TRUNK GROUP DATA
SOURCES AND MEASUREMENTS
NETWORK SWITCHING ENGINEERING—TRUNKING DATA
NETWORK SERVICES METHODS

CONTENTS PAGE

1. GENERAL

1.01 This section describes the sources of trunk group data and the measurement devices available for obtaining it. It discusses the types of measurements received and provides the recommendations of trunk group data measurements. Mechanized systems used for trunk data recording, accumulating, and/or processing are discussed. The frequency of data collection, the methods of data summarization, interpretation, and utilization are discussed in other sections of the 780-40Y-ZZZ series.

1.02 Whenever this section is reissued, the reasons for reissue will be given in this paragraph.

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

1.04 For the standard meaning of terms and definitions used in this section, refer to Section 780-400-305 "Glossary of Trunk Facilities Terms and Definitions."

1.05 Traffic measurement devices and mechanized systems are essential tools of the trunk engineer. They are necessary to design and maintain trunking layouts that will provide the quality of service that meets our service objectives. Adequately provided, used in the scope recommended and properly maintained, they will serve that need well.

1.06 On the other hand, if provision and use are less than recommended, or if operation is

faulty, the effect can be significant from the standpoint of service and costs. The trunk engineer is obligated to take a firm stand on the necessity for adequate measurement facilities and for the quality of maintenance required for accurate and dependable operation of those facilities. Beyond that, adequate arrangements must exist for the processing of these measurements so that they can be used to the best advantage.

2. TRUNK GROUP MEASUREMENT DEVICES

A. Traffic Registers

2.01 Traffic registers provide a method for accumulating measurements of loads in various forms. Their results provide a direct or indirect measurement of service. The basis of register provision varies, dependent on the type of switching equipment, its arrangement, the degree of mechanization and local considerations.

2.02 Functionally, traffic registers provide trunk group data in a number of categories, as defined in Table A.

B. The 4A Traffic Usage Recorder

2.03 The 4A traffic usage recorder (TUR) is designed to use the switch count method, ie, counting the number of contacts closed within a prescribed time interval, as its mode of operation.

2.04 The terminals of the TUR, connected to the equipment being measured, are scanned repeatedly at 100 second intervals. The number of circuits found busy on each scan are accumulated on registers. At the end of 1 hour (36 scans), the accumulated number of busy conditions encountered will indicate the amount of load carried in terms of hundred call seconds (CCS).

2.05 Certain items of common control equipment require a 10-second scan because of abbreviated holding time. This is accomplished in the TUR through a multipled arrangement which makes it possible to scan an item 10 times during the normal 100-second scan. These register results must be divided by 10 to arrive at a load in terms of CCS. The 10-second scan has limited application in trunk group measurements as trunk holding times normally exceed 10 seconds. In isolated cases, if usage on a specific trunk group becomes suspect as to its validity, a fast scan arrangement may reveal usage somewhat different from the normal 100-second scan.

2.06 The TUR crossbar scan and register switches are 100-point, 6-wire type. At each of the 100 switch crosspoints on one switch, there are six contacts numbered 0 through 5, inclusive. This permits usage to be taken on six different circuits simultaneously by closing one switch point. Therefore, a total of 600 circuits can be connected to each scan switch. One recorder unit, consisting of 6 scan switches, has the capacity to terminate 3600 circuits.

2.07 Control equipment sequences the scanning of the circuits whose usage is being measured. Scan switch crosspoints are closed one at a time, in sequence, until all 600 have been scanned. Corresponding crosspoints on the register switches are closed simultaneously, in the same sequence, thus providing a momentary connection from the circuits being measured through to the register receiving the scoring.

2.08 There is also an option which permits associating two TUR frames with one control panel. With this arrangement, the scan cycle interval becomes 200 seconds as a result of alternately scanning each frame for 100 seconds.

2.09 Where the 200-second cycle interval is used, the data must be doubled to convert it to equivalent 100-second cycle data as the initial step in processing for servicing and forecasting use. The change in TUR sampling and source error for 200-second scan over 100-second scan is negligible assuming typical trunk holding times.

2.10 Equipment features of the TUR and associated registers are described in Sections 984-503-100 and 951-510-100. It should be emphasized here that TUR readings on trunk groups can be interpreted properly only when related to trunks in service at the time the readings were taken. This makes it vitally important that each trunk be connected to the TUR at the point in time it goes into service. Conversely, when a trunk is disconnected, it is imperative that it be removed from the TUR concurrently.

2.11 In the trunking field, separate registers are not normally provided to score maintenance usage when trunks are made busy. Thus, the usage scored on a TUR may, dependent upon the type of end office equipment or specific types of trunk equip-

ment, be total usage (traffic plus maintenance) or traffic usage only.

2.12 Table B indicates whether maintenance usage is included in TUR measurements, whether a wiring option permits it to be included or excluded, or whether it is excluded because of standard wiring arrangements. Where options do exist, it is recommended that maintenance usage be included in the measured load since incidental outage is a recurring, service-affecting condition. Section 780-401-130, Trunking Data Quality, discusses maintenance as related to the quality of trunk group data.

2.13 When incoming trunk groups are associated with a TUR located at a tandem, such as Local Automatic Message Accounting (LAMA) or Centralized Automatic Message Accounting (CAMA) trunk groups, tandem access, or intertandem groups, etc, consultation with the equipment engineer is recommended to determine if maintenance usage is included in the TUR measurements. In most cases it is not.

2.14 If a trunk group from an end office is associated with a Traffic Service Position System (TSPS), the setup time from initial seizure of the trunk until cut through of the call by the TSPS equipment will not be reflected in the terminating TUR usage. It is, therefore, recommended that such groups be assigned to TURs located at the end office rather than at the tandem.

TUR Detector Test

2.15 One of the control features of the TUR which is of particular importance to the trunk engineer is the detector test. This test provides a check of detectors, grouping field cross-connections and register operation. The register reading of a trunk group load can only be interpreted properly when the number of trunks in service, at the time of the reading, is known. Consequently, as emphasized earlier, it is imperative that each trunk is cross-connected to the proper TUR register at the same time it is put into service and removed from the TUR when it is disconnected. The detector test provides necessary control information to ensure proper trunk order completion.

2.16 The detector test is made by imposing a busy indication on the input of all detectors in all recorder frame units that are under control of the panel equipment. When a scanning cycle is made under conditions of the detector test, with all cross-connections in perfect order, a registration is scored on the proper register each time an individual terminal cross-connected to that register is scanned. A registration is scored on the register whether or not the circuit connected to it is busy or idle at that instant. Even if no circuit is connected to a terminal which has been cross-connected in error to a register, a registration will be scored as that terminal is scanned.

2.17 The detector test is one complete scan of the TUR. Therefore, it provides a count of the number of items associated with a register. A trunk group of 16 trunks should have 16 register scores following a TUR detector test scan.

2.18 While the detector test is a valuable tool, the trunk engineer should bear in mind that while the scores on the register indicate the number of items connected to that register from the TUR, it does not prove that the trunks are in service. Nor does it prove that wiring is accurate, eg, that all trunks in trunk group A←→B are wired to their assigned register.

C. The 3B TUR

2.19 The 3B TUR has a basic scan point capacity of 200 and can be expanded to 600. Use of the 3B TUR is limited to small end offices, eg, community dial offices (CDOs) and large private branch exchanges (PBXs). The 3B TUR operates similarly to the TUR. More detailed information on the 3B TUR may be obtained in Section 984-502-100.

D. The Concentrator TUR and Small TUR

2.20 The Concentrator TUR (CTUR) and Small TUR (STUR) are both manufacture discontinued; however, both are still being used. The CTUR has a scan point capacity of 100; the STUR has a 200 scan point capacity. Like the 3B TUR, the CTUR and STUR are applicable to small end offices and large PBXs. More detailed information on the CTUR and STUR may be obtained in Section 951-500-100.

E. ESS Traffic Measurements

2.21 Whereas TURs are external devices with respect to an electromechanical switching system, Electronic Switching Systems (ESSs) have built-in features for making various traffic measurements including usage, peg count, and overflow.

2.22 The ESSs do not use conventional traffic registers common to other switching systems but perform measurement functions by utilizing the memory and call processing features of the system. The various measurements are identified by a 2-digit measurement code and in some instances, by a 2-digit office code number. They are recorded in specific words of call store memory called counters, which are used to accumulate counts, store data until called for by the program, and to indicate the number of circuits in the group that are simultaneously in use. The counters required for particular measurements are known as traffic registers. A given register can be arranged to measure peg count, overflow, or usage. A separate register is required for each item to be measured.

2.23 Measured usage for trunk groups in all No. 1 and 1A ESS offices includes maintenance usage. In No. 2 and 3 ESS, maintenance usage is provided as a separate item and must be added to the applicable trunk group usage.

2.24 Traffic measurements may be recorded on five different schedules. Some counts are permanently assigned to certain schedules, while others may be assigned to one of several schedules via translation. However, a count can be taken on only one schedule at a time, and overlapping time periods within a schedule cannot be accommodated. Traffic registers will be updated or "collected" and the data printed out according to schedules to which they are assigned. For trunk group data, the "C" schedule will normally be used. This is an hourly schedule that will usually be operated throughout the day and evening. It can be started at any clock quarter hour and can be set to provide quarter-hourly, half-hourly, or hourly data.

2.25 Printouts of current measurement data are received from the ESS on teletypewriter printers. A direct interface conveys the ESS measurement data to the Engineering and Administrative Data Acquisition System (EADAS) or other data accumulating and processing systems. Counters in the ESS are reset to zero at the end of each scheduled measurement period so that subtraction of readings is unnecessary.

3. TRUNK GROUP DATA—TYPES OF MEASUREMENTS

A. General

3.01 Direct measurements of load or measurements that are indicative of load provide the principal types of trunk group data input for the network planner.

3.02 There are several types of trunk group measurements which fall into one of two measurement categories:

(1) **Load Oriented**: Data counts or measurements that are indicative of the load carried or offered to a trunk group

(2) **Congestion Oriented**: Data counts or measurements that are observed only when congestion on the trunk group is evident.

B. Load Oriented Measurements

3.03 The principal load oriented indicators in use are as listed and defined below:

(a) Usage (U): A measurement of the observed load carried or occupied time of a trunk or group of trunks usually expressed in CCS.

(b) Peg Count (PC): A measurement of the number of attempts made to seize any trunk in a group, frequently referred to as the number of calls offered.

(c) Peak Load: A measurement of the daily peak hourly load carried on a group of trunks in a 24-hour period, usually expressed in CCS.

Note: Peg count (PC), as defined in paragraph 3.03 (b), is applicable to outgoing PC registers in non step-by-step (SXS) systems. Incoming PC registers and SXS PC registers exclude all calls not finding an idle server.

C. Congestion Oriented Measurements

3.04 The principal congestion oriented indicators in use are as listed and defined below:

(a) Overflow (O): A measurement of the number of calls or attempts failing to find an idle trunk. Overflow is usually expressed as percent overflow which is a calculation derived from measurements and describes the percent of the offered load failing to find an idle trunk. Percent overflow is the ratio of attempt failures (O) to the total attempts (PC), ie, O/PC = percent overflow.

(b) All Trunks Busy (ATB): A measurement of the number of times all trunks in a group were busy.

(c) Last Trunk Busy (LTB): A measurement of the number of times the last trunk in a group was busy.

(d) Last Trunk Usage (LTU): A measurement of the observed load carried or the occupied time of the last trunk in a SXS (graded multiple) trunk group usually expressed in CCS.

4. SUMMARY OF DATA PREFERENCES

4.01 The type of end office or tandem equipment and the type of trunk group dictate the selection of traffic measurements to be taken on the group. Table C provides a list of trunk groups by type, their equipment types, and the recommended traffic measurements.

4.02 Recently revised data collection recommendations reflect two important elements:

(a) A significant engineering need for more complete traffic data on most trunk groups

(b) The technical feasibility of such expanded data collection because of the widespread availability of mechanized data collection systems.

4.03 The most significant change relative to previously existing practices is the recommendation that more complete data be collected on primary high-usage and only-route trunk groups.

4.04 The revised recommendations in reference to preferred measurements are as follows:

(a) Usage, peg count, and overflow are recommended for all categories of trunks when technically feasible.

(b) Usage only is the second choice if usage, peg count, and overflow are unavailable.

(c) Peg count and overflow are the third choice if usage is unavailable.

(d) Overflow only is no longer a recommended measurement.

(e) Overflow and last trunk busy is no longer a recommended measurement combination.

(f) Last Trunk Usage (LTU) has been added as a possible measurement for SXS graded multiples.

(g) Last Trunk Busy (LTB) is no longer recommended as a preferred measurement for (SXS) rotary out trunk switch (ROTS) groups.

4.05 Peak Load is an output of the Small Office Network Data System (SONDS). The SONDS applies specific algorithms to peak load to provide an output of the daily time-consistent busy hour load. This may be used for grade-of-service trunk groups between small SXS offices that have no other measurement system available at either end of the trunk group.

4.06 Figure 1 provides a schematic representation of recommended traffic measurement assignments on final and parallel protective high-usage (PPHU) trunk groups. The types of measurements which can be collected on each trunk group depend on the switching equipment in the offices at which the trunk group terminates. These limitations are reflected in the Measurement Recommendation Chart shown in Table C.

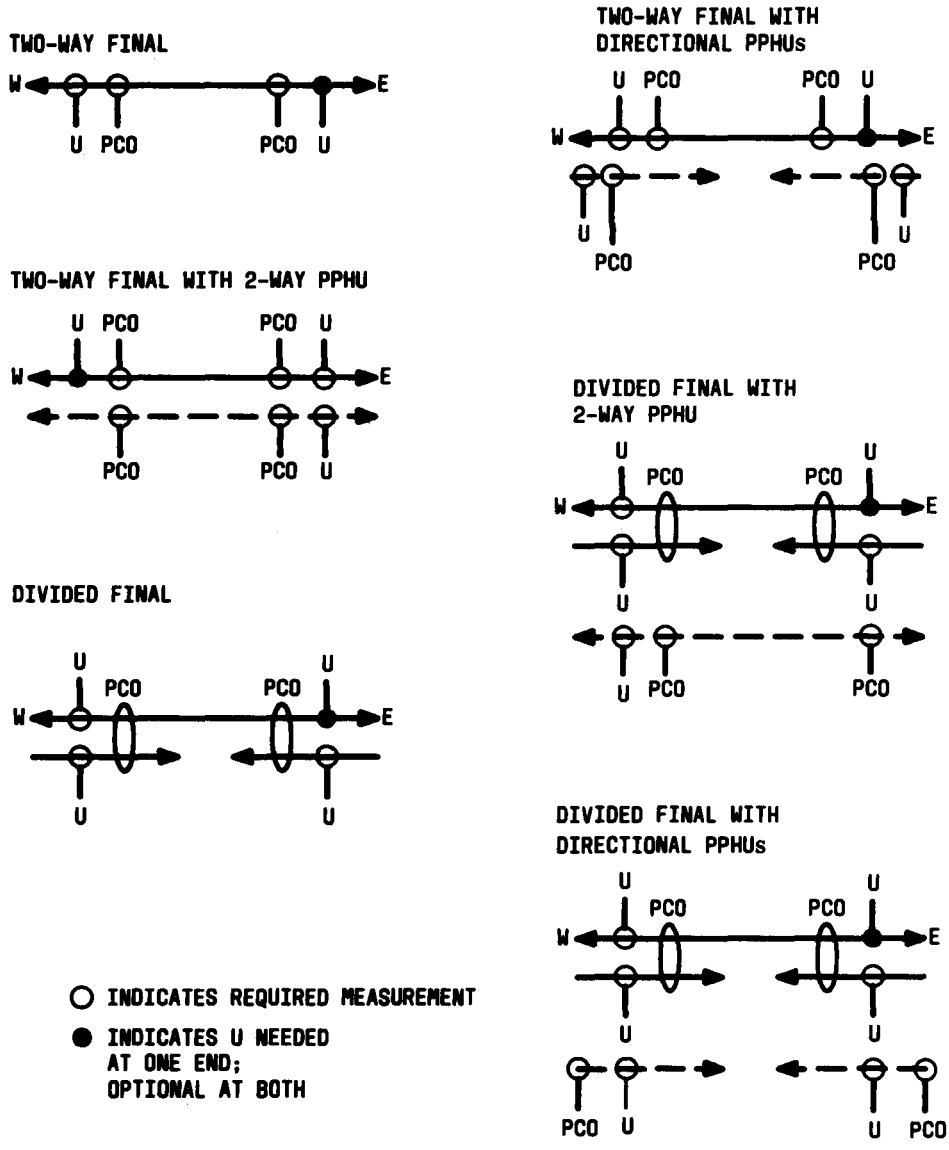

Fig. 1—Data Register Assignments on Final and PPHU Trunk Groups

TABLE A

TRAFFIC REGISTERS AND FUNCTIONS

TYPE OF REGISTER	REGISTER FUNCTION
Usage (U)	Scores once for each trunk, in a group of trunks, found busy at specified intervals, usually 100 seconds.
Peg Count (PC)	Scores each time an attempt is made to seize a trunk in a group of trunks.
Overflow (O)	Scores each time all of the trunks in a group have been tested and found busy.
All Trunks Busy (ATB)	Scores each time all of the trunks in a group become busy simultaneously.
Last Trunk Busy (LTB)	Scores each time the last trunk in a group becomes busy.
Last Trunk Usage (LTU)	Scores each time the last trunk in a group is found busy at specified intervals.

TABLE B

MAINTENANCE USAGE INCLUSION STATUS BY OFFICE TYPE

TYPE OFFICE	INCL.	WIRING OPTION	EXCL.
4A	Yes	-	-
XBT	-	Yes	-
SXS	Non-CAMA	CAMA*	-
Panel	Yes	-	-
#1XB	-	Yes	-
#5XB	-	Intertoll†	Nonintertoll
1&1A ESS	Yes	-	-
2 & 3 ESS	No‡	-	-

*The option that permits exclusion of maintenance usage is rated A and M.

†If modified per EM 728 and EM 914.

‡Maintenance usage is provided as a seperate item and must be added to regular usage.

TABLE C

TRAFFIC MEASUREMENT RECOMMENDATIONS

TYPE OF TRUNK GROUP		UPCO	U	PCO	U & ATB	ATB	LTU	LTB
	Final or Special Final							
	— 5XB, ESS, 4A, XBT	1	2	3				
	— SXS ROTS		2		1	3		
	— SXS Graded Multiple		1				3	2
Common Control	High-Usage							
	— 5XB, ESS, 4A, XBT	1	2	3				
	— SXS ROTS		2		1	3		
	— SXS Graded Multiple		1				3	2
	Only-Route							
	— 5XB, ESS, 4A, XBT	1	2	3				
	— SXS ROTS		2		1	3		
	— SXS Graded Multiple		1				3	2
	Operator Accessed		1			2		

LEGEND:

1 — Recommended.

2 — Permissible if economics rule out No. 1 recommendation.

3 — Permissible if economics rule out No. 1 and No. 2 recommendations.