DEFENSE INFORMATION SYSTEM NETWORK (DISN) ASYNCHRONOUS TRANSFER MODE (ATM) GOAL ARCHITECTURE AND TRANSITION STRATEGY

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ABSTRACT

Current DISN customer services include VOICE (telephony), DATA (computer networks) and VIDEO. The DISN that has operated for many years and is largely operational today evolved from times where these services required dedicated facilities, such as switching and transmission connectivity. Even today, each of these services continues to rely on dedicated resources. As a result, DISA cannot fully optimize the acquisition of the most expensive component of DISN services, which is transmission bandwidth. Much of the available bandwidth is not used regularly but must remain available to support unanticipated surges in demand. ATM affords the opportunity to consolidate all "native" services onto a single, integrated infrastructure. The single integrated architecture for DISN ATM Services exploits the promise of ATM as an enabling technology and will offer better overall services to DOD users at substantially reduced costs.

INTRODUCTION

The Defense Information System Network (DISN), formerly called the Defense Communications System (DCS) was created over 30 years ago to overcome the problems associated with the independent, non-interoperable and duplicative communication systems that were being implemented and operated by the various U.S. military services and agencies. From its early consolidation of voice services into the "Automatic Voice Network" (AUTOVON), and data services into the Automatic Digital Network (AUTODIN), the DISN has evolved to what today is a fully interoperable and multiservice worldwide communications network rivaling that available to many sovereign nations. Even so, current DISN services such as voice, data and video are provided by dedicating communication resources (switching and transmission bandwidth) to each disparate service. (See Figure 1)

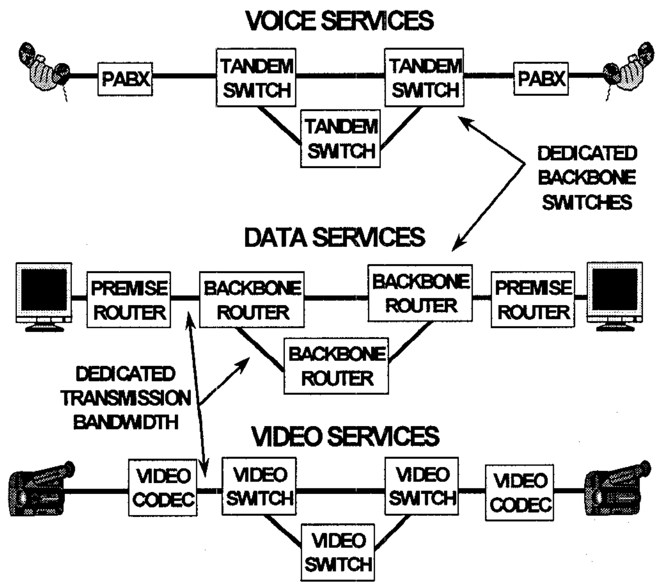

Figure 1. Current DISN Services Use Independent backbones

Recent technological advances offer the promise of overcoming the need to support DISN services with "stovepipe" networks with a single, integrated network able to allocate "bandwidth-on-demand" to all services. Asynchronous Transfer Mode (ATM) is the key enabling technology to allow the DISN to exploit this promise (see Figure 2). Recognizing this opportunity, DISA and the DOD have embraced ATM as the preferred technology approach to meet dramatically expanding requirements for Command, Control, Communications, Computers and Intelligence for the Warfighter (C4IFTW).

SHORT HISTORY OF DISN ATM

In 1994 DISA, in cooperation with other DOD and civilian Government Agencies, engaged in an ambitious project to establish a large high bandwidth ATM test bed to support research into advanced communications technologies. This Advanced Technology

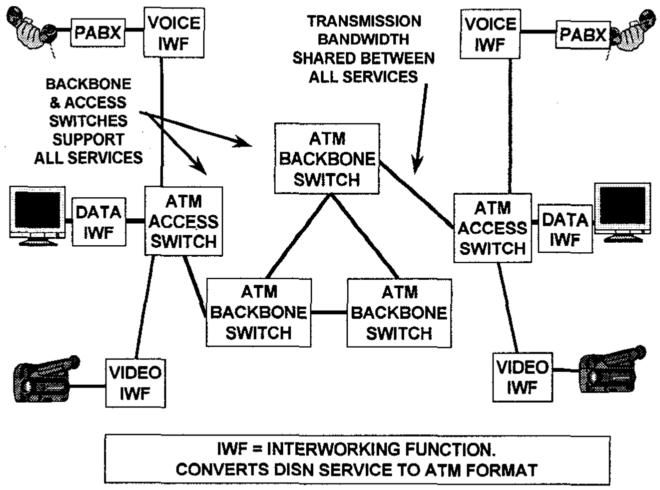

Figure 2. ATM: Multiple User Services Share backbone

Demonstration Network (ATDNet) began modestly as a Washington Metropolitan Area SONET OC-48 ring servicing the 7 ATDNet principals. Today, ATDNet extends as a complex, hyper-cube topology network reaching almost 200 ATM switching platforms. Also in 1994, as part of the Joint Warfighter Interoperability Demonstration (JWID) 94 exercise, DISA deployed an operational classified ATM network to the three major commands that were participating: ACOM (Norfolk), PACOM (Hawaii) and TRANSCOM (Illinois). In another pioneering effort, several major support agencies collaborated in deploying an operational intelligence-oriented ATM network under the project name PROTEUS.

Beginning in 1995 and building on lessons learned from ATDNet as well as other technology prototype efforts, DISA and the Advanced Research Projects Agency (ARPA) collaborated to deploy a large sale operational ATM network for classified users. This "DISN Leading Edge Service" (DISN LES) capitalized on the experience from JWID94, PROTEUS and other efforts to deploy a true common user wide area network for other than research purposes.

The evolution of ATM lessons learned from ATDNet and related network research projects culminated in October 1996, with DISA implementing the first generally available (UNCLASSIFIED) operational DOD wide area network service shown in Figure 3. The DISN ATM SERVICE - UNCLASSIFIED (DATMS-U) now provides high bandwidth information transfer for all of the day-to-day business transactions for DOD.

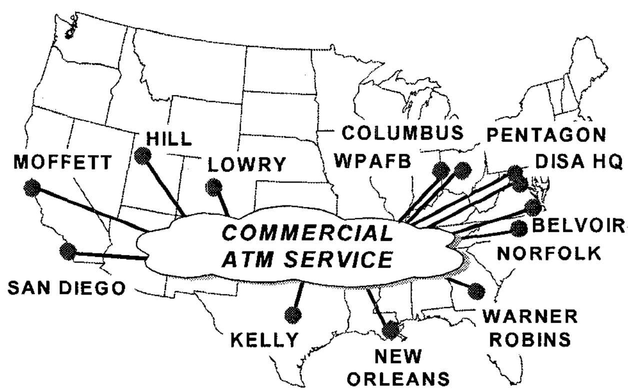

Figure 3. DISN ATM SERVICES-UNCLASSIFIED IOC, OCT 96

The implementation of DATMS-U was conceived as an interim capability that would be assimilated into an "Objective" DISN ATM Service. DATMS-U took advantage of the availability of commercial ATM services. The initial customer base for this service was DISA itself. The DISA-managed uNclassified IP Router Network (NIPRNet) was experiencing dramatic growth in traffic load. The plan used DISN ATM services to interconnect NIPRNet's first tier (backbone) routers. As a result, the use of ATM to interconnect these routers resulted in considerable cost savings over the alternative approach that would have used dedicated T3 leased circuits between routers. ATM's advantages were immediately obvious and heavily exploited by DISA to improve NIPRNet performance at a substantial cost saving to the customer.

Throughout 1997 and 1998, DISA consolidated the DISN LES and the DATMS and began offering classified and unclassified ATM services to a wider customer base. As of late 1998, the DATMS will have grown to over 125 locations and had begun to provide expanded ATM services at OCONUS locations

OBJECTIVE DISN ATM SERVICES

As the DOD enters the next millenium, a new and striking dilemma faces the DOD Information Systems Engineer. On one hand, the Warfighter's dependence on information increases unabated. The need to achieve "Information Dominance" over adversaries drives almost all activities in the advanced networking and application fields. On the other hand, this increased dependence generates increasing vulnerabilities of DOD information systems to those who would attempt to deny us the advantages of information superiority. As DOD information systems evolve, become more integrated and support ever-increasing levels of performance directly to the warfighter, the concomitant risk grows of being able to protect that capability.

DISA and the Military Services and Agencies have addressed this problem by developing and validating an architecture for future information systems that provides protection from denial-of-service attacks, multi-service and multi-vendor interoperability and positive control of resources. The key to achieving these objectives will be to migrate the DISN ATM network from dependence on a commercial ATM service provider to a network that affords "positive control" and exclusive government-only access to switching facilities. Figure 4 shows a notional design for this objective network. The design features government-controlled backbone switches interconnected (initially) by leased OC-3c transmission facilities. Outlying Service Delivery node sites will be themselves connected by leased DS3 transmission in a

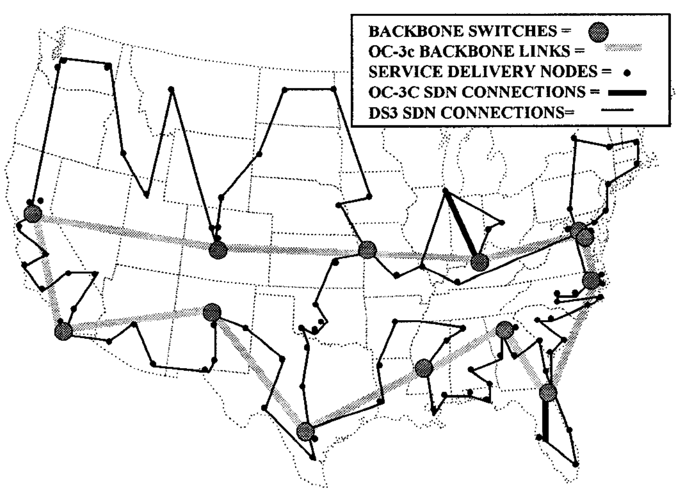

Figure 4. DISN ATM OBJECTIVE SYSTEM NOTIONAL DESIGN

multiple "ring" configuration. This preliminary design is intended to achieve a lowest cost solution to providing two routes to as many SDN facilities as possible. This network is expected to begin operational service in early CY 1999 and will be used as the target network to migrate the existing users.

An architectural perspective of this goal Objective DISN ATM SERVICE (Objective DATMS) is illustrated in Figure 5 .

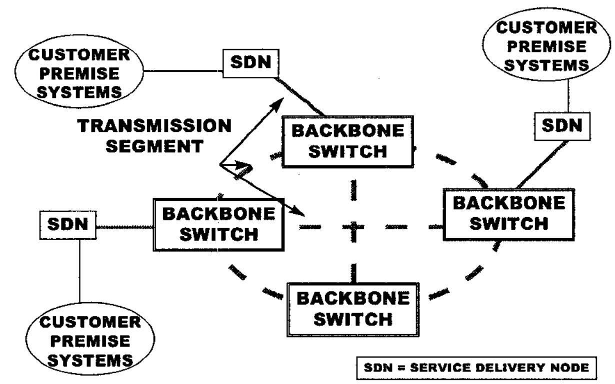

Figure 5. OBJECTIVE DISN ATM GOAL ARCHITECTURE

The key elements of the Objective DATMS have evolved from lessons learned in testbed efforts such as ATDNet, and operational services such as DISN LES and DATMS-U. For coverage in the Continental U.S. (CONUS), the Objective DATMS will use the two principal active CONUS DISN contracts for Bandwidth Management (currently awarded to MCI) and Transmission Service (currently awarded to AT&T). The key elements, or subsystems of the Objective DATMS are the Backbone Switch/Bandwidth Manager, the Transmission Segment, and the Service Delivery Node/Bandwidth Manager. Implementations in the Europe and Pacific area will be based on the same architectural approach and technical requirements as the CONUS portion of the Objective DATMS.

Several salient observations may be made concerning this architecture.
First, the intent of this architecture is to meet all of the growing needs of the DOD for Information Dominance while protecting that capability from overt and covert attempts to deny that dominance to the warfighter. To that end, the Objective DATMS will be a private line network, using dedicated ATM switching facilities in the access area and backbone. These physical subsystems will not generally be available to or shared with commercial service providers for use in commercial

network services due to the need to maintain positive control over the system resources. Although the design will allow for contingency use of commercial services where prudent, cost-effective and necessary to meet the overarching mission, it is not anticipated that commercial services will be widely or routinely used in the Objective DATMS, unlike the interim DATMS.

Second, the Objective DATMS architecture fully realizes the potential of using ATM as the bandwidth management enabling technology. As a result, the architecture excludes "interim" bandwidth management techniques such as the Digital Access and Cross-Connect System (DACS) and performs all bandwidth management functions at the ATM layer.

Third, the Objective DATMS architecture effectively provides for a single, integrated DOD infrastructure to the post, camp, station and even tactical level for all required DOD services. This architecture recognizes that DISA has mission responsibility for long haul portions of the DOD infrastructure. However, ultimate viability of end-to-end service can only be maintained so long as MILDEP "users" of the long haul service present a standards-based interface to the DISN that supports end-to-end signaling, flexibility, robustness and ease of management.

The critical component of the Objective DATMS is the DISN Service Delivery Node (SDN). As illustrated in Figure 6, the concept of the DISN Service Delivery Node modularizes the critical interworking functions (IWFs) that are necessary to convert contemporary DISN services to an ATM infrastructure.

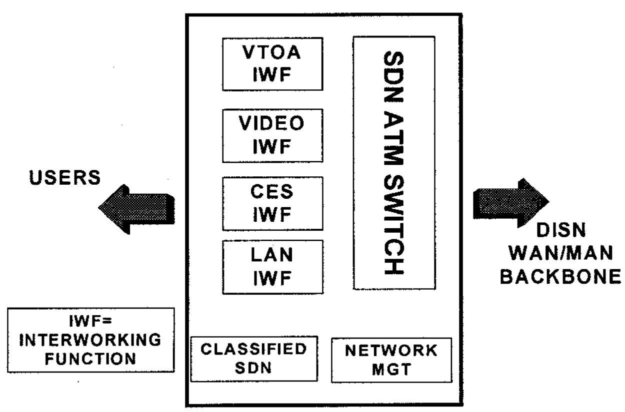

Figure 6. DISN ATM SERVICE DELIVERY NODE

The advantage of a design that uses a modular approach to Interworking functions is that they do not necessarily need to be fully integrated into one hardware subsystem such as the ATM switch. In fact, experience shows that most IWFs can be more cost effectively provided as physical adjuncts to the ATM switch. A second advantage is that these IWFs do not necessarily have to be performed by DISA in the DISN Service Delivery Node. As user systems mature and more Customer Premise systems become ATM capable, it may become more cost-effective to have the IWF conversion done as close to the user as possible.

For example, the Voice Telephony over ATM (VTOA) Interworking Function is specified so that it could be done in several different ways. Simply put, the Interworking function merely converts standards-based voice signals, such as structured DS1 from a PABX into standards-based ATM signals. As illustrated in Figure 7, the actual VTOA IWF could be done at several different physical locations within the access area environment and with varying degrees of physical integration into other subsystems.

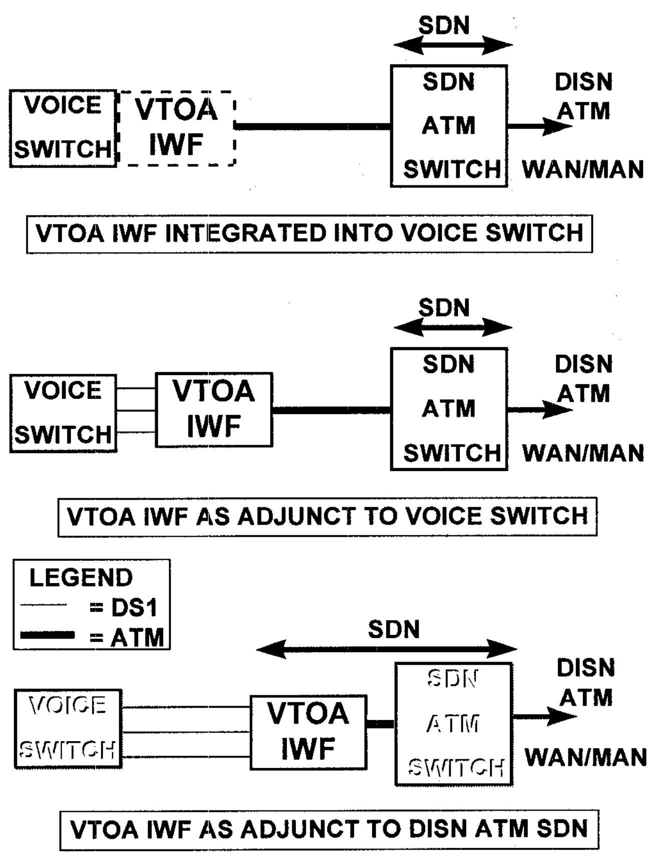

Figure 7. VTOA IMPLEMENTATION OPTIONS

IMPLEMENTATION STRATEGY

The Objective DISN ATM Services will be implemented in a carefully orchestrated sequence of events that maintain existing services while allow existing and new customers to interoperate. Figure 8 illustrates that, during the initial stages of implementation of the Objective DATMS, connectivity with the existing Interim DATMS will maintained by gateways at strategic locations. As technical and economic factors dictate, the customers being served by the interim network will be cut over to the Objective DATMS. Finally, the interim system will be terminated, leaving only the Final Operational Capability (FOC) configuration.

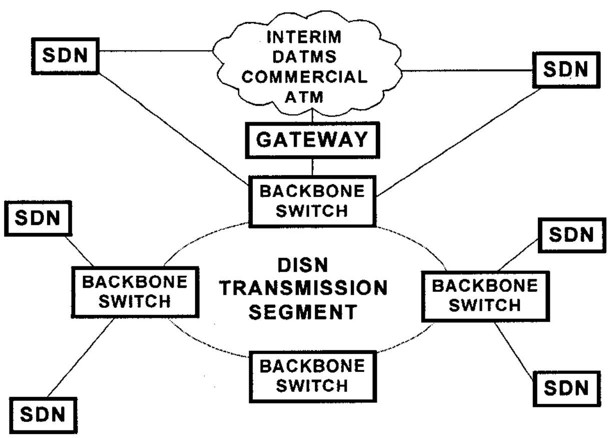

Figure 8. OBJECTIVE DISN ATM SERVICES - IOC

The strategy and general timeline for the implementation of the Objective DATMS and for transition of users from the Interim DATMS are illustrated in Figure 9. Note that specific schedules for contractual activities, implementation and cutover are subject to funding constraints, technical uncertainties and the need to avoid conflicts with other DISN implementation efforts.

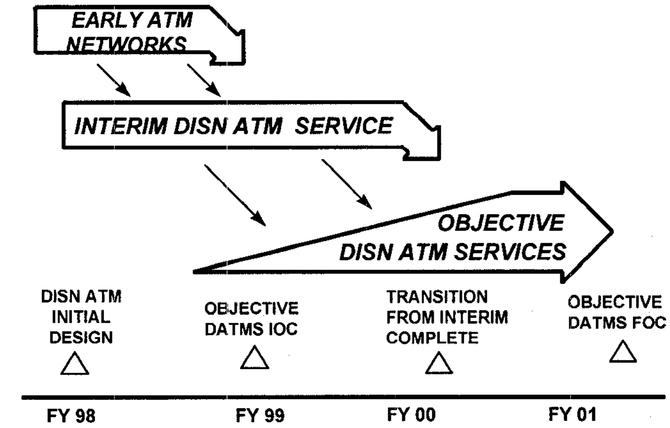

Figure 9. OBJECTIVE DATMS IMPLEMENTATION TIMELINE

CONCLUDING REMARKS

The Defense Information System Network represents an ambitious effort over many decades to meet the information needs of the United States warfighter. To meet those needs in the face of increasing demands as well as increasing threats requires an aggressive and forward-looking exploitation of information systems technology. Asynchronous Transfer Mode is not a panacea and brings its own tradeoffs to the system engineer's design table. However, ATM is seen by many, including the Department of Defense, as being a critical enabling technology to solidify and maintain the information dominance advantage that the Warfighter enjoys today.

The DISN ATM Services network will strive to continue to build on the DISN tradition of offering mission-capable, secure, robust and affordable information to the warfighter.