Networking Technology/Interoperability

Outputs

- Definition of structured planning process for telecommunication and IT networks.
- Suggestions for types of tools to assist in network design and administration.
- Definition of a structured approach for applying tools and methods in the analysis of network interoperability issues.

ITS has a long history of assisting other agencies and organizations with their telecommunication planning, assessment, and interoperability studies, but the complexity of today's telecommunication and information technology (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/Interoperability projects have defined structured methods for such studies, examined many tools and techniques that can be used in conducting such studies, and identified those tools and methodologies most likely to provide the greatest benefits. The previous two years' work focused on the selection and use of a suite of neworking tools that aid in discovering the topology of a network, the load on segments of a network, and the simulation of a network, as well as examining tools and methods useful in supporting two important aspects of network design and administration: network management and network security. This past year's efforts focused on the development of a structured approach to applying these tools, along with a systems engineering method to address the complex issue of network interoperability.

Network Interoperability

From a technical networking perspective, network interoperability involves the migration of existing (Legacy) systems which are not interoperable to current (Preferred) systems which are interoperable. Interoperability is a knowledge dimension (see Figure 2 on next page) of network systems engineering involving the technical ability of two or more cooperating networks at a given point in time to satisfy users' telecommunication needs (e.g., exchange of user information at specified quality levels). The ability to characterize and analyze network interoperability depends significantly on characterizing and understanding the following issues:

1. A complete understanding of the interoperability problem domain including an understanding of interoperability requirements and the problems generated by these requirements. An understanding of the organizations from which these requirements emerge. A thorough understanding of the

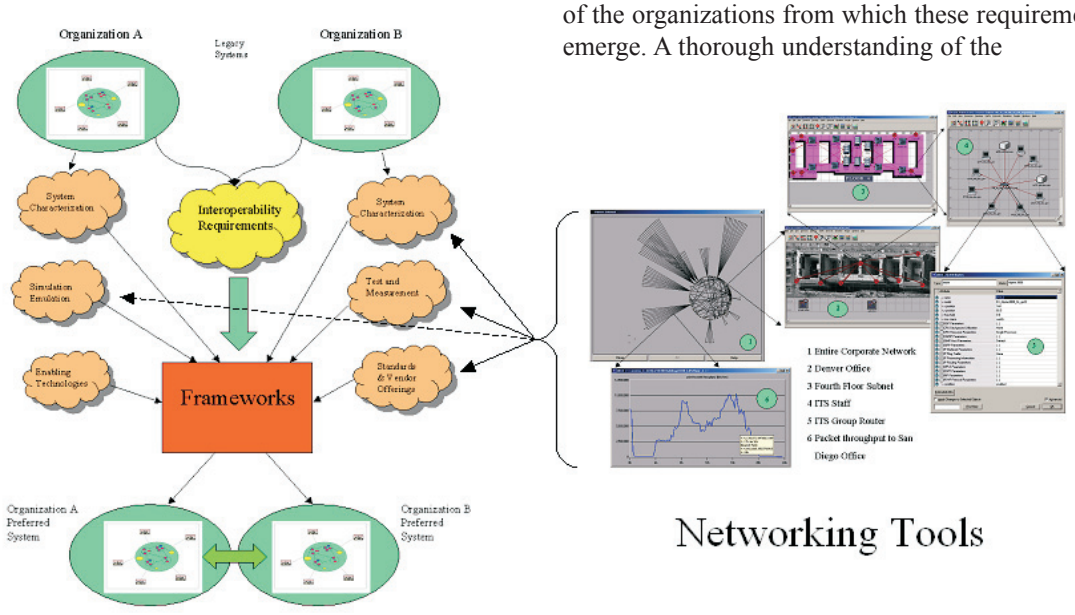

Figure 1. Graphical depiction of a structured approach to network interoperability analysis.

characteristics of the systems involved, including network type, topology, interfaces, components, services, traffic and utilization levels, and security and management infrastructures.
2. The use of existing or emerging enabling technologies to facilitate the development of interface and migration interoperability solutions.
3. The use of networking tools including test and measurement equipment and software as well as evaluation methods that aid in the design of alternative solutions and ensure that solutions meet goals and performance requirements. This includes tools for network simulation and emulation, network monitoring and management, and security assessment and protection.
4. The judicious use of frameworks within which the interoperability requirements can be described and solved using structured methods and decision-making techniques.

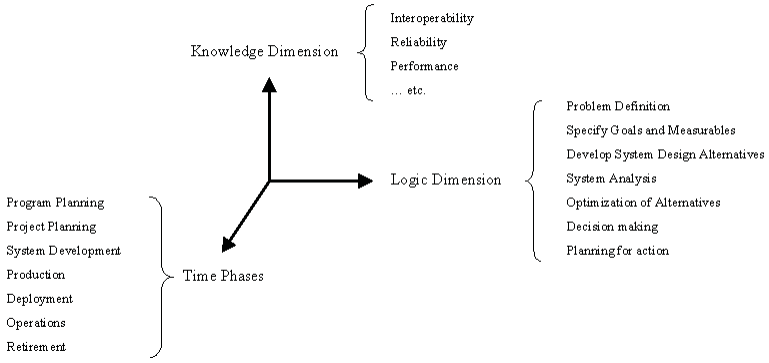

Figure 2. A three dimensional framework for systems engineering analysis.

Figure 1 on the previous page shows this structured approach to interoperability analysis in graphical form. The frameworks shown aid in developing an interoperability solution by offering a structure within which alternative solutions can be developed and compared. The systems engineering framework chosen for this project is a 3-dimensional framework of time, logic and knowledge dimensions. The time dimension consists of seven phases which describe the life cycle of most projects, the logic dimension describes steps followed in solving problems for each time phase of the project life cycle, and the knowledge dimension describes those branches of engineering and project management that guide the project staff in defining and solving problem areas. Figure 2 above shows this framework. For each knowledge dimension, the seven time phases help guide the project from inception to retirement. For each time phase, the seven logic steps aid in the definition of problems to be solved and guide the development team in the design of alternative solutions.

ITS applied this methodology to a hypothetical laboratory interoperability project involving three organizations, each of which has implemented a Voice over IP (VoIP) network using different vendor solutions and different technologies. It has now become necessary to make these systems capable of calling each other. The goal of the effort is to deploy a cost effective solution for interoperating these VoIP networks. In this simple case, we assumed that the organizations involved had similar missions so that organizational considerations did not result in any technical constraints.

Following the structured approach resulted in several alternative design solutions that satisfied the interoperability requirements. One solution was costly but had the most flexible hardware and very good customer support. A second solution was excellent for configuring and managing large networks but had significant overhead in software operation. A third solution was the least costly and simple to use but would not scale as well in large organizations. In addition, each solution had tradeoffs between voice quality and bandwidth requirements which could be a significant factor depending upon the infrastructure used (wireless or wireline). Since these VoIP networks operate over the existing IP infrastructure, it is also important to monitor the existing utilization levels on the network to ensure that the chosen solution will operate over a wide range of levels. Lastly, it is important to be able to simulate the existing system and the alternative solution designs to ensure that we can simulate scenarios which may be experienced. Using the ITS Interoperability Research Laboratory and the suite of networking tools for network discovery, monitoring, security, and management resulted in the development of excellent, well-understood, alternative solutions which could now be presented to management for final selection.

For more information, contact:
Brett Monson
(303) 497-4225
e-mail bmonson@its.bldrdoc.gov
or Robert O. DeBolt
(303) 497-5324
e-mail rdebolt@its.bldrdoc.gov