NETWORK PATH HUNT
SOFTWARE SUBSYSTEM DESCRIPTION
NO. 3 ELECTRONIC SWITCHING SYSTEM

CONTENTS PAGE

Figures

CONTENTS PAGE

CONTENTS PAGE

1. GENERAL

INTRODUCTION

1.01 This section describes the software required for network path hunting, path idling, and network auditing functions of the No. 3 Electronic Switching System (ESS). The intent of this section is to describe the functions correlating the software necessary to perform the functions. In addition, it will serve as an aid in using the program listings. Detailed program functions and coded software instructions can be found in the program listings.

1.02 When this section is reissued, this paragraph will contain the reason for reissue.

REFERENCES

1.03 A list of abbreviations, acronyms, and terms used in this section is included in Part 4.

1.04 The following Bell System Practices contain information on the network and on related software which may be useful in understanding the process of network path hunting.

- Section 254-340-100—Introduction to 3A Language
- Section 254-340-102—Introduction to 3A Instruction Set
- Section 254-340-104—Program Listing Standards and Usage
- Section 233-152-140—Audits
- Section 233-151-130—Basic Call Processing
- Section 233-151-150—Translations
- Section 233-120-100—Switching Network Description and Theory.

1.05 The following programs contain the codes and comments for the network path hunting, idling and auditing functions described in this section:

(a) Network path hunt, busy and idle (PATHNT) program, PR-3H166-01, provides a means for maintaining the proper busy/idle status of the network A and B links.

(b) Network audit program, (AUDNET) PR-3H003-01, performs routine network map audits and network map regeneration.

DESCRIPTION

1.06 Network path hunting consists of hunting for an idle path between two terminals, then maintaining the appropriate busy/idle status of the network links comprising that path. This is accomplished by correctly updating the status bits in a network map (NETMAP) in call store. In addition, the terminal memory record (TMR) for the selected junctor is updated with the new terminal information, and path information is placed in the transient call record (TCR).

1.07 Path idling changes the associated status bits for the links, used in the path to be idled, to show an idle status in the network map. The TMR associated with the junctor (of the idled path) is also changed to reflect an idle status.

1.08 Auditing compares two areas of the temporary store to the terminal memory record and the link out-of-service list to ensure the validity of the network map. Any discrepancies found in the comparison are reported via a TTY message and corrected as part of the network map regeneration.

2. NETWORK FUNCTIONAL DESCRIPTION

2.01 The switching network is constructed of concentrator groups. Each concentrator group consists of two concentrators with 192 terminals each, making a total of 384 terminals per concentrator group. Within each concentrator are first- and second-stage switches. There are twenty-four 8-by-8 first-stage switches and eight 8-by-8 second-stage switches per concentrator. This arrangement provides 64 outputs for the second stage associated with a concentrator. The outputs from each concentrator in the group are connected to maintain a 6-to-1 concentration ratio per concentrator group. Third-stage switching requires thirty-two 8-by-8 switches. One-half of the outputs of a concentrator group are connected directly to the 32 third-stage switches (one each). The other half of the outputs (32) are connected via circuit junctors to the third-stage switches; therefore, 32 junctors are always provided for each concentrator group.

2.02 The original network is comprised of from one to seven concentrators interconnected via 32 third-stage switches. An expanded office with two networks (concentrator groups 1-7 and groups 8-15) requires 128 third stage switches.

2.03 The switching network utilizes five stages of switches to form a complete path from party A to party B. A switched connection uses the first- and second-stage of one concentrator group plus a third-stage switch and the second (fourth) and first (fifth) stage switch of the same, or another, concentrator group. Figure 1 shows the basic interconnections.

2.04 Access paths designated A-links connect the first-stage switches to the second-stage switches. Access paths between the second- and third-stage switches are designated B-links. Half of the B-links are wire, and the other half are the junctor (circuit) type.

2.05 A-links connect the horizontal levels of first stage switches 0 through 7 to the horizontal levels 0 through 7 of the stage 2 switches. The horizontal level of the second is determined by use of an A-link selection table in memory.

2.06 Wire B-links directly connect the second-stage switches to the third-stage switches and are run from the odd-numbered verticals of the second-stage switches to third-stage switches. A junctor B-link, which provides an access circuit to the network, is connected from the even numbered verticals of the second-stage switches to the third-stage switches. The No. 3 ESS network B-link pattern is shown in Fig. 2.

2.07 A complete network path connects from terminal X, through an X A-link, through a junctor B-link, through a wire B link, and through a Y A-link to terminal Y. The network topology is such that only one third-stage switch is necessary per path. To completely specify the path, the third-stage switch number (junctor switch number) and the two terminal equipment numbers (TEN) (Fig. 3) are required.

3. SOFTWARE STRUCTURE

A-LINK SELECTION TABLE

3.01 The A-link selection table (Fig. 4) is used for associating a first-stage switch (input switch) with its eight connecting A-links. Because of the multiplying arrangement, two words are required for each first-stage switch resulting in the selection table being 48 words in length.

Each pointer in the table is 4 bits in length with the low 3 bits of each pointer equal the second-stage switch level which terminates the A-link. Eight pointers, one per second-stage switch, are required for each first-stage switch. The pointers are the same for like-numbered switches in all concentrators, and the selection table is indexed by a number equal to twice the first-stage switch number.

NETWORK MAP

3.02 One of the functions of the network path hunting software is maintaining the status bits of the network links in the network map (Fig. 5). The network map resides in main store, and for a single network office the network map is 96 words in length. Within the 96 words are the status bits of all of the A-links and B-links in the network. Every time an idle path is needed through the network, the network map is accessed by PATHNT to find an idle path. The network map is maintained by the network audit program, AUDNET, which routinely audits the network map and sets the status of the bits accordingly.

PROGRAMS

3.03 PATHNT performs network path hunting and idling functions. PATHNT is entered by PATHUNT and PATHIDLE macros. These macros are called by any program needing a path through the network or wanting to idle a path through the network. Using one of the aforementioned macros and information supplied by the calling program, a register of flags (Fig. 6) is generated for use by PATHNT. That macro also provides a branch table index according to the key words supplied with the macro request to be used to enter PATHNT via a branch table at entry point PATHST. A special entry point (PATHIDL) also exists which calculates the branch table index from the active path indicated in the TCR eliminating

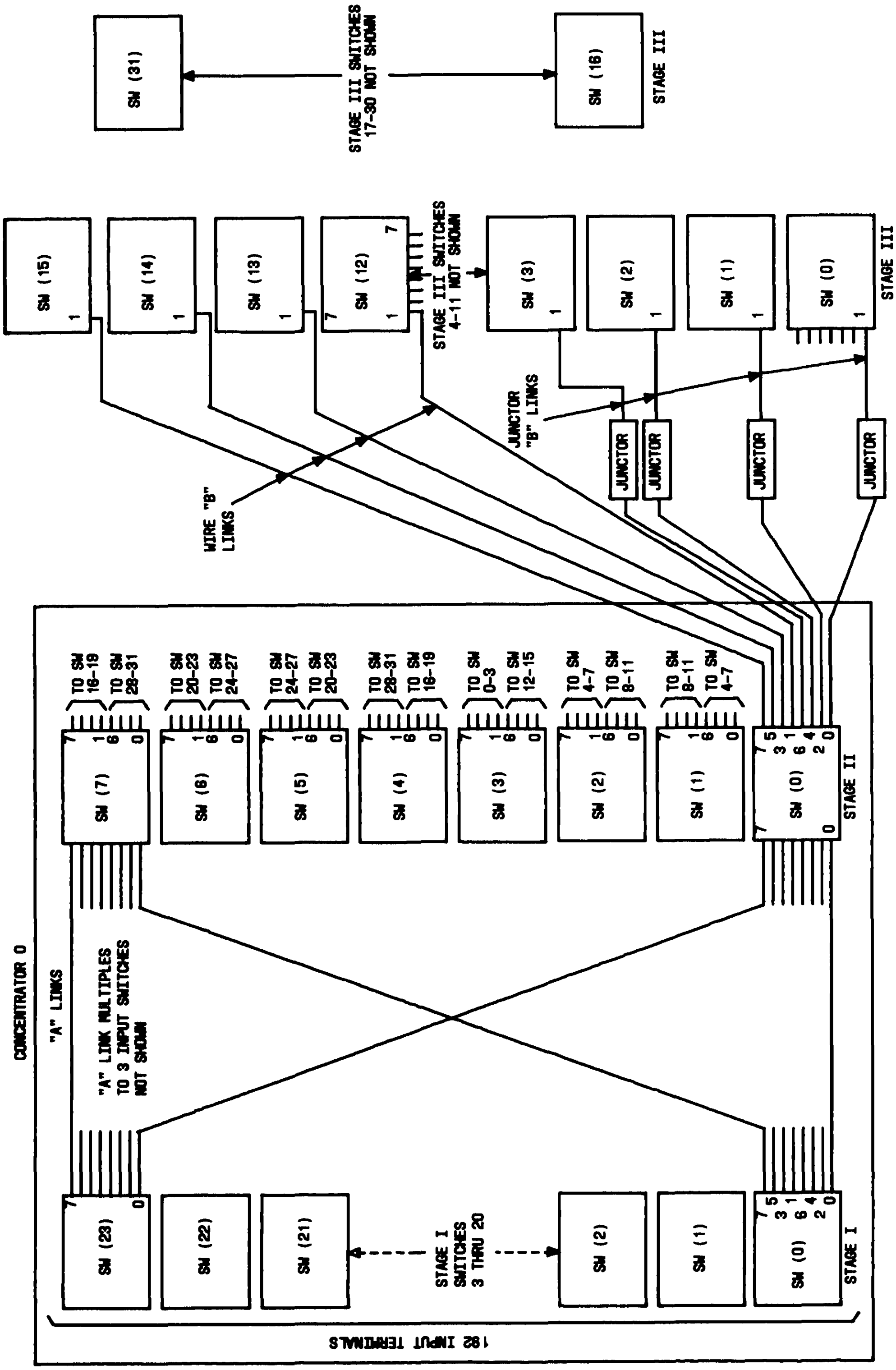

Fig. 1—No. 3 ESS Network Topology

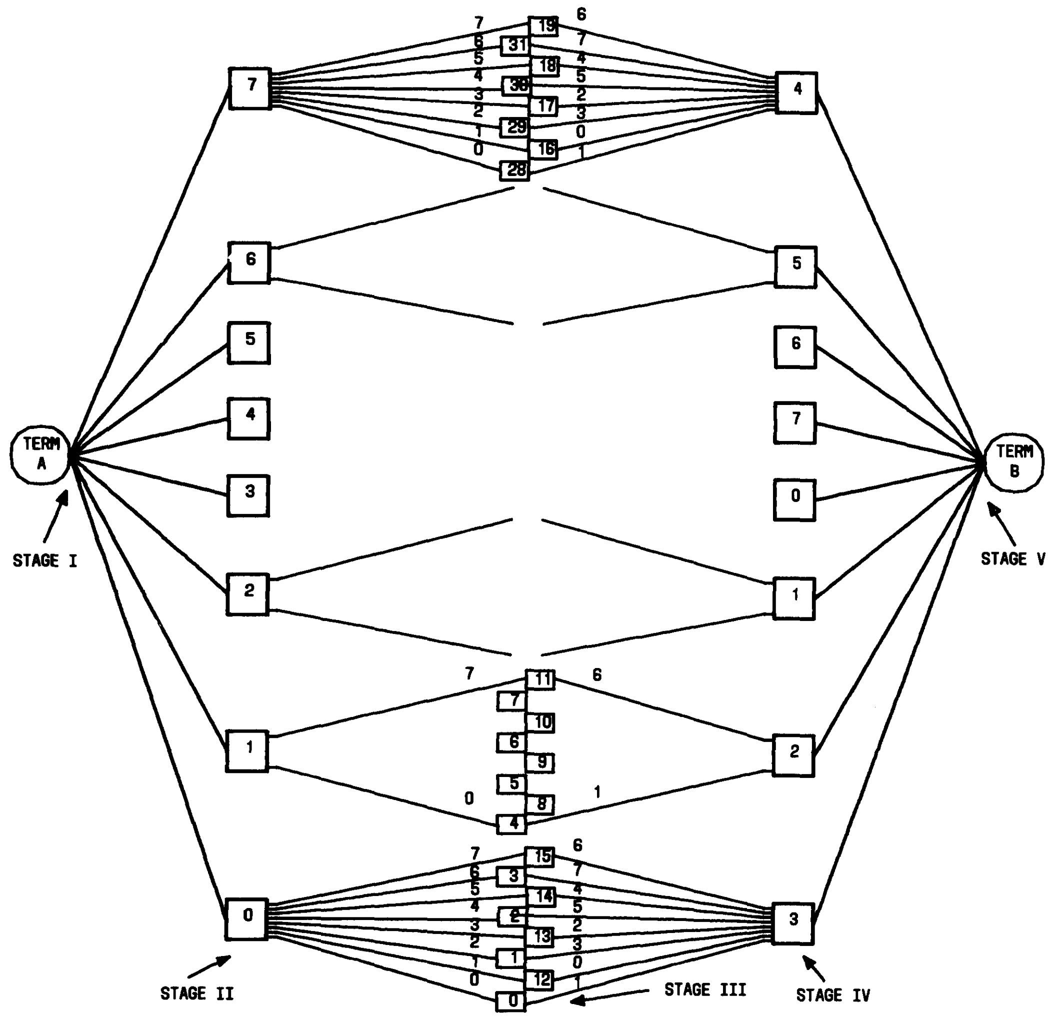

Fig. 2—No. 3 ESS B-Link Pattern

			NETWORK NUMBER	CONCENTRATOR GROUP NUMBER			2 HIGH ORDER BITS OF FIRST-STAGE SWITCH NUMBER		CONCENTRATOR NUMBER	LOW 3 BITS OF FIRST-STAGE SWITCH NUMBER			FIRST-STAGE SWITCH LEVEL OF THE TERMINAL		
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Fig. 3—Terminal Equipment Number Format

the necessity of returning to the called macro to enter PATHNT.

3.04 The usable forms of the PATHUNT and PATHIDLE macro calls are given below and expanded in 3.06 through 3.38.

- PATHUNT A to ASVC [NOSHR]
- PATHUNT A to MFRCVR
- PATHUNT A to CDPR

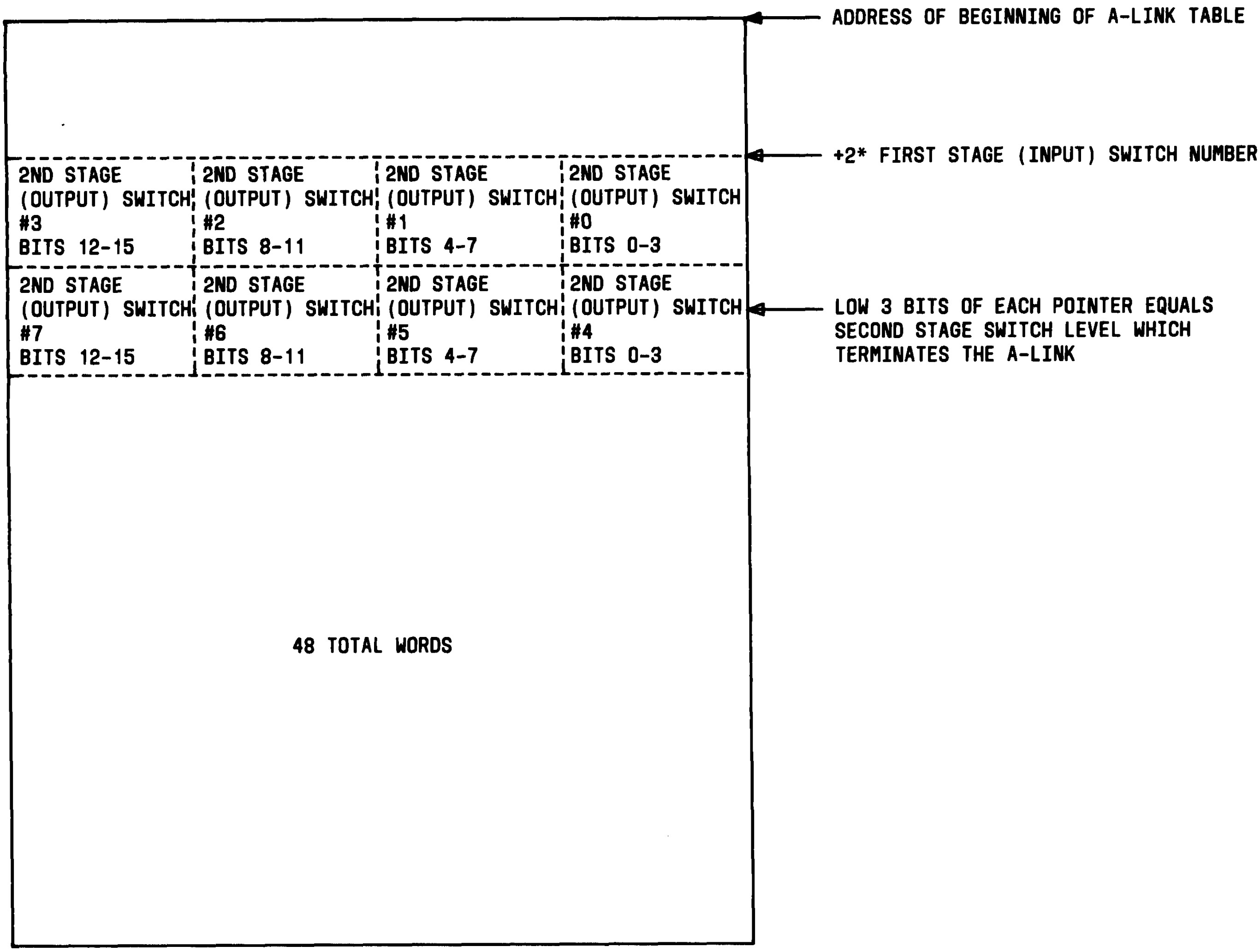

Fig. 4—A-Link Selection Table

- PATHUNT AB to ABSVC
- PATHUNT A to B [NOSHR]
- PATHUNT AB [NOSHR]
- PATHUNT B to BSVC [NOSHR]
- PATHIDLE A to ASVC
- PATHIDLE A to CDPR
- PATHIDLE A to MFRCVR
- PATHIDLE AB to ABSVC
- PATHIDLE AB to ABSVC YHAF
- PATHIDLE B to BSVC
- PATHIDLE A to B
- PATHIDLE XHAF.

A-links are normally shared, saving software the added burden of having to reconfigure the first-stage switches while processing a call. A-link sharing means a path uses the same A-link as another reserved or physical path to minimize A-link blocking. An example of A-link sharing is depicted on Fig. 7. The NOSHR option, where permitted, prohibits A-link sharing and connects all A-links necessary to process a call. This option is especially useful for special features such as conference calls. If either the stage 1 or stage 2 switches are blocked

A-LINK STATUS BITS FOR NETWORK 0 (X OR Y TERMINAL)
4 WORDS PER CONCENTRATOR = 64 WORDS (SEE 4 WORDS BELOW)

(OUTPUT) 2ND STAGE SWITCH 1 LEVEL 0-7 (bits 15 … 8)	(OUTPUT) 2ND STAGE SWITCH 0 LEVEL 0-7 (bits 7 … 0)
(OUTPUT) 2ND STAGE SWITCH 3 LEVEL 0-7 (bits 15 … 8)	(OUTPUT) 2ND STAGE SWITCH 2 LEVEL 0-7
(OUTPUT) 2ND STAGE SWITCH 5 LEVEL 0-7 (bits 15 … 8)	(OUTPUT) 2ND STAGE SWITCH 4 LEVEL 0-7
(OUTPUT) 2ND STAGE SWITCH 7 LEVEL 0-7 (bits 15 … 8)	(OUTPUT) 2ND STAGE SWITCH 6 LEVEL 0-7

JUNCTOR B-LINK STATUS BITS FOR NETWORK = 0, ie. 3RD STAGE (JUNCTOR) SWITCH 0-31 AND 32-63. 2 WORDS PER CONCENTRATOR GROUP = 16 WORDS. EACH BIT IN WORD N CORRESPONDS TO THE SAME LEVEL ON 16 3RD STAGE SWITCHES. NUMBERS BELOW ARE 3RD STAGE SWITCH NUMBERS.

15 AND 47	14 AND 46	13 AND 45	12 AND 44	11 AND 43	10 AND 42	9 AND 41	8 AND 40	7 AND 39	6 AND 38	5 AND 37	4 AND 36	3 AND 35	2 AND 34	1 AND 33	0 AND 32
31 AND 63	30 AND 62	29 AND 61	28 AND 60	27 AND 59	26 AND 58	25 AND 57	24 AND 56	23 AND 55	22 AND 54	21 AND 53	20 AND 52	19 AND 51	18 AND 50	17 AND 49	16 AND 48

WIRE B-LINK STATUS BITS FOR NETWORK = 0; ie. 3RD STAGE (JUNCTOR) SWITCH 0-31 AND 64-95
16 WORDS

A-LINK STATUS BITS FOR NETWORK 1
64 WORDS

JUNCTOR B-LINK STATUS BITS FOR NETWORK 1
16 WORDS, 3RD STAGE (JUNCTOR) SWITCH 64-95 AND 96-127.

WIRE B-LINK STATUS BITS FOR NETWORK 1 3RD STAGE SWITCH 32-63 AND 96-127
16 WORDS

47 AND 111	46 AND 110	45 AND 109	44 AND 108	43 AND 107	42 AND 106	41 AND 105	40 AND 104	39 AND 103	38 AND 102	37 AND 101	36 AND 100	35 AND 99	34 AND 98	33 AND 97	32 AND 96
63 AND 127	62 AND 126	61 AND 125	60 AND 124	59 AND 123	58 AND 122	57 AND 121	56 AND 120	55 AND 119	54 AND 118	53 AND 117	52 AND 116	51 AND 115	50 AND 114	49 AND 113	48 AND 112

Fig. 5—Network Map

YHAF	XHAF	IFLAG		AUDIT	ASHR	PARTY	AUDUSE	FAKRV	TR2	NLLIN	LLIN	RVRSFLG	SAMSW	IAY	IAX
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

YHAF = 1 IMPLIES HUNTING AND IDLING Y HALF PATH

XHAF = 1 IMPLIES HUNTING AND IDLING X HALF PATH

IFLAG = 1 IMPLIES SOMETHING OTHER THAN A PATH HUNT IS IN PROGRESS

AUDIT = 1 IMPLIES AN AUDIT IS USING PATHNT

ASHR = 1 IMPLIES A-LINK SHARING

PARTY = 0 IMPLIES X TERMINAL, = 1 IMPLIES Y TERMINAL

AUDUSE = 1 IMPLIES AN AUDIT USAGE OF PATHNT

FAKRV = 1 IMPLIES A FAKE REVERSAL (A PATH WAS REVERSED FOR REASONS OTHER THAN THE ABILITY TO FIND A PATH)

TR2 = 1 IMPLIES THE 2ND GROUP OF 16 PATHS ARE BEING EXAMINED

NLLIN = 1 INDICATES X PARTY IS A NON TREATED LINE IN A CONCENTRATOR GROUP HAVING LONG-LINE JUNCTOR CIRCUITS

LLIN = 1 INDICATES X OR Y PARTY IS A TREATED (LONG) LINE

RVRSFLG = 1 IMPLIES X AND Y TERMINALS WERE SWITCHED DURING PATH HUNT

SAMSW = 1 IMPLIES THE X AND Y TERMINALS ARE ON THE SAME SWITCH

IAY = 1 INDICATES ALL BUT THE Y A-LINK SHOULD BE IDLED BECAUSE Y A-LINK SHARED

IAX = 1 INDICATES ALL BUT THE X A-LINK SHOULD BE IDLED BECAUSE X A-LINK SHARED

Fig. 6—Flags Register

(ie, no path is found), each PATHUNT call may specify the point to which control is passed. An example is:

PATHUNT A to B FAIL B location

Otherwise, control is returned to the calling routine after the path hunting or idling tasks have been performed.

3.05 The network audit program, AUDNET, provides the means to (1) perform a routine network map audit, and (2) perform a network map regeneration. For map regeneration and emergency audits, AUDNET is accessed like a called subroutine. Map regeneration is usually called by initialization software. Regular audits of the network are called by the audit monitor, AUDITS. AUDITS obtains control once each base level loop to do auditing work. However, an audit of the network is not necessarily done each cycle depending on the time remaining in the loop.

NETWORK PATH HUNTING

A. PATHUNT A to B (NOSHR)

3.06 The A PARTY and B PARTY terminal equipment numbers must be identified in the TCR for this macro call prior to invoking PATHNT. The A PARTY is considered to be terminal X and the B PARTY terminal Y for the forward path hunt. If the path is reversed for a reverse path hunt A PARTY is Y and B PARTY is X. A-link information is extracted from the junctor area of the TCR and is used when A-link sharing is attempted. Absence of the no share (NOSHR) option means A-link sharing must be attempted and is indicated in the flags register. If PATHNT determines from the TCR that either party is a long loop line, it sets the long loop (LLIN) flag in the flag register (Fig. 6) to show range extension is required. Switched range extension is not offered in the No. 3 ESS, but the capability is included in PATHNT for future flexibility.

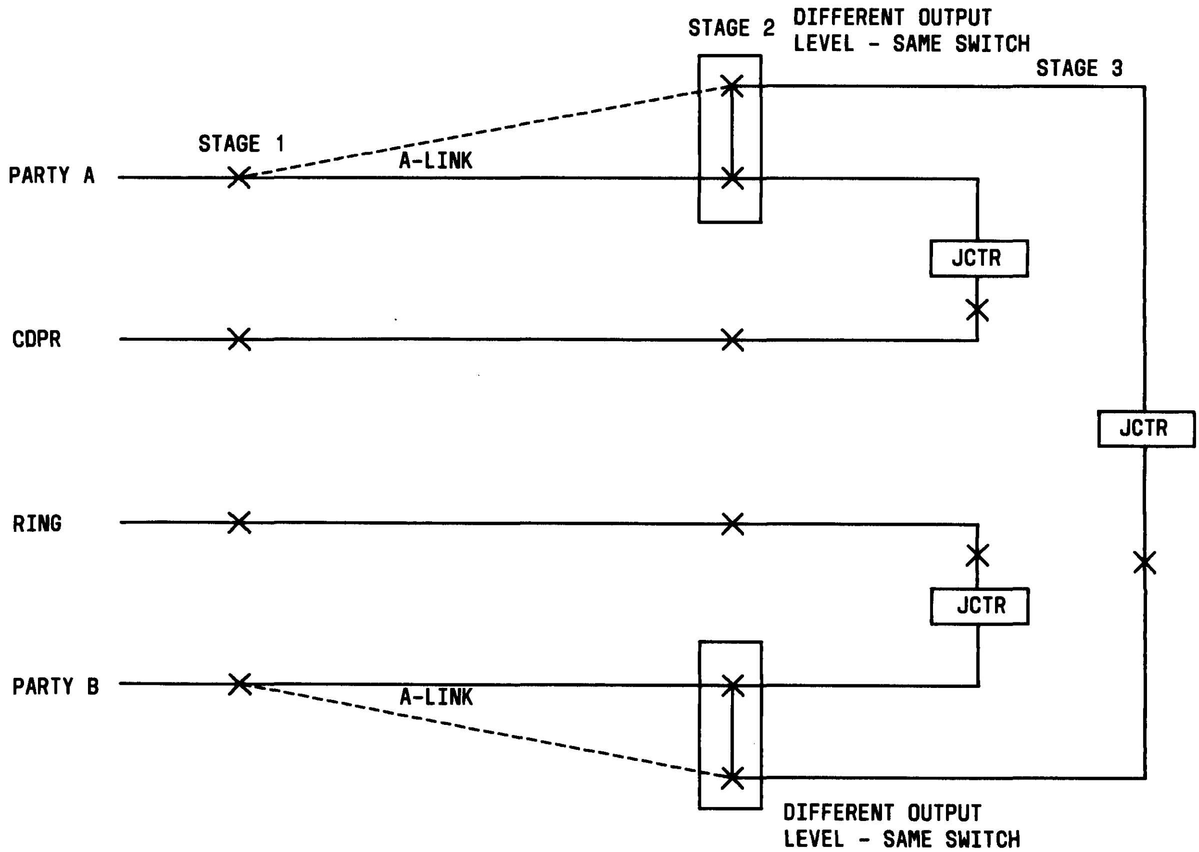

Fig. 7—A-Link Sharing Diagram

3.07 Before the path hunt is made, PATHUNT checks TCR flags register to determine if reversal is possible (path reversal is when a path through the network is hunted from the B PARTY to the A PARTY instead of the normal A PARTY to B PARTY search). Reversal is not possible if a junctor test, half path hunt, or path idle is being performed. Also, if the two terminals are in the same concentrator group, reversal is not necessary. Once it is determined that a reversal is possible, another test is made to see if it is necessary. Valid reasons for path reversal are: (1) to obtain access to a range extension junctor, (2) to ensure test vertical access, and (3) for traffic balancing. When range extension is needed, PATHNT checks the X concentrator group for range extension junctors. If the junctors are not present, PATHNT sets the reverse flag (RVRSFLG) and switches the A and B terminals. If range extension is not required, PATHNT checks the flags in the PATHDATA word (Fig. 8) to determine if there is a reason for path reversal. When the path is reversed for traffic balancing or test vertical access, the fake reverse (FAKRV) flag is set. The FAKRV flag, when set, indicates that although the path was reversed, the reversal was not done to find a usable path and therefore can be rereversed to find an idle path. In all cases of path reversal, the A and B terminals are reversed so that the path is hunted from Y to X (B PARTY to A PARTY).

3.08 PATHNT then calculates the following pointers from the terminal equipment numbers and stores them in a scratch area.

- A pointer for the X terminal used to index into the A-link table
- A pointer for the Y terminal used to index into the A-link table
- A pointer used to index into the A-link portion of NETMAP for the X terminal

								LOCK REVERSE HUNT	REVERSE HUNT	AUDIT IN PROGRESS	HIGH/ LOW	WALK WORD			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

LOCK REVERSE HUNT - 1 IMPLIES THAT BLMMA SHOULD NOT TOGGLE THE REVERSE HUNT BIT
REVERSE HUNT - 1 IMPLIES THAT PATH HUNTS SHOULD BE REVERSED INITIALLY
AUDIT IN PROGRESS - 1 INDICATES AUDIT OF NETWORK IS IN PROGRESS
HIGH/LOW - INDICATES WHICH HALF OF THE A-LINKS ARE EXAMINED FIRST
WALK WORD - USED TO DISTRIBUTE THE STARTING POINT OF PATH HUNTING

Fig. 8—PATHDATA Word

- A pointer used to index into the A-link portion of NETMAP for the Y terminal
- A pointer used to index into the circuit B-link portion of NETMAP
- A pointer used to index into the wire B-link portion of NETMAP.

3.09 There are 64 possible paths between two terminals—32 in the forward hunting direction and 32 in the reverse direction. Each set of 32 paths is divided into two 16-path groups. A bit in the PATHDATA word (Fig. 8) indicates which group of 16 paths are to be attempted first. In addition, PATHDATA contains a pointer to indicate which path of the sixteen paths to look at first and is, therefore, used to "walk through" the possible paths. These pointers are changed periodically to aid in distributing the traffic over the entire network.

3.10 Figure 9 shows the possible forward paths between two terminals. There are four words (16 bits each) used to temporarily store the NETMAP status bits, for the 16 paths of the possible A-links and B-links which can be used to connect the two terminals. These words are combined to find idle paths. The status bit of an idle link in NETMAP is zero (busy = 1); therefore, if the status bits of the X A-link, Y A-link, wire B-link, and junctor B-link associated with a path are all zero, the associated path is an idle path (Fig. 10).

3.11 When A-link sharing is attempted, software sets all bits in the word containing the A-link status bits to one except for the four bits corresponding to the shared A-link which are set to zero. These bits are placed in a word for the X A-links unless path reversal is also to be attempted in which case they are placed in the word for the Y A-links. Bit 4 of the A-link information, which is extracted from the junctor area of the TCR, is used to indicate the group of 16 paths containing the A-link. NETMAP and the A-link selection table do not have to be accessed for any A-link being shared.

3.12 When the A-links are not being shared, the A-link status bits for the 16 paths must be obtained from NETMAP for both the X and Y A-links. PATHNT uses a pointer (3.08) to index into the A-link selection table. PATHNT then uses the path group pointer to determine which of the words for the first-stage switch is to be checked. It also looks at the status bits in NETMAP as pointed to by the A-link selection table to determine the status of the A-links. The words used for temporarily storing the A-link status information are now loaded with the A-link status for the 16 paths being hunted.

3.13 PATHNT, by using the existing pointers stored in the scratch area, obtains from NETMAP the status bits for the B-links. The B-link status bits are stored in the B-link words and all four link status words are combined. All but the special junctors are masked if a special

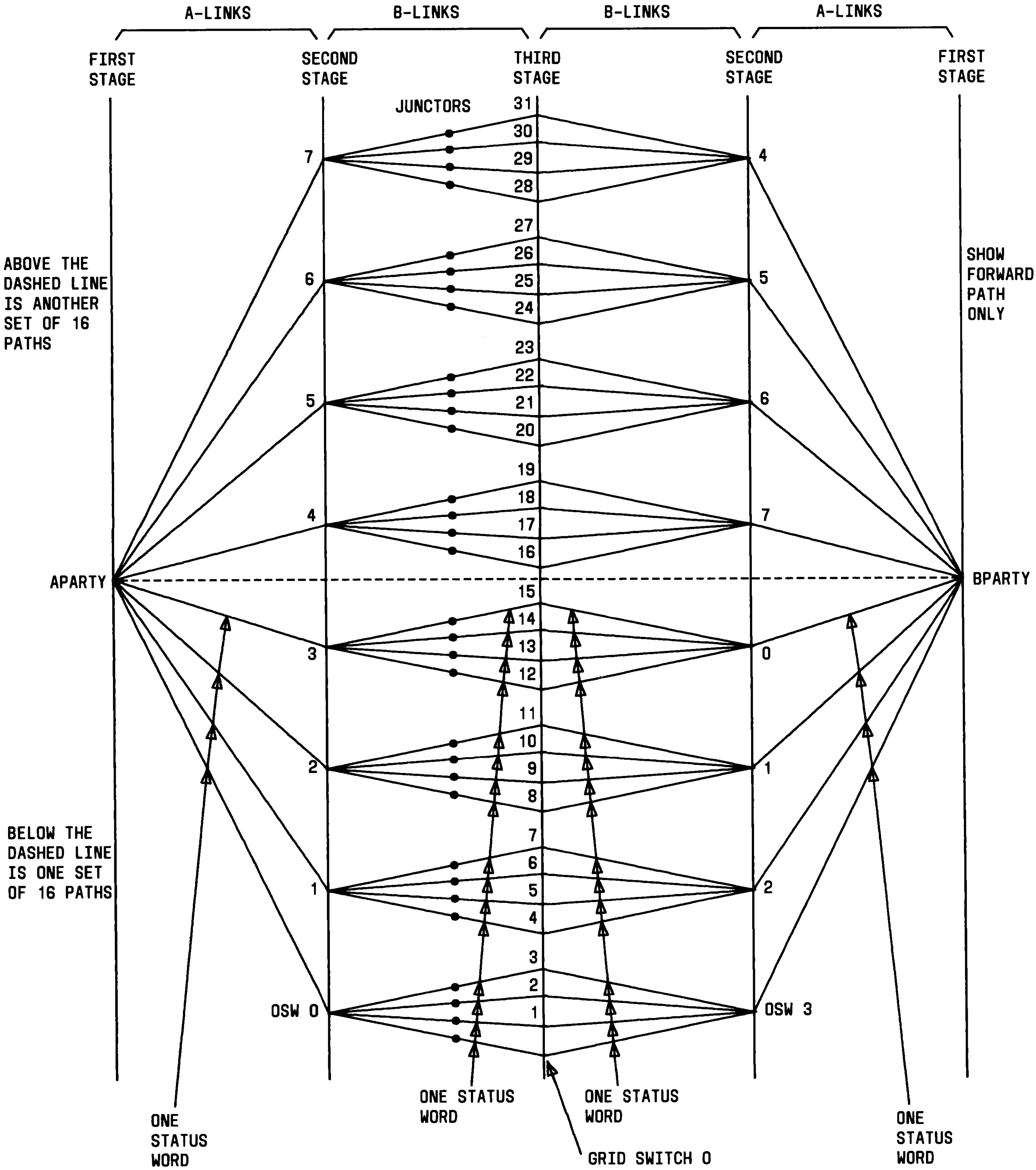

Fig. 9—Paths Between Two Terminals

X TERMINAL A-LINK STATUS BITS WORD

1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Y TERMINAL A-LINK STATUS BITS WORD

0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

JUNCTOR B-LINK STATUS BITS WORD

1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

WIRE B-LINK STATUS BITS WORD

1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

RESULTS OF COMBINING ABOVE 4 WORDS

1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

ZEROES IN THE ABOVE RESULTS WORD INDICATE IDLE PATHS

Fig. 10—Idle Path Selection

(range extension) junctor is needed. Likewise, when a special junctor is not needed, it is masked out.

3.14 The walk bits are accessed from the PATHDATA word and are used to point to the preferred path. The path hunting software starts with the preferred path and, if that path is busy, it "walks" looking for an idle path.

3.15 When the idle path is found, PATHNT busies the A- and B-links for that path by setting the status bits in NETMAP to one. In the case of a shared A-link, the status bit for that link is already one and does not have to be changed. The junctor switch number is formed using the result of the idle path hunt selection and is placed in the junctor area of the TCR. The type of path that is active along with the link-sharing bit and reverse bit are also stored in the TCR. PATHNT then obtains the TMR associated with the junctor and loads it with the TCR number associated with the call, the A PARTY and B PARTY scan point numbers (SPN) and the charge index (the charge index is determined from word 14 of the TCR for local calls and word 8 for outgoing calls). In addition, PATHNT marks the TMR to show its active status and indicates whether the path was reversed. PATHNT sets the ignore bits in the circuit status table for the selected junctor so that it will be ignored in subsequent scanning functions. A return code of 1 indicates to the calling program that an idle path was found.

3.16 If an idle path is not found in the first 16 paths tried, PATHNT makes a second try to hunt a path. If A-link sharing was attempted the first time and wasn't successful, PATHNT zeroes the link-sharing flag in the flags register. It then makes a second attempt without A-link sharing to obtain an idle path in the first group of 16 paths before looking at the second group of 16 paths. Otherwise, PATHNT tries to find an idle path in the second group of 16 paths as already described.

3.17 If all 32 paths have been examined without success, a check of the flags register is made to determine if range extension junctors were ignored. If they were ignored, an attempt is made including these junctors to find a path before attempting to reverse the direction of the hunt.

3.18 When all else has failed, a check is made of the flags to determine if the direction of the hunt can be reversed. If the terminals are on the same switch or if range extension is required, the path hunt cannot be reversed; therefore, a zero is returned to the caller to indicate no path is available. If the path hunt can be reversed, X and Y data and pointers are switched, the reverse flag is set, and another attempt to find an idle path is made on all 32 paths. If no path is found during this try, PATHNT returns a zero to the calling program to indicate no path was found.

B. PATHUNT A to ASVC (NOSHR)

3.19 The A PARTY and the service circuit (ASVC) have to be defined in the TCR for this macro. PATHNT obtains the TEN of the service circuit by calling the translation routine (SV-TEN) in the scan point number translation program (XSLSPN). With the TENs of both terminals now defined, PATHNT proceeds to hunt a path between the terminals as described in PATHUNT A to B (NOSHR).

3.20 The talk path must attempt A-link sharing unless the NOSHR option is set. Range extension is used if A is a long loop line; otherwise, it is not needed. Both options are indicated in the flags register by the PATHUNT macro upon entry to PATHNT.

C. PATHUNT A to CDPR, PATHUNT A to MFRCVR, PATHUNT AB to ABSVC

3.21 Both terminals must be defined in the TCR for the above macro calls. PATHNT calls the SV_TEN translation routine to get the TEN of the service circuit using the SPN. In hunting paths for the above calls, range extension and A-link sharing are never attempted. Otherwise, the path is hunted in the same way already described in PATHUNT A to B (NOSHR).

D. PATHUNT AB (NOSHR)

3.22 This macro call is used for a path for a revertive call and also for any other call from one terminal to a junctor. The A PARTY and B PARTY must be defined equal in the TCR for the call. A test is made upon entry to PATHNT to determine if A PARTY is a long loop line and needs range extension. If it needs range extension, the proper flag is set in the flags register. The absence of the NOSHR option means A-link sharing will be tried. Hunting a path from A to B in this case is the same as described in PATHUNT A to B (NOSHR) except reversal of the direction of the path hunt is not used since the terminals are on the same switch.

E. PATHUNT B to BSVC (NOSHR)

3.23 To hunt a path from B to BSVC, both the B PARTY and BSVC must be defined in the TCR. Range extension is not used in this case. Again the absence of the NOSHR option means A-link sharing must be attempted. The B-PARTY is considered by the path hunting software to be the X terminal and the BSVC to be the Y terminal unless there is a path reversal. The BSVC TEN is obtained by calling the translation routine SV_TEN in XSLSPN which translates the SPN into the TEN. The A-link information extracted from the junctor area of the TCR is complemented because the A-link to be shared was associated with the Y terminal. The path is hunted as described in PATHUNT A to B (NOSHR).

NETWORK PATH IDLING

A. Introduction

3.24 Before entry is made to PATHNT, the macro PATHIDLE initializes the flags register using information given with the macro call and provides the correct code for the branch table in PATHNT. PATHNT idles the status bits of the links used in that path in NETMAP. When an audit is in progress, it also idles the links in AUDMAP, an image map of NETMAP used in network audits. In addition, the TMR associated with the junctor used in the path is idled.

3.25 The functions required for idling a path for each possible PATHIDLE macro call are described in the following paragraphs.

- PATHIDLE A TO ASVC
- PATHIDLE A TO CDPR
- PATHIDLE A TO MFRCVR
- PATHIDLE AB TO ABSVC.

3.26 PATHNT obtains the junctor used in the path and the A PARTY TEN from the TCR for these macro calls. The translation subroutine SV_TEN in XSLSPN is called to translate the service circuit SPN from the TCR into its TEN. A PARTY is considered to be the X terminal and the service circuit the Y terminal unless the path is reversed. If the path is reversed, the terminals are switched. PATHNT initializes the appropriate flag in the flags register if A-link sharing was used in the path.

3.27 The pointers described in 3.08 are calculated from the terminal equipment numbers and are stored in the scratch area. They are then used to access the words needed from the A-link selection table and NETMAP for the status bits of the links. Bit 4 of the junctor switch number (third-stage switch number) indicates the group of 16 paths which includes the path to be idled.

3.28 PATHNT uses the appropriate pointers from the scratch area and the path group pointer to access the junctor B-link and wire B-link status bits. It idles, or sets equal to zero, the proper junctor B-link and wire B-link status bits in NETMAP and in AUDMAP (an image of NETMAP used in audits) if an audit is in progress.

3.29 PATHNT checks the idle A-link sharing flags in the flags register to determine if A-link sharing was being done in the path. The network status bit in NETMAP for a shared A-link is not idled at this time, but the proper link sharing bit in the TCR is set to zero. Using the pointers in the scratch area and the path group pointer, PATHNT accesses the appropriate words in the A-link selection table and NETMAP to obtain the status bits for the A-links used in the path. The A-links are then idled by setting the status bits in NETMAP for the A-links to zero. PATHNT also sets the associated bits in AUDMAP to zero if an audit is in progress. In the case of A-link sharing, only the A-link not being shared is idled.

3.30 PATHNT idles the TMR for the junctor which was idled and returns a one to the calling program to show completion.

B. PATHIDLE AB to ABSVC YHAF

3.31 This macro call is used for idling only the Y terminal half of a path. The macro sets the flag in the flags register indicating a Y half path idle. The remaining half path is used as a revertive talk path. AJCTR (junctor to A PARTY), A PARTY (X terminal), ASVC (service circuit to X terminal) are used from the TCR to idle the path. A PARTY is considered to be the X terminal and ASVC the Y terminal unless the path is reversed, in which case, the terminals are reversed.

3.32 It is necessary to calculate only the pointers associated with the Y terminal half and place them in the scratch area. Bit 4 of the junctor number points to the group of 16 paths including the path to be idled. Using this information and the pointers in the scratch area, PATHNT accesses the wire B-link status bits and the A-link status bits from NETMAP for the Y terminal half. It sets the bits to zero to idle the path. The junctor B-link and the A-link associated with the X terminal are not idled. Since the remaining half path is to be used as a revertive talk path, APTH is zeroed in the TCR and TPTH is set to one to indicate the talk path is active. A one is returned to the calling program to indicate success.

C. PATHIDLE XHAF

3.33 This macro call is used to idle a half path. It will not idle half of a full path, only a true half path such as a reorder or a revertive connection. The A PARTY and talk junctor in the TCR are used in idling the path.

3.34 PATHNT calculates the pointers for the X terminal half and places them in the scratch area. PATHNT accesses the junctor B-link status bit from NETMAP and idles the B-link. It then obtains the status bit for the A-link associated with the X terminal and idles it in NETMAP. If A-link sharing was used, the A-link is not idled at this time but the link sharing bit (LKSRA) in the TCR is set to zero. PATHNT also idles the TMR associated with the junctor and returns a one to the calling program to indicate completion.

D. PATHIDLE B to BSVC

3.35 PATHNT obtains the junctor used in the path and the B PARTY TEN from the TCR. The translation subroutine SV_TEN in XSLSPN is called to obtain the TEN of the service circuit. The B PARTY is considered to be the X terminal and the service circuit the Y terminal unless the path is reversed. If the path is reversed, the terminals are switched. PATHNT initializes the appropriate flag in the flags register if A-link sharing was used in the path.

3.36 PATHNT proceeds to idle the path as described in 3.27 through 3.30.

E. PATHIDLE A to B

3.37 The A PARTY, B PARTY, and talk junctor are used in idling the path for this macro call. The A PARTY is considered to be the X terminal and the B PARTY the Y terminal unless the path is reversed. The terminals are reversed if the path is reversed. PATHNT also initializes to one the appropriate idle flag in the flags register if A-link sharing was used in the path.

3.38 PATHNT then does the required path idling functions described in 3.27 through 3.30.

NETWORK AUDITS

A. Map Regeneration

3.39 AUDNET is called by an initialization routine to perform map regeneration. AUDNET sets the map regeneration flag to one in the audit flags register (Fig. 11). In addition, it zeroes the audit flag in the PATHDATA word (Fig. 8) to show an audit is not in progress.

3.40 AUDNET sets NETMAP to all ones initially because it zeroes the status bits of the busy links. After all links have been examined and the status bits have been set, the bits in NETMAP are complemented so that the bits for the idle links become zero and the bits for the busy links become one.

3.41 To help determine the correct status of the links, AUDNET examines each TMR. If the TMR indicates that the associated junctor is out of service (active bit=0, maintenance busy bit=1), AUDNET then calculates the address of the network map word containing the associated junctor B-link. It sets the appropriate bit for that B-link to zero.

3.42 If the TMR indicates that the associated junctor is idle (active bit=0 and maintenance busy bit=0), the status bit for the junctor B-link

															MAP REGENERATION IN PROGRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Fig. 11—Audit Flags Register

in NETMAP is not changed so that it remains equal to one.

3.43 If the TMR shows the junctor to be service busy (the active bit=1), AUDNET calls PATHNT to handle the NETMAP regeneration. The audit usage bit in the flags register to set to one to indicate the entry to PATHNT for the purpose of an audit. The TEN of terminal X, the TEN of terminal Y, the junctor switch number, and an entry code is passed to PATHNT. There are two different entry codes, one for nonrevertive calls and the other for revertive calls. In addition, the idle flag in the flags register used by PATHNT is set to one since the status bits of the busy links used in the path are to be set to zero in NETMAP. The links used for the revertive call path are idled by PATHNT in the same manner as idling an X half path described in 3.34. No link sharing is considered; therefore, all links involved are idled.

3.44 Links used in paths for nonrevertive calls are idled in the same manner as a path from A to B. The functions performed are described in 3.27 through 3.30. The NETMAP status bits for all links, including shared A-links which are used in the path, are set to zero by PATHNT.

3.45 PATHNT returns control to AUDNET after handling each service busy junctor. After all the TMRs are examined, AUDNET scans the out-of-service list which contains busy links not attributable to active network paths and not pointed to by a TMR. Figures 12 and 13 show the formats of the out-of-service list entries for A-links and B-links, respectively.

3.46 If an entry is all zeroes, AUDNET ignores the entry and accesses the next one. For all nonzero entries, AUDNET checks the link code to determine whether the link is an A-link or a B-link. The pointer into the network map for the word containing the link status bit is calculated using the network number, concentrator group number, and junctor switch number (third-stage switch number) for a B-link. For an A-link, the pointer is calculated using the network number, concentrator group number, concentrator number, and second-stage switch number. AUDNET accesses and sets to zero the appropriate bit in NETMAP for that link.

3.47 AUDNET, after examining all TMRs and the out-of-service list, complements the bits in NETMAP so that the status bits associated with busy or out-of-service links become ones while the bits of idle links become zeroes. Thus, the network map is regenerated and return of control is made by AUDNET to the calling program (usually an initialization routine).

B. Network Map Audits

3.48 Network map audits are performed as a routine audit. During routine audits, real-time breaks are allowed to return control to a pass

LINK CODE					NETWORK NUMBER	CONCENTRATOR GROUP NUMBER			CONCENTRATOR NUMBER	2ND STAGE SWITCH (OUTPUT SWITCH) NUMBER			2ND STAGE SWITCH LEVEL NUMBER		
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Fig. 12—A-Link Entry in the OOS List

LINK CODE							NETWORK NUMBER	CONCENTRATOR GROUP NUMBER			3RD STAGE (JUNCTOR) SWITCH NUMBER				
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Fig. 13—Link Entry in the OOS List

through the base level loop. The bit in the PATHDATA word (Fig. 8) used by PATHNT to tell it an audit is in progress is set to one. In addition, AUDNET copies the current state of NETMAP into an image map named AUDMAP.

3.49 AUDNET uses the TMRs and the out-of-service list as regenerative information sources. First, it examines each TMR. An idle TMR is ignored. AUDNET then accesses the next TMR. If the TMR indicates that the associated junctor is out of service, AUDNET then calculates the address of the NETMAP word containing the associated junctor B-link status bit. It checks the bit to determine if it is in its correct state of busy (bit = 1). If the bit is zero, the software sets it to one to busy it and prepares for a failure printout. A message in the format shown in Figure 14 is printed on the TTY with a failure code of 22 which indicates that an out-of-service junctor was not busied in NETMAP. In addition, AUDNET zeroes the corresponding bit in AUDMAP.

3.50 If the bit in NETMAP was correct (bit = 1) indicating that the junctor was busy, the check is just considered a verification and the corresponding bit in AUDMAP is set to zero. Then if the TMR indicates that the junctor is service busy, AUDNET calls PATHNT and passes to it the TEN of the X terminal, the TEN of the Y terminal, the junctor switch number, and an entry code. There are two different entry codes used—one code for a revertive call and another for a nonrevertive call. A revertive call is treated similarly to an X half path idle by PATHNT. Only the junctor B-link and X A-link status bits are audited. However, a nonrevertive call is handled like a path idle from A to B and both the X and Y A-links, the junctor B-link, and the wire B-link status bits are audited. The audit usage flag is set in the flags register to show the entry is for an audit.

3.51 PATHNT, by using the pointers, accesses the status bits in AUDMAP (an image of NETMAP) for the links used in the path and sets the bits to zero (idle status). Since this entry to PATHNT is for an audit usage, PATHNT then examines the associated status bits in NETMAP to determine if they show the correct status. If a B-link status bit is incorrect (bit = 0), AUDNET changes the bit in NETMAP to a one to busy the link and initiates a TTY message (Fig. 14) with a failure code of two. If an A-link status bit is incorrect (bit = 0), AUDNET changes the bit in NETMAP to one and initiates a TTY message with a failure code of one. After verifying the status bits for the links, PATHNT returns control to AUDNET.

3.52 After each service busy, the TMR is processed and control is returned to the calling program,

```
AbbxxbbbbRCOVRYbAUbNWyybzzzw

Where:

  A = means alarm
  B = blank
  xx = minutes pass the hour
  RCOVRY = means recovery message
  AU = means audit
  NW = means network audit
  yy = failure code
     yy = 1 - A-link status bit equals 0 when should be 1.
     yy = 2 - B-link status bit equals 0 when should be 1.
     yy = 11 - either A-link or B-link status bit equals 1
               when should be 0.
     yy = 21 - an out-of-service link status bit equals 0
               when should be 1
     yy = 22 - out-of-service junctor not busied
               in NETMAP

zzz = word in NETMAP contains incorrect bit that was found
w = bit position in word
```

Fig. 14—TTY Error Message Format

and audit monitor (AUDMON), which determines if a real-time break is needed. AUDNET saves the information needed to resume the audit before branching to AUDMON. After AUDMON returns control to AUDNET, AUDNET restores the needed information and continues to scan the TMRs until all TMRs have been examined.

3.53 After scanning the TMRs, AUDNET examines the entries in the out-of-service list for out-of-service links. If an entry in the list is all zeros, the entry is ignored. All nonzero entries in the list represent busy links not attributable to active network paths and thus not pointed to by a TMR. If the entry is nonzero and the audit is a routine audit, control is transferred to AUDMON which determines whether a real time break is needed. Needed information is saved by AUDNET and is restored after AUDMON returns control.

3.54 AUDNET calculates the pointer to access the NETMAP word containing the bit corresponding to the out-of-service link. If the bit is zero, it is changed to a one to show its correct status and a TTY message printout is initiated with a failure code of 21. See Fig. 14 for the format of the message. After the bit has been verified or corrected, AUDNET idles the corresponding bit in AUDMAP.

3.55 After all TMRs and out-of-service list entries have been examined, AUDNET looks for any ones remaining in AUDMAP. If a one is found, it is an error and a TTY error message is initiated with a failure code of 11. The corresponding bit in NETMAP is also changed to a zero to indicate the proper status of idle. After each word, with false ones, in AUDMAP is corrected, a check for a real time break is made.

3.56 When all audit tests are made and the audit is complete, the audit-in-progress flag in the PATHDATA word is set to zero and control is returned to the calling program.

4. GLOSSARY

APTH—Path from terminal A to the A service circuit.

ASVC—Service circuit used with the calling party or A PARTY.

AUDNET—Network Audit program.

Base Level—Major software loop which includes all functions not performed during interrupt level. High priority tasks which cannot be deferred are performed during interrupts of the base level loop.

Bit—(contracted from binary digit)—The binary unit of information which is represented by one of two possible conditions; such as, the digits 0 and 1, high potential or low potential, on or off.

BSVC—Service circuit used with the called party, or B PARTY.

CDPR—Customer dial pulse receiver.

FAKRV—A flag in the flags register that indicates a line reversal but not for the purpose of finding a path through the network.

LLIN—A flag in the flags register indicating that a long loop line exists.

Long Loop Line—Requires additional equipment to boost the signal level to the terminal.

Macro—A sequence of operations called by an abbreviated notation. A macro can generate different sequences of code depending on the parameters supplied in the macro call.

MFRCVR—Multifrequency receiver.

NETMAP—A stored map of the network indicating idle and active paths.

NOSHR—A program option that prohibits A-link sharing.

PATHNT—Network path hunt and idle program.

Register—A functionally associated set of memory elements.

RVRSFLG—A flag in the flags register indicating that the A PARTY and B PARTY have been reversed.

SPN—Scan point number.

SV_TEN—Service circuit terminal equipment number.

TCR (transient call record)—A 16-word block of writable main storage assigned to a call in the transient state. It contains control information, terminal and path information, and receiving and sending data applicable to the call.

TMR (terminal memory record)—A 4-word block of writable main storage assigned to each junctor. For stable calls, the junctor TMR specifies the scan point number of the talking parties and provides timing control. For transient calls, the TMR also specifies the TCR assigned to the call as well as the scan point numbers of the connected circuits.

TPTH—Talk path.

Word—A set of bits which occupies one location in storage and is treated by the system as a unit.

XSLSPN—Scan point number translation program.

X terminal—Terminal on the junctor B-Link side of the network path.

Y terminal—Terminal on the wire B-link side of the network path.