

Information Technology

Abstract. Forging an unprecedented partnership between the public and private sectors is essential to protect the vital interests of the United States in the wake of the ongoing Information Technology Revolution. This study will define the Information Technology Industry, give an overview of current domestic and international conditions, and then analyze the state of national network security and challenges faced by the United States government and U.S. and international businesses and corporations in building a secure, yet productive and innovative partnership. Particular emphasis will be placed on industry issues with national security implications.

LTC Kyle Burke, USA
COL Norvel “Rock” Dillard, USA
Mr. Patrick Dolan, The Boeing Company
Lt Col Gregory Edwards, USAF
Mr. Daniel Elins, GS-14, Department of the Navy
CDR Leonard Gaines, USN
Mr. Steven Goodwin, GS-14, Department of State
Lt Col Michael Lawrence, USMCR
LTC Paul Lepine, USA
CDR Kevin Redman, USN
Col Robert Stambaugh, USAF
Mr. Bereket Tanju, GS-15, Department of the Navy
Col William Thorton, USAF
Lt Col Roger Thrasher, USAF
LTC Krume Velkov, Macedonian Army
CDR Randy West, USN

COL (Ret) Richard Altieri USA, faculty
LTC Nathan Buccheit, USA, faculty

ICAF

PLACES VISITED:

Domestic:

Information Technology Association of America, Rosslyn, VA
Software and Information Industry Association, Washington, DC
Department of Homeland Security, Washington, DC
National Cable Television Association, Washington, DC
U.S. Telephone Association, Washington, DC
Microsoft, Washington, DC
Lucent Technologies, Holmdel, NJ
Cisco Systems, San Jose, CA
BEA Systems, San Jose, CA
Oracle, Redwood Shores, CA
Semiconductor Industry Association, San Jose, CA
Symmetricom, San Jose, CA
Apple, Cupertino, CA
Foundry Networks, San Jose, CA
Hewlett-Packard, Richmond, CA
Silicon Graphics, Mountain View, CA

International:

Beijing, China:

United States Embassy—China

Bangkok, Thailand:

Sanmina-SCI
American Chamber of Commerce-Thailand
Verizon Communications
Pan Pacific Associates
ISM Technology
GM Thailand
Pan Pacific Associates
American Embassy -Thailand
Software Park
Mustang Technologies
Telecommunications Association of Thailand
NECTEC (National Electronics and Computer Technology Center)
Minister, Ministry of Information and Communications Technology

Singapore

American Embassy, Singapore
Infocomm Development Authority (IDA)
TECH Semiconductor



I C A F

Tokyo, Japan

American Embassy – Japan

Hitachi

American Chamber of Commerce – Japan

Diet Member Mr. Taro Kono

Sony Media World

NTT DoCoMo

Asia Technology Information Program

Japan IT Policy Office





ICAF

I. Introduction.

The United States Information Technology (IT) industry was a major contributor to the growth of the U.S. economy throughout the '90s. Over the last decade, the American economy has grown faster with lower inflation than at anytime since the Vietnam War - largely due to advancements of IT systems and resultant productivity enhancements benefiting most U.S. industries.

Virtually every American industry has benefited from advances in information management and IT. Simply put—in the New Economy, America's economic competitive advantage is really an IT advantage. IT contributions are not limited to America's economic base; IT is also helping to transform the U.S. military from a Industrial Age platform-based force, into an Information Age, fully networked, capabilities-based force. Every military service transformation plan relies heavily upon IT as a means to substitute speed and precision for mass. Given our heavy dependence on IT and the great importance of the IT industry, the question becomes how do we promote a healthy, robust, and growth-oriented IT industry. This paper examines the IT industry, specifically the current health of the industry, and current challenges. Additionally, this paper will examine the role of government in addressing these challenges and ensuring the United States maintains a worldwide IT advantage. The 2004 IT Industry Study Group based this study on field research in the U.S., Ireland, China, Thailand, Singapore and Japan, as well as extensive research.

II. DEFINING THE INFORMATION TECHNOLOGY INDUSTRY

The Information Technology (IT) industry cannot be defined or captured by a single company or a single sector of our nation's economy. The Department of Commerce defines the IT-producing industries as those industries "...that procure, process, or transmit information goods and services"ⁱ It includes goods-producing industries related to the Internet and electronic commerce, manufacturers of some general and specialized electronic components, computers and peripheral equipment, specialized measuring and testing instruments, telecommunications equipment and pre-packaged software. It also includes those industries that provide computer, software, and telecommunications services. To better evaluate the IT industry, the Commerce Department divided it into four sectors using its North America Industry Classification System: (1) hardware industries, (2) software/computer service industries, (3) communications equipment industries, and (4) communication services industries.

General Economic Conditions

After two years of retrenchment, the IT-producing industries are showing signs of resuming the dynamic roles they played during 1996 – 2000ⁱⁱ (shown in Figure 1). Through the later portion of the 1990s, the IT industry grew steadily at about an overall 11% average annual growth rate, reaching a peak of \$878B in 2000. With the "dot.com" bubble collapse and the worldwide recession following the events of September 11, 2001, the IT industry fell 5.6% in 2001 to \$828B. In 2002, while the general economy started to recover from the mild recession, the IT portion recovery was delayed due to the low business spending for capital equipment.ⁱⁱⁱ It grew only 0.3% in 2002 to \$831B. Recovery in the IT industry began in the second half of 2003, with an estimated 11.5% gain in the fourth quarter^{iv} and a 4.8% annual gain for 2003 (\$878B).^v This pickup was

attributed to four factors: (1) an improved macroeconomic picture with favorable monetary conditions, (2) long overdue pre-Y2K desktop replacement cycle along with a need to improved security and lower cost of ownership, (3) a shift towards portable, wireless computing, and (4) stable cost of application software packages.^{vi}

While the overall IT industry improved in 2003, performance by sector varied widely (shown in Figure 2). The hardware sector showed the largest growth of 9.8%. However, communications equipment, which had fallen over 15% in 2002, slowed its decline 5.6%. The service sector continued their slow and steady growth with a 1.6% rise in software and services and 7.2% growth in communications services.^{vii}

IT employment, which fell sharply during the 2001-2002 downturn, has been slow to recover. Over 600,000 jobs were lost.^{viii} Contributing factors were the 2001 recession, labor saving productivity improvements, and foreign outsourcing of jobs. However, despite the pickup in the overall economy in 2003, the job market for IT workers remained weak.

In contrast to the changes in IT production and employment, IT industry investment in Research and Development (R&D) has shown greater stability.^{ix} Although the overall company R&D spending was flat for 2001 at about \$181B, R&D for IT companies grew in 2001 from \$46.9B to \$56.5B, according to the latest available data from the National Science Foundation.^x (Illustrated in Figure 3). More than other industries, IT is heavily reliant on R&D investment to drive the innovation required for market leadership.

The outlook for 2004 is for IT to continue to its recovery. According to the Prudential Financial Securities' proprietary survey of U.S. and European CIOs conducted in the first quarter 2004, respondents showed continuing confidence about long-term IT growth with mid-single to lower double digits percentage forecasts.^{xi} IT budgets for 2004 have remained stable or up slightly from the previous year.^{xii} CIO Magazine's Tech Poll conducted in February 2004 showed similar results.^{xiii} Another positive factor is the enlargement of the European Union. The ten new member states added May 1, 2004 create a greater, single market for IT goods and services.^{xiv} Growth in trade with eastern Asia (principally China) is expected to continue to outpace the rest of the world. Finally, worldwide use of the Internet will continue to grow driving demand for both goods and services.

Sector Analysis – Hardware (Computers and Networking)

Contribution to GDP: From 2002 to 2003, Hardware contribution to GDP increased 9.9 % from \$189.3B to \$208.0B. Hardware represents 1.9% of the total 2003 GDP. This sector comprises 23.9% of the IT Total in 2003.

Computers. This segment has three main components: personal computers (PC) (including notebooks), which accounts for 91% of total revenues, servers (including mainframes and supercomputers) 6.4%, and workstations 2.5%.^{xv}

Market Composition

The PC industry is becoming increasingly concentrated. In 1992 the top 10 worldwide vendors accounted for roughly half the market. By the third quarter of 2003, the top five vendors increased their hold to 48%^{xvi}: Dell (17.4%), Hewitt Packard (17.1%), and IBM (5.9%).^{xvii}

In the server industry the top five vendors command 84% of the market share in 2002. The top two leaders are IBM (29.5%) and Hewitt Packard (27.9%). Sun Microsystems market share slipped (13.6%) while recent entry Dell gained (8.2%). Fujitsu Siemens showed a modest decline (3.5%).^{xviii}

In the workstations segment the prognosis for growth is nil. Lower priced and more powerful desktop computers are providing a compelling and cheaper alternative.

Current Environment

PCs have become largely standardized, with the overwhelming majority being built with processors based on the Intel design and using Microsoft software. Due to this lack of product differentiation, price becomes the key differentiator. With increased competition, only the most cost-efficient vendors will survive. Consequently, PC vendors are broadening their product lines by entering consumer electronic markets (plasma and LCD televisions, digital cameras, and digital music players, etc.) with higher profit margins. Server sales, after nine quarters of annual declines, rose 17.5% in the second quarter of 2003. Revenues, however, remained flat—reflecting price competition.

^{xix}

Forecast

Computer hardware spending represents some 40% of worldwide spending on IT. IT spending is expected to grow from nearly \$1.0 trillion in 2001 to \$1.5 trillion in 2006.^{xx} Much of this growth is due to the Internet, both in the building of its infrastructure and for devices to access it. With an expected real GDP growth of 4.6% in 2004, PC sales are expected to expand 8% to 11% in 2004. Continued growth in a range of 7-12% for 2005 to 2008 is reasonable.^{xxi} Much of this growth will come from international markets, and offer long-term growth with the Asia-Pacific region exploding at a compound annual rate of 14.1%, while the United States is expected to grow at a more modest 7.0%.^{xxii}

With increasing price competition in PCs, further consolidated is expected. Many industry forecasters have predicted that the top five PC vendors may hold 70% market share in the near future.^{xxiii}

Prospects for server sales are uncertain. While servers sales in the U.S. are expected to grow 2.8% in 2004, oversea sales are expected to lag due to weak corporate spending environment and tight technology budgets.^{xxiv}

Traditional workstations that use the Unix operating system and reduced instruction set computer microprocessor will continue to be challenged by the influx of PC-based units, as well as increased competition from the lower-priced Windows NT workstations.^{xxv}

Networking

Market Composition. Five main product lines make up this sector, producing IT infrastructure equipment such as ethernet switches, routers, access equipment, mobility equipment, and optical transport equipment.^{xxvi}

The market leaders in each product line (based on 4th quarter 2002 revenues):

- | | |
|---------------------------------------|---------------|
| 1. Ethernet switches and wireless LAN | Cisco (60%) |
| 2. Routers | Cisco (49%) |
| 3. Access Equipment | Alcatel (22%) |

- | | |
|--------------------------------|------------------|
| 4. Mobility Equipment | Ericsson (28.5%) |
| 5. Optical transport equipment | Nortel (19.5%) |

Current Environment

Standard and Poor's assesses the current environment as an "...uncertain economy and excess network capacity due to prior over-investment." This "over-investment" has slowed the recovery from the 2000 – 2002 downturn.^{xxvii} Of the five segments, only Ethernet switches showed growth with a modest 3%.^{xxviii}

Forecast.

Standard & Poor's believes that this sector may see a recovery in 2004 and 2005 with annual sales growth of 8% to 12%, followed by annual growth rates of 10% - 15% over the next three to five years.^{xxix} Increased use of the Internet will continue to drive demand from networking equipment. International Data Corporation forecasts that Internet worldwide usage will rise from 500 million in 2001 to nearly one billion by 2006.^{xxx} New applications such as streaming video and desire for greater bandwidth and transmission capability will drive investment in infrastructure.^{xxxi}

Consolidation within this industry is expected to continue. The industry's largest players have found that purchasing small start-up firms specializing in emerging technologies is more effective than developing their own products internally.^{xxxii} For example, Cisco acquired 48 companies from 1993 – 1999, and another 23 in 2000. Merger activity slowed in 2002 and 2003 due to the economic downturn. However, with prospects for a recovering economy, companies may want to take advantage of the more reasonable current valuations and acquire additional holdings.

Computer Software, Services, and Internet

Contribution to GDP: From 2002 to 2003, the software and services sector contribution to GDP increased 1.6% from \$323.7B to \$328.8B. This represents 3.0% of the total 2003 GDP. This sector comprises 37.7% of the IT Total.

Computer Software: Software continues to play an increasingly important role in all sectors of the world's rapidly evolving high-technology society. The flow of information in today's global economy runs on software developed and supplied by Microsoft and a several competitors.

Market Composition: Microsoft continues to dominate the US and world software markets, with \$24,666,000,000 in revenue in 2002. Surprisingly, a hardware giant is second: IBM sells a huge volume of software, recognizing that as hardware functionality increases, so does demand. EDS, Accenture, Oracle, and NTT Corporation follow Microsoft and IBM.^{xxxiii}

Current Environment: After the dramatic "dot-com" bust of 2000-2001, IT spending continued to languish through 2002 (in the wake of 9/11 and the looming war with Iraq). IT spending in general, however, and software sales in particular, have shown steady improvement since the second quarter of 2003. Throughout the bust and the extended recovery, Microsoft continued "trucking along"—increasing market share and maintaining profitability. The "dwarfs" of the software industry, therefore, have borne the brunt of the bust, and disproportionately languished through the slow (if steady) recovery.

Linux continues to gain traction as an alternative source for enterprise servers such as business supply chain management, human resource management, financial records,

customer relations, Web services, and Employee Relationship Management (ERM). For the foreseeable future, however, Linux will likely remain a niche competitor with Microsoft.

Forecast: The software industry is changing rapidly. “Middleware,” which serves as “workhorse” between the clients on the front end and databases on the back end, is quickly gaining popularity, especially in “business to business” sales. BEA Systems and IBM lead sales in this software sub-market. Likewise, Nintendo and Sony continue to dominate the lucrative “interactive entertainment” or video game software sub-market, despite Microsoft’s aggressive marketing of X-Box systems. Finally, IBM is committed to developing hardware that operates on both open source software (most commonly Linux sold under General Public Licenses, or “GPL”) and proprietary source software—much to Microsoft’s chagrin.

These seemingly innocuous chinks in Microsoft’s armor may indicate a loss of dexterity. Traditional software companies must continue to innovate or lose market share to more nimble competitors. In spite of Microsoft’s near monolithic position atop the software industry, several sub-markets show signs of competition, and corresponding innovation.

Commercial Services

Spending on consulting and systems integration spending took a significant downturn from 2000 through 2003. With the steady recovery of the US economy since the first quarter of 2003, spending on IT services has correspondingly increased.

Market Composition: The IT Services market is widely diversified. According to Gartner Dataquest, IBM has a 7.5% market share, Electronic Data Systems 3.9%, Fujitsu 2.7%, and Hewlett-Packard 2.3%. Several hundred other firms scramble for the remaining 83.6%.^{xxxiv}

Current Environment: Not surprisingly, this highly fragmented and competitive market drives razor thin profit margins. Many smaller IT consulting firms were forced out of business after the dot-com crash. Those that survived started with or developed diversified revenue streams. Outsourcing and off-shoring, particularly to India, is a popular tactic to offset spiraling costs caused by fierce competition, high labor expenses, and unfavorable tax laws. In spite of these challenges, the net effects of globalization, deregulation, and technological innovation drive up demand world-wide, thereby benefiting US companies.

Forecast: The US economy experienced a solid turnaround in 2003, and more IT-related projects will be approved as customers emerge from more guarded postures. Standard and Poor’s projects that the growth rate on commercial spending on IT services will more than double in 2004. The expansion of the IT services market will continue for the foreseeable future, with federal, state, and local government IT spending driving much of the expansion.

Consumer Services and Internet

Market Composition: According to Standard and Poor’s, the top five Web Parent Companies in the United States are Microsoft, America on Line (previously AOL Time Warner), Yahoo, Google, and eBay. If the United States government were a company, it would be the sixth largest web parent company! While the “big 6” have a

solid hold over approximately 60% of the field, over 20 “mid-level” companies such as eUniverse, EarthLink, and Landmark Communications aggressively jockey for position.

Current Environment: The three-year downturn in Internet stocks ended in the first half of 2003. TheStreet.com Internet Index reported a 74% drop in Internet-based company stocks in 2000, followed by a further 56% drop in 2002. Two hundred eighty-three Internet companies discontinued operations between the first quarter of 2000 and the final quarter of 2003, resulting in over 150,000 IT job losses in the US.^{xxxv} Rising stocks from January 2003 to the present, however, indicate that this market correction is over. For e-commerce, business-to-business (B2B) sales still dwarfed business-to-consumer (B2C) sales in 2003.

Forecast: Standard and Poor’s predicts steady growth for Consumer Services and the Internet. Several fortunate factors converge in support of this prediction: PC prices continue to decline, the number and quality of web services continue to grow exponentially, and governments across the globe promote policies to stimulate and sustain Internet growth.

Sector Analysis – Communications Equipment

Contribution to GDP: From 2002 to 2003, Communications Equipment contribution to GDP decreased 6.8 % from \$46.6B to \$43.5B. This sector represents 0.4% of the total 2003 GDP. This sector comprises 5.0% of the IT Total.

Market Composition: In general, this industry provides the equipment to transmit voice, data and video services. The most interesting feature in the market for communications equipment is technology convergence. What used to be a market split by different technologies into different networks is now moving to linked sets of networks capable of delivering the same or similar services.^{xxxvi} Data, voice and video will soon be available from various sources such as cable, wireless, wireline, and satellite, which means that companies that would not have been head-to-head competitors in the past will increasingly compete against each other. So wireline (phone and cable) leaders such as Alcatel, Lucent, Nortel, and Cisco will increasingly compete with wireless leaders such as Motorola, Lucent, Nokia and Ericsson to provide cross-cutting digital technology equipment.^{xxxvii}

Current Environment: Following the telecommunications bust, recent Commerce Department indicators show that demand for communication hardware will stabilize during 2004.^{xxxviii} This implies slow sales growth tied to the overall pace of the US economic recovery. With the on-going convergence, it is difficult to determine market share since the definition of the market itself is in flux. This is leading companies in this sector to move outside their traditional comfort zone to pursue a market strategy that provides a variety of digital services via their products. Traditional measures of performance (return on investment, return on equity, etc.) may also be less important during this convergence phase. Just as important will be breadth of technology offerings (data, voice, video) that are appealing enough for companies to remain a player in a converged communications equipment market.

Forecast: In sum, the market is increasingly characterized more by the specific services provided than by the technology or delivery medium. This convergence process is enabled by new technologies that allow previously narrow companies to provide wider offerings. Such technologies include Internet telephony, 2.5G and 3G wireless, fixed

wireless (Wi-Fi and Wi-Max), and enhanced wireline service over cable, telephone and power lines.^{xxxix}

III. ENCOURAGING SECURITY AND COMPETITIVE ADVANTAGE

As reported to Congress in “Security in the Information Age: New Challenges, New Strategies Joint Economic Committee United States Congress,” our enemies are looking for our weaknesses: “It is very important to concentrate on hitting the U.S. economy through all possible means . . . look for the key pillars of the U.S. economy. The key pillars of the enemy should be struck . . .” Osama Bin Laden, December 27, 2001^{xi}

U.S. Risks, Threats, and Vulnerabilities

Cyber attacks are daily events, and they are also increasingly more evasive and damaging to computers and networks. As the number of attacks continues to rise, the number of vulnerabilities in both software and hardware also rise.^{xli} Networked computers now control everything from railways to pipelines to electric power grids, and present “malicious actors” increasing opportunities to cause disruption.

Threats and Vulnerabilities can be divided into five different levels for assessment and mitigation:

1. Home User / Small Business;
2. Larger Enterprises (including Universities);
3. Critical Sector / Infrastructures;
4. National;
5. Global;^{xlii}

Network Security: Defending networks today requires coordinated private and government action. A solid foundation is needed to protect infrastructures from worms, viruses, Trojan horses, and other threats that can cause extensive damage before they are even identified.

In the past three years, government systems have been illegally entered approximately 250,000 times. The Defense Information Security Agency (DISA) found that 88% of assaults could have been easily prevented. DISA also maintains that only very small number of attacks on DoD systems were reported and investigated.^{xliii} It is generally understood that a successful cyber attack on most DoD systems would cause hardly any casualties, but could cause loss of infrastructure and service.

The Government Accounting Office (GAO) has identified problems within the federal government and is tracking risks within 24 large federal agencies. GOA reports:

“For many years, we have reported that poor information security is a widespread problem with potentially devastating consequences. Further, since 1997, we have identified information security as a government wide high-risk issue in reports to the Congress—most recently in January 2003.”^{xliv}

Almost every aspect of American life and government has become increasingly dependent on computer technology. The economy is increasing dependant on electronic

transactions. In the rapidly evolving world of technology, new forms of cyber terrorism will certainly appear.

How safe are our networks? Cyber attacks can be launched from anywhere in the world.

According to the Federal Trade Commission (FTC), five years ago the number of identity theft complaints was around 23,000. By 2001, the rate had more than tripled to about 86,200. Figures for 2003 rose to 215,000.^{xlv}

The recent “Slammer” worm hit 55 million hosts in about 11 minutes. Blaster” struck about 128 million systems in 3 minutes. During the 2002 calendar year, the DoD Computer Emergency Response Team (CERT) detected, analyzed, and responded to more than 46,000 “events” on DoD’s unclassified networks.^{xlvi}

The physical threats are many, and wireless technology opens other potential seams. Wireless technology hacking techniques are cheap and plentiful. Wireless can increase the number of connections and multiply poor security practices. Even when wireless access points are secured by software, if the physical security is poor, hackers can “borrow” open access points. Time is on the side of intruders—even before new updates or patches can be installed, intrusions can cause costly and sometimes irreparable damage. Perimeter defenses are unable to fully protect networks, as many intruders are smart enough to get through them.

Services provided by network security companies can eliminate almost all of the false alarms typically generated by internal security devices, and can also stop real security breaches and network attacks faster.

A Strategy to Secure Cyberspace: The DISA information strategy is based on the theory that appropriate security actions will stop most of the cyber attacks. These protective mechanisms include physical, electronic, and procedural mechanisms. The main objectives of the plan are to 1) “prevent cyber attacks against America’s critical infrastructures, 2) reduce national vulnerability to cyber attacks, and 3) minimize damage and recovery time from cyber attacks that do occur.”^{xlvii}

Several large and small private sector corporations offer assistance and expertise to the public sector. As an example, SECNAP Network Security Corporation, a network security service provider experienced in private and government sectors of the telecom industry, is presenting an integral part of the cyber security strategy for the Homeland Security Department for Critical Infrastructure Security. The aim is to deliver Precise Attack Prevention service including a 24x7 Firewall, network monitoring, External Penetration Testing, Security, Audits and Network Security Consulting Services.^{xlviii}

Public-private partnerships at all levels of government are now supporting information security. At the federal level, the National Cyber Security Alliance (NCSA) is a cooperative effort between industry, industry associations and government organizations. NCSA’s mission is to provide education and foster public awareness of cyber security protection methods and technologies through its web page: www.staysafeonline.info.

Cisco Self-Defending Network Initiative: The Cisco Network Admission Control program is a new development in the Cisco Self-Defending Network Initiative, a

new security strategy designed to improve the ability of networks to identify, prevent and adapt to a range of security threats. The Cisco Self-Defending Network Initiative advances Cisco's strategy of integrating security services throughout Internet Protocol (IP) networks by delivering new network threat defense. It also ties leading anti-virus software to its network hardware, thereby transforming access ports into security checkpoints. This approach shifts security architecture from network protection to user and device level protection and identifies and prevents malicious behavior before it can occur.

The three largest anti-virus software vendors, Network Associates, Symantec and Trend Micro, promise they will include the licensed Cisco Trust Agent in client security products. Trend Micro, which intends to include the Trust Agent directly in its anti-virus software by the middle of next year, expects Cisco's approach to dramatically reduce worm effectiveness. McAfee, with Nortel, is working on projects to block desktop users without anti-virus updates.

Recommendations: 1. The best way to counter cyber threats is through prevention. 2. Intensify Internet security by improving screening processes and advanced security passwords. 3. Support cooperation among security agencies in tracking and locating cyber terrorists by sharing information about cyber threat inside or out of their own country. 4. Frequently update current systems and anti-virus software. 5. Institute a permanent scan for viruses, worms, and any other tools to prevent the spread of viruses and/or other methods of Internet attacking; and update intrusion detection systems and firewalls to stop any cyber terrorists/hackers that pass through the "check-point."

Deleted: ¶

Open Source Software and Proprietary Source Software Development

Open source software is software that is built and extended through open public collaboration.^{xlix} The source code for the software is freely available and anyone can use, modify and redistribute it.¹ It is considered the opposite of proprietary software, however, it is important to recognize that open source software is not "freeware" in that it is typically distributed under a license that specifies the rights and responsibilities of users.

One of the most popular open source licenses is the General Public License (GPL)^{li}, which allows users to modify and redistribute the code as long as they do not charge a fee for the modified software.^{lii} Open source software development is an evolutionary and transparent process characterized by flexibility to add new features and low up-front costs. Advocates maintain open source software provides better security, since security gaps can often be found and fixed quicker than proprietary software. On the other hand, open source software still requires support and training costs, development plans may be less defined, standards adoption may lag and interfaces may not be as "user friendly."^{liii}

Partly in response to Microsoft's monopoly of desktop operating systems, many IT companies have pursued open source software solutions such as Apache^{liv} and LINUX.^{lv} Likewise, countries including China, South Korea, India, Brazil and Thailand are promoting the use of open source software to reduce costs, control dependence on foreign suppliers, wring concessions from proprietary vendors, and enable "home-grown talent" to produce localized versions of open source software when it is uneconomical for proprietary software vendors to do so.^{lvi} In sum, the open source approach is an emerging

and increasingly robust alternative to proprietary software solutions. It is particularly threatening to Microsoft since the open source approach provides the only real challenge to Microsoft's monopoly of operating systems and office productivity software applications.

Open Standards: Open standards have been used around the world for many years and exist where multiple vendors and organizations agree to the specifics of a particular technical standard. All vendors can then use the technical standards in their products or services. Usually a third-party industry group or professional group maintains the open standard on behalf of the larger community. As with previous technological advances, open standards play a key role in the adoption of information technology. For example, the TCP/IP communications standard that underlies the Internet is an open standard. Likewise, the HTML standard used to deliver web pages is an open standard that anyone can use to deliver web content via an HTML-based browser. The availability of these Internet standards to many different companies and individuals fostered the widespread adoption of the World Wide Web. However, just because a standard is widely adopted does not necessarily make it an open standard. For example, Microsoft's office applications use proprietary document format standards, and only Microsoft has the right to use these standards as the default document format for office productivity software.

One of the most promising of open standards is called the eXtensible Markup Language (XML), which aims to provide an open standard for representing both web and office document content. Over five years ago the World Wide Web Consortium (W3C) introduced the XML as a tool to describe all kinds of data.^{lvii} Originally designed to enhance web services, XML is now used for many data sharing functions and has been called "the future lingua franca for the exchange of structured data."^{lviii} XML is the key candidate upon which to base an open next-generation format for use across the web and on the desktop. Even Microsoft is supporting XML in their upcoming release of Microsoft Office, although critics charge that Microsoft is keeping their specific XML implementation secret in an attempt to continue to lock users into a proprietary solution under Microsoft Office.^{lix} Despite these disagreements, it is probable that office productivity document standardization efforts led by the Organization for the Advancement of Structured Information Standards (OASIS) will lead to a future where data interoperability across platforms and applications can be the norm and not the exception.^{lx}

Microsoft's Monopolies: One of the most singular aspects of the modern information age world is that one company – Microsoft – holds an overwhelming monopoly on the basic operating software used to run most of the world's desktop computers, along with a virtual monopoly on the office productivity software used throughout the world. While this dominant position has no doubt driven and enabled widespread adoption of information technology, it raises issues of sole-source dependence, security vulnerabilities, lack of innovation, and monopoly abuse.

Microsoft Windows' operating system monopoly erects formidable barriers to other vendors wishing to enter the market. Potential competitors must offer a better product, and, more importantly, figure out a way to overcome the network benefits that Windows accrues from its dominant position. Another barrier to competition in the operating system market is that potential Windows competitors must offer not only an

attractive operating system, but also a compelling office productivity suite that meets or exceeds the features and network benefits of Microsoft Office. The reinforcing combination of the Office and Windows monopolies erects an almost unassailable wall to other software producers. This combination will allow the Windows' monopoly in particular to linger beyond its natural lifespan.

If these were the only barriers to entry, it is possible no antitrust actions would have been sought against Microsoft. What has prompted such suits is Microsoft's abuse of their monopoly position. While monopolistic positions may be tolerated for public good, what is prohibited is using monopoly advantage to stifle competition and innovation. Such behavior hurts consumers in the long run because competition is stifled, which means prices increase and innovation stagnates.

Both the US^{lxii} and the EU^{lxiii} won anti-trust lawsuits alleging illegal bundling software, such as Internet browsers and media players, in Windows. Microsoft attempted to bundle additional functionality into their operating system as a way of dominating new software markets. This practice of bundling is a common symptom of monopoly abuse.^{lxiii}

The challenge of dealing with Microsoft is many-faceted. Microsoft provided a real benefit with their Windows/Office market dominance by spreading the use of personal computers through network effects. The world and the US experienced faster information flow and increased productivity as a result.

Microsoft attained their monopoly position legally, and they deserve the rewards of a successful technical and business strategy. The question is whether they should continue to hold this dominant position given the potential for pricing abuses and stifling innovation. Certainly other vendors are motivated to bring innovative and potentially competitive products into this market. But they are unlikely to succeed against the combination of Microsoft's legally built Windows/Office monopoly and Microsoft's anti-competitive actions as documented in the courts. Thus, while a Government-made level playing field did not bring the US or the world to the Information Age, it is important for the Government to ensure a fair playing field where products and solutions compete on the basis of price and innovation alone.

Recommendations: 1. In the United States, the Justice Department and Judge Kollar-Kotelly should continue to closely monitor Microsoft's business practices. The primary goal is to prevent any further attempts to illegally bundle new capabilities into Windows or Office that other vendors might reasonably provide separately. **2.** A secondary goal is to ensure Microsoft does not inhibit the use of open standards by "adopting" such standards, and then building in proprietary components that serve to perpetuate a Microsoft monopoly. Stopping Microsoft from using their monopoly position to gain unwarranted dominance in new product areas and ensuring Microsoft does not undercut the adoption of open standards enables innovation, competition and interoperability. These actions do not stop Microsoft from competing in new areas, but instead allow consumers to benefit from having multiple vendors compete to provide best-value products or services. **3.** Also, Federal and State Government IT procurement requirements should be *neutral* with respect to software development approach, with an emphasis on the use of open standards to achieve interoperability. In particular, requirements for operating systems and office productivity software should be not exclusively mandate the use of specific proprietary products or the use of open source

software – both approaches should be considered. Setting IT standards that do not mandate either proprietary or open source solutions allows vendors to put together best-value solutions independent of the particular software development. 4. Finally, we should promote the use of open office productivity software document standards by having the Commerce Department require Microsoft to turn over their Office document formats to an international standards group so any software vendor can use them. In addition, Federal and State Government IT offices should eventually move towards adoption of emerging XML-based open data formats. Moving to an open set of document standards (first based on Office formats and potentially migrating to open XML-based formats) will immediately allow other vendors to develop applications with various feature and prices sets that would compete with the existing Office applications. All vendors, Microsoft included, will then compete on best price/value based on tailored applications, instead of one vendor selling a monolithic suite with no competition. This also reduce one of the main barriers to competition with Microsoft Windows.

IT Worker Shortage

The IT industry has stated that there is a shortage of workers with the IT skills necessary to keep their organizations competitive locally and globally. In the past four years, there has been the dot-com collapse, the telecom collapse, a recession and the subsequent jobless recovery, until recently spending on IT services and equipment has been slow.

The Information Technology Seminar made numerous visits made to IT associations (lobbyists) and IT companies. Most lobbyists and companies alike asserted that a shortage of qualified IT workers exists in the United States and can only be filled by foreign workers (at least short-term).

There are well over 100,000 programmers unemployed in the United States, and nearly 600,000 unemployed IT workers. According to data from the Bureau of Labor Statistics, unemployment in 2003 for all IT workers averaged 5.6%, with a 6.4% rate for computer programmers. (McGee). Economists generally agree that there is NO shortage of IT workers.^{lxiv} A basic tenet of capitalism is that if there were a shortage, wages would rise. Businesses and even universities have used the H-1B and L-1 visa programs to replace American workers, or to avoid hiring them in the first place.^{lxv} Workers are available, but not at the price that companies want to pay. They have used the Congress and other parts of government to obtain cheap sources of labor.

Another related issue is the “shortage” of engineers and scientists in the United States. Predictions of a shortage of nearly 675,000 scientists and engineers in the United States in the 1990’s never materialized and were wholly inaccurate. In fact, National Science Foundation (NSF) Director Neal Lane, in Congressional testimony, repudiated projections and stated that the shortage alarm had no basis.^{lxvi} Unfortunately, Congress had by that time nearly tripled the number of permanent visas for highly skilled immigrants.^{lxvii} It could be deduced that the role of bringing in students to receive PhDs and then retaining them was really to hold down salaries of American students earning PhDs. Salary restraints further reduce the attractiveness of PhDs to American students, which may *artificially* reduce American enrollment.^{lxviii} In fact, a PhD does not presently pay for itself over a lifetime of earnings.^{lxix}

VISAS: The H-1B visa program was introduced in 1990 in response to a perceived shortage of skilled labor in the U.S.. H-1B visas allow companies to bring in foreign college-educated workers for six years, but they cannot replace American workers, and they must be paid at prevailing U.S. wages. However, employers are not required to recruit Americans before hiring H-1B recipients.

The laws which require H-1B employees to be paid at the prevailing wage are so full of loopholes that they are virtually unenforceable. Additionally, the restrictions in the H-1B have failed to protect U.S. workers and IT workers. (Matloff, Worthen). A prominent and profitable Silicon Valley company applied for 4,000 H-1B visas. After the visas were approved, the company announced layoffs of 4,000 U.S. (but only after some were required to train their replacements).^{lxx}

Only 78,000 H-1B visas approved last year. Universities and non-profit institutions have no limits and are exempt from any cap.^{lxxi} There are currently over 450,000 H-1B visa workers in the country and the vast majority is in the IT industry (recall that there are over 600,000 unemployed IT workers).^{lxxii}

Another temporary work program is the L-1 visa program. L-1 visas are available for global companies to transfer personnel around the world. Global companies need this ability to transfer people around various departments located in different countries. L-1 visas have almost no restrictions – no labor restrictions and no annual cap. The program has been abused in recent times to bring programmers from India.^{lxxiii}

Numerous lobbyists and companies have claimed they need special skill sets that are not available in the United States.^{lxxiv} This claim does not fit with statistics showing reduced salary of H-1B visa applicants. It is a leap to believe that the “best and brightest” from around the world are flocking to the United States for substandard salaries. According to the Bureau of Labor statistics, 99 percent of I.T. related H-1B visas salaries are less than \$79,000 per year. Furthermore, only one percent of computer related H-1B visas have doctorates. Few H-1B visa recipients have Masters degrees, either.^{lxxv} Therefore, based on salaries and qualifications, it is clear that the very large majority of H-1B visas are extended to ordinary foreign workers that are paid below prevailing U.S. salaries.

Recommendations: 1. Numerous Bills are before Congress to reform the H-1B and L-1 Visa program (Mica Bill, DeLauro Bill, Dodd/Johnson Bill, and the Tancredo Bill).^{lxxvi} None of these bills are completely satisfactory. Wage parity requirements and stricter justification of workers are a good starting point. No exemptions should be granted for H-1B visas (i.e. universities and non-profit institutions should hire Americans as well). Employers should be required to advertise the position for 3 months in a national medium or database.^{lxxvii} L-1 visas should be completely revised as well and require justification to transfer personnel – vice hiring someone locally (the justification should be along the lines that a unique individual with experience in that company is required to execute the job). 2. There is no shortage of engineers or scientists in the United States. However, it is recommended that the total number of American students enrolled in PhD programs (engineering and science) be increased to ensure the United States maintains the capability of continued excellence in R&D and innovation.

Offshore Outsourcing: Offshore outsourcing is the contracting of IT work to companies outside of the U.S. In recent years, offshore IT contractors have demonstrated that they can provide many quality services for lower costs than are available in the U.S. In an effort to cut costs, many U.S. companies have started outsourcing work to India, China, and Eastern Europe, where wages are between 30 and 80 percent lower than in the U.S. (Frauenheim, Overby, Heeks, Murphy, Wilson). Indian firms now develop software for almost one-third of the Fortune 500 companies (i.e., Procter and Gamble, General Electric, American Express) and recent surveys show that the trend towards offshore outsourcing is rising. (Heeks, Koch, James, Messmer, Wilson, Chandras)

The amount of work being exported overseas is not insignificant. India, the largest overseas recipient of offshore IT work generated service and software exports of \$6.9 billion from April to December 2002. (McLaughlin) This year, the IDC predicts that \$16 billion in IT services will be imported, and by 2007 that number will rise to \$46 billion. (Ferranti). Forrester Research estimates that “by 2015, some 3.3 million U.S. jobs and \$136 billion in wages will transfer offshore to countries including India, Russia, China, and the Philippines”.^{lxviii}

Advocates believe that offshore outsourcing is a win-win scenario where the U.S. gets the benefits of skilled cheap labor and the demand for U.S. software and hardware products increases as offshore companies invest to improve their infrastructures and interoperability. Corporations argue that globalization is ultimately good for our economy. Sunil Mehta, Vice President of the National Association of Software and Service Company in India, estimates that US companies can save up to 11 billion dollars in 2004. At the same time, India will import approximately 3 billion in high-tech merchandise from the US. (Koch)

Opponents to offshore outsourcing argue that the loss of IT jobs in the U.S. will lead to an erosion of those skills. Gartner estimates that by the end of 2004, one in 10 IT jobs in IT intensive companies in the US and one in 20 IT jobs in non-IT intensive companies will move overseas. (Koch) Opponents claim that technology jobs are following the path of the manufacturing industry where over the last 30 years; millions of jobs were sent offshore or eliminated. They also argue that as technology jobs move offshore, the “deep, experiential knowledge that comes from coding applications and solving technology problems – the soil of technological innovation” will erode in the US. (Koch) is difficult to recruit computer science majors when all of the entry-level positions that are necessary to gain experience and develop more advanced skills are being exported. This erosion of IT skills can even have an impact on our national security. “If historical precedents are of any validity at all, the most critical constraint upon any ‘surge’ in wartime production has usually been in the area of skilled craftsmen.” (Kennedy p. 530)

Opponents also cite security concerns with exporting IT work overseas. Issues such as ensuring the integrity of corporate data, safeguarding proprietary information and the possibility of trapdoors and Trojan horses have the potential to create large security breaches. Although India is making strides to adopt international data privacy rules, they have little case precedents. Other countries that engage in outsourcing (China, Philippines) have horrible records at protecting intellectual property or data rights. (Overby, p. 28, Fitzgerald) A cyber-terrorist working at a company in India may be able to insert a security vulnerability into a program that could be exploited to create

economic and in some cases military damage. The possibility of the U.S. government and the military using Commercial-Off-The-Shelf (COTS) products developed in whole or in part overseas is becoming greater.

Opponents of offshoring cite genuine concerns that need to be addressed and managed. However, outsourcing to firms with particular expertise is a wise business decision. Offshoring to maintain a competitive position in the market place may be a similarly wise business decision and is a trend expected to continue and grow.^{lxxxix} Unlike abuses in the H-1B and L-1 visa programs, there is very little that can be done to prevent offshoring.^{lxxx} Furthermore, if market conditions require offshoring, interference would simply cause U.S. companies to become less competitive. In addition, offshoring can and is used to establish a presence in a market – which expands and creates additional business. If slowing down this offshoring trend is desired, U.S. policies must provide some financial incentives to offset the advantages of offshoring.

Recommendations: Policies that provide financial incentives, comply with WTO commitments, and minimize and slow down the rate of offshoring should be implemented to allow U.S. workforce time to adapt, increase productivity, and compete. Ultimately, market forces will determine the most productive and cost effective locations.

IT Convergence Implications

Largely due to technology convergence, data communications growth and performance have become increasingly more important than computer processing power or speed. Three major trends driving the future of networks and data communications are pervasive networking, integration of voice, video and data and new information service applications and protocols.

Pervasive networking: Computer networks and network devices are everywhere and growing at an explosive rate. Virtually any networked computer or device can communicate with any other device throughout the world. This technology will continue to revolutionize and transform the way we live and interact throughout the world. This so called “age of convergence”^{lxxxix} may be stalled in the U.S. due to last mile distribution issues, broadband development, regulatory issues and geographical dispersity problems. It is likely to take until 2007-2010 to provide most homes with high speed, low cost internet connections.^{lxxxii} What used to be a market split by different technologies into different networks is now moving to linked sets of networks capable of delivering the same or similar services.^{lxxxiii} Data, voice and video will soon be available from various sources such as cable, wireless, wireline, and satellite, which means that companies that would not have been head-to-head competitors in the past will increasingly compete against each other. So wireline (phone and cable) leaders such as Alcatel, Lucent, Nortel, and Cisco will increasingly compete with wireless leaders such as Motorola, Lucent, Nokia and Ericsson to provide cross-cutting digital technology equipment.^{lxxxiv}

With the on-going convergence, it is difficult to determine market share since the definition of the market itself is in flux. This is leading companies in this sector to move outside their traditional comfort zone to pursue a market strategy that provides a variety of digital services via their products. Traditional measures of performance (return on investment, return on equity, etc.) may also be less important during this convergence phase. Just as important will be breadth of technology offerings (data, voice, video) that

are appealing enough for companies to remain a player in a converged communications equipment market. The market is increasingly characterized more by the specific services provided than by the technology or delivery medium.

Integration of voice, video and data: Cellular telephone networks are competing with wired network services and electronic information exchange is used more extensively than voice communications. The integration of voice and data is mostly complete, but video integration over computers is lagging mostly due to past legal restrictions and the immense communications capacity needs of video. Broadband connections to the internet are growing at a 50% annual rate and quickly overtaking dial-up service. Broadband has penetrated more than 50% of the internet market (including 75% of U.S business workers)^{lxxxv}. Approximately 63% of broadband connections are made through cable modems and 37% via DSL.^{lxxxvi} The National Cable and Telecommunications Association estimates as of the 3rd quarter of 2003, there were 15 million cable modem customers with significant capability to increase as cable modem service passes by approximately 90 homes.^{lxxxvii} The number of broadband DSL users grew 78% worldwide last year, with North America at an estimated 11 million users. DSL gains were a result of lower prices over cable and increased line accessibility due to a lifting of line-sharing requirements by the Federal Communications Commission.^{lxxxviii} Wireless currently has a negligible share of the market, serving primarily in the low-density rural areas. Fixed wireless (Wi-Fi – wireless fidelity) is an emerging technology. It is high speed (54 Mbps) but limited to 2,000 feet coverage from its individual access point. By 2007, 5.4 million people will use Wi-Fi.^{lxxxix}

Recommendation: OMB designate the DOD Chief Information Officer (CIO) as the Executive Agent to develop and disseminate an enterprise or joint technical architecture document which provides industry an overview of how the federal and defense departments intend to use various new network devices. This architecture will help industry develop systems which fit government needs and help the government plan how best to take advantage of wireless implementations to reduce overall network infrastructure costs and enhance military operations.

New information service applications and protocols: Extensible Markup Language (XML) is designed to improve the functionality of the Web by providing more flexible and adaptable information identification. Originally designed to enhance web services, it is now used for many data sharing functions.^{xc} XML (and its extensions) is the key candidate upon which to base an open next-generation format for use across the web and on the desktop. XML is intended to make it straightforward to define, author and manage documents, making it easier to transmit and share them across the Web. XML is not just for Web pages; it can be used to store any kind of structured information and to enclose or encapsulate information in order to pass it between different computing systems which would otherwise be unable to communicate. For many applications and services, XML provides an interoperability bridge between different vendor products. XML also allows the flexible development of user-defined document types and provides a robust, non-proprietary, persistent, and verifiable file format for the storage and transmission of text and data, both on and off the Web.^{xc1}

Sun Microsystems and associations such as the Open Office Organization have defined an XML-based format for their office software suites, promising that it will be available under an open and free license so that other XML applications can use the

data.^{xcii} Even Microsoft is supporting XML in their upcoming release of Microsoft Office, although critics charge that Microsoft is keeping their specific XML implementation secret in an attempt to continue to lock users into a proprietary solution under Microsoft Office.^{xciii} Despite these disagreements, it is probable that office productivity document standardization efforts led by the Organization for the Advancement of Structured Information Standards (OASIS) will lead to a future where data interoperability across platforms and applications can be the norm and not the exception.^{xciv}

In the area of network enterprise management, XML is new application technology that can also be used to provide better management and control of enterprise tools such as firewalls and load balancers. The Vice President of Intelliden, Jeff Chapman, suggests that the “XML technology will help alleviate the complexity of managing large enterprise networks”. As router protocols reach inside the enterprise and interior gateway, they become more complex and require more sophisticated management tools. As the government moves toward network centricity, more powerful network management and transport tools are needed to study, configure and predict routing to approach a state of true self-configuration and self-healing. XML can lead in this regard.

Recommendation: The Federal CIO should oversee the investment of R&D funds designed to further define, develop, test and field XML-enabled capabilities to bridge the information gap between legacy (stove-pipe) databases (Medical, Personnel, Logistics, Finance etc.). Additionally, XML technology should be tested in warfighter Advanced Concept Technology Demonstration (ACTD) projects to pass information from machine-to-machine (vice manual entry) by using standard sets of data fields to overcome meta-data documentation and incompatibility problems. Furthermore, XML may be helpful in developing advances in the area of network centric warfare by automating intelligence surveillance and reconnaissance sensor operations to help fuse battlefield information for key decision makers.

Moving to an open set of document standards (first based on Office formats and potentially migrating to open XML-based formats) will immediately allow other vendors to develop applications with various feature and price sets that would compete with the existing Office applications. All vendors, Microsoft included, will then compete on best price/value based on tailored applications instead of having one vendor sell a monolithic suite with no competition. As a side benefit, this would also reduce one of the main barriers to competing with Windows.

IP Next Generation (IPng): Ipng offers the next big change to the Internet at the transport layer. The original designers and developers of TCP/IP never envisioned and probably never could have anticipated the extreme growth that the Internet has seen in the past decade. In the early 1990s, it was evident that Internet Protocol version 4 (IPv4) addressing and routing (due to backbone routing table growth) would break down in the near future. The primary driving force behind the development and the adoption of IPng was the impending exhaustion of the IPv4 32-bit address space due to the rapid growth of the Internet. The new IP version needs to support the large global inter-networks that exist now as well as the large amount of growth that will undoubtedly occur in the future. Over the past 3-5 years, the size of the Internet backbone routing tables has become a critical concern. If the routing tables were to become too large, there would be no way

for the backbone routers to store them. In 1993, "the backbone routing table was growing at a rate about 1.5 times as fast as memory technology."^{xcv}

An important design goal of IPng was to allow for efficient routing, route aggregation, and hierarchical address assignment. Under the term *Expanded Addressing and Routing Capabilities*, the IP address size is increased from 32 bits to 128 bits. This will provide support for many more addressable networks, nodes, and addressing hierarchies. IPng also includes *Required Support for Authentication and Privacy*, extension service provides support for authentication and data integrity. Security in IPng is an important issue because the risks in today's electronic world have increased exponentially and drive the demand improved security. IPng includes much awaited *Quality of Service Capabilities*. A new capability is added to enable the labeling of digitized packets belonging to particular traffic flows for which the sender has requested special handling (such as non-default quality of service or real-time service).

Enabled by IPng protocols, *Class of Service (CoS)* is a way of managing network traffic by grouping similar types of traffic (for example, e-mail, streaming video, voice, large document file transfer) together and treating each type as a class with its own level of service priority. Having the capability in network transport routers to classify services will give customers the ability to better manage their network bandwidth and application resources. Similar to CoS, *Quality of Service (QoS)* features offer a way to allocate bandwidth from the customer's network across the wide-area network.^{xcvi} QoS carves out a portion of available bandwidth and allocates it to the specific user. This allocation allows the service provider to measure traffic performance across the wide area network (WAN) and make incremental increases/decreases in bandwidth if throughput performance is degraded. A combination of CoS and QoS features allow enterprise service providers and managers to "guarantee service performance and availability".^{xcvii}

Multiple Protocol Labeling Switches (MPLS) is another popular routing enhancement service which is growing in popularity. It speeds up the network routing process by moving data based upon simple labels rather than a full IP address-based routing table decisions. Although routing/switching hardware has become much faster, MPLS offers network service providers the ability to build one network and use it to offer completely independent and separate services. Build once, sell many times...a concept any service provider love. Because MPLS service can also be provided over any medium its popularity is growing, but implementations are still very complex and require homogeneous WAN components.^{xcviii}

Enhanced network performance techniques, enabled through new protocol services, are critical capabilities needed in next generation networks (NGN). Simplified, but powerful web communication services like XML and next generation networking protocols like IPng, CoS, QoS, MPLS and others are sorely needed to handle the continued growth and complexity of future systems. As new information services are developed, computers become more pervasive, and data, voice and video services converge the methods used to more efficiently move and manage data throughout a WAN grow in importance.

Recommendation: ASD NII establish an Internet Protocol Next Generation task force to guide DOD planning and implementation in this area. The task force should be comprised of members of each service, key government agencies and industry. The task

force should focus on designing a voice, data and video convergence plan to make use of the global information grid. The plan should define the types of transport services, traffic engineering and management services envisioned to be used throughout the federal government's classified and sensitive but unclassified network enterprises. Following this overarching plan can help ensure the network upgrade and procurement efforts of the entire federal government can become better synchronized. Industry involvement will ensure their R&D investments are better focused on federal customer needs.

Encouraging IT Investment and Innovation

R&D Tax Credit: Congress originally enacted a temporary tax credit in 1981 in response to a decline in R&D spending relative to GNP. Since original passage, Congress has modified it incrementally and extended it eleven times, five retroactively.^{xcix} The current tax code allows firms to claim a 20% credit for qualified research expenses exceeding a base amount. The computation for the base amount relies on a measure of research intensity during 1984-1988.^c This defined base period complicates computation of the credit for the numerous new entrants to the IT field. "Start ups" yet to establish a research track history end up using a much less attractive alternate credit. The current credit has been an effective method to spur increases in R&D without "picking a winner". A recent ITAA survey showed 45% of their members stating that some of their products or whole technologies would not have been funded without the credit.^{ci} However, the current R&D credit structure suffers from uncertain political time horizons and a complicated structure that penalizes the numerous new entrants to the IT industry.

The President's FY 2005 budget request includes a provision for making the tax credit permanent. In early March 2004, the Senate responded with a unanimous vote to extend the current June 2004 deadline to December 2005.^{cii} Given the current state of the federal deficit and the stigma attached to pro-business tax treatment in an election year, an extension is likely the only reasonable expectation this year. The economic case still argues for a permanent credit that firms can count on in planning their long-term innovative research efforts. A Coopers and Lybrand study concluded that simply making the credit permanent would increase R&D investments by \$41B through 2010.^{ciii} The U.S. can firm up its IT leadership position by streamlining the R&D tax credit and making it permanent.

Recommendation: To encourage IT innovation, Congress should immediately make the R&D Tax Credit permanent.

Intellectual Property Rights.

Intellectual property protection has always been important to individuals and corporations. However, for the IT industry protection of intellectual property (IP) can be critical to the survival and growth of companies. If a company cannot protect its IP, it will not thrive and innovation will cease – since a reasonable return on investment of the development of new technologies becomes impossible. Theft of intellectual property (including by piracy) is costing U.S. corporations billions of dollars in lost revenue. Even more worrisome are patent infringements and wholesale theft of processes from U.S. corporations.^{civ} Patents and copyrights form the basis of intellectual property protection. International treaties hold great promise if enforced. In addition, the

international centralization of patents and copyrights by participating nations helps ensure the broadest protection of intellectual property. The World Intellectual Property Organization (WIPO) is one of 16 specialized agencies in the United Nations and can be an effective watchdog and promoter of IP protection. Activities such as the World Intellectual Property Day help create awareness of the value of protecting intellectual property to the public.^{cv} As we transform into a knowledge-based economy, protection of IP must become an important national interest, reflected in our foreign and trade policies. However, U.S. policymakers must understand that the concept of intellectual property is not universal and there are wide disagreements even among western nations regarding IP and what levels of protection it should be afforded. As a result, negotiation is the principle tool that will need to be employed in protecting U.S. intellectual property. Ultimately, the World Trade Organization (WTO) will be the most effective organization to protect intellectual property (most nearly universal with 145 member countries), but the U.S. needs to take small regional and bilateral steps now to set precedents now and frame the standards in the WTO.

Recommendations:

For the Department of Trade, in coordination with the Department of State:

1. Pursue the establishment of Bi-lateral agreements with all of the U.S. trading partners (and update those that exist) to include provisions for protecting Information Technology and Intellectual Property rights.
2. Track and report on international initiatives that affect US industry.

For the Department of State:

1. Engage the World Trade Organization to press for the leading regional software pirates with sanctions (China, Japan, Russia, Pakistan, India).
2. Engage the International Monetary Fund to add monitors and increase the reporting on the economic performance of nations identified on a “watch list”.
3. Increase the funding for US Agency for International Development (USAID) to deploy additional teams to countries identified on the watch list.

For the Department of Homeland Security:

1. Task the Information Analysis and Infrastructure Protection (IAIP) to include software piracy and IP violations on the list of Cyberspace Security reportable watch items.
2. Track the number of IP violation incidents within the Information Sharing and Analysis Center (ISAC) – Information Technology
3. Task US Customs to inspect incoming products for IP violations
4. Use National Intelligence assets to track and monitor the activities of identified piracy violators within the

ENDNOTES

- ⁱ Department of Commerce, "Digital Economy 2002 (DE2002)," Appendix Chap 3, p1.
- ⁱⁱ Department of Commerce, "Digital Economy 2003 (DE2003)," p9.
- ⁱⁱⁱ Department of Commerce, "Digital Economy 2003 (DE2003)," p11.
- ^{iv} Raymond James & Associates, "The IT Supply Chain Fourth Quarter IT Demand Survey," p2.
- ^v Department of Commerce, "Digital Economy 2003 (DE2003)," p15.
- ^{vi} Raymond James & Associates, "The IT Supply Chain Fourth Quarter IT Demand Survey," p2.
- ^{vii} Department of Commerce, "Digital Economy 2003 (DE2003)," p16.
- ^{viii} Department of Commerce, "Digital Economy 2003 (DE2003)," p19.
- ^{ix} Department of Commerce, "Digital Economy 2003 (DE2003)," p18.
- ^x Infobrief. "U.S. Industry Sustains R&D Expenditures During 2001 Despite Decline in Performers' Aggregate Sales." National Science Foundation, Oct 2003.
- ^{xi} Fortuna, Steven. "Proprietary CIO Survey Results: Optimistic View of Long-term I.T. Spending Growth, High Priority for PC Upgrades", Prudential Equity Group, LLC, 10 Mar 2004, p1.
- ^{xii} Fortuna, Steven. "Proprietary CIO Survey Results: Optimistic View of Long-term I.T. Spending Growth, High Priority for PC Upgrades", Prudential Equity Group, LLC, 10 Mar 2004, p1.
- ^{xiii} Fogarty, Karen. "Tech Spending Outlook Solid for Second Month in a Row." CIO Magazine Tech Poll, Feb 2004, p1.
- ^{xiv} Di Maio, Andrea. "A Larger European Union Means Greater IT Demand and Supply," Gartner Note Number: AV-21-9171, Feb. 19, 2004, <http://www3.gartner.com/DisplayDocument?id=42415>.
- ^{xv} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Hardware", p6.
- ^{xvi} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Hardware", p7.
- ^{xvii} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Hardware", p3.
- ^{xviii} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Hardware", p8.
- ^{xix} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Hardware", p3.
- ^{xx} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Hardware", p10.
- ^{xxi} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Hardware", p1.
- ^{xxii} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Hardware", p15.
- ^{xxiii} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Hardware", p7.
- ^{xxiv} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Hardware", p4.
- ^{xxv} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Hardware", p12.
- ^{xxvi} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Networking", p6-7.
- ^{xxvii} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Networking", p1.
- ^{xxviii} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Networking", p7.
- ^{xxix} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Networking", p1.
- ^{xxx} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Networking", p11.
- ^{xxxi} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Networking", p6-7.
- ^{xxxii} Graham-Hackett, Megan. "Standard & Poor's Industry Surveys Computers: Networking", p13.
- ^{xxxiii} Standard & Poor's Industry Survey of Computer Software, October 9, 2003.
- ^{xxxiv} Standard & Poor's Industry Survey of Computer Commercial Services, October 12, 2003.
- ^{xxxv} Standard & Poor's Industry Survey of Computers: Consumer Services and the Internet, September 4, 2003.
- ^{xxxvi} Bensinger, pg 1.
- ^{xxxvii} Bensinger, pg 5.
- ^{xxxviii} Bensinger, pg 1.
- ^{xxxix} Bensinger, pg 10-14.
- ^{xl} Security in the Information Age: New Challenges, New Strategies Joint Economic Committee United States Congress May 2002, Joint Economic Committee, Washington, D.C. Available on-line at: <http://www.house.gov/jec>
- ^{xli} Bush, George, "The National Strategy to Secure Cyber Space," The White House, Washington DC, February 2003. Available on-line at: www.whitehouse.gov, pg 1.

xlii Bush, pg 7-8.

xliii Statistics On Cyber-terrorism, from student paper by Jimmy Sproles and Will Byars for a Computer Ethics Course at ETSU 1998

xliv GAO, Highlights of GAO-04-483T, testimony before the Subcommittee on Technology, Information Policy, Intergovernmental Relations and the Census, House Committee on Government Reform, 16 March 2004, Available on-line at: www.gao.gov/cgi-bin/getrpt?GAO-04-483T.

xlv Changes to LES may reduce identity theft, February 27, 2004, http://www.dcmilitary.com/airforce/beam/9_08/national_news/27752-1.html

xlvi DISA Information assurance, <http://www.disa.mil/main/infoops.html>

xlvii White House. "National Strategy to Secure Cyberspace." Executive Summary. www.whitehouse.gov

xlviii Source: SECNAP Network Security Corporation, www.secnap.com.

xlix Dunne, pg 1.

¹ Pawezowski, pg 2.

li Wheeler, pg 2.

lii Lindquist, pg 2.

liii Lindquist, pg 3.

liv Kirkpatrick, pg 92.

lv Poynder, Pg 1.

lvi The Economist, December 6, 2003, pg 5.

lvii Hansen and Festa, pg 1.

lviii Bosak, <http://www.ibiblio.org/pub/sun-info/standards/xml/why/4myths.htm>.

lix Wilcox, December, 19, 2003, pg 1

lx Ricciuti, pg 1.

lxi Menn, pg 1.

lxii EU Press Release, March 24, 2003.

lxiii Baumol, pg 381.

lxiv "How and Why Government, Universities, and Industry Create Domestic Labor Shortages of Scientists and High-Tech Workers". Eric Weinstein. <http://nber.nber.org/~peat/PapersFolder/Papers/SG/NSF.html>. Pp. 1-5.

lxv Ibid.

lxvi "How and Why Government, Universities, and Industry Create Domestic Labor Shortages of Scientists and High-Tech Workers". Eric Weinstein. <http://nber.nber.org/~peat/PapersFolder/Papers/SG/NSF.html>. P. 9.

lxvii Ibid. p. 7.

lxviii Ibid. p. 8.

lxix "How and Why Government, Universities, and Industry Create Domestic Labor Shortages of Scientists and High-Tech Workers". Eric Weinstein. <http://nber.nber.org/~peat/PapersFolder/Papers/SG/NSF.html>. Pp. 10-24.

lxx "Problems and Needed Reforms for the H-1B and L-1 Work Visas. Norman Marloff. Feb 4, 2004. P. 2.

lxxi "High Tech Worker Visas", Numbers USA. www.numbersusa.com/interests/hightech.html

lxxii "High Tech Worker Visas", Numbers USA. www.numbersusa.com/interests/hightech.html

lxxiii Ibid. p. 5

lxxiv Personal interviews at numerous companies and business lobbying groups in Washington D.C.

lxxv "High Tech Worker Visas", Numbers USA. www.numbersusa.com/interests/hightech.html

lxxvi "Problems and Needed Reforms for the H-1B and L-1 Work Visas". Norman Marloff. Feb 4, 2004. Pp. 9-10.

lxxvii Ibid. p. 11.

-
- ^{lxxviii} “Outsourcing America”, Gordon Anderson. The World and I. Jan. 2004. P. 38.
^{lxxix} “Outsourcing: Myth vs. the Real Deal”. Bruce Caldwell. Gartner. 25 Mar 2004.
<http://outsourcing.weblog.gartner.com/weblog/index.php?blogid=9>.
^{lxxx} Personal observation and knowledge gleaned from laws of the United States and U.S. WTO obligations.
^{lxxxi} Plunkett’s Info Tech Industry Almanac 2003, P 7-8

The result of low cost, high speed internet access will be convergence of entertainment, telephony and computerized information, delivered to a rapidly evolving array of Internet appliances, PDAs, wireless devices and desktop computers

- ^{lxxxii} Plunkett’s Info Tech Industry Almanac 2003, P 8
^{lxxxiii} Bensinger, pg 1.
^{lxxxiv} Bensinger, pg 5.
^{lxxxv} Alex Salkever, Microsoft: Your Next Phone Company?,
<http://www.technewsworld.com/perl/story/33037.html>, Tech News World , March 4, 2004
^{lxxxvi} Gene J. Koprowski, Broadband Connections Eclipsing Dial-Up in Major Markets
<http://www.technewsworld.com/perl/story/33108.html>, TechNewsWorld , March 12, 2004
^{lxxxvii} National Cable & Telecommunications Association, Industry Statistics,
<http://ncta.com>
^{lxxxviii} Jay Lyman, DSL Booming with Asian and North American Growth,
<http://www.technewsworld.com/perl/story/33035.html>, TechNewsWorld, March 3, 2004

The number of broadband DSL users grew 78 percent worldwide (28 million new lines) last year to more than 63 million well on its way to achieving its global target of 200 million subscribers by the end of 2005 (20% of all phone lines). Strong growth in China (world’s largest DSL market), North America (estimated 11 million subscribers) and Europe based a lower price than cable and resolving the barriers to installation (i.e. ordering and customer service) although still concerns about DSL in terms of time and cost to provision

- ^{lxxxix} Standard & Poor’s Industry Survey, Communications Equipment, January, 29, 2004 p13
- ^{xc} Bosak, <http://www.ibiblio.org/pub/sun-info/standards/xml/why/4myths.htm>.
^{xci} Peter Flynn, The XML FAQ, World Wide Web Consortium’s XML Special Interest Group, 2003-01-14, <http://www.ucc.ie/xml/#java>
^{xcii} <http://xml.openoffice.org/>, pg 1.
^{xciii} Wilcox, December, 19, 2003, pg 1
^{xciv} Ricciuti, pg 1.
- ^{xcv} R, Hinden,, IP Next Generation Overview, URL: <http://playground.sun.com/pub/ipng/html/INET-IPng-Paper.html>
- ^{xcvi} Search web services.com, URL:
http://searchwebservices.techtarget.com/sDefinition/0,,sid26_gci213404.00.html
- ^{xcvii} Search web services.com, URL:
http://searchwebservices.techtarget.com/sDefinition/0,,sid26_gci213404.00.html
- ^{xcviii} McKeag, Louise, “Don’t get caught out by MPLS”, Techworld, 23 Sept 2003
^{xcix} “The R&D Tax Credit in the New Economy: A Federal Tax Policy Symposium”, Tax Council Policy Institute, Washington, D.C. Online. Internet. <http://www.thetaxcouncil.org/rdfinalreport.htm>
- ^c “Science and Technology in Congress: Research Tax Credit Expires”, Sep 1998. Online. Internet. <http://www.aaas.org/spp/cstc/pne/pubs/stc/bulletin/articles/9-98/credit.htm>

^{ci} “ITAA Applauds Senate Passage of R&D Tax Credit Extension”, ITAA Press Release, 3 Mar 2004. Online. Internet. <http://itaa.org/news/pr/pressrelease.cfm?ReleaseID=1078354439>

^{cii} “Promoting Innovation and Competitiveness: President Bush’s Technology Agenda”, The White House Home Page, Washington, D.C., March 2004. Online Internet <http://www.whitehouse.gov/infocus/technology/>

^{ciii} “Position on the Federal Tax Research Credit”, http://www.jointventure.org/initiative/tax/pos_hr835.html

^{civ} WIPO Home Page. www.wipo.int/about-ip/en/world-ip/204/index.html

^{cv} Ibid.



BIBLIOGRAPHY

- Abbasi, Arsalan H. "Voice over IP A Discussion of Business and IT Challenges." Stevens Institute of Technology, Wesley J. Howe School of Technology Management, 16 Dec. 2003.
- Achido, Byron. *Rivals Chip Away at Microsoft's Dominance*. USA Today. February 27, 2003.
- Alberts, D., Garstka, J., and Stein, F., *Network Centric Warfare Developing and Leveraging Information Superiority 2nd Edition Revised*, CCRP, Washington DC., August 1999.
- Anastasi, Robert P. et al. *The IT Supply Chain Fourth Quarter IT Demand Survey*, Raymond James & Associates. 5 Dec. 2003.
- Anderson, Gordon. "Outsourcing America", *The World and I*. Jan. 2004.
- Anderson, Silvia S. *Broadband-What is it and How Do We Get More?* Industrial College of the Armed Forces Industry Study. March 26, 2002.
- Annati, "GALILEO vs GPS – Battle Over Navigation Warfare," *Military technology*, December 2003
- Anonymous, "Bush wants cheap high-speed Internet access for all by 2007", CNN.com, Mar 26, 2004
- Anonymous, "2004 Domestic Production Forecasts for the Japanese Electronics Industry", Japanese Electronics and Information Technology Industries Association, Press Release, December 17, 2003, <http://www.jeita.or.jp/english/press/2003/1217/index.html>
- Anonymous, "3G Wireless Communications FAQ", 2003. Online. Internet. <http://www.eurotechnology.com>
- Anonymous, "Asynchronous Transfer Mode (ATM) Passive Optical Networks (PONs)", http://www.iec.org/online/tutorials/atm_pon/topic01.html
- Anonymous, "Beijing reports surge in trade of IT products" (Online posting: www.beijingportal.com, <http://www.beijingportal.com.cn/7838/2004/02/03/207@1855529.htm>, 2 March 2004).
- Anonymous, "Changes to LES may reduce identity theft, February 27, 2004, http://www.dcmilitary.com/airforce/beam/9_08/national_news/27752-1.html
- Anonymous, "China to be Determined to Implement Its Own WLAN Standard." *SinoCast China IT Watch*, 5 March 2004.
- Anonymous, "China to Lead World in IT Growth this Year." *Financial Times*, 6 January 2004.
- Anonymous, "CIO/G-6 Techno-Suite Summer 2003 Paradigm Forecast", Janus Research Group, Inc. 1999-2003 Available on line at <http://www.janusresearch.com>
- Anonymous, "Commission concludes on Microsoft investigation, imposes conduct remedies and a fine," Press Release, Commission of the European Communities, March 24, 2004.
- Anonymous, "Commission gives Microsoft last opportunity to comment before concluding its antitrust probe," Press Release, Commission of the European Communities, August 6, 2003.
- Anonymous, "Debate Rages Over "Digital Divide", *Schools Administrative Article*, http://www.educationworld.com/a_admin/admin103.shtml, March 1, 1999.
- Anonymous, "Digital Divide Basics Fact Sheet", *Digital Divide Staff, Benton Foundation*, <http://www.digitaldividenetwork.org/content/stories/index.cfm?key=168>

Anonymous, "DOC Outlines Comprehensive Strategy to Boost Competitiveness of U.S. Manufacturers", *Defense Daily International*, Potomac, VA, 23 Jan 2004, p. 1. Online. ProQuest. 10 Mar 2004.

Anonymous, "File that" (Online posting: Economist.com, http://www.economist.com/printedition/displayStory.cfm?Story_ID=2481530, 4 March 2004).

Anonymous, "Focus on Today, Leave 3G for Now", *Computer Weekly*, 17 Feb 2004, p.30. Online. ProQuest. 16 Mar 04

Anonymous, "GAO Backs Changes to DoD Procurement", *Satellite News*, Potomac, December 22, 2003, Vol. 26, Iss. 48

Anonymous, "Harnessing Innovation: A Manufacturer's Guide to Nanotechnology." *Industry Week* (December 2002): Online, LexisNexis

Anonymous, "High Tech Worker Visas", *Numbers USA*. www.numbersusa.com/interests/hightech.html

Anonymous, "Information Technology Services Industry In Japan 2003", *Japan Information Technology Services Industry Association*, Annual Report, June 2003

Anonymous, "Introduction to XML," accessed March 8, 2004 from <http://www.w3schools.com>

Anonymous, "IP Telephony." *SearchNetworking.com*. 15 Mar. 2004
<http://searchnetworking.techtarget.com/sDefinition/0,,sid7_gci212388,00.html>

Anonymous, "ITAA Urges Congress To Reject 'Buy American; Provisions of Defense Bill", *Communications Today*, Potomac, September 11, 2003, Vol. 9, Iss. 154

Anonymous, "Just a Small Slice Please." *Business Asia*; Vol. 36 Issue 2, 26 January 2004, p6.

Anonymous, "Korea Invests \$2B in Nanotechnology." *ExtremeTech* (7 May 2003) Online, LexisNexis

Anonymous, "New Industry Coalition Seeks Polices to Allow Promise of VOIP." *Yahoo! Finance*. 23 Feb. 2004 25 Mar. 2004 <http://biz.yahoo.com/prnews/040223/nym097_1.html>

Anonymous, "Open Source's local heroes," *The Economist*, December 6, 2003.

Anonymous, "Position on the Federal Tax Research Credit."
www.jointventure.org/initiative/tax/pos_hr835.html

Anonymous, "Promoting Innovation and Competitiveness: President Bush's Technology Agenda", *The White House Home Page*, Washington, D.C., March 2004. Online Internet
<http://www.whitehouse.gov/infocus/technology/>

Anonymous, "Research and Markets: Great Uncertainty in the Wireless Industry over the Demand for Future Mobile Services is Heightened by the Slow Take-up of Early 3G Services", *M2 Communications*, Coventry, U.K., 25 Feb 2004, p. 1. Online. ProQuest. 16 Mar 2004.

Anonymous, "Science and Technology in Congress: Research Tax Credit Expires", Sep 1998. Online. Internet. <http://www.aaas.org/spp/cstc/pne/pubs/stc/bulletin/articles/9-98/credit.htm>

Anonymous, "Sir Bill and his dragons—past, present and future," *The Economist*, January 31, 2004.

Anonymous, "The Bottom Line" *Asian Week*, Analysis of Saving Patterns, July 1996,
<http://www.asiaweek.com/asiaweek/96/0719/index.html>

Anonymous, "The ponytail versus the penguin," *The Economist*, May 24, 2004.

Anonymous, "The R&D Tax Credit in the New Economy: A Federal Tax Policy Symposium", Tax Council Policy Institute, Washington, D.C. Online. Internet.
<http://www.thetaxcouncil.org/rdfinalreport.html>

Anonymous, "The StarOffice XML based file format," accessed March 28, 2004 from
<http://xml.openoffice.org>

Anonymous, "Trends in Japan, Turning Point: Upturn in Capital Investment by Manufacturers", Japanese Information Network, Business and the Economy, August 7, 2003,
<http://www.jinjapan.org/trends/business/bus030808.html>

Anonymous, "US Firms Step up Pressure Against China's Wi-Fi Standard." *Washington Internet Daily*, vol. 5 no. 37, 25 February 2004.

Anonymous, "Verizon Wireless Launches National 3G Network", RBOC Update, Boynton Beach, 1 Feb 2004. Online. ProQuest. 16 Mar 04.

Anonymous, "Voice Over IP." GAO Research Inc., 27 Mar. 2004
<<http://www.gaoresearch.com/resources/whitepapers/other/voip.php>>

Anonymous, "VoIP." SearchNetworking.com. 15 Mar. 2004 <http://searchnetworking.techtarget.com/sDefinition/0,,sid7_gci214148,00.html/?offer=ik1>

Anonymous, "VON Coalition" biz.yahoo.com/prnews/020223/nym097_1.html

Anonymous, "Welcome to the eRulemaking Initiative", Available on-line at:
<http://www.regulations.gov/eRuleMaking.cfm>

Anonymous, "Western Europe" Business Software Alliance Internet News Release, Available on-line at: BSA.com

Anonymous, "What is VoIP?" InnoMedia. 27 Mar. 2004 <http://www.innomedia.com/ip_telephony/voip/index.htm>

Anonymous, "Winds of change are blowing," *Manufacturing Engineering*, March 2000, Vol. 124, Iss. 3

Anonymous, "Wireless Services: Thailand," Gartner Dataquest, September 15, 2003.

Anthes, Gary H. . "Darker Days Ahead", *Computerworld*. Sep 25, 2000.

Anthes, Gary, H., "Darker days ahead," *Computerworld*, 25 Sep 2000, Vol. 34, Iss.39, 57-58

APEC Economic Committee. Towards Knowledge Based Economics in APEC. 2000. Internet.
www.apec.info. 15 March 2004.

Apicella, Mario. *Enterprise Storage, Part 1: Strategies*. InfoWorld. February 10, 2003.

Arrison, Sonia, "Time To Clean Up the Nation's Telecom Mess"
<http://www.technewsworld.com/perl/story/33085.html>, TechNewsWorld , March 10, 2004

Arun, Mahizhnan and Yap, Mui Teng. *Singapore: The Development of an Intelligent Island and Social Dividends of Information Technology*. Urban Studies, Vol. 37, No. 10.

Baker, David R. "Government rules boost data storage industry" (Online posting: The Detroit News,
<http://www.detnews.com/2003/technology/0312/02/technology-339637.htm>, 2 December 2003)

Barnes, Cecily. *Winners and Losers of Stock Market 2000*. CNETNews.com. January 4, 2001.

Barnett, Steve, "The new cyberlife," *American Demographics*, 2000

-
- Bates, Bud. *The Fiber-Glut Myth*. CIO Magazine. October 15, 2002.
- Baumol, William J. and Blinder, Alan S., *Economics: Principles and Policy*, Thomson South Western, Mason, OH, 2003.
- Baumol, William. *Economics: Principles and Policy*. 8th Edition. Fort Worth: Harcourt College Publishers, 2001.
- Beckman, D., "Survey Reflects U.S. Tech Worker Angst," *Washtech News*, 13 February 2004.
- Bennett, Ray and Pryor, Peter, "Microsoft facing second probe by European Union," *Hollywood Reporter*, February 18-24, 2003.
- Bensiner, Ari. *Standard & Poor's Industry Survey - Communications Equipment (includes Computers: Networking)*, (New York, McGraw Hill Co.), 29 Jan. 2004.
- Berg, Gerry C., "Markets, Competition, and Industrial Analysis: Modern Views in a New Economy," *Economic Notes: Readings in the Economics and National Security Strategy and Resource Allocation*, Department of Economics, Industrial College of the Armed Forces, Washington, DC, AY 2003-2004.
- Berlind, David, "Microsoft blows smoke, but will the European Union smell it?" *Tech Update*, January 5, 2004.
- Bettleheim, Adriel. *Internet Tax Moratorium Extension Clears After Senate Rejects Multisate 'Compact'* CQ Weekly, November 17, 2001
- Blasi, Joseph; Kruse, Douglas; and Bernstein, Aaron. *In the Company of Owners; The Truth About Stock Options*. New York: Basic Books, 2003.
- Blitzer, David M. *Standard & Poor's Industry Surveys, Trends & Projections*. New York: McGraw Hill Co., February 20, 2003.
- Blustein, Paul. *China's Year in WTO Gets a Mixed Review*. *Washington Post*. December 12, 2002.
- Bolles, Gary A. "Technology: Sarbanes-Oxley" (Online posting: *CIO Insight*, <http://www.cioinsight.com/article2/0,1397,1213108,00.asp>, 8 August 2003)
- Bosak, Jon, "Four Myths about XML," *IEEE Computer*, October 1998, access 23 March 2004 from <http://www.ibiblio.org/pub/sun-info/standards/xml/why/4myths.htm>
- Bossong-Martines, Eileen M. *Standard & Poor's Industry Survey - Telecommunications: Wireland*, (New York, McGraw Hill Co.), 29 Feb. 2004.
- Botterman, Maarten [et al] *Enabling the Information Society by Stimulating the Creation of a Broadband Environment in Europe Analyses of Evolution Scenarios for Future Networking Technologies and Networks in Europe MR-1579*. RAND Europe, 2003 Santa Monica CA available on-line at <http://www.rand.org/> pg 62.
- Bourge, Christian. *Analysts Worry About Patriot Act II*. United Press International. March 10, 2003.
- Box, Don, "Lessons from the Component Wars: An XML Manifesto," *DevelopMentor*, September 1999.
- Braunschweig, Carolina. *Nano Nonsense: Venture Capitalists are Searching for the Next Big Thing in the Smallest of Technologies*. *Venture Capital Journal*. January 1, 2003.
- Brodsky, Ira. *Best Laid Plans*. *America's Network*. November 15, 2002.

Brown, Dolores, et al. *Information Technology Industry Study Report 2003*,
<http://www.ndu.edu/icaf/industry/IS2003/papers/2003%20Information%20Technology.htm>.

Brown, Ken. The Web's New Outlet, Wall Street Journal, March 2, 2004

Burgess, John, "EU Hits Microsoft With Record Fine," Washington Post, March 24, 2004.

Burton, David. "What Lies Ahead for Asia's Emerging Markets?" Speech for International Monetary Fund, 23 March 2004, Available on-line at:
<http://www.imf.org/external/np/speeches/2004/032304.htm#fig5>

Bush, George W. *Statement on Signing the Internet Tax Nondiscrimination Act*. Weekly Compilation of Presidential Documents, December 3, 2001.

Business Communications Company. *Nano/Bio Convergence News*.
<http://www.buscom.com/letters/nbcnpromo/nbcnpromo.html>

Business Software Alliance, "Eighth Annual BSA Global Software Piracy Study, Trends in Software Piracy 1994-2002," International Research Corporation, Washington, DC, Available on-line at:
www.bsa.org

Caldwell, Bruce. "Outsourcing: Myth vs. the Real Deal". Gartner. 25 Mar 2004.
<http://outsourcing.weblog.gartner.com/weblog/index.php?blogid=9>.

Calvert, John, "Network Services: Thailand," Gartner Dataquest, May 16, 2003.

Carr, Kathleen S., "3G or not 3G: That is the Question", Darwin online magazine, Mar 2002. Online. Internet. <http://www.darwinmag.com/read/030102/3g.html>

Cellular Telecommunications & Internet Association. *CTIA's Semi-Annual Wireless Industry Survey*. December 31, 2002.

Chaffin, Kenny A. *Computing With Light*. Poptronics. June 2001.

Chandras, R., "Going Offshore Without Going off the Deep End," *Intelligent Enterprise*, 10 August 2003.

Chapel, Chris. *The Next Generation*. Asian Business. January 2001.

Choo, Adrian; Tang Hsiu Chin; and Toh Mun Heng. "Mapping Singapore's Knowledge-Based Economy." Economic Survey of Singapore. (Third Quarter 2002) Internet. www.mti.gov.sg, 16 March 2004.

CIA Factbook 2003. Internet. 1 January 2003. www.cia.gov/cia/publications/factbook, 25 March 2004

Clark, Rolf; Kyriakopoulos, Irene. Aspects Of The New Economy, Economic Notes for The Industrial college of the Armed Forces, Academic Year 2003-2004

Comstock, Barbara. *Statement of Barbara Comstock, Director of Public Affairs*. Department of Justice News Release. February 7, 2003.

Cox, John, "Wireless LAN Industry Starts Raising Antennas over MIMO", Network World, 8 Mar 2004. Online. Internet. <http://www.nwfusion.com/news/2004/0308mimo.html>

Crandall, Maureen, "Antitrust in the Digital Age: An Overview," Economic Notes: Readings in the Economics and National Security Strategy and Resource Allocation, Department of Economics, Industrial College of the Armed Forces, Washington, DC, AY 2003-2004.

Cringely, Robert, "Making Lemonade: How Microsoft is Using Its Own Legal Defeat to Hurt Java," I, Cringely, August 16, 2001, accessed March 29, 2004 from <http://www.pbs.org/cringely/pulpit/pulpit20010816.html>

Dean, Joshua, "The supply chain's demand", *Government Executive*, Washington, May 2002, Vol. 34, Iss. 5, p.54-56

Defense AT&L, Interview with Arthur K. Cebrowski, Director, Force Transformation: Why Defense Transformation is an imperative for survival and competitive advantage in a changing world, Vol XXXIII, No 2, DAU 178, March/April 2004

Department of Commerce, "Digital Economy 2002 (DE2002),

Department of the Navy (DoN), Chief Information Officer, "Department of the Navy Information Management/Information Technology Workforce Strategic Plan Fiscal Years 2001-2006," May 2001.

Department of the Navy, Chief Information Officer, "Department of the Navy Information Management/Information Technology Workforce Strategic Plan Fiscal Years 2001-2006," May 2001.

DeRugy, Veronique. *State Bureaucrats Plot Higher Internet Taxes*. Human Events, December 16, 2002.

Di Maio, Andrea. *A Larger European Union Means Greater IT Demand and Supply*, Gartner Note Number: AV-21-9171, 19 Feb. 2004, <http://www3.gartner.com/Display/Document?id=425215>.

Dietz, Diane. *UO Forum Examines Reach of Patriot Act*. The Register Guard. October 25, 2002. www.registerguard.com/news/2002/10/25/1d.cr.patriotact.1025.html

DISA Information assurance, <http://www.disa.mil/main/infoops.html>

DISA, Best Value Provider of C4, <http://www.disa.mil/main/bvprov4.html>

Dornan, Andy. *Fast Forward to 4G?* CommWeb. March 4, 2002.

Doyle, Charles. *The USA Patriot Act: A Legal Analysis*. CRS Report for Congress. April 15, 2002.

Duffy, John. *Economics*. Cliff's Notes. 1993.

Dunne, Danielle, "What is '3G' Technology?", CNN.com, 22 Oct 2001. Online. Internet. <http://www.cnn.com/2001/TECH/industry/10/22/3g.defined.idg/index.html>.

Dunne, Danielle, "What is Open-Source Software?" Darwin Magazine, May 31, 2001.

Dvorak, John, "Deconstructing open source," Boardwatch, April 2002.

Ee, Teoh Lian. Singapore: Overview. 2004. Internet. www.legalmediagroup.com/expertguides/ 25 March 2004.

E-Government Strategy, Simplified Delivery of Services to Citizens, Implementing the President's Agenda for E-Government, February 27, 2002

Einhorn, Bruce. "Why Gates Opened Windows in China" (Online posting: *BusinessWeekOnline*, http://www.businessweek.com/print/technology/content/mar2003/tc2003033_6406_tc058.htm?tc, 3 March 2003).

Electronic Commerce Association. *Net Taxes, Streamlined Sales Tax Project*. January 2003. Available at: <http://www.theeca.org/nettaxes.html>

Ellig, Jerry, editor, *Dynamic Competition and Public Policy: Technology, Innovation and Antitrust Issues*, Cambridge University Press, New York, NY, 2001.

E-RULEMAKING: NEW DIRECTIONS FOR TECHNOLOGY AND REGULATION Regulatory Policy Program Center for Business and Government John F. Kennedy School of Government <http://www.ksg.harvard.edu/cbg/rpp>

Espiritu, Antonina. *Digital Divide and Implications on Growth: Cross-Country Analysis*. Journal of American Academy of Business. March 2003.

Evers, Liesbeth. *Service Provision; Keeping Up to Date When Preserving the Past*. Network News. June 12, 2002.

Federal Communications Commission. *2002 Annual Report*. June 2002.

Federal Communications Commission. *Federal Communications Commission Releases Data on High Speed Services for Internet Access*. December 17, 2002.

Federal Reserve Bank of Boston. *Identity Theft*. <http://www.bos.frb.org/consumer/identity/>

Ferguson, Charles H. *The United States Broadband Problem: Analysis and Policy Recommendation*. Brookings Working Paper. May 31, 2002.

Ferranti, M., "Going Abroad," *Infoworld*, No. 10, 8 March 2004.

First, Harry. "Evolving Toward What? The Development of International Antitrust, URL: <http://www.law.nyu.edu/kingsburyb/spring03/globalization/First.pdf>

Fishbine, Glenn. *The Investors Guide to Nanotechnology and Micromachines*. John Wiley & Sons, Inc., New York, 2002.

Fitzgerald, M., "At Risk Offshore," *CIO*, 15 November 2003.

Flynn, Peter. The XML FAQ, World Wide Web Consortium's XML Special Interest Group, 2003-01-14, <http://www.ucc.ie/xml/#java>

Fogarty, Karen. "Tech Spending Outlook Solid for Second Month in a Row." *CIO Magazine Tech Poll*, Feb 2004.

Fortuna, Steven. "Proprietary CIO Survey Results: Optimistic View of Long-term I.T. Spending Growth, High Priority for PC Upgrades", Prudential Equity Group, LLC, 10 Mar 2004.

Frauenheim, E., "IT Service Companies See Hope Overseas," *CNET News*, 11 March 2003.

Frauenheim, Ed. "Moving beyond data storage" (Online posting: [CnetNews.com](http://news.com.com/2008-7784-5140491.html), <http://news.com.com/2008-7784-5140491.html>, 14 January 2004).

Freeman, Peter and Aspray, William. *The Supply of Information Technology Workers in the United States, 1999*. Computing Research Association, Washington D.C.

Gantz, John. *40 Years of IT Looking Back, Looking Ahead*, IDC Corp., http://cdn.idc.com/prodserv/downloads/40_Years_of_IT.pdf, 15 Mar. 2004.

GAO Report # 04-49, INFORMATION TECHNOLOGY MANAGEMENT Government wide Strategic Planning, Performance Measurement, and Investment Management Can Be Further Improved www.gao.gov/cgi-bin/getrpt?GAO-04-49Report

Garrett, Thomas A. *Taxing Electronic Commerce: Boon or Boondoggle?* National Economic Trends. The Federal Reserve Bank of St. Louis, January 2003.

Gartner Research. www.gartner.com

Garvey, Martin J. *Right Data, Right Now*. Information Week. February 3, 2003.

Gates, Bill. *Business @ the Speed of Thought*. New York: Warner Books, 1999.

Gilleo, Ken. *The Great Nano-Hoax?* Electronic Packaging and Production. February 2003.

Gilliland, Martin, "Asia/Pacific: PC Market Outlook, 2004," Gartner Dataquest, March 12, 2004.

Global provider of information, images, research and events for information technology,
<http://www.jupiterresearch.com/bin/item.pl/home>

Gomes, Lee, "Do We Get Enough In Innovation for What We Give to Microsoft?" Wall Street Journal, March 8, 2004.

Gomes, Lee. *Boomtown: Visionaries See a Day When Radio Spectrum Isn't a Scarce Commodity*. Wall Street Journal. September 30, 2002.

Goth, G., "The Ins and Outs of IT Outsourcing," *IT Pro*, January/February 1999, pp. 11-14.

Graham-Hacket, Megan. *Standard & Poor's Industry Survey - Computers: Hardware*, (New York, McGraw Hill Co.), 11 Dec 2003.

Graham-Hacket, Megan. *Standard & Poor's Industry Survey - Computers: Networking*, (New York, McGraw Hill Co.) 18 Sep. 2003.

Graham-Hackett, Megan. *Standard & Poor's Industry Surveys, Computers: Hardware*. New York: McGraw Hill Co., November 14, 2002.

Graham-Hackett, Megan. *Standard & Poor's Industry Surveys, Computers: Networking*. New York: McGraw Hill Co., September 12, 2002.

Grant, Elaine X. *Battle Brewing Over European E-Tail Tax Plan*. E-Commerce Times. February 15, 2002.

Grant, Lorrie. *Some Big Web Sites Collecting Sales Tax*. USA Today, March 13, 2003.

Greaver, M., *Strategic Outsourcing: A Structured Approach to Outsourcing Decisions and Initiatives*, AMACOM, New York, 1999.

Greenspan, Robyn, "Ethnic Personalities Apparent Online", ClickZ Network, January 2, 2004,
<http://www.clickz.com/news/article.php/3294691.html>

Greenspan, Robyn, "The Digital Dirt Road Divide", ClickZ Network, February 23, 2004,
http://www.clickz.com/stats/big_picture/demographics/article.php/3316541.html

Greenspan, Robyn. *Broadband's Reach Gets Broader*. Cyberatlas, February 7, 2003.

Griffith, A., and Curle, D. "Shortage of Skilled Talent Ranks as the No. 1 Challenge for the Information Content Industry," *SIIA Press Release*, 12 January 2004.

Guerera, Francesco and Jennen, Birgit. *EU Moves Closer to Action Against Microsoft*. Financial Times (London). March 12, 2003.

Guglielmo, Karen. "Predictions for 2004: IT moves up and out" (Online Posting: *SearchCIO.com*,
http://searchcio.techtarget.com/originalContent/0,289142,sid19_gci943025,00.html, 31 December 2003).

Haase, Ken, "Joining Cellular and WiFi", America's Network, 15 Jan 2004, p. 23. Online. Internet.
http://wlvctronic.americasnetwork.com/011504/Page_23.asp

Hachman, Mark. "Storage Business Looking Up" (Online posting: Eweek.com,
<http://www.eweek.com/article2/0,4149,1493071,00.asp>, 15 September 2003).

Hall, Bronwyn H., "The Economics of R&D Tax Credits", Tutorial, University of California at Berkeley, Berkeley, CA, p. 17. Online. Internet.
<http://emlab.berkeley.edu/users/bhhall/rtaxpolicy01.pdf>

Hamilton, Anita. *Three for the Road*. Time, March 17, 2003.

Handy, Jim, Matthew Godfrey, and Adriene Downey. "Memory Markets Gather Momentum In 2004" (Online posting: ElectronicDesign.com,
<http://www.elecdesign.com/Articles/Index.cfm?ArticleID=7034>, 12 January 2004).

Hansen, Evan and Festa, Paul, "XML makes its mark," CNET News.com, accessed February 10, 2003 from <http://www.news.com>

Harris, Shane, "E-procurement lives", *Government Executive*, October 2002, Vol. 34, Iss.14, p.70-72

Harris, Shane. *Panel Urges Balanced Privacy Debate*. GovExec.com. February 6, 2003.

Hazlett, Thomas W., and Sosa, David W. Policy Analysis: Chilling the Internet? Lessons from FCC Regulation of Radio Broadcasting. Internet. 19 March 1997. www.cato.org. 23, March 2004.

Heartfield, Kate. *Tech Weekly*. Ottawa Citizen. October 10, 2002.

Heeks, R., Krishna, S., Nicholson, B., and Sahay, S., "Synching or Sinking: Global Software Outsourcing Relationships," *IEEE Software*, March/April 2001.

Hefter, Lawrence R. and Litowitz, Robert D., "What Is Intellectual Property?, International Information Programs, URL: [USINFO.STATE.GOV http://usinfo.state.gov/products/pubs/intelprp/accords.htm](http://usinfo.state.gov/products/pubs/intelprp/accords.htm)

Hellweg, Eric. *Microsoft's China Gamble*. Business 2.0. March 5, 2003.

Hinden, R. IP Next Generation Overview, URL: <http://playground.sun.com/pub/ipng/html/INET-IPng-Paper.html>

Hoffman, Donna L.; Kalsbeek, William D.; and Novak, Thomas P., "Internet and Web Use in the United States: Baselines for Commercial Development," Research: Manuscripts, Research for a Digital World, <http://elab.vanderbilt.edu/research/papers/html/manuscripts/baseline/internet.demos.july9.1996.html>

Hoffman, Thomas. *Report: IT Salaries Stable in '02, Higher for Government, Defense Jobs*. Computerworld. March 3, 2003.

Hogan, Mike. "Hearing the Call." Entrepreneur, Feb 2004, Vol. 32 Issue 2, p44. 15 Mar. 2004
<<http://search.epnet.com/direct.asp?an=12070877&db=bsh>>

Hundley, Richard O. [et al.] The Global Course of the Information Revolution: recurring themes and regional variations MR-1680. RAND, 2003 Santa Monica CA available on-line at <http://www.rand.org/>

Hunt, Steve. *The Need for a Chief Security Officer*. CIO Magazine. August 12, 2002.

Hurel, Jean-Louis, Cenzig Evci, Christopher Lerouge and Luoning Gui, "Mobile Network Evolution: From 3G Onwards", 5 Jan 2004, p. 8. Online. Internet.
<http://www.alcatel.com/publications/doctypes/articlepaperlibrary/html/ATR2003Q4>

IEEE* 802.16 and WIMAX, Broadband Wireless Access for Everyone.
http://www.intel.com/ebusiness/pdf/wireless/intel/80216_wimax.pdf, Intel Corporation, 2003

Infonetics Research, Inc., URL: <http://www.prnewswire.com>

Information Technology – Sneak Peek 2004 (Online posting: Forbes.com: <http://www.forbes.com>, 23 December 2003).

Information Technology Association of America (ITAA), “Bouncing Back: Jobs, Skills and the Continuing Demand for IT Workers” [<http://www.ita.org/news/pubs/product.cfm?EventID=437>], 6 May 2002.

Information Technology Association of America (ITAA), “ITAA Global Outsourcing Principles,” <http://www.ita.org/news/gendoc.cfm?DOCID=245>, 6 August 2003

Information Technology Association of America, “2003 Workforce Survey”, presented at the National IT Workforce Convocation, May 5, 2003 – Arlington, Virginia

Information Technology Association of America, “Report of the ITAA Blue Ribbon Panel on IT Diversity”, presented at the National IT Workforce Convocation, May 5, 2003 – Arlington, Virginia

Information Technology Association of America. *New Survey Finds Slight Increase in IT Workforce, But Demand Forecast Softens for IT Workers*. September 23, 2002. Available at: www.ita.org/news/pr/PressRelease.cfm?ReleaseID=1032791125

Information Technology Association of America. *The R&D Tax Credit*. March 29, 2003. www.ita.org/taxfinance/rntax.htm

Information Technology Association of America. *The U.S. Information Technology Industry: A Brief Overview*. March 8, 2003. www.ita.org/news/gendoc.cfm?DocID=120.

Information Technology Association of America. *Top Ten Public Policy Issues, Winter 2003*. January 15, 2003.

Information Technology Association of America, “ITAA Applauds Senate Passage of R&D Tax Credit Extension”, ITAA Press Release, 3 Mar 2004. Online. Internet. <http://ita.org/news/pr/pressrelease.cfm?ReleaseID=1078354439>

Information Technology Industry Council. *Incentives for Broadband Deployment*. Available at: http://www.itic.org/policy/tax_brdbnd.htm

International Telecommunication Union, “Trends in Telecommunication Reform 2003, Promoting Universal Access to ICTs, Practical Tools for Regulators”, September 2003.

Iritani, E., “High-Paid Jobs Latest U.S. Export,” *Los Angeles Times*, 2 April 2002.

Jacobs, Leonard. *States Re-examining Internet Sales Tax*. Back Stage, December 6, 2002.

Jacobs, T., *Strategic Leadership The Competitive Edge*, ICAF, 2002.

James, J., “Put the World Back to Work,” *San Diego Times*, 1 March 2001.

Jarich, Peter. *Broadband's 4G Solution*. Broadband Wireless, January – February 2003. <http://www.shorecliffcommunications.com/magazine/volume.asp?Vol=32&story=322>

Jayadev, K. *Two Years? Convergence Will Take at Least a Decade More to Happen*. Computers Today. July 2002.

Johnson, Charles. *Legal and Regulatory Issues*. Industrial College of the Armed Forces, Information Technology Industry Study, 2002.

Jubak, Jim. “Five Big Tech Trends to Watch in 2004” (Online posting: TheStreet.com, <http://www.thestreet.com/pf/funds/jubak/10134463.html>, 31 December 2003).

Kennedy, P., *The Rise and Fall of the Great Powers*, Vintage Books, New York, 1987.

Kenny, Charles. *Development's False Divide*. Foreign Policy. January/February 2003.

-
- Kerstetter, Jim and Burrows, Peter. *Why the Tech Turnaround Looks Real*. Business Week. May 5, 2003.
- Kessler, Scott H. *Standard & Poor's Industry Survey - Computers: Consumer Services & the Internet*, (New York, McGraw Hill Co.) 4 Sep. 2003.
- Kessler, Scott H. *Standard & Poor's Industry Surveys, Computers: Consumer Services & the Internet*. New York: McGraw Hill Co., September 5, 2002.
- Kharif, Olga , How Telcos Can Fight the Cable Invasion, <http://www.technewsworld.com/perl/story/33065.html>, Tech News World , March 8, 2004
- Kiernan, Pat. *Will the TV, PC and Phone Convergence Ever Happen?* The Biz. CNNfn. August 5, 2002.
- King, Julia. *Study: IT Workforce Down 5%*. Computerworld. May 6, 2002.
- King, W., "Guest Editorial Developing a Sourcing Strategy for IS: A Behavioral Decision Process and Framework," *IEEE Transactions on Engineering Management*, Vol. 48, No. 1, February 2001.
- Kinnan, C.J. *States' Internet Tax Scheme Could Lead to a National Sales Tax*. Citizens for a Sound Economy. February 6, 2003.
- Kirchhoff, S., "Bills to Keep Jobs In USA Create Uproar," *USA Today*, 28 August 2003.
- Kirkpatrick, David, "How the open-source world plans to smack down Microsoft, and Oracle, and....," *Fortune*, February 23, 2004.
- Knowledge-based Industries in Asia, Organization for Economic Co-operation and Development (OECD), OECD Publications, Paris, France, 2000.
- Kobitzsch, W., Rombach, D., and Feldmann, R., "Outsourcing in India," *IEEE Software*, March/April 2001.
- Koch, C., "Backlash," *CIO*, 1 September 2003
- Koehn, Jo Lynne; Del Vecchio, Stephen C.; Macke, H. *Should Internet Sales Be Taxed?* National Public Accountant, December 2001/January 2002.
- Kofi Anan: IT Industry Must Help Bridge Global Digital Divide", *The Digital Divide Network*, <http://www.digitaldividenetwork.org/content/stories/index.cfm?key=272>, June 19, 2003.
- Koprowski, Gene J. Broadband Connections Eclipsing Dial-Up in Major Markets <http://www.technewsworld.com/perl/story/33108.html>, TechNewsWorld , March 12, 2004
- Krause, Reinhardt. *Split FCC Snubs Chief*. Investor's Business Daily. February 21, 2002.
- Krebs, Brian and Krim, Jonathan. *Big Stores to Charge Sales Taxes Online*. Washington Post, February 7, 2003.
- Krim, Jonathan. *Bell Firms Pledge to Fight New FCC Rules*. Washington Post. February 25, 2003.
- Krim, Jonathan. *FCC Delivers Mixed Vote on Competition*. Washington Post. February 21, 2003.
- Krim, Jonathon, "Regulators, Rivals React: EU's Microsoft Decision Shows Split with US," Washington Post, March 25, 2004.
- Kuehn, Steven E. *Supporting a Common Mission: Protecting Intellectual Property And Promoting Secure Software E-Commerce*. Financial News. January 27, 2003.

Kunii, Irene. "Japan: A Tiny Leap Forward." *Business Week* (21 April 2003): Online. Proquest.

Kuralt, Charles. *Sunday Morning With Charles Kuralt*. CBS News. March 23, 2003.

Kuroda, Haruhiko, Japan's Vice Minister of Finance, "Information Technology, Globalization, and International Financial Architecture" Speech at the Foreign Correspondents Club of Japan, June 15, 2000, <http://www.mof.go.jp/english/if/if018.html>

Kurtin, Owen D. *Local Telephone Competition Remains a Big Issue*. *National Law Journal*. Vol. 25, No. 69.

LeBlanc, Steve. *New Law Could Pave Way for Internet Sales Tax in Massachusetts*. Associated Press. March 13, 2003.

Legard, David. "Software Piracy Still Big in Asia (Online posting: PCWorld.com, <http://www.pcworld.com/news/article/0,aid,114873,00.asp>, 20 February 2004).

Leon, Kenneth. *Standard & Poor's Industry Survey - Telecommunications: Wireless*, (New York, McGraw Hill Co.) 13 Nov. 2003.

Levine, Linda. *An Information Technology Labor Shortage? Legislation in the 106th Congress*. Congressional Research Service, Washington D.C. June 14, 2001.

Lewis, Charles and Mayle, Adam. *Justice Department Drafts Sweeping Expansion of Anti-Terrorism Act*. Center for Public Integrity. February 7, 2003.

Li, Feng. *Telecommunications Companies Urged to Move With the Times*. University of Newcastle, M2Presswire. October 11, 2002.

Liebowicz, Stan J. and Margolis, Stephen E., *Winners, Losers & Microsoft*, The Independent Institute, Oakland, CA, 2001.

Linden, Jan and Blum, Jan. *Voice Over 802.11 Case Study Wireless VoIP; The Next Step in the Communications Evolution*. March 1, 2003.
http://techxny.bitpipe.com/data/detail?id=1048087672_938&type=RES&x=823846127

Lindquist, Christopher, "Plotting an open-source path," *Computerworld*, September 13, 1999.

Litman, Jessica. *Digital Copyright*. New York: Prometheus Books, 2001.

Llewellyn, Howell. *Piracy Blamed for 'Brutal' Spanish Decline*. *Billboard*. March 8, 2003.

Lohr, Steve, "Court Lifts Order That Required Windows to Include Java," *New York Times*, June 27, 2003.

Lohr, Steve. *The Intellectual Property Debate Takes a Page From 19th Century America*. *New York Times*. October 14, 2002.

Loyola, Roman. *China: The Republic of Linux*. TechTV. August 13, 2002.

Lumpkin, Beverly. *Patriot Act Redux*. ABCNews.com. February 21, 2003.

Lyman, Jay DSL Booming with Asian and North American Growth,
<http://www.technewsworld.com/perl/story/33035.html>, TechNewsWorld, March 3, 2004

Lyman, Jay. "Internet Users in China Number Nearly 80 Million" (Online posting: E-Commerce Times, <http://www.ecommercetimes.com/perl/story/32610.html>, 15 January 2004).

Madigan, Michelle. *Report Card on the Patriot Act*. PCWorld.com. October 9, 2002.
<http://pcworld.com/news/article/0,aid,105786,00.asp>

Maguire, James, "Corel Wins Market Share from Microsoft Office," NewFactor Network, accessed 23 March 2004 from <http://www.newsfactor.com/perl/story/19693.html>

Manasian, David. *Digital Dilemmas*. The Economist. January 25, 2003.

Marloff, Norman. "Problems and Needed Reforms for the H-1B and L-1 Work Visas". Feb 4, 2004.

Matloff, N., "Problems and Needed Reform for the H-1B and L-1 Work Visas," [http://heather.cs.ucdavis.edu/itaa.others.html], 9 February 2004.

McGee, M., and Chabrow, E., "Immigration & Innovation," *InformationWeek* 23 February, 2004.

McKeag, Louise, "Don't get caught out by MPLS", Techworld, 23 Sept 2003

McLaughlin, L., "An Eye On India: Outsourcing Debate Continues," *IEEE Software*, Vol. 20, No. 3, May-June 2003.

Mechanick, Maury. "Is the VOIP Revolution Salvation or Armageddon?" Satellite News Potomac: 9 Feb. 2004. Vol. 27, Is. 6; p1. 12 Mar. 2004 <http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&res_dat=xri:pqd&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&genre=article&rft_dat=xri:pqd:did=000000541339941&svc_dat=xri:pqil:fmt>

Menn, Joseph and Shiver, Jube, "The Microsoft Decision," Los Angeles Times, November 2, 2002.

Merle, Renae, "U.S. Official Cool to 'Buy American' Legislation; Undersecretary Says Nation Could Be Isolated", *The Washington Post*, Jun 28, 2003, p. E.01

Messmer, E., "Overseas Outsourcing Gains Momentum", *Network World*, [http://www.Nwfusion.com/news/2003/0630outsourcing.html], 30 June 2003.

Microsoft Annual Report, The Microsoft Corporation, Redmond, WA, 2003, accessed 23 March 2004 from http://www.microsoft.com/msft/ar.mspx

Millard, E., "Probing the IT Skills Shortage," *E-Commerce Times*, 15 July 2003.

Miller, H., "Testimony of Harris N. Miller, President of Information Technology Association of America before the U.S. House of Representatives Committee on Small Business, A Hearing on The Offshoring of High Skilled Jobs," [www.itaa.org], 20 October 2003.

Miller, James P., Machines continue to take over, Chicago Tribune 3/7/04

Mingail, Sandra. To Tax or Not to Tax: The Struggles of E-Commerce Taxation Policies. Internet. 2002. www.canadalawbook.ca 15 March 2004.

Mintchell, Gary A. and Yacano, Frank. *Beam Me Up Some Information, Scotty*. Control Engineering. May 2002.

Moore, Fred. *Executive Summary*. Computer Technology Review. June 2002.

Murphy, C., "Crossing Borders," *InformationWeek*, 7 July 2003,

Muscovitch, Zak. Taxation of Internet Commerce. Internet.1997. www.firstmonday.dk 15 , March 2004.

NASA AMES Research Center brief on Nanotechnology. Spring 2003. Internet.

National Cable & Telecommunications Association, *Broadband Services*, http://ncta.com/Docs/PageContent.cfm?pageID=37

National Cable & Telecommunications Association, *Industry Statistics*, http://ncta.com

National Cable & Telecommunications Association. *Overview 2002 Year-End*. January 2003.

National Cable & Telecommunications Association.. *Cable Developments 2002*. January 2003.

National Governors Association. *Story Idea: Internet Taxes and the Streamlined Sales Tax Project*. October 31, 2002.

National Intelligence Council. *Global Trends 2015: A Dialogue About the Future With Nongovernment Experts*. NIC 2000-02. December 2000. Available at: www.odci.gov/cia/publications/globaltrends2015.

National Research Council (NRC), *Building a Workforce for the Information Economy*, The National Academies Press, Washington D.C., 2000.

Newburger, Eric C., "Home Computers and Internet Use in the United States: August 2000", Special Studies, U.S. Census Bureau Report, U.S. Department of Commerce Report P23-207 Issued September 2001.

Nobel, Carmen, "Lagging State of 3G Mobile Services Debated; but All Agree Support for WLANs is Key", eWeek, New York, 1 Mar 2004, p. 14. Online. ProQuest. 16 Mar 2004.

Noguchi, Yuki and Griff Witte, "Wireless Firms Look at Phones as Limitless", Washington Post, Washington, D.C., 19 Feb 2004, p. E6.

Noto, Nonna A. *Extending the Internet Tax Moratorium and Related Issues*. CRS Report for Congress, January 17, 2002.

Noto, Nonna A. *Internet Tax Bills in the 107th Congress: A Brief Comparison*. CRS Report for Congress, December 6, 2001.

Nyham, Ron, "The Procurement Revolution", *Journal of Public Procurement*, Boca Raton, 2003, Vol. 3, Iss. 2,

Olive, David A. *Public Policy Report 2002*. World Information Technology Services Alliance. February 26, 2002.

Oliver, Joseph H., "Accounting and Tax Treatment of R&D, An Update", The CPA Journal, New York, Jul 2003, Internet. ProQuest. 10 Mar 2004.

Onley, Dawn S. *DARPA's Plans for Data Mining Draw Criticism*. Government Computer News. December 16, 2002.

Organisation for Economic Co-Operation and Development. *Measuring the Information Economy 2002*. January 2003. www.oecd.org/sti/measuring-infoeconomy

Osamu, Kadota, "Short term economic forecast for 2003/2004", Central Research Institute of Electric Power Industry (CRIEPI), CRIEPI Newsletter, June 2003

Overby, S., "India to Adopt Data Privacy Rules," *CIO*, 1 September 2003

Overby, S., "The Hidden Costs of Offshore Outsourcing," *CIO*, 1 September 2003,

Overby, S., "U.S. Stays on Top," *CIO*, 15 December 2003/1 January 2004.

Pappalardo, Denise and Martin, Michael. *Lobbying Group Outlines Big-Pipe Dream*. Network World. January 21, 2002.

Pappalardo, Denise and Mears, Jennifer. *What is Broadband?* Network World. November 18, 2002.

Pappalardo, Denise. *FCC Plans 3G Spectrum Auction*. Network World. November 18, 2002.

Patrick, Steven. *Malaysia Steps Up Piracy Fight*. Billboard. March 1, 2003.

Pawezowski, Mike, "A rough guide to Open Source," Bull UK and Ireland White Paper, June 2003.

Peslak, Alan R., "An analysis of regional and demographic differences and United States Internet usage," *Peer-Reviewed Journal on the Internet*, http://www.firstmonday.dk/issues/current_issue/peslak

Petreley, Nicholas. *Debunking the Linux-Windows Market Share Myth*. LinuxWorld.com. March 14, 2003.

Photduang, Nanta, "Thailand: IT Services Market, 2002-2003 and Beyond," Gartner Dataquest, January 27, 2004.

Piazza, Peter. *A National Security for Securing Cyberspace*. Security Management, Vol. 46, Issue 9. September 2002.

Pietromonaco, Peter. *Optical Computing: The Wave of the Future*. Poptronics. October 2002.

Plunkett, Jack W. *Plunkett's Telecommunications Industry Almanac 2003-2004*.

Plunkett, Jack W.. *Plunkett's Telecommunications Almanac 2001-2002*.

Poindexter, John. *Overview of the Information Awareness Office*. Defense Advanced Research Projects Agency. August 2, 2002.

Poynder, Richard, "The Open Source Movement," Information Today, October 2001.

Pringle, Rodney L. *Broadband: The \$500B Boost to Slowing U.S. Economy*. Communications Today. July 17, 2001.

Public Broadcasting System. *Judge Approves Microsoft Settlement*. OnLine NewsHour. November 1, 2002.

Quan, Margaret. *IEEE-USA Asks for Rollback of H-1B Visa Quotas*. EE Times. February 9, 2003.

Ratner, M., Zoloth, L. "The Next Big Ideas is Really Small", Public Lecture Series (4 December 2003), American Association for the Advancement of Science, Washington, DC.

Raymond James & Associates, "The IT Supply Chain Fourth Quarter IT Demand Survey," 5 Dec. 2003.

Regan, Keith. *Five E-Commerce Trends to Watch*. E-Commerce Times. April 3, 2002.

Ricadela, Aaron. *Microsoft Lawyer Foresees Massive Software Piracy*. Information Week. October 23, 2002.

Ricciuti, Mike, "Word Games," CNET News.com, accessed February 10, 2003 from <http://www.news.com>

Rice, Condoleeza and Ridge, Thomas. *New Counter-Terrorism and Cyberspace Security Positions Announced*. www.whitehouse.gov October 9, 2001.

Roa, Girish. Airline e-ticketing set to take off in India, Economic Times of India, 3/10/04

Robb, Karen, "IT Spending Boom Appears Over: *Federal Times Online*, February 9, 2004

Robertson, Jack, "Senate Passes Permanent R&D Tax Credit", Silicon Strategies.Com, 29 May 2001. Online. Internet. http://www.siliconstrategies.com/story/OEG20010523S01110?_requestid=229530.

Rogers, Amy, "Some government agencies leery of non-U.S. products", *Jericho*, February 18, 2002, Iss. 983,

Rosato, Donna. *War: What (Stocks) Is It Good For?* New York Times. November 24, 2002.

-
- Ross, Seamus and Gow, Ann. *Digital Archaeology: Rescuing Neglected and Data Resources*. University of Glasgow. February 1999.
- Rucker, Teri. *Experts: Divide Internet Tax Moratorium from Online Sales Taxes*. CongressDaily AM, January 22, 2003.
- Rudy, Jonathan. *Standard & Poor's Industry Survey - Computers Software*, (New York, McGraw Hill Co.) 9 Oct. 2003.
- Rudy, Jonathan. *Standard & Poor's Industry Surveys, Computers: Software*. New York: McGraw Hill Co., October 10, 2002.
- Rush, Laura. E-Commerce Growth Spurred by Maturation. Internet. 23 January 2004. www.clickz.com/stats/markets/retailing. 31 March 2004.
- Russell, Richard G., What is the State of the VG Standard, Microsoft Corporation, Windows Core Operating System Division, Development Manager - Windows Client Performance Team
- Sabo, John. *CA Security Expert Calls for New Consumer Privacy Initiatives*. Financial News. February 10, 2003.
- Sakuma CPA Office, "Japan Corporate Tax", Japan AC Outsourcing Co., Ltd. <http://www.acojapan.com.japanesetax.html>
- Salkever, Alex. Microsoft: Your Next Phone Company?, <http://www.technewsworld.com/perl/story/33037.html>, Tech News World , March 4, 2004
- Samuelson, Robert. "Calling the Next Tech Challenger." Washington Post. 26 Mar. 2004. 26 Mar. 2004 <<http://www.washingtonpost.com/wp-dyn/articles/A25468-2004Mar25.html>>
- Sandra Mingail, To Tax or Not to Tax: the Struggles of E-Commerce Taxation Policy, Internet, (www.canadalawbook.ca, 2002).
- Scalet, Sarah. *They Want for a Safer Infrastructure*. CIO Magazine. June 15, 2002.
- Schonfeld, Erick. *The Wi-Fi Buzz at PC Forum*. Business 2.0. March 29, 2002.
- Seattle Times. *Moody's Sees Negative Turn for Wireless Firms*. Bloomberg News. June 22, 2002.
- SECNAP Network Security Corporation, www.secnap.com
- Semiconductor Industry Association. *Global Chip Sales Total \$11.8 Billion in February 2003*. April 21, 2003. Available at http://www.sia-online.org/pre_release.cfm?ID=268
- Simpson, Glenn R. & Squeo, Anne Marie, "Leading the News: Bush, EU Both Flight 'Buy American'", *Wall Street Journal*, New York, July 11, 2003, p.A3
- Singel, Ryan. *A Chilly Response to 'Patriot II'*. Wired News. February 12, 2003.
- Smith, Edward A., Effects Based Operations, Applying Network Centric Warfare in Peace, Crisis and War, November 2002
- Smith, Richard. *Closing the Digital Divide*. British Medical Journal. February 1, 2003.
- Smith, Tom. "Tech Keeps Riding a Rising Tide" (Online posting: *Business Week Online*, http://www.businessweek.com/investor/content/aug2003/pi20030820_2144_pi041.htm, 21 August 2003).
- Solomon, Mellisa, "Create diversity in culture, ideas," *Computerworld*, May 6, 2002, Vol. 36, Iss. 19.
- Sommers, Robert L. *Moratorium on Internet Taxes*. The Tax Prophet. October 17, 1999.

Soumitra Dutta, Bruno Lanvin, Fiona Puaa, *The Global Information Technology Report*, Oxford University Press, New York, 2003

Standard & Poor's Industry Survey, Communications Equipment, January, 29, 2004 p13

Standard & Poor's Industry Surveys, Auto & Auto Parts, December 25, 2003,

Standard & Poor's Industry Surveys, General Retailing, November 27, 2003

Standard & Poor's Industry Surveys, Health, Managed Care, September 25, 2003

Standard & Poor's Industry Surveys, Health, Pharmaceuticals, December 11, 2003

Standard & Poor's Industry Surveys, Investment Services, October 30, 2003

Starr, Sandy. 'Responsible' Regulation. Internet. 23 July 2003. www.spiked-online.com 15 March 2004.

State of New York, et al, v. Microsoft Corporation, United States District Court for the District of Columbia, final judgment filed November 1, 2002.

Stephens, Ronald. *Information Technology Trends and Outlook*. Industrial College of the Armed Forces, Information Technology Industry Study, 2002.

Stice, Richard. Standard & Poor's Industry Survey - Computers: Commercial Services, (New York, McGraw Hill Co.) 15 Jan. 2004.

Stice, Richard. *Standard & Poor's Industry Surveys, Computers: Commercial Services*. New York: McGraw Hill Co., January 16, 2003.

Stock, Kyle. *Patriot Act Expansion Debated*. PC World.com. February 24, 2003.

Styles, Costa, Jenkins, "In the Driver's Seat – Location Based Services Power GPS/GALILEO Market Growth," GPS World, October 2003

Swoyer, Stephen. *Ten Technology Predictions for 2004* (Online posting: Enterprise Systems, <http://www.esj.com/enterprise>, 16 December 2003).

Taiwan Economic News. *Microsoft Said To Cut Software Prices In Taiwan*. February 24, 2003.

Tellis, A., Bially, J., Layne, C., and McPherson, M., *Measuring National Power in the Postindustrial Age*, Rand, 2000.

Tenet, George J., "Global Trends 2015: A Dialogue About the Future With Non-government Experts", National Intelligence Council, Central Intelligence Agency, 3 December 2000

The 2004 Summit Seven: Emergence Of The Dynamic Computing Era (Boston, MA: Summit Strategies, Inc., 2003).

The Evolution of High –End Servers, http://www.esj.com/back_issues/contents.asp?EditorialsID=22

Thibodeau, Patrick. *H-1B Visa Count Down, Anger Up*. Computerworld. February 3, 2003. www.computerworld.com/printhis/2003/0,4814,78095,00.html

Thierer, Adam. Internet Taxation and Telecommunications Tax Policy. Internet. www.cato.org 23 March 2004.

Thorn, John. "The 1996 Telecommunications Act: What Went Wrong and Protecting the Broadband Buildout". , 2001.

Timmerman, Kenneth R., "U.S. to rogue states: Buy American", *Wall Street Journal*, New York, ISSN: 00996660, May 25, 1994

Tong, Yeo Cheow. *Liberalizing Singapore*. Telecom Asia. July 2001.

Top 10 Technology Predictions for 2004 (Wellesley, MA: Nucleus Research, Inc., 2003).

Tyson, Jeff. "How IP Telephony Works." How Stuff Works. 15 Mar. 2004
<<http://computer.howstuffworks.com/ip-telephony.htm>>

U.S. Customs Dismantles One of the World's Most Sophisticated Internet Piracy Networks, "Operation Buccaneer" Targets "Warezs" Cyberspace Gangs and their Multi-Billion-Dollar Software Piracy Scheme, U.S. Department of State, International Information Programs, December 11, 2001, URL:
<http://usinfo.org/usia/usinfo.state.gov/topical/econ/ipr/customsdec11.htm>

U.S. Department of State website, Country Briefing, Japan, Economy, Bureau of East Asian and Pacific Affairs, October 2003, <http://www.state.gov/r/pa/ei/bgn/4142.html>

U.S. Immigration and Naturalization (INS), "US Immigration Service Center NAFTA," [<http://www.infodomain.com/tnvisas.htm>], October 2003.

U.S. Trade Regulator (USTR) 2003 Special 301 Report, Intellectual Property, URL,
<http://www.ustr.gov/sectors/release.shtml>

Ulfelder, Steve. "Low-level IT work is its forte now, but this Asian giant is eyeing a future as a major outsourcing player." Computerworld, vol. 37 no. 37, 15 September 2003.

United States Department of Commerce, "Digital Economy 2002 (DE2002), Feb. 2002.
<http://www.esa.doc.gov/pdf/DE2002r1.pdf> (23 Mar. 2004)

United States Department of Commerce, "Digital Economy 2003 (DE2003)," Dec. 2003.
<http://www.esa.doc.gov/DigitalEconomy2003.cfm> (15 Mar. 2004)

United States Department of Commerce. *Digital Economy 2002*. Economics and Statistics Administration. February 2002.

United States Department of Commerce. *H1-B Visa Position Paper*. December 2002.

United States Department of Justice. *Identity Theft and Fraud*.
www.usdoj.gov/criminal/fraud/idtheft.html

United States Department of Justice. *INS Announces FY 2002 H-1B Processing Through June 30*. August 13, 2002. www.immigration.gov/graphics/publicaffairs/newsrels/02.08FYH-1BProcessing.html

United States Department of Labor, Bureau of Labor Statistics. *Career Guide to Industries, 2002-2003 Edition*. www.bls.gov/oco/cg/cgs033.htm

United States General Accounting Office, "H-1B Foreign Workers," GAO-03-883, September 2003

United States of America v. Microsoft Corporation, United States District Court for the District of Columbia, complaint filed May 18, 1998.

Uricj, Kristi and Kelly Ungs, "Taking IT to the Streets: A Guide to Wide Area Wireless for the Non-Technical Business Professional", Intermec Technologies Corporation, Everett, WA, 1 Mar 2003, pp 4-5. Online. Internet. http://www.bitpipe.com/detail/Res/1077899815-557.html?sec=TRM_TOPN

Vadun, Matthew. *Virginia Senator Introduces Bill to Make Internet-Tax Moratorium Permanent*. Bond Buyer, January 14, 2003.

Valbrun, M., and Thurm, S., "Foreign Workers Will Soon Get Fewer U.S. Visas," *The Wall Street Journal*, 1 October 2003.

Valentine, Lisa. "Tech Jobs: Data Storage" (Online posting: DataStorageToday, http://datastorage-today.newsfactor.com/story.xhtml?story_title=Tech_Jobs__Data_Storage&story_id=23296&category=stortrend, 4 March 2004).

Vance, Jeff, "One from Column A, One from Column G: A Guide to Making Sense of Wireless LAN Upgrade Options", *Network World*, 15 Mar 2004. Online. Internet. <http://www.nwfusion.com/2004/0315techinsiderag.html>

Venkat, Kumar. *Can Small Still Be Beautiful?* Christian Science Monitor. January 28, 2003.

Vettiger, Peter and Binnig, Gerd. *The Nanodrive Project*. Scientific American. January 2003.

Wagner, Mitch. *Study Says IT Job Market Stabilizing*. TechWeb. December 20, 2002.

Webb, Cynthia, "From Brussels with Love," *Washington Post*, February 24, 2004.

Webb, Cynthia, "The Antitrust Hydra," *Washington Post*, February 26, 2004.

Weinstein, Eric. "How and Why Government, Universities, and Industry Create Domestic Labor Shortages of Scientists and High-Tech Workers". <http://nber.nber.org/~peat/PapersFolder/Papers/SG/NSF.html>

West, Darrell M. "Global E-Government, 2003", Center for Public Policy, Brown University Providence, RI, available on-line at: www.INSidePolitics.org,

Wheeler, David, "Why Open Source Software/Free Software? Look at the Numbers," http://www.dwheeler.com/oss_fs_why.html, December 31, 2003.

Wiggins, D. and Gilliland, Martin, "Commentary: Thai PC Market May Change Global Windows Landscape," *Gartner Dataquest*, August 18, 2003.

Wilcox, Joe, "How open is the new Office?" *CNET News.com*, accessed December 16, 2002 from <http://www.news.com>

Wilcox, Joe, "Microsoft limits XML in Office 2003," *CNET News.com*, accessed April 11, 2003 from <http://www.news.com>

Wildstrom, Steve. *Nano Memory Chips Promise Jumbo Performance*. *Business Week*. February 17, 2003.

Wilson, Jim. *Quantum Computers*. *Popular Mechanics*. December 2002.

Wilson, T., "The Offshore Option is Here to Stay," *Network World*, [<http://www.Nwfusion/newsletters/asp/2003/0414out1.html>], 16 April 2003.

WIPO Home Page. www.wipo.int/about-ip/en/world-ip/204/index.html

Witte, Giff. "FCC Rule on Local Phone Service Rejected", *Washington Post*, 3 Mar 2004.

Woods, William T., General Accounting Office letter to Representative Tom Davis, February 14, 2003

World Information Technology and Services Alliance. *Digital Planet 2002: The Global Information Economy*. February 2002.

Worthen, B., "The Radicalization of Mike Emmons," *CIO*, 1 September 2003

www.boeing.com. ATM, Bold approach, Plan

Yegazarian, Anush. *Sales Taxes Hit the Web*. *PC World*. March 2003.

Yeo, George. Information Technology and Singapore's Future. Internet. 4 June 1998.
www.asiasociety.org 15 March 2004.

Zubey, Michael L., William Wagner, and James R. Otto. "A Conjoint Analysis of Voice over IP Attributes." Internet Research: Electronic Networking Applications and Policy, 12.1 (2002), 7-15.
<<http://ceres.emeraldinsight.com/vl=14586365/cl=61/nw=1/rpsv/cgi-bin/linker?ini=emerald&reqidx=/cw/mcb/10662243/v12n1/s1/p7>>

