server that manages the fonts on the HP MPower server
- A fax server that manages local fax modems
- A print server that manages local printers.

These server processes enable client applications to access a serially reusable resource attached to a given host. The font server enables the HP MPower server to service font requests from all applications, affording significant disk savings. The fax server handles file conversions (e.g., converting from PostScript to fax-file format), call routing, administrative databases, and incoming and outgoing telephone connections. The print server employs a variety of filters to convert popular imaging formats to a given printer's native language.

Descriptions of the audio, fax, and print server processes are covered in the articles on pages 62, 53, and 44, respectively. HP SharedX, which is a tool for sharing windows, is described in the article on page 23.

Interprocess Communication Mechanisms

HP MPower employs a variety of interprocess communication mechanisms to enable its asynchronous, distributed processes to communicate and cooperate. UNIX* domain and internet sockets provide most of the substrate, enabling remote procedure calls and event-driven protocols. Helper processes include a remote invocation daemon for launching distributed applications, a broadcast message server for passing simple strings, a location broker daemon for establishing

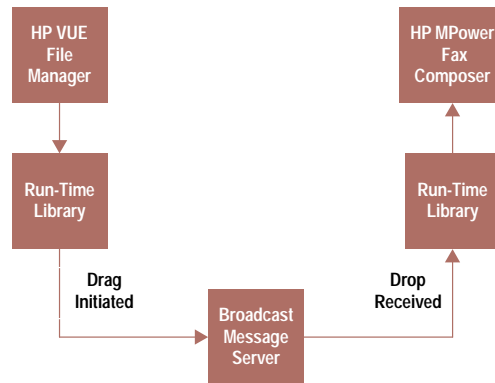


Fig. 7. The broadcast message server enables the fax composer to accept a dropped file from the HP VUE 3.0 file manager.

connections, and other standard UNIX services (X server, name server, remote print daemon, NFS-mount daemon, and a mail transport mechanism).

For example, in extending the HP VUE 3.0 drag and drop mechanism to the HP MPower tools, the broadcast message server (BMS) provides the communication link (see Fig. 7).

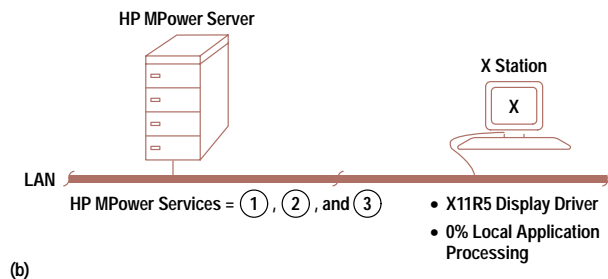
Desktop Configurations

HP MPower provides four preconfigured desktop clients as shown in Fig. 8. For each configuration, Fig. 8 indicates the approximate share of the HP MPower processing load that

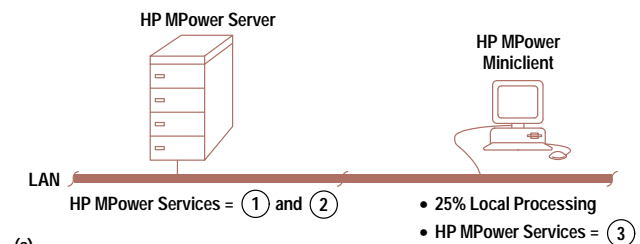
- ① Fax Server
PostScript Viewer
Online Help Files
HP SharedPrint Server
- ② HP VUE
Icon Images
Fonts and Font Server
Mail Viewer, Composer, and Server
Multimedia File Converter
- ③ X11R5 Server with Video and HP SharedX Extensions*
Fax Composer and Browser
Scanner
Image Viewer
Audio Editor
Audio Server
Whiteboard Client
HP SharedPrint Clients
HP SharedX Client

* This is the only component on an X station configuration.

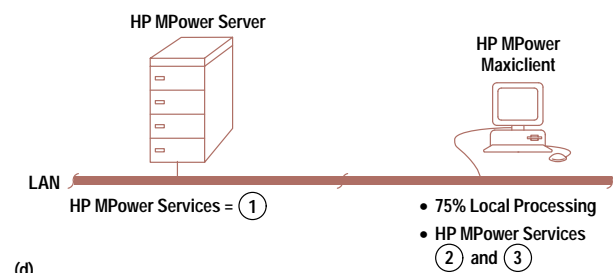
(a)



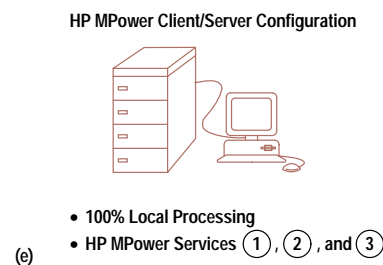
(b)



(c)



(d)



(e)

Fig. 8. Different desktop configurations provided with HP MPower. (a) HP MPower services provided by clients and servers. (b) X station configuration. (c) Miniclient configuration. (d) Maxiclient configuration, (e) Client-on-server configuration.

occurs locally on the desktop client before any other applications are started. Fig. 8a shows the HP MPower services distributed among the configurations shown in Figs. 8b to 8e.

X Station Configuration. In the X station configuration the user runs HP VUE 3.0 and the media services totally from the HP MPower server (Fig. 8b). There is no local processing, other than the display server portion of the X11R5 window display system.† HP 9000 Series 300 and 400 workstations and X stations and workstations from other vendors can function as HP MPower X stations. These stations will run the HP MPower software entirely on the HP MPower server (including the client services), but can run other applications locally on the workstation.

For more about X stations (or X terminals) see “X Stations in HP MPower” on page 16.

Note that the media tool software architecture shown in Fig. 5 is not applicable to the X station desktop configuration because with the exception of the display and audio driver software all software runs on the HP MPower server.

Miniclient Configuration. On an HP MPower miniclient most media services, such as audio and imaging, run locally (Fig. 8c). The user’s HP VUE session, including the file manager and the window manager, runs on the HP MPower server.

The miniclient configuration takes advantage of local HP-PA RISC processing power for imaging operations, such as rotation, scaling, and contrast.

Maxiclient Configuration. On an HP MPower maxiclient the HP VUE user interface and most media services can be run locally (Fig. 8d). The advantage here is that the dependence on the HP MPower server for the desktop user interface is removed.

Client-on-Server Configuration. This configuration uses a fully loaded workstation, running both server and client HP MPower software (Fig. 8e). Essentially, it offers standalone media services suitable for both networked and nonnetworked environments.

This configuration is easiest to configure and administer, but it is the least cost-effective solution. Also, it is limited to computers that support bitmap displays.

Network Home

To provide a consistent environment for users whose data files reside on one machine and applications on another, HP MPower implements a network home environment. This environment provides the user with a view of files that is consistent across all machines in the HP MPower network. The user sees the same colors, fonts, home directory, and so on regardless of the HP MPower client or X terminal on which a session is started.

To set up the home environment, system administrators have three options for locating users’ personal data (i.e., \$HOME directories):

- Leave the \$HOME directory on the user’s desktop workstation
- Place the \$HOME directory on the HP MPower server
- Place the \$HOME directory on an alternate file server.

† The new HP ENVIZEX X stations offer a local flexible disk drive, audio, printing, and scanning.

Installation and Configuration

Because of its complex interprocess interactions and client/server architecture, HP MPower depends heavily on the functionality of the HP-UX operating system. For example, HP-UX scripts are used to customize HP MPower during initial installation when the HP Instant Ignition†† process is running. Scripts are also used to add, delete, and reconfigure HP MPower clients.

Two of the most important scripts, which are run at instant ignition boot time, are responsible for setting up the HP MPower server and HP MPower clients. The server configuration script (`setup_server`) performs the following functions of the server system:

- Starts the network file system (NFS) for remote file access
- Starts the NFS automounter service to provide transparent access to remote file systems
- Starts the network computing system (NCS) to support remote printing, faxing, and audio
- Starts the X11 font server so that HP MPower clients can obtain their fonts from the HP MPower server system
- Starts the `sendmail` daemon so that users can send and receive multimedia mail.

The `setup_client` configuration script, which runs on the HP MPower client, performs the following functions:

- Enables NFS and automounter
- Sets up links between the client and server for the local client file system
- Establishes the fax, HP SharedPrint, and HP VUE connections to the HP MPower server
- Enables the drag and drop capability between server and client.

The system administrator can add or remove other clients at any time by running a simple `admin_server` script on the HP MPower server.

Session Startup and Login

At later system boots (after the initial installation described above), the `/etc/src.sh` script sets certain key global environment variables, such as the HP VUE server. On the HP MPower server, the `/etc/rc` file starts the fax server and the font server processes. Other boot-time scripts start the NFS, automount, and HP VUE login processes.

When a the user logs in through the graphical HP MPower welcome screen, other variables such as the user’s audio host, help path, and network home are established.

Testing

Because of the number of software components and hardware configurations, testing HP MPower was a daunting task. We concentrated on the configurations that would be most popular, as directed by our product marketing team, with particular emphasis on the HP 9000 Models 712 and 715 machines configured as standalone desktop clients. In the course of the project, we used more than 20 integration and test machines internally to verify software installation and configuration.

†† See “The HP Instant Ignition Program” on page 17.

X Stations in HP MPower

The X station (or X terminal) is a product optimized to run X Window System server software. X stations were developed when the X Window System was established as a standard distributed windowing system for the UNIX operating system. Three major factors accelerated the acceptance of X stations in the market:

- Emergence of the client/server model of computing
- Dramatic increases in processor compute power
- Improvements in networking technology.

The X station is a network-based display device that uses X protocol over a local area network (LAN) to communicate with the host. The programs specially written for X (called clients) run on the host but display their output on the X station. X stations are also able to run programs locally. The programs that run locally on the X stations are referred to as local clients. There are three major classes of local clients: local window managers, local terminal emulators, and local utilities.

X stations cannot operate without a host because they use the compute power, memory, and disk space of the host machine.

X Stations versus Workstations

The X station is a complementary product to the workstation in that it offers the look, feel, sound, and graphics performance of a workstation, but at a much lower price. Typically, the X station costs about half what the comparable workstation costs, while providing workstation-like graphics performance. X stations allow multiple users to access the power of a modern workstation (host), help to make better use of the compute power and disk space available on the network, and simplify system administration. X stations are not suitable for two types of users:

- Power users that run simulation and modeling programs
- 3D graphics users.

The reasons X stations are less expensive than workstations include:

- They use a low-cost embedded graphic controller as CPU. A general-purpose processor used in a workstation is much more expensive.
- They need much less memory to perform the same tasks since they have a compact, real-time, UNIX-system-like operating system that uses only a small fraction of the DRAM required for a complete UNIX operating system.
- Most of their electronic circuitry is integrated into application-specific integrated circuits (ASICs) to reduce cost even further.
- They use less power, making their power supplies less expensive.
- They do not have any hard disks.

Configuring X Stations in HP MPower

X stations support all HP MPower functionality with the exception of a live video input. X stations are not true HP MPower clients. They require that both the HP MPower server and client run on the host. The newly introduced HP ENVIZEX stations support local audio, local scanner, local floppy diskette in DOS format, and HP SharedX functionality as a sender and receiver. The following additions are recommended to the .xprofile file in a home directory for a user that uses an X station and the HP MPower software.

```
# AUDIO and SCANNER variables are derived from DISPLAY variable to ensure
# that multiple X stations can support local audio and local
# scanning while running HP MPower software on the same host.
```

```
xterm_name=$(echo $DISPLAY | sed 's:::;:;')
```

```
SCANNER=$xterm_name
export SCANNER
```

```
AUDIO=$xterm_name:0
export AUDIO
```

```
#SPEAKER=INTERNAL      # uncomment if there are no external speakers
SPEAKER=EXTERNAL      # comment out if there are no external speakers
export SPEAKER
```

Initially, our strategy was to support as small a number of configurations as possible and to increase that number with each subsequent product release. We began by providing support for the Series 700 only. With HP MPower 1.2 we expanded that base to include the Series 800 as HP MPower servers, the Series 300 and 400 as HP MPower X stations, and the new ENVIZEX X stations as media-enabled X stations. Similarly, our first release was English only; HP MPower 1.2 added support for Japanese and 16-bit character sets.

The team provided an alpha release to a select number of customers, which was hand-delivered and installed by a support group from the factory. We also created two separate beta releases to flush out installation and configuration problems. More than 40 internal HP sites installed early versions of the software. Our goal was to minimize the amount of time required to install more than 30M bytes of software.

Two usability tests helped shape the user interface of the system. We learned early that the user interfaces of the individual components had to change to fit the overall user interaction with the system. For example, all components adopted a uniform file selection dialog to enable users to access and save files consistently.

A system administration walkthrough resulted in installation and documentation adjustments, particularly in organizing the system installation into separate procedures for instant ignition and noninstant ignition systems. The prerelease feedback enabled us to cut the installation time from two weeks (at the project outset) to two days (at alpha release) to two hours (for the final product).

We divided testing responsibility among the component owners so that one team tested the fax, imaging, audio, and other media components, another team tested the HP SharedX and whiteboard components, and a third team covered the mail, desktop integration, and system installation areas. We relied extensively on an automated defect tracking system for monitoring defect levels and resolution rates on a weekly basis.

We performed a limited set of code inspections on new and critical modules. Team members spent many hours testing the components and system interactions manually. They have since started work to automate a number of these tests.

Diagnostics

HP MPower has a diagnostic facility called Dr_MPower which consists of a variety of submodules that check dozens of key system and personal files to ensure that the system and the media services are properly installed and configured. Dr_MPower can be run on either a server or a client.

Users can run Dr_MPower simply by double-clicking the tool's icon in the file manager toolbox. See the article above for more about this diagnostic.

Challenges

Besides working on a tight schedule, some of the challenges we encountered while developing the first HP MPower product included:

(continued on page 18)

The HP Instant Ignition Program

The HP Instant Ignition program is focused on increasing customer satisfaction by delivering a complete, integrated, preconfigured system† that is ready to use. The program has the following goals:

- Give the customer a positive “out of the box” experience (i.e., a positive first impression of our system)
- Decrease the “time to productive use” of a system
- Decrease HP’s field and factory cost by using common tools and standardized processes.

What Is an Instant Ignition System?

The HP Instant Ignition system is made up of the basic computer system hardware, including a disk that is preloaded with an operating system, optional application software, and system documentation.

The HP Instant Ignition design team set out to make HP 9000 systems less intimidating to the user. The team designed a number of usability enhancements aimed at addressing the program goals. For example, esoteric messages were removed from the boot process. The team replaced other messages with a concise checklist that indicates passing or failing portions of the boot procedure (Fig. 1). Labels on boxes were enhanced to make them more readable.

Additionally, the first time the system is booted, the user is prompted to provide system parameters that cannot be predicted in the factory, such as networking specifics. This method of configuring the system eliminates the need for a user to edit files manually.

The HP MPower team designed an extension to these system parameter prompts. The links between the client and server are established as the system is booted so that HP MPower is fully functional the first time any user logs into the system.

CHAMP

To preload the various operating systems and applications, the instant ignition team developed a software tool called CHAMP (channel-reseller and manufacturing process). CHAMP fits into an automated hardware manufacturing line at a point where the CPU is assembled with a disk and diagnostics have successfully completed. At this point, the customer’s disk is ready to be built using a two-phase process.

First, the customer’s CPU boots from a dedicated manufacturing disk that contains the CHAMP tool. CHAMP runs on the customer’s hardware and downloads the operating system to the customer’s disk or target disk. CHAMP then downloads

some utilities to the target disk to prepare for phase two. The last thing to occur in phase one is to reboot the customer’s system.

In phase two, the customer’s system boots from its own disk, the target disk created above. If necessary, instead of booting to the login screen as expected, the system runs the utilities downloaded in phase one to fetch additional software. This software may come from a netdist server or from another system on the network. The system will also configure its kernel, if necessary, based on the customer’s hardware and optional software.

The last thing to occur during a CHAMP build is to remove the CHAMP utilities and return the operating system to a pristine state. The system then shuts itself down and is ready for the customer.

Design Considerations

In designing CHAMP, a number of requirements had to be met. Some of the key design requirements were to:

- Preload HP 9000 Series 700 and Series 800 HP-UX operating systems
- Run from a command line, allowing existing manufacturing processes to invoke CHAMP automatically
- Run on the customer’s hardware (This guarantees that the HP-UX kernel and the recovery instructions are specific to the customer’s hardware.)
- Load application software that is delivered in a variety of formats (HP’s preferred method for packaging software is update format. The utility `/etc/update` is a standard part of the HP-UX operating system and is available to internal and external customers. CHAMP is flexible enough to load software in other formats, such as tar and cpio.)
- Load software in sequence (This means that if application 1 must be loaded before application 2, CHAMP can accommodate this sequence.)
- Generate customized recovery instructions for each system. (These instructions outline exactly how the system was created in manufacturing so that the customer can recreate the original system in the event of a disk failure. These instructions are online in a file, and a hard-copy version is added to the shipping boxes at the final stage of the manufacturing process.)

Other Uses for CHAMP

It became evident that CHAMP had potential uses outside of HP’s manufacturing process. For instance, resellers could be more effective in delivering HP Instant Ignition systems if they had access to CHAMP and if CHAMP was easy to use and maintain.

While flexibility is one of the outstanding features of the CHAMP tool, flexibility does not always equate to ease of use. To enhance usability, a graphical user interface was layered onto the basic CHAMP tool. With this interface, CHAMP is very easy for the nonexpert, such as a reseller, to use to build preloaded systems quickly.

CHAMP is also used by operating system and application developers internal to HP. These developers can use CHAMP to build a test system for their development. It takes about 30 minutes to create a new HP-UX system using CHAMP. This is considerably faster than using CD-ROM media to build a new system. All HP teams that develop pieces of the HP-UX operating systems and preloaded applications are required to test their software on the base system built by CHAMP.

Conclusion

Customer acceptance and popularity of the HP Instant Ignition program continues to grow. Customers like to receive their systems with preloaded software. Today the HP Instant Ignition program is limited to preloading HP applications because of internal issues related to selling and preloading third-party software.

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† Currently HP 9000 Series 700 and 800 machines.

<u>HP-UX Start-up In Process</u>	<u>Status</u>
Initializing System	[OK]
Starting Networking	[OK]
Starting Diskless Cluster Client	[OK]
Starting System Functions	[OK]
Starting Auditing	[OK]
Starting Diagnostics	[OK]

(a)

<u>HP-UX Start-up In Process</u>	<u>Status</u>
Initializing System	[OK]
Starting Networking	[FAIL]*
Starting Diskless Cluster Client	[OK]
Starting System Functions	[OK]
Starting Auditing	[OK]
Starting Diagnostics	[OK]

NOTE: An error has occurred!
Refer to the file `/usr/adm/rc.log` for more information.
Press [Return] to continue...

(b)

Fig. 1. An HP Instant Ignition boot checklist. (a) When things are OK. (b) When things are not OK.

Diagnosing and Reporting Problems in the Multimedia Environment

The need for installation and configuration diagnostics for user interface software became apparent soon after the release of HP VUE 2.0. Because of the large number of files associated with HP VUE and the dissemination of those files across the file system, response center† engineers were spending a lot of time telling customers about which files to check for known problems. An analysis of call-in data from the Atlanta response center revealed that the amount of time spent each quarter handling HP VUE configuration questions was rising rapidly.

As a result of this feedback, the technical training and support group in Corvallis decided that a script or program could more efficiently wander the highways of the file system and check on the existence, permissions, and ownership of most of the files that HP VUE depended on. Key files, such as `/usr/adm/inetd.sec`, `/etc/inittab`, and others could be searched with standard tools to determine if the attributes required for certain entries were proper. The use of a script could reduce the amount of time required to check basic configuration issues from hours or days to a matter of a minutes. Thus, `Dr_VUE` (diagnose and report Visual User Environment problems) was born.

`Dr_MPower` is a direct outgrowth of `Dr_VUE`. `Dr_MPower` consists of a collection of diagnostic tools used to help debug installation and configuration problems in the HP MPower environment. Since HP MPower combines several disparate applications, we decided to create a separate script to check each individual component. This resulted in a total of 12 scripts: one each for 10 components of HP MPower, a file that contains common functions used by each of the scripts, and a calling script. The calling script is `Dr_mpower`, which does some checking of system functions and then calls each of the remaining scripts in turn. Since HP MPower makes heavy use of the HP VUE environment, an action was defined to initiate `Dr_MPower`. This action is located in one of the toolboxes available to all users. A simple double-click on the `Dr_MPower` icon results in a new terminal window that displays the information output by `Dr_MPower`. Each of the scripts called by `Dr_MPower` can also be run individually to perform checking on the separate components of the HP MPower environment.

A myriad of configuration issues exist in the HP MPower environment. `Dr_MPower` certainly does not check each and every possible one, but rather looks at what we hope to be the vast majority of them. Since the MPower environment consists of servers, maxclients (clients running HP VUE locally), minclients (clients running HP VUE on the server), and X terminals, the first thing that `Dr_MPower` needs to determine is the type of system it is running on. When this has been accomplished, `Dr_MPower` will check items specific to that environment. For example, there are differences between the client and the server in recommended kernel parameters, as well as certain processes that run on the server and not on the client. Another difference is the fact that the minclient does not run HP VUE

† HP has several locations worldwide that are responsible for handling software or hardware problems from customers who have purchased response-line support contracts. These locations are called response centers.

locally, so the `check_vue` script that is called by `Dr_MPower` should not be run for that platform.

The installation and configuration of HP MPower makes heavy use of scripts, and since scripts fail occasionally, `Dr_MPower` attempts to verify that all the actions performed in the various configuration scripts have been accomplished. An example is checking in the file `/etc/netnfsrc` to see if the parameters `NFS_CLIENT`, `NFS_SERVER`, and `START_MOUNTD` were successfully set to one by the configuration scripts. Another example is checking to see that a line was added in `/etc/rc` to start the font server and that the font server is currently running. Fig. 1 is a graphical representation of the components checked by `Dr_MPower`.

Anytime `Dr_MPower` encounters something that appears to be in error, a message is written that attempts to inform the user as to the severity of the problem with either `INFO`, `WARNING`, or `ERROR` statements (similar to the feedback seen in an update log). If possible, an appropriate course of action is also given. For example, a check is made of the `/etc/src.sh` file to determine if the configuration script added two entries specifying the HP MPower and HP VUE servers. The following code performs this check and issues a `WARNING` statement if the installation script did not add the entries in the `/etc/src.sh` file:

```
## look in /etc/src.sh to see if VUE_SERVER and MPOWER_SERVER were
## added

count=$(grep -e VUE_SERVER -e MPOWER_SERVER /etc/src.sh | wc -l)

[ $count -eq 2 ] ||

print "WARNING:The MPower installation script should have added
two entries to /etc/src.sh:
VUE_SERVER=$hostname; export VUE_SERVER
MPOWER_SERVER=$hostname; export MPOWER_SERVER

This does not appear to be the case. You should rerun the
/usr/MPowerServer/setup_server script or add these
lines yourself."
```

This code performs the check and provides the user with two options to correct the perceived problem: either manually add the entries or rerun the configuration script that should have made the additions.

There are over 4000 lines of code in the various scripts that make up `Dr_MPower`. Considering the positive feedback we have received from support partners concerning `Dr_VUE`, we are confident that the `Dr_MPower` scripts will significantly reduce the time spent supporting customers with HP MPower problems.

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- Geographically separated teams. The HP MPower project team included members from Oregon, Massachusetts, California, Colorado, and Canada. Keeping the lines of communication open and efficient helped us understand some of the requirements of distributed work groups.
 - Integrating disparate components. Initially, team members designed their products (such as fax and whiteboard) as standalone applications. Achieving a common look and feel involved changing parts of our HP MPower subsystems such as interprocess communication mechanisms, icon visuals, online help, and dialog box behavior.
 - Incorporating a common file-typing mechanism. The HP-UX file system is designed to treat all files simply as bags of bytes. Within a graphical user environment, it is necessary to know file types to determine the appropriate actions for a given object (e.g., mail, print, edit, fax, play, and view). To preserve the file types of HP MPower media objects, we

- implemented a variety of file-typing mechanisms, ranging from appending file name suffixes to inspecting file contents.
- Living within workstation resources. OSF/Motif applications are quite large. Thus, running a variety of OSF/Motif-based applications and a myriad of server and helper processes on limited-memory systems forced us to adopt a client-server architecture.
- Large media objects. Media objects are by nature large. For example, a sound clip can cost 16K bytes per second, and each video frame can cost almost a megabyte. We use a number of compressed file formats to keep file sizes to a minimum such as the JPEG file format for video images. Fortunately, the processing power of the HP PA-RISC-based workstations makes the compression and decompression of media objects a fairly painless process.
- Configuring the distributed environment. System administration burdens can grow exponentially when services are

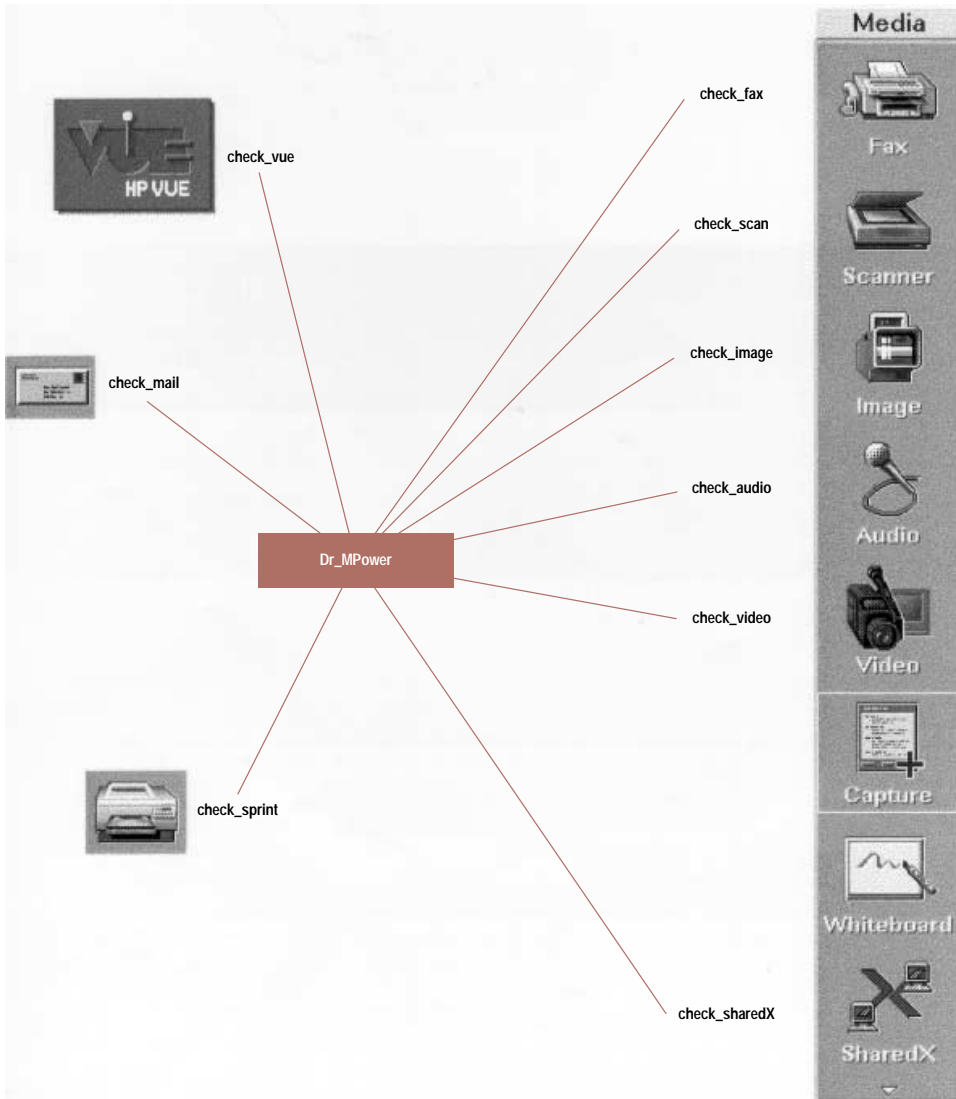


Fig. 1. The HP MPower components checked by Dr_MPower and the associated scripts responsible for making the checks.

distributed over several hosts. By offering a fairly restricted default configuration, we have reduced the headache of installing and maintaining HP MPower nodes.

- Living in the network home. Today's users are familiar with desktop computing, in which most of their applications and data reside on their local machine. When their environment is distributed across multiple hosts, users can become disoriented in the network environment. We have tried to make file access as transparent as possible and to invoke applications on the expected host.

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HP-UX is based on and is compatible with UNIX System Laboratories' UNIX* operating system. It also complies with X/Open's* XPG3, POSIX 1003.1 and SVID2 interface specifications.

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