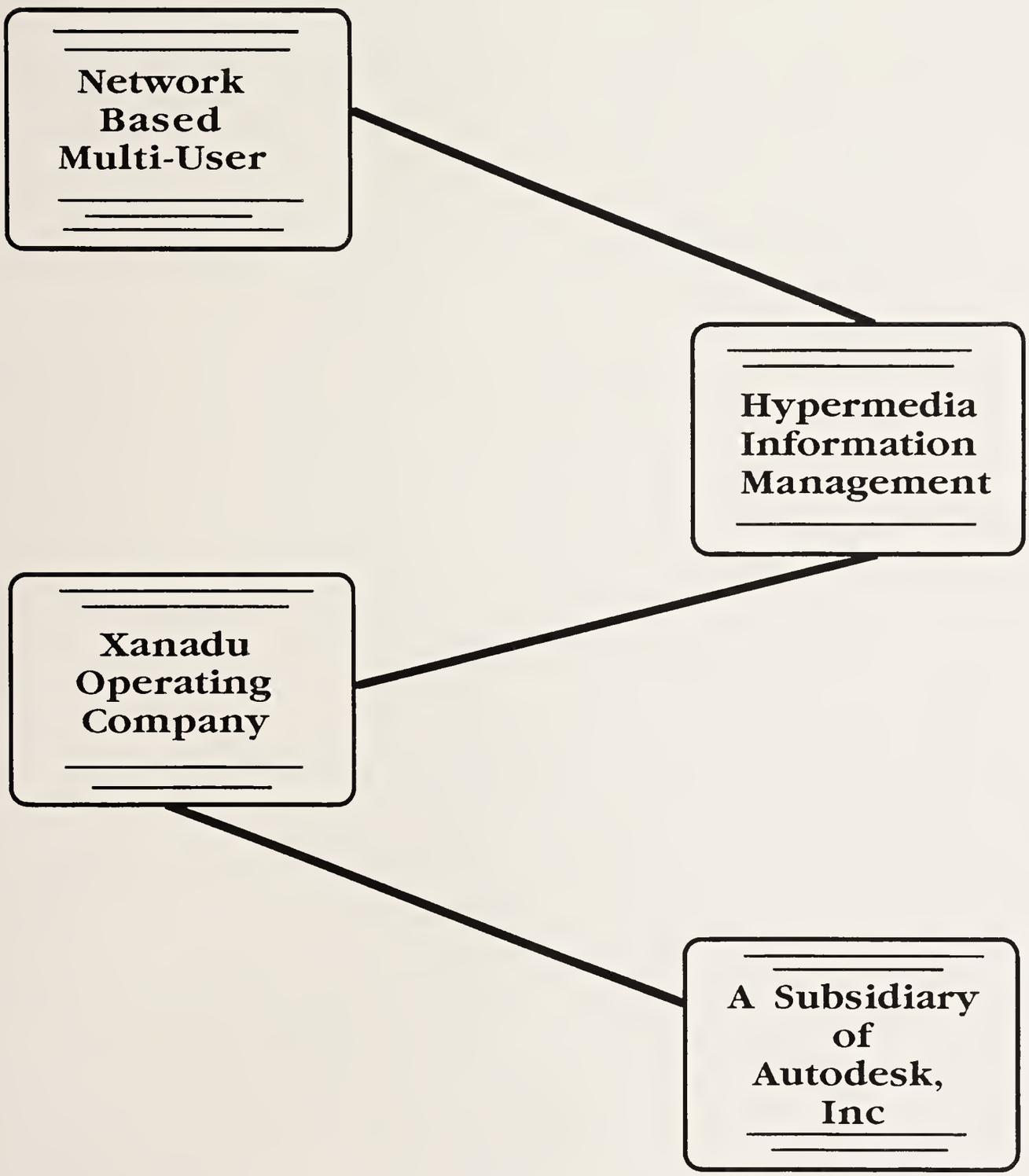
Xanadu/Server™



"Xanadu/Server" advertising piece, May 1991 ("Xanadu Gold")

(for Ted Nelson collection)

This is an advertising piece for the Xanadu Gold design, carried on by the team no longer under Roger Gregory's direction.

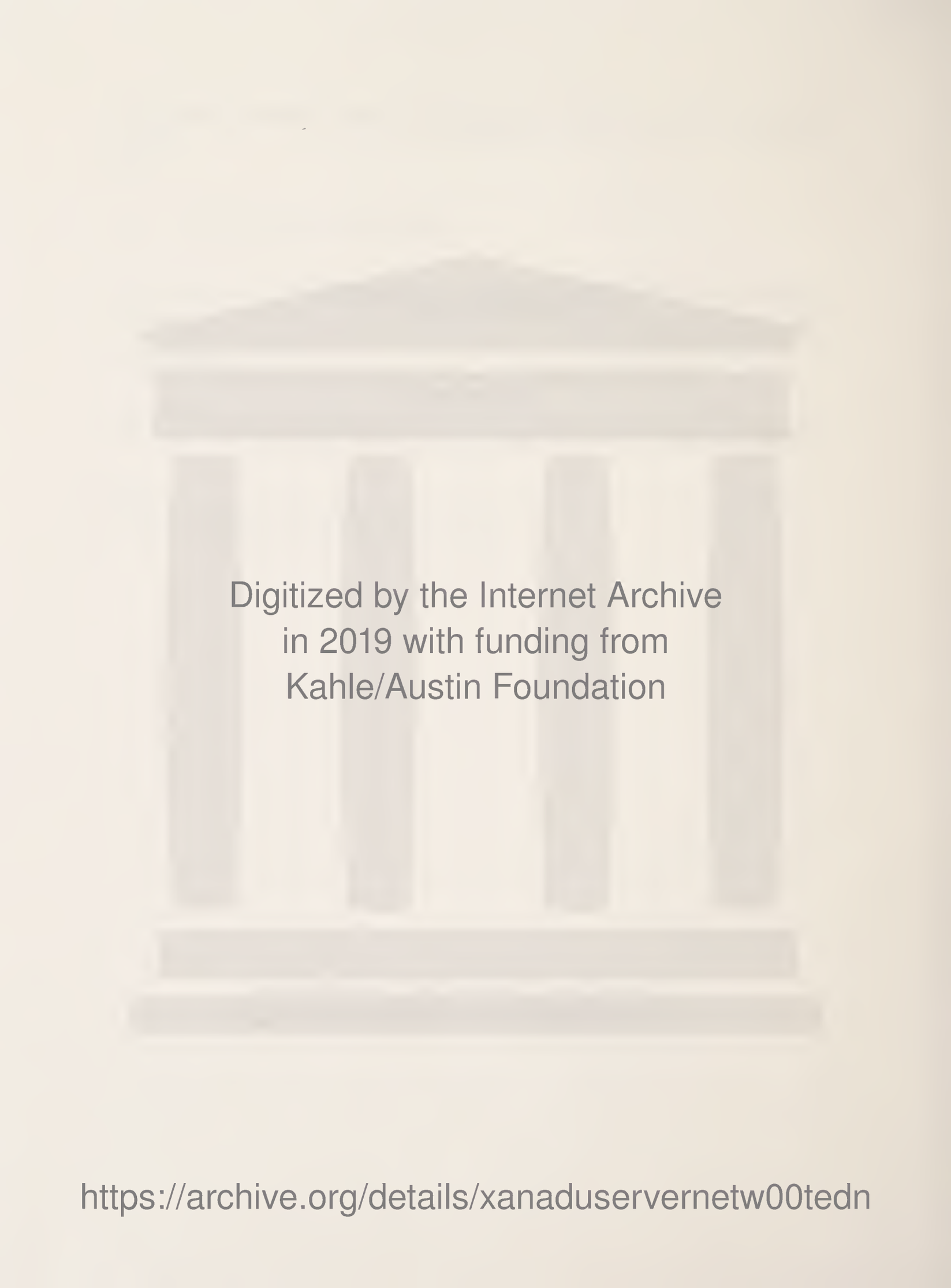
Says Xanadu hypermedia are much better than database.

tags
hypermedia, versioning , linkage

Xanadu/Server™

"Network-Based Software for Hypermedia Information Management"

Xanadu Operating Company
A Subsidiary of Autodesk®, Inc.



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A New Way of Organizing and Accessing Information

The Xanadu/Server is a revolutionary tool for the storage, manipulation, organization, and retrieval of information. As a hypermedia "engine", it is designed to provide new capabilities to developers for the creation of hypermedia document and workgroup-based information management applications. Now, for the first time, applications can be developed to deal with unstructured multimedia documents and distributed workgroup information requirements with the same power that traditional DBMS systems have dealt with structured databases - and with the same data integrity, performance and security users of Database Management Systems have come to expect.

While traditional database systems have evolved to provide powerful, standard approaches to handling highly structured information such as personnel files, inventory, price schedules, etc., techniques for handling unstructured information in the form of documents have not kept pace with database technology. There are numerous "document database systems" available which allow one to store, retrieve, and to some extent manipulate document-type information; however, there have been few systems available that allowed the development of custom applications that organize and interrelate documents with the same precision and flexibility available for structured data. This is a key design goal of the Xanadu/Server.

The design of Xanadu/Server recognizes that the majority of information used everyday - letters, memos, post-it notes, drawings, contracts, reports, etc - does not fit neatly into structured databases. Instead, these documents often vary greatly in their size, complexity and relationships to one another. Traditional database management systems are not designed to deal with this information problem: the Xanadu/Server is. Xanadu's combination of *Hypertext Links*, *Version Comparison*, *Sensors*, and other features provide an environment to deal with unstructured information and capture evolving relationships between this information. This not only assists the immediate requirements to analyze and organize irregularly structured information, but over time assists in capturing an organization's "memory" of interrelated information.

The Xanadu/Server has been designed to be a foundation for application developers. Using revolutionary hypertext techniques, the Xanadu system facilitates development of applications that deal with irregularly structured information and workgroup information management. Xanadu applications are built by writing to a **Xanadu Application Programming Interface or API,** known as the **FeBe** (**F**ront**e**nd-**B**ack**e**nd) Protocol and similar to the SQL Client/Server model. The Xanadu/Server handles all the core information management functions, freeing the client application to focus on local processing, presentation and editing of information. Xanadu applications can be built for any platform (personal computer or workstation) that runs on Xanadu supported networks.

The Xanadu/Server, developed by Xanadu Operating Company (A subsidiary of Autodesk, Inc.), provides both users and developers with the best of both

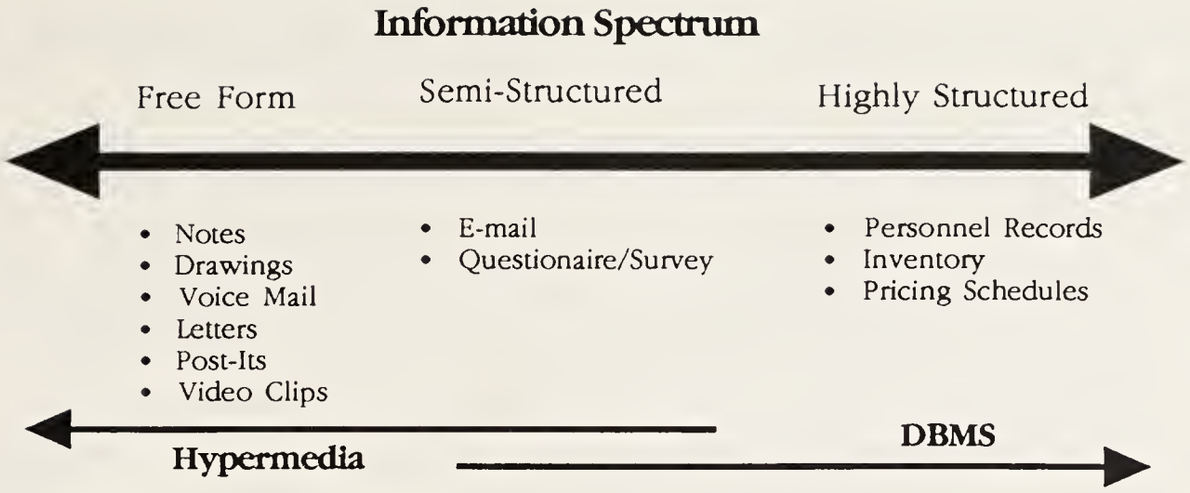
worlds: easy-to-use, low cost, high performance hypermedia computing combined with high volume, high integrity, information processing capabilities previously available only to users of large DBMS systems.

Key features of the Xanadu/Server:

- Support for all forms of data (text, graphics, audio, video)
- Support for composite, multimedia documents
- Flexible "Linking" of related information, including automatic, omnidirectional links to information blocks of any arbitrary size (from a single character to a library) and selectable link typing - allowing applications to filter a particular subset of links (and connected documents) for processing.
- Active Sensors that can be attached to documents to send alerts when specific events occur to a document
- Document Version Control and Comparison.
- An open platform for "frontend" application development
- Industry Standard Hardware, Networking and Operating System compatibility
- Full multi-user capabilities
- Advanced information management capabilities for superior security, performance, data integrity, and centralized information management
- Server Scalability - the future ability to add more, or larger servers to a Xanadu/Server workgroup and distribute the information base over several servers.

Hypermedia Information Management : What is It?

Hypermedia is a method of information management that is built around a network of multimedia nodes or documents connected together by "typed" links. Hypermedia systems aid in the organization and manipulation of irregularly structured multimedia information. In this respect, they complement the use of traditional DBMS systems in managing highly structured information. The overlap and differences between hypermedia and traditional DBMS's are shown in the following illustrations:



	Hypermedia	Database Management Systems
Data Types	Text, Numbers, Graphics, Video, Audio	Typically Text/Numbers Only
Query Modes	Select a link connecting related information	Boolean/SQL/QBE
Information Structure	Networks of Related Documents	Files/Records/Tables
Information Organization	Dynamic/Multiple Viewpoints	Relatively Static

Xanadu is an implementation of a *distributed* hypermedia management system characterized by the following general features:

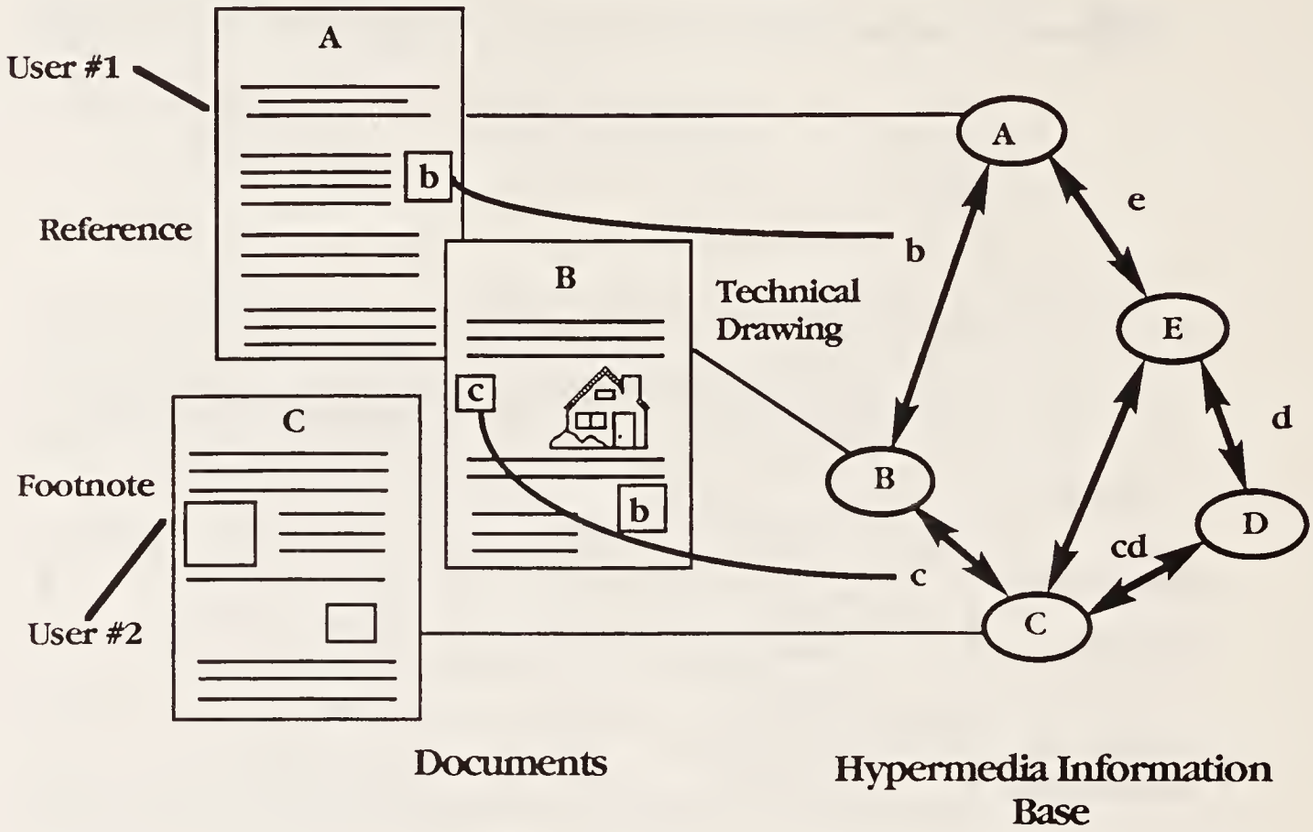
- Information is "chunked" into units of variable size. These units, documents in Xanadu terminology, can combine any type of information including digitized text, vector graphics, bitmapped images, sound and animation.

- Whole documents or "slices" of documents are interconnected by *links*. Users navigate in the hypermedia database by selecting links in order to travel from unit to unit.

- By creating, editing and linking information, users build information structures or applications for various purposes (e.g. Group Editing, Project Management, Publishing, Communications, etc).

- Multiple users may simultaneously access the hypermedia database, and (in future releases) portions of the database may be distributed across multiple workstations and servers on a network.

A Xanadu hypermedia database can manage the relationships between documents in a multiuser environment, allowing multiple users simultaneous access to linked documents.



To illustrate the differences between hypermedia and traditional DBMS, consider a Manufacturing Engineering department. A traditional DBMS would be used to manage the database of standard parts available for designers, complete with cost, inventory, physical properties, etc. The data is highly structured and easily accessed by structured queries. However, the management of the engineering drawings, design changes, engineer comments, notes, etc. related to the designs are best suited to a hypermedia system. Hypermedia can best manage this form of irregularly structured information with links interrelating a wide range of documents. In contrast to the parts database, many of the relationships between these documents become apparent only after the information is created. Hypermedia excels at managing changing relationships among project documents and other information.

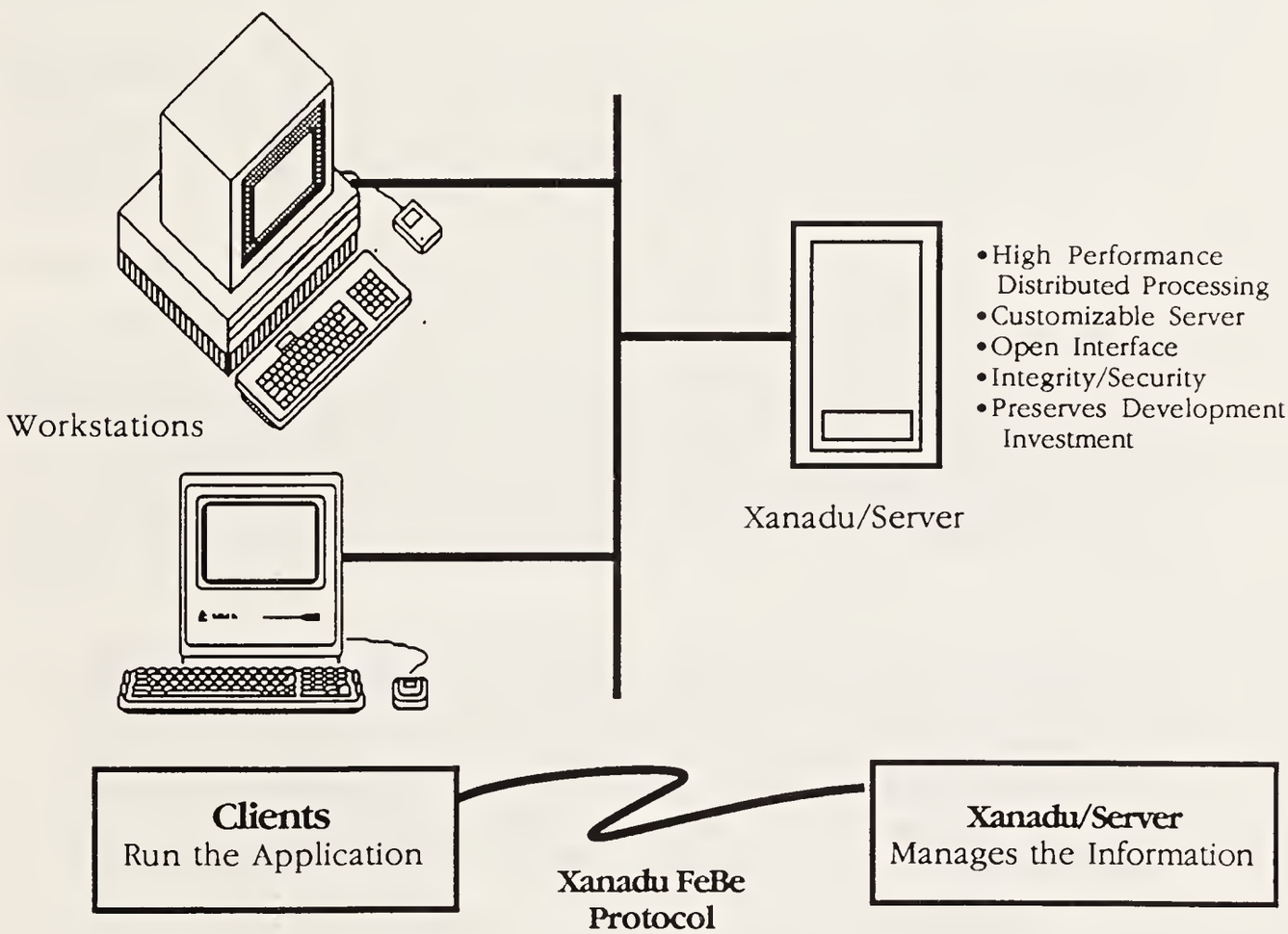
Xanadu/Server System Overview

Client/Server Architecture

Xanadu is based on the Client/Server model, an architecture that best meets the needs of workgroups and distributed information management. Combined with specific frontend applications, the Xanadu/Server provides the ideal workgroup information management solution.

The Client/Server model segments information management operations into two categories, thereby allowing developers and end users to exploit the strengths of each. The Xanadu/Server is responsible for the storage, maintenance and retrieval of information, as well as maintaining the integrity of the information. Great effort has been taken to ensure data consistency within the Xanadu environment. Additionally, the Xanadu/Server maintains all the complex linking relationships among the data, and performs editing operations on that data when requested by the application. Finally, the Xanadu system maintains session control utilizing a comprehensive system of individual and group permissions.

The Client application takes responsibility for presenting the information to the user and can be run on any of the popular personal computers or workstations.

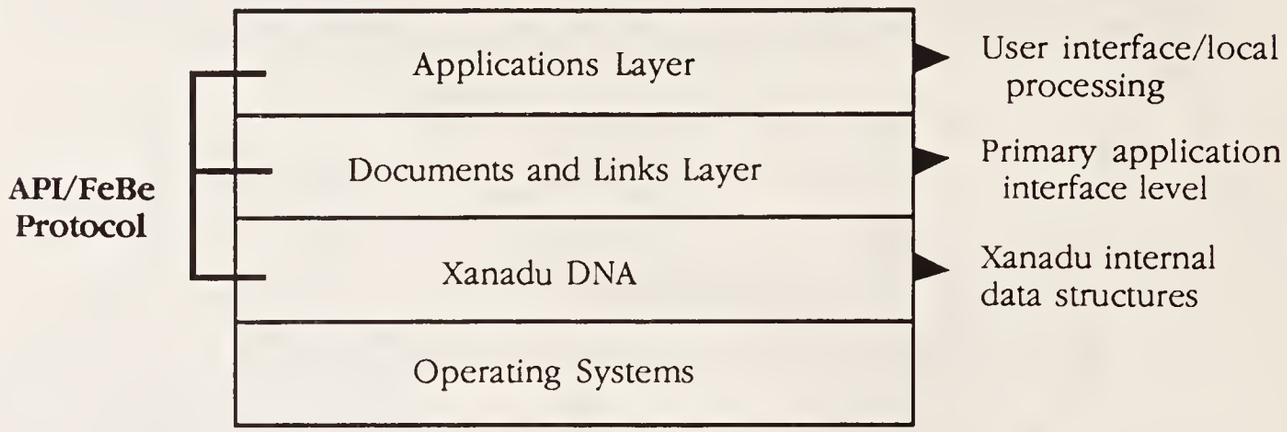


As with other Client/Server architectures, Xanadu clients communicate with the server using a published interface protocol, in this case the **FeBe** (Pronounced "fee-bee") Protocol. There is also a planned Server-to-Server protocol - the **BeBe** (pronounced "bee-bee") Protocol that will allow servers to be transparently linked together.

By intelligently dividing the computing functions between the client and server, Xanadu application developers can maintain the benefits of frontend applications, while dramatically increasing their functionality and performance and ensuring a high level of data integrity.

A Layered, Open Architecture

The Xanadu environment is a rich, open system incorporating several layers, each of which provides an important level of service to the other components.



A typical Xanadu application will spend most of its time doing one of two things: presenting information to the end-user and manipulating Xanadu Documents. These operations correspond to procedures that exist in the Application Interface layer and the Documents and Links layer, respectively. In most situations, frontend application developers will be concerned with only these two layers.

The Application Interface Layer consists of routines and data structures necessary for presenting and displaying Xanadu-based information to the user. Because of the intimate association of these functions with user-interface issues that are necessarily application-specific, the implementation of this layer is left in the control of the frontend application designers in accordance with the specific needs of their application. To aid developers in taking advantage of the unique features of the Xanadu/Server, Xanadu will offer guidelines and examples for feature implementation.

Some platforms and development environments (e.g. Macintosh, MS Windows) provide their own display and presentation routines and most developers will utilize these in the creation of their application's interface. However, it will still be necessary in these cases to have a set of routines that can translate the various data structures passed around in the Xanadu system into entities understood by the display routines and vice-versa. A Xanadu Developer Toolkit will provide translations which can be linked into standard C programs. This will allow C programmers to use their existing user interface libraries in their Xanadu frontend applications.

The Xanadu Developer Toolkit will also provide object-oriented libraries and tools for developers using C++ including sample text editing routines. Xanadu expects that many C++ programmers will use this code as a basis for developing their applications in a platform-independent fashion, but developers are free to develop and use their own routines as well.

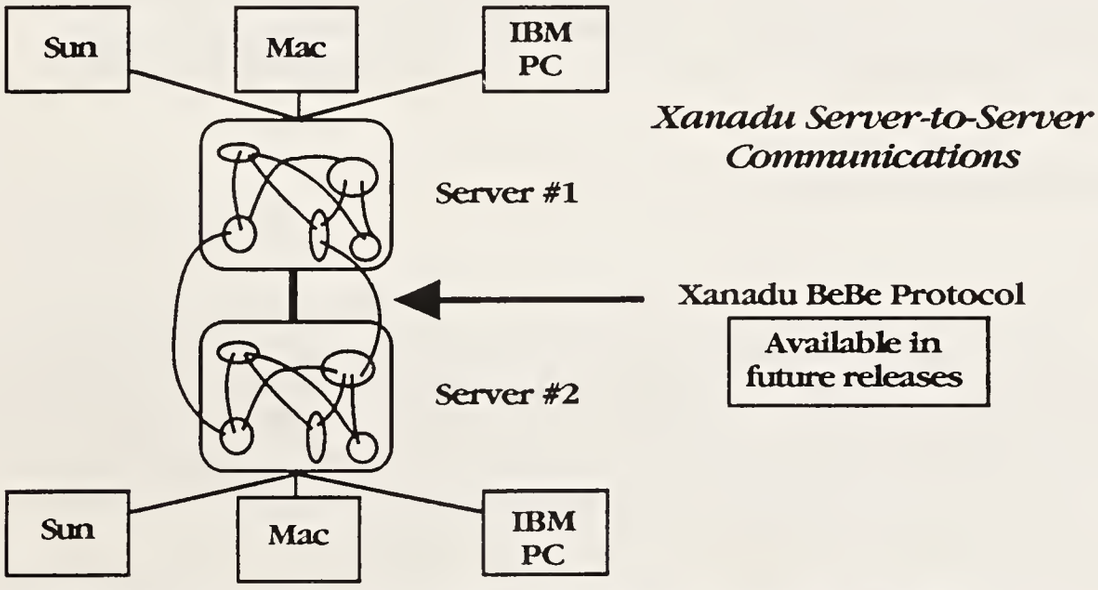
The Documents and Links Layer provides the primary application interface to the Xanadu/Server, containing most of the system calls for the creation and manipulation of Xanadu multimedia documents.

The Xanadu DNA Layer is in fact made up of several separate layers providing low-level services to and from the hardware and the upper layers, and is not directly accessed by frontend applications. These subterranean layers are implemented in the Server for high performance.

Regardless of the language used to develop your applications, Xanadu/Server is the platform that will best meet your Hypermedia Document/Workgroup application development needs. You can develop applications in a variety of languages and still allow users access to information with their favorite PC or workstation interfaces.

Scalable Performance

The Xanadu/Server is designed to grow as your information and application needs grow. As more users or information bases are added to the workgroup, more Xanadu/Servers will be able to be added to better meet their needs. Xanadu/Servers will eventually be transparently linked through the BeBe protocol (planned for future release), allowing seamless integration of information across any number of servers. The Xanadu/Server protects your application and information management investment by allowing scalable growth within and between workgroups.



Xanadu BeBe (Server-to-Server) Protocol allows scalable expansion

The Xanadu/Server 's performance has been a key design consideration since the outset of development. As a result, the performance of the Xanadu/Server, especially with very large and/or complex information bases and applications, is expected to be exceptional. As more information and/or links between information are added to the network, response time should remain nearly steady.

The scalability of applications is especially important for users and developers who are looking beyond "test pilot" programs and need assurance that the underlying system can grow with their needs. The Xanadu/Server has been specifically designed to operate in "industrial strength" application environments and provide the foundation for large, enterprise-wide information networks.

Information Integrity and Security

By incorporating a full compliment of centrally managed features, client applications can rely on the Xanadu/Server to manage security, and a host of other problems that occur in multi-user environments.

Application developers and users can then focus on what they do best - creating and using applications - and allow the Xanadu/Server to do what it does best - managing multimedia, multi-user access to information in a workgroup. Some advantages of the Xanadu/Server's enforced data integrity and security are:

- Reduced development costs
- Improved performance
- Increased control
- Reduced maintenance costs
- Improved reliability

Additionally, the Xanadu/Server's enforced data integrity allows dissimilar applications to access shared information in a controlled environment.

Xanadu/Server Features

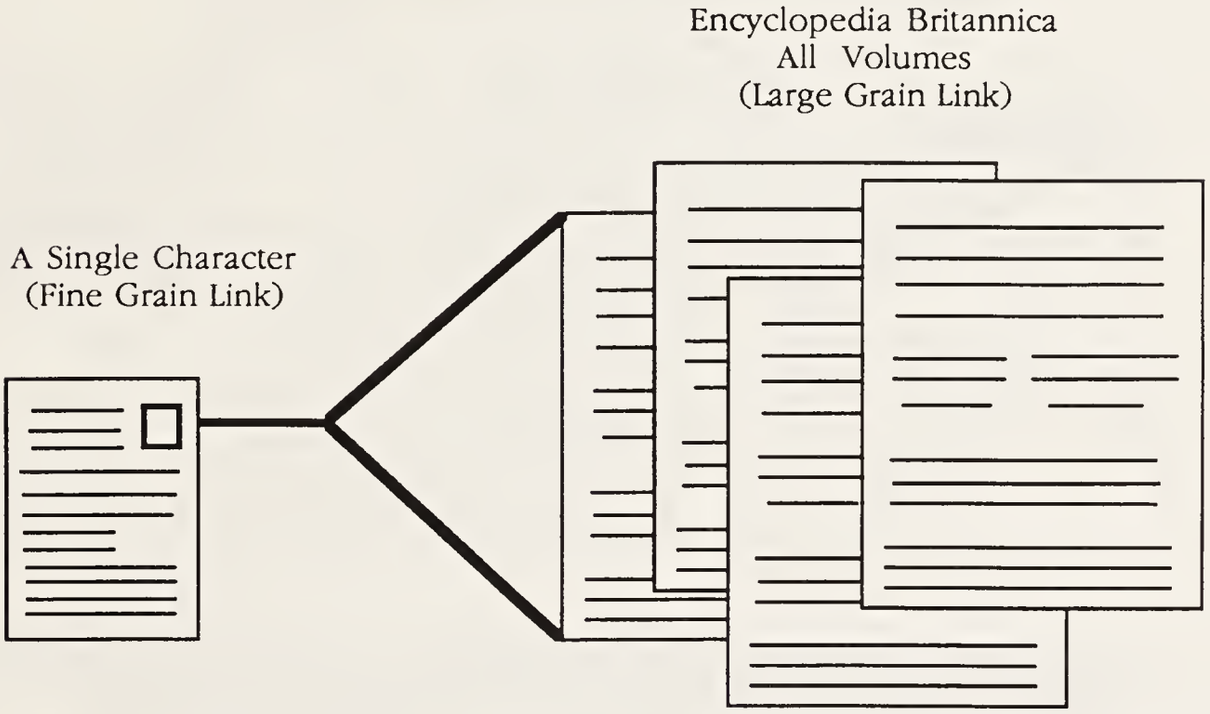
Links

Links are the fundamental organizational "glue" in the Xanadu system and are the primary means of access to documents within the information base. Applications and users access documents and elements by creating, editing and retrieving links between related information. Xanadu Links have several characteristics which aid in developing robust applications and useable information bases: Variable Granularity, Omnidirectionality, and Typing & Filtering.

Variable Link Granularity

Xanadu links can have varying degrees of "granularity". For example, a coarse-grain link may be "anchored" on a complete reference book, while a fine-grain link may be anchored on a single character or pixel in a drawing. In either case, links can refer to non-contiguous sections of material, or even to external material such as CD ROMS.

Variable Size Links: Fine /Large Grain



Xanadu can create and manage links between information at the Macro level (Document-to-Document) or at a Fine Grain Level (characters/words/paragraphs/pictures ...) within and between documents

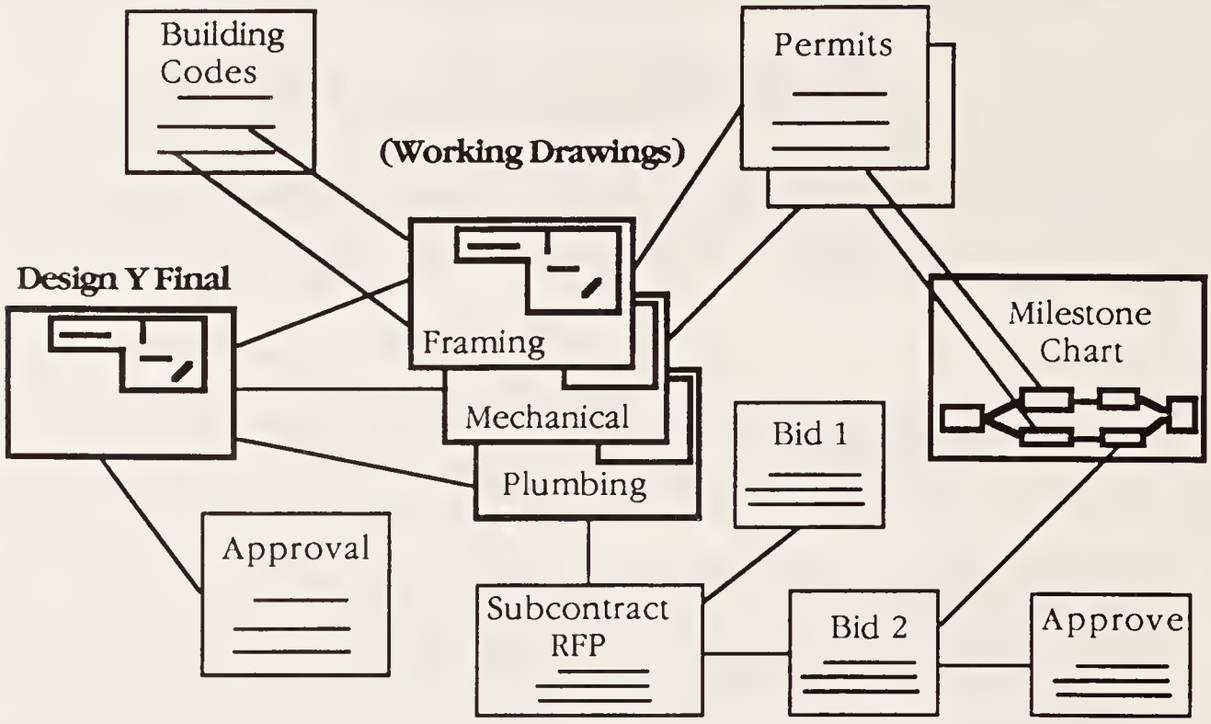
Omnidirectional Links

All links created in Xanadu are automatically omnidirectional, giving applications and users access to and visibility of all related materials. Without omnidirectional links, users would only be aware of forward branching possibilities; for example, to further readings or references. Omnidirectional links provide greater visibility and the capability of tracing backwards to all material referencing the linked document.

For example, in the illustration below, while looking at the "Design Y Final" drawing the user should be able to "see" that this references the Framing,

Mechanical and Plumbing drawings. Conversely, if they are looking at the Framing drawing, they should be able to see that it has been linked to a newer drawing, "Design Y Final".

Omnidirectional Links

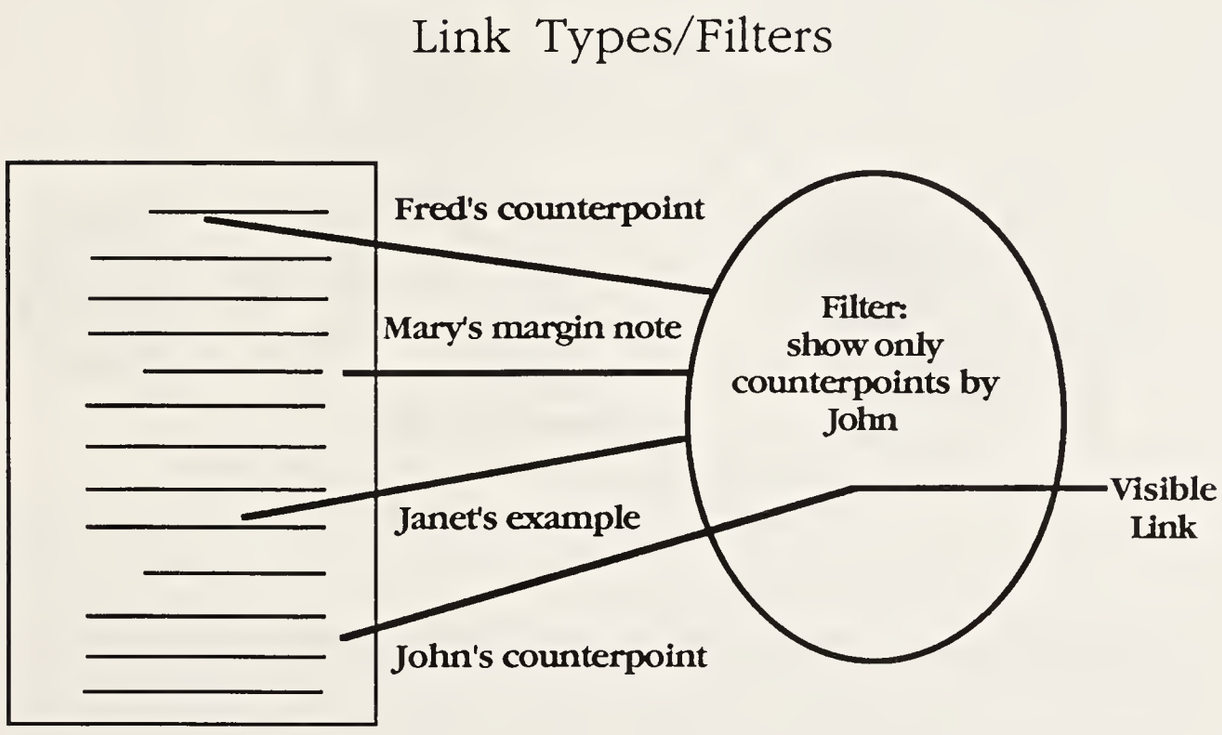


Links created with Xanadu automatically point to all referenced documents, regardless of where the link "originated". This minimizes the need for redundant linking and ensures maximum visibility of information relationships.

Link Types and Filtering

A potential problem with hypermedia/link-based information systems is the potential navigation confusion generated as the set of Links attached to a document grows very large. Without some way of selecting particular "sets" of links connected to a document based on the nature of the inquiry, finding the right connection could be time consuming. To address this problem, Xanadu offers the ability to create an unlimited number of link "types" based on the particular application requirements. Examples of link types might include *Comment Link* (links to or from material that is a reader comment), *Engineering Change Order Link* (links to documents which authorize changes in the linked Design Drawing) or *Subroutine Links* (links to or from source code for linked subroutines). The kind and number of link types available to a user is at the discretion of the application developer. Frontend developers can create virtually any kind of link type that makes sense within the context of their application.

Additionally, Xanadu provides the ability to filter a set of links based on type categories. For example, an application or user may be interested in seeing only the links on a document that are of link type "Engineering Change Order", "Material Cost" and were created by author "Jones", before January, 1988. Such a query would filter out all other links and only display the appropriate subset of links for viewing or further processing.

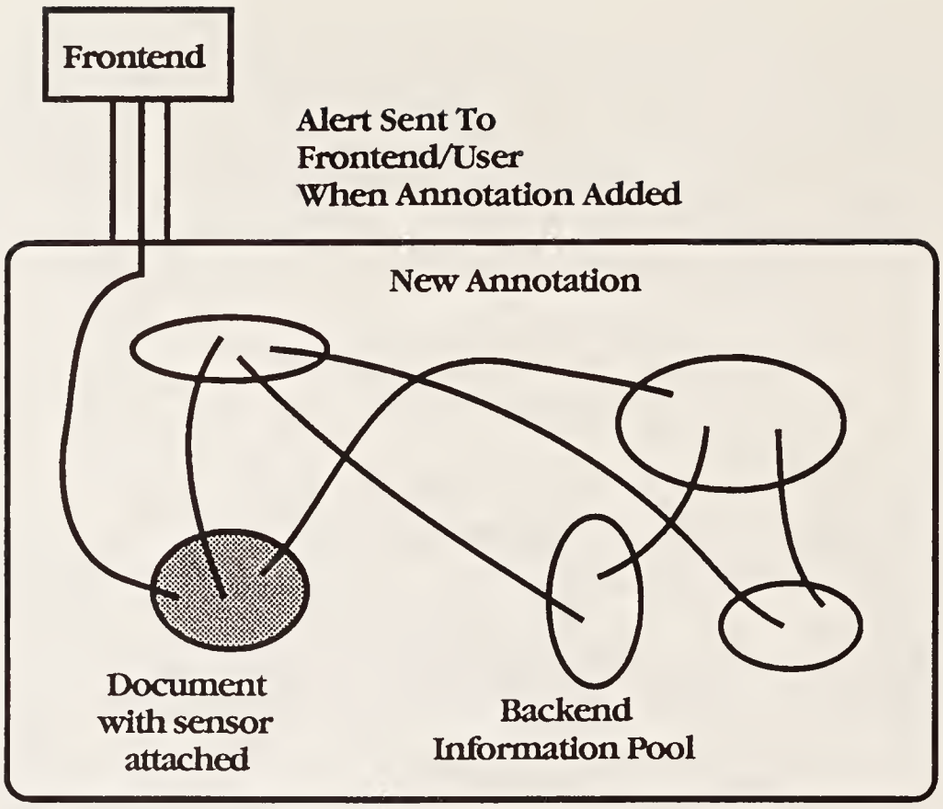


Unlike other hypertext systems, which only allow a small number of link "types", Xanadu permits unlimited and custom link types based on the application requirements. Together with filtering, this facilitates locating the correct set of related materials

Document Sensors

Because the Xanadu/Server was designed to operate in a distributed, multiuser environment, the ability to monitor the dynamic state of shared information and collaborate with other users has been a high priority. Xanadu Document Sensors offer a unique way of monitoring and interacting with the information base and other users.

Sensors can be attached to various documents (or specific parts of documents). The Sensors watch for specific events such as the attachment of a link, or the modification of the document. When these events occur, they send a signal to the application.

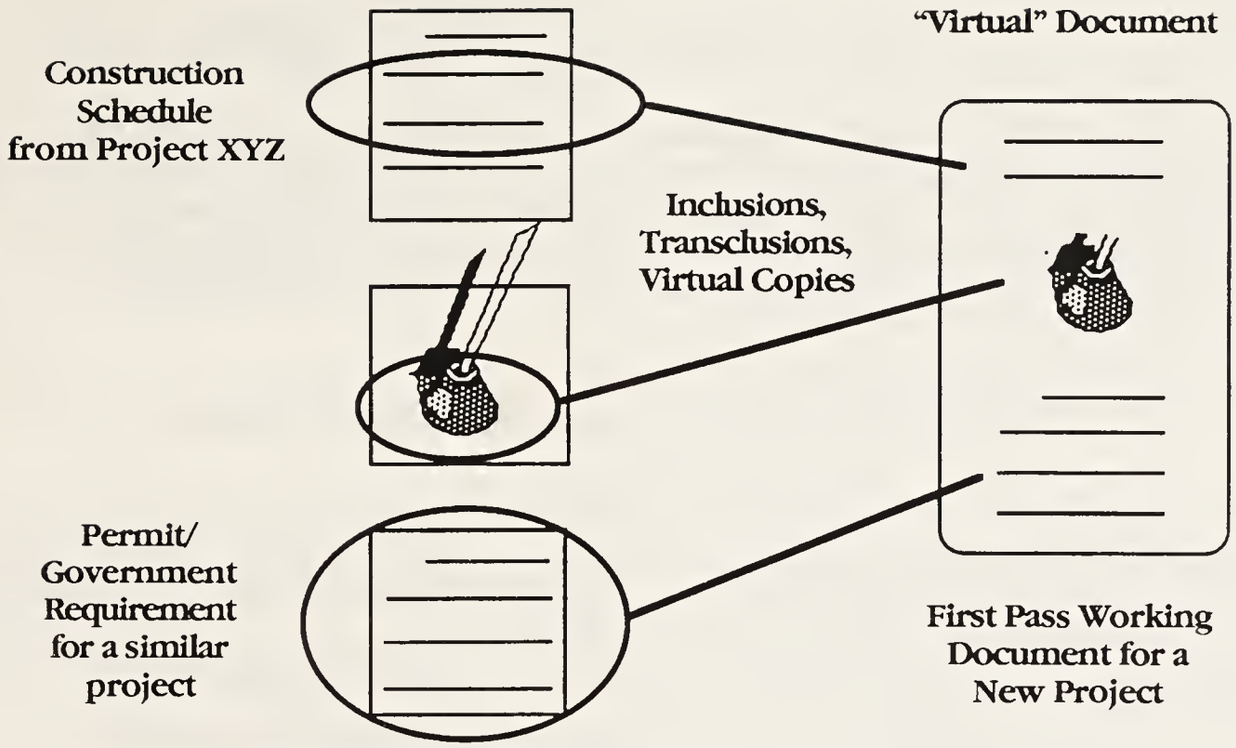


While Document Sensors can act as simple alert mechanisms based on remote procedure calls - for example, they could be used to notify a user when someone attempted to edit a specified document - they are, in fact, a very sophisticated mechanism for monitoring qualitative changes in the information base.

For example, a sensor could be attached to an Electronic Mailbox with instructions to alert the owner to the arrival of any new mail from members of the Engineering Department that relates to a proposed Specification Change for Project XYZ. Using Xanadu's document sensors, links and intelligent documents (discussed below), an entire next generation Electronic Mail system could be constructed.

Intelligent Compound Documents

At the core of the Xanadu system is the broadly defined object called the "Document". Xanadu defines documents to contain any form of digitized information. The document can have any number of versions, can be any size, contain any number of pages, and contain any mixture of information types. Thus, a Xanadu Document can include ASCII text, diagrams, vector CAD images or any set of arbitrary information that is specific to the Document.



Xanadu Documents are "soft-edged", extending beyond the common rigid definition of "Document = Distinct File". Xanadu includes the notion of a "virtual document", where a "Document" can be made up of individual elements (e.g. characters, vectors, bit maps, etc) that may be parts of other documents and share no particular (physical) proximity. With the addition of the planned BeBe protocol, the individual components of a Xanadu Virtual Document may exist at completely different physical locations. A paragraph of text might reside on a Xanadu/Server on the first floor of an office building, while the accompanying illustrations reside on a Xanadu/Server located on the tenth floor. The actual physical location is transparent to the user, who just sees a "Document". Although none of the material of such a "Virtual Document" is duplicated from the original material, the virtual document can be copied, edited, linked, etc. - in essence have all the characteristics of a "real" document.

In addition to their content, the linked materials that make up a Virtual Document are imbued with knowledge of their "ownership" and relationships to other documents. The linked material can be followed back to all other references of the document to check context and authorship.

Version/Revision Control

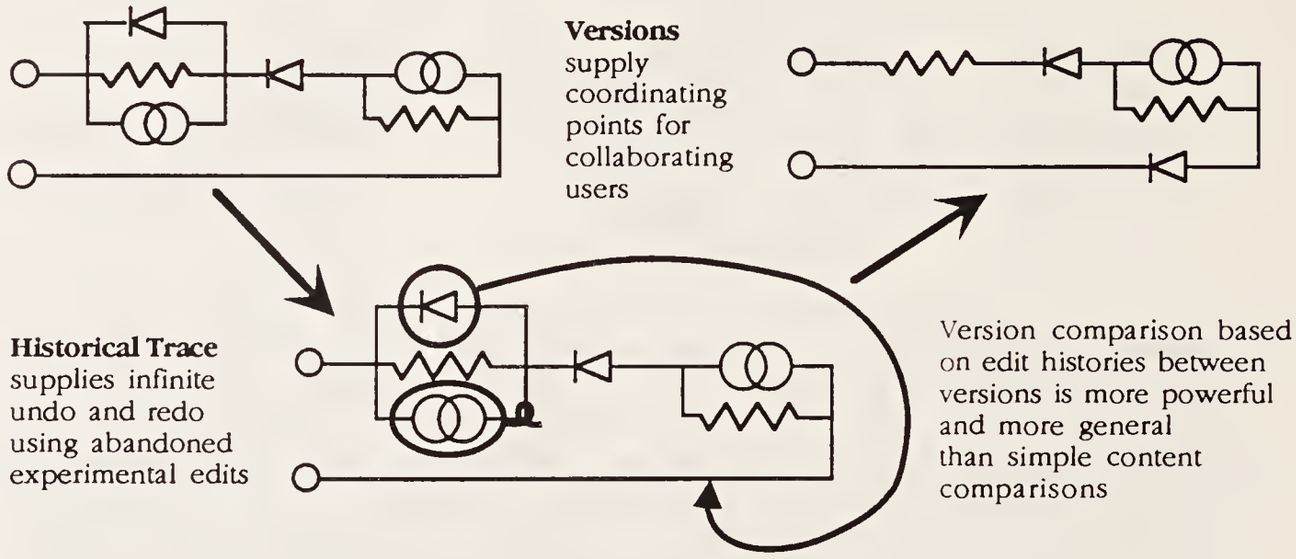
Anytime you have an individual or group working on documents involving multiple edits and versions, it is valuable to have powerful version comparison facilities. Very often the *trail of changes* is as important as the finished document. Xanadu supports a unique form of Version Control/Comparison.

The Xanadu/Server's version control and comparison works for text, graphics and other forms of information. Any two documents in a Xanadu information

base can be compared based on their edit histories, the result being a far more powerful form of Document Comparison than is available in any other system.

Most traditional version management systems keep full copies of all versions or store incremental changes. The former method (separate copies of every version) can greatly impact network storage as the number of copies grows, and the latter (incremental or "delta-storage") can result in performance degradation as a document must be built through a series of incremental constructions.

Version Control and Historical Trace



Using proprietary methods, the Xanadu/Server's Version Control and Comparison feature avoids the limitations of these traditional approaches. Unlimited multiple versions of a particular "document" can be stored and quickly retrieved without the burden of data redundancy, and without the need for time-consuming linear reconstruction. Version Control and History tracking take on new significance, giving users and applications the freedom to experiment freely with drawings, manuals, source code, etc, confident of the ability to quickly retrace their steps and to consolidate any interesting changes encountered along the way.

Typical Xanadu/Server-based Applications

Because of the incredible flexibility that the Xanadu/Server provides developers, the variety of applications that take advantage of the Xanadu/Server will cover a broad range of markets. Some typical applications based on the Xanadu/Server should include:

Education
• Authoring Systems • Research • Publishing

Government & Defense
• Command & Control • Documentation Systems • Configuration Management • Intelligence • Communications

Publishing/Information
• Electronic Publishing • Collaborative Writing • On-Line Info Services • Document Management

Manufacturing/Electronics
• Project Management • Electronic Communications • CASE • Group Design Projects • Document Management

Xanadu Developer Program

To promote the development of a wide assortment of commercially successful frontend applications, Autodesk will assist developers through a Xanadu Developer Program. The program will equip Third Party Developers with the tools, training, and support necessary for the development of outstanding Xanadu-based applications. Developer Program benefits will include:

- Technical literature on the Xanadu/Server
- Development tools and libraries supporting C and C++
- Xanadu Developer Seminars
- Technical support via Electronic mail and telephone
- Xanadu Technical Notes
- Sample application code and explanatory notes

Development Schedule and Further Information

Xanadu is currently being developed on Sun Microsystems workstations and the first version of the Xanadu/Server will be available for Sun platforms. Versions for other platforms are also planned. Toolkits are expected to be available to support client application development on Sun, Macintosh and some versions of DOS/Windows/PM.

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