THE ROLE OF NETWORKED INFORMATION IN HIGHER EDUCATION

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Abstract: In February, 1996, the Information Architecture Task Force of the University of Connecticut Libraries completed its examination of the architecture that would support and enhance public and staff access to electronic information services. As part of its investigation, the Task Force examined the current status of information architecture planning and the role of information technology within the university, and contrasted this role through interviews with approximately 18 institutions of higher education.

Both our literature survey and interviews revealed a number of similarities among "leading institutions" that were frequently mentioned as positive factors in the effective utilization of information technology and networked information. In most, but not all cases, there was a strong correlation between the rate of progress in the respective university libraries and the perceived value of information and information technology on campus.

While the Task Force Report addresses many issues of local interest to the UConn Libraries, it is the findings of our investigation regarding the perceived value of networked information, especially the similar and positive factors among institutions, that are presented. In addition, these factors are also analyzed with respect to their ability to positively effect design recommendations for information architectures.

Length: Approx. 25-30 minutes.
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PART I: THE CONTEXT

Institutional Background

The University of Connecticut is a Research I, Land Grant and Sea Grant institution spread over eight physical locations. It is the only public research University in Connecticut with Yale as the only other research university. The campus in Storrs Connecticut is the largest of the eight and the administrative center of the institution. A major health complex, which includes Schools of Medicine and Dentistry, exists at the Farmington Campus and is administratively independent from the other campuses. The School of Law is on a separate campus in Hartford. Regional Campuses which contain various blends of graduate and undergraduate programs are in Avery Point, Greater Hartford, Stamford, Torrington and Waterbury. The entire system is governed by a single President who reports to a Board of trustees. In 1996 there are some 24 thousand students and twelve hundred faculty at all of the UConn campuses with Storrs accounting for 18 thousand students and one thousand faculty.

The university of Connecticut’s libraries are organized into three administrative units. The Health Center library and the Law School library are both autonomous units reporting to the Senior Vice President for the health Sciences and the Dean of the Law School respectively. The University of Connecticut Libraries, the libraries at the Storrs campus and those at the five regional campuses, report to the University’s Director of Libraries.

A. Strategic Planning Leads the Way

In 1995, the University of Connecticut Libraries, completed a Strategic Planning Process which identified ten strategic initiatives. A significant number of those initiatives were based on the existence of a robust network that would facilitate the use of networked information both in support of the university’s missions of research, teaching/learning and service and also in support of a restructuring of the libraries internal processes.

While strategic planning had identified positive drivers in the development of new networked information infrastructures, there existed a set of negative drivers that were equally as powerful.

B. Conservative server architecture. The University of Connecticut had developed as a mainframe/terminal type service architecture and had remained so long after other major universities had moved decisively towards distributed computing on multiple platforms. As such, UConn’s experiences with multiple servers, multiple operating systems, associated applications and the types of networked services used to integrate users and multiple platforms was not as strong as it should have been for the times.

C. Network connectivity. At the start of 1995, the University of Connecticut had wide area networking that connected the academic buildings of the Storrs campus and connected the academic and hospital units of the Health Center campus. The Health center campus was connected to the Storrs campus. Networking also extended to one, and only one, of the three buildings of the Greater Hartford campus and to the Law School campus. No networking at all, either internal or external, was in existence at the other four
regional campus. During 1995/96 networking was extended to all facilities of three of the remaining four regional campuses. The remaining campus and the other two buildings at Greater Hartford are in process of network completion as of 10/96.

D. **Aging network topology.** The lack of network conductivity to the regional campuses has already been noted. In many cases, the wide area networking that had been installed on the Storrs campus during the 1980's and 1990's was based on a traffic pattern that was designed around the older mainframe architecture. Traffic was initially planned to be largely textual and based on equal access to and from a central (both logical and physical) service. As the 1990's moved forward, much of the network traffic was being routed to remote servers whose physical positioning was based on space availability in campus buildings but whose logical position on the network was based on available network connections in the physical space, not on the facilitation of network traffic flow. Much of this new traffic was packet based, transmitting full GUI screens and images. Most of the new servers were based on operating systems and transmission protocols that had not been commonplace on the UConn campus...UNIX, DOS, WINDOWS and NOVELL.

E. **Building and Campus construction/modification.** In 1995 the major library facility within the University of Connecticut libraries, the Homer Babbidge Library (HBL), was slated for major renovation to repair external structural problems. Taking advantage of the construction activity, funds were identified to upgrade the network infrastructure within HBL. This presented library and telecommunications staff with the opportunity to rethink the network topology within a building that contained one of the largest concentrations of servers and client workstations within the University. This was also one of the buildings that had been most effected by the changes in server platform and user interactions. Within HBL, servers and public access client workstations were placed where space and service functions required, not where network topology indicated.

At the regional campuses, networking was being extended but several more facilities projects were underway. The Stamford campus was in the process of planning to move from a suburban location to downtown Stamford. A moderately new department store building was being converted into a complete campus. Within this new facility, planning was underway for all aspects of library and computing services. Similarly at the Avery Point campus a new library building was being designed by architects for construction before the turn of the century.

F. **Reorganization of Human Resources.** As mentioned above, one of the positive drivers was a strategic planning process. That process set, as one of our highest priorities, a review of our organizational structure and our use of human resources. In particular, and in common with the development of many academic libraries, staff relating to networked information were split between those individuals who were identified with the administration and services of the integrated library management system and those individuals who were associated with the administration and delivery of direct information products based on CD-ROM, remote internet and, later, web technologies. With new generations of all products and with client workstations able to access OPACs and web products alike, there was strong need to integrate these functional units in the library. A reorganizational plan brought them together into a unit which was eventually named Information Technology Services (ITS).

At the same time other informational technologies with the libraries were directed towards this integrated unit. Media services, the library's public access computer cluster and copy services were brought into ITS.

Overlapping efforts between the library and computing, specifically in areas such as user support, network planning and user training did exist. However, in this planning effort, such reorganizational activities were limited to the library staff.

G. **An aging Integrated Library System (ILS).** The University of Connecticut Libraries were operating the NOTIS LMS running under IBM MVS. At the time of this planning process this system had no web interface nor Z39.50 connectivity. We were also running NOTIS's MDAS as our principle terminal based, database server. This was an aging ILS. A decision had to be made on replacing this system or taking
steps to upgrade it to extend its usable lifetime. Clearly, this decision would effect other decisions on information access.

**H. Inter-relationship between content and delivery options.** Many of UConn's existing networked information products were becoming available in multiple delivery options ... CD-ROM (networked and stand alone), tape loaded (local and internet remote), web based, telnet to remote server and others. Each options had, and still does have, pricing and service parameters that must be considered. Moreover, for our users, integrating our networked information product line into one obvious, menued, front end service for our users was a high priority. Integrated into this desired front end would be authentication and other issues of license compliance.

**I. Growing and vocal demand for independent access by end users.** Our users, both faculty and students, were increasingly demanding access to our electronic products from remote locations at all hours. Campus offices and residence hall networking was moving forward and access to the University from off campus via dial-up lines was increasing dramatically. As the regional campuses came on line, demand for networked services grew throughout the state. Access had to be increasingly fast, easy and reliable. Services had to be user-friendly and easy to navigate. Interfaces had to be consistent with one another. Success in user driven access bred even greater demand for such services.

**J. The rise of full text.** Here to fore, we had been used to most of our attention given to networked access to bibliographic and other secondary services. Increasingly, we were being asked to provide access to full text data. Faculty were making use of the network to deliver course support through either UConn's Virtual Classroom or Electronic Course Reserves projects. Data was flowing in many flavors. Clearly, we would have to learn to integrate the delivery of all formats of information.
PART II: THE PROCESS

Background

In June 1995, the Director of Libraries convened a small group of staff for the purpose of discussing the nature of networked information and the future needs of the Library. From this initial meeting several preliminary conclusions were made and these included the following.

First, the focus on investigating networked information and infrastructure did not imply that the vast majority of materials in print and other formats were less important but only that the financial allocations for electronic information were directly related to the issue of infrastructure.

Second, while many changes were occurring in the marketplace, it was clear that, in contrast to the past, new decisions about creating and distributing information throughout the library system would not be driven exclusively by the expansion, replacement, or acquisition of a new integrated library system or Library Management System (hereafter LMS). For reasons of economy, timing, and especially the lack of mature product alternatives in the marketplace at the time, an investigation of a successor LMS system would likely be the focus of a separate task force in the future. In this regard, the challenge to the IATF was to develop a framework that would support both short term (6 to 36 months) and longer term goals (greater than 36 months) and remain flexible enough to accommodate the acquisition of a new LMS at a later date.

Third, it was also fairly obvious that several departments within the Library were eager to offer and/or develop electronic information services somewhat independently of each other. Continuation of these entrepreneurial efforts in an uncoordinated fashion would only energy and resources from the development of an infrastructure that could support a system-wide distribution of most information products and services.

Subsequently, the Information Architecture Task Force was formally established to recommend a computer networking framework or information architecture that would support and enhance public and staff access to electronic information services during the next 24 to 36 months. Included in this study would be the identification of “classes” of electronic services “in relation to hardware, software, networking and a common user front end.

A. Matrix of Deliverables

The IATF arranged its work into three phases. In its first phase, the IATF developed a so-called “matrix of deliverables” or list of electronic products and services which the Library makes available from both stand-alone and/or networked workstations. In addition, the IATF also included those types of resources and products that could be identified and defined by faculty, staff, and students as useful resources. The list of deliverables appears in Table 1 below.

<table>
<thead>
<tr>
<th>TABLE 1: LIST OF DELIVERABLES</th>
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<tbody>
<tr>
<td>Staff Local Area Network files:</td>
</tr>
</tbody>
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Staff Directory
Department descriptions and Organization charts
Personnel Materials (e.g. Manager's Handbook)
LC Classification Summary
Committee Rosters & Activities
Minutes of meetings (archival copy)
Planning Materials (e.g. Strategic Planning)

Technical Services Web:
Cataloger workstation resources including LCSH, LCRI, AACR2,
  authority files; Homer cataloging manual, plus access to OCLC,
  Homer, Spirit, Internet, etc.
Acquisitions workstation resources: BIP+, Folio/YBP, BNA databases, etc.
Preservation workstation resources: ABLE, procedure manual
Library Systems resources: List of supported products, list of departmental
  liaisons, training schedule, and course descriptions.

Administrative Resources:
  Floorplans of the libraries, both public and staff areas.
  List of resource people

Various Information Databases:
  Homer (UCAT & JREF)
  CD-ROM Databases
  Electronic Text Archives
  Graphic Image Database
  MAGIC (Map & Geographic Information Center) Resources
  Numerical Databases

Bibliographic Catalogs & Indexes:
  Local MARC catalog (links to multimedia files)
  Local Non-MARC databases
  Remote MARC catalogs

Text Files in multiple formats:
  ASCII files; Bitmapped page images; Text in Word-Processed Format;
  Marked or structured text; SGML-marked text; HTML-marked text.

Multimedia:
  Combining Text; Audio; Images; and Motion.

B. Options for Delivery

Following the creation of this list, it was superimposed on a graphic which illustrated no fewer than eight
  computer interfaces that patrons and staff faced in using the current list of electronic products and services
  (Tables 2A & 2B).

| Table 2A
Examples of Library Access to Electronic Resources, 1995 |
This information was distributed to the staff and a hearing was held to collect opinions and comments and the results are presented in Tables 3A & 3B. The principal suggestions included: the need to move to as few computer interfaces as possible; specific ideas as to where products might best be collocated and arranged; the need to distribute as much information over the library and campus network as possible; and the overall desirability to reduce, to the extent possible, the number of stand-alone and special purpose computers and interfaces. Of particular interest was the desirability of migrating heavily used resources from the CD-ROM based stand-alone and CD-ROM local area networks to a robust library and campus network that could distribute information systemwide. Following these hearings the Task Force reached consensus regarding the feasibility of reducing the number of computer interfaces from eight to three.

C. Survey of Benchmark Institutions

While the IATF examined library and local campus options, we also wanted to discuss options that were being pursued by other institutions who were similarly designing the framework for library and campus information systems. To this end we identified a list of 12 library and university settings that were very similar to UConn. Some of the factors that we used for selecting these institutions were the following:

- Nature of the integrated library system (type and version)
- Nature of the library network(s);
- Nature of the campus network(s);
- Plans, if any, for moving to a new platform of information delivery for networked based information resources (e.g. Web-based);
- How were they organized to discuss & investigate these options.

Please note that we were not comparing programmatic similarities as opposed to network and information delivery commonalities. During this part of the investigation, the IATF collected and examined descriptions of other universities and university libraries’ information architectures. In many cases, the individual who
completed the survey contributed additional comments and suggestions which explained the history and rationale for particular courses of action at a particular department or university. Originally designed to take two months, August and September, this phase of data collection lasted through the end of October. Initially, 10 representative institutions were contacted and their suggestions and comments served as a point of departure for further investigation. Eventually representatives from 18 institutions (Table 4) were contacted.

**TABLE 4: List of Institutions Contacted during the Survey**

<table>
<thead>
<tr>
<th>Institution</th>
<th>University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case Western</td>
<td>Univ. of Delaware</td>
</tr>
<tr>
<td>Clemson</td>
<td>Univ. of Georgia</td>
</tr>
<tr>
<td>Emory</td>
<td>Univ. of Indiana</td>
</tr>
<tr>
<td>Georgia Tech.</td>
<td>Univ. of Pennsylvania</td>
</tr>
<tr>
<td>North Carolina State</td>
<td>Univ. of South Carolina</td>
</tr>
<tr>
<td>Rutgers</td>
<td>Univ. of Southern California</td>
</tr>
<tr>
<td>Stanford</td>
<td>Univ. of Vermont</td>
</tr>
<tr>
<td>Univ. of Arizona</td>
<td>Univ. of Washington</td>
</tr>
<tr>
<td>Univ. of California, Berkeley</td>
<td></td>
</tr>
<tr>
<td>Yale University</td>
<td></td>
</tr>
</tbody>
</table>

**D. Survey Took Us to a Broader View**

In order to ensure some form of comparability, the IATF developed a survey which was used to form a baseline description of each campus and library. The results and especially the comments regarding plans and directions were reviewed. The survey instrument was not designed to be a destination but rather a starting point for a conversation with each individual that we contacted. More often than not, only some of the questions could be answered which reflected the fact that only a few institutions had completed their own analysis of their respective network design. Even fewer institutions had developed campus-wide strategies that they had already begun to implement. Another point worth noting is that we used the information gained from the surveys and interviews as a reference and referral point to other institutions that were involved in similar investigations. Not surprisingly, the comments and suggestions from colleagues at other institutions were invaluable in considering other options. While several of the projects and plans were unique to individual campus situations, there were also several common elements among the benchmark institutions. These will be reported in the next section. On a local level, the information collected help us identify critical components for a further investigation within the UConn Libraries. However, instead of pursuing a theoretical model for an information architecture, the IATF focused on developing those components that would accomplish the following:

- First, build onto the existing infrastructure, workstation configurations, and user interfaces as opposed to developing something entirely new.
- Second, develop a framework that could deliver benefits to users within 6-12 months.
• Third, develop a structure that would also best position the library to take advantage of new opportunities, alone or in cooperation with other institutions, for delivering information via the World Wide Web.

• Fourth, enable the library staff to gain experience with components that will enhance our options to migrate to a fully distributed LMS (Library Management System) at some appropriate time in the near future.

• Fifth, develop an efficient mechanism for the improved management, development, and funding of information technology and the corresponding electronic information resources whether available physically within the UConn system or accessible remotely.

E. Results -- Transition to the IATF Report

In the investigation, “Environmental scanning report,” prepared for the University of Connecticut’s Strategic Planning Committee, Professor William Massy identified Information Technology as one of seven factors that are affecting higher education nationally. He states that “Institutions are investing substantial sums on network and other IT [information technology] infrastructure, to obtain the benefits of connectivity and position themselves to take advantage of future developments. Connectivity provides the capacity for "... resource sharing with other institutions via the Internet, and it is a prerequisite for distributed administrative data processing and for making library catalogues and collections broadly available." Indeed, many librarians have noted the changing approach of libraries, in the past 5-7 years, to utilize technology for developing "access" in addition to or even in lieu of ownership of materials. Alas, information does not organize itself and the electronic equivalent to printed sources doesn't always exist. So, "while the hardware technology and software already exist and can be utilized, the mere existence of hardware and software does not point in an unambiguous direction for future implementation." Furthermore, while libraries and computer centers have long realized the value of information technology, investment in “technology competes for ever-scarcer financial resources, along with such essentials as salaries, financial aid, physical plants and library holdings.”

Conceptually, the potential for information technology in higher education is that "IT eases the limits of time and space for education activities .... and it also enables self-paced learning with sensitivity to different learning styles and continuous assessment of student progress." Both of these factors have led some to conclude that the investment in IT is justified because it can enhance productivity in the traditional academic environment where the flat or declining resources have become the rule rather than the exception.

On the other hand, “while information technology offers great potential for improving higher education’s value for money, so far the result has been more promise than achievement.” For this reason it is important that as we recommend the utilization of information technology to improve services, we keep in mind the need to measure their benefits and communicate the value of these investments in a meaningful way. As one report noted, “perhaps the most important payoff from the investment in technology will be found, not on the balance sheet, but among more qualitative measures .... [such as] How have technologies furthered the institutional mission? .... or increased the ability to share resources?” Therefore, while it is not part of our charge of responsibility or currently assigned to any existing task force, the IATF strongly recommends to the Library Administration the importance of developing such benchmarks or measurements as soon as possible, perhaps in conjunction with aspects of the User Feedback Team, in conjunction with the Systems Department, and other groups.

F. Caveats Regarding the Findings
As noted earlier, the IATF was asked to examine some information architectures and strategies at other universities that had been successful in enabling the Library or the campus to make effective use of information technology. We proceeded by collecting information from three areas: First, there were several published sources, both print and electronic, which identified key institutions. Second, we selected organizations which had similar library management information systems and were planning or developing the next phase of information-based services; and Third, we contacted colleagues and asked them for recommendations as to which institutions might be good candidates for further investigation.

The extensive literature revealed a remarkable number of similarities among institutions. However, before we describe the characteristics of these organizations, it is important to state the following caveats.

- First, there are few qualitative or quantitative measures of success for the utilization of information technology. Ratios of publicly available computers to the number of students, the number of data jacks per students, or the number of multimedia classrooms per 1,000 students were not uniformly available.

- Second, in spite of the lack of measures, administrators and authors appeared to have strong feelings about which universities were making extensive and effective use of information technology on campus.

- Third, administrators were convinced that, while technology may not boost productivity, it does provide new opportunities for service enhancements on the operational side and on the educational side, and that it is an indispensable tool that should be acquired by all students.

- And fourth, we need to emphasize that the task force is not recommending that we follow a specific model. While we can learn from the success of others, every other campus has a unique history, culture, and explanation for the current status of their infrastructure. Instead, we prefer to identify characteristics or components of progressive campus network infrastructures which could help serve as goals for UConn.

**PART III: SELECTIONS FROM THE IATF REPORT**

**A. Institutional Factors**

For the university in general, and the computing environment in particular, the following characteristics were the most frequently mentioned as positive factors for the growth of information technology:

- First, the leading institutions had strategic planning processes in place that recognized information technology as a "strategic resource." As one author has noted, less successful organizations either view technology only "as an aide to operations" or "as a source of confusion." ¹⁰

- Second, there appeared to be a recognition on the part of senior administrators about the roles and potential applications of computer technologies. Thus, there were linkages between university strategic plans and those of the computer center and other information providers.

- Third, the university computer centers were keenly aware of the goals of the whole organization, uses of computing on campus, and funding limitations, and they provided critical and clear long-range plans for use by campus administrators. A good example of this was at The Pennsylvania State University where funding followed visionary planning such that "over the past decade, Penn State has won more than eighteen awards for innovative use of technology to enhance teaching and learning." ¹¹ This is in contrast to most computer centers which merely create laundry lists of projects without relating them to university or departmental goals.

- Fourth, at the successful organizations there was also a culture of risk-taking or risk-management that viewed information technology as an enabling tool and not an end in itself. In general, there were also patterns of experimentation at these campuses. While others debated the pros and cons of centralized
versus distributed computing, for example, most of these campuses began experiments with distributed client-server models of computing in the mid-late 1980's.

• Fifth, there were numerous examples of cooperation among various information providers and academic departments on campus.

• Sixth, there was a governance structure in place where end-users (generally faculty and staff) were able to provide input into the planning process via well-informed and well-functioning advisory groups.12

• And seventh, there tended to be a commitment to improving "end-user computing and distributed processing" rather that asserting "strict centralized control."13

B. Library Factors: Desirable features of an information architecture.

There isn't a cookbook or even a few recipes for the design of a successful campus infrastructure. Indeed, the design of strategies for a campus infrastructure are complex. As noted above, there are several factors including the need for senior staff, who are responsible for computing and the delivery of information, to be excellent managers, planners, and visionaries. Still, because we have so much ground to make up, there are several components and features of an enhanced campus infrastructure that would provide the library and other major departments on campus with positive, immediate, and enabling networking and computing support. These include the following:

B.1. The Future Campus Infrastructure.

The installation of a high-speed (>100 Mbps) multi-protocol network to handle both on-campus and Internet access, including the integration and activation of multimedia, voice, data, and video.

• Access to networked information and computing facilities exists that enables the same services to the regional campuses and from remote locations as well as the Storrs campus.

• A distributed computing environment exists including production-level implementation of file systems, directory services, remote procedure calls, and security. In addition, archival and backup systems are in place which support centralized computing resources.

• Message-enabled applications, electronic mail, groupware, and forms are in place.

• A campus wide information system is in place, using widely familiar access tools that are easy to use and providing an initial entry point to most of the institution’s general information resources.

• Small, scalable computers built on open systems and protocols are used as file, data, and cycle servers.

| Table 5 |
| Network Protocols |

B.2. The Future Library Infrastructure

Similar to the campus network, the network services supporting the libraries should be enhanced to ensure that sufficient data communication infrastructure is in place to support the transport and efficient delivery of a wide range of information services including bibliographic, text, image, and sound. Results of the environmental scan indicate that the following are critical to both our immediate and long-term services:

• Direct fiber-optic connections to all of the library’s servers with connections back to the high-speed campus backbone;
• 100 Mbps capability to all of the library-supported servers and selected workstations;

• Systematic migration from 16 Mbps token-ring to fast ethernet wherever possible, especially at time of workstation replacement;

• Direct fiber-optic connections to the desktop for selective specialized servers and workstations (e.g. GIS workstations; image and sound archives).

• Utilization of latest E.I.A. recommended wiring standards (currently category 5 wire for data) whenever possible.

• Installation of voice/data/video jacks in all public service classrooms, offices, and meeting rooms.

• Installation of at least 1 voice/data/video jack in all staff offices and areas. Areas and offices larger than 10’x10’ may require 2 or more of these jacks.

B.3. Server and Network Protocols
The library’s servers provide search engines for locating information in a wide variety of locations on and off campus, both through its own catalog and through other finding tools.

• In order to prepare the Library for the opportunities of the next 3-4 years, we need to have in place servers which supports the z39.50 protocol as a complement to its LMS. Among the growing number of alternatives, the clear choice is for the z39.50 software of Ameritech known as PacLink.

• A significant complement to PacLink would be the addition of an ALS product called InfoShare.

• The Library will need to make a continuing and planned financial commitment to sufficient mass storage capacity for the respective library servers.

• A plan and timetable should be developed for establishing which databases can and should be mounted on the appropriate servers or local area networks for system wide distribution, and which databases should be maintained on stand-alone workstations.

• A long-range plan, covering 3-5 years, should also be developed for upgrading, migrating, and/or replacing the Library’s information servers and networks.

B.4. User Interfaces
Our data collection indicates that while a universal interface may be desirable, it isn’t practical or affordable. However, the creation of a few common interfaces to the multiplicity of information products is both realistic and desirable from the perspective of the user. Here it’s important to note that we are not endorsing just the ability to point to another information resource which requires the user to learn new search commands. Instead, we are promoting the full utilization of common search and retrieval protocols such as those provided by a Web-interface connected to a z39.50 server. With z39.50, the user enters local search commands which are translated and applied by the search engine across other databases.

B.5. Workstation Standards
The University Libraries need to support a number of workstation configurations for public use. We acknowledge that there is a fiscal reality whereby we will continue to have an installed base of public workstations that is replaced in stages, not all at once. Therefore, it seems prudent to assess those electronic services and products that we deem to be “essential” or “core”, then ensure that all “basic” workstations are able to accommodate that functionality. Further, advanced functionality can be offered on high-end workstations, and computational intensive applications can reside on a small number of SuperHomer workstations. This strategy is based on the functionality required of the workstation.
In this scenario, as we suggest products that need to be incorporated into the suite of core services, we can ensure that the budget proposal includes any appropriate upgrades to the basic workstations. It makes sense that over time, we would replace the very high-end workstations, and those would trickle-down and become the new standard for the basic workstations.

HOMER Basic — Basic workstations would provide access to HOMER including JREF, InfoShare, z39.50 and non-z39.50 databases and resources that the library has paid for or purchased outright. The products and services that we define as “core” or “essential” should be available on these workstations, and should be the standard menu for users that attach remotely to our systems.

Super HOMER — these advanced workstations would provide access to all of the HOMER Basic resources, and in addition, all of the relevant Internet-accessed resources. These computers run client software for specialized databases (e.g. on a SuperHomer workstation a person could run PUN, the UnCover client, whereas on BasicHomer, a person would TELNET to UnCover). Likewise, it is the SuperHomer workstations that will provide support for ECR (Electronic Course Reserve), Oracle™ or any other locally developed SQL databases accessed by a database front-end, and full WEB functionality.

Specialized Workstations — While the concept of a single scholar’s work- station to support all types of users and uses is attractive from a service and support viewpoint, it is not realistic or affordable. Likewise, while we may strive to support two major categories of workstations, BasicHomer and SuperHomer, we recognize that this framework should not preclude those cases when specialized workstations, with unique components or client software, may be necessary.

B.6. Other Networked Access Points:
Electronic classrooms and other facilities have become an essential part of the infrastructure in support of library instruction. Typically these facilities are located within or adjacent to libraries. In the latter case, they provide service to both computer and library departments and frequently are jointly operated. While there are many possible configurations, a typical electronic classroom facility will have the following features:
- Network-connected workstations
- Projection equipment that will support multimedia presentations including the delivery of graphics, sound, and full-motion video.
- Workstations with large-monitors in support of viewing special formats.
- Workstations that are designed to assist learning by clients with hearing or visual impairments.
- Computer laboratories that support database searching, productivity tools (e.g. wordprocessing), access to the library’s information databases, and connections to the campus network.

In addition to classroom facilities, it will be extremely useful that a new infrastructure would also support videoconferencing and distance learning capabilities. For example, programs that are provided from one location (e.g. HBL, or Culpeper) could be broadcast to similar facilities located at other campuses.

B.7. Staff Support
From the perspective of users of public and staff workstations, it will be critical for the library to address comprehensively the issue of how best to provide technical assistance. At the present time, two different departments within the library provide support for staff and public workstations and there is additional technical assistance as follows:
- The computing center and libraries have in place support centers and help desks to help faculty, staff, and students solve technological problems related to the use and manipulation of information.
- The support services of information professionals are readily available, both in the computing, network support, and library areas, and training programs for the use of new technologies have been developed and offered.

B.8. Planning and Advisory Committee Support
In addition to the factors noted above, other organizations have cited the need for the planning and coordination of networked activities. The philosophies and functions of these groups can be summarized as follows:

- A commitment to and understanding of the importance of information resources at the institution is evident at the highest level and integral to the strategic planning process.
- Advisory committees for academic, administrative, library, access, and other services are in place to guide and advise the priorities of the information resource areas.
- A user-survey and benchmarking process is in place to assess the effectiveness of the information resources areas.
- Groups have been charged with looking into emerging new technologies and test beds have been established for the more promising of these.

C. Comparisons to other Universities

In contrast with the University of Connecticut, some other academic institutions have combined the decentralized environment with a structured approach to resource allocation. They have employed the concept of “right-sizing” which pushes computing and resources out to departmental support centers. In order to foster a culture of cooperative and collaborative computing and sharing of computing resources, these institutions prioritize resource allocation for requests based on evidence of multi-department collaboration. Standardization is not mandated, but rather, funding is more readily available for projects and products that fall within established standards. Furthermore, centralized technical support is offered only for these standard products.

Further differences exist in other institutions’ administration and oversight of networked information resources. These differences include: Steering committees charged with planning, goal setting, technical evaluation and budget recommendations; an administrative officer (Chief Information Officer) with oversight of all information technology; and combined information units (library, computing center, media center).

The libraries at these other institutions participate in collaborative budget requests for networked information resources such as commercial databases and numerical data (University of Michigan).14 Further, there are examples of collaborative efforts whereby staff from the library and computing center visit academic departments as a team, to investigate the technical and informational needs of those faculty (Yale). There are also examples of technical and information support centers that are staffed jointly by the library and computing center (University of Southern California) and/or examples where the computing center’s “help desk” has been moved into the library’s public service space (University of Pittsburgh).

While the examples above suggest that alternative structures exist for fostering the development of collaboration and resource sharing on campus, this is not the primary point of reviewing computing environments of other academic institutions. The principal difference appears to be a campus history and culture which encourages collaboration and resource sharing rather than administrative control from the central computing institutions. Clearly, some changes in structure can help but what is required is an administrative commitment that such a culture is desirable and should be supported through rewards and incentives.

There are literally dozens of college and university campuses which have invested significantly in building networking infrastructures to support a wide range of academic and administrative computing needs.15 They range in scope and size from small colleges to large universities. Some offer 2-year associate of arts degrees and some are doctoral-degree granting institutions. They include both privately funded and publicly supported state institutions. Regardless of their mission, scope, and size, these institutions have boldly committed to the use and integration of information technology as an integral component of undergraduate education. Not surprisingly, the libraries and information centers which are part of these same institutions also tend to be at the cutting edge of supporting the electronic access and delivery of
information resources across the campus and beyond. A dynamic infrastructure tends to serve as an enabling agent for information providers of all kinds.

PART IV: THE OUTCOME

The result of our investigations led us into two simultaneous directions, the implementation of local plans to reconceptualize our information architecture and the identification of strategies to address the institutional factors for success that have been previously identified. The outcome of our local considerations led us to the following action items:

A. Content and delivery decisions: It became clear to us that while individual content issues should not drive delivery decisions for the entire architecture, and while delivery infrastructure should not force us into one sided content decisions, if success were to be strengthened, the two areas had to be coordinated. We addressed that issue by developing two cross functional teams within the University Libraries. The Networked Services Team (NST) focuses on content. Their charge was to begin managing the growing portfolio of library funded digital information resources and services. NST makes recommendations for on-going and new products based solely on academic, collection development criteria.

The Information Server Team (IST) focuses on networked infrastructure, gateway access to resources and user clients. The charge to IST was to develop and maintain an information infrastructure based on the integration of network topologies, server platforms, server applications and client workstation applications. The job of IST is to create a robust and logically consistent whole that enables end-users to easily identify resources available to them and then to access those services in as simple and consistent manner as possible.

Both NST and IST share members who, while they primarily represent one team or the other, have a responsibility to communication discussions that are important if content and delivery are to function together smoothly. New products with different file formats or new access clients are brought to the attention of the IST so that delivery implications can be addressed and potential problems communicated back to the NST to assist in the final prioritizations. Changes in delivery patterns (for example, Internet overload or the development of SilverPlatter remote access) are brought from IST to inform NST of opportunities or limitations to current or prospective products.

B. Regional Campus Libraries: Every effort has been made to integrate all regional campus libraries into one virtual library. Regional Campus networking is being completed and the regional campus libraries are being integrated into the University Libraries library system. Most importantly, all networked information systems are being developed and implemented to be delivered consistently to all campus sites. Saving from unnecessary duplication will be folded back into content acquisition. However, the obvious result of the extension of networked services to regional campus libraries is to enable students at all campuses to learn to utilize a consistent set of networked information tools.

C. Library staff reorganization: As of August 1996, there is now one unit in the University Libraries designated to directly manage technology, Information Technology Service (ITS). The function of ITS is to manage the development and on-going support of: the NOTIS ILS in cooperation with the University Computing Center; the Library’s networking in conjunction with the University’s Office of Telecommunications; the 400 installed library workstations and public computing stations; all library servers including CD-ROM and UNIX based Web servers; all client applications; all media equipment; all photocopy and printing devices; direct user support and on-demand public equipment troubleshooting.

D. Network, client and server planning: The Information Server Team with members from many library functional units and the Information Technology Services Unit as described above have reviewed the integration of the libraries servers with campus network topology and with respect to local and remote client access and have developed a plan to enhance information delivery. This plan calls for servers to be
centralized at a node of the University’s (BANDWIDTH???) telecommunications backbone with switched ethernet connectivity. Primary feeds directly from the ethernet switch will carry information to the libraries’ client workstation clusters to reduce external traffic. Clients will be populated with a standard suite of software administered via Windows NT servers.

E. Current efforts for customer support: Specific efforts to improve the delivery of networked information or information over the network are focused on the following:

Domain Name Serving. With network traffic more important, there must be easy and reliable access to a domain name server to provide accurate and timely network addressing.

Distributed printing. As more information becomes available in full text or image formats, users must be able to direct files to high resolution printers strategically located around campus or otherwise geographically dispersed.

Authentication. As more faculty and students enter the campus network via ISPs, and as the library wishes to restrict even in-library access to the University Community, access to networked information services must be controlled by a robust authentication system.

Client application upgrades. A system of software licensing and distribution must enable faculty and students to acquire, configure and utilize client software that enables optimal use of available services.

Electronic Course Reserves or the Virtual Classroom. Faculty must be trained and supported to make course related information available over the network in support of student learning. In addition to the technical skills of mounting and serving such information, faculty must be instructed to adhere to an articulated university policy on intellectual property and fair use.

Document delivery. As the library continues to move from an information ownership to an information access model, the information architecture must facilitate direct end user identification of needed information and subsequent delivery to the users desktop with appropriate accounting of associated costs.

F. Broader Campus Issues: The institutional factors for success mentioned above are still the keys to success in any of the library’s or the University’s efforts to build effective information architectures. The library must be able to make successful strategic investments in networking, hardware, software, information licenses and, most importantly, in employees to make the architecture work. Good strategic investments begin with a notion of one’s overall level of strategic investment. The investment and expected outcomes must match. One can intend a low level of strategic involvement in information technology and still be successful if one appropriately scales infrastructure investments and expectations to match. However, success is more likely if there is a recognition of the long term, transformative benefits in a high level of information technology investment. It is crucial for institutions to articulate their investment level and to see that investment level through over the long term.

The University of Connecticut has had a poor record in adhering to the above factors but we are aware of what is ahead of us. The University is in the implementation phase of a strategic plan, Goal 2000 that was crafted under the direction of the University’s Board of Trustees. That plan does not in and of itself articulate a strategic investment level for information technology. A new Chancellor / Provost and a new President are implementing that plan. The senior administration does individually recognize the strategic importance of information technology but we have not identified an accountable individual for a strategic implementation. Without such an individual, and in a period of constrained finances, coordination and prioritization of IT efforts are very difficult. The University is attempting to refine its goals in order to leverage limited funds. There is not yet a climate of cooperation among the IT providers but the lack of close cooperation is spoken of openly and we are working towards improvement. Governance structures in information technology are still weak and the roles of those structures that exist are often unclear. There is a recognition of the importance of strengthening end-user computing but we have a mainframe tradition and we are behind the curve.
The University of Connecticut is working diligently to improve our effectiveness in the application of information technology to our primary missions. Clearly, networked information is one of the key enablers to redefining the processes of research, learning and service in today's technology rich environment. We recognize our own weaknesses. We do so not to criticize our own University but to recognize, through the observation of the converse, the importance of the institutional success factors identified in our survey.

References:

2. Ibid., p. 5.
3. Ibid., p. 7.
5. HEIRAlliance Executive Strategies Report #4, “What presidents need to know ... about the payoff on the information technology investment, May 1994.
7. Ibid.
12. op. cit.
13. Ibid.