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ENGINEERING AND IMPLEMENTATION METHODS SYSTEM (EMIS) GUIDE

T-CARRIER ADMINISTRATION SYSTEM (TCAS)

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1. GENERAL

1.01 The Engineering and Implementation Methods System (EMIS) Guide is intended to provide a convenient index of all documentation necessary to engineer, implement, operate, and maintain a T-Carrier Administration System (TCAS). In addition, the guide provides a summary of the referenced information as well as guidance to when the documents are to be used.

1.02 This section is being reissued to incorporate new features provided by generic 4. Revision arrows are used to emphasize the more significant changes. The following are the specific reasons for the reissue:

(a) Add information about the increase in data base capacity

(b) Add references to the maintenance alarm controller (MAC)

(c) Change references to the T-Carrier Restoration Control Center (TRCC) to the Facilities Maintenance and Administration Center- Metropolitan (FMAC-M)

(d) Update the areas of potential savings information

(e) Revise the training information.

OVERALL SYSTEM DESCRIPTION

A. Overview of System

1.03 The TCAS is an operational support system designed to provide administrative and operational support of the FMAC-M. Centralized detection and analysis of T-Carrier System alarms can provide the FMAC-M with an overall picture of the status of the metropolitan digital network. The T-Carrier System failures are detected and sectionalized thereby reducing outage time and time consuming manual sectionalization effort. ▶The data base can accommodate 19000 systems and 3600 patch lines.◀

1.04 The TCAS identifies major route failures thereby minimizing their service impact. Systems with marginal performance can be detected automatically by periodic performance measurements which provide the opportunity to schedule routines on an as needed basis. This centralized control permits effective utilization of existing facilities and available personnel. Finally, the system can provide management with current and accurate information on the status and performance of the T-carrier network.

1.05 The TCAS has been designed to permit varying degrees of implementation in terms of major maintenance capabilities:

(a) The following is provided by alarm monitoring and analysis:

(1) Centralized alarm analysis

(2) Alarm pattern recognition

(3) Maintenance line administration

(4) Administrative reporting.

(b) Sectionalization and control adds the ability to sectionalize troubles to a terminal or a span.

(c) Terminal office alarms are inhibited to prevent unnecessary response by the maintenance personnel.

(d) Periodic performance monitoring permits concentration of the routine maintenance activities on those systems exhibiting poor performance.

(e) Local office equipment used by the TCAS can be used manually on a standalone basis.

B. Features Provided

1.06 The following features are provided when the TCAS is implemented in the metropolitan area:

(a) To provide the FMAC-M with current picture of the status of the digital network, the TCAS operates in a real-time for the analysis of digital transmission.

(b) To provide the ability to sectionalize system failures or intermittent hits to a terminal or span which aids in eliminating personnel now expended on sectionalizing the trouble.

(c) To provide real-time monitoring and administration of maintenance lines and backbones used for restoration.

(d) The following listings are provided to aid restoration:

(1) Available maintenance lines

(2) Verification of manual patches

(3) Notification of maintenance line failures

(4) Unauthorized seizures.

(e) To provide the FMAC-M the ability to effectively implement restoration, the following rapid identifications of major route failures are given:

(1) Cable failures

(2) High-capacity facility failures

(3) Apparatus case failures

(4) Work activity in a splice.

(f) To permit maintenance effort to be concentrated on chronically poor-performance lines, a routine periodic measurement of digital transmission performance on all T1-carrier lines being monitored is given.

(g) To permit management to have a current and reliable overview of the T-carrier network for effective network management, automatic generation of periodic management reports on the performance of the metropolitan digital network are provided.

(h) Generation of the T-carrier index for all controlled systems.

GUIDE TO IMPLEMENTATION

1.07 Figure 1 provides a TCAS implementation guide. This guide comes in the form of specifying which paragraphs in this section refer to a particular portion of the system implementation. The specified paragraphs will refer to documents that contain the detailed information to perform that portion of the system implementation. Also, the specified paragraphs will contain a synopsis of the information contained in the referenced documents. The information is organized on the basis of major implementation functions.

1.08 The following is an explanation of the various parts of Fig. 1:

(a) ***Horizontal Solid Lines:*** Represent sequences of functions which must be accomplished to implement a TCAS. The functions which appear in tandem must be accomplished in that sequence. (The relative length of a function has no special significance.)

(b) ***Heavy Vertical Lines:*** Represent key decision points in the implementation. Certain functions must be completed by that point so that other functions can be initiated.

(c) ***Light Vertical Lines:*** Represent dependence between functions. For example, the initial data base load cannot be initiated until sometime after the central computer unit is installed. Likewise, the turnup of service cannot be performed until the central computer unit is installed, some remote units are installed, and the data base has been loaded.

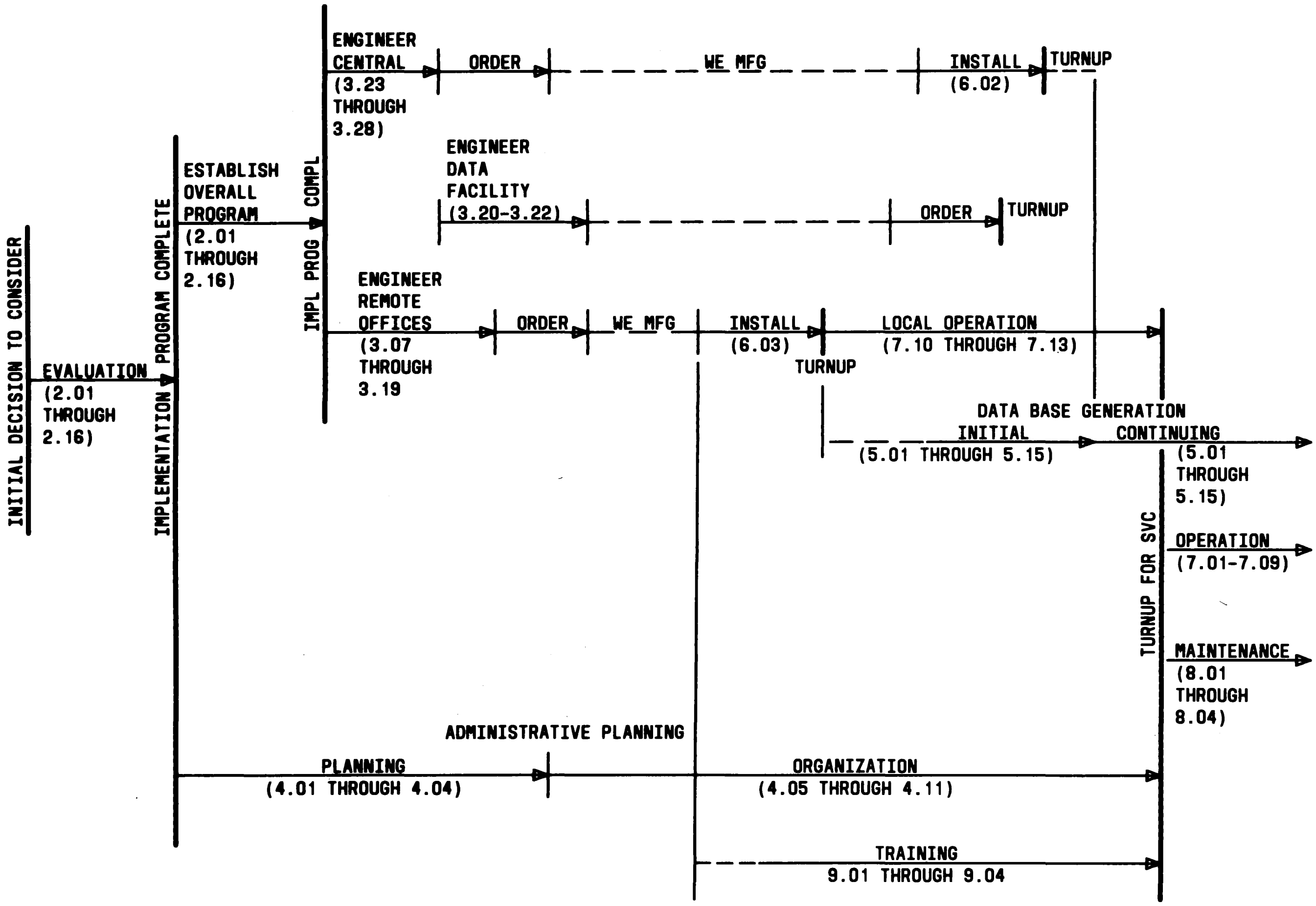

Fig. 1—TCAS Implementation Schedule

(d) ***Numbers in Parenthesis Under Each Function:*** Refer to the paragraph numbers that contain the corresponding information.

1.09 Certain functions, such as engineering remote offices, will continue over a period of years after the TCAS has been turned up for service. This type of information is not reflected in Fig. 1. Thus, Fig. 1 is primarily applicable to the initial implementation of the TCAS.

2. ECONOMIC EVALUATION

2.01 An economic evaluation of the TCAS feasibility is desirable and usually required. This evaluation should answer the many questions which will arise during the planning phases of the TCAS implementation. Foremost among these is the cost of the implementation and the corresponding annual savings. Data generated by these studies will be useful in the following determinations:

(a) Which metropolitan areas are potential candidates for TCAS

(b) The total expected investment

(c) The set of offices which will optimize the implementation

(d) A practical implementation interval.

2.02 An overview of the expected economic and service benefits and the procedures to follow in an economic study of the TCAS are provided in Engineering Letter (EL)-3936B or Plant Engineering (PL)-3148B.

2.03 The cost of implementation and use of the CUCRIT 3 in the economic analysis was updated for the cost reduced arrangements by EL-5722B/PL-3230B. This letter provides detailed guidelines for conducting an economic study of TCAS for large metropolitan digital networks.

2.04 The guidelines for conducting an economic evaluation of TCAS are summarized in the following paragraphs.

OFFICE AND AREA SELECTION CRITERIA

2.05 The following are the guidelines to select the areas of implementation of TCAS and the monitored offices:

(a) Any metropolitan area with a total of at least 1000 T-Carrier Systems is a candidate for TCAS. A number of smaller metropolitan areas may be combined in the study if the combined total exceeds 1000 T-Carrier Systems.

(b) Offices should be selected on the basis of largest terminal offices first, such that at least 95 percent of the T-Carrier Systems are monitored. Note that monitoring one end of a T-Carrier System is sufficient to classify the system as monitored.

(c) Sectionalization offices should be selected on the basis of the number of through systems (largest offices first). Since full sectionalization is expensive, some lesser degree of sectionalization would provide a more optimum cost-benefit tradeoff.

(d) When selecting offices for monitoring and sectionalization, the operational portion of administering the T-carrier network should be taken into consideration.

2.06 Detailed procedures for office selection are provided in EL-5722B, Appendix II. These procedures do not apply to locations without maintenance personnel or nonmetropolitan areas.

INSTALLED COST ESTIMATES

2.07 The installed cost estimates for a typical office are provided in EL-6132. The following are the typical areas for cost development:

(a) Alarm Monitoring

(1) E-Telemetry - Basic Unit per office

(2) E-Telemetry - Incremental per 60 T-Carrier Systems

(b) Maintenance Line Monitoring

(1) Maintenance Line Status Indicator (MLSI) per office

(2) E-Telemetry - Incremental per MLSI unit

(c) Sectionalization

(1) Directed line Monitor (DLM) per office

(2) Repeater Access Unit (RAU) per repeater bay

(3) E-Telemetry - Incidental per office.

2.08 The installed cost estimate for a TCAS central unit and the associated software right to use fee are provided in ➧EL-7669.

AREAS OF POTENTIAL SAVINGS

2.09 The major areas of potential savings are listed in EL-7669. The areas of savings discussed in the EL-7669 are capital and labor savings.

2.10 The use of generic 4 provides administrative and operational benefits. The benefits are derived because the network can be maintained as a single network instead of being split into two parts. The following are the benefits:

(a) Permits generation of a single index report

(b) Eliminates incomplete administrative reports

(c) Eliminates need to make and correlate two sectionalization measurements on a single system

(d) Eliminates overlap problems on alarms reported via telemetry, Carrier Maintenance System (CMS), and Switching Control Center System (SCCS).

2.11 The use of high-capacity alarm monitoring capability of generic 4 provides the following cost savings:

(a) An annual labor savings by eliminating the need to staff high-capacity facility offices to respond to alarms.

(b) A capital investment savings by eliminating the need to implement the DLM in a portion of the high-capacity offices.

2.12 The telecommunication alarm surveillance and control (TASC) data link to the TCAS will provide the following cost savings:

(a) Labor savings in the overall network administration through an increase in the overall system coverage.

(b) Capital savings by eliminating the need for additional TCAS remotes in metropolitan fringe and rural offices.

2.13 These estimated benefits obtained by using generic 4 are typical savings. Each user should tailor these benefits to fit their own operation.➧

ADDITIONAL CONSIDERATIONS

2.14 The following are considerations which cannot be measured economically:

(a) Reductions in routine testing

(b) Improvements in service

(c) Mechanization of T-carrier records.

EXAMPLE OF A TYPICAL EVALUATION

2.15 As an example of an economic evaluation of TCAS, consider a metropolitan area with 5000 T1-Carrier Systems distributed across 60 offices. Studies of such a network indicate that 95 percent of the systems can be monitored by providing access arrangements in 25 terminal offices. Further, a sectionalization ratio of 0.6 (the 0.6 figure was chosen as an illustrative example) can be achieved by placing DLM equipment in six large through offices. Using this model, an implementation of TCAS would result in the following approximate savings:

(a) Total capital investment - $1,300,000

(b) Present worth of annual charges - $3,100,000

(c) Average annual savings - $1,530,000

(d) CUCRIT 3 project rate of return - 49 percent.

2.16 The sectionalization ratio chosen for the study should consider operational as well as economic aspects of administering the T-carrier network.

3. ENGINEERING PLANNING

OVERALL

3.01 Implementation of the TCAS in a metropolitan area requires consideration of a number of factors. Based upon the economic analysis provided in EL-3969B and EL-5722B, any metropolitan area with 1000 or more T-Carrier Systems is a candidate for implementation of TCAS. It should be noted that several smaller T-carrier networks may have homed on one TCAS central unit. Each area may have its own independent FMAC-M with all of the TCAS capabilities. Implementation of the TCAS requires a substantial investment which is dependent upon the size of the office, the type of switching entity, and the level of the desired coverage.

3.02 Since the value derived from alarm monitoring depends upon the number of systems being monitored, the selection criteria stresses concentration on the large terminal offices. This will maximize the coverage with a minimum investment. A secondary consideration is to choose offices which maximize the number of new systems added (monitoring both ends of a system is not cost effective).

3.03 The value derived from the sectionalization feature is primarily dependent upon the number of access points available for sectionalization; therefore, offices selected for sectionalization should be large "through" offices and need not contain a large number of terminals.

3.04 The next consideration is the type of switching entities in the monitored offices. In offices employing only electromechanical switches or in buildings with more than 1000 T-carrier terminals, hard-wired arrangements must be used. In those buildings with the 1A ESS* switch and less than 1000 T-carrier terminals, carrier group alarms (CGAs) can be monitored either via a data bridge on the 1A ESS switch or data link between the TCAS and the SCCS serving the 1A ESS switching equipment. ➧T-carrier alarms can also be monitored via a TASC to TCAS data link.➧ This approach eliminates much of the telemetry equipment required as well as wiring to the CGA leads.

*Trademark of Western Electric.

3.05 Once the set of monitored offices have been selected, the type of equipment required can be determined using Fig. 2.

3.06 Detailed information on engineering considerations and detailed engineering of the remote offices and the TCAS central unit can be obtained from the following documents:

(a) EL-3963B/PL-3148B - TCAS Planning and Economic Guidelines

(b) EL-5722B/PL3230B - Cost Reduced Arrangements for the T-Carrier Administration System

(c) EL-6132 - Engineering and Ordering Information for TCAS Remote Access Arrangements

(d) EL-6132 Supplement 1 - TCAS-Arrangements for Multientity Building and Updated Pricing Information.

REMOTE OFFICE ENGINEERING

3.07 The following is the equipment required in a T-carrier office to centralize local alarm status:

(a) Connector Junction Panels (CJPs)

(b) Local Maintenance Center Display (LMCD)

(c) MLSI.

3.08 The following is the equipment arrangements required to centralize the alarm status within a metropolitan area:

(a) E-telemetry remotes

(b) Telemetry data network

(c) Data links to monitored 1 ESS or 1A ESS switches

(d) Data links between TCAS and the CMS-1B serving 4 ESS switches

(e) ➧Data link between TCAS and TASC.➧

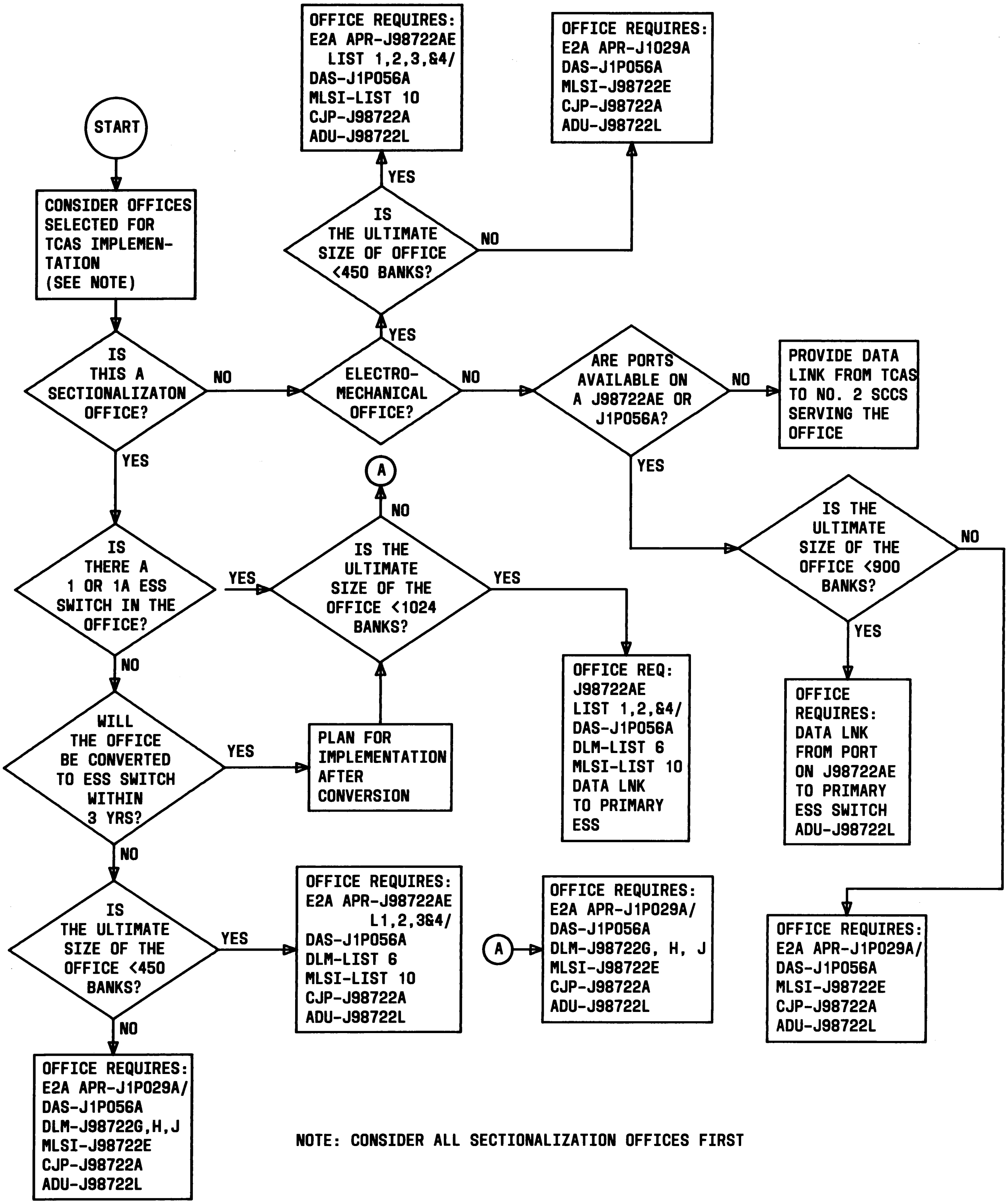

Fig. 2—Determine Method of Monitoring

3.09 The equipment used for either locally initiated or centralized sectionalization measurements are the RAU and DLM.

3.10 In order to determine the amount of the TCAS equipment required in an office, The following basic data is needed:

(a) Number and type of terminal bays installed (D1, D2, D3, D4, digital carrier terminal (DCT).

(b) Number and type of office repeater bays installed.

(c) Is a Digital Signal Cross-Connect (DSX) bay used? If so, how many?

(d) Number of terminating maintenance lines.

(e) Number of through and terminating backbone lines.

3.11 It should be noted that the total terminal and office repeater bays include those installed but not yet equipped. This total is necessary because it is most efficient to engineer TCAS arrangements for the complete office. Subsequent additions can then be equipped on a modular growth basis. All TCAS monitoring arrangements are designed for groups up to 64 CGAs. Growth in monitoring capability is on the basis of these modules. Any mixture of terminal types is permitted provided the complete bay is monitored.

3.12 In terminal offices employing hard-wired monitoring arrangements, one J98722A L4 and L5 CJP is required for each module. A J98722C L1 or J98722D L1 LMCD may be provided on an optional basis to centralize the alarm status within the office.

3.13 Implementation of the MLSI requires an inventory of the number and type of maintenance lines and backbone lines that terminate in or pass through the office. Each terminating or through appearance requires one MLSI detector circuit. The circuit pack 5 (CP5) detector card is an universal detector that can be used with any type of repeater, adapts automatically to either T1- or T1C-carrier lines, and will drive either an E-telemetry remote or a No. 1 or No. 1A Remote Master Scanner. Each detector card provides two MLSI detector circuits. One J98722E L1 MLSI shelf can accommodate up to 16 detector cards for a total of 32 maintenance or backbone line appearances.

3.14 To provide a flexible assignment arrangement and to provide bridging resistors within the monitored bay, each office repeater bay containing maintenance lines must be equipped with an ED-1P267-() MLSI Cross-Connect Panel (260 bays) or an ED-1P268-( ) MLSI Cross-connect Panel (201 bays). Alternatively, if a DSX-1 is used, an ED-1P269-() MLSI Cross-connect Panel must be provided in each DSX-1 bay and no panels are required in the office repeater bays. An alternate arrangement makes use of distributed resistors (ED-1C544-30, G4) and a centralized terminal strip (ED-2C503-30, G3 or G4) capable of accommodating 64 maintenance line appearances.

3.15 Monitoring arrangements using the J98722AE telemetry and display bay only require the provision of 110 or 1200 baud data links between the interface ports on the telemetry and display bay and the data bridge on the primary maintenance channel of the monitored ESS switch. The data sets and facilities are provided by the user.

3.16 Monitoring arrangements involving the SCCS require the provision of 1200 baud data links between the TCAS and each SCCS serving a monitored ESS switch. The 1 ESS, 1A ESS, and 2 ESS switches may be monitored by this means. The data links are provided by the user.

3.17 Sectionalization arrangements require the use of one J98722G and J98722H DLM in each sectionalization office. In addition, a J98722F RAU and associated bridging resistors are required for each office repeater bay. (Note that one J98722F L3 RAU can serve two 7- or 9-foot bays.)

3.18 The E-telemetry arrangements in hard-wired offices utilize the following equipment:

(a) J1P029A E2A alarm processing remote (APR)

(b) J98722E telemetry and display bay utilizing the E2A APR equipped with serial data ports (E2A APR SDP)

(c) ♦J1P056A digital alarm scanner (DAS).♦

3.19 The guidelines for engineering remote offices are provided in EL-6132 and EL-6132 Supplement 1. ➧Information on the DAS is provided in EL-7530.➧

TELEMETRY NETWORK ENGINEERING

3.20 The TCAS central unit can be equipped to handle up to 10 separate multipoint data networks, and an individual data network may contain up to 16 E-telemetry remote terminals. The total number of E-telemetry remote terminals associated with one TCAS central unit is restricted to 128. A typical TCAS application may involve 30 monitored offices and utilize five separate data networks with an average of six remotes each.

3.21 The TCAS central interface to an individual data network is via a computer interface card and a telemetry computer translator (TCT) with its associated 202T data set. The E-Telemetry System operates in an inquiry-response mode and requires a standard multipoint broadcast polling arrangement. Because of the multipoint and fast polling requirements, a 4-wire facility is required throughout. It is recommended that multipoint bridging arrangements be provided on a split bridge basis, that is, separate 2-wire bridging for transmission from the central and transmission to the central unit. It is also recommended that hubbing arrangements be used wherever possible to minimize the disabling effect of a single facility failure. In addition, care should be taken to distribute major offices across the required data networks so as to minimize the impact of a data facility failure on the TCAS operations.

3.22 The specific network design requirements are those specified for a full-period unconditioned 3002 voice-grade multipoint data channel. The network designs should be provided by the user. It should be in a manner consistent with that used for standard user applications. This should include the provision of proper administrative and maintenance criteria such as the use of serving test centers (STCs).

ENGINEERING THE TCAS CENTRAL UNIT

3.23 The TCAS central configuration consists of the following equipment:

(a) Hewlett-Packard (HP) 2113B minicomputer

(b) HP 7906 disk drive and controller

(c) HP 7920 disk drive and controller

(d) HP 7970E magnetic tape drive

(e) HP 9876A printer

(f) HP 2645A computer control console

(g) Telemetry-computer-translators (TCTs)

(h) DATASPEED* 40 terminal sets and printers.

3.24 The peripherals can be categorized in the following two ways:

(a) Real-time operation:

(1) TCT - Interconnects the computer to the telemetry network

(2) Disk - Provides rapid access to the data base and operating programs

(3) Computer data terminals (CDTs) - Input/output device used by the operating personnel to communicate and receive information from the TCAS

(4) Data linked to other operations support systems

(b) Bulk input/output and central control:

(1) Magnetic tape unit - Permits rapid input of data base information and provides backup for the data base and programs

(2) High-speed printers - Used to print management reports and to keep a running list of the network status for backup in the event of a TCAS failure

(3) Computer control console (CC) - Used to control the computer operation and to log computer activity.

3.25 Expansion of the central unit will be only in the number of peripherals specified in category (a). Preliminary modeling of the TCAS for typical metropolitan areas indicate that an area with a total of 60 central offices (25 monitored offices) and

*Trademark of AT&T.

5000 T-Carrier Systems would require a basic TCAS central unit with four TCTs and three CDTs. An operator position would be required for each 1500 to 2000 monitored T-Carrier Systems.

3.26 The TCAS software provides the following general features:

(a) Data base generation, update, and administration

(b) Alarm detection, analysis, and patterning

(c) Trouble case and maintenance line administration

(d) Trouble sectionalization

(e) Periodic performance evaluation

(f) Data links to the other operational support systems

(g) Management reports

(h) Support of the digital facilities measurement plan.

3.27 The DATASPEED 40 terminal sets which are used for the maintenance controller (MC), maintenance alarm controller (MAC), data base controller (DBC), equipment and facility administration center (EFAC), and supervisory controller (SC) may be direct cabled to the TCAS central unit if they are within 200 feet of the processor. For distances greater than 200 feet, a 1200 baud data channel is required. The data sets and facilities for these data links must be provided by the user. The data sets may be mounted in the same cabinet as the TCTs and the telemetry data sets.

3.28 Because of the noise generated by the printers and disk, it is recommended that the processor cabinet, printers, and computer control terminal be segregated from the room containing the operator positions. A room 9-feet by 12-feet with a 9-foot ceiling is about the minimum size recommended for this equipment. Alternatively, the central processor cabinets, data set cabinet, and computer control terminal can be clustered in the minicomputer operations center provided adequate arrangements are made for the following activities:

(a) Loading and removing disk images when required

(b) Loading and removing report tapes

(c) Performing telemetry and peripheral diagnostics as required.

4. ADMINISTRATIVE PLANNING

4.01 The full potential of the TCAS can only be realized when the operating personnel are properly organized and instructed. As part of the TCAS, documentation is being provided to recommend organization development and procedures which will maximize the benefits derived from the implementation and operation of the TCAS. Although these guidelines are not mandatory for an implementation and operation of a TCAS, they do form a structure within which the tools provided by TCAS can most effectively be utilized. The following paragraphs briefly describe the recommended administrative organization and responsibilities as defined in Practice 190-200-025.

OVERVIEW OF ADMINISTRATIVE CONTROL

4.02 The role of the FMAC-M will change. Initially, the FMAC-M responded to trouble reports from the field only, but with TCAS, the FMAC-M will be able to initiate and coordinate corrective action based on real-time knowledge of the status of the network.

A. Alarm Monitoring and Analysis

4.03 The TCAS permits the FMAC-M to directly monitor the T-Carrier Systems CGAs. They will no longer be dependent on system control office reports to ascertain the status of the network. The main FMAC-M function is to administer maintenance and backbone lines and coordinating service restoration. The effectiveness of this administration is greatly enhanced by the TCAS capabilities of receiving an alarm, determing a pattern of failures, and sectionalizing the trouble to a specific loction. In addition, the FMAC-M can initiate action on multisystem failures and individual system failures to which the system control office does not respond.

Summary reports will be utilized to identify systems and maintenance forces requiring corrective action.

B. Sectionalization and Control

4.04 With the capability of sectionalization, system failures can be sectionalized by the TCAS central unit. Office alarms may be automatically silenced to eliminate the initiation of manual sectionalization effort. The FMAC-M personnel will coordinate the restoration patch with the span offices and will direct the initiation of fault locating efforts. They will coordinate the dispatch of repair crews to ensure efficient use of resources. In addition, the sectionalization arrangements will permit positive completion reporting on new systems. This ensures satisfactory performance when the system is turned up for service.

C. DUTIES AND RESPONSIBILITIES

4.05 The duties and responsibilities of central office personnel, outside plant repair, construction personnel, and the FMAC-M personnel are outlined in Practices 190-200-001, 190-200-025, and 365-020-301, respectively. These responsibilities will somewhat change as the TCAS implementation evolves.

D. Central Office Personnel

4.06 In a pre-TCAS environment, the SCO is responsible for directing all 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 the FMAC-M is operational, the administration of backbone and maintenance lines and the coordination of restoration patches are relinquished to the FMAC-M.

4.07 Implementation of the TCAS monitoring does not appreciably change the responsibilities of the central office personnel. However, implementation of the trouble sectionalization capability does materially alter their responsibilities. Since office alarms of monitored systems may be automatically retried by the TCAS central unit, the system control and noncontrol offices will respond to alarms only if the telemetry facility is inoperative. At all other times, directives for corrective action will come from the FMAC-M. All restorations will be coordinated by the FMAC-M and only offices directly affected by the corrective action will be contacted.

4.08 In districts wherein the central office personnel are force loaded by a switching control center (SCC), the responsibilities will remain, but task assignments will be coordinated by the SCC.

4.09 Under a currently evolving organizational arrangement, fault location and manhole repeater replacement will become the responsibility of work groups responsible to the FMAC-M.

E. Outside Plant Crews

4.10 The functions of the outside plant repair crews are not directly affected by the implementation of the TCAS. The major change is that dispatches will be coordinated by the FMAC-M to maximize the effectiveness of the repair crews. The FMAC-M personnel will track the progress of the repair. The TCAS central unit will remotely test the line prior to its return to service. Also, as indicated previously, the manhole repeater replacement may become the responsibility of repair crews which report directly to the FMAC-M.

F. Facilities and Maintenance Administration Center-Metropolitan

4.11 The role of the FMAC-M becomes more central in the maintenance of the T-Carrier Systems as the implementation of the TCAS progresses. With alarm monitoring only, the FMAC-M functions as a restoration control and administration center with a real-time picture of the network. Individual system failure are still handled by the system control office with the FMAC-M administering the use of the backbone and maintenance lines. Since the TCAS central unit can pattern intermittent and multisystem failures, the FMAC-M will assume a role of directing the restoration of such failures. The FMAC-M will also generate, review, and distribute reports to the central office and outside plant managers as well generating the T-carrier service measurement plan results. In some cases, the FMAC-M may assume the responsibility for fault location and manhole repeater replacement. With the trouble sectionalization capability, the FMAC-M becomes responsible for directing restoration and corrective action on most system failures. All central office personnel respond to directives from the FMAC-M (coordinated through the SCC if required). All repair dispatches are coordinated by the FMAC-M. The FMAC-M is also responsible for positive completion reporting on new T-Carrier Systems and for periodic performance monitoring of all T-Carrier Systems being monitored.

5. DATA BASE PLANNING

5.01 The TCAS requires an extensive data base which encompasses most of the information on the system layout record (SLR) card. Because of this extensive data base, paper records are not required at the FMAC-M. Also, since the FMAC-M can easily access any information about the T-Carrier System, SLR information required by the terminal offices, repeater offices, or outside plant repair crews can be provided by the FMAC-M. Further, since telemetry and sectionalization assignment data must be correlated with the SLR data, the TCAS data base records must be virtually error free. Generating such a data base is a major task and should be considered early in the TCAS planning.

A. Data Requirements

5.02 Information required by the TCAS data base will be provided for the following sources:

(a) The T-Carrier System SLR information from the circuit provision center (CPC)

(b) CPC provided inventory records for each central office

(c) Telemetry assignment information from the central office records

(d) Administrative records provided by the FMAC-M personnel in the following form:

(1) Valid office identifications

(2) Cable identification

(3) Corporate structure

(4) Report distribution requirements

(5) Telemetry network configurations.

5.03 The T-Carrier System layout information constitutes the bulk of the data base information. The information required on each system includes the terminal locations and equipment type, repeater locations, and cable, case, socket and side information for each span of the system.

5.04 The telemetry assignment information originates with the Western Electric (WE) line engineer as a part of the engineering of the TCAS equipment in the local office. Scan point assignment information may be generated by WE if direct cabled or by the SCC if the local cross-connections are required.

5.05 Since the operation of the TCAS is totally dependent upon the parity of the data base, administrative controls must be established on the following information to ensure the parity of the data base:

(a) All T-carrier facility changes (additions, deletions, or changes) must be communicated to the FMAC-M for incorporation into the data base.

(b) Local offices must not be permitted to deviate from the facility assignment without making sure that such deviations are included in the data base.

(c) Methods of positive completion reporting, which are being provided, must be followed by the FMAC-M personnel to validate the data base.

B. Implementation Methods

5.06 Two approaches have been provided for implementing the T-Carrier System information part of the data base. These are referred to as the SLR method which uses the SLR cards and the equipment and facilities assignment (EFA) which uses the inventory/assignment (IA) records. Either of these methods can be used as the data source for the T-carrier data entries in the data base.

5.07 The SLR method requires that the SLR information be centralized and complete. The following are the required records:

(a) system identification and control office

(b) Terminal bank location and type

(c) Location of each control office repeater on each span

(d) Cable and pair identity for each span in each direction

(e) Apparatus case, socket, and side assignment for each span and each direction

(f) DSX cross-connect information if provided.

5.08 The information must be complete for each system or the system will be rejected by the TCAS. Using the SLR method, the systems can be added to the data base incrementally as monitoring arrangments are turned up in the remote offices. Changes must be made on a per system basis.

5.09 The EFA method makes use of the central office equipment assignment records as the basic input. These records may be obtained from a centralized assignment bureau or from an inventory of the central office equipment. The following is the basic information required:

(a) A list of controlled systems

(b) Terminal equipment locations and the associated system identification

(c) Span records which include the central office repeater location, cable identification, apparatus case, socket and side, and the associated system identification

(d) DSX locations and the associated system identifications.

5.10 With the EFA method, the information in the previous paragraph is stored in the EFA data base. When all of the information on a given system is complete, the information is automatically transferred to the SLR or working file. This information can be input and corrected on a piece-meal basis, but most of the inventory data must be complete for all offices before a substantial number of systems can be transferred to the working file.

5.11 The EFA method is particularly suited to those locations that have substantial portions of their T-carrier records already mechanized. It should be noted that if the EFA method is to be used on an ongoing basis, no changes to the T-Carrier System portion of the TCAS data base can be entered via the SLR method.

C. Data Entry Methods

5.12 Two methods are provided for entering data into the TCAS. One is via a specially prepared magnetic tape and the other is via interactive data masks from the DBC and/or EFAC positions.

5.13 For input via magnetic tape, the detailed system record information must be prepared offline in input message format as defined in practice 865-201-102. This data must then be placed on a specially formatted magnetic tape in a blocked format. This tape is then mounted on the TCAS magnetic tape unit. Either SLR or EFA data can be entered via magnetic tape.

5.14 The second method of input is via the DBC and/or EFAC positions. Any number of the CDT positions can be configured as a DBC or EFAC position. The appropriate data base masks are displayed on the CDT, and data is entered and checked in real time. Additions can take effect immediately. Data can be input via a CDT at the rate of three systems per hour.

D. Additional Information Sources

5.15 The following documents will provide additional information for data base planning and implementation:

(a) TCAS Data Base Information, EL-3640/PL-2891

(b) TCAS Data Base Planning Letter, EL-6628

(c) Data Base Controller (DBC) Position, Practice 190-200-310

(d) Equipment and Facility Assignment Controller (EFAC) Position, Practice 190-200-311.

6. INSTALLATION AND TURNUP

6.01 All TCAS equipment and software will normally be installed and checked by WE using installation handbook instructions. The purpose of the following procedures is to provide the user with an acceptance test and operational verification capability.

REMOTE OFFICES

6.02 The procedures for the turnup of the various TCAS equipment arrangements in remote offices are provided in Practices 365-330-200 and 365-330-201. These procedures are for both stand-alone and remote reporting operational equipment. In general, the highest level of testing should be used to verify the overall functional operation of the equipment. For example, the verification of alarm reporting and local display utilizes an alarm generated at the T-carrier bank and verifies proper operation of the display and transmission of the corresponding telemetry word by the E2A terminal. Initial turnup of an office should be checked through the telemetry remote using the KS-20937 digital simulator. Subsequent additions may be tested at the Status Input Panel using a volt-ohmmeter (VOM) without removing the E2A remote from service. In general, a sampling test which verifies at least one bit in each word of a display is adequate for acceptance testing.

TCAS CENTRAL UNIT

6.03 The turnup procedure for the TCAS central unit is described in Practice 190-200-300. It involves invoking a series of in-service diagnostics which check the operation of each peripheral and telemetry remote. These same diagnostics are used during operation to perform maintenance tests when required.

7. OPERATION

7.01 Operation of the TCAS involves utilizing the full capabilities of the system. This primarily involves use of the MC ♦and for high-capacity systems, the MAC positions.♦ Also, it includes operations at the computer control console, distribution of reports, and use of the central office equipment.

AUTOMATED OPERATION

A. Maintenance Controller (MC) and Maintenance Alarm Controller (MAC) Functions

7.02 The TCAS provides alarm thresholding which screens the many alarms that occur in a T-carrier network and identifies those failures that seriously affect service. The procedures for handling the variety of trouble conditions that may be encountered are provided in Practices ♦190-200-312 and 190-200-313.♦ The TCAS operational reports provide the MC and MAC with all of the information needed to identify and sectionalize the trouble, coordinate restoration, and track repair. The operational reports are described in Practice ♦190-200-102.♦ Information required to provide field support is also available to the MC and MAC positions.

7.03 Much of the repair tracking data used by the TCAS for report generation is input by the MC and MAC positions. Therfore, it is extremely important that all necessary update information be continuously entered by the MC and MAC positions.

B. Computer Control (CC) Position Functions

7.04 The CC position is responsible for a number of the following activities:

(a) Setting parameters and schedules

(b) Initiating restarts when necessary

(c) Conducting telemetry network tests

(d) Running diagnostic tests on the processor and peripherals.

7.05 The previous paragraph activities are described in Practices 190-200-300 and 190-200-500.

C. Administrative Functions

7.06 Another major facet of proper TCAS operation is the generation, use, and distribution of periodic reports. These reports fall into the following three categories:

(a) Trouble identification

(b) Administrative

(c) Index.

7.07 The daily and weekly central office reports and the monthly trouble type report should be used to identify chronic problem areas. The list of unrecognized facilities or scan points can be used to identify errors in the data base.

7.08 The administrative reports (district, division, etc) keep management advised of the performance of the network. The central office sectionalization and construction reports track the repair activities. The FMAC-M and TCAS reports summarize the load handled by the TCAS and the FMAC-M.

7.09 A number of reports are provided to enable the FMAC-M to aid in the preparation of the digital facilities measurement plan.

STAND-ALONE OPERATION

7.10 The TCAS remote office equipment can also be used effectively in a manual mode either as an adjunct to a TCAS operation or in a non-TCAS stand-alone environment. The LMCD, MLSI, and DLM have each been designed for a particular set of functions as described in the following paragraphs. Detailed procedures for use of the equipment are given in Practice 365-020-301.

A. Local Maintenance Center Display (LMCD)

7.11 The LMCD is located in the maintenance center and centralizes the status of CGA alarms within an office and enables the central office personnel to identify new failures and intermittent failures without leaving the maintenance center. Route failures can also be identified by observation of the failure pattern.

B. Maintenance Line Status Indicator (MLSI)

7.12 The MLSI can be used to determine the status of all maintenance lines and backbones in the office. By placing the MLSI in the maintenance center, all failed or patched lines monitored by the MLSI will be readily apparent. Use of the MLSI eliminates the need for periodic testing of maintenance lines.

C. Directed Line Monitor (DLM)

7.13 The DLM can take the place of a bipolar measuring set, such as the J98710G or KS-20775, in an office and will permit rapid sectionalization without leaving the maintenance center. Using this tool, the central office personnel can perform the following tests and measurement:

(a) All sectionalization tests requested by the FMAC-M or SCO

(b) Error performance test on special service systems as requested by the STC

(c) Perform measurements on a system prior to returning it to service.

8. MAINTENANCE

CENTRAL PROCESSOR AND PERIPHERALS

8.01 During operation, the TCAS software continually checks for proper operation of the peripherals and data networks. Failures are detected by the application programs and cause appropriate diagnostic messages to be displayed and printed at the CC position. The system operator can then request specific diagnostic tests to ascertain the nature of the trouble and to pinpoint its origin. If necessary, the system can often be reconfigured to operate without the defective peripheral until repair or replacement is accomplished. The maintenance procedures are described in Practice 190-200-300 and 190-200-500.

TELEMETRY DATA NETWORK

8.02 When a telemetry failure diagnostic is generated by the system, the operator at the CC position must examine the nature of the diagnostic message and the data network configuration to determine if a pattern is evident (such as a single remote, a leg, or a backbone route failure). If a serving end link or a remote terminal failure is indicated, test programs can be initiated to further sectionalize the trouble before involving the central office personnel in detailed troubleshooting.

8.03 The facility leg failures will normally be reported to the private line STC for restoration and corrective action; however, in the event of a complete facility failure, the TCT can be checked by looping to a test TCT to verify that the TCT and data set at the TCAS central unit are not defective. It should be noted that because each E2 remote has a unique address, the restoration of service can be accomplished by bridging the failed network onto a working network. The stations on the failed network are then temporarily reassigned to the working data network by the CC position operator. The following practices provide detailed information on E-telemetry data network and 202T data set:

(a) E-telemetry Data Networks - Practice 314-411-510

(b) 202T Data Sets - Practice 592-031-300 and 592-031-500.

REMOTE OFFICE EQUIPMENT

8.04 If a maintenance diagnostic indicates failure of the TCAS equipment in a remote office, the central office personnel in that office should be notified. Often the failure will be apparent to the local central office personnel through local office use of the equipment. The procedures required to check the operation of each type of TCAS equipment is described in Practice 365-330-500. If the failure is caused by the E-telemetry, Practice 201-644-504 describes the test procedure.

9. TRAINING

9.01 Proper training is essential to ensure effective use of the TCAS. ➧Training courses have been prepared for personnel who are familiar with generic 3.4 functions and need to be trained on generic 4 functions and entry level training for personnel not familiar with TCAS functions.

9.02 The following are the courses used to train personnel on the generic 4 functions. These courses are designed for personnel who have experience with the generic 3.4 functions:

(a) Network Management (NM)-766D - TCAS Generic 4, Maintenance Controllers Operations

(b) NM-768D - TCAS Generic 4, Data Base Controller Operations.

9.03 The following are the entry level courses used to train personnel on generic 4 functions. These courses are designed for personnel with no prior generic 3.4 function experience:

(a) NM-766E - TCAS Generic 4, Maintenance Controllers Operations

(b) NM-768D - TCAS Generic 4, Data Base Controller Operations.

9.04 The NM-323 is used to train personnel on the computer control position. It is based on generic 3.4 functions but is applicable to generic 4 until a new course is developed.➧