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SNA Fundamentals

TEXT Vol. 1

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PREFACE

This course is designed to teach concepts of Systems Network Architecture (SNA), functions of SNA components, and usage of SNA commands. This Text and a Personal Reference Guide (SR20-8492) form the nucleus of the course and are supported with a videotape.

Since this is an independent study course, the completion time may vary depending on the ability and experience of the individual student. However, most students' study time should fall in the range of 12 to 16 hours.

- *Before continuing in this Text, turn to your Personal Reference Guide (PRG) and start with the Course Introduction section. The PRG will guide you through the course.*

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Volume 2

SNA Fundamentals

Mini-Course 1

Introduction to Systems Network Architecture (SNA)

Printed in the United States of America.

Mini-Course 1. Introduction to Systems Network Architecture (SNA)

Introduction

Systems Network Architecture (SNA) is:

1. A blueprint.
2. A set of products.
3. An architecture.

Systems Network Architecture (SNA) is IBM's **blueprint** for today's Data Communications Systems and for development of Data Communications Systems in the future such as:

- Distributed Data Processing systems.
- Office Systems.
- Communications Network Management.

SNA is a **set of products**. The number of SNA products and the range of functions of the products have increased regularly since SNA was announced. SNA capabilities are available on the following range of products:

- The System/370 family of computers which include the 303Xs, 308Xs, and the 430Xs, with both telecommunication access methods (ACF/VTAM and ACF/TCAM), and the network control program (ACF/NCP/VS) in the 3705.
- A range of controllers that includes:
  - Processors, such as the S/32, S/34, and the Series/1.
  - The 3705 Communications Controller.
- Industry-oriented subsystems for:
  - Finance (3600, 4700).
  - Manufacturing (3630).
  - Retail (3650).
  - Supermarket (3660).
- General purpose displays such as the 3270 Information Display family.
- Software subsystems such as CICS, IMS, JES, POWER, TSO, and VSPC.

Systems Network Architecture (SNA) is IBM's **single architecture** for DATA Communications Systems. It is a set of rules to which product designs conform. For example, if a product needs a certain function, it should be done identically to the same function in other products, in accordance with the architecture. Also, if the function is new, it should be accomplished according to the philosophy and structure of the existing architecture. The function should then be made a part of the architecture for other products to use.

SNA is a comprehensive specification that describes:

- The logical structure of Data Communication Networks.
- Protocols (rules) for synchronizing communication between network resources.
- Message formats used within a network.
- Operational sequences for controlling network resources, network configuration, and for transmitting information through the network.

SNA:

- Does not specify internal product design nor does it prescribe the network functions that each product must be capable of performing. However, SNA does prescribe the manner in which a network function is to be performed in a product that implements SNA.
- Allows products to mix and match in a network.
- Allows users of the network to be independent of many of the characteristics of the network and the details of its operation.
- Provides a growth-oriented environment that minimizes the effort to install, maintain, and alter the network configuration.
- Provides for future networking technologies such as:
  - Packet switching.
  - Digital networks.
  - Text/Electronic mail
  - Image/Graphics.
  - Digitized voice.

An SNA network is made up of physical components and software components. Physical components consist of processors, communications controllers, and terminal controllers. The physical components are interconnected by data links, e.g., processor channels, telephone lines, microwave links, and satellites.

Software components consist of access methods (for example, ACF/VTAM and ACF/TCAM), application subsystems (for example, CICS and IMS), user application programs, and network control programs (for example, ACF/NCP/VS).

The main design point of SNA is end user to end user communication. An end u: is typically a person working at a terminal or an application program executing in processor of the data communications system. The SNA network provides servic that enable end users to communicate with other end users. For example, a bank teller submits an inquiry to the network via a display terminal requesting an account balance (See Figure 1-1).

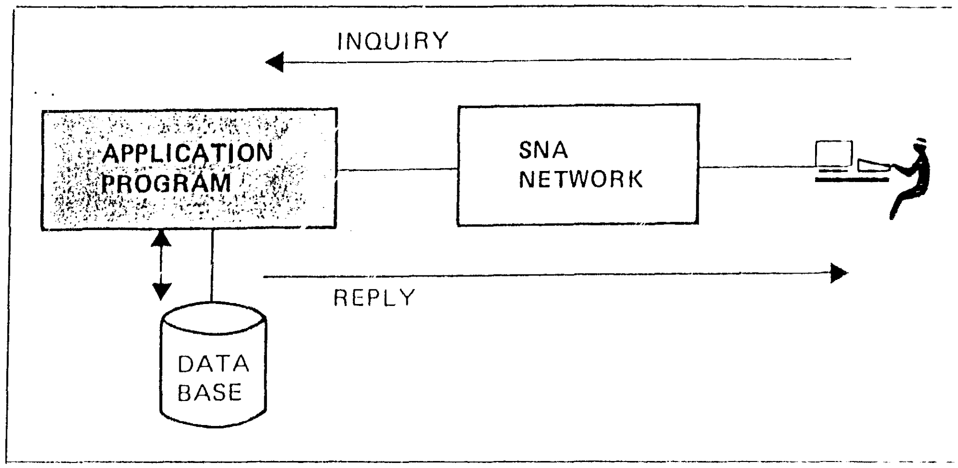

Figure 1-1. End Users

The inquiry is routed through the SNA network to the appropriate applicatior program to be processed. The application program generates a reply to the inquiry and presents it to the SNA network to be sent back to the bank teller. The bank teller and the application program are called **end users.** End-users submit information to and receive information from the network.

An objective of SNA is to keep the complexity of data communications systems ou of user application programs, that is, to make the SNA network as transparent as possible.

Figure 1-2 illustrates the relationship between end users and the SNA network. This network includes one processor, one communications controller, and one terminal.

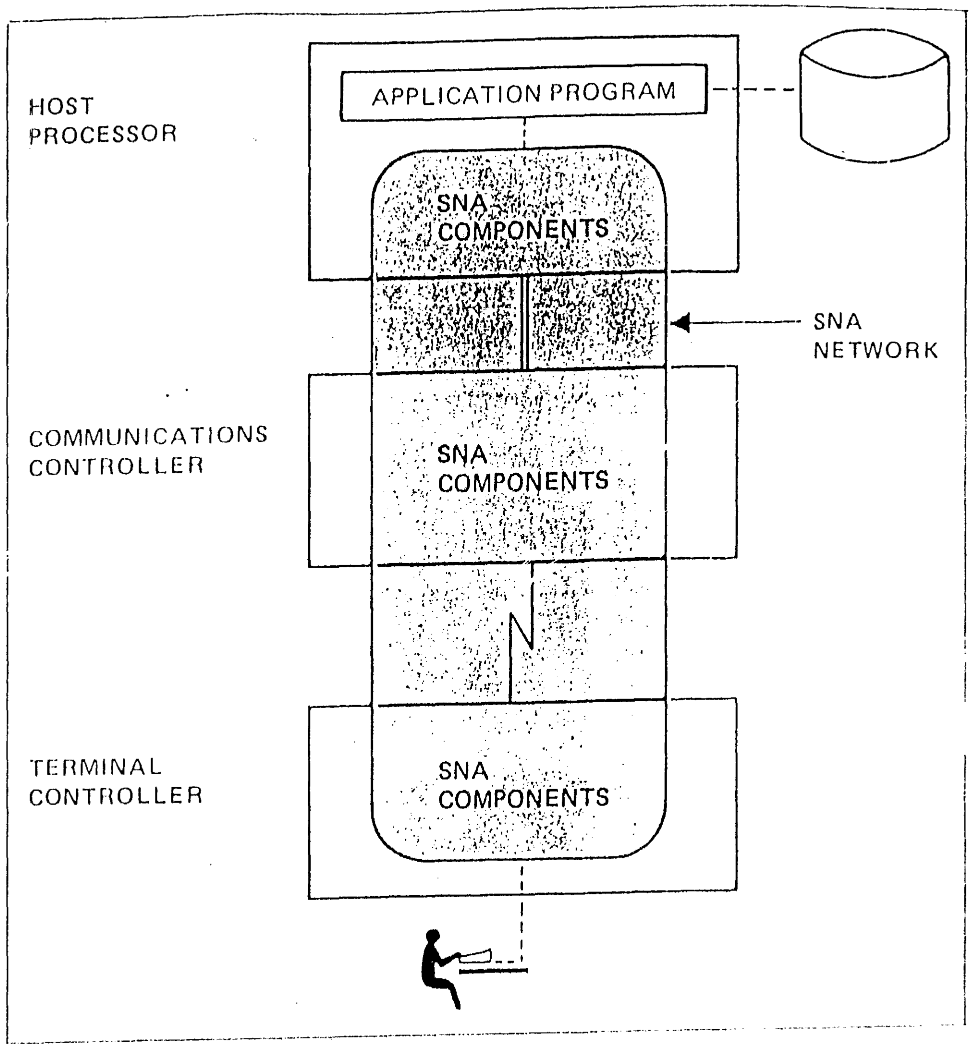

Figure 1-2. The SNA Network

The terminal operator and the application program in the host processor are the end users. The SNA network is responsible for moving data between the two end users in an efficient, orderly, and reliable manner. This is accomplished by SNA components that reside in the processor, in the communications controller, and in the terminal.

The SNA components specified in the figure are implemented by programming and hardware. For example, ACF/VTAM or ACF/TCAM make up the SNA components in the host processor, ACF/NCP/VS (network control program) in the communications controller, and the SNA components in the terminal controller which consist of hardware and/or programming.

Physical Network Structure

SNA has drawn upon the experience and excellence of many other systems. SNA imposes a logical structure on these systems for today's networks and for future networks. The physical components of a data communications network that are interconnected by data links are called **SNA nodes**. Figure 1-3 shows the hardware and software components that make up an SNA network for a specific configuration.

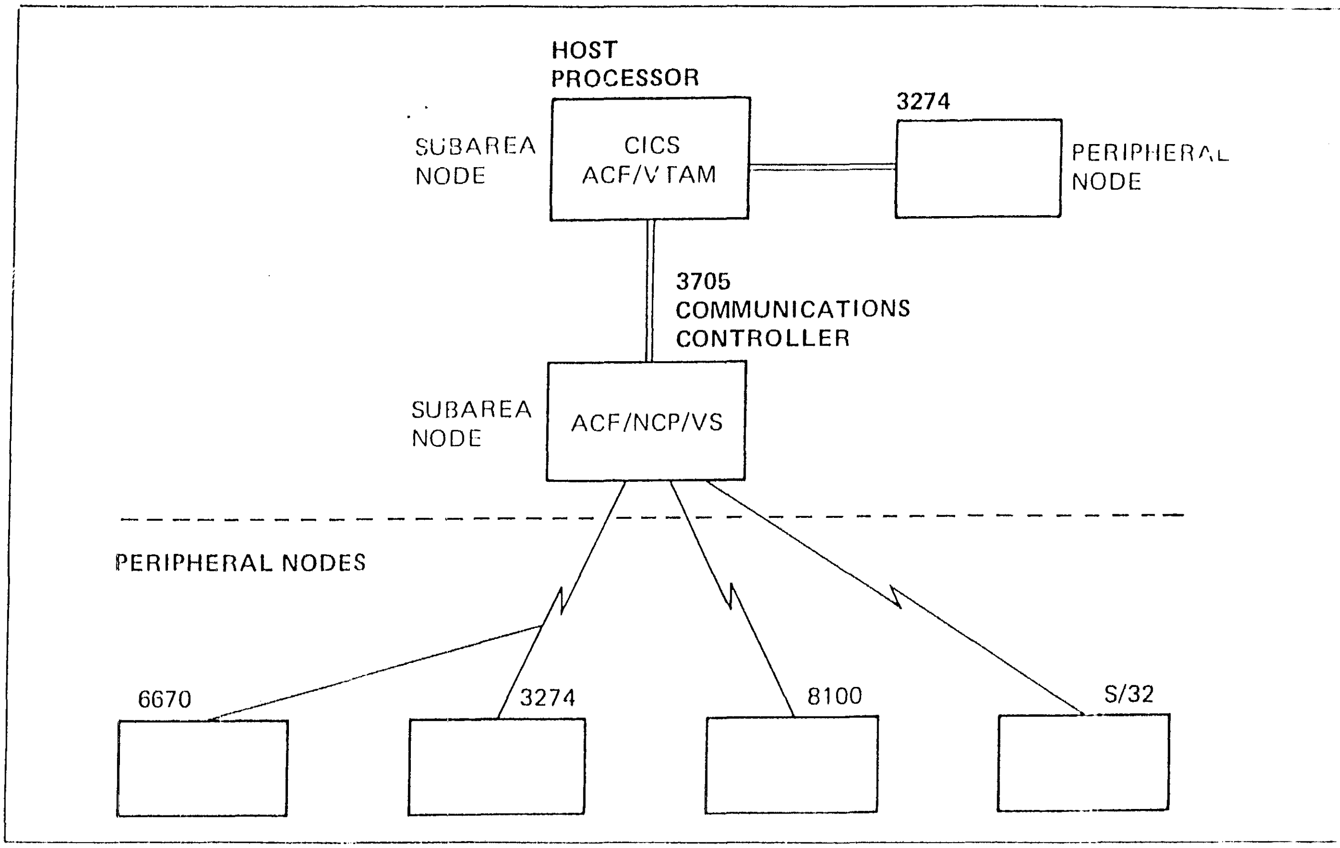

Figure 1-3. SNA Nodes

AN SNA network has **subarea nodes** and **peripheral nodes**. A host processor that contains a telecommunications access method (e.g., ACF/VTAM) is a subarea node and may be referred to as a host subarea node. The telecommunications access method controls the network, including all resources in all nodes.

A communications controller with its network control program (ACF/NCP/VS) is a subarea node and may be referred to as a communications controller subarea node. This node, under direction from the host subarea node, controls the links and terminals attached to the node.

All other nodes are called peripheral nodes. Peripheral nodes range from very simple function devices to broad function devices. A peripheral node could consist of a controller with a single display device, a controller that supports several display and printer devices, or a processor.

The SNA nodes illustrated in Figure 1-3 are interconnected by data channels and teleprocessing links and we will refer to both as data links.

SNA also identifies functions in a data communications network that manages the transmission of data between end users and defines logical components to handle those functions. Functions include:

1. Synchronizing communication between end users. For example, a terminal operator is to communicate with an application program in the host node. Are both end users to be allowed to send to each other at the same time, and, if errors occur between the two end users, which is responsible for handling the error recovery process?

2. Managing the physical resources of each node in the network.

3. Central point of control for the network.

4. Transmission of data across data links.

5. Routing of data from an end user through the network to another end user.

Referring to Figure 1-3, the SNA components and functions in the host subarea node are implemented by ACF/VTAM and by the CICS subsystem. The SNA components and functions in the communications controller subarea node are implemented by ACF/NCP/VS. SNA components and functions are implemented by hardware in non-programmable peripheral nodes and by hardware and/or software in programmable peripheral nodes.

Logical SNA Components

Providing a central point of control for the network, SNA defines logical components to perform the functions identified above. SNA defines the **logical unit** (LU) to handle communication between end users. SNA defines the **physical unit** (PU) to manage physical resources in each SNA node. SNA defines the **system services control point** (SSCP) as the central point of control for the network. SNA defines the **data link control** (DLC) component to manage the transmitting of data across data links. SNA defines the **path control** (PC) component to handle the routing of data through the SNA network.

Logical Units (LUs): **Logical units** provide each end user access to the SNA network. Logical units provide the services required to manage the transmission of information between end users. Figure 1-4 shows two logical units, one for each end user.

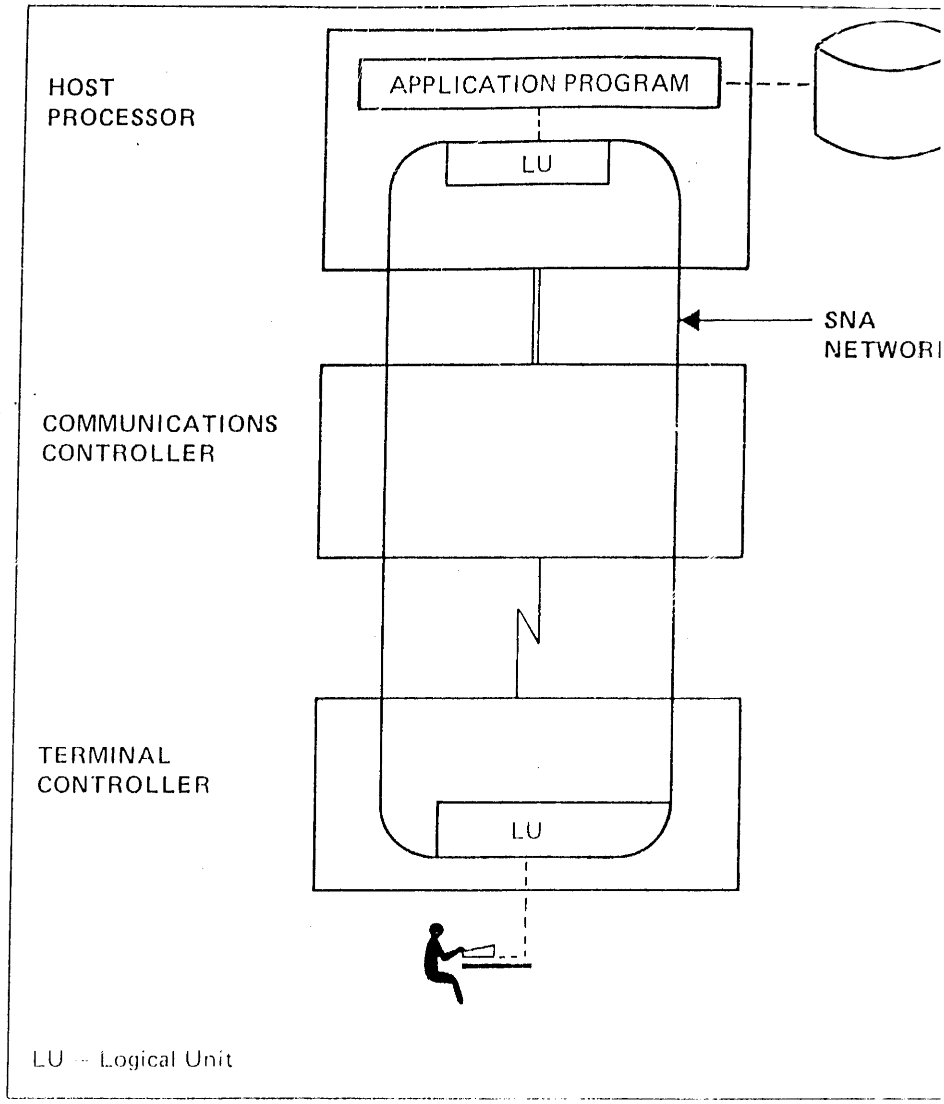

Figure 1-4. Logical Units

An end user, such as the terminal operator, can submit a message to its asso ciate logical unit. The logical unit will perform an operation to transmit the message to the logical unit that is associated with the destination end user. The logical unit in the host subarea node performs an operation to accept the message, and in turn gives the message to its end user. Both end users can send messages to, and recei messages from each other via associated logical units.

The two logical units perform all of the functions required to maintain communication between the two end users.

Logical unit services include:

- Send and receive functions.
- Error recovery functions.
- Formatting message units appropriately so they can be transmitted through the network.

- Formatting and displaying the information for end users.

End-users don't have to be concerned with providing the services to transmit message units through the network, logical units do that.

Logical units are implemented in some nodes by software and in other nodes by hardware. Software logical units reside in host subarea nodes and in certain programmable peripheral nodes. Hardware logical units reside in non-programmable peripheral nodes.

Network owners can use existing programming products that implement logical units or they can code their own programs to implement logical units.

There are several IBM subsystems that contain a logical unit:

- CICS VS
- IMS VS
- RJE
- DPPX DTMS
- VSPC

Logical units can be designed to service one or multiple end users. Logical units in host subarea nodes may provide services for multiple user application programs (end users). Programmable peripheral nodes may contain multiple logical units and a logical unit may provide services for multiple end users. Certain non-programmable peripheral nodes contain one logical unit and provide services for one end user. Other non-programmable peripheral nodes may contain multiple logical units and a logical unit may provide services for multiple end users.

A logical unit may be defined to provide services for end users that perform specific types of applications. For example, a logical unit could provide services for end users that perform data base operations. Another logical unit could provide services for end users that perform batch data transfer operations. And another logical unit could provide services for end users that provide system development and maintenance capabilities, e.g., TSO. TSO allows a user to do online operations e.g., develop application programs and create and modify data sets.

Physical Units (PUs): A physical unit resides in each SNA node and provides services to manage that node's physical resources. For example, the physical unit that resides in a communications controller subarea node manages that node's telecommunications links. Figure 1-5shows a physical unit in the processor, in the communications controller, and in the terminal controller.

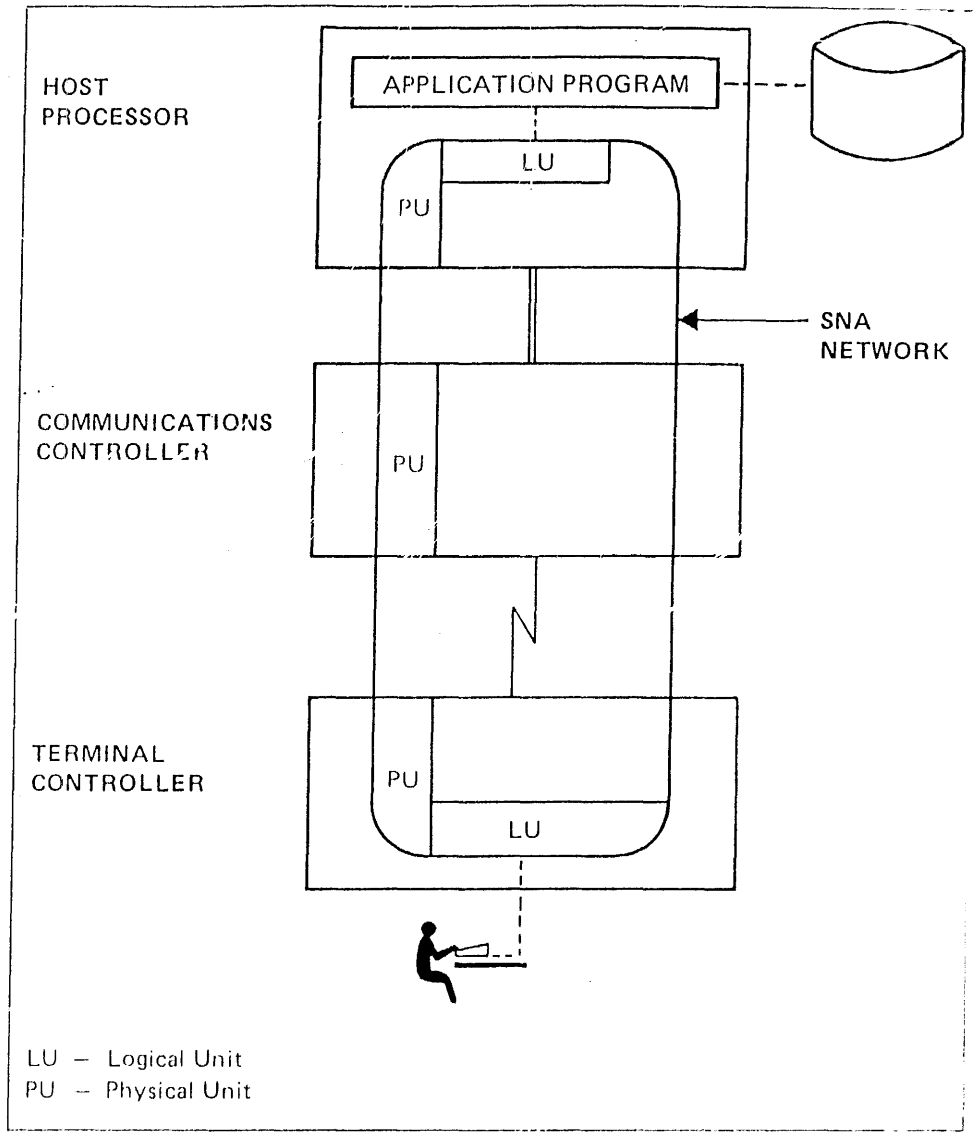

Figure 1-5. Physical Units

The SNA access method in the host processor implements the physical unit function for the host subarea node. The network control program, ACF/NCP/VS, in the communications controller implements the physical unit function for the communications controller subarea node. The physical unit function in a terminal controller is implemented by hardware and/or software, depending on the type of controller.

System Services Control Point (SSCP): The **system services control point (SSCP)** resides in a host subarea node and provides services for monitoring, managing, and controlling resources in the SNA network. Figure 1-6 shows an SSCP in the host subarea node.

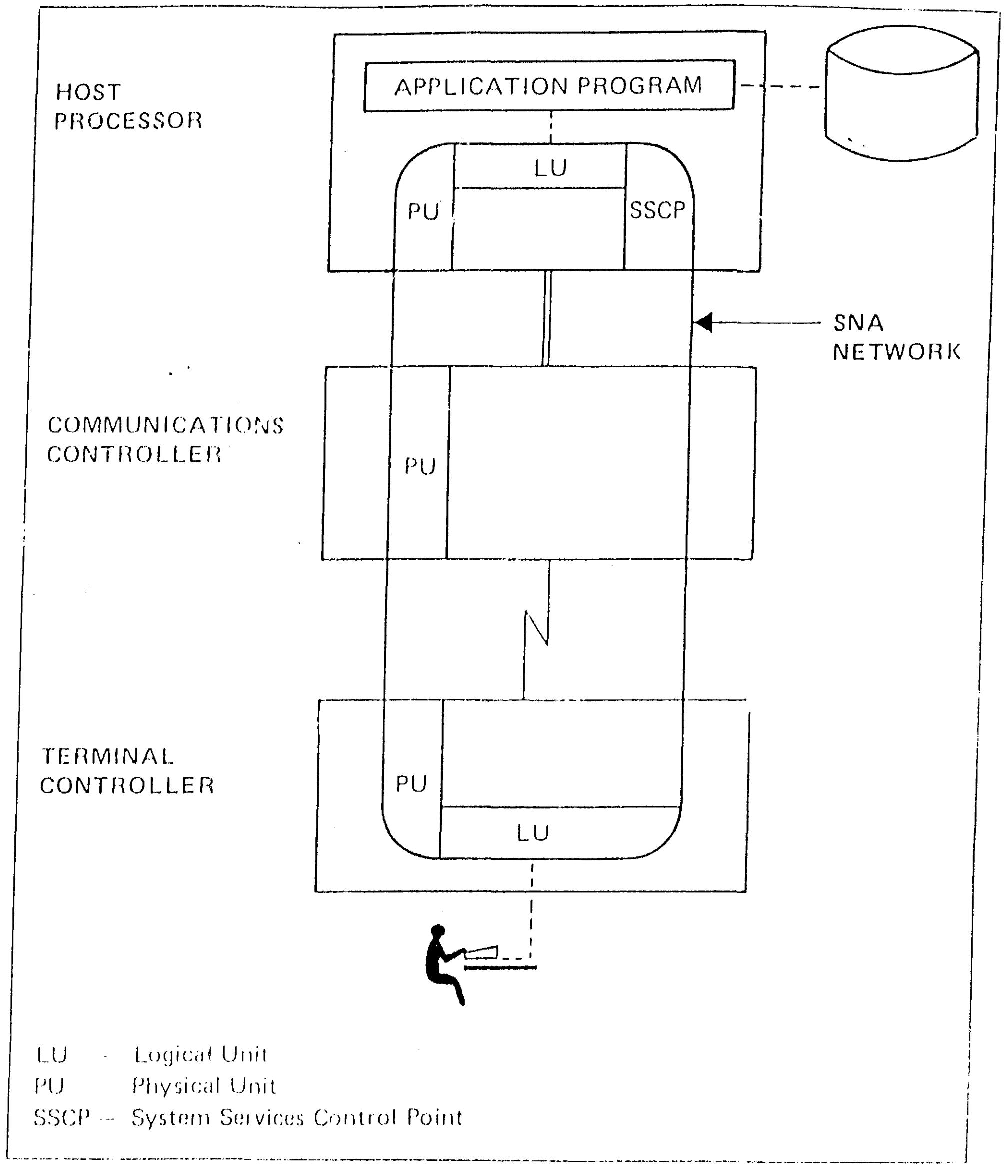

Figure 1-6. The System Services Control Point (SSCP)

The SSCP communicates with the physical unit in each node to manage the physical resources of that node. The SSCP communicates with each logical unit to manage those resources.

The SSCP is implemented by an SNA access method, such as ACF/VTAM or ACF/TCAM.

An SNA network can include one or multiple SSCPs. For networks that include multiple SSCPs, each SSCP controls specific resources in the network. The resources controlled by an SSCP is said to reside in the domain of that SSCP.

A network that contains multiple SSCPs is called a multiple-domain network. In a multiple-domain network, end users in one domain may communicate with end users in the other domains. We will discuss multiple-domain networks in the Mini-course entitled "Multiple Domains."

The Path Control Network: The **path control network** consists of two major components:

1. Data Link Control (DLC). DLC manages the transmission of data across data links.

2. Path Control (PC). PC provides services to route messages through the SNA network.

Path control and data link control components reside in every SNA node and are illustrated in Figure 1-7.

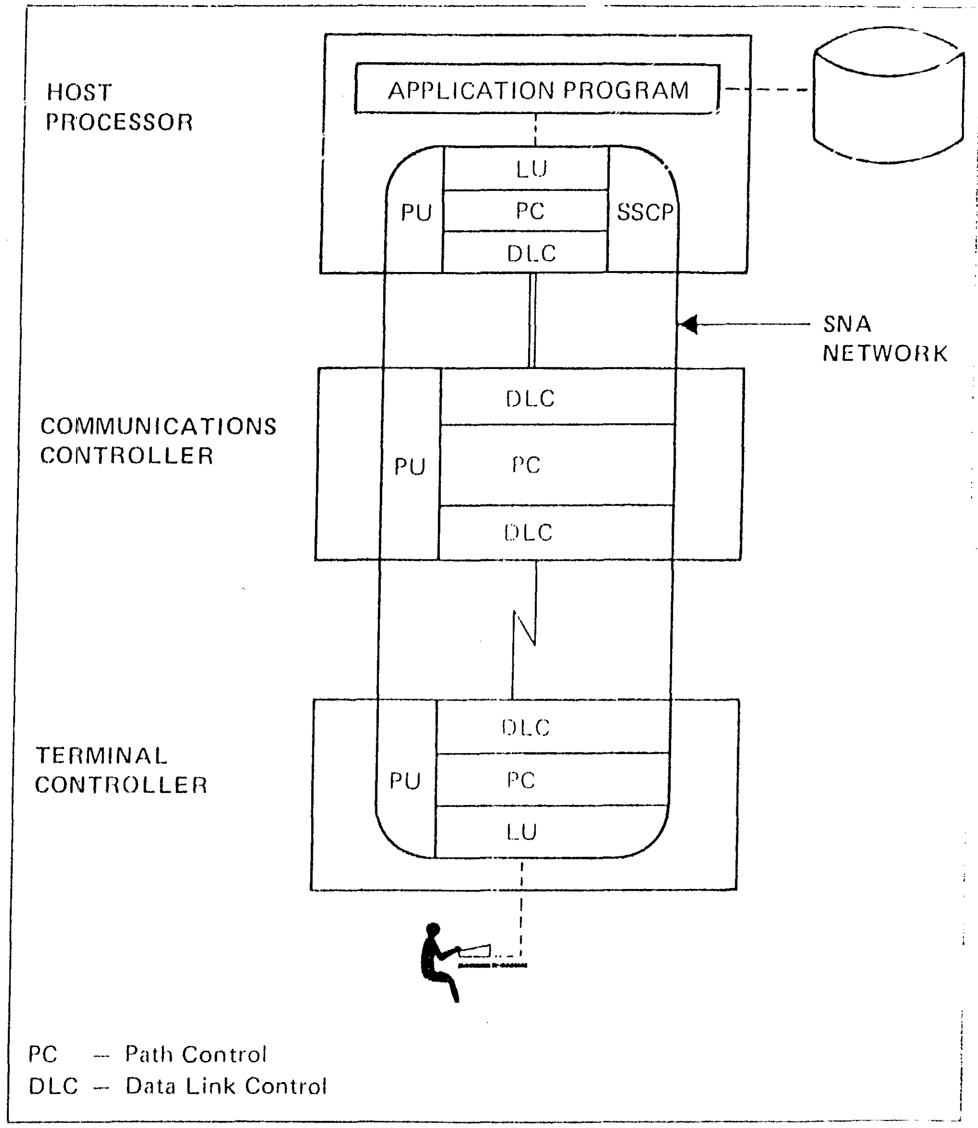

Figure 1-7. The Path Control Network

Path control and data link control components are implemented in the host subarea node by an SNA access method (ACF/VTAM or ACF/TCAM). The network control program, ACF/NCP/VS, implements path control and data link control components in a communications controller subarea node. Depending on the type of terminal controller, hardware and/or software implement path control and data link control components in peripheral nodes.

Data Flow: Figure 1-8illustrates the flow of data through SNA components within a 3 node SNA network. The data flow is between a user application program (end user) in the host subarea node and an end user (EU) in the peripheral node. Study the figure, then read the discussion that follows.

```
HOST SUBAREA NODE              SUBAREA NODE               PERIPHERAL NODE
                           |                          |
EU --▶LU --▶PC --▶DLC -|-▶DLC --▶PC --▶DLC -|-▶DLC --▶PC --▶LU --▶EU
                           |                          |

EU  -- End User
LU  -- Logical Unit
PC  -- Path Control
DLC -- Data Link Control
```

Figure 1-8. SNA Data Flow

The end user in the host subarea node gives a message to its associated logical unit (LU) for transmission to the end user in the peripheral node. The LU attaches a header to the message. We will call the message and header combination a message unit. The header contains information that describes the message and specifies how communication is to be handled between the two logical units. Only the two LUs use the information in the header.

The logical unit gives the message unit to the path control network for transmission to the destination logical unit. The path control (PC) component in the host subarea node attaches another header that contains routing information. Path control in each node that the message unit passes through uses the routing information to route the message unit to its destination.

Once the second header is attached, path control gives the message unit to the appropriate data link control (DLC) component for transmission across the data link to the communications controller subarea node. DLC attaches the required link control information for transmission across the data link (processor channel). The receiving DLC component in the communications controller subarea node removes the link control information and gives the message unit to path control in that node.

There could be multiple data links attaching other nodes to this communications controller subarea node. In which case, path control would determine the link over which the message unit is to be transmitted. Path control gives the message unit to the appropriate DLC component for transmission across the data link to the DLC component in the peripheral node. The sending DLC component attaches link control information and the receiving DLC component removes the information.

The receiving DLC component gives the message unit to path control. If multiple logical units reside in the peripheral node, path control routes the message to the appropriate one. Path control removes the header that was attached by path control in the host subarea node and gives the message unit to the destination logical unit. The logical unit removes the other header and gives the message to the end user.

The message has now traveled from the end user in the host subarea node through the SNA network to the end user in the peripheral node . The end user message was not monitored or altered by the logical units or by the path control network. The sending logical unit attached a header to communicate information to the receiving logical unit. Path control in the host subarea node attached a header that contained routing information for use by the path control components in the communications controller subarea node and in the peripheral node. Data link control components attached and removed link control information required for transmission across each link.

The two end users do not get involved in any of the activities for transmitting the message unit through the network.

The data flow from the end user in the peripheral node to the end user in the host subarea node is through the same SNA components in reverse order.

Network Addressable Units (NAUs)

Logical units (LUs), physical units (PUs), and systems services control points (SSCPs) are called **Network Addressable Units (NAUs)** NAUs are assigned network addresses so that data can be transmitted from one NAU to another NAU. For example, an end user in a host subarea node wants to send data to an end user in a peripheral node. Each end user is associated with a logical unit and since each logical unit has a network address, the logical unit in the host subarea node can transmit it's end user's data to the logical unit in the peripheral node. The logical unit in the peripheral node can transmit its end user's data to the logical unit in the host subarea node.

A logical connection must exist between two network addressable units in order for them to communicate with each other. That logical connection is called a **session**. In a single domain environment three types of sessions must be established:

1. SSCP-PU sessions. A session must be established between the SSCP and each physical unit (PU) so the SSCP can communicate with the PUs.

2. SSCP-LU sessions. A session must be established between the SSCP and each logical unit (LU) so the SSCP can communicate with the LUs.

3. LU-LU sessions. A session must be established between a pair of logical units so they can communicate with each other, allowing end users to communicate with each other.

LU-LU Sessions: Two logical units must be in session (logically connected) so that their associated end users can send messages to and and receive messages from each other. This is called a logical unit to logical unit **(LU-LU) session.**

The process of establishing an LU-LU session verifies that:

- Physical connectivity exists between the two logical units.

- The logical units are operational.

- Appropriate resources are available, such as buffers and processing capacity.

- The two logical units are willing to communicate with each other according to a given set of protocols (rules).

The LU-LU session will not be established if any of these conditions are not satisfied.

The LU-LU session is a temporary relationship. LU-LU sessions are necessary only for the time needed to handle the communication requirements of their associated end users. A logical unit may terminate a session with one logical unit and establish a session with another logical unit. For example, a logical unit in a peripheral node may establish a session with CICS in a host subarea node to process transactions. Once the transactions have been processed, the logical unit in the peripheral node may terminate the session and establish a session with another logical unit, e.g., TSO. Figure 1-9 illustrates logical connections between logical units.

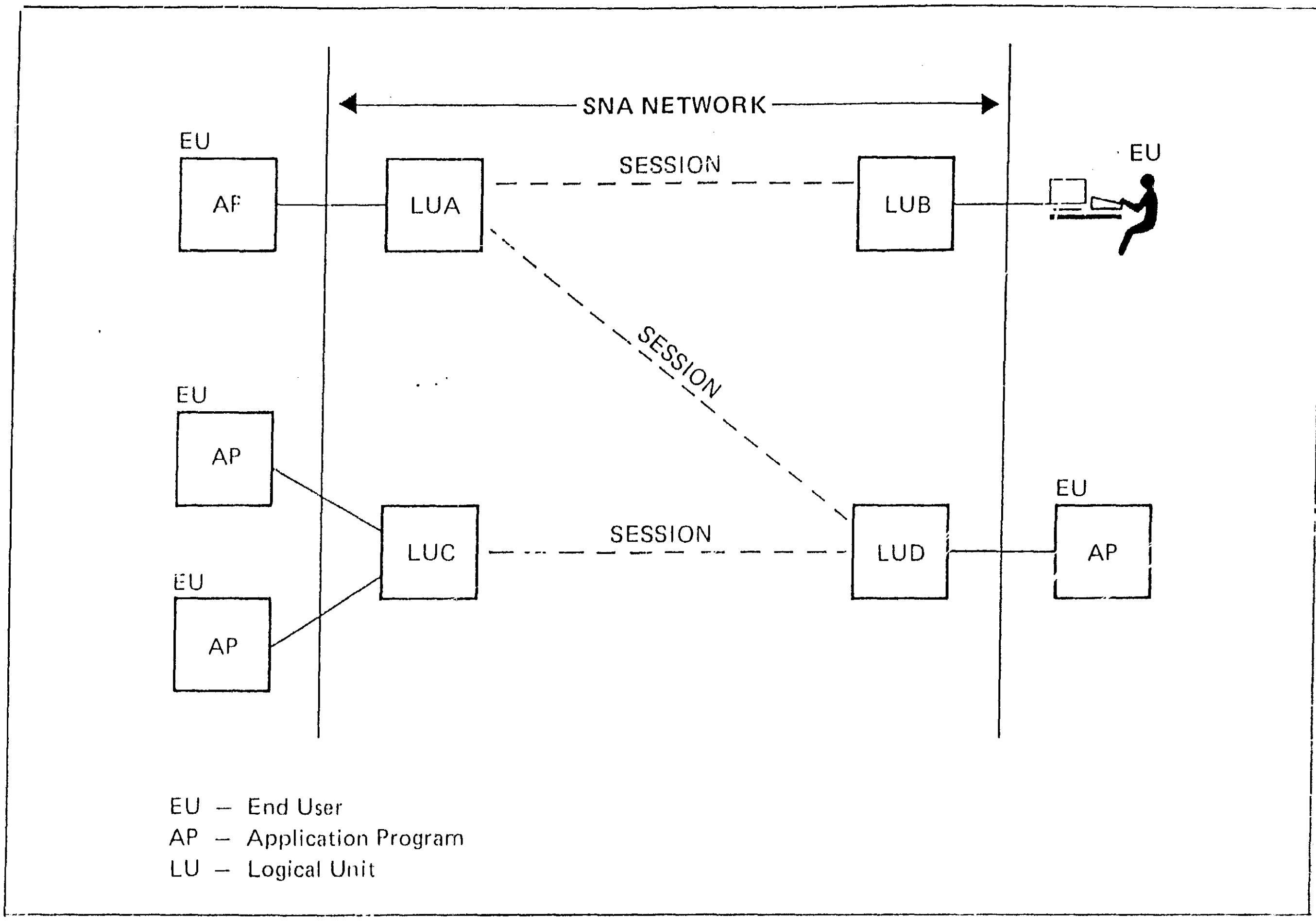

Figure 1-9. LU-LU Sessions

Each logical unit (LU) is assigned a unique symbolic name by the network definer and the network assigns network addresses. In our example the four logical units are arbitrarily assigned the symbolic names LUA, LUB, LUC, and LUD. A logical unit can request a session with another logical unit by symbolic name. Once the LU-LU session is established, the network addresses of the logical units are used for routing messages through the network between the two logical units. Figure 1-9 shows that logical unit "LUA" is in session with logical units "LUB" and "LUD" and logical unit "LU" is in session with logical unit "LUD." Most logical units in peripheral nodes support only one LU-LU session at a time. Logical units in a host subarea node may be designed to support multiple simultaneous LU-LU sessions.

SSCP Sessions: SSCP sessions must be established before LU-LU sessions can be established. Figure 1-10 shows the required sessions for that configuration and indicates the order in which the sessions can be established.

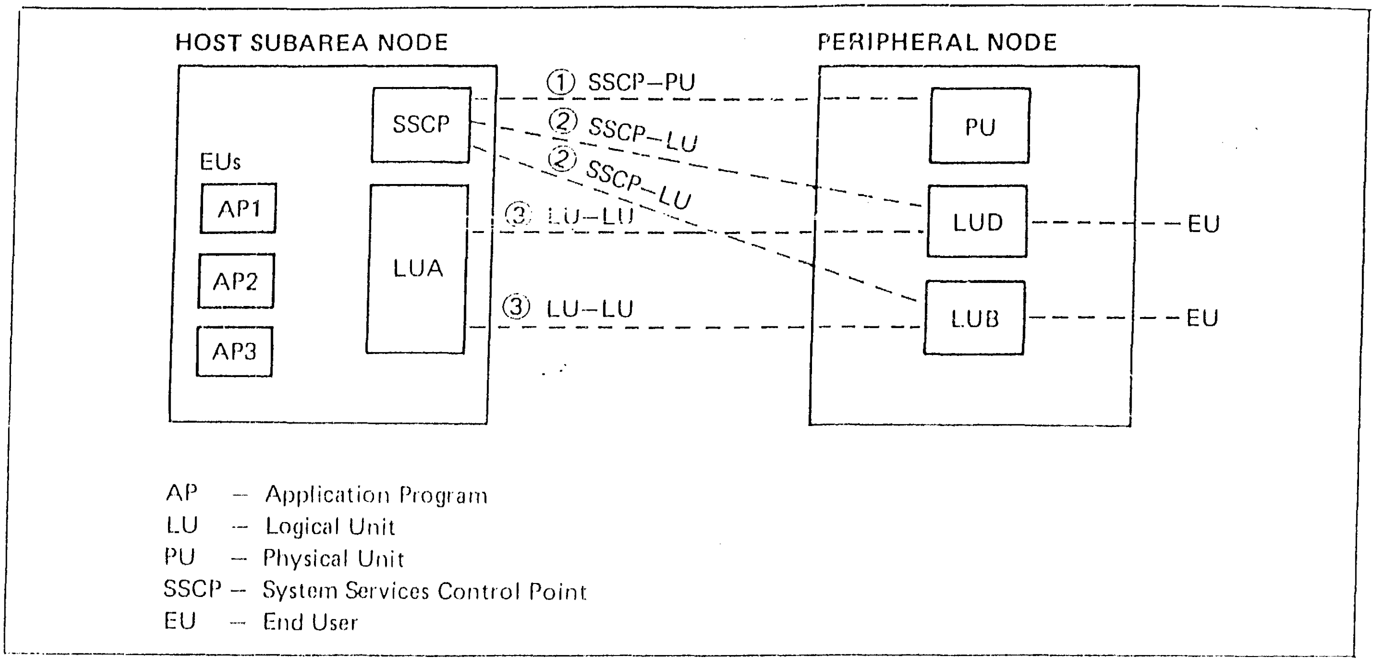

Figure 1-10. SSCP Sessions

The SSCP obtains and maintains control over all resources in the network. The SSCP obtains control of a resource by establishing a session with the resource. The SSCP first establishes sessions with physical resources (PUs) in each node and then with each logical resource (LU). Figure 1-10 shows that the SSCP establishes a session with the PU in the peripheral node first. This session verifies that the peripheral node and its resources are operational.

Once the SSCP-PU session is established, the SSCP can establish sessions with the logical units in the peripheral node. SNA does not require that SSCP-LU sessions be established in a specific order. SSCP-LU sessions verify that the logical units are operational.

The process by which LU-LU sessions are established is managed by the SSCP. For example, logical unit LUD wants a session with logical unit LUA. LUD sends a message (called a logon) over the SSCP-LUD session to the SSCP. The logon requests that a session be established between LUD and LUA. The SSCP manages the operation to establish the LUD-LUA session. A session can be established between LUB and LUA in the same manner.

The SSCP manages the SNA network via the SSCP sessions. Physical units (PUs) in each node report physical errors and component failures within their nodes to the SSCP. The SSCP stores the information for use by personnel that maintain the network. The information can be used to detect problems before they become severe and to do problem determination. The SSCP can recover some error conditions without intervention by network operations personnel.

The SSCP manages the establishment of LU-LU sessions and maintains a record of sessions. The SSCP also maintains the status of all network resources. SNA defines a network operator interface which allows a network operator to communicate with the SSCP to determine the status of any network resource.

The SSCP is the central point of control that manages the entire network. Physical units, under direction of the SSCP, manage the resources in each node and report errors and component failures to the SSCP. Logical units provide ports for end users to the SNA network.

Network Addresses

Each logical unit and each physical unit in an SNA network is assigned a unique symbolic name by the network definer. For multiple SSCP (multiple domain) networks, each SSCP is assigned a unique symbolic name.

Symbolic names are used when sessions are initiated and when sessions are terminated. For example, an end-user (e.g., a terminal operator) submits a logon message to its LU to establish a session with a logical unit in the host subarea node. The logon is sent to the SSCP and it contains the symbolic name of the submitting logical unit and the symbolic name of the logical unit in the host subarea node.

It is easier for network users to ask for sessions by symbolic names rather than by network addresses. Once the session is established, it's more efficient to use network addresses rather than symbolic names for routing message units between two session partners.

At the time that a session is established, the symbolic names are associated with the network addresses of the two resources. All communication on the session uses network addresses. Each message unit contains an origin network address and a destination network address. For example, a logical unit in the host subarea node sends a message unit to a logical unit in a peripheral node. The origin network address is for the logical unit in the host node and the destination network address is for the logical unit in the peripheral node. The network addresses are reversed in the message unit sent by the logical unit in the peripheral node to the logical unit in the host subarea node.

The network address that is assigned to each network addressable unit (SSCP, PU, and LU) consists of a **subarea address** and an **element address**. We need to know what makes up a subarea in order to understand a network address.

Subareas: An SNA network is divided into subareas as illustrated in Figure 1-11.

1 domain

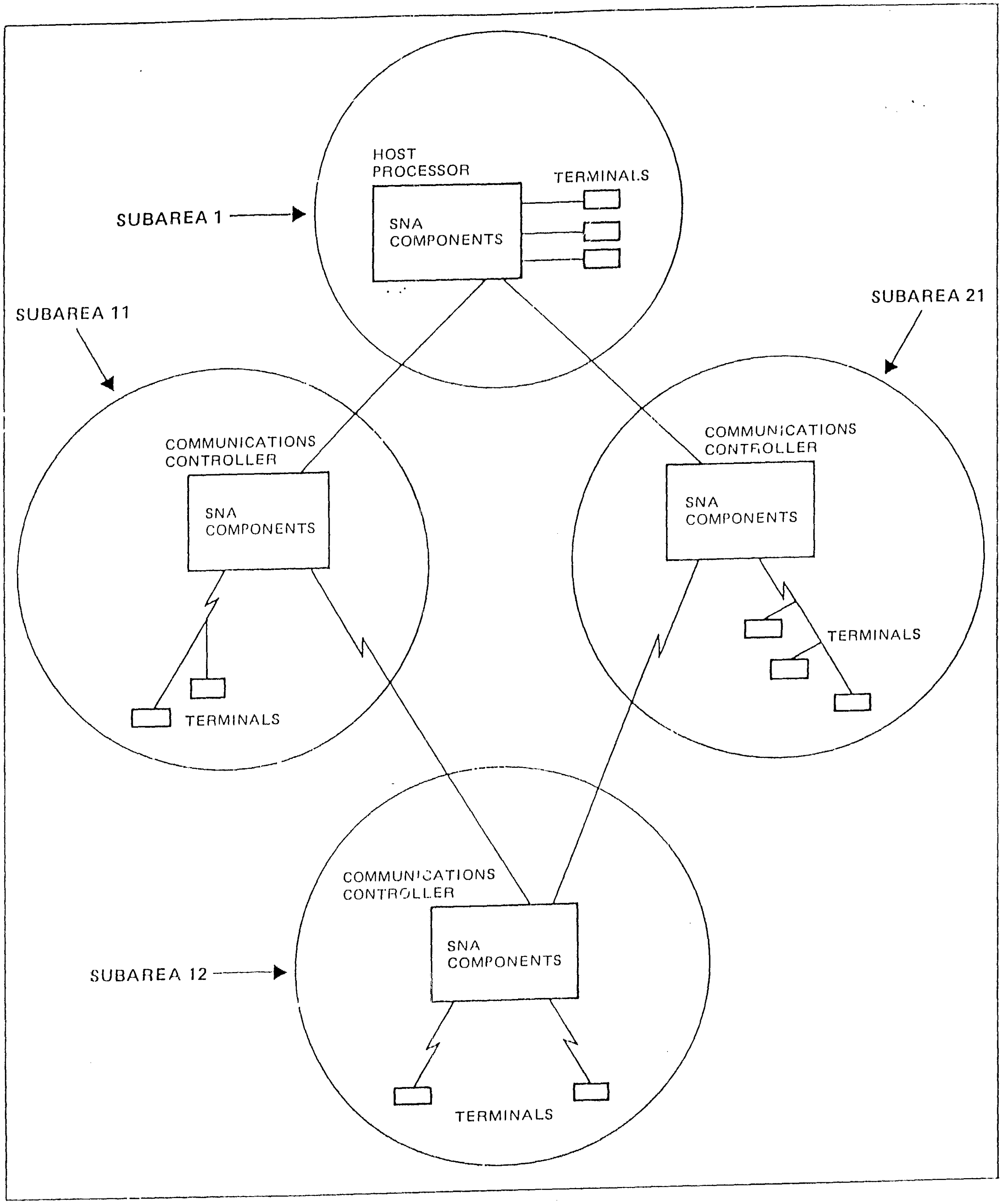

Figure 1-11. Subareas

A subarea consists of a subarea node and the peripheral nodes connected to that node. Four subarea nodes are illustrated in the figure, one host subarea node and three communications controller subarea nodes. The network definer assigns a unique number for each subarea (1, 11, 12, and 21).

The division of an SNA network into subareas is the basis of network addresses. All logical units, physical units, and the SSCP in subarea 1 are assigned network addresses. The subarea part of each address contains a 1 and the associated element address specifies the address of each resource within subarea 1. The network addresses of the resources in subarea 11 are made up of subarea address 11 and associated element addresses. The network addresses of resources in subarea 12 have a subarea address of 12 with associated element addresses, and the resources in subarea 21 have a subarea address of 21 with associated element addresses.

The subarea address is used by path control to route message units from subarea node to subarea node. Once a message unit reaches the destination subarea node, the associated element address is used to route the message to the appropriate resource within the subarea.

Item A in Figure 1-12shows the format of a network address.

a.	SUBAREA ADDRESS	ELEMENT ADDRESS
b.	12	1

Figure 1-12. Network Address Format

Assume that a logical unit in subarea 1 (Figure 1-11) is sending a message unit to a logical unit in subarea 12. Item B in Figure 1-12shows the network address of the logical unit in subarea 12. The network address of the logical unit in subarea 12 has a subarea address of 12 and an element address of 1. Element addresses are unique within each subarea.

Please turn to Mini-Course 1 in your Personal Reference Guide and read the summary.

SNA Fundamentals

Mini-Course 2

SNA Nodes

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Mini-Course 2. SNA Nodes

Introduction

An SNA network consists of subarea nodes and peripheral nodes interconnected b data links. Subarea nodes can be interconnected by data (processor) channels and SDLC links. Each peripheral node is connected to a subarea node by a data channel or by an SDLC link.

Communications controller subarea nodes can be interconnected by multiple SDL links, called parallel links.

Links that interconnect each subarea pair are defined as part of a logical grouping, called a transmission group.

We will discuss how nodes are interconnected, what makes up a route, and describ route extensions. First we will review SNA nodes.

Types of SNA Nodes

SNA defines a **node** as a point within an SNA network that contains SNA components. Nodes are either **subarea nodes** or **peripheral nodes**. The two kinds differ in the way they interconnect with other nodes and in their ability to route message units through the network. Host processors and communications controllers that contain SNA components are called subarea nodes. Cluster controllers, terminals, and some distributed processors that contain SNA components are called peripheral nodes. Figure 2-1 illustrates an SNA network with two subarea nodes and four peripheral nodes.

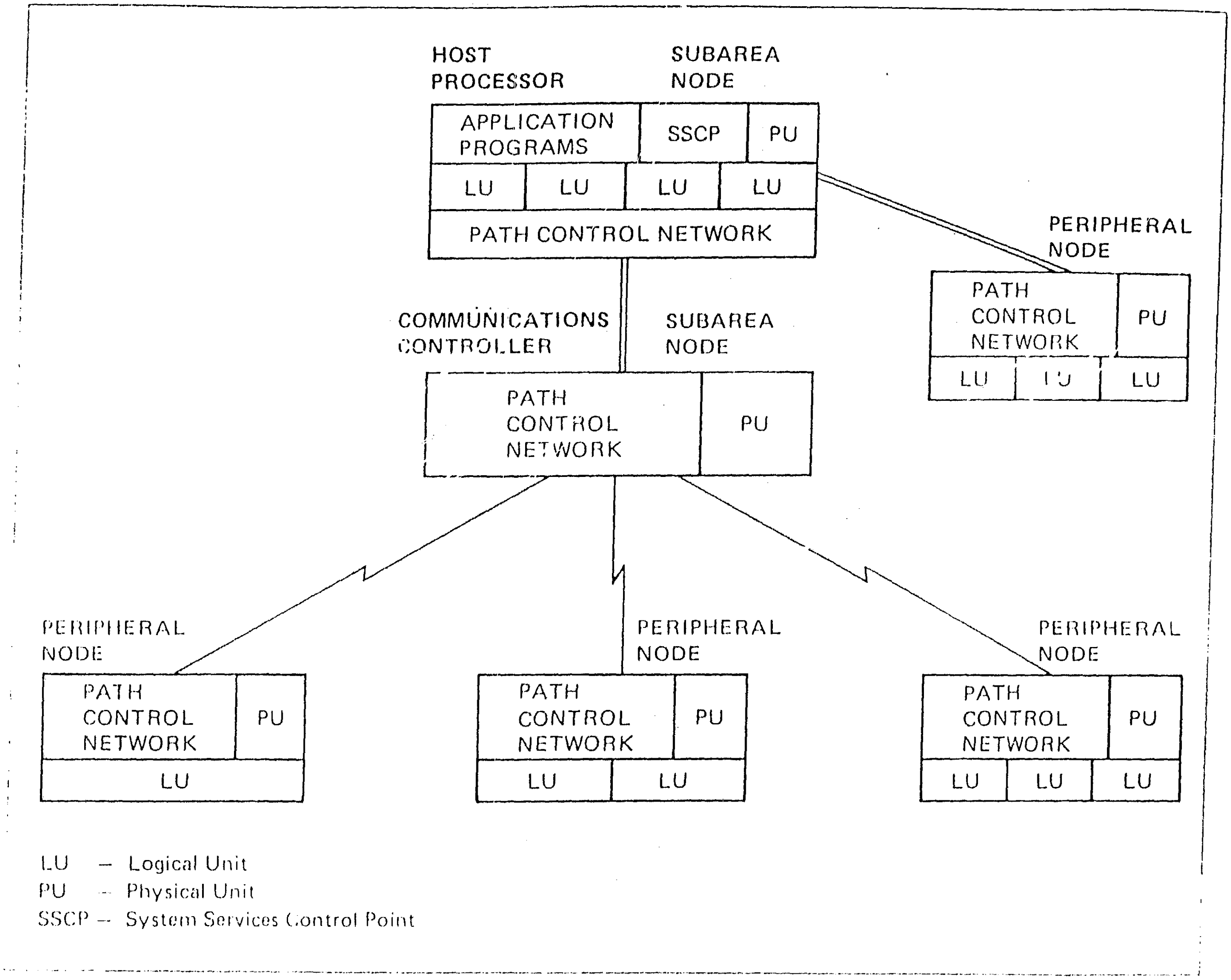


Figure 2-1. SNA Nodes

There are two types of subarea nodes:

1. A subarea node that contains an SSCP. This subarea node resides in a host processor and is also called a host subarea node. This node controls the resources in its own node as well as the resources in the other network nodes. The host subarea node is the central point of control for the network.

   The host subarea node has full routing capability. Its path control can handle the routing of message units for the following situations:

   a. The message unit originates in the host subarea node and its destination is the host subarea node. Logical units that reside in the host subarea node can communicate with each other.

   b. The message unit originates in the host subarea node and it is destined for a resource in another node.

   c. The host subarea node receives a message unit for a resource in its node.

d. The message unit neither originates in nor is destined for the host subar(node but is routed through the host subarea node.

2. A subarea node that does not contain an SSCP. This subarea node resides i communications controller and is also called a communications controller n(The communications controller node, under direction of the host subarea nc (SSCP), manages its own resources. Like the host subarea node, this node l full routing capability.

Peripheral nodes are connected to subarea nodes. A peripheral node, under direction of a host subarea node (SSCP), manages its own resources. It has fewe routing capabilities than subarea nodes. Message units received by a peripheral node are routed to the physical unit (PU) or to a logical unit (LU) in the node. Message units cannot be routed through the node. Message units that originate i a peripheral node are transmitted over the single link that connects it to a subare node.

The peripheral node is not aware of any part of the network beyond the adjacent subarea node. It cannot handle the network address contained in message units transmitted between subarea nodes. A simpler form of the network address is us by peripheral nodes. The address is called a **local address** as it is used only by the peripheral node and its subarea node.

Network addresses in message units are converted to local addresses by the adjacent subarea node before being transmitted over the link to the peripheral node. Path control in the peripheral node uses the local address to route the message unit to the resource (PU or LU) within the node. This process is reverse when the peripheral node transmits a message unit to its adjacent subarea node. The subarea node converts the local address in the message unit to a network address for routing to and through subarea nodes.

Physical Unit Types

The physical unit (PU) in each SNA node is defined as a **PU type**. The PU in a host subarea node is a **PU type 5 (PU.T5)**, the PU in a communications controller subarea node is a **PU type 4 (PU.T4)**, and the PU in a peripheral node is either a **PU type 1 (PU.T1)** or a **PU type 2 (PU.T2)**. Node types correspond to the PU typ used in the node.

The PU type, or node type, reflects the functional capabilities of the node as well as the format of the message unit used by the node. Type 5 nodes (nodes that contain a PU.T5) have more functional capability than the other node types. Typ 4 nodes have more functional capability than type 1 and type 2 nodes, and type 2 nodes have more functional capability than type 1 nodes.

In the remainder of the course, we will use the terms "node type" and "PU type" as appropriate to differentiate between node types.

Connecting SNA Nodes

All nodes in a multi-node SNA network are connected to one or more other SNA nodes by **data links**. The various data link facilities supported include **data channels, telephone lines, satellite links, and microwave links.**

An SNA network can consist of one or more nodes. A single node SNA networ! consists of a host subarea node, in which case, no data links are required. The h subarea node can support multiple logical units that can be associated with multi application programs (end users). LU-LU sessions can be established in the hos node allowing end users within the node to communicate with each other. Although a single node network is possible, it is not typical. A typical configuration is one in which peripheral nodes are connected to a host subarea node as shown in Figure 2-2.

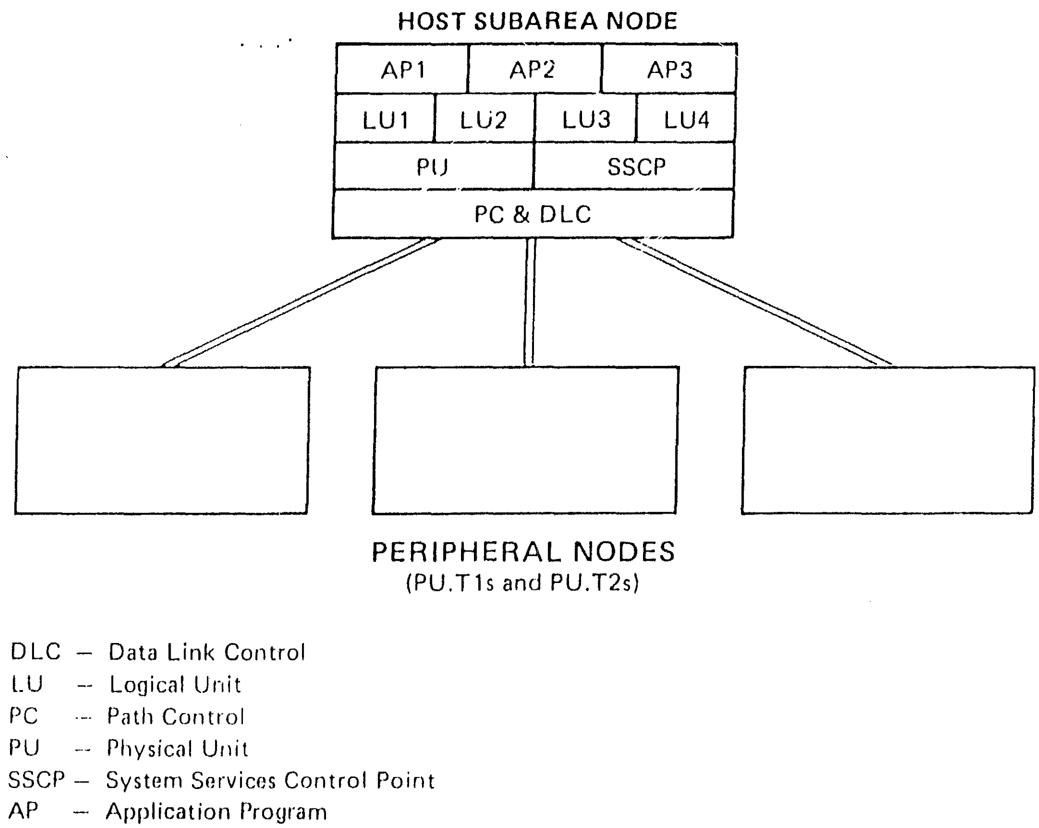
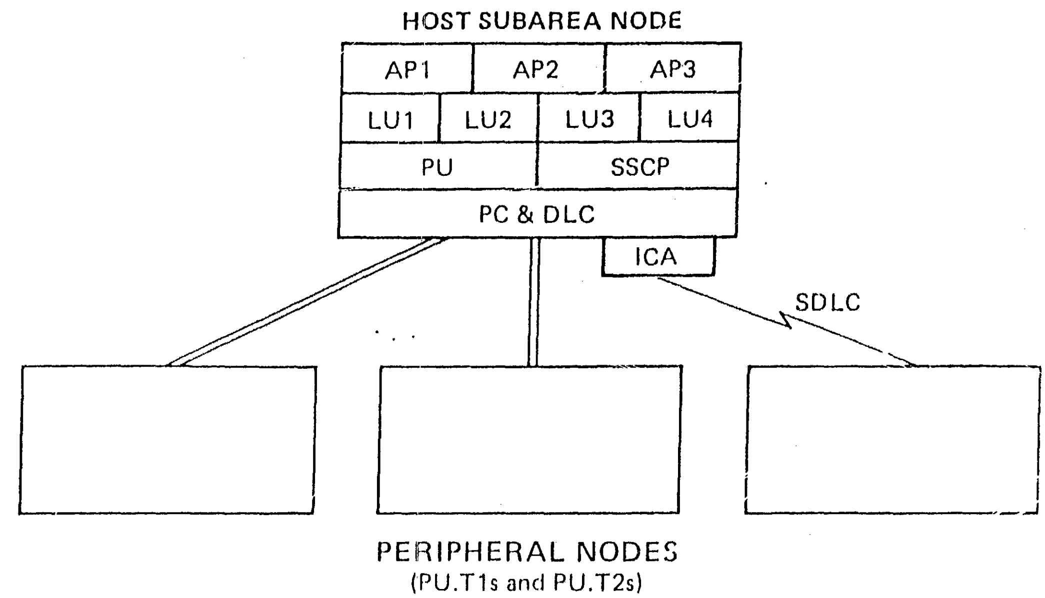


Figure 2-2. Connecting Peripheral Nodes to a Host Subarea Node

The peripheral nodes are connected to the host node by data channels. Data links that connect peripheral nodes to subarea nodes are called peripheral links.

If the processor and the SNA access method support the integrated communications adapter (ICA), then peripheral nodes can be attached to the host subarea node by SDLC links as illustrated in Figure 2-3.



DLC – Data Link Control
LU – Logical Unit
PC – Path Control
PU – Physical Unit
SSCP – System Services Control Point
AP – Application Program
ICA – Integrated Communications Adapter

Figure 2-3. Connecting Peripheral Nodes via the ICA

Together, the SNA access method and the ICA perform the functions to manage transmission over the SDLC link.

This figure includes two types of peripheral links: (1) data channel and (2) SDLC link.

A more complex SNA network consists of multiple subarea nodes as well as multiple peripheral nodes. Figure 2-4includes four subarea nodes and six peripheral nodes. The nodes are numbered for easy reference. The subarea nodes are numbered 1 through 4 and the peripheral nodes are numbered 5 through 10.

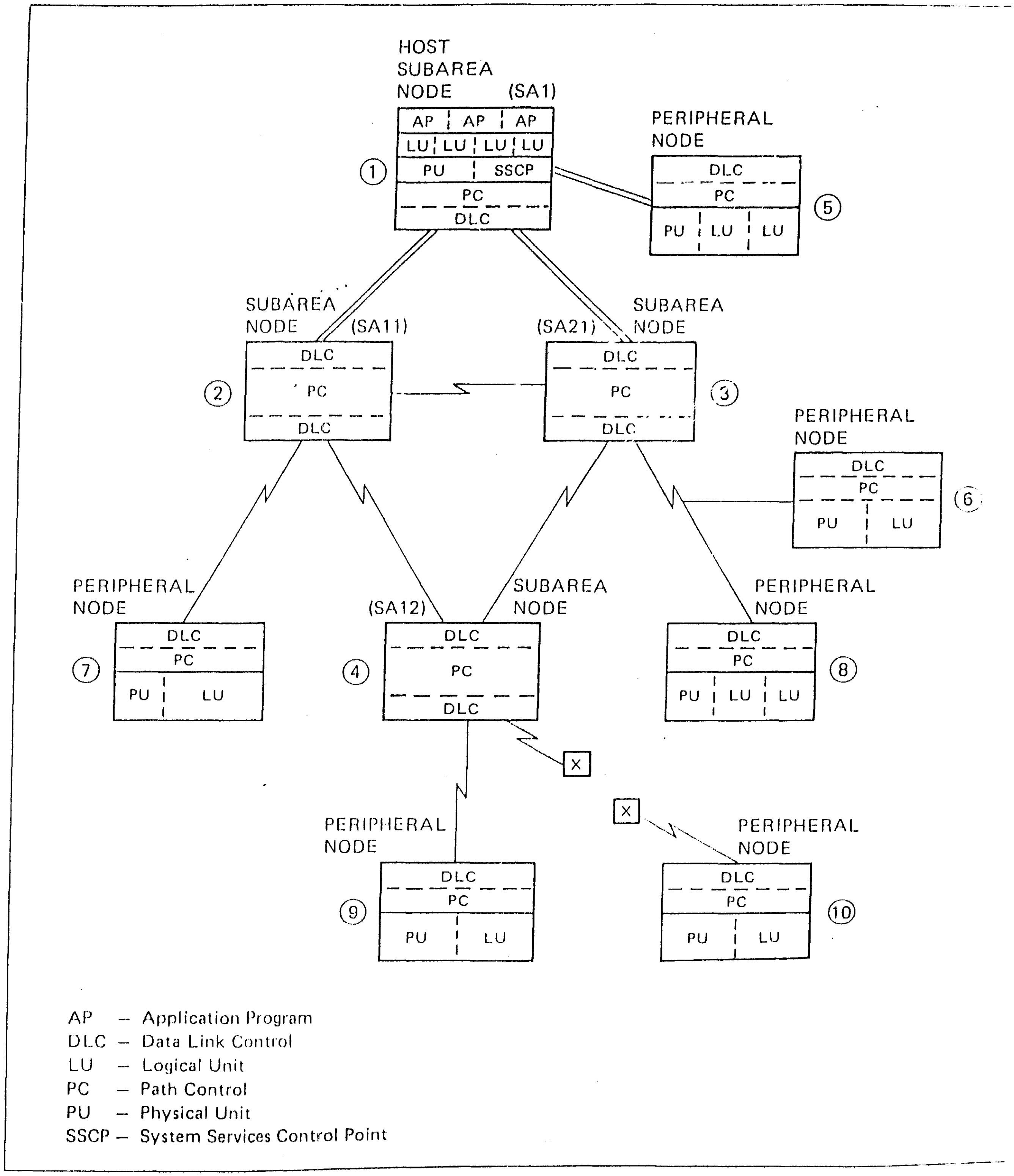


Figure 2-4. Multiple Subarea Network

A data channel (peripheral link) connects peripheral node number 5 to the host subarea node. Subarea nodes numbered 2 and 3 are connected to the host node by data channels. Subarea nodes numbered 2 and 3 are connected to each other by an SDLC link. Subarea node number 4 is connected via SDLC links to subarea nodes numbered 2 and 3.

A link that connects two subarea nodes is called a **cross-subarea link**. A cross-subarea link can be either a data channel or an SDLC link.

Peripheral nodes numbered 6, 7, 8, 9, and 10 are connected to their subarea nodes via SDLC links. Peripheral nodes numbered 6 and 8 are connected to their subarea node by the same SDLC link. Peripheral node numbered 10 is connected to subarea node numbered 4 by a switched-SDLC link.

Parallel Links: Figure 2-4 shows each node connected to another node by a single data link. SNA allows multiple SDLC links to be defined between type 4 subarea nodes as shown in Figure 2-5.

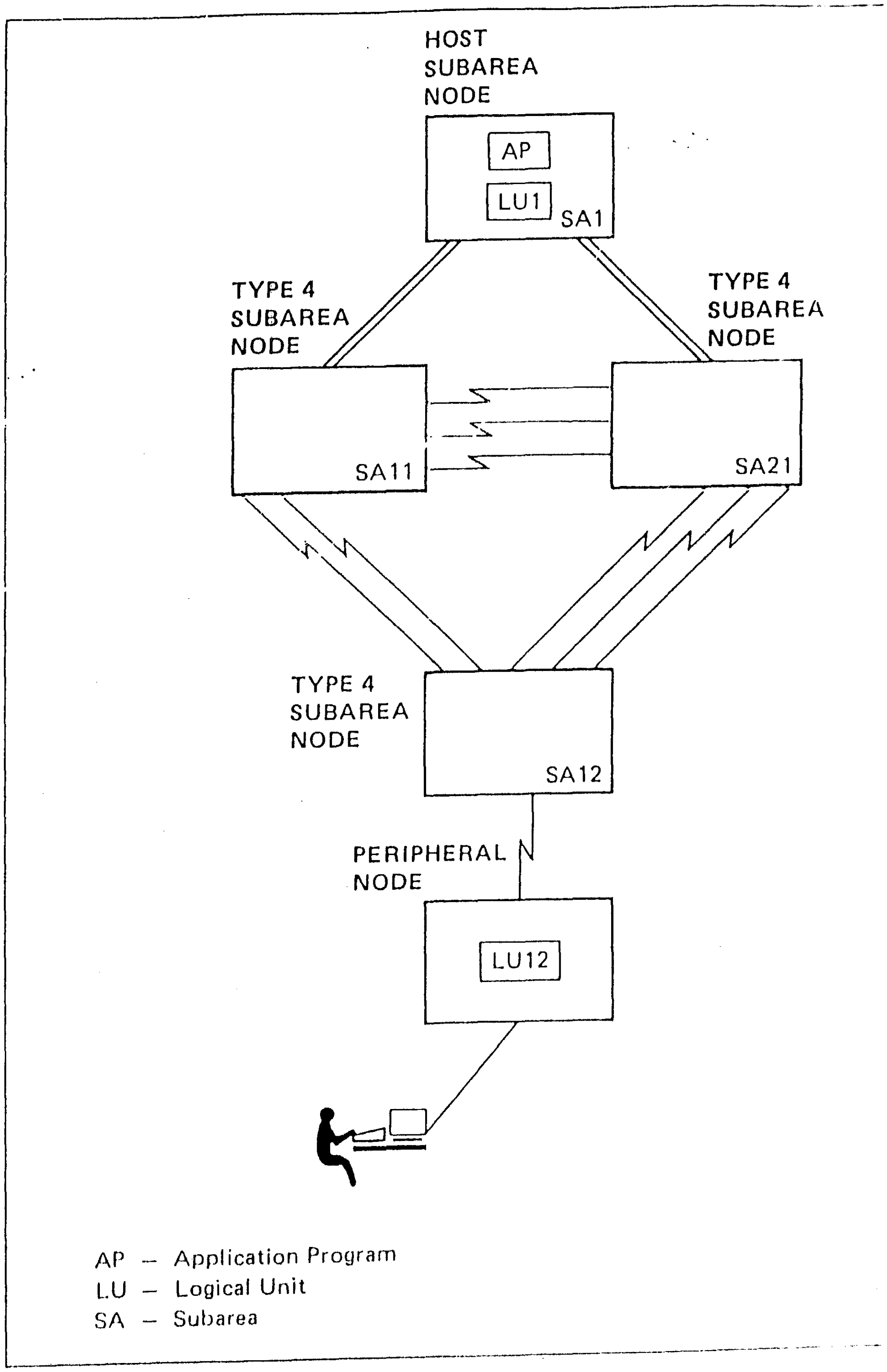


Figure 2-5. Parallel links

Multiple SDLC links that connect two subarea nodes and are operating concurrently are called **parallel links**. A host subarea node is not connected by parallel links to another subarea node, nor is a peripheral node. Only type 4 subarea nodes are interconnected by parallel links.

Traffic flowing between the two subarea nodes (SA21 and SA12) is distributed among the three links. Parallel links provide greater bandwidth than single links thus allowing a higher rate of traffic between the two nodes and increased reliability. If one of the links fails, traffic continues on the other operative links.

The maximum number of links that may connect two type 4 subarea nodes depends on the limitations of the communications controllers that house the subarea nodes. There is no SNA limitation.

Transmission Groups: SNA specifies that links connecting subarea nodes be assigned to logical groupings called **transmission groups**. For example, the three links connecting the subarea nodes in subareas 21 and 12 can be grouped into one, two, or three transmission groups. Multiple link transmission groups provide increased bandwidth over single link transmission groups. Figure 2-6shows all links assigned to transmission groups.

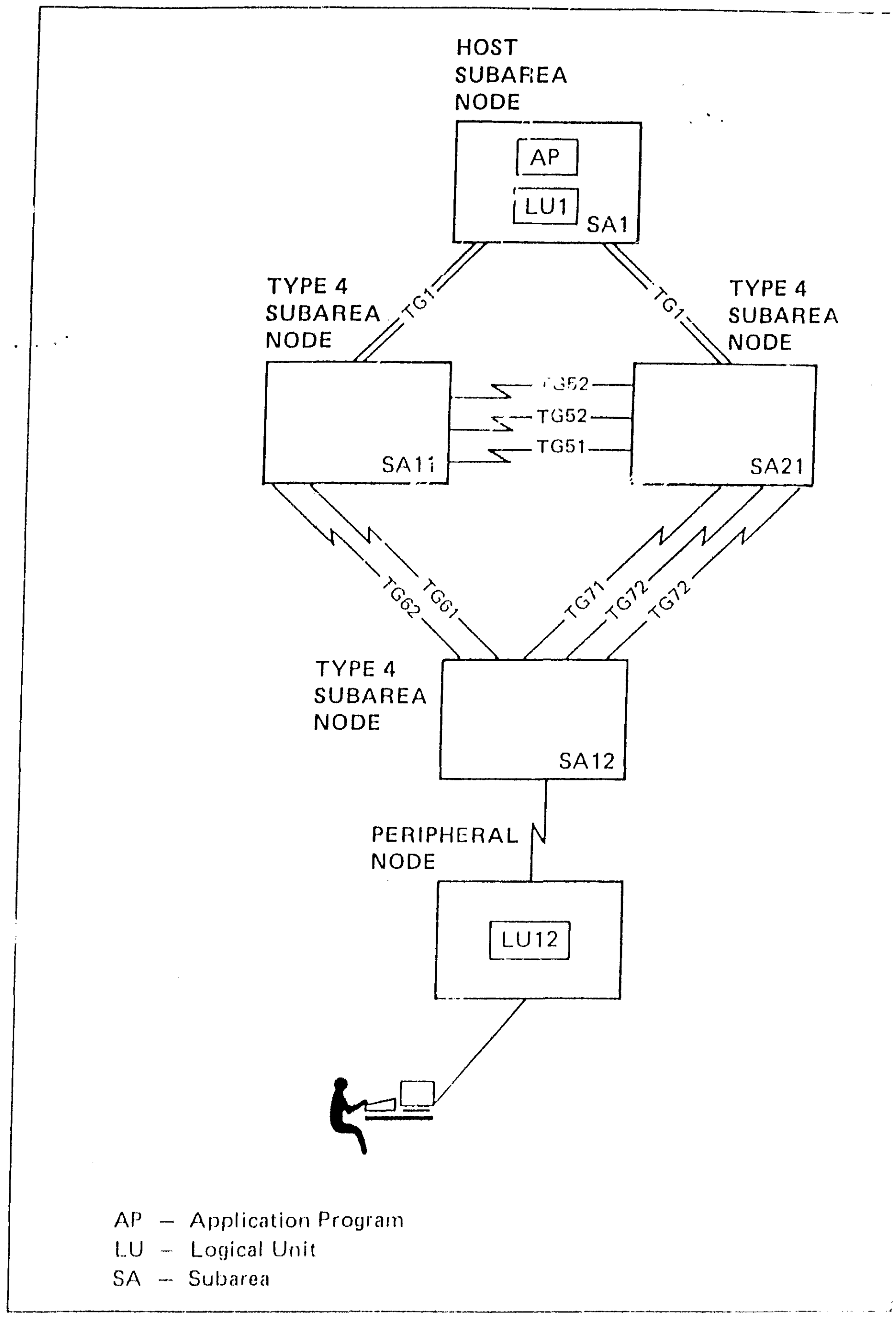


Figure 2-6. Transmission Groups

A transmission group is a group of cross-subarea links between adjacent subarea nodes that appears as a single logical link for routing message units. Each transmission group is identified by assigning the same number (called a transmission group number) to each link in the group. SDLC links can be numbered in the range of 1 to 255. Data channels are assigned transmission group 1 (TG1).

In Figure 2-6, two transmission groups connect the subarea nodes in subareas 11 and 21. TG51 includes one link and TG52 includes two links. Two transmission groups (TG71 and TG72) connect the subarea nodes in subareas 21 and 12 and two transmission groups (TG61 and TG62) connect the subarea nodes in subareas 11 and 12.

A transmission group is treated as one logical link regardless of the number of links in the transmission group. For example, if the subarea nodes in subarea 21 are to transmit message units to the subarea node in subarea 12 over transmission group 72, both links are used.

Links that connect peripheral nodes to subarea nodes (peripheral links) are single link connections. Peripheral links are not defined as transmission groups.

Routes in an SNA Network

There can be multiple **routes** between network addressable units (LUs, PUs, and the SSCP). Referring to Figure 2-6, there are several possible routes between logical unit LU1 and logical unit LU12. A message unit sent from LU1 to LU12 might flow over transmission group 1 (TG1) to the subarea node in subarea 21. From there, the message unit could flow over TG72 to the subarea node in subarea 12. Then the message unit flows over the peripheral link to the peripheral node in which LU12 resides. There are eleven other possible routes between LU1 and LU12.

When a session is established between LU1 and LU12, it is assigned to a specific route. For the duration of that session, all message traffic on the session travels over this route. Routes must be defined to the network for them to be used by a session.

Routes originate in one subarea node and terminate in another subarea node. A route from LU1 to LU12 originates in the subarea node in subarea 1 and terminates in the subarea node in subarea 12. A route from LU12 to LU1 originates in the subarea node in subarea 12 and terminates in subarea 1. A route does not include peripheral links and the attached peripheral nodes. A route consists of subarea nodes and the transmission groups that connect the subarea nodes. The part of the network from the subarea node in subarea 12 to LU12 is called a **route extension**.

Assume that LU1 sends a message unit to LU12 over the assigned route. The route terminates in the subarea node in subarea 12. The destination subarea node (in subarea 12) is responsible for getting the message unit to the peripheral node in which LU12 resides. The subarea node converts the message unit to the appropriate format for the peripheral node and transmits the message unit to the peripheral node. Path control in the peripheral node uses the local address in the message unit to route the message to LU12.

The activity performed by the destination subarea node in converting the format of the message unit and transmitting the message unit to the peripheral node is called the **boundary function**. The subarea node also performs the boundary function when it receives a message unit from one of its peripheral nodes. All subarea nodes provide the boundary function for connected peripheral nodes.

Subarea nodes also perform an **intermediate routing function** . In our previous example, the subarea node in subarea 21 received a message unit from subarea and transmitted it to the adjacent subarea node in subarea 12. That was an intermediate routing function, the message unit neither originated in nor was destined for subarea 21.

SNA Components and IBM Products

Now let's see how SNA components relate to IBM products. We know that there are two types of subarea nodes:

1. A type 5 subarea node (host) that contains an SSCP.

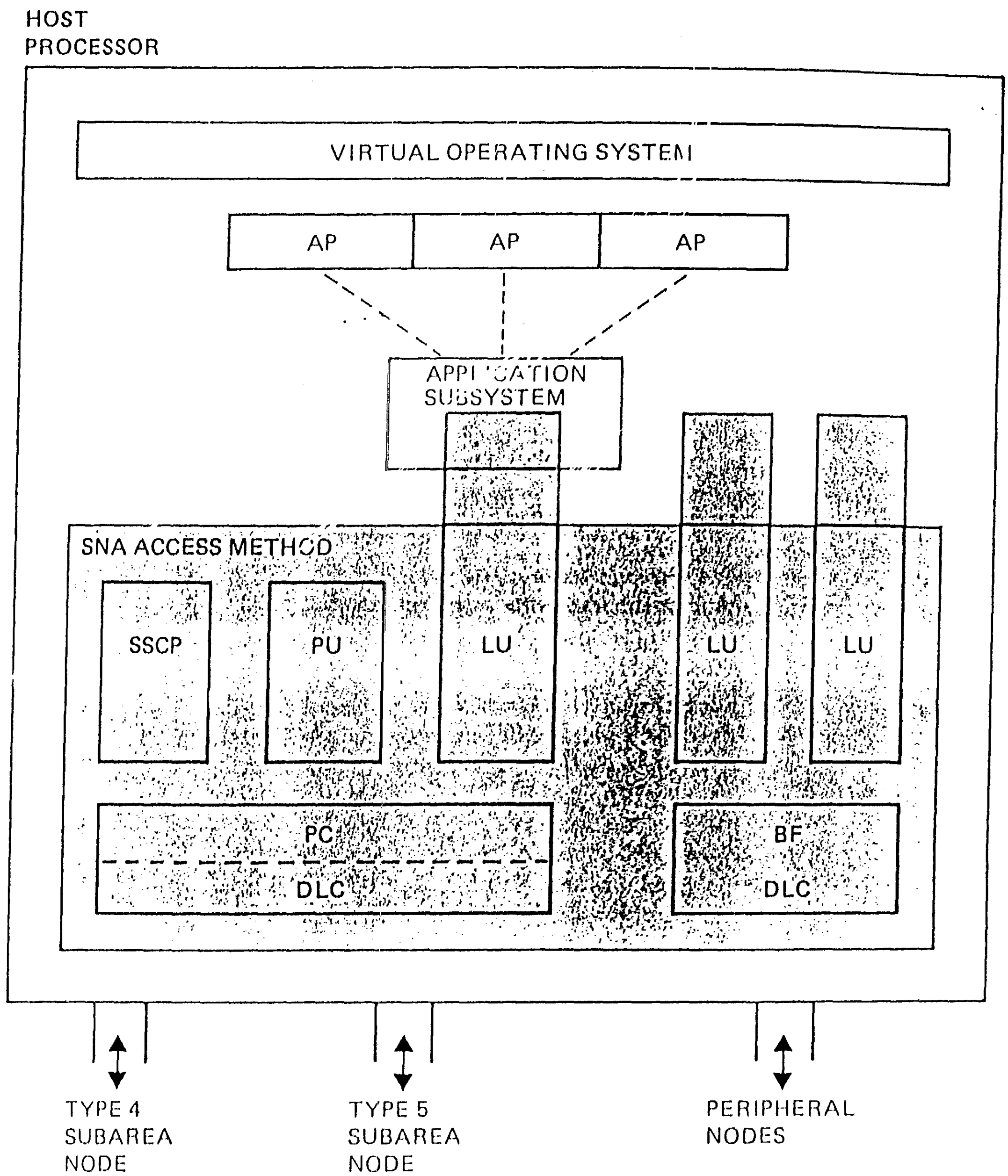
2. A type 4 subarea node that does not contain an SSCP

We also know that there are two types of peripheral nodes.:

1. A type 1 peripheral node.

2. A type 2 peripheral node.

SNA Components in a type 5 (host) Subarea Node: We will start by discussing how the host subarea node relates to IBM products as shown in Figure 2-7.



AP — Application Program
BF — Boundary Function
DFC — Data Link Control
LU — Logical Unit
PC — Path Control
PU — Physical Unit
SSCP — System Services Control Point

Figure 2-7. SNA Components in a Host Subarea Node

The components in the host processor include:

- A virtual operating system, e.g., OS/MVS, OS/VS1, or VSE.
- An application subsystem, e.g., CICS/VS, IMS/VS or user-written.
- Three user application programs that communicate with the subsystem.
- An SNA access method, e.g., ACF/VTAM, ACF/VTAME or ACF/TCAM

There can be any number of application subsystems and their application progran For our discussion, we will assume one application subsystem (CICS/VS) and three CICS application programs. The three CICS application programs are end users

CICS/VS supplies part of the logical unit component and the SNA access methoc supplies the remaining part The SNA access method also supplies the system services control point (SSCP), the physical unit (PU), path control components, and data link control components.

The SNA components (SSCP, PU, LU, path control, and data link control) make up the SNA node. Keep in mind that three SNA components are assigned networ addresses:

1. Logical unit (LU).
2. Physical unit (PU).
3. System services control point (SSCP).

The path control components route each message unit to a particular LU, PU, or SSCP using the network address that is attached to each message unit.

You should also keep in mind that there can be many logical units in this node although only three are shown.

A host processor may contain multiple host subarea nodes (type 5 nodes). For example an ACF/VTAM system and an ACF/TCAM system could both reside in the same host processor, however each would have its own SSCP and thus be separate subareas. Another example of a host processor with multiple SSCPs is a VM system with multiple operating systems and multiple SNA access methods. A host processor running under control of VM may contain more than two host subarea nodes.

SNA Components in a Type 4 Subarea Node: Figure 2-8 illustrates a type 4 subarea node and identifies the IBM product that implements the SNA components in the node.

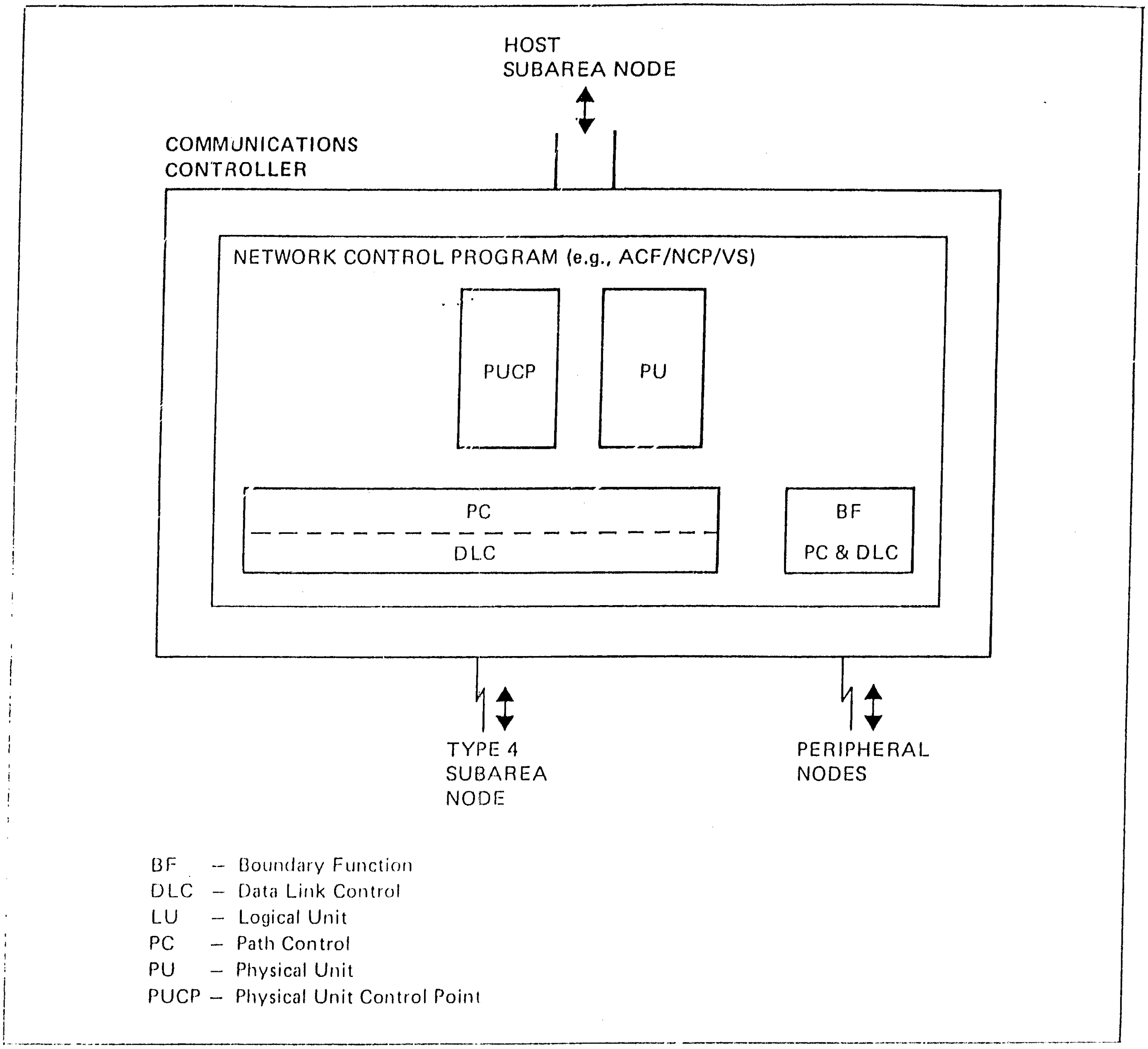


Figure 2-8. SNA Components in a Type 4 Subarea Node

The SNA components in this node are supplied by ACF/NCP/VS.

Although this subarea node does not contain an SSCP, it does contain a physical unit control point (PUCP) that provides some of the services for this subarea that the SSCP provides for the network. The physical unit (PU) in this node is a type 4 (PU.T4) physical unit. A node that contains a type 4 physical unit is responsible for such functions as:

- Controlling the communications links (polling and addressing) attached to it.
- Deleting and inserting line control characters.
- Translating character codes.

- Error recovery for the attached links and peripheral nodes.

This node also contains path control and data link control components which mak up the path control network.

SNA Components in a Peripheral Node: Peripheral nodes consist of a physical unit control point (PUCP), a physical unit (PU), one or more logical units, path contro (PC), and data link control (DLC). For some peripheral nodes, hardware implements all of the SNA components, and for other peripheral nodes hardware and/or software implements the SNA components. Figure 2-9illustrates a type 2 peripheral node, such as an 8100.

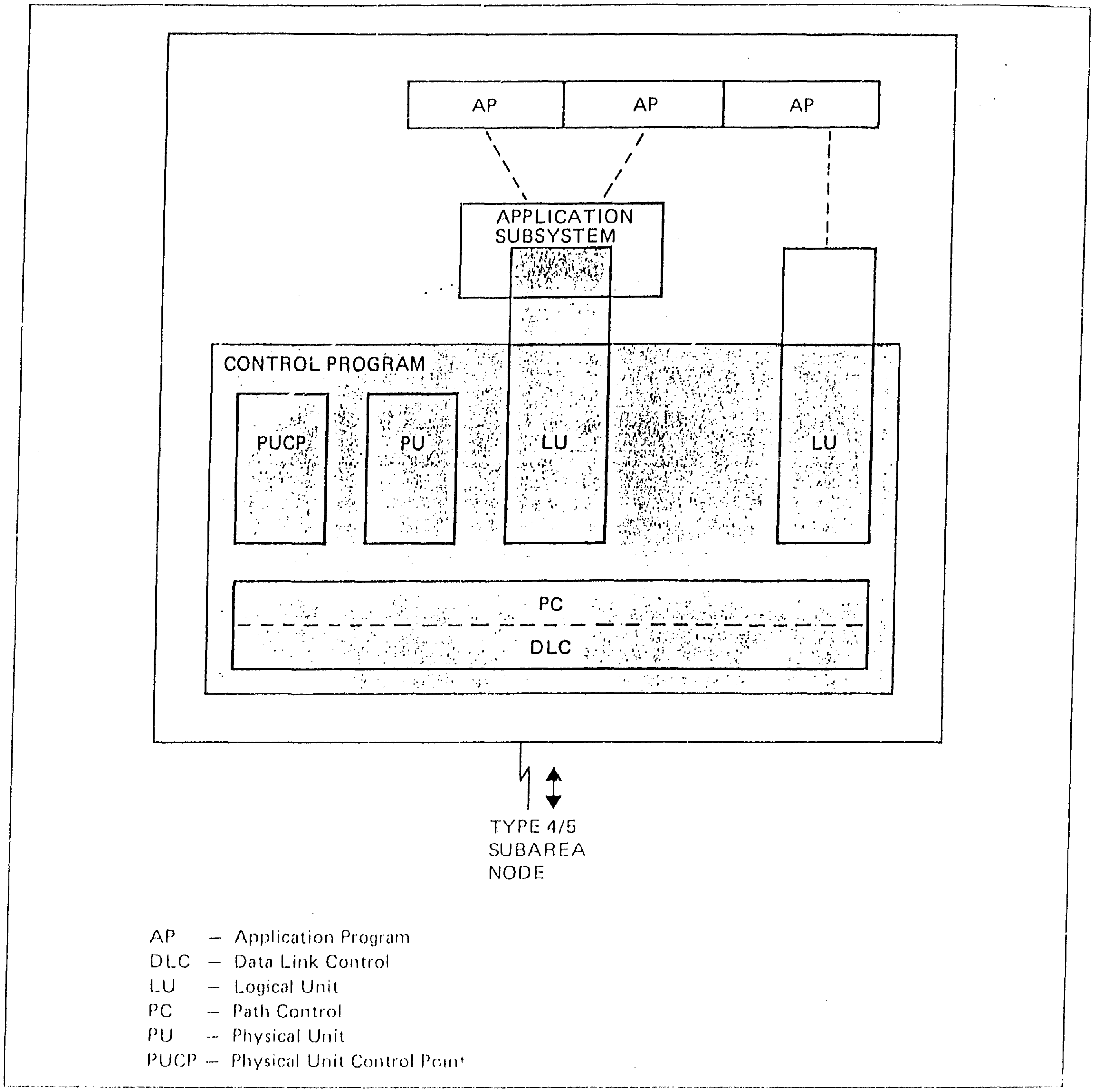


Figure 2-9. SNA Components in a Type 2 Peripheral Node

As in the host subarea node, for example, each application program in an 8100 is represented to the network by a logical unit (LU). This LU may be part of IBM supplied code, e.g., DTMS, DSC, or RJE or it may be coded by the user.

The other SNA components (physical unit control point, physical unit, path control components, and data link control components) are supplied by DPPX.

Figure 2-10 illustrates a type 1 peripheral node with a physical unit control point, a physical unit, and one logical unit.

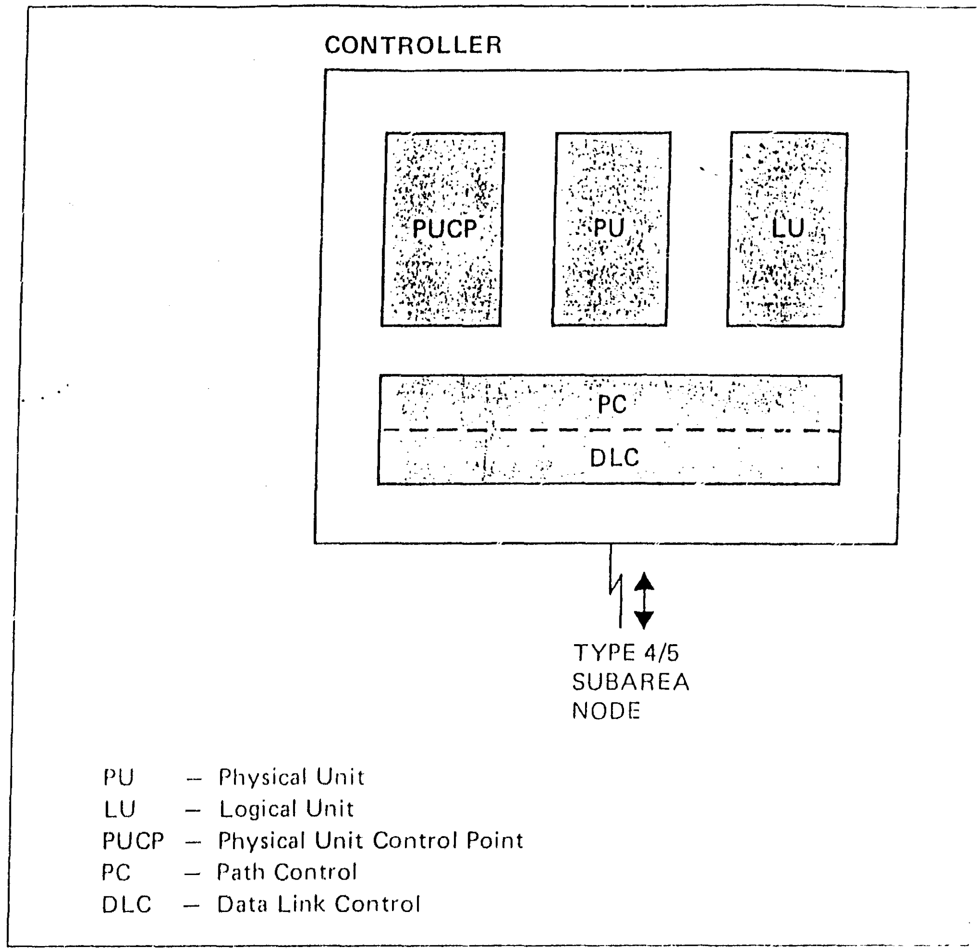


Figure 2-10. SNA Components in a Type 1 Peripheral Node

The 6670 Information Distributor is an example of a peripheral node that contains one logical unit.

We will now look at two figures that relate SNA components to IBM products. Figure 2-11 shows IBM products that make up a network configuration. Figure 2-12 shows the same network configuration but illustrates the SNA components that are implemented by the IBM products shown in Figure 2-11. Study the two figures as a summary of how SNA components relate to IBM products.

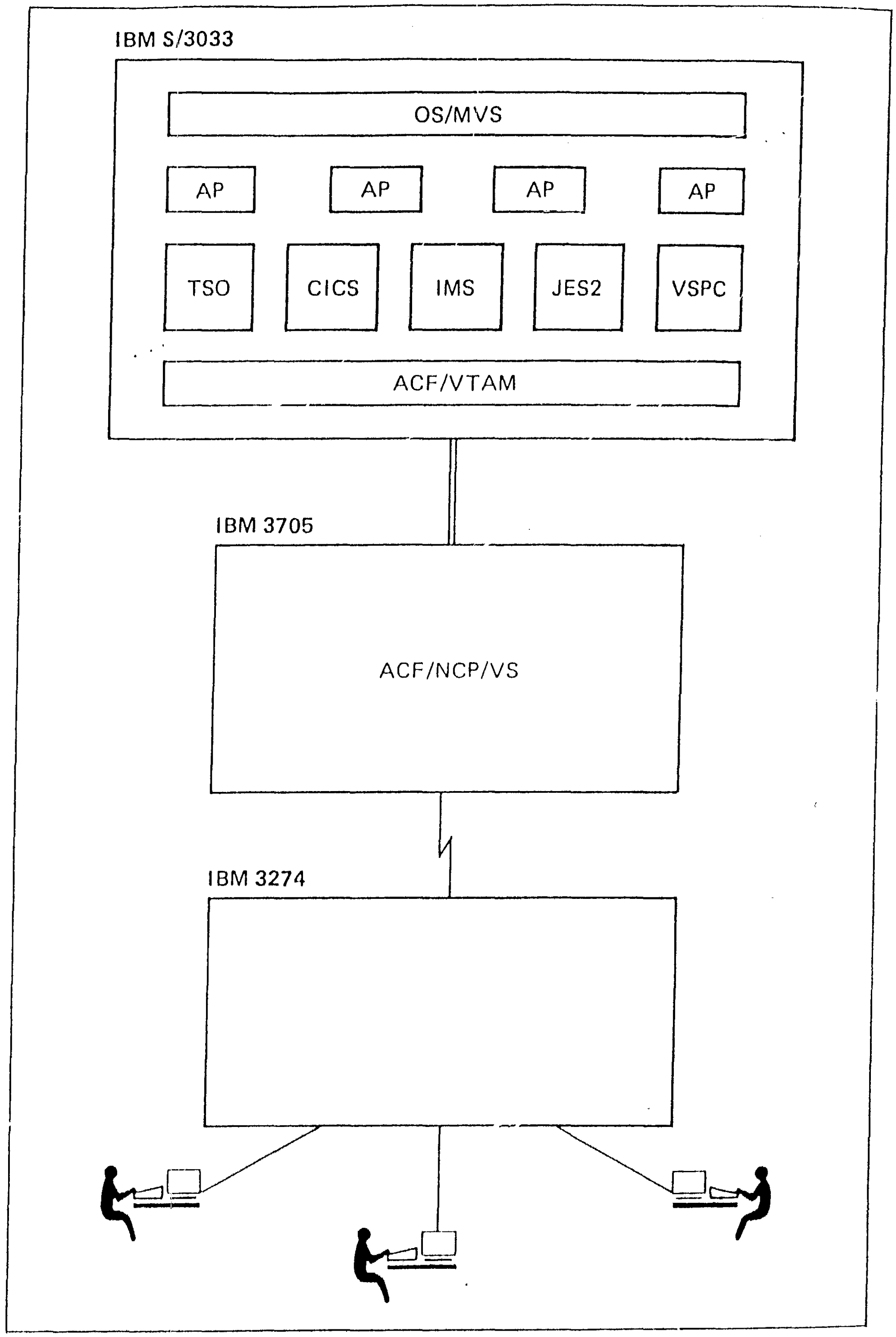


Figure 2-11. Configuration Of IBM Products

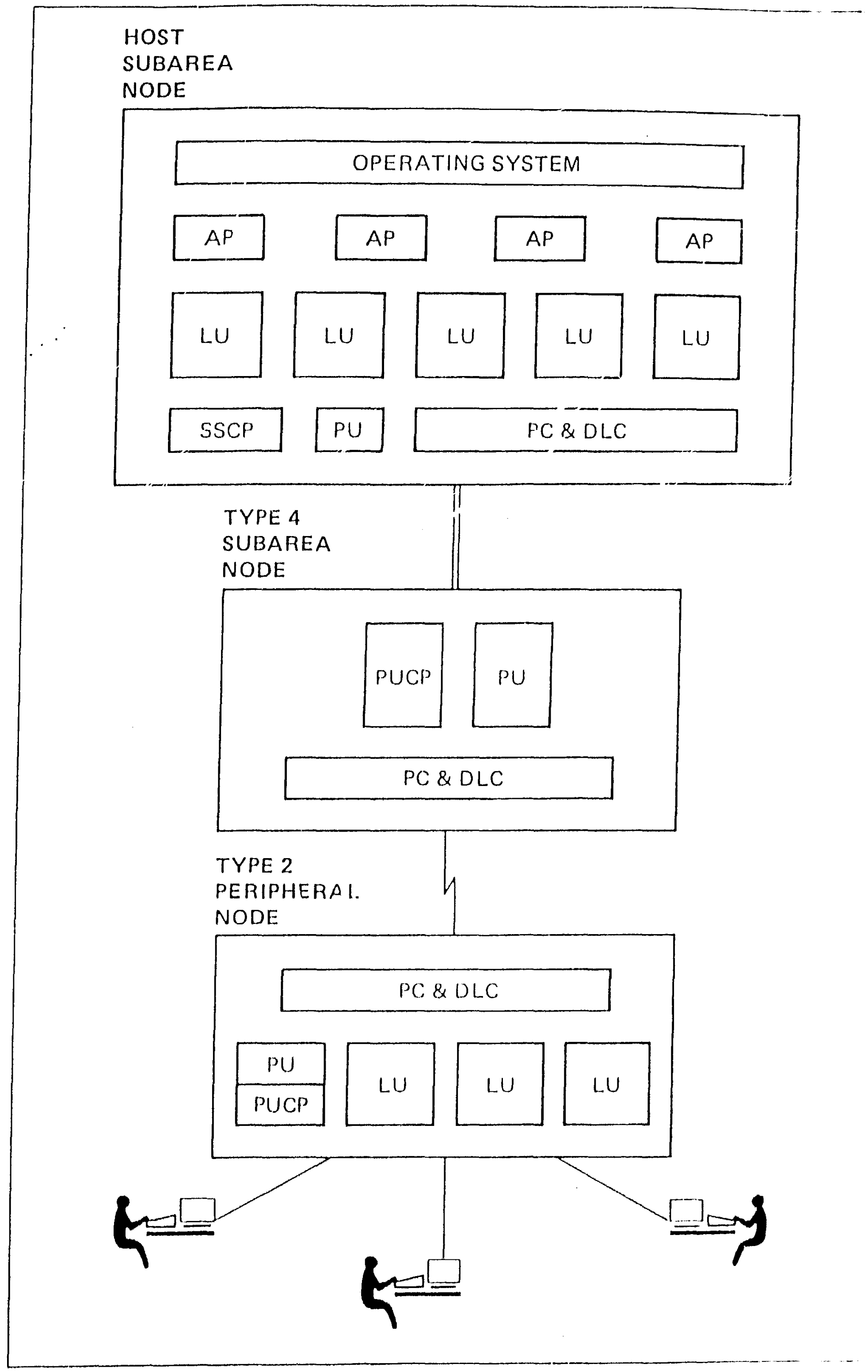


Figure 2-12. Configuration Of SNA Components

Please turn to Mini-Course 2 in your Personal Reference Guide and read the summary.