OPEN ARCHITECTURE SYSTEM FOR REAL TIME TELEMETRY DATA PROCESSING

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ABSTRACT

There have been many recent technological advances in small computers, graphics stations, and system networks. This has made it possible to build highly advanced distributed processing systems for telemetry data acquisition and processing. Presently there is a plethora of vendors marketing powerful new network workstation hardware and software products. Computer vendors are rapidly developing new products as new technology continues to emerge. It is becoming difficult to procure and install a new computer system before it has been made obsolete by a competitor or even the same vendor. If one purchases the best hardware and software products individually, the system can end up being composed of incompatible components from different vendors that do not operate as one integrated homogeneous system. If one uses only hardware and software from one vendor in order to simplify system integration, the system will be limited to only those products that the vendor chooses to develop.

To truly take advantage of the rapidly advancing computer technology, today's telemetry systems should be designed for an open systems environment. This paper defines an optimum open architecture system designed around industry wide standards for both hardware and software. This will allow for different vendor's computers to operate in the same distributed networked system, and will allow software to be portable to the various computers and workstations in the system while maintaining the same user interface. The open architecture system allows for new products to be added as they become available to increase system performance and capability in a truly heterogeneous system environment.

SYSTEM DESCRIPTION

The optimum Open Architecture System for telemetry (see Figure 1-1) supports workstations and servers from different vendors in an integrated homogeneous system environment. System software can execute on any workstation or server in the system with the same look and feel. Different software packages execute on different workstations while maintaining a consistent man-machine interface.

Data acquisition is performed by the Telemetry Front End equipment which synchronizes, decommutates, and processes raw telemetry data for storage to disk or digital tape. In an open system the data is stored in either the Telemetry Front End or on a server. The stored data is available to all workstations regardless of the file and number storage format.

Realtime display can be performed from any workstation utilizing the same display software. The displays have the same look and user interface regardless of the workstation vendor.

Playback and analysis display software accesses the stored data files as if the data was stored on the local workstation. For example, a particular system stores data on a DEC server in DEC file and number format. A Sun workstation on the system can access the stored data files as if they were stored in Sun file and number format. The system automatically translates the files and data between workstations whenever a data file is accessed.

Each workstation in the system is capable of performing setup and control. While the system maintains a central setup database for control and configuration management, a user can control system operation from any node in the network.

The Open Architecture System can accommodate new hardware and software products as they become available. This capability eliminates the need to redesign the entire system or rewrite all of the existing software each time the system is to be modified.

To achieve a truly open system, all of the system hardware and software is designed around industry standards. While the hardware and software packages may be different, the interfaces between them are consistent with widely accepted industry standards. In the optimum Open Architecture System there are four critical areas of system compatibility:

- Operating Systems
- Network Communications
- Network Database Setup
- Distributed Network Graphics

OPERATING SYSTEMS

In the optimum Open Architecture System, software is source code compatible across vendor hardware platforms. Therefore, the operating systems on workstations must be compatible. The only operating system on the market which is supported by most major vendors is UNIX. However, each vendor has its own variation. In order to achieve some compatibility between systems, two major consortiums of companies have been formed to establish UNIX standards (see Figure 1-2). UNIX International is recommending AT&T's System V Release 4 as the standard for UNIX operating systems. The Open Software Foundation has been working on OSF-1 as a standard for UNIX. What both consortiums agree on is that a common operating system should conform to IEEE's Portable Operating System for Information Exchange (POSIX) standard. This includes IEEE 1003.1 System Services, 1003.2 Shell Scripts, and 1003.4 Realtime Draft.

Therefore, the Open Architecture System is designed to conform to the POSIX standard. DEC has even announced that VMS is going to be POSIX compliant, making it possible to have workstations running VMS and UNIX in the same system. It is not always possible to write software without using some vendor specific extensions of UNIX. When this needs to be done, then the code is clearly identified and isolated so that it can be easily modified to run on other vendor's systems.

The operating system must support popular ANSI programming languages such as C and FORTRAN. In addition the system provides ADA support, since this is becoming a government requirement for new programs. The system software also supports bindings to ADA software since government software may require interfacing with Open Architecture System software packages.

NETWORK COMMUNICATIONS

All of the workstations, the server, and the Telemetry Front End equipment communicate over a common network in the Open Architecture System (See Figure 1-3). Currently the only network which is supported by all major vendors is Ethernet IEEE 802.2. In the future the system will use the new fiber optic FDDI network. Whereas Ethernet operates at 10 Mbits/second, the new fiber optic network will operate at 100 Mbits/second.

The Open System packet protocol is the Transmission Control Protocol / Internet Protocol (TCP/IP). TCP/IP is supported by all major workstation vendors and network software systems. TCP/IP supports all system network functions except for data broadcast. In this case the system uses the User Datagram Protocol (UDP). In the future, the Open Architecture System will use the Government Open System Interconnect Protocol (GOSIP) when it becomes more commonly supported.

In order to translate file and number formats between different vendor's workstations and servers, the Open Architecture System uses the Network File System (NFS). NFS allows all files in the system to be available to any workstation regardless of where the file is actually stored. In addition to translating the file formats from one workstation to another, the Open Architecture System supports system application code for further translation. This is where the system performs number format translation on the actual data stored in a file.

NETWORK DATABASE

In the optimum Open Architecture System all setup, processing, and display information is stored in a commercially available relational database (Figure 1-4). The system supports databases from multiple vendors such as Ingres, Oracle, and DEC's Rdb. This allows the system to use a database which is in common with existing systems. The system user can also use the same database to support mission specific processing routines.

For portability, all software which accesses the database uses ANSI Standard Query Language (SQL) for reading and writing database information. The database records are never accessed directly. This allows the database to be changed without rewriting all of the software, since the SQL calls remain the same. Most commercial databases support SQL as well as providing powerful SQL extension instructions. The Open Architecture System minimizes the use of extensions. Whenever a non-SQL instruction is used by a software routine accessing the database, the instruction is clearly identified and isolated. When the database is changed, the instruction is replaced by an equivalent instruction in the new database.

In an open system, a user can access the database for any workstation in the system. To support this the Open Architecture System provides network communications interfaces for accessing the database over the system network. This allows software such as display packages to access information from the database using embedded SQL calls in the code. The software may execute on any workstation but will still access the correct database stored on the server.

If the Open Architecture can not use the same database as the existing telemetry system, then the information will have to be copied. Most commercial databases offer gateway routines for copying data between different vendors databases. If a gateway is not available, the user can easily write a copy routine using SQL instructions for accessing the Open Architecture System's database.

In order to provide a consistent man-machine interface for setup across all workstations, the database setup menus are implemented separately from the database. The setup menus provide a standard windows based user interface. While the database itself may be changed, the user setup menus will remain the same.

NETWORK GRAPHICS

Users will interface with the optimum Open Architecture System through its OSF/Motif graphical user interface based on Version 11 of the X Window System (see Figure 1-5). Its familiar Microsoft Windows / Macintosh style appearance and behavior make it easy to learn and use with the advanced telemetry applications. Using a mouse or keystrokes, the user points and clicks on icons, pull-down menus, and control buttons to operate the entire system and its applications.

The Graphical User Interface (GUI) allows the telemetry user to view and run multiple applications in separate windows at the same time. Because of the networked client-server capabilities of the X Window System, programs can run locally or on remote servers with complete transparency to the program.

The Open Architecture System's Graphical User Interface consists of the Motif window manager, X Window System, menu manager, and numerous graphical applications. The graphical applications support functions such as telemetry front end setup, data acquisition, realtime display, playback display, and system administrative functions.

A complete set of user tools are provided with optimum Open Architecture System which supply industry standard services for supporting future needs without requiring the architecture of the system to be modified.

Application Programming Interfaces (API) are provided for:

- Networking
- X Window utility features
- Display hardcopy
- Data file manipulation and analysis

- Database access utilities for stream and parameter information
- Realtime calculations
- Data display primitives

SUMMARY

The optimum Open Architecture System as defined here, is truly a homogeneous system based on widely supported industry standards. The system software can execute on a variety of workstations and servers which support the POSIX operating system standard. Workstations from different vendors communicate across a commonly supported network based on Ethernet, TCP/IP, and the Network File System. The system can be setup and controlled from any workstation using a commercial SQL relational database. Network graphics support is provided by the X-11 Graphical User Interface. The Open Architecture System provides a common user interface for setup and display based on the Motif user interface style guide. The system is designed around industry accepted standards instead of specific vendor products. This allows the Open Architecture System to take advantage of the best hardware and software products available today and in the future.

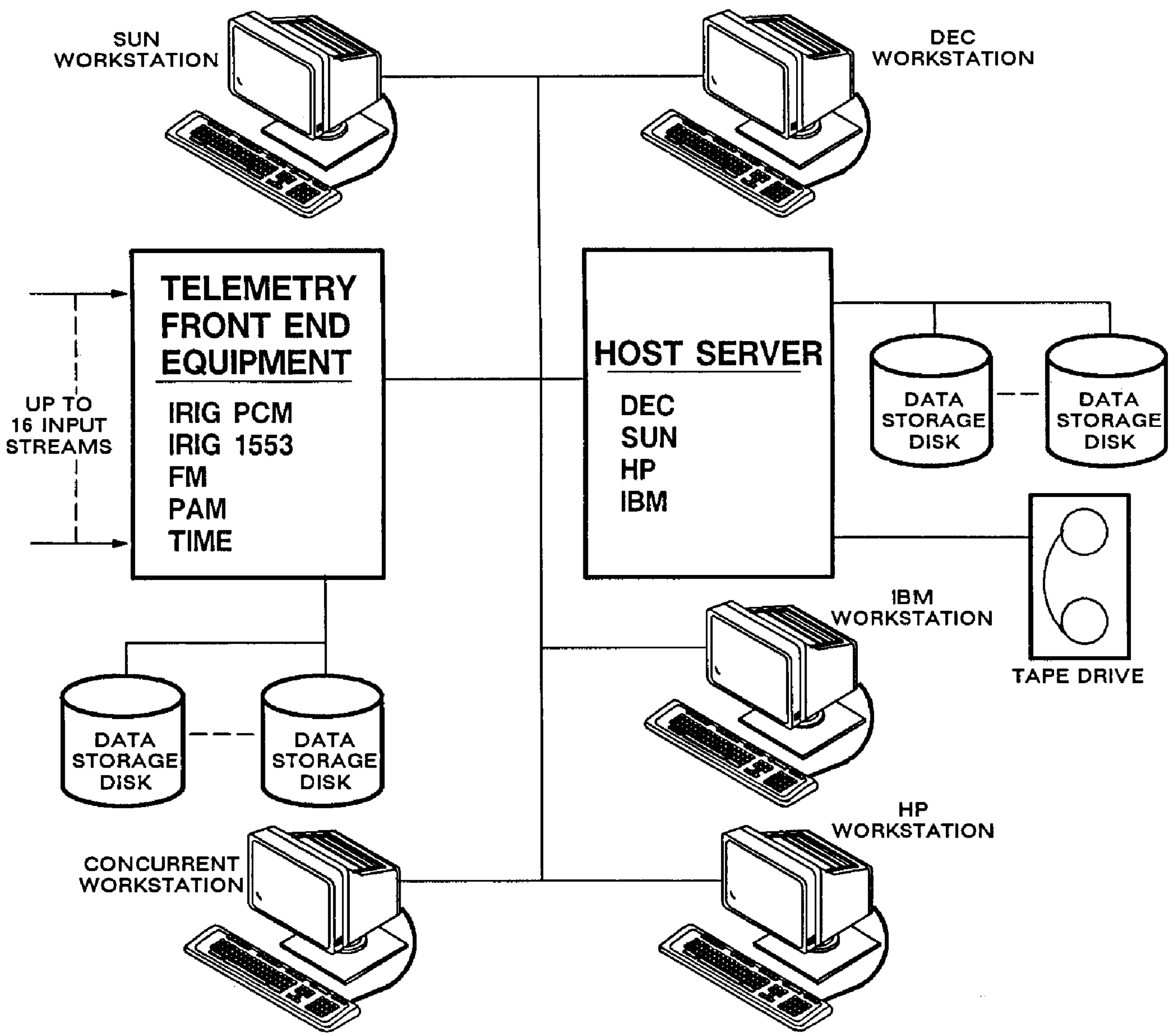


Figure 1–1. Open Architecture System

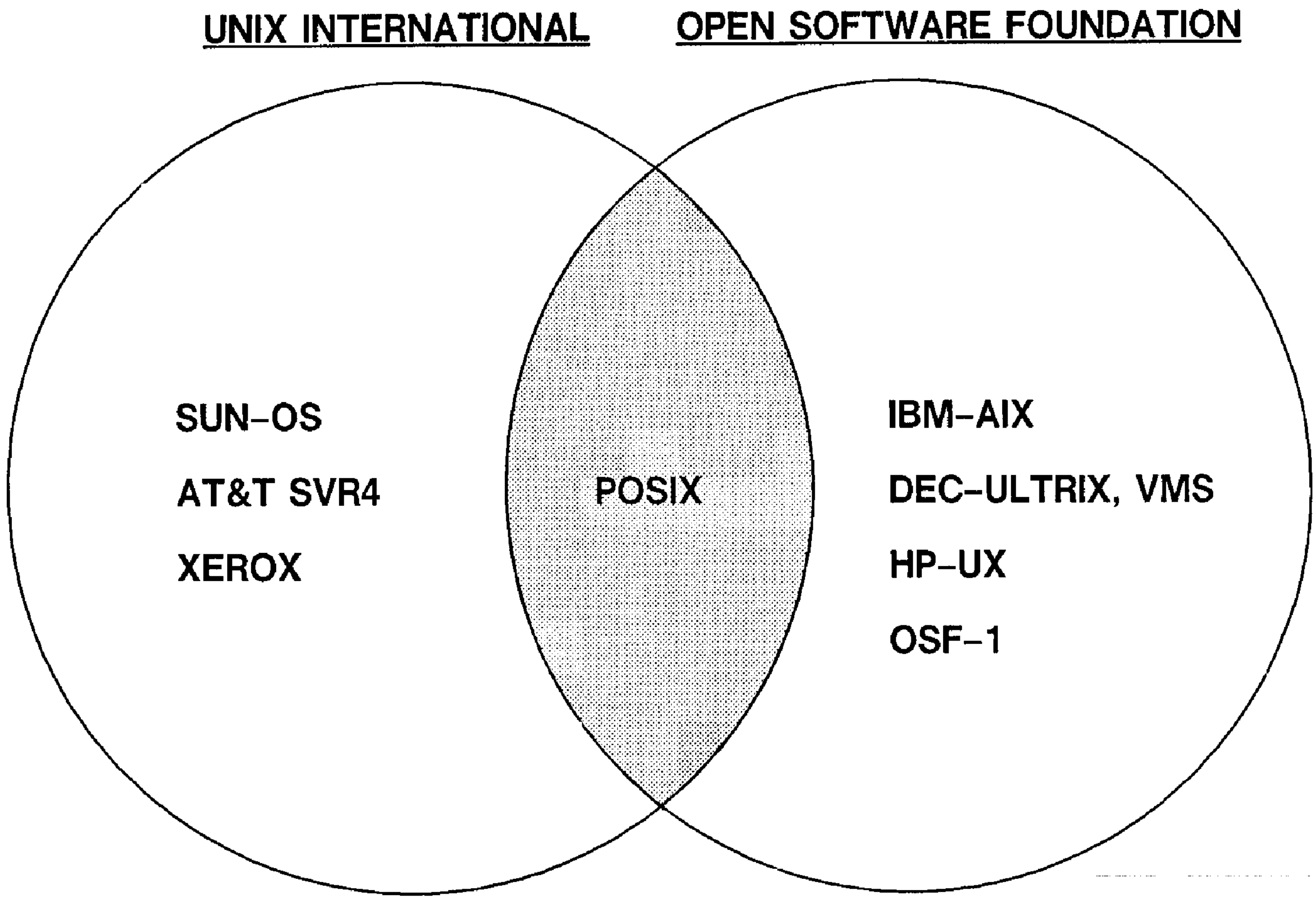
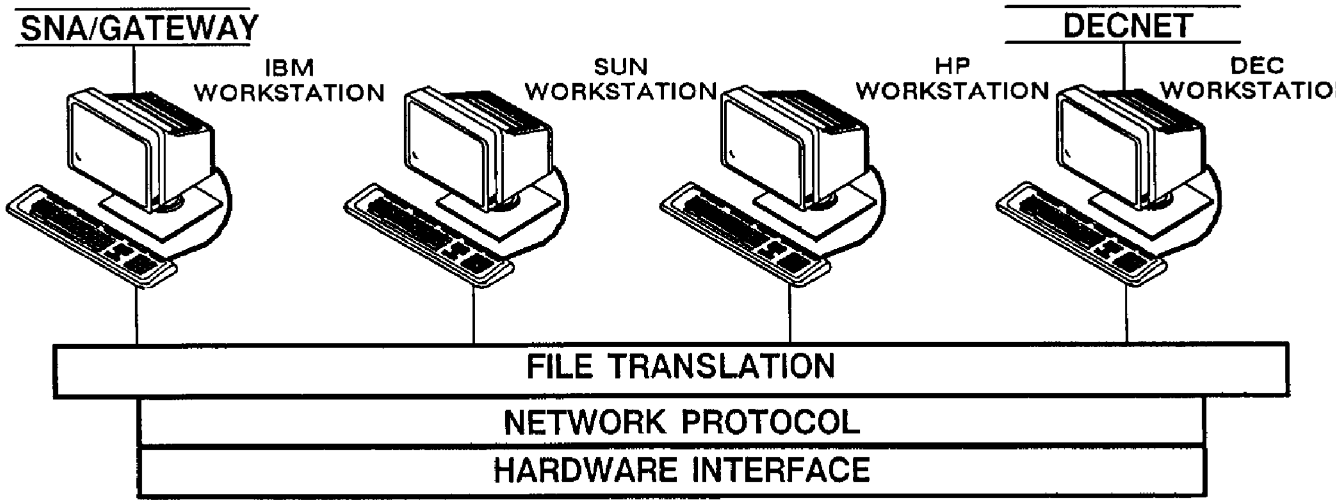


Figure 1-2. Operating Systems



CURRENT		FUTURE
NFS	TRANSLATES FILE FORMATS BETWEEN DIFFERENT TYPES OF COMPUTERS	NFS
TCP/IP	I/O PACKET PROTOCOL USED TO TRANSFER DATA OVER NETWORK	OSI
ETHERNET	SERIAL HARDWARE INTERFACE	FDDI

Figure 1–3. Network Communications

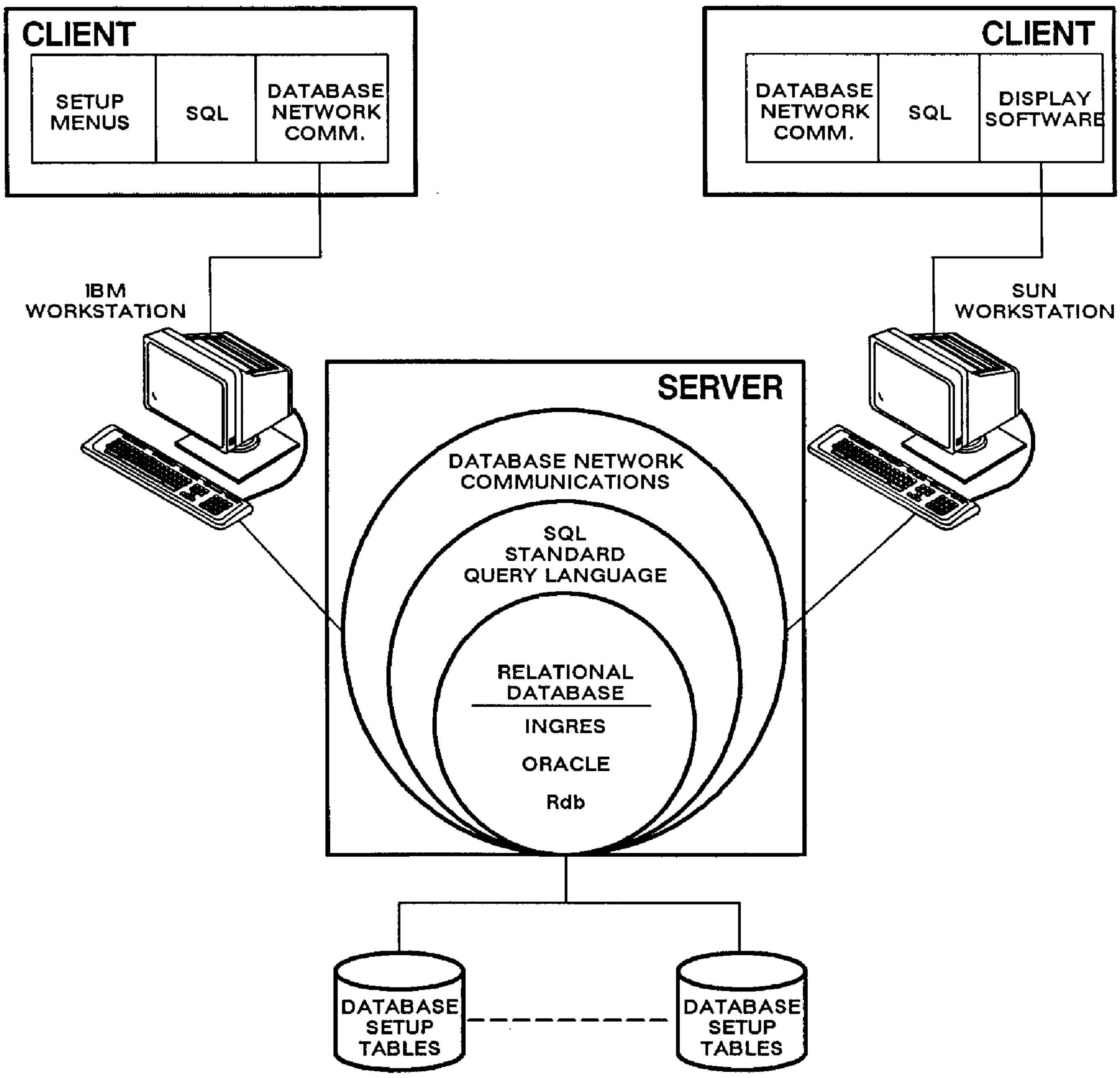


Figure 1–4. Network Database

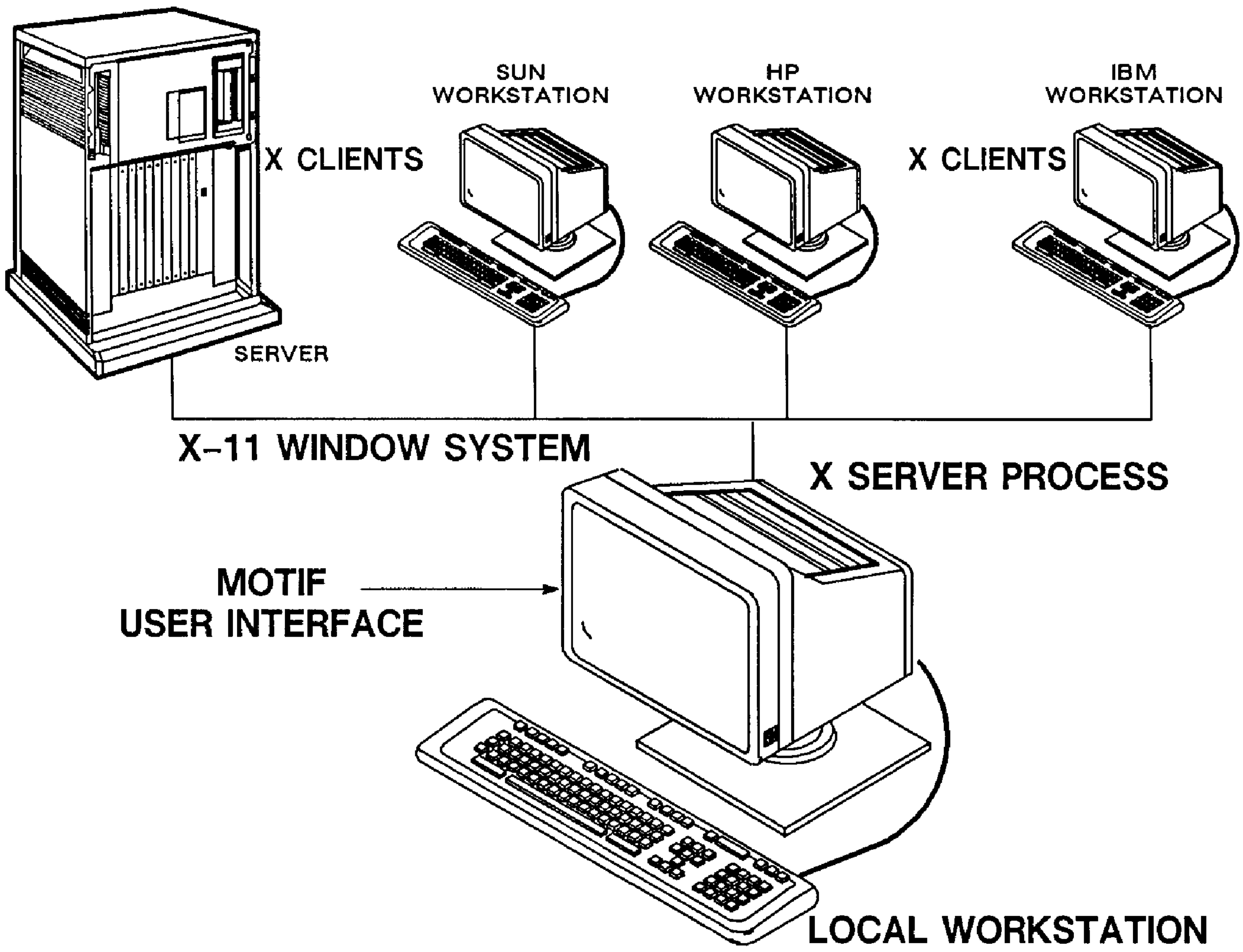


Figure 1–5. Network Graphics