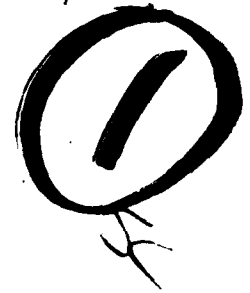


RESEARCH NOTE 80-14

LEVEL II



AD A092207

**USER'S MANUAL FOR THE
TACTICAL OPERATIONS SYSTEM
ANALYSIS PACKAGE**

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Human Factors Technical Area



U. S. Army

Research Institute for the Behavioral and Social Sciences

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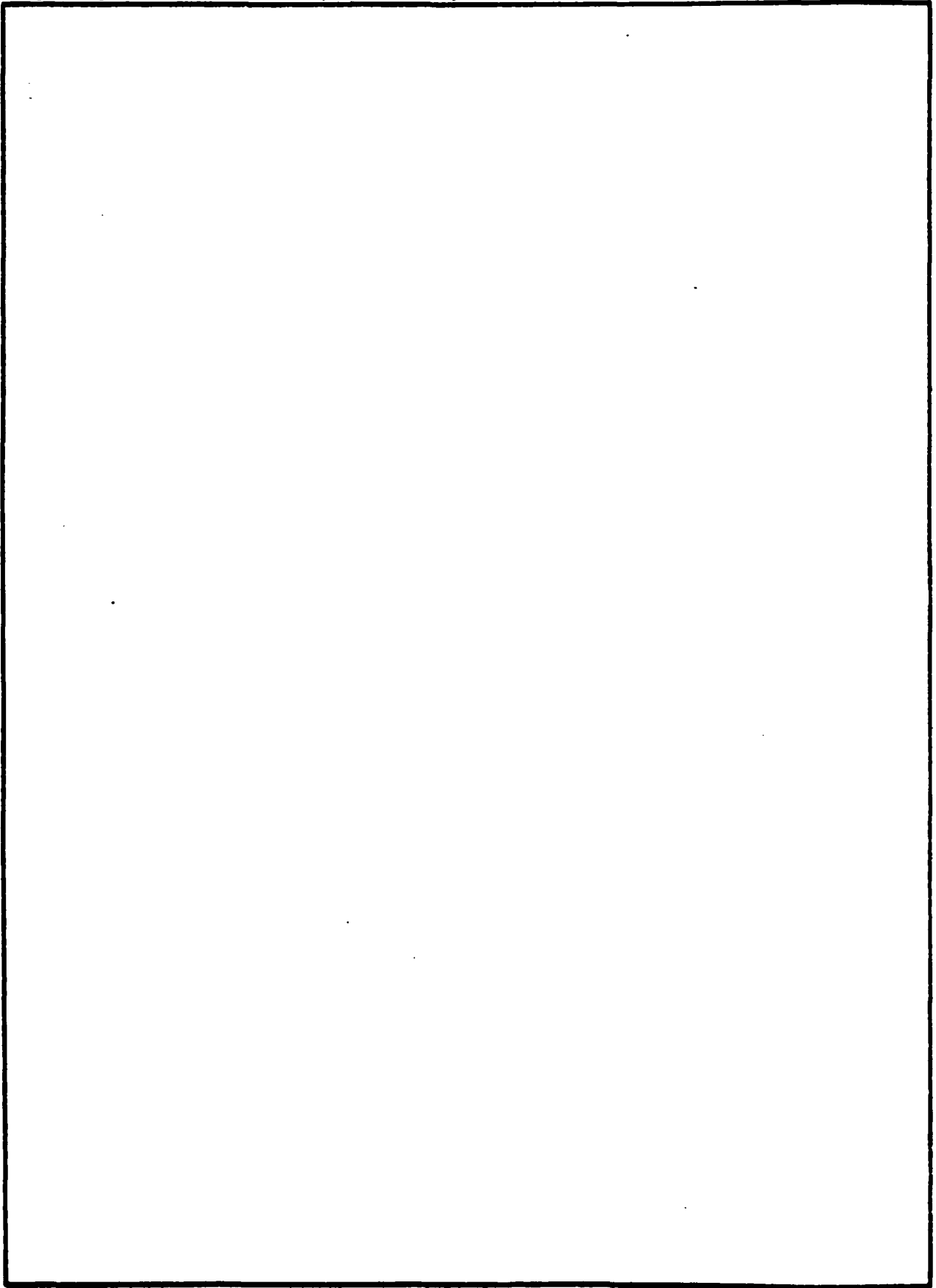
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Computers	Mathematical Modeling		
Data base Management	Networks		
Design aid	Queueing		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)			
This document provides instructions for the use and operation of a computer program package for the analysis of the Tactical Operations System (TOS). These programs were produced during the second phase of a project to develop information management concepts and procedures for automated battlefield command and control systems.			

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PREFACE

This document is one of eight reports which describe the work performed by Vector Research, Incorporated (VRI) and its subcontractor, Perceptronics, Incorporated, for the US Army Research Institute for the Behavioral and Social Sciences (ARI) under the second phase of contract number DAHC19-78-C-0027. The work described was performed over 12 months of an anticipated 36-month three-phased project. ~~The~~ overall objective of ^{this} ~~the~~ project ^{was} ~~has been~~ to produce procedural guidelines to be used by divisions in the field in developing standard operating procedures for information management in the Tactical Operations System (TOS). As a consequence of the redirection of the TOS development effort in November 1979, the objective of this work was reinterpreted to include automated battlefield command control systems (ABCCS) in general, using TOS for an explicit example of the design, human factors, and management control considerations which must be addressed.

The VRI study team for phase II was comprised of Dr. Robert W. Blum (Project Leader), Ms. Cathleen A. Callahan, Dr. W. Peter Cherry, Mr. Mark G. Graulich, Mr. Donald Kleist, Mr. Mark Meerschaert, Mr. Gregory Touma, and Mr. Gary Witus. The Perceptronics team for phase II consisted of Dr. Michael G. Samet and Dr. Ralph E. Geiselman.

The authors wish to acknowledge the helpful contributions of Dr. Stanley M. Halpin and Mr. Robert Andrews, who were charged with monitoring the study for ARI; and LTC L. Walker, MAJ. A. Edmonds, and Mr. M. Carrio, who performed a similar function for that portion of the study effort which was jointly sponsored with ARI by the US Army Communications Research and Development Command (CORADCOM).

The eight reports are as follows:

Blum et al. Information Management for an Automated Battlefield Command and Control System: Executive Summary. ARI Research Report 1249. -- presents an overview of the project and the other seven reports.

Callahan et al. Guidelines for Managing the Flow of Information in an Automated Battlefield Command and Control System. ARI Research Report 1348. -- describes considerations in and procedures for the management of contemporary ABCC systems.

Geiselman and Samet. Guideline Development for Summarization of Tactical Data. ARI Technical Report 458. -- an analysis of procedures for the extraction, summarization, and presentation of critical information.

Witus et al. Analysis of Information Flow in the Tactical Operations System (TOS). ARI Research Notes 80-12. -- describes the purpose, approach, and results of a TOS analysis which focused on TOS when integrated with a planned communications support system.

Witus et al. Description of the Tactical Operations System Information Flow Model. ARI Research Notes 80-13. -- describes the representation of TOS used to develop the analysis package and the mathematics of the model.

Witus et al. User's Manual for the Tactical Operations System Analysis Package. ARI Research Notes 80-14. -- explains the use and operation of the analysis package.

Witus et al. Programmer's Manual for the Tactical Operations System Analysis Package. ARI Research Notes 80-15. -- describes the programming details of the package to facilitate modifications or transfer between host systems.

Cherry, W. All Source Analysis System: Design Issues. ARI Working Paper HF80-XX. -- a discussion of design issues associated with the emerging ASAS concept.

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1.0 INTRODUCTION TO VOLUME III

The purpose of this volume is to provide instructions for the use and operation of the TOS analysis package. The user should have some familiarity with TOS and the model of TOS, such as could be gained from chapters 1.0 and 2.0 of ARI Research Notes 80-13, Description of the Tactical Operations System Information Flow Model.

This volume is organized into five chapters and an appendix. The remainder of this introductory chapter discusses the use, organization, and design considerations of the analysis package. Chapters 2.0 through 5.0 discuss each of the four computer programs in the package and present operating instructions and explanations of inputs and outputs. The appendix contains the dialogue of a sample run of all four programs in the analysis package. This document does not discuss the job control instructions to load and run the programs, since they depend on the host operating system.

The analysis package was created to facilitate the use of a mathematical model in the analysis of TOS. There are two primary ways in which the package can be used to analyze TOS. The first is to obtain point estimates of TOS performance. That is, for a specified TOS configuration and environment, the user can obtain estimates of the traffic, congestion, and delays throughout the system. The second way is to perform parametric analysis. That is, the user can investigate the impacts on TOS performance of changes in one or more of the inputs. Examples of both of these applications of the analysis package can be found in ARI Research Notes 80-12, Analysis of Information Flow in the Tactical Operations System (TOS).

The analysis package must perform three basic functions: (1) interact with the operator to set, alter, and examine the value of the inputs;

(2) perform the computations specified by the mathematics of the model; and (3) display the outputs. To perform these functions, the package has been designed to consist of four computer programs and one external data structure. The organization of the package in terms of the operator activities and the interactions between the programs, the data structure, and the operator activities are shown in exhibit 1-1. The program CREATE will prompt the operator to specify values for all of the inputs in the data file and will use them to create a new data file. The program MODIFY will read an existing data file and allow the user to select data elements for display and modification. The program will then create a new data file. The program DISPLAY reads, formats, and displays an existing data file. The program COMPUTE allows the operator to set values for two additional inputs not contained in the data file, performs all of the computations required by the model, allows the operator to select the output format, and displays the outputs.

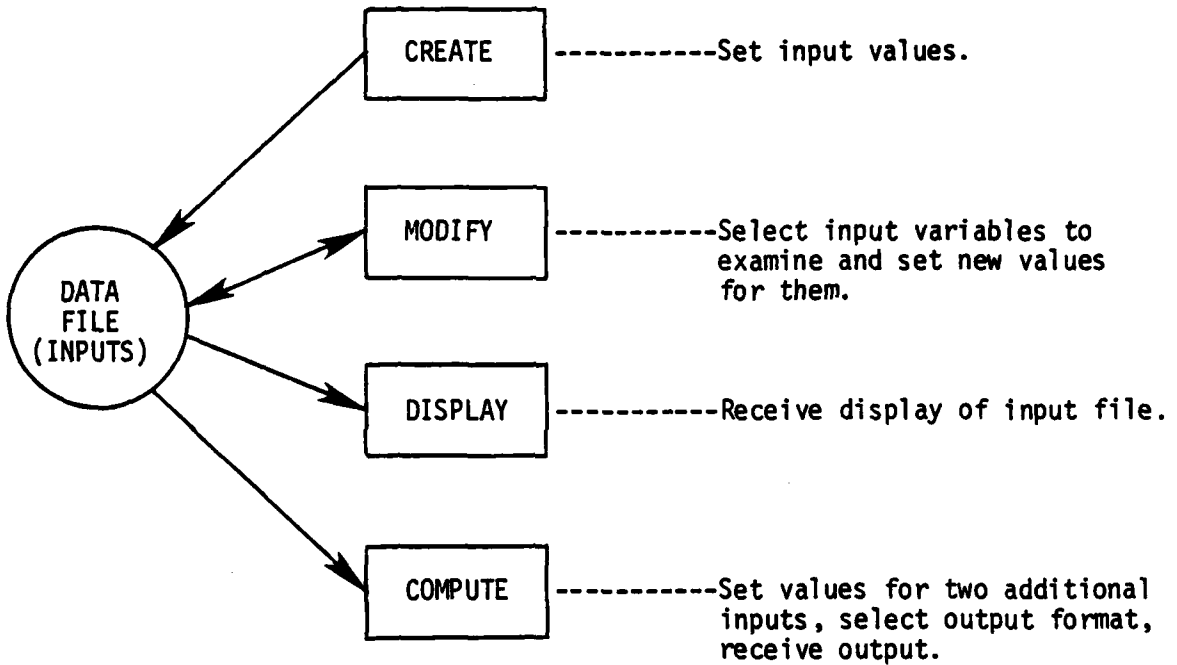
Pragmatic considerations governed the design of the package. The package was designed to be easy to use and efficient to operate in performing the intended analysis. For example, two input parameters specifying the error detection and correction (EDC) options which were to be changed frequently during the analysis have their values assigned in COMPUTE. Other parameters which were to be changed as part of the analysis could be changed by the program MODIFY without requiring the operator to create a new data file from scratch. Some parameters, such as those specifying the network configuration, were not intended to be changed as part of the analysis and cannot be changed by MODIFY. They can, however, be changed by creating a new data file with CREATE.

EXHIBIT 1-1: ANALYSIS PACKAGE ORGANIZATION

DATA
STRUCTURE

COMPUTER
PROGRAMS

OPERATOR
ACTIVITY



2.0 PROGRAM CREATE

The program CREATE is the initial interface between the user and the computer system and is employed to create the data files which are subsequently used in the analyses. CREATE is written as an interactive program which is to be run from a computer terminal. CREATE writes to I/O unit 6 and reads from I/O unit 5. The program will successively prompt the user for data and then will translate the user's inputs into the format required of the data files which are used in the other three programs. CREATE embodies minimal error checking routines which check the consistency of the data inputs. At the option of the user, CREATE will display the data file in an easy to understand format or will write the file to I/O unit 2 in the proper format for use in the other programs. When CREATE asks for the name of items, the name must be eight or less characters. When CREATE asks for numerical data, it can be provided in free format form.¹

2.1 OPERATING INSTRUCTIONS

Step 1: CREATE asks whether the user desires long or short queries. If short queries are selected, the first time each particular type of data is requested a full sentence question is presented. Subsequent requests for similar data are then indicated by very short prompts.

Step 2: CREATE requests input of the TOS configuration.

¹Values should be separated by blanks or commas.

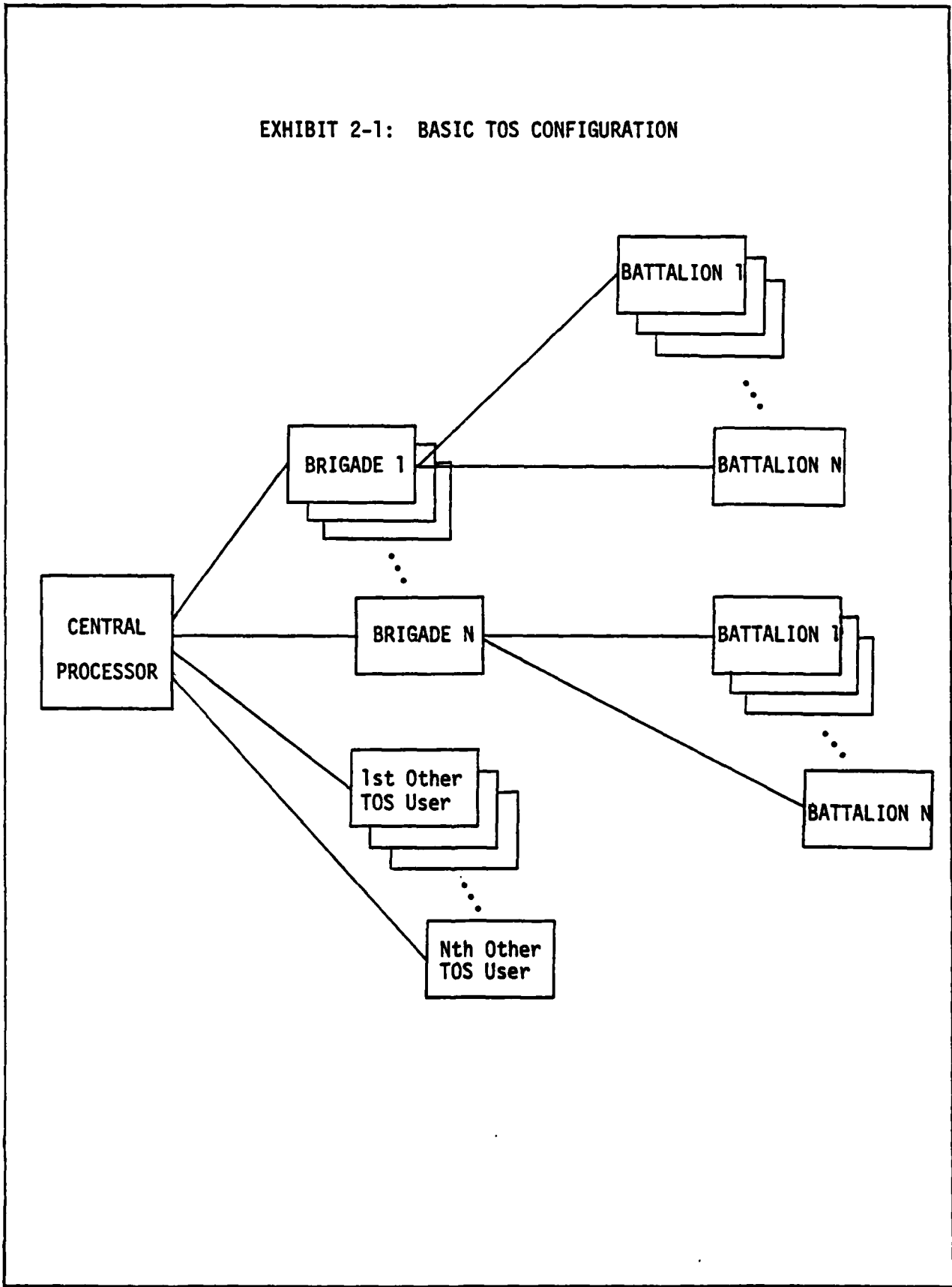
- Step 3: CREATE requests information concerning the message types in the TOS communications system.
- Step 4: CREATE asks for the Route Cross Message Array. This array is quite large and many of the data in the Route Cross Message Array are repetitive. CREATE provides the option to bypass this section. The array can be entered at a later time using file manipulating procedures. If this option is selected, CREATE will print a line of asterisks in the output file which indicates where the Route Cross Message Data Array is to be inserted.
- Step 5: CREATE prompts the user for engineering data describing the TOS hardware.
- Step 6: CREATE asks for data about the environment in which TOS would operate.
- Step 7: The user is asked whether a display of the input data is desired. If this option is selected, the data which the user has entered is printed on the terminal with headings which make the data easy to understand.
- Step 8: CREATE asks the user if he wishes to save the data file. The output file is written on I/O unit 2 in the appropriate format for use in the other programs in the analysis package.

2.2 INPUT DATA

2.2.1 CONFIGURATION DATA

Exhibit 2-1 shows the general form of the TOS configuration. Users which are directly connected to the central processor and not connected

EXHIBIT 2-1: BASIC TOS CONFIGURATION



to other nodes are called Other TOS Users within the program. An example of such a user in the design is ADA Battalion. Users which are connected to the central node and to other nodes are called brigades and these communicate with the central processor in one direction and with their respective battalions in the other. The user is asked to name the nodes and the channels which connect the nodes.

2.2.2 MESSAGE TYPE DATA

There are two types of messages: those initiated by users of the system and those initiated by TOS itself. The user is asked to provide a name for each of these messages and then to provide certain data about the messages. These data are different for the user-initiated and TOS-initiated messages and CREATE asks for the information for each type of message. The data consist of the names, average character lengths of the messages, and whether the messages cause other events to happen within the system; for example, do they cause other messages to be sent.

2.2.3 ROUTE CROSS MESSAGE ARRAY

The Route Cross Message Array data are relevant to the messages which are sent to or received from each particular node within the network. For user-initiated messages these data consist of the initiation rates of the messages at each node and the probabilities that brigade hierarchical review alters or deletes a message sent from a battalion. For TOS-initiated messages, the data consist of two proportionality constants, α and β , which determine the initiation rate of messages by the central processor.

2.2.4 ENGINEERING DATA

The engineering data for channels are the transmission rates, number of lines, and the overhead time to establish a link (referred to as rise time). The engineering times for the processors are the mean times to perform specified tasks.

2.2.5 ENVIRONMENTAL DATA

The environmental data consists of information describing the competition for communications nets by voice users, and the error rates for each transmitter-receiver pair.

3.0 PROGRAM MODIFY

The program MODIFY allows the user to modify values in an existing data file for the TOS simulation package. The program is designed to be run interactively from a computer terminal. Before running MODIFY a data file must exist such as is created by program CREATE. It is suggested that the user obtain a listing of the data file such as is provided by the program DISPLAY before running the program MODIFY. Program MODIFY reads an existing data file from logical I/O unit 1. The program writes the new version of the data file onto logical I/O unit 2.

The program MODIFY will interact with the user in order to alter data. Data may be input in free format. Yes or no questions may be answered "Y" or "YES" for affirmative, and "N" or "NO" for negative. In order to respond to prompts by the program, the user will need to know certain information about the data file. For example, in order to set the transmission rate on a communications channel, the user needs to input the number of that channel. The user can get this number by reading the display of the data file output by the program DISPLAY.

As currently implemented, the program MODIFY allows only the following modifications to data:

- any communications system data may be changed;
- message traffic rates for the entire TOS network may be multiplied by a factor; and
- bit error rates may be changed by channel.

4.0 PROGRAM DISPLAY

Program DISPLAY was written to facilitate examination of the data file which is output from the CREATE or MODIFY programs and is used in the COMPUTE program. Program DISPLAY merely reads the data file and prints it out with English headings which contain the names of the data elements. The read statements from program DISPLAY are identical with the read statements from program COMPUTE.

Exercising program DISPLAY is a very simple procedure. It consists of designating the device from which the data file will be read and indicating where the output is to be written. The way the program is presently constituted, the file is read from device number two and is written in the standard FORTRAN manner to device six. Thus, if DISPLAY is exercised from a terminal, the user needs to designate the file as device two and the program DISPLAY will write the output back to the terminal. In the batch mode, the output would be printed on a line printer.

Program DISPLAY is set up to read the output file and tell whether the file contains the Route Cross Message Array. If the array is present, it is printed. If the array is not present, only the header is printed and a message which says, "THE ROUTE CROSS MESSAGE ARRAY IS TO BE READ IN LATER" is printed in lieu of the data.

Other than designating the input and output files, the user need do nothing to use program DISPLAY. The data file is structured so that the first row supplies all the data needed to set the DO LOOPS in the subsequent portion of the program.

5.0 PROGRAM COMPUTE

At the beginning of execution the program prompts the operator to specify the EDC procedures¹ by inputting the blocking number (the number of copies of a message that will be transmitted under one link-up overhead), and indicating whether or not the retained-message-copy (RMC) scheme will be employed. Next the program reads an input file and performs the necessary computations. Lastly the program goes into a loop in which it prompts the operator to select output tables and display options, and prints the tables. Exhibit 5-1 shows the use of logical I/O channels. The program does not do any error checking on the operator inputs.

5.1 OPERATING INSTRUCTIONS

After the prompt "INPUT BLOCKING NUMBER AND RMC SWITCH (0=> USE RMC, 1=> DO NOT)," the operator should input the two integer values on the same line separated by blanks or commas.² The blocking number should be a positive integer equal to one for single blocking, two for double blocking, and so on. The program will represent the use of RMC only if the RMC switch has the value zero.

After the prompt "SPECIFY: (1) OUTPUT TABLE; (2) RANKING STATISTIC; (3) ORDERING OPTION," the operator should input three integers

¹More EDC procedures in addition to majority voting and Hamming code.

²A free-format read subroutine is used in this part of the program. If the package is transferred to another system, a different input format might be used. The current version will interpret a null entry as a zero.

EXHIBIT 5-1: I/O UNIT ASSIGNMENTS IN COMPUTE

I/O UNITUSE

5	Write to Terminal.
6	Read from Terminal.
7	Read Data File.
8	Write Output Tables.

on one line separated by blanks or commas. There are five output tables, numbered one through five. The output table number selects the output table to be printed. A zero value for the output table will cause termination of the program. When a table is listed, the items will be ranked by the value of one of the performance measures for that table. The ranking statistic number selects which performance measure will be used to rank the items. For example, Table 1 has four columns: (1) the route name; (2) the expected delay; (3) the traffic rate; and (4) the rank. If the operator were to select table 1 with ranking statistic value of 1, the routes would be ranked by decreasing expected delay. A ranking statistic value of 2 would cause ranking by decreasing traffic rate. The ordering option is a switch which should be set to a non-zero value to list the items in the table in order of increasing rank. Otherwise the ordering will be a default ordering. The ranking and ordering options do not apply to table 5, which has only four rows.

5.2 OUTPUT TABLES

Five tables display outputs describing routes, message types, remote processors, channels, and DCC components. All outputs are written in FORTRAN format F8.3. The tables are: (1) Route Summary Statistics; (2) Message Summary Statistics; (3) Processor Summary Statistics; (4) Channel Summary Statistics; and (5) DCC Component Summary Statistics.

The first table presents route summary statistics. A route is a path between a user and the DCC. There is a one-to-one correspondence between routes and users, and the name of a route is the name assigned to

the user at one end of the route. The components on a route from a battalion are a TCT, an FM channel, a TCS, a multichannel frequency, and the DCC. Two outputs are presented for each route. The expected delay along a route is the expected time elapsed from when a message is entered at the user's terminal to when the message is fully processed at the data base processor (this does not include the time to distribute any DCC-generated messages resulting from an arrival), or from when the data base processor generates a message for the user at the end of the route to when the user receives it. The expected delay is, therefore, a measure of the "one-way" delay. The traffic rate is simply the rate at which messages are originating or terminating at the user end of the route.

The second table, Message Summary Statistics, presents similar information for each type of message handled by the system. The expected delay for a type of message is the expected time interval between origination and termination of that type of message. The expected delay is influenced by which users send or receive most of the messages of that type, and the length of the message.

Tables 3, 4, and 5 all present the same four categories of outputs, but for differing TOS network components. Table 3 relates to the central processing units of the remote processors -- the TCTs and TCSs. Table 4 relates to the communications channels. Table 5 relates to the four primary components of the DCC. The five output columns are expected delay, expected queue length, traffic rate utilization and capacity. Traffic rate is the rate at which messages arrive at the component, and

utilization is the long run fraction of time that the component is busy. Capacity is that traffic rate which, at the specified mix of message types, will cause 80 percent utilization of the component.¹

¹A thorough explanation of this measure of capacity and its significance can be found in chapter 3.0 of ARI Research Notes 80-12.

APPENDIX A: SAMPLE RUN

This appendix presents the dialogue of a sample run of each of the four programs in the analysis package. The TOS configuration used in the sample run consists of the DCC, a TCS at the TAC CP, and one brigade with two battalions, and is shown in exhibit A-1. Four message types are represented: (1) ESD file updates (ESD.UP); (2) ESD file queries (ESD.Q); (3) ESD SRI outputs (ESD.O); and (4) ESD query responses (ESD.QR). The dialogue is contained in exhibit A-2.

EXHIBIT A-1: SAMPLE RUN TOS CONFIGURATION

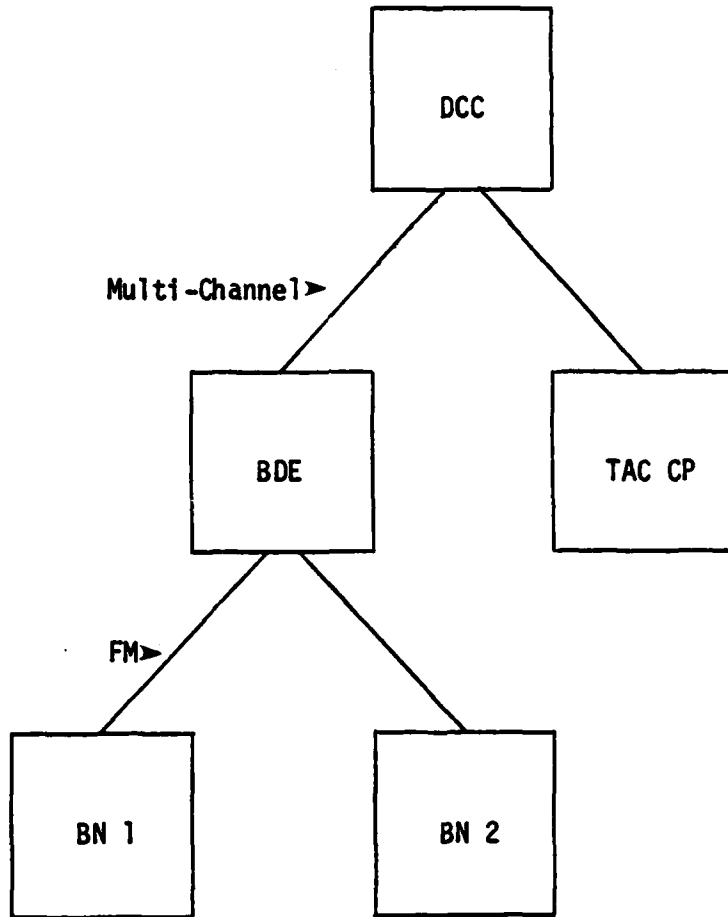


EXHIBIT A-2: SAMPLE RUN DIALOGUE

```

#RUN CREATE.OBJ T=10 2=DATAFILE
#EXECUTION BEGINS
  IF YOU WANT SHORT PROMPTS ENTER A "1"
?
  ENTER NUMBER OF BRIGADES
?1
  ENTER NAME OF BRIGADE 1
?BDE
  ENTER TYPE OF PROCESSOR AT BDE
?TCS
  ENTER NUMBER OF BATTALIONS IN BRIGADE BDE
?2
  ENTER NAME OF BATTALION 1, BRIGADE BDE
?BN 1
  ENTER TYPE OF PROCESSOR AT BN 1
?TCC
  ENTER NAME OF BATTALION 2, BRIGADE BDE
?BN 2
  ENTER TYPE OF PROCESSOR AT BN 2
?TCC
  ENTER NUMBER OF OTHER TOS USERS
?1
  ENTER NAME OF OTHER TOS USER 1
?TAC CP
  ENTER TYPE OF PROCESSOR AT TAC CP
?TCS
  HOW MANY COMMUNICATIONS CHANNELS ARE THERE?
?2
  ENTER NAME OF CHANNEL 1
?MULTI
  ENTER NAME OF CHANNEL 2
?BDE FM
  ENTER NAME OF CHANNEL CONNECTING BATTALION BN 1 WITH BRIGADE BDE
?BDE FM
  ENTER NAME OF CHANNEL CONNECTING BATTALION BN 2 WITH BRIGADE BDE
?BDE FM
  ENTER NAME OF CHANNEL CONNECTING BRIGADE BDE AND THE FEP
?MULTI
  ENTER NAME OF CHANNEL CONNECTING TAC CP AND THE FEP
?MULTI
  ENTER NUMBER OF MSG TYPES AND NUMBER OF USER INPUT MSG TYPES
?4 2
  ENTER NAME OF USER MSG TYPE 1
?ESD.UP
  ENTER NAME OF USER MSG TYPE 2
?ESD.O
  ENTER NAME OF TOS MSG TYPE 1
?ESD.O
  ENTER NAME OF TOS MSG TYPE 2
?ESD.OR
  ENTER MEAN LENGTH IN CHARACTERS OF MSG ESD.UP
?111
  ENTER NAME OF MSG CAUSED AS OUTPUT ON SAME ROUTE BY MSG ESD.UP ENTER "0" IF NONE
?0
  ENTER NAME OF MSG CAUSED AS OUTPUT ON OTHER ROUTES BY MSG ESD.UP ENTER "0" IF NONE
?ESD.O
  ENTER MEAN LENGTH IN CHARACTERS OF MSG ESD.O
?222
  ENTER NAME OF MSG CAUSED AS OUTPUT ON SAME ROUTE BY MSG ESD.O ENTER "0" IF NONE
?ESD.OR
  ENTER NAME OF MSG CAUSED AS OUTPUT ON OTHER ROUTES BY MSG ESD.O ENTER "0" IF NONE
?0

```

- Continued -

**EXHIBIT A-2: SAMPLE RUN DIALOGUE
(Continued)**

```

ENTER MEAN LENGTH IN CHARACTERS OF MSG ESD.O
?333
ENTER MEAN LENGTH IN CHARACTERS OF MSG ESD.OR
?444
IF YOU WANT TO READ THE ROUTE CROSS MESSAGE ARRAY INTO THE OUTPUT FILE LATER, ENTER A "1"
?
ENTER INITIATION RATE IN MSG/HR OF USER MSG ESD.UP AT TAC CP
?30
ENTER INITIATION RATE IN MSG/HR OF USER MSG ESD.Q AT TAC CP
?30
ENTER PROPORTIONALITY CONSTANTS A(I,J) AND B(I,J) FOR TOS MSG ESD.O ON ROUTE TAC CP
?1 1
ENTER PROPORTIONALITY CONSTANTS A(I,J) AND B(I,J) FOR TOS MSG ESD.OR ON ROUTE TAC CP
?1 1
ENTER INITIATION RATE IN MSG/HR OF USER MSG ESD.UP AT BDE
?20
ENTER INITIATION RATE IN MSG/HR OF USER MSG ESD.O AT BDE
?20
ENTER PROPORTIONALITY CONSTANTS A(I,J) AND B(I,J) FOR TOS MSG ESD.O ON ROUTE BDE
?1 1
ENTER PROPORTIONALITY CONSTANTS A(I,J) AND B(I,J) FOR TOS MSG ESD.OR ON ROUTE BDE
?1 1
ENTER INITIATION RATE IN MSG/HR OF USER MSG ESD.UP AT BN 1
?5
ENTER PROBABILITY THAT USER MSG ESD.UP FROM BN 1 IS DELETED AT BDE REVIEW
?0
ENTER PROBABILITY THAT USER MSG ESD.UP FROM BN 1 IS ALTERED BUT NOT DELETED AT BDE REVIEW
?0
ENTER INITIATION RATE IN MSG/HR OF USER MSG ESD.O AT BN 1
?5
ENTER PROBABILITY THAT USER MSG ESD.Q FROM BN 1 IS DELETED AT BDE REVIEW
?0
ENTER PROBABILITY THAT USER MSG ESD.Q FROM BN 1 IS ALTERED BUT NOT DELETED AT BDE REVIEW
?0
ENTER PROPORTIONALITY CONSTANTS A(I,J) AND B(I,J) FOR TOS MSG ESD.O ON ROUTE BN 1
?1 1
ENTER PROPORTIONALITY CONSTANTS A(I,J) AND B(I,J) FOR TOS MSG ESD.OR ON ROUTE BN 1
?1 1
ENTER INITIATION RATE IN MSG/HR OF USER MSG ESD.UP AT BN 2
?7
ENTER PROBABILITY THAT USER MSG ESD.UP FROM BN 2 IS DELETED AT BDE REVIEW
?0
ENTER PROBABILITY THAT USER MSG ESD.UP FROM BN 2 IS ALTERED BUT NOT DELETED AT BDE REVIEW
?0
ENTER INITIATION RATE IN MSG/HR OF USER MSG ESD.O AT BN 2
?10
ENTER PROBABILITY THAT USER MSG ESD.O FROM BN 2 IS DELETED AT BDE REVIEW
?0
ENTER PROBABILITY THAT USER MSG ESD.O FROM BN 2 IS ALTERED BUT NOT DELETED AT BDE REVIEW
?0
ENTER PROPORTIONALITY CONSTANTS A(I,J) AND B(I,J) FOR TOS MSG ESD.O ON ROUTE BN 2
?1 1
ENTER PROPORTIONALITY CONSTANTS A(I,J) AND B(I,J) FOR TOS MSG ESD.OR ON ROUTE BN 2
?1 1
ENTER MEAN DATA DISK ACCESS TIME IN MILLISECONDS
?30
ENTER MEAN MESSAGE DISK ACCESS TIME IN MILLISECONDS
?30
ENTER CPU TIME IN MILLISECONDS AT A TCS TO ORIGINATE, PER MSG AND PER CHARACTER, (2 NUMBERS NEEDED)
? 1 0
ENTER CPU TIME IN MILLISECONDS AT A TCS TO SEND, PER MSG AND PER CHARACTER, (2 NUMBERS NEEDED)

```

- Continued -

**EXHIBIT A-2: SAMPLE RUN DIALOGUE
(Continued)**

```

?1 0
  ENTER CPU TIME IN MILLISECONDS AT A TCS TO RECEIVE, PER MSG AND PER CHARACTER, (2 NUMBERS NEEDED)
?1 0
  ENTER CPU TIME IN MILLISECONDS AT A TCS TO TEMPLATE, PER MSG AND PER CHARACTER, (2 NUMBERS NEEDED)
?0 0
  ENTER CPU TIME IN MILLISECONDS AT A TCS TO TERMINATE, PER MSG AND PER CHARACTER, (2 NUMBERS NEEDED)
?0 0
  ENTER CPU TIME IN MILLISECONDS AT A TCT TO ORIGINATE, PER MSG AND PER CHARACTER, (2 NUMBERS NEEDED)

?1 1
  ENTER CPU TIME IN MILLISECONDS AT A TCT TO SEND, PER MSG AND PER CHARACTER, (2 NUMBERS NEEDED)

?1 1
  ENTER CPU TIME IN MILLISECONDS AT A TCT TO RECEIVE, PER MSG AND PER CHARACTER, (2 NUMBERS NEEDED)
?1 0
  ENTER CPU TIME IN MILLISECONDS AT A TCT TO TERMINATE, PER MSG AND PER CHARACTER, (2 NUMBERS NEEDED)
?0 0
  ENTER CPU TIME IN MILLISECONDS AT THE FEP TO INITIATE, PER MSG AND PER CHARACTER, (2 NUMBERS NEEDED)
?1 1
  ENTER CPU TIME IN MILLISECONDS AT THE FEP TO TERMINATE, PER MSG AND PER CHARACTER, (2 NUMBERS NEEDED)
?0 0
  ENTER RISE IN SECONDS TIME ON CHANNEL MULTI
?1 1
  ENTER TRANSMISSION RATE CHARA/SEC ON CHANNEL MULTI
?2666
  ENTER NUMBER OF LINES ON CHANNEL MULTI
?2
  ENTER RISE IN SECONDS TIME ON CHANNEL BDE FM
?1.5
  ENTER TRANSMISSION RATE CHARA/SEC ON CHANNEL BDE FM
?100
  ENTER NUMBER OF LINES ON CHANNEL BDE FM
?2
  ENTER DBP PROCESSING IN MILLISECONDS TIME FOR MSG ESD.UP
?1
  ENTER MSG DISK READS/Writes FOR MSG ESD.UP
?3
  ENTER DATA DISK READS/Writes FOR MSG ESD.UP
?1
  ENTER DBP PROCESSING IN MILLISECONDS TIME FOR MSG ESD.O
?1
  ENTER MSG DISK READS/Writes FOR MSG ESD.O
?3
  ENTER DATA DISK READS/Writes FOR MSG ESD.O
?1
  ENTER DBP PROCESSING IN MILLISECONDS TIME FOR MSG ESD.O
?1
  ENTER MSG DISK READS/Writes FOR MSG ESD.O
?3
  ENTER DATA DISK READS/Writes FOR MSG ESD.O
?1
  ENTER DBP PROCESSING IN MILLISECONDS TIME FOR MSG ESD.OR
?1
  ENTER MSG DISK READS/Writes FOR MSG ESD.OR
?3
  ENTER DATA DISK READS/Writes FOR MSG ESD.OR
?1
  ENTER NUMBER OF TEMPLATES AT BDE
?5
  ENTER NUMBER OF TEMPLATES AT THE FEP
?6
  ENTER PROPORTION OF TIME CHANNEL MULTI IS BEING USED FOR VOICE TRANSMISSIONS

```

- Continued -

EXHIBIT A-2: SAMPLE RUN DIALOGUE
(Continued)

```
? .1
ENTER PROPORTION OF TIME CHANNEL 3DE FM IS BEING USED FOR VOICE TRANSMISSIONS
? .25
ENTER BIT ERROR RATE FROM TAC CP TO THE FEP
? 0
ENTER BIT ERROR RATE FROM THE FEP TO TAC CP
? 0
ENTER BIT ERROR RATE FROM 3DE TO THE FEP
? 0
ENTER BIT ERROR RATE FROM THE FEP TO 3DE
? 0
ENTER BIT ERROR RATE FROM BATTALION BN 1 TO BRIGADE 3DE
? 0
ENTER BIT ERROR RATE FROM BRIGADE 3DE TO BATTALION BN 1
? 0
ENTER BIT ERROR RATE FROM BATTALION BN 2 TO BRIGADE 3DE
? 0
ENTER BIT ERROR RATE FROM BRIGADE 3DE TO BATTALION BN 2
? 0
IF YOU WANT TO DISPLAY THE OUTPUT FILE ENTER A "1"
?
IF YOU WANT TO CREATE THE OUTPUT FILE ENTER A "1"
? 1
#EXECUTION TERMINATED
#T=0.438 DR=99 S.75, S2.08T
#
```

- Continued -

EXHIBIT A-2: SAMPLE RUN DIALOGUE
(Continued)

RUN DISPLAY.OBJ T=10 2=DATAFILE
EXECUTION BEGINS

**** SYSTEM CONFIGURATION ****

** MANEUVER BRIGADES **

UNIT NAME	COMMUNICATIONS LINK W/ FEP	PROCESSOR TYPE	NUMBER OF TEMPLATES
RDE	MULTI	TCS	5

** MANEUVER BATTALIONS **

UNIT NAME	COMMUNICATIONS LINK W/ BRIGADE	PARENT BRIGADE	PROCESSOR TYPE
RN 1	RDE FM	RDE	TCT
RN 2	RDE FM	RDE	TCT

** OTHER TOS USERS **

UNIT NAME	COMMUNICATIONS LINK	PROCESSOR TYPE
TAC CP	MULTI	TCS

**** COMMUNICATIONS SYSTEM ****

CHANNEL NAME	NUMBER OF LINES	X-MISSION RATE (CHARA/SEC)	RISE TIME (SECONDS)	UNAVAILABLE CAPACITY (FRACTION)
MULTI	2	2670	0.10	0.10
RDE FM	2	100	1.50	0.25

**** MESSAGE DATA ****

MESSAGE NAME	ORIGINATOR	MEAN LENGTH (CHARACTERS)	DSP TIME (MILLISEC)	MSG DISK READS/WRITES (PER MSG)	DATA DISK READS/WRITES (PER MSG)	MSG OUT SAME ROUTE	MSG OUT OTHER ROUTE
ESD.OP	USER	111	1.000	3	1	NONE	ESD.O
ESD.O	USER	222	1.000	3	1	ESD.OR	NONE
ESD.O	TOS	333	1.000	3	1	NONE	NONE
ESD.OR	TOS	444	1.000	3	1	NONE	NONE

EXHIBIT A-2: SAMPLE RUN DIALOGUE
(Continued)

 ***** PROCESSOR DATA *****

** DCC **

MEAN DATA DISK ACCESS TIME (MILLISEC)	MEAN MSG DISK ACCESS TIME (MILLISEC)	NUMBER OF TEMPLATES	FEP CPU TIME TO INITIATE		FEP CPU TIME TO TERMINATE	
			PER MSG (MILLISEC)	PER CHARA (MILLISEC)	PER MSG (MILLISEC)	PER CHARA (MILLISEC)
30.000	30.000	6	1.000	1.000	0.0	0.0

** CPU TIME TO: **

	ORIGINATE		SEND		RECEIVE		TEMPLATE		TERMINATE	
	PER MSG (MILLISEC)	PER CHARA (MILLISEC)	PER MSG (MILLISEC)	PER CHARA (MILLISEC)	PER MSG (MILLISEC)	PER CHARA (MILLISEC)	PER MSG (MILLISEC)	PER CHARA (MILLISEC)	PER MSG (MILLISEC)	PER CHARA (MILLISEC)
RCS	1.000	0.0	1.000	0.0	1.000	0.0	0.0	0.0	0.0	0.0
DC	1.000	1.000	1.000	1.000	1.000	0.0	NOT DONE	NOT DONE	0.0	0.0

 ***** ROUTE CROSS MESSAGE DATA *****

** USER GENERATED MESSAGES **

BRIGADE			MESSAGE TYPE	INITIATION RATE (MSG/HOUR)		
RDE			ESD.UP	20		
RDE			ESD.Q	20		
BATTALION	PARENT BRIGADE	MESSAGE TYPE	INITIATION RATE (MSG/HOUR)	PROB OF DELETION AT RDE	PROB OF ALTERATION AT RDE	
BN 1	RDE	ESD.UP	5	0.0	0.0	
RN 1	RDE	ESD.Q	5	0.0	0.0	
RN 2	RDE	ESD.UP	7	0.0	0.0	
RN 2	RDE	ESD.Q	10	0.0	0.0	
OTHER USERS			MESSAGE TYPE	INITIATION RATE (MSG/HOUR)		
TAC CP			ESD.UP	30		
TAC CP			ESD.Q	30		

- Continued -

EXHIBIT A-2: SAMPLE RUN DIALOGUE
(Continued)

** TOS GENERATED MESSAGES **

TERMINUS	MESSAGE	OUTPUT	OUTPUT
	TYPE	RATIO A	RATIO B
BDE	ESD.O	1.000	1.000
BDE	ESD.OR	1.000	1.000
BN 1	ESD.O	1.000	1.000
BN 1	ESD.OR	1.000	1.000
BN 2	ESD.O	1.000	1.000
BN 2	ESD.OR	1.000	1.000
TAC CP	ESD.O	1.000	1.000
TAC CP	ESD.OR	1.000	1.000

 ***** ERROR RATES *****

SENDING NODE	RECEIVING NODE	ERROR RATE	SENDING NODE	RECEIVING NODE	ERROR RATE
BDE	FEP	0.0	FEP	BDE	0.0
BN 1	BDE	0.0	BDE	BN 1	0.0
BN 2	BDE	0.0	BDE	BN 2	0.0
TAC CP	FEP	0.0	FEP	TAC CP	0.0

EXECUTION TERMINATED
 AT=0.187 DR=43 S.50, S2.50T
 **

- Continued -

EXHIBIT A-2: SAMPLE RUN DIALOGUE
(Continued)

#RUN MODIFY.OBJ T=10 1=DATAFILE 2=NEWDATAFILE
#EXECUTION BEGINS

*** PROGRAM: MODIFY ***
DO YOU WISH TO ALTER THE CONFIGURATION? (YES OR NO)
?NO
DO YOU WISH TO ALTER THE COMMUNICATIONS SYSTEM?
?YES
HOW MANY CHANNELS DO YOU WISH TO ENTER DATA FOR?
?1
ENTER THE NUMBERS CORRESPONDING TO THOSE CHANNELS
?1
FOR EACH CHANNEL ENTER:
RISE TIME, TRANSMISSION RATE, UNAVAILABLE CAPACITY, # OF LINES
ENTER DATA FOR CHANNEL MULTI
?.1 2666 0 2
DO YOU WISH TO SEE CURRENT COMMUNICATIONS SYSTEM DATA?
?YES

```
*****
*****
*****      COMMUNICATIONS SYSTEM      *****
*****
*****
```

CHANNEL NAME	NUMBER OF LINES	TRANSMISSION RATE (CHARA/SEC)	RISE TIME (SECONDS)	UNAVAILABLE CAPACITY (FRACTION)
MULTI	2	2666	0.10	0.0
RDE FN	2	100	1.50	0.25

DO YOU WISH TO CHANGE MORE COMMUNICATIONS SYSTEM DATA?
?NO
DO YOU WISH TO ALTER THE MESSAGE DATA?
?N
DO YOU WISH TO ALTER THE PROCESSOR DATA?
?NO
DO YOU WISH TO ALTER THE SYSTEM LOADS?
?YES
ENTER LOAD FACTOR
?.1.25
DO YOU WISH TO ALTER THE ERROR RATES?
?YES
HOW MANY CHANNELS DO YOU WISH TO ENTER DATA FOR?
?2
ENTER THE NUMBERS OF THOSE CHANNELS
?1 2
ENTER ERROR RATE FOR CHANNEL MULTI
?.001
ENTER ERROR RATE FOR CHANNEL RDE FN
?.003
DO YOU WISH TO SEE CURRENT ERROR RATE DATA?
?YES

EXHIBIT A-2: SAMPLE RUN DIALOGUE
(Continued)

 ***** ERROR RATES *****

SENDING NODE	RECEIVING NODE	ERROR RATE	SENDING NODE	RECEIVING NODE	ERROR RATE
BDE	FEP	0.001000	FEP	RDE	0.001000
RN 1	RDE	0.003000	RDE	RN 1	0.003000
RN 2	RDE	0.003000	RDE	RN 2	0.003000
TAC CP	FEP	0.001000	FEP	TAC CP	0.001000

DO YOU WISH TO CHANGE MORE ERROR RATE DATA?
 ?NO
 DO YOU WISH TO MAKE ANY ADDITIONAL CHANGES?
 ?NO

A NEW INPUT FILE HAS BEEN CREATED
 #EXECUTION TERMINATED
 #T=0.250 DR=46 S.42, S3.00T
 #

- Continued -

EXHIBIT A-2: SAMPLE RUN DIALOGUE
(Continued)

#RUN COMPUTE.OBJ T=10 7=NEWDATAFILE 8=*MSINK*
#EXECUTION BEGINS
INPUT BLOCKING NUMBER AND RIC SWITCH (0=>USE RIC, 1=>DO NOT)
?1 1

SPECIFY: (1) OUTPUT TABLE; (2) RANKING STATISTIC; (3) ORDERING OPTION
?1 1 1

***** TABLE 1: ROUTE SUMMARY STATISTICS *****

ROUTE	EXPECTED DELAY (MIN)	TRAFFIC RATE (MSG/HR)	RANK
BN 2	0.269	102.500	1.000
BN 1	0.269	90.000	2.000
TAC CP	0.009	152.500	3.000
BDE	0.008	127.500	4.000

SPECIFY: (1) OUTPUT TABLE; (2) RANKING STATISTIC; (3) ORDERING OPTION
?2 1 1

***** TABLE 2: MESSAGE SUMMARY STATISTICS *****

MESSAGE TYPE	EXPECTED DELAY (MIN)	TRAFFIC RATE (MSG/HR)	RANK
ESD.O	0.073	232.500	1.000
ESD.OR	0.040	81.250	2.000
ESD.C	0.030	81.250	3.000
ESD.WP	0.020	77.500	4.000

- Continued -

EXHIBIT A-2: SAMPLE RUN DIALOGUE
(Continued)

SPECIFY: (1) OUTPUT TABLE; (2) RANKING STATISTIC; (3) ORDERING OPTION
23 1 1

***** TABLE 3: PROCESSOR SUMMARY STATISTICS *****

PROCESSOR	EXPECTED DELAY (MIN)	EXPECTED QUEUE LENGTH	TRAFFIC RATE (MSG/HR)	UTILIZATION	CAPACITY (MSG/HR)	RANK
-----------	----------------------------	-----------------------------	-----------------------------	-------------	----------------------	------

WARNING OUTPUT FIELD WIDTH TOO SMALL. CONDITION OCCURRED DURING A FORMATTED WRITE ON FORTRAN UNIT 8 WHICH IS ATTACHED TO
MSINK. FOR THIS AND ALL FUTURE OCCURRENCES OF THIS CONDITION, A FIELD OF *'S WILL BE WRITTEN.

TAC CP	0.001	0.004	152.500	0.004	*****	1.000
BN 2	0.001	0.002	102.500	0.002	*****	2.000
BN 1	0.001	0.001	90.000	0.001	*****	3.000
RDE	0.000	0.007	320.000	0.003	*****	4.000

SPECIFY: (1) OUTPUT TABLE; (2) RANKING STATISTIC; (3) ORDERING OPTION
24 1 1

***** TABLE 4: CHANNEL SUMMARY STATISTICS *****

CHANNEL	EXPECTED DELAY (MIN)	EXPECTED QUEUE LENGTH	TRAFFIC RATE (MSG/HR)	UTILIZATION	CAPACITY (MSG/HR)	RANK
RDE FM	0.260	1.079	192.500	0.398	387.065	1.000
MULTI	0.006	0.030	472.499	0.014	*****	2.000

SPECIFY: (1) OUTPUT TABLE; (2) RANKING STATISTIC; (3) ORDERING OPTION

EXHIBIT A-2: SAMPLE RUN DIALOGUE
(Concluded)

***** TABLE 5: DCC COMPONENT SUMMARY STATISTICS *****

DCC COMPONENT	EXPECTED DELAY (MIN)	EXPECTED QUEUE LENGTH	TRAFFIC RATE (MSG/HR)	UTILIZATION	CAPACITY (MSG/HR)
DBP	0.000	0.000	472.499	0.000	*****
DD CONTROL	0.002	0.006	472.499	0.012	*****
DD CONTROL	0.001	0.002	472.499	0.004	*****
FEP	0.000	0.000	472.499	0.000	*****

SPECIFY: (1) OUTPUT TABLE; (2) RANKING STATISTIC; (3) ORDERING OPTION

EXECUTION TERMINATED
RT=0.072 DR=26 S.42, S3.56T
#