

SWITCHING SYSTEMS MANAGEMENT
CROSSBAR TANDEM
INEFFECTIVE MACHINE ATTEMPT REPORT
PREPARATION AND ANALYSIS

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1. INTRODUCTION

1.01 Crossbar tandems are a necessary and vital part of the telephone network. It is essential that management have complete knowledge of the service provided by crossbar tandems and the associated trunk networks in order to maintain switching service at an acceptable level.

1.02 The crossbar tandem ineffective machine attempt report is a means of directing management's attention and efforts toward improving

service at crossbar tandems. It identifies service items in need of improvement and is a valuable tool for use by dial administrators and switching maintenance personnel. The principal service items measured at the crossbar tandem are no circuit conditions on intertoll and tandem completing trunks, reorders which are blocked calls due to equipment failures, sender overload, vacant codes and CAMA equipment failures.

1.03 The system report is submitted via a computer system called ineffective machine attempts (IMAs). This system allows the operating companies to transmit via teletypewriter the ineffective machine attempt data directly to a central file, to correct any inconsistencies that the computer program may uncover, and to obtain a summary of the completed data and the status of data entered for all machines within their own companies. Instructions for using this system are provided in Dial Facilities Management Practices Division D, Section 3a.

1.04 Once the data is correct and complete, various reports may be requested. The computer program permits the companies to obtain the IMA and the CAMA performance reports by area, company, or regional groupings as required by the Associated Companies. These reports include averages for the machines summarized in the report, the system averages, and the performance rank of the company within the system. In addition, during specified intervals each month, users in one company can obtain reports on machines in other companies, company and system averages, rank of the companies within the system, and a report on the sender delay days for each machine.

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1.05 One of the purposes of the IMA reports is to permit comparisons of results between machines and between companies. Therefore, measurements should be as equitable as possible. A problem exists in revertive senders where both customer-abandoned calls and certain trouble indications route to reorder and there is no way to obtain a separate count. For this reason, the IMA data for crossbar tandems equipped with revertive senders, which handle at least 30 percent of the total marker peg count, will be summarized separately and will not be included in the system or company average results.

2. FREQUENCY OF REPORT

2.01 The system report is a monthly time-consistent busy hour report covering each normal business day. All weekdays (Monday through Friday) are included except Christmas Day, Christmas Eve, and Thanksgiving Day. In addition special peak-day reports will be requested.

2.02 The time-consistent busy hour should be determined by periodic office busy hour studies with selection based on the hour which has the highest marker peg count for the most weekdays of the study.

2.03 The report period shall be from the 23rd of each month until the 22nd of the following month with data input to the computer program between the 1st and the 15th of the following month. A minimum of five days' data is required for each data item. If fewer than five days per month are available all items should be reported as not available.

3. AUTHORIZED EXCLUSIONS

3.01 The only authorized exclusions of call blockages will be those due to the following customer control conditions.

(a) **Centrex or PBXs:** Crossbar tandems used as the serving office for centrex customers or as the terminating office for PBXs with direct-in-dialing features may have trunks directly to the customer's location. Where trunk quantities of this type are determined by the customer the overflows should be excluded from the report. These overflow calls should be routed to the line busy (60 ipm) tone group.

(b) **Dedicated Local Choke Network:** Crossbar tandems arranged to block calls directed toward a dedicated NNX code used exclusively for mass calling should exclude these overflows from the report, as the choke network is designed to block as close to the source as possible those calls which had little chance of completing because the customer had insufficient answering capability to handle the offered calls. Where possible, these overflow calls should be routed to the line busy (60 ipm) tone group.

(c) **Dedicated Nationwide Code 900 Choke Network:** Toll crossbar tandems arranged to block calls to NPA code 900 by limiting trunk access to the number of trunks specified in the system choke network plan should exclude any of these overflows from the report. The code 900 dedicated choke network is designed to route overflow calls to the no circuit announcement (NCA) group. It provides protection for the toll network by blocking as close to the source as possible those calls which had little chance of completing due to the customer's limited answering capability.

(d) **Outward WATS and Foreign Exchange Trunks:** Crossbar tandems are used in some locations to provide PBX and centrex customers with direct outward dialing to the world through direct access lines to a tandem. After dialing an access code (such as 9), the subscriber receives a second dial tone and is then able to dial the desired number. The customer's toll call is then completed over the outward WATS lines or the dedicated foreign exchange trunks. The number of foreign exchange trunks and the number of outward WATS lines are determined by the customer and overflows of those lines are therefore excluded from the report.

(e) **Incoming Register Permanent Signal (PS) and Partial Digit (PD):** There are several different treatments given to PS and PD conditions encountered on incoming registers. A study is now being made to devise an equitable measurement system for these conditions. Until completion of this study, PS and PD conditions on 3-digit or 10-digit registers are not to be included as ineffective attempts.

3.02 The above items of traffic are the *only* authorized exclusions. Overflow of test lines, operator trunks, weather, rate quoting, or other

similar groups provided for telephone company or other use should not be excluded. Overflows due to network management controls or other special arrangements designed to protect the network during a general overload or from heavy calling to customers not assigned to the dedicated mass calling NNX should not be excluded.

3.03 Authorization has not been provided for excluding any vacant code announcement (VCA), sender overload announcement (SOA), or other reorder announcement (ROA) calls regardless of situation.

3.04 Adherence to the guidelines is essential if uniformity is to be maintained in the measurement of crossbar tandem ineffective machine attempts.

4. RESPONSIBILITY OF DIAL ADMINISTRATOR

4.01 It is the responsibility of the dial administrator to ensure proper and accurate preparation of all forms. This responsibility includes the computer input which produces the system report and the extraction of area and system reports.

4.02 The dial administrator should be aware of the importance of maintaining acceptable service levels and should recognize the necessity for complete and accurate data followed with prompt corrective action where required. The dial administrator should continually work to maintain service levels within established company and system objectives and should make known to higher management any problems that could develop into weak spots.

4.03 A monthly business day average busy hour (ABH) report has been selected as representative of the service provided in a crossbar tandem office and to serve as a system report. It will be used to compare machine and company results, to establish system averages, and to determine the rank of each company in the system. However, the dial administrator is responsible for maintaining proper service levels at all times and may find it necessary to periodically prepare a total day, Sunday evening, midnight to 8:00 am, or other IMA reports to determine if the service provided meets objectives at all times. Such studies may reveal problems not evident during the office busy hour and may serve as a tool in improving switching machine performance.

5. PREPARATION OF CROSSBAR TANDEM IMA WORKSHEET, FORM E-5110

5.01 All data required is obtained from registers and is then entered on the crossbar tandem IMA worksheet, form E-5110 (Fig. 1). A brief description of each register is provided with the associated column number of the worksheet indicated in parentheses. The announcement arrangements, type of senders, type of incoming registers, and trunking vary by tandem and require slightly different methods to complete the report. The various situations which have been covered will not necessarily be applicable to all tandems. The crossbar tandem IMA worksheet should be prepared as follows.

(1) **Marker Peg Count (1):** Scores each time a marker seizes an idle trunk on an office link frame on both first and second trial.

(2) **Reorder Announcement (2):** Scores when calls encountering equipment blockages and failures such as permanent signals, partial digits, matching loss, normal sender timeouts, marker second trial failures, and CAMA equipment failures are routed to this group. Certain types of senders unless modified will return a reorder (120 ipm) tone on some failures. Offices with this type of equipment must collect additional data as required to obtain a complete count of reorder failures.

(3) **Incoming DP Registers:** There are different methods for handling PS and PD conditions in both the 3-digit and the 10-digit registers. Until completion of an evaluation of the effect of these differences, incoming registers PS and PD conditions are not to be included as ineffective attempts. It is therefore necessary to know the handling given to PS and PD conditions to make a proper report of total ROA conditions.

(a) **Permanent Signals (3D Column 3 and 10D Column 37)**—Scores when the incoming register times out awaiting the start of impulsing.

(b) **Partial Digits (3D Column 4 and 10D Column 38)**—Scores when the incoming register times out after impulsing has started and before registration is complete.

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(c) No Sender Attached (5)—Scores when the third digit is registered in the 3-digit incoming register before the sender is attached.

Note: The notes accompanying GL 74-05-196, "Crossbar Tandem Ineffective Attempt Recording and Analysis and Marker Route Verification," introduce equipment changes which are being offered to cause the 3-digit incoming register to route permanent signals and partial dial conditions to the ROA group. After these modifications are made, the PS and PD data in columns 3 and 4 for the 3-digit incoming registers are to be subtracted from the total ROA in column 2 to remove these conditions from the reported IMA. In offices with 10-digit incoming registers, senders may be arranged with "wink-off" which will not score any register, therefore no adjustment is necessary. Ten-digit offices with senders not arranged for wink-off will route PS and PD to ROA. The PS and PD conditions are registered and should be subtracted from ROA.

(4) **Senders:** There are seven different numbered senders in tandem offices at the present time. PEL 7323 issued July, 1964 covers modifications removing the sender reorder trunks and directing all reorders to the reorder announcement trunk group. The following is a brief description of how reorders are handled in various types of senders.

(a) **Multifrequency (MF) Senders:** SD-27024 will route all reorders to the announcement trunks. Unless modified, SD-25978 and SD-25769 will return reorder tone from the sender on permanent signals, partial digits, and stuck senders and will route all other failures to the reorder announcement trunk group.

(b) **Dial Pulse (DP) Senders:** SD-25999 will route all reorders to the announcement trunks. Unless modified, SD-25478 will return reorder tone from the sender on partial digits and stuck senders and will route all other failures to the reorder announcement trunk group.

(c) **PCI Senders:** SD-25961 will route all failures to the reorder announcement trunk group.

(d) **Revertive Pulse (RP) Senders:** SD-25359 will cause the sender in the originating office to go to reorder under some conditions. Other failures will be routed to the tandem reorder announcement trunk group.

(5) Offices with senders of the older types should verify that the modifications have been made to route all failures to the reorder announcement trunks. Where this has not been completed, data must be collected on the individual reorder items.

(a) **Permanent Signals (6):** Scores each time the MF sender is seized but receives no digits and times out.

(b) **Partial Digit (MF Column 7 and DP Column 9):** Scores each time the sender times out awaiting complete registrations of digits in a DP sender. Scores when a start pulse is received before a complete code is registered in the MF sender.

(c) **Stuck Sender (MF Column 8 and DP Column 10):** Scores when the sender times out waiting for a sender at the distant office when short sender timing is not in effect.

(6) **Total Reorders (11):** Column 2 less columns 3 and 4 or columns 37 and 38 in offices where incoming register PS and PD conditions route to ROA as described in 5.01(3) above. All other offices may enter ROA peg count in this column.

(7) **Vacant Code Announcement (12):** Calls are routed to this announcement group when translation has not been provided for the code as received. These calls may include customer and operator dialing errors, class of service denials, and switching machine routing errors.

(8) **Sender Overload Announcement (13):** Calls are routed to this announcement group when all senders in a group are busy and where the outgoing trunk fails to obtain a sender in the distant office or where the sender fails to obtain a TSP position.

(9) **No Circuit Announcement (14):** Calls are routed to this announcement group when an all trunks busy condition is encountered on a

final intertoll trunk group. This trunk group may be all announcement trunks or may be a combination of tone (120 ipm) and announcement trunks. All final intertoll trunk groups should route advance to the NCA trunk group as the peg count register provides the count of all no circuit conditions encountered on intertoll trunks. These failures are classified as NC-IT in the ineffective machine attempt report.

(10) **Overflow Code 900 (15):** Calls blocked on the system choke network are routed to the NCA group. An overflow register must be assigned to the dedicated code 900 trunks and must be read with the IMA data when the choke network is utilized.

(11) **NC-IT (16):** Subtract column 15 from column 14.

(12) **NC Announcement or Tone (17):** Calls are routed to this tone group when an all trunks busy condition is encountered on a tandem completing trunk group. In a toll crossbar tandem this may be identified as toll completing trunk groups. In both situations the no circuit conditions are classified as NC-TC in the ineffective machine attempt report.

(13) **Revertive Pulse Reorder (18):** Scores when a marker is handling a call from a RP sender and finds all outgoing trunks busy.

(14) At some locations the crossbar tandems are equipped with 60 ipm, line busy, tone trunks. Calls which overflow direct customer-controlled trunk groups are routed to this tone group. These calls are not included in the IMA results. Therefore, if calls other than those described as authorized exclusions in Part 3 are directed to this group, arrangements must be made for proper classification and for inclusion in the IMA report.

(15) Offices not equipped with 60-ipm tone trunks route calls which overflow direct customer-controlled trunk groups to the 120-ipm tone trunks and arrangements must be made to identify and exclude these overflows from the IMA report. It is suggested that two route (relay) numbers be used to obtain separate peg count data. All final tandem-completing trunks should advance to the regular 120-ipm route (relay) number to provide the NC-TC data. All

direct customer-controlled trunk groups, described in Part 3, should route advance to the line-busy, 60-ipm route (relay) number and the associated peg count data should not be included in the report.

(16) Offices not equipped with 60-ipm tone trunks or arranged as suggested in (15) above must collect overflow data on each direct customer-controlled trunk group. Columns 19, 20, and 21 are provided for recording these items which are to be subtracted from the 120-ipm peg count to obtain the NC-TC figure.

(17) **Announcement or Tone Overflows to 120 IPM (22):** Office arrangements vary and must be reviewed to determine how to correctly report announcement and tone trunk group overflows. Column 22 is provided to record the sum of the overflow registers of any announcement or tone trunk group arranged to route advance to the route relay or route number of the 120-ipm trunk group used for obtaining NC-TC.

(18) **NC-TC (23):** This figure must represent the total no circuit conditions encountered on final tandem completing trunks, operator service, and test trunks. Tandem completing trunks are defined as group to class 5 (END) offices or to crossbar tandem offices used for local alternate route traffic. The NC-TC figure is obtained by adding columns 17 and 18 in offices with RP senders, subtracting columns 19, 20, and 21 for exclusion of customer overflows where separate data are not available, and subtracting column 22 where other announcement or tone groups are arranged to route advance to the 120-ipm (NC-TC) trunk group.

(19) **High and Dry (24):** Tones and announcements are used to advise the calling party of a failure. High and dry calls are those calls which were not provided a tone or announcement. In a route relay tandem this is the sum of the overflow registers on all tone or announcement trunk groups assigned to a route relay in ground supply 5. In a ring marker tandem it is the total overflow of all final tone and announcement groups.

(20) **Transverter ONI (25):** Scores when the calling customer's number is obtained by calling in an operator who requests this information from the customer.

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- (21) **Transverter ANI (26):** Scores when the calling customer's number is identified automatically by the originating office.
- (22) **Total Transverter Attempts (27):** A sum of the ONI and ANI transverter peg count registers.
- (23) **Misrouted Non-CAMA Announcement (28):** Local calls which are misrouted over a CAMA trunk group because the customer misdialed or the equipment malfunctioned are routed to this announcement group.
- (24) **Unauthorized Code Announcement (UCA) (29):** Calls are routed to this announcement group when the marker is arranged for unauthorized code detection. Upon receiving a 0 or 1 in the B digit from a subscriber class of service, the marker will route calls with an improper code format to this announcement group.
- (25) **Total CAMA Announcements (30):** Sum of NCAs (column 28) and UCAs (column 29).
- (26) **Wrong Calling Code (31):** Blocked calls due to customer giving and the operator keying as the calling office code an office code not among those in the recorder which serves the originating central office.
- (27) **Match Check (32):** Blocked calls due to customer giving and the operator keying the called number rather than the calling number.
- (28) **Total Wrong Calling Code (33):** Sum of wrong calling code (column 31) and match check (column 32).
- (29) **No Position Attached (34):** Calls on which the sender times out on a bid for a CAMA or TSP position. (TSP tandems will route no position attached calls to SOA when short sender timing is in effect.)
- (30) **Position Disconnected (35):** Calls on which the operator depresses the position disconnect key to free her position from the customer.
- (31) **Incoming Register Peg Count (36):** Scores each time an incoming register is seized.

(This figure should include 3-digit and 10-digit incoming register peg count data for those offices equipped with both types.)

(32) **Total Incoming Register Permanent Signals (39):** Sum of the 3-digit (column 3) and 10-digit (column 37) incoming registers.

(33) **Total Incoming Register Partial Digits (40):** Sum of the 3-digit (column 4) and 10-digit (column 38) incoming registers.

(34) **Sender Attachment Delay Recorder (SADR):** SADR is a service measurement device which samples the interval experienced by trunks in gaining access to a sender and records delays in excess of 3 seconds. Two registers are provided for each type of sender, one register to record the number of test bids and a second register to record the number of delays encountered. Columns 41, 44, 47, and 50 are provided for recording the tests for each type of sender; columns 42, 45, 48, and 51 for the delays; and columns 43, 46, 49, and 52 for recording the percentage of delay. The percentage is obtained by dividing the number of delays by the number of tests and multiplying by 100. At the end of the report period count the number of days that the percentage of sender delay over 3 seconds exceeds 1.0 percent in the busy hour for each type of sender, and enter this figure in the space provided at the bottom of the worksheet.

5.02 Data should be entered in the appropriate columns for each business day as it becomes available. At the end of the report period total each column and record sum on line 24. Count the number of available data days for each column, and enter figure on line 25. Any differences must be rectified as the computer program uses one figure to average each data item. A day should be excluded in its entirety from the report if data are not available for the basic items (columns 1, 11, 12, 13, 16, and 23 of the worksheet). If data are missing for any other item the day may be excluded or the total may be adjusted by averaging the existing data for the item and substituting an average for the missing day. With the completion of lines 24 and 25 the data may be transcribed to the computer input worksheet.

5.03 Lines 24, 25, and 26 may be used as follows to compute the percentage of ineffective

machine attempts for each category. Obtain the average by dividing line 24 by line 25 for each column. Calculate the percentages for columns 11, 12, 13, 16, 23, and 24 by dividing line 26 of each column by the average marker peg count and multiplying by 100; the percentage for column 30 by dividing line 26 by the average total transverter attempts and multiplying by 100; the percentages for columns 33, 34, and 35 by dividing line 26 by the average ONI transverter attempts and multiplying by 100; and the percentages for columns 39, 40, and 5 by dividing line 26 by the average incoming register peg count and multiplying by 100.

6. PREPARATION OF COMPUTER INPUT WORKSHEET, FORM E-511B

6.01 The computer input worksheet (Fig. 2) is used as the data source in preparing the teletypewriter message required to enter the data into the computer program. Raw data, total monthly peg count, and overflow figures are required as the program performs validation functions, makes calculations, and produces a teletypewriter IMA report. The following considerations must be made in determining the correct value or message to be entered on each line.

6.02 If a particular item is not applicable (not a function of this switching machine) enter "NAP".

6.03 If a particular item is not available (normally reported but not this time) enter "NAV".

6.04 If a particular item is not measured (register not provided) enter "NMS".

6.05 If a crossbar tandem is used as a directional toll tandem handling incoming toll traffic the value for NC-IT, line 5, should be shown as 0 not NAP. A crossbar tandem handling only outgoing toll traffic should report the values for NC-IT on line 5 and NC-TC (test lines, etc) on line 6 of the worksheet.

6.06 Crossbar tandems handling only local traffic should report NC-IT, line 5 as NAP.

6.07 Complete the crossbar tandem IMA computer input worksheet as follows:

XBT Office - — Name of crossbar office.

Month - —

Month and year of report.

IMA—

Company name (use 3-letter abbreviation per list provided in Division D, Section 3a). Crossbar tandem offices equipped with revertive pulse senders, which handle at least 30 percent of the total marker peg count, should use the company abbreviation NBS.

XBT—

Enter "ABH" to identify report.

Items=

The word "all" should be entered to indicate that a value or message will be included in the input for each item.

Machine=

Enter common language location identification (CLLI) name.

Number of Days

Enter figure from line 25 of worksheet.

Values 1 to 17

Enter monthly totals by transcribing from the worksheet the figures on line 24 for each value. The associated worksheet column number is provided in parenthesis.

Values 18 to 21

Count the number of days sender delay in the busy hour exceeded 1.0 percent for each type of sender. Enter 0 if delay did not exceed 1.0 percent on any day during the report period. Enter NAP for sender types not provided and NAV or NMS if appropriate.

6.08 The CAMA data, values 8 to 17, are not required as part of the system report. However, the CAMA portion of the IMA program is available and may be used by those companies that wish to use the IMA program to obtain area, region, or company results.

6.09 Upon completion of the crossbar tandem IMA computer worksheet, the following checks should be made: lines 2 through 7 should not exceed line 1, line 9 should not exceed line 8, lines 11 through 13 should not exceed line 10, and

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lines 15 through 17 should not exceed line 14. Line 12 (no position attached) may occasionally exceed line 10 due to a major ONI failure which scores the no position attached register but does not score the ONI transverter peg count register. If this occurs the input for line 10 should be changed to the sum of lines 10 and 12. The teletypewriter input message may then be prepared per instructions in Division D, Section 3a.

7. CROSSBAR TANDEM IMA SUMMARY, FORM E-5111

7.01 The crossbar tandem IMA summary, form E-5111 (Fig. 3), is designed to provide a current view of service, to maintain a record of past performances for trending purposes, to display established objectives for reviewing progress, and to keep management personnel informed of the crossbar tandem performance.

7.02 The system teletypewriter report may be used as the data source for the busy hour. If results are desired for other intervals use the worksheet, form E-5110, to collect data; upon completion of the computations on line 27 transcribe the percentages by categories to the summary.

8. ANALYSIS OF THE IMA RESULTS

8.01 Before releasing the IMA report the dial administrator should check for accuracy and reasonableness. It is suggested that data be collected daily to prevent service or register problems from going undetected. Prompt detection of a problem often helps to identify the cause as it may be related to recent maintenance or installation work, network changes, or difference in traffic due to public events. Unusual changes from the previous month, up or down, should be investigated, documented, and discussed with appropriate personnel.

8.02 If the marker peg count is collected on a totalizer circuit the totalizer registrations should be checked with the total of the individual marker registers monthly as results may be distorted by totalizer errors.

8.03 Every effort should be made to quickly identify any unusual NC-IT or NC-TC conditions. Arrangements should be made to collect overflow data on all final groups. Close contact should be maintained with trunk administration

and the dial administrator should make sure that accurate trunk data are provided in sufficient quantity for proper trunk administration.

8.04 The dial administrator and the maintenance supervisor share the responsibility for the reorder results and must work together to maintain acceptable service results. The dial administrator should collect data on the individual reorder items to identify the causes or reorders and should be aware of reorder trap arrangements and analysis activities for the office.

8.05 In offices with high no position attached the dial administrator should work with the operator services group to achieve improvement. The dial administrator should: request that the ATR and the FADS circuitry be verified to insure that proper load indications are being provided; review intersender timing, sender holding time, and sender capacity with the traffic engineer; identify offices experiencing ANI failures; and seek improvements. The transverter peg count registers are not scored until the billing indexer is seized. Failures which occur in an earlier stage of the call processing may equal 100 percent or more when computed as a percentage of transverter peg counts, ONI, or total if excessive failures have occurred. It must be recognized that the normal volume of CAMA calls, particularly ONI, may be very small. Thus, results must be reviewed in total for an accurate interpretation of the CAMA service.

8.06 It is suggested that the vacant code cards be collected and analyzed on a regular basis by the dial administrator. The frequency and volume of codes analyzed should be in relationship to the percentage of VCA ineffective machine attempts. Special attention should be given to the collection and analysis of VCA cards following network rearrangements requiring routing changes into the crossbar tandem.

9. DISTRIBUTION OF REPORT

9.01 The data may be entered into the computer program between the 1st and the 15th of the following month. System averages and company results may be obtained between the 16th and the end of the month following the end of the report period.

9.02 The crossbar tandem ineffective machine attempt report may be distributed to all groups directly or indirectly concerned with service. This would normally include dial administration,

switching and testboard maintenance supervisors, network management, DDD service bureau, trunk administration, and area or company staff representatives.

