CHAPTER 11

CALL PROCESSING

11.1 INTRODUCTION

This chapter describes major call processing routines.

11.2 CALL PROCESSING OVERVIEW

The CBX computer controls call processing. The computer first reads or fetches an instruction from memory and then executes the instruction. Instructions perform arithmetic functions or manipulate data.

Data is stored in tables, and system parameters in memory. Tables include the following:

- First digit table
- Class of service (COS) table
- Extension number line assignment and characteristics tables

System parameters include the following:

- LFLASH
- HFLASH
- TMIDGI
- TMBUSY

Tables and system parameters are explained in Defining and Coding a ROLM CBX (stock no. 300399) and in Chapter 13 of this manual.

A system configuration printout for each system lists the contents of the tables and the values of the system parameters for that system. The printout is used for call process troubleshooting.

Figure 11-1 shows the interaction between hardware and software during a call.

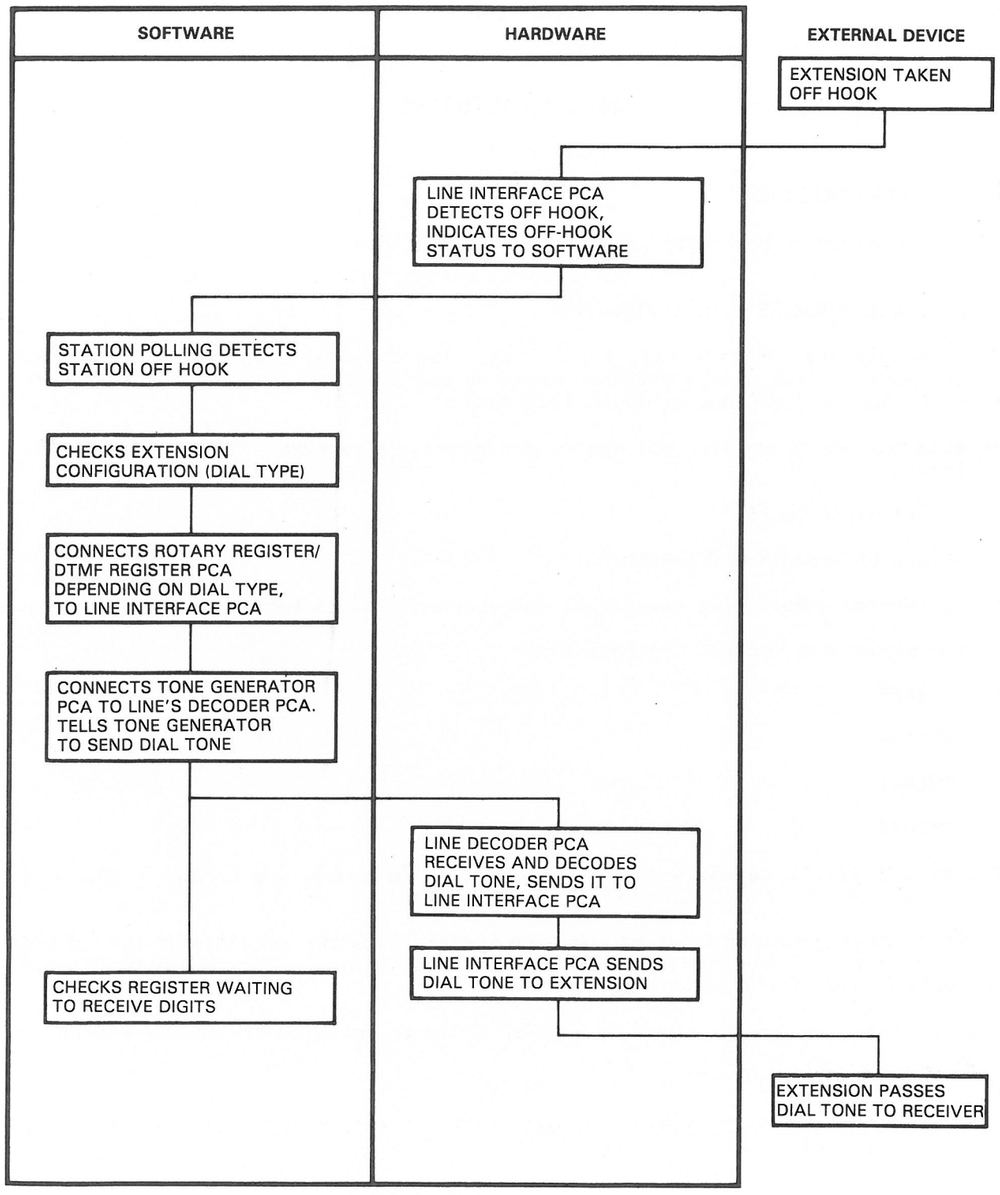


Figure 11-1. CBX Call Process

11.2.1 Transaction Blocks

Transaction blocks are located in the computer's dynamic memory. The blocks keep track of a call while it is being processed. A transaction block stores the following data for each extension:

- Connected channels
- Call state (dialing, flashing, ringing, connected)
- Dialed digits

Information about the transaction blocks can be listed with the list traffic table (LTT) or the list traffic table entry (LTE) command. These commands list information as traffic pegs (Table 11-1).

Table 11-1. Traffic Table Pegs

TRAFFIC TABLE PEG NUMBER	DEFINITION
0071	Maximum number of transaction blocks (TBs) that have ever been in idle queue.
0072	Maximum number of TBs that have ever been in ring queue.
0073	Maximum number of TBs that have ever been in connect queue.
0074	Maximum number of TBs that have ever been in dial queue.
0075	Maximum number of TBs that have ever been in outpulsing queue.
0076	Maximum number of TBs that have ever been in attendant queue.
0077	Maximum number of TBs that have ever been in station camp on and trunk queue.
0078	Maximum number of TBs that have ever been in hold queue.
0079	Maximum number of TBs that have ever been in tone queue. (Counts TBs on busy tone, error tone, or howler.)

11.2.2 Queues

Queues are lines of transactions blocks waiting for service from a particular subroutine or task. Queues are first-in-first-out buffers. The first transaction block stored is the first transaction block processed.

11.2.3 State

A transaction block is always in one of the following states or queues:

- Idle
- Ringing
- Connected
- Station camp on
- Outpulsing
- Queued for loop select (LPS)
- Held
- Receiving tone

Each queue of transaction blocks is in one state (idle queue, ring queue, dial queue). Transaction blocks in each queue wait for the subroutine that moves them to the next state in the call process. For example, a state handler subroutine moves a transaction block from idle state to dialing state. The status extension (STE) or status trunk (STT) command can be used to list the state of a call or to trace its transition from one state to another.

11.2.4 Status Table

The status table is part of dynamic memory. It identifies the state of each station and trunk channel (off hook, flashing). The interface channels send 16-bit words that tell the computer to update the status table; for example, to change the status from on hook to off hook.

11.2.5 Task

A task is part of the operating system and consists of a main routine and subroutines. Routines and subroutines are the computer instructions that process calls. The main routine or task determines which subroutine also will be used in that task. For example, when a trunk or an extension initiates ringing, the main routine of the ring task determines what kind of channel is initiating the call and selects the appropriate subroutine.

11.2.6 Scheduler

The scheduler is the master timing for the operating system. It calls up the appropriate tasks one at a time in the proper sequence.

11.3 INTERNAL STATION TO STATION

Figure 11-2 illustrates the process for an internal station-to-station call. The flow chart shows the specific tasks that process the call through different queues.

11.3.1 *9 Hold

Figure 11-2 shows the *9 hold call process. This flow chart continues the call process from Figure 11-3. It shows the tasks that process the call through different queues after extension 5555 places extension 213 on *9 hold.

11.3.2 Can't Ring and Busy

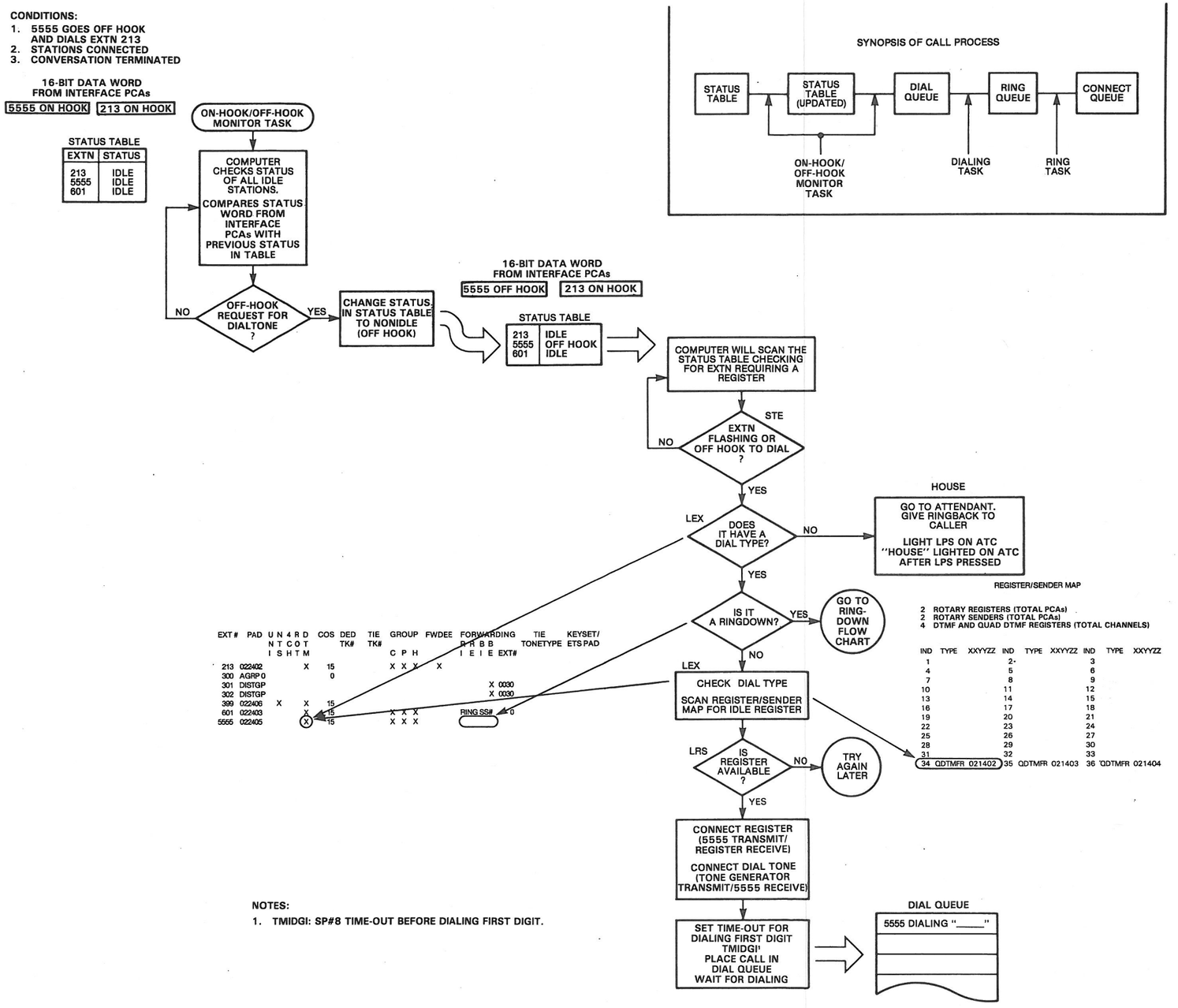
Figure 11-4 shows the tasks the scheduler calls up if a called station does not answer and is not system forwarded.

11.3.3 COM Group

Figure 11-5 illustrates the COM group call process. The dialing task reads the first digit and checks the first digit table. It recognizes the call as a COM group call. The task expects only two digits, and it ignores called-station do not disturb (DND) and forwarding.

11.3.4 Ringdown

Figure 11-6 illustrates the ringdown call process. When a ringdown extension goes off hook, the computer checks the extension number line assignment and characteristics table. It finds a system speed call index number that represents the ringdown target extension. The computer cross-references the index number in the system speed call table to obtain the associated extension or trunk number. The call process then continues as shown in Figure 11-2.



NOTES:

1. TMIDGI: SP#8 TIME-OUT BEFORE DIALING FIRST DIGIT.

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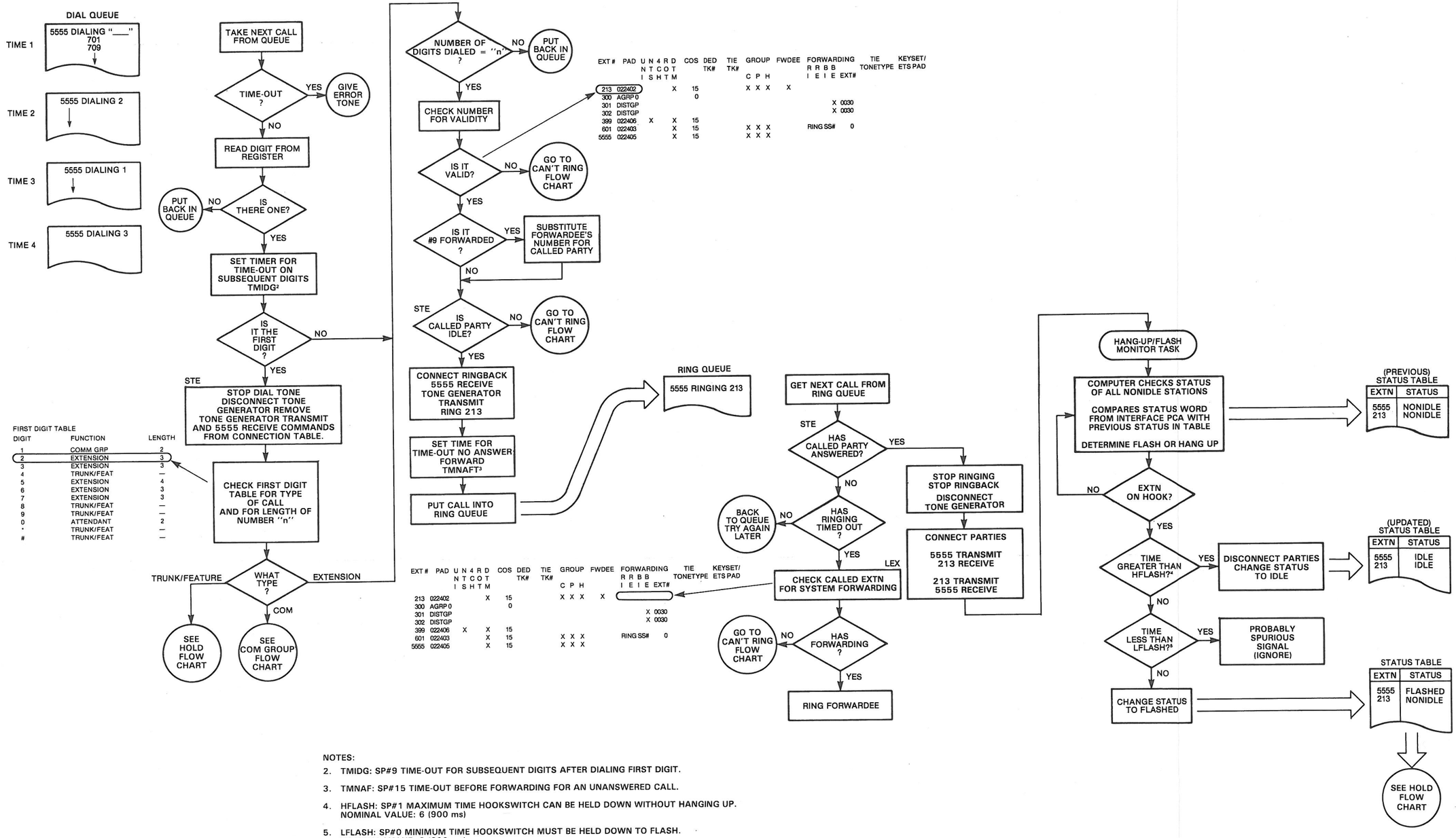
ɔation-To-Station
Call Process (Sheet 1 of 2)



NOTES:

2. TMIDG: SP#9 TIME-OUT FOR SUBSEQUENT DIGITS AFTER DIALING FIRST DIGIT.
3. TMNAF: SP#15 TIME-OUT BEFORE FORWARDING FOR AN UNANSWERED CALL.
4. HFLASH: SP#1 MAXIMUM TIME HOOKSWITCH CAN BE HELD DOWN WITHOUT HANGING UP. NOMINAL VALUE: 6 (900 ms)
5. LFLASH: SP#0 MINIMUM TIME HOOKSWITCH MUST BE HELD DOWN TO FLASH. NOMINAL VALUE: 2 (300 ms)

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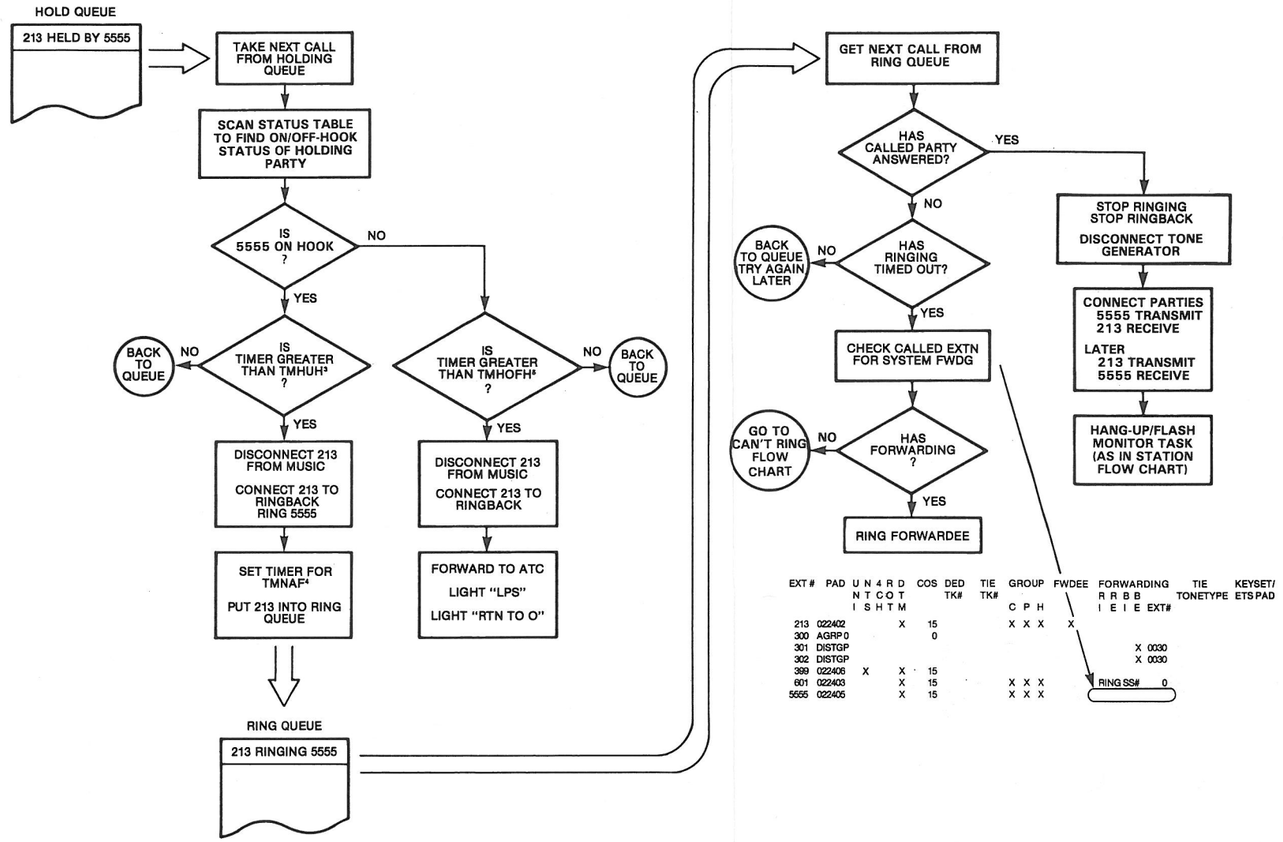
Figure 11-2. Station-To-Station Call Process (Sheet 2 of 2)



NOTES:

3. TMHUH: SP#13. TIME-OUT FOR HELD CALL TO RING BACK TO EXTENSION THAT INITIATED HOLD.
4. TMNAF: SP#15. TIME-OUT BEFORE FORWARDING FOR AN UNANSWERED CALL.
5. TMHOFH: SP#14. TIME-OUT FOR CALL TO REMAIN ON HOLD BEFORE INTERCEPTED BY ATTENDANT (IF EXTENSION THAT INITIATED HOLD IS BUSY).

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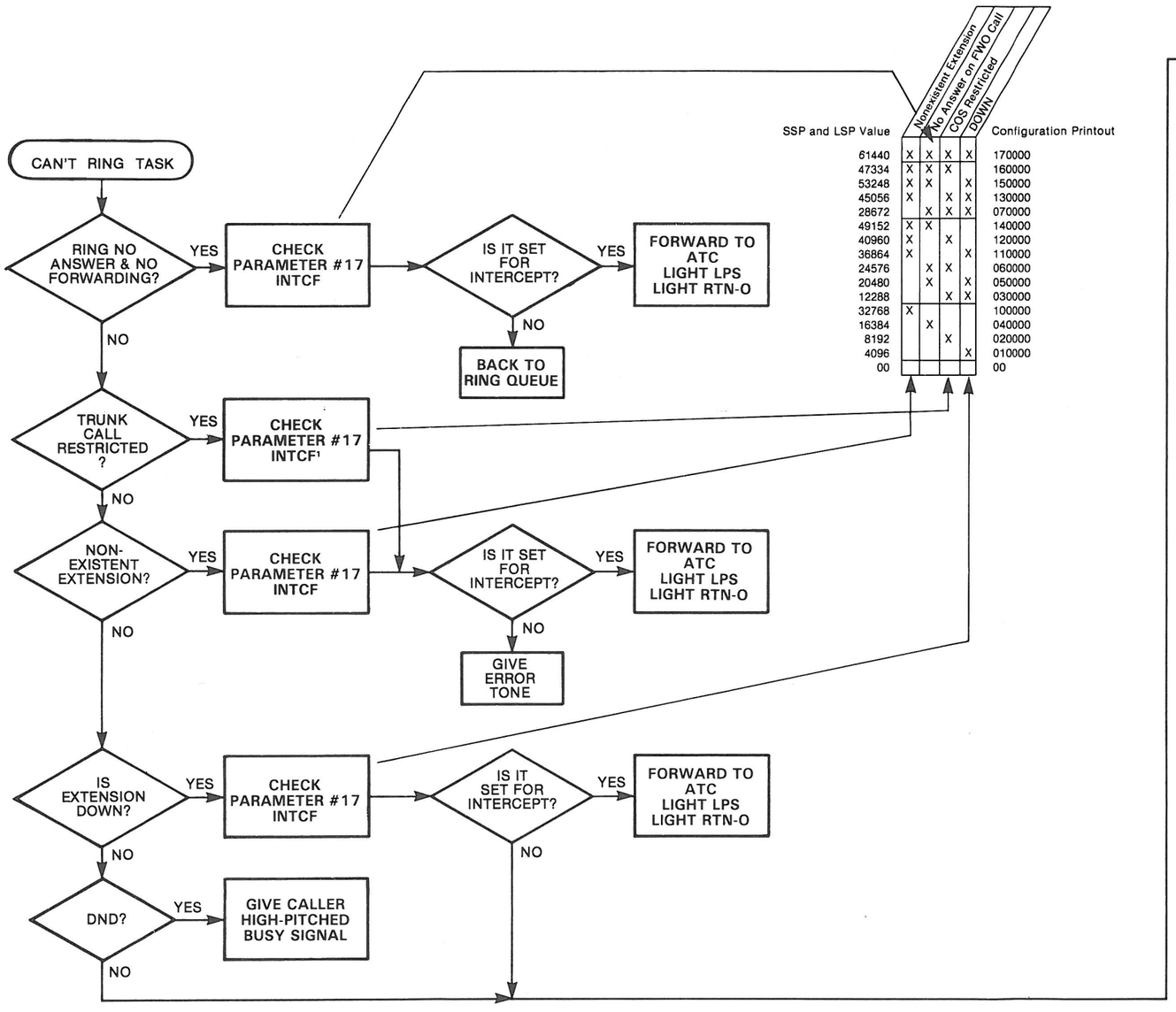
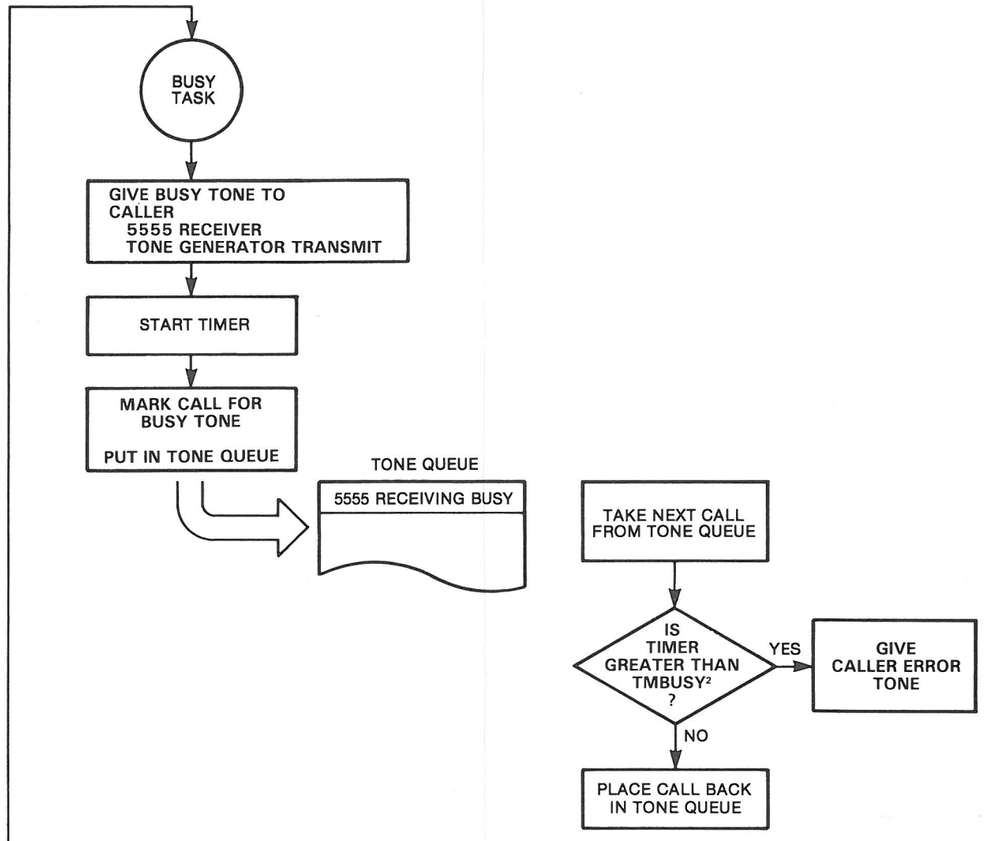
Figure 11-3. *9 Hold Call Process





NOTES:

1. 32768- INTERCEPT CALLS TO NONEXISTENT EXTENSION

   16384- INTERCEPT FORWARDED OR HELD CALLS THAT ARE NOT ANSWERED

   8192- INTERCEPT CALLS THAT VIOLATE COS RESTRICTIONS

   4096- INTERCEPT CALLS TO EXTNS DOWNED BY SELF-TEST FOR FAULT CONDITION OR, THE SUM OF VARIOUS COMBINATIONS

2. TMBSY: SP#12. TIME-OUT FOR CALL TO SWITCH FROM BUSY TONE TO ERROR TONE

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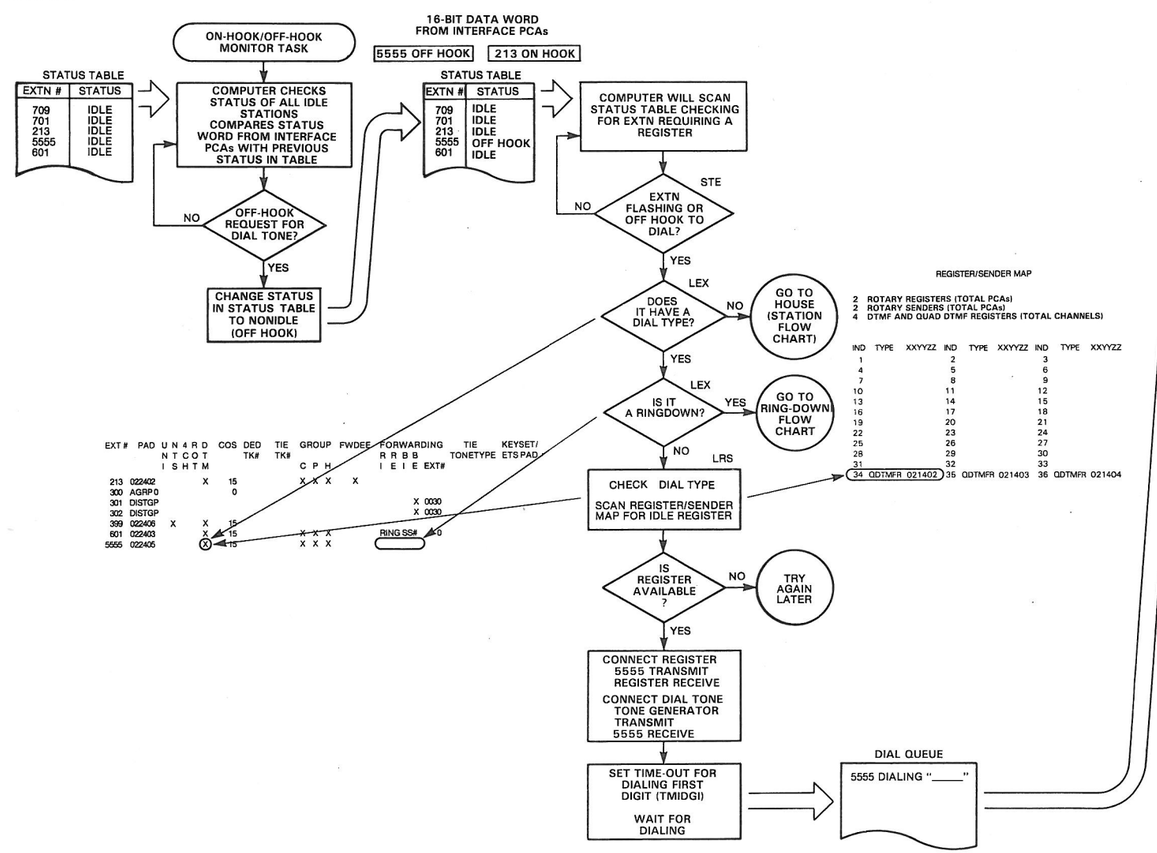
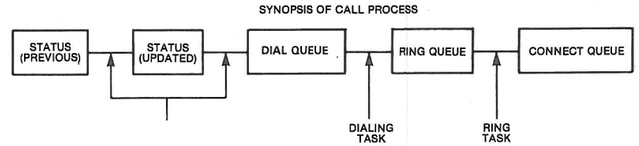
Figure 11-4. Can't Ring and Busy Call Process





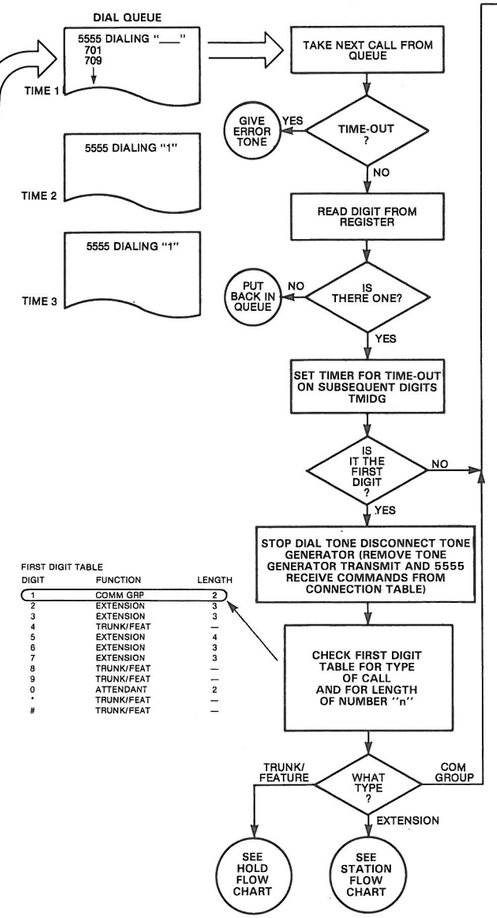


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Figure 11-5. COM Group Call Process

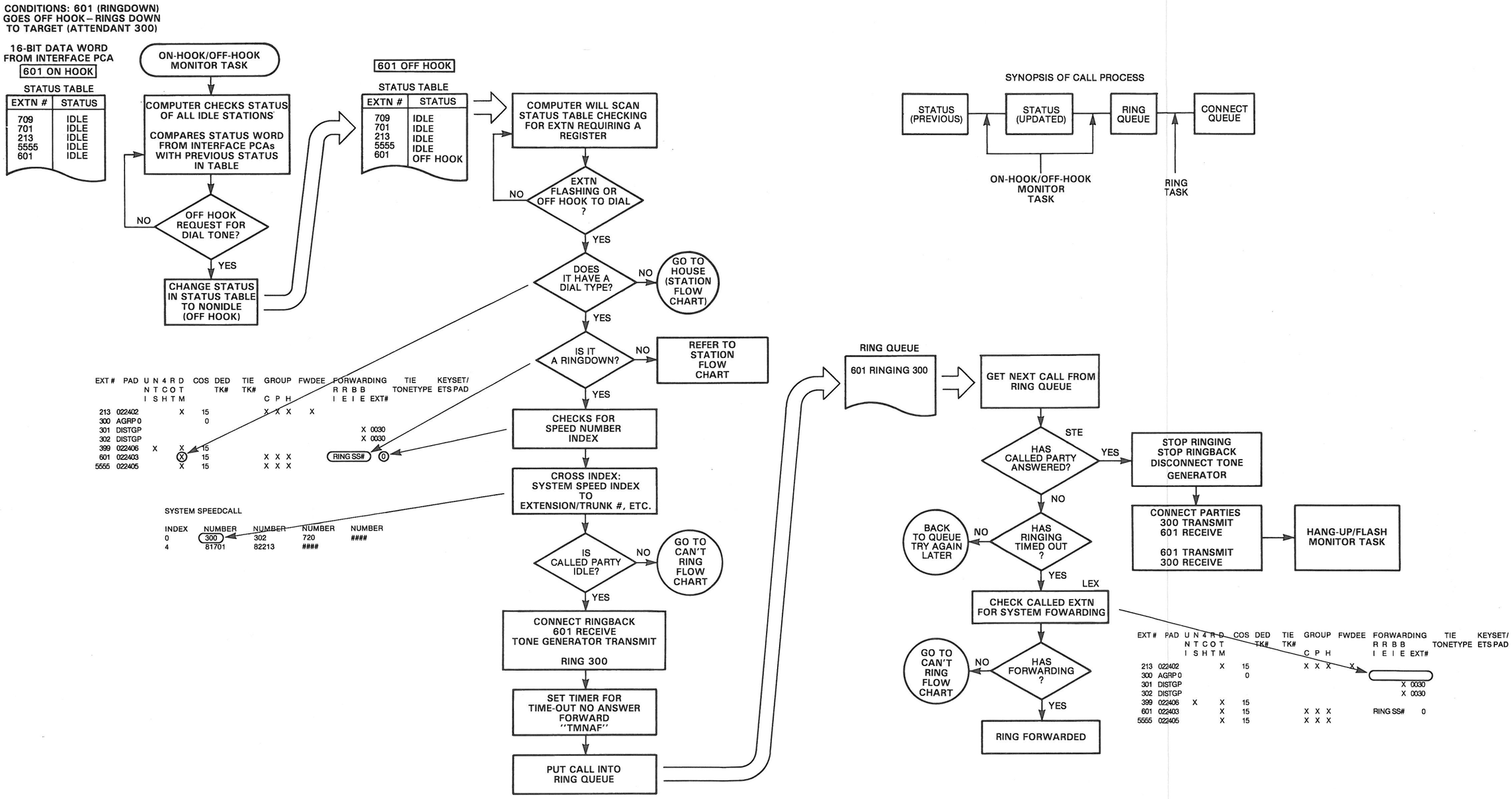

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Figure 11-6. Ring-Down Call Process

11.4 STATION TO TRUNK

This paragraph describes call processing routines that connect the station user to an outgoing trunk. The flow charts show basic and route-optimized call process routes.

11.4.1 Basic Trunk-Accessing Call Process

Figure 11-7 illustrates the basic call process required to access an outside trunk. This flow chart represents a CBX system without toll restriction or route optimization.

11.4.2 Release 4 Route Optimization

This paragraph describes the call process using Release 4 route optimization.

Figure 11-8 illustrates the process of accessing an outside trunk with Release 4 route optimization. Release 4 route optimization uses autoselect and area autoselect tables to select the most economical route available. This simplifies dialing and eliminates the need for separate access codes for each special service trunk group.

a. Last Choice Trunk. The last choice trunk is the last trunk group over which route optimization will send a call. This trunk group does not have a table associated with it. The CBX identifies it by the access code dialed. Last choice trunks are usually direct trunks.

b. Autoselect Tables. These tables contain office codes (prefixes or 1+ office codes). These codes are for an area that is called on a specific trunk or group of trunks.

c. Area Autoselect Tables. These tables contain area codes, area plus office codes, or +1 area plus office codes. These codes also are for an area that is called on a specific trunk or group of trunks.

d. Trunk Access Code. The trunk access code is a specific number used to seize a trunk. In route optimization, the last choice trunk group is assigned an access code. This access code must be the same as the autoselect access code.

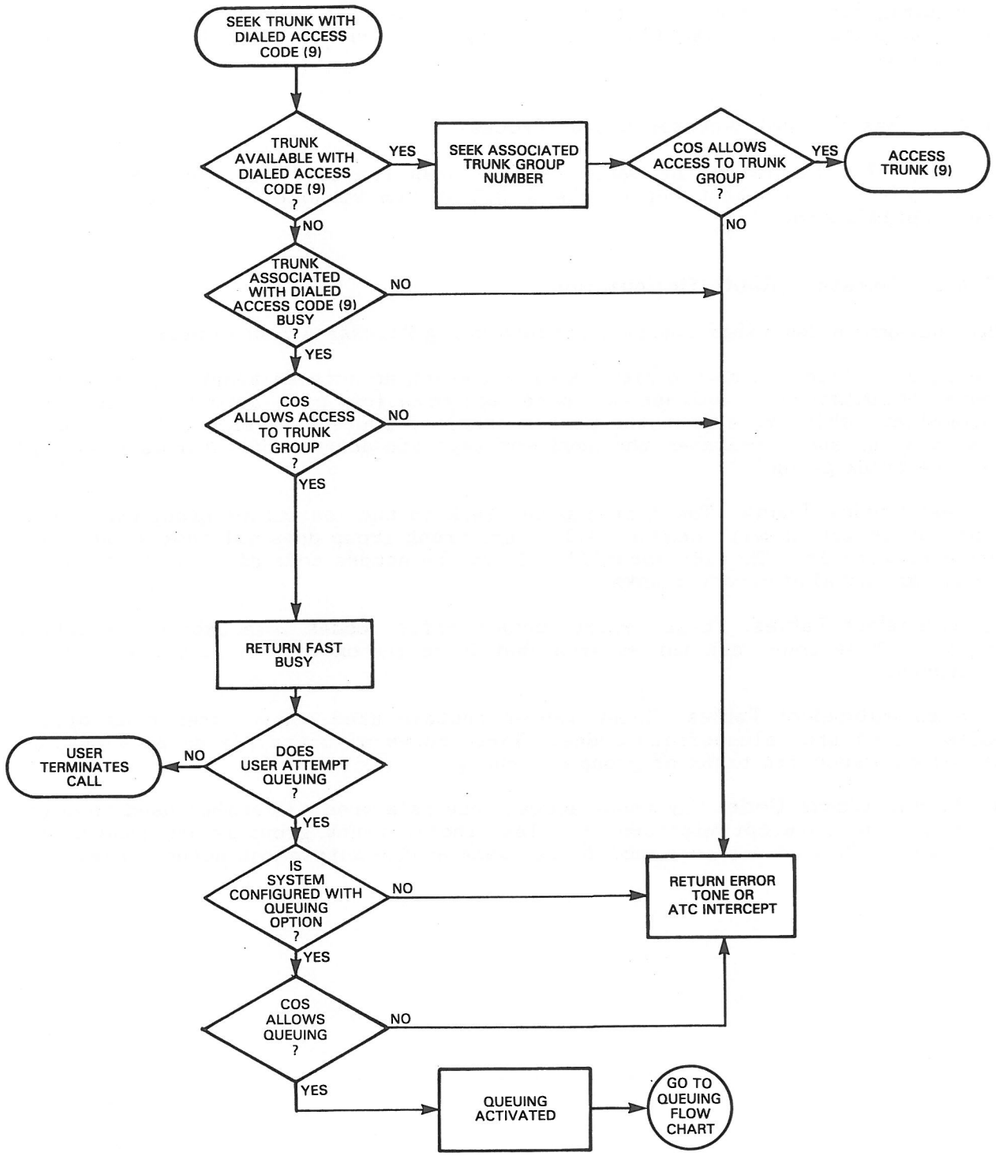

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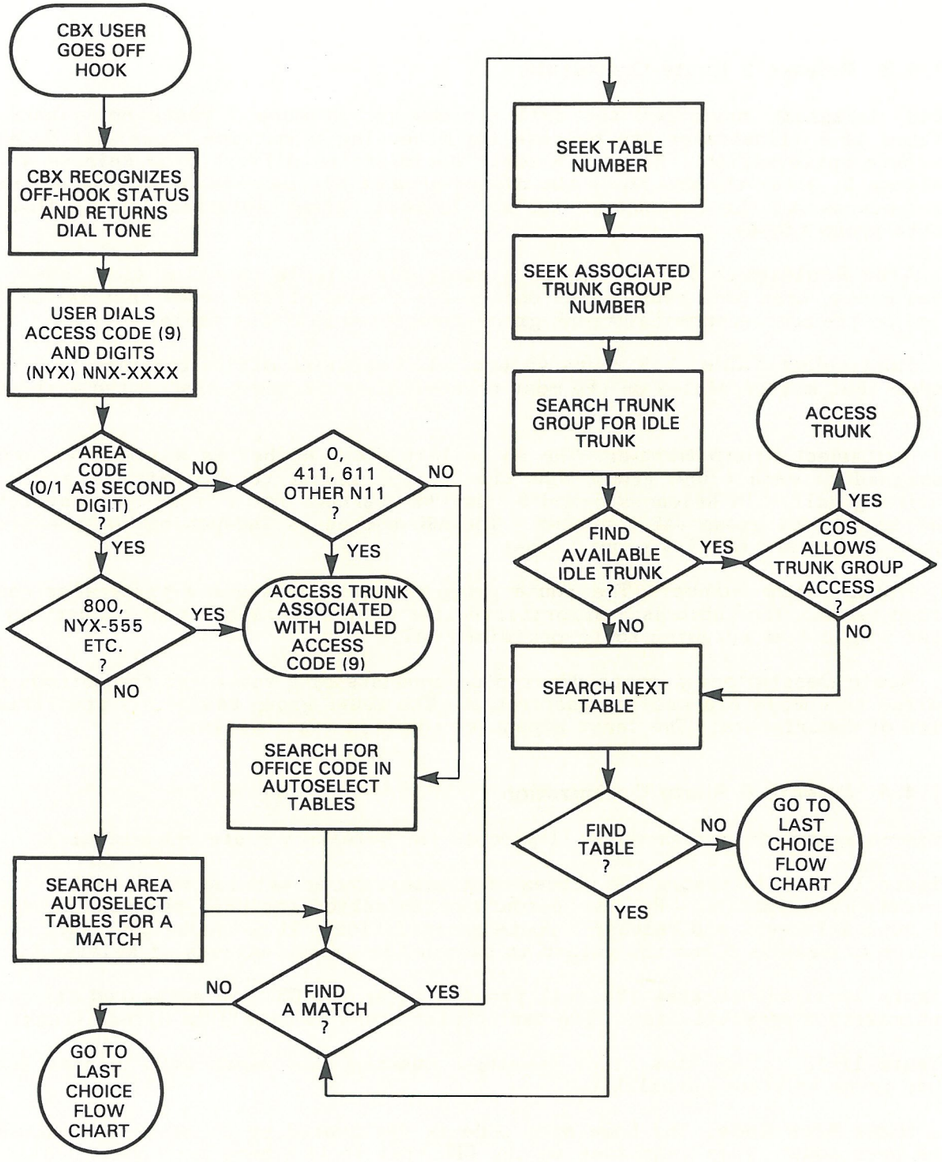
Figure 11-7. Basic CBX Station-to-Trunk Call Process



NOTE:

N = ANY DIGIT 2 THROUGH 9
Y = 0 OR 1
X = ANY DIGIT

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Figure 11-8. Release 4 Route Optimization Call Process

11.4.3 Release 5 Route Optimization

This paragraph describes the call process for Release 5 route optimization. Figure 11-9 illustrates the process for accessing an outside trunk with Release 5 route optimization. Release 5 route optimization differs from Release 4; in Release 5, after the CPU finds the dialed area or office code on a table, it never returns to the autoselect table. Instead, trunk selection is handled by route group tables.

a. Area Routeselect Table. The area routeselect table contains area codes, 1+ area codes, area code plus office codes, and 1+ plus office codes that may be dialed on the most economical trunk group associated with the table.

b. Routeselect Table. The route select table contains office codes or 1+ office codes that may be dialed on the most economical trunk group associated with that table.

c. Autoselect Group Number. The autoselect group number is a number (1 to 63) assigned to each trunk group that the CBX can select to economically route an outgoing call. In Releases 5 and 6, the CBX searches for a trunk by identifying the autoselect group (ASG) number. The ASG number is independent of the trunk group number and display group number.

d. Route Group Number. The route group number represents a particular route group table. The table is a prioritized list of all available routes that can be used to place an outgoing route-optimized call.

e. Route Descriptor. A route descriptor consists of a route and the methods required to complete a call on that route. The route group table is a prioritized list of descriptors. The least expensive route is listed first.

11.4.4 Release 6 Route Optimization

This paragraph describes the call process for Release 6 route optimization.

Figure 11-10 illustrates the process for accessing an outside trunk with Release 6 route optimization. Release 6 route optimization includes the best features of both Release 4 and Release 5 route optimization. It includes the route group search of Release 5 and the return to search autoselect entries of Release 4.

Figure 11-11 illustrates the call process after the CBX has exhausted all route optimization possibilities. The last choice trunk is usually a direct trunk.

Figure 11-12 illustrates trunk queuing. Queuing lets users wait in line for a busy trunk to become available.

a. Home Area Code. The home area code is designated by an asterisk following the area code. This indicates to the CPU that it is a home area code. Calls to that area are placed over the same route, whether or not the area code is dialed before the office code.

b. Selectroute Table. Selectroute tables contain office codes and may list a specific area or code that serves with the office codes only or to office codes and area codes.

c. Areacodeonly Table. Areacodeonly tables contain only area codes associated with a given calling area.

NOTE

Release 6 route optimization also uses autoselect group numbers, route numbers, and route descriptors (paragraph c above).

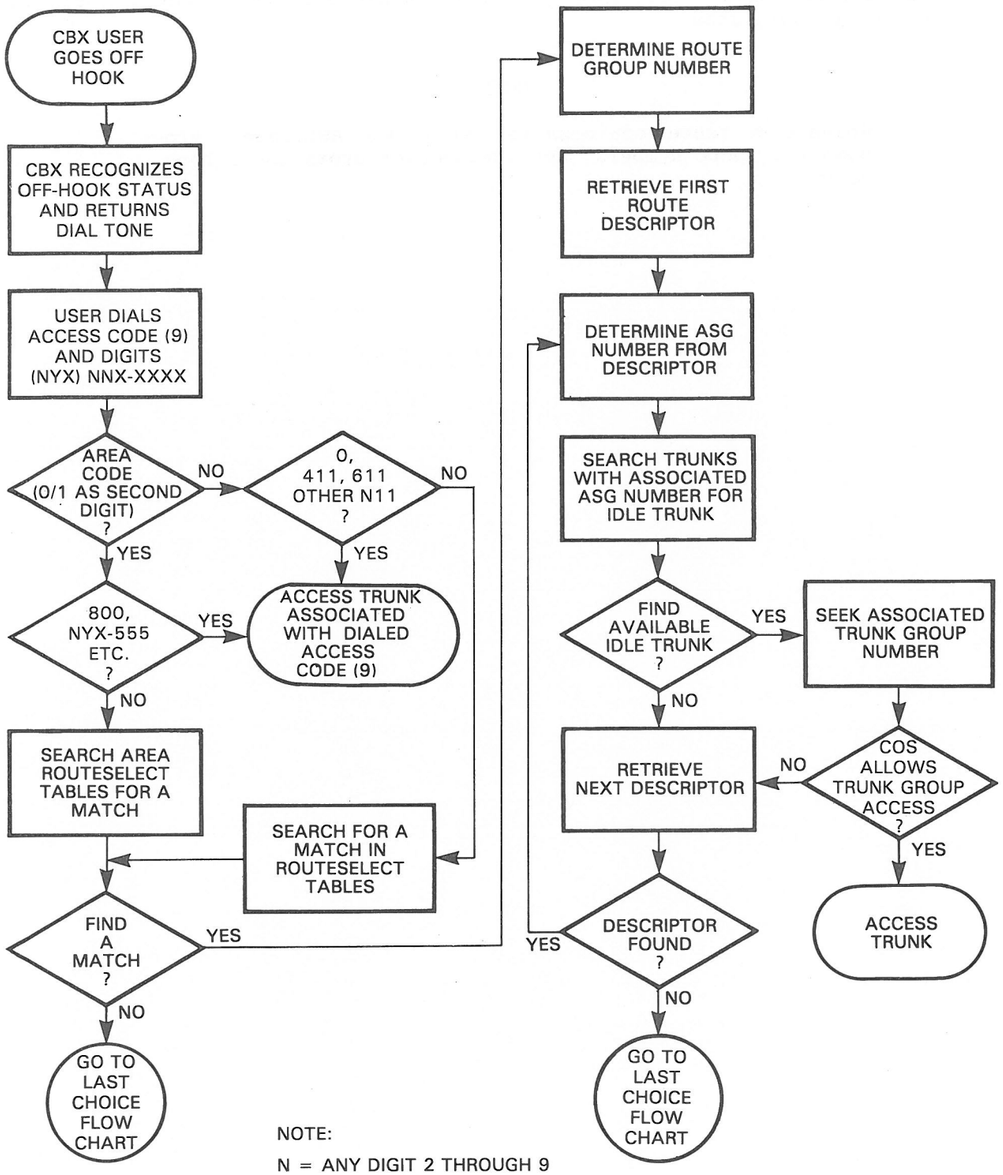

Figure 11-9. Release 5 Route Optimization Call Process

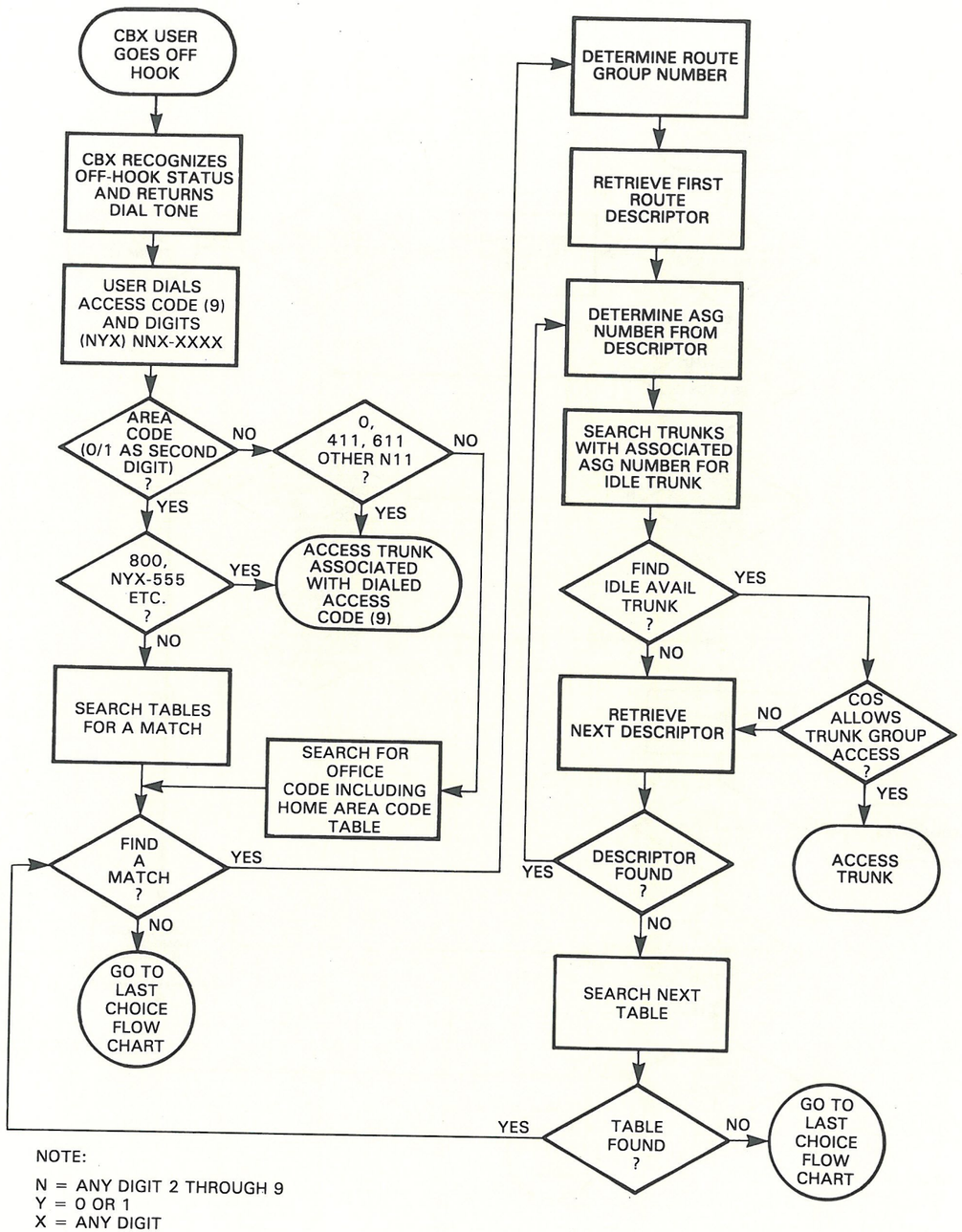

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Figure 11-10. Release 6 Route Optimization Call Process

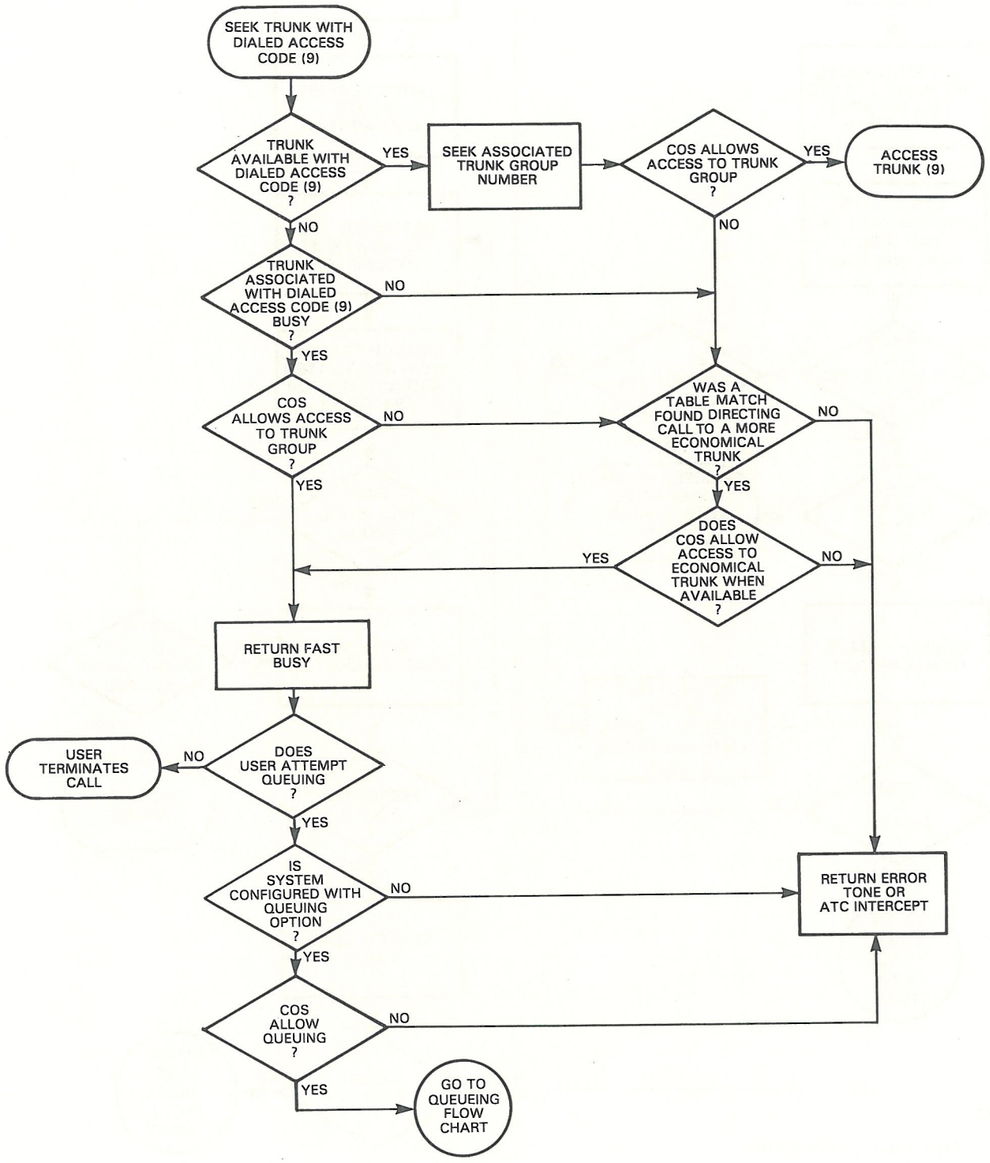

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Figure 11-11. Last Choice Trunk Call Process

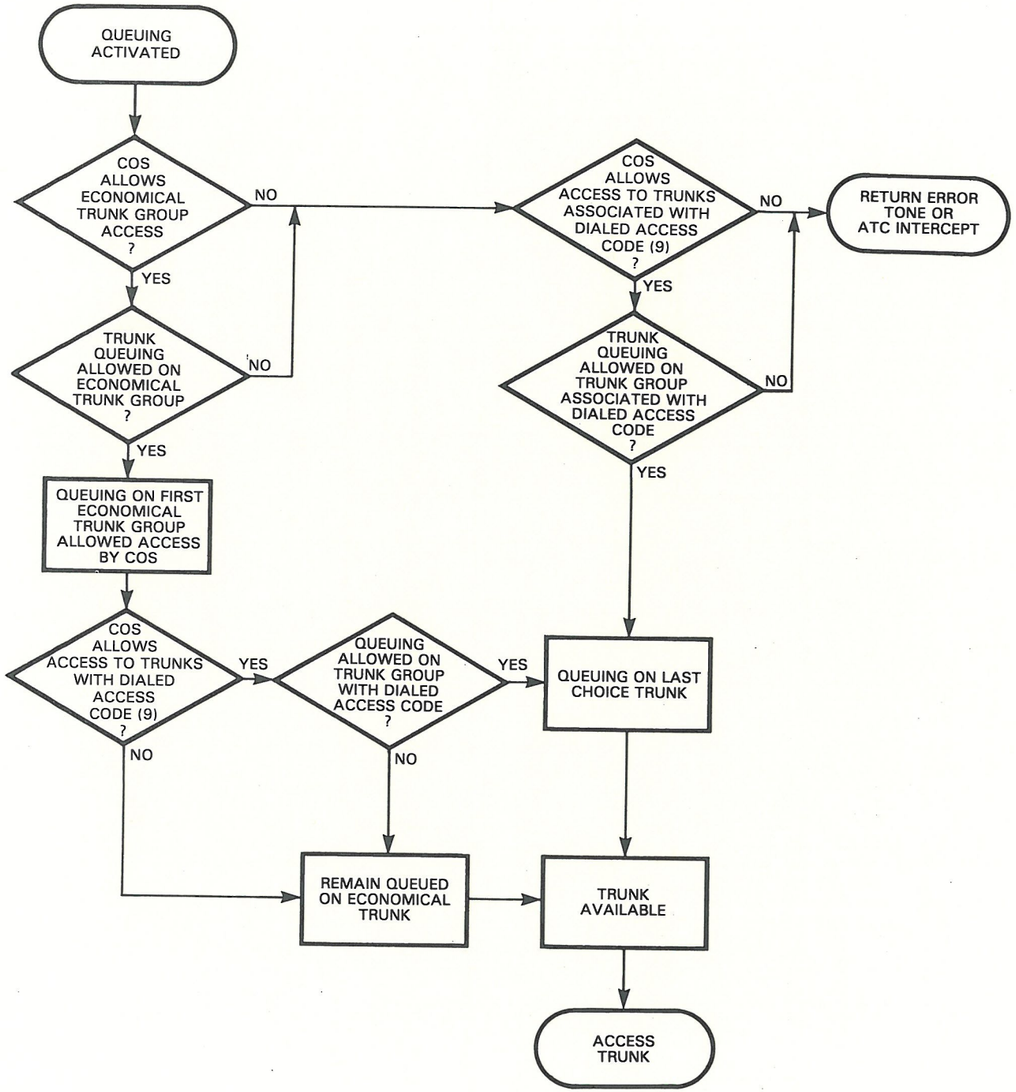

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Figure 11-12. Queuing Call Process