Overview of NMC to IBM host setup

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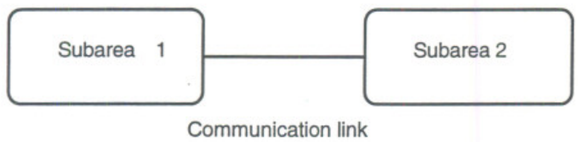
Date: 06/28/95

Introduction

The objective of this report is to give a general outline of SNA in the hope this might help better understand the way the NMC communicates with IBM customer computers (both IBM mainframe and IBM midrange computers).

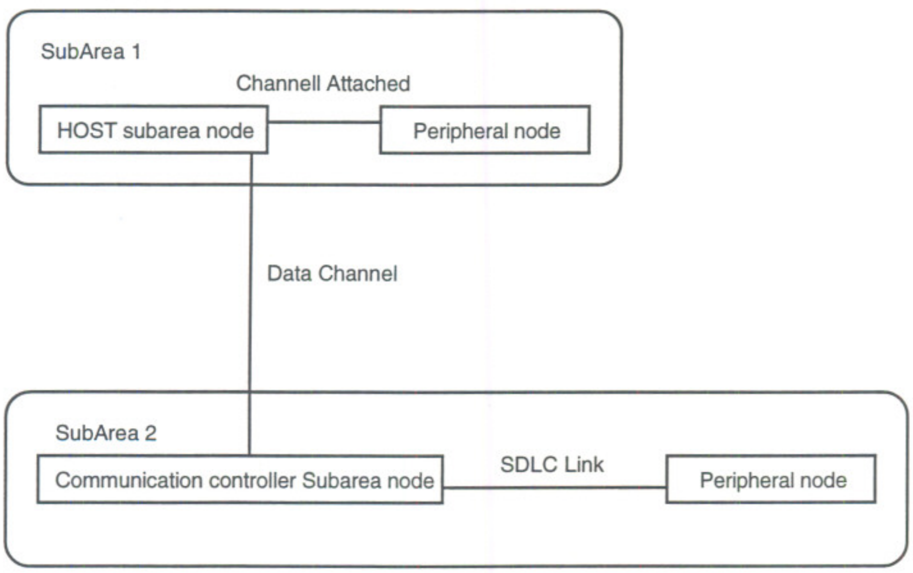
Overview of SNA architecture

An SNA network consists of SUBAREA's connected to each other via a communication link:



There are 2 kinds of subareas : A Host subarea and a communication controller subarea.

A Subarea contain in it a subarea nodes and peripheral nodes. There are 2 types of subarea nodes: A Host subarea node and a Communication controller subarea node. A peripheral nodes include cluster controllers, workstations, printers and so on. A subarea can not contain 2 different kinds of Subarea nodes, it is either is a Host subarea node or a communication controller subarea node, but a subarea can contain a subarea node and a peripheral node. The following diagram shows a typical SNA network:



A Host subarea node that contain a Physical Unit of type 5.0 (PU5.0) together with a software called SSCP (system service control point) are refereed to as type 5.0 node. the SSCP software manages the activation or termination of sessions between different SNA connections and manages network resources and can only reside on a Host subarea node.

NMC/CI link to PU5.0 and PU2.1 IBM nodes

A communication controller subarea node that contains a PU4.0 device is called a type 4.0 node.

A peripheral node that contains a PU2.0 device is called type 2.0 node.

A peripheral node that contains a PU2.1 device together with its own SSCP software is called type 2.1 node.

PU5.0 is products such as ACF/VTAM, 4300, 308x, 9370, 3090.

PU4.0 is products such as NCP, 3720,3705,3725,3745.

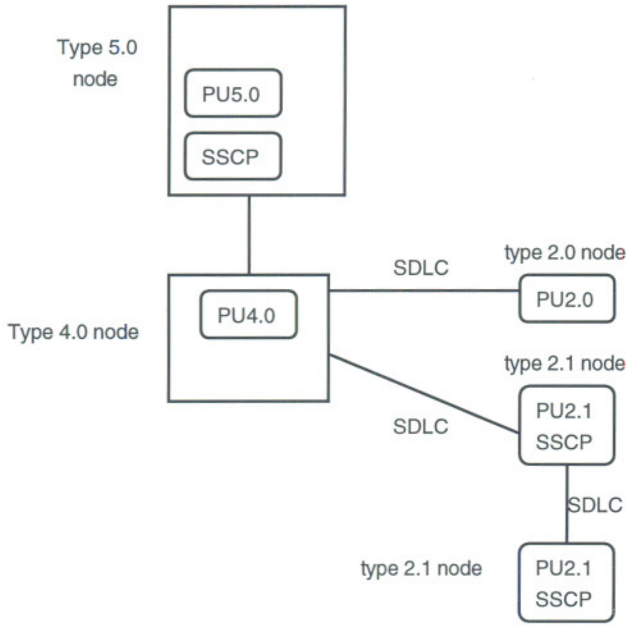
PU2.1 is products such as system/36,system/38,IBM/PC,TPF,AS/400.

PU2.0 is products such as 3174,3274,3276,IBM/PC,3770..

There is also a PU1.0 for products such as 3271,6670,3767.

Node type 2.1 together with LU6.2 are the main components of IBM new network architecture called APPN (advanced program to program Network).

So a typical SNA network drawn in terms of node types would look like this:



Communications in SNA network occurs between what is called NAU's (Network Addressable Units).

SNA recognizes three types of NAU's:

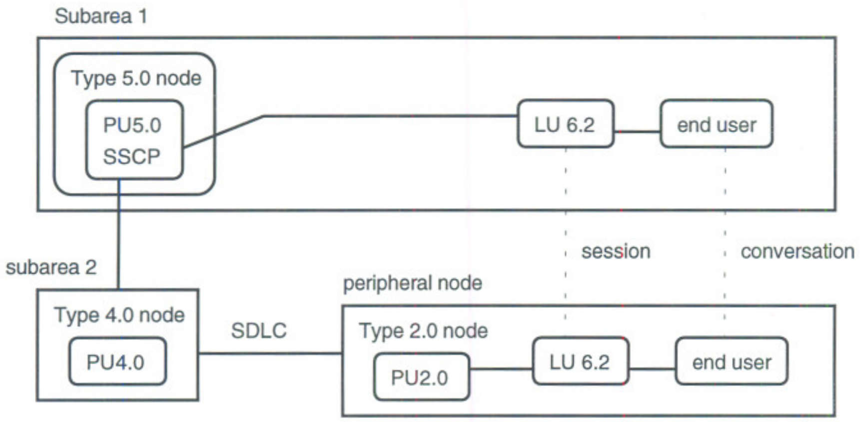
- Logical Unit (LU). An LU can be looked at as the port to the network through which an end user (such as a program) can enter the network. SNA only sees the LU, any end user can use the LU to communicate with another end user on a different LU. (Think of an LU as sort of a socket if you well, but they are not the same).
- Physical Units (PU).
- SSCP (System Service Control point).

Different Physical units (PU) support different LU types. There are 8 LU types (classified in terms of the capability they provide to the end user). More powerful node types (such as 5.0 and 4.0) support more types of LU's.

Node types and LU types they support:

1. Type 2.0: supports LU2,LU3,LU6.2,LU1
2. Type 2.1: supports LU1,LU2,LU3,LU6.2 and direct link connection to other 2.1 nodes.
3. type 4.0: no support for LU NAU's. type 4.0 nodes perform routing and control of flow.
4. type 5.0: support all LU's.

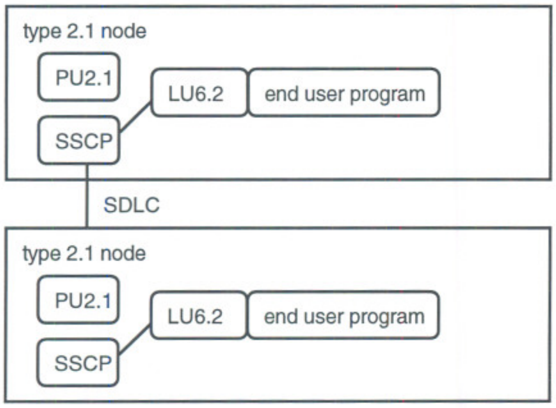
The following diagram shows a typical SNA network showing how the LU fits in the overall picture:



In the above diagram , the LU residing in the peripheral node is called the secondary LU, and the LU residing in the type 5.0 node is called the primary LU. The diagram shows that LU's residing on type 2.0 units can only communicate with LU's residing on type 5.0 node.

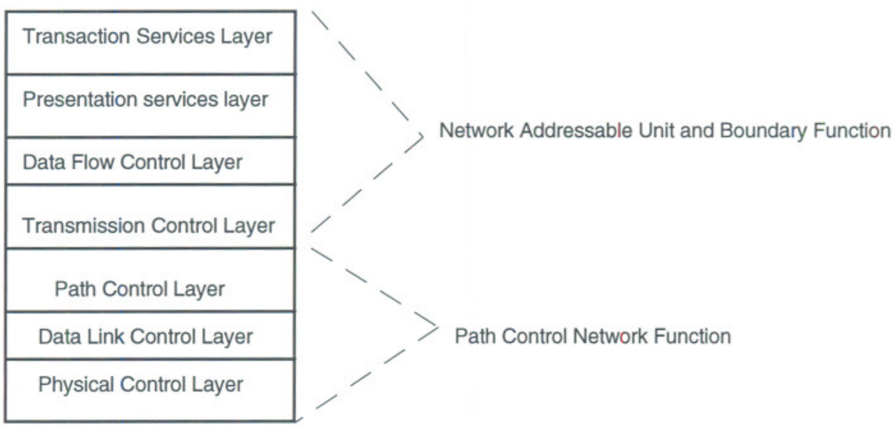
type 2.1 nodes were created by IBM to allow end users on peripheral nodes to communicate with other end users on other peripheral nodes without the need to have a PU5.0 nodes in the network.
The following diagram shows how this is done (this is a typical SNA network for APPN layout).

NMC/CI link to PU5.0 and PU2.1 IBM nodes



SNA stack outline

The SNA stack can be looked at as broken into 2 functional groups, the Network Addressable Unit and the Path Control network function, as shown in this picture:



Functions of each layer in the stack:
Physical layer: Physical medium over which signal travel.
Data link layer: Implements the protocol to insure accurate and orderly exchange of information between 2 or more DTE's (Data Terminal Equipment). The type of devices that use the physical line dictate the link protocol to use, so there is hardware dependencies of a device for a specific data link protocol. There are 2 main categories of link protocols, non-SNA link protocols and SNA link protocols.
Non-SNA link protocols are:

1. S/S (Start/Stop Asynchronous protocol), used for IBM 3767, IBM 3101, WTTY type device. S/S link protocol is not supported by VTAM.
2. BSC (Binary Synchronous Communication) which is older and being rapidly replaced by SDLC (Synchronous Data Link Control).
3. X.25. This allows the application to transmit data over public telephone circuits, data is broken up in packets, X.25 headers added and the packet send over the public telephone network. (DECnet also supports X.25 data link protocols).

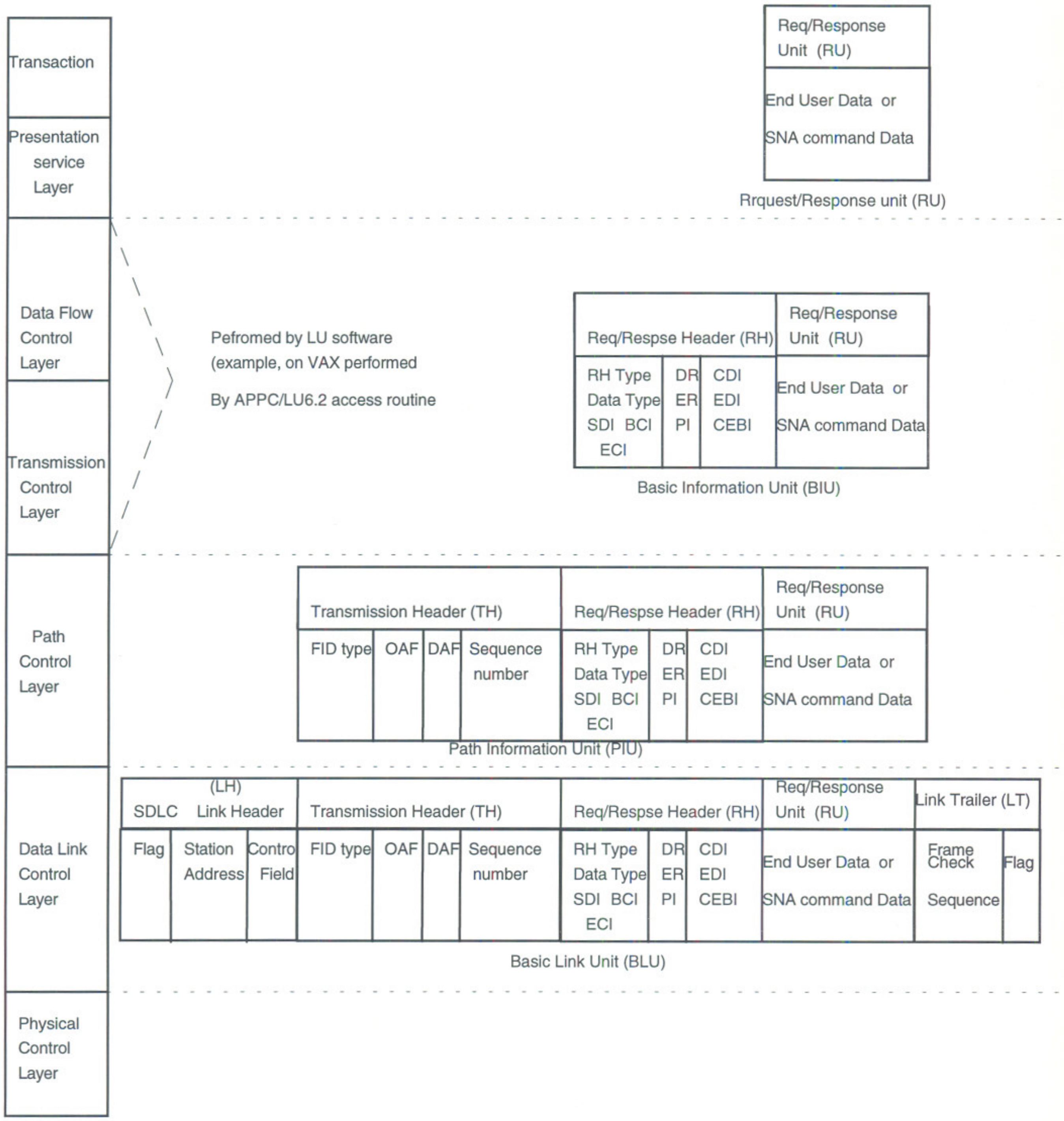
SNA main link protocol is the SDLC. This is more efficient for data transmission and recovery. SDLC frame is shown later on.
Path Control Layer:Selects the next link on the path towards the destination. Routing decision is made here.

Transmission control layer: This layer is responsible for maintaining the session. Routes message from path control to the correct destination inside the data flow control layer. This layer also builds the RH before sending the message to the path control layer.
Data flow control layer: Concerned with management of message protocol. Such as correlating responses with requests, managing sequence numbers, controlling which side can send and when, to do this the data flow control layer sends data flow control messages to the other data flow control layer in the other computer.
Presentation services layer: Interpretation of data to the user is done here, for example the DEC implementation of APPC/LU6.2 (the product than runs on VMS) will perform EBCDIC to ASCII and vise versa translation at this level when communicating with IBM computers.
Transaction services layer: The end user applications CICS transactions or VAX/VMS applications.

As we will see below, The DEC APPC/LU6.2 Software that runs on the VAX implements the NAU and Boundary Function part(Presentation, Data Flow Control, Transmission Flow Control) , while the DEC SNA GATEWAY implements the path control network functions. This is because each LU type will have different implementation of the NAU/Boundary function layer, while the common software (the Path Control Network function) is shared among all LU types and resides on the SNA GATEWAY.

The following diagram shows the SNA message unit structure at each layer of the SNA stack:

NMC/CI link to PU5.0 and PU2.1 IBM nodes



The SDLC frame size breaks down like this:

8 bits	8 bits	8 bits	variable	16 bits	8 bits
Flag	station address	Control field	Variable length information (Path Information Unit)	Frame check	Flag

NMC/CI link to PU5.0 and PU2.1 IBM nodes

Acronyms description:
the flag in the LH always has value of HEX 7E, this indicates the start of a new SDLC frame.
Station address: For broadcast message (all stations) SDLC uses HEX FF. for no station, it uses 00, else a specific station address is used.
FID: Format Identification Field, this field specifies the type of PU, depending of the PU type, the TH length can vary in size from 10 bytes to 26 bytes. So the TH header has 5 different formats depending on the FID value.
OAF: Originating address field.
DAF: Destination address field.
SDI: Sense Data Indicator.
BCI: Begin Chain Indicator.
CDI: Change Direction Indicator.
CEBI: Conditional End Bracket Indicator.
DR: Definite Request/Response Indicator.
ECI: End Chain Indicator.
EDI: Enciphered Data Indicator.
ER: Exception Request/Response Indicator.
PI: Pacing Indicator. Pacing is the IBM SNA method of flow control; it allows the network to regulate buffer usage per individual session.

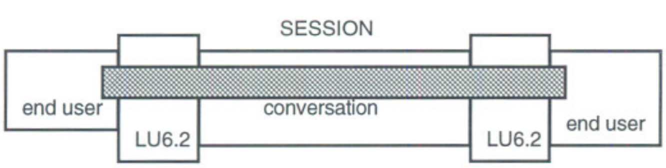
Summary of communications in SNA network and LU6.2 protocol

SNA is considered a hierarchical (or star) type of network (peripheral nodes connect to a controller which connects to a host node). With the addition of PU2.1 type node that allows peer to peer communications (since a host is not needed any more), IBM is moving SNA to become a peer-to-peer type of network (less centralized). LU6.2 and PU2.1 nodes are the main components for this new SNA architecture called APPN.

Communications in SNA between end user is accomplished via LU's. A session is started between 2 LU's with the help of SSCP. An LU resides in an SNA node. different SNA nodes can support different LU capabilities. LU6.2 is the most flexible LU type. Traffic flows between 2 LU6.2 type LU's over a session.

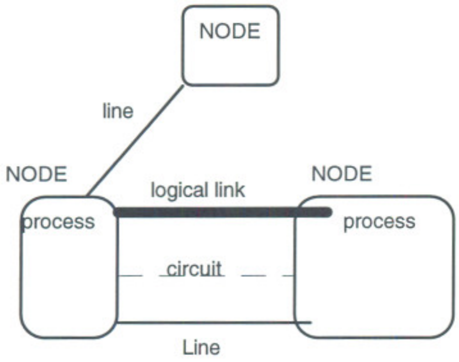
Communication between 2 end users who are using LU6.2 type of LU requires first the establishment of a session, once a session is created between the 2 LU's, then traffic can start. Data flow in an LU6.2 session once a conversation is started. A conversation can start and finish while the session remain for future reuse . Many conversation can occur over one session. LU6.2 data flow is full-duplex type of protocol, Traffic can flow in either direction over the same session during a conversation.

The following diagram shows an LU6.2 conversation in progress:



DECnet Overview

DECnet is a symmetric peer-to-peer based architecture, i.e. nodes in DECnet can communicate with other nodes without having to go though a centralized node (such as with SNA). each node in DECnet has its own unique DECnet address that is made of an area address and node address within that area. nodes in the network are connected by lines over which circuits operate, see below:



A line is the physical connection between 2 nodes (can be Ethernet, FDDI, microwave, etc..). A circuit is the logical connection between the nodes, it is the logical data path over which traffic travel between the nodes. I/O between nodes occur over circuits.

A logical link is a link between 2 processes running over 2 DECnet nodes. A logical link connects 2 processes for the purpose of exchanging data. (a logical link can be established between 2 processes over the same node as well.)

DEC SNA product architecture

I outline briefly DEC SNA architecture as that will help show how the SNA gateway fit in the big picture.

DEC SNA architecture is made up of 5 layers. The layers are:

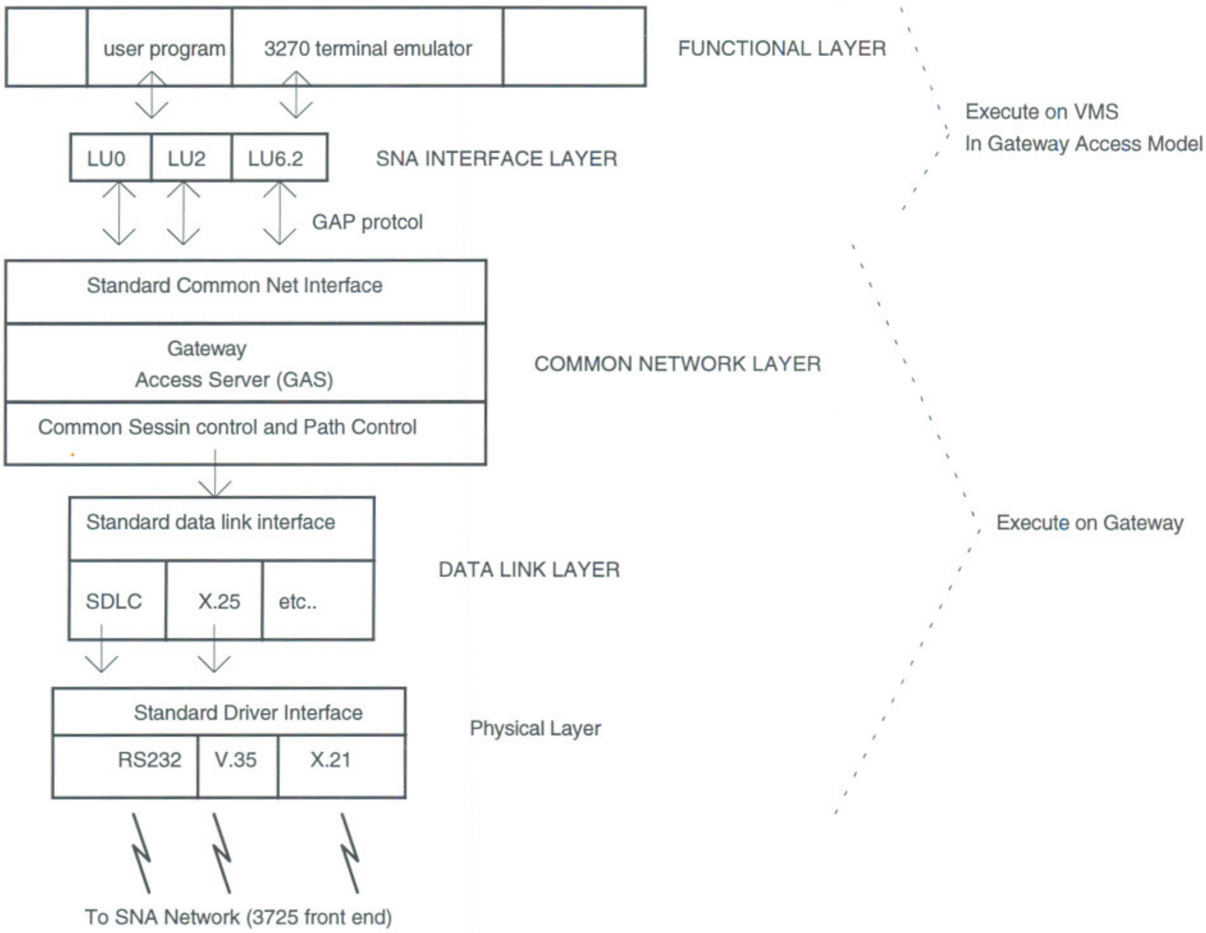
- Functional layer
- SNA interface layer
- Common network layer
- Data link layer
- Physical layer

These five layers are not all implemented in the same node as the end user. DEC defines 2 distinct distributions, one is called the gateway access model (which is how NMC connects to the SNA/Gateway) and the other called the server mode. In the gateway access model, the Functional and SNA interface layers are located in the same node as the user, while the other 3 layers are located in the gateway node. The interface between the SNA interface layer and the common network layer in this case is DEC proprietary protocol and is called GAP (gateway access protocol).

NMC/CI link to PU5.0 and PU2.1 IBM nodes

In the Server model, all 5 layers are located in the gateway, and the user access the gateway using many of the already available methods, for example DECnet task-to-task.

The following diagram outlines DEC SNA product architecture



The GAS component above supports GAP. GAS receives messages from SNA network session and sends them to the correct DECnet logical link. It also does the reverse, takes messages from DECnet logical links and send them to the correct IBM SNA session. GAS keeps the correlation between an SNA session and a DECnet logical link, this correlation starts at connection time.

It is important to note that connection to the IBM applications always initiated from the DECnet side (I don't know if DEC has any new products that would allow IBM applications to start the connection to VAX/VMS applications).

NMC connections to the SNA world

Since NMC runs on DEC computers and the customer dispatch software runs on IBM computers, NMC uses the following 2 methods to connect to the customer computers depending on if the customer uses type 5.0 nodes or type 2.1 nodes.

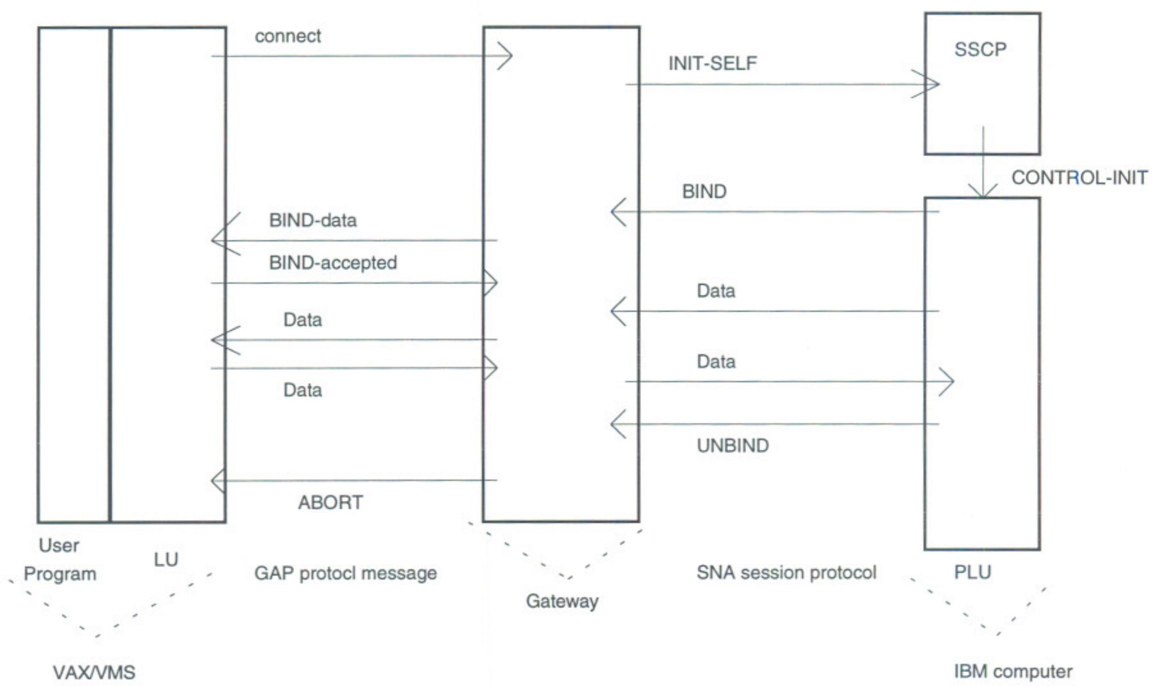
1. NMC connects to IBM host (PU5.0) using DEC SNA gateway (PU2.0) using LU6.2 LU type.
2. NMC connects to IBM midrange computer (AS/400) using PC SNA gateway (PU2.1) over Ethernet link.

The following describes in more details each connection.

NMC connection to type 5.0 nodes (370,43xx computers)

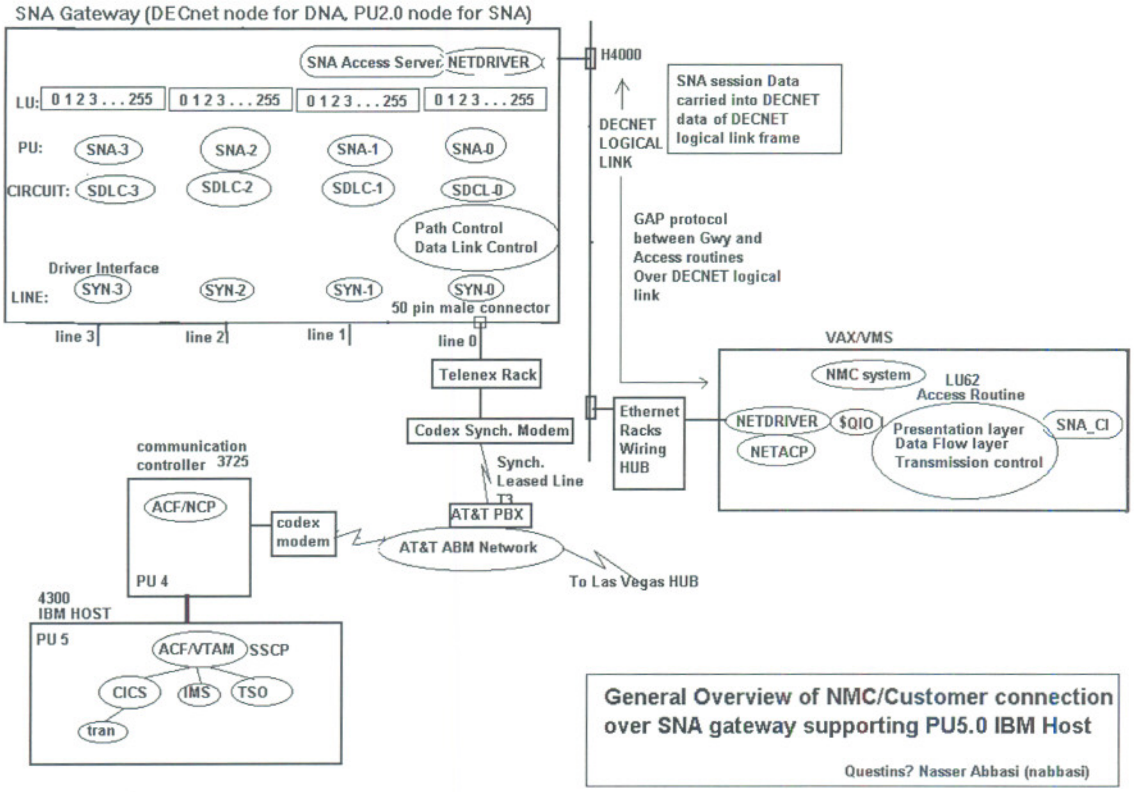
NMC uses DEC SNA gateway-ST to communicate with PU5.0 IBM host. NMC software component (SNA_CI) program communicate with the CICS transaction running on the host over LU6.2 LU types. The DEC SNA gateway looks like a DECnet node to VAX running the NMC software, while it looks like a PU2.0 to the SSCP software running on the IBM host.

The following diagram shows how the messages flow between the user program (on VMS) and the gateway in a typical communication session with IBM computer. This diagram show how a connection is started, it shows the BIND arriving from IBM (BIND is the data that the IBM LU uses to specify the type of session characteristics it will be using during this session such as max. buffer size for messages over this session), then it shows the data is exchanged between the 2 LU's and then an UNBIND arrives to end the session. Time flows from top to bottom. i.e. the activities at the top of the diagram happen before the activities at the bottom of the diagram.



NMC/CI link to PU5.0 and PU2.1 IBM nodes

The following diagram shows in more details the software and hardware involved in the above simplified connection



Note that the SNA software is downloaded from the VMS host, it is also possible to bootstrap the gateway with TRIGGER or LOAD commands from the host (see NCP commands). It is also possible to set it up such that gateway dumps are uploaded to the VMS host when and if the gateway crashes for later analysis. Gateway management tools (which are installed on the VMS host) consists of SNANCP, SNAP, SNATRACE. there is also the LOGMASK logical that can be used for additional logging by the access routines on the VMS host.

$MCR SNAP <gateway_node_name> shows what LU's are in use in the gateway, buffer usage, number of links and sessions in use and other goodies.
$MCR SNATRACE, allows you to get a readable output of gateway protocol messages between the gateway and the IBM side.
$SNANCP is the interface to managing the gateway from the VMS host. (define the LU's, PU's, Lines, Circuits etc..)

NMC connection to type 2.1 nodes (AS/400 computers)

NMC uses PC SNA gateway to communicate with PU2.1 IBM AS/400.
The PC SNA gateway looks like a PU2.1 to the SSCP software running on the AS/400.

NMC CI program uses ECIR.EXE to communicate over ethernet to the PC SNA gateway. ECIR.EXE uses $QIO to interface with the ethernet driver. ECIR.EXE read the file OMNI_CONFIG:ECIR_CONFIG.DAT to find out the ethernet device name to obtain a channel on the local node, then once a channel is assigned, ECIR.EXE uses $QIO to send write and read ethernet packets from that channel on the ethernet device, ECIR.EXE send ethernet packets received from the remote PC/SNA gateway to the correct CI program based on the CI ID number (via VMS mailbox).

Note on the Direct Interface to Ethernet device drivers

VMS comes with a number of I/O drivers. $QIO system service calls are used to interface to the drivers though the use of the P1 though P6 paramters on the $QIO calls).

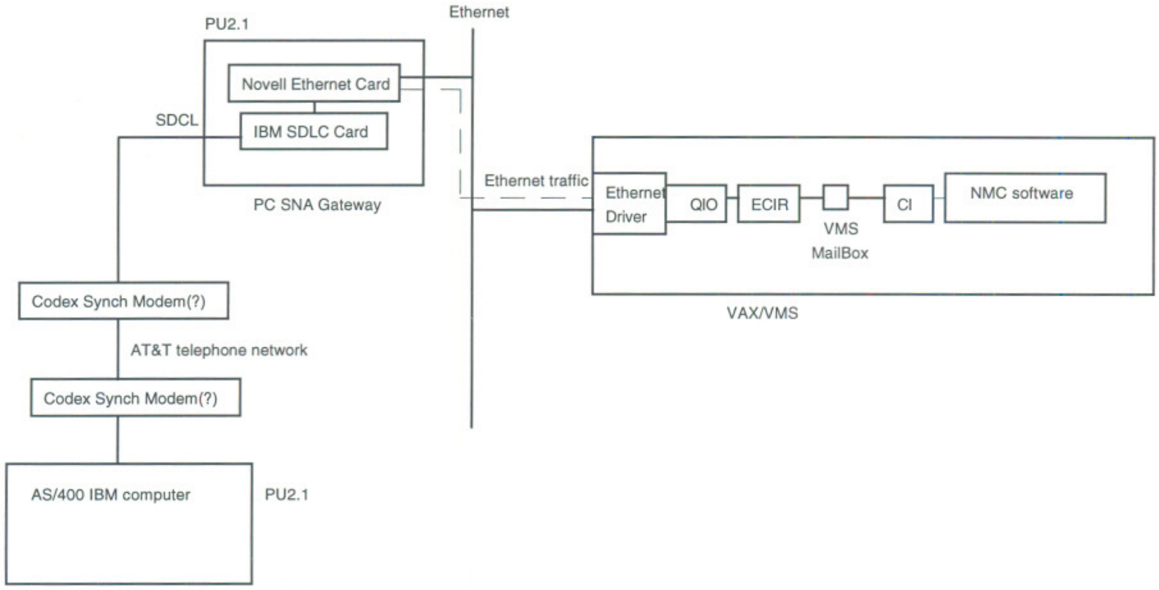
The NMC connection to the PC SNA gateway is done by direct ethernet I/O over ethernet using the VMS ethernet driver. The format of ethernet packet is like this:

6 bytes	6 bytes	2 bytes	2 bytes	variable	variable	4 bytes
Destinatin ethernet address	Source Ethernet addess	protocol type ID	Length of user data	DATA	PAD	CRC

the minimum size of ethernet packet must be 64 bytes, padding is used to make the header, data and CRC 64 bytes if needed.

For the purpose of this discussion that is all we need to know about DECnet. (actually that is about all I know about DECnet stuff).

The following diagram shows in more details the software and hardware involved in this connection



A note about Forest Computer 5740

I did some looking around to find a way to replace the many PC SNA boxes that we have with just one box that will allow the CI's to talk to IBM midrange computers, with the goal of having a better way , easier to maintain method, of establishing this link without using the many PC SNA boxes. Found a company in Michigan called Forest Computer, (Please see attached information sheets they faxed me) that builds a box that allows VMS based applications to connect to IBM midrange computers (AS/400).

The VMS applications (in our case the CI's) communicate with this box using DECnet task-to-task communication (a server on the 5740 box is a DECnet object). The box in turn communicates with IBM midrange computers using APPC/LU6.2 protocol over SDLC line.

Either side can start the conversation, multiple clients can talk to the same server (on the 5740).

Since the 5740 box uses DECnet task-to-task to talk to the VAX side, there would have to be code written (new CI interface) to communicate with this box. More information is needed to investigate this more.

Talking to their sale person, he mentioned that pricing starts about $30,000 per box, for about 12 sessions per box. support for 36 concurrent sessions is more $$.

The sale person I talked to is Russ Ferance at 517-349-4700.