ENGINEERING AND ADMINISTRATION DATA ACQUISITION SYSTEM
SURVEILLANCE APPLICATIONS
APPENDIX A
NO. 5 CROSSBAR HOURLY REPORT FORMAT/CALCULATIONS/THRESHOLDS

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ENGINEERING AND ADMINISTRATION DATA ACQUISITION SYSTEM

SURVEILLANCE APPLICATIONS

APPENDIX A

NO. 5 CROSSBAR HOURLY REPORT FORMAT/CALCULATIONS/THRESHOLDS

1. GENERAL

1.01 This appendix to DFMP Division D, Section 4-h should be used as a guide in the preparation of hourly report formats, calculation sets and appropriate threshold settings for No. 5 Crossbar switching equipment associated with EADAS.

1.02 Whenever this appendix is reissued, the reason for reissue will be stated in this paragraph.

1.03 Included in these guidelines are the rationale for the recommended hourly report format, calculation sets and threshold levels.

1.04 This appendix should be used in conjunction with the material presented in DFMP Division D, Section 4-h.

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

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

2. HOURLY REPORT FORMAT

2.01 A recommended hourly report format for No. 5 Crossbar offices is shown in Fig. 1. The hourly report is intended to provide an overview of office performance plus certain items of information needed for index calculations. It should be generated for the official service observing busy hour as a minimum, and would probably be desired for one or more side hours.

2.02 The header of the report includes entity name, date and end time of the hour for which the report is generated. This is followed by the first section of the report which includes some general statistics on office load, and some associated overflow measurements where appropriate. The specific report items are as follows:

(1) Office overflow and originating peg count.

(2) Incoming matching loss (or incoming first-failure-to-match) and total incoming peg count.

(3) Intraoffice (IAO) trunk overflow and IAO peg count. These are totals for all IAO trunk groups.

(4) Through switch peg count.

(5) Total office peg count (the sum of originating, incoming and through switch peg counts) and average CCS per line link frame.

2.03 The next section of the report gives percent overflow statistics on key outgoing trunk groups. A capacity for four trunk groups is shown here, however this could easily be expanded to ten or so. Selective surveillance of key trunk groups only is recommended. This will conserve calculation and hourly report format capabilities.

2.04 The next section of the report deals with completing markers, dial tone markers and AMA transverters. Total usage expressed as a percentage of critical level is given for each of these components, and since this figure includes maintenance usage, this information is also given separately. The concept of percent critical level is discussed in DFMP Division D, Section 4-h, Part 6.

2.05 The originating register section of the report provides dial tone delay statistics in a format suitable for index purposes and two statistics on originating register loading. Separate lines of statistics are provided for dial pulse and TOUCH-TONE originating register groups. The first column is percent dial tone delay. This is followed by percent dial tone delay weighted by originating register group peg count (WTD). Summing these two figures will provide weighted dial tone delay for the DP and TT classes having the same busy hour. In offices where DP and TT classes have different busy hours, these figures cannot be used to compute the official index. Instead, manual weighting must be done as prescribed in the Traffic Service Observing Practice, Division F, Section 2B. The next two columns are dial tone speed delays and tests. The test count provides a positive indication that the proper number of tests were performed. Finally, originating register usage is given as a percent of engineered capacity, followed by maintenance usage.

2.06 The next two sections of the report provide information on individual sender groups and incoming register groups. Percent overflow is given on sender groups, and usage as a percent of critical level for incoming register groups. Twelve groups of each kind are covered by the format shown here. The maximum quantity of groups to be handled should be determined for each EADAS installation. Fewer groups will be required in many installations.

2.07 Finally, TUR frame cycle count is given at the bottom of the report. These counts provide a general indication of the reliability of the remainder of the statistics on the printout which involve usage registers.

2.08 As it is presented here, the basic hourly report format utilizes 60 of the 64 possible print positions. The remaining four could be used in a number of ways if desired, eg., coin supervisory circuit loads, or overflow on additional trunk groups.

3. RECOMMENDED HOURLY AND EXCEPTION REPORT CALCULATIONS

GENERAL

3.01 This portion of the practice outlines a recommended calculation set for No. 5 crossbar offices. Some calculations are for hourly report purposes only, some for exception reporting purposes only, and some are for both.

3.02 A summarized list of recommended calculations is given in Fig. 2. Suggested calculation terms and threshold types are listed along with an indication of whether or not each calculation is to be used in an hourly report format. Standard term labels should be used since the system can store a maximum of 256 unique ones. A reference number for threshold setting purposes is also given in Fig. 2 for each calculation. This will be explained in the next portion of this appendix which is devoted to thresholds. Finally, algebraic forms preferred for calculation definition input purposes are given. The recommended number of decimal places is denoted where appropriate, at the end of the calculation definition example. Asterisks are used to denote the optional calculations previously mentioned in paragraph 3.07 of Section 4-h.

3.03 In those cases where it is thought to be helpful, illustrative derivations of the algebraic forms given in Fig. 2 are provided in the following paragraphs. In all cases, these derivations assume 30 minute data collection intervals, 200 second TUR scan interval for regular scan items and 20 second scan for fast scan items. In cases where these assumptions do not apply, calculation formula must be rederived using the procedures specified in subsequent paragraphs. For brevity, sums of like registers are denoted by a summation notation, eg.:

$\sum_{CM}$ USG = Sum of the individual completing marker usage registers.

$\sum_{DTM}$ ORGB PC = Sum of the originating register group busy peg counts which are provided on a one register per dial tone marker basis.

The notation used for calculation terms is similar to that used in actual calculation definition inputs, ie., <Expression>. In some cases, extra parentheses are used for overall clarity.

TRAFFIC MEASUREMENT SYSTEM SURVEILLANCE CALCULATIONS (REFER TO FIG. 2, ITEM A)

3.04 The calculations listed below are intended to provide a near-real time surveillance capability for detection of major traffic measurement apparatus faults. These should be entered first in the calculation set for an office, since exception report messages are generated in the same order as their calculation definitions are stored. Thus, one or more exception reports on data link failures or TUR scanning failures, etc., may serve to explain the cause for a following group of machine surveillance related exception messages.

(1) TUR Frame Cycle Count—One calculation per TUR frame should be provided. This count should preferably be generated by grounding a TUR scan point in switch 5, horizontal 9, rather than using a CC-lead. In this way pulse generator and/or steering circuit failures can also be detected.

(2) ETDC Cycle Count (Scan Command)—One calculation per ETDC should be provided. The ETDC is arranged to generate one count every 100 seconds in its associated cycle count register. This count provides an indication that the reverse channel signaling feature is working properly, and that the ETDC is able to generate a count when one of its inputs is grounded. Register 31 is reserved for ETDC cycle count.

(3) Data Transmission Errors—The central control unit can currently detect two types of data word transmission errors: (1) words received with improper parity (incorrect coding of transmitted bits) and (2) words received with proper parity but illegal addresses or register numbers. The latter condition is called a "grey word". Parity errors are counted in register 001 for both ETDC and TDRS type converters (TURC or PCC). A count of grey words received during each collection interval is maintained in register 999. Let the sum of these two readings be called "ERRORS". Then the calculation definition would be:

$$\text{ERRORS} = \langle R1 \rangle + \langle R999 \rangle$$

Each register is also defined as a calculation term so that parity error and grey word counts can be obtained separately when an exception message is produced. Exception reports only will be produced by this calculation. One calculation per TDC should be provided.

(4) ETDC Buffer Overflow Indicator—The ETDC will cause one count to be scored in register 000 for each 100 second interval during which one or more counts were lost due to buffer overflow. Provide one calculation per ETDC for exception reporting purposes only.

(5) Data Link Carrier Failure Indicators—The data set at the central control unit end continuously monitors its transmission channel for presence of carrier. If the carrier signal is lost, an output lead from the data set is appropriately conditioned. The central processor unit periodically (every few seconds) scans the data sets to ensure that carrier is present. If not, a count is registered in address 998. Provide one calculation per incoming channel for exception reporting purposes only.

(6) Dial Tone Speed Tests—Provide one calculation per office to ensure proper operation of the dial tone speed test circuit. If two or more classes of service are involved, they should be summed to obtain a total test count for all classes. If a single class of service is all that is provided, this calculation is not needed since it becomes identical to one recommended later for printing dial tone speed tests by class in the hourly report.

GENERAL LOAD AND SERVICE RESULTS INDICATORS (REFER TO FIG. 2, ITEM B)

3.05 This group of calculations has two principal purposes; (1) to provide for surveillance of certain key service results measurements, and (2) to provide information on overall office load conditions for hourly report purposes. Some optional calculations are provided for a more extensive surveillance of ineffective attempt problems.

(1) % Office Overflow—This is a measure of the proportion of originating calls sent to overflow due to lack of idle outgoing trunks, idle outgoing senders or failures to match. It is recommended for both hourly and exception reporting purposes.

(2) % Originating Matching Loss—This is a measure of failures-to-match on originating class calls. This calculation is considered optional, since the % Incoming Matching Loss calculation should always be provided, and is generally more sensitive to line and trunk link overloads. Nonetheless, if desired, this can be provided as a slave to the % Office Overflow calculation as a potential aid in analyzing Office Overflow exception messages. It should be noted that the definition shown in Fig. 2 must be modified to include through switch peg count in offices arranged for tandem operation.

(3) Total Originating Peg Count—A traffic volume measurement. Provided for hourly report purposes only.

(4) % Incoming Matching Loss—An important surveillance item. Also printed in hourly reports for index calculation purposes, so two decimals should always be specified.

(5) % Incoming First Failures to MATCH should be substituted for or added to the % IML calculation if proper register features have been provided. These calculations differ in two regards. First, IFFM peg count replaces IML. Secondly in accordance with AT&T general letter 73-01-047, the line busy peg count is subtracted from the total incoming peg count in the denominator of this calculation.

(6) Average CCS per Line Link Frame—A slave to the preceding calculation, useful in analyzing % IML exception messages. This calculation requires use of line link frame (or trunk link frame) DGU registers, since the 600 (or 300) registers provided for individual horizontal group usage cannot be summed in a single calculation. It should not be provided unless the TUR frame is modified to disable DGU outputs during detector test cycles. This capability will be provided in a forthcoming change in the TUR circuit recommended for hourly reports.

NOTE: This calculation requires departure from the "single deferred division" rule. If the CCS/LLF calculation for an office having 40 or more line link frames is expressed as a single deferred division, multiplication overflows are likely to result, assuming the calculation is normalized to permit it's use in both hourly and exception reports.

In the calculation form given in Fig. 2, B,6, the normalization procedure is done in a slightly different manner to avoid multiplication overflows, and at the same time minimize truncation error. The rationale behind this procedure can probably best be illustrated by example. Suppose a set of 30 minute measurements were such that:

$$\frac{(\Sigma\,\text{LLF DGU})\,(\Sigma\,\text{TOT CH PC})}{(\Sigma\,\text{SAMP CH PC})} = 600$$

Furthermore, suppose that the expected TUR cycle count for 1 hour was 36, but the actual count for the 1/2 hour measurement interval was 17. A properly normalized result then is:

$$(600)\,(\frac{36}{17}) = (600)\,(2.118) = 1270.588$$

But in EADAS, this would be calculated as:

$$(600)\,(\frac{36}{17}) = (600)\,(2) = 1200$$

which is a significant error. To eliminate this error, we may arrange the calculation definition as follows:

$$(600)(36)(100)/17)/100$$

which would be evaluated by EADAS as follows:

$$(2{,}160{,}000/17)/100 = (127058)/100 = 1270$$

Note that scaling before and then descaling after the division by 17 has given a more accurate result. This illustrates the principle involved in the calculation provided.

(7) Total Incoming Peg Count—A volume measurement for hourly report purposes only.

(8) % Intraoffice (IAO) Trunk Group Overflow—This is an aggregate result for all IAO trunk groups, intended primarily for hourly reporting

purposes since it identifies an important component of total office load. Exception reports could be generated by giving this item an Upper Bound threshold. However, this approach may conceal overflow problems in offices which have a number of IAO groups. Consequently, it is considered better to provide additional calculation for exception reporting (only) on a per IAO trunk group basis.

(9) Total IAO Peg Count—A volume measurement for hourly report purposes only.

(10) Total Through Switch Peg Count—A volume measurement for hourly report purposes only. This calculation should be provided in offices arranged for EAS tandem, toll center or CCSA network operation. It could be omitted in offices where the only source of tandem class calling is due to "internal sources," eg., LAMA or coin junctor operation, since this will usually represent a small proportion of the total traffic volume.

(11) Total Office Peg Count—A volume measurement for hourly report purposes only. Provides the sum of originating, incoming and tandem class calls.

(12) % Completing Marker Second Trial Failures—An optional calculation for surveillance of maintenance oriented ineffective attempt problems. Requires assignment of plant register leads to traffic data converters. This calculation provides a measure of the proportion of completing marker seizures which resulted in overflow tone being returned to the calling subscriber due to equipment malfunctions.

(13) % Dial Tone Marker Second Trial Failures—All of the comments made for the preceding calculation apply here as well, with the exception that dial tone marker second trial failures do not result in overflow tone being returned to the subscriber. However, this item may provide some insight into the cause of dial tone service problems since it is a measure of repeated failures to establish requested dial tone connections.

(14) % AMA Transverter Second Trial Failures—Another optional calculation based on a plant register. Transverter second trial failures may cause overflow tone to be returned to the subscriber, or the call may go free, depending on service options provided in the particular office under consideration.

(15) % AMA Related Ineffective Attempts—An optional calculation provided as a slave to % AMA transverter second trial failures. This calculation provides a measure of the severity of transverter second trial failures in terms of ineffective subscriber attempts. It provides the percentage of those transverter seizures (1) which resulted in a second trial failure, and (2) for which overflow was returned rather than permitting the call to complete free of charge.

TRUNK GROUP SURVEILLANCE CALCULATIONS (REFER TO FIG. 2, ITEM C)

3.06 Exception calculations are recommended for % Overflow on key outgoing trunk groups. This should be limited to only the most important trunk groups since the surveillance feature of EADAS is presently limited to 6800 calculations per system and overflow calculations on every final trunk group could easily exceed this limit.

3.07 Consideration was also given to % Occupancy, ACH and CCH calculations for key trunk groups. While they could certainly be provided, they were judged to be not too useful for dial administrative purposes. % Overflow for key final groups provides a direct, easily understood measure of trunk group congestion and its effects on customer service. If desired, % Overflow results for the most important trunk groups in each office can be printed in hourly reports.

DIAL TONE SERVICE CALCULATIONS (REFER TO FIG. 2, ITEM D)

3.08 The next series of calculations provides for surveillance of dial tone delay results and originating register and dial tone marker performance.

(1) % Dial Tone Delay—One calculation should be provided per originating register group. Two decimal places should be specified.

(2) % Engineered Capacity—Originating Register Usage—This calculation provides a measure of originating register group load, expressed as a percentage of engineered high day capacity. It is a slave to the % Dial Tone Delay calculation.

(a) The originating register usage figure should include maintenance usage. This will always apply to wire spring registers. In flat spring offices it may be necessary to add maintenance usage depending on local circuit options provided. (See paragraph 3.09.) The algebraic form given in Fig. 2 is derived as follows:

$$\% \text{CAP} - \text{OR} = \frac{[1/5]\,(\text{OR USG})}{(\text{HD CCS CAP})} \times \frac{(18)}{(\text{TUR CYC})} \times (100)$$

This calculation assumes that a 20 second TUR scan rate is used, hence total usage is divided by 5 to convert to CCS. The factor of 100 is used to convert the result to a percentage. The factor (18/TUR Cycle Count) is used to "normalize" the measurement to an hourly figure.

(b) A simple algebraic rearrangement yields the form shown in Fig. 2. Note that the calculation is expressed as a single, deferred division. Also note that the terms provide for printing the "raw usage" measurement without adjustment for fast scan, hence the term label CCS would be misleading. "USG" or "FSU" (fast scan usage) would be a better choice.

(c) This calculation need not have a threshold since the dial tone speed measurement will provide positive indication of originating register overloads. Its purpose is to provide additional information about dial tone delay exception messages.

(3) Originating Register Holding Time—This calculation is also provided primarily to provide insight into the cause of dial tone delay exception messages. It can also be used on a demand basis to analyze the impact of completing marker overloads. Note that it is a slave calculation and provides maintenance usage information (as a term) whenever a dial tone delay exception message is generated.

NOTE: By providing a LU type threshold on this calculation, a useful data validation capability is provided since measurements of total usage, maintenance usage and peg count are all involved here. But this is a "side benefit," the primary purpose of this calculation is to help explain the cause of other exception messages.

(4) % Originating Register Group Busy—This is another slave calculation to the % Dial Tone Delay calculation for each originating register group. It provides a measure of the proportion of attempted originating register seizures which were aborted due to an all originating register busy condition. It is useful in (1) determining if an excessive dial tone delay condition is caused by dial tone marker or originating register overloads, or (2) determining which of two originating register groups in an office may be the cause of a dial tone delay problem in all classes of service.

(5) Originating Register Maintenance Usage—Provide one master calculation per originating register group. Originating register maintenance usage is printed for every dial tone speed exception message (as a term of the holding time calculation). The purpose of this master calculation is to provide an independent indicator of excessive register outages before they develop into dial tone service problems.

(6) Weighted % Dial Tone Delay—Provide one master calculation per originating register group, for hourly reporting purposes only. This calculation provides a weighted dial tone speed figure for each originating register group for use in calculating official dial line index results. ***This procedure is applicable only when all classes of service have the same busy hour.**** Two decimal places should be specified. By manually adding the weighted result for each group, a weighted figure for the office is obtained. Directly calculating a weighted total office figure will generate intermediate results which exceed the limit of 2^{30}-1 in most offices. This calculation is not required in offices having a single originating register group.

*Division F, Section 2B of the Traffic Service Observing Practice stipulates that a two day peg count study should be used to develop the weighting factor used throughout each month. This requirement has been waived when coincident class of service busy hours exist to permit the more accurate daily weighting method shown here. Future issues of the practice will be revised accordingly.

(7) Dial Tone Speed Tests—Provide one master calculation per originating register group for hourly reporting purposes only.

(8) Dial Tone Speed Delays—Provide one master calculation per originating register group for hourly reporting purposes only.

3.09 In offices equipped with flat spring originating registers, the total usage measurement (traffic plus maintenance) assumed in Fig. 2-D may not be provided. This is dependent on options provided in the originating register circuit. In the event a total usage measurement is not provided:

—Maintenance usage should be included (added) in the percent Engineered Capacity calculation.

—The subtraction of maintenance usage shown for the Originating Register Holding Time calculation may be omitted.

—The Originating Register Maintenance Usage calculation should be entered as a slave calculation so as to provide maintenance usage information whenever the corresponding percent Dial Tone Delay threshold is exceeded.

3.10 The remaining calculations shown in Fig. 2-D under Dial Tone Service Calculations pertain to dial tone markers. Ideally, one would like to see the results of these calculations in the event of an exception message on dial tone delay. However, in offices having more than one originating register group, this would require provision of a duplicate set of dial tone marker calculations for each register group, which is not recommended. An independent group of dial tone marker calculations will hopefully provide an adequate surveillance capability by producing exception messages whenever dial tone marker performance is a contributing factor to dial tone service degradation. These calculation results are also available at any time for demand reporting in connection with "real-time" analysis of dial tone delay problems.

3.11 In those offices having only one originating register group, all of the following calculations could be implemented as additional slaves to the % Dial Tone Delay calculation without penalty. ***The subparagraph numbers below continue to reference the calculations contained in Fig. 2, ITEM D.***

(9) % Critical Threshold Level—Dial Tone Marker Load—This calculation provides a measure of dial tone marker load, expressed as a percent of a critical level. The algebraic form shown in Fig. 2 for this calculation may be derived as follows:

$$\%\,\text{CRL} = \frac{(1/5)\,(1.05)\,\sum\limits_{\text{DTM}} \text{USG}}{(\text{ADJUSTED CRITICAL CCS})} \times \left[\frac{18}{\text{TUR CYC}}\right] \times (100)$$

(a) We assume here a 20 second TUR scan interval and a TUR undermeasurement factor of 1.05. TUR undermeasurement factors should be calculated for each office following the method outlined in paragraphs 3.18 through 3.22. Carrying out the multiplications in the numerator ($18 \times 100 \times 1.05 \times 1/5 = 378$), the form shown in Fig. 2 is obtained.

(b) A discussion of the % Critical level concept and adjustments for TUR Measurement Variation is presented in Section 4-h, Parts 6 and 7. The reader should be familiar with this material.

(10) Average Dial Tone Marker Holding Time—Provided as a slave to the preceding calculation. Note the terms of the holding time calculation include maintenance usage, hence this statistic is provided whenever the total measured load (which includes maintenance) exceeds its threshold. This approach is recommended throughout for all common equipment components.

(a) The algebraic form shown in Fig. 2 is derived from the following formula for average dial tone marker holding time:

$$\text{DTM} - \text{HT} = \frac{(20)\,(1.05)\,\sum\limits_{\text{DTM}} \text{USG} - (200)\,(\text{MB USG})}{\sum\limits_{\text{DTM}} \text{PC}}$$

(b) Each of the two terms in the numerator express measured usage in seconds. We assume a 20/200 second TUR scan interval, and an adjustment factor of 1.05 for TUR undermeasurement as before. Now, recall that EADAS calculated results are limited to two decimal places. But marker holding times, especially this one, are usually expressed to three decimal places. We therefore express the holding time in milliseconds as follows:

$$DTM - HT = \frac{(20)\,(1.05)\,\sum_{DTM} USG - (200)\,(MB\ USG)}{\sum_{DTM} PC} \times \left[\frac{1000\ MSEC}{}\right]$$

(c) Performing the indicated multiplications and expressing constants greater than 8191 in a factored form, the final result given in Fig. 2 is obtained.

(d) The temptation to request additional decimal places should be resisted as this may cause an intermediate result overflow in the calculation program for large offices. One decimal place is certainly sufficient since this provides accuracy to three figures. To avoid confusion, a result label like "MSEC" is recommended.

(11) % Ineffective Dial Tone Marker Seizures—An optional slave calculation providing additional information on possible causes of dial tone marker overloads or dial tone delay. This calculation provides a measure of dial tone marker seizures which did not result in a channel being established to an originating register. This would include all-originating- register busy conditions, second failures-to-match and false starts.

(12) % Dial Tone Marker Second Failures to Match—Another optional slave calculation which may be of particular interest in offices where line link blockages are a suspected cause of dial tone delay problems.

(13) Dial Tone Marker Maintenance Usage—A master calculation. Similar to the previous discussion for originating registers, the calculation is intended to provide an independent indication of excessive outages before dial tone delay problems result.

COMPLETING MARKER AND AMA TRANSVERTER CALCULATIONS (REFER TO FIG. 2, ITEM E)

3.12 Item E of Fig. 2 shows recommended calculations for completing markers and AMA transverters. Three identical calculations are recommended for each case. Because of their similarity only the completing marker calculations are shown here and in Fig. 2. They would be identical for AMA transverters except for different factors for TUR undermeasurement. (Refer to paragraphs 3.18-3.22.)

(1) % Critical Threshold Level—Completing Marker Usage—The calculation definition example shown in Fig. 2 comes from the formula:

$$\%\ THL = \frac{(1/5)\,(1.04)\,(\sum_{CM} USG)}{(THRESHOLD\ CCS)} \times \left[\frac{18}{TUR\ CYC}\right] \times (100)$$

(2) Average Completing Marker Holding Time—A slave to the % threshold level calculation. Derived from the formula:

$$CM - HT = \frac{(20)\,(1.04)\,(\sum_{CM} USG) - 200\,(MB\ USG)}{\sum_{CM} PC} \times \left[\frac{1000\ MSEC}{SEC}\right]$$

—As discussed before for dial tone markers, the result is expressed in milliseconds. This is also perfectly acceptable for transverters. Additional decimal places should not be specified; an intermediate result overflow could occur for completing markers, a final result overflow would almost certainly occur for AMA transverters since the holding time would most likely exceed 655.35 milliseconds (see paragraph 10.15 of DFMP Division D, Sec. 4g—System Definition)

(3) Completing Marker Maintenance Usage—A master calculation with one calculation per marker group.

OUTGOING, LLP, CAMA and IMG SENDER GROUP CALCULATIONS (REFER TO FIG. 2, ITEM F)

3.13 Item F of Fig. 2 shows recommended and optional calculations for Outgoing, LLP, CAMA and IMG sender groups. Separate sets of calculations are provided for each individual sender group as follows:

(1) % Sender Group Overflow—A master calculation giving the proportion of attempted sender seizures which failed due to an all senders busy condition.

(2) % Engineered Capacity—A slave to the % overflow calculation relating measured sender usage to recommended average ten high capacity given in Traffic Facilities Practices. A % critical level calculation is not used here since the % overflow calculation provides a more positive measure of service affecting overloads. This calculation merely provides additional information on sender group loading whenever a percent overflow exception message is produced.

(3) Sender Group Holding Time—Also a recommended slave calculation to the percent overflow item.

(4) % Intersender Timeout—In offices arranged for this feature, intersender timing is automatically reduced during periods when all senders are busy. Calls for which this interval is exceeded may be set to overflow. This optional calculation provides a measure of the sender seizures ending in this way, and as such, is a measure of ineffective attempts. It is to be used as a slave to the % overflow calculations.

(5) % Stuck Senders—This optional slave calculation to % overflow calculation requires use of a plant register lead. It also is a measure of ineffective attempts. Both this and the preceding calculation provide a measure of the amount of delay experienced by this office's senders in outpulsing to other senders, and may therefore help to explain sender group overload or holding time exception messages.

(6) % No Position Attached—An optional calculation for CAMA sender groups. Provides an indication of the proportion of sender seizures ended by timeout while waiting for CAMA position attachment. If desired, it can be slaved to the % overflow calculation. This calculation may also be useful in interpreting sender group overload or holding time exception messages.

(7) Maintenance Usage—Provide one master calculation per sender group.

INCOMING REGISTER GROUP CALCULATIONS (REFER TO FIG. 2, ITEM G)

3.14 Incoming registers should also be provided with a separate set of calculations for each register group. The (optional) link release ratio calculation is provided on a one per marker group basis.

(1) % Critical Threshold Level—Incoming Register Usage—Provide one master calculation per incoming register group.

(2) Incoming Register Holding Time—One per register group should be provided as a slave to the % critical level calculations.

(3) % Permanent Signal—An optional slave calculation which is sensitive to trunk facility troubles.

(4) % Partial Dial—An optional slave calculation. In groups serving CAMA trunks, separate registers are provided for CAMA and TOL incoming trunk classes. These can be summed in a single calculation and the partial dial peg count scorings printed individually as terms.

(5) % Incoming Register Group Busy Timing PC—An optional slave calculation, giving an estimate of the percentage of time that all incoming registers in the group are busy. During periods when all registers are busy a group busy timing registration is scored once every second, the theoretical maximum then being 3600 registrations per hour. So:

$$\% \text{ IRGB} = \left[\frac{\text{IRGB PC}}{3600}\right] \times \left[\frac{18}{\text{TUR CYC}}\right] \times (100)$$

$$= (\text{IRGB PC}) \div (2)\ (\text{TUR CYC})$$

(6) Maintenance Usage—Provide one master calculation per register group.

(7) Link Release Ratio—An Optional master calculation which can be provided on a one-per-marker group basis for ineffective attempt surveillance purposes. When an incoming register link malfunction is detected, the link release

register is scored and the trunk set to overflow. The calculation shown in Fig. 2 expresses link release peg count as a percentage of total incoming peg count, primarily to reduce the amount of variation to be dealt with in setting thresholds on this item.

MISCELLANEOUS CALCULATIONS (REFER TO FIG. 2, ITEM H)

3.15 Some important miscellaneous surveillance items are listed in Item H of Fig. 2.

(1) % Permanent Signals—A master calculation. Since extreme permanent signal conditions can cause dial tone service deterioration, this calculation (and the next three) are recommended for all offices.

(2) % Permanent Signal Holding Trunk Overflow—Gives the proportion of permanent signals overflowed to common overflow trunks.

(3) % Common Overflow Trunk Overflow—Common overflow trunks serve calls overflowed from combination tone and permanent signal holding trunks. When an idle common overflow trunk cannot be found, the completing marker must arrange for tone to be returned from the originating register, thereby increasing register holding time. This situation can quickly degenerate into dial tone service problems.

(4) % Abandoned/Partial Dial Peg Count—This calculation is optional. It may be useful in analyzing the severity of a dial tone delay problem, since studies have shown that customers are apt to abandon or dial prematurely when confronted with delays for dial tone longer than 2-3 seconds.

(5) % Critical Threshold Level—Coin Supervisory Circuit Usage—A master calculation providing a measure of total load, expressed as a percentage of a threshold level.

CONCLUSION

3.16 This completes the list of recommended calculations for No. 5 Crossbar offices plus optional items which may be worthwhile to those administrators with an interest in ineffective attempt surveillance. This list could be easily expanded to provide an even more comprehensive surveillance capability by including items such as percent office overflow by individual completing marker, percent first trial failures by individual marker or transverter, total channel to sample link peg count ratios by individual marker, etc. Routine, near-real time surveillance or individual circuit performance of the kind implied by these calculations does not seem to be desirable from a dial administration point of view. Such calculations are likely to produce many exception messages in response to troubles which are alarmed and routinely cleared by maintenance personnel within each EADAS surveillance interval. It is therefore felt that they would soon fail to have any significance.

3.17 Holding time calculations for ***individual*** markers and AMA transverters are not recommended. Although such calculations are useful in data validation computations, it is felt that this is a proper function for the downstream processes rather than in EADAS. Thirty minute usage measurements on these individual equipment items are subject to considerable statistical variation. They are, therefore, of little use for near-real time surveillance applications.

TUR USAGE UNDERMEASUREMENT FACTOR

3.18 In traffic engineering calculations for No. 5 Crossbar, usage measurements on dial tone markers, completing markers and AMA transverters are normally adjusted for TUR "undermeasurement". The need for this adjustment arises from the fact that the TUR scan lead is not grounded for the entire interval of time during which these circuits are unavailable for service to another call. In other words, the TUR measurement provides a slight underestimate of server holding time. As suggested in Traffic Facilities Practices, the necessary correction is normally made by adding some specified number of milliseconds of circuit use per seizure to the TUR measurement. The appropriate adjustments for No. 5 Crossbar circuits are as follows:*

Circuit Type	Added Circuit Use per Seizure	CCS Equivalent
Wire Spring Completing and Dial Tone Markers	15 msec	.00015
Flat Spring Completing and Dial Tone Markers	25 msec	.00025
LAMA and CAMA Transverters	20 msec	.0002
ANI Transverters	25 msec	.00025

*These adjustments may not agree with the values given in Traffic Facilities Practices sections issued in 1963. Corrected adjustments were published in an AT&T General Letter entitled "Common Systems—TUR Measurement of Common Control Equipment" dated January 13, 1965.

3.19 TUR usage measurements used in EADAS calculation definitions should also be adjusted for undermeasurement since peak equipment loads, which are of prime importance in this application, would otherwise be understated. Also, this will eliminate or at least minimize disparities between the numerical results produced by EADAS calculations and downstream processes, eg., COER (Central Office Equipment Reports system). This adjustment is apt to cause calculation overflow problems if carried out in the conventional way. The following alternative procedure is suggested.

3.20 First, recognize that the TUR undermeasurement is in essence an understatement of true server holding time. Holding times may vary significantly with load, and this is especially true for No. 5 Crossbar markers which cancel certain tests during heavy loads. For surveillance purposes we would like the adjustment procedure used in EADAS calculations to be most accurate under peak load conditions. The following steps should provide the desired result.

(a) Calculate average ten high day usage (unadjusted) and average ten high peg count for the last busy season. Call these values ATHD CCS and ATHD PC. Maintenance usage should be excluded from ATHD CCS.

(b) For dial tone or completing markers, if the value of ATHD CCS represents an occupancy level significantly below 70 percent, adjust ATHD CCS for heavy traffic relay operation per the Traffic Facilities Practices. (See for example, Division D, Section 8-e-2). Flat spring marker usage should not be adjusted for wire spring equivalence.

(c) Calculate the adjustment factor to two decimal places as follows:

$$\text{ADJ} = \frac{\text{ATHD CCS} + \text{X} \times \text{ATHD PC}}{\text{ATHD CCS}}$$

where X is the appropriate adjustment expressed as CCS for the type of equipment being considered, per paragraph 3.18. If a combination of flat spring and wire spring markers is involved, apply the appropriate factor to the ten high day average for each type of peg count.

(d) The resultant factors are to be applied to total traffic usage measurements wherever they appear in EADAS calculation definitions.

3.21 Separate factors should be developed for dial tone markers, completing markers, and LAMA, CAMA, and ANI transverters. Typical TUR undermeasurement factors would be in the order of:

W.S. Dial Tone Markers = 1.04—1.06
W.S. Completing Markers = 1.03—1.04
LAMA/CAMA Transverters = 1.01—1.03
ANI Transverters = 1.09—1.11

3.22 The adjustment for LAMA and CAMA transverters can probably be ignored in some offices without serious effects on the validity of exception reports.

4. RECOMMENDED THRESHOLD SELECTION PROCEDURES

GENERAL

4.01 The purpose of this practice is to describe recommended threshold setting procedures for the surveillance calculations discussed in the preceding paragraphs. Thresholds can be established beforehand for some of these calculations because of their fixed nature. For example, the lower/upper bounds for a TUR frame cycle count should be set at 8/10 for frames which are supposed to scan 9 times per 30 minute data collection interval. Other calculations in the set must have thresholds which are tailored to the particular office for which they are implemented. A sender group holding time is an example. The threshold ***schedules*** which are used in lower bound and upper bound type threshold tests must also be established.

4.02 In setting thresholds on surveillance calculations, there are two objectives to be met. First, we hope to provide a high degree of assurance that an exception message will be generated whenever (1) an abnormal, service affecting condition prevailed during the preceding data collection interval, or (2) there is an imminent danger of such a condition during the next data collection interval. Second, and equally important, "false warning," or spurious messages, should be kept to an absolute minimum. Ideally, exception messages should only be produced when a condition occurs which is both unusual and important enough to warrant immediate dial administrative attention.

DIVIDING THRESHOLD PROBLEMS BY TYPE

4.03 Threshold setting problems can be divided into several distinct cases, and this is the meaning of the reference numbers given in Fig. 2. These reference numbers generally pertain to the following cases of threshold application:

Case 1—Traffic Measurement Apparatus Surveillance Thresholds

Case 2—Upper Bound (UB) Thresholds on Maintenance Usage

Case 3—Upper Bound (UB) Thresholds on Common Control Equipment Component Loads

Case 4—Upper Bound (UB) Thresholds on Service Results Indicators

Case 5—Lower-Upper Bound (LU) Thresholds on Holding Times

4.04 In the following paragraphs, a recommended approach is given to setting thresholds for each of these cases.

CASE 1—TRAFFIC MEASUREMENT APPARATUS SURVEILLANCE THRESHOLDS

4.05 These thresholds pertain to the first six calculations listed in Fig. 2. Proper threshold values are readily determined for these items, since in most cases the normal result may be prescribed. Threshold schedules are not appropriate for these calculations.

(a) TUR Frame Cycle Count—Improper TUR scanning may cause invalid EADAS exception messages at best, or if the cycle count deviation is large enough, data for an entire measurement interval may be aborted by the downstream processes. The LU type threshold should be set to produce a message whenever the count deviates one or more cycles from its proper value, ie.:

EADAS Collection Interval (min)	TUR Scan Interval (sec)	LU Threshold Values
30	200	8/10
30	100	17/19
15	100	8/10
15	200	3/6*

*A TUR arranged for 200 second scan and an EADAS collection interval of 15 minutes should result in a cycle count of 5 for one quarter hour and 4 in the succeeding quarter hour.

(b) ETDC Cycle Count (Scan Command)—This calculation may provide the only near-real time indication available for certain types of ETDC outages. The LU Threshold values should be set to produce a message for deviations of one or more cycle count, ie.:

EADAS Collection Interval (min)	LU Threshold Values
30	17/19
15	8/10

(c) Data Transmission Errors—As described earlier, this calculation provides a measure of lost registrations due to mutilation of data words. Such losses will occur even in "good" transmission channels, but they should be kept at a very low level in order to insure that valid traffic measurements are obtained. A lost registration rate in the order of 0.1 percent is a reasonable upper limit. It is expected that the average business day-busy hour count load for a fully loaded ETDC will be in the neighborhood of 100,000 counts per hour. The upper bound threshold for this calculation would then be:

EADAS Collection Interval (min)	Upper Bound Threshold
15	25
30	50

For ETDCs carrying substantially less than 100,000 average business day-busy hour counts these threshold levels should be reduced. Actual ETDC count loads can be checked using the Sum Registers (SU:RG:) command.

(d) ETDC Buffer Overflow Indicators—Pending further field experience, a threshold value of 9 for half hour system periods (4 for 15 minute periods) should be supplied for this calculation. When this value is exceeded, a load-service type analysis should be undertaken to determine if some corrective action such as additional input scaling or channel deloading is necessary.

(e) Data Link Carrier Failure Indicator—As described previously, counts stored in address 998 provide a measure of the amount of time during which the associated 202T data set has detected an absence of carrier. The central control unit is arranged to flag the data for a particular collection period and channel as being suspected when the count in address 998 exceeds a global threshold level applicable to all channels on the system. The threshold on this calculation should be set at some lower level so as to provide warning messages before a carrier failure problem becomes so severe as to cause loss of data in downstream processes. The current global threshold setting will be known to each central control unit administrator.

(f) Dial Tone Speed Tests—The Traffic Service Observing Practice stipulates that, in order to be considered valid and therefore usable in index calculations, the number of dial tone speed tests should not vary more than 3 percent from the expected amount. To provide a leading indicator of potential losses of index data, the LU threshold for this calculation should be set to detect variations of ± 1 percent from the expected number of tests.

CASE 2—UPPER BOUND THRESHOLDS ON MAINTENANCE USAGE

4.06 As noted earlier, the purpose of these calculations is to provide exception messages which warn of excessive maintenance outages before they result in service problems. It is considered to be good routine dial administrative practice to periodically review current traffic volumes and equipment capacities. The difference represents a satisfactory level for maintenance outages and provides a basis for setting thresholds on these calculations. These margins should be agreed to by both Central Office Maintenance and Dial Administration Managers.

4.07 Allowable maintenance margins should be expressed for each common control equipment component in terms of: (1) an acceptable maintenance outage level during the component busy hour(s), and (2) some higher amount of outage during all other hours of the day.* Maintenance usage calculations, having UB type thresholds, permit specification of busy hour and nonbusy hour threshold levels and an associated threshold schedule. Since a maximum of three different threshold schedules are available for each calculation set, the same schedules used for controlling service level (Case 4) threshold tests should be used for these calculations. Methods for establishing these schedules are discussed in subsequent paragraphs concerned with Case 4 thresholds.

*A nonbusy hour specification should be understood to mean those hours of the day during which the TUR frames are scheduled for operation, but which are not regarded as busy hours. During very late night or early morning hours maintenance personnel will often make very large amounts of equipment busy. But this condition need not concern us in setting threshold levels because the TUR frames are normally not running during these hours.

CASE 3—UPPER BOUND THRESHOLDS ON COMMON CONTROL EQUIPMENT COMPONENT LOADS

4.08 The primary purpose of these calculations is to provide warning messages when a component load has reached the point where significant service deterioration is either; (1) a reality or (2) an imminent possibility. Because of the intended "alarm" nature of these calculations, careful consideration must be given to the selection of threshold levels.

4.09 The term critical level, as previously discussed, is used to denote that load level for which an exception message is desired. With the critical level type calculations recommended herein, the corresponding threshold specification should not be set higher than 100%. This will produce an exception report whenever measured load equals or exceeds the predetermined critical level adjusted for TUR Measurement Variation. Since the dial administrator will typically have little or no empirical data upon which to base such decisions recommended unadjusted critical CCS levels for No. 5 Crossbar exception reporting purposes are provided in paragraph 4.12. To ensure that loads at the "critical level " are not overlooked due to TUR measurement variation, the actual critical level value in the calculation definition must be set somewhat lower. A discussion of the critical level concept and a procedure for determining the proper adjusted critical levels applicable to all types of switching equipment is discussed in parts 6 and 7 of DFMP Division D, Section 4-h.

4.10 The UB type threshold specifications used for these calculations must be assigned to a threshold schedule. However, for simplicity, it is recommended that the critical levels given here be assigned to both busy and nonbusy hours. If this approach is taken, the threshold schedule assignment is arbitrary. No matter which schedule is chosen these critical levels will be applicable for all hours in which the TUR is running. In all other hours, the threshold tests will be automatically aborted.

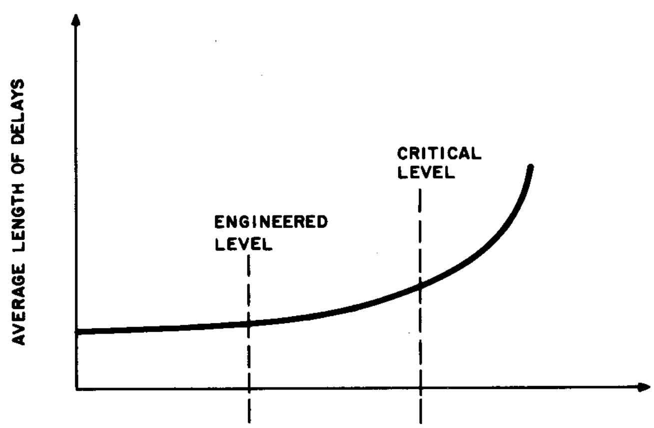
4.11 The recommended unadjusted critical CCS levels shown herein are based on the following degraded service criteria:

(a) Non-by-link Incoming Registers—The probability of delay greater than one average register holding time is equal to 0.01. This 0.01 probability figure will almost always be an upper bound for the probability of intersender timeout in distant offices.

(b) By-link Incoming Register Groups—The probability of any delay at all for incoming register attachment is equal to 0.01. In other words, the probability of mutilated or lost digits on incoming calls is approximately 0.01.

(c) Coin Supervisory Circuits—The probability of any delay at all for coin supervisory circuit attachment is equal to 0.005.

(d) Dial Tone and Completing Markers and AMA Transverters—The critical CCS levels shown below are based on an analysis of expected delays for marker/transverter availability. At engineered capacity levels and somewhat above, the duration of such delays should be near-negligible. But as equipment occupancy is increased, a region is encountered in which the duration of delays increases very rapidly and consequently machine performance may deteriorate very rapidly. The critical levels shown below are designed to produce exception messages before this region of rapid loss of stability is encountered.



4.12 The following upper bound unadjusted critical levels are recommended by type of common control equipment:

1. Non-Bylink Incoming Register Group

No. of NBL Inc. Reqs.	Critical Level Occupancy	CCS
2	0.18	13
3	0.30	32
4	0.40	58
5	0.46	83
6	0.52	112
7	0.58	146
8	0.62	179
9	0.65	211
10	0.67	241

2. Bylink Incoming Register Group

No. of BL Inc. Reqs.	Critical Level Occupancy	CCS
2	0.07	5
3	0.13	14
4	0.20	29
5	0.26	47
6	0.30	65
7	0.33	83
8	0.36	104
9	0.38	124
10	0.41	148

3. Coin Supervisory Circuits

No. of Coin Supv. Ckts.	Critical Level Occupancy	CCS
2	0.051	4
3	0.109	12
4	0.164	24
5	0.212	38
6	0.255	55
7	0.290	73
8	0.320	92
9	0.351	113
10	0.371	134

4. Dial Tone Markers, Completing Markers and AMA Transverters

No. of Servers	Critical Level Occupancy	CCS
2	0.80	58
3	0.85	92
4	0.88	127
5	0.89	160
6	0.90	194
7	0.90	227
8	0.91	262
9	0.91	295
10	0.92	331

4.13 The critical levels recommended above represent a reasonable alternative between meaningless exception messages due to low threshold values and failure to generate exception reports prior to equipment overload because thresholds were too high. The EADAS user is encouraged to experiment and is, of course free to select any threshold level desired.

CASE 4—UPPER BOUND (UB) THRESHOLDS ON SERVICE RESULTS INDICATORS

4.14 Setting thresholds on these calculations involves two steps: (1) deriving ***threshold schedules*** which give a rough indication of component busy/nonbusy hours and (2) setting busy/nonbusy hour ***threshold levels*** on each calculation.

THRESHOLD SCHEDULE DETERMINATION

4.15 Since a maximum of three unique threshold schedules are available for all the calculations under a single entity definition, the threshold schedule determination procedure can be a fairly gross one. The following general procedure is suggested:

(a) First, establish one schedule which covers all hours of the day during which there are significant amounts of traffic in the office. For example, in a business-residence type office, this schedule would probably cover all hours of the day and evening. In a "pure business" situation, this schedule would probably cover the day only.

(b) Next determine if there are any significant differences between incoming and originating traffic characteristics. If so, it may be desirable to establish a separate threshold schedule for those components dominated by each type of traffic. For example, dial tone markers, originating registers, outgoing sender groups, etc., would be assigned to the originating busy hours' schedule, incoming register groups to the incoming busy hours' schedule, etc. This can be determined by reviewing a few simple peg count volumes, say total originating and total incoming peg counts from completing markers. A recent busy hour determination study might serve the purpose, or listings from the long term data storage area for the originating and incoming peg count calculations provided as a part of this calculation set could be used. If there is no significant difference in originating and terminating busy hours then the overall schedule described under (1) above can be used.

(c) If no significant difference in originating and terminating busy hours needs to be accounted for, then it may be desirable to use the remaining schedule for special components with "odd" busy hours, eg., coin supervisory circuits, a particular sender group dominated by a toll busy hour, etc. If all schedules are already used, these items can be assigned to one of those three schedules already defined which fits best.

THRESHOLD LEVEL DETERMINATION

4.16 In setting threshold levels on these calculations, the primary objective is to cause exception messages to be produced when service results or machine performance is "unusually poor." This will necessarily involve a great deal of dial administrator judgment. It should be clear that dial line index or engineering service standards will be of little value in making these judgments since they represent a considerably different measurement base than that used in this application. Service standards are frequently stated in terms of monthly or busy season averages, and invariably represent an hourly measurement period rather than the 15 or 30 minute measurements used here.

4.17 It is probably easiest to initially select trial threshold values on a judgment basis where possible, and then adjust them later on the basis of actual data is necessary to reduce exception message volumes. Having already decided on the threshold schedule to be used fcr each calculation, threshold levels can be established in one of the three following ways, discussed in order of their preference:

(a) If the measurement under consideration is a familiar one to the dial administrator, he/she may be able to simply select some appropriate level on a judgment basis. For example, the reasoning might run as follows: "The dial tone delay in this originating register group is averaging 1 percent. Therefore, individual hours must occasionally run higher, 2 or 3%, and would be no cause for concern.

(b) If enough recent hourly measurements are available for the calculated result in question, they may be useful in setting a trial threshold level. For example, if busy hour measurements are available for the last month or so from a COER-like summary, then the user can merely select the highest measurement (subject to tests for reasonableness) as a trial value. In most cases, this trial value will require a subsequent upward adjustment to account for the greater amount of variation inherent in 15 or 30 minute measurements. This adjustment will come as a natural consequence of the threshold administration procedure outlined in subsequent paragraphs. The main advantage in this approach is that it requires looking at less data than the next method to be discussed. If, on the other hand, the required hourly measurements are not available, it is probably not worth the effort to accumulate them solely for the purpose of setting thresholds.

(c) If neither of the foregoing methods seem appropriate, then the calculation can be initially entered with an NP threshold type specification. This will cause the calculation to be performed each system period and the calculated results to be accumulated in the long term storage area. These results can then be listed daily using the OP:CA: command until a sufficiently large base of empirical data is accumulated to provide a basis for setting thresholds. After a week's worth of data is obtained in this manner, the results should be scanned for extreme values in the busy and nonbusy hours defined by the threshold schedule. If these values seem reasonable, then thresholds can be set at these levels.

THRESHOLD ADJUSTMENT DETERMINATION

4.18 After ***initial*** values have been selected for all thresholds, the resultant exception messages should be retained and reviewed on a weekly basis. The object here is to ensure that spurious exception message volumes are maintained at a reasonable level. As a rule of thumb, it is suggested that any threshold which is exceeded more than five times per week for no apparent reason other than random traffic variations be considered a candidate for upward adjustment. The highest values given in the exception messages themselves can be used as the basis for such adjustments. Care must be exercised to ensure that the values which produced the message are not outliers caused by some abnormality. The terms and slave calculation results recommended herein will provide useful information for making such decisions. Once an equilibrium is reached, these reviews should be continued but at less frequent intervals.

4.19 The foregoing review procedure should also provide for automatic upward or downward adjustments of threshold levels in response to changing traffic patterns, seasonal levels, and growth. For example, as the busy season approaches, thresholds on trunk group overflow, matching loss, etc., might be increased on an as required basis. After the busy season has passed however, this would leave thresholds set at a level which may be too high. All of the calculations in this group should be periodically reviewed, say at two or three month intervals, to ensure that their thresholds are not too high due to a major drop in traffic volumes or some other cause.

CASE 5—LOWER—UPPER BOUND (LU) THRESHOLDS ON COMPONENT HOLDING TIMES

4.20 Since component holding times will generally be unique to each office, these threshold settings must be based on empirical data. The recommended approach here is very similar to the third one outlined for Case 4 type thresholds, the differences being that both upper and lower extremes are of interest and threshold schedules are not involved. In general, these calculations should not be as sensitive to seasonal load fluctuations, and need not be considered in the 2-3 month reviews. But it is recommended that they be included in the initial weekly review procedure using the "five messages per week" rule for resetting thresholds.

```
                        *** 5XB HOURLY REPORT ***

ENTITY: AAAAAAAAAAA
DATE  : MM/DD/YY
TIME  : HH:MM
                 %OFL      PC

ORIG             XX.XX     XXXXX
INC              XX.XX     XXXXX
INTRA            XX.XX     XXXXX
THRU                       XXXXX
TOT                        XXXXX    XXXX     CCS/LLF

TRK GRP-A        XX.XX
       -B        XX.XX
       -C        XX.XX
       -D        XX.XX

                 %CRL      MB

COMP MKR         XXX.X     XXX
DT MKR           XXX.X     XXX
AMA TV           XXX.X     XXX

ORIG REGS        %DTD      WTD      DLYS     TSTS     %CAP     MB     PC
  DP             XX.XX     XX.XX    XXX      XXX      XXX.X    XXX    XXXXX
  TT             XX.XX     XX.XX    XXX      XXX      XXX.X    XXX    XXXXX

SDR GRPS                   %OFL
  0—3            XX.XX     XX.XX    XX.XX    XX.XX
  4—7            XX.XX     XX.XX    XX.XX    XX.XX
  8—11           XX.XX     XX.XX    XX.XX    XX.XX

INC REG GRPS                    %CRL
  0—3            XXX.X     XXX.X    XXX.X    XXX.X
  4—7            XXX.X     XXX.X    XXX.X    XXX.X
  8—11           XXX.X     XXX.X    XXX.X    XXX.X

TUR CYC-0          XX
       -1          XX
       -2          XX
```

Fig. 1—Hourly Report (2.01)

RECOMMENDED CALCULATION SET FOR NO. 5 CROSSBAR OFFICES

	CALCULATION TERMS	HOUR REPORT	THRESHOLDS TYPE	THRESHOLDS REF.	CALCULATION DEFINITION EXAMPLES
A. TRAFFIC MEASUREMENT SYSTEM SURVEILLANCE CALCULATIONS					
1. TUR Frame Cycle Count — (1 calc. per TUR Frame)	—	X	LU	1	= TUR CYCLE COUNT
2. ETDC Cycle Count — (1 calc. per ETDC)	—	—	LU	1	= R31
3. Data Transmission Errors — (1 calc. per ETDC or TDRS converter)	PARITY ERRORS, GREYWORDS	—	UB	1	= <R1> + <R999>
4. ETDC Buffer Overflow Indicators — (1 calc. per ETDC)	—	—	UB	1	= RO
5. Data Link Carrier Failure Indicators — (1 calc. per ETDC on TDRS converter)	—	—	UB	1	= R998
6. Dial Tone Speed Tests	—	—	LU	1	= Σ DTS TST CLASS
B. GENERAL LOAD AND SERVICE RESULTS INDICATORS					
1. % Office Overflow	OFC. OFL., ORIG. PC	X	UB	4	= (<Σ OFL PC> x 100) ÷ <Σ ORIG PC-DP + CM CM Σ ORIG PC-TT>, 2 CM
*2. % Originating Matching Loss (Slave to % Office Overflow)	OML PC, ORIG. PC	—	UB	4	= (<OML PC> x 100) ÷ <Σ ORIG PC-DP + CM Σ ORIG PC-TT>, 2 CM
3. Total Originating Peg Count	—	X	NP	—	= Σ ORIG PC — DP + Σ ORIG PC-TT CM CM
4. % Incoming Matching Loss —	IML PC, INC. PC	X	UB	4	= (<IML PC> x 100) ÷ < Σ INC PC>, 2 CM
5. % Incoming First Failure to Match	IFFM PC, INC. PC, LINE BSY. PC	X	UB	4	= (<IFFM PC> x 100) ÷ (< Σ INC PC> — < Σ LN BSY PC>), 2 CM CM
6. CCS/LLF — (Slave to % IML calc.)	LLF DGU, SAMP. CH. PC, TOT. CH. PC	X	NP	—	= (((< Σ LLF CCS> x < Σ TOT CH PC>) ÷ DGU CM (No. of LLF's x < Σ SAMP. CH PC>)) x CM (36 x 100 ÷ TUR CYC)) ÷ 100

Fig. 2—Recommended Calculations (Sheet 1 of 5) (3.02, 3.03, 3.04-3.15, 4.03, 4.05)

B. GENERAL LOAD AND SERVICE RESULTS INDICATORS (CONT.)	CALCULATION TERMS	HOUR REPORTS	THRESHOLDS TYPE	THRESHOLDS REF.	CALCULATION DEFINITION EXAMPLES
7. Total Incoming Peg Count	—	X	NP	—	= $\sum_{CM}$ INC PC
*8. % IAO Trunk Group Overflow (Aggregate result for all IAO trunk groups)	TOTAL IAO OFL, TOTAL IAO PC	X	NP	—	= (< $\sum_{IAO\ GRPS}$ IAO GRP OFL> x 100) ÷ < $\sum_{IAO\ GRPS}$ IAO GRP PC>, 2
*9. Total IAO Peg Count	—	X	NP	—	= $\sum_{IAO\ GRPS}$ IAO GRP PC
10. TOTAL Through Switch Peg Count	—	X	NP	—	= $\sum_{CM}$ THRU SW PC
11. Total Office Peg Count	—	X	NP	—	= $\sum_{CM}$ (ORIG PC-DP + ORIG PC-TT + INC PC + THRU SW PC)
*12. % Completing Marker Second Trial Failures	2TF PC, CM PC	—	UB	4	= (<CM 2TF PC> x 100) ÷ < $\sum_{CM}$ CM PC>, 2
*13. % Dial Tone Marker Second Trial Failures	2TF PC, DTM PC	—	UB	4	= (<DTM 2TF PC> x 100) ÷ < $\sum_{DTM}$ DTM PC>, 2
*14. % AMA Transverter Second Trial Failures	2TF PC, AMA TV PC	—	UB	4	= (<AMA TV 2TF PC> x 100) ÷ < $\sum_{TV}$ AMA TV PC>, 2
*15. % AMA Related Ineffective Attempts — (Slave to preceding calc.)	BBF PC	—	NP	—	((AMA TV 2TF PC) — <BBF PC>) x 100 ÷ < $\sum_{TV}$ AMA TV PC>, 2
C. TRUNK GROUP OVERFLOW MEASUREMENTS					
16. % Trunk Group Overflow — (Recommended for key tandem and alternate route finals)	OFL, PC, TRK. GRP. PC	*	UB	4	= (<TRK GRP OFL> x 100) ÷ <TRK GRP PC>, 1
D. DIAL TONE SERVICE CALCULATIONS					
1. % Dial Tone Delay — (Provide one calc. per Orig. Reg. Grp.)	DELAYS, TESTS	X	UB	4	= (<DELAYS> x 100) ÷ <DTS TESTS>, 2

Fig. 2—Recommended Calculations (Sheet 2 of 5) (3.02, 3.03, 3.04-3.15, 4.03, 4.05)

D.	DIAL TONE SERVICE CALCULATIONS (CONT)	CALCULATION TERMS	HOUR REPORT	THRESHOLDS TYPE	THRESHOLDS REF.	CALCULATION DEFINITION EXAMPLES
2.	% Engineered Capacity — Originating Registers — (Provide one calc. per orig. reg. grp. as a slave to corresponding % DTS calc.)	ORIG. REG. USAGE,	X	NP	—	= (360 x <TOT OR USG>) ÷ (TUR CYC x CCS CAP), 1
3.	Originating Register Holding Time — (Provide one calc. per orig. reg. grp, as a slave to corresponding % DTS calc.)	ORIG. REG. USAGE, MAINT. USAGE, ORIG. REG. PC	—	LU	5	= (20 x <TOT OR USG> — 200 x <MB USG> ÷ (<ΣOR PC> — DTS TSTS), 2 DTM
4.	% Originating Register Group Busy — (Provide one slave calc. per Orig. Reg. Grp.)	ORGB PC, OR GRP PC	X	UB	4	= (< Σ ORGB PC> x 100) ÷ < Σ (OR GRP PC + ORGB PC)>, 1 DTM DTM
5.	Originating Register Maintenance Usage — (Provide one master calc. per Orig. Reg. Grp.)	—	X	UB	2	= MB USG
6.	Weighted % Dial Tone Delay — (Provide one calc. per Orig. Reg. Grp.)	—	X	NP	—	= ((DTS DLYS) x Σ OR GRP PC) ÷ (DTS TSTS x DTM (Σ DP OR PC + TT OR PC)), 2 DTM
7.	Dial Tone Speed Tests — Per class of Service (Provide one calc. per Orig. Reg. Grp.)	—	X	NP	—	= DTS TSTS
8.	Dial Tone Speed Delays — Per class of service (Provide one calc. per Orig. Reg. Grp.)	—	X	NP	—	= DTS Delays
9.	% Critical Threshold Level — Dial Tone Marker Load	DTM USAGE	X	UB	3	= (378 x < Σ DTM USG>) ÷ (TUR CYC x THRESH. CCS), 1 DTM
10.	Average DTM Holding Time — (Slave to preceding calc.)	DTM USAGE, MAINT. USAGE DTM PC	—	LU	5	= (105 x 200 x < Σ DTM USG> —(200) x (1000) x DTM <MB USG>) ÷ < Σ DTM PC>, 1 DTM
11.	% Ineffective DTM Seizures — (Slave to % DTM Threshold calc.	DTM PC, ORIG. REG. PC	—	UB	4	= 100 x (< Σ DTM PC> — < Σ DP OR PC + Σ TT OR PC>) DTM DTM DTM ÷ Σ DTM PC , 1 DTM
*12.	% DTM 2nd Fail-To-Match — (Slave to % DTM Threshold calc.)	FM PC, DTM PC	—	UB	4	= (100 x < Σ FM PC>) ÷ < Σ DTM PC>, 1 DTM DTM
13.	Dial Tone Marker Maintenance Usage (Master calc.)	—	X	UB	2	= MB USG

Fig. 2—Recommended Calculations (Sheet 3 of 5) (3.02, 3.03, 3.04-3.15, 4.03, 4.05)

	CALCULATION TERMS	HOUR REPORT	THRESHOLDS TYPE	THRESHOLDS REF.	CALCULATION DEFINITION EXAMPLES
E. COMPLETING MARKER AND AMA TRANSVERTER CALCULATIONS					
1. % Critical Threshold Level — Completing Marker/AMA Transverter Usage — (Master calc.)	USAGE	X	UB	3	= (1872 x < Σ_{CM} USG>) ÷ (5 x (THRESH CCS) x (TUR CYC)), 1
2. Average CM/TV Holding Time — (Slave to % Threshold calc.)	USAGE, MAINT. USAGE, PC	—	LU	5	= (200 x 104 x < Σ_{CM} USG > — 200 x 1000 x <MB USG>) ÷ < Σ_{CM} PC>, 1
3. CM/TV Maintenance Usage — (Master calc.)	—	X	UB	2	= MB USAGE
F. OUTGOING, LLP, CAMA AND IMG SENDER GROUP CALCULATIONS					
1. % Sender Group Overflow — (1 Master calc. per sender group)	OFL, PC	X	UB	4	= (100 x <SDR GRP OFL>) ÷ (< Σ_{CM} SDR GRP PC> + SDR GRP OFL), 2
2. % CCS Capacity — Sender Group (Slave to % Overflow calc.)	USAGE	—	NP	—	= (360 x <SDR GRP USG>) ÷ (TUR CYC x ATHD CCS CAP), 1
3. Sender Group Holding Time — (Slave to % Overflow calc.)	USAGE, MAINT. USAGE, PC	—	LU	5	= (20 x <SDR GRP USG) — 200 x <MB USG>) ÷ < Σ SDR GRP PC>, 2
4. % Intersender Timeout — (Slave to % Overflow calc. for outgoing Sdr. Grps.)	IST PC, SDR GRP PC	—	UB	4	= (100 x <IST PC>) ÷ < Σ_{CM} SDR GRP PC>, 2
*5. % Stuck Senders — (Slave to % Overflow calc. for Outgoing or LLP Sdr. Grps)	SS PC, SDR GRP PC	—	UB	4	= (100 x <SS PC>) ÷ < Σ SDR GRP PC>, 2
*6. % No Position Attached — (Master calc. for CAMA Sender Groups)	NPA PC, SDR GRP PC	—	UB	4	= (100 x <NPA PC>) ÷ < Σ_{CM} SDR GRP PC>, 2
7. Maintenance Usage — (1 Master calc. per Sender Group)	—	—	UB	2	= MB USG
G. INCOMING REGISTER GROUP CALCULATIONS					
1. % Critical Threshold Level — Incoming Register Group Usage — (1 Master calc. per Inc. Reg. Grp.)	INC. REG. USAGE	X	UB	3	= (360 x <IR GRP USG>) ÷ (TUR CYC x THRESH CCS), 1

Fig. 2—Recommended Calculations (Sheet 4 of 5) (3.02, 3.03, 3.04-3.15, 4.03, 4.05)

	CALCULATION TERMS	HOUR REPORT	THRESHOLDS TYPE	THRESHOLDS REF.	CALCULATION DEFINITION EXAMPLES
G. INCOMING REGISTER GROUP CALCULATIONS					
2. Incoming Register Holding Time — (1 Slave calc. per Inc. Reg. Grp.)	USAGE, MAINT. USAGE, PC	—	LU	5	= (20 x <IR GRP USG> — 200 x <MB USG>) ÷ < Σ IR GRP PC>, 2 IRMC
*3. % Permanent Signal — (1 Slave calc. per Inc. Reg. Grp.)	PERM. SIG PC, TOT. PC	—	UB	4	= (100 x <PS PC>) ÷ < Σ IR GRP PC>, 2 IRMC
*4. % Partial Dial PC — (1 Slave calc. per Inc. Reg. Grp.)	PART. DIAL PC, TOT. PC	—	UB	4	= (100 x <PD PC>) ÷ < Σ IR GRP PC>, 2 IRMC
*5. % Incoming Reg. Grp. Busy Timing PC — (1 Slave calc. per Inc. Reg. Grp.)	IR GB PC	—	UB	4	= <IRGB PC> ÷ (2 x TUR CYC), 2
6. Maintenance Usage — (1 Master calc. per Inc. Reg. Grp.)	—	—	UB	2	= MB USG
*7. Link Release Ratio — (1 Master calc. per marker group)	LR PC, TOT. INC. PC	—	UB	4	= (100 x <LR PC>) ÷ < Σ INC PC>, 2 CM
H. MISCELLANEOUS CALCULATIONS					
1. % Permanent Signal PC — (Master calc.)	PERM. SIG. PC, ORIG. REG. PC	—	UB	4	= (100 x <PS PC>) ÷ < Σ DP OR PC + Σ TT OR PC>, 2 DTM DTM
2. % Permanent Signal Holding Trunk Ofl — (Master calc.)	PERM. SIG. TRK. OFL. PERM. SIG. PC	—	UB	4	= (100 x <PSHT OFL> ÷ <PS PC>, 2
3. % Common Overflow Trunk Overflows — (Master calc.)	OFL., PC	—	UB	4	= (100 x <COM DFL OFL> ÷ <COM OFL PC>, 2
*4. % Abandoned/Partial Dial Peg Count	AB/PD PC, ORIG. REG. PC	—	UB	4	= (100 x <AB/PD PC> ÷ < Σ DP OR PC + Σ TT OR PC>, 2 DTM DTM
5. % Critical Threshold Level — Coin Supv. Circuit Usage — (Master calc.)	USAGE	—	UB	3	= (360 x <CN SUP CKT USAGE> ÷ (TUR CYC x THRESH CCS), 2

Fig. 2—Recommended Calculations (Sheet 5 of 5) (3.02, 3.03, 3.04-3.15, 4.03, 4.05)