A FEASIBILITY ASSESSMENT DEFENSE REGIONAL TELECOMMUNICATIONS SYSTEMS (DRTS)

Norman Mandir and George Moran
Defense Information Systems Agency

ABSTRACT

The present Defense Communications System (DCS) will evolve to a modern integrated worldwide information system that permits geographically dispersed defense establishments to economically share and exchange information. The future network, the Defense Information Systems Network (DISN), is now being formulated. A fundamental architectural attribute of the DISN is the inclusion of three serving areas, the local base, the regional area and the long haul interconnecting structure.

This paper covers the results of a study which was initiated to perform a feasibility assessment of integrating and consolidating telecommunications (voice, data, and video) services within a regional area. A regional area consists of a number of military bases which are situated within close geographic proximity. Further, all of the Services and Defense Agencies within the region will become part of a single unified communications service network.

INTRODUCTION

The Defense Regional Telecommunications Systems (DRTS) effort was initiated to assess the operational and economic advantages associated with consolidation of certain telecommunications functions/services for groups of military bases which may presently be performing such functions/services separately at each individual base.

The DRTS concept is to establish single centralized functions within a region which will provide service to all bases within the region (regardless of military department affiliation). Therefore, where a function is presently performed at each base within a region, e.g., operator services, the function would be centralized at a single location and a consolidated operator position would provide services for all bases. Thereby, DRTS would achieve the economic benefits of resource sharing by consolidating stand-alone support systems into an integrated regional system.

The military bases selected for analysis under the regionalization concept would be located within close geographic proximity. Examples of base cluster locations are shown in Figure 1. The locations depicted are examples only of major military installations, further refinement is required to identify all viable candidate locations.

Since the DRTS effort at this time is to perform a feasibility assessment of the viability of the regionalization concept, two locations only were chosen to be analyzed, one is Puget Sound (Seattle) in the State of Washington and the second San Antonio, Texas.

OBJECTIVE

The objective of the DRTS concept is to identify those functions which are presently performed independently at individual bases and determine the economic and operational advantages of consolidating these functions at a single location from which all bases within a region would be served. Examples of the functions which will be addressed include operator services/dial service assistance, billing functions, switch maintenance, local area network (LAN) maintenance, network control and a central management concept for the entire region.

In line with the consolidation concept, all transmission facilities used within the region to support telecommunications services between bases will be assessed for combining into wideband facilities vice retaining as separate single circuits. The bundling of long-distance transmission facilities are not addressed since they are handled by the Defense Information Systems Agency (DISA) under a separate project.

BACKGROUND

In the late 1970's, the Department of Defense initiated a program which would consolidate telephone service for DoD components located within specified regions, generally metropolitan areas. The program was known as the Defense Metropolitan Area Telephone System (DMATS). All DoD components assigned to a DMATS would obtain telephone service through a single manager.

However, DMATS was restricted to the management of telephone services. In the time period that DMATS was evoked, voice service was by far the predominate service. There was practically no opportunity for integrating voice services with other services such as data. Today's situation is different, not only has voice service demands grown but data has become a significant factor of the total communications services needed by the user. In addition, video services, i.e., the use of video conferencing, has increased significantly within the defense community. DMATS was a good idea, however, opportunity for large cost reductions was not available when telephone service dominated. The DRTS concept presents new and greater opportunities for deriving cost economies through consolidation of all types of services.

APPROACH

In order to determine the viability of the regionalization concept, it is necessary to identify the current operations performed at each of the bases and identify associated costs. Information was obtained from base personnel on major telecommunications network operations to include operator services, video services, network management, maintenance, billing and the transmission facilities needed to interconnect switching centers. Typically, the functions indicated

50.2.1

Figure 1
Examples of Base Cluster Locations

above are performed at each base without sharing of functions among the bases.

In addition to compiling information on existing base telecommunications, it is vital that information be received on planned enhancements. Reductions in force strength are now occurring, a number of bases have been identified for closing and military organizations are being relocated. Therefore, some bases may close and some bases may increase or decrease in number of users.

Another important aspect regarding information pertaining to the base is to confer with the local exchange carriers (LEC) that serve the area. It is necessary to confer with the LEC regarding any upgrades that may be planned for the region. In the case of Puget Sound, it was learned that US West has plans to provide a fiber ring around Puget Sound. In fact, a large portion of the construction work was already accomplished. Further, US West would introduce SONET and then switched multi-megabit data service (SMDS) in subsequent years. In the San Antonio area which is served by Southwestern Bell, fiber optic routes in the form of a hub and spokes are already in place to each of the bases. Also, Southwestern Bell plans to enhance telecommunications survivability within metropolitan San Antonio by adding a fiber optic ring which will interconnect with the existing fiber routes.

The concept of regionalization is presented in Figure 2 which also identifies three typical transport service levels. At the base level, LANS, PBXS and other telecommunication sources may interconnect

with other bases within the same region via a common broadband transmission facility located at the access level. The transport facility at the access level is typically implemented by the LEC to serve an entire metropolitan area. The facility will most likely be fiber optic cable in the form of a ring or hub and spoke configuration. The base level will also connect to longhaul facilities (which is managed by DISA) via the access level for interoperability with bases which are remote from the bases located within the local region.

When all pertinent information is collected, correlated and verified, the new design for the region can be initiated.

DESIGN

The new design for the region would emphasize the consolidation of assets which are presently distributed among all bases. In addition, where applicable, new technology would be introduced to increase the level of automation existing for any services/functions with the possibility of further reducing operating personnel while increasing user productivity (by increasing the quality of services). An additional important function of the new design is to ensure that any near-term enhancements would be compatible with the mid-term and long-term architectures developed by the military services and the Defense Information Systems Agency (DISA).

The basic premise of the regional design in achieving economies is that the pooling of resources leads to greater efficiency when compared to distributed resources. The consolidation of personnel to support user services and the consolidation of transmission circuits, e.g., the bundling of individual circuits into a single wideband facility

derives economic benefits due to the economy of scale. Also, with a large personnel force concentrated at a single location, there is a greater flexibility in the ability to respond to unusual loads. An added unforeseen load could be shared more readily by a large number of servers, when compared to small groups at a number of locations. The following provides some examples of economies derived through consolidation of services.

ATTENDANT SERVICE/DIAL SERVICE ASSISTANCE

General

Attendant service is defined as the numerous services performed by telephone operators associated with automatic dial switching centers. This service is also commonly known as Dial Service Assistance (DSA).

Where a number of telephone switching centers are in operation within a region, a single Centralized Attendant Service (CAS) center may be economically introduced in lieu of provisioning separate groups of attendants at each switching center. CAS allows for consolidating attendants at a single location, these attendants would be able to provide dial service assistance for any users associated with the switching centers previously served by local attendants.

In general, when operator service is provided at each of a number of switching centers, a consolidated operator service will permit a more efficient and economical operation. For example, at many locations during off-hours, an operator is on duty to provide needed coverage even though the work load does not support the need for a full-time operator. With a consolidated configuration, the minimal numbers of operators would be properly assigned and the number of operators would normally be less than one for each separate switching center to be served. Reductions in the number of operators needed during busy-hours could also be achieved, small groups of operators located at each of a number of separate switching centers are normally less efficient than a single consolidated group of operators situated at one location.

The following is an example of the manner in which the reduction of personnel is calculated when operators are combined into a single consolidated team: For the example, the tables used are based on the Erlang C formula. The Erlang C assumes that blocked calls will remain in the system (queued) until served. The Erlang load is estimated from the number of switching center lines, operator work functions and speed of operator response.

San Antonio Operator Services

- Seven switches installed, three are remote line units, operators are located at three sites.
- Total number of busy-hour operators at three locations. . . . 64.
- Total number of busy-hour operators consolidated at one location. . . . 48.
- Total number of operators during non-busy hours (2 eight hour shifts) at three locations. . . . 6.

- Total number of operators during non-busy hours consolidated at one location. . . . 2.
- Total savings. . . . 20 operators.
- A median annual salary is \$21,000.
- Estimated annual saving = \$420,000.

NOTE: The above does not include offset investment costs for consoles, signaling links, etc. Therefore, a break-even point in months/years is unknown at this time.

Automated Attendant Service

Additional economies are possible with the application of automated attendant service. The service allows a caller to receive, for example, a desired telephone directory number by interfacing directly with a database. The directory information would be provided to the caller without any operator assistance. The actual reduction in operator work load will vary depending on a number of factors. If the service requires the caller to spell out the called party's name, the caller may use a touchtone telephone. Therefore, the type of telephone available to the user is important since users with rotary dial telephones must interact with a voice input system or continue to access the operator. A second important factor is training the user to use the new service and explaining the economic advantages since many users may resist using the automated feature and simply wait for an operator.

Service Area

Attendant service personnel may be located within the vicinity of the serving switching center or the attendant may be remotely located from the user, e.g., 800 service. The trade-off is the cost of the transmission facilities (from the area served to the operator location) versus the number of operators which may be reduced when consolidated.

The area(s) to be served by consolidated operator service may vary considerably. The area may be one of the regions depicted on Figure 1 or the area to be served may include two or more regions. The Department of Army proposes to segment the CONUS into six areas and establish a consolidated operator service center for each area. Therefore, operator service for a proposed DRTS region may be integrated with the Department of Army implementation.

DoD Directory Service

DoD is planning the implementation of an integrated DoD Directory based on the CCITT X.500 directory standards. The CCITT X.500 is also a candidate for GOSIP Version 3. The objective is for an integrated electronic directory which will eliminate paper directories and any electronic directories which are non-standard implementations. Therefore, when consolidating directories in support of CAS, the directory should conform to CCITT X.500 criteria. An initial X.500-based DoD Directory is planned for 1995 in support of the Defense Message System. By the year 2000, a common electronic directory to support all DoD voice, data and video directory requirements is planned. Further information is available in Reference 1.

50.2.3

Figure 2
Typical Transport Service Levels

TRANSMISSION FACILITIES

General

DISA databases contain information on transmission circuits which are leased or owned by DISA. These databases, in addition to information received from the regions surveyed, provided a good representation of both inter-base and long-distance circuits. DISA manages the long-distance circuits, and the MILDEPs manage intrabase and regional interbase circuits.

In general, transmission facilities costs per circuit will decrease as the number of circuits within the transmission media is increased. As an example, the leased cost of a number of single circuits (e.g. seven to twelve circuits depending on mileage and tariffs) can equal or exceed the cost of a single T-1 facility (consisting of 24 circuits). The basic objective therefore is to consolidate circuits within the region where practical and cost effective.

Transmission Requirements

Within a region consisting of a number of military locations, communications links are necessary between locations. The inter-base voice traffic user demands may be satisfied over leased or government-owned circuits (tie lines) which interconnect base telephone switches, or users may make telephone calls through commercial facilities. The use of tie lines is cost effective when both the traffic demands and the commercial charges for interbase calling are high. When tie lines are implemented, local and toll charges are eliminated for calls made between bases. Also, toll calls destined beyond the DRTS area may be reduced in cost by traversing the DRTS network and egressing at the switch closest to the called destination (i.e. tail-end hop-off).

In addition to voice traffic, data traffic may also be completed over dial-up circuits using base switches or by using dedicated facilities. Data users with high speed transmission requirements, kilobits or megabits per second, will require connectivity to local area networks

(LAN). The LAN was designed to satisfy high-speed data transmission needs over relatively short distances, e.g. intra-base. Where requirements exist for high-speed data connectivity beyond the base, metropolitan and wide area networks need to be provided. Data traffic has the fastest growing requirement over all other type traffic.

Another fast growing service within DoD is video teleconferencing (VTC). In fact, the majority of imagery traffic within DISN is transmitted via VTC. Presently, video rates are 1.544 mbps. Due to technology advances, quality at lower rates has been enhanced. Service at lower rates will now be made available to users. Presently, VTC is available at 89 studio locations. Studios may be constructed as fixed locations or roll-about video systems which may be moved to any location with video network connectivity.

Network Topology

A variety of candidate solutions are available in determining the preferred network topology for any particular region. For example, based on community-of-interest traffic requirements, interconnecting facilities between bases may be needed. The designer must trade-off type of transmission media to be used based on both near-term and long-term bandwidth requirements and associated costs, the need for switched service versus dedicated service and many other considerations such as security and survivability. In the San Antonio area, each military service owns the on-base switching facilities. The Southwestern Bell Co, which serves the area determined a number of years ago to provide optical fiber in place of cable or radio facilities. The fiber is presently being used to interconnect all bases within the region and to interconnect the bases with Southwestern Bell Toll offices. At present, a hub and spoke arrangement has been implemented. Future plans of Southwestern Bell includes expansion of the existing fiber service into a mesh configuration which contains a ring.

At Puget Sound, US West heads a consortium of different telephone companies which is presently completing the implementation of a fiber ring throughout Puget Sound. The leasing of optical fiber circuits from the Local Exchange Carrier is particularly attractive since all bandwidth needs: voice, data, video, LAN to LAN connectivity, surge requirements and others can be satisfied with a single wideband facility, e.g. T-1 or T-3, depending on demand. Economy of scale is realized when all MILDEP requirements within a region are combined when presented to the LEC instead of each military department leasing circuits separately. There is an alternative approach which should be considered for satisfying circuit requirements within a region. A bandwidth of sufficient capacity can be leased from the LEC for sole use by DoD. The bandwidth can be leased within a ring or a hub and spoke configuration (see figure 2). The leased bandwidth would then be managed by DoD and partitioned as needed among the bases.

A bandwidth which is acquired within a region solely for the use of DoD provides the potential for a number of advantages. A surge bandwidth could be included which would be available to any organizations, during relatively short term conditions, which required increases in communications. In addition, new growth demands could be satisfied quickly, avoiding delays associated with leasing facilities or new construction.

The following provides information on alternative methods for acquiring transmission facilities within Puget Sound. A total of 816 circuits are estimated to be needed by 1996, voice circuits will still be the predominate type. The estimated cost for these circuits, which are not bundled, is \$5.49 million/year. The estimated cost of bundling of these circuits and leasing T1/T3 on fiber ring provided by US West is \$3.61 million/year. Preliminary results indicate a significant cost savings of \$1.88 million/year when circuits are bundled into T1/T3 capacities.

SURVIVABILITY

When optical fiber is used, a large number of circuits are combined into a single medium. Therefore, the concern for a transmission failure is considerable for a military network. For a hub and spoke configuration all bases would not lose service simultaneously if one spoke only suffered a fiber outage. However, each individual base must consider the need for an alternate route in case of a fiber outage. When the fiber is configured in the form of a ring, all bases are served on a single transmission facility and adequate protection must be provided to offset transmission failures. Work is being performed within the standards committees in regards to evaluating different self-healing methods for survivability of ring architectures. Both commercial and military needs are being considered. Within, ANSI, these survivability efforts are under the purview of the T1Q1.2 working group.

FUTURE CONSIDERATIONS

The concept of regionalization does not preclude consolidated functions from serving more than a single region. For example, operator services and telecommunications billing services may initially serve only a single region. However, in time, the local

regional service may be expanded to serve other nearby regions which undergo consolidation.

When military bases are consolidated and served on fiber facilities, high speed connectivity between users become readily available. A LAN may be connected to another remote LAN within the region at T1, T3 or greater speeds when warranted. The local exchange carriers (LEC) are readying high-speed on-demand service through frame relay and Switched Multimegabit Data Service (SMDS) for the near term.

Looking further into the future, implementation of the SONET (Synchronous Optical Network) standard for fiber-optic networks will become more prevalent. SONET speeds start at approximately 50 megabits/second and reach into the gigabit/second range. ATM (Asynchronous Transfer Mode) will be used at wideband switching centers to switch SONET speeds over wide areas. The long-range (circa 2000) communications architecture projected for the Defense Information Systems Network (DISN) will basically consist of SONET transmission capabilities with ATM switching.

CONCLUSIONS

Based upon information collected and analyzed for two regions, results have shown that regionalization can provide economic benefits. To further confirm this conclusion, up to five additional regions will be analyzed.

When opportunities become available, consolidated services may be expanded to serve a number of regions, thereby increasing cost savings.

Finally, regionalization will place the military bases in position to economically take advantage of oncoming technology such as SONET transmission and the oncoming wideband on-demand technologies of frame relay, SMDS and ATM.

REFERENCE

1. Defense Information Systems Agency, Concept for Integrated DoD Directory Services, Washington D.C. November 1991.