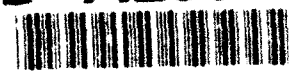

WRDC-TR-90-8007
Volume I
Part 1

INTEGRATED INFORMATION SUPPORT SYSTEM (IISS)
Volume I - Project Overview
Part 1 - Executive Summary

D. Mann

Control Data Corporation
Integration Technology Services
2970 Presidential Drive
Fairborn, OH 45324-6209

September 1990

Final Report for Period 1 April 1987 - 31 December 1990

Approved for Public Release; Distribution is Unlimited

MANUFACTURING TECHNOLOGY DIRECTORATE
WRIGHT RESEARCH AND DEVELOPMENT CENTER
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-6533

NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, regardless whether or not the government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data. It should not, therefore, be construed or implied by any person, persons, or organization that the Government is licensing or conveying any rights or permission to manufacture, use, or market any patented invention that may in any way be related thereto.

This technical report has been reviewed and is approved for publication.

DAVID L. JUDSON, Project Manager
WRDC/MTI
Wright-Patterson AFB, OH 45433-6533

25 July 91
DATE

FOR THE COMMANDER:

BRUCE A. RASMUSSEN, Chief
WRDC/MTI
Wright-Patterson AFB, OH 45433-6533

25 July 91
DATE

If your address has changed, if you wish to be removed form our mailing list, or if the addressee is no longer employed by your organization please notify WRDC/MTI, Wright-Patterson Air Force Base, OH 45433-6533 to help us maintain a current mailing list.

Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on a specific document.

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for Public Release Distribution is Unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) FTR620300001	5. MONITORING ORGANIZATION REPORT NUMBER(S) WRDC TR 90 8007 Vol I Part 1
6a. NAME OF PERFORMING ORGANIZATION Control Data Corporation; Integration Technology Services 6b. OFFICE SYMBOL *(if applicable)*	7a. NAME OF MONITORING ORGANIZATION WRDC/MTI
6c. ADDRESS *(City, State, and ZIP Code)* 2970 Presidential Drive Fairborn, OH 45324-6209	7b. ADDRESS *(City, State, and ZIP Code)* WPAFB, OH 45433-6533
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Wright Research and Development Center, Air Force Systems Command, USAF 8b. OFFICE SYMBOL *(if applicable)* WRDC/MTI	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUM F33600-87-C-0464
8c. ADDRESS *(City, State, and ZIP Code)* Wright-Patterson AFB, Ohio 45433-6533	10. SOURCE OF FUNDING NOS. PROGRAM ELEMENT NO: 78011F; PROJECT NO: 595600; TASK NO: F95600; WORK UNIT NO: 20950[illegible]
11. TITLE *(Include Security Classification)* Project Overview: Executive Summary	
12. PERSONAL AUTHOR(S) Control Data Corporation: Mann, D	
13a. TYPE OF REPORT Final Report	13b. TIME COVERED 1Apr87 31Dec90
14. DATE OF REPORT *(Yr, Mo, Day)* 1990 September 30	15. PAGE COUNT 42
16. SUPPLEMENTARY NOTATION WRDC/MTI Project Priority 6203	

17. COSATI CODES			18. SUBJECT TERMS *(Continue on reverse if necessary and identify block number)*
FIELD	GROUP	SUB GR.	
1308	0905		

19. ABSTRACT *(Continue on reverse if necessary and identify block number)*

This document provides an executive overview of the Integrated Information Support System (IISS)

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED x SAME AS RPT DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL David L Judson	22b. TELEPHONE NO *(Include Area Code)* (513) 255-7371 22c. OFFICE SYMBOL WRDC/MTI

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

FOREWORD

This technical report covers work performed under Air Force Contract F33600-87-C-0464, DAPro Project. This contract is sponsored by the Manufacturing Technology, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. It was administered under the technical direction of Mr. Bruce A. Rasmussen, Branch Chief, Integration Technology Division, Manufacturing Technology Directorate, through Mr. David L. Judson, Project Manager. The Prime Contractor was Integration Technology Services, Software Programs Division, of the Control Data Corporation, Dayton, Ohio, under the direction of Mr. W. A. Osborne. The DAPro Project Manager for Control Data Corporation was Mr. Jimmy P. Maxwell.

The DAPro project was created to continue the development, test, and demonstration of the Integrated Information Support System (IISS). The IISS technology work comprises enhancements to IISS software and the establishment and operation of IISS test bed hardware and communications for developers and users.

The following list names the Control Data Corporation subcontractors and their contributing activities:

SUBCONTRACTOR	ROLE
Arizona State University	Responsible for test bed operations and support in Arizona
Control Data Corporation	Responsible for the overall Common Data Model design development and implementation, IISS integration and test, and technology transfer of IISS. Also responsible for USAF and DoD Booth at CALS EXPO '88 and CALS EXPO '89.
D. Appleton Company	Responsible for providing software information services for the Common Data Model and IDEF1X integration methodology.
International Business Machines	Responsible for studies in Enterprise Integration Framework.
ONTEK	Responsible for defining and testing a representative integrated system base in Artificial Intelligence techniques to establish fitness for use.
Simpact Corporation	Responsible for Communication development.
Structural Dynamics Research Corporation	Responsible for User Interfaces, Virtual Terminal Interface, and Network Transaction Manager design, development, implementation, and support.
Universal Technology Corporation	Responsible for test bed operations and support in Dayton.
Northrop Aircraft Division	Responsible for studies in Enterprise Integration Framework.
TCS Consulting	Responsible for OSI communications development.

SECTION 1

INTRODUCTION

1.1 Background

Since 1979, projects have been supported to design and develop a prototype of an integrated computer system called the Integrated Information Support System (IISS). The Data Automation Processor (DAPro) project was created to continue the development, testing, and demonstration of IISS. The objective of the DAPro project is to establish and operate a Test Bed, to validate the concept of integrated applications supported by IISS, and to maintain and enhance IISS.

DAPro is a continuation of technical results from Project 6202 and its predecessor Project 6201. The initial objective of Project 6201, ICAM Integrated Center (ICENT) Manufacturing Control Material Management (MCMM) System, was to establish the Requirements Definition and Detail Design of an ICENT-level MCMM System. As work proceeded, it became apparent that accomplishing this objective required an integrating mechanism that allowed the integration of higher-level planning systems, with lower-level shop floor control systems.

Work under ICAM Project 3101, Computer-Based Information System (CBIS), established a number of principles as guides in formulating solutions for the near term that are extendible for the long term. The solution to the ICENT integration issue appeared to be generic to the entire spectrum of system and data integration. It was apparent that undertaking IISS would ultimately yield not only the solution to integrating high-level and shop floor systems but to the entire spectrum of integrating existing enterprise systems and future systems.

Project 6201 and 6202 objectives were to establish and operate a Test Bed to validate the concept of integrated applications supported by establishing an IISS. In addition, the projects established a standards guideline document called the "Interim Standards and Procedures" to guide the design of the IISS and to provide guidance to other ICAM projects. A set of requirements and a migration strategy were established as the basis for enhancement direction to the IISS.

The DAPro objective, under the prime contractor Control Data Corporation, is to establish, operate, and enhance a Test Bed containing services provided under Project 6201 and 6202. This project will provide technical and educational support for IISS users representing several manufacturing technology centers and disciplines, including integration technology, sheet metal, machinery, composites, electronics and assembly. Each center could be supported by the Test Bed, which includes system development, tests, production emulation, and technology transfer environments.

1.1.1 Today's Non-Integrated Environment

Today, factories are characterized by a multiplicity of discrete information systems that have been designed to serve individual users or activities within an organization. Since many of these activities receive information from and generate information for many other activities, an extremely complex non-integrated information system has been developed. Additionally, today's environment is characterized by a number of different computers that do not easily communicate, have different keyboard access methods, and require expertise in order to use them. These conditions lead to a reluctance to implement other types of software and equipment.

While capital spending for computer equipment and software is soaring, and information costs are mounting rapidly, the current environment results in the poor treatment of data and a waste of information, which is a valuable corporate resource. This situation becomes more complex and difficult to contain as more discrete systems are installed.

The Air Force's Manufacturing Technology Directorate at Wright-Patterson Air Force Base (WRDC/MTI) recognized the advantages and requirements for integrated computer systems. The Air Force realized that an integrated computer system would reduce the cost of these manufacturing processes. Therefore, the Air Force has been supporting the design and development of a prototype of an integrated computer system, the IISS, since 1979. The DAPro project was created to continue this effort of the development, testing, and demonstration of IISS.

1.1.2 What is the Integrated Information Support System?

IISS is a software system that provides the user with a single view of data, even though that data might reside on one or more databases on one or more computers. The system under IISS appears as a single computer system with one central repository of data. Users and applications access this data without regard to its location, the type of terminal available, or the format of the stored data. Under IISS, the user does not have to be familiar with a specific database management system or a specific vendor's hardware and software to access data. IISS provides the tools to allow the business enterprise to define and control data, enforce data integrity, and provide data shareability, data quality, data timeliness, and ease of use.

IISS is an evolutionary approach to the design of an information system. This approach allows new computers and software systems to be added or implemented within the organization as required.

IISS uses the three-schema ANSI/SPARC concept developed for integrated environments. Using this concept, data is available to users regardless of the system environment.

1.1.3 Test Bed

To develop the IISS software, prove the concepts, and demonstrate the system's use, a combination of hardware, software, and communications have been established. This combination is called the IISS Test Bed.

The Test Bed hardware currently consists of two interconnected VAX computers. These VAXes are used as the main computers for user interface and central database access. The computers are interconnected using DECNET. Communications include leased lines, dial-up lines, multiplexors, and modems. The Test Bed allows access for system development, technology transfer, and implementation of advanced technology centers, which expect to use this environment to validate production prototypes.

1.2 Goals of DAPro and IISS

It is estimated that in large U.S. corporations most of the existing computer applications will be redesigned over the next 10 to 20 years. It is further expected that, because of the rapidly changing computer technology, the construction techniques and operation modes of new applications will bear little resemblance to those of existing systems.

Because of the complexity of these new systems, integrating them becomes even more important. However, data integration must be accomplished using new application techniques and designed for interaction in conjunction with existing applications. The IISS software architecture

allows for an integrated application process that can access data existing on one or more databases and computers.

IISS development and the DAPro project are required to meet several goals:

1. Provide a testing facility for separate Computer Integrated Manufacturing (CIM) software products.

2. Demonstrate initial integration of CIM products
   - Data integration via the CDM and IDEF modeling methodology.
   - Techniques for more extensive integration of program functions.

3. Provide a site for demonstration and evaluation of CIM products
   - Applications.
   - Methodologies.
   - Information support system.

4. Reduce risk to subsequent users of CIM products by providing an environment to test the concepts of IISS.

5. Provide standards, guidelines, and procedures
   - For development of CIM products.
   - For evaluation/adoption by industry.

6. Demonstrate strategies evolving from current application processing and development methods and techniques that will subsequently reduce cost and increase system flexibility.

1.3 Summary of Benefits of IISS

DAPro is a support service that assists others in achieving the benefits of an integrated environment using IISS technologies and concepts. Other projects using the concepts can implement CIM systems faster and with less risk by providing a test environment to prove applications concepts in an integrated environment.

The design of IISS provides the following capabilities:

- Portability between computer systems.
- A common data management system that provides one common method for defining and accessing data from the system regardless of location.
- A common data definition language to define data within the system.
- A common data manipulation language to allow standard access to data without regard to location, access system, or format.
- A common user interface to allow one central type of access to the system from multiple terminal types.
- Computers to communicate throughout the IISS environment. Data access is not bounded by hardware or software systems.

- Data that is managed by HSS software as it is transmitted throughout the system. This allows HSS to be responsible for data transmission instead of the application program.
- Computers that appear in the HSS environment as one computer. HSS is responsible for accessing different hardware systems. It is not the responsibility of the programmer or the user to know the characteristics of each computer being accessed.

Benefits of HSS include:

- Distributed heterogeneous systems, distributed data, and distributed processing is provided by HSS.
- Independence of application data from considerations of actual internal storage organization and database management system access techniques is available.
- Reduced and controlled data redundancy.
- Automated data validation, assertions, triggers and constraint checking through the Common Data Model.
- Transaction-oriented applications.
- Standardized user interface (similar menu construction for all applications, standard user "HELP" procedures, standard error messages, etc.).
- Control of execution in a consistent manner of processes on different computers with different operating systems.
- Facilitation and control of passing data and messages between processes on the same or different computers.
- Consistent error handling throughout the system.
- System-wide control of startup, shutdown, restart, and recovery.
- Application programs written with relational database languages referencing non relational databases.
- Independence of application program from the characteristics of the terminal on which it will be used.
- System-supported translation of information formats to host-specific representations.
- Standardized electronically generated documentation.

SECTION 2

EXECUTIVE OVERVIEW

A prototype operation of IISS was demonstrated in March 1983, and the first official release, Release 1.0, occurred in September 1983. In the second quarter of 1988, Release 2.3 was issued. Release 3.0 was released in the third quarter of 1990.

The IISS software architecture is designed to support the interconnection of heterogeneous computer systems through a local area network (LAN) complemented by Wide Area Synchronous and Asynchronous Communication (WASAC) lines.

The software architecture provides:

- Layered architecture for maximum flexibility
- Distributed application data on heterogeneous data bases
- Process-to-process communications through preplanned transactions- Distributed at the application layer - Distributed access at the system layer
- Integration and coordination through a Common Data Model (CDM) and an integrated Network Transaction Manager (NTM).

The software architecture reflects the issues of portability and flexibility. Consequently, the software architecture is layered and modular. The software architecture reflects the intent to minimize the amount of software changes which must be made to application programs to allow their integration into IISS.

2.1 Present Environment

Today's factories are characterized by a multiplicity of discrete information systems which have been designed to serve individual users or individual activities within an organization. In today's environment, each user receives information, manipulates it, generates his own information and passes it to another activity. The second activity takes this information, combines it with other information and passes it along. Since many of these individual activities receive information from and generate information for many other activities, an extremely complex information system has been developed. This complexity is compounded by the fact that information is inaccurate, untimely and unshared.

Additionally, today's environment is characterized by a number of different computers which do not easily communicate, which have different keyboard access and which create careers for experts on specific computers. This expertise leads to a reluctance to tackle other types of equipment.

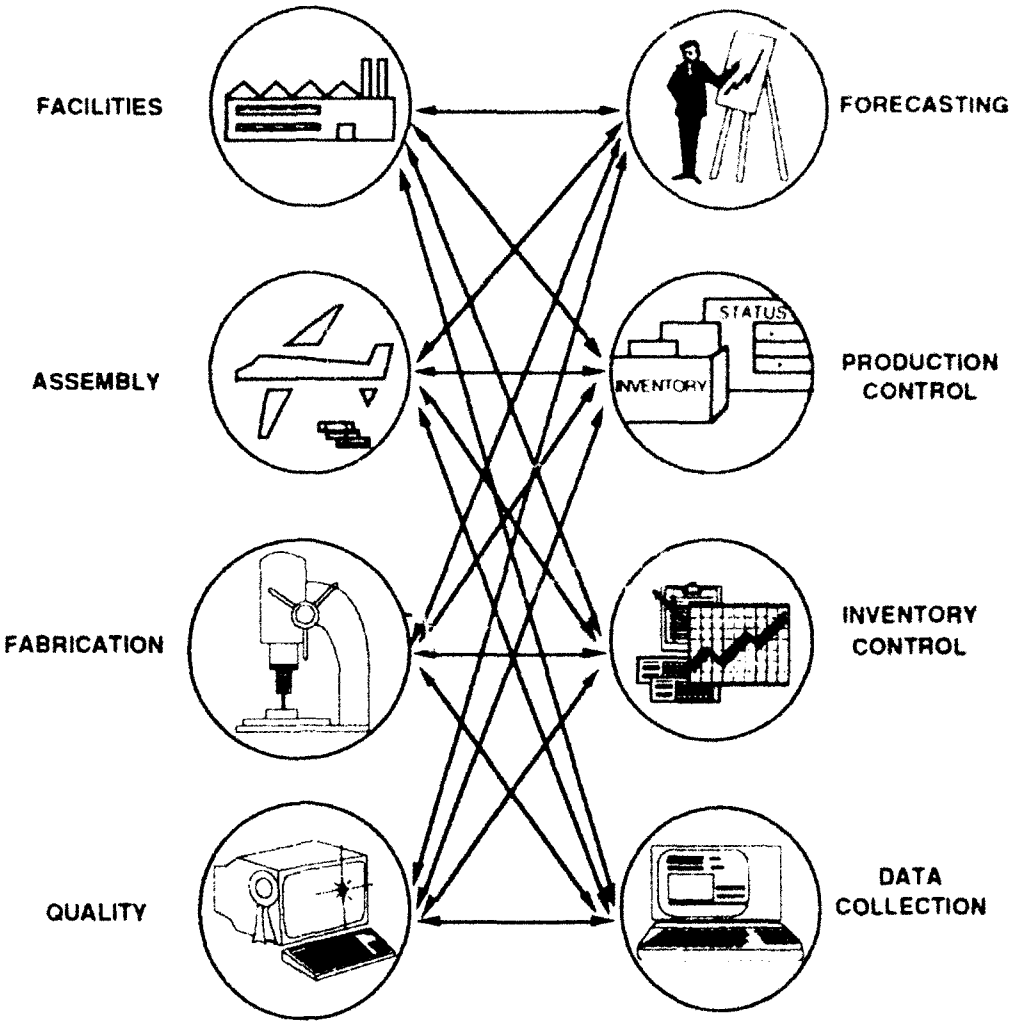

Figure 2-1. Complexity of Current Information Interchange

While capital spending for computer equipment and software is soaring and information costs are mounting rapidly, the current environment is resulting in the poor treatment of data and waste of information, a valuable corporate resource. This situation is worsening as more systems are put into place.

2.2 Integrated Information Support System (IISS)

The IISS is an evolutionary approach to the design of an information system which has near and long term impact and which will function in the current environment. The IISS achieves control of and access to information to allow data shareability, data quality, data timeliness and ease of use. The IISS answers important information questions, related to location of data, passing of data, recognition of data and control of data.

2.2.1 Communication

The design of IISS makes it possible to communicate among computers throughout the business from engineering to the shop floor. This allows access to information, shareability of information and timeliness of information.

2.2.2 Management and Control

The design of IISS manages the passage of information throughout the IISS system by routing the user's request to the appropriate host computers assures operability of the IISS system by performing necessary coordination, communication and housekeeping functions.

2.2.3 Multi-Computer Environment

The design of IISS makes all computers look like a single computer. Access to several vendors computers is transparent to the user, who is not required to be an expert on a computer in order to use it.

2.2.4 Data Shareability

The design of IISS makes all the information on the different systems look like it's in one place, in one format. This approach makes it possible to share information among users and has a substantial impact on the quality of data.

2.2.5 Ease of Use

The design of IISS makes each user's terminal able to access the apparent single computer and apparent single information repository. This makes it possible to easily use the information.

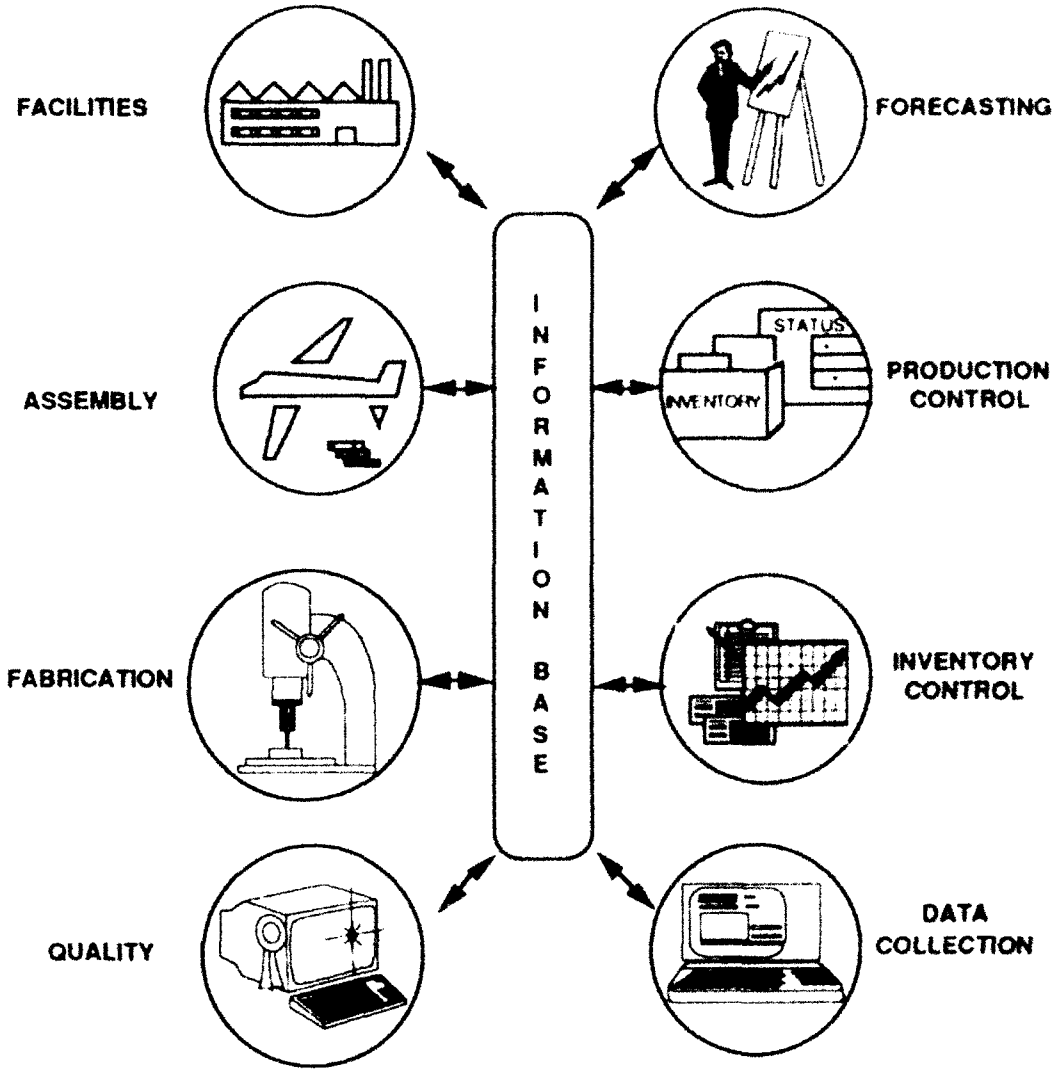

Figure 2-2. Information Base Technology

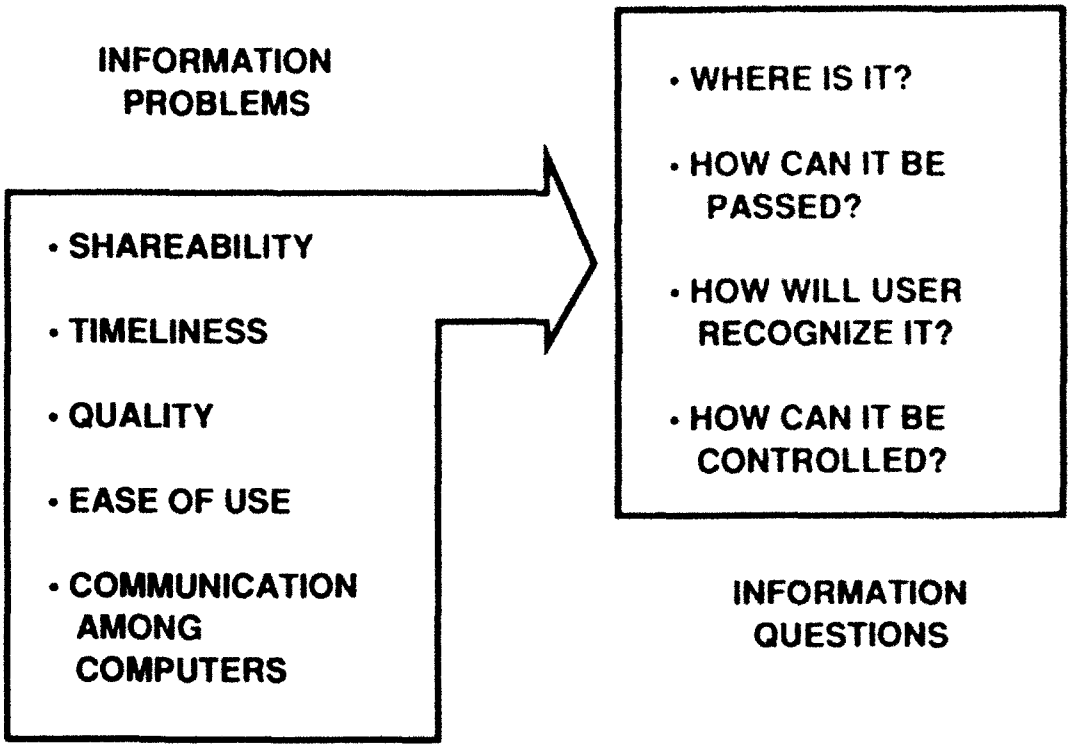

Figure 2-3. Information Problems and Questions

2.3 Major Subsystems of the IISS

The Integrated Information Support System is made up of four subsystems which together provide answers to the information questions:

- Where is it?
- How can it be passed?
- How will the user recognize it?
- How can it be controlled?

These four subsystems are:

- Common Data Model (CDM)
- User Interface (UI)
- Network Transaction Manager (NTM)
- Communication (COMM)

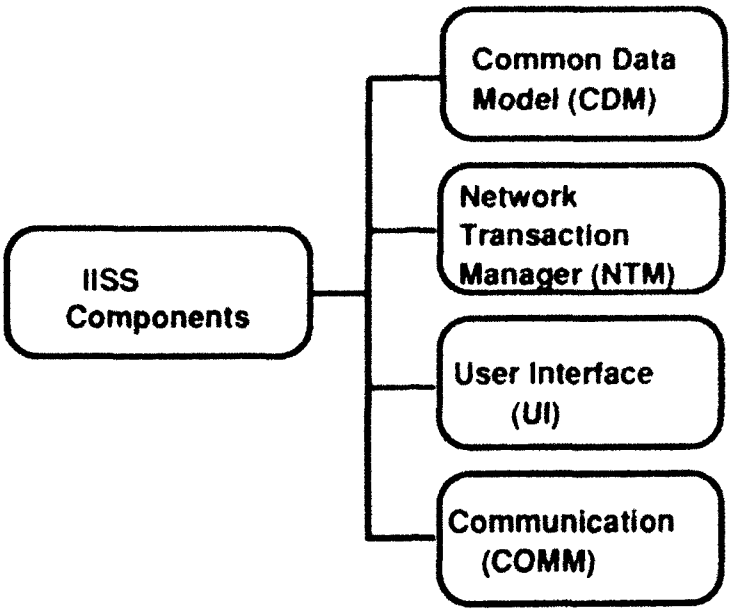

Figure 2-4. IISS Subsystems

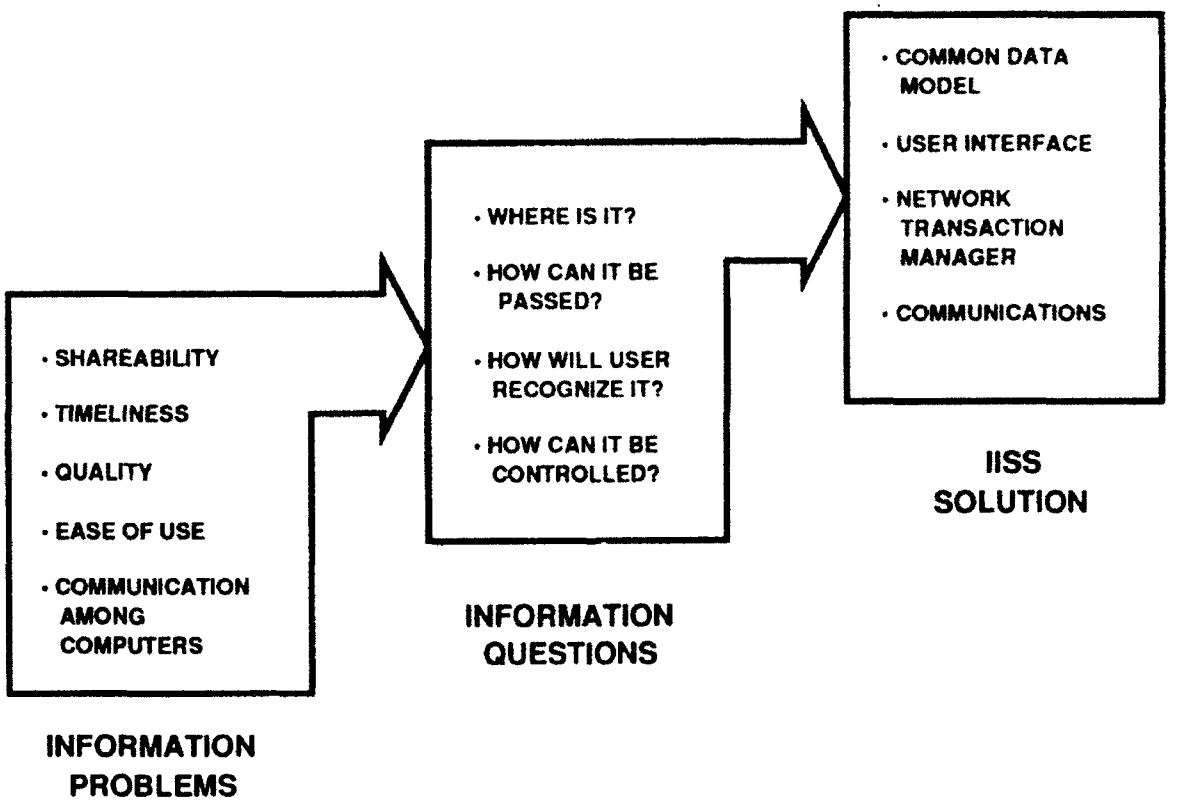

Figure 2-5. System Modules Evolutionary Approach

The system-level interfaces between the principal IISS software subsystems is described briefly in the following paragraphs. The major software components in the IISS environment are:

1. Integrated Application Programs
2. Non-Integrated Application Programs
3. Common Data Model
4. Distributed Database System Processes
5. Local Database Management
6. Network Transaction Manager
7. User Interface
8. Communication Subsystem
9. IISS Monitor

The following diagram shows the interfaces between the components. There are several layers or levels of interfaces and there are protocols between the components.

The services which are provided by a software component are typically a subset of the functions of the component. For example, the NTM is called to send messages between application processes. This is a service. The NTM must also validate the message header information and route messages to their destinations, but these are not considered services in this context.

Integrated application programs provide "external" services to IISS users and may cooperate with other IISS programs. Application programs are not considered to serve in any subordinate role with respect to other IISS software. Hence, no "internal" services are associated with application programs.

The structure of a typical application program as consists of COBOL source code (this could also be C or FORTRAN source code) and several layers of service routines which are provided from IISS libraries. The first-level interfaces connect the application program with the User Interface, Distributed Database Processes (through precompiled Neutral Data Manipulation Language statements), and Network Transaction Manager. The lower-level interfaces connect with Interprocess Communications and the host operating system.

Non-integrated application programs neither provide nor use IISS related services.

The Common Data Model has two principal roles in the IISS environment. One is maintaining an accurate picture of the data stored throughout the IISS computer network. The other is making this information available to IISS system and user processes. Maintenance of the CDM database is the responsibility of the CDM database administrator and is not considered a service. Providing data to IISS processes, however, is a service. The mechanism for calling upon CDM services is through NDML statements. Translation of NDML statements is a CDM function, but it is not considered a service.

The processes to perform a query for distributed data for an application require the following services:

1. Distributed Request Supervisor
2. Local Request Processors
3. Data Aggregators
4. Conceptual to External Schema Transformer

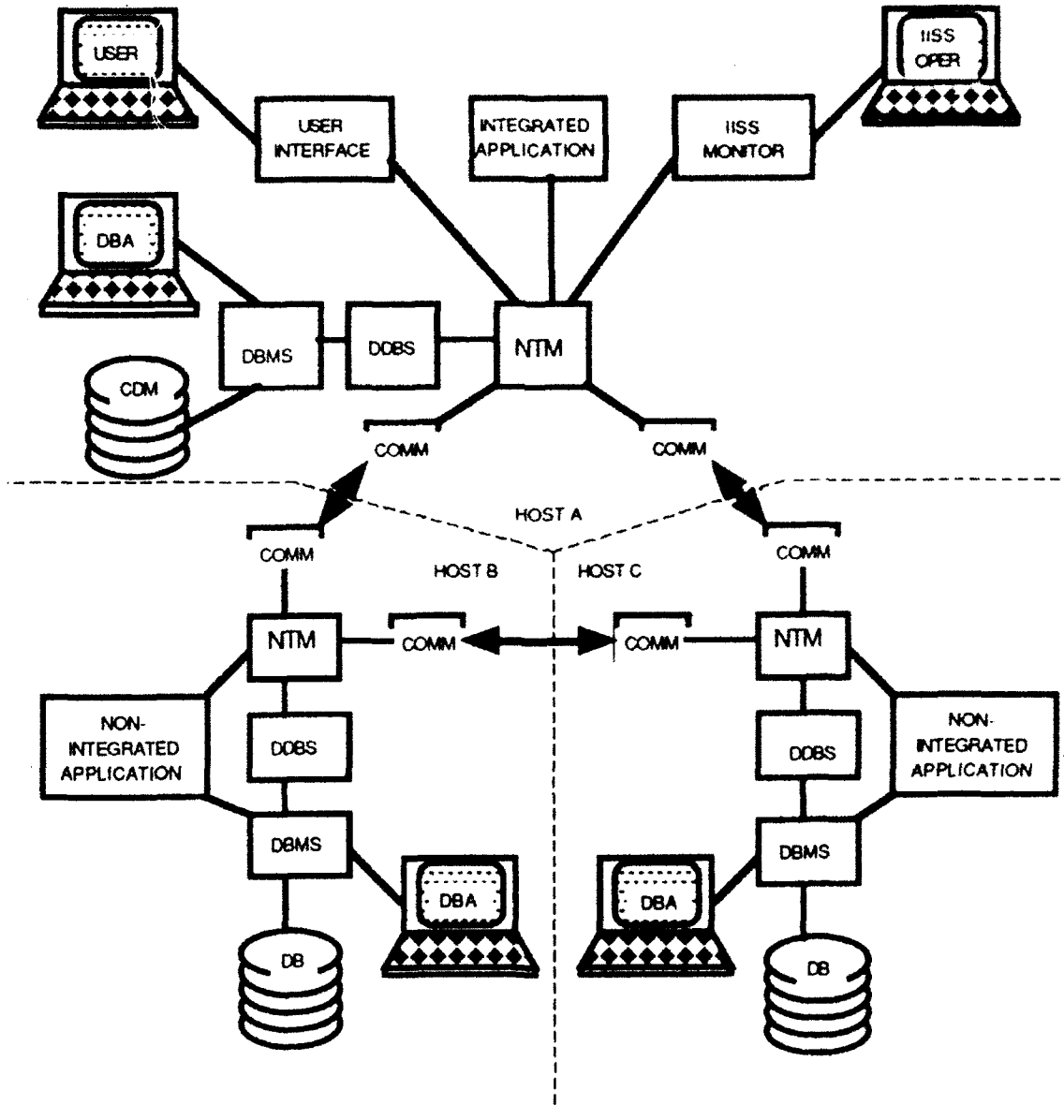

Figure 2-6. IISS System Overview

All of these processes (except the application process initiating the request) are "owned" by the CDM and only provide services for query processing. Distributed queries are the most complex scenarios of communicating processes considered for the IISS environment, and they have "driven" the requirements for the NTM.

Each local DBMS represents a unique interface the local database request processes.

Application processes, Distributed Database Processes, the User Interface , and other IISS programs call upon the NTM for the following major categories of services:

1. Process Logon and Logoff

2. Initiating and Terminating Processes

3. Sending and Receiving Messages

4. Obtaining Status of Messages and Processes

The mechanism for invoking these services is through a library of service routines which is linked into each calling program. This technique allows the NTM to view AP's, database processes, and the UI as simply "processes". It also allows the NTM to effectively hide the details of NTM message headers, packet size, and the IPC interface from the NTM users.

The User Interface provides a number of services to IISS users such as simple menu-driven control of programs and a convenient "help" function. The interface described here focuses on the services provided by the UI to other IISS software components - principally application programs. The UI provides the following services to control the display of forms and data, and retrieve user input:

1. Select forms to be displayed from a collection of forms

2. Insert data into fields before they are displayed

3. Display part or all of a form on the user's screen

4. Allow field values to be updated on the screen

5. Erase part or all of a display

6. Accept data from the user's keyboard.

The principal role of the Communications subsystem is to provide host-to-host message transfer. The IISS software architecture has allocated two COMM processes (one at either end) for each pair of communicating machines. Messages sent via a given COMM process go to only a single destination. The only routing and distribution function performed by COMM processes is in handling high- and low-priority messages which are sent and received in different IPC channels but are transmitted between machines over a common communications channel.

The system monitor provides performance monitoring and nonrecoverable failure handling.

The objectives of the Interprocess Communication Primitives (IPC) are to provide a machine-independent, COBOL interface for communication between cooperating concurrent processes. In the IISS environment, application programs are provided higher-level message-

passing services by the NTM. IPC services are used, directly, only by IISS "system" software such as the NTM and COMM.

The function of the Virtual Terminal Interface (VTI) is to insulate application programs and other IISS software from the special characteristics of individual display terminals. Each brand of computer terminal uses a different set of control characters and different control sequences to clear the screen, position the cursor, highlight text, scroll displayed information,etc. The service provided by the VTI is the conversion of standard control characters and control sequences as needed to support the terminals connected to IISS computers.

2.3.1 Common Data Model

The Common Data Model (CDM) is responsible for making the information on different databases, which may be on different computers, look like a single data repository in order to address data shareability and data quality. The Common Data Model refers to a single logical Enterprise Database. The logical Enterprise Database, which appears to be a single database to the user, is an integrated view of the enterprise developed without physically combining data. This is accomplished utilizing a three-schema architecture made up of an internal schema, a conceptual schema and an external schema. Each individual database in the IISS system is described by an internal schema. The contents of the internal schemas of all of the databases are logically reflected in the enterprise's conceptual schema. This represents the description of all of the data that any program with the correct access privileges can obtain. This data is also known as common data.

The external schemas give individual programs a view of a portion of the common data. Mappings are also described so that data in an external schema format may be transferred to conceptual format and then to internal format. Included in this are changes such as name change , metric to English conversion, number of decimal places, unit conversion or number of characters in a name.

The CDM consists of four components:

1. Neutral Data Definition Language Processor
2. Neutral Data Manipulation Language Precompiler
3. Distributed Database Manager
4. Utilities

The NDML Precompiler and the Distributed Database Manager are referred to as the Common Data Model Processor (CDMP).

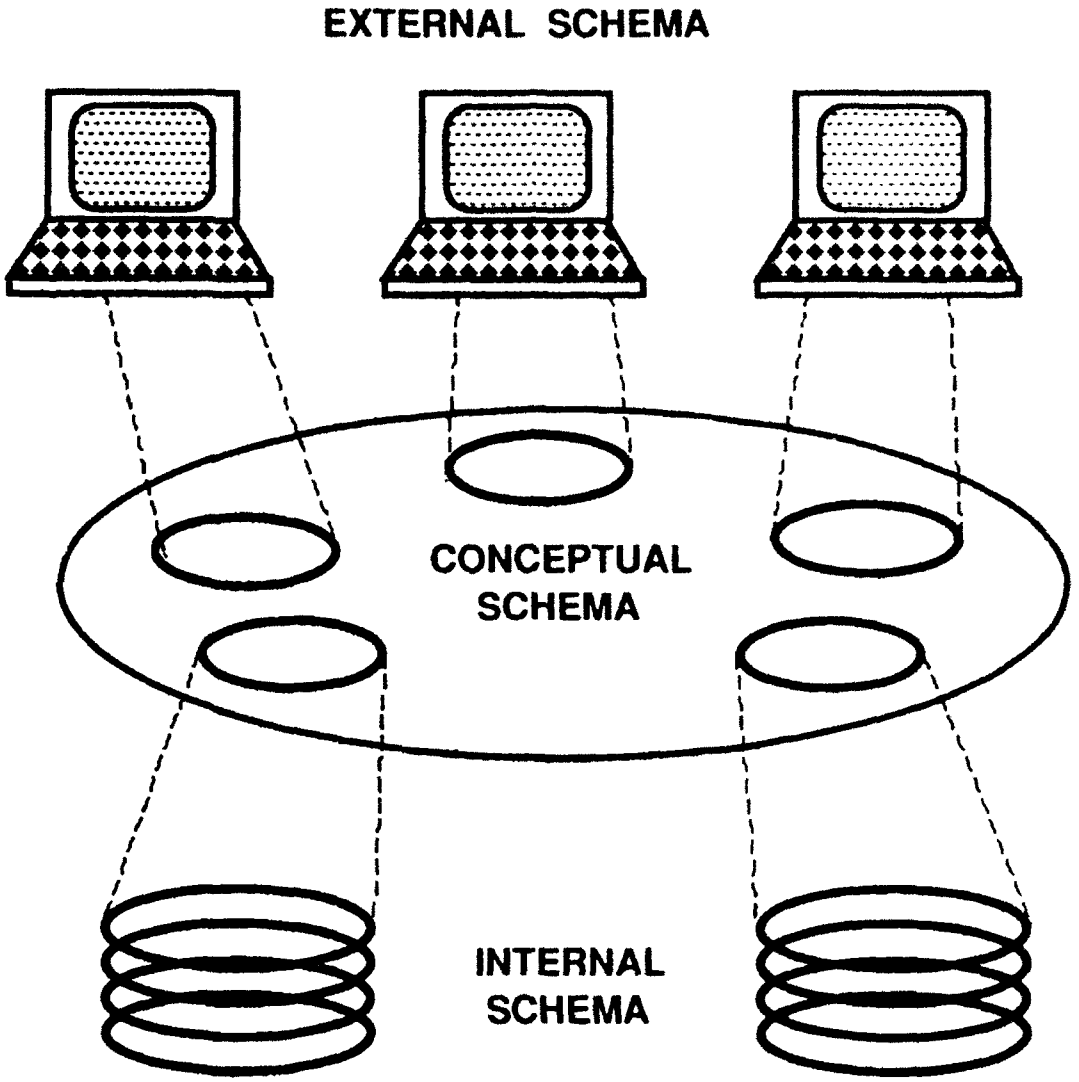

Figure 2-7. Three-Schema Architecture

The precompiler transforms schema formats and decomposes a request for IISS data into requests for data found in specific data bases. The precompiler utilizes the locations and format of all data in the system described in the CDM. For each user's application, using a neutral language, the precompiler generates a modified users application program as well as Request Processor programs to allow retrieval and/or update of actual data from each appropriate existing database. The precompiler generates another program to do the translation from conceptual form to external form. All of these programs are generated only once for each users application. This is accomplished automatically.

During program execution the Distributed Request Supervisor (DRS) interprets the input message from the modified users application and passes requests to the Request Processors which access the appropriate databases . The Request Processors convert the values to conceptual form, output them to their sub results and report the volume of data extracted to the DRS. Based on minimizing communication, the DRS initiates data transfer to move each sub result to the

appropriate host computer. For each pair of sub results, the DRS initiates the Aggregator which combines two sub results into a third sub result. The modified users application accesses the results by initiating the Conceptual-External Transformer to convert the result to the format specified by the Users External Schema.

2.3.2 User Interface

The subsystem which makes each user's terminal able to access information anywhere in the system and addresses the problems of ease of use and how the user will recognize the data is called the User Interface (UI). The software to provide this capability consists of the following.

- User Interface Development System (UIDS)
- User Interface Management System (UIMS)
- Electronic Documentation System (EDS)

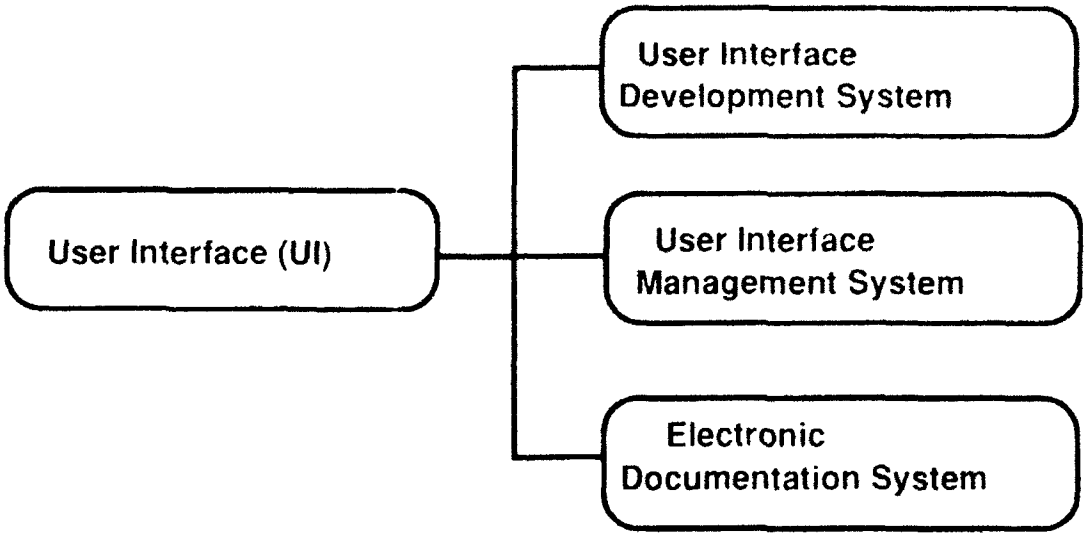

Figure 2-8. User Interface Modules

The User Interface Development System has three components. The first is a text editor for use by developers and users. The second is a forms editor that is used to build and maintain form definitions. The third component is the application generator which has two subparts for report writing and rapid application generation.

The User Interface Management System has four components:

1. User Interface Services
2. Forms Processor
3. Virtual Terminal Interface
4. Application Interface.

The Virtual Terminal Interface (VTI) is responsible for handling terminals of different types and converting the data stream into a neutral form that is independent of the actual terminal. In this

way, the rest of the system can be terminal independent. Data is passed normally from the VTI to the Forms Processor where all of the forms logic is contained.

The Forms Processor addresses the Form Processor Application Interface which interfaces to the Application. The forms are described using the Form Editor and stored in the screen format database. The application program then can interface with high level commands without concern for the actual format of the screens. The programmer is only concerned about the name of the form and the name of the data on the forms. The User Interface Management System provides the interface to the NTM, which is the subsystem for messages and requests to initiate applications. The UIMS also allows messages to be routed directly where this is needed. The direct routing, or pass through mode, is used in some existing applications that already have screen formatting capability, and are written expecting to be addressing real terminals. In this case, a VTI is added to the application to do the appropriate conversion between real and neutral form.

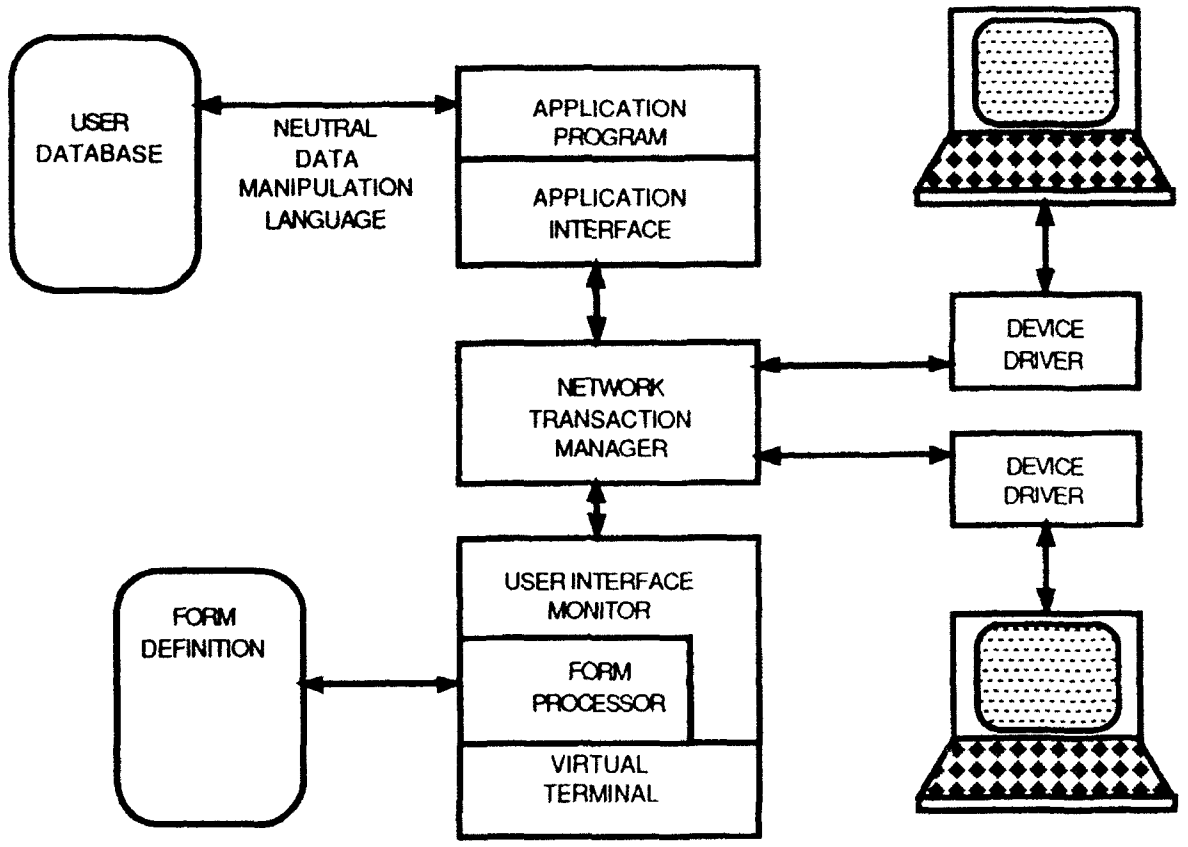

Figure 2-9. User Interface

2.3.3 Network Transaction Manager

The subsystem which controls or manages all IISS activities is called the Network Transaction Manager (NTM). All information which travels around the IISS system between different components is in the form of messages. The NTM manages all messages by receiving and interpreting messages, authorizing messages to be sent and addressing, logging, routing and sending messages. The NTM manages all computer programs by requesting the appropriate computer operating system to start and stop a program, by delivering and picks a program and by monitoring program status. Finally, it maintains system capability by starting up and shutting down the system and by monitoring and recording system status.

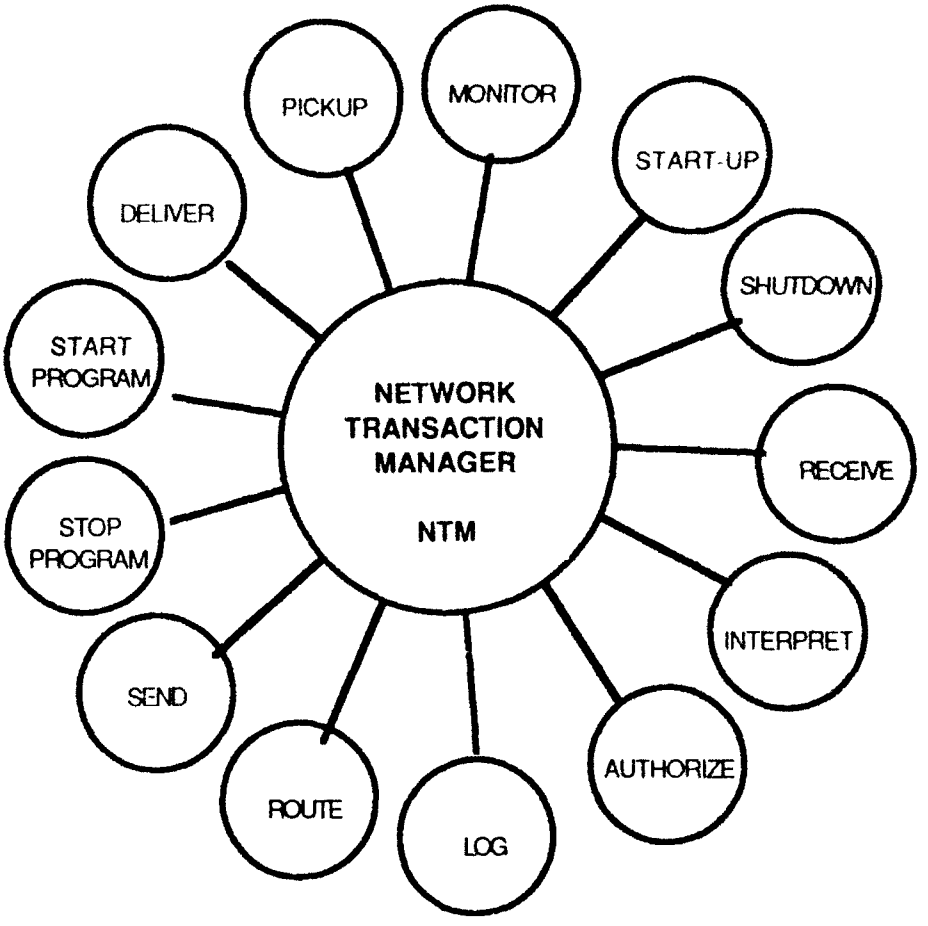

Figure 2-10. Network Transaction Manager

2.3.4 Communication

The subsystem which allows communications between computers and addresses the problems of data timeliness and passing of data, is called Communications (COMM). COMM contains both hardware and software. The hardware consists of an area network which connects several computers. There is a copy of the COMM software for each link on each computer. Each copy is responsible for communications with one of the other computers. The majority of the software is the same on all computers. A small amount of software called the Interhost

Communication Primitives (IHC) are responsible for interfacing to each computer. These are machine dependent and must change for each different computer implementation.

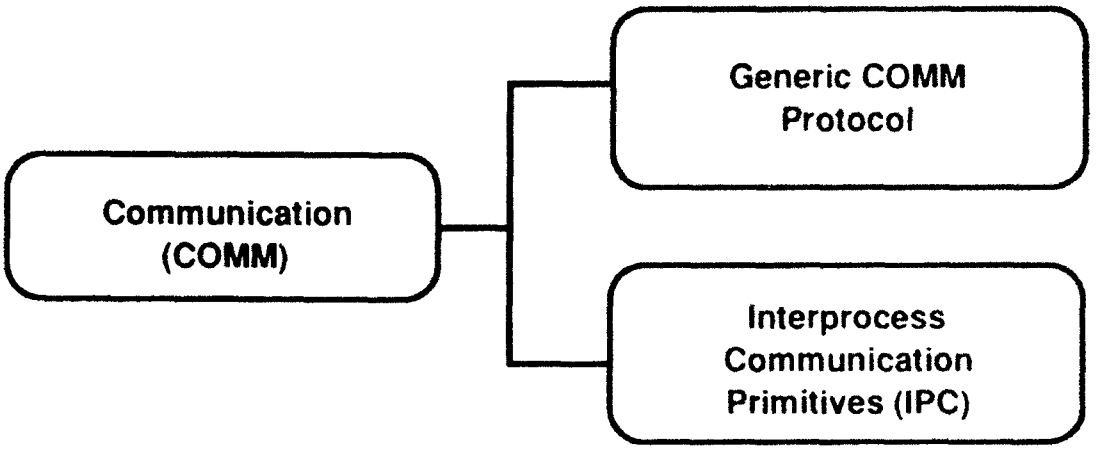

Figure 2-11. Communication Modules

SECTION 3

REFERENCE DOCUMENTS

The following information provides information on documents that relate to IISS.

3.1 Previous Interim Reports

This is the Final Technical Report provided by the DAPro project. This report deals with the completion of the CDM enhancements that incorporate IDEF1X, ML/MT-NET, three-dimensional graphics, and the relocation of the Test Bed. The next section gives a detailed list of the documentation accompanying specified DAPro software products.

3.2 Test Bed Life Cycle Documents

The following set of prefixes defines the types of manuals that are listed in this section.

CMA	Configuration Management Administration
CMU	Configuration Management User
DS	Development Specification
EIF	Enterprise Integration Framework
FTR	Final Technical Report
IRD	Information Resource Dictionary Standard
ITR	Interim Technical Report
OM	Operator Manual
PRM	Programmer's Reference Manual
PS	Product Specification
QAP	Quality Assurance Plan
SAB	Software Availability Bulletin
SCD	System Control Document
SDS	System Design Specification
SRB	System Release Bulletin
SRD	System Requirements Document
STP	System Test Plan
STR	System Test Report
SUM	System User's Manual
TCD	Technical Control Document
UM	User's Manual
UTP	Unit Test Plan

The list on the following pages shows the documents provided as part of the DAPro project. These are the documents that are updated and included with the IISS 3.0 release software package. Also shown in this section is a graphical representation of the documents and how they are organized. This section lists the volume number, what figure the document is represented in, the configuration item number, and title of the document.

Volume Number	Part Num.	Figure Number	Configuration Item Number	Title
I	1	Figure 3-1	FTR620300001	Project Overview: Executive Summary
II	1	Figure 3-1	FTR620300002	Project Overview: Technical Summary
III	1	Figure 3-1	QAP620320000	Quality Assurance Plan
III	2	Figure 3-1	SUM620320000	System Administrator's Guide
III	3	Figure 3-1	TCD620321000	Technical Control Document
III	4	Figure 3-1	SCD620322000	Schedule Control Document
III	5	Figure 3-1	SUM620323000	System User's Manual
III	6	Figure 3-1	CMU620324000	SCM User's Manual
III	7	Figure 3-1	CMA620324000	SCM Administrator's Manual
III	8	Figure 3-1	DS 620324000	SCM Development Specification
III	9	Figure 3-1	UM 620324000	Software Development Guidelines
III	10	Figure 3-1	SUM620324000	System Software Document
III	11	Figure 3-1	OM 620324001	VAX Install Guide for Executable Code
III	12	Figure 3-1	OM 620324002	IBM Installation Guide
III	13	Figure 3-1	UM 620325000	DM User's Manual
III	14	Figure 3-1	SUM620325000	FAD Administrator's Manual
III	15	Figure 3-1	SRB620326000	Software Release Bulletin
III	16	Figure 3-1	SAB620326000	Software Availability Bulletin
III	17	Figure 3-1	OM 620324003	VAX Installation Guide for Source Code
IV	1	Figure 3-1	SRD620340000	System Requirements Document
IV	2	Figure 3-1	SDS620340000	System Design Specification
IV	3	Figure 3-1	STP620340000	System Test Plan
IV	4	Figure 3-1	STP620340001	System Integration Test
IV	5	Figure 3-1	STR620340000	System Test Report
IV	6	Figure 3-1	EIF620350001	EIF Technical Report
IV	7	Figure 3-1	EIF620350002	EIF Technical Report
V	1	Figure 3-2	UM 620341001	CDM Administrator's Manual
V	2	Figure 3-2	UTP620341000	CDMP Test Case Report
V	3	Figure 3-2	TBM620341000	CDMP: IDEF1 Model of the CDM -- CDM Development Specification
V	4	Figure 3-2	UM 620341002	Information Modeling Manual - IDEF1X
V	5	Figure 3-2	DS 620341100	NDDL Processor Development Specification
V	6	Figure 3-2	PS 620341100	NDDL Processor Product Specification
V	7	Figure 3-2	UM 620341100	NDDL User's Guide
V	8	Figure 3-3	PRM620341200	NDML Programmer's Reference Manual
V	9	Figure 3-3	DS 620341200	NDML Precompiler Development Specification -- CDMP Development Specification
V	10	Figure 3-3	PS 620341200	NDML Precompiler Control Module Product Specification
V	11	Figure 3-3	PS 620341211	NDML Precompiler Parse Application Program
V	12	Figure 3-3	PS 620341212	NDML Precompiler Parse Process Division Product Specification
V	13	Figure 3-3	PS 620341213	NDML Precompiler Parse NDML Product Specification

Volume Number	Part Num.	Figure Number	Configuration Item Number	Title
V	14	Figure 3-3	PS 620341231	NDML Precompiler Transform NDML
V	15	Figure 3-3	PS 6203 41232	NDML Precompiler Decomposition Concept
V	16	Figure 3-3	PS 620341251	NDML Precompiler Select Internal Schema
V	17	Figure 3-3	PS 620341252	NDML Precompiler Trans Internal Schema
V	18	Figure 3-3	PS 620341253	NDML Precompiler Generate Conceptual Schema
V	19	Figure 3-3	PS 620341254	NDML Precomp Generate Oracle Request
V	20	Figure 3-3	PS 620341255	NDML Precompiler Generate CODASYL
V	21	Figure 3-3	PS 620341256	NDML Precompiler Generate Total Request
V	22	Figure 3-3	PS 620341258	NDML Precompiler Build Calls/Messages
V	23	Figure 3-3	PS 620341259	NDML Precompiler Build Source Code
V	24	Figure 3-3	PS 620341260	NDML Precompiler Generate Support
V	25	Figure 3-3	PS 620341261	NDML Precompiler Generate Request
V	26	Figure 3-4	DS 620341310	Distributed Request Supervisor Development Specification
V	27	Figure 3-4	PS 620341310	Distributed Request Supervisor Product Specification
V	28	Figure 3-4	DS 620341320	Data Aggregators Development Specification
V	29	Figure 3-4	PS 620341320	Data Aggregators Product Specification
V	30	Figure 3-4	DS 620341330	File Utilities Development Specification
V	31	Figure 3-4	PS 620341330	FIle Utilities Product Specification
V	32	Figure 3-5	UM 620341400	CDM Subsystem Database Build Instructions User's Manual
V	33	Figure 3-5	UM 620341401	Define/Construct the Neutral Data Definition for the Common Data Model (CDM) Subsystem User's Manual
V	34	Figure 3-5	UM 620341403	CDM Reports and Application User's Manual
V	35	Figure 3-5	DS 620341410	DDL to NDDL Translator Development Specification
V	36	Figure 3-5	UTP620341410	DDL to NDDL Translator Test Plan
V	37	Figure 3-5	UM 620341410	DDL to NDDL Translator User's Manual
V	38	Figure 3-5	UM 620341411	DDL to NDDL Translator Build Instructions User's Manual
V	39	Figure 3-5	DS 620341420	CDM Impact Analysis Development Specification
V	40	Figure 3-5	UTP620341420	CDM Impact Analysis Unit Test Plan
V	41	Figure 3-5	UM 620341420	CDM Impact Analysis User's Manual
V	42	Figure 3-5	UM 620341421	Impact Analysis Build Instructions User's Manual
V	43	Figure 3-5	DS 620341430	CDM Compare Utility Development Specification
V	44	Figure 3-5	UTP620341430	CDM Compare Utility Unit Test Plan
V	45	Figure 3-5	UM 620341430	CDM Compare Utility User's Manual
V	46	Figure 3-5	UM 620341431	CDM Compare Utility Build Instructions User's Manual

Volume Number	Part Num.	Figure Number	Configuration Item Number	Title
V	47	Figure 3-5	UM 620341440	SQL User's Manual
V	48	Figure 3-5	PRM620341440	SQL Reference Manual
V	49	Figure 3-5	IRD620341500	CDM IRDS Feature Evaluation Report
VI	1	Figure 3-6	DS 620342000	NTM Development Specification
VI	2	Figure 3-6	PRM620342000	NTM Programmer's Guide
VI	3	Figure 3-6	OM 620342000	NTM Operator's Manual
VI	4	Figure 3-6	SUM620342000	NTM System Programmer's Manual
VI	5	Figure 3-6	PS 620342100	NTM Monitor Product Specification
VI	6	Figure 3-6	PS 620342200	NTM MPU Product Specification
VI	7	Figure 3-6	PS 620342300	NTM Services Product Specification
VII	1	Figure 3-7	DS 620343000	COMM Development Specification
VII	2	Figure 3-7	PS 620343100	Generic COMM Protocol Product Specification
VII	3	Figure 3-7	PS 620343200	VAX IPC Product Specification
VII	4	Figure 3-7	DS 620343300	IBM IHC and IPC Development Specification
VII	5	Figure 3-7	PS 620343400	File I/O Primitives Product Specification
VII	6	Figure 3-7	UTP620343400	File I/O Primitives Unit Test Plan
VIII	1	Figure 3-8	OM 620344000	Terminal Operator's Guide
VIII	2	Figure 3-9	DS 620344100	User Interface Services Devel Spec -- User Interface Management System Development Specification
VIII	3	Figure 3-9	PS 620344100	User Interface Services Product Specification
VIII	4	Figure 3-9	UTP620344100	User Interface Services Unit Test Plan
VIII	5	Figure 3-9	DS 620344200	Form Processor Development Specification
VIII	6	Figure 3-9	UM 620344200	Form Processor User's Manual
VIII	7	Figure 3-9	UTP620344200	Form Processor Unit Test Plan
VIII	8	Figure 3-9	PS 620344200	Form Processor Product Specification
VIII	9	Figure 3-10	UTP620344403	Graph Definition Language
VIII	10	Figure 3-10	UTP620344220	Graph Support System
VIII	11	Figure 3-9	DS 620344300	Virtual Terminal Development Specification
VIII	12	Figure 3-9	PS 620344300	Virtual Terminal Product Specification
VIII	13	Figure 3-9	UM 620344300	Virtual Terminal User's Manual
VIII	14	Figure 3-9	UTP620344300	Virtual Terminal Unit Test Plan
VIII	15	Figure 3-10	UM 620344400	Forms Editor User's Manual
VIII	16	Figure 3-10	DS 620344401	Forms Language Compiler Development Specification
VIII	17	Figure 3-10	PS 620344401	Forms Language Compiler Product Specification
VIII	18	Figure 3-10	UTP620344401	Forms Language Compiler Unit Test Plan
VIII	19	Figure 3-10	DS 620344402	Forms Driven Editor Development Specification
VIII	20	Figure 3-10	PS 620344402	Forms Driven Editor Product Specification
VIII	21	Figure 3-10	UTP620344402	Forms Driven Forms Editor Unit Test Plan
VIII	22	Figure 3-10	DS 620344403	Graph Language Development Specification
VIII	23	Figure 3-10	DS 620344501	Rapid Application Generator and Report Writer Development Specification

Volume Number	Part Num.	Figure Number	Configuration Item Number	Title
VIII	24	Figure 3-10	PS 620344501	Report Writer Product Specification
VIII	25	Figure 3-10	UM 620344501	Application Generator User's Manual
VIII	26	Figure 3-10	UTP620344501	Report Writer Unit Test Plan
VIII	27	Figure 3-10	PS 620344502	Rapid Application Generator Product Specification
VIII	28	Figure 3-10	UTP620344502	Rapid Application Generator Unit Test Plan
VIII	29	Figure 3-10	DS 620344600	Text Editor Development Specification
VIII	30	Figure 3-10	PS 620344600	Text Editor Prod Specification
VIII	31	Figure 3-10	UM 620344600	Text Editor User's Manual
VIII	32	Figure 3-10	UTP620344600	Text Editor Unit Test Plan
VIII	33	Figure 3-8	DS 620344700	Application Interface Development Specification
VIII	34	Figure 3-8	PS 620344700	Application Interface Product Specification
VIII	35	Figure 3-8	UTP620344700	Application Interface Unit Test Plan
VIII	36	Figure 3-8	UTP620344800	Layout Optimization System Unit Test Plan
VIII	37	Figure 3-8	DS 620344800	Layout Optimization System Development Specification
VIII	38	Figure 3-11	DS 620344900	Electronic Documentation System Development Specification
VIII	39	Figure 3-11	UM 620344900	Electronic Documentation System User's Manual
VIII	40	Figure 3-11	UTP620344901	SGML Tagger Unit Test Plan
VIII	41	Figure 3-11	UTP620344902	EDS Parser Unit Test Plan
VIII	42	Figure 3-11	UTP620344903	EDS Document Type Definition Unit Test Plan
VIII	43	Figure 3-11	UTP620344904	EDS Layout Editor Unit Test Plan
VIII	44	Figure 3-11	UTP620344905	EDS Document Formatter Unit Test Plan
VIII	45	Figure 3-11	UTP620344906	EDS MacPaint to Postscript Unit Test Plan

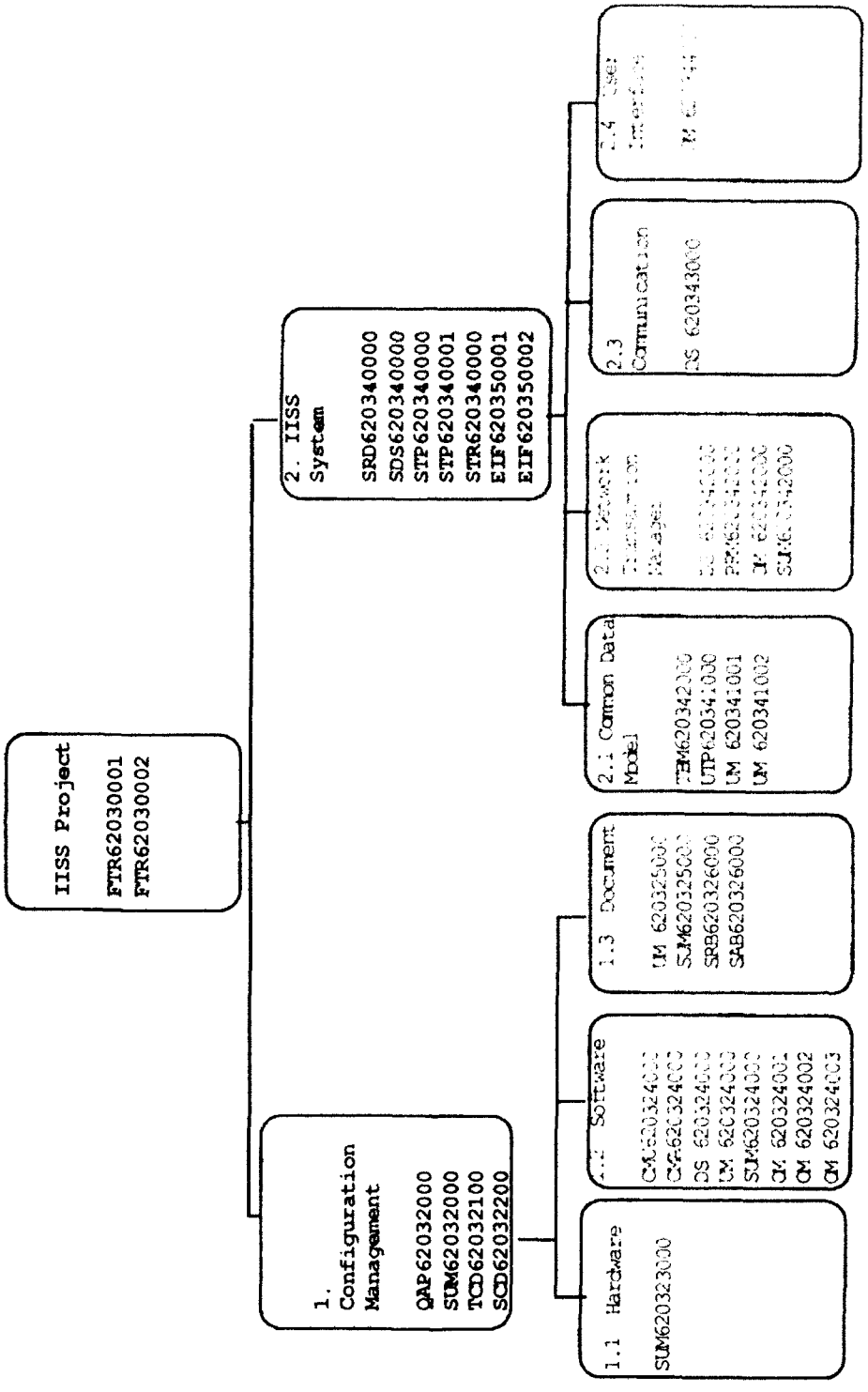

Figure 3-1. Documentation Tree-IISS Program

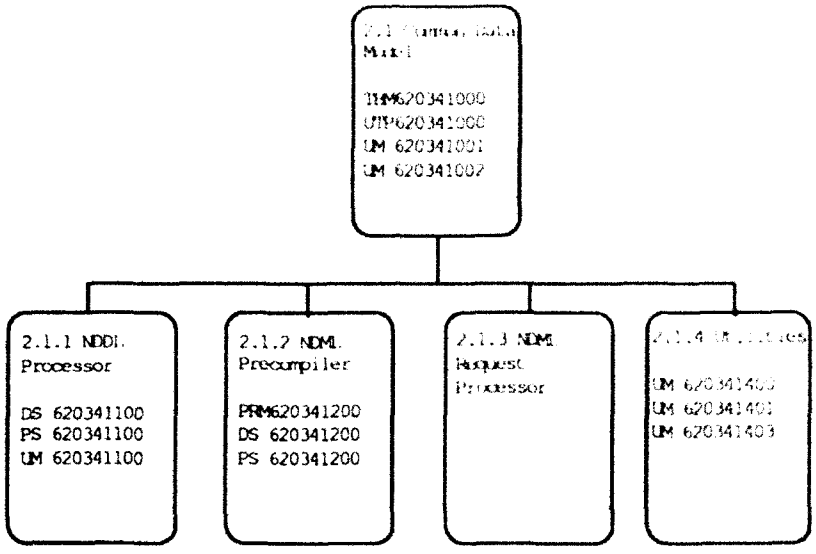

Figure 3-2. Documentation Tree-Common Data Model

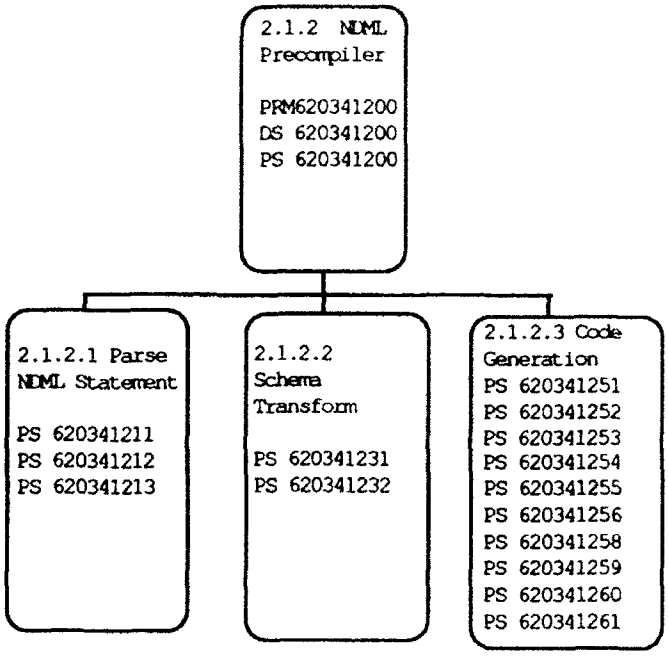

Figure 3-3. Documentation Tree-NDML Precompiler

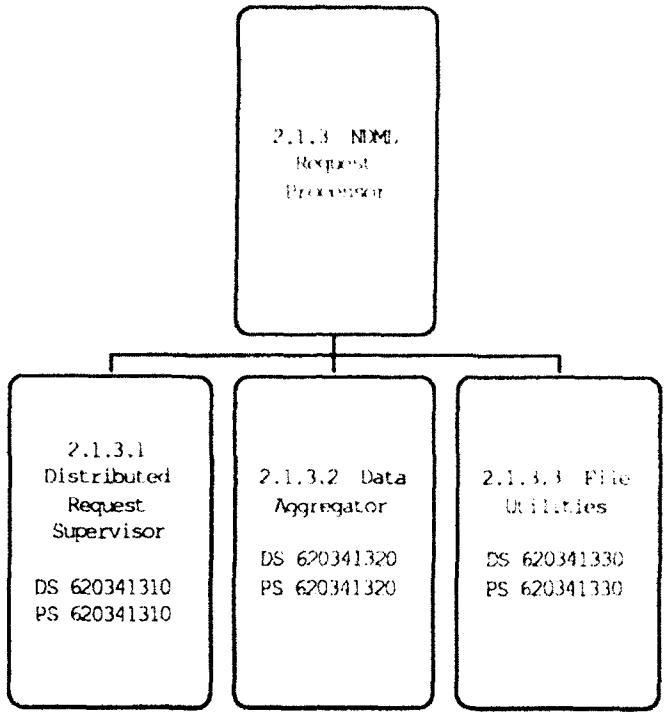

Figure 3-4. Documentation Tree-NDML Request Processor

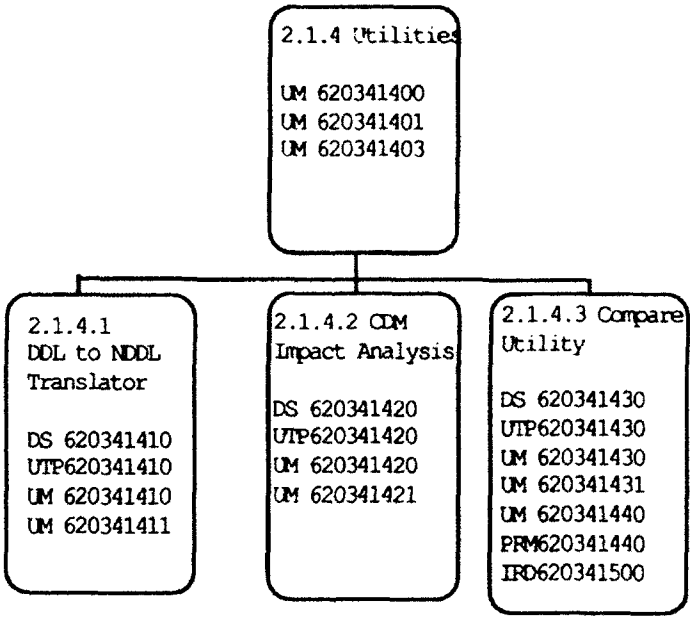

Figure 3-5. Documentation Tree-Utilities

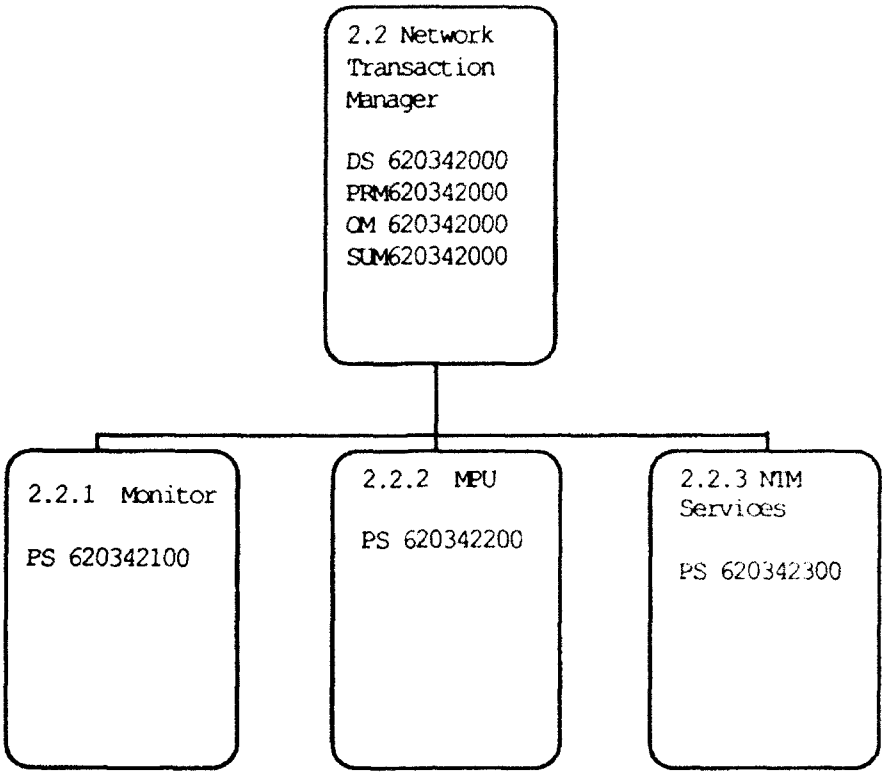

Figure 3-6. Documentation Tree-Network Transaction Manager

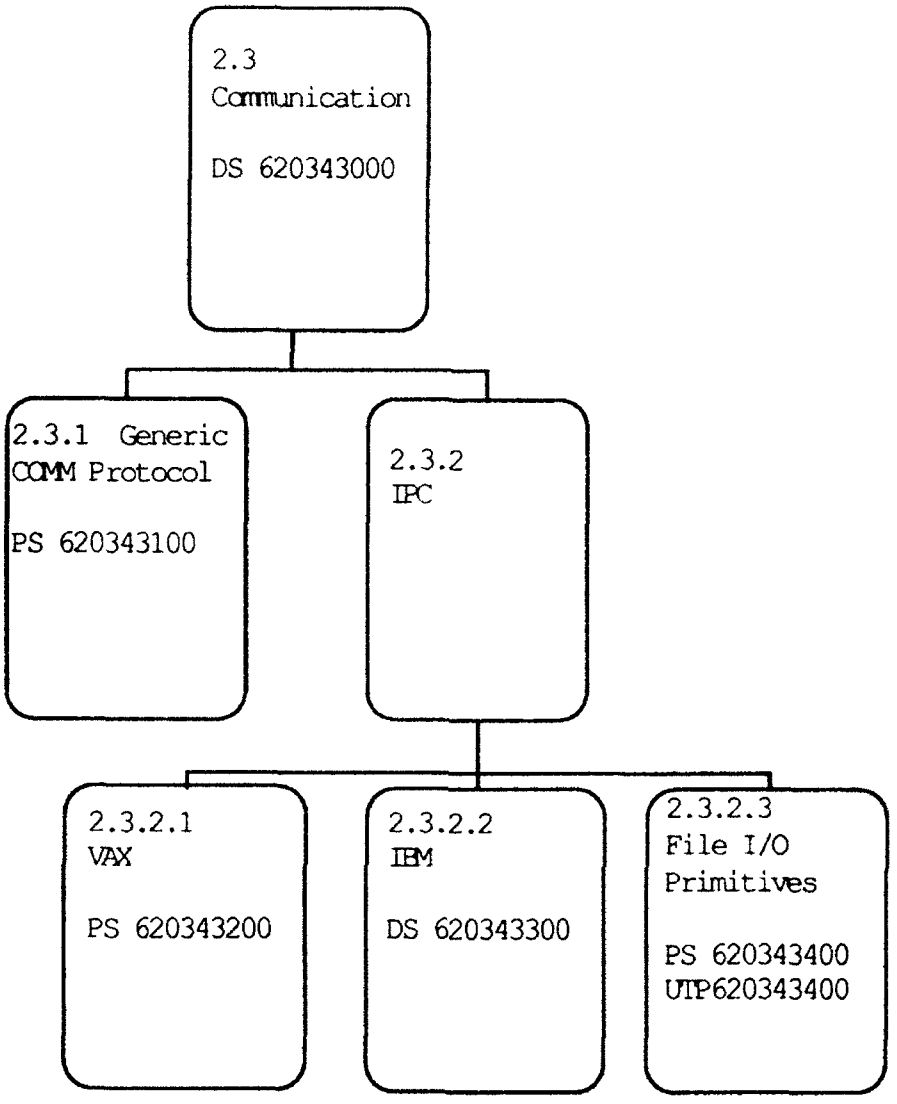

Figure 3-7. Documentation Tree-Communication

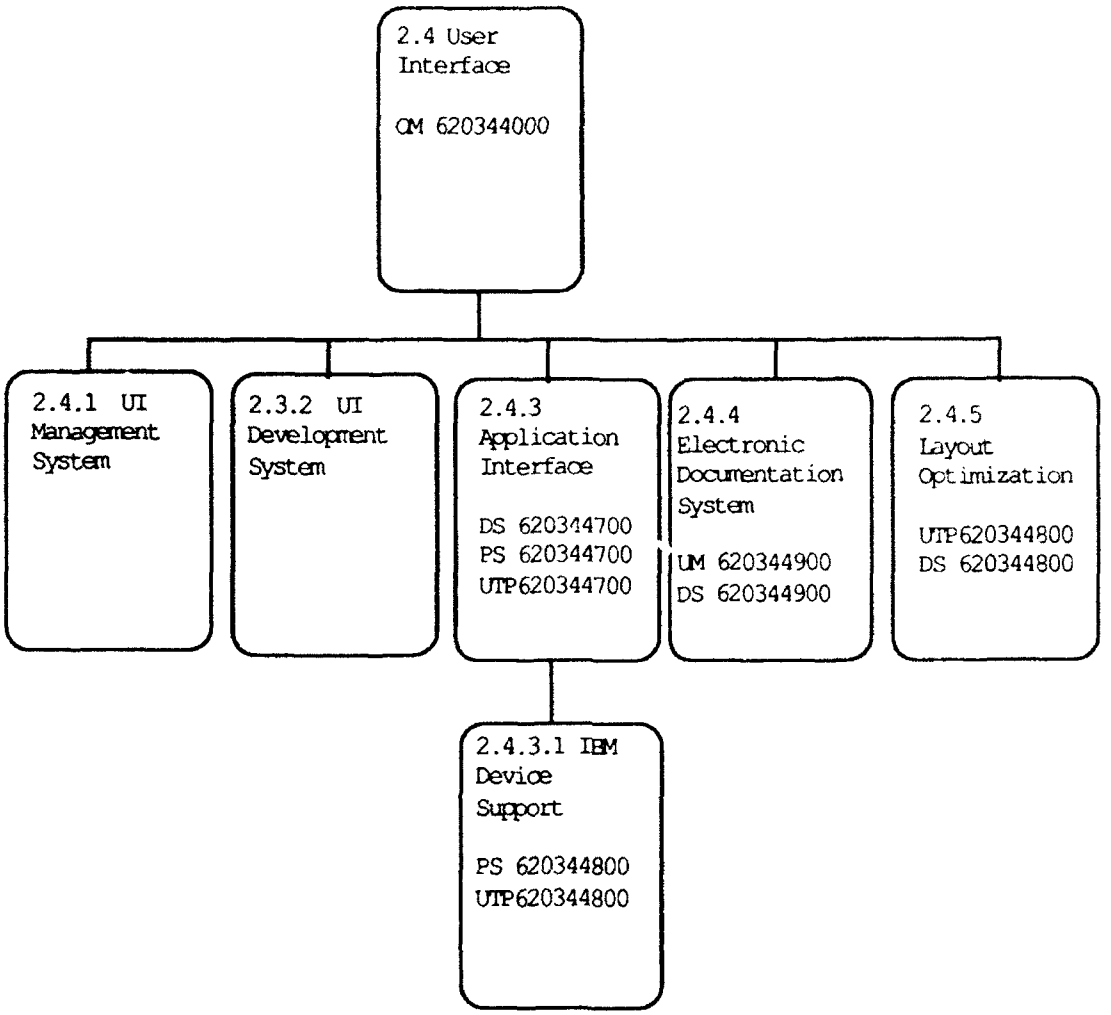

Figure 3-8. Documentation Tree-User Interface

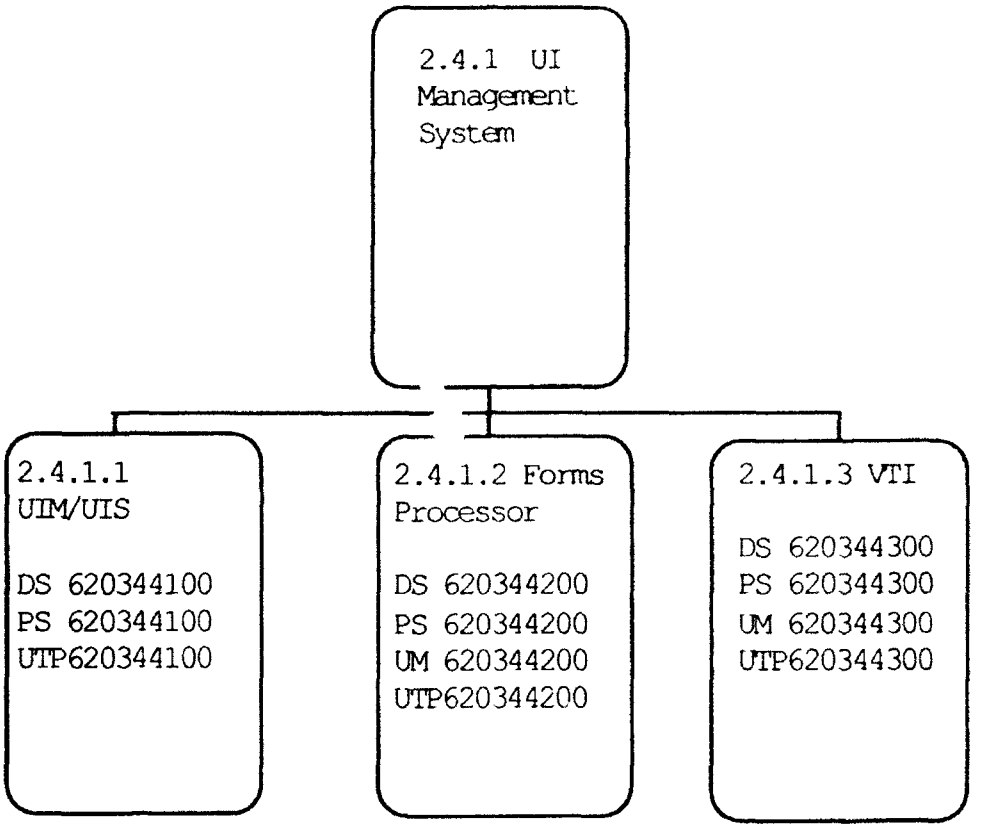

Figure 3-9. Documentation Tree-UI Management System

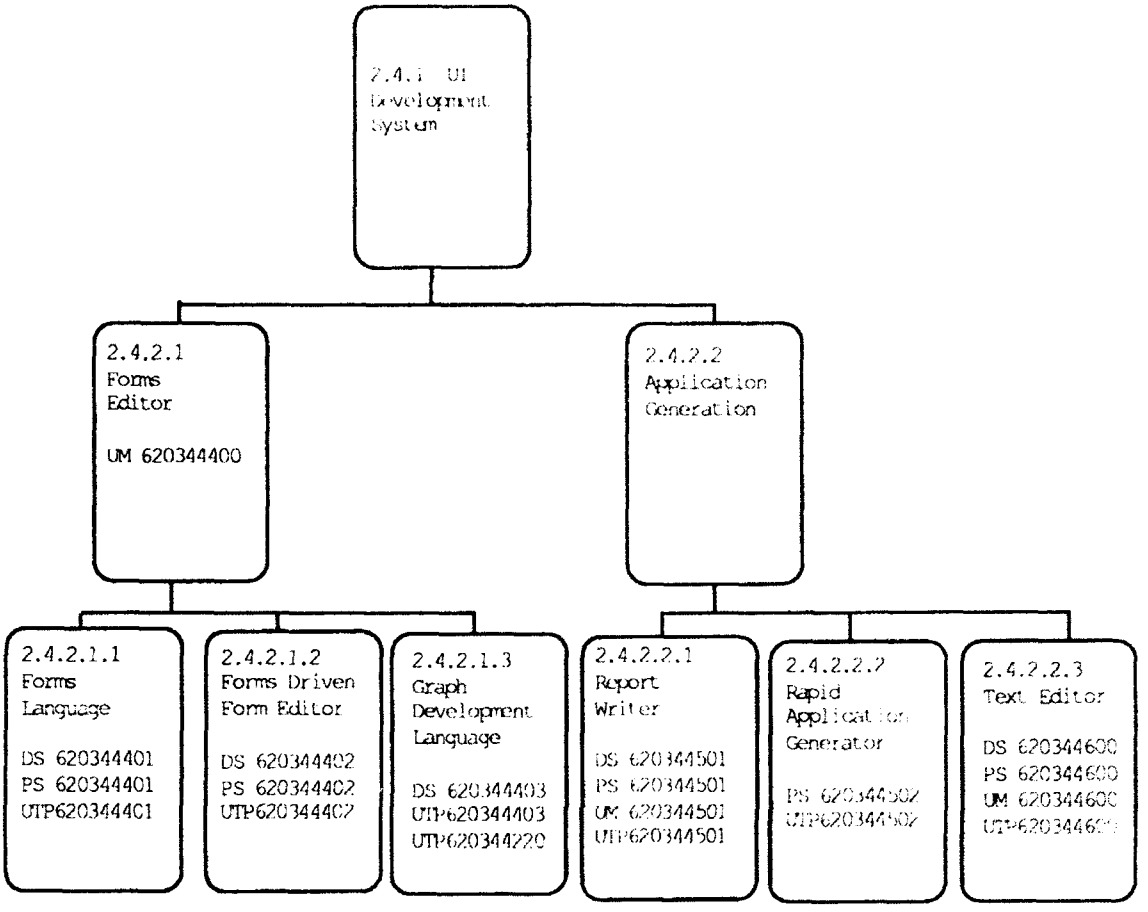

Figure 3-10. Documentation Tree-UI Development System

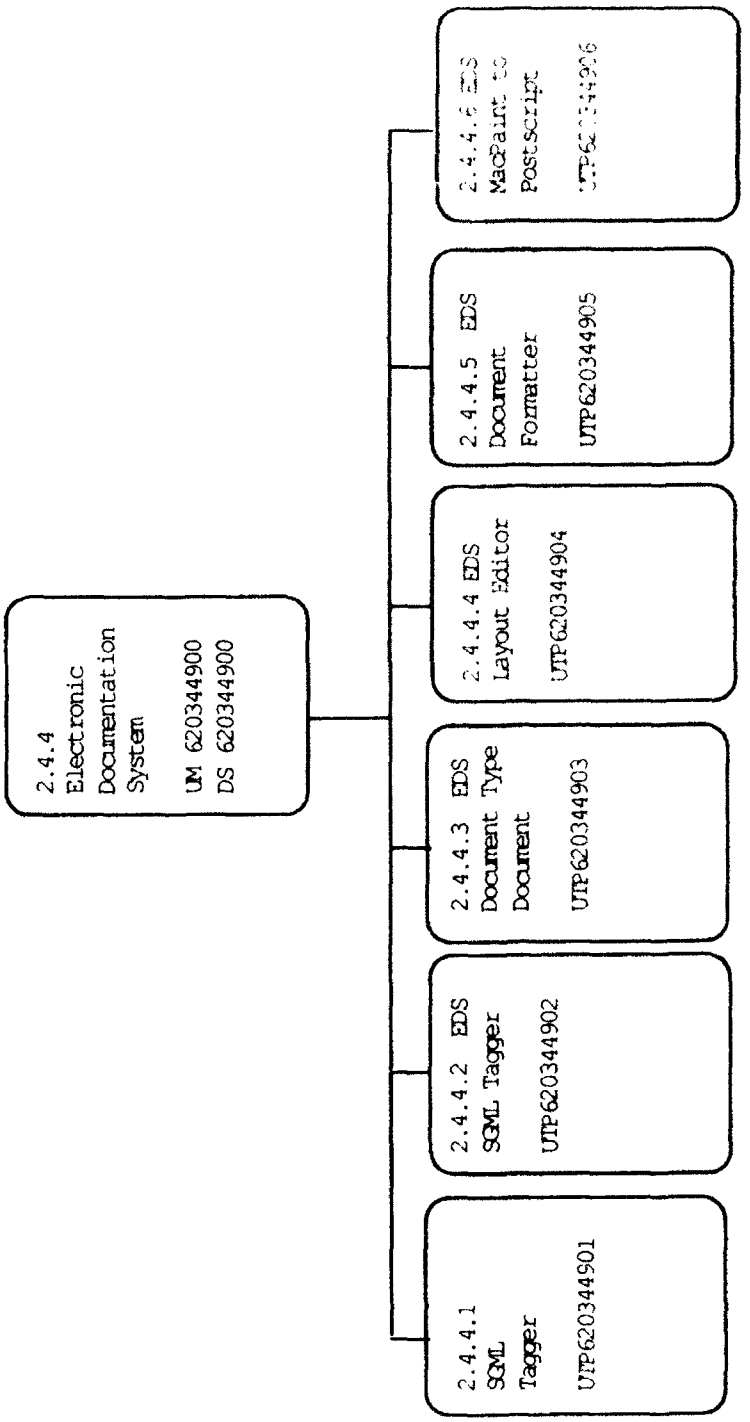

Figure 3-11. Documentation Tree-Electronic Documentation System

3.2 Ordering Documents From NTIS

Additional DAPro documents can be purchased from the National Technical Information Service (NTIS). To obtain price and ordering information you can telephone NTIS directly at 1-800-336-4700. Make sure that you provide NTIS with the report number, volume and part number, plus the NTIS accession number when calling.

REPORT NUMBER: WRDC-TR-90-8007 (for all volumes and parts)

Volume	Part	NTIS Accession #	Title
I	1		Project Overview: Executive Summary
II	1	A252445	Project Overview: Technical Summary
III	1	A250105	Quality Assurance Plan
III	2	A250106	System Administrator's Guide
III	3	A250107	Technical Control Document
III	4	A250108	Schedule Control Document
III	5	A250109	System User's Manual
III	6	A250110	SCM User's Manual
III	7	A250111	SCM Administrator's Manual
III	8	A250112	SCM Development Specification
III	9	A250113	Software Development Guidelines
III	10	A250114	System Software Document
III	11	A250115	VAX Install Guide for Executable Code
III	12	A250116	IBM Installation Guide
III	13	A250117	DM User's Manual
III	14	A250118	FAD Administrator's Manual
III	15	A250119	Software Release Bulletin
III	16	A250120	Software Availability Bulletin
III	17	A250121	VAX Installation Guide for Source Code
IV	1	A250122	System Requirements Document
IV	2	A250123	System Design Specification
IV	3	A250124	System Test Plan
IV	4	A250125	System Integration Test
IV	5	A250126	System Test Report
IV	6	A252446	EIF Technical Report
IV	7	A252525	EIF Technical Report for Electronics
V	1	A250448	CDM Administrator's Manual
V	2	A252447	CDMP Test Case Report
V	3	A252448	CDMP: IDEF1 Model of the CDM -- CDM Development Specification
V	4	A252449	Information Modeling Manual - IDEF1X
V	5	A252450	NDDL Processor Development Specification
V	6, Section 1	A252451	NDDL Processor Product Specification
V	6, Section 2	A252528	NDDL Processor Product Specification
V	6, Section 3	A251997	NDDL Processor Product Specification
V	6, Section 4	A251998	NDDL Processor Product Specification
V	6, Section 5	A251999	NDDL Processor Product Specification
V	6, Section 6	A252053	NDDL Processor Product Specification
V	7	A250449	NDDL User's Guide
V	8	A250450	NDML Programmer's Reference Manual
V	9, Section 1	A252529	NDML Precompiler Development Specification -- CDMP Development Specification
V	9, Section 2	A252526	NDML Precompiler Development Specification -- CDMP Development Specification

REPORT NUMBER: WRDC-TR-90-8007 (for all volumes and parts)

Volume	Part	NTIS Accession #	Title
V	9, Section 3	A252530	NDML Precompiler Development Specification -- CDMP Development Specification
V	9, Section 4	A251955	NDML Precompiler Development Specification -- CDMP Development Specification
V	9, Section 5	A252527	NDML Precompiler Development Specification -- CDMP Development Specification
V	10	A250451	NDML Precompiler Control Module Product Specification
V	11	A252452	NDML Precompiler Parse Application Program
V	12	A250452	NDML Precompiler Parse Process Division Product Specification
V	13	A250453	NDML Precompiler Parse NDML Product Specification
V	14	A250454	NDML Precompiler Transform NDML
V	15	A250455	NDML Precompiler Decomposition Concept
V	16	A252453	NDML Precompiler Select Internal Schema
V	17	A250456	NDML Precompiler Trans Internal Schema
V	18	A251031	NDML Precompiler Generate Conceptual Schema
V	19	A250457	NDML Precomp Generate Oracle Request
V	20	A250458	NDML Precompiler Generate CODASYL
V	21	A252454	NDML Precompiler Generate Total Request
V	22	A250459	NDML Precompiler Build Calls/Messages
V	23	A250460	NDML Precompiler Build Source Code
V	24	A250461	NDML Precompiler Generate Support
V	25	A250462	NDML Precompiler Generate Request
V	26	A250463	Distributed Request Supervisor Development Specification
V	27	A250464	Distributed Request Supervisor Product Specification
V	28	A252455	Data Aggregators Development Specification
V	29	A252531	Data Aggregators Product Specification
V	30	A250465	File Utilities Development Specification
V	31	A252456	File Utilities Product Specification
V	32	A250466	CDM Subsystem Database Build Instructions User's Manual
V	33	A251432	Define/Construct the Neutral Data Definition for the Common Data Model (CDM) Subsystem User's Manual
V	34	A250467	CDM Reports and Application User's Manual
V	35	A250468	DDL to NDDL Translator Development Specification
V	36	A250469	DDL to NDDL Translator Test Plan
V	37	A250470	DDL to NDDL Translator User's Manual
V	38	A250471	DDL to NDDL Translator Build Instructions User's Manual
V	39	A250472	CDM Impact Analysis Development Specification
V	40	A251433	CDM Impact Analysis Unit Test Plan
V	41	A250473	CDM Impact Analysis User's Manual
V	42	A250474	Impact Analysis Build Instructions User's Manual
V	43	A250475	CDM Compare Utility Development Specification
V	44	A250476	CDM Compare Utility Unit Test Plan
V	45	A250628	CDM Compare Utility User's Manual
V	46	A250477	CDM Compare Utility Build Instructions User's Manual
V	47	A250478	SQL User's Manual
V	48	A250479	SQL Reference Manual
V	49	A250480	CDM IRDS Feature Evaluation Report
VI	1	A248905	NTM Development Specification
VI	2	A248906	NTM Programmer's Guide

REPORT NUMBER: WRDC-TR-90-3007 (for all volumes and parts)

Volume	Part	NTIS Accession #	Title
VI	3	A248907	NTM Operator's Manual
VI	4	A248908	NTM System Programmer's Manual
VI	5	A248984	NTM Monitor Product Specification
VI	6	A250481	NTM MPU Product Specification
VI	7	A248909	NTM Services Product Specification
VII	1	A248910	COMM Development Specification
VII	2	A248911	Generic COMM Protocol Product Specification
VII	3	A248912	VAX IPC Product Specification
VII	4	A248913	IBM IHC and IPC Development Specification
VII	5	A248914	File I/O Primitives Product Specification
VII	6	A248915	File I/O Primitives Unit Test Plan
VIII	1	A248916	Terminal Operator's Guide
VIII	2	A249205	User Interface Services Development Specification -- Users Interface Management System Development Specification
VIII	3	A248917	User Interface Services Product Specification
VIII	4	A248418	User Interface Services Unit Test Plan
VIII	5	A248419	Form Processor Development Specification
VIII	6	A250482	Form Processor User's Manual
VIII	7	A251224	Form Processor Unit Test Plan
VIII	8	A248918	Form Processor Product Specification
VIII	9	A248919	Graph Definition Language
VIII	10	A248920	Graph Support System
VIII	11	A248983	Virtual Terminal Development Specification
VIII	12	A248921	Virtual Terminal Product Specification
VIII	13	A249197	Virtual Terminal User's Manual
VIII	14	A248922	Virtual Terminal Unit Test Plan
VIII	15	A248923	Forms Editor User's Manual
VIII	16	A248924	Forms Language Compiler Development Specification
VIII	17	A248925	Forms Language Compiler Product Specification
VIII	18	A248926	Forms Language Compiler Unit Test Plan
VIII	19	A248927	Forms Driven Editor Development Specification
VIII	20	A248928	Forms Driven Editor Product Specification
VIII	21	A248929	Forms Driven Forms Editor Unit Test Plan
VIII	22	A248930	Graph Language Development Specification
VIII	23	A250483	Rapid Application Generator and Report Writer Development Specification
VIII	24	A248931	Report Writer Product Specification
VIII	25	A248932	Application Generator User's Manual
VIII	26	A248933	Report Writer Unit Test Plan
VIII	27	A250484	Rapid Application Generator Product Specification
VIII	28	A248967	Rapid Application Generator Unit Test Plan
VIII	29	A248968	Text Editor Development Specification
VIII	30	A248969	Text Editor Product Specification
VIII	31	A248970	Text Editor User's Manual
VIII	32	A248971	Text Editor Unit Test Plan
VIII	33	A248972	Application Interface Development Specification
VIII	34	A248973	Application Interface Product Specification
VIII	35	A248974	Application Interface Unit Test Plan

REPORT NUMBER: WRDC-TR-90-8007 (for all volumes and parts)

Volume	Part	NTIS Accession #	Title
VIII	36	A248975	Layout Optimization System Unit Test Plan
VIII	37	A248976	Layout Optimization System Development Specification
VIII	38	A248977	Electronic Documentation System Development Specification
VIII	39	A250485	Electronic Documentation System User's Manual
VIII	40	A248978	SGML Tagger Unit Test Plan
VIII	41	A248979	EDS Parser Unit Test Plan
VIII	42	A248980	EDS Document Type Definition Unit Test Plan
VIII	43	A248981	EDS Layout Editor Unit Test Plan
VIII	44	A252457	EDS Document Formatter Unit Test Plan
VIII	45	A248982	EDS MacPaint to Postscript Unit Test Plan

U.S. GOVERNMENT PRINTING OFFICE: 1990-[illegible]