Telecommunications and Information Technology Planning

The telecommunications and information technology planning function represents the highest-level system or network perspective of the Institute. This work can be characterized generally as planning and analyzing existing, new, and proposed telecommunications and information technology systems, especially networks, for the purpose of improving efficiency and enhancing the technical performance and reliability of those systems. In many cases, ITS performs this work for both wireline and wireless applications. This portion of the ITS technical program encompasses work that is frequently referred to in industry as "systems engineering."

All phases of strategic and tactical planning are conducted under this work area; problem solving and actual implementation engineering also are done. ITS engineers identify or derive users' functional requirements and translate them into technical specifications. Telecommunication system designs, network services, and access technologies are analyzed, as well as information technologies (including Internet and Internet-related schemes). Associated issues, such as network management and control and network protection and privacy, also are addressed. Integration of individual services and technologies is a common task in many projects, along with the application of new and emerging technologies to existing applications.

Areas of Emphasis

Broadband Wireless Standards The Institute develops new radio propagation algorithms and methods that improve spectrum usage of wireless systems. Technical standards are prepared that support U.S. interests in broadband wireless systems. The project is funded by NTIA.

Network Interoperability The Institute identifies and provides unbiased perspectives for network interoperability problems of particular significance to U.S. interests and provides candidate approaches useful for resolving the problems. The project is funded by NTIA.

Network Survivability and Restoration The Institute uses traditional methods as well as network modeling and simulation tools to develop practical and effective ways to specify and assess the survivability performance and reliability of both wireline and wireless communications networks. This project is funded by the National Communications System (NCS).

Networking Technology The Institute defines a structured process for telecommunications and information technology planning and assessment studies, uses this process to identify needs for automated tools that aid in producing solutions that satisfy users' requirements, and prepares a handbook for performing the entire planning or assessment study process. This project is funded by NTIA.

Public Safety Telecommunications Interoperability Standards The Institute conducts a technical program aimed at providing effective interoperability and information-sharing among dissimilar telecommunications and information technology systems of the public safety community. The main thrust is the development of interoperability standards. Projects are funded by NTIA, NCS, and a Center of the National Institute of Justice – the Office of Law Enforcement Standards.

Railroad Telecommunication Planning The Institute performs radio infrastructure system planning in support of a high-speed rail pilot program, and demonstrates newly designed digital land mobile radio technology and infrastructure, compliant with TIA-102 standards, along the Pacific northwest rail corridor. The Federal Railroad Administration funds this project.

Telecommunication Terminology Standards The Institute develops automated web-page and e-mail procedures for updating FED-STD-1037C, *Glossary of Telecommunication Terms* (1996) and uses the procedures to produce a revised draft of the standard, now known as Proposed ANS *Telecom Glossary 2000*. This project is funded by NCS.

Broadband Wireless Standards

Outputs

- Preparation of technical standards and documents that support the U.S. interest in broadband wireless systems.
- Development of new radio propagation algorithms or methods that improve spectrum usage of wireless systems.

The wireless industry projects an explosive growth in wireless system use within the U.S. as more and more new users begin using wireless services. Figure 1 and Table 1 below provide industry data and projections on U.S. deployment of wireless services by subscriber numbers and penetration.

As users expect better quality voice service and more features such as caller ID and call forwarding, the wireless services providers have moved from analog modulation on single channels to digital modulation using a variety of channel access methods. All of these changes are made to improve the quality of the service, add features, and serve more users on the system.

Table 1. Growth in Subscriber Penetration for Wireless Services

	1998	2000	2002
Wireless service subscriber penetration in the U.S.	24%	35%	42%

The wireless industry has made projections on how they expect the rollout of technology to progress in the next few years, as shown in Table 2. Besides the number of users increasing, the types of services (beyond just voice communications) are increasing, with more emphasis on Internet-type uses. These new services require greater bandwidths (and more radio spectrum).

Table 2. Growth in Subscribers (North America) by Wireless Service Technology

Technology	1998	2000	2002
Advanced mobile phone service (AMPS), analog	53 million	42 million	24 million
Time Division Multiple Access (TDMA), digital	10 million	27 million	44 million
Code Division Multiple Access (CDMA), digital	8 million	27 million	52 million
GSM, a TDMA standard developed in Europe with worldwide use	4 million	10 million	20 million

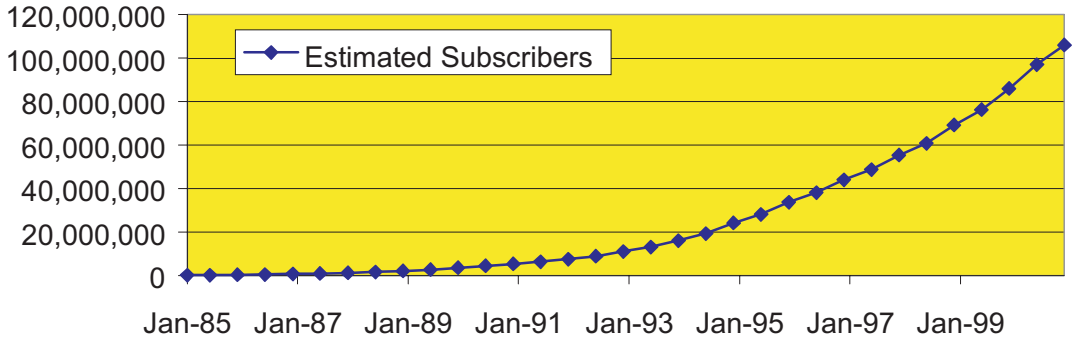


Figure 1. Growth in estimated number of wireless subscribers.

In order to predict wireless signal coverage more accurately, ITS and other research organizations are developing and evaluating propagation models that are more responsive to the needs of cellular and private land mobile radio service providers. A common model used by system planners is the ITS Irregular Terrain Model (ITM), also known as the Longley-Rice model. While a good predictor in irregular terrain, it does not have the capability to utilize land-use, land-cover databases to predict losses due to man-made objects. Another common model is the Okumura-Hata model. It is a good predictor in urban and suburban environments, but it does not handle irregular terrain nor does it handle changing environments, e.g., from urban to suburban to rural.

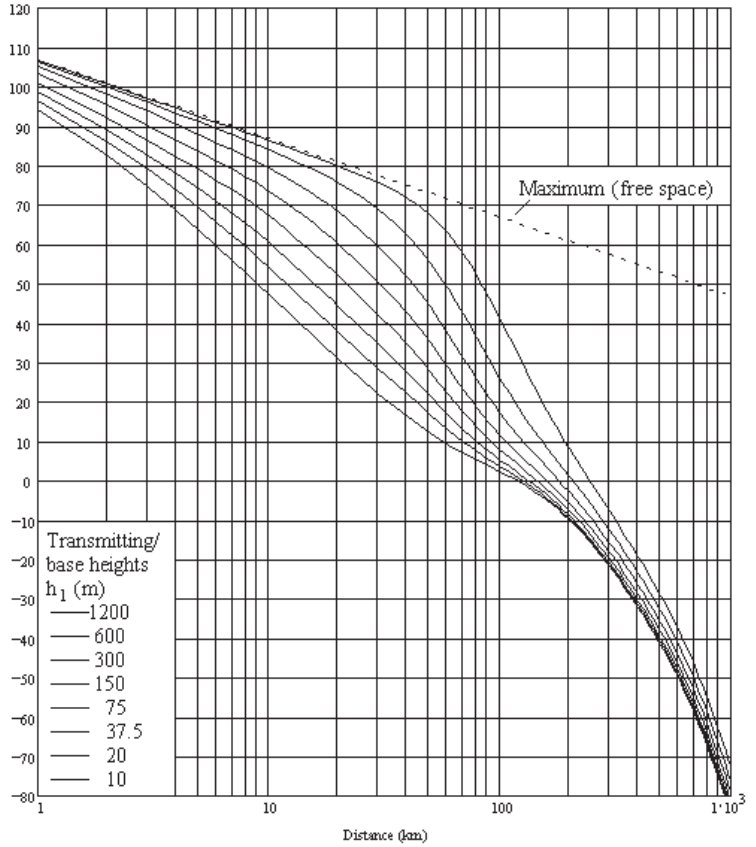


Figure 2. Predicted field strength values versus distance for mobile and broadcast systems over land at 2000 MHz for 50% of the time and 50% of locations.

Radio propagation predictions made using land-use, land-cover databases should estimate signal losses due to objects on a propagation path more accurately than predictions calculated without knowledge of the obstacles. The improved predictions allow service providers to better evaluate locations for base stations and to predict where additional base stations might be needed to fill in areas of inadequate signal coverage. ITS is evaluating the incorporation of land-use, land-cover databases into the ITM propagation prediction model to provide better estimations of signal loss. Although better databases are now available for land-use, land-cover descriptions, the signal loss associated with the various land-use, land-cover categories is not well known, nor is the loss versus frequency well known. ITS is also evaluating the means of incorporating land-use, land-cover information into the Okumura-Hata model, to make it more responsive to the changing environment.

Another effort supported by ITS is the international development of propagation prediction models that can be used by spectrum managers and system planners of both land mobile and terrestrial broadcast services. As the two services are becoming more similar in terms of RF equipment characteristics, it is appropriate to use the same propagation model for both services. The ITU-R Study Group 3 on Radio Propagation is developing such a model, which blends features that the two services have previously used independently of one another. Figure 2 shows an example prediction of field strength for various land mobile base station or broadcast transmitter antenna heights. The model, for example, can be used to effect coordination between services, countries, or systems in the same service.

For more information, contact:
Eldon J. Haakinson
(303) 497-5304
e-mail ehaakinson@its.bldrdoc.gov

Network Interoperability

Outputs

- Identification and assessment of emerging network interoperability issues.
- Resources supporting telecommunication and information technology system planning efforts.

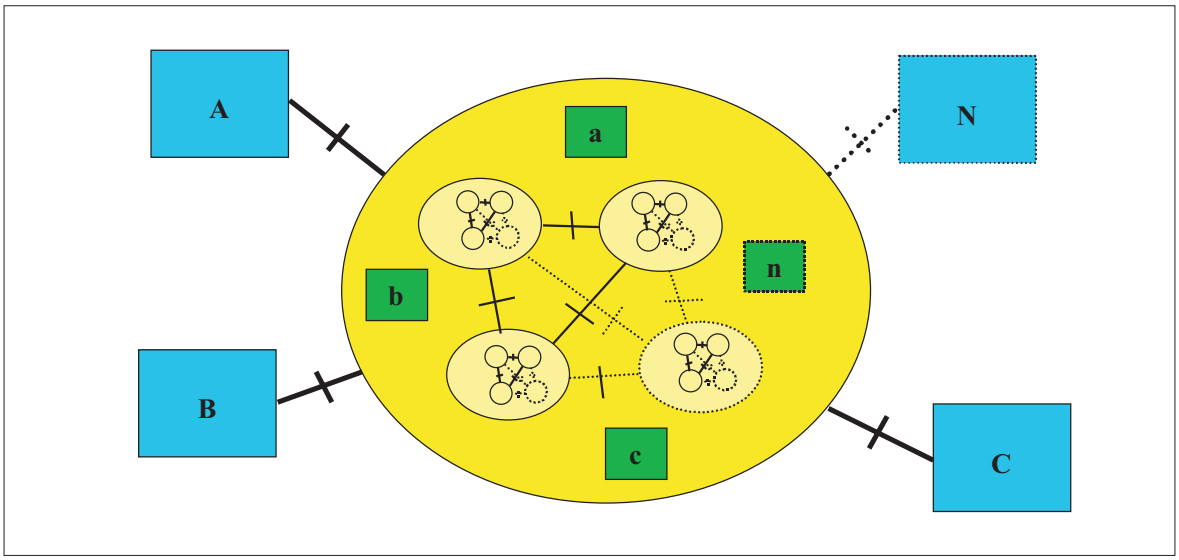
A nationally critical need exists for *interoperable* telecommunication services and equipment. Domestic economic and social growth depends greatly on emerging telecommunication and information technologies (IT). Interoperability is required to perform a variety of telecommunication functions that meet user needs, including the end-to-end transport of user information involving multiple, heterogeneous network technologies and supported multimedia applications.

The current lack of interoperability among systems is a serious concern in the public safety community, whose members may experience difficulties communicating with others from different jurisdictions. But this problem also occurs more subtly throughout many other systems worldwide, especially due to unprecedented innovation in technology and demand for advanced services and equipment. Federal agencies (and state and local governments) need guidance regarding the most effective way(s) to interoperate among dissimilar systems. This guidance also will be of value in matching customer needs with offered telecommunications and IT service and equipment in both the public and private sectors.

The problem of interoperability has become an increasingly important technical challenge in the design, procurement, and operation of advanced wireless systems, including those systems that rely on terrestrial (wireline) elements to provide a large network configuration. This is essentially the networking problem associated with wireless communications: How can wireless communication networks interoperate? Can transmission or signaling technologies such as transmission control protocol (TCP), Internet protocol (IP), Internet control message protocol (ICMP), asynchronous transfer mode (ATM), and signaling system no. 7 (SS7) be used to facilitate interoperability?

In consideration of such needs and challenges, the Institute recently established a long-term program to address — from an unbiased perspective — network interoperability problems of particular significance to U.S. interests and to provide candidate approaches useful for resolving those problems. For the short term, the program's focus is on conducting studies of the wireless-to-wireline incompatibility dilemma involving not only the protocols involved with the transfer of traffic across different networks but also the performance and migration path implications. Because the understanding of critical interoperability-related problems requires ongoing technical efforts, continuing studies in a variety of technical areas will be necessary. Collectively, these studies will enable the timely dissemination of relevant research results in support of both public and private sector interoperability efforts, and will involve (1) technology forecasting and assessment, (2) consideration of design, operation, maintenance, and migration issues associated with public and private networks, (3) evaluation of standards-related processes and products, (4) research, development, and application of promising new communication technologies, and (5) interoperability characterization, including the analysis and testing of specific communication systems (i.e., requirements and implementations). Overall, the program is intended to promote deployment of interoperable public safety and criminal justice hybrid communication systems, broadband wireless technologies to rural areas, and public and private telecommunication systems that meet national security and emergency preparedness needs.

Interoperability issues involve two basic facets: the *exchange* and *use* of information, as illustrated in the Figure. An initial study framework has been established, taking into account the mutually interacting related aspects of *plans, infrastructures,* and *practices.* The planning process involves consideration of both endogenous and exogenous factors that affect the users' and providers' development of business plans (strategic and tactical), interoperability requirements (technical and process), technical architectures (system and component), service definitions and implementations, and standards (technical and process), taking into account infrastructures and practices. The infrastructure development process



Interoperability involves consideration of how information is exchanged (through networks of networks) and used (through user-based (A, B, C, ..., N) and network-based (a, b, c, ..., n) applications and services). Interoperability issues involve, for example, specification of protocol suites, provision of basic and enhanced services, secure information exchange among authorized users, user selection of transit networks and content providers, connection admission control, end-to-end quality of service, network management, and user data element format, processing, and storage/retrieval.

involves the users' and providers' development and implementation of prototype and operational systems, taking into account plans and practices. A key perspective in assessing infrastructures is to analyze services, architectures, and implementations, extant and planned. Practices are users' and providers' short- and long-term activities (offering and use of services and equipment), taking into account plans and infrastructures. Importantly, practices provide the operational and management experiences essential for the planning process. Collectively, the framework recognizes the complexity of issues affecting the rate at which innovative new candidate technologies are adopted while legacy systems are retired (i.e., forces affecting system migration).

During FY 2000 a preliminary framework, including a broad survey of supporting concepts and industry activities, useful for the characterization and analysis of interoperability issues was developed (highlighted above). Additionally, a preliminary assessment of techniques and technologies that may be effective in facilitating interoperability was conducted. Initial results have been disseminated with the primary audience being ITS telecommunication/IT system planners.

During FY 2001 an emphasis will be placed on advancement of the initial results including evaluation of candidate techniques and technologies that address interoperability issues in defined baseline and operational telecommunication/IT systems. Specific areas of interest include the identification and assessment of interoperability-related issues as they affect multi-network (e.g., wireless and wireline) provision of dynamically requested end-to-end quality of service associated with emerging multimedia applications, internetworking of IP-based and telephony-based networks, and technology forecasting of the increasingly diverse set of networking technologies that collectively compose the rapidly evolving global information infrastructure .

For more information, contact:
Randall S. Bloomfield
(303) 497-5489
e-mail rbloomfield@its.bldrdoc.gov

Network Survivability and Restoration

Outputs

- Technical Contributions to ANSI Working Group T1A1.2.
- Technical report to NCS defining traffic engineering techniques to enhance network survivability performance.

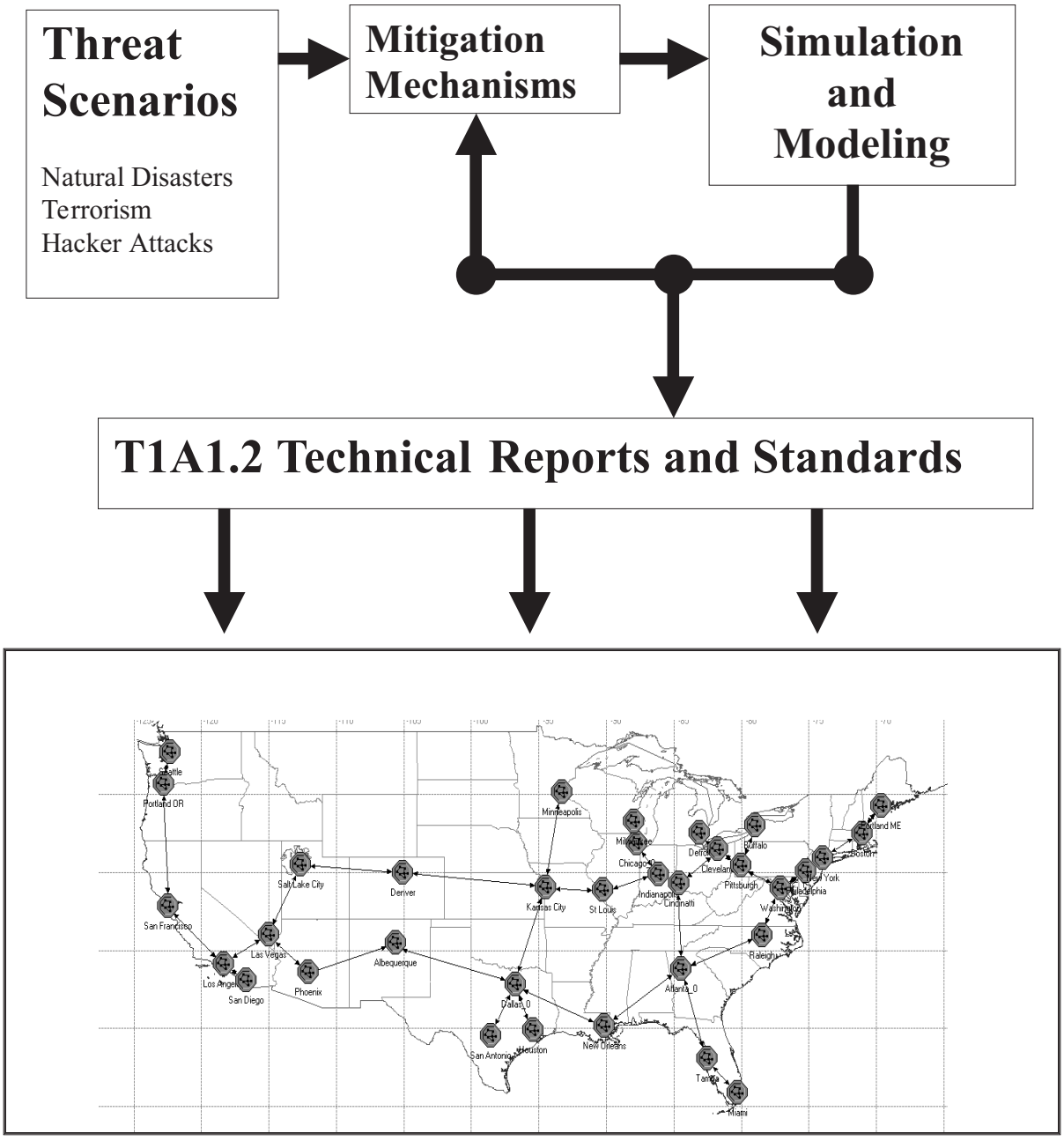
As the world becomes more dependent on communications and computer networks, there is a growing concern about the potentially devastating effects of network failures. Failures can occur as the result of natural disasters (flooding, hurricanes) or as the result of human action (war, terrorism, hacker attacks) or even by unintentional failures in software or control systems. The need for voice, video, and data messaging systems offering high reliability and high capacity is growing dramatically. Existing standards do not provide effective survivability performance measures and, as a result, congested networks can break down under heavy traffic loads. Multivendor environments create the potential for interoperability problems as well. The ANSI-accredited Standards Committee T1 (Telecommunications) Working Group T1A1.2 (Network Survivability Performance) is working to meet these challenges with simple but effective performance metrics for use in the design of survivable networks.

The National Communications System (NCS) asked ITS to participate in and develop technical contributions to T1A1.2 in order to provide more practical and effective ways of specifying and assessing the survivability performance and reliability of both wireline and wireless communications networks. ITS is helping to motivate, strengthen, and extend the work of T1A1.2. The results will advance national security and emergency preparedness (NS/EP) goals by making network survivability — and the potential benefits of survivability enhancement techniques — more quantifiable. This work supports NCS in its mission to protect the national security telecommunications infrastructure, and to ensure the responsiveness and survivability of essential telecommunications during a crisis.

Since modern networks have become so complex, traditional analysis methods are not adequate to predict the effects of service outages. Therefore, in addition to traditional methods, ITS is using network modeling and simulation tools to address the needs of T1A1.2, NS/EP, and the nation. While modeling and simulation are powerful tools for the assessment of threats and mitigation techniques, the simulations need to be well-grounded in the physical measurement of important parameters. This is an area where other project work at ITS can be utilized to help meet the needs of this project. The Figure shows one approach taken in the Network Survivability and Restoration project.

During FY 2000 ITS presented several technical contributions to T1A1.2. These included inputs to the T1 Technical Report on Enhanced Network Survivability Performance — now out for T1 Letter Ballot. Recent contributions to T1A1.2 focused on the new Draft Technical Report on Reliability/ Availability of IP-based Networks and Services. These contributions covered several topics including historical perspectives on network survivability, traffic engineering and queueing theory as it relates to packet networks, and terms and definitions for the new report. An ITS engineer currently serves as the editor of this Technical Report.

In FY 2001 ITS will continue to address network survivability and the measurement of its performance. In addition, many issues associated with the multiple vendor community are arising in this new networking and Internet environment. The work on survivability performance must of necessity be conducted with the help of representatives from network providers as well as NCS. The work in FY 2001 will focus on survivability of IP and other packet-based networks as well as address NS/EP concerns in wireless networks. Network modeling and simulation tools will be used extensively to validate proposed methods for network survivability enhancement.



Survivable Networks

System diagram for Network Survivability and Restoration project.

For more information, contact:
Arthur A. Webster
(303) 497-3567
e-mail awebster@its.bldrdoc.gov

Networking Technology

Outputs

- Definition of structured planning process for telecommunication and information technology networks.
- Identification and description of automated tools to assist network planners.
- Handbook for telecommunication and information technology network planning.

The Institute has a rich history of performing telecommunication planning and assessment studies for other organizations – our customers. But, the complexity of today's telecommunication and information technology (hereafter referred to as "telecom and IT") requirements, and the technology available to satisfy those requirements, create demands for enhanced sophistication in the methodologies and tools used to perform these studies. The Networking Technology project has defined a structured planning process for such studies, examined many automated tools that *could be used* in conducting such studies, and identified those tools determined most likely to provide the greatest benefits. The results, conclusions, and recommendations are contained in a document entitled *A Telecommunication and Information Technology Planning Process*, intended to become an NTIA Report.

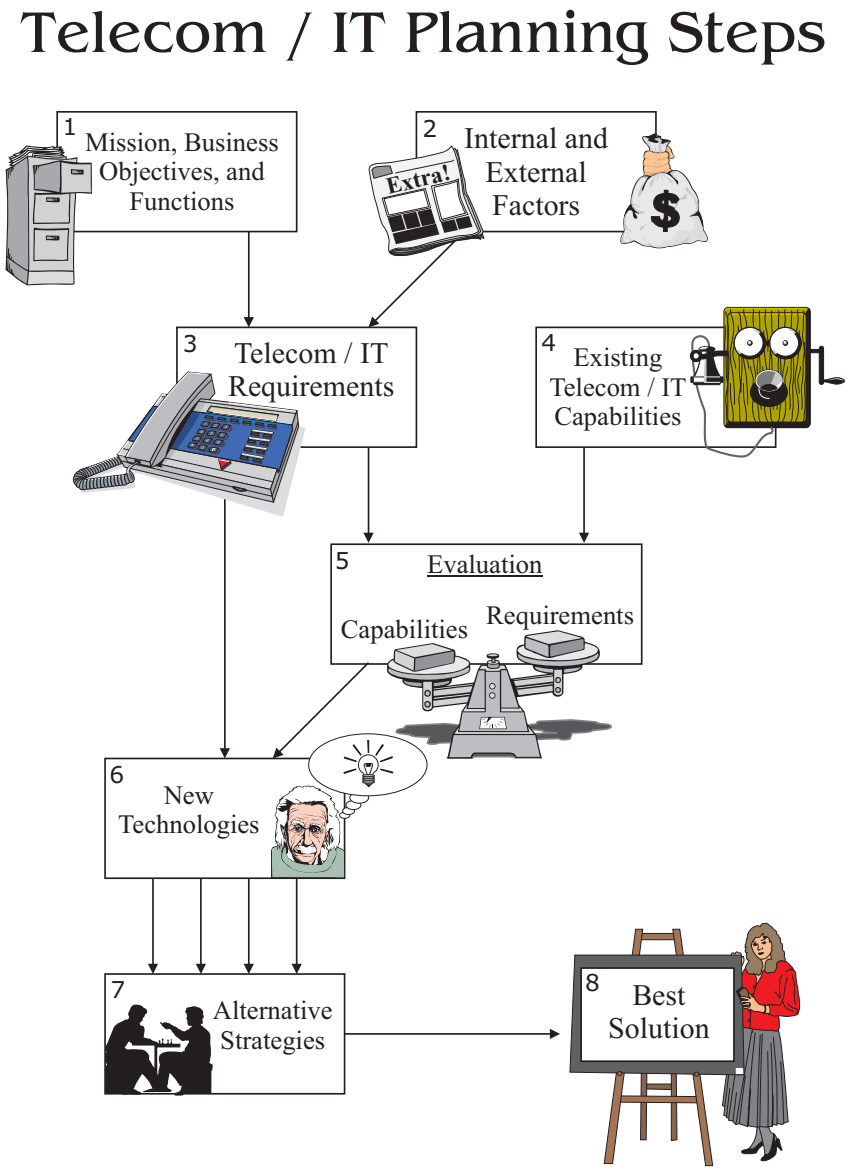
The eight steps of the structured planning process are illustrated in the Figure. The first step is to identify mission, business objectives, and functions of an organization for which planning is being undertaken. This information *about* an organization must be obtained from the organization, working with its managers. The second step is to identify and assess all internal and external factors that will influence the organization's telecom and IT requirements. There may be constraints such as available funds, internal policies, or external regulations (local or governmental). The third step is to use the information from the first two steps to define the organization's functional requirements (requirements for *types of capabilities,* not *specific capabilities* which are defined in step 7).

Next, the organization's existing telecom and IT capabilities – systems, networks, services – and practices must be identified and defined. The fifth step is to evaluate the existing capabilities and determine if the requirements *can be satisfied* – through modified utilization and practices, perhaps. The likely conclusion is that the requirements *cannot be satisfied* with existing capabilities. Step 6, then, is identification of (new) technologies that can satisfy the organization's telecom and IT requirements. In step 7, alternative strategies/solutions for satisfying the requirements are constructed and evaluated. Finally, step 8 is the selection and recommendation to the organization of the "best" solution for satisfying their telecom and/or IT requirements. This solution, with an Implementation Plan, must be presented to the organization's managers for approval.

There are many automated tools available to assist planners in the work they must do to identify and evaluate existing capabilities (steps 4 and 5) and while constructing and evaluating alternative solutions (step 7) to satisfy requirements. These automated tools are of two general types: (1) tools for discovering the topology of existing networks and monitoring utilization, availability, and traffic features of these networks, and (2) tools for modeling a network and predicting its performance. Evaluations of expected network performance may be based on discrete-event simulation, analysis-based modeling, or a combination (hybrid) of these technologies.

Much of the research done in FY 2000 has been to identify available tools for the purposes noted, select a subset of those tools considered most likely to enhance ITS' capabilities for network analysis (particularly as a part of planning and assessing networks to satisfy requirements for telecom and IT services), and research information to more thoroughly understand and describe (evaluate) the capabilities of this subset of tools. Nearly 70 prospective tools were identified and studied briefly. Detailed technical information has been prepared for 26 tools (representing 16 tool-developing organizations) – 20 network modeling and simulation tools and 6 network discovery and monitoring tools. The results of this research will be published as an ITS handbook.

As a result of various synergistic relationships in ITS projects and programs, the Institute has operational software for three of the tools identified (not necessarily the best – nor the worst – tools to satisfy the Institute's goal of developing enhanced capabilities for network analysis). The first tool has extensive capabilities for creating a network model and conducting a discrete-event simulation to predict the network's performance. The second is a network discovery and monitoring tool purchased to assist in monitoring and managing the ITS LAN. The third is the Communication System Planning Tool (CSPT, described on pp. 46-47), developed at ITS for modeling and predicting the performance of modern wireless systems and networks as part of our research work to develop improved propagation models and enhanced capabilities for assisting our customers in solving their telecom and IT problems.



Steps that define a structured telecommunication and information technology planning process.

The Institute is considering acquiring two additional types of tools to further enhance its capabilities for telecom and IT network analysis and planning. These are as follows: (1) an analysis-based (or hybrid technology) network modeling and analysis tool (to complement the discrete-event simulation tool that the Institute currently owns) and (2) a network monitoring tool to measure the characteristics of traffic in an existing network.

For more information, contact:
Val J. Pietrasiewicz
(303) 497-5132
e-mail valp@its.bldrdoc.gov

Public Safety Telecommunications Interoperability Standards

Outputs

- Voice and data encryption standards.
- User requirements documents for wireless telecommunications and information technology (IT) interoperability.
- Specifications for Interoperability Process and Procedures testing of public safety radios.

With the explosion of telecommunications and information technologies has come a disturbing trend – a lack of interoperability among systems. This is demonstrated most dramatically in the public safety community, as police and other agencies fail to communicate with each other during multi-jurisdictional events. Even when calamities do not occur, however, daily interoperability problems continue to plague public safety agencies nationwide. ITS is conducting a technical program aimed at providing effective interoperability and information sharing among dissimilar public safety telecommunications and information technology systems. The key to the program is the identification and/or development of interoperability standards to allow local, State, and Federal agencies to exchange information, without requiring substantial changes to internal systems or procedures. The ITS program is sponsored by three Federal agencies: the National Communications System (NCS), NTIA, and the National Institute of Justice (NIJ) (through its Advanced Generation of Interoperability for Law Enforcement (AGILE) Program). The three projects are summarized below.

National Communications System support

The Institute is assisting NCS's Technology and Programs Division (NCS-N2) in developing a comprehensive series of interoperability standards for digital land mobile radio (LMR) for public safety applications. Next generation LMR standards are being developed by the Federal Government, in conjunction with industry and local and State governments, within a group called Association of Public-Safety Communications Officials/National Association of State Telecommunications Directors/Federal (APCO/NASTD/FED) Project 25. This project consists of three phases. Phase 1 of Project 25 has been completed. It included the development of a comprehensive set of standards for 12.5 kHz digital LMRs. Phase 2, in progress, is developing a set of interoperability standards for narrowband (6.25 kHz) digital LMRs; standards defining TDMA radios with an equivalent 6.25 kHz/channel efficiency may be developed. ITS efforts have mainly supported Phase 2. Phase 3 (sometimes referred to as "Project 34") has also begun, and is focused on the development of standards for wideband mobile data applications.

The NCS, Federal law enforcement agencies, and the National Security Agency (NSA) with assistance from ITS are participating in the development of these standards, and are taking the lead in the development of related Information System Security (INFOSEC) standards. An ITS representative chairs the Project 25 Encryption Task Group and works closely with its members in developing Project 25 INFOSEC standards. ITS also participates on the related Telecommunications Industry Association (TIA) TR 8 Encryption Committee to insure that TIA standards meet Government requirements. ITS also participates in other TIA TR 8 Committees and Project 25 working groups as necessary to insure that the total suite of Project 25 LMR interoperability standards meets Federal requirements, and to continually assess Project 25's impact on Federal agencies. An ITS representative also serves as alternate for NCS on the Project 25 Steering Committee. To date ITS has contributed to the development of standards for the encryption of voice and data sent over the Project 25 Common Air Interface and for the over-the-air-rekeying (OTAR) of Project 25 radios.

NTIA's Public Safety Program support

As a result of the findings from the NTIA and FCC Public Safety Wireless Advisory Committee's (PSWAC) Final Report, NTIA established the Public Safety Program (PSP) to follow up on the PSWAC recommendations. ITS has provided some of the technical engineering support to develop standards and specifications for the Project 25 system. In particular, ITS has been involved with the development of the Interoperability Process and Procedures specifications. This year, ITS wrote and presented for committee approval the Test Procedures for the data aspects of OTAR for encryption. ITS is presently developing the test specifications for Data Services, and Trunking. ITS has also provided technical

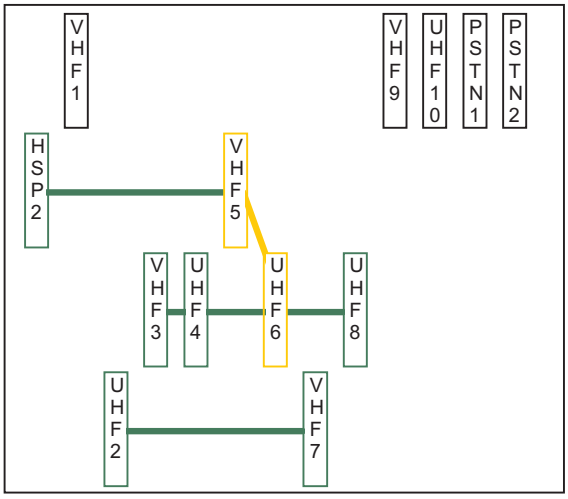
support to the development of the Inter-RF Sub-System Interface (ISSI) specification. This document defines the message and control flow across the ISSI to allow mobile units to roam from one jurisdiction's radio system to another.

NIJ's AGILE Program Support

As the U.S. Department of Justice's science and technology arm for assisting State and local agencies, NIJ has been addressing interoperability technology issues for some time. However, the AGILE program has applied a concentrated thrust to facilitate the efforts of the criminal justice and public safety organizations to effectively coordinate and share information with other criminal justice (CJ) and public safety (PS) organizations. This will be accomplished primarily through standardization. The AGILE program will identify relevant standards developed by other standards development organizations and adopt them as NIJ interoperability standards. (In rare cases, new standards will need to be developed by AGILE.) ITS leads the AGILE standardization activities under the auspices of NIST's Office of Law Enforcements Standards (OLES), one of NIJ's technology centers.

Before NIJ Standards could be identified/developed and adopted, a great deal of preparatory work was necessary. The results of the work to date have been incorporated into two strategic plans for wireless and information technology that will guide the standards selection and adoption process. An ITS process plan delineates the work, including review and analysis of: (1) user requirements for wireless communications and information technology applications; (2) current and planned assets — legacy systems, replacement plans, and status of jurisdictions' systems for wireless communications and information technology; (3) internal and external factors (e.g., State privacy laws on sharing PS and CJ information gathered on individuals); and (4) technologies appropriate to satisfying the requirements. In addition, the formal structure and procedures of the AGILE standards organization must be thoroughly documented. ITS has reviewed and analyzed the four items listed above, and has produced the standards organization and procedures manual. The formal AGILE standardization process will now begin.

While formal NIJ standards are being adopted (over several months), interim interoperability measures (including devices) are also being considered and analyzed. One such device used to assist neighboring jurisdictions and agencies with differing land



An audio gateway switch that has bridged different radio networks for interoperability purposes.

mobile radio equipment is an audio gateway switch that allows wireless communications to be combined at a common denominator, namely the audio baseband. Thus, radios that operate within different parts of the radio spectrum, that use different modulation and access techniques, or that use analog versus digital encoding, can interoperate by exchanging the received audio from one radio technology and using it as the source audio for one or more other transmitters of differing technologies. An example of the utility of such a gateway is shown in the Figure. Three radio networks were created by the gateway in the Figure. Radios on UHF2 and VHF7 comprise one network; radios on VHF3, UHF4, UHF6, and UHF8 comprise a second network; radio VHF5 and the local dispatcher or commander console-handset interface on HSP2 comprise a third network; and finally, radios VHF1 and VHF9 as well as Public Switched Telephone Network interconnect devices are presently unused in the example configuration. This example shows how a gateway can be used to bridge different radio networks to provide more interoperability among the radio systems and the agencies that use the radios. ITS conducted a series of laboratory evaluation measurements on one commercially available audio gateway and provided the results to the PS/CJ community through AGILE. More evaluations are planned on similar telecommunications devices and equipment.

For more information, contact:
Val J. Pietrasiewicz
(303) 497-5132
e-mail valp@its.bldrdoc.gov

Railroad Telecommunication Planning

Outputs

- Demonstration of new advanced radio technology and infrastructure along the Pacific northwest rail corridor in support of the Federal Railroad Administration's and Oregon Dept. of Transportation's high-speed rail pilot program.

Newly designed digital land mobile radio (LMR) equipment, complying with TIA-102 standards, employs narrowband strategies and radio channel trunking solutions in order to more efficiently utilize radio spectrum resources. The railroads are currently addressing migration and compatibility issues associated with introducing this new equipment into their existing LMR networks.

The Wireless Communication Task Force (WCTF), an ad-hoc committee comprised of the railroads, radio manufacturers, and State and Federal Governments, has commenced testing this new narrowband digital radio equipment along the Pacific northwest rail corridor (Figure 1). Audio samples were transmitted over the new system between base station and locomotive, and received transmissions recorded in both conventional analog FM and new digital C4FM modulation formats for analysis. These audio samples were cataloged by the geographic location of the locomotive and can be aurally reviewed by visiting this website: http://www.its.bldrdoc.gov/FRA6380/odot/testdata1

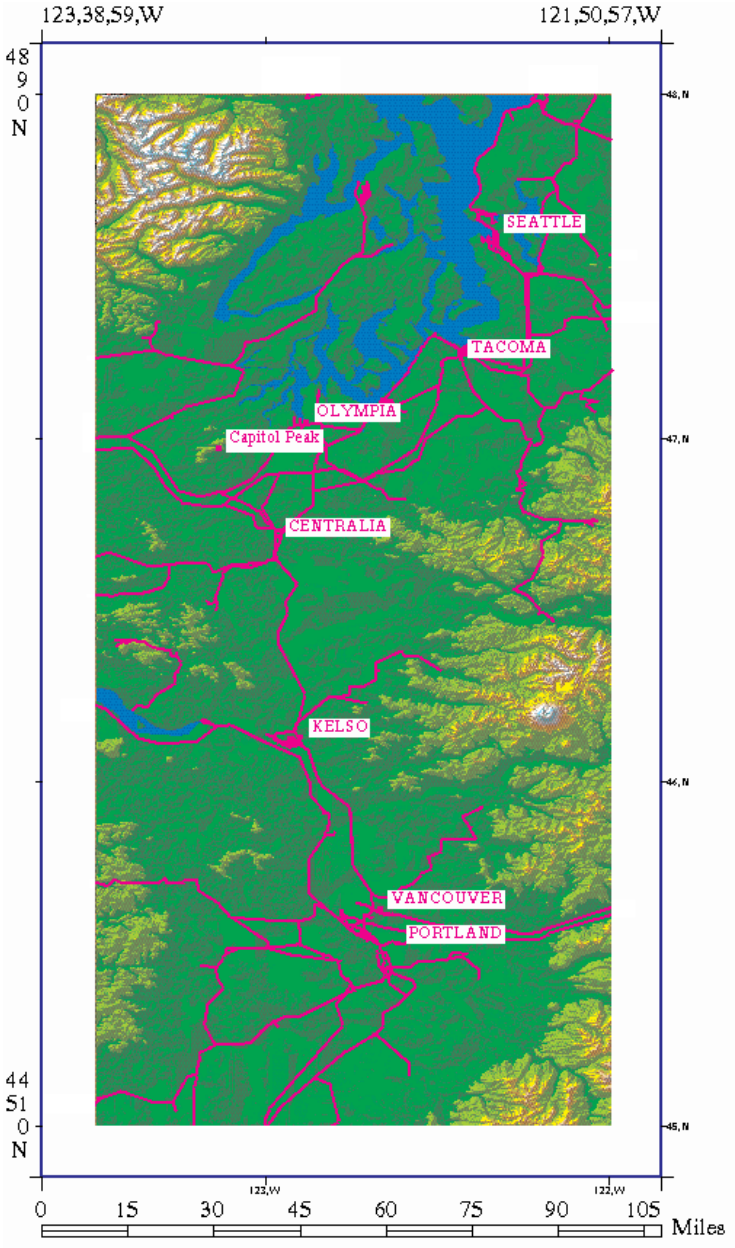


Figure 1. Pacific northwest rail corridor.

Several towns and cities are indicated on the map, along with the location of the Capitol Peak base station site utilized during this test. Audio samples can be reviewed by clicking on the map at a railroad track location. If a set of audio samples was collected at that location, textual and graphical information pertinent to the site, and additional hyperlinks to launch the audio files, will be displayed. An example web page is shown in Figure 2.

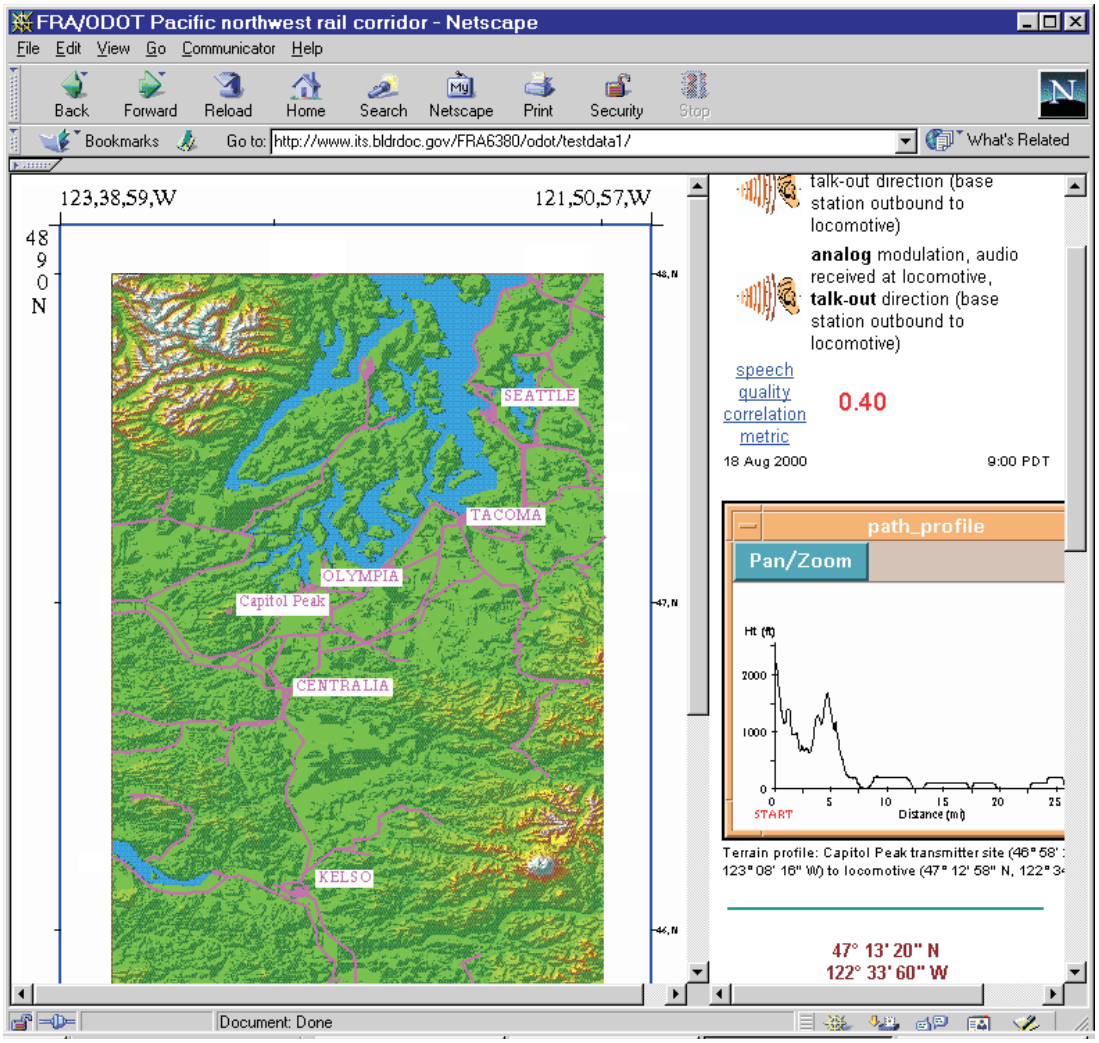


Figure 2. Example web page. Clicking on the map at a railroad track location where audio samples have been collected causes links to those audio files and other pertinent information to display on the right of the screen.

Some of the audio files were evaluated for audio quality, utilizing the measuring normalizing blocks (MNB) algorithm described in NTIA Report 98-347, "Objective estimation of perceived speech quality using measuring normalizing blocks" (Voran 1998; see Publications Cited, p. 102). A numeric score for audio quality is given. In addition, the website visitor is provided an opportunity to listen to the relative quality of traditional analog FM transmissions versus the newer digitally-modulated transmissions.

Other work in FY 2000 included channel occupancy measurements of the railroad VHF band in the Portland, Oregon area. Upon implementation of trunking within the Portland railroad arena, a comparison between the channel usage statistics in trunked and non-trunked modes will demonstrate the improvements in spectrum efficiency that are achievable by incorporating trunking technology in LMR networks. Analysis of this data is ongoing, and results of this work will be posted at the web site mentioned above, and documented in a formal NTIA publication, anticipated to be published in FY 2001.

Continued work in this area will assist railroads in evaluating the efficacy of TIA-102 equipment for such applications as data messaging for positive train control and positive train separation.

For more information, contact:
John M. Vanderau
(303) 497-3506
e-mail jvanderau@its.bldrdoc.gov

Telecommunication Terminology Standards

Outputs

- Draft of Proposed ANS *Telecom Glossary 2000*, on the web.
- Automated web-page and e-mail procedures for updating FED-STD-1037C, *Glossary of Telecommunication Terms* (1996).
- Draft NTIA Report, "Committee Development of an Interactive Web Glossary."

Common understanding of technical terminology is essential in a wide range of telecommunications planning functions, including the development of interoperable equipment and the generation of precise product and procurement specifications. ITS, under sponsorship of the National Communications System (NCS), has spearheaded the development of telecommunications terminology standards for many years through its leadership and technical contributions in the development of the FED-STD-1037 series of telecommunication glossaries.

FY 2000 work involved three major activities: (1) coordinating a standards project proposal and related agreement with Committee T1 (Telecommunications) and its sponsoring organization, the Alliance for Telecommunications Industry Solutions (ATIS), (2) developing techniques for updating the glossary using the web, e-mail, and "virtual meetings," in lieu of the traditional face-to-face standards meetings, and (3) preparing new entries to update the glossary's contents on security, Internet/web technology, and photonics, and to incorporate T1-standardized telecommunication terms.

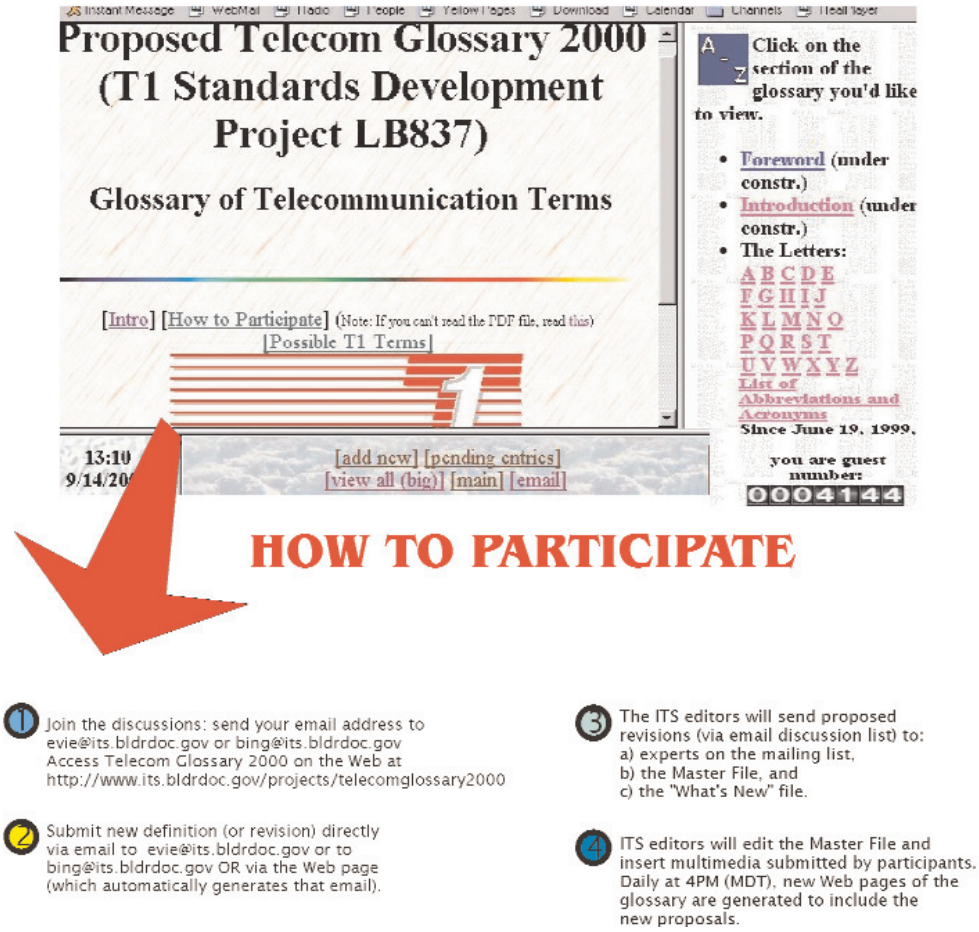
At the suggestion of NCS, ITS explored with three ANSI-accredited industry standards organizations their possible cooperation in joint industry/government development of the revised glossary and its proposal as an American National Standard (ANS). ITS selected Committee T1 as its preferred industry partner in the development and coordination of the revised glossary. After coordination with ATIS and the Committee T1 Advisory Group, ITS participants formally presented a Standard Project Proposal on the glossary project to Technical Subcommittee T1A1 for action at its January 2000 meeting. T1A1 approved the proposal for T1 Letter Ballot at that meeting, and Committee T1 approved the Letter Ballot on March 3, 2000. Reflecting this commitment, ITS updated the glossary Home Page as indicated in the Figure, and ATIS updated its Home Page to indicate links to the *Telecom Glossary 2000* project web site. ATIS also announced the project via a press release. Technical Subcommittee T1A1 formed an Ad Hoc Group, convened by an ITS staff member, to coordinate and advance the project.

The proposed ANS, *Telecom Glossary 2000*, will enhance FED-STD-1037C by adding terminology addressing new technology areas and will eliminate government-specified material and obsolete terms (e.g., "Mosaic"). The ANS will also add more than 900 terms defined in T1-developed standards, requirements, and reports.

The project is being accomplished using web-based processes, including on-line HTML revision of definitions, e-mail communication and data entry, and "virtual meetings." Instructions on how to participate in the project were provided to participants in the *Telecom Glossary 2000* project on the website, as summarized in the lower portion of the Figure. During FY 2000, ITS staff members developed and presented to the revision committee several innovative techniques for automated e-mail and web entry of proposals for draft definitions. These electronic revision methods have several advantages:

- **Wider reach:** The revision achieves a broader exposure due to the web-review techniques.
- **Cheaper:** The cost is less because participants are not required to travel to meetings.
- **Faster:** Revision is faster and participation is more efficient because participants can review terms intermittently, between other tasks.
- **Focused participation:** Participants can focus their revision efforts on only those fields of interest and expertise.

During FY 2000, ITS developed a draft NTIA Report that describes and evaluates the on-line standards development process.



Web-based development of the draft of Telecom Glossary 2000.

In addition to the 5800 entries already in FED-STD-1037C, more than 2100 new entries have been proposed, including 1250 new entries of (1) web/Internet terms (e.g., cookies, portal, web browser); (2) security terms (including INFOSEC definitions from NSTISSI No. 4009); and (3) photonics terms (e.g., photonic computer, photonic switching); as well as 900 entries from T1 standards and reports. During FY 2000, ITS also upgraded the website to bring it into compliance with the World Wide Web Consortium's (W3C) Web Content Accessibility Guidelines for producing web pages with accessibility to people with disabilities. These additions and enhancements will keep the standard abreast of rapidly changing technologies, make it more accessible, and augment its contents to reflect both industry and government needs.

The end product of the work will be a proposed ANS, in the form of a web-based HTML document comprising more than 7500 hyperlinked terms and definitions. The document will be equipped with its own search engine, optimized for glossary application, similar to that provided in the web-accessible version of FED-STD-1037C. That earlier version will continue to be available during the revision process at:
http://www.its. bldrdoc.gov/fs-1037/
The draft of the newer, updated glossary, *Telecom Glossary 2000*, can be viewed on the Web at
http://www.its.bldrdoc.gov/projects/telecomglossary2000/
The revised standard will be made accessible free of charge at the ATIS/T1 web page and at
http://www.atis.org

For more information, contact:
Evelyn M. Gray
(303) 497-3307
e-mail egray@its.bldrdoc.gov