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FINAL REPORT
VIDEO DISTRIBUTION SYSTEM COST MODEL

July 1980

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(NASA-CR-160020) VIDEO DISTRIBUTION SYSTEM
COST MODEL Final Report (Arinc Research
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ARINC
RESEARCH CORPORATION
This report describes a cost model that can be used to systematically identify the costs of procuring and operating satellite-linked communications systems. The user defines a network configuration by specifying the location of each participating site, the interconnection requirements, and the transmission paths available for the uplink (studio to satellite), downlink (satellite to audience), and voice talkback (between audience and studio) segments of the network. The model uses this information to calculate the least expensive signal distribution path for each participating site. Cost estimates are broken down by capital, installation, lease, and operations and maintenance. The design of the model permits flexibility in specifying network and cost structure.

ARINC Research Corporation performed the work for the National Aeronautics and Space Administration (NASA) under Contract NAS5-25401; the Public Service Satellite Consortium served as a major subcontractor.
SUMMARY

As part of its pioneering work in applying advanced communications technology to the improvement of public services' productivity, the National Aeronautics and Space Administration (NASA) has demonstrated the feasibility of using satellite-linked video communications systems. This report is concerned with ARINC Research Corporation's development of a model that can systematically identify the costs of procuring and operating such systems.

First, we accomplished a quick-look evaluation of the cost of a one-way-video, two-way-voice distribution system to serve federal office buildings in 14 cities. The analytical procedures used in preparing this initial report then were used in addressing the major task: developing a model for analyzing the costs of the options available for transmitting a video signal via satellite and selecting the preferred options. The costs were grouped into four categories, each of which can be analyzed independently of the others:

- Uplink: The cost of producing the video signal and transmitting it to the satellite
- Downlink: The cost of receiving the satellite signal and distributing it to the local audiences
- Voice Talkback: The cost of a voice link from the audience to the program originators
- Administrative: The costs associated with planning, management, and other overhead activities

Each of these costs may be further divided into recurring and nonrecurring elements.

The model's user must define the network configuration by specifying the location of each participating site, the interconnection requirements, and the transmission paths available for the uplink, downlink, and voice talkback segments of the network. The model uses this information to calculate the least expensive path for each participating site.

In the uplink cost category, five options were used in the model; they involved combinations of transmitting-earth-terminal costs, studio costs, and terrestrial-link costs.
In the downlink cost category, up to 37 options were available; they involved combinations of costs for a receiving earth terminal, a terrestrial link, a local distribution medium, and end user equipment. The network itself might own the earth terminal or simply be linked to a shared terminal. Local distribution might be accomplished by video lines, microwave links, cable TV (CATV), or Instructional Television Fixed Service (ITFS) lines. Voice talkback might be accomplished through direct dial, WATS, or private line. Direct dial was modeled as a straight hourly rate, private line as a fixed monthly charge dependent on distance, and WATS as having both fixed and hourly components.

Administrative costs are not used as parameters for the model; they are merely inserted into the data base to be read directly as part of the output.

The model was used to analyze eight cases. All were hypothetical or proposed nonprofit public service applications of differing complexities. Five represented individual networks, and three involved several networks sharing transmission equipment. The cases are briefly characterized as follows:

1. **Federal Cities Network** - 14 major U.S. Government offices distributed throughout the continental United States. Programming originates from Washington, D.C.

2. **Appalachian Educational Satellite Project (AESP)** - 45 small cities and towns located in or near the Appalachian Mountains, from New York to Alabama. Many of the receiving sites are small colleges. Programming originates from Lexington, Kentucky.


4. **"East" Case** - a combination of the following networks:
   a. The Federal Cities Network
   b. 70 AESP sites (an expansion of case 2)
   c. 10 Veterans Administration (VA) hospitals

5. **"West" Case** - a combination of the following networks:
   a. The Federal Cities Network
   b. The WAMI Network
   c. 32 VA hospitals
   d. 10 Denver Research Institute sites
   e. 5 Project Interchange sites
   f. 27 California Education sites
   g. 3 California Conferencing sites
6. **Standard Metropolitan Statistical Areas (SMSA) Cases** - a series of cases involving progressively higher numbers of downlink cities. Programming originates from Washington, D.C. The following networks were analyzed:

a. 10 Federal Regional Headquarters
b. (a) plus 12 additional cities to include the top 20 SMSAs
c. (b) plus 42 additional SMSAs at or near state capitals
d. (c) plus 14 additional state capitals that are not SMSAs

7. **Federal Regional Programming** - a network where each of the 10 federal regional offices independently produces a small amount of programming each week. The receiving sites are the same 78 cities as in case 6d.

8. **Cost Allocation Case** - a network of the 10 federal regional offices and the top 20 SMSAs (similar to 6b). Eight of the 10 federal offices are also SMSAs. The overall cost is allocated to the two organizations on the basis of various network parameters.

The results of exercising the model for these cases are summarized in Table S-1. Annual operating costs for each network depended primarily on hours of utilization. Some economy of scale could be observed since average cost per uplink hour tended to be lower for the larger networks. Benefits from sharing facilities were a function of the level of shared investment. The East case, which had few common facilities among its three member organizations, showed much lower savings attributable to sharing than did the West case, which had a relatively large number of shared facilities. The cost allocation case quantifies possible savings from sharing facilities. By consolidating facilities in the eight cities that receive programming from both organizations, the number of required sites can be cut significantly. As a result, an equivalent level of service can be provided at lower cost than either organization acting alone could achieve.
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<th>Number of Organizations</th>
<th>Number of Sites</th>
<th>Uplink Hours</th>
<th>Total Annualized Cost ($ Thousands)</th>
<th>Average Cost per Uplink Hour per Site (Dollars)</th>
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<td>6,812</td>
<td>3,638**</td>
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<tr>
<td>a.</td>
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<td>b.</td>
<td>1</td>
<td>22</td>
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<td>517†</td>
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<td>c.</td>
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<td>620†</td>
<td>29.81</td>
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*Based on 5-year amortization at 10 percent rate.
**Based on 8-year amortization at 10 percent rate.
†Based on 8-year amortization at 12 percent rate.
CONTENTS

ABSTRACT ....................................................... iii

SUMMARY ....................................................... v

CHAPTER ONE: INTRODUCTION ....................................... 1-1
  1.1 Background .............................................. 1-1
  1.2 Project Overview ......................................... 1-3
  1.3 Report Organization ...................................... 1-3

CHAPTER TWO: MODEL OVERVIEW ..................................... 2-1
  2.1 Overall Model Structure ................................... 2-3
  2.2 Uplink Formulation ....................................... 2-4
  2.3 Downlink Formulation ..................................... 2-6
  2.4 Voice Talkback Formulation ............................... 2-8
  2.5 Administrative Costs ..................................... 2-8
  2.6 Other Special Features ................................... 2-9
    2.6.1 Interactive Scenario Builder ......................... 2-9
    2.6.2 Transponder Channels ................................. 2-10
    2.6.3 Hierarchical Levels ................................... 2-10
    2.6.4 Earth Terminal Data Base ............................. 2-10
    2.6.5 Model Output ......................................... 2-11

CHAPTER THREE: CASES ANALYZED ................................... 3-1
  3.1 Federal Cities Network ................................... 3-2
  3.2 Appalachian Educational Satellite Project (AESP) ........ 3-4
  3.3 Washington-Alaska-Montana-Idaho (WAMI) ................ 3-7
  3.4 "East" Case ............................................. 3-8
  3.5 "West" Case ............................................. 3-12
  3.6 SMSA Cases .............................................. 3-15
  3.7 Federal Regional Programming ............................ 3-18
  3.8 Cost Allocation Case .................................... 3-23

CHAPTER FOUR: CONCLUSIONS ........................................ 4-1

APPENDIX A: DATA ASSUMPTIONS .................................. A-1

APPENDIX B: MODEL FORMULATION .................................. B-1

APPENDIX C: SAMPLE OUTPUTS ..................................... C-1
CONTENTS (continued)

APPENDIX D: PROGRAM LISTINGS ..................... D-1
APPENDIX E: MODEL INSTALLATION .................. E-1
APPENDIX F: OPERATIONAL COSTS AND MANAGEMENT CONSIDERATIONS ...... F-1
CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND

NASA has been a pioneer in the development of communications technology to improve the productivity of public services. Experiments conducted on the ATS-1, -3, -6, and CTS demonstrated that communications satellites have the technical capability to improve access to vital public services.

Public service agencies that participated in the NASA experiments now are in the process of changing over to the use of commercial facilities. An essential element in making this transition a success is demonstrating to the agencies and to other potential users that cost savings and improved service can be achieved by increased use of these communications techniques. The key lies in establishing appropriate shared-use networks. To this end, under Contract NAS5-25401, ARINC Research Corporation and its subcontractor, the Public Service Satellite Consortium, undertook the development and trial application of a computer model that would facilitate the design and costing of shared video distribution systems that would use common carrier facilities and serve the needs of various combinations of public service users. The work and results are described in this report.

The most difficult phase in the creation of a shared-use public service communications network will be the start-up phase. Once a backbone of users is established, it will be comparatively easy to expand the network. ARINC Research has found in studies of other industries that usually a small percentage of the users (e.g., 10 percent) generate a substantial amount of the total traffic (e.g., 90 percent). In the public service community, a similar phenomenon can be expected. Large urban institutions would make or break the cost-effectiveness of a public service network, even though the greatest benefits in terms of improved access and cost containment could accrue to smaller institutions located outside the major cities. Therefore, one must examine a base of users having complementary requirements in cities where established carriers can provide the desired services at a savings. The model described herein can remove many of the existing uncertainties regarding costs, preferred services, and locations associated with establishing the initial system users and suppliers.

There are several issues to be considered in establishing a shared-use network for one-way video. A number of earth stations that are interconnected by Western Union's WESTAR satellite or RCA's SATCOM have already been
installed or are about to be installed. The systems include 150 Public Broadcasting Service (PBS) stations, 190 National Public Radio (NPR) stations, and more than 400 cable TV (CATV) earth stations. Holiday Inns, Inc. is planning to install a large number of earth stations to provide closed-circuit television to some of its 1,500 outlets. Public service might be able to use these networks to establish a shared-use system for one-way video on an incremental cost basis. Feedback or a return communications path could be provided by a separate voice/data network or by Wide Area Telephone Service (WATS), if necessary.

Unfortunately, in many cases there is no existing local loop that could connect the earth station to institutions that are of interest to potential public service users. Before our work started, the Public Service Satellite Consortium (PSSC) evaluated the recurring and nonrecurring costs of providing end-to-end closed circuit TV service to interested public service users in 14 U.S. cities* served by PBS earth stations. Ten of these cities already have one or more Instructional Television Fixed Service (ITFS) or CATV systems. However, in only three of these 10 cities is the PBS earth station interconnected to an existing local loop. The cost of installing this interconnection (about $25,000) would exceed the cost of a new receive-only earth station (which could view either WESTAR or SATCOM) if this new station were installed at the head-end facility of a CATV or ITFS system. Although all PBS earth stations have a redundant receiver that may be used on a preemptive basis at the discretion of the licensee, a new receive chain (at a cost of about $10,000) might be required to provide regular nonbroadcast service once a certain volume is reached. Six of the 14 PBS installations have a "terrestrial tail" between the earth station and the studio. Additional channels (at a cost of $15,000 per channel) might have to be installed on these microwave relays once the volume of nonbroadcast service became appreciable.

Thus, while existing earth stations might provide an excellent starting point for a shared-use, one-way video network, in many cities the lack of channel capacity or of an interconnected local loop might necessitate new capital investment to provide end-to-end transmission service. The decision on whether to augment existing facilities or construct new facilities will depend critically on the access arrangements that can be negotiated with owners of existing earth stations and local loops.

These considerations led to the work reported herein: the development of a model that could consider numerous options for the uplink (studio to satellite), downlink (satellite to audience), and talkback (between audience and studio) segments of a video distribution system and selection of the optimum ones for each of the cities in the network.

*Atlanta, Boston, Chicago, Cleveland, Dallas, Denver, Kansas City, Mo., Los Angeles, New York, Philadelphia, San Diego, San Francisco, Seattle, and Washington, D.C.
1.2 PROJECT OVERVIEW

The project outputs are (1) a model that can be used to define preferred configurations and to evaluate shared public service video communications systems and (2) the results of several trial applications of this model.

The initial phase of the project involved a 21-day effort to make a quick-look evaluation of the cost of a one-way video, two-way voice communications system serving federal office buildings in 14 major cities and to submit a report on the results. The analytical procedures developed in this work were later used as a guide for model formulation. The model was developed and was applied to five test cases. As a result, several additional refinements to the model were identified that would increase its capability and ease of use. The model was enhanced and tested against a new set of test cases.

Throughout the project there was a continuing effort to develop and refine a data base of applicable communications tariffs and hardware costs. The two prime activities -- the development of the video distribution systems cost model and the analysis of specific public service satellite communications scenarios -- were performed in parallel. The specific configuration requirements of the individual scenarios served to guide the features that were incorporated into the model. The model was used to develop insight into the types of economies that could be achieved through shared public service video distribution systems.

The Public Service Satellite Consortium (PSSC) provided many of the inputs to the data base and commented on and reviewed other aspects of the project.

1.3 REPORT ORGANIZATION

This report consists of this introductory chapter and three chapters that provide a model overview, the results of the cases analyzed, and concluding comments on the utility of the model in evaluating the benefits of sharing. There are six appendices:

- Appendix A - Data Assumptions. The justification for some of the cost assumptions used in the uplink and downlink segments are presented.
- Appendix B - Model Formulation. Detailed documentation of the model is presented, including a description of the calculations and definitions of variables.
- Appendix C - Sample Outputs. The input data and output reports for a selected model run are shown.
- Appendix D - Program Listings. The main FORTRAN program and subroutines used are listed.
• Appendix E - Model Installation. The procedures required to install the model on a minicomputer are explained.

• Appendix F - Operational Costs and Management Considerations. The feasibility of offering access to the model to a large community of users is assessed and presented in terms of the costs required to support the model.
CHAPTER TWO

MODEL OVERVIEW

A common requirement in business, government, and education is establishing efficient communications among individuals scattered over a wide geographic area. Face-to-face meetings are the most effective way to accomplish this, but the high cost of travel, room, and board often make them an unattractive alternative.

With the advent of satellite communications, it became more economically feasible to use video transmission to conduct meetings. In an education or presentation environment, where a single person presents the bulk of the material, a one-way video channel may be particularly effective. Interaction between the lecturer and the audience can be accomplished by either a conventional voice line or a second video channel. Economic feasibility of a video meeting depends on the number of participating sites, system utilization, individual equipment lease charges, and other lesser factors.

To analyze the complex trade-offs that can be involved, a model has been developed that permits rapid cost analysis of alternative transmission options in networks using video transmission. In a typical case, a small number of uplink sites originate video programs and transmit them via satellite to geographically diverse audience sites. Each receiver must have its own earth terminal or a link to a shared terminal. A terrestrial voice circuit may be required to enable each receiving site to talk back to the transmitting site. Figure 2-1 illustrates this typical video distribution system.

The cost model provides an estimate of capital and operating costs for video communications via satellite from signal generation to reception. At each stage of signal transmission there may be several options concerning the type of equipment or common carrier to use. The model can analyze these options and choose the most cost-effective "path." By performing a comparison between a baseline and a scenario case, the model can show the results of a single change in network parameters.

The model can also be used to highlight the cost benefits of sharing facilities. Two or more organizations that individually cannot use a facility effectively might find that sharing the facility would be mutually beneficial. Multiple organizations sharing earth terminals or recording studios, for example, provide substantial cost benefits to the users. The
savings limit would be reached when the shared facility became fully used. The model allows the user to establish his own cost allocation methodology by specifying the member organizations that will share the cost and applying weighting factors to the various cost items (e.g., peak versus off-peak usage) that affect each organization's share.

2.1 OVERALL MODEL STRUCTURE

The Video Distribution System Cost Model is designed primarily to analyze the economic options in transmitting a video signal, but may be applied to nonvideo systems as well. The cost structure is divided into four segments that can be analyzed independently of each other:

1. **Uplink.** The cost of producing the video signal and transmitting it through the satellite system. This includes costs of studio space and equipment, camera crews, and satellite transponder lease, and the cost of any terrestrial links from the studio to the uplink earth station.

2. **Downlink and Local Distribution.** The cost of receiving and decoding the satellite signal and distributing it to the local audience. This includes costs of receiving earth terminals, local distribution, and monitors. Distribution can be accomplished through a tie-in to a local CATV or Instructional Television Fixed Service (ITFS) system by a terrestrial video line or by microwave link.

3. **Voice Talkback.** The cost of the optional voice link from the audience to the originators of the programming. Depending on utilization and distance, voice talkback can be accomplished via direct dial, private line, or WATS.

4. **Administrative.** The management and overhead cost of the network as a whole. It includes items such as planning studies, management salaries, building space, and any other costs not directly attributable to the uplink, downlink, or voice talkback segments.

The costs for each of the segments are further divided into capital, installation, lease, and operations and maintenance (O&M) categories. Capital and installation costs are one-time charges for facilities necessary to bring the system into operation; lease and O&M costs are recurring. Capital and lease costs are for equipment; installation and O&M costs are for services. The capital and installation costs may be amortized as an ongoing expense over a period depending on interest rate and equipment life.

For each of the major cost segments other than "Administrative," the model user must specify a set of available options, or "paths," that define the various means of sending the information through that particular link of the system. The model will calculate the cost of each feasible option.
and choose the least expensive option for each city under consideration. Because of variations in hourly utilization, distances between cities, and other factors, the optional path will not necessarily be the same in each city.

Three types of input data are required from the model user:

1. Cost Element Data. These consist of the capital, installation, lease, and O&M costs of each cost element (piece of equipment or nonhardware cost unit) used in the analysis. A single cost element may consist of many individual items, as long as they are always considered together.

2. Path Data. A path consists of one or more cost elements and represents a method of transmitting the signal through one of the model segments. In the uplink segment, for example, a typical set of path data might consist of studio rental, a video link between the studio and the earth terminal, and the transponder lease.

3. City Data. For each audience site in the network, the user must specify location, utilization, local distribution requirements, voice talkback requirements, and which of the defined paths are feasible.

Figure 2-2 shows how the three types of data interact to generate the least-cost path. Costs are summed over all cost elements associated with each path and then modified by any variables (e.g., hourly utilization of the system) that are dependent on the city under consideration. This enables the calculation of costs of all feasible paths for the given city, from which the least-cost path is selected.

The following four sections address the model formulation in terms of the four cost categories: uplink, downlink, voice talkback, and administration. The last section examines the model’s special features. A more detailed description of the model’s logic and parameters can be found in Appendix B. A detailed description of how to use the model is presented in the User’s Guide to the Video Distribution System Cost Model, published as ARINC Research Publication 1358-01-TR-2234, dated July 1980.

2.2 UPLINK FORMULATION

Uplink costs in the model are those involving production and transmission of the video signal to the satellite.

Figure 2-3 shows a representative set of uplink paths. Each box represents a cost element; any combination of elements connected by a link denotes an acceptable path. All paths will incur costs for satellite usage (transponder lease) and a television studio to produce the video signal. If an existing uplink earth terminal is to be used, a
Cost Element Data

Path Data

City Data

Cost of Each Path

Cost of Each Feasible Path in Each City

Select Least Cost Path for Each City

Figure 2-2. INFORMATION FLOW DIAGRAM

Start

Television Studio

Microwave Link

AT&T Video Link

New Earth Terminal

Existing Earth Terminal

Transponder Lease

Figure 2-3. UPLINK PATHS

2-5
terrestrial video circuit or microwave link will be required to carry the signal from its point of origination to the uplink earth terminal. In some locations, a new earth terminal will be required; if it is colocated with the studio, a terrestrial video link between the two will not be necessary. These possibilities generate the five possible paths shown in the diagram:

- Microwave link to existing earth terminal
- AT&T video link to existing earth terminal
- Microwave link to new earth terminal
- AT&T video link to new earth terminal
- New earth terminal colocated with studio

Not all of the five paths are necessarily feasible for every uplink city. For example, if there is no existing earth terminal in a given city, then a new facility must be built, and the first two paths will not be feasible.

2.3 DOWNLINK FORMULATION

Downlink costs in the model are those associated with receiving the satellite video signal and distributing it to the audience.

Figure 2-4 shows the 37 possible downlink paths. Other paths might be possible, but those considered here were thought to be typical of most applications. The seeming complexity of the diagram is misleading, since the 37 paths simply represent various combinations of a receiving earth terminal, a terrestrial link, a local distribution medium, and end user equipment.

As in the uplink segment, each receiving site must have its own earth terminal or link to an existing one. In the diagram, options are displayed for a link to a CATV earth station, a PBS earth station, or a common carrier satellite station. If there was only one end audience in a particular city, it was considered practical to link it directly to the earth station via 1-hop or 2-hop microwave. For multiple users, the signal could be locally distributed via CATV or an ITFS transmission system. If either of these methods were used, it might be necessary to establish a microwave or video link between the earth terminal and the local transmission system.

The private earth terminal could also be colocated with one of the audience sites. If there is only one audience organization associated with a particular downlink city, there will be no need for a local transmission system as well. With multiple receiving organizations, it will be necessary to establish a local distribution system through a CATV or ITFS network. In cases where the receiver must also be used as a transmitter, either for a two-way video communications or for one-way transmission at a different hour of the day, a single two-way earth terminal could suffice.
Figure 2-4. LOCAL DISTRIBUTION OPTIONS
for the downlink. A final alternative is to receive the signal by using an earth terminal in a nearby city and then running a one- or two-hop microwave link between the earth terminal and the viewing site.

2.4 VOICE TALKBACK FORMULATION

In some applications it is necessary that the audience of the video programming communicate with the originators to comment or ask questions. This communication, whether occurring during or after the presentation, would be by common-carrier voice circuits external to the satellite system.

There are three telephone options available for such voice talkback: Direct Distance Dialing (DDD), measured WATS, and private line. The most cost-effective approach depends on the distance between the two cities and the number of monthly hours of talkback required. DDD costs are modeled at a fixed rate of $0.55 per minute regardless of distance, which corresponds approximately to the cost of a one-minute personal coast-to-coast long distance call during business hours. Rates are slightly lower for shorter distances or for additional minutes. Therefore, the 55 cents may be considered a worst case. The principal advantage of DDD is that there is no minimum charge. Private line charges, on the other hand, are based solely on mileage and are not dependent on utilization. Charges per month are set by interstate tariff at $190.40 plus $0.40 per mile. WATS charges fall between those of DDD and private line and have fixed (per month or mile) and variable (per hour) components. The average fixed monthly charge is approximately $60.00; the average hourly charge is approximately $18.00.

On the basis of this schedule of costs, DDD will be the preferred alternative for low-utilization circuits and private line for high-utilization circuits, regardless of distance. WATS will be preferred when utilization is sufficient to take advantage of the lower hourly tariffs and the two cities are so far apart that the private line charge would be prohibitive. Figure 2-5 shows the cost trade-offs associated with the three alternatives for Washington-to-Chicago communications.

2.5 ADMINISTRATIVE COSTS

Administrative costs accrue in addition to the direct costs of a video satellite system. They include costs for planning studies and legal procedures involved in establishing the network, and general management costs not attributable to the uplink, downlink, or voice talkback segments. Administrative costs are not expected to vary according to network configuration, utilization, or any other factor. The data are inputted by the user and read out directly in the output; the model performs no calculations with these figures.
2.6 OTHER SPECIAL FEATURES

2.6.1 Interactive Scenario Builder

The interactive scenario builder is used to establish the user's network configuration and associated cost elements. The scenario builder accepts as input either a system-created scenario file that contains
typical network costs (see Appendix A) or a scenario created by the user during a previous computer session.

Use of the system-created scenario file allows the user to provide minimum input. The only required data are the list of uplink and downlink network cities and their location in latitude/longitude or Bell System V and H coordinates, hours of satellite utilization by city, number of receiving organizations per city, terrestrial microwave or video link requirements, and voice talkback connectivity and utilization requirements.

Use of a previously created scenario allows the user to examine the sensitivity of the network configuration costs to changes in the number of uplink and downlink cities and in various cost allocation methodologies.

Other features of the scenario builder include automatic prompting for user input, simple procedures for implementing minor network changes, and sufficient generality so that nonvideo network distribution problems can be worked.

2.6.2 Transponder Channels

In the uplink segment, the user can assign a transponder channel number to each uplink site. The numbers have no significance except to indicate that cities assigned the same channel number are sharing a particular frequency. Fixed costs and minimum operating costs associated with using a transponder channel are assigned only to the first city associated with each unique channel number. If no channel assignment is made by the user, the model will assume that all programming is done on a single transponder frequency. The model is not currently equipped to schedule the time slots on the transponder; the user must do this. However, it is a simple process and can be done manually for all but the most complex cases.

2.6.3 Hierarchical Levels

In the downlink segment, the user can assign a single-digit hierarchical number to each downlink city. This number indicates the city's position in the overall organizational structure of the network. If the assigned level is two or less, talkback costs will be calculated from the given city to each uplink city; if three or greater, the city is assumed to talk back to the nearest level two city, which serves as a central relay point to the uplink city.

2.6.4 Earth Terminal Data Base

An earth terminal data base is available for determining the possibility of sharing an existing site. The data base is a subset of the data stored by the Federal Communications Commission (FCC) and consists of call sign, licensee, city, state, latitude/longitude, type of service, antenna size, and licensed points of communication (satellites). Unlicensed stations
and stations whose applications are pending are not included. The data base indicates all satellites to which the earth terminal is licensed to point, but does not indicate which satellite the earth terminal is currently pointing to. A sample record is illustrated in Figure 2-6. A utility exists to access this data base and provide appropriate data to the user.

2.6.5 Model Output

The major output of the model is a tabulation of costs for the least expensive system, broken out for the uplink, downlink, voice talkback, and administrative segments. Costs are further subdivided by capital, installation, lease, and O&M. Other reports show costs for the uplink, downlink, and voice talkback segments in greater detail. Output from a sample run is shown in Appendix C.

<table>
<thead>
<tr>
<th>Fields Included</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call Sign</td>
<td>KB20</td>
</tr>
<tr>
<td>Licensee</td>
<td>Teleprompter</td>
</tr>
<tr>
<td>City</td>
<td>Anaheim</td>
</tr>
<tr>
<td>State</td>
<td>CA</td>
</tr>
<tr>
<td>Service</td>
<td>DFS-FES-D-TR*</td>
</tr>
<tr>
<td>Latitude</td>
<td>37-37-02</td>
</tr>
<tr>
<td>Longitude</td>
<td>121-49-51</td>
</tr>
<tr>
<td>Antenna Size</td>
<td>4.5 Meter</td>
</tr>
<tr>
<td>Licensed Points of Communication</td>
<td>KS20, KS21**</td>
</tr>
</tbody>
</table>

*Domestic Fixed Satellite - Fixed Earth Station - Developmental-Transmit/Receive.
**WESTAR I, WESTAR II.

Figure 2-6. SAMPLE EARTH TERMINAL RECORD
CHAPTER THREE

CASES ANALYZED

The model was exercised to analyze the eight cases described in this chapter. Most of them represent individual networks; three involve several networks sharing satellite transponder channels. The cases analyzed, varying widely in complexity, are characterized as follows:


2. **Appalachian Educational Satellite Project (AESP)** - 45 small cities and towns located in or near the Appalachian Mountains from New York to Alabama. Many of the receiving sites are small colleges. Programming originates from Lexington, Kentucky.


4. **"East" Case** - A combination of the following networks:
   a. The Federal Cities network
   b. 70 AESP sites (an expansion of case 2)
   c. 10 Veterans Administration (VA) hospitals

5. **"West" Case** - A combination of the following networks:
   a. The Federal Cities network
   b. The WAMI network
   c. 32 VA hospitals
   d. 10 Denver Research Institute sites
   e. 5 Project Interchange sites
   f. 27 California Education sites
   g. 3 California Conferencing sites
6. **Standard Metropolitan Statistical Areas (SMSA) Cases** - A series of cases involving progressively higher numbers of downlink cities. Programming originates from Washington, D.C. The following networks were analyzed:
   a. 10 Federal Regional Headquarters
   b. a plus 12 additional cities including the top 20 SMSAs
   c. b plus 42 additional SMSAs at or near state capitals
   d. c plus 14 additional state capitals that are not SMSAs

7. **Federal Regional Programming** - A network where each of the 10 Federal regional offices independently produces a small amount of programming each week. The receiving sites are the same 78 cities as in case 6d.

8. **Cost Allocation Case** - A network of the 10 federal regional offices and the top 20 SMSAs (similar to 6b). For this case, the computed overall cost is allocated to the two organizations on the basis of various network parameters.

   These cases are intended to illustrate the capabilities of the model over a variety of video network problems. In most applications of this model it is expected that several runs will be required to refine cost and other parameters and to calculate the sensitivity to various cost components. The cases described in this chapter were developed and run at different times. As new and better information became available, the model's cost assumptions were updated; consequently, results from two different cases may not be directly comparable.

### 3.1 FEDERAL CITIES NETWORK

The Federal Cities network is a hypothetical one-way-video, two-way-voice communications system linking seven federal organizations in Washington with regional offices in federal office buildings in 14 major cities. The utilization requirements of each organization are shown in Table 3-1. The Bureau of Alcohol, Tobacco, and Firearms requires only occasional and minimal channel utilization for its needs, so its utilization is modeled as 0. Nevertheless, facilities must be made available for these occasional broadcasts.

Washington is the only uplink city; however, a separate studio and video link is required for each department. These are necessary to originate the programming and transmit it to a single uplink facility located in the Washington area. Transmission to the uplink terminal could be accomplished by either a leased video line or a microwave link. Principally because of the lower operating costs, microwave links were found to be less expensive than AT&T video lines.
On the downlink side, options depended on the facilities available in each city. CATV earth terminals that might be used were available in Atlanta, New York, and Seattle. Existing ITFS systems could be used for local distribution in Atlanta, Chicago, Los Angeles, New York, and San Francisco. All cities have a PBS earth station that could be wired into a local distribution system. Alternatively, all cities could construct their own receive-only earth terminals and install them close enough to each federal building that it would be necessary only to run a short coaxial line directly to the viewing room. Because of the relatively low cost of an earth station and because there was only one site in each city (since all agency offices are selected to be colocated), the private earth terminal option was found to be the most cost-effective for all cities. Different options might be preferred if it were necessary to distribute the video signal to more than a single site in each of the cities.

In the voice talkback segment, only the WATS and private-line alternatives were considered. Monthly utilization of the talkback circuits ranged from 29 hours in Denver to 134 hours in Dallas. (Even the 29 hours is far beyond the maximum cost-effective level of DDD.) Private line was the preferred medium for all cities except Denver, where a combination of low utilization and high mileage to Washington made WATS the cheaper alternative.

Table 3-2 summarizes the preferred configuration and the model's cost output for this network. The capital expenditures are concentrated in the purchase of the microwave equipment to carry the video signal to the uplink terminal and the receive-only earth stations to be used in each downlink.
Table 3-2. FEDERAL CITIES NETWORK

<table>
<thead>
<tr>
<th>City</th>
<th>Uplink</th>
<th>Downlink</th>
<th>Voice Talkback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanta, GA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Boston, MA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Chicago, IL</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Cleveland, OH</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Dallas, TX</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>WATS</td>
</tr>
<tr>
<td>Denver, CO</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Fort Worth, TX</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Houston, TX</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Kansas City, MO</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>New York, NY</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>San Diego, CA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Washington, DC</td>
<td></td>
<td>Private Earth Terminal, studio, microwave links</td>
<td></td>
</tr>
</tbody>
</table>

**Cost Summary**

<table>
<thead>
<tr>
<th>Model Segment</th>
<th>Capital Expenditures</th>
<th>Planning and Installation</th>
<th>Annual Lease</th>
<th>Annual O&amp;M&amp;A</th>
<th>Annualized Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uplink</td>
<td>420,000</td>
<td>70,000</td>
<td>198,787</td>
<td>28,000</td>
<td>356,048</td>
</tr>
<tr>
<td>Downlink</td>
<td>350,000</td>
<td>0*</td>
<td>0</td>
<td>224,000</td>
<td>316,328</td>
</tr>
<tr>
<td>Voice Talkback</td>
<td>28,000</td>
<td>1,429</td>
<td>113,070</td>
<td>0</td>
<td>120,833</td>
</tr>
<tr>
<td>Administrative</td>
<td>0</td>
<td>160,100</td>
<td>0</td>
<td>96,500</td>
<td>138,734</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>798,000</strong></td>
<td><strong>231,529</strong></td>
<td><strong>311,857</strong></td>
<td><strong>348,500</strong></td>
<td><strong>931,943</strong></td>
</tr>
<tr>
<td><strong>Total Annualized Cost</strong></td>
<td><strong>210,510</strong>****</td>
<td><strong>61,077</strong>****</td>
<td><strong>311,857</strong></td>
<td><strong>348,500</strong></td>
<td><strong>931,944</strong></td>
</tr>
</tbody>
</table>

*Installation costs included in capital expenditures for downlink segment.

**Effective yearly costs for 5-year, 10.00 percent amortization.

city. Satellite usage and voice lines account for most of the lease costs. The bulk of O&M expenses are for the operation of the downlink earth terminals.

3.2 APPALACHIAN EDUCATIONAL SATELLITE PROJECT (AESP)

AESP is a network of about 45, mostly small, cities and towns in or near the Appalachian Mountains between New York and Alabama. Each downlink organization, many of which are small colleges, receives community service programming originating in Lexington, Kentucky. In some cities, programming is locally distributed through a CATV outlet.
Each city in the network was assigned to one of three "levels" depending on its role in the network hierarchical structure. Level 1 denoted an uplink site. Levels 2 and 3 were assigned on the basis of the city's role in the voice talkback subsystem: level-2 cities were equipped to call Lexington directly, while level-3 cities could talk only to the nearest level-2 city. In an actual programming environment, the level-2 cities would receive questions or comments from viewers in the level-3 cities, screen them, and relay them to Lexington, possibly adding a few comments of their own. An algorithm was programmed into the model to search through the level-2 cities to find the closest one to a given level-3 city. Only Lexington was assigned level 1; 22 cities were assigned to level 2 and 22 to level 3.

In the uplink segment, a new transmitting earth terminal was required because there was no common-carrier earth terminal with which to link. No microwave or video link was necessary since it was assumed that the transmitter would be collocated with the studio. Thus, there was only one option available.

In the downlink segment, all cities have the same system utilization, so the cost of a given path would be the same in each city in which it was feasible -- if it was the most economical in one city, it would be the most economical in all cities. A city that was within 20 miles of another network-city was permitted to establish a single microwave link to that city*. If the distance was 20-100 miles, a two-hop microwave link was permitted. However, the two-hop microwave option turned out to be the most expensive and even the one-hop microwave proved to be more expensive than a private earth terminal. Therefore, a private terminal was the preferred option for all downlink segments except Lexington's. In the case of Lexington, from which the programming originates, there was no need for any downlink equipment, since the audience is local.

Because of high utilization (87 hours per month)** and low distances between cities, private line was more cost-effective for talkback than WATS in every case. DDD was not examined because at $33.00 per hour it would certainly have been considerably more expensive than either WATS or private line.

The preferred configuration of the AESP network and the results of exercising the model for this case are shown in Table 3-3. The annualized cost of about $900,000 is divided approximately equally between one-time capital, leases, and operations expenses. A five-year, 10-percent amortization rate was used to annualize the capital expenses and planning and installation charges.

*Although one-hop microwave is often feasible at a distance of 50 miles or more, 20 miles was felt to be a conservative bound; i.e., if the distance is less than 20 miles, a one-hop microwave can always be built, whereas at 20-50 miles, it depends on the terrain.

**This was an early estimate of AESP talkback that was later revised.
<table>
<thead>
<tr>
<th>City</th>
<th>Uplink</th>
<th>Downlink</th>
<th>Voice</th>
<th>Talkback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guntersville, AL*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Rainsville, AL*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Gadsden, AL</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Huntsville, AL</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Clayton, GA*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Rome, GA*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Gainesville, GA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Hazard, KY</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Lexington, KY</td>
<td>Private Earth Terminal collocated with studio</td>
<td>Monitors Only</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Morehead, KY</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Somerset, KY</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Hagerstown, MD*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Cumberland, MD</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>McHenry, MD</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Booneville, MS*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Tupelo, MS</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Scooba, MS</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Alfred, NY*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Fredonia, NY</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Olean, NY</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Boone, NC*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Marion, NC*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Morganton, NC*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Sylva, NC</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Athens, OH</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Ebensburg, PA*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Edinboro, PA*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Smethport, PA*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Pittsburgh, PA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Columbia, SC*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Greenville, SC</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
</tbody>
</table>

*Level 2 cities.
### Table J-J. (continued)

#### Available Option (continued)

<table>
<thead>
<tr>
<th>City</th>
<th>Uplink</th>
<th>Downlink</th>
<th>Voice Talkback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spartanburg, SC</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Chattanooga, TN</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>McMinnville, TN</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Johnson City, TN</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Tazewell, TN</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Cookeville, TN</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>LaFollette, TN</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Stickleyville, VA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Dublin, VA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Norton, VA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Petersburg, WV</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Wheeling, WV</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Romney, WV</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Bethany, WV</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
</tbody>
</table>

### Cost Summary

<table>
<thead>
<tr>
<th>Model Segment</th>
<th>Capital Expenditures</th>
<th>Planning and Installation</th>
<th>Annual Lease</th>
<th>Annual O&amp;M&amp;A</th>
<th>Annualized Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uplink</td>
<td>285,000</td>
<td>5,000</td>
<td>133,225</td>
<td>66,000</td>
<td>275,726</td>
</tr>
<tr>
<td>Downlink</td>
<td>705,000</td>
<td>0**</td>
<td>0</td>
<td>132,000</td>
<td>317,977</td>
</tr>
<tr>
<td>Voice Talkback</td>
<td>88,000</td>
<td>4,752</td>
<td>134,257</td>
<td>0</td>
<td>158,722</td>
</tr>
<tr>
<td>Administrative</td>
<td>0</td>
<td>160,100</td>
<td>0</td>
<td>96,500</td>
<td>138,734</td>
</tr>
<tr>
<td>Totals</td>
<td>1,078,000+</td>
<td>169,852+</td>
<td>267,482</td>
<td>294,500</td>
<td>891,159</td>
</tr>
<tr>
<td>Total Annualized Cost</td>
<td>284,373</td>
<td>44,806</td>
<td>267,482</td>
<td>294,500</td>
<td>891,161</td>
</tr>
</tbody>
</table>

*Level 2 cities.
**Installation costs included in capital expenditures for downlink segment.
*Effective yearly costs for 5-year, 10.00 percent amortization.

3.3 WASHINGTON-ALASKA-MONTANA-IDAHO (WAMI)

The WAMI network examined in this study is a medical-education network of 15 cities, 11 of which are in the northwestern United States and four in Alaska. The hub of the network is Seattle, where the programming originates from the medical school at the University of Washington, the only medical school in the four-state area.
Two types of programming are carried by WAMI. In the first, Seattle and Fairbanks or Seattle and Bozeman transmit medical-school programs full duplex on different channels for three hours per week; this programming is also received in Pullman. In the other, Seattle and Boise transmit clinical programs full duplex for 10 hours per week. This programming is received by clinics in all WAMI cities except Bozeman, Boise, and Pullman.

The uplink cities are, therefore, Seattle, Fairbanks, Bozeman, and Boise. During operations, Seattle and one of the other three cities will be transmitting video signals full duplex to the satellite. Each requires a two-way earth terminal and a television studio. The studio is assumed to be colocated with the earth terminal, therefore no microwave link or terrestrial video line should be needed. The other 11 cities require receiving capability only. It is also necessary that all cities be able to talk back to Seattle. Fairbanks, Bozeman, and Boise can accomplish this with no additional facilities because they are transmitting video to Seattle. The other cities will need WATS, private line, or DDD service to meet their talkback needs.

In the Federal Cities case, it was learned that for the given set of assumptions, the private earth terminal provides the least expensive downlink path. Consequently, this was the only downlink option specified for the 11 receive-only cities. Since each receiving site is a single clinic or university, it was assumed that there would be no need for local distribution of the signal.

The preferred configuration of this network and the results of exercising the model for this case are shown in Table 3-4. The detailed report for the uplink segment (not shown) indicates that neither the Seattle channel nor the Fairbanks-Bozeman-Boise channel was used enough to exceed the minimum charge for transponder leasing. Equipment and lease costs for the four uplink cities were identical, except for the allocation of satellite usage costs. On the downlink segment, each city showed the same costs for a receive-only earth terminal and two monitors. The four uplink cities already had the cost of their earth terminals allocated to the uplink side and therefore incurred costs only for the monitors. In the talkback segment, most cities were suited for private lines; only Bethel, Alaska was suited for WATS. Leases ranged from $217 per month in Anacortes, Washington (68 miles from Seattle) to $941 in Bethel (1,876 miles away).

3.4 "EAST" CASE

The "East" case is a hypothetical aggregation of several smaller networks. The purpose of analyzing such a configuration was to examine economies that would result from sharing facilities. The total system consists of the Federal Cities network, 10 VA hospital sites, and 70 AESP cities, 25 of which are planned additions to the AESP network. Johnson City, Tennessee, is the only city that is a member of more than one network.
Table 3-4. WASHINGTON-ALASKA-MONTANA-IDaho (WAMI) NETWORK

<table>
<thead>
<tr>
<th>City</th>
<th>Uplink</th>
<th>Downlink</th>
<th>Voice Talkback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle, WA</td>
<td>Private Earth Terminal</td>
<td>Monitors Only</td>
<td>--</td>
</tr>
<tr>
<td>Fairbanks, AK</td>
<td>Private Earth Terminal</td>
<td>Monitors Only</td>
<td>--</td>
</tr>
<tr>
<td>Bozeman, MT</td>
<td>Private Earth Terminal</td>
<td>Monitors Only</td>
<td>--</td>
</tr>
<tr>
<td>Boise, ID</td>
<td>Private Earth Terminal</td>
<td>Monitors Only</td>
<td>--</td>
</tr>
<tr>
<td>Spokane, WA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Pullman, WA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Anchorage, AK</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Billings, MT</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Ketchikan, AK</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Whitefish, MT</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Anacortes, WA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Pocatello, ID</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Bethel, AK</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Missoula, MT</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Great Falls, MT</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
</tbody>
</table>

**Cost Summary**

<table>
<thead>
<tr>
<th>Model Segment</th>
<th>Capital Expenditures</th>
<th>Planning and Installation</th>
<th>Annual Lease</th>
<th>Annual O&amp;M&amp;A</th>
<th>Annualized Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uplink</td>
<td>1,140,000</td>
<td>20,000</td>
<td>266,450</td>
<td>264,000</td>
<td>836,455</td>
</tr>
<tr>
<td>Downlink</td>
<td>180,000</td>
<td>0*</td>
<td>0</td>
<td>33,000</td>
<td>80,483</td>
</tr>
<tr>
<td>Voice Talkback</td>
<td>22,000</td>
<td>1,105</td>
<td>58,572</td>
<td>0</td>
<td>64,667</td>
</tr>
<tr>
<td>Administrative</td>
<td>0</td>
<td>160,100</td>
<td>96,500</td>
<td>138,734</td>
<td></td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>1,342,000**</td>
<td>181,205**</td>
<td>325,022</td>
<td>393,500</td>
<td>1,120,339</td>
</tr>
</tbody>
</table>

**Total Annualized Cost**

|                   | 354,016              | 47,801                    | 325,022      | 393,500      | 1,120,339      |

*Installation costs included with capital expenditures for downlink segment.
**Effectively yearly costs for 5-year, 10.00 percent amortization.

The uplink options are the same as those of the previous cases. Each of the three uplink cities (Lexington, Philadelphia, Washington) bears the cost of satellite time and a transmitting earth terminal. Washington also requires seven studios and video lines because the programming on the Federal Cities network originates from seven locations. The model chose microwave over AT&T land lines for the video links.

Five paths are feasible in the downlink segment: (1) A private earth terminal colocated with monitors is available in all cities. (2) If a CATV earth terminal is located within 20 miles, the signal may be received and distributed through the cable systems. (The 20-mile figure is based
on estimated "range" of a CATV network beyond the earth terminal.) For this case, the only costs would be for equipment to receive the additional frequency at the earth terminal and feed it into the local distribution network, and for user subscription charges. (3) One-hop microwave from an existing terminal is a feasible option if the sites are less than 20 miles apart; (4) two-hop microwave is feasible if they are less than 100 miles apart. (5) If a downlink city is also an uplink city (Lexington, for example), the cost of the earth terminal has already been allocated in the uplink segment; therefore, earth terminal costs will not be counted in the downlink segment as well.

Since the cost of the five paths is not dependent on utilization, each path would cost the same in every city. As in the AESP case, the microwave options, because of their high capital costs, are more expensive than the private earth terminal option, which is available in every city. However, the CATV path is less expensive than the private earth terminal. The monitors-only option (Lexington) is the least expensive of all because no additional equipment is required. The least expensive available downlink option for each city is identified in Table 3-5.

In the talkback segment, DDD is the most cost-effective method for the low-utilization routes to Lexington and Philadelphia. WATS is better for some city pairs where utilization is three hours per month or more. For the 14 federal cities, utilizations range from 33 to 134 hours per month, which is sufficient to make private line the most attractive option in most cases.

The preferred configuration for this network and the models' costs output for it are shown in Table 3-5. The costs are not directly comparable to those obtained for the Federal Cities or AESP cases because cost estimates for most of the uplink and some downlink cost elements were updated; talkback hours were set at two hours per month except for the 14 federal cities; and the amortization rate was adjusted to be 8 years at 10 percent.

The principal economy gained by these three organizations' sharing facilities is in channel utilization. Alone, neither Washington nor Lexington met the 1800-hour minimum charge for a transponder channel, but together they did and saved about $147,000 per year. Common facilities in Johnson City, Tennessee (the only downlink city in more than one of the three networks) would save about $5,200; common talkback facilities would save the negligible amount of about $72 per year.

The total network required a one-time investment of about $5.1 million and incurred annual lease and maintenance costs of about $1.1 million. Assuming an amortization rate of 10 percent for 8 years, annual expenses were about $2.0 million. Only about 7 percent of this figure is saved as a result of sharing. In the next case to be discussed, the "West" Case, there is much more overlap between the subnetworks and consequently more significant savings.
### Table J-5. "EAST" CASE

#### Selected Options

<table>
<thead>
<tr>
<th>City</th>
<th>Uplink</th>
<th>Downlink</th>
<th>Voice Talkback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philadelphia, PA</td>
<td>Private Earth Terminal</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>studio, microwave</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Washington, DC</td>
<td>Private Earth Terminal</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>studio, microwave</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Lexington, KY</td>
<td>Private Earth Terminal</td>
<td>Monitors Only</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>studio, microwave</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atlanta, GA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Boston, MA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Chicago, IL</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Cleveland, OH</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Dallas, TX</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Denver, CO</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Fort Worth, TX</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Houston, TX</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Kansas City, MO</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>New York, NY</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>San Diego, CA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Group A (25)</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>DDD</td>
</tr>
<tr>
<td>Group B (8)</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>DDD</td>
</tr>
<tr>
<td>Group C (3)</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>DDD</td>
</tr>
<tr>
<td>Group D (8)</td>
<td>--</td>
<td>Link to CATV</td>
<td>DDD</td>
</tr>
<tr>
<td>Group E (9)</td>
<td>--</td>
<td>Link to CATV</td>
<td>DDD</td>
</tr>
<tr>
<td>Group F (16)</td>
<td>--</td>
<td>Link to CATV</td>
<td>--</td>
</tr>
<tr>
<td>Group G (9)</td>
<td>--</td>
<td>Link to CATV</td>
<td>--</td>
</tr>
</tbody>
</table>

#### Cost Summary

<table>
<thead>
<tr>
<th>Model Segment</th>
<th>Capital Expenditures</th>
<th>Planning and Installation</th>
<th>Annual Lease</th>
<th>Annual O&amp;M&amp;A</th>
<th>Annualized Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uplink</td>
<td>1,585,000</td>
<td>180,000</td>
<td>393,200</td>
<td>300,000</td>
<td>1,400,612</td>
</tr>
<tr>
<td>Downlink</td>
<td>915,000</td>
<td>109,200</td>
<td>7,920</td>
<td>129,300</td>
<td>129,347</td>
</tr>
<tr>
<td>Voice Talkback</td>
<td>136,000</td>
<td>1,470</td>
<td>158,118</td>
<td>0</td>
<td>183,887</td>
</tr>
<tr>
<td>Administrative</td>
<td>0</td>
<td>160,100</td>
<td>0</td>
<td>96,500</td>
<td>126,510</td>
</tr>
<tr>
<td>Totals</td>
<td>4,636,000</td>
<td>450,770</td>
<td>550,238</td>
<td>525,800</td>
<td>2,040,357</td>
</tr>
</tbody>
</table>

Total Annualized Cost: 869,139* 86,183* 525,800 2,040,357

*Effective yearly costs for 8-year, 10.00 percent amortization.
### Table 3-5. (continued)

<table>
<thead>
<tr>
<th>GROUP A: Private earth terminal downlink only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dublin, GA</td>
</tr>
<tr>
<td>Fayetteville, NC</td>
</tr>
<tr>
<td>Salisbury, NC</td>
</tr>
<tr>
<td>Oteen, NC</td>
</tr>
<tr>
<td>Altoona, PA</td>
</tr>
<tr>
<td>Wilkes-Barre, PA</td>
</tr>
<tr>
<td>Johnson City, TN</td>
</tr>
<tr>
<td>Clarkesburg, WV</td>
</tr>
<tr>
<td>Guntersville, AL</td>
</tr>
<tr>
<td>Rainsville, AL</td>
</tr>
<tr>
<td>Clayton, GA</td>
</tr>
<tr>
<td>Home, GA</td>
</tr>
<tr>
<td>Boone, NC</td>
</tr>
<tr>
<td>Marion, NC</td>
</tr>
<tr>
<td>Morganton, NC</td>
</tr>
<tr>
<td>Ebensburg, PA</td>
</tr>
<tr>
<td>Edinboro, PA</td>
</tr>
<tr>
<td>Smethport, PA</td>
</tr>
<tr>
<td>Towanda, PA</td>
</tr>
<tr>
<td>Petersburg, WV</td>
</tr>
<tr>
<td>Stickleyville, VA</td>
</tr>
<tr>
<td>Romney, WV</td>
</tr>
<tr>
<td>Scooba, MS</td>
</tr>
<tr>
<td>Alfred, NY</td>
</tr>
<tr>
<td>Morehead, KY</td>
</tr>
<tr>
<td>GROUP B: Private earth terminal or one- or two-hop microwave</td>
</tr>
<tr>
<td>Sylva, NC</td>
</tr>
<tr>
<td>Athens, OH</td>
</tr>
<tr>
<td>Pittsburgh, PA</td>
</tr>
<tr>
<td>GROUP C: Private earth terminal or CATV Link</td>
</tr>
<tr>
<td>Oakley, NY</td>
</tr>
<tr>
<td>Dublin, VA</td>
</tr>
<tr>
<td>Bethany, WV</td>
</tr>
<tr>
<td>GROUP D: Private earth terminal or CATV Link</td>
</tr>
<tr>
<td>Salem, VA</td>
</tr>
<tr>
<td>Beckley, WV</td>
</tr>
<tr>
<td>Hagerstown, MD</td>
</tr>
<tr>
<td>Booneville, MS</td>
</tr>
<tr>
<td>Chattanooga, TN</td>
</tr>
<tr>
<td>McMinnville, TN</td>
</tr>
<tr>
<td>Columbia, SC</td>
</tr>
<tr>
<td>Wheeling, WV</td>
</tr>
<tr>
<td>GROUP E: Private earth terminal, CATV Link, or two-hop microwave</td>
</tr>
<tr>
<td>Gadsden, AL</td>
</tr>
<tr>
<td>Huntsville, AL</td>
</tr>
<tr>
<td>Cumberland, MD</td>
</tr>
<tr>
<td>Greenville, SC</td>
</tr>
<tr>
<td>Spartanburg, SC</td>
</tr>
<tr>
<td>Cookeville, TN</td>
</tr>
<tr>
<td>LaFollette, TN</td>
</tr>
<tr>
<td>Norton, VA</td>
</tr>
<tr>
<td>Gainesville, GA</td>
</tr>
<tr>
<td>GROUP F: Private earth terminal, CATV Link, or two-hop microwave; no talkback required</td>
</tr>
<tr>
<td>Florence, AL</td>
</tr>
<tr>
<td>Decatur, AL</td>
</tr>
<tr>
<td>Birmingham, AL</td>
</tr>
<tr>
<td>Chatsworth, GA</td>
</tr>
<tr>
<td>Dalton, GA</td>
</tr>
<tr>
<td>Barbourville, KY</td>
</tr>
<tr>
<td>Crooksville, OH</td>
</tr>
<tr>
<td>Elkins, WV</td>
</tr>
<tr>
<td>Wytheville, VA</td>
</tr>
<tr>
<td>Sparta, TN</td>
</tr>
<tr>
<td>Crossville, TN</td>
</tr>
<tr>
<td>Oak Ridge, TN</td>
</tr>
<tr>
<td>New Albany, MS</td>
</tr>
<tr>
<td>Anderson, SC</td>
</tr>
<tr>
<td>N. Wilkesboro, NC</td>
</tr>
<tr>
<td>Corinth, MS</td>
</tr>
<tr>
<td>GROUP G: Private earth terminal, CATV Link, one- or two-hop microwave; no talkback required</td>
</tr>
<tr>
<td>Cumberland, KY</td>
</tr>
<tr>
<td>Frostburg, MD</td>
</tr>
<tr>
<td>Salamanca, NY</td>
</tr>
<tr>
<td>Erie, PA</td>
</tr>
<tr>
<td>Emporium, PA</td>
</tr>
<tr>
<td>Nelsonville, OH</td>
</tr>
<tr>
<td>New Lexington, OH</td>
</tr>
<tr>
<td>Moundsville, WV</td>
</tr>
<tr>
<td>Wellsburg, WV</td>
</tr>
</tbody>
</table>

### 3.5 "WEST" CASE

The "West" case is a hypothetical aggregation of several smaller networks. It includes the Federal Cities network, the WAMI network, and 32 VA hospitals. Also included is the Denver Research Institute (DRI), a network of 10 sites in Colorado, Montana, and Utah. There are three California
networks included: Project Interchange (5 sites), Education (27 sites), and Conferencing (3 sites). There is considerable overlap among the various subnetworks, the 106 sites representing only 82 downlink cities.

Most of the same uplink and downlink options that were used in the East case were available in the West. The major difference is that the one-hop and two-hop microwave options were not considered because of their high cost, as demonstrated in Section 3.2. As in the East case, the cheapest downlink option was monitors only, but this is available only for those cities that are uplink cities also. Linking to a CATV system again was found to be cheaper than using a private earth terminal.

There are a total of nine uplink cities in the West network: Seattle, Fairbanks, Bozeman, and Boise are the uplinks for WAMI; Seattle is also the uplink for the VA cities; Washington is the hub of the Federal Cities network; Moffett Field, near San Francisco, is the uplink center for all three of the California networks. In the case of the California Conferencing, Sacramento and either Moffett Field or Los Angeles transmit full duplex video; finally, Denver is the uplink city for the DRI group. Transmissions for all six subnetworks can be accommodated on three satellite channels, assuming all of them operate during normal business hours.

Talkback requirements are two hours per month, except for the Federal Cities network, where lines must be open whenever transmission is in progress. No talkback is required for the California Conferencing, since all three sites are transmitting full duplex. The options in this segment are similar to those of the East case. DDD was the preferred alternative for three hours per month usage or less; the crossover point varied according to the distance between the two cities. Private line was the medium generally preferred for the 14 federal cities due to the high utilization of the lines.

The preferred configuration for this network and the model's cost output for it are shown in Table 3-6. The total network required capital and installation expenditures of $9.2 million. Amortized annual expenses were $3.6 million, of which $0.9 million were for leases, $1.0 million for operations and maintenance, and $1.7 million for payment on capital equipment. The biggest cost component was $7.8 million capital expenditures (1.4 million per year amortized) for uplink earth terminals, studios, and associated installation costs.

Savings resulting from sharing occur in all three major segments of the model. In the uplink, only three transponder frequencies are required to serve the member networks, instead of the nine frequencies that would be required without sharing. This reduction in the number of frequencies saves approximately $940,000 annually. Sharing downlink equipment eliminates the need for 24 earth terminals and video links, which results in annual savings of approximately $78,000. Common talkback facilities could save about $7,600 per year; these savings would occur primarily on equipment expenditures.
### Table J-6. "WEST" CASE

#### Selected Options

<table>
<thead>
<tr>
<th>City</th>
<th>Uplink</th>
<th>Downlink</th>
<th>Voice Talkback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle, WA</td>
<td>Private Earth Terminal;</td>
<td>Monitors Only</td>
<td>Private Line</td>
</tr>
<tr>
<td></td>
<td>link required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairbanks, AK</td>
<td>Private Earth Terminal;</td>
<td>Monitors Only</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>no link required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bismarck, ND</td>
<td>Private Earth Terminal;</td>
<td>Monitors Only</td>
<td>DOD</td>
</tr>
<tr>
<td></td>
<td>no link required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boise, ID</td>
<td>Private Earth Terminal;</td>
<td>Monitors Only</td>
<td>DOD</td>
</tr>
<tr>
<td></td>
<td>no link required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moffett Field, CA</td>
<td>Private Earth Terminal;</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>link required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sacramento, CA</td>
<td>Private Earth Terminal;</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>link required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>Private Earth Terminal;</td>
<td>Monitors Only</td>
<td>Private Line</td>
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<td>11 Federal Cities</td>
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#### Cost Summary

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<th>Capital Expenditures</th>
<th>Planning and Installation</th>
<th>Annual Lease</th>
<th>Annual O&amp;M</th>
<th>Annualized Cost</th>
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<td>160,100</td>
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<td><strong>725,836</strong></td>
<td><strong>887,867</strong></td>
<td><strong>1,024,700</strong></td>
<td><strong>3,637,630</strong></td>
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<tr>
<td><strong>Total Annualized Cost</strong></td>
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<td><strong>136,053</strong></td>
<td><strong>887,867</strong></td>
<td><strong>1,024,700</strong></td>
<td><strong>3,637,636</strong></td>
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*Effective yearly costs for 8-year, 10.00 percent amortization.*
3.6 SMSA CASES

Several cases were developed on the basis of a network of Standard Metropolitan Statistical Areas (SMSAs). These represent urban areas within the United States. Cities chosen for this network fall into at least one of the following categories: (1) the top 20 SMSAs, (2) the largest city in each state, and (3) the state capitals. The purpose of those cases was to examine the incremental cost impact of adding additional cities to a network. Although increasing the size of the network must increase the total cost, there are economies of scale that will reduce the average cost of service provided.

Programming for this hypothetical network is produced and uplinked from Washington, D.C., five hours per day, five days per week, for a total of 1,300 hours per year. All transmissions are to take place during business hours; therefore, off-peak rates for satellite usage apply. Voice talkback is required for 2 minutes per hour of programming for each downlink city; this is equivalent to 3.6 hours per month.

Scenarios were run for four different downlink city groups. The first contained downlinks for the 10 regional federal offices. The second case contained the 10 regional office cities plus all other cities ranked in the top 20 SMSAs according to the 1970 census. Kansas City and Denver are Federal regional offices and were not included in the top 20 SMSAs; therefore, this second group contains 22 cities. The third case included

---

**Table 3-6. (continued)**

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<th>DEFINITION OF CITY GROUPS</th>
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<td>Whitefish, MT</td>
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<td>Bethel, AK</td>
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<td>Phoenix, AZ</td>
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<td>Tucson, AZ</td>
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<tr>
<td>Sheridan, WY</td>
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<tr>
<td>Fort Lyon, CO</td>
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<tr>
<td>American Lake, WA</td>
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<td>Vancouver, WA</td>
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<td>Walla Walla, WA</td>
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<tr>
<td>Roseburg, OR</td>
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<tr>
<td>White City, OR</td>
</tr>
<tr>
<td>Fort Harrison, MT</td>
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<tr>
<td>Miles City, MT</td>
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</tbody>
</table>


an additional 42 cities representing SMSAs at or near state capitals. The fourth and final case included 14 additional state capitals that were not considered SMSAs.

Four uplink transmission options were available from Washington. All included costs for a high-capability color video studio and the satellite transponder lease. An earth station with transmit capability was found to exist in the Washington area; the signal could be uplinked either from this earth station or from a new station built for this purpose. Because of space requirements, the earth terminal could not be colocated with the studio, and a microwave or terrestrial video link would be required to transmit the signal between the studio and the earth station. Thus, there are four possible paths: microwave or terrestrial link to a new or existing earth station.

In the downlink segment, all cities are assumed to be capable of constructing a receive-only earth station sufficiently close to the viewing area that no local distribution system is required. Washington is the only city allowed the “monitor only” option because it is assumed that the viewing area will be colocated with the studio, and therefore no interaction with the satellite will be necessary for this city. Other options depend on the availability of existing earth terminals to receive the satellite signal. A scan of the earth terminal data base showed that receive capability earth terminals exist within 15 miles for 69 of the 78 downlink cities considered. These cities would be permitted to receive the signal on the “borrowed” earth terminal and bring the signal to its audience via a microwave link. Sixty-one of those 69 cities have at least one cable TV earth station. For these cities it would be permissible to buy or rent capacity on the CATV earth station, or to receive the signal on a private terminal and use the CATV system to transmit the signal locally.

Since the available options or city parameters did not change among the four cases, an option preferred in one case for a particular city will be preferred in all cases for that city. Table 3-7 shows the available downlink options by city, the selected downlink option, and which of the four cases each city was included in. In all cases, talkback utilization was low enough to make direct dial the preferred talkback option, although 3.6 hours is fairly close to the point where WATS becomes feasible.

Table 3-8 (a-d) shows cost summaries for these four scenarios. Uplink costs are identical because the structure of that segment is unchanged. Downlink costs grow disproportionately from $18,904 in annualized cost to $209,499 while the number of cities expands from 10 to 78. However, many of the cities added for the larger scenario have no earth terminals to link to and thereby incur additional downlink costs. Because uplink costs are constant, overall annualized costs per city decrease significantly, from roughly $44,000 in the federal regions scenario to $9,800 in the full 78-city scenario. The incremental cost of adding a city, however, is only about $3,300 per year.
Table J-7. SMIA CASES

<table>
<thead>
<tr>
<th>City/State</th>
<th>Private E-T</th>
<th>Microwave from E-T</th>
<th>Cable TV E-T</th>
<th>Monitors Only</th>
<th>Selected Path</th>
<th>a</th>
<th>b</th>
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(continued)
### Table 3-7. (continued)

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<th>Cable TV E-T</th>
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#### 3.7 FEDERAL REGIONAL PROGRAMMING

This case is similar to 6d except that the program production is done in 10 different cities instead of one. Each Federal regional office is assumed to broadcast 2.5 hours of programming per week; all 10 offices share the same transponder channel. The resulting 1,300 hours per year of channel utilization all occur during daylight (off peak) hours.

Available options for the uplink and downlink segments are the same as in the SMSA cases. For uplink, it is assumed that any city that has a transmit capability earth station within 15 miles may link to it. Five of the 10 cities have such a capability; the rest will be forced to incur costs for building their own transmitting earth stations.
Table 3-8(a). OVERALL COST SUMMARY -- SMSA CASE 1

FEDERAL REGIONAL OFFICES

OVERALL COST SUMMARY

<table>
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<tr>
<th></th>
<th>CAPITAL EXPENDITURES</th>
<th>PLANNING AND INSTALLATION</th>
<th>ANNUAL LEASE</th>
<th>ANNUAL O&amp;M&amp;A</th>
<th>ANNUALIZED COST</th>
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<tbody>
<tr>
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<td>1800</td>
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ANNUALIZED COST  

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EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $481107.
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EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $517150.
Table J-3(c). OVERALL COST SUMMARY -- SMSA CASE J

FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S, AND SMSA STATE CAPITALS

OVERALL COST SUMMARY

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<th>ANNUAL LEASE</th>
<th>ANNUAL O&amp;MIA</th>
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EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $ 689413.
Table 3-8(d). OVERALL COST SUMMARY -- SMSA CASE 4

FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S, AND STATE CAPITALS

OVERALL COST SUMMARY

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EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $762742.
Results for this case are shown in Tables 3-9 and 3-10. Table 3-9 shows the results for the uplink segment, and Table 3-10 may be compared with Table 3-8d, which shows the SMSA scenario for a single uplink city. Those uplink sites that cannot use an existing earth terminal must buy and maintain a new one. This results in an additional cost of about $120,000 per year per earth terminal, or $600,000 in all. In addition, a studio is required for each uplink site. It was assumed that the studios used would be less expensive than the full-capability studio assumed for the SMSA case. Even so, since 10 are required instead of 1, an additional $200,000 in annualized cost is required. Downlink costs are somewhat lower because 10 of the cities will no longer require a receive capability. Overall, the cost impact of 10 regional broadcast centers is considerable, resulting in roughly a doubling in system cost.

3.8 COST ALLOCATION CASE

One scenario was developed primarily to test the model's cost allocation capability. This case is similar to Case 2 in Section 3.6. The network consists of a single uplink city (Washington) broadcasting to both a network of 10 Federal regional offices and a network of the top 20 SMSAs. Because eight of the 10 Federal regional offices are located in cities that are also in the top 20 SMSA's, there are only 22 cities in the combined network.

It was assumed that the Federal network would be on the air 5 hours per day, or 1,300 hours per year, during off-peak hours. The SMSA network would be on the air 4 hours per day, 1,040 hours per year, during peak hours.

Each of the uplink and downlink cities must be associated with the Federal network, the SMSA network, or both. For those cities that are associated with one network but not the other, the entire uplink or downlink cost attributable to that city is allocated to the proper organization. If the city is associated with both organizations, cost must be allocated. This was done by assigning weighting factors to the hours of utilization according to the ratio of peak to off-peak hourly costs. Thus, the SMSA network incurs most of the uplink costs, even though it uses fewer transponder hours, because it is running at peak times. Voice talkback is an unweighted allocation based on talkback hours, and administrative costs are allocated in the same fashion as the downlink costs.

Table 3-11 shows the results of this scenario. Because the SMSA network has more sites than the Federal network and since it must pay peak-hour surcharges in addition, it is allocated about 65 percent of the total network cost. The allocated Federal network cost of $332,221 is lower than the $481,107 cost estimated for the Federal network alone in Case 1 of the SMSA cases.
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<td>UPLINK TOTAL</td>
<td>1611500</td>
<td>310000</td>
<td>180000</td>
<td>592000</td>
<td>1158804</td>
</tr>
</tbody>
</table>

3-24
Table 3-10. OVERALL COST SUMMARY — FEDERAL REGIONAL PROGRAMMING

OVERALL COST SUMMARY

<table>
<thead>
<tr>
<th></th>
<th>CAPITAL EXPENDITURES</th>
<th>PLANNING AND INSTALLATION</th>
<th>ANNUAL LEASE</th>
<th>ANNUAL O&amp;M&amp;A</th>
<th>ANNUALIZED COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPLINK</td>
<td>1611500.</td>
<td>310000.</td>
<td>180000.</td>
<td>592000.</td>
<td>1158804.</td>
</tr>
<tr>
<td>DOWNLINK</td>
<td>650400.</td>
<td>114800.</td>
<td>9360.</td>
<td>31800.</td>
<td>195197.</td>
</tr>
<tr>
<td>VOICE TALKBACK</td>
<td>986.</td>
<td>2720.</td>
<td>50918.</td>
<td>0.</td>
<td>51664.</td>
</tr>
<tr>
<td>ADMINISTRATIVE</td>
<td>0.</td>
<td>160000.</td>
<td>0.</td>
<td>85000.</td>
<td>117208.</td>
</tr>
<tr>
<td>TOTALS</td>
<td>2262886.</td>
<td>587520.</td>
<td>240279.</td>
<td>708800.</td>
<td>1522873.</td>
</tr>
<tr>
<td>ANNUALIZED COST</td>
<td>455525.</td>
<td>118269.</td>
<td>240279.</td>
<td>708800.</td>
<td>1522873.</td>
</tr>
</tbody>
</table>

EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $1522873.
### Table J.11. Network Cost Allocation -- Cost Allocation Case

**Federal Regional Offices, Top 20 SMSA's -- Cost Allocation Case**

#### Network Cost Allocation

<table>
<thead>
<tr>
<th></th>
<th>Capital</th>
<th>Install</th>
<th>Lease</th>
<th>O&amp;MIA Annualized</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uplink</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Federal Offices</td>
<td>143165</td>
<td>36617</td>
<td>162500</td>
<td>72516</td>
</tr>
<tr>
<td>2 SMSA's</td>
<td>255635</td>
<td>65383</td>
<td>290160</td>
<td>129484</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>398800</td>
<td>102000</td>
<td>452660</td>
<td>202000</td>
</tr>
<tr>
<td><strong>Downlink</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Federal Offices</td>
<td>50200</td>
<td>1800</td>
<td>1800</td>
<td>1000</td>
</tr>
<tr>
<td>2 SMSA's</td>
<td>142400</td>
<td>22200</td>
<td>2880</td>
<td>6500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>192600</td>
<td>24000</td>
<td>4680</td>
<td>7500</td>
</tr>
<tr>
<td><strong>Voice Talkback</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Federal Offices</td>
<td>87</td>
<td>240</td>
<td>8511</td>
<td>0</td>
</tr>
<tr>
<td>2 SMSA's</td>
<td>218</td>
<td>600</td>
<td>14976</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>305</td>
<td>840</td>
<td>23587</td>
<td>0</td>
</tr>
<tr>
<td><strong>Administrative</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Federal Offices</td>
<td>0</td>
<td>53333</td>
<td>0</td>
<td>28323</td>
</tr>
<tr>
<td>2 SMSA’s</td>
<td>0</td>
<td>106667</td>
<td>0</td>
<td>56667</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>160000</td>
<td>0</td>
<td>85000</td>
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<tr>
<td><strong>Total Network</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Federal Offices</td>
<td>193452</td>
<td>91990</td>
<td>172911</td>
<td>101849</td>
</tr>
<tr>
<td>2 SMSA's</td>
<td>398253</td>
<td>194850</td>
<td>30016</td>
<td>192651</td>
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<tr>
<td><strong>Total</strong></td>
<td>591705</td>
<td>286840</td>
<td>480927</td>
<td>294500</td>
</tr>
</tbody>
</table>

**Federal Regional Programming**

3-26
CHAPTER FOUR

CONCLUSIONS

NASA has demonstrated that access to vital public services can be improved by using communications satellites. There are plans to establish several public service networks for the purpose of securing large blocks of video transmission time and redistributing that time to qualified public service organizations. Depending on requirements, the participating organizations may find it cost-effective to buy the transmission equipment they need, rent or lease the equipment on a short-term basis, or enter into a sharing agreement with an existing equipment user. While the existing network of earth stations and other associated facilities might provide an excellent starting point for a shared-use video network, lack of channel capacity and lack of a local distribution system in many cities might require substantial new investment. The decision whether to upgrade existing facilities or to construct new facilities will depend critically on the access arrangements that can be negotiated with owners of existing earth stations and local loops.

The Video Distribution System Cost Model developed during this study is designed to analyze these kinds of issues. At each stage of signal propagation there may be several options concerning the type of equipment or common carrier to use. The model can analyze these options and choose the most cost-effective "path." The output of the model consists of an estimate of capital and operating costs for public service video communications via satellite from signal generation to reception. By comparing the results of a baseline and a scenario run, the effect of a single change in network parameters can be shown. This procedure can be used to calculate the incremental cost of an additional city in the network or an additional hour of channel utilization.

In addition, the model can highlight the cost benefits of sharing facilities. A group of organizations, none of whom may be able to afford a particular facility alone, may find that together they can use the facility effectively. The savings limit is reached when the shared facility becomes fully used. It must also be realized that the cost of establishing a communications link between the proposed shared facility and the additional site may exceed the cost of a new facility. For example, in many cases installing a new receive-only earth terminal was found to be less expensive than using a terrestrial line to an existing terminal. In the cases that were analyzed, the greatest benefit from sharing was found to be the savings
generated by efficient scheduling of transponder time. Sharing of downlink equipment showed substantial, although less significant, savings.

The purpose of this study was to demonstrate the capability of the model to help managers make better decisions concerning which of several available options might be best in a given situation. The eight cases analyzed were hypothetical networks chosen to demonstrate some of the analysis capabilities of the model.

The Video Distribution System Cost Model is a useful tool in the analysis of video satellite costs in public service networks. Through the sample cases run in this study, the model has begun to establish general criteria or "rule of thumb" guidelines on the basis of which new networks could be implemented cost-effectively. It has measured sensitivity of network costs to a number of key parameters. The model has been developed into a powerful user-oriented analysis tool that is applicable to a broad spectrum of network cost problems, and it can be used by video network managers in the analysis of transmission alternatives at all stages of signal propagation.
APPENDIX A

DATA ASSUMPTIONS

This appendix presents justification for some of the cost assumptions used in the uplink and downlink segments of the model. This effort was conducted in parallel with the running of the cases; consequently, the assumptions presented here were not used in every instance. In addition, such factors as bulk equipment prices and prior agreements between the vendors and a given network may result in a different cost from that presented. The purpose of the cases was not so much to calculate the cost of a network as to demonstrate the capability to do so under a range of cost assumptions. Thus the cost assumptions should be viewed as careful estimates.

These costs are included in the sample scenario, which is presented at the end of this appendix. The sample scenario is accessed by the user to form the basis for the user's unique application.

VIDEO STUDIO COSTS

Simple Studio

Capital

Cameras: 2 Cameras (modest quality) $16,000
Remote controls on cameras 3,000
Switching 3,000
Lighting 1,500
Microphones
Mixer 1,500
Video monitors 2,000
Audio monitors 500
Echo suppressor 3,000
Synch generator 1,500
Room modifications $ 5,000
Installation costs 5,000

Total Capital $42,000

Operating

"Production" --
Scheduling 5,000
Maintenance 4,200

Recurring Costs $ 9,200

More Complex Studio (Not Full Production Quality)

Capital

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameras</td>
<td>40,000</td>
</tr>
<tr>
<td>Remote control</td>
<td>3,000</td>
</tr>
<tr>
<td>Switching</td>
<td>6,000</td>
</tr>
<tr>
<td>Lighting</td>
<td>3,000</td>
</tr>
<tr>
<td>Microphones</td>
<td>5,000</td>
</tr>
<tr>
<td>Mixer (audio)</td>
<td></td>
</tr>
<tr>
<td>Synch generator</td>
<td>2,500</td>
</tr>
<tr>
<td>Video monitors</td>
<td>2,000</td>
</tr>
<tr>
<td>Large screen display</td>
<td>4,000</td>
</tr>
<tr>
<td>Video cassette machine</td>
<td>4,000</td>
</tr>
<tr>
<td>Audio monitors</td>
<td>1,500</td>
</tr>
<tr>
<td>Echo suppressor</td>
<td>3,000</td>
</tr>
<tr>
<td>Character generator capability</td>
<td>3,500</td>
</tr>
<tr>
<td>Room modifications</td>
<td>7,500</td>
</tr>
<tr>
<td>Installation costs</td>
<td></td>
</tr>
</tbody>
</table>

Total Capital $92,500

Operating

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td></td>
</tr>
<tr>
<td>Writing</td>
<td>25,000</td>
</tr>
<tr>
<td>Scheduling</td>
<td></td>
</tr>
<tr>
<td>Maintenance 10 percent</td>
<td>9,250</td>
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</table>

Recurring Costs $34,250
Production Studio (Campus Production)

Capital

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameras (3)</td>
<td>$75,000</td>
</tr>
<tr>
<td>Synch generator</td>
<td>3,000</td>
</tr>
<tr>
<td>Switching</td>
<td>10,000</td>
</tr>
<tr>
<td>Character generator</td>
<td>6,000</td>
</tr>
<tr>
<td>Lighting</td>
<td>5,000</td>
</tr>
<tr>
<td>Microphones, audio mixing</td>
<td>7,500</td>
</tr>
<tr>
<td>Video monitors</td>
<td>14,000</td>
</tr>
<tr>
<td>1 inch helical record/playback/edit</td>
<td>50,000</td>
</tr>
<tr>
<td>Audio monitors</td>
<td>1,500</td>
</tr>
<tr>
<td>Room modifications</td>
<td>30,000</td>
</tr>
<tr>
<td>Installation</td>
<td>15,000</td>
</tr>
<tr>
<td><strong>Total Capital</strong></td>
<td><strong>$217,000</strong></td>
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</tbody>
</table>

Operating

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer/Director</td>
<td>25,000</td>
</tr>
<tr>
<td>Cameras (3)</td>
<td>45,000</td>
</tr>
<tr>
<td>Maintenance (1)</td>
<td>17,500</td>
</tr>
<tr>
<td>Coordinator</td>
<td>11,000</td>
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<tr>
<td><strong>Recurring Costs</strong></td>
<td><strong>$ 98,500</strong></td>
</tr>
</tbody>
</table>

LINE OF SIGHT MICROWAVE LINK COSTS

Single Hop Link

Equipment is Housed in Existing Building

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tower stubs (2)</td>
<td>2,000</td>
</tr>
<tr>
<td>Transmit and receive electronics</td>
<td>21,000</td>
</tr>
<tr>
<td>Waveguide 250 feet</td>
<td>1,500</td>
</tr>
<tr>
<td>Antenna and feed (2)</td>
<td>1,000</td>
</tr>
<tr>
<td>Pressurizing system (2)</td>
<td>900</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>1,000</td>
</tr>
</tbody>
</table>
### Installation Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation</td>
<td>$5,000</td>
</tr>
<tr>
<td>Licensing, frequency coordination</td>
<td>$1,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$33,400</strong></td>
</tr>
<tr>
<td>Operations and maintenance (per year)</td>
<td>$2,500</td>
</tr>
</tbody>
</table>

### Double Hop Link Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tower stubs (3)</td>
<td>$3,000</td>
</tr>
<tr>
<td>Transmit and receive electronics</td>
<td>$36,000</td>
</tr>
<tr>
<td>Shelter (at midpoint)</td>
<td>$5,000</td>
</tr>
<tr>
<td>Waveguide 500 feet</td>
<td>$3,000</td>
</tr>
<tr>
<td>Antenna and feed (4)</td>
<td>$2,000</td>
</tr>
<tr>
<td>Pressurizing system (3)</td>
<td>$1,350</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>$2,000</td>
</tr>
<tr>
<td>Installation</td>
<td>$7,500</td>
</tr>
<tr>
<td>Licensing, frequency coordination</td>
<td>$2,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$61,850</strong></td>
</tr>
<tr>
<td>Operations and maintenance (per year)</td>
<td>$3,300</td>
</tr>
</tbody>
</table>

### Satellite Transponder Usage Costs

The rates for transponder usage vary according to the length of the commitment, the particular carrier, and the time of day. In addition, whether the service is protected or can be preempted is a factor. A selection of the range of charges available is given below:

#### RCA Global (Customer Supplied Downlink)

<table>
<thead>
<tr>
<th>Occasional Service</th>
<th>Cannot Be Preempted</th>
<th>Can Be Preempted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Peak*</td>
<td>Off-Peak*</td>
</tr>
<tr>
<td></td>
<td>$750/hr</td>
<td>$650/hr</td>
</tr>
</tbody>
</table>

**Fixed Term**

<table>
<thead>
<tr>
<th>Protected</th>
<th>Unprotected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak</td>
<td>Off-Peak</td>
</tr>
<tr>
<td>5 hour/day</td>
<td>$279/hr</td>
</tr>
<tr>
<td>10 hour/day</td>
<td>$266/hr</td>
</tr>
</tbody>
</table>

*Peak Time: Monday through Friday 5:00 P.M. - 2:00 A.M. ET.
Off-Peak Time: Monday through Friday 2:00 A.M. - 5:00 P.M. ET.
Western Union (Customer Supplied Downlink)

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Earlybird*</th>
<th>Daytime*</th>
<th>Primetime*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occasional Service</td>
<td>$90/hr</td>
<td>$200/hr</td>
<td>$450/hr</td>
</tr>
<tr>
<td>Monthly Scheduled</td>
<td>$90/hr</td>
<td>$195/hr</td>
<td>$425</td>
</tr>
<tr>
<td>Long-Term Scheduled</td>
<td></td>
<td>Anytime</td>
<td>$300/hr</td>
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</tbody>
</table>

Broker of Western Union Services

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Earlybird</th>
<th>Daytime</th>
<th>Primetime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occasional Service</td>
<td>$100/hr</td>
<td>$170/hr</td>
<td>$200/hr</td>
</tr>
</tbody>
</table>

FEES FOR USE OF EXISTING CATV AND ITFS SYSTEMS

There is not a uniform cost structure for the use of existing CATV and ITFS systems. Since ITFS is a wireless transmission system, the end-user charge for ITFS usage will probably be based on incremental administrative costs. Charges for CATV distribution are more likely to depend on channel capacity and local regulatory factors. In some cases, charges for CATV transmission will be nearly zero if the cable company can attract a number of new subscribers as a result of the additional programming. The following estimates for these systems are based on small samples and should be used with caution.

CATV

Hourly rate for video signal to be received at an existing CATV earth station and to be passed to an existing (unused) channel.

-- $30/hour

ITFS

Hourly rate for video signal to be passed through an existing ITFS system.

-- $10/hour

*Earlybird Time: Monday through Friday 2:00 A.M. - 12:00 P.M. ET.
Daytime: Monday through Friday 12:00 P.M. - 4:00 P.M. ET
Primetime: Monday through Friday 4:00 P.M. - 2:00 A.M. ET
EARTH STATION COSTS

Receive-Only Earth Station

- 4.5 meter antenna system: $6,000
- GaAs FET low noise amplifier: 3,000
- Downconverter/Demodulator: 5,000
- Frequency coordination: 1,200
- Installation*: 5,000

Total: $20,200

Operations and maintenance (per year): 1,500

Two-Way Earth Station

- 10 meter antenna system: $50,000
- GaAs FET low noise amplifier: 3,000
- HPA system: 50,000
- Receive chain: 7,500
- Transmit chain: 13,000
- Baseband monitoring: 5,000
- Test equipment: 40,000
- Spares: 20,000
- Shelter: 15,000
- Site development: 10,000
- Installation and engineering: 20,000

Total: $233,500

Maintenance and operations (per year): 95,000
(2 people and parts)

PUBLIC TELEVISION FACILITIES COSTS

Public television stations are somewhat uneven both in the facilities they can make available and in the charges for these facilities. In addition, there is considerable variance in the additional connectivity to other viewing locations that the public television stations possess. Nevertheless, the PSSC has experience with a significant cross section of the total set of public television stations and the following is provided as typical information. The only way exact information can be provided about

*Assumes equipment colocated in existing buildings.
any particular location is to construct an extensive data base. (The PSSC is currently undertaking this task.)

**Typical Charges:**

1. Receive signal from satellite and pass through to further interconnect: $35/hour
2. Receive signal from satellite and view at television station in conference-room type situation: $50/hour
3. Additional charges if further interconnect is station-owned ITFS system: $5/hour

**AT&T VIDEO LINK**

**Local Video Link, Less Than 20 Miles**

<table>
<thead>
<tr>
<th>Lease:</th>
<th>$1,000/month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation:</td>
<td>$2,500</td>
</tr>
</tbody>
</table>

**VOICE TALKBACK COSTS**

**Talkback Capital Costs**

Cost of station set, black, no Touch-Tone: $14.50

**Direct Dial Costs**

Based on 1-minute daytime call over 1,500 miles distance: $0.52 per minute

**WATS Costs**

Based on interstate tariff "L"

- First ten hours (per month): $240.00
- Each additional hour: $18.00

**Private Line Costs**

Based on MPL tariff

- First two terminations: $40.00
- Each additional termination: $0.52 per mile per month
- Mileage charge: $215.00 per month
## ADMINISTRATIVE COSTS*  

### INSTALLATION AND PLANNING

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Salaries</td>
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</tr>
<tr>
<td>Travel &amp; Expenses</td>
<td>$29,000</td>
</tr>
<tr>
<td>Management</td>
<td>$25,000</td>
</tr>
<tr>
<td>Overhead</td>
<td>$59,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$160,100</strong></td>
</tr>
</tbody>
</table>

### OPERATIONS & MAINTENANCE (per year)

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
<td>$33,900</td>
</tr>
<tr>
<td>Travel &amp; Expenses</td>
<td>$21,000</td>
</tr>
<tr>
<td>Overhead</td>
<td>$41,600</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$96,500</strong></td>
</tr>
</tbody>
</table>

*PSSC Estimates
SAMPLE SCENARIO

This section presents the sample scenario that may be accessed by the user when building his own scenario. The sample scenario contains a nominal set of costs and paths, all of which may be changed by the user. The information is presented in the same order in which it would be requested in the scenario builder.

TITLE - Sample Scenario Containing Nominal Costs

COST ALLOCATION - There are no member organizations and therefore no cost allocation.

UPLINK COST INDEXES - fixed, per peak hour, per off-peak hour, per studio, per ground link

UPLINK COST INDEX WEIGHTING FACTORS - There are no weighting factors since this applies only to cost allocation

UPLINK COST ELEMENTS:

DATA FOR COST ELEMENT SU -- SATELLITE USAGE

<table>
<thead>
<tr>
<th></th>
<th>FIXED</th>
<th>PER PEAK HR</th>
<th>PER OFFPK HR</th>
<th>PER STUDIO</th>
<th>PER GRD LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAP</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>INS</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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MINIMUM LEASE COST = 180000.00

DATA FOR COST ELEMENT S3 -- CASE 3 STUDIO COSTS

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MINIMUM LEASE COST = 0.00

A-9
### DATA FOR COST ELEMENT M1 -- 1-HOP MICROWV TO TOC*

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**MINIMUM LEASE COST =** 0.00

### DATA FOR COST ELEMENT VL -- AT&T VIDEO LK TO TOC

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**MINIMUM LEASE COST =** 0.00

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**MINIMUM LEASE COST =** 0.00

### DATA FOR COST ELEMENT S1 -- CASE 1 STUDIO COSTS

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**MINIMUM LEASE COST =** 0.00

### DATA FOR COST ELEMENT M2 -- 2-HOP MICROWV TO TOC

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**MINIMUM LEASE COST =** 0.00

*Television Operations Center

A-10
UPLINK COST/PATH MATRIX:

<table>
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<tr>
<th></th>
<th>SU</th>
<th>S3</th>
<th>M1</th>
<th>VL</th>
<th>T2</th>
<th>S1</th>
<th>M2</th>
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<td>★</td>
<td>★</td>
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<td>★</td>
<td>★</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>USE OWN E-T</td>
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<td>★</td>
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<td>★</td>
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DOWNLINK COST INDEXES - fixed, per peak hour, per off-peak hour, organization.

DOWNLINK COST INDEX WEIGHTING FACTORS - There are no weighting factors since this applies only to cost allocation.

DOWNLINK COST ELEMENTS:

DATA FOR COST ELEMENT CH -- 3RD CHNL RCVR ON E-T

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<tr>
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DATA FOR COST ELEMENT CT -- RENT CDN CARR E-T

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DATA FOR COST ELEMENT PT -- PVT EARTH TERMINAL

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A-11
### DATA FOR COST ELEMENT M1 -- 1-HOP MICROWAVE LINK

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| Minimum Lease Cost = 0.00

### DATA FOR COST ELEMENT VL -- AT&T VIDEO LINK

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| Minimum Lease Cost = 0.00

### DATA FOR COST ELEMENT CU -- USAGE OF CATV SYSTEM

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| Minimum Lease Cost = 0.00

### DATA FOR COST ELEMENT CC -- CATV SUBSCRIPTIONS

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| Minimum Lease Cost = 0.00

### DATA FOR COST ELEMENT MT -- TV MONITORS

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| Minimum Lease Cost = 0.00

A-12
DATA FOR COST ELEMENT M2 -- TWO-HOP MICROWAVE

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DATA FOR COST ELEMENT NC -- CATV COLOC WITH E-T

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<td>0.00</td>
</tr>
<tr>
<td>INS</td>
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</tr>
<tr>
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</tr>
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DOWNLINK COST/PATH MATRIX:

CH CT PT M1 VL CU CC MT M2 NC

- DIRECT LINK TO CATV
- OWN LINK TO CATV SYS
- PRIVATE EARTH TERM
- MICROWAVE TO USER
- 2-HOP MCRWV TO USER
- MONITOR ONLY
- RENTED E-T TO CATV

UPLINK CITIES - There are no uplink cities.

DOWNLINK CITIES - There are no downlink cities.

AUXILIARY PARAMETERS - see below.

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AMORTIZATION:

- INTEREST RATE 12.00 PERCENT
- EQUIPMENT LIFE 8.00 YEARS

A-13
GENERAL AND ADMINISTRATIVE:
CAP 0.00
INS 160000.00
LES 0.00
OMA 85000.00

TALKBACK CAPITAL EXPENDITURES:
14.50
APPENDIX B

MODEL FORMULATION

1. GENERAL STRUCTURE

The cost model consists of four basic parts: the input scenarios, the scenario builder, the cost algorithms, and the earth terminal data base and its corresponding utility (see Figure B-1).

The user establishes the network configuration with the aid of the scenario builder. The scenario builder accepts as input a scenario file that contains either system-supplied cost information (Appendix A) or some previously defined network scenario that requires modification. The
scenario builder allows the user to add, delete, and modify information interactively in the scenario. The output of the builder is a finished scenario tailored to the user's specifications.

The finished scenario serves as input to the model's cost algorithms (described in subsequent sections). In this module, the user inputs only the segments of the model of interest and the number and type of reports to be generated. Examples of the available reports appear in Appendix C.

The earth terminal module accesses the earth terminal data base. The user supplies a distance from his sites that is acceptable and the satellite that is desired. The module creates a list of earth stations that are within that given distance of the user's uplink and downlink cities and are licensed to point to the given satellite. It is up to the user to determine if the earth terminal can be shared. If so, the user specifies this condition during the scenario build.

Section 2 describes the software structure of the model, including a description of each of the programs used. Section 3 describes the variables and parameters used in the model. Section 4 presents the cost algorithms used in the uplink, downlink, and voice talkback segments of the model.

2. SOFTWARE STRUCTURE

The model is written in extended FORTRAN IV (Digital Equipment Corporation's FORTRAN IV-PLUS). It consists of three distinct modules: BUILD (scenario builder), MODEL (cost algorithms), and EARTH (earth terminal module).

This section describes each main program and subroutine and specifies the calling program, the subroutines called, and the arguments passed. A number of the subroutines are general utility subroutines and are called by all three modules. The section is organized as follows: BUILD, MODEL, and EARTH main program and subroutines, followed by the general utility subroutines.

-----------------------------------
BUILD - SCENARIO BUILDER
-----------------------------------

BUILD Main program for the scenario builder. It initializes certain parameters, and calls in the necessary subroutines to read in the scenario file, edit the cost, path, city, and rate information, and saves the modified scenario data.

Calls: COST, PATH, CITY, RATE, READIN, RITOUT, YESNO.
COST  Add to or modify data for the uplink or downlink cost elements. The user has the capability to define additional cost elements, add data for them, and include them in one or more paths. Cost element data consist of capital, installation, lease, and operations and maintenance costs for each cost element (piece of equipment or nonhardware cost unit) used in the analysis. The user also has the capability to set up a cost allocation methodology.

Called By: BUILD

Calls: GETTER, CODCHK, DISAPR, REPRTR, YESNO, UPDOWN, RDCOST, MATMOD

PATH  Defines or modifies data for uplink or downlink paths. Paths are video signal transmission options. The user can add or delete paths, change the cost elements associated with any of the paths, or specify the cities for which a path is valid.

Called By: BUILD

Calls: YESNO, UPDOWN, CODCHK, GETTER, MATMOD, DISAPR, REPRTR

CITY  Define or modify the characteristics of the cities that constitute the network under consideration. The user can add, modify, or delete cities from the network and associate paths with cities. City data include name (and member organization if applicable), state, location (latitude/longitude or Bell System V and H coordinates), channel number (for uplink cities), cost index values, and feasible paths.

Called By: BUILD

Calls: YESNO, UPDOWN, GETTER, CODCHK, CTYCHK, VANDH, MATMOD, DISAPR, REPRTR

RATE  Add or modify telephone charges, interest rates, and general and administrative costs.

Called By: BUILD

Calls: YESNO, GETTER, CODCHK, RATECK, REPRTR

MODEL - COST ALGORITHMS

MODEL  Main program for the cost algorithm model. It determines the portion(s) of the model that the user would like run, and the number and type of reports required, and it calls the appropriate subroutines to execute the cost algorithms.

Calls: MODUP, MODDN, MODTK, READIN, GETTER, CODCHK, REPRTR
MODUP  Executes the cost algorithms for the uplink segment of the model.
Called By: MODEL
Calls: REPRTR, VANDH

MODDN  Executes the cost algorithms for the downlink segment of the model.
Called By: MODEL
Calls: REPRTR, VANDH

MODTK  Executes the cost algorithms for the talkback segment of the model.
Called By: MODEL

EARTH - EARTH TERMINAL MODULE

EARTH  Main program for the earth terminal module. This program provides a list of earth terminals that are within a given distance from each city in a given user scenario. The list may be limited to those earth stations that are licensed to point to a particular user-specified satellite. The earth terminal information is obtained from an FCC-supplied data base.

Calls: MOVREC, CODCHK, VANDH, READIN

MOVREC  This subroutine sets up the array of selected earth terminals which will then be sorted and printed.
Parameters: i - index into city array
            j - index into earth terminal array
Called By: EARTH

GENERAL UTILITIES

READIN  Reads the scenario data file into an unnamed common.
Called By: BUILD, MODEL, EARTH

RITOUT  Writes out the scenario data into a new file.
Called By: BUILD
YESNO	 Determines if the responses to a question is "YES" or "NO" or in error and sets the appropriate flag.
Called By: BUILD, COST, PATH, CITY, RATE

UPDOWN	 Determines if the response to a question is "UPLINK" or "DOWNLINK" or in error and sets the appropriate flag.
Called By: COST, PATH, CITY

CODCHK	 Checks an input argument against a list of valid arguments.
Parameters: NCHAR - number of characters in input argument
INDATA - array containing input argument
NCOMPR - number of possible values
CMPARR - array containing list of possible values
POSTN - position in the array where input argument matched a possible value
Called By: COST, PATH, CITY, RATE, RDCOST, MATMOD, MODEL, EARTH

GETTER	 Retrieves the next argument on the command line.
Called By: COST, PATH, CITY, RATE, RDCOST, MATMOD, MODEL
Calls: CCOUNT

CCOUNT	 Counts characters in an input argument.
Parameters: ARG - argument to be counted
NCHAR - number of characters (computed)
Called By: GETTER

DISAPR	 Deletes a cost element, path, or city from the scenario data.
Parameters: Code - type of deletion
Index - position in arrays to be deleted
Called By: COST, PATH, RATE

RDCOST	 Reads in an input argument and tests for a cost element code.
Called By: COST
Calls: GETTER, CODCHK

RATECK	 Performs a range check of a data element.
Parameters: LOW - lower limit
UP - upper limit
XDAT - data element
Called By: RATE
CTYCHK  Determines if a city exists and, if it does, returns the index in the appropriate array.
Parameters:  POS - position in city array
             ORG - member organization
Called By:  CITY, MATMOD

VANDH  Converts latitude/longitude to Bell System V and H coordinates (provides a simpler means of estimating the distance between two cities).
Parameters:  M - latitude
             N - longitude
Called By:  CITY, MODUP, MODDN, EARTH

MATMOD  Associates (disassociates) a path with a city or cost element.
Parameters:  CODE - type of modify
             ONOFF - direction (1 or 0)
             MODPOS - index of element being modified
Called By:  COST, PATH, CITY
Calls:  GETTER, CODCHK, REPRTR, CTYCHK

REPRTR  Prepares reports on scenario data -- cost elements, cost element/path matrix, paths, path/city matrix, cities and cost index values, uplink/downlink talkback matrix, member organizations, and rates.
Parameters:  REPTYP - report type
             POS - index into arrays
Called By:  COST, PATH, CITY, RATE, MATMOD, MODEL, MODUP, MODDN

3. PARAMETER AND VARIABLE DEFINITIONS

This section describes the parameters and variables contained in the unnamed common, which is used in both the scenario builder and the cost algorithms modules. All arrays are shown dimensioned and, where applicable, the sizing parameter is specified. These parameters are also included in this description, and their nominal values are presented.

AMORT  Amortization factor.
ANNL(NDPATH)  Annualized cost of each path for a given city.
AORGCS(NUMORG,5)  Administrative capital, installation, lease, OMA, and annualized cost per member organization.
ARG(80)  General array used to hold the argument being processed.
BADD
Statement label to go to after processing an error.

BLANK
Holds four blank characters for use in output reports.

CAPCST
Capital cost of least-cost path.

CILO(5,2)
Literals for 'CAPITAL', 'INSTALL', 'LEASE', 'O&M&A', 'ANNUALZD' - used in output records.

CONTCD
Code indicating the presence of an additional argument in the user's input buffer.

DCINDX (NDINDX,8)
8-character downlink cost index names.

DCITYH (NDCITY)
Downlink city location -- H Coordinate.

DCITYV (NDCITY)
Downlink city location -- V Coordinate.

DCOSTX (NDCITY,4)
Capital, installation, lease, and OMA cost for each downlink city.

DCSCOD (NDELEM,2)
2-character downlink cost element code.

DCSDAT (NDELEM,NDINDX,4)
Capital, installation, lease, and OMA costs for a given downlink cost element and cost index.

DCSMIN (NDELEM)
Minimum lease cost for a given downlink cost element.

DCSNAM (NDELEM,20)
20-character downlink cost element name.

DCSPTH (NDELEM,NDPATH)
Matrix of cost elements for each downlink path.

DCTLVL (NDCITY)
Hierarchical level number for downlink city.

DCTNAM (NDCITY,16)
16-character downlink city name.

DCTORG (NDCITY)
Organization code for each downlink city.

DCTXVL (NDCITY,5)
Downlink city cost index values.

DDDCH
Direct dial cost per hour.

DDDINS
Direct dial installation cost.

DDDLES
Direct dial less cost per month.

DDXWHT (NDINDX)
Weighting factors for each downlink cost index.

DISCNT
Discount rate for amortization.

DORGCS (NUMORG,5)
Downlink capital, installation, lease, OMA, annualized costs by member organization.

DPTHCY (NDPATH,NDCITY)
Array of feasible paths for a downlink city.

DPTHNM (NDPATH,20)
20-character downlink path name.

DPTIDX (NDPATH,NDINDX,5)
Downlink capital, installation, lease, OMA, annualized costs for a given cost index and a given path.

DSTCOD (NDCITY,2)
2-character state code for downlink city.
EQPLIF  Number of years of equipment life (for amortizing capital expenditures).
GANDAD(4)  Capital, lease, installation, OMA general and administrative costs.
INDATA(80)  80-character input buffer for user responses.
INSCST  Installation cost of least-cost path.
LESCST  Lease cost of least-cost path.
MAXCS(2)  Maximum number of cost elements (overlay).
MAXCT(2)  Maximum number of cities (overlay).
MAXDCS  Maximum number of downlink cost elements (30).
MAXDCT  Maximum number of downlink cities (80).
MAXDPA  Maximum number of downlink paths (20).
MAXPA(2)  Maximum number of paths (overlay).
MAXUCS  Maximum number of uplink cost elements (15).
MAXUCT  Maximum number of uplink cities (10).
MAXUPA  Maximum number of uplink paths (10).
NCHAR  Number of characters in an argument.
NCITY(2)  Number of cities (overlay).
NDCITY  Number of downlink cities (80).
NDELEM  Number of downlink cost elements (30).
NDINDX  Number of downlink cost indexes (6).
NDPATH  Number of downlink paths (20).
NELEM(2)  Number of cost elements (overlay).
NINDX(2)  Number of cost indexes (overlay).
NPATH(2)  Number of paths (overlay).
NSTART  Pointer into input buffer.
NUCITY  Number of uplink cities (10).
NUELEM  Number of uplink cost elements (15).
NUINDX  Number of uplink cost indexes (6).
NUMORG  Number of member organizations (9).
NUPATH  Number of uplink paths (10).
NUPREF(NDCITY)  Preferred path for each city.
OMACST  OMA cost of least-cost path.
ORGNAM(NUMORG,20)  20-character member organization name.
PER  Literal 'PER'.

B-8
POSITN General index pointer into an array
PVTFIX Private line zero-mileage monthly charge.
PVTINS Private line installation charge.
PVTLES Private line monthly lease charge for a given city pair in talkback segment.
PVTMIL Private line monthly lease charge per mile.
REPLST(20,2) Literal numbering for output reports.
REPNUM(20) On/off array for report requests.
RUNSEC(4) On/off array for execution of the different segments of the model.
TALKBK(ND CITY,NU CITY) Number of talkback hours for a given city pair.
TCOST(6,5) Total cost array for a network.
TITLE(72) 72-character title for output reports.
TLKCAP Added capital expenditures required for adding voice talkback.
TORGCS(NUMORG,5) Talkback capital, installation, lease, OMA costs by member organization.
UCINDX(NUINDX,8) 8-character uplink cost index name.
UCITYH(NU CITY) Uplink city location -- H coordinate.
UCITYV(NU CITY) Uplink city location -- V coordinate.
UCOSTX(NU CITY,4) Capital, installation, lease, OMA costs for each uplink city.
UCSCOD(NUELEM,2) 2-character uplink cost element code.
UCSDAT(NUELEM,NUINDX,4) Capital, installation, lease, OMA costs for a given uplink cost element and cost index.
UCSMIN(NUELEM) Minimum lease cost for a given uplink cost element.
UCSNAM(NUELEM,20) 20-character uplink cost element name.
UCSPTH(NUELEM,NUPATH) Matrix of cost elements for each uplink path.
UCTCHN(NU CITY) Uplink city channel assigned.
UCTNAM(NU CITY,16) 16-character uplink city name.
UCTORG(NU CITY) Organization code for each uplink city.
UCTXVL(NU CITY,5) Uplink city cost index values.
UDXWHT(NUINDX) Weighting factor for each uplink cost index.
UORGC5(NUMORG,5) Uplink capital, installation, lease, OMA, annualized by member organization.
UPORDN(2,2) Literal -- 'UPLINK', 'DOWNLINK'.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPDPWN</td>
<td>Flag indicating the response to an uplink/downlink question (1 - uplink, 2 - downlink).</td>
</tr>
<tr>
<td>UPTHCY(NUPATH,NUCITY)</td>
<td>Array of feasible paths for an uplink city.</td>
</tr>
<tr>
<td>UPTHNM(NUPATH,20)</td>
<td>20-character uplink path name.</td>
</tr>
<tr>
<td>UPTIDX(NUPATH,NUINDX,5)</td>
<td>Uplink capital, installation, lease, OMA, annualized costs for a given cost index and a given path.</td>
</tr>
<tr>
<td>USTCOD(NUCITY,2)</td>
<td>2-character state code for an uplink city.</td>
</tr>
<tr>
<td>WATCPH</td>
<td>WATS charge per hour of utilization.</td>
</tr>
<tr>
<td>WATINS</td>
<td>WATS installation charge.</td>
</tr>
<tr>
<td>WATLES</td>
<td>WATS lease charge per month.</td>
</tr>
<tr>
<td>WATMAX</td>
<td>Maximum monthly charges for WATS.</td>
</tr>
<tr>
<td>WGTARR(NDCITY)</td>
<td>Weight factors for cost allocation.</td>
</tr>
<tr>
<td>XDATA(NDINDX)</td>
<td>Temporary storage for cost index data.</td>
</tr>
<tr>
<td>XORGCS(NUMORG,5)</td>
<td>Total capital, installation, lease, OMA, annualized cost by member organization.</td>
</tr>
<tr>
<td>YESSNO</td>
<td>Flag indicating the response to a yes/no question (1 - yes, 2 - no).</td>
</tr>
</tbody>
</table>

4. COST ALGORITHMS

This section presents the cost algorithms used in the uplink, downlink, and voice talkback segments of the model. Variable names mentioned were described in Section 3 of this appendix.

**UPLINK SEGMENT**

Calculations in the uplink segment are done one city at a time. For each city, the annualized cost of each path is calculated and stored temporarily. Data for the least expensive path are set aside, and the process is repeated for the other cities.

The calculations are shown diagrammatically in Figure B-2. The process consists of a number of matrix multiplications. Braces in the diagram indicate what each dimension of the matrix signifies. The C, I, L, and O indicate that calculations are done for Capital, Installation, Lease, and O&M&A costs. These component costs are ultimately annualized and the results compared to determine the best path. Once the best path is known, the model can extract the component capital, installation, lease, and O&M cost corresponding to that path for reporting purposes.
The first step in the computation process is to calculate the capital, installation, lease, and O&M cost of each path. That is,

\[
UPTIDX(I, K, L) = \sum_{J=1}^{N} UCSPTH(J, I) \times UCSDAT(J, K, L)
\]

where
- \( I \) = path number
- \( J \) = cost element subscript
- \( K \) = cost index subscript
- \( L \) = cost categories (1 = capital, 2 = installation, 3 = lease, 4 = O&M)

**Figure 8-2. MATRIX CALCULATIONS IN THE UPLINK AND DOWNLINK SEGMENTS**
This calculation yields the cost by cost index (i.e., per hour or per organization) for each path, broken out by the four cost categories. The matrices resulting from this calculation would apply to any of the cities.

The second step is to multiply the resulting matrix by the values of each of the cost indexes for the city under consideration. Thus,

\[
\begin{bmatrix}
\text{CAPCST} \\
\text{INSCST} \\
\text{LESCST} \\
\text{OMACST}
\end{bmatrix}
= \sum_{K=1}^{\text{NUINDX}}
\begin{bmatrix}
\text{UCTVL(M,K)} \\
\text{UPTIDX(I,K,1)} \\
\text{UPTIDX(I,K,2)} \\
\text{UPTIDX(I,K,3)} \\
\text{UPTIDX(I,K,4)}
\end{bmatrix}
\]

where

I = path number
K = cost index subscript
M = city subscript
UCTVL(M,K) = the value of the Kth cost index (e.g., hours, studios) for city M

The calculation of lease costs is somewhat more complicated because the user may specify a minimum lease charge to apply to any of the cost elements. If a minimum is specified, the program recalculates LESCST to take this into account.

Finally, the capital and installation costs are amortized to an annual expenditure and added to the lease and O&M&A costs, yielding an annualized cost for each path:

\[
\text{ANNL(I)} = \frac{(\text{CAPCST} + \text{INSCST})}{\text{AMORT}} + \text{LESCST} + \text{OMACST}
\]

AMORT is the amortization factor, equal to \(\sum_{i=1}^{N} \left(\frac{1}{1+R}\right)^i\). R is the interest rate, and N the number of years of amortization. The resulting vector \(\text{ANNL}\) contains the annualized cost of each path in the given city. A simple comparison will determine the least expensive path.

**DOWNLINK SEGMENT**

The program logic of the downlink segment is identical to that of the uplink, except that the array names are different.

As in the uplink segment, calculation of the least-cost path is done in the following three steps:

1. **Calculate Cost Parameters for Each Path**

\[
\text{DPTIDX(I,K,L)} = \sum_{J=1}^{\text{NDELEM}} \text{DCSPTH(J,I)} \times \text{DCSDAT(J,K,L)}
\]
where

\[ I = \text{path number} \]
\[ J = \text{cost element subscript} \]
\[ K = \text{cost index subscript} \]
\[ L = \text{cost categories} \]

2. Calculate Cost of Each Path in Each City

\[
\begin{bmatrix} \text{CAPCST} \\ \text{INSCST} \\ \text{LESCST} \\ \text{OMACST} \end{bmatrix} = \sum_{K=1}^{NDINDX} \frac{DCXTVL(M,D) \times DPTIDX(I,K,2) - DPTIDX(I,K,1)}{DPTIDX(I,K,3) - DPTIDX(I,K,4)}
\]

3. Calculate Annualized Cost by Path

\[ \text{ANNL}(I) = \frac{\text{CAPCST} + \text{INSCST}}{\text{AMORT}} + \text{LESCST} + \text{OMACST} \]

The ANNL array contains the annualized cost of each path for a given city. The entries of this array are compared to determine the least-cost path.

**VOICE TALKBACK SEGMENT**

When building the scenario, the user must specify for each downlink city the voice talkback requirements to each uplink city. Depending on the network requirements, the talkback can be either directly to the uplink city or to an intermediate "feeder" city. The hierarchical levels specified for the downlink segment are used. In this situation, if a given downlink city is of level 3, the voice communications link must go to the nearest level-2 city.

The talkback segment is similar to uplink and downlink in that there are cost elements and paths; however, the paths may not be altered by the user. Three possible paths are available: private line, WATS, and DDD. The most cost-effective option depends on monthly utilization and the distance between the two cities. Installation charges are amortized and added to the lease for the purpose of comparing monthly costs. However, even a $100 installation charge amortizes to less than $2 per month, and so these costs can be a negligible amount. Therefore, lease is the primary factor determining which option is selected.
This appendix presents the reports generated by the system cost model. The scenario illustrated here is the cost allocation case where the Federal regional offices and the top 20 SMSA cities share costs. The scenario is described in more detail in Chapter Three.

The appendix consists of 20 reports. The first 19 reports are the output from the cost model program. The last report is the output of the earth terminal utility. These reports are described by number and in the order in which they appear.

1. **Auxiliary Parameters.** Presents talkback parameters, amortization rates, and general administrative costs. This information is provided in the sample scenario and can be modified during the "rate" portion of the scenario builder.

2. **Uplink Cost Element Data.** Presents each of the uplink cost elements in the scenario, including the cost element name, its associated code, and the associated cost matrix broken down by capital, installation, lease, and OMA, and by each of the applicable cost indexes (such as fixed, per peak hour, per studio). This information is provided in the sample scenario and can be modified during the "cost" portion of the scenario builder.

3. **Matrix of Cost Elements and Paths -- Uplink.** Identifies the uplink cost elements associated with each uplink transmission path and presents them in matrix format. Cost elements are represented by their 2-character codes. This information is provided in the sample scenario and can be modified during the "cost" and "path" portions of the scenario builder.

4. **Matrix of Paths and Cities -- Uplink.** Identifies a matrix of uplink cities and paths. Uplink paths are represented by their path number. ORG represents the member organization number (if cost allocation has been selected). Cities will be listed once for each associated member organization. The information may be entered by the user in the "path" or "city" portion of the scenario builder, but this cannot be done until the city is defined.
5. **Uplink Cost Index Values.** Presents the cost index values associated with each uplink city. This corresponds to the number of peak hours, studios, etc., for a given city. The information may by entered during the "city" portion of the scenario builder.

6. **Matrix of Talkback Requirements.** Presents a matrix of talkback hours between downlink and uplink cities. Uplink city names are abbreviated to 3 characters, and the associated organization number is presented below. An entry exists for each uplink and downlink city by member organization. This information can be modified in the "city" portion of the scenario builder.

7. **Sensitivity of Path Costs to Network Parameters -- Uplink.** Combines the uplink cost element data with the matrix of uplink cost elements and paths (Report 3) to obtain the generalized cost of each uplink path. Annualized figures per path are also included.

8. **Cost of Each Path -- Uplink.** Presents, for each of the uplink cities, the total cost of each applicable path.

9. **Uplink Costs by City.** Presents, for each of the uplink cities, the total cost of the selected path. The report also includes the cost index values for each city and the aggregate cost for all uplink cities.

10. **Downlink Cost Element Data.** Downlink equivalent of report 2.


13. **Downlink Cost Index Values.** Downlink equivalent of report 5.


15. **Cost of Each Path -- Downlink.** Downlink equivalent of report 8.

16. **Downlink Costs by City.** Downlink equivalent of report 9.

17. **Talkback System Lease Costs.** Presents one report per uplink city identifying the comparative costs of voice talkback using WATS, private line, and direct dial, and suggests the preferred medium in each case.

19. **Overall Cost Summary.** Presents total network costs by model segment but does not indicate cost allocation.

20. **Earth Terminal Report.** Presents earth terminal information for those earth stations within a given distance from a scenario's uplink or downlink city and licensed to point to a given satellite. The following conventions are used in the report:

a. **Satellites** are represented by the following identifiers:

- KS20 - WESTAR I
- KS21 - WESTAR II
- KS22 - WESTAR III
- KS26 - COMSTAR D-1
- KS27 - COMSTAR D-2
- KS28 - COMSTAR D-3
- KS29 - COMSTAR D-4
- KS30 - SATCOM I
- KS31 - SATCOM II
- KS32 - SATCOM III
- ANIK1 - Canadian Telesat Satellites
- ANIK2
- ANIK3
- MR1 - Marisat I
- MR2 - Marisat II
- MR3 - Marisat III
- IN1 - Intelsat I
- IN2 - Intelsat II
- IN3 - Intelsat III
- IN4 - Intelsat IV
- IN4A - Intelsat IV-A
- IN5 - Intelsat V
- KS36 - SBS I
- KS37 - SBS II
- KS38 - SBS III

b. **Service** is a combination of abbreviations that indicate the type of service, class of station, regulatory classification, and type of facility. The abbreviations have the following meanings:

**Type of Service**

- **DFS** - Domestic fixed satellite
- **CS** - Communications satellite
- **MMS** - Maritime mobile-satellite
- **IP** - International press service (IHF)
- **IFP** - International fixed public (IHF)
- **IC** - International control
- **X** - Other
Class of Station

FES - Fixed earth station
SS - Space station
TFE - Temporary fixed earth station
PPT - Point-to-point telephone/telegraph (IMF)
TEL - Point-to-point telephone (IMF)
TGF - Point-to-point telegraph (IMF)

Regulatory Classification

C - Common carrier
P - Private
D - Developmental

Type of Earth Station Facility

TO - Transmit-only
RO - Receiver-only
TR - Transmit/receive

c. Size is the antenna size expressed in tenths of a meter.
### Auxiliary Parameters

**Talkback:**
- **Installation:** 40.00
- **Zero Usage Charge/Mo.:** 0.00
- **Mileage Charge:**
  - **Hourly Charge:** 31.20
  - **Maximum Charge:** 1200.00
- **Amortization:**
  - **Interest Rate:** 12.00 PERCENT
  - **Equipment Life:** 8.00 YEARS

**General and Administrative:**
- **CAP:** 0.00
- **INS:** 160000.00
- **LES:** 0.00
- **OMA:** 85000.00

**Talkback Capital Expenditures:** 14.50

---

_Federal Regional Offices, Top 20 SMSA's -- Cost Allocation Case_

**Report 1 - Auxiliary Parameters**

C-5
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

UPLINK COST ELEMENT DATA

DATA FOR COST ELEMENT SU -- SATELLITE USAGE

<table>
<thead>
<tr>
<th></th>
<th>FIXED</th>
<th>PER PEAK HR</th>
<th>PER OFFPK HR</th>
<th>PER STUDIO</th>
<th>PER GRD LINK</th>
</tr>
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<tr>
<td>CAP</td>
<td>0.00</td>
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<td>0.00</td>
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<td>0.00</td>
<td>0.00</td>
</tr>
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MINIMUM LEASE COST = $180000.00

DATA FOR COST ELEMENT S3 -- CASE 3 STUDIO COSTS

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MINIMUM LEASE COST = $0.00

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MINIMUM LEASE COST = $0.00

DATA FOR COST ELEMENT VL -- AT&T VIDEO LK TO TOC

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MINIMUM LEASE COST = $0.00

(continued)
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Minimum Lease Cost = 0.00

### DATA FOR COST ELEMENT S1 -- CASE 1 STUDIO COSTS

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Minimum Lease Cost = 0.00

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Minimum Lease Cost = 0.00

REPORT 2 - (continued)
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

MATRIX OF COST ELEMENTS AND PATHS -- UPLINK

| MICROWAVE TO E-T | * | * | * |
| VIDEO LINK TO E-T | * | * | * |
| USE OWN E-T | * | * | * |
| MICROWAVE TO OWN E-T | * | * | * | * |
| VIDEO LINK TO OWN E-T | * | * | * | * |

REPORT 3 - MATRIX OF COST ELEMENTS AND PATHS -- UPLINK

C-8
### FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

**MATRIX OF PATHS AND CITIES -- UPLINK**

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REPORT 4 - MATRIX OF PATHS AND CITIES -- UPLINK

C-9
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FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS-- UPLINK

PATH 1 -- MICROWAVE TO E-T

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PATH 5 -- VIDEO LK TO OWN E-T

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REPORT 7 - SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS -- UPLINK
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

COST OF EACH PATH -- UPLINK

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REPORT 8 -- COST OF EACH PATH -- UPLINK

C-13
### Uplink Costs by City

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<th>Capital Install</th>
<th>Lease</th>
<th>QM&amp;A Annualized</th>
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<td>102000.</td>
<td>452660.</td>
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Peak HR: 1040.
OffPk HR: 1300.
Studio: 2.
Grd Link: 2.

**Uplink Total:**
- Capital: 398800.
- Install: 102000.
- Lease: 452660.
- QM&A Annualized: 202000.
- Total: 755472.

---

**Report 9 - Uplink Costs by City**

C-14
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

DOWNLINK COST ELEMENT DATA

DATA FOR COST ELEMENT CN -- 3RD CNL RCVR ON E-T

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MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT CT -- RENT CDM CARR L-T

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MINIMUM LEASE COST = 0.00

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MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT M1 -- 1-HOP MICROWAVE LINK

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MINIMUM LEASE COST = 0.00

(continued)
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**MINIMUM LEASE COST = 0.00**

### DATA FOR COST ELEMENT CU -- USAGE OF CATV SYSTEM

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**MINIMUM LEASE COST = 0.00**

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**MINIMUM LEASE COST = 0.00**

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**MINIMUM LEASE COST = 0.00**

### DATA FOR COST ELEMENT M2 -- Two-Hop Microwave

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**MINIMUM LEASE COST = 0.00**

(continued)

**REPORT 10 - (continued)**

C-16
DATA FOR COST ELEMENT NC -- CATV COLOC WITH E-T

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MINIMUM LEASE COST = -10000.00

REPORT 10 - (continued)
### MATRIX OF COST ELEMENTS AND PATHS -- DOWNLINK

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FEDERAL REGIONAL OFFICES, TOP 20 SMSA’S -- COST ALLOCATION CASE

MATRIX OF PATHS AND CITIES--DOWNLINK

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REPORT 12 – MATRIX OF PATHS AND CITIES -- DOWNLINK
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REPORT 13 - (continued)

C-21
### FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

**SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS -- DOWNLINK**

**PATH 1 -- DIRECT LINK TO CATV**

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**PATH 2 -- OWN LINK TO CATV SYS**

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**PATH 5 -- 2-HOP MICROWAVE TO USER**

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### FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

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**REPORT 15 - COST OF EACH PATH -- DOWNLINK**

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FEDERAL REGIONAL OFFICES; TOP 20 SMSA’S -- COST ALLOCATION CASE

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REPORT 16 - DOWNLINK COSTS BY CITY

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REPORT 16 (continued)

C-29
### FEDERAL REGIONAL OFFICES: TOP 20 SMSA'S -- COST ALLOCATION CASE

#### TALKBACK SYSTEM LEASE COSTS TO WASHINGTON

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**REPORT 17 - TALKBACK SYSTEM LEASE COSTS**

C-30
### Federal Regional Offices, Top 20 SMSA's -- Cost Allocation Case

#### Network Cost Allocation

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<td>162500</td>
<td>72516</td>
<td>271206</td>
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<td>63383</td>
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<td>452660</td>
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| **Downlink**   |         |         |        |         |            |
| 1 Federal Offices | 50200  | 1800   | 1800   | 1000    | 13268      |
| 2 SMSA's       | 142400  | 22200  | 2880   | 6500    | 42514      |
| **Total**      | 192600  | 24200  | 4680   | 7500    | 55782      |

| **Voice Talkback** |         |         |        |         |            |
| 1 Federal Offices | 87      | 240    | 8611   | 0       | 8677       |
| 2 SMSA's         | 218     | 600    | 14976  | 0       | 15141      |
| **Total**        | 305     | 840    | 23587  | 0       | 23818      |

| **Administrative** |         |         |        |         |            |
| 1 Federal Offices | 0       | 53333  | 0      | 28333   | 39069      |
| 2 SMSA's         | 0       | 104667 | 0      | 56667   | 78139      |
| **Total**        | 0       | 160000 | 0      | 85000   | 117208     |

| **Total Network** |         |         |        |         |            |
| 1 Federal Offices | 193452  | 91990  | 172911 | 101849  | 332221     |
| 2 SMSA's         | 398253  | 194850 | 308016 | 192651  | 620060     |
| **Total**        | 591705  | 286840 | 480927 | 24500   | 952281     |

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Report 18 - Network Cost Allocation

C-31
OVERALL COST SUMMARY

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<th>ANNUAL O&amp;M</th>
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EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $ 952,281.
### Federal Regional Offices and Top 20 SMSA's

#### Uplink Cities--Earth Stations Within 15 Miles and Licensed to Point to KS30

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<th>Licensee</th>
<th>City</th>
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<td>WE74</td>
<td>AMERICAN SATELLITE CORPORATION</td>
<td>GREENBELT</td>
<td>MD</td>
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#### Downlink Cities--Earth Stations Within 15 Miles and Licensed to Point to KS30

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<th>State</th>
<th>Service</th>
<th>Size</th>
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<td>MA</td>
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KR53 KTS CORP. DBA KINNELOA TELEVISION S PASADENA CA DFSFESPRO 0045
KR30 SAMMONS COMMUNICATIONS, INC. GLENDALE CA DFSFESPRO 0043
KQ77 THE CHRISTIAN BROADCASTING NETWORK, LOS ANGELES CA DFSFESPRO 0100
KL76 DOUGLAS TELEVISION COMPANY, INC. PAYSON AZ DFSFESPRO 0050
KL47 KING VIDEOCABLE COMPANY LOS ANGELES CA DFSFESPRO 0050
KJ96 SPANISH INTERNATIONAL COMMUNICATION HOLLYWOOD CA DFSFESPTR 0100
KB94 THETA CABLE OF CALIFORNIA SANTA MONICA CA DFSFESPRO 0045
K072 RCA AMERICAN COMMUNICATIONS, INC. PASADENA CA DFSFESCTR 0100

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WX69 RCA AMERICOM SOUTHFIELD MI DFSFESDRO 0070
WX56 THE CHRISTIAN BROADCASTING NETWORK, DETROIT MI DFSFESPRO 0050
WX80 CONTINENTAL CABLEVISION OF MACOMB ROSEVILLE MI DFSFESPRO 0050
WX61 HI-NET COMMUNICATIONS, INC. LIVONIA MI DFSFESPRO 0050
WX60 HI-NET COMMUNICATIONS, INC. WARREN MI DFSFESPRO 0050
WH30 GREATER STAR LINK CORP. DETROIT MI DFSFESCTR 0100

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WV73 ANTHONY MANCINI PITTSBURGH PA DFSFESPRO 0046
WV70 ANGELO VALENT CABLE TV OAKDALE PA DFSFESPRO 0050
WS31 CENTRE VIDEO INC. PENN HILLS TWP PA DFSFESPRO 0050
WR27 WESTERN PENNSYLVANIA CHRISTIAN BROA WALL BOROUGH PA DFSFESPRO 0060
WG87 BAILSY TV & CABLE CO., INC. CANONSBURG PA DFSFESPRO 0045

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REPORT 20 - (continued)
APPENDIX D

PROGRAM LISTINGS

This appendix presents the program listings for the Video Distribution System Cost Model. The programs are presented in four sections. The first three sections include the principal programs associated with each of the three modules -- BUILD, MODEL, and EARTH. The last section includes the general utility subroutines used by all three modules.
SECTION 1. BUILD MODULE

Section 1 includes listings for the common area description, the main program for the BUILD module, and the following subroutines:

COST
PATH
CITY
RATE
THIS IS THE COMMON AREA 'INCLUDED' IN THE SCENARIO BUILDER AND MODEL PROGRAMS. THE FILE NAME IS 'COMSLK'.

INTEGER*2 NUELEM, NDELEM, NUINDEX, NDINDEX, NUCITY, NDCITY, NUPATH, NDPATH
COMMON NUELEM, NDELEM, NUINDEX, NDINDEX, NUCITY, NDCITY, NUPATH, NDPATH
INTEGER*2 NUELEM(2), NUINDEX(2), NUCITY(2), NUPATH(2)
EQUIVALENCE (NUELEM, NUELEM(1)), (NUINDEX, NUINDEX(1))
EQUIVALENCE (NUCITY, NUCITY(1)), (NUPATH, NUPATH(1))
INTEGER*2 NUMORG, MAXUCS, MAXDSCS, MAXUPA, MAXDPA, MAXUCT, MAXDCT, BADD
COMMON NUMORG, MAXUCS, MAXDSCS, MAXUPA, MAXDPA, MAXUCT, MAXDCT, BADD
INTEGER*2 MAXUCS(2), MAXDSCS(2), MAXUPA(2), MAXDPA(2), MAXUCT(2), MAXDCT(2)
EQUIVALENCE (MAXUCS, MAXUCS(1)), (MAXDSCS, MAXDSCS(1)), (MAXUPA, MAXUPA(1)), (MAXDPA, MAXDPA(1)), (MAXUCT, MAXUCT(1)), (MAXDCT, MAXDCT(1))
INTEGER*2 UCITYV(10), UCITYH(10), DCITYV(80), DCITYH(80)
COMMON UCITYV, UCITYH, DCITYV, DCITYH
INTEGER*2 MAXCS(2), MAXPA(2), MAXCT(2)
EQUIVALENCE (MAXUCS, MAXCS(1)), (MAXDSCS, MAXPA(1)), (MAXUPA, MAXCT(1))
INTEGER*2 UCITYV(10)
COMMON UCITYV
INTEGER*2 NCHAR, NSTART, PCONT, YESSNO, UP, DOWN, POSITON
COMMON NCHAR, NSTART, PCONT, YESSNO, UP, DOWN, POSITON
REAL*4 DDDCPH, DDLES, PDOPLIF, QVLES, PVTLES, PVTFIX, PVTINS, PVTMIL
COMMON DDDCPH, DDLES, PDOPLIF, QVLES, PVTLES, PVTFIX, PVTINS, PVTMIL
REAL*4 DCSDAT(30, 6, 4), DCSAMP(30, 6, 4), UCSDAT, DCSDAT, GANDAD
COMMON DCSDAT, UCSDAT, GANDAD
REAL*4 UCSMIN(15), UCSMAX(10), UCSDAT(30, 6, 4), UCSMAX(10), UCSDAT(30, 6, 4)
COMMON UCSMIN, UCSMAX, UCSDAT, UCSMAX
REAL*4 DDXWHT(6), UCXWHT(6), TALKBK(80, 10), XDATA(6)
COMMON DDXWHT, UCXWHT, TALKBK, XDATA
LOGICAL*1 UCSMIN(15, 2), UCSMAX(10, 16), UCSMIN(30, 20), UCSMAX(30, 20)
COMMON UCSMIN, UCSMAX, UCSMIN, UCSMAX
LOGICAL*1 UCSPTH(15, 10), UCSPTH(30, 20), UCSPTH(10, 10), UCSPTH(20, 80)
COMMON UCSPTH, UCSPTH, UCSPTH, UCSPTH
LOGICAL*1 UCSTNM(10, 16), UCSTNM(30, 16), UCSTNM(10, 2), UCSTNM(30, 2)
COMMON UCSTNM, UCSTNM, UCSTNM, UCSTNM
LOGICAL*1 INDATA(80), ORGNAM(9, 20), UCINDEX(15, 8), DCINDEX(15, 8)
COMMON INDATA, ORGNAM, UCINDEX, DCINDEX
LOGICAL*1 UPTNHM(10, 20), UPTNMH(20, 20), ARG(80)
COMMON UPTNHM, UPTNMH, ARG
LOGICAL*1 UCTCHN(10), DCCHN(80), UCCTCHN(10), DCCHN(80)
COMMON UCTCHN, DCCHN, UCCTCHN, DCCHN
LOGICAL*1 TITLE(72)
COMMON TITLE
THIS IS THE MAIN PROGRAM FOR THE MODEL

SUBROUTINE CALLS: READIN, COST, PATH, CITY, RATE, YESNO, RITOUT

VARIABLES

MAXUCS - MAXIMUM NUMBER OF UPLINK COST INDEXES
MAXDCS - DOWNLINK

MAXUPA - MAXIMUM NUMBER OF UPLINK PATHS
MAXDPA - DOWNLINK

MAXUCT - MAXIMUM NUMBER OF UPLINK CITIES
MAXDCT - DOWNLINK

UCINDX - THE 'FIXED' UPLINK COST INDEX
DCINDEX - THE 'FIXED' DOWNLINK COST INDEX

INCLUDE 'SYO:COMBLK.FTN/NOLIST'

DATA MAXUCS /15/, MAXDCS /30/, MAXUPA /10/, MAXDPA /20/

DATA UCINDX /'F'95*/, 'P'IPS*, 'R'X#,5*, 'P'EPS*, 'R'D#,23*/

DATA DCINDEX /'F'#$*, 'P'IPS*, 'R'X#,5*, 'P'EPS*, 'R'D#,23*/

C     OPEN AND READ USER-SELECTED SCENARIO FILE

CALL READIN

WRITE (1,8) 'SCENARIO TITLE IS...

WRITE (1,10) (TITLE(I),I=1,72)

FORMAT (1072A1)

10 FORMAT ('O'72A1/)

20 WRITE (1*) 'DO YOU WANT TO ENTER A NEW TITLE'

CALL YESNO

C     CALL SUBROUTINES TO EDIT COST, PATH, CITY, AND RATE INFORMATION

CALL COST

CALL PATH

CALL CITY

CALL RATE

C     DO YOU HAVE ANY MORE MODIFICATIONS TO MAKE TO THE SCENARIO?

CALL YESNO

C     GO TO (30, 50, 100) YESNO

CALL RITOUT

STOP

END
SUBROUTINE COST

THE COST MODULE IS USED TO ADD TO OR MODIFY DATA FOR THE UPLINK OR DOWNLINK COST ELEMENTS. THE USER HAS THE CAPABILITY TO DEFINE ADDITIONAL COST ELEMENTS, ADD DATA FOR THEM, AND INCLUDE THEM IN ONE OR MORE PATHS. COST ELEMENT DATA CONSISTS OF CAPITAL, INSTALLATION, LEASE, AND OPERATIONS AND MAINTENANCE COSTS FOR EACH COST ELEMENT (PIECE OF EQUIPMENT OR NON-HARDWARE COST UNIT) USED IN THE ANALYSIS. A SINGLE COST ELEMENT MAY CONSIST OF MANY INDIVIDUAL ITEMS AS LONG AS THEY ARE ALWAYS CONSIDERED TOGETHER.

THE USER ALSO HAS THE CAPABILITY TO SET UP A COST ALLOCATION METHODOLOGY.

ARRAY VARIABLES

UCSCOD - 2 CHARACTER UPLINK COST ELEMENT CODE
DCSCOD - DOWNLINK
UCSNAM - 20 CHARACTER UPLINK COST ELEMENT NAME
DCSNAM - DOWNLINK
UCSDAT - CAPITAL, INSTALLATION, LEASE, AND OPERATIONS COSTS FOR EACH UPLINK COST ELEMENT AND COST INDEX
DCSDAT - DOWNLINK
UCSMIN - MINIMUM LEASE CHARGE FOR EACH UPLINK COST ELEMENT
DCSMIN - DOWNLINK
UCSPTH - MATRIX OF COST ELEMENTS FOR EACH UPLINK PATH
DCSPTH - DOWNLINK
ORGNAM - 20 CHAR NAMES OF MEMBER ORGANIZATIONS FOR ALLOCATING COSTS
UCINDX - 8 CHARACTER COST INDEX NAMES FOR UPLINK
DCINDX - DOWNLINK
UDXWHT - WEIGHTING FACTORS FOR COST ALLOCATION OF UPLINK COSTS
DDXWHT - DOWNLINK
CSTCMD - ARRAY OF COMMANDS FOR USE IN THE COST MODULE
CSMCMD - ARRAY OF SUBCOMMANDS USED IN THE COST MODULE

SCALAR VARIABLES

NUELEM - NUMBER OF UPLINK COST ELEMENTS
NDELEM - DOWNLINK
NUINDX - NUMBER OF UPLINK COST INDEXES
NDINDX - DOWNLINK
UPPDWN - FLAG SET TO SPECIFY UPLINK OR DOWNLINK PROCESSING
XDAT, XDATA - VARIABLES USED TO READ USER RESPONSE INTO
SUBROUTINE CALLS: GETTER, CDDCHK, DISAPR, REPRT
THIS ROUTINE CALLED BY: BLD

LOCAL VARIABLES

LOGICAL: MODFLAG, CSTCMD(5,3), CBXCMD(9,3)
REAL: PER I INPUT2
DATA PER /"PER"
DATA CSTCMD /"E","A","H","D","L"
2 /"E","D","G","E","I"
3 /"I","D","L","S"
DATA CBXCMD /"C","I","L","D","C","N","A","R","E"
2 /"A","N","E","D","M","O","A","D","E","X"
3 /"P","E","A","A","D","N","R","I"

ASK FOR COST INFORMATION

WRITE (1,*),'DO YOU HAVE COST INFORMATION TO ENTER?'
CALL YESNO
WRITE (1,*),'DO YOU WANT TO CHANGE YOUR COST ALLOCATION?'
CALL YESNO

NUMORG = 0
WRITE (1,*),'ENTER LIST OF MEMBERS TO SHARE COSTS - 1 TO END'
READ (1,01) (INDATA(I), I=1,80)
CALL GETTER
IF (ARG(1).NE.1) GO TO 85
IF (NUMORG.EQ.0) WRITE(1,*),'WARNING: NO ORGANIZATIONS SPECIFIED.'
IF (NUMORG.EQ.0) WRITE(1,*),'COST ALLOCATION IGNORED.'
GO TO 97
C TOO MANY MEMBERS
C
0066 95 WRITE (1,*),'ONLY 9 ORGANIZATIONS CAN BE SPECIFIED'
C
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C ASK FOR UPLINK OR DOWNLINK PROCESSING
C
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0067 97 WRITE(1,*),'DO YOU WANT TO EDIT UPLINK OR DOWNLINK COST DATA?'
0068 98 WRITE(1,*),'(UP OR DOWN)'
0069 CALL UPDOWN
0070 C
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C MODIFY COST INDEXES
C
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0071 100 WRITE (1,*),'DO YOU WANT TO MODIFY COST INDEXES?'
0072 CALL YESNO
C YES NO ERR
0073 120 GO TO (120,280,100), YESNO
0074 120 YESNO = 1
0075 122 WRITE (1,*),'ENTER NEW LIST OF COST INDEX NAMES'
0076 125 READ (1,1010),(INDATA(I),I=1,80)
0077 130 CALL GETTER
0078 132 IF (ARG(1).EQ.'1') GO TO 150
0079 IF (NCHAR.EQ.0) GO TO 138
0080 IF (NINDEX(UPPDWN).EQ.6) GO TO 145
0081 NINDEX(UPPDWN) = NINDEX(UPPDWN) + 1
0082 DO 133 J=1,6
0083 IF (UPPDWN.EQ.1) UCINDEX(MINDEX,J) = ARG(J)
0084 IF (UPPDWN.EQ.2) DCINDEX(MINDEX,J) = ARG(J)
0085 133 CONTINUE
0086 138 IF (CONTCD.EQ.0) GO TO 122
0087 IF (CONTCD.NE.0) GO TO 130
C TOO MANY INDEXES INPUT
C
0088 145 WRITE (1,*),'ONLY 6 COST INDEXES CAN BE SPECIFIED'
C
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C ENTER COST INDEX WEIGHTING FACTORS
C
D-9
COST.FTN

```fortran
0090 150 IF (NUMORG.EQ.0) GO TO 280
0091  ASSIGN 150 TO BADD
0092  GO TO (152,160) UPPDWN
0093 152 WRITE (1,1200) ((UCINDX(I,J),J=1,NI),I=1,NUINDX)
0094  READ (1,*ERR=170) (XDATA(I),I=1,NUINDX)
0095  DO 155 I=1,NUINDX
0096 155 UDWH(T(I)) = XDATA(I)
0097  GO TO 280
0098 160 WRITE (1,1200) ((DCINDX(I,J),J=1,NJ),I=1,NDINDX)
0099  READ (1,*ERR=170) (XDATA(I),I=1,NDINDX)
0100  DO 165 I=1,NDINDX
0101 165 DDWHT(I) = XDATA(I)
0102  GO TO 280
C
C ERROR IN READ
C
0103 170 WRITE(1,*)'ERROR IN READING NUMERICAL DATA--PLEASE RE-ENTER'
0104  GO TO BADD
C
C COST COMMAND PROCESSING
C
0105 280 WRITE (1,*) 'ENTER COST COMMAND'
0106  READ (1,1010) (INDATA(I),I=1,80)
0107  CALL GETTER
0108  CALL CODCHK (3,ARG,CSTCMD,POSITN)
C
C EXI ADD DEL MOD LIS
0109  IF (POSITN .NE. 0 ) GO TO (900,400,705,800) POSITN
0111  WRITE (1,*) 'INVALID COST COMMAND'
0112  GO TO 280
C
C ADD COST ELEMENT
C
0113 400 WRITE (1,*) 'ENTER NEW COST ELEMENT CODE - 2 CHARACTERS'
0114  ASSIGN 400 TO BADD
0115  CALL RDCCOST
```

D-10
IF (NCHAR.EQ.1.AND.ARG(1).EQ.'1') GO TO 280
IF (POSITN .EQ. 0 ) GO TO 410
WRITE (1,*) 'COST ELEMENT CODE ALREADY EXISTS'
WRITE (1,*) 'USE A DIFFERENT CODE'
GO TO BADD

C ERROR -- TOO MANY COST ELEMENTS
   IF (NELEM(UPPDWN) .LT. MAXCS(UPPDWN)) GO TO 415
   WRITE (10*) 'ONLY MAXCS(UPPDWN) COST ELEMENTS CAN BE SPECIFIED'
   NELEM(UPPDWN) = NELEM(UPPDWN) + 1
   NCSTEL = NELEM(UPPDWN)
   WRITE (1,*) 'THIS IS THE LAST COST ELEMENT WHICH MAY BE ADDED'
   DO 417 I=1,2
      IF (UPPDWN.EQ.1) UCSNAM(NCSTEL) = ARG(I)
      IF (UPPDWN.EQ.2) DCSNAM(NCSTEL) = ARG(I)
   CONTINUE
   IF (MODFLO .EQ. 1) GO TO 523
   ADD COST ELEMENT NAME
   DO 429 J=1,20
      IF (UPPDWN.EQ.1) UCSNAM(NCSTEL) = ARG(J)
      IF (UPPDWN.EQ.2) DCSNAM(NCSTEL) = ARG(J)
   CONTINUE
   IF (MODFLO .EQ. 1) GO TO 523
   MOVE NEW NAME TO ITS ARRAY
   DO 429 J=1,20
      IF (UPPDWN.EQ.1) UCSNAM(NCSTEL) = ARG(J)
      IF (UPPDWN.EQ.2) DCSNAM(NCSTEL) = ARG(J)
   CONTINUE
   IF (MODFLO .EQ. 1) GO TO 523

D-11
C C ENTER COSTS FOR EACH COST INDEX - CAP, INS, LES, OMA
C C

0147 WRITE (1,*) 'COST INDEXES ARE:'
0148 IF (UPPDWN.EQ.1) WRITE (1,1200) ((UCINDX(I,J), J=1,8),I=1,NUINDX)
0149 IF (UPPDWN.EQ.2) WRITE (1,1200) ((DCINDX(I,J), J=1,8),I=1,NDINDX)
0150 WRITE (1,*) 'ENTER CAPITAL COST (ENTER A VALUE FOR EACH COST INDEX)'
0151 ASSIGN 432 TO BADD
0152 READ (1,* ERR=170) (XDATA(I), I=1,NINDX(UPPDWN))
0153 DO 434 J=1,NINDEX(UPPDWN)
0154 IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J,1) = XDATA(J)
0155 IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J,1) = XDATA(J)
0156 CONTINUE
C C C ENTER INSTALLATION COSTS
C C

0157 WRITE (1,*) 'ENTER INSTALLATION COSTS'
0158 ASSIGN 440 TO BADD
0159 READ (1,* ERR=170) (XDATA(I), I=1,NINDX(UPPDWN))
0160 DO 443 J=1,NINDEX(UPPDWN)
0161 IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J,2) = XDATA(J)
0162 IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J,2) = XDATA(J)
0163 CONTINUE
C C C ENTER LEASE COSTS
C C

0164 WRITE (1,*) 'ENTER LEASE COSTS'
0165 ASSIGN 450 TO BADD
0166 READ (1,* ERR=170) (XDATA(I), I=1,NINDX(UPPDWN))
0167 DO 455 J=1,NINDEX(UPPDWN)
0168 IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J,3) = XDATA(J)
0169 IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J,3) = XDATA(J)
0170 CONTINUE
C C C ENTER OMA COSTS
C C

D-12
0171 465 WRITE (1,*) 'ENTER OPERATIONS AND MAINTENANCE COSTS'
0172 ASSIGN 465 TO BADD
0173 READ (1,*,ERR=170) (XDATA(I),I=1,INDDX(UPPDWN))
0174 DO 470 J=1,INDDX(UPPDWN)
0175 IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J+4) = XDATA(J)
0176 IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J+4) = XDATA(J)
0177 470 CONTINUE

0178 471 WRITE (1,*) 'ENTER MINIMUM LEASE COST, IF APPLICABLE'
0179 ASSIGN 471 TO BADD
0180 READ (1,*,ERR=170) XDATA(1)
0181 IF (UPPDWN.EQ.1) UCSMIN(NCSTEL) = XDATA(1)
0182 IF (UPPDWN.EQ.2) DCSMIN(NCSTEL) = XDATA(1)
0183 DO 475 I=1,INPATH(UPPDWN)
0184 IF (UPPDWN.EQ.1) UCSPTH(NCSTELPJ) = 0
0185 IF (UPPDWN.EQ.2) DCSPTH(NCSTELPJ) = 0
0186 475 CONTINUE

0187 480 WRITE (1,*) 'ENTER PATH NAMES TO WHICH THIS COST ELEMENT IS TO BE ADDED'
0188 J = UPPDWN + 2
0189 CALL MATMOD(J,1,NCSTEL)
0190 IF (MODFLG .EQ. 1) GO TO 523
0191 GO TO 280

0192 500 WRITE (1,*) 'ENTER COST ELEMENT CODE TO BE MODIFIED'
0193 CALL RDCOST
0194 IF (POSITN .NE. 0) GO TO 510
0195 WRITE (1,*) 'COST ELEMENT CODE DOES NOT EXIST'
0196 GO TO 280
C CCCCCCCCCCCCCCCCCCCCC
C C ENTER MODIFIED CODE
C CCCCCCCCCCCCCCCCCCCCCCCC

0197 510 WRITE (1,* ) 'COST ELEMENT TO BE MODIFIED IS:
0198 519 IF (UPPDWN.EQ.1) WRITE(1,1020)
0199 519 2 (UCSCOD(POSITN+J),J=1,2)+(UCSNAM(POSITN+J),J=1,20)
0199 519 2 (DCSCOD(POSITN+J),J=1,2)+(DCSNAM(POSITN+J),J=1,20)
C C

0200 520 NCSTEL=POSITN
0201 523 WRITE (1,* ) 'ENTER COST MODIFY SUBCOMMAND'
0202 525 MODFLG = 0
0203 526 READ (1,1010) (INDATA(I),I=1,80)
0204 527 CALL GETTER
0205 528 CALL CODCHK (3,ARG,9,CSMCMD,POSITN)
0206 529 IF (POSITN.NE.0) GO TO 530
0207 530 WRITE (1,* ) 'INVALID SUBCOMMAND.'
0208 533 WRITE (1,1270) (UCSNAM(INDATA(J),J=1,20)
0209 535 IF (NUINDX.OE.2) WRITE(1,1220) (PERT JN2,J,NUINDX)
0210 537 WRITE (1,1230) (UCINDX(I,J),J=1,8),I=1,NUINDX)
0211 539 WRITE (1,1240) (UCSDAT(NCSTEL+J,POSITN),J=1,NUINDX)
0212 540 WRITE (1,1290)
0213 541 WRITE (1,1230) (UCINDX(I,J),J=1,8),I=1,NUINDX)
0214 542 WRITE (1,1240) (UCSDAT(NCSTEL+J,POSITN),J=1,NUINDX)
0215 543 WRITE (1,1260)
0216 544 WRITE (1,1280)
0217 545 WRITE (1,* ) 'ENTER CHANGE -N*VALUE OR 0*0 TO END'
0218 546 ASSIGN 545 TO BADD
0219 550 READ (1,* ,ERR=170) K,INPUT2
0220 551 IF (K.LE.0) WRITE(1,1240) (UCSDAT(NCSTEL+J,POSITN),J=1,NUINDX)
0221 552 IF (K.LE.0) GO TO 523
0222 553 IF (K.LE.NUINDX) GO TO 560
0223 554 WRITE (1,1250) K
0224 555 GO TO 545
0225 556 UCSDAT(NCSTEL+K,POSITN) = INPUT2
0226 557 GO TO 545
C C DOWNLINK MODIFY

D-14
561  WRITE (1,1210) ((INDATA(J),J=1,3),(DCSCOD(NCSTEL,J),J=1,2)),
     2 (DCSNAM(NCSTEL,J),J=1,20)
0228  IF (NDINDX.GE.2) WRITE(1,1220) (PER(J),J=2,NDINDX)
0229  WRITE (1,1230) ((DCINDX(I,J),J=1,8),I=1,NDINDX)
0230  WRITE (1,1240) (DCSDAT(NCSTEL,J,POSITN,J=1,NDINDX)
0231  WRITE (1,1280)
0232  545  WRITE (1,*)'ENTER CHANGE - N+VALUE OR 0+0 TO END'
0233  ASSIGN 565 TO BADD
0234  570  READ (1,*,ERR=170) K,PJ
0235  IF (K.LE.0) WRITE(1,1240) (DCSDAT(NCSTEL,J,POSITN,J=1,NDINDX)
0236  IF (K.LE.0) GO TO 523
0237  IF (K.LE.NDINDX) GO TO 580
0238  WRITE (1,1250) K
0239  GO TO 565
0240  580  DCSDAT(NCSTEL,K,POSITN) = INPUT2
0241  GO TO 545

C C C MODIFY COST ELEMENT CODE
C C
0242  620  WRITE (1,*)'ENTER NEW COST ELEMENT CODE'
0243  ASSIGN 620 TO BADD
0244  CALL RDCOST
0245  IF (POSITN.NE.0) GO TO 405
0246  MODFLG=1
0247  GO TO 416

C C C MODIFY COST ELEMENT NAME
C C
0248  640  WRITE (1,*)'ENTER COST ELEMENT NAME (20 CHARACTERS MAXIMUM)'
0249  ASSIGN 640 TO BADD
0250  READ (1,1010) (INDATA(I),I=1,80)
0251  CALL BETTER
0252  IF (UPPDWN.EQ.1) CALL CODCHK (20,ARG,MAX,UCSNA,M,POSITN)
0253  IF (UPPDWN.EQ.2) CALL CODCHK (20,ARG,MAX,DCSNA,POSITN)
0254  IF (POSITN.NE.0) GO TO 425
0255  MODFLG=1
0256  GO TO 430

C C C ADD A COST ELEMENT TO A PATH
C C
0257  660  MODFLG=1
0258  GO TO 480
C REMOVE A COST ELEMENT FROM A PATH

C

0259 680 WRITE (1,*) 'ENTER PATH NAMES FROM WHICH THIS COST ELEMENT IS TO
2 BE REMOVED'
0260     J = UPFDWN + 2
0261     CALL MATMOD(JPOPNCSTEL)
0262     GO TO 523

C DELETE COMMAND

C

0263 705 WRITE (1,*) 'ENTER COST ELEMENT CODE TO BE DELETED'
0264     CALL RDCOST
0265     IF (ARG(1).EQ. '3') GO TO 280
0266     IF (POSITN.EQ. 0) GO TO 710
0267 706 IF (UPFDWN.EQ. 1) WRITE(1,1260)(UCSNAM(POSITN,I),I=1,20)
0268     IF (UPFDWN.EQ. 2) WRITE(1,1260)(DCSNAM(POSITN,I),I=1,20)
0269     CALL YESNO

C YES NO ERR
0270     GO TO (708, 280, 706) YESNO
0271 708 CALL DISAPR(UPPDWN, POSITN)
0272     IF(NELEM(UPPDWN).GT. 0) GO TO 280
0273     WRITE(1,*)'********** WARNING **********
0274     WRITE(1,*)' ALL COST ELEMENTS HAVE BEEN DELETED'
0275     WRITE(1,*)' IN THIS SEGMENT'
0276     WRITE(1,*)'THE MODEL WILL NOT WORK UNLESS AN ELEMENT IS ADDED'
0277     WRITE(1,*)'********** ERROR **********
0278     GO TO 280

C ERROR IN COST CODE

C

0279 710 WRITE (1,*) 'COST ELEMENT CODE DOES NOT EXIST'
0280     GO TO 280

C LIST COST ELEMENT INFORMATION

C

0281 800 WRITE (1,*) 'ENTER LIST SPECIFICATION'
0282     N=0
0283     READ (1,1010) (INDATA(I),I=1,80)

D-16
0284  803  CALL GETTER
0285  804  IF (NCHAR.EQ.0) GO TO 804
0286  805  IF (ARG(1).EQ. 'A'.AND. ARG(2).EQ. 'L'.AND. ARG(3).EQ. 'L')
0287  820  $ GO TO 820
0288  840  2 GO TO 840
0289  860  2 GO TO 860
0290  880  IF (ARG(1).EQ. 'P'.AND. ARG(2).EQ. 'A'.AND. ARG(3).EQ. 'T')
0291  900  GO TO 900
0292  920  IF (POSITN.EQ. 0 ) GO TO 920
0293  940  CALL REPRTR(1, POSITN)
0294  960  IF (CONTCD.EQ.0) GO TO 960
0295  980  IF (CONTCD.NE.0) GO TO 980

C  ERROR - INVALID RESPONSE OR CODE DOESN'T EXIST
C
0296  810  WRITE (1,* )'INVALID LIST OPTION'
0297  830  WRITE(1,*)'LIST OPTIONS ARE: ALL, COST, PATH, A COST ELEMENT CODE,
0298  850  2 OR I'
0299  870  DO 830 I = 1, MELEM(UPPDWN)
0300  890  CALL REPRTR(1, I)
0301  910  CONTINUE

C  PRINT PATH MATRIX AND COST INFORMATION
C
0302  930  CALL REPRTR(2, I)
0303  950  GO TO 950
C  PRINT PATH MATRIX ONLY
C
0304  970  CALL REPRTR(9, I)
0305  990  GO TO 990
C  PRINT COST ELEMENT CODES AND NAMES
C
 C  EXIT COMMAND
0306   900  IF (UPPDWN.EQ.2) GO TO 950
0307   901  WRITE (lr*) 'DO YOU WANT TO MODIFY OWNLINC COST DATA'
0308   902  CALL YESNO
          C
0309   910  GO TO (910,950,900), YESNO
0310   911  UPPDWN = 2
0311   912  GO TO 100
0312   950  RETURN
          C
0313  1010 FORMAT ( 80A1)
0314  1020 FORMAT (I1,2A1, -- 20A1/
0315  1200 FORMAT (1X,6(8A1,2X))
0316  1210 FORMAT(1M0,3A1, COSTS FOR 2A1, -- ,20A1)
0317  1220 FORMAT(1H,19X,5(7X,A4))
0318  1230 FORMAT(1H,8X,6(3X,A4))
0319  1240 FORMAT(1H,6X,6F11.2)
0320  1250 FORMAT(1MO, 'SPECIFIED SUBSCRIPT TOO LARGE: ', I10)
0321  1260 FORMAT(1X, 'COST ELEMENT TO DELETE IS ',20A1,' Y OR N')
0322  1270 FORMAT(1X, 'VALID COMMANDS: ', 9(1X,3A1))
0323  1280 FORMAT(1X, 'Y', 1, 2, 3, 4
0324  1290 END
0325  1291 D-18
SUBROUTINE PATH

THE PATH MODULE DEFINES OR MODIFIES DATA FOR UPLINK OR DOWNLINK PATHS. PATHS ARE OPTIONS FOR TRANSMITTING THE VIDEO SIGNAL THROUGH A PARTICULAR SEGMENT OF THE MODEL. THE USER CAN ADD OR DELETE PATHS, CHANGE THE COST ELEMENTS ASSOCIATED WITH ANY OF THE PATHS OR SPECIFY THE CITIES FOR WHICH A PATH IS VALID.

ARRAY VARIABLES

\text{UPTHCY} - ARRAY OF UPLINK CITIES FOR WHICH A PATH IS FEASIBLE
\text{DPTHCY} - DOWNLINK
\text{UPTHNM} - 20 CHARACTER ARRAY OF UPLINK PATH NAMES
\text{DPTHNM} - DOWNLINK
\text{UPTIDX} - CAPITAL INSTALLATION, INSTALLATION, LEASE, OMA, ANNUALIZED COST FOR A GIVEN COST INDEX AND PATH - UPLINK
\text{DPTIDX} - DOWNLINK

SCALAR VARIABLES

\text{NDPATH} - NUMBER OF UPLINK PATHS
\text{NDPATH} - NUMBER OF DOWNLINK PATHS
\text{MAXUPA} - MAXIMUM NUMBER OF UPLINK PATHS
\text{MAXDPA} - MAXIMUM NUMBER OF DOWNLINK PATHS

SUBROUTIN CALLS: \text{GETTER, YESNO, COOCHK, DISAPR, REPRTR, UPDOWN, MATMOD}

CALLED BY: \text{BUILD}

INCLUDE 'SYO:COMBLK.FTN/NOLIST'

LOCAL VARIABLES

\text{INTEGER} CURRENTrORG
\text{LOGICAL} PTHLST(4,2), PTHCMD(8,5), PTHCMD(5,3)
\text{DATA} PTHLST /'C', 'C', 'P', 'P', 'I', 'I' /
\text{ASK IF THE USER WANTS TO ENTER PATH DATA}
PATH.FTN

0045 3000 WRITE (1,*),'DO YOU HAVE PATH INFORMATION TO ENTER'
0046 CALL YESNO
0047 C YES NO ERR
0048 3010 WRITE (1,*),'UPLINK OR DOWNLINK'
0049 CALL UPDOWN
0050 IF(UPPDWN .EQ. 3) GO TO 3010
C PATH COMMAND PROCESSING
0051 3015 WRITE (1,*),'ENTER PATH COMMAND'
0052 READ (1,*),(INDATA(I))
0053 CALL CODCHK (3,INDATA(5),PTCMDCSRTN)
0054 IF (POSTN .EQ. 0) GO TO 3020
C BRANCH ON PATH COMMAND
C EXIT ADD MOD DEL LIST
0055 GO TO (3700,3100,3300,3500,3600,3015)
C NO SUCH COMMAND
0056 3020 WRITE (1,*),'INVALID PATH COMMAND'
0057 3015 WRITE (1,*),'VALID COMMANDS: EXIT/ADD/MOD/DEL/LIST'
0058 GO TO 3015
C CHECK FOR TOO MANY PATHS
0059 3100 IF (NPATH(UPPDWN) .LT. MAXPA(UPPDWN)) GO TO 3110
0060 3100 WRITE (1,*),'ONLY MAXPA(UPPDWN) PATHS CAN BE SPECIFIED'
0061 GO TO 3015
C REQUEST PATH NAME
C
0062 3110 WRITE (1,*),'ENTER NEW PATH NAME'
0063 ASSIGN 3110 TO HADD
0064 READ (1,*),(INDATA(I),I=1,80)
0065 IF (ARG(1).EQ.'/') GO TO 3015
0066 CALL GETER
0067 IF (UPPDWN .EQ. 1) CALL CODCHK (16,ARG,MAXUPA,UPTHMN,POSITN)
0068 IF (UPPDWN .EQ. 2) CALL CODCHK (16,ARG,MAXDPD,DPTHMN,POSITN)
0069 IF (POSITN .EQ. 0) GO TO 3120
C
C DUPLICATE PATH NAME

11:5 WRITE (1,*) 'PATH NAME ALREADY EXISTS'
WRITE (1,*) 'ENTER A DIFFERENT NAME'
GO TO 1000

MOVE NAME TO NEW ARRAY

120 NPATH(UPFDWN) = NPATH(UPFDWN) + 1
DO 130 I = 1,20
125 IF (UPFDWN.EQ.1) UPTHNM(NPATH(I)) = ARG(I)
130 IF (UPFDWN.EQ.2) DFTHNM(NPATH(I)) = ARG(I)
135 CONTINUE

ADD LIST OF COST ELEMENTS WHICH COM普RISE THIS PATH

115 WRITE (1,*) 'ENTER LIST OF COST ELEMENT CODES FOR THIS PATH'
CALL MATMOD(UPFDWN,1,NPATH(UPFDWN))
REQUEST CITY NAMES FOR WHICH THIS PATH IS FEASIBLE

11:5 WRITE (1,*) 'ENTER LIST OF CITY NAMES (ORG) FOR WHICH THIS PATH IS FEASIBLE'
J = 4 + UPFDWN
CALL MATMOD(J + 4,NPATH(UPFDWN))
GO TO 1062

MODIFY COMMAND

WRITE (1,*) 'ENTER PATH NAME YOU WANT TO MODIFY'
READ (1,*) I
CALL BETTER
IF (UPFDWN.EQ.1) CALL CODCHK(NCHAR,ARG,MAXUPA,UPTHNM,POSITN)
IF (UPFDWN.EQ.2) CALL CODCHK(NCHAR,ARG,MAXDFP,DFTHNM,POSITN)
IF (POSITN.EQ.3) GO TO 3300
IF (POSITN.EQ.1 .AND. UPFDWN .EQ. 1) CALL CODCHK(20,ARG,MAXUPA,UPTHNM,POSITN)
IF (POSITN.EQ.1 .AND. UPFDWN .EQ. 2) CALL CODCHK(20,ARG,MAXDFP,DFTHNM,POSITN)
3310 IF (POSITN.EQ.1 .AND. UPFDWN .EQ. 2) GO TO 3310

ERROR - PATH DOES NOT EXIST

D-21
PATH.FTN

0094 3310 WRITE (1,*) 'PATH DOES NOT EXIST'
0097 3315 WRITE (1,*) 'SPECIFIED PATH NOT UNIQUE - ENTER MORE INFORMATION'
0099 3300 GO TO 3300

C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C BRANCH TO MODIFY SUBCOMMAND
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

0100 3320 WRITE (1,*) 'ENTER PATH MODIFY SUBCOMMAND'
0101 READ (1,4910) (INDATA(I), I=1,80)
0102 CALL GETTER
0103 CALL CODCHK (5,ARG,8,PTMCHD,POSITN)
0104 IF (POSITN .EQ. 0) GO TO 3335
C CADC0-MLC0-WUC0-ADCY-PLICW-NUCW-NWMM-EXIT
0105 GO TO (3340,3360,3380,3390,3420,3440,3460,3480,35015,POSITN)
C CNO SUCH COMMAND
C
0106 3333 WRITE (1,*) 'INVALID SUBCOMMAND. VALID SUBCOMMANDS ARE...'
0107 WRITE (1,4920)((PTMCHD(I,J),J=1,5),I=1,8)
0108 3320 GO TO 3320

C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C ADD A COST ELEMENT TO PATH
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

0109 3340 WRITE (1,*) 'ENTER LIST OF COST ELEMENT CODES TO ADD TO PATH'
0110 CALL MATMOD(UFPDWN1,CURRENT)
0111 GO TO 3320
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C DELETE A COST ELEMENT FROM PATH
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

0112 3360 WRITE (1,*) 'ENTER LIST OF COST ELEMENT CODES TO DELETE FROM PATH'
0113 CALL MATMOD(UFPDWN0,CURRENT)
0114 GO TO 3320
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C REPLACE COST ELEMENTS FOR PATH
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

0115 3380 DO 3390 I=1,NELEM(UFPDWN)
0116 IF (UFPDWN.EQ.1) UCSPTH(I,CURRENT) = 0
0117 IF (UFPDWN.EQ.2) DCSPTH(I,CURRENT) = 0
0118 3390 CONTINUE
PATH.FTN /TRIPLOCKS/WR

0119   WRITE (1,*) 'ENTER NEW LIST OF CIRT ELEMENT CODES FOR PATH'
0120   CALL MATMOD(UPPDWN+1,CURRENT)
0121   GO TO 3320

C CCCCCCCCCCCCCCCCCCCCCC
C C ADD A CITY TO PATH
C CCCCCCCCCCCCCCCCCCCCCC

0122   3400 WRITE(1,*)'ENTER LIST OF CITY NAMES (/ORO) TO ADD THIS PATH TO '
0123   J = 6 + UPPDWN
0124   CALL MATMOD(J-1,CURRENT)
0125   GO TO 3320

C CCCCCCCCCCCCCCCCCCCCCC
C C DELETE A CITY FROM PATH
C CCCCCCCCCCCCCCCCCCCCCC

0126   3420 WRITE(1,*)'ENTER LIST OF CITY NAMES (/ORO) TO DELETE FROM THIS PATH '
0127   J = 6 + UPPDWN
0128   CALL MATMOD(J-1,CURRENT)
0129   GO TO 3320

C CCCCCCCCCCCCCCCCCCCCCC
C C REPLACE CITIES FOR PATH
C CCCCCCCCCCCCCCCCCCCCCC

0130   3440 DO 3450 J=1,N,CITY(UPPDWN)
0131     IF (UPPDWN.EQ.1) UPTHCY(CURRENT,J) = 0
0132     IF (UPPDWN.EQ.2) DPTHCY(CURRENT,J) = 0
0133    3450 CONTINUE
0134   3450 WRITE (1,*) 'ENTER NEW LIST OF CITIES (/ORO) FOR THIS PATH'
0135   J = 6 + UPPDWN
0136   CALL MATMOD(J-1,CURRENT)
0137   GO TO 3320

C CCCCCCCCCCCCCCCCCCCCCC
C C REPLACE PATH NAME
C CCCCCCCCCCCCCCCCCCCCCC

0138   3460 WRITE (1,*) 'ENTER THE NEW NAME FOR PATH'
0139   ASSIGN 3450 TO BADD
0140   READ (1,*10) (INDATA(I),I=1,BADD)
0141   CALL GETER
0142   IF (UPPDWN.EQ.1) CALL CODCHN (20,ARG[MAXUFA+UPTHNM,POSITN])
0143   IF (UPPDWN.EQ.2) CALL CODCHN (20,ARG[MAXDF+UPTHNM,POSITN])
0144   IF (POSITN .NE. 0) GO TO 3115

D-23
DO 3465 I = 1,20
IF (UPPDWN.EQ.1) UPTHNM (CURENT,I) = ARG (I)
IF (UPPDWN.EQ.2) DPTHNM (CURENT,I) = ARG (I)
3465 CONTINUE
GO TO 3320

C DELETE A PATH FROM SCENARIO
C
3';00 WRITE ( 19* )'ENTER PATH NAME TO DELETE FROM SCENARIO'
READ ( 1,4910 ) (INDATA(I),I=1,80)
ALL GETTER
IF (ARG(1).EQ.'i') GO TO 3015
IF (UPPDWN.EQ.1) CALL CODCHK(NCHAR,ARG,MAXUPA,UPTHNM,POSITN)
IF (UPPDWN.EQ.2) CALL CODCHK(NCHAR,ARG,MAXDPA,DPTHNM,POSITN)
IF(POSITN .EQ. -1 .AND. UPPDWN .EQ. 1)CALL CODCHK(20,ARG,MAXUPA,2UPTHNM,POSITN)
IF(POSITN .EQ. -1 .AND. UPPDWN .EQ. 2)CALL CODCHK(20,ARG,MAXDPA,2DPTHNM,POSITN)
IF(POSITN .EQ. -1 ) GO TO 3515
IF(POSITN EQ. 0 ) GO TO 3310
 CALL DISAPR (J,POSITN)
 IF(NPATH(UPPDWN) .GT. 0) GO TO 3015
 WRITE(19*)'**************dolt* WARNING ##************'
 WRITE(19*)'	 ALL PATHS DELETED FROM THIS SECTOR'
 MODEL WILL NOT WORK UNLESS A PATH IS ADDED'
 WRITE(19*)'****#**#**********************************'
 GO TO 3015
 SPECIFIED PATH NOT UNIQUE - ENTER MORE INFORMATION'
 GO TO 3500

C LIST PATH INFORMATION
C
3600 WRITE ( 19* )'ENTER LIST SPECIFICATION '
READ ( 1,4910 ) (INDATA(I),I=1,80)
 CALL GETTER
 CALL CODCHK (2,ARG,4,PTHLTR,POSITN)
 IF ( POSITN .EQ. 0 ) GO TO 3610
 COST CITY PATH /
 GO TO ( 3620, 3630, 3640, 3015) POSITN
 NO SUCH COMMAND

0176  3610 WRITE (1,*) 'INVALID LIST OPTION'
0177  WRITE (1,*) 'VALID COMMANDS: COST, CITY, PATH'
0178  GO TO 3600

C
C PRINT PATH/COST MATRIX
C
0179  3620 CALL REPRTR (2,1)
0180  GO TO 3015

C
C PRINT PATH/CITY MATRIX
C
0181  3630 CALL REPRTR (4,1)
0182  GO TO 3015

C
C PRINT PATH NAMES AND NUMBER
C
0183  3640 CALL REPRTR (3,1)
0184  GO TO 3015

C
C EXIT FROM PATH MODULE
C
0185  3700 IF (UPPDWN.EQ.2) GO TO 3720
0186  WRITE (1,*) 'DO YOU WANT TO MODIFY DOWNLINK PATH DATA?'
0187  CALL YESNO
0188  GO TO (3710, 3720, 3700), YESNO
0189  3710 UPPDWN = 2
0190  GO TO 3015
0191  3720 RETURN
0192  4910 FORMAT (8OA1)
0193  4920 FORMAT (1X, 'COMMANDS: ', 8(1X, 'A1'))
0194  END
SUBROUTINE CITY

THE CITY MODULE IS USED TO DEFINE OR MODIFY THE CHARACTERISTICS
OF THE CITIES WHICH COMprise THE NETWORK UNDER CONSIDERATION.
THE USER CAN ADD, MODIFY OR DELETE CITIES FROM THE NETWORK
AND ASSOCIATE PATHS WITH CITIES. CITY DATA INCLUDES NAME (AND
MEMBER ORGANIZATION IF APPLICABLE), STATE, LOCATION (LATITUDE/
LONGITUDE OR BELL SYSTEM V AND H COORDINATES), CHANNEL NUMBER
(FOR UPLINK CITIES), HIERARCHICAL LEVEL (FOR DOWNLINK CITIES),
COST INDEX VALUES, AND FEASIBLE PATHS.

ARRAY VARIABLES

UCTXVL - VALUES ASSOCIATED WITH UPLINK COST INDEXES
DCTXVL - DOWNLINK

UCTNAM - ARRAY OF UPLINK CITY NAMES - 16 CHARACTERS EACH
DCTNAM - DOWNLINK

USTCOD - ARRAY OF 2 CHARACTER STATE CODES CORRESPONDING TO UPLINK
CITIES
DSTCOD - DOWNLINK

UCITYV - VERTICAL COORDINATES FOR UPLINK CITIES
DCITYV - DOWNLINK

UCITYH - HORIZONTAL COORDINATES FOR UPLINK CITIES
DCITYH - DOWNLINK

DCTLVL - THE HIERARCHICAL LEVEL OF EACH DOWNLINK CITY

UCTCHN - THE CHANNEL ASSIGNED TO EACH UPLINK CITY

TALKBK - THE HOURS OF TALKBACK NEEDED FROM EACH DOWNLINK CITY
TO THE ORIGINATING CITY

SCALAR VARIABLES

NUCITY - NUMBER OF UPLINK CITIES
NDCITY - NUMBER OF DOWNLINK CITIES
LATLON - FLAG TO TELL THE PROGRAM WHEN V AND H COORDINATES ARE
INPUT IN TERMS OF LATITUDE AND LONGITUDE

SUBROUTINE CALLS: GETTER, YESNO, CODCHK, DISAPR, REPRTR,
UPDOWN, MATHOD, CTYCHK, VANDH

CALLED BY: BUILD

INCLUDE 'SYO:COMBLK.FTN/NOLIST'

LOCAL VARIABLES
LOGICAL*1 MODFLG, BYPASS, CTYCMD(6,3), CTLSTS(8,4), MODSUB(10,4),
2 BLANK
INTEGER*2 ORGNUM, CURRENTR, LAT, LON
REAL*4 UD

DATA CTYCMD/'A', 'O', 'M', 'D', 'L', 'E',
* 'D', 'U', 'E', 'I', 'X',
* 'B', 'E', 'O', 'L', 'S', 'I'/
DATA CTLSTS/ 'I', 'P', 'T', 'O', 'A', 'C', 'I',
* 'N', 'A', 'R', 'L', 'G', 'L', 'T',
* 'E', 'H', 'N', 'K', 'Y', 'T'/
DATA MODSUB/ 'U', 'C', 'C', 'I', 'D', 'C', 'T', 'E',
2 'A', 'H', 'N', 'D', 'E', 'H', 'A', 'X',
3 'N', 'A', 'L', 'G', 'G', 'L', 'I',
4 'D', 'N', 'V', 'E', 'P', 'F', 'N', 'K', 'T'/
DATA BLANK/' /

WRITE ( 1, *) 'DO YOU HAVE CITY INFORMATION TO ENTER?'
CALL YESNO

GO TO ( 6010, 6980 ) YESNO
WRITE ( 1, *) 'VALID COMMANDS ARE: ADD, OVER, MOD, DEL, LIST, EXIT'
GO TO 6015

WRITE ( 1, *) 'ENTER CITY COMMAND'
READ ( 1, 7990 ) ( INDATA(I), I=1, 80)
CALL GETTER
BYPASS = 0
CALL CODCHK( 3, ARG, 6, CTYCMD, POSITN)
IF ( POSITN .EQ. 0 ) GO TO 6020

BRANCH ON UPLINK CITY COMMAND
ADD OVER MOD DEL LIST EXIT
GO TO ( 6100, 6050, 6300, 6700, 6800, 6900 ) POSITN

ERROR IN RESPONSE

WRITE ( 1, *) 'INVALID CITY COMMAND'
WRITE ( 1, *) 'VALID COMMANDS ARE: ADD, OVER, MOD, DEL, LIST, EXIT'
GO TO 6015

ADD OR OVERLAY COMMANDS
OVERLAY CITIES

0063  6050  BYPASS = 1
0064  IF ( NUMORG .GT. 0 ) GO TO 6100
   C  NO COST ALLOCATION - INVALID COMMAND IN THIS CASE
   C
0065  WRITE (1,*)'INVALID COMMAND UNLESS COST ALLOCATION IS USED'
0066  BYPASS = 0
0067  GO TO 6015
0068  6100  WRITE (1,*)'ENTER CITY NAME (*.ORG)'
0069  ASSIGN 6100 TO BADD
0070  READ ( 1,9990) (INDATA(I)+IO3.80)
0071  MODFLG = 0
0072  CALL GETTER
0073  IF(ARG(1) .EQ. 'i') GO TO 6015
0074  CALL CTYCHK ( POSITN,ORGNUM )

C POSITN < 0  - ERROR - START OVER
C
C POSITN = 0 AND ORGNUM = 0 - ERROR UNLESS NO COST ALLOCATION - NO CITY
C MATCH AND NO ORGANIZATION MATCH

C POSITN > 0 AND ORGNUM = 0 - CITY MATCH AND ORG MATCH
C
C POSITN > 0 AND ORGNUM > 0 - EXISTING CITY AND NEW ORGANIZATION
C VALID FOR OVERLAY ONLY
C
C POSITN = 0 AND ORGNUM > 0 - NEW CITY AND NEW ORGANIZATION
C VALID FOR ADD ONLY
C
C ERROR - RETURNED NEGATIVE POSITN

0075  IF ( POSITN .LT. 0 ) GO TO BADD
C ADD WITH NO COST ALLOCATION

0076  IF ( NUMORG .EQ. 0 .AND.
            2  POSITN .EQ. 0 .AND.
            3  ORGNUM .EQ. 0 ) GO TO 6103
C
C NOT VALID FOR ADD OR OVERLAY
C
0077  IF ( POSITN .GT. 0 .AND. ORGNUM .EQ. 0 ) GO TO 6322
C
C OVERLAY
```
C
IF ( BYPASS .EQ. 1 .AND. 
  POSITN .GT. 0 .AND. 
  ORGNUM .GT. 0 ) GO TO 5102
C
ADD
C
IF ( BYPASS .NE. 1 .AND. 
  POSITN .EQ. 0 .AND. 
  ORGNUM .GT. 0 .AND. 
  NUMORG .GT. 0 ) GO TO 5102
C
IF ( POSITN .EQ. 0 ) GO TO 6315
C
C
6101 WRITE (1,*) 'INVALID RESPONSE - PLEASE RE-ENTER'
GO TO 5015
C
6102 IF ( NCITY(UPPDWN) .LT. MAXCT(UPPDWN) ) GO TO 6103
C
605 WRITE (1,*) 'ONLY 'MAXCT(UPPDWN)' CITIES CAN BE SPECIFIED'
GO TO 5015
C
6103 NCITY(UPPDWN) = NCITY(UPPDWN) + 1
C
605 UD = 'DOWN'
C
607 IF ( NCITY(UFPDOWN) .GE. MAXCT(UFPDOWN)) WRITE (1,7992) UD
C
7992 FORMAT (1x,'THIS IS THE LAST CITY YOU MAY ADD TO A4,'LINK')
C
609 IF ( UFPDOWN .NE. 1 ) GO TO 6104
C
6104 CURRENT = NCITY(UFPDOWN)
C
617 IF ( NUMORG .GT. 0 ) DCTORG(CURRENT) = ORGNUM
GO TO 5015
C
6104 CURRENT = NCITY(UFPDOWN)
C
613 IF ( NUMORG .GT. 0 ) DCTORG(CURRENT) = ORGNUM
C
615 NCURRENT = CURRENT
C
617 CONTINUE
C
613 IF ( NUMORG .GT. 0 ) DCTORG(CURRENT) = ORGNUM
C
615 NCURRENT = CURRENT
C
617 CONTINUE
C
613 IF ( BYPASS .EQ. 1 ) GO TO 6175
C
615 CONTINUE
```

```
6117 WRITE (1,*) 'ENTER THE 2 CHARACTER STATE CODE FOR THIS CITY'
C
READ (1,7090) (INDATA(I),I=1,2)
```

D-29
DO 6120 I=1,2
   IF (UPPDWN.EQ.1) USTCOD(CURRENT,I)=INDATA(I)
   IF (UPPDWN.EQ.2) DSTCOD(CURRENT,I)=INDATA(I)
   CONTINUE

C ENTER V AND H COORDINATES

WRITE (1,*,'(1,X) ENTER V COORDINATE OR LATITUDE (-DDMM) FOR THIS CITY')
ASSIGN 6130 to BADD
READ (1,*ERR=7000) LON
IF (LON .LT. 0) go to 6135
IF (LON .GT. 15000) go to 7100
IF (UPPDWN.EQ.1) UCITYV(CURRENT)=LON
IF (UPPDWN.EQ.2) DCITYV(CURRENT)=LON
GO TO 6160
C V COORDINATE INPUT AS LATITUDE
LAT = LON
LATLON = 1
C ENTER H COORDINATE AS LONGITUDE
WRITE (1,*,'(1,X) ENTER THE POSITIVE LONGITUDE (0DDMM) FOR THIS CITY')
ASSIGN 6145 to BADD
READ (1,*ERR=7000) LON
IF (LON .GT. 15000 .OR. LON .LT. 0) go to 7100
CALL VANDH(LATPLON)
IF (UPPDWN .EQ. 2) go to 6150
UCITYH(CURRENT) = LAT
UCITYM(CURRENT) = LON
GO TO 6155
DCITYV(CURRENT) = LAT
DCITYH(CURRENT) = LON
IF (MODFLG .EQ. 1) go to 6525
GO TO 6180
C ENTER HORIZONTAL COORDINATE
WRITE (1,*,'(1,X) ENTER HORIZONTAL COORDINATE FOR THIS CITY')
ASSIGN 6160 to BADD
READ (1,*ERR=7000) LON
IF (LON .GT. 15000 .OR. LON .LT. 0) go to 7100
IF (UPPDWN.EQ.1) UCITYH(CURRENT)=LON
IF (UPPDWN.EQ.2) DCITYH(CURRENT)=LON
IF (MODFLG .EQ. 1) go to 6525
GO TO 6180
C OVERLAY COMMAND WITH EXISTING CITY
C SET STATE, V AND H, AND ORGANIZATION FROM PREVIOUS CITY DEFINITION

0145 6175 IF ( UPPDWN EQ. 2 ) GO TO 6177
0146  UCTORG(CURRENT) = ORGNUM
0147  USTCOD(CURRENT) = USTCOD(POSITN+1)
0148  USTCOD(CURRENT) = USTCOD(POSITN+2)
0149  UCITYV(CURRENT) = UCITYV(POSITN)
0150  UCITYH(CURRENT) = UCITYH(POSITN)
0151  GO TO 6180
0152  6177 DCTORG(CURRENT) = ORGNUM
0153  DSTCOD(CURRENT) = DSTCOD(POSITN+1)
0154  DSTCOD(CURRENT) = DSTCOD(POSITN+2)
0155  DCTYV(CURRENT) = DCTYV(POSITN)
0156  DCTYH(CURRENT) = DCTYH(POSITN)

C ENTER CHANNEL NUMBER

0157 6180 IF ( UPPDWN EQ. 2 ) GO TO 6185
0158  WRITE ( 1,* )'ENTER CHANNEL NUMBER FOR THIS UPLINK CITY'
0159  ASSIGN 6180 TO BADD
0160  READ ( 1,* ,ERR=7000) LON
0161  IF ( LON GT. 999 OR LON LT. 0 ) GO TO 7100
0162  UCTCHN(CURRENT) = LON

C ENTER HIERARCHICAL LEVEL

0163 6185 WRITE ( 1,* )'ENTER HIERARCHICAL LEVEL NUMBER FOR THIS CITY'
0164  ASSIGN 6185 TO BADD
0165  READ ( 1,* ,ERR=7000) LON
0166  IF ( LON LT. 2 OR LON GT. 100 ) GO TO 7100
0167  DCTVL(CURRENT) = LON
0168  IF ( MODFLO EQ. 1 ) GO TO 6525

C ENTER VALUES FOR COST INDEXES

0171 6195 IF ( UPPDWN EQ. 2 ) GO TO 6205
0172  IF(NUINDX EQ. 1 ) GO TO 6213
0173  DO 6200 I=2,NUINDX
0174  6196 WRITE (1,*) 'ENTER THE VALUE FOR NUMBER OF...'
0175  ASSIGN 6196 TO BADD
0176  WRITE (1,6197) (UCINDX(I,J),J=1,6)
0177  6197 FORMAT (2X,8A1)
0178  READ (1,*,ERR=7000) UCTXVL(CURENT,I-1)
0179  6200 CONTINUE
0180  GO TO 6213

0181  6205 IF (NDINDX .EQ. 1) GO TO 6213
0182  DO 6212 I=2,NDINDX
0183  6206 WRITE (1,*) 'ENTER THE VALUE FOR NUMBER OF...'
0184  ASSIGN 6206 TO BADD
0185  WRITE (1,6197) (DCINDX(IP,J),J=1,8)
0186  READ (1,*,ERR=7000) DCTXVL(CURENT,I-1)
0187  6212 CONTINUE

0188  6215 WRITE (1,*) 'ENTER LIST OF PATH NAMES FEASIBLE FOR THIS CITY'
0189  CALL MATMOD (J,CURENT)
0190  IF (MODFLO .EQ. 1) GO TO 6525
0191  6225 IF(UPPDWN .EQ. 1) GO TO 6015

0194  DO 6240 I=1,NUCITY
0195  6235 WRITE (1,6236) (UCTNAM(I,J),J=1,16),UCTORG(I)
0196  6236 FORMAT (1X,’ENTER TALKBACK HOURS TO: ’,16A1,’/’),I)
0197  ASSIGN 6235 TO BADD
0198  READ(1,*,ERR=7000)TALKBK(CURENT,I)
0199  6240 CONTINUE
0200  GO TO 6015

0201  6300 WRITE (1,*) 'ENTER NAME OF CITY (/ORG) TO MODIFY'
0202  ASSIGN 6015 TO BADD
0203  READ (1,7990) (INDATA(I),I=1,80)
C

0209 IF ( POSITN .LT. 0 ) GO TO 6300
0210 6305 IF ( ORGNUM .LT. 0 ) GO TO 6320
C
C CHECK FOR EXISTANCE OF CITY/ORGANIZATION COMBINATION
C
C CITY DOES NOT EXIST
C
0211 6315 WRITE (1,*) 'CITY DOES NOT EXIST'
0212 GO TO 6015
C
C CITY/ORGANIZATION COMBO DOES NOT EXIST
C
0213 6320 WRITE (1,*) 'CITY/ORG COMBINATION DOES NOT EXIST'
0214 GO TO 6015
C
C 6322 WRITE (1,*) 'CITY AND ORG COMBINATION ALREADY EXIST'
0215 6325 CURRENT = POSITN
0216 6327 WRITE (1,*) 'ENTER CITY MODIFY SUBCOMMAND'
0217 MODFLG = 0
0218 READ (1,7990) (INDATA(I),I=1,80)
0219 CALL GETTER
0220 CALL CODCHK ( 4,ARG,10,MODSUB,POSITN)
0221 IF ( POSITN .EQ. 0 ) GO TO 6330
C
C BRANCH ON MODIFY SUBCOMMAND
C
MODFLG = 1
0224 VAND CHAN CHLV INDE ADDP DELP CHGP CHGN TALK EXIT
0225 GO TO ( 6130,6390,6390,6195,62,5,6550,6600,6025,6630,6015 ) POSITN
C
C NO SUCH MODIFY COMMAND
C
0226 6330 WRITE (1,*) 'INVALID SUBCOMMAND'
0227 WRITE (1,*) 'COMMANDS ARE: VAND,CHAN,CHLV,INDE,ADDP,DELP,CHGP,CHGN,TALK,EXIT'
0228 GO TO 6327
C
C CHANGE CHANNEL ASSIGNMENT
0229 6390 IF ( UPPDWN .NE. 2 ) GO TO 6180
0230  WRITE (1,*),'THIS COMMAND VALID ONLY FOR UPLINK CITIES'
0231  GO TO 6327

0232 6390 IF ( UPPDWN .NE. 1 ) GO TO 6185
0233  WRITE (1,*),'THIS COMMAND VALID ONLY FOR DOWNLINK CITIES'
0234  GO TO 6327

0235 6525 MODFLO=0
0236  GO TO 6327

0237 6550 WRITE (1,*),'ENTER LIST OF PATH NAMES TO DELETE FROM THIS CITY'
0238    J=UPPDWN + 4
0239    CALL MATMOD ( J,0,CURENT )
0240  GO TO 6327

0241 6600 DO 6610 I = 1, NPATH
0242 6610  UPTHCY ( I, CURENT ) = 0
0243  WRITE (1,*),'ENTER A NEW LIST OF PATH NAMES FOR THIS CITY'
0244    J=UPPDWN + 4
0245    CALL MATMOD ( J,1,CURENT)
0246  MODFLO = 1
0247  GO TO 6327

D-34
0249 6625 WRITE (1,1)'ENTER NEW NAME FOR THIS CITY'
0250  ASSIGN 6625 TO BADD
0251  READ (1,7990)(INDATA(I),I=1,80)
0252  CALL GETTER
0253  IF (UPPDWN.EQ.1) CALL LOCCHK(NCHAR,ARG,MAXUCT,UCTNAM,POSITN)
0254  IF (UPPDWN.EQ.2) CALL LOCCHK(NCHAR,ARG,MAXDCT,DCTNAM,POSITN)
0255  IF (POSITN.GT.0) GO TO 6322
0256  IF (UPPDWN.EQ.2) GO TO 6628
0257  DO 6627 I=1,NCHAR
0258  6627 UCTNAM(CURRENT(I)) = ARG(I)
0259  GO TO 6630
0260  6628 DO 6629 I=1,NCHAR
0261  6629 DCTNAM(CURRENT(I)) = ARG(I)
0262  NCHAR = NCHAR+1
0263  DO 6640 I=NCHAR-16
0264  IF (UPPDWN.EQ.1) UCTNAM(CURRENT(I))=BLANK
0265  IF (UPPDWN.EQ.2) DCTNAM(CURRENT(I))=BLANK
0266  6640 CONTINUE
0267  6640 CONTINUE
0268  GO TO 6327
C
C CHANGE TALKBACK PARAMETERS
C
0275  6650 IF (UPPDWN.EQ.1) GO TO 6390
0277  6651 WRITE (1,1)'ENTER UPLINK CITY NAME (/ORO)'
0278  6651 ASSIGN 6651 TO BADD
0279  6652 READ (1,7990)(INDATA(I),I=1,80)
0280  6653 CALL GETTER
0281  IF (ARG(1).EQ.'1') GO TO 6327
C
C UPPDWN MUST BE 1 TO CHECK UPLINK CITIES
C
0285  UPPDWN = 1
0286  CALL CTCHECK(POSITN,ORGNUM)
0287  UPPDWN=2
0288  IF (POSITN.LT.0) GO TO 6651
0289  IF (POSITN.EQ.0) GO TO 6315
0290  IF (POSITN.GT.0 .AND. ORGNUM.EQ.0) GO TO 6652
0291  GO TO 6320
0292  6652 TALKBK(POSITN,CURRENT) = 0
0293  6653 WRITE (1,1)'ENTER TALKBACK HOURS'
0294  ASSIGN 6653 TO BADD
0295  READ (1,1,ERR=7000)(XLO
0296  IF (XLO.LT.0 .OR. XLO.GT.9999.9) GO TO 7100
0297  TALKBK/CURRENT,POSITN) = XLO
0298  GO TO 6327
C
C NO SUCH CITY
C
CCC
DELETE A CITY FROM THE SCENARIO

0288 6700 WRITE (1,*) 'ENTER CITY (/ORO) TO BE DELETED'
0289  ASSIGN 6700 TO BADD
0290  READ (1,7990) (INDATA(I),I=1,80)
0291  CALL GETTER
0292  IF(ARG(I) .EQ. 'I') GO TO 6015
0293  CALL CITCHK (POSITN,ORGNUM )
0294  IF (POSITN .LT. 0) GO TO 6700
0295  IF (POSITN .EQ. 0 .OR. ORGNUM .NE. 0) GO TO 6320
0296  IF (POSITN .GT. 0 .AND. ORGNUM .EQ. 0 ) GO TO 6710
0297  IF(POSITN .GT. 0 ) GO TO 6700
0298  GO TO 6305
0299  6710  UPPDWN +4
0300  CALL DISAPR (J,POSITN)
0301  IF (UPPDWN.EQ.1.AND.NUCITY.EQ.0.OR.UPPDWN.EQ.2.AND.NDCITY.EQ.0) 2 GO TO 6806
0302  GO TO 6015

LIST INFORMATION PERTAINING TO CITY

0303  6800 IF (UPPDWN.EQ.1.AND.NUCITY.EQ.0.OR.UPPDWN.EQ.2.AND.NDCITY.EQ.0) 2 GO TO 6806
0304  WRITE (1,*)'ENTER CITY LIST SPECIFICATION'
0305  READ (1,7990) (INDATA(I),I=1,80)
0306  CALL GETTER
0307  CALL CODCHK(4,ARG,B,CTLSTS,POSITN)
0308  IF (POSITN .EQ. 0) GO TO 6805

INDE PATH PNAM TALK ORGS ALL CITY

0309  GO TO (6810, 6830, 6840, 6850, 6860, 6870, 6885, 6015) POSITN

NO SUCH COMMAND

0310  6805 WRITE (1,*)'INVALID LIST OPTION'
0311  WRITE(1,*)'VALID COMMANDS: INDE, PATH, PNAM, TALK, ORGS, ALL, CITY 2'
0312  GO TO 6800

ALL CITIES HAVE BEEN DELETED

0313  6806 WRITE (1,*)'ALL CITIES HAVE BEEN DELETED'
0314  GO TO 6015

INDEXES
CITY.FTN /TR:BLOCKS/WR

CCC

0315   6010   CALL REPRTR (5, 1)
0316   GO TO 6015

CCC

0317   6030   CALL REPRTR (4, 1)
0318   GO TO 6015

CCC

0319   6040   CALL REPRTR (3, 1)
0320   GO TO 6015

CCC

0321   6050   CALL REPRTR (6, 1)
0322   GO TO 6015

CCC

0323   6060   CALL REPRTR (7, 1)
0324   GO TO 6015

CCC

0325   6065   CALL REPRTR (10, 1)
0326   GO TO 6015

CCC

0327   6070   CALL REPRTR (5, 1)
0328   CALL REPRTR (4, 1)
0329   CALL REPRTR (6, 1)
0330   CALL REPRTR (7, 1)
0331   CALL REPRTR (10, 1)
0332   GO TO 6015
C EXIT FROM CITY

0333 6900 IF(UPPDWN .EQ. 2) GO TO 6980
0334 WRITE (1,'(1,A)') 'DO YOU WANT TO MODIFY DOWNLINK CITY DATA?'
0335 CALL YESNO

0336 Go to (6910, 6980, 6900) YESNO
0337 6910 UPPDWN = 2
0338 Go to 6015
0339 6980 RETURN
0340 7000 WRITE (1,'(1,A)') 'ERROR IN NUMERICAL READ -- PLEASE RETYPE'
0341 Go to BADD
0342 7100 WRITE (1,'(1,A)') 'SPECIFIED VALUE IS OUT OF RANGE:', PLON
0343 Go to BADD
0344 7990 FORMAT(80A1)
0345 7991 FORMAT(1X,'COMMANDS:', '12(1X,4A1)')
0346 END
SUBROUTINE RATE

RATE MODULE

THE RATE MODULE IS FOR THE PURPOSE OF ADDING OR MODIFYING TELEPHONE CHARGES, INTEREST RATES, OR GENERAL AND ADMINISTRATIVE COSTS. THE INTEREST AND A RATES PERTAIN TO THE NETWORK(S) AS A WHOLE AND THUS ARE NOT DIVIDED BETWEEN UPLINK AND DOWNLINK.

VARIABLES

DDDCPH - DIRECT DIAL COST PER HOUR

DDDINS - DIRECT DIAL INSTALLATION COST

DDDLES - DIRECT DIAL LEASE COST PER MONTH

DISCNT - DISCOUNT RATE FOR AMORTIZATION

EQPLIF - NUMBER OF YEARS OF EQUIPMENT LIFE (FOR AMORTIZING CAPITAL EXPENDITURES)

GANDAD - ARRAY OF THE FOUR COSTS FOR GENERAL AND ADMINISTRATIVE COSTS FOR CAPITAL, LEASE, INSTALLATION AND OPERATIONS AND MAINTENANCE

PVLES - PRIVATE LINE MONTHLY LEASE CHARGE FOR A GIVEN CITY PAIR IN TALKBACK SEGMENT

PVTFIX - PRIVATE LINE ZERO MILEAGE MONTHLY CHARGE

PVTING - PRIVATE LINE INSTALLATION CHARGE

PVTHIL - PRIVATE LINE MONTHLY LEASE CHARGE PER MILE

TLKCAP - ADDED CAPITAL EXPENDITURES REQUIRED FOR ADDING VOICE TALKBACK

WATINS - WATS INSTALLATION CHARGE

WATCPH - WATS CHARGE PER HOUR OF UTILIZATION

WATLES - WATS LEASE CHARGE PER MONTH

WATMAX - MAXIMUM MONTHLY CHARGE FOR WATS

SUBROUTINE CALLS: GETTER, CODCHK, YESNO, RATECK, REPTR

CALLED BY: BUILD

INCLUDE 'SY0:COMBLK.FTN/NLIST'

LOCAL VARIABLES

LOGICAL*1 RATECD(8,4)

INTEGER*2 XDAT
DATA RATECD/’P’,’W’,’D’,’I’,’G’,’T’,’L’,’E’,
2 ’R’,’A’,’D’,’N’,’A’,’A’,’I’,’X’,
3 ’I’,’T’,’D’,’T’,’T’,’L’,’S’,’I’,
4 ’U’,’E’,’ ’,’ ’,’ ’,’ ’,’K’,’T’,’T’/

C
0043 8000 WRITE ( 1,* ) ’DO YOU HAVE RATE INFORMATION TO ENTER?’
0044 CALL YESNO

C
0045 GO TO ( 8010, 8800, 8000 ) YESNO
0046 8010 WRITE ( 1,* ) ’ENTER RATE COMMAND’
0047 READ ( 1,8990 ) (INDATA(I),I=1,80)
0048 CALL GETTER
0049 CALL CODCHK (4, ARG, RATECD, POSITN)
0050 IF ( POSITN .EQ. 0 ) GO TO 8015

C BRANCH ON RATE COMMAND

C PRIV WATS DDD INT GA TALK LIST EXIT
0051 GO TO ( 8100, 8200, 8300, 8400, 8500, 8600, 8700, 8800 ) POSITN

C INVALID COMMAND

C
0052 8015 WRITE ( 1,* ) ’INVALID RATE COMMAND’
0053 WRITE (1,* ) ’VALID COMMANDS: PRIV, WATS, DDD, INT, GA, TALK, LIST, EXIT’
0054 GO TO 8010

C MODIY PRIVATE LINE COSTS

C
0055 8100 WRITE ( 1,* ) ’PRIVATE LINE CHARGES’
0056 WRITE ( 1,* ) ’INSTALLATION ZERO CHG/MO CHG/MILE/MO’
0057 WRITE ( 1,8991 ) PUTINS, PUTFIX, PUTMIL
0058 WRITE ( 1,* ) ’N= 1 2 3’

C
0059 8105 WRITE ( 1,* ) ’ENTER CHANGE : N, VALUE OR 0,0 TO END’
0060 ASSIGN 8105 TO BADD
0061 READ ( 1,* ) ERR=8115, XDAT, XDATA(2)
0062 IF ( XDAT .EQ. 0 OR .AND. XDATA(2) .EQ. 0 ) GO TO 8010
0063 CALL RATECK ( 1,3,XDAT )
0064 IF ( POSITN .EQ. 0 ) GO TO 8105

C INS FIX MIL
0065 GO TO ( 8120, 8140, 8160 ) XDAT

C ERROR IN RESPONSE

C
0066 8115 WRITE ( 1,* ) ’ERROR IN NUMERICAL READ – PLEASE RETYPE’
0067 GO TO BADD
0068 8120 PUTINS=XDATAL D(2)
0069 GO TO 8105
0070 8140 PUTFIX= XDATAL D(2)
0071 GO TO 8.5
0072 8160 PUTMIL= XDATAL D(2)
C MODIFY WATS CHARGES
C
8200 WRITE ( 1,* ) 'WATS CHARGES'
8072 WRITE ( 1,* )' INSTALLATION ZERO CHG/MO CHG/HR MAX CHG'
8073 WRITE ( 1,* )' WATINS=WATLES=WATCPH=WATMAX
8074 WRITE ( 1,* )' N= 1 2 3 4'
8075 WRITE ( 1,* )' ENTER CHANGE: N+VALUE OR 0+0 TO END'
8076 ASSGN 8205 TO BADD
8080 READ ( 1,* ,ERR=8115) XDAT, XDATA(2)
8081 IF ( XDAT .EQ. 0 .AND. XDATA(2) .EQ. 0 ) GO TO 8010
8082 CALL RATECK ( 1,4, XDAT )
8083 IF ( POSITN .EQ. 0 ) GO TO 8205
C INS LES CPH MAX
C
8300 WRITE ( 1,* ) 'DIRECT DIAL CHARGES'
8092 WRITE ( 1,* )' INSTALLATION PER MINUTE ZERO CHG/MO'
8093 WRITE ( 1,* )' DDDINS, DDDCPM, DDLES
8094 WRITE ( 1,* )' N= 1 2 3'
8095 WRITE ( 1,* )' ENTER CHANGE: N+VALUE OR 0+0 TO END'
8096 ASSGN 8305 TO BADD
8099 READ ( 1,* ,ERR=8115) XDAT, XDATA(2)
8100 IF ( XDAT .EQ. 0 .AND. XDATA(2) .EQ. 0 ) GO TO 8010
8101 CALL RATECK ( 1,3,XDAT )
8102 IF ( POSITN .EQ. 0 ) GO TO 8305
C DDIINS DDCPM DDLES
C
8360 DDDLES=XDATA(2)
C        MODIFY INTEREST INFORMATION
C

0110  B400  WRITE ( 1,* )'INTEREST RATES'
     0111  WRITE ( 1,* )'EQUIPMENT LIFE (YEARS)  DISCOUNT (%)'
     0112  WRITE ( 1,B993) EQPLIF,DISCNT
     0113  WRITE ( 1,* )'N=        2'
     0114  B405  WRITE ( 1,* )'ENTER CHANGE: N.VALUE OR 0.0 TO END'
     0115  ASSIGN B405 TO BADD
     0116  READ ( 1,*ERR=B115) XDAT, XDATA(2)
     0117  IF ( XDAT .EQ. 0 .AND. XDATA(2) .EQ. 0 ) GO TO 8010
     0118  CALL RATECK ( 1,2,XDAT )
     0119  IF ( POSITN .EQ. 0 ) GO TO B405

C        EQUIP DISCNT
     0120  8420  EQPLIF=XDATA(2)
     0121  GO TO 8405
     0122  8430  DISCNT=XDATA(2)
     0123  GO TO 8405

C        MODIFY GENERAL AND ADMINISTRATIVE EXPENSES
C

0125  B500  WRITE ( 1,* )'GENERAL AND ADMINISTRATIVE EXPENSES'
     0126  WRITE ( 1,* )'CAPITAL INSTALLATION  LEASE  OP AND MAIN
     0127  2T'
     0128  WRITE ( 1,* )'N=        2'
     0129  B505  WRITE ( 1,* )'ENTER CHANGE: N.VALUE OR 0.0 TO END'
     0130  ASSIGN B505 TO BADD
     0131  READ ( 1,*ERR=B115) XDAT, XDATA(2)
     0132  IF ( XDAT .EQ. 0 .AND. XDATA(2) .EQ. 0 ) GO TO 8010
     0133  CALL RATECK ( 1,4,XDAT)
     0134  IF ( POSITN .EQ. 0 ) GO TO B505

C        GANDAD(XDAT)=XDATA(2)
     0135  GO TO 8505

C

C        MODIFY TALKBACK CAPITAL EXPENDITURES
C

0137  B600  WRITE ( 1,* )'TALKBACK CAPITAL COSTS'
     0138  WRITE ( 1,B994) TLKCAP
WRITE ( 1,1 )'ENTER NEW VALUE'
ASSIGN 8605 TO BADDD
READ ( 1,1,ERR=8115) TLKCAP
GO TO 8010

C LIST RATE INFORMATION

CALL REPRTR ( 8)
GO TO 8010

EXIT FROM RATE

RETURN
FORMAT ( 2X,3(2X, F9.2, 3X ))
FORMAT ( 2X,4( 2X, F9.2, 3X ))
FORMAT ( 2X,2(6X, F9.2, 5X ))
FORMAT ( F9.2 )
END
SECTION 2. MODEL MODULE

Section 2 includes listings for the extended common area description, the main program for the MODEL module, and the following subroutines:

MODUP
MODDN
MODTK
THIS IS THE EXTENSION TO THE COMMON AREA "INCLUDED" IN THE MODEL
PROGRAMS. THE FILE NAME IS 'MODBLK'.

INTEGER*2 NUPREF(80)
COMMON NUPREF
REAL*4 UORGCS(9,5), DORGCS(9,5), TORGCS(9,5), AORGCS(9,5), XORCS(9,5)
COMMON UORGCS, DORGCS, TORGCS, AORGCS, XORCS
REAL*4 WGTARR(80)
COMMON WGTARR
REAL*4 UFTIDX(10,6,5), DFTIDX(20,6,5), UCOSTX(19,4), DCOSTX(80,4)
COMMON UFTIDX, DFTIDX, UCOSTX, DCOSTX
REAL*4 CAPCST, INSCST, LESCST, OMACST, AMORT
COMMON CAPCST, INSCST, LESCST, OMACST, AMORT
REAL*4 ANNL(80), TCOST(6,5)
COMMON ANNL, TCOST
REAL*4 CILO(5,2), PER, BLANK, UPODN(2,2)
COMMON CILO, PER, BLANK, UPODN
LOGICAL*1 RUNSEC(4), REPNUM(20), REFLST(20,2)
COMMON RUNSEC, REPNUM, REFLST
C THIS IS THE MAIN PROGRAM FOR THE COST SECTION OF THE MODEL
C
C SUBROUTINE CALLS: READIN, GETTER, REPTR, CODCHK,
C
C MODUP, MODDN, MODTK

0001 INCLUDE 'DK2:COMBLK.FTN/NOLIST'
0039 INCLUDE 'DK2:MODBLK.FTN/NOLIST'
0056 LOGICAL*I, LBLANK

C DATA INITIALIZATIONS

0057 DATA LBLANK
0058 DATA BFVT /'BFVT'/, BWATS /'WATS'/, BDDD /'DDD'/
0059 DATA CILO /'CILO'/, 'CAN', 'CLST', 'CLEAS', 'C0M', 'ANN':
0060 DATA PER /'PER'/, BLANK /'BLANK'/
0061 DATA UPORDN /'UPORDN'/, 'DOWN', 'LINK', 'LINK'
0062 DATA UCINDX /'UCINDX'/, 'F', 'I', 'X', 'E', 'S', 'D', 'D'
0063 DATA DCINDX /'DCINDX'/, 'F', 'I', 'X', 'E', 'S', 'D', 'D'
0064 DATA REFLST /'REFLST'/, '1', '2', '3', '4', '5', '6', '7', '8', '9', '10', '11', 'A'
0065 DATA REPNUM /'REPNUM'/
0066 DATA MAXUCS, MAXDCS, MAXUPA, MAXDPA, MAXUCT, MAXDCT /'MAXUCS'/
0067 DATA UCOSTX /'UCOSTX'/, DCOSTX /'DCOSTX'/, TCOST /'TCOST'/

C READ IN SCENARIO

0071 CALL READIN

C NOW DETERMINE WHICH REPORTS ARE REQUESTED

0072 160 WRITE(1,'(A)') 'INDICATE THE REPORT NUMBERS YOU WISH TO SEE'
0073 WRITE (1,*1) 'ENTER THE NUMBERS (1-19) SEPARATED BY COMMAS AND'
0074 WRITE (1,*1) 'OR SIMPLY ENTER "ALL" FOR ALL REPORTS'
0075 READ(1,1000) (INDATA(I), I=1,10)
0076 170 CALL GETTER
0077 IF (ARG(1).EQ.'I') GO TO 220
0078 IF (NCHAR.EQ.1) ARG(2) = LBLANK
0079 CALL CODCHK (ARG(1), ARG(2), ARGNC(2), POSITN)
0080 IF (POSITN.LE.0) GO TO 190
0081 IF (POSITN.EQ.20) GO TO 200
0082 POSITN(POSITN) = 1
0083 180 IF (CONTCD.EQ.0) GO TO 160
0084 IF (CONTCD.EQ.1) GO TO 170

C ERROR -- INVALID REPORT SPECIFIED

0085 190 WRITE (1,*1) ARG(1), ARG(2)
0086 GO TO 180

C ALL REPORTS DESIRED
C 0087 200 DO 210 I=1,19
C 0088 210 REPNUM(I) = 1
C
C CALCULATE INTEREST RATE AMORTIZATION FACTOR
C
0089 220 NYEARS = IFIX(EQPLIF)
0090 AMORT = 0.
0091 DO 230 I=1,NYEARS
0092 230 AMORT = (AMORT + 1.)/(1. + DISCNT/100.)
C
C INTEREST RATE, EQUIP. LIFE, AND MISC. ASSUMPTIONS REPORT
C
0093 IF (REPNUM(1).EQ.0) GO TO 240
0094 WRITE (3,1002) (TITLE(I),I=1,72)
0095 CALL REPRTR (8,1)
C
C UPLINK SEGMENT
C
0096 240 UPPDWN = 1
0097 CALL MODUP
C
C DOWNLINK SEGMENT
C
0098 UPPDWN = 2
0099 CALL MODDN
C
C VOICE TALKBACK AND SUMMARY
C
0100 CALL MODTK
0101 STOP
C
C FORMAT STATEMENTS
C
0102 1000 FORMAT (80A1)
0103 1001 FORMAT (1H0,'INVALID REPORT NUMBER: ',2A1,/)
0104 1002 FORMAT (1H1,72A1)
0105 END
SUBROUTINE MODUP

C
C    THIS SUBROUTINE DOES THE CALCULATIONS FOR THE UPLINK SEGMENT
C    OF THE MODEL.
C
C    SUBROUTINE CALLS: REPRTR, VANDH
C
INCLUDE 'DK2:COMBLK.FTN/NOLIST'
INCLUDE 'DK2:MODBLK.FTN/NOLIST'

C COST ELEMENT DATA

IF (REPNUM(2).NE.1) GO TO 110
WRITE (3,1001) (TITLE(I),I=1,972)
WRITE(3+1002) UPORDN(191)+UPORDN(192)
DO 100 I=1,NUELEM
   CALL REPRTR (19I)
100 CONTINUE

C PRINT COST/PATH MATRIX

IF (REPNUM(3) .EQ. 0) GO TO 112
WRITE (3+1001) (TITLE(I),I=1,972)
CALL REPRTR (291)

C PATH/CITY MATRIX

IF (REPNUM(4) .EQ. 0) GO TO 114
WRITE (391001) (TITLE(I),I=1,972)
CALL REPRTR (491)

C CITY COST INDEXES

IF (REPNUM(5) .EQ. 0) GO TO 116
WRITE (391001) (TITLE(I),I=1,972)
CALL REPRTR (591)

C MATRIX OF TALKBACK REQUIREMENTS

IF (REPNUM(6) .EQ. 0) GO TO 118
WRITE (3,1001) (TITLE(I),I=1,972)
CALL REPRTR (691)

C CALCULATE COSTS OF UPLINK PATHS, BY COST INDEX

DO 130 J=1,NUPATH
   DO 130 I=1,NUELEM
      DO 130 M=1,NUINDEX
         DO 120 L=1,4
         N = UCSPTH(I,J)
         UPTIDX(J,M,L) = UPTIDX(J,M,L) + FLOAT(N)AMUCSDAT(I,M,L)
         UPTIDX(J,M,L) = UPTIDX(J,M,L) + FLOAT(N)*
                      ((UCSDAT(I,M,1)+UCSDAT(I,M,2))/AMORT+UCSDAT(I,M,3)+UCSDAT(I,M,4))
120 CONTINUE
130 CONTINUE

C COST SENSITIVITY REPORT
MODUP.FTN /TR:BLOCKS/WR

0082  IF (REPNUM(7).NE.1) GO TO 160
0083  WRITE (3,1001) (TITLE(I),I=1,72)
0084  WRITE (3,1020) UPORDN(1,1),UPORDN(1,2)
0085  DO 150 I=1,NPATH
0086  WRITE (3,1021) I, (UPTHNM(IPJ),PJ=1,20)
0087  IF (NUINDX.GT.1) WRITE (3,1022) (PER,J=2,NUINDX)
0088  WRITE (3,1023) ((UCINDX(J,K),K=1,8),J=1,NUINDX)
0089  DO 140 J=1,5
0090  WRITE (3,1024) CILO(J+1),CILO(J+2),(UPTIDX(I,K,J),K=1,NUINDX)
0091  150 CONTINUE

C IF COST ALLOCATION SPECIFIED; REMOVE MULTIPLE CITY LISTINGS
C
0092  160 IF (NUMORG.EQ.0) GO TO 250
0093  DO 240 K=1,NUCITY
0094  WGTARR(K) = UDPWHT(1)
0095  IF (NUINDX.EQ.1) GO TO 180
0096  DO 170 L=2,NUINDX
0097  170 WGTARR(K) = WGTARR(K) + UCTXVL(K,L-1)*UDPWHT(L)
0098  IF (WGTARR(K).LE.0.0) WGTARR(K) = 1.0
0099  180 IF (K.EQ.1) GO TO 240
0100  DO 230 I=1,K-1
0101  DO 190 J=1,6
0102  IF (UCTNAM(K,PJ).NE.UCTNAM(I,J)) GO TO 230
0103  190 CONTINUE
0104  DO 200 J=1,NUINDX-1
0105  200 UCTXVL(I,J) = UCTXVL(I,J) + UCTXVL(K,J)
0106  DO 210 J=1,NDCITY
0107  TALKBK(J,I) = TALKBK(J,I) + TALKBK(J,K)
0108  DO 220 J=1,NUPATH
0109  220 UPTHCY(I,J) = UPTHCY(I,J) .OR. UPTHCY(K,J)
0110  UCITYV(K) = -1
0111  GO TO 240
0112  230 CONTINUE
0113  240 CONTINUE

C CALCULATE COSTS FOR UPLINK PATHS BY CITY, AND CHOOSE THE BEST ONE. THEN ADD 'CHOSEN' PATH COSTS TO TOTALS FOR SUMMARY TABLE
C
0114  250 IF (REPNUM(8).EQ.0) GO TO 255
0115  WRITE (3,1001) (TITLE(I),I=1,72)
0116  WRITE (3,1034) UPORDN(1,1),UPORDN(1,2)
0117  255 DO 350 K=1,NUCITY
0118  INDIC = 0
0119  IF (UCITYV(K).EQ.-1) GO TO 350
0120  IF (UCITYV(K).LT.0) CALL VANDH(UCITYV(K),UCITYH(K))
0121  BOTTOM = 1.0E38
0122  DO 310 J=1,NUPATH
0123  IF (UPTHCY(J,K).EQ.0) GO TO 310
0124  CAPCST = UPTIDX(J+1)
0125  INSCST = UPTIDX(J+2)
0126  OMACST = UPTIDX(J+4)
0127  IF (NUINDX.EQ.1) GO TO 270
0128  DO 260 M=2,NUINDX
0129  260 260 CAFST = CAPCST + UPTIDX(J,M+1)*UCTXVL(K,M-1)
0130  310 CONTINUE

C OMIT LEASE CALCULATIONS; BECAUSE OF THE MINIMUM VARIABLE
C
0131  350 CONTINUE
0132  355 CONTINUE

D-51
MODUP.FTN  /TR:BLOCKS/WR

0130 INSCST = INSCST + UPTIDX(J,M,2)*UCTXVL(K,M-1)
0131 OMACST = OMACST + UPTIDX(J,M,4)*UCTXVL(K,M-1)

C CALCULATE LEASE COSTS
C
0132 LESCST = 0.
0133 DO 290 I=1,NUELEM
0134 TEMP=0.
0135 IF (UCSPTH(I,J).EQ.0) GO TO 290
0136 TEMP = TEMP + UCSDAT(I,J)*3
0137 IF (NUINDX.EQ.1) GO TO 290
0138 DO 280 M=2,NUINDEX
0139 TEMP = TEMP + UCSDAT(I,M)*UCTXVL(K,M-1)
0140 IF (TEMP.LT.UCSMIN(I)) TEMP=UCSMIN(I)
0141 LESCST = LESCST +TEMP
0142 CONTINUE
0143 ANNL(J) = (CAPCST+INSCST)/AMORT + LESCST + OMACST
C COMPARE ANNUALIZED COST WITH BEST PREVIOUS PATH
0144 IF (REPNUM(I).NE.1) GO TO 300
0145 IF (INDIC.EQ.0) WRITE (3,1035) (UCTNAM(KPM),M=1,16),J
0146 IF (INDIC.EQ.1) WRITE (3,1036) J,CAPCST,INSCST,LESCST,OMACST,ANNL(J)
0147 INDIC = 1
0148 IF (ANNL(J).GE.BOTTOM) GO TO 310
0149 NUPREF(K) = J
0150 BOTTOM = ANNL(J)
0151 CONTINUE
0152 N=NUPREF(K)
0153 DO 340 L=1,N
0154 UCOSTX(K,L) = UPTIDX(N,L)
0155 IF (NUINDX.EQ.1) GO TO 330
0156 DO 320 M=2,NUINDEX
0157 UCOSTX(K,L) = UCOSTX(K,L) + UPTIDX(K,M,4)*UCTXVL(K,M-1)
0158 CONTINUE
0159 IF (L.EQ.3) TCOST(1,L) = TCOST(1,L) + UCOSTX(K,L)
0160 CONTINUE
0161 UCOSTX(K,3)=BOTTOM-UCOSTX(K,3)-(UCOSTX(K,1)+UCOSTX(K,2))/AMORT
0162 TCOST(1,3) = TCOST(1,3) + UCOSTX(K,3)
0163 TCOST(1,5) = TCOST(1,5) + BOTTOM
0164 CONTINUE

C NO COST ALLOCATION CALCULATIONS
C
0165 IF (NUMORO.EQ.0) GO TO 410
0166 DO 400 I=1,NUCITY
0167 TOTWT=0.
0168 DO 380 J=1,NUCITY
0169 DO 360 K=1,16
0170 IF (UCTNAM(K).NE.UCTNAM(J,K)) GO TO 380
0171 CONTINUE
0172 IF (USTCOD(I,K).NE.USTCOD(J+2)) 2,USTCOD(I,K).NE.USTCOD(J,K)
0173 TOTWT = TOTWT + WGTARR(J)
0174 IF (J.EQ.J) GO TO 380
0175 DO 370 L=1,4

D-52
MODUP.FTN /TRIBLOCKS/WR

UCOSTX(JrL) = UCOSTX(IrL)

N = UCTORG(I;
DO 390 L=1,4
390 UORGCS(NrL) = UORGCS(NrL) + UCOSTX(IrL)*WGTARR(I)/TOTWGT
CONTINUE
C
C UPLINK SUMMARY REPORT
C
IF (REPNUM(9).NE.1) RETURN
WRITE (3,1001) (TITLE(I),I=1,72)
WRITE(3,1010) UPORDN(1,1), UPORDN(1,2)
DO 420 I=1,NUINDX
420 CONTINUE
IF (UCITYV(I).LT.0) RETURN
YEARLY = (UCOSTX(I,1)+UCOSTX(I,2))/AMORT+UCOSTX(I,3)+UCOSTX(I,4)
WRITE(3,1012) (UCTNMN(I,J),J=1,16),(UCOSTX(I,J),J=1,4),YEARLY
IF (NUINDX.GT.1) WRITE (3,1013) ((UCINDX(K,J),J=1,8),K=1,NUINDX)
IF (NUINDX.GT.1) WRITE (3,1014) (UCTXL(I,J),J=1,NUINDX-1)
RETURN
C
C FORMAT STATEMENTS
C
1001 FORMAT (1H1X72A1)
1002 FORMAT (1H0,17X,2A4,' COST ELEMENT DATA',//)
1010 FORMAT (1H0,26X,2A4,' COSTS BY CITY')
1011 FORMAT (1H0,3X,'CITY',15X,'CAPITAL',4X,'INSTALL',6X,'LEASE',6X,'OM&IA',2X,'ANNUALIZED')
1012 FORMAT (1H0,16A1,2X,5F11.0)
1013 FORMAT (1H0,18X,5X,8A1)
1014 FORMAT (1H0,18X,5F11.0)
1015 FORMAT (1H0,7X,2A4,' TOTAL',2X,5F11.0)
1020 FORMAT (1H0,11X,'SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS--',2,2A4,(/)
1021 FORMAT (1H0,'PATH',12,10X,'TOTAL',2,2A4,(/)
1022 FORMAT (1H0,20X,5X,4A))
1023 FORMAT (1H0,20X,5X,4A)
1024 FORMAT (1H0,3X,2A4,6F11.0)
1034 FORMAT (1H0,25X,'COST OF EACH PATH--',2A4,6X,'CITY',2X,'PATH',5X,'CAPITAL',4X,'INSTALL',6X,'LEASE',6X,'OM&IA',3X,'ANNUALIZED',//)
1035 FORMAT (1H0,16A1,14,F13.0,3F11.0,F12.0)
1036 FORMAT (1H0,16X,14,F13.0,3F11.0,F12.0)
END
SUBROUTINE MODDN

C
C  THIS SUBROUTINE PERFORMS THE CALCULATIONS FOR THE DOWNLINK
SEGMENT OF THE MODEL
C
C  SUBROUTINE CALLS: REPRTR, VANDH
C
C
INCLUDE 'DK2:CCMBLK.FTN/NOLIST'
INCLUDE 'DK2:MODBLK.FTN/NOLIST'

C
C  COST ELEMENT DATA
C
IF (REPNUM(10).NE.1) GO TO 200
WRITE (3,1001) (TITLE(I),I=1,72)
WRITE (3,1002) UPORDN(2,1),UPORDN(2,2)
DO 100 I=1,NDELEM
CALL REPRTR(I)
100 CONTINUE

C
C  PRINT COST/PATH MATRIX
C
IF (REPNUM(11).EQ.0) GO TO 225
WRITE (3,1001) (TITLE(I),I=1,72)
CALL REPRTR(2)

C
C  PATH/CITY MATRIX
C
IF (REPNUM(12).EQ.0) GO TO 250
WRITE (3,1001) (TITLE(I),I=1,72)
CALL REPRTR(4)

C
C  CITY COST INDEXES
C
IF (REPNUM(13).EQ.0) GO TO 275
WRITE (3,1001) (TITLE(I),I=1,72)
CALL REPRTR(5)

C
C  CALCULATE COSTS OF DOWNLINK PATHS BY COST INDEX
C
DO 400 J=1,NDPATH
DO 400 I=1,NDELEM
DO 400 M=I,NDEINDEX
N = DCSPTH(J)
DF'TIDX(J,M,L) = DPTIDX(J,M,L) + FLOAT(N)*DCSDAT(I,M,L)
400 DPTIDX(J,M,L) = DPTIDX(J,M,L) + FLOAT(N)*
2*(DCSDAT(I,M,L)+DCSDAT(I,M+2))/AMORT+DCSDAT(I,M,3)+DCSDAT(I,M,4)

C
C  COST SENSITIVITY REPORT
C
IF (REPNUM(14).NE.1) GO TO 700
WRITE (3,1001) (TITLE(I),I=1,72)
WRITE (3,1020) UPORDN(2,1),UPORDN(2,2)
DO 600 I=1,NDPATH
WRITE (3,1021) I,(DPTHMN(I,J),J=1,20)
600 IF (NDINDEX.GT.1) WRITE (3,1022) (PER,J=2,NDINDEX)
WRITE (3,1023) ((DCINDX(J,K),K=1,NDCITY),J=1,NDINDX)
0086 DO 500 J=1,5
0087 500 WRITE (3,1024) CILO(J,1), CILO(J,2), (DPTIDX(I,K,J),K=1,NDINDX)
0088 CONTINUE
0089 IF (COST_ALLOCATION_SPECIFIED, REMOVE_MULTIPLE_CITY_LISTINGS)
0090 700 IF (NUMORG.EQ.0) GO TO 1600
0091 DO 1500 K=1,NDCITY
0092 WGTARR(K) = DDXWHT(1)
0093 IF (NDINDX.EQ.1) GO TO 900
0094 DO 800 L=2,NDINDX
0095 WGTARR(K) = WGTARR(K) + DCTXVL(K,L-1)*DDXWHT(L-1)
0096 900 IF (K.EQ.1) GO TO 1500
0097 DO 1400 I=1,K-1
0098 DO 1000 J=1,16
0099 IF (DCTNAM(K,J).NE.DCTNAM(I,J)) GO TO 1400
0100 1000 CONTINUE
0101 DO 1100 J=1,NDINDX-1
0102 1100 DCTXVL(I,J) = DCTXVL(I,J) + DCTXVL(K,J)
0103 DO 1200 J=1,NDCITY
0104 TALKBK(I,J) = TALKBK(I,J) + TALKBK(K,J)
0105 DO 1300 J=1,NPATH
0106 DPTHCY(I,J) = DPTHCY(I,J) + DPTHCY(K,J)
0107 DCITYV(K) = 1
0108 GO TO 1500
0109 DO 1400 J=1,1400
0110 1400 CONTINUE
0111 IF (REPNUM(15).EQ.0) GO TO 1650
0112 WRITE (3,1001) (TITLE(I),I=1,72)
0113 WRITE (3,1034) UPORDN(2,1),UPORDN(2,2)
0114 DO 1650 K=1,NDCITY
0115 INDIC = 0
0116 IF (DCITYV(K).EQ.0) GO TO 2500
0117 IF (DCITYV(K).LT.0) CALL VANDH(DCTNAM(K),DCTNAM(I,J))
0118 BOTTOM = 1.0
0119 DO 2100 J=1,NPATH
0120 IF (DPTHCY(K,J).EQ.0) GO TO 2100
0121 C OMIT LEASE CALCULATIONS, BECAUSE OF THE MINIMUM VARIABLE
0122 CAPCST = DPTIDX(J,1,1)
0123 INSCST = DPTIDX(J,1,2)
0124 QMACST = DPTIDX(J,1,4)
0125 IF (NDINDX.EQ.1) GO TO 1800
0126 DO 1700 M=2,NDINDX
0127 C CALCULATE LEASE COSTS
0128 CAPCST = CAPCST + DPTIDX(J,M,1)*DCTXVL(K,M-1)
0129 INSCST = INSCST + DPTIDX(J,M,2)*DCTXVL(K,M-1)
0127 1700 QMACST = QMACST + DPTIDX(J,M,4)*DCTXVL(K,M-1)
0128 CONTINUE
0129 1800 LESCST = 0.
MODDN.FTN /TR:BLOCKS/WR

0130 DO 1900 I=1,NDELEM
0131 TEMP=0.
0132 IF (DCSPTH(I,J).EQ.0) GO TO 1900
0133 TEMF + TEMP + DCSDAT(I,1,3)
0134 IF (NDINDX.EQ.1) GO TO 1900
0135 DO 1900 M=2,NDINDEX
0136 TEMP = TEMP + DCSDAT(I,M,3)*DCXTVL(K,M-1)
0137 IF (TEMP.LT.DCSMIN(I)) TEMP = DCSMIN(I)
0138 LESCST = LESCST + TEMP
0139 1900 CONTINUE
0140 AMNL(J) = (CAPCST+INSCST)/AMORT + LESCST + OMACST
C COMPARE ANNUALIZED COST WITH BEST PREVIOUS PATH
0141 IF (REPNUM(15).NE.1) GO TO 2000
0142 IF (INDIC.EQ.0) WRITE (3,1035) (DCTNAM(K,M),M=1,16),J+
0143 WRITE (3,1036) J,
C 1035 CAPCST,INSCST,LESCST,OMACST,AMNL(J)
C 1036 CAPCST,INSCST,LESCST,OMACST,AMNL(J)
0144 2000 INDIC = 1
0145 IF (AMNL(J).GE.BOTTOM) GO TO 2100
0146 NUPREF(K) = J
0147 BOTTOM = AMNL(J)
0148 2100 CONTINUE
0149 H=NUPREF(K)
0150 DO 2400 L=1,4
0151 DCOSTX(K,L) = DPTIDX(N+1,L)
0152 IF (NDINDEX.EQ.1) GO TO 2300
0153 DO 2200 M=2,NDINDEX
0154 DCOSTX(K,L) = DCOSTX(K,L) + DPTIDX(N+M,L)*DCXTVL(K,M-1)
0155 2200 CONTINUE
0156 2300 IF (L.NE.3) TCOST(2,L) = TCOST(2,L) + DCOSTX(K,L)
0157 2400 CONTINUE
0158 TCOST(2,3) = BOTTOM-DCOSTX(K,4)-(DCOSTX(K,1)+DCOSTX(K,2))/AMORT
0159 TCOST(2,3) = TCOST(2,3) + DCOSTX(K,3)
0160 TCOST(2,5) = TCOST(2,5) + BOTTOM
0161 2500 CONTINUE
C DO COST ALLOCATION CALCULATIONS
C
0162 IF (NUMORG.EQ.0) GO TO 3100
0163 DO 3000 I=1,NDCITY
0164 TOTWGT=0.
0165 DO 2800 J=1,NDCITY
0166 DO 2600 K=1,16
0167 IF(DCTNAM(I,K).NE.DCTNAM(J,K)) GO TO 2800
0168 2600 CONTINUE
0169 IF (DSTCODD(I,1).NE.DSTCODD(J,1)) OR.
0170 2 DSTCODD(I,2).NE.DSTCODD(J,2)) GO TO 3000
0171 TOTWGT = TOTWGT + WGTARR(J)
0172 IF (I.EQ.J) GO TO 2800
0173 DO 2700 L=1,4
0174 2700 DCOSTX(I,L) = DCOSTX(I,L)
0175 2800 CONTINUE
0176 M = DCTORG(I)
0177 DO 2900 L=1,4
0178 2900 DORGCS(N,L) = DORGCS(N,L) + DCOSTX(I,L)*WGTARR(I)/TOTWGT
0179 3000 CONTINUE

D-56
C    DOWNLINK SUMMARY REPORT
C
0179  3100 IF (REPNUM(16).NE.1) RETURN
0180  WRITE (3,1001) (TITLE(I),I=1,72)
0181  WRITE(3,1010) UPORDN(2,1), UPORDN(2,2)
0182  DO 3200 I=1,NDCITY
0183   IF (DCITYV(I).LT.0) GO TO 3200
0184   WRITE (3,1011)
0185   YEARLY = (DCOSTX(I,1)+DCOSTX(I,2))/AMORT+DCOSTX(I,3)+DCOSTX(I,4)
0186   WRITE(3,1012) (DCTNAM(I,J),J=1,16),(DCOSTX(I,J),J=1,4),YEARLY
0187   IF (NDINDX.GT.1) WRITE (3,1013) ((DCINDX(K,J),J=1,B),K=2,NDINDX)
0188   IF (NDINDX.GT.1) WRITE (3,1014) (DCTXVL(I,J),J=NDINDX-1)
0189  3200 CONTINUE
0190  WRITE(3,1015) (UPORDN(2,K),K=1,2), (TCOST(2,K),K=1,5)
0191  RETURN
C    FORMAT STATEMENTS
C
0192  1001 FORMAT (1H1,72A1)
0193  1002 FORMAT (1H0,17X,2A4,' COST ELEMENT DATA'///)
0194  1010 FORMAT(1H0,26X,2A4,' COSTS BY CITY')
0195  1011 FORMAT(1H0,3X,'CITY',15X,'CAPITAL',4X,'INSTALL',6X,'LEASE',6X,
2     'O&M',2X,'ANNUALIZED')
0196  1012 FORMAT(1H0,16A1,2X,5F11.0)
0197  1013 FORMAT (1H0,18X,5(3X,BA1))
0198  1014 FORMAT(1H0,18X,5F11.0/)  
0199  1015 FORMAT(1H0,'/X',2A4,' TOTAL',2X,5F11.0)
0200  1020 FORMAT(1H0,11X,'SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS--',
2     2A4,'///')
0201  1021 FORMAT(1H0,'PATH ',12,' -- ',20A1)
0202  1022 FORMAT (1H0,20X,5(7X,A4))
0203  1023 FORMAT (1H0,11X,6(3X,BA1))
0204  1024 FORMAT (1H0,16A1,2X,6F11.0)
0205  1034 FORMAT(1H0,25X,'COST OF EACH PATH--',2A4,'///4X','CITY',
2     10X,'PATH',5X,'CAPITAL',4X,'INSTALL',6X,'LEASE',6X,'O&M',
2     2X,'ANNUALIZED'///)
0206  1035 FORMAT(1H0,16A1,4F13.0,3F11.0,F12.0)
0207  1036 FORMAT(1H0,16X,4F13.0,3F11.0,F12.0)
0208  END
SUBROUTINE MODTK

THIS SUBROUTINE PERFORMS THE CALCULATION FOR THE TALKBACK SEGMENT OF THE MODEL. IT ALSO PRODUCES THE GRAND SUMMARY REPORT.

INCLUDED 'DK2:COMBLK.FTN/NOLIST'
INCLUDED 'DK2:MODBLK.FTN/NOLIST'
REAL*4 BPVTPBWATSFBDDD
DATA BPVTP 'PVT', BWATS 'WATS', BDDD 'DDD'

PREPARE AND PRINT TABLE FOR VOICE TALKBACK SYSTEM COSTS

DO 1700 J=1,NUCITY
IF (UCITYV(J).EQ.-1) GO TO 1700

CHECK FOR NO TALKBACK REQUIREMENT AND SET V AND H COORDINATES

T = 0.
DO 100 I=1,NDCITY
T = T + TALKBK(I,J)
100 CONTINUE
IF (T.EQ.0.0) GO TO 1700

REPEAT FOR EACH COMBINATION OF UPLINK AND DOWNLINK CITY

IF (REPNUM(17).EQ.0) GO TO 150
WRITE (3+1001) (TITLE(K),K=1,72)
WRITE (3,1015) (UCTNAM(JPN),N=1,16)
150 DO 1600 I=1,NDCITY
IF (DCITYV(I).EQ.-1) GO TO 1600
TOTWGT = 0.
IF (TALKBK(I+J).GT.0.AND.DCTLVL(I).EQ.0) GO TO 200
IF (TALKBK(I+J))1600.1600+500
200 DIST=1.E38
DO 400 K=1,NDCITY
IF (K.EQ.I) GO TO 400
IF (DCTLVL(K)-2)400,300,400
300 X = DCITYV(K) - DCITYV(I)
Y = DCITYH(K) - DCITYH(I)
DIST=MIN1(DIST,SORT((X**2+Y**2)/10.))
400 CONTINUE
GO TO 600
500 X = UCITYV(J) - DCITYV(I)
Y = UCITYH(J) - DCITYH(I)
DIST=SQRT((X**2+Y**2)/10.)
600 HOURS = TALKBK(I,J)
PLEASE=MIN1(WATLES+WATCPH*HOURS,WATMAX)
PLEASE=PUTFIX+DIST*PVTMIL
DDLEAS=DDDCPH*HOURS
TCOST(3,1)=TCOST(3,1)+TLKCAF
IF(WPLEASE-PLEASE)700,800,800
700 IF(WPLEASE.GT.DDLEAS) GO TO 900
TALK=BWATS
INSCST = WATINS
LESCST = WPLEASE/12.
GO TO 1000
MODTK:'N
/TRAN:BLOCKS/WR
0097 800 IF(PLEASE.GT.DDLEAS) GO TO 900
0098 TALK=BPUT
0099 INSCST=PVTINS
0100 LESCST=PLEASE*12.
0101 GO TO 1000
0102 900 TALK=BDDB
0103 INSCST=DDDINS
0104 LESCST=DDLEAS*12.
0105 1000 TCOST(3+2)=TCOST(3+2)+INSCST
0106 TCOST(3+3)=TCOST(3+3)+LESCST
0107 TCOST(3+5)=TCOST(3+5)+TLKCAP/AMORT+INSCST/AMORT+LESCST
C DO COST ALLOCATION CALCULATIONS, IF APPLICABLE
C
0108 IF (NUMORG.EQ.0) GO TO 1500
0109 DO 1200 L=1+NDCITY
0110 DO 1100 K=1,16
0111 IF (DCTNAM(I+K).NE.DCTNAM(L+K)) GO TO 1200
0112 1100 CONTINUE
0113 IF (DSTCOD(I+1).NE.DSTCOD(L+1),OR.
  2 DSTCOD(I+2).NE.DSTCOD(L+2)) GO TO 1200
0114 TOTWGT=TOTWGT+WGTARR(L)
0115 1200 CONTINUE
0116 DO 1400 I=1,16
0117 N=DCTORG(L)
0118 TORGCS(N+1)=TORGCS(N+1)+TLKCAP*WGTARR(L)/TOTWGT
0119 TORGCS(N+2)=TORGCS(N+2)+INSCST*WGTARR(L)/TOTWGT
0120 TORGCS(N+3)=TORGCS(N+3)+LESCST*WGTARR(L)/TOTWGT
0121 TORGCS(N+4)=0.
0122 1400 CONTINUE
C TALKBACK REPORT
C
0127 1500 IF (REPNUM(17).EQ.1) WRITE(3,1016)(DCTNAM(I),I=1,16),
  2 HOURP,DIST,WATINS,WLEASE,PVTINS,PLEASE,DDDINS,DDLEAS,TALK
0128 1600 CONTINUE
0129 1700 CONTINUE
C ALLOCATE ADMINISTRATIVE COSTS
C
0130 IF (NUMORG.EQ.0) GO TO 3300
0131 TOTWGT=0.
0132 DO 1800 I=1,NDCITY
0133 TOTWGT=TOTWGT+WGTARR(I)
0134 1800 CONTINUE
0135 DO 2000 I=1,NDCITY
0136 N=DCTORG(I)
0137 DO 1900 L=1,4
0138 1900 AORGCS(N,L)=AORGCS(N,L)+BANDAD(L)*WGTARR(I)/TOTWGT
0139 2000 CONTINUE
C
C COST ALLOCATION TABLE
C
0140 2100 IF (REPNUM(18).NE.1.OR.NUMORG.EQ.0) GO TO 3300
0141 WRITE (3*1001) (TITLE(I),I=1,72)
0142 WRITE (3*1025)
0143 WRITE (3*1026)
0144 DO 2200 I=1,25
0145 2200 ANNL(I) = 0.
0146 DO 2400 I=1,NUMORG
0147 UORGCS(I,5) = (UORGCS(I,1) + UORGCS(I,2))/AMORT + UORGCS(I,3)
2 + UORGCS(I,4)
0148 DO 2300 J=1,4
0149 2300 ANN(J) = ANN(J) + UORGCS(I, J)
0150 ANN(S) = ANN(S) + UORGCS(I, S)
0151 WRITE (3*1027) I, (ORGNAME(I,J), J=1,20), (UORGCS(I,J), J=1,5)
0152 2400 CONTINUE
0153 WRITE (3*1028) (ANNL(J), J=1, 5)
0154 WRITE (3*1029)
0155 DO 2600 I=1, NUMORG
0156 DORGCS(I, 5) = (DORGCS(I, 1) + DORGCS(I, 2))/AMORT + DORGCS(I, 3)
2 + DORGCS(I, 4)
0157 DO 2500 J=6, 9
0158 2500 ANN(J) = ANN(J) + DORGCS(I, J)
0159 ANN(10) = ANN(10) + DORGCS(I, 5)
0160 WRITE (3*1027) I, (ORGNAME(I,J), J=1,20), (DORGCS(I,J), J=1,5)
0161 2600 CONTINUE
0162 WRITE (3*1028) (ANNL(J), J=6, 10)
0163 WRITE (3*1030)
0164 DO 2800 I=1, NUMORG
0165 TORGCS(I, 5) = (TORGCS(I, 1) + TORGCS(I, 2))/AMORT + TORGCS(I, 3)
2 + TORGCS(I, 4)
0166 DO 2700 J=11, 14
0167 2700 ANN(J) = ANN(J) + TORGCS(I, J)
0168 ANN(15) = ANN(15) + TORGCS(I, 5)
0169 WRITE (3*1027) I, (ORGNAME(I,J), J=1,20), (TORGCS(I,J), J=1,5)
0170 2800 CONTINUE
0171 WRITE (3*1028) (ANNL(J), J=11, 15)
0172 WRITE (3*1032)
0173 DO 3000 I=1, NUMORG
0174 AORGCS(I, 5) = (AORGCS(I, 1) + AORGCS(I, 2))/AMORT + AORGCS(I, 3)
2 + AORGCS(I, 4)
0175 DO 2900 J=21, 24
0176 2900 ANN(J) = ANN(J) + AORGCS(I, J)
0177 ANN(25) = ANN(25) + AORGCS(I, 5)
0178 WRITE (3*1027) I, (ORGNAME(I,J), J=1,20), (AORGCS(I,J), J=1,5)
0179 3000 CONTINUE
0180 WRITE (3*1028) (ANNL(J), J=21, 25)
0181 WRITE (3*1031)
0182 DO 3200 I=1, NUMORG
0183 DO 3100 J=1, 5
0184 XORGCS(I,J) = UORGCS(I,J) + DORGCS(I,J) + TORGCS(I,J) + AORGCS(I,J)
0185 ANN(J+15) = ANN(J+15) + XORGCS(I,J)
0186 DO 3100 CONTINUE
0187 WRITE (3*1027) I, (ORGNAME(I,J), J=1,20), (XORGCS(I,J), J=1,5)
0188 3200 CONTINUE
0189 WRITE (3*1028) (ANNL(J), J=16, 20)
C CALCULATE AND PRINT TOTAL COSTS FOR GRAND SUMMARY TABLE
C
0190 DO 3500 K=1,5
0191 DO 3400 J=1,4
0192 TCOST(4,J) = GANDAD(J)
0193 TCOST(5,K) = TCOST(5,K)+TCOST(J,K)
0194 CONTINUE
0195 TCOST(4,5)=(TCOST(4,1)+TCOST(4,2))/AMORT + TCOST(4,3) + TCOST(4,4)
0196 TCOST(6,1)=TCOST(5,1)/AMORT
0197 TCOST(6,2)=TCOST(5,2)/AMORT
0198 TCOST(6,3)=TCOST(5,3)
0199 TCOST(6,4)=TCOST(5,4)
0200 TCOST(5,5)=(TCOST(5,1)+TCOST(5,2))/AMORT+TCOST(5,3)+TCOST(5,4)
0201 TCOST(6,5)=TCOST(6,1) + TCOST(6,2) + TCOST(6,3) + TCOST(6,4)
0202 IF (REPNUM(19).NE.1) RETURN
0203 WRITE(3,1001) (TITLE(I),I=1,72)
0204 WRITE(3,1004)
0205 WRITE(3,1005) ((TCOST(I,J),J=1,5),I=1,6)
0206 NYEARS = IFIX(EGPLIF)
0207 WRITE(3,1006)NYEARS,DISCNT,TCOST(6,5)
0208 RETURN
C FORMAT STATEMENTS
C
0209 1001 FORMAT (1H1,72A1)
0210 1004 FORMAT (1H0///,30X,'OVERALL COST SUMMARY',///,20X,
1  'CAPITAL',3X,'PLANNING AND',7X,'ANNUAL',7X,'ANNUAL',
2  '3X','ANNUALIZED',17X,'EXPENDITURES',1X,'INSTALLATION',
3  '7X','LEASE',8X,'0%MIA',7X,'COST')
0211 1005 FORMAT (1H0,'UPLINK',9X,5F13.0,'ODOWNLINK',7X,5F13.0,
1 2/,'OVOICE TALKBACK',1X,5F13.0,,'OADMINISTRATIVE',1X,5F13.0,
3/,'0 TOTALS',6X,5F13.0,'OANNUALIZED COST',5F13.0)
0212 1006 FORMAT (///,1X,'EFFECTIVE YEARLY COSTS FOR ',12,' YEAR',', ',5F2.2,
1 2 PERCENT AMORTIZATION --- $9F9.0)
0213 1015 FORMAT (1H0,'27X','TALKBACK SYSTEM LEASE COSTS',///,35X,'70 ',16A1///,
1 2 '21X','HOURS',8X,'WATS COSTS',4X,'PRIVATE LINE',3X,
3 '5X','CITY',6X,'LEVEL',1X,'UTIL',1X,'DIST',1X,
4 'INSTALL LEASE',2X,'INSTALL LEASE',2X,'INSTALL LEASE',2X,
5 'BEST')
0214 1016 FORMAT (1H0,'28X','NETWORK COST ALLOCATION',///,30X,'CAPITAL',4X,
1 2 'INSTALL',6X,'LEASE',6X,'0%MIA',1X,'ANNUALIZED')
0215 1025 FORMAT (1H0,'28X','NETWORK COST ALLOCATION',///,30X,'CAPITAL',4X,
1 2 'INSTALL',6X,'LEASE',6X,'0%MIA',1X,'ANNUALIZED')
0216 1026 FORMAT (1H0,' UPLINK',/)
0217 1027 FORMAT (1H13,1X,20A1,1X,5F11.0)
0218 1028 FORMAT (1H0,' TOTAL',12X,5F11.0)
0219 1029 FORMAT (1H0,' DOWNLINK',/)
0220 1030 FORMAT (1H0,' VOICE TALKBACK',/)
0221 1031 FORMAT (1H0,' TOTAL NETWORK',/)
0222 1032 FORMAT (1H0,' ADMINISTRATIVE',/)
0223 END
SECTION 3. EARTH MODULE

Section 3 includes listings for the main program for the EARTH module and the following subroutines:

MOVREC
EARTH STATION REPORT PROGRAM

This program produces a report of all earth stations that are within a given distance from an uplink or downlink city that is in a user’s scenario. The report may be limited by specifying a unique satellite that the earth terminal must be licensed to point to.

Subroutine calls: READIN, VANDH, MOVREC, CODCHK

Include 'SYOICOMBLK.FTN/NOLIST'

Logical*1 PAD(12460)

Common PAD

Logical*1 CALSIM(5), LICENSE(40), CITY(20), STATE(2), SERVIS(18)

Logical*1 BAND(4*2), SIZE(4)

Integer*2 UPDOWN

Common /ESTATN/ UPDOWN, CALSIM, LICENSE, CITY, STATE, SERVIS, BAND, SIZE

Local variables

Logical*1 SATLIT(5), AUTHCD, INCHAR(5)

Logical*1 SATCOD(25*5), HEADER(72), TMPARY(82), SAT(5,5)

Logical*1 NAMUCT(10*16), NAMDC(80*16), DCDST(10*2), DODST(80,2)

Integer*2 BAD, LAT, LON, UCTARY(10), DCTARY(80), NUMCHR, NUMSAT

Integer*2 POS, UCITY, DCITY, NUMREC, J, FIRST, LAST

Integer*2 ORGNUM, UCITY(10), DCITY(10), VDCITY(80), HDCITY(80)

Real*4 DIST, DISTNC, DOWNUP(2), X, Y

To provide consistency between the build model and earth modules, the subroutine READIN is used to read the user’s scenario. Since this requires a lot of overhead in terms of data that is not required for this module, those variables that are needed are saved in local arrays and the earth terminal array is overlayed on top of the common. To protect against writing over other variables, the common must be 'padded' out to assume the size of the earth terminal array. The formula for doing this is:

Size of PAD = 78 + 82 * (Number of records in array - 199)

Logical*1 BIGREC(350,82)

Equivalence (BIGREC(1,1), NULEM)

Data NUMSAT /25/, DATA NUMUP /DOWN'/


5 /'2', '2', '2', '2', '2', '2', '3', '3', '3', '3', '3', '3', '3', '3', '3', '1', '2'/

6 /'3', '2', '2', '2', '2', '2', '3', '4', '4', '5', '5', '3', '3', '3', '3', '0', '1', '2'/

7 /'6', '7', '8', '9', '0', '1', '2', 'K', 'K', 'K', 'K', 'K', 'K', 'K', 'K', 'K'/


CALL READIN
OPEN (UNIT=2, TYPE='OLD', NAME='SYO: EARTH.DAT',
      CARRIAGECONTROL='LIST', ERR=9010)

SINCE THE COMMON AREA WILL BE USED TO STORE THE EARTH TERMINAL
RECORDS, SOME OF THE COMMON VARIABLES WILL HAVE TO BE SAVED AS
LOCAL VARIABLES.

UCITY=NUCITY
DCITY=NCITY
ORGNUM=NUMORG
DO 5 I=1,72
      HEADER(I)=TITLE(I)
      5 CONTINUE

DO 30 I=1,DCITY
      DCITYV(I)=DCITY(I)
      30 CONTINUE

DO 40 I=1,UCITY
      UCITYV(I)=UCITY(I)
      40 CONTINUE

C ELIMINATE UPLINK DUPLICATE CITIES IF THERE IS COST ALLOCATION

IF (ORGNUM.EQ.0) GO TO 140

DO 90 K=2,UCITY
      DO 80 I=1,K-1
      DO 70 J=1,16
          IF (NAMUCT(K,J).NE.NAMUCT(I,J)) GO TO 90
          70 CONTINUE
          VUCITY(K)=-1
          GO TO 90

C ELIMINATE DOWNLINK DUPLICATE CITIES IF THERE IS COST ALLOCATION

DO 130 K=2,DCITY
      DO 120 I=1,K-1
      DO 110 J=1,16
0090  IF (NAMDC(T(I,J)).NE.NAMDC(T(I,J))) GO TO 120
0099  110  CONTINUE
0100  VDCITY(K)=1
0101  GO TO 130
0102  120  CONTINUE
0103  130  CONTINUE

C        NOW CLEAR OUT THE COMMON BY FILLING THE SIGREC ARRAY WITH BLANKS
C
0104  140 DO 160 I=1,330
0105  150 DO 150 J=1,32
0106  160 SIGREC(I,J)=''
0107  150 CONTINUE
0108  160 CONTINUE

C
0109  170 WRITE (14) 'ENTER THE MAXIMUM ACCEPTABLE DISTANCE (IN MILES)'
0110  180 WRITE (14) 'BETWEEN AN EARTH STATION AND A CITY'
0111  ASSIGN 170 TO SAD
0112  READ (14,ERR=9900) DISTNC
0113  IF (DISTNC.GT.0.AND.DISTNC.LE.50.) GO TO 200

C        DISTANCE OUT OF RANGE
C
0114  190 WRITE (14) 'DISTANCE MUST BE LESS THAN 50 MILES'
0115  200 GO TO 170

C        ENTER SATELLITE
C
0116  210 WRITE (14) 'ENTER THE SATELLITE OF INTEREST BY CALL NUMBER'
0117  READ (14,210) (SATLIT(I),I=1,5)
0118  210 FORMAT (5A1)
0119  IF (SATLIT(I).EQ.'A'.AND.SATLIT(2).EQ.'L'.AND.SATLIT(3).EQ.'L')
0120  CALL CODCHK(SATLIT,NUMSAT,SATCOD,POS)
0121  IF (POS.NE.0) GO TO 500
0122  WRITE (14) (SATLIT(I),I=1,5)
0123  220 FORMAT (1X,'INVALID SATELLITE CALL NUMBER '5A1/)
0124  230 WRITE (14) 'VALID SATELLITES ARE...'
0125  240 FORMAT (1X,5A1,2X,'WESTAR I',/)
0126  250 FORMAT (1X,5A1,2X,'WESTAR II',/)
0127  260 FORMAT (1X,5A1,2X,'WESTAR III',/)
0128  270 FORMAT (1X,5A1,2X,'COMSTAR D-1',/)
0129  280 FORMAT (1X,5A1,2X,'COMSTAR D-2',/)
0130  290 FORMAT (1X,5A1,2X,'COMSTAR D-3',/)
0131  300 FORMAT (1X,5A1,2X,'COMSTAR D-4',/)
0132  310 FORMAT (1X,5A1,2X,'SATCOM I',/)
0133  320 FORMAT (1X,5A1,2X,'SATCOM II',/)
0134  330 FORMAT (1X,5A1,2X,'SATCOM III',/)
0135  340 FORMAT (1X,5A1,2X,'CANADIAN TELESAT SATELLITES',/)
0136  350 FORMAT (1X,5A1,2X,'MARISAT I',/)
0137  360 FORMAT (1X,5A1,2X,'MARISAT II',/)
0138  370 FORMAT (1X,5A1,2X,'MARISAT III',/)
0139  380 FORMAT (1X,5A1,2X,'INTELSAT I',/)

D-67
GO TO 200

BYPASS=1

UPDOWN=0

NUMREC=0

READ THE DATA BASE

READ (2,520=ERR=9020,END=580) (CALBIN(I),I=1,5), (LICENSE(I),I=1,40),
      (CITY(I),I=1,10), (STATE(I),I=1,2), AUTHCD

FORMAT (SA1,IX=40A1,IX=20A1,IX=2A1,IX=A1)

READ(2,535=ERR=9020,END=580) (SERVIS(I),I=1,18),
      (BAND(I),I=1,2),
      I=1,4), (SIZE(I),I=1,4), LAT, LON, ((SAT(I),J=1,5),I=1,5)

FORMAT (6X,IX=2A1,IX=1A1,IX=2X,IX=1A1,IX=2X,IX=1A1,IX=2X,IX=1A1)

LOOK FOR SATELLITE

IF (BYPASS.EQ.1) GO TO 536

CALL CODCHK(5,SATLIT,3,SAT,POS)

IF (POS.EQ.0) GO TO 520

CALCULATE V AND H COORDINATES

LATT=LAT

CALL VANDH(LAT,LON):

CALCULATE: DISTANCE FROM UPLINK CITIES

UPDOWN=1

IF (SERVIS(I),NE,'T') GO TO 537

VUCITY(I)=1,UCITY

IF (VUCITY(I),EQ.0) IF 545

X=VUCITY(I)-LAT

Y=VUCITY(I)-LON

DIST=(X**2+Y**2)/10.

DIST=SQR(DIST)

IF (DIST.GT.DISTNC) GO TO 545

IF (NUMREC.EQ.750) GO TO 570

NUMREC=NUMREC+1

CALCULATE: DISTANCE FROM DOWNLINK CITIES

UPDOWN=2

D-68
IF (SERVIS(B).NE. 'R',AND,SERVIS(9).NE. 'R') GO TO 520
DO 560 I=1,DCITYN
IF (VDCITY(I).EQ.-1) GO TO 560
X=VDCITY(I)-LAT
Y=VDCITY(I)-LON
DIST=(X**2+Y**2)/10.
DIST=SORT(DIST)
IF (DIST.OT.DISTNC) GO TO 560
IF (NUMREC.EQ.350) GO TO 570
NUMREC=NUMREC+1
CALL MOVREC(I,NUMREC)
CONTINUE
GO TO 520
WRITE (1*) '***** OVER 350 EARTH STATIONS QUALIFY *****'
WRITE (1*) 'ONLY A PARTIAL REPORT WILL BE CREATED'
WRITE (1*) 'USE A SMALLER DISTANCE FOR A FULL REPORT'
CLOSE THE EARTH TERMINAL FILE AND SORT THE ARRAY
DO 610 L=1,NUMREC
TMPARY(L)=BIGREC(J-1)
DO 620 L=1,NUMREC
IF (BIGREC(J-1).GT.BIGREC(I-1)) GO TO 700
IF (BIGREC(J-1).LT.BIGREC(I-1)) GO TO 600
IF (BIGREC(J-1).GT.BIGREC(I-1)) GO TO 700
DO 630 L=1,NUMREC
TMPARY(L)=BIGREC(J-1)
CONTINUE
DO 610 L=1,NUMREC
WRITE (3,4100) (HEADER(I),I=1,72)
4100 FORMAT ('T**2A1')
4100 FORMAT ('T**2A1')
IDIST=DISTNC
WRITE (3,4600) DOWHUP(2),IDIST,(SATLIT(I),I=1,5)
4600 FORMAT (3,4460)
WRITE (3,4460) 'CALL SIGN',11X,'LICENSEE',21X,'CITY',6X,'STATE',2X,
2 'SERVICE',3X,'SIZE'
4460 FORMAT (3,4460)
FIRST=1
4460 FORMAT (3,4460)
DO 4750 I=1,UCITYN

IF (VUCITY(I).EQ.-1) GO TO 4750

IF (UCTARY(I).EQ.0) GO TO 4740

WRITE (3,4730) (NAMUCT(I,J),J=1,16),(CODUST(I,J),L=1,2)

LAST=FIRST+UCTARY(I)-1

DO 4735 K=FIRST,LAST

WRITE (3,4731) (BIGREC(K,L),L=3,82)

CONTINUE

FIRST=LAST+1

GO TO 4750

END

C
C
C

4730 FORMAT (/,"%16A1,2X,2A1")

4731 FORMAT (/sIX."NO EARTH STATIONS NEAR ",16A1,2X,2A1)

4735 CONTINUE

4740 FORMAT (/,s1X,NO EARTH STATIONS NEAR ",16A1,2X,2A1)

4745 CONTINUE

C

DOWNLINK PART OF REPORT
C
C

5000 WRITE (3,4600) DOWNUP(I),IDIST(SATLIT(I),I=1,5)

5012 WRITE (3,4620)

5013 DO 5750 I=1,DCITYN

5014 IF (VDCITY(I).EQ.-1) GO TO 5750

5015 IF (DCTARY(I).EQ.0) GO TO 5740

5016 WRITE (3,4730) (NAMDCT(I,J),J=1,16),(CODDST(I,J),L=1,2)

5017 LAST=FIRST+DCTARY(I)-1

5018 DO 5735 K=FIRST,LAST

5019 WRITE (3,4731) (BIGREC(K,L),L=3,82)

5020 CONTINUE

5021 FIRST=LAST+1

5022 GO TO 5750

5023 WRITE (3,4745) (NAMDCT(I,L),L=1,16),(CODDST(I,J),L=1,2)

5024 CONTINUE

C

5025 GO TO 9900

C

9000 WRITE (1,*) 'ERROR IN NUMERICAL READ - PLEASE REENTER'

9010 WRITE (1,*) 'ERROR OPENING EARTH TERMINAL FILE'

9020 WRITE (1,*) 'ERROR READING EARTH TERMINAL FILE'

9900 STOP

END
SUBROUTINE MOVREC(I, J)

C THIS ROUTINE MOVES THE EARTH TERMINAL INFORMATION INTO AN ARRAY
C WHICH IS PRINTED IN THE PROGRAM EARTH.
C
C CALLED BY: EARTH
C
BIGREC — AN ARRAY CONTAINING UPLINK OR DOWNLINK CODE, CITY INDEX,
C AND A PRINT RECORD FOR EACH EARTH TERMINAL NEAR EACH
C CITY
C I — INDEX OF THE UPLINK OR DOWNLINK CITY
C J — INDEX OF THE BIGREC
C UPDOWN = 1 = UPLINK, 2=DOWNLINK

INCLUDE 'SY0:COMBLK.FTN/NOLIST'

LOGICAL*1 PAD(12460)
COMMON PAD

LOGICAL*1 CALSIN(5), LICNSE(40), CITY(20),
2 STATE(2), BAND(4+2), SIZE(4), SERVIS(18)
INTEGER*2 UPDOWN, I, J

COMMON /ESTATN/ UPDOWN, CALSIN, LICNSE, CITY, STATE, SERVIS, BAND, SIZE

LOGICAL*1 BIGREC(350, 82)
EQUIVALENCE (BIGREC(1, 1), NUELEM)

BIGREC(J, 1) = UPDOWN
BIGREC(J, 2) = I
DO 10 K = 3, 7
BIGREC(J, K) = CALSIN(K - 2)
DO 20 K = 9, 43
BIGREC(J, K) = LICNSE(K - 8)
DO 30 K = 46, 61
BIGREC(J, K) = CITY(K - 45)
DO 40 K = 64, 65
BIGREC(J, K) = STATE(K - 63)
DO 50 K = 68, 76
BIGREC(J, K) = SERVIS(K - 67)
DO 60 K = 79, 82
BIGREC(J, K) = SIZE(K - 78)

RETURN
END
SECTION 4. GENERAL UTILITY SUBROUTINES

Section 4 includes listings for the general utility subroutines used by all of the modules.

READIN
RITOUT
YESNO
UPDOWN
CODCHK
GETTER
COUNT
DISAPR
RDCOST
RATECK
CTYCHK
VANDH
MATMOD
REPRTR
SUBROUTINE READIN

CALLED BY: BUILD, MODEL, EARTH

OPEN INPUT SCENARIO FILE

WRITE(1,'(A1)') 'ENTER NAME OF SCENARIO FILE'

READ(1,5001) TITLE, I=1,72

NUMBER OF COST ELEMENTS, INDEXES, CITIES, PATHS, COST ALLOCATION ORGS

READ(2,5002) NUELEM, NDELEM, NINDX, NDINDX, NCITY, NDCITY, NPATH, NDPATH, NUMORG

ALL OTHER SCALARS

COST ALLOCATION ORGANIZATION NAMES, IF APPLICABLE

IF (NUMORG.EQ.0) GO TO 510

L1 = 1

L2 = MAX(NNUMORG,L1+3)

READ (2,5004) (ORGNAM(I,J),J=1,20),I=L1,L2

IF (L1.LE.NUMORG) GO TO 501

UPLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS
0063  S10  IF (NUINDX.GE.2)
  2  READ(2,5005,ERR=5030) ((UCINDX(I,J),J=1,8),I=2,NUINDX)
0064  5005  FORMAT (5(I1,1X))
0065  5006  IF (NUMORG.GT.0) READ(2,5006,ERR=5030) (UDXWHT(I),I=1,NUINDX)
0066  5007  FORMAT (6(F7.3,1X))
     UPLINK COST ELEMENT DATA
0067  JERROR=2
0068  DO 530  I = 1,NUELEM
0069  530  READ(2,5007,ERR=5030) (UCSCOD(I,J),J=1,2),(UCSNAM(I,J),J=1,20),
     2  (UCSMIN(I),(UCSDAT(I,J,K),K=1,4)
0070  5007  FORMAT (2A1,1X,20A1,1X,16F10.3)
0071  5008  IF (NUINDX.EQ.1) GO TO 540
0072  J = 0
0073  S18  J = J + 2
0074  IF (J .LT. NUINDX) GO TO 530
0075  520  JJ = J + 1
0076  5008  READ(2,5008,ERR=5030) (UCSDAT(I,J,K),K=1,4),(UCSDAT(I,J,J,K),K=1,4)
0077  5009  FORMAT (8F10.3)
0078  540  GO TO 518
0079  525  READ(2,5009,ERR=5030) (UCSDAT(I,J,K),K=1,4)
0080  S30  CONTINUE
     UPLINK PATH DATA
0081  JERROR=3
0082  DO 540  ISL#NUPATH
0083  540  READ(2,5010,ERR=5030) (UPTHNM(ISL#J),J=1,20),(UCSPTH(J),J=1,NUELEM)
0084  5010  FORMAT (20AIMP1511)
0085  CONTINUE
     UPLINK CITY DATA
0086  JERROR=4
0087  IF (NUCITY.EQ.0) GO TO 555
0088  DO 550  ISL#NUCITY
0089  550  READ(2,5010,ERR=5030) (UCTNAM(ISL#J),J=1,16),(USTRCD(ISL#J),J=1,12),
     2  (UCITYV(ISL#J,1),UCITYV(ISL#J,20),UCITYM(ISL#J,1),UCITYM(ISL#J,20),
     2  UCITYM(ISL#J,1),UCITYM(ISL#J,20)
0090  5010  FORMAT (160A1,1X,2A1,1X,16F10.3)
0091  IF (NUINDX.GT.1) READ(2,5008,ERR=5030) (UCTXVL(I,J),J=1,NUINDX-1)
0092  CONTINUE
     DOWNLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS
0093  555  JERROR=5
0094  IF (NDINDEX.GE.2)
  2  READ(2,5005,ERR=5030) ((DCINDEX(I,J),J=1,8),I=2,NDINDEX)
0095  IF (NUMORG.GT.0) READ(2,5006,ERR=5030) (DDXWHT(I),I=1,NDINDEX)
     DOWNLINK COST ELEMENT DATA
0096  DO 630  I = 1,NDELEM
0097  630  READ(2,5007,ERR=5030) (DCSCOD(I,J),J=1,2),(DCSNAM(I,J),J=1,20),
  2  (DCSMTN(I),(DCSDAT(I,J,K),K=1,4)

D-76
READIN.FTN /TR1$LOCKS/WR
0098 IF (NDINDX.EQ.1) GO TO 640
0099 J = 0
0100 IF (J .EQ. NDINDX) 620,425,630
0102 JJ = J + 1
0103 READ(2,5008,ERR=5030) (DCSDAT(I,J,K),K=1,4),(DCSDAT(I,JJ,K),K=1,4)
0104 GO TO 618
0105 READ(2,5008,ERR=5030) (DCSDAT(I,J,K),K=1,4)
0106 CONTINUE
C C C
DOWNLINK PATH DATA
0107 JERROR=6
0108 DO 640 I=1,NDPATH
0109 READ(2,5009,ERR=5030)(DPTHNM(I,J),J=1,20),(DCSPTH(I,J),J=1,NDPATH)
0110 CONTINUE
C C C
DOWNLINK CITY DATA
0111 JERROR=7
0112 IF (NDCITY.EQ.0) 00 TO 690
0114 READ(2,5010,ERR=5030) (DCTNM(I,J),J=1,16),(DCTCOD(I,J),J=1,2),
2 DCITYV(I),DCITYH(I),DCTLVL(I),DCTORG(I),(DPTHCY(JI),J=1,NDPATH)
0115 IF (NDINDX.GT.1) READ(2,5008,ERR=5030) (DCTXVL(I,J),J=1,NDINDEX-1)
0116 CONTINUE
C C C
TALKBACK INFORMATION
0117 JERROR=8
0118 IF (NUCITY.EQ.0) GO TO 690
0119 DO 680 J=1,NUCITY
0121 L1 = L2 + 1
0122 L2 = L1 + 12
0123 IF(L1.GT.NDCITY) GO TO 680
0124 IF(L2.GT.NDCITY) L2=NDCITY
0125 READ(2,5011,ERR=5030) (TALKBK(I,J),J=L1,L2)
0126 CONTINUE
0127 CONTINUE
0128 CLOSE (UNIT=2)
0130 RETURN
C C IF ERRORS OCCUR WHILE READING THE INPUT FILE
C C
0131 WRITE(1,5025) (INNAME(I),I=1,16)
0132 5025 FORMAT(1H 'ERROR IN OPENING FILE ','16A1)
0133 GO TO 5040
0134 WRITE(1,5035)(PROBLM(I,JERROR),I=1,3)
0135 5035 FORMAT(1H 'ERROR READING ','3A4', 'DATA')
0136 5040 WRITE (1,*), 'PROGRAM TERMINATED'
0137 CLOSE (UNIT=2)
0138 STOP
0139 END

D-77
SUBROUTINE RITOUT

CALLING REASON: BUILD

INCLUDE 'SYO:COMBLK.FTN/NOLIST'

NON-COMMON ARRAY VARIABLES

LOGICAL I INNAME(16)
REAL*4 PROBLM(3, 8)
DATA INNAME /'B', 'Y', 'O', 'L', 'X', 'A', 'T', 'O'/
DATA PROBLM /* SC, ALAR, UPNI, MK C, STEL, 2 UPNI, NK P, ATH, 3 DNLI, NK C, ITY, TALK, BACK */

OPEN OUTPUT SCENARIO FILE

WRITE(1,*)('ENTER NEW 6 CHARACTER NAME FOR THE SCENARIO FILE JUST CREATED', I=1,10)
READ(1,5001,ERR=5030) (INNAME(I), I=5,10)
OPEN (UNIT=2, TYPE='NEW', NAME=INNAME, CARRIAGECONTROL='LIST', ERR=5020)

HEADER RECORD

JERROR = 1
WRITE(2,5001,ERR=5030) (TITLE(I), I=1,72)
5001 FORMAT(72A1)

NUMBER OF COST ELEMENTS, INDEXES, CITIES, PATHS, COST ALLOCATION ORGS

WRITE(2,5002,ERR=5030) NUELE, NDELE, NUINDX, NDIDX, NUCITY, NDCITY, NUPATH, NDPATH, NUMORG
5002 FORMAT(9I4)

ALL OTHER SCALARS

WRITE(2,5003,ERR=5030) DDCPH, DDDINS, DDDLIES, EQPLIF, PUTLIES, PUTFIX, 2 PUTINS, PUTMIL, DISCNET, TLKCAP, WATINS, WATLES

WRITE(2,5050,ERR=5050) WATMAX, WATCPH, (GANDAD(I), I=1,4)
5050 FORMAT(2F8.2,4F12.2)

COST ALLOCATION ORGANIZATION NAMES, IF APPLICABLE

IF(NUMORB.EQ.0) GO TO 510
LI = 1
L2 = MIN(NUMORB,LI+3)
WRITE(2,5004,ERR=5030) ((ORGNAME(I,J), J=1,20), I=LI,L2)
5004 FORMAT (4(20A1))

5056 IF(NUMORG.EQ.0) GO TO 510
5057 LI = 1
5058 L2 = MIN(NUMORG,LI+3)
5059 WRITE(2,5004,ERR=5030) ((ORGNAME(I,J), J=1,20), I=LI,L2)
5060 5004 FORMAT (4(20A1))
RITOUT.FTN /TR2b2.00KS/WR

0041  LI = L2 + 1
0042  IF (LI.LE.NUMORG) GO TO 501

C UPLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS

0043  510  IF (NUINDX.GE.2) 2  WRITE(2,5005) ((UCINDX(I,J),J=1,8),I=1,NUINDX)
0044  5005  FORMAT (5(8A1:I))
0045  5006  IF (NUMORG.GT.0) WRITE(2,5006) (UDXWHT(I),I=1,NUINDX)
0046  5006  FORMAT (6F7.3)

C UPLINK COST ELEMENT DATA

0047  JERROR=2
0048  DO 520 I = 1,NUELEM
0049  520  WRITE(2,5007) ((UCSC00(I,J),J=1,2), (UCSNAME(I,J),J=1,20),
0050  5007  (UCSNMN(I)), (UCSDAT(I,J,K),K=1,4))
0051  IF (NUINDX.EQ.1) GO TO 540
0052  518  J = 0
0053  518  J = J + 2
0054  IF (J - NUINDX) 520 525 530
0055  520  JJ = J + 1
0056  520  WRITE(2,5008) ((UCSNAME(I,J,K),K=1,4), (UCSDAT(I,J,J,K),
0057  5008  2  K=1,4))
0058  5008  IF (NUINDX.GT.1) WRITE(2,5008) (UCSDAT(I,J,J,K),K=1,4)
0059  525  CONTINUE

C UPLINK PATH DATA

0060  JERROR=3
0061  DO 540 I=1,NUPATH
0062  540  WRITE(2,5009) (UPTHNM(I,J),J=1,20), (UCSPATH(I,J),J=1,
0063  5009  2  NUELEM)
0064  5009  IF (NUINDX.GT.1) WRITE(2,5009) (UCSPATH(I,J),J=1,NUINDX-1)
0065  540  CONTINUE

C UPLINK CITY DATA

0066  JERROR=4
0067  IF (NUCITY.EQ.0) GO TO 555
0068  DO 550 I=1,NUCITY
0069  550  WRITE(2,5010) ((UCCTNM(I,J,K),J=1,16), (UCSTCOD(I,J),J=1,2),
0070  5010  2  UCITYU(I)), (UCITYU(I), I=1,NUCITY)
0071  550  IF (NUINDX.GT.1) WRITE(2,5010) (UCCTNM(I,J,K),J=1,NUINDX-1)
0072  550  CONTINUE

C DOWNLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS

0073  555  JERROR=5
0074  IF (NDINDX.GE.2) 2  WRITE(2,5005) ((DCINDX(I,J),J=1,8),I=1,NDINDX)
0075  5005  IF (NUMORG.GT.0) WRITE(2,5006) (DDXWHT(I),I=1,NDINDX)

D-79
C DOWNLINK COST ELEMENT DATA
C
DO 630 I = 1, NDELEM
0096 WRITE(2,5007) (DCSCOD(I,J), J=1,2), (DCSNAM(I,J), J=1,20),
       (DCSMIN(I), (DCSDAT(I,J,K), K=1,4)
0097 IF (NDEIDX.EQ.1) GO TO 640
0098 J = 0
0100 J = J + 2
0101 IF (J - NDEIDX) 620,625,630
0102 JJ = J + 1
0103 WRITE(2,5008) (DCSDAT(I,J,K), K=1,4), (DCSDAT(I,J,J), J=1,
       2, K=1,4)
0104 GO TO 610
0105 WRITE(2,5009) (DCSDAT(I,J,K), K=1,4)
0106 CONTINUE
C DOWNLINK PATH DATA
C
JERROR = 6
C
DO 640 I = 1, NDELPATH
0107 WRITE(2,5009) (DPTHNM(I,J), J=1,20), (DCSPTH(I,J), J=1,
       2, NDELEM)
0108 CONTINUE
C DOWNLINK CITY DATA
C
JERROR = 7
C
IF (NDCITY .EQ. 0) GO TO 690
C
WRITE(2,5010) (DCITYN(I,J), J=1,16), (DCXVL(I,J), J=1,16),
       (DCSPLT(I,J), J=1,16), (DCSORTH(I,J), J=1,16),
C
IF (NDEIDX .GT. 1) WRITE(2,5011) (TALKBK(I,J), I=1, L1)
0117 JERROR = 8
0118 IF (NDCITY .EQ. 0) GO TO 690
0119 DO 680 J = 1, NUCITY
0120 L2 = 0
0121 L1 = L2 + 1
0122 L2 = L1 + 12
0123 IF(L1 .GT. NDCITY) GO TO 690
0124 IF(L2 .GT. NDCITY) L2 = NDCITY
0125 WRITE(2,5011) (TALKBK(I,J), I=1, L2)
0126 5011 FORMAT (13F6-1)
0127 CONTINUE
0128 CONTINUE
0129 CLOSE (UNIT=2)
0130 RETURN
C IF ERRORS OCCUR WHILE WRITING THE OUTPUT FILE
C
5020 FORMAT (1H ERROR OPENING FILE ',16A1)
0131 5025 FORMAT (1H ERROR OPENING FILE ',16A1)
0132
0133  GO TO 5040
0134  5030  WRITE(1*,5035) (PROBLM(I,ERROR),I=1,3)
0135  5035  FORMAT(1H,'ERROR WRITING ',3A4,' DATA')
0136  5040  WRITE (1*,8) 'BUILDTER TERMINATED'
0137  8    CLOSE (UNIT=2)
0138  STOP
0139  END
SUBROUTINE YESNO

YESNO DETERMINES IF THE RESPONSE TO A QUESTION IS 'YES' OR 'NO'
OR IN ERROR AND SETS THE APPROPRIATE FLAG - ONLY THE FIRST
CHARACTER OF THE RESPONSE IS CHECKED.

0001 SUBROUTINE YESNO
0002 INCLUDE 'SYO:COMBLK.FTN/NOLIST'
0040 YESNO = 3
0041 READ(1,10,ERR=20) INDATA(1)
0042 10 FORMAT (A1)
0043 IF (INDATA(1),EQ,'Y') YESNO = 1
0044 IF (INDATA(1),EQ,'N') YESNO = 2
0045 20 IF (YESNO.EQ.3) WRITE (1,8) 'ANSWER MUST BE 'YES' OR 'NO''
0046 RETURN
0047 END
SUBROUTINE UPDOWN

UPDOWN determines if the response to a question is 'UPLINK' or 'DOWNLINK' or in error and sets the appropriate flag - only the first character of the response is checked.

0001 SUBROUTINE UPDOWN
0002 INCLUDE 'SYO:COMBLK.FTN/NOLIST'
0040 UPPDWN = 3
0041 READ(1,10) INDATA(1)
0042 10 FORMAT(A1)
0043 IF (INDATA(1).EQ.'U') UPPDWN = 1
0044 IF (INDATA(1).EQ.'D') UPPDWN = 2
0045 20 IF (UPPDWN.EQ.1) WRITE (1,*)'ANSWER MUST BE 'UP' OR 'DOWN''
0046 RETURN
0047 END
SUBROUTINE CODCHK

CALLED BY: COST, PATH, CITY, RATE, METHOD, RDCOST, MODEL, EARTH

CODCHK CHECKS AN INPUT ARGUMENT AGAINST A LIST OF VALID ARGUMENTS

SUBROUTINE CODCHK(NCHAR, INDATA, NCOMPR, CNPARR, POSITN)

ARGUMENTS:
NCHAR = NUMBER OF CHARACTERS IN INPUT ARGUMENT
INDATA = ARRAY CONTAINING INPUT ARGUMENT
NCOMPR = NUMBER OF POSSIBLE VALUES
CNPARR = ARRAY CONTAINING LIST OF POSSIBLE VALUES
POSITN = POSITION IN THE ARRAY WHERE INPUT ARGUMENT MATCHED A POSSIBLE VALUE.

0001 INTEGER NCHAR, NCOMPR, POSITN, I, J, NMATCH
0002 LOGICAL INDATA(I), CNPARR(NCOMPR, I)
0003 C
0004 POSITN = 0
0005 NMATCH = 0
0006 DO 10 I = 1, NCOMPR
0007 DO 20 J = 1, NCHAR
0008 IF (INDATA(J).NE.CNPARR(I, J)) GO TO 20
0009 10 CONTINUE
0010 20 CONTINUE

USER'S RESPONSE CONTAINED TOO FEW CHARACTERS TO MAKE A UNIQUE MATCH

0013 IF (NMATCH.GT.1) POSITN = -1
0014 RETURN
0015 END
SUBROUTINE GETTER

This subroutine retrieves the next argument on the command line.

SUBROUTINE GETTER

CALLS: CCOUNT

THIS SUBROUTINE GET RID OF LEADING BLANKS IN INPUT ARGUMENT AND CLEAR ARG ARRAY

GET RID OF LEADING BLANKS IN INPUT ARGUMENT AND CLEAR ARG ARRAY

GET RID OF LEADING BLANKS IN INPUT ARGUMENT AND CLEAR ARG ARRAY

CASE WHERE ENTIRE LINE IS EMPTY

CHECK EACH CHARACTER

SEMicolon encountered

IF CHARACTER COUNT IS ZERO

C-85
C IF COMMA IS ENCOUNTERED
C
0065   GO TO 90
C
0066  50 IF (INDATA(I).NE.COMMA) GO TO 70
0067   NCHAR = I - NSTART
0068  2 IF (NCHAR.EQ.0)
0069  2 WRITE(1,*),'NULL ARGUMENT SPECIFIED--IT WILL BE IGNORED.'
C SCAN REMAINDER OF LINE TO SEE IF THIS IS THE LAST ARGUMENT
C
0070 DO 60 J = NSTART+80
0071   IF (INDATA(J).NE.BLANK) GO TO 90
0072  60 CONTINUE
0073   CONTCD = 0
0074   NSTART = 1
0075 GO TO 90
C
C IF CHARACTER (OTHER THAN BLANK, COMMA, SEMICOLON) ENCOUNTERED
C
0076  70 NCHAR = NCHAR + 1
0077   ARG(NCHAR) = INDATA(I)
0078  80 CONTINUE
C
C END OF INPUT LINE REACHED
C
0079   CONTCD = 0
0080   NSTART = 1
0081  90 CALL CCOUNT(ARG,NCHAR)
0082 RETURN
0083 END
SUBROUTINE CCOUNT

This subroutine counts characters in an input argument until it sees a semicolon or comma. Trailing blanks are ignored.

SUBROUTINE CCOUNT
LOGICAL*1 ARG(1), COMMA, BLANK, SEMIC
INTEGER*2 NCHAR
DATA COMMA /'r'/, SEMIC /'i'/, BLANK '/' /

ARGUMENTS:
ARG = ARGUMENT TO BE COUNTED
NCHAR = NUMBER OF CHARACTERS (COMPUTED)

DO 20 I = 1, 24
   IF (ARG(I).EQ.BLANK) GO TO 20
   IF (ARG(I).NE.SEMIC.AND.ARG(I).NE.COMMA) GO TO 10
   NCHAR = I - 1
20 CONTINUE
RETURN
10 NCHAR = I
RETURN
END
SUBROUTINE DISAPR

CALLING ARGUMENTS:
- CODE = CODE INDICATING TYPE OF DELETION:
  1 = UPLINK COST ELEMENT
  2 = DOWNLINK COST ELEMENT
  3 = UPLINK PATH
  4 = DOWNLINK PATH
  5 = UPLINK CITY
  6 = DOWNLINK CITY

INDEX = POSITION IN ARRAYS TO BE DELETED

IF CODE = 1:
0001 EXIT

DO 110 K = 1, 4
    DO 110 J = 1, NINDEX
        DO 110 I = 1, NUELEM
            UCSDAT(I-1, J, K) = UCSDAT(I, J, K)
        END DO
    END DO
    DO 120 I = 1, NUELEM
        UCSMIN(I-1) = UCSMIN(I)
    END DO
    DO 130 J = 1, 20
        UCSNAM(I-1, J) = UCSNAM(I, J)
    END DO
    DO 150 I = 1, NPATH
        UCSPTH(I-1, J) = UCSPTH(I, J)
    END DO
    CONTINUE
END DO

IF CODE = 2:
0064 EXIT

DO 210 K = 1, 4
    DO 210 J = 1, NDINDEX
        DO 210 I = 1, NDELEM
            UCSDKOD(I-1, J) = UCSDKOD(I, J)
        END DO
    END DO
    UCSNAM(I-1, J) = UCSNAM(I, J)
    UCSDKOD(I-1, J) = BLANK
    UCSDKOD(I-1, J) = BLANK
    MUELEM = NUELEM - 1
    RETURN
END DO

IF CODE = 3:
0064 EXIT

IF CODE = 4:
0064 EXIT

IF CODE = 5:
0064 EXIT

IF CODE = 6:
0064 EXIT
FORTRAN IV-PLUS version 02-SIC

DISAPR.FTN

0069 210 DCSDAT(I-1,J,K) = DCSDAT(I,J,K)
0070 220 DO 220 I=I1,NDELEM
0071 230 DCBMINM(I-1) = DCBMINM(I)
0072 240 DO 240 I = I1,NDELEM
0073 250 J = 1:2
0074 260 DCSCOD(I-1,J) = DCSCOD(I,J)
0075 270 DO 270 J = 1:20
0076 280 DCSNAMM(I-1,J) = DCSNAMM(I,J)
0077 290 DCSTH(I-1,J) = DCSTH(I,J)
0078 300 CONTINUE
0079 310 NDELEM = NDELEM - 1
0080 320 RETURN

C UPLINK PATH

0084 330 IF (INDEX.EQ.NUPATH) GO TO 390
0085 340 I1 = INDEX+1
0086 350 DO 360 I=I1,NUPATH
0087 360 UCSPTH(J,I-1) = UCSPTH(J,I)
0088 370 DO 380 J = 1:NUELEM
0089 380 UCSPTH(I,J) = UCSPTH(I,J)
0090 390 CONTINUE
0091 400 NUPATH = NUPATH-1
0092 410 RETURN

C DOWNLINK PATH

0097 420 IF (INDEX.EQ.NDPATH) GO TO 490
0098 430 I1 = INDEX+1
0099 440 DO 450 I=I1,NDPATH
0100 450 DCSTH(I,J) = DCSTH(J,I)
0101 460 DO 470 J = 1:NDELEM
0102 470 DCSTH(I,J) = DCSTH(I,J)
0103 480 CONTINUE
0104 490 NDPATH = NDPATH-1
0105 500 RETURN

C UPLINK CITY

0110 510 IF (INDEX.EQ.NUCITY) GO TO 590
0111 520 I1 = INDEX + 1
0112 530 DO 540 J = I1,NUCITY
0113 540 UCITYV(I,J) = UCITYV(I,J)

D-89
DISAPR.FTN /TR:BLOCKS/WR

0114  UCITYN(I-1) = UCITYN(I)
0115  UCTCHN(I-1) = UCTCHN(I)
0116  IF ( NUMORG .GT. 0 ) UCTORG(I-1) = UCTORG(I)
0117  DO 510 J=1,16
0118    510  UCTNAM(I-1,J) = UCTNAM(I,J)
0119    DO 520 J=1,NUIINDEX
0120      520  UCTXVL(I-1,J) = UCTXVL(I,J)
0121    DO 530 J=1,2
0122      530  USTCOD(I-1,J) = USTCOD(I,J)
0123    DO 540 J=1,NDCITY
0124      540  TALKBK(J-1,I) = TALKBK(J,I)
0125    DO 550 J=1,NUPATH
0126      550  UPTHCY(J-1,I) = UPTHCY(J,I)
0127  560  CONTINUE
0128  590  UCTNAM(NDCITY+1) = BLANK
0129  RETURN
0130  
C
C DOWNLINK CITY
C
C
0131  600  IF ( INDEX .EQ. NDCITY ) GO TO 690
0132    I1 = INDEX + 1
0133    DO 660 I=I1,NDCITY
0134      DCITYV(I-1) = DCITYV(I)
0135      DCITYH(I-1) = DCITYH(I)
0136      DCTLVL(I-1) = DCTLVL(I)
0137      DCTVM(I-1) = DCVM(I)
0138      DO 610 J=1,16
0139      610  DCTNAM(I-1,J) = DCTNAM(I,J)
0140      DO 620 J=1,NUIINDEX
0141        620  DCTXVL(I-1,J) = DCTXVL(I,J)
0142      DO 630 J=1,2
0143        630  DSTCOD(I-1,J) = DSTCOD(I,J)
0144      DO 640 J=1,NDCITY
0145        640  TALKBK(I-1,J) = TALKBK(I,J)
0146      DO 650 J=1,NUPATH
0147        650  DPTHCY(J-1,I) = DPTHCY(J,I)
0148      660  CONTINUE
0149      690  DCTNAM(NDCITY+1) = BLANK
0150    NDCITY = NDCITY-1
0151  RETURN
0152  END

D-90
SUBROUTINE RDCOST
SUBROUTINE CALLS: GETTER, CODCHK
CALLED BY: COST

THIS SUBROUTINE READS IN AN INPUT ARGUMENT AND TESTS FOR A COST ELEMENT CODE.

SUBROUTINE RDCOST
INCLUDE 'SYO:COMBLK.FTN/NODELIST'

READ (1,1000) (INDATA(I),I=1,80)
1000 FORMAT (80A1)
CALL GETTER
IF (UPPDWN.EQ.1) CALL CODCHK(2,ARG,MAXUCS,UCSCOD,POSITN)
IF (UPPDWN.EQ.2) CALL CODCHK(2,ARG,MAXDCS,DCSCOD,POSITN)
RETURN
END
SUBROUTINE RATECK

THIS ROUTINE CHECKS THE VALUE INDEXES FOR THE RATE MODULE TO MAKE SURE THEY ARE IN RANGE.

INCLUDE 'SYO:COMBLK.FTN/NOLIST'
INTEGER*2 XDAT,LOW,UP

POSITN=0
IF ( XDAT .LT. LOW ,OR. XDAT .GT. UP) GO TO 10
POSITN=XDAT
GO TO 20

WRITE ( 1,* ) 'NUMBER OUT OF RANGE - PLEASE RETYPE'
RETURN
END
SUBROUTINE CTYCHK

CALLING BY: CITY, MATMOD

THIS SUBROUTINE WILL DETERMINE IF A CITY/ORGANIZATION PAIR EXISTS
AND IF SO, WILL RETURN THE INDEX TO THAT PAIR. ORGANIZATION WILL BE
IGNORED IF COST ALLOCATION HAS NOT BEEN SELECTED.

0001 SUBROUTINE CTYCHK(POSPORG)
0002 INCLUDE 'SYOICOMBLK.FTN/NOLIST'
0040 INTEGER*2 ORG,NMATCH,LIMIT,POS,POS2
0044 POS = 0
0045 ORG = 0
0046 POS2=0
0047 NMATCH = 0
0048 IF (NCHAR.EQ.1.OR.ARG(NCHAR-1).NE.'/') GO TO 100
0049 ORG = ARG(NCHAR)-48
0050 IF (ORG.LE.O.OR.ORG.GT.NUMORG) GO TO 1001
0051 NCHAR = NCHAR-2
0052 DO 130 I=LIMIT+1,LIMIT
0053 DO 110 J=1,NCHAR
0054 IF (UPPDWN.EQ.1.AND.ARG(J).NE.UCTNAM(I,J).OR.
0055 UPPDWN.EQ.2.AND.ARG(J).NE.DCTNAM(I,J)) GO TO 130
0056 POS2 = 1
0057 IF (ORG.EQ.UCTORG(I).AND.UPPDWN.EQ.1.OR.
0058 ORG.EQ.DCTORG(I).AND.UPPDWN.EQ.2) GO TO 120
0059 NMATCH=NMATCH+1
0060 POS = I
0061 CONTINUE
0062 IF (NMATCH.GT.1) WRITE (1,*) 'SPECIFIED CITY NOT UNIQUE — ENTER MORE INFORMATION'
0063 IF (NMATCH.GT.1) POS=-1
0064 IF (NMATCH.EQ.1) ORG=0
0065 IF (NMATCH.EQ.0) POS=POS2
0066 RETURN
0067 WRITE (1,*) 'AN ORGANIZATION CODE MUST BE SPECIFIED'
0068 GO TO 1002
0069 WRITE (1,*) 'INVALID ORGANIZATION CODE'
0070 POS=-2
0071 RETURN
0072 END
SUBROUTINE VANDH

CALLED BY: CITY, MODUP, MODDN, EARTH

THIS SUBROUTINE CONVERTS LATITUDE/LONGITUDE TO BELL SYSTEM V AND H COORDINATES (PROVIDES A SIMPLER MEANS OF ESTABLISHING THE DISTANCE BETWEEN TWO CITIES).

PARAMETERS: M - NEGATIVE OF THE LATITUDE IN DDMM FORMAT
N - LONGITUDE IN DDDMM FORMAT

SUBROUTINE VANDH(M,N)
INTEGER*4 I,J

COMPUTE 'A' WHICH IS THE LATITUDE IN RADIANS AND FRACTIONS OF A RADIANS

I=(-1)*M/100
J=(M+I*100)*(-1)
A=FLOAT(I)/57.2958+FLOAT(J)/3437.75

COMPUTE 'B' WHICH IS THE LONGITUDE IN THE SAME UNITS

I=N/100
J=N-I*100
B=FLOAT(I)/57.2958+FLOAT(J)/3437.75

THE FOLLOWING CALCULATIONS ARE A GEOMETRIC APPROXIMATION TO A BELL SYSTEM PROPRIETARY ALGORITHM. A KNOWN POINT IN BOTH SYSTEMS IS USED AS A REFERENCE (IN THIS CASE, NEW YORK CITY WHICH HAS A V AND H OF 4995.1408). SPHERICAL TRIGONOMETRY IS USED TO DETERMINE THE AZIMUTH AND DISTANCE TO THE UNKNOWN POINT. AZIMUTH AND DISTANCE FORM A VECTOR USED TO COMPUTE THE V AND H COORDINATE.

ALPHA=0.412786*SIN(A)+0.757542*COS(A)*COS(1.29144-B)
THETA=(SIN(A)-ALPHA*0.652786)/(0.757542*SQR(1.-ALPHA*ALPHA))
THETA=ACOS(THETA)
IF(P.GT.1.29144)THETA*6.:83185-THETA
BETA=2.22013-THETA
DIST=12510.25*ACOS(ALPHA)
M=IFIX(4995.-DIST*SIN(BETA))
N=IFIX(1408.-DIST*COS(BETA))
RETURN
END
SUBROUTINE MATMOD

SUBROUTINE CALLS: GETTER, CODCHK, CTYCHK, REPRTR

CALLED BY: COST, PATH, CITY

THIS SUBROUTINE CHANGES THE MATRICES OF 1's AND 0's. IT READS A
LIST OF COST ELEMENTS, PATHS, OR CITIES, AND MAKES APPROPRIATE
CHANGES IN UCSPTH, DCSPTH, UPTHCY, AND DPTHCY. ARGUMENTS:

CODE=TYPE OF CHANGE
1=READ UPLINK COST ELEMENTS, MODIFY COST ELEMENT/PATH MATRIX
2=READ DNLINK COST ELEMENTS, MODIFY COST ELEMENT/PATH MATRIX
3=READ UPLINK PATHS, MODIFY COST ELEMENT/PATH MATRIX
4=READ DNLINK PATHS, MODIFY COST ELEMENT/PATH MATRIX
5=READ UPLINK PATHS, MODIFY PATH/CITY MATRIX
6=READ DNLINK PATHS, MODIFY PATH/CITY MATRIX
7=READ UPLINK CITIES, MODIFY PATH/CITY MATRIX
8=READ DNLINK CITIES, MODIFY PATH/CITY MATRIX

ONOFF=1 OR 0, DEPENDING ON WHETHER THE MATRIX IS TO BE SET ON OR OFF
MODPOS=ELEMENT IN THE MATRIX WHICH IS NOT BEING READ IN

COST ELEMENTS SPECIFIED

100 WRITE (1,*) 'ENTER COST ELEMENT CODES; ALL, OR 1'
105 CALL GETTER
100 IF (ARG(1).EQ.1) RETURN
190 IF (ARG(1).EQ.1.AND.ARG(2).EQ.'L'.AND.ARG(3).EQ.'L') GO TO 170
170 IF (NCHAR.EQ.0) GO TO 100
105 IF (CONTCD.EQ.0) GO TO 100
170 IF (CONTCD.NE.0) GO TO 105

D-95
DO 195 I = 1, NELEM(UPPDWN)
   IF (CODE.EQ.1) UCSPTH(I, MODPOS) = ONOFF
   IF (CODE.EQ.2) DCSPTH(I, MODPOS) = ONOFF
195 CONTINUE
RETURN

PATHS SPECIFIED

WRITE (1, *) 'ENTER PATH NAMES, ALL, OR 1'
READ(1, 900) (INDATA(I), I = 1, 80)

CALL GETTER
IF (ARG(1).EQ.1) RETURN
IF (ARG(1).EQ.'A' .AND. ARG(2).EQ.'L' .AND. ARG(3).EQ.'L') GO TO 295
IF (NCHAR.EQ.0) GO TO 270
IF (UPPDWN.EQ.1) CALL CTCYCHK(NCHAR, ARG, MAXUPA, UPTCYH, POSITN)
IF (UPPDWN.EQ.2) CALL CTCYCHK(NCHAR, ARG, MAXLPF, DPTCYH, POSITN)
IF (POSITN.EQ.0) GO TO 280
IF (POSITN.LE.0) GO TO 290
IF (CODE.EQ.3) UCSPTH(MODPOS, POSITN) = ONOFF
IF (CODE.EQ.4) DCSPTH(MODPOS, POSITN) = ONOFF
IF (CODE.EQ.5) UPTHCY(POSITN, MODPOS) = ONOFF
IF (CODE.EQ.6) DPTHCY(POSITN, MODPOS) = ONOFF
270 IF (CONTCD.EQ.0) GO TO 200
IF (CONTCD.NE.0) GO TO 205

IF ERRORS HAVE OCCURRED
WRITE (1,*) 'PATH DOES NOT EXIST, VALID PATHS ARE...'
CALL REPTR(3, 1)
GO TO 200
WRITE (1,*) 'SPECIFIED PATH NOT UNIQUE - ENTER MORE INFORMATION'
GO TO 200

DO 297 I = 1, NPATH(UPPDWN)
   IF (CODE.EQ.3) UCSPTH(MODPOS, I) = ONOFF
   IF (CODE.EQ.4) DCSPTH(MODPOS, I) = ONOFF
   IF (CODE.EQ.5) UPTHCY(I, MODPOS) = ONOFF
   IF (CODE.EQ.6) DPTHCY(I, MODPOS) = ONOFF
297 CONTINUE
RETURN

CITIES SPECIFIED

WRITE (1,*) 'ENTER CITY NAMES, ALL, OR 1'
READ(1, 900) (INDATA(I), I = 1, 80)
CALL GETTER
IF (ARG(1).EQ.1) RETURN
IF (ARG(1).EQ.'A' .AND. ARG(2).EQ.'L' .AND. ARG(3).EQ.'L') GO TO 390
IF (NCHAR.EQ.0) GO TO 370
CALL CTCYCHK(POSITN, ORG)
IF (POSITN.EQ.0) GO TO 380
IF (POSITN.LE.0) GO TO 370
IF (NUMORG.GT.0 .AND. ORG.NE.0) GO TO 380
IF (CODE.EQ.7) UPTHCY(MODPOS, POSITN) = ONOFF
IF (CODE.EQ.8) DPTHCY(MODPOS, POSITN) = ONOFF
370 IF (CONTCD.EQ.0) GO TO 300
IF (CONTCD.NE.0) GO TO 305

C IF ERRORS HAVE OCCURRED
C
0106 380 WRITE (1*) 'CITY DOES NOT EXIST'
0107 WRITE (1*) 'VALID CITIES ARE...'
0108 CALL REPRTR(10,1)
0109 GO TO 300
C
0110 390 DO 393 I=1,NCITY(UPPDWN)
0111 IF (CODE.EQ.7) UPTHCY(MODPOS;I)=ONOFF
0112 IF (CODE.EQ.8) DPTHCY(MODPOS;I)=ONOFF
0113 393 CONTINUE
0114 RETURN
C
0115 900 FORMAT(90A1)
0116 END
SUBROUTINE REPTR

CALLED BY: COST, PATH, CITY, RATE, METHOD, MODEL, MODUP, MODON

THIS SUBROUTINE CONTAINS THE REPORT FORMATS USED IN THE MODEL

0001 SUBROUTINE REPTR (REPTYP, POS)
0002 INCLUDE 'SYOICOMPL.FTN/NOLIST'
0040 INTEGRALS REPTYP, POS, BLANK, STAR, OUTARR(30)
0041 REAL PER, CTYPETE(4), LINK, UPDOWN(2)
0042 DATA PER /'PER', 'BLANK', 'STAR', 'LINK'/
0043 DATA UPDOWN /'UP', 'DOWN'/
0044 DATA CTYPES /'CAP', 'INS', 'LES', 'OMA'/
0045 00 TO (1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 10000), 2 REPTYP
0046 1000 IF (UPDOWN.EQ.2) GO TO 1500
0047 C UPLINK COST ELEMENT REPORT
0048 1400 FORMAT (10H0, 'DATA FOR COST ELEMENT', 2A10)
0049 1410 FORMAT (1H0, 'MINIMUM LEASE COST:', F9.2)
0050 1500 WRITE (3, 1400) (UCSCOD(POS, J), J=1, 2), (UCSNAM(POS, J), J=1, 20)
0051 WRITE (3, 1410) (DCSCOD(POS, J), J=1, 2), (DCSNAM(POS, J), J=1, 20)
0052 WRITE (3, 1420) (UCINDX(I, J), J=1, 8), I=1, NUIDX
0053 WRITE (3, 1460) (DCINDX(I, J), J=1, 8), I=1, NUIDX
0054 WRITE (3, 1470) UCMN(POS)
0055 WRITE (3, 1470) UCMN(POS)
0056 WRITE (3, 1470) UCMN(POS)
0057 WRITE (3, 1470) UCMN(POS)
0058 WRITE (3, 1470) UCMN(POS)
0059 GO TO 99999
0060 C DOWNLINK COST ELEMENT REPORT
0061 1500 WRITE (3, 1500) (DCSCOD(POS, J), J=1, 2), (DCSNAM(POS, J), J=1, 20)
0062 IF (NUINDX.GE.2) WRITE (3, 1410) (PER, I=2, NUIDX)
0063 WRITE (3, 1420) (UCINDX(I, J), J=1, 8), I=1, NUIDX
0064 WRITE (3, 1410) (PER, I=2, NUIDX)
0065 WRITE (3, 1410) (PER, I=2, NUIDX)
0066 WRITE (3, 1470) UCMN(POS)
0067 WRITE (3, 1470) UCMN(POS)
0068 WRITE (3, 1470) UCMN(POS)
0069 WRITE (3, 1470) UCMN(POS)
0070 GO TO 99999
0071 C MATRIX OF UPLINK COST ELEMENTS ASSOCIATED WITH EACH PATH
0072 2000 IF (UPDOWN.EQ.2) GO TO 2500
0073 WRITE (3, 1800) UPLINK(I), LINK
0074 WRITE (3, 1800) UPLINK(I), LINK
0075 WRITE (3, 1800) UPLINK(I), LINK
0076 WRITE (3, 1800) UPLINK(I), LINK
0077 WRITE (3, 1800) UPLINK(I), LINK
0078 GO TO 99999
FORTRAN IV-PLUS V02-51C

REPRTR FTN /TR:BLOCKS/WR

0072 FORMAT (1H0,20X,15(1X,2A1))
0073 DO 1600 J=1,NUPATH
0074 DO 1590 I=1,NUELEM
0075 OUTARR(I) = BLANK
0076 IF (UCSPTH(I,J).EQ.1) OUTARR(I) = STAR
0077 1590 CONTINUE
0078 WRITE (3,1910) (UPTHNM(J+K),K=1,30),(OUTARR(I),I=1,NUELEM)
0079 1910 FORMAT(IH0,20A1,15(1X,A2))
0080 1600 CONTINUE
0081 GO TO 99999

C MATRIX OF DOWNLINK COST ELEMENTS ASSOCIATED WITH EACH PATH

0082 2500 WRITE (3,1910) UPDOWN(2),LINK
0083 1910 FORMAT (1H0,'
   NO.'r6X,'PATH NAME'/)
0084 DO 2600 J=1,NDPATH
0085 DO 2590 I=1,NUELEM
0086 OUTARR(I) = BLANK
0087 IF (DCSPTH(I,J).EQ.1) OUTARR(I) = STAR
0088 2590 CONTINUE
0089 2590 CONTINUE
0090 2600 CONTINUE
0091 GO TO 99999

C LIST OF UPLINK PATH NUMBERS AND NAMES

0092 3000 IF (UPPDWN.EQ.2) GO TO 3500
0093 WRITE (3,3010)
0094 3010 FORMAT(1H0,' MATRIX OF PATHS AND CITIES--',2A4)
0095 J1 = 1
0096 J2 = MIN(NPATH(UPPDWN),16)
0097 DO 3600 I=J1,J2
0098 3600 CONTINUE
0099 GO TO 99999

C MATRIX OF DOWNLINK PATH NUMBERS AND NAMES

0100 3500 WRITE (3,3010)
0101 DO 3600 I=1,NDELEM
0102 WRITE (3,3090) I,(DPTHNM(I,J),J=1,20)
0103 3600 CONTINUE
0104 GO TO 99999

C MATRIX OF UPLINK PATHS AND CITIES

0105 4000 IF (NCITY(UPPDWN).EQ.0) GO TO 4600
0106 WRITE (3,4010) UPDOWN(UPPDWN),LINK
0107 4010 FORMAT (1H0,' MATRIX OF PATHS AND CITIES--',2A4)
0108 J1 = 1
0109 J2 = MIN(NPATH(UPPDWN),16)
0110 WRITE (3,4030) (J,J=J1,J2)
0111 4030 FORMAT(1H0,' CITY',13X,'ORG ','16I3')
0112 IF (UPPDWN.EQ.2) GO TO 4500
0113 DO 4080 I=1,NCITY
0114 IF (UCITYV(I).EQ.-1) GO TO 4080
0115 DO 4070 J=J1,J2
0116 4070 CONTINUE

D-99
OUTARR(J) = BLANK
IF (UPTHCY(J,JrI).LE.1) GO TO 4070
CONTINUE
IF (NUMORG.EQ.0)
2 WRITE (3,4075) (UCTNAM(I,J),J=1,16), (OUTARR(J-J1+1),J=J1,J2)
4075 FORMAT ('O'16A1,'X','16(1X,A2))
2 (OUTARR(J-J1+1),J=J1,J2)
IF (NUMORG.GT.0) WRITE (3,4076) (UCTNAM(I,J),J=1,16), UCTORG(I),
2 (OUTARR(J-J1+1),J=J1,J2)
4076 FORMAT ('O'16A1,'X','2X,'16(I16,A2))
CONTINUE
GO TO 99999
C
MATRIX OF DOWNLINK PATHS AND CITIES
C
DO 4580 I=1,NDCITY
IF (DCITYV(I).EQ.-1) GO TO 4580
DO 4570 J=J1,J2
OUTARR(J) = BLANK
IF (DPTHCY(J,JrI).LE.1) OUTARR(J) = STAR
4570 CONTINUE
IF (NUMORG.EQ.0)
2 WRITE (3,4075) (DCTNAM(I,J),J=1,16), (OUTARR(J-J1+1),J=J1,J2)
4075 FORMAT ('O'16A1,'X','16(1X,A2))
2 (OUTARR(J-J1+1),J=J1,J2)
IF (NUMORG.GT.0) WRITE (3,4076) (DCTNAM(I,J),J=1,16), DCTORG(I),
2 (OUTARR(J-J1+1),J=J1,J2)
4580 CONTINUE
GO TO 99999
C
WRITE (3,'(3,A) THERE ARE NO CITIES IN THIS SEGMENT')
GO TO 99999
C
UPLINK CITIES AND ASSOCIATED COST INDEX VALUES
C
WRITE (3,5050) UPDOWN(UPPDWN), LINK
5050 FORMAT ('O',14A4,' COST INDEX VALUES')
IF (UPPDWN.EQ.2) GO TO 5500
DO 5275 I=1,NUCITY
WRITE (3,5060) (UCTNAM(I,J),J=1,16), UCTORG(I)
5060 FORMAT ('O','16A19I3')
WRITE (3,5075) (UCINDX(K,J),J=1,NUINDX-1)
5075 FORMAT (9X,F8.2,4(4X,F8.2))
IF (UCITYV(I).EQ.-1) GO TO 5275
WRITE (3,5100) (DCTXVL(I,K),K=1,NDINDX-1)
5100 FORMAT (9X,F8.2,4(4X,F8.2))
5275 CONTINUE
GO TO 99999
C
DOWNLINK CITIES AND ASSOCIATED COST INDEXES
C
DO 5800 I=1,NDCITY
WRITE (3,5800) (DCTNAM(I,J),J=1,16), DCTORG(I)
5800 FORMAT ('O',24A4,' COST INDEX VALUES')
IF (DCTORG(I).EQ.2) GO TO 5800
WRITE (3,5825) (DCTXVL(I,K),K=1,NDINDX-1)
5825 FORMAT (9X,F8.2,4(4X,F8.2))
GO TO 99999

D-100
TALKBACK MATRIX BETWEEN UPLINK AND DOWNLINK CITIES

0157 6000 IF (NDCITY.EQ.0) GO TO 6600
0158 6050 FORMAT(1H0, 'MATRIK OF TALKBACK REQUIREMENTS',/)
0159 2 'DOWNLINK CITY ORG', 10(2X,3A1))
0160 WRITE (3,6100) (UCTORG(I), I=1,NUCITY)
0161 6100 FORMAT (21X,10I5/) 
0162 DO 6500 I=1,NDCITY
0163 WRITE (3,6150) (DCTNAM(I,J), J=1,NDCITY)
0164 6150 FORMAT (1H16A1, 5X, I12, 5X, I11)
0165 6500 CONTINUE
0166 GO TO 99999
C
0167 6600 WRITE (3,*) 'THERE ARE NO DOWNLINK CITIES IN THIS SEGMENT'
0168 GO TO 99999
C
ORGANIZATION NAMES AND NUMBERS

0169 7000 IF (NUMORG.EQ.0) GO TO 7200
0170 7025 FORMAT ('O', 'ORGANIZATION NAMES AND NUMBERS'/)
0171 DO 7100 I = 1,NUMORG
0172 WRITE (3,7050) (ORGNAM(I,J), J=1,20)
0173 7050 FORMAT (1X, 20A1, 5X, I1)
0174 7100 CONTINUE
0175 GO TO 99999
C
0177 7200 WRITE (3,*) 'THERE ARE NO ORGANIZATIONS IN THIS SCENARIO'
0178 GO TO 99999
C
AUXILIARY PARAMETERS

0179 8000 WRITE (3,8010) DDDINS, WATINS, PUTINS,
0180 8010 FORMAT (1H0, 'AUXILIARY PARAMETERS',/)
0181 2 ' TALKBACK:', 24X, 'DDD', 8X, 'WATS', 8X, 'PUT',/ 
0182 4 'INSTALLATION:', 4X, 'DDD', 2X, 'F10.2', 2X, 'F10.2/', 
0183 5 'ZERO UC GE CHARGE/MO.', 4X, F10.2, 2X, F10.2/, 
0184 5 'MILEAGE CHARGE', 33X, F10.2/, 
0185 6 'HOURLY CHARGE', 12X, F10.2, 2X, F10.2/, 
0186 7 'MAXIMUM CHARGE', 23X, F10.2/, 
0187 8 'AMORTIZATION', 1H0
9 3X,'INTEREST RATE',7X,'F5.2','PERCENT'/,
A 3X,'EQUIPMENT LIFE',6X,'F5.2','YEARS'/,
B 'GENERAL AND ADMINISTRATIVE:',4(3X,'A4.5X','F12.2')//,
C 'TALKBACK CAPITAL EXPENDITURES:',2X,'F10.2//'
0181 GO TO 99999
C LIST COST ELEMENTS AND COST ELEMENT CODES
C
0182 9000 WRITE (3,9050)
0183 9050 FORMAT ('O', 'COST ELEMENT CODES AND NAMES')
0184 IF (UPPDWN.EQ.2) GO TO 9300
0185 DO 9200 I=1,NUELEM
0186 WRITE (3,9100) (UCSCOD(I,J),J=1,2), (UCSNAM(I,J),J=1,20)
0187 9100 FORMAT (1X,2A1,2X,2O1)
0188 9200 CONTINUE
0189 GO TO 99999
0190 9300 DO 9400 I=1,NDCELEM
0191 WRITE (3,9100) (DCSCOD(I,J),J=1,2), (DCSNAM(I,J),J=1,20)
0192 9400 CONTINUE
0193 GO TO 99999
C LIST CITIES/ORG AND STATES
C
0194 10000 WRITE (3,10001)
0195 10001 FORMAT ('O', 'CITY',13X,'ORG',2X,'STATE')
0196 IF (UPPDWN.EQ.2) GO TO 10300
0197 DO 10200 I=1,NUCITY
0198 WRITE (3,10100) (UCTNAM(I,J),J=1,16), (UCTORG(I),
2 (USTCOD(I,J),J=1,2)
0199 10100 FORMAT (1X,16A1,2X,II,4X,2A1)
0200 10200 CONTINUE
0201 GO TO 99999
0202 10300 DO 10400 I=1,NUDCITY
0203 WRITE (3,10100) (DCTNAM(I,J),J=1,16), (DCTORG(I),
2 (DSTCOD(I,J),J=1,2)
0204 10400 CONTINUE
0205 99999 WRITE (3,'(3,X)')
0206 RETURN
0207 END
APPENDIX E

MODEL INSTALLATION

The Video Distribution System Cost Model has been developed for implementation on a Digital Equipment Corporation PDP-11. The programs are written in extended FORTRAN IV and consist of 3 distinct modules -- BUILD, MODEL, and EARTH. In addition, there are two data files -- the earth terminal data base and the sample scenario.

The model is installed under Digital Equipment Corporation's RSX-11M operating system. The programs have been compiled by using version 02-51C of FORTRAN IV-PLUS. Standard compiler switch settings may be used for all programs except EARTH and REPRTR, which require larger buffers for continuation lines (switch - /CO:26.).

Both BUILD and MODEL are overlayed tasks because of large memory requirements. The ODL files are as follows:

BUILD.ODL

.ROOT BUILD-REPRTR-SUBS-VANDH-*(READIN,COST,PATH,CITY,RATE,RITOUT)
SUBS: .FCTR YESNO-UPDOWN-CCOUNT-MATMOD-GETTER-CODCHK-CTYCHK-DISAPR-A@
A@: .FCTR RDCOST-RATECK
.ROOT

MODEL.ODL

.ROOT MODEL-MODSUB-*(READIN,MODUP,MODDN,MODTK)
MODSUB: .FCTR YESNO-GETTER-CCOUNT-CODCHK-REPRTR-VANDH
.ROOT

The disk swapping occurs at natural breaks in the programs and is not very noticeable.
The task build command files are as follows (it is assumed that all files are located on the system disk - SYØ):

**BUILD.CMD**

BUILD/CP/FP=BUILD/MP
UNITS = 3
ACTFIL = 2
ASG = TI:1, SYØ:2, TI:3

**MODEL.CMD**

MODEL/CP/FP = MODEL/MP
UNITS = 3
ACTFIL = 2
ASG = TI:1, SYØ:2, TI:3

**EARTH.CMD**

EARTH/CP/FP = EARTH, READIN, MOVREC, VANDH, CODCHK
UNITS = 3
ACTFIL = 2
ASG = TI:1, SYØ:2, TI:3

The data files are named EARTH.DAT (earth terminal data base) and SAMPLE.DAT (sample scenario).
APPENDIX F

OPERATIONAL COSTS AND MANAGEMENT CONSIDERATIONS

This appendix identifies the tasks and costs associated with maintaining and operating the Video Distribution System Cost Model. Cost estimates are included where feasible; they are based on the development effort that produced the model and on experience with commercial time-sharing services.

1. INSTALLATION

To provide access to a large number of users, the model should be installed either on a commercial time-sharing service that has nationwide dial-up access or on a privately owned or government-owned computer with dial-up access and In-WATS capability (if traffic warrants).

The most cost-effective installation would be on a Digital Equipment Corporation (DEC) PDP-11 minicomputer because the installation procedures listed in Appendix E could be applied directly. This computer should have at least 128K bytes of memory, should be running a recent version of the RSX-11M operating system, and should be equipped with a FORTRAN IV-PLUS compiler. Installation, in this case, should require less than two man-days. Other DEC operating systems could be used but would require a different task build procedure. Other versions of FORTRAN may require changes in the source code.

If unavailable, dial-up access could be provided by a standard asynchronous interface with a low-speed (300-baud) originate/answer modem for manual connections or by an auto-answer modem for automatic pickup. Either option leases for less than $50 per month. Nationwide toll-free access (In-WATS) can be provided on a metered rate ($244.00 for the first 10 hours and $18.31 for each additional hour) or on a full-business-day rate (240 hours for approximately $1,500.00 per month). The breakpoint occurs around 80 hours. Projected line utilization should be the determining factor.

Installation on other computers or on a commercial time-sharing service could be a costly proposition. Compatibility with DEC FORTRAN should be the primary consideration. A minimum of two man-weeks should be allocated for conversion, assuming that the target system is well understood. If a commercial time-sharing service is the target system, a minimum of $1,500 should be budgeted for the conversion. The advantage of converting the model to a
large computer is that larger scenarios could be developed (more cities, more paths, and more cost elements). In addition, most commercial time-sharing services offer nationwide dial-up access as part of their general services.

2. SOFTWARE MAINTENANCE

As with any user-oriented model, there will be requests for model enhancements. Approximately two man-weeks will be required for a FORTRAN programmer to become familiar enough with the model software to make any extensive changes. After that, modifications should require no more than a few hours to complete.

The sample data file includes all of the model's current cost assumptions, and it should be reviewed and updated at least twice a year. Four man-days per year should be allocated for this purpose. A new sample data file can be created by use of the scenario builder.

The earth terminal data file should be updated quarterly. A tape of the file must be acquired from the National Technical Information Service (NTIS). The tape must then be processed to strip out extraneous information, and it must be formatted into a form readable by the model. The format of the tape can be obtained from the Federal Communications Commission. This process is technically simple but will require three to four man-days to perform all the necessary coordination, processing, and validation.

Backup of the system should be performed on a periodic basis depending on model use. Backup procedures should not require more than two hours each time.

Commercial time-sharing charges for software maintenance will probably average about $100 per month. In addition, if software and data files are kept on line, storage charges should run about $500 per month. These charges are not necessarily applicable to a small minicomputer system.

3. HARDWARE MAINTENANCE

Hardware maintenance costs are not applicable to commercial time-sharing because they are included in the normal charge algorithm. Maintenance costs on a minicomputer would vary depending on the hardware configuration, but they would probably run less than $600 per month. However, unless the cost model were the only application using the computer, only a percentage of this cost would apply.

4. CUSTOMER SERVICE

The user's guide should answer most questions about the model, but it will not be of much help in answering application-dependent inquiries. Therefore, it would be most useful for the organization that maintains the
model to have staff available to assist in user applications or refer users to another organization. Service can be provided on a consulting basis (user charged by the hour) for complex questions or handled under an overhead account for simple questions. The amount of time required to perform this activity is proportional to the number of user requests for assistance, but it can be billed on a cost-reimbursement basis.

5. COSTS AND BILLING

There are three areas of costs: direct processing costs, indirect processing costs, and administrative costs. Direct processing costs reflect the costs of building scenarios, processing the earth terminal database, executing the cost algorithms, and preparing the output reports. The indirect processing costs include the software maintenance activities of program changes, backup activities, and earth terminal file updates and the on-line costs that accumulate. The administrative costs reflect the manpower required to perform the software maintenance activities, the user interface, and the billing process, as well as overhead items such as telephone and equipment rentals.

Direct processing costs can be estimated as follows (commercial time sharing used as a basis for comparison):

- Build a large scenario file* $35.00
- Modify an existing scenario $ 5.00
- Execute cost model $ 3.00
- Print all output reports $ 3.00
- Process earth terminal data $15.00

Indirect processing costs will probably run about $100 per month. Billing will require approximately two man-days per month. An overhead service charge, based on estimated usage, should be computed to cover these indirect costs and all administrative costs.

6. SUMMARY AND RECOMMENDATIONS

The various costs and manpower requirements are summarized in Table F-1. The most cost-effective solution appears to be installation on a government-owned or privately owned PDP-11 minicomputer because the installation and recurring costs will be lower.

*Assumes a two-hour hookup to computer.
<table>
<thead>
<tr>
<th>Task</th>
<th>Commercial Time-Sharing Service</th>
<th>Government-owned or Privately owned PDP-11 Minicomputer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manpower</td>
<td>2 man-weeks</td>
<td>2 man-days</td>
</tr>
<tr>
<td>Computer Charges</td>
<td>$1,500</td>
<td>$0</td>
</tr>
<tr>
<td>Software Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Familiarization</td>
<td>2 man-days*</td>
<td>2 man-weeks</td>
</tr>
<tr>
<td>Monthly Maintenance</td>
<td>3 man-days</td>
<td>3 man-days</td>
</tr>
<tr>
<td>Computer Charges</td>
<td>$100</td>
<td>$0</td>
</tr>
<tr>
<td>Monthly On-Line Storage Charges</td>
<td>$500</td>
<td>$0</td>
</tr>
<tr>
<td>Hardware Maintenance</td>
<td>$0</td>
<td>0-$600**</td>
</tr>
<tr>
<td>Customer Service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model Assistance</td>
<td>3 man-days per month</td>
<td>Same</td>
</tr>
<tr>
<td>(depends on model usage)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network Consulting</td>
<td>As required, directly billable</td>
<td></td>
</tr>
<tr>
<td>Administration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Billing</td>
<td>2 man-days per month</td>
<td>2 man-days per month</td>
</tr>
<tr>
<td>Nationwide Dial-up Access</td>
<td>$0</td>
<td>$244 for 10 hours and $18.31 for each additional hour per month</td>
</tr>
</tbody>
</table>

*Most of necessary familiarization is achieved as part of installation.
**Depends on hardware configuration (only a percentage of total cost applicable to the model).