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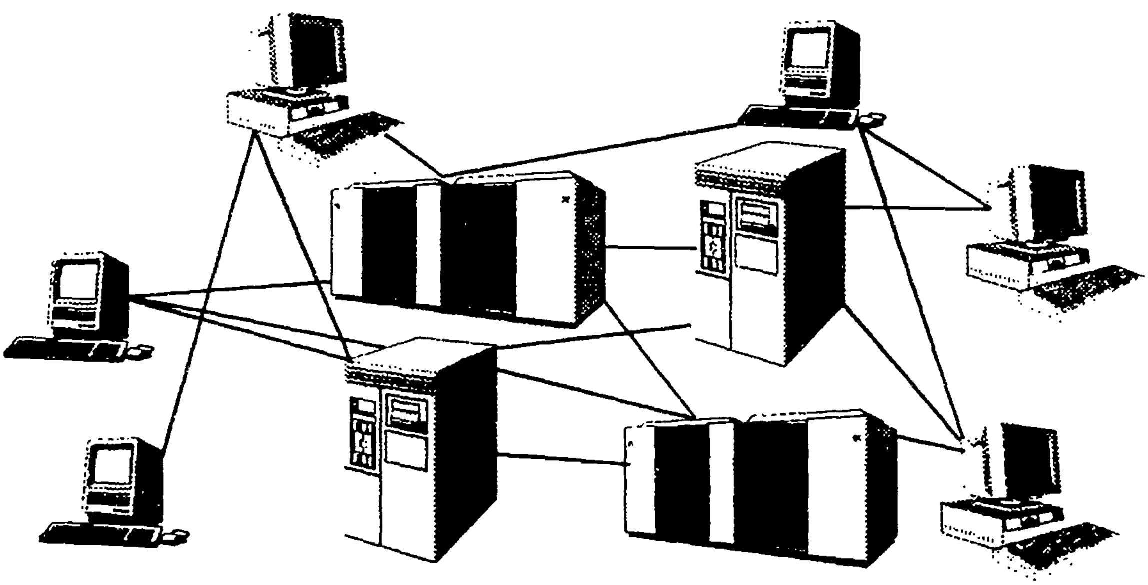
ABSTRACT

The topic of open systems as it relates to the needs of libraries to establish interoperability between dissimilar computer systems can be clarified by an understanding of the background and evolution of the issue. The International Standards Organization developed a model to link dissimilar computers, and this model has evolved into consensus standards. The American library community has also developed a standard for interoperability, referred to as Z39.50. An operating system called Unix, developed by AT&T, is often specified as the system that can handle future software. Although there are benefits to the standard Unix, it is less efficient than some proprietary systems, and it lacks networking standards. Today computer manufacturers are beginning to make sure that their operating systems will comply with the new Portable Operating System Information Exchange (POSIX), a new standard developed by the U.S. government. Although librarians have already established a standard for interoperability, care must be taken to insure that vendors comply with the standard. It is concluded that the library's focus should be on linking systems without becoming too concerned about the operating system that a particular system uses. A list of CISC- and RISC-based hardware and compatible operating system software is appended, and a glossary is provided. (KRN)

Opening Up "Open Systems"

Moving toward True Interoperability among Library Software



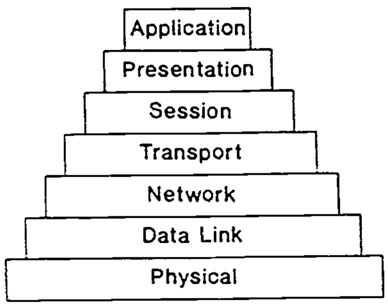
DATA RESEARCH
AUTOMATION GUIDE SERIES

OPENING UP "OPEN SYSTEMS"

The topic of "open systems," popular in the computer press, is beginning to appear in various other industry publications, including library journals. Yet despite the importance of the underlying concepts, the terms "open systems" and "standards" have become perhaps the most overworked and meaningless words in the computer and library industry.

The Genesis of Open Systems

The original concept of open systems evolved out of the International Standardization Organization's (ISO) efforts to develop a model to link disparate or dissimilar computers together. This resulted in the ISO/OSI (Open Systems Interconnect) seven-layer model in which the responsibilities and activities that occur at each layer of the model are carefully defined. The development and definition of each of these layers has occurred over the past ten years and have now become consensus standards.



OSI Layers

Role of the ISO Model

The foundation of the ISO seven-layer model is that communication between dissimilar computers should and would take place if a model defined the responsibilities of the communication process. The lower and middle layers (layers 1-6) of the model deal with the actual movement of the messages between computer systems.

The Application Layer

The top-most layer is called the Application Layer. This layer builds upon the lower six levels and allows a user on one computer to talk to and interact with application software on another make and model of computer. In fact, this second computer most likely has a different operating system.

The important thing about this "interaction" is that even though the user is connected to another computer system, the screens and the system interaction are identical to their own computer system. It should be noted that for many years it has been possible with most computers to connect to another system. However, the user has been required to learn the second computer's commands and to become familiar with screens that are different from what the user has become accustomed to.

The development of the Application Layer eliminates the need to learn all new commands and screens. In the library environment, as with all other industries, this development is the responsibility of the automated system provider –– either the vendor, or the library itself if it is developing its own system.

Z39.50: A Library–Developed Standard for Open Systems

The American library community has adopted a standard called Z39.50 (Information Retrieval Service Definition and Protocol Specifications for Library Applications) to allow one computer operating in the client mode to perform information retrieval inquiries against another computer acting as an information server.

Connecting Libraries

The standards approach means that libraries will be able to connect to nearby or distant libraries in order to share information and ultimately resources –– provided that their system provider has developed and tested the Z39.50 client/server software. For software developers, the standards approach means that software can be developed which will change slowly and only after a thorough review of all of the issues.

Without Z39.50 software, the library is forced to learn the ways in which the user of another computer system actually uses that system: different command language, different menu choices, and different displays. When confronted with the prospect of having to learn a number of different systems, most users will simply give up.

Machine Independence vs. Transparent User Interface

Often when the term "open system" is used, one of two issues is usually being addressed. Often these two issues are used interchangeably. Specifically, these issues are:

- Machine Independence
- Transparent User Interface

Machine Independence

In order to protect the investment in application software, especially software that has been developed in–house by an organization, the Data Processing Manager (Information Systems Manager, Computing Center Director) will establish a requirement that all future systems must use a specific operating system, typically Unix. Since many hardware vendors' machines can run using Unix, this requirement provides machine independence for any software application that can run using Unix.

Unix History

A bit of history about Unix will help the reader overcome some of the emotional rhetoric that often accompanies this topic. Unix was developed by AT&T Bell Labs in the early 1970s as a powerful, yet flexible, operating system. The power and flexibility are illustrated by the fact that a knowledgeable programmer can modify Unix directly to solve a particular problem or connect a new peripheral device to the system.

As Unix spread, it developed a following. (Some would even say that in the early years, Unix had a religious cult-like following complete with evangelists, missionaries and zealots). Various versions of Unix became popular, especially as the hardware manufacturers added "features" to Unix. The implication of this multiplicity of Unix versions is that an application that runs on one version of Unix would not run on another version of Unix without modification of the application programs. (See Appendix A for a list of the Unix variants and other operating systems used by various hardware platforms.)

The Open Software Foundation

Based in part on the requirement of customers for a truly "standard and transportable" version of Unix and the fact that Unix is owned by AT&T, a group of computer manufacturers -- IBM, DEC, Hewlett Packard and others -- formed an association called the Open Software Foundation (OSF) to develop a family of software products that would be truly "open". This "openness" of these software products would transcend the use of Unix.

The Unix International Consortium

Responding to this competitive initiative, AT&T and Sun (and a few others) announced the formation of Unix International (UI), the goal of which was to make Unix truly "open." The UI version of Unix is available.

While there was a brief spurt of activity that would have merged the two competing products (OSF and UI), this effort to have one "open" operating system came to naught.

So what's going on here? In a word: politics. Computer makers are trying to bend the movement towards standards and "open systems" to their advantage.

Benefits of a Standard Unix

Once the OSF and UI versions of Unix become available, there will, in theory, be several benefits for users of such systems:

- A customer will be able to move more easily or to transport one or more applications from one machine to another as the price performance improves on an alternative machine.

  Note: It is not likely that the application will run without some modification since the implementation of neither OSF or UI Unix will be 100% identical.

- The presence of an "open" Unix will force the hardware manufacturers to compete more on price and less on the technical merits of their respective systems. In short, the computer box is becoming a commodity.

The Pitfalls of Unix in the Library Environment

Response Time

Libraries have expectations that circulation transactions -- checkin and checkout -- will be on average 2 seconds or less; online catalog inquiries -- author, title and subject searches -- will be on average 5 seconds, with keyword searches averaging 8 seconds or less. And these expectations hold, even in the face of extremely high transaction volumes -- annual circulation of 1,000,000+ transactions.

Efficiency

Compared to "proprietary" operating systems -- such as VMS on Digital VAX machines, MPE on HP 3000 machines, etc. -- Unix will be less efficient in a transaction environment by a factor of 30% to more than 50%. Thus, libraries using Unix to achieve the same levels of performance as their counterparts using a proprietary-based operating system will need to invest more in the computing equipment for a larger and faster computer.

CISC vs. RISC

It is true that computers using proprietary operating system use Complex Instruction Set Computer (CISC) chips that are more expensive than the Reduced Instruction Set Computer (RISC) chips that are used with Unix-based machines. But due to the need to buy a larger RISC-based computer for high-transaction applications, any cost advantage is negligible.

In addition, some libraries have expectations that they will be able to connect 300, 400, 500+ terminals to their system. Some versions of Unix limit the number of terminals or devices that can be connected to the system to 256.

Lack of Unix Networking Standards

Another difficulty lies in the lack of networking standards for Unix. Within the Unix world, networking is accomplished through the use of a set of documents called Request For Comment (RFC) which, after comments, are amended and become the "standard". Perhaps most important from the user's point of view is that there is no assured path to a remote location. Most networks employ the concept of a link in which the user is notified if a link fails or an alternative path is not found.

For example, many users of the Internet -- a Unix and TCP/IP-based network -- have had messages simply disappear into the ether. It is for these reasons that proven, secure networking products like DECnet have many advantages over Unix solutions.

Vendors moving to provide Unix have discovered that some of the tools and utilities provided by Unix are either lacking or primitive. Thus they have written their own software to provide these tools. Unfortunately, it has turned out that these tools work differently in different versions of Unix.

Beyond Unix: A Consensus Standard (POSIX) for an "Open" Operating System

While the above discussion on Unix is interesting and informative, it must be stated that the mere presence of machine independence does not really provide an "open" system. This reality was recognized by the United States Federal Government when it established a new standard for operating systems: the Portable Operating System Information Exchange (POSIX, ISO Operating System Standard 945). The net effect of POSIX is that computer manufacturers are beginning to make sure that their operating systems, whether proprietary or Unix, are becoming POSIX-compliant. This will make the objective of "open systems" independent of any operating system.

In fact, some vendors, including Digital Equipment Corporation, have already made their existing proprietary operating systems (in Digital's case, VMS) compliant with level 1 of POSIX. All operating systems will continue to have enhancements made to them, both to ensure compliance with various standards and to improve the performance of the operating system. Thus, the issue of operating systems becomes less of an issue in the "open systems" debate.

Defining "Open Systems"

This paper has thus far stated what an open system isn't. It now seems proper to define what an open system is.

A good starting point is the definition developed by the Institute of Electrical and Electronics Engineers (IEEE). IEEE defines openness in terms of software applications rather than on specific hardware or operating system capabilities. Open systems should be based on open specifications for interfaces, services and supporting formats and be developed and maintained by public consensus and be consistent with international standards.

The IEEE Definition

According to the IEEE, an open system allows software:

- to be ported with minimal changes across a wide variety of systems
- to interoperate with other applications on local and remote systems
- to interact with users in a style that facilitaties user portability.

That second point is key to library applications. It addresses what the librarian is primarily interested in -- being able to see what other libraries have, regardless of their automated system. As we noted earlier, such interoperability entails not just connecting to a remote system, but also being able to retrieve information and view it using commands and screens used by a local system.

So in terms of the library environment, an open system:

- is vendor neutral
- complies with international information technology standards
- permits software application portability
- permits system and network interoperability using commands and screens already familiar to the user.

The means to this interoperability is called a Transparent User Interface.

Transparent User Interface: The Fundamental Tool for Open Library Systems

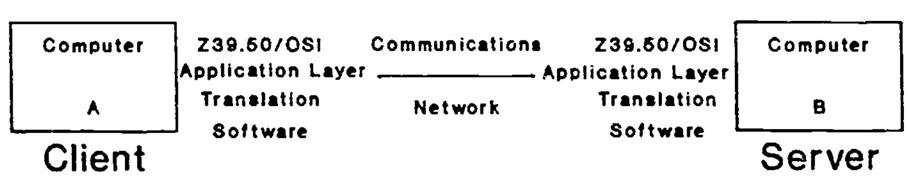
A "transparent user interface" is the connection that allows the user of one type of library automation system -- for example, a Data Research system -- to view the collection of a library with a different system -- for example, a NOTIS or VTLS system -- without having to learn the screen layout and command syntax of the second system. It is "transparent" because the user never knows that the remote system is another type of system with different commands and screens. In short, the transparent user interface makes the second system look as if it were identical to the system that the library staff member/patron normally uses.

Mapping vs. Standards

In order to accomplish this "transparent user interface" both systems will need to have developed some special software to convert the commands normally used by one system into the syntax used by the second system. This could be done on an ad hoc case-by-case basis (sometimes called mapping), or within the context of national or international standards.

Z39.50

As we have already noted, such a standard -- Z39.50 -- already exists. On an international basis, Z39.50 is completely compatible with the corresponding International Standardization Organization (ISO) 10162/10163 standard.



It is important to note that both computer systems need to have Z39.50 software in order to facilitate the linking and networking of computer systems. Both machines will need to have client and server software to make the user interface "transparent" to users of both systems.

The Client/Server Model

The "client" software initiates the connection with the other machine and then forwards the user's search request to the destination or "server" computer. The "server" software processes the search request and then formats the response in a prescribed manner to send it back to the "client" computer system.

Levels of Compliance

An important consumer protection note: Since there are different levels of compliance within the Z39.50 standard, a vendor can be Z39.50–compliant, yet customer libraries of that vendor are ONLY able to "talk" to other customer libraries of that vendor. It is critical to demand that your vendor develop Z39.50 client and server compliance that allows you to communicate with ALL other Z39.50–compliant systems and databases.

Verifying Compliance

Another important concept centers on the issue of verifying compliance with a standard search as Z39.50. What organization will verify and certify compliance? Even with Z39.50 software, it is easy to forsee a situation with two or more vendors pointing fingers because a Z39.50 link between two or more libraries does not work.

In addition to the Z39.50 client/server software, another important ingredient for a successful "open systems" recipe is the adherence to the standards embodied in the lower 6 levels of the ISO model. Digital Equipment Corporation has made all of this software available in its DECnet networking software.

Conclusion

"Open Systems" are a desirable objective for any organization, especially libraries. Yet, to achieve true open systems, it would seem much more important to focus on the real objective, that of linking systems (and systems will almost certainly be diverse for the foreseeable future) without becoming too concerned about the operating system that a particular system uses.

Appendix A: Operating Systems

HARDWARE PLATFORM	OPERATING SYSTEM SOFTWARE
CISC-Based	
Intel 80X86	
IBM PCs and clones	MS/DOS (Microsoft)
	OS/2 (Microsoft/IBM)
	XENIX* (Santa Cruz Operations)
	AIX* (IBM)
Sequent minicomputers	DYNIX* (Sequent)
Motorola 68000 Series	
Apple Macintosh	Macintosh OS/System 7 (Apple)
	AUX* (Apple)
HP Workstations	HP/UX* (Hewlett Packard)
	OSF/1*
Next Workstations	Mach* (NeXT)
Sun Workstations	Sun OS* (Sun)
Digital Equipment	
DEC VAX family	VMS
Hewlett Packard	
HP3000 computers	MPE
IBM	
IBM computers	MVS
RISC-Based	
IBM RS/6000	AIX* (IBM)
MIPS R3000 Series	
DEC Workstations	Ultrix* (DEC)
	OSF/1*
Silicon Graphics	
Pyramid minicomputers	OSx* (Pyramid)
Motorola 88000	
Data General workstations	DG/UX* (Data General)
Unisys workstations	Unix V.4* (AT&T)
Precision Architecture	
Hewlett Packard	HP/UX* (Hewlett Packard)
	OSF/1*
Sun Sparc	
Sun workstations	Sun OS*
Solbourne workstations	Sun OS*
Fujitsu workstations	Sun OS*

* = Variants of Unix
CISC = Complex instruction-set computing
RISC = Reduced instruction-set computing

GLOSSARY

ANSI	An abbreviation for American National Standards Institute.
Application Layer	The seventh and uppermost layer of the OSI Reference Model. The application layer gives the user access to a network and performs tasks and activities according to a defined protocol or standard.
Channel	The communication pathway that a transmission medium uses to pass data signals between a transmitter and a receiver.
Client	A user on a computer that initiates transactions with a remote computer, called a "Server."
Complex Instruction Set Computer	A computer processor architecture that uses a relatively complex set of instructions that can be executed by the CPU, sometimes referred to as CISC.
Data Link Layer	The OSI protocol defining basic connection information.
De facto standard	A technology that has become uniform throughout an industry through consensus and common practice, although it may not be supported by an official standards organization. Same as Industry standard.
EDI (Electronic Data Interchange	EDI is the automated exchange of structured business data between computer applications. EDI is defined in the family of X.12 standards.
Gateway	A network device that allows two networks with different protocols to communicate with each other.
Interoperability	The ability to exchange information among computer networking systems produced by the same vendor or by multiple vendors.
IEEE	An abbreviation for the Institute of Electrical and Electronic Engineers.
ISO	An abbreviation for International Standardization Organization.
LAN	An abbreviation for Local Area Network.
Link	The connecting line over which data is transmitted between two nodes in a computer network.
Network Layer	The OSI protocol defining WAN routing, connection of LANs, etc.
NISO	An abbreviation for the National Information Standards Organization.
Node	A computer system or server that can communicate with other computer systems or servers in a network.

OSF	An abbreviation for Open Systems Foundation. An organization to develop multi-vendor software standards and products, especially Unix-based software.
OSI	Open Systems Interconnect, an international standard for a layered networking architecture published by the International Standardization Organization (ISO).
POSIX	An abbreviation for Portable Operating System Information Exchange. A set of standards developed and published by IEEE for operating systems and applications portability.
Physical Layer	The OSI protocol defining wire and pin connections
Presentation Layer	The OSI protocol defining transformation of data, e.g., ASCII and EBCDIC
Protocol	A set of rules.
Reduced Instruction Set Computer	RISC is a processor architecture based on fast execution of a relatively small number of simple, low-level instructions.
Server	A computer system that responds to inquiries from a "Client" computer system.
Session Layer	The OSI protocol defining transfer of data between applications.
Standard	A commonly agreed-upon, published specification for communications or systems hardware, software, or interface.
TCP/IP	An abbreviation for Transmission Control Protocol/Interconnect Protocol. TCP/IP refers to a set of protocols for networks with Unix-based operating systems, and also a network that implements the TCP/IP protocols.
Transport Layer	The OSI protocol defining transfer of data between systems.
Unix	A computer operating system developed by AT&T.
WAN	An abbreivation for Wide Area Network.
Z39.50	The NISO Information Retrieval Service Definition and Protocol Specifications for Library Applications. Compatible with the ISO 10162/10163 standard.

NOTES

The Guide Series is designed to provide concise, practical and relevant information about a variety of topics related to automated library systems. Topics to be addressed in this series include:

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1 Opening Up "Open Systems" Guide
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12 Guide to Local Area Networks
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14 Mobile Library Automation Guide
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