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NATIONAL COMMUNICATIONS SYSTEM

TECHNICAL INFORMATION BULLETIN 90-14

QTCM SOFTWARE DOCUMENTATION

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VOLUME II: USER'S MANUAL

OCTOBER 1990

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Office of the Manager
National Communications System
Washington, D.C. 20305

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Final Report

QTCM Software Documentation
Volume II: User's Manual

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Booz, Allen & Hamilton, Inc.
4330 East-West Highway
Bethesda, MD 20014

National Communications System
Office of Technology & Standards
701 S. Court House Road
Arlington, VA 22204-2199

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Volume II of the QTCM Software Manual is a user's manual for those who need to conduct QTCM analyses, but do not require an in-depth knowledge of the software model's structure and development. This manual describes the operating environment necessary to support QTCM and provides step-by-step instructions for operating the model.

EMP Mitigation Program

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NCS TECHNICAL INFORMATION BULLETIN 90-14

QTCM SOFTWARE DOCUMENTATION
VOLUME II: USER'S MANUAL

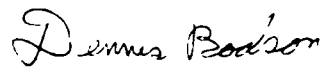
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PROJECT OFFICER



ANDRE RAUSCH
Electronics Engineer
Office of Technology
and Standards

APPROVED FOR PUBLICATION



DENNIS BODSON
Assistant Manager
Office of Technology
and Standards

FOREWORD

The National Communications System (NCS) is an organization of the Federal Government whose membership is comprised of 23 Government entities. Its mission is to assist the President, National Security Council, Office of Science and Technology Policy, and Office of Management and Budget in:

- o The exercise of their wartime and non-wartime emergency functions and their planning and oversight responsibilities.
- o The coordination of the planning for and provision of National Security/Emergency Preparedness communications for the Federal Government under all circumstances including crisis or emergency.

In support of this mission the NCS has initiated and manages the Electromagnetic Pulse (EMP Mitigation Program). The major objective of this program is to significantly reduce the vulnerability of the U.S. telecommunications infrastructure to disabling damage due to nuclear weapon effects in direct support of the survivability and endurability objectives addressed by Executive Order 12472 and National Security Decision Directive 97. Nuclear weapon effects include EMP, magnetohydrodynamic EMP (MHD-EMP), and fallout radiation from atmospheric detonations. The purpose of this Technical Information Bulletin is to provide the reader with information relating to specific areas of EMP which are being investigated in support of the NCS EMP Mitigation Program.

Comments on this TIB are welcome and should be addressed to:

Office of the Manager
National Communications System
ATTN: NCS-TS
Washington, DC 20305-2010
(202) 692-2124




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1.0 INTRODUCTION

Volume II of the QTCM software manual is a user's manual for those who need to conduct QTCM analyses, but do not require an in-depth knowledge of the software model's structure and development. This manual describes the operating environment necessary to support QTCM and provides step-by-step instructions for operating the model.

QTCM consists of three executable segments - the input file formatter, the network analysis segment, and the output file formatter. The input file formatter, INPFMT, allows the user to create or amend a formatted input file via a series of user menus and prompts. NETWORK reads in the input file produced by INPFMT and performs the network analysis function of QTCM, including traffic distribution and calculation of network statistics. The output formatter, OUTFMT, then takes the output from NETWORK and allows the user to selectively display and output statistical traffic data via a series of user menus and prompts. These output data may be written to an ASCII text file if the user desires. The operation of each of these executables is described in the following sections.

Section 2.0 describes the computer system hardware and software required for proper execution of the current QTCM configuration. Sections 3.0, 4.0, and 5.0 detail the operating instructions for the input formatter, analysis segment, and output formatter, respectively. Included in each description are examples of displayed menus and required user responses, as well as a description of each step required to execute the three QTCM segments. Appendix A contains examples of each data section of the ASCII input file, so that the advanced user can better understand the details of the data required to conduct a QTCM network analysis.

2.0 SYSTEM REQUIREMENTS

The QTCM program requires a certain operating environment. This section describes that environment in terms of hardware and software conditions.

2.1 HARDWARE

The QTCM program is written in the FORTRAN programming language and runs on the Digital Equipment Corporation (DEC) 6310 computer using the Virtual Memory System (VMS) operating system. The program can be run on any DEC computer that has sufficient space (143,360 bytes for executable plus space for data) and the VAX/VMS operating system. The processing requirements of the QTCM vary according to the size of network being analyzed. The following user quotas enable processing with the QTCM:

Process Quotas:

CPU limit:	Infinite	Direct I/O limit:	18
Buffered I/O byte count quota:	39904	Buffered I/O limit:	18
Timer queue entry quota:	10	Open file quota:	74
Paging file quota:	99060	Subprocess quota:	4
Default page fault cluster:	64	AST quota:	22
Enqueue quota:	150	Shared file limit:	0
Max detached processes:	0	Max active jobs:	0

No special user privileges are required to run the QTCM. To modify the VAX SYSGEN working set parameter in the user authorization file (UAF), the user must either have system privileges or request the larger working set from his or her VAX system manager. The size of the output files generated by the QTCM is dependent on the size of the network being modeled and must also be considered when running the program. If sufficient space is not available on the system, the program run terminates.

2.2 SOFTWARE

The QTCM program is written in standard FORTRAN 77, except that VAX/VMS system service calls are allowed. The system service routines currently used by the QTCM are CDATE and CTIME. These system service routines are used to date and time-stamp all output files from the model. They are automatically included in the executable on compilation and linking.

The names of the executable files for creating or changing input files, the modeling, and the development of output files are INPFMT, NETWORK, and OUTFMT, respectively.

3.0 INPUT FORMATTER

Nine sections of the input file are necessary to run QTCM. The sections are as follows:

- Section 1: General Network Details
- Section 2: Network Costs & Kilometric Distances
- Section 3: Routing Table
- Section 4: Minimum Link Size Constraints
- Section 5: Link Connectivity Constraints
- Section 6: Link Size Details
- Section 7: Offered Load
- Section 8: Nodal Switch Constraints
- Section 9: Damage and Non-preferred Routing

The input formatter allows the user to create or amend the input file section-by-section through a series of user choices. The process to create an input file is described below along with examples of the various menu screens. An example of a complete formatted input file is given in Appendix A.

At the '\$' system prompt, type RUN INPFMT. This initializes the input files necessary for the QTCM. The following menu appears:

```
INPUT PREPROCESSOR - FILE EDITOR
*****

1. CREATE A NEW DATA FILE
2. AMEND AN EXISTING DATA FILE
3. EXIT

ENTER ABOVE OPTION
```

This menu allows the user to choose one of the QTCM's two primary functions - creating a new file or amending an existing file. In Section 3.1 below, the file creation process is described in detail.

3.1 CREATE A NEW DATA FILE

If a '1' is entered at the prompt 'ENTER ABOVE OPTION' on the main input formatter menu, then the first menu for creating a new data file is displayed as follows:

```

                                CREATING A NEW FILE
*****
EDITING OPTIONS
=====
1.  DESIGN A NEW NETWORK
2.  ANALYSIS OF AN EXISTING NETWORK
3.  EXIT
ENTER ABOVE OPTION

```

All menus for the QTCM input preprocessor are functionally the same for amending or creating data files. The creation of data files is discussed in-depth in this section. INPFMT amend functions are a subset of creation functions and are therefore easily explained after working through the creation of an input data file. Entering a '1' for designing a new network or a '2' for analysis of an existing network at the above prompt produces the following menu screen:

```

                                CREATING A NEW FILE
CURRENTLY IN SECTION 1. GENERAL NETWORK DETAILS
*****
METHOD OF DATA ENTRY
=====
1.  AMEND/DISPLAY/ACCEPT DATA
2.  USE DATA FROM AN EXISTING FILE

ENTER ABOVE OPTION OR A (ABORT) OR S (SAVE)

```

If a '1' or '2' is entered to the above option, the following menu is displayed. If a '2' is entered, the user is prompted to enter the name of the existing file. If the user enters an 'A', a confirmation of the abort is requested, and if given, the program exits. If not given, the "Sectional Data Options" menu as shown below is displayed. If the user enters an 'S', an "Incomplete File" message is displayed on the user screen, and the user is prompted for confirmation of the save function. If the user continues to try to save an incomplete file, an error message is written to the screen, and the main input formatter menu is redisplayed. If the user answers 'NO' to the save-confirmation prompt, then menu of data sections is redisplayed.

```

CREATING A FILE
CURRENTLY IN SECTION 1.  GENERAL NETWORK DETAILS
*****
SECTIONAL DATA OPTIONS
=====

```

1. AMEND CURRENT DATA SECTION
2. DISPLAY CURRENT DATA SECTION
3. ACCEPT CURRENT DATA SECTION
4. RETURN TO PREVIOUS MENU

ENTER ABOVE OPTION

Entering a '1' produces a message asking if the values in screen 1 are to be altered. If the user enters 'Y' for "YES" then a series of prompts follows. The general network detail values can be altered by typing a new value followed by a <RETURN>. Just entering <RETURN> stores the old value and produces a new prompt message. Screens 2 and 3 are controlled in the same manner.

```

DO YOU WANT TO ALTER VALUES IN SCREEN           :    1
NUMBER OF NODES IN NETWORK                       :   28
DESIGN OBJECTIVE FOR ARITHMETIC MEAN GOS         :0.0000
TOLERANCE LIMIT IN MEETING DESIGN OBJECTIVE     :0.0010
DISTRIBUTION CONSTRAINT FOR INDIVIDUAL LINK GOS  :0.0010
1ST CRITERIA FOR ROUTING TABLE - BASED ON MINIMUM :LENGTH
2ND CRITERIA FOR ROUTING TABLE - BASED ON MINIMUM :DISTANCE
MAXIMUM PATH LENGTH BETWEEN SOURCE - DESTINATION :    2
NUMBER OF ANALYSIS ITERATIONS                   :  100

DO YOU WANT TO ALTER VALUES IN SCREEN           :    2
MINIMUM PARCEL SIZE INITIALIZED AT              :0.0100
MINIMUM VALUE FOR SIZE OF PARCEL                :0.0002
MINIMUM VALUE FOR NETWORK STABILITY             : 0.1000
MAXIMUM NUMBER OF SATELLITE HOPS                :    0
PERCENTAGE OF OFFERED LOAD                      :150.000%

```

```

WEIGHTING FOR SATELLITE COSTS           :1.0000
WEIGHTING FOR MILITARY COSTS           :1.0000
CHANGES TO NETWORK CONFIGURATION CONSTRUED ON : PTT

DO YOU WANT TO ALTER VALUES IN SCREEN : 3
LINK BLOCKING FACTOR                   :0.0100
LINK VARIANCE BLOCKING FACTOR          :0.0100
MINIMUM BLOCKING FACTOR                :0.0000
TRUNK CREATION PARAMETER                :0.7000
E1FRAC - DISTRIBUTION FACTOR           :0.2000
E2FRAC - DISTRIBUTION FACTOR           :0.9000
MAXIMUM NUMBER OF DESIGN ITERATIONS    : 1

```

After the user completes the 3 screens of general network details, the previous menu of sectional data options is displayed. If option '2' is chosen to 'DISPLAY CURRENT DATA SECTION', screens 1 thru 3 are displayed once again with any changes made during the amend procedure. If option '3' is chosen, the data section is updated, verified, and the following menu is displayed. It should be noted that each data section must be accepted before another data section can be edited, and all sections must be accepted before the data file can be saved. Option '4' returns the previous menu screen.

```

                                CREATING A FILE
CURRENTLY IN SECTION 2. NETWORK COSTS & KILOMETRIC DISTANCES
*****
METHOD OF DATA ENTRY
=====

NETWORK COSTS

1. AMEND/DISPLAY/ACCEPT DATA

2. USE DATA FROM AN EXISTING FILE

ENTER ABOVE OPTION OR A (ABORT) OR S (SAVE)

```

If a '1' is entered to the above prompt, the following menu appears. If a '2' is entered, the user is asked to enter the 'NAME OF FILE TO BE READ'. After the file name is entered, the following menu is then displayed:

```

                                CREATING A FILE
CURRENTLY IN SECTION  2. NETWORK COSTS & KILOMETRIC DISTANCE
*****
SECTIONAL DATA OPTIONS
=====
  1. AMEND CURRENT DATA SECTION
  2. DISPLAY CURRENT DATA SECTION
  3. ACCEPT CURRENT DATA SECTION
  4. RETURN TO PREVIOUS MENU

ENTER ABOVE OPTION
```

Enter a '1' to amend the network cost section of the input file. The network cost section provides a matrix of cost weighting factors for switch pairs. These weighting factors are used as one of the routing criteria. The diagonal of the matrix is always zeros since a call is never routed to its origination point. The network cost matrix is required to be symmetrical, so if a source node is set to one value, then all destination nodes connected to it must be set to the same cost value. The following menu appears:

```

                                CREATING A FILE
CURRENTLY IN SECTION  2. NETWORK COSTS & KILOMETRIC DISTANCES
*****
MATRIX HANDLING OPTIONS
=====
  1. SET MATRIX TO ONE VALUE.
  2. SET A SOURCE NODE TO 1 VALUE.
  3. SET A DESTINATION NODE TO 1 VALUE.
  4. SET A SOURCE NODE TO VARIOUS VALUES.
  5. SET A DESTINATION NODE TO VARIOUS VALUES.
  6. SET VARIOUS SOURCE-DESTINATION POINTS.
  7. RETURN TO PREVIOUS MENU.

ENTER ABOVE OPTION
```

Enter the number of the above option to edit the network cost section and enter the appropriate values. When finished editing, enter '7' to return to the previous menu. The sectional data options menu then appears:

```

                CREATING A FILE
CURRENTLY IN SECTION  2. NETWORK COSTS & KILOMETRIC DISTANCES
*****
SECTIONAL DATA OPTIONS
=====

    1. AMEND CURRENT DATA SECTION
    2. DISPLAY CURRENT DATA SECTION
    3. ACCEPT CURRENT DATA SECTION
    4. RETURN TO PREVIOUS MENU

ENTER ABOVE OPTION
  
```

Entering a '2' to the above prompt produces the following series of prompts. To display the network cost section, enter the appropriate parameters to the prompts.

ENTER SCOPE OF SOURCE NODES TO BE DISPLAYED OR E 1, 8

ENTER SCOPE OF DESTINATION NODES TO BE DISPLAYED 2, 7

These particular source and destination node ranges result in a display screen of the network cost section as shown below:

NETWORK COST DETAILS						
S\D	2	3	4	5	6	7
1:	1	1	1	1	1	1
2:	0	1	1	1	1	1
3:	1	0	1	1	1	1
4:	1	1	0	1	1	1
5:	1	1	1	0	1	1
6:	1	1	1	1	0	1
7:	1	1	1	1	1	0
8:	1	1	1	1	1	1

To display a different range of the network cost details, enter new parameters or 'E' to return to the previous menu. If larger ranges are entered than can be displayed, error messages are displayed to the user's screen. To accept the updated version of the section, enter a '3' at the previous menu. To return to the previous menu, enter a '4'. Once the network cost details have been entered and accepted, the

following screen prompts the user to update the distance matrix. The distance section provides distances between switch pairs (in kilometers). The screens to update the distance matrix are operated in the same manner as those for the network cost details. Again, the diagonal of the matrix is always zeros since traffic is never routed to its origination point. The user must enter distances as integers and equivalent values for both directions of each network link.

```

                                CREATING A FILE
CURRENTLY IN SECTION  2. NETWORK COSTS & KILOMETRIC DISTANCES
*****
METHOD OF DATA ENTRY
=====

KILOMETRIC DISTANCES

    1. AMEND/DISPLAY/ACCEPT DATA

    2. USE DATA FROM AN EXISTING FILE

ENTER ABOVE OPTION OR A (ABORT) OR S (SAVE)

```

An example of the kilometric distance matrix is as follows:

KILOMETRIC DISTANCE DETAILS						
S\D	3	4	5	6	7	8
2:	697	587	1225	596	566	190
3:	0	460	1332	217	277	697
4:	460	0	881	244	606	710
5:	1332	881	0	1120	1480	1410
6:	217	244	1120	0	394	654
7:	277	606	1480	394	0	498
8:	697	710	1410	654	498	0
9:	1221	816	710	1020	1229	931

Once the kilometric distance data is entered and accepted, a menu to update the routing table is displayed.

```

          CREATING A FILE
CURRENTLY IN SECTION  3.  ROUTING TABLE
*****
METHOD OF DATA ENTRY
=====

1.  AMEND/DISPLAY/ACCEPT DATA
2.  USE DATA FROM AN EXISTING FILE

ENTER ABOVE OPTION OR A (ABORT) OR S (SAVE)

```

Entering a '1' produces the following menu. If a '2' is entered, the user is prompted to enter the 'NAME OF FILE TO BE READ' and then the following menu is displayed:

```

          CREATING A FILE
CURRENTLY IN SECTION  3.  ROUTING TABLE
*****
SECTIONAL DATA OPTIONS
=====

1.  AMEND CURRENT DATA SECTION
2.  DISPLAY CURRENT DATA SECTION
3.  ACCEPT CURRENT DATA SECTION
4.  RETURN TO PREVIOUS MENU

ENTER ABOVE OPTION

```

If a '1' is entered, the user is asked if the model is to create the routing table. If 'YES' is entered, the model creates the table at run-time. Otherwise, the user is prompted to enter the source-destination pair to be updated. The user is then prompted for alternate routes and path lengths for each alternate route. Alternate routes are entered in terms of the first intermediate node in the source to destination path. Path length represents the minimum number of links to connect the source and destination nodes. Where no link exists, the path length is assigned to be 99. The information for that source-destination pair is then displayed. The user is prompted again to enter another source-destination pair or 'E' to exit. The following is an example of the routing table display and prompts:

```

          ROUTING TABLE DETAILS
          *****

DO YOU WANT THE MODEL TO CREATE THE ROUTING TABLE (Y/N)      N
ENTER SOURCE - DESTINATION PAIR OR E TO EXIT                  5, 9

```

```

S   D :           ALTERNATES           :   MINIMUM PATH LENGTHS
*****
5   9 :   9  12  17  11  20  26  15  1 :   1  2  2  2  2  2  2  2

```

```

ALTERNATE ROUTE:  1                               10
DO YOU WANT THIS TO BE DOWN FOR MAINTENANCE ?      N
PATH LENGTH FOR ALTERNATE ROUTE                    7
ALTERNATE ROUTE:  2                               <RETURN>
DO YOU WANT THIS TO BE DOWN FOR MAINTENANCE ?      N
PATH LENGTH FOR ALTERNATE ROUTE                    8
ALTERNATE ROUTE:  3                               7
DO YOU WANT THIS TO BE DOWN FOR MAINTENANCE ?      N
PATH LENGTH FOR ALTERNATE ROUTE                    4
ALTERNATE ROUTE:  4                               <RETURN>
DO YOU WANT THIS TO BE DOWN FOR MAINTENANCE ?      N
PATH LENGTH FOR ALTERNATE ROUTE                    7
ALTERNATE ROUTE:  5                               <RETURN>
DO YOU WANT THIS TO BE DOWN FOR MAINTENANCE ?      N
PATH LENGTH FOR ALTERNATE ROUTE                    5
ALTERNATE ROUTE:  6                               <RETURN>
DO YOU WANT THIS TO BE DOWN FOR MAINTENANCE ?      N
PATH LENGTH FOR ALTERNATE ROUTE                    9
ALTERNATE ROUTE:  7                               <RETURN>
DO YOU WANT THIS TO BE DOWN FOR MAINTENANCE ?      N
PATH LENGTH FOR ALTERNATE ROUTE                    2
ALTERNATE ROUTE:  8                               <RETURN>
DO YOU WANT THIS TO BE DOWN FOR MAINTENANCE ?      N
PATH LENGTH FOR ALTERNATE ROUTE                    3

```

```

S   D :           ALTERNATES           :   MINIMUM PATH LENGTHS
*****
5   9 :  10  12  7  11  20  26  15  1 :  7  8  4  7  5  9  2  3

```

ENTER SOURCE - DESTINATION PAIR OR E TO EXIT E

Entering 'E' returns the "Sectional Data Options" screen as shown below:

```

                CREATING A FILE
CURRENTLY IN SECTION 3. ROUTING TABLE
*****
SECTIONAL DATA OPTIONS
=====

1. AMEND CURRENT DATA SECTION
2. DISPLAY CURRENT DATA SECTION
3. ACCEPT CURRENT DATA SECTION
4. RETURN TO PREVIOUS MENU
ENTER ABOVE OPTION

```

Enter a '2' to display the routing table or a '3' to accept the updated routing data and display the following screen. Option '4' displays the previous menu.

```
                CREATING A FILE
CURRENTLY IN SECTION 4. MINIMUM LINK SIZE CONSTRAINTS
*****
METHOD OF DATA ENTRY
=====
1. AMEND/DISPLAY/ACCEPT DATA
2. USE DATA FROM AN EXISTING FILE
ENTER ABOVE OPTION OR A (ABORT) OR S (SAVE)
```

Enter a '1' or '2' to display the following screen. If '2' is entered, the user is first prompted to enter the 'NAME OF FILE TO BE READ'.

```
                CREATING A FILE
CURRENTLY IN SECTION 4. MINIMUM LINK SIZE CONSTRAINTS
*****
SECTIONAL DATA OPTIONS
=====
1. AMEND CURRENT DATA SECTION
2. DISPLAY CURRENT DATA SECTION
3. ACCEPT CURRENT DATA SECTION
4. RETURN TO PREVIOUS MENU
ENTER ABOVE OPTION
```

Enter option '1' to amend the link matrix and display the following menu, '2' to display the matrix, '3' to accept the updated matrix and proceed with the next section, or '4' to return to the previous menu.

```
                CREATING A FILE
CURRENTLY IN SECTION 4. MINIMUM LINK SIZE CONSTRAINTS
*****
MATRIX HANDLING OPTIONS
=====
1. SET MATRIX TO ONE VAL
2. SET A SOURCE NODE TO 1 VALUE.
3. SET A DESTINATION NODE TO 1 VALUE.
4. SET A SOURCE NODE TO VARIOUS VALUES.
5. SET A DESTINATION NODE TO VARIOUS VALUES.
6. SET VARIOUS SOURCE-DESTINATION POINTS.
7. RETURN TO PREVIOUS MENU.
ENTER ABOVE OPTION
```

The minimum link size matrix consists of the minimum number of trunks required between each switch pair in the network. Enter one of the above options and appropriate parameters to amend the link matrix as desired. The menu handles the link size matrix in the same manner as the cost and distance matrices are handled. Refer to those descriptions for more details on matrix handling options. The following is an example of how to display the link matrix.

```
ENTER SCOPE OF SOURCE NODES TO BE DISPLAYED OR E      1, 8
ENTER SCOPE OF DESTINATION NODES TO BE DISPLAYED     2, 5
```

After entering these source and destination node ranges, the selected portion of the minimum trunk size matrix is output to the user's screen. This output is shown below:

MINIMUM TRUNK SIZE				
S\D	2	3	4	5
1:	1056	840	1440	312
2:	0	480	1320	312
3:	480	0	720	168
4:	1320	720	0	600
5:	312	168	600	0
6:	720	456	1704	288
7:	744	408	840	168
8:	1080	216	648	120

Once the matrix has been updated and accepted, the following menu is displayed to update connectivity matrices:

```

          CREATING A NEW FILE
CURRENTLY IN SECTION 5. LINK CONNECTIVITY CONSTRAINTS
*****
METHOD OF DATA ENTRY
=====

SATELLITE DETAILS

    1. AMEND/DISPLAY/ACCEPT DATA

    2. USE DATA FROM AN EXISTING FILE

ENTER ABOVE OPTION OR A (ABORT) OR S (SAVE)

```

Enter '1' or '2' to update the satellite connectivity matrix. If '2' is entered, the user is again prompted to enter the 'NAME OF FILE TO BE READ'. The following screen is then displayed:

```

                                CREATING A FILE
CURRENTLY IN SECTION  5. LINK CONNECTIVITY CONSTRAINTS
*****
SECTIONAL DATA OPTIONS
=====

    1. AMEND CURRENT DATA SECTION
    2. DISPLAY CURRENT DATA SECTION
    3. ACCEPT CURRENT DATA SECTION
    4. RETURN TO PREVIOUS MENU

ENTER ABOVE OPTION
```

Enter a '1' to amend the satellite connectivity matrix. To display the matrix, enter a '2'. To accept the satellite data section and display the menu to update the terrestrial matrix, enter option '3'. Enter '4' to return to the previous menu. If the option '1' is entered, the following menu is displayed:

```

                                CREATING A FILE
CURRENTLY IN SECTION  5. LINK CONNECTIVITY CONSTRAINTS
*****
MATRIX HANDLING OPTIONS
=====

    1. SET MATRIX TO ONE VALUE.
    2. SET A SOURCE NODE TO 1 VALUE.
    3. SET A DESTINATION NODE TO 1 VALUE.
    4. SET A SOURCE NODE TO VARIOUS VALUES.
    5. SET A DESTINATION NODE TO VARIOUS VALUES.
    6. SET VARIOUS SOURCE-DESTINATION POINTS.
    7. RETURN TO PREVIOUS MENU.

ENTER ABOVE OPTION
```

Enter the option numbers and appropriate parameters to update the satellite connectivity matrix. When finished updating, enter a '7' to return to the previous menu. Once the satellite data is entered and accepted, the menu to amend the terrestrial connectivity matrices is displayed. The menu displays are the same for the terrestrial, military, and overall matrices. Each of these four subsections

contains a matrix expressing switch pair connectivity in terms of 1's and 0's. A 1 indicates a connection, while a 0 indicates no connection. The first three subsections represent the different link media types, and the overall subsection is a combination of all media types. An example display of the satellite connectivity matrix is as follows:

ENTER SCOPE OF SOURCE NODES TO BE DISPLAYED OR E 2, 9
 ENTER SCOPE OF DESTINATION NODES TO BE DISPLAYED 3, 8

MANDATORY CONNECTIVITY - SATELLITE						
S\D	3	4	5	6	7	8
2:	0	0	0	0	0	0
3:	0	0	0	0	0	0
4:	0	0	0	0	0	0
5:	0	0	0	0	0	0
6:	0	0	0	0	0	0
7:	0	0	0	0	0	0
8:	0	0	0	0	0	0
9:	0	0	0	0	0	0

This example shows that there is no satellite connectivity utilized by the network under study. The trunk connectivity matrices are always symmetrical and have 0's along the matrix diagonal.

Once data has been entered and accepted for the satellite, terrestrial, military, and overall connectivity matrices, the following menu is displayed to update Section 6:

```

          CREATING A FILE
CURRENTLY IN SECTION 6. LINK SIZE DETAILS
*****
METHOD OF DATA ENTRY
=====
SATELLITE DETAILS
  1. AMEND/DISPLAY/ACCEPT DATA
  2. USE DATA FROM AN EXISTING FILE
ENTER ABOVE OPTION OR A (ABORT) OR S (SAVE)
  
```

Enter '1' or '2' to update the satellite portion of section 6. If option '2' is entered, the user is requested to enter the 'NAME OF FILE TO BE READ'. The following menu is then displayed:

```

          CREATING A FILE
CURRENTLY IN SECTION 6. LINK SIZE DETAILS
*****
SECTIONAL DATA OPTIONS
=====
1. AMEND CURRENT DATA SECTION
2. DISPLAY CURRENT DATA SECTION
3. ACCEPT CURRENT DATA SECTION
4. RETURN TO PREVIOUS MENU
   ENTER ABOVE OPTION

```

Select option '1' to display the amend data section menu. Option '2' displays the data section. Section '3' accepts the updated data and displays the menu to update the terrestrial data for Section 6. If option '1' is chosen, the following screen is displayed:

```

          CREATING A FILE
CURRENTLY IN SECTION 6. LINK SIZE DETAILS
*****
MATRIX HANDLING OPTIONS
=====
1. SET MATRIX TO ONE VALUE.
2. SET A SOURCE NODE TO 1 VALUE.
3. SET A DESTINATION NODE TO 1 VALUE.
4. SET A SOURCE NODE TO VARIOUS VALUES.
5. SET A DESTINATION NODE TO VARIOUS VALUES.
6. SET VARIOUS SOURCE-DESTINATION POINTS.
7. RETURN TO PREVIOUS MENU.

ENTER ABOVE OPTION

```

Enter the option numbers and the appropriate parameters to update the satellite portion of Section 6. When finished updating the matrix, enter '7' to return to the previous menu. Once the data has been entered and option '3' is chosen to accept the updates, the menu to update the terrestrial matrix for Section 6 is displayed. The menu screens for terrestrial and military matrices are the same as those for the satellite section. An example display of the satellite matrix for Section 6 is shown below:

```

ENTER SCOPE OF SOURCE NODES TO BE DISPLAYED OR E      1, 9
ENTER SCOPE OF DESTINATION NODES TO BE DISPLAYED     2, 9

```

SATELLITE TRUNK SIZE								
S\D	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0
2:	0	0	0	0	0	0	0	0
3:	0	0	0	0	0	0	0	0
4:	0	0	0	0	0	0	0	0
5:	0	0	0	0	0	0	0	0
6:	0	0	0	0	0	0	0	0
7:	0	0	0	0	0	0	0	0
8:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0

After all matrices in Section 6 have been amended and the data accepted, the menu display to update Section 7 is as follows:

```

          CREATING A FILE
CURRENTLY IN SECTION 7. OFFERED LOAD
*****
METHOD OF DATA ENTRY
=====
1. AMEND/DISPLAY/ACCEPT DATA
2. USE DATA FROM AN EXISTING FILE
ENTER ABOVE OPTION OR A (ABORT) OR S (SAVE)

```

Select option '1' if creating the offered load matrix. Otherwise, select option '2' if editing data from an existing file and then enter the name of the file to be used. The following menu is then displayed:

```

          CREATING A FILE
CURRENTLY IN SECTION 7. OFFERED LOAD
*****
SECTIONAL DATA OPTIONS
=====
1. AMEND CURRENT DATA SECTION
2. DISPLAY CURRENT DATA SECTION
3. ACCEPT CURRENT DATA SECTION
4. RETURN TO PREVIOUS MENU
ENTER ABOVE OPTION

```

Enter '1' to display the amending menu that follows. Option '2' displays the offered load matrix. Select '3' to accept the data and display the menus to amend Section 8. Option '4' returns the previous menu.

CREATING A FILE
 CURRENTLY IN SECTION 7. OFFERED LOAD

 MATRIX HANDLING OPTIONS
 =====

1. SET MATRIX TO ONE VALUE.
 2. SET A SOURCE NODE TO 1 VALUE.
 3. SET A DESTINATION NODE TO 1 VALUE.
 4. SET A SOURCE NODE TO VARIOUS VALUES.
 5. SET A DESTINATION NODE TO VARIOUS VALUES
 6. SET VARIOUS SOURCE-DESTINATION POINTS.
 7. RETURN TO PREVIOUS MENU.
- ENTER ABOVE OPTION

Enter the option numbers and appropriate parameters to update the offered load matrix. When finished amending section, select option '7' to return to previous menu. The following is an example display of an offered load matrix:

ENTER SCOPE OF SOURCE NODES TO BE DISPLAYED OR E 3, 9
 ENTER SCOPE OF DESTINATION NODES TO BE DISPLAYED 2, 8

OFFERED LOAD DETAILS							
S\D	2	3	4	5	6	7	8
3:	184.60	0.00	276.93	64.60	175.40	156.87	83.13
4:	507.73	276.93	0.00	230.80	655.40	323.13	249.20
5:	120.00	64.60	230.80	0.00	110.80	64.60	46.20
6:	276.93	175.40	655.40	110.80	0.00	138.53	101.53
7:	286.20	156.87	323.13	64.60	138.53	0.00	304.60
8:	415.40	83.13	249.20	46.20	101.53	304.60	0.00
9:	406.20	184.60	590.80	212.33	276.93	230.80	230.80

As with the other data matrices, the diagonal of the offered load matrix is all 0's since no traffic is routed to its origination.

After the offered load matrix is updated and accepted, the following menu is displayed to update Section 8:

```

          CREATING A FILE
CURRENTLY IN SECTION  8. NODAL SWITCH CONSTRAINTS
*****
METHOD OF DATA ENTRY
=====

1. AMEND/DISPLAY/ACCEPT DATA

2. USE DATA FROM AN EXISTING FILE

ENTER ABOVE OPTION OR A (ABORT) OR S (SAVE)

```

Select option '1' if creating the nodal switch matrix. Otherwise, select option '2' if editing data from an existing file and then enter the name of the file to be used. The following menu is then displayed:

```

          CREATING A FILE
CURRENTLY IN SECTION  8. NODAL SWITCH CONSTRAINTS
*****
SECTIONAL DATA OPTIONS
=====

1. AMEND CURRENT DATA SECTION
2. DISPLAY CURRENT DATA SECTION
3. ACCEPT CURRENT DATA SECTION
4. RETURN TO PREVIOUS MENU

ENTER ABOVE OPTION

```

Enter option '1' to obtain the following menu for amending the switch matrix. Option '2' displays the matrix. To accept the data and display menus to exit Section 9, enter option '3'. Option '4' returns the user to the previous menu.

```

          CREATING A FILE
CURRENTLY IN SECTION  8. NODAL SWITCH CONSTRAINTS
*****
SWITCH OPTIONS
=====

1. MAXIMUM NUMBER OF ALTERNATES
2. PROTOCOL
3. MAXIMUM NUMBER OF GROUPS
4. MINIMUM NUMBER OF GROUPS
5. MAXIMUM NUMBER OF CHANNELS
6. EXIT

ENTER ABOVE OPTION

```

Enter the option numbers and appropriate parameters to amend the switch matrix. When finished updating, enter option '6' to exit and return to the previous menu. An example display of a switch matrix is shown below:

SWITCH DETAILS											

SWITCH NUMBER	:	1	2	3	4	5	6	7	8	9	10
MAX NO OF ALTERNATES	:	8	8	8	8	8	8	8	8	8	8
PROTOCOL	:	2	2	2	2	2	2	2	2	2	2
MAX NO OF GROUPS	:	24	24	24	24	24	24	24	24	24	24
MAX NO OF GROUPS	:	12	12	12	12	12	12	12	12	12	12
MIN NO OF GROUPS	:	1	1	1	1	1	1	1	1	1	1
MAX NO OF CHANNELS	:	24	24	24	24	24	24	24	24	24	24

Switch protocol indicates each switch's ability to reroute traffic. Protocol 1 means the switch can reroute traffic, while protocol 2 means the switch cannot reroute traffic. The maximum number of alternates is the upper limit of alternate routes (up to 8) allowed to exit from each switch. The maximum and minimum number of groups characteristics sets the limits for the number of trunk groups leaving each network node. Likewise, the maximum number of channels refers to the greatest number of channels per trunk leaving each network node. All switch details enable individual settings for each network switch. After the switch matrix has been updated and accepted, the following menu is displayed to edit Section 9:

CREATING A FILE

CURRENTLY IN SECTION 9. DAMAGE AND NON-PREFERRED ROUTING

 ENTER ONE OF THE FOLLOWING:

"YES" TO CONTINUE AND SET DAMAGE OPTIONS

"NO" TO DISABLE ALL DAMAGE OPTIONS

DO YOU REQUIRE DAMAGE CONTROL ?

To disable damage options enter 'N' or 'NO'. Otherwise, the following menu is displayed:

```

                CREATING A FILE
CURRENTLY IN SECTION 9. DAMAGE AND NON-PREFERRED ROUTING
*****
METHOD OF DATA ENTRY
=====
SWITCHES

    1. AMEND/DISPLAY/ACCEPT DATA

    2. USE DATA FROM AN EXISTING FILE

ENTER ABOVE OPTION OR A (ABORT) OR S (SAVE)

```

Select option '1' if amending the switch portion of Section 9. Otherwise, select option '2' if editing data from an existing file and then enter the name of the file to be used. The following menu is then displayed:

```

                CREATING A FILE
CURRENTLY IN SECTION 9. DAMAGE AND NON-PREFERRED ROUTING
*****
SECTIONAL DATA OPTIONS
=====
    1. AMEND CURRENT DATA SECTION
    2. DISPLAY CURRENT DATA SECTION
    3. ACCEPT CURRENT DATA SECTION
    4. RETURN TO PREVIOUS MENU
        ENTER ABOVE OPTION

```

Select '1' to amend the switch damage matrix. Option '2' displays the matrix. Enter '3' to accept the data section and display the menu of the switch damage matrix. Select '4' to return to the previous menu. If option '1' is chosen, the following prompt is displayed:

```

ENTER NODES WITHOUT USERS (1 PER LINE OR E)
(ENTER NEGATIVE VALUE TO REMOVE OPTION)

```

Enter the nodes without users separating each node listed by a space or a comma. When finished, enter 'E' to return to the previous menu. The damage to users can then be displayed with option '2'. To accept the data section and display menus to edit terrestrial damage matrix, enter a '3'. Enter option '4' to return to the previous menu. Menu screens for terrestrial, military and preferential routing are operated in the same manner as those for switch damage.

3.2 AMEND AN EXISTING DATA FILE

If option '2' 'AMEND AN EXISTING DATA FILE' is chosen from the main menu of the input formatter, the user is given the option to amend particular sections of the input file. For example, if the user chooses to edit Section 3 - Routing Table, then option '3' should be entered from the following menu screen. Otherwise, the options, menus, and displays for each section are the same as described in Section 3.1.

AMENDING FILE	LAST FILE ACCESSED

SECTION 1.	GENERAL NETWORK DETAILS
SECTION 2.	NETWORK COSTS & KILOMETRIC DISTANCES
SECTION 3.	ROUTING TABLE
SECTION 4.	MINIMUM LINK SIZE CONSTRAINTS
SECTION 5.	LINK CONNECTIVITY CONSTRAINTS
SECTION 6.	LINK SIZE DETAILS
SECTION 7.	OFFERED LOAD
SECTION 8.	NODAL SWITCH CONSTRAINTS
SECTION 9.	DAMAGE AND NON-PREFERRED ROUTING
ENTER ABOVE OPTION OR A (ABORT) OR S (SAVE)	

4.0 MODEL SECTION

Once the input file has been formatted correctly, the network analysis portion of the model can be executed. At the '\$' system prompt, type RUN NETWORK. The prompt 'Enter 0 for Erlang B, 1 for Erlang C:' is then displayed. Enter the appropriate parameter followed by <RETURN>. At the prompt 'ENTER NAME OF INPUT FILE:', type in the name of the input file created or amended as in Section 3.0 followed by <RETURN>. The model then begins distributing the specified offered traffic throughout the network. Processing continues until a steady-state network load is reached. An example of a model run display is shown below:

```
Enter 0 for Erlang B, 1 for Erlang C:
1
  ENTER NAME OF INPUT FILE:
  CAT2
  214326.1                Total Erlangs offered.
I:          1 [          1]
              0 2.6758584E+09
              1 2.6758584E+09
              2 0.0000000E+00
              3 0.0000000E+00
              4 0.0000000E+00
              5 0.0000000E+00
```

The offered traffic (214326.1 erlangs) shown above is calculated from the offered traffic data section of the input data file. The remaining lines of the display represent convergence towards a steady-state network traffic load as the minimum traffic parcel goes to zero during successive iterations.

5.0 OUTPUT FORMATTER

The data generated from the input file and model sections of the QTCM must be processed through the output file formatter, OUTFMT, portion of the QTCM. This formatter allows the user to write the ASCII data out to a file name designated by the user. To run the output formatter, type RUN OUTFMT at the '\$' system prompt. The user is then asked to 'ENTER NAME OF OUTPUT FILE'. At this prompt, the user should enter up to a 8-character name followed by <RETURN>. The following menu then appears:

```
OUTPUT FILE HANDLER
*****

1. DUMP SECTIONS OF DATA TO A FILE

2. DISPLAY SECTIONS OF DATA

3. EXIT

ENTER ABOVE OPTION
```

Currently, selection '1' to dump all data sections to a file is not operational. However, option '2' to display sections of data also has the ability to dump the individual sections to an ASCII output file. If '2' is entered, the following menu is displayed.

```
MAJOR AREAS OF OUTPUT FILE
*****

1. INPUT DATA

2. SUMMARY ITERATION DATA

3. DETAILED ANALYSIS DATA

4. EXIT

ENTER ABOVE OPTION
```

To display or dump sections of the input file, enter option '1'. The following menu appears:

DATA SECTIONS
=====

- 1 - GENERAL INFORMATION
- 2 - NETWORK COSTS & DISTANCES
- 3 - ROUTING TABLE
- 4 - MINIMUM TRUNK GROUP
- 5 - MANDATORY TRUNK CONNECTIONS
- 6 - TRUNK SIZE
- 7 - OFFERED LOAD
- 8 - SWITCH DETAILS
- 9 - DAMAGE & PREFERRED ROUTING

ENTER ABOVE OPTION

Enter the number of the section that is to be displayed or dumped to a file. For example, if section 1 is to be dumped to a file the following screen appears when a '1' is entered:

SECTION - 1 GENERAL PROGRAM VARIABLES
=====

NUMBER OF NODES IN NETWORK	:	28
DESIGN OBJECTIVE FOR ARITHMETIC MEAN GOS	:	0.0000
TOLERANCE LIMIT IN MEETING DESIGN OBJECTIVE	:	0.0010
DISTRIBUTION CONSTRAINT FOR INDIVIDUAL LINK GOS	:	0.0010
1ST CRITERIA FOR ROUTING TABLE - BASED ON MINIMUM	:	LENGTH
2ND CRITERIA FOR ROUTING TABLE - BASED ON MINIMUM	:	DISTANCE
MAXIMUM PATH LENGTH BETWEEN SOURCE - DESTINATION	:	2
NUMBER OF ANALYSIS ITERATIONS	:	100

HIT <RET> OR D TO DUMP

Enter <RETURN> to display the next screen or D to dump the screen output to the output file. This procedure follows for the second and third screens of general network details as well. All other input sections can be displayed or dumped in the same manner. When finished displaying or dumping input sections, the previous menu is displayed again. All output statistics shown throughout this section are explained in more detail in Volume I of the QTCM Software Manual. Refer to that volume for an in-depth discussion of the derivation of various QTCM statistical parameters.

MAJOR AREAS OF OUTPUT FILE

1. INPUT DATA
2. SUMMARY ITERATION DATA
3. DETAILED ANALYSIS DATA
4. EXIT

ENTER ABOVE OPTION

Entering selection '2' produces the following menu:

SUMMARY ITERATION SECTIONS

1. TRUNK SIZE DETAILS
2. ROUTING TABLE
3. SUMMARY STATISTICS

ENTER ABOVE OPTION

The user makes a menu selection of 1, 2, or 3 followed by <RETURN>. Again, enter <RETURN> to display the next screen or D to dump screen to output file. An example of option '3' is as follows:

SECTION 3 - GENERAL STATISTICS

MEAN PT-PT GOS	:	1.0000
VARIANCE	:	0.0000
DELTA MEAN	:	-1.0000
NETWORK BLOCKED TRAFFIC	:	214326.1
CHANGE	:	0.0000
SPECIALY HANDLED TRAFFIC	:	0.0000
MINIMUM PARCEL SIZE	:	0.0100
MEAN LINK BLOCKING	:	1.0
VARIANCE	:	0.0000
DELTA MEAN	:	-1.0000

HIT <RET> OR D TO DUMP

After all selected general statistics screens are displayed or dumped, the following menu is again displayed:

```
MAJOR AREAS OF OUTPUT FILE
*****

1. INPUT DATA
2. SUMMARY ITERATION DATA
3. DETAILED ANALYSIS DATA
4. EXIT

ENTER ABOVE OPTION
```

Entering '3' produces the following menu:

```
DETAILED ANALYSIS DATA
*****

1. NODE STATISTICS
2. LINK STATISTICS
3. POINT TO POINT STATISTICS
4. TRAFFIC INFORMATION

ENTER ABOVE OPTION
```

Enter the number of desired detailed analysis data selection followed by <RETURN>. An example of the 3-page output from option '4' is as follows:

```
SECTION 4 - TRAFFIC INFORMATION

PRIMARY PATH DETAILS

TRAFFIC USING PRIMARY PATH LENGTH 1 : 0.0 PERCENTAGE
.000

TOTAL CARRIED TRAFFIC OVER PRIMARY PATH : 0.0 PERCENTAGE
.000

PERCENTAGE OF TOTAL TRAFFIC CARRIED : 1.000
AVERAGE NUMBER OF (TANDEMED) LINKS : 1.000

HIT <RET> OR D TO DUMP
```

SECTION 4 - TRAFFIC INFORMATION

TRAFFIC DISTRIBUTION - ERLANGS

	+0.00	+0.09	+0.01				
0.01 *	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0			
0.11 *	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0			
0.21 *	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0			
0.31 *	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0			
0.41 *	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0			
0.51 *	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0			
0.61 *	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0			
0.71 *	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0			
0.81 *	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0			
0.91 *	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	206460.4				

FLASH TRAFFIC (≤ 0.0001) : 0.0
 IMMEDIATE TRAFFIC (≤ 0.001) : 0.0

HIT <RET> OR D TO DUMP

SECTION 4 - TRAFFIC INFORMATION

TRAFFIC DISTRIBUTION - COUNT OF PAIRS

	+0.00	+0.09	+0.01							
0.01 *	0	0	0	0	0	0	0	0	0	0
0.11 *	0	0	0	0	0	0	0	0	0	0
0.21 *	0	0	0	0	0	0	0	0	0	0
0.31 *	0	0	0	0	0	0	0	0	0	0
0.41 *	0	0	0	0	0	0	0	0	0	0
0.51 *	0	0	0	0	0	0	0	0	0	0
0.61 *	0	0	0	0	0	0	0	0	0	0
0.71 *	0	0	0	0	0	0	0	0	0	0
0.81 *	0	0	0	0	0	0	0	0	0	0
0.91 *	0	0	0	0	0	0	0	0	0	680

FLASH COUNT (≤ 0.0001) : 0
 IMMEDIATE COUNT (≤ 0.001) : 0

HIT <RET> OR D TO DUMP

The following menu is again displayed after the user enters <RETURN> following the last displayed data screen.

```
MAJOR AREAS OF OUTPUT FILE
*****

1. INPUT DATA
2. SUMMARY ITERATION DATA
3. DETAILED ANALYSIS DATA
4. EXIT

ENTER ABOVE OPTION
```

If option '4' is entered, the main output menu is then displayed.

```
OUTPUT FILE HANDLER
*****

1. DUMP SECTIONS OF DATA TO A FILE
2. DISPLAY SECTIONS OF DATA
3. EXIT

ENTER ABOVE OPTION
```

Enter option '3' to exit from OUTFMT, the output section of QTCM.

To print the output file consisting of user-selected dump screens, simply type PRINT followed by the name of the output file at the '\$' system prompt and enter <RETURN>.

APPENDIX A - INPUT FILE FORMAT

This appendix contains an example of each section and subsection of the necessary QTCM input data file. The data displayed here corresponds to the data that can be edited using the procedures described in Section 3.0. The input formatter can be used to produce this file. However when analyzing large networks or making a large number of global changes, advanced users may find it more efficient to edit the file with an ASCII editor. It should be noted that each line displayed below begins in Column 1 of the input data file. Where data sections were too large to be shown here in their entirety, a series of three dots (. . .) is used to represent 'and so on.'

SECTION 01 - GENERAL NETWORK DETAILS

28

```
.00000.00100.0010
3 4
  2 2      100
  0.0100   0.0002   1.5000   1.0000   1.0000   0.7000
  0.0100   0.0100   0.1000   0.0000   0.2000   0.9000   1
```

SECTION 02 - NETWORK COSTS AND DISTANCES

SUBSECTION 1 - NETWORK COSTS

```
0 1 1 1 1 1 1 1 1 1 . . . 1 1 1 1 1 1
1 0 1 1 1 1 1 1 1 1 . . . 1 1 1 1 1 1
1 1 0 1 1 1 1 1 1 1 . . . 1 1 1 1 1 1
      .
      .
      .
1 1 1 1 1 1 1 1 1 1 . . . 1 1 1 0 1
1 1 1 1 1 1 1 1 1 1 . . . 1 1 1 1 0
```

SUBSECTION 2 - DISTANCES

```
    0  530  184  328 1208 . . .  466  640  2039  281
  530    0  697  587 1225 . . .  862  900  2175  541
  184  697    0  460 1332 . . .  323  720  2110  290
      .
      .
      .
2039 2175 2110 1725  971 . . . 2420 1400    0 2319
 281  541  290  600 1470 . . .  321  921  2319    0
```

SECTION 03 - ROUTING TABLE

1	1	0	0	0	.	.	.99	99	99	99
2	1	1	14	6	.	.	2	2	2	2
.										
.										
28	1	1	7	3	.	.	2	2	2	2
[For each of the network nodes]										
.										
1	28	28	7	3	.	.	2	2	2	2
2	28	28	7	8	.	.	2	2	2	2
.										
.										
28	28	0	0	0	.	.	.99	99	99	99

SECTION 04 - MINIMUM LINK SIZE CONSTRAINTS

0	1056	840	1440	312	.	.	.	816	792	432	408
1056	0	480	1320	312	.	.	.	816	768	336	384
840	480	0	720	168	.	.	.	408	840	168	144
.											
.											
408	384	144	672	384	.	.	.	1224	432	216	0
432	456	216	552	168	.	.	.	384	504	120	192

SECTION 05 - LINK CONNECTIVITY CONSTRAINTS

SUBSECTION 1 - SATELLITE

0	0	0	0	0	.	.	.	0	0	0	0
0	0	0	0	0	.	.	.	0	0	0	0
0	0	0	0	0	.	.	.	0	0	0	0
.											
.											
0	0	0	0	0	.	.	.	0	0	0	0
0	0	0	0	0	.	.	.	0	0	0	0

SUBSECTION 2 - TERRESTRIAL

0	1	1	1	1	. . .	1	0	1	1
1	0	1	1	1	. . .	1	1	1	1
1	1	0	1	0	. . .	1	1	0	1
					.				
					.				
1	1	0	1	1	. . .	1	1	0	1
0	1	1	1	0	. . .	1	1	1	0

SUBSECTION 3 - MILITARY

0	0	0	0	0	. . .	0	0	0	0
0	0	0	0	0	. . .	0	0	0	0
0	0	0	0	0	. . .	0	0	0	0
					.				
					.				
0	0	0	0	0	. . .	0	0	0	0
0	0	0	0	0	. . .	0	0	0	0

SUBSECTION 4 - OVERALL

0	0	0	0	0	. . .	0	0	0	0
0	0	0	0	0	. . .	0	0	0	0
0	0	0	0	0	. . .	0	0	0	0
					.				
					.				
0	0	0	0	0	. . .	0	0	0	0
0	0	0	0	0	. . .	0	0	0	0

SECTION 06 LINK SIZE DETAILS

SUBSECTION 1 - SATELLITE

0	0	0	0	0	. . .	0	0	0	0
0	0	0	0	0	. . .	0	0	0	0
0	0	0	0	0	. . .	0	0	0	0
					.				
					.				
0	0	0	0	0	. . .	0	0	0	0
0	0	0	0	0	. . .	0	0	0	0

SUBSECTION 2 - TERRESTRIAL

0	1056	840	1440	312	. . .	816	792	432	408	432
1056	0	480	1320	312	. . .	816	768	336	384	456
840	480	0	720	168	. . .	408	840	168	144	216
.										
.										
408	384	144	672	384	. . .	1224	432	216	0	123
432	456	216	552	168	. . .	384	504	120	123	0

SUBSECTION 3 - MILITARY

0	0	0	0	0	. . .	0	0	0	0
0	0	0	0	0	. . .	0	0	0	0
0	0	0	0	0	. . .	0	0	0	0
.									
.									
0	0	0	0	0	. . .	0	0	0	0
0	0	0	0	0	. . .	0	0	0	0

SECTION 07 - OFFERED LOAD

0.0	609.3	484.7	830.7	180.0	. . .	456.9	249.3	235.3	249.3
609.3	0.0	276.9	761.6	415.4	. . .	443.1	193.8	221.6	263.1
484.7	276.9	0.0	415.4	96.9	. . .	484.7	96.9	83.1	124.7
.									
.									
235.3	221.6	83.1	387.8	221.6	. . .	249.3	124.7	0.0	110.7
249.3	263.1	124.7	318.5	96.9	. . .	290.7	69.3	110.7	0.0

SECTION 08 - NODAL SWITCH CONSTRAINTS

SWITCH NUMBER	1	2	3 . . .	26	27	28
MAX NO OF ALTERNATES	8	8	8 . . .	8	8	8
PROTOCOL	2	2	2 . . .	2	2	2
MAX NO OF GROUPS	900	900	900 . . .	900	900	900
MIN NO OF GROUPS	1	1	1 . . .	1	1	1
MAX NO OF CHANNELS	90000	90000	90000 . . .	90000	90000	90000

SECTION 09 - DAMAGE AND NON-PREFERRED ROUTING

SUBSECTION 1 - USERS

1 1 1 1 1 . . . 1 1 1 1

SUBSECTION 2 - SWITCHES

1 1 1 1 1 . . . 1 1 1 1

SUBSECTION 3 - TRUNKS - SATELLITE

0 0 0 0 0 . . . 0 0 0 0
0 0 0 0 0 . . . 0 0 0 0
0 0 0 0 0 . . . 0 0 0 0

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0 0 0 0 0 . . . 0 0 0 0
0 0 0 0 0 . . . 0 0 0 0

SUBSECTION 4 - TRUNKS - TERRESTRIAL

0 0 0 0 0 . . . 0 0 0 0
0 0 0 0 0 . . . 0 0 0 0
0 0 0 0 0 . . . 0 0 0 0

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0 0 0 0 0 . . . 0 0 0 0
0 0 0 0 0 . . . 0 0 0 0

SUBSECTION 5 - TRUNKS - MILITARY

0 0 0 0 0 . . . 0 0 0 0
0 0 0 0 0 . . . 0 0 0 0
0 0 0 0 0 . . . 0 0 0 0

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0 0 0 0 0 . . . 0 0 0 0
0 0 0 0 0 . . . 0 0 0 0

SUBSECTION 6 - PREFERENTIAL ROUTING

0	0	0	0	0	.	.	.	0	0	0	0
0	0	0	0	0	.	.	.	0	0	0	0
0	0	0	0	0	.	.	.	0	0	0	0
					.						
					.						
					.						
0	0	0	0	0	.	.	.	0	0	0	0
0	0	0	0	0	.	.	.	0	0	0	0