Honeywell

Manage LCN Reconnect

L61525

LCN

TotalPlant

Notices and Trademarks

This module supports **TotalPlant** Solution (TPS) system network.

TPS is the evolution of TDC 3000^{X}.

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Table of Contents

Figures and Tables

Acronyms

AM..... Application Module
AXM .....Application ModuleX
CG .....Computer Gateway
CLCN A/B I/O .....CE compliant LCN interface I/O board(Five/Ten-slot)
CLCNA I/O.....CE Compliant dual node module LCN interface I/O board (Cable A)
CLCNB I/O.....CE Compliant dual node module LCN interface I/O board (Cable B)
EMI.....Electro Magnetic Interference
EPLCG.....Enhanced Progammable Logic Controller Gateway
GUS ..... Global User Station
HM .....History Module
K2LCN ..... 68020 based single board Node Processor
K4LCN ..... 68040 based single board Node Processor
LCN..... Local Control Network
LLCN..... LCN interface board
NIM .....Network Interface Module
PLCG .....Programmable Logic Controller Gateway
RFI .....Radio Frequency Interference
US..... Universal Station
UXS.....Universal StationX

References

Publication Title	Publication Number	Binder Title	Binder Number
For R500 and later:			
LCN Guidelines - Implementation, Troubleshooting, and Service	LC09-510	LCN Installation	TPS 3025

Introduction

Module Overview

About this module

This module addresses the restoration of normal communications between Local Control Network (LCN) nodes after communications have been disrupted by a failure in both of the redundant LCN cable networks. This type of failure is called a double cable fault.

Objectives

Given a segmented LCN network, with at least two Universal Stations or Global User Stations, restore communications between all LCN nodes and verify proper operation.

Terms You Should Know

Critical path

The term “critical path” is a reference to the LCN nodes and process control devices required to remain operational in order for the operator to maintain his or her view and access to the process. For example, a critical path will always include at least one Universal Station (US) or Global User Station (GUS), and a gateway device such as a Hiway Gateway (HG), Network Interface Module (NIM), or Programmable Logic Controller Gateway (PLCG).

LCN segment

When an LCN becomes separated, separate (isolated) communication networks are formed between the nodes that can still communicate with one another. This course module refers to the separated networks as LCN segments (portions) of the LCN.

Ring (or token passing ring)

The LCN data is transmitted on the cable network using a token passing communication discipline established among the LCN modules. This mechanism is also known as a logical token-passing ring.

Isolation/isolated

LCN nodes are unable to communicate with each other at the software level.

Double cable fault

A concurrent failure on both the A and B cables of the LCN. It prevents the normal software communication between some of the LCN nodes.

Manage LCN Reconnect

Normal LCN Communications

What is considered normal

All communications between LCN nodes are functioning properly without error or timeout. Two levels of communication concurrently run between nodes: the hardware level and the software level.

Hardware level

The hardware, combined with embedded firmware, is responsible for the token-passing mechanism between nodes. This token-passing mechanism serves as the traffic director for all communications between nodes. Software cannot communicate without the token-passing mechanism running.

Each node has LCN interface hardware and firmware. This consists of the LCN I/O boards and some form of LCN interface control circuits. The LLCN board performs this function in older nodes, whereas the K2LCN and K4LCN boards have this function incorporated into the node processor board. In A GUS or APP node, this performed in the LCNP (or LCNP4) board.

The redundant LCN cables (A and B) are connected to all nodes on the LCN. Clean and secure connections together with proper termination are an absolute requirement to support communications traffic.

Software level

Information is passed between nodes as dictated by system events and configuration. Several overhead messages are periodically sent to keep every node on the network aware of the status of all other nodes. Two of these messages are detailed below:

- Every 30 seconds, each node (with software loaded) sends out a Node Administrator broadcast message containing information about the transactions of this node to all other LCN nodes. This is done to keep all other nodes aware of the sending nodes' status.
- If a node is in the QUALIFIED or POWER_ON state, it sends out a firmware "I am alive" message every 30 seconds.

All nodes expect to receive either of the following every 30 seconds:

- A status message from all other running LCN nodes, or
- the "I am alive" message from nodes in the QUALIFIED or POWER_ON state.

Normal LCN Communications, Continued

Typical LCN

The following diagram illustrates a typical LCN network. A single token-passing mechanism (ring) includes all nodes. All nodes are free to communicate with one another and all nodes share the same view of the LCN.

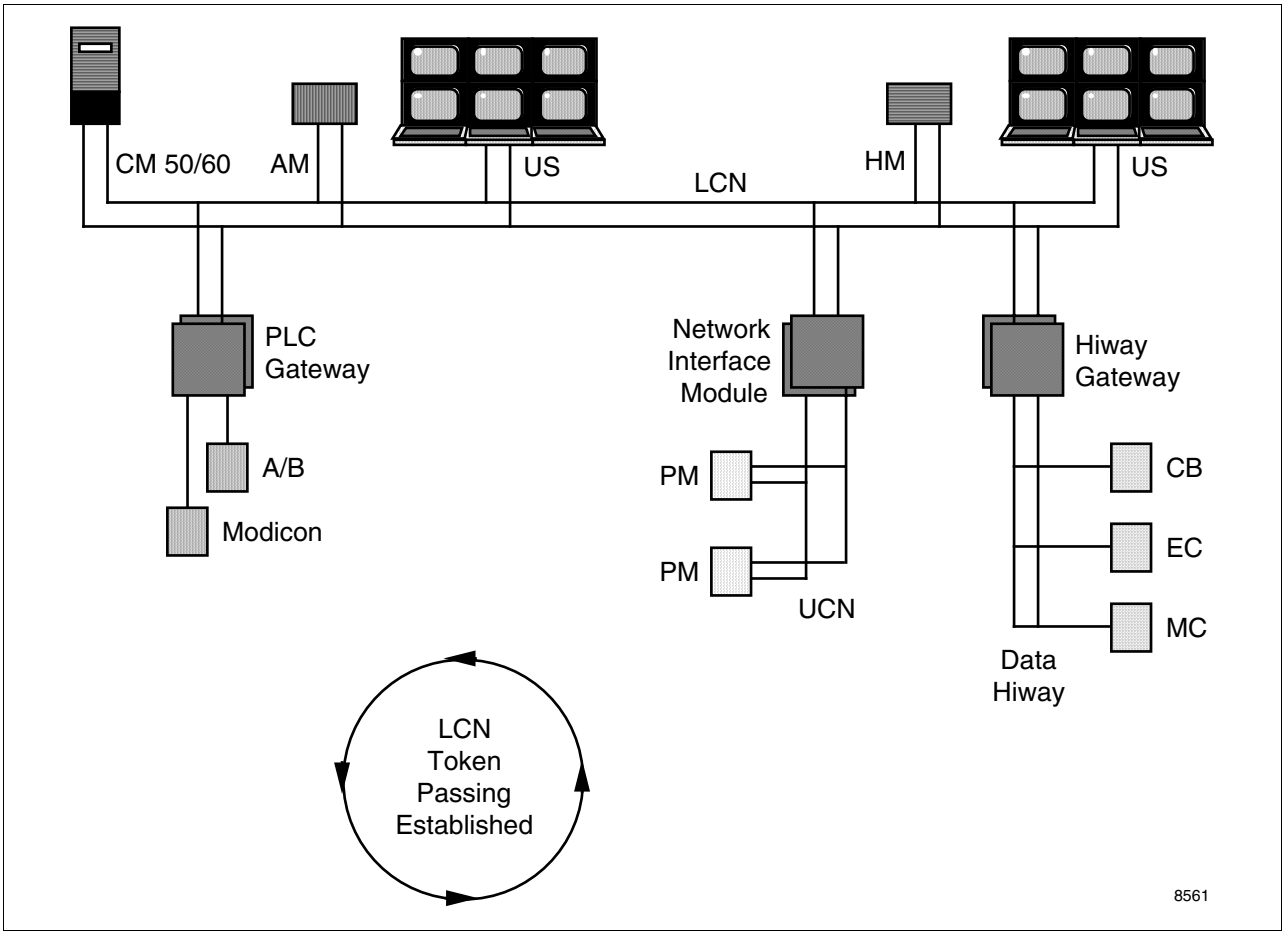


Figure 1 – Typical LCN Example (Normal Operation)

Disruptions to LCN Communications

Double cable break

The LCN is made up of a redundant set of cables between all nodes. Both of these cables are normally used alternately (cable swapping). A failure detected on a given cable results in automatic switching to the good cable and LCN internode communications continue without ill effect. Only if a failure exists on both cables will a double cable break (fault) occur.

It is highly recommended that cable problems be corrected when they are discovered. A single LCN cable problem can be repaired concurrently with normal system operation. A simple single LCN cable problem in the system can easily turn into a double cable fault, with possible loss of view to the process, if something should happen to the remaining good cable.

Disruptions to LCN Communications, Continued

Cable failures

LCN cable failures are most frequently caused by

Cable damage—physical damage to the LCN cable can cause a range of failures from a slight impedance mismatch (damage to the insulation and shield proximity) to complete disconnection if the center element of the cable is cut.

This is the most catastrophic because it occurs without warning such as when forklift movement (or similar activity) severs an LCN cable.

Improper Cable connections—Each connection on the LCN cable run (including tees) must be secure and clean. Improper connections cause an impedance mismatch, which in turn causes signal reflections (standing waves). It also causes signal attenuation (reduced strength) that may affect each node's ability to receive. Open connections completely sever the LCN network. This can occur while adding a node when improper procedures are used, which results in breaking both LCN cables at the same time.

A cable connection failure is most frequently intermittent, especially if connections become corroded. The severity of the problem at any given node depends on the amount of impedance mismatch and footage of cable between it and all of the other nodes.

Improper Cable termination—LCN cables A and B both have their own separate network. Improper or no termination at either end (or both ends) of an LCN cable network causes reflections (standing waves) that interfere with a node's reception of normal messages. This may cause so much interference that none of the nodes can communicate with any of the remaining nodes.

The severity of the problem at any given node depends on the footage of cable between it and all of the other nodes. This problem is generally seen as a solid failure by some nodes and intermittent by others.

Improper Cable Shield Grounding—Failure to provide the single point ground to the LCN cable shield or broken shield continuity along the cable is most frequently the cause.

RFI/EMI interference—Signal interference from a radiating source outside of the system can cause severe to total failure of communications on an LCN cable if the level is high enough. This is most frequently caused by routing the LCN cable near a known source of interference. It can also occur when a source of interference is moved into the proximity of the LCN cable.

Power Failures—Power loss of A/B LCNEs.

LCN Segmentation

Hardware aspects of LCN segmentation

LCN segmentation can occur due to physically severing both LCN cables. This kind of double cable failure results in breaking the LCN into two or more separate LCN segments (or portions). See Figure 2.

This leaves two or more segments (portions) of the original LCN. In each of these segments the two LCN cables have one end (at the break) unterminated. Even with improperly terminated cables, some of the nodes in each segment may still be able to communicate and the hardware portion of the nodes will form their own independent token-passing ring on both sides of the break.

The Universal Stations at the right may still have view to the process connected through the Process Manager and Hiway devices.

The first step in approaching a problem like this is to locate and disconnect both ends of the damaged cable and properly terminate the two segments as soon as possible. See Figure 3. This must be done to stabilize communications on the individual LCN segments. Once the terminations are in place, and if view to the process still exists from some Universal Station on one of the segments, the process can be viewed/controlled while the cable repair/replacement is under way.

If total view was lost because of severe communication problems while the LCNs were improperly terminated, a limited reconnect activity can be performed to restore communications and view from a partial LCN. The repair/replacement of the bad cables and reconnection of the remaining nodes can be accomplished later.

Hardware aspects of LCN segmentation,
continued

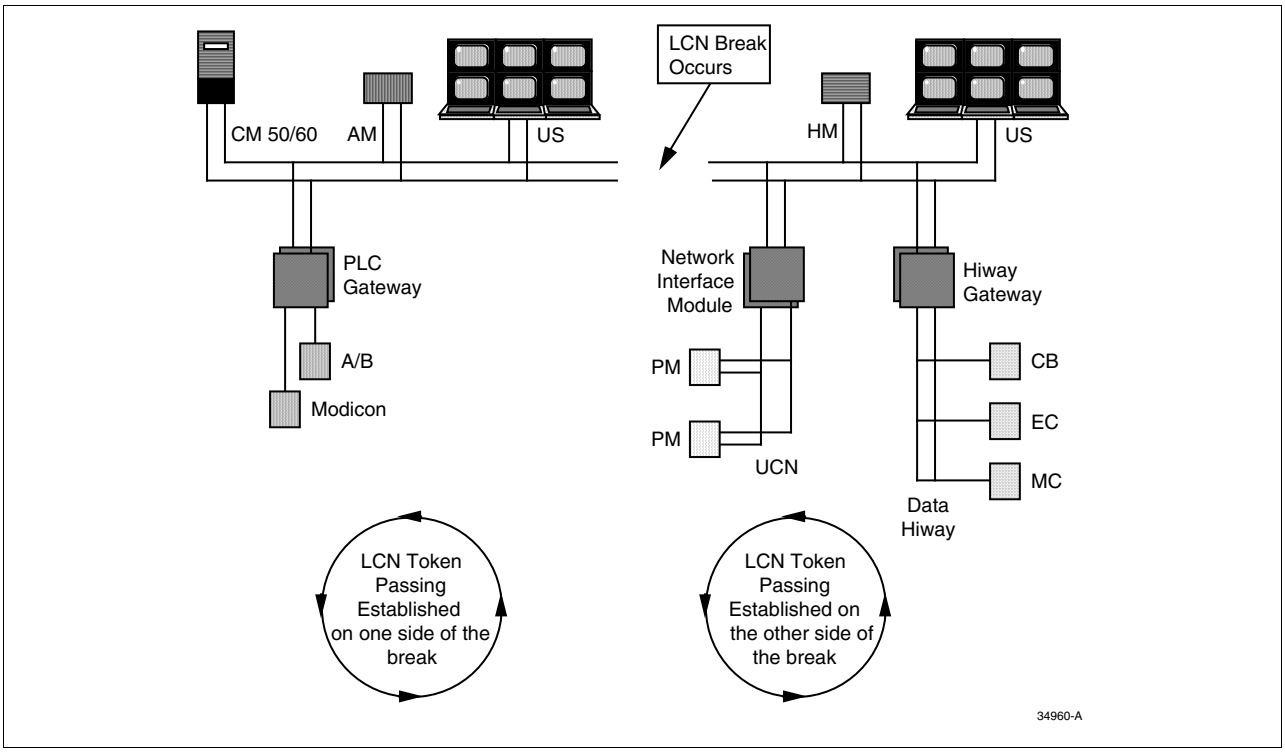


Figure 2 - LCN Double Cable Break

Hardware aspects of LCN segmentation, continued

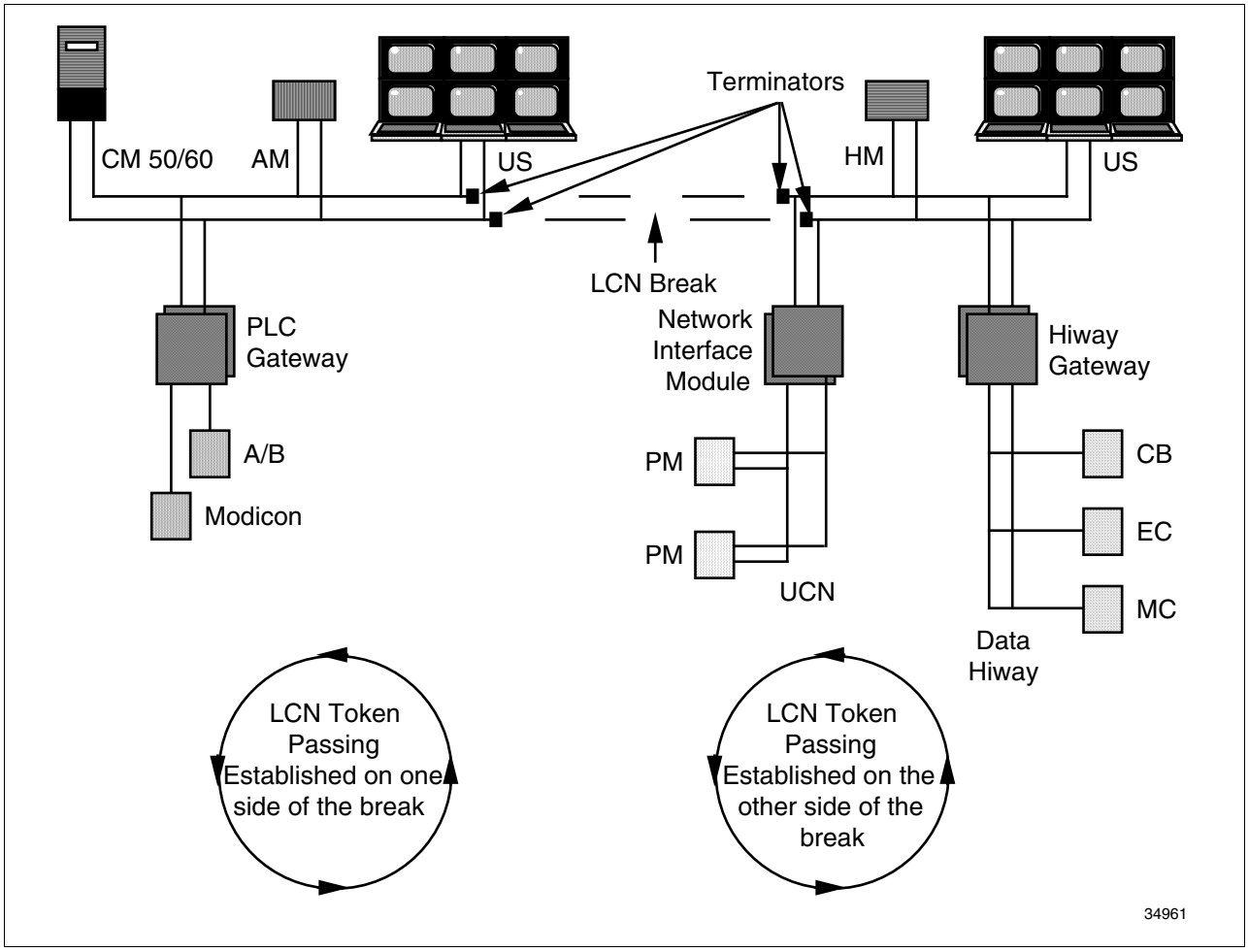


Figure 3 - Double Cable Break (With Cable Termination at the Break)

Other Hardware aspects of LCN segmentation

LCN segmentation can occur due to the presence of other kinds of electrical problems on the LCN even while both cables are physically intact. Poor termination, bad tees or cables, improper grounding, RFI and EMI interference can possibly interrupt communications on both cables, resulting in effective, if not physical, segmentation.

These kinds of problems may or may not result in multiple token passing rings; however, all hardware problems can possibly result in interruptions of communications at the software level even while the token ring may be intact.

LCN Segmentation, Continued

Software aspects of LCN segmentation

Each node expects to receive a status message from every other existing LCN node that is running (Node Administrator broadcast message), or in the power-on state (“I am alive” message), every 30 seconds.

If LCN communications are disrupted on both cables for any reason,

- Each node waits some period of time (two or three minutes, depending on the number of nodes involved) for the status messages from the nodes with whom communications are disrupted.
- After this period of time passes, each node declares other nodes with whom they cannot communicate as ISOLATED. Once a non-communicating node is declared ISOLATED by a node, operator intervention is required to reestablish communications with the isolated node.

Isolated Nodes

An isolated view of another node means that this node is unable to continue communicating with that specific node at the software level. This can be brought about by an excessive error rate between the nodes (on both cables) or total disconnection as shown in the previous illustrations. This will remain even if the double break cable problem is repaired. Once software has declared a node isolated, manual intervention is needed to restore communications with those nodes.

When nodes are isolated from each other, separate logical LCNs have been created. These logical LCNs may or may not include all of the nodes on the current token-passing ring that is running at the hardware level.

Nodes ignore messages from nodes they view as isolated except for the POWER_ON and QUALIFIED status messages. Once the cable problems have been resolved, nodes ignore most messages that come from nodes that are seen as isolated. The exceptions to this are diagnostic frames from other LCN nodes, such as messages containing the SHUTDOWN and LOAD commands.

The reason for node isolation is to ensure that the high level of data integrity between nodes is not compromised when communication is lost. It also avoids any overhead associated with communication retries on messages.

Impact on the process

View down the critical path (to the process) may or may not be lost when LCN segmentation occurs because of a double cable fault. It depends on where the break occurs as well and other factors. The question that must be uppermost in your mind is ”does view to the process still exist?” If so, from which Station is the view the best?

See Figure 4. The break is conveniently located between the two clusters of Universal Stations. In this case, the process connected to the Process Manager and Hiway devices may still have view (and control) available from the cluster of stations at the right.

Only the user (relying on the knowledge of their process) will know which view is best.

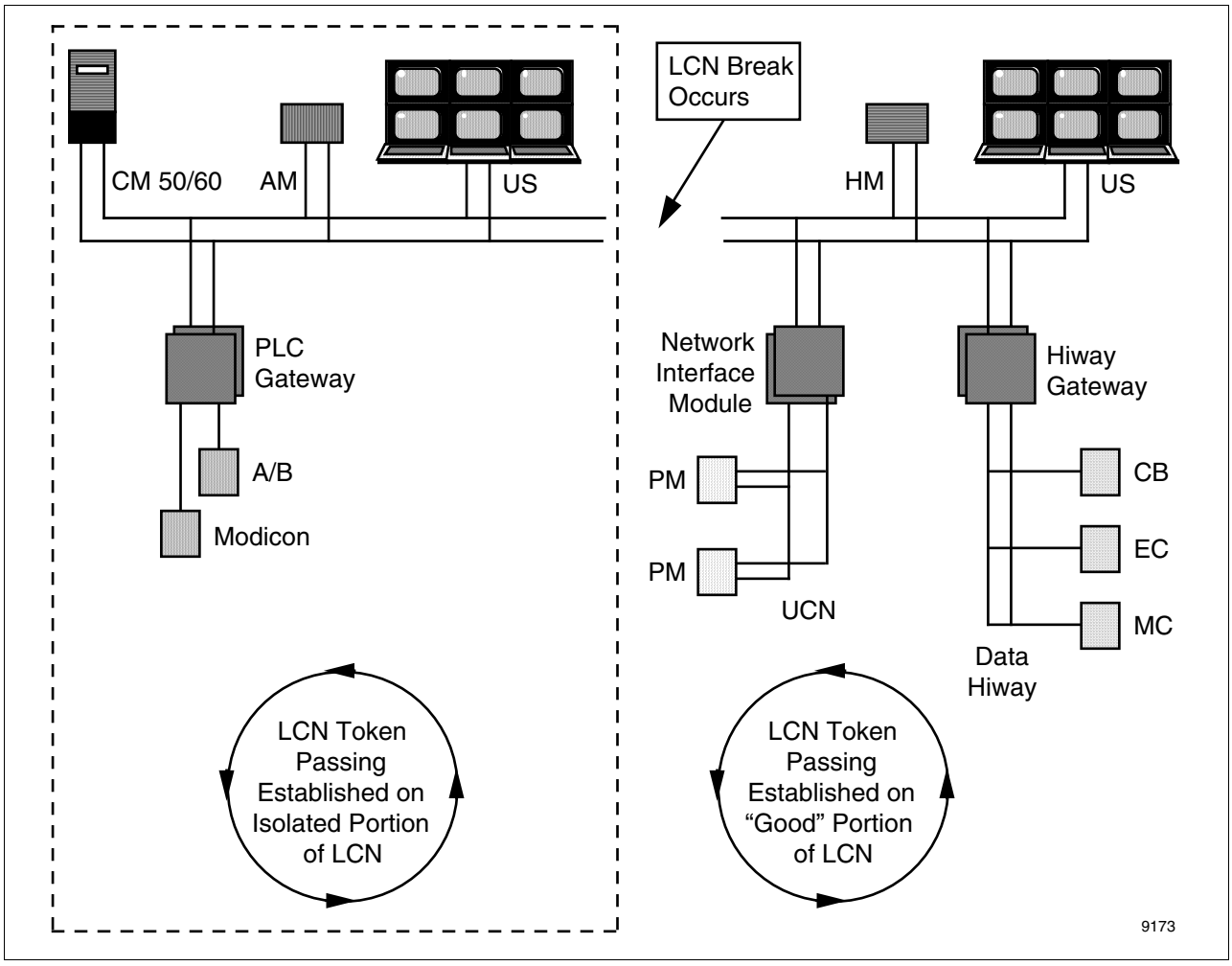


Figure 4 - Double Cable Break (View to the Process)

Best view of the process

Some considerations for judging the "best view" include

- The critical paths to the process. You never want to lose view to the process.
- The location of redundant gateways. One of the gateways may be isolated because of different views of the LCN. With proper handling of redundant gateways during the reconnect process, you may not need to lose view. Appendix C describes the procedure for reloading redundant gateways during a reconnect procedure.
- The location of the system HM. Access to the HM is needed when isolated nodes are reloaded. It is easiest if the HM node already shares the same view of the LCN as the Station from which you direct the reconnect activities.
- The location of a US/GUS with removable media. You may want to use removable media to reload some nodes if the HM is not available because cable repairs cannot be made immediately.
- The portion with the fewest number of nodes to reload.

LCN Overview Display

Description

There is a separate LCN Overview display for every node. This display shows that node's view of the LCN. See Figure 5.

Display access

You must first determine which node's view you want to see by selecting the appropriate LCN node on the System Status display. The view is then displayed by selecting the the LCN OVERVIEW target at the bottom of the system status display.

Note: This view is available from both the Standard and Custom System Status displays.

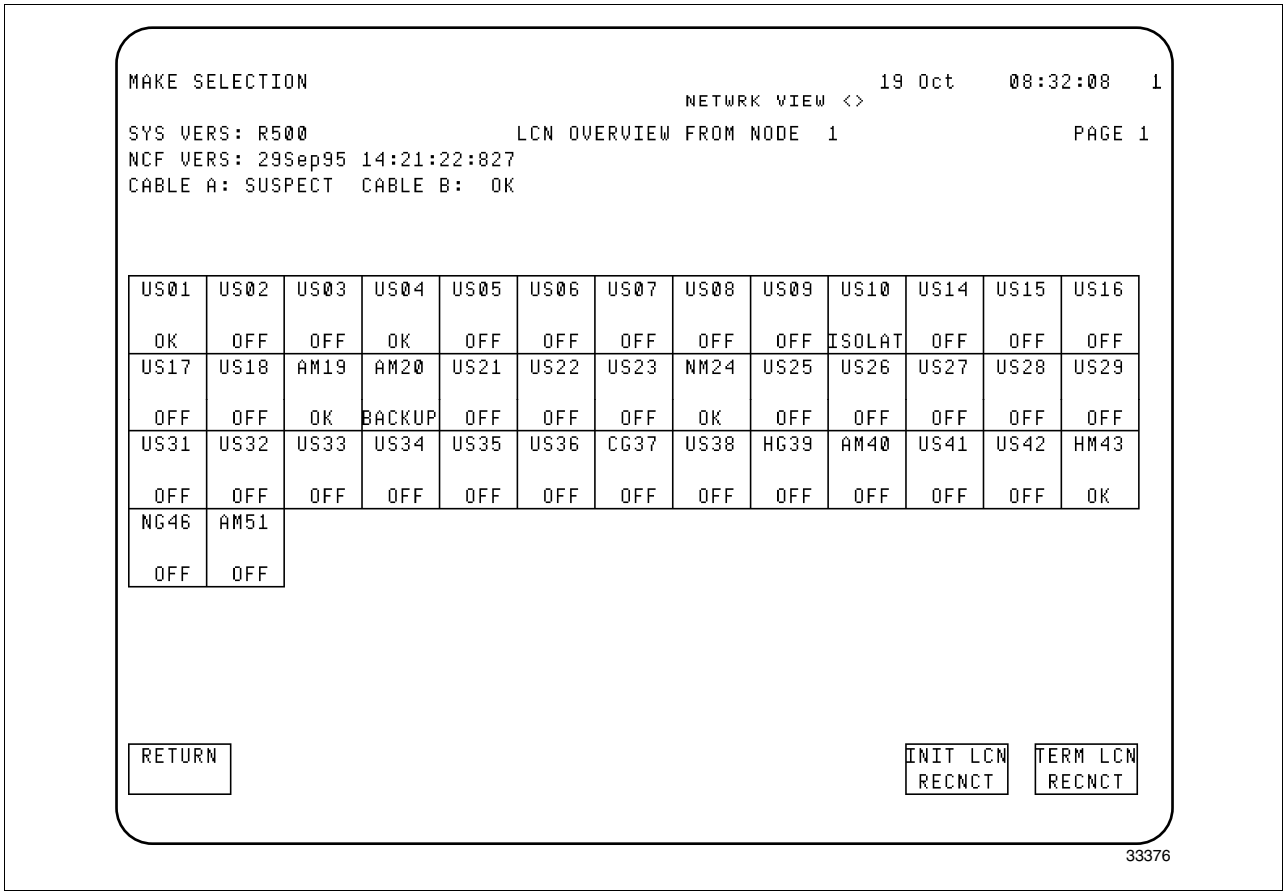


Figure 5 - LCN Overview display (View From Node 1)

NETWRK VIEW Message

Notice the “NETWRK VIEW <>“ message to the left of the date at the top right. This message appears red if there are different node views of the LCN in existence.

Interpretation

If LCN communications are disrupted (double cable fault), it is possible to tell which nodes are still communicating with each other and which ones have become isolated from the others by looking at several LCN Overview displays from different Stations along the network. Notice the isolated node US10.

This display from various Stations along the LCN, together with an accurate topology map of your LCN, may help you determine the physical location of the hardware problem. It is highly recommended that an up-to-date topology map of your system be maintained and within reach at all times. This topology information can/should be included in the Custom System Status display of your specific system.

Reconnect Targets

Notice the two targets at the lower right. These targets will appear only if the node view displayed is that of the Station from which the display is called up.

The INIT LCN RECNCT target is used to initiate the procedure required to get all isolated nodes back in communication with each other once the physical problem has been repaired.

The TERM LCN RECNCT target terminates the procedure once all isolated nodes have been shut down and reloaded.

Node's View of the Network

Definition

A node "sees" other nodes on the network as being in a state, such as OK, ISOLATED, or FAILED. This determines a particular node's "view" of the network. If all running nodes have the same Node Administrator database information, they all have the same view of the network. If some nodes have different Node Administrator database information (because of missed broadcast messages), they will have a different view of the network from the rest of the nodes that are in synch.

When initiating a LCN RECONNECT activity from a Station (the one with the best view to the process), nodes having a different view of the LCN (than the initiating Station), will end up isolated. Some of these nodes may not show as isolated before initiating the reconnect activity.

Conceptual Diagram

Refer to Figure 6:

- Nodes A, B, C, and D represent one portion of the LCN.
- Likewise, Nodes E, F, G, and H represent the other portion of the LCN.
- Because Nodes H and D can communicate with each other, they do not have the same view of the network as the nodes on their respective portion.
- Node D would become isolated after initiating a reconnect procedure from either Node A, B, or C.
- Node H would become isolated after initiating a reconnect procedure from either Node E, F, or G.

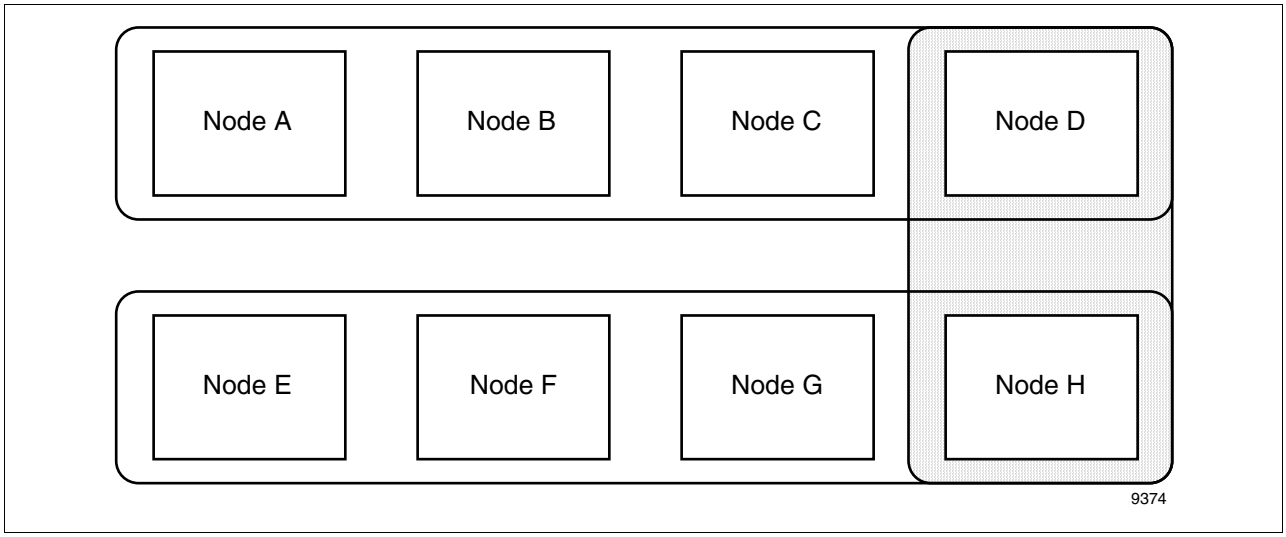


Figure 6 - Multiple LCN Views

Procedure

The following procedure describes how to locate which nodes will go isolated during an LCN Reconnect.

Table 1 – Locating Nodes That Will Do Isolated During Reconnect

Step	Action
1	Go to the US/GUS you have determined to have the best view to the process and call up the System Status display.
2	Select the node number of your “best view “ US/GUS.
3	Select the LCN OVERVIEW target at the bottom of the display. • Any nodes with which your Station is currently capable of communicating show a Status of OK. • Nodes that are isolated appear as ISOLATED. • Nodes that are in the Power ON state appear as POWER_ON or QUALIFIED.
4	Select the INIT RECNCT target. **DO NOT PRESS THE [ENTER] KEY!** **Wait for 2-3 minutes to allow the system to stabilize (all nodes to react).** The OK nodes that turn red have a different view of the LCN even though you are currently capable of communicating with them. They will go isolated if you continue with the reconnect activity. This may lead you to change your mind about the US/GUS with the best view. You can do that at this point by selecting the RETURN target and the reconnect activity is never initiated.
5	If you want to continue with the reconnect activity, in which all isolated (including newly isolated) nodes must be reloaded, press [ENTER]. This places you in manual control of the node loading process.

The LCN Reconnect Activity

Overview

What must be done to get everything back to normal after the LCN became segmented because of a hardware problem?

First, the physical problem must be repaired. The repair activity restores the two segments of the LCN into a common network. A single token passing ring is reestablished by the hardware communications in all of the nodes.

Second, restablish communications between nodes at the software level. Even though the physical problems have been repaired and a single token ring exists, the nodes are still isolated (See Figure 7). To do this, you must initiate an LCN reconnect procedure from the LCN overview display of the Station with the best view of the process, and shut down and reload all isolated nodes.

Third, after all isolated nodes have been shut down and reloaded, terminate the reconnect procedure from any Station's LCN overview display.

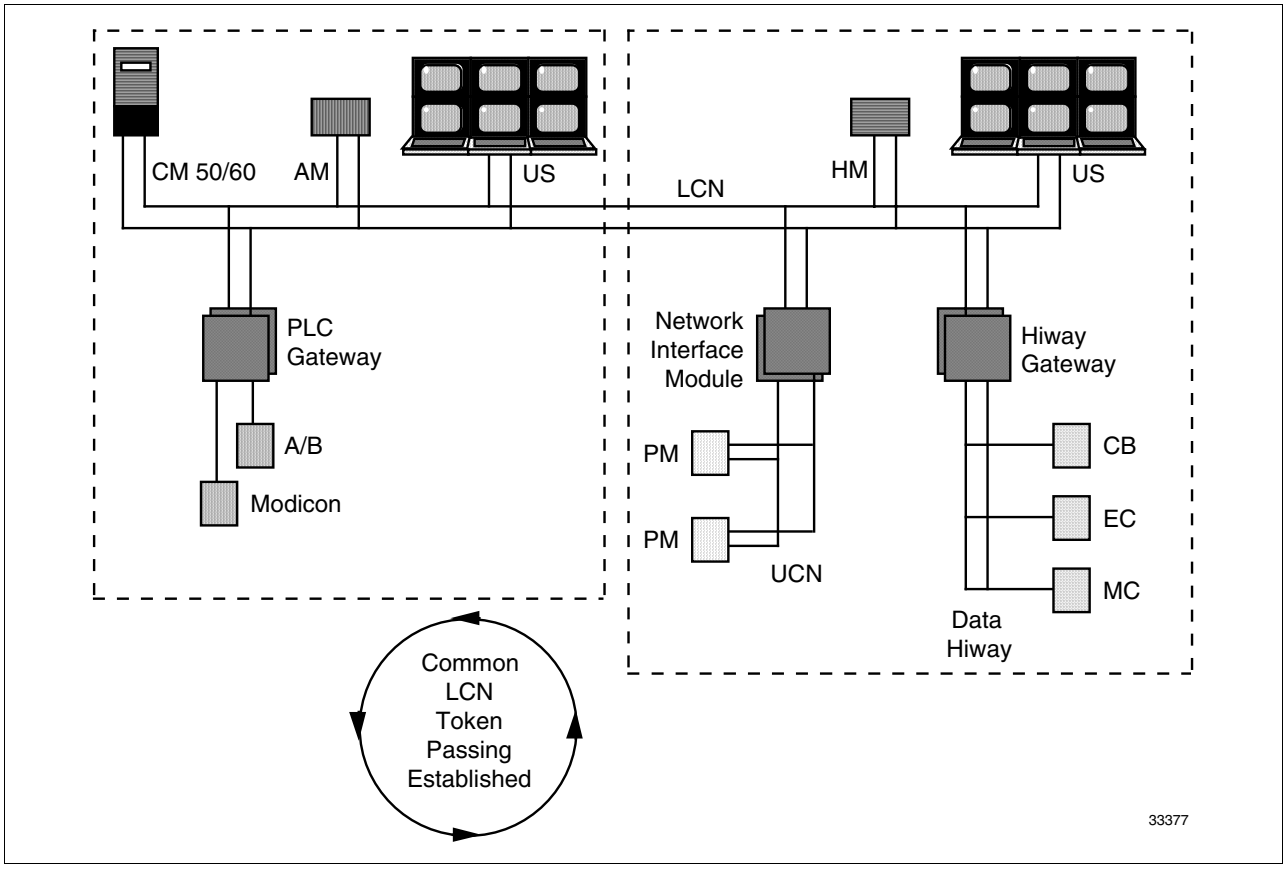


Figure 7 - LCN Cables Repaired/Software Still Isolated

NETVERS Parameter

Description

All LCN nodes contain the “network version” on which the system is operating in their PSDP parameter NETVERS. For example, a node loaded with R600 software contains the integer “600” in the NETVERS parameter.

When LCN Reconnect is initiated by the user by selecting the INIT RECONNECT target on LCN Overview display, the NETVERS parameter is changed to -1 (minus one) in all nodes that have the same view of the network as the initiating node. This is a way the user can designate the "good" Node Administrator database.

When the LCN Reconnect is terminated, the NETVERS parameter is changed back to the software release.

Viewing NETVERS

The value of the NETVERS parameter is displayed in the SYSTEM VERS field of the LCN Overview display.

You can call the NETVERS integer value into a schematic by using this format:

```
$PRSTS40.NETVERS
```

NETVERS and LCN reconnect

Table 2 summarizes how the NETVERS parameter is affected by LCN Reconnect.

Table 2 – NETVERS Parameter During LCN Reconnect

Parameter Value	Description
NETVERS = -1	All nodes with NETVERS = -1 • Have the ability to communicate with each other while an LCN reconnect is in progress. • Have the same view of the network as the initiating node. • Indicate INIT LCN RECONNECT in the SYSTEM VERS field on LCN Overview display.
NETVERS = nnn where nnn = software release number	All Nodes NETVERS = nnn • Are isolated nodes (do not have the same view of the network as the initiating node). • Indicate nnn in the SYSTEM VERS field on LCN Overview display.

NETVERS and node loading

When a node is loaded, it imports a Node Administrator view from a running node so it can find the HMs. It requests this view from nodes as follows:

1. Requests a view from nodes with addresses 1 - 10 with NETVERS = -1.

2. If there is no response, it queries nodes with addresses 11 - 20 with NETVERS = -1; and so on.

3. If there is no response, it starts over with addresses 1 - 10. It will import a Node Administrator view from whichever node responds first.

ATTENTION

ATTENTION—If no node has NETVERS = -1, node loading may not import a "good" view of the network.

For this reason, it is necessary that an LCN Reconnection be initiated from the LCN Overview display in order to designate a "good" view to be imported when loading nodes from the "bad" side to the "good" side.

Failure to Terminate

If Reconnect does not terminate, all node's NETVERS parameter remains at -1. Everything will work properly until you are faced with another series of isolations.

If nodes go isolated at some time in the future you will then not be able to designate a "good" Node Administrator database because all nodes' NETVERS parameter will have the value of -1.

In this case, all nodes would have to be shut down at the same time and then reloaded to ensure that they came up with the proper view.

LCN Reconnect Job Aid

Introduction

The following Job Aid is provided to assist you if you should find the need to approach a system that has just encountered a double LCN cable fault. It is designed to guide you through the different stages of locating the problem, repairing the hardware, and then restoring the LCN nodes to a common view (normal) of the LCN.

Reconnect assistance

Table 3 – Job Aide for Performing LCN Reconnect

Step	Action
1	**Locate the "break."** This may require the use of several of the standard LCN displays on multiple Stations along the LCN. The displays used are • LCN Overview • System Status • LCN cable diagnostics • Clock Status • System Error logs
2	**Terminate the separated portions.** If the break is a physical break and it is desired to temporarily operate with separated LCNs, each portion must be terminated at the point of disconnection; otherwise, communication errors may prevent operation.
3	**Determine if the Critical Path is lost.** The critical path is the combination of working elements required to provide an operator with a view of the process so that control can be maintained. It includes, as a minimum, a US/GUS, a Gateway (NIM or HG), and a process control device (PM, MC, etc.). All devices must be functional and able to communicate through a segment of the LCN.
4	**Determine the portion of the LCN to be used as the "good portion."** If a US/GUS is capable of viewing the critical path after the disruption occurs, its view of the LCN should be considered the "good portion" of the LCN from which to initiate the LCN-Reconnect procedure. If the critical path is not lost, determine which portion of the LCN represents the "best" portion to restore complete LCN operations. If there are redundant gateways on the system, it is possible to bring one over to the "good" portion while the other one remains on the "bad" portion of the LCN. In this way, it may be possible to never lose view. The procedures are outlined in Appendix C of this training module.
5	**Repair the "break."** Verify that the LCN Extenders (if used) and the LCN cables are operating properly. If you proceed with the LCN reconnection with the break still present, you may not be able to back out of the reconnection process.

Reconnect assistance, continued

Initiate the LCN RECONNECT:	
Step	**Action**
6	From the System Status display of a US/GUS on the "good" portion of the LCN, call up the LCN Overview display with its own node selected. The [LCN OVERVIEW] target is used to call this display. RESULT: LCN Overview display appears, showing the view of the LCN from this US/GUS. ATTENTION: You must use the LCN Overview display that provides the LCN view of the US/GUS from which you direct the reconnect activity (not the view from some other node).
7	Select the [INIT LCN RECONNECT] target. RESULT: It is possible that some additional nodes will be highlighted in half-intensity red color, indicating that they do not have the same view of the LCN as the initiating node (they have a different Node Administrator database). NOTE: The red node(s) will become isolated after you press [ENTER] in step 8 to invoke the INIT LCN RECONNECT command. You can back out at this point and reconsider selecting another Station with a better view. Do not press [ENTER] if you want to try to find a Station with a better view. Then restart with step 6.
8	Press the [ENTER] key. RESULT: a. The SYSTEM VERS field in the upper-left corner indicates INIT LCN RECONNECT (the NETVERS parameter changes from the software release number to -1). b. Nodes that have a different view of the LCN than the initiating US/GUS appear as ISOLATED from the initiating US/GUS. c. LCN Reconnect begins.
Verify/Establish access to the system HM	
9	Is access to the HM containing system files possible or is it isolated? If it is isolated, continue with step 10. below. If it is accessible (has same LCN view as the Station from which you are directing the reconnect), skip forward to step 13.
10	Select the System HM node on the System Status display.

Reconnect assistance, continued

Step	Action
11	Select the SHUT DOWN target at the bottom of the System Status display. The HM status goes from ISOLATED to FAIL as the shutdown command is received. Continue watching the HM status. **If the HM status changes to LOC_LOAD within a minute**, the HM autoboot feature was enabled and the HM is performing an autoboot. All you have to do in this case is wait for it to go through the LOC_LOAD and READY states, and finally reach the OK state. Node loading can start when the HM reaches the READY. **If the HM status remains FAIL for more than one minute**, the HM autoboot feature was not enabled and you then must do the following: a. Locate the HM node hardware. b. Turn OFF the the HM node power supply. (**Do not press the node reset button to prevent computing files.**) c. Wait 10 seconds. d. Turn ON the HM node power supply and watch the HM status as it goes through the LOC_LOAD and READY states, and finally reaches the OK state. Node loading can start when the HM reaches the READY state.
12	The HM is now ready to support isolated node reloading. Continue with step 13.
Restore critical paths if necessary and other LCN nodes:	
13	If the critical paths to the process are not part of the "good" LCN portion, shut down and reload the gateways that are critical for resuming view. ATTENTION: Appendix C in this course module provides detailed instructions for reloading isolated redundant nodes in such a manner that complete loss of view does not occur during the reconnect process. This assumes that view to the process currently exists from a US/GUS on the isolated LCN segment.
14	After view to the process is restored, shut down and/or reload any remaining nodes that are seen as isolated or failed. Note: In the case of an A^XM, U^XS, GUS, or APP node, only the LCN node processor needs to be reloaded. The NT (or UNIX) coprocessor can remain functional. RESULT: The remaining nodes are transferred from segmented communicating node clusters on the LCN to fully communicating nodes in the LCN node cluster in which the initiating US/GUS resides. Once all of the nodes have been reloaded, all nodes again see the complete LCN as a common view.
Verify Node Operation:	
15	Check the LCN Overview display carefully. There should be no more isolated nodes remaining.

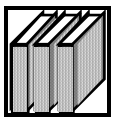
Reconnect assistance, continued

Step	Action
16	From the LCN Overview display, select the TERM LCN RECONNECT target. RESULT: All nodes now indicate the software release number in the SYSTEM VERS field of the LCN Overview display (the NETVERS parameter changes from -1 to the software release number). Example: R6XX. If, for some reason, a node remains with a different view of the LCN, this node will again be seen as isolated by the other nodes. This could happen if you forgot to reload a node or if the message to terminate reconnect was not received by the node (most usually caused by detecting an error while receiving the message.

Additional Information

ATTENTION

ATTENTION—Appendix C provides a detailed procedure for reloading isolated redundant nodes.



REFERENCE—The following manual provides additional information about LCN reconnect activities, including the following:

- The software volumes that are necessary to reload a node.
- How to determine whether a node is off or failed.
- How to use the Software Upgrade target .
- How to add a node to the LCN.

LCN Guidelines - Implementation, Troubleshooting, and Service
LC09-510
Sections 6.2, 6.3, 6.7-6.9
Binder TPS 3025

Lab Exercise

Introduction

Overview

The purpose of the following lab exercise is to familiarize you with LCN reconnect procedures. These procedures are used to reconnect an LCN that has experienced a double cable break.

The lab equipment you will be using consists of two minisystems (three nodes each) connected together into a 6-node system through the use of a LCN Fiber Optic Extender option.

The LCN double cable failure is simulated by turning off the Fiber Optic connection that splits the system. The Software forms two independent networks and isolates the nodes that cannot communicate.

Time to complete

This lab exercise is expected to take approximately 50-60 minutes.

Software restriction

The LCN software revision must be at R500 or later.

ATTENTION

ATTENTION—You will be expected to reserve time on the lab equipment that is used for this course module. Discuss your anticipated schedule for this with your course manager and reserve the equipment pointed out to you. Your course manager will also assist with negotiating for equipment time if schedule conflicts occur.

ATTENTION

ATTENTION—This lab will require the approval of your course manager before proceeding, to preserve the integrity of the Training Lab System and to prevent possible interruptions to one of your fellow students. You will be expected to get your course manager's initials (signifying permission was obtained to use the equipment) as the first step of your lab exercise.

Orientation on Lab Equipment

Overview

The following steps are intended to give you an orientation regarding the different LCN nodes that make up the total LCN. You will become aware of their location, and interconnection.

Obtain your course managers initials

Please have your course manager initial here. _____
These initials indicate that you can use the equipment without causing problems/interruptions for someone else currently working on a portion of the system.

Minimum Hardware

The following minimum hardware configuration on the LCN is needed to complete the lab exercise:

- At least six LCN nodes loaded and operational.
- At least two of the six nodes must be Universal Stations or Global User Stations. It does not matter what personality is loaded into the US/GUS, but the preferred personality is universal.

The student will benefit more from this lab exercise if a US/GUS becomes isolated on each separate LCN segment. This way you will be able to see the effects of isolation from both views of the LCN after the simulated cable break is inserted.

Locate nodes

Locate the individual LCN nodes on both minisystems that are tied together through the LCN Expander option (fiber optic link between LCN segments). Both LCNs should be working as a single LCN as you start this lab exercise.

If you have questions about the organization of the equipment, discuss them with your course manager.

Locate switches

Locate the LCNE “RESET/RUN” switches that control the functionality of the Fiber Optic Extender Option (Link between LCN segments). They are located on the LCNE I/O boards on back of a node in each of the “3-node” minisystems. Fiber optic cables run between these LCNE I/O boards. If you have not completed the course module for the LCN Extender option (L5291), you may need some assistance from your course manager in locating the switches.

Verify system operation

Verify that the LCN system is operational from both US/GUSs. Call up the LCN System Status display at each US/GUS. Select the LCN OVERVIEW target to call up the LCN Overview display at each US and verify that the nodes are operational.

Both US/GUSs should have a status of UNVL (preferred but not required). If you cannot get them to a good status, ask your course manger for assistance.

LCN communications display

The following lab activities are easier to understand if the "Show LCN Communications" feature is enabled. The following steps enable this feature.

1. Press the System Status key on the operator keyboard.
2. Select the SELECT AUX INFO target at the bottom of the display.
3. Select the SHOW LCN COMM target at the bottom of the display. Notice the center line of all the node boxes on the display. If LCN communications with that node are working properly, OK appears. A "suspect" status is shown if LCN communications are not working properly.
4. Select the SINGLE NODE OPS at the bottom of the display to return to the normal System Status display.

Leave the "Show LCN Communications" feature enabled as you perform the following lab exercises.

Failure Insertion and Analysis

ATTENTION

ATTENTION—In the next step, you will introduce a double LCN cable break by disabling the LCN Expander option. This is done by placing the RESET/RUN switches to RESET for both A and B cables. The switches are located on the LCNE I/O card (on rear of chassis). Both ends of the LCN Extender option (connected between LCN segments) have an LCNE I/O card. Placing the RESET/RUN switches in the RESET position at either end will disable the fiber optic link.

Introduce simulated double cable break

Now place the RESET/RUN switches to RESET for both A and B cables (two switches) on the LCNE I/O paddle board. NOTE THE TIME:

_____

Verify double cable break occurs

Call up the LCN Overview display again and verify that the simulated break will cause those nodes on the opposite side of the break to be isolated. The nodes on each segment (portion) of the LCN will declare the other nodes as isolated after approximately two to three minutes.

If the isolation does not appear, ask your course manager for assistance.

Verify nodes on separated segments

Verify that each LCN segment has at least three nodes. One of these must be a Station to allow examination of the LCN Overview display on each LCN segment. The status must be other than isolated (OK, or INIT). List below the Station node numbers from which you are watching the LCN Overview display (in both LCN segments). Also list the node numbers of the other nodes that are currently communicating with these Stations.

Segment: _____

Segment: _____

Correct the cable break

Now place the RESET/RUN switches on the LCNE I/O board to the RUN position for both A and B cables. Make sure the switches are in the run position at both ends of the fiber optic link.

This will join the LCN into one segment and token passing will join into one orderly token ring, but the node software will continue to see the previously isolated nodes as **ISOLATED**. The LCN communications will be **OK** because the break has been repaired. Verify this from your LCN Overview displays.

Determine which LCN cluster of nodes is the good cluster

From the LCN Overview display at each US/GUS, determine which cluster of communicating nodes represents the "good" portion or best portion to keep on line. Use this US/GUS to initiate the LCN reconnect.

Depending on the lab equipment you are using, in most cases it will be the LCN portion with the most nodes online. The good portion is normally determined by finding the best view to the process. This lab equipment setup may not have a process controlling device connected to the LCN.

(If a system HM is on one of the segments, select the other segment as the good side to observe that the HM will autoboot to the good side during the reconnect process)

Reconnect LCN Activity

Initiate reconnect activity

From the System Status display at a US/GUS that you determined to be on the good portion, select the Station itself and then select the LCN OVERVIEW target. The LCN Overview display appears.

Select the INIT LCN RCNCT target at the bottom right of the display. A message indicating that this function is keylocked may appear. The keyed permission to perform a LCN reconnect is software configured in the Network Configuration File (NCF). The permission to do this is configured as SUPERVISOR in the training lab systems. Turn the key to the Supervisor position.

What does the red warning message state? Write your answer below.

_____

This warning message indicates that any nodes backlit in red will be in the isolated state after you press [ENTER]. Some nodes could currently be shown as not isolated but backlit. (There should not be any other additional nodes going to an isolated state in this lab exercise.) Press [ENTER].

Notice in the upper-left of the screen that the system version has changed to INIT LCN RECONNECT.

Reload isolate nodes

Shut down and reload each node one at a time, loading the US/GUS **last** so that you can view the selected node on the bad side going from ISOLATED to FAIL, QUALIF, or PWR_ON and finally to OFF. On the good side the final state will be OK. Normally multiple node reloading is done using the LOAD ISOL and LOAD SELECT targets.

WARNING The use of the LOAD ISOL target is not recommended if Redundant nodes such as NIM and HG pairs are isolated but still providing view from the isolated segment. Loss of view can result. Manual procedures involving the use of the SOFTWARE UPGRADE target are provided in Apendix C. The LOAD ISOL target can be used to finish the reconnect after the redundant NIMs and HGs are resolved

NOTE: Isolated HMs must be shut down. If the HM autoboot feature was enabled, the HM autoboots automatically after shutdown. If the HM auto boot feature was not enabled, the HM node power supply must be powered OFF and ON again. (**Do NOT touch the reset button on the HM node power supply**.) The data on the HM disk drive can become corrupted in some cases, if the reset button is pressed while disk drive activity is in progress. Power OFF has automatic safeguards to allow successful completion of any disk operation.

Verify all isolated nodes have been reloaded

Call up the LCN Overview display again and verify that the nodes on the good portion of the LCN do not see any previously separated nodes as isolated. They should all be in an operational state.

Terminate reconnect activity

From the LCN Overview display at the Station used for directing the reconnect activity, select the [TERM LCN RECNCT] target.

Notice in the upper-left of the screen the system version has not changed from INIT LCN RECONNECT. Press [ENTER]. Now the system software version changes to R5xx.

Disable Show LCN Communications function

Restore the System status display to normal by turning off the Show LCN Communications function. The steps to do this are as follows:

1. Press the System Status key on the operator keyboard.
2. Select the [SELECT AUX INFO] target at the bottom of the display.
3. Notice the [SHOW LCN COMM] target at the bottom of the display is currently active (white). Select this target again to disable this function. The centerline of the node boxes disappears.
4. Select the [SINGLE NODE OPS] at the bottom of the display to return to the normal System Status display.

Appendix A

Targets for Reloading

Targets for reloading

There are several targets that can be used for reloading isolated nodes during the LCN reconnect activity. They all will work but each has its limitations. Only you, who understands the process, can make the determination as to which target or combination of targets best suits your situation.

The following is a review of the System Status display targets that can be used for reloading of isolated nodes.

Table 4 – Node Loading Targets

Target…	Description
LOAD ISOL	Results in the automatic LCN reconnect activity. This includes initiating the reconnect activity, the sequential reloading of all isolated nodes on the LCN, and terminating the reconnect activity. (It searches for and reloads the isolated nodes, one at a time, in node number sequence starting with the lowest node number.) This sequence of node loading may not satisfy your immediate needs. Reconnect activities can be initiated manually and critical nodes reloaded using the LOAD SELECT target. The LOAD ISOL target can then be used to complete the process for the remaining isolated nodes. **WARNING** The use of this target is not recommended if Redundant nodes such as NIM and HG pairs are isolated but still providing view from the isolated segment. Loss of view can result. Manual procedures involving the use of the SOFTWARE UPGRADE target are provided later in this module.
LOAD SELECT	Results in the automatic sequential loading of all selected nodes in the order you selected them. This method allows you to prioritize the sequential node loading. It also allows you to determine how many of the isolated nodes are reloaded in sequence. You can reload only one node at a time if you so choose. Note: The isolated nodes must first be shut down by using the SHUT DOWN target before you can load them by using this target.
LOAD PWR_ON	Results in the automatic sequential loading of all nodes in the POWER_ON state. It searches for and reloads the POWER _ON state nodes, one at a time, in node number sequence starting with the lowest node number.
LOAD FAIL	Results in the automatic sequential loading of all nodes in the FAIL state. It searches for and reloads the FAIL state nodes, one at a time, in node number sequence starting with the lowest node number.

Appendix B

Causes Of Node Isolation

Table 5 – Causes of Node Isolation

	Condition	Cause
1	Three or more nodes missed four Node Administrator broadcasts or firmware “I am alive” messages from another node within a 2-minute window. In R320 and beyond, it could also be caused if a single node missed six Node Administrator broadcasts or firmware “I am alive” messages from another node within a 3-minute window.	• A physical loss of communications between multiple nodes on both A and B cables. Nodes on both sides of the break are on a ring but cannot communicate across the break. • A double cable problem (such as connectors or terminators) causes message reflections on the LCN such that any given node can successfully receive only a subset of all Node Administrator messages being sent. • A double cable fault that stomps on the tokens of one or more nodes and does not let the node enter the ring. • A node fails, but its broadcast message is not received by all of the nodes (could be caused by a single cable fault or heavy traffic on the network). • The power to a node has been turned off and left off. • A problem in which Communication Management did not know it was off the ring and therefore did not re-enter the ring. This problem was fixed in a release before R300.
2	A node received a Node Administrator broadcast message from another node and the number of new transactions exceeded 62.	• A large number of state transitions occur, because of multiple node failures or loading, and a single broadcast message is missed. The next broadcast message indicates that too many transactions have been missed. • Because of some upset condition, a node is temporarily out of heap and loses one or more Node Administrator broadcast messages from a node that has had many state changes.
3	A node received a Node Administrator message from another node that has already “isolated” the node that received the message.	• Because of reflections, one node can receive messages from another node, but cannot successfully send messages to that node.
4	During initiation of the Reconnect procedure, a node had a different view than that of the US/GUS from which the Reconnect procedure was being performed and became isolated when the reconnect was confirmed. OR During termination of the reconnect, nodes that did not respond to the request to terminate using the “reconnect network version number” became isolated.	• A Reconnect procedure is initiated and some of the nodes showing “OK” are not totally synchronized with the originating US/GUS. These nodes become isolated when the [ENTER] key is pressed. • The Reconnect termination message and its retries are lost because of temporary loss of communications.
5	Communication was lost to a node during a node load.	• The node being loaded detects a hardware fault when starting up and cannot successfully send the failed message to the loading node.

Appendix C

Procedures for Reloading Isolated Redundant Nodes

Procedures for Reloading Isolated Redundant Nodes

Purpose

The procedures provided in this appendix are intended for use in conjunction with the LCN Reconnect Job Aid. This Job aid was given earlier in this course module (Table 4).

This appendix provides detailed procedures for minimizing and/or eliminating loss of view while reloading redundant isolated nodes. This assumes that view to the process is still possible from an isolated Station that shares the LCN view of the isolated redundant nodes.

For HGs and NIMs, the procedures involve shutting down the isolated backup node and making it functional as the new primary on the LCN segment with the proper LCN view while the original primary node continues to provide view for the isolated segment of the LCN. Once view is available on the good side (with proper LCN view), the original primary node can be shut down and reloaded, to become the new backup node with the proper view of the LCN.

The procedures provided are

Table 5 = Reloading of isolated Redundant HGs.

Table 6 = Reloading of isolated Redundant NIMs

Table 7 = Reloading of isolated Redundant PLCGs

Table 8 = Reloading of isolated Redundant AMs

ATTENTION

ATTENTION—The following are considerations when reconnecting redundant nodes:

Node Shutdown

The *shutdown* of any node on the separated portion can be initiated from *any* Station on the physical network or by pressing RESET at the node. The *load* must always be initiated from a Universal Station on the *good* portion.

Source of Load Program and Data

The source varies for both program and data used in reloading the nodes being moved to the good portion; either can come from a removable media or from one or more History Modules, depending on the system volume assignments.

Establishing a US/GUS for Subsequent Gateway Loading

To establish one or more US/GUSs with the appropriate database in order to load HGs and NIMs, move one or more US/GUSs to the good portion by shutting down and then reloading them, one at at time.

Gateway Loading

For each remaining HG pair on the separated portion, follow steps 1 through 6 in Table 5; then for each remaining NIM pair on the separated portion, follow steps 1 through 5 in Table 6.

HG reloading

The following procedure is used to reload isolated redundant HGs during a LCN reconnect activity.

Table 6 – Reloading of Isolated Redundant HGs

Step	Action
1	For an HG pair on the isolated segment of the LCN: a. From the System Status display, shut down the backup HG (hereafter referred to as HG2). NOTE: HG redundancy is lost. b. Reload HG2 from a Station that is currently on the good segment of the LCN: • Select the HG2 on the System Status display • Select the NODE STATUS target on the System Status display. • Make sure the correct HG2 is selected on the Gateway Status display • Select MANUAL LOAD • Select LOAD SFW UPGRADE . NOTE: This selection is necessary to enable both HG and HG2 to operate as primaries during the transition period. This is the only time that this target is used in the reloading process. • Select the NET for the PGM and DATA SOURCE. RESULT: Once the reload of HG2 is complete, both HG and HG2 act as primaries on separate logical LCN networks. You can now observe operation of hiway boxes at Stations on both the isolated and good LCN portions.
2	Disable alarming on HG from a US/GUS on the isolated portion, through the HWY ALM ENB/DIS target of the Gateway Status display. Enable alarming on HG2 from a US/GUS on the good portion. NOTE: Event-initiated processing by this HG pair is lost until Step 5 is complete.
3	Prepare for transfer of the AM (See AM reloading in table 8) by setting the Control State for HG to BASIC (HG2 comes up in BASIC Control State.).
4	Shut down the original primary HG. NOTE: If the HG has HTD responsibility, that function is automatically switched to HG2.
5	From the Gateway Status Display at a US/GUS on the good LCN segment, select the ENABLE UPGRADE target for HG2. RESULT: HG2 now has full functionality, but no backup.
6	Reload the original primary HG using the AUTOLOAD NET target. RESULT: That HG now comes up as the backup HG and redundancy is restored.

NIM reloading

The following procedure is used to reload isolated redundant NIMs during a LCN reconnect activity.

Table 7 – Reloading of Isolated Redundant NIMs

Step	Action
1	Use the System Status display to shut down the backup (secondary) NIM (hereafter referred to as NIM2).
2	To load NIM2 with the new software: • Select NIM2 on the System Status display using a US/GUS on the good LCN segment • Select the NODE STATUS target on the System Status display. • Make sure the correct NIM is selected on the Gateway Status display • Select MANUAL LOAD • Select LOAD SFW UPGRADE . NOTE: This selection is necessary to enable both NIM and NIM2 to operate as primaries during the transition period. This is the only time that this target is used in the reloading process. RESULT: Once the reload of NIM2 is complete, both the NIM and NIM2 act as primaries on separate logical LCN networks. You can now observe operation of UCN devices at Stations on both the isolated and good LCN portions.

NIM reloading,
continued

Step	Action
3	From a US/GUS on the good portion, use the Gateway (Node) Status display to shut down NIM (the original primary). NOTE: This must be done to allow completion of the reconnection for this pair. RESULT: Gateways Status display / UCN Status display NIM — QUALIFIED — OFFNET NIM2 — UPGRADE — BACKUP ATTENTION—Do not reload NIM until step 4 is completed.
4	From the US/GUS on the good portion, select the ENABLE UPGRADE target for NIM2. NOTE: NIM2 determines if the original primary NIM is still on the UCN. If so, reconnection cannot continue and an error message is issued. RESULT: • If NIM is not on the UCN (after step 3, it should not be), the status for NIM2 goes from UPGRADE to OK and it becomes the fully functional primary, with NIM as its secondary. • NIM2 assumes the odd UCN address and becomes the primary (previously, it had the even address and was the backup). The UCN Status display shows NIM2 (odd UCN address) as OK.
5	Use the AUTOLOAD NET target at the Gateway Status display at a US/GUS (on the good LCN portion) to load the new software into NIM. RESULT: The original primary NIM becomes the backup NIM and NIM redundancy is restored.

PLCG reloading

The following procedure is used to reload isolated redundant PLCGs/EPLCGs during a LCN reconnect activity.

Table 8 – Reloading of Isolated Redundant PLCGs

Step	Action
1	For a PLCG pair on the isolated segment of the LCN a. Shut down the backup PLCG (hereafter referred to as PLCG2). NOTE: PLCG redundancy is lost. b. Reload PLCG2 with a Station that is currently on the good segment of the LCN: • Select the PLCG2 on the System Status display • Select the NODE STATUS target on the System Status display. • Make sure the correct PLCG2 is selected on the Gateway Status display • Select MANUAL LOAD • Select LOAD SFW UPGRADE . NOTE: This selection is necessary to enable both PLCG and PLCG2 to operate as primaries during the transition period. This is the only time that this target is used in the reloading process. • Select the NET for the PGM and DATA SOURCE. RESULT: Once the reload of PLCG2 is complete, both PLCG and PLCG2 act as primaries on separate logical LCN networks. You can now observe operation of hiway boxes at Stations on both the isolated and good LCN portions.
2	Disable alarming on the PLCG from a US/GUS on the isolated portion, through the ENB/DIS target of the Gateway Status display. Enable alarming on PLCG2 from a US/GUS on the good portion. NOTE: Event-initiated processing by this PLCG pair is lost until Step 5 is complete.
3	Prepare for transfer of the AM (See AM reloading in table 8) by setting the Control State for the PLCG to BASIC (PLCG2 comes up in BASIC Control State.).
4	Shut down the original primary PLCG. NOTE: If the PLCG has HTD responsibility, that function is automatically switched to PLCG2.
5	Select the ENABLE UPGRADE target for PLCG2. RESULT: PLCG2 now has full functionality, but no backup.
6	Reload the original primary PLCG using the SHUT DOWN and LOAD SELECT target on the System Status display. RESULT: That PLCG now comes up as the backup PLCG and redundancy is restored.

Continued on next page

Procedures for Reloading Isolated Redundant Nodes, Continued

AM reloading

The following procedure is used to reload isolated redundant AMs during a LCN reconnect activity.

Table 9 – Reloading of Isolated Redundant AMs

Step	Action
1	Shut down and reload any isolated portion Application Modules, using your normal criteria for selection between COLD, WARM, and HOT restart. For any redundant AM pair, both AMs must be shut down and then reloaded.
2	Set the control status for the Data Hiway or UCN to FULL to enable AM control. Start AM control by placing HG and NIM points into Cascade mode.

LAST PAGE