

OPERATIONS SUPPORT SYSTEMS
T-CARRIER ADMINISTRATION SYSTEM (TCAS)
OVERALL SYSTEM DESCRIPTION

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1. GENERAL

1.01 This section provides an overall description of the T-Carrier Administration System (TCAS) and its specific application to T1 Carrier. TCAS applications for other services and for high-capacity digital systems will be covered in future sections.

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

1.03 The T-Carrier Administration System (TCAS) is a combination of computer-based equipment, central office equipment, programs, procedures, and personnel which provides automated, centralized administration of metropolitan digital networks.

1.04 When fully implemented in a metropolitan area, TCAS provides the following capabilities:

- (a) Real-time analysis and trouble case administration of T-Carrier system alarms
- (b) Automatic sectionalization of system failures to the faulty terminal or span line
- (c) Automatic alarm cutoff capability
- (d) Real-time monitoring and administration of maintenance and backbone lines used for system restoration
- (e) Rapid identification and analysis of major failures, eg, cable damage, central office power failure
- (f) Automatic periodic measurement of transmission performance of all monitored lines
- (g) Automatic generation of periodic management reports on the performance of various aspects of the metropolitan digital network.

1.05 The following abbreviations and terms are used in relation to TCAS:

ACO—Alarm Cut-Off

CGA—Carrier Group Alarm

NOTICE

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CJP—Connector Junction Panel

DLM—Directed Line Monitor

LMCD—Local Maintenance Center Display

MLSI—Maintenance Line Status Indicator

QRSS—Quasi-Random Signal Source

RAU—Repeater Access Unit

RIU—Relay Interface Unit

RU—Relay Unit

TCT—Telemetry-Computer Translator

Red Alarm—An alarm indication generated by a D-type bank which indicates a receive failure.

Remote Office—A telephone network central office containing (from TCAS considerations) T-Carrier transmission equipment, TCAS equipment, and telemetry.

TRCC—T-Carrier Restoration Control Center: An administrative center which works with central offices and outside plant forces in a metropolitan area to coordinate rapid restoration and timely repair of T-Carrier systems that have failed in the repeatered line. It has complete authority over the use of all maintenance and backbone lines in the network. The TRCC also keeps records of outage time due to bank (terminal) failures, and assists in restoration where possible.

TCAS Center—An administrative center which includes personnel, procedures, and the TCAS Central. It evolves from a TRCC with the implementation of TCAS equipment at remote offices and the TCAS Center. T-Carrier network status information is provided by telemetry. Records of trouble case and maintenance line administration are kept via the computer and its peripherals: The TCAS Central initiates automatic sectionalization of T-Carrier failures. The TCAS Center has complete authority over the use of all maintenance and backbone lines in the network.

TCAS Central—The hardware, software, and data base of the TCAS Center.

T-Carrier Network—A group of systems and the central offices, lines, and facilities serving these systems that can be adequately administered and controlled by one, centralized group.

2. EQUIPMENT

2.01 The equipment used for TCAS is located in selected central offices and in a central control location (TCAS Center). These various locations are linked together by 4-wire multipoint data networks.

REMOTE (CENTRAL) OFFICE

2.02 The equipment available for use in a remote TCAS office consists of the maintenance line status indicator (MLSI), local maintenance center display (LMCD), directed line monitor (DLM), relay unit (RU), repeater access unit (RAU), relay interface unit (RIU), connector junction panel (CJP), and E2 or E2A telemetry equipment. The MLSI, LMCD, and DLM will normally be mounted in the same bay in a remote office.

2.03 The following paragraphs briefly describe the functions of the equipment used in a remote office. For a more detailed description, refer to Section 365-330-110.

2.04 **MLSI:** The maintenance line status indicator (Fig. 1) monitors the performance and integrity of T1 maintenance and backbone lines appearing in the remote office. It continually checks each monitored line for violations and provides both visual and E telemetry outputs as violations occur.

2.05 **LMCD:** The local maintenance center display provides the remote office with a centralized lamp display of alarm status from the systems being monitored. The display gives the remote office forces the ability to quickly identify failed systems from a central location. The display also has a locking set of horizontal and vertical grid indicators which permit rapid identification of new and intermittent alarms. Figure 2 is the initial basic unit in a display bay while Fig. 3, the supplementary unit, provides a modular growth capability.

2.06 **DLM:** The directed line monitor (Fig. 4) identifies the signal (working line, all 1s, QRSS, or no signal) and measures the bipolar violation error rate on a T1 or T1C line. Any

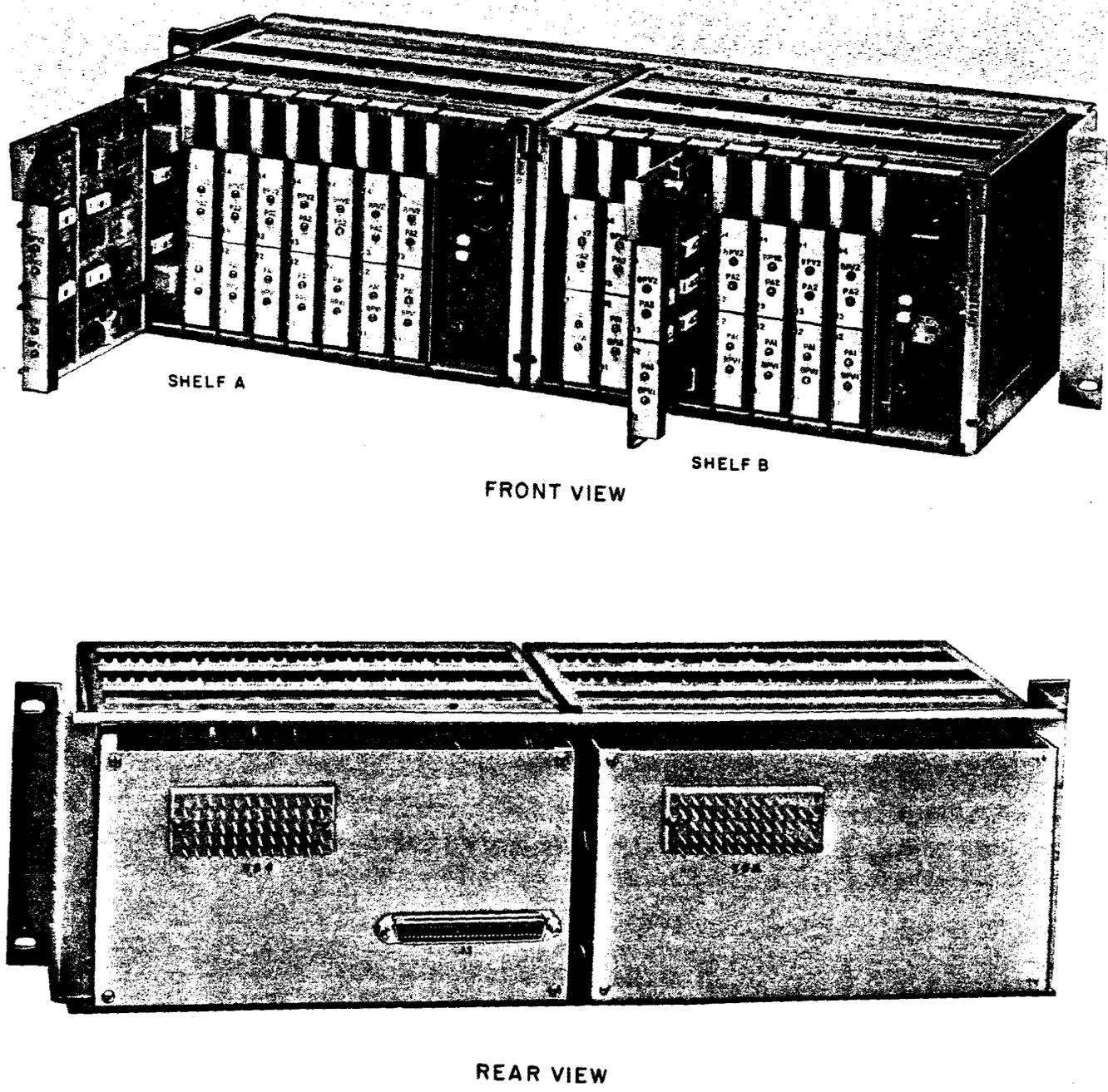


Fig. 1—Maintenance Line Status Indicator (MLSI)

central office repeater that is connected to the monitoring system can be measured either manually by the central office forces or by the TCAS Central via telemetry.

2.07 RU: The relay unit (Fig. 5) provides the interface and memory needed to operate

the repeater access unit (RAU) and to enable the line or test signal to be measured by the DLM.

2.08 RAU: The repeater access unit (Fig. 6) is a CE1 small crossbar switch that can bridge onto any T1 or T1C line in its associated central office repeater bay. It is used in conjunction with

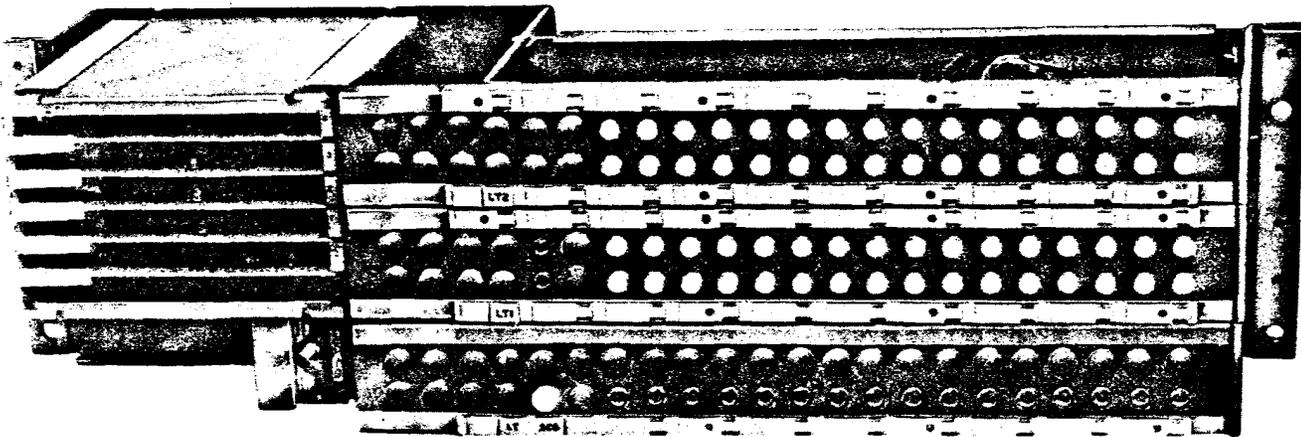


Fig. 2—Local Maintenance Center Display (LMCD)—Basic Unit

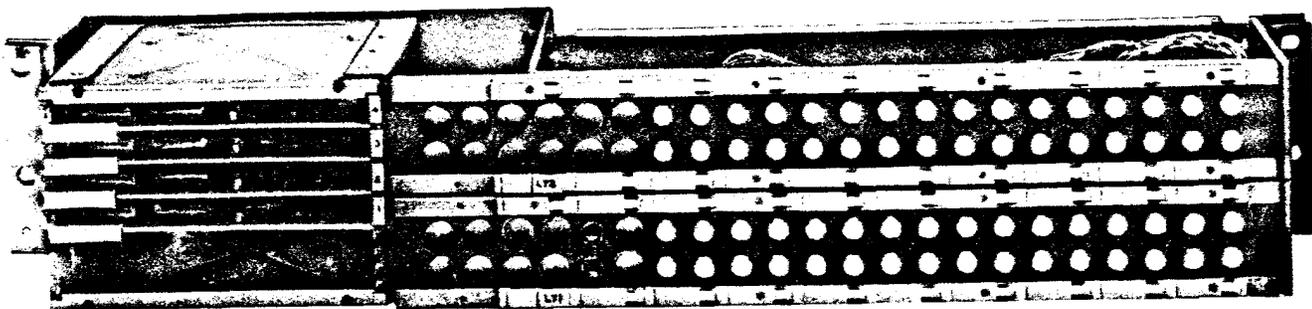


Fig. 3—Local Maintenance Center Display (LMCD)—Supplementary Unit

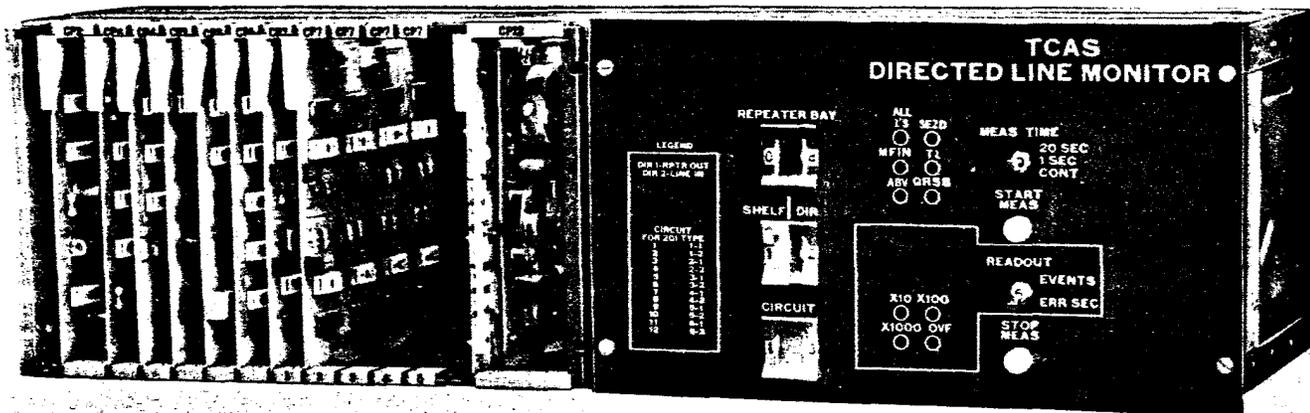


Fig. 4—Directed Line Monitor (DLM)

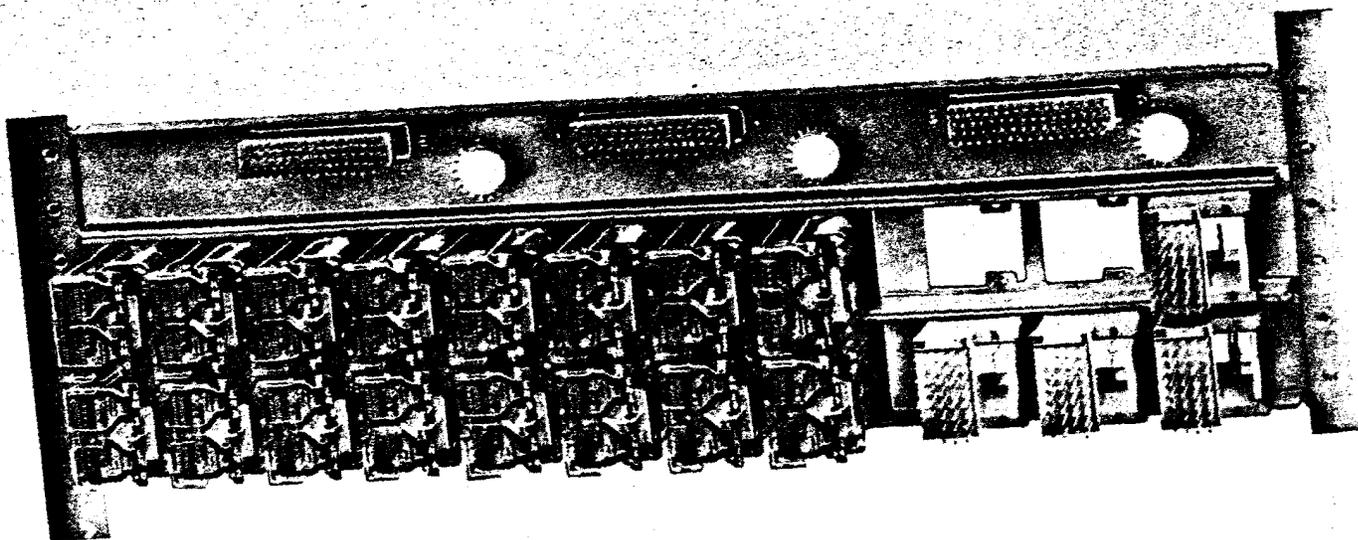


Fig. 5—Relay Unit (RU)

the DLM and RU to select a particular line for measurement.

2.09 RIU: The relay interface unit (Fig. 7) is used to isolate the E2 telemetry equipment status inputs from the monitored equipment. It is required when the E2 equipment is used for the red alarms of D1 banks and when an LMCD is used on the carrier group alarm (CGA) of any D bank. The RIU is not required when E2A telemetry equipment is used.

2.10 CJP: The connector junction panel (Fig. 8 and 9) is an arrangement used to facilitate

interconnection of the TCAS equipment by grouping many status points into a connectorized cable.

2.11 E2 and E2A: The E2 Status Reporting and Control System provides the means of transferring alarm and status information from the remote offices to the TCAS Central. The E2 system also gives the TCAS Central the ability to send switching commands to a remote office. A typical E2 remote station is shown in Fig. 10. The E2A is a new vintage of the E2. The E2A remote station can be optioned to function in the same telemetry network as the slower speed E2 (600

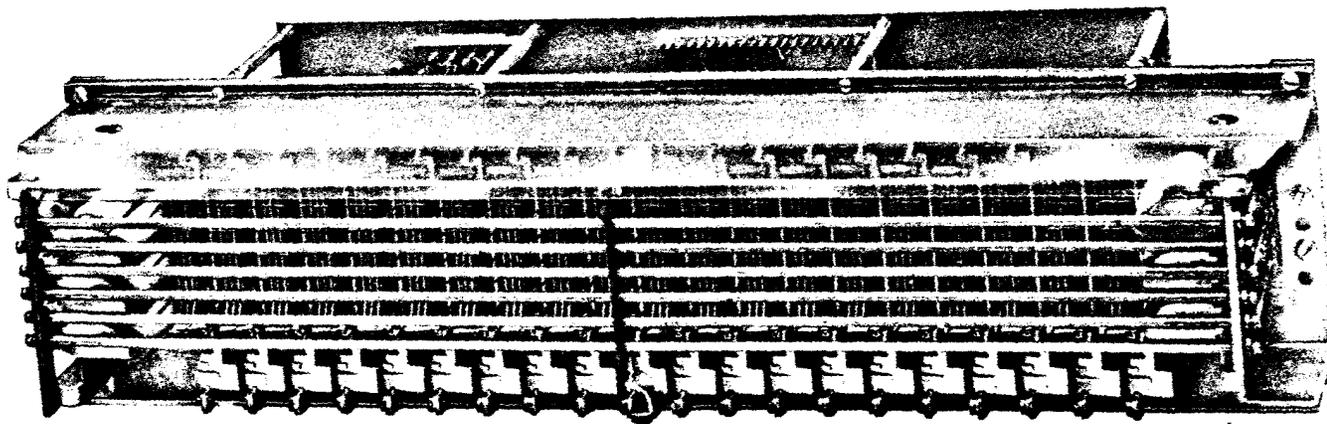
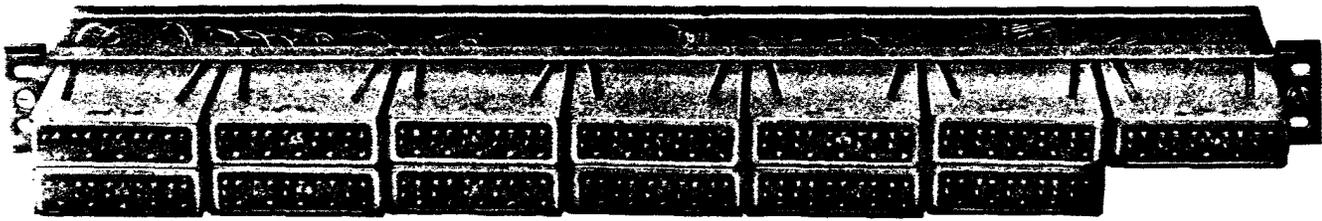
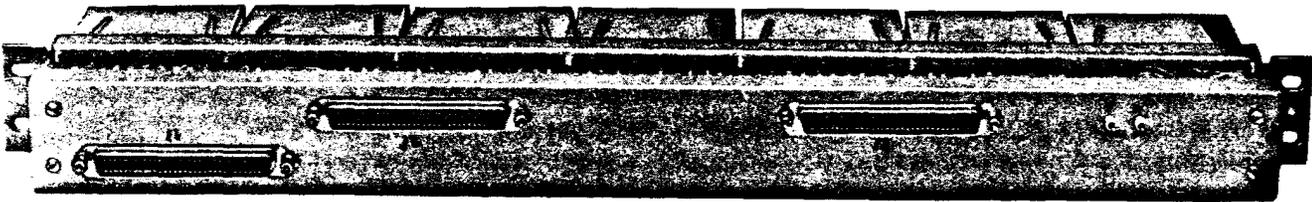


Fig. 6—Repeater Access Unit (RAU)



FRONT VIEW

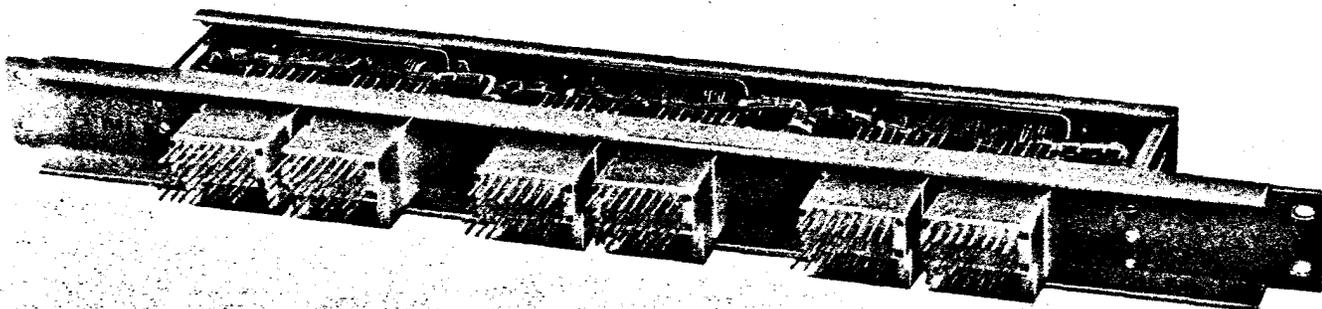


REAR VIEW

Fig. 7—Relay Interface Unit (RIU)



FRONT VIEW



REAR VIEW

Fig. 8—Connector Junction Panel (CJP)—Early Model

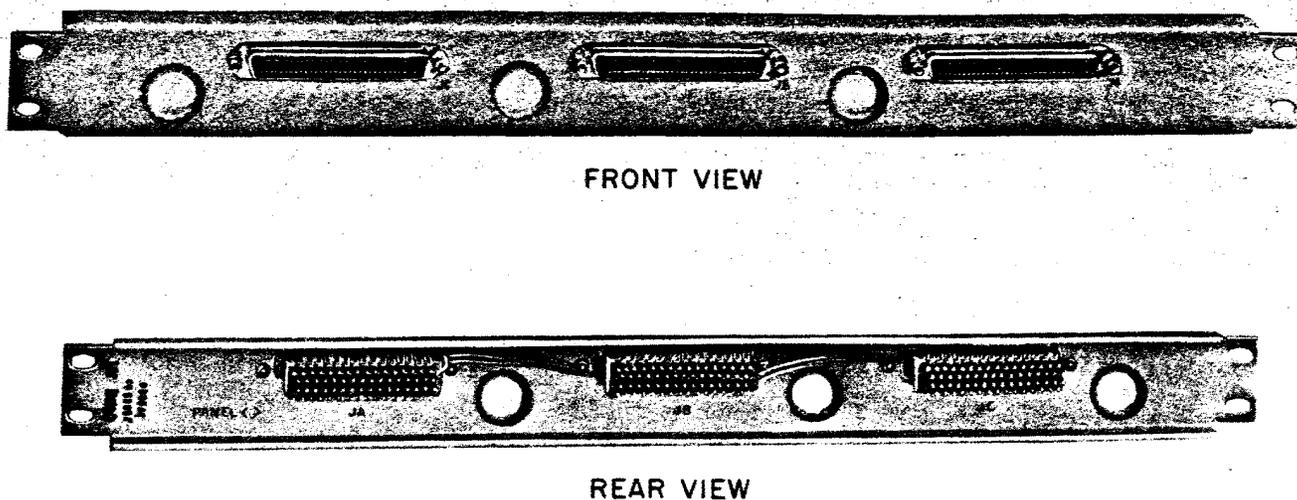


Fig. 9—Connector Junction Panel (CJP)

bps). Refer to Sections 201-644-100 and 865-100-101 for information relating to E telemetry.

2.12 Other equipment such as diode panels and bridging resistor panels are used to complete the equipment interconnection.

2.13 Figure 11 is a simplified diagram of a typical TCAS E telemetry data network. Figures 12 and 13 show how the remote office TCAS equipment is interconnected.

TCAS CENTRAL

2.14 The TCAS Central equipment consists of a central processor cabinet, interface cabinet, and associated peripheral equipment. For a functional description of the Central capabilities, refer to Section 190-200-100.

2.15 A Hewlett-Packard 2100A minicomputer, equipped with a 32K core memory, is the heart of the TCAS Central. A cartridge disc subsystem, a magnetic tape subsystem, an input/output extender, and a paper tape reader make up the rest of the central processor cabinet (Fig. 14).

2.16 Two types of interface cabinets are available. One cabinet (Fig. 15) contains up to ten telemetry-computer translators (TCT), a test TCT, a TCT test panel, and mounting space for up to sixteen 202T data sets. The other available cabinet contains up to four TCTs, a test TCT, and a TCT

test panel. With this smaller cabinet, the data sets must be mounted elsewhere. The larger interface cabinet is recommended for normal TCAS Central installations, with the smaller cabinet used only in special situations.

2.17 An HP2762A "Terminet" Keyboard/Printer (Fig. 16) is used as the Central (Computer) Control Console (CC). It is used for central control, telemetry tests, diagnostic messages, and diagnostic tests.

2.18 One DATASPEED[®] 40 Keyboard/Display terminal, also referred to as a computer display terminal (CDT), (Fig. 17), is used for each maintenance controller position, each data base input position, and each supervisor position. These terminals may be located near the processor or remotely to another building via 4-wire data facilities. The number of each position is determined by the size and layout of the network served. A maximum of 12 CDTs can be driven by one TCAS Central.

2.19 A DATASPEED 40 friction-feed printer (Fig. 18) may be provided optionally with one or more of the CDTs. These printers permit the production of a paper copy of the host CDT display contents.

2.20 Two DATASPEED 40 tractor-feed printers (Fig. 19) are used as the line printers (LP1, LP2). LP1 maintains a record of the overall T-Carrier network status so that manual TRCC

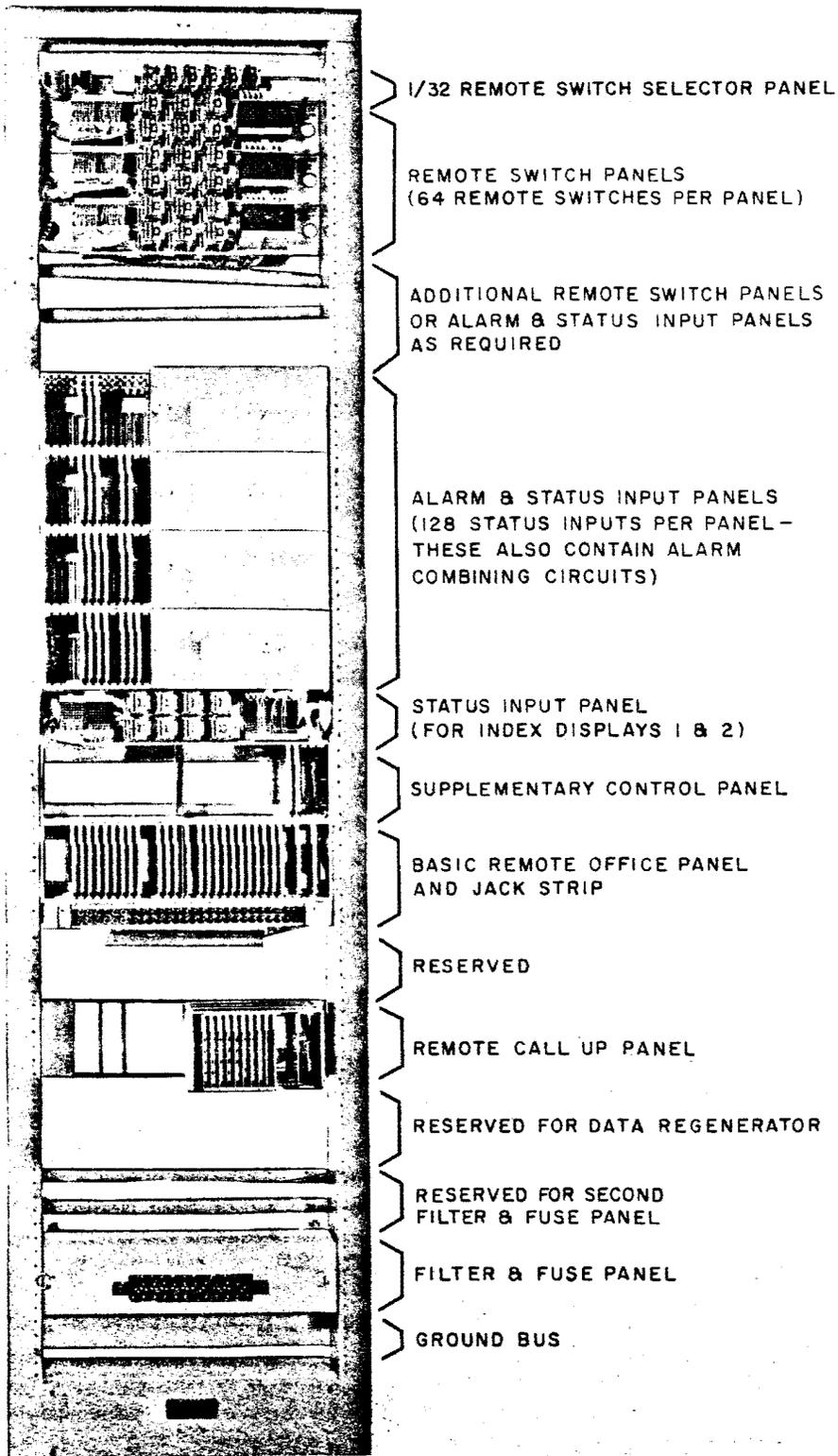


Fig. 10—Typical E2 Remote Station

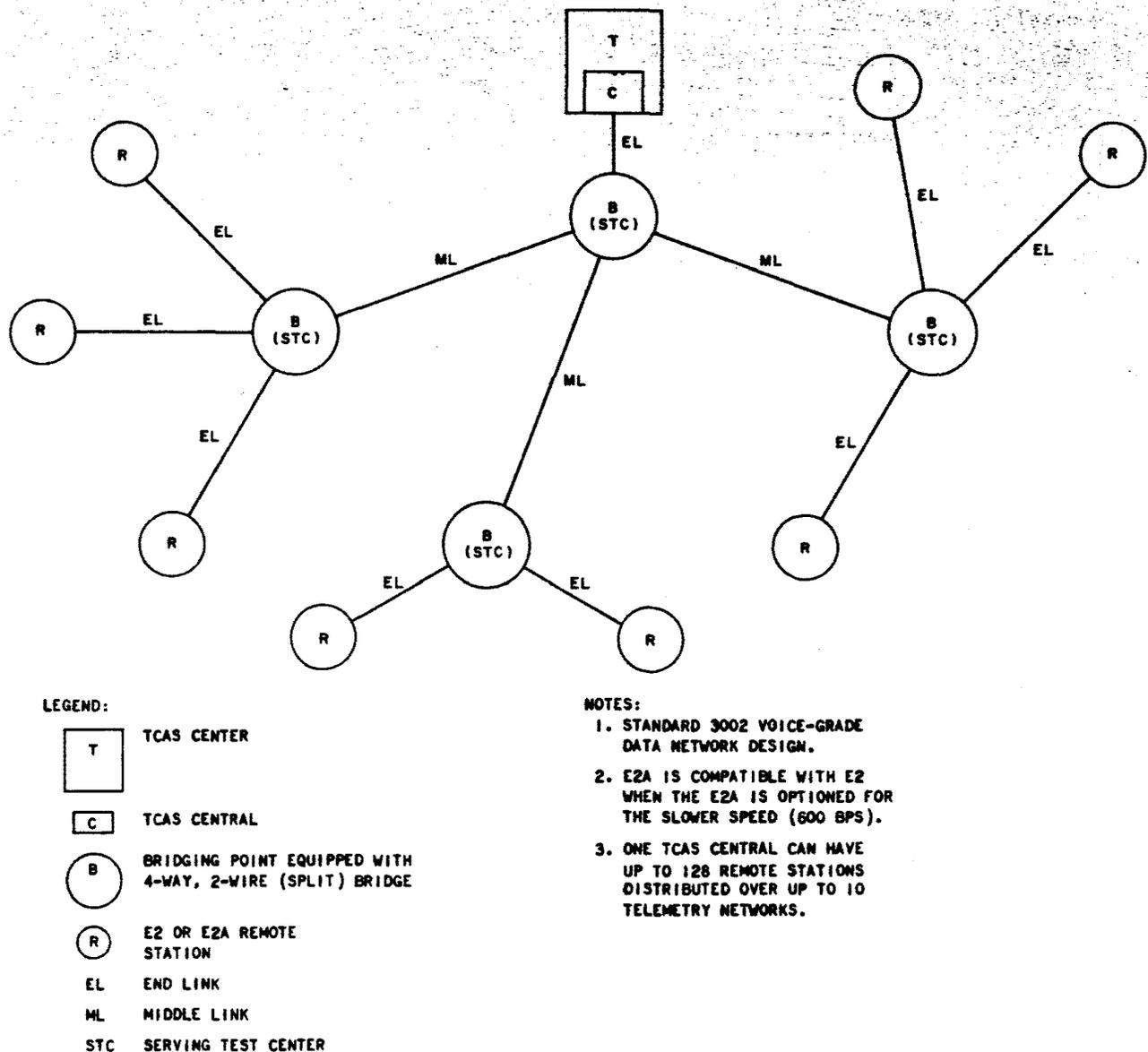


Fig. 11—Typical TCAS E Telemetry Network

functions can be initiated in the event of a computer or disc failure. LP2 provides the necessary periodic reports.

2.21 Other hardware arrangements such as input/output extenders and data link interface cards are used as required to satisfy the system objectives.

2.22 Figure 20 shows a TCAS Central equipment arrangement. Figure 21 shows a typical TCAS Central.

TCAS SOFTWARE

2.23 TCAS uses the Hewlett-Packard real-time executive (RTE) as the operating system. The remainder of the software was developed specifically for the TCAS application. This software provides the TCAS Central with the following general features:

- (a) Data base generation, update, and administration
- (b) Alarm detection, analysis, and patterning

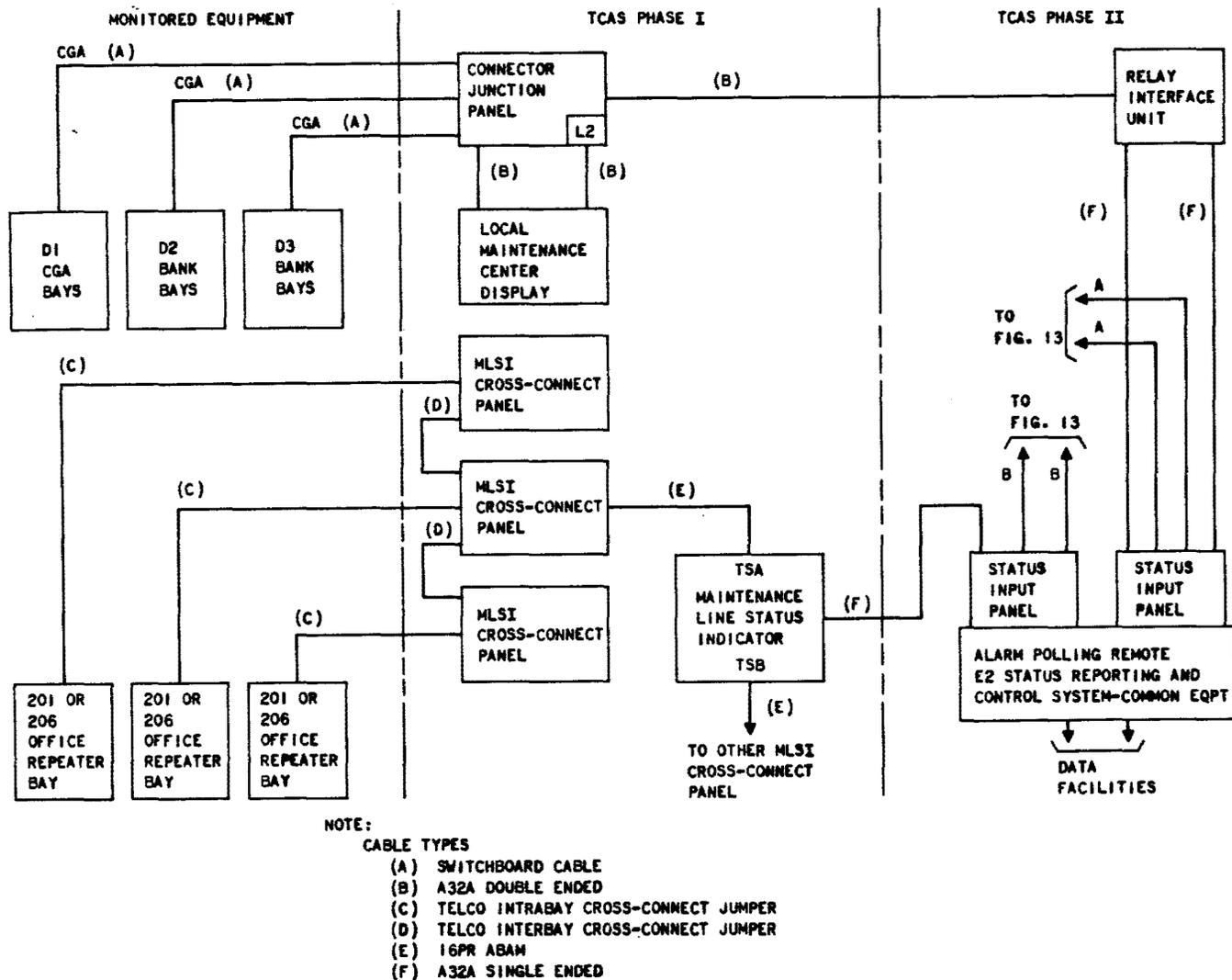


Fig. 12—TCAS Remote Office Arrangements With E2 Telemetry (Phases I and II)

- (c) Automatic trouble sectionalization
- (d) Periodic performance evaluation
- (e) Status displays and management reports
- (f) Trouble case and maintenance line administration.

2.24 The following paragraphs describe the general software features in more detail.

2.25 The data base information required for an operating TCAS includes most of the information currently provided on the T-Carrier—System Layout Record, E-4940 (see Fig. 22). In addition,

assignment information for the E telemetry and directed line monitor equipment in remote offices, and information concerning the overall TCAS system layout are also required.

2.26 The initial data base is usually generated by an input of bulk records via magnetic tape. Subsequent updating is accomplished either by magnetic tape or by a CDT. Usually one maintenance controller would be designated as also having data base responsibility.

2.27 Some TCAS installations will have much of the input data supplied by a mechanized Coordination of Record and Data Base System

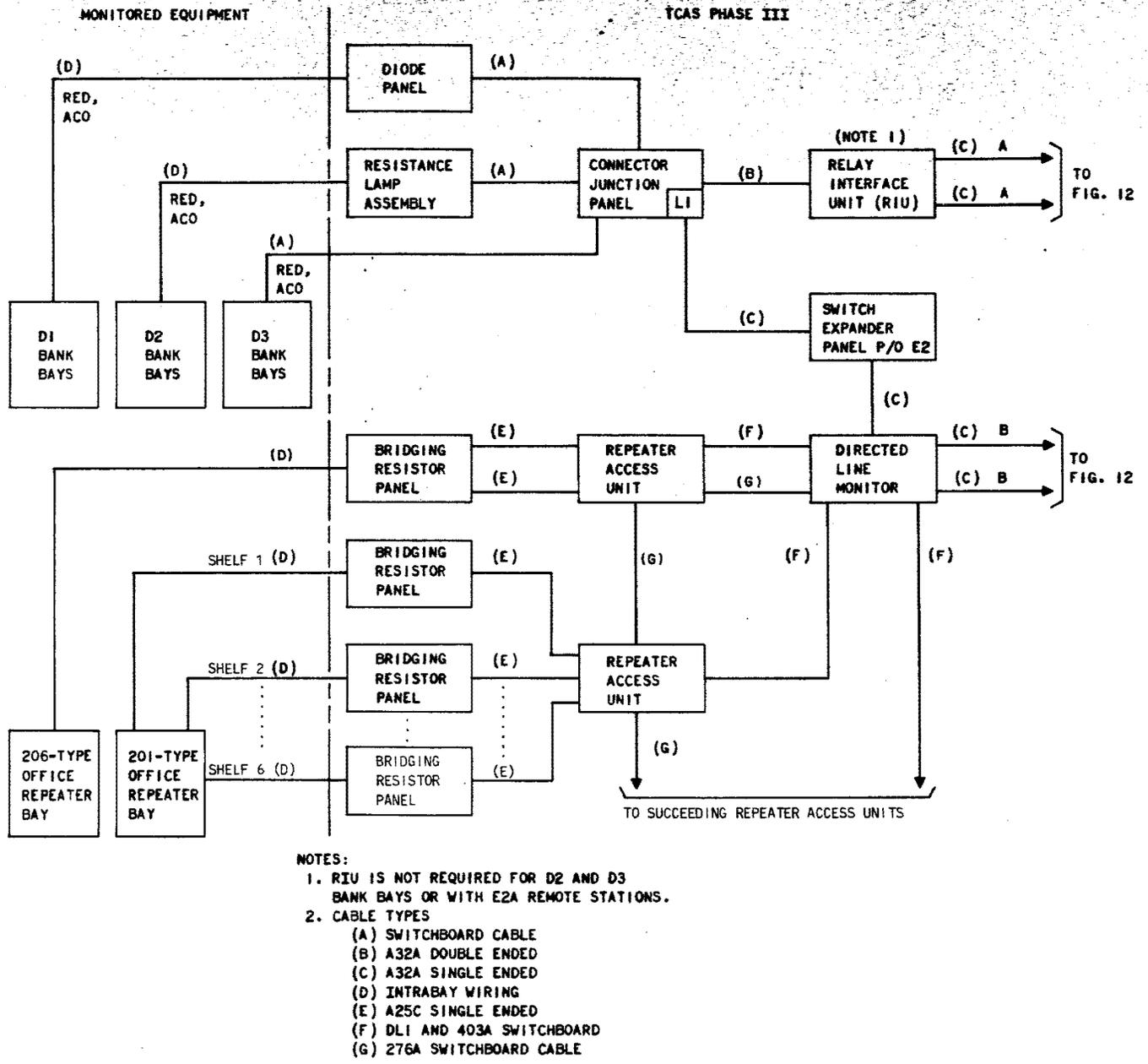


Fig. 13—TCAS Remote Office Arrangements With E2 Telemetry (Phase III)

(CORDS) or by a mechanized circuit layout process. In the absence of a mechanized input, the TCAS Center is responsible for generating and updating the data base from information supplied by the engineering, circuit layout, supplier, and central office groups.

2.28 The data base input formats allow for the use of Common Language; however, they

do not require Common Language. Section 865-201-102 discusses data base preparation in detail.

2.29 The alarm detection, analysis, and patterning package provides the routines needed to retrieve status and alarm information from the remote offices, identify the failed or intermittent systems, correlate alarms (patterning), and report these results to the maintenance controller.

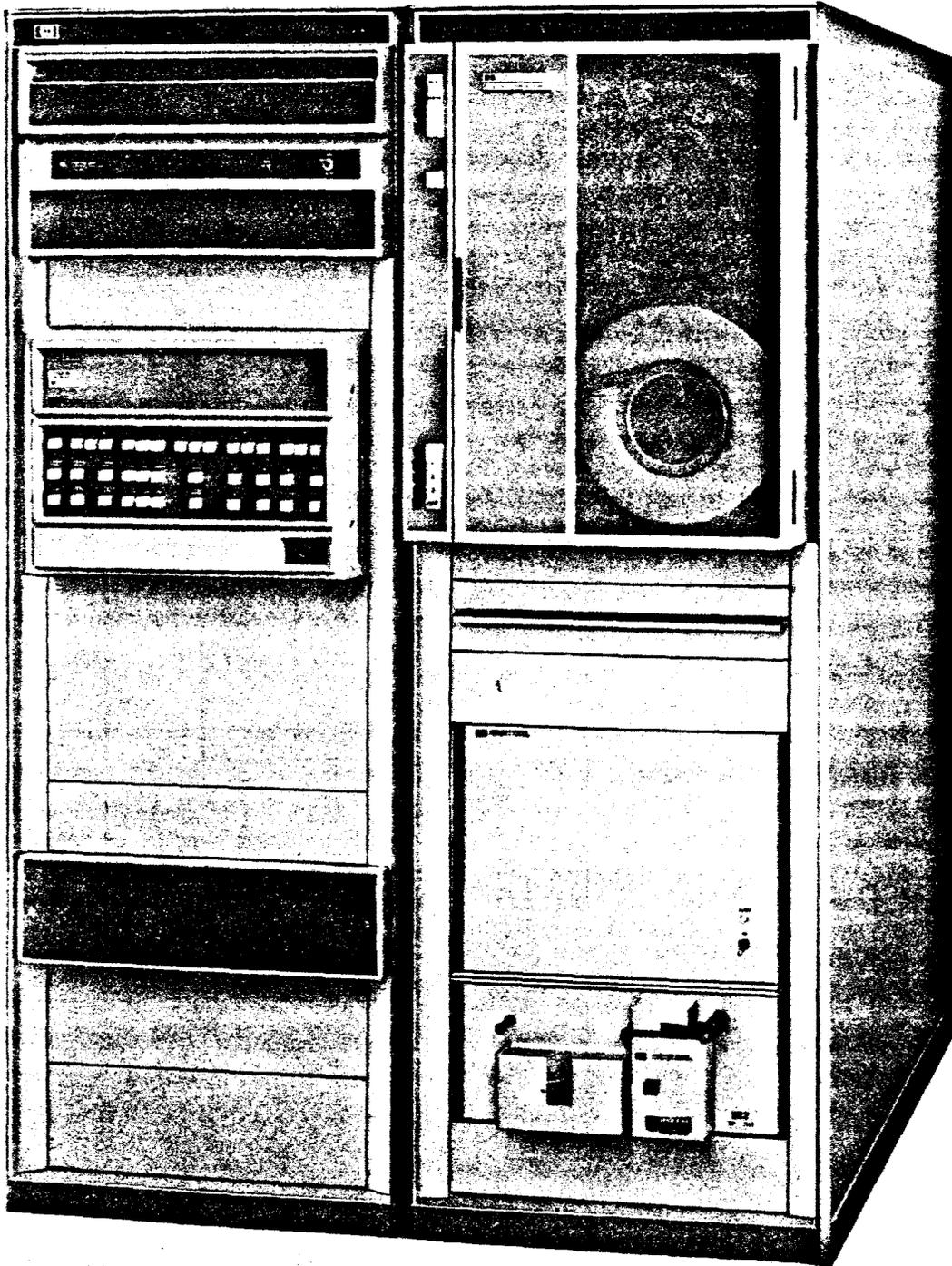


Fig. 14—Processor Cabinet

Nonrecurring short outages will be automatically logged for report information but will not be brought to the attention of the controller. Thus, work activity is directed to those failure or intermittent conditions which require immediate

action. The logged information is available to provide network status reports and displays.

2.30 The automatic sectionalization package enables the TCAS Central to automatically request

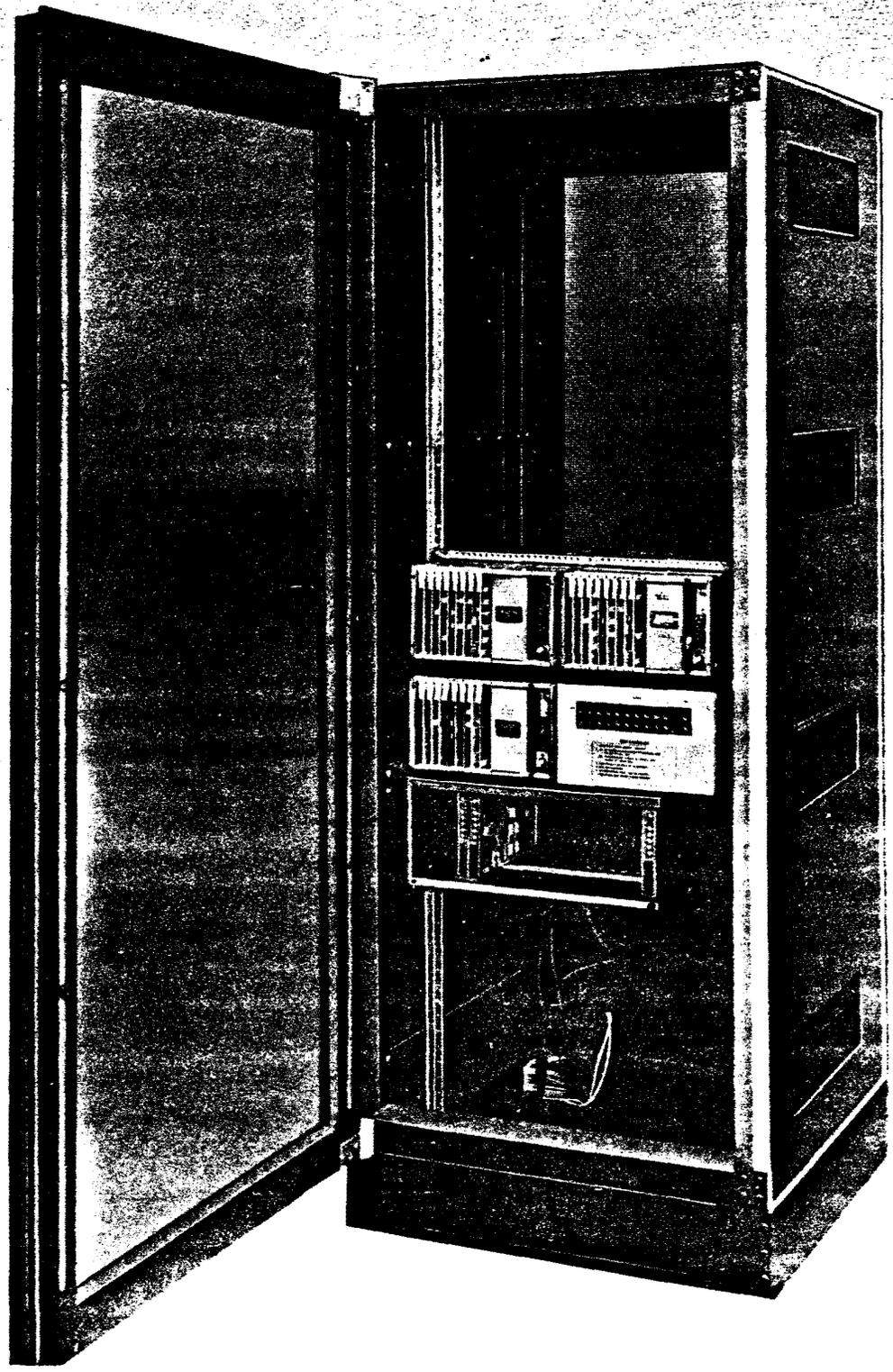


Fig. 15—Interface Cabinet (Partially Equipped)



Fig. 16—Central (Computer) Control Console (CC)

performance measurements on a T1 line, via a DLM, as part of the alarm analysis process. Analysis of these measurements enables the Central to sectionalize a failure to a terminal or to a particular span line. The sectionalization measurements may also be initiated manually from a maintenance control position to aid in sectionalizing high error-rate troubles which degrade performance but do not result in system failures.

2.31 The performance measurements described above can also be performed periodically to determine the overall quality of the digital network.

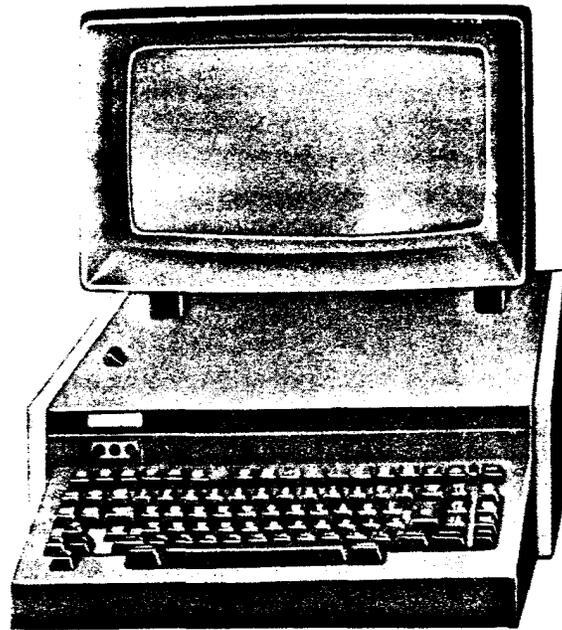


Fig.17—DATASPEED® 40 Keyboard/Display Terminal (CDT)

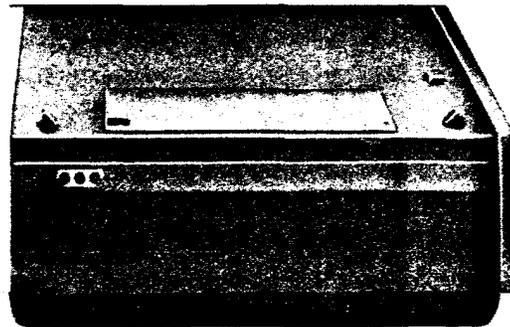


Fig.18—DATASPEED® 40 Friction-Feed Printer (Optional)

All terminating systems can be automatically measured on a routine basis to detect marginal or poor performance.

2.32 With the data collected by the Central, a variety of reports can be generated to provide a clear picture of the performance of the metropolitan digital network. These reports include:

- (a) Failure frequency and duration statistics by control office for various levels of the administrative hierarchy

- (b) Failure statistics for each span
- (c) Maintenance and backbone line utilization
- (d) Breakdown of troubles isolated to span line, terminal, work activity, etc.

3. IMPLEMENTATION

3.01 The basic requirement for a TCAS is the existence of a centralized administrative organization capable of directing restoration activities and responsible for the repair administration of the T-Carrier network. Therefore, a prerequisite for the successful implementation of TCAS is the effective operation of a T-Carrier Restoration Control Center (TRCC) (see Section 190-200-001). This Center manually controls the administration

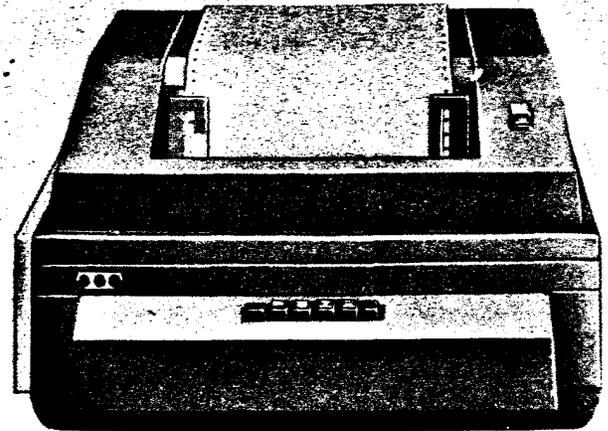


Fig. 19—DATASPEED® 40 Tractor-Feed Printer (LP1, LP2)

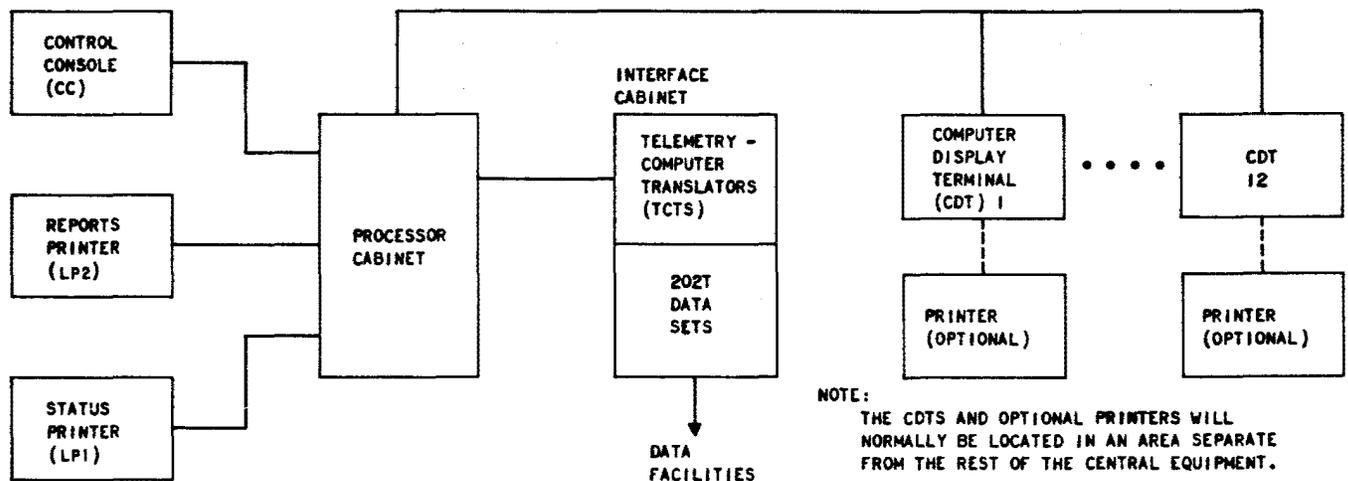


Fig. 20—TCAS Central Arrangement

of maintenance and backbone lines and also controls the line restoration and repair processes.

3.02 Implementation of TCAS in a metropolitan area requires consideration of a number of factors. For example, to be effective a TCAS must include a significant number of both terminal and intermediate office locations comprising the T-Carrier network. Section 865-201-100, Overall Engineering Considerations, and Section 865-201-190, EIMS Guide, provide general guidelines for implementation. These guidelines cover the general character of the T-Carrier network, the size and number of remote offices, the types of T-Carrier systems, etc.

3.03 TCAS is designed to be implemented in three distinct phases. This permits flexibility in the method and extent of the system installation. Since most of the equipment related to TCAS is in the remote office locations, a particular metropolitan area may have offices in all three phases at the same time.

PHASE I—REMOTE OFFICE MAINTENANCE AIDS

3.04 The first step in centralizing the administration of a metropolitan digital network is to permit better administration *within* a remote office. T-Carrier alarms are often intermittent, and identifying these alarms is often difficult. The

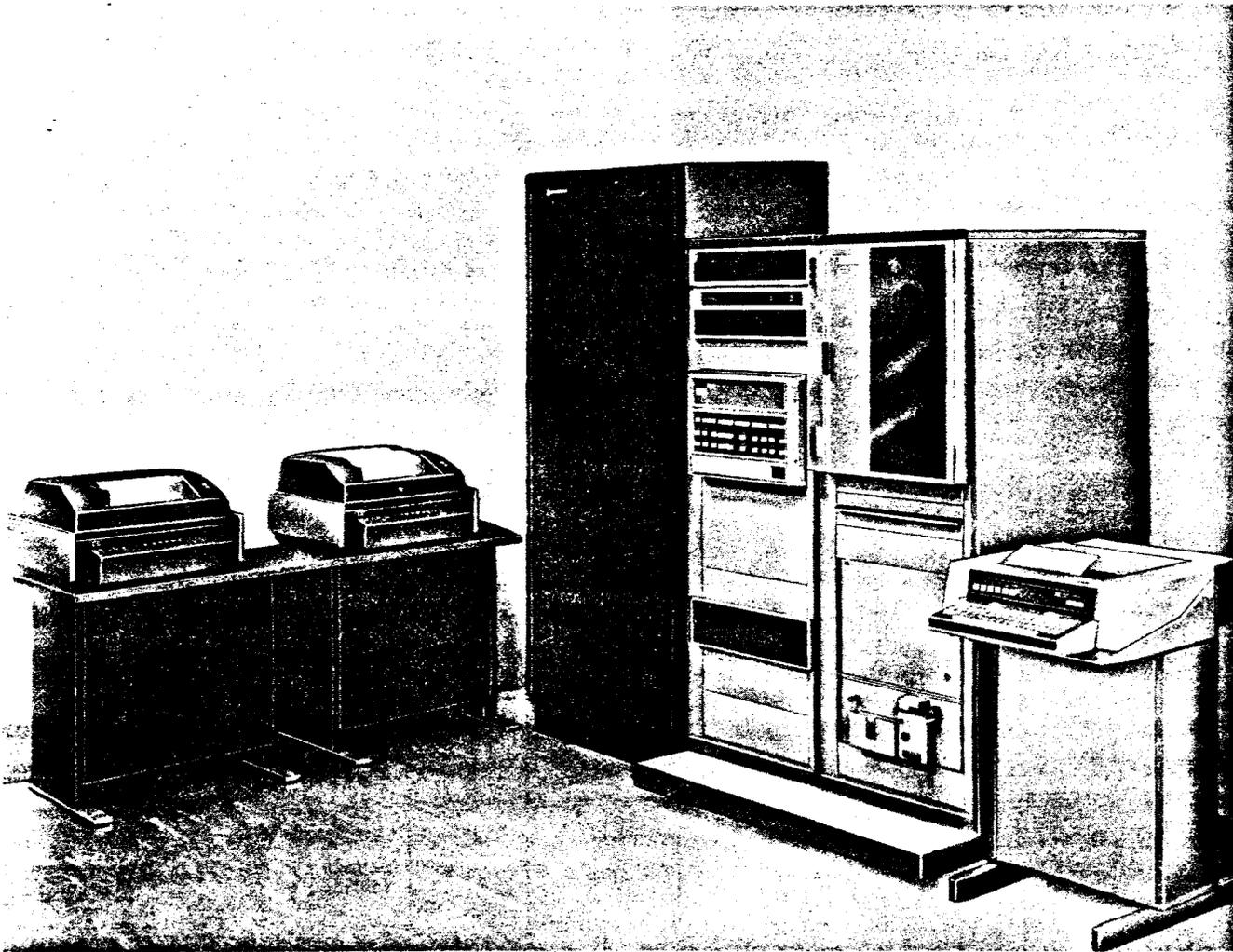


Fig. 21—Typical TCAS Central (CDTs and Optional Printers not Shown)

local maintenance center display (LMCD) permits the centralization of all T-Carrier terminal alarms to a maintenance center within the office. This makes the status of all systems terminating in that office readily available.

3.05 The connector junction panel (CJP) is used to interconnect the LMCD to the monitored equipment. The connections on the CJP are also readily available for connection to the telemetry system as part of Phase II.

3.06 In addition to the LMCD, Phase I provides a maintenance line status indicator (MLSI) for full-time monitoring of maintenance and backbone lines. The MLSI, which can be mounted in the

same central office bay as the LMCD, eliminates the need for periodic testing of maintenance and backbone lines. Status leads from the MLSI are readily available for connection to the telemetry system as part of Phase II.

PHASE II—CENTRALIZED ALARM REPORTING AND ANALYSIS

3.07 The second phase of TCAS involves the installation of the TCAS Central equipment in an operating TRCC and telemetry connections to remote offices. The terminal alarm information is transmitted from a number of remote offices to the Central via the telemetry data networks. The addition of real-time status information changes

E-4940 (11-66)

T CARRIER SYSTEM LAYOUT RECORD

BSP 365-000-010

A CHANNEL GROUP <i>101 DI FRANKLIN - KENNEDY</i>										CONTROL OFFICE <i>KENNEDY</i>							
B AREA MI.		AREA MI.		AREA MI.		TOTAL MI. <i>12.6</i>		CKT. ORDER NO. <i>4.20055</i>		DATE IN EFFECT <i>11-8-74</i>		ISSUE NO. <i>1</i>		CARD NO. <i>1 OF 1</i>			
C OFFICE A <i>FRANKLIN</i>			D TERM BAY <i>227.01</i>		BTA		POSITION <i>4</i>		OFFICE B <i>KENNEDY</i>			D TERM BAY <i>233.14</i>		BTA		POSITION <i>12</i>	
D TRANS. FROM A		CASE SOCK.	SPAN TERMINATION				OFFICE OR STATION		TRANS. FROM B		CASE SOCK.	SPAN TERMINATION					
CABLE PAIR			INPUT		OUTPUT		SPAN		CABLE PAIR			INPUT		OUTPUT			
1	2	3	RR BAY NO POS		RR BAY NO POS		SPAN	SPAN	7	8	9	RR BAY NO POS		RR BAY NO POS			
E			4		5		6	6				10		11			
F	5808	402	2-1			225.00	1-2	FRA	2	1	5887	452	2-1				
G				141.04	1441	141.04	1451	LYN						141.04	1451	141.04	1441
H	5050	1813	13-1					1	4	5050	1263	13-1					
I				113.05	2751	113.05	2911	LAU						113.05	2911	113.05	2751
J	4986	657	5-1					2	1	4996	560	5-1					
K				233.01	261			KDY								233.01	261
L																	
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R																	
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Fig. 22—T-Carrier-System Layout Record

the nature of operation of the TRCC such that it is now designated as a TCAS Center.

3.08 The TCAS Central receives real-time alarm information to be used for trouble case administration and for alarm patterning.

3.09 The Central also receives real-time status information from the MLSIs in the remote offices. This allows the Center to be continually aware of the status of the maintenance and backbone lines.

3.10 The TCAS Central also generates the periodic reports required to effectively administer the T-Carrier network.

PHASE III—AUTOMATIC SECTIONALIZATION

3.11 The third phase of TCAS involves the installation of repeater access units (RAUs) in remote office repeater bays and directed line

monitors (DLMs) in remote office maintenance centers. When the TCAS Central detects a system failure, it will direct the DLMs in associated intermediate offices to measure the line performance and identify the span line or terminal that is failed.

3.12 Phase III also includes red alarm status and remote alarm cutoff (ACO) capability. With the ACO feature, the TCAS Central can silence remote office alarms when desired, thereby eliminating unnecessary manual sectionalization effort.

ADDITIONAL CAPABILITIES

3.13 In addition to the capabilities provided in Phases I, II, and III, TCAS can provide data link interconnections to other operations support systems.

3.14 TCAS is capable of supporting satellite administrative centers which are separated

from the TCAS Central but have access to it through interactive CDTs. A satellite center may be used to administer a T-Carrier network which is *isolated* from the primary network. The satellite center's control can be returned to the TCAS Center during unstaffed periods.

4. OVERVIEW OF OPERATION

ADMINISTRATION

4.01 The role of the TCAS Center evolves from that of a TRCC responding to trouble reports from the field to that of a control center which initiates and coordinates corrective action based upon a real-time knowledge of the status of the network.

4.02 Prior to Phase II TCAS, T-Carrier systems are maintained using a system control concept. One terminal end of a system is responsible for responding to alarms and coordinating the sectionalization and restoration of the system. When the network becomes sufficiently large, administrative control of maintenance and backbone lines is given to a TRCC to provide more efficient use of these facilities. Responsibility for detection and sectionalization of failures still rests with the control office.

4.03 With Phase II TCAS, by monitoring the CGA of T systems in major offices, the maintenance controllers at the TCAS Center no longer depend entirely upon reports from the system control offices to determine the status of the network. However, since automatic sectionalization and alarm cutoff capability is not yet provided, the system control offices must still respond to system alarms and initiate corrective action. The major function of the TCAS Center is still that of administering maintenance and backbone lines. The effectiveness of this administration is improved by real-time monitoring of the maintenance and backbone lines and a mechanized patching record. In addition, the TCAS Central can assist in the isolation of multisystem failures with the aid of the patterning package, follow-up on T1 system failures or intermittents which are not being cleared, and provide failure and restoration data reports necessary for administration of the network. The maintenance controller also coordinates the dispatch of repair crews to ensure efficient use of resources.

4.04 In Phase III, system failures are automatically sectionalized by the TCAS Central. Office alarms can be automatically silenced to eliminate the initiation of manual sectionalization. The maintenance controller directs the initiation of terminal repair, coordinates the restoration patch with the span offices, and directs the initiation of fault locating efforts. In addition, the Phase III arrangements permit positive completion reporting on new systems, thereby ensuring satisfactory performance when the system is turned up for service.

RESPONSIBILITIES

4.05 In a pre-TRCC/TCAS environment, the system control office is responsible for directing the sectionalization and restoration effort. The span control office is responsible for initiating fault locating and requesting the dispatch of the repair crew. Maintenance lines are administered by the span control office. When a TRCC is employed, the administration of maintenance and backbone lines and the coordination of restoration patches are relinquished to the TRCC.

4.06 Implementation of Phase II TCAS does not appreciably change the responsibilities of the central offices; however, Phase III does. The system control and noncontrol offices respond to alarms only if the telemetry facility is inoperative, the ACO is specifically inhibited, or a terminal office is not monitored. At all other times, directives for corrective action will come from the TCAS Center. All restorations will be coordinated by the TCAS maintenance controllers, and only the offices directly affected by the corrective action will be contacted. Fault location will still be the responsibility of the span control office but the dispatch of repair crews should be coordinated by the TCAS Center.

4.07 The responsibilities of the outside plant repair crews are not directly affected by the implementation of TCAS. The major change is that dispatches will be coordinated by the TCAS Center to maximize the effectiveness of the crews. The maintenance controllers will track the progress of the repair and will conduct the testing of the line prior to its return to service.

4.08 The role of the TCAS Center becomes more vital in the maintenance of T-Carrier systems as the implementation of TCAS progresses. In

Phase II, individual system failures are still handled by the system control office with the TCAS Center administering the use of the maintenance and backbone lines and directing restoration. Since the TCAS Central can pattern multisystem and intermittent failures, the TCAS Center assumes the role of directing the immediate restoration of such failures independent of the system control office.

4.09 In Phase III, the TCAS Center becomes responsible for directing restoration and corrective action on all system failures. Central office forces respond to directives from the maintenance controllers. All repairs dispatches are coordinated by the TCAS Center. The Center is also responsible for positive completion reporting on new T1 systems and for periodic performance monitoring of all T1 systems being monitored.

4.10 The following steps describe the restoration of a typical system failure under Phase III TCAS. (In this example the failure is due to span line trouble.)

- (1) A T-Carrier system fails. The terminal offices have central office alarms and failure indications on their local maintenance center displays. The TCAS Central also receives an alarm indication.
- (2) The TCAS Central begins processing the failure.
 - (a) The alarms in the terminal offices may be cut off at various times throughout the restoration process as determined by local constraints and policies.
 - (b) The Central determines if more than one system failed at the same time. Two simultaneous failures could indicate that a system and its side system have failed. Multiple system failures at the same time could indicate a possible major failure.
 - (c) The TCAS Central sectionalizes the trouble to the line or a terminal using DLM and RED alarm indications at the terminal offices.
 - (d) Automatic sectionalization begins by directing the remote office DLMs to the associated T1 line for performance measurements.
- (3) With the failure sectionalized to a particular span, a trouble case number is assigned and the maintenance controller is notified of the failure. The maintenance controller contacts the intermediate remote offices at each end of the suspect span.
- (4) The MLSI in the associated intermediate office indicates the status and availability of maintenance lines. With this information, the maintenance controller assigns a maintenance line for patching the system. The system is patched according to Section 365-226-500.
- (5) Through the system restoral indication and the associated MLSI seizure indication, the patch is verified by the TCAS Central and the maintenance controller is notified.
- (6) The side system, if any, is patched and verified in the same manner.
- (7) The patches are tagged with the trouble case number.
- (8) The intermediate remote offices determine, through testing, that the trouble is in the line and not in one of the remote offices.
- (9) The span control office is responsible for performing the fault location testing and relating the fault locate information for the trouble case number to the TCAS Center.
- (10) The maintenance controller relates the system restoral information to the system control office.
- (11) The maintenance controller relates the fault locate information to the outside plant dispatcher.
- (12) The trouble case number on this failure is not closed until the span line trouble is cleared, the patches are removed, and the failure information is recorded.

SECTION 190-200-010**5. REFERENCES**

5.01 The following sections pertain to the T-Carrier Administration System (TCAS):

SECTION	TITLE	SECTION	TITLE
		365-330-300	TCAS Remote Office Equipment Maintenance
		365-330-500	TCAS Remote Office Equipment—Test Procedures
190-200-001	T-Carrier Restoration Control Center (TRCC) Organization and Responsibilities	644-202-050	T-Carrier Cable Restoration Implementation
190-200-025	TCAS—Organization and Responsibilities	824-101-104	(J98722) TCAS Remote Office Equipment—Requirements
190-200-030	TCAS Center—Operating Procedures	824-101-106	(J1P025) TCAS Central—Equipment Requirements and Software Requirements
190-200-100	TCAS Central Capabilities—Functional Description	865-100-101	E-Telemetry Systems Data Network—Engineering
190-200-200	TCAS Central—Turnup Procedures	865-201-100	TCAS—Overall Engineering Considerations
190-200-300	TCAS—System Maintenance	865-201-101	TCAS Central—Engineering Considerations
190-200-500	TCAS Central—Test Procedures	865-201-102	TCAS—Data Base Preparation
201-644-100	E2 Status Reporting and Control System—Description	865-201-110	TCAS Remote Office Engineering—General
365-020-302	T1 Carrier—Maintenance Plan With TCAS	865-201-111	TCAS Remote Office Engineering—T1 Carrier
365-330-100	TCAS—General Description	865-201-190	Engineering and Implementation Methods System (EIMS) Guide for TCAS
365-330-110	TCAS—Remote Office Equipment Description		
365-330-200	TCAS Remote Office—Turnup Procedures		