CHAPTER 3

TRANSMISSION SUBSYSTEM [18]

Transmission subsystem is one of the major function layer in SNA structure. The purpose of transmission subsystem is to transfer the data from one end user to another user using communication system components. These components include data links, cluster controllers, communication controller, component in individual terminals, and most of the functions in the host access method.

Layer of the Transmission Subsystem

As noted previously, one of the characteristics of SNA is the separation of the application oriented functions from the transmission functions. The advantages of this separation increases with the introduction of a series of data links between the application program and the terminal which it wants to communicate, since management of these multiple links is a complex task. Further, the need of simultaneously sharing data links among a number of application program makes it impossible for one application program to manage a link. Thus, link management and routing of data from one link to the next link have been isolated from the application program and locate in the transmission subsystem.

Communication Controller

A communication controller has the function of supporting the data link protocol for remote attachments and the channel interfaces for a CPU local attachment. Programmable communication controllers are used to relieve the CPU from processing required in the transmission subsystems. For example, polling control of each of the lines attached to a host node can be done in the controller rather than in the CPU. One subchannel with a sufficient data- transfer rate is sufficient for software in the controller to transfer data to CPU. There are three different software package found in programmable controllers.

1. Emulation Program (EP) is the program to emulate the communication controllers as the old non-programmable controller. It is used with Binary Synchronous Control (BSC). and Start-Stop protocol

2. Network Control Program (NCP) is used in support of System Network Architecture (SNA) . It can support Synchronous Data Link Control (SDLC) .

3. Partitioned Emulated Program (PEP) is the combination of EP and NCP loaded in the same controller.

Cluster Controller

A cluster controller is used to share terminal control facalities with a multiple variety of terminals. It is remotely attached to a communication controller. Terminals may be connected to a cluster controller with local and remote attatchements. A cluster controller also handle data link and buffer data.

Terminal

A terminal is a device which provides an external interface to a teleprocessing system. Terminals normally include control units which provide function such as buffering and character translation required for terminal's operation. Terminals are ,typocally, locally attached to a cluster controller. However some terminals may also be:

- Remotely attached to cluster controller.
- Remotely attached to a communications controller.
- Locally attached to a channel.

Concentrator

A concentrator may be viewed as the functional equivalent of cluster controller without the option for local attachments. A concentrator only support remote attachments and is to be associated with telecommnunication components that support by SNA.

LOGICAL VIEW OF AN SNA NETWORK

An SNA network can be described in two ways; the physical facilities : the CPUs, terminals, controllers, teleprocessing lines, etc.,or the logical functions: data transmission, integrity checking, data mapping, etc. For a complete understanding of the network , both views are important.

Figure 3-1 presents the logical view of an SNA network; the physical view is discussed earlier in the previous chapter. The network consists of two parts; the transmission subsystem and a number of network addressable units(NAU) surrounding it. The NAUs are logical entities, respresenting the various ports through which end users may access the communication facilities. Some NAUs appear in the host computer; other NAUs are logical functions in cluster controllers or terminals

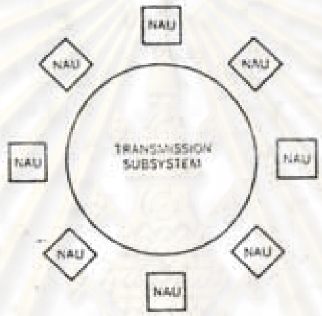

Figure 3-1 Logical view of the communication system

The functions and internal structure of NAU are important factor in SNA. An NAU provides both data management to present information to the end user and protocol management to govern the rules of conversation between end users. The NAU and the Transmission subsystem are collectively called communication system

When one end user wants to communicate with another, the comversation, called session, is started by using a control request to the communication system. A session is analogous to a human conversation

The key features of sessions are;

A session is a temporary logical connection between two, and only two NAUs

Certain NAUs may have simultaneous sessions with several other NAUs, supporting a number of end-user conversations at once. The application program may make any appropriate correlation or mixture of data it receives in its various sessions.

In addition to its user sessions, each NAU has a session with the communication itself for control operations such as initiating and terminating sessions.

A Session typically contains several user transactions.

During a session, a logical path is established through the transmission subsystem between two NAU.

No other NAU can intrude on the session by inserting data in this logical path.

TYPE OF NAU

System service control point; the NAU responsible for the management of the communication subsystem, network operator communication, configuration control, network start up, session initialization, system error recovery, etc.

Logical Unit

The type of NAU serving as the port for application oriented end user.

Physical Unit

A Physical Unit exits in each node in the network, The Physical Unit's session with the system service control point is used for controlling the physical resources in the a node participates in the activation and deactivation of the data links attached to the node and the nodes attached to the links. It also may provide control functions for an operator located at the node.

Layers of the transmission subsystem

There are two layers of functions are within the transmission subsystem, an outer layer (transmission control) with components uniquely in support of an individual session and an inner layer (path control and data link control) that is used in common by all sessions and refered as the common network.

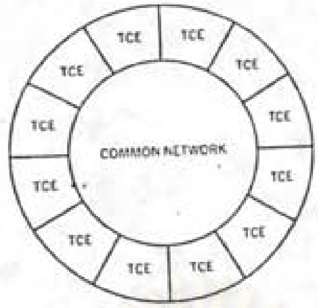

Figure 3-2 The Transmission Subsystem

A number of function related to transmission require unique support for each session, for example, session is supplied by a transmission control element (TCE). Each time an NAU enters in its node. Thus if an NAU has multiple session simultaneously, it has a transmission control element for each session, a third transmission control element serves as a conversion mechanism enabling the two NAU to work together. There are three principles of this mechanism.

1. The secondary NAU is typically not able to process data as quickly as the primary NAU can send to it. For this reason, a process called 'pacing' is used in which data is temporarily held at transmission control element in the communication controller until the secondary NAU can accept it. In conjunction with this, there is also pacing between the host transmission control element, so that it is no overrun with the information to be held until it can be forwarded to the destination.

2. The formats of control information used by terminals and cluster controllers are different form those used by host nodes and communication controller nodes. The transmission control element in the communications controller translates between these different formats.

3. In order to carry out these responsibilities , this transmission control must process the system to start and end sessions.

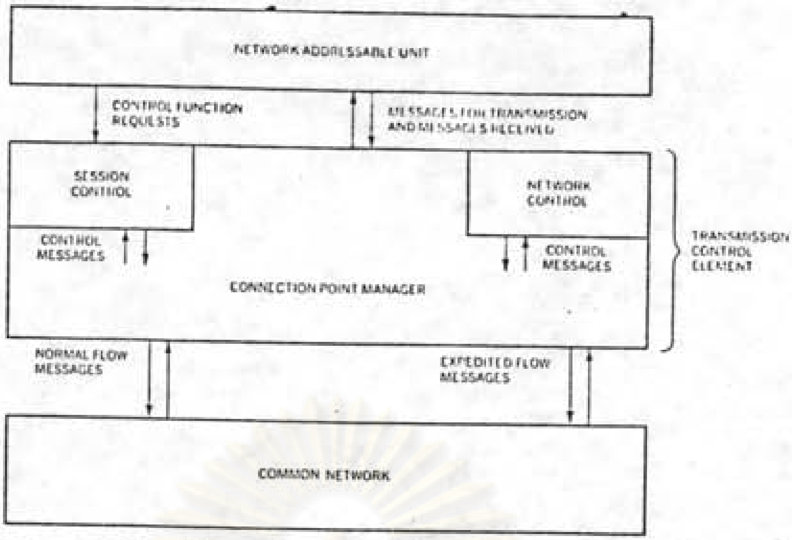

Figure 3-3 Structure of the transmission control element and its relation to the NAU and common network

Figure 3-3 shows the detail structure of the transmission control element in relation to the common network and to the NAU. The control element consists of three parts; connection point manager, session control, and network control. the main-line section is the connection point manager, whose function is the management of data transmission to and from the NAU. In each session are four data flows, two from the primary NAU and two from the secondary NAU. The end user's data is transmitted in the normal flow from its NAU. Control functions originating in the transmission subsystem on behalf of the session, as well as some of the control functions originating in the NAUs, flow on the expedited flow to avoid being detained by NAU protocols or by a queue of data from the end user awaiting transmission. The connection point managers for the session keep the two flows in each direction separate and give the expedited flow priority in their processing.

Each message that an NAU sends on the normal flow is assigned a 16 bit sequence number by its connection point manager. When message is sent, the connection point manager notifies its NAU of the sequence number assigned. When a message is received from the network, the connection point manager ensures that it is in sequence and that no prior messages were lost.

A second component of the transmission control element is session control, which provides the session management functions for the NAU. These functions include session initiation and termination and session error recovery.

When an NAU wants a session with another NAU, it sends a system message to the system service control point, requesting clearance for the session. Unless the system services control point find impedements to the session, it notify the primary NAU to start the session. The primary NAU uses session control functions to build a request that is the initial transmission sent in the session and to establish the rules to be used to control the session. Once the bind session request is created , it is passed to the connection point manager and from it to the common network for transmission to the session control element at the secondary NAU. The secondary session control uses the information in the request to establish the control facilities that will be used in the session. It also passes the information to the secondary NAU so that the required NAU protocols can be established.

The third component of a transmission control element is network control. It is used for the internal administrative communication of the communication system that is not directly related to the end user.

PHYSICAL VIEW OF AN SNA NETWORK

The inner core in figure 3-2, the common network, is itself composed of two things - path control and data link control. The physical view of a network shown in figure 3-4.

Physically, the network consists of a number of nodes interconnected by data links. These nodes have been divided into classes according to their function. In each network, there is a single host, which oversees the network and in which the majority of application programs reside. Attached to the host are communication controllers that perform data routing , multiplexing, and concentrating functions, and remote communication controllers may be attached to them. Also attached are various cluster controllers and terminals, both those for specific industry systems and those for use in applications in many situations. Physically, the collection of nodes has a tree structure.

The logical view of the network can be related to the physical view noting that, in general, the NAUs are scattered around the periphery of the network in the host, cluster controllers and terminals, the exception are the

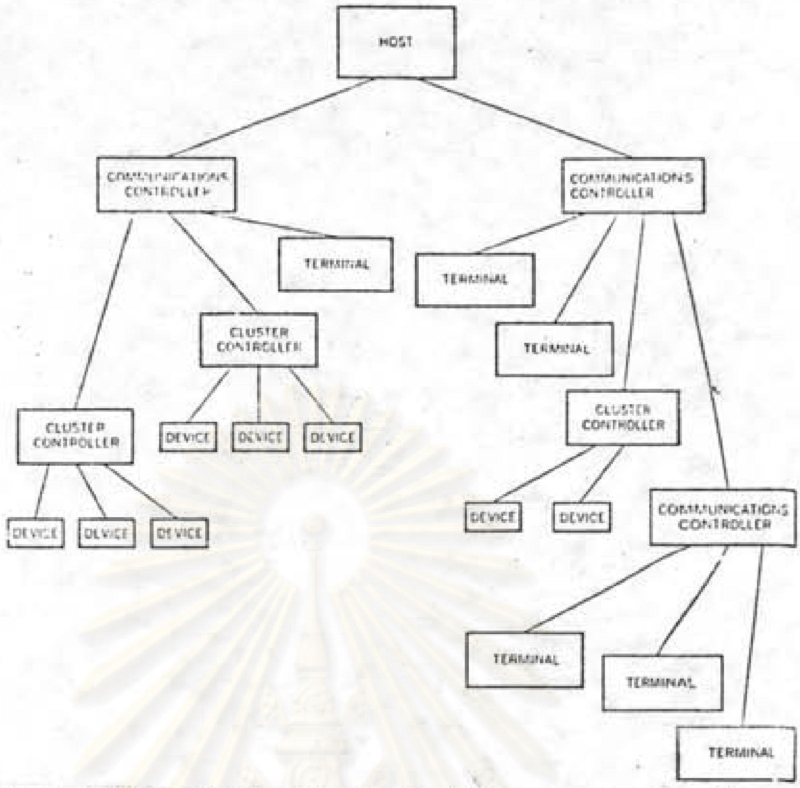

Figure 3-4 Physical view of the communication system

physical units which appear in each node of the network.

To transmit information from one NAU to another, the proper sequence of data links and nodes must be selected, and the actual transmission of the message must be managed. These two functions are assigned to path control and data link control, respectively.

The responsibility of path control is routing of data received from the various connection point managers through the network. This routing is accomplished in stepwise way. Path control function is in each node in the network. For each message received, either from a connection point manager in the node or from other node, path control determines which node is the appropriate next step in the logical path and which data link should be used for transmission. The message is then transfered to data link control, whose function is to manage the movement of messages across the individual links from this node to the adjacent nodes. Data link control , like path control , is present in each node of the network. It manage the protocols required to transmit information across the data link. For example , data link control for SDLC data links supplies the send and receive sequence counts and the frame check sequence for outgoing information frames and verifies this control information for the frames it receives. The data link control elements at the nodes attached to a data link work cooperatively to manage the data traffic on that data link.

Figure 3-5 shows the route a request unit travels from the time it is created by a logical unit until the destination logical unit receives it. At each step along the path, the applicable control in formation is shown.

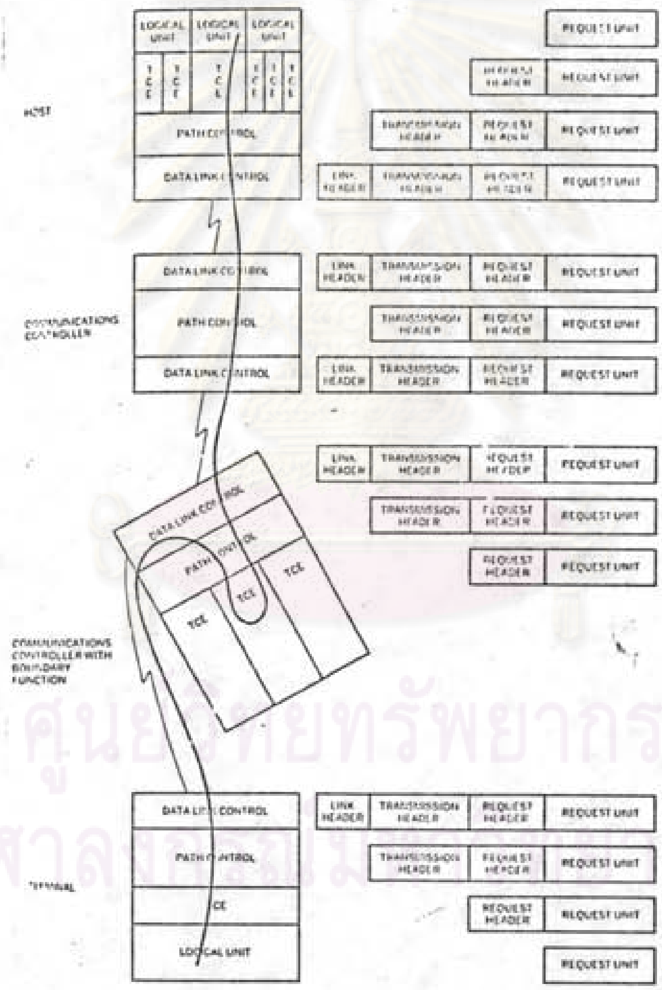

Figure 3-5 progression of a request through the network showing the information present at each point

Assignment and use of Network address.

When a specific network installation is created, each NAU in the network is assigned a unique network address by which it is known to other NAUs and the transmission subsystem. NAUs conected via dial links are an exception. Their network addresses are assigned by the system services control point when the connection is made.

```
◄-------- 16 bits -------►
+----------+-----------+
] Subarea  ]  Element  ]
] Address  ]  Address  ]
+----------+-----------+
```

Figure 3-6 Network address format

The entire network is partitioned into regions called subarea. Each subarea is assigned a subarea address. Each NAU is in one and only one subarea. Within a subarea, the NAU are each assigned an element address. The network address, shown in figure 3-6, reflects this two-part structure. The first field in the address specify the subarea; the second field specifies the element address with in subarea. When the installation first defines its network configuration, it determines how many of the 16 bits in the network address will be allocated to define the subarea and how many will be reserved for elements.

Figure 3-7 show the same configuration that is shown in figure 3-4, giving more detail, including the division of the network into subareas. Also shown are the logical units, physical units, and the system service control point, along with the network address that might be assigned.

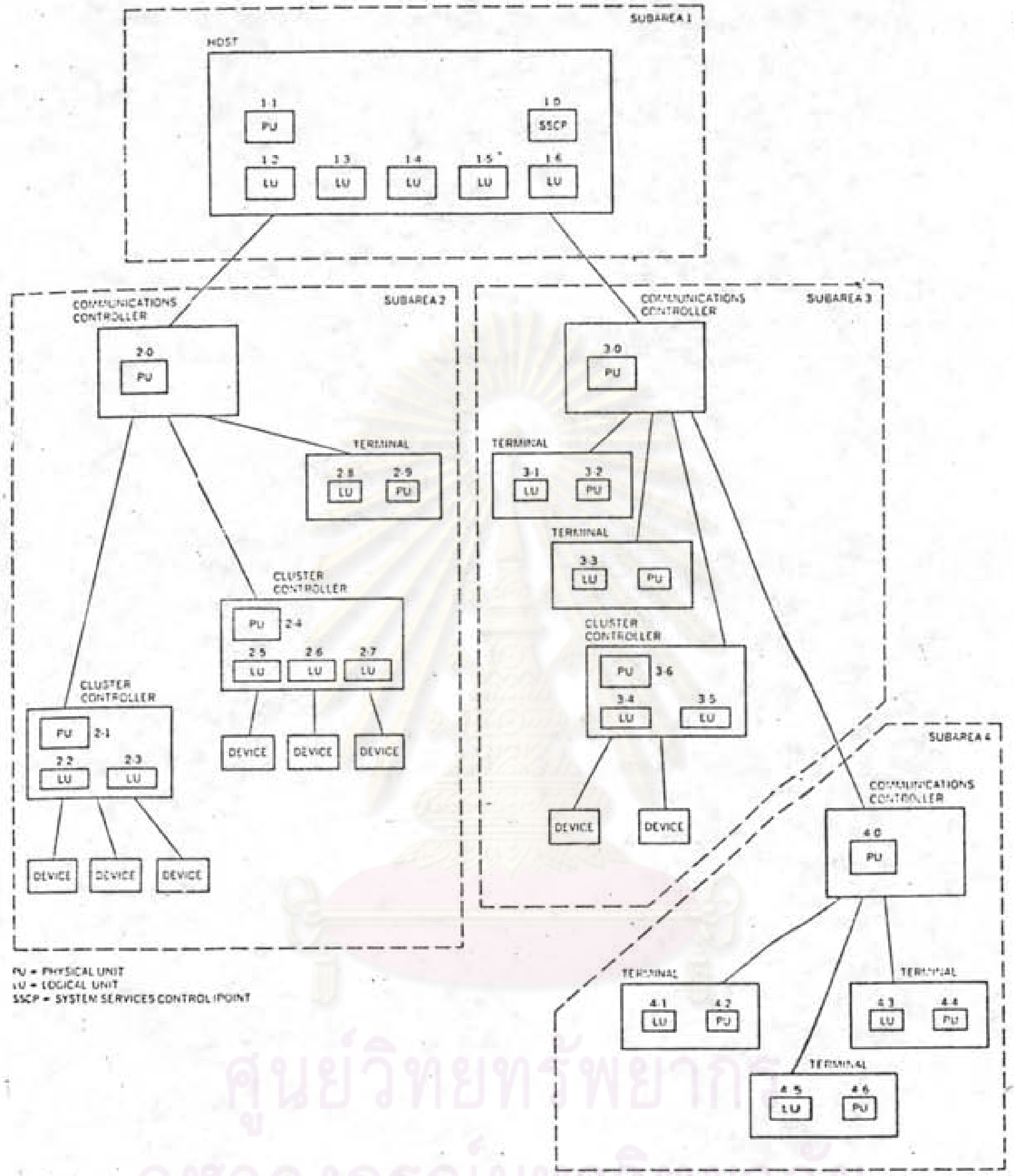

Figure 3-7 Sample configuration showing assignment of network address

Each subarea, except the ones directly controlled by host (i.e. the subarea containing host application programs and the subareas containing channel - attached cluster controllers), contains a communications controller through which all the data flows into and out of the subarea. It disperses incoming data to the various cluster controllers and terminals in the subarea and gathers the data from them to be sent elsewhere in the network.

INFORMATION UNITS AND FORMATS

The communication between NAU is of two types. First, one of the NAU sends a request unit to the other. A request might be a line of data to be oriented, a card image to be punched, an inquiry against a data base, etc. Second, when the receiver completes processing the request, it sends a response unit to report the outcome of the request. The response can be inhibited by the requesting NAU, which can ask that no response be returned or that a response be returned only if an error occurs during processing. In front of each request or response unit that is sent, the connection point manager attaches a request or response header, containing various control information. For example, the header indicates whether the unit sent is a request or a response and, consequently, what format the header has.

There are four categories of requests; two categories which is called functional management data and data flow control are processed by the NAU and the two categories which is called session control and network control are processed within the transmission subsystem. The category of the unit sent is indicated by the header.

The form of response to be used; i.e. no response, respond only on error, definitely respond, is indicated in the request header. The response header indicates whether an error occurred. If an error occurred, the response will contain four bytes of sense information . A pacing indicator in both the request header and the response header is used to regulate the rate of information flow into the secondary NAU so that its processing capacity is not exceed.

In addition to the indicators used by the connection point manager, a number of indicators are carried in the header for the convenience of the NAUs, These indicators regulate some of the protocols the NAU use their communication; they are not inspected by the transmission subsystem.

When the connection point manager has attached the header to the sent it passes them to path control for routing into the network. Path control attaches a header, called the transmission header, to each message it receives. The transmission header contains the information needed to route the message through the network, including the origin and the destination address, the sequence number assigned, and the length of the message. In some cases for transmission efficiency or to match buffer size limitations of the next node, path control may choose to devide the message into segments that it transmits separately. In this case, each segment is preceded by a transmission header. Indicator in the header allow a path control element receiving a message in segments to reconstruct the entire message.

Destination Subarea	Outgoing Link	Outgoing Station Address
1	1	1
2	2	1
3	2	2
4	3	1
5	3	2
6	*	
7	4	2

Table 3-1 Routing table

In the host and in each communications controller, a routing table unique to each , specifies how path control in this node should route the messages it receives from a connection point manager or from data link control, Table 3-1 shows an example of a routing table. It is organized by destination and indicates the next step along the path to which this path control should forward messages it receives for a given destination. The table entry for a given destination indicates the link on which the message should be transmitted and at the station on the link which is to receive it. For the first node along the path that the message travels, only the subarea portion of the address is of interest, since all messages for nodes in the subarea take the same path until they arrive at communication controlling that subarea. Thus only the subarea portion of the destination address is used as a search argument for the routing table.

At the communications controller in the destination subarea, the routing table has an indication (represent in table 3-1 by an asterisk) that it is not to forward the message to another communications controller, but it is to look into a supplementary routing table and process the controller, which processes it as a described above. One fact of this processing, the conversion of the control information format, requires further discussion.

LOCAL ADDRESSING AND FORMAT CONVERSION

Cluster controller nodes and terminal nodes have limited addressing capability. They use a simplified version of address called the local address, so called because it is used and is meaningful only locally to the node and does not have a network-wide interpretation as does the network

controller, when the installation defines the logical units it contains. Use of the logical address allows the cluster controllers and terminals to be insensitive to the configuration requirements above. The same local address may be used to refer to many different NAUs. For example, if a particular application program exits in cluster controllers in each of several branch offices of a business concern, the application could have the same local address in each controller. An other example is the physical unit in the cluster controller or terminal that always has local address 0. Since the communications controller boundary function is aware of the physical location of each nau, it uses this information to provide the uniqueness lacked by the local address.

When a session is established between an NAU is a cluster controller or a terminal and one in the host, the communications controller dynamically assigns a local address representing the host NAU, which will be used throughout the session. In messages form the host NAU, the original and the destination network addresses in the transmission header are replaced with their local equivalent before being sent to the destination NAU. When a transmission is received from a cluster controller or terminal, the communications controllers uses the identity of the originating node and the local addresses in the transmission header to determine the network address to be reinserted in the header. Figure 3-8 shows a sample configuration indicating the local addresses that might be assigned to NAUs in the cluster controller and terminal nodes.

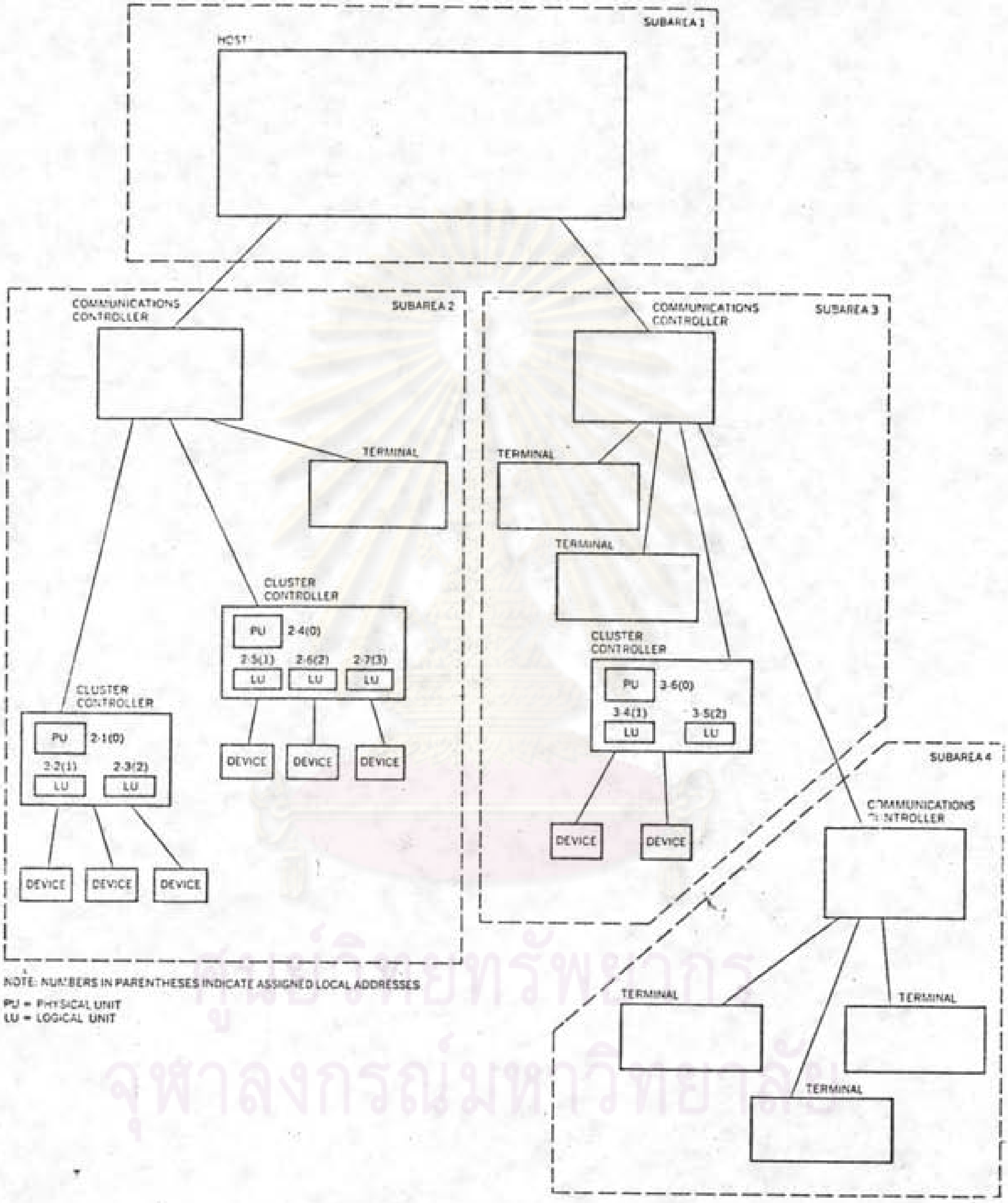

Figure 3-8 Sample configuration showing assignment of network addresses and local addresses to NAUs in terminals and cluster controller.