Meeting Summary

The National Academies
Steering Committee

on

Impact of Information Technology on the Future of the Research University

August 24-25, 2000

Hosted by Lucent Technologies and IBM

List of Attendees
James Duderstadt
Daniel Atkins
Marye Anne Fox
Nils Hasselmo
Paul Horn*
Shirley Ann Jackson
Marshall Smith
Lee S. Sproull
Doug Van Houweling
Robert Weisbuch
William Wulf*
Raymond E. Fornes

Guests
Ruzena Bajcsy**- National Science Foundation
Steve Mahaney -National Science Foundation
Deborah Diserens - National Research Council Staff (Debbie)
Hadass Sheffer Woodrow Wilson Foundation
Art Sanderson   Rensselaer

*   (IBM portions only)
**   (Bell Labs portion only)

General Overview

Through the efforts of Committee members Gerald Butters of Lucent Technologies and Paul Horn of IBM, their respective companies jointly hosted a meeting of the Steering Committee of the Impact of Information Technology on the Future of the Research University (ITFRU) Project.   The primary purpose of this meeting was for the committee to learn about examples of current and anticipated cutting edge IT technology advances that will likely have significant impact on the research enterprise, and in particular, the Research University. IT experts from both Bell and IBM Laboratories participated in the program. The agenda for the meetings is shown in Appendix A.

The program began at Bell Laboratories in Murray Hill, NJ on the afternoon of August 24, 2000. Vice President William Brinkman served as the host. The remaining parts of the program took place at two IBM sites, the first at the IBM Executive Conference Center in Palisades, NY during the evening of August 24 and the second at the IBM Watson Laboratories in Yorktown Heights, NY on August 25, 2000. The program concluded with meeting of the Steering Committee.

Program at Bell Laboratories

Overview:

The meeting started with an overview of IT developments at Bell Laboratories presented by Bill Brinkman, Vice President for Physical Sciences Research, and was followed by an exchange with him and the Committee.   Points cited by Brinkman included the rapid advances in wireless communication technology (consistent with that described in the May 5, 2000 meeting of the IT subgroup at Sloan Foundation). It was noted that wireless IT developments are occurring much more rapidly abroad than in the U.S. Major efforts are being placed on increasing the "bit rate" in wireless technologies. While the total computation power of wireless devices will soon surpass that of all other computer systems, the limitation of the latter on "bit rate" for high streaming data transmission will not be cost competitive for the foreseeable future.

A second major advancement described relates to the dramatic changes in optical communications and networking including development of routers and high speed switching devices, many of which will be enhanced by coupling to MEMS (Micro-Electro-Mechanical Systems) devices.   Other anticipated IT advances will include distributed computing and software development involving in many cases the storage and mining of enormous amounts of data, and advances in multimedia IT (audio, speech recognition, and video). All these are expected to impact the Research University significantly.

It was suggested that a single optical fiber will have a fundamental limiting bandwidth capacity of ca. 10 teraflops/s. However, that limit is so far out in the future that significant increases in bandwidth capability will occur before it is approached, and new, unanticipated developments may well occur in the interim.

Some discussion took place regarding the most appropriate experiences for today's graduate students. While industry requires very quick response times, they need employees that have breadth and are flexible. In particular, the need to attract more women in the IT workforce was cited.

Presentations and Demos:

1.   <u>MultiMedia Collaboration / Lab Visit</u>   (Tom Szymanski)

Demonstrated here were examples of multi-point video accompanied by stereo audio, streaming video with rates up to 15 frames per second, and voice recognition for email log on and for providing responses to personalized questions.

2.   <u>Distributed Computing/Software Backplanes</u>   (Joe Olive)

Much of this presentation and subsequent discussion centered around how a multitude of data repositories, which will accumulate and store massive amount of data, will be able to deliver its data. There remains a real need to validate data, to mine it with appropriate code, to secure the data, distribute the data and provide the computational services. Issues of who is to pay for these data/data mining services points to a major infrastructure problem, as well as who will or should become the "data police." While a number of research communities are currently networked, few long-range plans have been developed and accepted for most data collection/storage. The analogy between this problem and problems in "open source computing" were noted.

3.   <u>Wavelength Switching and Routing / Lab Visit</u>   (Dave Bishop)

An overview of MEMS was presented. It was noted that a large number of vendors are now developing MEMS processing technologies. An impressive demonstration was shown of one of the early practical optical-switching technologies using MEMS. Each switch is a gold-plate mirror on one end place on a tiny, pivoting bar. The mirrored end fits in a space, about one-tenth as wide as a human hair, between two hair-thin optical fibers lined up end to end. When the switch is off, the mirror rests below the cores of the two fibers, allowing lightwave signals to travel from the core of one to the other. To turn the switch on, a voltage is applied at the other end of the bar, beneath an attached plate; the electrostatic forces pull the plate down, lifting the bar so the mirror reflects the light instead of letting it move from one fiber to the other. It was suggested that the technology would apply to a wide variety of computer devices and systems and would allow tremendous power savings.

4.   <u>Integrated Wireless Networks</u>   <u>(Rich Howard)</u>

A number of examples of the use and growth trends in wireless networking was presented including communications by phones, pagers, faxes, email and chat rooms and involving people to people, people to machine, machine to machine communications. The rapid growth rate in wireless communication was again noted in comparison to growth rates of IT transmission by hard wire.

A final point noted was the major shift over the past few years by industry in overall IT research investment in software development versus investments in hardware development (at both Lucent Technologies and IBM).

Evening Program at IBM Palisades Executive Conference Center

This consisted of a presentation to the Steering Committee by Doug Van Houweling followed by discussion. A transcript is provided in Appendix B.

Program at IBM Watson Laboratories

Overview
        Paul Horn, Vice President for Research, gave a brief overview of IBM worldwide research describing activities at Watson, Almaden, Austin, Zurick, Haifa, Beijing, Tokyo and Dehli. He noted the strong connections between IT research in industry and universities. He then outlined the program for the Steering Committee and introduced the presenters. The program was organized around four general themes that illustrate IT development that are particularly relevant to research and education in universities:

- Evolution of business models for universities
- Mew methodologies for collaborative research and learning
- New means for gathering and managing information
- The growing importance of Intellectual Property

The agenda is shown in Appendix A.

Presentations and Demos:
1.   <u>Web Intermediates (WBI)</u>   (D. Russell)
        Web Intermediaries is an example development of a programmable web proxy and web server that provides an architecture and framework for creating intermediary applications on the web connecting information with the user. It is designed to add functionality to a system when the data producer (e.g., server or database) or the data consumer (e.g., browser) cannot be modified. It can be positioned anywhere along an information stream. It can be programmed to tailor, customize, personalize, integrate and aggregate or otherwise enhance data as they flow along the stream. An example application is the transformation of information from one form to another by a process called transcoding.

2.   <u>Video Authoring Tools (Cue Video)</u>   (A. Amir)
        The example of CueVideo is an attempt to address the challenges that arise in the indexing and effective use of large video databases. With advances in hardware and network technology, low-cost video capture devices, and the rapid emergence of high bandwidth availability on the web, an emerging area in education is distance or distributed learning employing video, audio, text and foils.
        Two bottlenecks cited that currently limit video from becoming an integral part of distributed learning are:

a) the cost and time to index and hyperlink the video; and
b) enabling users to easily search and browse the video content,

---not the cost of basic hardware and software.   CueVideo is an example of development of full automation in near real time of the indexing and hyperlinking process combining video and audio analysis, and speech recognition. It provides an off-line indexing engine that computes indices, hyperlinks and data for browsing, and an interactive user interface that provides the user tools for searching and browsing videos and that can be run on standard web browsers using standard media plug-ins.

3.	Intelligent Interconnection Software (T-Spaces)	(T. Truong)
	T-Spaces is an example of network middleware development designed to enable communication between applications and devices in a network of heterogeneous computers and operating systems, as is normally found in university computing environments. It addresses the need to provide group communication services, database services, URL-based file transfer services, and event notification services. It is designed to possess platform independence, as well as a standard type representation for all datatypes, and can bring network services to small and embedded systems; for example, to palm devices, making them fully-fledged network computers and particular useful to students.

4.	University - Research IP Interactions	(M. Schecter)
	(Open Source vs. Proprietary Technology)
	This presentation addressed a number of intellectual property issues between industry and the universities. While the number of patents owned by and licensing agreements assigned by universities is rapidly growing, the total number represents a very small fraction of the enterprise. The speaker noted that universities were acting more like business, and that more conflicts were occurring leading to increasing litigation. With the enormous variation in the range of university-industry agreements, he suggested the movement toward more homogenization and uniformity would strengthen the universities' hand. He identified future issues in the IT area include:

•	What will be the balance of university objectives
•	What will become the scope of IP in universities
•	Will universities view corporations as allies or targets of competition
•	How will accounting issues in joint projects with universities-industry be addressed
•	How will warranty and indemnity issues be addressed
•	How will standards, open source computing and free electronic access be addressed.

5.	Knowledge Management & Portals	(A. Marwick)
	The explosion of all kinds of data accessible to the individual makes data management an ever increasing challenge, especially to those in universities. (e.g., scientific, text, music, video, other). These data exist in file systems, object servers and the web in addition to databases. There is a distinct advantage in having the capability to manage all these data like one is able to manage database data. Described were developments to link these data and to create a way to manage the linkage to provide security, access control and recovery (transaction) semantics for all the data, and to provide content management search engines that incorporates modeling and indexing.
	Knowledge management was looked at in five categories:

•	Data warehousing
•	Collaborations
•	Knowledge Discovery
•	Knowledge Transfer
•	Mapping Expertise

Portals are becoming available that not only access diverse data/data sources, but also allow user groups to use and manipulate the data. This approach also promotes non-linear or asynchronous learning as well as provides access to peers. Issues of both privacy and data quality become increasingly common. While significant progress has been made in both text recognition and voice translation, a number of problems remain in these two lateral areas.

6.   Electronic Commerce: "What does it mean to Universities?" (S. Feldman}
        The explosion in growth in e-commence was cited (estimated ca. 175%/year) as well as the continuation of this growth over the next decade. It was noted that while universities are lagging the business world in the extent of use of e-commerce, there are a number of major opportunities for research universities. Among these are:

- Technologies to operate the universities
- The University as a competitive vendor
- E-commerce as a hot teaching topic (from BS to Ph. D.)
- E-commerce as a major research field
- Special issues such as security, privacy, IP rights, services, and outsourcing.

The technologies are projected to include procurement, information and financial management, the commercialization of university intellectual products and memorabilia, consulting and contract research services. While e-commerce will open markets for universities, it will help drive down the cost structure. It was suggested that e-commerce is so dynamic that its growth is pushing the limits of software development and execution, and will lead to new tools, technologies and research

Steering Committee Meeting
A transcript of the Steering Committee meeting held from
12:30-2:00 PM on August 25, 2000 is in Appendix C.

PROGRAM
Impact of IT on the Future of the Research University
Steering Committee Meeting

Hosted by:
Lucent Technologies and IBM

Topic:
A View of Technology Futures

August 24-25, 2000

August 24:
Location: Bell Labs
               600 Mountain Avenue
               Murray Hill, NJ 07974-0636

11:45-12:00 AM	Welcome by Hosts	Bill Brinkman
12:00-1:00 PM	Lunch & Overview of Afternoon Program	Bill Brinkman
1:00-4:30 PM	Laboratory Program	
1:00-1:45 PM	MultiMedia Collaboration / Lab Visit	Joe Olive
1:45-2:30PM	Distributed Computing Models / Software Backplanes	Tom Szymanski
2:30-2:45 PM	Break	
2:45-3-45 PM	Wavelength Switching and Routing / Lab Visit	Dave Bishop
3:45-4:30 PM	Integrated Wireless Networks	Rich Howard
4:30-4:45 PM	Summary	Bill Brinkman

2.   August 24—Evening Program
          6:00 PM   Arrival at IBM Palisades Executive Conference Center
                             Location: Route 9W
                                           Palisades, NY 10964-8001
          6:30 PM   Reception

7:00-8:30 PM	Welcome by IBM Hosts and Dinner	
8:30-9:30 PM	Speaker Doug Van Houweling	

3. August 25

8:00 AM	Vans Depart Palisades Executive Conference Center for travel to IBM Watson Laboratories
	Location: IBM Research Division
	                T. J. Watson Research Center
	                Yorktown Heights, NY 19598	

8:45 AM	Arrival at IBM Watson Laboratories	
8:45-9:00 AM	Welcome to IBM / Introductions	P. Horn
9:00- 9:30 AM	Web Intermediates (WBI)	D. Russell
9:30-10:00 AM	Video Authoring Tools (Cue Video)	A. Amir
10:00-10:30 AM	Intelligent Interconnection Software (T-Spaces)	T. Truong
10:30-11:00 AM	University - Research IP Interactions (Open Source vs. Proprietary Technology)	M. Schecter
11:00-11:15 AM	Break	
11:15-12:00 AM	Knowledge Management & Portals	A. Marwick
12:00-12:30 PM	Electronic Commerce "What does it mean to Universities?"	S. Feldman
12:30-2:00 PM	Lunch & Steering Committee Meeting	J. Duderstadt

Appendix B
Transcription of presentation by Doug Van Houweling to the
Steering Committee
and following discussion.
8:00-9:30 PM on August 24, 2000

Appendix C
A transcript of the Steering Committee meeting held from
12:30-2:00 PM on August 25, 2000