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MINICOMPUTER MAINTENANCE

AND OPERATIONS CENTER

CENTER DESCRIPTION

Prepared by the Information Management Services Division,
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CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.01 Purpose

This practice provides a general description of the purpose, objectives, functions, facilities, and personnel associated with the Minicomputer Maintenance and Operations Center (MMOC).

1.02 Reasons for Reissue

This practice is being reissued to reflect changes caused by divestiture.

2. GENERAL

2.01 MMOC Overview

An MMOC is an operations center responsible for the operation of clustered minicomputer hardware associated with centrally developed operations systems and locally-designed systems. In addition, the MMOC is responsible for the maintenance of clustered and remote minicomputer systems located within its geographic boundaries and for which self-maintenance is feasible. The work functions of an MMOC are divided into two categories; (1) Minicomputer Operations, and (2) Maintenance. Each of these categories is normally cared for in one of two MMOC subgroups, the Minicomputer Operations Group (MOG) or the Minicomputer Maintenance Group (MMG). The MOG and MMG in a model MMOC are joined under common management. The specific level at which they are joined is dependent on local conditions and span of control considerations. The organization of a typical MMOC is shown in Figure 1.

2.02 MOG Responsibilities

The MOG is responsible for the day-to-day operation of minicomputers not operated by the user work center (UWC). The MOG-operated systems are clustered in one or more locations. The MOG is responsible for starting and restarting each system, making entries in the system operation run logs, making computer switch settings specified in the operating instructions, and appropriate media handling and administration. It responds to system error messages and alarms and takes specified actions in response to user trouble reports. The MOG is responsible for sectionalizing minicomputer system trouble conditions and referring them to the appropriate maintenance organizations. It is responsible for analyzing computer performance, preparing management reports, and providing environmental and security management. The MOG is also responsible for coordinating and installing all software changes.

2.03 MMG Responsibilities

The MMG is responsible for conducting preventive maintenance (PM) routines and performing corrective maintenance (CM) of computer subsystem hardware. This includes the processors and peripherals (disks, tapes, etc.) and terminal equipment associated with the computer system (e.g., console terminal). The MMG is responsible for stocking spare parts, managing spare parts inventory at efficient levels, and maintaining an inventory of installed hardware components. The MMG is also responsible for the installation and administration of field changes, the reflection of these changes in the records, and, where necessary and possible, installing these changes in stocked spare parts.

2.04 Minicomputer Technical Support

Various administrative and technical support functions are needed for the efficient maintenance and operation of minicomputer systems. These functions include system software and documentation release coordination, system hardware change coordination, hardware and software technical support, methods and procedure support for the MMOC, technical and operational support for new system planning, negotiating service agreements between the UWC and the MMOC, and for tracking MMOC performance

relative to service agreements. The acronym "MSG," describes the group which has these responsibilities.

3. INTERFACES

The MMOC interfaces with various UWCs, repair centers, general trade computer vendors, and the MMOC Support Group (MSG). These interfaces are:

(a) The MMOC inputs

(b) The MMOC outputs

(c) The MMOC negotiations involving other UWCs.

Table A provides a list of MMOC inputs. For each input, this list shows the media, relative frequency, the external organization from which the input is received, and the MMOC work function for which the input is applicable. The acronym "UWC" denotes any user work center which uses the operations or maintenance services of the MMOC.

Table B provides a list of the MMOC outputs. This output table contains the external organization receiving each output, as well as the associated MMOC work function.

Table C provides a list of negotiations in which the MMOC participates. It shows the external organizations with which the negotiations take place, along with the corresponding MMOC function.

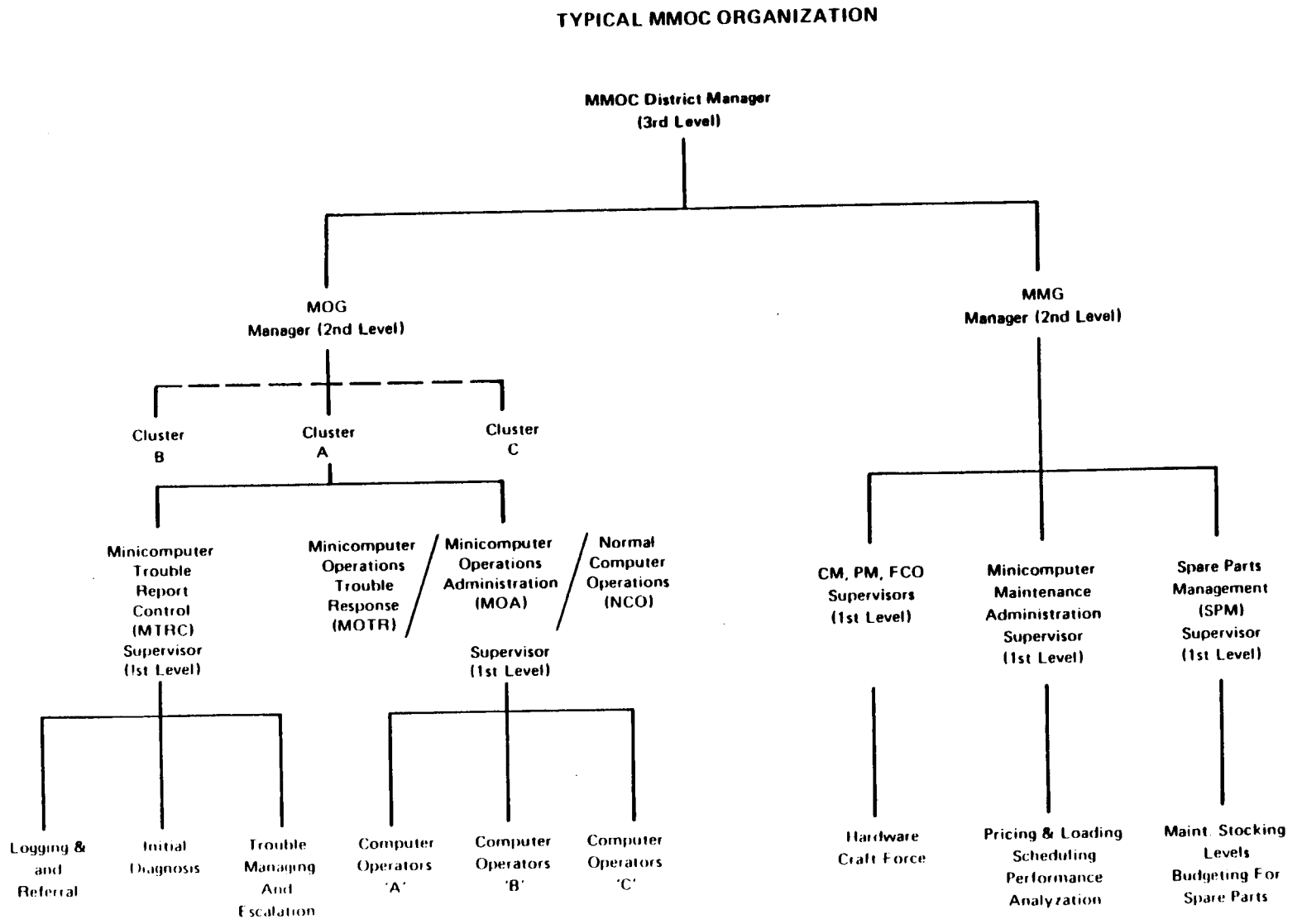

Figure 1. Typical MMOC Organizational Structure

TABLE A. MMOC INPUTS

INPUT	MEDIA	FREQUENCY	FROM	FUNCTION
User Works Requests	Written or Telephone	Daily (as required)	UWC	Normal Computer Operations (NCO)
Parts Shipment	Parts and Bills	Daily (as required)	Vendor	Spare Parts Management (SPM)
Vendor Maintenance	Verbal	As Required	Vendor	Minicomputer Operations Trouble Response (MOTR)
Work Group Referral	Telephone	As Required		Special Service Center (SSC) Minicomputer Trouble Report Control (MTRC)
New Release Material	Documentation and Tapes	Yearly (as required)	MSG	Minicomputer Operations Administration (MOA)
User Trouble Reports	Telephone	As Required	UWC	MTRC
User Operated System	Telephone	As Required	UWC	Minicomputer Corrective Maintenance (MCM)
Hardware Change	Written	Monthly (as required)	MSG	Minicomputer Maintenance Administration (MMA)

TABLE B. MMOC OUTPUTS

INPUT	MEDIA	FREQUENCY	TO	FUNCTION
Data Base Trouble	Telephone	As Discovered	UWC	NCO
Work Request Results	Requested Material	Daily (as requested)	UWC	NCO
Scheduled Reports	Computer Printouts	Daily (as scheduled)	UWC	NCO
Purchase Order	Purchase Order Form	As Required	Vendor	SPM
User Trouble Reports	Telephone	As Required	UWC	MTRC
Software Trouble	Telephone and Written	Rare	UWC	MOTR MSG
Vendor Maintenance	Telephone	As Required	Vendor	MOTR
Work Group Trouble	Trouble Ticket	As Required	MTRC	SSC MTRC
System Availability	Written	Monthly	MSG	MCA
User Operated System	Telephone	As Required	UWC	MCM

TABLE C. MMOC NEGOTIATION ACTIVITIES

NEGOTIATION	MEDIA	FREQUENCY	WITH	FUNCTION
Preventive Maintenance Scheduling	Verbal and Written	Quarterly (as required)	UWC	MOA MMA
Data Base Backup Scheduling	Verbal and Written	Monthly (as required)	UWC	MOA
Hardware Change Scheduling	Verbal and Written	As Required	UWC MMA	MOA
Service Agreement Negotiation	Written	Yearly (as required)	UWC	MCA
Intermittent Trouble Investigation Scheduling	Telephone	As Required	UWC	MOA
Escalated Technical Assistance	Telephone and On-site Support	As Required	MSG	MMA

4. RESOURCES

The MMOC resources include minicomputer system-provided features, logs, history files, environmental monitors, operation and maintenance documentation, diagnostic programs, and maintenance tools.

4.01 Minicomputer-Provided Features

Minicomputer systems have features intended for use by the computer operations personnel. These include an operator command language, system console messages, system alarms, system error log listings, and system-provided diagnostics.

4.02 Logs

The following logs are needed for MMOC functions:

(a) **Operation Activity Log:** All computer operation activities that could affect the system user or that should be added to the system history file are recorded in this log. The following information should be included in this log:

- System backups
- System failures and restarts (including key register readings following a system crash)
- System alarm and console message investigations
- System maintenance referrals.

(b) **System Maintenance Activity Log:** All pertinent activities pertaining to system PM procedures, CM procedures, and hardware changes are recorded in this log. The following information should be included in this log:

- Trouble symptoms (PM or CM)
- Diagnostic programs used
- Boards or modules swapped
- Trouble disposition.

(c) **User Trouble Referral Log:** Every user trouble referred to the MMOC, including the symptom, the agency referred to for investigation or repair, and the disposition of each referral is recorded in this log.

(d) **Purchase Order Log:** All purchase orders, incoming vendor shipments, bills, and payments are recorded in and tracked in this log.

4.03 Information Files

The following information files are required for MMOC functions:

(a) **System Media Location File:** Using this file, minicomputer operators can locate any retained system media (e.g., backup tapes).

(b) **System Error Log History File:** Minicomputer system-generated error log listings should be retained an appropriate length of time for analysis purposes.

(c) **Inventory File:** This file is needed to keep track of spare parts and to have a detailed breakdown of all minicomputer hardware components deployed in systems for which the MMG is responsible.

(d) **Minicomputer System Operation Documentation File:** Self-explanatory.

(e) **Minicomputer System Maintenance Documentation File:** Self-explanatory.

(f) **Minicomputer System Diagnostic Program Library:** Self-explanatory.

4.04 Environmental Monitors

Equipment is needed for monitoring and recording temperature, humidity, and electric power levels in the minicomputer equipment rooms.

4.05 Maintenance Tools

The following maintenance tools are needed to support many MMG activities:

(a) Electronic measurement equipment (e.g., oscilloscopes)

(b) Test media for peripheral calibration procedures

(c) Mechanical tools

(d) Maintenance test bench computers for testing boards

(e) Automatic circuit board test equipment.

5. PHYSICAL DESCRIPTION

Some MMOC work functions require special-designed work locations. These work locations are:

(a) **Minicomputer Equipment Room:** Where the clustered minicomputer equipment is located and where most of the MOG work functions occur.

(b) **Office Space:** A location isolated from the noise of the equipment room is needed to house the desks and files needed for both MOG and MMG personnel.

(c) **Minicomputer System Media Library:** This location, with a separate fire zone, is equipped with special cabinets for the system media storage.

(d) **Spare Parts Stockroom:** The spare parts needed for MMG functions are kept on shelves and in spare parts kits, housed in appropriate centralized and on-site locations. Space is also needed in the central location for dispatching parts and for receiving defective and purchased parts.

(e) **Module Repair Facility:** This location needs test equipment, board repair equipment (e.g., desoldering tools), and maintenance test bench computers for testing modules.

6. COMMUNICATIONS DESCRIPTION

The MOG is responsible for checking the operational status of the minicomputer communications equipment (e.g., data sets) associated with the clustered minicomputers.

MMOC personnel use voice telephone communications to receive trouble referrals from users, to refer problems, and to report on the status of trouble referrals.

Work requests from the UWC and other less timely information interchanges are distributed by company mail.

7. MODEL COMPANY ENVIRONMENT

7.01 Parameters

MMOC documentation is based upon a specific operating environment. Two approaches were considered for characterizing the model MMOC environment; (1) actual telephone company minicomputer profiles, or (2) a representative model derived for a typical operating area. Because many minicomputer configurations throughout the Bell Operating Companies possess similar characteristics and face similar operations and maintenance requirements, the latter approach was followed. The application of this approach considered the following parameters:

(a) Operating company geography

(b) Number of deployed systems and centers

(c) Projected planning considerations through 1985

(d) Number of deployed processors, including local and vendor developed

(e) Span of control methodologies

(f) Clustering considerations

(g) Major characteristics of model companies taken from the Total Network Operations Plan (TNOP) Issue 2

(h) Data previously gathered from Bell Communications Research Inc. on clustering design.

7.02 Area Types

The TNOP, for defining model company areas, was used to construct these model areas. The Bell Operating Companies were divided into 62 potential operating areas. Wherever possible, boundaries were chosen to coincide with numbering plan areas, states, or companies so that they could be expected to be reasonably invariant with time. These areas were then classified into one of four basic area types based on geographical area and main station density. From each area type, a representative model area was subsequently constructed that characterized a typical operating environment of that area type.

Four area types could reasonably span the various geographies, populations, and equipment configurations existing in the Bell Operating Companies.

A Type I area is defined as a highly dense, compact metropolitan region covering more than four million main stations. The New York City Region of New York Telephone Company, which coincides with the 212 and 718 numbering plan area, is the only area classified as Type 1.

Type II areas are large, densely populated metropolitan regions of about two million main stations. Detroit, Cleveland, and Philadelphia are examples of Type II areas.

A Type III area is typically either an entire state or a portion of a large state which contains at least one urban area with over 200,000 main stations but not as many main stations as a Type II metropolitan region. Indiana, Georgia, Virginia, and the part of Illinois excluding the Chicago metropolitan area are examples of Type III areas.

Areas classified as Type IV are large, rural states primarily, having no metropolitan areas with more than 200,000 main stations. Two examples are Wyoming and New Mexico.

Figure 2 shows the classification of the 62 Bell System areas in terms of the four area types. There is one Type I area, twelve Type II areas, thirty-six Type III areas, and thirteen Type IV areas. The

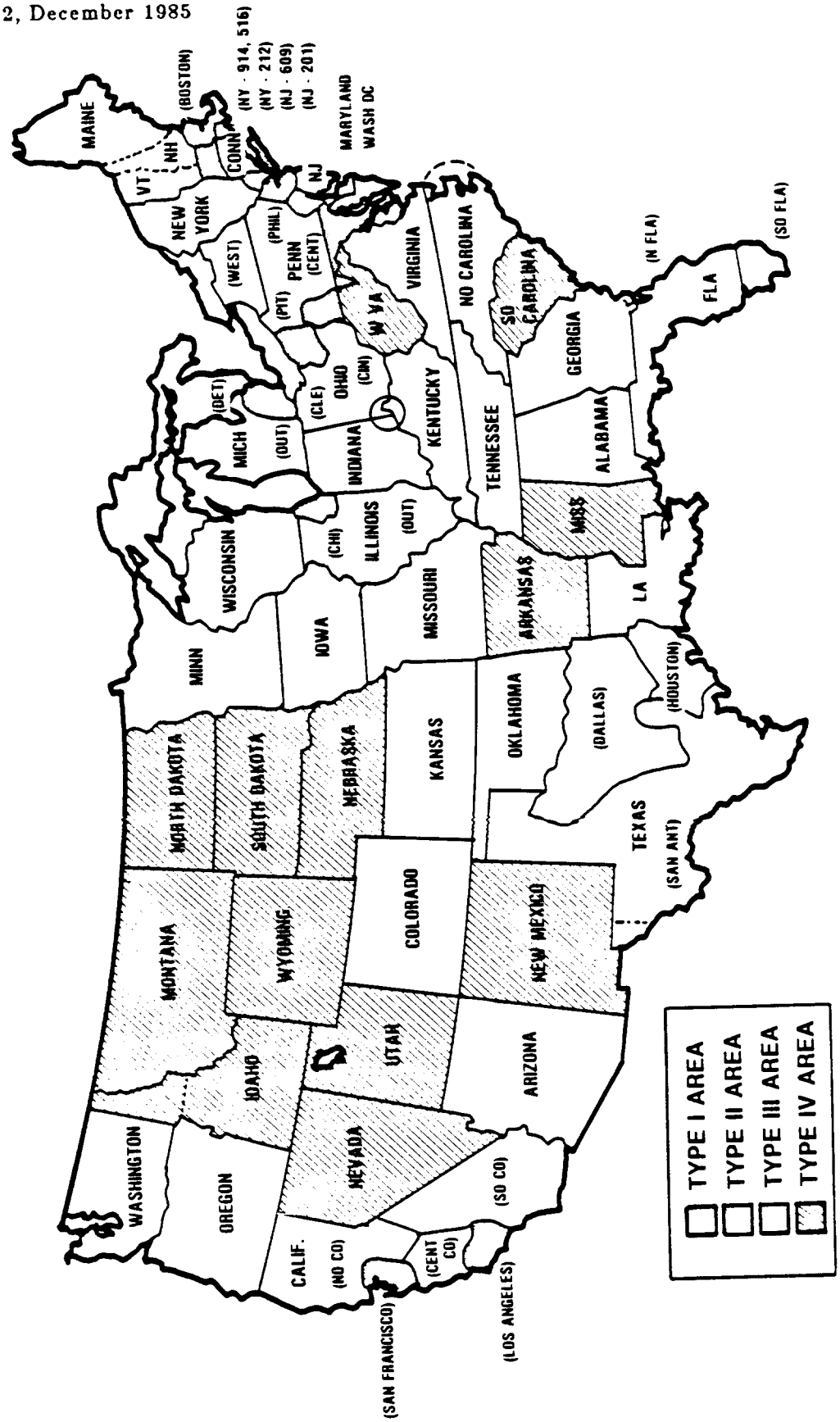

Figure 2. Classification of Operating Company Types

composition of the Bell Operating Companies (BOCs) by area type and number of processors deployed is shown in Table D.

Model Areas I, II, III, and IV are described for two specific years, 1981 and 1985. The geographic and physical characteristics for each model were computed from the statistics of the corresponding area types projected to 1981 and 1985.

7.03 Model Company Descriptions

Most operating companies encompass more than one area type. Therefore, besides the model areas already discussed, four model telephone companies were built from Model Areas II, III, and IV. The statistics for these model companies are simply sums of the statistics for the component model areas.

Model Company A consists of a single Model Area III. It is intended to represent a single state company, like Indiana Bell.

Model B Company, like Model A Company, represents a single state company, but it is comprised of one Model Area II and one Model Area III. Michigan Bell or Illinois Bell are examples of what a Model B Company is intended to represent.

Model C Company represents a multistate company. It consists of five Model Areas III. Southern Bell is an example of what a Model C Company represents.

Model D Company comprises two Model Areas III and three Model Areas IV. It is intended to represent a multistate company with large rural serving environments, such as Northwestern Bell.

7.04 MMOC Model Company Environment

For the purpose of these guides, all references to sizing of organizations, clusters, etc., are based on the typical Model B Company. The Model B Company was selected considering it best represented the majority of the Bell Operating Companies from the four model companies identified in this practice. The average processor and system quantities associated with the Model B Company is shown in Table E.

Recognizing the potential value of centralized operation and maintenance of minicomputer-based systems, clustering configuration guidelines were developed by Bellcore. Considerations were given to the number and type of systems that should be collocated that would minimize costs associated with communication links, personnel, parts, and environmental requirements.

The average Model B Company will have approximately 130 to 140 clusterable systems by 1985 with approximately 75 percent actually being clustered. This would equate to 6 to 8 clusters to satisfy minimum requirements for cost-effective operations and maintenance. Maximum economy-of-scale benefits can be achieved in clusters of at least 15 systems. Factors to determine the choice of which systems to collocate have been examined. Factors such as system design, disaster recovery, site redundancy, spare parts provisioning, and system interfaces were major considerations.

Table F shows the minicomputer systems included in the Model B Company. There are 118 systems deployed using 138 processors. Based upon the clustering guidelines recommendations, six clusters have been designed; these are depicted in Table G, Table H, and Table I. The first cluster (Table G) contains all systems that interface with the Loop Maintenance Operation System (LMOS). While there are 28 systems at this site, the majority are microprocessor-based PDP 11/34 systems that do not have the personnel requirements of the larger system. This cluster requires about 5000 square feet of floor space.

Clusters 2 and 3 (Table H) contain all the remaining systems that can use line concentration access from the wire centers. Operations systems which interface with these wire centers are included to allow

for local networking. Wherever possible, multiple applications of systems are divided between these two sites to provide for disaster recovery backup. These sites have 18 and 19 systems requiring 6700 and 6000 square feet, respectively. Table I shows the remaining three clusters. There are 16 processors in each cluster with COSMOS being the predominant system at each site. The space requirements range from 6000 to 7000 square feet.

TABLE D. BOC STATISTICS/CLASSIFICATION—AREA/MODEL COMPANY TYPES

BOC	MODEL COMPANY TYPE (NOTE)	AREA TYPE				NUMBER OF PROCESSORS	
		I	II	III	IV	1981	1985
Indiana				1		83	102
Wisconsin				1		74	100
Pacific Northwest Bell*	A			2		278	197
Southern New England				1		92	98
Cincinnati				1		31	55
New England†			1	1		212	285
New Jersey			1	1		116	128
Ohio			1	1		159	218
Michigan			1	1		273	333
Illinois	B‡		1	1		245	353
Pennsylvania			2	1		120	125
Chesapeake and Potomac			2	1	1	90	125
Pacific§			2	3	1	303	488
New York		1	1	2		771	847
Southern				4	1	575	694
South Central	C			4	1	252	382
Southwestern**				6	1	506	690
Northwestern Bell				2	3	152	230
Mountain	D			2	5	417	531

Note: Although no BOC is identical to any of the four model companies, each will be close enough to one of them that the MMOC documentation will provided meaningful guidance.

* Best represented by two Model A companies.

† Maine, Vermont, and New Hampshire are treated as one Type III area.

‡ Average number of processors for Model B company = 190 processors in 1981 and 245 processors in 1985.

§ Best represented by two Model B companies.

Best represented by Model 1 Area I and Model B company.

** Best represented by two Model C companies.

TABLE E. MODEL B COMPANY MINICOMPUTER STATISTICS

COMPONENT	1981	1985
Number Systems	150	190
Number Processors	190	245
Number Systems Clusterable	105	138
Number Processors Considered Telephone Company Maintainable	130	220

TABLE F. MODEL B COMPANY

SYSTEM (NOTE 1)	NO. (NOTE 2)
Automatic Data Test System (ADTS)	1
Automatic Message Accounting Recording Center (AMARC)	7 (X2)
Automatic Trouble Analysis (ATA)	5
Automatic Trouble Reporting System (ATRS)	1
Centralized Automatic Reporting on Trunks (CAROT)	3 (X2)
Circuit Maintenance System (CMS-1)*	1
CMS-3	2 (X2)
Computerized Maintenance and Administration Support (COSMOS-III)*	1
COSMOS	22
COSMOS -- Work Manager (COSMOS-WM)	6
Cable Pressure Monitoring System (CPMS)*	1
Cable Repair Administrative System (CRAS)	1
Carrier Transmission Maintenance System (CTMS)*	4
Data Base Administration System (DBAS)	2
No. 1A Engineering and Administrative Data Acquisition System (EAQDAS 1A)	3
No. 2 EADAS	
EADAS/Network Management (NM)	1
Engineering Implementation System (EIS)	1
E911/Automatic Location Identification (ALI)	1
E911/Data Management System	1
Hotel Billing Information System (HOBIS)	1 (X2)
Loop Cable Administration and Maintenance Operations Systems (LCAMOS)	2

TABLE F (contd)

SYSTEM (NOTE 1)	NO. (NOTE 2)
LMOS.FE	5
LMOS.XFE	1
Mechanized Loop Testing System (MLTS)	19
Network Service Center System (NSCS)	1
Peripheral Bus Computer (PCB)	2
Remote Memory Administration System (RMAS)	1 (X6)
Remote Maintenance, Administration, and Traffic System (RMATS)	1
Switched Access Remote Testing System (SARTS)	4
Service Control Center System (SCCS)	7
Service Evaluation System (SES No. 2)	1 (X3)
SES 1A	1
Telecommunications Alarm Surveillance and Control System (TASC)	2
T-Carrier Administration System (TCAS)	2
Trunk and Facility Maintenance System (TFMS)*	2

Note 1: Systems = 118; 107 with no severe clustering restrictions.

Note 2: Processors = 138; 127 clustered.

*Systems that have severe restrictions to clustering.

TABLE G. EXAMPLE CLUSTER 1 WIRE CENTER INTERFACES - LMOS

OPERATIONS SYSTEM	HARDWARE	NUMBER INSTALLED
LMOS.FE	PDP 11/40 System	5
LCAMOS	PDP 11/70 System	2
MLT	PDP 11/34 System	19
LMOS.XFE	PDP 11/34 System	1
CRAS	VAX* 11/780 System	1
	Total Systems =	28
	Square Feet =	5000

* Registered trademark of Digital Equipment Corporation.

TABLE H. EXAMPLE CLUSTERS 2 AND 3 WIRE CENTER INTERFACES

OPERATIONS SYSTEM	OTHER INTERFACES	HARDWARE	NO. INSTALLED	
			CLUSTER 2	CLUSTER 3
ATA		PDP 11/70 System	2	3
TASC	No. 5 Crossbar	Hewlett-Packard 2113 System	1	1
TCAS		Hewlett-Packard 2113 System	1	1
CAROT*		Hewlett-Packard 2113 and 2013 System	1	2
SCCS		PDP 11/70 System	3	4
RMAS*	Digital Access and Cross-Connect System	PDP 11/23 System (X6)	-	1
SARTS*		PDP 11/34 System	2	2
CMS-3	SSC	PDP 11/780 System	1	1
Automatic Data Test Design		PDP 11/04 System, 21MX	1	-
NSCS		PDP 11/780 System	1	-
SES No. 2	Network Service Center	PDP 11/780 System (X3)	1	-
ATRS		PDP 11/40 System	1	-
SES 1A*		PDP 11/70 System	1	-
EADAS 1A		PDP 11/70 System	-	2
EADAS NM	Network Data Collector Center	PDP 11/70 System	-	1
EADAS No. 2		PDP 11/70 System	1	1
		Total Systems =	18	19
		Square Feet =	6700	6000

* Clustering limitation.

TABLE I. EXAMPLE CLUSTERS 4, 5, and 6

OPERATIONS SYSTEM	HARDWARE	NO. INSTALLED		
		CLUSTER 4 (NOTE)	CLUSTER 5 (NOTE)	CLUSTER 6 (NOTE)
COSMOS	PDP 11/70 System	7	7	8
COSMOS - WM	PDP 11/70 System	2	2	2
AMARC	PDP 11/70 System (X2)	4	3	-
HOBIS	PDP 11/70 System (X2)	-	1	-
E911 ALI	PDP 11/70 System	-	-	1
E911 Data Management System	PDP 11/70 System	-	-	1
DBAS	PDP 11/70 System	-	-	2
RMATS II	PDP 11/780 System	-	-	1
EIS	-	-	-	1
	Total Systems =	13	13	16
	Square Feet =	6000	6000	7000

Note: - indicates operations system to operations system.

8. GLOSSARY

Abbreviations/acronyms used in this practice are defined as follows:

ALI

Automatic Location Identification.

AMARC

Automatic Message Accounting Recording System.

AT&T

American Telephone and Telegraph Company.

ADTS

Automatic Data Test System.

ATA

Automatic Trouble Analysis.

ATRS

Automatic Trouble Reporting System.

BOC

Bell Operating Company.

CAROT

Centralized Automatic Reporting On Trunks. This is a BTL-developed minicomputer operations system which tests the operational status of trunks periodically through the use of remote office test lines (ROTLs).

CM

Corrective Maintenance.

CMS

Circuit Maintenance System.

COMAS

Computerized Maintenance and Administrative Support. This is a centrally-developed minicomputer operations system which does ineffective attempt analysis for electromechanical central offices.

COSMOS

Computer System for Main Frame Operation.

CPMS

Cable Pressure Monitoring System.

CRAS

Cable Repair Administration System.

CTMS

Carrier Transmission Maintenance System.

DACS

Digital Access and Cross-Connect System.

DBAS

Data Base Administration Center.

EADAS

Engineering and Administrative Data Acquisition System. This is a BTL-developed minicomputer operations system which gathers traffic data from central offices.

EIS

Engineering Implementation Center.

HOBIS

Hotel Billing Information System.

LCAMOS

Loop Cable Administration and Maintenance Operations System.

LMOS

Loop Maintenance Operations System.

MCM

Minicomputer Corrective Maintenance. This is an MMG work function.

MLTS

Mechanized Loop Testing System.

MMA

Minicomputer Maintenance Administration. This is an MMG work function.

MMG

Minicomputer Maintenance Group.

MMOC

Minicomputer Maintenance and Operations Center.

MOA

Minicomputer Operations Administration. This is an MOG work function.

MOG

Minicomputer Operations Group.

MOTR

Minicomputer Operations Trouble Response. This is an MOG work function.

MSG

MMOC Support Group. This is the telephone company staff organization responsible for minicomputer system technical and administrative support and planning.

MTRC

Minicomputer Trouble Report Control. This is an MOG work function.

NCO

Normal Computer Operations. This is an MOG work function.

NDCC

Network Data Collection Center.

NM

Network Management.

NSCS

Network Service Center System.

PBC

Peripheral Bus Computer.

PM

Preventive Maintenance. This is a MMG work function.

RMAS

Remote Memory Administration System.

RMATS

Remote Maintenance Administration Traffic System.

ROTL

Remote Office Test Line.

SARTS

Switched Access Remote Testing System.

SCCS

Switching Control Center System.

SES

Service Evaluation System.

SPM

Spare Parts Management. This is an MMG work function.

SSC

Special Service Center.

TASC

Telecommunications Alarm Surveillance and Control System.

TCAS

T-Carrier Administration System.

TFMS

Trunk and Facility Maintenance System.

TNOP

Total Network Operations Plan.

UWC

User Work Center.

WM

Work Manager.