# NO. 4 ELECTRONIC SWITCHING SYSTEM

# NETWORK MANAGEMENT

# CONTROLS

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## 1. GENERAL

**1.01** The No. 4 Electronic Switching System (ESS) will have a large impact on the network. This machine has a capacity of 350,000 engineered busy hour attempts, or 385,000 peak busy hour attempts. The No. 4 ESS has a capacity of 107,520 terminations. It is unlikely that any machine will grow to 100,000 equipped terminations since the system is designed to be processor attempt limited. This limitation will result in a maximum of about 70,000 active terminations in the largest machines. Up to 5 percent of these terminations will be used for service circuits.

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

**1.03** The network manager is provided with new tools to effectively manage the network. The network management system, with highly sophisticated control and surveillance capabilities, permits the network manager (NM) more flexibility than ever before. The network management system has automatic controls which are both selective and expansive. An extensive manual control system has been provided to supplement the automatic system.

**1.04** The network management system utilizes the exception alerting approach. The alerting function is accomplished using an exception panel which notifies the NM that a situation exists which may require network management intervention. To further investigate and identify the problem, a CRT display system is included in the network management system.

**1.05** This document provides information required by the NM to use, maintain, and administer

the No. 4 ESS, Network Management System. As this system is still in the process of being developed, information contained herein is based on information available at this writing.

Some features will not be available for the first machines. These items are identified, and proposed operation is provided. It must be understood that changes will be forthcoming. This document will be updated as information is finalized and made available.

**1.06** DFMP, Division H, Section 9i(1) through 9i(5) are devoted to description and operation of the network management system. Items in these sections which are not firm are denoted by an asterisk. In Section 9i(1), Parts 2 and 3 identify terms which will be used throughout the five sections.

**1.07** Section 9i(5) is intended to provide information which is required to use this system. Many parameters and operating limits are now being studied by Bell Laboratories and recommendations will be forwarded when available.

## 2. TRUNK SUBGROUP

**2.01** All trunks that terminate in the No. 4 ESS are members of a trunk subgroup (TSG). A TSG is made up of all trunks with common characteristics that connect the same two points. Trunks in a TSG must have the same directionality (ie, they must be all 2-way, all one-way incoming or all one-way outgoing), signaling, etc. A TSG can contain up to a maximum of 1024 trunks.

**2.02** All TSGs are members of a trunk group. A trunk group contains all trunks which connect the same two points. A trunk group may contain one or more TSGs.

## 3. ADJUNCT TRUNK SUBGROUP HEADCELL

**3.01** The adjunct trunk subgroup headcell (ASGHC) is a data structure which contains TSG dependent control and traffic information. When a TSG is assigned to a study class, a TSG control is to be applied, or traffic data is to be accumulated for a TSG, an ASGHC must be linked to that TSG. Traffic data is accumulated on a 5-minute interval when an ASGHC is assigned.

**3.02** The ASGHCs are pooled structures which must be linked to a TSG to provide any one of the functions described in 3.01. A TSG will have an ASGHC linked to it when a manual control is applied or when the TSG is equipped for automatic control. The ASGHC remains linked to that TSG until the control is removed or the equipage for automatic control is removed.

**3.03** There are three states associated with the ASGHC. Allocation, final measurement accumulation (referred to as inactive state), and idle are as follows.

(a) The allocation state is the assignment of an ASGHC to a TSG for the purpose of control application or assignment of traffic study class.

(b) The final measurements accumulation is the measurement collection state. In this state the ASGHC is not used to effect control actions, but is awaiting collection of traffic data retrieved by the traffic program.

(c) The idle state is the condition where all controls have been removed and traffic data has been collected. At this time the ASGHC is returned to the idle ASGHC pool.

**3.04** The maximum number of ASGHCs which can be installed is 512. This is an engineered item and it is recommended that the maximum number be installed.

**3.05** There is no explicit assignment procedure, by the NM, required to link or unlink an ASGHC. The NM executes control or assigns a study group to a TSG. If the TSG does not already have an ASGHC assigned (due to some existing control or study group assignment), the system software, which executes the NM request, links the TSG to an ASGHC. Removal of all control or study group index assignment results in the system software returning the ASGHC to the inactive state, if traffic data collection is still pending, or to the idle state at the end of all accumulation intervals involving the TSG. The maximum allowable time from busy to idle state is 15 minutes.

## 4. HARD TO REACH

**4.01** The function of identifying hard-to-reach (HTR) codes is provided to enhance traffic flow through the network. By using per code

completion data, the system can identify those codes which have a poor probability of completion.

**4.02 *Control List:*** A HTR control list will be automatically established to identify those destination codes which have a high probability of failure in distant machines. These codes will be considered HTR for control of outgoing traffic. The list will accommodate up to a maximum of 512 entries. All entries on the control list will be six digits. If a numbering plan area (NPA) goes on the list it will be entered as ABC000. A central office code (NXX) in the home NPA is entered 000ABC. For an NPA which uses six digit routing the NPANXX table entry is ABC000. Under this condition all codes in the NPA are HTR unless NXX resolution is provided.

**4.03 *HTR Determination:*** The internal HTR code is determined by considering the ratio of answers to total attempts and answers to forwarded calls. Automatic determination of HTR codes is accomplished by collecting three statistics on each NPA, NXXs within the home NPA, and NXXs in up to six specified foreign NPAs.

(a) ***A-2 Counts*** (Outgoing Attempts): The A-2 counts are the number of attempts which are successfully forwarded to connected offices and are awaiting answer supervision after completing outpulsing or receiving a common channel interoffice signaling (CCIS) ***check ok*** signal.

(b) ***F-1 Counts*** (Ineffective Machine Attempts): The F-1 counts are the number of attempts which cannot be forwarded to connected offices and are routes to reorder or announcement trunks. The count includes time-out conditions which do not succeed on retrial, but excludes attempts which abandon prior to the time a routine attempt is made. The F-1 counts are defined as ineffective machine attempts (IMA).

(c) ***F-2 Counts*** (Ineffective Network Attempts): The number of attempts for which A-2 counts have been obtained, but released without receiving answer supervision, is designated F-2. F-2 counts are defined as ineffective network attempts (INA). This count is based on answer supervision from the called party end and not just a go ahead dial from the next machine.

**4.04** Using these three counts, the HTR control list is updated on a 5-minute basis. The system will automatically enter and remove codes designated HTR at the end of each 5-minute HTR code update interval.

**4.05 *Control List Additions:*** Codes will automatically be entered on the HTR control list if, at the end of the HTR update interval, the number of attempts (A-2) surpasses a threshold (AC), determined by the NM, and the number of attempts failing to get answer supervision (F2), divided by the number of attempts outpulsed awaiting answer supervision, surpasses some percent failure rate (FC) established by the NM. The formulas are thus stated:

$$\underline{A2} \geq AC \text{ and } \frac{F2}{A2} \geq \frac{FC}{100}$$

The first formula establishes that the number of attempts have reached an amount great enough to be significant in determining a code HTR. The second formula determines the failure rate.

**4.06 *Removing HTR Codes From Control List:*** Codes which have been entered on the HTR control list will remain on the list until, at the end of a 5-minute HTR update interval, the following criteria are met.

(a) The number of attempts (A2) decreases to an amount less than the threshold AC multipled by the removal threshold ΔAC (4.08(c)), designated by the NM. The formula for this is stated:

$$A2 < [AC \cdot \Delta AC]$$

(b) The failure rate reduced to an acceptable level is a second condition which will cause a code to be removed from the list.

$$\frac{F2}{A2} < \left[\frac{FC}{100} \cdot \Delta FC\right]$$

**4.07** These two conditions are not dependent on each other, either condition will cause the code to be removed from the control list. Destination codes internally declared HTR will be entered and removed from the control list in the following order: foreign NPA codes first, NXX codes in the home NPA second, and NXX codes in foreign NPAs third.

**4.08** *Thresholds:*

(a) The outgoing attempts threshold, AC, must be assigned a value between 1 and 9999. This determines the significant number of attempts for HTR determination.

(b) The percent failure rate threshold, FC, must be assigned in integers within a range of 1 to 100. This determines the failure rate at which a code will be entered on the HTR control list.

(c) Removal thresholds ΔAC and ΔFC are total office parameters, applicable to all code categories. These thresholds are assigned by the NM in multiples of 0.1 in the range of 0.1 to 1. The purpose of ΔAC and ΔFC is to prevent HTR codes from being removed prematurely from the control list when the number of outpulsed attempts and INAs decline as a result of control actions exerted on these codes.

**4.09** Parameters required to initialize the HTR system are input via CRT control page by the NM. If the parameters are not specified they will be set to 0. When the parameters are designated, the system will verify that all parameters are in the allowable range. Any parameter unassigned and set to 0 will be identified to the NM through a teletypewriter message which generates the 512 HTR codes every 5 minutes. The generation of all 512 codes will be the indication provided to indicate the parameters are set to 0.

**4.10** Different AC and FC thresholds can be selected for the three categories of foreign NPAs, NXXs in home NPA, and NXXs in foreign

NPAs. However, the same thresholds must be used for all codes in each of these categories.

**4.11** *HTR Counter Blocks:*

(a) These structures contain data necessary to calculate ineffective network attempts on codes assigned to these blocks. There are two blocks provided with the option of six additional blocks for a maximum of eight. Counts are always accumulated on NXXs in the home NPA and on all NPAs. The additional six blocks can be used for NXX breakouts on NPA data contained in the NPA block. The counts contained in these blocks are failure to outpulse, failure to answer, and successfully outpulsed.

(b) The NM is responsible for determining the six foreign NPAs for which NXX resolution is required. The NM must also communicate to the engineers the requirements for HTR counter blocks. It is recommended that the full complement of counter blocks be installed.

**4.12** *Manual Input:*

(a) The NM has the capability to manually designate a total of 512 codes as HTR. When a code is manually input as HTR, the NM must specify one or more in-chain TSGs for which the code will be treated as HTR. A code manually declared HTR will remain on the control list until manually removed. There is no need to specify TSGs for codes which do not have routing, such as an NPA with 6-digit translation or an entire NPA. This provides a means to code block an entire NPA without specifying all possible TSGs which would route this traffic. The system determines those TSGs which are involved.

(b) The NM may exclude up to 512 codes from being declared HTR. For an excluded code, one or more in-chain TSGs must be designated. A code excluded will remain excluded until manually restored to automatic input. There is no requirement to specify TSGs for codes which do not have routing as stipulated in (a) above.

(c) Manually declared or excluded codes will take one slot on the HTR control list, regardless of the TSGs which are specified. It should be understood that the HTR control list can only accommodate 512 entries which include

automatically and manually determined HTR codes and manually excluded HTR codes.

(d) The internal HTR control list (4.05) input can be manually turned off for all codes simultaneously. Codes which have been input prior to turnoff will be restored to normal at the end of the current 5-minute interval. The internal input turnoff will remain in effect until manually restored. Turnoff of internal input will not inhibit manual activation or manual exclusion of HTR codes.

**4.13** *Future *:* At some future date the HTR system will be expanded to include several additional features. There will be two additional HTR transmission lists. These lists will be transmitted between offices via CCIS for communicating those codes which have been determined HTR, at the source office, and should be considered for the purpose of controlling incoming traffic to that office.

**4.14** *Transmission Lists:*

(a) These lists will identify codes which have a high rate of IMA, a high rate of INA or both.

(b) The first list will contain HTR codes for traffic destined to the *world* that is for offices other than subtending offices. The *world* transmission list will contain codes which are candidates for control in subtending machines connected to the office which determined them HTR (HTR code source office). The list will accommodate up to 32, three and six digit codes.

(c) The second list will consist of codes for subtending offices which are HTR. The HTR codes on this list are candidates for control in all machines connected to the source office. This list also will accommodate up to 32, three and six digit codes.

**4.15** *Automatic Remoting of Transmission Lists:*

(a) The machine will transmit the contents of the transmission lists from the HTR source office to connected HTR execute offices (those offices which will exert controls) at the end of each 5-minute HTR update interval.

(b) The *world* transmission list will only be transmitted to subtending machines. At the direction of the NM, the machine administrator will designated those machines to which the list will be transmitted, via recent change.

(c) The subtending code transmission list will be transmitted to subtending and non-subtending machines. The machine administrator (MA) will designate the machines which will receive the transmitted list. This is accomplished via recent change, the NM provides requirements to the MA.

**4.16** A HTR execute office will be able to receive the transmission lists from several HTR source offices via CCIS messages. The execute office will then enter the received codes on its own HTR control list. These codes will only be treated HTR on the TSG connected to the HTR source office which transmitted the code on its list.

**4.17** If the source office does not retransmit the code at the next 5-minute update interval, the code will be automatically restored to normal on the control list of the execute office. The HTR source office will not transmit messages to restore codes previously declared HTR.

**4.18** The two transmission lists may each contain up to 32 codes. In some cases, it may be necessary to transmit up to a maximum of 64 codes to subtending machines (world list and subtending list). In addition, up to 32 codes (subtending list) may have to be transmitted to other connected machines. To avoid possible overload of the automatic system, the NM will have the capability to limit the number of codes remoted to subtending and non-subtending offices. This is accomplished by establishing thresholds: RS for subtending and RN for non-subtending offices.

**4.19** *List Additions:* At the end of each 5-minute HTR code update interval, the machine will automatically calculate the contents of the two transmission lists. A code will automatically be considered as a candidate for entry on one of two transmission lists if, at the end of the update interval, the attempts (A2) plus the attempts to reorder (F1) exceed a threshold (AT), and the total failures (F1 + F2) divided by total attempts (A2 + F1) exceed some threshold (FT).

$$A2 + F1 \geq AT \text{ and } \frac{F1 + F2}{A2 + F1} \geq \frac{FT}{100}$$

### 4.20 *Code Removal:*

(a) Codes which were previously entered by internal input will be removed from the transmission list at the end of a new 5-minute update interval if the attempts (A2 + F1) decrease to a value determined by threshold AT times threshold $\Delta$AT (4.21(c)).

The calculation performed:

$$[A2 + F1] < AT . \Delta AT$$

(b) The second condition that will cause a code to be removed is the failure rate decreasing to an amount indicated by the threshold $\frac{FT}{100}$ times $\Delta$FT.

The calculation performed:

$$\frac{F1 + F2}{A2 + F1} < \left[ \frac{FT}{100} . \Delta FT \right]$$

### 4.21 *Thresholds Future:*

(a) Parameters AT (incoming attempts) and FT (percent failure rate) must be assigned by the NM. The AT threshold must be assigned in integers between 1 and 9999. The FT threshold must be assigned a value in integers between 1 and 100.

(b) Different percent failure thresholds (FG) can be assigned for foreign NPAs, NXXs in home NPA, and NXXs in foreign NPAs. The same FT threshold must be used for all codes in each of the three categories. Because of the rank ordering process, which is explained later, only one value of attempts threshold (AT) need

be selected. This value will be applied to all categories.

(c) The removal thresholds $\Delta$AT and $\Delta$FT must be assigned in multiples of 0.1 between 0.1 and 1. These are total office parameters and will be applied to all categories. The purpose of $\Delta$AT and $\Delta$FT is to prevent HTR codes from being prematurely removed from the list as the result of control actions exerted on these codes.

(d) The RS must be assigned between 1 and 64. The RN must be assigned between 1 and 32. These thresholds were discussed in 4.18.

### 4.22 *Control Leverage Factor:*

(a) Due to the limited number of codes that can be entered on each transmission list, it is desirable to enter the codes that will produce the greatest effect when controls are exerted.

(b) A rank ordering will be performed with the purpose of entering on each list those 32 codes associated with the highest control leverage (CL) factor. The CL factor will be calculated on each code that has surpassed the AT and FT thresholds. This factor is determined by multiplying the percent failure rate, above the threshold, by the total attempts.

$$\left[ \frac{F1 + F2}{A2 + F1} - \frac{FT}{100} \right] . (A2 + F1) = CL$$

(c) The flexibility provided to select different percent failure thresholds (FT) for each category permits the NM to change by the CL factor the weight assigned to percent failure and attempt volume.

### 4.23 *Manual Input:*

(a) The NM will be able to specify a maximum of 32 direct distant dialing (DDD) domain codes which will override the internal transmission list inputs. The NM must specify if the code is to be excluded from entry on either of the two lists, or if the code is to be manually entered on the world list or the subtending list.

(b) Manual inputs will not be affected by thresholds RS and RN, and they will stay in effect until manually restored. Codes manually entered will be excluded from rank ordering and will reduce the available slots on the list by one for each code. Codes manually excluded will not occupy code slots on these lists.

### 4.24 *Inhibits:*

(a) The NM will be able to inhibit all automatically derived HTR codes from being entered on the transmission lists. This command will not prevent internal inputs to the control list discussed in 4.02 thru 4.05.

(b) All codes which were entered on the list prior to a manual turnoff will be removed at the end of the next 5-minute update interval. The turnoff will stay in effect until manually restored and will not prevent manual inputs to the lists.

## 5. SELECTIVE DYNAMIC OVERLOAD CONTROL

**5.01** Selective dynamic overload control (SDOC) is an automatic TSG control designed to alleviate machine congestion. The system is designated to transmit and receive signals that indicate machine congestion levels. When a machine receives an indicator signal, it will return an acknowledgement signal. Where available CCIS is used to convey these signals. Those offices not equipped with CCIS must be provided with some type of on-off signaling arrangement (eg, telegraph).

**5.02** *Machine Congestion:* There are three levels of machine congestion identified for control.

(a) Machine Congestion Level 1 (MC1): Engineered machine capacity has been surpassed and delays on incoming attempts are being experienced.

(b) Machine Congestion Level 2 (MC2): Machine congestion has increased as indicated by further delays in service to incoming calls, loss in switching effectiveness, or both.

(c) Machine Congestion Level 3 (MC3): This level is triggered only when the machine is in a major recovery phase and is usable to process traffic.

### 5.03 *Overload Program:*

(a) Machine congestion is monitored and administered by the overload program (OVLD). The OVLD is responsible for detecting machine congestion by monitoring various system resources and traffic levels in the machine.

(b) Congestion can be caused by heavy traffic load, facility shortage, or real-time shortage. The OVLD monitors the traffic load by measuring the incoming load by call type; facilities are monitored by observing the number of idle client registers, idle MF receivers, idle CCIS transceivers, and DP work list space. Real-time is monitored by measuring the average base-level-cycle (BLC).

(c) To relieve real-time congestion, the OVLD proceeds through several levels of deferring work on a BLC basis. The OVLD provides less system time to perform deferrable work such as routine maintenance, routine audits, and certain recent change routines. To gain added real-time, the program can also cancel CCIS voice path assurance testing on a percentage of CCIS calls. If real-time congestion is not relieved after all non-load affecting controls have been taken, the OVLD can reduce the total offered load through total dynamic overload control (DOC) (all call types). The OVLD can also reduce the accepted load by restricting the number of originations that will be accepted during each BLC.

(d) Incoming congestion is determined by comparing, by call type, the offered load against the accepted load. If the difference is excessive, the OVLD will request DOC to be sent for that call type. The program then distributes client registers to all call types based on their offered load.

(e) The OVLD operates in five different states. The program state is determined by the cumulative base-cycle length compared with predetermined thresholds. As the time required to complete the BLC increases or decreases, the state of the program changes accordingly. In each state, certain actions are taken to alleviate congestion. Part of these functions are the MC1, MC2, and MC3 controls. When SDOC controls are invoked, there is a one second delay between SDOC level changes even if the program state changes in less time. Table A presents the five states in which the program operates,

the controls invoked for each state, and an estimate of control leverage.

(f) The thresholds associated with the OVLD program are generic and therefore do not have to be set by the NM. The machine status section of the exception panel provides a means for the NM to monitor OVLD program activity. The NM must verify that the generic thresholds are set to proper operating values.

**5.04   Non-CCIS:**

(a) Due to hardware limitations certain restrictions must be adhered to.

(1) Hardware has been provided to equip up to a maximum of 64 TSGs; up to three levels of SDOC can be transmitted for each TSG.

(2) Hardware has been provided to equip up to a maximum of 16 TSGs; up to three levels of SDOC can be received for each TSG.

(b) Scan and signal distributor (SD) points must be assigned for each signal which is to be transmitted or received. The assignments for these points will be made at the time of the office data assembler (ODA) process.

(c) The requirements for the assignment of scan and SD points are the responsibility of the NM. Consideration should be given to the number of non-CCIS TSGs, the number of levels, and the call types for which the NM requires control capability.

(d) Pre-cut verification should be made by the NM to determine if the traffic engineer has considered network management requirements in the miscellaneous distributor points which have been ordered.

**5.05   Control Application:**

(a) The SDOC can be assigned to up to 512 TSGs (limited only by the number of available ASGHCs), but can only be activated simultaneously on 256 TSGs. This number includes CCIS and non-CCIS TSGs.

(b) The SDOC can be selective on call type (dial pulse (DP), multifrequency (MF) and CCIS)

or can affect all call types. This is referred to as total SDOC.

(c) Selective trunk reservation (STR) can be assigned to the same TSG as SDOC. If this is the case, the SDOC control will take preference, unless the STR control level is higher STR is explained in Part 6.

(d) The office originating the SDOC signal will be referred to as the SDOC source office. The office implementing the control will be the SDOC execute office. When the NM determines that SDOC is to be assigned to a TSG, assignments will have to be made at the SDOC source and SDOC execute offices of that TSG.

(e) For offices equipped with the first generic, the MC1 signal will always be transmitted with the MC2 signal.

(f) The MC1 and MC2 thresholds are comparable to the sender queue low and sender queue high thresholds in the SDOC systems associated with 4A machines.

**5.06   Control Acknowledgment:**

(a) The system is designed to incorporate acknowledgment signals when control commands are initiated.

(b) The non-CCIS execute office will return a unique signal to the source office to verify the integrity of the SDOC signal. This signal does not verify the execution of the command.

(c) Checks will be made by the system to determine if there is a false acknowledgement or failure to acknowledge SDOC signals. If the source office has entered the MC3 state, it will only check for acknowledgments on non-CCIS TSGs prior to removing the MC3 command. Checks for false acknowledgments and failure to acknowledge will only be made when the source office is not in the MC3 state. When an acknowledgement is received, this acts as a stimulus for the program to check all SDOC controls in effect and the SDOC ACK signals received. If there is an inconsistency, a teletypewriter and exception panel output is generated.

## TABLE A

### REAL-TIME CONTROLS

| | STIMULUS | | CONTROLS INVOKED | CONTROL LEVERAGE (ESTIMATED MAXIMUMS) |
|---|---|---|---|---|
| 1. | Cumulative BLC length (CBLCL) threshold 1 (T1) | | *MAC — restricted to 2 segments per BLC | 3-ms/BLC |
| 2. | CBLC | T2 | (a) MAC — restricted to 1 segment per BLC | (a) 3-ms/BLC |
| | | | (b) 1/0 and recent changes restricted to 1 segment per 3 BLCs, and traffic restricted to 1 segment per 2 BLCs | (b) 5.5-ms/BLC |
| | | | (c) Total DOC — MC1** | (c) Offered load reduced + |
| 3. | CBLC | T3 | (a) MAC — restricted 1/N segments per BLC | (a) 2-ms/BLC |
| | | | (b) Reduce VPA testing | (b) 1300 cycles/CCIS call |
| | | | (c) Restrict load — level 1 | (c) Accepted load reduced 33 percent |
| 4. | CBLCL | T4 | (a) Total DOC — MC2 | (a) Offered load further reduced + |
| | | | (b) Restrict load — level 2 | (b) Accepted load reduced additional 33 percent |
| 5. | CBLCL | T5 | Deschedule MF origination program and set CCIS and DP number of CRs available = 0 | Accepted load reduced to zero |

* MAC — Maintenance Control Program

** Total DOC MC1 is considered a nonload affecting control.

+ Amount of reduction is office dependent.

(d) The CCIS SDOC commands will not be acknowledged if the command is executed or if the corresponding control is already in effect. If the command is not executed due to a manual inhibit, an SDOC inactive message will be returned to the source office. If an execute office receives a command for a CCIS TSG that has not been assigned for SDOC, the command will be ignored and no acknowledgment message will be generated.

(e) False acknowledgement and failure to acknowledge indications will be furnished to the NM and plant forces. The CCIS SDOC inactive acknowledgment will be furnished only to the NM.

**5.07** *Control Options:*

(a) For each TSG to which the NM assigns SDOC control capabilities, the control option must be specified. Cancel or skip must be designated. If no option is specified, the default control is skip and will be implemented when the control is activated.

(b) For each TSG controlled by SDOC, the percentage of traffic controlled will be applied by the execute office as indicated in Table B. The NM is provided the capability of adjusting the percentage of control applied in the following categories:

(1) MC1: Unspecified alternate routed traffic—Some value between 0 and 100 percent must be specified.

(2) MC2: Unspecified alternate routed traffic—Some value between 0 and 100 percent must be specified.

(3) Unspecified first routed traffic—Some value between 0 and 75 percent must be specified.

(c) These values are to be specified by the NM in denominations of 25, 50, 75, 87.5, or 100 percent. These values are entered via the outgoing trunk control page of the CRT system. If no value is input the percentage will be set to 0 by the system.

**5.08** Manual control capabilities are provided with this system and are covered in Part 8.

**5.09** The assignment of SDOC to a TSG and the setting of control options and thresholds are input to the system via outgoing trunk control page of the CRT system. Further description of the CRT system can be found in Section 9i(3).

**TABLE B**

**SELECTIVE DYNAMIC OVERLOAD CONTROL**
**PERCENTAGE OF CALLS CONTROLLED PER**
**CLASS OF TRAFFIC**

| CLASS OF TRAFFIC | MACHINE CONGESTION LEVEL | | |
|---|---|---|---|
| | MC1 (SQL) | MC2 (SQH) | MC3 |
| HTR Alternate Routed | 100 | 100 | 100 |
| HTR First Routed | 50 | 100 | 100 |
| Unspecified Alternate Routed | (100) | (100) | 100 |
| Unspecified First Routed | 0 | (75) | 100 |
| Previously Skipped Local and Remote | 100 | 100 | 100 |

Percentages in parenthesis are office options to be specified by the NM from 0 to the indicated value. These values to be input in increments of **25, 50, 75, 87.5, or 100 percent.**

**TABLE C**

**SELECTIVE DYNAMIC OVERLOAD CONTROL**

| | MACHINE CONGESTION LEVEL | | | | | | | | |
| | MC1 (SQL) | | | | MC2 (SQH) | | | | MC3 |
| RESPONSE CATEGORY | A | B | C | D | A | B | C | D | A<br>B<br>C<br>D |
|---|---|---|---|---|---|---|---|---|---|
| Type of Traffic | | | | | | | | | |
| HTR Alt. Routed | 0 | 100 | 100 | 100 | 0 | 100 | 100 | 100 | 100 |
| HTR First Routed | 0 | 0 | 100 | 100 | 0 | 100 | 100 | 100 | 100 |
| Unsp. Alt. Routed | 0 | 0 | 0 | 100 | 0 | 0 | 100 | 100 | 100 |
| Unsp. First Routed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 75 | 100 |
| Prev. Skipped Local and Remote | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Out of Chain | | | | | | | | | |
| Local and First Link | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

The NM must specify the same category of control response for MC1 and MC2 assigned to the same TSG.

**5.10** *Future \*:* It is intended to improve the SDOC system in a later issue of the generic. Some features cannot be implemented until the CCIS network is deployed. Final design of these features are not firm at this writing.

**5.11** *Response to Receive SDOC Commands:* The response to receive SDOC commands will change as the system is developed. The percentage of controlled traffic will be applied at the values stated in Table C. The NM will designate one of the four categories in Table C. There will be no variable within these categories. It will not be possible to assign a different response category for MC1 and MC2 assigned to the same TSG.

**5.12** *Automatic Restoral of CCIS SDOC:* The SDOC execute office will remove presently executed CCIS MC1 and MC2 levels for any CCIS TSG for which no new MC1 or MC2 messages have been received within the last 3 minutes. The SDOC source office will repeat CCIS MC1 or MC2 messages once every 2 minutes if the SDOC state did not change within the last 2 minutes. An indication will be given to the NM when a CCIS SDOC level is automatically restored by the execute office.

**6. SELECTIVE TRUNK RESERVATION**

**6.01** Selective trunk reservation (STR) is an automatically activated TSG control designed to dynamically sense outgoing TSG congestion on a call-by-call basis.

**6.02** The STR can be assigned to up to 512 TSGs, but can only be activated simultaneously on up to 256 TSGs. When the number of idle trunks in a TSG reach a predetermined number, the STR system controls certain amounts of traffic to relieve congestion. Trunk congestion is identified in the following two levels.

(a) *Selective Reservation Level 1 (SRL 1):* When the number of idle trunks in a TSG

## TABLE D

### SELECTIVE TRUNK RESERVATION
### PERCENTAGES OF CALLS CONTROLLED PER CLASS OF TRAFFIC

**TRUNK RESERVATION LEVEL**

|  | SRL 1 | SRL 2 |
|---|---|---|
| Hard-to-Reach ALT | 100 | 100 |
| Hard-to-Reach FRT | 0 | 75 |
| Unspecified ALT | 0 | 100 |
| Unspecified FRT | 0 | (100) |
| Previously Skipped — Local | 100 | 100 |

Percentage in parenthesis is an office option and may vary from
0 up to indicated value as specified by the network manager.
Values to be input in steps of 25, 50, 75, 87.5, or 100 percent.

## TABLE E

### SELECTIVE TRUNK RESERVATION
### PERCENT OF TRAFFIC CONTROLLED

| | TRUNK RESERVATION LEVEL | | | | | | | |
| | SRL 1 | | | | SRL 2 | | | |
| RESPONSE CATEGORY | A | B | C | D | A | B | C | D |
|---|---|---|---|---|---|---|---|---|
| HTR ALT | 0 | 100 | 100 | 100 | 0 | 100 | 100 | 100 |
| HTR FRT | 0 | 0 | 75 | 87.5 | 0 | 100 | 100 | 100 |
| UNSP ALT | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100 |
| UNSP FRT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Previously Skipped Local | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Out of Chain Local | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

reach an amount determined by the NM, SRL 1 is invoked and traffic is controlled in the amounts specified in Table D.

(b) *Selective Reservation Level 2 (SRL 2):*
This is a second threshold specified by the NM. This threshold will be some number of

idle trunks, less than SRL 1, determined by the NM. When this threshold is surpassed, traffic will be controlled in the amounts indicated in Table D.

**6.03** The NM has the capability to designate the way controlled traffic is handled. The options provided are skip and cancel. If no option is specified the system will implement the skip control.

**6.04** High usage trunk groups may only be compared to one threshold. The TSGs which are full or final will be compared to both SRL 1 and SRL 2 thresholds. If fewer trunks are idle than the SRL 1 threshold but more than the SRL 2 threshold, the SRL 1 control will be invoked. If fewer trunks are idle than the SRL 2 threshold, the SRL 2 control will be invoked.

**6.05** By using the outgoing trunk control page of the CRT system, those TSGs to be equipped with STR must be assigned by the NM. The NM must also designate the control option desired. The inputs for the SRL 1 and SRL 2 thresholds are included on this CRT page. The threshold values may vary between 0 and 15. This provides several control options to the NM. The only restriction is that SRL 1 must be equal to or greater than SRL 2.

(a) Setting SRL 2 = SRL 1 will cause SRL 2 to be executed and not SRL 1.

(b) Setting SRL 2 = 0 will cause only SRL 1 to be executed.

(c) Setting a different value for SRL 1 and SRL 2, with the SRL 1 larger than SRL 2 will permit full operation of the STR system.

(d) Setting the desired threshold to 1 will activate STR actions when all trunks are busy. Manual override has not been provided; however, the NM can deactivate STR actions by setting both SRL 1 and SRL 2 thresholds to 0.

**6.06** The NM must designate the percent of controlled, unspecified first routed traffic under SRL 2 conditions. The value to be specified must be between 0 and 100 percent. The available options are 25, 50, 75, 87.5 or 100 percent. If the NM does not specify a value, the amount will remain at 0.

**6.07** *Future *:*

(a) At some later time, the control action initiated for a TSG that has surpassed the SRL 1 or SRL 2 categories will be in accordance with Table E. At this time, the NM will assign one of four response categories: A, B, C, or D. It will not be possible to assign different categories to SRL 1 and SRL 2 on the same TSG.

(b) If for a given TSG both SDOC and STR are assigned, the response category must be the same for both. The purpose of this restriction is to allow the machine to resolve coincidence of STR and SDOC by executing the SDOC command and waiving the STR control in all cases except when SDOC-MCI and STR-SLR 2 are in coincidence. In this situation, the machine will execute the STR-SLR 2 control. The NM will not be able to vary any percentages in Table E as all values are generic.

## 7. AUTOMATIC OUT-OF-CHAIN ROUTING

**7.01** Automatic out-of-chain routing (AOCR) is an automatic routing control that provides extended routing to calls when they have overflowed their in-chain final TSG. Extended routing will only be permitted when there is idle capacity in the out-of-chain route (OCR) and in the via switching machine. In order to discipline this type of traffic a traveling class mark will accompany each call which is routed out-of-chain. The choice of outgoing TSGs for OCR calls will not be limited to CCIS TSGs.

**7.02** This control can be activated on up to 256 routing data blocks (RDB). A restriction to this assignment is that all destination codes that share a common in-chain RDB must also share the same out-of-chain RDB. The automatic out-of-chain (AOC) RDBs are assigned to in-chain RDBs on a one to one basis. This must be done to provide a meaningful relationship of the reroute to counts accumulated for the AOC RDB.

As an example if more than one RDB is associated with a given final group, all RDBs could be pointed to the same AOC RDB. In this case, the NM is sure that all out-of-chain routed traffic is from the final group.

A case where the RDBs from more than one final group are pointed to the same AOC RDB presents

the NM with the problem, which final group is contributing traffic to the OCR. The NM can determine how much traffic is being routed out-of-chain; however, it is difficult to determine the amount of traffic each final group is contributing.

**7.03** Out-of-chain routing will allow trunk hunting in one of up to seven OCRs. Out-of-chain traffic is equally distributed over an out-of-chain RDB by rotating the first choice TSG preference on a per call basis. Overflow from the hunt of an OCR causes that out-of-chain TSG to be unavailable for out-of-chain routing for 5 to 10 minutes.

**7.05** When a non-CCIS call is forwarded to a via office, it is either routed by the first-choice TSG as specified in the RDB or overflows to final treatment (NC). Without the traveling class mark (CCIS), there is no way for the via office to recognize a rerouted call and thus treat it differently than other calls.

If the call is a CCIS call, a congestion signal may be transmitted to the office that initiated the out-of-chain routing. The congestion signal results in the TSG being turned off for 5 to 10 minutes as an OCR.

**7.07** When the No. 4 ESS is used as the via office, only first choice routes will be used, overflow of first choice routes will go to final treatment.

**7.08** Automatically and manually out-of-chain routed calls will be identified on CCIS-equipped TSGs by an out-of-chain routed traveling class mark.

(a) *First-Link Out-of-Chain:* The office originating this OCR will insert this class mark to identify the call to the via office as first link out-of-chain routed.

(b) *Subsequent-Link:* When the via office receives a CCIS call identified as first link routed, the via office will substitute a subsequent-link class mark for the first-link class mark. Any office receiving this class mark will repeat it when forwarding the call.

**7.09** The via office will restrict outgoing trunk selection to all TSGs in the first choice trunk group for any call received with the first-link

class mark. The via office will deny first-link calls access to outgoing TSGs that have SDOC commands executed.

**7.10** *National Trunk Congestion:* When the outgoing TSG, which is selected as the first choice by an out-of-chain routed call is busy, the CCIS national trunk congestion signal will be returned to the office that originated the OCR. Congestion signals returned due to this condition will be interpreted as a turnoff indication by the OCR originating office.

**7.11** Automatic and manual rerouting will be denied to calls that carry subsequent-link class marks and CCIS class marks that identify a call as international inbound, international outbound or international transient. Service codes (0 or 1 as the ABC digits) and inwats calls (800 as ABC digits) also will be denied.

**7.12** *Manual Overrides:* The machine administrator (MA) will have the capability to exclude specified 3-digit codes from manual reroutes. The MA will also be able to exclude a code from automatic OCR by assigning that code to an RDB that does not have an out-of-chain RDB assigned to it. Identity of the TSGs in an OCR and the assignment of out-of-chain RDBs to in-chain RDBs is the responsibility of the MA.

**7.13** The NM will be able to prevent specified TSGs in all out-of-chain RDBs from being accessed by OCR. On the outgoing trunk control page the NM has the ability to inhibit OCR. The NM is responsible for coordinating those OCRs to be used.

## 8. MANUAL CONTROLS AND OPTIONS

**8.01** Manual controls can be activated by the NM via input to the CRT. As manual controls are activated, selected options associated with control must be specified. Of these options, only the terminating treatment is defaulted (see Note).

> *Note:* Defaulted refers to an option the system selects when no option has been input by the NM.

(a) *Percentage of Control:* The NM must specify the amount of traffic to be controlled. The NM must designate one of the following values: 25, 50, 75, 87.5 or 100 percent.

(b) *Routing:* The type of traffic to be controlled must be specified as alternate-routed or the combination of alternate-routed and first-choice.

(c) *HTR:* This option determines that only codes designated HTR or all codes, both HTR and unspecified, are controlled.

(d) *Terminating Disposition:* This option determines the final treatment given to a call. The call can be sent to no circuit announcement (NCA), emergency announcement (EA) 1, or EA 2, as specified by the NM. If no option is specified, the call will be processed to NCA.

**8.02** *Types of Manual Controls:* The following manual controls are provided.

(a) *Code Block:* Application of this control inhibits a call from hunting for an idle TSG. The call is routed to NC-type treatment, EA 1, or EA 2. The No. 4 ESS provides the capability for 10-digit code blocking. Code block can be placed on up to 128 codes. These can be 3-digit NPA, 3-digit office code (NXX), 6-digit NPA office codes, 7-digit office line numbers or the total 10-digit NPA office line number. When code block is activated, the control percentage and termination treatment must be specified.

(b) *Cancel To:* This control can be activated on up to 512 TSGs. A call encountering this control on a TSG will not search for an idle trunk in the TSG, based on the type of traffic it is classified as alternate or direct routed, HTR or HTR and unspecified. The NM has the capability to be selective as to the type of traffic that is controlled. If alternate routed traffic is specified, the direct routed traffic offered to this TSG will not be affected. If 100 percent direct and alternate routed traffic has been specified, the TSG has been directionalized and any call to this TSG will be routed to no circuit available (NC) treatment.

When this control is applied percent control, routing, HTR, and terminating treatment must be specified. When the NM specifies the type

of traffic (alternate or direct and alternate) to be controlled, either HTR or HTR and unspecified must be selected.

(c) *Cancel From:* The application of this control will prevent a call from advancing any further after hunt on the TSG that has the control applied. An unsuccessful hunt will advance the call to final treatment as specified by the NM. The type of traffic, alternate routed or direct and alternate routed, must be specified by the NM. The percent to be affected, HTR or HTR and unspecified, must also be specified.

(d) *Skip:* Application of this control will result in traffic offered to this TSG being routed to the next in-chain TSG. The percent of traffic affected and the type of traffic must be specified. The type of traffic must be designated alternate routed or direct and alternate routed, and HTR or HTR and unspecified.

(e) *Reroutes:*

(1) When this control is implemented, the traffic overflowing this TSG will route to a manually specified TSG that is not normally in-chain. If the traffic overflows this manually specified TSG, it will then return to the next TSG in the in-chain RDB.

(2) The capability is provided to automatically prefix area code digits, if necessary.

(3) Reroutes can be placed on up to 512 TSGs. The NM must specify the selected option for percentage and HTR. A manually rerouted call is identified by a traveling class mark (provided the via office is a CCIS office) so that the via office routes the call via the normal first choice TSG, as specified by its routing chain or by the NM.

(4) An override capability is provided whereby specified 3-digit codes in the DDD domain are excluded from manual rerouting. This is accomplished by recent change message input.

**TABLE F**

**ABBREVIATIONS AND ACRONYMS**

| ABBREVIATION | TITLE |
| --- | --- |
| ALT | Alternate |
| AOCR | Automatic Out of Chain Routing |
| ASGHC | Adjunct Trunk Subgroup Headcell |
| BLC | Base Level Cycle |
| CBLC | Cumulative Base Level Cycle |
| CBLCL | Cumulative Base Level Cycle Length |
| CCIS | Common Channel Interoffice Signaling |
| CL | Control Leverage |
| CRT | Cathode Ray Tube |
| DOC | Dynamic Overload Control |
| DP | Dial Pulse |
| ESS | Electronic Switching System |
| FRT | First Route |
| FT | Failure Thresholds |
| HTR | Hard To Reach |
| IMA | Ineffective Machine Attempt |
| INA | Ineffective Network Attempt |
| MA | Machine Administrator |
| MAC | Maintenance Control Program |
| MF | Multifrequency |
| NM | Network Manager |
| NPA | Numbering Plan Area |
| NXX | Central Office Code |
| OCR | Out of Chain Route |
| ODA | Office Data Assembler |
| OVLD | Overload |
| RDB | Routing Data Blank |
| SD | Signal Distributor |
| SDOC | Selective Dynamic Overload Control |
| STR | Selective Trunk Reservation |
| TSG | Trunk Subgroup |
| VPA | Voice Path Assurance Testing |