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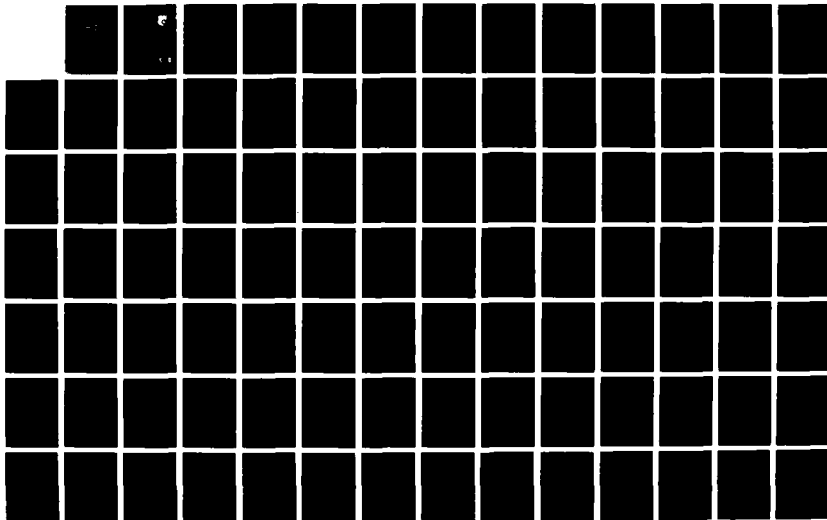
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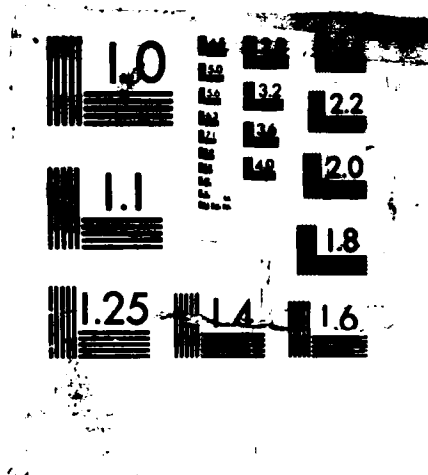
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**AFWAL-TR-86-4006
Volume VI
Part 2**



**INTEGRATED INFORMATION
SUPPORT SYSTEM (IISS)
Volume VI - Network Transaction Manager Subsystem
Part 2 - NTM Programmer's Guide**

**General Electric Company
Production Resources Consulting
One River Road
Schenectady, New York 12345**

**Final Report for Period 22 September 1980 - 31 July 1985
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PREPARED FOR:

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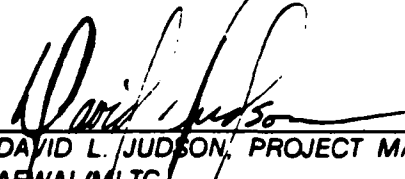
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This report has been reviewed by the Office of Public Affairs (ASD/PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

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



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19. ABSTRACT (Continue on reverse if necessary and identify by block number) This technical manual describes the services provided by the Network Transaction Manager (NTM) for application processes (APs). Information on integrating new APs with IISS and writing new APs for IISS is provided. Each NTM service call is described in detail.					
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PREFACE

This programmer's guide covers the work performed under Air Force Contract F33615-80-C-5155 (ICAM Project 6201). This contract is sponsored by the Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. It was administered under the technical direction of Mr. Gerald C. Shumaker, ICAM Program Manager, Manufacturing Technology Division, through Project Manager, Mr. David Judson. The Prime Contractor was Production Resources Consulting of the General Electric Company, Schenectady, New York, under the direction of Mr. Allan Rubenstein. The General Electric Project Manager was Mr. Myron Hurlbut of Industrial Automation Systems Department, Albany, New York.

Certain work aimed at improving Test Bed Technology has been performed by other contracts with Project 6201 performing integrating functions. This work consisted of enhancements to Test Bed software and establishment and operation of Test Bed hardware and communications for developers and other users. Documentation relating to the Test Bed from all of these contractors and projects have been integrated under Project 6201 for publication and treatment as an integrated set of documents. The particular contributors to each document are noted on the Report Documentation Page (DD1473). A listing and description of the entire project documentation system and how they are related is contained in document FTR620100001, Project Overview.

The subcontractors and their contributing activities were as follows:

TASK 4.2

Subcontractors

Role

Boeing Military Aircraft
Company (BMAC)

Reviewer

D. Appleton Company
(DACOM)

Responsible for IDEF support,
state-of-the-art literature
search

General Dynamics/
Ft. Worth

Responsible for factory view
function and information
models

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<u>Subcontractors</u>	<u>Role</u>
Illinois Institute of Technology	Responsible for factory view function research (IITRI) and information models of small and medium-size business
North American Rockwell	Reviewer
Northrop Corporation	Responsible for factory view function and information models
Pritsker and Associates	Responsible for IDEF2 support
SofTech	Responsible for IDEFO support

TASKS 4.3 - 4.9 (TEST BED)

<u>Subcontractors</u>	<u>Role</u>
Boeing Military Aircraft Company (EMAC)	Responsible for consultation on applications of the technology and on IBM computer technology.
Computer Technology Associates (CTA)	Assisted in the areas of communications systems, system design and integration methodology, and design of the Network Transaction Manager.
Control Data Corporation (CDC)	Responsible for the Common Data Model (CDM) implementation and part of the CDM design (shared with DACOM).
D. Appleton Company (DACOM)	Responsible for the overall CDM Subsystem design integration and test plan, as well as part of the design of the CDM (shared with CDC). DACOM also developed the Integration Methodology and did the schema mappings for the Application Subsystems.

Subcontractors

Role

Digital Equipment
Corporation (DEC)

Consulting and support of the
performance testing and on DEC
software and computer systems
operation.

McDonnell Douglas
Automation Company
(McAuto)

Responsible for the support and
enhancements to the Network
Transaction Manager Subsystem
during 1984/1985 period.

On-Line Software
International (OSI)

Responsible for programming the
Communications Subsystem on the
IBM and for consulting on the
IBM.

Rath and Strong Systems
Products (RSSP) (In 1985
became McCormack & Dodge)

Responsible for assistance in
the implementation and use of
the MRP II package (PIOS) that
they supplied.

SofTech, Inc.

Responsible for the design and
implementation of the Network
Transaction Manager (NTM) in
1981/1984 period.

Software Performance
Engineering (SPE)

Responsible for directing the
work on performance evaluation
and analysis.

Structural Dynamics
Research Corporation
(SDRC)

Responsible for the User
Interface and Virtual Terminal
Interface Subsystems.

Subcontractors and other prime contractors under other
projects who have contributed to Test Bed Technology, their
contributing activities and responsible projects are as follows:

Subcontractors

Role

General Dynamics/
Ft. Worth

Responsible for
factory view

<u>Contractors</u>	<u>ICAM Project</u>	<u>Contributing Activities</u>
Boeing Military Aircraft Company (BMAC)	1701, 2201, 2202	Enhancements for IBM node use. Technology Transfer to Integrated Sheet Metal Center (ISMC)
Control Data Corporation (CDC)	1502, 1701	IISS enhancements to Common Data Model Processor (CDMP)
D. Appleton Company (DACOM)	1502	IISS enhancements to Integration Methodology
General Electric	1502	Operation of the Test Bed and communications equipment.
Hughes Aircraft Company (HAC)	1701	Test Bed enhancements
Structural Dynamics Research Corporation (SDRC)	1502, 1701, 1703	IISS enhancements to User Interface/Virtual Terminal Interface (UI/VTI)
Systran	1502	Test Bed enhancements. Operation of Test Bed.

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LIST OF SYMBOLS, ABBREVIATIONS, ACRONYMS

AP	Application Process
APC	Application Process Cluster
API	Application Process Interface
CDMRP	Common Data Model Request Processor
COMM	Communications Handler
CPCI	Computer Program Configuration Item
DBMS	Data Base Management System
DML	Data Manipulation Language
ICAM	Integrated Computer Aided Manufacturing
IDSS	Integrated Decision Support System
IISS	Integrated Information Support System
IPC	Inter Process Communication
LAN	Local Area Network
MCMM	Manufacturing Control Material Management
MDL	Message Definition Language
MM	Message Manager
MO	Maintain Operability
MPU	Message Processing Unit
MRP	Materials Requirements Planning
MSG	Message
NTM	Network Transaction Manager
OS	Operating System
PM	Process Manager
QA	Quality Assurance
SS	System Specification
UI	User Interface
VAX	Trademark of Digital Equipment Corporation: 32 bit minicomputer
VMS	Trademark of Digital Equipment Corporation: The VAX OS

SECTION 1

INTRODUCTION

This NTM Programmer's Guide describes the services provided to IISS Programmers by the Network Transaction Manager (NTM). These services are used by IISS Application Programs to send messages to and receive messages from other programs in the IISS.

The Programmer's Guide is being released as a series of interim documents to allow the IISS coalition members who are now building IISS component programs to use the currently available NTM service calls in their programs. The available services have been used both in the development of NTM APs and in the development of IISS component APs. The calls described for these services are in their final calling form.

Throughout the document there are notes on restrictions, helpful hints, and various "lessons learned." For the user's convenience, these are collected in Appendix D.

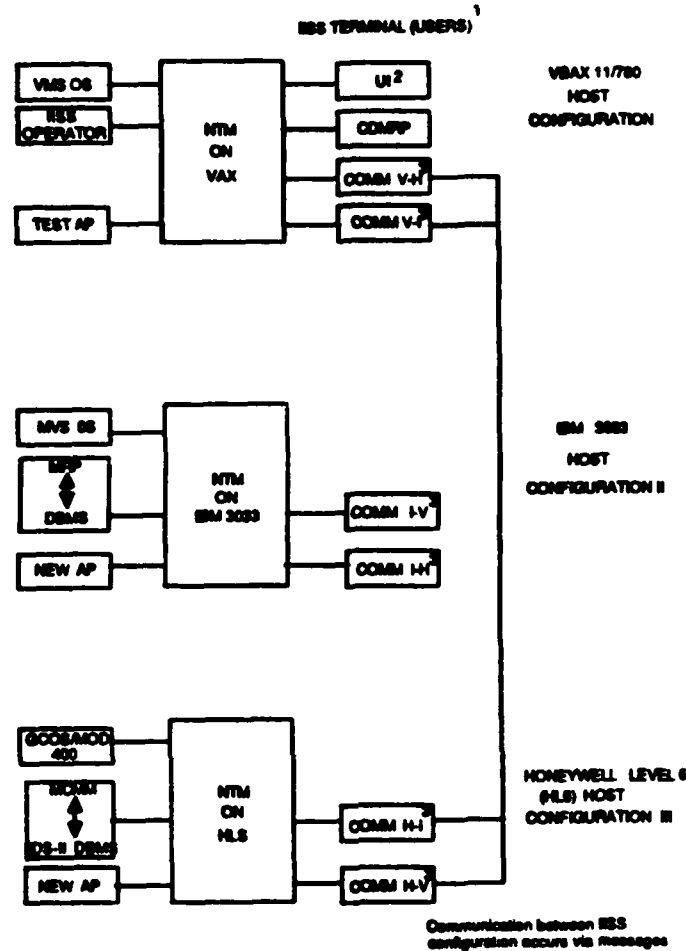
SECTION 2

THE IISS ENVIRONMENT

The Integrated Information Support System (IISS) is a test computing environment used to investigate and demonstrate techniques for integrating data resident on heterogeneous databases supported on heterogeneous computers. The environment will support users' and application processes' access to this integrated resident IISS data in a controlled distributed processing environment. Network Transaction Manager (NTM) components that reside on each host cooperate to perform the coordination, communication and housekeeping functions required to integrate the application processes into the IISS system and to allow the integrated APs the access to the data and to each other within a well-defined authorization structure. The NTM components form the distributed executive of the IISS.

The IISS architecture is described in Figures 2-1 and 2-2. The architecture is based on the concept of cooperating clusters of application processes (AP clusters). Each cluster is a collection of Application Processes (APs) that are uniquely addressable but may form a subsystem or application from the user's perspective. Each cluster has its own dedicated portion of the NTM to provide services directly to each AP residing on the cluster. Certain AP clusters support IISS system components. These include the Communications (COMM), the Common Data Model Request Processor (CDMRP), and the User Interface (UI) clusters. These system components in combination with the entire NTM are the IISS network operating system and utilities. They cooperate to provide transaction processing, communication, and data integration services to users at IISS terminals and to Application Processes.

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Notes:

1. The IISS operator interface will be implemented as an IISS terminal or as a separate console interface. It is treated as a separate entity.
2. For the initial test bed, the User Interface (UI) will reside on only one host, the VAX. There will be one UI instance for each IISS terminal that is logged on.
3. The Communication components are named to indicate the link pair (i.e., COMM V-H indicates the component on the VAX that communicates with the Honeywell Level 6).

Figure 2-1. IISS System External Interfaces. An NTM will reside on each of the three hosts configured as illustrated to IISS components and other subsystems.

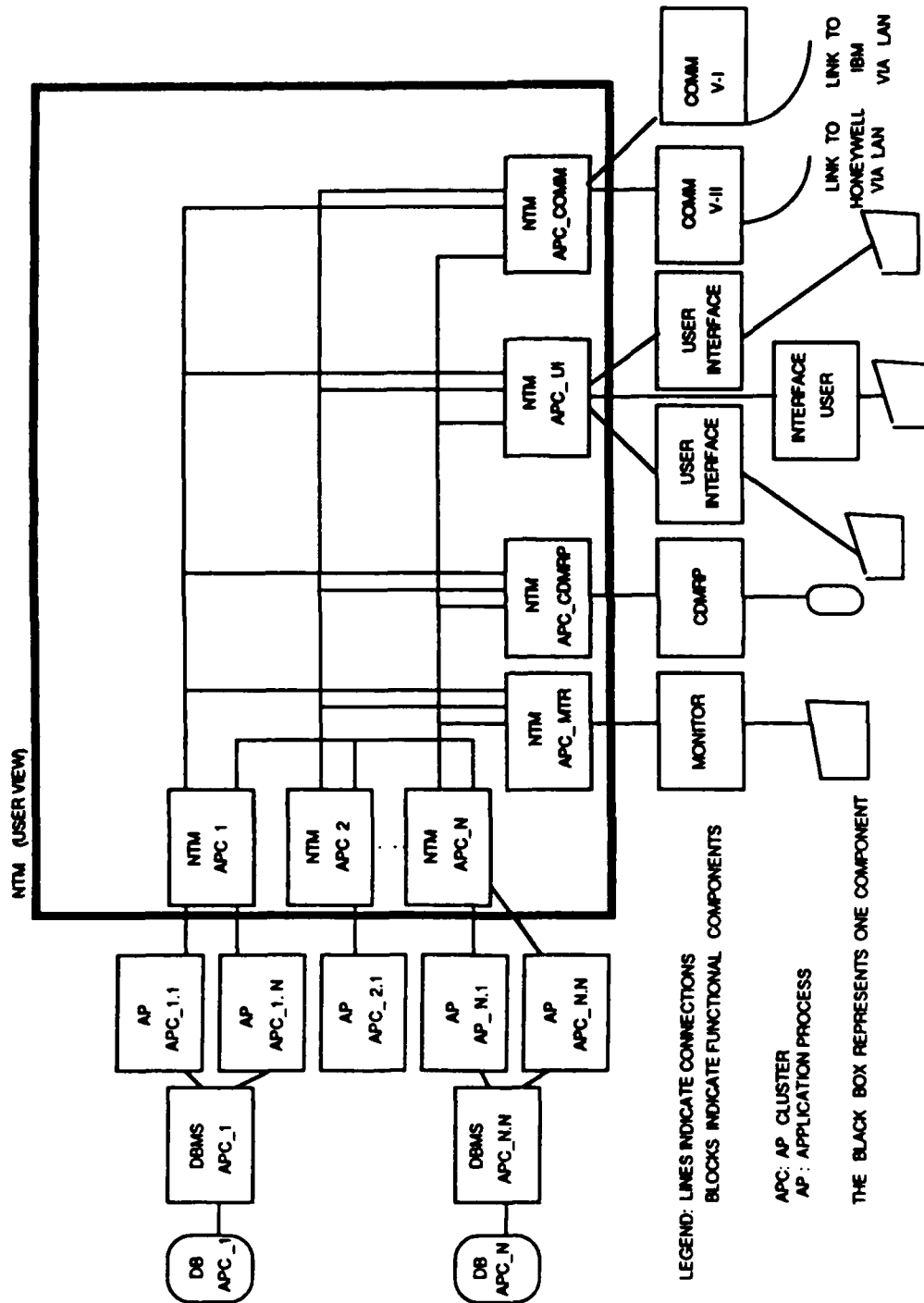


Figure 2-2. IISS Architecture - Conceptual Model NTM on VAX

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A major function of the NTM is process management for all IISS APs. As part of this process management, an interface between each AP and the NTM is provided. It is called the AP Interface and is described in detail in Sections 3, 4, and 5. It provides a set of high level NTM calls for use by the AP, that are, in concept, similar to traditional operating system calls. The functionality represented by these calls is provided by using the message services of the NTM. The message services are transparent to the AP.

SECTION 3

INTEGRATING NEW USER APPLICATION PROCESSES (APs) INTO THE IISS ENVIRONMENT

3.1 Application Process Interface for New Applications

3.1.1 Overview of the NTM Services

The Application Process (AP) Interface is a group of subroutines that are linked to each new AP to provide the integration of the AP into the IISS Test Bed. Conceptually the AP, AP Interface, and NTM interfaces are described in Figure 3-1.

The number of input mailboxes for an AP is specified as part of the AP characteristics as 0, 1, or 2. If an AP will receive no messages (e.g., all of its information is in a shared database), it will have zero mailboxes. To receive normal messages from other APs, then a single mailbox is specified. This will be referred to as the "cold" or "normal" mailbox by the NTM. If an AP wants to receive high priority messages from the NTM, such as "shutdown pending," then it must specify two mailboxes. This second mailbox will be referred to by the NTM as the "hot" or "priority" mailbox. (Note: The priority mailbox is not accessible for sending messages between applications, as there is no message priority logic supported by the NTM). A third mailbox type, the "Acknowledgment" mailbox, or "ACK" mailbox, is automatically provided by the system if one or two mailboxes are specified by the user. This is used strictly for the NTM MPU to send back acknowledgment messages to the NTM services to indicate that messages have been received and are acceptable. In this way the ACK messages can go straight back and do not become queued up with other messages in either the hot or cold mailboxes. Thus, in fact, there are 0, 2, or 3 mailboxes actually used, and even if 0 are specified, one is provided during startup to receive startup information, but this is not seen by the user.

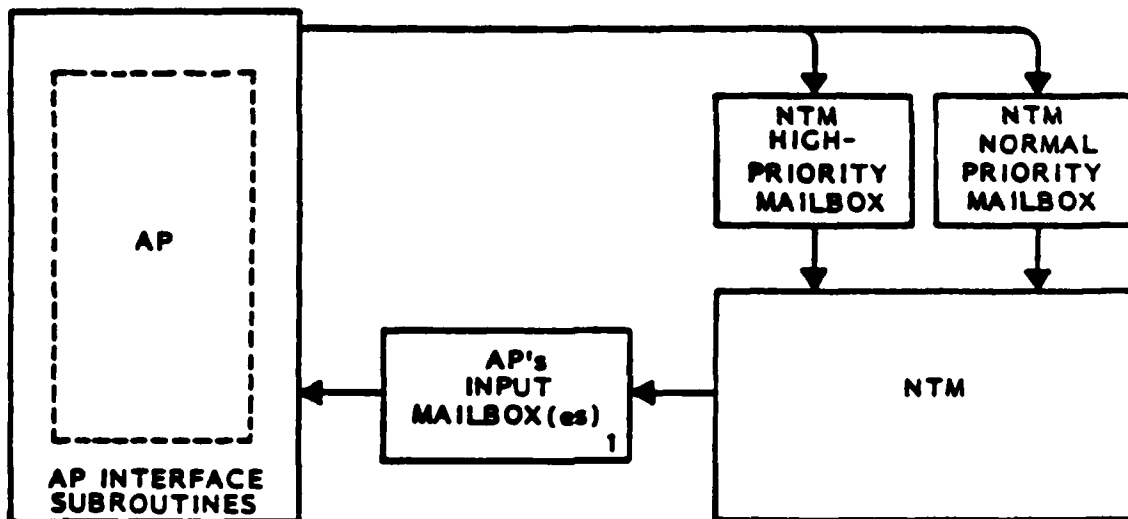


Figure 3-1. NTM/AP Interfaces

The AP Interface provides an AP with the ability to send messages to other APs and NTM components in the IISS. These communicating APs may be associated with the same or different AP Clusters and may reside on different IISS host computers. The AP programmer can send messages to any AP that it is authorized to access by using the NTM high level "send" calls. The programmer need only know the IISS name of the AP to which it is sending the message, and the AP-AP message protocol (message types, etc.). The NTM provides the routing and message delivery processing for the APs.

The only restriction placed on an AP that is to be integrated into the IISS, and therefore use the message services of the NTM, is that the AP be written according to a format that includes NTM Initiation (INITAL) and termination (TRMNAT) calls at the beginning and the end of its Procedure Division (COBOL) (Figure 3-2). The CALL "INITAL" and CALL "TRMNAT," respectively, provide the IISS connection and termination service. Communication between IISS APs is accomplished by using the NTM calls that are described in Section 5. For example, the CALL "NSEND" USING ..., will cause a program's message to be delivered to the NTM for routing. The NTM routes the messages through the IISS to the destination AP specified in the "NSEND" call. The destination AP receives its messages by using the NTM "RCV" call.

AP PROGRAM

PROCEDURE DIVISION.

CALL "INITAL" USING BUFFER,

BUFFER-SIZE,

SYSTEM-STATE,

RET-CODE.

...

AP CODE: can include NTM calls that are described in
 Section 5 to communicate with other IISS AP's.

...

CALL "TRMNAT" USING TERMINATION-STATUS*.

*CALL "TRMNAT" is the last executable statement in the AP.

Figure 3-2. IISS AP-COBOL Procedure Division Structure

Figure 3-3 lists the NTM Service calls. There are four functional categories of calls: connection services, communication services, NTM Requests, and privileged services. Most APs will use only the connection and communication services. The NTM Request Services provide status information that can help the AP optimize its performance. They also offer processing services to APs, such as the UI and CDMRPs, that have special NTM handling requirements.

The basic connection services ("INITAL" and "TRMNAT") and communications services (sending messages and receiving messages) are described from a functional viewpoint in Sections 3.1.2 through 3.1.4. All of the calls, with their arguments and return codes, are described in Section 5.

Connection Services

- * INITIAL Provide initiation services for an AP
- * TRMNAT Signal AP termination status
- ENDRCY Signal end of recovery processing

Communication Services

- * MSEND Send a message
- GDSEND Send a guaranteed delivery message
- * ISEND Send an initiation request
- * QSEND Send reply message (used by Queue-Server APs only)
- * CHKMSG Check for any current messages (use RCV to retrieve messages)
- SETDLY Specify delay condition for next message
- * SIGERR Notify the NTM and UI of an AP (non-fatal) error
- GDACK Acknowledge receipt of a guaranteed delivery message
- MSGACK Acknowledge receipt of a message
- * RCV Receive a message
- * TSTMOD Switch IISS message test mode on or off

NTM Requests

- APSTAT Get the status of a specified AP
- HSTATS Get the status of a specified host
- * WHTHST Request the name of the current host
- WHATAC Request the name of the current AP Cluster
- WKONCA Request "wake-up" on specified AP Cluster availability
- ACSTAT Get the status of a specified AP Cluster
- SIGABT Signal to NTM to abort an AP
- PRSTAT Get the status of one or more paired messages
- GDSTAT Get the status of one or more guaranteed delivery messages
- * GETUSR Get the user's name and Original Source APname

Privileged Services

- * INICOM Provide initiation services for the COMM APs
- * INITEX Provide initiation services for UI AP
- * LOGON Send IISS user information to NTM
- * LOGOFF Send IISS user Logoff information to NTM
- * CHGROL Change the users's role during a session
- * TRMNAX Signal COMM AP Termination Status

* Services currently available for use by IISS AP developers.

Figure 3-3. NTM Services Calls

3.1.2 Initiation ("INITAL")

INITAL sets up the NTM to provide message services to all APs except for COMM and the UI (COMM and UI special initiation requirements are described in Appendix C). Messages are routed and delivered by the NTM through 'mailboxes'. INITAL provides the AP mailbox connection to the NTM, performs the initiation logic necessary to handle later NTM calls from the AP, and establishes IISS condition handling for the AP. The condition handling service** traps all machine and operating system exception conditions, informs the NTM of the event (who informs the original source AP of the event, if possible), and then aborts the AP. This service provides an additional level of integrity checking to the IISS.

The NTM initiation service also provides system state information to APs that perform special logic on certain events (i.e., IISS startup, IISS Recovery, or for AP startup events such as "First Run of AP"). The system state message also provides the AP Interface with certain AP characteristics such as the number of mailboxes the AP supports.

Section 5 contains a more complete description of INITAL and its arguments. It also includes an example of its use and guidelines for establishing buffer space for the APs' messages.

3.1.3 SEND Messages

APs may send messages to other APs in the IISS by using the basic message delivery services of the NTM. Four different send calls are provided to APs. The first, "NSEND", is used for normal AP-AP communication. The others, "GDSSEND" (guaranteed delivery)**, "ISEND" (specific initiation of a new AP instance), and "QSEND" (queue-server reply message), all request special NTM message services. Additionally, the user can specify delayed, conditional or test mode delivery with special calls to enable these services prior to actually sending the message. The following paragraphs contain a description of the basic 'send' functions followed by a more detailed description of the three "send" calls.

**This service is not implemented.

The AP Interface provides the following basic functions on all of the send calls:

- a. The AP Interface receives a message from an AP that is to be delivered to another AP when the AP issues any one of the four send calls.
- b. The Interface encapsulates the AP's data (message) into NTM messages. The AP's data will be packetized into NTM message units that have an NTM header which is used for NTM processing and routing. The NTM also provides message continuation logic, transparent to the AP, for data strings which are longer than the NTM maximum message size.
- c. The AP Interface delivers these messages containing the user's data to the local MPU's mailbox.
- d. The AP Interface returns the NTM's accept-status of the AP's message to the AP. A successful return indicates that the NTM has performed an integrity check on the message header, authorized the message, set up pairing information for messages that require a response, and has accepted the message for delivery. A nonsuccessful return will indicate where the send failed NTM processing. Failure may be due to invalid calling arguments, send service processing errors, or NTM table errors.
- e. Some messages sent by an AP require responses from the receiving AP. These are called message pairs. The NTM provides message pairing support to the APs on the "NSEND" and "ISEND" calls. An AP can indicate that a particular message requires a response, and hence, pairing support from the NTM, by setting the timeout indicator argument of the "send" calls with an appropriate value. The NTM will provide the APs required timeout service where the elapsed time expires before a response has returned. The AP developer indicates the AP timeout handling requirements to the IISS CDM administrator before the AP becomes part of the IISS. (See Appendix B for AP characteristics and Handling Options.)

- f. An AP may request conditional or time-triggered delivery of a message by using the "SETDLY" call just prior to a "send" call. "SETDLY" provides three triggered delivery modes for a message: 1) a specified absolute time (i.e., 12:58 p.m., June 20, 1984), 2) delivery after some elapsed relative time (i.e., four hours after the message is submitted), or 3) on some condition (i.e., after Event X).
- g. An AP can establish a test mode of operation with the "TSTMOD" service. The "TSTMOD" call allows the Test Mode service to be either enabled or disabled. All messages that are sent while the sending AP is in test-mode will have the NTM header test-mode field set to "1". The destination AP will receive the message with a "RCV" call whose return code will be set to indicate that the message was sent in test mode. The receiving AP then must handle the test-mode message appropriately (i.e., perhaps inhibiting file updates). The TSTMOD call further enables the AP to receive messages signalling an AP error condition (SIGERR).

CALL "NSEND" USING ... is used to send data that requires no special NTM handling beyond message pairing and continuation logic. The caller specifies the destination AP name and may use a logical channel specifier (see Section 3.1.6 and Section 5) to manage communications between the sending and receiving APs.

CALL "GDSEND" USING ... is used to send a guaranteed delivery message to an AP. (A guaranteed delivery message is a "registered letter" message to the NTM that this message will be delivered to its destination. The NTM provides special logging for later delivery of the message if a required host or AP cluster is not available when the message is sent, and recovery of these messages in the event of a system "crash.") The "GDSEND" call returns the NTM's message serial number to the sending AP in the event that the sending AP wishes to later determine the status of the message (CALL "GDSTAT" USING MSG-SERIAL-NO). The destination AP, on receipt of a guaranteed delivery message, must acknowledge that receipt (CALL "GDACK") when the AP completes the processing of the guaranteed delivery message.

CALL "ISEND" USING ... is the "send" call that should be used when an AP is aware that its message will require the initiation of a new instance of the destination AP. It can also

be used by APs who require concurrent access to multiple instances of the same AP. This service allows those APs (primarily component APs) to specifically request the initiation of a new instance of an AP. If the AP writer is in doubt whether to use an "ISEND" or "NSEND", "NSEND" should be the one chosen. The NTM can normally determine whether or not an AP requires an initiation, and will handle these messages accordingly.

The "ISEND" call must be used in the situation where the destination AP has the characteristic of requiring a specific initiator message. This restriction is placed on the AP by the AP Developer when the AP is installed on the IISS. It serves to prevent the initiation of the AP upon receipt of unsolicited messages. This restriction applies only to initiation messages. Once the AP is running, it may receive any message from an authorized source AP using CALL "NSEND".

CALL "QSEND" USING... is the send call to use if you are a Queue-Server Application. Q-servers are a special type of application that is usually used by component APs to get information that is kept system- (or at least machine-) wide. By keeping up one copy of a program that can be called by any number of applications, this program is common to all APs. Every time it gets a message, it sends back the needed information as soon as possible. In this way it is really replying to the last message as if it was a request of some sort. The QSEND call guarantees that the reply is sent specifically to the sender of the last message received.

3.1.4 RECEIVE Messages

An AP receives messages from other APs in the IISS by using the CALL "RCV" USING ... service. The AP has two basic options available to it on the "RCV" call. These are a wait/no-wait option and a receive any message/receive specific message option. These options are described below.

WAIT/NO WAIT OPTION: If the AP uses a "RCV" with the wait argument set, its processing will be suspended until a message arrives (the message being either the message it was waiting for or an indicator of a time-out). On a "RCV" with "no wait", the AP will have control returned to it immediately. The return code on the "RCV" with "no wait" will either indicate that a message was received and can then be retrieved in the call's DATA argument or will

indicate that no message of the type indicated has arrived for the AP.

RECEIVE ANY/RECEIVE SPECIFIC MESSAGE OPTION: On a "RCV" call, an AP can use this option in several ways. An AP may request to receive the first message in its buffer regardless of the source, the first message from a specific AP; the first from a specific AP on a specified channel (Section 3.1.6); or the first message from any AP on a specified channel. This feature provides flexibility to the AP programmer and off loads some of the AP's message bookkeeping and buffering. For example, if an AP has issued multiple "sends" and needs a response from a particular AP before it can continue, it can issue a "RCV" with a wait and the source specified. The AP Interface will buffer all of the AP's incoming messages until the requested response arrives and then return control and the requested message to the AP.

A companion service to "RCV" is "CHKMSG". It checks the AP's mailbox to determine whether any messages have arrived for the AP. (The AP can also check to see if a message has arrived from a particular source or channel by specifying one or both of these in the call). The AP can later retrieve any messages indicated by "CHKMSG" with the call "RCV". The "CHKMSG" service should be particularly useful to AP programs that receive unsolicited messages. For example, an AP that can receive IISS shutdown messages could periodically call "CHKMSG" to determine if it has received a shutdown message.

3.1.5 Termination (TRMNAT)

"TRMNAT" disconnects the AP from the NTM, does any required cleanup, (such as mailbox deletion) and then terminates the AP. It is required as the last executable statement in a new IISS AP's program.

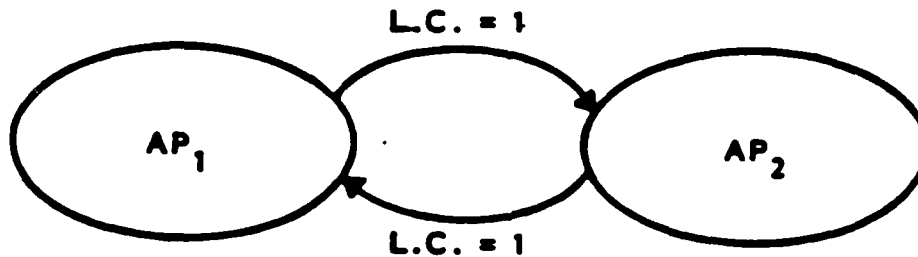
3.1.6 AP-AP Communication - the Logical Channel Concept

The NTM supports several modes of communication between IISS APs by providing a logical channel specifier capability. Logical channels are an optional argument in the send and receive calls that can be used by the APs to:

- **Pair Request and Response Messages.** The source AP supplies a logical channel specifier with the destination AP's name on a send data request. The

destination AP receives the logical channel specifier on the receive data call (CALL "RCV") and uses it when it returns the response with its CALL "NSEND." See Figure 3-4a. In this way, a message pair can be confirmed by matching the pair source AP and the logical channel. This is critical when the response comes from an AP that is not the destination specified in the original request message.

- **Pair Multiple Outstanding Requests and Responses.** The AP can use logical channel specifiers to manage multiple outstanding message pairs between one or several AP destinations. (See Figures 3-4b and 3-4c.) The requesting AP manages the pairs by using the destination AP and logical channel to identify a unique pair. For example, in Figure 3-4b, AP1 sends four messages to AP2, each on a different channel. AP2, whose protocol determines that it expects multiple messages from AP1, issues four consecutive CALL "RCV"s (Section 5). On each of its RCVs, it obtains AP1's name and the logical channel specifier for the specific message. AP2 pairs the requests from AP1 to its responses by using the relevant logical channel when it sends a response to AP1. This provides an easy and flexible pair management capability to the AP Programmer. Note that the AP must manage the assignment of the logical channel to the message.



AP₁ specifies
logical channel
1 on its "CALL "SEND"

AP₂ receives a message
from AP₁ on Channel 1
and uses Channel 1 when
responds to AP₁

L.C. = Logical Channel

Figure 3-4a. Simple Paired Message Handling - Logical Channels

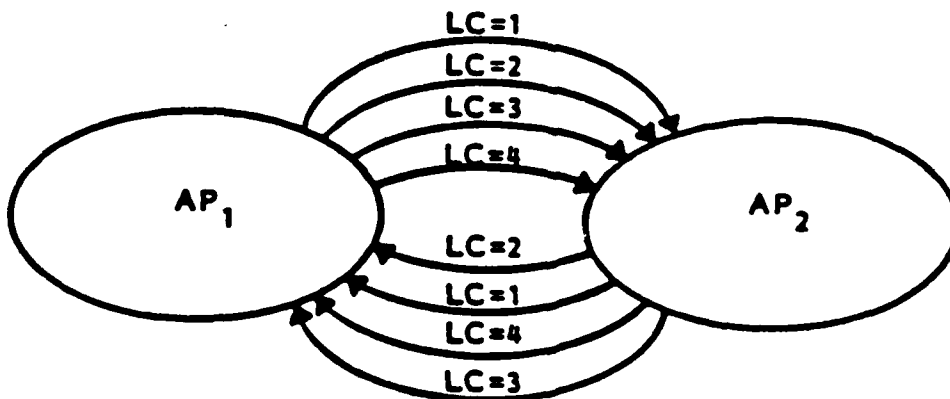


Figure 3-4b. Multiple Pairs Between Two APs Using Logical Channels

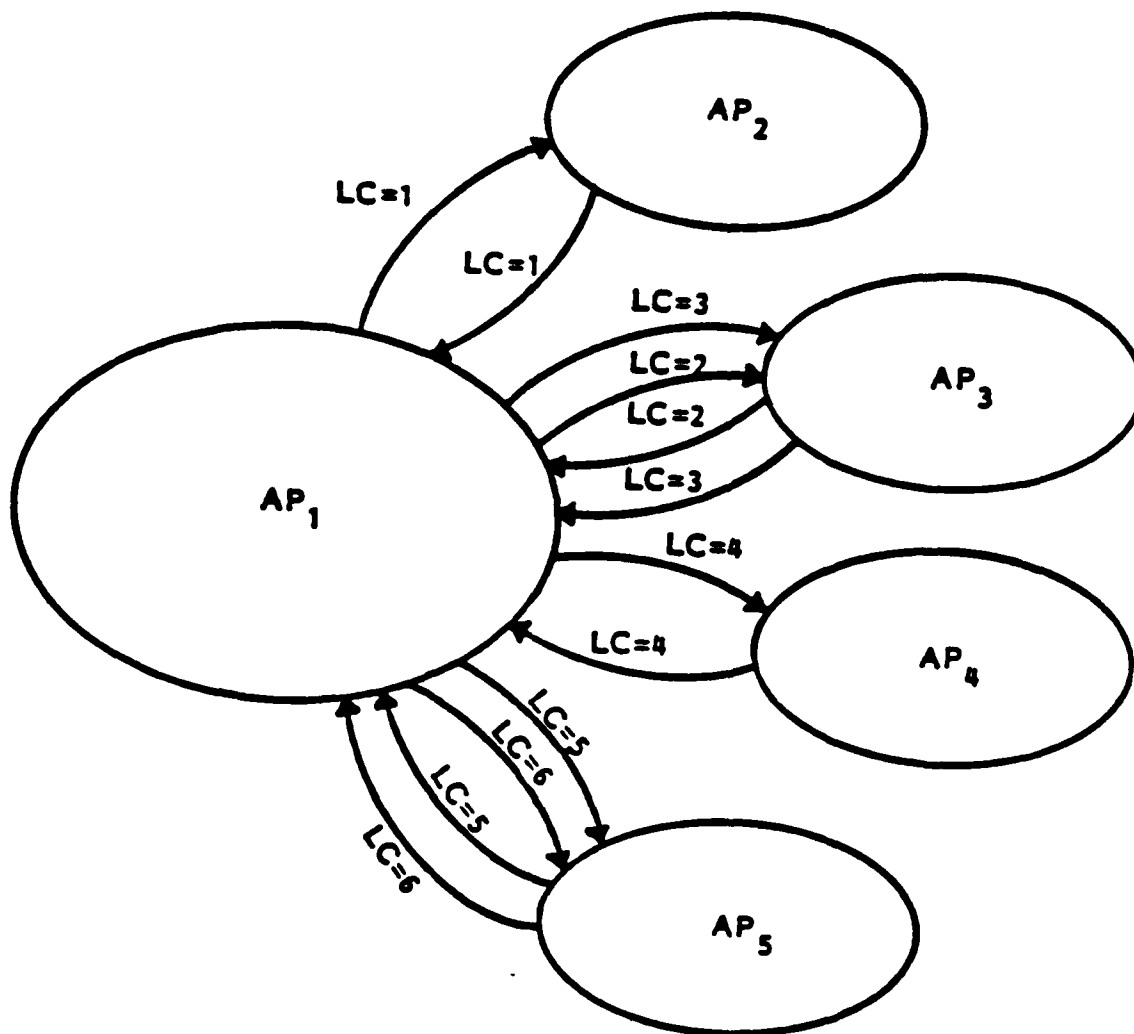


Figure 3-4c. Multiple Pairs Between One AP and Many Destination APs

There is a restriction on this use of logical channels. When an AP wishes to communicate with a second AP on multiple channels, it must specify the destination instance when a new channel ID is introduced. This requires that the source AP has received at least one message from the destination AP in order to obtain the destination AP's instance number. This restriction applies only when dealing with AP's requiring child chaining support.

- **Support AP Chaining.** The AP can maintain a chain of communications between APs by using the Logical Channel specifier as the AP chain identifier (Figure 3-4d). Each AP in the chain will use the same logical channel when sending messages to or receiving messages from any other AP in the chain. The NTM supports the chaining by dynamically building a chain or child table as the chain is built. In this table, the child AP is assigned the channel ID specified in the message causing it's initiation. This function allows any AP in the chain to get the name of the chain's originating AP and the channel of this chain (CALL "GETUSR" . . . , see Section 5). With this information, any AP in the chain can send a message directly to the chain's originator.

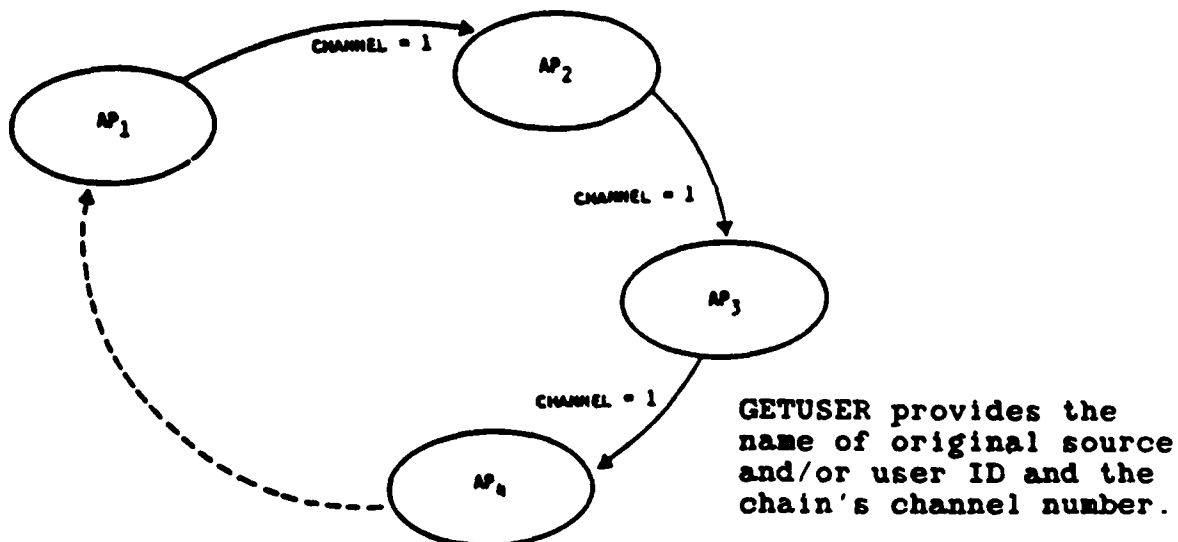


Figure 3-4d. AP Chaining-Logical Channels

- **Maintain a Communication Path Between Two AP's.** An AP can maintain a "telephone like" conversation (Figure 3-4e) with another AP by reserving one channel for this function. The APs support this link by using the same logical channel on their "send" and "receive" calls. This is most useful to an AP that maintains simultaneous communication with multiple APs.

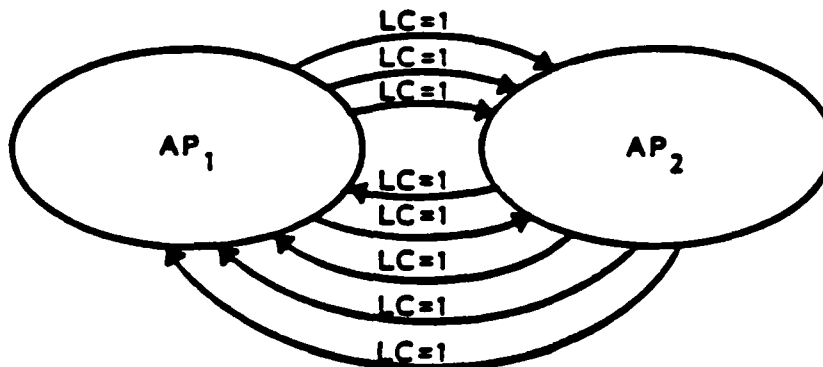


Figure 3-4e. Maintain a Communication Path Using Logical Channels

When a request message is sent, it is quite possible for the requesting AP to receive the response from an AP other than the destination specified in the original "send" call. (As an example: AP₁ requests data from AP₂. AP₂ does not have the data itself and in its turn spawns AP₃ with instructions to obtain the data and send it directly to AP₁. In this situation, the logical channel is the critical variable in matching the request and response message pair. Therefore, in order to support these message pairs it is necessary to place a restriction on the use of the channel numbers. This restriction requires that the requesting AP use unique channel numbers for each outstanding message pair. This should not impact an AP's functionality and allows the NTM to ensure the integrity of its pairing and chaining logic. Figure 3-4c shows the supported use of unique channel numbers for pairs.

3.2 Writing New Application Processes for the IISS Test Bed

The following are guidelines for writing new applications for the IISS Test Bed.

1. For COBOL applications, the body of the Procedure Division must have the basic format illustrated in Figure 3-2.
2. If the AP provides logic for special startup conditions (IISS startup or recovery), then it must include logic to test the startup-status and perform the appropriate code indicated by the startup-status return. (See INITIAL example, Section 5.)
3. If the AP expects to receive unsolicited messages (time-outs, shutdown requests, etc.), then it will periodically request these messages using CALL "RCV"; or CALL "CHKMSG" followed by CALL "RCV".
4. If the AP characteristic record (Appendix B) indicates that the AP does special shutdown processing on IISS shutdown, then the AP must also service unsolicited messages in the manner described above in Item 3. On recognition of a shutdown message, it must perform its shutdown logic and then call "TRMNAT".
5. The AP must be linked or bound with the AP Interface routines for IISS execution.
6. The AP must be integrated into the IISS testbed through the CDM Administrator. The AP writer must indicate the AP's characteristics (see Appendix B) and execution requirements on a provided form.
7. The AP must supply the IISS AP name of the APs to which it sends messages on the NTM "send" calls. This name includes the directory prefix specifying the directory where the destination AP's executable module resides.
8. All AP Interface service return codes are described in the library file "SRVRET". Integrated APs can use this file by using the statement "COPY SRVRET OF IISSCLIB" in the Working-Storage Section of the data division. The legal values of the service's parameters are given in Section 5 of this document.
9. If the AP expects to receive high priority messages

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(get user response, IISS shutdown pending, IISS
Shutdown cancelled), it must support a "hot"
mailbox.

SECTION 4

INTEGRATING EXISTING APs

Existing APs may be integrated into the IISS to use the NTM and other system services to the extent that the existing APs can be modified to use IISS services. The changes that may have to be made are specific to any application, so only general guidelines can be given here.

The minimum requirement is that the AP be modified to include the INITIAL and TRMNAT services as explained in Section 3.1.1. With these, the AP can be called by the NTM and properly terminated and disconnected from the NTM. Beyond that, the AP can use any of the services as described in Section 3 if it is properly modified.

Since each application may be different, it is not possible to specify exactly how to integrate existing types of applications, but following are some guidelines of the types of things that should be looked for in the existing applications:

- All calls to the operating system must be reviewed for compatibility with IISS.
- Any input/output logic must be reviewed and probably revised. The application is not connected to a terminal except by way of the User Interface. Direct calls to a terminal, Cobol Display statement, for example, will go to the Operator's terminal.
- All user interaction through terminals must be converted to User Interface services (described in the User Interface manuals).
- Any use of "Event Flags" and "Mailboxes" (VAX system services) must be compatible with IISS.

The AP must, of course, be properly installed and its characteristics specified to the NTM like any other application.

SECTION 5

NTM SERVICES

5.1 Services Available to All Categories of IISS "User"

Services noted with an asterisk (*) are currently available. The service return parameter values are defined for each call. Examples of the uses of certain calls are also given.

The values of the service returns are defined in the include member "SRVRET".

ACSTAT

Get the status of a specified AP cluster.

Calling Sequence:

CALL "ACSTAT" USING AP-CLUSTER-NAME,
RET-CODE.

Description:

ACSTAT returns to the caller a status code containing relevant information about the AP cluster which was specified in the request.

Inputs:

AP-CLUSTER-NAME

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
ACSTAT-AC-UP	The specified AP Cluster is active.
ACSTAT-AC-DOWN	The specified AP Cluster is not active.

APSTAT

Get the status of a specified AP spawned by the caller.

Calling Sequence:

CALL "APSTAT" USING AP-NAME,
RET-CODE.

Description:

APSTAT returns to the caller a status code containing relevant information about the AP which was specified in the request. If the AP has initiated multiple instances of the specified AP, only information about the first AP found with that AP name will be returned.

Inputs:

AP-NAME

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
APSTAT-AP-EXECUTING	The specified AP is active
APSTAT-AP-INITIATED	The specified AP has been initiated but has not yet informed the NTM that it is active.
APSTAT-AP-INIT-PENDING	The specified AP received an Abort Command before its initiation message. When the initiation message arrives, the AP will be aborted.

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<u>Legal Value</u>	<u>Value Definition</u>
APSTAT-AP-NOT-IN-AP- STATUS-TBL	There is no record of an active instance of the specified AP
APSTAT-AP-NOT-IN- IISS-DIR	There is no record of the existence (active or not) of the specified AP.

* CHKMSG

Check for the arrival of messages in the AP's mailbox.

Calling Sequence:

CALL "CHKMSG" USING LOGICAL-CHANNEL,
SOURCE,
RET-CODE.

Description:

CHKMSG can be used to determine whether any message, or a specific message, has arrived at the AP's Mailbox. The message can then be retrieved with a CALL "RCV" at a more convenient place in the program logic as CHKMSG does not deliver messages to the AP. This capability would be used, for example, in applications where a long calculation or database query is being performed, and the program must watch for Shutdown messages, but the program logic is such that a certain amount of processing is required, such as saving status information, before the current processing can be interrupted and a new message accepted and acted upon.

For Messages in the AP's cold mailbox:

- To check for any message, leave the logical channel and source arguments blank. If more than one message has arrived, the channel and source of the first message in the buffer will be returned.
- To check for a message from a specific source on any channel, specify the source argument and leave the channel argument blank. If more than one message has arrived from the specified source, the channel of the first message in the buffer from the specified source will be returned.
- To check for a message from a specific source on a specific channel, specify both of these arguments. If any messages have arrived from this source on this channel, the return CODE will indicate CHKMSG-MESSAGE-FOUND.

For Messages in the AP's hot mailbox:

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- To check for hot messages from the NTM (such as Shutdown Pending, Cancel Shutdown, or Shutdown), the message source must be specified as "NTMPU.....". The following blanks are required by the IISS naming conventions.

* CHKMSG (Continued)

Inputs or Outputs:

LOGICAL-CHANNEL
SOURCE

Outputs:

RET-CODE

RET-CODE Values: (Values are defined in the include member
SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
CHKMSG-MESSAGE-FOUND	The specified (or any, depending on values in the call parameters) message was found.
CHKMSG-NO-MESSAGES	The specified message was not found - or - if any, no message was found.
CHKMSG-FATAL-ERROR	An error has occurred within the CHKMSG routine.
CHKMSG-BUFFER-FULL	There is no available space to hold the message.

Examples:

1. To check for any cold message:

```
MOVE SPACES TO MSG-SOURCE
MOVE SPACES TO LOGICAL-CHANNEL
CALL "CHKMSG" USING LOGICAL CHANNEL,
                     MSG-SOURCE,
                     RET-CODE
IF CHKMSG-MESSAGE-FOUND
  PERFORM RECEIVE-MESSAGE
ELSE
  NEXT SENTENCE
```

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2. To check for a "hot" message:

```
MOVE SPACES TO LOGICAL-CHANNEL.  
MOVE "WTMPU....." to MSG-SOURCE.  
CALL "CHKMSG" USING LOGICAL-CHANNEL,  
                     MSG-SOURCE,  
                     RET-CODE.  
IF CHKMSG-MESSAGE-FOUND  
    PERFORM SUSPEND-PROCESSING  
    PERFORM RCV-UNSOL-MSG  
    PERFORM SHUTDOWN-CHECK  
    IF SD-PENDING  
        PERFORM SD-PREP  
ELSE  
    PERFORM UNSOL-MSG-ERR  
ELSE  
    NEXT SENTENCE.
```

ENDRCY

Signal end of recovery processing to the NTM (for APs that do special processing in the IISS recovery mode).

Calling Sequence:

CALL "ENDRCY" USING ENDRCY-STATUS.

Description:

ENDRCY allows the calling AP to inform the NTM that the AP has completed its internal recovery processing. A relevant status code is passed to the NTM by the calling AP.

Inputs:

ENDRCY-STATUS

Outputs:

None

ENDRCY-STATUS Values:

<u>Legal Value</u>	<u>Value Representation</u>	<u>Value Definition</u>
ENDRCY-SUCCESSFUL	1	The AP has successfully completed its recovery procedures.
ENDRCY-NOT-SUCCESSFUL	0	The AP could not recover.

*GDACK

Signal receipt of a guaranteed delivery message.

Calling Sequence:

CALL "GDACK" USING MSG-SERIAL-NUMBER,
RET-CODE.

Description:

GDACK is used by the calling AP to signal to the NTM that it has received and processed the specified guaranteed delivery message. It is a required response to guaranteed delivery messages and should be issued after the related processing is complete.

Inputs:

MSG-SERIAL-NUMBER (of received Guaranteed Delivery Message)

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
GDACK-SUCCESSFUL	The receiving AP has received and completed processing of the Guaranteed Delivery message.
GDACK-INVALID-SERIAL-NUMBER	There is no record of a guaranteed delivery message having the specified message serial number.

*GDSEND

Send a guaranteed delivery message through the NTM.

Calling Sequence:

CALL "GDSEND" USING DESTINATION,
LOGICAL-CHANNEL,
DATA-TYPE,
MESSAGE-TYPE,
DATA-LENGTH,
DATA,
ACCEPT-STATUS,
MSG-SERIAL-NUMBER.

Description:

GDSEND is used to send a guaranteed delivery message from an AP to any authorized destination via the services provided by the NTM and other subsystems of the IISS. The NTM guarantees the delivery of messages sent with this call.

Inputs:

All except ACCEPT-STATUS and
MSG-SERIAL-NUMBER.
LOGICAL-CHANNEL is optional. (If blank, the AP
Interface will supply a default value.)

The Destination argument must include the directory
prefix.

Outputs:

ACCEPT-STATUS and MSG-SERIAL-NUMBER. (The returned
MSG-SERIAL-NUMBER can be used in GDSTAT to find the status
of the message sent with this GDSEND.)

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GDSEND (Continued)

ACCEPT-STATUS Values*:

SEND-MSG-ACCEPTED
SEND-MSG-NOT-AUTHORIZED
SEND-MSG-ILLEGAL-TYPE
SEND-INVALID-DESTINATION
SEND-INVALID-DATA-LENGTH
SEND-INVALID-BIN-NAT-FLAG
SEND-RESOURCES-NOT-AVAILABLE
SEND-INVALID-TIMEOUT-REQUEST
SEND-INVALID-SOURCE

*See NSEND for a full description of these values.

GDSTAT

Get the status of a specified guaranteed delivery message.

Calling Sequence:

CALL "GDSTAT" USING MSG-SERIAL-NUMBER,
RET-CODE.

Description:

GDSTAT returns to the caller a status code containing relevant information about the specified guaranteed delivery message originated by the caller.

Inputs:

MSG-SERIAL-NUMBER

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
GDSTAT-MESSAGE- IN-SYSTEM	The specified guaranteed delivery message is in process.
GDSTAT-MESSAGE- NOT-FOUND	The specified message cannot be found.

* GETUSR

Determine the AP Name and user name of the original node or source in an AP chain. The User Logon information is determined only where the original source AP is the User Interface.

Calling Sequence:

```
CALL "GETUSR" USING AP-NAME,  
                    LOGICAL-CHANNEL,  
                    USER-NAME,  
                    ROLE-NAME,  
                    TERMINAL-ID,  
                    RETURN-CODE.
```

Description:

GETUSR returns to the caller the current user name, AP-NAME, and logical channel associated with its original source. This call allows any AP in a chain to determine its originating source and chain communication channel. If the originating source is a user at a terminal, a user-name and the name of the associated AP, a UI, are returned.

If the originating source is an AP (not a terminal user), then the user Logon data will be blank on return. Only the AP-Name and Logical-Channel will have non-blank values.

Inputs:

None

Outputs:

```
AP-NAME  
LOGICAL-CHANNEL  
USER-NAME  
ROLE-NAME  
TERMINAL-ID  
RETURN-CODE
```

* GETUSR (Continued)

RETURN-CODE Values:
(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
SRV-SUCCESSFUL	The GETUSR service has successfully obtained all of the requested data.
GETUSR-NOT-SUCC	The GETUSR service was not able to obtain the requested data. This would be due to an error in accessing the LOGON Table.

Example:

Using Call "GETUSR" to obtain the values needed to send a message to the AP's original source.

```
CALL "GETUSR" USING AP-NAME,
                  ORIG-CHANNEL,
                  USER-NAME,
                  ROLE-NAME,
                  TERM-ID,
                  RET-CODE.
IF SRV-SUCCESSFUL
    NEXT SENTENCE
ELSE
    MOVE "8" TO GOOF-CODE
    PERFORM GOOF-IN-PROGRAM
    MOVE "XTSAP5 HAS DONE ITS JOB." TO LAST-MSG.
    MOVE AP-NAME TO MSG-DESTINATION.
    MOVE ORIG-CHANNEL TO LOGICAL-CHANNEL.
    MOVE 25 TO DATA-LENGTH-SEND.
    MOVE "DM" TO MESSAGE-TYPE-SEND.
    MOVE ZEROS TO TIMEOUT-VALUE.
    MOVE LAST-MSG TO DATA-SEND.
    CALL "NSEND" USING MSG-DESTINATION,
                    LOGICAL-CHANNEL,
                    TIMEOUT-VALUE,
                    BINARY-NATIVE-FLAG,
                    MESSAGE-TYPE-SEND,
                    DATA-LENGTH-SEND,
                    DATA-SEND,
```

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```
                ACCEPT-STATUS.  
IF SEND-MSG-ACCEPTED  
PERFORM FINISH-PROGRAM  
ELSE  
    MOVE "4" TO GOOF-CODE  
    PERFORM GOOF-IN-PROGRAM.
```

HSTATS

Get the status of a specified HOST.

Calling Sequence:

CALL "HSTATS" USING HOST-NAME,
RET-CODE.

Description:

HSTATS returns to the caller a status code containing relevant information about the HOST which was specified in the request.

Inputs:

HOST-NAME

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
HSTATS-HOST-UP	The specified host is active.
HSTATS-HOST-DOWN	The specified host is not active.
HSTATS-HOST-NOT-IISS	The specified host is not part of the IISS configuration.

* INICOM

Provide initiation service for COMM AP.

Calling Sequence:

CALL "INICOM" USING COMM-RCV-EVENT-BLOCK,
INPUT-MBX-NAME,
APC-HOT-MBX-NAME,
APC-COLD-MBX-NAME,
RET-STATUS.

Description:

INICOM is a routine used by the COMM APs. It creates COMM's input mailbox, sends the COMM's "I'm Alive" message to the local MPU, and returns the mailbox names and initiation status to the COMM AP.

Inputs:

COMM-RCV-EVENT-BLOCK

Outputs:

INPUT-MBX-NAME
APC-HOT-MBX-NAME
APC-COLD-MBX-NAME
RET-STATUS

* INITIAL

Provide initiation services for an AP.

Calling Sequence:

CALL "INITAL" USING BUFFER,
 BUFFER-SIZE,
 SYSTEM-STATE,
 RET-CODE.

Description:

INITAL is the routine called by an AP to request that the AP interface perform the necessary initialization to allow the AP to execute and communicate with the IISS.

Inputs:

BUFFER
BUFFER-SIZE

Outputs:

SYSTEM-STATE
RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
INITAL-SUCCESSFUL	The AP has successfully connected with the NTM.
INITAL-NOT-SUCCESSFUL	The AP did not connect with the NTM.

* INITIAL (Continued)

SYSTEM-STATE Values:
(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
INITAL-RECOVERY	The IISS is currently running in recovery mode.
INITAL-IISS-START	The IISS is currently running in start-up mode.
INITAL-NORMAL	The IISS is operating normally.
INITAL-FIRST-RUN	Identifies the first run of the AP after an event that is significant to the AP.

* INITIAL (Continued)

(Example: An AP that does no recovery, but does special first-run processing.)

DATA DIVISION.

WORKING-STORAGE SECTION.

COPY SRVRET OF IISSCLIB.

01 BUFFER PIC X(4096).
01 BUFFER-SIZE PIC 9(4) VALUE 4096.
01 SYSTEM-STATE PIC(X).
01 RET-CODE PIC X(3).

PROCEDURE DIVISION.

START PROGRAM.

CALL "INITAL" USING BUFFER,
BUFFER-SIZE,
SYSTEM-STATE,
RET-CODE.

IF INITIAL-SUCCESSFUL
 IF INITIAL-IISS-START OR
 INITIAL-FIRST-RUN
 PERFORM INITIAL-CODE
 PERFORM RUN-CODE
 ELSE
 PERFORM RUN-CODE
ELSE
 PERFORM TERMINATION-CODE.

INITIAL-CODE.

RUN-CODE.

TERMINATION-CODE.

* ISEND

Send a message that requests the specific initiation of a new instance of an AP. Data for the new destination AP instance may be included in the message.

Calling Sequence:

CALL "ISEND" USING DESTINATION,
LOGICAL-CHANNEL,
TIMEOUT-VALUE,
DATA-TYPE,
MESSAGE-TYPE,
DATA-LENGTH,
DATA,
ACCEPT-STATUS.

Description:

ISEND is used to specifically request the initiation of a new instance of a destination AP. Except for this feature, the services provided to an AP by this call are the same as NSEND. This call is intended to support complex APs that must manage communications between multiple instances of the same AP. The ISEND user must specify different channel indicators to manage the communication between multiple instances of the same AP. The ISEND call may be used with or without data.

Inputs:

All except ACCEPT-STATUS
LOGICAL-CHANNEL is optional. (Field should be blank if no channel is required.)
TIMEOUT-VALUE should be set to zero if pairing support is not required. A non-zero timeout value will activate the message pairing processing. The Destination argument must include the directory prefix.

Outputs:

ACCEPT-STATUS

* ISEND (Continued)

ACCEPT-STATUS Values*:

SEND-MSG-ACCEPTED
SEND-MSG-NOT-AUTHORIZED
SEND-MSG-ILLEGAL-TYPE
SEND-INVALID-DESTINATION
SEND-INVALID-DATA-LENGTH
SEND-INVALID-DATA-TYPE
SEND-RESOURCES-NOT-AVAILABLE
SEND-INVALID-TIMEOUT-REQUEST
BUFFER-OVERFLOW
SEND-FATAL-ERROR
SEND-INVALID-SOURCE

*See NSEND for the description of these values.

NOTES:

The ISEND call must be used when starting APs having the characteristic of requiring a specific initiation. For APs having no restriction on initiation, the use of call ISEND serves to guarantee the initiation of a new instance.

Example:

```
MOVE "NTTSAP2MPU" TO MSG-DESTINATION.  
MOVE "002" TO LOGICAL-CHANNEL.  
MOVE "IR" TO MESSAGE-TYPE-SEND.  
MOVE 25 TO DATA-LENGTH-SEND.  
MOVE "SEND PART INVENTORY DATA." TO DATA-SEND.  
MOVE ZEROS TO TIMEOUT-VALUE.  
CALL "ISEND" USING MSG-DESTINATION,  
                    LOGICAL-CHANNEL,  
                    TIMEOUT-VALUE,  
                    BINARY-NATIVE-FLAG,  
                    MESSAGE-TYPE-SEND,  
                    DATA-LENGTH-SEND,  
                    DATA-SEND,  
                    ACCEPT-STATUS.  
IF SEND-MSG-ACCEPTED  
    DISPLAY "MESSAGE IS ON ITS WAY."  
ELSE
```

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MOVE "05" TO GOOF-CODE
PERFORM SERVICE-ERROR.

MSGACK

Acknowledge receipt of a message.

Calling Sequence:

CALL "MSGACK" USING ACCEPT-INDICATOR,
MSG-SERIAL-NUMBER,
RET-CODE.

Description:

MSGACK is used by a calling AP to notify the NTM that the AP has received a specified message. The NTM then formulates and delivers an acknowledgement message to the AP that requested the acknowledgement. It is part of the AP-AP protocol to determine when this simple acknowledgement to a message that requires a response can be used. The original message sender must send the message that requires this MSGACK as a paired message.

Inputs:

ACCEPT-INDICATOR
Value: "0" = Msg-Not-Accepted
 "1" = Msg-Accepted
MSG-SERIAL-NUMBER

Outputs:

RET-CODE

RET-CODE Values:
(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
MSGACK-SUCCESSFUL	The specified message has been received.
MSGACK-INVALID-SERIAL-NUMBER	The specified message serial number is invalid.

* NSEND

Send a message through the NTM.

Calling Sequence:

CALL "NSEND" USING DESTINATION,
LOGICAL-CHANNEL,
TIMEOUT-VALUE,
BINARY-NATIVE-FLAG,
MESSAGE-TYPE,
DATA-LENGTH,
DATA,
ACCEPT-STATUS.

Description:

NSEND is used to send a message that does not require special NTM handling from an AP to any authorized destination via the services provided by the NTM and other subsystems of IISS.

Inputs:

All except ACCEPT-STATUS
LOGICAL-CHANNEL can be blank if a specific channel is not required. TIMEOUT-VALUE must be zero if no pairing support is required. If a non-zero timeout value is specified, the AP must specify a non-blank LOGICAL-CHANNEL in order to pair the responses or timeout message. In Release 2.0 any non-zero timeout value will invoke the pairing support on a system timer (i.e., a system specified time is used instead of the value specified in the cell. In Release 2.0 the system timeout value was set to 30 seconds). The Destination argument must specify the directory prefix.

Outputs:

ACCEPT-STATUS

* NSEND (Continued)

ACCEPT-STATUS Values:
(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
SEND-MSG-ACCEPTED	The message sent under any of the SEND calls has been accepted by the NTM.
SEND-MSG-NOT-AUTHORIZED	The message failed the authorized check performed by the NTM. The source is not authorized to send a message of the given type to the destination.
SEND-MSG-ILLEGAL-TYPE	The given message type is not valid for the given destination or the Message Type argument is blank.
SEND-INVALID-DESTINATION	The destination AP name as in the calling argument was not found in the NTM tables.
SEND-INVALID-DATA-LENGTH	The data length argument is blank.
SEND-INVALID-BIN-NAT-FLAG	The given binary-native flag is not valid.
SEND-RESOURCES-NOT-AVAILABLE	The resources needed by the NTM to process the message are not available.
SEND-INVALID-TIMEOUT-REQUEST	The given timeout request is not valid.
BUFFER-OVERFLOW	The buffer used to hold messages for processing is full. There is nothing wrong with the message, it simply

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cannot be processed at the
time.

SEND-FATAL-ERROR

The MPU has rejected the
message for reasons beyond the
control of the source AP.

SEND-INVALID-SOURCE

The source AP name cannot be
found in the NTM tables.

* NSEND (Continued)

Examples:

1. To send a paired message. Note: The value of Binary-Native-Flag has been set in the DATA DIVISION.

MOVE "NTTSAP3MPU" TO MSG-DESTINATION.
MOVE "003" TO LOGICAL-CHANNEL.
MOVE "ID" TO MESSAGE-TYPE-SEND.
MOVE "DETERMINE THE LOCATION OF PART X AND MOVE ALL TO
POINT B." TO
DATA-SEND.
MOVE 57 TO DATA-LENGTH-SEND.
MOVE "0000000000000001" TO TIMEOUT-VALUE.
CALL "NSEND" USING MSG-DESTINATION,
LOGICAL-CHANNEL,
TIMEOUT-VALUE,
BINARY-NATIVE-FLAG,
MESSAGE-TYPE-SEND,
DATA-LENGTH-SEND,
DATA-SEND,
ACCEPT-STATUS.

IF SEND-MSG-ACCEPTED
DISPLAY "MESSAGE IS ON ITS WAY."

ELSE
MOVE "06" TO GOOF-CODE
PERFORM SERVICE-ERROR.

* NSEND (Continued)

Examples (Continued):

2. To send an unpaired message:

```
MOVE "NTTSAP8MPU" TO MSG-DESTINATION.  
MOVE "005" TO LOGICAL-CHANNEL.  
MOVE "ID" TO MESSAGE-TYPE-SEND.  
MOVE "HELLO" TO DATA-SEND.  
MOVE 5 TO DATA-LENGTH-SEND.  
MOVE ZEROS TO TIMEOUT-VALUE.  
CALL "NSEND" USING MSG-DESTINATION,  
                    LOGICAL-CHANNEL,  
                    TIMEOUT-VALUE,  
                    BINARY-NATIVE-FLAG,  
                    MESSAGE-TYPE-SEND,  
                    DATA-SEND,  
                    ACCEPT-STATUS.  
IF SEND-MSG-ACCEPTED  
    DISPLAY "MESSAGE IS ON ITS WAY."  
ELSE  
    MOVE "06" TO GOOF-CODE  
    PERFORM SERVICE-ERROR.
```

PRSTAT

Get the status of a specified paired message.

Calling Sequence:

CALL "PRSTAT" USING DESTINATION,
LOGICAL-CHANNEL,
RET-CODE.

Description:

PRSTAT returns to the caller a status code containing relevant information about the specified paired message request originated by the caller.

Inputs:

DESTINATION
LOGICAL-CHANNEL

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
PRSTAT-MESSAGE- IN-SYSTEM	The specified message is being processed.
PRSTAT-MESSAGE- NOT-FOUND	The specified message cannot be found.

* QSEND

Send a reply message through the NTM from a queue-server AP.

Calling Sequence:

CALL "QSEND" USING DESTINATION,
LOGICAL-CHANNEL,
TIMEOUT-VALUE,
BINARY-NATIVE-FLAG,
MESSAGE-TYPE,
DATA-LENGTH,
DATA,
ACCEPT-STATUS.

Description:

QSEND is used to send a reply message that uses the exact name and instance of the previous message received by this AP from the specified destination via the services provided by the NTM and other subsystems of IISS.

Inputs:

All except ACCEPT-STATUS
LOGICAL-CHANNEL can be blank if the specific channel is not known. The message will be sent out on the same channel upon which it was received. TIMEOUT-VALUE must be zero since no pairing support is available. The Destination argument must specify the directory prefix.

Outputs:

ACCEPT-STATUS (values same as those for NSEND)

* QSEND (Continued)

Example:

1. To send a reply message. Note: The value of
Binary-Native-Flag has been set in the DATA DIVISION.
RCV-SOURCE was set upon return from the RCV call.
LOGICAL-CHANNEL was set upon return from the RCV call.

MOVE RCV-SOURCE TO MSG-DESTINATION.
MOVE "ID" TO MESSAGE-TYPE-SEND.
MOVE "YOU ARE THE TENTH PROGRAM TO TALK TO ME TODAY" TO
DATA-SEND.
MOVE 45 TO DATA-LENGTH-SEND.
MOVE ZERO TO TIMEOUT-VALUE.
CALL "QSEND" USING MSG-DESTINATION,
LOGICAL-CHANNEL,
TIMEOUT-VALUE,
BINARY-NATIVE-FLAG,
MESSAGE-TYPE-SEND,
DATA-LENGTH-SEND,
DATA-SEND,
ACCEPT-STATUS.

IF SEND-MSG-ACCEPTED
DISPLAY "REPLY MESSAGE IS ON ITS WAY."

ELSE
MOVE "06" TO GOOF-CODE
PERFORM SERVICE-ERROR.

* RCV

Receive a message through the NTM.

Calling Sequence:

CALL "RCV" USING LOGICAL-CHANNEL,
WAIT-FLAG,
SOURCE,
MESSAGE-TYPE,
DATA-LENGTH,
DATA,
ACCEPT-STATUS,
MSG-SERIAL-NUMBER.

Description:

RCV is used to receive a message, of any type, from any authorized source, including the NTM itself, via the services provided by the NTM and other subsystems of IISS.

Inputs:

WAIT-FLAG
Values: "0" = No-Wait
"1" = Wait

Outputs:

MSG-SERIAL-NUMBER, MESSAGE-TYPE, DATA-LENGTH, DATA,
ACCEPT-STATUS

ACCEPT-STATUS Values:
(Values are defined in the include member SRVRET)

Inputs/Outputs:

LOGICAL-CHANNEL,
SOURCE.

* RCV (Continued)

NOTES:

1. SOURCE and/or LOGICAL-CHANNEL can be specified if messages from a specific source, or specific source and logical-channel are required. If source and logical-channel are blank, the first message in the buffer will be returned with its source and logical-channel. On a source match, the directory prefix must be specified.
2. If the AP wishes to specify the NTM for a source match, the source parameter must be entered as "NTMPU....." on the call. This will retrieve any message that may be in the AP's hot mailbox. If the AP supports a "hot" mailbox, it will be routinely checked on a RCV where source and Logical channel are not specified.
3. If the RCV service is called after a call CHKMSG, the source parameter should be the message source returned on the CHKMSG call.
4. If the AP expects to receive paired messages it must use the condition "IF RCV-REPLY-REQUIRED-MESSAGE" to test the RCV call return.
5. If "RCV" is called with no wait set, the AP must be able to deal with the possibility of a "RCV-NO-MESSAGE" return.

<u>Legal Value</u>	<u>Value Definition</u>
RCV-NORMAL-MESSAGE	A message having a category of E, F, G, or H has been retrieved from the AP's mailbox.
RCV-REPLY-REQUIRED-MESSAGE	A message having a category of "B" or "J" has been retrieved from the AP's mailbox.
RCV-ACK-MESSAGE	Message Received is an ACK from a destination AP using the "MSGACK" service.

RCV (Continued)

<u>Legal Value</u>	<u>Value Definition</u>
RCV-NACK-MESSAGE	Message Received is a NACK from a destination AP using the "MSGACK" service.
RCV-GD-MESSAGE	A message having a category of "A" has been retrieved from the AP's mailbox.
RCV-NO-MESSAGE	No message was found in the AP's mailbox.
RCV-TIME-OUT	A message time-out notification has arrived from the local MPU.
RCV-MSG-TEST-MODE	The message retrieved from the AP's mailbox is from an AP currently operating in test mode.
RCV-FATAL-ERROR	The NTM cannot access the Inter-Process Communication facilities.
RCV-BUFFER-FULL	The resources needed to process incoming messages are not available.

* RCV (Continued)

Examples:

1. RCV with no wait - to retrieve any message.

```
MOVE SPACES TO MSG-SOURCE.  
MOVE SPACES TO WAIT-FLAG.  
MOVE SPACES TO LOGICAL-CHANNEL.  
MOVE SPACES TO DATA-RCV.  
MOVE "0" TO WAIT-FLAG.  
CALL "RCV" USING LOGICAL-CHANNEL,  
                    WAIT-FLAG,  
                    MSG-SOURCE,  
                    MESSAGE-TYPE-RCV,  
                    DATA-LENGTH-RCV,  
                    DATA-RCV,  
                    ACCEPT-STATUS,  
                    MESSAGE-SERIAL-NUMBER.  
IF RCV-NORMAL-MESSAGE  
    ADD 1 TO RCV-COUNT  
ELSE IF RCV-NO-MESSAGE  
    DISPLAY "NO MESSAGE YET - HANG IN THERE!"  
ELSE  
    MOVE "07" TO GOOF-CODE  
    PERFORM SERVICE-ERROR.
```

2. RCV with a wait - The AP expects to receive paired messages.

```
MOVE "1" TO WAIT-FLAG.  
MOVE SPACES TO LOGICAL-CHANNEL.  
CALL "RCV" USING LOGICAL-CHANNEL,  
                    WAIT-FLAG,  
                    MSG-SOURCE,  
                    MESSAGE-TYPE-RCV,  
                    DATA-LENGTH-RCV,  
                    ACCEPT-STATUS,  
                    MESSAGE-SERIAL-NUMBER.  
IF RCV-NORMAL-MESSAGE  
    OR RCV-REPLY-REQUIRED MESSAGE  
    NEXT SENTENCE  
ELSE  
    MOVE "1" TO GOOF-CODE  
    PERFORM GOOF-IN-PROGRAM.
```

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3. RCV with a wait - The AP is looking for a specific message.

```
MOVE "1" TO WAIT-FLAG.  
MOVE "NTTSAP1MPU" TO MSG-SOURCE.  
MOVE "001" TO LOGICAL-CHANNEL.  
CALL "RCV" USING LOGICAL-CHANNEL,  
                    WAIT-FLAG,  
                    MSG-SOURCE,  
                    MESSAGE-TYPE-RCV,  
                    DATA-LENGTH-RCV,  
                    ACCEPT-STATUS,  
                    MESSAGE-SERIAL-NUMBER.  
IF RCV-NORMAL-MESSAGE OR RCV-REPLY-REQUIRED-MESSAGE  
    NEXT SENTENCE  
ELSE  
    MOVE "1" TO GOOF-CODE  
    PERFORM GOOF-IN-PROGRAM.
```

SETDLY

Set the delay parameters for the next "NSEND," "ISEND," or "GDSEND" call.

Calling Sequence:

CALL "SETDLY" USING DELAY-TRIG-INDICATOR,
 DELAY-TRIG-TIME-VALUE,
 DELAY-TRIG-CONDITION-SPECIFIER,
 RET-CODE.

Description:

SETDLY is used to specify the delay trigger parameters which are to be used in the next "NSEND," "ISEND," or "GDSEND" call. These are parameters that are put in the header of messages, but due to their infrequent use, this special call is provided instead of requiring that they be specified in the calling sequence for all "send" services. This logic has not been designed in Release 2.0, but the intent is to provide a mechanism to allow messages to be delivered, and hence programs started, after specified time delays, at a specified time of day, or following certain conditions, such as when the program next runs.

Inputs:

DELAY-TRIG-INDICATOR
DELAY-TRIG-TIME-VALUE
DELAY-TRIG-CONDITION-SPECIFIER

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
SETDLY-SUCCESSFUL	The delay condition specified

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in the call has been set
successfully.

SETDLY-INVALID-TIME

The time value given in the
call is not valid -- the
condition has not been set.

SETDLY-INVALID-
TRIG-COND

The trigger condition given in
the call is not valid -- the
condition has not been set.

SIGABT

Signal to the NTM that an AP is to be aborted.

Calling Sequence:

CALL "SIGABT" USING AP-NAME,
LOGICAL-CHANNEL,
RET-CODE.

Description:

SIGABT allows the calling AP to indicate to the NTM that the AP wishes to abort another AP which it (the caller) has spawned, directly or indirectly.

Inputs:

AP-NAME
LOGICAL-CHANNEL

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
SIGABT-SUCCESSFUL	The message to abort a child AP has been accepted for processing by the NTM.
SIGABT-NOT-SUCCESSFUL	The message to abort an AP has not been accepted by the NTM.

Note: These code values only signify the acceptance of the abort message by the NTM. If the AP requires a specific acknowledgement of the actual abort, it must indicate this

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requirement when it defines its characteristics to the CDM Administrator (see Appendix B).

* SIGERR

Allows an AP to signal the NTM and it's original source when a non-fatal error occurs.

Calling Sequence:

CALL "SIGERR" USING ERROR-CODE,
SEVERITY-LEVEL,
ERROR-DESCRIPTION,
RET-CODE.

Description:

SIGERR accepts error data from the calling AP and forwards that data to both the calling AP's original source and the Monitor AP.

Inputs:

ERROR-CODE
SEVERITY-LEVEL
ERROR-DESCRIPTION

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
SUCCESSFUL	The SIGERR message has been sent successfully.
SIGERR-UNSUCCESSFUL	The SIGERR message could not be sent.

* TRMNAT

Signal AP termination status to the NTM.

Calling Sequence:

CALL "TRMNAT" USING TERMINATION-STATUS.

Description:

TRMNAT allows an executing AP, which is terminating, to signal the NTM that it is terminating and pass to the NTM a status code specifying the termination conditions.

Inputs:

TERMINATION-STATUS

Outputs:

None

TERMINATION-STATUS Values:

<u>Legal Value</u>	<u>Value Representation</u>	<u>Value Definition</u>
TRMNAT-NORMAL-TERMINATION	"1"	The AP has terminated normally.
TRMNAT-SHUTDOWN-COMPLETE	"2"	The AP has completed its shutdown processing.
TRMNAT-ABORTED	"3"	The AP has terminated as the result of a soft abort command.

* TRMNAT

TERMINATION-STATUS Values (Continued):

<u>Legal Value</u>	<u>Value Representation</u>	<u>Value Definition</u>
TRMNAT-EXCEPTION	"4"	The AP has terminated as the result of an internal (to the AP) exception condition.
TRMNAT-ON-BAD-INIT	"5"	The AP has terminated due to an error incurred when trying to connect to the NTM.

NOTES:

1. The Termination Status values defined above must be used in this call. These values are used by the NTM to direct the clean-up procedures executed upon the AP's termination.
2. The call "TRMNAT" with TERMINATION-STATUS set to TRMNAT-ON-BAD-INIT must be used if the AP did not successfully connect to the NTM in call "INITAL."

Example:

```
IF INITAL-NOT-SUCCESSFUL
    MOVE TRMNAT-ON-BAD-INIT TO TERMINATION-STATUS
ELSE
    MOVE TRMNAT-NORMAL-TERMINATION TO
TERMINATION-STATUS.
CALL "TRMNAT" USING TERMINATION-STATUS.
```

TSTMOD (Partially implemented)

Switch IISS message test mode on or off. When test mode is on, the calling AP will be able to receive error messages. When test mode is off, these error messages will be discarded.

Calling Sequence:

CALL "TSTMOD" USING TEST-STATUS,
RET-CODE.

Description:

TSTMOD is used by a calling AP to indicate to the IISS system whether or not it wishes to receive error messages which are generated by its children (i.e., programs called by it). This requires special consideration in the program because these error messages can arrive at any time.

Inputs:

TEST-STATUS

Values: "0" = Test-Mode off
"1" = Test-Mode on
"2" = Fatal Error Messages only

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
TSTMOD-TEST-MODE-ON	The test mode value for subsequent messages has been set to "on."
TSTMOD-TEST-MODE-OFF	The test mode value for subsequent messages has been set to "off."

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TSTMOD-FATAL-ONLY

The test mode value for subsequent messages has been set for fatal messages only.

TSTMOD-INVALID-REQUEST

The test status value given in the calling argument is not recognized by the service.

(Note: This description does not fully represent the intended test mode capability, nor the logic that was only partially designed and implemented in Release 2.0.)

WHATAC

Request the name of the AP cluster on which a given AP resides.

Calling Sequence:

CALL "WHATAC" USING AP-NAME,
AP-CLUSTER-NAME,
RET-CODE.

Description:

WHATAC will provide the caller with the name of the work station that the given AP currently resides on. The user may specify a particular AP-NAME as input, or leave the AP-NAME field blank to obtain the name of the current AP cluster.

Inputs:

AP-NAME - (If blank, the NTM will return the name of cluster on which the calling AP resides)

Outputs:

AP-CLUSTER-NAME
RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
WHATAC-SUCCESSFUL	The APC name for the given AP has been found.
WHATAC-AP-NOT-FOUND	The given AP name was not found in the tables.

*WTHST

Request the name of the Host on which a given AP resides.

Calling Sequence:

CALL "WTHST" USING AP-NAME,
 HOST-NAME,
 RET-CODE.

Description:

WTHST will provide the caller with the name of the Host machine that the specified AP currently resides on.

Inputs:

AP-NAME - (If blank, the NTM will return the name of the host on which the calling AP resides)

Outputs:

HOST-NAME
RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
WTHST-SUCCESSFUL	The host name for the given AP has been found.
WTHST-API-NOT-FOUND	The given AP name was not found in the NTM's AP Information table.
WTHST-APC-NOT-FOUND	The APC name given in the AP Information table was not found in the AP Cluster Status Table.

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WHTHST-NOT-SUCCESSFUL

The message requesting the
AP's Host Name could not be
sent.

WKONCA

Request "wake-up" on specified AP cluster availability.

Calling Sequence:

CALL "WKONCA" USING AP-CLUSTER-NAME,
RET-CODE.

Description:

WKONCA will provide an AP with the ability to "hibernate" itself until another specified AP cluster is available.

Inputs:

AP-CLUSTER-NAME

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
WKONCA-SUCCESSFUL	The "wake-up call" has been accepted.
WKONCA-AP-CLUSTER- NOT-FOUND	The specified AP Cluster was not found in the tables.

5.2 Services Available Only to IISS Components and System Operator

*CHGROL

Changes the user's role name during a logon session. This service assumes that the UI has performed an authorization check on the new role prior to making the change.

Calling Sequence:

Call "CHGROL" USING TERMINAL-ID,
USER-NAME,
NEW-ROLE-NAME,
RET-CODE.

Description:

The new role name is given to the NTM where it replaces the previous role name in the logon table. NOTE: The UI must use the new role name in its call "LOGOFF" as this service does not maintain records of this change.

Inputs:

TERMINAL-ID
USER-NAME
NEW-ROLE-NAME

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
CHGROL-SUCCESSFUL	The message informing the Monitor AP of the new role name has been sent successfully.
CHGROL-NOT-SUCCESSFUL	The message to the Monitor AP

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was not sent. The new role
has not been entered in the
Logon Table.

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* INICOM

Provides initiation service for COMM AP.

Calling sequence:

Call "INICOM" USING COMM-RCV-EVENT-BLOCK,
 INPUT-MBX-NAME,
 APC-HOT-MBX-NAME,
 APC-COLD-MBX-NAME,
 RET-STATUS.

Description:

INICOM is a routine used by the COMM APs. It creates COMM's input mailbox, sends the COMM's "I'm Alive" message to the local MPU, and returns the mailbox names and initiation status to the COMM AP.

Inputs:

COMM-RCV-EVENT-BLOCK

Outputs:

INPUT-MBX-NAME
APC-HOT-MBX-NAME
APC-COLD-MBX-NAME
RET-STATUS

* INITEX

Provide initiation services for UI AP.

Calling Sequence:

CALL "INITEX" USING BUFFER,
 BUFFER-SIZE,
 RET-CODE.

Description:

INITEX is a routine called by APs that requires special NTM connection service (i.e., UI). It requests that the AP interface perform the necessary initialization to allow the special AP to connect to and communicate with the IISS.

Inputs:

BUFFER
BUFFER-SIZE

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
INITEX-SUCCESSFUL	The UI has successfully connected to the NTM.
INITEX-NOT-SUCCESSFUL	The UI could not connect to the NTM.
INITEX-RES-NOT-AVAIL	The UI's AP status table entry could not be made due to a table full condition. The connection was not made to the NTM. As this is a temporary condition, INITEX may be called again.

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* INITEX (Continued)

Example:

```
CALL "INITEX" USING BUFFER,  
                        BUFFER-SIZE,  
                        RET-CODE.  
IF INITEX-NOT-SUCCESSFUL  
    MOVE "01" TO GOOF-CODE  
    PERFORM SERVICE-ERROR  
ELSE NEXT SENTENCE.
```

* LOGOFF

Allows a UI to inform the NTM of a user logoff.

Calling Sequence:

CALL "LOGOFF" USING TERMINAL-ID,
USER-NAME,
ROLE-NAME,
RET-CODE.

Description:

LOGOFF is used by the UI to inform the NTM of a user logoff.

Inputs:

TERMINAL-ID
USER-NAME
ROLE-NAME

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
LOGOFF-SUCCESSFUL	The Monitor AP has been sent a message informing it that the User has logged off.
LOGOFF-NOT-SUCCESSFUL	The message to the Monitor AP was not sent.

* LOGOFF (Continued)

NOTE:

Where the role-name is changed during a given session (via Call "CHGROL"), the value of the role name parameter must be the current role the user is operating under.

Example:

```
CALL "LOGOFF" USING TERMINAL-ID,  
                    USER-NAME,  
                    ROLE-NAME,  
                    RET-CODE.  
IF LOGOFF-SUCCESSFUL  
    NEXT SENTENCE  
ELSE  
    DISPLAY "WE'RE DONE BUT WE HAVE A BUG IN LOGOFF".
```

* LOGON

Allows a UI to pass logon information to the NTM.

Calling Sequence:

CALL "LOGON" USING TERMINAL-ID, USER-NAME,
 ROLE-NAME,
 SESSION-START-TIME,
 CHANNEL-RANGE-START,
 CHANNEL-RANGE-END,
 RET-CODE.

Description:

LOGON is used by a UI to provide the NTM with the logon "user" information which the NTM needs to build its logon table. The NTM assumes that the UI has already performed the required authority checks on the user.

Inputs:

TERMINAL-ID
USER-NAME
ROLE-NAME
SESSION-START-TIME
CHANNEL-RANGE-START
CHANNEL-RANGE-END

Outputs:

RET-CODE

RET-CODE Values: (Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
LOGON-SUCCESSFUL	The Monitor AP has successfully entered the Logon data in the Logon Table.
LOGON-NOT-SUCCESSFUL	The Monitor AP could not write the new entry to the Logon table.

* LOGON (Continued)

Example:

*OBTAIN THE USER NAME AND ROLE NAME

*GET THE SESSION START TIME

*

CALL "GET-TIME" USING STR-TIME
GIVING SS-STATUS.

IF SS-STATUS NOT = SS-NORMAL
DISPLAY "BAD CALL"

ELSE

CALL "ASCII-TIME" USING
BY REFERENCE TIME-LENGTH
BY DESCRIPTOR SESSION-START-TIME
BY REFERENCE STR-TIME
BY VALUE 0,
GIVING SS-STATUS.

IF SS-STATUS = SS-NORMAL
DISPLAY SESSION-START-TIME

ELSE

DISPLAY "BAD CALL".

*

*INFORM THE NTM OF A SUCCESSFUL LOGON

*

CALL "LOGON" USING TERMINAL-ID,
USER-NAME,
ROLE-NAME,
SESSION-START-TIME,
CHANNEL-RANGE-START,
CHANNEL-RANGE-END,
RET-CODE.

IF LOGON-NOT-SUCCESSFUL
MOVE "02" TO GOOF-CODE
PERFORM SERVICE-ERROR

ELSE NEXT SENTENCE.

NOTES:

1. CHANNEL-RANGE-START and CHANNEL-RANGE-END specify a contiguous set of logical channel specifiers assigned to a user by the UI. They provide the flexibility to support a multiple terminal UI.
2. The SESSION-START-TIME is currently configured in VAX ASCII. It may be obtained by the UI on the VAX by the call "SYS\$ASCTIM".

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3. On the VAX the GET-TIME and ASCII-TIME functions can be implemented using the VMS system services SYS\$GETTIM and SYS\$ASCTIM directly.

5.3 Services Which Will Be Available as Future Enhancements

CKRSRC

Check the availability of all resources needed for a specified task.

Calling Sequence:

CALL "CKRSRC" USING TASK-CODE,
RET-CODE.

Description:

CKRSRC returns to the caller a status flag which indicates whether or not all resources needed to perform a specified task exist.

Inputs:

TASK-CODE

Outputs:

RET-CODE

RET-CODE Values:

<u>Legal Value</u>	<u>Value Representation</u>	<u>Value Definition</u>
TBD		

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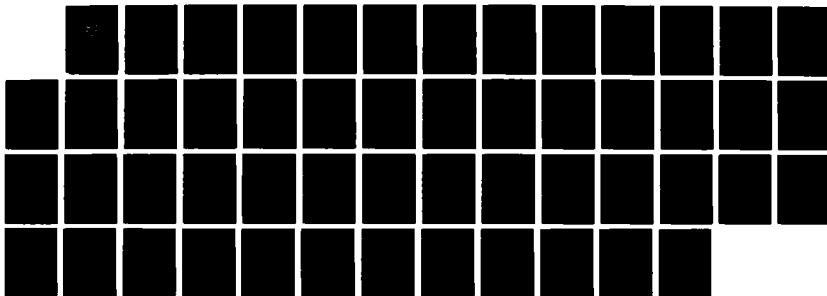
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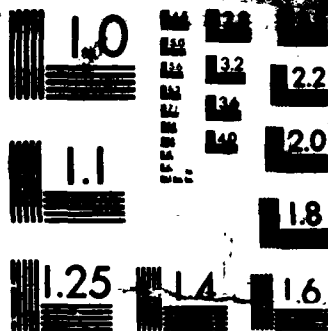
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MICROCOPY RESOLUTION TEST CHART

5.4 Description of Parameters Used in NTM Service Calls

ACCEPT-INDICATOR

ACCEPT-STATUS

The parameter ACCEPT-STATUS contains a code which indicates whether or not the current message was successfully processed by the NTM. Its description in COBOL is

01 ACCEPT-STATUS PIC X(5).

AP-CLUSTER-NAME

The parameter AP-CLUSTER-NAME contains a 3-character alphanumeric that is used to identify a specific work station. Its description in COBOL is

01 AP-CLUSTER-NAME PIC X(3).

AP-NAME

The parameter AP-NAME contains a 10-character alphanumeric that is used to specify the AP for whom the caller wishes to obtain status information. The general format of AP names is

DPSYAPNAME

where "DP" is the directory ID for the directory where the AP's executable module resides, "SY" is the subsystem identifier, "APNAME" is the unique AP name on the specified subsystem. Its description in COBOL is

01 AP-NAME PIC X(10).

BINARY-NATIVE-FLAG

The parameter BINARY-NATIVE-FLAG contains a code which specifies the generic type of data contained in the data portion of a message. Binary indicates that the data is in the host

machine's internal representation form whereas native indicates that the data is character data represented by the host machine's character code (ASCII, EBCDIC, etc.). Its description in COBOL is

01 BINARY-NATIVE-FLAG PIC X.

BUFFER

The parameter BUFFER is the name of the AP area that is passed to the AP Interface on the INITAL and INITEX calls. The AP Interface uses this area to buffer incoming AP messages. It allows the AP to size this space according to its communication requirements.

01 BUFFER PIC X (BUFFER-SIZE)

BUFFER-SIZE

The parameter BUFFER-SIZE is the size (in bytes) of the buffer area, BUFFER, that is used by the AP Interface to hold incoming AP messages. Guidelines for determining this value are presented in the description of BUFFER. It's description in COBOL is

01 BUFFER-SIZE PIC 9(4).

Any value 0001-9999 is supported.

CHANNEL-RANGE-START

The lowest Logical Channel ID in the range of ID's allocated to a user at Logon. This item is represented as a Logical Channel ID. It's value is dynamic. The item is used as a field in the Logon Table.

01 CHANNEL-RANGE-START PIC X(3).

CHANNEL-RANGE-END

The highest Logical Channel ID in the range of ID's allocated to a user at Logon. This item is represented as a Logical Channel ID. Its value is dynamic. It is used as a field in the Logon Table.

01 CHANNEL-RANGE-END PIC X(3).

DATA

The parameter DATA contains an alphanumeric which represents the data portion of the message currently being processed. Its description in COBOL is

01 DATA PIC X(DATA-LENGTH).

While the maximum length of one data package is 1908 bytes, the continuation logic of the "SEND" calls allows this value to be set at any number up to 9999.

DATA-LENGTH

The parameter DATA-LENGTH contains a 4 digit numeric value which specifies the length of the data portion of the message currently being processed. Its description in COBOL is

01 DATA-LENGTH PIC 9(5)COMP.

DELAY-TRIG-CONDITION-SPECIFIER

The parameter DELAY-TRIG-CONDITION-SPECIFIER contains a code which specifies the condition which is used in conjunction with a conditional delay trigger request. Its description in COBOL is

01 DELAY-TRIG-CONDITION-SPECIFIER PIC X.

Values are TBD.

DELAY-TRIG-INDICATOR

The parameter DELAY-TRIG-INDICATOR contains a code which

specifies the type of delay trigger, if any, to apply to the message currently being processed. Its description in COBOL is

01 DELAY-TRIG-INDICATOR PIC X.

Values are TBD.

DELAY-TRIG-TIME-VALUE

The parameter DELAY-TRIG-TIME-VALUE contains a 15-character numeric value which represents a time value in 100 ns increments which is to be used in conjunction with a specified delay trigger option. Its description in COBOL is

01 DELAY-TRIG-TIME-VALUE PIC X(15).

DESTINATION

The parameter DESTINATION contains a 10-character alphanumeric that is used to specify the destination AP for the message currently being processed. See the description of AP-NAME for more detail. Its description in COBOL is

01 DESTINATION PIC X(10).

ENDRCY-STATUS

The parameter ENDRCY-STATUS contains a code which indicates whether or not the AP which is called "ENDRCY" successfully completed recovery processing. Its description in COBOL is

01 ENDRCY-STATUS PIC X.

ERROR-CODE

The parameter ERROR-CODE contains the value associated with the error that triggers a call to "SIGERR". Its description in COBOL is

01 ERROR-CODE PIC X(5).

ERROR-DESCRIPTION

The parameter ERROR-DESCRIPTION contains information about the error triggering a call to "SIGERR". The content of this parameter is defined by the calling AP. The parameter's description in COBOL is

01 ERROR-DESCRIPTION PIC X(72).

HOST-NAME

The parameter HOST-NAME contains a 3-character alphanumeric that is used to specify the "physical" name of the host computer system that the caller is on. Its description in COBOL is

01 HOST-NAME PIC X(3).

LOGICAL-CHANNEL

The parameter LOGICAL-CHANNEL contains a value which is used by the APs and the NTM to manage communication paths between APs (see Section 3.1.6). A value must be supplied on a SEND call when the AP wants to pair the send with a response. Its description in COBOL is

01 LOGICAL-CHANNEL PIC X(3).

MESSAGE-TYPE

The parameter MESSAGE-TYPE contains a code which specifies the message type of the message currently being processed. Its description in COBOL is

01 MESSAGE-TYPE PIC X(2).

MSG-SERIAL-NUMBER

The parameter MSG-SERIAL-NUMBER contains a 7-character

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alphanumeric that is used to identify a message. Its description in COBOL is

01 MSG-SERIAL-NUMBER PIC X(7).

RET-CODE

The parameter RET-CODE contains a value which indicates the return status of a specific request. Its description in COBOL is

01 RET-CODE PIC X(5).

ROLE-NAME

The parameter ROLE-NAME contains a 10-character alphanumeric which identifies the role under which a user is logged on. Its description in COBOL is

01 ROLE-NAME PIC X(10).

SESSION-START-TIME

The parameter SESSION-START-TIME contains a 23-character alphanumeric which specifies the system clock time when a specified user logged on. Its description in COBOL is

01 SESSION-START-TIME PIC X(23).

SEVERITY-LEVEL

The parameter contains a code specifying the level of the error that triggered a call to "SIGERR". Its description in COBOL is

01 SEVERITY-LEVEL PIC X.

SOURCE

The parameter SOURCE contains a 10-alphanumeric that is used to specify the source AP for a call to RCV with a source match. See the description of AP-NAME for more detail. Its description in COBOL is

01 SOURCE PIC X(10).

SYSTEM-STATE

The parameter SYSTEM-STATE contains a code which indicates the system state of the IISS at the time "INITAL" is called. Its description in COBOL is

01 SYSTEM-STATE PIC X.

TASK-CODE

The parameter TASK-CODE contains a 4-character alphanumeric which represents the identifier for a specific generic task which can be performed on the IISS Test Bed. It is used on conjunction with a "CKRSRC" request. Its description in COBOL is

01 TASK-CODE PIC X(4).

TERMINAL-ID

The parameter TERMINAL-ID identifies the terminal where a given user is logged on. Its description in COBOL is

01 TERMINAL-ID PIC X(2).

TERMINATION-STATUS

The parameter TERMINATION-STATUS contains a code which indicates the specific condition under which an AP is terminating. Its description in COBOL is

01 TERMINATION-STATUS PIC X.

TEST-STATUS

The parameter TEST-STATUS contains a code which indicates whether the AP wishes to receive any asynchronous error message, fatal errors only, or not at all. Its description in COBOL is

01 TEST-STATUS PIC X.

TIMEOUT-VALUE

The parameter TIMEOUT-VALUE contains a 15-character numeric value which represents a time value in 100 ns increments which is used in conjunction with a paired message request. Its description in COBOL is

01 TIMEOUT-VALUE PIC X(15).

USER-NAME

The parameter USER-NAME contains an 8-character alphanumeric value which identifies a specific user. Its description in COBOL is

01 USER-NAME PIC X(8).

WAIT-FLAG

The parameter WAIT-FLAG contains a code which indicates whether or not the message currently being processed should have a wait associated with it. Its description in COBOL is

01 WAIT-FLAG PIC X.

APPENDIX A

MESSAGE FORMATS

An AP may receive messages from the NTM if it has designated by its AP Characteristics (see Appendix B) that it wants to receive NTM messages, and which ones it wants to receive. These messages will provide either status information or child APs or system commands.

Each message is described below as to purpose, priority, source, type, data, and action to be taken by the receiving AP.

Messages exchanged between APs may use the message type for internal protocols. The only restrictions on the use of message types are:

1. There must always be a message type.
2. The type "X1" is reserved for the message associated with the "MSGACK" service only.
3. The type "SE" is reserved for messages associated with the "SIGERR" service.

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Message Type: AP Ending

Type ID: AE

Message Priority: Low (retrieved from Cold Mailbox)*

Message Purpose:

This message is sent to APs requiring messages on child events. The message informs the parent AP that a child AP has terminated processing.

Message Source: Local MPU

Data Carried in Data Portion:

Child-AP-Process-Name	
AP-Name	PIC X(10)
Instance	PIC X(2)
Child-AP-Channel-ID	PIC X(3)
Child-AP-Status	PIC X
(at Termination)	

Action by Receiving AP:

The AP may continue processing. If a new instance of the child AP is needed, it may be started using call "ISEND".

*On the CALL "RCV" for this message the AP may leave the source parameter blank or specify "NTMPU....." as the source.

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Message Type: Cancel Shutdown

Type ID: CS

Message Priority: High (retrieved from Hot Mailbox)

Message Purpose:

Overrides a shutdown pending message.

Message Source: Local MPU

Data Carried in Data Portion: None.

Action by Receiving AP: (UI only)

Display a message to the user that shutdown has been cancelled. The session can then continue.

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Message Type: Shutdown AP

Type ID: DA

Message Priority: High (retrieved from Hot Mailbox)

Message Purpose:

Command to the AP to commence its internal shutdown procedures.

Message Source: Local MPU

Data Carried in Data Portion: None.

Action by Receiving AP:

Begin shutdown procedures. Inform the NTM when shutdown is complete via call "TRMNAT" using the TRMNAT-SHUTDOWN-COMPLETE status value.

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Message Type: Shutdown Pending

Type ID: SP

Message Priority: High (retrieved from Hot Mailbox)

Message Purpose:

Notification that the IISS will be shutting down in X minutes. This message is sent once a minute until shutdown processing begins.

Message Source: Local MPU

Data Carried in Data Portion:

Shutdown-Data	PIC X(2)	Value "SP"
Time-Until-Shutdown (in Minutes)	PIC X(2)	

Action by Receiving AP: (UI only)

Inform the user that shutdown will take place in X (Time-Until-Shutdown) minutes. Continue to check the hot mailbox for either the next shutdown pending message or a cancel shutdown message.

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Message Type: Signal Error

Type ID: SE

Message Priority: Low

Message Purpose:

Asynchronous message informing an AP of an existing error condition.

Message Source: Child AP

Data Carried in Data Portion:

ERROR-CODE	PIC X(5)
SEVERITY-LEVEL	PIC X
ERROR-SOURCE-AP	PIC X(10)
ERROR-DESCRIPTION	PIC X(72)

Action by Receiving AP:

Defined by internal AP protocol.

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Message Type: Unsuccessful Initiation

Type ID: NI

Message Priority: Low (retrieved from Cold Mailbox)

Message Purpose:

Sent when a child AP fails initiation.

Message Source: Child MPU

Data Carried in Data Portion:

Child-AP-Name	PIC X(10)
Parent-AP-Process-Name	PIC X(12)

Action by Receiving AP:

Terminate any processing requiring the child AP.

APPENDIX B

AP CHARACTERISTICS

In order to integrate new APs into the IISS, the AP Programmer will have to define the AP's message processing features to the CDM administrator. The NTM will use this information to build an AP characteristic record that the NTM will use to determine the correct message handling procedures for the AP. The AP characteristics that have been defined for this AP record for the NTM are the following.

- a. AP Participates in IISS Shutdown (Yes/No). The AP programmer must indicate whether the AP performs special cleanup or processing on IISS shutdown. APs that do participate in shutdown must regularly check for "shutdown" messages from the NTM. (Using "NTMPU....." as the source).
- b. AP Participates in IISS Recovery (Yes/No). APs that participate in IISS recovery provide recovery logic when they receive a "recover" indicator in the SYSTEM-STATE return of the "INITAL" call. Upon completion of recovery processing, the AP must call "ENDRCY". The NTM will initiate all APs that do recovery processing during this IISS state.
- c. AP's I/O Characteristics. The AP programmer must characterize the AP's I/O characteristics as one of the following.
 1. Does not send to or receive any messages from other IISS APs. (i.e., supports no mailboxes).
 2. Sends and receives messages; but sends no messages that require responses. (These APs will receive an error condition if they issue any PVC with a non-zero time-out value.)
 3. Sends and Receives messages - that require responses as well as ones that may not. This indicates to the NTM that this AP may use NTM message pairing support.

4. Is a "Queue Server" - Can receive messages from multiple APs (maximum number of APs from which it can receive messages during one program run must also be indicated).
- d. AP Handling on Message Time-Outs. The services initially identified are:
 1. AP receives time-out messages and decides whether to resubmit, terminate, or requests a clock reset by the NTM on the outstanding message (the clock reset service is an enhancement feature). This allows the program to decide whether it wants to wait a longer period of time for a response.
 2. Is terminated by the NTM on a time-out.
 - e. AP Handling on "Child" or "Spawned Task" Termination
 1. On normal child termination -
 - AP wants a termination status message (Yes/No)
 2. On abnormal child termination or abort
 - AP wants a termination status message (Yes/No)
 3. Require an abort of AP on "child" termination (Yes/No)
 - f. AP Chaining Support. AP's of the type Queue Server are not amenable to child chaining support. These AP's may, however, receive message chaining support from the NTM. All AP's must be identified with respect to the type of chaining support that is required, Child, Messages, or none.

The NTM record will also contain information that will be established by the CDM Administrator with the assistance of the AP Programmer. This includes the:

- a. maximum number of concurrent instances of the AP allowed, and
- b. the maximum number of queued messages allowed for the AP.

APPENDIX C

INTEGRATING IISS COMPONENT APs

C.1 User Interface

The User Interface (UI) is the application process that interfaces to the IISS user terminals. Initially, there will be one UI per IISS terminal with a number of UIs associated with one AP Cluster. Conceptually, the NTM-UI Interface is depicted in Figure C-1.

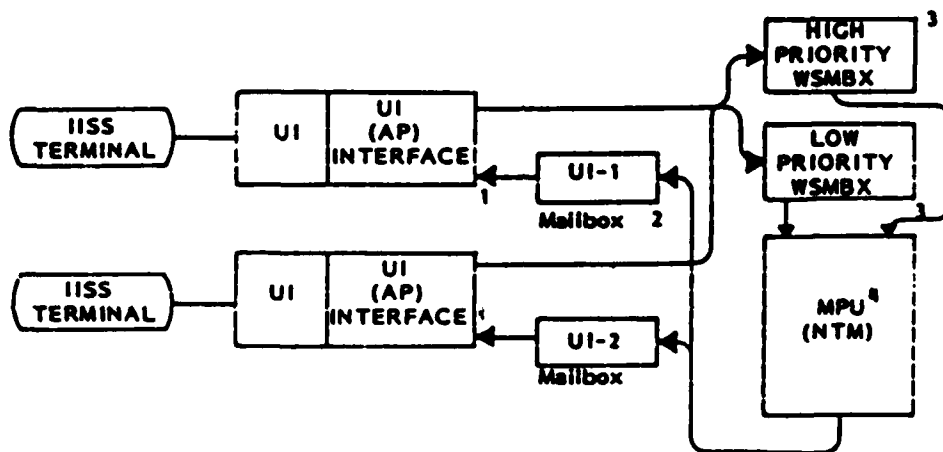


Figure C-1. NTM-UI Interface

1. UI represents the UI code.
UI (AP) Interface is the special AP Interface for the UI.
The UI code is bound with the UI (AP) Interface.
2. The UI-1 Mailbox is the Input mailbox for the first instance of the UI.
3. These represent the AP Cluster high and low priority mailboxes.
4. The MPU is the Message Processing Unit of the NTM.

The connection protocol of these terminals causes this AP to be handled in a slightly different manner than other AP's. However, this difference is transparent to the UI AP's. The UI (AP) Interface and the NTM protocols handle this special requirement by providing the necessary NTM connection logic on the UI's initiation call, CALL "INITEX" (see Section 5 for a description of the call and its arguments). The services of INITEX are described below. The formats of UI-NTM messages are

in Appendix A. This implementation is specific for the VAX under VMS.

C.1.1 UI-NTM Initiation Service (INITEX)

The UI requires an "external" initiation connection service that is supplied by the routine "INITEX." This allows a user to logon to an IISS the NTM, and initiate a UI process. The UI must now connect to the NTM, rather than the NTM initiating the UI as in the normal IISS process initiation procedure. External connection is required in light of the way that the UI will manage the terminals. INITEX performs the following initiation functions for the UI.

1. Sends an "I'm alive" message that contains the UI's operating system given process name to the UI's NTM.
2. Creates the UI's input mailboxes.
3. Establishes the IISS condition handler for the UI.
4. Saves the UI's buffer address and buffer size for later message services.
5. Returns to the UI with the status of the initiation.

C.1.2 The UI and Logical-Channels

A UI will manage communications between the NTM and any terminals connected to it (initially, one). The logical channel specifier provides a mechanism for the UI to map messages to terminals, or to multiple screens on a given terminal. The UI can manage the mapping between messages and screens or terminals by maintaining a table that carries the current channel assignments for a terminal or screen and using the channel numbers as suggested in Section 3.

The requirement for an AP to send an unsolicited form to a terminal can be supported by the use of a specified channel for UI unsolicited messages (channel 000 is being reserved for these unsolicited messages for single-terminal UIs).

Multiterminal UIs can also be supported by the NTM with a slight modification to the INITEX routine. The UI will assign

blocks of channel specifiers to a terminal when the terminal logs on. The NTM will need to know the channel numbers associated with a logon, and will provide a message format for this data when multiterminal UIs are developed.

C.1.3 UI-NTM Interface Programming Conventions

The UI must use the following guidelines to communicate successfully in the IISS Test Bed.

1. It must be bound with the UI (AP) Interface supplied by the NTM.
2. It must initiate communications with the NTM with a 'CALL "INITEX" USING'.
3. It must support asynchronously received (unsolicited) messages using CALL "RCV" or CALL "CHKMSG" and CALL "RCV" at regular intervals.
4. It must handle "shutdown" messages.
5. If the IISS is in a recovery or down state, the UIs will get a "connection-failure-reason" status return on the CALL "INITEX." It should inform the user at the terminal of the state of the IISS and provide a logoff or local mode capability to the user.
6. It must use the NTM Service Calls (Section 5) to communicate with other IISS APs.
7. It should terminate with the NTM call, "TRMNAT".

C.2 COMM

The Communication or COMM AP cluster will support a COMM application process for each host connection. The COMM AP cluster on the VAX host is conceptually represented in Figure C-2.

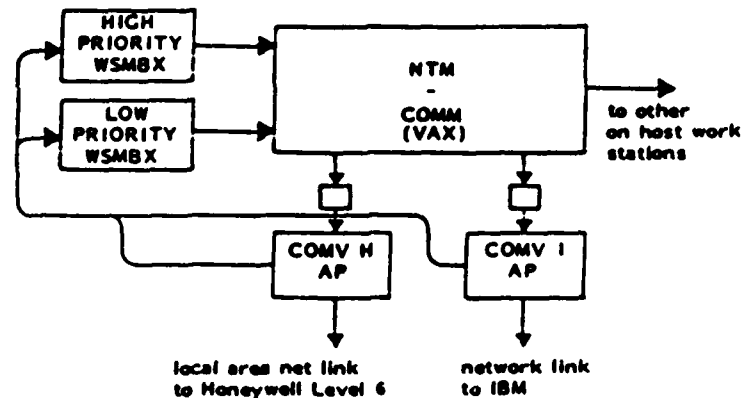


Figure C-2. NTM-COMM Interface

Because the COMM APs perform many of the AP Interface functions directly, they will have only a selected set of AP Interface routines bound to them. The exact configuration of routines has not been determined. However, from the initialization logic described in Section 3 and the NTM Services in Section 5, a tailored interface can be designed for the COMM APs.

C.3 The CDMRP

The Common Data Model Request Processor (CDMRP) is treated as a new AP by the NTM and will use the conventions of Section 3 to develop its IISS communication capability. It should handle asynchronously received messages, the IISS recovery mode shutdown, and time-outs.

APPENDIX D

HELPFUL HINTS

1. Paired Messages must have a non-zero timeout value on the CALL "SEND". The receiving AP must expect a return of "REV-REPLY-REQUIRED-MESSAGE" on its CALL "RCV".
2. AP's having the characteristic of requiring a specific initiation message must be started with a CALL "ISEND". An initiation message sent with a CALL "NSEND" will be rejected for these AP's.
3. CALL "CHKMSG" checks the mailbox once. If the AP needs to poll the mailboxes (for NTM messages, for example) it must invoke the call periodically. A timer or a counter may be used. As a guideline, when IISS shutdown is pending, a message to that effect is sent every minute until shutdown procedures actually begin.
4. "TRMNAT" is the last executable statement in a program. This service ends the AP's execution. The AP should not stop its own run.
5. The logical channel is a critical variable in pairing messages. It must be specified whenever the sending AP wants to ensure that it will receive the correct response from the correct instance of the responding AP. See Section 3.1.6 for details.
6. On any "SEND" call, the sending AP must specify the destination message type, and data length. There are no default values for these data items.
7. When CALL "CHKMSG" returns the information that a message has been found, the AP can immediately invoke the CALL "RCV" to retrieve the message.
8. AP's invoking any service must expect to receive any of the returns.
9. When the AP wants to receive a message from its hot mailbox, it must specify "NTMPU....." as the source in the calling parameters. This holds for both CALL "RCV" and CALL "CHKMSG".

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10. Message Types may be defined by the AP programmer. The type "X1" and "SE" are the only type values currently reserved for the NTM.
11. If the AP supports a "hot" mailbox, a call "RCV" with any match or channel match will cause the service to poll both the hot and cold mailboxes for a message.
12. If an AP wishes to receive asynchronous error messages, a call to TSTMOD is required to set test mode to on.
13. The directory prefix of the destination AP must be specified in any "SEND" call. If the NTM cannot specify the location of the executable module, initiation cannot take place.

APPENDIX E

REMOTE COMPILE AND LINK

E.1 RCL Overview

The Function of RCL is to provide IISS programmers and users with the ability to have primitive operations preformed on a specified node. This is beneficial to the AP programmer who wishes to have system commands executed from within the AP. For the IISS user RCL provides the expertise to have system commands built and executed to perform a desired task.

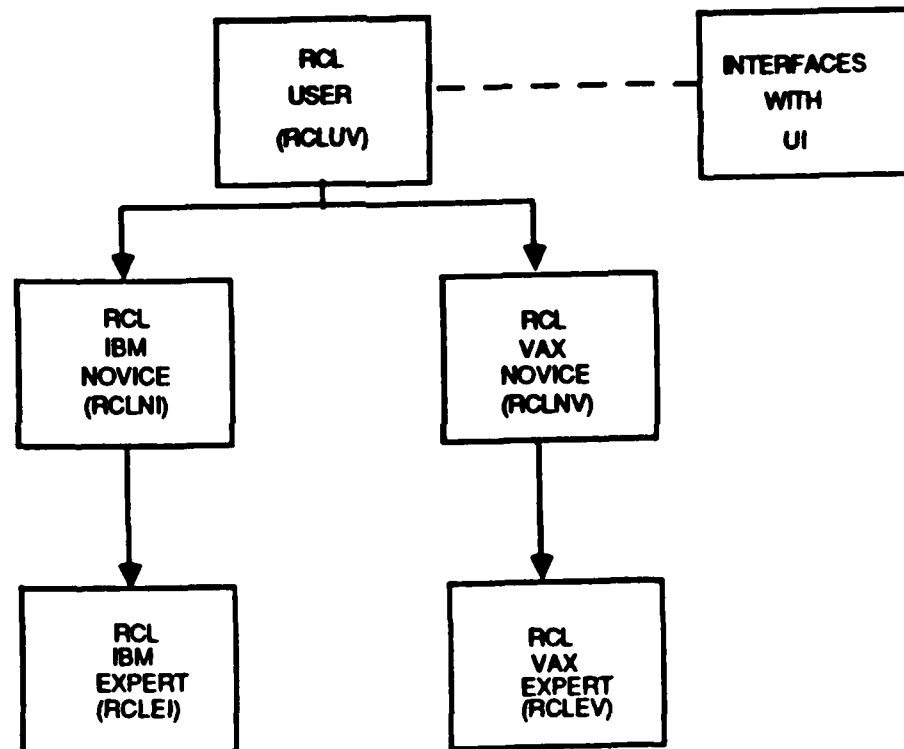
The RCL is divided into three layers, as shown in Figure E-1. The "expert" layer actually gets the commands executed. This layer can be used by AP programmers who have specific operations to perform and wish to build their own system commands. It is also used by the next layer up. The "novice" layer can be used by AP programmers who wish to have operations performed without having to build the necessary system command. The novice layer is also used by the third layer. The "user" layer provides the interface between the external IISS user and RCL services.

The RCL is a component of the NTM services. Its relationship to the rest of the NTM is shown in the RCL Software Architecture Diagram, Figure E-2. The "expert" layer has been implemented on the VAX node. It still remains to be implemented on the other IISS nodes. The "novice" layer services have been designed but not implemented. The "user" layer is still in the development stage.

E.1.1 Expert Layer

The function of "expert" layer, or RCLE, is to execute system control cards which it receives in a message at initiation. The RCLE AP performs this task by building a system command file which it then executes. This command file includes the control cards found in the message area with some additional command file instructions. The RCLE AP is started by using the SNDRCLE services.

When RCLE has completed its tasks, it will send a message to its parent to return the status and results of its execution. This message will contain a code to indicate the success or failure of the operation, and, if successful, the message will



NOTE: RCL PROGRAMS INTERFACE WITH MPU

Figure E-1. RCL Program Flow

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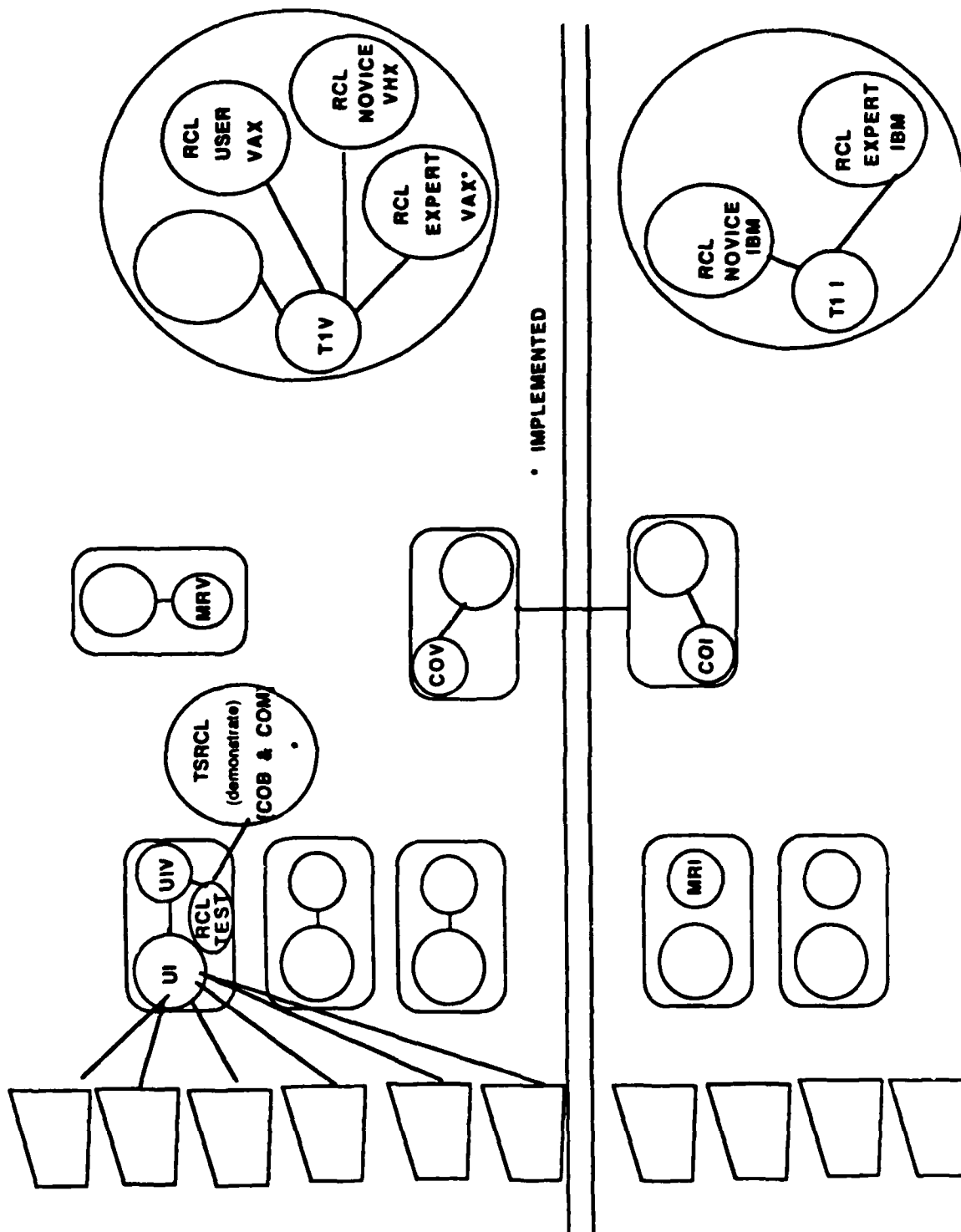


Figure E-2. RCL Software Architecture Diagram

contain the name of a file which contains the information generated by the command file which was created but not executed. The file that is returned should be deleted by the caller when it is finished processing the information.

E.1.2 Novice Layer

The "novice" layer consists of services to provide five operations. These operations are compiles, links, directory/catalog listings, deletion of files, and insertion of VAX files into libraries. The services are named RCLCOM, RCLINK, RCLCAT, RCLDEL, and RCLSTO. Each service will call on the RCLN AP on the proper node to have the control card built for the operation.

The RCLN AP is responsible for building the actual control card, calling on RCLE to have the operation performed, deleting the output file after it is finished checking the result of the operation, and returning the success or failure status to the caller of the "novice" service.

E.1.3 RCLETEST

A test program, RCLETEST, has been written to demonstrate the "expert" layer of RCL on the VAX. The test runs as an external AP which calls on the RCLE AP. The test provides two methods for having control cards executed by RCLE.

The RCLEDEMO option has RCLE execute the TSRCL command file. This command file contains the system commands to compile the COBOL source file "TSRCL.COB," link the object code which is created, and then run the executable image. The TSRCL.COB is a simple COBOL program which inputs its own source code and prints it to the output file. After running the program, the command file will also provide cleanup by deleting the object and image files created. When this test option is run successfully, the returned output file will contain a copy of the TSRCL.COB source.

The second test option allows the tester to submit his own commands to be executed by RCLE. These may be any valid system commands including one to start a tester written command file. Any command files submitted will be run in the batch mode. The tester then can check the output file to determine if the expected results were returned.

E.2 Program Specification for the RCLE AP

E.2.1 Function of RCLE

1. The function of the RCLE AP is to execute system control cards which it receives in a message at initiation. The AP performs this task by building a system command file which it then executes. This command file includes the control cards found in the message area with some additional command file instructions.

2. When RCLE has completed its tasks, it will send a message to its parent to return the status and results of its execution. This message will contain a code to indicate the success or failure of the operation, and, if successful, the message will include the name of a file which contains the information generated by the command file. If RCLE was unsuccessful, the message area will contain the name of the command file which was created but not executed.

3. RCLE uses the TIV message processing unit (MPU). The AP has VAX specifics, but the logic was designed for conversion to another node. This AP requires the privilege to create a detached process.

E.2.2 Implementation of RCLE

1. The RCLE AP is implemented in five major steps. Two of the steps, the first and the last, are the standard initiation and termination of a child AP. The remaining three are building the command file, executing the command file, and sending the message to the parent.

2. The command file is built with the help of three subroutines and the filenamer AP accessed through an interface. The subroutine RCLFILE opens, closes, and writes to the command file built by RCLE. These control cards turn off command file verification, direct command file program flow in the event of an error, and delete the command file before exiting. The filenamer AP is used to generate a unique filename for the command file. The RCLE builds the command file in the following steps:

- A. Call on the filenamer to get a unique name for the command file.
- B. Call RCLFILE to open the command file.

- C. Call PRECOM to write system-specific control cards needed before the actual control cards.
- D. Write the control cards received in the message area to the command file.
- E. Call POSTCOM to write system-specific control cards needed after the actual control cards.
- F. Call RCLFILE to close the command file.

3. The command file is executed by starting it as a detached process. This is accomplished by using the VAX SYSTEM service \$CREPRC. The filenamer AP is also used again to generate a unique name for the output file parameter in \$CREPRC. This output file will receive all information generated by the execution of the command file. After the command file is started, RCLE periodically attempts to open the command file. If it is unsuccessful in doing so, it knows that the command file has deleted itself and completed execution.

4. A message is sent by RCLE to its parent through the normal NTM NSEND service call. The message contains two things. A status code indicates the success or failure of RCLE (an unsuccessful call to system service \$CREPRC or failure of the filenamer AP would result in a failure code). The second part of the message would contain the name of a file. If RCLE is successful, this file will be the output file from the execution of the command file. If RCLE is unsuccessful, it will be the name of the command file which was built but not executed.

E.3 Program Specification for RCLETEST

The RCLETEST AP demonstrates the capabilities of the RCL "expert" layer. This test will go through the logon procedure, initialize to the NTM, give the test person the demonstration options, and go through the logoff procedure when the tester is finished. The test options are to run the TSRCL command or to allow the test person to submit his own commands or file for execution.

The TSRCL command file contains the system commands to compile the COBOL source file "TSRCL.COB," link the object code which is created, and then run the executable image. The TSRCL.COB is a simple COBOL program which inputs its own source code and prints it to the output file. After running the program, the command file will also perform clean-up by deleting the created object and executable files. When this test is run successfully, the test person will be returned the name of an output file which contains the generated information including the output from the COBOL program.

If the tester selects the second test option, he will be prompted to submit his own system commands for execution. These may be any valid system commands including one to run a tester-written command file. The tester must realize, though, that if a command file is submitted to RCL for execution, it will be run in batch mode and not interactively. The tester ends the input of commands by entering a blank line.

Both test options are then followed by a request for the tester to enter the node to be used in the operation. The RCLE only exists on the VAX node at this time, but other nodes may be input to determine what results will occur if an inactive or invalid node is entered. If a blank line is entered, the test will default to the VAX node.

When the node has been entered, the tester will be returned to status of the SNDRCLE service call. If the node was valid and service to initiate RCLE returned a good status code, the tester will receive the message that the RCLE AP has been initiated. The test program will now be waiting on a response from RCLE. The test person can check the status of the test program by entering a blank line. (Entering CANCEL will cause SIGABT to be called to terminate RCLE.)

When RCLE completes execution, it will send a message to the test AP. The next status request will then contain the

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results of RCLE. If RCLE completed successfully, the test person will be given the name of the output file which contains the results of the operation. If RCLE completed unsuccessfully, the tester will be given the name of the command file which was built but not executed.

At the completion of a test, the test person will be given the test options again. If he is finished, the END option should be chosen. This causes the test AP to terminate from the NTM. At termination RCLETEST will also give the test person the name of a command file to be run to delete all files his tests have generated.

APPENDIX F

RCL PROGRAMMER'S GUIDE

F.1 Introduction

This RCL Programmer's Guide describes the services provided to IISS Programmers by the RCL component of the Network Transaction Manager (NTM). These services are used by IISS Application Programs to perform specific system tests.

The RCL guide is being released as a reference for component AP programmers who desire to use the service currently available and, as a development, report on the RCL services yet to be implemented. The available service will be fully documented on its functionality and usage. The services yet to be implemented will be described along with considerations still to be made in their development.

F.2 RCL Overview

The RCL provides the AP programmer with the ability to perform specific system tasks from within his AP. It consists of two APs on each node and six services to call the appropriate AP. The services and APs of the RCL are separated into two groups.

The "expert" layer allows the programmer to call the expert service to get the appropriate AP initiated to perform the tasks specified by the control cards he has built. The expert service will validate the node and that the control card area has the proper end-of-lines and a termination sequence but leaves the details of creating valid system control cards up to the calling AP. Once the service determines the validity of the call, it will return a status to the caller. If a valid call was made, the RCL AP on the requested node will be initiated to perform the tasks and send the results back to the caller.

The "novice" layer takes the burden of building valid control cards away from the programmer and puts it into the hands of the novice services and APs. The services provide for performing five different system tasks. Each service will validate the node of the requested operation and then call the novice AP on the appropriate node, if valid. The novice AP will actually build the card and then call the expert layer to have the service performed. The RCLN will receive the generated

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information, determine if the operation was a success or failure, and send it to the caller of the novice service.

F.3 RCL Services

F.3.1 RCL Service Availability

The RCL Expert Service is currently available. The service return parameter values are defined and an example of the service usage is given.

The values of the service returns are defined in the include member "SRVRET."

* SNDRCLE

Send control card(s) to RCLE AP for execution.

Calling Sequence:

CALL "SNDRCLE" USING NODE.
CHANNEL.
CTL-CARD.
RET-CODE.

Description:

SNDRCLE will check that the caller has requested the initiation of a RCLE AP on a valid node with a valid control card area format. (See page F-19 for a description of the control card area.) If these parameters are valid, SNDRCLE will initiate an instance of the proper AP. The service returns a status to the caller. If a valid status is returned, the caller will want to issue a RCV to receive the information from the RCLE AP. The information will be in a file generated by RCLE. The caller is responsible for deleting this file after extracting the desired information.

The received message will have the following format:

BYTE #	CONTENTS
0-3	IDENTIFIER ROLE
4	blank
5	STATUS CODE
6	blank
3-36	Filename containing information

If the message is identified as a RCLE message, the caller will want to check the status code for success or failure. An 'S' code indicates successful completion of RCLE. An 'F' code indicates failure.

Inputs:

NODE
CHANNEL
CTL-CARD

SNDRCLE (Continued)

Outputs:

RET-CODE

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
RCL-INITIATED	Call valid / RCLE started.
RCLE-NODE INVALID	Invalid node for IISS.
RCLE-LINE-INVALID	Control card exceeded 73 characters in length.
RCLE-CARD-INVALID	Control card area did not end with termination sequence.
RCLE-INITIATION FAILED	The RCLE AP could not be initiated.

SNDRCLE (Continued)

Example:

1. To compile the COBOL source "EXAMPLE.COB" on VAX host.

```
01 CTL-CARD.  
05 CC-COMMAND          PIC X(10)  VALUE SPACES.  
05 CC-FILENAM          PIC X(60)  VALUE SPACES.  
05 TERMINATOR          PIC XX     VALUE ' '.
```

```
*  
* THE TERMINATOR IS THE TWO END OF LINE CHARACTERS (1Eh)  
* REQUIRED TO END A VALID CTL-CARD AREA.  
*
```

```
01 DATA-RCV           PIC X(4096).  
01 RCLE-RCV REDEFINES DATA-RCV.  
05 IDENTIFIER          PIC X(4).  
05 FILLER              PIC X.  
05 STATUS              PIC X.  
    88 RCLE-SUCCESS    VALUE 'S'.  
    88 RCLE-FAILED      VALUE 'F'.  
05 FILLER              PIC X.  
05 INFO FILE           PIC X(30).  
05 FILLER              PIC X(4059).
```

```
MOVE 'VAX' TO NODE.  
MOVE '001' TO CHANNEL.  
MOVE 'COB/ANSI' TO CC-COMMAND.  
MOVE 'EXAMPLE' TO CC-FILENAM.  
CALL "SNDRCLE" USING NODE.
```

```
CHANNEL.  
CTL-CARD.  
RET-CODE.
```

```
IF ROLE-INITIATED  
    PERFORM GET-RCLE-MESSAGE  
ELSE  
    PERFORM ERROR-PROCEDURE.
```

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SNDRCLE (Continued)

*

```
GET-RCLE-MESSAGE.  
  MOVE SPACES TO LOGICAL-CHANNEL.  
  MOVE SPACES TO MSG-SOURCE.  
  MOVE SPACES TO DATA-RCV.  
  PERFORM CHKMSG-PARAGRAPH  
  UNTIL CHKMSG-MESSAGE-FOUND.  
  CALL "RCV" USING LOGICAL-CHANNEL.  
                      WAIT-FLAG.  
                      MSG-SOURCE.  
                      MSG-TYPE-RCV.  
                      DATA-LENGTH-RCV.  
                      DATA-RCV.  
                      ACCEPT-STATUS.  
                      MESSAGE-SERIAL-NUMBER.  
  IF IDENTIFIER = RCLE  
    PERFORM RCV-LAST-MESSAGE  
    IF RCLE-SUCCESS  
      NEXT SENTENCE  
    ELSE  
      PERFORM ERROR-PROCEDURE  
  ELSE  
    PERFORM UNSOLICITED-MESSAGE.
```

E.3.2 Novice Services Which Remain To Be Implemented

RCLCAT

Obtain a Directory / Catalog listing.

Calling Sequence:

CALL RCLCAT USING NODE.
CHANNEL.
CATALOG.
LISTFILE.
RET-CODE.

Description:

RCLCAT will put a directory / catalog listing specified by CATALOG into the file LISTFILE. The service will initially check that NODE is a valid IISS node and then initiate RCLN on that node to build the proper control card. A status return will be returned to the caller and, if valid, the caller should issue a RCV to receive the completion status of the operation.

Inputs:

NODE
CHANNEL
CATALOG
LISTFILE

Outputs:

RET-CODE

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RCLCAT (Continued)

RET-CODE Values:
(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
RCLN-INITIATED	Call valid / RCLN started.
RCLCAT-NODE-INVALID	Invalid node for IISS.
RCLN-INITIATION- FAILED	The RCLN AP could not be initiated.

RCLCOM

Compile (COBOL. Fortran. C. FLAN) source code.

Calling Sequence:

CALL RCLCOM USING NODE.
 CHANNEL.
 FUNCTION.
 SOURCE.
 OBJECT.
 LIST.
 ERROR.
 RET-CODE.

Description:

RCLCOM will do the compile specified in FUNCTION on the source code specified by SOURCE. The service will initially check that NODE is a valid IISS node and then initiate RCLN on that node to build the proper control card. A status will be returned to the caller and, if valid, the caller should issue a RCV to receive the completion status of the operation. Development questions still remain on what parameters should be included on the control card and if the service should give the caller the option to have certain parameters included.

Inputs:

FUNCTION
SOURCE
OBJECT
LIST
ERROR

Outputs:

RET-CODE

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RCLCOM (Continued)

RET-CODE Values

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
RCLN-INITIATED	Call valid / RCLN started.
RCLCOM-NODE-INVALID	Invalid node for IISS.
RCLN-INITIATION- FAILED	The RCLN AP could not be initiated.

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RCLDEL

Delete a file / dataset.

Calling Sequence:

CALL RCLDEL USING NODE.
CHANNEL.
DEL-FILE
RET-CODE.

Description:

RCLDEL will delete the file specified in DEL-FILE. The service will initially check that NODE is a valid IISS node and then initiate RCLN on that node to build the proper control card. A status return will be returned to the caller and, if valid, the caller should issue a RCV to receive the completion status of the operation.

Inputs:

NODE
CHANNEL
DEL-FILE

Outputs:

RET CODE

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RCLDEL (Continued)

RET-CODE Values:

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
RCLN-INITIATED	Call valid / RCLN started.
RCLDEL-NODE-INVALID	Invalid node for IISS.
RCLN-INITIATION- FAILED	The RCLN AP could not be started.

RCLINK

Link object files and libraries.

Calling Sequence:

CALL RCLINK USING NODE.
CHANNEL.
EXEC.
P1.
P2.
RET-CODE.

Description:

RCLINK will link the object files and libraries specified in P1 and P2. P1 is an array to contain up to eight object files to be linked. At least one file must be specified. P2 is an array to contain up to eight optional object libraries to be used in the link. The created executable will be in the file specified in EXEC. The service will initially check that NODE is a valid IISS node and then initiate RCLN on that node to build the proper control card. A status will be returned to the caller and, if valid, the caller should issue a RCV to receive the completion status of the operation. Development questions remain on what parameters should be included on the control card and if the service should give the caller the option to have certain parameters included.

Inputs:

NODE
CHANNEL
EXEC
F1
F2

Outputs:

RET-CODE

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RCLINK (Continued)

RET-CODE Values
(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
RCLN-INITIATED	Call valid / RCLN started.
RCLINK-NODE-INVALID	Invalid node for IISS.
RCLN-INITIATION- FAILED	The RCLN AP could not be initiated.

RCLSTO

Store file into object library (VAX only).

Calling Sequence:

CALL RCLSTO USING NODE.
CHANNEL.
STORE-FILE.
LIBRARY.
NAME.
RET-CODE.

Description:

RCLSTO is a VAX-specific service to store the file specified in STORE-FILE in the library specified in LIBRARY as NAME. The service will initially check that NODE is valid for this operation and then initiate RCLN to build the proper control card. A status will be returned to the caller and, if valid, the caller should issue a RCV to receive the completion status of the operation.

Inputs:

NODE
CHANNEL
FILE
LIBRARY
NAME

Outputs:

RET-CODE

RCLSTO (Continued)

RET-CODE Values

(Values are defined in the include member SRVRET)

<u>Legal Value</u>	<u>Value Definition</u>
RCLN-INITIATED	Call valid / RCLN started.
RCLSTO-NODE-INVALID	Invalid node for IISS.
RCLN-INITIATION- FAILED	The RCLN AP could not be started.

3.3 Description of Parameters Used in RCL Service Calls

CATALOG

The parameter CATALOG contains the fully qualified name of a directory or catalog to be listed by RCLCAT.

01 CATALOG PIC X(100).

CHANNEL

The parameter CHANNEL contains a value which is used by APs and the RCL services to send messages via the NTM. Its description in COBOL is

01 CHANNEL PIC X(3).

CTL-CARD

The parameter CTL-CARD is an area to contain system control cards to be processed by by SNDRCLE. Individual cards in this area cannot exceed 73 characters including an end-of-line (1Eh) indicator. The CTL-CARD area has a size of 1096 bytes, which allows for a maximum of 15 control cards of the maximum length of 73 with one additional end-of-line indicator at the end to terminate all control cards. Amounts and size of control cards less than these are allowable with service performance being improved by efficient use of the end of lines. If any line exceeds 73 characters, or the CTL-CARD area does not contain the final end-of-line terminator, an error code will be returned by SNDRCLE. The parameter's description in COBOL is

01 CTL-CARD PIC X(1096).

DEL-FILE

The parameter DEL-FILE contains the fully qualified name of a file to be deleted by RCLDEL. Its description in COBOL is

01 DEL-FILE PIC X(100).

ERROR

The parameter ERROR contains the fully qualified name of a file to receive error results from a compile started by RCLCOM. Its description in COBOL is

01 ERROR PIC X(100).

EXEC

The parameter EXEC contains the fully qualified name of a file to receive the executable code generated by RCLINK. Its description in COBOL is

01 EXEC PIC X(100).

FUNCTION

The parameter FUNCTION contains the type of Compile to be started by RCLCOM. Options are 'COB', 'FOR', 'C', AND 'FLAN'. The parameter's description in COBOL is

01 FUNCTION PIC X(4).

LIBRARY

The parameter LIBRARY contains the fully qualified name of an object library for a file to be stored in by RCLSTO. Its description in COBOL is

01 LIBRARY PIC X(100).

LIST

The parameter LIST contains the fully qualified name of a file to receive the listing from a compile started by RCLCOM. Its description in COBOL is

01 LIST PIC X(100).

LISTFILE

The parameter LISTFILE contains the fully qualified name of a file to receive the directory / catalog listing from RCLCAT.

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Its description in COBOL is

01 LISTFILE PIC X(100).

NAME

The parameter NAME contains the name for a VAX object to be stored in an object library by RCLSTO. Its description in COBOL is

01 NAME PIC X(100).

NODE

The parameter NODE contains the IISS node for a requested operation. Its description in COBOL is

01 NODE PIC X(3).

OBJECT

The parameter OBJECT contains the fully qualified name of a file for the object to be stored by a compile started by RCLCOM. Its description in COBOL is

01 OBJECT PIX X(100).

P1
P2

The parameters P1 and P2 are arrays to contain names of object files or libraries to be used in the linking started RCLINK. P1 contains up to eight object files, and P2 contains up to eight object libraries. The parameter descriptions in COBOL are

```
01      P1                      PIC X(800).
01      P1TBL REDEFINES P1.
      05      OBJFILES OCCURS 8 TIMES
              INDEXED BY P1-INDEX.
              10      FILENAM                      PIC X(100).

01      P2                      PIC X(800).
01      P2TBL REDEFINES P2.
      05      LIBRARIES OCCURS 8 TIMES
              INDEXED BY P2-INDEX.
              10      LIBNAM                      PIC X(100).
```

RET-CODE

The parameter RET-CODE contains a value which indicated the return status of a specific request. Its description in COBOL is

```
01      RET-CODE                      PIC X(5).
```

SOURCE

The parameter SOURCE contains the fully qualified name of a file to be compiled through RCLCOM. Its description in COBOL is

```
01      SOURCE                      PIC X(100).
```

STORE-FILE

The parameter STORE-FILE contains the fully qualified name of a file to be stored in an object library by RCLSTO. Its description in COBOL is

```
01      STORE-FILE                  PIC X(100).
```

END

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DTIC