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ELECTRONIC
GOVERNMENT

Federal Initiatives Are
Evolving Rapidly But They
Face Significant
Challenges

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Mr. Chairman and Members of the Subcommittee:

I appreciate the opportunity to be here today to participate in the Subcommittee's hearing on electronic government issues. There is perhaps no topic that generates more lively discussion than the rapid changes that the Internet is introducing to our personal lives, the economy, and institutions throughout our society. The United States is the world's leading Internet nation, with over 110 million users. By some estimates, worldwide Internet traffic is doubling every 100 days.

Electronic commerce and business strategies made possible by widespread Internet access and interconnected systems are transforming how organizations, both public and private, will operate in the next decade. This trend is accelerating at a rapid pace, with investments in information technology expected to account for 40 percent of all capital investment in the United States by 2004. According to recent forecasts by the Gartner Group, spending by federal, state, and local governments on e-government will quadruple over the next 5 years, from \$1.5 billion in 2000 to \$6.2 billion in 2005.

Mr. Chairman, the rising connectivity and interdependence fostered through information technology create both benefits and challenges. The potential for benefits to the public sector is vast. Today, governments at all levels are using the Internet and other electronic commerce means to improve internal business operations and to provide on-line public access to information and services. Opportunities for further improvements abound. New global Web technology applications and opportunities undoubtedly will continue to transform the way the federal government conducts business, communicates, and interacts with citizens, industry, and other government entities.

As we recently witnessed with the "ILOVEYOU" computer virus, the potential for improvements in service and productivity offered by the Internet come intertwined with a whole new set of management challenges.¹ As such, electronic business initiatives must still address the many costs, benefits, and risks associated with any information technology decision-making. With the speed and ease of massive interconnectivity offered by the Internet, improvements in operational

¹ *Critical Infrastructure Protection: "ILOVEYOU" Virus Highlights Need for Improved Alerts and Coordination Capabilities* (GAO/T-AIMD-00-181, May 18, 2000) and *Information Security: "ILOVEYOU" Computer Virus Emphasizes Need for Agency and Governmentwide Improvements* (GAO/T-AIMD-00-171, May 10, 2000).

efficiencies, lower costs, and improved customer service delivery truly can be dramatic. On the other hand, general business risks such as fraud, theft, and destruction of assets, along with legal issues such as liability and the loss of reputation, are exacerbated by the openness of the Internet. Other matters related to adequate technical infrastructure planning, stability in the numbers and skills of the technology workforce required to build and maintain web-enabled products and services, and adequate top management leadership and involvement further complicate the underlying challenges.

Congressional interest in both the opportunities and challenges posed by electronic government is evident from the numerous oversight hearings and legislative proposals on topics ranging from Internet taxation, privacy, computer security, consumer protection, open access, and competition. At GAO, we have numerous reviews underway examining these and other electronic government issues, such as use of the Internet to improve rule-making and the implementation of electronic commerce programs at specific agencies. We expect to be able to provide more comprehensive information and analyses on many of these topics in the near future.

In my remarks today, I would like to address a few key aspects of the evolving electronic government environment. Specifically, I'll focus on the statutory and policy framework, describe key efforts to implement electronic government programs, and outline the major challenges confronting both government and the private sector in making the transition to on-line business and service environments. Because the terms electronic commerce and electronic government are often used interchangeably, let me begin by briefly discussing how they overlap. As I will discuss shortly, the same capacities that are transforming the business community offer equal opportunities for government to excel.

Electronic Government Can Build Upon Electronic Commerce Experiences and Approaches

Many private sector enterprises are now working hard to take advantage of the new opportunities created by ubiquitous Internet connectivity. For these companies, e-commerce has three important aspects. First, it means streamlining the way business is conducted to reduce paperwork and delays, increasing operational efficiencies, and enhancing customer service. Second, beyond enhancing existing business avenues, the world of e-commerce is leading to the creation of entirely new digital products and new markets for those products. Finally, in response to these new products and markets, new classes of buyers and sellers are emerging to take advantage of those opportunities.

The basic idea of e-commerce has actually been around for quite some time, but the World Wide Web has brought a lot of changes and new opportunities in the last few years. Until recently, e-commerce was mainly identified with electronic data interchange, or EDI. EDI allows one business's computer system to send routine information about transactions to another business's system, following standardized formats. Its focus is on business or trading partner data interactions, not serving consumers directly. The rise of the World Wide Web over the last few years has dramatically broadened the scope of electronic commerce. Electronic commerce is now seen as encompassing all aspects of buying and selling electronically, including marketing, end-to-end transactions with consumers, and on-line auctions. It is transacted through a variety of technologies, including EDI, electronic mail, electronic funds transfer, and web-based applications.

Electronic commerce often involves two kinds of relationships: business-to-business and business-to-consumer. Generally business-to-business relationships are ongoing and contractually established, involving many transactions over a long period of time, such as between a commercial business and its suppliers. Typically, the seller extends credit to the buyer, and transactions are initiated with purchase orders, which are used to monitor and control the entire buy-sell-pay process.

The business-to-consumer relationship is a newer one that largely builds on the emerging power of the World Wide Web. It involves moving information, products, and services on-line for consumption and purchase by consumers. Indeed, the Web is forcing businesses and governments alike to rethink their methods of communicating and interacting with the public, and, in some cases, rethink how they deliver their core mission services and products. Already we have seen a wave of new electronic businesses spring up on the Internet to capitalize on the Web's advantages of (1) attracting broad new customer communities, (2) setting up and maintaining a Web "storefront," and (3) highly targeted marketing with tailored offers that the consumer can accept and finalize on the spot.

The recent advances in web-based commerce mean that comparable advances in e-government are just as possible. Generally speaking, electronic government refers to government's use of technology, particularly web-based Internet applications, to enhance the access to and delivery of government information and service to citizens, business partners, employees, other agencies, and government entities. It has the potential to help build better relationships between government and the public by making interaction with citizens smoother, easier, and more efficient. Indeed, government agencies report using electronic commerce

to improve core business operations and deliver information and services faster, cheaper, and to wider groups of customers. For example, the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), the General Services Administration (GSA) and other agencies have been implementing on-line procurement operations for several years. The Internal Revenue Service (IRS), the Department of Education, and the Social Security Administration have been actively using electronic commerce techniques to improve service delivery to taxpayers, students, and senior citizens. As such, e-government includes many of the same characteristics of electronic commerce used in the private sector, with the exception of having a more defined customer base and less focus on revenue generation as a primary business driver.

A Diverse Statutory and Policy Framework Underlies Expectations for Electronic Government

While market and technology developments in private industry are inevitably bumping the public sector more and more into the e-business domain, an evolving framework of laws and policies are influencing the speed, pace, and direction of electronic government initiatives. In many cases, statutory requirements authorizing agency programs may explicitly mandate action that involves electronic and on-line processes. These agency actions can vary widely, ranging from efforts to improve internal business operations to mandates for reforms outside the agency. For example:

- The Clinger-Cohen Act of 1996 requires GSA to provide governmentwide on-line access to information about products and services available under the multiple award schedules program.²
- The Fiscal Year 1999 DOD Authorization Act required DOD to establish a single, Defense-wide electronic mall system for ordering supplies and materials.³
- The Electronic Benefit Transfer Interoperability and Portability Act of 2000 requires the Department of Agriculture (USDA) to establish a national standard of interoperability and portability for electronic food stamp benefit transactions.⁴

²Sec. 5401, P.L. 104-106, 40 U.S.C. 1501

³Sec. 332, P.L. 105-261, 10 U.S.C. 2451 note.

⁴P.L. 106-171, 7 U.S.C. 2016.

Additionally, federal departments and agencies are governed by general management statutes that affect electronic processes, again, in a variety of ways. For example:

- In response to the Clinger-Cohen Act, federal agencies are developing internal investment control and performance management processes designed to improve their acquisition, use, and management of information technology. This has spurred attention to new information systems—many web-based—such as the Information Technology Information Processing System (I-TIPS) supported by the federal Chief Information Officers (CIO) Council and currently used by several federal agencies including the Departments of Housing and Urban Development, the Treasury, Labor, Energy, and Agriculture.⁵
- The Privacy Act requires agencies to protect the confidentiality of records containing personal information and forms the basic requirements that are now being applied to protecting personal information that is captured by agency web sites.⁶
- The Government Paperwork Elimination Act of 1998 sets a deadline of October 2003 for agencies to develop capabilities to permit, where practicable, electronic maintenance, submission, or disclosure of information, including the use of electronic signatures.⁷

In addition to legal statutes, the executive branch coordinated cross-agency projects and issued numerous policies in the last few years encouraging the growth and adoption of electronic government. For example, in 1993, the National Performance Review (NPR), initially developed proposals to implement electronic government. In 1997, NPR outlined further steps to encourage and increase citizen and business Internet access to the most commonly requested government services.⁸ These and other similar efforts reflect two overarching themes supported

⁵I-TIPS is a web-based Internet or intranet decision support and project management tool for managing information technology investments. It was initially funded through an award from the Government IT Services Board and the Interagency Management Council's IT Innovation Fund.

⁶P.L. 93-579, 5 U.S.C. 552a; OMB Circular No. A-130, Appendix I, "Federal Agency Responsibilities for Maintaining Records About Individuals."

⁷Title XVII, P.L. 105-277, 44 U.S.C. 3504 note.

⁸*Creating a Government That Works Better and Costs Less: Reengineering Through Information Technology*, accompanying report of the National Performance Review, Vice President Al Gore, September 1993; and *Access America: Reengineering Through Information Technology*, National Performance Review, 1997.

by champions of e-government: (1) a need for the federal government to tangibly demonstrate an ability to improve its "service and access to the citizen" and (2) a recognition that web-based technologies can be effective levers to override cultural and organizational barriers to change. That is, web-based applications can provide a friendly citizen interface over confusing and suboptimized government agency structures, responsibilities, and processes.

Other executive branch policies seek to ensure private sector leadership and avoid unnecessary governmental regulation. For example, in 1997 the Administration outlined the following policy principles in a special report:⁹

- The private sector should lead.
- Governments should avoid undue restrictions on electronic commerce.
- Where governmental involvement is needed, its aim should be to support and enforce a predictable, minimalist, consistent, and simple legal environment for commerce.
- Governments should recognize the unique qualities of the Internet.
- Electronic commerce over the Internet should be facilitated on a global basis.

Particularly in the last 6 months, the administration has devoted increasing attention to promoting electronic government. On December 17, 1999, presidential memoranda directed agencies to undertake numerous actions to provide "one-stop access" to government information and services and better, more efficient services and accountability, and to promote the broader social benefits of information technology.¹⁰ Among other things, agencies are tasked with providing easy public access to government information on the Web, making forms available on-line, and making assistance benefits available through private, secure on-line transactions.

In addition to these actions taken by the administration, a number of cross-agency groups have emerged to assist agencies in managing the transition from paper to electronic services. For example, the Federal Electronic Commerce Program Office, co-chaired by GSA and DOD, is

⁹A *Framework for Global Electronic Commerce*, The White House, July 1, 1997.

¹⁰Presidential Memorandum on "Electronic Government" and Presidential Memorandum on "Use of Information Technology To Improve Our Society," Dec. 17, 1999.

chartered to provide central leadership, coordination, and reporting on governmentwide electronic commerce implementation. In addition, the Interagency Acquisition Internet Council was established to promote ways of using the Internet to streamline the federal acquisition process. Similarly, the Interagency Electronic Grants Committee (IAECG) was established to promote the use of electronic commerce throughout the federal grants community.

Both the President's Management Council (PMC) and the CIO Council have announced initiatives to support the goal of promoting electronic government. The PMC, for example, has formally set a cross-agency goal of committing the necessary resources and priorities to ensure creation of a one-stop on-line help center that will be available through a central web access point, or portal. The PMC has committed to reprogram the necessary resources, currently estimated to be several million dollars, to get this effort started. Called WebGov, it will help guide citizens to various federal government web sites with the information or services they need. The PMC is currently evaluating how best to facilitate the efforts of Internet Service Providers and other Internet companies to improve their customers' access to government information.

The CIO Council recently established an e-government committee that is formulating a strategic plan and undertaking various short-term initiatives. Several of these efforts involve working in partnership with industry and state governments. For example, CommerceNet (a nonprofit market and business development organization) is working with the federal government to allow citizens to find on-line government surplus items.

Government Use of the Internet Is Evolving

For the most part, federal, state, and local governments are in the early stages of shifting their perspective to citizen-centered services and are just beginning to move towards the real potential of e-government. In August 1999, GSA in conjunction with the Intergovernmental Advisory Board (IAB), reported that the development of on-line transactional services is in its early stages and the number of governments producing a wide variety of integrated services was still small.¹¹ But government use of Internet-based services is broadening and becoming more sophisticated. In particular, agencies are increasingly turning to the Internet to conduct paperless acquisitions (electronic malls), provide interactive electronic services to the public, and tailor or personalize information. The GSA/IAB

¹¹*Integrated Service Delivery: Governments Using Technology to Serve the Citizen*, Intergovernmental Advisory Board, August 1999.

study mentioned above suggests that the next step is to determine whether the use of the Internet is actually improving government services and being integrated across different levels of government.

To provide a better picture of the scope and range of ongoing e-government activities, I would like to elaborate on some ongoing individual efforts as they relate to trends in using the Internet to conducting basic transactional services, on-line procurement, and interactive communication and information dissemination.

Transactions and Applications

It is increasingly common to find governments are using the Internet for basic transactional services, such as submitting and paying taxes, processing renewal fees, and filing applications. For example:

The Electronic Tax Administration (ETA), is designed to reduce taxpayer burden by making it easier and faster to file returns and communicate with IRS. IRS expects to receive over 33 million electronically filed individual tax returns in fiscal year 2000, or over 26 percent of all individual tax returns. One key initiative for fiscal year 2000 is expanding the use of identification numbers to facilitate secure filing by tax preparers. IRS also plans to make more electronic payment options available and to accept more forms and schedules through electronic filing.

Several state and local governments offer on-line, form-based transactions, such as job applications, business and professional licensing, and registering vehicles. For example, the state of Florida's web site¹² offers easy-to-navigate categories of information and services, including on-line job applications, consumer complaint forms, and business and professional license searches. The state of Virginia became the first state to allow citizens to renew drivers' licenses via the Web. It allows citizens to log onto the Department of Motor Vehicle's web site, check on whether personal information is correct, and pay the renewal fee with a credit card.

On-line Procurement

In addition to serving citizens, governments are also using the Internet to buy the goods and services that support their operations. Many federal agencies and state governments are using on-line catalogs, ordering, payment, and posting of contracting opportunities and awards. For example:

¹²<http://fn.state.fl.us/gsd/>.

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- The state of West Virginia has an electronic bid submission program and the state of Florida has Web site services relating to purchasing and leasing. The state of Texas also receives electronic bids and proposals and is establishing an electronic procurement marketplace, which is expected to be operating statewide by September 2001.
 - Since 1998, the GSA has been working with several other agencies to provide businesses, large and small, with convenient, single point-of-entry Internet access to synopses of government contracting opportunities, solicitations, awards, and other acquisition-related documentation. The Electronic Posting System (EPS) initiative—currently in a pilot stage—allows vendors to search for contracting opportunities over \$25,000, receive automatic e-mail notification about agencies' requirements for specific supplies or services, receive automatic e-mail notification about changes and amendments to solicitations, download documents related to a specific procurement; and view summaries of contract awards.
 - In September 1995, GSA Advantage went on-line. It was the federal government's first electronic catalog on the Internet. Advantage allows agencies to search for products and services and place orders from GSA's federal supply schedule contractors. According to GSA, there are currently over 2,000 schedule vendors on Advantage and fiscal year 1999 sales were \$86 million.¹³ We are currently conducting a review of the Advantage program for this Subcommittee and expect to report on our assessment later this year.

Interactive Communication and Information Dissemination

Governments are also establishing "portals" or integrated web sites for targeted citizen information and services. Increasingly, agencies are working together to aggregate government information and services by category and citizen interest. For example:

- Access America for Seniors¹⁴ is designed to be an entry portal for senior citizens to reach government services and information on such topics as benefits, taxes, health and nutrition, and consumer protection. Similarly, the Access America for Students web site¹⁵ acts as a gateway to

¹³In 1998, the GSA Inspector General (IG) reported that GSA was experiencing difficulties in placing schedule products on-line and vendors were concerned about data formatting and transmission. Some vendors also felt that Advantage duplicated their own Internet web site development efforts. The IG recommended that GSA develop a comprehensive plan that outlines the critical actions needed for achieving Advantage's objectives.

¹⁴<http://www.seniors.gov>.

¹⁵<http://www.students.gov>.

information of interest to students, with links to some on-line transactional resources such as applications for federal financial aid, a calculator (to compute monthly loan repayments), a form to consolidate loan repayments, selective service applications, and links to the IRS e-filing service.

- Several federal agencies are developing expert systems and intelligent technology to provide businesses compliance assistance and to reduce burden. For example, the Department of Labor has developed 18 "E-law Advisors," web-based expert systems that the public can query through menus and routine questions to better understand and comply with DOL regulations. Occupational Safety and Health Administration is working on the next generation of these systems that would combine interactive questionnaires and electronic forms with legal analysis.
- More than 20 federal agencies are participating in the Federal Commons, an interagency effort to use electronic commerce to streamline grants administration. The federal government has over 800 grant programs managed by 33 agencies. Each program has a unique legislative base. As a result, there is a plethora of different forms, procedures, award decision-making processing systems, and payment systems. The Federal Commons web site is expected to become the single point of entry for federal grants programs and a central repository for grant-related information. At present, the site accepts data from grant applicants and recipients for the 20 participating agencies in any format and transmits the data to each agency in its desired format.

Challenges in Transitioning to Electronic Government

As you can see, Mr. Chairman, the opportunities for the growing use of e-government to provide faster, convenient, and efficient on-line services to citizens are immense. Many innovative applications and services are just in early development and adoption stages. However, past mistakes serve to remind us that technology solutions may often involve risks in addition to expected benefits. Let me briefly address some significant challenges confronting government in making the transition to full electronic service delivery. None are insurmountable, but they deserve attention and must be addressed to ensure successful e-government outcomes.

Effective Executive Leadership and Management

Effective top management leadership, involvement, and ownership are a cornerstone of any information technology investment strategy. Effective and responsive management processes must support electronic government initiatives—like any other information technology project—

and decision-making that is focused on achievements in quality improvements, cost-effectiveness, speed in service delivery, or operational effectiveness.

As government expands the volume and scope of its electronic business transactions and the diversity of the users of electronic services, it will become increasingly important for government leaders and managers to devote time and attention to interagency and intergovernmental design, implementation, and coordination of these programs. Information technology (IT), particularly web-based applications, provide the opportunity to reengineer government and to allow government services to be organized in ways that fit the needs of citizens rather than the requirements of bureaucracies.

In government's rush to electronic service delivery, it is important to remember that fundamental principles and practices of good IT planning and management apply equally as well to effective customer-centric web-based applications. Some of these fundamentals include

- developing a well-defined project purpose and scope and realistic, measurable expectations,
- understanding and improving business processes before applying technology,
- performing risk assessments and developing appropriate risk mitigation strategies,
- using industry standard technology and solutions where appropriate,
- adopting and abiding by data standards,
- training thoroughly and supporting users, and
- reviewing and evaluating performance metrics.

An immediate and complex leadership challenge confronting government policymakers and managers is the need to adopt informed strategies to guide agencies in how best to use the Internet to deliver services to all citizens and business partners. Today there is considerable disparity in access to and use of the Internet among citizen groups and businesses. Those with limited access include many small businesses and citizens who live in remote areas and the inner city, businesses and citizens with little or no computer knowledge, and the disabled. An important policy consideration governments face is how to provide services and access to

these segments of the population and ensure their participation in this new electronic environment. Multiple access methods to government services and processes—in person, by phone, via fax, using public kiosks—may be essential to supplement Internet use.

Developing and Sustaining a “Citizen as Customer” Focus

Today, governments at all levels increasingly recognize the individual citizen and citizen “communities of interest” as customers. However, translating this growing awareness into better, efficient, and friendly services can be challenging. Among other things, it requires commitment to a “customer-centric” vision throughout the agency, and a long-term, enterprisewide view of operations rather than the “silo” thinking that has long characterized the way governments have operated.

Just as the Internet and web-based technologies force organizations to rethink their business processes, they force organizations to reconsider their customers—specifically how their customers need, perceive, and digest information and services in a viewable, electronic format. For example, private industry web sites are increasingly being tailored to allow for individual preferences and needs to restrict information only to those products and services desired. Interactive and e-mail messages are transmitted to remind specific customers of products, services, and information that they have expressed past interests in. “Interactive” consumers meanwhile are starting to demand even more convenience and operational excellence from the on-line companies they deal with on a regular basis. Although there are privacy concerns related to these practices, the same expectations can surface for electronic government service delivery as well.

Government agencies and other organizations have identified a number of areas in which there needs to be a governmentwide strategy, guidance, and framework of policies and practices to ensure effective design, development, and implementation of customer-focused electronic service delivery. For example, some agency officials have pointed out that the public will expect a more consistent level of service across agencies, including navigable web sites with intelligent search capabilities, similar user interface conventions, and interoperable authentication policies and methods.

Security and Privacy

Electronic government will only succeed when all its participants—including government agencies, private businesses, and individual citizens—feel comfortable using electronic means to carry out private, sensitive transactions, such as obtaining a license, bidding on a contract,

or making a benefit claim. While progress is being made, the necessary comfort level is not there yet. Stories in the press of hacker attacks, web page defacements, and credit card information being posted on electronic bulletin boards makes many federal agency officials—as well as the general public—reluctant to do “real” business over the Internet. Their concerns are not unjustified. In recent years we have consistently found security weaknesses at many federal government agencies.¹⁶ Weaknesses at agencies such as IRS, the Health Care Financing Administration, the Social Security Administration, or the Department of Veterans Affairs could place sensitive tax, medical, and other personal records at risk of unauthorized disclosure. Moreover, federal web sites themselves have been subject to cyber-attacks.¹⁷

A big piece of the solution to this problem will be in the development and implementation of so-called Public Key Infrastructure or “PKI” technology. I would like to address this in some detail because it is integral to ensuring a successful future for e-government. A PKI is a system of computers, software, and data that relies on certain sophisticated cryptographic techniques to secure on-line messages or transactions. A key component is the use of electronic “certificates” that vouch for a particular user’s identity. A properly implemented and maintained PKI can offer several security services. Specifically, it can provide assurance that (1) the parties to an electronic transaction are really the people they claim to be, (2) the information has not been altered or shared with any unauthorized entity, and (3) neither party will be able to wrongfully deny that they took part in the transaction. Key federal security experts believe these assurances would provide the comfort level necessary to spark widespread implementation of electronic government services.

The federal government is aggressively promoting the deployment of PKI technology. Currently federal agencies—including NASA, DOD, and the Patent and Trademark Office—are experimenting with 24 pilot PKI programs. A Federal Public Key Infrastructure Steering Committee has been established to coordinate PKI pilot projects on a governmentwide basis and to take initiatives to encourage the adoption of PKIs. For example, the Steering Committee has sponsored the development of a prototype Federal Bridge Certification Authority, which is a mechanism

¹⁶*Federal Information Security: Actions Needed to Address Widespread Weaknesses* (GAO/T-AIMD-00-135, March 29, 2000) and *Information Security: Serious Weaknesses Place Critical Federal Operations and Assets at Risk* (GAO/AIMD-98-92, Sept. 23, 1998).

¹⁷*Information Security: Recent Attacks on Federal Websites Underscore Need for Stronger Information Security Management* (GAO/T-AIMD-99-223, June 24, 1999).

that will allow disparate agency PKIs to recognize each other's electronic certificates. GSA built the prototype on behalf of the steering committee, and it was demonstrated in April 2000. The intent of the demonstration was to show that the bridge authority can interoperate with other PKI domains with varying certificate policies, including DOD's separate demonstration bridge certification authority. However, the Federal Bridge Certification Authority is still a prototype, and so far it has only been demonstrated in a test environment. Questions have been raised as to whether the technology will be able to handle large numbers of users and transactions in a real-world environment.

Furthermore, GSA has been working since 1996 on a program called Access Certificates for Electronic Services (ACES), which is intended to help jumpstart agency adoption of PKI technology to provide the public with secure access to privacy-related government information and services. In 1999, GSA awarded ACES contracts to three vendors to provide a range of support services to agencies wishing to adopt PKI technology.¹⁸ The first vendor was authorized to issue ACES certificates in April 2000, so the capability has only very recently become available. The significant feature of ACES is that it can support the use of digital signature certificates without individual agencies having to build their own PKIs. In this kind of arrangement, certificates are provided to the public for free, and whenever they are used to support a transaction, the agency involved must pay a fee to the relevant ACES vendor.¹⁹

Some agency officials believe it will be difficult to budget for ACES certificates because the total cost, which depends on how heavily the service is used, is not known. Agency officials also worry that if their programs are successful and heavily used, their ACES costs may be high. In addition, it would be advantageous for certificates to be interoperable and certificate policies to be consistent across the government. Guaranteeing the authentication of certificate holders, for example, can be problematic if agencies and vendors all use different processes.

Despite all the useful development work that has been conducted to date, PKIs are not yet commonplace, either in the private sector or in government. And a number of significant challenges must still be overcome before the technology can be widely deployed and implemented. For example:

¹⁸The three vendors are AT&T, Inc.; Digital Signature Trust Co., Inc.; and Operational Research Consultants, Inc.

¹⁹The fee will range from \$0.40 to \$1.20 per transaction.

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- *Most large-scale implementations have been limited to pilot environments or specific applications.* Issues have been raised regarding how well PKI technology can scale to the level of hundreds of thousands or millions of users, as will be encountered in government applications. A network of trusted registration authorities may be needed to verify the identities of all users. In addition, another vast network of electronic directories will need to be in place so that every user's identity can be looked up and verified before any transaction takes place. As such, problems with verification failures or unacceptably slow response times are possible until further operational experience is gained with large-scale PKI implementation.
 - *It can be expensive to establish a PKI.* A significant up-front cost is involved with fielding and maintaining a PKI capability in a production environment. New systems must be set up to positively identify users, issue them electronic certificates, and manage the exchange and verification of certificates. In addition, existing software applications and legacy systems must be modified so they can interact with the PKI. These activities can involve significant costs. Funding for some key governmentwide PKI infrastructure has not yet been established but they will be needed to build and maintain an operational federal bridge certificate authority for fiscal years 2001 and beyond.
 - *Although many PKI products are currently on the market, they generally are not interoperable.* Choosing among them means taking the risk of adopting a "dead end" technological approach that may soon need to be replaced. The Federal Bridge Certification Authority may help resolve some agency-to-agency interoperability issues, but it is not yet operational. Having additional standards to help facilitate interoperability can also help resolve this issue.
 - *PKI implementations are not always user-friendly.* Some early adopters of PKI have found it difficult for users to interact with PKI systems. Users need proper training to perform functions such as generating their private/public keys, protecting their private keys, backing up and using their certificates. As you know, in the world of computers, a system that is too difficult to use probably won't be used at all.
 - *Compounding the security problem are concerns about sharing private information electronically.* Individuals should be able to determine when, how, and to what extent personal information is collected and used. However, if not properly implemented and managed, the technologies that have been developed to manage massive volumes of personal information could also be abused. It is no longer technically difficult for the government to establish databases that collect extensive personal

information about large numbers of individual citizens. This means that when technologies such as PKI are implemented, extra care must be taken to avoid improperly gathering or using personal information.

As you know, we are currently reviewing the development and implementation of PKI technology throughout the federal government at your request and will be providing a fuller report later this year.

Technology-Related Challenges

A solid technical foundation needs to be in place before e-government services can be offered reliably and effectively to the public. We have already reported some trial-and-error attempts, such as the Social Security Administration's effort to provide earnings and benefits statements over the Web in 1997.²⁰ In that case, concerns were raised that one person could access another individual's record if the first individual knew the second person's personal authenticating information. It was held that the information needed to answer these questions was relatively easy to obtain from sources other than the Social Security Administration. In short, the public was not comfortable with the way the service had been implemented. After approximately 1 month of service, the capability was withdrawn.

The key to success in e-government is to plan for and implement an adequate technical infrastructure that will support a user's experience of easy and reliable electronic access to government. Elements of this supporting infrastructure include:

- *Adequate network capacity, or bandwidth.* Government agencies will need to consider the amount of electronic traffic that will be generated by an electronic offering and provide adequate connectivity to support that load. Some web sites have been completely overwhelmed and disabled when far greater numbers of users visited the sites than their developers had anticipated.
- *Platform and software application reliability.* The web servers and other computer platforms that support e-government services—including their operating systems and the software that connects them—must also be capable of supporting potentially heavy user demands and must run reliably. The system must reliably confirm that a transaction is complete and also must reliably abort a transaction completely and consistently in

²⁰*Social Security Administration: Internet Access to Personal Earnings and Benefits Information* (GAO/T-AIMD/HEHS-97-123, May 6, 1997).

the event that some problem intervenes. The technology in use today does not always respond consistently and unambiguously. Users may fill out lengthy on-line forms and submit them without getting any clear response from the system at all, leaving them unsure whether their submission was received and accepted.

- *Interoperability.* Even a smoothly operating electronic delivery service will fail to fulfill the promise of e-government if it is isolated from or unable to work with other related applications. Instead, e-government applications should be able to communicate and exchange relevant data with each other. To ensure interoperability, government officials need to recognize its importance and design it in from the start. The emergence of key technical standards for electronic business will help.
- *Technical roadmaps.* Application developers will need to agree upon an overall systems roadmap to guide the development and evolution of e-government systems. Architecture development is a primary means of integrating systems and business processes across an organization in a cost-effective manner. Architectures align information system requirements with the business areas and processes that they support and promote systems that readily exchange and share information. They also can help avoid inconsistent design and development decisions and their associated increased costs and performance shortfalls. Our work at other agencies, such as the Customs Service and IRS, has illustrated the criticality of an agencywide architecture in helping reduce systems development risk and minimizing investment costs.²¹
- *Alternative media, such as wireless devices.* Finally, it is important to note that technology is continuing to evolve at a rapid pace, and today's web-based applications are not necessarily the final incarnation that e-government will take. As the public moves to more compact wireless devices, the government will need to move as well, perhaps supporting a variety of media through which to conduct transactions, from traditional paper-based methods on end of the spectrum to small wireless receivers on the other.

²¹ *Tax Systems Modernization: Blueprint Is a Good Start But Not Yet Sufficiently Complete to Build or Acquire Systems* (GAO/AIMD/GGD-98-54, Feb. 24, 1998) and *Customs Service Modernization: Architecture Must Be Complete and Enforced to Effectively Build and Maintain Systems* (GAO/AIMD-98-70, May 5, 1998).

Human Capital: Demand for IT Skills

As governments at all levels increase their efforts to provide electronic service delivery systems, they face the reality that IT human resources to develop and manage web-based Internet applications are in short supply. The demand for IT workers is large and growing. Employers will attempt to fill 1.6 million new IT jobs in 2000. The largest skill gaps are for enterprise systems integration and web development positions. These positions have high complexity and a scarcity of qualified applicants. The increasing need for qualified IT professionals puts governments in direct competition with the private sector for scarce resources. In addition, the increasing government reliance on private sector service providers and outsourced application development has created a growing demand in the federal workplace for more traditional skills, such as contract management and project and program management.

Agencies are also becoming acutely aware that electronic government technology applications work only if people have the right training to execute them properly. The challenge of new technology and the mandate on improving customer service have led to an increased commitment to training. Without fully developing staff capabilities, agencies stand to miss out on the potential customer service benefits presented by technology. Employees must have the training and tools they need to do their jobs. The process of adopting a new system can be made much less difficult by offering well-designed, user-oriented training sessions that demonstrate not only how the system works, but how it fits into the larger work picture and "citizen as customer" orientation. A significant challenge for all agencies is providing internal incentives for customer service, reducing employee complaints, and cutting the time employees spend on non-customer-related activities.

Conclusions

Mr. Chairman, our government stands today poised for a dramatic transformation. When the transition is complete, our citizens will view obtaining government services no differently than conducting any other business transactions. Standard interactions with government—like renewing a driver's license or claiming social security benefits—may be no different than buying a book today from *Amazon.com*. As some of the limited examples I have discussed today illustrate, significant progress is being made. New opportunities for further changes brought on by web-based and other information technologies are just now emerging. Clearly, there is a substantial amount of legislation and policies issued that provides strong incentives for government agencies to adapt to this new electronic environment.

Nevertheless, despite its promise, technology advancement is not a panacea for government performance problems. I want to emphasize that we still face some formidable challenges. While considerable technological progress has been made, successful e-government must still deal with some of the same basic challenges that have plagued information systems for decades—inadequate attention to technical and business architecture, adherence to standards, and security. We still have limited experience in implementing the mechanisms for security and privacy—especially PKI—which is just one among many factors affecting the large-scale use of e-commerce and e-government. We also need systems that operate together seamlessly behind the scenes, offering a single face to the public and allowing transactions to occur in a way that is reliable, and easy to navigate.

Beyond technology, government executives and senior managers must recognize and embrace the efficiencies offered by e-government proposals and develop effective investment strategies and plans to make them reality. Moreover, top leadership must effectively merge the power of electronic interactions—among agencies, with businesses, and with the public—with necessary and corresponding management and process improvements that will better ensure positive outcomes. In addition, the Web provides new challenges for several traditional information policy areas. The mechanisms used to ensure freedom of information, copyright protections, records management, and privacy may need to be reevaluated given increasing reliance on the Web and its capacity to distribute and present information to both known and unknown audiences. These, too, are familiar themes behind recent information management reforms and should not be ignored.

Mr. Chairman, that concludes my statement. I would be happy to answer any questions that you or other members of the Subcommittee may have.

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