SWITCHING SYSTEMS MANAGEMENT
LINE CONCENTRATORS—LOOP SWITCHING SYSTEM ADMINISTRATION

CONTENTS PAGE

Figures

1. GENERAL

A. Purpose

1.01 This section describes the procedures to administer a loop switching system (LSS). The administrative concepts are the same as in Dial Facilities Management Practices, Division H, Section 15b(2), for the subscriber loop multiplexer. However, the procedures have been simplified. Weekly peak load data are used to predict main station capacity and to establish loading guidelines. Also included in this section is a description of the service performance monitoring and alarm system of the LSS.

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

B. Description

Note: Throughout this section, it is important to distinguish carefully between lines and main stations.

1.03 The LSS is a system that will serve 96 lines, some of which may be multiparty. These 96 lines are divided into 24 line groups of four lines each and are served by 32 voice channels through a grading arrangement that provides each line group with access to seven voice channels. Thus, communication between a customer and the central office may be temporarily blocked because the access channels are busy handling calls to or from other lines. Blocking should be held to the lowest level that can reasonably be achieved, so that service provided to customers on an LSS is virtually indistinguishable, from a traffic viewpoint, from service provided on cable pairs. For this reason, traffic performance on the LSS is discussed in terms of the number of times per year in which

the probability of blocking exceeds one-half of 1 percent.

> ***Note:*** Studies have shown that, for this grading arrangement, load imbalance on the line groups has no appreciable effect on service. For this reason, the LSS has no load balance requirement or measurement capability.

C. Measurement Use

1.04 Traffic studies have shown that the loads generated by subscribers vary widely from place to place, from customer to customer, and from time to time for any group of customers. The LSS is therefore equipped with traffic measurement capabilities which are used to monitor performance and to prevent overloads. These measurements are also used to determine the number of main stations that can be served by a particular system without exceeding the traffic capacity of the LSS. This section describes how these measurements are used to calculate ***allowed main station*** capacity (the number of main stations that can safely be served by an LSS based on the available data). Use of these procedures should make it unnecessary, in most cases, to deload a system.

D. Loading

1.05 Although the LSS is physically limited to 96 lines, more than 96 main stations can be connected if some are multiparty lines. Traffic patterns indicate that very few LSSs would be overloaded when serving 96 rural residential main stations. Maximum fill below 96 main stations will be found more often among systems serving other than rural residential subscribers. Thus, no more than 70 main stations should be connected to an LSS until at least 4 weeks of weekly peak load traffic measurements are taken and indicate that it is safe to increase the number of working main stations.

E. Subscriber Characteristics

1.06 As a general rule, an LSS is most effectively used if it serves low-usage lines, thus utilizing the line concentration in the LSS. Lines with high usage, such as coin or business lines, lines serving professional people, and full 8-party lines, should be excluded from the LSS (and served on cable pairs) in favor of low-usage lines.

2. MEASUREMENTS

A. Measurement Capability

2.01 Each LSS is equipped with the blocked calls display (BCD) register and the weekly peak load (WPL) register. These registers are used to determine the allowed main station capacity and to detect overloaded conditions. The registers are the resettable type and are located on the central office terminal (COT).

B. The Blocked Calls Display Register

2.02 A measurement of the current performance of the system comes from the BCD register, which counts the number of blocked or delayed calls. A terminating call which finds no path to the called line will be routed to reorder (120 IPM) and will score the BCD register. An originating call which finds no immediate path to the central office will observe a dial-tone delay and will score the BCD register. For manual monitoring, the BCD register should be reset to zero when read and when next read will contain the total number of blocked or delayed calls since the register was reset. This register normally will be read and reset once a week. The interpretation of this measurement is discussed in Parts 7 and 8. In any ESS office, terminating blocked calls are not scored on the BCD register; only originating delayed calls are scored. (See 7.02 for a discussion of the BCD register in ESS offices.)

C. The Traffic Overload Alarm

2.03 A second internal BCD register is monitored by the electronics of the central office terminal of the LSS. As described more completely in Part 9, when the traffic service objective is not being met, the central office terminal has the capability of indicating a minor central office alarm and turning on a traffic overload indicator light. For this reason, the BCD register need not be manually monitored. However, optional manual monitoring procedures are given in Parts 7 and 8 for situations where a close watch of service is desired. Also, momentary power failures will disrupt the automatic alarm system.

D. The Weekly Peak Load Register

2.04 The WPL register records the highest hourly carried load in CCS/10 that has occurred

since the register was last read and reset to zero. Each voice channel is scanned every 100 seconds. The register display, however, records only to the nearest 10 CCS. For example, 324 CCS will read as 32 and 325 CCS will read as 33. The WPL register must be read and reset to zero once a week for the procedure described below to be valid. This register should be read at a specific time each week. Maintenance and permanent signal usage are included in the CCS reading.

E. Measurement Concept

2.05 The methods used in this section are considerably different from most other traffic measurements and associated administrative procedures in the Bell System. The load carried in the time-consistent busy hour is not measured. Instead, only the peak hourly load per week is measured. Also, the ongoing performance of the LSS is automatically monitored by the count of blocked or delayed calls. The main purposes of this approach are to maintain surveillance 24 hours per day and to minimize the amount of traffic data that have to be recorded and processed.

3. SERVICE CRITERIA

A. Service Objective

3.01 The LSS is designed to be basically transparent or nonblocking. Transparency is defined as no more than four occurrences of one-half of 1-percent blockage during a 12-month period. This service objective has been established so that service provided by an LSS is virtually indistinguishable from service provided on cable pairs. The loading procedures in Parts 4 and 5 are based on this objective.

B. Heavy-Load Hour

3.02 The probability of blocking is one-half of 1 percent when, on the average, one out of every 200 calls is blocked and receives reorder tone (120 IPM) or experiences dial-tone delay. An hour in which the offered load is high enough to cause blockage of one-half of 1 percent or worse service is called a ***heavy-load hour.*** For the LSS, this is about 562 CCS when 30 percent of the traffic is intrasystem.

C. Deload Criterion

3.03 To avoid continual adding and removing of main stations because of normal variations in traffic loads, the criterion for deloading a system is less restrictive than the service objective. The deload criterion is that the system should experience no more than 12 occurrences of a heavy-load hour in a 12-month period. The monitoring procedures described in Parts 7, 8, and 9 are based on this criterion.

4. LOADING PROCEDURE

A. General

4.01 The basic approach to loading an LSS is to first measure the weekly peak loads generated by the customers presently served by the system. From these measurements and a knowledge of the number of customers assigned when the data were collected, the number of customers that can be assigned to a given LSS is estimated. As the loading continues, this procedure is repeated, thus providing increasingly accurate estimates of the eventual allowed main station capacity. Consequently, the eventual allowed main station capacity is determined by the traffic characteristics of the customers on the LSS and will differ for individual systems. The predictive feature allows a planned loading of the LSS and gives information necessary for the provision of additional facilities when needed. It is assumed that the customers who will be served by a system in the future are, as a group, similar to those whose traffic is measured. There is no way of ensuring the truth of this assumption which leads to certain precautions in the following rules:

(a) The network administrator should never knowingly load onto an LSS a large group of customers who are likely to generate substantially more traffic than do the customers already being served.

(b) The loading administrative procedure should begin when there are 40 or more main stations being served because there is little predictive value in weekly peak load measurements from less than 40 main stations.

B. Measurement Week

4.02 The total administrative procedure requires 16 valid weekly readings. The basic

measurement interval is called a measurement week and is the period corresponding to a valid reading of the weekly peak load register. A measurement week should normally include 5 business days. This, however, may not always be possible. Measurement weeks may be made up of not less than 4 business days. For example, if the weekly peak load register is read every Friday and a Monday is a holiday, the fact that the week has only 4 business days is ignored, and the week is treated like any other week. Or, suppose that the register is usually read on Friday but in one case is read the following Monday afternoon or evening instead, the 2 adjacent measurement weeks would consist of almost 6 business days and just over 4 business days, respectively. Both of these weeks would be considered as valid measurement weeks. Data could not be used, on the other hand, if readings were more than 1 business day away from the normal schedule, i.e., if the period over which a peak load was measured contained more than 6 or less than 4 business days. When this happens, the period involved is not a valid measurement week, and the measured peak load must be discarded and not used in administering the LSS.

4.03 A period is not a valid measurement week if, during the period, there has been a central office power failure or a removal of logic unit 4 from the central office terminal. These events reset the weekly peak load register to zero.

C. Measurement Month

4.04 The measurement weeks are grouped into a measurement month, consisting of 4 valid measurement weeks. The weeks neither need be consecutive nor in the same calendar month. The measurement month is merely the last 4 valid measurement weeks that can be used to predict allowed main station capacity. Suppose, for example, that a weekly reading of the peak load register is skipped 1 week so that, when next read, the register contains the peak load that occurred over a 2-week period. Such a reading must be discarded; but if obtained for subsequent weeks in the usual way, the data can be used to make up a measurement month that has a 2-week gap in it, e.g., using weeks 1, 2, 5, and 6 if no valid readings were obtained in weeks 3 and 4.

D. Estimated Main Station Capacity

4.05 At the end of each measurement month, an estimated main station capacity is calculated by using Form 1 (Fig. 1), which is described later. The system is allowed to be loaded according to the rules on Form 2 (Fig. 2) as explained in Part 5. No system should be loaded beyond 70 main stations until at least 4 weeks of data are collected and the procedure indicates that it is safe to do so.

E. Predicted and Allowed Main Station Capacity

4.06 The predicted main station capacity is determined by computing the weighted mean of the estimated main station capacity from up to and including 4 measurement months. (See Form 2, Fig. 2.) The allowed main station capacity is the number of main stations that safely can be served by the LSS based on the available traffic data. With 4 measurement months of data, the allowed main station capacity is the smaller of the predicted main station capacity and the current average number of working main stations plus 40. With less than 4 measurement months, additional restrictions are imposed in computing the allowed main station capacity.

F. Measurement Frequency (Fully Loaded Systems)

4.07 An LSS is fully loaded to its traffic capacity if, with 4 measurement months of weekly peak load data, the current number of working main stations is equal to or greater than the allowed main station capacity. At this point, no main stations should be added to the LSS, and continuous weekly peak load readings are not needed. The service of the LSS will be monitored by the automatic traffic monitoring and alarm system or optionally by the BCD register and manual monitoring.

5. LOADING PROCEDURE WORKSHEETS

A. Form 1 (Measurement Month Calculation)

5.01 The date of reading, the number of working main stations, and the WPL readings are recorded on Form 1. It also serves as a worksheet to accumulate weekly figures for a measurement month. The primary uses of this form are as follows:

(1) To check the 10-percent growth limit on main stations

(2) To calculate the estimated peak load that is expected to be exceeded four times a year

(3) To calculate an estimated main station capacity based on data for a single measurement month.

B. Record Data

5.02 Once a week, at a predetermined time, read and reset the WPL register. On Form 1 (Fig. 1), record the WPL reading in column (3), the date of the reading in column (1), and the current number of working main stations in column (2). Since the WPL register records in CCS/10, the reading should be multiplied by 10 before applying the procedures. For this reason, the final zero has been printed in columns (3) and (4). For example, in week 1, the meter read 34 but appears in column (3) as 340 CCS.

C. The 10-Percent Growth Limit Check

5.03 Growth is limited to 10 percent for valid measurements. This limit is checked by taking the smallest number of working main stations, which is 66 in the example in Fig. 1, and adding 10 percent (6.6) which rounds out to 73. Then check to see that the other three weekly main station values do not exceed 73. In the example, 66, 69, and 70 do not exceed 73. Thus, proceed to find the average working main stations.

D. Over 10-Percent Growth Limit

5.04 Do not proceed if, for example, the number of working main stations is 66, 69, 70, and 74. These weeks cannot constitute a valid measurement month because 74 is greater than the lowest week, 66, plus 10 percent. Discard week 1 and start with the second week where the working main stations equal 69. Adding 10 percent to 69, a new growth limit of 69 plus 7 equals 76 main stations is established. We now have measurement weeks of 69, 70, and 74 main stations with a growth limit of 76. If the next measurement week of readings has 76 or less working main stations, it constitutes a valid measurement month. If the working main stations exceed 76, the procedure starts again with week 3 with 70 main stations.

E. Estimated Main Station Capacity

5.05 In order to determine the estimated main station capacity, the following calculations are required:

(1) Average working main stations

(2) Estimated quarter-year load

(3) Fractional capacity in use.

Average Working Main Stations

5.06 When 4 weeks of valid data are collected, add all four numbers in column (2) and record the total in the space marked SUM. The average of working main stations is determined by taking the sum and dividing by 4. In the example, this would be 271 divided by 4 equals 68.

Estimated Quarter-Year Load

5.07 The four WPL readings in column (3) are transcribed into column (4) in numerical order from the smallest to the largest. This is indicated by the ***S*** (smallest) for the first entry in column (4) and an ***L*** (largest) for the last entry in column (4). Each entry in column (4) is multiplied by the corresponding weighting factor in column (5), and the product is placed in column (6). The products in column (6) are then algebraically added. It is important to note that the first weighting factor in column (5) is negative. Therefore, the first product in column (6) is negative. When algebraically adding column (6), the absolute value of the first product is subtracted from the sum of the last three products. In the example in Fig. 1, the sum of the last three products is 238 plus 237 plus 144 equals 619, and the algebraic sum is 619 minus 252 equals 367 CCS. This sum is entered in the box labeled SUM = ESTIMATED QUARTER-YEAR LOAD.

Fractional Capacity in Use

5.08 The fractional capacity in use (F) is obtained by dividing the estimated quarter-year load by the LSS heavy-load hour capacity (562 CCS). This is recorded in the box in the lower left of Fig. 1. F is 0.65 in the example.

Determining Estimated Main Station Capacity

5.09 The estimated main station capacity (E) is obtained by dividing the average working main stations by the fractional capacity in use. This is recorded in the box in the lower right of Fig. 1. In the example, the estimated main station capacity is 105 main stations. The estimated main station capacity is not used to load the LSS. It is used to determine the allowed main station capacity as calculated using Form 2.

F. Form 2 (Monthly Summary)

5.10 The procedure described in 5.05 through 5.09 is repeated for each of 3 additional measurement months and summarized on Form 2 (Fig. 2). For each measurement month, the estimated main station capacity and the end-of-month date [last entry in column (1) on Form 1] are obtained. Copy these dates into column (1) and the estimated main station capacities into column (2). Also copy the average number of working main stations from Form 1 into column (3) for each measurement month.

G. Predicted Main Station Capacity

5.11 For each month, multiply the estimated main station capacity by the average number of working main stations, and enter each product in column (4). When four monthly readings are obtained, add columns (3) and (4). Copy these totals into the box for step 1, divide, and round to the nearest whole number to get the predicted main station capacity of the LSS system (116 main stations in this example).

H. Allowed Main Station Capacity

5.12 Following the ***YES*** branch of step 2, because there are data for 4 measurement months, copy the predicted main stations onto line B; and on line A, add 40 to the last number of average working main stations in column (3) (82 in Fig. 2) to get 122. (Because no more than 40 main stations may be added on the basis of a predicted capacity, 40 is added.) The smallest number on lines A and B is the allowed main station capacity of the system. (If the predicted number of main stations had been larger than 122 in this example, the allowed main station capacity would have been 122.) The allowed number of main stations that can safely be served by this LSS on the basis of the weekly peak load measurements already taken is 116. Note the large differences among the numbers of estimated main stations [column (2), Fig. 2] in the 4 measurement months; this variability is atypical. If allowed main station capacity is less than the number of currently working main stations, the LSS should not be deloaded. (Deloading should only be done according to the monitoring procedures described in Parts 7 and 8.) When 4 measurement months of data are available and the allowed main station capacity is less than or equal to the number of currently working main stations, the system is fully loaded and WPL readings may be discontinued. Each busy season, the allowed main station capacity should be recomputed to determine that the LSS is fully utilized. Monitoring with the blocked call display register should continue on an ongoing basis.

I. LSS Loading With Less Than 4 Months of Data

5.13 Occasions may arise in which decisions about loading of an LSS must be made before 4 measurement months of traffic data have been obtained. The following rules, which include precautions that are otherwise unnecessary, will allow a system's main station fill to increase before 4 measurement months have elasped.

(a) No more than 40 additional main stations can be added to the last average number of working stations.

(b) The system must remain at least 20 main stations below predicted main station capacity.

(c) The fill must go no further than halfway from the last average number of working main stations to the predicted main station capacity.

5.14 Three separate limits must be found as shown in the box on branch ***NO*** of step 2 in Fig. 2. The system can then be loaded to the smallest of these three numbers of main stations. The 1, 2, or 3 measurement months of data can be obtained in the usual way and their estimated main station capacity found. These can be combined into a predicted main station capacity, but this value of predicted main stations must be used somewhat differently. An example for 2 measurement months is shown in Fig. 3. Suppose for example that held orders will occur unless some customers are promptly added to a system for which the predicted number of main stations is 111 based on

only 2 measurement months and that the last of these measurement months had an average number of working main stations of 72. As shown, the three limits are 112, 91, and 92 main stations, respectively. The fill could be increased to 91 main stations without waiting for additional measurements. It is possible for the predicted main stations minus 20 to be less than the last average number of working main stations. If this happens, the system does not have to be deloaded; it simply means that it is not safe to add more main stations with the available data, and additional data must be collected.

6. USING THE PROCEDURE

A. System Growth

6.01 This procedure is valid only when system growth does not exceed 10 percent within a measurement month. If this rule is violated, the procedure is likely to yield inaccurate results. However, the system may be loaded to the allowed main station capacity even if this growth is more than 10 percent. The weekly peak load register readings may have to be discarded during such a period. When main stations are added in this manner, the predicted main station capacity will be derived from measurement months of widely varying values. An example of when this would apply would be if a predicted main station capacity of 140 came from measurement months with average working main stations of 68, 72, 78, and 82. The allowed main station capacity would be 122 (82 plus 40). If 40 main stations were added immediately, a new predicted main station capacity would be based on measurement months with 72, 78, 82, and 122 main stations. Preferably, further measurements with about 120 working main stations should be taken, if possible getting 4 measurement months with average working main stations of about 120, to find a new value for predicted main station capacity before additional main stations are loaded onto the LSS.

B. Busy Season Considerations

6.02 Studies of rural traffic have shown little variation in peak loads between seasons of the year, but this pattern of uniformity does not describe all communities. Some groups of main stations will generate traffic having a pronounced busy season. Local knowledge will usually warn of this possibility. This section contains no specific rules for handling an LSS with seasonal traffic, but it is obvious that the measurement months used for loading such a system must be in the busy season if one exists.

7. MONITORING PROCEDURE

A. Blocked Calls Display Register Use

7.01 The blocked calls display (BCD) register is used primarily to detect systems that have exceeded the deload criterion of 12 heavy-load hours in a 12-month period. For manual monitoring, this register should be read and reset to zero once a week. The register scores once for every incoming call which does not find an idle channel to the called line and receives a reorder tone or once for every originating call which does not find immediate access to the central office and experiences some dial-tone delay attributable to congestion in the LSS. In ESS offices, terminating blocked calls are not scored by the BCD register (7.02). Dial-tone delay caused by central office congestion is not scored. Traffic on an LSS is expected to be highly variable, and any blocking at all should be rare. Therefore, it is assumed that most blocking experienced over the period of a week occurs during 1 hour. Since the LSS can carry about 300 average-length calls during a heavy-load hour, a count of 2 on the BCD register is assumed to indicate that a heavy-load hour has occurred. Such a week will be called a heavy-load week. Since a nonrecurring local disaster may temporarily cause high traffic or an equipment malfunction may cause a false reading and since removing main stations that are being served by an LSS may be expensive or impossible, the procedure is designed so that deloading is recommended only when there is a reasonable degree of assurance that the service criterion is being violated. Consequently, deloading on the basis of one or two weekly BCD measurements alone is not recommended.

B. Monitoring in an ESS Office

7.02 In any ESS office, the LSS passes to the office an indication that an LSS line group is blocked when all seven channels associated with that line group are busy. Those calls destined to terminate at the blocked line group are stopped at the central office and given a reorder (120 IPM) tone. Therefore, the LSS is unaware of such calls, and the BCD register cannot score such blocked calls. In any ESS office, the BCD register scores only originating delayed calls. Therefore, the

detection of an overloaded system will be slightly less effective in an ESS office. The difference in detection capability is small enough that the introduction of different procedures for ESS offices is not warranted for this section.

8. MANUAL MONITORING PROCEDURE WORKSHEET

A. Form 3 (Weekly Blocked Calls Display Record)

8.01 Figure 4 is a numerical example of how Form 3 is to be used. Each line represents a measurement week. The date of the reading is written in column (1) and the reading is recorded in column (2). The procedure is initialized by setting the BCD register to zero, writing the date in column (1), and placing an X mark in the column labeled 0 under ***(3) STATE.***

B. Monitoring Procedure

8.02 The LSS is monitored by using the four columns under ***(3) STATE.*** Each week, an X mark is placed in one of the four boxes labeled 0, 1, 2, or 3. If the week is a heavy-load week, indicated by a BCD reading of 2 or more, the mark is moved one box to the right of where it was the previous week. Examples of heavy-load weeks in Fig. 4 are weeks dated 2-12-75, 2-26-75, 3-5-75, 4-2-75, 4-9-75, 4-23-75, and 4-30-75. If the week is not a heavy-load week, the mark is moved one box to the left of where it was the previous week unless the process was in STATE 0 in the previous week; in this case, the mark is again placed in STATE 0. In Fig. 4, examples of weeks that are not heavy-load weeks are the ones dated 2-5-75, 2-19-75, 3-12-75, 3-19-75, 3-26-75, and 4-16-75. If the process goes into STATE 3 (such as for the week dated 4-30-75), the LSS is overloaded, and customers must be removed from the system.

8.03 A central office power failure or a removal of logic unit 4 from the central office terminal will reset the BCD register to zero. If either of these events is known to have occurred in a week, then the mark should not be moved to the left for such a week if the reading is less than 2, but it should be moved to the right if the reading is 2 or more.

C. Deloading

8.04 When the process goes to STATE 3 and the system requires deloading, the heavy users, if known, should be removed from the system. If a history of WPL readings is available, the procedures in Forms 1 and 2 will indicate roughly how many main stations should be removed. Once some main stations have been removed, the procedure in Form 3 should be reinitialized as described in 8.01.

9. AUTOMATIC MONITORING

A. Traffic Overload Alarm

9.01 The electronics of the central office terminal of the LSS have an automatic monitoring and alarm system which automates the manual procedure described in Parts 7 and 8. It has an elapsed time clock which only knows when a week has elapsed, an internal weekly BCD counter, and an index which keeps track of the ***STATE*** as in Form 3. When the clock indicates that a week has elapsed, the state index is altered according to the procedure in 8.02, and the elapsed time clock and the internal BCD counter are set to zero. If the state index reaches STATE 3, the traffic-alarm indicator on the central office control terminal lights, and a minor office alarm sounds. The central office maintenance force will notify the network administrator when STATE 3 is reached. When the alarm is turned off, the state index is automatically reset to zero. Note that the alarm is indicated only at the end of a week, not during a period of high traffic.

B. Relationship Between Manual and Automatic Monitoring

9.02 For most situations, the automatic alarm should eliminate the need for manually monitoring the BCD reading. A momentary power failure will cause the elapsed time clock, the state index, and both BCD counters to revert to zero. For a system operating close to the service objective, it may be desirable to follow the manual methods. The week of the elapsed time clock will probably not coincide with a calendar week or the week chosen for the manual method. Thus, the two methods may not exactly agree.

10. RELATIONSHIP BETWEEN LOADING AND MONITORING

A. Loading and Monitoring Rules

10.01 Since the theories behind the recommended procedures for using the weekly peak load and the blocked calls display are approximate, the two procedures may disagree. In such a situation, some rules have been established. The rules are based on the idea that the weekly peak load reading is primarily used as a guide for adding main stations, and the blocked calls display is used as a guide for removing main stations. The rules are as follows:

(a) Deload a system only if the BCD readings show a need to do so, regardless of what the weekly peak load readings indicate.

(b) Increase the main stations on a system only if the weekly peak load readings indicate that it is safe to do so and the BCD readings, if recorded manually as described in Part 8, have been less than 2 for the last 13 weeks. (These 13 weeks must not, of course, be in a known off-season.) Since this constraint on the BCD reading cannot be used with automatic monitoring, the chances of having to deload due to unusual traffic patterns increase slightly with automatic monitoring.

10.02 Under normal conditions, the application of rule b should eliminate the need to apply rule a. Some situations which may cause the need to apply rule a are as follows:

(a) A sudden shift in the traffic characteristics of the customers being served

(b) A seasonal variation not adequately accounted for

(c) An extreme within-hour variation of traffic load.

B. Measurement Frequency

10.03 The automatic monitoring of the BCD will continue as long as the LSS is in service since it is the only direct indication that blocking of calls has occurred. The LSS is fully loaded when the allowed main station capacity, based on 4 measurement months of weekly peak load data, is less than or equal to the number of currently working main stations. At this point, no more stations may be added. The weekly peak load readings may be discontinued, but the allowed main station capacity should be determined on a yearly basis (5.12). Weekly peak load readings may be discontinued if the total physical capacity (i.e., 96 lines) of the LSS is being utilized and the system is not fully loaded from a traffic viewpoint. In addition, weekly peak load readings can be suspended for a slowly growing LSS until the main station fill approaches the allowed main station capacity. At this time, weekly peak load readings should be taken, and an updated allowed main station capacity should be computed.

LOOP SWITCHING SYSTEM
ESTIMATED MAIN STATIONS

FORM 1

OFFICE: 949 | LSS NO. 01

LOCATION: MAIN ST

Step 1. Check 10% Growth Limit on Working Main Stations

Working Main Stations = W
Maximum Working Main Stations = 1.10 x Smallest W
Maximum Working Main Stations = 1.10 x 66
Maximum Working Main Stations = 73
(Round to nearest whole no.)
Is the value of the Working Main Stations for any week, greater than this value?

NO | YES

10% growth limit has been exceeded. Start with week 2 and take another week's reading.

WEEK	(1) DATE	(2) WKG.MAIN STATIONS = W	(3) WEEKLY PEAK LOAD = WPL	(4) ORDERED WPL	(5) WEIGHTS	(6) PRODUCT (4) x (5)
1	7-10-75	66	240	S 280	−.900*	− 252 *
2	7-17-75	66	280	300	.481	144
3	7-24-75	69	300	330	.719	237
4	7-31-75	70	330	L 340	.700	238
SUM		271	SUM = ESTIMATED QUARTER–YEAR LOAD			367
		÷ 4				
AVG. WKG. MAIN STATIONS		68				

* Since the first weight in Col. (5) is negative the first product in Col. (6) should be subtracted when accumulating the sum.

F = Fractional Capacity in Use

$$F = \frac{\text{Estimated Quarter–Year Load}}{\text{LSS Capacity}}$$

$$= \frac{(\ 367\ )}{562\ \text{CCS}}$$

F = .65

E = Estimated Main Stations

$$E = \frac{\text{AVG. WKG. MAIN STATIONS}}{F}$$

$$E = \frac{(\ 68\ )}{(\ .65\ )}$$

E = 105

REFERENCE: DFMP DIV. H SEC. 15a PART 5

PREPARED BY: | DATE:

Fig. 1—Form 1 (Measurement Month Calculation)

LOOP SWITCHING SYSTEM
4–MONTH SUMMARY

FORM 2

OFFICE: 949 LSS NO.: 01

LOCATION: MAIN ST

	(1) Date End of Month	(2) Estimated Main Stations = E	(3) Average Working Main Stations = W	(4) (Col. 2) x (Col. 3)
Month 1	7-31-75	105	68	7140
Month 2	8-28-75	116	72	8352
Month 3	9-25-75	146	78	11388
Month 4	10-23-75	96	82	7872
Sum →			300	34752

Step 1. Calculate Predicted Main Stations

Predicted Main Stations = (Sum Col. 4) ÷ (Sum Col. 3)
Predicted Main Stations = 34752 ÷ 300
Predicted Main Stations = 116
(Round to nearest whole no.)

Step 2. Calculate Allowed Main Stations

Do you have values for all 4 months?

YES all 4 months

A. Add 40 to the last value of Average Working Main Stations in Col. 3
last Avg. W + 40 = 122

B. From Step 1,
Predicted Main Stations = 116

The Allowed Main Stations is equal to the lower of these two values
Allowed Main Stations = 116

Note 1:
If the Allowed Main Stations are less than or equal to the Average Working Main Stations for Month 4, the LSS is fully loaded with Allowed Main Stations and the Weekly peak load readings may be discontinued.

Note 2:
The value of the number of Allowed Main Stations determines the number of Main Stations to which this LSS can be loaded until another months' reading is available, and the number of Allowed Main Stations is recalculated.

NO 1, 2, or 3 months

A. Add 40 to the last value of Average Working Main Stations in Col. 3
last Avg. W + 40 = _____

B. Subtract 20 from Predicted Main Stations (Step 1)
Predicted Main Stations – 20 = _____

C. Find the average of last Average Working Main Stations (Col. 3) and predicted Main Stations (see Step 1)

(last Avg. W + P) ÷2
(_____ + _____) ÷2
_____ ÷2
= _____
(Round to nearest whole no.)

The Allowed Main Stations is equal to the lowest among these three numbers.

Allowed Main Stations = _____

REFERENCE: OFMP DIV. H SEC 15a PART 5

PREPARED BY: DATE:

Fig. 2—Form 2 (Monthly Summary)

LOOP SWITCHING SYSTEM
4—MONTH SUMMARY

FORM 2

OFFICE: 949 | LSS NO.: 01

LOCATION: MAIN ST

	(1) Date End of Month	(2) Estimated Main Stations = E	(3) Average Working Main Stations = W	(4) (Col. 2) x (Col. 3)
Month 1	7-31-75	105	68	7140
Month 2	8-28-75	116	72	8352
Month 3				
Month 4				
Sum →			140	15492

Step 1. Calculate Predicted Main Stations

Predicted Main Stations = (Sum Col. 4) ÷ (Sum Col. 3)
Predicted Main Stations = 15492 ÷ 140
Predicted Main Stations = 111
(Round to nearest whole no.)

Step 2. Calculate Allowed Main Stations

Do you have values for all 4 months?

YES — all 4 months

A. Add 40 to the last value of Average Working Main Stations in Col. 3
last Avg. W + 40 = _____

B. From Step 1,
Predicted Main Stations = _____

The Allowed Main Stations is equal to the lower of these two values
Allowed Main Stations = _____

Note 1:
If the Allowed Main Stations are less than or equal to the Average Working Main Stations for Month 4, the LSS is fully loaded with Allowed Main Stations and the Weekly peak load readings may be discontinued.

Note 2:
The value of the number of Allowed Main Stations determines the number of Main Stations to which this LSS can be loaded until another months' reading is available, and the number of Allowed Main Stations is recalculated.

NO — 1, 2, or 3 months

A. Add 40 to the last value of Average Working Main Stations in Col. 3
last Avg. W + 40 = 112

B. Subtract 20 from Predicted Main Stations (Step 1)
Predicted Main Stations – 20 = 91

C. Find the average of last Average Working Main Stations (Col. 3) and predicted Main Stations (see Step 1)

(last Avg. W + P) ÷2
(72 + 111) ÷2
183 ÷2
= 92
(Round to nearest whole no.)

The Allowed Main Stations is equal to the lowest among these three numbers.
Allowed Main Stations = 91

REFERENCE: DFMP DIV H SEC 15a PART 5

PREPARED BY: DATE:

Fig. 3—Form 2 (Measurement Month Example)

LOOP SWITCHING SYSTEM
WEEKLY BLOCKED CALLS DISPLAY RECORD

FORM 3

OFFICE: 949 | LSS NO.: 02

LOCATION: MAIN ST

– If the BCD reading is greater or equal to 2, the mark (X) is moved one block to the right. Otherwise it is moved one block to the left or stays in state O.

(1) DATE	(2) BCD Reading	(3) STATE 0	1	2	3*	(1) DATE	(2) BCD Reading	(3) STATE 0	1	2	3*
2-5-75	0	X									
2-12-75	2		X								
2-19-75	1	X									
2-26-75	5		X								
3-5-75	3			X							
3-12-75	0		X								
3-19-75	1	X									
3-26-75	0	X									
4-2-75	2		X								
4-9-75	4			X							
4-16-75	0		X								
4-23-75	3			X							
4-30-75	2				X						

* If the system goes to State 3 the LSS is overloaded.

REFERENCE: DFMP DIV H SEC 15a PART 8

PREPARED BY: | DATE:

Fig. 4—Form 3 (Weekly Blocked Calls Display Record)

LOOP SWITCHING SYSTEM ESTIMATED MAIN STATIONS

FORM 1

OFFICE: | LSS NO.

LOCATION:

Step 1. Check 10% Growth Limit on Working Main Stations

Working Main Stations = W
Maximum Working Main Stations = 1.10 x Smallest W
Maximum Working Main Stations = 1.10 x _____
Maximum Working Main Stations = _____
(Round to nearest whole no.)
Is the value of the Working Main Stations for any week, greater than this value?

NO | YES

10% growth limit has been exceeded. Start with week 2 and take another week's reading.

WEEK	(1) DATE	(2) WKG.MAIN STATIONS = W	(3) WEEKLY PEAK LOAD = WPL	(4) ORDERED WPL	(5) WEIGHTS	(6) PRODUCT (4) x (5)
1			0	S 0	−.900*	− *
2			0	0	.481	
3			0	0	.719	
4			0	L 0	.700	
SUM			SUM = ESTIMATED QUARTER–YEAR LOAD			
		÷ 4				
AVG. WKG. MAIN STATIONS						

* Since the first weight in Col. (5) is negative the first product in Col. (6) should be subtracted when accumulating the sum.

F = Fractional Capacity in Use

$$F = \frac{\text{Estimated Quarter–Year Load}}{\text{LSS Capacity}}$$

$$= \frac{(\quad\quad)}{562 \text{ CCS}}$$

F = _____

E = Estimated Main Stations

$$E = \frac{\text{AVG. WKG. MAIN STATIONS}}{F}$$

$$E = \frac{(\quad\quad)}{(\quad\quad)}$$

E = _____

REFERENCE:

PREPARED BY: | DATE:

LOOP SWITCHING SYSTEM
4–MONTH SUMMARY

FORM 2

OFFICE: | LSS NO.:

LOCATION:

	(1) Date End of Month	(2) Estimated Main Stations = E	(3) Average Working Main Stations = W	(4) (Col. 2) x (Col. 3)
Month 1				
Month 2				
Month 3				
Month 4				
Sum →				

Step 1. Calculate Predicted Main Stations

Predicted Main Stations = (Sum Col. 4) ÷ (Sum Col. 3)

Predicted Main Stations = _____ ÷ _____

Predicted Main Stations = _____

(Round to nearest whole no.)

Step 2. Calculate Allowed Main Stations

Do you have values for all 4 months?

YES — all 4 months

NO — 1, 2, or 3 months

If YES (all 4 months):

A. Add 40 to the last value of Average Working Main Stations in Col. 3

last Avg. W + 40 = _____

B. From Step 1,

Predicted Main Stations = _____

The Allowed Main Stations is equal to the lower of these two values

Allowed Main Stations = _____

If NO (1, 2, or 3 months):

A. Add 40 to the last value of Average Working Main Stations in Col. 3

last Avg. W + 40 = _____

B. Subtract 20 from Predicted Main Stations (Step 1)

Predicted Main Stations – 20 = _____

C. Find the average of last Average Working Main Stations (Col. 3) and predicted Main Stations (see Step 1)

(last Avg. W + P) ÷2

(_____ + _____) ÷2

_____ ÷2

= _____

(Round to nearest whole no.)

The Allowed Main Stations is equal to the lowest among these three numbers.

Allowed Main Stations = _____

Note 1:

If the Allowed Main Stations are less than or equal to the Average Working Main Stations for Month 4, the LSS is fully loaded with Allowed Main Stations and the Weekly peak load readings may be discontinued.

Note 2:

The value of the number of Allowed Main Stations determines the number of Main Stations to which this LSS can be loaded until another months' reading is available, and the number of Allowed Main Stations is recalculated.

REFERENCE:

PREPARED BY: DATE:

FORM 3

LOOP SWITCHING SYSTEM
WEEKLY BLOCKED CALLS DISPLAY RECORD

OFFICE: | LSS NO.:

LOCATION:

– If the BCD reading is greater or equal to 2, the mark (X) is moved one block to the right. Otherwise it is moved one block to the left or stays in state O.

(1) DATE	(2) BCD Reading	(3) STATE				(1) DATE	(2) BCD Reading	(3) STATE			
		0	1	2	3*			0	1	2	3*

* If the system goes to State 3 the LSS is overloaded.

REFERENCE: DFMP

PREPARED BY: | DATE: