THE PRESIDENT'S

NATIONAL SECURITY TELECOMMUNICATIONS

ADVISORY COMMITTEE

"LAST MILE" BANDWIDTH AVAILABILITY

TASK FORCE REPORT

March 2002

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EXECUTIVE SUMMARY

As we begin the 21st century, the Information Age continues to evolve, with organizations transforming their business practices to maximize the benefits of unparalleled communications and information-processing capabilities. Internet communications and access to high-bandwidth services have become a necessity for doing business in today's fast-paced environment, where technical, economic, and regulatory factors combine to form an increasingly complex and dynamic telecommunications marketplace. This report explores the factors surrounding the procurement and provisioning of high-bandwidth services at the local level, referred to as the "last mile," and offers recommendations for reducing the periods for obtaining such services.

In November 2000, the President's National Security Telecommunications Advisory Committee's (NSTAC) Industry Executive Subcommittee formed the "Last Mile" Bandwidth Availability Scoping Group, and later the "Last Mile" Bandwidth Availability Task Force, to undertake the following activities:

- Examine how the provisioning process is affected by economic and technological factors

- Recommend how Government might work with industry to reduce provisioning times or to otherwise mitigate the effects of extended provisioning periods

- Examine what policy-based solutions can be applied to the provisioning of high-bandwidth circuits for national security and emergency preparedness (NS/EP) services.

The provisioning periods for high-bandwidth services in the "last mile" are affected by a combination of complex factors.

The provisioning periods for high-bandwidth services in the "last mile" are affected by a combination of complex factors, such as intricate legislative, regulatory, and economic environments; challenging site locations; and contracting policies and procedures. The Telecommunications Act of 1996 sought to encourage competition; however, many carriers, both incumbent and competitive, are dissatisfied with the results. This, combined with a high level of marketplace uncertainty, has reduced investment by incumbents and competitors alike.

Current contracting arrangements also create difficulties. In many instances, contracts are only vehicles for ordering services and do not represent a firm commitment on the part of the Government to purchase a service. Because such commitments are not in place, the carrier cannot be assured of recovering its infrastructure investment. To expect a carrier to deploy high-bandwidth networks without signed customer orders assumes that the carrier will accept more risk than the economic situation may justify.

Furthermore, even when the business case warrants such investment, carriers are limited by contracts' failure to list the sites to be served or the types and quantities of services to be provided. Problems also occur because Government contracts legally bind the prime contractor but make no explicit demands on subcontractors on which the prime contractor depends.

Even when signed customer orders are in place, carriers assume a high level of risk. In many instances, current contracting procedures allow Government customers to cancel a service at any time during or after installation, which may prevent carriers from recovering their investment. Without stipulations that Government customers share the investment risk, this will remain a problem.

The Government is adversely affected by funding cycles that do not coincide with the time needed to obtain high-bandwidth services.

The Government is adversely affected by funding cycles that do not coincide with the time needed to obtain high-bandwidth services. Funding is not allocated until the user identifies an immediate need and obtains approval. However, the deployment of high-bandwidth infrastructure often requires years of planning and coordination for allocating capital, obtaining rights-of-way authority, and installing service facilities. The imperfect intersection of these inherently mismatched processes often results in lengthy provisioning periods.

The negative consequences of the funding process are often exacerbated by a fragmented management structure. In many cases, project managers are responsible for separate portions of the network, with no single entity responsible for planning or monitoring the provisioning of end-to-end service. Overall project management is vital to effective network deployment, systems integration, and achievement of project goals. Because telecommunications services are provided by a multitude of companies, users must track service orders and manage the network from a centralized perspective. An overall project manager is the only entity who can see the "total picture" needed to comprehend the complex factors affecting the provisioning process across the network. Without this understanding, the user organization cannot effectively mitigate the effects of the extended provisioning periods that sometimes occur in obtaining high-bandwidth services. Perhaps the most critical role for the project manager, however, is to engage end users and telecommunications service providers in joint planning sessions that enable each participant to share information and formulate network requirements. Although a concerted focus on overall project management will not eliminate problems that are beyond the control of both the user and the service provider, it will improve the efficiency with which services are obtained and mitigate the effects of "last mile" provisioning periods.

Many individuals within the NS/EP community question whether the Telecommunications Service Priority (TSP) System can be used to expedite "last mile" provisioning requests. TSP provisioning assignments are used by the NS/EP community to facilitate the expedited installation of telecommunications circuits that otherwise could not be installed within the required time frame. Although TSP seems to be an applicable solution for many NS/EP "last mile" bandwidth requests, TSP provisioning assignments *can only be applied to services originating from new business requirements*. Therefore, TSP provisioning cannot be used to replace or transfer existing services, such as those associated with the transition from the Federal Telecommunications System 2000 to the Federal Technology Service 2001 contracts.[1[1]] Finally, TSP cannot be used to make up for time lost because of inadequate planning or logistical difficulties. According to these parameters, many "last mile" provisioning requests are not eligible for the TSP System, even if the requested service could be used for executing an agency's NS/EP mission. An alternative for meeting Government organizations' service requirements may be the implementation of alternative technologies to fulfill bandwidth requirements on a temporary or permanent basis.

1[1] General Services Administration FTS 2001 Transition Bulletin. Issue #44. December 4, 2000.

On the basis of this analysis, the NSTAC offers the following recommendations.

NSTAC Recommendations to the President

The NSTAC recommends that the President, in accordance with responsibilities and existing mechanisms established by Executive Order 12472, *Assignment of National Security and Emergency Preparedness Telecommunications Functions* and other existing authority—

- Direct the appropriate departments and agencies, in coordination with industry, to reevaluate their communications service contracting and purchasing procedures and practices and take action to—

  – Provide sufficient authority and flexibility to meet their needs, consistent with current conditions

  – Allow long-lead-time ordering and funding commitments based on projected requirements

  – Allow infrastructure funding where necessary for anticipated future needs or to accelerate installation so that customer requirements can be met

  – Share or assume risk for new service capital investment to ensure timely delivery

  – Allow and provide for performance incentives for all performing parties: industry and Government, organizational and individual

  – Require end-to-end project management of communications service ordering and delivery.

- Direct the Federal Government Chief Information Officers Council to propose, and assist in implementing, improved Government contracting practices for communications services that will enhance the availability of broadband services for the "last mile."

In support of the recommendations, NSTAC suggests that both industry and Government encourage—

- Government contracting officers to engage all industry and Government representatives in joint planning sessions

- Industry representatives to work with Government contracting officers in joint planning sessions

- Use of a contract structure that makes all carriers involved in the delivery of the service parties to the contract with direct accountability to the Government contracting entity

- Contracting practices that require end users to identify requirements and to communicate future needs to network providers. End users and network providers should jointly identify complicating factors and discuss alternatives.

The NSTAC encourages Government to—

- Establish realistic service requirements and timelines and select the service options that meet its needs with acceptable risk.

- Convene a working group consisting of industry and Government stakeholders in the provisioning process to develop and recommend a streamlined approach to all aspects of the process, including planning, ordering, and tracking. The resulting proposal should be comprehensive, simplifying steps and organizations as much as possible; should share information appropriately at all points; and should support flexibility in meeting end-user needs. The working group should give strong consideration to a single Government database to support the process and a single point of contact, such as a phone number or an e-mail address, to ensure accuracy of information and provide exception handling.

- Establish or contract for project managers who have all necessary management control tools at their disposal; access to pertinent information; and experience, responsibility, and authority for obtaining and overseeing delivery of the end-to-end service. The project manager's responsibilities should include, among other functions, convening joint industry and Government meetings, executing site surveys, and troubleshooting problems as they arise.

- Modify its policies to support prudent advance investment in bandwidth capacity—especially local access bandwidth—to meet forecasted needs based on experience or other prudent factors (i.e., going beyond known requirements). Factors to consider should include known limitations in supporting infrastructure, suitability and availability of alternatives, and current or forecasted mission criticality.

The NSTAC encourages telecommunications service providers to work together effectively to plan infrastructure deployment based on identified needs.

1.0 introduction and charge

The late 20th century was an era of tremendous growth and change for the telecommunications industry. The development and implementation of technologies that optimized bandwidth capacity, coupled with the growth of the Internet and the widespread use of distributed computing applications, helped industry and Government achieve new levels of efficiency and productivity. As we begin the 21st century, the Information Age continues to evolve, with organizations transforming their business practices to maximize the benefits of unparalleled communications and information processing capabilities.

Internet communications and access to high-bandwidth services have become a necessity for doing business in today's fast-paced environment. It is estimated that bandwidth demand doubles every 3 to 6 months.[2[2]] Studies have shown that this demand is continuing to grow exponentially, leaving carriers unable to provision high-bandwidth services rapidly enough to meet user expectations.

The delivery of services at the local level, what is commonly referred to as the "last mile," presents the greatest difficulty in the deployment of high-bandwidth technologies. Technical, economic, and regulatory factors combine to form an increasingly complex, dynamic telecommunications environment, rendering long-term planning difficult. This report explores the factors surrounding the deployment of high-bandwidth services at the "last mile" and offers recommendations for reducing the provisioning periods for obtaining such services.

1.1 background

At the 23rd meeting of the President's National Security Telecommunications Advisory Committee (NSTAC XXIII) on May 16, 2000, several senior Government officials addressed the Government's reliance on commercial industry for the provisioning of high-bandwidth nodes and facilities. The Honorable Rudy de Leon, then Deputy Secretary of Defense, and LTG David Kelley, U.S. Army, then Manager, National Communications System (NCS), and Director, Defense Information Systems Agency, described the challenges encountered in deploying the Nation's Defense Information Infrastructure, both nationally and globally. Both officials asked the NSTAC how the Government should work with industry to ensure timely local access to high-bandwidth capabilities on the backbone networks. Subsequently, at the

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[2[2]] DeCarlo, Amy Larsen, and Brian Washburn. "The Blame Game." Teledotcom.com. http://www.teledotcom.com/521/features/tdc521_blame.html.

direction of the NSTAC Chair, the NSTAC's Industry Executive Subcommittee (IES) formed the "Last Mile" Bandwidth Availability Scoping Group, and later, the "Last Mile" Bandwidth Availability Task Force (LMBATF), to examine the Government's provisioning experiences in obtaining bandwidth in the "last mile."

Specifically, the NSTAC IES tasked the LMBATF to—

- Examine how the provisioning process is affected by economic and technological factors
- Recommend how the Government might work with industry to reduce provisioning times or otherwise mitigate the effects of extended provisioning periods
- Examine what policy-based solutions could be applied to the provisioning of high-bandwidth circuits for national security and emergency preparedness (NS/EP) services.

1.2 approach

The task force sought the participation of numerous industry and Government organizations to ensure that diverse perspectives and experiences were considered in the NSTAC's analysis. Participants of the task force included representatives of NSTAC member companies and designees of the NCS Committee for NS/EP Communications (formerly the Committee of Principals) and Council of Representatives. The task force asked these organizations (1) to provide examples of factors that hinder their ability to obtain high-bandwidth services and (2) to provide recommendations for mitigating

those factors.

The contributions of task force members and other industry and Government organizations that responded to the NSTAC's request for information were vital to this study. The NSTAC recognizes that the inability to obtain or provision services in a manner consistent with user expectations can present challenges and frustrations to both users and service providers and often results in contention among the parties involved. The NSTAC would like to acknowledge the task force members, participants, and guest speakers who participated in this study for their cooperative and professional approach and their commitment to reaching mutually beneficial conclusions and recommendations. A list of task force members and Government participants is provided in Appendix A.

In executing this study, the NSTAC attempted to capture the systemic contractual issues that pertain to the provisioning of "last mile" bandwidth, without providing any specific contractual information. The task force asked its members and contributors to draw insights and conclusions from their overall experiences. Because the input drew on a wide range of experiences, the NSTAC obtained pertinent information without compromising the proprietary nature of any of the involved contracts.

The NSTAC is grateful to Dr. Peter Fonash, Chief, Technology and Standards Division, Office of the Manager, NCS, who initiated an extensive study of the relationship between "last mile" bandwidth provisioning and contractual processes. This study and its recommendations were shared with task force members and provided valuable input to the NSTAC's analysis.

1.3 scope

The NSTAC's charge to the LMBATF specifically addressed bandwidth availability in the "last mile." The term "last mile" is not an official telecommunications term[3[3]] but has come to represent the telecommunications infrastructure between the customer and the telecommunications carrier's central office, a wireless provider's mobile telephone switching office, or the cable company's end office. For the purposes of this study, the term "last mile" refers to the physical infrastructure between the service provider's point of presence and the end user.

"Last mile" provisioning periods are an issue of potential concern for any service that is not universally provisioned throughout the United States.

Briefings and discussions clarified that concerns about the provisioning periods for "last mile" infrastructure deployment commonly focused on broadband services but also included other services that are not universally available. The NSTAC determined that the "last mile" provisioning periods are an issue of potential concern for any service that is not universally provisioned throughout the United States. Therefore, this study encompasses most non-universally provided services, including Digital Subscriber Line and Integrated

[3[3]] The term "last mile" is not defined in the Telecommunications Act of 1996, Federal Standard 1037C, the Federal Communications Commission Glossary of Terms, or the National Telecommunications and Information Administration Glossary of Terms.

Services Digital Network technologies, T-1 lines, T-3 lines, and fiber-optic cables, and the NS/EP community's ability to obtain those services.

In addition, in this report the NSTAC uses the term "high bandwidth" to signify the breadth of technologies covered in the study that might not otherwise be included in a broadband definition. This includes any service that is not universally available.

2.0 factors affecting provisioning periods

Many complex and interrelated factors affect the provisioning of high-bandwidth services, many resulting from the dynamic and evolving nature of the telecommunications landscape. Specifically, the NSTAC has found that the following factors affect the provisioning of high-bandwidth services—

- Challenging site locations
- The legislative and regulatory environment
- The economic environment
- Contracting policies and procedures
- Project management
- The applicability of the Telecommunications Service Priority (TSP) System
- The availability of alternative technologies.

2.1 challenging site locations

The ability to deploy high-bandwidth services is affected by numerous factors pertaining to the site location, such as the range and availability of the carrier's existing network, the physical landscape, zoning rules, and the demand for services within the area. Challenging site locations, including remote areas that are not easily served and urban areas that are highly congested, can result in longer provisioning periods.

Many provisioning requests cannot be satisfied without building new infrastructure. The competitive environment, coupled with the high cost of deploying a sophisticated network, encourages carriers to plan and build their infrastructure judiciously. Carriers do not build expensive networks until a need is identified and cost recovery can be ensured. Because of a lower demand in less densely populated areas, a supporting infrastructure may not exist in these locations; therefore, such locations often face longer provisioning times.

Remote and Rural Service Areas. The terms “remote” and “rural” generally characterize areas of limited population and, in some cases, of difficult terrain. In most cases, it is much more expensive to provide high-speed access (or even, in some cases, basic telephone service) to such areas than to areas with more concentrated populations and higher demands for services. Many rural and remote areas are served by large companies that have broad experience in serving such locations. However, in other cases, rural areas may be served by small companies that may or may not be highly sophisticated and advanced in their capabilities and deployments. The key issues in providing advanced capabilities in remote areas are the provisioning expense and cost recovery potential. Determinations and judgments about the viability of providing and obtaining services in rural areas should be made case by case on the basis of the applicable conditions, not on the basis of simplistic characterizations. Finally, in some locations, challenges in obtaining rights of way to install infrastructure may further delay service provisioning. Local regulations that seek to minimize construction and impact on the local infrastructure can also impede deployment.

2.2 legislative and regulatory environment

Given its potential impact on the Nation’s continued economic prosperity in the Information Age, the U.S. Congress and the Federal Communications Commission (FCC) have taken a keen interest in the widespread deployment of broadband technology and have examined various methods for encouraging its implementation. Incumbent local exchange carriers (ILEC) and competitive local exchange carriers (CLEC) agree that affordable broadband access for Government, business, and consumers is of critical importance to the country’s economic future.

As mandated by the Telecommunications Act of 1996 (the 1996 Act), the FCC annually reports on the status of broadband deployment and has instituted other measures to encourage broadband access. The 107th Congress is considering several legislative initiatives concerning broadband deployment and widespread access to high-speed Internet services. There has been an ongoing debate about how this goal can best be achieved. Proposed incentives, some specifically aimed at rural areas, include offering grants and loans and providing tax relief for planning and deploying services. The level of activity within Congress, the Nation’s regulatory bodies, and other policymaking arenas highlights the dynamic and unpredictable nature of the telecommunications environment, which often increases risks associated with planning and deploying advanced broadband services. Absent a compelling business case, carriers are unlikely to invest in additional infrastructure.

2.3 Economic environment

The current economic environment is a major contributor to the industry's reluctance to invest in new technologies. Because of the high cost of deploying fiber-optic networks, telecommunications service providers must more thoroughly evaluate the risk associated with each build-out. Service providers routinely accept certain levels of risk based on cost-benefit analyses and similar evaluations. However, if there is no explicit demand for the build-out of a high-bandwidth capability in a given area, carriers are likely to decline to make the investment. Explicit demand guarantees that deployment costs will be recovered. Because carriers will not accept more risk than the economic situation may justify, they cannot be expected to deploy high-bandwidth networks without signed customer contracts in place.

The competitive telecommunications environment has affected the deployment of "last mile" bandwidth through several other economic factors that vary in response to economic cycles. Consequently, the future impact of these factors cannot be predicted fully and accurately. Nevertheless, the NSTAC believes that the following factors will continue to impact provisioning periods—

Shortage of Optical Technology Components. The increased demand for bandwidth has directly increased demand for expensive optical network components, which require a complicated and intricate manufacturing process. As with many new technologies, production yields are often low. Although Internet traffic doubles every 6 to 9 months, the ability of vendors to develop and manufacture optical network equipment doubles only every 9 to 12 months, resulting in a significant backlog.[4][4]

Shortage of Information Technology Professionals. The increased demand for bandwidth in a highly competitive industry has resulted in a shortage of information technology professionals. Higher bandwidth serving structures tend to be unique in their details and require highly skilled technical individuals for quick and reliable installation. This need has been compounded by the surge in demand for high-bandwidth circuits throughout the industry. Industry simply has not

[4][4] DeCarlo, Amy Larsen, and Brian Washburn. "The Blame Game." Teledotcom.com. http://www.teledotcom.com/521/features/tdc521_blame.html.

been able to hire, train, and retain enough skilled technicians to satisfy the demand. In addition, the highly competitive nature of the industry makes it necessary to provide service at the lowest possible cost. These factors create a shortage in the availability of service technicians for installing and maintaining services.

Effects of Rapid Advances in Technology. The shortages described above are more difficult to address because of the rapid advances in technology. Demands for high-bandwidth in mass competitive markets require frequent transitions of technology and result in short service lives for investments compared with those for previous technologies. Ironically, the advances that make the services possible make them more difficult to install and maintain. The net effect is an engineering, deployment, and operational challenge on a scale never before encountered.

2.4 contracting policies and procedures

Government contracting policies and procedures directly affect the ability of Federal Government departments and agencies to obtain bandwidth in the most timely manner possible. The task force examined the factors that inhibit the contracting and provisioning processes and identified potential ways to ameliorate lengthy provisioning periods.

Factors considered by the task force range from seemingly simple to inherently complex. Each factor requires a concerted effort by industry and Government to improve the contracting and provisioning processes. The task force recommends that all industry and Government organizations engaged in the provisioning of services meet regularly in joint sessions to enable end users to identify requirements, communicate future needs to service providers, and identify and explore solutions to complicating factors. Similarly, telecommunications service providers involved in provisioning a service must effectively work together to plan infrastructure deployment based on clearly identified customer needs.

Information sharing is critical to shortening provisioning periods.

Several industry and Government user responses reflected that today's competitive telecommunications environment does not provide incentives for carriers to work together. It was also clear that not all carriers involved in providing the end-to-end service are parties to the applicable contracts. Therefore, such parties cannot be subject to the requirements therein. Often the "last mile" must be obtained by the prime vendor through contractual means other than those between the Government and the prime vendor or tariffed service offerings. Formal, joint-planning processes can institutionalize the information-sharing process, encourage interaction, and facilitate full exploration of the options available for resolving issues. A formal, joint planning process could also mitigate the following problems—

Fragmented Provisioning Activities. The task force found that numerous levels of coordination within the Government are required before the service is actually ordered, adding significant time to the overall provisioning process, which results in perceived delays by the end user. This process often becomes fragmented and disjointed, with similar responsibilities being assigned to multiple positions, creating further confusion. The separate organizations involved often maintain separate databases and use different procedures for authorizing service orders. Information is often manually transferred throughout the order process. In addition to creating longer processing periods, this fragmented, unintegrated approach facilitates the introduction of errors.

Lengthy and Disjointed Funding

Processes. Government funding is not allocated until a need is identified and adequately communicated to the approval authorities. The contract is merely the vehicle through which service can be ordered when needed; it is not a commitment to provision a given level of service. The provisioning process does not begin until the specific service is required and the funds are allocated. However, a carrier's deployment of high-bandwidth infrastructure often requires years of advance planning and coordination for allocating capital, obtaining rights-of-way authority, and installing service facilities. The intersection of these two inherently mismatched processes often results in lengthy provisioning periods.

Information sharing is often inhibited by funding and contracting processes.

Administrative Issues. Lengthy delays are often caused by administrative issues, including changes in the point of contact (POC) or location information, confusion over the service delivery date, and uncertainty surrounding the demarcation point.

Fragmented and disjointed management processes make it extremely difficult to coordinate service delivery and often introduce errors that slow down the provisioning processes.

Database Inconsistencies. The ordering and implementation processes often use multiple databases by both the user and the vendor. Because each database is configured to conform to the user's or the vendor's business practices, the conventions used in the various databases are inconsistent. The resulting interoperability and consistency problems can delay service delivery. Data frequently must be manually reentered into successive, multiple databases in processing orders. In addition, when questions arise about status or operational factors, there is no single, authoritative POC for resolution. Basic information, like the identity of the local designated POC and the POC's phone number, can easily become outdated because of the multiple databases.

Identified Contracting or Policy Needs. In many cases the local access providers are not parties to the contract under which service is being ordered. Consequently, they have limited (if any) participation in the planning and resolution process for Government requirements, and the Government has no direct contractual influence on or leverage over them. All parties involved should be aware of, and subject to, the contractual terms and conditions. The contractual vehicle should be structured to facilitate early and continual coordination among the carriers and the Government customer and flexibility in meeting requirements. Contracts should address mutually agreeable, time frames, pricing, incentives, exception handling, risk sharing, and where needed, up-front Government investment in infrastructure. An organized, streamlined Government project management must be complemented with contract vehicles that address these considerations.

Government policy and regulation create other contract-related constraints that contribute to problems in today's environment. For example, Government managers and contracting officials should have the flexibility to invest in bandwidth capacity in advance of establishing hard requirements when infrastructure lead times are known to be longer than usual or are unknown or when continuity of the missions serviced is critical. In addition, whenever services are being ordered, the Government managers and contracting officials should have the authority to overbuild capacity by large factors (e.g., 50 to 100 percent) based on coordinated planning, since even if the details for a given situation are not known at the time of ordering, experience suggests that requirements will grow. At the same time, Government must assume the risk of infrastructure capital expenses. Companies cannot be expected to build infrastructure at their own risk when the Government can cancel an order at any time, without regard to investment cost recovery. Military exercises frequently require even more specialized preplanning and pre-positioning of service capacity.

2.5 project management

Overall project management is vital to effective network deployment, systems integration, and service delivery. The disconnect between the funding and the provisioning processes makes effective project management by the Government difficult. In many cases, project managers are assigned responsibilities for separate portions of the activity, and generally no single entity actively plans and monitors   the provisioning of end-to-end service.

Although users order services as if they were commodities, available in quantity “off-the-shelf,” non-universally available services must be uniquely engineered and installed to meet the Government’s requirements, often before they are available in that area. When the Government procures services on a piecemeal basis, users must assemble an end-to-end service by centrally tracking service orders and provisioning activities. The user organization must designate a project manager to actively manage the architecture and the provisioning of services. Such an overall project manager is the only entity who can clearly understand the “total picture” and the complex factors affecting the provisioning process across the network. Without this clear and focused understanding, the user organization cannot minimize the impact of extended provisioning periods. Although a concerted focus on overall project management will not mitigate technical, economic, and regulatory problems that are beyond the control of the user and the service provider, it will, as described in this report, improve the efficiency with which services are obtained and shorten “last mile” provisioning periods.

Project Manager Responsibilities. The overall project manager is responsible for communicating information about user requirements and the existing and planned network architecture to ensure that the most effective solution is implemented. Similarly, the project manager should actively manage provisioning requests and follow up with telecommunications service providers as services are implemented.

Most important, project managers must work with end users and service providers to implement each provisioning request on a case-by-case basis after completing an analysis of the user’s requirements, the existing and planned telecommunications infrastructure, and the overarching factors applicable to the provisioning request, as described above. Because high-bandwidth services are not implemented as standard service offerings, but rather as customized solutions to specific client requirements, such services cannot be obtained with the same ease as more traditional services. A highly visible project manager will help to convey planning requirements and will also incorporate planning procedures into the provisioning process.

The assignment of responsibilities to an overall project manager will enable organizations to minimize the levels of bureaucracy that can impede the provisioning process. This, in turn, should diminish a problem noted by several study participants, namely, the difficulty in obtaining complete, accurate, and up-to-date project information during the provisioning process. This difficulty is generally a direct result of the fragmented and disjointed project management structure and is exacerbated by the number of databases used for ordering and obtaining telecommunications services. Organizations should strive to streamline and consolidate procedures, and eliminate as much bureaucracy as possible within the provisioning process.

In addition, they should review the number of databases they need to make or fulfill a provisioning request. Implementing one database that enables the project manager to access all the necessary information from a single source can shorten provisioning periods and reduce administrative costs associated with inaccurate information.

2.6 federal technology service transition process

The Federal Government began the transition from Federal Telecommunications System 2000 to Federal Technology Service (FTS) 2001 in June 1999. Since then, delays encountered in the transition have extended the transition period beyond the original December 2000 date. In a March 2001 study,[5[5]] the General Accounting Office (GAO) cited five factors contributing to transition delays. The last factor cited was "some local service providers outside the FTS2001 program did not provide services and facilities as scheduled that were needed to deliver FTS2001 services to discrete locations." The GAO was not tasked to identify potential solutions and offered no substantive recommendations for addressing this factor.

2.7 applicability of the tsp system

Many individuals within the NS/EP community question whether TSP can be used to expedite "last mile" provisioning requests. The TSP System rules[6[6]] mandate that telecommunications service providers give priority treatment to telecommunications circuits designated as critical to NS/EP, as defined by the FCC's criteria. TSP provisioning assignments are used by the NS/EP community to facilitate the expedited installation of telecommunications circuits that otherwise could not be installed within the required time frame. Under the TSP System, vendors must make their best effort to install essential services (those identified with a 1–5 priority) by the required due date. In rare cases, such as in the establishment of disaster field offices, TSP provisioning can be given emergency status. Vendors then must install the service as soon as possible because the service is required immediately.[7[7]]

The applicability of TSP depends on a number of issues. For example, if a provider does not offer a service to a particular area, TSP cannot be used to force the provider to offer the service. TSP also cannot be used to cause a provider to accelerate the deployment of services to its serving area.

[5[5]] GAO Report GAO-01-289. FTS2001 Transition. March 30, 2001.

[6[6]] Volume 47, U.S. Code of Federal Regulations, Part 64, Appendix A.

[7[7]] NCS Manual 3-1-1. Telecommunications Service Priority (TSP) System for National Security Emergency Preparedness (NS/EP) Service User Manual. May 5, 2000.

Although TSP helps resolve priority-of-effort issues, it is not effective in all situations. For example, it will not resolve a right-of-way issue or an equipment shortage problem.

> **The authority to implement alternative technologies to order services in advance could enable the Government to meet required time frames for obtaining high-bandwidth services.**

> **There are limitations to the use of TSP, and, as such, the TSP System may not be applicable in all "last mile" provisioning requests.**

Although TSP seems to be an applicable solution for many NS/EP "last mile" bandwidth requests, TSP provisioning assignments *can only be applied to services originating from new business requirements*. Therefore, TSP provisioning cannot be used to replace or transfer existing services, such as those associated with the transition from the Federal Telecommunications System 2000 to the FTS2001 contract.[8][8]
Finally, TSP cannot be used to make up for time lost because of inadequate planning or logistical difficulties. These parameters render many "last mile" provisioning requests ineligible for the TSP System, even if the requested service could be used for executing an agency's NS/EP mission.

The TSP Oversight Committee, which comprises representatives from NS/EP telecommunications service providers and Federal, state, and local government, discussed the use of TSP for eligible high-bandwidth provisioning requests at its April 25, 2000, meeting. The committee advised the OMNCS, which administers the TSP System, to review such requests on a case-by-case basis and to issue a TSP assignment for a non-universally available service only after consulting each of the parties involved.[9][9]

2.8 use of alternative technology solutions

As stated in Section 1.3, the NSTAC's study focused on the deployment of wireline services. Research showed, however, that non-wireline services could provide interim solutions and, in some cases, could fulfill the user's requirement for bandwidth. Appendix B, Alternative

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[8][8] General Services Administration FTS 2001 Transition Bulletin. Issue #44. December 4, 2000.

[9][9] April 25, 2000, TSP Oversight Committee Meeting Summary.

Technologies, describes service offerings that could facilitate deployment of “last mile” bandwidth.

3.0 CONCLUSIONS

Economic, regulatory, and technological factors affect the provisioning of "last mile" bandwidth services. The NSTAC developed the following conclusions based on its examination and analysis of circumstances surrounding development of "last mile"

infrastructure:

- Challenging site locations, including remote areas that are not easily served and urban areas that are highly congested, can result in longer provisioning periods.

- The dynamic and unpredictable nature of the telecommunications environment often increases risks associated with planning and deploying advanced broadband services.

- Economic incentives frequently argue against at-risk investment in facilities, and the contracts currently used do not enable Government to share the capital investment risk with the carriers.

- Government contracting policies and procedures directly affect the ability of Federal Government departments and agencies to obtain bandwidth in the most timely manner possible. Communications, early information sharing, and coordination of planning among all parties involved, including end users, local service providers, and interexchange carriers, are vital to shortening the provisioning periods for high-bandwidth services.

- Early information sharing is inhibited by the current funding and contracting processes.

- Many services require building out of the infrastructure over periods that exceed the normal funding cycles. Contract vehicles currently do not accommodate such building out of infrastructure. For instance, Government organizations cannot order long-lead-time services based on indefinite future requirements. In addition, current contracts do not prevent the Government from choosing not to order the service, canceling the order during installation, or discontinuing the service before sufficient time has passed to allow the carrier to recover its investment.

- The current management process is fragmented, leading to errors of coordination and omission. In particular, multiple management tools and databases can never be perfectly synchronized or offer a complete picture.

- The applicability of TSP to "last mile" provisioning requests must be addressed on a case-by-case basis. TSP cannot be used to make up for planning difficulties and is not a solution in every case.

- Greater flexibility should be provided to facilitate the use of alternative technologies or the advance ordering of services before final requirements are known in order to meet long lead times for implementation.

4.0 recommendations

Based on its analysis of the provisioning of high-bandwidth services in the “last mile” and the conclusions outlined above, the NSTAC offers the following recommendations to industry and Government.

NSTAC Recommendations to the President

The NSTAC recommends that the President, in accordance with responsibilities and existing mechanisms established by Executive Order 12472, *Assignment of National Security and Emergency Preparedness Telecommunications Functions* and other existing authority—

- Direct the appropriate departments and agencies, in coordination with industry, to reevaluate their communications service contracting and purchasing procedures and practices and take action to—

  – Provide sufficient authority and flexibility to meet their needs, consistent with current conditions

  – Allow long-lead-time ordering and funding commitments based on projected requirements

  – Allow infrastructure funding where necessary for anticipated future needs or to accelerate installation so that customer requirements can be met

  – Share or assume risk for new service capital investment to ensure timely delivery

  – Allow and provide for performance incentives for all performing parties: industry and Government, organizational and individual

  – Require end-to-end project management of communications service ordering and delivery.

- Direct the Federal Government Chief Information Officers Council to propose, and assist in implementing, improved Government contracting practices for communications services that will enhance the availability of broadband services for the “last mile.”

In support of the recommendations, NSTAC suggests that both industry and Government encourage—

- Government contracting officers to engage all industry and Government representatives in joint planning sessions

- Industry representatives to work with Government contracting officers in joint planning sessions

- Use of a contract structure that makes all carriers involved in the delivery of the service parties to the contract with direct accountability to the Government contracting entity

- Contracting practices that require end users to identify requirements and to communicate future needs to network providers. End users and network providers should jointly identify complicating factors and discuss alternatives.

The NSTAC encourages Government to—

- Establish realistic service requirements and timelines and select the service options that meet its needs with acceptable risk.

- Convene a working group consisting of industry and Government stakeholders in the provisioning process to develop and recommend a streamlined approach to all aspects of the process, including planning, ordering, and tracking. The resulting proposal should be comprehensive, simplifying steps and organizations as much as possible; should share information appropriately at all points; and should support flexibility in meeting end-user needs. The working group should give strong consideration to a single Government database to support the process and a single point of contact, such as a phone number or an e-mail address, to ensure accuracy of information and provide exception handling.

- Establish or contract for project managers who have all necessary management control tools at their disposal; access to pertinent information; and experience, responsibility, and authority for obtaining and overseeing delivery of the end-to-end service. The project manager's responsibilities should include, among other functions, convening joint industry and Government meetings, executing site surveys, and troubleshooting problems as they arise.

- Modify its policies to support prudent advance investment in bandwidth capacity—especially local access bandwidth—to meet forecasted needs based on experience or other prudent factors (i.e., going beyond known requirements). Factors to consider should include known limitations in supporting infrastructure, suitability and availability of alternatives, and current or forecasted mission criticality.

The NSTAC encourages telecommuni-cations service providers to work together effectively to plan infrastructure deployment based on identified needs.

APPENDIX A

TASK FORCE MEMBERS, GOVERNMENT PARTICIPANTS, AND OTHER CONTRIBUTORS

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AND OTHER CONTRIBUTORS

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APPENDIX B

ALTERNATIVE TECHNOLOGIES

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ALTERNATIVE TECHNOLOGIES

Based on an analysis of available service offerings, users may choose to obtain "last mile" bandwidth through alternative technologies, basing their selections on the underlying infrastructure, the level of competition for services within an area, pricing options, and physical topologies. Wireless and wireline technologies are not mutually exclusive—carriers with diversified networks can combine transmission methods to provide end-to-end service delivery.[10[10]] This appendix briefly describes alternative technologies.

Microwave Technology. Microwave technology is one of the most popular fixed wireless broadband applications. It provides a capacity of up to 155 megabits per second (Mbps) and a range of 5 to 100 kilometers. This technology includes frequencies whose wavelengths can be measured in centimeters or less—those from 1 gigahertz (GHz) to 300 GHz—and is used to transmit voice, data, and video signals via rooftop antennas. Microwave systems can transmit large volumes of data at the same speeds as fiber-optic cables. Because they provide service to locations where it is not economically feasible to install fiber, these systems provide a reliable alternative connection for rural areas. The higher the frequency, the greater its ability to transmit information. However, higher frequencies carry information across shorter distances and are less tolerant to adverse weather.[11[11]]

Provisioning microwave technology can cost 30 percent less than provisioning fiber for data services.[12[12]] However, microwave technologies pose a challenge with respect to service reliability. For example, such transmission requires line-of-sight placement of receiver and transmitter and can be severely impacted by weather-related interference. In addition, providers are restricted to those bands of frequencies that are licensed or allocated by the Government.[13[13]] However, microwave technologies could be suitable for remote site locations where a clear line of sight is available because of a lack of physical infrastructure.

Satellite Technology. Analysts predict that by 2003, less than 2 percent of the world's broadband customers will access the Internet via satellite.[14[14]] Satellites are ideal for delivering

10[10] Williamson, John. "Racing for the 'Last Mile.'"

Global Telephony. February 1, 2000.

11[11] "'Last Mile' Technologies." Telecommunications Strategic Planning. 1999. http://www.telsyte.com.au/feature/last_mile_a.htm

12[12] Keener, Adrianna. "Teligent to Cut Out 'Last Mile' Cost." The Business Journal. March 26, 1999.

13[13] "'Last Mile'Technologies." Telecommunications Strategic Planning. 1999.

14[14] "Look to the Skies." PC Magazine. January 19, 2001.

digital services to remote locations, or areas with difficult terrain, that fixed wire-lines cannot reach. Satellites used for this purpose are geostationary earth orbit (GEO), transmitting up to 155 Mbps; medium earth orbit (MEO), which supports transmission speeds from 9.6 to 38.4 kilobits per second; or low earth orbit (LEO), offering transmission of 16 to 155 Mbps.[15[15]]

The Federal Communications Commission (FCC) recently licensed the provisioning of data applications, including Internet access, through LEO and MEO satellites.[16[16]]

LEO satellite technology has many advantages. LEO satellites are less expensive to launch, propagation delay is kept to a minimum, and the equipment needed on the ground is more portable and less expensive. However, because the LEO satellite is closer to the Earth, it orbits more quickly and communication between the satellite and the dish is frequently lost. This last problem can be solved by using "necklaces"—a number of LEO satellites placed at equidistant points so that when one goes out of range, another comes into range immediately and picks up the signal. The necklace approach provides truly global coverage and is not limited by buildings, mountains, or other obstructions.[17[17]]

One of the primary issues for satellite transmission is the propagation delay, which can range from 250 to 500 milliseconds and cause quality-of-service problems with real-time applications, such as voice, and delay-sensitive protocols. In addition, reception can be greatly affected by bad weather.

Laser Technology. Laser technology uses a network of connectors to beam data between invisible lasers placed on rooftops or delivered through office windows. Rooftop nodes can be installed for around $30,000—less than most wireless radio systems—and can provide service to all of a building's occupants. Laser technology that can deliver dedicated high-speed links, with capacities of up to 1 gigabit per second, can be provisioned within a few weeks. The links are fairly short (between 100 and 500 meters), so inclement weather—including fog, rain, and

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15[15] '"Last Mile' Technologies." Telecommunications Strategic Planning. 1999.

16[16] "Handicapping the Race for the 'Last Mile.'"

17[17] The "Last Mile." Department of Computer Science, University of Glasgow. http://www.dcs.gla.ac.uk/~finniel/nct/satellite.html snow—does not seriously impede transmission. However, because the links are short, they cannot be used in more rural areas.[18[18]]

Laser networks provide a secure method of communication because such transmission has a narrow optical beam path. The narrow infrared beam is not accessible unless viewing directly into the transmission path. In addition, laser beams cannot be detected with spectrum analyzers or radio frequency meters. Various proprietary transmission protocols are also used to code the data being transmitted. Because of the secure transmission that laser networks often provide, they have been used for applications requiring confidential communications, including military and financial applications.[19[19]]

However, earthquakes, rainstorms, birds, and fog can all impede the ability of a laser network to allow its customers to communicate. Interruptions to the laser beam—through either blockage or misalignment—will instantly sever the flow of data. With respect to earthquakes, network operators can employ automatic tracking to keep the laser beam aligned through building sway or tremors. Fog creates greater difficulties for laser communication—the moisture acts as a prism and diffuses the light.[20[20]]

Spread Spectrum Technology. Spread spectrum technology can provide quick, high-speed wireless access to the Internet and is a cost-effective way of connecting the last mile.[21[21]] This technology has been used since the 1940s, primarily in military communications systems, where resistance to jamming is important. During the past 10 years, the FCC has allowed the technology's use for unlicensed commercial applications in specific microwave frequency bands. Spread spectrum technology uses wideband, noise-like signals. Such signals are hard to intercept or demodulate and, because they are noise-like, hard to detect. Further, spread spectrum signals are harder to interfere with than are narrowband signals. They are intentionally

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[18[18]] Bickers, Charles. "Tackling the 'Last Mile.'" Far Eastern Economic Review. December 21, 2000.

[19[19]] "'Last Mile' Network." PAV Data Systems Ltd. http://www.pavdata.com/Applications/Last_Mile_Network/last_mile_network.html

[20[20]] Bickers. "Tackling the 'Last Mile.'" Far Eastern Economic Review.

[21[21]] "ABCs of Spread Spectrum—A Technology Introduction and Tutorial." http://www.sss-mag.com/ss.html made to be much wider band than the information they carry, which makes them more noise-like.[22[22]]

Because spread spectrum technology spreads its signals over a wide frequency within its assigned bands, it transmits at a much lower spectral power density, measured in watts per hertz, than do narrowband transmitters. In addition, spread spectrum operates in the license-free 2.4 GHz band, which can be subject to interference from microwave ovens. The signals may also encounter difficulty in penetrating trees, heavy snow, or anything that contains water (since water absorbs a portion of the signal).[23[23]]

Spread spectrum technology provides very reliable signal transmission, with an error rate of 10^{-10} under ideal conditions. Its reliability is due to the redundancy built into the system—every bit of data is replaced with 16 bits of a special code. When the receiver filters the code, a few errors in the code word do not result in an errored data bit. The resulting signal is far less likely to contain errors than the signals of conventional radios.[24[24]] In addition, spread spectrum is effective in an urban environment because of its immunity to the multipath problems experienced by narrow microwave radios and its inherent resistance to interference. However, spread spectrum systems do not operate well in conditions where there are other spread spectrum systems operating in close proximity.[25[25]]

The low probability of intercept and antijam features with spread spectrum technology have great implications for privacy and account for this technology's military usage. Spread spectrum technology's resistance to jamming, interference, detection, and interception also makes it a robust link for many applications. Therefore, it has been adopted throughout the world for network connectivity, traffic, "last mile" applications, and establishing voice and data infrastructure.[26[26]]

22[22] "ABCs of Spread Spectrum—A Technology Introduction and Tutorial."

23[23] Glass, Brett. "Overcrowded Airwaves." PC Magazine. October 16, 2000.

24[24] "AirLink Spread Spectrum Technology: Clearing up Misconceptions." http://www.essentia.it/spread_spectrum_faq.htm

25[25] Glass. "Overcrowded Airwaves." PC Magazine.

26[26] "ABCs of Spread Spectrum—A Technology Introduction and Tutorial."