Technology Forecast for the Federal Judiciary

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FORECASTING TECHNOLOGY, in particular forecasting information technology, can be problematic. The difficulty is that the ebb and flow of information technology is regularly interrupted by episodes of paradigm disruption. The introduction of personal computers, the World Wide Web, and cellular communications are episodes that lifted technology from one track and dropped it clumsily on another. This paper treads on safer ground . . . it focuses on more predictable aspects of technology . . . it avoids forecasting the 'whiz-bang' and makes a wide path around consumer electronics. This paper reviews major trends that represent opportunities for the judiciary—opportunities to invest in and exploit technology to improve business processes. A complement to the Long Range Plan for Information Technology in the Federal Judiciary, it addresses the future. As a result, some technologies discussed are not quite ready for implementation but will likely play a lead role on the three- to five-year planning horizon.

This paper organizes technology trends into five categories: networking, security, the "people factor," information management, and standards. All five categories share some clear similarities:

- The undeniable influence of the Internet. The Internet—perhaps the most significant force in the future of information technology—has dramatic effects on product development and on the ways in which people perceive information systems. Indeed, the sudden, explosive, growth of the Internet has moved the discussion from "if we use it" to "how we use it." The Internet is firmly entrenched in the present: it is here, it is now, it is ubiquitous.
- A change in attitudes about technology, both in the private sector and in the government. Technology consumers used to be concerned only with requirements: "How can we meet our current needs with technology?" It is now common knowledge that technology developments may offer previously unforeseen opportunities, and concerns have changed to "How can we exploit technological developments to improve our business processes?"
- Information technology (IT) as a necessary infrastructure for doing business. No longer just a curiosity or a typewriter surrogate, computers have infiltrated all business processes, and the quality of these processes depends upon reliable, well-planned computer systems.

The judiciary has generally adopted a "state-of-the-market" strategy to guide IT investment decisions. This is a safe strategy that avoids the risks encountered by more aggressive "early-adopters" (those who invest in technology as soon as it becomes available—before its value is proven and limitations are shown). There are several notable exceptions to this rule where the judiciary has opted to be an early-adopter in order to take advantage of the extraordinary benefits obtainable by some new (and admittedly risky) technology. The judiciary has mitigated the risk by prototyping the technology before committing to it. Either strategy buys some breathing room for the technology forecaster. Whether current or future, the IT market can be fickle. Even investment decisions based on the state of the market are best made with an eye toward the future in an attempt to project whether the current state is a stable state. And that is the principal charter for this technology forecast.

The remainder of this paper presents major trends, impacts on the federal judiciary, and possible courses of action for each major trend along with links to the following 2000 IRM strategic initiatives:

- Implement electronic libraries to enhance desktop access to a variety of electronic research tools and databases.
- Modernize case management through the use of state-of-the-market technology and refined business processes, such as electronic case files systems.
- Use video telecommunications technologies to facilitate more efficient training, conferencing, administration, and judicial proceedings.
- Employ technologies to improve the quality and efficiency of courtroom proceedings.
- Use the Internet and judiciary intranet on the judiciary's DCN to make publications, information, and services more accessible within the judiciary and to the public.
- Implement the strengthened post-automation review program.

Networking

Network computing architecture and the Next Generation Internet represent two

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strong trends that place the data network as the fundamental building block for implementing new information technology.

More than a decade ago, Scott McNealy (CEO of Sun Microsystems) said, "The network is the computer." Although it took a long time to happen, it was a prescient forecast. Perhaps the ultimate embodiment of this thinking is the current trend toward "network computing architectures." There are two main underlying concepts: 1) the thin-client, a stripped-down, desktop personal computer which depends on the network for computing and storage resources, and 2) the network appliance, a special purpose computer that does one thing well.

The thin-client trend addresses a significant problem in information systems: the cost of owning and maintaining PCs. For the consumer, purchasing a PC can cause even more dissatisfaction than buying a car—within a year of purchase, a PC is obsolete. New software products require more processing speed, more memory, and more disk space. It becomes increasingly difficult to run new software releases and take advantage of improved technology with a one-year-old museum piece.

This cost/obsolescence problem is amplified when the PC is part of a business environment. The new hardware purchase price is dwarfed by the cost of maintenance and operation. These costs have been termed "total cost of ownership," or "TCO." TCO includes the salaries of the systems administrators and technicians who must visit each PC, perform routine and emergency maintenance on hardware and software, keep track of how users have customized their PCs to personal preferences, and make sure the PC can continue to run applications such as case management.

The biggest benefit of a thin-client architecture is that it reduces reliance on the desktop computer by moving software and data onto the network. The support costs for a thin-client are reduced because the software for all thin-client PCs are installed on the network in one place, once, for all PCs. A thin-client PC will also have a longer usable life because it relies on the network for the computing and storage resources required to run the latest programs. The downside of a thin-client strategy is the increased reliance on the network for performing basic functions such as word processing and spreadsheet activity—if the network is down, the user is down.

One extreme version of the thin client is the network computer (or NC). Network computers are PCs with no local disk storage, but with a fast connection to the network. All programs and data are downloaded from the network as they are needed. Early enthusiasm for network computers has waned greatly, but the TCO savings potential of the network computing architecture means that many organizations will be looking for ways to exploit some variation of thin-client technology in their information systems. Perhaps hand-held computers (e.g. the Palm Pilot), which by their very essence are thin, will replace the NC.

Filling the enthusiasm gap are network appliances. Network appliances run the gamut from toasters and door-knobs[1] to massive super-computers. The common theme is a stand-alone device that can be attached to a network. In practice, most interest is focused on devices that deliver service-level applications (like a database or web servers). Since thin-clients only see services on the network and never the operating systems on the computer that provide the service, the application can run on raw iron, a computer with no operating system, or on a computer with a special-purpose operating system. An application running on raw iron is expected to be faster and less expensive than an application running on a general purpose computer. Time will tell.

Greater reliance on networks will require that investments be made in building reliability and bandwidth. The Next Generation Internet (NGI) and Internet2 (I2) projects—part of a federally, academically, and industrially supported research and development program—illustrates the widespread recognition of the importance of investing in networks.

NGI's objectives include making a quantum leap in the capacity delivered to Internet users. NGI plans to bring 100 times the typical Internet data transfer speeds to 100 pilot sites, and they plan to bring 1,000 times the speed to 10 pilot sites. The NGI vision is to "provide a powerful and versatile environment for business, education, culture, and entertainment. Sight, sound, and even touch will be integrated through powerful computers, displays, and networks."[2]

NGI, as it grows, will reformulate the public's concept of what can be accomplished over a network. For example, a network environment such as NGI would accommodate widespread deployment of videoconferencing with capacity to spare.

The judiciary will be affected by pressures to reduce total cost of ownership and increase the data communications speeds offered by the Data Communications Network (DCN) and other networking services.

The judiciary can reap some TCO benefits from the trend toward network computing web work browsers, such as Netscape Navigator and Microsoft Internet Explorer, as the user interface. This strategy keeps the PC (or the client) thin. It reduces the amount of software needed locally on the PC and establishes a common, familiar interface to applications—a sensible near-term step for the judiciary to take while keeping an eye on the progress of network computing over the next few years. A gradual "thinning" of the client can reduce the PC management burden and cost and still use existing equipment and software.

Regardless of the success of network computing, projects such as NGI indicate that there will be growing pressure to improve the reliability and increase the data transfer capacity of networks. One of the judiciary's IT strategic initiatives explicitly identifies increased use of Internet, intranet, and DCN services to make information more accessible. The visionaries behind NGI realize that improving networking infrastructure is an ambitious undertaking that should be started small and then grown. This approach also makes sense for the judiciary's network infrastructure.

Security

The need to protect credit card purchases on the Web has advanced two important information security technologies: identification and authentication (I&A), and encryption. Information security did not carry widespread audience appeal until people started buying merchandise on the Web. A simple credit card purchase over the Web invokes sophisticated identification and authentication (I&A) and encryption technologies and algorithms. Web consumers have come to trust this technology to protect their credit card numbers as they are being broadcast over the Internet. I&A includes a wide array of techniques used to prove to two parties that each is who they claim to be—in the case of electronic commerce, that the consumer is the actual credit card owner and that the Web site is run by a legitimate merchant.

More generally, I&A is the fundamental first step in maintaining the security of any general-purpose information system. The information system must confirm that its users are who they say they are and grant access privileges accordingly. Advances in both I&A and cryptography have introduced many new security tools to make it easier on the user while also protecting information resources:

- **Single log-on.** Password protection is the most common way to implement security. Typically, users are asked to remember multiple passwords and are encouraged to change them frequently. This results in users selecting simple, easily guessed passwords, and diminishes the strength of password protection. Single log-on technology allows users to enter a password once and gain access to all systems for which they have privileges.

- **Biometrics.** Biometric I&A relies on a unique physical characteristic of the information system user: a fingerprint, a retinal image, a voice. Devices that can reliably read fingerprints are affordable and virtually eliminate the need to memorize and manage passwords.
- **Smart cards and one-time passwords.** A smart card looks like a credit card but has an embedded computer chip. Smart cards have many uses, but one of the most interesting security-related uses is to generate one-time passwords. A one-time password is time-sensitive and can be used only once. Even if it is "sniffed" (i.e., intercepted by an electronic eavesdropper), it cannot be reused.
- **Public key cryptography**. Traditional cryptography uses a single, secret key to encrypt (scramble) information to protect privacy and to decrypt (unscramble) the protected information. Communicating parties must somehow share knowledge of the secret key. Public key cryptography uses key pairs: a private key, known only to the individual user, and a public key, published for all to know. Messages encrypted with the private key can only be decrypted with the public key, and vice versa.

This concept is very useful. If Bob has a message that he wants only Alice to read, he can encrypt it with Alice's public key. If Alice wants to digitally sign a message so that Bob can confirm that it came from her and her alone, she can encrypt it with her private key—only her public key will make sense out of it.

The judiciary's 2000 IRM strategic initiatives will result in increased information accessibility, increased exposure, and increased risk of a security breach. To be effective in mitigating this risk, security must be applied consistently, and security tools must be easy to use.

The technology is available to ensure the protection and integrity of sensitive court documents and information. Information security is an area in which the application and management of the technology is the primary challenge. The judiciary is moving forward on some of the following information security fronts and may wish to explore some of the most recent technologies:

- Implement a consistent security architecture and policy. The information security chain is as strong as its weakest link. A consistent architecture and set of policies for protecting information will provide the most important security tool: uniform implementation of technology and procedures to safeguard sensitive information. The judiciary has begun this effort.
- Implement a Public Key Infrastructure. Public key cryptography offers essential tools to protect information and ensure integrity; they are used for both authentication and encryption. The organizational structure required to manage public keys is called a Public Key Infrastructure, or PKI. The PKI will have to address policy issues such as the escrow of public keys used for encryption.
- Explore I&A tools that make it easy for the user to follow security guidelines. Many of the new security tools, particularly biometrics and smart cards, are aimed at improving protection while reducing the user's burden. The judiciary is currently evaluating several of these tools.

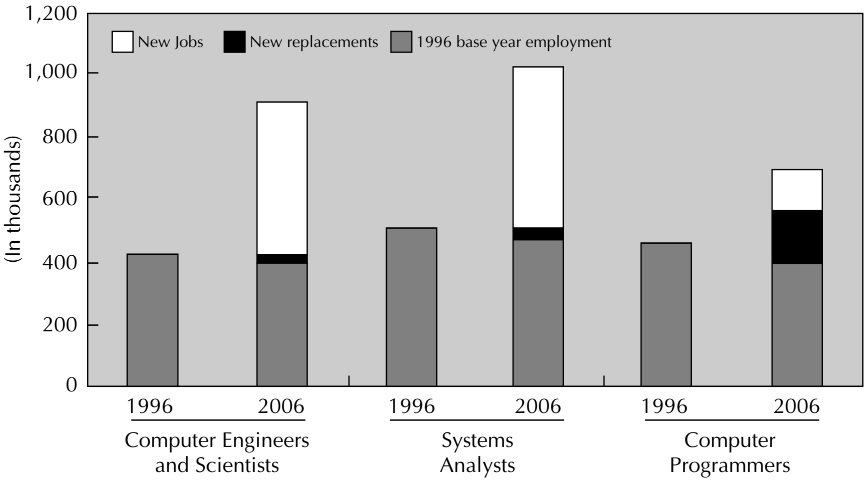
The People Factor

The people factor is more significant than most technologists allow and may be the limiting factor in determining how completely and how quickly new technology can be effectively deployed. The growing role of information technology in nearly every business sector will increase the need for trained, skilled staff at all levels. Figure 1 projects a near doubling of the demand for skills in the key IT disciplines, and there are indications that supply will not keep pace with demand. For example, the years 1985 through 1997 saw a 16 percent drop in the number of students graduating with bachelor of engineering degrees. From 1985 to 1996, there was a 29 percent drop in math and computer science graduates and a 42 percent drop in information system bachelor degree recipients.[3] (See Figure 1)

The next decade will see a high demand for IT skills. While sources of information systems development and operations skills are decreasing, the needs and expectations of the information worker are increasing. The judiciary's IRM strategic initiatives to modernize case management, employ technologies to improve the quality of courtroom proceedings, and increase information accessibility will require skilled IT system development and operations staff, and it appears likely that these skills will be in short supply through the next decade. The judiciary will be called upon to focus increasingly on internal training to improve staff skills in IT disciplines and tools. In addition, it will become increasingly necessary to take advantage of the economies of scale in stretching available expertise over a wider range of courts with similar needs.

As the information audience grows, more accommodations must be made for the disabled and the aged. As the designers and implementers of judiciary information sys-

FIGURE 1:
Projected Growth of IT Professions



Source: Bureau of Labor Statistics, U.S. Department of Labor, 1996 tems begin providing greater accessibility to a wider audience through electronic media, they will need to consider the broad spectrum of that audience's needs. Americans with disabilities may have sight or motor skill impairments that prevent them from accessing information presented through Web pages or other electronic means. Aging Americans may also have limitations.

Emerging presentation and programming technologies and products address the need that visually impaired, hearing impaired, and motor-skill impaired Americans have to access public information maintained by a court computer system. Current interactive voice response (IVR) systems such as the Appellate Voice Information System (AVIS) and the Bankruptcy Voice Case Information System (VCIS) are examples of positive steps being taken in this direction.

Information Management

The growing volume of information from the Internet, intranets, and online libraries is overwhelming. The issues surrounding the management of information—extending beyond the technology itself—are critical to using the power of information accessibility to improve court processes.

Access to information is no longer the challenge; the new challenge is to find information and use it effectively. On the Internet, for example, an entire industry has grown around "portal" Web sites (e.g., Yahoo! and America Online) that provide search engines to find and place a temporary, rudimentary organizational structure around information. Recognizing that information known only to one person is of limited use, software products, loosely labeled GroupWare, provide tools to refine the organization of information and share it.

The judiciary currently employs three GroupWare tools: electronic mail, videoconferencing, and the Intranet. Other more sophisticated tools implement document management, workflow management to automate business process flows, and collaborative tools to allow judges, attorneys, clerks, probation and pre-trial officers, and staff to interact and share information electronically.

Workflow management products are fairly mature and provide a good example of GroupWare beyond the basic office tools. Workflow tools automate the movement of information through one or more business processes during which documents, information, or tasks are passed from one participant to another for action, according to a set of defined procedural rules. The step-by-step processing of a court case according to the Federal Rules of Procedure and local district rules is an example of a workflow.

Automated workflow systems were initially designed to increase productivity in processing high-volume, repetitive transactions. In addition to accelerating processing times, workflow can also improve collaboration, increase adherence to procedures, and reduce the routing of paper documents. Workflow tools in a court environment could help to reduce administrative tasks such as monitoring calendars, ensuring that responses are received at the proper time, that hearings are promptly held, that orders are issued on time and, in general, that the work of the court efficiently moves in the proper sequence. The court's administrative staff and the judges can then spend more time on the delivery of justice and less time recording and monitoring the process of justice.

There is an overwhelming need to use GroupWare and knowledge-based technology to better manage information. The judiciary's experience with the J-Net Intranet site has revealed the importance of policy-related issues in information management:

- *Data Ownership and Information Maintenance.* Electronic publishing gives life to information and documents. Those that access the information electronically expect it to be up-to-date and accurate. This raises a host of policy questions and challenges such as who "owns" the information? Who can authorize updates? What is the responsibility of the owner for maintaining currency?

- *Electronic Records Management.* A recent decision of the Court of Appeals for the D.C. Circuit identified electronic records that were subject to the provisions of the Federal Records Act. The decision resulted in the issuance of an IRM bulletin stating that "The Court found that the paper copy of an electronic message might not include all of the information that the electronic record contained and thus was not a duplicate record." This means that a subset of electronic records must now be handled and managed as formal federal documents. Policies and procedures must be established that apply to many electronic records including some e-mail previously considered to be transient and disposable.

- *Privacy.* Although there is already the need to set policy on what information is available to the public, publishing electronically adds complexity. By increasing the ease of access and the scope of exposure, electronic publishing represents an increased level of public availability and potential violation of personal privacy. In cases where information access is only provided to a subset of authorized individuals, reliable technology must be in place to enforce access policy. Technologists must become aware of privacy needs, and policy makers must become aware of the capabilities and limitation of information security technology. The judiciary must also be aware that commercial resellers of judiciary information may not have the same privacy concerns that the judiciary has.

Although answers to these questions are not all technological, technology can help in implementing information management policy as it is developed. For example, GroupWare products are beginning to include Intranet and Web site management tools to implement ownership and maintenance policies.

The public has begun to trust the Internet for conducting commerce and now sees its convenience and efficiency. Many court transactions can take advantage of electronic commerce (EC) technologies.

It is estimated that more than 12 million consumers purchased merchandise over the Internet in 1997. By 2002, the number of consumers is expected to increase by a factor of five and their individual spending to increase by 400 percent.[4] If there ever was a phobia about conducting commerce electronically, it seems to be passing.

For the same reasons that consumers have been drawn to Internet shopping—convenience, efficiency, and value—the judiciary may wish to consider EC for conducting a wide variety of transactions including filing fees, fines, restitution payments, court costs, and reimbursement for public defender services. Not all EC transactions are necessarily financial transactions. Electronic filing of court documents is an important technology that also falls into this category. The CM/ECF project already offers electronic filing as part of its first release, and is exploring fee collection over the Internet for a future release. As the judiciary has learned with electronic document filing, security and reliability are fundamental issues to the success of EC. The maturity of technologies to ensure that, for example, credit card numbers remain protected in a consumer purchase, can be applied to protect court transactions as well.

Standards

The Internet has fortified standards and created real tools for exchanging electronic information between business partners. Insistence on standards will add longevity to technology, improve interoperability, and increase flexibility in product selection.

When it comes to standards, the Internet is the benchmark. The Internet has become a final testing ground for most information system standards. It has created real working standards out of many previous paper-only standards.

Perhaps the biggest success story is the Transmission Control Protocol/Internet Protocol (TCP/IP) standard—the workhorse protocol that provides basic connectivity for the 50 million or so computers that interoperate on the Internet. The protocol was originally adopted in 1982, and it is estimated that a new version will not be needed until 2015. Other standards have evolved into valuable interoperability tools: Simple Mail Transfer Protocol (SMTP) allows universal e-mail connectivity, and the worldwide web protocols (HTTP and HTML) allow users to access all kinds of data from all kinds of computers from anywhere in the world.

There are lessons to be learned from the success of these standards:

- *Permanence.* Standards compliance reduces product dependence and product obsolescence. For example, documents that must be available for many years in the future should not be stored in proprietary formats.
- *Interoperability.* Strategic initiatives to automate case management and court proceedings require that a large group of "trading partners"—both internal and external to the judiciary—exchange information. For this exchange to happen, the form and structure of that information must be standardized.
- *Increased competition and vendor independence.* Adherence to standards reduces reliance on a single vendor for important technological tools and provides the added financial benefit of increased competition among suppliers.
- *Business benefits.* The benefits of IT industry standards may be extended into business-specific areas of the judiciary. E-mail naming conventions are a simple example of how internal standards could improve interoperability within the judiciary.

Unfortunately, there are some drawbacks to information systems standards. Although there are many mature, well-subscribed standards, compliance with standards is not always viewed by product vendors as being in their best interest. Many vendors—in some cases, influential vendors—work very hard to differentiate themselves by adding nonstandard bells and whistles to their products. In general, a practical information system strategy favors standards wherever possible, but recognizes that in some cases a product-based standard may be necessary.

Parting Words

This is the second year that the Long Range Plan for Information Technology in the Federal Judiciary has included a technology forecast—a clear, and now consistent, signal that the federal judiciary recognizes the importance of technology trends and direction in their plans for future information systems. Although network computers have been depreciated and network appliances have been added, there have been relatively few changes. One year is not much of an interval when the future is concerned. This paper opened with a charter to identify technology developments that can improve judiciary business processes and maintain an eye toward potential future states of the market. Technology offers more opportunities than we probably care to have. Even the capabilities of current technology stretch our ability to manage information and processes.

In addition, any investment decision, technological or otherwise, must be tempered by available funding. The future challenge will be to make sure policy and management practices mature to keep pace with rapid technological advances and to deploy IT products that produce real benefits. For many of the trends described in this forecast, the true challenge is the management of technology.

Endnotes

[1] Both devices actually exist and, at least in the latter case, are useful. Controlled from the network, the door knob can report who uses it and can be set with different security profiles and keys.

[2] NGI Concept Paper. (1997, July). Retrieved November 20, 1998 from http://www.ngi.gov/concept-Jul97/.

[3] Sweat, Jeff. (1998, April 10). TechWeb. *IT Hiring Shoots Up While Tech Graduates Decline.* Retrieved November 20, 1998 from http://www.techweb.com/wire/story/TWB199804410S0009.

[4] Consumer Internet—The U.S. and Worldwide Forecast for Consumer Internet Usage and Commerce. IDC/Link (1998, March).