Honeywell

UCN Guidelines

UN12-510

TotalPlant

Honeywell

Installation

Universal Control Network

UCN Guidelines

UN12-510
Release 500
CE Compliant
8/96

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About This Publication

This publication provides guidance to the user to ensure the best performance of the Universal Control Network (UCN) through system configuration rules and installation guidelines.

This publication supports **TotalPlant** Solution (TPS) System network Release 500. TPS is the evolution of TDC 3000X.

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Acronyms

APM .... Advanced Process Manager
APMM .... Advanced Process Manager Module
HPM .... High-Performance Process Manager
HPMM .... High-Performance Process Manager Module
I/O .... Input/Output
LCN .... Local Control Network
LLC .... Link Layer Control
LM .... Logic Manager
LMM .... Logic Manager Module
NIM .... Network Interface Module
PM .... Process Manager
PMM .... Process Manager Module
RWR .... Request with Response
SOE .... Sequence of Events
TAC .... Technical Assistance Center
TBC .... Token Bus Controller
UCN .... Universal Control Network

References

Publication Title	Publication Number	Binder Title	Binder Number
TPS System Site Planning	SW02-550	System Site Planning - 1	TPS 3020-1
Universal Control Network Planning	UN02-501	System Site Planning - 1	TPS 3020-1
Universal Control Network Installation	UN20-500	Installation/Universal Control Network	TPS 3041
Process Manager/Advanced Process Manager Planning	PM02-501	System Site Planning - 1	TPS 3020-1
Process Manager/Advanced Process Manager Installation	PM20-501	Implementation/PM/APM	TPS 3043
Process Manager/Advanced Process Manager Service	PM13-501	PM/APM/HPM Service -1	TPS 3061-1
Logic Manager Planning	LM02-501	System Site Planning - 2	TPS 3020-2
Logic Manager Installation	LM20-500	Implementation/Logic Manager	TPS 3070
Logic Manager Service	LM13-500	LM Service	TPS 3073
High-Performance Process Manager Planning	HP02-500	System Site Planning - 2	TPS 3020-2
High-Performance Process Manager Installation	HP20-500	Implementation/HPM-3	TPS 3063-3
High-Performance Process Manager Service	HP13-500	PM/APM/HPM Service	TPS 3061-1

Section 1 – Introduction

1.1 Overview

Section contents

The topics covered in this section are:

Purpose and scope

This manual's purpose is to improve the performance and reliability of a Universal Control Network (UCN). This can be accomplished by practicing the configuration guidelines and installation guidelines.

Section 2—contains hardware and configuration guidelines that ensure proper system performance.

Section 3—contains guidelines for UCN trunk cable design.

Section 4—contains instructions that enable the user to access cable statistics, defines the contents of the statistics displays, and in Table 4-5, relates error messages to a probable cause.

Section 5—contains recommended procedures for handling single and double cable faults.

Appendix A—contains a detailed installation procedure for installing trunk cables, trunk cable taps, mounting brackets, and drop cables in cabinets. An important part of these procedures is the marking of Cable A and Cable B trunks, and the isolated ends of cables.

Section 2 – UCN System Configuration Guidelines

2.1 Configuration Guidelines

Section contents

The topics covered in this section are:

Introduction

This section provides the user with configuration information to ensure the best system performance.

Configuration rules

The following rules should be used as a guideline for ensuring the best system performance possible.

Area	Description
NIM	Rules: • Network Interface Modules (NIMs) have the lowest addresses on the UCN (starting at 1). • Pin the hardware address to match the system address. • Addresses should be given in odd/even pairs. (When unused, the even address is still reserved.) • No more than four NIM pairs on a single UCN. Suggestions: • Because of the prior rules, non-NIM nodes begin at address pair 9/10. Continue with 9/10, 11/12, 13/14, etc. • Address pairs (NIM and non-NIM nodes) may be skipped to allow for future expansion.
Cables	Rules: • The order of the UCN nodes along the trunk must be the same for Cable A and Cable B. • Connect redundant nodes to the same tap port and the same tap (Figure 2-1). • A spare UCN tap drop port must be provided at both ends and the middle of Cable A and Cable B. These spare ports are used for diagnostic purposes without disturbing the system.
Error Handling	Rules: • Build a UCN point (UCN Node Configuration) for every node on the UCN. • Build a node-specific point (Node Specific Configuration) for every node on the UCN except NIMs.

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Configuration rules, continued

Area	Description
NIM	Rules: • Network Interface Modules (NIMs) have the lowest addresses on the UCN (starting at 1). • Pin the hardware address to match the system address. • Addresses should be given in odd/even pairs. (When unused, the even address is still reserved.) • No more than four NIM pairs on a single UCN.

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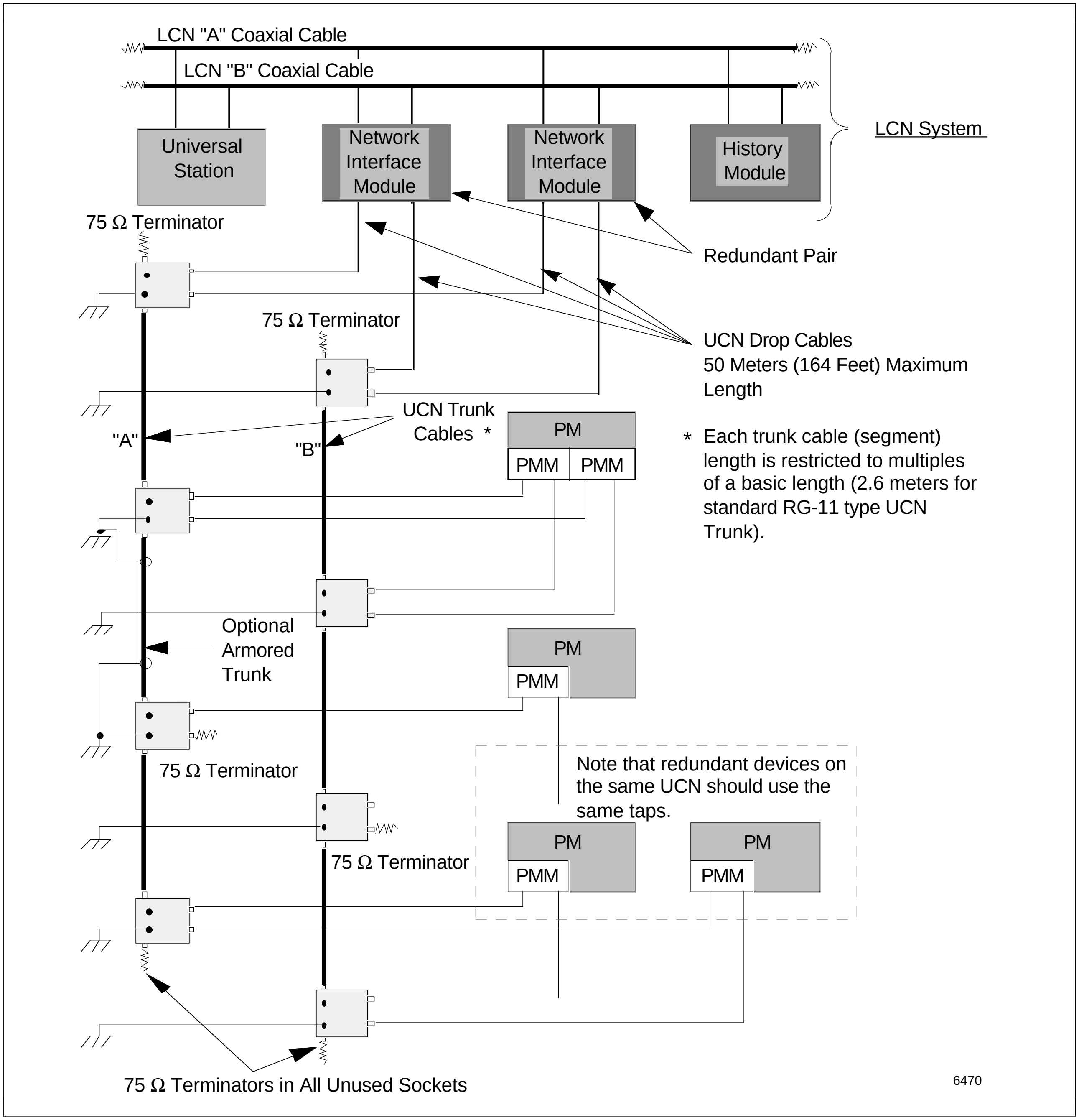
Figure 2-1 UCN Cable and Tap Connections



2.2 Configuration of TIMESYNC

Introduction

Configuration of time synchronization is done with the TIMESYNC parameter enabled in a NIM's UCN point configuration when configuring each primary NIM. There are several factors to be considered when deciding which NIMs, connected to a single UCN, should have the TIMESYNC parameter enabled.

Configuration rules

Application	Description
General	Rules: • A pair of NIMs with the TIMESYNC parameter enabled must both have EPNI boards. • The lowest addressed NIM (with an EPNI board) on the UCN becomes the NIM responsible for time synchronization of all Advanced Process Managers (APM) connected to that UCN. • More than one NIM pair can have the TIMESYNC parameter enabled, thus, preparing a natural succession of NIM(s) to control time synchronization. However, there can only be one NIM passing time synchronization on any one UCN. • To prepare for failure scenarios, the other NIMs on the same LCN should also have the TIMESYNC parameter enabled (would only be used if all other lower numbered nodes failed). Fact: APMM SOE time synchronization will continue for 30 minutes after NIM failure to give time to reload a NIM.
UCN Tied to Multiple LCNs	Rules (refer to Figure 2-2): • The TIMESYNC parameter should not be configured in NIMs that connect a UCN to other LCNs. • If there is only one pair of NIMs on the main LCN, it may be desirable to have the security of another NIM pair configured for time synchronization. If this NIM pair resides on a second LCN, the second NIM pair must have a higher UCN address than the first pair of NIMs. If control of time synchronization does failover to the second LCN, that LCN time base will be used. Because of the expected difference in LCN timebases, correlation of SOE across this failover may be difficult. • If there are two or more different LCN systems that communicate with APMs and other controllers on a single UCN, only the NIMs on the LCN select to generate time synchronization can have the TIMESYNC parameter enabled.

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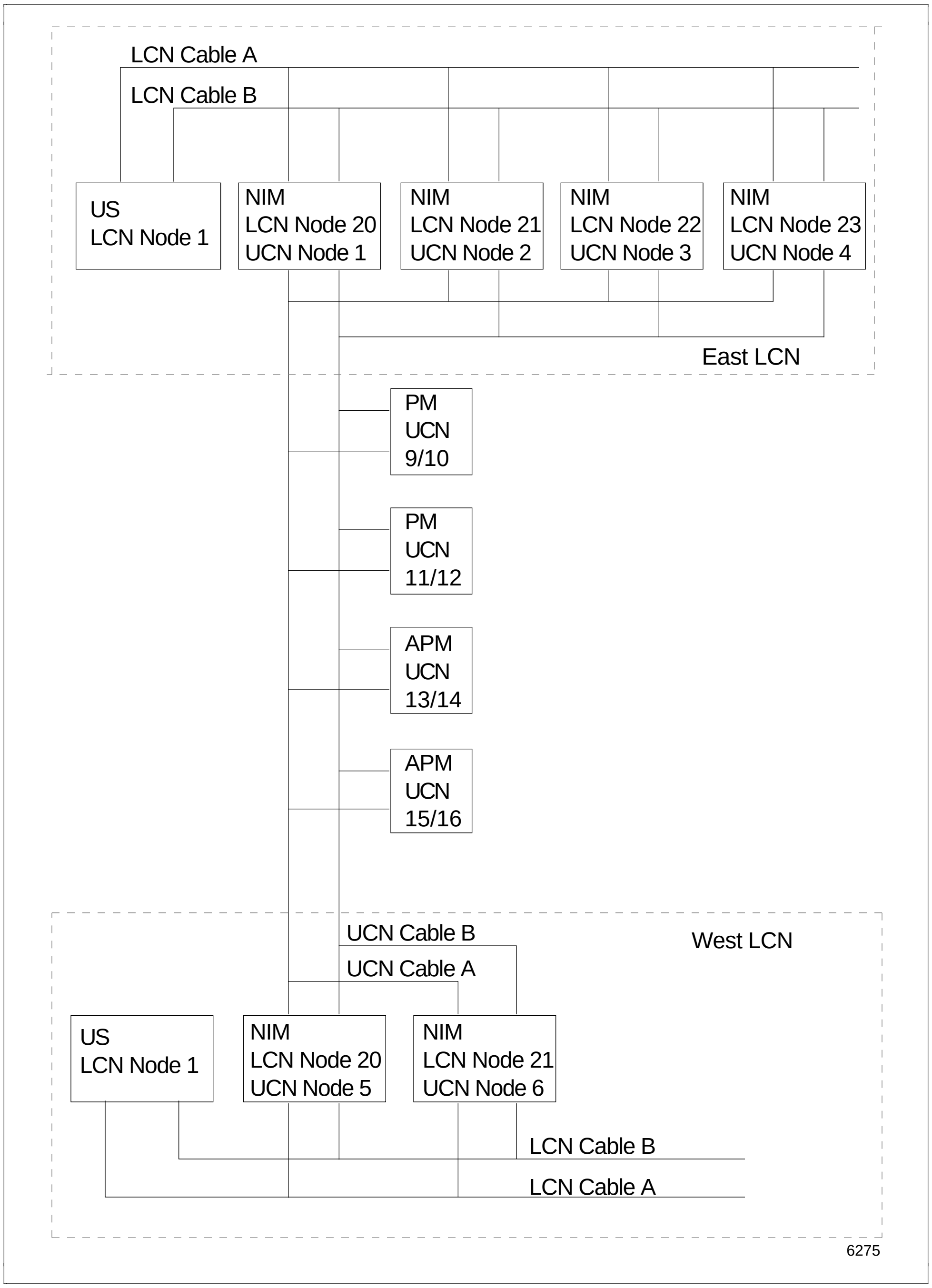
Addressing NIMs with multiple LCNs

Figure 2-2 Addressing NIMs with Multiple LCNs Connected



Section 3 – Guidelines for Trunk Cable and Taps

3.1 Overview

Section contents

The topics covered in this section are:

Introduction

This section provides the user with guidelines for trunk cable and tap installations that ensure the best performance.

Definitions

Terms and definitions that will be used in this section are defined here.

TERM	DEFINITION
BEND RADIUS	Tightest bend allowed to a cable without damaging the cable electrical capability.
CABLE A	One of a redundant pair of trunk/drop cables that are diversely routed (from cable B) to prevent simultaneous damage.
CABLE B	One of a redundant pair of trunk/drop cables that are diversely routed (from cable A) to prevent simultaneous damage.
DROP CABLE	Cable that connects the PM, APM, HPM, or LM module to the trunk tap.
TAP	Adapts the trunk cable to two, four, or eight drop cables while maintaining the impedance of the trunk cable.
TAP PORT	An F-type connector on the tap that provides for the connection of a trunk cable or a drop cable.
TRUNK CABLE	The complete main cable made up of one or more segments connected together by taps.
TRUNK SEGMENT	A segment of the main trunk connecting two taps together.

3.2 UCN Trunk Cable System

Definition: UCN

The Universal Control Network (UCN) is a network of Network Interface Modules (NIMs), process control systems, trunk cables, taps, and drop cables that interconnect the network.

Important reference

Refer to the *Universal Control Network (UCN) Planning*, *TPS System Site Planning*, or *UCN Installation* manual for specific information about planning and installation.

Introduction

There are many different ways of routing cable and locating taps and drop cables. The rules for doing this are discussed in the site planning manual. What is discussed here are some suggested ways of installation that will help improve the performance of the UCN.

Routing the cable

As explained in the *Universal Control Network (UCN) Planning* manual or *TPS System Site Planning* manual, the two cables, Cable A and Cable B, should be routed differently such that if one trunk cable is damaged, the other is not likely to be damaged and will still be operational. Other than this restriction, there are many options; the cables can be in conduit, strung through the air with support, placed in cable troughs, etc.

Locating the taps

The taps can be located inside the system cabinets, or externally. The mounting procedure which is included with the taps is also found in the *Process Manager/Advanced Process Manager Installation* manual or the *High-Performance Process Manager Installation* manual..

What can I do if the trunk cable is not long enough?

The total length of the trunk cable is limited by the type of cable used, the number of taps and the length of the longest drop cables used. This maximum length can be determined in several ways as discussed in the *Universal Control Network (UCN) Site Planning* manual.

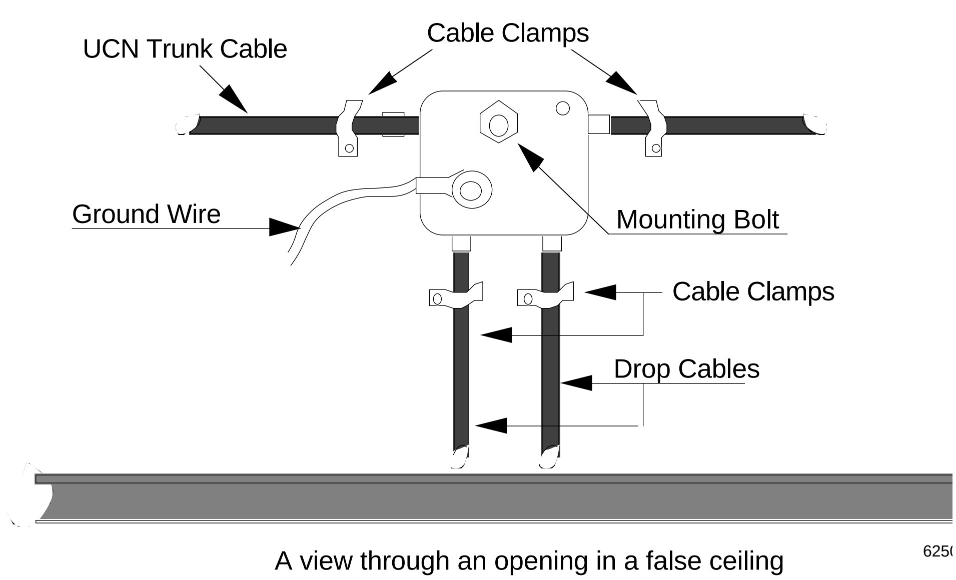
For the purpose of this discussion, consider a trunk cable (Standard RG-11 coax) with a NIM located at one end of the trunk and an APM (or PM, or LM) located at the other end of the cable. The maximum length is 650 meters of trunk cable, plus 100 meters of drop cable (two 50 meter cables). If distance is a problem, the taps can be located outside of the cabinet on I-beams, on walls above false ceilings, or just high on a wall. This allows a maximum distance of 750 meters. Refer to Figures 3-1 and 3-2.

- All taps must be permanently and securely mounted to a wall or I-beam such that cables can be strain relieved and can maintain a controlled, minimum bend radius to protect the characteristics of the cable.
- Taps must be physically isolated well enough that they are not abused by bumping or by exposure to the elements (weather or sunlight).
- Grounding guidelines must be followed—see subsection 3.3.

Continued on next page

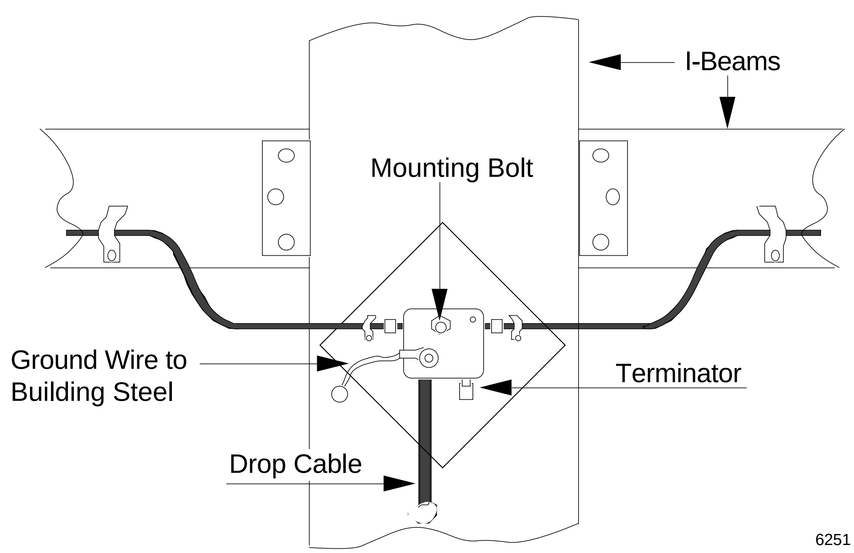
Mounting a UCN tap in the ceiling

Figure 3-1 Mounting a UCN Tap in the Ceiling



Mounting a UCN tap on an I-beam

Figure 3-2 Mounting a UCN Tap on an I-beam



3.3 Improving UCN Performance

Introduction

The key to proper system operation is the trunk cable tap since this is the center of the system. Improper installation is the largest contributor to high error rates on the UCN. Refer to the *Process Manager/Advanced Process Manager Installation* manual or *High-Performance Process Manager Installation* manual for the recommended installation procedure.

What factors can improve performance of the UCN?

The following factors are extremely important to improving the performance of the UCN.

- Ground each tap with a single direct ground wire from the tap ground screw to the nearest Safety ground (building steel) using star washers at each end of the wire. There should be no daisy-chaining of the ground wire. Check connections for resistance due to paint, dirt, corrosion, or any other contaminant.
- Tighten cable connections. UCN F-type connectors must be tightened to 25 inch/pounds. The Torque Wrench Kit, MU-NKTQ01, provides a torque wrench designed to ensure the tightening torque of 25 inch/pounds.
- Correct connection of trunk cable segments to the tap. In Appendix A the concept of isolated cable connections is discussed. **This is extremely important and a very common problem.** The installation procedures in Appendix A should be followed to the last detail.
- Crossed cable segments. The cross connection of cable A and Cable B segments is a subtle condition that must be prevented. This condition can be avoided at the time of installation by using the provided color rings on trunk cable connectors, drop cable connectors, and tap connectors. If your system does not have these color marking rings, they are available as kits to be installed (51195454-300).

  Of course, installing the rings may not guarantee that there will not be any crossed cables. To ensure that the cables are not crossed, completion of the crossed cable detection procedure will identify any crossed segments.

WARNING

This crossed cable detection procedure involves a certain amount of risk to an on-line system and should only be done in conjunction with the Honeywell Technical Assistance Center (TAC). TAC will provide the procedure.

How can improvement in system performance be measured

Improvements in system performance can be measured by recording the error rate over a 24 hour period for Cable A and Cable B before any attempt is made to improve the UCN system performance, and again after the factors mentioned above have been checked.

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 PMM, APMM, or HPMM display has a hardware configuration status.
- The TYPE status is different (PMM, APM, HPMM, or NIM).
- The Event Receiver Statistics, for non-NIM displays, are not displayed.
- The Event Sender Statistics counts for the NIM display are always zero.

Overview

The procedures in subsections 4.4.1 and 4.4.2 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
- PMM, APMM, LM, or HPMM Local UCN Statistics Display —displays statistics for any non-NIM node.
- UCN Network Statistics Display

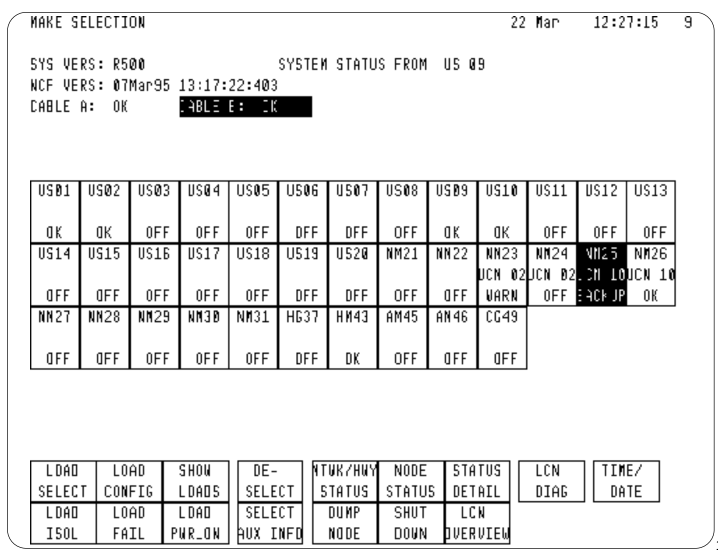
How to access these displays and interpret them will be discussed in the next three subsections.

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	Choose the NIM node on the display grid and then select the **NTWK/HWY** target on the System Status display for the network you wish to examine to invoke the UCN Status display.



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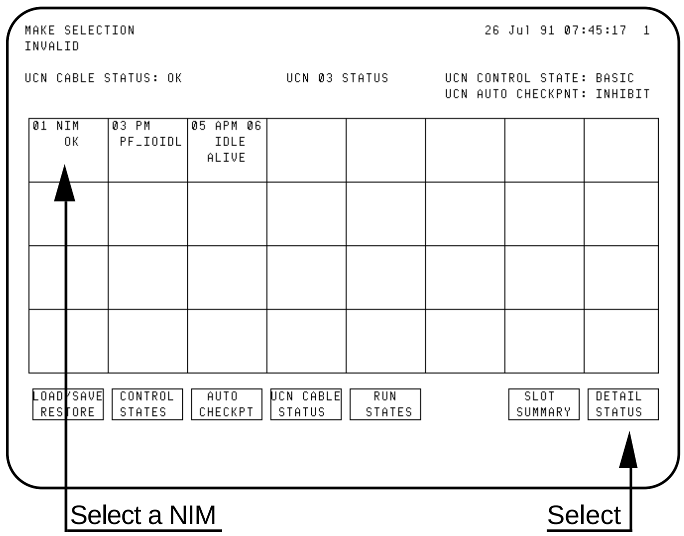
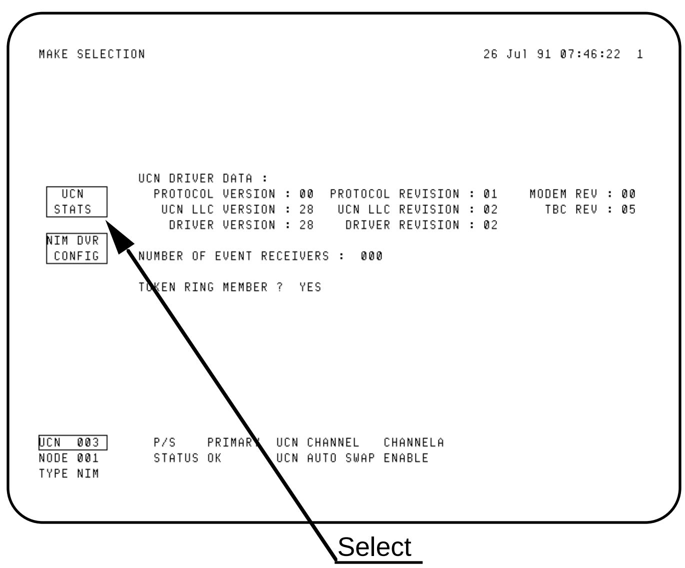
4.4.1 Accessing NIM Local UCN Statistics Display, Continued

Procedure to access, continued

Step	Action
3	Select the NIM of interest. Select the **DETAILED STATUS** target 
4	The NIM Driver Configuration Display will appear. Select the **UCN STATS** target 

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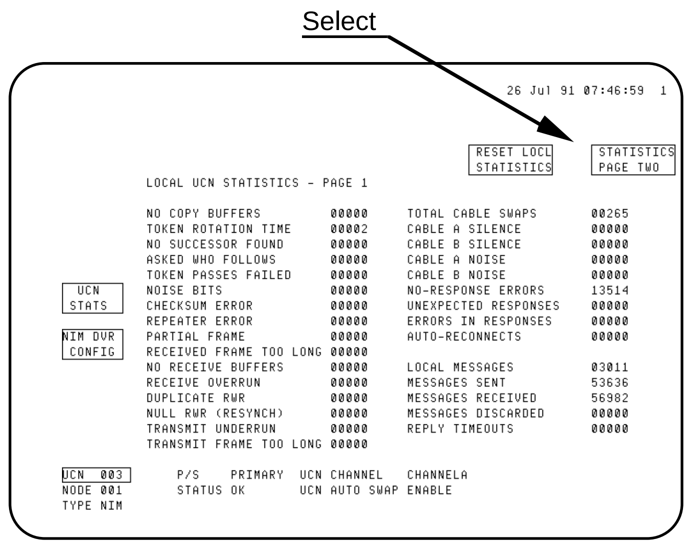
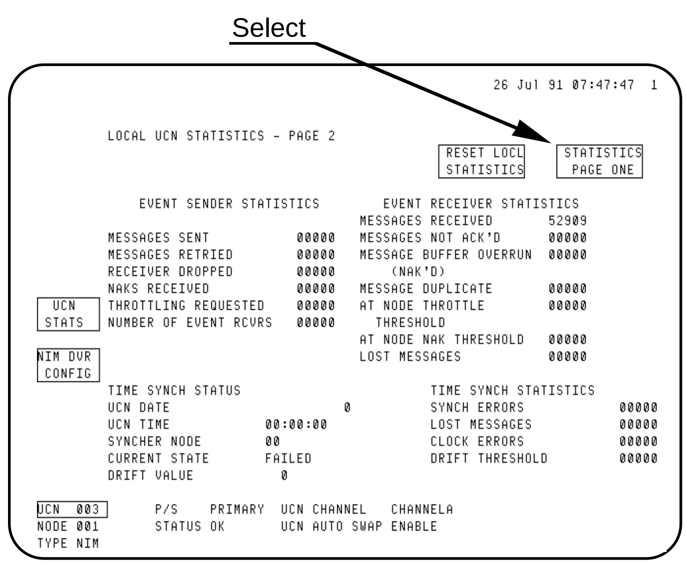
Procedure to access, continued

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

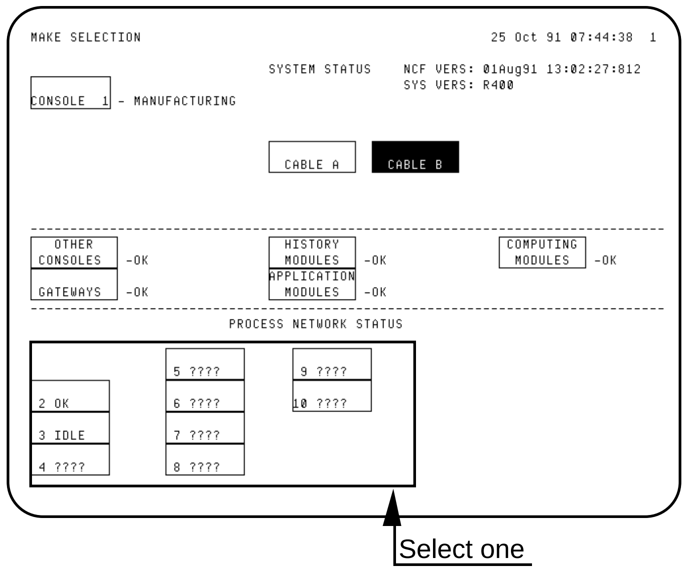
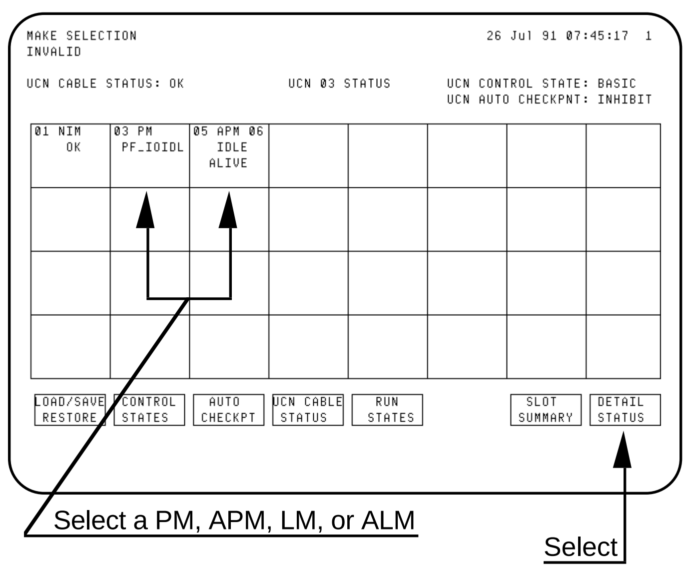
Displays

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, HPMM, 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, HPMM, or LMM of interest. Select the **DETAILED STATUS** target 

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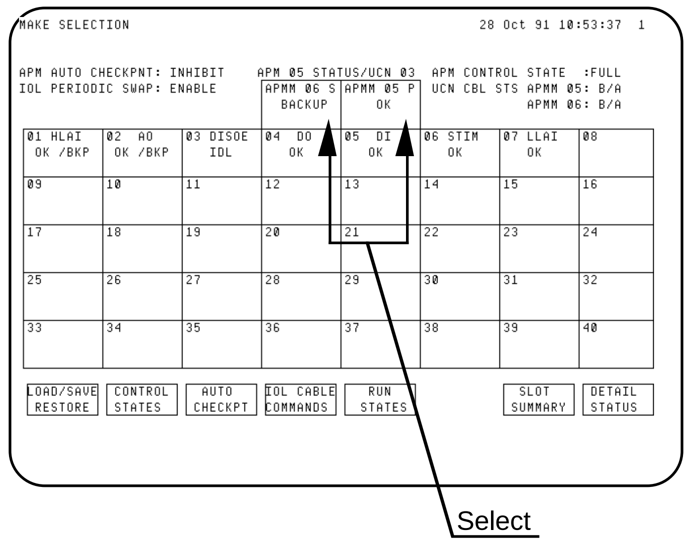
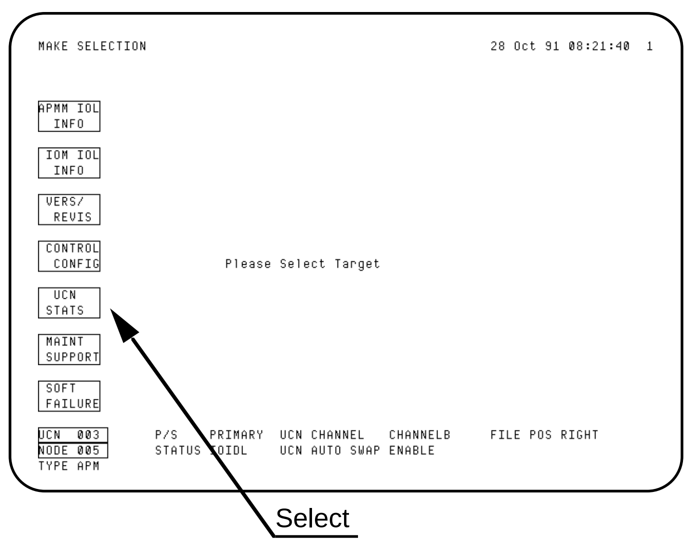
Procedure to access, continued

Step	Action
4	Select the APMM, PMM, HPMM, or LMM of interest. Select the **DETAILED STATUS** target 
5	The PMM, APMM, HPMM, or LMM **DETAILED STATUS MENU** Display will appear. Select the **UCN STATS** target 

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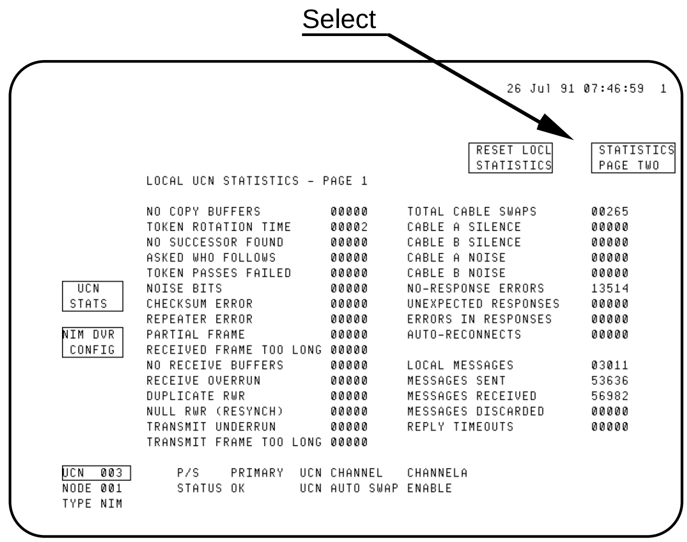
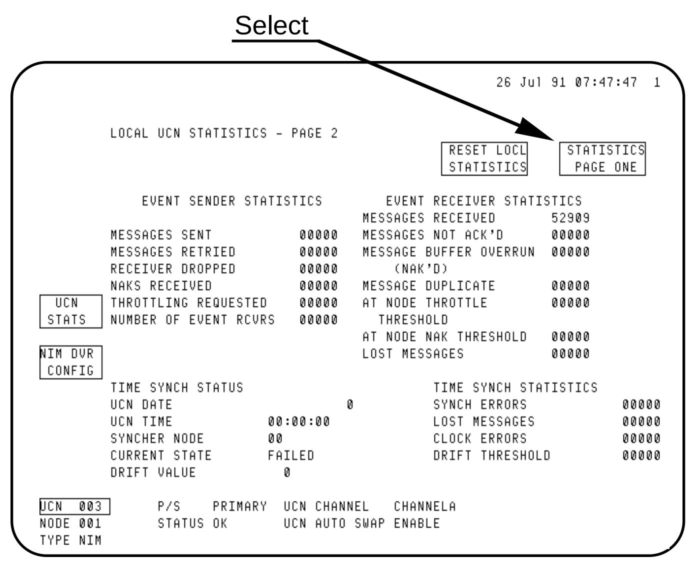
Procedure to access, continued

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 a PM, APMM, or HPMM.
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

4.4.3 Display Descriptions, Continued

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 5 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 (PM, APMM, or HPMM) 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

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 the EPNI and the PMMs, APMMs, or HPMMs. 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 or HPM.	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 or HPM 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, APM and HPM only.	The number of primary NIMs running on the UCN.	N/A	N/A

* APMMs,PMMs, HPMMs, 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

4.4.4 Troubleshooting Tables, Continued

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 PMM, APMM, HPMM, 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

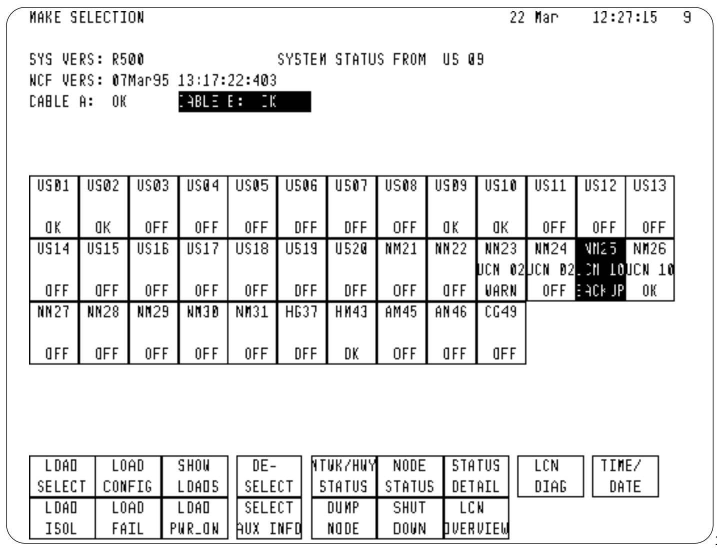
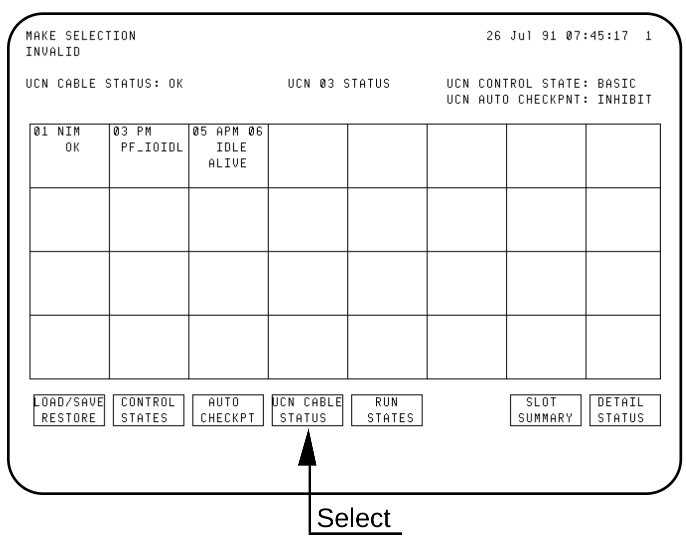
Table 4-9 Timesynch Status

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.

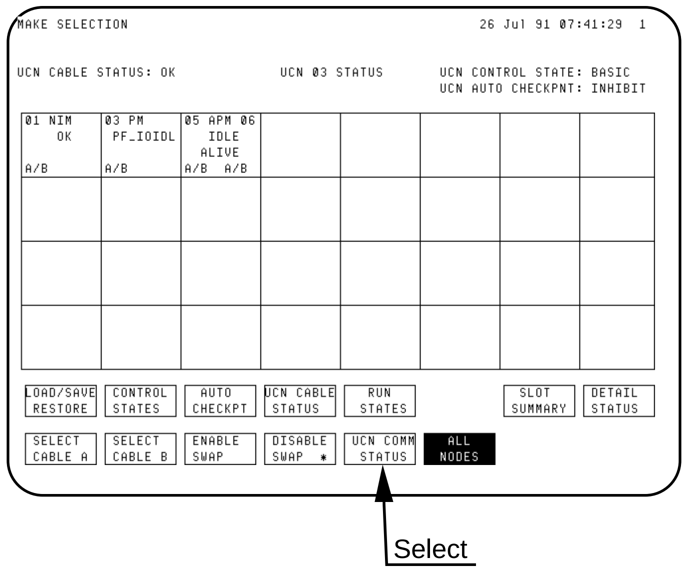
Step	Action
1	Select the **<SYST STATS>** (SYSTEM STATUS) key on the console.
2	Choose the NIM node on the display grid and then select the **NTWK/HWT** target on the System Status display for the network that you wish to examine to invoke the UCN Status display.  15244
3	Select the **UCN CABLE STATUS** target. 

Continued on next page

Procedure to access, continued

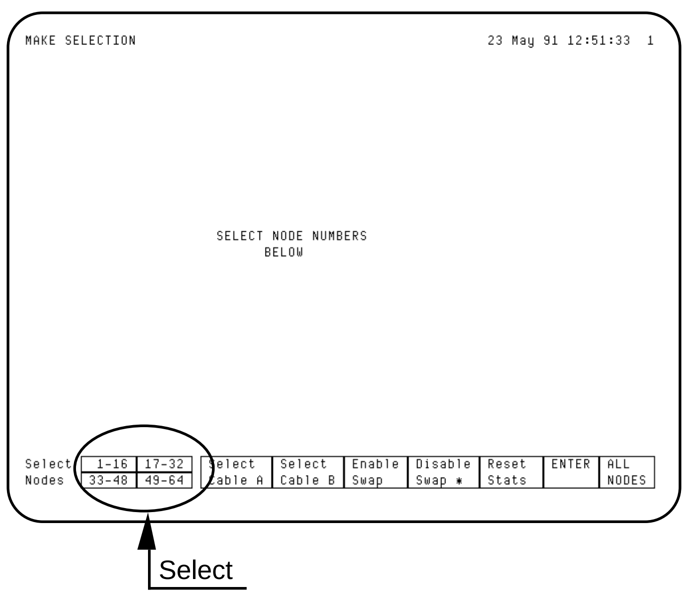
<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>4</td><td>

Select the **UCN COMM STATUS** target.



</td></tr>
<tr><td>5</td><td>

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**.

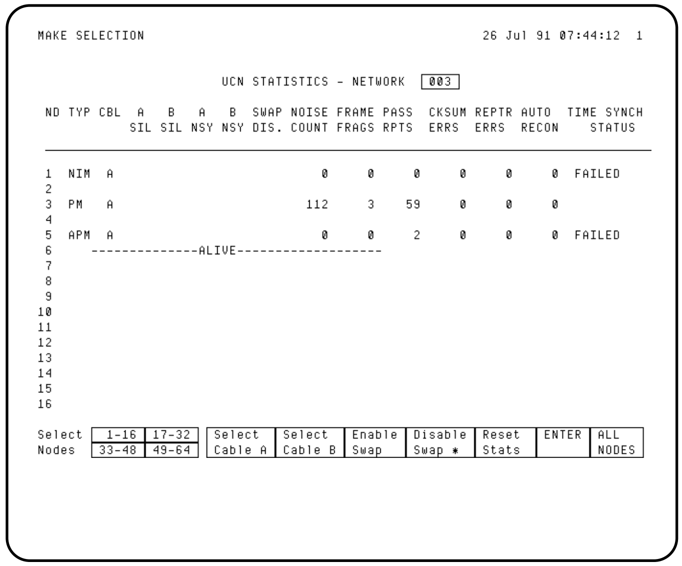


</td></tr>
</table>

Continued on next page

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>

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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, HPM, 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.

Section 5 – Handling Cable Faults

5.1 Overview

Section contents

The topics covered in this section are:

Introduction

This section provides guidance in the following:

- configuring the cable system to allow correct handling of cable faults.
- cable fault handling procedures and guidelines.

Guidelines

The following rules should be strictly observed:

- The node with the lowest address should always be a NIM.
- One NIM should be used for UCN cable commands. Never issue UCN cable commands from a different primary NIM at the same time.
- For proper cable handling, we recommended that you enable periodic cable swapping whenever possible. This prevents a second cable fault from causing a network disruption.
- Select the same cable for all nodes at all times. Otherwise, a cable fault can result in the failure of one or more nodes. This implies that periodic swapping must be either enabled or disabled in all nodes on the network.

WARNING

- Do not attempt to run the UCN Exerciser on-line (that is, a system controlling a process). Running the UCN Exerciser on-line may result in delayed responses, time outs, and possible node failure.

WARNING

Attempting to `SHUTDOWN` many failed secondaries (which cause `AUTO-RESTART`) as fast as possible, causes the secondaries to `FAIL` with 0A 2x errors. The user must pause at least 10 to 15 seconds after each shutdown, before attempting the next.

5.2 Single Cable Fault Handling Procedures

Procedure for cable faults on multiple nodes

The following faults/solutions address the most common situations.

Step	Action
1	Inspect the faulty cable and repair it if necessary. Some of the more common cable problems are: • Loose or disconnected terminators • Loose or disconnected drop cable on a tap • Loose or disconnected drop cable on a modem • Loose or disconnected trunk cable on a tap
2	At the UCN Status display, command all UCN nodes to select the faulty cable. If the fault has been fixed, all nodes will remain on the cable. If cable swapping was enabled prior to the fault, cable, swapping will automatically be re-enabled approximately 1 minute after all faults have been fixed and the error cleared (by this step). If the faulty cable has not been fixed, the nodes will switch back to the good cable and indicate the error by backlighting the bad cable target.
3	**CAUTION** Do not proceed with Step 3 unless the nodes remain on the faulty cable for at least 30 seconds. Use the UCN Status display to enable periodic switching (**SWAP ENABLE**) for all nodes on the UCN.

Start up with a bad cable

If a node starts up with a bad drop cable and its good cable is not the one the rest of the Network is listening on, it may not be able to communicate and identify the problem as a bad cable.

Step	Action
1	Do a cable swap for the network. Then start up the node. This may help identify the problem as a bad cable.
2	At the UCN Status display, command all UCN nodes to select the faulty cable. If the fault has been fixed, all nodes will remain on that cable. If cable swapping was enabled prior to the fault, cable swapping will automatically be re-enabled approximately 1 minute after all faults have been fixed and the error cleared. If the faulty cable has not been fixed, the nodes switch back to the good cable and indicate the error by backlighting the bad cable.

5.3 Double Cable Fault Handling Procedures

Introduction

The UCN provides correct communications in the presence of faults on one trunk or drop cable because all nodes move to the backup cable. If all nodes do not correctly move to the backup cable, some nodes will be unable to communicate.

Faults on both Cable A and Cable B of the UCN are known as double faults. Double faults will cause one or more nodes to be unable to communicate over the UCN, causing loss-of-view, loss of AM control and/or loss of peer-to-peer control. Dual faults to any one node's drop cables will cause it to be unable to communicate over the UCN. Trunk faults are likely to affect all nodes to some extent depending the location of the physical problem.

Fault Indications

In either case, failovers in redundant nodes may occur. On the UCN STATUS DISPLAY, the NIM may

- show itself as OK and most other nodes as OFFNET, or
- if it cannot communicate with at least one other node it will show itself as COMMFAIL, and all other nodes as UNKNOWN.

At least one special single-fault case looks like a double fault: when there is an undetected fault in a backup drop or trunk cable and a node is shutdown, or is powered off, or fails over, one or more nodes may be unable to communicate.

Recovery Approach

A double cable fault situation must be reduced to a single fault situation before communications can begin to be restored—one of the cables (A or B) must be restored completely. **Start by repairing the cable in use by the NIM, then repair the other cable.** In some cases , full view may not be restored even after one cable is completely restored.

NIMs

Dual drop faults to a primary NIM will only cause that NIM to failover. Dual drop faults to a secondary NIM will not cause that NIM to fail. Dual trunk faults will generally cause NIM failover. Do not reload the failed partner until after the cable faults are repaired. If necessary, Release 430 NIMs will disconnect from the UCN and periodically attempt to reconnect. This attempt can be observed at the LEDs on the PNI or EPNI board edge in the NIM module. The self-test Led will cycle for each attempt. Also the Pass Module Test LED (green) will cycle each half second.

Continued on next page

PMMs

Dual drop faults to a primary PMM (or non-NIM) will only cause that PMM to failover. Dual drop faults to a secondary PMM (or non-NIM) will cause that PMM to fail. Dual trunk faults may cause PMM failover. The node pair will end up in one of the states in the following table, each of which requires a specific action. Local control and IOLINK operation are maintained through loss of UCN communications except in the rare FAILED/FAILED case.

The PMM SHUTDOWN command is used to recover from most cases of loss of view, which are evidenced by an error code of 0A2x in the COMM loss of view (where the node state is FAIL), which are evidenced by an error code of 0A2x in the COMM ERROR BLOCK (PMM DETAILED STATUS, MAINT INFO). This command is accessed from the UCN STATUS DISPLAY, MODULE COMMANDS, SHUTDOWN. Issue the command only once.

WARNING

Issuing the command twice causes a real shutdown, which will force local control to stop (force the PMM to the ALIVE state).

Primary	Secondary	Action
OK	FAILED	Issue SHUTDOWN command to FAILED node, wait for it to become BACKUP.
OFFNET	FAILED	Issue SHUTDOWN command to FAILED node and wait for it to become BACKUP, **resynchronize its database with the primary**, and failover to restore correct operation. The OFFNET partner will go to failed. Issue the SHUTDOWN command to the FAILED partner and wait for it to become BACKUP.
OFFNET	OFFNET	In this case, you must locate and physically cycle power to one of the pair (not both at once). Examine the status LEDs on the Control cards of the partners. • If one of the Control cards' LEDs is on steadily, local control is continuing. **Do not cycle power on that PMM card set.** • If one of the Control board STATUS LEDs is blinking twice per second, cycle power on that Control board by gently lifting, then lowering the top lever card extraction lever. • If both STATUS LEDs are blinking at the same rate or both are out, cycle power on either one. Wait for view to be restored. • If the remaining partner does not subsequently become visible, then cycle power on it.

Continued on next page

Primary	Secondary	Action
FAILED	FAILED	Local control and IOLINK are not running. Issue the SHUTDOWN command to either node and wait for it to become OK. Issue the SHUTDOWN to the remaining partner and wait for it to become BACKUP.
OFFNET	BACKUP or BKUP_PF	The primary is still running but did not failover. Issue the SWAP Primary command. Wait for the failover, then proceed according to the new states of the nodes.

After completing the above procedures and the view has not been restored, SHUTDOWN to ALIVE and reload any PMMs remaining FAILED.

APMMs or HPMMs

APMMs and HPMMs operate like PMMs, except:

- Dual drop faults to a primary APMM or HPMMs will only cause that APMM to failover.
- Dual drop faults to as secondary APMM or HPMM will not cause that APMM or HPMM to failover.
- Dual trunk faults may cause an APMM or HPMM to failover only if one node of the redundant pair is in a better state.
- The APMM or HPMM has the capability of automatically reconnecting on the network after cable have been repaired, hence regaining view instead of remaining OFFNET (as PMMs do).

LMMs

LMMs will failover. The backup will periodically attempt to reconnect to the UCN. A failover occurs after the communications have been restored.

Section 6 – UCN Cable Handling and Troubleshooting

6.1 Overview

Section contents

These are the topics covered in this section:

6.2 Functionality Overview

Introduction

Release 500 software, or a later software release, provides the UCN cable handling and fault recovery.

This section provides the user sufficient functional knowledge to interface with systems running R500, and later, software for the purpose of troubleshooting UCN cable problems. Guidelines and procedures for problem isolation are also provided.

ATTENTION

ATTENTION—Reading this section completely is highly recommended for all who anticipate using manual intervention targets related to UCN cable handling.

New features

The following list identifies improved post R410 software features:

- Fault recovery algorithms have been improved.
- Human interface with the system has been improved for troubleshooting purposes. This includes new/changed targets on UCN displays as well as targets whose functionality has changed to some degree.
- The backup cable is tested before attempting a cable swap. A test failure prevents the cable swap from taking place.
- Automatic cable swap time interval has changed from 15 minutes to 5 minutes.
- Detection of an error still causes a swap to the Backup Cable, but it no longer automatically forces a Disable Swap condition. Instead, the bad cable is tested every 60 seconds to see if the problem still exists. This allows the automatic recovery of the bad cable when the problem is corrected or disappears.
- Manual cable swap commands to an individual node are no longer supported.
- The primary nodes of all device types (NIM, PM, APM, HPM, and LM) are capable of automatically recovering communications after a double cable fault has been repaired.

Continued on next page

CAUTION

Operational restrictions

The following operational restrictions must be rigorously adhered to:

- The user must wait 10 to 15 seconds after SHUTDOWN of a UCN device secondary before attempting to SHUTDOWN another UCN device secondary. Attempting to SHUTDOWN many secondaries (which cause auto-restart) as fast as possible, causes the secondaries to fail with A.2x errors. This applies to the PMs, APMs, and HPMs but does not apply to the NIMs.
- Never issue manual intervention commands related to UCN cable handling from two or more sources (primary NIMs sharing the same physical UCN) concurrently. Confine your troubleshooting activity to one logical UCN at a time.
- Do not attempt to run the UCN exerciser test on a system that is on process. The UCN exerciser creates additional traffic on the UCN which can cause delayed responses, time outs, and possible node failures.

Configuration restriction

The following configuration rules must be 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 must be connected to the same (corresponding) port on the A cable tap as on the B cable tap.
- The lowest UCN addressed device on the UCN must be a NIM.
- 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.

Recommendations

- 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.
- Honeywell **highly recommends** that the periodic automatic UCN cable swapping remain enabled whenever possible. This ensures a backup cable failure is detected within 5 minutes. **The backup cable is not periodically checked if automatic swapping is disabled**. An undetected failure on the backup cable can cause a serious network disruption and possible loss of view if the currently active cable should fail and cause a swap to occur.
- All NIMs should be connected to the same physical tap to avoid creating multiple communication islands due to reflections from double trunk cable faults between NIMs.

6.3 UCN Addressing

UCN node types

The NIM is used as the interface adapter between the LCN and the UCN. Up to three pairs of redundant NIMs are supported on a common UCN. Each NIM pair operates as a separate logical UCN on the common physical UCN.

The details about the physical construction of a UCN are covered in Sections 2 and 3 of this manual.

A UCN can have up to 32 redundant devices connected. This number is governed by several factors, such as the physical plant layout and the throughput requirements of the network in its specific application.

Devices currently seen on the UCN are the Network Interface Module (NIM), the Process Manager (PM), the Advanced Process Manager (APM), High-Performance Process Manager (HPM), and the Logic Manager (LM). PMs, APMs, HPMs, and LMs can all operate on a common UCN and can use peer-to-peer communication.

UCN node address configuration

The device (node) with the lowest UCN address assumes the responsibility of being Cable Master on the UCN network. Configuration rules specify that the cable master must be a NIM. This means that a NIM must be configured as the lowest address on the network.

If multiple NIMs exist, at least one NIM (including redundant partner) must have an address lower than other device types on the network. This ensures that a NIM will be cable master if the original cable master should fail. The Cable Master is always the lowest address (running node) on the physical network.

Normally the NIMs are addressed on the UCN in redundant pairs starting with address 1, 3, etc. The other device types are addressed in redundant pairs starting with address 7, 9, 11, etc. (providing room for the maximum of 3 possible redundant NIMs). Nonredundant devices are always addressed by using only the odd address; the corresponding even address is assumed by the redundant partner.

NIMs running online personality software have their UCN addresses determined by software configuration. These NIM UCN addresses become functional as soon as the NIM node is loaded.

Continued on next page

CAUTION

CAUTION—It is possible for the system to operate when the NIM (or NIMs) are configured with addresses that are not the lowest as described above. However, proper recovery from communication errors may not always occur. Honeywell **HIGHLY RECOMMENDS** that the NIMs be configured with UCN addresses that are lower than the address of any other device on the network.

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 offline 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.

Note: The NIM 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.

6.4 Physical UCN Cabling

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. Failure to do so introduces a slight timing differential between redundant nodes and can cause problems during cable fault recovery scenarios. Also, the A and B drop cables should be connected to the same port position on these taps.

Cable connector torque

All UCN cable and attenuator connections must be tightened to 25-inch pounds by using a torque wrench. Loose connections are the most common cause of communication problems. Experience has shown that some sealing washers inside the terminator connectors collapse a minute amount over a long period of time; therefore, it is recommended that the connection torque be rechecked once a year even if no problems are being detected.

Connection corrosion

The UCN cable and terminator connections must also be corrosion free. A thorough visual inspection is required if problems begin to appear. Metal parts in the connections should appear bright and shiny.

6.5 UCN Cable Handling Functionality

UCN cable management

Each node on the UCN always transmits data on both cables simultaneously but listens only to the active cable.

Cable network swapping is normally enabled. In this case, each node on the UCN listens exclusively to cable network “A” or “B” as commanded by the Cable Master node (UCN node with the lowest UCN address, normally a NIM). The cable network (A or B) that is not currently in use for listening, is commonly referred to as the “backup cable.”

Cable alignment

The Cable Master sends a cable alignment command to all other nodes approximately every 10 seconds. This is used to ensure that all nodes are listening to the active cable as declared by the Cable Master node. The cable alignment command does the following:

- Aligns newly added nodes (just loaded) to the active cable.
- Aligns nodes to the declared active cable during cable fault situations.

Automatic cable swap on error

If a node detects serious problems with the current cable, the detecting node does a cable swap (change) and listens to the data on the Backup Cable. This error situation is reported to the Cable Master node. The Cable Master then commands all other nodes to test and then select the other (good) cable. This ensures that all nodes are listening to the same (good) cable. The switching from a bad cable shows as a FAILURE status for the Process Network on the System Status display. The node detecting the problem indicates this by flagging the cable on the display with red backlighting.

Automatic periodic cable testing and swap

The automatic cable switching (swap) functionality is normally enabled and consequently cable switching is commanded by the Cable Master node every 5 minutes. The alternate (inactive) cable is tested immediately prior to commanding the whole network to switch. The Cable Master node will not send the switch cable command if the alternate cable network is found to have a problem (detected by any node on the network). Instead, cable errors are indicated on the displays and annunciated through the System Status alarm.

The automatic cable testing sequence is initiated by the the Cable Master node 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 switching 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.

Continued on next page

Disable of periodic cable test and swap

The automatic cable switching (swap) mechanism can be turned off and on by using the [Disable Swap *] and [Enable Swap] targets on the UCN Status or UCN COMM Status display. This capability is needed/used for troubleshooting purposes. When swapping is disabled, the nodes will remain on the current cable indefinitely or until you issue manual commands.

Effect of double cable breaks

It must be understood that if a UCN network is broken into two sections (both A and B cable broken), a Cable Master establishes itself on each section. This double cable break could result in a node other than a NIM serving as cable master.

Auto reconnect

The primary nodes of all device types (NIM, PM, APM, HPM, and LM) are capable of automatic restoration of communications after a double UCN cable fault has been repaired. Communications are resumed as soon as one of the UCN cable networks becomes functional. Backup (redundant) nodes may not always recover and will require manual intervention for recovery in these cases.

6.6 Backup Cable Testing

Automatic cable testing description

The automatic cable testing that occurs immediately prior to 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, etc.). 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 be 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.

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.

Continued on next page

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.

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, etc.). 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).

6.7 UCN Error Rate Monitoring

UCN error rate monitoring

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 serve as a baseline for later comparison.

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 since their values are cumulative. The error rate over a given time is important whereas the total number of errors is not. This 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.

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 switch to the Backup Cable (due to errors) occurs only when the error threshold on a cable reaches the point where it could impact successful system operation.

More information

Section 4 of this manual describes the UCN statistics monitoring activities.

6.8 Technical Assistance Center

TAC Capabilities

Honeywell's U.S. Technical Assistance Center (TAC) is a state-of-the-art facility that provides centralized support for Honeywell warranty and service customers. Capabilities include the following:

- Information, advice, and problem-solving assistance.
- Access by way of toll-free telephone, FAX, or modem.
- Expert technical staff.
- Support for all Honeywell IAC hardware products in service.
- Support for all current versions of Honeywell IAC software.
- Simulation labs that allow TAC engineers to reproduce problems.
- Optional service online TACLink for remote troubleshooting.

Support options

Customers register for TAC support by one of the following methods:

- Warranty Support—The customer has purchased a Honeywell system. The scope and duration of support are as defined by Honeywell's Warranty Support Policy. Warranty support is limited to normal working hours.
- Service Support—The customer has purchased a Honeywell service contract.
- Demand Support—The customer has issued an open purchase order to be used on an "as needed" basis (call-by-call).
- TACLink —The customer has purchased the TACLink service contract for online remote diagnostic service over a RULA (Remote User LCN Access) communications link.

6.9 Information and Displays Needed for Troubleshooting

Knowledge required

Troubleshooting UCN problems requires five basic types of knowledge:

- Knowing the physical routing and connection of the UCN cables.
- Understanding what is being displayed in the various status displays.
- Knowing what the cable manipulation targets do for you.
- Knowing what should happen in specific failure scenarios (theory of operation as provided throughout this section of documentation).
- Knowledge of the UCN node peer-to-peer relationships as dictated by the system software implementation is helpful in some cases.

Hardware physical map

Troubleshooting UCN cable problems can be simplified through the use of a UCN cable topology map. The topology map details will show how the UCN trunk cables, taps, and drop cables are routed and connected. This topology map should be created at the time of system installation and should be religiously maintained through system changes and upgrades.

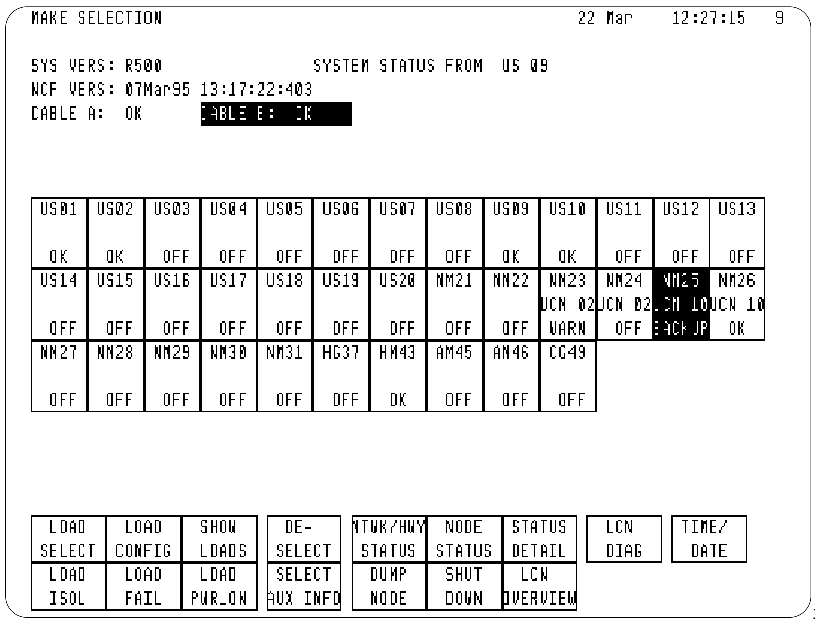
It is difficult to troubleshoot UCN trunk cable problems without the exact knowledge of how (sequence) the UCN nodes are connected.

6.10 UCN Problem Recognition

System Status display

The System Status display, shown in Figure 6-1, will indicate a UCN cable network problem by a blinking red UCN number. The failure indicates a problem with one of the UCN cables (A or B). The cables are automatically switched.

Figure 6-1 System Status Display



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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 (FAILURE) at the bottom of the display.

Next action

Choosing the network and selecting the NTWK/HWY target produces the UCN Status display for UCN network.

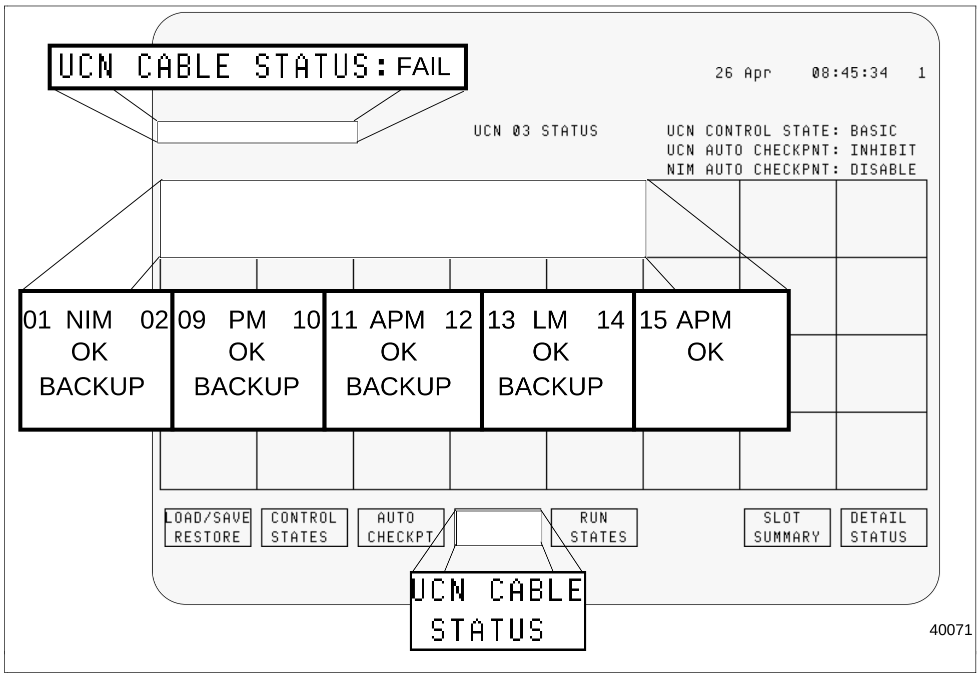
Continued on next page

UCN Status display

Figure 6-2 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 6-2 UCN Status Display



It must be clearly understood that the order (left to right) of the UCN nodes shown on the UCN Status display always appear in ascending UCN address order. It 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.

The UCN cable status at the top left of Figure 6-2 shows FAIL.

The UCN CABLE STATUS target at the bottom of the display (Figure 2) must be selected to give greater visibility into the cable status as seen at each node. See next two pages for displays after selecting this target.

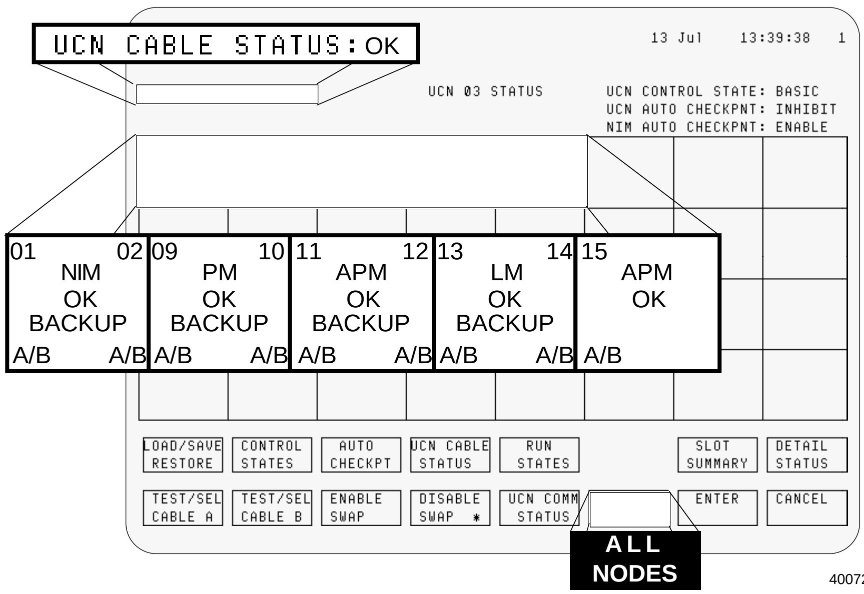
Continued on next page

UCN Status display

Figure 6-3 shows the result of selecting the [UCN CABLE STATUS] target. Notice the UCN cable status at the top left. The OK indicates no problems with either cable.

Notice that each node separately shows the A/B cable status. This 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. The cable letter on the left identifies which cable is the active cable (currently used for listening).

Figure 6-3 UCN Status Display (Listening to Cable A)



You may have noticed the [ALL NODES] selected (backlighted). This target is automatically selected as the display appears. The actions of the manual cable command targets (located to the left of this target) will be directed to all nodes on the UCN when the [ALL NODES] target is selected. This target automatically becomes deselected when an individual node is selected.

The left four targets on the bottom row disappear when an individual node is selected. The [BACKUP CABLE TEST] appears for all nodes except for the following:

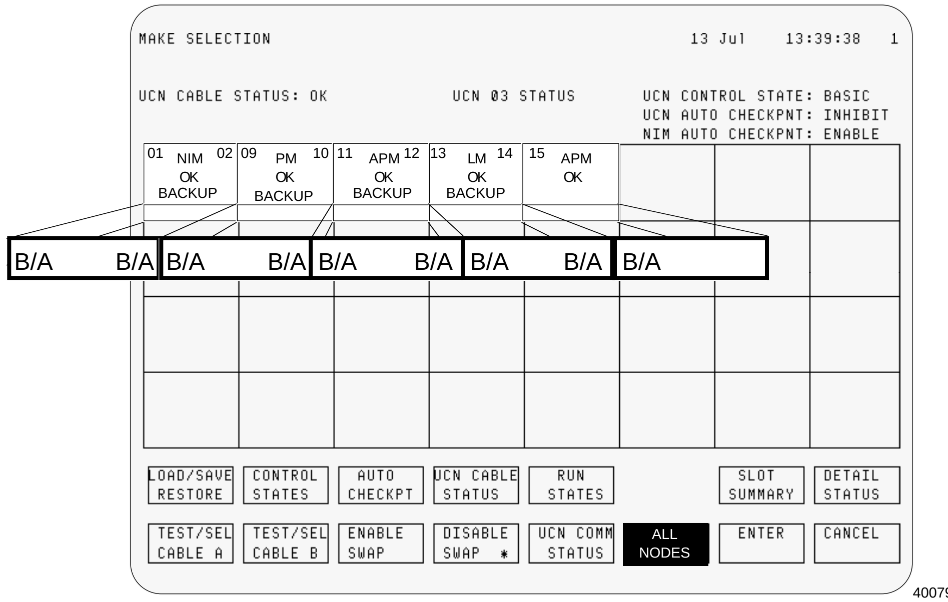
The [RECOVER CABLE A] and [RECOVER CABLE B] targets will appear for the Primary NIM, if the NIM is in the COMM FAIL state for longer than 10 minutes.

Continued on next page

UCN Status display (with cable status) , continued

Figure 6-4 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 6-4 UCN Status Display (Listening to Cable B)



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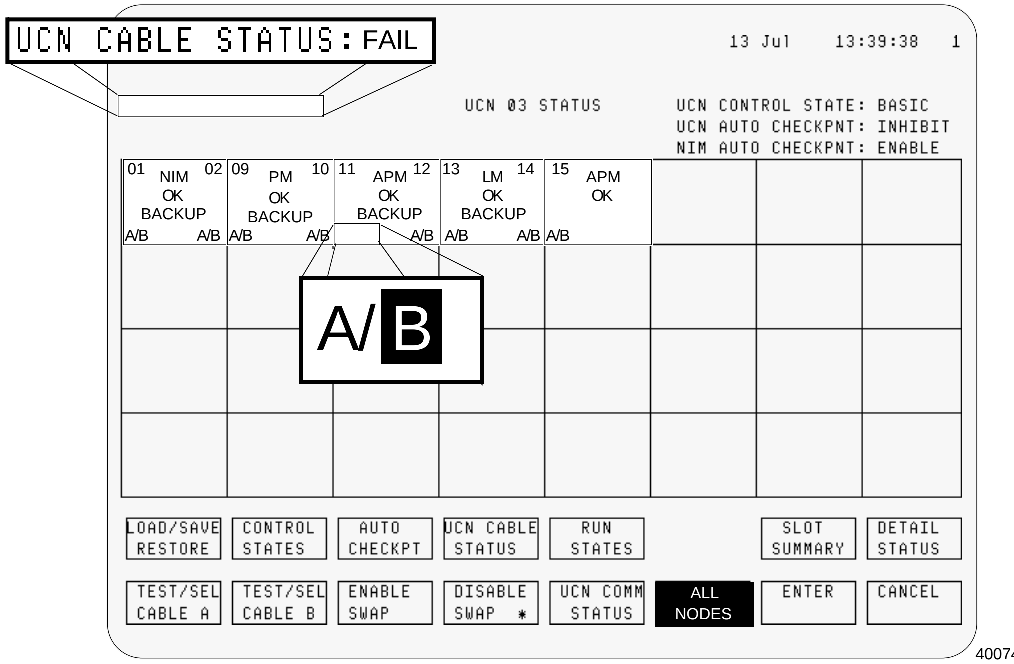
UCN Status display (on cable A with cable B problem)

Figure 6-5 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 6-5 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 6-5 UCN Status Display (Listening to Cable A, Error B)



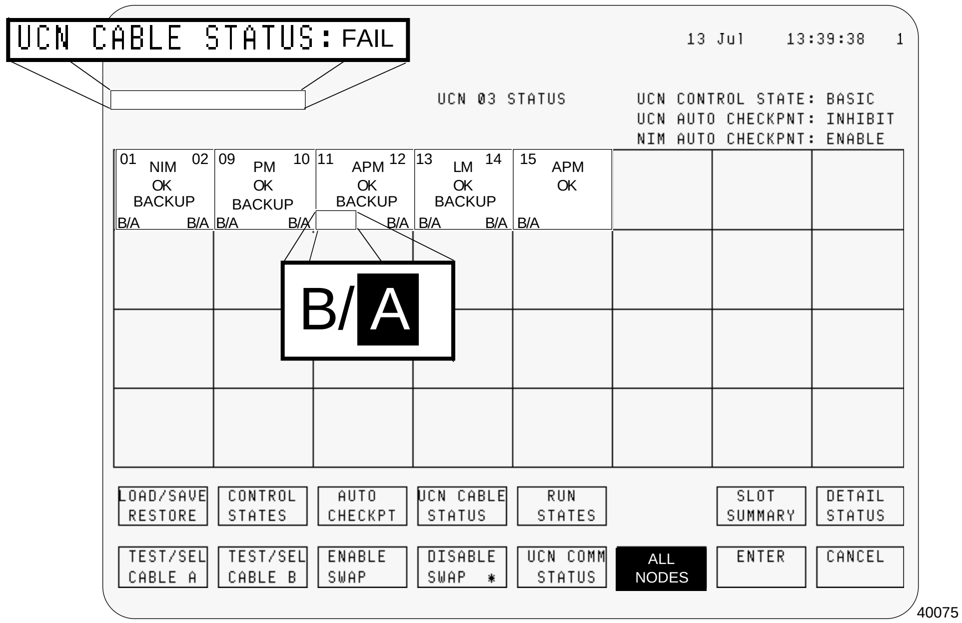
Once a cable has been identified (by the system) to have a problem and automatic cable swapping is **not** disabled, an automatic single node test of the bad cable is initiated by the Cable Master node every 60 seconds as the system continues to operate on the good cable. If the problem still exists, 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

UCN Status display (on cable B with cable A problem)

Figure 6-6 shows the UCN nodes listening to cable B and a problem identified with cable A. Compare Figures 5 and 6. The difference is that the cable failure is on the opposite cable. The failure shown in Figure 6-6 was created by disconnecting the A drop cable from the APMM (address 11) in the APM.

Figure 6-6 UCN Status Display (Listening to Cable B, Error on A)\



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Manual disable of automatic cable swapping

The automatic (periodic) cable swapping can be manually disabled and enabled. It is done with the DISABLE SWAP * and ENABLE SWAP targets. The disable feature stops two normal activities. They are:

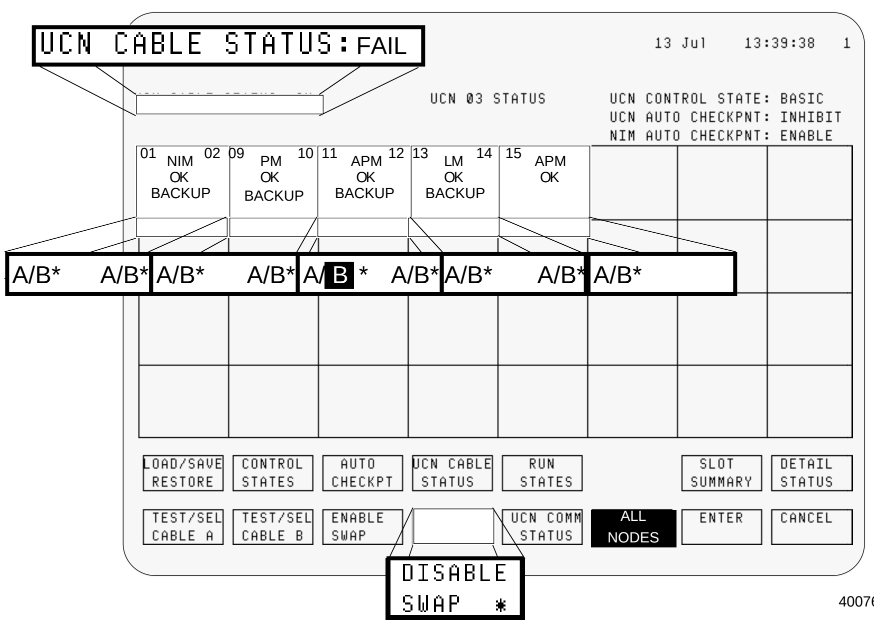
- With Swap disabled, the automatic backup cable test and subsequent swap to the backup (every 5 minutes) is not done.

- With Swap disabled, the detection of a problem on the current active cable still causes an automatic unconditional switch 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

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.

Selecting the DISABLE SWAP * target will cause the cable information on the UCN status display to be flagged with an asterisk. See Figure 6-7 below. This indication serves as a reminder that the Disable Swap feature is in effect.

Figure 6-7 UCN Status Display (Cable Swap Disabled)



6.11 Status Display to Physical Hardware Correlation

Physical UCN map

An **accurate** physical (topology) map immensely simplifies the task of troubleshooting UCN communication problems. The following map shows one possible physical configuration that would support the UCN Status display examples you have seen in Figures 2 through 7. Everything is in sequential order just like the UCN status displays you have been referencing.

Figure 6-8 UCN 03 Physical Map (Example 1)

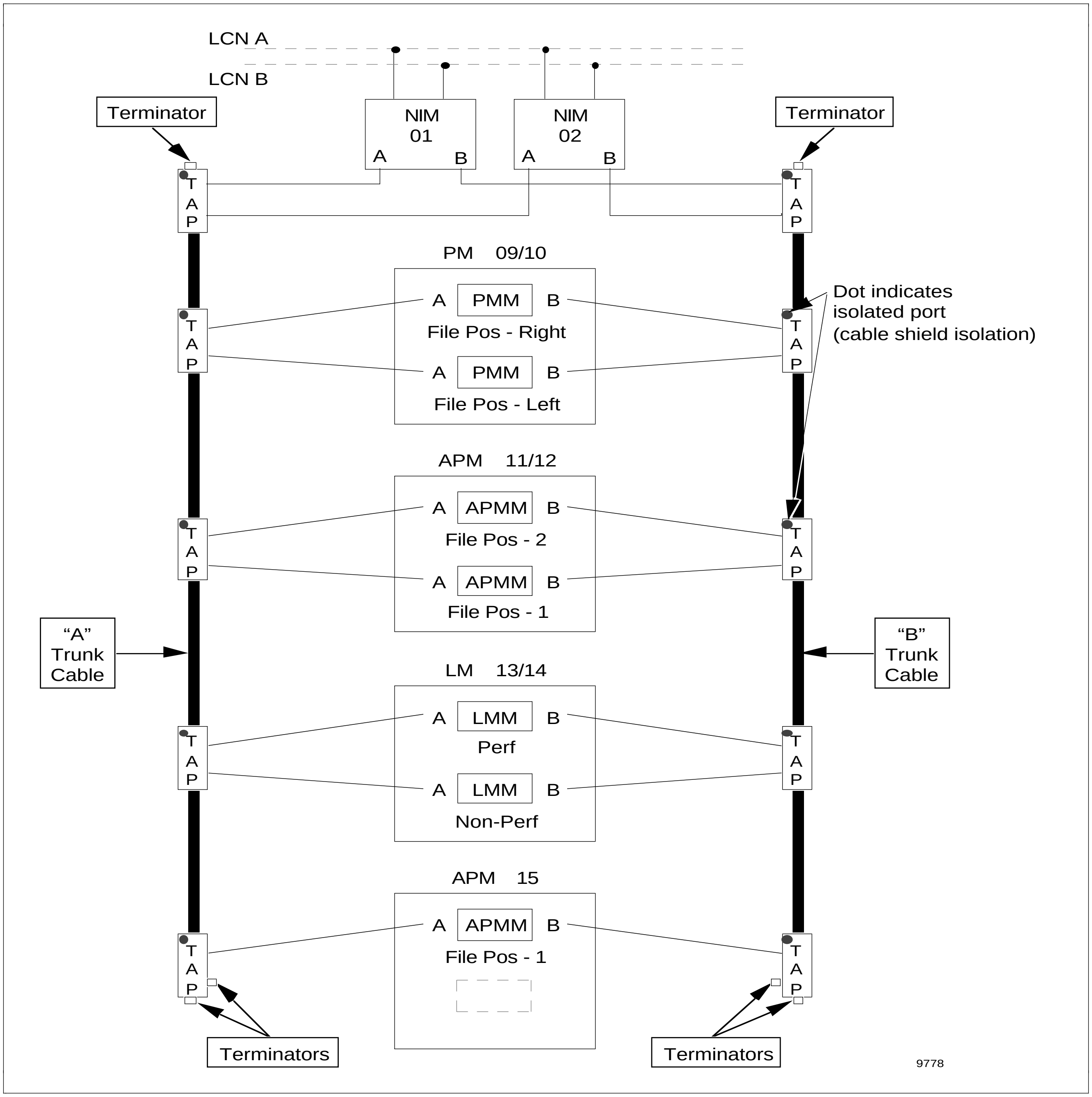


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Figure 6-9 is an example of physical UCN cable connections, including trunk and drop cables, taps, and terminators. Notice that the physical order of the devices on the UCN is not the same as displayed in the UCN status displays.

Compare Figures 8 and 9.

Now correlate Figures 8 and 9 to the UCN status display shown in Figure 10.

Remember that the order in which devices appear on the UCN display is decided by software and it is always in ascending UCN address order. You **must always** be able to look at the UCN Status display and correlate it to the physical UCN map of your plant.

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Figure 6-9 UCN 03 Physical Map (Example 2)

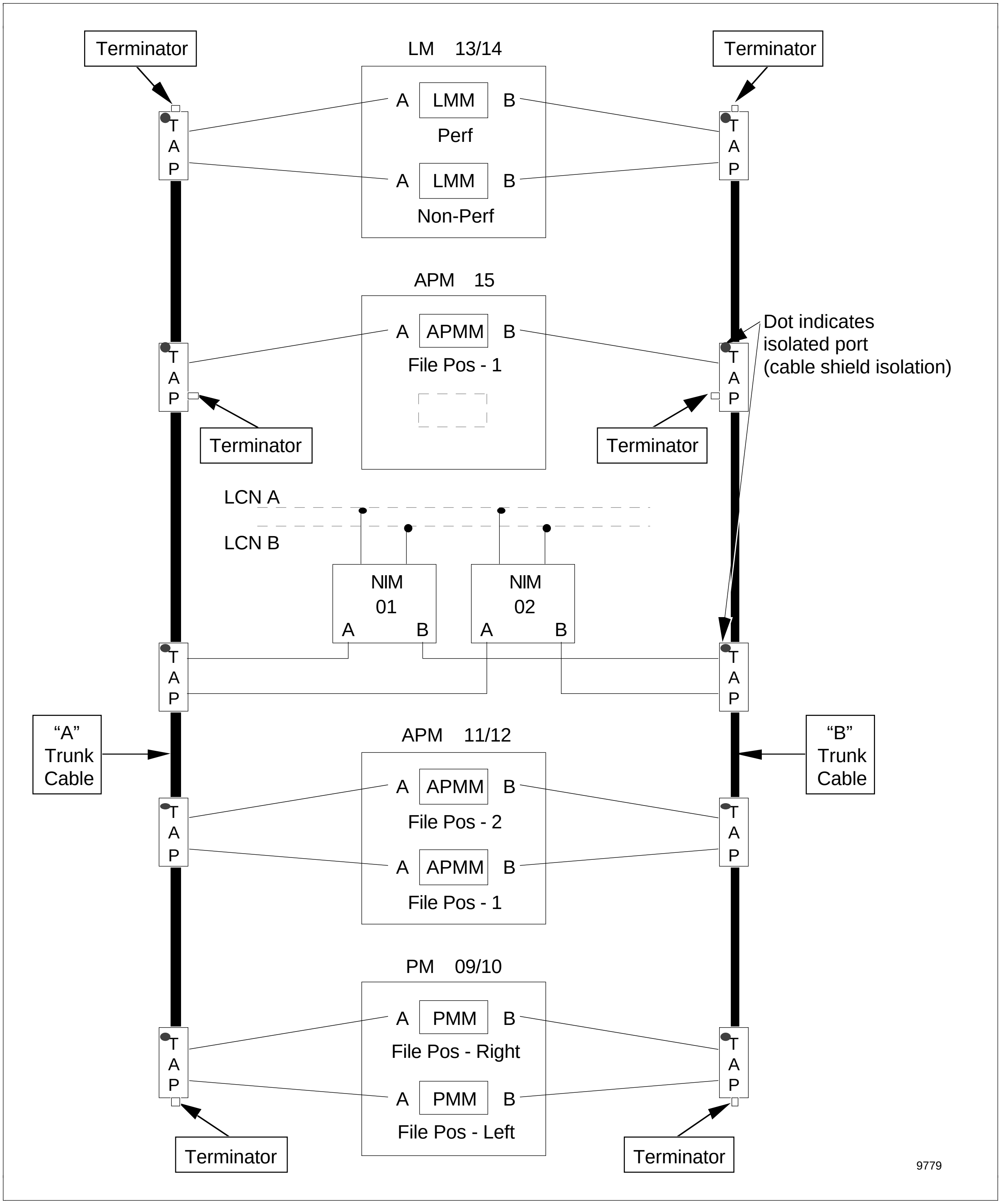

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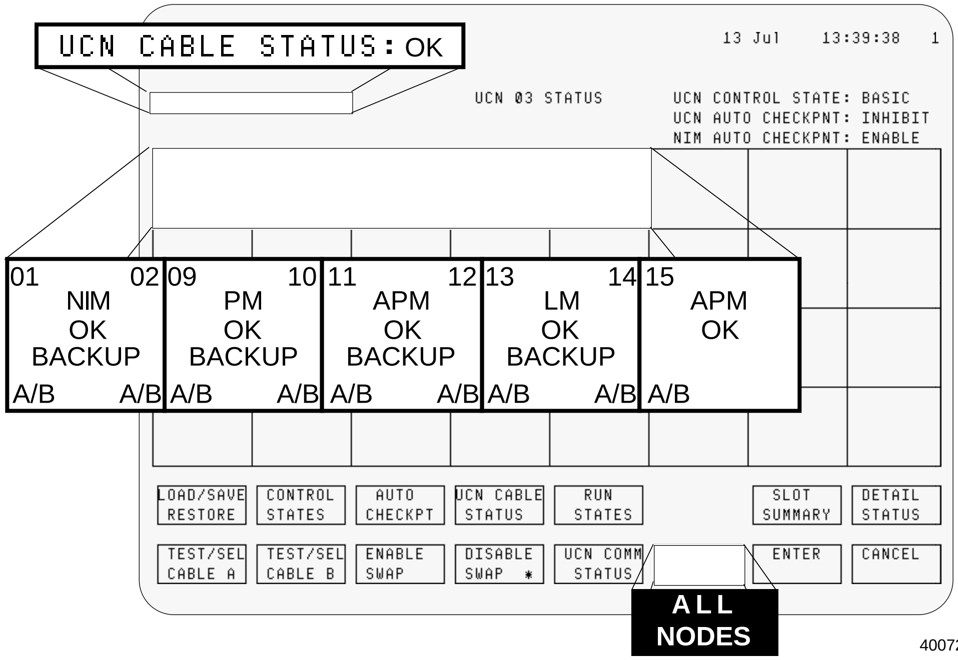
Figure 6-10 UCN 03 Status Display



6.12 Node Specific UCN Stats Display

General

The following discussions cover UCN STATS displays, which provide UCN status and statistics as viewed by each UCN node itself. All available UCN device types (NIM, PM, APM, HPM, and LM) have a similar display available.

The method of access to these displays is also similar. The displays applicable to the APM are used for the discussion. NIM, PM, HPM, and LM displays are nearly identical in format and content. The method of display access is addressed separately.

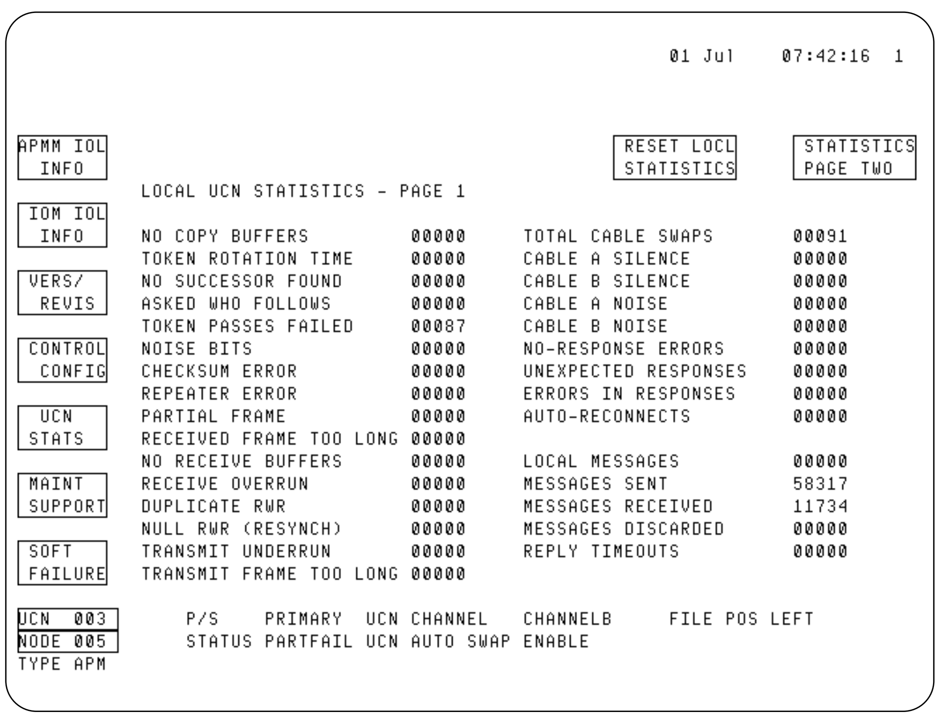
UCN STATS display

Figures 11 and 12 show pages 1 and 2 of the UCN STATS display for an APM. Look over this 2-page display example.

The information on these two pages is made up of UCN communication statistics as seen by the specific UCN node you select when obtaining this display. The five entries at the top of the right-hand column of page 1 are most helpful when troubleshooting solid UCN cable network failures.

Look over this 2-page example from a primary APMM (PMM and HPMM displays are nearly identical). If the display is taken from a redundant partner (BACKUP), some of the information does not apply and is not shown.

Figure 6-11 APMM UCN STATS Display (Page 1)



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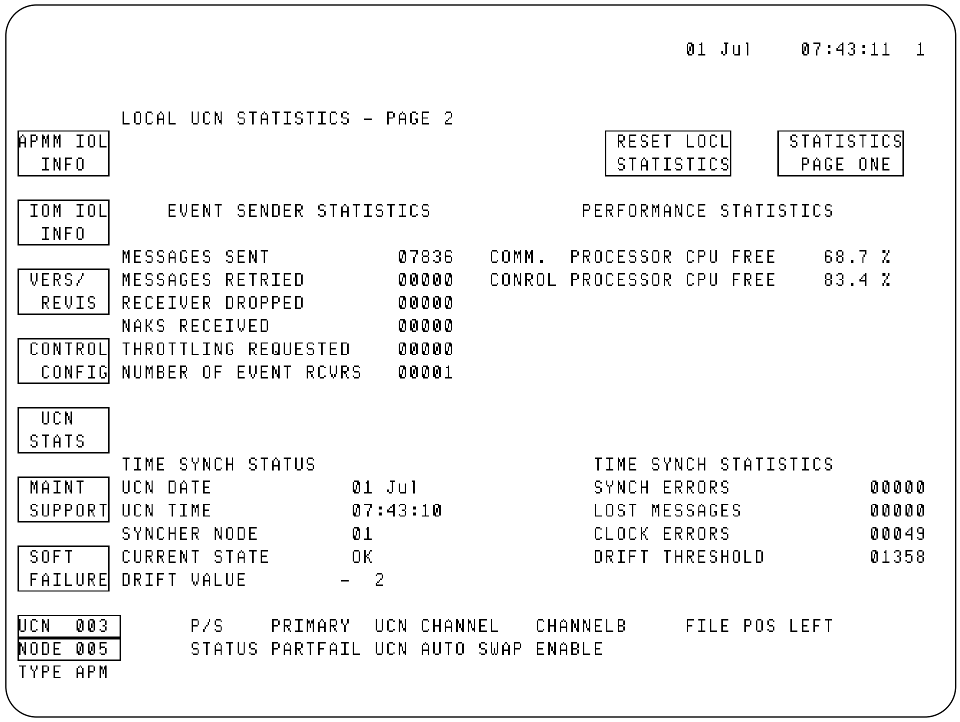
UCN STATS display, continued

Figure 6-12 APMM UCN STATS Display (Page 2)



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Each of the statistical entries on these pages can be useful when troubleshooting UCN problems. Some entries appear to be self-explanatory while others may need a bit of explanation. This information is documented in Section 4 of this manual. Tables 4-1 through 4-9 provide explanations for the entries you see on the display. They are a valuable reference for troubleshooting.

ATTENTION

ATTENTION—Do not be mislead by an excessively high value for the NO-RESPONSE error statistic on the right side of display page 1 (Figure 6-11) if the node does not have a redundant partner. A primary node (single) will continue looking for the redundant partner even if it is not configured and does not exist. This error accumulation is normal for a single node (nonredundant).

Continued on next page

UCN STATS display access for NIM

The access to the node-specific UCN STATS display is outlined below.

For NIM UCN STATS display access

Table 6-1 UCN STATS Display Access for NIM

From	Action	Result
System Status display	Select the appropriate Process Network target.	The UCN Status display appears.
UCN Status display	Select the desired NIM. For redundant devices you may have to select the target a second time to select the specific device. Select the [DETAIL STATUS] target.	The selected device has its address number backlighted. The NIM Status display appears.
NIM Status display	Select the [UCN STATS] target.	Page 1 of the 2-page UCN STATS target appears.

UCN STATS display access for PM /APM/HPM/LM

For PM, APM, HPM,or LM UCN STATS display access

Table 6-2 UCN STATS Display Access for PM, APM, HPM, or LM

FROM	ACTION	Result
System Status display	Select the appropriate Process Network target.	The UCN Status display appears.
UCN Status display	Select the desired PM (APM, HPM, or LM) Select the [DETAIL STATUS] target.	The PM (APM, HPM, or LM) Status display appears.
PM (APM, HPM, or LM) Status display	Select the specific PMM (or APMM, HPMM, or LMM) Select the [DETAIL STATUS] target.	The PMM (APMM, HPMM, or LMM) Status display appears.
PMM (APMM, HPMM, or LMM) Status display	Select the [UCN STATS] target.	Page 1 of the 2-page UCN STATS target appears

6.13 UCN Network Statistics Display

Purpose

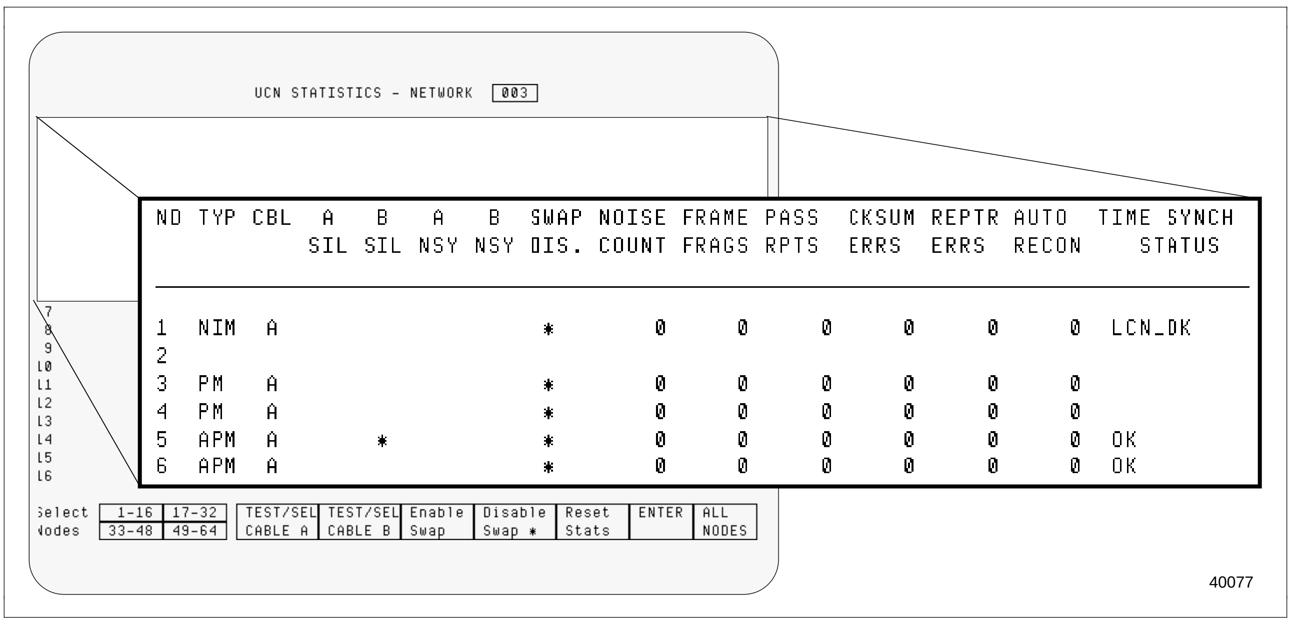
The UCN Statistics—Network display provides a summary view of the most prominent information from all UCN nodes. This allows you to make a quick assessment of the complete UCN Network condition. This summary is available in four parts that are selected separately:

- UCN nodes 1-16
- UCN nodes 17-32
- UCN nodes 33-48
- UCN nodes 49-64

UCN Network Status display

The display in Figure 6-13 shows the UCN node status for node addresses 1 through 16. Four displays exist to cover all node addresses. They are accessible through the four Select Nodes targets at the bottom left of the display. It is accessed from the UCN Status display by selecting UCN COMM STATUS after selecting UCN CABLE STATUS.

Figure 6-13 UCN Statistics—Network Display



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 node-specific UCN STATS displays.

Continued on next page

UCN Network Status display, continued

Refer to Figure 6-13. The commands that originate from the targets across the bottom of the display can be directed to an individual node or to all nodes. Each UCN node (one node per line) is individually selectable. For example, the [RESET STATS] target, near the bottom right (followed by ENTER), causes the local statistics in each UCN node to be reset when the [ALL NODES] target is selected first. The [RESET STATS] target resets only the selected node statistics if an individual node (line) is selected first.

The column headings may need some explanation. They are documented in the second table in UCN Statistics Display section in this document.

Continued on next page

UCN cable manipulation targets

Notice the UCN cable manipulation targets at the bottom of the display in Figure 6-13. These are exactly the same as those you saw on the UCN Status display earlier. Their functions are described in Table 6-3.

Table 6-3 Manual UCN Cable Manipulation Commands

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 manipulation targets, continued

Table 6-3 Manual UCN Cable Manipulation Commands, 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 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

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.

Continued on next page

6.13 UCN Network Statistics Display, Continued

UCN Network Status display access

The access to the UCN Network Status display shown in Figure 6-13 is outlined below:

Table 6-4 UCN Network Status Display Access

From	Action	Result
System Status display	Select the appropriate Process Network target.	The UCN Status display appears.
UCN Status display	Select the UCN CABLE STATUS target. Select the UCN COMM STATUS target.	An additional row of targets appears at the bottom of the display. The first display (nodes 1-16) appears on the display.
UCN Network Status display	Select the desired group of nodes target. Access the data for the other node groups from this same display by selecting the target for the other node groups.	The data for the selected node group appears.

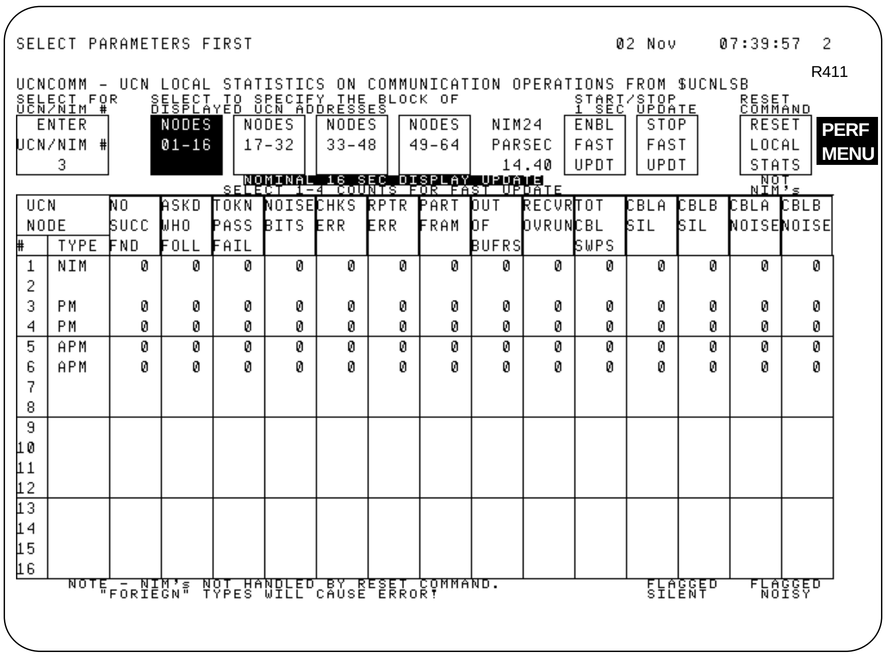
6.14 UCNCOMM Display (PERFMENU)

UCNCOMM display

The UCNCOMM display is available through the PERFMENU schematic. It is accessed by pressing the schematic key and entering PERFMENU as the schematic name.

This display is intended to be used for a quick overall look at one specific UCN from the system level. To use this display, you must input the UCN number and primary NIM LCN address after selecting the target at the top left. Next you must identify which group of nodes you want to look at by using the the next four targets at the top of the display.

Figure 6-14 UCNCOMM Display



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This display provides an excellent summary of how communications are going on the UCN. Notice the last four columns in the display. The entries in these columns are backlighted with a red color if the node has reported problems with a UCN cable. The statistics displayed throughout the display are obtained from each individual node on the UCN. A fast update of the statistics is available by selecting the [ENBL FAST UPDT] target.

The [RESET LOCAL STATS] target, at the top right, causes the local statistics in each UCN node (except NIMs) to be reset. Notice the note NOT NIMS under the reset target. The statistics in the PM, APM, HPM, and LM nodes are reset with this target, but the NIM nodes are not reset.

Continued on next page

UCNCOMM display access

The access to the UCNCOMM display is outlined below.

Table 6-5 UCNCOMM Display Access

FROM	ACTION	RESULT
Any Operator level display	Select the [SCHEM] key. Enter PERFMENU in the box that appears at the top left of the display.	Page 1 of the Performance Menu appears.
Performance Menu (Page 1)	Select the [Select For Page 2] target.	Page 2 of the Performance Menu appears.
Performance Menu (Page 2)	Select the [UCNCOMM] target.	A skeleton of the UCNCOMM display appears.
UCNCOMM display	Select the [UCN/NIM #] target at the top left. • Enter the UCN number • Press [ENTER] • Enter the NIM LCN address • Press [ENTER}	The statistics for your selected UCN and NIM (nodes 1-16) appear.
UCNCOMM display	Select the appropriate target to see another desired group of nodes. [NODES 17-32] [NODES 33-48] [NODES 49-64]	

6.15 Hardware Indicators

Check the NIM indicators

The condition of the NIM hardware indicators may help identify and isolate problems on the UCN. The information provided by the indicators must be used in conjunction with the information obtained from the various status displays. Table 6-6 shows the NIM indicators.

Table 6-6 NIM Indicators

Indicator	Meaning
TX Located on the front edge of the PNI/EPNI board ----------- also --------- Located on the NIM Modem paddle board (newer nodes) ----------- also --------- Located on the front edge of the PNM board (older nodes)	Normally ON when the node is loaded. It indicates the NIM is transmitting on the UCN.
RX-B Located on the front (very left side, behind the latch) of the EPNI board. ---------- also --------- Located on the NIM Modem paddle board (newer nodes)	ON when the node is listening on cable B.
SELF TEST/ERROR Located on the front edge of PNI/EPNI board ----------also--------------- Located on the front edge of PNM board (older nodes)	ON when the board has failed the self-test or has detected an internal error on-line.
PASS MOD TEST Located on the front edge of PNI/EPNI board ----------Also------------- Located on the front edge of PNM board (older nodes))	ON when the PNI/EPNI has successfully passed self-tests.
BUS TRANS ERROR Located on the front edge of PNI/EPNI board	A backplane bus error has been detected by the board.
RCVE CABLE A Located on the front edge of the PNM board (older nodes only)	Normally ON when the node is listening on cable A.
RCVE CABLE B Located on the front edge of the PNM board (older nodes only)	Normally ON when the node is listening on cable B.

Continued on next page

Check PMM/APMM indicators

The condition of the PMM/APMM hardware indicators may help identify and isolate problems on the UCN. The information provided by the indicators must be used in conjunction with the information obtained from the various status displays. Table 6-7 shows the PMM/APMM indicators.

Table 6-7 PMM/APMM Indicators

Card	Indicator	Meaning
MODEM	POWER	Normally ON indicating 24 volt power is applied to the board.
	STATUS	Normally ON indicating UCN communications are occurring. This may appear to flicker instead of being a steady ON state.
		Blinks when the PMM/APMM is in the alive state.
	Unmarked	This indicator is located behind the lower latch of the latest technology Modem boards. Requires pulling out lower latch somewhat to observe the yellow indicator. Do not touch the upper latch or you will power down the PMM/APMM. On = Node listening to B cable. Off = Node listening to A cable.
COMMUN -----or----- ADVANCED COMMUN	POWER	Normally ON indicating 24-volt power is applied to the board.
	STATUS	Normally ON if no errors have been detected. Blinks at a 1-second rate if a soft failure has been detected. Blinks at a 1/2 second rate when a self-test error has occurred. OFF if the card has detected a self-test failure.
CONTROL -----or----- ADVANCED CONTROL	POWER	Normally ON indicating 24-volt power is applied to the board.
	STATUS	Normally ON if no errors have been detected. Blinks at a 1/2-second rate if a soft failure has been detected. OFF if the card has detected a failure during self-test or on-line.
I/O LINK -----or----- ADVANCED I/O LINK	POWER	Normally ON indicating 24-volt power is applied to the board.
	STATUS	Normally ON if no errors have been detected. OFF if the card has detected a failure during self-test or on-line.
REDUNDANCY DRIVER (PMM only)	POWER	Normally ON indicating 24-volt power is applied to the board.
	STATUS	On indicates PMM is the Primary. Blinking rapidly indicates the PMM is the redundant partner

Continued on next page

Check LMM indicators

The condition of the LMM hardware indicators may help identify and isolate problems on the UCN. The information provided by the indicators must be used in conjunction with the information obtained from the various status displays. Table 6-8 shows the LMM indicators.

Table 6-8 LMM Indicators

Indicator	Meaning
UCN-A	ON when listening to UCN cable A.
UCN-B	On when listening to UCN cable B.
PASS	Normally ON, indicating that the LMM did not detect an error during self-test.
XMIT	Normally flickers, indicating communications through the backplane with the PLC.
BAT	Normally ON, indicating that the memory battery backup is OK.

HPMM indicators and displays

The HPM provides a much more complex method of reporting failures and status through indicators and an alphanumeric display. Refer to the *High-Performance Process Manager Service* manual for detailed information.

6.16 UCN Problem Approach

Problem awareness

A UCN communications problem is generally seen first on the System Status display. The Process Network status shows a failure status.

Approach summary

The basic steps to approaching a UCN cable problem are as follows:

Step	Action
1	Perform a visual inspection of the cable network(s) in question checking for the following: • Damaged cables • Crossed cables Be thorough when looking for the possibility of crossed cables. The system diagnostic design cannot tolerate crossed cables. Consequently the diagnostic information that you gather will be misleading if crossed cables exist. • Secure connections (proper torque) • Terminators (in place and proper torque) • Reversed taps
2	Gather diagnostic and statistical information.
3	Determine Cable Master node.
4	Check if all NIMs are configured to see all nodes.
5	Correlate the error indications to the UCN topology map.
6	Determine if the problem is confined to single node, single cable network (A or B), or a double cable fault.

Continued on next page

Gather diagnostic information

The first course of action in approaching a UCN communication problem should be to gather information and record the initial failure conditions. This can be done by printing copies of the applicable status displays. **It is recommended that you gather the information before attempting any manual cable manipulation commands.**

ATTENTION

ATTENTION—Section 7 of this manual provides guidance for obtaining and plotting detailed UCN error data. The gathering of information is based on results obtained when manually initiated backup cable tests (on the bad cable) are executed on individual nodes using the [BACKUP CABLE TST] target.

These single node tests are initiated after the automatic cable testing and swapping has been disabled with the [SWAP DISABLE] target.

The resultant plot of the failure scenario is then analyzed to assist in localizing the problem. It is recommended that the technique provided in Section 7 be used if the initial exploration given in Table 6-9 and remaining UCN Problem approach information does not result in a quick solution.

Cursory problem analysis

Table 6-9 Gathering Diagnostic Information

Step	Action
1	Print or record the Process Network status on the System Status display. (FAILURE)
2	Select the Network with the problem to call the UCN Status display.
3	Select the [UCN CABLE STATUS] target.
4	Examine the UCN Status display for indications of cable problems. Nodes with red backlighting of the cable status have detected problems with that specific cable.
5	Print the display or record the abnormal conditions.
6	Call and examine the node-specific UCN STATS displays of the nodes showing cable problems. Be very aware of the Silence and Noise statistics plus other communication errors.
7	Print the display or record the abnormal conditions.

Continued on next page

Determine Cable Master node

It is imperative that you determine which NIM is the Cable Master if multiple single NIMs (or NIM pairs) are configured on the same UCN. Some of your isolation decision making will most likely be affected by this knowledge. Check the UCN Status displays. The node with lowest UCN address is the Cable Master. The node must be loaded and functional to become cable master.

Do not assume that the UCN configuration guidelines were followed. The lowest node numbers on UCN must be NIMs for cable handling and fault recovery to work properly in all cases.

Check if all NIMs have access to all nodes.

More than one logical UCN Process Network can be configured on one physical UCN cable network. Multiple redundant NIM pairs are normally used to accomplish this. It is a required practice that all UCN devices on the physical UCN be configured on each logical UCN network.
This is to ensure that any possible NIM can properly act as the UCN Cable Master node. This requirement is to allow proper cable handling and recovery from some cable failure scenarios.

The NIM configuration should be checked. If the NIM configurations do not provide for access to all nodes on the network, perform your cable troubleshooting from the configured logical network that includes the NIM that is the Cable Master node.

Continued on next page

Problem clarification steps

The following describes the steps to clarify the cause of the problem using the information collected to this point.

Table 6-10 Procedure to Clarify Problem

Step	Action
1	Obtain a UCN topology map. (User provided. This document should have been created at installation time and maintained as subsequent changes were made.)
2	From the UCN status display, select the UCN CABLE STATUS target at the bottom. (May already be selected from previous actions.)
3	From the UCN Status display, identify all nodes that are having problems with the cable (red backlight on cable indication).
4	Locate the nodes with problems (noted in the preceding step) on the topology map.
5	Look for patterns of failures if more than one node is involved.
6	If you choose to disable cable swapping during your examination/information gathering activities, you must remember that repeated selection of the BACKUP CABLE TEST or TEST/SEL CABLE X targets is required for any cable testing to occur. It is suggested that manually initiated tests be repeated several times to help in determining if a problem is solid or intermittent.
7	Make a preliminary determination if the problem is confined to a single node, single cable network, or if it is a double cable fault. The following list should help your analysis. • Is just a single node flagging an A or B cable problem (not both cables)? If so, the problem is most likely in the associated tap, drop cable, or node interface (modem). See Figure 6-15, if needed. • Is more than one node flagging an A or B cable problem (same cable)? Problem is associated with the trunk cable, taps, or termination. Could also be a bad drop cable (noise)or bad transmitter on one of the nodes. See Figure 6-16, if needed. • Is one or more nodes flagging a problem with an A or B cable and other nodes OFFNET? This is frequently an indication that there is a double cable fault. • Is any NIM node flagging a problem with both cables (both cables backlighted)? This symptom is frequently accompanied by most (or all) nodes going OFFNET. This is a double cable fault condition. See Figure 6-17, if needed.

Continued on next page

Failure display examples

The following Figures 6-15 through 6-17 illustrate how different types of cable problems appear. As you examine these figures, notice that automatic swap is enabled (no asterisk (*) appears beside A and B cable indicators).

Figure 6-15 UCN Status Display — Single Node Problem

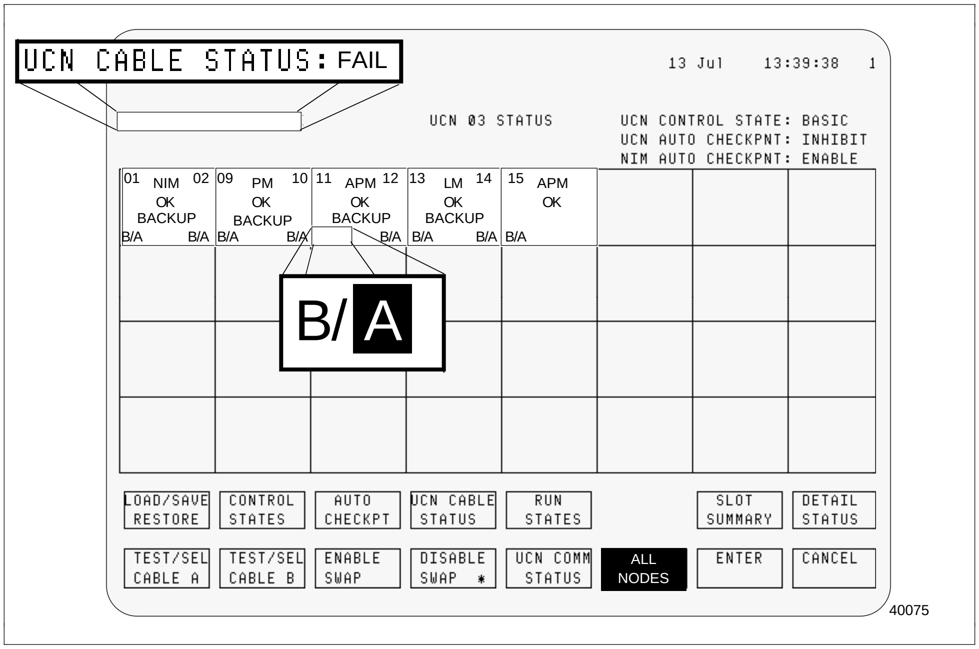
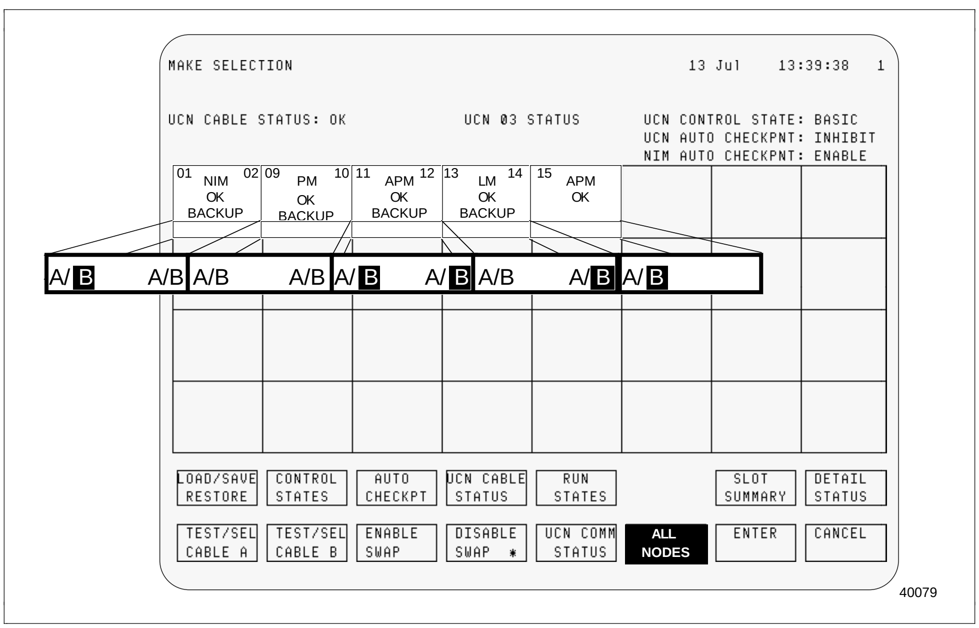


Figure 6-16 UCN Status Display —Trunk Cable Problem



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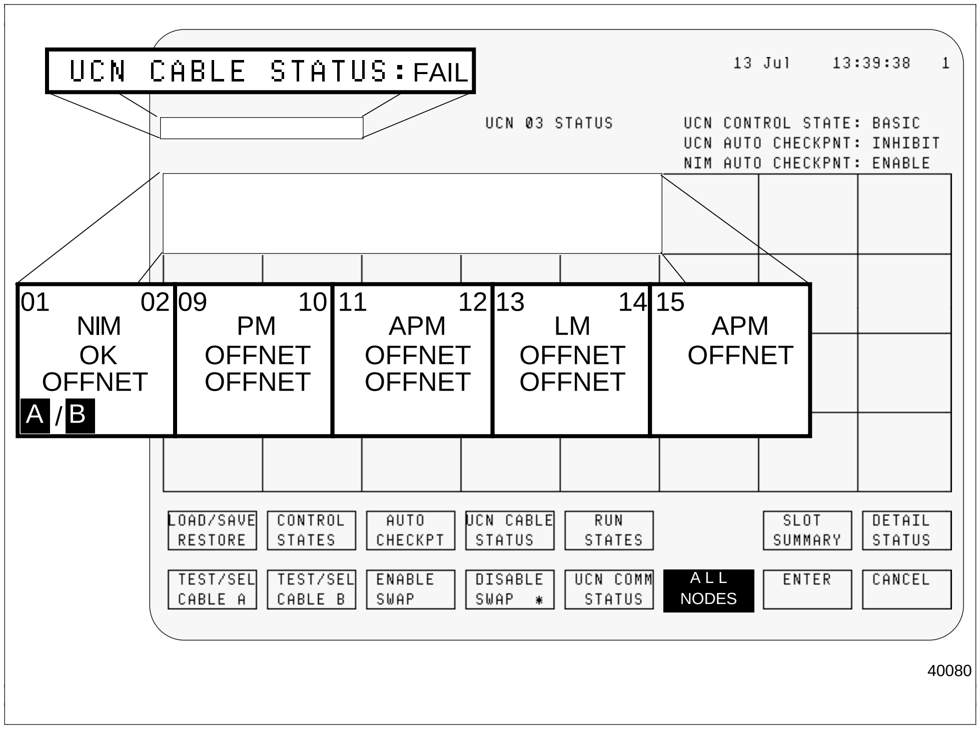
Failure display examples, continued

Figure 6-17 UCN Status Display — Dual Cable Fault



Determine if solid or intermittent problem

Once the system has identified a bad cable, the Cable Master node will perform a single node test of the bad cable once every 60 seconds (if automatic cable swapping is not disabled).

To determine if the problem is intermittent or solid, watch the flagged cable problem indications on the UCN Status display over a period of several minutes. If they disappear on occasion and then reappear, the problem is intermittent.

An optional way of checking for intermittent errors is to select the [TEST / SEL CABLE A] or [TEST / SEL CABLE B] targets (with automatic Swap Disabled) as you watch the error indications on the UCN Status Display. If the error indications disappear as the result of some test sequences, the problem is intermittent.

Be sure to provide up to 25 seconds for the test results after each test initiation.

6.17 Problem Analysis/Isolation

Detailed problem analysis

The Detail Failure Analysis—Section 7 of this manual is provided to assist in gathering information and making a calculated determination of where a cable problem is located. It is specifically useful when multiple nodes are detecting problems.

The gathering of information is based on results obtained when manually initiated backup cable tests (on the bad cable) are executed on individual nodes using the [BACKUP CABLE TST] target. These single node tests are initiated after the automatic cable testing and swapping has been disabled with the [DISABLE SWAP *] target.

Single node tests consist of a test message being sent (on the Backup Cable) from the selected node to all other nodes and all other nodes respond to the sending node. Cable errors will be flagged and are readily visible on the UCN Status display and UCN Statistics—Network display. There is no sequencing through all nodes when using Single node tests.

Components that can cause individual node failures

The following component failures generally cause node failure-related problems:

- Loose connection (not torqued) at either end of the drop cable
- Bad connection at either end of drop cable caused by corrosion
- Bad drop cable
- Bad trunk tap (OK trunk-to-trunk—bad trunk-to-tap)
- Bad modem board/card in the node (PM, APM, LM, NIM)
- Bad UCN miniature coax cables (inside node)
- Bad communications board/card in the node
  - NIM—PNI/EPNI
  - PMM/APMM—COMM card
  - LM—LMM assembly (includes modem)
- Bad connection between modem board and backplane connector
- Missing trunk terminator.

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Noise related problems

Noise on the trunk cable network (A or B) can cause problems with many or all nodes. Noise can be caused by several things (identified in this table below). Some nodes may be affected much more than others because of their relative position on the trunk cable footage and the number of connections involved. Cable breaks may appear as noise on some nodes and silence on others.

The following table describes the steps that should be performed when attempting to locate (and repair) the source of noise on a cable network.

Table 6-11 Correcting General Noise Problems

Item	Action
1	Check the cable connections all along the cable network for corrosion and proper torque. This includes both ends of all drop cables and all terminators. Do not forget the terminators that are used to terminate unused connections on the taps. Terminators are used to prevent signal reflections from unused connections on the taps.
2	Check each tap for improper or poor grounding.
3	Check for reversed taps along the trunk cables.
4	Check for violation of the minimum bend radius for trunk and drop cables. No sharp bends or kinks.
5	Check for possible sources of RFI/EMI interference. The UCN is reasonably immune to interference from these sources, but an overwhelming level can cause serious problems. These problems are aggravated if cable connections are corroded or not properly torqued.
6	Check for improperly constructed trunk cable ends or damaged cables as a source for noise.
	The preceding steps will lead to the correction of many noise problems. In some cases, it may be necessary to completely remove the bad cable network from all nodes and proceed with cable diagnostic efforts using a Time Domain Reflectometer (TDR) or Carrier Band Tester (CBT). The TDR and CBT test devices are used to send a variety of signals down the cable and then analyze signal strength and reflections. Your findings should be compared to the (TDR and CBT) cable analysis results obtained and recorded when the system UCN was initially installed. If the initial values are not available, you have no reference to go by and the task becomes much more difficult.

Continued on next page

List of causes for network failures

The following component failures can cause the whole cable network (A or B) to appear bad:

- Loose connection (not torqued) on the trunk cable
- Loose (not torqued) terminators
- Bad connection on trunk cable or terminator caused by corrosion
- Bad trunk cable segment (may require use of TDR)
- Bad modem board/card in the node (PM, APM, HPM, LM, NIM)
- Bad backplane in the node
- Bad communications board/card in the node
  - NIM—PNI/EPNI
  - PMM/APMM—COMM card
  - HPMM—High-Performance Comm/Control card
  - LM—LMM assembly (includes modem)
- Bad trunk tap (bad trunk-to-trunk)
- Improperly grounded trunk tap
- Reversed trunk tap
- Electro Magnetic Interference
- Improper Master Reference Ground
- Noise on primary power source

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Isolating Cable Master NIM

If all (or most) UCN nodes appear to be having a problem with the same cable, the NIM and/or trunk cable is suspect. The following Table describes how to isolate the Cable Master NIM from the network if redundant NIMs are configured.

Table 6-12 Isolating the Cable Master from the Network

Step	Action
1	If the Cable Master NIM has a redundant partner, shut down the Primary NIM (also is the current cable master) from the Gateway Status display to isolate the NIM from the network. This causes the redundant partner to take over and become the Primary NIM and Cable Master. Note: The cable master node designation happens automatically through software. The cable mastership will always be dynamically moved to the loaded node with the lowest UCN address. NIMs are always (should be) configured to be the lowest UCN node numbers.
2	You will need to analyze the cable indications again as you do the following: Select the [TEST / SEL CABLE A] target or [TEST / SEL CABLE B] target. This requires the [ALL NODES] target to be selected. The above initiates a test sequence of the backup cable. Be sure to wait about 25 seconds for results to show. The testing of the Backup cable takes time and one must be patient.The cable error indications will be removed if the problem no longer exists. Note: The NIM modem board could be the cause of failure. The PNI/EPNI board or node backplane could also be at fault. (Older version nodes have the PNM and paddle board for a modem.)
3	Reload the NIM that was shut down in the preceding step if isolating the NIM did not correct the network problem.
4	Correct the NIM problem if the problem was isolated to the NIM and test for fix verification.

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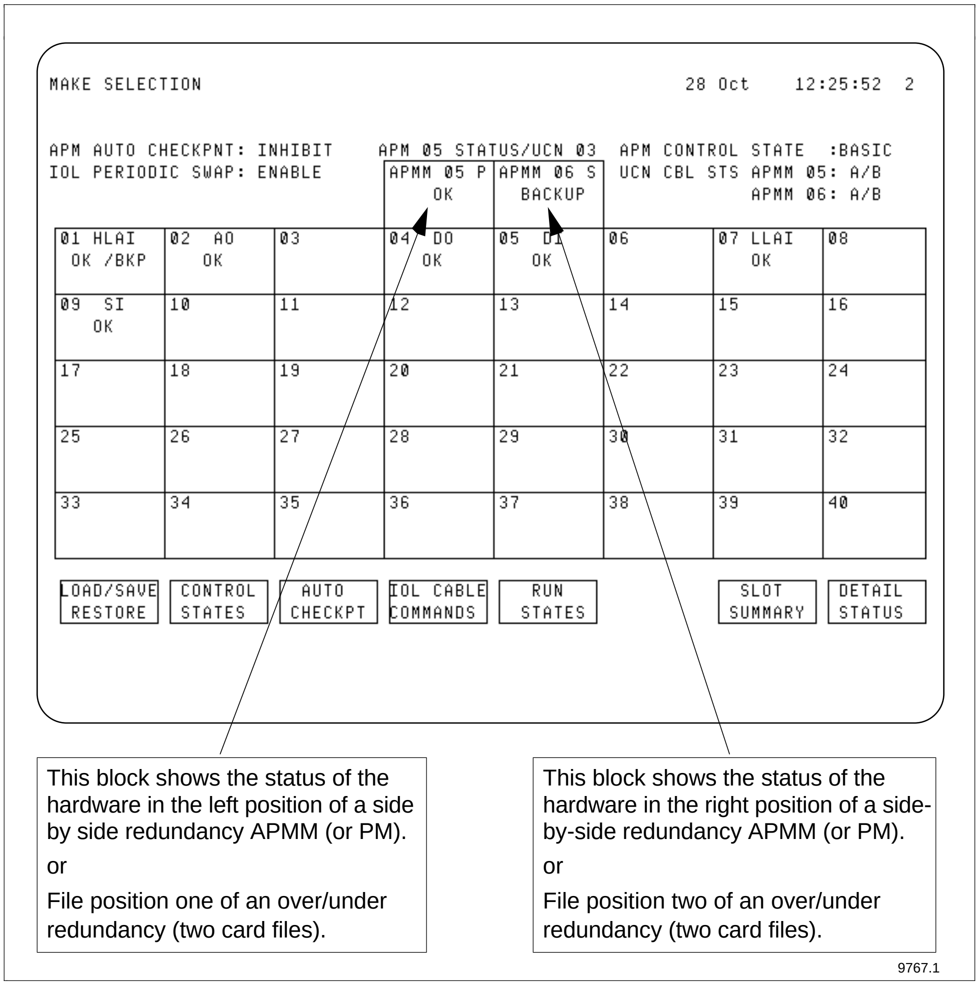
6.18 Isolating Problems Between Redundant PM/APM/HPM Nodes

PM/APM/HPM physical device to functionality correlation

When attempting to troubleshoot a communications problem with a PM/APM/HPM, the first task is to identify which physical PMM/APMM/HPMM is Primary and which is Backup (if redundant PMM/APMM/HPMMs exist). This is easily done by accessing the PM/APM/HPM Detail Status display. Figure 6-18 shows how to determine which physical device is the Primary and which is the Backup.

Figure 6-18 PM/APM/HPM Node to Primary and Backup Correlation



A physical check of the hardware indicators on the PMM/APMM/HPMM should also be made to verify the above. The Status indicator on the Redundancy Driver board blinks on the BACKUP node.

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Problem with a PM/APM/HPM node

If the node having cable problems (PMM, APMM, or HPMM) has a redundant partner, further isolation is possible by using the following technique at the PM/APM/HPM failing node. Be sure to do this only one node at a time.

CAUTION

CAUTION—Before attempting the following, ensure that the secondary (backup) node is not having UCN cable problems as well. In addition, ensure that the BACKUP state is displayed in blue and not yellow. Failing to check and certify the above items could result in a process shutdown if a PMM/APMM/HPMM modem board is removed.

Table 6-13 Isolating PMM/APMM/HPMM Redundant Partners

Step	Action
1	Remove the PMM/APMM/HPMM redundancy driver board of the failing node half-way, without doing a node shutdown. This powers down the node and isolates the node connection (both cables A and B) from the UCN. (Memory content is retained.) You do not have to worry about removing the board with power on. Lifting the upper latch automatically removes +24 volt power from the PMM/APMM/HPMM cards.
2	Manually command the system to test and swap to the bad cable by using the [TEST / SEL CABLE X] target on the UCN Status display.
3	Watch the cable error indications on the UCN Status Display. (Be sure to allow up to 25 seconds for the Backup Cable test to complete.) If the cable error indications disappear, the node you just isolated is causing the problem. The problem to be in the node and/or its associated drop cables. If there is no change (errors remain), the isolated node is not the cause of the problem. Reinstall the redundancy board. The device will return to the BACKUP state.

6.19 Double Cable Faults

Suggested approach

A double cable fault (problems on both A and B cables). The following sequence may assist you in recovering from double cable faults.

Table 6-14 Approaching Double Cable Faults

Step	Action
1	Attempt to resolve one cable problem at a time.
2	It is recommended to work on the last cable that failed before attempting to resolve the backup cable problems. The UCN Status display can be used to determine which cable. Nodes with cable errors flagged (red cable backlighting), did so as the first cable failed and a swap was accomplished. The subsequent failure on the "swapped to" cable will generally not cause a swap because there is no good backup cable available. Nodes that go OFFNET are identifying problems with the current cable. A cable swap to a bad cable is done, in some cases, where the first cable failure was a simple drop problem for one node and a subsequent failure consisting of a problem for all nodes occurs on the second cable.
3	Once a single cable has been restored to proper operation, the recovery of failed nodes should be accomplished. This is done by selecting the individual nodes and selecting the RECOVER target. If this is not successful, they much be shutdown and reloaded. In each of these cases, provide sufficient time for the software (and hardware) to go through its programmed scenario before you attempt yet other actions. Patience is needed in this area.
4	Call for assistance. The Honeywell TAC can provide expertise to resolve your given double cable fault in a more expeditious manner. A Honeywell Site Support Specialist may also prove to be a valuable asset.

Section 7 – Detailed Failure Analysis

7.1 Overview

Section contents

These are the topics covered in this section:

Topic — See Page

Introduction

Use the procedures in this section to analyze and troubleshoot a newly installed UCN or an existing UCN that has begun to exhibit deteriorating performance with increased errors in the form of silences and noise events.

ATTENTION

Analysis of the data gathered by the procedures in this section is complex. In depth training and/or extensive experience can make this task easier.

It is suggested that a Honeywell Site Support Specialist or TAC Support Specialist be consulted for assistance, if needed.

7.2 Manual Backup Cable Testing

ATTENTION

ATTENTION—These procedures are time consuming and the effectiveness of the analysis depends upon the experience of the analyst.

To ensure the accuracy of the statistics, procedures, and diagnostics , cable swapping must be disabled for the duration of the testing.

Functionality

This function tests the inactive/backup cable and will be referred to as the Backup Cable Test. The test must be run using each node as test Master. This test will detect both Silence and Noise conditions.

- Each node sends a message to each other node on the UCN. The message requests a response.
- Then, for the next node, in turn, repeat the process of sending to the other nodes.
- The UCN STATS display shows the resulting silences and noisy transmissions.
- The data is recorded on the analysis chart.
- The data is analyzed to isolate the probable point(s) that is the source of the failure.

Definitions

Each Node on the UCN has the capability to:

- initiate this test (Test Master) and send a Test Message on the Backup Cable for all other Nodes to hear.
- respond to another Node who may be running the test (Test Responder) and will check the Test Message for proper reception.
- Each Backup Cable Test takes approximately 2 milliseconds to run.

Test Master sequence

The "Test Master" will send a test message on the backup cable for all other nodes to hear, and each "Test Responder" will check the test message for proper reception.

In order for a backup cable to be completely tested, each node must take a turn as the "Test Master," in order to check its transmit capability. Each node must be tested as Test Master separately and data recorded afterwards. To test for intermittences, repeat the test multiple times for each node. This function of taking turns being the Test Master, is called a "**Backup Cable Test Sequence**."

Continued on next page

7.2 Manual Backup Cable Testing, Continued

Sequence

Each pass of the manually executed Backup Cable Test has test events as follows.

- Each node, in node number order from lowest to highest configured, will send a message requesting a response to each of the other nodes on the UCN.
- Now record the data for the silences and noisy responses on the horizontal line to the right, on the analysis form, of that node number.
- Run the Backup Cable Test for as many node numbers as required to diagnose the problem (usually requires running all the nodes).

7.3 Backup Cable Test Preparation

Initial preparation

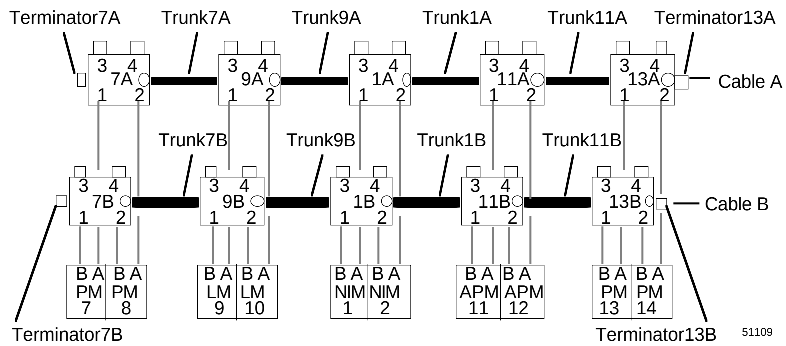
Do the following:

1. Obtain or prepare a topology map, similar to Figure 7-1, showing the exact order the nodes and cable segments.
2. Prepare a table, similar to Figure 7-2, with the node types and respective node numbers to represent your UCN topography. **A template for your use is provided at the end of this section.**

Topology map

Create a topology map similar to the example below.

Figure 7-1 UCN Topology Map Example



Test analysis table

List the nodes in order that they are on the physical UCN Cable.

Figure 7-2 Backup Cable Test Result Analysis Table

R ESULTS

The Nodes should be listed in physical Node order. →

ORDER OF TESTING ↓

►	►	PM7	PM8	LM9	LM10	NIM1	NIM2	APM11	APM12	PM13	PM14
PM_7	Sil Nsy										
PM_8	Sil Nsy										
LM_9	Sil Nsy										
LM_10	Sil Nsy										
NIM_1	Sil Nsy										
NIM_2	Sil Nsy										
APM_11	Sil Nsy										
APM_12	Sil Nsy										
PM_13	Sil Nsy										
PM_14	Sil Nsy										

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7.4 Gathering Statistics

ATTENTION

ATTENTION—To ensure the accuracy of the statistics, procedures, and diagnostic assumptions, cable swapping must be disabled for the duration of the testing.

Data preparation

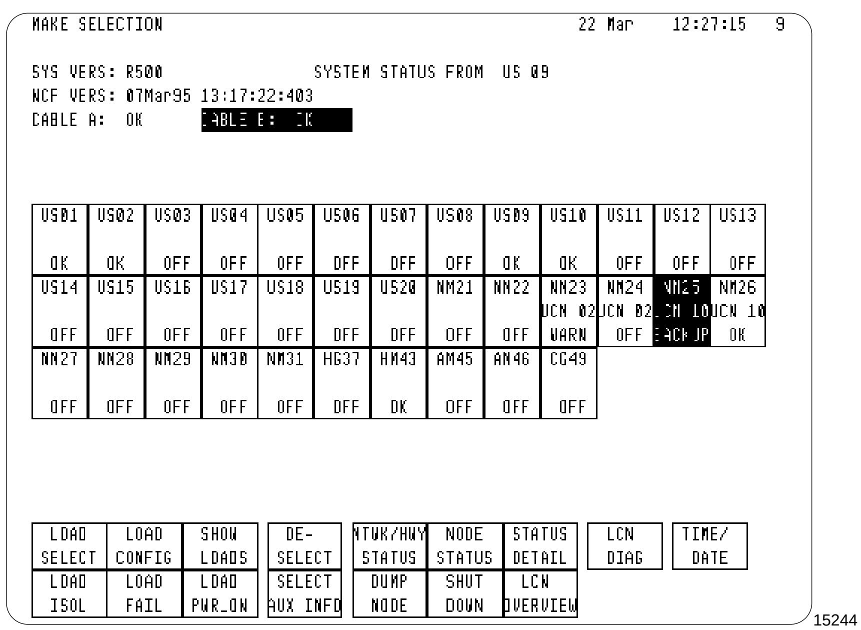
Prior to running the backup test, the UCN Cable Comm statistics should be reset (Table 7-1) or the data recorded (Table 7-2) to establish a baseline to begin analyzing results.

Table 7-1 Resetting UCN Cable Comm Statistics

Step	Action	Result
1	Select SYSTEM STATS button to get system Status display.	System Status display appears. See Figure 7-3.
2	Select the UCN to be tested.	UCN ## Status display appears. See Figure 7-4.
3	Select UCN CABLE STATUS	Another row of targets appears. See Figure 7-5.
4	Select UCN COMM STATUS target.	UCN Cable Statistics display appears. See Figure 7-7 and 7-8.
5	Select ALL NODES and select the RESET STATS target.	Wait until the data is reset.

Display

Figure 7-3 System Status Display



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Display

Figure 7-4 UCN Cable Status Display

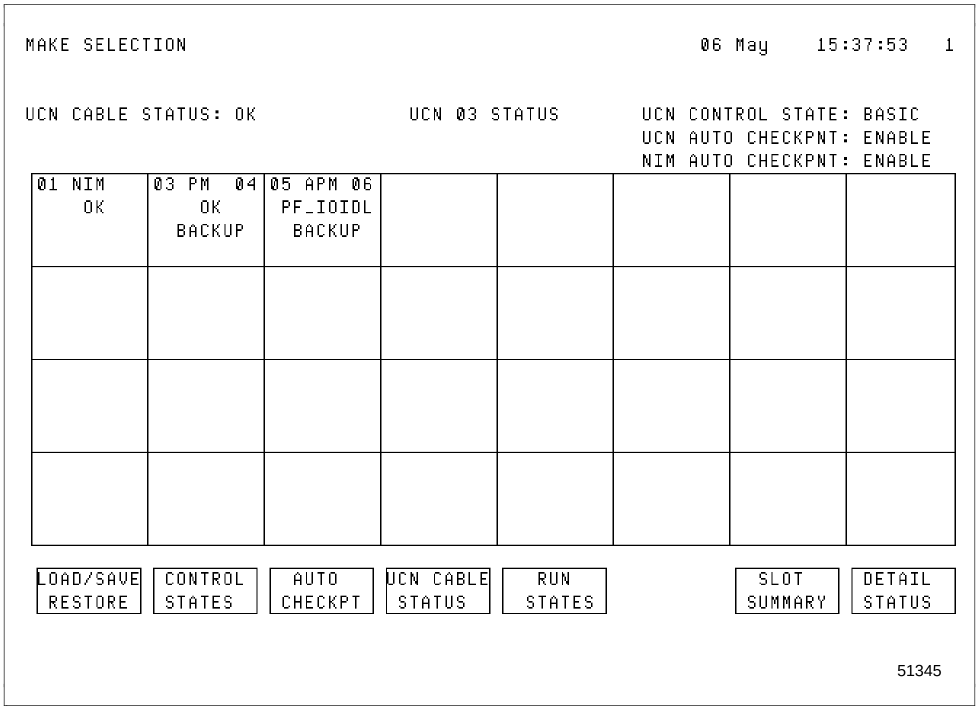
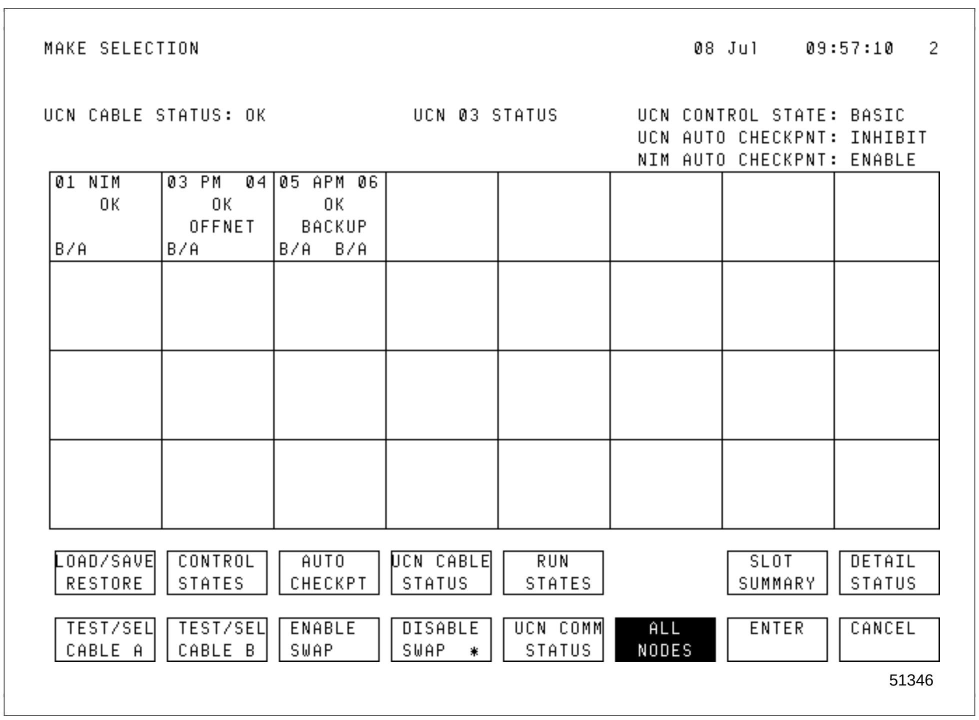


Figure 7-5 UCN Cable Status Display—Additional Targets



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Display

Figure 7-6 UCN Cable Status Display—NIM Selected

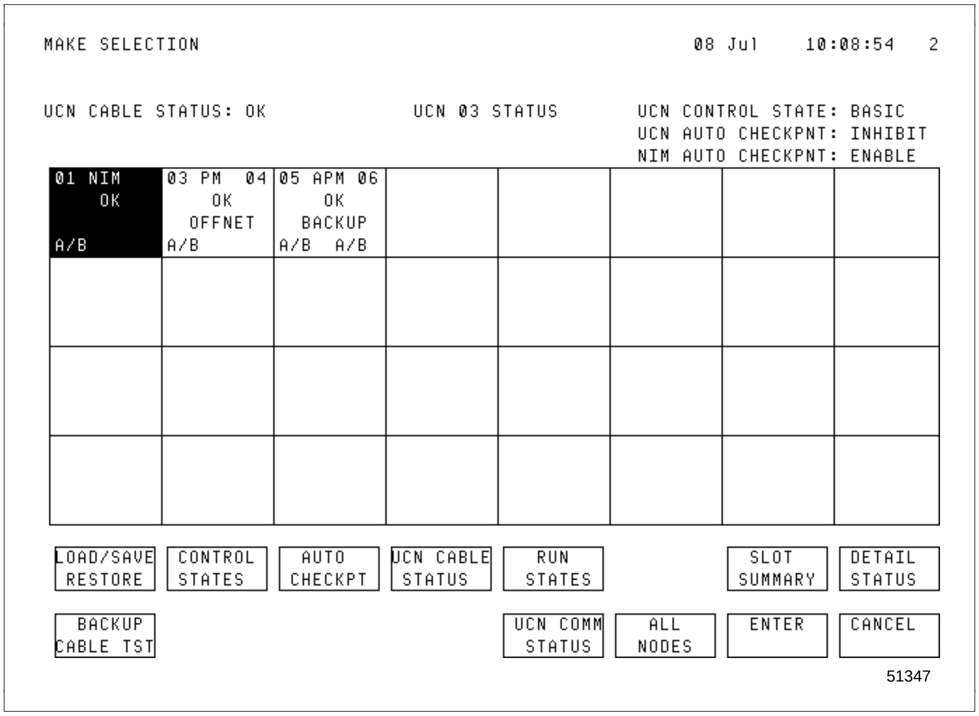
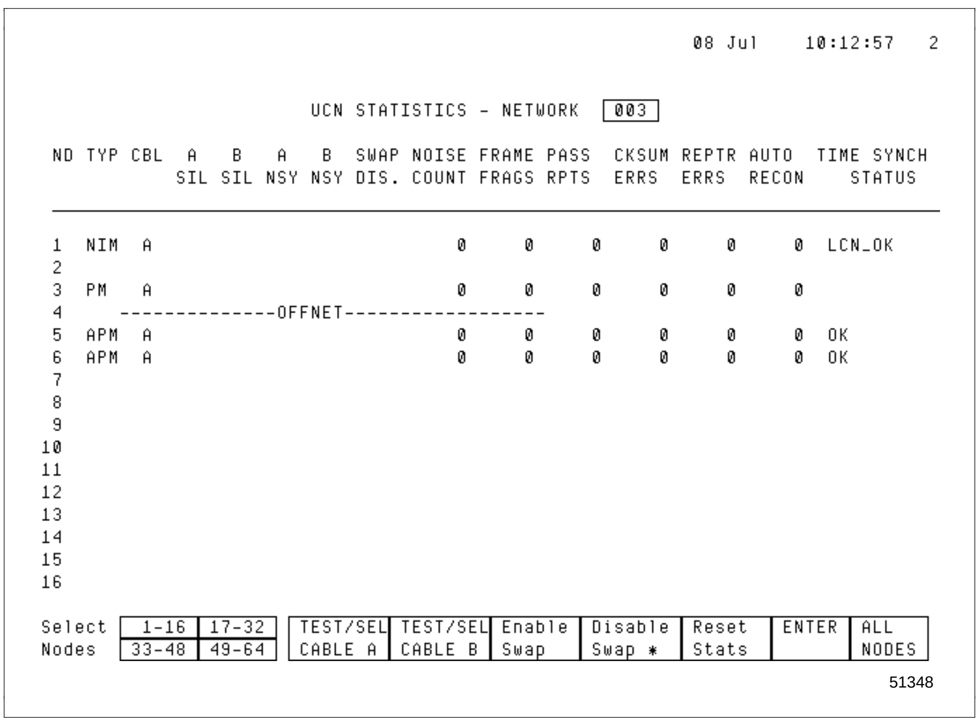
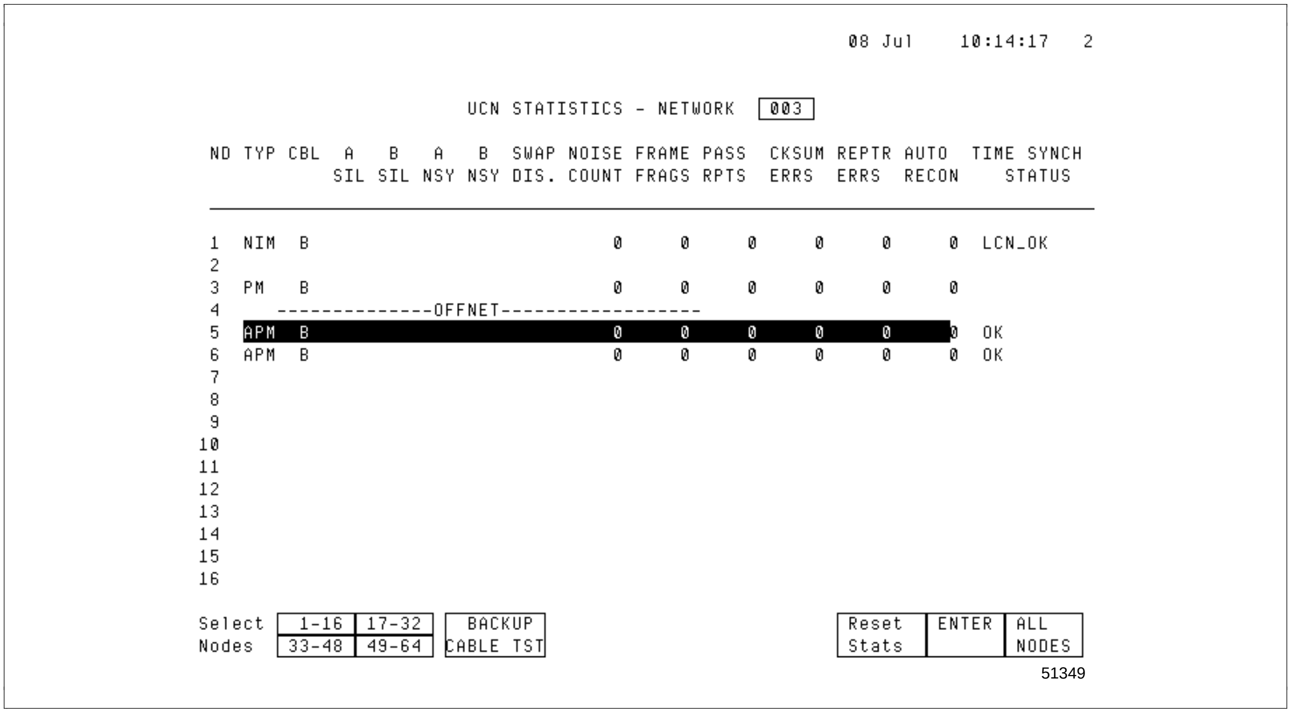


Figure 7-7 UCN COMM Statistics Display



Continued on next page

Figure 7-8 UCN COMM Statistics Display—APM Selected



7.5 Running the Backup Test and Recording Results

Testing procedure

The sequence will:

- start the test from node PM_7 and send test messages to the other nodes.
- you, the tester, will record the test values as shown by numbers 1 through 18 in Figure 7-9.
- start the test from node PM_8 and send test messages to the other nodes.
- you, the tester, will record the test values as shown by numbers 19 through 38 in Figure 7-9.
- continue testing, starting the test at each succeeding node and recording the results, until all the nodes have been tested.

Table 7-2 provides detailed instructions for running each pass of the test.

Table 7-2 Analysis for Silences and Noise Counts Using Backup Test

Step	Action	Result
1	From the UCN Statistics display, select DISABLE SWAP AND ENTER. See Figure 7-7.	A red asterisk will appear in the DISABLE SWAP target.
2	Swap to Cable A, if not already there.	An A will appear in the third column of the display indicating all the nodes listening are on Cable A.
3	Select a node. All of the nodes will be tested, so start at the top of the list.	The SELECT CABLE A, SELECT CABLE B, ENABLE SWAP, and DISABLE SWAP targets are replaced by a TEST BACKUP CABLE target.
4	Select the TEST BACKUP CABLE target and ENTER.	Wait for results. Record results on analysis form for Cable A. This should be no longer than 19 seconds.
5	Record the results on the analysis table.	Use a blank table like the figure at the end of this section.
6	Repeat the steps 3-5 for each node until all have been tested.	

Continued on next page

Figure 7-9 Example of Backup Cable Test Results

		PM7	PM8	LM9	LM10	NIM1	NIM2	APM11	APM12	PM13	PM14
PM_7	Sil Nsy		1 2	3 4	5 6	7 8	9 10	11 12	13 14	15 16	17 18
PM_8	Sil Nsy	19 20		21 22	23 24	25 26	27 28	29 30	31 32	33 34	35 38
LM_9	Sil Nsy										
LM_10	Sil Nsy										
NIM_1	Sil Nsy										
NIM_2	Sil Nsy										
APM_11	Sil Nsy										
APM_12	Sil Nsy										
PM_13	Sil Nsy										
PM_14	Sil Nsy										

7.6 Analyzing the Results

Scope

There are no set rules or guidelines for analyzing the data you have just gathered. There are some fairly direct pointers that may help.

Pointers

There are pointers that indicate the type of problem present in the UCN.

- Silences usually indicate broken or disconnected cable.
- Noise indicates a loose cable, bad tap, or a bad connection (corroded.) Some nodes at the end of an open cable may also detect noise.
- Both silences and noise indicates an intermittent connection, or bad tap, or a partially cut cable.

A cluster of either noise or silences at one general area is an indicator of a problem area.

7.7 Examples of Backup Cable Test Analysis

Scope

In each example in the following subsections, two figures are shown:

- Topology map indicating the failure point with a star symbol.
- Analysis table with generic test results.

These examples are given as a classic case and what you see in actual conditions may differ, but may be similar enough to allow diagnosis.

ATTENTION

Each failure case is different and there is no way that all cases can be documented. Use the example as a guide of what to look for.

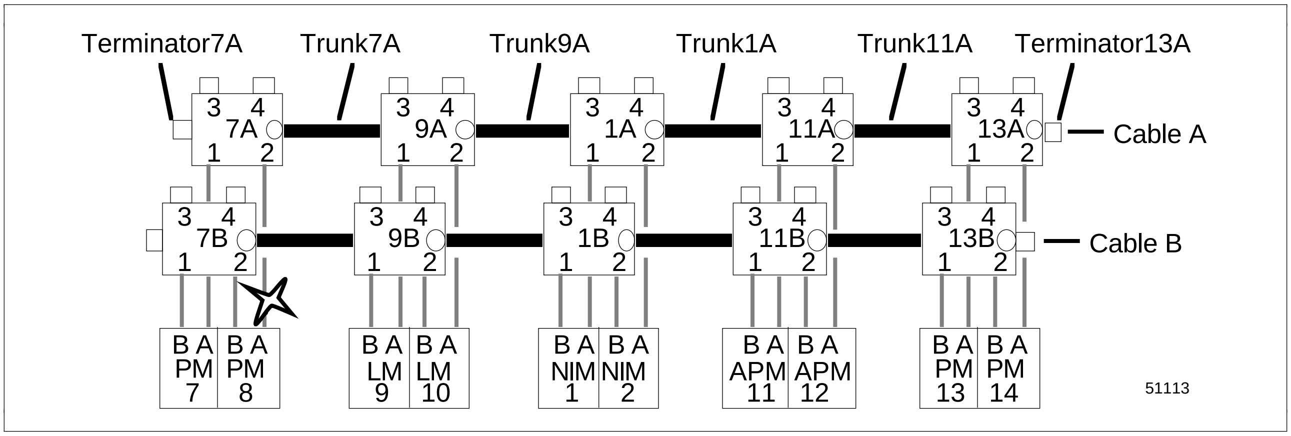
Keys to analysis tables

In the example that follows, some of the asterisk (*) entries refer to intermittent occurrences and some are constant. The constant occurrences are indicated by a box drawn around that data.

7.8 Example 1—Disconnected PM_8's Drop Cable A

Illustration

Figure 7-10 Example 1—Disconnected Drop Cable A



Problem analysis

This example shows silences (no response) from every node that tried to communicate with PM 8. It is probably a damaged/disconnected drop cable or a damaged tap.

Figure 7-11 Example 1 Analysis

CABLE A TESTED

		PM7	PM8	LM9	LM10	NIM1	NIM2	APM11	APM12	PM13	PM14
PM_7	Sil Nsy		*								
PM_8	Sil Nsy	*		*	*	*	*	*	*	*	*
LM_9	Sil Nsy		*								
LM_10	Sil Nsy		*								
NIM_1	Sil Nsy		*								
NIM_2	Sil Nsy		*								
APM_11	Sil Nsy		*								
APM_12	Sil Nsy		*								
PM_13	Sil Nsy		*								
PM_14	Sil Nsy		*								

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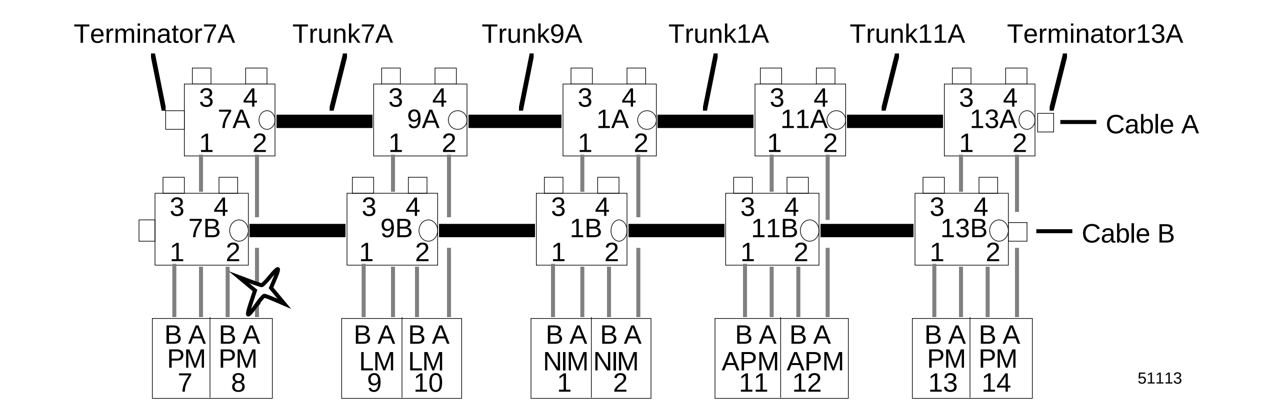
7.9 Example 2—Loose PM_8's Drop Cable A

Illustration

Figure 7-12 Example 2—Loose Drop Cable A



Problem analysis

This example shows silences (no response) from every node that tried to communicate with PM 8 and noise indicating an intermittent connection. It is probably a damaged/disconnected drop cable or a damaged tap.

Figure 7-13 Example 2 Analysis

CABLE A TESTED

		PM7	PM8	LM9	LM10	NIM1	NIM2	APM11	APM12	PM13	PM14
PM_7	Sil Nsy		* *								
PM_8	Sil Nsy	* *		* *	* *	* *	* *	* *	* *	* *	* *
LM_9	Sil Nsy		* *								
LM_10	Sil Nsy		* *								
NIM_1	Sil Nsy		* *								
NIM_2	Sil Nsy		* *								
APM_11	Sil Nsy		* *								
APM_12	Sil Nsy		* *								
PM_13	Sil Nsy		* *								
PM_14	Sil Nsy		* *								

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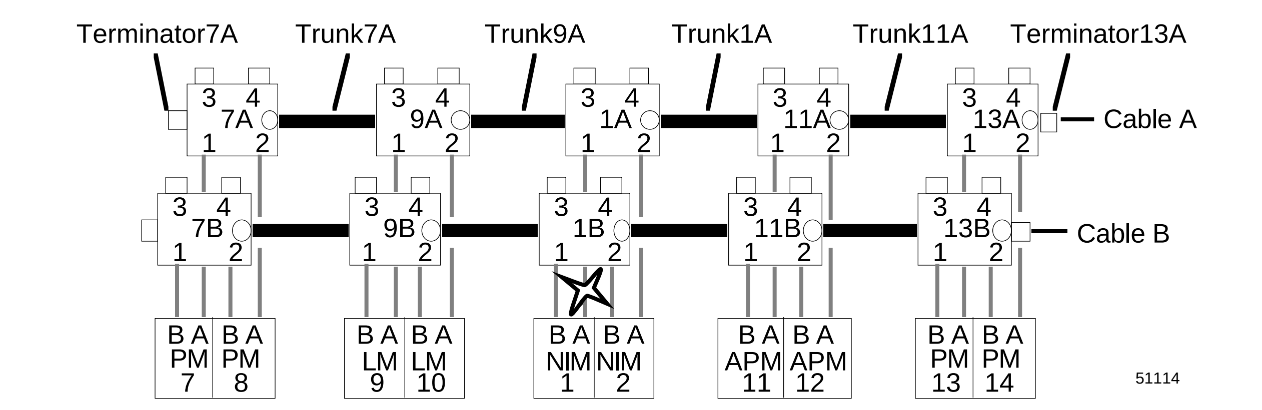
7.10 Example 3—Disconnected NIM_1's Drop Cable A

Illustration

Figure 7-14 Example 3—Disconnected Drop Cable A



Problem analysis

This example shows silences (no response) from every node that tried to communicate with NIM 1. This is similar to Example 1, except it is a different node. It is probably a damaged/disconnected cable or a damaged tap.

Figure 7-15 Example 3 Analysis

CABLE A TESTED

		PM7	PM8	LM9	LM10	NIM1	NIM2	APM11	APM12	PM13	PM14
PM_7	Sil					*					
	Nsy										
PM_8	Sil					*					
	Nsy										
LM_9	Sil					*					
	Nsy										
LM_10	Sil					*					
	Nsy										
NIM_1	Sil	*	*	*	*		*	*	*	*	*
	Nsy										
NIM_2	Sil					*					
	Nsy										
APM_11	Sil					*					
	Nsy										
APM_12	Sil					*					
	Nsy										
PM_13	Sil					*					
	Nsy										
PM_14	Sil					*					
	Nsy										

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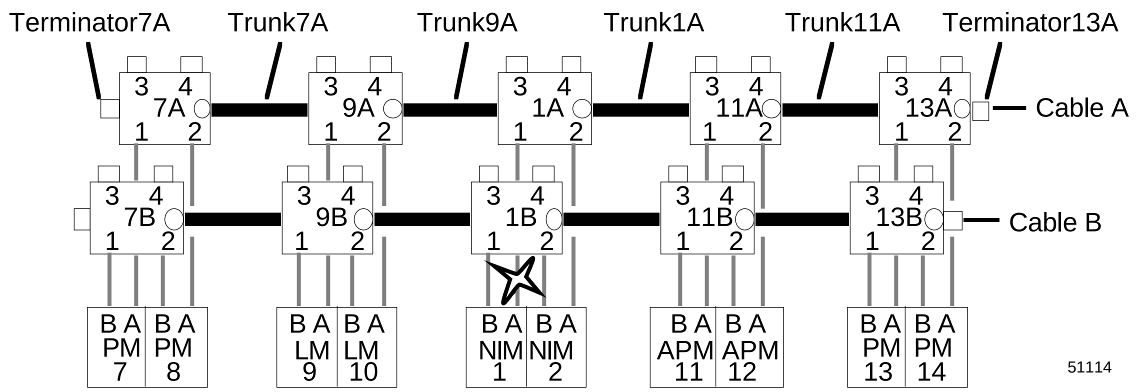
7.11 Example 4—Loose NIM_1's Drop Cable A

Illustration

Figure 7-16 Example 4—Loose Drop Cable A



Problem analysis

This example shows silences (no response) from every node that tried to communicate with NIM 1 and noise indicating an intermittent connection. This is similar to Example 2, except it is a different node. It is probably a damaged/disconnected cable or a damaged tap.

Figure 7-17 Example 4 Analysis

CABLE A TESTED

		PM7	PM8	LM9	LM10	NIM1	NIM2	APM11	APM12	PM13	PM14
PM_7	Sil					*					
	Nsy					*					
PM_8	Sil					*					
	Nsy					*					
LM_9	Sil					*					
	Nsy					*					
LM_10	Sil					*					
	Nsy					*					
NIM_1	Sil	*	*	*	*		*	*	*	*	*
	Nsy	*	*	*	*		*	*	*	*	*
NIM_2	Sil					*					
	Nsy					*					
APM_11	Sil					*					
	Nsy					*					
APM_12	Sil					*					
	Nsy					*					
PM_13	Sil					*					
	Nsy					*					
PM_14	Sil					*					
	Nsy					*					

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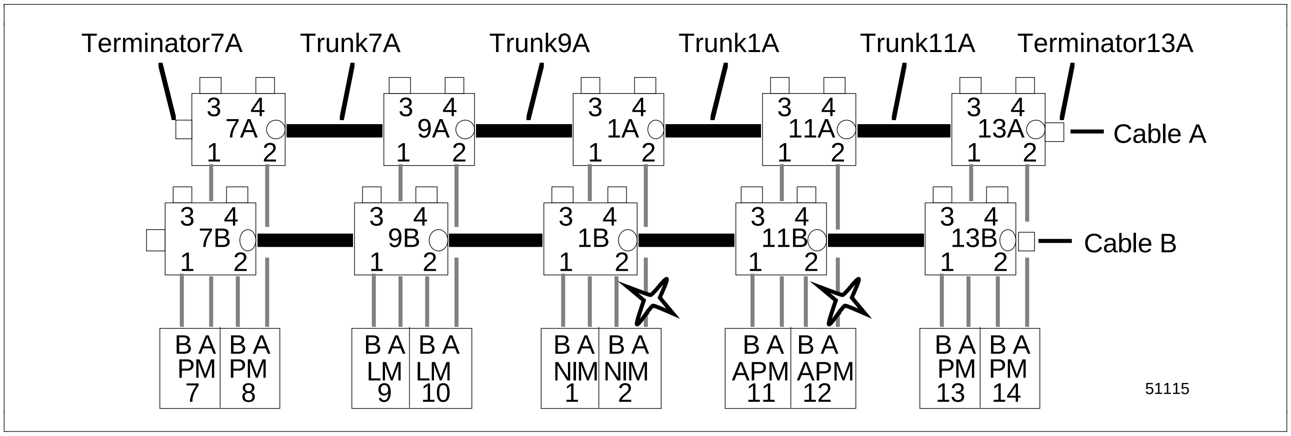
7.12 Example 5—Disconnected NIM_2 & APM_12's Drop Cable A

Illustration

Figure 7-18 Example 5—Disconnected Drop Cable A



Problem analysis

This example shows silences (no response) from every node that tried to communicate with either of NIM 2 and APM 12. This is similar to Example 1 and 3, except it is a different node. It is probably a damaged/disconnected cable or a damaged tap.

Figure 7-19 Example 5 Analysis

CABLE___A____ TESTED ___________

		PM7	PM8	LM9	LM10	NIM1	NIM2	APM11	APM12	PM13	PM14
PM_7	Sil Nsy						*		*		
PM_8	Sil Nsy						*		*		
LM_9	Sil Nsy						*		*		
LM_10	Sil Nsy						*		*		
NIM_1	Sil Nsy						*		*		
NIM_2	Sil Nsy	*	*	*	*	*		*	*	*	*
APM_11	Sil Nsy						*		*		
APM_12	Sil Nsy	*	*	*	*	*	*	*		*	*
PM_13	Sil Nsy						*		*		
PM_14	Sil Nsy						*		*		

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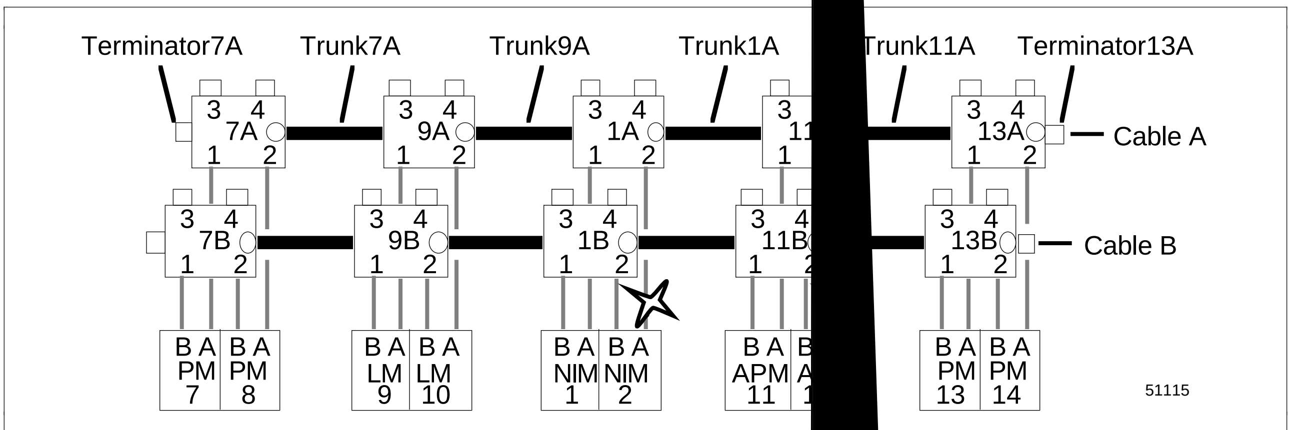
7.13 Example 6—Loose NIM_2 & APM1[redacted]s Drop Cable A

Illustration

Figure 7-20 Example 6—Disconnected Drop Cable A



Problem analysis

This example shows silences (no respo[redacted]from every node that tried to communicate with NIM 2 and APM 12[redacted]noise indicating an intermittent connection. This is similar to Example[redacted]cept it is a different node. There are two separate problems here. [redacted] are probably damaged or disconnected cable or a damaged tap.

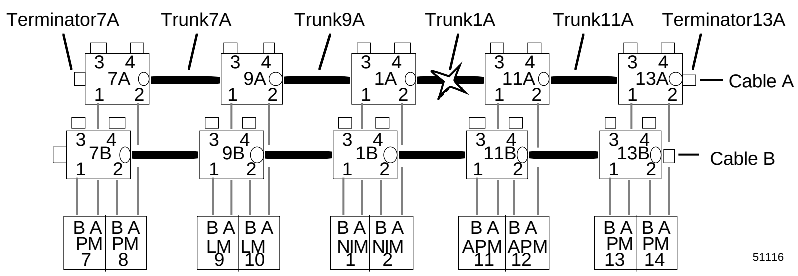
Figure 7-21 Example 6 Analysis

CABLE		TESTED PM7	PM8	LM9	LM10	NIM1	NIM2	[redacted]	APM12	PM13	PM14
PM_7	Sil						*	[redacted]	*		
	Nsy						*	[redacted]	*		
PM_8	Sil						*	[redacted]	*		
	Nsy						*	[redacted]	*		
LM_9	Sil						*	[redacted]	*		
	Nsy						*	[redacted]	*		
LM_10	Sil						*	[redacted]	*		
	Nsy						*	[redacted]	*		
NIM_1	Sil						*	[redacted]	*		
	Nsy						*	[redacted]	*		
NIM_2	Sil	*	*	*	*	*		[redacted]	*	*	*
	Nsy	*	*	*	*	*		[redacted]	*	*	*
APM_11	Sil						*	[redacted]	*		
	Nsy						*	[redacted]	*		
APM_12	Sil	*	*	*	*	*	*	[redacted]		*	*
	Nsy	*	*	*	*	*	*	[redacted]		*	*
PM_13	Sil						*	[redacted]	*		
	Nsy						*	[redacted]	*		
PM_14	Sil						*		*		
	Nsy						*		*		

7.14 Example 7—Disconnected Trunk 1A

Illustration

Figure 7-22 Example 7—Disconnected Trunk 1A



Problem analysis

This example shows a clear division in the noise reported from every node on each side of the break in the trunk cable. The silences reported from nodes on the same side of the break were intermittent and the silences from nodes on the opposite side of the break were constant (inside the dark outline).

It is probably a damaged/disconnected trunk cable or a damaged tap.

Figure 7-23 Example 7 Analysis

CABLE___A_____ TESTED ____________

		PM7	PM8	LM9	LM10	NIM1	NIM2	APM11	APM12	PM13	PM14
PM_7	Sil		*	*	*	*	*	*	*	*	*
	Nsy		*	*	*	*	*				
PM_8	Sil	*		*	*	*	*	*	*	*	*
	Nsy	*		*	*	*	*				
LM_9	Sil	*	*		*	*	*	*	*	*	*
	Nsy	*	*		*	*	*				
LM_10	Sil	*	*	*		*	*	*	*	*	*
	Nsy	*	*	*		*	*				
NIM_1	Sil	*	*	*	*		*	*	*	*	*
	Nsy	*	*	*	*		*				
NIM_2	Sil	*	*	*	*	*		*	*	*	*
	Nsy	*	*	*	*	*		*	*	*	*
APM_11	Sil	*	*	*	*	*	*		*	*	*
	Nsy								*	*	*
APM_12	Sil	*	*	*	*	*	*	*		*	*
	Nsy							*		*	*
PM_13	Sil	*	*	*	*	*	*	*	*		*
	Nsy							*	*		*
PM_14	Sil	*	*	*	*	*	*	*	*	*	
	Nsy							*	*	*	

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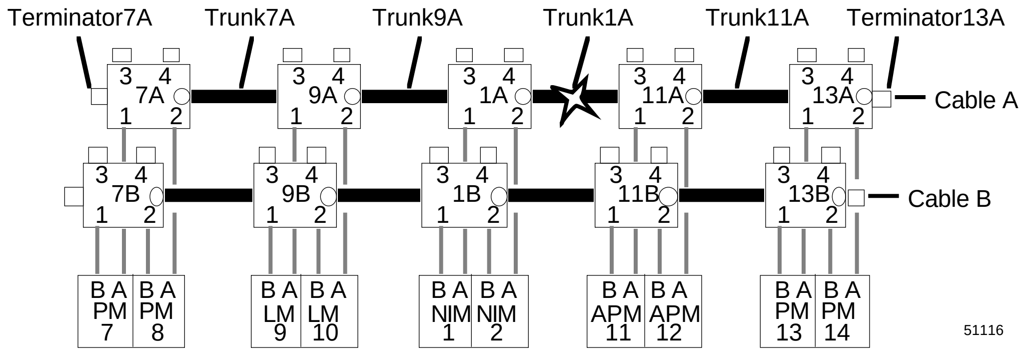
7.15 Example 8—Loose Trunk 1A

Illustration

Figure 7-24 Example 8—Loose Trunk 1A



Problem analysis

This type of fault is the most difficult to find. If after tightening all trunk connectors, all indications are still intermittent, then the fault is due to a faulty cable, external noise, improper grounding, or a faulty tap. Test equipment such as a carrier band tester may be needed to further isolate the problem.

Figure 7-25 Example 8 Analysis

CABLE A TESTED

		PM7	PM8	LM9	LM10	NIM1	NIM2	APM11	APM12	PM13	PM14
PM_7	Sil		*	*	*	*	*	*	*	*	*
	Nsy		*	*	*	*	*	*	*	*	*
PM_8	Sil	*		*	*	*	*	*	*	*	*
	Nsy	*		*	*	*	*	*	*	*	*
LM_9	Sil	*	*		*	*	*	*	*	*	*
	Nsy	*	*		*	*	*	*	*	*	*
LM_10	Sil	*	*	*		*	*	*	*	*	*
	Nsy	*	*	*		*	*	*	*	*	*
NIM_1	Sil	*	*	*	*		*	*	*	*	*
	Nsy	*	*	*	*		*	*	*	*	*
NIM_2	Sil	*	*	*	*	*		*	*	*	*
	Nsy	*	*	*	*	*		*	*	*	*
APM_11	Sil	*	*	*	*	*	*		*	*	*
	Nsy	*	*	*	*	*	*		*	*	*
APM_12	Sil	*	*	*	*	*	*	*		*	*
	Nsy	*	*	*	*	*	*	*		*	*
PM_13	Sil	*	*	*	*	*	*	*	*		*
	Nsy	*	*	*	*	*	*	*	*		*
PM_14	Sil	*	*	*	*	*	*	*	*	*	
	Nsy	*	*	*	*	*	*	*	*	*	

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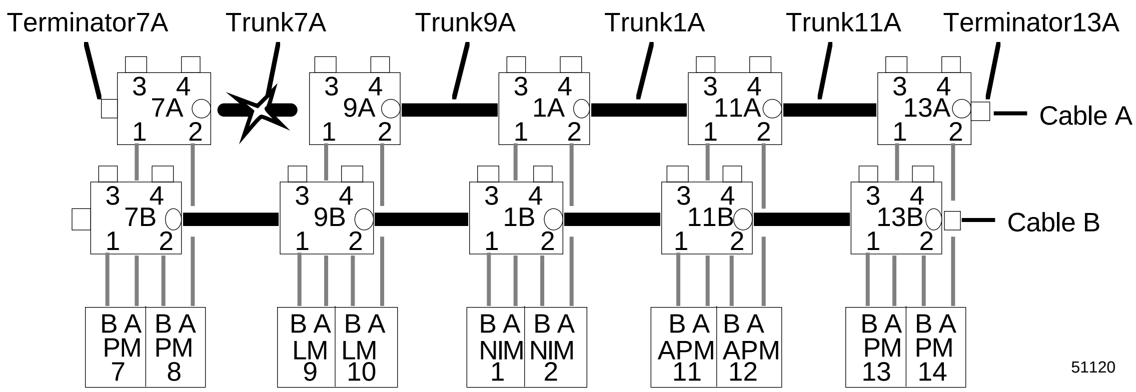
7.16 Example 9—Trunk 7A Fault

Illustration

This example may help identify a trunk fault.

Figure 7-26 Trunk 7A Fault



Problem analysis

This example shows a clear division in the silences reported from nodes on the opposite side of the break were constant. It is probably a damaged/disconnected trunk cable or a damaged tap.

Figure 7-27 Example 9 Analysis

CABLE A TESTED

		PM7	PM8	LM9	LM10	NIM1	NIM2	APM11	APM12	PM13	PM14
PM_7	Sil Nsy			*	*	*	*	*	*	*	*
PM_8	Sil Nsy			*	*	*	*	*	*	*	*
LM_9	Sil Nsy	*	*								
LM_10	Sil Nsy	*	*								
NIM_1	Sil Nsy	*	*								
NIM_2	Sil Nsy	*	*								
APM_11	Sil Nsy	*	*								
APM_12	Sil Nsy	*	*								
PM_13	Sil Nsy	*	*								
PM_14	Sil Nsy	*	*								

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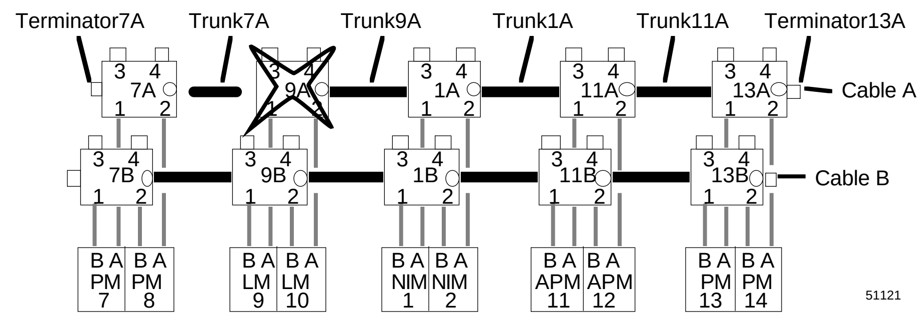
7.17 Example 10—Tap 9A Fault

Illustration

This example may help identify a tap fault.

Figure 7-28 Tap 9A Fault



Problem analysis

This example shows a clear division in:

- the noise reported from every node on each side of the break in the trunk cable
- the silences reported
  - silences from nodes on the same side of the break were intermittent
  - silences from nodes on the opposite side of the break were constant (inside the dark outline)

It is probably a damaged/disconnected trunk cable or a damaged tap.

Figure 7-29 Example 10 Analysis

CABLE________ TESTED ____________

		PM7	PM8	LM9	LM10	NIM1	NIM2	APM11	APM12	PM13	PM14
PM_7	Sil			*	*	*	*	*	*	*	*
	Nsy			*	*	*	*	*	*	*	*
PM_8	Sil			*	*	*	*	*	*	*	*
	Nsy			*	*	*	*	*	*	*	*
LM_9	Sil	*	*		*	*	*	*	*	*	*
	Nsy				*	*	*	*	*	*	*
LM_10	Sil	*	*	*		*	*	*	*	*	*
	Nsy			*		*	*	*	*	*	*
NIM_1	Sil	*	*	*	*		*	*	*	*	*
	Nsy			*	*		*	*	*	*	*
NIM_2	Sil	*	*	*	*	*		*	*	*	*
	Nsy			*	*	*		*	*	*	*
APM_11	Sil	*	*	*	*	*	*		*	*	*
	Nsy			*	*	*	*		*	*	*
APM_12	Sil	*	*	*	*	*	*	*		*	*
	Nsy			*	*	*	*	*		*	*
PM_13	Sil	*	*	*	*	*	*	*	*		*
	Nsy			*	*	*	*	*	*		*
PM_14	Sil	*	*	*	*	*	*	*	*	*	
	Nsy			*	*	*	*	*	*	*	

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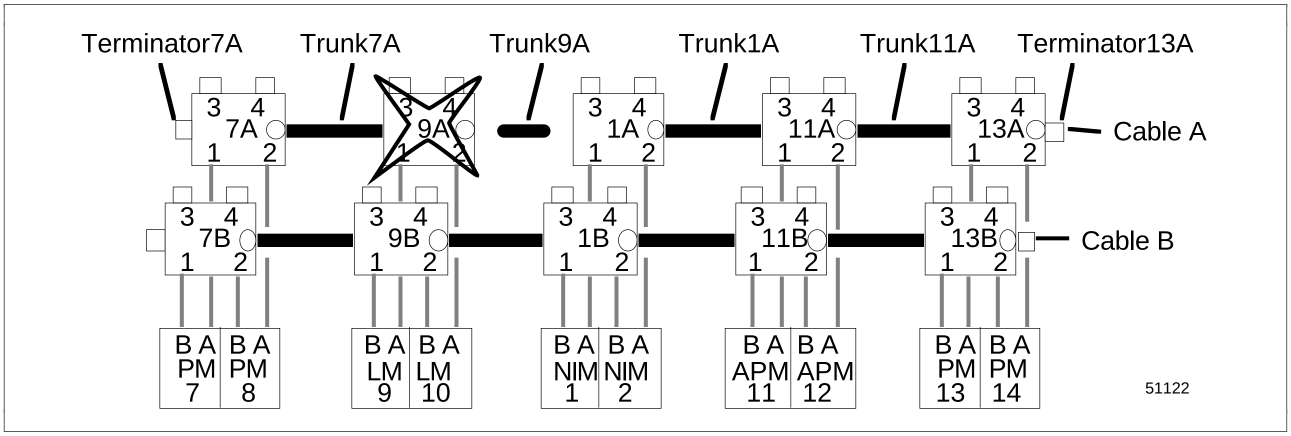
7.18 Example 11—Tap 9A Fault with Trunk 9A Isolated

Illustration

This example may help identify a tap fault.

Figure 7-30 Tap 9A Fault with Trunk 9A Isolated



Problem analysis

This analysis shows the difference after trunk 9A was isolated (trunk cable disconnected and tap terminated.)

Figure 7-31 Example 10 Analysis with Trunk 9A Isolated

CABLE A TESTED

		PM7	PM8	LM9	LM10	NIM1	NIM2	APM11	APM12	PM13	PM14
PM_7	Sil		*	*	*	*	*	*	*	*	*
	Nsy		*	*	*						
PM_8	Sil	*		*	*	*	*	*	*	*	*
	Nsy	*		*	*						
LM_9	Sil	*	*		*	*	*	*	*	*	*
	Nsy	*	*		*						
LM_10	Sil	*	*	*		*	*	*	*	*	*
	Nsy	*	*	*							
NIM_1	Sil	*	*	*	*						
	Nsy										
NIM_2	Sil	*	*	*	*						
	Nsy										
APM_11	Sil	*	*	*	*						
	Nsy										
APM_12	Sil	*	*	*	*						
	Nsy										
PM_13	Sil	*	*	*	*						
	Nsy										
PM_14	Sil	*	*	*	*						
	Nsy										

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7.19 Backup Cable Test Analysis Form

Usage

This form is provided for use in the cable fault test analysis procedure.

Cable Test Data Form

Cable ________ Tested ________

	Sil																
	Nsy																
	Sil																
	Nsy																
	Sil																
	Nsy																
	Sil																
	Nsy																
	Sil																
	Nsy																
	Sil																
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Document Number: **UN12-510**

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