THE PRESIDENT'S
NATIONAL SECURITY TELECOMMUNICATIONS
ADVISORY COMMITTEE

GLOBALIZATION TASK FORCE REPORT

MAY 2000

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EXECUTIVE SUMMARY

Since the last meeting of the President's National Security Telecommunications Advisory Committee (NSTAC) in June 1999, the Globalization Task Force (GTF)[1] has concentrated its efforts on national security and emergency preparedness (NS/EP) issues related to the global information infrastructure (GII) in 2010, foreign ownership of NS/EP critical communications systems, and technology export policies.

In October 1998, the NSTAC's Industry Executive Subcommittee (IES) tasked the Information Infrastructure Group (IIG), now known as the GTF, to postulate the nature of the GII in 2010 and to assess the implications for NS/EP communications. The GTF conducted research and received briefings from industry and Government experts on the emerging wireline, wireless, and satellite-based technologies expected to compose the GII in 2010.

The GTF concluded that in 2010, NS/EP communications would be facilitated by a GII featuring new technologies and improved network features. The GII in 2010 would also provide increased global availability of broadband communications, with satellite communications and wireless technologies bringing the GII and NS/EP communications to less accessible geographic regions. However, despite the plethora of technological capabilities forecasted for 2010, there is no guarantee that all essential communications capabilities will be ubiquitously available. Given the global reach and communications needs of some U.S. NS/EP missions, prudent NS/EP communications contingency planning should consider end-to-end systems using a broad range of wireless, satellite, and terrestrial capabilities.

In addition to planning for the global availability of the GII in 2010, the Government must also consider the richness of service envisioned in the future network architecture and decide whether NS/EP communications will require quality of service (QoS) features beyond commercially available capabilities. Any, and perhaps all, the potential protocols of 2010 could be considered candidates for hosting NS/EP requirements, thus the Government must continue being proactive in its attempts to cooperate in the development of industry standards and technical specifications for next-generation and Internet Protocol (IP)-based networks.

The GTF also examined the implications of foreign ownership of critical U.S. telecommunications facilities on NS/EP services. Subsequently, the GTF tasked NSTAC's Legislative and Regulatory Working Group (LRWG) with developing a scoping paper on the issue and reporting any findings to the GTF before the completion of the GII report. The LRWG concluded that the current regulatory structure effectively accommodated increasing levels of foreign ownership of U.S. telecommunications facilities, while allowing the Federal Government

[1] The GTF was formed as a result of the reorganization of the IES working group structure in September 1999.

to retain the authority to prevent any such foreign ownership that might compromise national security interests.

Following the NSTAC XXII meeting, the GTF was also tasked to examine technology export policies dealing with the transfer of strong encryption products, satellite technology, and high-performance computers. The GTF compiled basic information about key technology export issue areas and monitored the implementation of new export policies and regulations. The GTF also investigated the development of guidelines to assist companies in understanding Government approval of technology sales. The GTF concluded that because technology progresses faster than policy can keep up with it, industry and Government should continue to reevaluate the limits placed on the export of technologies.

NSTAC Recommendations to the President

The President should direct appropriate departments and agencies to—

- conduct exercises in those areas and environments in which NS/EP operations can be expected to take place to ensure that the required high-capacity, broadband access to the GII is available,
- ensure that NS/EP requirements, such as interoperability, security, and mobility, are identified and considered in standards and technical specifications as the GII evolves to 2010, and identify any specialized services that must be developed to satisfy NS/EP requirements not satisfied by commercial systems, and
- ensure that the review process for commercial arrangements involving foreign ownership remains adequate to protect NS/EP concerns as the environment evolves and becomes more complex.

1.0 INTRODUCTION

In 1993, the Clinton Administration recognized the growing importance and criticality of the information infrastructure. With the release of *An Agenda for Action*, the Administration promoted a national strategy to develop a robust, accessible, and reliable information infrastructure that would satisfy the national and economic security interests of the United States. The goal was a national information infrastructure (NII) that would greatly benefit Government, businesses, and the American public. Since that time, growing competition and technological innovation have resulted in a national, and increasingly global, interconnected and open information infrastructure that offers commercial efficiencies and societal benefits. NSTAC provided industry expertise and insights to the President as the Administration promoted the development of the NII.

Soon after the release of *An Agenda for Action*, the Government focused on the development and expansion of the GII, the international extension of the U.S. NII initiative. Although the expansion of the GII and the globalization of communications and information technology generate obvious economic and societal benefits, they pose new risks for U.S. NS/EP services. In its role of providing industry-based advice to the President on NS/EP telecommunications policy, the NSTAC examined the emerging NS/EP communications issues associated with globalization. NSTAC's IIG and, following a reorganization of the IES in September 1999, GTF have continued the NSTAC's work in this area.

This report captures the efforts of the GTF through the current cycle. The NSTAC XXIII GTF members are listed in Appendix A. The GTF's current charge is outlined in the following section.

2.0 CHARGE

Since the NSTAC XXII meeting in June 1999, NSTAC has continued to examine globalization issues. The NSTAC's IES charged the IIG, and subsequently the GTF, to—

- postulate the GII for 2010 and identify NS/EP opportunities and issues,
- investigate the NS/EP implications of foreign ownership of U.S. telecommunications facilities, and
- examine and monitor technology export policy and regulations.

3.0 RESULTS

Listed below are the results of the GTF's study on NS/EP issues related to the GII in 2010, the foreign ownership of NS/EP critical communications systems, and technology export policies.

3.1 Global Information Infrastructure

3.1.1 Analysis

In 1993, the NSTAC established an NII Task Force and charged it with examining the implications of the evolving United States information infrastructure for NS/EP communications. The NII Task Force observed that the NII's connectivity to the emerging GII potentially presented opportunities and risks for NS/EP communications. In its March 1997 report to NSTAC XIX, the NII Task Force concluded that the pervasive and rapidly evolving nature of the GII necessitated a continuing effort by NSTAC task forces and working groups to track the GII's implications for NS/EP communications. As a result, the IIG was tasked by the IES in October 1998 to conduct a forward-looking analysis of the GII and associated NS/EP opportunities and challenges.

The IIG agreed to address its charge from the IES by undertaking two tasks: postulating the nature of the GII in 2010 and assessing the potential implications of the future GII for NS/EP communications. In selecting 2010 for the purpose of characterizing the future GII, the IIG considered that systems that would be operational in 2010 could be characterized because they were in planning, under construction, or in operations; protocols in use in 2010 would provide for transparent packet-based switching offering advanced Quality of Service (QoS), availability, reliability, and security features; and the scope of similar Government projects such as the Department of Defense (DOD)-sponsored "Joint Vision (JV) 2010" project involving the future warfighting capabilities of the U.S. armed forces.

During a reorganization of the IES and its working group structure in September 1999, the GTF was formed to continue to address globalization issues, including the GII. For its analysis, the GTF defined the GII in the context of those physical network elements, services, and types of protocols that the group believed would be featured prominently in 2010. Specifically, the group agreed to gather data in three main subject areas: GII components (e.g., wireline, wireless, and satellite communications systems), services, and protocols. To that end, the GTF received briefings from selected industry experts regarding the potential role of the various communications systems in the future GII.

These information-gathering activities provided the GTF with the insights needed to characterize the GII in 2010, based on the best-available information, and draw conclusions about NS/EP telecommunications preparedness. Drawing on these insights, the GTF described what physical network elements, services, and types of protocols would be prominently featured in 2010, paying specific attention to the global homogenization of communications capabilities, expected improvements to QoS and network assurance, and the ubiquity and availability of advanced communications technologies as pertaining specifically to NS/EP users. The GII Report, with its findings and conclusions, is attached as Annex B of this report.

3.1.2 Conclusions

By examining current communications trends, the GTF was able to develop a picture of the communications capabilities expected to be offered in 2010. The GTF analyzed the vast array of communications and information transfer technologies in use or being developed to meet the growing global demand for broadband telecommunication services. This global demand will also fuel continual improvements in transmission system capacities, last-mile connectivity solutions, mobile communications, and network QoS.

While there will be broad combinations of transmission capabilities available in 2010, including specialized applications and networking protocols to facilitate efficient networking, ubiquitous connectivity to the GII in 2010 cannot be assumed. Even with the growth in accessibility and efficiency of transmission capabilities, there is no guarantee that all essential capabilities will be available on a global scale. Given the global reach and communications needs of some U.S. NS/EP missions, this issue should be considered in NS/EP planning efforts.

The GTF also analyzed the Federal Government's NS/EP communications requirements for 2010, drawing those requirements from various Federal Government policy statements and JV 2010 documentation. The GTF determined that existing NS/EP telecommunications requirements would still be valid in 2010; however, QoS and network assurance features were expected to be so robust, that the need for specialized services to facilitate certain NS/EP requirements would likely be reduced. NS/EP operations responding to national disasters that have destroyed local commercial telecommunications infrastructure will be accommodated by mobile portable access systems to access the GII. Of potential concern are the broadband access requirements envisioned in support of DOD's national security operations.

3.1.3 Recommendation

The GTF proposes the following recommendation.

Recommendation to the President

The President should direct the appropriate departments and agencies to—

- conduct exercises in those areas and environments in which NS/EP operations can be expected to take place to ensure that the required high-capacity, broadband access to the GII is available, and
- ensure that NS/EP requirements, such as interoperability, security, and mobility, are identified and considered in standards and technical specifications as the GII evolves to 2010, and identify any specialized services that must be developed to satisfy NS/EP requirements not satisfied by commercial systems.

3.2 Foreign Ownership: Telecommunications and NS/EP Implications

3.2.1 Analysis

Following the reorganization of the IES, the GTF was also tasked to examine and make recommendations on the implications of foreign ownership of critical U.S. telecommunications facilities on NS/EP services. Subsequently, the GTF tasked the Legislative and Regulatory Working Group (LRWG) with developing a scoping paper on the issue and reporting its findings to the GTF before the completion of the GII report.

To accomplish this task, the LRWG focused its attention on foreign ownership-related policies affecting the GII and NS/EP. The group placed particular emphasis on two related issues: granting foreign-owned entities access to the U.S. market with a view to gaining foreign market access for U.S. industry on fair and equitable terms, and balancing these initiatives with national security concerns. The LRWG determined that U.S. Federal statutes and regulations had evolved in accordance with the development of international telecommunications facilities and markets, effectively accommodating increasing levels of foreign ownership of U.S. telecommunications facilities while allowing the Federal Government to retain the authority to prevent any such foreign ownership that may compromise national security interests.

The LRWG reported its findings and conclusions to the GTF in February 2000. Information from the scoping paper is referenced in the Legal and Regulatory section of the GII report. The scoping paper is attached as Annex C.

3.2.2 Conclusions

The GTF concurred with the LRWG findings, which addressed commercial arrangements for ownership of communications facilities, the efficacy of communications-related U.S. Federal statutes and regulations designed to protect national security interests, and the potential for future regulatory adaptations governing foreign ownership to impact NS/EP policies. The conclusions and findings from this scoping effort are as follows:

- The World Trade Organization (WTO) Basic Telecommunications Agreement and liberalization of the global trade environment in general have enabled companies to provide telecommunications services in other countries' jurisdictions. This global liberalization encourages the continued expansion of the GII.
- U. S. Government policy has adapted to this increasingly globalized telecommunications industry. Strict limits on foreign ownership and/or control of domestic telecommunications facilities were loosened in the Telecommunications Act of 1996 and again in the Federal Communication Commission's (FCC) implementation of the WTO Agreement. Simultaneously, the FCC has included Government agencies with national security responsibilities (e.g., DOD and the Federal Bureau of Investigations [FBI]) as part of the regulatory review process. Agreements between U. S. companies and the security agencies are now an important part of the FCC's review process of mergers and other commercial arrangements involving foreign ownership.
- The current regulatory structure appears to satisfy the diverse interests of the parties. U.S. companies generally are able to receive approval to conduct transactions involving foreign telecommunications companies, subject to agreements with the defense and law enforcement agencies. The FCC is able to fulfill its role of protecting the public interest. In addition, the defense and law enforcement agencies are able to exact the commitments they require to protect national security. It is not clear that any further statutory or regulatory changes would effectively enhance the role of national security issues in foreign ownership situations at present.

3.2.3 Recommendation

The GTF proposes the following recommendation.

Recommendation to the President

The President should direct the appropriate departments and agencies to—

- ensure that the review process for commercial arrangements involving foreign ownership remains adequate to protect NS/EP concerns as the environment evolves and becomes more complex.

3.3 Technology Export Policy

3.3.1 Analysis

As part of the trend toward globalization, many nations, including the United States, have begun to liberalize their technology export control policies. The IES determined that the issue of technology export control should be addressed by the GTF, with the GTF examining current technology export policies.

In analyzing the issue of technology export policies, the GTF considered the various, conflicting opinions regarding the long-term national security implications of current export control policies. A few of these export policies deal with the transfer of strong encryption products, satellite technology, and high-performance computers (HPC).

Realizing the need to prevent U.S. adversaries and criminals from obtaining advanced technologies, the U.S. Government has sought to restrict the export of specific items. However, the U.S. Government also acknowledges the need to periodically reevaluate the limits placed on the export of technologies. Conversely, industry advocates the liberalization of export policies and contends that the Nation's security is heavily dependent on the economic well-being of its technological base.

3.3.2 Conclusions

Effective communications among industry, the Executive Branch, and Congress are essential in resolving the issues surrounding technology export policies. Export control policies can significantly affect national security and the U.S. economy. As the GTF analyzed the issue throughout the past cycle, the Administration continued to revise and update technology export policies. Given that technology progresses faster than policy can keep up with it, industry and Government should continue to reevaluate the limits placed on the export of technologies.

APPENDIX A

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APPENDIX B

GLOBAL INFORMATION INFRASTRUCTURE REPORT

THE PRESIDENT'S
NATIONAL SECURITY TELECOMMUNICATIONS
ADVISORY COMMITTEE

GLOBALIZATION TASK FORCE
Global Information Infrastructure Report

MAY 2000

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EXECUTIVE SUMMARY

This Global Information Infrastructure (GII) Report is the result of a thorough examination and analysis of the GII by the President's National Security Telecommunications Advisory Committee (NSTAC) Globalization Task Force (GTF). On an ongoing basis, the NSTAC tracked the emerging GII's implications for national security and emergency preparedness (NS/EP) telecommunications. This report represents the GTF's forward-looking analysis of the GII in 2010 and associated NS/EP opportunities and challenges. To complete this tasking, the GTF received briefings from and held discussions with industry and Government experts actively involved either in the development of the GII, or NS/EP telecommunications planning efforts.

In essence, this is an interim report on the possibilities that advances in computing and communications can offer to daily activities. Forecasts can be made for 2005, 2010, or 2020. However, the usefulness of such an exercise is for those involved in NS/EP communications planning to keep up with and take advantage of the possibilities associated with the developing GII.

Included among the more significant conclusions of this report are:

- A global homogenization of communications capabilities is taking place as domestic and international boundaries are being eliminated by the converging technologies and services.
- The global technical and operational environment precludes the United States from acting in isolation.
- Soaring demand for services, particularly broadband-intensive services, combined with the needs for greater mobility, for the Internet to provide business quality of service, and for lower costs for the service provider and for the user, are driving networks and protocols toward convergence and intelligence from the core networks to the edges.
- Planning for domestic and international fiber optic cable and communications satellites calls for vastly increased capacity, flexibility, and capabilities over present-day systems.
- Commercial demand, rather than Government requirements or regulation, will likely continue to be the force driving new services, applications, and supporting technologies; but the public switched network will not disappear by 2010.
- Based on experience to date, global liberalization of the telecommunications and information industries bodes well for the GII and should have no negative impact on national security.

- NS/EP communications in 2010 will be facilitated by a GII featuring new technologies and improved packet-switched network features— a dramatically different "network of networks."
- Prudent NS/EP communications contingency planning should continue using the complementary capabilities of terrestrial wireless communications systems and fiber optic systems to meet global coverage goals.

Recommendations to the President

The GTF recommends the following regarding the GII in 2010:

The President should direct appropriate departments and agencies to—

- conduct exercises in those areas and environments in which NS/EP operations can be expected to take place to ensure that the required high-capacity, broadband access to the GII is available, and
- ensure that NS/EP requirements, such as interoperability, security, and mobility, are identified and considered in standards and technical specifications as the GII evolves to 2010 and identify any specialized services that must be developed to satisfy NS/EP requirements not satisfied by commercial systems.

1.0 INTRODUCTION

1.1 Purpose

This report (1) postulates the nature of the global information infrastructure (GII) in the year 2010, (2) assesses potential opportunities and challenges for national security and emergency preparedness (NS/EP) communications in this future environment, and (3) analyzes the NS/EP communications requirements of the Federal Government.

1.2 Summary of GII History

In March 1994, the Administration presented its concept of the GII to the International Telecommunication Union (ITU) World Telecommunication Development Conference in Buenos Aires, Argentina. The action plan for the GII was based on the following principles:

- encourage private investment,
- promote competition,
- create a flexible regulatory framework to keep pace with technological and market changes,
- provide open access to the network for all network providers, and
- ensure universal service.[1]

The developing GII has been a prominent item for the NSTAC agenda for several years. On an ongoing basis, the NSTAC provides the Administration with assessments and recommendations concerning this global infrastructure.

In 1993, the Industry Executive Subcommittee (IES) of the President's NSTAC established a National Information Infrastructure (NII) Task Force and charged it to examine the implications of the evolving United States information infrastructure for NS/EP communications. During its analysis, the NII Task Force determined that the NII's connectivity with the emerging GII potentially presented both opportunities and risks for NS/EP communications. According to the March 1997 NII Task Force Report to NSTAC XIX, the pervasiveness of the GII and its rapidly evolving nature necessitate a continuing effort by NSTAC to track the GII's implications for NS/EP telecommunications. To that end, the IES tasked the NSTAC's Information Infrastructure Group (IIG) in October 1998 to conduct a forward-looking analysis of the GII and associated NS/EP opportunities and challenges. Due to IES reorganization, however, the GII tasking was given to the newly formed Globalization Task Force (GTF).

[1] Information Infrastructure Task Force Website: www.iitf.nist.gov.

1.3 GII Definition

The GII is a complex concept without a universally agreed on definition. The GII is generally understood to mean a "network of networks"— a worldwide network of local, national, regional, and international networks. The GII concept also includes hardware and software; a system of applications, activities and relationships, including the information itself; and standards, interface, and transmission codes that facilitate interoperability and ensure privacy, security, and reliability. Most important, the GII comprises the people involved in its use and development. These individuals are identified as primarily from the private sector, and include vendors, operators, service providers, and users.[2]

The GII is the international extension of the U.S. NII initiative. Many nations have subsequently announced their own NII initiatives. NII components are similar in composition to the GII but their scope is national, not global. The United States also operates a Defense Information Infrastructure (DII), which is the shared and interconnected system of computers, communications, data applications, security, people, training, and other support structures serving Department of Defense (DOD) information needs. Much of the DII relies on the facilities of the GII. The DII includes command and control (C2), tactical, intelligence, and commercial communications systems used to transmit DOD data.[3]

For the purposes of this report, the GII is discussed in the narrower context of those physical network elements, services, and protocols that the GTF believes will be featured prominently in 2010. The report does not detail every country's physical communications infrastructure and relevant legal, policy, and regulatory approach. Instead, broad technological and policy trends are considered in an attempt to identify communications systems, protocols, and services most likely to be prominent parts of the global communications landscape in 2010. This task includes assessing the impact of future technologies and service offerings and their ability to satisfy the NS/EP requirements that drive technology. Findings are based on current trends in global communications and the foundations being put in place to provide future technology capabilities. Considering the significant technological and structural changes occurring daily within the telecommunications industry, this report is not a wholly definitive view of the future, but rather a survey of probable scenarios based on the best currently available information.

The pace and diversity of change within the GII can be put in perspective by noting the business news information in the January 19, 1999, edition of the *New York Times* on the Web. The edition featured news of a cable modem provider's acquisition of a major Internet portal and search engine company; an international merger between two wireless telecommunications service providers; an alliance between software and consumer electronics companies to tie

[2] NSTAC NII Task Force, Report to NSTAC XVIII, February 1996, borrowing from *The Global Information Infrastructure: Agenda for Cooperation*, February 15, 1995.
[3] Joint Chiefs of Staff, *Concept for Future Joint Operations, Expanding Joint Vision 2010*, May 1997.

together home devices over global computer networks; and the plans of a broadcast television station-owned Internet provider to partner with major telecommunications carriers to deliver travel, personal finance, and entertainment content into the home via high-speed Internet connections.[4]

1.4 Approach/Methodology

The methodology used to characterize the GII in 2010 and forecast its implications for NS/EP was as follows:

- examine the GII from three perspectives: wireline, wireless (personal communications services [PCS], and cellular) and satellite communications systems,
- receive briefings from industry and Government personnel on emerging technologies affecting the development of the future GII and NS/EP services,
- establish a baseline of current communications capabilities and describe the transition to the future GII,[5] and
- conduct research and analysis of emerging technologies and anticipated trends and their potential effects on NS/EP.

[4] *New York Times* Website: http://www.nytimes.com/99/1/19/tech.
[5] For a more detailed discussion of this issue, please see the *Convergence Report*, NSTAC Information Technology Progress Impact Task Force (ITPITF). The ITPITF has included this document in its report to NSTAC XXIII.

2.0 DRIVING TRENDS

With the support of Government policies, industry has taken the lead in advancing the GII through developing and deploying many innovative global networks, information services, and consumer electronics. The companies contributing to the GII have established applications to support electronic mail capabilities, distance learning projects, commercial networks, and interconnected libraries, medical facilities, and service organizations.[6] However, new technologies and capabilities, and the subsequent transition period to the "next generation network" (NGN), may generate some problems related to feature interaction, security, and reliability.[7] By assessing the growth of the networks, capabilities, and applications fueling the development of the GII, the GTF identified the following driving trends in global communications and technology in 2010:

There is a global homogenization of communications capabilities taking place. Developing countries are building their communications infrastructures using the latest and most advanced technologies. For example, Zhenghou Cable Television, which serves 320,000 subscribers in China's Henan province, will upgrade its network to offer Voice over Internet Protocol (VoIP), videoconferencing, video on demand, and Internet Protocol (IP) virtual private network (VPN) services using a new packet transport technology. Because such initiatives are occurring worldwide, a digital divide in global communications capabilities that now separates developed and developing nations should be reduced significantly by 2010.

Quality of Service (QoS) and network assurance capabilities will continue to improve. By 2010, QoS across the network is expected to be so high and network assurance capabilities are expected to be so robust that the need for additional services to facilitate NS/EP is likely to be reduced. Outstanding quality will be a minimum requirement to attract and retain a global commercial and Government customer base. Telecommunications companies will benchmark their performance against the best in the world and adopt continuous improvement processes to remain competitive. Due to the complexity, diversity, converged interworking environment of the GII in 2010, there will be a proliferation, both in scope and scale, of network interconnections, each with a new set of technical challenges requiring adequate internetwork interoperability testing. Commercial and Government security techniques will also converge by 2010 as commercial enterprises recognize the importance of security in business-to-business (B2B) and electronic commerce as needed for user confidence. Government will want to make more use of commercial security practices in addition to DOD practices because of economics and effectiveness.

The global technical and operational environment will preclude the United States from acting in isolation. For the U.S. public and private sectors to succeed in the emerging GII,

[6] Computer Systems Policy Project, "*Perspectives on the Global Information Infrastructure*," February 1995.
[7] Lucent Technologies White Paper, "*Feature Interaction and Multi-Services Networks.*"

strategic information technology planning must be globally oriented. Information is largely free of geopolitical boundaries, so a global focus is required. However, despite the required global perspective and the emerging global homogeneity with regard to communications capabilities, the U.S. public and private sectors cannot assume the availability and ubiquity of advanced communications capabilities. Guaranteed access to certain communications capabilities may be infeasible for industry and Government entities for reasons related to geography, political considerations, levels of infrastructure development, or market demand.

The public-switched network (PSN) will not disappear by 2010. Because it is growing at a more modest rate than Internet traffic, voice traffic will eventually form a much smaller percentage of the traffic carried over telecommunications backbone networks. The PSN, however, will coexist with data-centric networks for at least the next decade, while multiservice packet-switched networks emerge. Connection-oriented voice networks with fixed telephone-to-telephone connections will still be in use in 2010, but voice as a percentage of total network traffic will be considerably smaller.

There is growth in available communications capabilities. The demand for telecommunications services is being increasingly satisfied by a broad combination of transmission capabilities. Consumers can choose from traditional voice telephony, wireless cellular, wireless spread spectrum, traditional satellite, low Earth orbit satellite, cable, or digital subscriber line (DSL) to make a voice call or data connection.[8] Growth in communications capabilities is expected to continue, particularly as specialized applications and universal networking protocols become more prevalent.

As this section explains, several dominant trends are driving progress in the GII: convergence and the emergence of the Internet as the universal communications medium, the increased availability of bandwidth and the more effective use of existing bandwidth, and the economic efficiencies realized through emerging microchip technology. These trends form the basis for the assumptions outlined in this section.

2.1 Internet

The rapidly expanding technology offered by the Internet promises to become a necessary economic underpinning for all successful countries in the new global economy.[9] The Internet is growing at an exponential rate, with more than 70,000 new Websites being created every hour. Global Internet traffic doubles every 3 months, and global Internet commerce revenues grow by

[8] Pennsylvania State University Institute for Information Policy: "*The New Global Telecommunications Industry & Consumers*," (online): http://home.imc.net/naruc/chapter1.htm.
[9] United States Department of Commerce, National Telecommunications and Information Administration, *Falling Through the Net: Defining the Digital Divide*, July 1999.

more than 100 percent annually—from $35 billion in 1998 to a projected $1.4–$3.2 trillion in 2003.[10]

Many industry and Government organizations also rely heavily on intranets, or dedicated networks using Transmission Control Protocol/Internet Protocol (TCP/IP). These dedicated networks rely on the same protocols, architecture, applications, and hardware as the public Internet, and often are connected to it.[11]

2.1.1 Evolving Features of the Public Internet

QoS, availability, reliability, interconnectivity, and security are evolving features of the public Internet and are instrumental in shaping the future GII. The features are described in brief below.

QoS: The ability to define a level of performance in a data communications system.[12] The level of performance may be based on such network characteristics as reliability, connectivity, and robustness.

Availability: The assurance that a given resource will be usable during a given time period.[13]

Reliability: The assurance that a given system will perform its mission adequately under expected operating conditions.[14]

Interconnectivity: The property of a network that allows dissimilar devices and networks to communicate with each other. [15]

Security: The protection of data against unauthorized access, danger, harm, or risk of loss. Security also includes the assurance that users will employ available security mechanisms and procedures for protecting both the data and the systems to which they have access.[16] Tools for providing security focus on availability, nonrepudiation, confidentiality, and integrity.[17]

Unlike the PSN, the Internet was originally designed as a connectionless, "best-effort" delivery model that did not guarantee the same QoS features exemplified by the PSN.[18] However, the

[10] Cisco Systems Website: www.cisco.com/warp/public/779/ibs/solutions/icsfacts.html
[11] The President's National Security Telecommunications Advisory Committee, *Internet Report*, June 1999, p. 2-1.
[12] Telcordia Technologies, *Network Evolution and Convergence Report*, June 1999, p. 11-5.
[13] The President's National Security Advisory Committee, *Internet Report*, June 1999, p. C-1.
[14] *Ibid*., p. C-2.
[15] TechWeb Website: http://www.techweb.com/encyclopedia/defineterm?term=connectivity
[16] Terry Bernstein, *Internet Security for Business*, (New York: John Wiley and Sons, 1996).
[17] The President's National Security Advisory Committee, Electronic Intrusion Threat Report, March 1999, p.77.
[18] Telcordia Technologies, "Network Evolution and Convergence," briefing given to the Information Technology Progress Impact Task Force of the NSTAC.

Internet's transition from an experimental network to a ubiquitous, functional network and the increasing global customer demand for and reliance on new and emerging business-related Internet services, are driving the further development and exponential growth of the Internet and its QoS features. These features will enhance network reliability, robustness, and interconnectivity.[19] As a result of new protocols and standards, the Internet is fast becoming an integral component of the interconnected and interoperable global satellite, wireless, and wireline architectures being developed by leading companies. This expanding broadband communications network has the potential to far surpass the current reach of the PSN by 2010. New fiber optic and DSL access technologies are increasing available bandwidth and improving robustness of the local loop network while decreasing the amount of time it takes to access the Internet. Solutions to latency, jitter, and packet loss, common in packet networks, are addressed in current Internet Engineering Task Force (IETF) Reservation and Differentiated Service QoS models used in IPv4 and IPv6 protocols.[20]

The increasing global expansion of the Internet in both the public and private sectors leaves the new broadband networks highly vulnerable to a host of intentional and unintentional threats and fuels the demand for information assurance capabilities. The Internet is an ever expanding, globally interconnected network of networks with unrestricted access and no governing body to monitor security.[21] Instead, industry groups have emerged and taken the lead in addressing current security concerns. The IP Security Consortium and the IETF are examining solutions for authentication and privacy issues through the use of encryption and firewall technologies. In addition, the IETF's IP Security (IPSEC) Working Group has developed an end-to-end security model based on Public Key Infrastructure (PKI) technology to provide authentication and encryption for mission-critical Internet applications.[22] The ITU has also done considerable work regarding the evolving features of the Internet, as the ITU's Study Group 13 has developed an ITU-IP Project, intended to encompass all of the ITU-Telephony IP related work.

2.1.2 Internet2 and Next Generation Internet

Two specific initiatives have the goal of enhancing Internet development: Internet2 and the Next Generation Internet (NGI).

Internet2 is an industry-Government partnership involving 140 member universities working with corporate and affiliate organizations. Internet2 goals are as follow:

[19] These standards are being developed by such groups as the Internet Engineering Task Force, European Telecommunications Standards Institute, Telecommunications Internet Protocol Harmonization Over Networks, and American National Standards Institute T1S1.
[20] Cisco Systems "QoS Technologies and Call Admission Control" briefing given to the Information Technology Progress Impact Task Force of the NSTAC.
[21] Telcordia Technologies, *Network Evolution and Convergence Report*, June 1999, p. 5-18.
[22] *Ibid*., 5-19.

- enable a new generation of applications,
- recreate a leading edge research and education network capability, and
- transfer new capabilities to the global production Internet.[23]

NGI is being developed by Federal Government agencies and commercial and academic entities in the information technology (IT) industry. The NGI will be characterized by larger bandwidth and more powerful networks designed specifically to support advanced multimedia applications. Goals of this initiative are as follow:

- connect universities and national labs with high-speed networks that are 100 to 1,000 times faster than today's Internet,
- promote experimentation with the next generation of networking technologies, and
- demonstrate new applications that meet important national goals and missions.[24]

2.2 Convergence of Networks and Technology

The phenomenal growth of the Internet and the increasing deployment of high-speed fiber optic networks have spawned a movement to the convergence of traditional circuit-switched networks with packet-switched networks based on Asynchronous Transfer Mode (ATM) and IP.[25] This converging IP-based network expands on the current voice, text, and fixed-image capabilities to include real-time multimedia services emphasizing audio and video applications. Telecommunications analysts agree that the volume of data transfer will soon overtake the volume of voice transfer. In fact, some estimates by industry analysts predict that beyond the Year 2000, 80 percent of telecommunications companies' profits will be derived from data-based services.[26] Although IP-based networks allow carriers to implement and offer new communications services in a simpler and more cost-effective manner, industry experts contend packet-based networks will not completely eliminate circuit-switched technology within the next 10 years. The communications environment of 2010 will consist of both types of networks, fully integrated by distributed network intelligence.[27]

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[23] Internet2 Website: http://www.internet2.edu/html/mission.html#.
[24] Next Generation Internet Website: http://www.ngi.gov/white-house/background.html#goals.
[25] Telcordia Technologies, op cit. p. ES-2.
[26] D. Chiaroni and A. Jourdan, "Data, Voice and Multimedia Convergence over WDM: The Case for Optical Routers," Alcatel Telecommunications Review, 2nd quarter, p. 138.
[27] Telcordia Technologies, op cit. p. ES-4, ES-5.

2.3 Globalization

Historically, the industries composing the information infrastructure have either had distinct information transport capabilities, been the creators and distributors of the vast and diverse information, or manufactured computing devices and consumer electronics. The current extraordinary technological innovations, including the digitization of information and the evolution of broadband communications, have facilitated a major transformation of the information industry. As a result of this technological transformation, the convergence of information-related industries, including computer products and services, telecommunications, media and entertainment, and consumer electronics, has become a salient trend within the GII. A continuing cross-sector convergence of these industries is occurring, as is widespread consolidation within each industry. Additionally, each sector is converging to operation on and with the GII. The commercial economy and rapid pace of technology are likely to continue as the drivers of the GII as industries come together as a global information economy.

2.4 Broadband Communications Demand

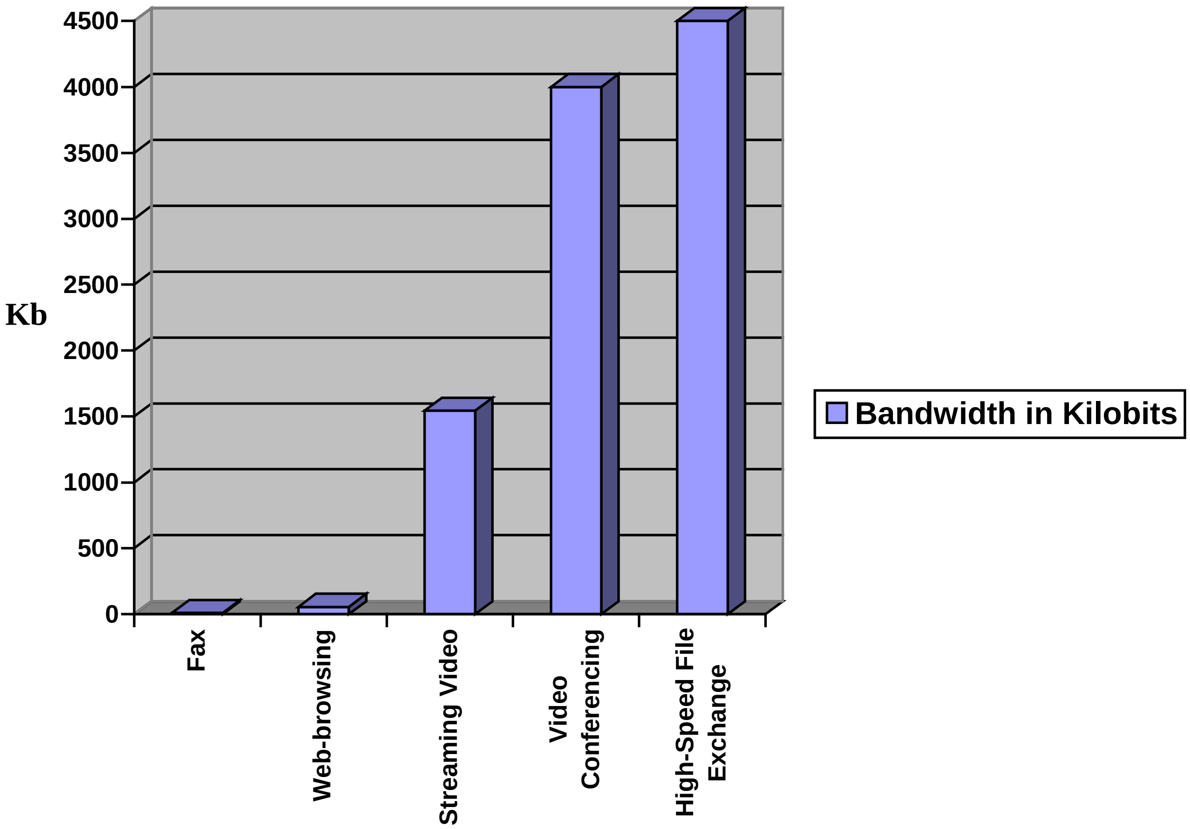
In this discussion, bandwidth refers to the transmission capacity of a communications network, expressed in bits per second, bytes per second, or in Hertz (cycles per second).[28] More specifically, broadband communications refers to the greater data traffic capabilities made possible by technologies that have increased the capacity of cable and phone lines and wireless and satellite platforms. Increases in processing power and spectrum availability, including the use of advanced applications, have driven the demand for broadband for both commercial and residential use. Additionally, public and private entity requirements for broadband capabilities to support remote users and their distributed workforces have driven the demand.

Some industry estimates state that advances in silicon, optics, and wireless technologies will increase network capacity by as much as 250-fold by the year 2005. Nonetheless, even if the demand for broadband communications and the technical capabilities to provide access to broadband communications are widespread, regulation can restrict its availability.

The following figure depicts the increasing amounts of bandwidth needed to support the mass-market applications that have been developed or are being developed to run on next generation processors. As Figure 1 indicates, early communications capabilities, such as fax, were not as bandwidth intensive as current advanced capabilities, such as streaming video or video conferencing, or high-speed file exchange.

[28] TechWeb Website: http://www.techweb.com/encyclopedia/defineterm?term=bandwidth.

Figure 1
Bandwidth Requirements of Mass-Market Applications[29]



About a million households have some form of broadband Internet access, according to research reports by the investment bank Goldman Sachs Group, Inc. The company predicts that the percentage of households with broadband will increase dramatically during the next decade, as carriers offer broadband services such as DSL, cable modems, terrestrial wireless, and satellite communications and compete for the growing residential broadband access market.[30]

2.5 Electronic Business/Electronic Governance

The rapid pace of change and growth in electronic business capabilities and the information technology industries is dramatically altering the way people connected to the GII communicate and conduct business transactions. The evolving electronic commerce and electronic

[29] David Ackerman, "The WinStar Network," briefing to the NSTAC Globalization Task Force, September 14, 1999.
[30] John Schwartz, "How Much Room in the Fat Pipe?," *The Washington Post*, September 19, 1999, p. H1.

collaboration activities that facilitate electronic business include multimedia telecommuting, research on worldwide networks, global sourcing and procurement, large-scale development and sharing of databases, new training and education capabilities, and many alliances or networks of companies.[31] Electronic business networks enable a wide variety of international transactions, including consumer credit card purchases, bill payments, customs duty collections, and just-in-time inventory management. As a result, even traditional retail business is likely to be overshadowed by advances in electronic business. The value of electronic business transactions, while still small relative to the size of the overall global economy, continues to grow at a remarkable rate and plays a major role in development of the GII.[32]

Recent market trends toward globalization, increased consumer mobility and choice, increased velocity, and advancements in technology have also required enterprises to implement interenterprise electronic capabilities that operate within communities of business. Such electronic business capabilities are a necessity for companies seeking to develop and maintain their market positions.[33] The exponentially increasing volume and importance of B2B e-commerce conducted over today's broadband networks are driving the development of essential packet network QoS and security features necessary to the growth and success of future business. Enterprises cannot afford downtime, delay, or discontinuity in service if they intend to increase revenue and maintain excellent standards of service and loyal customers. Industry experts predict that by 2010, the importance of B2B commerce and electronic business in general will mandate exceptionally high QoS and security capabilities in packet networks. These features will preclude the need to implement additional QoS and security measures, even to facilitate and guarantee NS/EP services. Industry experts also predict that service level agreements (SLA) will define network QoS, as users will determine the level of QoS they require for their communications needs. The business case for secure and reliable networks has been singularly responsible for improvements in QoS capabilities and network security that are available to the public and private sectors.

2.6 Economics of Microchip Technology

The computer, telecommunications and Internet revolutions, and subsequently the demand for bandwidth, can be characterized by the technical anomaly known as Moore's Law. Moore's Law states that while most technological innovations have grown more expensive and larger as they have increased in power and complexity, machines based on semiconductor circuitry are becoming significantly less expensive and smaller.[34] The economic advantages of employing microchip technology include the ability to utilize more processing power and conduct electronic

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[31] IBM White Paper, "Living in the Information Society."
[32] U.S. Department of Commerce, *The Emerging Digital Economy II*. June 1999.
[33] SAIC Website: www.saic.com.
[34] Howard Rheingold, "Pro & Con: The Underside of Moore's Law," (online): www.intellectualcapital.com, May 20, 1999.

transactions more efficiently at a lower cost. Over the last two decades, the cost of computing processing power has dropped tremendously worldwide. Processor power costs less than 1/3,330 than it did in 1971; computer memory (Read Access Memory [RAM]) is about 1/4,000,000 the cost.[35] The efficiencies realized through microchip use have fueled the demand for new technologies, revolutionized communications capabilities, and facilitated the expansion of the GII. Most technology experts expect Moore's Law and the pace of microchip technology change to be sustained for at least another 10 to 20 years. For example, high-performance atomic-scale transistors are being developed to deliver more processing power at higher speeds and lower costs. [36]

[35] Pennsylvania State University Institute for Information Policy, op cit.
[36] Bob Martin, Lucent Technologies, "Global Communications R/EvoLUtion" presentation to the NSTAC Globalization Task Force, January 13, 2000.

3.0 GII COMPONENTS

The GII is generally understood to mean a "network of networks"— a worldwide network of local, national, regional, and international networks. In 2010, the GII will provide the bandwidth needed for commercial and Government services through the seamless interconnection of wireline, wireless, and satellite communications systems.

3.1 Wireline

The forces of competition have driven the Nation's telecommunication system to new levels of service, and industry will continue to deploy new technologies to provide these services. The telecommunications industry has coined the NGN to describe the integration of traditional telephony and Internet services. This NGN will be based on TCP/IP protocols and employ more fiber optics in the transport mechanisms.[37] Although the companion NSTAC Convergence Report provides further detail on the NGN,[38] several briefings to the GTF also provided insight into the wireline technologies that will deliver services in the more distant future. These technologies include fiber optic, submarine, and coaxial cable; copper wire; and microwave transmissions.

3.1.1 Domestic Fiber Optics

In 2010, networks will provide orders of magnitude more bandwidth, greatly enhanced reliability, and expanded services. According to a briefing received by the GTF, the future network will show—

- explosive growth in core network bandwidth,
- unified networking based on packet technology,
- networking infrastructure based on optics,
- broadband access support over xDSL, cable, wireless and fiber,
- distributed switching and service platforms, and
- applications provided on a networked basis – "The network is the computer."[39]

The core network in 2010 will be based on fiber optics and will use multi-wavelength technology to maximize the capacity of the fiber networks. Optical fibers are thin strands of glass that transmit light signals. These light pulses are capable of transmitting simultaneous voice, data, and video at speeds to 100 Gigabits per second (Gbps).[40] Although fiber has historically been

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[37] For more detail, please refer to NSTAC's Information Technology Progress Impact Task Force's *Convergence Report*, May 2000.
[38] *Ibid*.
[39] Mark Klerer, Nortel Networks, "Networking in the 3rd Millennium," briefing to the NSTAC Information Technology Progress Impact Task Force and Globalization Task Force, February 25, 2000.
[40] Lucent Technologies Website: http://www.lucent.com/press/1097/971016.nsa.html.

used to increase the backbone capacity of network service providers, it is also increasingly being found throughout the world in public and private communication networks, on campuses, within buildings and even on desktops for applications such as interactive media.[41]

Although fiber optic technology is costly to install, wavelength division multiplexing (WDM) technology is turning fiber optics into a cost-effective option for telecommunications companies to maximize the amount of bandwidth available to customers for a wide variety of services. WDM and dense wavelength division multiplexing (DWDM) allow previously installed fiber optic cables to carry trillions of bits of information without the need to lay new cable or upgrade existing infrastructure.[42] These technologies multiplex separate wavelengths of data into a lightstream transmitted on a single optical fiber.[43] DWDM can merge at least 32 wavelengths over a single fiber. Industry analysts predict that by 2010, DWDM technology will advance to such a degree that one fiber will be able to carry more than 1,000 wavelengths.[44] Figure 2 graphs the improved loss performance that will be provided by new AllWave fiber.[45]

Furthermore, solid state technology advances will yield new optical amplifiers, such as Raman amplifiers, that will operate over a wider bandwidth, minimize the need for regenerators and intermediate sites between locations, and produce a flat response across the operating spectrum.[46] Selective optical filters and combiners will enable an optical switching function, resulting in a flexible, very high-performance network and drive the costs per port down.

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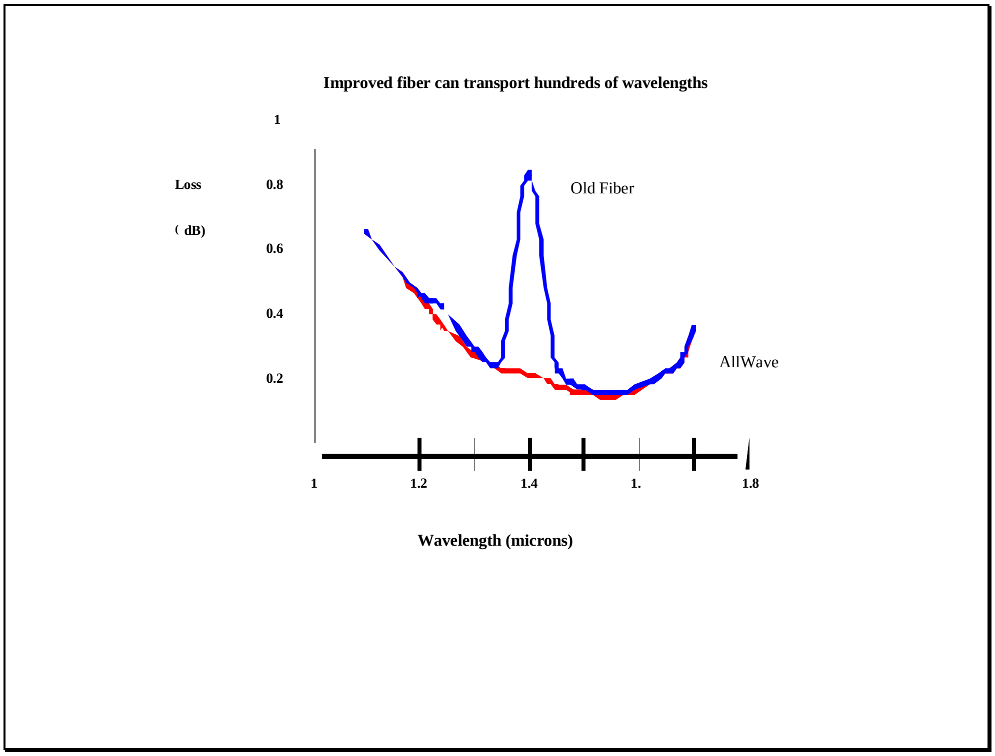
[41] *Ibid*.
[42] Telecommunications Industry Association, "Carriers Turn to DWDM for Enhancing Fiber Optic Networks," *PulseOnline*, (online): http://www.tiaonline.org/pubs/pulse/1999/pulse0599-2.cfm.
[43] *Ibid*.
[44] Alan Schaevitz, AYS Associates, "Developments in Broadband Networking," briefing presented at the Next Generation Networks Conference, Washington, DC, November 1, 1999.
[45] Bob Martin, op cit.
[46] *Ibid*.

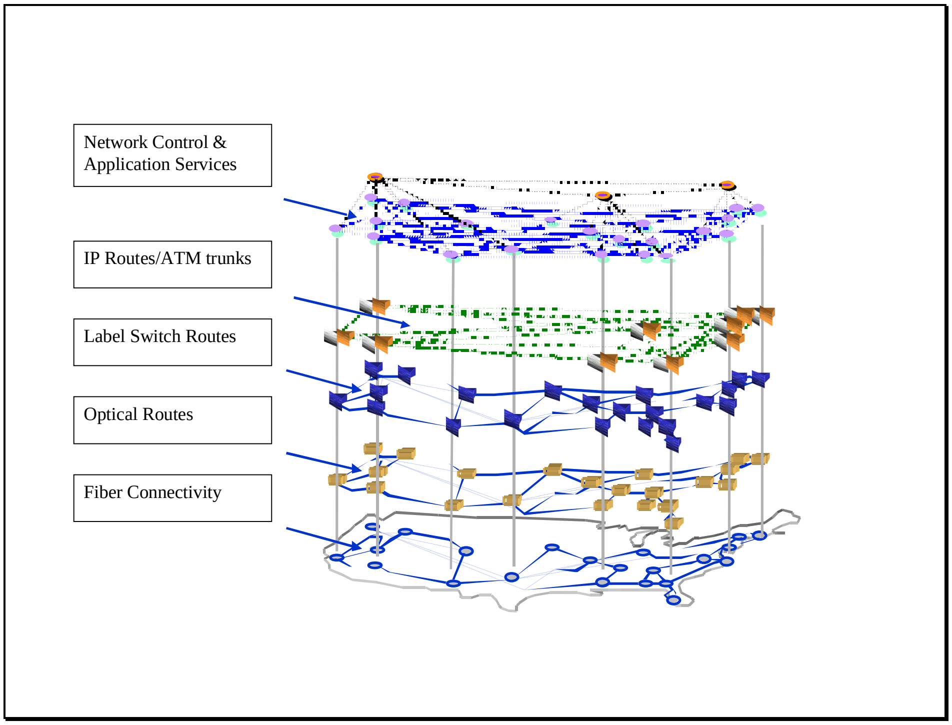
Figure 2
Low-Cost, Flexible Optical Transport



These technological advances will lead to an all-optical core network, with the conversion to electrical signals moving closer to the network's edge. Figure 3 describes the layers of the evolving full service network and the fiber connectivity and optical "trunk" routes at the lowest levels.[47]

[47] Mark Klerer, op cit.

Figure 3
Optical Full-Service Network



The network control and application services will reside at the uppermost network layer. Layers three and four carry the switching and message routing. Section 4.0 of this document considers the implication of protocols.

3.1.2 International Fiber Optics

International communications connectivity has increased considerably in recent history. In 1999 alone, enough undersea cable was installed to encircle the globe about five times.[48] Since the installation of the first transatlantic fiber optic cable, TAT8, in 1988, the recent accelerated growth of fiber optic submarine cable systems and the transport capacity cable systems provide can be attributed to Internet-fueled broadband demand, technological innovation, favorable political and regulatory environments, and the changing nature of telecommunications business. These trends are expected to continue.

[48] Charles W. Petit, "Spaghetti Under the Sea," *U.S. News and World Report*, August 30, 1999.

3.1.2.1 Worldwide Investment and Projected Demand

Investment over the first decade of commercial deployment of submarine fiber optic deployment totaled about $15 billion. [49] The cumulative worldwide investment between 1999 and 2004 is projected to total $31 billion, or about twice as much as that of the preceding decade.[50]

Although investment in fiber optic systems indicates the growth of international cable transport capabilities, it is important to note that capacity grows at a higher rate than investment due to the utilization of advanced technology. Thus, the dollar amounts invested in transoceanic cable systems translate into an even greater amount of transmission capability due to the enabling technologies that permit the efficient use of bandwidth.

3.1.2.2 Enabling Technologies

Evolutionary innovations in fiber optic technology have enabled the growth of international cable as a communications capability. Improved fiber optic production techniques have resulted in less expensive, higher capacity cables. Industry experts anticipate the introduction of 10 Gbps transmission capabilities in both submarine and terrestrial systems, thus facilitating global seamless networks. WDM and dense WDM are conducted over the same cable, substantially increasing cable capacity and requiring fewer repeaters on long transoceanic systems. The foregoing improvements have enabled the deployment of high-capacity cable systems with self-healing capabilities, through route diversity and various ring configurations on major transoceanic routes and regions.

3.1.2.3 Commercial Arrangements

Liberalization and privatization have led to new commercial arrangements resulting in an increase in new submarine fiber optic cables. A shift has occurred from ownership of systems by international common carrier consortia and common carrier consortia to non-common carrier systems owned by privately financed companies or major cable suppliers operating either as carriers' carriers or private systems.[51] The changing ownership of submarine fiber optic cables results from liberalization in the regulation of telecommunications facilities and services, privatization, and the continuing demands for broadband services.

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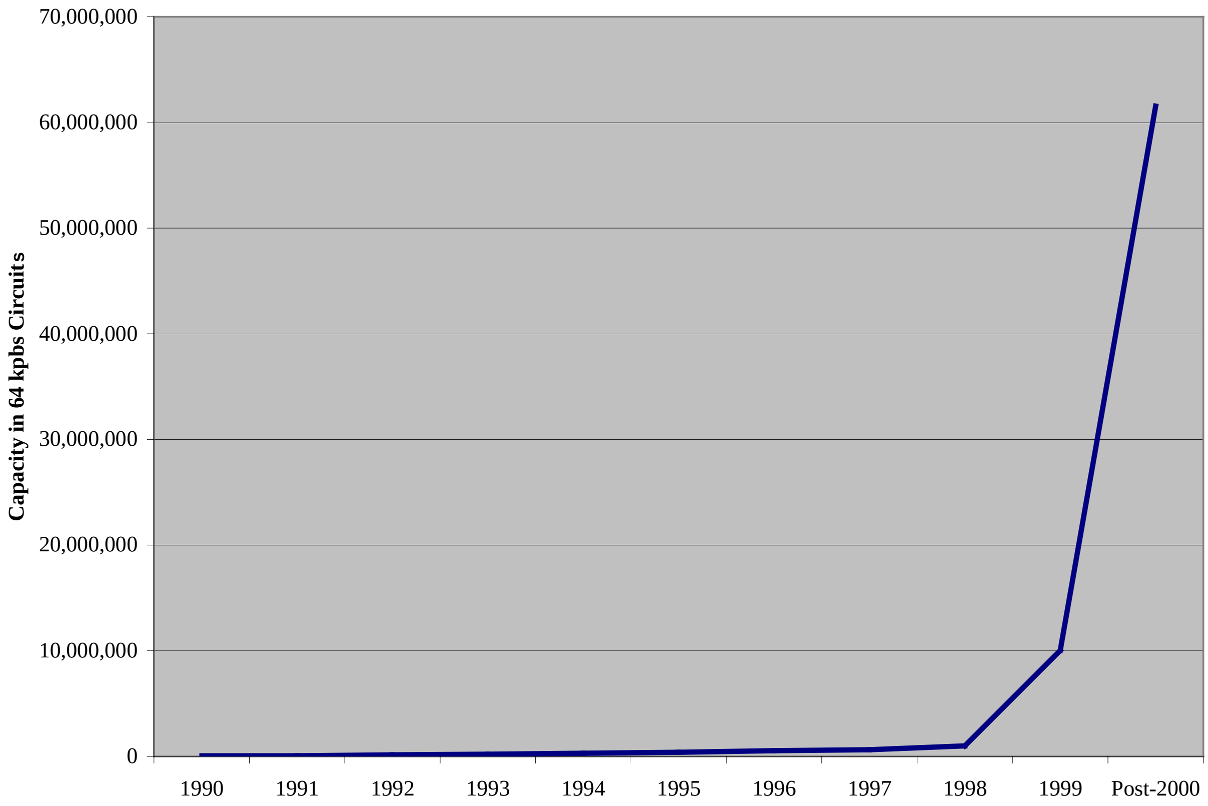
[49] Pioneer Consulting, LLC, *1999 Worldwide Submarine Fiber Optic Systems Report*, p 5.
[50] *Ibid.*
[51] Whether these newer systems should be referred to as private systems or non-common carrier systems was a major topic of discussion among cable owners at a recent FCC meeting. *Transcript of the FCC's "Under-sea Cable Public Forum," November 8, 1999.

3.1.2.4 U.S.-Transoceanic Fiber Optic Cables

A dramatic example of the expansion in transoceanic fiber optic capabilities is the growth of U.S.-Europe, U.S.-transPacific, and more recently, U.S.-Latin American transoceanic fiber optic capabilities. Figure 4 charts the combined growth of existing and planned fiber optic cable capacity in the three transoceanic regions that adjoin the United States.[52]

Figure 4
United States Connected Transoceanic Cable Systems



Although the information presented in this graph is U.S.-centric, the aforementioned factors are expected to drive growth in other geographic areas.

3.1.2.5 Regional and Global Transoceanic Cable Systems

Transoceanic fiber optic cable systems and transmission capacity are also expected to experience dramatic growth in global systems and systems not connected to the United States. A number of

[52] From the *FCC International Bureau Report: 1998,* Section 43.82 "Circuit Status Data," December 1999.

factors, however, must be considered before attempting to predict the future deployment of submarine fiber optic cable beyond 5 years. These variables include liberalization and deregulation, which are creating both uncertainty and opportunity; industry restructuring and consolidation; planned links to less stable developing countries; the demand for bandwidth; network convergence; and the effects of non-common carrier ownership of cables.

3.1.2.5.1 The Indian Ocean

Efforts to close the fiber optic gap between the Pacific region and Atlantic Ocean region countries have led to the competitive deployment of two systems: Southeast Asia-Middle East-Western Europe (SEA-ME-WE 3) and Fiber Link Around the Globe (FLAG).

SEA-ME-WE 3 is international common carrier-owned, including many Government-owned telecommunications organizations, and links about 30 countries. SEA-ME-WE 3 is a US $1.5 billion, 38,000 kilometer (km) long system made of three segments: Europe-Singapore, Singapore-Australia, and Singapore-Japan. This system represents the largest international Synchronous Digital Hierarchy (SDH) network in the world and operates using WDM at 8 x 2.5 Gbps over two fiber pairs, allowing a total trunk capacity of 40 Gbps.[53]

FLAG describes itself as a company, not a consortium, with 16 landing points in 13 countries: Japan, South Korea, China (including Hong Kong), Thailand, Malaysia, India, United Arab Emirates, Saudi Arabia, Jordan, Egypt, Italy, Spain and the United Kingdom. The system has over 28,000 kms of cable, 120,000 digital circuits operating at 64 Kbps, two fiber pairs— each operating at 5 Gbps— and SDH compatibility.[54]

3.1.2.5.2 Global Networks

The most recent phenomenon has been the emergence of three proposed global systems: Project OXYGEN, the TyCom Global Network, and Global Crossing.

Project OXYGEN was conceived in 1997 as a global super-Internet system. This worldwide network system, which is planned to enter into service in 2001, will interconnect six continents. The project is eventually planned to link an ambitious 265 points in 171 countries, but Phase I of the project is limited to 78 countries worldwide. The planned capacity of 160 Gbps is to be leased on demand. This system will be financed by carriers purchasing capacity and private lenders and investors providing equity. Planned U.S. landing points are in Oregon, California (2), New Jersey, Massachusetts, Florida, Guam, Hawaii, Puerto Rico, and the Midway Islands.[55]

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[53] General Offshore Website: http://www.generaloffshore.com/news/SBSS.htm.
[54] FLAG Telecom Website: http://www.flag.bm/technology.htm
[55] Project Oxygen Website: www.projectoxygen.com.

The TyCom Global Network is being projected by Tyco International, the first fiber cable supplier to announce plans for a global fiber optic network. The project will be funded, in part, through a public stock offering. A trans-Atlantic section is planned for 2001, followed by trans-Pacific and European sections in 2002. With a planned capacity of 2.56 Tera-Bits Per Second (Tbps), the system is planned to connect 25 cities worldwide. Planned U.S. landing points are: Hawaii, California, New York, Seattle, and Guam.[56]

The privately owned Global Crossing network is designed as an almost global submarine cable/ terrestrial network composed of the following systems: North American Crossing, Atlantic Crossing, Pacific Crossing, Pan European Crossing, Mid-Atlantic Crossing, Pan American Crossing, South American Crossing, and East Asia Crossing. Each of the systems features self-healing ring structures, erbium-doped fiber amplifier repeaters, wavelength division multiplexing, and varied high-bandwidth transmission capacities.[57]

3.1.3 Copper Wire and Coaxial Cable

In the distant past, long-distance telecommunications traffic was carried over large-gage copper wire pairs. Later, large-gage multipair copper wire was used. More recently, coaxial cable, microwave systems, satellite systems, and, finally, fiber optic technology were employed to carry these increased traffic loads.[58] Similarly, as communications systems designed to carry interoffice traffic were deployed, fiber optics were used instead of large-pair-count copper cables.[59] Fiber also became widespread in the feeder part of the subscriber loop, to accommodate large, bursty traffic loads. Although high-capacity fiber optic transmission capabilities have become the norm for telephone company backbone networks and the transmission of broadband traffic between telephone company offices, the local loop access network, which connects the end users to the fiber-optic backbone network, is most commonly composed of copper wire.

Because of the predominance of embedded copper in the present last mile in the network, it is unlikely that emerging wireless and fiber-based technologies will take over the distribution part of the access loop in the near future.[60] Even though the business and residential demand for broadband multimedia applications continues to grow, many industry experts predict that the majority of voice calls and data packets will flow over copper loops for the next 20 years.[61] Practically every home and office has access to copper loops. In addition, DSL technology has made it possible to maximize the use of bandwidth on these loops and operate a telephone and personal computer without installing a second line. Lastly, the traditional telephone loop has the

[56] Tyco International Website: http://www.tyco.com.
[57] Global Crossing Website: http://www.globalcrossing.com/index.asp.
[58] William T. Black, "Telecommunications Issues for Copper Wire and Cable," paper presented at Wire and Cable Focus 1998, September 15, 1998.
[59] *Ibid*.
[60] *Ibid*.
[61] Dr. Jerry Lucas, "Year 2020 Predictions and Beyond," *Billing World*, January 7, 2000.

ability to receive power simply and efficiently over copper wire, whereas fiber optics require an auxiliary power supply.

3.1.3.1 DSL Technology

The several versions of DSL technology in use are known collectively as xDSL. Industry experts predict that wider deployment and more consumer-friendly pricing options will make xDSL more widely accepted in the next few years.[62] DSL encodes a stream of digital data to maximize the use of the available bandwidth and continuously monitors the quality of transmission, detecting and correcting transmission errors. The different versions of xDSL (asymmetric DSL, high-bit-rate DSL, rate-adaptive DSL, and very-high-bit-rate) provide varied bandwidths, generally as high as twice the transmission speed of Integrated Services Digital Network (ISDN) lines.

3.1.3.2 Coaxial Cable

Currently, coaxial cable appears to be the main competitor with DSL technology to provide residences and small businesses with a broadband, last-mile access solution. Cable television operators are upgrading and rebuilding their systems with hybrid fiber-coax (HFC) networks, lasers, amplifiers, and other transmission enhancements to deliver simultaneous analog and digital television and broadband communications.

HFC cable technology is less expensive than full fiber-to-the-curb (FTTC) solutions and offers the increased bandwidth needed for video, digital telephone, dedicated data transport, and high-speed Internet access. One advantage of coaxial cable is its ubiquity and existing connection to the home. More than 66 million households in the United States currently receive cable television service.[63] Other attributes of HFC include its flexibility, reliability, and the ability to upgrade HFC cable networks from one-way to two-way transmission.

3.1.3.3 Premises Wiring

Premises wiring consists mostly of copper twisted-pair wires connecting personal computers with local area networks (LAN). In 2010, new structures will be provided with broadband communications. Buildings will have wideband copper plant installed using high-quality wire and Ethernet protocol or have widely available wireless capabilities for mobile communications. Copper wire has shown considerable growth over the past decade as enterprises have moved away from mainframe computing to connected personal computers (PC), typically in a star pattern using Ethernet protocol.[64] Applications such as data warehousing, network backup, videoconferencing, and high-traffic Internet sites are placing a heavy load on LAN backbones. Ethernet remains a favorite among network administrators to handle such high-traffic, because it

[62] The Yankee Group, *Cable Modems and DSL: High-Speed Growth for High Speed-Access*, January 28, 2000.
[63] AT&T Website: www.att.com.
[64] Black, op cit.

is inexpensive and easy to use.[65] Although HFC is not expected to be as prevalent, some enterprises are likely to employ HFC cable technology for their premises' wiring needs. Residences may also emerge as a potential market for premises wiring, with a number of prominent companies currently developing residential programs. For home data wiring, builders and contractors will connect various rooms in a home by installing twisted-pair wires linking to a central distribution device.[66]

3.1.4 Microwave Transmissions

Microwave transmissions occur in the upper range of the radio spectrum used mostly for point-to-point communications systems, including common carrier, private operational, and broadcast auxiliary radio services. Initially, these systems were designed to carry voice traffic over common carrier and military communications networks. However, modern microwave systems are deployed in dense urban networks and in remote rural connections to accommodate bandwidth-intensive digital transmissions such as voice, data, facsimile, and video.

3.1.4.1 Evolution of Microwave Technology

Although early technology limited the operations of microwave systems to radio spectrum in the 1 gigahertz (GHz) range, technology enhancements have enabled commercial microwave systems to transmit in the 40 GHz region.[67] Point-to-point microwave facilities became valuable components of the Nation's PSN, but for long-haul transmissions, fiber optics are currently more commonly used. Microwave systems and radio frequency (RF) technology can function as the major trunk channel for long distance communication, enabling wireless systems to operate in less-populated areas and provide a cost-effective last-mile solution for regions where terrain prevents the installation of other transmission capabilities. A near-term market also exists for short-haul, encrypted, urban microwave communications. By utilizing spectrum above 40 GHz in microwave systems, a variety of communications possibilities become available, such as short-range, high-capacity wireless systems that support educational and medical applications, wireless access to libraries, or other information databases.[68] It is also possible for emergency operations to set up temporary microwave point-to-point communications quickly and efficiently.

3.1.5 Wireline Conclusions

The core network of 2010 will be composed of fiber optic technology. Advances in wavelength multiplexing will exponentially increase the capacity of fiber optic cables, both domestic and transoceanic, while also decreasing the cost of implementing the new technology. This new full

[65] William Wong, "Quest for Copper Wire Standard Continues," *PC Week*, July 24, 1998.
[66] Black, op cit.
[67] FCC Website: www.fcc.gov.
[68] *Ibid*.

service optical network will have a layered network architecture with the conversion of electrical signals taking place closer to the network's edge.

The economic and operational benefits of fiber optic systems, including lower user costs and increasing QoS capabilities, are apparent. Based on projected system capabilities and industry's ability to respond to market demand in a timely manner, adequate wireline capacity is expected to be available to meet most global telecommunications requirements worldwide. However, while fiber optic cables will continue to increase in number and location, they will not be entirely ubiquitous. Communications contingency planning should consider the complementary operational capabilities of submarine fiber optic cables and other capabilities such as communications satellites. In areas where geography hinders the use of newer technologies, microwave systems may also be used as part of the transport network.

By 2010, a variety of technologies, including xDSL and coaxial cable, will be in place as the last-mile delivery options for commercial and residential use, provided that consumer demand is present. For the next 10 to 20 years, copper loops will likely remain the dominant component of the access loop and a more viable option for connectivity to the backbone than fiber optics. Much of copper's continued viability will be attributable to the ubiquity and low cost of copper wire. Nevertheless, the transmission capabilities and efficiencies of xDSL may be equally important in enabling copper wire to resist penetration by fiber optics or coaxial cable in the access loop. In premises wiring, copper will remain the primary transport medium within commercial LANs, but there is the potential for this market to be eroded somewhat by fiber optic capabilities.

Although these technologies will continue to increase globally in number and location, they will not be entirely ubiquitous. Communication contingency planning should consider the complementary capabilities of the various communications systems in meeting global coverage goals. For example, in advanced nations, buildings designed to 2010 specifications will be fully wired to provide the latest broadband capabilities. In developing countries, wireless technologies will be employed in nations where fixed broadband capabilities are not in place.

3.2 Wireless

Wireless communications is poised on the brink of a revolution.[69] The technology will become a significant substitute for wireline connectivity in developing countries, where wireless communications are a more cost-effective prime telecommunications infrastructure building block than wireline. Wireless technology will also function as a driver of data services growth in developed countries. At 400 million subscribers worldwide, a number that is expected to exceed 1 billion by 2005, wireless more than doubles the penetration of the world's 180 million PCs and

[69] "The World in Your Pocket, a Survey of Telecommunications," *The Economist*, October 9, 1999.

global wireless subscribership and increases by 300,000 users daily.[70] The Gartner Group estimates that by 2004, at least 40 percent of business-to-customer e-commerce transactions outside North America will be initiated from wireless devices.[71]

Mergers and acquisitions transpiring among communications companies around the world generally fall into two categories: (1) deals involving similar companies (i.e., cell service providers) seeking to plug gaps in their coverage footprints, to cut costs and related equipment purchases; and (2) deals involving complementary companies (long distance and local/wireless service providers) looking to increase revenue by bundling services, selling them to a larger customer base, and creating new service offerings.[72]

Reasons for this major growth industry include the increased mobility of the current workforce; the Internet-fueled customer demand for wireless access to the applications offered via wireline (including e-mail, calendars, fax, access to corporate databases and the Internet); the lower cost of the wireless infrastructure as compared with burying cable; and the growing demand for mobile e-services.

3.2.1 Cellular/PCS

A multitude of digital cellular technologies exist for wireless communications, collectively referred to as PCS, which offers varied coverage and capacities.

Like its wireline predecessor, wireless communications began in a basic circuit-switched environment designed more than 100 years ago. The cellular concept originated at Bell Labs in 1947. The first automatic analog cellular system started operation in Japan in 1979 and in the Nordic countries in 1981. The first commercial analog cellular or Advanced Mobile Phone Service (AMPS) wireless cellular system in the United States began service in October 1983 in Chicago. Analog cellular service operates on the 800 Megahertz (MHz) frequency band and is based on Frequency Division Multiple Access (FDMA).[73]

Although North and South America analog cellular systems conform to the AMPS standard, in the remainder of the world, several types of analog cellular exist. In Europe and Asia, these include Total Access Communications System (TACS), Nordic Mobile Telephone (NMT), Cnet, and MATS-E. Analog technology is considered to have been the first generation (1G) of cellular technologies.[74] By definition, analog cellular technology is not included as a PCS technology

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[70] *Ibid*.
[71] Brad Smith,"Behold the Wireless Internet," *Wireless Week* 5, Number 50, December 13, 1999, p. 20.
[72] Michael J. Riezenman, "Communications," IEEE Spectrum, January 2000, p. 33.
[73] Judy Beck, "A Brief History of PCS (Digital Cellular) Technology Development in the United States," (online): www.pcsdata.com/history, April 1998.
[74] *Ibid*.

because PCS refers only to digital technologies, which were specifically designed to provide improvements over analog. [75]

Analog cellular is inherently less efficient than digital for transmitting data. The analog cellular system has the widest coverage of any system, with service available in almost any city or town, and on most major highways in the United States. Because of its broad coverage, analog cellular will remain the only wireless data option in rural areas for some time to come.[76]

Within a few years after analog cellular systems were introduced, it became apparent that higher capacity, more reliable, and lower cost wireless systems were needed to meet the booming demand and projected saturated capacity.[77] There were only three ways to expand: move to new spectrum bands, split existing cells into smaller cells, or introduce new technology. No new spectrum was available, and splitting cells required expensive additional infrastructure, so new technology appeared the best route. [78]

After many proposals and much debate between proponents of Time Division Multiple Access (TDMA) and FDMA— technologies evolved from the original AMPS— a hybrid of the technologies, TDMA Interim Standard 54, was introduced in 1991. Newer, more comprehensive standards, called second generation (2G) PCS technologies, have been developed since then. In 1994 the Federal Communications Commission (FCC) announced that it was allocating spectrum specifically for PCS technologies at the 1900 MHz band; the following year, network operators deployed cellular service in each of the PCS technologies at the 1900 MHz frequency band.[79] Table 1[80] lists the current technologies:

Table 1
Current PCS Technologies

Technology	Classification	Frequency Band
AMPS Analog or FDMA	Analog Cellular	800 MHz
CDMA (IS-95)	Digital Cellular or PCS	800 MHz or 1900 MHz
TDMA (IS-136) or Digital-AMPS or D-AMPS or NA-TDMA	Digital Cellular or PCS	800 MHz or 1900 MHz
GSM 1900 (e.g., PCS-1900 or DCS-1900)	PCS	1900 MHz only

[75] "The Different PCS Technologies," www.pcsdata.com/PCSTechs.htm.
[76] Beck, op. cit.
[77] *Ibid*.
[78] *Ibid*.
[79] *Ibid*.
[80] *Ibid*.

TDMA increases capacity by dividing frequency bands into time slots, with each user having access to one time slot at regular intervals. Code Division Multiple Access (CDMA) is a particular form of spread spectrum where users are assigned digital codes within the same broad spectrum to yield increases in efficiency, capacity, and privacy. GSM (Global System for Mobile Communications) was developed in Europe and is based on narrowband TDMA technology. Of the PCS technologies, GSM networks are the only ones that provide data services such as fax, Internet access, and e-mail in the United States. GSM is also the only technology that permits automatic roaming among North American, European and Asian countries.[81]

Present wireless data capabilities are limited to low bandwidth services and considered insufficient for mobile multimedia. Perceived and forecasted customer demand focuses on the following features[82]:

- **capacity—** in networks,
- **convergence—** in voice and data communications,
- **content—** in information services,
- **commonality—** in handsets and networks,
- **consistency—** in handset, services, and network operations, and
- **coverage—** in the home, office, car, and around the world.

In 1999 the agreement between Ericsson of Sweden and Qualcom of the United States settled a long-standing patent dispute on third generation (3G) cellular systems and opened the door for a new global standard based on Qualcom CDMA technology.[83] The ITU is the United Nations-related standards body that controls the destiny of 3G, which it calls IMT-2000. The ITU has recommended a single 3G standard, which really refers to multiple radio technologies that are incompatible.[84] Formal approval is expected in May 2000 at the ITU Radiocommunication Assembly.

The ITU's standards are divided among CDMA, TDMA, and frequency modulation technologies. Each industry proponent of these technologies is plotting an iterative path to take it to 3G— an IP protocol-based packet service with standard of data speeds of: 144 Kbps at driving speeds, 384 Kbps for outside stationary use or walking speeds, and 2 Mbps indoors.[85] In the meantime, so-called 2.5G systems will be in commercial use by 2001 or 2002. Generally, 2.5G

[81] *Ibid*.
[82] Jerry Kaufman, "Introduction - Analysis of Customer Demand and Requirements for Mobile Internet and Third Generation Wireless Products and Services," 2000 Alexander Resources, (online): www.alexanderresources.com.
[83] Linda Geppert and William Sweet, "Technology 2000 Analysis and Forecast," *IEEE Spectrum*, January 2000, p. 28.
[84] Sally Ruth Bourrie, "Slouching Toward the Next Generation," *Wireless Week*, Vol. 5, No. 50, December 13, 1999, p. 14.
[85] Peter Rysavy, "The Evolution of Cellular Data: The Road to 3G," *GSM Data Knowledge Site*, (online): www.gsmdata.com.

technologies have been developed for 3G networks, but they are applied incrementally to existing networks. This approach allows carriers to offer high-speed data and increased voice capacity at lower costs than deploying new 3G networks and within existing 2.5G frequency spectrum.[86] General packet radio service (GPRS) is generally considered the 2.5G step, and is being tested extensively with a data rate of about 115 Kbps and is expected to be available by 2002.

Looking at the emerging wireless technologies, the following forecasts can be made regarding the rapid growth of PCS in the mobile market:

- The demand for universal ubiquitous connectivity will fuel internetworking between different wireless networks with different technologies while also driving integration with the fixed IP backbone networks, permitting seamless roaming and coverage.
- Applications will create the demand that drives the mobile market. Current applications to allow fixed networks to link to corporate data will be extended to the mobile environment.
- IP will increasingly be used for voice communications. As a result, delivery of IP-based voice to cell phones will be critical.
- As e-commerce becomes more prevalent, mobile customers will demand robust security protocols.

3.2.2 Wireless/Mobile Data

The development of wireless or mobile data service is a continuation of developments in the PCS area. The Internet has had an extraordinary impact on how humans live and work. It has driven expectations and demands for information and service. With the Internet continuing to influence an increasing portion of daily life and with ever more of the work being performed away from the office, it is inevitable that the demand for wireless data will intensify. Already, significant public demand exists for wireless Internet capabilities and immediate access to institutional data.

In 1999 the primary cellular-based data services were Cellular Digital Packet Data (CDPD), circuit-switched data services for GSM networks, and circuit-switched data service from CDMA networks. Another wireless option included connecting a PC card modem to an analog cellular phone. Each of the aforementioned services offers speeds in the 9.6 to 14.4 Kbps range, because cellular provided data is currently allocated the same radio bandwidth as a voice call.[87] CDPD networks are based on open IP standards, overlay existing cellular networks, and allow not only packet-switched data services but also circuit-switched voice and data.

[86] *Ibid*.
[87] *Ibid*.

The cellular industry currently delivers data services in two basic ways. The first capability is provided through wireless modems supplied either in a PC card format or via a cellular phone with a cable connection to a computer. The other approach involves smart cellular phones that include microbrowsers. Both approaches can provide access to the Internet and corporate systems, including e-mail, databases, and host-based systems. [88]

The next generation rollout of cellular data services will be those associated with 2.5G identified above. As noted previously, the 2.5G technologies have been developed for 3G networks; but they will be applied incrementally to existing networks using available spectrum. The 3G standard data rates were identified in section 3.2.1. Noteworthy is that the outdoor standard is an IP protocol-based packet service operating at 384 Kbps.[89] This service will enable the virtual office concept— the wireless extension of the office and Internet to any location. The technology that will provide 3G service is the same technology that will provide 2.5G service beginning in 2000 or 2001, although at slightly lower data rates (in the 50 to 150 Kbps range).[90] The 3G service is expected to be deployed starting in 2003. Both 2.5G and 3G will enable wireless multimedia applications such as video conferencing. Table 2 lists the service, data capabilities, and expected deployment of the three major cellular data technologies.

[88] *Ibid*.
[89] *Ibid*.
[90] *Ibid*.

Table 2
Summary of Forthcoming Cellular Data Services
(Times estimated by Rysavy Research [91])

Core Technology	Service	Data Capability	Expected deployment
GSM	Circuit-switched data based on the standard GSM 07.07	9.6 Kbps or 14.4 Kbps	Available worldwide now
	High-speed circuit-Switched data (HSCSD)	28.8 to 56 Kbps service likely	Limited deployment 1999 and 2000 because many carriers will wait for GPRS
	General Packet Radio Service	IP and X.25 communications	Trial deployments in 2001, rollout of service in 2002
	Enhanced Data Rates for GSM Evolution (EDGE)	IP Communications to 384 Kbps. Roaming with IS-136 networks possible	Trial deployment in 2001, rollout of service in 2002
	Wideband CDMA (WCDMA)	Similar to EDGE but adds 2 Mbps indoor capability. Increased capacity for voice.	Initial deployment in 2002 or 2003
IS - 136	Circuit-switched data based on the standard IS-135	9.6 Kbps	Not expected on a widespread basis because key carriers already offer CDPD
	EDGE	IP communications to 384 Kbps. Roaming with GSM networks Possible	Initial deployment 2002 or 2003
	WCDMA or Wideband TDMA (WTDMA)	Similar to EDGE but adds 2 Mbps indoor capability	No stated deployment plans
CDMA	Circuit-switched data based on the standard IS-707	9.6 Kbps or 14.4 Kbps	Available now from some Carriers
	IS-95B	IP communications to 64 Kbps	Expected in Japanese markets By early 2000
	CDMA2000 - 1XRTT	IP communications to 144 Kbps	Trial deployment in 2001, rollout Of service 2002
	CDMA2000 - 3XRTT	IP communications to 384 Kbps outdoors and 2 Mbps indoors	Initial deployment in 2002 or 2003

[91] *Ibid.*

As noted above, cellular data capabilities in 2010 involve the employment of 3G technology, fueled by the unrelenting demand for applications in a mobile and wireless environment. The capability will exist, but whether a business case for implementation will exist is unknown. It appears that 3G systems will first be implemented outside of the United States because significant spectrum limitations constrain wireless broadband capabilities in the United States.

In addition to 3G technology, the next logical wireless capability is to merge wireless and mobile communications with mobile computing. The result of current initiatives in this area is the industry collaboration to establish a technology code-named "Bluetooth." Bluetooth involves building a single common radio into every mobile computer. The low-power radio module can be built into mobile computers, mobile phones, printers, fax machines, and network connection points. Although designed to primarily facilitate wireless connection between mobile computers or between computers and wireless network devices such as cellular phones, Bluetooth supports data rates up to 721 Kbps (including a 56 Kbps backchannel) and 3 voice channels. This wireless technology capability will allow printing without cables or aiming an infrared beam. Potential future scenarios include users being able to transfer data by simply placing a notebook computer in the vicinity of a desktop, because the notebook computer will sense being within range of the desktop and automatically initiate the exchange of data to update both systems. [92]

3.2.3 Fixed-Wireless Broadband

Small- and medium-size businesses and even households are demanding more bandwidth; and these demands are going to continue through 2010. Demand for high-speed Internet and data networks continue to grow; however, the availability of fiber access is limited.[93] Only 5 percent of all U.S. businesses have fiber-optic connectivity.[94] In many communities in the United States, Internet access is provided by standard dial-up phone lines, xDSL lines provided by the local telephone companies, or cable–modem connections maintained by local cable companies. All these solutions require inside and outside wiring, including telephone company provided infrastructure. In many cases, the telephone company cannot support the required expansion, or it is difficult or very expensive to wire an existing structure.

Fixed-wireless broadband can circumvent the last mile or local loop traffic jam for businesses delivering multi-T1 capacity in a building. It can also deliver that capacity significantly faster than cable systems, sometimes within hours in contrast to the time required to order a T1 from a local exchange carrier. It also takes time to arrange and install new wireline networks. Wireless networks are relatively quick to install if the network hub is already in place. [95]

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[92] Andrew Seybold, "Bluetooth Technology: The Convergence of Communications and Computing," PCS Data Knowledge Site, (online): www.pcsdata.com, May 1998.
[93] Strategis Group, *World Wireless Broadband,* (online): www.strategisgroup.com.
[94] James Careless, "Fixed Broadband on the Verge of Boom," *Wireless Week* 5, No. 50, December 13, 1999, p. 32.
[95] *Ibid*.

Fixed-wireless broadband in the 2.5 GHz band, multichannel multipoint distribution services (MMDS) can provide 30 to 35 miles coverage; whereas, local multipoint distribution systems (LMDS) signals travel about 2 miles in the 28 to 31 GHz frequency range. The LMDS short propagation range is especially suited for integration with the cellular model of transmission. Additionally, the FCC-allocated 1.3 GHz bandwidth makes it an even better choice than the 200 MHz bandwidth MMDS. With the Fast Ethernet or OC-3 speeds now available and OC-12 or Gigabit Ethernet speeds to be ready in the near future, both can support multiple applications, delivering voice, video, and high-speed data. These features are major benefits given the current trend to the convergence of data and voice networks and the growing popularity of bundled services. [96]

Fixed-wireless broadband could be the last-mile solution and killer application of the new century, given the limits of wireline networks, ASDL, and cable modems notwithstanding.[97] Fixed-wireless broadband will serve as an attractive method for providing business customers with much-needed bandwidth and speed.

3.2.4 Telematics

All indicators point to increasing user mobility. With the demand for increased access to applications and the Internet, wireless capability and services will spread to different devices and platforms. The quality of commuting life will receive a significant boost when wireless communications and transportation are coordinated on a large scale, offering the same connectivity and access to information currently offered through cell phones, pagers, and web browsers.[98] Fulfilling these requirements is a new set of functions called telematics, the integration of vehicle control and monitoring systems with wireless communications and location-tracking devices. [99] Advances in telematics, the spread of digital wireless networks, access to the Internet, and increased bandwidth are trends that the automobile industry is embracing with the view to incorporating these capabilities when developing product lines.

Telematics applications currently include on-the-road safety, vehicle navigation, automatic door locking, crash notification, emergency roadside assistance, information services, and the like. Telematics include Global Positioning System (GPS) receivers for location information and analog cellular transceivers for communications, encased in a automotive-hardened device. On the wireless side, telematics is generally carrier independent, although systems rely on analog networks because that technology still offers the best overall coverage. [100]

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[96] *Ibid*.
[97] *Ibid*.
[98] Geppert, op. cit.
[99] Geppert, op. cit.
[100] Mark Dziatkiewicz, "Will Telematics Live up to the Hype?," *Wireless Week*, Vol. 5, No. 50, December 13, 1999, p. 40.

The future of telematics lies in migrating to data-centric services such as e-mail downloaded to an automobile, navigation information, stock information, weather and sports news, audio on demand, Internet access, fax service, travel information and reservations, product and service pricing and availability, broadcast and public information messaging, short message delivery, and paging.[101] Any service that is applicable to a handset is applicable to an automobile. Additionally, the information can be delivered, based on the requestor, in either voice or text format. Carriers also embrace telematics because they see a new entry point for location-based services. Further, legislative mandates to increase safety by reducing the number of people who hold phones to their ears while driving may also give telematics a push.[102]

3.2.5 Private Radio

Although the main application for the private radio community is still push-to-talk dispatch and netted user communications, the increasing demands of radio users include interconnection with the public telephone network, wireless data applications, and wide-area coverage. There are more than 16 million radio users in the United States today, most with expensive but outdated equipment. Private radio is used in nearly every major industry and throughout the Government.

Private radio users were found to be significant users of paging and cellular and PCS services, albeit at a lesser percentage when compared with non-radio users. Private radio usage varies considerably across industries, with public safety and wholesale and retail trade being the heaviest users.

Spectrum availability is critical to the growth of the private radio industry. Private radio users have indicated that about 20 percent of their channels are capacity constrained, with virtually all those radio channels concentrated in metropolitan areas. In response to this over-crowding of radio frequencies, new FCC rules are encouraging the migration to more spectrally efficient radio equipment while issuing narrow bands of private radio channels.[103]

3.2.6 Public Safety Radio

There is also an increasing demand among public safety radio users for bandwidth intensive data applications capable of providing access to specific data (fingerprints, photos, database information, and video) at emergency response sites. This user community represents a significant market for trunked systems and 2.5G PCS growth, with the appropriate security. Consequently, this market, which was predominately voice operation, now must transition to data-centric communications. Public safety mobile data service is considered an enhancement to mobile command and control (C2) capabilities, not a replacement for voice systems; extends the

[101] Geppert, op. cit.
[102] Dziatkiewicz, op. cit.
[103] StrategisGroup, op. cit.

public safety infrastructure capabilities for efficiency and operational flexibility providing location independence; promotes interoperability among Federal agencies and State and local public safety officials; and reduces the demand on voice systems by permitting reduction and consolidation of requirements. However, updating or creating a private public safety wireless infrastructure is expensive, given the one-time costs and operation, administration and maintenance (OAM) of private wireless systems. Increasingly, public safety organizations have been turning to nationwide public CDPD systems to provide their data capabilities. Although other private data systems are available, such as RAM, ARDIS/ISR, Ricochet, PCS and satellite systems, these systems are often proprietary and offer limited availability.

Significant benefits accrue from employing CDPD systems, especially because the systems use existing cell site tower infrastructure, provide an all digital network with appropriate levels of security, and each mobile user has an IP address. By using an open-standards IP approach, significant capital investment can be avoided; and time to construct a fixed, private network is reduced. Furthermore, CDPD would provide a cost-effective OAM approach; support the narrow-band conversion of voice push-to-talk radios by reducing voice requirements by more than 40 percent; extend the public safety infrastructure building on in-place, survivable, public packet data infrastructure; and promote secure mobile multisource digital information access.

Although it is not available nationwide, the demand for CDPD capability is driving the implementation of the various interoperable services by the carriers. Unfortunately, Federal law enforcement agencies have not fully recognized their emerging mobile data requirements and the associated impacts on their voice requirements. Therefore, these agencies continue to maintain that public infrastructures are not appropriate for their requirements.

3.2.7 Wireless Communications Conclusions

Wireless communications, especially wideband mobile data applications, will continue to be a significant global growth area as an increasing amount of personal consumer and professional business is being conducted in this manner. The pace of innovation in wireless and mobile data remains rapid, and as the demand for new services continues, new broadband applications will be developed. New applications will, in turn, drive additional demand— both on wireless capabilities and the networks that support wireless.

As a result of these emerging wireless applications, multiple global standards could be in use, with adoption of standards based principally on consumer reaction to available products— user friendliness, personalization, and visualization capabilities will play key roles in consumer acceptance. As the public increasingly relies on wireless communications, certain issues will become prevalent, including increasing wireless QoS, transactional verification and security, information assurance, and spectrum management.

3.3 Satellite Systems

Since the launch of the first military and commercial satellites in the 1960s, satellite systems have become an integral part of the GII and are essential to providing full connectivity for the "global village." A new generation of satellite networks is being developed to handle highly bursty Internet and multimedia traffic. In these networks, satellite links are used for interconnecting remote network segments and for providing direct network access to homes and businesses.[104]

Satellite communication systems can be described in terms of operating frequency, orbital height, operational use, and other features. The various satellite systems, described in the context of their use, include fixed satellite systems (FSS), which support geographically fixed or transportable Earth stations; mobile satellite systems (MSS), which support users while moving; direct broadcast systems (DBS), which can support both fixed and mobile receive earth stations; and multimedia satellite systems, the next generation of satellites, which will provide bandwidth on demand for multimedia applications.[105]

3.3.1 Orbit Considerations

3.3.1.1 Geosynchronous Earth Orbit

As implied by the name, the geosynchronous Earth orbit (GEO) satellite remains in position, fixed above a geographic point on Earth. To achieve this fixed position, the satellite must be in equatorial orbit at 35,800 kilometers above the Earth's surface. Historically, because of its advantages, most military and commercial communications satellites have been GEO. With a global antenna, a GEO satellite illuminates more than one-third of the Earth's surface, except the polar regions, providing communications between any two Earth stations located in the global beam. Additionally, because of its fixed location with respect to the Earth's surface, sophisticated tracking mechanisms are not required except with highly directive high-gain antennas. This is a significant advantage because small antennas do not require tracking mechanisms. From a commercial perspective, a single GEO satellite can and has provided the basis for profitable business operations.

The primary disadvantages of the GEO satellite are time delay and loss of signal strength due to the path length. The time delay is about 250 ms from Earth station to Earth station. With a

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[104] *IEEE Communications Magazine*, March 1999.

[105] The terms Earth station and satellite terminal are interchangeable with "Earth station" being used in commercial international systems and "terminal" normally used by the Department of Defense and many domestic satellite system service providers. A separate, introductory discussion of orbital types, their advantages, and disadvantages is provided.

global beam, Earth stations near the subsatellite position, directly below the satellite on the surface of the Earth, can have up to a 4.3 decibel (db) advantage over a satellite at beam edge.

3.3.1.2 Medium Earth Orbit

The medium Earth orbit (MEO), also known as the intermediate circular orbit (ICO), is located above the Van Allen belt but below the GEO. The one MEO commercial communications system under development plans a 12-satellite system at 10,390 kilometers. The advantages of the MEO with respect to GEO are reduced signal path delay and less signal strength loss, allowing voice communications using an omnidirectional antenna on the Earth terminal. Additionally, if a polar or highly inclined orbit is employed, polar coverage can be provided. The disadvantage is that more satellites are required for full Earth coverage than in a GEO system. Conversely, fewer satellites are required than in a LEO system. A commercial disadvantage is the full satellite constellation must be in orbit before beginning global commercial service.

3.3.1.3 Low Earth Orbit

The low Earth orbit (LEO) orbit is located below the Van Allen belt and is the closest to the Earth's surface. Several LEO commercial communications systems have been proposed at altitudes ranging from 700 to 1457 km. The primary disadvantage of the LEO is the large number of satellites required for full Earth coverage. The primary advantage is the relatively short transmission path for a satellite system, minimizing signal path delay and power loss. Like the MEO, the full satellite constellation must be on orbit before beginning global commercial service.

3.3.1.4 Elliptical Orbit

One commercial satellite communications system is planned that proposes to use an elliptical orbit. The advantage of this system is that the orbit can be optimized to provide extended loiter time over heavily populated areas of the Earth and a quick low-altitude transit of areas of minimal population. Another advantage of this system is that it requires fewer satellites than MEO and LEO systems to provide full-time coverage of populated areas. However, elliptical orbit requires better electromagnetic shielding than other systems because of the repeated transit of the Van Allen belt as it moves from low to high orbits. As with MEO and LEO systems, the full constellation must be deployed before beginning global commercial service.

3.3.2 Fixed Satellite Systems

Commercial, fixed satellite communication systems provide wideband for voice, Internet, video, and data services between fixed and transportable Earth stations, providing points of entry into the terrestrial backbone of the GII. Currently, all FSS systems are based on GEO satellite constellations, but two FSS systems being planned are based on LEO constellations. Commercial systems now in operation operate in the C-band (4-8 GHz) and Ku-band (10.9-17 GHz). Several FSS systems have been proposed that will operate in the Ka-band (18-31GHz).[106]

International frequency-allocation regulations allow 500 MHz total link bandwidth. This can be increased by frequency reuse and physical diversity. The nominal transponder bandwidth is 36 MHz; however, transponders of much wider bandwidth have been utilized for the last several years. Internationally, throughput is frequently described in terms of 64 Kbps equivalent channels.

FSS Earth station antennas vary in size from 30 meters to less than 1 meter. Initially, Earth stations in FSS service were major telecommunications nodes, providing an interface from the satellite into the terrestrial telecommunications network. As satellite communications have matured, most Earth stations are smaller, providing both interconnection to the terrestrial network and private line service. The development and utilization of smaller terminals, such as very small aperture terminals (VSAT) both internationally and domestically have greatly increased the private line networks and services being provided by satellite.

FSS service supports many applications. Until the late 1980s, the preponderance of international telephone service (greater than 80 percent) was carried by satellite. The deployment of undersea fiber optic telephone cables has greatly reduced the international telephone service carried by satellite. Satellite systems still carry a significant percentage level of international telephone traffic; but satellite systems are providing those services for which satellites are uniquely qualified, that is, thin route point-to-point services, point-to-multipoint services, and private line VSAT services. Other typical FSS service offerings are full- or part-time transponder lease; full-time, part-time, and occasional use television service; shared or dedicated data, video, voice and digital private line service.

Operational international FSS systems include Columbia, INTELSAT, Intersputnik, and PanAmSat. According to the Phillips 2000 Satellite Industry Directory, there are 6 regional and 36 national systems in use, all of which could be used in an NS/EP operation taking place in their coverage areas. Current commercial FSS technology supports NS/EP requirements in the field utilizing VSAT and larger transportable terminals. Future GEO and LEO systems will provide

[106] Joseph N. Pelton, *Wireless and Satellite Telecommunications: The Technology, The Market, and the Regulations.* (New York: Prentice Hall, 1995).

bandwidth on demand and significantly increase the capacity and availability of FSS systems to support NS/EP requirements.

Several FSS systems, some of which will be operational in 2010, have been proposed for both GEO and LEO operating in both the Ku- and Ka-bands. In addition to the traditional FSS services, many of the proposed systems are focusing on wideband, high-speed access to the Internet using small antennas. Thirteen Ka-band multimedia systems have been proposed, 12 in GEO and 1 LEO. These systems are slated to provide global, regional, and domestic coverage with system capacities ranging from 365 Gbps to 11,000 Gbps. Eight of these systems are planned to have onboard processing on the satellite, and seven are designed with intersatellite links. User data rates of 32 Kbps to 1 Gbps are planned, with user terminal sizes typically from 24 centimeters to 5 meters.[107] A significant characteristic of the system architectures provides for maximizing capacity over populated areas. Significantly, many proposed satellite systems on file with the FCC appear to be "place holders," with perhaps a half-dozen serious contenders. Business case uncertainties include high system costs, addressable market size, service availability, and terminal cost.

3.3.3 Mobile Satellite Systems

Most commercial, mobile satellite communications systems provide voice and data services between mobile terminals and fixed Earth station entry points for further connection into the GII. Some architectures, including one operational MSS system, Iridium, provide for cross-links between the satellites in the constellation, thereby providing direct communications between mobile-to-mobile terminals without traversing a ground entry point. Currently, Inmarsat provides analog and digital service; however, it is expected that analog service will be phased out. The maximum MSS data rate commercially available is 64 Kbps, and most systems operate at data rates significantly lower— 2.4 to 9.6 Kbps. Most MSS systems operate in L-band (0.5 to 1.5 GHz) to the low 2 GHz range between the mobile terminal and the satellite entry points. There are two regional systems in North America, originally one serving the United States and the other Canada. As a result of the World Trade Organization (WTO) agreement discussed in Section 5, these systems, with the proper authorizations, can now serve all of North America and adjacent waters covered in the footprint of the satellites. Both of these satellites operate at GEO altitude. Three global MSS systems operate: One constellation, Inmarsat, operates at GEO altitude; and the two newer constellations, Iridium and Globalstar, operate at LEO altitudes. Utilization of the LEO MSS systems has not measured up to their promise. Globalstar has just begun service to selected users; but Iridium, which began operations in late 1998, is currently in Chapter 11 bankruptcy proceedings. Additionally, one planned MSS system, based on a MEO architecture, ICO, is currently in Chapter 11. Two other systems, one LEO system and one with an elliptical orbit architecture, are not fully funded. It has become apparent that uneconomic commercial systems will fail.

[107] Dr. John Evans, COMSAT, presentation to the NSTAC Globalization Task Force, January 21, 1999.

MSS terminals vary in size from shipboard terminals with tracking antennas to handheld telephones with an omnidirectional antenna. Currently, only LEO systems operate with handheld telephones, and the smallest mobile terminals operating with GEO systems are laptop size with a built-in flat plate antenna. However, Asia Cellular Satellite (ACeS), a regional MSS system with GEO satellites, is scheduled to begin operations in 2000 using dual-mode handheld telephones.

3.3.4 Direct Broadcast Satellites

Satellites have been used for video transmission since the very first Syncom series in 1963–64. These early live global television transmissions were transmitted to the user's location by the television networks. Indeed, in the 1960s, the message "live via satellite" on a television screen meant international events were being watched as they happened. As the television networks changed from terrestrial to satellite distribution of programming, the first direct user reception of satellite television signals evolved as rural users installed relatively large (3 to 5 meter) C-band television receive-only (TVRO) terminals to receive the programming being transmitted.[108] In the 1980s, commercial satellite direct broadcast television was attempted but was unsuccessful. In 1994, DirecTV introduced commercial satellite direct broadcast television programming, offering more than 210 TV channels via a geosynchronous satellite transmitting from the satellite to a home-mounted, 18-inch parabolic antenna. Other domestic direct broadcast television via satellite systems have also been commercially successful; and digital audio broadcasting (DAB) via satellite is being implemented domestically.

In addition to the domestic commercial direct broadcast television systems, numerous national and regional direct broadcasting satellites (DBS) systems exist worldwide. The Phillips 2000 Satellite Industry Directory lists 14 DBS systems and 7 DAB systems as operational. Additionally, the DOD has implemented DBS on commercial FSS satellites.

DBS applications are expected to increase as satellite power and processing capabilities increase. NS/EP planners should consider their use for "pushing" information to the NS/EP user in the field during NS/EP operations.

3.3.5 Multimedia Satellite Systems

The increasing international demand for broadband communications to support bandwidth-intensive applications, such as Internet access, interactive multimedia, and video conferencing, has sparked the development of a new generation of high-powered, broadband satellite systems that will begin deployment in the next 2 years. These multimedia satellite systems will provide bandwidth on demand and ubiquitous global coverage for the packet-based (IP, frame, cell) GII networks carrying voice, video, and data. In fact, Internet and intranet connectivity may well

[108] Pelton, op. cit.

prove to be the primary driver for the rapid deployment of broadband satellites, with the first generation of Ka-band, broadband satellites expected to be launched in 2001.[109] Additionally, the multimedia satellite systems can take advantage of the inherent broadcast and broad coverage capabilities of satellite technologies to provide multicasting services.

Current plans call for both global and regional GEO systems and global LEO systems. Generally, GEO systems are considered best for multimedia applications that are tolerant to the transmission delay associated with the higher geosynchronous orbit, whereas LEO systems support real-time applications that are intolerant of transmission delay. New digital signal processing advances are drastically reducing the delay impact; and in the future, this may not be a determining factor. In any event, multimedia satellite system services will be available from GEO or both GEO and LEO systems. In addition, broadband services will be provided at Ku-band and Ka-band. The future options are so varied that firm plans cannot be established. The prudent planner must, therefore, maintain and consider all options while monitoring the development of commercial multimedia satellite communications.

Initially, satellites were bent-pipe systems, translating the frequency and relaying the received signal to the receiving Earth station. Some newer operational systems have introduced processing and TDMA switching and routing, and this trend will continue. Next generation broadband satellite networks will introduce advanced switching and processing capabilities to the orbiting satellite. With the development of new switch matrices, optimal switching, and on-board base band processing technologies, advanced satellites will employ new link access methods to deliver interactive bandwidth-on-demand data services anywhere in the world.

A current snapshot of commercial communications satellite development illustrates the rapidly changing situation. Planned multimedia systems include CYBERSTAR, ASTROLINK, SKYBRIDGE, SPACEWAY, and TELEDESIC. ICO is being financed with a view toward making it an Internet rather than a voice system. Satellite system capability to provide ubiquitous broadband coverage is uniquely suited to support NS/EP telecommunications requirements; however, total systems that use the best of satellite and terrestrial technology should be considered in NS/EP planning.

In addition to the multimedia satellite capability, several companies have proposed the use of airships to serve as multimedia communications platforms operating at high altitudes over a specific area. The survivability of such a platform supporting a national security operation in a hostile environment is uncertain; however, if available, such a capability could prove more than adequate in a natural disaster, emergency preparedness scenario.

[109] *Satellite Communications*, July 1999.

3.3.6 Satellite Communications Conclusions

On the basis of review of current planning, it is foreseen that commercial satellite communications in 2010 will have vastly increased power, capacity, flexibility, and capability over present-day systems. Multimedia satellite system services operating in Ku- and Ka-bands in GEO, and, possibly, LEO, employing on-board switching, base band processing technologies, and new link access methods will deliver interactive bandwidth-on-demand services worldwide. DBS systems and multimedia satellites providing multicasting services will provide a push capability for transmitting information to individual users, and multimedia satellites will provide for near real-time interactive telecommunications.

It is obvious that many of the proposed satellite systems on file with the FCC will never become operational, and 1999 events have raised serious concerns about the viability of some MSS service providers. Despite the technological capabilities forecast for 2010, it must be recognized that commercial satellite service providers will not provide services that prove uneconomical.

4.0 PROTOCOLS

A critical area of network convergence, evolution, and revolution focuses on the protocols that permit expanded interworking of the PSN. Significant planning, engineering, and standards work is under way to ensure that future protocols address the QoS challenges resulting from the convergence and integration of the PSN with the Internet and NGN.[110]

4.1 Introduction

Network protocols as a facilitator of communication assurance will become more important in the converged, distributed, intelligent, multimedia public networks of 2010. Industry and Government will define and vet protocols over the next decade to create the expanded NGN. As these activities move forward, the future implications of particular QoS requirements must be considered and incorporated.

Currently, several working groups of the IETF are developing protocols to support voice-data integration and evolution.[111] The working groups are focusing on PSN-Internet interworking, IP telephony, media gateway control, multiparty session control, and signaling transport. In Europe, a related initiative to develop voice-data protocols is the Telecommunications and Internet Protocol Harmonization Over Network (TIPHON), a project of the European Telecommunications Standards Institute (ETSI). Industry and Government coordination and participation in various protocol fora have been part of the effort to develop responsive, reliable, and effective network protocols for the NGN.

4.2 2010 Protocols

The current vision of the 2010 network entails a five-layer model, with layers three and above reflecting the embedded network "intelligence." In presentations to the GTF, industry experts have noted areas within the specific layers where protocols offering advanced QoS, availability, reliability, interconnectivity, and security features could reside. At layer three, for example, multi-protocol label switching (MPLS) could provide a routing/switching mechanism for packets within a connectionless network to be based on a label within the packet. This feature would allow the network routers/switches to operate at higher speeds. MPLS could also be used to

[110] For a detailed discussion of this issue, refer to the *Convergence Report,* NSTAC Information Technology Progress Impact Task Force (ITPITF). The ITPITF has included this document in its report to NSTAC XXIII.
[111] The IETF is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. It is open to any interested individual. Growth in the IETF membership during the last 3 years has helped to expand the international dimensions with 33 countries now represented. Structure and governance of the IETF consists of the Internet Architecture Board, Internet Engineering Steering Group and Workings Groups. Currently 120 working groups are aligned under 8 working group areas: Internet, Routing, Transport, Applications, Security, Network Operations and Management, User Services, and General.

create virtual paths with quality and security functionality, with access to particular MPLS paths available to specific users only. At the highest layer, evolving protocols could support applications defining and authenticating the universe of individuals and entities with specific access privileges.

4.3 Protocol Conclusions

Any, and perhaps all, of the potential protocols for 2010 can be considered candidates for satisfying certain industry and Government requirements, including QoS, availability, reliability, interconnectivity, and security. However, given the richness of service expected to be provided by the envisioned network architecture of 2010, the needs of the industry and Government may not exceed the highest QoS commercially available.

5.0 REGULATORY AND LEGAL FRAMEWORK

The changing domestic and international regulatory and legal environments have accelerated the emergence of a global economy and the evolution of the GII. In this post-Cold War era, the telecommunications and information technology sectors— the key components of the GII— have undergone significant transformations as companies have adopted new business models to expand the scope of their operations internationally, while simultaneously converging and, sometimes, contracting their domestic operations.

Concurrently, the rapid pace of technological change and the introduction of new telecommunications and information capabilities have brought new public policy issues to the forefront. These issues pose unique challenges to regulators and require governments to formulate policies, both formal and informal, that keep pace with this complex change.

5.1 Global Regulatory and Legal Issues

Due to the complexity of the public policy issues resulting from the emergence of the GII and the global economy, a discussion of all of the related issues cannot be presented in this section. Instead, significant domestically oriented issues that are affecting the growth and ubiquity of the GII, and, consequently, the support of NS/EP telecommunications services, are highlighted.

- **Liberalization and Elimination of Regulatory Barriers*:*** The global growth of competition in the telecommunications industry has been driven by new fiber optic, satellite, and wireless technologies and has rendered the regulated nature of many nations' telecommunications policies obsolete.[112] As a result, many countries have begun to adopt policies that open their markets and privatize Government-owned industries. Nonetheless, the elimination of regulatory barriers to liberalization has proven difficult for regulators and legislators to fully accomplish.[113] This stifled liberalization of global markets has the potential to slow deployment of the GII. In light of that, the European Union, the Asia Pacific Economic Cooperation (APEC) forum, and the Group of 8 (G8) Summits have undertaken initiatives aimed at overcoming this resistance to change.

  As new ownership arrangements of international telecommunications facilities have appeared and foreign-owned entities have sought to enter the U.S. market, Government policy makers have responded positively in meeting their international obligations, such as those of the World Trade Organization's Basic Telecommunications Agreement, and the pro-competitive thrust of the Telecommunications Act of 1996. Simultaneously, policy makers have sought to

[112] IBM White Paper, "*Understanding the Global Information Infrastructure*."
[113] *Ibid*.

ensure that national security and law enforcement concerns are not compromised. Federal statutes, namely the Communications Act of 1934, as amended by the 1996 Act; the Cable Landing License Act of 1921; and the regulations and executive branch review processes that have been developed have been shown to tolerate the increasing levels of foreign ownership of telecommunications facilities in or towards the United States. These processes have allowed for executive branch input by the Department of State, the DOD, the Department of Justice, and the FBI. The latter three entities have focused on ensuring, among other things, that management of the domestic telecommunications facilities remains in the United States, that the facilities remain subject to law enforcement efforts, and that access to these companies' premises is controlled; indeed, these companies are subject to agreements between the Government and the U.S. carrier. In addition, reviews are performed by the U.S. Trade Representative and the Cabinet-level interagency committee— the Committee on Foreign Investments in the United States (CFIUS). CFIUS was established in 1975 to examine national security implications of mergers, acquisitions, and joint ventures involving foreign-owned companies.[114]

- **Interoperability:** Creation and expansion of the GII are impossible without global network interoperability. Without the development of global standards and the adoption of open interfaces available to all manufacturers and service providers on reasonable terms, the optimal GII will not be realized.[115]
- **Universal Access:** To fully realize the benefits stemming from the development of the GII, access to the networks and services must be global and universal, interconnecting industrialized and developing nations alike. Intergovernmental organizations (IGO), such as the United Nations (UN), the International Bank for Reconstruction and Development (IBRD), and the World Bank Group, working with developing nations, can further promote this worldwide access.
- **Intellectual Property Protection:** Without appropriate international mechanisms to enforce intellectual property rights, the creators of software, hardware, and content will not participate in developing of the GII. International variations in copyright, patent, and other intellectual issues make harmonizing these laws imperative.[116]

[114] NSTAC Legal and Regulatory Working Group, *Foreign Ownership: Telecommunications and NS/EP Implications*," May 2000.
[115] IBM, "*Understanding the Global Information Infrastructure*."op. cit. and NSTAC Protecting Systems Task Force Report.
[116] *Ibid*.

5.2 International Regulation

In discussing the regulatory and legal framework of the GII, it is important to emphasize the IGOs within which Government and private sector representatives are working to develop international standards and practices. For the purpose of this report, the most notable are recent initiatives of the WTO and the ITU.[117]

5.2.1 World Trade Organization

Created in 1995, the WTO was developed from the General Agreement on Tariffs and Trade (GATT).[118] It is noteworthy that more than 90 of the WTO's 123 members are developing countries or countries with economies in transition that are receiving increasingly more attention through this international forum.[119]

5.2.1.1 WTO Basic Telecommunications Agreement

Under the auspices of the WTO, the framework for a single global telecommunications market was established on February 15, 1997, when 69 developed and developing countries concluded negotiations on the Basic Telecommunications Agreement. Charlene Barshefsky, the United States Trade Representative (USTR), declared that the "fully enforceable" agreement (a) provide[d] U.S. companies "market access for local, long-distance and international service through any means of network technology, either on a facilities-based or through resale of existing network capacity"; (b) ensure[d] that U.S. companies "could acquire, establish, or hold a significant stake in telecom companies around the world"; and (c) include[d] pro-competitive regulatory principles "based upon the landmark 1996 Telecommunications Act."[120] Commitments made by WTO members in response to the Basic Telecom Agreement were varied. Domestically, the United States agreed to relax the 25% indirect foreign ownership limitation (found in §310 (b)(4) of the Communications Act of 1934) for Basic Telecom Agreement signatories.

5.2.2 International Telecommunication Union

The ITU was founded in 1847 to address the growing need for the international coordination of telegraphy. It became a UN specialized agency in 1947 and is now split into three sectors that

[117] These issues are discussed in greater detail in *Foreign Ownership: Telecommunications and NS/EP Issues,* attached as Annex B of the *Globalization Task Force Report to NSTAC XXIII*.
[118] The WTO recognizes the need of developing nations to gain a share in international trade to stimulate economic development, and derives its power from members' agreements to cooperate in solving trade problems and negotiate binding, trade liberalizing agreements. Crede, Andreas, *Knowledge Societies in a Nutshell: Information Technology for Sustainable Development*, Ottawa, Ontario, Canada: The Centre, 1998.
[119] *Ibid*.
[120] Statement of Ambassador Charlene Barshefsky, "Basic Telecom [sic] Negotiations," February 15, 1997.

address specific issues in radio communications, standardization, and development.[121] The radio communications sector ensures the efficient use of radio frequency spectrum by all services, including those using geostationary satellite orbits. The standardization sector issues recommendations on all aspects of telecommunications standards. The development sector assists developing countries in advancing their telecommunications services.[122]

5.2.2.1 Global Mobile Personal Communications by Satellite Memorandum of Understanding

In an attempt to facilitate deployment of global mobile personal communications by satellite (GMPCS), the United States urged the ITU to begin examining potential issues regarding GMPCS technology in 1996. The Global Mobile Personal Communications by Satellite Memorandum of Understanding (MoU) was adopted under ITU auspices in 1998 and is "designed to facilitate the mutual recognition and cross-border transport of GMPCS terminals providing voice, data, Internet and broadband services."[123] The MoU provides international guidelines "intended to facilitate worldwide deployment and trans-border use of fixed and mobile satellite terminals and equipment."[124]

Early in 1999, the FCC released a Notice of Proposed Rulemaking outlining guidelines for the "licensing, marking, certification, and customs treatment of GMPCS terminals."[125] Under this rulemaking, the FCC seeks to require manufacturers to obtain a mandatory certification for GMPCS terminals sold or leased for use in the United States, through the FCC's equipment certification process. Similarly, all terminals brought into the United States are required to have the "ITU Mark." The FCC has yet to issue a final ruling on this matter. However, because new issues could emerge as new relationships are established, this matter requires continuing review.

5.3 Foreign Ownership Conclusions

A telecommunications framework for the global economy is being established. The WTO Basic Telecommunications Agreement and liberalization of the global trade environment in general have given companies the ability to provide telecommunications services in other countries' jurisdictions. This global liberalization bodes well for the continued expansion of the GII.

U.S. Government policy has adapted to this increasingly globalized telecommunications industry. Strict limits on foreign ownership or control of domestic telecommunications facilities were loosened in the Telecommunications Act of 1996 and again in the FCC's implementation of the

[121] Crede, op. cit.
[122] *Ibid*.
[123] "FCC Proposes Steps to Implement GMPCS-MOU, Facilitating Deployment of New Global Mobile Satellite Services While Protecting Against Interference to Radionavigation Services," IB Docket 99-67, International Action, Report IN 99-9 (released February 25, 1999).
[124] *Ibid*.
[125] *Ibid*.

WTO agreement. Simultaneously, the FCC has included Government agencies with national security responsibilities (e.g., DOD and the FBI) as part of the regulatory review process. Agreements between U.S. companies and the security agencies are now an important part of the FCC's review process of mergers and other commercial arrangements involving foreign ownership.

The current regulatory structure appears to satisfy the diverse interests of the parties. U.S. companies generally are able to gain approval to conduct transactions involving foreign telecommunications companies, subject to agreements with the defense and law enforcement agencies. The FCC can fulfill its role of protecting the public interest, and defense and law enforcement agencies have the ability to exact the commitments they require to protect national security. It is unclear whether any further statutory or regulatory changes would enhance the role of national security issues in foreign ownership situations at this time.

6.0 NS/EP REQUIREMENTS

Although the NS/EP needs of the Government are satisfied by the current communication network architecture, planning efforts are under way to help ensure that the NS/EP communications and the information architecture will continue to meet the Government's mission critical needs in 2010. Because the GII is rapidly changing and QoS features of packet-based networks are improving, it is difficult to forecast the additional services or network features that may be necessary to support NS/EP operations in 2010. However, information and specific guidance are available from several Government sources, such as: Executive Order (E.O.) 12472, the "White House Memorandum on National Level Telecommunications Program Implementation and Functional Requirements" (October 15, 1991), and documentation regarding the Joint Chiefs of Staff's Joint Vision 2010. In sum, these documents emphasize that mission-critical needs require assured service under all conditions now and into the future.

6.1 NS/EP 2010 Telecommunications Functional Requirements

The basic functional requirements for NS/EP telecommunications are described in Executive Order 12472 [126] and the previously cited White House Memorandum.[127] Using the information given in the aforementioned policy documents, NS/EP communications functional requirements operating within the 2010 GII can be described as follows:

- **Enhanced Priority Treatment—** Voice and data services should, if necessary, provide end-to-end preferential treatment over other traffic. This requires enhanced routing within and between networks and the ability for all service providers including ISPs, to distinguish NS/EP calls. The future network, however, may provide such robust communications capabilities that additional features to facilitate priority treatment of NS/EP traffic may not be needed.
- **Secure Networks—** User authentication and expanded encryption techniques will be necessary to facilitate access to and prevent corruption of the shared data and applications supporting NS/EP communications.
- **Infrastructure Restoration—** Should a service disruption occur, NS/EP voice and data services must be capable of being reprovisioned, repaired, or restored to required service levels on a priority basis.
- **International Connectivity—** International gateways should process NS/EP telecommunications on an expedited basis. The future network may provide such

[126] Executive Order 12472, *Assignment of National Security and Emergency Preparedness Telecommunications Functions*, April 3, 1984.
[127] White House Memorandum for the Honorable Dick Cheney, Executive Agent, NCS, *National Level Telecommunications Program Implementation and Functional Requirements*, Oct. 15, 1991.

robust communications capabilities that additional features to facilitate priority treatment of international NS/EP traffic may not be needed.

- **Interoperability—** NS/EP service must allow hand-off of calls between service providers as needed. Voice and data services must interconnect and interoperate with other networks and services likely to be operated by the NS/EP user community, such as:
  - **FTS—** The Federal Telecommunications System carries long-distance voice and broadband services for mission-critical users. Federal employees will access follow-ons to FTS2001 through mobile or fixed satellite service.
  - **DTS—** Diplomatic Telecommunications Service is a global network of telecommunications circuits serving the foreign communications needs of more than 50 Federal agencies. DTS combines Government-owned and Government-operated circuits with leased, commercially-operated circuits.
  - **DISN—** The Defense Information System Network (DISN) is a long-haul infrastructure providing voice, data, and video to the warfighter and organizations supporting the warfighter. DISN is designed to connect and sustain base communications and gateways to deployed networks and support all command and control operations.[128]
- **Mobility—** The NS/EP communications infrastructure must support mobile voice and data communications. Mobility is defined as:
  - **User Mobility—** Services should be available via mobile service providers, including cellular, PCS, satellite, and HF radio.
  - **Service Mobility—** Available services should be tied to the user and or the needs of an NS/EP mission, not exclusively to specific access instruments or equipment.
  - **Provider Mobility—** Services should not be tied to a single provider. All providers should be accessible to all users.
- **Global Coverage—** To support the national security leadership and inter- and intra- agency emergency operations, regardless of location, NS/EP services will require ubiquitous access via landline phones, wireless communications, HF radio, and ISPs offering telephony. Services will also need to interoperate with various customer premises equipment (CPE).
- **Survivability—** Voice and data services must be robust enough to support surviving users under a broad range of circumstances ranging from the widespread damage caused by a natural or manmade disaster up to and including nuclear war. NS/EP communications must be able to use surviving assets of service providers to overcome damage or congestion. This also includes the ability of one service

[128] Defense Information Systems Network Website: http://www.disa.mil/DISN/disnhome.html.

provider network to recover from damage or congestion via alternate routing to other providers.

- **Voice Band Service—** NS/EP service providers must provide voice band support over landline PSN, wireless, HF radio, and IP telephony in support of NS/EP communications.

Functional communications requirements are also derived from NS/EP operational "best practices" and include the following:

- **Scalable Bandwidth—** NS/EP operations will need to manage the capacity of communications services to support variable bandwidth requirements and the introduction of new technologies.
- **Addressability—** Voice and data traffic should be routed to NS/EP users regardless of user location or deployment status. In a connectionless environment, NS/EP users will need communications capabilities based on device address to support their missions.
- **Affordability—** In designing NS/EP communications systems, existing and planned public network capabilities should be leveraged to minimize cost. This may be accomplished through the use of commercial off-the-shelf technologies (COTS) and services and existing infrastructure.

These functional requirements illustrate continuing Government requirements even as the telecommunications networks continue to evolve. In fact, it is possible to forecast that these functional requirements will still be important in ensuring Government can continue to support its NS/EP needs and develop a national-level telecommunications program for 2010 and beyond. The inherent challenge is determining what new or additional services or capabilities may be needed to fulfill this charge, given the rapid pace of change in GII technologies and regulatory environments and the potential for new vulnerabilities.

Similarly, in its Convergence Report, the NSTAC Information Technology Progress Impact Task Force (ITPITF) also cites the aforementioned NS/EP requirements to assess the impact of IP network PSN-convergence on existing NS/EP priority services. Although the ITPITF adopted a more near-term focus, the requirements remain a useful tool for assessing the impact of globalization on the NS/EP communications goals of the Federal Government in 2010.

6.2 Goals of Joint Vision 2010

Joint Vision 2010 is the policy for the continuing transformation of U.S. military capabilities through the development of improved information capabilities for enhancing joint operations. This entails making information operations (IO) and information superiority (IS) the focus of military innovation. Military innovations and improvements in information and integration technologies will significantly impact future military operations by providing warfighters with accurate information in a timely manner.[129] Advances in computer processing, global positioning, and telecommunications will be leveraged to magnify the power of small units and enable the warfighter to collect, process, and distribute information to thousands of locations in real time.[130]

To achieve greater mobility and increased dispersion for 2010, the warfighter will require additional communications and coordination capabilities establishing an accessible worldwide information infrastructure that can synchronize global warfighting elements.[131] For focused logistics capabilities, DOD will also require a secure, robust communications infrastructure operating in an intranet/Internet environment that allows all authorized users to access shared data and applications, regardless of location.[132] For DOD to incorporate the aforementioned capabilities into the DII, it will have to leverage advancements in commercial technologies and rely upon commercial systems to transfer its data.

6.3 NS/EP Requirements Conclusions

NS/EP communications in 2010 will be facilitated by a GII featuring new technologies and improved packet-switched network features. To adequately support NS/EP missions, the future GII must provide NS/EP users with QoS profiles to meet different performance levels; priority routing schemes for NS/EP calls (if necessary); various service capabilities and spectrum on demand; configuration control and user authentication measures; and transparent critical data interchange between service providers and end users.[133] The Federal Government has been, and should continue to be, active in its attempts to cooperate in developing industry standards and technical specifications for next-generation and IP-based networks.

To meet the information exchange requirements of 2010, NS/EP communications will continue to rely heavily on commercial assets. Also, commercial assets will provide Government additional solutions and capabilities, such as wireless, for ensuring NS/EP communications in any areas not adequately covered by the GII in 2010.

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[129] Joint Chiefs of Staff Website: http://www.dtic.mil/jcs.
[130] *Ibid.*
[131] *Ibid.*
[132] *Ibid.*
[133] Hal Folts, OMNCS-N2, *Technology Direction for NS/EP Mission Support*, presentation to the Globalization Task Force and Information Technology Progress Impact Task Force meeting, February 25, 2000.

7.0 CONCLUSION

Expansion of the U.S. NII into a globally available network offers a wealth of new opportunities and services for business and Government, including NS/EP missions. The following findings describe the expected global information and communications environment in 2010.

- **User demand for bandwidth-intensive services and increased mobility will bring greater bandwidth to the network edges**. User demand will encourage and drive further technological advances. This demand will push the GII into currently unreachable areas of the globe, making broadband local access increasingly available at the fringes of the network. Often, this bandwidth will be provided through wireless technology to meet demands for greater mobility and service availability anywhere, anytime. Increased mobile capabilities will likely facilitate greater human mobility and fuel additional demand. NS/EP applications and usage will get a tremendous qualitative boost in capabilities through these technological advances. NS/EP planners must be aware of this technological change and advance their plans to accommodate the resulting changes in capability.
- **Lower costs and greater availability of bandwidth will increase customer demand for multimedia communications**. Features such as higher data rates, bandwidth on demand, and voice over IP will facilitate new applications such as telecommuting and e-commerce. New services and applications will affect how work is done. Mobile offices and "offices in the sky," which take full advantage of World Wide Web technologies (e.g., better search engines, information "brokers," and yet-to-be-developed technologies), will be ubiquitous. Users will expect electronic collaboration and conferencing capabilities over disparate networks. The cost-effectiveness of the applications will drive demand.
- **Prudent NS/EP communications contingency planning should consider using the complementary capabilities of wireless and satellite systems along with wireline communications to meet global coverage goals.** Adequate wireline capacity worldwide is expected to be available to meet most global telecommunications requirements in 2010, including JV 2010 and NS/EP communications in general. Fiber-optic cables using DWDM technology will provide most long-haul, high-bandwidth backbone transport in 2010, and a variety of transport technologies, including xDSL, coaxial cable, and microwave transmissions, will comprise the last-mile delivery options for commercial and residential use. However, although the number and locations of these technologies will continue to increase globally, they will not be ubiquitous. DOD cannot be assured that adequate wireline communications to support JV 2010 and NS/EP services will be available at any location in the world.

- **In advanced nations, buildings designed to 2010 specifications will be NS/EP-ready during crisis situations, because of their broadband communications capabilities.** Fixed broadband capabilities will enhance the effectiveness of NS/EP missions during response scenarios. In lesser-developed areas, wireless technologies will be used to complete NS/EP missions when fixed broadband capabilities are not available.
- **Satellite communications (SATCOM) and wireless technologies will be instrumental in bringing the GII and NS/EP communications to less accessible geographic regions and in meeting requirements for increased mobility.** Increasingly, customers will look to SATCOM and wireless service providers to provide enhanced services such as facsimile, Internet access, and conferencing. Next-generation satellite networks are being developed to handle bursty Internet and multimedia traffic, and networks such as Inmarsat, Iridium, Globalstar, and ICO are designed to support global mobile users. Again, prudent NS/EP communications contingency planning should consider the complementary capabilities of satellite systems to meet global coverage goals.
- **Current planning indicates commercial satellite communications in 2010 will have vastly increased power, capacity, flexibility, and capability over present-day satellite systems**. Multimedia satellite system services operating in Ku-band and Ka-band in GEO and possibly LEO, employing on-board switching and baseband processing technologies, and using new link access methods will deliver interactive bandwidth-on-demand services anywhere in the world. DBS systems and multimedia satellites supporting multicasting services will provide a push capability for transmitting information to individual users, and multimedia satellites will allow near-real-time interactive telecommunications.
- **Despite the plethora of technological capabilities forecast for 2010, commercial service providers will not provide services that prove uneconomical**. Many of the proposed satellite systems on file with the FCC will not become operational, and 1999 events have raised serious concerns about the viability of numerous MSS service providers. Uneconomical commercial systems will not survive and will not be available for NS/EP support. However, satellite system capability to provide ubiquitous broadband coverage is uniquely suited to support NS/EP telecommunications requirements, and end-to-end systems using the best of satellite and terrestrial technology should be considered in NS/EP planning.
- **Demand for services, particularly an ever-increasing demand for data services, the need for the Internet to provide high QoS, and a desire to cut costs will drive networks and protocols toward convergence.** In 2010, multiple networks will likely exist but they will be integrated transparently via intelligent network services and protocols. The move to wireless applications will require more

dynamic reconfiguration— reconfiguration that is automatic without human intervention. Convergence will occur as carriers replace circuit switches with packet switches and IP evolves and gains capabilities and strength. Although any, and perhaps all, the potential protocols of 2010 could be considered candidates for hosting NS/EP requirements, the Government must consider the richness of service provided by the envisioned future network architecture and decide whether the NS/EP community will need QoS features beyond commercially available capabilities.

- **NS/EP communications in 2010 will be facilitated by a GII featuring new technologies and improved packet-switched network features.** To adequately support NS/EP missions, NS/EP users will require QoS profiles to meet different performance levels; priority routing schemes for NS/EP calls (if necessary); various service capabilities and spectrum on demand; configuration control and user authentication measures; and transparent critical data interchange between service providers and end users. The Federal Government will need to continue being proactive in its attempts to cooperate in the development of industry standards and technical specifications for next-generation and IP-based networks.
- **Reliability, QoS, and security are all uniquely related**. Users generally do not care whether a loss or interruption of data services occurred as a result of unreliable network components, bandwidth contention, or a denial of service attack. As networked services continue to grow in importance and become even more critical to commercial and NS/EP operations, service providers, particularly data or Internet service providers, must guarantee not only network and application availability but also resource allocation and security of user data. Scalable QoS will require packet prioritization based on level of service authorized or paid for. Basic security services will be expected, and higher security and assurance will be provided at additional cost. Because NS/EP services will continue to need cutting-edge priority service capabilities at difficult geographical locations, the Federal Government should remain active in efforts to guarantee such top-level QoS.
- **Commercial demand, rather than Government requirements or regulation, will likely continue to be the driving force for new services, applications, and supporting technologies.** To meet the information exchange requirements of 2010, NS/EP communications will continue to rely heavily on commercial assets because they will provide Government with additional solutions and capabilities (i.e., wireless) for ensuring NS/EP communications in any areas not adequately covered by the GII in 2010. In 2010, the NS/EP user should expect greatly increased, almost ubiquitous, services and bandwidth. Nevertheless, NS/EP users may experience contention for these same services and bandwidth, just as they do today. Continued contention points toward ongoing requirements for alternative means of communication and data transmission for critical NS/EP functions and information systems.

- **Network security concerns and requirements will be common and will not be limited to Government and a few critical business concerns (e.g., banking and finance).** By 2010, the increased reliance on the Internet for business-quality services will support a strong business case for security.
- **In 2010, "The Network of Networks" will provide service features not currently available.** It is a distinct possibility that new features will satisfy NS/EP requirements currently only satisfied by unique military features developed and funded at Government expense.
- **Global liberalization of regulatory policies bodes well for the GII and has not had a negative impact on national security.** Although liberalization has raised several national security concerns for the United States, the review processes established between the FCC and the executive branch appear adequate for addressing the DOD's national security concerns.

8.0 RECOMMENDATIONS

8.1 Recommendations to the President

The President should direct appropriate departments and agencies to—

- conduct exercises in those areas and environments in which NS/EP operations can be expected to take place to ensure that the required high-capacity, broadband access to the GII is available, and
- ensure that NS/EP requirements, such as interoperability, security, and mobility, are identified and considered in standards and technical specifications as the GII evolves to 2010, and identify any specialized services that must be developed to satisfy NS/EP requirements not satisfied by commercial systems.

ANNEX A

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ANNEX B

WEB ADDRESSES

System	Web Address
Astrolink	www.astrolink.com
Cyberstar	www.cyberstar.com
DirecTV	www.directv.com
DirecPC	www.direcpc.com
EchoStar	www.echostar.com
ELLIPSO	www.ellipso.com
ICO	www.ico.com
Inmarsat	www.inmarsat.org
Iridium	www.iridium.com
ISky	www.isky.net
INTELSAT	www.intelsat.com
PanAmSat Corporation	www.panamsat.com
Skybridge	www.skybridgesatellite.com
Spaceway	www.spaceway.com
Teledesic	www.teledesic.com
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APPENDIX C

PAPER ON FOREIGN OWNERSHIP: TELECOMMUNICATIONS AND NS/EP IMPLICATIONS

THE PRESIDENT'S
NATIONAL SECURITY TELECOMMUNICATIONS
ADVISORY COMMITTEE

Foreign Ownership: Telecommunications and NS/EP Implications

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1.0 INTRODUCTION

The end of the Cold War accelerated transformation of the telecommunications and information technology (IT) sectors against the backdrop of a globalizing economy. As domestic and foreign companies in these industry sectors have sought to adapt to this changing environment, they have put into motion new business models seeking to expand the scope of their operations internationally, while converging, and sometimes contracting, domestically. Simultaneously, rapid changes in technologies, introduction of new services, and new business models themselves have identified public policy issues that, though not necessarily new, have confronted policymakers with unique challenges. Government policy, both informally and through laws and regulations, has tried to keep pace with these changes.

This policy scoping paper has been prepared at the request of the President's National Security Telecommunications Advisory Committee's (NSTAC) Globalization Task Force (GTF), which was tasked by the Industry Executive Subcommittee (IES) to examine and make recommendations on, as appropriate, one of the major public policy issues associated with the new business models— foreign ownership of U.S. telecommunications facilities. Because this policy paper is also intended to be used as a reference for the GTF's Global Information Infrastructure (GII) in 2010 project, it focuses on foreign ownership-related policies affecting the GII and national security and emergency preparedness (NS/EP), particularly: (a) granting foreign-owned entities access to the U.S. market with a view to gaining foreign market access for U.S. industry on fair and equitable terms; and (b) balancing these initiatives with national security concerns. A number of related issues exist that are outside the scope of this paper, including: the "competitive safeguards" that the Federal Communications Commission (FCC) has established to regulate the changing domestic and international service markets, e.g., dominant carrier regulation, cost-based accounting rates and "no special concessions"; national foreign ownership regulations of other countries; foreign administrations' regulatory review processes and timelines; and U.S. and foreign export regulations, which are in a state of flux.

For a listing of NSTAC Legislative and Regulatory Working Group (LRWG) members, see Table 1 at the end of this document.

2.0 BASIC TELECOMMUNICATIONS STATUTES ADDRESSING NATIONAL SECURITY

As demonstrated below, international telecommunications facilities and markets have evolved, U.S. Federal statutes and regulations have tolerated increasing levels of foreign ownership of telecommunications facilities in or toward the United States. Concurrently, the Government has retained authority to prevent any such foreign ownership that may compromise national security interests.

The two statutes on which regulators have relied in opening the U.S. market to foreign entities are the Submarine Cable Landing License Act[1] (Cable Act) of 1921 and the Communications Act of 1934[2] (Act), as amended. Their language and legislative histories reflect national security concerns that existed at the time of enactment.[3] National security considerations have been factored into U.S. international policy and regulation ever since.

When Congress passed the Cable Act and the 1934 Communications Act, there were two transoceanic technologies—submarine telegraph cable and high-frequency radio. Throughout World War II, individual companies, in the case of the United States, or foreign governments, in the case of the remainder of the world, owned these facilities. This changed after World War II when multinational ownership of international facilities was introduced. International consortium-owned submarine telephone cables, beginning with TAT-1 in 1956, started to replace submarine telegraph cables, and globally owned satellite systems, beginning with "Early Bird"–INTELSAT I–in 1965, started to replace high frequency radio. Since then, a worldwide movement toward privatization and liberalization has changed the operational landscape even more and, again, legislators and regulators have had to adapt.

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[1] 47 U.S.C. §§34-39.

[2] 47 U.S.C. § 310 (1934).

[3] For radio, U.S. foreign ownership policy dates to the Radio Act of 1912. Based on lessons learned during the Russo-Japanese War, the U.S. Navy staunchly supported the Act, especially the provision that forbids non-U.S. citizens from holding radio licenses. Based on lessons learned during the early years of World War I, when two German-controlled wireless telegraph radio stations warned German vessels off the U.S. East Coast to seek cover, Section 12 of the Radio Act of 1927 limited foreign ownership to 20% to prevent aliens from engaging in espionage. Less than a decade later, the 1934 Communications Act further tightened foreign ownership regulations by limiting indirect ownership and barring any foreign governments or agents thereof from owning FCC licenses. With respect to submarine cables, national security problems that had been encountered during World War I in relying on foreign-owned and -controlled cable systems to Latin America were discussed in Congressional hearings in 1919 on the cable landing law. (U. S. Congress, House, Committee on Foreign Interstate and Foreign Commerce, *Hearings on Cable Landing Licenses,* 67th Congress, 1st Session.)

Cable Landing License Act

The original Cable Act gave the President the authority to grant licenses for landing and operating submarine cable systems in the United States, and, as appropriate, to establish license terms and conditions. In 1954, via Executive Order 10530,[4] the President delegated authority over cable landing licenses to the FCC with the provision that approval is obtained from the Department of State (State) and other Executive Branch agencies as the Commission deems necessary. In practice, State has coordinated with the Department of Defense (DOD) and the Department of Commerce (DOC), sometimes imposing conditions on approved cable landing applications. One of the standing conditions on cable landing licensees is that they advise the U.S. Government of proposed changes in levels of foreign ownership.

A history of the 1934 Act at the time indicated that the FCC could take foreign ownership of submarine cables into account in imposing terms and conditions, pursuant to Section 2 of the Cable Licensing Act, which the FCC subsequently has done. [5]

Communications Act of 1934

The above-discussed foreign ownership provisions were incorporated into Section 310 of the Communications Act of 1934, which restricted ownership of broadcast, common carrier, and aeronautical fixed radio licenses, and addressed both ownership of a licensed carrier and direct and indirect control of such a carrier. [6]

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[4] E.O. 10530, May 10, 1954, reprinted in 19 FR 2709, 3 CFR, 1954-1958 Comp.

[5] James M. Herring and Gerald C. Gross. *Telecommunications: Economics and Regulation.* 1936, pp. 396-399.

[6] License Ownership Restrictions Sec. 310(a)-(c)

(a) Grant to or holding by foreign government or representative

The station license required under this chapter shall not be granted to or held by any foreign government or the representative thereof.

(b) Grant to or holding by alien or representative, foreign corporation, etc.

No broadcast or common carrier or aeronautical en route or aeronautical fixed radio station license shall be granted to or held by -

(1) any alien or the representative of any alien;

(2) any corporation organized under the laws of any foreign government;

(3) any corporation of which more than one-fifth of the capital stock is owned of record or voted by aliens or their representatives or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country;

(4) any corporation directly or indirectly controlled by any other corporation of which more than one-fourth of the capital stock is owned of record or voted by aliens, their representatives, or by a foreign government or representative thereof, or by any corporation organized under the laws of a foreign country, if the Commission finds that the public interest will be served by the refusal or revocation of such license.

(c) Authorization for aliens licensed by foreign governments multilateral or bilateral agreement to which United States and foreign country are parties as prerequisite. In addition to amateur station licenses which the Commission may issue to aliens pursuant to this chapter, the Commission may issue authorizations, under such conditions and terms as it may prescribe, to permit an alien licensed by his government as an amateur radio operator to operate his

- **Ownership-** Section 310 provides that for a carrier to receive an FCC license, no more than 20% of its capital stock may be owned by foreign individuals, governments, or corporations organized under the laws of a foreign country.

- **Control-** A more recent amendment, Section 310(b)(4),[7] provides that a carrier may not receive an FCC license if it is directly or indirectly controlled by a corporation of which more than 25% of the capital stock is owned by foreign individuals, governments, or corporations organized under the laws of a foreign country, but only if the FCC finds that the public interest will be served by refusal or revocation of such a license. Without such a public interest finding, foreign control of a U.S. carrier is permitted in excess of the established 25% limit, even up to 100%, for common carrier, broadcast and aeronautical radio services.

Section 310 became a point of contention both domestically and abroad as U.S. policymakers in the 1980s and 1990s sought, through bilateral discussions and World Trade Organization (WTO) negotiations, to create and capitalize on a more fair and open international marketplace. During this time, the FCC started to identify the best way to encourage Congress, which was debating the rewrite of the Act, to "shift the focus of Section 310 from its original national security rationale to an approach which better accommodates global trends." [8]

amateur radio station licensed by his government in the United States, its possessions, and the Commonwealth of Puerto Rico provided there is in effect a multilateral or bilateral agreement, to which the United States and the alien's government are parties, for such operation on a reciprocal basis by United States amateur radio operators. Other provisions of this chapter and of subchapter II of chapter 5, and chapter 7, of title 5 shall not be applicable to any request or application for or modification, suspension, or cancellation of any such authorization.

[7] Pub. L. No. 93-505 (1974).

[8] Statement of Reed E. Hundt, Chairman, Federal Communications Commission (FCC). Testimony before the Committee on Commerce, Subcommittee on Commerce, Trade and Hazardous Materials, U.S. House of Representatives. 1995.

3.0 ADAPTING REGULATORY ENVIRONMENT

During the same general time frame that Congressional debate over revision of the Communications Act intensified, discussions were initiated in international trade talks to open up the telecommunications markets worldwide, and foreign administrations started expressing concern over how the proposed global satellite systems working with handheld receivers (i.e., the big low earth orbit systems) would be administered. In the United States, Congress passed the Telecommunications Act of 1996 to overhaul the Communications Act of 1934. In 1997, under the auspices of the WTO, 29 nations signed the WTO Basic Telecommunications Agreement to establish a timetable for opening their domestic telecommunications markets. Two years later, under the auspices of the International Telecommunication Union (ITU), a number of countries and companies signed the Global Mobile Personal Communications by Satellite Memorandum of Understanding (GMPCS MOU) to address the movement of mobile terminals across international borders.

These three actions have been included in the following chronology to illustrate the multi-dimensional aspects of how the U.S. regulatory environment has been adapting to the broader dynamics of globalization.

Foreign Carrier Entry Order[9]

Traditionally, the FCC's public interest determination focused on whether an applicant met certain technical, financial, and legal standards. In November 1995, 9 months after the WTO was established, the Foreign Carrier Enter Order added a new standard—"effective competitive opportunities" (ECO)—by which to regulate entry of foreign carriers into the U.S. market for international telecommunications services. The Order mandated that the ECO-test be applied to: (a) Section 214[10] applications filed by foreign carriers or their affiliates seeking to provide U.S. international services on routes where the foreign carriers have market power on the other end; (b) Section 214 applications filed by resale carriers, with foreign investment, to provide switched services over resold private lines; and (c) Section 310 (b)(4) applications for common carrier radio licenses involving indirect foreign ownership.[11] The ECO test allowed foreign applicants

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[9] *Market Entry and Regulation of Foreign-affiliated Entities*, IB Docket 95-22, Report and Order, 11 FCC Rcd 3873 (1995) (rel. November 30, 1995).

[10] 47 U.S.C. §214(a) (1994). Section 214 of the Act permits the FCC to license "construction of a new line or of an extension of a line"; acquisition or operation of any line or its extension; carriers to "engage in transmission over or by means of such additional or extended line"; or discontinuance, reduction, or impairment" of service.

[11] The ECO test for §214 applications by foreign carriers and affiliates foreign-owned in excess of 25% involves determining the existence of the following factors: (1) a law that permits U.S. carriers to offer international facilities-based services in the destination foreign country, (2) reasonable and nondiscriminatory charges, terms, and conditions for interconnection to a foreign carrier's domestic facilities for origination and termination of international services, (3) competitive safeguards in the foreign country to protect against anticompetitive practices, and (4) an effective regulatory framework in the destination country to develop, implement and enforce (1), (2) and

to enter the U.S. market only if their respective domestic markets offered effective competitive opportunities for U.S. companies. An application analysis was also to include a determination of the significance of the proposed entry to the promotion of competition in the U.S. communications services market, and "additional public interest factors" (i.e., Executive Branch concerns regarding national security, law enforcement, foreign policy and trade).

DISCO 1 Order[12]

The January 1996 DISCO 1 Order authorized U.S.-licensed fixed satellite service systems (FSS), mobile satellite service (MSS) systems, and direct broadcast satellite (DBS) systems to provide both domestic and international services. While national security issues were not raised in this proceeding, DISCO 1 demonstrated how U.S. regulators were responding to "the trend toward a globalized market." Until this order, two regulatory policies had been applied to U.S.-licensed satellite systems: (1) the Transborder Policy, 1981, which permitted U.S. domestic fixed satellites to provide limited international services within the footprint of the satellites, and (2) the Separate Systems Policy,[13] 1985, which permitted U.S.-licensed separate systems to provide a wider range of international services, but restricted their provision of domestic services. Both of these policies were related to U.S. obligations in line with the INTELSAT Agreement.[14] Even though distinctions between U.S.-licensed domestic and international systems were eliminated through DISCO 1, the satellite systems were still subject to intersystem consultations pursuant to the INTELSAT Agreement. Also, certain restrictions on the international services provided by separate systems were retained, although these restrictions have since been removed.

Telecommunications Act of 1996[15]

The U.S. Congress overhauled the Act of 1934 with the passage of the Telecommunications Act of 1996 (1996 Act). Foreign ownership was an issue Congress had explored, but the 1996 Act made limited changes to foreign ownership regulations. The 1996 Act removed the ban on aliens (non-U.S. nationals) serving as officers or directors of common carrier licensees or their holding

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(3). The ECO test for Section 310 (b)(4) includes the preceding §214 ECO factors and identifying a single "home market" for each foreign investor, conducting a service-by-service comparative analysis, and focusing in the first instance upon *de jure* restrictions on alien ownership. §214 applications to provide switched services via international private lines, regardless of any foreign carrier affiliation in the destination market, will be subjected to an equivalency test, which is essentially the same as the ECO test.

[12] *Amendment to the FCC's Regulatory Policies Governing Domestic Fixed Satellites and Separate International Satellite Systems et al.,* IB Docket 95-41, Report and Order, FCC 96-14 (rel. January 22, 1996).

[13] For more information, see *Amendment to the Commission's Regulatory Policies Governing Domestic Fixed Satellites and Separate International Satellite Systems*, IB Docket 95-41, Notice of Proposed Rulemaking, FCC 95-146 (rel. April 25, 1995).

[14] See 47 U.S.C. §§ 701-744.

[15] Pub. L. No. 104-104, 110 Stat. 56, codified at 47 U.S.C. §§ 151 *et seq.*

companies. It also disbanded local loop restraints (State and local regulations) and opened local loop competition to domestic and partly foreign owned telecommunications services companies.

WTO Basic Telecommunications Agreement

The WTO Basic Telecommunications Agreement was negotiated under the framework of the General Agreement on Trade in Services (GATS) that had brought trade in services into the international trading regime. Before GATS, the focus had been on trade in goods, internationally regulated by the General Agreement on Tariffs and Trade (GATT). The framework for a single global telecommunications market was established on February 15, 1997, when 69 developed and developing countries concluded negotiations on the WTO Basic Telecommunications Agreement. Charlene Barshefsky, the United States Trade Representative (USTR), declared that the fully enforceable Agreement (a) provide[d] U.S. companies "market access for local, long-distance and international service through any means of network technology, either on a facilities-based or through resale of existing network capacity"; (b) ensure[d] that U.S. companies "could acquire, establish, or hold a significant stake in telecom companies around the world"; and (c) include[d] pro-competitive regulatory principles "based upon the landmark 1996 Telecommunications Act. "[16] Commitments made by WTO members, in response to the WTO Basic Telecommunications Agreement, were varied. Domestically, the U.S. agreed to relax the 25% indirect foreign ownership limitation (§310 (b)(4)) for WTO Basic Telecommunications Agreement signatories.

Foreign Participation Order[17]

In anticipation of the January 1, 1998, start date of the WTO Basic Telecommunications Agreement, the Commission adopted an Order and Notice of Proposed Rulemaking, in June 1997, to bring the U.S. regulatory framework into agreement with WTO's global trade rules for telecommunications services. The FCC proposed to replace the ECO and equivalency tests with an open entry standard for WTO members seeking to enter the U.S. market and to strengthen the competitive safeguards to enforce this new standard. Five months later this Foreign Participation Report and Order on Reconsideration formally adopted the open entry standard for WTO member country applicants to enter the U.S. market. In a separate Report and Order,[18] referred to as DISCO II (see below), the Commission also established a uniform framework for foreign-licensed satellite systems seeking to enter the U.S. market.

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[16] Statement of Ambassador Charlene Barshefsky, "Basic Telecom [sic] Negotiations," February 15, 1997.
[17] *Rules and Policies on Foreign Participation in the U.S. Telecommunications Market,* IB Docket 97-142, Report and Order and Order on Reconsideration, FCC 97-398 (rel. November 26, 1997).
[18] *Amendment of the Commission's Regulatory Policies to Allow Non-U.S. Licensed Space Stations to Provide Domestic and International Satellite Service in the United States,* IB Docket 96-111, Report and Order, FCC 97-399 (rel. November 26, 1997).

Simply stated, the open entry standard was based on "a rebuttable presumption in favor of entry" by WTO member applicants. ECO tests would no longer be required for: (a) applicants for Section 214 authority from foreign carriers from WTO members; (b) authorization to exceed the Section 310 (b)(4) indirect foreign ownership benchmark; or (c) cable landing licenses. The FCC did, however, reserve the right to deny applications in exceptional cases where a particular application could pose a very high risk to competition in the U.S. market and where FCC safeguards and conditions would be ineffective. For non-WTO members, ECO and equivalency tests were retained. As before, the significance of the proposed entry was to promote competition in the U.S. communications services market and to factor additional Executive Branch-related public interest issues into the public interest analysis, as dictated under §310(b)(4) of the Act.

DISCO II Order[19]

The Commission issued a Notice of Proposed Rulemaking in May 1996, shortly after the domestically focused DISCO I decision, to address how non-U.S. licensed satellite systems could provide service to the U.S. market. Rather than requiring these foreign-licensed systems to also be licensed by the FCC, there was a proposal that their access to the U.S. market be addressed through the licensing of U.S. Earth stations to use the satellites. It was also proposed that an ECO-Sat test be applied to foreign applications, ensuring effective competitive opportunities for U.S. satellite systems in the home markets of each non-U.S. satellite, and on various route markets that non-U.S. satellites were seeking to serve from the United States. Before Earth station applications would be granted, under DISCO II, service-by-service analyses would be conducted for FSS, MSS, and DBS systems. To prevent interference with U.S. satellite systems and promote spectrum management, these systems would also need to comply with the technical and reporting requirements imposed on U.S. satellite systems. Additional factors might also be taken into account.

In July 1997, the Commission released a Further Notice of Proposed Rulemaking extending the terrestrially oriented open entry standard to non-U.S.-licensed satellite systems seeking to enter the U.S. satellite market. Four months later, in this DISCO II Report and Order, an open entry standard was formally adopted on "a presumption that entry by WTO member satellite systems will promote competition in the U.S. satellites services market." The Commission presumed that applications by investors from WTO member countries that exceeded the 25% foreign ownership limitation under Section 310 (b)(4) would further promote competition. The onus was placed on any opposing parties to demonstrate why granting an application would cause "a very high risk to competition in the U.S. satellite market," in which case the FCC could attach conditions on an application or deny an application altogether.

[19] *Ibid.*

Even WTO member countries that had not made specific domestic market access commitments for satellite services were included in the open entry standard, as were affiliates of intergovernmental satellite organizations (IGO), namely INTELSAT and Inmarsat.[20] Satellites licensed by non-WTO members and all satellites providing Direct-to-Home (DTH), DBS, and Digital Audio Radio Services (DARS) would remain subject to the ECO-test.

Global Mobile Personal Communications by Satellite Memorandum of Understanding

The GMPCS-MOU comprises international guidelines "intended to facilitate worldwide deployment and trans-border use of fixed and mobile satellite terminals and equipment."[21] In an attempt to facilitate deployment, the U.S. urged the International Telecommunication Union (ITU) to begin examining potential issues regarding GMPCS technology in 1996. The MOU was adopted under ITU auspices, in 1998 and is "designed to facilitate the mutual recognition and cross-border transport of GMPCS terminals providing voice, data, Internet and broadband services."[22]

Early in 1999, the FCC released a Notice of Proposed Rulemaking outlining guidelines for the "licensing, marking, certification, and customs treatment of GMPCS terminals."[23] Under this rulemaking, the FCC seeks to enable manufacturers to obtain a mandatory certification for GMPCS terminals sold or leased for use in the United States, through the FCC's equipment certification process. Similarly, all terminals brought into the United States are required to have the ITU Mark. The FCC has not yet issued a final ruling on this matter.

[20] Should COMSAT, the U.S. Signatory to INTELSAT and Inmarsat, seek to provide U.S. domestic service via INTELSAT and Inmarsat satellites, the corporation would be required to waive its immunity from suit and demonstrate that the service would enhance competition in the U.S. market. Inmarsat was privatized, effective April 15, 1999, and is no longer an IGO.

[21] *FCC Proposes Steps to Implement "GMPCS-MOU," Facilitating Deployment of New Global Mobile Satellite Services While Protecting Against Interference to Radionavigation Services,* IB Docket 99-67, International Action, Report IN 99-9 (rel. February 25, 1999).

[22] *Ibid.*

[23] *Ibid.*

4.0 FOREIGN COMMERCIAL ARRANGEMENTS

While the FCC was implementing the Telecommunications Act of 1996 and the WTO's Basic Telecommunications Agreement, new arrangements involving closer commercial and operational relationships between domestic and foreign telecommunications carriers emerged posing new domestic market entry issues.

The proposed merger between MCI Communications Corporation (MCI) and British Telecommunications plc (BT) was never completed due to the merger between MCI and Worldcom. Nevertheless a brief summary of the FCC's 1997 decision is included in this paper, because it set a precedent for reviewing national security, law enforcement, and public safety matters in more recent commercial arrangements. Subsequent national security conditions imposed by the FCC on transactions involving foreign entities were based on the agreement reached among MCI, BT, DOD, and the FBI. Such transactions include the Vodafone/AirTouch merger in June 1999, the AT&T/BT Joint Venture in October 1999, SatCom's access to a Canadian satellite in November 1999, and the Globalstar entry into the U.S. market in 2000.

MCI/BT Merger[24]

In mid-December 1996, the FCC issued a Public Notice inviting comments on a proposed merger of MCI and BT. As proposed, MCI would be merged into a U.S. subsidiary of BT and would become a subsidiary of a newly created U.K. company, Concert plc (Concert). At the time BT owned 20% of MCI, and non-BT foreign investors owned an additional 8%. MCI had been authorized to increase the level of foreign ownership from 28% to 35%. Because the merger required transfer of MCI's licenses and authorizations to BT, the Commission was required to determine whether the proposed transfer was in the public interest under the terms of Sections 214 and 310 and in accordance with the Cable Landing License Act. Further, inasmuch as the merger involved the entry of a foreign carrier into the United States market, at that time, an ECO analysis pursuant to the Foreign Carrier Entry Order was required.

In deciding to approve the proposed merger in September 1997, the Commission essentially applied the same analytical framework that had been applied in authorizing the merger between Bell Atlantic and NYNEX a month earlier. Relevant end-user markets (i.e., US-UK outbound international services) and input markets (i.e., the US-UK international transport market) were analyzed, and it was concluded that significant harm to these markets was unlikely. MCI's entry into the U.S. local exchange market was likely to promote competition locally; similarly, Concert's entry into the market for global seamless services was projected to have the same effect internationally. In addition, the Commission drew attention to the UK's pro-competitive

[24] The Merger of MCI Communications Corporation and British Telecommunications plc, GN Docket 96-245, Memorandum Opinion and Order, FCC 97-302 (rel. September 24, 1997).

regulatory policies and the existence of effective competitive opportunities for U.S. carriers in each of the markets that BT was seeking to enter in the United States.

Of most significance to this scoping paper, however, was an agreement that was reached among DOD, the FBI, MCI, and BT relating to national security, law enforcement, and public safety concerns. The Commission's grant of transfer of control of MCI licenses to BT was conditioned upon compliance with this agreement. In brief, the Agreement contained a number of requirements, including: (a) the location and domestic control of MCI and Concert facilities in the United States; (b) the adoption and maintenance of policies by those Concert subsidiaries providing domestic telecommunications services to prevent the improper use of Concert's network and facilities with regard to unauthorized electronic surveillance and unauthorized access to, or use or disclosure of, customer proprietary network information; (c) the adoption and maintenance of policies by MCI and Concert with regard to confidentiality and security of electronic surveillance orders and authorizations, orders, legal process, and statutory authorizations and certifications related to subscriber records and information; and (d) implementation of measures requiring personnel security clearances, secure storage facilities, and the prevention of access by unauthorized personnel to secure or sensitive network facilities and offices.[25]

Vodafone/AirTouch Merger[26]

In February 1999, Vodafone Group, Plc (Vodafone), a U.K. company, and AirTouch Communications (AirTouch), a U.S. company, filed applications to merge AirTouch with a Vodafone subsidiary to establish Vodafone Airtouch, Plc, a global wireless company, that would be owned equally by the former shareholders of each company. Four months later, the Commission found, under the terms of Sections 214 and 310, that the proposed merger was in the public interest and would pose no risk of harm to U.S. telecommunications markets. The merger would likely permit the companies to generate significant efficiencies that would likely result in expanded service options at competitive prices. In light of the Commission's Foreign Participation Order, and because the U.K. was a member of the WTO, it was presumed that the public interest would be served by authorizing Vodafone and U.K. shareholders indirect ownership up to 100%.

One of the conditions of this Order was compliance with an agreement among Vodafone, AirTouch, the DOD, DOJ, and the Federal Bureau of Investigation (FBI). The agreement required, among other things: (a) AirTouch facilities that are part of or are used to direct, control, supervise or manage all or any part of the domestic telecommunications infrastructure will be located in the United States; (b) control of the domestic telecommunications infrastructure and

[25] *Ibid.*, Appendix A.
[26] In re: Applications of *Airtouch Communications, Inc. and Vodafone Group, PLC.*, File Nos. 0000003690, *et al*, Memorandum Opinion and Order, DA 99-1200 (rel. June 22, 1999).

control over monitoring and diagnosis of problems will be performed in the United States; (c) reasonable and appropriate measures will be taken to prevent improper use of facilities used in the domestic telecommunications infrastructure, specifically with respect to personnel holding sensitive positions, information storage and access, and disclosures to foreign entities; (d) policies will be adopted and maintained with regard to confidentiality and security of electronic surveillance orders and authorizations, orders, legal process, and statutory authorizations and certifications related to subscriber records and information; and (e) measures requiring personnel security clearances, secure storage facilities, and the prevention of access by unauthorized personnel to secure or sensitive network facilities and offices will be implemented.[27] The Commission emphasized that the Agreement "reflects a unique situation and contains certain provisions that, if broadly applied, would have significant consequences for the telecommunications industry." Therefore, it should not be considered a precedent.

Globalstar Agreement

Because AirTouch is authorized, under FCC order, as Globalstar's U.S. service provider,[28] a side agreement was also made among Vodafone, AirTouch, the DOD, the DOJ, and the FBI regarding Globalstar satellite communication service offerings in the United States. The agencies had various law enforcement, public safety, and national security concerns associated with Globalstar handling "U.S. domestic telecommunications through two Canadian satellite communication gateways or any other terrestrial facilities located outside the United States."[29] Through terms of the agreement, Airtouch/Vodafone would not seek §214 authority to provide domestic services through its Canadian gateway facilities until the DOD, DOJ, and FBI were satisfied that law enforcement, public safety, and national security concerns had been addressed adequately. Furthermore, Executive Branch agencies would not approve §214 authorization unless Globalstar agreed to allow the U.S. Government to conduct electronic surveillance as stipulated under Federal law and adhere to other provisions in line with the Communications Assistance for Law Enforcement Act (CALEA).

[27] *Ibid.*, Appendix A.
[28] Under the Commission's blanket-licensing policy for Big LEO mobile Earth terminals, set forth in Sections 25.115 and 25.136 of its rules, authorizations are issued to Big LEO service providers, rather than to end users. End users operate the mobile terminals under derivative authority from the blanket licensees and may not transmit via Big LEO satellites without prior permission from the satellite licensee or authorized service vendor. (*Order and Authorization*, File No. 1367-DSE-P/L-97).
[29] Globalstar Agreement with the Department of Defense, Department of Justice, and Federal Bureau of Investigation. June 18, 1999.

AT&T/BT Joint Venture[30]

In early November 1998, AT&T and BT filed an application seeking Commission consent for the grant, transfer, and modification of certain licenses and authorizations in connection with a proposed joint venture between the two companies. VLT Co. L.L.C. (VLT), incorporated in Delaware and a subsidiary of a holding company based in the Netherlands, owned equally by AT&T and BT, would be assigned AT&T's ownership interests in: (a) cable landing stations in the United States and (b) submarine cable systems within the U.S. territorial limits. In turn, VLT would provide global facilities-based and resold international basic switched, private line, data television, and business services. TNV (Bahamas) Limited (TLTD), a Bahamas-based corporation, also a subsidiary of the Netherlands-based holding company, would be assigned: (a) AT&T's ownership interests in international submarine cable facilities outside U.S. territorial waters; (b) BT's ownership interests in international submarine cable systems outside the U.K. territorial limits; and (c) the two companies' operating agreements with various countries. In turn, TLTD would provide global facilities-based and resold international basic switched, private line, data television and business services. Lastly, License Co., another Delaware incorporated company, would be a wholly owned subsidiary of VLT and would be assigned AT&T's Earth station licenses.

In evaluating the proposed joint venture, the Commission applied essentially the same analytical framework that had been used in the proposed MCI/BT merger. Again, the intent was to determine if the proposal was in the public interest under the terms of Section 214 and Section 310 and in accordance with terms and conditions of the Cable Landing License Act. In conditionally approving the joint venture, the Commission concluded that the proposal would not eliminate a significant competitor in the growing global seamless services market nor would it pose a barrier to market entry.

DOD, DOJ, the FBI, AT&T, and BT reached an agreement regarding national security, law enforcement, and public safety concerns. The Commission's grant of the joint venture was conditioned on compliance with the DOD/DOJ/FBI Agreement which was, in many ways, similar to the earlier industry/Government agreements. In brief, the Agreement contained a number of requirements, including: (a) all domestic telecommunications infrastructure owned directly or indirectly by AT&T/BT would be owned and controlled by VLT and License Co. (collectively "the Company") and would be at all times located in the United States; (b) all telecommunications services to U.S. subscribers, carried over the Company's facilities, would pass through a facility, from which surveillance can be conducted, that is physically located in

[30] In the Matter of AT&T Corp., British Telecommunications plc, VLT Co. L.L.C., Violet License Co. LLC and TNV (Bahamas) Limited Applications For Grant of Section 214 Authority, Modification of Authorizations and Joint Assignment of Licenses in Connection With the Proposed Joint Venture Between AT&T Corp. and British Telecommunications, plc, IB Docket 98-212, Memorandum Opinion and Order, FCC 99-313 (rel. October 29, 1999).

the U.S. and under control of either the Company or a licensed U.S. carrier; (c) reasonable and appropriate measures would be taken to prevent improper use of facilities used in the domestic telecommunications infrastructure, specifically with respect to personnel holding sensitive positions, information storage and access, and disclosure to foreign entities; (d) policies would be adopted and maintained with regard to confidentiality and security of electronic surveillance orders and authorizations, orders, legal process, and statutory authorizations and certifications related to subscriber records and information; and (e) measures requiring personnel security clearances, secure storage facilities, and the prevention of access by unauthorized personnel to secure or sensitive network facilities and offices would be implemented.[31] As was the case in earlier decisions, it was indicated that the Agreement reflected a unique situation and should not be considered to be a precedent.

SatCom Access to a Canadian Satellite

In early March 1998, SatCom Systems, Inc, (SatCom), a U.S. company, applied for blanket authority to operate up to 25,000 mobile Earth terminals (MET) in the United States for communications through the Canadian-licensed mobile satellite, MSAT-1. In late March, TMI Communications and Company, LP (TMI), a Canadian company that owns and operates MSAT-1, applied for blanket authority to operate to 100,000 METs in the United States. The Commission granted the SatCom and TMI Earth station applications in November 1999, consistent with the framework of the DISCO II Order that was designed to consider requests for foreign access to the U.S. satellite market in a transparent and non-discriminatory fashion.

A condition of the license was compliance with the agreement between TMI and the DOJ and the FBI. The agreement was intended to ensure that SatCom and TMI's proposed use of a Canadian gateway, to switch, control, and route U.S. communications, would not "impair the U.S. Government's ability" to: (a) carry out lawfully-authorized electronic surveillance of domestic U.S. calls or calls that originate or terminate in the U.S.; (b) prevent and detect foreign-based electronic surveillance and espionage conducted in violation of U.S. law; and (c) satisfy national security and emergency preparedness (NS/EP) and U.S. infrastructure protection requirements.[32] Largely patterned after earlier industry/Government agreements, this agreement likewise requires TMI "to establish a point of presence [POP] in the United States, and to route to that point of presence all communications traffic emanating from TMI METs to which users domiciled in the United States subscribe." The POP will include a network switch "which has substantially the same functions as TMI's Canadian network switch" and shall be connected to TMI's Canadian gateway network "in such a manner as to

[31] *Ibid.*, Appendix B.
[32] In the Matter of the Applications of SatCom Systems, Inc. For Blanket Authorization to operate to 25,000 mobile satellite Earth terminals (MET) through Canadian-licensed satellite MSAT-1 at 106.5 degrees W.L., in frequency bands 1631.5-1660.5 MHz (transmit) and 1530-1559 MHz (receive) throughout the Continental United States, United States territories, Alaska, and Hawaii, File no. 730-DSE-P/L-98 (rel. November 30, 1999) Paragraph 55.

allow for the real-time switching of communications over TMI's mobile satellite network at TMI['s] U.S. POP and/or TMI's Canadian network switch." Costs for establishing the U.S. POP and for daily operations will be borne by TMI.

In 1999, besides TMI, the FCC authorized another non-U.S. satellite service provider, New Skies, to offer service within the United States. The Commission also developed a permitted list of U.S. and non-U.S. satellite systems whereby Earth station operators providing fixed satellite service in the conventional C- and Ku-bands would be able to access any of these designated satellites without additional Commission action, consistent with the technical parameters authorized in the Earth station licenses.[33]

In summary, except for the BT/MCI proposed merger, transactions discussed in this section were approved in line with foreign ownership regulations laid out by the Report and Order and Order on Reconsideration (FCC 97-398), in the matter of Policies on Foreign Participation, in accordance with the WTO Basic Telecommunications Agreement.

[33] Report on International Telecommunications Markets 1999 Update. International Bureau, Federal Communications Commission, DA 00-87, January 14, 2000. Prepared for Senator Ernest F. Hollings, Committee on Commerce, Science, and transportation, United States Senate.

5.0 NATIONAL SECURITY IN THE REGULATORY FRAMEWORK

The FCC recognized that opening the U.S. telecommunications market to foreign carriers involved national issues outside the parameters of traditional public interest analyses. In its 1995 Foreign Carrier Entry Order and subsequent orders, the FCC stated it intended to actively solicit the views of, and accord deference to, the Executive Branch in several areas that including a determination of the general significance of the proposed entry to promote competition in the U.S. communications services market and "additional public interest factors," including national security, law enforcement, foreign policy, and trade.[34] The Commission later clarified that it would make independent decisions on applications to be considered and evaluate concerns raised by the Executive Branch agencies "in light of all of the issues raised (and comments in response) in the context of a particular situation."[35]

The Commission expected that the Executive Branch would advise them of concerns "only in very rare circumstances" and that any such advice: (a) would occur only after "appropriate coordination" among Executive Branch agencies; (b) would be communicated in writing, and (c) would become part of the public file.[36] Normal Executive Branch review would be conducted within a 1-month period. The U.S. Trade Representative (USTR) indicated to the FCC, in comments filed in IB Docket 97-142, that it expected any Executive Branch concerns communicated to the FCC to be fully consistent with U.S. law and international obligations, including the WTO Basic Telecommunications Agreement.

With respect to Cable Landing Licenses, DOD stated that it was not necessary in every instance for the FCC to impose restrictions on ownership of cable landing stations. Should a concern arise in a particular situation, the procedures of E.O. 10530 would be adequate. DOD also suggested that conditions be imposed on foreign licensees along the lines of those that had been agreed between MCI, DOD, and the FBI, relative to the FCC's approval of the now defunct MCI/BT merger. The Commission assured that Executive Branch agencies would be given an opportunity to review proposed increases in foreign ownership of licensees who already exceed the 25% benchmark and of licensees who planned to exceed the 25% benchmark.

In the matter of Section 310 (b)(4) authorizations, the FBI identified "special national security concerns presented by foreign ownership or control of, or influence over, common carrier radio licenses": (1) foreign-power-sponsored interceptions of U.S. communications for intelligence purposes; (2) compromise of U.S. Government efforts to conduct electronic surveillance for law enforcement or national security purposes against foreign targets associated with the home country of a foreign-owned telecommunications carrier; (3) exposure to the home government of

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[34] *Rules and Policies on Foreign Participation in the U.S. Telecommunications Market*, IB Docket 97-142, Report and Order and Order on Reconsideration, FCC 97-398 (rel. November 26, 1997) p. 30.
[35] *Ibid*. p. 30.
[36] *Ibid*. p. 31.

the foreign-owned carrier of sensitive governmental and private sector information maintained in common carrier records, databases and central office facilities; (4) exposure of intercept capabilities and vulnerabilities of U.S. law enforcement and intelligence agencies; and (5) compromise of NS/EP functions that all telecommunications licenses are expected to perform in the event of a national emergency.[37] Notably, the FBI stated that the existing Executive Branch coordination procedures were adequate.

[37] *Ibid.* p. 47.

6.0 ADDITIONAL NS/EP COMMUNICATIONS OVERSIGHT

Committee on Foreign Investments in the United States

As discussed previously, a process to accommodate national security concerns of the Executive Branch has been formally incorporated into the FCC's regulatory process. Additional Executive oversight is provided through a Cabinet-level interagency committee—the Committee on Foreign Investments in the United States (CFIUS).

President Ford established CFIUS in 1975 to examine national security implications of mergers, acquisitions, and joint ventures involving foreign-owned companies. CFIUS is housed under the Office of International Investment at the Department of Treasury. Currently, the Committee is composed of the Secretaries for the Departments of Treasury (CFIUS Chair), State, Commerce, and Defense, the USTR, the Chairman of the Council of Economic Advisors, the Director of the Office of Management and Budget (OMB), and the Attorney General.

Any merger, acquisition, or joint venture involving a foreign entity is subject to Treasury regulations under 31 CFR Ch. VIII. Theoretically, parties involved submit information regarding the transaction to CFIUS. If CFIUS is not notified or allowed to review the transaction, theoretically, the deal remains open to investigation and possibly a later divestiture order.

CFIUS agencies have 30 days to independently review the proposed transaction. If any issues pertinent to national security are discovered, the Committee as a whole has another 45 days to investigate the proposed transaction and recommend further action to the President. The President, under the Exon-Florio Provision[38] (1988) has the authority, without judicial review, to unconditionally block mergers, acquisitions, or takeovers of U.S. businesses by foreign persons if they threaten to impair U.S. national security.

[38] Section 5021 of the Omnibus Trade and Competitiveness Act of 1988 amended §721 of the Defense Production Act of 1950, which was further amended by §837(a) of the National Defense Authorization Act for Fiscal Year 1993 (Byrd Amendment).

7.0 OBSERVATIONS AND RECOMMENDATIONS

U.S. government policy has adapted to an increasingly globalized telecommunications industry. Section 310's strict limits on foreign ownership and control of domestic telecommunications facilities were loosened in the Telecommunications Act of 1996, and again in the FCC's implementation of the WTO agreement. Today, under the right circumstances, a company controlled by a foreign entity can own domestic telecommunications facilities.

Simultaneously, the FCC regularly includes Government agencies with national security responsibilities (e.g., DOD, DOS, DOC, and FBI) in the decision whether to approve business combinations and other events that would create such foreign ownership or control. Agreements with security agencies are now an important part of the FCC's merger review process, exemplified by the MCI-BT-DoD-FBI agreement. These agencies have focused on assuring that management of the domestic telecommunications facilities remains in the United States, that the facilities remain subject to law enforcement efforts, and that access to these companies' premises is tightly controlled.

The current regulatory structure appears to satisfy the diverse interests of the parties. The companies generally are able to receive approval to conduct transactions involving telecommunications companies, subject to agreements with the defense and security agencies. The FCC is able to fulfill its role of protecting the public interest. And the defense and security agencies have the ability to exact the commitments they require to ensure national security.

It is not clear that any further statutory or regulatory changes would effectively enhance the role of national security issues in foreign ownership situations at this time. It is true that some issues are left to agency discretion and thus depend on the actions of the agency officials in place at the time a review is completed. Congress could more specifically spell out the type of considerations the FCC or other agencies should weigh in reviewing mergers and FCC license applications, but that would likely only limit the discretion of the defense and security agencies, which now are subject only to the traditionally broad national security analysis.[39] Given the robust role defense and security agencies now play in foreign ownership reviews, the current scheme appears to adequately protect national security and emergency preparedness.

[39] See, e.g., Moving Phones Partnership L.P. v. F.C.C., 998 F.2d 1051, 1056 (D.C. Cir. 1993) (national security concerns provided a rational basis for Section 310(b) restrictions on alien ownership of telecommunications licensees).

Table 1

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