SWITCHING SYSTEMS MANAGEMENT

NO. 2 ELECTRONIC SWITCHING SYSTEM

MACHINE CAPACITY MANAGEMENT

POSTCUTOVER CALL PROCESSING CAPACITY

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1. GENERAL

1.01 This section provides the network administrator with information on the acquisition of data and the methods to be used in determining the call processing capacity of a working No. 2 Electronic Switching System (ESS) using machine-produced real-time measurements. It is applicable to Issue 4.2 and subsequent issues of generic programs LO-1 and to Issue 3.2 and later of the extended feature generic program EF-1. The methods used in this section for determining call processing capacity have been mechanized in a program called Capacity Determination (CADET), a subprogram of the Program for Administrative Reports On-Line (PATROL). It is recommended that CADET be used for determining call processing capacity.

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

1.03 References in this section to methods, planning, data requirements, service levels, and equipment quantities are based on American Telephone and Telegraph Company recommendations.

1.04 The title for each figure includes a number(s) in parentheses which identifies the paragraph(s) in which the figure is referenced.

1.05 The No. 2 ESS generic program along with translations make up the stored program or logical instructions which are contained in the program store. Translations make up the information which defines the characteristics of an individual office and each customer in the office. A generic program contains the logical sequence that provides for call processing, maintenance, and administration of a system. Call processing programs furnish the functions needed to control the progress of calls with diversified operational features whereas maintenance and administrative programs support an operational system and diagnose faulty units if troubles arise.

1.06 Call processing is accomplished by scanning lines, trunks, junctors, and service circuits; by recognizing and interpreting service requests; and by generating outputs to appropriately control the networks, trunks, junctors, and service circuits in response to these service requests. The central processor must perform all of the tasks required to process a volume of service requests within the time intervals required to maintain objective service levels.

1.07 The determination of call processing capacity of a No. 2 ESS using real-time measurements will be a coordinated effort involving the network design engineer, the network administrator, and the central office maintenance personnel.

1.08 Part 2 of this section describes the equipment arrangements of the central processor.

1.09 Part 3 explains the concepts of call processing capacity determination for a working machine based on real-time measurements.

1.10 Part 4 describes the method to be used in determining the call processing capacity of a working office using real-time measurements. Blank reproducible forms are provided at the end of this section for use in capacity determination. An example of the completed computation forms for a hypothetical office is also provided.

2. EQUIPMENT ARRANGEMENTS

2.01 The No. 2 ESS control complex consists of duplicated control units with a common maintenance center. In Figure 1 the terminology "control complex" refers to the equipment depicted to the left of the vertical dotted line in the figure. Each of the two control units consists of a central processor and its associated program store. Each control unit is designed as a single, switchable entity. The central processor of each control unit consists of call store, input-output control, and program control equipment.

2.02 The program control is the central processor unit which executes the instructions that are read from program store. In order to execute these instructions, the central processor must be able to communicate with the peripheral units such as the scanners, switching networks, trunks and service circuits, and peripheral decoders. (The peripheral units are depicted to the right of the vertical dotted line in Fig. 1.) The input-output unit serves as the communication interface between the central processor and the peripheral units. The input-output control works with the program to scan for line originations, to collect dialed digits, and to transmit and receive data.

2.03 The input-output unit provides and controls address bus drivers, scan answer bus receivers, and central pulse distributors. The central pulse distributor selects and enables a peripheral unit to receive information via an address bus. It also sends information to network controllers and peripheral decoders in serial form over dedicated buses.

2.04 Both the program control and the input-output control unit need a "scratch pad" to perform their functions and the call store serves this purpose. Call store is the variable (temporary) memory storage, shared by the program control and input-output control, used to hold information of a transient nature. The input-output control unit accesses call store on a somewhat lower priority than does the program control unit.

3. CONCEPTS OF CALL PROCESSING CAPACITY DETERMINATION BASED ON REAL TIME

3.01 The two components of processor real time are overhead time and call time. The manner in which processor work is done is a function of two main programs: the base level program and the 25-millisecond (ms) interrupt program. Figure 2 lists the primary tasks accomplished by each program. Each group of tasks is labeled according to the type of real time that is used when the tasks are being accomplished.

3.02 The base level program controls the main program loop called the base level scan (BLS). The 25-ms interrupt program interrupts the base level program every 25 ms. When its tasks have been completed, the 25-ms interrupt program then returns control to the base level program.

3.03 The base level program attempts to maintain an average BLS length of approximately 100 ms. However, the length of the BLS is sensitive to traffic load conditions. Beyond a certain load point, the heavier the traffic volume, the longer the average BLS. Certain overhead tasks must be accomplished within each BLS and after these are done the remaining time is available to process individual calls. During a BLS, each call is processed as far as possible with the existing information available. A real-time break in the processing of a call occurs when the processor must wait for further information or customer action such as dialing or answer supervision. When a break occurs,

the state of the call is denoted by an updated "progress mark" in the transient call record (TCR). If several actions (required to further process the calls that have progress marks) occur "simultaneously", the program will attempt to process all of these actions, one at a time, during a single BLS. Such an attempt could cause that scan to exceed 100 ms in length, depending on the number of calls in progress. The heavier the traffic load, the greater the probability that BLSs will exceed 100 ms. Over a given interval of time (for instance, 15 minutes), if traffic load conditions cause any BLS length to exceed 100 ms, then the total number of scans occurring in that 15-minute interval will be less than if all BLS lengths were 100 ms. The point at which the number of BLSs begins to decrease can vary significantly from one office to another, depending upon call mix, but may occur in an average office at *approximately 4000 calls per quarter-hour.*

3.04 A single BLS will not extend indefinitely in length. *In order to control the amount of work that the processor attempts to handle in any single BLS,* the base level program will accept *only three new call originations* (incoming and/or originating) per BLS. For example, 30 simultaneous originations would require a *minimum* of 30 divided by 3 (30 ÷ 3) or 10 BLSs to be processed.

FOUR COMPONENTS OF REAL TIME

3.05 The tasks listed in Figure 2 are accomplished within four different work-priority categories of processor real time. Figure 3 is a regrouping of the tasks listed in Figure 2. The four real time categories are called fixed overhead time, variable overhead time, call time, and periodic deferrable time (PDT). These four components comprise 100 percent of processor real-time. All consumption of real time occurs during each BLS and within one scan, three or four of these components of real time may occur, depending on traffic load conditions. Each component of real time is described in detail and graphically interrelated in 3.06 through 3.32.

3.06 The use of fixed overhead time occurs in every BLS and is associated with the primary task of scanning hardware, accessing certain call store registers, and recording traffic measurements. These tasks are high-priority tasks and must be accomplished at their appointed times. The amount

of real time required to perform these tasks is dependent upon equipment quantities and the type of generic program installed in the office. Fixed overhead time **is not dependent upon** the offered traffic load. Therefore, for a given equipment configuration and generic program, the fixed overhead time is not changed significantly until the equipment configuration and/or the generic program are changed.

3.07 In an office with an ultimate hardware configuration, fixed overhead time is not expected to exceed 30 percent of the total real time. If, for a particular machine, the percentage of fixed overhead time (%FO) is subtracted from 100 percent of real time, the remainder is time available for call processing. If the time remaining is labeled "R_o," this concept may be expressed as shown in the equation below:

$$R_o = (100\% - \%FO)$$

For a given hardware quantity and generic program, R_o is a constant, since %FO is constant. This is depicted in Sketch 1 on a graph of originating plus incoming calls versus the percentage of real time (O+I versus % real time). The %FO line is a straight horizontal line, unchanging with originating plus incoming (O+I) calls, which intersects the vertical axis at R_o. The graph is as follows:
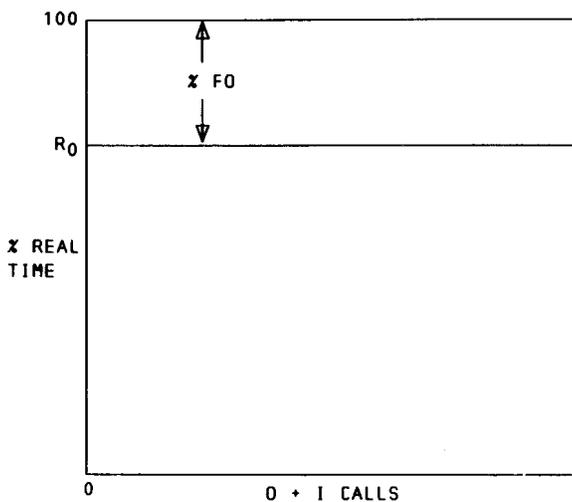
Sketch 1

3.08 Variable overhead time (Fig. 3) also occurs once per BLS. It is the time required to perform certain call processing and maintenance functions. The amount of variable overhead time required is relatively constant **per BLS.** However, under heavy traffic load conditions, as the number of BLSs begins to decrease, the percentage of total real-time that is variable overhead time begins to decrease accordingly. Therefore, the amount of variable overhead time is traffic-load dependent beyond a certain load point (approximately 4000 calls per quarter-hour).

3.09 The percentage of variable overhead time (%VO) that occurs within a given time interval (for instance, 15 minutes) is dependent on three factors: the amount of variable overhead time per BLS for a particular machine, the number of BLSs in that time interval, and the O+I calls in that interval. Sketch 2 shows %VO added to the graph in Sketch 1. Notice that %VO is constant (a straight line) until a certain load point is reached and then the %VO begins to decrease as the number of calls continues to increase.
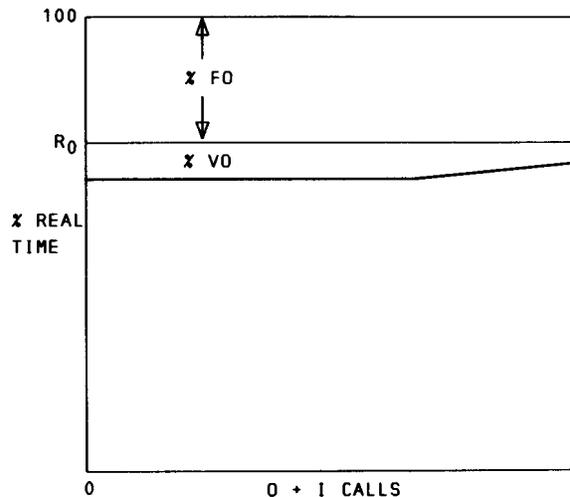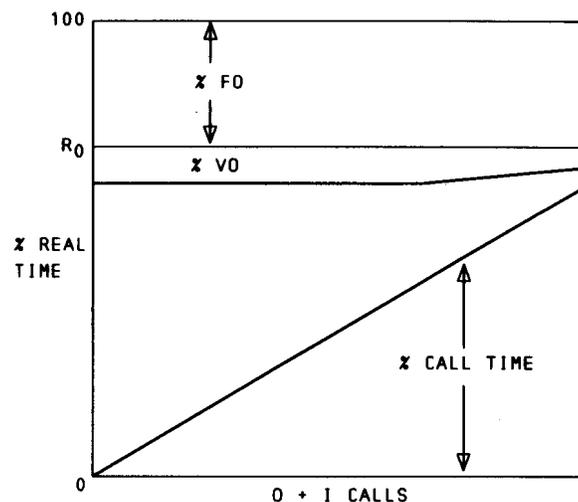

Sketch 2

3.10 The next component of real time is call time, which occurs within a BLS if there are calls to be processed during that scan. Call time consists of the time spent performing the tasks necessary to process the calls offered to the system.

Some examples of primary call-time tasks are: sending and receiving digits, operating relays, selecting paths, and testing for busy conditions. The amount of call time that is required depends upon the numbers and types of O+I calls being processed during the time interval.

3.11 Call mix has a major impact on the amount of call time required to process a given set of calls. Suppose that system A is offered 1000 O+I calls in 15 minutes, some of which are automatic message accounting (AMA) billed calls. Suppose also that system B is offered 1000 O+I calls in 15 minutes of the same call mix as was system A except that none of them are AMA-billed calls. To process its 1000 calls, system A would require more call time than system B because AMA calls require more processing time than most non-AMA calls. Other types of calls requiring more-than-average call time are coin calls, tandem calls, custom-calling calls, automatic number identification (ANI) calls, etc. As the main-station load increases in a machine, the total office call mix characteristics become more stable. For example, if a machine has 80 percent of its ultimate main stations working, the remaining 20 percent of the main stations are not likely to change the call mix characteristics of the total office enough to significantly change the ultimate call capacity. When a machine is near its main station capacity, other factors such as call rate changes and overhead time changes have more significant effects on ultimate-call and main-station capacities than do call mix changes.

3.12 Graphically, the percentage of real time that is call time is represented by a line starting at the 0,0 point, zero calls and zero call-time, and extending upward as calls increase. The slope or steepness of the line depends on the call mix of a particular office. The call mix determines the rate of real time used per call. Sketch 3 reflects the addition of call time to the graph of Sketch 2.

Sketch 3

3.13 PDT also occurs during a BLS. The processor uses this time to accomplish its lowest-priority or deferrable tasks. Examples of these tasks are: certain control unit detection tests, audits, and off-line call store updates. The amount of PDT that occurs is inversely related to the traffic load at any given time. The processor always uses 100 percent of the total real-time available to perform the tasks assigned to the four components of real time. In attempting to maintain an average BLS length of 100 ms during periods of idle-to-medium traffic loads, the processor may have some time left over after it has performed its required higher priority overhead and call processing tasks. The time remaining is used to perform the deferrable tasks, hence PDT occurs. As calls increase, call processing time requirements increase and the PDT decreases. Deferrable tasks cannot be postponed indefinitely if objective service is to still be maintained. PDT will decrease to zero if the processor is overloaded and excessive dial tone delays will begin to occur. There are necessary lower bounds on the amount of PDT that occurs within a 15-minute interval in order to maintain a service level that meets established criteria. These considerations are important in the call capacity determination process discussed later in this section.

3.14 The percentage of periodic deferrable time (%PDT) that occurs is inversely related to the O+I call load. This is reflected by the undefined

areas in the graph in Sketch 3. Sketch 4 is the completed graph reflecting the interrelationships of all four components of real time. Note that %PDT is at its maximum at the zero-calls point and decreases accordingly as O+I calls (hence, call time) increase. When one of these two variables (call time or PDT) is known, the other can be computed, provided that the overhead time and the rate of use per call are known. This is reflected in the call processing capacity determination formulas provided later in this section.
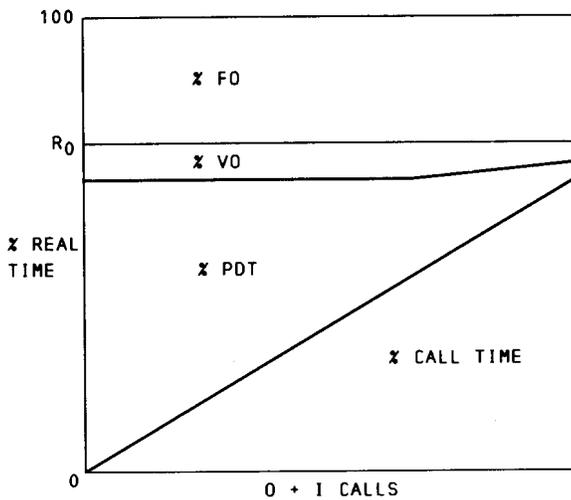
Sketch 4

THE BASIC MODEL

3.15 There are two basic variables that must be determined to calculate call processing capacity based on real-time measurements. First, the amount of the total real-time actually available for call processing must be determined. Secondly, a parameter must be developed that describes (in ms) the average amount of processor real-time required to process one call. If these two variables are known, then a basic model describing the real-time call capacity can be expressed as follows:

$$\text{CALL CAP} = \frac{\text{REAL TIME AVAIL. FOR CALLS}}{\text{AVG. TIME TO PROCESS ONE CALL}}$$

The numerator of this fraction is actually the definition of R_o which is $(100\% - \%\text{FO})$. R_o is dependent upon the amount of fixed overhead time required and is constant for a given hardware configuration and generic program. The denominator is called RATE and describes in ms the slope or steepness of the call-time line shown in Sketches 3 and 4. The value of RATE largely depends upon call mix but typically will be slightly over 100 ms. The basic model formula for expressing call capacity per BLS now becomes:

$$\text{CALL CAP} = \frac{R_o}{\text{RATE}}$$

This formula can be put into a time frame of 15 minutes; the components of this 15-minute time frame are 100-ms units (average BLS length). Since there are 9000 100-ms units in 15 minutes, the basic call-capacity formula can be expressed as:

$$\text{CALL CAP/QTR. HR} = \frac{(R_o)\,(9000)}{\text{RATE}}$$

3.16 This basic call-capacity model might be complete if the processor reacted the same under heavy load conditions as it does under idle-to-medium load conditions. However, as the offered load approaches the peak capacity of the system, delays in call setups begin to occur. Customers can experience these delays in the form

of increased dial tone delay or increased time between audible ringing and end of dialing. One system measure of these call-setup delays (caused by processor real-time capacity being approached) is the percentage of calling attempts experiencing dial tone delay over 3 seconds. Bell System service criteria for dial tone speed specify that dial tone delays not exceed 3 seconds in 20 percent of the attempts during the high day (HD) busy hour and in 1.5 percent of the attempts during the busy hour on an average-busy-season (ABS) basis. Since processor overloads will affect dial tone delay, these service criteria must be built into the basic call-capacity formula.

3.17   Laboratory simulations in which the processor was the main contributor to dial tone delay have shown that these 20 percent and 1.5 percent delay levels are reached when the call processing plus overhead time requirements consume all but 3 percent and 10 percent, respectively, of 100 percent of real time. The dial tone delay objectives are accounted for by subtracting the corresponding real-time factors from R_o, the total time available for call processing. The basic call-capacity formula thus becomes two formulas as follows:

(a) $C_{20} = CALL\ CAP_{20}/QTR.\ HR = \dfrac{(R_o - 3\%)\ (9000)}{RATE}$

(b) $C_{1.5} = CALL\ CAP_{1.5}/QTR.\ HR = \dfrac{(R_o - 10\%)\ (9000)}{RATE}$

3.18   Formulas (a) and (b) represent two independent call-capacity statements, each based on unique service criteria and each of which must be met. Therefore interrelated HD and ABS call-capacity statements must be developed. These statements are done by using an HD/ABS call-peaking factor, P, based on O+I calls. The HD and ABS basic model formulas are interrelated as follows:

(c) $C_{HD} = CALL\ CAP_{HD}/QTR.\ HR. = C_{20}$

(d) $C_{ABS} = CALL\ CAP_{ABS}/QTR.\ HR. = \dfrac{C_{HD}}{P}$

provided: $C_{ABS} \leq C_{1.5}$

3.19   Formula (c) indicates that the HD call processing capacity (C_{HD}) is established at a point where 20 percent dial tone delay resulting from processor overload will be experienced. Formula (d) indicates that the ABS call-capacity (C_{ABS}) point is established by dividing C_{HD} by the O+I call-peaking factor labeled P. Formula (d) provides the interrelationship between the HD and the ABS call-capacity statements and ensures that both dial tone delay criteria are met simultaneously.

3.20   The two capacity statements discussed above were developed in the manner described because of the accelerated deterioration of service (ie, rapid increase in the percentage of dial tone delays) when operating beyond a certain traffic-load point. If a machine is operating near 20 percent dial tone delay as a result of processor real-time limitation, a 5 percent increase in calls can cause the dial tone delay to increase from 30 to 40 percent during that period of time. Therefore, critical observation of HD call data versus dial tone speed data is very important when judging the validity of a $C_{HD} = C_{20}$ statement.

3.21   The HD/ABS peaking factor, $\bar{P}$, is very critical in the establishment of a C_{ABS} statement. It is determined by dividing the HD O+I calls ($[Q6 + Q7]_{HD}$) by the ABS O+I calls ($[Q6 + Q7]_{ABS}$). Careful examination of HD and ABS O+I call data is required to establish a realistic value of P. It is recommended for the purpose of this section that P be assigned a value of **no less than 1.15.** In the absence of actual data, use P = 1.30. An actual peak factor that significantly exceeds 1.30 should be examined very carefully before use in call processing capacity determination. If these peak-factor criteria are met, under normal circumstances with capacity statements developed as in formulas

(c) and (d), the C_ABS restriction that follows formula (d) will hold.

CALL CAPACITY REMAINING CONCEPT

3.22 To determine call-processing capacity based on real-time measurements, the variables involved must be either directly measured items or items which can be computed from measured items. A variable identified as call capacity remaining (CCR) has been developed for this purpose. CCR is expressed as a percentage of real time. The percentage of CCR (%CCR) decreases as O+I calls increase, it depends on all three traffic-dependent components of real time, and it can be computed from machine-produced traffic measurements. These features of %CCR make it a practical tool to use to compute call-processing capacity.

3.23 Sketch 5 shows how %CCR is graphically related to the four components of real time. The shaded area of Sketch 5 represents %CCR and clearly indicates how %CCR decreases as O+I calls increase.
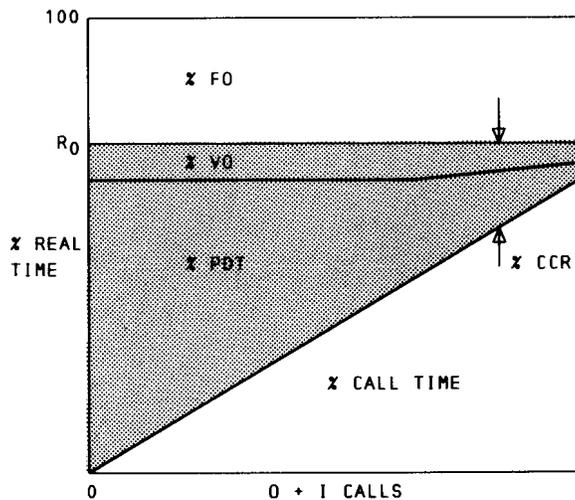
Sketch 5

Sketch 5 also indicates that the formula for %CCR is as follows:

$$\% \, CCR = \% \, VO + \% \, PTT$$

The rate at which %CCR decreases as calls increase was determined by RATE in the basic model formula. The quantity R_0 in Sketch 5 is the maximum value of %CCR and occurs at the zero-calls point. These facts about %CCR allow a simple graph to be drawn (%CCR versus O+I calls) as depicted in Sketch 6.
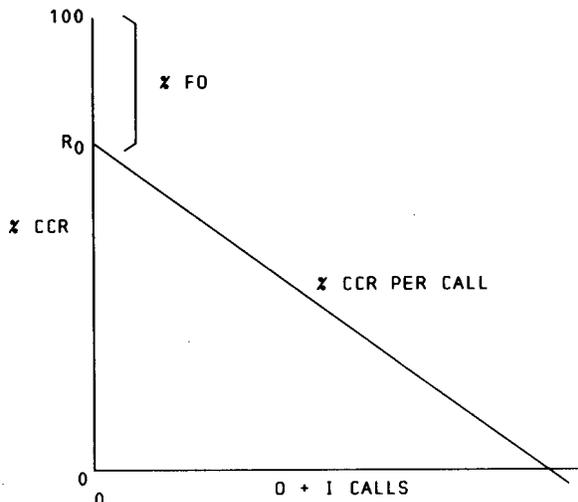
Sketch 6

3.24 Sketch 6 actually reflects the same real time relationships with respect to O+I calls as does Sketch 5. The difference between Sketch 5 and Sketch 6 is that Sketch 5 reflects call time which is increasing as calls increase and Sketch 6 reflects variable overhead time plus PDT decreasing as calls increase. However, the rate at which both of these events occur is the same; therefore, Sketch 6 is adequate to express total real-time variation with O+I calls.

3.25 The variable %CCR, when computed for any given call load, is the percentage of

total real-time that remains available to process calls. Therefore %CCR has the same relationship to the dial tone speed delay criteria as previously discussed. Accordingly, the 20 percent (HD) dial-tone-delay- over-3-seconds point occurs at approximately 3 percent CCR and the 1.5 percent dial-tone-delay- over-3-seconds point occurs at approximately 10 percent CCR. These basic model capacity statements are reflected in Sketch 7 as follows:
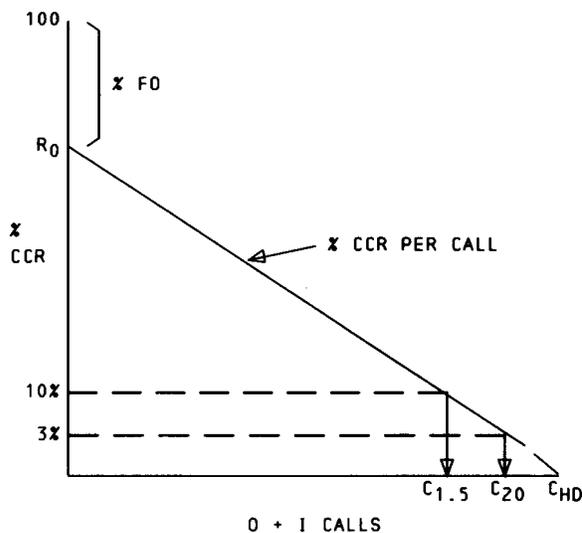
Sketch 7

3.26 The C_{ABS} point is not shown in Sketch 7 because it is computed by dividing C_{HD} by P, the HD/ABS call-peaking factor. Normally C_{ABS} is less than or equal to C1.5 (CABS ≤ C1.5), therefore the C_{ABS} point would fall on or to the left of the $C_{1.5}$ point on Sketch 7, depending on the value of P. The greater the value of P, the farther to the left of $C_{1.5}$ C_{ABS} will fall. P is a critical variable in the establishment of a valid C_{ABS} statement.

3.27 One reason that %CCR is the variable used to compute call processing capacity is that it can be computed from unique machine-produced traffic measurements. Sketch 5 indicates that the largest portion of the value of %CCR is %PDT. PDT is a direct traffic measurement recorded on the Q14 traffic register and printed out on the traffic Q-schedule. The Q14 reading, when divided

by 100, represents the average percentage of real time that was PDT during that quarter-hour period. Therefore, for any particular quarter-hour, Q14/100 = %PDT. It follows then, for that quarter-hour, that %CCR = %VO + Q14/100. The %VO can also be computed from traffic measurements and will be discussed in Part 4 of this section. The %PDT or Q14/100 will always account for 90 percent or more of the value of %CCR.

3.28 Sketch 8 graphically exhibits the relationship between %CCR and %PDT (Q14/100). Q_o on the graph denotes the maximum value of Q14/100 that can be attained for a given hardware configuration and generic program and it occurs at the zero-calls point.
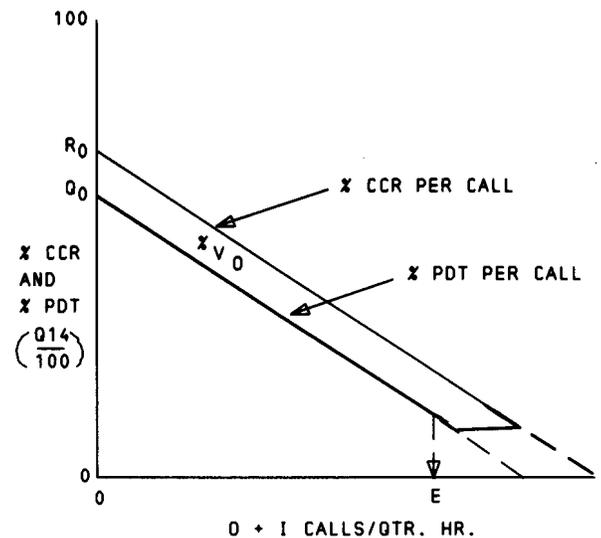
Sketch 8

The distance between the two lines in Sketch 8 represents %VO. Notice that the two lines are parallel until the load-point E is reached. This is the point at which the average BLS begins to exceed 100 ms in length and the total number of BLSs decreases. Hence, %VO decreases. Until that particular load point is reached in a given office, %CCR can be quickly estimated if %PDT is known for any given O+I call load.

3.29 Because the process of postcutover capacity determination described in this section involves many variables, there are many areas for

potential error.   One such area is in machine measurements. The Q14 register (PDT measurement) is accomplished by sampling; that is, by periodically reviewing the BLSs.   In any sampling process, there is an error factor.   In this case, although the measurement error in Q14 reading should not exceed 1 percent, a 1 percent measurement error can have significant impact on the accuracy of the value of %CCR when estimating a call-capacity-exhaust point.   The degree of this impact depends upon the O+I call load during the time that the Q14 readings are taken. The effect of sampling errors in the Q14 measurement is worse when the ABS call load is low, with the maximum effect occurring at Q_o. This concept is exhibited in the graphs in Sketches 9 and 10 which follow:
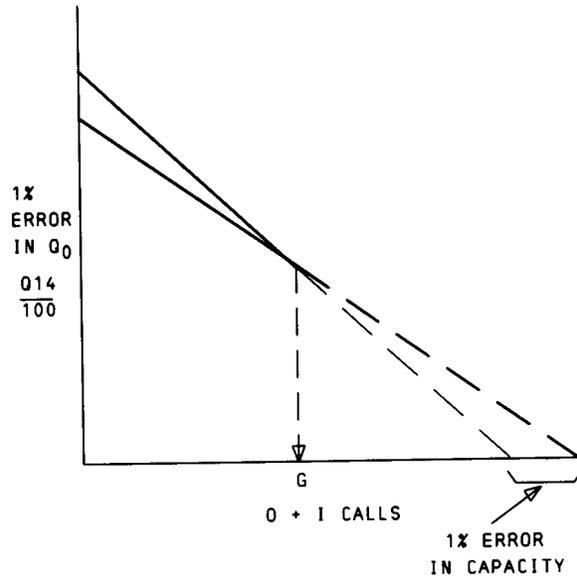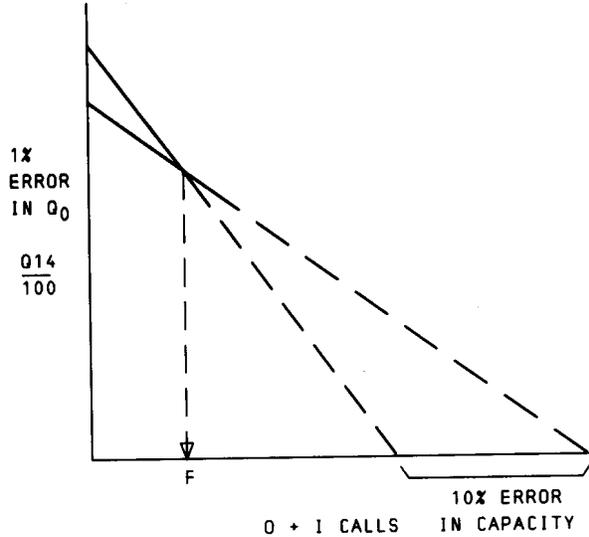
Sketch 9 & Sketch 10

3.30   The error reflected on the vertical axes of Sketches 9 and 10 refers to the error in Q_o resulting from the sampling error in the Q14 measurements.   Load-points F and G represent the current ABS call-load averages that occurred when the corresponding ABS values of Q14/100 were recorded. Thus, the solid parts of the lines represent actual data and the dotted parts represent projections resulting from the data. Load-point F occurs at about 10 percent of maximum call capacity and point G occurs at approximately

50 percent of maximum capacity. It is obvious that the potential for error in a capacity statement is much greater in the situation represented by Sketch 9 than in that represented by Sketch 10 although both reflect the same 1 percent sampling error in Q14 measurements.

3.31 Because of the Q14 error factor and because of the sensitivity of PDT to call-mix variations, a test must be made to determine whether or not the postcutover call-capacity determination process provided in this section will accurately apply to a given office at its particular load level. To accomplish this test, a variable called current processor percentage of occupancy (%OCC) will be computed. This occupancy statement is based on the percentage of call time currently being used to process the offered calls divided by R_o, the total real-time available for calls. Graphically, the percentage of call time can be included on the %CCR graph and is shown in Sketch 11 as follows:
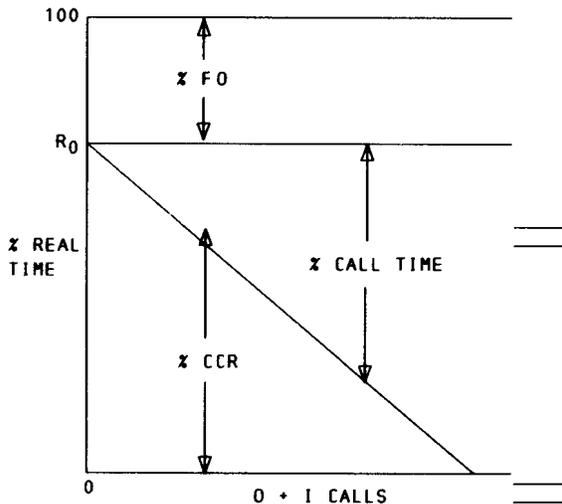
Sketch 11

Sketch 11 also implies the formula for %OCC as follows:

$$\% OCC = \frac{\% CALL\ TIME}{R_0} = \frac{R_0 - \% CCR}{R_0}$$

If a machine is at its ultimate hardware configuration and generic program, the statement of current call capacity is actually the ultimate call capacity, assuming that there are no major call mix changes. If, however, the machine is not at its ultimate hardware configuration, there is an optional step at the end of the method which projects the current capacity statement to ultimate. The details of all steps to the method are discussed in Part 4 of this section.

3.32 To accomplish the %OCC test, two weeks of data, gathered at the beginning of the busy season, should be used to develop the %OCC test as described in Part 4 of this section. If the resulting %OCC is less than 45 percent, it is recommended that the call processing capacity be determined by using the precutover method described in Traffic Facilities Practices, Division D, Section 12f-4, Call Processing Capacity—Precutover. If, however, %OCC is equal to or greater than 45 percent, the postcutover method given in this section can be used to determine both current and ultimate call-processing capacity. Therefore, once a machine has been loaded beyond the 45-percent occupancy level, it is no longer necessary to perform this test.

4. DETERMINATION OF CALL PROCESSING CAPACITY

4.01 This part describes the method to be used to determine postcutover call-processing capacity based on real-time measurements. Included at the end of this section are forms which have been completed for a hypothetical office; a set of blank reproducible forms is also included. The computation forms are arranged in lettered functions: function A for the test of %OCC on two weeks of data, function B for calculation of current call-processing capacity if the test proves this method should be applied, and function C for calculation of ultimate call-processing capacity if the existing machine is not at the ultimate configuration. An office data summary is included at the beginning of function A and function B.

Daily data collection forms are not included in this section. Part 4 should be read in its entirety and discussed with all groups involved before any data collection or computation is done.

4.02 The network administrator is responsible for data collection. The network administrator and the network design engineer share the responsibility for data validation. They also share in making reasonable estimates of traffic characteristics for the end of the engineering period.

4.03 The required data for call processing capacity determination can be compiled manually or by a mechanized process such as PATROL.

TRAFFIC REGISTERS REQUIRED

4.04 Only a few traffic registers are required for postcutover call processing capacity calculations. Additional information on traffic measurements is available in Dial Facilities Management Practices, Division H, Section 10i, No. 2 ESS Network Administration Measurements, and in Bell System Practices, Section 232-120-301, No. 2 ESS Traffic and Plant Measurements.

(a) *Q-Schedule:* The registers required for postcutover call processing capacity calculations include the following:

(1) *Q5—Total Line Originations* - Off-hook, counted before a customer digit receiver (CDR) is connected, do not include dial tone speed tests.

(2) *Q6—Total Originating Calls* - Counted after CDR connection plus at least one digit dialed.

(3) *Q7—Total Trunk Originations* - Incoming seizure on by-link, one-way incoming, and 2-way trunks (includes tandem).

(4) *Q11—Total Number of Base Level Scans* - A peg count of the total number of BLSs performed.

(5) *Q14—Periodic Deferrable Time* - an indication of the average amount of time spent during the average BLS performing deferrable tasks (control unit detection, call store updates, audits). The contents of this register divided by 100 represent the average percentage of real time that was spent performing deferrable tasks.

Example: a Q14 reading of 6500 means that 65 percent of the total processor real-time was PDT during the 15-minute interval (6500 ÷ 100 = 65 percent).

4.05 Some of these data can also be collected on the H-schedule, depending on the installed generic program. In the EF generic program, all five of the Q-schedule traffic measurements appear also on the H-schedule (OFT registers). Each of the OFT registers (5, 6, 7, 51, and 54) will contain the sum of the four quarterly-hour readings of its corresponding Q-register (5, 6, 7, 11, and 14) for the hour that the H-schedule is printed.

In the LO generic program, only the OFT 5, 6, and 7 registers appear. The OFT 51 and 54 measurements are not available and therefore PDT and BLS measurements must always be taken via the Q-schedule with the LO generic program.

4.06 A Q14 reading that exceeds 9999 for a quarter-hour indicates that the real-time measurement was suspended at some time during that quarter-hour. Real-time measurement will be suspended if the two processors go out of synchronization, if a teletypewriter audit request was entered, or if the processor itself initiated a high-priority audit request. A Q14 reading exceeding 9999 is an invalid quarter-hour reading (and should be omitted from studies) which also produces an invalid OFT 54 reading for any hour to which that quarter-hour belongs. *Therefore, it is very important that when using the H-schedule to collect data for the procedures in this section that the Q14 register be manually checked every quarter-hour of the H-schedule hour in order to recognize invalid OFT 54 readings.*

DEFINITION OF O+I CALLS

4.07 For the purposes of this section, O+I calls are defined as the sum of all line originations for which at least one digit has been dialed plus the incoming seizures on trunks. In other words, O+I calls per quarter-hour equal Q6+Q7 and O+I calls per hour equal OFT 6 + OFT 7. (The term "originations" refers to the sum of the traffic registers Q5+Q7 of OFT 5 + OFT 7.)

PERCENTAGE OF OCCUPANCY TEST DESCRIPTION (FUNCTION A)

4.08 The purpose of the percentage of occupancy test (function A) is to determine whether a particular machine is carrying a sufficient level of traffic load to produce an accurate postcutover call-processing capacity statement. If it is suspected (based upon the precutover method given in Traffic Facilities Practices, Division D, Section 12f-4, Call Processing Capacity-Precutover) that a machine will approach 45-percent occupancy during the coming busy season, the data required for function A should be collected at the beginning of that busy season. It has been determined that two weeks for busy-hour, busy-season data are sufficient to accomplish the %OCC test. If the test indicates a %OCC equal to or greater than 45 percent, then functions B and C can be done using full-busy-season data. Once a machine has passed 45-percent occupancy, then this test need not be done in the future before functions B and C are performed for each busy season. In this case, a full ABS %OCC statement is included in function B for use in administrative procedures as well as for planning purposes.

POSTCUTOVER CALL PROCESSING CAPACITY DETERMINATION DESCRIPTION (FUNCTIONS B AND C)

4.09 If the current machine satisfies the 45-percent %OCC test either in the present busy season, or has satisfied it in some past busy season, functions B and C can be applied to produce current and ultimate HD and ABS call-processing capacity statements. The current capacity statements (CC$_{ABS}$ and CC$_{HD}$) apply only to the existing machine hardware configuration and the call mix presently offered. They are capacity statements applying only to the end of the engineering period of the *current* machine. The current capacity statements do not account for future hardware additions and their relative effect on FO requirements nor for future major call-mix changes. When this method is used for a machine which is currently at its ultimate hardware configuration, the current call-capacity statements are actually the ultimate call-capacity statements. When the machine is not at its ultimate hardware configuration, function C (Figure 6) contains steps to project the current capacity statements to ultimate ABS and HD capacities (UC$_{ABS}$ and UC$_{HD}$). The CC$_{ABS}$ and CC$_{HD}$ statements of the postcutover method can be used

for planning processor relief if the processor call capacity is the ultimate limiting item.

4.10 To determine current call-processing capacity via the postcutover method, several factors must be computed. The main ones for function B are as follows:

(a) VO per BLS (t_1)

(b) %CCR for an idle system (%CCR$_i$)

(c) %CCR for ABS (%CCR$_a$)

(d) %CCR at zero calls (R$_o$)

(e) ABS rate of real-time use per call (RATE)

(f) Busy-hour current call capacity for HD (BH CC$_{HD}$)

(g) Busy-hour current call capacity for ABS (BH CC$_{ABS}$)

The concepts discussed in Part 3 of this section for developing the basic-model call-capacity formulas are used in function B.

4.11 The validity of the results of the postcutover capacity determination method depends heavily upon the appropriateness of the HD/ABS call-peaking factor, P, used and also upon the conditions of the total machine when the data are collected. For example, if Q14 readings are used that were collected during periods of repeated call attempts caused by a shortage of another equipment component, the resulting capacity statements could overstate the actual capacity. Therefore, it is important to analyze the state of the total office when data are being compiled for postcutover call capacity determination. Permanent signals, false starts, overflows, etc, should be within normal operating limits on an ABS basis. This analysis will aid in the determination of equipment problems which could adversely affect the accuracy of call-processing capacity statements.

IDLE-HOUR MEASUREMENTS

4.12 The network administrator is responsible for data acquisition for both idle-hour and busy-hour periods. Idle-hour measurements are required to compute R$_o$, the total real time available for calls. R$_o$ is a very important factor in both

the %OCC test and in the call-processing capacity statements. Therefore, special effort should be made to obtain valid idle-hour readings. The specific traffic registers required for the idle-hour study are found on the first pages of functions A and B computation forms at the end of this section.

4.13 The idle-hour study requires data collection for five days during the four consecutive quarter-hours of the most idle hour of the day. The most idle hour is the hour at which the quantity of O+I is regularly at a *minimum.* This hour should correspond to the hour at which the sum of the four consecutive Q14 readings is regularly at a *maximum* (provided that the maintenance restrictions discussed in 4.14 are observed). The idle hour should be determined the week before the actual idle-hour study. The most idle hour may occur between midnight and 5 am. If an hour between midnight and 2 am is chosen, there are automatic machine audits which must be inhibited via teletypewriter request every day of the idle-hour-study week. Also the restriction against printing the "end-of-day" label on the AMA recorder (AML schedule) during an idle-hour study, as discussed in the 4.14, may force the decision for the selected idle hours to exclude the quarter-hour ending at 3 am. The choice of the idle hour to be studied must be discussed and coordinated among the network design, network administration, and network maintenance groups.

4.14 The idle-hour study must be conducted under the following restrictions.

(a) No control unit or peripheral unit exercise should be scheduled to run during the idle hour.

(b) The traffic work table (TWT) activities and plant diagnostics associated with the following print schedules **shall not be initiated** or overlap into the selected idle hour: H, C, D, W, PLT, ATT, AST, AJT, AML, LIT, WKE, WKS.

(c) The Q-schedules (MQ and TQ) **should be** scheduled to print every quarter-hour of the selected idle hour.

(d) It is preferable that **no testing** from the trunk test panel, interoffice trunk testing, other testing, **or manual use of the**

teletypewriter be done during the selected idle hour.

If any of the above restrictions are violated, the readings should be discarded because they may produce an invalid R_o.

4.15 If the postcutover capacity determination method is being used, idle-hour measurements of a working office must be done as soon as the office stabilizes after a change in generic program, after a new translation update (Office Data Administrative System run) is loaded, or after any new equipment is put into service. After each new idle-hour study is complete, existing postcutover capacity statements should be recalculated using the new idle-hour study results even if new busy hour data are not available. If an idle-hour study is conducted at the beginning of a busy season for use in function A and if none of the changes mentioned in this paragraph have occurred, the same idle-hour data can be used in function B. The data can be used with the full-busy-season data if the occupancy test of function A was satisfied.

AVERAGE BUSY SEASON MEASUREMENTS—BUSY-HOUR SELECTION

4.16 The ABS data required for functions A, B, and C should be collected during the processor component busy hour (CBH). The processor CBH is defined as the hour at which the sum of the four consecutive Q14 readings (or the OFT 54 reading) is regularly at a *minimum.* This hour should be determined during normal busy-hour-determination studies and may be noncoincident with the network CCS busy hour or the O+I call busy hour as a result of call mix variations, although coincidence of these busy hours is normal.

AVERAGE BUSY SEASON MEASUREMENTS—USE OF THE H-SCHEDULE

4.17 The formulas used in this section are structured for quarter-hour data. However, if an EF generic program is installed, all the required data can be collected via the H-schedule provided that OFT 54 readings are validated daily by manual checks for valid Q14 readings during the corresponding hour. These hourly readings are to be divided by four to produce the required average quarter-hour (AQH) data.

4.18 The completed forms (Fig. 4 and Fig. 5) are discussed in 4.19 through 4.24 using hypothetical data. References will be made to the forms as follows: A1.0, A2.0, etc. This type of reference will identify the specific item being discussed. For instance, A1.0 is the office data for the processor occupancy test.

FUNCTION A—PROCESSOR OCCUPANCY TEST

4.19 The office data required to compute the test processor occupancy should be developed as follows:

(a) *A1.1*—Post the measured AQH data averages from the 5-day idle-hour study and from two weeks of busy-season processor CBH data. The idle-hour data should be the average of 20 quarter-hours and the busy-hour average will be the average of 40 quarter-hours.

(b) *A1.2*—In A1.2a and A1.2b the terminology "current office" refers to the office configuration during the data base busy season. Post the number of TCRs in call store and the number of attendant data link circuits in the current office in A1.2a and A1.2b, respectively. The terminology "data base" refers to the busy season during which the processor data were collected.

(c) *A2.0*—Compute the variable overhead time per BLS (t_1) in ms. In a normal office, t_1 will be approximately 7.5 ms.

4.20 The test value of the total time available for calls (Test R_o) is computed in the following steps.

(a) *A3.1*—Compute %CCR for the idle hour (%CCR$_i$) using the formula shown. The first component of this formula represents %VO for the AQH of the idle hour. The factor in this component that is "Idle Hour (Q5 + Q7) ÷ 3" represents the minimum number of BLSs required to process Q5 + Q7 originations. The second component of the formula is the %PDT for the AQH of the idle hour. The %CCR$_i$ that results can also be used later in function B if it is done and if no changes as described in 4.15 occur before the end of the busy season.

(b) *A3.2*—Compute Test %CCR$_a$ in a manner similar to that in which %CCR$_i$ is computed.

This time, however, busy-hour readings from two weeks of busy-season data are used, including the number of BLSs (Q11). The value of %CCR$_a$ that results should be used only for the purposes of the occupancy test. Test %CCR$_a$ should not be used in function B since Test %CCR$_a$ is based on only two weeks of busy season data.

(c) *A3.3*—Calculate Test R_o using the values of %CCR$_i$, Test %CCR$_a$, and the AQH O+I call loads experienced during the idle and busy hours. The value of test R_o should be used only for the %OCC test. If function B is done at the end of the busy season, R_o will be recalculated using full-busy-season data.

4.21 The following steps describe how the %OCC test is computed and how the determination is made as to which call-processing capacity method should be used.

(a) *A4.0*—Compute %OCC$_{test}$ using Test R_o and Test %CCR$_a$ as indicated in the formula. The resulting percentage represents the percentage of the total real time available for calls that was actually used for calls during the AQH of the busy hour for the two weeks during which the busy-hour data were collected. This percentage should not be assumed to be the ABS %OCC which will be computed in function B. However, it is quite likely to be close to the ABS %OCC.

(b) *A5.0*—Compare the result of %OCC$_{test}$ to 45 percent. If %OCC$_{test}$ is less than 45 percent, it is not necessary to collect any more data for function B. The precutover method of call-processing capacity determination should be used on call-mix data gathered during the busy season. If %OCC$_{test}$ is equal to or greater than 45 percent, functions B and C can be used for postcutover call-processing capacity determination and full-busy-season data should be gathered as specified in function B.

FUNCTION B—ESTIMATING CURRENT OFFICE CALL PROCESSING CAPACITY

4.22 The office data required to use the postcutover method should be developed as follows.

(a) *B1.1*—Post the AQH data averages from the two data collection periods. The idle-hour data should be AQH data from the 5-day idle-hour study and can be the same as that used in

function A if it was collected at the beginning of this data-base busy season. The ABS data items should be AQH data averages from the entire data-base busy season. The terminology "data base" refers to the busy season during which the ABS data were collected.

(b) **B1.2**—In B1.2a and B1.2b, the terminology "current office" refers to the office configuration during the data-base busy season. Post the number of TCR **blocks** in call store and the number of attendant data link **circuits** in the current office in B1.2a and B1.2b, respectively.

(c) **B1.3**—The purpose of this step is to give usable, short-symbol names to each collected, computed, or projected data item. The symbols given in this step will be used in all subsequent references to the corresponding data items in function B. In B1.3a through B1.3d transcribe the appropriate data items from B1.1. The HD-to-ABS O+I call-peaking factor, P, in B1.3e is a very critical factor in a valid capacity statement (see 3.21). The selection of P should be based on current data as well as historical data. The value of P should not fall below 1.15 and actual data will normally produce: 1.15 is equal to or less than P which is equal to or less than 1.3 ($1.15 \leq P \leq 1.3$). If the actual data does not produce $1.15 \leq P \leq 1.3$, the data should be reexamined and justified. In lieu of actual data use P=1.3. The end-of-engineering-period (EOP) ABS calling rate per main station (B1.3f) should be the expected EOP calling rate; that is, the rate expected at the exhaust of the current job.

4.23 The steps required to compute the current office call processing main-station capacity are as follows.

(a) **B2.0**—Compute the VO per BLS (t_1) in ms. In a normal office, t_1 will be approximately 7.5 ms.

(b) **B3.0**—To compute R_o, $\%CCR_i$ and $\%CCR_a$ must first be computed. Compute %CCR for the idle hour ($\%CCR_i$) using the formula in B3.1. The first component in this formula represents the %VO for the AQH of the idle hour. The factor in this component that is $ORIG_i/3$ represents the minimum number of BLSs required to process ($Q5+Q7$) originations. The second component in the formula is the

%PDT for the AQH of the idle hour. The $\%CCR_i$ for a large office will be approximately 70 percent. If CCR_i was computed at the beginning of the busy season for function A and no changes as described in 4.15 have occurred since, $\%CCR_i$ need not be recomputed here. Next, compute %CCR for the ABS ($\%CCR_a$) in B3.2 in a manner similar to that in which $\%CCR_i$ was computed. In this case, however, notice that the Q11 measurement (number of base level scans) is substituted for the constant 9000 that appeared in the $\%CCR_i$ formula. This is done because in a normal medium-to-heavy busy-hour load, the number of base level scans will drop below 9000. Finally, in B3.3, compute R_o using $\%CCR_i$ and $\%CCR_a$ and the O+I call load measured at the respective times (L_i and L_a).

(c) **B4.0**—Calculate the current office ABS processor %OCC ($\%OCC_{ABS}$) using R_o and $\%CCR_a$. The resulting percentage represents the average percentage of the total real time available for calls that was actually used for calls during the busy season. This percentage can be used for planning purposes as discussed later in this section.

(d) **B5.0**—Calculate the RATE in ms based on R_o, $\%CCR_a$, and L_a. RATE represents the average number of ms of call time plus VO required to process the average call offered to the system on an ABS basis. In an office with average call-mix characteristics, RATE will be slightly over 100 ms.

(e) **B6.0**—Compute the AQH call capacities at dial tone delay objectives (1.5 percent and 20 percent delay, respectively). Notice that in both formulas the variable that has the greatest impact is R_o.

(f) **B7.0**—Compute the current office call capacities HD and ABS, AQH and busy hour, as shown in B7.1 through B7.5. The verification check in B7.5 is provided to ensure that the ABS call capacity statement will meet ABS dial tone delay criteria. If the AQH CC_{ABS} capacity computed satisfies the verification check, go on to B7.5. If it does not satisfy the verification check, first recheck all computations for errors. If no errors are found, then revalidate the peak factor P; it may be too small. Check the HD call data used to select P. In any case, do not

go on until B7.4 is satisfied. Once the verification check is satisfied, convert AQH CC$_{ABS}$ to an hourly capacity (in B7.5) by multiplying it by 4.

(g) **B8.0**—Compute the current office ABS main station capacity by dividing BH CC$_{ABS}$ by the EOP processor CBH O+I calling rate per main station. This calling rate is the rate expected during the last busy season before the exhaust of the currently-installed job. In the case where the current machine is at its ultimate configuration, the current capacity is the ultimate call capacity and the calling rate used to determine main station capacity should be the ultimate rate (ie, the rate which is expected in the busy season before machine exhaust). If the current configuration is the ultimate configuration, function C is not required.

4.24   C1.0—The steps in function C (Figure 6) are optional steps to be used in those cases where function B is being used for a machine which is not at its ultimate hardware configuration. In this situation, the overhead time requirements will increase when future hardware is added. This change must be accounted for in the computation of the call processing capacity of the ultimate office. Function C does not apply if a machine is currently at ultimate hardware configuration since the current office capacity (B8.0) is actually the ultimate office capacity. If, however, function C does apply, the ultimate office capacity is computed as follows (see Fig. 6).

(a) **C1.1**—Describe the ultimate office characteristics in C1.1a through C1.1d. In C1.1a and C1.1d, the ultimate calling rate and peaking factor are very critical items in the capacity statement and a small error here can result in significant error in main-station capacity.

(b) **C1.2 through C1.4**—To determine feature overhead time changes, first determine ΔCS, the change in overhead due to changes in call store layout. Use Table A to choose the value of ΔCS, and post in C1.2. Next, compute the current office scan point overhead time in steps (a) through (c) of C1.3. The current office parameters will be applied in a linear growth fashion to develop the ultimate office requirements. In C1.4, determine ΔRATE, the change in RATE which results from the change in variable overhead time at base level. From the change in attendant

data links expected (C1.1c), use Table B to choose ΔRATE and post this in C1.4.

(c) **C2.0**—Estimate the ultimate office AQH call capacity by first computing the AQH UC$_{HD}$ in C2.1 using the formula shown. This formula assumes that the ultimate office configuration can be estimated with a linear extrapolation of the current office scan points. Compute the ultimate office ABS AQH call capacity (AQH UC$_{ABS}$) in C2.2 by dividing AQH UC$_{HD}$ by the ultimate HD/ABS call peaking factor P.

(d) **C2.3**—Compute the estimated ultimate office ABS call-processing main-station capacity using the formula shown. *The resulting capacity represents the ultimate office call capacity of the processor while it is operating with the currently installed generic program and carrying the currently offered call mix. It also represents an estimate of ultimate hardware quantities and projected ultimate calling rate and peaking factor.* Any time any of these parameters no longer hold true for the ultimate situation, appropriate adjustments should be made and this capacity statement should be recomputed.

USE OF CAPACITY STATEMENTS FOR PLANNING PURPOSES

4.25   The following cases can exist and result in different applications of capacity statements.

Case I: If the %OCC$_{test}$ of function A of this section is less than 45 percent it is recommended that the precutover model found in the network design worksheets (Traffic Facilities Practices, Division D, Section 2f-4, Call Processing Capacity-Precutover) be used to determine ultimate machine call processing capacity and to estimate the percentage of processor occupancy expected on the next job.

Case II: If the current ABS %OCC is equal to or greater than 45 percent, the postcutover method should be used to calculate current and/or ultimate office call capacities. If the office is at its ultimate hardware configuration, it is recommended that until actual data are collected and the capacity statements are verified, the planned ultimate main stations should not exceed the percentages (shown in the chart below)

of the ultimate main-station capacity as determined by function B of the postcutover method.

CURRENT ABS % OCC

	45–60%	>60%
PERCENT OF ULT. MS. CAP	92%	95%

MECHANIZED AID (CADET)

4.26 The postcutover call capacity determination procedures have been mechanized as a subprogram of PATROL, called CADET, for No. 2 ESS. It is recommended that the CADET subroutine be used to accomplish postcutover call capacity statements. Patrol lesson numbers 37 through 42 are available for this purpose. The network administrator is responsible for using the CADET subroutine to produce the capacity statement if the postcutover method has been agreed upon for use by the network designer and the network administrator. The data and office parameters input to the CADET program should be agreed upon for such use by both the network administrator and designer.

5. GLOSSARY OF TERMS AND SYMBOLS

TERMS

5.01 The following is a list of important terms used throughout this section.

Base level scan   The main program loop controlled by the base level program. The base level scan is the task unit during which all processor real time is spent.

Call capacity remaining   Expressed as a percentage, call capacity remaining defines what percentage of the total processor real time remains available to process calls.

Call time   That portion of total real time that is spent performing call processing tasks.

Current call capacity (HD or ABS)   Expressed as a quantity of O+I calls, this is the call capacity of the processor, as limited by real time, while operating with the generic program, the hardware amounts, and the offered call mix that existed when the data were gathered to compute this capacity statement.

Fixed overhead time   That portion of total real time that is spent performing top-priority overhead tasks. The amount of fixed overhead time required for a given hardware configuration and generic program issue to be constant and independent of traffic load.

Network CCS busy hour   The time-consistent hour during which the measured network usage (CCS) is regularly at a maximum.

O+I call busy hour   The time-consistent hour during which the sum of the originating and incoming calls is regularly at a maximum.

Periodic deferrable time   That portion of total real time that is spent performing low-priority overhead tasks. The amount of periodic deferrable time that occurs is inversely related to the amount of call time that occurs. Periodic deferrable time is also the only component of real time that is machine-measured.

Processor component busy hour   The time-consistent hour during which the measured amount of periodic deferrable time is regularly at a minimum.

Variable overhead time   That portion of total real time that is spent performing medium-priority overhead tasks. The amount of variable overhead time that occurs is constant per base level scan and at the load point where the number of base level scans begins to decrease, the total amount of variable overhead time decreases accordingly.

Ultimate call capacity (HD or ABS)   Expressed as a quantity of O+I calls, ultimate call capacity is the estimate of the call capacity of the processor, as limited by real time, while operating with the current generic program, the currently-offered call mix, and the *ultimate* hardware configuration. If any of these situations change, the statement of ultimate call capacity should be recomputed based on the new information.

SYMBOLS

5.02 The following is a listing of important symbols used throughout this section.

CC$_{ABS}$ (AQH or BH) Average quarter-hour or busy-hour ABS current office call capacity.

CC$_{HD}$ (AQH or BH) Average quarter-hour or busy-hour high-day current office call capacity.

P The HD/ABS call peaking factor.

%CCR Percentage of call capacity remaining.

%FO Percentage of fixed overhead time of total (100 percent) real time.

%OCC Current percentage of occupancy of the processor based on the percentage of the total real time available for calls that is currently being used for calls.

%PDT Percentage of periodic deferrable time of total (100 percent) real time.

%VO Percentage of variable overhead time of total (100 percent) real time.

Q$_0$ Value of Q14/100 at the theoretical zero-calls point. Q$_0$ is a percentage of PDT.

R$_0$ The value of %CCR at the theoretical zero-calls point. R$_0$ is the total percentage of real time that is available for calls. (100% − %FO).

RATE Expressed in ms, the rate of real time use per call.

t$_1$ Expressed in ms, the amount of variable overhead time required per base level scan.

UC$_{ABS}$ (AQH or BH) Average quarter-hour or busy-hour ABS ultimate office call capacity.

UC$_{HD}$ (AQH or BH) Average quarter-hour or busy-hour high-day ultimate office call capacity.

ULT MS CAP Ultimate office main-station capacity as limited by call processing capacity based on processor real time with the currently offered call mix, the existing generic program, and the future (ultimate) hardware configuration and ultimate calling rate and peaking factor projected.
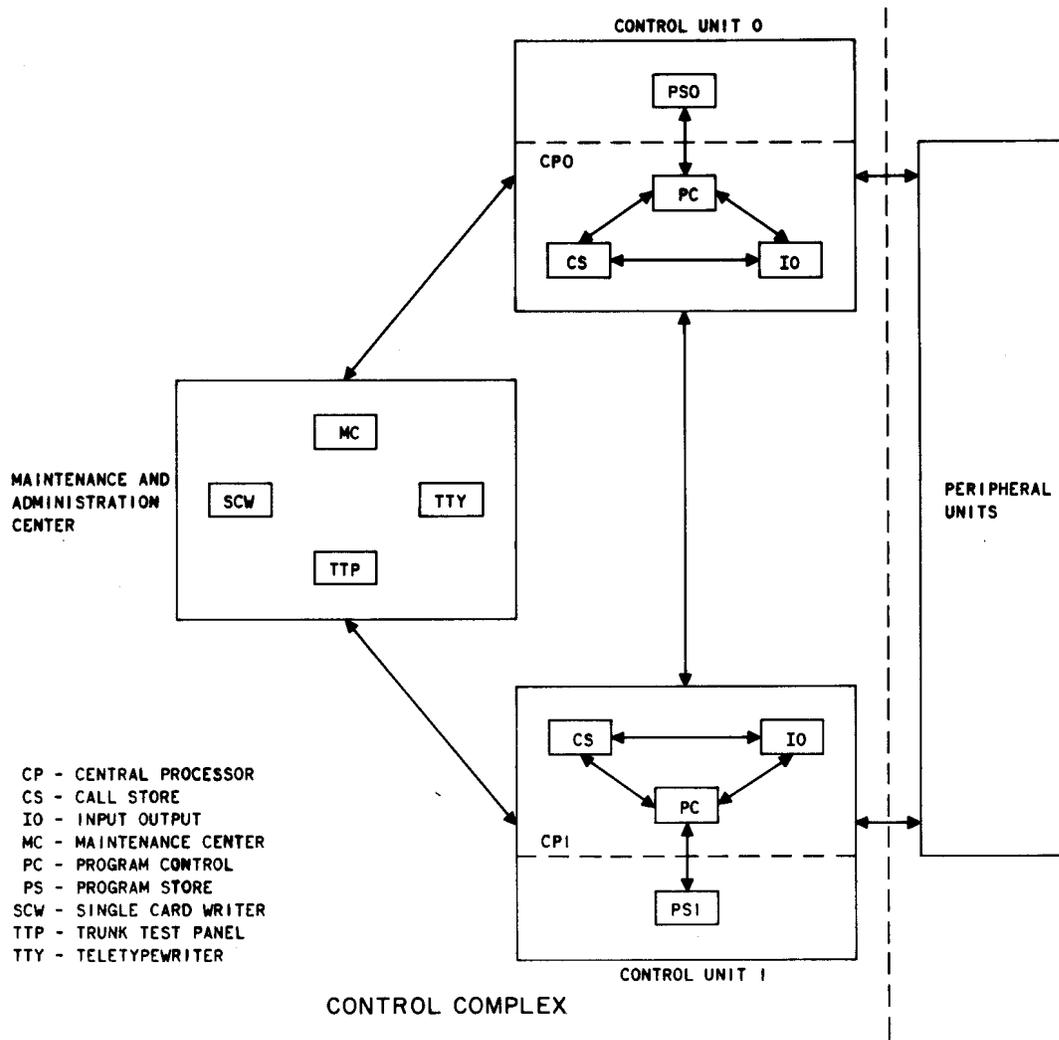
Fig. 1—System Interrelationship—Control Complex (2.01, 2.02)

25 ms INTERRUPT PROGRAM

- SCANNING (Lines and Trunks)   OVERHEAD TIME

- DIGITS (Send and Receive)
- OPERATE RELAYS (Trunks, Service Circuit, Network)   CALL TIME

BASE LEVEL PROGRAM

- ACCESSING CALL RECORDS
- TRAFFIC USAGE MEASUREMENTS
- ACCESSING CALL PROCESSING and MTCE, MONITORS   OVERHEAD TIME

- SELECT PATHS, TRUNKS, SERVICE CIRCUITS
- BUSY TEST   CALL TIME

- CONTROL UNIT DETECTION TESTS
- AUDITS
- OFFLINE CALL STORE UPDATES   OVERHEAD TIME

Fig. 2—Program Definitions (3.01, 3.05)

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┌─────────────────────────────────────────────┐
│ ● SCANNING (Lines and Trunks)                 │    FIXED OVERHEAD TIME
│ ● ACCESSING CALL RECORDS                      │
│ ● TRAFFIC USAGE MEASUREMENTS                  │
└─────────────────────────────────────────────┘


┌─────────────────────────────────────────────┐
│ ● ACCESSING CALL PROCESSING and MTCE MONITORS │    VARIABLE OVERHEAD TIME
└─────────────────────────────────────────────┘


┌─────────────────────────────────────────────┐
│ ● DIGITS (Send and Receive)                   │
│ ● OPERATE RELAYS (Trunks Service Circuits Network) │  CALL TIME
│ ● SELECT PATHS, TRUNKS, SERVICE CIRCUITS      │
│ ● BUSY TEST                                   │
└─────────────────────────────────────────────┘


┌─────────────────────────────────────────────┐
│ ● CONTROL UNIT DETECTION TESTS                │
│ ● AUDITS                                      │    PERIODIC DEFERRABLE TIME
│ ● OFFLINE CALL STORE UPDATES                  │
└─────────────────────────────────────────────┘
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Fig. 3—Four Types of Real Time (3.05, 3.08)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

A. PROCESSOR OCCUPANCY TEST

1.0 Office Data

1.1 Average Quarter Hour Data

DATA ITEM	AQH – IDLE HOUR	TWO WEEK'S AVG. AQH – BUSY HOUR
Q5 + Q7	_234_ a.	_5700_ d.
Q6 + Q7	_176_ b.	_4300_ e.
Q11	—	_8710_ f.
Q14	_6290_ c.	_1795_ g.

1.2 Office Characteristics

a. Number of TCR's in current office. _288_

b. Number of Attendant Data Link circuits in current office. _0_

2.0 Variable Overhead Time Per Base Level Scan (t_1 milliseconds per call)

$$t_1 = 5.6 + \left[(.45) \times \left(\frac{\text{TCR's}}{70} + \text{Data Links}\right)\right]$$

$$= 5.6 + \left[(.45) \times \left(\frac{\text{A1.2a}}{70} + \text{A1.2b}\right)\right]$$

$$= 5.6 + \left[(.45) \times \left(\frac{\mathbf{288}}{70} + \mathbf{0}\right)\right]$$
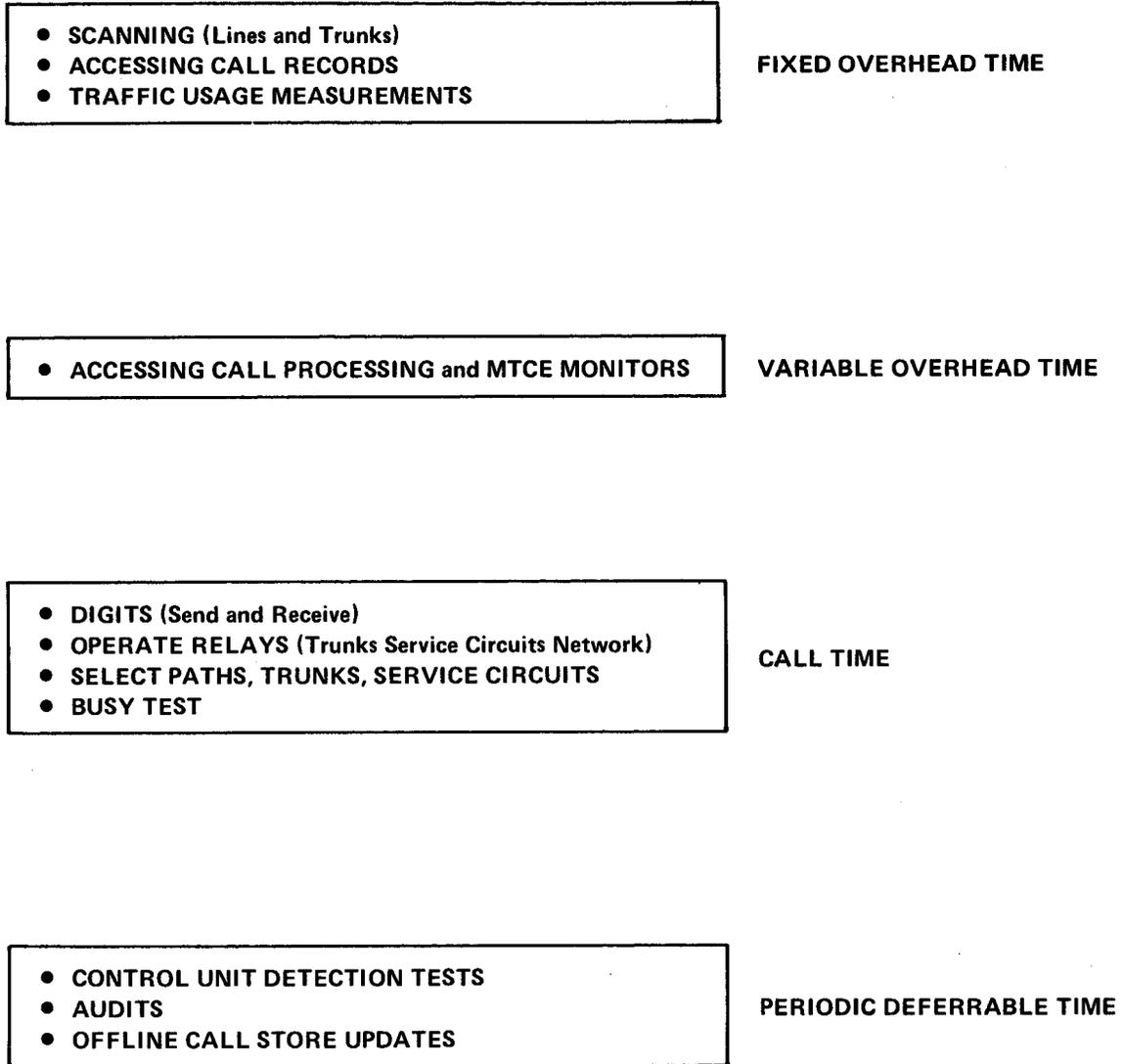
_7.5_ ms/call

3.0 Calculate Test R_0

3.1 Percent Call Capacity Remaining for Idle System ($\%CCR_i$)

$$\%CCR_i = \frac{\left(\frac{t_1}{90}\right)\left(9000 - \dfrac{\text{Idle Hour (Q5 + Q7)}}{3}\right)}{100} + \frac{\text{Idle Hour Q14}}{100}$$

$$= \frac{(\text{A2.0})\left(100 - \dfrac{\text{A1.1a}}{270}\right) + \text{A1.1c}}{100}$$

$$= \frac{(\mathbf{7.5})\left(100 - \dfrac{(\mathbf{234})}{270}\right) + (\mathbf{6290})}{100} = \underline{70.3}\ \%$$

Fig. 4—Function A Worksheets (Sheet 1 of 3) (4.18)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

A. PROCESSOR OCCUPANCY TEST

3.0 Calculate Test R_o (Cont)

3.2 Percent Test Call Capacity Remaining for Busy Hour (Test %CCR$_a$)

$$\text{Test \%CCR}_a = \frac{\left(\frac{t_1}{90}\right)\left(Q11 - \frac{(\text{Busy Hour Q5} + \text{Q7})}{3}\right)}{100} + \frac{\text{Busy Hour Q14}}{100}$$

$$= \frac{\left(\frac{A2.0}{90}\right)\left(A1.1f - \frac{(A1.1d)}{3}\right) + A1.1g}{100}$$

$$= \frac{\left(\frac{7.5}{90}\right)\left(8710 - \frac{(5700)}{3}\right) + (1795)}{100} = \underline{23.6}\%$$

3.3 Test Maximum Percent Real Time for Calls (Test R_o)

$$\text{Test } R_o = \frac{(\%CCR_i - \text{Test \%CCR}_a) \times (\text{Idle Hour Q6} + \text{Q7})}{(\text{Busy Hour Q6} + \text{Q7} - \text{Idle Hour Q6} + \text{Q7})} + \%CCR_i$$

$$= \frac{(A3.1 - A3.2)\ (A1.1b)}{(A1.1e - A1.1b)} + A3.1$$

$$= \frac{(70.3 - 23.6)\ (176)}{(4300 - 176)} + (70.3) = \underline{72.3}\%$$

4.0 Calculate Test Percent Occupancy (%OCC$_{TEST}$)

$$\%OCC_{TEST} = \frac{(\text{Test } R_o - \text{Test \%CCR}_a)}{\text{Test } R_o} \times 100$$

$$= \frac{(A3.3 - A3.2) \times 100}{A3.3}$$

$$= \frac{(72.3 - 23.6)\,100}{(72.3)} = \underline{67.4}\%$$

Fig. 4—Function A Worksheets (Sheet 2 of 3) (4.18)

A. PROCESSOR OCCUPANCY TEST

5.0 Test For Determination of Call Capacity Calculation Method

Is $\%OCC_{TEST} < 45\%$?

Is __67.4__ $< 45\%$?

If yes, use pre-cutover method of Section 12f(4) to determine call processing capacity.

If no, collect full busy season data as required in function B of this section. With full busy season data averages compute current and ultimate call processing capacities as shown in functions B and C of this section.

Fig. 4—Function A Worksheets (Sheet 3 of 3) (4.18)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

B.   ESTIMATING CURRENT OFFICE CALL PROCESSING CAPACITY

1.0   Office Data

1.1 Average Quarter Hour Data

DATA ITEM	AQH – IDLE HOUR	FULL BUSY SEASON AVG. AQH – BUSY HOUR
Q5 + Q7	_234_ a.	_5710_ d.
Q6 + Q7	_176_ b.	_4295_ e.
Q11	–	_8719_ f.
Q14	_6290_ c.	_1800_ g.

1.2 Current Office Characteristics

a.   Number of TCR's in current office.   _288_

b.   Number of Attendant Data Links in current office.   _0_

1.3 Office Data Summary

a. $ORIG_i$ = Idle system line + trunk originations. (B1.1a)   _234_

b. $ORIG_a$ = ABS line + trunk originations. (B1.1d)   _5710_

c. L_i = Idle System O + I call load. (B1.1b)   _176_

d. L_a = ABS O + I call load. (B1.1e)   _4295_

e.   P = HD/ABS O + I call peaking factor.   _1.3_

f. CR/MS_{ABS} = EOP ABS O + I calling rate per Main Station.   _1.20_

2.0   Variable Overhead Time Per Base Level Scan (t_1 milliseconds per call)

$$t_1 = 5.6 + \left[(.45) \times \left(\frac{TCR's}{70} + Data\ Links \right) \right]$$

$$= 5.6 + \left[(.45) \times \left(\frac{B1.2a}{70} + B1.2b \right) \right]$$

$$= 5.6 + \left[(.45) \times \left(\frac{288}{70} + \underline{\ 0\ } \right) \right] \qquad = \underline{\ 7.5\ }\ ms/call$$

Fig. 5—Function B Worksheets (Sheet 1 of 4) (4.18)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

B.   ESTIMATING CURRENT OFFICE CALL PROCESSING CAPACITY

3.0   Calculate R_o

3.1   Percent Call Capacity Remaining for Idle System ($\%CCR_i$)

$$\%CCR_i = \frac{\left(\frac{t_1}{90}\right)\left(9000 - \frac{ORIG_i}{3}\right)}{100} + \frac{\text{Idle Hour Q14}}{100}$$

$$= \frac{(B2.0)\left(100 - \frac{B1.3a}{270}\right) + B1.1c}{100}$$

$$= \frac{(7.5)\left(100 - \frac{(234)}{270}\right) + (6290)}{100} \qquad = \underline{\quad 70.3 \quad} \%$$

3.2   Percent Call Capacity Remaining for ABS ($\%CCR_a$)

$$\%CCR_a = \frac{\left(\frac{t_1}{90}\right)\left(Q11 - \frac{ORIG_a}{3}\right)}{100} + \frac{\text{ABS Q14}}{100}$$

$$= \frac{\left(\frac{B2.0}{90}\right)\left(B1.1f - \frac{B1.3b}{3}\right) + B1.1g}{100}$$

$$= \frac{\left(\frac{7.5}{90}\right)\left((8719) - \frac{(5710)}{3}\right) + (1800)}{100} \qquad = \underline{\quad 24.0 \quad} \%$$

3.3   Maximum Percent Real Time for Calls (R_o)

$$R_o = \frac{(\%CCR_i - \%CCR_a) \times (L_i)}{(L_a - L_i)} + \%CCR_i$$

$$= \frac{(B3.1 - B3.2) \times (B1.3c)}{(B1.3d - B1.3c)} + B3.1$$

$$= \frac{(70.3-24) \times (176)}{(4295 - 176)} + (703) \qquad = \underline{\quad 72.3 \quad} \%$$

Fig. 5—Function B Worksheets (Sheet 2 of 4) (4.18)

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NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

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B.   ESTIMATING CURRENT OFFICE CALL PROCESSING CAPACITY

4.0   Current Office ABS Processor Percent Occupancy

$$\%OCC_{abs} = \frac{R_o - \%CCR_a}{R_o} \times 100 = \frac{(B3.3 - B3.2)\ 100}{B3.3}$$

$$= \frac{(72.3 - 24)\ 100}{(72.3)} \qquad \qquad = \underline{\quad 66.8 \quad} \%$$

5.0   Rate of Real Time Use Per Call (RATE)

$$RATE = \frac{(R_o - \%CCR_a)\ 9000}{L_a} = \frac{(B3.3 - B3.2)\ 9000}{B1.3d}$$

$$= \frac{(72.3 - 24)\ 9000}{(4295)} \qquad \qquad = \underline{\quad 101.2 \quad} \text{ms/call}$$

6.0   Average Quarter Hour Call Capacities at Dial Tone Delay Objectives

6.1   *AQH Capacity at 1.5% Dial Tone Delay (AQH $C_{1.5}$)*

$$AQH\ C_{1.5} = \frac{(R_o - 10)\ (9000)}{RATE} = \frac{(B3.3 - 10)\ 9000}{B5.0}$$

$$= \frac{(72.3 - 10)\ (9000)}{(101.2)} \qquad = \underline{\quad 5541 \quad} \text{calls}$$

6.2   *AQH Capacity at 20% Dial Tone Delay (AQH C_{20})*

$$AQH\ C_{20} = \frac{(R_o - 3)\ (9000)}{RATE} = \frac{(B3.3 - 3)\ (9000)}{B5.0}$$

$$= \frac{(72.3 - 3)\ (9000)}{(101.2)} \qquad = \underline{\quad 6163 \quad} \text{calls}$$

7.0   Current Office Processor Busy Hour Call Capacity

7.1   *High Day AQH Current Call Capacity (AQH CC_{HD})*

$$AQH\ CC_{HD} = AQH\ C_{20} = (B6.2) \qquad \qquad = \underline{\quad 6163 \quad} \text{calls}$$

7.2   *High Day Processor Busy Hour Current Call Capacity (BH CC_{HD})*

$$BH\ CC_{HD} = (4)\ (AQH\ CC_{HD}) = (4)\ (B7.1) = (4)\ (\ 6163\ ) \qquad = \underline{\quad 24,652 \quad} \text{calls}$$

Fig. 5—Function B Worksheets (Sheet 3 of 4) (4.18)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

B. ESTIMATING CURRENT OFFICE CALL PROCESSING CAPACITY

7.0 Current Office Processor Busy Hour Call Capacity (Cont)

7.3 Average Busy Season AQH Current Call Capacity (AQH CC_{ABS})

$$\text{AQH } CC_{ABS} = (\text{AQH } CC_{HD}) \div P = (B7.1) \div (B1.3e) = \frac{(6163)}{(1.3)} \qquad = \underline{4741}\text{ calls}$$

7.4 Verification Check

Is AQH $CC_{ABS} \leq$ AQH CC_{15} ?

Is _____4741_____ (B7.3) $\leq$ _____5541_____ (B6.1) ?

If yes, go on to B7.5. If no, recheck computations and validate P.

7.5 Average Busy Season Processor Busy Hour Current Call Capacity (BH CC_{ABS})

$$\text{BH } CC_{ABS} = (4)\,(\text{AQH } CC_{ABS}) = (4)\,(B7.3^*) = (4)\,(\quad 4741 \quad) \qquad = \underline{18,964}\text{ calls}$$

8.0 Current Office Call Processing Main Station Capacity

$$\text{Current MS Cap} = \frac{\text{BH } CC_{ABS}}{\text{CR}/\text{MS}_{ABS}} = \frac{B7.5}{B1.3f} = \frac{(18,964)}{(1.20)} \qquad = \underline{15,803}\text{ ms}$$

* Do not use B7.3 unless it satisfies B7.4, Verification Check.

Fig. 5—Function B Worksheets (Sheet 4 of 4) (4.18)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

C. ESTIMATING ULTIMATE OFFICE CALL PROCESSING CAPACITY

1.0 Determination of Future Overhead Time Requirements

1.1 *Ultimate Office Characteristics*

a. CR/MS_{ULT} = Ultimate ABS O + I calling rate per Main Station = __/.28__

b. Number of Attendant Data Link circuits expected in ultimate office. = __0__

c. Change in number of Attendant Data Link circuits. (C1.1b — B1.2b) = __0__

d. P = Ultimate office HD/ABS O + I call peaking factor = __/.3__

1.2 *Change in Overhead Due To Change in Call Store Layout (ΔCS)*

ΔCS (from Table A below) = __0__ %

TABLE A

CURRENT TCR's (B1.2a)	0—70	71—140	141—210	211—288
ΔCS	2.2*	1.4*	.3*	0*

1.3 *Current Office Scan Point Overhead †*

a. Slow scan points x .14 = (*5540*) (.14)   __776__

b. Fast + bylink scan points x .55 = (*500*) (.55)   + __275__

c. Total scan point overhead (C1.3a + C1.3b)   = __/05/__

d. Scan point overhead per ABS call =

$$\frac{(\text{Total scan point overhead}) (90)}{L_a} =$$

$$\frac{(C1.3c)(90)}{B1.3d} = \frac{(\text{/05/})(90)}{(\text{4295})}$$ = __22.0__ ms/call

e. %SPO = Percent scan point overhead =

$$\frac{\text{Total scan point overhead}}{100} = \frac{C1.3c}{100} = \frac{(\text{/05/})}{100}$$ = __/0.5__ %

* Add .8 to this number if current office does not have AIOD equipment but ultimate office will have.

† Slow, fast, and bylink scan points are summarized on the ODA output form 2504-R (Trunk Scanner Definition Report).

Fig. 6—Function C Worksheets (Sheet 1 of 2) (4.09, 4.24)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

C. ESTIMATING ULTIMATE OFFICE CALL PROCESSING CAPACITY

1.0 Determination of Future Overhead Time Requirements (Cont)

1.4 Change in RATE Due To Change in Variable Overhead Time (Δ RATE)

ΔRATE (from Table B below) _____0_____

CHANGE IN ATT. D.L. (C1.1c)	0	4	8	12	16	20	24	28	32
ΔRATE	0	.7	1.4	2.1	2.9	3.6	4.3	5.0	5.7

2.0 Estimate of Ultimate Office Call Processing Capacity

2.1 High Day AQH Ultimate Office Call Capacity ($AQH\ UC_{HD}$)

$$AQH\ UC_{HD} = \frac{(R_o + \%SPO - \Delta CS - 3)\ (9000)}{RATE + \Delta RATE + \dfrac{Scan\ pt.\ overhead\ per\ call}{P}}$$

$$= \frac{(B3.3 + C1.3e - C1.2 - 3)\ (9000)}{B5.0 + C1.4 + \dfrac{C1.3d}{C1.1d}}$$

$$= \frac{(72.3 + 10.5 - 0 - 3)\ (9000)}{101.3 + 0 + \dfrac{(22)}{(1.3)}} \qquad = \underline{\quad 6080 \quad}\ calls$$

2.2 Average Busy Season AQH Ultimate Office Call Capacity ($AQH\ UC_{ABS}$)

$$AQH\ UC_{ABS} = AQH\ UC_{HD} \div P$$

$$= \frac{C2.1}{C1.1d} = \frac{(6080)}{(1.3)} \qquad = \underline{\quad 4677 \quad}\ calls$$

2.3 Estimate of Ultimate Office ABS Busy Hour Call Processing Main Station Capacity

$$ULT\ MS\ CAP = \frac{(4)\ (AQH\ UC_{ABS})}{CR/MS_{ULT}}$$

$$= \frac{(4)\ (C2.2)}{C1.1a} = \frac{(4)\ (4677)}{(1.28)} \qquad = \underline{\quad 14,615 \quad}\ ms$$

Fig. 6—Function C Worksheets (Sheet 2 of 2) (4.09, 4.24)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

A. PROCESSOR OCCUPANCY TEST

1.0 Office Data

1.1 *Average Quarter Hour Data*

DATA ITEM	AQH – IDLE HOUR	TWO WEEK'S AVG. AQH – BUSY HOUR
Q5 + Q7	_____ a.	_____ d.
Q6 + Q7	_____ b.	_____ e.
Q11	—	_____ f.
Q14	_____ c.	_____ g.

1.2 *Office Characteristics*

a. Number of TCR's in current office.   _____

b. Number of Attendant Data Link circuits in current office.   _____

2.0 Variable Overhead Time Per Base Level Scan (t_1 milliseconds per call)

$$t_1 = 5.6 + \left[(.45) \times \left(\frac{TCR's}{70} + \text{Data Links} \right) \right]$$

$$= 5.6 + \left[(.45) \times \left(\frac{A1.2a}{70} + A1.2b \right) \right]$$

$$= 5.6 + \left[(.45) \times \left(\frac{\underline{\quad\quad}}{70} + \underline{\quad\quad} \right) \right] \qquad \underline{\qquad\qquad}\text{ms/call}$$

3.0 Calculate Test R_0

3.1 *Percent Call Capacity Remaining for Idle System (%CCR$_i$)*

$$\%CCR_i = \frac{\left(\frac{t_1}{90} \right) \left(9000 - \dfrac{\text{Idle Hour (Q5 + Q7)}}{3} \right)}{100} + \frac{\text{Idle Hour Q14}}{100}$$

$$= \frac{(A2.0) \left(100 - \dfrac{A1.1a}{270} \right) + A1.1c}{100}$$

$$= \frac{(\quad) \left(100 - \dfrac{(\underline{\quad})}{270} \right) + (\quad)}{100} = \underline{\qquad\qquad}\%$$

Function A Worksheet (Sheet 1)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

A.   PROCESSOR OCCUPANCY TEST

3.0   Calculate Test R_o (Cont)

3.2   Percent Test Call Capacity Remaining for Busy Hour (Test %CCR$_a$)

$$\text{Test \%CCR}_a = \frac{\left(\frac{t_1}{90}\right)\left(Q11 - \frac{(\text{Busy Hour Q5} + \text{Q7})}{3}\right)}{100} + \frac{\text{Busy Hour Q14}}{100}$$

$$= \frac{\left(\frac{A2.0}{90}\right)\left(A1.1f - \frac{(A1.1d)}{3}\right) + A1.1g}{100}$$

$$= \frac{\left(\frac{\underline{\qquad}}{90}\right)\left(\underline{\qquad} - \frac{(\underline{\qquad})}{3}\right) + (\underline{\qquad})}{100} = \underline{\qquad}\%$$

3.3   Test Maximum Percent Real Time for Calls (Test R_o)

$$\text{Test } R_o = \frac{(\text{\%CCR}_i - \text{Test \%CCR}_a) \times (\text{Idle Hour Q6} + \text{Q7})}{(\text{Busy Hour Q6} + \text{Q7} - \text{Idle Hour Q6} + \text{Q7})} + \text{\%CCR}_i$$

$$= \frac{(A3.1 - A3.2)\ (A1.1b)}{(A1.1e - A1.1b)} + A3.1$$

$$= \frac{(\underline{\quad} - \underline{\quad})\ (\underline{\quad})}{(\underline{\quad} - \underline{\quad})} + (\underline{\quad}) = \underline{\qquad}\%$$

4.0   Calculate Test Percent Occupancy (%OCC$_{TEST}$)

$$\text{\%OCC}_{TEST} = \frac{(\text{Test } R_o - \text{Test \%CCR}_a)}{\text{Test } R_o} \times 100$$

$$= \frac{(A3.3 - A3.2) \times 100}{A3.3}$$

$$= \frac{(\underline{\quad} - \underline{\quad})\ 100}{(\underline{\qquad})} = \underline{\qquad}\%$$

Function A Worksheet (Sheet 2)

A. PROCESSOR OCCUPANCY TEST

5.0 Test For Determination of Call Capacity Calculation Method

Is $\%OCC_{TEST} < 45\%$?

Is _____ $< 45\%$?

If yes, use pre-cutover method of Section 12f(4) to determine call processing capacity.

If no, collect full busy season data as required in function B of this section. With full busy season data averages compute current and ultimate call processing capacities as shown in functions B and C of this section.

Function A Worksheet (Sheet 3)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

B. ESTIMATING CURRENT OFFICE CALL PROCESSING CAPACITY

1.0 Office Data

1.1 Average Quarter Hour Data

DATA ITEM	AQH — IDLE HOUR	FULL BUSY SEASON AVG. AQH — BUSY HOUR
Q5 + Q7	_____ a.	_____ d.
Q6 + Q7	_____ b.	_____ e.
Q11	—	_____ f.
Q14	_____ c.	_____ g.

1.2 Current Office Characteristics

a. Number of TCR's in current office. _____
b. Number of Attendant Data Links in current office. _____

1.3 Office Data Summary

a. $ORIG_i$ = Idle system line + trunk originations. (B1.1a) _____
b. $ORIG_a$ = ABS line + trunk originations. (B1.1d) _____
c. L_i = Idle System O + I call load. (B1.1b) _____
d. L_a = ABS O + I call load. (B1.1e) _____
e. P = HD/ABS O + I call peaking factor. _____
f. CR/MS_{ABS} = EOP ABS O + I calling rate per Main Station. _____

2.0 Variable Overhead Time Per Base Level Scan (t_1 milliseconds per call)

$$t_1 = 5.6 + \left[(.45) \times \left(\frac{TCR's}{70} + Data\ Links \right) \right]$$

$$= 5.6 + \left[(.45) \times \left(\frac{B1.2a}{70} + B1.2b \right) \right]$$

$$= 5.6 + \left[(.45) \times \left(\frac{}{70} + \underline{} \right) \right] \qquad = \underline{} ms/call$$

Function B Worksheet (Sheet 1)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

B.   ESTIMATING CURRENT OFFICE CALL PROCESSING CAPACITY

3.0   Calculate R_o

3.1   Percent Call Capacity Remaining for Idle System (%CCR$_i$)

$$\%CCR_i = \frac{\left(\frac{t_1}{90}\right)\left(9000 - \frac{ORIG_i}{3}\right)}{100} + \frac{\text{Idle Hour Q14}}{100}$$

$$= \frac{(B2.0)\left(100 - \frac{B1.3a}{270}\right)}{100} + B1.1c$$

$$= \frac{(\quad)\left(100 - (\frac{\quad}{270})\right)}{100} + (\quad)$$

$= \underline{\qquad}\%$

3.2   Percent Call Capacity Remaining for ABS (%CCR$_a$)

$$\%CCR_a = \frac{\left(\frac{t_1}{90}\right)\left(Q11 - \frac{ORIG_a}{3}\right)}{100} + \frac{\text{ABS Q14}}{100}$$

$$= \frac{\left(\frac{B2.0}{90}\right)\left(B1.1f - \frac{B1.3b}{3}\right)}{100} + B1.1g$$

$$= \frac{\left((\underline{\quad})\right)\left((\quad) - (\frac{\underline{\quad}}{3})\right)}{100} + (\quad)$$

$= \underline{\qquad}\%$

3.3   Maximum Percent Real Time for Calls (R_o)

$$R_o = \frac{(\%CCR_i - \%CCR_a) \times (L_i)}{(L_a - L_i)} + \%CCR_i$$

$$= \frac{(B3.1 - B3.2) \times (B1.3c)}{(B1.3d - B1.3c)} + B3.1$$

$$= \frac{(\underline{\quad}) \times (\underline{\quad})}{(\quad - \quad)} + (\quad)$$

$= \underline{\qquad}\%$

Function B Worksheet (Sheet 2)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

B.   ESTIMATING CURRENT OFFICE CALL PROCESSING CAPACITY

4.0   Current Office ABS Processor Percent Occupancy

$$\%OCC_{abs} = \frac{R_o - \%CCR_a}{R_o} \times 100 = \frac{(B3.3 - B3.2)\ 100}{B3.3}$$

$$= \frac{(\quad - \quad)\ 100}{(\quad)} \qquad\qquad = \underline{\hspace{2cm}}\%$$

5.0   Rate of Real Time Use Per Call (RATE)

$$RATE = \frac{(R_o - \%CCR_a)\ 9000}{L_a} = \frac{(B3.3 - B3.2)\ 9000}{B1.3d}$$

$$= \frac{(\quad - \quad)\ 9000}{(\quad)} \qquad\qquad = \underline{\hspace{2cm}}\text{ms/call}$$

6.0   Average Quarter Hour Call Capacities at Dial Tone Delay Objectives

    6.1   AQH Capacity at 1.5% Dial Tone Delay (AQH $C_{1.5}$)

$$AQH\ C_{1.5} = \frac{(R_o - 10)\ (9000)}{RATE} = \frac{(B3.3 - 10)\ 9000}{B5.0}$$

$$= \frac{(\quad - 10)\ (9000)}{(\quad)} \qquad\qquad = \underline{\hspace{2cm}}\text{calls}$$

    6.2   AQH Capacity at 20% Dial Tone Delay (AQH C_{20})

$$AQH\ C_{20} = \frac{(R_o - 3)\ (9000)}{RATE} = \frac{(B3.3 - 3)\ (9000)}{B5.0}$$

$$= \frac{(\quad - 3)\ (9000)}{(\quad)} \qquad\qquad = \underline{\hspace{2cm}}\text{calls}$$

7.0   Current Office Processor Busy Hour Call Capacity

    7.1   High Day AQH Current Call Capacity (AQH CC_{HD})

$$AQH\ CC_{HD} = AQH\ C_{20} = (B6.2) \qquad\qquad = \underline{\hspace{2cm}}\text{calls}$$

    7.2   High Day Processor Busy Hour Current Call Capacity (BH CC_{HD})

$$BH\ CC_{HD} = (4)\ (AQH\ CC_{HD}) = (4)\ (B7.1) = (4)\ (\qquad) \qquad = \underline{\hspace{2cm}}\text{calls}$$

Function B Worksheet (Sheet 3)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

B.   **ESTIMATING CURRENT OFFICE CALL PROCESSING CAPACITY**

7.0   **Current Office Processor Busy Hour Call Capacity (Cont)**

   7.3   Average Busy Season AQH Current Call Capacity (AQH CC$_{ABS}$)

   $$\text{AQH CC}_{ABS} = (\text{AQH CC}_{HD}) \div P = (B7.1) \div (B1.3e) = \frac{(\quad\quad)}{(\quad\quad)} \qquad = \underline{\hspace{2cm}}\text{calls}$$

   7.4   Verification Check

   Is AQH CC$_{ABS} \leq$ AQH CC$_{15}$?

   Is $\underline{\hspace{2cm}}$ (B7.3) $\leq \underline{\hspace{2cm}}$ (B6.1) ?

   If yes, go on to B7.5. If no, recheck computations and validate P.

   7.5   Average Busy Season Processor Busy Hour Current Call Capacity (BH CC$_{ABS}$)

   $$\text{BH CC}_{ABS} = (4)(\text{AQH CC}_{ABS}) = (4)(B7.3^*) = (4)(\quad\quad) \qquad = \underline{\hspace{2cm}}\text{calls}$$

8.0   **Current Office Call Processing Main Station Capacity**

   $$\text{Current MS Cap} = \frac{\text{BH CC}_{ABS}}{\text{CR/MS}_{ABS}} = \frac{B7.5}{B1.3f} = \frac{(\quad\quad)}{(\quad\quad)} \qquad = \underline{\hspace{2cm}}\text{ms}$$

* Do not use B7.3 unless it satisfies B7.4, Verification Check.

Function B Worksheet (Sheet 4)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

C. ESTIMATING ULTIMATE OFFICE CALL PROCESSING CAPACITY

1.0 Determination of Future Overhead Time Requirements

    1.1 Ultimate Office Characteristics

        a. CR/MS_{ULT} = Ultimate ABS O + I calling rate per Main Station   = _____

        b.   Number of Attendant Data Link circuits expected in
            ultimate office.   = _____

        c.   Change in number of Attendant Data Link circuits.
            (C1.1b − B1.2b)   = _____

        d.   P = Ultimate office HD/ABS O + I call peaking factor   = _____

    1.2 Change in Overhead Due To Change in Call Store Layout (ΔCS)

        ΔCS (from Table A below)   = _____%

TABLE A

CURRENT TCR's (B1.2a)	0−70	71−140	141−210	211−288
ΔCS	2.2*	1.4*	.3*	0*

    1.3 Current Office Scan Point Overhead †

        a.   Slow scan points x .14 = (   ) (.14)   _____

        b.   Fast + bylink scan points x .55 = (   ) (.55)   + _____

        c.   Total scan point overhead (C1.3a + C1.3b)   = _____

        d.   Scan point overhead per ABS call =

$$\frac{(\text{Total scan point overhead}) (90)}{L_a} =$$

$$\frac{(C1.3c) (90)}{B1.3d} = \frac{(\qquad) (90)}{(\qquad)} \qquad = \underline{\qquad} \text{ms/call}$$

        e.   %SPO = Percent scan point overhead =

$$\frac{\text{Total scan point overhead}}{100} = \frac{C1.3c}{100} = \frac{(\qquad)}{100} \qquad = \underline{\qquad}\%$$

* Add .8 to this number if current office does not have AIOD equipment but ultimate office will have.

† Slow, fast, and bylink scan points are summarized on the ODA output form 2504-R (Trunk Scanner Definition Report).

Function C Worksheet (Sheet 1)

NO. 2 ESS
POST-CUTOVER CALL CAPACITY WORKSHEET

C.   ESTIMATING ULTIMATE OFFICE CALL PROCESSING CAPACITY

1.0   Determination of Future Overhead Time Requirements (Cont)

1.4   *Change in RATE Due To Change in Variable Overhead Time (Δ RATE)*

ΔRATE (from Table B below)   _____

CHANGE IN ATT. D.L. (C1.1c)	0	4	8	12	16	20	24	28	32
ΔRATE	0	.7	1.4	2.1	2.9	3.6	4.3	5.0	5.7

2.0   Estimate of Ultimate Office Call Processing Capacity

2.1   *High Day AQH Ultimate Office Call Capacity ($AQH\ UC_{HD}$)*

$$AQH\ UC_{HD} = \frac{(R_o + \%SPO - \Delta CS - 3)\ (9000)}{RATE + \Delta RATE + \dfrac{Scan\ pt.\ overhead\ per\ call}{P}}$$

$$= \frac{(B3.3 + C1.3e - C1.2 - 3)\ (9000)}{B5.0 + C1.4 + \dfrac{C1.3d}{C1.1d}}$$

$$= \frac{(\underline{\quad} + \underline{\quad} - \underline{\quad} - 3)\ (9000)}{\underline{\quad} + \underline{\quad} + \dfrac{(\underline{\quad})}{(\underline{\quad})}} \qquad\qquad = \underline{\qquad\qquad} calls$$

2.2   *Average Busy Season AQH Ultimate Office Call Capacity ($AQH\ UC_{ABS}$)*

$$AQH\ UC_{ABS} = AQH\ UC_{HD} \div P$$

$$= \frac{C2.1}{C1.1d} = \frac{(\underline{\quad\quad})}{(\underline{\quad\quad})} \qquad\qquad = \underline{\qquad\qquad} calls$$

2.3   *Estimate of Ultimate Office ABS Busy Hour Call Processing Main Station Capacity*

$$ULT\ MS\ CAP = \frac{(4)\ (AQH\ UC_{ABS})}{CR/MS_{ULT}}$$

$$= \frac{(4)\ (C2.2)}{C1.1a} = \frac{(4)\ (\underline{\quad\quad})}{(\underline{\quad\quad})} \qquad\qquad = \underline{\qquad\qquad} ms$$

Function C Worksheet (Sheet 2)