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BUSY HOUR DETERMINATION—END OFFICE

GENERAL PROCEDURES

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1. GENERAL

1.01 This section describes the general procedures to be used for busy hour determination for end (class 5) offices. These procedures may be employed to satisfy the reporting requirements for the Network Switching Performance Measurement Plan (NSPMP), eg, dial tone speed (DTS) and matching loss (ML). The procedures described in this section basically provide instructions for busy hour determination in a manual environment. The same results may be derived by mechanized means. Locations that have access to the Central Office Equipment Reports (COER) subsystems for busy hour determination, or equivalent, should use these mechanized systems to complete busy hour studies. (Refer to the COER lessons that relate to the office type being studied.) Where these systems are not available, the studies must be completed manually. In either case, the method used should meet the following objectives:

- To select hours that best provide data for engineering purposes
- To select service busy hours that most accurately reflect the service rendered by the office being measured
- To select busy hours that permit a minimum amount of data processing to satisfy the varied data requirements for a given office.

Note: This section does not apply to class 5 offices that use extreme value engineering (EVE) such as step by step (SXS) with Small Office Network Data System (SONDS), 5ESS* switch, etc.

1.02 This section is reissued to incorporate instructions previously contained in the Service Evaluation Practices (SEP). Because this is a general revision, revision arrows have been omitted.

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2. TYPES OF BUSY HOURS

A. Office Busy Hour

2.01 For engineering purposes, the office busy hour is defined as the time-consistent 60-minute period with the highest usage per main station throughout the office busy season. The 60-minute period may begin on the hour or half-hour.

2.02 This period of highest usage in ESS switches and electromechanical switches refers to line network usage measured in hundred call seconds (CCS).

2.03 To determine the office busy hour, it is necessary to collect and analyze usage data by half-hours during all periods of the day that may produce high loads. The data collection period is normally between 8 am and 11 pm and from 5 through 15 consecutive business days. Office calling characteristics determine the hours and number of study days. (See paragraph 3.01.)

2.04 In some cases, an office may have an obvious and unchanging busy hour and 5 days would be an adequate period for the busy study. In this case, the study is only to verify that the hour has not changed. In other offices, several hours may appear to carry loads of approximately the same magnitude. Therefore, studies of longer duration (10 or 15 days) would be required. If several hours regularly carry approximately the same load, data should be collected for these hours throughout the office busy season.

2.05 Customer calling characteristics within a service area may change, resulting in a shift from the predetermined busy hours. This shift usually occurs gradually unless there is an unusual influence, eg, a rate change, large business relocations, area transfers, etc. When shifts do occur or are suspected of occurring, the network administrator should conduct additional busy hour studies to assure that the proper data are being reported and used. This could involve reporting the past busy hour and the overtaking hour to provide sound historical trend data.

B. Component Busy Hours

2.06 The component busy hour(s) relates to hardware and software items. The component busy hour is usually the time-consistent hour with the highest usage (CCS) for the individual component. However, busy hours are not always determined by usage (For example, dial tone markers in No. 5 crossbar are determined by peg count).This hour may be concurrent with the office busy hour. The office components for which busy hours must be determined vary by office type. Some examples are as follows:

- Step-by-Step—Line finders, connectors, etc
- Crossbar—Originating registers, outgoing senders, incoming registers, etc
- ESS Switch—Customer digit receivers, transmitters dial pulse receivers, etc.

2.07 Prior to the start of the busy hour determination study, the network administrator should plan to study all components for which they are responsible (normally all traffic sensitive components). After the busy hour determination studies have been completed, the network administrator and engineer should review the hours and agree on the office and component hours for the new data year.

C. Service Busy Hours

2.09 Service busy hours relate to those time-consistent 60-minute periods starting on the hour or half hour when:

(a) The highest percentage of users attempting to originate a call must wait more than 3 seconds for dial tone. This is the dial tone speed (DTS) busy hour. This busy hour is based on DTS tests (or actual calls for 2 and 3ESS switches) encountering dial tone delay over 3 seconds.

(b) For common control offices, a call encounters a network blockage preventing the completion of the call. This is referred to as matching loss. The time-consistent hour with the greatest matching loss is the matching loss busy hour. Each individual type of matching loss may have its own busy hour. Examples of matching loss include: incoming matching loss (IML), network matching loss (NML), and incoming first failure to match (IFFM).

D. Call Busy Hour

2.10 The call busy hour is the time-consistent 60-minute period (on the hour or half hour) with the highest call rate per main station (CR/MS).

3. BUSY HOUR DETERMINATION STUDY—GENERAL PROCEDURES

3.01 Busy hour determination (BHD) studies must be conducted on a regular systematic basis to ensure that the proper hours are being measured throughout the busy season. Normally one BHD study is scheduled each year just prior to the busy season. Another BHD study should be scheduled later in the busy season as a verification.

3.02 The busy season is defined as the 3 months (not necessarily consecutive) having the highest average time consistent busy hour load.

3.03 Busy hour studies should include a study of component, office, and service busy hours.

3.04 To ensure that the correct busy hours are studied during the busy season, the BHD study should be completed just prior to the busy season. However, timing is very important. The BHD study must be taken as close to the busy season as possible, yet completed early enough to allow busy hour changes to be made in the various data collection systems.

3.05 It should also be noted that after major addition, area transfer, etc, in which calling characteristics change, a BHD study should be taken, no matter what time of year. This study will ensure that the data are being collected on the right hour.

A. Office Busiest Hours Not Known

3.06 If the busier hours of the day are not known or changes in the office calling characteristics are suspected and the busy hour study is taken manually, then a preliminary study should be conducted as described in the following paragraphs.

3.07 Just prior to the busy season, accumulate half-hourly data for 5 business days for each equipment component, normally from 8 am through 11 pm. Summarize and compute a 5-day average for each hour of each component. Select the 3 through 6 busiest hours. These hours will be used in the actual busy hour studies over a period of 5 through 15 business days. The larger number of hours and days is required if a predominant busy hour is not evident.

3.08 Study the 3 through 6 busiest hours, by half-hours. The half-hour intervals should start 30 minutes before and end 30 minutes after the selected hours.

3.09 For each component, compute the 5- to 15-day average for each half-hour. Combine adjacent half-hour averages and select the busy hour.

B. Office Busiest Hours Are Known

3.10 If the busiest hours of the day are known, a 10-day busy hour study should be scheduled directly for a 2-week period (normally just prior to the busy season). If it is determined that the office and component busy hours have remained fixed for several years, it may be necessary to take only one 5-day study of these hours. This 5-day study is intended to confirm the designated busy hour(s). If the BHD study confirms that the correct busy hour is being reported, no change is made. The hour(s) should continue to be used for the current and following busy season.

3.11 If the change to daylight saving time occurs during the busy season, a new busy hour study may be required.

C. Busy Hour Study Preparation

3.12 Prior to the start of data collection for the busy hour studies, measuring devices should be thoroughly tested for proper operation and proper cross-connections. This includes detector tests in locations using traffic usage recorders. Equipment outages should be identified and necessary action taken to eliminate them. An early morning review (eg, 2 am through 3 am) of usage during the study is suggested. This review, taken during a period of light traffic, should reveal any false usage due to equipment busied out or malfunctioning.

4. STUDY PERIOD EVALUATION

4.01 The network administrator must examine the validity of the data in the light of occurrences within the study period. The studies may be distorted by short-duration peaks in load caused by conditions such as school closing, weather phenomena, local

group activities, holidays, etc. The study should be rescheduled if the data is deemed invalid.

4.02 The network administrator should make checks of the busy hour study data that are pertinent to the switching system being studied. The following checks should be performed:

(a) Stored Program Control System-Central Office Equipment Reports (SPCS-COER) Environment: Batch status and reliability reports should be checked weekly (on line) for data entry or reliability problems.

(b) Manual Environment

- Compare usage totals of appropriate components
- Compare usage totals of similar groups or frames in the office
- Check day-by-day consistency of usage for each group or frame
- Derive and analyze holding times of various components
- Check usage against service.

5. RATIO OF COMPONENT BUSY HOUR TO OFFICE BUSY HOUR

5.01 For those offices that have access to COER (or equivalent) the component busy hour/office busy hour ratio method may be applied to any component to conserve the amount of COER cost. In general, using 1 or 2 hours of SPCS-COER for most components and busy hour ratios for the remaining components will conserve COER cost sufficiently. In non-COER offices a ratio of the component busy hour to the office busy hour may be applied to any component to conserve the amount of busy hour data collected during the busy season. In any case, this ratio is developed by dividing the component busy hour usage by the component usage during the office busy hour.

Example:

Component usage during the component busy hour = 732 (CCS)

Component usage during the office busy hour = 681 (CCS)

$$732 \div 681 = 1.07$$

The 1.07 factor is applied to the office busy hour component usage for the remainder of the busy season and the result is reported as the components busy hour usage.

5.02 The ratio method should not be used when as a result of applying the factor, the usage indicates 100 percent or more of the component's engineered capacity. In these cases the actual component busy hour usage should be collected.

6. SERVICE BUSY HOUR DETERMINATION

6.01 Busy hours must be determined for certain service measurements to satisfy NSPMP requirements. These service measurements include:

- Dial tone speed (DTS) results for all measured offices
- Matching loss (ML) results for all common control offices.

A. Dial Tone Speed Service Busy Hour

6.02 The DTS service busy hour may coincide with the office busy hour or a separate busy hour may be determined. The busy hour may start on the hour or half-hour, eg, 10 am to 11 am or 10:30 am to 11:30 am, etc.

6.03 For purposes of computing DTS measurement results, the DTS service busy hour is defined as: ***the time-consistent hour having the greatest average business day percentage of dial tone speed delay greater than 3 seconds.*** If the office is experiencing no dial tone delay, the hour with the highest usage on dial tone equipment should become the designated busy hour, eg, customer digit receiver (CDR) usage, originating register usage, etc.

6.04 At the beginning of the busy season, the DTS busy hour that was determined from the previous busy season data is used for accumulating and reporting DTS results.

Busy Hour Study

6.05 The DTS busy hour determination study should be conducted just prior to the busy season, normally coincident with the office and component busy hour studies.

6.06 If the DTS busy hour has remained constant, a 5-day study may be sufficient. If the busy hour has not been readily apparent, then a study of 10 days may be appropriate. Local knowledge of the office will determine the length of the study. The data collection period is normally between 8 am and 11 pm and the data is collected in half-hour periods. The DTS results are summarized and a 5-day average for each hour is computed.

Designated Busy Hour Confirmed

6.07 When the study confirms that the current busy hour is the same as the designated busy hour, then this hour is used for the remainder of the busy season.

New Busy Hour Indicated

6.08 When the busy hour determination study results indicate another time-consistent hour having an average business day DTS delay percentage that is at least 0.5 percent greater than the designated hour, continue to collect data for both hours. If the new hour results continue to exceed the designated hour results by 0.5 percent for 4 consecutive weeks, the new hour is designated as the busy hour. Then start using the new DTS busy hour at the beginning of the next service month.

6.09 If the busy hour study records no dial tone delays recorded, then use the component usage busy hour for the equipment supplying the dial tone. For example, CDR busy hour (1ESS switch) originating register busy hour (No. 5 Crossbar).

6.10 Other activities related to a busy-hour change include:

(a) Validation of the data should be completed before any shift to a new busy hour.

(1) Recognition should be given to the equipment made busy, maintenance outages, abnormal equipment operating conditions affecting service results; to area transfers, new tariff offerings, or other factors affecting traffic characteristics; and to pertinent network switching and customer reports.

(2) When the hour of highest dial tone delay does not substantially coincide with the hour of maximum usage on related equipment (eg, CDRs, line finders originating registers) for that class of service, the reason(s) should be investigated. If the data proves to be invalid, conduct another busy hour determination study.

(b) Note on the DTS NSPMP worksheets (see Section 780-350-060) when an observed DTS busy hour is changed. The notation should include the following:

(1) Show the time period and service results for the previously designated busy hour.

(2) Indicate the dates of the verification study.

(c) If an office has more than one loading division, the busy hour shall be determined separately for each loading division.

Offices With 100 Percent Dial Pulse or 100 Percent TOUCH-TONE* Service

6.11 The following rules apply to offices that are either 100 percent dial pulse service or 100 percent TOUCH-TONE service.

(a) ***No. 5 Crossbar Offices:*** All classes of service are mixed on the line link frames. Therefore, a single DTS busy hour is selected for the entity as a whole.

(b) ***No. 1 Crossbar Offices:*** More than one class of service may be served from the line link frames. Therefore, selection of the DTS busy hour is based on each type of line link frame, ie, individual frame, party frame, and coin frame.

(c) ***Step-by-Step Offices:*** The DTS busy hour is selected by class of service, ie, flat rate, message rate, coin, etc.

* Registered service mark of AT&T

(d) ***1, 2, and 3ESS Switch Offices:*** The DTS busy hour is selected for the control group as a whole.

Offices With Dial Pulse and TOUCH-TONE Service

6.12 The following rules apply to offices with both dial pulse (DP) and TOUCH-TONE service equipment:

(a) ***No. 5 Crossbar Offices:*** Where separate originating register equipment is provided, DTS results for each type must be obtained.

(b) ***No. 1 Crossbar Offices:*** The selection of the DTS busy hour is based on each type of line link frame, ie, individual frame, party frame, and coin frame (DP and TOUCH-TONE service). The TOUCH-TONE service is not considered a separate class of service, except in those offices partially equipped which do not have a common overflow group of senders.

(c) ***Step-by-Step Offices:*** The DTS busy hour is selected by class of service, ie, flat rate, message rate, or coin. The TOUCH-TONE service shall be considered as a separate class of service only if provided on a common control basis.

(d) ***1ESS Switch Offices:*** A common CDR overflow group is recommended in 1ESS switch. A single DTS busy hour is selected. Due to three group operation and customer calling characteristics, it is possible to have different DTS busy hours for dial pulse and TOUCH-TONE service.

(e) ***2 and 3ESS Offices:*** A separate DTS busy hour is selected for TOUCH-TONE service and DP receivers.

B. Matching Loss Service Busy Hour

6.13 Each busy season the matching loss service busy hour must be determined. The following paragraphs give instructions for selecting matching loss busy hours by type of office. This selection process will satisfy the busy hour requirements for the related NSPMP. Busy hour determination studies for just these measurements are normally taken just prior to the office busy season.

No. 1 and 5 Crossbar Offices

6.14 The NSPMP matching loss measurement for No. 1 and 5 Crossbar Offices is incoming matching loss (IML). For No. 5 Crossbar Offices, Incoming First Failure to Match (IFFM) is also reported on the NSPMP. The same methods that apply to matching loss also apply to IFFM.

6.15 The IML service busy hour is defined as the time-consistent hour having the greatest average business day percentage of incoming matching loss. The busy hour may start on the hour or half-hour, eg, 10 am through 11 am or 10:30 am through 11:30 am, etc. If the office records no IML, then the hour with the greatest network usage is designated as the IML busy hour.

1ESS Switch Offices

6.16 The NSPMP matching loss service busy hour measurement for 1ESS switch offices is weighted percentage of matching loss total month. This measurement combines IML and intraoffice matching loss (IAML) results on a weighted basis and is defined as the time-consistent hour having the greatest average business day weighted matching loss. The busy hour may start on the hour or half-hour. If the office records no matching loss, the hour with the greatest network usage is designated as the weighted percentage of matching loss busy hour. Refer to paragraph 6.22 for instructions on computing weighted percentage of matching loss.

2 and 3ESS Switch Offices

6.17 The NSPMP matching loss service measurement for 2 and 3ESS switch offices is network matching loss (NML). This measurement combines IML, IAML, tandem and outgoing matching loss (OML). (Refer to Sections 232-070-041 and 233-020-034 for NML calculations and worksheets.) The office busy hour is used for the NML busy hour and may start on the hour or half-hour.

Matching Loss Service Busy Hour Study Procedures

6.18 The matching loss service busy hour determination studies are normally taken during the same period that the office and component busy hour studies are taken, just prior to the busy season. The study hours normally range between 8 am and 11 pm. The busy hour determined from the previous busy

season data is retained for the duration of the current busy season unless the study indicates a new hour should be used. If the new study shows another time-consistent hour having an average business day percentage of matching loss that exceeds the designated busy hour results by an amount of at least 0.5 percent for each of 4 consecutive weeks, the new hour is designated as the busy hour. Then, start using the new busy hour at the beginning of the next service month.

6.19 If the busy hour study records no matching loss, then use the hour with the greatest network usage.

6.20 Other activities related to a matching loss busy hour change include:

(a) Validation of the data should be completed before any shift to a new busy hour.

(1) Recognition should be given to:

- Equipment made busy
- Abnormal equipment operating conditions affecting service results
- Area transfers
- New tariff offerings
- Other factors affecting traffic characteristics.

(2) When the hour of highest matching loss does not substantially coincide with the hour of maximum network usage the reason(s) should be investigated. If the data proves invalid, conduct another busy hour determination study.

(b) Note on matching loss NSPMP worksheets (see Section 780-350-060) when a matching loss service busy hour is changed. Include the following:

(1) The hour and service results for the previously designated busy hour

(2) The dates of verification studies.

(c) If an office has more than one loading division, the busy hour shall be determined separately for each loading division.

Computing Weighted Percentage of Matching Loss (1ESS Switch)

6.21 To determine the matching loss service busy hour for 1ESS switches, weighted percentage of matching loss results must be computed. Refer to Fig. 1 for a sample of a Weighted Percent Matching Loss Determination worksheet. This form should be reproduced locally.

6.22 For each day of the study period, make the following entries for each study hour. The equipment group or office count number (EGO) is shown in parentheses.

(a) ***Column 1, Date Bus Day:*** Enter the date of the business day being studied.

(b) ***Column 2, Inc Calls:*** Enter the total incoming calls (EGO 015).

(c) ***Column 3, TDM Calls:*** Enter the total tandem calls (EGO 131).

(d) ***Column 4, Inc Calls Minus TDM:*** Subtract Column 3 from Column 2 and enter the result in Column 4.

(e) ***Column 5, Matching Loss:*** Enter IML (EGO 016).

(f) ***Column 6, % IML:*** Divide Column 5 by Column 4 and multiply by 100. Enter the result in Column 6.

(g) ***Column 7, IAO Calls:*** Enter the total intraoffice (IAO) calls (EGO 031).

(h) ***Column 8, Matching Loss:*** Enter the total IAML (EGO 032).

(i) ***Column 9, % IAML:*** Divide Column 8 by Column 7 and multiply by 100. Enter the result in Column 9.

(j) ***Column 10, Total Calls:*** Enter the sum of Columns 4 plus 7.

(k) ***Total:*** Enter totals of Columns 2, 3, 4, 6, 7, 9, and 10.

(l) ***Average:*** Divide each total by the number of study days.

(m) ***Column 11, Weighting Factor:*** Complete the following steps:

(1) Enter in block 12 the average calls from Column 4.

(2) Enter in block 13 the average calls from Column 7.

(3) Total the average incoming calls (Column 4) and IAO calls (Column 7) and enter in block 14.

(4) Divide block 12 by block 14, carry to three decimal places. Enter the result in block 15.

(5) Divide block 13 by block 14, carry to three decimal places. Enter the result in block 16. The total of block 15 and 16 should equal 1.000.

(6) Multiply the average of Column 6 by the factor in Column 15. Enter the result in block 18.

(7) Multiply the average of Column 9 by the factor in Column 16. Enter the result in block 19.

(8) Add blocks 18 and 19. Enter the sum in block 20.

6.23 After the data has been summarized for each hour, compare the Total Weighted % Matching Loss results with the results of the designated busy hour. If there is a time-consistent hour that the Total Weighted % Matching Loss is at least 0.5 percent greater than that of the designated busy, hour continue to study both hours. If the new hour continues to exceed the designated busy hour by 0.5 percent for 4 consecutive weeks, the new hour is designated as the busy hour. Start using the new busy hour at the beginning of the next service month.

7. BUSY HOUR DETERMINATION RECORD RETENTION

7.01 All reports or worksheets, standard or locally developed, which document the determination and selection of busy hours shall be retained for 1 year.

WEIGHTED PERCENT
MATCHING LOSS BUSY HOUR
DETERMINATION

OFFICE_____ HOUR_____

LEAD GROUP	IML					IAML			TOTAL CALLS (4+7)
DATE BUS. DAY	INC. CALLS	TDM CALLS	INC. CALLS MINUS TDM (2-3)	MATCHING LOSS	% IML (5÷4)	IAO CALLS	MATCHING LOSS	% IAML (8÷7)	
1	2	3	4	5	6	7	8	9	10
TOTAL									
AVERAGE									

WEIGHTING FACTOR					WEIGHTED % IML	18	NOTES:
LOAD GRP.	AVERAGE CALLS		FACTOR				
IML		12		15	WEIGHTED % IAML	19	
IAML		13		16			
TOTAL		14	1,000	17	TOTAL WEIGHTED % ML	20	

Fig. 1—Example of Weighted Percent Matching Loss Busy Hour Determination Worksheet (6.21)