MESSAGE ROUTING THROUGH STORED PROGRAM CONTROL SIGNAL TRANSFER POINT OFFICES

1. GENERAL

1.01 This section describes message switching in a signal transfer point (STP) office. Also, an example of messages routed by STPs is the direct signaling 800 service messages routed between an originating screening office (OSO) and a feature processor. (For a description of the 4A/OSO, see Section 212-100-003.)

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 An STP office receives data messages from many access points and other STPs. (See Fig. 1.) The ***link*** between an STP and an access point is a group of signaling links called "A links." Other signaling links interconnect the STPs. Paired STPs ***control and mate*** in the same area are interconnected with signaling links called "C links," other parts of STPs are connected with signaling links called "B links." Area STPs are connected to regional STPs by "D links."

1.04 A more expanded view of the STPs and connecting links in the Common Channel Interoffice Signaling (CCIS) network is shown in Fig. 2. The STPs, access points, and feature processors are referred to as nodes. Each node in the network is assigned a ***function number.***

1.05 The central office equipment in an STP office is shown in Fig. 3. The voice frequency link (VFL) access circuit and the ***CCIS terminal*** circuit at each end of the signaling link provides the interface between the voice frequency link and the peripheral equipment of the stored program control (SPC). The CCIS terminals are assigned one for one to the ***signaling links.*** Thus, the SPC works into ***terminals and terminal groups*** when doing routing translations.

2. ROUTING

2.01 An STP office is programmed to process two types of signaling messages: CCIS signal path (banded) and direct signaling messages.

A. CCIS Signal Path Routing

2.02 The STP data consists of routing instructions and signaling link information. The routing data consists of a table called a band translation table for each signaling link complement. The table has 512 words, with one word for each ***band of 16 trunks.*** Each word contains corresponding outgoing link and ***band*** number. Signaling link information contains link type, equipment arrangements, and the identification of alternate signaling links.

2.03 The function of signal path routing is performed by the message handler program. The fundamental process is to take an incoming message from one signaling link, change its band number, and transmit it on another signaling link as an outgoing message. The band translation and routing is accomplished by using the band translation table (Fig. 4) provided for each incoming signaling link. Using the incoming link member to identify the band translation table and using the band number from the incoming message as an index into the translation table, the outgoing band number and outgoing signaling link number are identified. The message handler replaces the incoming band number in the first signaling unit of the message with the outgoing band number, and places the message in an outgoing queue of the appropriate terminal. The outgoing link number from the translation table is the preferred route in the fixed routing scheme of the signaling network. (See Table A.) The signaling link load on any given pair of B links to another region is balanced by assigning odd band numbers to the link to the odd STP and even band numbers to its mate.

2.04 Alternate routing on outgoing signaling links, if required because of an out-of-service condition of the preferred link, is achieved by retrieving a switch stored in scratch memory for the outgoing link. The switch affects a transfer to a routine which routes the message around a failed link or STP to its final destination. This is called the transmit switch and is kept current by the link security programs so that the message handler may quickly make a disposition of any outgoing message.

2.05 In addition to band translation and alternate routing, the message handler is equipped to recognize signal units that initiate processing at the STP. As examples of this, a certain class of noncall-related messages causes the STP to broadcast dynamic overload control (DOC) messages to prescribed switching offices on certain bands while other messages inform the STP of the suitability of a given signaling link to carry traffic. Most noncall-related messages, as well as regular telephone messages, are processed to completion once the incoming message is unloaded from a terminal. Lengthy sequences initiated by certain noncall-related messages are scheduled to be run as background jobs by the message handler.

2.06 The message handler itself is scheduled to execute as two separate tasks, a timed interrupt level job which runs every 10 milliseconds and is responsible for high-priority telephone traffic and a base level job which handles low priority telephone messages and noncall-related messages.

2.07 Every 10 milliseconds the high-priority message handler is entered to look for high-priority traffic, consisting of answer and changeover messages each of which consists of one signal unit. The high-priority "signal present" indicators of each in-service terminal group (TG) are scanned looking for set bits which flag a terminal as having incoming traffic in its high-priority receive buffer. The message handler retrieves each signal unit, translates the incoming band, and routes answer messages to the proper outgoing terminal. Changeover events are queued for base level processing. The message handler continues to unload and process the messages from the active terminals associated with the current TG until all of the high-priority buffers are empty at which time the high-priority signal present indicators return to zero. The message handler then moves on to the next TG. After all TGs have been served, the system returns to base level processing.

2.08 The low-priority message handler which is entered on base level performs functions similar to the high-priority job with the added tasks of multiunit message (MUM) processing and filtering a wider class of message types which may require STP actions beyond routing. Upon entry, the message handler reads the low-priority signal present indicators of each TG looking for traffic queued in any of the low-priority input buffers of the 16 terminals. For every flag set, the message handler retrieves the first signal unit of the incoming message and uses the first seven bits (the heading and signal information fields) as an index into a task dispenser which transfers control to a specific routine to deal with that message. (See Fig. 4.) A small percentage of the incoming traffic is trapped and processed at the STP, while the bulk of the messages—initial address messages (IAM), call-related lone signal units (LSU) and direct signaling messages—are translated and routed. All LSUs that are routed through the STP are given the same treatment as described above for priority messages. Routed MUM traffic requires timed interrupt protected sequences for the transfer of the message from the incoming terminal to the outgoing terminal to prevent message interwrite. That is, once the outgoing link has been determined using the initial signal unit (ISU) of the incoming MUM, each subsequent signal unit (SSU) is retrieved from the incoming terminal and loaded into the outgoing terminal; the protected sequences prevent any timed interrupt generated low-priority traffic from being loaded prior to completion of the transfer of the last SSU. Incomplete MUMs are flushed by the terminal and never passed to the STP while any block of SSUs not preceded by an ISU is flushed by the STP from the network.

2.09 If the outgoing signal path of a banded message is blocked, the message is dropped. However, if the message was an IAM or CONTINUITY, a message refusal is returned to the originating point. If the outgoing link is overloaded, most messages are allowed to be transmitted anyway. (They are assumed to be regulated at the source as part of calls in progress.) However, an IAM which encounters link overload is dropped, and a message refusal and a group signaling congestion signal are returned to the originating point.

2.10 Incoming C-link traffic is always processed as a low-priority miscellaneous MUM since the message has been prefixed with a header signal unit which contains the outgoing signaling link number. This outgoing signaling link number is a result of translation performed at the mate STP which was unable to route the message due to the present network configuration. After stripping this header, a unique task dispenser is executed to process that particular message while implicity recognizing that the message was received from, and preprocessed by, the mate STP.

2.11 Each TG, in turn, has all low-priority traffic emptied from each of its 16 terminals which is then followed by an interject break to allow time-critical jobs to execute. After all TGs have been processed, the message handler relinquishes control to the next base level job.

B. Direct Signaling Routing

2.12 All direct signaling (DS) messages are MUM and are processed by the low-priority message handler. There are two different routing mechanisms used in DS to reach a destination (access node). One data structure is for domain zero and the other is for all other domains. (See Fig. 5.)

2.13 Domain zero is reserved for routing by function number, a 15-bit number which identifies every functional destination in the network. The STPs receive this function number as part of an MUM. (See Fig. 6.) The function number is used to index a table of ***route numbers.*** The route number is used to index the route status table whose contents determine call routing.

2.14 Routing by domain other than zero uses one of the domain (D) field (domains 1 through 7) and the 10-bit A-field (loosely "the first three digits") and, if necessary, the 10-bit B-field ("second three digits"). (See Fig. 7.) The present domain assignments are:

Domain 1—A=NPA B=XXX	To local or toll switching offices
Domain 2—A=NPA B=NXX	To data base serving INWATS (A=800 only) or billing verification file

2.15 When the message handler program receives the ISU and identifies a direct signaling message domain other than zero, the domain and A-field are used to index a table of ***route numbers.*** The route number identifies the appropriate ***pool*** of signal links out of the STP office. (See Fig. 8.) The message handler now checks the ***route status switch*** and modifies the outgoing route if necessary. A link is now selected from the pool and checked for overload. If there is no overload restriction, the message is sent on the selected link. Using Fig. 2, the following example of link-type connections serves to show the desired order and combination of links that would be selected for desired routing when various link combinations exist at an STP:

INTRA	INTER
A-A	A-D-A
A-D-A	A-B-A
A-B-A	A-D-D-A
	A-D-B-A
	A-B-D-A
	A-D-B-D-A

> ***Note:*** An A-link end section in each combination above may be an I-link when the route is to a feature processor associated with an STP.

C. 800 Service Feature

2.16 All 800 services use a feature processors (FP) data base to translate 800 codes to plain old telephone service (POTS) 10-digit number, for use in the DDD network. When an 800 service code is received at a CCIS OSO, the OSO will make the translation request by forwarding a DS message to the data base containing all ten digits of the INWATS number and the identity of the NPA in which the call originated. (See Fig. 9.) When the INWATS INQUIRY message is sent to an STP, the DS routing is done as described in (B) above.

2.17 When the DS message is received at the FP, the DS application (SSU#2) tells the FP that this is an 800-type INWATS INQUIRY. The message is sent to the INWATS process program for translation. When the translation is made, an

INWATS SUCCESS DS message is entered into the CCIS network, with the function number of the OSO (the return address of the INQUIRY), as the destination for the DS message. (See Fig. 10.)

2.18 The STP receives the DS message (Fig. 10) and routes it as domain 0 and function number.

2.19 When a direct signaling message with a return address encounter abnormal conditions at an STP, the STP generates a failure reply and sends it back to the originating node. The failure reply may contain one of four feature codes as follows:

0—No routing data

1—Overload

2—Blocked

3—Destination not equipped.

2.20 A direct signaling message without a return address will be dropped by an STP (flushed from the network) when it cannot be forwarded through the network.

TABLE A
DESIRED SIGNALING PATHS FOR
NODES SHOWN IN FIG. 2

Nodes	Intra	Inter
A-B	A-A	-
A-C	E-A, A-E, A-D-A	-
A-D	-	A-D-A, A-D-B-A
A-E	-	E-A, A-B-A, A-D-D-A, A-D-B-D-A
A-F	-	A-D-A
A-G	A-E, A-B-A	-
B-C	E-A, A-E, A-D-A	-
B-D	-	E-A, A-D-A, A-D-B-A
B-E	-	A-D-D-A, A-D-B-D-A
B-F	-	A-D-A
B-G	E-A, A-B-A	-
C-D	-	E-A, A-E, A-B-A
C-E	-	A-E, A-B-D-A
C-F	-	A-B-A
C-G	A-D-A	-
D-E	E-A, A-E, A-D-A	-
D-F	-	A-B-A
D-G	-	A-E, A-B-D-A
E-F	-	A-D-A, A-D-B-A
E-G	-	A-D-B-D-A
G-F	-	A-D-A, A-D-B-A

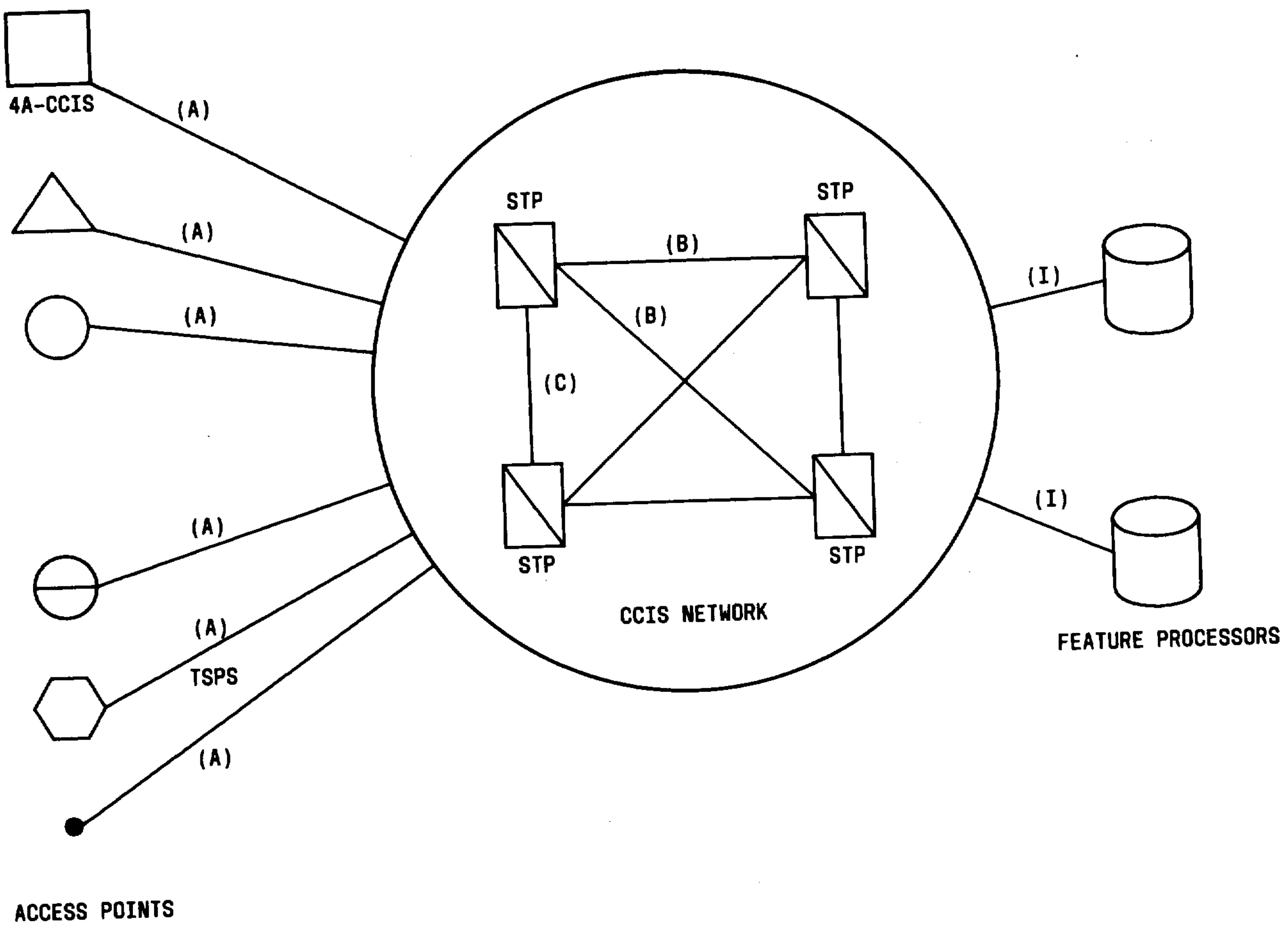

Fig. 1—Basic CCIS Network

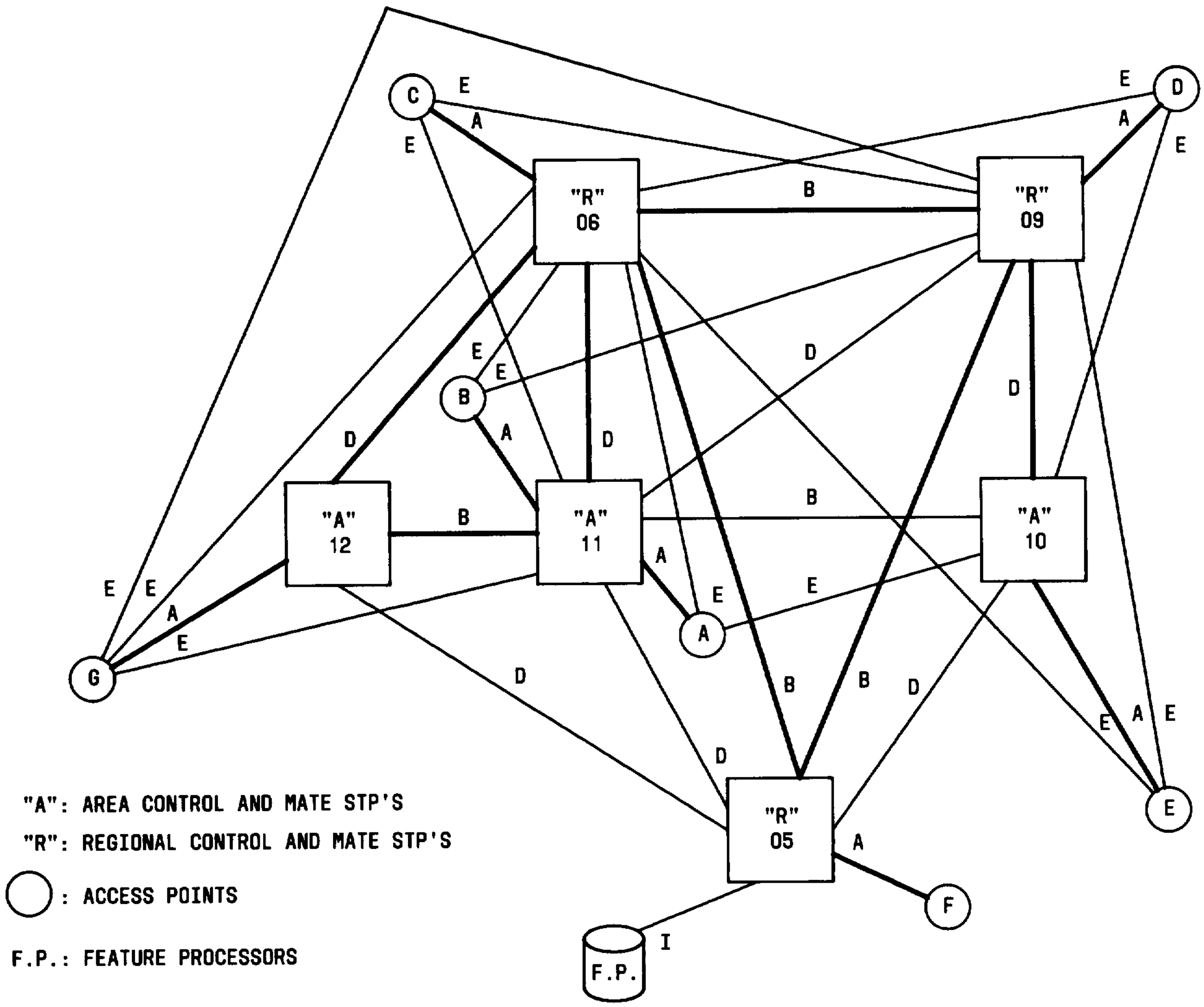

Fig. 2—STPs and Connecting Links

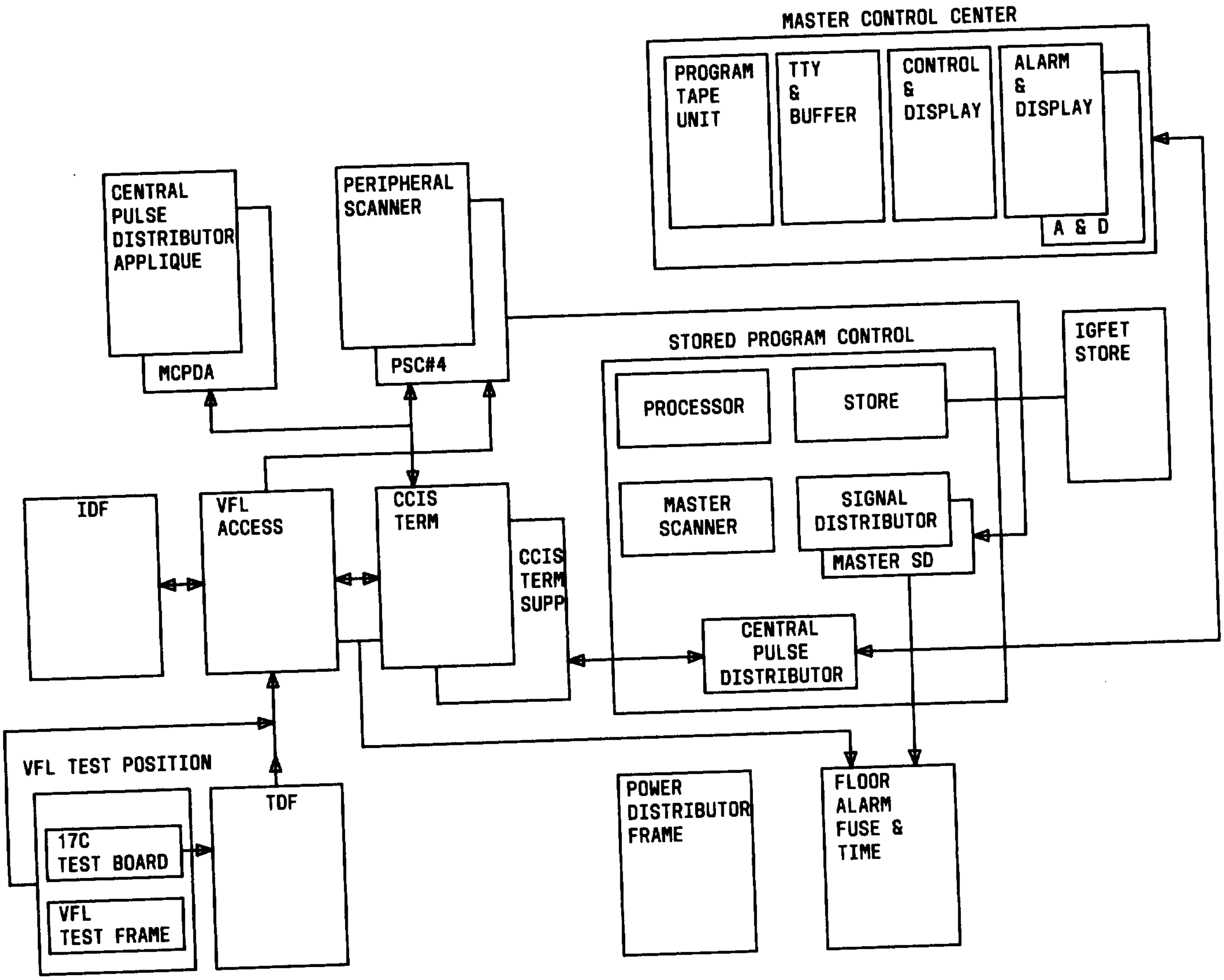

Fig. 3—STP Central Office Equipment

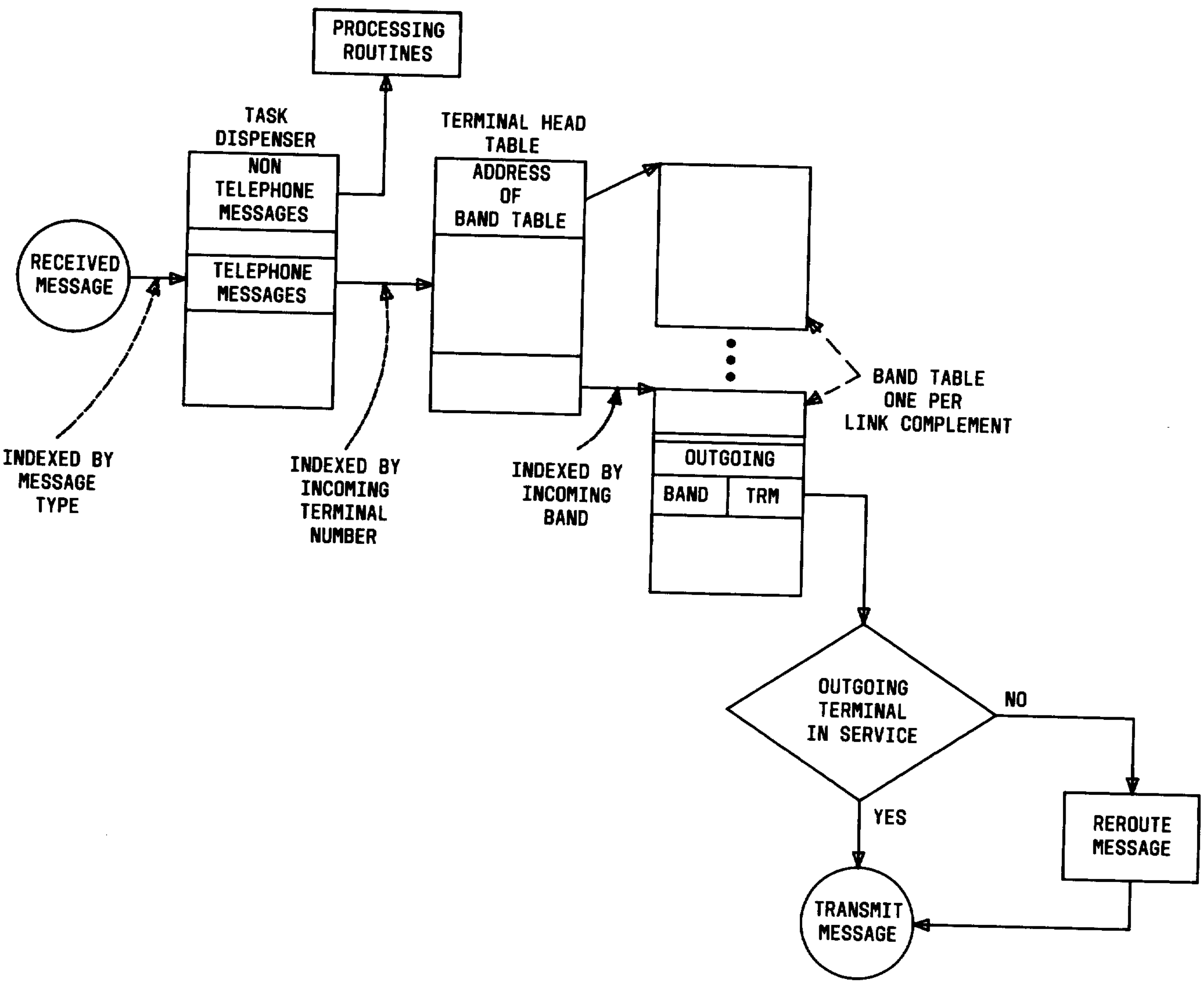

Fig. 4—STP Banded Message Routing

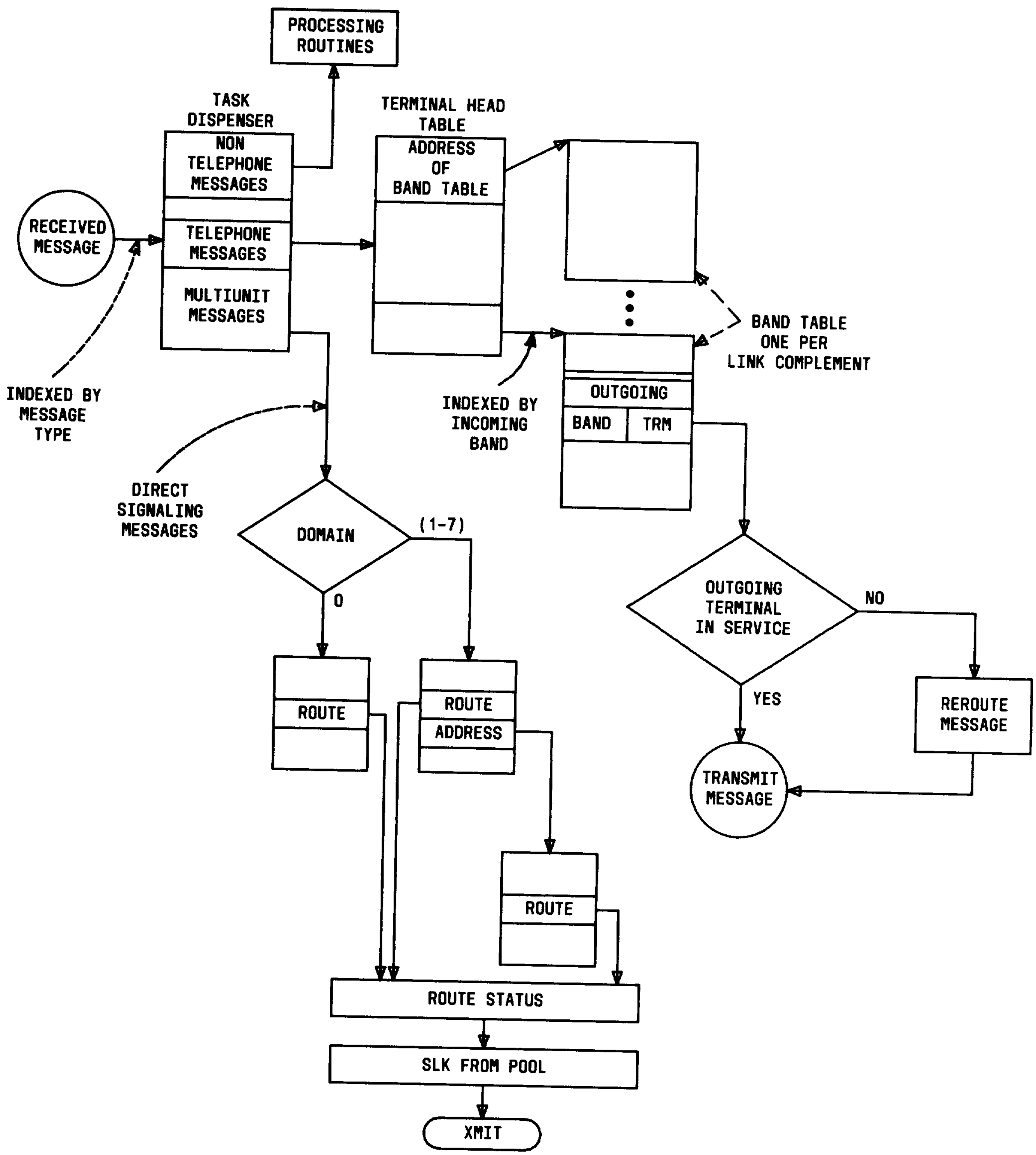

Fig. 5—DS Message Routing

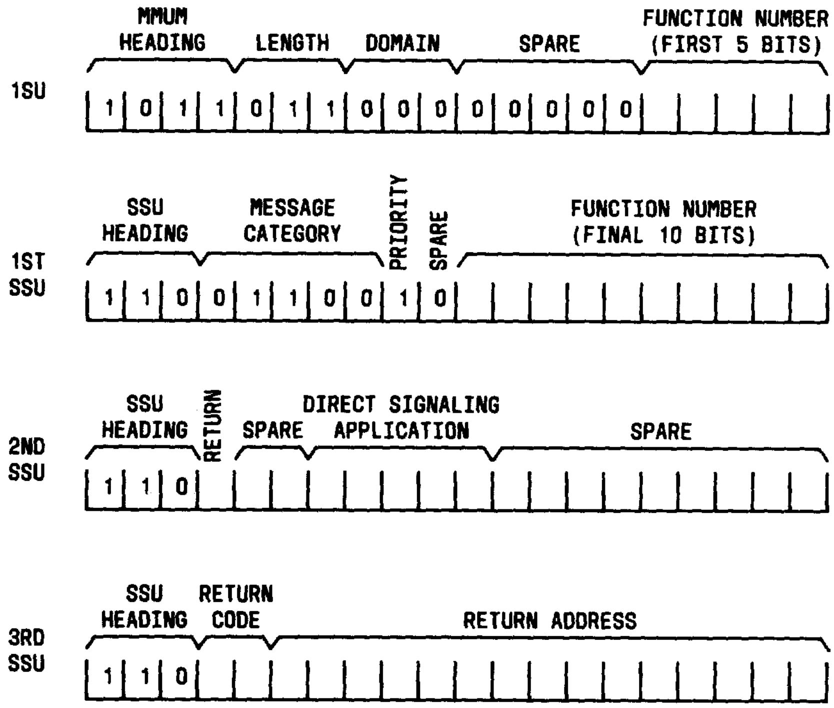

Fig. 6—Direct Signaling Message Including a Return Address (Domain 0)

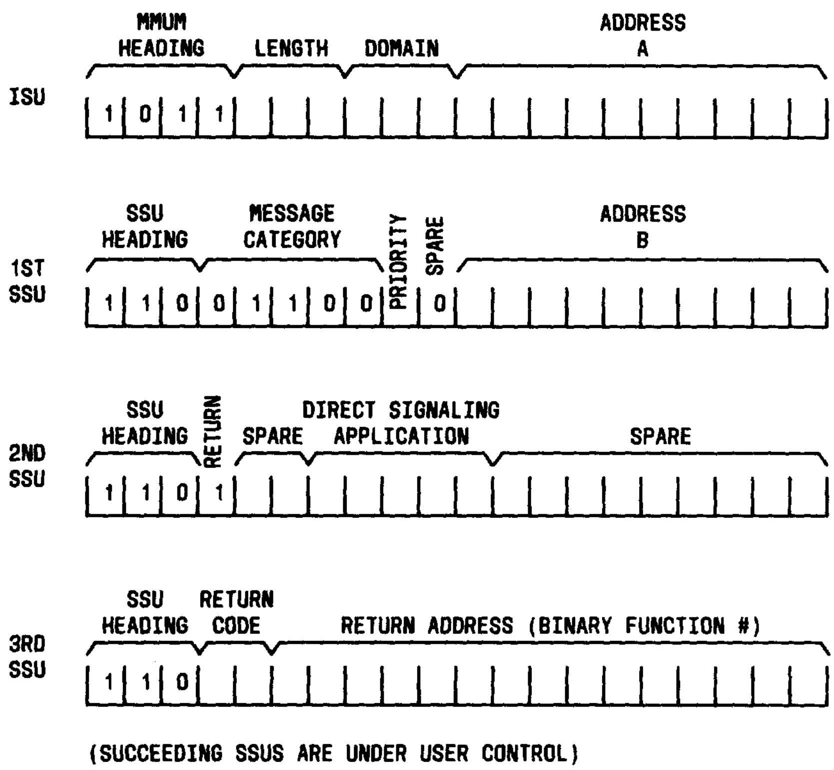

Fig. 7—Direct Signaling Message Including a Return Address (Domain 1-7)

L9RTINFO

Route Number				NOTES: ROUTE TO...
0	0	FILL = 0		(UNASSIGNED)
EVEN	1	FILL = 0	C-SLK POOL	EVEN STP IN SAME REGION
ODD	1	"	C-SLK POOL	ODD " " " "
EVEN OR ODD	2	"	A-SLK POOL	END OFFICE
EVEN OR ODD	3	EVEN B/D-SLK POOL	COMBINED POOL	BOTH STPS IN ANOTHER REGION
EVEN	4	FILL = 0	EVEN B/D-SLK POOL	EVEN STP IN ANOTHER REGION
ODD	4	"	ODD B/D-SLK POOL	ODD " " " "
EVEN	5	"	EVEN B/D-SLK POOL	EVEN PRIMARY/SECONDARY FUNCTION IN ANOTHER REGION
ODD	5	"	ODD B/D-SLK POOL	ODD " " " " "
EVEN	6	"	I-SLK POOL	EVEN SIMPLEX PERIPHERAL FUNCTION
ODD	6	"	I-SLK POOL	ODD " " "
EVEN	7	"	I-SLK POOL	EVEN DUPLEX PRIMARY/SECONDARY PERIPHERAL FUNCTION
ODD	7	"	I-SLK POOL	ODD " " " "
EVEN	8	"	I-SLK POOL	EVEN AUXILIARY PROCESSOR
ODD	8	"	I-SLK POOL	ODD " "
511	19		0	

NOTE: EVEN/ODD PAIRS OF ROUTES ARE ALWAYS TO DESTINATIONS IN THE SAME REGION AND SPECIFICALLY TO THE EVEN/ODD STP RESPECTIVELY.

Fig. 8—Route Information Table

```
                I
                S
                U  LTH  DMN      AAA = 800
SU#1    /1 0 1/1/1 0 0/0 1 0/1 1 0 0 1 0 0 0 0 0/

                   DIRECT P
                SIGNALING R      BBB = XXX
SU#2    /1 1 0/0 1 1 0 0/1/r/b b b b b b b b b b/

               R
               T      MESSAGE TYPE
               N     INWATS INQUIRY  CALL ID
SU#3    /1 1 0/1/r r/0 0 0 0 1 0 0 1/b b b b b b/

                         OSO RETURN ADDRESS
SU#4    /1 1 0/r r/b b b b b b b b b b b b b b/

                      ORIG NPA
SU#5    /1 1 0/b b b b b b b b b b/v v v v v v/

                   X     X      X        X
SU#6    /1 1 0/b b b b/b b b b/b b b b/b b b b/v/

b - call dependent
v - vacant  (set to zero)
r - reserved  (set to zero)
```

Fig. 9—DS INWATS Inquiry Message

```
                          I
                          S                         AAA=
                          U   LTH   DMN          OSO FUNCTION NO.
SU#1              /1 0 1/1/1 0 0/0 0 0/v v v v v/b b b b b/

                            DIRECT  P        BBB=
                          SIGNALING R        OSO FUNCTION NO.
SU#2              /1 1 0/0 1 1 0 0/1/r/b b b b b b b b b b/

                          R
                          T     MESSAGE TYPE
                          N    INWATS SUCCESS      CALL ID
SU#3              /1 1 0/0/r r/0 0 0 0 1 0 1 0/b b b b b b/

                                                      CMDS
                                                  DATA FIELD
                                                       I I
                                                       B I
                             N       P       A         I I
SU#4              /1 1 0/b b b b/b b b b/b b b b/v/0 0 b b/

                             X       X       X
SU#5              /1 1 0/b b b b/b b b b/b b b b/v v v v v/

                             X       X       X         X
SU#6              /1 1 0/b b b b/b b b b/b b b b/b b b b/v/
```

CMDS Data Field - A four-bit field copied by the CCIS OSO onto the AMA tape.

IBI = Independent Bell System Indicator (1 = Independent, 0 = Bell System). This is an indication of the ownership of the terminating line.

III = Intrastate Interstate Indicator (1 = Intrastate, 0 = Interstate)

The CMDS data field is used for the division of data base costs and for division of revenue studies. The data contained in the CMDS data field will be transferred to an AMA record by the CCIS OSO. Two nonused bits in the CMDS data field have been reserved for future use. The INWATS data base should insert the required data into the CMDS data field based on the Bell or Independent and Intrastate or Interstate nature of the returned POTS number.

Fig. 10—DS INWATS Success Message