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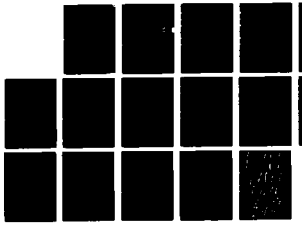

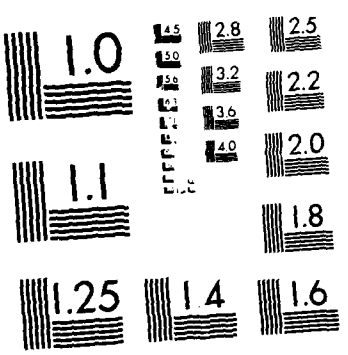
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6 May 1988

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ARMY IMPLEMENTATION
of
DOD & FEDERAL STANDARDS

EXECUTIVE SUMMARY

PREPARED UNDER CONTRACT DAEA18-84-D-0058

DELIVERY ORDER 0088

FOR

U.S. ARMY INFORMATION SYSTEMS ENGINEERING COMMAND

FORT HUACHUCA, ARIZONA 85613-5300

PREPARED BY

prc
Planning Research Corporation

1001 Executive Drive
Sierra Vista, AZ 85635

REPORT DOCUMENTATION PAGE

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Technical Standards
Automation
Communications
Records Management
Visual Information
Printing and Publications
Competition in Contracting Act (CICA)
Implementation Guidance

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TABLE OF CONTENTS

1.0 INTRODUCTION.

This report summarizes an effort to identify and recommend to the Army a set of standards to promote efficiency, effectiveness, and interoperability of systems supporting the Army Information Mission Area (IMA). Standards are needed because information is increasingly viewed as being a key to effective functioning of the Army and that it is necessary for such information to be widely available across the Army. Army systems must be procured competitively, resulting in an information environment consisting of systems from many sources. Without standards, it is essentially impossible to integrate those systems into a whole that provides information interoperability across the Army. While standards alone will not produce information interoperability, they make the task much easier.

2.0 TASKING.

The tasking under which this effort was performed requires that the recommendations represent an independent view of the Army's needs for information system standards. Views were to be solicited from a wide range of Army, Government agency, and private industrial sources; however, the recommendations were to represent the contractor's best independent judgement of the Army's needs, unbiased by particular Army views. The principal constraints placed on this independence were:

a. Competition. All recommendations must meet competitive requirements as specified in the Competition in Contracting Act (CICA) of 1984.

b. Justification. Standards are not to be recommended for their own sakes. All recommendations must provide benefits to the Army. Benefits may be operational or economic.

c. Transition. A reasonable means must be demonstrated by which the Army can transition from its current baseline to systems based on the recommendations.

3.0 SCOPE.

The tasking required treatment of all aspects of the IMA. Specifically, the five mission areas (telecommunications, automation, records management, visual information, and publishing and printing), the three operational arenas (sustaining base, strategic, and theater/tactical), and three aspects (baseline, current target, and objective) of the Army Information Architecture (AIA) were to be covered. The tasking requires *identification* of standards that will benefit the Army's IMA; *development* of standards is not within the scope of the effort. Where standards are not in existence or nearing completion, the reports identify shortfalls but make no recommendations.

4.0 APPROACH.

This section summarizes the general approach to the tasking and briefly discusses several key aspects.

4.1 General Approach. A standard systems engineering approach was used. Requirements were identified. Functions were analyzed. Alternative approaches to supporting the functions through use of standards were identified. The alternatives

were evaluated. Selections were made on the basis of the evaluations. Finally, the recommendations and supporting rationale were documented in the reports.

4.2 Target. It is important to understand the target of the effort. Department of Army has stated that the recommendations will be fully staffed. Those recommendations that survive the staffing process will be announced to industry as the Army's standards. Industry will then be given one year before the new standards take effect and appear in procurements. Given that the staffing of a major initiative takes about a year, it is likely that at least two years will lapse before the recommendations take effect and appear in procurements. Thus, the results of the effort are intended to support new procurements, not to support current efforts to integrate existing information systems.

4.3 Status Criterion. The standards community is moving rapidly in some areas that have great potential value to the Army. Given that the recommendations will not take effect and appear in procurements for two years, it was decided that consideration would not be limited to standards that are currently complete and for which products are currently available. In the decision process, an attempt was made to look ahead to the time when the standards will be used, assess which standards will be sufficiently mature for Army use at that time, and make recommendations accordingly. There is some risk in taking this approach. It was judged that such risks were outweighed by the shortfalls in needed recommendations that would result from limiting consideration to standards that are fully mature at the present time.

4.4 Focus. It is also important to understand that the recommendations made in this report are not all-encompassing. In the course of performing the effort, a

listing was obtained of major standardization organizations and actions related to the automation and telecommunications portions of the information mission area. The list contained 21 major standards organizations and 2500 standards. One of the 21 organizations is the ANSI X3 Committee for Information Processing Systems. This committee alone has 86 subcommittees supported by 3200 volunteers working on 651 standardization projects. In addressing a field of this magnitude, it became necessary to narrow the focus to those areas of major importance to the Army. Such a narrowed focus is obviously a matter of judgement. The subjects treated represent the best judgement of the contractor regarding the most important issues in the Army IMA and the areas in which standardization impacts on those issues.

4.5 Competition Criterion. There are many views of what is meant by competition and how it relates to the adoption of standards in the acquisition process. The following subparagraphs summarize three of the main themes.

a. No standards. This view holds that the adoption of any standards restricts competition, since not all potential suppliers will have chosen to make products conforming to whatever standards are adopted. This view holds that the Army should simply state its operational requirements for any given system at the time of its procurement and let the proposal and evaluation process chose the best solution in that setting. The problem with this approach is that the Army needs widespread information interoperability. The competitive procurement process has proved to be a blunt instrument in regard to achieving coherent objectives over a large number of independent actions covering a wide span of time. To achieve information interoperability using the competitive process in the complete absence of standards is infeasible.

b. De Facto Standards. A "de facto" standard comes about when a particular vendor's product achieves sufficient market domination that it is widely imitated and available from multiple sources. The de facto standards view holds that the Army can adopt such products as standards and restrict its acquisitions to those that conform. The problem with this view is that the product is generally controlled by the dominant vendor. In many cases the product is subject to patent, copyright, or private knowledge owned by the dominant vendor. Such proprietary properties may be licensed. In many cases, proprietary rights are infringed by imitators in the hope that the owners of those rights will not exercise legal recourses to protect them. In most cases, the dominant vendor has the ability to change the product, upsetting the market. When such an event takes place without warning, the imitators are placed in a disadvantageous position until they can bring out products imitating the latest version. These characteristics of a market based on de facto standards give inherent competitive advantage to the dominant vendor. To restrict competition to products conforming to "de facto standards" is generally viewed under the law as an "undue restriction," in the absence of mitigating circumstances. Since mitigating circumstances must generally be determined on a case-by-case basis, it would be infeasible for the Army to adopt such "standards" as its general rule for procurement.

c. Voluntary Standards. A voluntary standard is one that has been developed by the consensus process of the industry as a whole. Generally, such standards are developed under specific guidelines promulgated by a recognized standards certifying body such as the International Standards Organization (ISO) or the American National Standards Institute (ANSI). This process eliminates all proprietary aspects of the standard and vests control of changes in the certifying body. All companies have equal access to the properties of the standard and are

free to chose whether to make products conforming to the standard. In effect, a standard completely levels the playing field and places all competitors on an equal footing as far as requirements are concerned. To specify a standard limits what the acquisition authority will acquire; however, it does not limit competition.

The three views of competition were carefully considered. The "no standards" view was rejected because it does not support the objective of achieving widespread information interoperability. The "de facto standards" view was rejected because such "standards" would be generally viewed as "unduly restrictive" of competition, therefore not meeting the requirements of the CICA. The voluntary standards view was chosen as the means of meeting the requirement to support competition. All of the recommendations of this effort are the products of voluntary standards bodies and the voluntary standards process. Where such standards are not available, no recommendations are made and a shortfall is identified to the Army.

5.0 MODEL OF THE ARMY IMA.

This section discusses a model of the Army's IMA. It treats the five areas, the three operational arenas, and the architecture.

5.1 Army Mission Areas. The Army's IMA is complex and difficult to describe. Part of the complexity stems from the fact that functional consistency is lacking across the mission areas. Figure 1 illustrates this point. In earlier years, each mission area was self-sufficient. Each functioned under its own regulations and had its own procedures. There was very little interaction among them. Currently, there is a growing trend to use general-purpose automation assets to support user services and to use communications networks to support the automation systems. The

following subparagraphs will elaborate on this point. No attempt is made to describe rigorously the complete missions of these areas; rather, the intent is to describe broadly how technology is changing the mission areas, particularly in relation to each other.

5.1.1 Records Management. Until very recently, records management has consisted principally of manual procedures for identifying, scheduling, managing, and disposing of records in hard-copy form. These processes remain. However, the growth of office automation has led to considerable interest in methods for automating these procedures and for maintaining records in electronic form. The records management community is looking to the automation community for the tools and resources to support these new ways of managing records.

5.1.2 Printing and Publishing. Like records management, printing and publishing has traditionally been dominated by centralized, manual procedures creating and distributing hard-copy product. Current trends retain centralized creation and copying of published materials. However, the objective is to create published materials in electronic form and largely keep them in that form. They would be stored electronically, distributed electronically, displayed electronically, and printed locally (on-demand) using nonimpact printers. All of these electronic functions will depend heavily on automation assets. Current Army intent is to embed the electronic functions to the greatest extent feasible into ongoing automation projects, so that growth of support for these functions will follow growth of the Army's automation capability, particularly in the office.

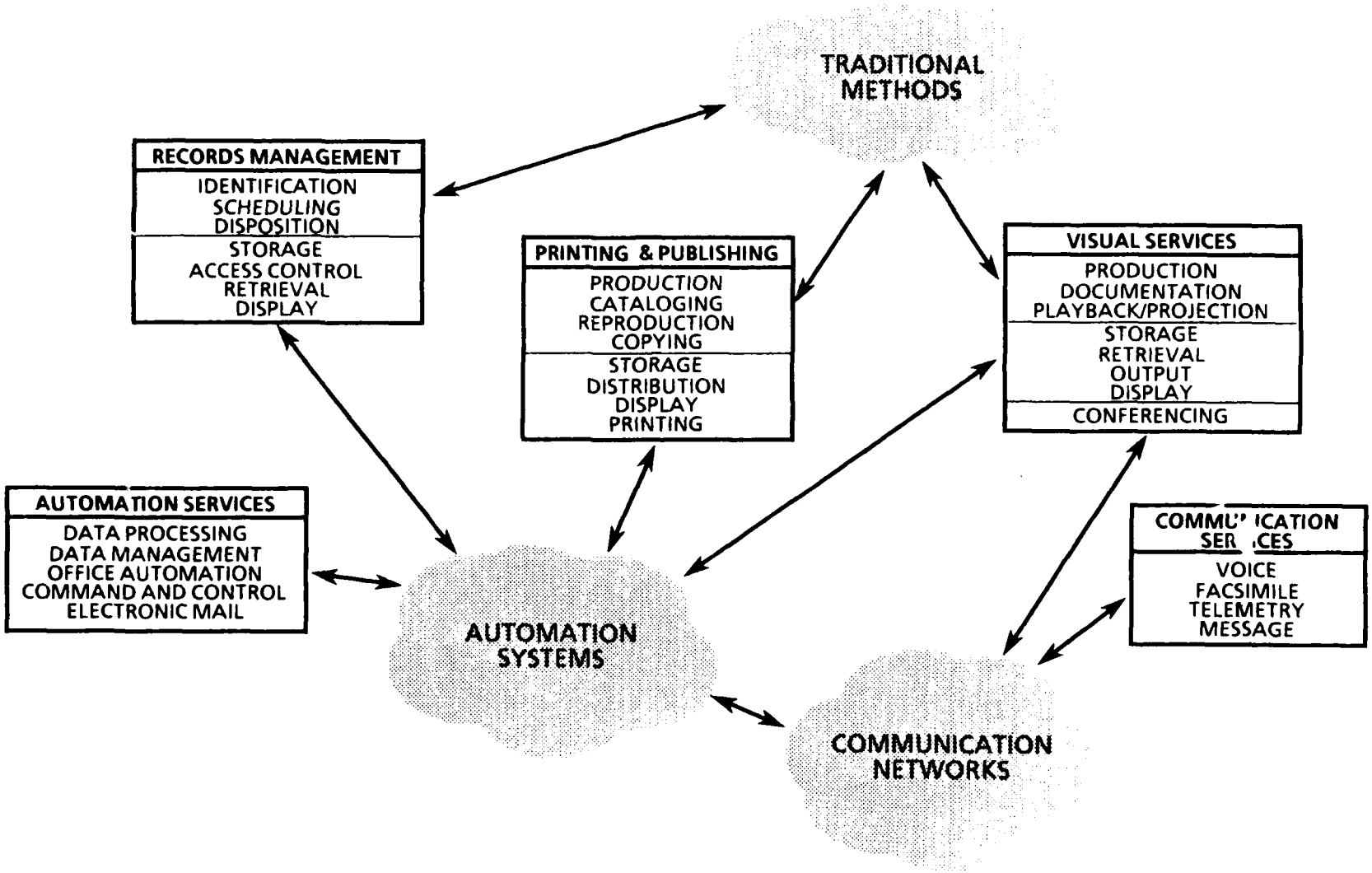

Figure 1 -- Hierarchical Relationship of Army Mission Areas

5.1.3 Visual Information. The visual information mission area has been and continues to be dominated by manual use of physical media, such as film, tape, and graphic arts. Much of the activity in the VI area is devoted to management of personnel and equipment to support these media. Two areas are causing a move away from these traditional ways of operation. These are computer supported visual information and video conferencing. There is a clear commonality of interest between use of computers to support visual information and use of computers for more traditional automation purposes. Video conferencing depends on telecommunications for provision of service.

5.1.4 Automation. A distinction needs to be made between traditional automation services and automation systems. There are two primary reasons. First, automation has historically been divided into data processing and office automation, two classes of service that have substantially different operational requirements which have led to substantial differences in the systems fielded to support them. It is not common, for instance, to do word processing in a mainframe computer, or to do major data processing using a microcomputer. It will be some time before seamless integration of such applications is accomplished. Second, as has been shown in the preceding paragraphs, the records management, printing and publishing, and visual information mission areas are increasingly depending on automation systems to provide key services. This means that automation systems must become increasingly multifunctional, taking on attributes not necessarily implied by traditional automation services. The ability to handle high-quality graphics used in published and visual materials is a specific example. Thus, automation systems should be considered in a broader light than is customary. In the objective time frame, automation systems should be viewed as general purpose utilities, suitable

to support a wide variety of services, not just those relating to traditional automation missions. Requirements and standards should be selected with these expanded services in mind.

5.1.5 Communications. The traditional communications services are voice, facsimile, telemetry, and messaging. Voice, in the form of telephone, remains the most ubiquitous information service. Telemetry is a special application that also remains a direct communication network subscriber. Messaging, in the form represented by the AUTODIN, is gradually migrating to electronic mail. This trend will accelerate as improved COMSEC becomes available. Electronic mail typically runs in general purpose computers, and is more appropriately considered an automation service than a communications service. Facsimile has traditionally been considered a communications service. However, new technologies in scanning equipment and nonimpact printing, coupled with appropriate software running in desktop computers, has led to the integration of facsimile into office automation systems. As office automation systems proliferate, it is likely that standalone facsimile will wither. Facsimile standards are currently being used to support document graphics and to support visual conferencing. These changes lead to the conclusion that facsimile should no longer be considered a communications service. For purposes of this report, facsimile is treated as a visual information service. Automation systems, as has been stated, constitute a new and rapidly growing subscriber of communications networks. Thus, the communications area of the future will primarily have the mission of providing networks to support voice automation, and video conferencing subscribers. Except for voice, the end-devices will be considered to be outside of the network.

5.2 Army Environments. The Army functions in three environments: strategic, theater/tactical, and sustaining base. Requirements among the five mission areas are different in some cases across the three environments. The relationships of the mission areas to the environments are discussed in the following subparagraphs.

5.2.1 Strategic Environment. Architectures, requirements, and properties in the strategic environment are determined in the joint arena. The Army has relatively little unilateral control. This is true even in the case of command and control automation. The joint system is the Worldwide Military Command and Control System (WWMCCS), and automation to support it is called the WWMCCS Information System (WIS). WIS operates system-high Top Secret, and above. A specific architecture has been chosen, and a specific vendor (Honeywell) supplies systems. The Army's participation is called AWIS. It follows the same architecture and uses the same systems as WIS. Similar statements could be made for the other mission areas.

5.2.2 Theater/Tactical. Architectures, requirements, and properties in the theater/tactical environment are dictated by the maneuver and physical requirements of combat. Much that is used in the theater/tactical environment is developed specifically for that environment. This is particularly true of the communications networks, which are moving toward unified 16 kbps channels with the fielding of the Mobile Subscriber Equipment (MSE) and new combat net radio. The properties of these communication systems are quite different from those of communication systems in the other two environments. Theater/tactical automation systems are less peculiar to the environment than communication systems. As a goal, automation systems are to have the same functional characteristics as those in other environments, and even to consist of

nondevelopment items where feasible. The records management, printing and publishing, and visual mission areas differ from other environments still less, because many of the functions are performed in centralized locations away from the battlefield.

5.2.3 Sustaining Base. The Army's sustaining base closely resembles the setting of a major industrial company that is widely decentralized. Essentially the same information functions are performed in essentially the same ways. Flexibility is somewhat limited by federal law in some cases, particularly in records management, resulting in some procedures that are necessarily different from private industry. However, the bulk of Army requirements are being addressed by private industry, and the solutions being developed there are directly applicable.

5.3 Army Three-Tier Structure. Following the lead of private industry, the Army has adopted a three-tier structure for its information systems. Tier-1 consists of functions and systems to which the entire Army must have access. Tier-2 consists of functions and systems that support major commands and installations. Tier-3 consists of functions and systems that support individual workers, whatever their rank, in the performance of their duties.

6. SUMMARY OF FINDINGS AND RECOMMENDATIONS.

This section provides a very condensed summary of the key findings and recommendations contained in Volume 1 and its annexes. Figure 2 is a condensation of Figure 1, designed to show the relationships between the principal elements of the IMA model. User services are satisfied through use of manual procedures, automated procedures, or direct access to communications networks.

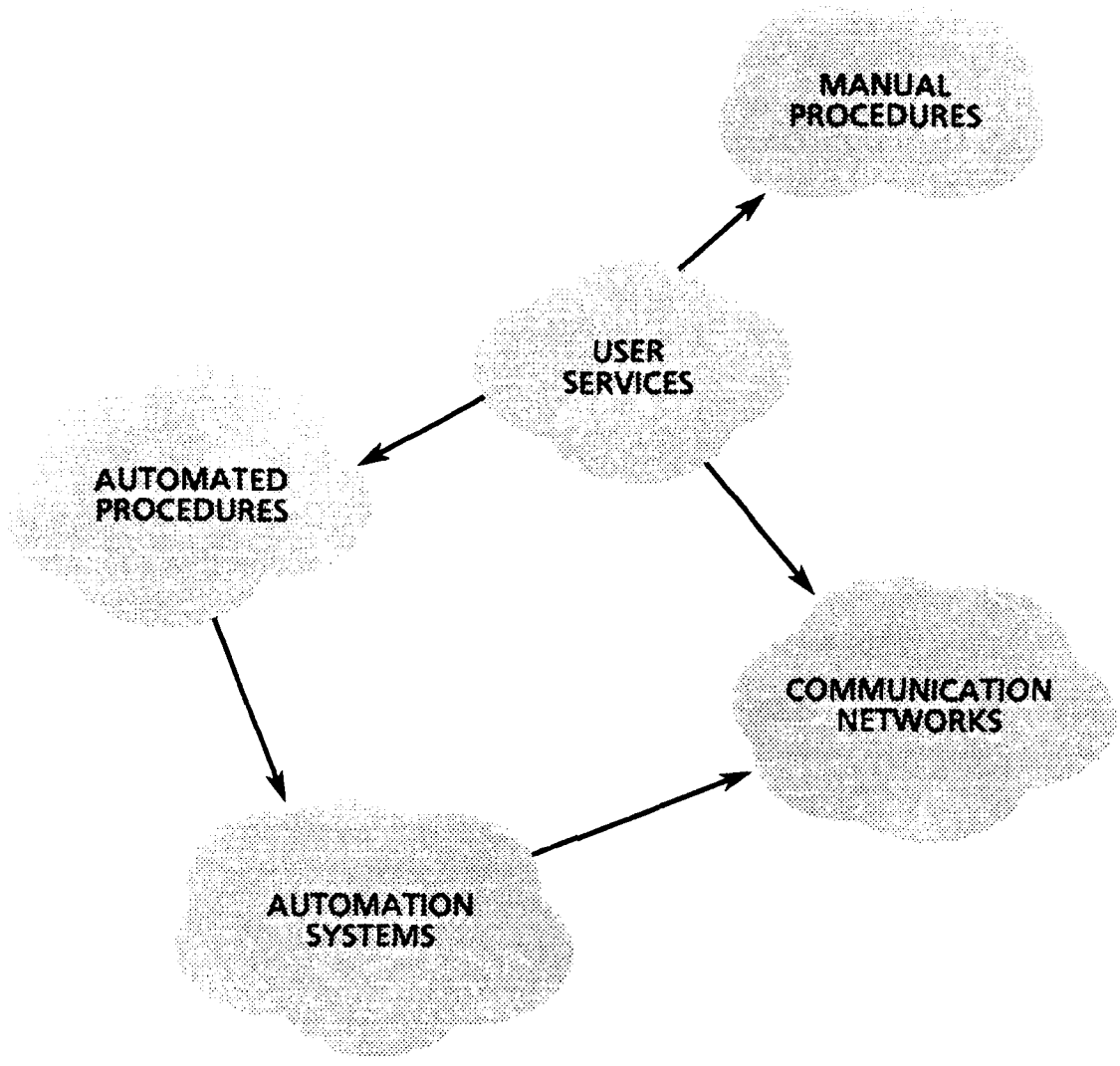

Figure 2 -- Army Information Model

Automated procedures require support by automation systems. Most modern automation systems require support by communications. Table 1 shows the principal standardization topics covered in each of these areas and shows the principal standards (if any) recommended. The standards recommended are shown in italics. Cases where standards are needed but are not available are indicated by the word "none." The following sections will treat the most important of these issues and recommendations.

AUTOMATED PROCESSES

LANGUAGES
- *ADA*

GRAPHICS
- PROCESSING
  - *PHIGS*
- FILE
  - *CGM*
- INTERFACE
  - *CGI*

CHARACTER SETS
- *ISO/ASCII*

DOCUMENTS
- *SGML*
- *SPDL*

DATA MANAGEMENT
- ARCHITECTURE
  - *ANSI/SPARC*
- DBMS
  - NONE
- DATA DICTIONARY
  - *IRDS*
- DATA LANGUAGE
  - *SQL*
- INTERFACE DATA LANG.
  - NONE
- DATA TYPES
  - NONE
- TEXT-TYPE DBMS
  - NONE

COMMUNICATION PROTOCOL
- *GOSIP*

AUTOMATION SYSTEMS

OPERATING SYSTEMS
- SYSTEM
  - NONE
- INTERFACE
  - *POSIX*

PROCESSORS
- NONE

BUSSES
- DESKTOP COMPUTER
  - NONE
- CUSTOM COMPUTER
  - *VMEBUS*
- PERIPHERAL
  - *IPI*

PERIPHERALS
- BUS INTERFACES
  - *IPI*
- GRAPHICS INTERFACE
  - *CGI*
- CONTROL DEVICE
  - *ANSI MOUSE*

STORAGE
- TAPE
  - HALF-INCH -- NONE
  - QUARTER-INCH -- *QIC*
- MAGNETIC DISK
  - NONE
- OPTICAL DISC
  - READ-ONLY
    - *CD-ROM*
  - READ/WRITE
    - NONE

COMM. NETWORKS

ARCHITECTURES
- LONG-TERM OBJECTIVE
  - *B-ISDN*
- MID-TERM OBJECTIVE
  - *ISDN*
- LAN OVERLAY
  - *IEEE 802.e*

WIRING
- *ANSI WIRING STANDARD*

VOICE-BAND INTERFACES
- MODEM
  - LINE SIDE
    - *CCITT V.32*
  - DTE/DCE
    - *EIA RS-232D/530*
  - COMMAND SET
    - NONE

MISCELLANEOUS

VIDEO CONFERENCE
- CODEC
  - NONE
- HIGH-RES GRAPHICS
  - NONE

STAND-ALONE FACSIMILE
- *CCITT GROUP IV*

ARCHIVAL STORAGE
- *WET-PROCESS FILM*
- *9-TRACK TAPE*
- *MULTIPLATTER DISK*

Table 1 -- Structured Portrayal of Recommended Standards

6.1 User Services. All IMA user services are shown as a single cloud. User services are provided by manual procedures, automated procedures, or direct support from the telecommunications network. Automated procedures require support from automation systems which, in turn, frequently require support from the telecommunications network.

6.2 Manual Procedures. As previously stated, a number of the mission areas continue to be dominated by manual procedures, many of which have been codified into procedural standards. These standards have not been addressed in this effort.

6.3 Automated Procedures. Three topics dominate automated procedures. These are information processing, management, and transfer. Information, in turn, breaks down into two subsets, which have to do with whether the information is in the form of data or objects. Data can be processed using classical automated data processing (ADP) procedures. Information in object form is contextual and must be treated within context. Examples of objects are documents and pictures. Procedures and standards appropriate for data are generally quite different from those appropriate for objects.

6.3.1 Processing. The processing function involves input, output, and manipulation of information. These functions are generally performed using some kind of application program. Data processing programs allow algorithmic manipulation of data. The programs are generally designed to perform specific operations on data identified to the application. The principal issue involved in data processing is the

language in which the application programs are to be written. The subsidiary issues in choice of languages are many and revolve around the degree to which they support (or enforce) modern software engineering practices. Current Army policy is to use the Ada language as the Army's standard for data processing programs. It is recommended that this policy be retained.

Object-oriented processing allows construction and rearrangement of the objects (e.g., text documents and graphics objects) of the processing. The functions required to perform these operations are generally common to most applications. Consequently, application programs are not written specifically for each use. Rather, the tendency is to select among competing off-the-shelf programs based on the functionality and user interface provided. The issue in object-oriented processing is to define object sets rich enough to meet a wide variety of requirements. It is recommended that the Army adopt the Standard Generalized Markup language (SGML), an ISO standard, for object processing. SGML is independent of processing envionment, supports database publishing, and has the ability to construct complex objects consisting of text and various graphics.

6.3.2 Management. The management function involves the cataloging, storage, and retrieval of information. In data-oriented management, the data are stored in structures (e.g., hierarchical and relational) that facilitate optimal interaction with the processing environment. The issues are many, including common definitions of data elements, optimal storage structures, query languages suitable for retrieving the specific data required, and the security (defined in the broadest sense) of the data. In management of object-oriented material, the complete objects are generally stored and retrieved. The issues are common definitions of the objects, means of finding objects that meet retrieval criteria and, again, the security of the

information. Information management is an area in which major shortfalls exist in regard to standards available in the time frame of interest. Among the many standards needed, data query languages are the only ones sufficiently advanced to be depended on. The Structured Query Language (SQL) is recommended for use with relational database management systems. The Information Resources Dictionary System (IRDS) standard may become available in the timeframe of interest. A number of other data management standards are in various stages of work, but availability is uncertain and no recommendations can be made. Management systems for objects are not currently the subject of standardization actions, and no recommendations can be made.

6.3.3 Transfer. Of concern under this tasking is the transfer of information in electronic form. In some cases, the timeliness criteria make it necessary that the information be transferred electrically via communication networks. In others, the timeliness criteria and bulk of the material lead to transfer in electronic form on physical media. The issues are primarily cost-effective use of media, interoperability at all points of use, and security. For physical distribution in electronic form of centrally produced materials, such as published documents, the Compact Disc Read-Only Memory (CD-ROM) is recommended. For transfer by communications, the ISO Open System Interconnection (OSI) Protocols are recommended. Specifically, the Government Open System Interconnection Profile (GOSIP) is recommended.

6.4 Automation Systems. Two principal components of automation systems will be treated. These are operating systems and processors.

6.4.1 Operating Systems. An operating systems is a set of computer instructions that control the functioning of the components of an automation system and give it

its personality. Automated procedures typically interface with automation systems at the operating system. The issues are the degrees to which operating systems provide functionality to automated procedures, the transportability of such procedures, and the degree to which such procedures are interoperable across different automation systems. Standards for operating systems, per se, are not available. It is recommended that the Army not attempt to standardize operating systems. However, a standard for operating system interfaces (called POSIX) is available. This standard supports software portability and (in conjunction with the GOSIP file transfer protocol) will considerably enhance interoperability across different product lines.

6.4.2 Processors. A processor is an electronic device that performs arithmetic and logical operations on information represented in binary form. A processor generally functions under the control of an operating system. The specifics of processors are generally of less consequence in the determination of key information systems properties (such as interoperability) than other functions, such as operating systems. Processor technology is advancing at a very rapid rate; standardization would have a stifling effect on these advances. It is recommended that the Army not standardize processors.

6.5 Communications Networks. Communication networks are used to move information from one location to another quickly. There are many ways in which communications networks can be characterized as functions of geographical coverage, information bandwidth, timeliness of delivery, reliability, and cost. Of principal interest under this effort are establishment of network design objectives and protocols by which users may request and obtain required services and achieve interoperability with each other across the network.

6.5.1 Long-term Network Objective. A set of standards are in work to define a network that will support voice, all kinds of data, and high-definition television to the level of the individual subscriber using a single integrated network. Such a network is called the Broadband Integrated Services Digital Network (B-ISDN). Its availability is anticipated in about 1995. It is recommended that the Army adopt B-ISDN in principle as its long-term objective.

6.5.2 Intermediate Objective. A set of standards exists currently that will support voice and medium performance data (up to 64 kbps) to the subscriber in an integrated network. This is called the Integrated Services Digital Network (ISDN). It is also coming to be called narrowband ISDN to distinguish it from B-ISDN. It is recommended that the Army adopt ISDN standards pending transition to B-ISDN in the 1995 time frame.

6.5.3 Local Area Network (LAN) Overlay. The Tier-3 automation environment requires immediate and widespread enhancement of data communications capabilities. To accomplish timely enhancements will require use of existing telephone cable. A set of standards exist which will support high performance (currently 1 Mbps, 10 Mbps in the near future) data communications using telephone wire. These are the IEEE 802.3 standards for LANs. It is recommended that the Army adopt the IEEE 802.3 standard for use in overlaying LANs on existing Tier-3 communications using telephone wire.

7. TRANSITION.

This section will address the means by which the Army can transition to systems using the key recommendations.

7.1 Sustaining Base Communications. The key issue in sustaining base communications transition is illustrated in Figure 3. The current subscriber count is

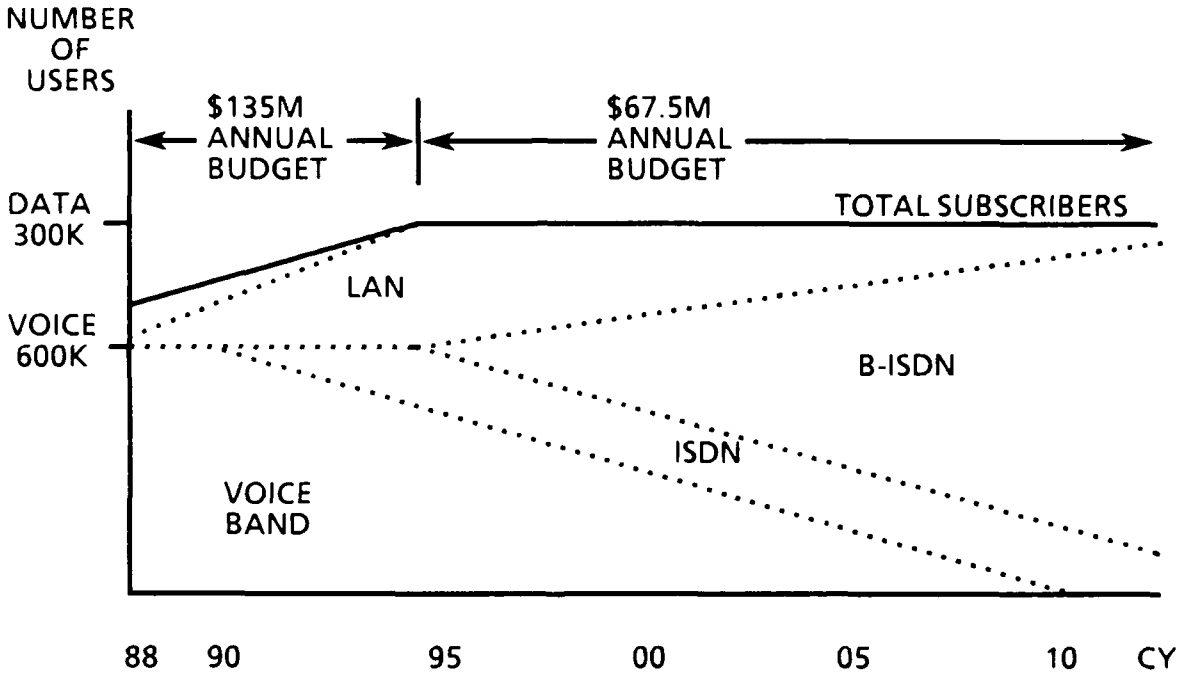

Figure 3 -- Sustaining Base Communications Transition

approximately 600,000. The systems supporting these subscribers are currently voice-band, which provide very poor support to data communications. Upgrade costs approximately $1500.00 per subscriber, for a total of approximately $900M. Currently, the Army has fielded 110,000 desktop computers, of which fewer than 10,000 are connected to networks. The number of desktop computers is expected

to rise to 300,000 by 1995. Most of these computers will require connection to networks providing better data communications than can be obtained from voice-band networks. The recommended strategy is to overlay existing networks at Tier-3 using IEEE 802.3 standards and existing telephone wire. This would allow desktop computers to obtain connection without the need for a general cable plant upgrade. General installation-level upgrades would be accomplished using ISDN standards until 1995, when B-ISDN standards would be phased-in. The estimated budget required to support this transition is shown at the top of the figure.

7.2 Operating System Interfaces and Communications Protocols. Transition strategies for operating system interfaces and communications protocols are similar. Benefits of one are not fully realized without the other. Therefore, it is recommended that they be coordinated. Figure 4 illustrates the strategy. Shown is a current Standard Army Management Information System (STAMIS) application running on two computers that use IBM operating systems and IBM communications protocols (i.e., System Network Architecture -- SNA) connected to an SNA network. It is desired that the environment be transitioned to POSIX, GOSIP, and the Defense Data Network (DDN). To effect the transition, several actions are required. One is the development of an interface between the application and POSIX and GOSIP. This would be done by the Army either as a part of STAMIS Redesign or as a retrofit to the application software. A second action is the development of an interface between the proprietary operating system and POSIX and GOSIP. This would presumably be done by the supplier of the operating system. Note that both of these actions are accomplished off-line without interference with ongoing operations. Once both actions are taken, the operating system and application software are reloaded with versions containing the new interfaces, and the GOSIP stack is connected to the DDN. At this point, the application can run

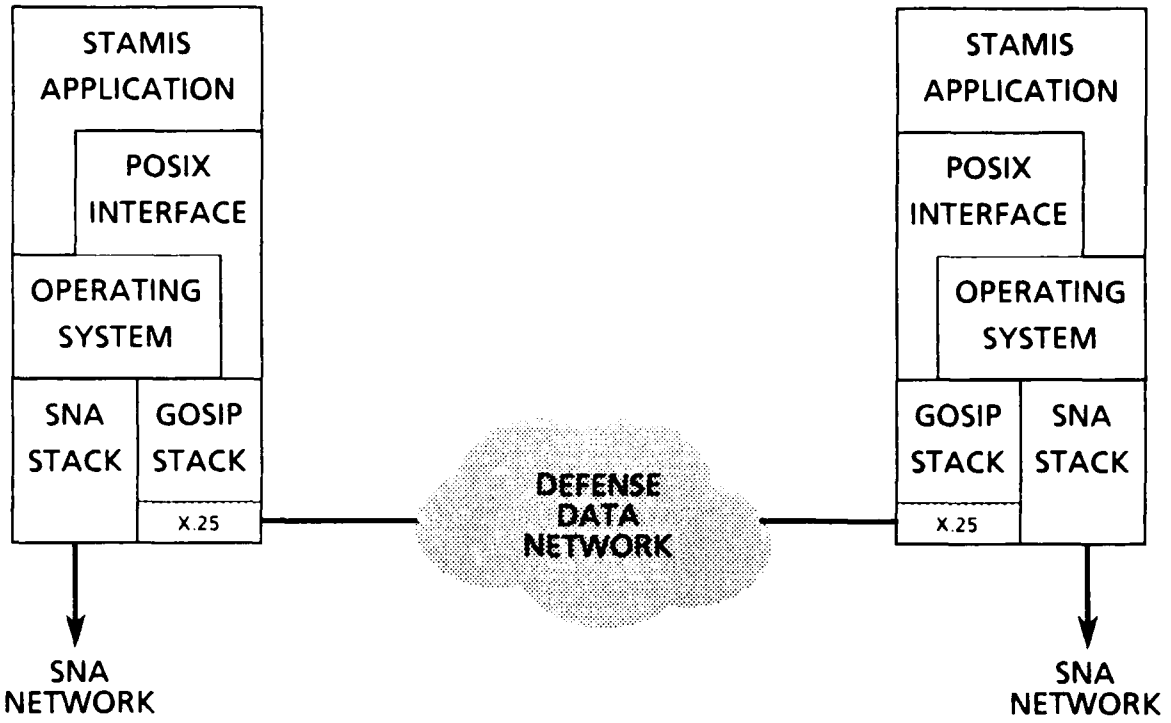

Figure 4 -- Operating Environment and Protocols Transition Strategy

under either the old environment or the new. None of the old capability is lost. Once the new capability is verified to function correctly, and all interfacing systems are upgraded to the same capability, the old environment can be deactivated.

8. CONCLUDING REMARKS.

This executive summary has highlighted the issues and recommendations regarding standardization of Army information systems. By following the recommendations, the Army will bring those systems closer to interoperability. However, the

recommendations will not solve all of the Army's information system interoperability problems. Several problems will remain.

a. Unstandardized Areas. Some topics are not subject to standardization. For example, the representation and interpretation of data are subject to internal Army design and discipline. It will not be of any value to have data dictionary standards if the Army does not develop and enforce data element definitions across the IMA.

b. Unavailable Standards. The need for standards has been identified in several areas, but standards are unpredictably far into the future. The whole area of data management is an example of this case. Until a full suite of standards is available and implemented, barriers will remain, even though the solution is conceptually known.

c. Weak Standards. In a number of areas, standards are being developed incrementally. The existing version is weak and incomplete; later versions are expected to stronger and more capable. The GOSIP is only one example. Several additional protocols have been identified as being crucial to effectual communications. SQL is another example. The current standard does not offer a number of commands considered by many application developers as being essential.

d. Discipline. The final problem will be discipline on the part of the Army. Many standards will fall significantly short of providing the full functionality desired by the Army. The vendor community will continue to build systems that offer enhanced performance and functionality available only through use of their

proprietary implementations. The Army must choose between competing priorities: whether to pursue the objective of enhanced interoperability at the expense of reduced performance and functionality in the short term or to sacrifice interoperability in favor of enhanced functionality and performance. The achievement of interoperability will be slow and will require sustained discipline and focus on that objective.

The following quote is a fitting conclusion to this report. While it was written in regard to the ISO communication protocol standards, it is equally applicable to the other standards recommended.

> "Vendors will still attempt to distinguish themselves by developing proprietary implementations with greater functionality than can be obtained through the OSI architecture. As vendors continue to differentiate themselves, full interoperability at the highest layers of OSI will continue to be elusive. OSI can provide basic connectivity among diverse computing environments. And while establishing these lowest common denominators is less than ideal, it should make life easier for users with multivendor nets." Network World, 7 December 1987.

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