PACKET SWITCH ROUTING GUIDELINES

AT&T *WESTERN ELECTRIC*® 1 PACKET SWITCHING SYSTEM

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1. GENERAL

1.01 The purpose of this section is to provide AT&T *WESTERN ELECTRIC* 1 Packet Switching System (1PSS) operating personnel with a description of the call routing methods used in the packet switch. This document covers the routing found in 1PSS Release 2 and Release 3.

1.02 When this document is reissued, the reason(s) for reissue will be shown in this paragraph.

1.03 The packet switch routing scheme is capable of operating in the following network environments:

(a) ***Dedicated Network:*** A stand-alone network, within a shared packed switch environment, with each customer owning their own trunk

groups and access lines. Examples of this are the 1PSS Local Area Data Transport (LADT), and the AT&T Communications Packet Internal Network.

(b) ***Transit Network:*** A shared network for inter-network calls that provides general service between different customers. This network can be used for transit calls between networks.

(c) ***Segmented Network:*** A group of physically separate segments of a network that appear to the customer as one network (Release 3).

Each of these items will be discussed in detail later in this document.

1.04 Throughout this document references are made to routing tables. These tables are not available for access by the craft except by service order procedures. They are used here only as an aid in understanding the call routing methods. As such, specific detail is not provided.

2. NETWORKS

2.01 There are three types of networks available for packet switching service. They are as following:

- Dedicated Network
- Transit Network
- Segmented Network.

These networks consist of packet switches connected by Data Design System data trunks of 9.6 kb or 56 kb.

A. Dedicated Network

2.02 The dedicated network is a stand-alone network, not connected to any other, and is dedicated to a set of customers that share the switches. Each customer owns a subnetwork within the larger network, with their own leased transmission facilities, providing them with a dedicated network (Fig. 1). The trunks and access lines are given a Subnetwork Identification Number (SID) that identifies them as assigned to an individual customer. With the SID, all customer traffic is routed over the facilities dedicated to that customer. In Release 3, alternate routing is supported.

2.03 Routing between locations within a network is initiated by the customer inputting a Logical Network Address (LNA) code. The LNA is a 10-digit address consisting of a 6-digit Service Region Service Area (SRSA) (also called a DNPA-DCO in a segmented network), and a 4-digit End Point Number (EPN) (Fig. 2). The LNA is translated into an End Point Identifier (EID) that consists of four parts:

- Packet switch number
- Packet Switching Module (PSM) number
- Facility number relative to the (PSM) of the access line
- Channel number for the access line.

The SRSA directs the call to the proper packet switch within that network. The EPN then provides the PSM, and slot number on the PSM, corresponding to the access line.

B. Transit Network

2.04 A transit network is a common user network, consisting of packet switches, interconnected by trunks to all the switches (Fig. 3). This configuration allows a call from one switch to connect to any other switch in the network. In Release 2, alternate routing was not possible, and if a trunk was not available the call would not complete. Release 3 permits second choice routing, allowing calls to use an alternate path through another packet switch for completion, if the first choice is not available.

2.05 In the transit network the trunks and the switches are shared by all customers. The customers are then all assigned the same SID.

2.06 Other characteristics of a transit network are the ability to communicate with other networks, and to be a network through which other networks can communicate with each other. To allow this, a prefix 0 and a 4-digit Data Network Identification Code (DNIC) must be input by the customer, in addition to the 10-digit LNA, for inter-network calls. The DNIC code is a prefix to the LNA (Fig. 4). Its function is to identify another network. It is also used to select the proper gateway to that network. The prefix 0 informs the packet switch that the following 4 digits are a DNIC.

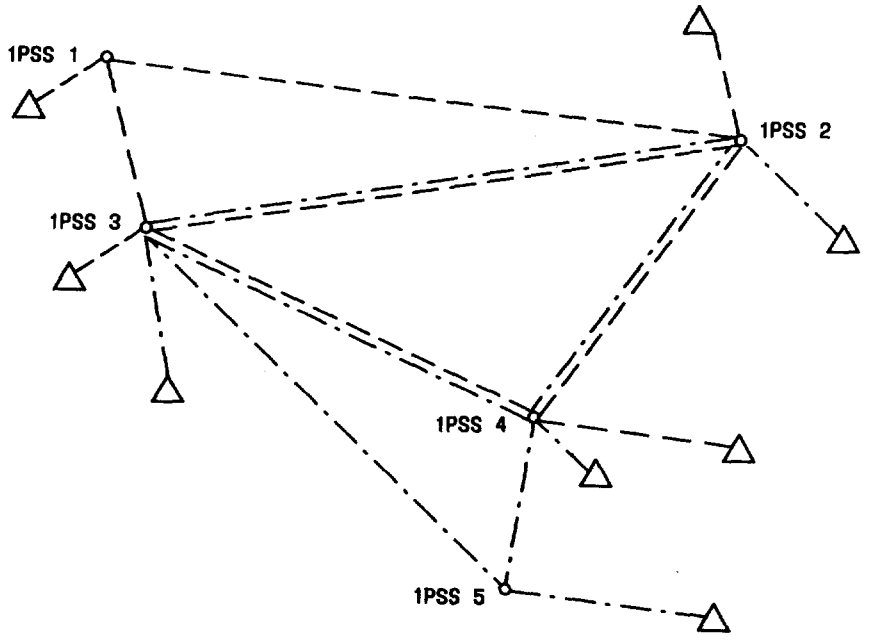


Fig. 1—Dedicated Network

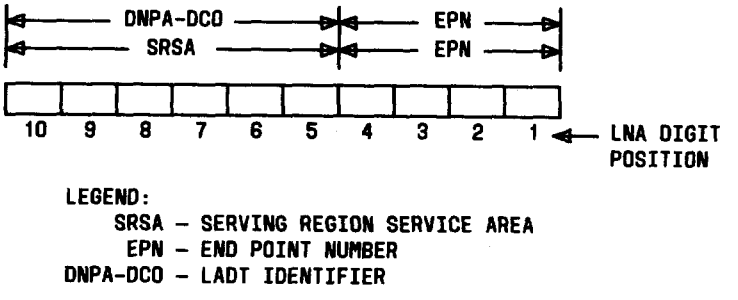


Fig. 2—Logical Network Address (LNA) Code

C. Segmented Network

2.07 A segmented network is a group of physically separate networks that are viewed as a single network (Fig. 5). One example of a segmented network is the 1PSS Local Area Data Transport (LADT). Segments are connected by one or more Inter-Exchange Carriers (IEC), and can be accessed by the 10-digit LNA. The DNPA-DCO (or SRSA in a nonsegmented network), determines the destination segment, and the destination packet switch within that segment. The EPN determines the PSM and access line on the destination packet switch.

2.08 Calls within a segmented network use Inter-Exchange Carriers (IEC) if the call is intersegment, but does not involve IEC if it is intrasegment.

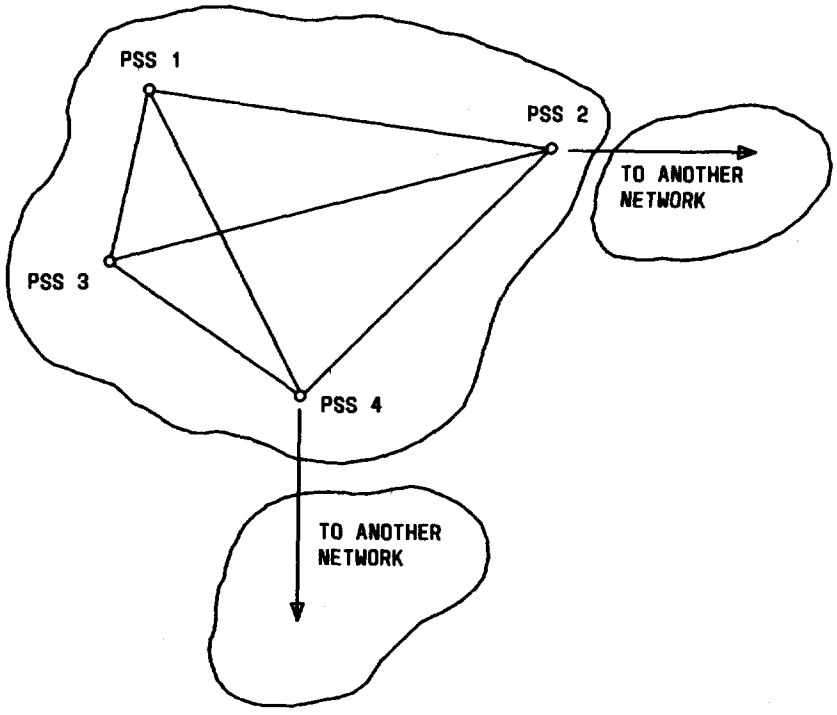
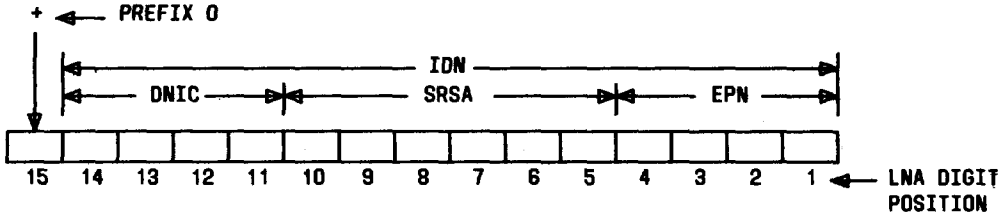


Fig. 3—Transit Network



LEGEND:
DNIC – DATA NETWORK IDENTIFICATION CODE
SRSA – SERVING REGION SERVICE AREA
EPN – END POINT NUMBER
IDN – INTERNATIONAL DATA NUMBER

Fig. 4—Logical Network Address (LNA) Code With Inter-Network Select Code

2.09 Intra-LATA calls must go through an Inter-Exchange Carrier (IEC). There may be more than one IEC interconnecting the 1PSS LATAs, and a customer can preselect the IEC desired to carry the calls for each access line. This must be done by service order at the time the service is provided. The IEC is then the default carrier for all inter-LATA calling. The customer can, however, override the preselect by using the RPOA. If neither RPOA or preselect is present the call is blocked.

3. ROUTING

3.01 There are three modules discussed in this document that are concerned with the routing and switching of calls in a packet switch. They are as following:

(a) ***Central Routing Handler (CRH):*** Responsible for translating an address into the description of the addressed device For example, the

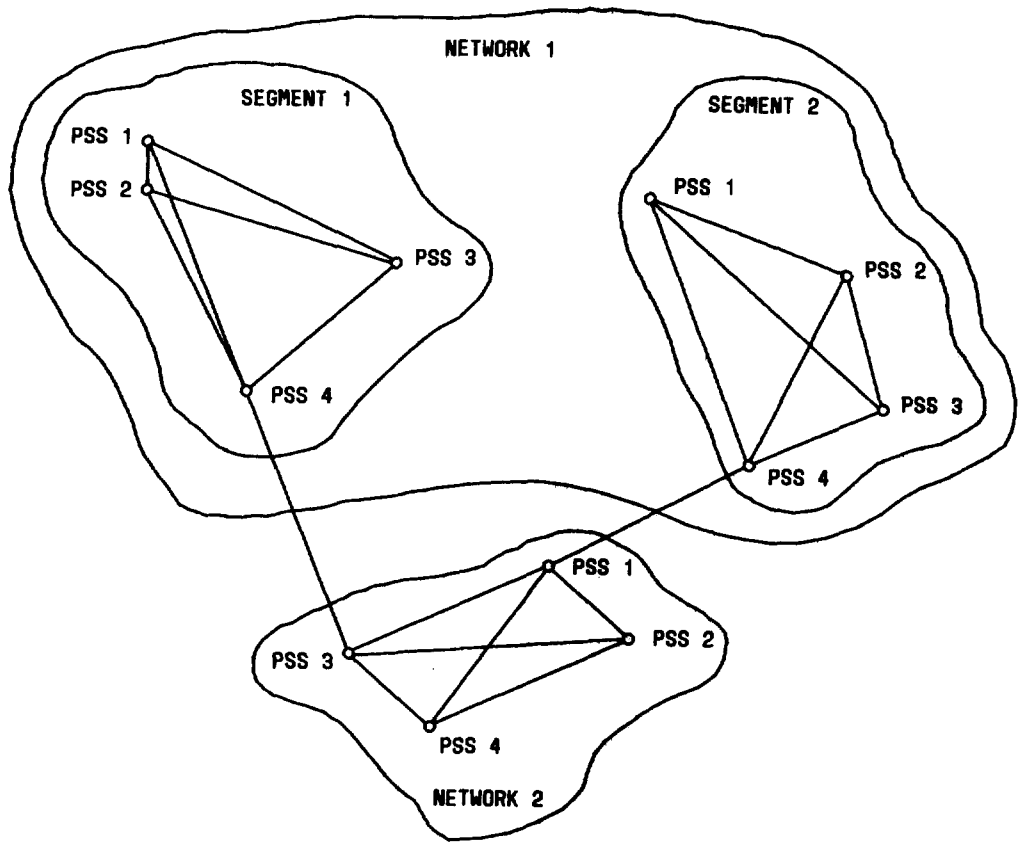


Fig. 5—Segmented Network

SRSA (or first 6 digits of the LNA), is translated by the originating packet switch into a destination packet switch. The EPN, or last 4 digits, is translated by the terminating packet switch into the Packet Switching Module (PSM) and the slot number corresponding to the access line on the PSM. In Release 3 the CRH also performs the translations on the DNIC, or the LADT DNPA-DCO (which is the first six digits of the LADT LNA) and gets the gateway link number, machine number, PSM number, and the slot number.

(b) ***Central Switching Handler (CSH):*** Responsible for providing the PSM number. If a packet is going to an access line or specific PSM, the CSH simply reads the destination PSM. If a packet is going to another packet switch the CSH selects a trunk from the trunk group connecting to the other packet switch.

(c) ***Central Routing and Switching Transaction Handler (CRSTR):*** For Release 2 and 3, it updates the Trunk Group Information Table (TGINF) to reflect available trunks.

4. INTRA-NETWORK CALLING

4.01 Intra-network functions deal with calls whose end points are not in a segmented network, but originate and terminate in the same physical network. These calls are identified in one of two ways:

(a) The called, or destination, address is an LNA.

(b) The called address is an LNA with a prefix 0 and the DNIC of the originating network.

If the DNIC is for the originating network then the routing is the same as if there was no DNIC.

4.02 When the originating packet switch receives a call setup packet containing an LNA, the CRH matches the SRSA of the LNA against the SRSA table to determine the destination packet switch (Fig. 6). (Note that there may be more than one SRSA pointing to the same packet switch.) The SRSA is then checked to ensure that it is not code blocked. The SRSA is then checked to determine if the destination packet switch is a remote or local destination (the terminating packet switch may also be the originating packet switch).

4.03 The CSH must then determine if a trunk to the destination packet switch is available by:

(1) Checking the Routing Information (ROUTE_INFO) table (Fig. 7) for the trunk group number to the destination packet switch.

TRUNK GROUP	REMOTE SRSA	GROWTH
TRUNK GROUP	REMOTE SRSA	GROWTH
TRUNK GROUP	REMOTE SRSA	GROWTH

Fig. 7—Routing Information (ROUTE_INFO) Table

(2) Checking the Trunk Group Information Table (TGINF) (Fig. 8) for an available trunk.

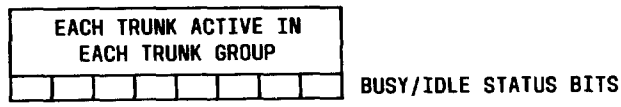


Fig. 8—Busy/Idle Trunk Status (TRUNK_GROUP_INFO) Table

If a direct route is not available an alternate route is selected. The CRH will use the destination packet switch number and the SID to determine the alternate packet switch to use, by accessing the Alternate Path Table (Fig. 9).

4.04 At the destination packet switch the CRH must translate the EPN into the destination access line's PSM number, and the slot number on that PSM. This is done by accessing the EPN Table with the received EPN. The result is the PSM and slot (Fig. 10).

5. INTER-NETWORK CALLING

5.01 Inter-network calling deals with traffic whose origination and destination are in different physical networks. Inter-network calls involving a

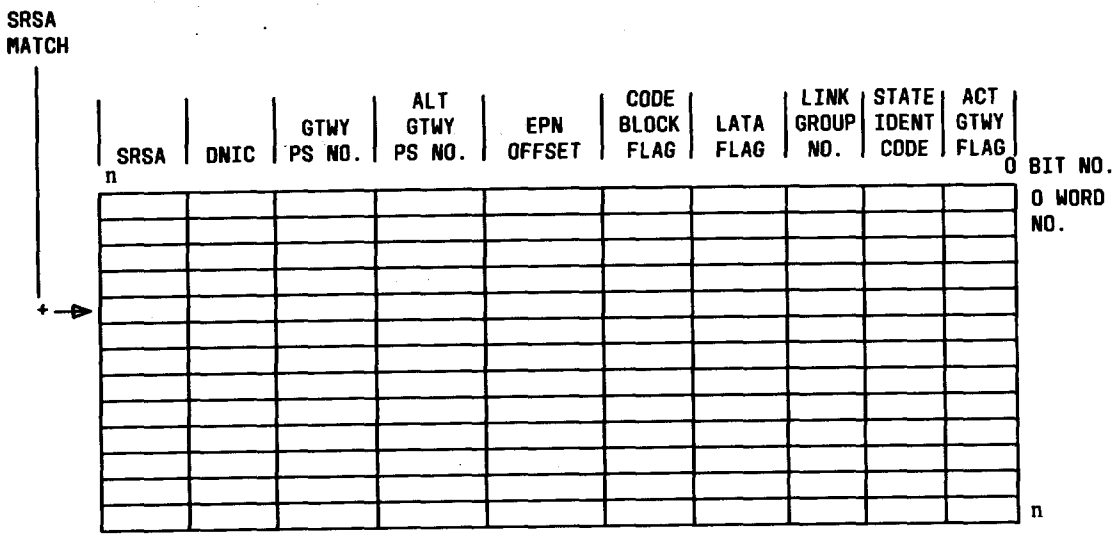


Fig. 6—Serving Region Service Area (SRSA) Table

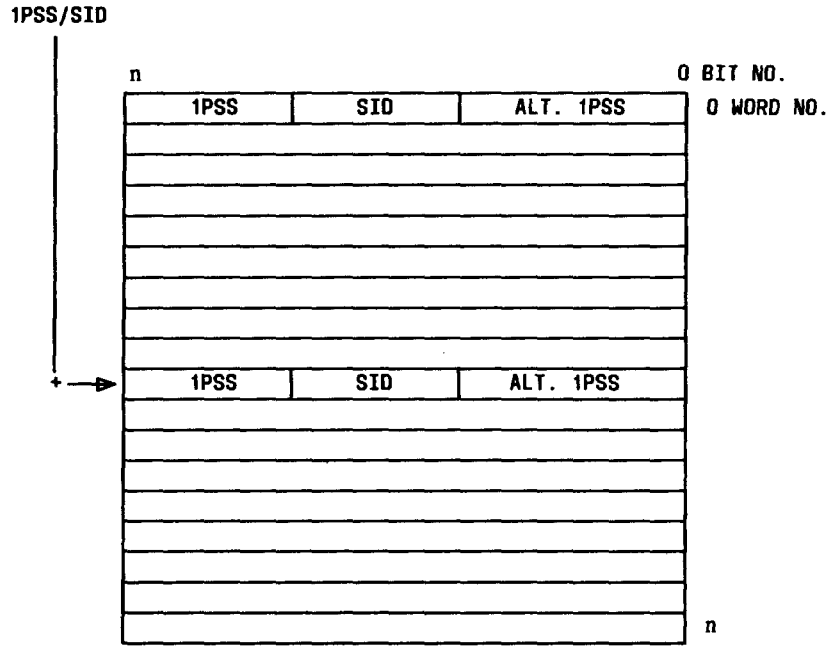


Fig. 9—Alternate Path (ALT_PATH) Table

EPN

EPN MIN	EPN MAX	NEXT EPN INDEX	HUNG GRP INDEX	MACH NO.	FAC. NO.	
n						0 BIT NO.
0	100	3	1	2	0	0 WORD NO.
2	2	3	2	4	1	
5	5	3	NULL	2	1	
400	400	4	NULL	3	1	
401	401	6	5	1	0	
402	402		NULL	1	0	
						n

Fig. 10—End Point Number (EPN) Table

segmented network will be discussed later. The specific functions are as following:

- Routing based on a Recognized Private Operating Agency (RPOA) facility field of an X.25 call setup packet
- Inter-network call screening
- Routing from the originating packet switch to the gateway packet switch
- Crossing the gateway
- Routing from gateway to gateway
- Routing from the gateway to the destination packet switch.

5.02 An inter-network call is identified by the existence of a DNIC in addition to an LNA. This DNIC is then checked against the list of DNICs for segmented networks in the Segmented List (SEGNET) table. If the DNIC is not listed, and is not the identifier for the local network, then the call is handled as an inter-network call.

5.03 A network-wide default gateway packet switch is assigned between two networks for each DNIC. The CRH then uses the called DNIC to search the DNIC translation table (Fig. 11) for the gateway number. If the customer used the facility then the DNIC in the RPOA facility is used to search the table. This will allow an alternate choice gateway to the other network.

5.04 When calling across a network boundary, the customer must specify the prefix 0 plus the full International Data Number (IDN) (Fig. 4). The IDN is the absolute address specifying the end point. It consists of the DNIC plus the LNA. The DNIC in the called IDN specifies the destination network. The transit network, to be used if the origination and destination network are not directly connected, is a default network address specified by the network administration. However, since there may be more than one transit network interconnecting the networks, the customer can select another transit network by using another RPOA facility. If the search

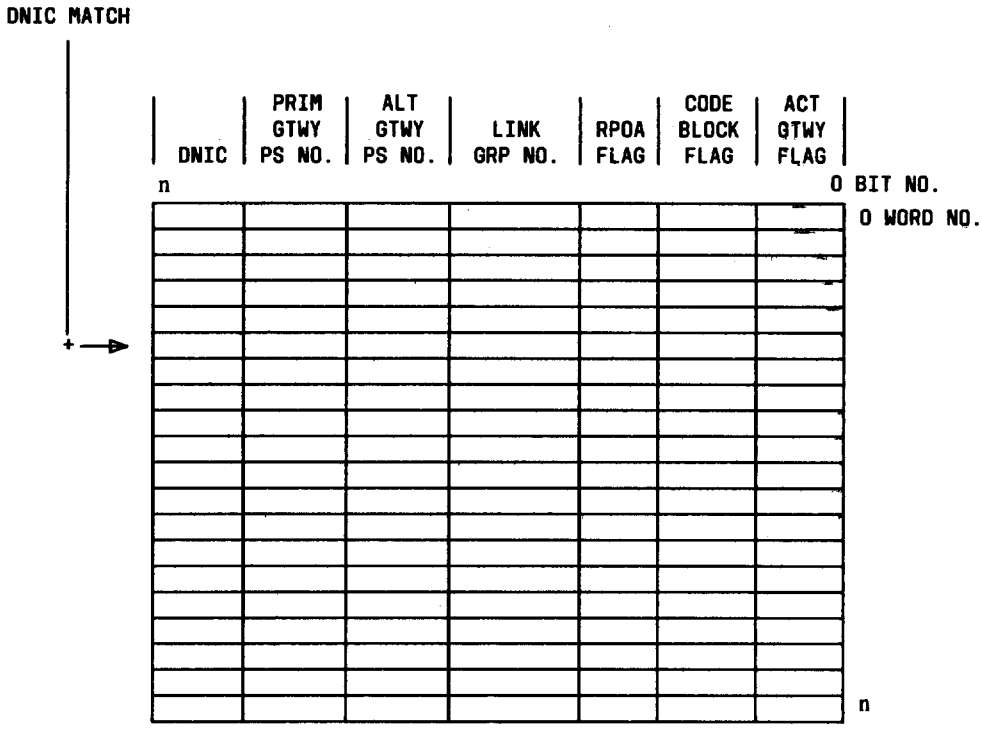


Fig. 11—Data Network Identification Code Translation (DNIC_tab) Table

for a gateway is successful then the packet is now ready for transport to the gateway packet switch.

A. Gateway

5.05 The two networks are connected by gateway links which use the X.75 protocol for communication. The gateway may or may not connect to the desired network. It may be necessary to route the call through one or more transit networks to reach the destination network.

5.06 Gateway links for a gateway are assigned to a link group. The links assigned to a specific group are stored in the LGINF table. The link assignments are handled like a hunt group for selection of an available link. All links of the group are in the table even though some may not be available for service.

5.07 Call screening is performed on each call at the gateway. At each gateway of a network, two lists of DNICs are stored in the LGINF; the Accept List, and the Send List. When a call is exiting the network through a gateway, the calling DNIC must be in the accept list, and the called DNIC must be in the send list. When the gateway is receiving a call from another network, the calling DNIC must be in the send list and the called DNIC must be in the accept list. If neither condition is met the call is rejected. The accept and send lists are updated by service order procedures.

5.08 To send a call out of the network, when a call setup packet is received by the exit gateway packet switch, the CRH must complete the same translation and screening as the originating packet switch. The RPOA DNIC or the called DNIC must be translated to provide the gateway packet switch, here, in the local packet switch. Screening is also performed for possible call blocking. The CRH must now translate the DNIC into a gateway link group number. The link group number is found in the DNIC translation table. Since the CRH had already found the DNIC translation, it can now use the same index to get the link group number, and then, by accessing the LGINF table, a gateway link can be selected.

5.09 When the setup packet reaches the destination network, the receiving gateway packet switch screens the received addresses, including checking for call blocking. If the packet passes screening, CRH recognizes the DNIC as the DNIC for the local network, and routing now progresses as an intra-network call.

5.10 In Release 3, up to two gateway packet switch locations may be specified for each DNIC. One is marked as the primary, with the other as an alternate. If the primary is not available for service, the craft can, at the maintenance terminal, mark the alternate as the primary, using the input message SW:ALTGTEWAY. Population of the DNIC translation table with the alternate gateway number is by service order.

6. SEGMENTED NETWORK CALLING

A. Intra-LATA Calling

6.01 A segmented network is a set of physically separate exchange area packet networks, each of which operates within a local exchange area, e.g., 1PSS Local Access Transport Area (LATA). While physically separated, the segmented network operates as though all parts are as one network. Each segmented network is given a DNIC for the total, interconnected 1PSS LATA network. Routing within the 1PSS LADT is by DNIC or by 10-digit LNA. The DNIC, if present, is compared with the Segmented Network (SEGNET) Table (Fig. 12) to determine if it is for a segmented network. If it is, the DNPA-DCO of the LNA is then translated by CRH into the packet switch, and the EPN provides the access line on the destination packet switch. The call is then handled like an intra-network call.

6.02 If the called number does not contain a DNIC the CRH translates the DNPA-DCO, or first six digits of the called LNA, into a LATA identifier flag by accessing the SRSA translation table. If a match is found, and the call is identified as an intra-segment call, the call is then handled as an intra-network call.

B. Inter-LATA Calling

6.03 If the call is identified as an inter-segment call, routing requirements state that the source packet switch can route on the RPOA facility or the preselect DNIC only for an inter-LATA call, with the RPOA facility having precedence over the preselect DNIC. When the RPOA is not specified by the customer, the preselect DNIC is placed in the RPOA field. Thus, the source packet switch can always route on the RPOA field.

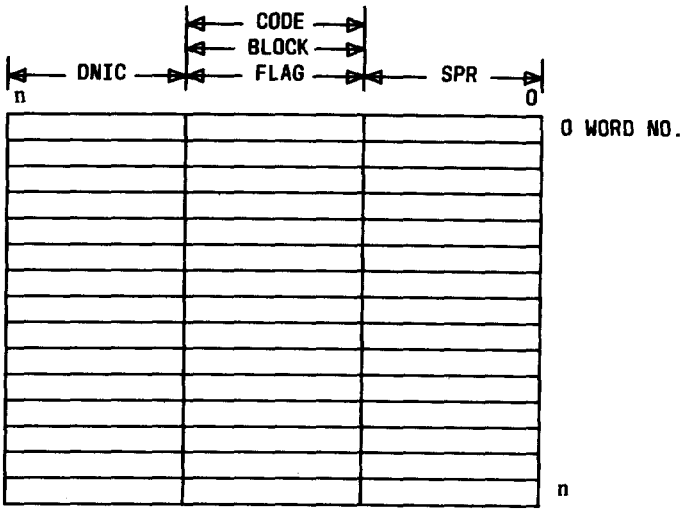


Fig. 12—Segmented Network (SEGNET) Table

6.04 The CRH translates the DNIC in the RPOA field into a gateway packet switch for the desired network. This information is placed in the packet along with the PSM and slot number of the link, and the packet is routed to the gateway. At the source network gateway, the CRH uses the RPOA field to route the packet. The RPOA DNIC is translated into a link group number, and an available link is selected from the LGINF table.

6.05 At the entering gateway of an IEC, the CRH, after identifying the call as an inter-exchange call, must translate on the DNPA-DCO, which is the equivalent of an SRSA here. The DNPA-DCO is translated into the destination packet switch number, the EPN is translated into the PSM and slot numbers for the access line. From this point on, the call is handled like an intra-network call.

6.06 For calls from a non-LADT network to an 1PSS LADT the routing procedure is handled just like routing from a gateway packet switch to a gateway packet switch.

6.07 For calls from an 1PSS LADT network to a non-LADT the routing procedure is handled just like routing for an intra-network call.

7. TERMINATING A CALL

7.01 The EPN specifies the access line. The following three types will be found:

(a) ***Single Address:*** A single address EPN points to a single access line. It will be the only assignment.

(b) ***Multiple Address:*** A multiple address EPN points blocks of EPNs, in multiples of 100, to a single access line. Thus a customer can call a range of numbers to reach the same destination.

(c) ***Hunt Group:*** A line in a hunt group may be accessed by specific addressing of a line in the hunt group by a single EPN, or by a block of EPNs pointing to a group of access lines. Thus an EPN accessing a hunt group can search over many access lines. The selection of the access line is by the CRH.

7.02 If the EPN falls between the EPN MIN and EPN MAX (Fig. 10), or is equal to the entry in the EPN MIN and EPN MAX, then the access line entry for this packet has been found. The minimum and maximum fields are used to allow multiple EPNs on one access line, multiple access lines, or hunt groups, without the need to list all legitimate EPNs. If there is only one EPN for this access line then EPN MIN is equal to EPN MAX.

7.03 When a legitimate entry is found in the EPN table, the entry is then checked to determine if it is a member of a hunt group. If it is, there will be an entry in the hunt group link field pointing to the next entry in the hunt group (up to a maximum of 20 lines).

7.04 A hunt group can have either a single EPN or a range of EPNs, similar to the ranges for individual access lines. If the hunt group does not use multiple addresses, the entry for each access line in the hunt group will have the one legal EPN as the EPN MIN and EPN MAX. If a range of EPNs is specified during service order, the one with the lowest value within the range is reserved to indicate that any of the hunt group access lines can be used. Thus if the received EPN equals the lowest number assigned in the group, then any line in the hunt group may be selected. If the received EPN is equal to the second through the twentieth EPN then the packet must be sent over the line that has this particular EPN. This allows accessing a specific access line within a hunt group.

7.05 If the hunt group is selected on the first reserved EPN, then any line in the hunt group may be selected. The incoming packets are then routed to the access lines in a round-robin method, rotating the assignments over the idle lines.

8. SERVICE PROVISIONING

8.01 Service provisioning is by the interactive forms mode of operation. This is handled by a modified version of the On-Line Data Integrity System (ODIN). The ODIN supports an on-line data base and provides the terminal operator with several levels of interactive data verification.

8.02 Due to the volatile nature of the service order forms and procedures, the OM-70000-03 Manual, Appendix IM/OM-E, should be followed when providing and/or changing service conditions in the packet switch.

8.03 There are several forms used for providing service in the packet switch. The layout of each form is displayed in the Appendix IM/OM-E, along with a description of the fields. The following is a list of the forms:

- System Data (sysdata) Form
- Facility Interface Processor (fip) Form
- Trunk Group (tgroup) Form
- Data Network Identification Code (dnic) Form
- Service Region Service Area (srsa) Form
- X.25 Customer Service (customer) Form
- Permanent Virtual Circuit (pvc) Form
- X.75 Gateway Link (gateway) Form
- IDTE Client Process (idte) Form.

9. ABBREVIATIONS AND ACRONYMS

9.01 A list of the abbreviations and acronyms used in this section is found in Table A.

TABLE A

ABBREVIATIONS AND ACROMYMS

ACRONYM	DESCRIPTION
1PSS	AT&T WESTERN ELECTRIC 1 Packet Switching System
ALT_PATH	Alternate Path Table
CRH	Central Routing Handler
CRSTR	Central Routing and Switching Transaction Handler
CSH	Central Switching Handler
CTSP	Central Transport Service Process
DNIC	Data Network Identification Code, consisting of a 4-digit prefix to the LNA for inter-network calling.
DNPA_DCO	Destination LATA, and Destination 1PSS within that LATA
EID	End Point Identifier
EPN	End Point Number (Last 4 digits of the LNA)
EPN MAX	Maximum number of the end point number of the access line
EPN MIN	Minimum number of the end point number of the access line
IDN	International Data Number
IDTE	Internal Data Terminal Equipment
IEC	Inter-Exchange Carrier
LADT	Local Area Data Transport
LATA	Local Access Transport Area
LGINF	Link Group Information Table
LNA	Logical Network Address, consisting of a 6-digit SRSA, and a 4-digit EPN.
LOR	Local or Remote Bit
ODIN	On-Line Data Integrity System
PSM	Packet Switching Module
PVC	Permanent Virtual Circuit
ROUTE_INFO	Routing Information Translation Table
RPOA	Recognized Private Operating Agency flag (Inter-Exchange Carrier Code)
SEGNET	Segmented Network List
SID	Subnetwork Identification Number
SRSA	Serving Region Serving Area, consisting of the first 6 digits of the LNA.
TGINF	Trunk Group Information Table