SWITCHING SYSTEMS MANAGEMENT

LINE CONCENTRATORS – SUBSCRIBER LOOP MULTIPLEXER

SYSTEM DESCRIPTION & ASSIGNMENT PROCEDURES

DIAL FACILITIES MANAGEMENT PRACTICES – USER COMMENTS

Form E-6366
(11-73)

D.F.M.P. Div._____ Sec. _____

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1. INTRODUCTION

1.01 This section describes the Subscriber Loop Multiplexer (SLM), the Traffic Department procedures for assignment of customers, service order processing and traffic characteristics for loading consideration. This section outlines departmental responsibilities required to plan for and maintain an ongoing SLM system. Another DFMP, Div. H, Sec. 15b(2) describes in detail the Traffic administration procedures and techniques.

1.02 The Subscriber Loop Multiplexer is a carrier and switching system primarily intended to be used in exceptionally long rural area cable routes. The system is designed to provide service over 24 carrier derived channels between a single central office Control Terminal, having a physical capacity of 80 line equipments and a maximum of six Remote Terminal Cabinets. Each Remote Terminal has the capacity for 40 of the 80 line equipments. These Remote Terminals are strategically located along the cable route close to customer servicing areas. (See Figure 1.)

1.03 The SLM system is compatible with Bell System standard local dial facilities including present and proposed ESS types. Single and multiparty as well as coin service can be provided.

1.04 The SLM is designed to be basically transparent or non-blocking. Transparency is defined as no more than four occurrences of one half of one percent (B.005) blockage during a 12 month period. This service objective ceiling has been established so that service provided by an SLM is virtually indistinguishable from service provided on outside plant facilities (cable and pair). (See DFMP, Div. H, Sec. 15b(2) for administrative procedures.)

1.05 The SLM provides a means for upgrading or extending rural area telephone service by allowing the addition of facilities where the cost of normal plant expansion for the same rural service is prohibitive.

1.06 The system has the following service capabilities:

(See 6.04 for loading considerations and restrictions.)

One Party
Two Party ONI
Two Party ANI (Note 1)
Four Party Semi-Selective (Coded)
Four Party Selective (Note 2)
Eight Party Coded Ringing
Coin (Pre-Pay)
Key and PBX systems not employing "ground-start" features
Touch-Tone

Note: (1) Available 2Q 1974
(2) Four Party selective service requires additional cross-connection to a four party adapter unit located in the Central Office.

2. OPERATION OF THE SUBSCRIBER LOOP MULTIPLEXER (SLM)

2.01 The major components of the SLM system are as follows:

CONTROL TERMINALS (CT) — Located in the Central Office, the Control Terminal contains 24 carrier channels, crossbar switches, and associated equipment required to process calls through the system. The crossbar switch is the new small type and provides full access connections between the 80 line appearances and the 24 carrier channels. A sleeve lead is required for each line equipment connected to the Control Terminal.

DIGITAL LINE — A "T-1 type repeatered carrier line" links the Control Terminal in the Central Office to the Remote Terminal in the Field. The Digital Line requires two cable pairs (one transmitting and one receiving). A Secondary Digital Line is provided as a backup facility. In case of trouble on the Primary Digital Line, the system will automatically switch to the Secondary Digital Line. Associated with the Digital Line are the Order Wire (used by repairmen to communicate with the central office in case of an SLM failure) and Fault Locating Facilities.

FOUR PARTY ADAPTER UNIT — Four party selective ringing can be provided by use of this adapter circuit located in the Central Office. Two Control Terminal Line equipment appearances and Remote Terminal line units must be used to provide four party selective ringing. Two line equipment appearances will also be required.

REMOTE TERMINAL (RT) — Located at strategic sites in the field, the Remote Terminal provides the interface between the SLM digital line and the subscriber loops as well as a regenerative repeater location for other Remote Terminals on the same digital line. Each Remote Terminal contains location for 40 Line Packs. A ringing generator, circuitry protection and other equipment common to all subscribers is located in the Remote Terminal.

LINE PACKS — 40 plug-in line units are located in the Remote Terminal and contain the circuitry necessary to code and decode the digital signals for speech, ringing, dialing, etc. Line units are designed to minimize the potential for total Remote Terminal failure through the use of individual circuitry wherever possible. Line Packs are universal for all services except two party ANI which requires a two-party ANI-type pack.

2.02 Incoming calls at the Control Terminal are converted from speech waveforms to digital signals. These signals are transmitted to the Remote Terminals via the digital line. At the Remote Terminal, these data are translated to voice wave-forms and transmitted to the subscriber. An originating call in the SLM system would be handled in reverse order. The ringing source is from a generator in the Remote Terminal. Power for the Remote Terminal is from a local AC connection. Batteries with twelve hours reserve power are provided in case of AC failure.

2.03 A prime objective in the design of the SLM is the minimization of out of service time. Automatically controlled circuits have been designed to detect the trouble. The main testing features include:

- Checks all channel transmit and receive circuits once daily and removes defective channels from service. When defective channels are found, an alarm in the central office is activated.

- Monitors itself for failures in the field and automatically activates a "loop back" feature which deletes from service the Remote Terminals beyond the failure point. This will minimize full system outage. Customers in Remote Terminals beyond the "loop back" point do not have telephone service until the trouble is corrected.

- There are 80 line jack appearances at the Control Terminal for plugging up subscriber lines on permanent signal. When a subscriber's line is on permanent signal the line is plugged up and the subscriber is denied service to prevent channels from being used. When a permanent signal line goes back on-hook, it is automatically restored to service.

2.04 Simultaneous originating and incoming calls are served at random. If all channels are busy, originating calls are held until either a vacant channel becomes available or the call is abandoned; incoming calls are blocked and will receive system standard reorder tone (120 IPM).

3. CONDITIONS OF USE

3.01 Prior to installation, a feasibility study coordinated by the Outside Plant Engi-

neer, should be completed to determine that SLM is the most advantagous method of serving the subscribers. Feasibility determination will be made by representatives from the Traffic, Plant and Engineering Departments. The type and characteristics of the subscribers (business, residence, etc.) as well as the alternative methods of serving them should be considered. If SLM is selected as a suitable serving vehicle, the Outside Plant Engineer will chair a committee to determine the following:

- Define Remote Terminal serving areas.
- Consider additional Remote Terminals and associated areas.
- Examine the loading plan with the Dial Administrator to determine if any subscribers should not be included on the SLM due to their traffic characteristics (see 3.02).
- Determine if the SLM system is to have ONI or ANI two party subscribers. In central offices equipped for ANI, two-party ANI service should be provided.
- Set guidelines for determining spare facility levels in each SLM system. These facilities would be available for restoral purposes in the eventuality of SLM failure.

3.02 When preparing for initial or subsequent loading of the SLM system, the traffic characteristics of subscribers should be analyzed by the Dial Administrator. Items for consideration include:

- The system is traffic sensitive and can be overloaded. This can be avoided by commencing with a partial load of 60 customers and adding customers only to the extent that traffic measurements of peak loads permit. Traffic administration procedures are discussed in DFMP Div. H, Sec. 15b(2).
- Customer traffic characteristics most suitable for SLM service correspond to rural residential subscribers. Stations in categories known to generate higher loads, such as business service and Physicians' telephones should be avoided.
- Caution should be exercised (by ensuring that system loading proceeds slowly and only as supported by traffic measurements) when load or intra-system calling is likely to be unusually high, as in trailer parks, suburban apartment complexes and isolated resort communities.
- When analyzing customer calling characteristics for SLM loading, office load balance should not be overlooked. Normal load balance procedures may continue as usual since the cross-connect between the line equipment appearance and the SLM Control Terminal is not permanently wired and can be changed by Plant if line equipment load balance transfers are necessary. As sleeve loads are required, sufficient quantities of sleeve lead equipment should be provided so that normal assignment and load balance procedures are possible.
- It is recommended that only new service and upgrades of service be put on the system. Multiparty (4 and 8) should be maintained on current facilities if possible to maximize use of carrier equipment for upgrading and to minimize rearrangements.
- As Allowed Main Station levels (Note 1) are being approached, the Dial Administrator should work with the Plant and Engineering Departments to develop plans for serving additional subscribers. The Dial Administrator ***should not*** wait until the fill level is reached as reaction time is lost. It is imperative that the objective service ceiling is not exceeded. If unanticipated demand is encountered service restrictions should be imposed, such as offering only four party service, held orders, etc. In no case should existing service be degraded in order to add new subscribers.

Note 1 — Allowed Main Station level is defined as the number of main stations that traffic measurements indicate an SLM system can safely carry and without the possibility of exceeding the service objective. (B.005 blockage shall not be exceeded more than four times in a 12 month period.)

4. RESPONSIBILITIES

4.01 *Traffic Department*

- The Dial Administrator shall establish and adjust, as load measurements dictate, the Allowable Main Station level for each SLM system.

- The Dial Administrator should notify the Outside Plant Engineer and the Plant Assignment Center of the current Allowable Main Station level.

- The Dial Administrator shall maintain records, Form E-6305, (See Figure 2) for each SLM system in order to monitor current and projected fill levels. As Allowable Main Station levels are being approached the Dial Administrator should work with the Engineering and Plant Departments to develop plans for serving additional subscribers.

4.02 *Engineering Department*

- Determine in connection with a feasibility study, where an SLM system can be utilized. See 3.02 for traffic considerations.

- Originate an appropriate work order to install the system.

- Originate an appropriate work order for additional line packs after receiving a "Notification of Facility Shortage" from the Plant Department.

- Coordinate material procurement with the supplier and coordinate storage for maintenance replacements.

- Submit, as part of the original work order, a detailed SLM system lay-out showing repeater locations and spacing, Remote Terminals, cable pairs, etc.

- Number each SLM system.

- Establish spare line pack position and mounting slot levels in Remote Terminals for a notification of facility shortage procedure.

- Prior to assigning additional equipment to a working SLM system, verify the current Allowed Main Station level with the Traffic Dial Administrator.

- Arrange for removal and/or relocation of an SLM system after it has served its intended purpose. SLM is generally intended to be a permanent installation.

4.03 *Plant Department*

- Install and maintain SLM equipment.

- Provide Plant instructions and/or training for installation, maintenance and record keeping of SLM equipment.

- Maintain appropriate assignment records of SLM facilities.

- Install or remove line packs as directed by the Outside Plant Engineer.

- Utilize "Notification of Facilities Shortage" procedure for circuit pack shortages.

- Ensure that the Dial Administrator receives the traffic copy of each SLM service order for their records.

- Do not exceed the Allowed Main Station level that is provided by the Traffic Dial Administrator.

5. ASSIGNMENT RECORDS

5.01 The Traffic Assignment center shall keep a current record of the customers assigned to each SLM. The records need only be kept for the central office Control Terminal portion of each SLM system. Form E-6305 is to be used to keep traffic SLM assignment records. (See Figure 2.)

5.02 Traffic will not be responsible for keeping records of assignments at the Remote Terminals. Likewise, assignment records of special equipment, such as four party selective adapters, etc., will not be the responsibility of the Traffic Department. The Plant Assignment Center will maintain all of these records as well as a Control Terminal line assignment record.

5.03 The Plant Assignment Center uses Form E-4009A-52 and E-4009A-53 to record the customers assigned to each line of the Control Terminal. The Allowed Main Station level, determined by Traffic, is recorded on one sheet of the assignment record to ensure that the SLM system is not inadvertently overloaded.

6. SERVICE ORDERS

6.01 Service orders for SLM will be issued in the normal manner. Current connect and disconnect procedures are to be followed in the Directory Number and Line Equipment Records. An Additional SLM record, Form E-6305 will be required for each SLM system.

6.02 A typical SLM service order will contain the following information needed by the Dial Administrator:

- Directory Number
- Class of Service
- Line Equipment
- Subscriber Loop Multiplexer System Number
- Control Terminal Line Appearance Location

The directory number, class of service and line equipment will be designated in the normal manner. The SLM system number will appear as SLM 01 or 02, etc. The Control Terminal line appearance locations will be indicated as Control A1 or A2, etc.

6.03 Following are examples of connect, disconnect and regrade service orders:

(a) New Connect —
1FR service with a telephone number of 531-5454.

Central Office Line Equipment

SLM System Number

Control Terminal Line Location

New Connect

10E 10-01-2 F1 SLM 01, Control B5, 1317 Urban-7/F2 RT#1, 0201, 2137 Country, 10-37, RT 89/RZ C/BR V/OAB RAN.

The line equipment, class of service, and directory number would be assigned to SLM system number 01, opposite SLM line 10, Control Terminal B5 on the assignment record, Form E-6305. (See Figure 3.)

(b) Disconnect —
of the above 1FR, 531-5454, service. Information on the service order would appear as follows:

Disconnect

00E 10-01-2F1 SLM 01, Control B5, 1317 Urban-7/F2 RT #1, 0201, 2137 Country, 10-37, RT 89/RZ C/BR V/OAB RAN.

When the SLM line is disconnected the SLM record should be cleared.

(c) Regrade —
2FR service to a 1FR.

Regrade – 2FR to 1FR within the same SLM system

10E 02-09-2/F1 SLM 01, Control C3, 2390 Juniper, 7-53, RT 92/RZ C/BR V/OAB RAN.

00E 11-01-3/PT4 1/F1 SLM 01, Control D1, 2390 Juniper-9/F2 RT #2, 0301, 2300 Juniper, 2-53, RT 02/RZ C/BR V/OAB RAN.

The new upgraded service 531-7777, 1FR, is assigned to SLM system number 01, SLM line 13, Control Terminal number C3. The line equipment (-2-09-2), class of service (1FR) and directory number (531-7777) are recorded against this SLM line. The disconnected service, 2FR, was working on SLM 01, SLM line 16, Control Terminal number D1. A line should be drawn through the directory number on this line to indicate the change. (See Figure 4.)

6.04 The following restrictions apply to the assignment of various classes of service to an SLM:

CLASS OF SERVICE	RESTRICTIONS
One Party	None.
Two Party	Both Parties work on same SLM line. ANI requires a special 2 party line pack.
Four Party semi-selective (Coded)	All parties work on same SLM line.
Four Party selective	Two lines are required at the Control Terminal and the Remote Terminal. Two line equipments are also required.
Eight Party (coded)	All parties work on the same SLM line.
Business/PBX	Do not assign to SLM because of higher calling rates. Standard loop start key and PBX systems will function on SLM. Ground start key and PBX systems *will not* function on SLM.
Coin (Pre-pay)	Each SLM has capacity for six coin stations, two per Remote Terminals.

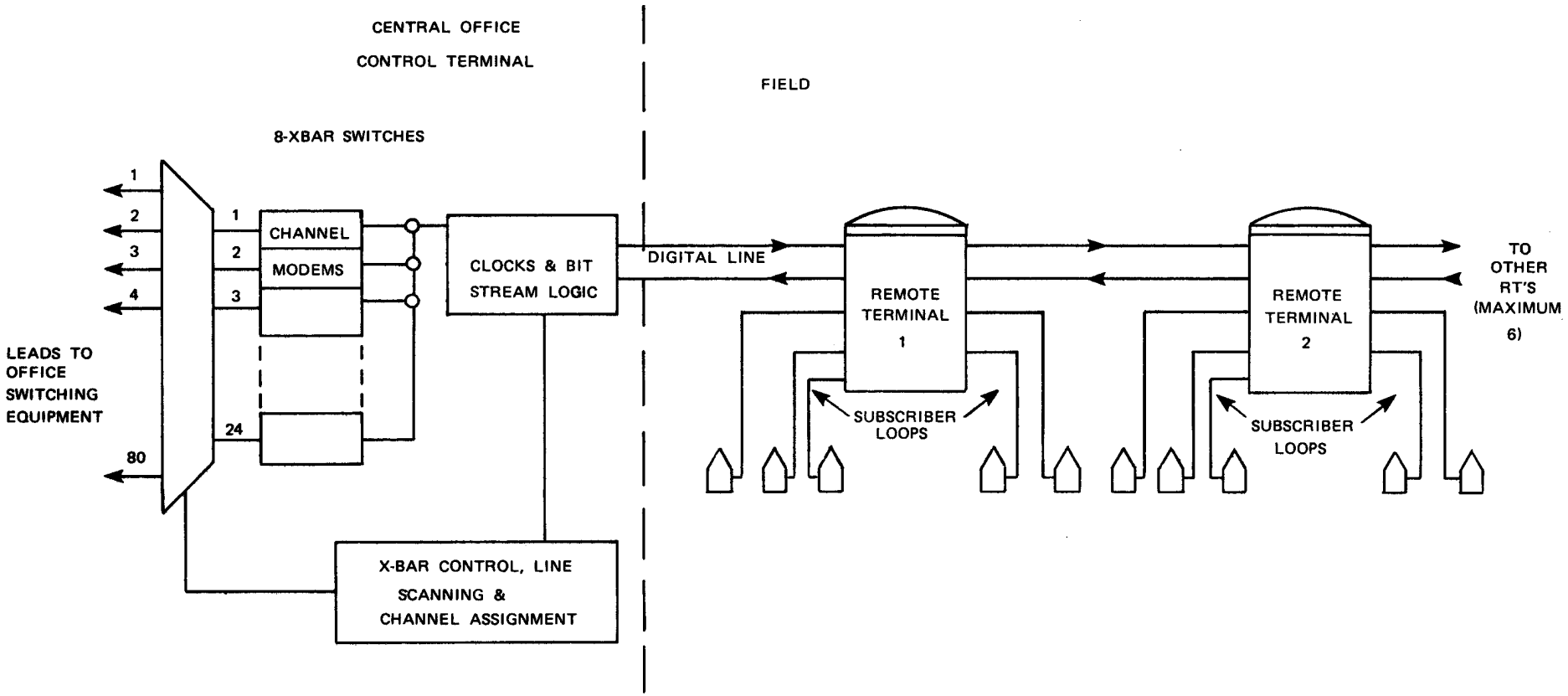

FIG. 1
TYPICAL SUBSCRIBER LOOP MULTIPLEXER SYSTEM

SUBSCRIBER LOOP MULTIPLEXER
LINE & STATION RECORD

FORM E-6305
(11-73)

OFFICE:	SLM NO.:
LOCATION:	
ALLOWABLE MAIN STATIONS:	DATE ESTABLISHED:
ACTUAL WORKING M.S.:	DATE ESTABLISHED:
ACTUAL WORKING LINES:	DATE ESTABLISHED:

SLM LINE	CT NO.	LL FRM	VERT GRP. / COL. / L.F. GRP.	HOR GRP. / TERM	VERT. FILE	CLASS SERV	PARTY 1	PARTY 2	PARTY 3	PARTY 4	REMARKS
							DIRECTORY NUMBER				
1	A1										
2	2										
3	3										
4	4										
5	5										
6	B1										
7	2										
8	3										
9	4										
10	5										
11	C1										
12	2										
13	3										
14	4										
15	5										
16	D1										
17	2										
18	3										
19	4										
20	5										
21	E1										
22	2										
23	3										
24	4										
25	5										
26	F1										
27	2										
28	3										
29	4										
30	5										
31	G1										
32	2										
33	3										
34	4										
35	5										
36	H1										
37	2										
38	3										
39	4										
40	5										

FIGURE 2

SUBSCRIBER LOOP MULTIPLEXER
LINE AND STATION RECORD

FORM E-6305
(11-73)

OFFICE:	SLM NO.:
LOCATION:	
ALLOWABLE MAIN STATIONS:	DATE ESTABLISHED:
ACTUAL WORKING M.S.:	DATE ESTABLISHED:
ACTUAL WORKING LINES:	DATE ESTABLISHED:

SLM LINE	CT. NO.	L.L. FRM.	VERT. GRP. / COL. / L.F. GRP.	HOR. GRP. / TERM	VERT. FILE	CLASS SERV.	PARTY 1 / DIRECTORY NUMBER	PARTY 2 / DIRECTORY NUMBER	PARTY 3 / DIRECTORY NUMBER	PARTY 4 / DIRECTORY NUMBER	REMARKS
41	J1										
42	2										
43	3										
44	4										
45	5										
46	K1										
47	2										
48	3										
49	4										
50	5										
51	L1										
52	2										
53	3										
54	4										
55	5										
56	M1										
57	2										
58	3										
59	4										
60	5										
61	N1										
62	2										
63	3										
64	4										
65	5										
66	P1										
67	2										
68	3										
69	4										
70	5										
71	R1										
72	2										
73	3										
74	4										
75	5										
76	S1										
77	2										
78	3										
79	4										
80	5										

FIGURE 2

SUBSCRIBER LOOP MULTIPLEXER
LINE & STATION RECORD

FORM E-6305 (11-73)

OFFICE: 532	SLM NO.: 01
LOCATION: MAIN ST. BUILDING	
ALLOWABLE MAIN STATIONS:	DATE ESTABLISHED:
ACTUAL WORKING M.S.:	DATE ESTABLISHED:
ACTUAL WORKING LINES:	DATE ESTABLISHED:

SLM LINE	CT NO.	LL FRM	VERT GRP. / COL. / L.F. GRP.	HOR GRP. / TERM	VERT. FILE	CLASS SERV	PARTY 1 / DIRECTORY NUMBER	PARTY 2	PARTY 3	PARTY 4	REMARKS
1	A1										
2	2										
3	3										
4	4										
5	5										
6	B1										
7	2										
8	3										
9	4										
10	5		10	01	2	1FR	531-5454				
11	C1										
12	2										
13	3										
14	4										
15	5										
16	D1										
17	2										
18	3										
19	4										
20	5										
21	E1										
22	2										
23	3										
24	4										
25	5										
26	F1										
27	2										
28	3										
29	4										
30	5										
31	G1										
32	2										
33	3										
34	4										
35	5										
36	H1										
37	2										
38	3										
39	4										
40	5										

FIGURE 3

SUBSCRIBER LOOP MULTIPLEXER
LINE & STATION RECORD

FORM E-6305 (11-73)

OFFICE: 532 | SLM NO.: 01

LOCATION: MAIN ST. BUILDING

ALLOWABLE MAIN STATIONS: | DATE ESTABLISHED:

ACTUAL WORKING M.S.: | DATE ESTABLISHED:

ACTUAL WORKING LINES: | DATE ESTABLISHED:

SLM LINE	CT NO.	LL FRM	VERT GRP. / COL. / L.F. GRP.	HOR GRP. / TERM	VERT. FILE	CLASS SERV	PARTY 1 (DIRECTORY NUMBER)	PARTY 2 (DIRECTORY NUMBER)	PARTY 3 (DIRECTORY NUMBER)	PARTY 4 (DIRECTORY NUMBER)	REMARKS
1	A1										
2	2										
3	3										
4	4										
5	5										
6	B1										
7	2										
8	3										
9	4										
10	5										
11	C1										
12	2										
13	3		02	09	2	1FR	531-7777				
14	4										
15	5										
16	D1		11	01	3	2FR	~~531-7777~~	531-2222			
17	2										
18	3										
19	4										
20	5										
21	E1										
22	2										
23	3										
24	4										
25	5										
26	F1										
27	2										
28	3										
29	4										
30	5										
31	G1										
32	2										
33	3										
34	4										
35	5										
36	H1										
37	2										
38	3										
39	4										
40	5										

FIGURE 4