Honeywell

Interpret UCN Communications

L53687

UCN

TotalPlant®

Copyright, Notices, and Trademarks

Honeywell
Industrial Automation and Control
Automation College
2820 West Kelton Lane
Phoenix, AZ 85053

1-800-852-3211

Table of Contents

Figures

Tables

Acronyms

APM .... Advanced Process Manager
APMM .... Advanced Process Manager Module
CG .... Computer Gateway
CL .... Control Language
DSAP .... Destination Service Access Point
EMF .... Electro Motive Force
EPNI .... Enhanced Process Network Interface
HM .... History Module
I/O .... Input/Output
IEEE .... Institute of Electrical and Electronics Engineers
IOP .... Input/Output Processor
ISO .... International Standards Organization
LAN .... Local Area Network
LCN .... Local Control Network
LLC .... Logical Link Control
LM .... Logic Manager
MAC .... Medium Access Control
NCF .... Network Configuration Files
NIM .... Network Interface Module
OSI .... Open System Interconnection
PLC .... Programmable Logic controller
PM .... Process Manager
PMM .... Process Manager Module
PNI .... Process Network Interface
RAM .... Random Access Memory
RDR .... Read Data Response
RWR .... Request With Response
SAP .... Service Access Point
SMCC .... System Maintenance Control Center
SOE .... Sequence of Events
SSAP .... Source Service Access Point
TAC .... Technical Assistance Center
TBC .... Token Bus Controller
TDC .... Total Distributed Control
TPS .... **TotalPlant** Solution
UCN .... Universal Control Network
US .... Universal Station

References

Publication Title	Publication Number	Binder Title	Binder Number
For R5xx :			
HPM Service	HP13-500	PM/APM/HPM Service-1	TPS 3061-1
PM/APM Service	AP13-500	PM/APM/HPM Service-1	TPS 3061-1
Universal Control Network Guidelines	UN20-500	Installation/Universal Control Network	TPS 3041
HPM Implementation Guidelines	HP12-500	Implementation/HPM-1	TPS 3066-1
APM Implementation Guidelines	AP12-500	Implementation/APM-1	TPS 3042-1
PM Implementation Guidelines	PM12-500	Implementation/PM-1	TPS 3040-1
For R4xx:			
APM Service	AP13-400	PM/APM Service	TPS 2061
PM Service	PM13-400	PM/APM Service	TPS 2061
UCN Guidelines	UN20-400	Installation/UCN	TPS 2041
APM Implementation Guidelines	AP12-400	Implementation/APM	TPS 2042-1
PM Implementation Guidelines	PM12-400	Implementation/PM	TPS 2040-1

Interpret UCN Communications

Introduction

About this module

This course module provides an overview of UCN communications. Having an understanding of UCN communications provides insight into the configuration, system administration, and maintenance tasks that you perform. For example, one benefit upon completing this course module is a more in-depth understanding of the UCN Statistics display, which helps you effectively manage and troubleshoot your system.

Objectives

The objectives of this course module are to

- Describe how UCN communications occur.
- Relate communication concepts to UCN statistics.
- Use UCN statistic displays.
- Describe UCN cable handling algorithms.
- List configuration considerations.

Conventions used in this module

In the discussion of UCN communication concepts, some words are marked with a superscript letter. This superscript letter cross references a UCN Statistic (see Figure 3) that has particular relevance to the topic being discussed. You may find it helpful to have a copy of the UCN Statistics display available when UCN communication topics are described.

Sample test items

This course module's Criterion Test includes the following items:

- Demonstrate the following:
  - From the UCN Status display, call up the local UCN Statistics display
  - Call up a display showing timesynch statistics
- If a node is experiencing cable noise, noise bits, and checksum errors, it usually means (select one)
  - 1) Excessive UCN traffic,
  - 2) Node is OFFNET,
  - 3) Heavy peer-to-peer load, or
  - 4) A problem with UCN cable and cabling components.

Continued on next page

REFERENCE—Some concepts are discussed in more detail in related publications. The UCN Guidelines and the HPM/APM/PM/LM/SM Service Manuals provides additional information about your UCN.

Terms

Some terms you should become familiar with are :

- TBC—Token Bus Controller, which performs the Medium Access Control (MAC) function in a UCN node.
- MAC—Medium Access Control, the lower sublayer of the Data Link control function defined by the Open System Interconnection (OSI) standard.
- LLC—Logical Link Control, the upper sublayer of the Data Link control function defined by the Open System Interconnection standard.

These terms are described in more detail later in this course module.

Assumptions

Most of this course module assumes that you are *not* familiar with ISO 8802/2 and ISO 8802/4 standards. While knowledge of these standards is helpful to any user, it is not necessary to know these standards when using the UCN. The course material provides enough information about how the UCN follows the ISO standards to do your job more effectively.

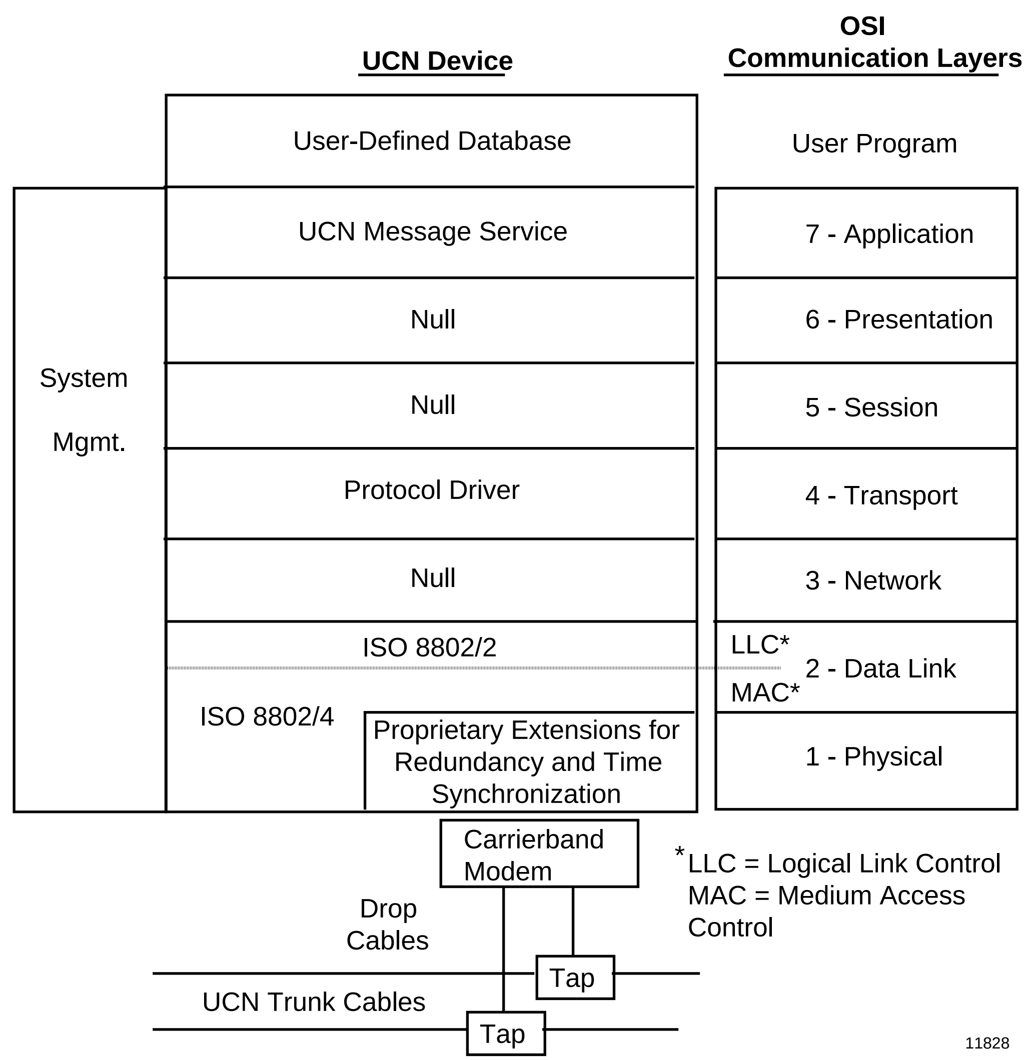
You can quickly review much of the material in the first section if you are already familiar with the ISO standards

UCN Relationship to Open System Standards

How UCN relates to OSI

Figure 1 shows the relationship of the UCN architecture to Open System Interconnection (OSI) standards. This relationship is discussed in the next section.

Figure 1   UCN Relationship to OSI



Other references

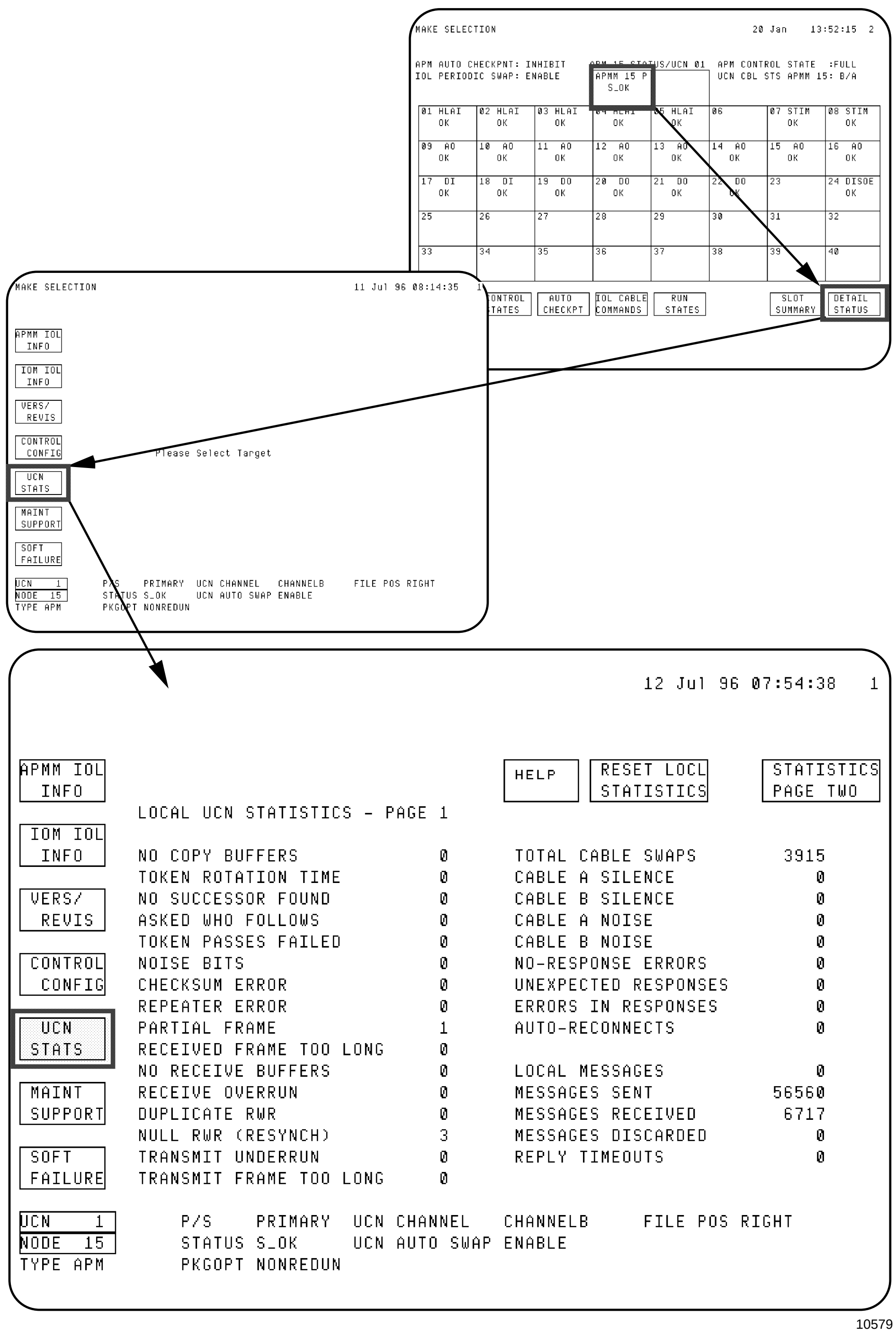
Various public domain information is available that discusses OSI and International Standards Organization (ISO) standards at length. You can consider reviewing those at a later time for a detailed understanding of Local Area Network (LAN) architectures.

Navigation to UCN Statistics

Navigation review

The UCN Statistics display is referred to throughout this course module. Figure 2 shows the navigation path to this display.

Figure 2 Navigation to UCN Statistics

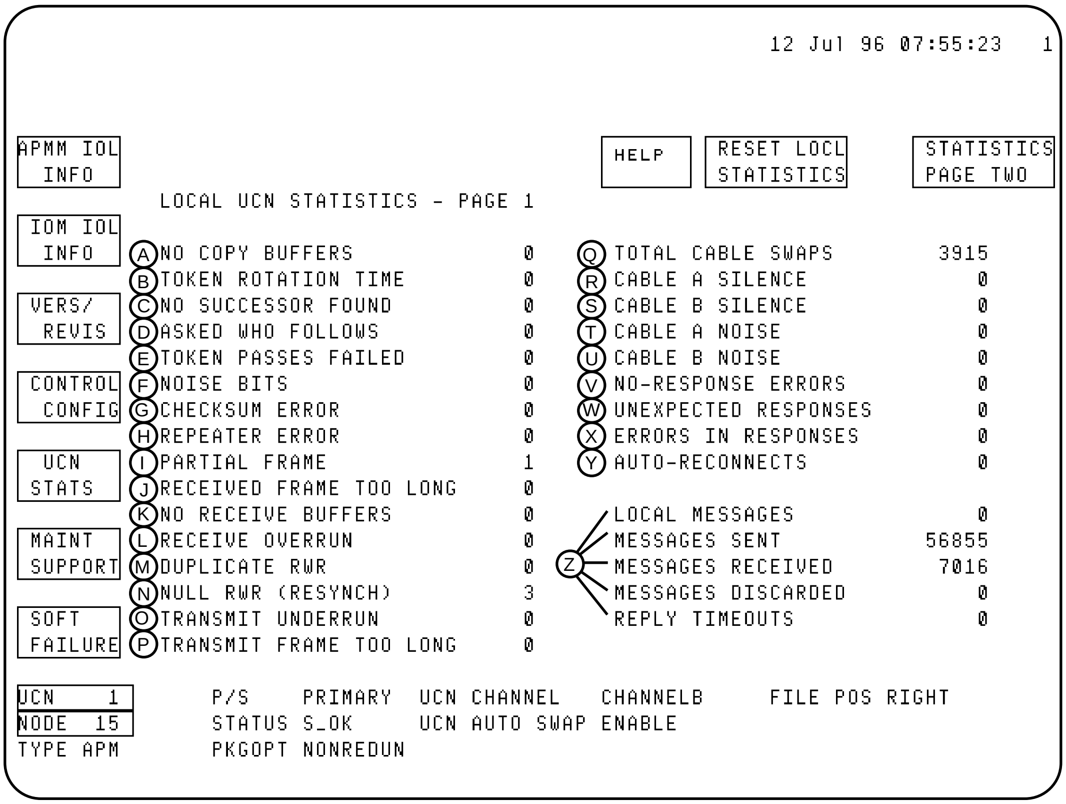


Example Statistics Display

Refer to this example

We suggest that you take this page out of this course material and have it available when various UCN communication topics are discussed. At various times in this section, you will see a superscript letter, A-Z , to find a statistic that relates to the topic discussed. (Note: Page 2 of the statistics display is discussed later in this course module.)

Figure 3 UCN Statistic Display Example



10580

REFERENCE—Appendix A of this course module describes the UCN Statistics displays. It is an excerpt from the *UCN Guidelines* manual.

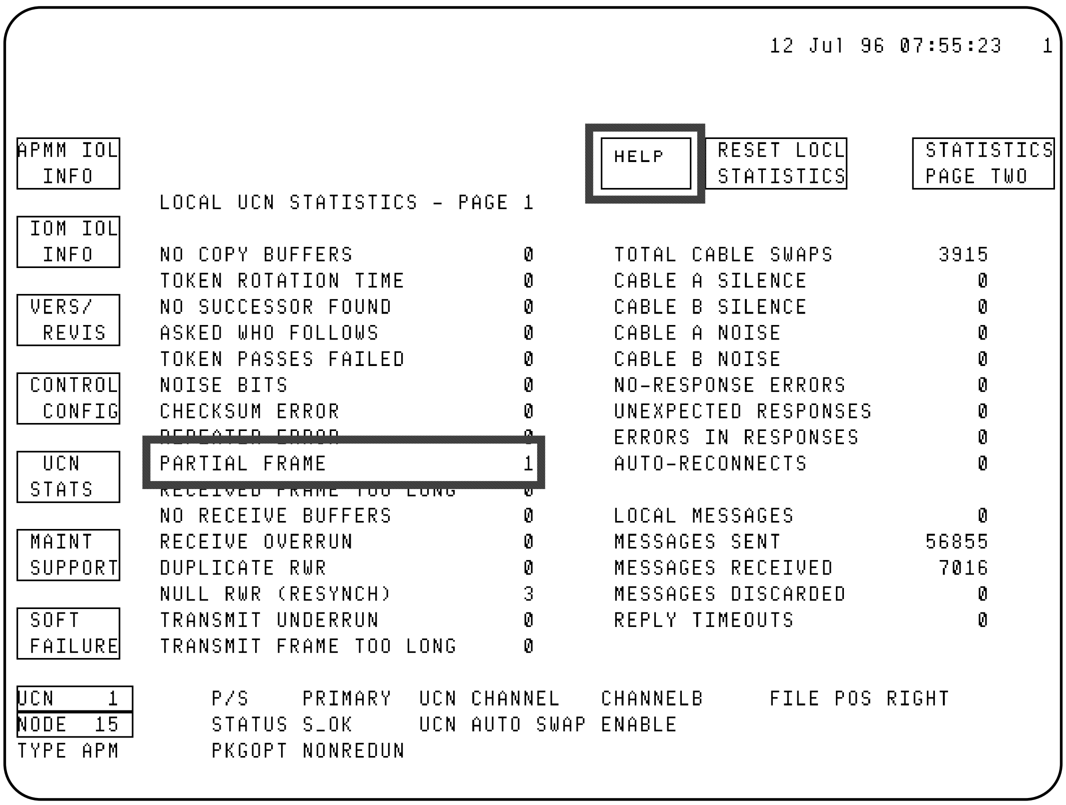
Help Displays for UCN Statistics (R500 and Later)

Description

In R500 and later, a Help display is available for each UCN statistic.

As shown in Figure 4, to call up the Help display, first select the statistic you are interested in, then select the HELP target.

Figure 4 How to Call up Help Display for Statistics



34453

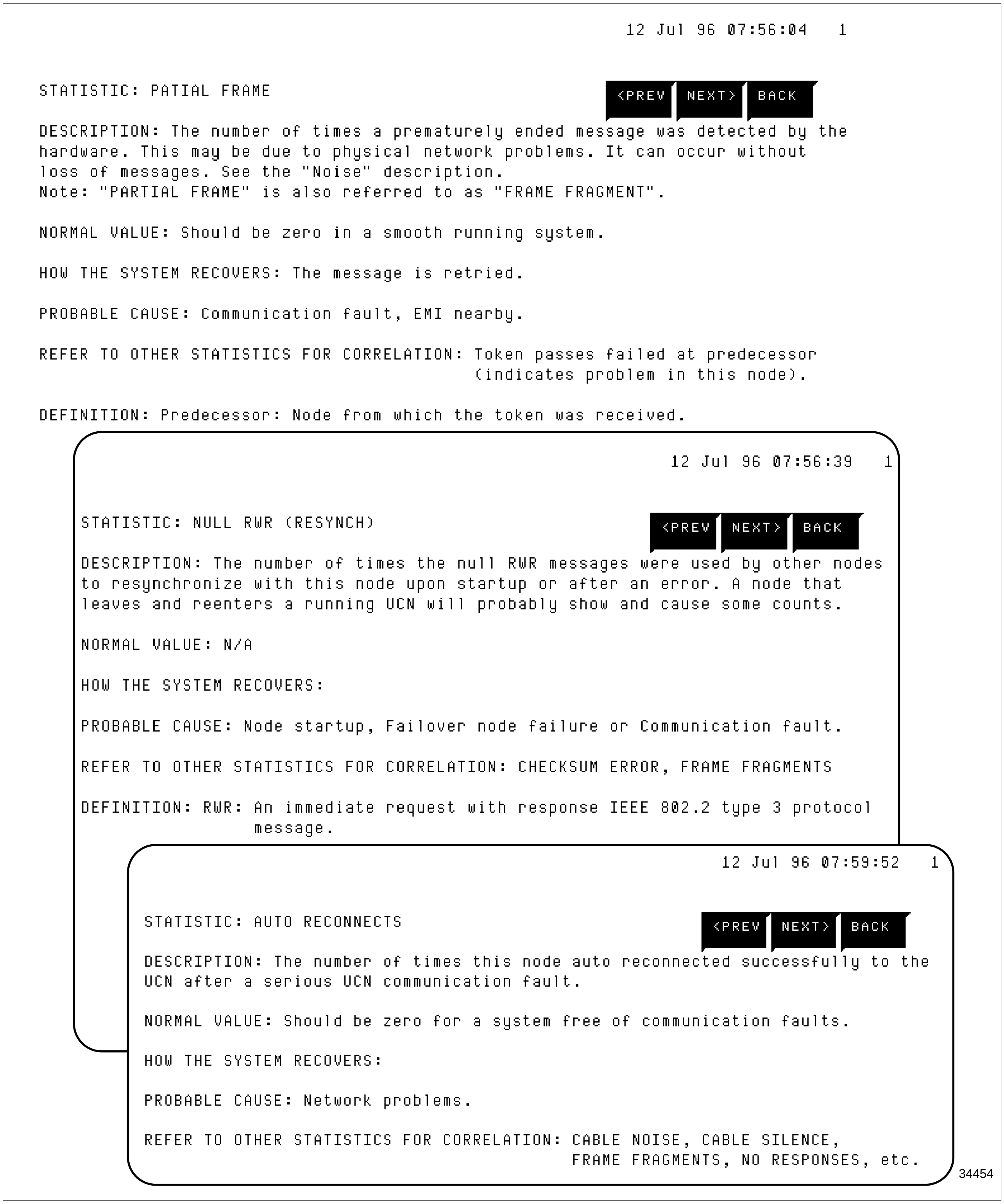
Example

Figure 5 shows the Help displays for these statistics:

- PARTIAL FRAME
- NULL RWR (RESYNCH)
- AUTO RECONNECTS

Continued on next page

Figure 5 Help Displays for UCN Statistics



12 Jul 96 07:56:04 1

STATISTIC: PATIAL FRAME <PREV NEXT> BACK

DESCRIPTION: The number of times a prematurely ended message was detected by the hardware. This may be due to physical network problems. It can occur without loss of messages. See the "Noise" description.
Note: "PARTIAL FRAME" is also referred to as "FRAME FRAGMENT".

NORMAL VALUE: Should be zero in a smooth running system.

HOW THE SYSTEM RECOVERS: The message is retried.

PROBABLE CAUSE: Communication fault, EMI nearby.

REFER TO OTHER STATISTICS FOR CORRELATION: Token passes failed at predecessor (indicates problem in this node).

DEFINITION: Predecessor: Node from which the token was received.

12 Jul 96 07:56:39 1

STATISTIC: NULL RWR (RESYNCH) <PREV NEXT> BACK

DESCRIPTION: The number of times the null RWR messages were used by other nodes to resynchronize with this node upon startup or after an error. A node that leaves and reenters a running UCN will probably show and cause some counts.

NORMAL VALUE: N/A

HOW THE SYSTEM RECOVERS:

PROBABLE CAUSE: Node startup, Failover node failure or Communication fault.

REFER TO OTHER STATISTICS FOR CORRELATION: CHECKSUM ERROR, FRAME FRAGMENTS

DEFINITION: RWR: An immediate request with response IEEE 802.2 type 3 protocol message.

12 Jul 96 07:59:52 1

STATISTIC: AUTO RECONNECTS <PREV NEXT> BACK

DESCRIPTION: The number of times this node auto reconnected successfully to the UCN after a serious UCN communication fault.

NORMAL VALUE: Should be zero for a system free of communication faults.

HOW THE SYSTEM RECOVERS:

PROBABLE CAUSE: Network problems.

REFER TO OTHER STATISTICS FOR CORRELATION: CABLE NOISE, CABLE SILENCE, FRAME FRAGMENTS, NO RESPONSES, etc.

34454

UCN Communication Concepts

UCN Components

Introduction

To adequately describe UCN communications, some familiar concepts (such as token passing) are reviewed in order to introduce additional concepts (such as the Token Bus Controller, TBC).

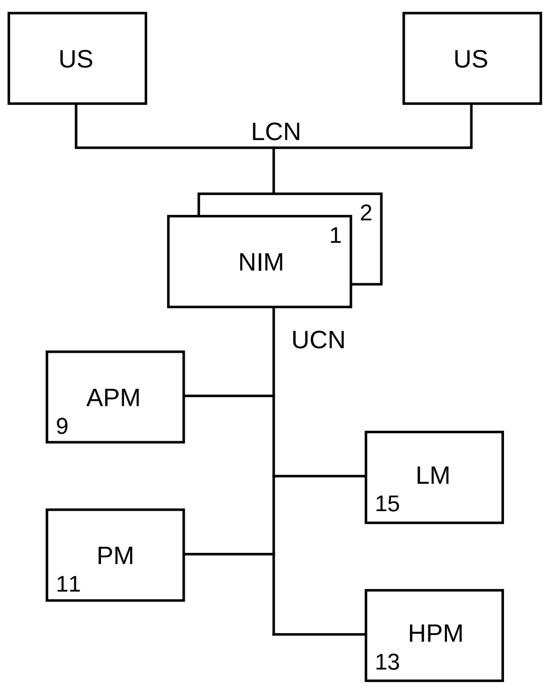
What makes up a UCN?

The UCN can be simply thought of as having hardware components that fall into two categories:

- UCN nodes (which are the computing devices such as NIMs, PMs. APMs, HPMs, LMs, and SMs), and
- cabling components (such as coaxial trunk cables, drop cables, taps, and terminators).

The UCN nodes are interconnected with the coaxial cable components. Because the cable components make up a common transmission medium, in effect you have a “bus.” The network access control method Honeywell uses to access this bus for the UCN is called “token bus.”

Figure 6 UCN Bus Topology



Concept: UCN devices are connected to a common communication channel, making it a bus topology.

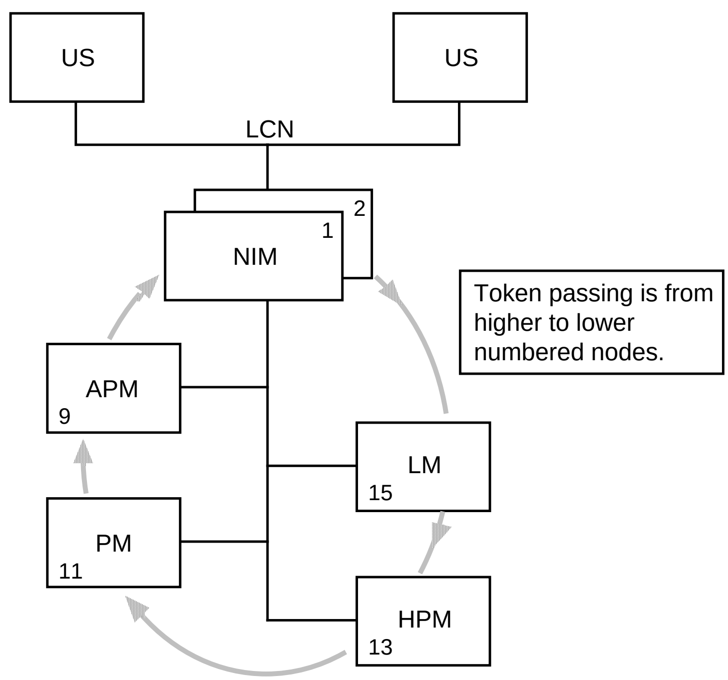
10100

Token Bus Overview

What does "token bus" mean?

Token bus represents one of several network access control methods defined by ISO (other ISO defined access control methods include token ring and Carrier Sense Multiple Access/ Collision Detection.) Although the physical arrangement of the network as shown in Figure 6 is a common shared medium or bus, the network actually forms a logical ring as shown in Figure 7. The logical ring is formed because nodes pass a token to each other in order to transmit data on the UCN. When a node completes its transmissions, it passes the token in sequence to the next node. In this way, each node is allowed an opportunity to transmit data on the UCN.

Figure 7 UCN as Logical Ring



Concept: Token passing on a network with a bus topology is known as the token bus method. A logical ring results because of the token passing that occurs.

10582

What is a "token"?

A *token* is a message that is passed from one station to the next. The token can be thought of as *the right to transmit on the network*. The token passing order is a descending order, higher numbered devices to lowered numbered devices[B]. When a station has the token, it is allowed to transmit its data until a maximum amount of time is reached.

Continued on next page

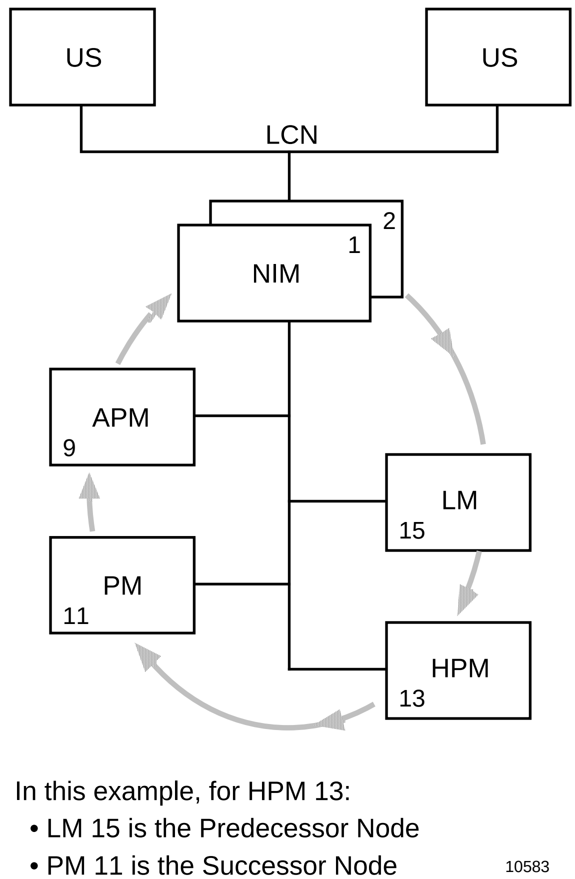
Token handling

Because the token message is sent to all devices on the network, all nodes on the network must have a way to “know” who has the token. Within the token message is an address field that identifies the node that has the right to transmit. When that node has transmitted its messages, it changes the address field in the token to that of the next UCN node. This implies that a node must know its *predecessor* (the UCN node it received the token from) and its *successor* (the UCN node it is sending the token to)[B,C].

Predecessor and successor

Figure 8 illustrates the predecessor and successor concept.

Figure 8 Predecessor and Successor



Continued on next page

Ring management

Because stations know their predecessors and successors, UCN nodes periodically check and allow stations to be added to or deleted from the network. When that happens, a nodes successor and predecessor values are updated.

Token fault management

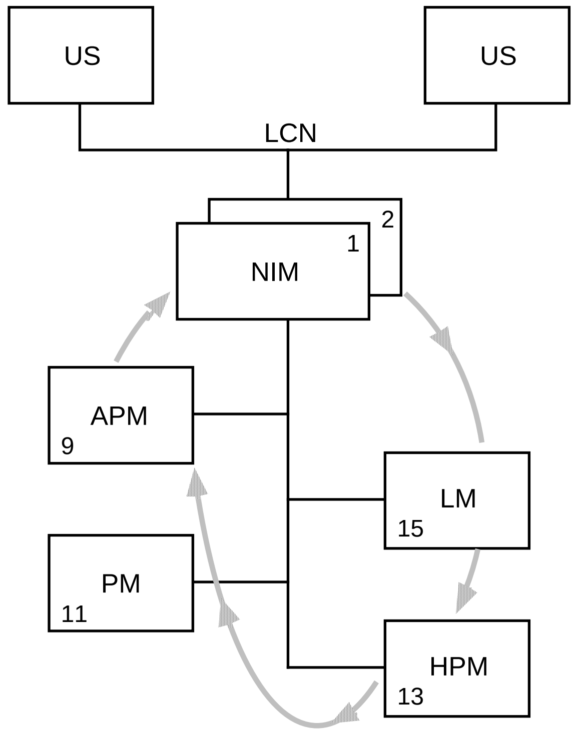
Nodes also can detect certain error conditions, such as a node being inactive when it is passed a token. That is, a node in the ALIVE state is a nontoken passing node. A node listens after it transmits a token to be sure the successor node has received the token.

Asked who follows

If the node sending the token does not detect the successor transmitting within a certain time frame[C] , it assumes the successor node has failed[E]. The node that had sent the token then sends an *asked who follows* message[D]. The message *asks* the node *who follows* the failed node to identify itself. When the node (that originally tried to send the token) receives the new successor's identification, it increments its "ask who follows" statistic, updates its successor address, and passes the token to the new successor.

Continued on next page

Figure 9 Asked Who Follows



In this example, if HPM 13 cannot pass the token to PM 11, it "asks who follows" PM 11. When APM 9 responds, APM 9 becomes the successor to HPM 13.
10584

Summary

The UCN access control method is called token bus. In order for a node to transmit on the network, it must have the token. Nodes on a UCN also provide fault management and allow for new nodes to be added to or deleted from the network.

Having had a functional overview of how nodes access the network, next consider how nodes are structured to handle data.

Functional Layers of a UCN Node

Introduction

To get an idea of how nodes handle data requires some discussion of functional layers, which is a characteristic common to local area network devices. Because a network node has a large number of tasks to perform, these tasks (functions) are organized into layers.

What is a layer?

A *layer* performs a set of *tasks*. A task can be thought of as program code written to perform specific functions (or, service primitives). A set of interfaces exists between each layer in the node (Figure 8) to route the data back and forth between UCN devices. Some examples of tasks performed by layer interfaces are notifying the next layer that a message has been received, and routing the message to the right function in a layer.

Layer analogy

One analogy to layers is a the way a business corporation is organized. For example, a large business has functions (layers) for accounting, purchasing, and manufacturing. The accounting function has certain jobs to do, rules (protocol) to follow, and knows how to communicate with other accounting functions in other businesses. The purchasing and manufacturing functions occasionally communicate with accounting, but for the most part the functions work independently of each other. In a similar fashion, the layers in a LAN node operate independently and have specific jobs to perform.

Data passes through layers

When data is being processed in a node, it is passed from one layer to the next layer. Two scenarios that illustrate this are

- messages that are sentZ
- messages that are receivedZ

Message sending

When a message is being sent by a node, it starts at the highest layer in the node and is passed successively down to the next layer. The lowest layer in the node transmits it across the coaxial cable. As you will see later in this course module, each layer adds information (sometimes referred to as headers, or control fields) to the UCN data that is sent to another device.

Continued on next page

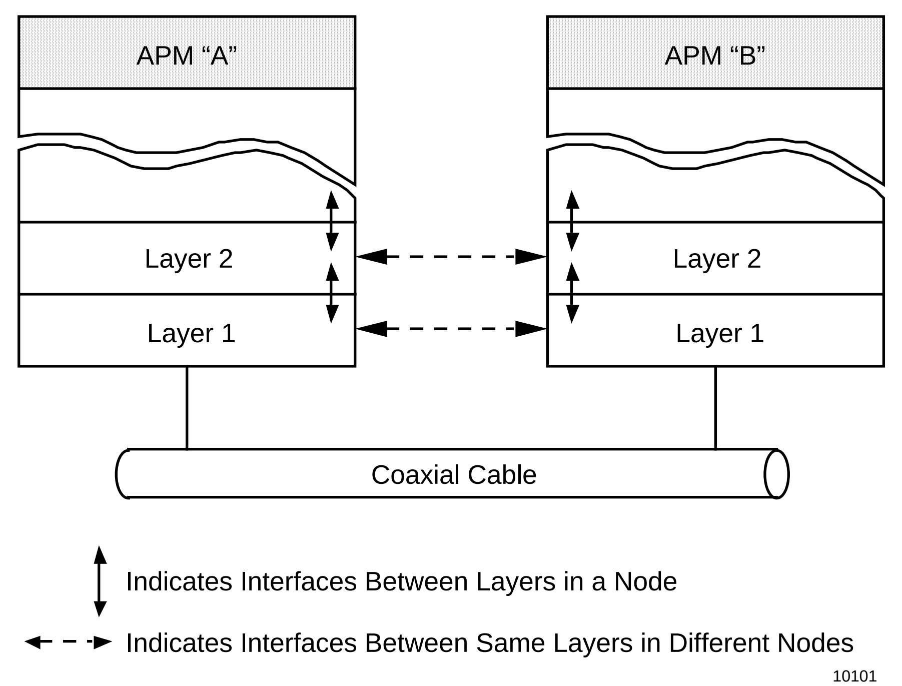
Message receiving

When a message is being received by a node, it starts at the lowest layer in the node and is passed successively up to the next layer. As you will see later in this course module, each layer is concerned only about information (sometimes referred to as headers, or control fields) in the UCN message that is sent by another device's peer layer.

Interfaces required

In order for data to be sent between nodes and between layers in a node, the interfaces must follow certain rules (protocol). These interfaces are beyond the scope of this discussion, however they provide the necessary services for nodes to pass data internally and externally.

Figure 10 Layers and Interfaces



Layers help you interpret diagnostics

Knowing what the UCN layers are and their general functions helps you interpret the information in the various UCN Communication displays. The next section discusses the Logical Link Control, Token Bus Controller, and UCN Communication Driver layers of a UCN node.

Continued on next page

Functional Layers of a UCN Node, Continued

What are the UCN node layers?

The UCN node layers follow the Open System Interconnection (OSI) model in the following layers:

- Application
- UCN Communication Driver
- Logical Link Control
- Token Bus Controller
- Modem

What the layers do

The layers are briefly described as follows:

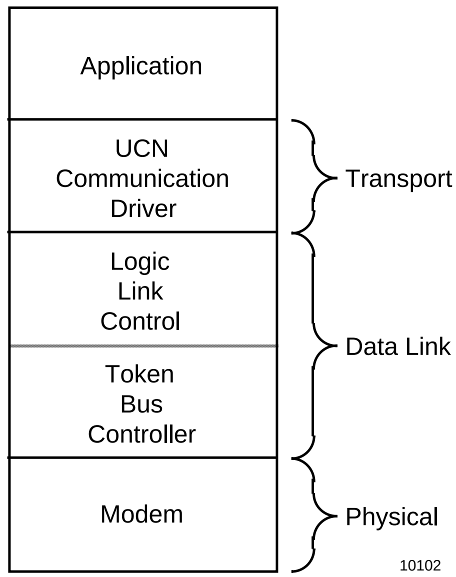
- Application layer—This layer allows the database you built (such as points, CL programs) to access the system. This layer also monitors and manages a node's resources.
- UCN Communication Driver—This layer performs the transport function.
- Logical Link Control and Token Bus Controller—These two functions are actually sublayers of the Data Link layer. These sublayers ensure that the data transmissions are reliable (error free) from one node to another.
- Modem—This device follows the Physical layer function of the OSI model. This layer transmits the electrical signals (that is, bits previously formatted in a message) across the coaxial cable between more than one node.

Continued on next page

Layers as they relate to UCN node

In Figure 11, a UCN device's layers and how they correspond to the transport, Data Link, and physical layer of the OSI model are shown.

Figure 11 Software Layers in a UCN Node



UCN Communication Driver purpose

The UCN Communication Driver is primarily concerned with routing messages between the Application tasks and Logical Link Control. The UCN Communication Driver is also responsible for time synching, cable handling, node status, and handling UCN commands.

Driver terminology

The function of UCN transport is also referred to in diagnostic displays as "UCN Communication Driver" or "driver." For example, in some SMCC error displays you may see this function represented as the "driver error record."

TBC + LLC = Data Link

The next two layers in a UCN node follow the standard for Data Link. In this approach, the Data Link layer is further subdivided into two sublayers:

- Logical Link Control layer (LLC)
- Token Bus Controller (TBC), which performs the Medium Access Control (MAC) functions of the ISO standard.

Continued on next page

Logical Link functions

The Logical Link Control layer generally

- organizes data flow
- generates responses
- performs error control
- initiates signal exchanges

To summarize, the Logical Link Control layer “logically links” up with another UCN node.

Token Bus Controller

In a UCN node, the Medium Access Control (MAC) functions are performed by the Token Bus Controller (TBC). In nontechnical terms, the TBC turns information from the modem (physical layer) into the “1s” and “0s” the other layers can use. The functions the Token Bus Controller performs include

- passing the token
- transmitting node messages to their destinations
- receiving messages addressed to the node
- collecting statistics
- prioritizing transmit/receive buffers.

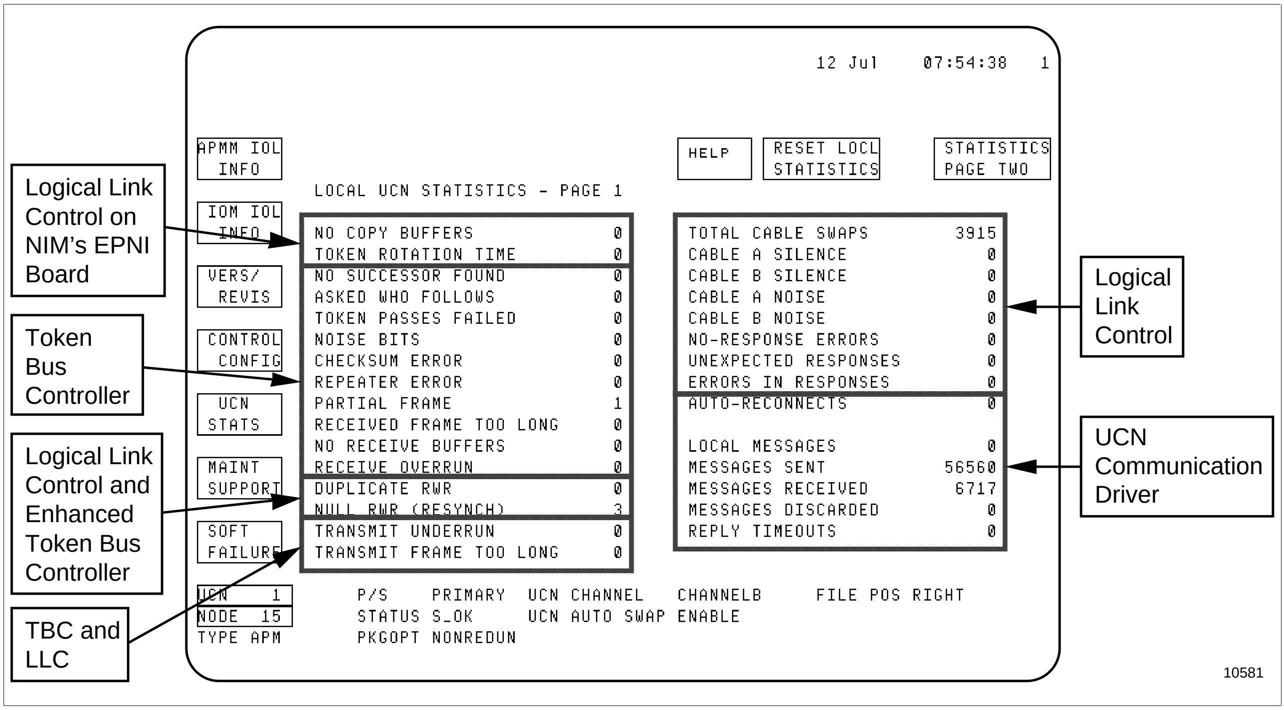
To summarize, the Token Bus Controller layer decides who, what, and when data gets on the UCN cable. You can see that the term, “medium access” is appropriate. At times you may see the TBC also referred to as MAC in some error explanations.

Continued on next page

How does this relate to statistics?

At this point you may have asked yourself what is the relevance of information about node layers. As you can see in Figure 12, the statistics display has a direct relationship to the functional layers. The statistics display is formatted in a such a manner that the various layers are responsible for reporting statuses as shown in Figure 12.

Figure 12 UCN Statistic Display Relationship to Functional Layers



It's all Data Link

You don't have to be overly concerned about remembering whether it's an LLC or a TBC statistic. The purpose here is to show you how the statistics relate to the functional UCN node layers. Because the LLC and TBC make up the Data Link layer, consider this display as Data Link statistics.

What's next

Because the LLC and TBC layers provide most of the statistical information, a more detailed discussion of those layers follows.

Logical Link Layer Concepts

Introduction

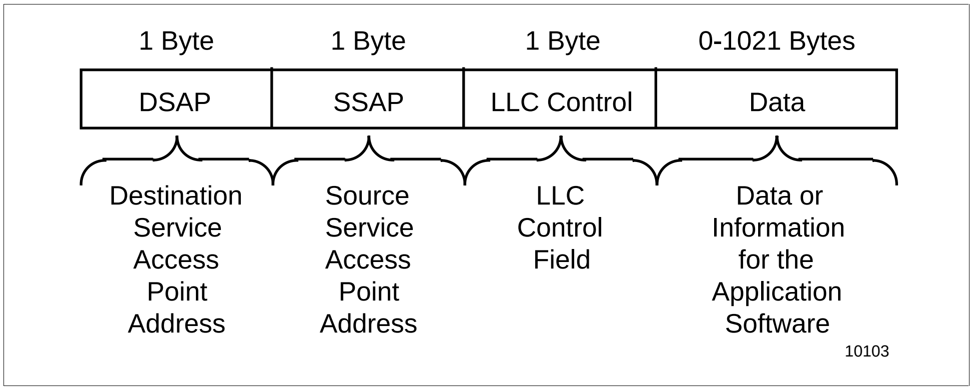
The Logical Link Layer controls the data (message) exchange between different nodes. For example, a logical link can be established between two nodes. To understand the data exchanges a node may have with other nodes requires introducing two terms:

- data unit
- Service Access Point (SAP)

LLC data unit

The LLC data unit is that part of the UCN message that carries, for example, user data, UCN commands, or responses. You could think of the LLC data unit as establishing a “logical link” with another UCN node so that they can exchange data (messages). The format of an LLC data unit is in Figure 13. First consider the Data field, then the LLC Control field.

Figure 13 LLC Data Unit



Data field

The information in the data field is for the Application layer. The contents of this field are passed to the upper layers without any examination by the LLC or TBC. An analogy is a letter you send to a friend (Figure 15). The LLC data field is like the letter inside the envelope, which is not examined by the letter carrier service.

LLC control field

The LLC control field tells a destination node about the type of information in the UCN message, how it should be handled, and whether a response is needed. It also permits duplicate message (frame)M detection. The LLC control field is somewhat analogous to a letter carrier service (for the letter in Figure 15), which may require you to sign for the letter (immediate acknowledgement) or it may send a letter to you as a routine service.

Continued on next page

Access points

Two other fields in the LLC data unit identify where the information is going to and coming from in the upper layers of a node—these are the service access points.

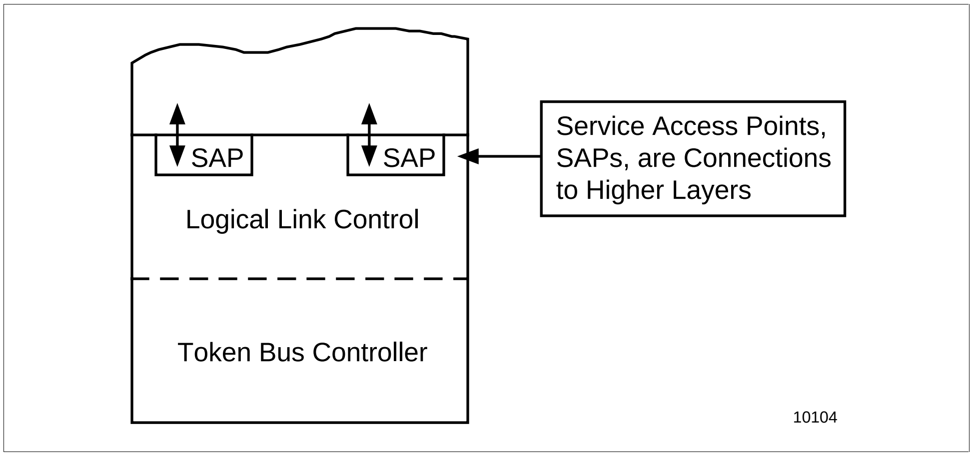
What is a service access point?

Service access points are connection points or access functions to higher level layers. Some example service access point information exchanges are:

- parameter requests,
- trend requests,
- event sender and receivers, and
- node status scans.

Figure 14 summarizes service access point functions. You can think of a service access point as a "software port" to another layer.

Figure 14 Service Access Point Function

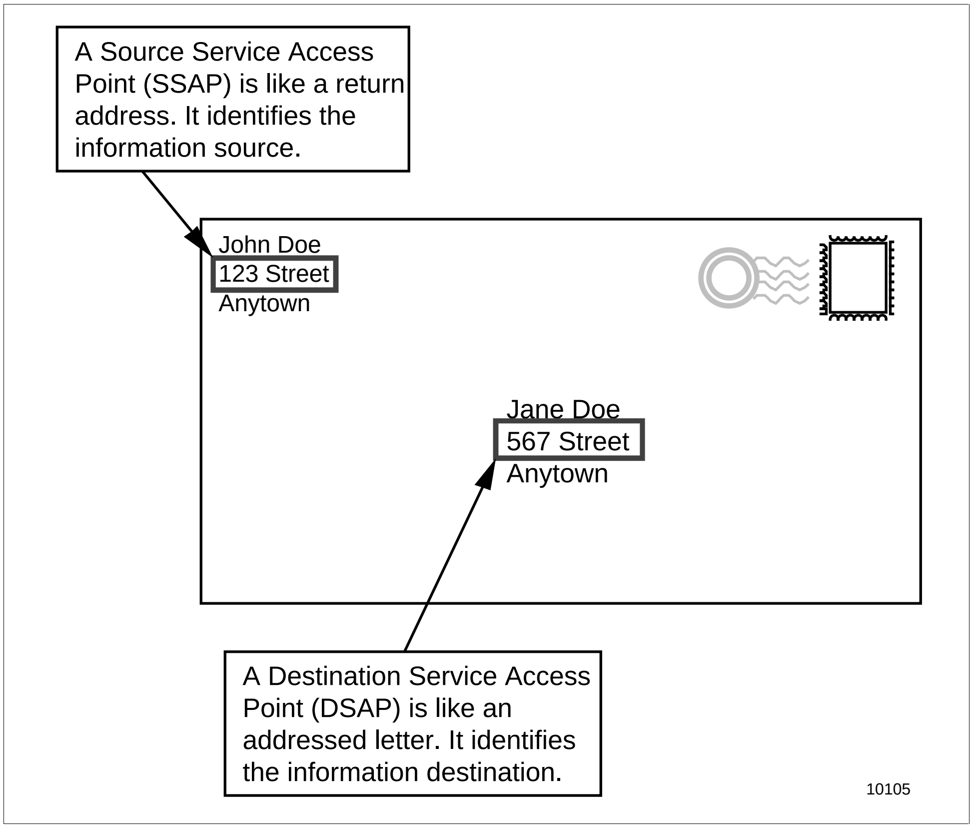


Continued on next page

Service access point role

Service access points route information to the sending node and receiving node applications. Returning to our letter analogy in Figure 15, you can see that service access points are like return and destination addresses on a letter.

Figure 15 Service Access Point Analogy



TBC Layer Concepts

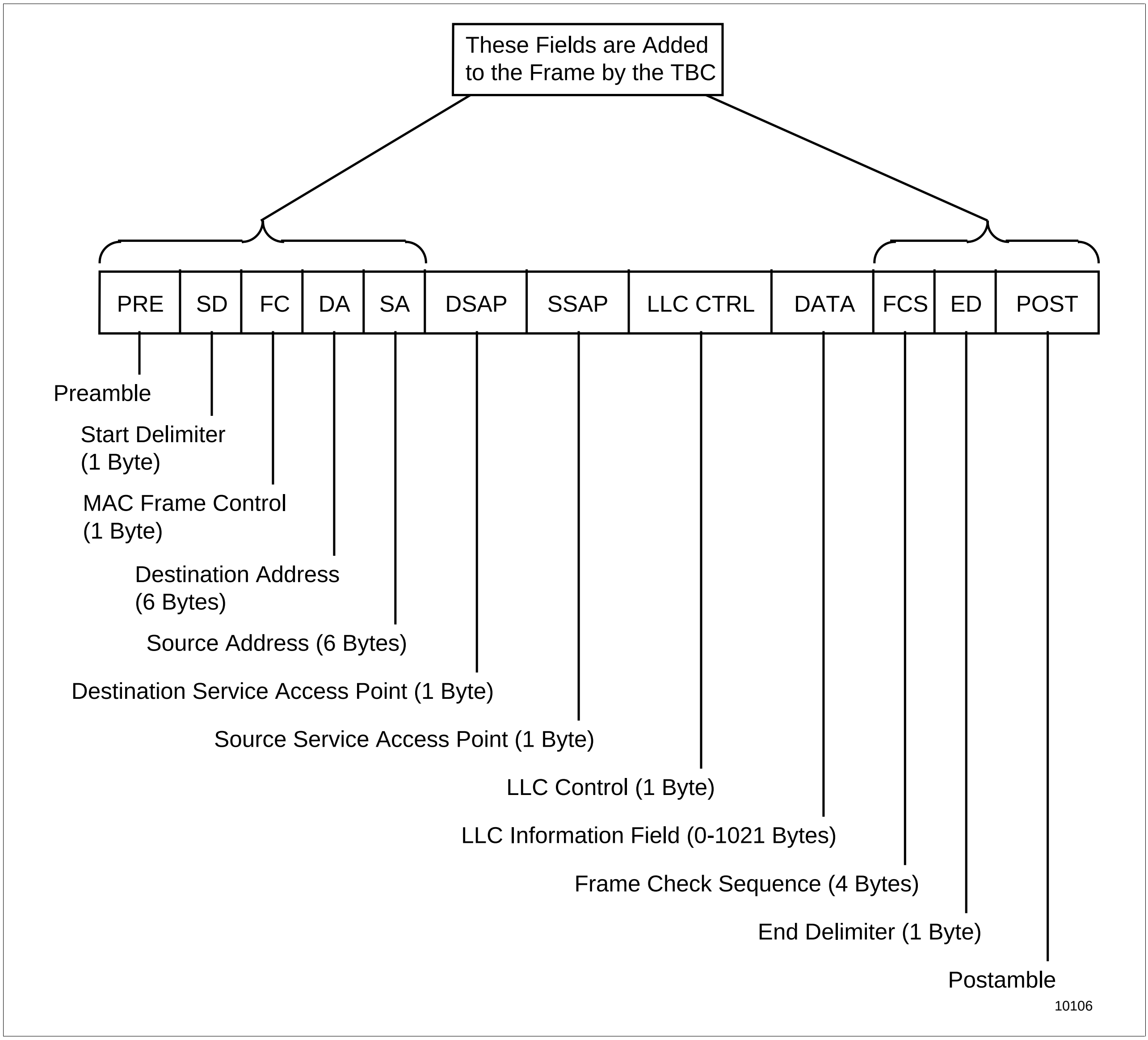
Introduction

When a message is routed through the TBC layer from the LLC layer, additional fields are added. These fields provide the following functions such as error checking[F-J] and token control.

Frame format

Figure 16 shows the fields of a complete UCN frame[G-J, P]. Recall that as data is routed through each layer, fields (headers) are added to the UCN message. At the TBC level the final fields are added, resulting in a UCN frame.

Figure 16 UCN Frame



Continued on next page

Overview of frame fields

A brief description of the frame fields added by the TBC follows.

- Preamble/postamble—The information in these fields represents the “wakeup” and “go back to sleep” calls to the modem. For example, the modem gets a frame when it acquires a signal level and phase lock using a known UCN preamble pattern.
- Start Delimiter/End Delimiter—Delimiters are like a period at the end of an English language sentence, they help you synchronize the beginning and ending of a message. Delimiters notify the TBC (also referred to as MAC) where the start or end of a frame is by using a predetermined data pattern, which cannot occur in a message.
- MAC frame control—The information in this field lets the TBC know whether the information is for
  - MAC control,
  - LLC data, or
  - Station management.
- Destination/source address—This field represents the device addresses of the sending and receiving nodes.
- Frame check sequence—This field represents the results of a frame check calculation for each frame and is used for error checking. This ensures that the data received is reliable.

MAC frame control

In general the information in the MAC control field tells the UCN device whether to perform token-related functions (station management) such as token passing, token recovery, and asked who follows.

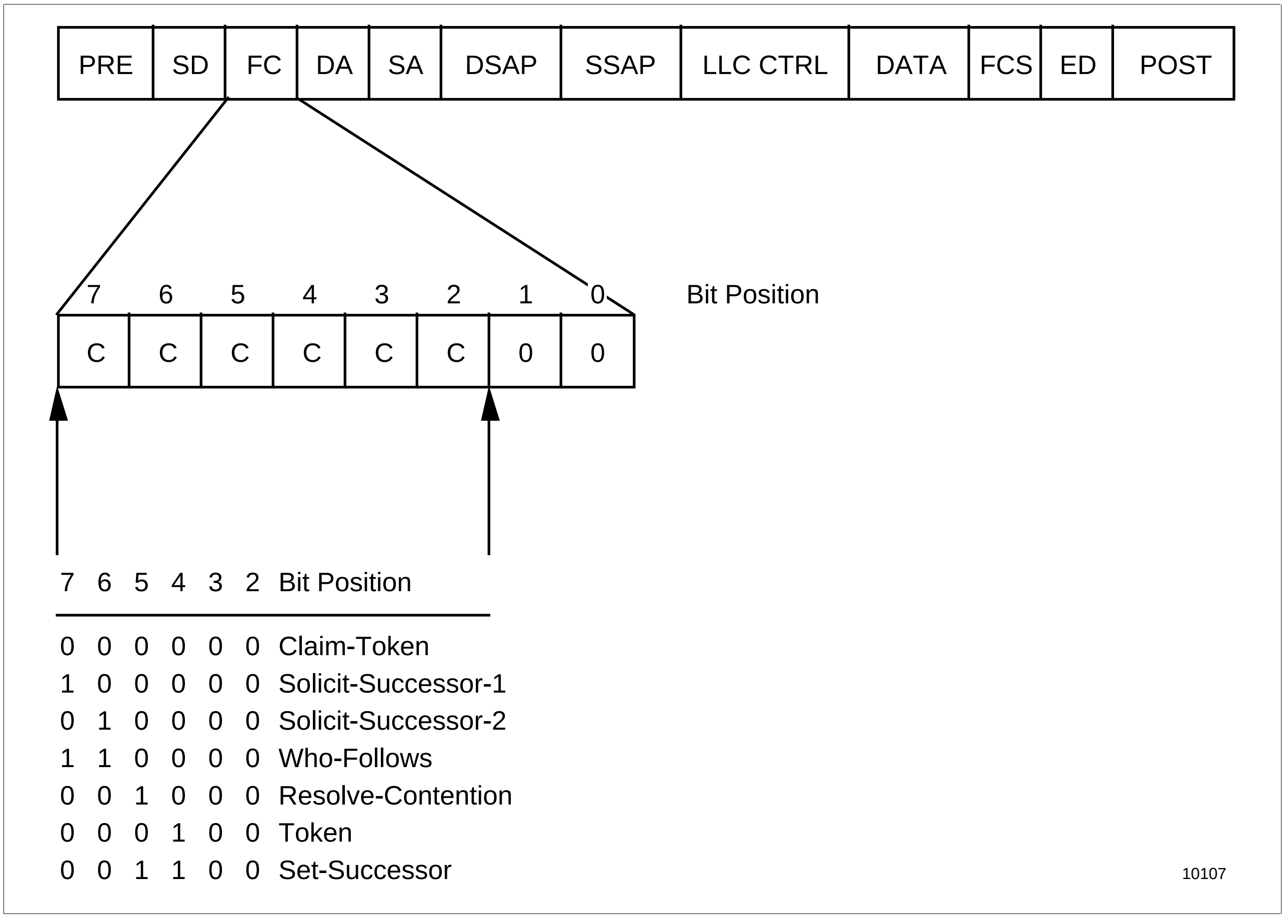
Depending on the information in this field, it can also identify whether it is the LLC data frame. In the Figure 15 analogy, a letter is sent that sometimes can be sent as a high priority or low priority letter. Likewise, the information in this field can also assign a priority to the UCN message.

Continued on next page

Station management example

The values of the first two bits of the frame control field determine whether or not it is used for station management. In the example in Figure 17, the various bit position values are shown. Our purpose in showing you this is to remove the mystery of the token. As you can see, the token is simply a UCN message with bit 4 set in the MAC control field.

Figure 17 Token in UCN Frame



Summary

This section has discussed the layers of a UCN node, their functions, and how they relate to the UCN Statistics Display. As you know, there are two pages to the UCN Statistics Display. The second page (shown in Figure 22) also displays information about messages sent and messages received. This requires some discussion about the types of messages on the UCN, and how they are sent and received.

Message Data Flow

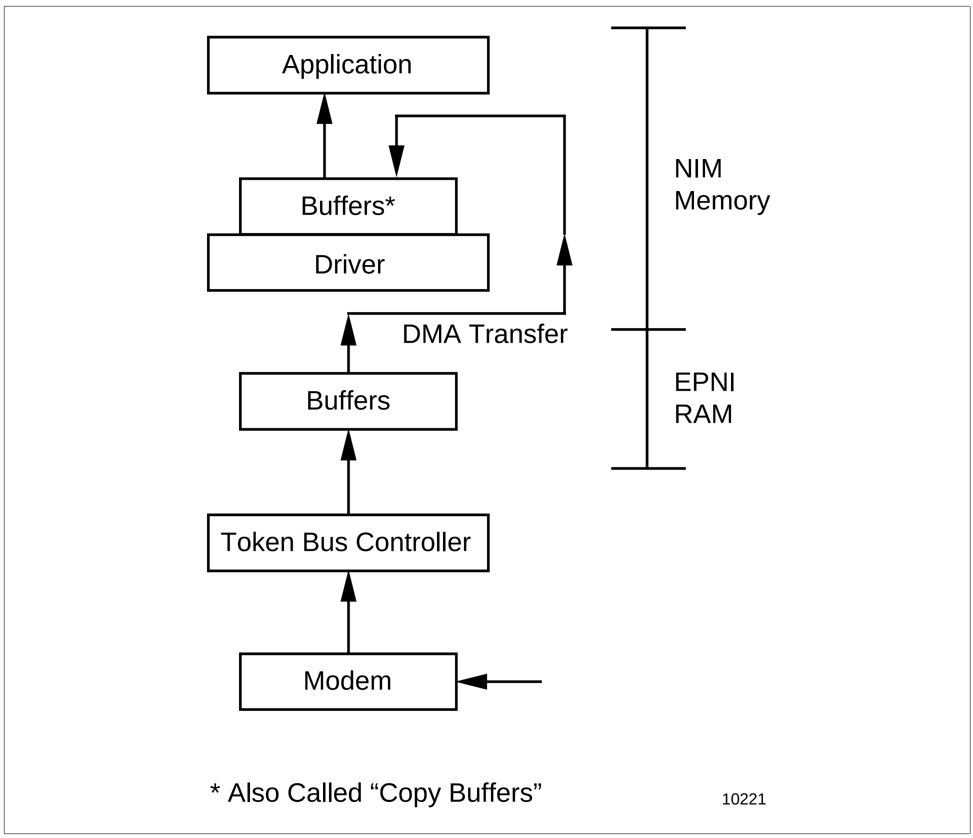
Introduction

Messages are routed differently in the NIM than in the other UCN nodes. Knowing this helps you interpret statistics for copy and receive buffers in the UCN Statistics display.

NIM receive messages

NIM messages[Z] are first received by a set of receive buffers [K] on the EPNI RAM. The messages are then routed to receive buffers in NIM memory. These buffers are referred to as copy buffers[A]. Figure 18 illustrates the flow.

Figure 18 NIM Receive Data Flow

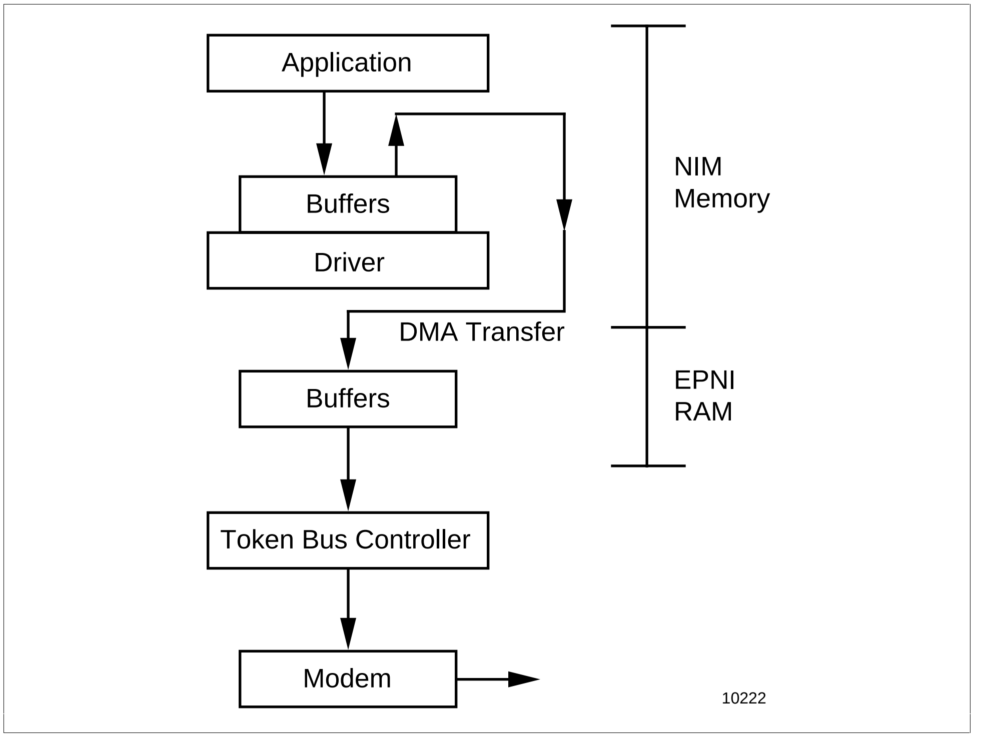


Continued on next page

NIM transmit messages

NIM messages are sent from a set of application transmit buffers in NIM memory. The messages are then routed to transmit buffers on the EPNI. Figure 19 illustrates the flow.

Figure 19 NIM Transmit Data Flow

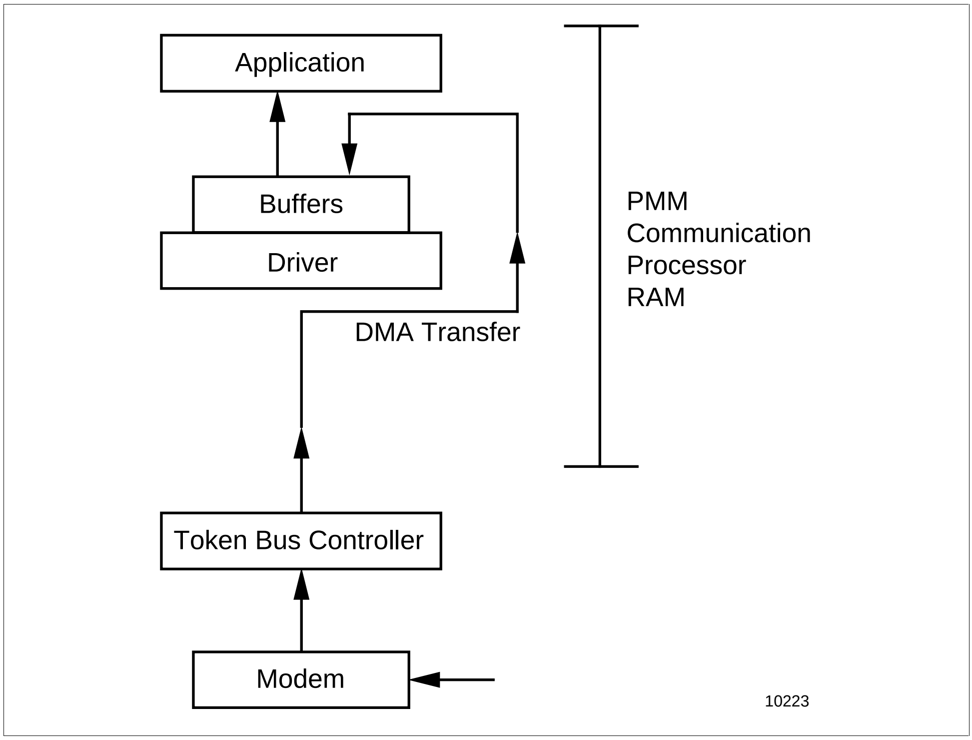


Continued on next page

PM/APM/HPM receive messages

PM/APM/HPM messages are received by a set of receive buffersK on the PMM/APMM/HPMM Communication Processor. Figure 20 illustrates the flow.

Figure 20 PM/APM/HPM Receive Data Flow



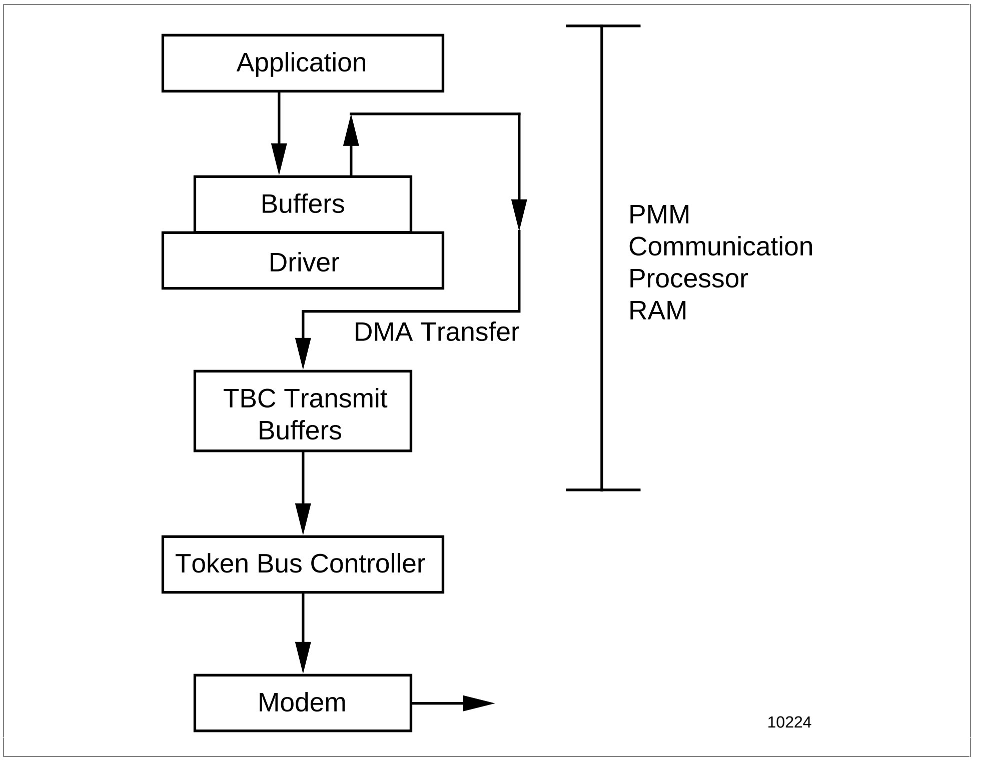
Continued on next page

Message Data Flow, Continued

PM/APM/HPM transmit messages

PM/APM/HPM messages are sent from a set of transmit buffers on the PMM/APMM/HPMM Communication Processor. The messages are then routed to TBC transmit buffers. Figure 21 illustrates the flow.

Figure 21 PM/APM/HPM Transmit Data Flow



Types of Messages

Introduction

Having seen the structure of a UCN message and how they are sent and received, the next section discusses the types of UCN messages. For example, in the UCN Statistics Display, publication references are made to Type 3 messages. This section discusses the UCN message types.

Types of messages

The Logical Link layer for the UCN supports Class 3 operations as defined by ISO 8802/2. Briefly, this means that two types of messages are supported:

- Type 1 messages
- Type 3 messagesZ

Type 1 messages

Type 1 message operations are also called "unacknowledged - connectionless;" that is, there is no establishment of a data link connection or acknowledgement *from the destination node's LLC*. While this may sound unusual, note that a higher level layer typically performs the acknowledgement, eliminating the need for the Logical Link layer to do the same job twice. Type 1 messages are either multicast (sent to more than one node) or singlecast (sent to one node).

- Multicast messages are used in event delivery, timesynching, and cable control.
- Singlecast messages are used for event delivery retries, cable control, and timesynching arbitration.

Type 3 messages

Type 3 message operations are called "acknowledged connectionless." Upon receiving a frame, the destination node sends back an immediate acknowledgement. The acknowledgement frame can contain information in the information field (Figure 13 and Figure 16). This means that there are two kinds of Type 3 messages:

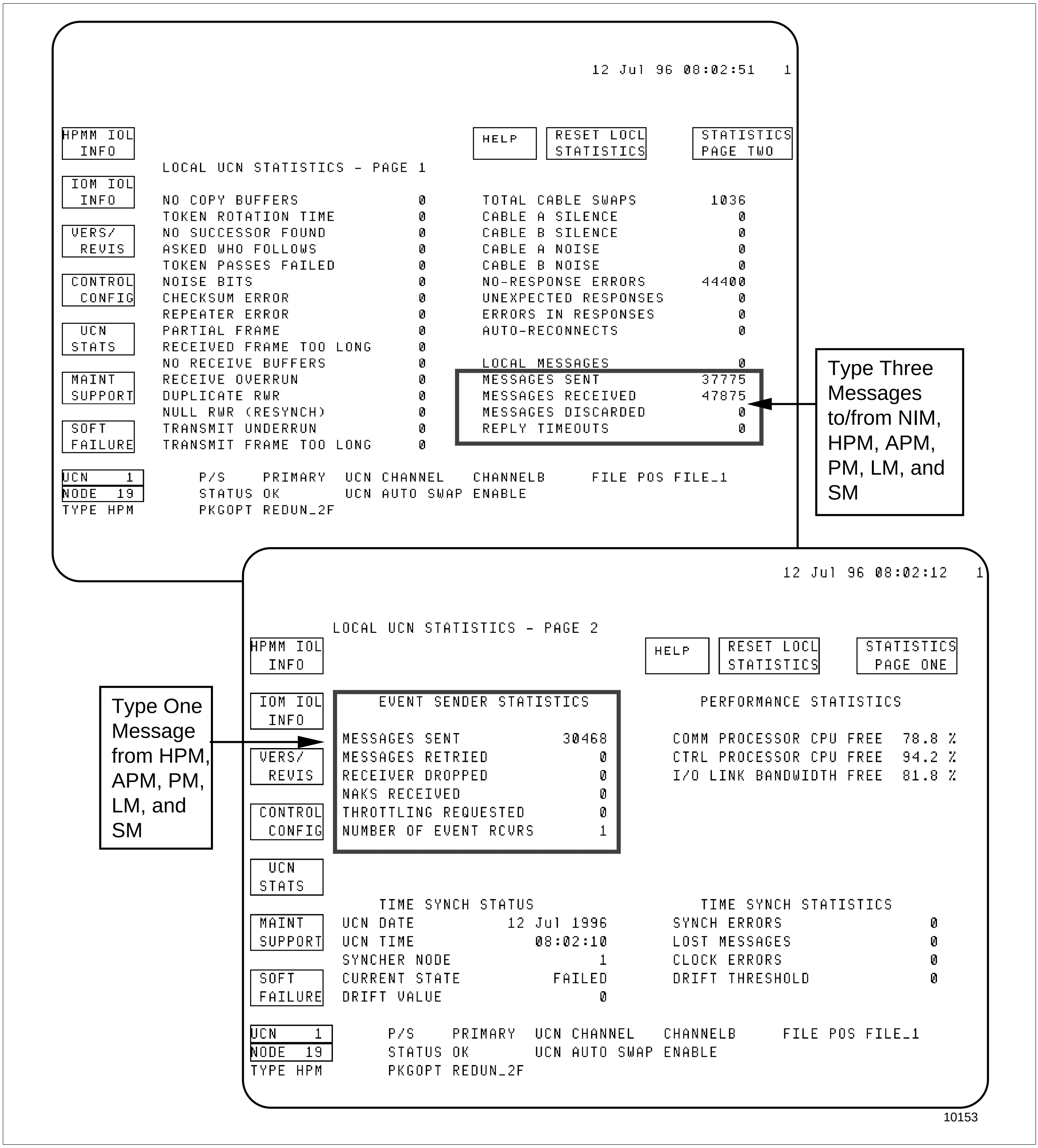
- Immediate acknowledgement—These messages are used for parameter accesses, peer-to-peer communications, and NIM redundancy.
- Immediate data—These messages are for node status scans and node redundancy.

Continued on next page

Where are messages shown?

In Figure 22, both UCN Statistics displays are shown. On page 1, the messages statistics refer to Type 3 messages. On page 2, Type 1 messages are displayed.

Figure 22 Statistic Display of Type 1 and Type 3 Messages



Event senders and receivers

While UCN nodes displays show both event sending and receiving statistics, it may be noteworthy to mention that

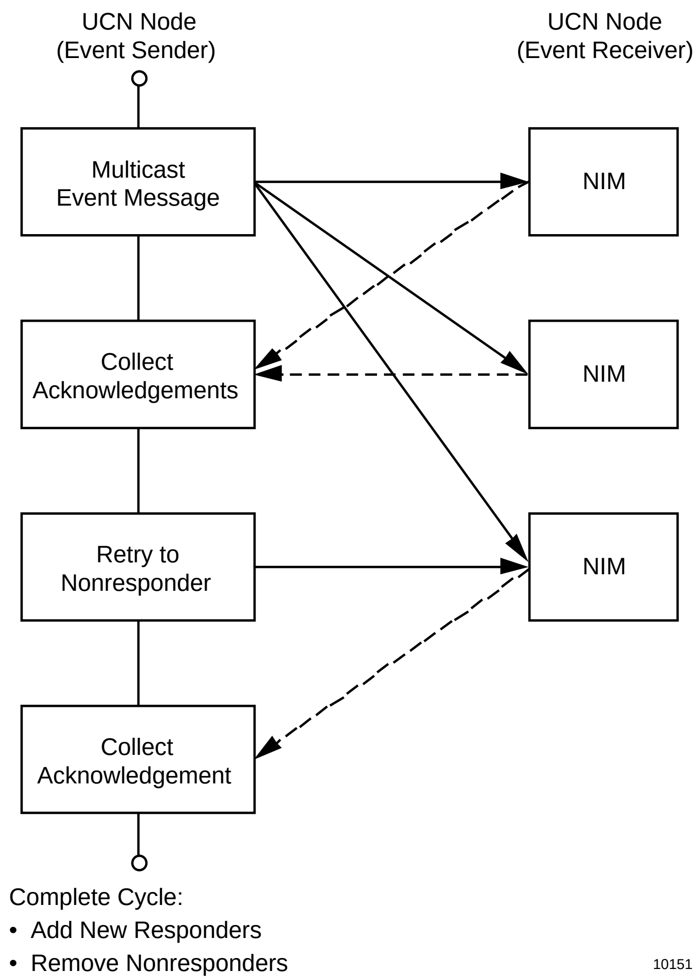
- NIMs are event receivers
- HPMs, APMs, PMs, LMs, and SMs are event senders.

Depending on the node you are looking at (such as a NIM), you may see 0 counts in its statistics. For example, a NIMs statistics for event senders will show 0 counts because a NIM is an event receiver.

How is a Type 1 message sent?

Type 1 messages are used for event delivery. In this type of message, up to 20 events can be contained. Some examples of events are process alarms, status changes, alarm conditions, and return to normal conditions.. Figure 23 shows an example of how the UCN handles Type 1 messages.

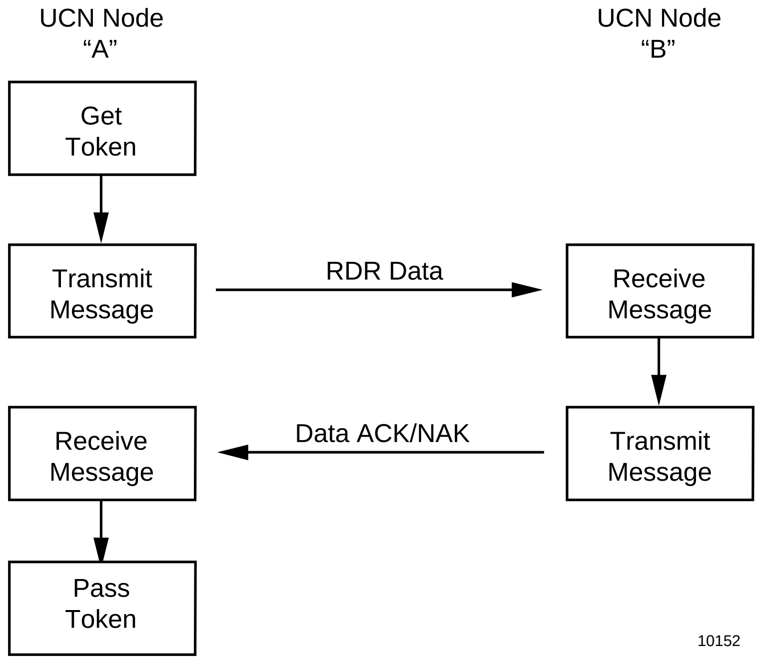
Figure 23 Type 1 Message Handling



How is a Type 3 message sent?

Type 3 messages are used for parameter accessing. Figure 24 shows an example of how the UCN handles Type 3 messages.

Figure 24 Type 3 Message Handling



RWR = RDR

Type 3 messages use an option called an RWR or RDR message. Occasionally the UCN Statistic displays refer to to these terms, which mean the same thing. RDR means Read Data Response, while RWR means Request With Response. For example, suppose a node wants a parameter from another node. When an RDR Type 3 message requesting data is sent to a destination node, it also sends a temporary delegation to transmit on the network. This way the destination node can make an immediate response to the requesting node. The response data message causes the right to transmit to return to the node that originally sent the RDR message. The RDR message permits some level of communication with nontoken holding nodes for status and loading.

Continued on next page

Summary

The two UCN message types are Type 1 and Type 3. Type 1 messages are used for events, while Type 3 are typically used in parameter requests. HPMs, APMs, PMs, LM, and SMs are event senders, while NIMs are event receivers.

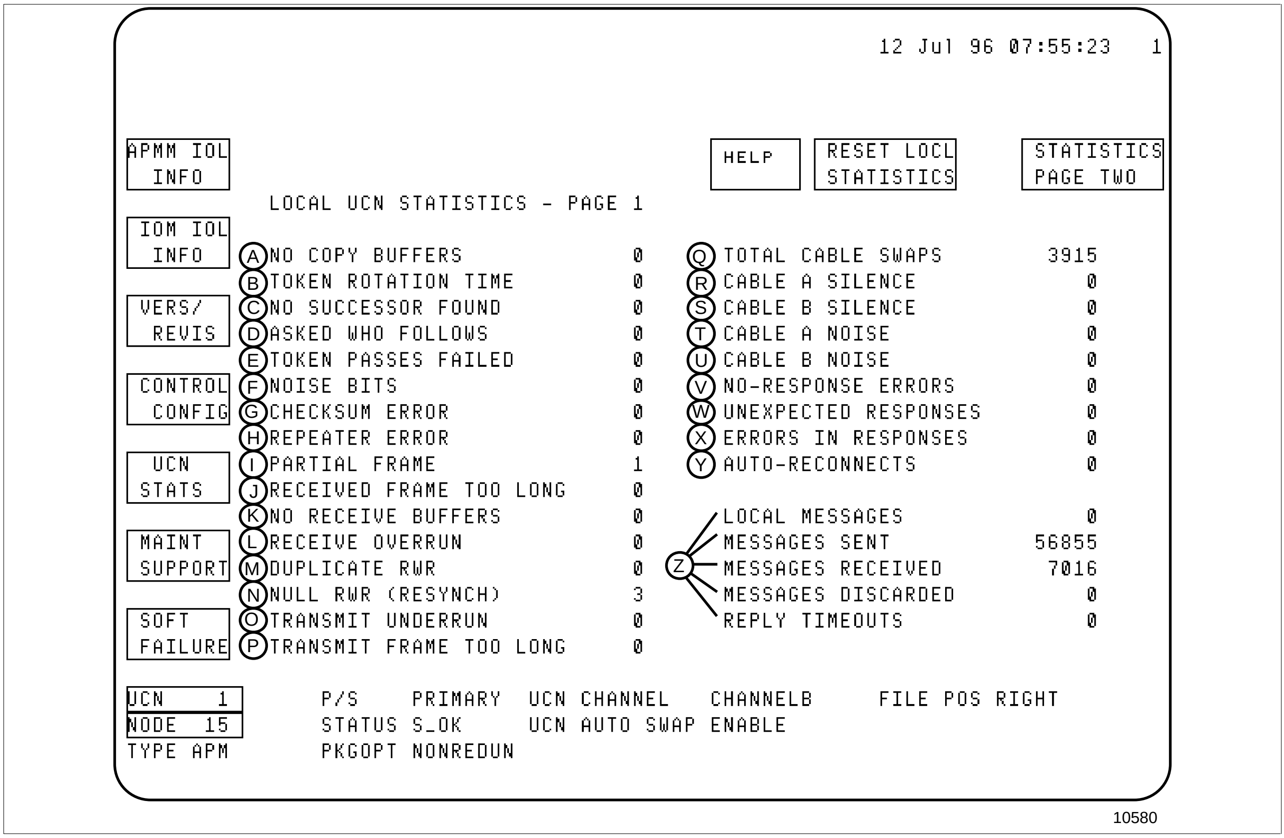
Some mechanisms must be in place by the network to control the amount of UCN message traffic. These are the topics of our next discussion—flow control and throttling.

Statistical Correlations

Quick reference list

You can use Figure 25 as a quick reference for statistical correlations.

Figure 25 Statistical Correlation



Description of listing

The columns in Table 1 represent the following:

- UCN health—Statistics represent a probable cause from the cabling components (taps,cable, terminators, etc).
- Hardware—Statistics represent a probable cause from the cabling or other hardware problem, such as modem, grounding,and EMF.
- Offnet—Statistics represent a probable cause from a node being powered down, offnet, or in the ALIVE state.
- Transactions—Statistics that can be used to monitor the number of UCN transactions per node.
- UCN traffic—Statistics represent a probable cause from a node being overloaded by requests from the LCN, or UCN peer-to-peer traffic. Note that UCN health can contribute to counts.

Continued on next page

Quick reference guide

Causes vary in their effect on statistics, Table 1 is intended as a quick reference guide. You can trend the health of the communication system using UCN statistics listed in Table 1.

As an example of how to reference the statistic on messages sent for APM 5 on UCN 1, enter the following: $NM01B05.UCNLSB(27). For example, you can trend events using the UCN statistics parameters.

Table 1 Statistical Correlation

Item	Description	Health	Hardware	Offnet	Transactns	Traffic	Parameter
A	No copy buffers					x	$UCNLSB(1)
B	Token rotation time	x		x		x	$UCNLSB(2)
C	No successor found	x	x	x			$UCNLSB(3)
D	Asked who follows	x	x	x			$UCNLSB(4)
E	Token passes failed	x	x	x			$UCNLSB(5)
F	Noise bits	x	x				$UCNLSB(6)
G	Checksum error	x	x				$UCNLSB(7)
H	Repeater error	x	x				$UCNLSB(8)
I	Partial frame	x	x				$UCNLSB(9)
J	Received frame too long						$UCNLSB(10)
K	No receive buffers					x	$UCNLSB(11)
L	Receive overrun		x				$UCNLSB(12)
M	Duplicate RWR						$UCNLSB(13)
N	Null RWR (Resynch)	x	x	x			$UCNLSB(14)
O	Transmit underrun		x				$UCNLSB(15)
P	Transmit frame too long						$UCNLSB(16)
Q	Total cable swaps						$UCNLSB(17)
R	Cable A silence	x	x				$UCNLSB(18)
S	Cable B silence	x	x				$UCNLSB(19)
T	Cable A noise	x	x				$UCNLSB(20)
U	Cable B noise	x	x				$UCNLSB(21)
V	No response errors	x		x		x	$UCNLSB(22)
W	Unexpected responses		x				$UCNLSB(23)
X	Errors in response	x	x				$UCNLSB(24)
Y	Auto reconnects	x	x				$UCNLSB(43)

Continued on next page

Quick reference guide, continued

Table 1 Statistical Correlation, *continued*

Item	Description	Health	Hardware	Offnet	Transactns	Traffic	Parameter
Z	Local messages						$UCNLSB(26)
Z	Messages sent				x	x	$UCNLSB(27)
Z	Messages received				x	x	$UCNLSB(28)
Z	Messages discarded					x	$UCNLSB(29)
Z	Reply timeouts			x		x	$UCNLSB(42)

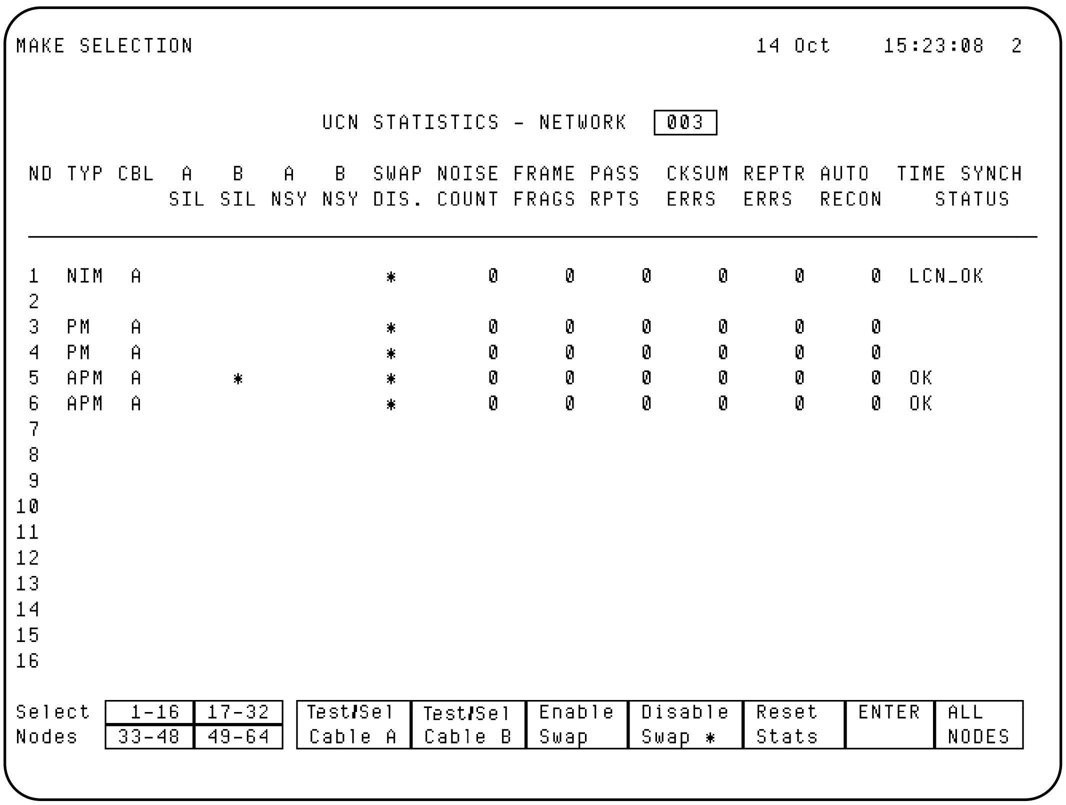
Continued on next page

UCN Network Status display

The display in Figure 26 shows the UCN node status for node addresses 1 through 16. Similar displays exist for node addresses greater than 16.

The statistics displayed are obtained from each individual node on the UCN. It is an abbreviated list of the information available from the UCN Status display and the local UCN statistic displays.

Figure 26 UCN Statistics—Network Display



33054

Flow and Error Control

Introduction

The number of event messages a UCN node sends should not overwhelm the event-receiving NIM. The techniques to prevent this are flow and error control.

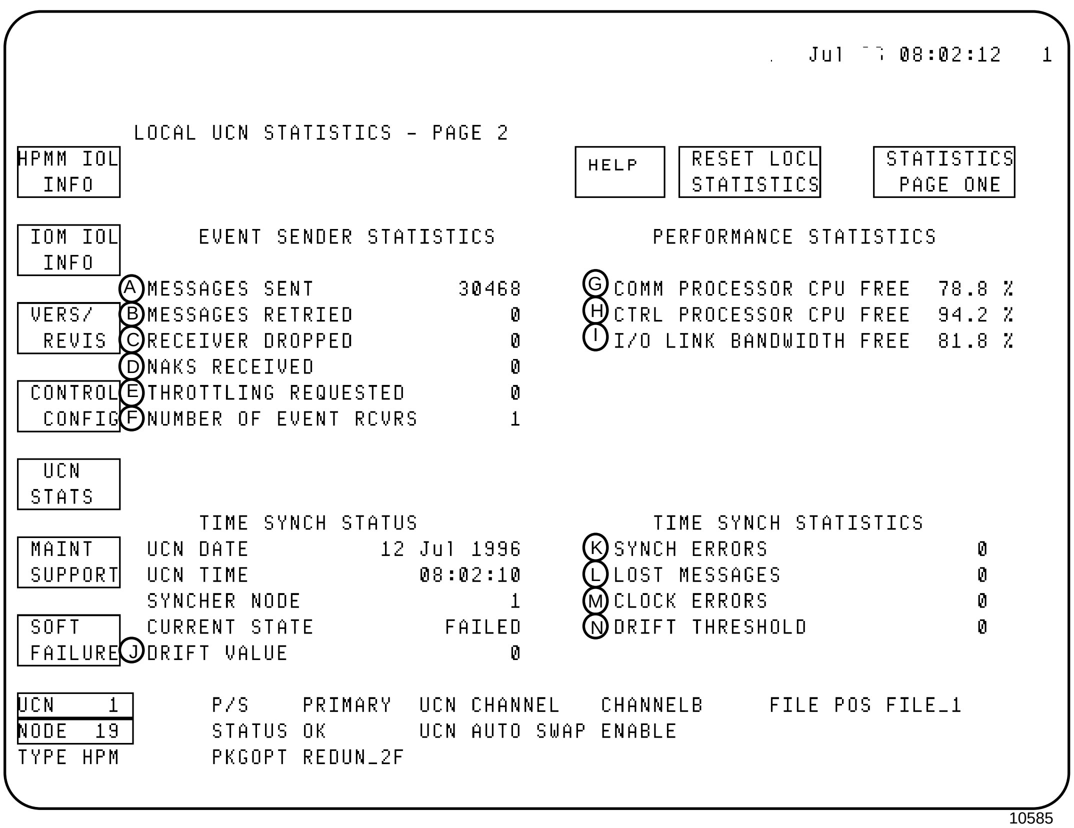
Implementation of control

For Type 3 messages, flow control and error control is implemented in the LLC layer. For event messages (Type 1) to the NIM, the flow control is implemented in the higher layers. Two throttling scenarios to consider then are when a NIM is at threshold, or when an event sender has exceeded threshold.

Statistical representation

Refer to Figure 27 for the discussion that follows on flow and error control. When a concept is discussed that refers to a statistic, a superscript letter, A-Z , appears next to the topic. Table 2 describes each statistic and lists its parameter name.

Figure 27 UCN Statistics, Page 2 ($UCNLSB)



Continued on next page

Cross reference

The listing for statistics (Page 2) are listed in Table 2.

Table 2 Statistic Parameters

Item	Description	Parameter
A	Messages sent	$UCNLSB(30)
B	Messages retried	$UCNLSB(31)
C	Receiver dropped	$UCNLSB(32)
D	NAKS received	$UCNLSB(33)
E	Throttling requested	$UCNLSB(34)
F	Number of event receivers	$UCNLSB(43)
G	COMM Processor CPU Free %	$UCNSLB(35)
H	CTRL Processor CPU Free %	$UCNLSB(36)
I	I/O Link Bandwidth Free %	$UCNLSB(37)
J	Drift value	$UCNLSB(47)
K	Synch errors	$UCNLSB(45)
L	Lost messages	$UCNLSB(48)
M	Clock errors	
N	Drift threshold	$UCNLSB(46)

NIM event flow control

When a NIM reaches a buffer threshold it sends a warning[K, E] that the number of buffers used for events exceeds the threshold. The NIM broadcasts the warning message to all event senders. This technique is called NIM back-pressure. The event senders will delay sending events to the NIM for a few seconds, so the NIM can catch up. The NIM back-pressures when multiple nodes send too many events to the NIM, or when a single node sends too many events to the NIM.

Negative acknowledge

When a single node exceeds the numbers of events permitted per node, the NIM also sends a negative acknowledgement (NAK)[L, D] and discards the events. This is the NIM's way of telling the sending node that it had received the message but was not able to handle it. In this case, the event sender retries after several seconds to send the event(s) again.

Continued on next page

Event throttling

Event senders (HPM, APM, PM, LM, and SMs) are rate-limited to a designated number of events (such as alarm conditions and status changes) per second. After reaching the threshold is reached (that is, a node exceeded the number of events it is permitted to send), the node delays additional transmissions until the rate can be met.

TOOLKIT displays

UCN statistics are also accessible from TOOLKIT displays:

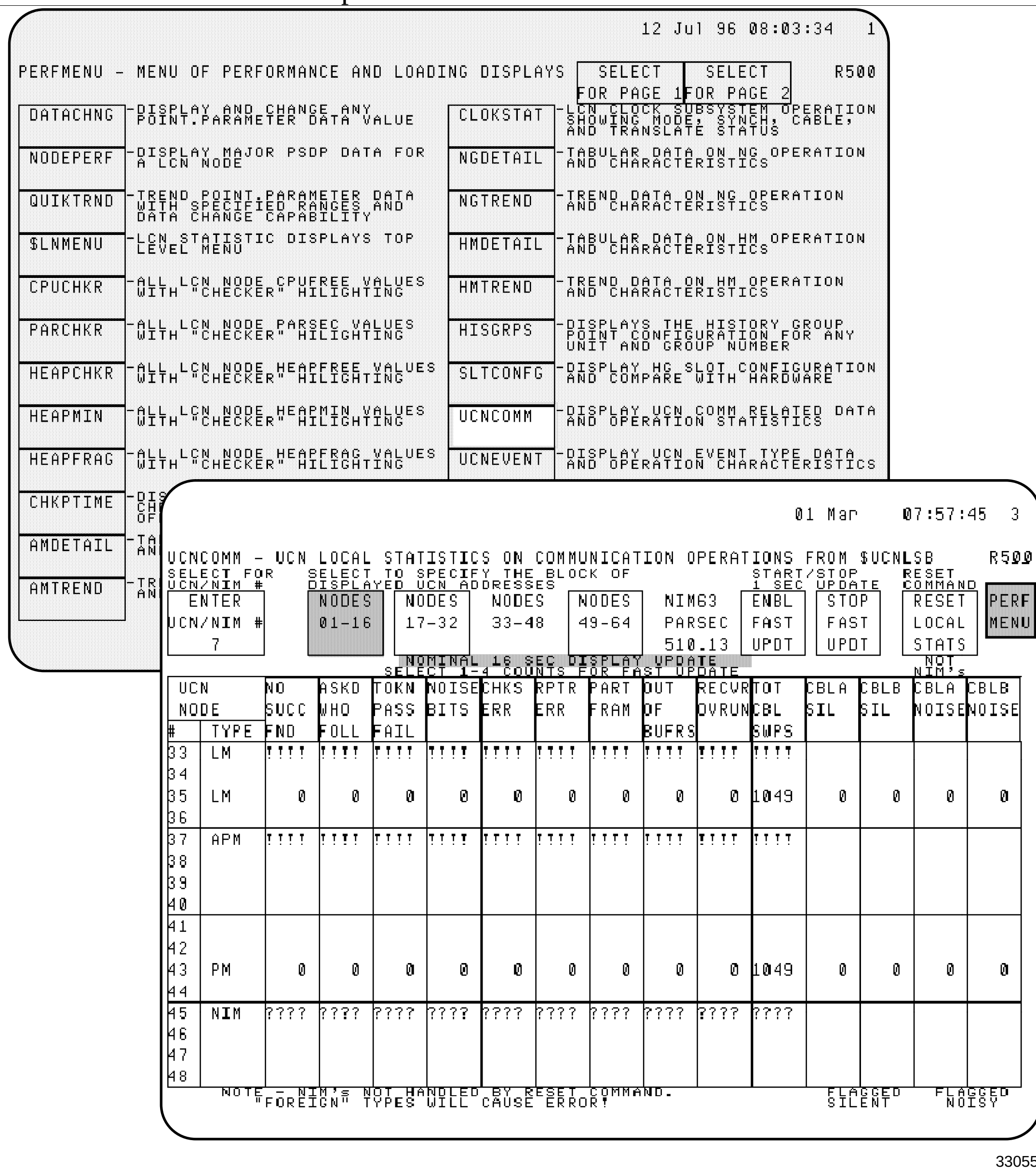
- UCNCOMM—A global view of UCN cable statistics (Figure 28)
- UCNEVENT—A global view of UCN event statistics (Figure 29)

Additional UCN TOOLKIT displays are discussed in another course module, “Use UCN Toolkit Displays.” The displays use statistics provided in the $UCNLSB format.

Continued on next page

TOOLKIT displays, continued

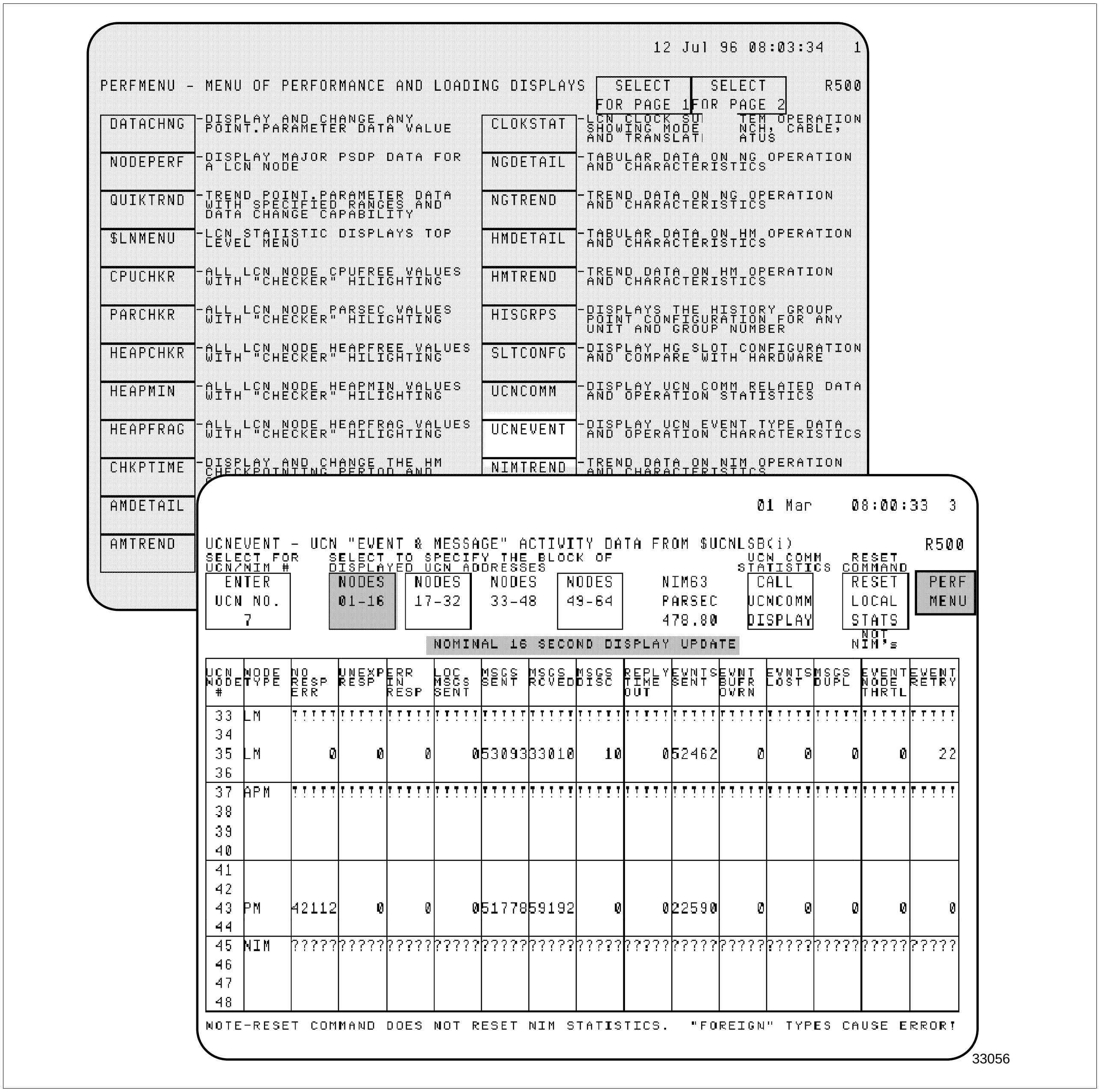
Figure 28 UCNCOMM Example



Continued on next page

TOOLKIT displays, continued

Figure 29 UCNEVENT Example



Continued on next page

Flow and Error Control, Continued

DIRECTIONS—At this point in the course module, you are ready to review additional information about the UCN Statistics display provided in the UCN Guidelines manual or the Service Manual for the specific UCN node. Your course manager may decide to review the statistic descriptions in a classroom discussion. This discussion is intended to show how the UCN statistics help you manage your system.

If time permits, your course manager may also describe the UCN Exerciser, a diagnostic used to find communication faults on the UCN. The statistics you have discovered thus far helps you interpret what and how the UCN Exerciser is used.

Time Synchronization and Sequence of Events

Introduction

This section gives an overview of time synchronization and sequence of events. Time synchronization is required when Sequence of Events IOPs are installed in an APM or HPM. The discussion that follows first reviews the Sequence of Events function.

What sequence of events means

The term “Sequence of Events” originated in the power generation industry to identify the order of occurrence of a number of physical events. These are normally digital inputs from various parts of a power plant. The purpose is to determine from a printed Sequence of Events journal which event occurred first to shut down the power plant. The APM/HPM’s Digital Input Sequence of Events point provides you this method of monitoring events on a “first out” basis.

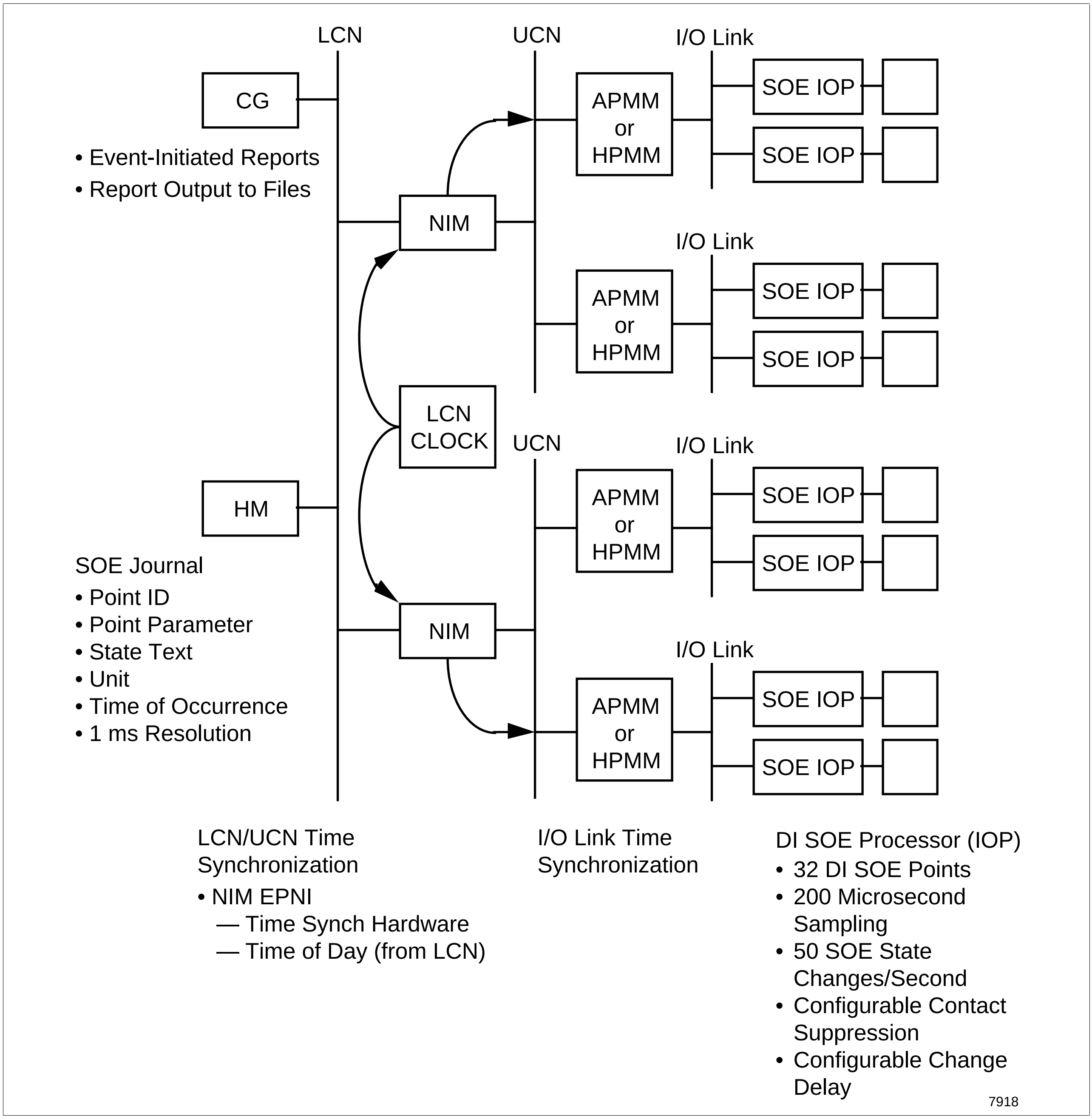
Why use sequence of events ?

Using the Sequence of Events data can assist companies to prevent future incidents. All industries can use Sequence of Events to help analyze abnormal process events, such as a compressor tripping.

Summary of functionality

Figure 30 summarizes the Sequence of Events functionality from an overall system view.

Figure 30 System View of APM Sequence of Events



Continued on next page

Summary of how SOE works

The Digital Input Sequence of Events IOP samples inputs at the field termination assembly. The change is read from the field termination assembly to the IOP. The APMM or HPMM collects the time stamped event from the IOP and broadcasts it to the Network Interface Module. The Network Interface Module sends the event to the LCN where it is journaled at the History Module.

How is time synchronized?

To provide reliable data, the LCN time is used as a reference for the whole system, including the UCNs. The NIM uses two time synchronization message commands:

- timesynch—which starts the time synchronization process.
- synchtime—which uses the LCN transmission time of the previous timesynch message to calculate the correct LCN time reference.

These two messages are referred to occasionally in the statistical descriptions.

Network time synchronization

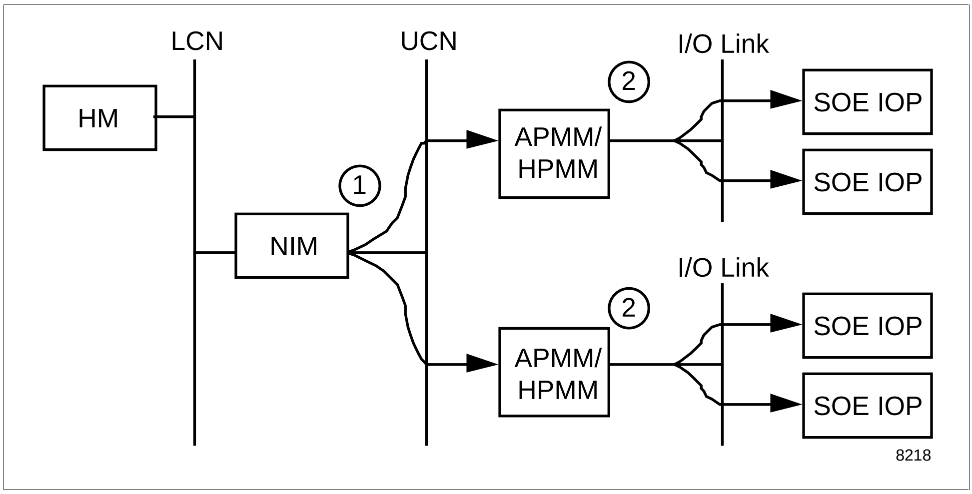
Network time synchronization is accomplished as follows:

1. The NIM transfers LCN time to the APMM/HPMMs through periodic time synchronization commands over the UCN.
2. The APMM/HPMMs s in turn broadcast periodic time synchronization commands to all the IOPs residing on their I/O Link. These commands are based on the last received UCN time synchronization command.

Thus the Digital Input Sequence of Events IOP contains the current time as broadcast from the APMM/HPMM.

Continued on next page

Figure 31 Network Time Synchronization

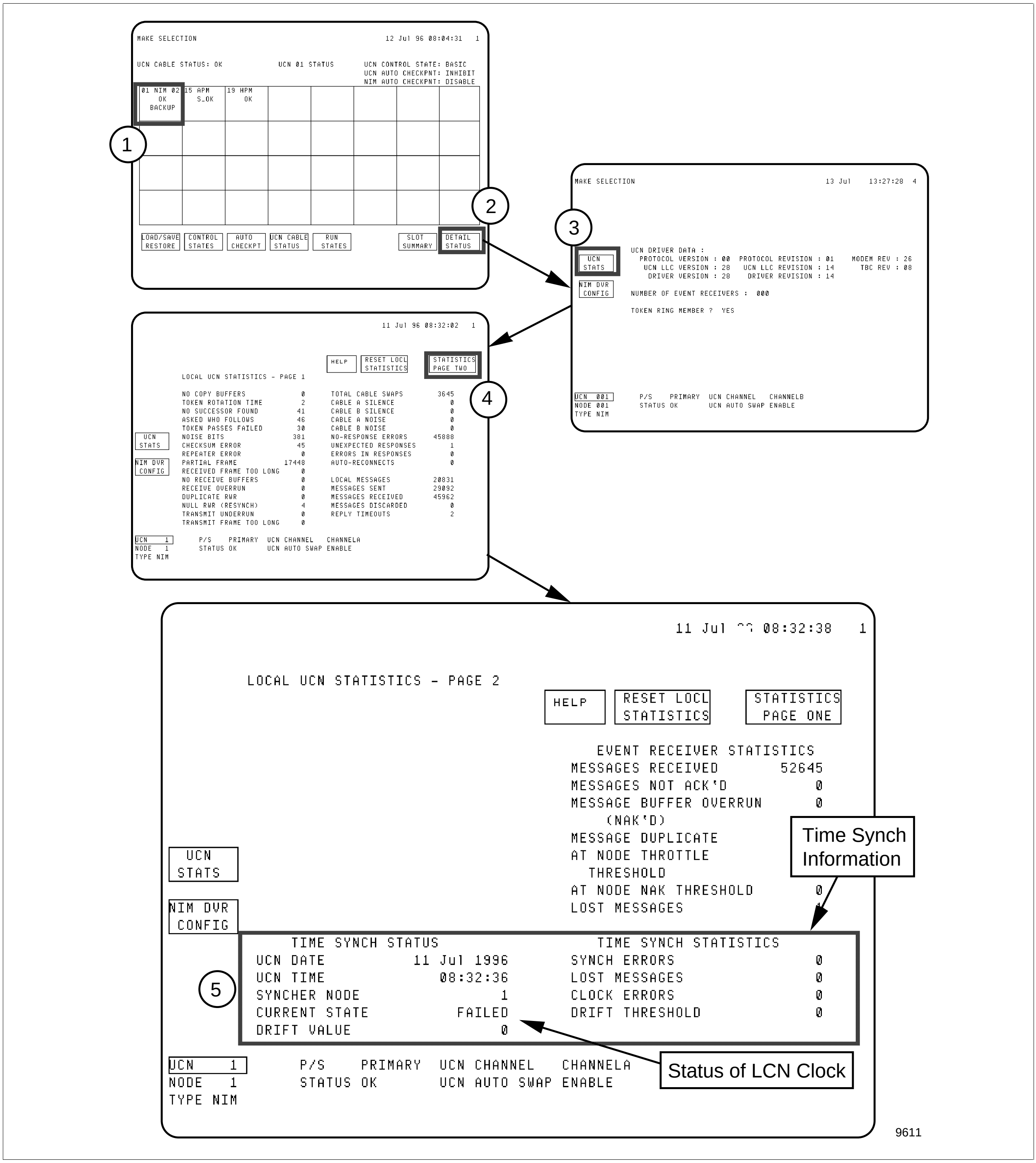


Timesynching status

An engineer enables time synchronization during NIM configuration. You can easily verify time synchronization status from the statistics displays.

Continued on next page

Figure 32 Time Synch Information on the Local UCN Statistics Display



Continued on next page

Synchronization is important

From this brief discussion, you can see the important role the LCN clock has in providing your system the most reliable data possible. Periodic maintenance checks should include checking the LCN clock's health. Your normal checks can include calling up the standard clock displays, as shown in Figure 32.

Best NIM wins!

The lowest addressed NIM becomes the syncher NIM when it has the best combination of

- EPNI over PNI boards
- OK LCN clock over bad LCN clock
- Time synchronization enabled.

The other NIMs monitor the synching process.

Continued on next page

Time synching status information

Table 3 lists the status information you could expect to see in the current state field.

Table 3 Time Synch Statuses

Status	Description	Comments/possible causes.........
INITIAL	The node is waiting for the first complete UCN synch operation.	The initial state is reached on initial load and after a NIM syncher gives up mastership. In other words, INITIAL means that synching has not started.
FAILED	Represents the maximum time without a complete UCN synch operation, either after initialization or while running.	Any NIM that does not have an EPNI. Failed is also reported when 30 minutes have elapsed without a valid UCN synchronization.
DEGRADED	The timebase of this node is degraded because of a computed or suspected problem.	Degraded is reported when 10 minutes has elapsed without a valid UCN synchronization. In nonsyncher NIMs and APMM/HPMMs, an excessive time without a complete UCN time synch operation has elapsed. To correct this, • first, check the UCN Communication Status display to identify the problem, • if the first step does not resolve the problem, call up the local statistics display of the affected node to identify the problem.
LCN BAD	UCN synch operations are taking place regularly, but the syncher NIM's clock is not synched with its LCN clock.	This status is reported only by the syncher NIM.
LCN OK	UCN synch operations are taking place regularly, and the syncher NIM's clock is properly synched with its LCN clock.	This status is reported only by the syncher NIM.
OK	This status is reported by APMMs and NIMs when the UCN time synchronization commands are working properly.	
SYNC FAILED	Clock not pinned or external.	

Troubleshooting UCN Time Synchronization

Introduction

Your troubleshooting technique can eliminate easily corrected causes, using standard displays available on your TPS system. Your approach is a "top down" approach that includes

- checking the LCN clock performance, then
- examining the whole UCN network, and finally
- checking suspect UCN nodes.

Procedure

Table 4 summarizes UCN time synchronization troubleshooting.

Table 4 Time Synchronization Troubleshooting

Step	Action
1	Use the Toolkit LCN clock troubleshooting displays. To call up the LCN clock displays, press the [SCHEM] schematic key, then enter PERFMENU, select the clock targets from the menu. • Verify that there is both a master and slave clock source. • You must fix any LCN clock problems before you can correct any UCN problems.
2	Use the UCN Communication Status display to check the time synchronization status of all NIMs and APMM/HPMMs.To call up the UCN Communication Status display, call up the UCN Status display, Select the [UCN CABLE STATUS] target. Next select the [UCN COMM STATUS] target • Only one NIM (the syncher NIM) should show either LCN_OK or LCN_FAIL. • Other nodes (APMMs or HPMMs) should show OK. • Double cable faults generally prevent synching, single cable faults are acceptable. Refer to Table 3 for an interpretation of DEGRADED, FAILED, and INITIAL statuses.
3	Use the UCN Communication Statistics display for the NIM. To call up the UCN Communication Statistics display, call up the UCN Status display, select the [DETAIL STATUS] target, select the [UCN STATS] target, then select the [STATISTICS PAGE TWO] target. • Identify whether any clock errors or excessive drift has occurred. • Refer to Table 4-4 and Table 4-8 in Appendix A for additional details on interpreting the clock statistics. • Diagnosing the problem can include shutting down the current syncher NIM and letting the secondary NIM pick up the synching tasks. NOTE THAT THIS STEP WILL CAUSE TEMPORARY LOSS OF VIEW TO THE PROCESS. • Diagnosing the problem may also include calling up System Maintenance displays, getting the current revision levels of EPNI boards, and then calling TAC for further assistance.
4	Use the APMM/HPMM Soft Failure display. To call up the APMM/HPMM Soft Failure display, call up the UCN Status display, select the [DETAIL STATUS] target, select the [SOFT FAILURE] target. • Look for hard clock problems, the APMM/HPMM will failover if the primary has a timesynch clock problem. • An APMM/HPMM Modem crystal or Communication Processor crystal problem will cause a clock problem to be reported.

Cable Swapping Algorithm

Token bus controller

In a UCN node, the Token Bus Controller (TBC) is responsible for performing Medium Access Control (MAC) functions. The TBC used on the UCN (Motorola MC68824) is designed according to the IEEE 802.4 specification to perform token-passing functions on a single cable. Honeywell, however, requires cable redundancy on the UCN to ensure that communication continues in the case of a fault on one cable.

Honeywell has added a proprietary extension for redundancy, called the Cable Swapping algorithm, to the MAC layer as shown in Figure 1. This algorithm enables a node to detect a faulty cable and swap to the redundant cable.

Design of the algorithm

The design of the UCN cable swapping algorithm is based on the following:

- IEEE 802.4 token-passing protocol
- Motorola Token Bus Controller (TBC) MC68824
- Concord Data Systems carrierband modem
- Properties of the UCN.

The Concord Data Systems modem enables a UCN node to transmit on two cables. The TBC is designed to listen to a single cable at a time. The cable swapping algorithm for UCN nodes assumes that all nodes are listening on the same cable at the same time.

Tasks performed by node

The cable swapping algorithm uses information supplied by the TBC to enable a node to perform the following tasks:

- identify a healthy cable upon joining the network,
- periodically test the health of each cable during normal operations,
- detect specific fault conditions on the UCN and swap to the redundant cable if necessary,
- test the inactive cable before swapping to make it the active cable (R430 and later).

Continued on next page

Cable Swapping Algorithm, Continued

Where is the cable algorithm?

The TBC in each node generates hardware interrupts upon detection of problems related to

- hardware malfunctions,
- network conditions, and
- problems with transmitting and receiving messages.

These interrupts are serviced by the LLC. The cable-swapping algorithm for the UCN is implemented in the LLC. The TBC and LLC firmware reside on the EPNI board for the NIM, the COMM/CTRL board for the HPM, the COMM board for the APM/PM, and the PLC card for the LM.

Some of these interrupts may result in a cable swap, while others may cause an autoreconnect attempt.

Each node is independent

The cable-swapping algorithm is run independently in each node. Once a cable fault has been detected, each node will react depending on certain conditions as seen from that node; therefore, it may take several seconds for all nodes to agree on which cable is faulty.

Nodes in the ALIVE state

Nodes in the ALIVE state are not token-passing members of the network, but are in the listen-only mode; however, the cable swapping algorithm guarantees that the node will be able to identify the healthy cable in the instance of a cable fault.

The NIM reads the status of all other nodes every 6 seconds. The cable-swapping algorithm in an ALIVE (listen only) node will swap the cable every 8 seconds until a valid frame is received on one of the cables. Because the NIM is reading statuses at 6-second intervals, there should be traffic within an 8-second interval on a healthy cable.

Normal UCN Cable Operations

UCN cable handling node

The lowest numbered node on the UCN is responsible for sending the following cable commands:

- Periodic cable-swap command,
- Cable-alignment command.

According to UCN addressing guidelines, the lowest numbered node must be the NIM. Although other UCN nodes are capable of performing cable swapping responsibilities, the NIM is preferred because:

- recovery from certain communication failures is affected if the NIM is not the lowest numbered node,
- the NIM is the UCN node that an operator can access from the LCN in the case of a fault,
- cable-swapping responsibilities would add processing overhead to a process-connected node, which is not desirable.

R430 configuration restriction

On R430 and later, the following UCN configuration rules must be followed:

- The lowest UCN-addressed device on the UCN must be a NIM (see explanation above).
- All NIMs (on a physical UCN) should be configured with UCN addresses that are lower than all other device types on the network. This is not an absolute requirement, but recovery from some communication failure scenarios can be affected if this guideline is not followed.
- All devices connected to a physical UCN must be configured on all logical NIMs on this physical UCN. This is required for backup cable testing and fault recovery to function properly in some failure scenarios.
- The drop cables for a given node should be connected to the same (corresponding) port on the A cable tap as on the B cable tap. Failure to do so introduces a slight timing differential between redundant nodes and can cause problems during cable fault-recovery scenarios.

Continued on next page

Automatic periodic cable testing and swap

Normally, automatic cable switching (swap) is enabled; consequently, the Cable Master node sends cable swap commands. On R430 and later, automatic cable swap occurs every five minutes. The Cable Master node tests the alternate (inactive) cable immediately before commanding the entire network to swap. The Cable Master node does not send the swap cable command if the alternate cable network has a problem (detected by any node on the network); instead, a System Status alarm annunciates the cable error and indicates the error on the UCN displays.

The Cable Master node initiates the automatic cable testing sequence and all loaded nodes on the network participate in the test process. The total automatic cable swap operation actually consists of first testing the backup cable and then swapping to it.

The automatic cable testing is tied directly to automatic cable swapping. If automatic cable swapping is disabled, the automatic testing of the alternate cable is also disabled.

Cable alignment command

For the fault-detection algorithms to accurately identify cable problems, it is important that all nodes listen on the same cable at the same time.

In addition to the periodic cable-swap command, the lowest numbered node multicasts a cable-alignment command every 10 seconds.

The cable-alignment command:

- forces the nodes on the UCN to swap to the cable specified by that node, and
- aligns newly added nodes (just loaded) to the active cable.

ALIVE nodes

Although nodes in the ALIVE state are not token passers but listeners only, they do receive the periodic cable-swap and cable-alignment commands. This ensures that nodes entering the ring will select the correct cable for listening.

Continued on next page

When is periodic swapping disabled?

Before R430, if one or more nodes on the UCN detect cable errors, periodic swapping will be disabled. If one or more nodes have cable swap disabled, normal periodic cable swapping will not occur.

On R430 and later, the system does not disable cable swapping and cable commands cannot be sent to individual nodes, only to the entire network. Before R430, cable swapping could be performed and disabled on a node basis by the operator (Note that single node cable-swap disabling is not recommended.).

Network status check

During normal network operations, the status of the network is checked every 300 msec in order to detect low occurrence noise that impacts network performance without causing a collapse of the token ring. If noise bursts or frame fragments over a predetermined threshold occur within a 900 msec interval (3 consecutive 300 msec periods), a cable swap is performed.

Backup Cable Testing

Automatic cable testing description

The automatic cable testing that occurs immediately before an automatic cable swap is actually a sequence of tests. Each loaded node on the network will (in turn) send a test message to all other nodes. The receiving nodes will respond to the sending node if they received the message and it was error free (including noise). The testing sequence starts with the lowest node number and finishes when it reaches the highest configured node number.

The time required to run the cable test for each node is approximately 2 milliseconds. A period of time is allocated for each node number starting with the lowest configured node number through the highest configured node number.

The sequenced tests (testing by each node) are separated in time by approximately 300 milliseconds to minimize the impact on UCN operational throughput. The total test time can be quickly calculated by taking the highest node number, then multiplying this total by 300 milliseconds. If 64 nodes exist, this time calculates to 19.2 seconds.

Gaps in the sequence of configured node numbers will result in total test time being longer than if the same nodes were using consecutive numbers and ending with a lower node number.

Manual initiation of cable test and swap

It is possible to manually initiate a test sequence and swap UCN cables. This functionality is most useful when troubleshooting. The following targets on the UCN Status display (or UCN COMM Status display) are used for this purpose.

TEST / SEL CABLE A

This target initiates (through the Cable Master node) a backup cable test sequence followed by a swap to cable A. If the system is already on cable A, the backup cable (B) is tested and cable A remains selected.

TEST / SEL CABLE B

This target initiates (through the Cable Master node) a backup cable test sequence followed by a swap to cable B. If the system is already on cable B, the backup cable (A) is tested and cable B remains selected.

Continued on next page

Manual initiation of cable test and swap, continued

The above commands are most frequently used while troubleshooting with automatic cable swap is disabled; however, they are functional while automatic cable swap is enabled and simply cause an additional test sequence and cable swap when used.

ATTENTION

Time delay associated with manual cable swaps

It must be understood that selecting the [TEST / SEL CABLE A] and [TEST / SEL CABLE B] targets and initiating their action by selecting the [ENTER] target, does not produce an immediate visible result of cable swap/selection as viewed on the UCN status display. Time will first be consumed for the backup cable test sequence and then the cable selection is done. The time delay could add up to a maximum of about 20 seconds (depending on the highest configured node number).

The above manual cable commands must be followed by a bit of patience to see/obtain the results. A good practice is to provide 25 seconds (on large UCNs with high node numbers) for these commands to have their effect. If the same errors continue to exist, there may never be any visual feedback that the command has completed.

Continued on next page

Manual initiation of single node backup cable test

Manual initiation of a single node backup cable test is possible through the use of the following target on the UCN Status display. This target is available only when a specific UCN device is selected (instead of ALL NODES).

BACKUP CABLE TST

Selecting this target (and initiating its action by selecting [ENTER]) causes the selected UCN node to send a test message (on the backup cable) to all other nodes. The receiving nodes will respond to the sending node if they received the message and it was error free (including noise). There is no automatic sequencing to the other nodes.

The above manual command is normally used for troubleshooting when the automatic cable swap has been purposely disabled. It allows the experienced troubleshooter to see the results after any selected node transmits on the backup cable. The repetitive use of this command (through different nodes) assists the troubleshooter to isolate problems to a specific node (or group of nodes).

Cable Fault Detection

Purpose

The purpose of UCN fault-detection algorithm is to accomplish the results listed in Table 5.

Table 5 Cable Fault Detection Results

Cable Fault	Result
Single cable fault	All nodes continue with no loss of communication or performance.
Multiple faults to one cable	All nodes continue with no loss of communication or performance.
Two different cable faults	Nonredundant nodes: • Control functions continue • Communication between nodes may be impacted Redundant nodes: • In some cases, the node may fail itself.

Upon fault detection

Upon detecting a cable fault, a node performs the following sequence:

- swaps to the redundant cable (for listening), and
- reports the cable fault to the Cable Master node.

The Cable Master node multicasts a cable-swap command to force all nodes to the healthy cable.

R430 and later allows autorecovery when the cable fault goes away.

After receiving a cable swap command

After receiving a cable swap command from the Cable Master, the node swaps to the commanded cable (for listening).

At the time of automatic cable swap, the Cable Master runs a cable test. All nodes test the alternate cable and report problems; if there are no problems, then the Cable Master issues a swap command.

A node may ignore a cable swap command if

- the node is already listening to the commanded cable,
- the node has already received the message, or
- the node has detected silence/noise on the commanded cable.

Continued on next page

Conditions causing swap

Table 6 lists conditions detected by the cable-swapping algorithm that cause a cable swap to be initiated and the possible causes of those conditions.

Table 6 Conditions Causing Swap

Condition	Possible Causes
Silence	• Fault in drop or trunk cable. • Node is alone on the network. • One NIM with other nodes in ALIVE state. In this case, there is no token passing occurring. The NIM will read the status of the nodes on the network every 6 seconds, which causes traffic on the cables; however, the algorithm checks for silence at much shorter intervals (about 96 msec). Therefore silence will be detected in this situation.
Cannot pass token	• Node in possession of the token can't pass the token to its successor or any other node because the trunk or drop cable is faulty. • A node entered the network but is the only token-passing node (others may be ALIVE). **NOTE:** If a node is unable to pass the token on either cable because of noise, it will swap cables every 3 seconds until token passing is successfully established on one of the cables.
Successor changes	• Drop cable of successor node is faulty so can't receive token. The node establishes a new successor, but by swapping to the redundant cable the previous successor can re-enter the ring on its healthy cable. • A node's successor goes OFFNET or is powered down. The node swaps to the other cable, disables swapping, and sends a message to other nodes to do the same. In some cases, the nodes return to the original cable. Once nodes stabilize on a cable, periodic cable swapping is enabled. **NOTE**: If the successor change is caused by a new node entering the token ring (its address is between the node and its successor), no action is taken as this is a normal operation.
Token passing stops	• When token passing stops suddenly, it is assumed to be because of one or more faults on the selected cable. By swapping to the redundant cable, the token ring can be re-established.
Noise	• Faulty trunk cable. • No termination. **NOTE:** The thresholds are 25 noise bursts or frame fragments within a 300 msec interval.
Low occurrence noise	• Faulty hardware. **NOTE:** The thresholds are 3 noise bursts or 2 frame fragments in a 900 msec interval.

Continued on next page

After a cable swap

After a cable swap, the following sequence occurs:

- The 300 msec network check timer is delayed for 7 msec.
- Once token passing has been successfully established on the new cable, the 300 msec timer is started.
- If the cable was swapped because of a fault, the suspected faulty cable is tested for silence 900 msec after the swap. This allows enough time for all nodes to successfully swap to the healthy cable and stabilize network communications before testing the other cable. If silence is detected on the faulty cable, this condition is reported.
- Following a cable swap caused by a cable fault, further cable swapping is inhibited for 7.5 seconds to allow the network to stabilize after a cable fault.

Monitoring UCN Performance and Errors

Purpose

Monitoring of cable error statistics provides a means to detect a trend of deterioration in a complete cable network or in an individual node on the UCN. Planned action to correct a deteriorating UCN cable prevents serious situations later. Sudden failures caused by cable damage or circuit failure cannot be anticipated.

Monitor to establish a base line

The UCN performance and error statistics should be monitored frequently when the system is first placed on-process. Once all problems are resolved, the normal running UCN statistics should be recorded to establish a base line for later comparison.

Monitor at routine intervals

The UCN error statistics should be monitored at routine intervals and compared to the normal values for the site. After recording the error statistics, the statistics should be reset because their values are cumulative. The error rate over a given time is important whereas the total number of errors is not.

Partial frame errors

The normal cable swapping at 5-minute intervals can create the scenario where a partial frame error will occur. This error statistic can be safely ignored if the error occurs only at the time of cable swap. The number of cable swaps will closely track the number of partial frame errors in this case.

Expectations

The normal site environment is expected to cause an occasional communication error and it will be reflected in the statistics. The system is designed to operate reliably with an occasional error.

An occasional error will not cause a cable swap immediately. The automatic swap to the backup cable (caused by errors) occurs only when the error threshold on a cable reaches the point where it could impact successful system operation.

NIM Addressing and Physical UCN Cabling

NIM UCN address pinning

The NIM has UCN address pinning jumpers on the paddle board that connects to the UCN. The address created by these jumpers is used only in an off-line test mode. The NIM off-line test mode is used during UCN installation checkout.

It is suggested that the pinned NIM UCN address match the normal software-configured address to prevent possible confusion during off-line testing/troubleshooting.

In the cases of redundant NIMs, one should be pinned for the even address and the other as odd. Duplicated pinned NIM UCN node addresses are not allowed; they create problems during the off-line checkout testing.

ATTENTION

ATTENTION—The NIM's pinned UCN address must have the correct odd parity. The new EPNI board checks for this and will fail self-test if the parity is wrong. The older PNI board did not check this hardware address pinning.

Physical cable configuration

All nodes on the UCN must be cabled in the same physical sequence for both the A and B cable networks. There is no address sequence requirement along the UCN.

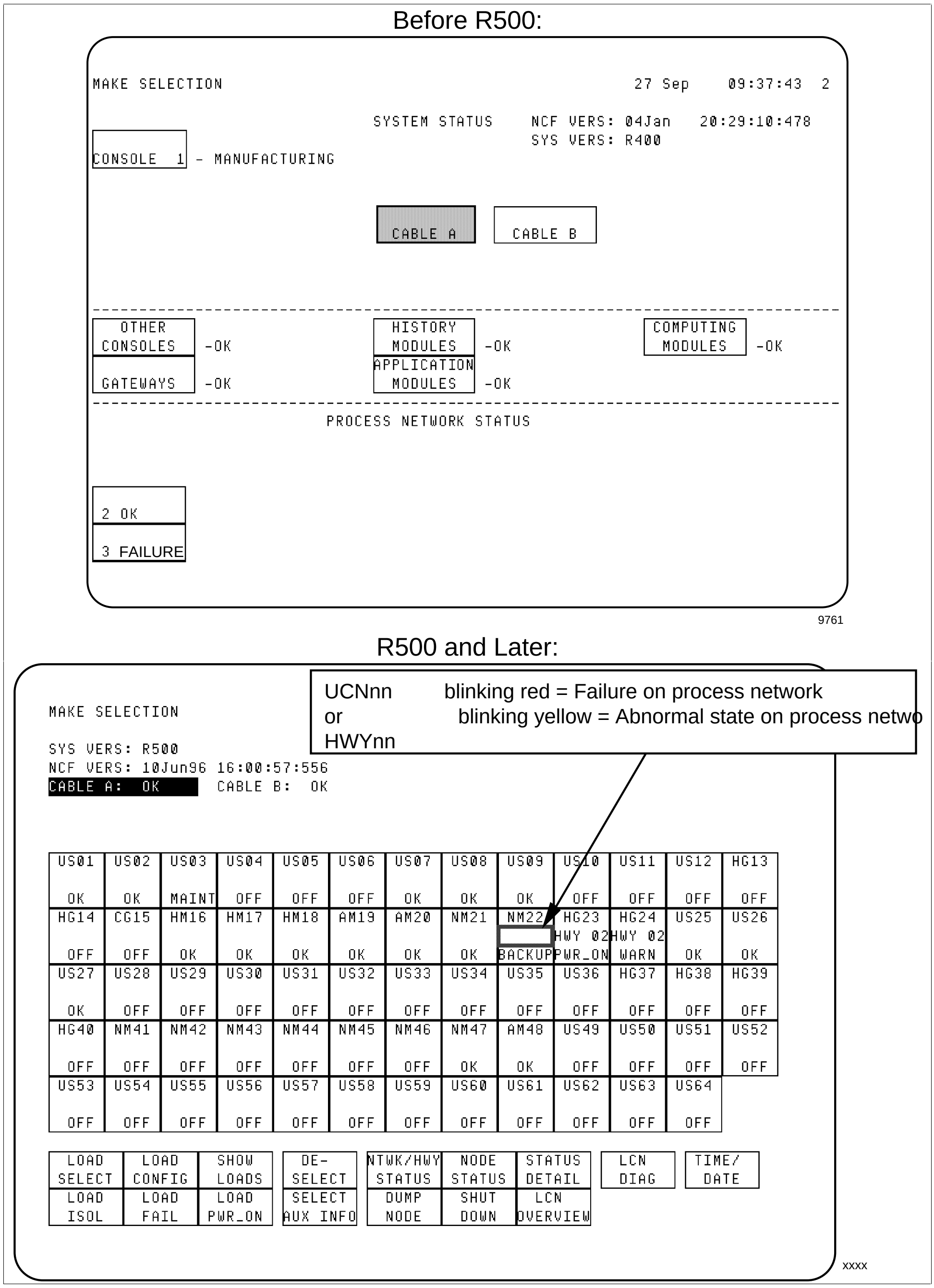
Honeywell highly recommends that all redundant nodes (NIMs and other device types) should have their UCN A and B drop cables connected to the same physical trunk tap (for their respective drop cables) whenever possible. The NIM A and B drop cables should also be of equal length; also, the A and B drop cables should be connected to the same port position on the taps. Failure to do so introduces a slight timing differential between redundant nodes and can cause problems during cable fault-recovery scenarios.

UCN Cable Status Indicators—System Status Display

System Status display

The System Status display shows information concerning the status of the system including the NCF version, the system software version, the current LCN cable, the overview status of the nodes on the LCN, and the status of the process networks on the system.

Figure 33 System Status Display



Continued on next page

Indicators

The System Status display shows the process network status for each process network on the system:

- Before R500—Indicator appears at the bottom of the display, inside the target for the process network.
- R500 and later—Indicator appears in the middle of the display, inside the target for the NIM.

PreR500 Indication

Before R500, the following states would indicate a UCN communications failure inside the process network target the bottom of the System Status display:

State	Description
SWITCH	The SWITCH status indicates that a problem was detected on one UCN cable, that it has automatically swapped cables, and all nodes are running properly on the remaining cable.
FAILURE	The FAILURE status is brought up by a multitude of things. UCN problems that result in a node going offnet or failing fall into this category.

R500 and later

When a process network node is configured, but not present on the current page of an R500 *custom* System Status display, the message OTHER PROCESS NETWORKS appears along with the composite status of the process network nodes that are not displayed:

- OK
- IDLE
- SWITCH
- RECOVER
- FAILURES

REFERENCE—Refer to Table 11-3 of the Process Operations manual for a description of the composite statuses for OTHER PROCESS NETWORKS.

Continued on next page

PreR500 SWITCH status

Prior to R500, the SWITCH status indicated a problem with one cable of the network and that it has automatically swapped cables.

The status will not be annunciated because there is no alarm situation. The view to the process has not been interrupted. It is highly recommended that the operator periodically look at the system status display to detect a SWITCH status concerning UCN cable network.

NOTE: The cable A and B targets at the top center of the display indicate the condition of the LCN cables. They should not be confused with the process network cable (UCN or hiway) indications (SWITCH) at the bottom of the display.

Next step

You do not know the exact nature or scope of the problem without selecting the target of the specific network with the problem. Selecting the network target produces the UCN Status display for UCN networks. A Hiway Status display appears if the network is implemented on Data Hiway equipment.

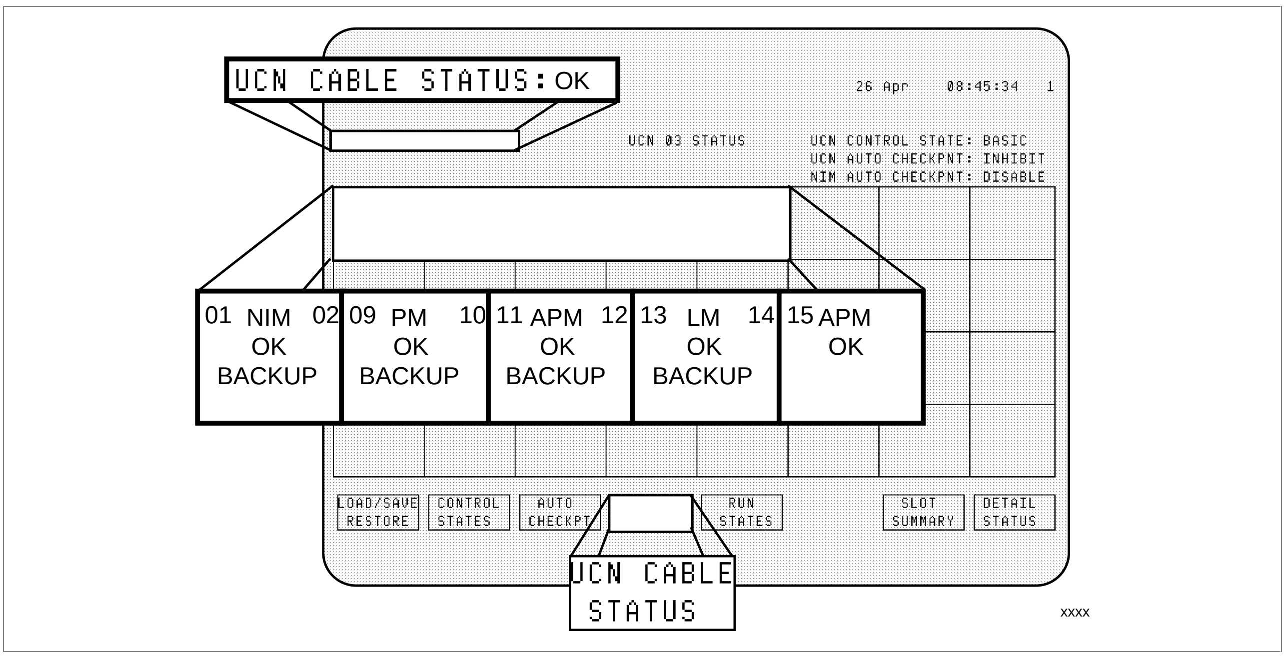
UCN Cable Status Indicators—UCN Status Display

UCN Status display

Figure 34 shows an example UCN Status display. Each of the possible 32 configured UCN node pairs appears here as a square. The example shows the following:

- Redundant NIM (UCN addresses 01 and 02)
- Redundant PM (UCN addresses 09 and 10)
- Redundant APM (UCN addresses 11 and 12)
- Redundant LM (UCN addresses 13 and 14)
- Nonredundant APM (UCN address 15)

Figure 34 UCN Status Display



Node numbering

It must be clearly understood that the order (left to right) of the UCN nodes shown in the display always appears in ascending UCN address order. The display does **NOT** show the physical UCN cable routing from node to node. It is possible that the physical map would match this display, but only if it was deliberately cabled to be that way.

Cable status indication and target

The UCN cable status at the top left shows either OK or FAIL. The OK indicates no problems with either cable. Select the [UCN CABLE STATUS] target at the bottom of the display to obtain greater visibility into the cable status as seen at each node.

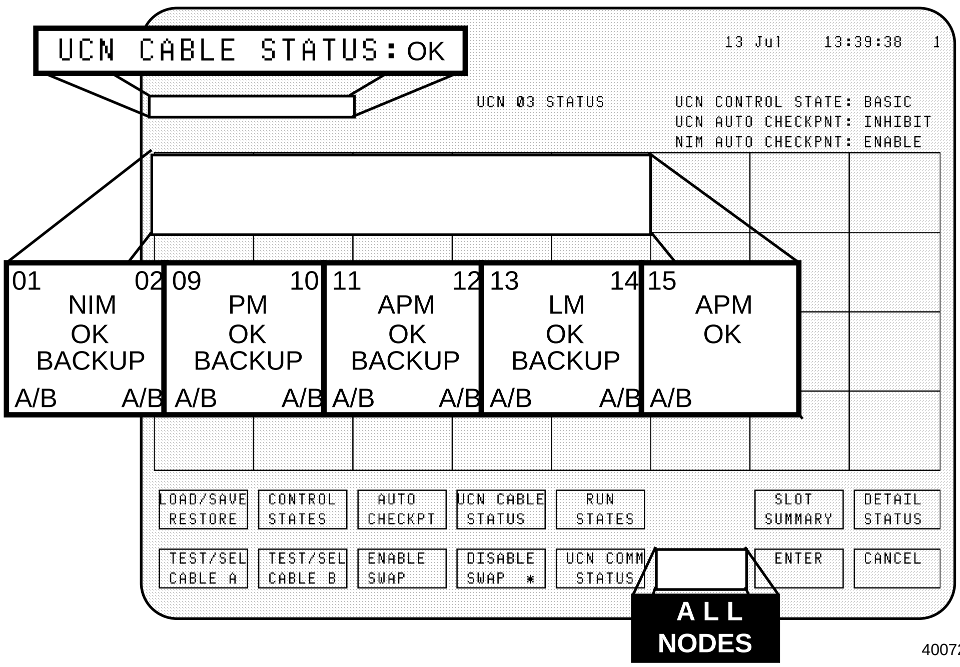
Continued on next page

UCN Cable Status Indicators—UCN Status Display, Continued

Node cable status indication

After selecting the [UCN CABLE STATUS] target, the cable indications appear in each node status box, as indicated in Figure 35. Each node separately shows the A/B cable status. The cable letter on the left identifies which cable is the active cable (currently used for listening).

Figure 35 UCN Status Display (Listening to Cable A)



Example—cable A active

The example in Figure 35 tells you that each node identifies both cables as acceptable (error-free or very low error rate) and they are currently listening only to the A cable.

ALL NODES target

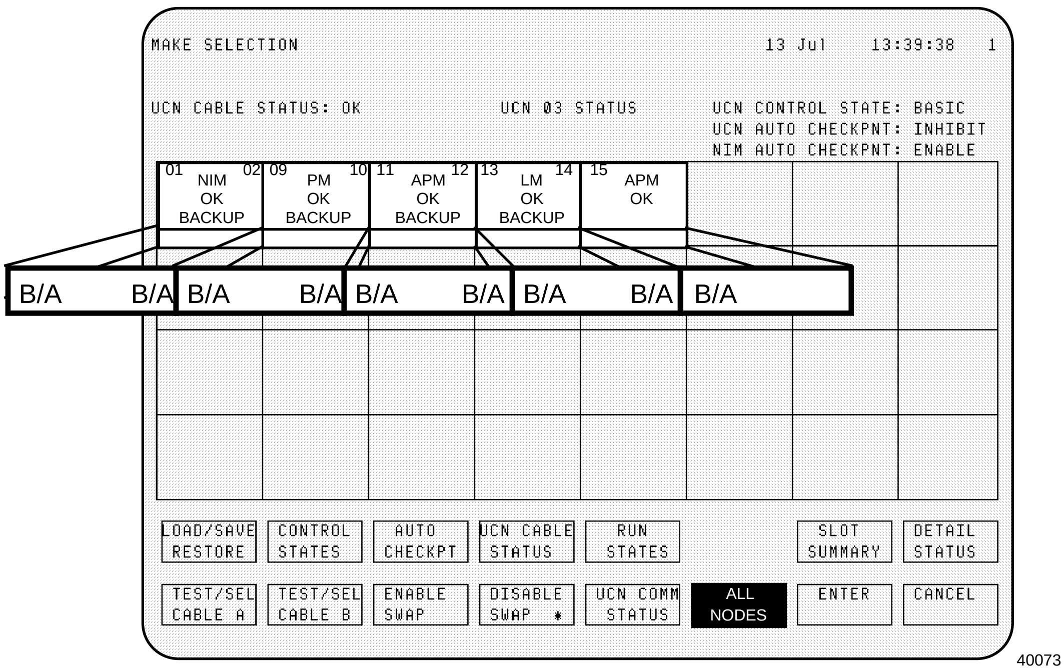
The [ALL NODES] target is automatically selected (backlighted) when the display appears, because manual cable commands to individual nodes are not allowed.

Continued on next page

Example—cable B active

Figure 36 shows that all is well with both cables and that the UCN nodes are currently listening to the data transmissions on the B cable.

Figure 36 UCN Status Display (Listening to Cable B)

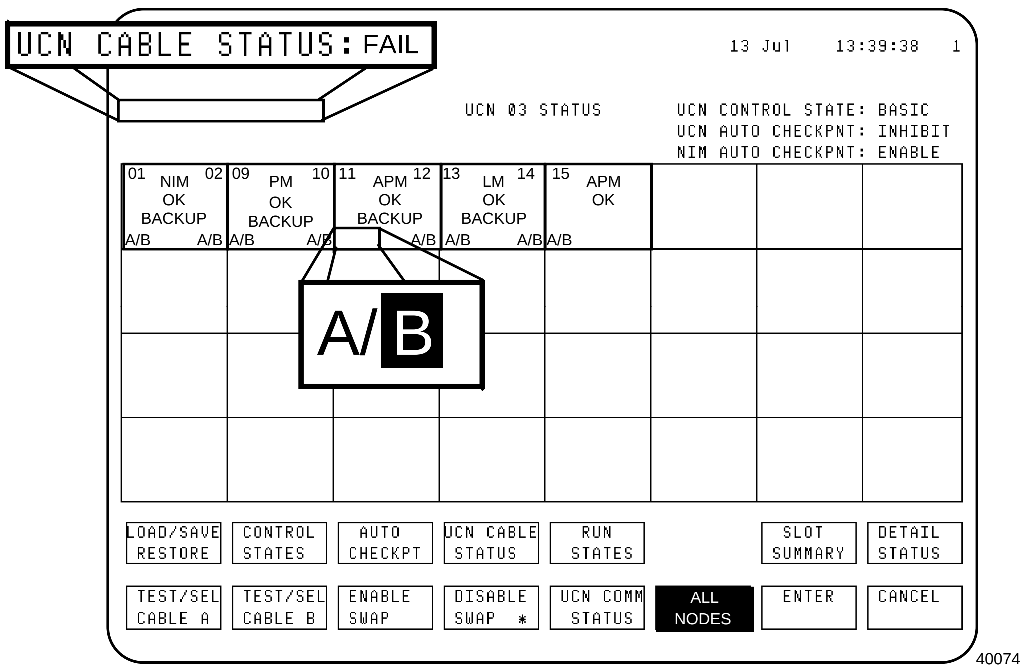


Continued on next page

Example—cable B problem

Figure 37 shows the UCN nodes listening to cable A. Notice that the B (cable display) has backlighting (red) in one of the nodes. The backlighting identifies the node (or nodes) that detected a failure on that cable. The failure you see in Figure 37 was created by disconnecting the B drop cable from the APMM (address 11) in the APM. The failure detecting nodes “swapped” cables and communicated this fact to the Cable Master node. Subsequently the other nodes were commanded to “swap” to the good cable by the Cable Master node.

Figure 37 UCN Status Display (Listening to Cable A, Error B)



Automatic recovery

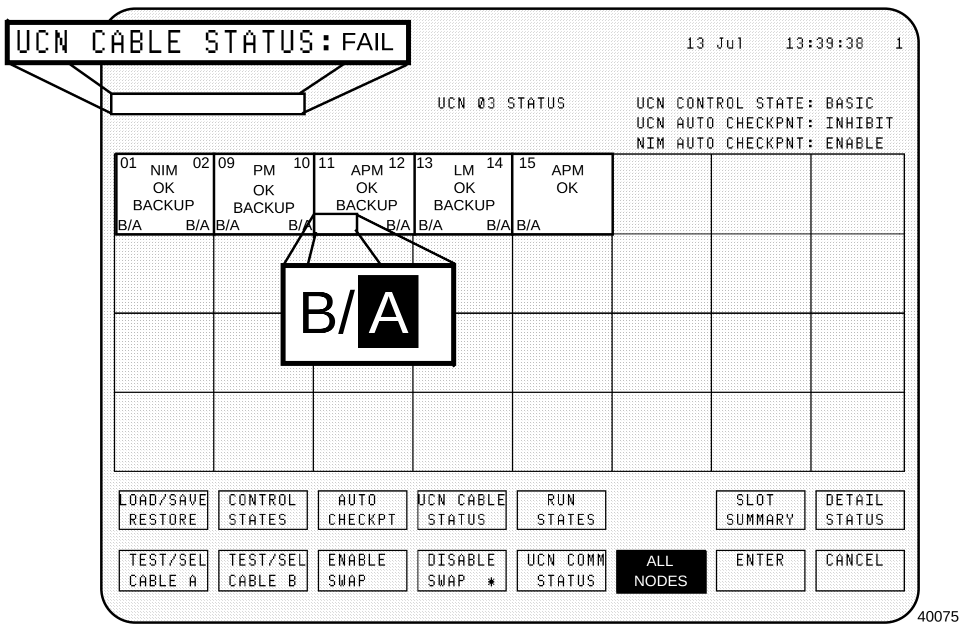
Once a cable has been identified (by the system) to have a problem and automatic cable swapping is **not** disabled, an automatic single node test of the bad cable is initiated by the Cable Master node every 60 seconds as the system continues to operate on the good cable. If the problem still exists, nothing changes. If the problem has been repaired (or disappeared), the error indication is automatically removed and the cable operation returns to normal with automatic cable swap occurring every 5 minutes.

Continued on next page

Example—cable A problem

Figure 38 shows the UCN nodes listening to cable B and a problem identified with cable A. Compare Figures 37 and 38. The difference is that the cable failure is on the opposite cable. The failure shown in Figure 38 was created by disconnecting the A drop cable from the APMM (address 11) in the APM.

Figure 38 UCN Status Display (Listening to Cable B, Error on A)



Procedure to Disable Automatic Cable Swapping

Purpose

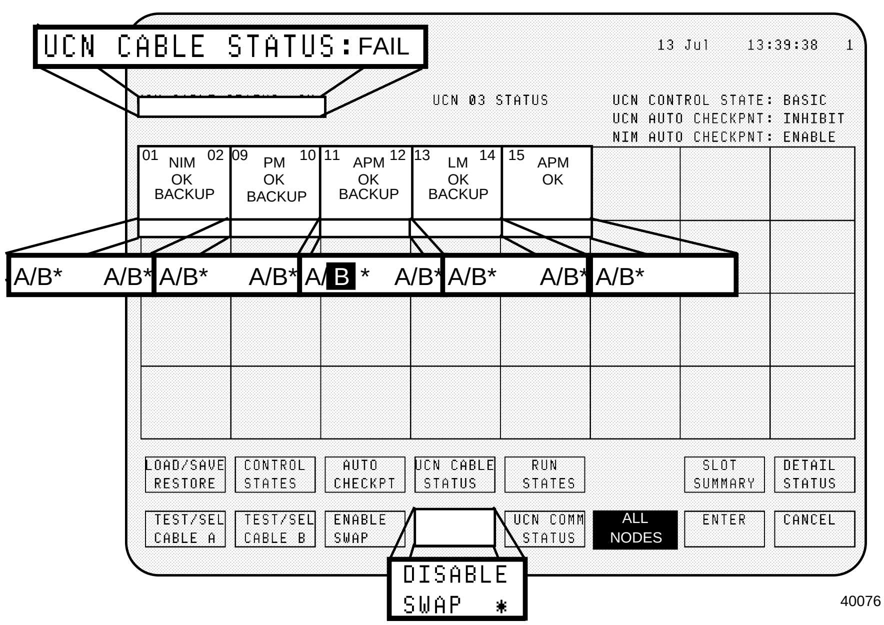
The automatic (periodic) cable swapping can be manually disabled and enabled. The disable of automatic cable swapping is frequently used when troubleshooting. It prevents interference by the system while manual cable manipulation commands are in use to isolate or repair a problem. The disable feature stops two normal activities:

- The automatic backup cable test and subsequent swap to the backup (every 5 minutes) is not done.
- The detection of a problem on the current active cable still causes an automatic unconditional swap to the backup cable; however, the normal subsequent automatic testing of the backup cable (every 60 seconds) is not done. The backup cable will not be recovered even if the problem disappears or is repaired. You must perform a manual cable command (TEST BACKUP CABLE or TEST/SEL CABLE X) for the system to attempt any action with the backup cable.

Procedure

Enabling and disabling the automatic cable swap is done with the [DISABLE SWAP *] and [ENABLE SWAP] targets. Selecting the [DISABLE SWAP *] target causes the cable information on the UCN status display to be flagged with an asterisk (see Figure 39). The asterisk serves as a reminder that automatic swapping is disabled.

Figure 39 UCN Status Display (Cable Swap Disabled)



Continued on next page

UCN cable targets—before R430

Notice the UCN cable manipulation targets at the bottom of the UCN Status display shown in the previous section. Their functions before R430 are described in Table 7.

Table 7 Manual UCN Cable Commands—Before R430

Target	Description	Result
SELECT CABLE A	Causes a command to be sent on the UCN, instructing the selected node to swap to cable A (for listening).	This command is sent to all nodes if the ALL NODES target is backlighted (selected). See note below.
SELECT CABLE B	Causes a command to be sent on the UCN, instructing the selected node to swap to cable B (for listening).	This command is sent to all nodes if the ALL NODES target is backlighted (selected). See note below.
ENABLE SWAP	Causes an Enable Swap command to be sent to the selected node. This command causes the Disable Swap (*) and possible error indications to be cleared. Subsequent detected errors are displayed as before.	This command is sent to all nodes if the ALL NODES target is backlighted (selected). Cable Swap commands are multicast on the UCN every 15 minutes by the node responsible for cable swapping.
DISABLE SWAP	Causes a Disable Swap command to be sent to the selected node. The node no longer responds to Cable Swap commands from the node responsible for cable swapping.	This command is sent to all nodes if the ALL NODES target is backlighted (selected).
Note: Because of cable alignment commands from the node responsible for periodic cable swapping, an individual node stays on the nonsystem cable for only 10 seconds or less.		

Continued on next page

UCN cable targets—before R430, continued

Table 7 Manual UCN Cable Commands—Before R430 (cont.)

Target	Description	Result
UCN COMM STATUS	Selecting this target pulls up the UCN Statistics-Network display (refer to Figure 25).	A blank UCN Network Statistics display appears with the message “SELECT NODE NUMBERS BELOW.”
ENTER	Selecting this target executes the action of any command selection (five targets located to the left of this target).	
ALL NODES	Selecting this target will cause any command selection to be sent to all nodes on the UCN.	

WARNING

—Before R430

WARNING—Refer to Table 8. The use of the SELECT CABLE targets and the ENABLE/DISABLE targets (with individual UCN nodes selected) can cause undesirable results when used concurrently with certain unique failure scenarios. They should not be used on an on-process system unless you are in voice contact with a TAC Engineer. Unique recovery actions may be needed if loss of view to the process occurs because of the use of these targets.

These diagnostic commands can be safely used at any time if the ALL (all nodes) target is selected.

Continued on next page

UCN cable targets—R430 and later

Table 8 describes the UCN cable command targets for R430 and later.

Table 8 Manual UCN Cable Commands—R430 and later

Target	Description	Result
TEST / SEL CABLE A	This command is sent to the UCN Cable Master node. The Master node commands a Backup Cable test sequence followed by a Swap to Cable A command.	The Master node sends the test and swap commands to all nodes. If no error is detected, cable A becomes the current active cable after the test completes. The cable swap action will take up to 20 seconds to take effect (depends on total number of nodes to be tested). If a failure is detected, it is flagged by the detecting node (cable backlighting on display) and the cable swap command is not issued.
TEST / SEL CABLE B	This command is sent to the UCN Cable Master node. The Master node commands a Backup Cable test sequence followed by a Swap to Cable B command.	The Master node sends the test and swap commands to all nodes. If no error is detected, cable B becomes the current active cable after the test completes. The cable swap action will take up to 20 seconds to take effect. (depends on total number of nodes to be tested. If a failure is detected, it is flagged by the detecting node (cable backlighting on display) and the cable swap command is not issued.
ENABLE SWAP	Causes an Enable Swap command to be sent to the Cable Master node. This command causes the Disable Swap (*) to be cleared.	This command is broadcast to all nodes by the Cable Master node. Backup Cable Test and Cable Swap commands are broadcast on the UCN every 5 minutes by the Cable Master node.
DISABLE SWAP	Causes a Disable Swap command to be sent to the Cable Master node.	The automatic Backup Cable Test and Cable Swap (every 5 minutes) are not done. If an error is detected on the currently active cable, a swap is done to the good backup cable, but the automatic test of the bad cable (every 60 seconds) is not done.

Continued on next page

UCN cable targets—R430 and later, continued

Table 8 Manual UCN Cable Commands—R430 and later, Continued

Target	Description	Result
RESET STATS	Selecting this target resets all of the statistics of the selected node to zero.	This command is broadcast to all nodes if the ALL NODES target is backlighted (selected).
ENTER	Selecting this target executes the action of any command selection (five targets located to the left of this target).	
ALL NODES	Selecting this target will cause any available command selection to be sent to all nodes on the UCN.	
RECOVER CABLE A RECOVER CABLE B	These targets appear after selecting the primary NIM on the logical UCN if the NIM has been in the COMMFAIL state longer than 10 minutes.	The NIM restores view to the UCN on the repaired/selected cable.
BACKUP CABLE TST	Appears only when single nodes are selected.	Causes a single node test of the alternate cable to be initiated from the selected node. Nodes detecting problems on the backup cable will report errors (red stars or red backlighting of cable on displays).

WARNING

—R430 and later

WARNING—Honeywell highly recommends that the system be operated with automatic cable swapping enabled. Failure to do so prevents the automatic testing and use of the alternate cable (every 5 minutes). If the system is operated with automatic swapping disabled, a Backup Cable failure will go undetected until a problem on the active cable causes a swap.

Crossed Network Cables

Problem description

Crossed cables are not apparent when both cables are working properly. Cable switching appears to work normally and manual cable manipulation commands also work. The problem shows up when a true cable fault occurs. The cable error detection and subsequent cable swap algorithms designed into each UCN node become defeated and the node (with crossed cables) detecting the true cable problem may end up dropping OFFNET. There is no recovery form this until the cable problem is resolved.

The crossed cable situation can occur in two ways:

1. Crossed node drop cables that cause the specific node to be out of step with the cable swap algorithms of the Cable Master and other nodes of the UCN.
2. Crossed trunk cables anywhere along the network—This can result in more than one node being out of step with the cable swap algorithms of the Cable Master node.

Preventing Crossed Cables

Purpose

The importance of preventing a crossed-cable situation cannot be stressed enough. Crossed UCN cables between the Cable Master node and any or all other nodes is a serious situation that has the potential of creating a real disaster (loss of view to the process) for a single cable failure.

Cable network marking

It is highly recommended (should be absolutely mandatory) that the A and B UCN cable networks be clearly marked at all points. This includes trunk cables, taps, and drop cables. This should greatly reduce the human error factor and provide a means for a quick visual check. Color-coded cable marking kits (rings) are available from Honeywell.

The careful cable marking and connection discipline becomes infinitely more complex when outside vendors are used for installing the UCN cable networks. Detailed instructions must be provided to the vendors with checks to verify that the cable installation and markings are indeed correct. The requirement of a detailed physical UCN map must also be specified.

Continued on next page

UCN Installation sequence suggestion

The chances of completing a UCN installation containing crossed cables can be greatly reduced if a planned sequence is followed. The UCN cable connections should be made and verified one cable at a time if possible. The following steps can be used if software has been loaded and UCNs have been configured on the LCN.

The above sequence can be done starting with network cable B and finishing with network cable A in step 8.

Table 9 Installing UCN Cables

Step	Action
1	Observing color codes, connect only the cable A drop cable to the Cable Master NIM (Primary, if redundant NIMs are configured).
2	Observing color codes, connect only the cable A drop cable to the remaining UCN nodes, including additional NIMs.
3	Ensure that the Cable Master node is loaded. Leave all other NIMs (including redundant partner, if so configured) in the POWER_ON (OFFNET) state.
4	Power up all other connected nodes and observe the Network Status display. HPMs, APMs, PMs, LMs, and SMs should show as ALIVE (with the B cable flagged as bad) after power up and established communication with the NIM.
5	All connected nodes (except additional NIMs) should work on cable A, as seen on the Network Status display.
6	Resolve all problems with the connected nodes (except additional NIMs that are not yet loaded) by using the UCN status displays, before you continue. Crossed cables can easily be detected because the B cable does not have any connection to the Cable Master NIM.
7	Load the additional NIMs one at a time and observe the Network Status display. The additional NIMs should all show as working on cable A. Resolve any problems before you continue.
8	Observing color codes, connect the cable B drop cables to all of the nodes including NIMs. All nodes should work on cable B. Resolve all problems by using the UCN status displays.

Continued on next page

Crossed Network Cables

WARNING

WARNING—The following crossed-cable detection technique can cause loss of view to the process when a crossed cable is found. It is highly recommended that you be in direct contact with a TAC support engineer if you attempt this technique on an on-process network.

Background for detecting a crossed cable situation

The process of checking for a crossed network cable requires introducing a cable fault at each node, one at a time.

The problem insertion consists of disconnecting one of the UCN drop cables at the node. Nodes with correct cable alignment automatically swap cables and operate on the remaining error-free cable, whereas nodes with crossed cables drop OFFNET. Redundant partners remain operational.

Redundant partners of PMM/APMM/HPMMs show a PARTFAIL status. This is caused by the failure of communications with the redundant partner. Redundant partners communicate with one another in the following ways:

1. The majority of communication is done through the private dedicated redundancy driver circuits and dedicated redundancy path between the redundant partners.
   - This path is provided through the backplane in *side-by-side* PMMs/APMMs.
   - In o*ver/under* PMM/APMM configurations, this path is provided by the cable connected between each partner card file.
   - In *all configurations* of redundant HPMMs, a cable provides the redundancy path between the redundant partners.
2. Some status information is passed between redundant PMM/APMM/HPMM partners over the UCN cable. This is the reason for the PARTFAIL error when a crossed-cable situation encounters a real cable problem.

Continued on next page

Detecting Crossed Network Cables

Detecting a crossed cable

The procedure in Table 10 can be used when attempting to detect crossed cables in a network that appears to be running without cable problems. Remember, this can cause a node to go OFFNET and lose vision to the process when crossed cables are encountered. It is best to plan this as an off-process activity.

Table 10 Procedure for Detecting Crossed Cables

Step	Action
1	Obtain the Network Status display for the UCN network in question.
2	Select the [UCN CABLE STATUS] target.
3	Select the [ENABLE SWAP] target.
4	Observe the display for the first UCN node to be tested for crossed cables. Everything should appear normal.
5	If the node to be tested has a redundant partner, determine the physical hardware that has the BACKUP status by selecting the specific partner (PMM/APMM/HPMM target turns blue). Then select the [DETAIL STATUS] target to obtain the node status display. **Never introduce a cable fault at the node with the OK (Primary) status when redundant partners are present**. It causes a switchover to the the redundant partner with a possible failure of the node you are testing. This may also require reloading of the node. In other words, avoid all the confusion by testing only the BACKUP node when redundant partners exist. A redundant partner node with the OK status (primary) can be safely tested for crossed cables only after switching the primary functionality to the partner with the original backup status. This reversal of PMM/APMM roles is done by selecting the [RUN STATES] target, then selecting the [SWAP PRIMARY] target. This switch should be done with all cables connected.
6	Return to the Network Status display of the network in question.

Continued on next page

Detecting a crossed cable, continued

Table 10 Procedure for Detecting Crossed Cables (cont.)

Step	Action
7	Select the [TEST / SEL CABLE A] target on the Network Status display with the [ALL NODES] target selected. This ensures that the network operation will attempt to stay on cable A for the next 5 minutes. You are expected to create the failure on cable A within this time period. If there is any doubt, select cable A again before you introduce the failure in the next step.
8	Watch the node status and cable status on the Network Status display as you disconnect the UCN drop cable A at the node to be tested for crossed cables. One of two things will happen: 1. The node remains in a functional status with the cable statistics showing a problem with cable A (*). This then is reflected throughout all nodes on the network. This result is normal for a disconnected cable. There are no crossed cables to this node. 2. The node cable status disappears and the node goes OFFNET a few seconds later. This indicates the node has crossed cables somewhere between it and the Cable Master Node. If the node does not have a redundant partner, view to the process is lost. If this node has a redundant partner (PMM, APMM, or HPMM), the functional partner shows a PARTFAIL status caused by failed UCN communications from the node under test for crossed cables. The node can quickly be brought back to functional status by connecting the removed cable. You have detected crossed cables at this node but the problem is not corrected nor is it completely defined as to where the cross is located. If the node goes to the FAILED state and the Communication Error Block value is 0A2x, it can be returned to service by executing the SHUTDOWN/RECOVER command.
9	Repeat steps 4 through 8 for each node on the network. You will be able to make a determination of where the cables are crossed by learning which nodes are showing crossed cables and then correlating this information against the UCN physical map.

Continued on next page

REFERENCE—The following manual explains how to read and interpret UCN node error block values. Refer to it if you require assistance performing this task.

PM/APM Service manual or *HPM Service* manual
Section 4 (Fault Isolation)
Figure 4-1 (flowchart sheet 3 of 6)
Binder: TPS 3061-1, PM/APM/HPM Service

Continued on next page

Correcting Crossed Cables

Correction of crossed cables

The correction of crossed drop cables to a node can be accomplished quite easily if extra tap connections to the trunk cable are available near the node with crossed drop cables. You should not lose vision to the process while doing this if no real errors occur in the process; therefore, it is recommended that you be in direct contact with a TAC Support Engineer if you attempt to do the following in an on-process system.

ATTENTION

You will have to remain aware of time as you go through the steps to correct crossed cables. The automatic cable swap will occur every 5 minutes and may change the cable selection you performed in a previous step.

Procedure

Table 11 describes the procedure to correct crossed-cables.

Table 11 Procedure for Correcting Crossed Cables

Step	Action
1	Command the UCN network to select Cable A. The crossed node is actually listening to the B cable through the A cable connection.
2	Disconnect the drop cable (currently between the node cable B connector and UCN A trunk tap) from the A cable tap. Be sure to terminate the trunk as you remove the cable.
3	Make sure the system remains on Cable A. If it switched to cable B, again command it to switch to cable A.

4	Connect the removed drop cable to an extra tap available on the B trunk cable
5	Command the UCN network to select Cable B. The node is now properly listening to the B cable through its B cable connector.
6	Disconnect the drop cable (currently between the node cable A connector and UCN B trunk tap) from the B cable tap. Be sure to terminate the drop at the tap as you remove the cable.
7	Make sure the system remains on Cable B. If it switched to cable A, again command it to switch to cable B.
8	Connect the removed drop cable to the A trunk cable. This must be physically on the same tap used by its partner node if a redundant partner exists.

Continued on next page

Correction of crossed cables, continued.

Table 11 Procedure for Correcting Crossed Cables, continued

Step	Action
9	Command the UCN network to select cable A.
10	Disconnect the B cable from the spare drop connection and connect it to the B trunk cable using the same tap used by its partner node if a redundant partner exists.

Providing for extra tap drop connections on the trunk cables within reach of each UCN node is a recommended practice.

If there are no spare trunk taps available, the correction of the cable cross may have to wait until such time that the process is brought down or in such a state that loss of view for some time will not cause a problem. This is especially true if the cross is on the trunk cables. You will have to make the determination based on the process and conditions at hand.

Summary

It is far easier to take steps to prevent crossed cables than it is to correct them once the system has gone on-process. Diligent cable marking and attention to physical map details will go a long way in preventing crossed cables; however, continued care and discipline are required when performing maintenance or system upgrade tasks to prevent crossed-cable situations from appearing in a system.

UCN Autoreconnect

Introduction

What is autoreconnect?

When double or multiple cable faults occur on the UCN, nodes on the network may lose communication with each other. Autoreconnect is the mechanism that allows UCN nodes to automatically re-establish communication on the UCN following repair of certain fault conditions. This means that communication, view, and peer-to-peer control are recovered without operator interaction.

Which nodes can autoreconnect?

NIMs, PMs, APMs, and LMs in the R4xx environment (and the HPMs and SMs in R500 and later) have the ability to autoreconnect. This applies to nonredundant nodes, and at least one node in a redundant pair.

What initiates the autoreconnect?

The LLC in a node is responsible for notifying the driver when a communication failure has been detected. The autoreconnect task, which is normally in a dormant state, will then be initiated by the driver if the failure is caused by one of the following conditions listed in Table 12.

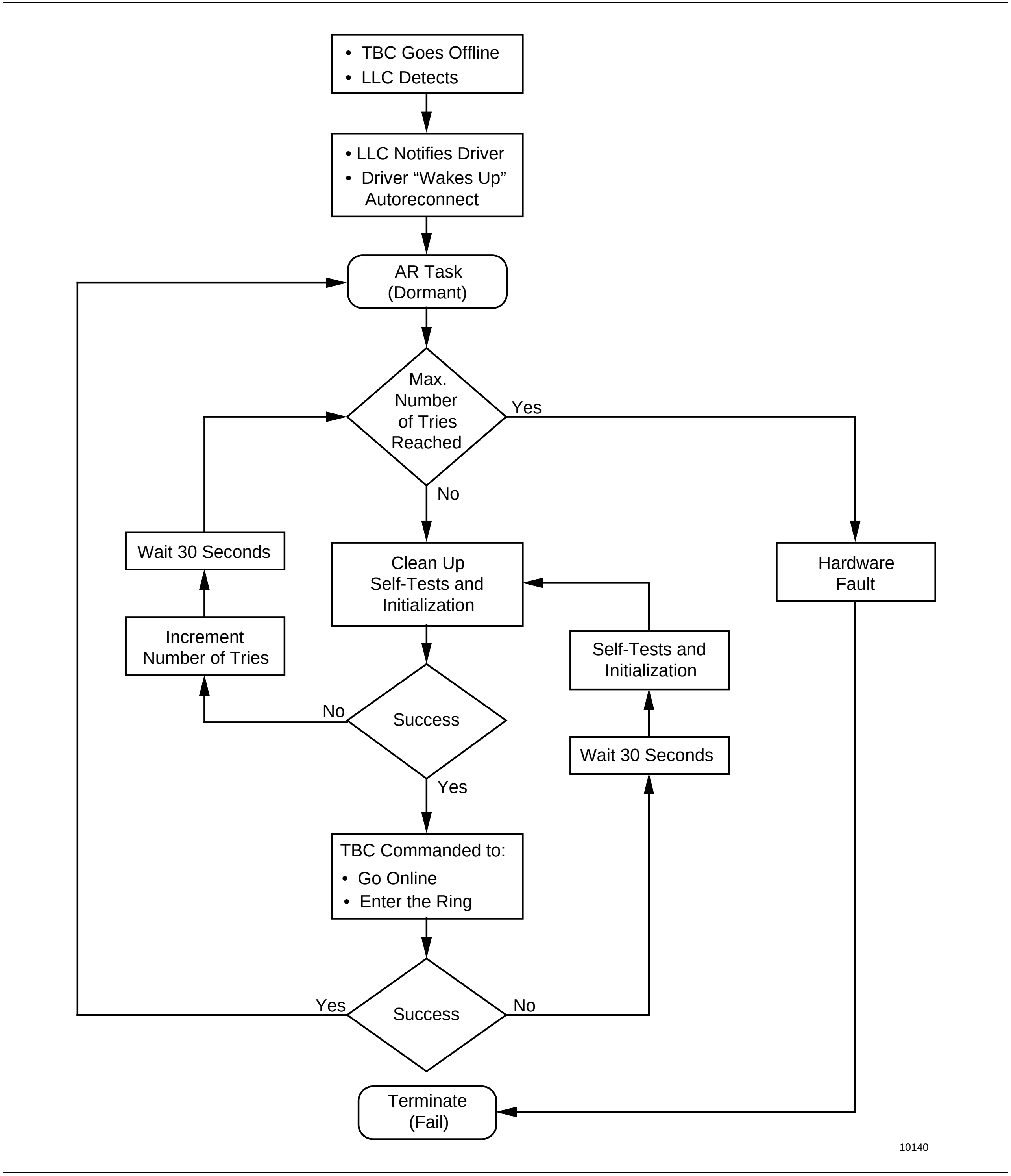
Table 12 Conditions for Reconnect

Condition	Definition
Transmit hang	When frame fragments or noise occur on both cables, the TBC will not go OFFLINE, but the driver will eventually detect that frames are not being successfully transmitted on the network.
Jabber	The modem detected that the TBC transmitted for more than half a second. The TBC enters the OFFLINE state.
Faulty transmitter	The TBC goes OFFLINE following the detection of six transmitter errors in the lowest numbered node, or after seven transmitter errors for all other nodes. Because the cable-swapping algorithm is designed to detect conditions that might be interpreted by the TBC as faulty transmitter and to take actions to avoid the TBC entering the OFFLINE state, it's not likely that cable faults will cause this condition; however, the autoreconnect task is designed to act upon detection of this condition.

Autoreconnect Task

Autoreconnect sequence

Figure 40 Autoreconnect Sequence



Autoreconnect for Nonredundant Nodes

Nonredundant NIMs

When a nonredundant NIM detects that UCN communications have been lost, the Autoreconnect function will become active in that node if the LLC has detected one of the previously listed conditions.

While the NIM is attempting to autoreconnect, its status on the UCN Status display will show COMMFAIL. The status of the other UCN nodes will be UNKNOWN.

If the autoreconnect is successful in restoring communications, the status of the NIM will change to OK and the status of the other UCN nodes will return to normal as well.

Nonredundant HPMMs, APMMs, LMMs, and SMMs

If an HPMM, APMM, LMM, or SMM loses its UCN communication, its status will change to OFFNET while attempting to autoreconnect. During this time, local control is maintained.

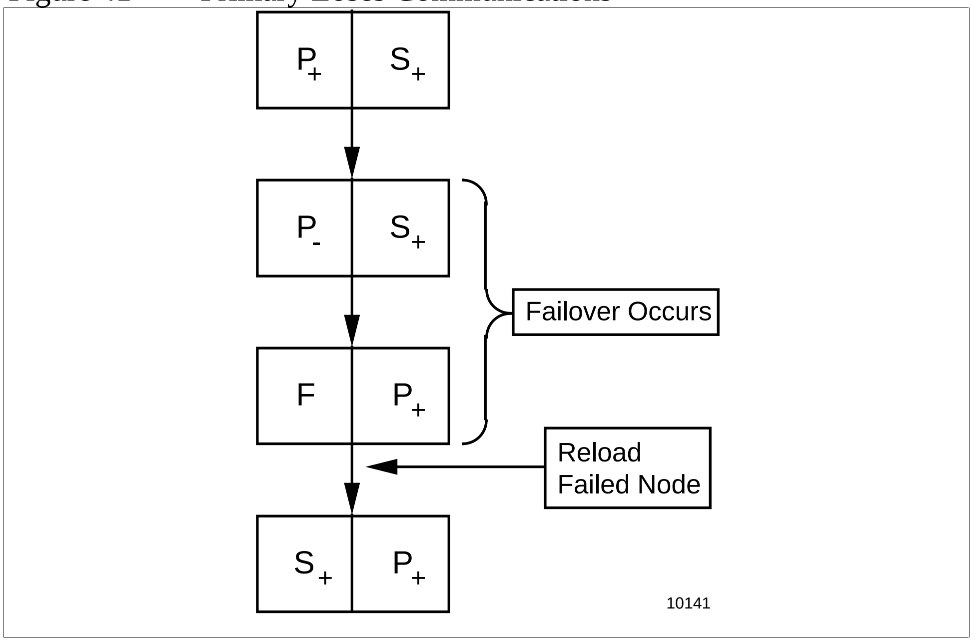
Autoreconnect for Redundant Nodes

Primary loses communication

In this case, the Primary node loses UCN communication while the Secondary node retains normal communication. The Primary will fail in order to allow the Secondary to take over as a healthy primary. No autoreconnect functions will occur. The operator must reload the failed node once the problem has been fixed in order to re-establish it as a healthy Secondary.

This scenario applies to redundant NIMs, PMMs and APMMs in R400 as well as prior releases and is depicted in Figure 41.

Figure 41   Primary Loses Communications



Where	P	= Primary
	S	= Secondary
	+	= Node is in an operational state (OK,IDLE, etc.)
	-	= Node is in the OFFNET or COMMFAIL state
	F	= Node is in a FAIL state

Continued on next page

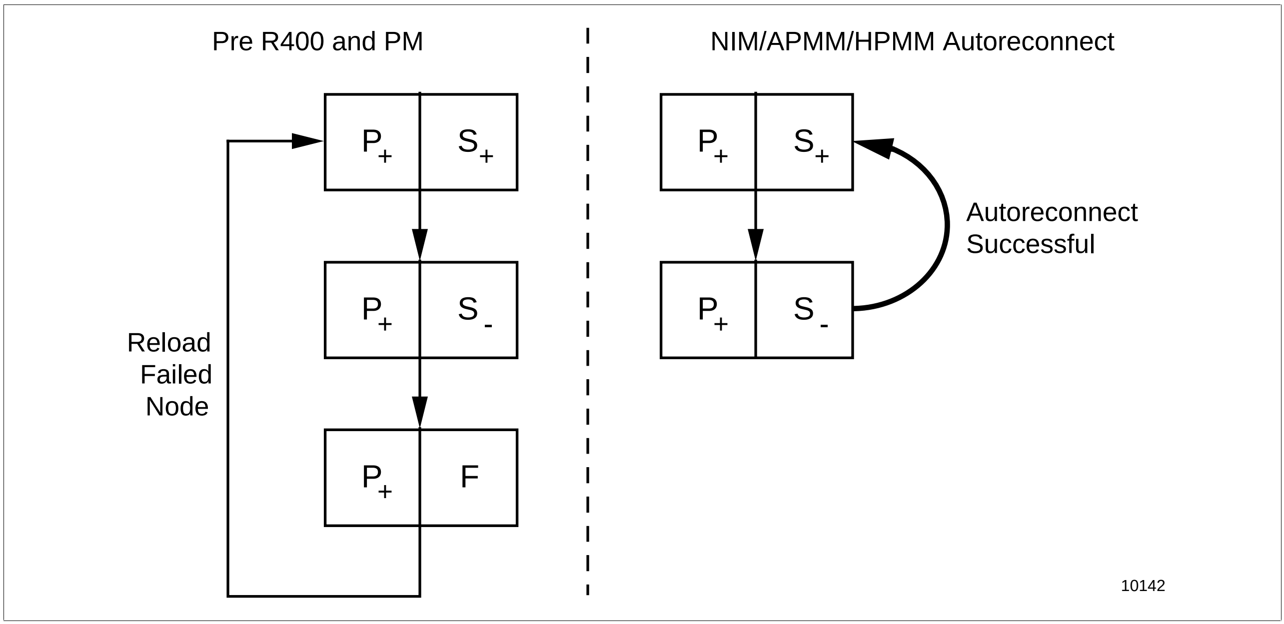
Secondary loses communication

In this scenario, the Secondary node can’t communicate on the UCN while the Primary continues to communicate normally.

Before R400, a Secondary node that lost UCN communication was failed. In R400 and later, Secondary NIMs, APMMs, HPMMs, and SMMs in this situation attempt to re-establish communication on the UCN by using the autoreconnect procedure. A Secondary NIM involved in autoreconnect will show a status of COMMFAIL. A Secondary APMM/HPMM/SMM will have a status of OFFNET while attempting to autoreconnect. If the autoreconnect is unsuccessful, the node will then fail.

Figure 42 shows this situation for nodes before R400 and for R400 (and later) NIMs and APMM/HPMM/SMMs.

Figure 42 Secondary Loses Communication



Where	P	= Primary
	S	= Secondary
	+	= Node is in an operational state (OK,IDLE, etc.)
	-	= Node is in the OFFNET or COMMFAIL state
	F	= Node is in a FAIL state

Continued on next page

Primary and secondary lose communication

In this scenario, both Primary and Secondary nodes detect communication problems. Failover does not occur in this situation.

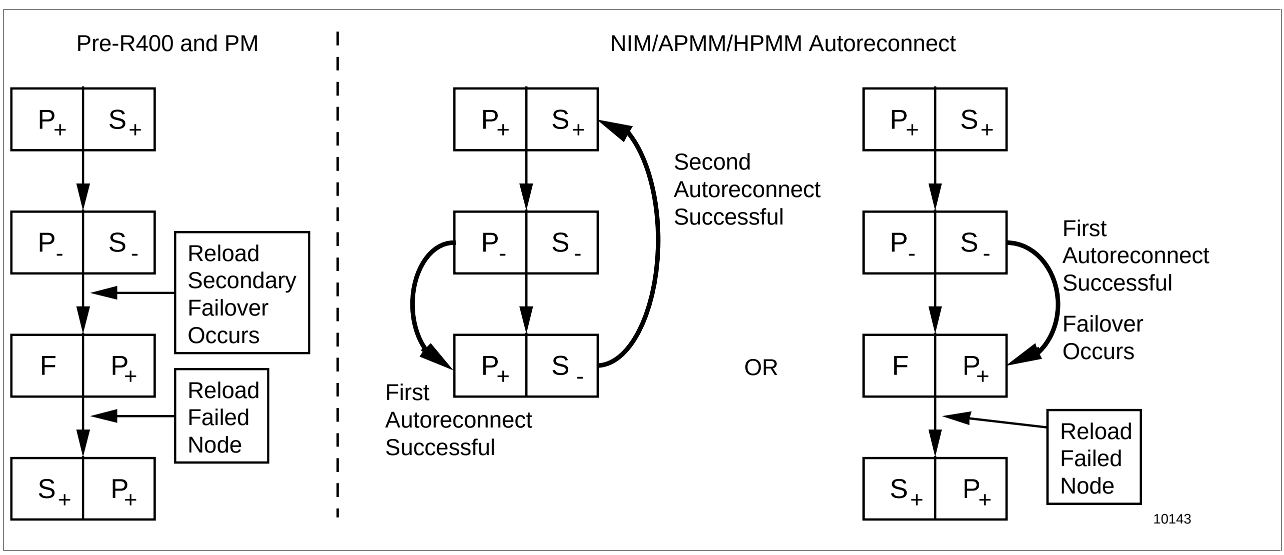
Before R400, this situation could be cleared by initiating a reload of the failed Secondary (once the problem was fixed). Once the Secondary was successfully loaded and communicating on the UCN, failover would occur, enabling the node to function as the Primary. A reload of the old Primary would then establish it as the Secondary.

As of R400, redundant NIMs and APMMs that are both experiencing UCN Communication problems will both attempt to re-establish themselves on the UCN through autoreconnect. While attempting to autoreconnect, NIMs will show a status of COMMFAIL and other UCN nodes will show a status of UNKNOWN, indicating that they can no longer communicate with the NIM. Redundant APMMs performing autoreconnect will show a status of OFFNET on the UCN Status display.

There are two possibilities when both nodes are successful in autoreconnection:

1. The Primary is successful first. In this case, the Secondary node continues to function as a Secondary once communication is successfully re-established.
2. The Secondary is successful first. The Primary then fails itself to allow the Secondary to take over as Primary. The old Primary must then be reloaded in order to be re-established as a new Secondary.

Figure 43 Primary and Secondary Lose Communication



Autoreconnect Reporting

Node status during autoreconnect

There are several UCN node states that appear on the UCN Status displays while a node is attempting an autoreconnect.

Table 13 Node States

State	Nodes	Meaning
COMMFAIL	Nonredundant NIM Secondary NIM	The NIM can't communicate on the UCN and is in the process of an autoreconnect.
UNKNOWN	UCN process boxes Secondary NIM Remote NIM	The node can't communicate with the primary NIM.
OFFNET	UCN process boxes	The node can't communicate on the UCN, but local control and I/O link activity continue.

In addition, a NIM that is attempting to autoreconnect to the UCN will show a state of SEVERE on the LCN Gateway Status display.

Continued on next page

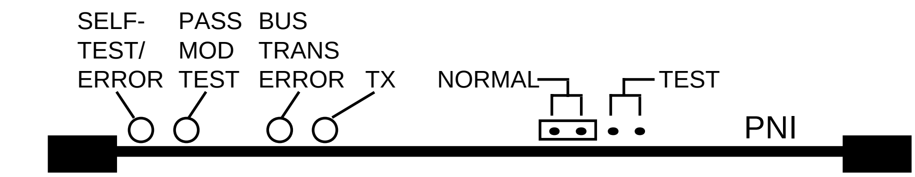
Other indications of autoreconnect

The visual indications listed in Table 14 will also be in effect during an autoreconnect.

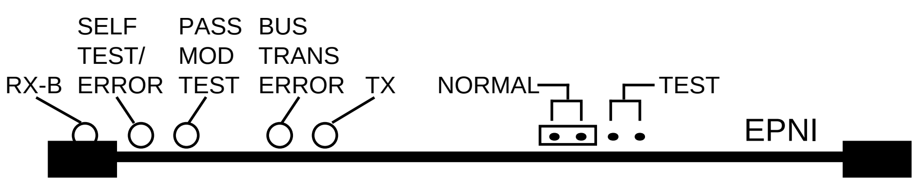
Table 14 LED Indications

Node	Indication
NIM	The Pass Module Test LED on the PNI/EPNI card will be flashed once a second while an autoreconnect is in progress.
APMM HPMM	During an autoreconnect, the node is in a soft fail state; therefore, the Status LED (on the COMMUN card of the APMM and on the COMM/CNTL card in the HPMM) will blink once a second while an autoreconnect is in progress.

Figure 44 PNI/EPNI LED Displays



SELF-TEST ERROR	PNI has failed the powerup self-test
PASS MOD TEST	PNI has passed the powerup self-test
BUS TRANS ERROR	Data transfer error on module bus
TX	PNI transmitting to PNM
NORMAL/TEST JMPR	Used to run the UCN network test



SELF-TEST ERROR	EPNI has failed the powerup self-test
PASS MOD TEST	EPNI has passed the powerup self-test
BUS TRANS ERROR	Data transfer error on module bus
TX	EPNI transmitting to PNM
NORMAL/TEST JMPR	Used to run the UCN network test
RX-B	Receive active for channel B

7204

Lab Exercise

Lab Overview

Introduction

The following lab exercises help you become more familiar with UCN communication concepts. In some of these exercises, you are asked to look at various UCN communication statistic displays to see the results of some actions you or your course manager take.

Lab requirements

The lab exercises require a training center lab system that is not in use by other users or on process control. This is because some steps require fault insertions and powering down UCN nodes. Some steps require that you work as a group. Your course manager will provide any additional lab directions if necessary.

Lab overview

Some UCN communication statistics can be best understood by inserting faults and observing the results. Some faults to be inserted include

- Powering down a UCN node and observing token pass errors.
- Leaving a UCN node in the ALIVE state and observing token pass errors.
- Disconnecting drop cables.
- Using the UCN Exerciser.
- Loading down the UCN with heavy LCN requests.

Lab 1—Display Orientation

Introduction

In this exercise, navigate to UCN Statistic displays.

Display familiarization

Step	Action
1	Call up the UCN Status display for the UCN network assigned to you.
2	Select the PM, APM, or HPM assigned to you.
3	Call up the Detail Status display for that node by selecting the [DETAIL STATUS] target.
4	At the top of the Detail Status display, select the PM, APM, or HPM assigned to you.
5	Call up the Detail Status display for that node by selecting the [DETAIL STATUS] target.
6	From the menu, select the [UCN STATS] target.

Reset local statistics

7	Select the [RESET LOCL STATISTICS] to reset the local statistics so you can have a good starting point for statistic collection. Result: Resets statistics for this node.
8	Select the [STATISTICS PAGE TWO] to call up the second page of statistics.

Help displays

9	Select any statistic and call up its HELP display.
10	Select [BACK] to return to the statistics

Navigation

11	Select in the lower left hand corner the target with your node number, [NODE ###] .
12	See if you can repeat calling up local statistics from memory!
13	This time while in the local UCN Statistics display, select in the lower left-hand corner the target with your network number, [UCN ###] .

Continued on next page

UCN Communication display

14	On the UCN Status display, select the targets to call up the UCN Communication display. Select the [UCN CABLE STATUS] target.
15	Next select the [UCN COMM STATUS] target. Result: Nodes 1-16 appear.
16	To see nodes 7-32, select the [7-32] target.

Reset statistics

17	Reset the statistics; select [RESET STATS] and [ENTER] . Result: Statistics for all nodes shown on the current display are reset.

Navigation

18	Return to the UCN Status display by selecting the Network number target; for example [001] at the top of the display.
19	See if you can repeat calling up UCN COMM STATUS from memory!

Lab 2—Interpret Statistics Exercise

Background

In this exercise, either you or your course manager inserts faults on the UCN. These faults have an effect on the statistics display that can be observed from your Universal Station. This helps you become more familiar with the statistics and any statistical correlations.

Statistical familiarization

Step	Action
1	Call up the UCN Status display for the UCN network assigned to you.
2	Your course manager will identify a UCN node to power down, *but do not power it down yet*.
3	Call up the Detail Status display for the predecessor node (to the node to be powered down) by selecting the predecessor node and its DETAIL STATUS target.
4	At the top of its Detail Status display, select the UCN node again.
5	Call up the Detail Status display for that node by selecting the DETAIL STATUS target.
6	From the menu, select the UCN STATS target.
7	Reset the local statistics on the predecessor node so you can have a good starting point for statistic collection.
6	Insert a fault by powering down the UCN node your course manager has identified for you.
7	Observe the statistics affected on the *predecessor* node.
8	List the statistic(s) affected on the *predecessor* node (in some cases more than one statistic may be affected: • ______________________________ • ______________________________
9	Relate this statistic to UCN communication concepts you know and describe why you think the statistic incremented. • _______________________________________
10	Return the *successor* node to the processing state.

Continued on next page

Statistical familiarization, continued

11	Reset the local statistics for a PM/APM/HPM with IOPs so you can have a good starting point for statistic collection.
12	Gradually increase the message load on the PM/APM/HPM with IOPs by calling up I/O Link diagnostic displays from more than one US.
13	Gradually clear the IOL diagnostic displays from the USs to see its effect on reducing the number of messages.
14	From the menu on the left side of the local statistic display, the diagnostics are represented by the [IOM IOL INFO]. Call them up on the USs your course manager has indicated.
15	List the local UCN message statistics affected: • ______________________ • ______________________
16	Relate this statistic to UCN communication concepts you know and describe why you think the statistics incremented. • ______________________________
17	Be sure to clear the IOL diagnostic displays from the USs.
18	Reset the local statistics on the primary PM/APM/HPM of a redundant PM/APM/HPM pair so you can have a good starting point for statistic collection.
19	Insert an error by powering down the *secondary*.
20	Observe the statistics affected on the *primary* node.
21	List the statistic(s) affected on the *primary* node: • ______________________
22	Relate this statistic to UCN communication concepts you know and describe why you think the statistic incremented. • ______________________________

Continued on next page

Statistical familiarization, continued

23	Reload the powered down node, returning it to the backup state.
24	Return the secondary to the backup state.
25	List the statistic(s) affected on the *primary* node: • ______________________________
26	Relate this statistic to UCN communication concepts you know and describe why you think the statistic incremented. • ______________________________________
27	Reset the local statistics on the primary of a redundant PM/APM/HPM pair so you can have a good starting point for statistic collection.
28	Insert an error by unconfiguring the *secondary*, then power the *secondary* down.
29	Observe the statistics affected on the *primary* node.
30	List the statistic(s) affected on the *primary* node: • ______________________________
31	Relate this statistic to UCN communication concepts you know and describe why you think the statistic incremented. • ______________________________________
32	Reconfigure the secondary node, returning it to the backup state.

This is the end of the statistical interpretation exercise. If you have any questions, ask your course manager for assistance.

Lab 3—Call Up UCNCOMM and UCNEVENT Displays

Background

The TOOLKIT displays also provide UCN statistics, providing a global view of the UCN. These displays are

- UCNCOMM—A global view of communication statistics.
- UCNEVENT—A global view of event statistics.

These TOOLKIT displays are discussed in more detail later in the course.

Call up the displays

Step	Action
1	In order to use the TOOLKIT displays, you need the UCN network number and *LCN* address of your NIM. Call up the System Status display and obtain the following: • UCN number____________ • LCN address of primary NIM____________
2	Call up the UCNCOMM display using the schematic (SCHEM) key and typing in UCNCOMM, press [ENTER] or go through the PERFMENU schematic.
3	Select the target [ENTER UCN/NIM#] and enter the appropriate network data
4	Note the similarities between the statistics reported in the local statistics displays, page 1.
5	Call up the UCNEVENT display using the schematic (SCHEM) key and typing in UCNEVENT, press [ENTER].
6	Select the target [ENTER UCN/NIM#] and enter the appropriate network data
7	Note the similarities between the statistics reported in the local statistics displays, page 1 and page 2

This is the end of the familiarization exercise. If you have any questions about the displays, ask your course manager, otherwise proceed to the next exercise.

Lab 4—Use the UCN Exerciser

Background

If your course manager did not review using the UCN Exerciser during the classroom discussion, ask for a demonstration now. Using the Exerciser helps you become familiar with the communication concepts you covered in this course module, and with an easy to use a UCN communication diagnostic.

Exerciser constraints

Note that this diagnostic exercises the network by sending out Type 1 and Type 3 messages. This means that the diagnostic should be run in an off-process system

Additional operational requirements include

- Call up HPNXOVR to start the test. This schematic resides on either &DSY or DIA1.
- The diagnostic must run on its own logical UCN (you cannot include UCN nodes on a different logical UCN; false errors result).
- Type 1 messages cannot be observed in the node's local statistics display.

Lab requirements

The exerciser should be run in an off-process system. To illustrate UCN communication concepts, at least two USs should be available. The exerciser is run on at least one US, while the effects on the statistics are observed at another US.

Continued on next page

Call up the exerciser

Step	Action
1	To use the UCN Exerciser, you need the UCN node numbers. Call up the System Status display and UCN Status display and obtain the following: • NIM LCN address(es)____________ • NIM UCN address(es)____________ • PM/APM/HPM UCN node address(es)____________
2	Call up the UCN Exerciser by using the schematic (SCHEM) key and typing in HPNXOVR, press [ENTER].
3	*This step is optional.* Select the HELP target. Review and print out the HELP displays if you feel a need to do so.
4	Follow the steps outlined in Appendix A to start the exerciser.
5	While the UCN Exerciser is running, from another US observe the effect on a UCN node's local UCN statistics display. You should see the Type 3 messages increment at rates proportional to the entries you make in the UCN Exerciser display.
6	While the UCN Exerciser is running, observe the effects on the UCN Communication Status display.
7	Try different combinations of UCN Exerciser entries to observe the effects on the statistics. You should see the messages sent, messages received statistics vary according to the time delay selection entries you make in the UCN Exerciser.
8	Be sure to turn off the UCN Exerciser when you have completed observing the effects of the exerciser on the UCN statistic displays.

Lab 5—UCN Cable Commands and Status Display

Background

The purpose of this lab is to become familiar with the UCN cable commands and status displays.

Lab requirements

You need access to a UCN for this lab. Your course manager may assign you to a small group to perform this exercise depending on equipment availability and the size of your class.

UCN Status display and cable commands

Step	Action
1	Pull up the UCN Status display for your assigned UCN.
2	Select the [UCN CABLE STATUS] target. The A/B cable information should appear in the bottom half of each UCN node shown on your display.
3	Which cable is being used at the moment? __________
4	Is cable swapping enabled or disabled? . __________ If cable swapping is disabled at any node, Select the [ENABLE SWAP] target. This should remove all * flags in all nodes. If it does not, some problem exists on the UCN.
5	The [ALL NODES] target should be illuminated. Select this target if it is not illuminated. This defines that all manual commands (which can be selected) are sent to all nodes on this UCN.
6	Cause the UCN to swap cables by selecting the appropriate target [SELECT CABLE x] . Select the [ENTER] target. Notice the reversal of cables in the cable status on the display.
7	Cause the network to swap cables several times, using the appropriate target. Always wait about 15 seconds between all commands to be sure you have seen the total results of the previous command.

Continued on next page

UCN Status display and cable commands, continued

8	Select the [DISABLE SWAP] target. Select or press ENTER. What appears on the status display to indicate that swapping is disabled? ______________________________ Do not wait for 5 minutes to see if cable swapping is disabled.
9	Select the [ENABLE SWAP] target. Select or press ENTER. What changed on the status display? ______________________________
10	You may want to experiment a bit with the cable manipulation targets. Remember that the [ALL] target should always be illuminated to ensure that the commands are sent to all nodes. Cable manipulation on a individual-node basis is not recommended unless you are in direct contact with a TAC support specialist.

Note: If the network refuses to swap and * flags appear (disable swap), the network is having problems with that specific cable. In case of a detected cable problem, "swap to the other cable" and "swap disable" commands are sent to all nodes.

Remember: The network UCN node responsible for cable swapping commands all nodes to swap cables every 5 minutes if there are no problems. The [DISABLE SWAP] target allows you to manually stop this automatic cable swap.

End of lab exercise. If you have any questions, ask your course manager for assistance.

Lab 6—Monitor Cable Behavior

Background

This lab demonstrates cable behavior in response to

- shutting down a node, and
- disconnecting a drop cable from a UCN node.

Lab requirements

This lab must be done as a group. Your course manager will perform the operations of shutting down a node and removing drop cable from a node while you monitor cable behavior by using the UCN Status display and individual UCN node statistic displays.

Cable behavior following node shutdown

Step	Action
1	Your course manager will reset statistics for all nodes on your UCN.
2	Pull up the UCN Status display for your assigned UCN.
3	Select the [UCN CABLE STATUS] target. The A/B cable information should appear in the bottom half of each UCN node shown on your display.
4	Which cable is being used at the moment? _________
5	Your course manager will shut down a node on the UCN.
6	According to the status display, what happened? • ____ • ____
7	Which cable is being used now? _________
8	When the shutdown node stabilized to the ALIVE state, did it select a cable? __________ (NOTE: Remember that in the ALIVE state, a node is not a token passer, but is in listen mode only. It does, therefore, select a cable for listening, and it does receive cable alignment messages.)
9	Which cable did the ALIVE node select? __________ If this is not the same cable as the other nodes are listening to, the ALIVE node should change to this cable next time a cable alignment message is sent (within 10 seconds).
10	What is the node number of the ALIVE node's predecessor? _____

Continued on next page

Cable behavior following node shutdown, continued

11	Call up the Detail Status display for the predecessor node by selecting the predecessor node and its DETAIL STATUS target.
12	If the node is a NIM, continue to the next step. If the node is not a NIM, its Detail Status display will appear. Select the node again (PMM/APMM/HPMM), and call up its Detail Status display by selecting the DETAIL STATUS target.
13	From the menu, select the UCN STATS target.
14	Which statistic (which also caused the cable swap) changed for the predecessor node ? • ________________________________
15	Your course manager will now load the ALIVE node.

Continued on next page

Cable behavior with a faulty drop cable

Step	Action
1	Your course manager will reset statistics for all nodes on your UCN.
2	Pull up the UCN Status display for your assigned UCN.
3	Select the [UCN CABLE STATUS] target. The A/B cable information should appear in the bottom half of each UCN node shown on your display.
4	Which cable is being used at the moment? __________
5	Your course manager will disconnect the drop cable for the cable not being used from one of the nodes on the UCN. No errors will occur initially because all nodes are listening on the good cable.
6	Your course manager will manually swap all nodes to the other cable so that the fault will be detected (rather than wait 5 minutes for the cable to swap naturally).
7	According to the status display, what happened? • ______________________________ • ______________________________ • ______________________________
8	Which cable is being used now? __________ Is periodic swapping disabled in all nodes? __________ Which node(s) detected the problem? ____________
9	Call up the System Status display by pressing the System Status key. What is the status displayed for your Process Network?___________
10	Select the Process Network target for your assigned UCN to return to the UCN Status display.
11	Call up the UCN Statistics display for the node detecting the fault. (by selecting the [DETAIL STATUS] target, and then the [UCN STATS] target).

Continued on next page

Cable behavior with a faulty drop cable, continued

12	List the statistics that were affected by the fault: • ________________________________ • ________________________________ • ________________________________
13	Call up the UCN Statistics display for the predecessor node (by selecting the DETAIL STATUS target and then the UCN STATS target).
14	List the statistics that were affected by the fault: • ________________________________ • ________________________________ • ________________________________
15	Your course manager will now reconnect the drop cable and manually select the cable to ensure that the fault is corrected.

Lab 7—Autoreconnect Familiarization

Background

While autoreconnect is a task that the system performs, your course manager may decide to cause a node to go offnet and then reconnect. This helps you become familiar with the display sequence you may see during a reconnect.

Lab requirements

This lab must be worked as a group exercise, with an off-process control system.

Reconnect familiarization

Step	Action
1	Call up the UCN Status display for the UCN network assigned to you
2	Select the UCN node assigned to you.
3	Call up the detail display for that node.
4	While in the detail display, select the [UCN STATS] target.
5	Reset the local statistics so you can have a good starting point for statistic collection.
6	At another US, have the UCN Status display called up so you can see the display sequence through a reconnect.
7	Your course manger may remove the fault when the sequence completes. If so, you may see the node cycle through another reconnect sequence.

Lab 8—Effects of Crossed Network Cables

Background

In this lab, your course manager will insert crossed UCN cables in your system. As long as no cable faults exist on the UCN, cable activity appears normal.

If a cable fault does occur on the UCN, however, serious consequences can follow, including loss of view to the process. This is because the cable fault-detection algorithms that run independently in each node assume that all nodes are listening on the same cable. If the cables are crossed, the nodes may indicate they are on the same cable when in reality they are not. Errors may be reported against a "good" cable and a swap directed to the cable with the fault.

Lab requirements

This lab requires access to a UCN. Because of the nature of the lab, it must be done as a group activity.

Effects of crossed UCN cables

The following steps should be performed after your course manager has crossed the cables at some point on your UCN.

Step	Action
1	Call up the UCN Status display for your assigned UCN.
2	Select the [UCN CABLE STATUS] target. The A/B cable information should appear in the bottom half of each UCN node shown on your display.
3	Which cable is being used at the moment? __________
4	Your course manager will cause a fault on one of the cables.
5	According to the status display, what happened? • ____________________ • ____________________ • ____________________
6	Which cable is being used now? __________ Is periodic swapping disabled in all nodes? __________ Which node(s) detected the problem? __________ Did any nodes go OFFNET? Which ones? __________
7	Your course manager will correct the fault and inform you of the location of the crossed cables.

Directions

DIRECTIONS—This is the end of the study material for this module. Discuss questions concerning the study material or the lab activities with a colleague or a course manager

If you are satisfied that you have achieved the objectives of this module, continue with the next section, the Student Proficiency Evaluation.

Student Proficiency Evaluation

Criterion Test

Test item 1

Your course manager may ask you to demonstrate the following:

- From the UCN Status display, call up the Local UCN Statistics display.
- Call up a display showing timesynch statistics.

Test item 2

Answer the following questions:

- If a node is experiencing cable noise, noise bits, and checksum errors, it usually means (select one)
  - 1. excessive UCN traffic,
  - 2. node is OFFNET,
  - 3. heavy peer-to-peer load, or
  - 4. a problem with UCN cable and cabling components.

- Give an example of
  - 1. Type 1 message ____________________

    ____
  - 2. Type 3 message ____________________

    ____

Test item 3

On your UCN, PM 15 is reporting an increase in its token passes-failed count, and PM 13 is reporting checksum errors and partial frames. Which node is most likely to have the problem?

Self-Evaluation

Test item 1

- *To pull up the Local UCN Statistics display for a UCN node:*
  - *Pull up the UCN Status display for the UCN,*
  - *Select the UCN node you are interested in,*
  - *Select the [DETAIL STATUS] target,*
  - *If the node is not a NIM, select the node (PMM,APMM, HPMM) again, and select the [DETAIL STATUS] target,*
  - *Select the [UCN STATS] target, and*
  - *Page one of the Local UCN Statistics display appears.*

- *Timesynch statistics are found on Page two of the Local UCN Statistics display. To get to Page two, select the [STATISTICS PAGE TWO] target from Page one of the Local UCN Statistics display.*

Test item 2

- If a node is experiencing cable noise, noise bits, and checksum errors, it usually means (select one)
  - *4. a problem with UCN cable and cabling components.*

- Give an example of
  - 1. Type 1 message

    Type 1 messages are used for event delivery. Some examples of events are process alarms, status changes, alarm conditions, and return to normal conditions.
  - 2. Type 3 message

    Type 3 messages are used for parameter access.

Test item 3

On your UCN, PM 15 is reporting an increase in its token passes failed count, and PM 13 is reporting checksum errors and partial frames. Which node is most likely to have the problem?

According to the information given in the UCN Guidelines Manual, it is most likely that PM 13 is having a physical network or modem problem. The increasing count of token passes failed in the predecessor node correlates with the checksum errors and partial frames seen in PM 13.

Directions

DIRECTIONS—This is the end of this module.

Use your course map to

- Get your course manager to sign off this module.
- Choose your next eligible module.

If you have a question

- Ask your course manager.

Appendix A

Monitoring UCN Error Statistics

(excerpt from UCN Guidelines Manual)

Section 4 – Monitoring UCN Error Statistics

4.1 Overview

Section contents

The topics covered in this section are:

4.2 Why Monitor Statistics

Introduction

UCN cable statistics provide a reference point for monitoring UCN system performance. By comparing error rates over a similar period of time, it is possible to determine when a significant change in system performance has taken place. Identifying system degradation can lead to problem identification and correction before network communication is impaired.

When should I start collecting statistics?

The time to start collecting statistics is during the checkout phase of system installation. As the UCN is checked out and problems are solved (if there are any—see Section 3) a baseline is established and can be easily monitored and maintained. Knowing when a system degradation occurred should help identify events that caused problems and establish the complete correction when the error rate returns to previous levels.

4.3 Local UCN Statistics Displays

Introduction

The Local UCN Statistics Displays for the NIM and other node types are similar but they have the following differences:

- The targets available on the display are different.
- The APMM display has a hardware configuration status.
- The TYPE status is different (APM or NIM).
- The Event Receiver Statistics counts and token rotation time for the non-NIM displays are always zero.
- The Event Sender Statistics counts for the NIM display are always zero.

Overview

The procedures in subsections 4.3.1 and 4.3.2 show examples of NIM Local UCN Statistics Displays and APMM Local UCN Statistics Displays.

The statistics displays consist of two pages.

Page	Description
1	displays the local statistics for the UCN node, NIM, or APMM.
2	displays UCN Event Sender statistics, UCN Event Receiver statistics, TIMESYNC status, and TIMESYNC statistics.

The following tables describe the terms used in the displays.

Table	Descriptions
1, 5	Local UCN Statistics—their probable cause, the acceptable accumulative total, and system recovery
2, 6	UCN Event Sender Statistics
3, 7	UCN Event Receiver Statistics
4, 8	TIMESYNC Statistics
9	TIMESYNC Status

4.4 Accessing Cable Statistics

Introduction

There are three different cable statistic displays.

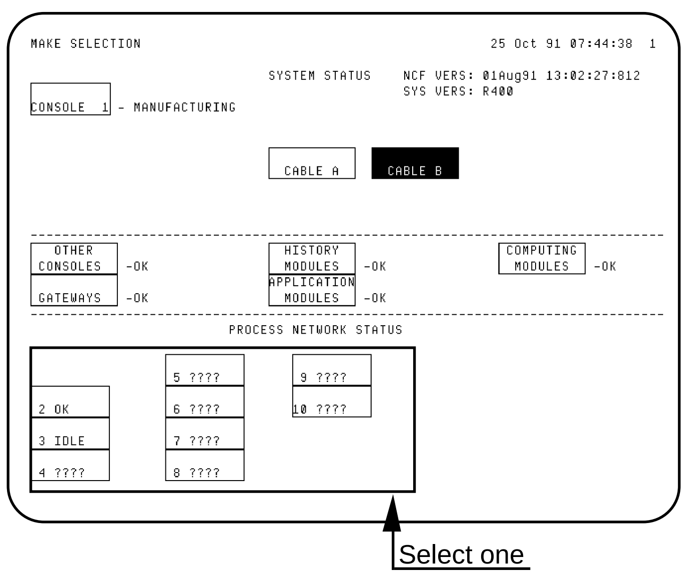
- NIM Local UCN Statistics Display—displays statistics for a specified NIM
- APMM Local UCN Statistics Display (PMM or LMM)—displays statistics for any non NIM node.
- UCN Network Statistics Display

How to access these displays and interpret them will be discussed in the next three subsections.

4.4.1 Accessing NIM Local UCN Statistics Display

Procedure to access

To call the NIM Local UCN Statistics Display, complete the tasks below.

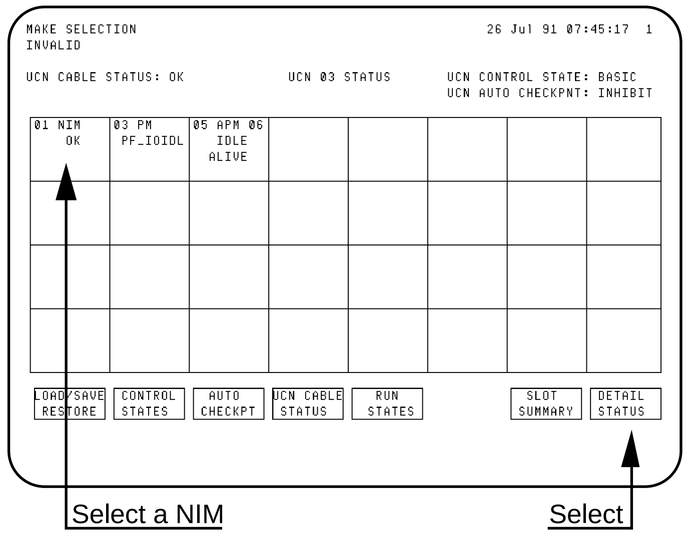
Step	Action
1	Select the **<SYST STATS>** (SYSTEM STATUS) key on the console.
2	Select one of the **PROCESS NETWORK STATUS** targets on the display for the UCN network you wish to examine. This will call up the next display. 

Continued on next page

Procedure to access, continued

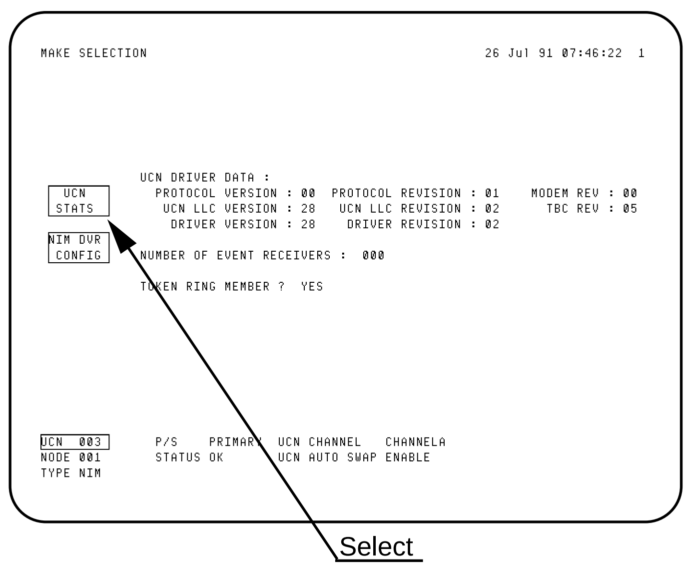
<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>3</td><td>
Select the NIM of interest.

Select the **DETAILED STATUS** target



</td></tr>
<tr><td>4</td><td>
The NIM Driver Configuration Display will appear.

Select the **UCN STATS** target



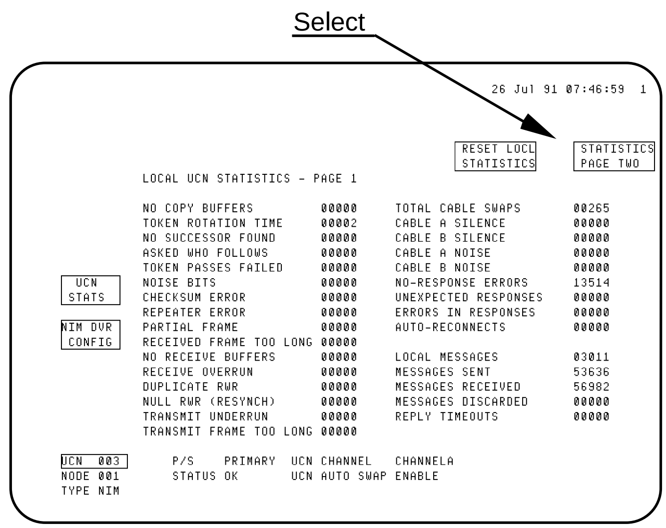
</td></tr>
</table>

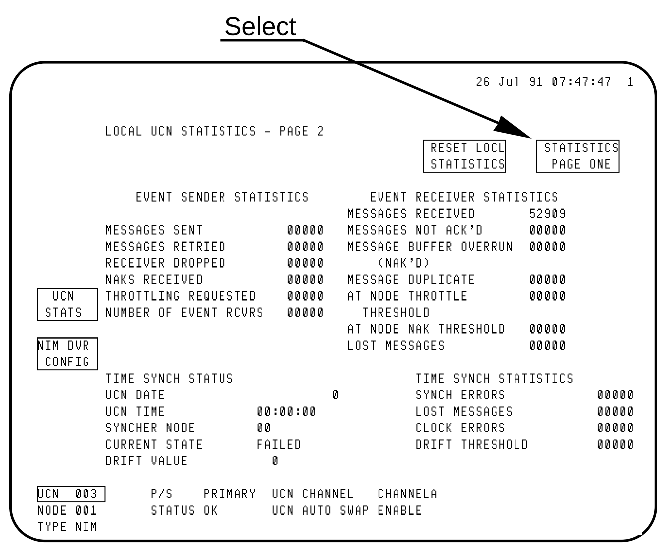
Continued on next page

Procedure to access, continued

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>5</td><td>Page 1 of the NIM Local UCN Statistics Display will appear.

To display Page 2 select the STATISTICS PAGE TWO target


</td></tr>
<tr><td>6</td><td>Select the STATISTICS PAGE ONE target on the display and the Page 1 display will appear.


</td></tr>
</table>

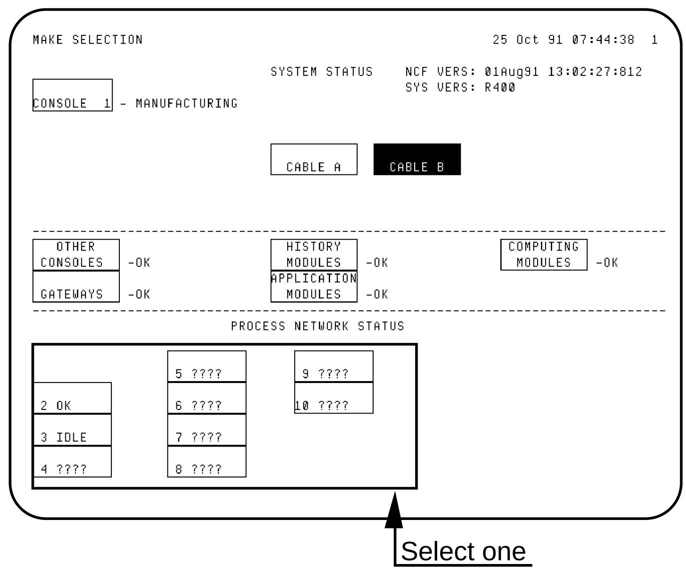
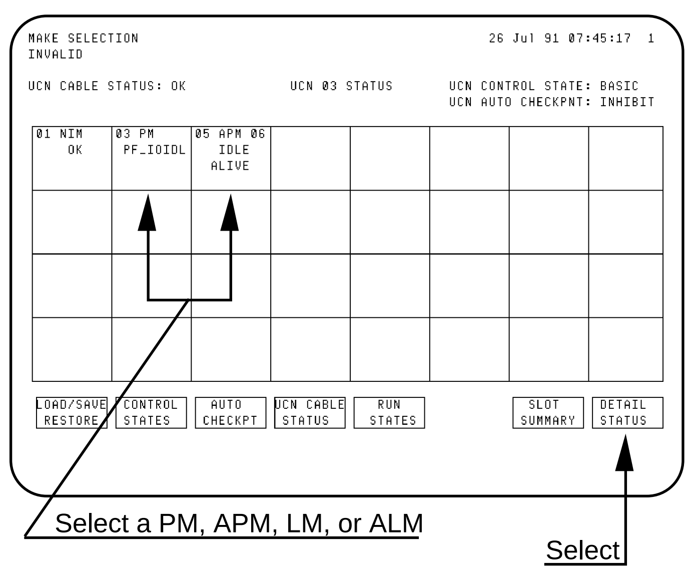
Displays

You can switch between the Page 1 and Page 2 displays by alternately selecting the STATISTICS PAGE TWO target on the Page 1 display and the STATISTICS PAGE ONE target on the Page 2 display.

4.4.2 Accessing Node Local UCN Statistics Display

Procedure to access

To call the APMM, PMM, or LMM Local UCN Statistics Display, complete the tasks below.

Step	Action
1	Select the **<SYST STATS>** (SYSTEM STATUS) key on the console.
2	Select one of the **PROCESS NETWORK STATUS** targets on the display for the network you wish to examine. This will call up the next display. 
3	Select the APMM, PMM, or LMM of interest. Select the **DETAILED STATUS** target 

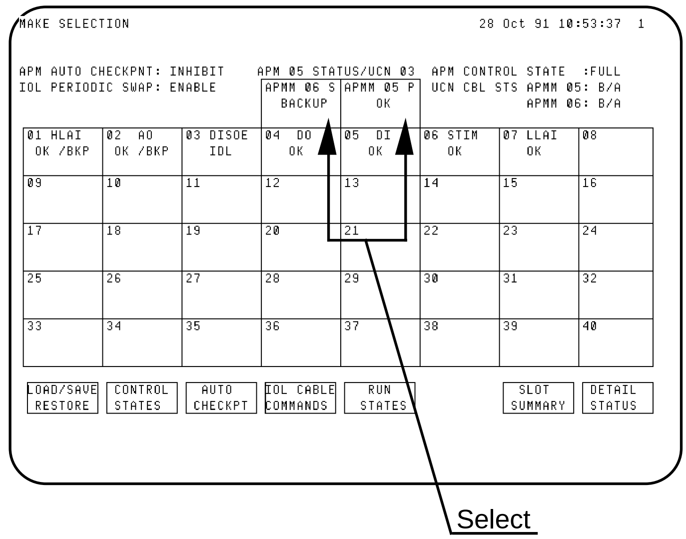
Continued on next page

4.4.2 Accessing Node Local UCN Statistics Display, Continued

Procedure to access, continued

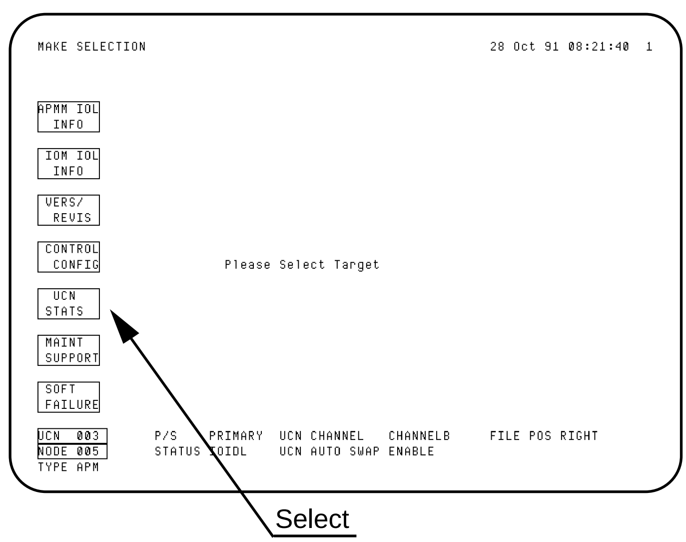
<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>4</td><td>
Select the APMM, PMM, or LMM of interest.

Select the **DETAILED STATUS** target



</td></tr>
<tr><td>5</td><td>
The PMM, APMM, or LMM **DETAILED STATUS MENU** Display will appear.

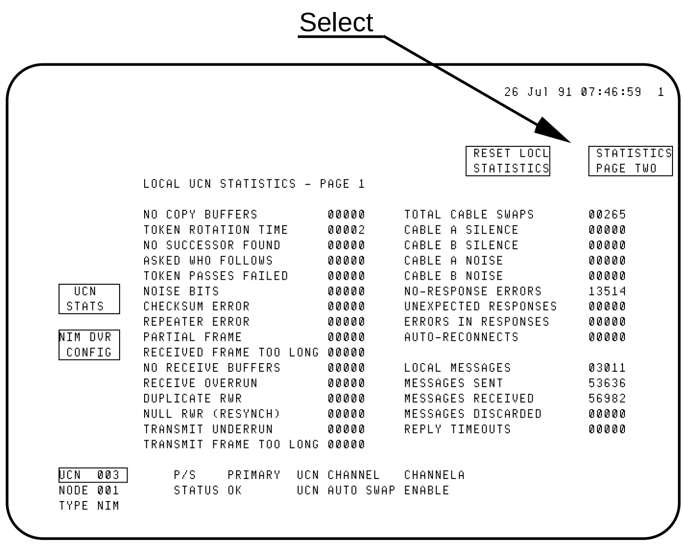
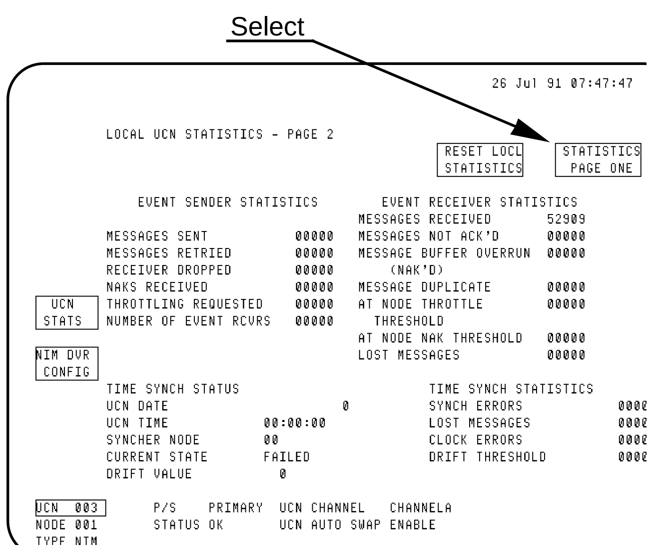
Select the **UCN STATS** target



</td></tr>
</table>

Continued on next page

Procedure to access, continued

Step	Action
6	Page 1 of the NIM Local UCN Statistics Display will appear. To display Page 2 select the **STATISTICS PAGE TWO** target 
7	Select the **STATISTICS PAGE ONE** target on the display and the Page 1 display will appear. 

Switching between the displays

You can switch between the Page 1 and Page 2 displays by alternately selecting the STATISTICS PAGE TWO target on the Page 1 display and the STATISTICS PAGE ONE target on the Page 2 display.

4.4.3 Display Descriptions

Definition of Terms

The following definition of terms supports Table 4-1.

TERM	DEFINITION
LLC	Link Layer Control. The IEEE 802 standard protocol residing between the MAC (physical layer) and the higher software protocols.
Predecessor	Node from whom the token was received.
RWR	An immediate request with response type 3 message.
Successor	Node to whom token is passed.
TBC	Token Bus Controller
Token Passing Order	64,63,.....2, 1, 64 (predecessor to successor)
Type 3	The 802.2 LLC immediate acknowledge protocol used for node status, peer-to-peer and parameter access.

Table of Descriptions

The statistics terms in Table 4-1 are listed in alphabetical order. The use of these statistics in troubleshooting is described in Table 4-5.

Table 4-1 Local UCN Statistics Descriptions

Statistic	Description
Asked Who Follows	The number of times the successor node dropped out of the ring, temporarily or permanently (shutdown, failure, failover). It does not change in a system that is running normally.
Auto-Reconnects	The number of times this node auto reconnected successfully to the UCN after a serious UCN communication fault.
Cable A Noise	The number of times Cable A was found noisy. A count of zero is expected. This is normally a trunk fault that is typically reported by many nodes.
Cable A Silence	The number of times Cable A was found silent. A count of zero is expected. Normally, a silent cable is a broken or disconnected drop cable, or a bad tap. Certain types of trunk cable problems, such as a short in the middle of a trunk cable segment, can also cause silence to be reported, perhaps by multiple nodes.
Cable B Noise	The number of times Cable B was found noisy. A count of zero is expected.
Cable B Silence	The number of times Cable B was found silent. A count of zero is expected.

Continued on next page

Table of description, continued

Table 4-1 Local UCN Statistics Descriptions, Continued

Statistic	Description
Checksum Error	The number of times message corruption was detected by the hardware. The theoretical bit error rate for errors not detected by the modem and noted as noise or frame fragments is 1 x 10E-9. This works out to approximately three checksum errors per hour, per network. The observed rate is much less, and because most messages are tokens, real messages are seldom lost. If frequent checksum errors occur, there may be a physical network or modem problem. If the predecessor to a node with checksum errors indicates a corresponding increase in the “Token Pass Failed” count, the problem is likely to be in the node with the checksum errors.
Duplicate RWR	The number of times a duplicate Type 3 message was received. This could be due to the hardware retrying a message because an ACK was lost. A count of zero is expected, but a small number is acceptable. A count here can sometimes be explained by an increase in one of the other error statistics.
Errors In Responses	The number of times the LLC part of an RWR was incorrect. This may indicate corruption in a node, or network contention. A count of zero is expected. The count is incremented by the LLC based on the transmit status and/or message size, or header contents.
Local Messages	The number of messages between tasks in this node. The count is always incrementing in a NIM, zero in an APMM.
Messages Discarded	The number of messages discarded by this node. Normally zero, but may occasionally count occurrences of: • a reply received after the reply timeout period expired • a duplicate reply message due to retry because the immediate ACK of a reply message was not received by the node sending the reply message • a bad protocol version • a message for an inactive function • a message from a nonconfigured node (NIM only)
Messages Received	The number of messages received by this node.
Messages Sent	The number of messages sent from this node. The count does not include automatic TBC retries or driver retries.
No Copy Buffers (NIM Only)	The number of times no buffers on the LCN side of the PNI/EPNI for copying received messages (NIM only) were available. The count is normally zero. Increasing counts indicate extreme NIM congestion. The situation may lead to a “No Receive Buffers” count.

Continued on next page

Table of description, continued

Table 4-1 Local UCN Statistics Descriptions, Continued

Statistic	Description
No Receive Buffers	The number of times no buffers were available to store received messages. Zero is the expected count, but an occasional count under continuous, very heavy demand is acceptable.
No Successor Found	The ring collapsed, and token-passing was lost. The count is incremented once in most nodes for a ring collapse. It is preceded by an “Asked Who Follows” count in the node that had the token.
No-Response Errors	The number of times one or more nodes did not respond to RDR messages. One or more nodes may be OFFNET or may be temporarily overloaded. The count is normally zero, but will increase when access to an OFFNET node is attempted. The count is incremented by the LLC based on the transmit status. The count is not incremented if the TBC is successful on its automatic retry.
Noise Bits	Noise periods or bursts are detected by the hardware. This may be due to physical network problems. It can occur without the loss of any messages. A count of zero is expected. A burst of noise and/or frame fragment counts over 25 in one 300 ms period, and/or three successive 300 millisecond periods of noise counts of 3, and/or partial frames of 2, will cause noise to be reported, the “Cable A/B Noise” count to be incremented, and the cable to be swapped. These low thresholds are empirically derived from introducing various types of trunk faults.
Null RWR (Resynch)	The number of times the Null RWR messages were used by other nodes to resynchronize with this node upon startup or after an error. A node that leaves and reenters a running UCN will probably show and cause some counts. The count is incremented by the LLC based on the transmit status.
Partial Frame	The number of times a prematurely ended message was detected by the TBC. This may be due to physical network problems. It can occur without loss of messages. See the “Noise” description.
Receive Overrun	The number of times there was insufficient local processor DMA bandwidth to copy a received message into memory. A count of zero is expected.
Received Frame Too Long	The number of times the received message exceeded the 8 K byte IEEE 802.4 limit. Note that UCN messages are limited to 1 K byte in length. A count of zero is expected.

Continued on next page

Table of description, continued

Table 4-1 Local UCN Statistics Descriptions, Continued

Statistic	Description
Repeater Error	The number of times the hardware detected that the error bit in the message end delimiter was set, indicating that a repeater received a message with a bad checksum, then retransmitted it. Because the UCN does not use repeaters, this means corruption in the end delimiter of the message.
Reply Timeouts	The number of times a reply was not received during the user-specified timeout interval. If a Type 3 request, the request was received and ACK'd, but the reply was not received. It may be due to receive buffer overload in the local node, or the remote node failed after the ACK, but before sending the reply.
Token Passes Failed	The number of times a token pass to successor node was retried. The count is normally zero. This does not change in a smoothly operating system. The cause may show up as noise, checksum error, or frame fragment count in the successor node.
Token Rotation Time (NIM Only)	Sampled, the averaged token rotation time in 0.1 millisecond units. This is not an absolute measurement, and 2 NIMs may show different values. A 2-node UCN with no traffic will be in the 0.1 millisecond range, while a moderately-loaded 64-node UCN will be in the 4-15 millisecond range. OFFNET nodes and heavy traffic will increase the observed token rotation time. The nominal token rotation time for the system should be recorded when there are no errors and the load is moderate. Deviations from the count noted in a smoothly operating system should be investigated. An abnormally slow token rotation time may be caused by a level of trunk noise not quite high enough to cause a cable swap.
Total Cable Swaps	A count of the operator, periodic, or fault-induced cable swaps. The periodic swap is every 15 minutes.
Transmit Frame Too Long	The number of times there was a discrepancy between the frame length and the sum of the data block lengths given to the TBC. A count of zero is expected. The count is incremented by the LLC based on the transmit status.
Transmit Underrun	The number of times there was insufficient local processor DMA bandwidth for the TBC to transmit a message. A count of zero is expected. The count is incremented by the LLC based on the transmit status.

Continued on next page

Table of description, continued

Table 4-1 Local UCN Statistics Descriptions, Continued

Statistic	Description
Unexpected Responses	The number of times MAC control was not correct for a RWR response message (such as the wrong node number in a response). This indicates network contention or corruption within a node. A count of zero is expected. It also indicates the number of times SAPs were not as expected. The count is incremented by the LLC based on the transmit status and/or message header contents.

Continued on next page

Event delivery description

Event delivery performs retries to nodes in a dynamically maintained receiver list. New nodes are added to the list as they respond and are dropped when retries have failed. Each event message contains 1 to 20 event/alarm/status conditions.

Display descriptions

Table 4-2 Local UCN Statistics Descriptions — Event Sender

Statistic	Description
Messages Retried	The number of messages retried due to no response, lost ACK or NAK. The count is normally zero unless event overload has occurred. The count normally correlates with the “NAKs Received” count in the event senders.
Messages Sent	The number of messages sent, not including retries. When an idle or running event sender has no new events to send, it resends the last message every 10 seconds so that the NIM can watchdog event delivery.
NAKs Received	The number of times a message was temporarily not accepted by an event receiver. Retries are performed after a delay. The count is normally zero, except under heavy event traffic.
Number of Event Rcvrs	The number of event receivers that are currently acknowledging events from this event sender. In APMMs, this count is normally the number of primary NIMs.
Receiver Dropped	The number of times any event receiver failed to respond to a message after retries, and thus was removed from the retry list. Retries are no longer performed to nonresponding event receivers. The count is normally zero in NIMs. A single count in each event sender may accompany a NIM failure (primary and secondary).
Throttling Requested	The number of times this node was requested to delay before sending another message. A count of zero is normal, except under heavy event traffic. The count corresponds to the “At Node Throttle Threshold” statistic in the event senders.

Continued on next page

Display descriptions, continued

Table 4-3 Local UCN Statistics Descriptions — Event Receiver

Statistic	Description
At Node NAK Threshold	The number of times this node received too many messages from any one event sender and asked the node to resend the last message after a delay. This causes the "NAKs Received" count to be incremented in the event sender. The count is normally zero, except under heavy event load when it would increment slowly.
At Node Throttle Threshold	The number of times this node reached the buffer threshold at which it requested event senders to delay before sending the next message. This causes "Throttling Requested" count to be incremented in the event sender. The count is normally zero, except under a heavy load, when it would increment slowly.
Lost Messages	The number of times there was an event message sequence number gap. This implies a lost message. Event recovery is normally initiated after a gap. The count is normally zero. This situation can occur when a NIM failsover or starts up in a running network. Frequent counts indicate a problem. If multiple receivers (NIMs) increment their "Msg Lost" counts at the same time, the problem is probably in a sender (APMM) or the network.
Message Buffer Overrun (NAK'd)	The number of times no buffers were available to accept events from any event sender — a NAK is sent to force resend of message after a delay. The count is normally zero, except under a heavy burst of events from a number of event senders, because throttling should prevent this condition.
Message Duplicate	The number of messages that were duplicates because an ACK was not sent, or was lost causing a retry. An ACK is sent, but the message is discarded by the event receiver. The count is normally zero. The count will be accompanied by a "Msg Retried" count in the event sender.
Messages Not ACK'd	The number of messages not ACK'd by this node due to a temporary shortage of buffers from which to send ACKs. A "Msg Duplicate" count is expected due to the retry caused by the lack of an ACK. The count is normally zero.
Messages Received	The number of messages received, including duplicates. Each event message can contain up to twenty alarm and event conditions.

Continued on next page

4.4.3 Display Descriptions, Continued

Timesynch process

A normal time synchronization cycle consists of a time synchronization message followed by a synchtime message. The time synchronization message performs the clock synchronization between EPNI and APMMs. The synchtime message carries the actual time information.

Display description

Table 4-4 TIMESYNC Statistics Descriptions

Statistic	Description
Clock Errors	The number of times in both synchronizer and synchronized nodes where the UCN clock interval and LCN clock interval did not agree within tolerance. In the Synchronizer node: 1 or 2 counts may occur on becoming the Synchronizer node; the synchtime time is nulled to avoid its use by the synched nodes; frequent occurrences may indicate that the Synchronizer node has (LCN) clock problems and cannot obtain a valid Timesynch time. In the synched nodes: 1 or 2 counts may be reported on startup; frequent occurrences without any occurrences in the Synchronizer node may indicate a local clock problem.
Drift Threshold (exceeded)	The number of times in both the Synchronizer and the synched nodes when the UCN clock interval and LCN clock interval did not agree within the drift threshold in a synch operation. It may indicate a problem with the affected node's UCN or LCN hardware. If the count is incrementing in the Synchronizer NIM, it is probably also incrementing in the synched nodes.
Lost Messages	The number of times a synchtime message was not preceded by a matching Timesynch message, based on: 1) the hardware did not detect a Timesynch message; 2) the serial number and Synchronizer node number of the most recent Timesynch and synchtime messages did not match.
Synch Errors	The number of times two Timesynch messages in a row were processed before a synchtime message. Frequent occurrences may indicate multiple Synchronizer nodes contending for mastership.

4.4.4 Troubleshooting Tables

Introduction

The following tables provide basic interpretation of the statistics displays, probable cause of errors, and references to other statistics that are possibly related to the problem.

Local UCN statistics

Table 4-5 Local UCN Statistics — Page 1

Statistic	Description	Nominal Range Over Specified Time Period; How the System Recovers	Probable Cause	Statistic Correlation
No Copy Buffers	NIM only; no buffers in the processor to copy received messages.	Ideally, should be 0. Events are throttled to reduce the probability of errors; the event recovery logic will ensure events are up to date.	Increases when the NIM is congested.	Messages Received and Event Messages Received.
Token Rotation Time	NIM only; the average network token rotation in 0.1 millisecond units.	Depends on number of configured nodes that are on the network (for example, for a six node UCN network, the nominal range is between 4-5 ms). When running smoothly, the user should record the nominal range of his system for comparison.	Increases when any configured nodes are offnet. Also increases with more peer-to-peer traffic.	No Response Errors, network traffic.
No Successor Found	The token ring collapsed.	Should be zero in systems with two or more nodes passing tokens and no communications problems. The communications system will automatically attempt to reestablish the ring.	Fewer than two token passers, a network communication problem.	Asked Who Follows
Asked Who Follows	A successor node change.	N/A Communications system will automatically look for a new successor.	The shutdown of a node, the powering off of a node, a communication fault.	Token pass failures, noise, checksum error, frame fragment.

Continued on next page

Local UCN statistics, continued

Table 4-5 Local UCN Statistics — Page 1, Continued

Statistic	Description	Nominal Range Over Specified Time Period; How the System Recovers	Probable Cause	Statistic Correlation
Token Passes Failed	Token pass to the successor retried.	Should be zero in a smooth network with no faults or nodes entering or leaving. The communications system retry may attempt to find a new successor.	Commun. fault, shutdown, or power down node failover.	Noise, checksum error, frame fragment in Successor Who Follows.
Noise Bits	Noise detected.	• 1 count/10 sec is typical; the lower, the better.	Commun. fault, grounding problem. EMI	A noise event is reported if the noise is excessive.
Checksum Error	Corrupt Message, checksum detected.	Should be zero in a smooth system. The message is retried.	Commun. fault, marginal modem, noisy local power supply. EMI	Token passes failed at predecessor (indicates problem in this node).
Repeater Error	Corruption in the end delimiter. Corrupt message	Should be zero. The message is retried.	Commun fault, EMF nearby.	Token passes failed at predecessor (indicates problem in this node).
Frame Fragments	Full message not received.	Should be zero in a smooth system. The message is retried.	Commun fault.	Token passes failed at predecessor (indicates problem in this node).
Received Frame Too Long	Message received > 8 kB.	Should be zero.	Has not yet been observed. Software bug	N/A
No Receive Buffers	No buffers to receive messages.	Should be zero if not overloaded. See recovery procedure for No Copy Buffers.	Overload	No copy buffers (NIM), or resynch in affected node.

Continued on next page

Local UCN statistics, continued

Table 4-5 Local UCN Statistics — Page 1, Continued

Statistic	Description	Nominal Range Over Specified Time Period; How the System Recovers	Probable Cause	Statistic Correlation
Receive Overrun	Not enough Direct Memory Access (DMA) bandwidth to copy the received message to memory.	Should be zero.	Hardware problem	N/A
Duplicate RWR	Duplicate message received.	In a smooth system, this may occur about twice a day.	ACK lost.	Checksum error, frame fragments, etc.
Null RWR (Resynch)	Used to resynch communications.	N/A	Node startup, failover node failure, Commun fault.	Checksum error, frame fragment.
Transmit Underrun	Not enough DMA bandwidth to transmit.	Should be zero.	Hardware problem	N/A
Transmit Frame Too Long	Inconsistent information	Should be zero.	Software bug	N/A
Total Cable Swaps	The sum of all swaps: operational, automatic, and periodic.	Once every 15 minutes when there are no faults, noise, or silence present. Also incremented when the operator manually swaps cables.	Periodic cable swap enabled.	Noise or silence events will stop periodic swaps.
Cable A Silence	No energy on Cable A.	Should be zero. The network swaps to Cable B.	Cabling not connected correctly, bad cable, bad tap.	Silence event
Cable B Silence	No energy on Cable B.	Should be zero. The network swaps to Cable A.	Cabling not connected correctly, bad cable, bad tap.	Silence event

Continued on next page

Local UCN statistics, continued

Table 4-5 Local UCN Statistics — Page 1, Continued

Statistic	Description	Nominal Range Over Specified Time Period; How the System Recovers	Probable Cause	Statistic Correlation
Cable A Noise	Excessive noise on Cable A.	Should be zero. The network swaps to Cable B.	Cabling not connected correctly, bad cable, missing terminator ground.	Noise event, Noise Bits.
Cable B Noise	Excessive noise on Cable B.	Should be zero. The network swaps to Cable A.	Cabling not connected correctly, bad cable, missing terminator ground.	Noise event, Noise Bits.
No Response Errors	One or more nodes did not respond to a RWR.	Should be zero in a smooth system with all nodes on net and properly configured.	Node(s) offnet, node(s) overloaded.	Checksum Error, frame fragment, null RWR, No Receive Buffers.
Unexpected Responses	MAC control incorrect in RWR.	Should be zero.	Network problems	N/A
Errors In Responses	LLC part of RWR incorrect.	Should be zero.	Network problems	N/A
Auto-Reconnect	Node successfully reconnected.	Should be zero for a system free of communications faults.	Network problems.	Cable noise, cable silence, frame fragments, no responses, etc.
Local Messages	Intra-node local messages.	An Increasing number in NIM, zero in an APM.	N/A	N/A
Messages Sent	Messages sent from node.	Incremental according to number of sent messages	N/A	N/A
Messages Received	Messages received by node.	Incremental according to number of receive messages	N/A	N/A

Continued on next page

Local UCN statistics, continued

Table 4-5 Local UCN Statistics — Page 1, Continued

Statistic	Description	Nominal Range Over Specified Time Period; How the System Recovers	Probable Cause	Statistic Correlation
Messages Discarded	Messages ignored.	Should be zero.	Reply received after reply timeout, duplicate reply due to lost ACK, bad protocol version, messages from a non-configured node (NIM only).	Reply Timeouts
Reply Timeouts	Reply not received in applicable time.	Should be zero.	Overload, failover, power off, shutdown.	No Receive Buffers.

Local UCN statistics,
continued

Table 4-6 Local UCN Statistics — Event Sender*

Statistic	Description	Nominal Range Over Specified Time Period; How the System Recovers	Probable Cause	Statistic Correlation
Messages Sent	Event messages sent, not including retry.	Heartbeat message sent every 10 seconds.	N/A	N/A
Messages Retried	Retries due to NORESP, NAK, or lost ACK for the event.	Messages Retried count does not necessarily imply lost messages.	Event overload, communication fault.	NAKs Received
Receiver Dropped	The number of times an event receiver did not respond after retry.	Zero in NIM, one in an APM if there is a NIM failure.	NIM shutdown, NIM failure, NIM congested. LCN congested	N/A
NAKs Received	Message not accepted by receiver.	Should be zero except under heavy event load. Message retried.	Heavy event load. LCN congested	Messages Retried
Throttling Requested	The number of times the node was requested to delay before sending the next message.	Should be zero except under heavy event load.	Heavy event load. LCN congested	NAKs Received
Number of Event Rcvrs	The number of nodes ACKing events; LM and APM only.	The number of primary NIMs running on the UCN.	N/A	N/A

* APMMs,PMMs, LMMs only — NIMs display statistical counts of zero.

Continued on next page

Local UCN statistics,
continued

Table 4-7 Local UCN Statistics — Event Receiver*

Statistic	Description	Nominal Range Over Specified Time Period; How the System Recovers	Probable Cause	Statistic Correlation
Messages Received	Events received, including any duplicates.	Should be incrementing according to number of received events.	N/A	N/A
Messages Not ACK'd	Cannot ACK because no buffers are available.	Should be zero.	Temporary overload, power off, shutdown	N/A
Message Buffer Overrun (NAK'd)	No buffers to accept events.	Should be zero except under heavy burst of events. Sender retries unless throttling is requested.	Temporary overload. LCN congested	Messages Retried
Message Duplicate	ACK lost at the sender.	Should be zero. Duplicates discarded.	Commun. fault.	Messages Not ACK'd, Messages Retried.
At Node Throttle Threshold	Event receive buffer limit met.	Should be zero except under heavy event load.	Heavy event load. LCN congested	Throttling Requested
At Node NAK Threshold	Too many messages from one sender.	Should be zero except under heavy event load.	Heavy event load. LCN congested	NAKs received by sender.
Lost Messages	A gap in the event message sequence number.	Should be zero. Event recovery.	Heavy event load, failover, NIM startup, network problem, or sender problem.	Message Buffer Overrun, message not ACK'd.

* NIM only

Continued on next page

Timesynch statistics

Table 4-8 Timesynch Statistics

Statistic	Description	Nominal Range Over Specified Time Period; How the System Recovers	Probable Cause	Statistic Correlation
Synch Errors	Multiple Timesync messages per cycle.	N/A	Synchronizer contention, network problems	
Lost Messages	Timesynch message lost, sequence broken.	Increments on Synchronizer change.	Synchronizer change, network problem.	
Clock Errors	Discrepancy between LCN and EPNI, or between APMM and UCN time.	N/A	LCN clock problem.	
Drift Threshold	Same as Clock Errors statistic	N/A	LCN clock, EPNI clock, APMM clock.	High drift may lead to clock errors.

Timesynch status

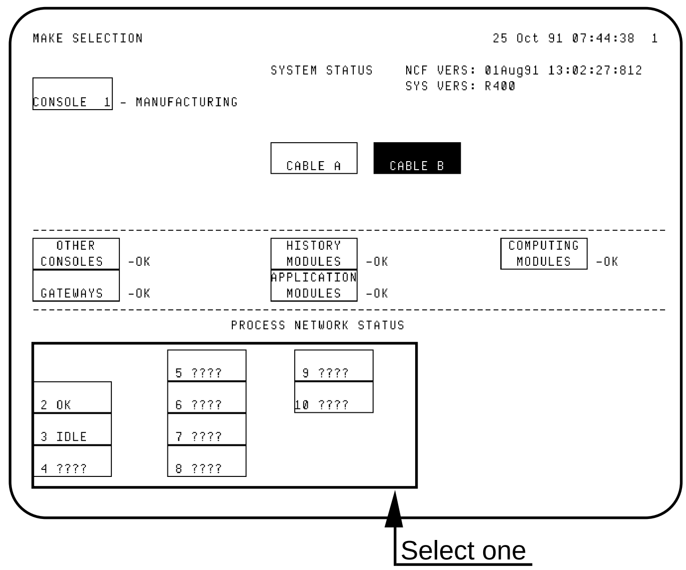
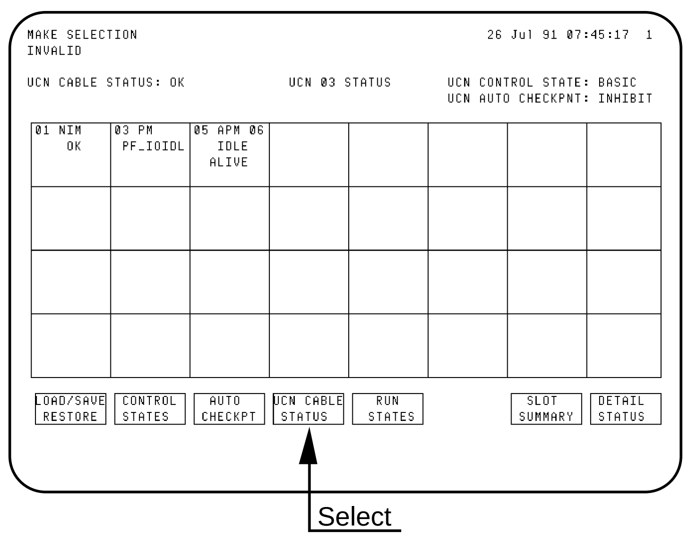
Table 4-9 Timesynch Status

Status	Description
UCN Date	The date resident in the current Synchronizer node.
UCN Time	The time resident in the current Synchronizer node. The time is accurate to plus or minus one second.
Synchronizer Node	The UCN node number of the Synchronizer node.
Current State	The Timesynch state of this node. A PNI NIM, or a NIM with Timesynch disabled, will report "Failed."
Drift Value	The value, in units of 50 microseconds, of the difference between the LCN and UCN clocks over a period between synchronization cycles (normally 6 seconds). A positive value means that the UCN node clock is running faster than the LCN clock. A negative value means that the LCN clock is faster. In synched nodes, the value is derived from averaging eight synchronization cycles. In the Synchronizer node, this value is the signed averaged difference between the two clocks for the previous two synchs.

4.5 UCN Network Statistics Display

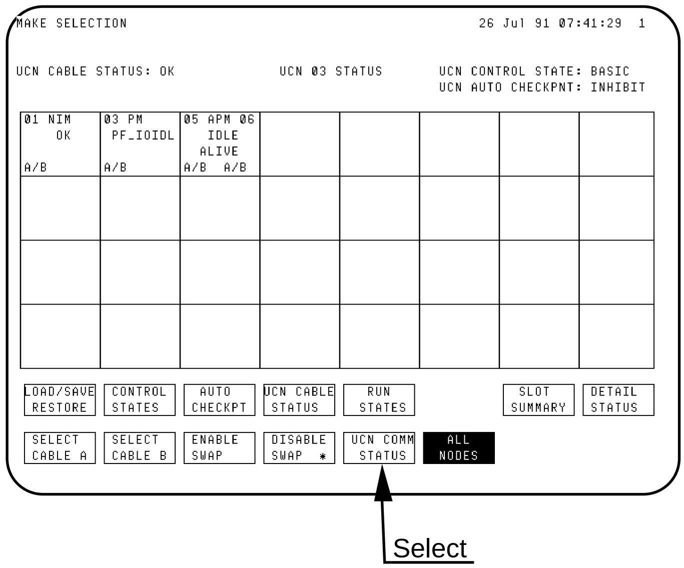
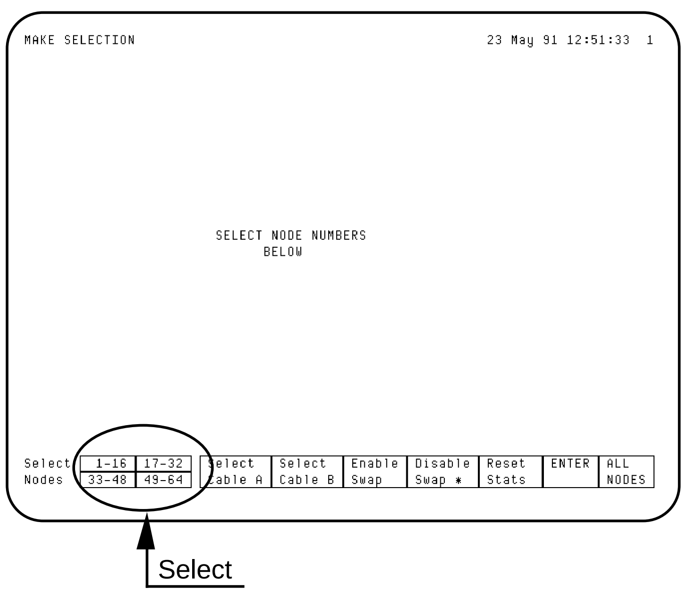
Procedure to access

To call the UCN Network Statistics Display, complete the tasks below.

Step	Action
1	Select the **<SYST STATS>** (SYSTEM STATUS) key on the console.
2	Select one of the **PROCESS NETWORK STATUS** targets on the display for the network you wish to examine. This will call up the next display. 
3	Select the **UCN CABLE STATUS** target. 

Continued on next page

Procedure to access, continued

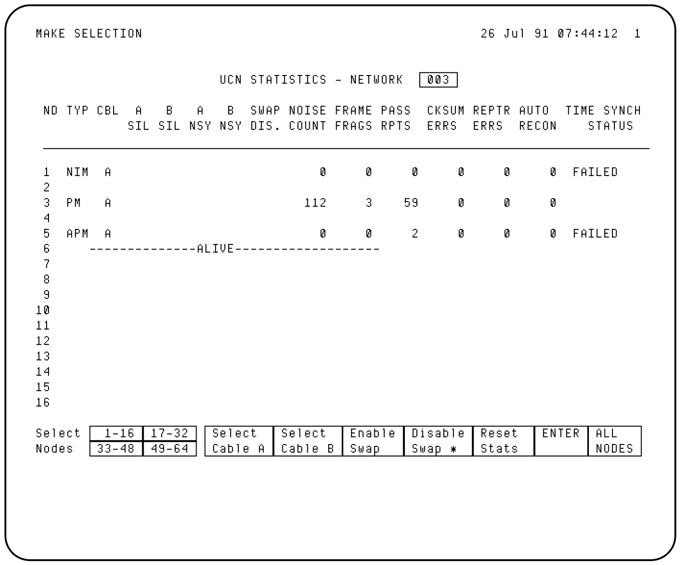
Step	Action
4	Select the **UCN COMM STATUS** target. 
5	You can now select the display that provides statistics for a group of sixteen (16) nodes on the Universal Control Network that you have previously selected. The node group of interest is chosen by selecting one of four targets, **SELECT NODES 1-16**, **17-32**, **33-48**, or **49-64**. 

Continued on next page

4.5 UCN Network Statistics Display, Continued

Procedure to access, continued

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>6</td><td>The UCN Statistics Nodes 1-16 Display selected by the Select Nodes 1-16 target is shown in Figure 4-8.



You can access the displays for the other groups of nodes by selecting that group’s target.</td></tr>
</table>

Continued on next page

Definitions

The information in the UCN Statistics Nodes Display is defined as follows:

Statistic	Definition
ND	The node number.
TYP	The node type (NIM, PM, LM, or APM).
CBL	The UCN cable being listened to by each UCN node (normally the same for all nodes).
A SIL	An asterisk indicates the node detected silence on Cable A.
B SIL	An asterisk indicates the node detected silence on Cable B.
A NSY	An asterisk indicates the node detected noise on Cable A.
B NSY	An asterisk indicates the node detected noise on Cable B.
SWAP DIS.	An asterisk (*) indicates that UCN cable auto-swap (periodic swap) is disabled.
NOISE COUNT	The total number of times the node detected noise bits.
FRAME FRAGS	The total number of times the node detected frame fragments.
PASS RPTS	The total number of times the node retried a token pass to a successor node.
CKSUM ERRS	The total number of times the node detected a checksum error.
REPTR ERRS	The total number of times the node detected a repeater error.
AUTO RECON	The total number of times the node successfully auto reconnected to the UCN.
TIME SYNCH STATUS	The status of the node’s Time Synch. (OK or FAILED)

4.6 Establishing the Base Line

Introduction

When a system has been completely installed and is ready for use, a baseline of cable error statistics must be established. This baseline can then be used to compare future statistics to identify cable degradation.

Which of these statistics will help to establish the baseline?

All statistic network problem indicators should be zero*. Any deviation is an indication that a problem exists in one of the following areas.

- Improper grounding (refer to installation procedure in Appendix A.
- Drop cable connection—check drop cable connections (for tightness) at the tap and the controller card file. This is very likely the problem area if the error statistics are significantly higher for one node. Also, the drop cable itself could be bad.
- Trunk cable—if all devices connected after one point in the trunk have a similar level of errors, check trunk cable connections (for tightness) at the next closest point in the trunk. A topology map is very helpful in performing an error analysis.

An exception to these error conditions are the statistics for TOTAL CABLE SWAPS, MESSAGES SENT and MESSAGES RECEIVED.

It is also acceptable to record low levels of NO RESPONSE errors and RESYNCHS.

* No response may indicate the absence of a redundant partner or in the case of a nonredundant PM, the presence of a redundancy daughter board on the PM's control board.

Appendix B

UCN Exerciser

(excerpt from HPM Service Manual)

Section 5 – UCN Exerciser

5.1 Overview

Section contents

The topics covered in this section are:

Purpose

This section covers the operation of the UCN Exerciser program that is used for isolating communications problems in a UCN node.

CAUTION

CAUTION—The UCN Exerciser is an off-process program intended to provide a level of confidence in the connectivity and communication capabilities of an installed network. This test must not be used for an on-process system because the added communication and CPU loads induced by the test may cause throughput and response time degradation of the control system. The test works best if the physical node states of the participating configured nodes do not change during the duration of the test.

Each node must be configured in the NIM to participate in either test.

More than one logical UCN can normally be configured for a single physical UCN. The UCN Exerciser program must be configured to include, for test, only NIMs (and their redundant partners) from the same logical UCN. Configuring NIMs from more than one logical UCN will cause false errors to be indicated for some of the NIMs. This restriction does not apply to for other UCN node types, such as a High-Performance Process Manager, Advanced Process Manager, Process Manager, or Logic Manager.

5.2 Applications

Purpose

The purpose of the UCN Exerciser is:

- To provide the user with confidence that the UCN is operating properly by sending messages between UCN nodes.
- To test the peer-to-peer communications path. The status of peer-to-peer communications between High-Performance Process Managers is not shown on the Universal Station (US) display.
- To provide a means of isolating communication problems to a certain High-Performance Process Manager by observing the gross level of errors detected.

Two part test

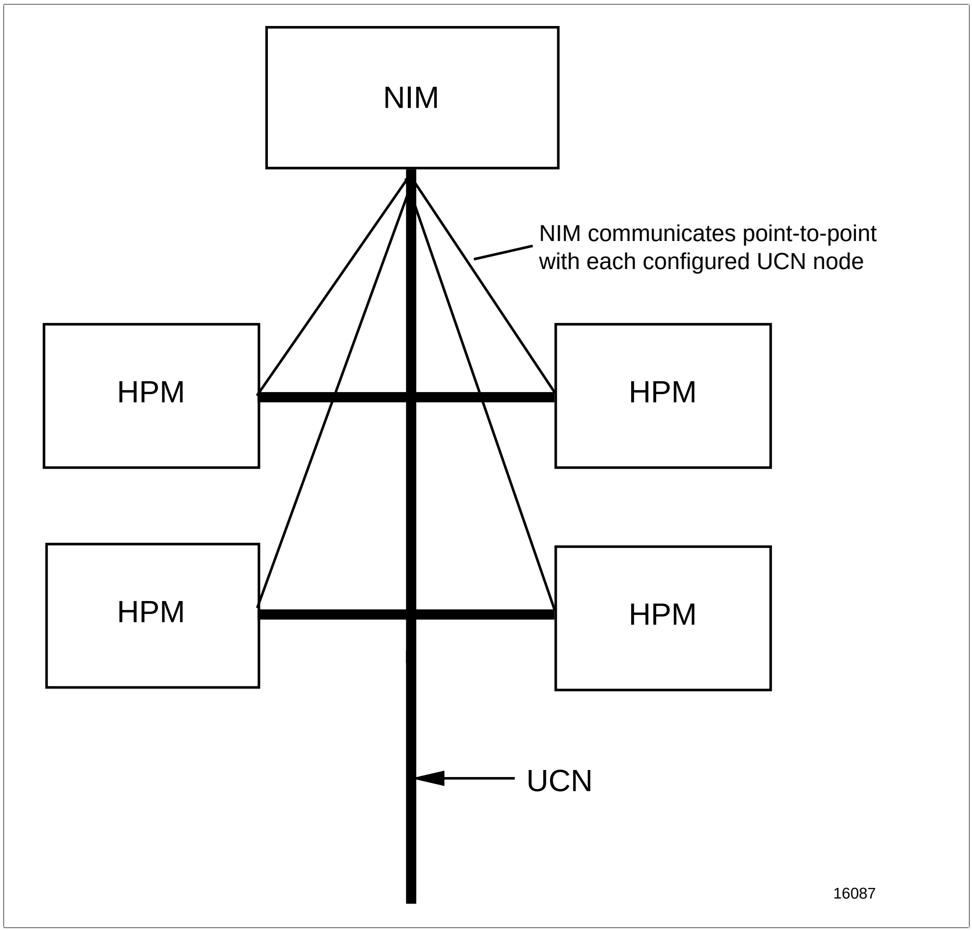
The test has two parts, an RDR test and a Triangulation test, with both performed in succession repeatedly until the test is halted.

5.3 Request Data Response (RDR) Test

Introduction

In the Request Data Response test, as illustrated in Figure 5-1, the Test Master, a Network Interface Module (NIM), attempts to communicate on a point-to-point basis with every UCN node configured to participate in the test. A node can be ALIVE, BUT NOT TOKEN PASSING and still participate in this test using its "shadow address," numbered 65-128. This check is to determine with which participants in the test the Master can communicate.

Figure 5-1 RDR Test Configuration



RDR protocol

The communications protocol used for this part of the test is RDR protocol. All nodes that are powered on and/or are capable of receiving and transmitting messages, should respond to the RDR from the test Master. A node that does not respond is assumed to be not on the network and is not requested to participate in the triangulation part of the test. A node that does respond but whose status indicates that it is not capable of token passing will also not be requested to participate in the triangulation part of the test.

5.4 Triangulation Test

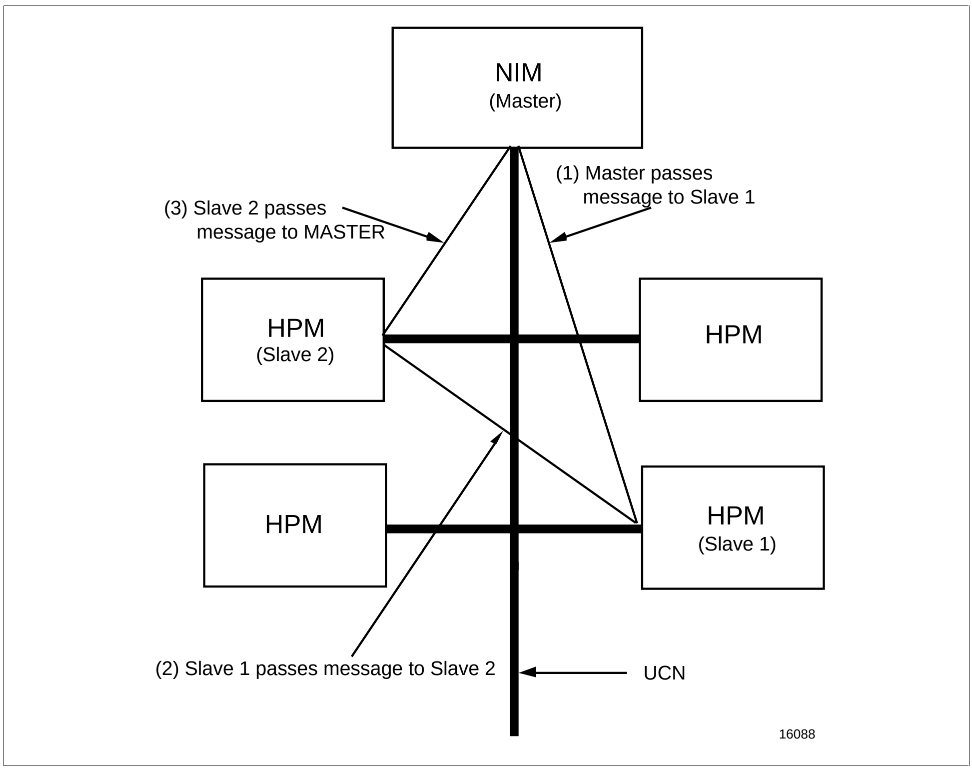
ATTENTION

ATTENTION—This test requires a minimum of one NIM and one server (other UCN nodes). With only two nodes, the NIM talks point-to-point. Three nodes are required for true triangulation.

Introduction

In the triangulation test, as illustrated in Figure 5-2, only nodes that are configured in the test are capable of token passing participate. For example, HPMs that have not been loaded, cannot pass tokens and therefore do not participate. For those nodes that do participate, the test Master issues a message to another node in the test and requests the message to be forwarded to a third node. The third node in the test then sends a message back to the test Master, which verifies that the path has successfully completed. While passing the message, the following communication paths are checked: Master (NIM) to Slave 1, Slave 1 to Slave 2, and Slave 2 to back to the Master.

Figure 5-2 Triangulation Test



Timeout policy

Because a message may be lost or an error may occur, the Master has a reasonable timeout policy for receiving the response back from Slave 2. The timeout policy assumes that each Slave in the test is serving only one Master. This means that responses arriving late are considered errors. By examining several paths together, it is usually possible to determine which nodes are experiencing communication problems.

5.5 Test Operation

UCN Exerciser operation

The operator at the Universal Station (US) can control the operation of the UCN Exerciser. Use the following procedure to perform the UCN Exerciser tests. The display used in the test is explained below. Use the procedure in Table 5-1 to run the UCN Exerciser.

ATTENTION

ATTENTION—If the display does not appear after starting the UCN Exerciser, the Pathname Catalog must be reconstituted by adding the search path **NET>DIA1**.

Starting the UCN Exerciser

The UCN Exerciser is started by pressing the <**SCHEM**> key, typing in **HPNXOVR**, and pressing the <**ENTER**> key.

Page 1 of the UCN Exerciser Overview display will appear as shown in Figure 5-3. The display shows the status of the UCN Exerciser for the LCN nodes 1 through 64 that are NIMs on the LCN. If no status is indicated for the node address, the node is not a NIM.

PAGE target

Selecting the **PAGE** target will invoke Page 2 of the UCN Exerciser Overview display as shown in Figure 5-4. LCN nodes 65 through 96 are represented.

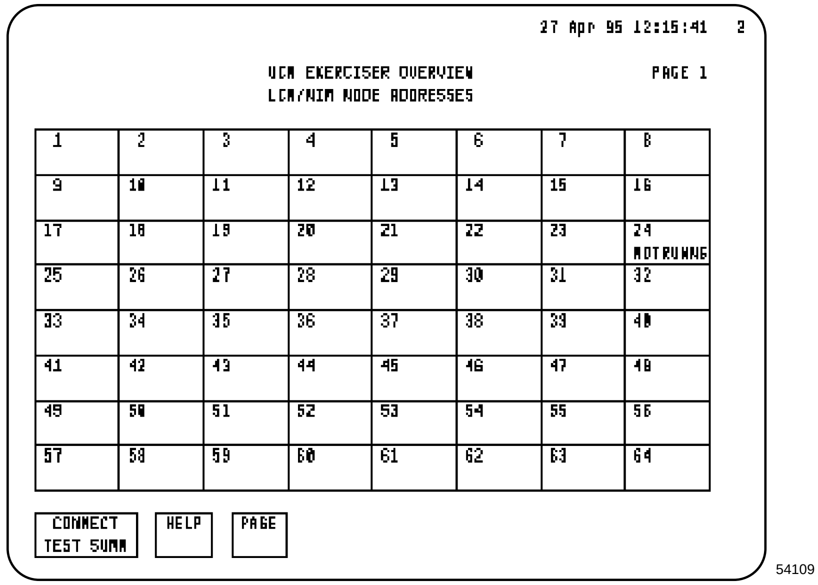
HELP target

Selecting the **HELP** target will invoke the UCN Exerciser Help display as shown in Figure 5-5. Selecting the **UCN EX OVERVIEW** target provides a return to the UCN Exerciser Overview display.

Continued on next page

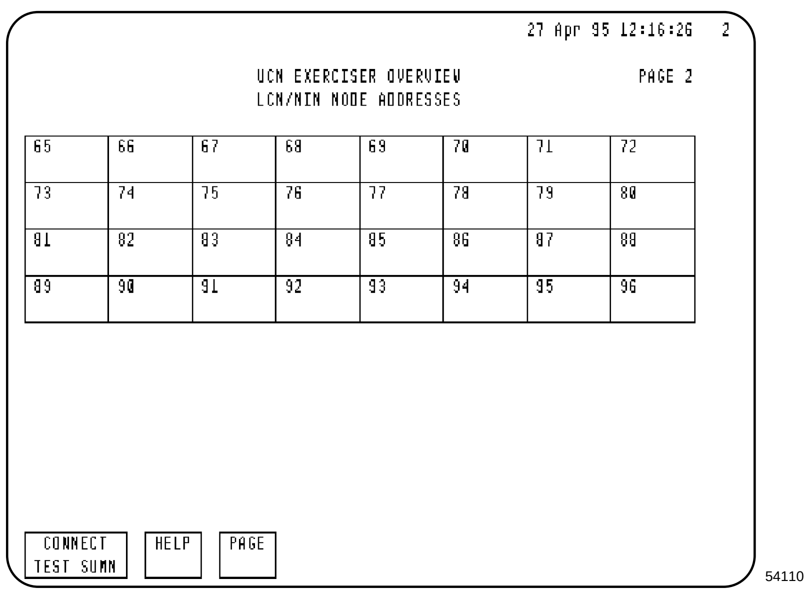
UCN Exerciser Overview display Page 1

Figure 5-3 UCN Exerciser Overview Display – Page 1



UCN Exerciser Overview display Page 2

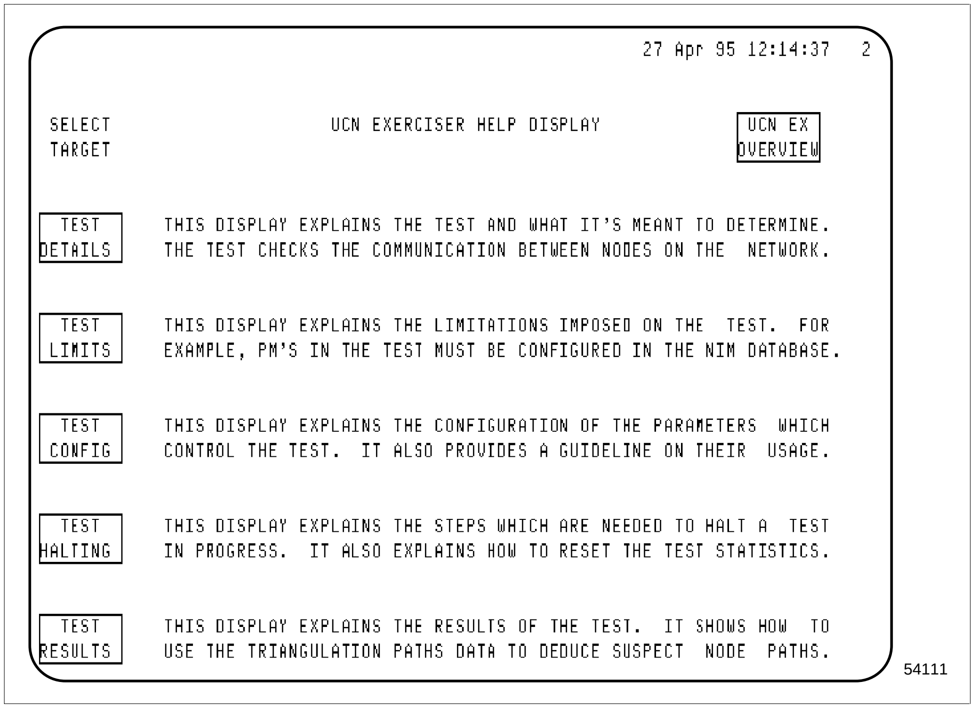
Figure 5-4 UCN Exerciser Overview Display – Page 2



Continued on next page

UCN Exerciser Help display

Figure 5-5 UCN Exerciser Help Display



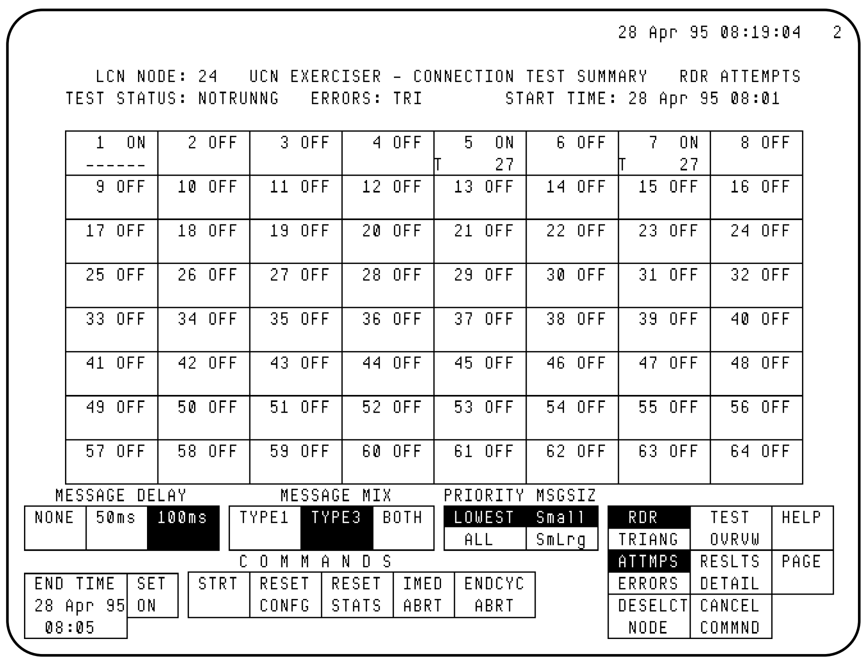
Continued on next page

Connection Test Summary display – Page 1

Each box in the grid on the UCN Exerciser Overview is a target, that when chosen and followed by selection of the **CONNECT TEST SUMM** target, invokes Page 1 of the Connection Test Summary display for the NIM node.

The display is shown in Figure 5-6. Nodes 1 through 64 are represented.

Figure 5-6 Connection Test Summary Display – Page 1



54112

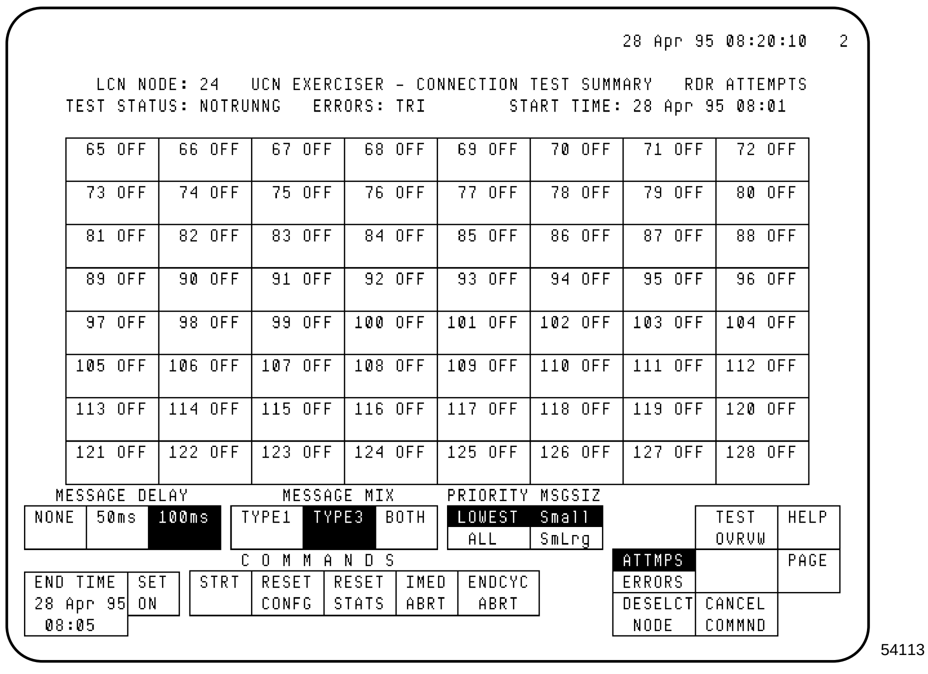
Continued on next page

Connection Test Summary display – Page 2

Selecting the **PAGE** target invokes Page 2 of Connection Test Summary display. Nodes 65 through 128 are represented. The display is shown in Figure 5-7.

Selecting the **PAGE** target provides a return to Page 1 of the Connection Test Summary display.

Figure 5-7 Connect Test Summary Display – Page 2



Continued on next page

UCN Exerciser test procedure

Table 5-1 is a UCN Exerciser test procedure. Follow the procedure to test the UCN.

Table 5-1 UCN Exerciser Test Procedure

Step	Action
1	Start the UCN Exerciser by pressing the <**SCHEM**> key, type in **HPNXOVR**, and press the <**ENTER**> key.
2	Each box in the grid on the UCN Exerciser Overview display is a target, that when chosen and followed by selection of the **CONNECT TEST SUMM** target, invokes Page 1 of the Connection Test Summary display for the NIM node. Nodes 1 through 64 are represented. Selecting the **PAGE** target invokes Page 2 of Connection Test Summary display. Nodes 65 through 128 are represented. Make a selection.
3	Select each node on the UCN that is to participate in the test. This is accomplished by choosing the node in the grid and then the **SET ON** target. Repeat this procedure until all desired nodes are on. For example, Figures 5-6 and 5-7 show nodes 1, 5, and 7 configured for the test. If a node is selected by mistake, select it again and the **SET ON** target will toggle to **SET OFF**. Selecting **SET OFF** deselects that node.
4	Configure the MESSAGE DELAY parameter by selecting the **NONE**, **50 ms**, or **100 ms** target. For example, Figures 5-6 and 5-7 show 100 ms selected.
5	Configure the MESSAGE MIX parameter by selecting one of the three targets • **TYPE 1** Send only Type 1 messages. These are unacknowledged unconnected messages. • **TYPE 3** Send only Type 3 messages. These are acknowledged messages. • **BOTH** Send both Type 1 and Type 3 messages. Figures 5-6 and 5-7 show **TYPE 3** selected.
6	Configure the **PRIORITY** parameter by selecting one of two targets. • **LOWEST** Send messages at the lowest priority. • **ALL** Send messages at each of four priorities.

Continued on next page

UCN Exerciser test procedure, continued

Table 5-1 UCN Exerciser Test Procedure, Continued

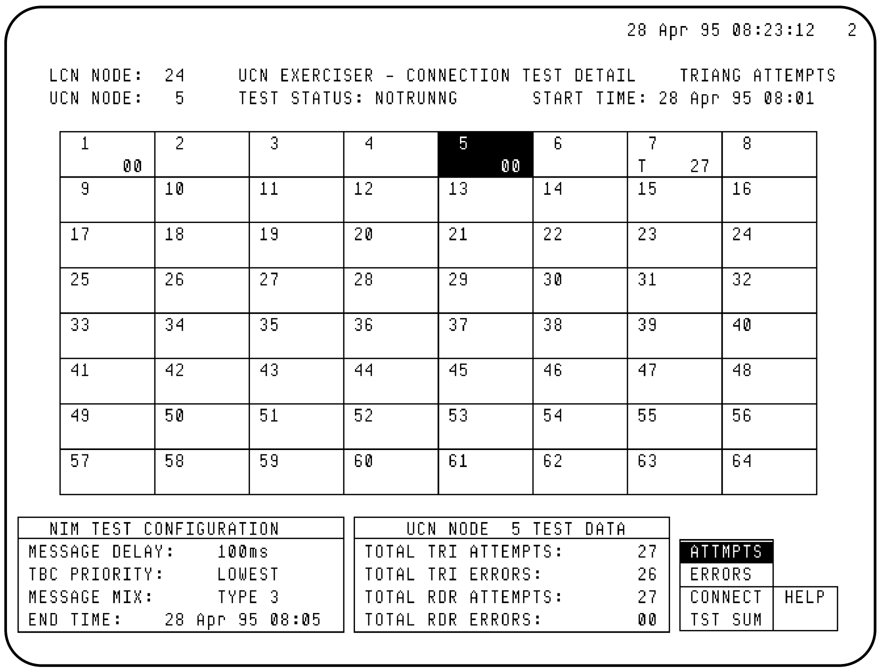
Step	Action
7	Configure the **MSGSIZ** (MESSAGE SIZE) parameter by selecting one of two targets. • **SMALL** Send 50 word messages. • **SMLRG** Send 50 and 100 word messages.
8	Configure the end time date parameter by selecting the **END TIME** target and entering the date in the format shown. Press <**ENTER**>. Enter the time parameter in the format shown and press <**ENTER**>.
9	Select the **STRT** (START) target followed by the **EXEC** (EXECUTE) target to start the test. The **EXEC** target appears to the right of the **ENDCYC** (END CYCLE) target when the **STRT** target has been selected. There are five commands shown in Figures 5-6 and 5-7. To execute the chosen command, the **EXEC** target must also be selected. The following commands are available. • **STRT** Starts the RDR and Triangulation test. • **RESET CONFG** Resets the configuration to off for all nodes. • **RESET STATS** Resets the statistics to zero. • **IMED ABRT** Aborts the test wherever it is in the procedure. • **ENDCYC ABRT** Aborts the test at the end of the current test cycle.
10	Select the **TEST OVRVW** (TEST OVERVIEW) target to return to the UCN Exerciser Overview display. See Figures 5-6 and 5-7. Wait for the test to complete. The **NOTRUNNG** (NOT RUNNING) status appears on the UCN Exerciser Overview display as shown in Figure 5-3.

5.6 Analyzing Results

Connect Test Detail display

To see the results, chose the node of interest and select the **RESLTS DETAIL** (RESULTS DETAIL) target on the Connect Test Summary display. This invokes the Connection Test Detail display as shown in Figure 5-8.

Figure 5-8 Connection Test Detail Display



54114

Number of attempt errors

Check the boxes in the grid target for nodes 0, 5, and 7. The number in the lower right corner of the box reports the number of attempts if the **ATTMPS** (ATTEMPTS) target is backlighted, or the number of errors if the **ERRORS** target is backlighted on the Connect Test Summary display. The display is selected with the **CONNECT TST SUM** (Connect Test Summary) target.

Problem correction

The node that has the highest number of errors is likely to be the node causing a problem. The problem should be corrected by replacing the HPM UCN Interface module or by checking the UCN cable connections. If this does not correct the problem, call the Technical Assistance Center (TAC) for assistance.

LAST PAGE