Chapter 4

FUNCTIONAL AND TECHNICAL COMPARISONS

General system design

Each system available today shares many similarities in the basic computer design principles. All the systems characterize themselves as having a multitier client-server architecture.

This general approach involves separating the different aspects of the application into distinct logical layers. This design approach provides more flexibility in addressing each of the individual layers, and it allows the system to be distributed among multiple physical devices as necessary to allow it to scale to large proportions. Figure 3 illustrates a generic library automation system in a multitier client-server design.

Though many different variations exist, the basic components of a multitier client-server environment would include many layers:

- A data layer, consisting of the database and the routines that related to data management and indexing
- The application logic layer that includes all the programs that implement the features, functions and transactions that define the functionality of the system
- The presentation logic that includes the various clients that access the system

Figure 3. General system architecture.

System	Characteristics
Aleph 500	Multitier client-server design
Horizon	Multitier client-server design; Web-based PAC
Library.Solution	Multitier client-server design
Millennium	Multitier client-server design
Polaris	Multitier client-server design
Unicorn	Multitier client-server design
Virtua	Multitier client-server design
Voyager	Multitier client-server design

The programming language used to develop a system is a relatively minor consideration but is often worth noting. The language used reflects the vintage of the system. An application as complex as an ILS may consist of components built with different development tools and languages as the system evolves over time.

Figure 4. Programming languages used for server environment.

System	Programming languages used
Aleph 500	C, C++, Microfocus Cobol
Horizon	C++, Java
Library.Solution	C++, Java
Millennium	C, C++, Java
Polaris	C++, Transact SQL, ASP.NET (VB)
Unicorn	C, C++, Visual C++, Java
Virtua	C, C++
Voyager	Voyager server code written in C/C++. Voyager client code is written in C++ and Microsoft Visual Basic.

Operating systems

All the flagship library automation systems run under either some version of Unix or the Windows server environments. Large installations tend to operate under Unix and Windows servers typically support small and mid-sized implementations.

Two of the systems, Library.Solution and Polaris operate only under Windows. Many the systems use only Unix for the server, including Aleph 500, Millennium, Virtua, and Voyager.

Figure 5. Operating systems supported for server.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
IBM AIX	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Sun Solaris	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
HP-Unix	No	Yes	Yes	Yes	No	Yes	Yes	No
Linux	Yes	Planned for 2004	Yes	Yes	No	No	Yes	No
Windows Server (NT, W2K, Win2003)	No	Yes	Yes	Yes	Yes	Yes	No	Yes

The staff interfaces for the library automation systems must be compatible with the desktop operating systems used in the libraries. Today Microsoft Windows prevails as the desktop operating system for most businesses and educational organizations, though Macintosh systems continue in some niches and the use of Linux on the desktop is rising as a low-cost alternative to Microsoft Windows.

When client-server systems began to emerge in the mid-1990s, the prevailing choice for staff clients was Microsoft Windows. An attractive alternative to an

A **client** is the requesting program or user in a client/server relationship. The computer handling the request and sending back the HTML file is a **server**. (www.whatis.com)

interface written specifically in Microsoft Windows would be to develop one in Java by creating applications that operate in any hardware platform and operating system that support the Java Runtime Environment (JRE).

A **staff client** is the graphical interface that runs on a computer used by a library staff member to operate the ILS.

Through environments such as JFC/Swish (Java Foundation Classes) a developer can write programs with a graphical user interface that will operate in multiple environments. Innovative's Millennium's staff clients have been written in this environment from the beginning, and other companies have shown interest in migrating their staff clients to Java. Sirsi indicates that its Workflows staff client will have some modules available in Java as soon as 2004.

Figure 6. Operating environment supported for staff clients.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Windows	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Native Macintosh	No	No	No	No	No	No	No	No
Native Linux KDE/Gnome	Yes	No	No	No	No	No	No	No
Java	No	Planned for 2004	No	Yes	No	Planned for 2004	No	No

Database options

Integrated library systems are data-driven applications. Libraries make huge investments in the creation of their bibliographic databases, a representation of their collections. Flexible options are needed for how data flows into and out of the system.

Typical scenarios involve the need to be able to periodically load and update the database of patron records from an external student registration system, to extract sets of bibliographic records to load in other systems, and the ability to extract detailed statistical information about the use of the system.

Some libraries may have an interest in creating interactive connections between the ILS and other applications within its organization, such as an accounting system.

The way the ILS stores its data significantly affects the ways the library can use the system beyond the functionality delivered by the vendor. The trend of the last decade or more has been toward reliance on relational database management systems (RDBMS), with a preference toward specific database products that have been deployed in a broad range of businesses and other organizations.

An important characteristic of an RDBMS includes the ability to organize data in a table structure that reflects relationships among different data groups or elements, avoiding unnecessary duplication of data and support for standardized ways for accessing the data.

On a high level, a RDBMS will support the standard syntax for sending queries to the database, either through Structured Query Language (SQL) or through

standard database connectivity routines such as open database connectivity (ODBC) or Java database connectivity (JDBC).

Making use of an off-the-shelf RDBMS offers significant advantages to ILS developers. Rather than having to re-invent data access routines from scratch, they can make use of functions available through the RDBMS. Developers can then focus their efforts on other parts of the application.

Many different RDBMS implementations are available. The two most widely used RDBMS products include DB2 from IBM and products from Oracle. For the various flavors of the Microsoft Windows Server operating system, Microsoft SQL Server is a popular RDBMS platform. Other RDBMS represented among ILS products include those from Informix and Sybase.

Among library automation systems, Oracle has grown to be the preferred RDBMS. Many libraries will stipulate during the procurement process that the system must support Oracle. Especially in the academic environment, many campuses have negotiated site licenses for Oracle and use it to power many different applications. By virtue of the site license, that often-significant component of the library automation cost can be avoided.

The technical management of a RDMBS requires a significant level of expertise, usually in the form of a specialist called a database administrator, or DBA. Much of the expertise needed by the DBA is product specific. If the organization already employs a DBA experienced with Oracle products, it has significant reasons to prefer an Oracle-based ILS.

The RDBMS, as a major subsystem within the environment, requires a certain level of hardware resources to function efficiently. Although the RDBMS offers a significant level of flexibility and sophistication, it introduces a layer of overhead that must be considered when sizing the hardware for the ILS server.

Licensing costs for the RDBMS can be a significant portion of the cost of the ILS. Organizations, especially universities that have many database-driven applications, may see savings by purchasing a site license for a RDBMS rather than paying the license fees associated with all the individual applications. If the library or its parent organization owns such a site license, the RDBMS component of the ILS can be avoided.

Some systems considered here predate the prevalence of RDBMS, relying on data management programming created specifically for the application, or they make use of data management products that preceded the current slate of RDBMS products.

One database product in this category is Informix' C-ISAM, a library of C functions and a precursor to the modern relational database management systems. C-ISAM does not include SQL access natively, but tools are available that add SQL access to C-ISAM files. This database product predates the company's flagship Informix-4GL and Informix OnLine Dynamic Server.

For more information on C-ISAM, see "IBM Informix C-ISAM Version 7.x for Unix and Linux" (www-3.ibm.com/software/data/informix/pubs/whitepapers/cisam_wp.pdf).

Using this efficient Index Sequential Access Method, this database provides a fast and efficient approach for accessing data. Informix became part of IBM in April 2001 through an acquisition valued at $1 billion. IBM integrated Informix into its data management division and continues to market and support Informix database products, including C-ISAM.

All the ILS products considered in this report have either made use of an RDBMS from its original design or have been re-engineered to support one. An ongoing debate in the industry centers on whether the systems originally designed for a nonrelational database environment can be, or have been,

effectively reconstituted to offer the true benefits of a RDBMS relative to those that incorporated that design from the beginning.

Two companies offer versions that do not make use of an RDBMS, Sirsi and Innovative. Libraries that do not need the functionality of an RDBMS as described above can avoid the additional cost and technical overhead by selecting this option.

Figure 7. Database design and options.

System	Characteristics
Aleph 500	RDBMS; Oracle
Horizon	RDBMS; Sybase (originally) Microsoft SQL Server (added recently), Oracle (planned). From its inception, Horizon was designed for the Sybase RDBMS. Dynix current strategy is to allow Horizon to work with any of the major RDBMS. The current version of Horizon supports Microsoft SQL Server, with an Oracle version to be available in the near future.
Library.Solution	RDBMS; Oracle only
Millennium	Proprietary or RDBMS; Oracle. Innovative had created its own proprietary database system for Innopac. When Millennium was developed, it made use of the existing database environment. Responding to the trend away from proprietary databases and toward industry-standard relational databases, Innovative created a version of Millennium for Oracle in 1999.
Polaris	RDBMS: Microsoft SQL Server only
Unicorn	C-ISAM program libraries / RDBMS: Oracle. Microsoft SQL Server planned. Sirsi's original data architecture was based on C-ISAM. Beginning in January 1999 Sirsi has offered a version of Unicorn that uses the Oracle relational database management system instead of C-ISAM. Sirsi continues to offer both the C-ISAM and Oracle versions of Unicorn to new customers; Oracle especially tends to find favor with the large sites. Sirsi's use of Oracle is evolving from a simple port of C-ISAM files into Oracle tables, to an implementation that takes full advantages of the performance and sophistication available in Oracle.
Virtua	RDBMS; Oracle
Voyager	RDBMS; Oracle

Adherence to standards

The library community has long valued adherence to standards as a basic requirement of library automation systems. Especially in an environment where commercial companies provide the majority of software that libraries use, having data available through well-documented standards offers libraries a great deal of protection. Knowing, for example, that the library can extract all its bibliographic and holdings data in MARC-21 format offers a level of reassurance that most libraries would not live without.

Standards ensure interoperability. In today's environment of expanding information resources and increased need for resource sharing, an ILS would be severely constrained if it were not able to interact with other services and systems. Standards for protocols in several different aspects of the ILS have emerged to allow systems to communicate with one another even when they are produced by different companies and perform different functions.

The primary body in the United States for developing standards is the National Information Standards Organization (NISO). Companies have a strong interest in being represented in NISO, giving them a seat at the table where the standards are developed.

www.niso.org

As shown in the table below, all the major companies that develop multiuser ILS products are currently voting members of NISO. The activities of NISO are largely funded through the annual dues paid by each voting member.

The International Organization for Standardization (ISO) develops international standards for a broad array of industries. With ISO, NISO's Technical Committee 46/Subcommittee 4 (TC46/SC4) is the one that addresses library-related standards. Many standards developed by ISO and NISO are closely related, if not interchangeable.

www.iso.org

Two key documents a librarian might review as it selects a library automation are *Library Technology Reports,* "Model RFP for Integrated Library System Products," by Nicole Waller, July-August 2003, and *The RFP Writer's Guide to Standards for Library Systems,* by Cynthia Hodgson, published by NISO in 2002. This publication reviews each major library standard and offers sample language that can be integrated into a library's RFP for a new ILS and gives guidance on how to evaluate the vendor's response.

Library Technology Reports are available at www.techsource.ala.org

The Hodgson publication is available from the NISO website: www.niso.org/standards/resources/RFP_Writers_Guide.pdf.

Figure 8. Support for NISO.

System	NISO voting member
Dynix	Yes
Endeavor Information Systems	Yes
Ex Libris	Yes
GIS Information Systems	Yes
Innovative Interfaces	Yes
Library Corp.	Yes
Sirsi Corp.	Yes
VTLS	Yes (VTLS COO Carl Grant is chair-elect for 2003/04)

Search and retrieval lies at the heart of library automation. Having a standard protocol for sending queries and receiving results has widespread uses for libraries. Typical examples of the use of Z39.50-based searching include:

- Searching the catalog of a remote library (The searcher must have a Z39.50 client, and the catalog being searched must have a Z39.50 server.)
- Forming virtual union catalogs that allow a whole group of library systems to be searched at the same time
- Searching other information resources though the library's OPAC: local digital library collections and external article citation databases

- Metasearching environments (Z39.50 is but one of the protocols typically employed in a library portal product that provides a single user interface to search multiple information resources simultaneously.)
- Copy-cataloging utilities (A Z39.50-based cataloging system can find and retrieve MARC records from sources such as OCLC, RLIN, the Library of Congress, or from peer libraries.)

RLIN: Research Libraries Information Network

Figure 9. Support for Z39.50.

System	Z39.50 Version 3	Bath Profile
Aleph 500	Yes	
Horizon	Yes	Yes
Library.Solution	Yes	Support focused on Z39.89 U.S. National Profile
Millennium	Yes	Yes
Polaris	Yes	Yes
Unicorn	Yes	Level 1. Full Bath Profile Level-1 compliance across function areas A, B, and C is already in production on the Texas State Library and Memorial University Unicorn servers. Unicorn production servers are also fully Bath Profile Level-1 compliant with the XML and SUTRS record syntaxes. Level-1 compliance was demonstrated in December 2000.
Virtua	Yes (uses Z39.50 as internal query language)	Yes
Voyager	Yes	Planned

Figure 10. Support for Unicode.

System	Characteristics
Aleph 500	Fully Unicode compliant in all modules
Horizon	Unicode available in Cataloging. Development in process. Unicode in other parts of the system except for the SQL Database.
Library.Solution	Yes, with some limitations
Millennium	Yes, Millennium offers complete Unicode support. Able to store, display, load, export, and index diacritics and multi-language characters. Supports UTF-8 encoding for passing data between client and server and displaying characters on the client.

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Figure 10. Support for Unicode, cont.

Polaris	Yes, support for Unicode input, storage, display—complete for all MARC-defined character sets, partial for non-MARC-defined character sets
Unicorn	Planned for 2004
Virtua	Yes, used internally by all subsystems
Voyager	Yes. Released in 2003. Database fully converted to UTF8. Search, edit, and display capability in OPAC and Cataloging module. Voyager with Unicode fully supports the MARC 21 repertoire of characters. No proprietary or third-party software or peripherals are required to search for and display records in their native languages. Voyager Cataloging supports the complete add and edit of non-Roman scripts in any field.

Figure 11. Support for MARC family of standards.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
MARC 21 for Bibliographic Data	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MARC 21 for Authority Data	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MARC 21 for Holdings Data	Yes	Planned	Yes	Yes	Yes	Yes	Yes	Yes
MARC 21 for Community Information	No	Yes	Yes	Yes	Yes	Yes	Yes	No
MARC 21 for Bibliographic Data	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure 12. Support for other library standards.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
ISO 10160/10161	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NCIP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial today/ Full planned
OpenURL	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes

Figure 13. Standard OPAC functionality.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Search by keywords	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Boolean operators in queries (AND OR NOT)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Relational Operators (ADJACENT NEAR)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Cross-references	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Order results by relevancy	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Order results chronologically	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Browse by author, title, subject	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Truncation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Library can customize record and index displays	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Links to external resources	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Customized help displays	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Modify search without re-keying the initial terms	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Search within result set	No	Yes	No	No	Yes	No	No	No, but can sort and limit within result set.

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Figure 13. Standard OPAC functionality, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
View and recall the search history for the current session	No	No	No	Yes	Yes	Planned for 2004	Yes	Yes
Ability to limit results to an individual library or location	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Display of checkout status of items	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure 14. Extended Web OPAC functionality.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Name of Product	Web PAC	Horizon Information Portal	You SeeMore	Millennium AccessPlus	Polaris PowerPAC Portal	iLink/ iBistro/ Web2	Yes	WebVoyáge
Enriched biblio-graphic display: cover art, TOC, summaries, reviews, etc.	Through SFX	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Provider of Enriched content	Syndetic Solutions	Syndetic Solutions or Baker & Taylor (library choice)	Syndetic Solutions	Syndetic Solutions	Syndetic Solutions	Syndetic Solutions, Reed Business Information, the Children's Literature Comprehensive Database Co., H.W. Wilson Co., NoveList, Ebsco, ebrary, and Barnes & Noble.	Yes	Syndetic Solutions

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Figure 14. Extended Web OPAC functionality, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Authenti-cated patron login	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Support for external authentication services (LDAP, Kerberos, Radius, etc.)	Yes	Planned for 2004	No	Yes	Yes	Yes	Yes	Yes
View items charged	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Renew items	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
View result sets from previous sessions	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
SDI features; alerts for new items the library receives on a given topic	Yes	Planned for 2004	Yes	Yes	Yes	Yes	Yes	Yes
User-initiated holds	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
User-initiated recalls	Yes	Yes	Yes	Yes	Yes	No, However, users can fill out a Recall Request form online & email to a designated staff account for review and processing.	Yes	Yes
Ability to request items from other branches or libraries in consortium	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Figure 14. Extended Web OPAC functionality, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Self-update for mailing address and e-mail address	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Password change	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Recover forgotten passwords	Yes	Planned	Yes	Yes	Yes	No	Yes	No
Select preferred language for user interface	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes, multilingual OPAC available
Save or e-mail result sets or individual records	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
E-Commerce: No allow users to make payments for fines and fees; credit-card validation and online banking transaction to library account		Planned for 2004	No	Yes	Yes, no online banking	Yes, the 2003.1 release of Unicorn includes e-commerce options with PayPal and VeriSign	Yes	No

Figure 15. OpenURL reference linking.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Name of product	SFX	Horizon Link Resolver	None	WebBridge		Sirsi Resolver	Planned	LinkFinder Plus
Link resolver technology provider	Ex Libris	Serials Solution partnership	Third-party	Innovative	No	Openly Informatics	TBA	Endeavor
OPAC functions as link target	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OPAC serves as Link Source	Yes	Planned 1Q2004	Third-party partnership	Yes	No	No	Yes	Yes

Figure 16. Metasearch interfaces.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Name of Product	MetaLib	Horizon Information Portal	Partnership with WebFeat	Millennium Access Plus	Polaris	Sirsi SingleSearch	Planned	ENCompass
Meta-search technology provider	Ex Libris	WebFeat/ Dynix*		MuseGlobal	GIS**	Sirsi SingleSearch uses plugins from MuseGlobal (Sirsi does not sell off-the-shelf products from Muse.)	TBA	ENCompass includes three methods for multiprotocol searching: Z39.50 searching was developed by Endeavor; XML gateway searching developed by Endeavor; HTTP Search Engine developed by Endeavor and MuseGlobal

*Dynix currently offers metasearching based on WebFeat, but is developing a new technology based on Web Services (SRW).

**Polaris includes embedded metasearch capabilities natively but based only on Z39.50. It does not offer the multiprotocol federated searching

Figure 17. Cataloging module: Basic features.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Original cataloging with full MARC template	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multiple custom templates for simplified or special-purpose cataloging	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Automatic validation of all MARC data	Yes	Yes	Yes	Yes (on demand)	Yes	Yes	Yes	Yes
Spell check	No	Yes	No	No	No	No	Yes	No

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Figure 17. Cataloging module: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Context-sensitive online help or definitions for each field	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard editing features: Cut and paste	Yes	Yes	Yes	Yes	Yes	Planned for 2004	Yes	Yes
Search and replace	Yes	Yes	Yes	Yes	No	Yes	Yes	Planned
Drag and Drop	Yes	Yes	Yes	No	Yes	Planned for 2004	Yes	No
Z39.50 copy cataloging client	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Interface to OCLC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Interface to RLIN	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Transfer and overlay of records from OCLC/RLIN	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Transfer of MARC records to OCLC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MARC 21 format for bibliographic data	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
The system can import and export bibliographic records in MARC 21	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Figure 17. Cataloging module: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Ability to display the full MARC21 record in the cataloging client, including all field tags, subfield codes and indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
The system should not have limitations on the overall length of a bibliographic record or on the number of fields or instances of a repeatable field	Yes, within the bounds of MARC limits	Yes	Yes	Yes	Yes	Yes, Unicorn supports the MARC standard, with up to 99,999 characters per MARC record. Unicorn supports the MARC standard of 9,999 characters per field. There is no limit to the number of fields or the instances of a repeatable field.	Yes	Yes
Records can be edited or deleted only by the owning library	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Convenient access to authority records from the cataloging module	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Online authorization of names and subjects against the authority files	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Figure 17. Cataloging module: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Detect duplicate records	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Support for multiple classification schemes: Library of Congress, Dewey Decimal, SuDocs, Locally defined	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Call number index correctly sorted for shelf-listing	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure 18. Database maintenance: Basic features.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Standard data integrity protection: record locking during edit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Ability to customize the structure of the indexes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indexes are updated in real time as new records are added or updated in the cataloging module	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Figure 18. Database maintenance: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Do indexes need to be updated or refreshed in batch mode	No	No	No	No	No	Yes, Indexes are updated in real-time each time a new title is added to the catalog and are immediately available for searching. Inaddition, housekeeping reports run automatically each night to refresh and integrate indexes	No	No
Does indexing maintenance interfere with online searching?	No	Yes	Yes	Yes	No	No	No	No
Does the system include automated tools for performing daily, weekly, and monthly backups of all databases?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system support journaling to allow the recovery of transactions performed since the last backup?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system perform roll-backs of incomplete transactions?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the vendor provide documentation of database schema to the library?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure 19. Acquisitions module: Basic features.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Does the system include a database of all book and serial vendors?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system display the order status of an item in online catalog?	Yes	Yes	Yes	Yes	Yes	Yes, The library can also hide on-order status, if desired	Yes	Yes
Can the system generate purchase orders to vendors to initiate a purchase?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Can the system generate invoices to vendors?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Can the system automatically generate claims to vendors for items not received within a specified threshold interval?	Yes	Yes	Yes	Yes	Yes	The system does not generate invoices to vendors; however, it does receive invoices from vendors.	Yes	Yes
Can the system generate checks or vouchers to make payments?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes

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Figure 19. Acquisitions module: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Does the system manage funds and budgets related to library materials?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ability to separate accounting functions by authorization	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ability to manage library funds in hierarchical relationships. Support for regular budgets, gift funds, grants	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system provide a full audit trail of all financial transactions?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system support multiple simultaneous fiscal years (different libraries or organizations within a consortia having different cycles)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Figure 19. Acquisitions module: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Does the system automatically perform a fiscal year close with selective carryover of unspent funds or encumbrances?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system support EDI?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the the system support X12?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system provide links to external accounting or financial systems?	Yes	Yes	Yes	Yes	Yes	Yes, with optional APIs	Yes	Yes
Does the system provide a process for transferring items ordered on a book vendors online system to the local acquisitions system?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure 20. Circulation module: Basic features.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Does the system offer a multi-dimensional policy for calculating due dates, renewal options, and fines?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Are due dates calculated checked against the Library open/ close calendar?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the calculation of the due date take into consideration category of borrower?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the calculation of the due date take into consideration the type of material?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system issue an alert during checkout for problems and exception conditions? (such as: the patron owes fines)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system allow circulation staff to easily create brief records for items presented for circulation that do not already have a record?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Figure 20. Circulation module: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Does the system track fines owned for each library user?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system provide controls on what staff are authorized to waive or reduce fine payments?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system issue a warning if the item being charged is already checked out to another borrower?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system provide an automatic process for transferring patron charges to bursar system or collection agency?	Yes	Yes	Yes	Yes	Yes	Yes, by using optional APIs and Debt Collection module	Yes	Yes
Does the system provide cash control to track and balance funds taken at a circulation desk?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system offer offline circulation software that will allow the library to check out or discharge materials when the ILS server is down or unavailable?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes, charge No, discharge

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Figure 20. Circulation module: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Does the system allow an item to be placed on hold if requested by another borrower?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system manage holds based on all copies of the title when held by another branch?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system offer the ability to easily route or transfer items among branches?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system offer a telephone notification system?	No	Yes	Yes	Yes	Yes	Yes	Yes	Integration via 3M SIP2
Does the system include the ability to send availability and overdue notices by e-mail?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system track statistics for items consulted in-house but not checked-out?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Figure 20. Circulation module: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Does the system include an academic reserve desk module?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system support short loan periods for reserve items: hourly, overnight, daily?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ability to create bibliographic and item records for materials placed on reserve that are not part of the library's permanent collection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ability to find items according to course number or instructor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ability to transfer items from other branches to reserve system	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system include an electronic reserves module?	Yes	Yes, not a separate module, but e-reserves are accommodated	Yes	Yes	No	No	Yes	Yes
Does the system have the ability to include locally scanned articles in reserves	Yes	Yes	Yes	Yes	No	Yes, the library can create brief bibliographic records for any type of material with an 856 field link directly to the item.	Yes	Yes

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Figure 20. Circulation module: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Ability to link to electronic content in the reserves module	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
A patron database represents the valid users of the system	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
The patron file can be loaded through a batch process with data from external systems	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual records can be created and modified through the online system	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
The patron record file should contain at least the following fields: Patron Name, a unique patron identifier, multiple mailing addresses, e-mail address, category or type, expiration date, and free-text notes.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
The patron record shall maintain dynamic information including the number of items currently charged, a list of currently charged items, fines owed, a history of fines paid, time of last check-out, etc.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Figure 20. Circulation module: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Does the system distinguish patrons from each library within a multilibrary organization or consortium?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system automatically produce overdue notices based on delinquency intervals determined by the library?	Yes	Yes	Yes	Yes	No, currently in development	Yes	Yes	Yes
Does the system produce circulation activity reports (daily, weekly, monthly, etc)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system have the ability to perform inventories of all or selected parts of the collection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure 21. System administration: Basic features.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Does the system offer a graphical interface for managing system policies and configuration options?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Figure 21. System administration: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Does the system offer a graphical interface for updating the library open/close calendar?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system include utilities for loading or updating bibliographic records?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system include utilities for loading or updating patron records?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system include utilities for loading or updating authority records?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system allow the library to customize displays in the public catalog?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system allow the library to customize displays in the staff clients?	Yes, some features	Yes	Yes	Yes	No	Yes	Yes	Yes

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Figure 21. System administration: Basic features, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Does the system provide standard reports that can be run by authorized staff?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the system provide the ability to create customized reports?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the vendor provide automatic scripts or programs for implementing new major releases or minor version updates of the software?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the vendor provide a backout process for removing an update?	Yes	No, would need to be handled through customer support. Some clients install upgrades on test/training servers first.	Yes	Yes	No	Yes	Yes	Yes

Figure 22. System support.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Does the company make available to its customers an online knowledgebase of common problems?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the company offer 24-hour/ 7-day e-mail support?	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Does the company offer 24-hour/ 7-day telephone support?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Has the company implemented a system to automatically track each issue submitted to customer support?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the support structure include a mechanism to flag high-priority problems, such as those that involve system downtime?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the company guarantee a specific response time for critical problems that involve system downtime?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Figure 22. System support, cont.

Function	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Are there additional charges for after-hours support?	No	No/Yes*	No	No	No	No	Yes	Yes

*Normal support hours are Monday to Friday, 5 a.m. to 6 p.m. Mountain Time, with emergency support available at no additional charge Monday to Sunday 5 a.m. to 9 p.m. Mountain Time. Emergency support outside of these extended hours is available at an hourly rate.

Market share and installed base

The following table shows installed base of each of the major automation systems. The numbers in the table reflect the numbers of installations of each system.

For these systems, a single installation usually serves more than one library. The data in the table illustrates the relative success of each of the systems in attracting libraries and in what type of libraries typically use each system.

Figure 23. Installations by percentage and total.

	Aleph	Horizon	Library. Solution	Millennium	Polaris	Unicorn	Virtua	Voyager
Number installed in North America:								
Academic Libraries	72% 363	10% 197	21% 117	68% 562	5% 9	28% 267	34% 15	73% 944
Public Libraries	6.0% 30	37% 695	59% 321	22% 178	86% 162	25% 243	22% 10	2% 24
School Libraries	14% 71	39% 732	9% 50	1% 7	7% 14	7% 68	2% 1	0% 5
Special Libraries	8% 39	14% 268	11% 60	9% 75	2% 3	40% 385	40% 18	25% 323
Total (North America)	503	1,029	548	822	188	548	44	1,296
Total (worldwide)	1,250+	1,353	570	1,018	188	1,277	160	1,296
Consortia (North America)	13	27	4	59	18	62	1	79
Consortia (worldwide)	37	42	1	67	18	69	7	94

*Counts provided are worldwide. Statistics for North America alone are not available. About 25% of Endeavor's sales are outside North America.