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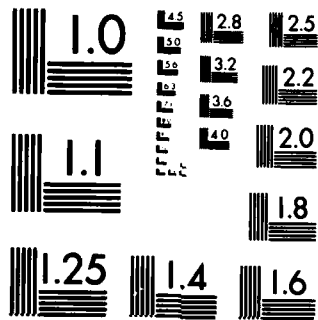UNCLASSIFIED   DTIC/TR-83/6   F/G 5/2   NL

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AN INTELLIGENT GATEWAY
FOR THE DEPARTMENT OF DEFENSE
THE TECHNOLOGY INFORMATION SYSTEM

JUNE 1984

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Office of Information Systems and Technology
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The Director of Research and Laboratory Management, Office of the Under Secretary of Defense for Research and Engineering, Research and Advanced Technology (OUSDRE(R/AT/R/LM)) has directed that DTIC be the DoD focal point for development of an intergovernmental intelligent gateway computer system. The gateway is a cooperative effort among DoD/DTIC, DOE, NASA, and NTIS. Present day access to information resources (databases) is limited since each database has its own complex access procedures and command language. In addition, results from multiple databases cannot be combined or analyzed easily by the user. The gateway system will provide DoD researchers and managers access to many different databases using a single, simple access procedure. Data Analysis, merging, post processing, and graphical presentation can be easily and quickly accomplished through the gateway.

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BACKGROUND

The Defense Technical Information Center (DTIC) is participating in an joint agency effort with the Department of Energy (DOE) and the National Aeronautics and Space Administration (NASA) to develop an intelligent gateway computer system. We have similar and often mutual users who need access to a wide variety of information resources, many of which are available online. Unfortunately, incompatible computer resources, complex and different access procedures and command languages, and the absence of the ability to aggregate, post-process and analyze data online limit the usage and usefulness of these resources. Our goal is to maximize online availability of these resources through the use of an intelligent gateway computer.
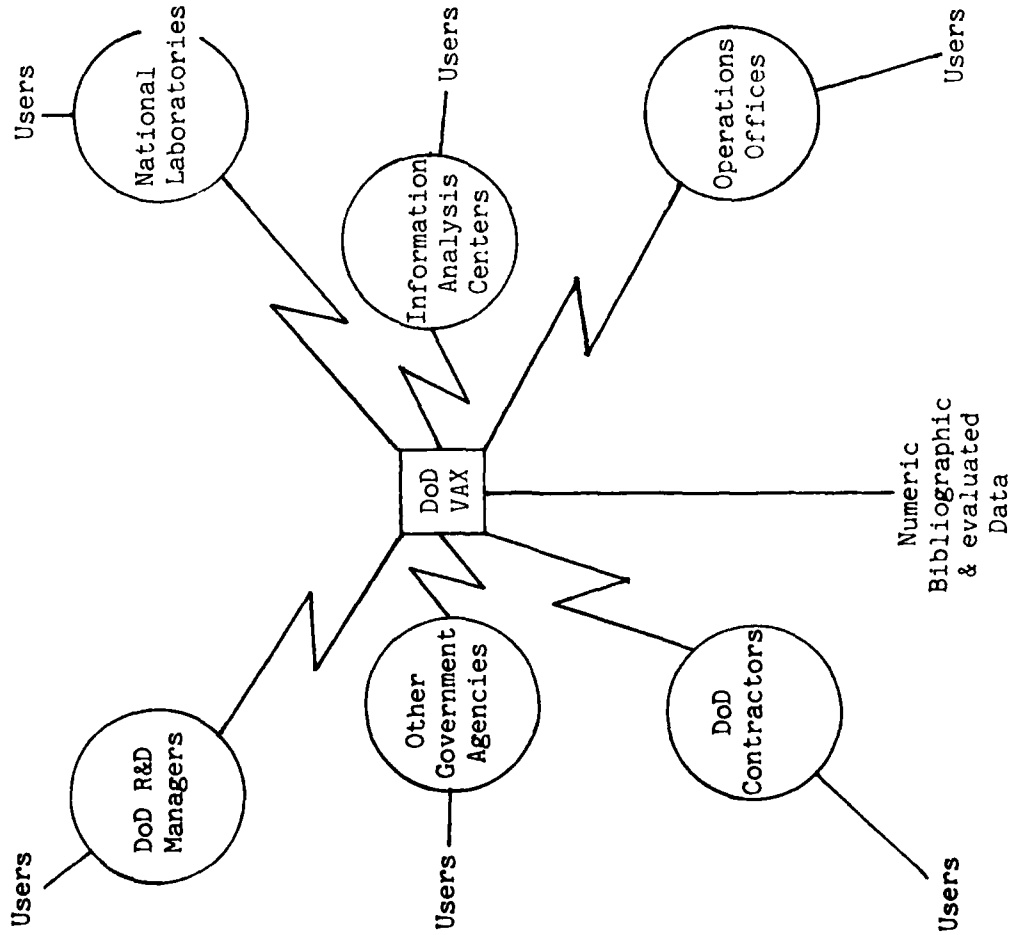
Each participating agency is responsible for developing a directory of the online information resources under its control. DTIC has surveyed the DoD community to identify existing DoD databases, their scope and availability for sharing. Survey results are being used to develop the DoD resource directory and determine which databases should be accessible through the gateway. This information will provide the basis for establishing a DoD gateway which, in turn, will be a node in an intergovernmental gateway network with NASA and DOE. This network is depicted in Figure 1.
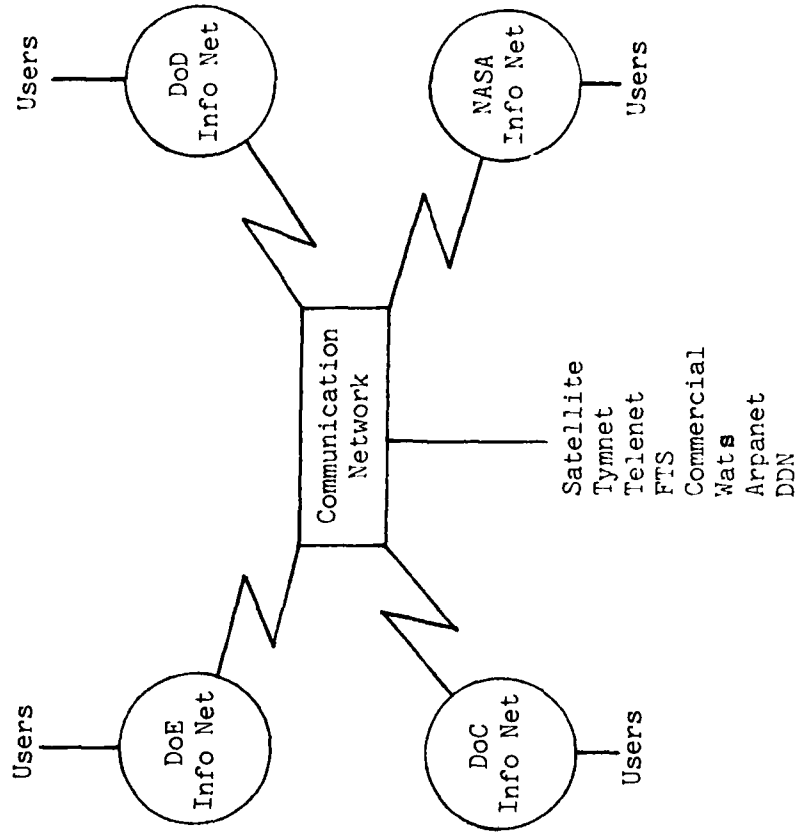
THE TECHNOLOGY INFORMATION SYSTEM (TIS)

The Technology Information System (TIS), currently under development at the Lawrence Livermore National Laboratory (LLNL), is the prototype system for the network. TIS is an intelligent gateway computer system which provides for distributed networking, electronic communication, interactive modeling, data management, and graphics.

Figure 1. DoD INTELLIGENT GATEWAY COMPUTER SYSTEM

CONCEPTUAL MODEL FOR AGENCY NETWORKING

Users — DoD Info Net

NASA Info Net — Users

Communication Network

Satellite
Tymnet
Telenet
FTS
Commercial
Wats
Arpanet
DDN

Users — DoE Info Net

DoC Info Net — Users

DoD INTEGRATED INFORMATION NETWORK

Users — National Laboratories

Information Analysis Centers — Users

Operations Offices — Users

DoD VAX

Numeric
Bibliographic
& evaluated
Data

DoD R&D Managers

Other Government Agencies

DoD Contractors

Users

Users

Users

The current method for searching a database by use of a remote terminal requires that the researcher identify and access an appropriate distant computer and follow the unique search practices that have been programmed into it. The normal search requires that several databases be accessed, probably more than once each, and the researcher is burdened with interpreting and following a different instruction manual for each system. The product of the search is a volume of printed matter that must be culled for the relevant material that is to be retained for use. For the infrequent user, most of the time and effort expended in a search are non-productive; they are given over to identifying appropriate databases, accessing them, reading instruction manuals, and cutting and pasting printouts. The need is for the resulting information product, which takes relatively little time to assemble. The rest of the search process is expensive overhead.

The Technology Information System links people, information centers and computers. To accomplish this TIS functions as an electronic switch, a translator, a super-intelligent terminal, a communications interface and a transaction controller. TIS streamlines, speeds-up, and modernizes the search process by providing a fast, smart robot to do much of the drudge work. The researcher need only access one computer -- TIS -- and learn one set of access protocols. Through TIS, the researcher has a single point of access to multiple, diverse databases which are geographically distributed throughout the world. TIS provides a directory of resources which can be accessed through the gateway and automatically switches authorized users to the information utility of their choice. TIS provides a protocol translator for connecting to and disconnecting from these resources. Users are provided online instructions, sample search sessions, and contact points with phone numbers for each of the resources. In addition, data analysis can be performed through the extensive TIS library of post-processing routines. As a result, TIS eliminates much of the non-productive overhead of database searching.

COMMUNICATIONS CAPABILITIES

Communications capabilities are the backbone of any gateway system and TIS has many outstanding features here. Users can access TIS via TYMNET, ARPANET, FTS, WATS and commercial phone lines. After login, many communications options are available. I will focus on electronic mail, write, link, connect, dial, and download.

Electronic Mail

Electronic mail service is available to all TIS users twenty four hours a day. Standard electronic mail features, such as send, receive, answer, and forward, are incorporated. Mail messages can be sent simultaneously to multiple addresses, with lengthy documents attached if needed. Users recognize the benefits of being able to comunicate with numbers of people at the same time and of avoiding the call-back routine. Messages can be filed for future reference or deleted from the system upon command.

Write

WRITE is another communications option, which allows users online to communicate with each other via their terminals. You first enter the command %WHO, to get a display list of who is currently online. You then enter the command %WRITE, followed by the name of the user you wish to communicate with, which notified that user who then has the option of responding. The WRITE command is only useful when parties who want to communicate are at their terminals, by chance or arrangement, at the same time.

Link

The LINK command is unique to TIS and allows users at different and various locations to link their terminals so that they are viewing the same data display. All users have control

over the display and can issue commands at will. Of course,
linking necessitates a cooperative spirit and some coordination.

The LINK command has proven advantageous in numerous
situations. For example, an instructor can provide on-line
tutorials to a student or a class at a different location. This
technique was used by Dr. Sullivan of the Chemical Information
System (CIS), in Washington, D.C., to provide a demonstration of
CIS to a class in Brazil. The use of a speaker phone enhanced
this demonstration by providing simultaneous voice communication.

The LINK command is also useful for joint online editing of
reports. This practice eliminates mail delays and allows users to
discuss changes while viewing the data together.

Through the LINK command information specialists and
end-users can perform interactive database searches. The end-user
benefits from the specialist's expertise while the specialist
benefits from the end-user's immediate feedback. This
communications capability can be used to facilitate technology
transfer from the government to industry.

Connect

The CONNECT command provides users with automatic access to
information resources. Users do not have to know telephone
numbers, ARPANET locations, passwords, access protocol or logout
protocol. The user issues the CONNECT command and a data resource
name. TIS then attempts to establish a connection to the resource
and logs the user in. The user is provided feedback during this
process with a display such as:

> **Attempting TYMNET connection to DoD/MATRIS**
> **Connection made**
> **Attempting login to DoD/MATRIS**
> **Login complete**
> **DoD/MATRIS is ready. Please enter your request.**

TIS uses TYMNET, TELENET, ARPANET, COMMERCIAL TELEPHONE and FTS to establish connections.

The CONNECT command can be used to access information centers worldwide. Systems such as DoD/MATRIS, DOE/RECON, NASA/RECON and DIALOG are currently available. In order to be eligible to use the CONNECT command for access to a resource, a TIS user establishes an account with that resource and obtains the required access identification information, such as passwords, to be programmed into the gateway by the TIS Data Base Administrator. The billing process is unaffected by gateway access. Vendors maintain the same billing structure and users maintain the same reimbursement structure, regardless of the TIS access procedures. TIS has several levels of security to ensure that password integrity is not violated.

Dial

Users who wish to access a resource other than those listed in the TIS resource directory take advantage of the DIAL command, rather than the CONNECT command. DIAL allows users to call any information center, computer, or terminal, no matter where the location. Using DIAL implies that the user knows the necessary passwords and telephone numbers. DIAL allows the user to access an off-network facility while retaining TIS capabilities such as downloading and file transfer.

Downloading

Once you are connected to a resource through TIS, you can download data from that resource. Downloading data opens many options to you. For example, you can review it at your own pace, merge it with other data, and share it with other users by allowing them to access your file. You can also transfer your file to other users so that they can manipulate the data to suit their own needs. You can share your data selectively on a worldwide basis.

POST PROCESSING

TIS offers a library of post-processing routines for numeric and bibliographic data. In order to execute post-processing routines, users must download the data into a TIS file. Post-processing routines, as with the CONNECT command, are available for selected resources. The routines currently available are REVIEW, DISPLAY, PERMUTE, CROSS-CORRELATE, and CONCORD.

REVIEW allows users to process citations and determine relevance at their convenience. Users are presented with the author, title, date and several lines of an abstract. Based on this information they may choose to continue to work with the citation or discard it and move on to the next. If they continue to work with the citation they may add local options, which include assigning relevancy values and index categories that are searchable. Users also can flag citations for which they wish to order the full text, plus add their own comments to a citation.

The DISPLAY routine allows users to generate bar charts representing the yearly publication rate for a subject area, personal author, or corporate author. This type of graphic representation makes growth trends immediately apparent.

PERMUTE provides statistics on the frequency of occurrence for descriptive terms in the citations. Single and compound expressions containing up to four terms are analyzed. These terms are presented in alphabetic order, preceded by the number of occurences.

The CROSS-CORRELATION and CONCORD routines analyze the relationships among data elements chosen by the user. These routines provide intelligence that is very tedious to extract manually from standard bibliographies.

A goal which is shared by DTIC, NASA, and DOE is to provide our users with the capability to merge search results from our databases, eliminate duplicate citations, and produce one relevant information product in the desired format. We want our users to be able to work with our databases and get more value from them. We are convinced that TIS is a major step toward achieving this goal.

Output from TIS can be transfered to word processors and merged with reports, sent to typesetters as camera ready copy or routed to high speed printers. TIS simplifies all phases of technical reporting. Information processing, report generation, review and release and publication can all be accomplished through TIS with this printing interface capability.

TIS is linking the electronic office, on-line information centers, computer centers and home computers. Through the integrated information system, it provides unified access to numerous, dissimilar data files. Some of the ways in which TIS currently is being used are:

- To find, aggregate, organize, evaluate, and report technical information/data.

- To do comparative, interactive modeling and performance prediction.

- To provide communications among administrators and project staff, nationwide.

- To access any national or international information center, or domestic or foreign-based computer.

TIS brings high efficiency to the database searching process because:

- It integrates all of the procedural and mechanistic
  functions of the process in one automated system that
  is search-logic specific.

- It automatically provides connections between and
  among information systems.

- It provides routines to extract, aggregate,
  disaggregate, and post-process data collected during a
  search.

- It provides routines for generating conventional
  graphics.

- It is friendly with - even compassionate of -
  computers, terminals, word processors, typesetting
  equipment, and other hardware.

- It is indifferent to the communications path - trunk
  line, FTS, WATS, TYMNET, ARPANET - as long as someone
  pays the bill.

- It provides users with a guiding menu and help
  options.

TIS is running on a VAX-11/780, uses the UNIX operating
system, and includes INGRES as the database management system.

INTERAGENCY DEVELOPMENT GOALS

A Steering Committee, comprised of representatives from DoD,
NASA and DOE, meets on a regular basis to establish mutual goals
for TIS and evaluate progress toward achieving those goals. Our
ultimate objective is to develop a system which can respond to a
researcher's information need by locating the appropriate
databases conversing with them on the researcher's behalf, and

providing a single, final, relevant information product. We are
proceeding towards this goal in stages which we believe are
realistic from technological and budgetary viewpoints.

The development goals for FY 1984 are to extend the TIS
post-processing routines to all of our databases and to initiate
efforts to provide automatic multi-file post-processing. As
mentioned earlier, multi-file post-processing involves the
elimination of duplicate citations. To accomplish this, we plan
to utilize TIS to translate citations into a common format and
execute an algorithm for identifying duplicate citations. The
formula for the algorithm has yet to be developed, but initial
discussions indicate that some combination of author, report date,
and title will be utilized. Users will be able to override
machine decisions about duplicates, if they desire. In addition,
we want to have menus available so that users can add databases to
the post-processing programs. Many of these efforts will be
carried over into 1985.

Also in FY 1985, we will concentrate on developing a design
for a common interface for querying diverse databases. This
interface will relieve the user of the need to learn and master
separate languages and procedures for each data base accessed. We
intend to explore command-, menu- and natural lanaguage-oriented
interfaces. It is possible that the disparate needs of our user
community will require that more than one type of interface be
implemented. Research, development and implementation efforts in
this area will carry on through FY 1987.

DoD IMPLEMENTATION

DTIC has the mission to explore and acquire techniques and
arrangements to facilitate access to STI data bases, on-line
services, and networks relevant to the conduct and management of
research and engineering programs. In recognition of this

mission, DTIC was established as the DoD focal point for all
actions required to develop TIS for the DoD community. These
actions include coordinating requirements from all DoD sources and
serving as a channel for interservice funding of the project.

At the present time, all system development, test and
evaluation is taking place on the TIS prototype system at LLNL.
DTIC is sponsoring a number of DoD user entities who have agreed
to test TIS in their operations and make recommendations regarding
its evolution into a DoD Intelligent Gateway System. These users
are issued TIS passwords and dial into the LLNL prototype via
TYMNET or WATS lines. Users can choose the applications they wish
to test. TIS orientations are provided at DTIC, or at the user's
location through TIS linking technology. We also provide
demonstrations of the system for interested members of the DoD
community.

During FY 1985, DTIC will procure equipment for the DoD
gateway prototype. The TIS software will be ported to the DoD
equipement. Our current plans call for the DoD gateway prototype
system to be sited at the Pentagon.

The DoD system will be run in test mode for 12 months.
Selected members of the DoD user community will be invited to
participate in the test and evaluation. The purpose of this
period will be to demonstrate "proof-of- concept". If all goes
well, the system will be moved to an operational status shortly
thereafter.

If you would like further information on this topic, you can
contact:

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