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FINAL REPORT

VIDEO DISTRIBUTION SYSTEM COST MODEL

July 1980

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GOODRARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771
under Contract NAS5-25401

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by

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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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<tr>
<th>Case</th>
<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>Federal Cities</td>
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<td>15</td>
<td>1,612</td>
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<td>Appalachian Educational Satellite Project (AESP)</td>
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<td>1</td>
<td>15</td>
<td>1,664</td>
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<td>44.87</td>
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<td>3</td>
<td>95</td>
<td>3,932</td>
<td>2,040**</td>
<td>5.46</td>
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<tr>
<td>&quot;West&quot; Case</td>
<td>7</td>
<td>86</td>
<td>6,012</td>
<td>3,638**</td>
<td>6.21</td>
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<td>SMSA Cases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>1</td>
<td>10</td>
<td>1,300</td>
<td>481†</td>
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<td>b.</td>
<td>1</td>
<td>22</td>
<td>1,300</td>
<td>517†</td>
<td>18.08</td>
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<td>c.</td>
<td>1</td>
<td>64</td>
<td>1,300</td>
<td>689†</td>
<td>8.28</td>
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<td>d.</td>
<td>1</td>
<td>78</td>
<td>1,300</td>
<td>763†</td>
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<tr>
<td>Full Duplex Federal Regions</td>
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<td>1,300</td>
<td>813†</td>
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<tr>
<td>Overall</td>
<td>2</td>
<td>22</td>
<td>2,340</td>
<td>952†</td>
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<tr>
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<td>10</td>
<td>1,300</td>
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<td>Top 20 SMSAs</td>
<td>1</td>
<td>20</td>
<td>1,040</td>
<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.
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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-used 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 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
Figure 2-1. TYPICAL VIDEO DISTRIBUTION SYSTEM
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
Figure 2-2. INFORMATION FLOW DIAGRAM

Figure 2-3. UPLINK PATHS
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

3-1
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 links.
Table 3-1. SYSTEM UTILIZATION

<table>
<thead>
<tr>
<th>Department</th>
<th>Agency</th>
<th>Cities</th>
<th>Utilization</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treasury</td>
<td>IRS</td>
<td>12</td>
<td>5 hrs/wk</td>
<td>Training for examiners</td>
</tr>
<tr>
<td></td>
<td>BATF</td>
<td>9</td>
<td>0 hrs/wk</td>
<td>Bureau of Alcohol, Tobacco, and Firearms</td>
</tr>
<tr>
<td>DOL</td>
<td>ETA</td>
<td>9</td>
<td>3 hrs/wk</td>
<td>Employment Training Administration</td>
</tr>
<tr>
<td>DOI</td>
<td>Secretary</td>
<td>4</td>
<td>2 hrs/wk</td>
<td>Office of the Secretary</td>
</tr>
<tr>
<td>U.S. House</td>
<td>Secretary</td>
<td>10</td>
<td>32 hrs/mo</td>
<td>Congressmen discussions with constituents</td>
</tr>
<tr>
<td>U.S. Senate</td>
<td>Secretary</td>
<td>8</td>
<td>20 hrs/mo</td>
<td>Senators discussions with constituents</td>
</tr>
<tr>
<td>DOC</td>
<td>Secretary</td>
<td>6</td>
<td>2 hrs/wk</td>
<td>Office of the Secretary</td>
</tr>
</tbody>
</table>

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>798,000</td>
<td>231,529</td>
<td>311,857</td>
<td>348,500</td>
<td>931,943</td>
</tr>
</tbody>
</table>

**Total Annualized Cost**

|                  | 210,510**            | 61,077**                  | 311,857      | 348,500        | 931,944         |

*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 colocated 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 Talkback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guntersville, AL*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Rainsville, AL*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Gadsden, AL</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Huntsville, AL</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Clayton, GA*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Rome, GA*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Gainesville, GA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Hazard, KY</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Lexington, KY</td>
<td>Private Earth Terminal collocated with studio</td>
<td>Monitors Only</td>
<td>None</td>
</tr>
<tr>
<td>Morehead, KY</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Somerset, KY</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Hagerstown, MD*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Cumberland, MD</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>McHenry, MD</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Booneville, MS*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Tupelo, MS</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Scooba, MS</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Alfred, NY*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Fredonia, NY</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Olean, NY</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Boone, NC*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Marion, NC*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Morganton, NC*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Sylva, NC</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Athens, OH</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Ebensburg, PA*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Edinboro, PA*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Smethport, PA*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Pittsburgh, PA</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Columbia, SC*</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Greenville, SC</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
</tbody>
</table>

*Level 2 cities.
### Table J-1. (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>
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<tr>
<td>Voice Talkback</td>
<td>88,000</td>
<td>4,752</td>
<td>134,257</td>
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<td>158,722</td>
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<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>
<thead>
<tr>
<th>City</th>
<th>Available Option</th>
<th>Uplink</th>
<th>Downlink</th>
<th>Voice Talkback</th>
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<tbody>
<tr>
<td>Seattle, WA</td>
<td>Private Earth Terminal</td>
<td>Monitors Only</td>
<td>--</td>
<td>--</td>
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<tr>
<td>Fairbanks, AK</td>
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<td>Boise, MT</td>
<td>Private Earth Terminal</td>
<td>Monitors Only</td>
<td>--</td>
<td>--</td>
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<tr>
<td>Spokane, WA</td>
<td>Private Earth Terminal</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
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<tr>
<td>Pullman, WA</td>
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<tr>
<td>Anchorage, AK</td>
<td>Private Earth Terminal</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
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<tr>
<td>Billings, MT</td>
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<td>Private Earth Terminal</td>
<td>Private Line</td>
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<tr>
<td>Ketchikan, AK</td>
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<td>Private Earth Terminal</td>
<td>Private Line</td>
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<tr>
<td>Whitefish, MT</td>
<td>Private Earth Terminal</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Anacortes, WA</td>
<td>Private Earth Terminal</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
<td></td>
</tr>
<tr>
<td>Pocatello, ID</td>
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<td>Private Line</td>
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<tr>
<td>Bethel, AK</td>
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<td>Missoula, MT</td>
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<td>Private Line</td>
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</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>
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<td>Uplink</td>
<td>1,140,000</td>
<td>20,000</td>
<td>266,450</td>
<td>264,000</td>
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<td>Downlink</td>
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<td>0</td>
<td>33,000</td>
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<td>Voice Talkback</td>
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<td>64,667</td>
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<tr>
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<td>160,100</td>
<td>0</td>
<td>96,500</td>
<td>138,734</td>
</tr>
<tr>
<td>Totals</td>
<td>1,342,000**</td>
<td>181,205**</td>
<td>325,022</td>
<td>393,500</td>
<td>1,120,339</td>
</tr>
<tr>
<td>Total Annualized Cost</td>
<td>354,016</td>
<td>47,801</td>
<td>325,022</td>
<td>393,500</td>
<td>1,120,339</td>
</tr>
</tbody>
</table>

*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, utilisations 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-3. "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>
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</tr>
<tr>
<td>Boston, MA</td>
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<td>Private Earth Terminal</td>
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</tr>
<tr>
<td>Chicago, IL</td>
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<tr>
<td>Cleveland, OH</td>
<td>--</td>
<td>Private Earth Terminal</td>
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</tr>
<tr>
<td>Dallas, TX</td>
<td>--</td>
<td>Private Earth Terminal</td>
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<tr>
<td>Denver, CO</td>
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<td>Private Earth Terminal</td>
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</tr>
<tr>
<td>Fort Worth, TX</td>
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<td>Private Earth Terminal</td>
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<tr>
<td>Houston, TX</td>
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<td>Private Earth Terminal</td>
<td>Private Line</td>
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<tr>
<td>Kansas City, MO</td>
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<td>Private Earth Terminal</td>
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<tr>
<td>Los Angeles, CA</td>
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<tr>
<td>New York, NY</td>
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<td>Private Earth Terminal</td>
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<tr>
<td>San Diego, CA</td>
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<tr>
<td>San Francisco, CA</td>
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<td>Private Earth Terminal</td>
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<tr>
<td>Seattle, WA</td>
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<tr>
<td>Group A (25)</td>
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<td>Private Earth Terminal</td>
<td>DDD</td>
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<tr>
<td>Group B (8)</td>
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<td>Private Earth Terminal</td>
<td>DDD</td>
</tr>
<tr>
<td>Group C (3)</td>
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<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>3,585,000</td>
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<td>129,347</td>
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<td>Voice Talkback</td>
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<td>Total Annualized Cost</td>
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<td>86,181*</td>
<td>525,800</td>
<td>2,040,359</td>
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*Effective yearly costs for 8-year, 10.00 percent amortization.
### Table 3-5. (continued)

<table>
<thead>
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<th>GROUP A: Private earth terminal downlink only</th>
<th>GROUP B: (continued)</th>
<th>GROUP C: Private earth terminal or one- or two-hop microwave</th>
<th>GROUP D: Private earth terminal or CATV Link</th>
<th>GROUP E: Private earth terminal, CATV Link, or two-hop microwave</th>
<th>GROUP F: Private earth terminal, CATV Link, or two-hop microwave; no talkback required</th>
<th>GROUP G: Private earth terminal, CATV Link, one- or two-hop microwave; no talkback required</th>
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<td>Sylva, NC</td>
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<td>Erie, PA</td>
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<td>Cookeville, TN</td>
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<td>Emporium, PA</td>
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<tr>
<td>GROUP B: Private earth terminal or two-hop microwave</td>
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</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 3-6. "WEST" CASE

#### Selected Options

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<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; link required</td>
<td>Monitors Only</td>
<td>Private Line</td>
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<td>Private Earth Terminal; no link required</td>
<td>Monitors Only</td>
<td>--</td>
</tr>
<tr>
<td>Bozeman, MT</td>
<td>Private Earth Terminal; no link required</td>
<td>Monitors Only</td>
<td>DDD</td>
</tr>
<tr>
<td>Boise, ID</td>
<td>Private Earth Terminal; no link required</td>
<td>Monitors Only</td>
<td>DDD</td>
</tr>
<tr>
<td>Moffett Field, CA</td>
<td>Private Earth Terminal; link required</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Sacramento, CA</td>
<td>Private Earth Terminal; link required</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>Private Earth Terminal; link required</td>
<td>Monitors Only</td>
<td>Private Line</td>
</tr>
<tr>
<td>Denver, CO</td>
<td>Private Earth Terminal; link required</td>
<td>Monitors Only</td>
<td>Private (to Seattle)</td>
</tr>
<tr>
<td>Washington, DC</td>
<td>Private Earth Terminal; link required</td>
<td>--</td>
<td>CATV Link</td>
</tr>
<tr>
<td>11 Federal Cities</td>
<td>--</td>
<td>Private Earth Terminals</td>
<td>Private Line</td>
</tr>
<tr>
<td>Grand Junction, CO</td>
<td>--</td>
<td>CATV Link</td>
<td>DDD</td>
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<tr>
<td>Menlo Park, CA</td>
<td>--</td>
<td>Private Earth Terminals</td>
<td>DDD</td>
</tr>
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<td>Group A (48)</td>
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<td>Private Earth Terminal</td>
<td>DDD</td>
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<tr>
<td>Group B (16)</td>
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<td>CATV Link</td>
<td>DDD</td>
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#### Cost Summary

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<tr>
<th>Model Segment</th>
<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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</thead>
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<td>442,000</td>
<td>681,200</td>
<td>774,000</td>
<td>2,930,756</td>
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<td>Downlink</td>
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<td>121,700</td>
<td>3,780</td>
<td>154,200</td>
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<td>Voice Talkback</td>
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<td>2,036</td>
<td>202,868</td>
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<td>Administrative</td>
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<tr>
<td>Totals</td>
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<td>725,836</td>
<td>887,867</td>
<td>1,024,700</td>
<td>3,637,630</td>
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<tr>
<td>Total Annualized Cost</td>
<td>1,589,016*</td>
<td>136,053*</td>
<td>887,867</td>
<td>1,024,700</td>
<td>3,637,636</td>
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</table>

*Effective yearly costs for 8-year, 10.00 percent amortization.
### Table 3-6. (continued)

<table>
<thead>
<tr>
<th>GROUP A: Private downlink earth terminal</th>
<th>GROUP B: CATV Link</th>
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<td>Sepulveda, CA</td>
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<td>Torrance, CA</td>
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<td>Vancouver, WA</td>
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<td>Belmont, CA</td>
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<td>Dominquez, CA</td>
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<td>Claremont, CA</td>
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<td>Costa Mesa, CA</td>
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<td>Miles City, MT</td>
<td>Irvine, CA</td>
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#### 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
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>
<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>
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<th>b</th>
<th>c</th>
<th>d</th>
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(continued)
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<td>X</td>
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<td>Private E-T</td>
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<td>Private E-T</td>
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<td>CATV link</td>
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<td>CATV link</td>
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</table>

### 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>
<thead>
<tr>
<th></th>
<th>Capital Planning and Expenditures</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>199400</td>
<td>180000</td>
<td>101000</td>
<td>331406</td>
</tr>
<tr>
<td>DOWNLINK</td>
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<td>1800</td>
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<td>VOICE TALKBACK</td>
<td>145</td>
<td>13478</td>
<td>0</td>
<td>13588</td>
</tr>
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<td>0</td>
<td>85000</td>
<td>117208</td>
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<td>TOTALS</td>
<td>276545</td>
<td>195278</td>
<td>187000</td>
<td>481107</td>
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</table>

ANNUALIZED COST 55669 43159 195278 187000 481107

EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $ 481107.
Table 3-8(b). OVERALL COST SUMMARY -- SMSA CASE 2

FEDERAL REGIONAL OFFICES AND TOP 20 SMSA'S

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</th>
<th>ANNUALIZED COST</th>
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</thead>
<tbody>
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<td>180000.</td>
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<td>331406.</td>
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<td>218140.</td>
<td>212085.</td>
<td>188200.</td>
<td>517150.</td>
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ANNUALIZED COST 72953. 43912. 212085. 188200. 517150.

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

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

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</th>
<th>ANNUALIZED COST</th>
</tr>
</thead>
<tbody>
<tr>
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<td>51000.</td>
<td>180000.</td>
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<td>285520.</td>
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ANNUALIZED COST 181403. 57476. 274634. 205900. 689413.

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

<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>
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Annualized Cost 183430. 66748. 294764. 217800. 762742.

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 3-9d, 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.
### Table 3-9. UPLINK COSTS BY CITY -- FEDERAL REGIONAL PROGRAMMING

<table>
<thead>
<tr>
<th>CITY</th>
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<th>INSTALL</th>
<th>LEASE</th>
<th>O&amp;M</th>
<th>ANNUALIZED</th>
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<td>11700</td>
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<td>18000</td>
<td>11700</td>
<td>44878</td>
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<td>16000</td>
<td>18000</td>
<td>11700</td>
<td>44878</td>
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<td>San Francisco</td>
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<td>18000</td>
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3-24
### Table 3-10. OVERALL COST SUMMARY — FEDERAL REGIONAL PROGRAMMING

**OVERALL COST SUMMARY**

<table>
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<tr>
<th></th>
<th>Capital Planning and Expenditures</th>
<th>Annual Lease</th>
<th>Annual O&amp;M&amp;A</th>
<th>Annualized Cost</th>
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<td>160,000.00</td>
<td>0.00</td>
<td>85,000.00</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>2,262,886.00</td>
<td>587,520.00</td>
<td>2,402,799.00</td>
<td>708,800.00</td>
</tr>
<tr>
<td><strong>ANNUALIZED COST</strong></td>
<td>455,525.00</td>
<td>118,269.00</td>
<td>2,402,799.00</td>
<td>708,800.00</td>
</tr>
</tbody>
</table>

*Effective Yearly Costs for 8 Year, 12.00 Percent Amortization — $1,522,873.*
### 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;M</th>
<th>Annualized</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uplink</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Federal Offices</td>
<td>143165.0</td>
<td>36617.0</td>
<td>162500.0</td>
<td>72516.0</td>
<td>271206.0</td>
</tr>
<tr>
<td>2 SMSA's</td>
<td>255635.0</td>
<td>65383.0</td>
<td>290160.0</td>
<td>129484.0</td>
<td>484266.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>398800.0</td>
<td>102000.0</td>
<td>452660.0</td>
<td>202000.0</td>
<td>755472.0</td>
</tr>
<tr>
<td><strong>Downlink</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Federal Offices</td>
<td>50200.0</td>
<td>1800.0</td>
<td>1800.0</td>
<td>1000.0</td>
<td>13268.0</td>
</tr>
<tr>
<td>2 SMSA's</td>
<td>142400.0</td>
<td>22200.0</td>
<td>2880.0</td>
<td>6500.0</td>
<td>42514.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>192600.0</td>
<td>24000.0</td>
<td>4680.0</td>
<td>7500.0</td>
<td>55782.0</td>
</tr>
<tr>
<td><strong>Voice Talkback</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Federal Offices</td>
<td>87.0</td>
<td>240.0</td>
<td>8611.0</td>
<td>0.0</td>
<td>8677.0</td>
</tr>
<tr>
<td>2 SMSA's</td>
<td>218.0</td>
<td>600.0</td>
<td>14976.0</td>
<td>0.0</td>
<td>15141.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>305.0</td>
<td>840.0</td>
<td>23587.0</td>
<td>0.0</td>
<td>23818.0</td>
</tr>
<tr>
<td><strong>Administrative</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Federal Offices</td>
<td>0.0</td>
<td>53333.0</td>
<td>0.0</td>
<td>2852.3</td>
<td>39049.0</td>
</tr>
<tr>
<td>2 SMSA's</td>
<td>0.0</td>
<td>106667.0</td>
<td>0.0</td>
<td>56667.0</td>
<td>78139.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0.0</td>
<td>160000.0</td>
<td>0.0</td>
<td>85000.0</td>
<td>117208.0</td>
</tr>
<tr>
<td><strong>Total Network</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Federal Offices</td>
<td>193452.0</td>
<td>91990.0</td>
<td>172911.0</td>
<td>101849.0</td>
<td>332221.0</td>
</tr>
<tr>
<td>2 SMSA's</td>
<td>398253.0</td>
<td>194850.0</td>
<td>308016.0</td>
<td>192451.0</td>
<td>620060.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>591705.0</td>
<td>286840.0</td>
<td>480927.0</td>
<td>294500.0</td>
<td>952281.0</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 and Installation Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room modifications</td>
<td>$5,000</td>
</tr>
<tr>
<td>Installation costs</td>
<td>$5,000</td>
</tr>
<tr>
<td><strong>Total Capital</strong></td>
<td>$42,000</td>
</tr>
</tbody>
</table>

### Operating Costs

#### "Production"

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing</td>
<td>$25,000</td>
</tr>
<tr>
<td>Scheduling</td>
<td>$5,000</td>
</tr>
<tr>
<td>Maintenance</td>
<td>$4,200</td>
</tr>
<tr>
<td><strong>Recurring Costs</strong></td>
<td>$9,200</td>
</tr>
</tbody>
</table>

### More Complex Studio (Not Full Production Quality)

#### Capital Costs

<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>$5,000</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>$7,500</td>
</tr>
<tr>
<td><strong>Total Capital</strong></td>
<td>$92,500</td>
</tr>
</tbody>
</table>

### Operating Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>$25,000</td>
</tr>
<tr>
<td>Writing</td>
<td>$5,000</td>
</tr>
<tr>
<td>Scheduling</td>
<td>$4,200</td>
</tr>
<tr>
<td>Maintenance 10%</td>
<td>$9,250</td>
</tr>
<tr>
<td><strong>Recurring Costs</strong></td>
<td>$34,250</td>
</tr>
</tbody>
</table>

**Total Capital**: $92,500

**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>
</tr>
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</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>
</tr>
<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>
<tr>
<td>Description</td>
<td>Cost</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>--------</td>
</tr>
<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**

<table>
<thead>
<tr>
<th>Description</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>
<tr>
<td>Fixed Term</td>
<td>Protected</td>
<td>Unprotected</td>
</tr>
<tr>
<td></td>
<td>Peak</td>
<td>Off-Peak</td>
</tr>
<tr>
<td>5 hour/day</td>
<td>$279/hr</td>
<td>$125/hr</td>
</tr>
<tr>
<td>10 hour/day</td>
<td>$266/hr</td>
<td>$125/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>Anytime</td>
<td></td>
<td>$300/hr</td>
</tr>
</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

A-5
EARTH STATION COSTS

Receive-Only Earth Station

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5 meter antenna system</td>
<td>$6,000</td>
</tr>
<tr>
<td>GaAs FET low noise amplifier</td>
<td>3,000</td>
</tr>
<tr>
<td>Downconverter/Demodulator</td>
<td>5,000</td>
</tr>
<tr>
<td>Frequency coordination</td>
<td>1,200</td>
</tr>
<tr>
<td>Installation*</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$20,200</strong></td>
</tr>
</tbody>
</table>

Operations and maintenance (per year) 1,500

Two-Way Earth Station

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 meter antenna system</td>
<td>$50,000</td>
</tr>
<tr>
<td>GaAs FET low noise amplifier</td>
<td>3,000</td>
</tr>
<tr>
<td>HPA system</td>
<td>50,000</td>
</tr>
<tr>
<td>Receive chain</td>
<td>7,500</td>
</tr>
<tr>
<td>Transmit chain</td>
<td>13,000</td>
</tr>
<tr>
<td>Baseband monitoring</td>
<td>5,000</td>
</tr>
<tr>
<td>Test equipment</td>
<td>40,000</td>
</tr>
<tr>
<td>Spares</td>
<td>20,000</td>
</tr>
<tr>
<td>Shelter</td>
<td>15,000</td>
</tr>
<tr>
<td>Site development</td>
<td>10,000</td>
</tr>
<tr>
<td>Installation and engineering</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$233,500</strong></td>
</tr>
</tbody>
</table>

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**

- **Lease:** $1,000/month
- **Installation:** $2,500

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

### INSTALLATION AND PLANNING

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
<td>$47,100</td>
</tr>
<tr>
<td>Travel &amp; Expenses</td>
<td>$29,000</td>
</tr>
<tr>
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<td>Overhead</td>
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<td><strong>TOTAL</strong></td>
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### OPERATIONS & MAINTENANCE (per year)

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<tr>
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*PSSC Estimates
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

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

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### DATA FOR COST ELEMENT T2 -- 2-WAY EARTH TERMINAL

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

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

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*Television Operations Center

A-10
### UPLINK COST/PATH MATRIX:

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<th>VL</th>
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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**

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**MINIMUM LEASE COST = 0.00**

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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>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>LES</td>
<td>-180.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>OMA</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>MINIMUM LEASE COST</td>
<td></td>
<td></td>
<td></td>
<td>-10000.00</td>
</tr>
</tbody>
</table>

DOWNLINK COST/PATH MATRIX:

<table>
<thead>
<tr>
<th>CH</th>
<th>CT</th>
<th>PT</th>
<th>M1</th>
<th>UL</th>
<th>CU</th>
<th>CC</th>
<th>MT</th>
<th>M2</th>
<th>NC</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td>*</td>
<td>*</td>
<td>**</td>
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<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

UPLINK CITIES - There are no uplink cities.
DOWNLINK CITIES - There are no downlink cities.
AUXILIARY PARAMETERS - see below.

TALKBACK:

<table>
<thead>
<tr>
<th></th>
<th>DDD</th>
<th>WATS</th>
<th>PUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>INSTALLATION</td>
<td>40.00</td>
<td>30.00</td>
<td>60.00</td>
</tr>
<tr>
<td>ZERO USAGE CHARGE/MO.</td>
<td>0.00</td>
<td>60.00</td>
<td>215.00</td>
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<tr>
<td>MILEAGE CHARGE</td>
<td></td>
<td></td>
<td>0.52</td>
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<tr>
<td>HOUiLY CHARGE</td>
<td>31.20</td>
<td>18.00</td>
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<tr>
<td>MAXIMUM CHARGE</td>
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<td>1200.00</td>
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</table>

AMORTIZATION:

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</thead>
<tbody>
<tr>
<td>INTEREST RATE</td>
<td>12.00 PERCENT</td>
</tr>
<tr>
<td>EQUIPMENT LIFE</td>
<td>8.00 YEARS</td>
</tr>
</tbody>
</table>

A-13
GENERAL AND ADMINISTRATIVE:
  CAP  0.00
  INS  160000.00
  LES  0.00
  OMA  95000.00

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).

![Model Architecture Diagram]

Figure B-1. MODEL ARCHITECTURE

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 database. 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.
DDDCPH 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).

NINDEX(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'.
POSITN General index pointer into an array
PVTFIX Private line zero-mileage monthly charge.
PVITINS 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(NDNITY,NUCITY) 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(NUINDEX,8) 8-character uplink cost index name.
UCITYH(NUCITY) Uplink city location -- H coordinate.
UCITYV(NUCITY) Uplink city location -- V coordinate.
UCOSTX(NUCITY,4) Capital, installation, lease, OMA costs for each uplink city.
UCSCOD(NUELEM,2) 2-character uplink cost element code.
UCSDAT(NUELEM,NUINDEX,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.
UCTCN(NUCITY) Uplink city channel assigned.
UCTNAM(NUCITY,16) 16-character uplink city name.
UCTORG(NUCITY) Organization code for each uplink city.
UCTXVL(NUCITY,5) Uplink city cost index values.
UDXWHT(NUINDEX) Weighting factor for each uplink cost index.
UORGCS(NUMORG,5) Uplink capital, installation, lease, OMA, annualized by member organization.
UPORDN(2,2) Literal -- 'UPLINK', 'DOWNLINK'.

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UPPDWN
Flag indicating the response to an uplink/downlink question (1 - uplink, 2 - downlink).

UPTHCY (NUPATH,NUCITY)
Array of feasible paths for an uplink city.

UPTHNM (NUPATH,20)
20-character uplink path name.

UPTIDX (NUPATH,NUINDX,5)
Uplink capital, installation, lease, OMA, annualized costs for a given cost index and a given path.

USTCOD (NUCITY,2)
2-character state code for an uplink city.

WATCPH
WATS charge per hour of utilization.

WATINS
WATS installation charge.

WATLES
WATS lease charge per month.

WATMAX
Maximum monthly charges for WATS.

WGTARR (NDCITY)
Weight factors for cost allocation.

XDATA (NDINDX)
Temporary storage for cost index data.

XORGCS (NUMORG,5)
Total capital, installation, lease, OMA, annualized cost by member organization.

YESSNO
Flag indicating the response to a yes/no question (1 - yes, 2 - no).

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,

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

where

\begin{align*}
I & = \text{path number} \\
J & = \text{cost element subscript} \\
K & = \text{cost index subscript} \\
L & = \text{cost categories} (1 = \text{capital}, 2 = \text{installation}, 3 = \text{lease}, 4 = \text{O&M})
\end{align*}
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,

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

where

I = path number
K = cost index subscript
M = city subscript

\(UCTXVL(M,K)\) = 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:

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

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

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

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where

I = path number
J = cost element subscript
K = cost index subscript
L = cost categories

2. Calculate Cost of Each Path in Each City

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

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 be 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:

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>KS20</td>
<td>WESTAR I</td>
</tr>
<tr>
<td>KS21</td>
<td>WESTAR II</td>
</tr>
<tr>
<td>KS22</td>
<td>WESTAR III</td>
</tr>
<tr>
<td>KS26</td>
<td>COMSTAR D-1</td>
</tr>
<tr>
<td>KS27</td>
<td>COMSTAR D-2</td>
</tr>
<tr>
<td>KS28</td>
<td>COMSTAR D-3</td>
</tr>
<tr>
<td>KS29</td>
<td>COMSTAR D-4</td>
</tr>
<tr>
<td>KS30</td>
<td>SATCOM I</td>
</tr>
<tr>
<td>KS31</td>
<td>SATCOM II</td>
</tr>
<tr>
<td>KS32</td>
<td>SATCOM III</td>
</tr>
<tr>
<td>ANIK1</td>
<td>Canadian Telesat Satellites</td>
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<tr>
<td>ANIK2</td>
<td></td>
</tr>
<tr>
<td>ANIK3</td>
<td></td>
</tr>
<tr>
<td>MR1</td>
<td>Marisat I</td>
</tr>
<tr>
<td>MR2</td>
<td>Marisat II</td>
</tr>
<tr>
<td>MR3</td>
<td>Marisat III</td>
</tr>
<tr>
<td>IN1</td>
<td>Intelsat I</td>
</tr>
<tr>
<td>IN2</td>
<td>Intelsat II</td>
</tr>
<tr>
<td>IN3</td>
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</tr>
<tr>
<td>KS36</td>
<td>SBS I</td>
</tr>
<tr>
<td>KS37</td>
<td>SBS II</td>
</tr>
<tr>
<td>KS38</td>
<td>SBS III</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Type of Service</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFS</td>
<td>Domestic fixed satellite</td>
</tr>
<tr>
<td>CS</td>
<td>Communications satellite</td>
</tr>
<tr>
<td>MMS</td>
<td>Maritime mobile-satellite</td>
</tr>
<tr>
<td>IP</td>
<td>International press service (IHF)</td>
</tr>
<tr>
<td>IFF</td>
<td>International fixed public (IH?)</td>
</tr>
<tr>
<td>IC</td>
<td>International control</td>
</tr>
<tr>
<td>X</td>
<td>Other</td>
</tr>
</tbody>
</table>
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.
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

AUXILIARY PARAMETERS

<table>
<thead>
<tr>
<th>TALKBACK:</th>
<th>DDD</th>
<th>WATS</th>
<th>PVT</th>
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<tr>
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<td>30.00</td>
<td>60.00</td>
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<tr>
<td>HOURLY CHARGE</td>
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<tr>
<td>MAXIMUM CHARGE</td>
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<td>1200.00</td>
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</table>

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

REPORT 1 - AUXILIARY PARAMETERS
### FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

#### UPLINK COST ELEMENT DATA

**DATA FOR COST ELEMENT SU -- SATELLITE USAGE**

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

**DATA FOR COST ELEMENT S3 -- CASE 3 STUDIO COSTS**

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<th>PER</th>
<th>OFFPK HR</th>
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<th>STUDIO</th>
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<td>0.00</td>
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<td>0.00</td>
<td>0.00</td>
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**MINIMUM LEASE COST = 0.00**

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

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<th>PER</th>
<th>OFFPK HR</th>
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<th>STUDIO</th>
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**MINIMUM LEASE COST = 0.00**

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

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<td>0.00</td>
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**MINIMUM LEASE COST = 0.00**

(continued)
### DATA FOR COST ELEMENT T2 -- 2-WAY EARTH TERMINAL

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<th>OFFPK HR</th>
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**MINIMUM LEASE COST =** 0.00

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

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<thead>
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<th>OFFPK HR</th>
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**MINIMUM LEASE COST =** 0.00

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

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<th>PER</th>
<th>PEAK HR</th>
<th>OFFPK HR</th>
<th>STUDIO</th>
<th>PER</th>
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</thead>
<tbody>
<tr>
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**MINIMUM LEASE COST =** 0.00

---

REPORT 2 - (continued)

C-7
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

MATRIX OF COST ELEMENTS AND PATHS -- UPLINK

<table>
<thead>
<tr>
<th>SU S3 M1 UL T2 S1 M2</th>
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</thead>
<tbody>
<tr>
<td>MICROWAVE TO E-T</td>
</tr>
<tr>
<td>VIDEO LINK TO E-T</td>
</tr>
<tr>
<td>USE OWN E-T</td>
</tr>
<tr>
<td>MICROWAVE TO OWN E-T</td>
</tr>
<tr>
<td>VIDEO LINK TO OWN E-T</td>
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</tbody>
</table>

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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<thead>
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<th>CITY</th>
<th>ORG</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
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<td>1</td>
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<td>**</td>
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<tr>
<td>WASHINGTON</td>
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**REPORT 4 - MATRIX OF PATHS AND CITIES -- UPLINK**

C-9
<table>
<thead>
<tr>
<th>City</th>
<th>Peak Hr</th>
<th>OffPk Hr</th>
<th>Studio</th>
<th>GRD Link</th>
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FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

MATRIX OF TALKBACK REQUIREMENTS

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<td>PHILADELPHIA</td>
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</tr>
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<td>NEW YORK</td>
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<tr>
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<td>0.0</td>
</tr>
<tr>
<td>CHICAGO</td>
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<tr>
<td>DALLAS</td>
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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 2 -- VIDEO LINK TO E-T**

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**REPORT 7 - SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS -- UPLINK**

C-12
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

COST OF EACH PATH -- UPLINK

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

UPLINK COSTS BY CITY

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<table>
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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

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**MINIMUM LEASE COST =** 0.00

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**MINIMUM LEASE COST =** 0.00

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

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REPORT 10 - (continued)
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

MATRIX OF COST ELEMENTS AND PATHS -- DOWNLINK

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- 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

REPORT 11 - MATRIX OF COST ELEMENTS AND PATHS -- DOWNLINK
### 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

C-19
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE
DOWNLINK COST INDEX VALUES

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(continued)

REPORT 13 - DOWNLINK COST INDEX VALUES

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REPORT 13 - (continued)
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS--DOWNLINK

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

<table>
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<tr>
<td>LEASE</td>
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<tr>
<td>O&amp;MIA</td>
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**PATH 2 -- OWN LINK TO CATV SYS**

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**PATH 3 -- PRIVATE EARTH TERM**

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**PATH 4 -- MICROWAVE TO USER**

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

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(continued)
### PATH 6 -- MONITOR ONLY

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<td>LEASE</td>
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<tr>
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<tr>
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<td>ORGNZTN</td>
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### PATH 7 -- RENTED E-T TO CATV

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REPORT 14 (continued)
### Federal Regional Offices, Top 20 SMSA's -- Cost Allocation Case

#### Cost of Each Path -- Downlink

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WASHINGTON

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

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DOWNLINK TOTAL 192600. 24000. 4680. 7500. 53782.

REPORT 16 (continued)

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

### NETWORK COST ALLOCATION

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<th></th>
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### REPORT 18 - NETWORK COST ALLOCATION

C-31
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

OVERALL COST SUMMARY

| CAPITAL PLANNING AND ANNUAL ANNUALIZED |
| EXPENDITURES INSTALLATION LEASE O&M&A COST |
|-----------------------------------------|-----------------|-----------------|----------------|----------------|
| UPLINK 398800. 102000. 452660. 202000. 755472. |
| DOWNLINK 192600. 24000. 4680. 7500. 55782. |
| VOICE TALKBACK 305. 840. 23587. 0. 23818. |
| ADMINISTRATIVE 0. 16000. 0. 85000. 117208. |
| TOTALS 591705. 286840. 480927. 294500. 952281. |

ANNUALIZED COST 119112. 57742. 480927. 294500. 952281.

EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $ 952281.

REPORT 19 - OVERALL COST SUMMARY

C-32
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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<td>BRENN MAR</td>
<td>VA</td>
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<td>WE74</td>
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<td>GREENBELT</td>
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DOWNLINK CITIES--EARTH STATIONS WITHIN 15 MILES AND LICENSED TO POINT TO KS30

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<th>SIZE</th>
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~~~~~~~~~~~~ PHILADELPHIA   PA

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WX74 HI-NET COMMUNICATIONS, INC. MILWAUKEE-N.E. WI DFSFESPRO 0046
WT41 WITI-TV, INC. BROWN DEER VILLA WI DFSFESPRO 0050
KK28 HI-NET COMMUNICATIONS, INC. MILWAUKEE-SO AIR WI DFSFESPRO 0046

WASHINGTON	 DC
WU31 MARQUEE TELEVISION NETWORK, INC. BETHESDA MD DFSFESPRO 0050
WM43 NATIONAL CABLE SATELLITE CORP. BREN MAR VA DFSFESPTR 0100
WH49 ARLINGTON TELECOMMUNICATIONS CORP. ARLINGTON VA DFSFESPRO 0045
WE87 RCA AMERICAN COMMUNICATIONS, INC. SUITLAND MD DFSFESCRO 0110
WE74 AMERICAN SATELLITE CORPORATION GREENBELT MD DFSFESCTR 0100

REPORT 20 - (continued)

C-38
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, NCITY, NDINDEX, NPATH, NPATH
COMMON NUELEM, NDELEM, NUINDEX, NDINDEX, NCITY, NDINDEX, NPATH, NPATH
INTEGER*2 NELEM(2), NDELEM, NUINDEX(2), NDINDEX(2), NUINDX, NDINDX
COMMON NUINDEX, NDINDEX, NUINDX, NDINDX
EQUIVALENCE (NUINDEX, NINDEX(1)), (NDINDEX, NINDEX(1))
EQUIVALENCE (NUELEM, NELEM(1)), (NDELEM, NDELEM(1))
EQUIVALENCE (NUINDEX, NCITY(1)), (NDINDEX, NCITY(1))
INTEGER*2 NUMORO, MAXUCS, MAXDCS, MAXUPA, MAXDPA, MAXUCT, MAXDCT, BADD
COMMON NUMORO, MAXUCS, MAXDCS, MAXUPA, MAXDPA, MAXUCT, MAXDCT, BADD
INTEGER*2 NUELEM, NDELEM, NUINDEX, NDINDEX, NCITY, NDINDEX, NPATH, NPATH
COMMON NUELEM, NDELEM, NUINDEX, NDINDEX, NCITY, NDINDEX, NPATH, NPATH
EQUIVALENCE (NUINDEX, NCITY(1)), (NDINDEX, NDINDEX(1))
EQUIVALENCE (MAXUCS, MAXDCS(1)), (MAXUPA, MAXPA(1)), (MAXDPA, MAXPA(1))
EQUIVALENCE (MAXUCS, MAXDCS(1)), (MAXUPA, MAXPA(1)), (MAXDPA, MAXPA(1))
INTEGER*2 UCITYV(10), UCTYH(10), UCITY(10), DICYV(80), DICYH(80)
COMMON UCITYV, UCTYH, UCITY, DICYV, DICYH
INTEGER*2 NUMORO, MAXUCS, MAXDCS, MAXUPA, MAXDPA, MAXUCT, MAXDCT, BADD
COMMON NUMORO, MAXUCS, MAXDCS, MAXUPA, MAXDPA, MAXUCT, MAXDCT, BADD
REAL*4 UCSDAT(SS), DCSDAT(30), UCSDAT(30), DCSDAT(30)
COMMON UCSDAT, DCSDAT
REAL*4 UCSMIN(15), DCSCMIN(30), UCSMIN(30), DCSMIN(30)
COMMON UCSMIN, DCSMIN
REAL*4 UCSDAT, DCSDAT, UCSDAT, DCSDAT
COMMON UCSDAT, DCSDAT
LOGICAL*1 UCSPTH(15), DCSPTH(30), UCSPTH(30), DCSPTH(30)
COMMON UCSPTH, DCSPTH
LOGICAL*1 UCSTYP, DCSTYP, UCSTYP, DCSSTYP
COMMON UCSTYP, DCSTYP
LOGICAL*1 UCTCHN(10), DCTCHN(80), UCTCHN(10), DCTCHN(80)
COMMON UCTCHN, DCTCHN
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
DCINDX - DOWNLINK

INCLUDE 'SYO:COMBLK.FTN/NOLIST'
DATA MAXUCS /15/, MAXDCS /30/, MAXUPA /10/, MAXDPA /20/
DATA MAXUCT /10/, MAXDCT /80/
DATA UCINDX /'F'5*' 'P'I'PS* 'r'X'#5*' 'P'E'PS* 'r'D'#23X'/
DATA DCINDX /'F'#$*' 'P'I'PS* 'r'X'.5*' 'P'E'PS* 'r'D'.23X'/

OPEN AND READ USER-SELECTED SCENARIO FILE

CALL READIN
WRITE (1,2) 'SCENARIO TITLE IS...
WRITE (1,10) (TITLE(I),I=1,72)
10 FORMAT ('0'72A1/)
WRITE (1,20) 'DO YOU WANT TO ENTER A NEW TITLE?
CALL YESNO
YES NO ERR
GO TO (30, 50, 20) YESNO
30 WRITE (1,3) 'ENTER NEW SCENARIO TITLE
READ (1,40) (TITLE(I),I=1,72)
40 FORMAT (72A1)

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

CALL COST
CALL PATH
CALL CITY
CALL RATE

WRITE (1,5) 'DO YOU HAVE ANY MORE MODIFICATIONS TO MAKE TO THE SCENARIO?
CALL YESNO
YES NO ERR
GO TO (50, 500, 100) YESNO

SAVE MODIFICATIONS IN A NEW SCENARIO FILE

CALL RITOUT
STOP
END
COST MODULE

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 OMA 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
OGRNAM - 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
CSMCMN - ARRAY OF SUBCOMMANDS USED IN THE COST MODULE

SCALAR VARIABLES

NULEM - 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, REPRTR
YESNO, UPDOWN, RDCOST, MATHOD

THIS ROUTINE CALLED BY: BUILD

INCLUDE 'SYOICOMBLK.FTN/NOLIST'

LOCAL VARIABLES

0040  LOGICAL=1 MODFLG,CSTCMD(5,3),CSTCMD(9,3)
0041  REAL=4 PER,INPUT2
0042  DATA PER,'PER /
0043  DATA CSTCMD,'E','A','M','D','L,'
2  'X','D','Q','E','I,'
3  'I','D','L','S','I'
0044  DATA CSTCMD,'C','I','L','D','C','N','A','R','E','E','K','X','K','Y','P','S','A','D','N','I','I'

ASK FOR COST INFORMATION

WRITE (1,*),'DO YOU HAVE COST INFORMATION TO ENTER?'
CALL YESNO
YES NO ERR
GO TO (50,50,10), YESNO

COST INFORMATION PROCESSING

WRITE (1,*),'DO YOU WANT TO CHANGE YOUR COST ALLOCATION?'
CALL YESNO
YES NO ERR
GO TO (70,70,50), YESNO

COST ALLOCATION PROCESSING

NUMORG = 0
WRITE (1,*),'ENTER LIST OF MEMBERS TO SHARE COSTS - 1 TO END'
READ (1,017) (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 TOOG MANY MEMBERS
C
0066 95 WRITE (1,9) 'ONLY 9 ORGANIZATIONS CAN BE SPECIFIED'
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C ASK FOR UPLINK OR DOWNLINK PROCESSING
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0067 97 WRITE(1,9) 'DO YOU WANT TO EDIT UPLINK OR DOWNLINK COST DATA?'
0068 98 WRITE(1,9) '(UP OR DOWN)'
0069 CALL UPDOWN
0070 IF (UPDOWN.EQ.1) GO TO 97
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C MODIFY COST INDEXES
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0071 100 WRITE (l,1) 'DO YOU WANT TO MODIFY COST INDEXES?'
0072 CALL YESNO
C
YES NO ERR
0073 101 GO TO (120,260,100), YESNO
0074 120 MINDX(UPDOWN) = 1
0075 122 WRITE (1,1) 'ENTER NEW LIST OF COST INDEX NAMES'
0076 125 READ (1,1010) (INDATA(I),I=1,80)
0077 130 CALL GETTER
0078 IF ( ARQ(I).EQ. '1' ) GO TO 130
0079 IF (NCHAR.EQ.0) GO TO 136
0080 IF (NINDEX(UPDOWN).EQ.6) GO TO 145
0081 MINDX(UPDOWN) = MINDX(UPDOWN) + 1
0082 DO 133 J=1,6
0083 IF (UPDOWN.EQ.1) UCINDEX(NINDEX,J) = ARQ(J)
0084 IF (UPDOWN.EQ.2) DCINDEX(NINDEX,J) = ARQ(J)
0085 133 CONTINUE
0086 135 IF ( CONTCD .EQ. 0 ) GO TO 122
0087 IF ( CONTCD .NE. 0 ) GO TO 130
C
TOOG MANY INDEXES INPUT
C
0088 145 WRITE (1,1) 'ONLY 6 COST INDEXES CAN BE SPECIFIED'
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C ENTER COST INDEX WEIGHTING FACTORS
C
D-9
IF (NUMORG.EQ.0) GO TO 280
WRITE (1,*)( 'ENTER WEIGHTING FACTORS FOR COST INDEXES')
ASSIGN 150 TO SADD
GO TO (152,160),(UPPDWN
WRITE (1,1200) ((UCINDX(I,J),J=1,8),I=1,NUINDEX)
READ (1,*),(XDATA(I),I=1,NUINDEX)
DO 155 INDEX
UDXWHT(I) = XDATA(I)
GO TO 280
WRITE (1,1200) ((DCINDX(I,J),J=1,8),I=1,NDINDEX)
READ (1,*),(XDATA(I),I=NDINDEX)
DO 165 INDEX
DDXWNT(I) = XDATA(I)
GO TO 280
WRITE (1,*)( 'ENTER COST COMMAND')
READ (1,1010),(INDATA(I),I=1,80)
CALL GETTER
CALL CODCHK (3,ARG,5,CSTCMD,POSITN)
IF (POSITN .NE. 0) GO TO (900,400,(POSITN)
WRITE (1,*)( 'INVALID COST COMMAND')
WRITE (1,*)( 'VALID COMMANDS ARE: EXI,ADD,DEL,MOD,LIS')
GO TO 280
WRITE (1,*)( 'ENTER NEW COST ELEMENT CODE - 2 CHARACTERS')
ASSIGN 400 TO SADD
CALL RDCOST
0116  IF (NCHMAR.EQ.1.AND.ARG(1).EQ.'1') GO TO 290
0117  IF (POSTN.EQ.0) GO TO 410
0118  405 WRITE (1,*)'COST ELEMENT CODE ALREADY EXISTS'
0119  WRITE (1,*)'USE A DIFFERENT CODE'
0120  GO TO BADD

C ERROR -- TOO MANY COST ELEMENTS
C
0121  410 IF (NELEM(UPPDWN).LT.MAXCS(UPPDWN)) GO TO 415
0122  WRITE (1,*)'ONLY MAXCS(UPPDWN) COST ELEMENTS CAN BE SPECIFIED'
0123  GO TO 290

C ADD NEW ELEMENT CODE TO ARRAY
C
0124  415 NCSTEL = NCSTEL + 1
0125  NCSLT = NELEM(UPPDWN)
0126  IF (NCSTEL.EQ.MAXCS(UPPDWN)) 2 WRITE(1,*),'THIS IS THE LAST COST ELEMENT WHICH MAY BE ADDED'
0127  416 DO 417 I = 1,2
0128  IF (UPPDWN.EQ.1) UCSCOD(NCSTEL,I) = ARG(I)
0129  IF (UPPDWN.EQ.2) DCSCOD(NCSTEL,I) = ARG(I)
0130  417 CONTINUE
0131  IF (MODFLG.EQ.1) GO TO 523

C ADD COST ELEMENT NAME
C
0132  420 WRITE (1,*),'ENTER NEW COST ELEMENT NAME'
0133  ASSIGN 420 TO BADD
0134  READ (1,I010) (INDATA(I),I=1,20)
0135  CALL BETTER
0136  IF (UPPDWN.EQ.1) CALL CODCHK (20,ARG,MAXUCS,UCSNAM,POSITN)
0137  IF (UPPDWN.EQ.2) CALL CODCHK (20,ARG,MAXDCS,DCSNAM,POSITN)
0138  IF (POSTN.EQ.0) GO TO 430
0139  425 WRITE (1,*),'COST ELEMENT NAME ALREADY EXISTS'
0140  WRITE (1,*),'USE A DIFFERENT NAME'
0141  GO TO BADD

C MOVE NEW NAME TO ITS ARRAY
C
0142  430 DO 429 J = 1,20
0143  IF (UPPDWN.EQ.1) UCSNAM(NCSTEL,J) = ARG(J)
0144  IF (UPPDWN.EQ.2) DCSNAM(NCSTEL,J) = ARG(J)
0145  429 CONTINUE
0146  IF (MODFLG.EQ.1) GO TO 523

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

0147 WRITE (1, *) 'COST INDEXES ARE:'
0148 IF (UPPDWN.EQ.1) WRITE (1,1200) ((UCINDX(I), J=1,8), I=1,NUINDX)
0149 IF (UPPDWN.EQ.2) WRITE (1,1200) ((DCINDX(I,J), J=1,8), I=1,NDINDX)
0150 432 WRITE (1,9) 'ENTER CAPITAL COST (ENTER A VALUE FOR EACH COST INDEX)'
0151 ASSIGN 432 TO BADD
0152 READ (1,9,ERR=170) (XDATA(I), I=1,NINDX(UPPDWN))
0153 DO 434 J=IPNINDX(UPPDWN)
0154 IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J,1) = XDATA(J)
0155 IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J,1) = XDATA(J)
0156 434 CONTINUE

C ENTER INSTALLATION COSTS

0157 440 WRITE (1,9) 'ENTER INSTALLATION COSTS'
0158 ASSIGN 440 TO BADD
0159 READ (1,9,ERR=170) (XDATA(I), I=1,NINDX(UPPDWN))
0160 DO 434 J=IPNINDX(UPPDWN)
0161 IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J,2) = XDATA(J)
0162 IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J,2) = XDATA(J)
0163 434 CONTINUE

C ENTER LEASE COSTS

0164 450 WRITE (1,9) 'ENTER LEASE COSTS'
0165 ASSIGN 450 TO BADD
0166 READ (1,9,ERR=170) (XDATA(I), I=1,NINDX(UPPDWN))
0167 DO 455 J=1,NINDX(UPPDWN)
0168 IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J,3) = XDATA(J)
0169 IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J,3) = XDATA(J)
0170 455 CONTINUE

C ENTER OMA COSTS
C CCCCCCCCCCCCCCCCC
C
0171 465 WRITE (1,*) 'ENTER OPERATIONS AND MAINTENANCE COSTS'
0172
0173 ASSIGN 465 TO BADD
0174 READ (1,*,ERR=170) (XDATA(I),I=1,NINDX(UPPDWN))
0175 DO 470 J=1,NINDX(UPPDWN)
0176 IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J+4) = XDATA(J)
0177 IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J+4) = XDATA(J)
0178 470 CONTINUE
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C ENTER MINIMUM LEASE COST, IF APPLICABLE
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0179 471 WRITE (1,*)'ENTER MINIMUM LEASE COST (IF APPLICABLE; OTHERWISE 0)'
0180 ASSIGN 471 TO BADD
0181 READ (1,*,ERR=170) XDATA(1)
0182 IF (UPPDWN.EQ.1) UCSMIN(NCSTEL) = XDATA(1)
0183 IF (UPPDWN.EQ.2) DCSMIN(NCSTEL) = XDATA(1)
0184 DO 475 I=1,NPATH(UPPDWN)
0185 IF (UPPDWN.EQ.1) UCSPTH(NCSTEL,PJ) = 0
0186 IF (UPPDWN.EQ.2) DCSPTH(NCSTEL,PJ) = 0
0187 475 CONTINUE
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C ENTER PATH INFORMATION
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0188 480 WRITE (1,*)'ENTER PATH NAMES TO WHICH THIS COST ELEMENT IS TO BE ADDED'
0189 J = UPPDWN + 2
0190 CALL MATMOD(J,PJ,NCSTEL)
0191 IF (MODFLG .EQ. 1) GO TO 523
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 500 CONTINUE
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C MODIFY COST ELEMENT
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0197 523 CALL RDCOST
0198 IF (POSITN .NE. 0) GO TO 510
0199 WRITE (1,*) 'COST ELEMENT CODE DOES NOT EXIST'
0200 500 CONTINUE
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
ENTER MODIFIED CODE

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

0200 520 NCSTEL=POSITN
0201 523 WRITE (1,* ) 'ENTER COST MODIFY SUBCOMMAND'
0202 MODFLG = 0
0203 READ (1,1010) (INDATA(I),I=1,80)
0204 CALL GETTER
0205 CALL CODCHK (3,ARG,CSMCMD,POSITN)
0206 IF (POSITN.NE.0) GO TO 530
0207 WRITE (1,* ) 'INVALID SUBCOMMAND.'
0208 WRITE (1,1270) (CSMCMD(I),I=1,9)
0209 GO TO 523

BRANCH TO MODIFY COST SUBCOMMAND

0210 530 BCAP INS LES O+M COOD NAM ADD REM EXI

0211 540 GO TO (541,561,UPPDWN)
0212 541 WRITE (1,1210) (INDATA(J),J=1,3),(UCSCOD(NCSTEL,J),J=1,2),  
2 (UCSNAM(NCSTEL,J),J=1,20)
0213 IF (NUINDX.GE.2) WRITE (1,1220) (PER, J=2,NUINDX)
0214 WRITE (1,1230) (UCINDEX(I),I=1,8),I=1,NUINDX)
0215 WRITE (1,1240) (UCSDAT(NCSTEL,J+POSITN),J=1,NUINDX)
0216 WRITE (1,1250) (UCSDAT(NCSTEL,J+POSITN),J=1,NUINDX)
0217 545 WRITE (1,* ) 'ENTER CHANGE -N,VALUE OR 0=0 TO END'
0218 ASSIGN 545 TO BADD
0219 550 READ (1,* ,ERR=170) K,INPUT2
0220 IF (K.LE.0) WRITE (1,1240) (UCSDAT(NCSTEL,J+POSITN),J=1,NUINDX)
0221 IF (K.LE.0) GO TO 523
0222 IF (K.LE.NUINDX) GO TO 560
0223 WRITE (1,1250) K
0224 GO TO 545
0225 560 UCSDAT(NCSTEL,K,POSITN) = INPUT2
0226 GO TO 545

DOWNLINK MODIFY
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COST.FTN  /TRIBLOCKS/WR

0227 561 WRITE (1,1210) (INDATA(J),J=1,3),(DCSCOD(NCSTEL,J),J=1,2),
     2 (DCSNAM(NCSTEL,J),J=1,20)
0228   2 IF (NDINDX.GE.2) WRITE(1,1220) (PER(J,J),J=1,NDINDX)
0229   2 WRITE (1,1230) ((DCINDX(I,J),J=1,8),I=1,NDINDX)
0230   2 WRITE (1,1240) (DCSDAT(NCSTEL,J,POSITN,J),J=1,NDINDX)
0231   2 WRITE (1,1280)
0232 565 WRITE (1,*,'ENTER CHANGE - NVALUE OR 0 TO END')
0233 ASSIGN 565 TO BADD
0234 570 READ (1,*ERR=170) K,INPUT2
0235   1 IF (K.LE.0) WRITE(1,1240) (DCSDAT(NCSTEL,J,POSITN),J=1,NDINDX)
0236   1 IF (K.LE.0) GO TO 523
0237   1 IF (K.LE.NDINDX) GO TO 580
0238   1 WRITE (1,1250) K
0239   1 GO TO 545
0240 580 DCSDAT(NCSTEL,K,POSITN) = INPUT2
0241   1 GO TO 545
0242 640 'ENTER NEW COST ELEMENT CODE'
0243 ASSIGN 640 TO BADD
0244 CALL RDCOST
0245 IF (POSITN.NE.0) GO TO 405
0246 MODFLG=0
0247 GO TO 416
0248 640 '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,MAXDCS,UCSNAM,POSITN)
0253 IF (UPPDWN.EQ.2) CALL CODCHK (20,ARG,MAXDCS,DCSNAM,POSITN)
0254 IF (POSITN.NE.0) GO TO 425
0255 MODFLG=0
0256 GO TO 430
0257 640 MODFLG=0
0258 GO TO 480

D-15
C
C REMOVE A COST ELEMENT FROM A PATH
C
C
0259 680 WRITE ( 1,* ) 'ENTER PATH NAMES FROM WHICH THIS COST ELEMENT IS TO
0260 2 BE REMOVED'
0261 690 J = UPDDWN + 2
0262 780 CALL MATMOD(JPOPNCSTEL)

C
C
C
C
0263 705 WRITE ( 1,* ) 'ENTER COST ELEMENT CODE TO BE DELETED'
0264 710 CALL RDCOST
0265 690 IF ( ARG(1) .EQ. '3') 00 TO 280
0266 690 IF ( POSITN .EO. 0 ) GO TO 710
0267 706 IF ( UPDDWN .EQ. 1) WRITE(1,1260)(UCSNAM(POSITN,I),I=1,20)
0268 710 IF ( UPDDWN .EO. 2) WRITE(1,1260)(DCSNAM(POSITN,I),I=1,20)
0269 710 CALL YESNO
0270 720 CALL DISAPR (UPPDWN, POSITN)
0271 780 IF(NELEM(UPPDWN) .GT. 0 ) GO TO 280
0272 730 WARNING **********#***********'
0273 740 WRITE(i.*)'ALL COST ELEMENTS HAVE BEEN DELETED'
0274 750 WRITE(i.*)'IN THIS SEGMENT'
0275 760 WRITE(i.*)'THE MODEL WILL NOT WORK UNLESS AN ELEMENT IS ADDED'
0276 770 WARNING **********#***********'
0277 780 GO TO 280

C
C
C
C
0279 710 WRITE ( 1,* ) 'COST ELEMENT CODE DOES NOT EXIST'
0280 780 GO TO 280

C
C LIST COST ELEMENT INFORMATION
C
C
C
C
0281 800 WRITE ( 1,* ) 'ENTER LIST SPECIFICATION'
0282 810 N=0
0283 820 READ ( 1,1010 ) (INDATA(I),I=1,80)
0284  803  CALL GETTER
0285  804  IF (NCHAR.EQ.0) GO TO 804
0286          IF (ARG(1) .EQ. 'A' .AND. ARG(2) .EQ. 'L' .AND. ARG(3) .EQ. 'L')
0287          # GO TO 820
0288          IF (ARG(1) .EQ. 'P' .AND. ARG(2) .EQ. 'A' .AND. ARG(3) .EQ. 'T')
0289          # GO TO 840
0288          IF (ARG(1) .EQ. 'C' .AND. ARG(2) .EQ. '0' .AND. ARG(3) .EQ. 'S')
0289          # GO TO 860
0289  804  IF (CONTCD.EQ.0) GO TO 800
0290  803  IF (CONTCD.NE.0) GO TO 803
0290  820  DO 830 I = 1,NELEM(UPPDOWN)
0291  830  CONTINUE
0292  840  CALL REPRTR (1,1)
0293  830  CONTINUE
0294  860  CALL REPRTR (9,1)
0295  800  IF (CONTCD.NE.0) GO TO 803
C ERROR - INVALID RESPONSE OR CODE DOESN'T EXIST
C
0296  810  WRITE (1,*,'(A)') 'INVALID LIST OPTION'
0297          WRITE(1,*,'(A)') 'LIST OPTIONS ARE: ALL, COST, PATH, A COST ELEMENT CODE, 2 OR I'
0298  800  GO TO 800
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C PRINT PATH MATRIX AND COST INFORMATION
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0299  820  DO 830 I = 1,NELEM(UPPDOWN)
0300  830  CONTINUE
C CCCCCCCCCCCCCCCCCCCCCCCC
C PRINT PATH MATRIX ONLY
C CCCCCCCCCCCCCCCCCCCCCCCC
C
0301  840  CALL REPRTR (2,1)
0302  830  CONTINUE
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C C PRINT COST ELEMENT CODES AND NAMES
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0303  860  CALL REPRTR (9,1)
0304  830  CONTINUE
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C C EXIT COMMAND
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
COST.FTN /TR:BLOCKS/WR

0306     900     IF (UPPDWN.EQ.2) GO TO 950
0307     900     WRITE (1,X) 'DO YOU WANT TO MODIFY OWNLINK COST DATA?'
0308     900     CALL YESNO
0309     900     GO TO (910r950r900)r YESSNO
0310     910     UPPDWN = 2
0311     910     GO TO 100
0312     950     RETURN

C

0313     1010     FORMAT (80A1)
0314     1020     FORMAT (1H 'X',2A1,' -- ',20A1/)
0315     1200     FORMAT (1X,6(A1,2X))
0316     1210     FORMAT(1H,3A1.' COSTS FOR '20A1,' -- ',20A1)
0317     1220     FORMAT(1H,19X,5(7X,A4))
0318     1230     FORMAT(1H,8X,6(3X,A1))
0319     1240     FORMAT(1H,'SPECIFIED SUBSCRIPT TOO LARGE:', I10)
0320     1250     FORMAT(1X,'COST ELEMENT TO DELETE IS ',20A1,' Y OR N')
0321     1260     FORMAT(1X,'VALID COMMANDS: ',9(1X,A1))
0322     1270     FORMAT(1X,'N= 1 2 3 4 5 6')
0323     1280     END
SUBROUTINE PATH

PATH MODULE

THE PATH MODULE DEFINES OR MODIFIES DATA FOR UPLINK OR DOWNLINK F.THS. 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

UPTHCY - ARRAY OF UPLINK CITIES FOR WHICH A PATH IS FEASIBLE
DPTHCY - DOWNLINK

UPTHNM - 20 CHARACTER ARRAY OF UPLINK PATH NAMES
DPTHNM - DOWNLINK

UPTIDX - CAPITAL INSTALLATION, INSTALLATION, LEASE, OMA, ANNUALIZED COST FOR A GIVEN COST INDEX AND PATH - UPLINK
DPTIDX - DOWNLINK

SCALAR VARIABLES

NUPATH - NUMBER OF UPLINK PATHS
NDPATH - NUMBER OF DOWNLINK PATHS
MAXUPA - MAXIMUM NUMBER OF UPLINK PATHS
MAXDPA - MAXIMUM NUMBER OF DOWNLINK PATHS

SUBROUTIN CALLS: GETTER, YESNO, CODCHK, DISAPR, REPRTR, UPDOWN, MATMOD

CALLED BY: BUILD

INCLUDE 'SYO:COMBLK.FTN/NOLIST'

LOCAL VARIABLES

CURRENTR, ORG

DATA PTHCMD /'E', 'A', 'N', 'D', 'L'/
2 /'X', 'D', 'O', 'E', 'I'/
3 /'I', 'D', 'L', 'S'/

DATA PTHLS7 /'C', 'C', 'P', '/
2 /'O', 'I', 'A', '/

DATA PTHCMD /'A', 'D', 'N', 'A', 'D', 'N', 'E'/
2 /'D', 'E', 'D', 'E', 'E', 'X'/
3 /'D', 'W', 'D', 'L', 'W', 'I'/
4 /'C', 'C', 'C', 'L', 'C', 'N', 'T'/
5 /'C', 'O', 'O', 'I', 'I', 'A', '/

ASK IF THE USER WANTS TO ENTER PATH DATA
FORTRAN IV-PLUS V02-S1C

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PATH.FTN /TR:BLOCKS/WR

0045 3000 WRITE (1,*),'DO YOU HAVE PATH INFORMATION TO ENTER?'
0046 CALL YESNO
0047 C YES NO ERR
0048 C GO TO (3010,3720,3000), YESNO
0049 C
0050 3010 WRITE (1,*),'Do you have path information to enter?'
0051 CALL UPDOWN
0052 IF(UPPDWN .EQ. 3) GO TO 3010
0053 C PATH COMMAND PROCESSING
0054 C
0055 3015 WRITE (1,*),'Enter path command'
0056 CALL CODCHK (3,INDATA,PTHCMD,POSITN)
0057 IF (POSITN .EQ. 0 ) GO TO 3020
0059 C BRANCH ON PATH COMMAND
0060 C EXIT ADD MOD DEL LIST
0061 C
0062 3020 WRITE (1,*),'Invalid path command'
0063 WRITE (1,*),'Valid commands: exit/add/mod/del/list'
0064 GO TO 3015
0065 C
0066 3100 IF (NPATH(UPPDWN) .LT. MAXPA(UPPDWN)) GO TO 3110
0067 3101: WRITE (1,*),'Only 'PMAXPA(UPPDWN)' paths can be specified'
0068 3110 WRITE (1,*),'Enter new path name'
0069 ASSIGN 3110 TO HADD
0070 READ (1,*),(INDATA(I),I=1,80)
0071 IF (ARG(1).EQ.'') GO TO 3015
0072 CALL GETTER
0073 IF (UPPDWN.EQ.1) CALL CODCHK (16,ARG,MAXUPA,UPTHNM,POSITN)
0074 IF (UPPDWN.EQ.2) CALL CODCHK (16,ARG,MAXDPA,UPTHNM,POSITN)
0075 IF (POSITN .EQ. 0 ) GO TO 3120

C

C

D-20
C DUPLICATE PATH NAME

1120 WRITE (1,*) 'PATH NAME ALREADY EXISTS'
1121 WRITE (1,*) 'ENTER A DIFFERENT NAME'
1122 GO TO 1080

MOVE NAME TO NEW ARRAY

1120 NPATH(UPDOWN) = NPATH(UPDOWN) + 1
1121 DO 1130 I = 1, NPATH(UPDOWN)
1122 IF (UPDOWN.EQ.1) UPTHNM(NPATH(I)) = ARG(I)
1123 IF (UPDOWN.EQ.2) DFTHNM(NPATH(I)) = ARG(I)
1124 CONTINUE

ADD LIST OF COST ELEMENTS WHICH COMPRISE THIS PATH

1130 WRITE (1,*) 'ENTER LIST OF COST ELEMENT CODES FOR THIS PATH'
1131 CALL MATMOD(UPDOWN, NPATH(UPDOWN))

REQUEST CITY NAMES FOR WHICH THIS PATH IS FEASIBLE

1140 WRITE (1,*) 'ENTER LIST OF CITY NAMES FOR WHICH THIS PATH IS FEASIBLE'
1141 J = 1 + UPPDOWN
1142 CALL MATMOD(J, NPATH(UPDOWN))
1143 GO TO 301

MODIFY COMMAND

1200 WRITE (1,*) 'ENTER PATH NAME YOU WANT TO MODIFY'
1201 READ (1,*) (INDATA(I), I = 1, 60)
1202 CALL BETTER
1203 IF (UPDOWN.EQ.1) CALL CODCHK (NCHAR, ARG, MAXUPA, UPTHNM, POSITN)
1204 IF (UPDOWN.EQ.2) CALL CODCHK (NCHAR, ARG, MAXUPA, DFTHNM, POSITN)
1205 IF (POSITN.EQ.0) GO TO 3310
1206 IF (POSITN.EQ.1) IF (UPDOWN.EQ.1) CALL CODCHK (20, ARG, MAXUPA, UPTHNM, POSITN)
1207 IF (POSITN.EQ.1) IF (UPDOWN.EQ.2) CALL CODCHK (20, ARG, MAXUPA, DFTHNM, POSITN)
1208 IF (POSITN.EQ.0) GO TO 3315
1209 IF (POSITN.EQ.0) GO TO 3310
1210 CONTINUE
1211 GO TO 3200

ERROR - PATH DOES NOT EXIST
0094  3310 WRITE (1,*) 'PATH DOES NOT EXIST'
0095  3315 WRITE (1,*) 'SPECIFIED PATH NOT UNIQUE - ENTER MORE INFORMATION'
0099  GO TO 3300

C
BRANCH TO MODIFY SUBCOMMAND
C

0100  3320 WRITE (1,*) 'ENTER PATH MODIFY SUBCOMMAND'
0101  READ (1,4910) (INDATA(I),I=1,80)
0102  CALL GETTER
0103  CALL CODCHK (S#ARO9, 8#PTMCMD, POSITN)
0104  IF (POSITN .LE. 0) GO TO 3335

C
ADO$DLC0$9NWCO9ADCYPDLCY9NWNM$EXIT
0105  GO TO (3340,3360,3380,1,0,3420,3440,3460,3015,POSITN)

C
NO SUCH COMMAND
C

0106  3333 WRITE (1,*) 'INVALID SUBCOMMAND. VALID SUBCOMMANDS ARE...'
0107  WRITE (1,4920)((PTMCMD(I),J=1,5),I=1,8)
0108  GO TO 3320

C
ADD A COST ELEMENT TO PATH
C

0109  3340 WRITE (1,*) 'ENTER LIST OF COST ELEMENT CODES TO ADD TO PATH'
0110  CALL MATMOD(UPPDWN,1,CURRENT)
0111  GO TO 3320

C
DELETE A COST ELEMENT FROM PATH
C

0112  3360 WRITE (1,*) 'ENTER LIST OF COST ELEMENT CODES TO DELETE FROM PATH'
0113  CALL MATMOD(UPPDWN,0,CURRENT)
0114  GO TO 3320

C
REPLACE COST ELEMENTS FOR PATH
C

0115  3380 DO 3390 I=1,NELEM(UPPDWN)
0116  IF (UPPDWN.EQ.1) UCSPTH(I,CURRENT) = 0
0117  IF (UPPDWN.EQ.2) DCSPTH(I,CURRENT) = 0
0118  CONTINUE

D-22
PATH.FTN /TRIPLOCKS/WR

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

CCCCCCCCCCCCCCCCCCCCCC
C
C ADD A CITY TO PATH
C
CCCCCCCCCCCCCCCCCCCCCC

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

CCCCCCCCCCCCCCCCCCCCCC
C
C DELETE A CITY FROM PATH
C
CCCCCCCCCCCCCCCCCCCCCC

0126 3420 WRITE(1,*)'ENTER LIST OF CITY NAMES (ORG) TO DELETE FROM THIS PATH'
0127 J = 6 + UPPDWN
0128 CALL MATMOD(J,0,CURRENT)
0129 GO TO 3320

CCCCCCCCCCCCCCCCCCCCCC
C
C REPLACE CITIES FOR PATH
C
CCCCCCCCCCCCCCCCCCCCCC

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

CCCCCCCCCCCCCCCCCCCCCC
C
C REPLACE PATH NAME
C
CCCCCCCCCCCCCCCCCCCCCC

0138 3460 WRITE (1,*) 'ENTER THE NEW NAME FOR PATH'
0139 ASSIGN 3460 TO ADD
0140 READ (1,610) (INDATA(I),I=1,10)
0141 CALL GETTER
0142 IF (UPPDWN.EQ.1) CALL CODCHK(20,ARG,MAXUFU,UPTHNM,POSITION)
0143 IF (UPPDWN.EQ.2) CALL CODCHK(20,ARG,MAXDFP,DPYHNM,POSITION)
0144 IF (POSITION.NE.0) GO TO 3115

D-23
DO 3465 I = 1, 20

IF (UPPDWN.EQ.1) UPTHNM (CURRENT+I) = ARG (I)
IF (UPPDWN.EQ.2) DPTHNM (CURRENT+I) = ARG (I)
CONTINUE

GO TO 3320

C DELETE A PATH FROM SCENARIO
C

WRITE ( 19* ) 'ENTER PATH NAME TO DELETE FROM SCENARIO'
READ ( 1, 4910 ) (INDATA(I), I=1, 80)

IF (ARG(1).EQ.'0') 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
J = 2 + UPPDWN
CALL DISAPR (J, POSITN)

WRITE (1, 4910) 'NO SUCH COMMAND'
GO TO 3015

WRITE (1, 4910) 'SPECIFIED PATH NOT UNIQUE - ENTER MORE INFORMATION'
GO TO 3500

C

C LIST PATH INFORMATION

WRITE ( 19* ) 'ENTER LIST SPECIFICATION '
READ ( 1, 4910 ) (INDATA(I), I=1, 80)
CALL GETTER
CALL CODCHK (2, ARG, MAXHLST, POSITN)
IF (POSITN .EQ. 0 ) GO TO 3610

C COST CITY PATH
GO TO (3620, 3630, 3640, 3015) POSITN
C
C NO SUCH COMMAND
C

D-24
0176 3610 WRITE (1,*), 'INVALID LIST OPTION'
0177      WRITE (1,*), 'VALID COMMANDS: COST, CITY, PATH'
0178      GO TO 3600

C
CCCCCCCCCCCCCCCCCCCCCCCC
C PRINT PATH/COST MATRIX
C
CCCCCCCCCCCCCCCCCCCCCCCC
C
0179 3620 CALL REPRTR (2,1)
0180      GO TO 3015
C
CCCCCCCCCCCCCCCCCCCCCCCC
C PRINT PATH/CITY MATRIX
C
CCCCCCCCCCCCCCCCCCCCCCCC
C
0181 3630 CALL REPRTR (4,1)
0182      GO TO 3015
C
CCCCCCCCCCCCCCCCCCCCCCCC
C PRINT PATH NAMES AND NUMBER
C
CCCCCCCCCCCCCCCCCCCCCCCC
C
0183 3640 CALL REPRTR (3,1)
0184      GO TO 3015
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C EXIT FROM PATH MODULE
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
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,5A1))
CITY MODULE

0001 SUBROUTINE CITY

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

C ARRAY VARIABLES
C
C UCTXVL - VALUES ASSOCIATED WITH UPLINK COST INDEXES
C DCTXVL - DOWNLINK
C
C UCTNAM - ARRAY OF UPLINK CITY NAMES - 16 CHARACTERS EACH
C DCTNAM - DOWNLINK
C
C USTCOD - ARRAY OF 2 CHARACTER STATE CODES CORRESPONDING TO UPLINK
C CITIES
C DSTCOD - DOWNLINK
C
C UCITYV - VERTICAL COORDINATES FOR UPLINK CITIES
C DcityV - DOWNLINK
C
C UCITYH - HORIZONTAL COORDINATES FOR UPLINK CITIES
C DcityH - DOWNLINK
C
C DCTLVL - THE HIERARCHICAL LEVEL OF EACH DOWNLINK CITY
C
C UCTCHN - THE CHANNEL ASSIGNED TO EACH UPLINK CITY
C TALKBK - THE HOURS OF TALKBACK NEEDED FROM EACH DOWNLINK CITY
C TO THE ORIGINATING CITY

C SCALAR VARIABLES
C
C NUCITY - NUMBER OF UPLINK CITIES
C NDCITY - NUMBER OF DOWNLINK CITIES
C LATLON - FLAG TO TELL THE PROGRAM WHEN V AND H COORDINATES ARE
C INPUT IN TERMS OF LATITUDE AND LONGITUDE
C
C SUBROUTINE CALLS: GETTER, YESNO, CODECHN, DISAPR, REPRTR,
C UPDOWN, MATHOD, CTYCHK, VANDH

C CALLED BY: BUILD

0002 INCLUDE 'SYO:COMBLK.FTN/NOLIST'

C LOCAL VARIABLES

D-26
LOGICAL*1 MODFLG, BYPASS, CTYCMD(6:1), CTLSTS(8:4), MODSUB(10:4),
2 BLANK
INTEGER*2 ORGNUM, CURRENTr, LAT, LON
REAL*4 UD
DATA BLANK/’ ’

DO YOU HAVE CITY INFORMATION TO ENTER?
NO ERR
6980 YESSNO
DO UPLINK OR DOWNLINK?
.E.G. 3 GO TO 6010
C
C CITY PROCESSING
C
C ADD OR OVERLAY COMMANDS
C
C
6000 WRITE (1, *) ’ENTER CITY COMMAND’
CALL YESNO
C
6016 WRITE (1, *) ’INVALID CITY COMMAND’
WRITE (1, *)’VALID COMMANDS ARE: ADD, OVER, MOD, DEL, LIST, EXIT’
GO TO 6015
C
6059 GO TO (6100, 6050, 6300, 6700, 6800, 6900) POSITN
C
6099 ADD OVER MOD DEL LIST EXIT
C
C ERROR IN RESPONSE
C
6060 WRITE (1, *) ’INVALID CITY COMMAND’
6061 WRITE (1, *) ’VALID COMMANDS ARE: ADD, OVER, MOD, DEL, LIST, EXIT’
GO TO 6015
C
C ADD OR OVERLAY COMMANDS
C
OVERLAY CITIES

0063 6050 BYPASS = 1
0064 IF ( NUMORG .GT. 0 ) GO TO 6100

C NO COST ALLOCATION - INVALID COMMAND IN THIS CASE

0065 WRITE (1,*), 'INVALID COMMAND UNLESS COST ALLOCATION IS USED'
0066 BYPASS = 0
0067 GO TO 6015
0068 6100 WRITE (*,1390), 'ENTER CITY NAME (/ORO)'
0069 ASSIGN 6100 TO BADD
0070 READ (1,7990) (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 POSITN = 0 AND ORGNUM = 0 - ERROR UNLESS NO COST ALLOCATION - NO CITY MATCH AND NO ORGANIZATION MATCH
C POSITN > 0 AND ORGNUM = 0 - CITY MATCH AND ORG MATCH
C THIS SITUATION IS ONLY VALID FOR MODIFY OR DELETE
C POSITN > 0 AND ORGNUM > 0 - EXISTING CITY AND NEW ORGANIZATION
C VALID FOR OVERLAY ONLY
C POSITN = 0 AND ORGNUM > 0 - NEW CITY AND NEW ORGANIZATION
C VALID FOR ADD ONLY
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 NOT VALID FOR ADD OR OVERLAY

0077 IF ( POSITN .GT. 0 ) .AND. ORGNUM .EQ. 0 ) GO TO 6322
C OVERLAY
C IF (BYPASS .EQ. 1 .AND.
2 POSITN .GT. 0 .AND.
3 ORGNUM .GT. 0 ) GO TO 6102
C
ADD

IF (BYPASS .NE. 1 .AND.
2 POSITN .EQ. 0 .AND.
3 ORGNUM .GT. 0 .AND.
4 NUMORG .GT. 0 ) GO TO 6102
C
IF (POSITN .EQ. 0 ) GO TO 6315
IF(POSITN .GT. 0) GO TO 6322

6101 WRITE (1,*)'INVALID RESPONSE - PLEASE RE-ENTER'
GO TO 601
C
6102 IF (NCITY(UPPDWN) .LT. MAXCT(UPPDWN)) GO TO 6103
WRITE (1,*)'ONLY 'MAXCT(UPPDWN)' CITIES CAN BE SPECIFIED'
GO TO 601
C
6103 NCITY(UPPDWN) = NCITY(UPPDWN) + 1
UD = 'DOWN'
IF (NCITY(UPPDWN) .LT. MAXCT(UPPDWN)) WRITE (1,7992) UD
7992 FORMAT (1X,'THIS IS THE LAST CITY YOU MAY ADD TO THIS LINK')
IF (UPPDWN .EQ. 1 ) GO TO 6104
C CURRENT = NCITY(UPPDWN)
IF (NUMORG .GT. 0 ) DCTORG(CURRENT) = ORGNUM
GO TO 6105
C
6104 CURRENT = NCITY(UPPDWN)
IF (NUMORG .GT. 0 ) UCTORG(CURRENT) = ORGNUM
6105 DO 6106 I=1,NCHAR
IF (UPPDWN .EQ. 1 ) UCTNAM(CURRENT,I) = ARG(I)
IF (UPPDWN .EQ. 2 ) DCTNAM(CURRENT,I) = ARG(I)
6106 CONTINUE
6107 IF (NCHAR .GE. 16 ) GO TO 6110
NCHAR = NCHAR + 1
6108 DO 6107 I=NCHAR,16
IF (UPPDWN .EQ. 1 ) UCTNAM(CURRENT,I) = BLANK
IF (UPPDWN .EQ. 2 ) DCTNAM(CURRENT,I) = BLANK
6107 CONTINUE
C
6110 IF (BYPASS .EQ. 1 ) GO TO 6113
WRITE (1,*)'ENTER THE 2 CHARACTER STATE CODE FOR THIS CITY'
READ (L7099) (INDATA(I),I=1,2)
0110      DO 6120 Iwlr2
0111      IF (UPPDWN.EQ.1) USTCOD(CURRENT,I)=INDATA(I)
0112      IF (UPPDWN.EQ.2) DSTCOD(CURRENT,I)=INDATA(I)
0113  6120  CONTINUE

C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C ENTER V AND H COORDINATES
C
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

0114  6130  WRITE (1,*),'ENTER V COORDINATE OR LATITUDE (-DDMM) FOR THIS CITY'
0115      ASSIGN 6130 TO PADD
0116      READ (1,*ERR=7000) LON
0117      IF ( LON .LT. 0 ) 00 TO 6135
0118      IF ( LON .GT. 15000 ) GO TO 7100
0119      IF (UPPDWN.EQ.1) UCITYV(CURRENT)=LON
0120      IF (UPPDWN.EQ.2) DCITYV(CURRENT)=LON
0121      GO TO 6160
C
C V COORDINATE INPUT AS LATITUDE
C
0122  6135  LAT = LON
0123      LATLON = 1
C
C ENTER H COORDINATE AS LONGITUDE
C
0124  6145  WRITE (1,*),'ENTER THE POSITIVE LONGITUDE (1DDMM) FOR THIS CITY'
0125      ASSIGN 6145 TO PADD
0126      READ (1,*ERR=7000) LON
0127      IF ( LON .LT. 0 ) 00 TO 6145
0128      CALL VANDH(LATLON)
0129      IF (UPPDWN .EQ. 2 ) GO TO 6150
0130      UCITYH(CURRENT) = LAT
0131      UCITYH(CURRENT) = LON
0132      GO TO 6155
0133  6150  DCITYV(CURRENT) = LAT
0134      DCITYH(CURRENT) = LON
0135  6155  IF ( MODFLG .EQ. 1 ) GO TO 6525
0136      GO TO 6180
C
C ENTER HORIZONTAL COORDINATE
C
0137  6160  WRITE (1,*),'ENTER HORIZONTAL COORDINATE FOR THIS CITY'
0138      ASSIGN 6160 TO PADD
0139      READ (1,*ERR=7000) LON
0140      IF ( LON .LT. 15000 .OR. LON .LT. 0 ) GO TO 7100
0141      IF (UPPDWN.EQ.1) UCITYH(CURRENT)=LON
0142      IF (UPPDWN.EQ.2) DCITYH(CURRENT)=LON
0143  6170  IF ( MODFLG .EQ. 1 ) GO TO 6525
0144      GO TO 6180
C
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C OVERLAY COMMAND WITH EXISTING CITY
C
C
C SET STATE, V AND H, AND ORGANIZATION FROM PREVIOUS CITY DEFINITION
C
0145 6175 IF (UPPDWN .EQ. 2 ) GO TO 6177
0146  UCTORG(CURRENT) = ORGNUM
0147  USTCOD(CURRENT,1) = USTCOD(POSITN,1)
0148  USTCOD(CURRENT,2) = 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,1) = DSTCOD(POSITN,1)
0154  DSTCOD(CURRENT,2) = DSTCOD(POSITN,2)
0155  DCITYV(CURRENT) = DCITYV(POSITN)
0156  DCITYH(CURRENT) = DCITYH(POSITN)
C
C ENTER CHANNEL NUMBER
C
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  UCCHNL(CURRENT) = LON
C
0163  IF (MODFLG .EQ. 1 ) GO TO 6525
0164  GO TO 6195
C
C ENTER HIERARCHICAL LEVEL
C
0165  6185 WRITE (1,*) 'ENTER HIERARCHICAL LEVEL NUMBER FOR THIS CITY'
0166  ASSIGN 6185 TO BADD
0167  READ (1,*,ERR=7000) LON
0168  IF (LON .LT. 2 .OR. LON .GT. 100) GO TO 7100
0169  DCTHLVL(CURRENT) = LON
0170  IF (MODFLG .EQ. 1 ) GO TO 6525
C
C ENTER VALUES FOR COST INDEXES
C
0171  6195 IF (UPPDWN .EQ. 2 ) GO TO 6205
0172  IF(NUINDX .EQ. 1 ) GO TO 6213
0173  DO 6200 I=2,NUINDX
CITY.FTN

0174  6196  WRITE (1*) 'ENTER THE VALUE FOR NUMBER OF...
0175       ASSIGN 6196 TO BADD
0176       WRITE (1*6197) (UCINDX(IvJ)rJwl
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(IPJ)vJmlpS)
0186       READ (1*,ERR=7000) DCTXVL(CURENT;I-1)
0187  6212  CONTINUE

0188  6213  IF ( MODFLG .EQ. 1 ) 00 TO 6523

C ENTER LIST OF PATHS FEASIBLE FOR THIS CITY
C

0189  6215  WRITE ( 1*) 'ENTER LIST OF PATH NAMES FEASIBLE FOR THIS CITY'
0190       J = UPPDOWN +4
0191  CALL MATMOD ( J,CURREN)
0192  IF ( MODFLG .EQ. 1 ) GO TO 6525
0193  6235  IF(UPPDWN .EQ. 1) 00 TO 6015

C ENTER TALKBACK HOURS
C

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,'/',11>
0197       ASSIGN 6235 TO BADD
0198  READ(1*,ERR=7000) TALKBK(CURREN;I)
0199  6240  CONTINUE
0200       GO TO 6015

C MODIFY PARAMETERS FOR CITY
C

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)
CALL GETTER
0205 IF ( ARG(1) .EQ. 'I' ) GO TO 6015
0206 CALL CTYCHK ( POSITN, ORGNUM )
0207 IF ( POSITN .LT. 0 ) AND ORGNUM .EQ. 0 ) GO TO 6325
0208 IF ( POSITN .LT. 0 ) GO TO 6320
0209 IF ( POSITN .LT. 0 ) GO TO 6300
0210 6305 IF ( ORGNUM .GT. 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
0215 6322 WRITE (1,*) 'CITY AND ORG COMBINATION ALREADY EXIST'
0216 GO TO 6015
C
C ENTER MODIFY SUBCOMMAND
C
C
0217 6325 CURRENT = POSITN
0218 6327 WRITE (1,*) 'ENTER CITY MODIFY SUBCOMMAND'
0219 MODFLG • 0
0220 READ (1,7990) (INDATA(I),I=1,80)
0221 CALL GETTER
0222 CALL CODCHK (4, ARG(10), MODSUB, POSITN)
0223 IF ( POSITN .EQ. 0 ) GO TO 6330
C
C BRANCH ON MODIFY SUBCOMMAND
C
0224 MODFLG • 1
C VAND CHAN CHL U INDE ADDP DELP CHGP CHGN TALK EXIT
0225 GO TO ( 6130, 6390, 6195, 6215, 6350, 6600, 6025, 6620, 6015) POSITN
C
C NO SUCH MODIFY COMMAND
C
0226 6330 WRITE (1,*) 'INVALID SUBCOMMAND'
0227 WRITE(1,*) 'COMMANDS ARE: VAND, CHAN, CHLU, INDE, ADDP, DELP, CHGP, CHGN, TALK, EXIT'
0228 GO TO 6327
C
C CHANGE CHANNEL ASSIGNMENT
C

D-33
C
0229 6380 IF ( UPPDWN .NE. 2 ) GO TO 6180
0230 WRITE (1,*)'THIS COMMAND VALID ONLY FOR UPLINK CITIES'
0231 GO TO 6327
C
0232 6390 IF ( UPPDWN .NE. 1 ) GO TO 6185
0233 WRITE (1,*)'THIS COMMAND VALID ONLY FOR DOWNLINK CITIES'
0234 GO TO 6327
C
0235 6525 MODFLG=0
0236 GO TO 6327
C
0237 6550 WRITE (1,*)'ENTER LIST OF PATH NAMES TO DELETE FROM THIS CITY'
0238 J=UPPDWN + 4
0239 CALL MATMOD ( J,CURRENT )
0240 GO TO 6327
C
0241 6600 DO 6610 I = 1, NUPATH
0242 6610 UPTHCY ( I,CURRENT ) = 0
0243 WRITE (1,*)'ENTER A NEW LIST OF PATH NAMES FOR THIS CITY'
0244 J=UPPDWN + 4
0245 CALL MATMOD ( J,CURRENT)
0246 MODFLG = 1
0247 GO TO 6327
C
D-34
WRITE (1,*) 'ENTER NEW NAME FOR THIS CITY'

ASSIGN 6625 TO BADD
READ (1,7990) (INDATA(I),I=1,80)

CALL GETTER

IF (UPPDWN .EQ. 1) CALL LOCCHK(NCHAR,ARG,MAXUCT,UCTNAM,POSITN)

IF (UPPDWN .EQ. 2) CALL CDCHK(NCHAR,ARG,MAXDCT,DCTNAM,POSITN)

IF (POSITN .EQ. 0) GO TO 6322

IF (UPPDWN .EQ. 2) GO TO 6628

DO 6627 I=1,NCHAR

6627 UCTNAM(CURRENT(I)) = ARG(I)

GO TO 6630

DO 6628 I=1,NCHAR

6628 DCTNAM(CURRENT(I)) = ARG(I)

IF (NCHAR .GE. 16) GO TO 6640

NCHAR=NCHAR+1

DO 6640 I=1,NCHAR-16

IF (UPPDWN.EQ.1) UCTNAM(CURRENT(I))=BLANK

IF (UPPDWN.EQ.2) DCTNAM(CURRENT(I))=BLANK

CONTINUE

GO TO 6327

C

CHANGE TALKBACK PARAMETERS

C

IF (UPPDWN .EQ. 1) GO TO 6390

WRITE (1,*) 'ENTER UPLINK CITY NAME (/ORO)'

ASSIGN 6651 TO BADD

READ (1,7990) (INDATA(I),I=1,80)

CALL GETTER

IF (ARG(1) .EQ. '1') GO TO 6327

UPPDWN = 1

CALL CTYCHK(POSITN,ORGNUM)

UPPDWN=2

IF (POSITN .LT. 0 ) GO TO 6651

IF (POSITN .EQ. 0 ) GO TO 6315

IF (POSITN .GT. 0 .AND. ORGNUM .EQ. 0 ) GO TO 6652

GO TO 6320

TALKBK(POSITN,CURRENT) = 0

WRITE (1,*) 'ENTER TALKBACK HOURS'

ASSIGN 6653 TO BADD

READ (1,*,ERR=7000) XLON

IF (XLON .LT. 0 .OR. XLON .GT. 9999.9) GO TO 7100

TALKBK(CURRENT,POSITN) = XLON

GO TO 6327

C

NO SUCH CITY

C

1
DELETE A CITY FROM THE SCENARIO

0288 WRITE (1,8) 'ENTER CITY (/ORJ) TO BE DELETED'
0289 ASSIGN 6700 TO BADD
0290 READ (1,7990) (INDATA(I),I=1,80)
0291 CALL GETTER
0292 IF(ARO(1).EQ. 'I') 00 TO 6015
0293 CALL CTYCMK (POSITN,ORGNUM)
0294 IF (POSITN.LT. 0) GO TO 4700
0295 IF (POSITN. EQ. 0 .OR. ORGNUM .NE. 0 ) GO TO 6320
0296 IF (POSITN .GT. 0 .AND. ORGNUM .EQ. 0 ) GO TO 4710
0297 IF(POSITN .GT. 0 ) GO TO 4700
0298 GO TO 6305
0299 6710 JUMPDOWN +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 (1,1) 'ENTER CITY LIST SPECIFICATION'  
0305 READ (1,7990) (INDATA(I),I=1,80)
0306 CALL GETTER
0307 CALL CODCHK(4,ARO,CTLSTS,POSITN)
0308 IF (POSITN .EQ. 0 ) GO TO 6805

INDICE PATH FNAM TALK ORGS ALL CITIES 

0309 GO TO (6810, 6830, 6840, 6850, 6860, 6870, 6880, 6015) POSITN

NO SUCH COMMAND

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

ALL CITIES HAVE BEEN DELETED

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

INDEXES
CITY.FTN /TR:BLOCKS/WR

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

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

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

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

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

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

0327  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
C EXIT FROM CITY
C
0333  6900  IF(UPPDWN .EQ. 2 ) GO TO 6980
0334  6900  WRITE (1,*)'DO YOU WANT TO MODIFY DOWNLINK CITY DATA?'
0335  CALL YESNO

0336  6910  GO TO ( 6910, 6980, 6900) YESNO
0337  6910  UPPDWN = 2
0338  6980  RETURN
0340  7000  WRITE (1,*)'ERROR IN NUMERICAL READ -- PLEASE RETYPE'
0341  7100  GO TO BADD
0342  7100  WRITE (1,*)'SPECIFIED VALUE IS OUT OF RANGE:'+LONG
0343  7100  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 (AND A RATES PERTAIN TO THE NETWORK(S) AS A WHOLE AND THUS ARE NOT DIVIDED BETWEEN UPLINK AND DOWNLINK.

VARIABLES

DDDCHP - DIRECT DIAL COST PER HOUR

DDDINS - DIRECT DIAL INSTALLATION COST

DDDLES - DIRECT DIAL LEASE COST PER MONTH

DISCMT - DISCOUNT RATE FOR AMORTIZATION

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

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

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

PVTFIX - PRIVATE LINE ZERO MILEAGE MONTHLY CHARGE

PVTINS - PRIVATE LINE INSTALLATION CHARGE

PVTMIL - 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 'SYO:COMBLK.FTN/NOLIST'

LOCAL VARIABLES

LOGICAL*1 RATECD(8+4)

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

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

C YES	 NO	 ERR
0045 GO TO (8010, 8015, 8010) YESNO
0046 8010 WRITE (1,*),'ENTER RATE COMMAND'
0047 CALL GETTER
0048 READ (1,8990) (INDATA(I),I=1,89)
0049 CALL CODCHK (4,ARG,B,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, 8105, 8100, 8105, 8100, 8105)

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 MODIFY 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 ENTER CHANGE : N,VALUE OR 0,0 TO END
0059 8105 WRITE (1,*),'ENTER CHANGE : N,VALUE OR 0,0 TO END'
0060 ASSIGN 8105 TO BADD
0061 READ (1,8115) XDAT, XDATA(2)
0062 IF (XDAT .EQ. 0 .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=XDATA(2)
0069 GO TO 8105
0070 8140 PUTFIX=XDATA(2)
0071 GO TO 8105
0072 8160 PUTMIL=XDATA(2)
C MODIFY WATS CHARGES

C

8200 WRITE (1,*),'WATS CHARGES'
8201 WRITE (1,*),'INSTALLATION ZERO CHG/MO CHG/HR MAX CHG'
8202 WRITE (1,*),8992 WATINS, WATLES, WATCPH, WATMAX
8203 WRITE (1,*),N= 1, 2
8204 WRITE (1,*),'ENTER CHANGE: N+VALUE OR 0+0 TO END'
8205 ASSIGN 8205 TO BADD
8206 READ (1,*),ERR=8115 XDAT, XDATA(2)
8207 IF (XDAT.EQ.0.AND. XDATA(2).EQ.0) GO TO 8010
8208 CALL RATECK (14, XDAT)
8209 IF (POSITN.EQ.0) GO TO 8205

C MODIFY DIRECT DIAL CHARGES

C

8300 WRITE (1,*),'DIRECT DIAL CHARGES'
8301 WRITE (1,*),'INSTALLATION PER MINUTE ZERO CHG/MO'
8302 WRITE (1,*),8991 DDDINS, DDDCPM, DDDLES
8303 WRITE (1,*),N= 1, 2
8304 WRITE (1,*),'ENTER CHANGE: N+VALUE OR 0+0 TO END'
8305 ASSIGN 8305 TO BADD
8306 READ (1,*),ERR=8115 XDAT, XDATA(2)
8307 IF (XDAT.EQ.0.AND. XDATA(2).EQ.0) GO TO 8010
8308 CALL RATECK (1+3, XDAT)
8309 IF (POSITN.EQ.0) GO TO 8305

C DDDS DDDCPM DDDLES
8310 GO TO (8320, 8340, 8360) XDAT

C

8320 DDDINS=XDATA(2)
8321 GO TO 8305
8340 DDDCPM=XDATA(2)
8341 GO TO 8305
8360 DDDLES=XDATA(2)
C MODIFY INTEREST INFORMATION
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0110 8400 WRITE (1,*)'INTEREST RATES'
0111 WRITE (1,*),'EQUIPMENT LIFE (YEARS) DISCOUNT (%)'
0112 WRITE (1,8993) EQPLIF,DISCNT
0113 WRITE (1,*),'N= 1 2'
0114 8405 WRITE (1,*),'ENTER CHANGE: N.VALUE OR 0 TO END'
0115 ASSIGN 8405 TO BADD
0116 READ (1,*,ERR=8115) 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 8405
C
C MODIFY GENERAL AND ADMINISTRATIVE EXPENSES
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0120 8500 WRITE (1,*),'GENERAL AND ADMINISTRATIVE EXPENSES'
0121 WRITE (1,*),'CAPITAL INSTALLATION LEASE OP AND MAIN
2'
0122 WRITE (1,8992) (GANDAD(I),I=1,4)
0123 WRITE (1,*),'N= 1 2 3 4'
0124 8505 WRITE (1,*),'ENTER CHANGE: N.VALUE OR 0 TO END'
0125 ASSIGN 8505 TO BADD
0126 READ (1,*,ERR=8115) XDAT, XDATA(2)
0127 IF (XDAT .EQ. 0 .AND. XDATA(2) .EQ. 0 ) GO TO 8010
0128 CALL RATECK (1,4,XDAT)
0129 IF (POSITN .EQ. 0 ) GO TO 8505
C
C MODIFY TALKBACK CAPITAL EXPENDITURES
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0130 8600 WRITE (1,*),'TALKBACK CAPITAL COSTS'
0131 WRITE (1,8994) TLKCAP
RATE.FTN

0139  8605  WRITE (1, *) 'ENTER NEW VALUE'
0140   ASSIGN 8605 TO BADD
0141   READ (1, *, ERR=8115)TLKCAP
0142   GO TO 8010

C
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C LIST RATE INFORMATION
C
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0143  8700  CALL REPRTR (8)
0144   GO TO 8010

C
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C EXIT FROM RATE
C
C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0145  8800  RETURN
0146  8990  FORMAT (80A1)
0147  8991  FORMAT (2X,3(2X, F9.2, 3X))
0148  8992  FORMAT (2X,4(2X, F9.2, 3X))
0149  8993  FORMAT (2X,2(6X, F9.2, 5X))
0150  8994  FORMAT (F9.2)
0151   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), XORGCS(9,5)
COMMON UORGCS, DORGCS, TORGCS, AORGCS, XORGCS
REAL*4 UGTARR(80)
COMMON UGTARR
REAL*4 UFTIDX(10,6,5), DFTIDX(20,6,5), UCOSTX(10,4), DCOSTX(80,4)
COMMON UFTIDX, DFTIDX, UCOSTX, DCOSTX
REAL*4 CAFCST, INSCST, LESCST, OMACST, AMORT
COMMON CAFCST, INSCST, LESCST, OMACST, AMORT
REAL*4 ANNL(80), TCOST(6,5)
COMMON ANNL, TCOST
REAL*4 CILO(5,2), PER, BLANK, UPORDN(2,2)
COMMON CILO, PER, BLANK, UPORDN
LOGICAL*1 RUNSEC(4), REPNUM(20), REPLST(20,2)
COMMON RUNSEC, REPNUM, REPLST
THIS IS THE MAIN PROGRAM FOR THE COST SECTION OF THE MODEL

SUBROUTINE CALLS: READIN, GETTER, REPTR, CODCHK,
MODUP, MODDN, MOTK

INCLUDE 'DK2:COMBLK.FTN/NOLIST'
INCLUDE 'DK2:MODBLK.FTN/NOLIST'
LOGICAL*1 LBLANK

DATA INITIALIZATIONS

DATA LBLANK /'/'
DATA BPVT /'PVT '/ SWATS /'WATS'/, BDDD /'DDD'/
DATA CILO /'CAP/ INST', LEAS', O1M%', 'ANNU',
2 /'TAL', 'ALL', 'E', 'A', 'ALZD'/
DATA PER /'PER', 'BLANK'/
DATA UPORDN /'UP', 'DOWN', 'LINK', 'LINK'/
DATA UCINDX /'F', 'I', 'X', '5', 'E', '23'/
DATA DCINDX /'F', 'I', 'X', '5', 'E', '23'/
DATA REFLST /'1', '2', '3', '4', '5', '6', '7', '8', '9', '0', '1', 'A'/
2 /'9', '0', '1', '2', '3', '4', '5', '6', '7', '8', '9', 'L'/
DATA REPNUM /20*/
DATA MAXUCs, MAXDCs, MAXUPA, MAXDPA, MAXUCT, MAXDCT /15, 30, 10, 20, 10, 80/
DATA UOUGC5, DORGS /45*, TORCS /45*, XORGS /45* /
DATA WGTARR /80*/
DATA UPTIDX /300*, DPTIDX /600*/
DATA UCOSTX /40*, DCOSTX /320*, TCOST /30*/

READ IN SCENARIO

CALL READIN

NOW DETERMINE WHICH REPORTS ARE REQUESTED

WRITE (1*) 'INDICATE THE REPORT NUMBERS YOU WISH TO SEE'
WRITE (1*) 'ENTER THE NUMBERS (1-19) SEPARATED BY COMMAS AND'
WRITE (1*) 'TERMINATE WITH 'i' OR SIMPLY ENTER 'ALL' FOR ALL RE-
PORTS'
READ (1) (INDATA(I), I=1,80)
CALL GETTER
IF (ARG(1).EQ. 'I') GO TO 220
IF (NCHAR.EQ.1) ARG(2) = LBLANK
CALL CODCHK (2, ARG(2), REFLST, POSITN)
IF (POSITN.LE.0) GO TO 190
IF (POSITN.EQ.20) GO TO 200
REPNUM(POSITN) = 1
IF (CONTCD.EQ.0) GO TO 160
IF (CONTCD.EQ.1) GO TO 170

ERROR--INVALID REPORT SPECIFIED

WRITE (1*,1001) ARG(1), ARG(2)
GO TO 180

ALL REPORTS DESIRED
C 0087   200     DO 210 I=1,19
C 0088   210     REPNUM(I) = 1
C
C 0089   220     NYEARS = IFIX(EQPLIF)
C 0090   230     AMORT = 0.
C 0091     DO 230 I=1,NYEARS
C 0092   230     AMORT = (AMORT + 1.)/(1. + DISCNT/100.)
C
C 0093     IF (REPNUM(1).EQ.0) GO TO 240
C 0094  240     WRITE (3,1002) (TITLE(I),I=1,72)
C 0095     CALL REPRTR (8,1)
C
C 0096   240     UPPDWN = 1
C 0097     CALL MODUP
C
C 0098   240     UPPDWN = 2
C 0099     CALL MODDN
C
C 0100     CALL MODTK
C 0101     STOP
C
C 0102   1000     FORMAT (80A1)
C 0103   1001     FORMAT (1H1,'INVALID REPORT NUMBER: ',2A1,/) 
C 0104   1002     FORMAT (1H1,72A1)
C 0105   1003     END
SUBROUTINE MODUP

THIS SUBROUTINE DOES THE CALCULATIONS FOR THE UPLINK SEGMENT
OF THE MODEL.

SUBROUTINE CALLS: REPRTR, VANDH

INCLUDE 'DK2:COMBLK.FTN/NOLIST'
INCLUDE 'DK2:MODBLK.FTN/NOLIST'

C

C COST ELEMENT DATA

IF (REPNUM(2).NE.1) GO TO 110
WRITE (3,1001) (TITLE(I),I=1,72)
WRITE(3,1002) UPORDN(1,1),UPORDN(1,2)
DO 100 I=1,NUELEM
CALL REPRTR (1,I)
CONTINUE

PRINT COST/PATH MATRIX

IF (REPNUM(3).EQ.0) GO TO 112
WRITE (3,1001) (TITLE(I),I=1,72)
CALL REPRTR (2,1)

PATH/CITY MATRIX

IF (REPNUM(4).EQ.0) GO TO 114
WRITE (3,1001) (TITLE(I),I=1,72)
CALL REPRTR (4,1)

CITY COST INDEXES

IF (REPNUM(5).EQ.0) GO TO 116
WRITE (3,1001) (TITLE(I),I=1,72)
CALL REPRTR (5,1)

MATRIX OF TALKBACK REQUIREMENTS

IF (REPNUM(6).EQ.0) GO TO 118
WRITE (3,1001) (TITLE(I),I=1,72)
CALL REPRTR (6,1)

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)*UCSDAT(I,M,L)
UPTIDX(J,M,5) = UPTIDX(J,M,5) + FLOAT(N)*
2 *((UCSDAT(I,M+1)+UCSDAT(I,M+2))/AMORT+UCSDAT(I,M,3)+UCSDAT(I,M,4))

C

C COST SENSITIVITY REPORT
IF (REPNUM(7).NE.1) GO TO 160
WRITE (3,1001) TITL(I),I=1,72
WRITE (3,1020) UPORDN(I,1),UPORDN(I,2)
DO 150 I=1,NPATH
WRITE (3,1021) I, (UPTNAM(I,J),J=1,20)
IF (NUINDEX.GT.1) WRITE (3,1022) (PER,J=2,NUINDEX)
WRITE (3,1023) (UCINDEX(J,K),K=1,8),J=1,NUINDEX)
DO 140 J=1,5
WRITE (3,1024) CILO(J),CILO(J),UPTIDX(I,K),K=1,NUINDEX)
CONTINUE
C IF COST ALLOCATION SPECIFIED; REMOVE MULTIPLE CITY LISTINGS
C
160 IF (NUMORG.EQ.0) GO TO 250
DO 240 K=1,NUCITY
WGTARR(K) = UDXWHT(1)
IF (NUINDEX.EQ.1) GO TO 180
DO 170 L=2,NUINDEX
WGTARR(K) = WGTARR(K) + UCTXVL(K,L-1)*UDXWHT(L)
IF (WGTARR(K).LE.0.0) WGTARR(K) = 1.0
IF (K.EQ.I) GO TO 240
DO 230 J=2,K-1
DO 190 I=1,K-1
IF (UCTNAM(K,I).NE.UCTNAM(I,J)) GO TO 230
DO 200 J=1,NUINDEX-1
DO 310 J=1,NPATH
IF (UPTHCY(J,K).EQ.0) 00 TO 310
C OMIT LEASE CALCULATIONS. BECAUSE OF THE MINIMUM VARIABLE
CAPCST = UPTIDX(J,1)
INSCST = UPTIDX(J,2)
OMACST = UPTIDX(J,4)
IF (UCITYV(K).EQ.-1) GO TO 270
IF (UCITYV(K).LT.0) CALL VANDH(UCITYV(K),UCITYH(K))
BOTTOM=1.0E38
DO 310 J=1,K-1
IF (UPTHCY(I,J).EQ.0) GO TO 240
DO 300 J=1,NDCITY
TALKBK(J,K) = TALKBK(J,I) + TALKBK(J,K)
DO 220 J=1,NPATH
UPTHCY(I,J) = UPTHCY(I,J) .OR. UPTHCY(K,J)
UCITYV(K) = -1
GO TO 240
CONTINUE
DO 250 K=1,NUCITY
IF (UCITYV(K).EQ.-1) GO TO 250
IF (UCITYV(K).LT.0) CALL VANDH(UCITYV(K),UCITYH(K))
IF (UCITYV(K).EQ.0) GO TO 270
IF (UCITYV(K).LT.0) CALL VANDH(UCITYV(K),UCITYH(K))
BOTTOM=1.0E38
DO 310 J=1,K-1
IF (UPTHCY(I,K).EQ.0) GO TO 240
DO 300 J=1,NDCITY
TALKBK(J,K) = TALKBK(J,I) + TALKBK(J,K)
DO 220 J=1,NPATH
UPTHCY(I,J) = UPTHCY(I,J) .OR. UPTHCY(K,J)
UCITYV(K) = -1
GO TO 240
CONTINUE
C CALCULATE COSTS FOR UPLINK PATHS BY CITY, AND CHOOSE THE BEST
C ONE. THEN ADD ‘CHOSEN’ PATH COSTS TO TOTALS FOR SUMMARY TABLE
C
250 IF (REPNUM(8).EQ.0) GO TO 255
WRITE (3,1001) TITL(I),I=1,72
WRITE (3,1034) UPORDN(I,1),UPORDN(I,2)
DO 350 K=1,NUCITY
INDIC = 0
IF (UCITYV(K).EQ.0) GO TO 350
IF (UCITYV(K).LT.0) CALL VANDH(UCITYV(K),UCITYH(K))
BOTTOM=1.0E38
DO 310 J=1,K-1
IF (UPTHCY(I,J).EQ.0) GO TO 310
C OMIT LEASE CALCULATIONS; BECAUSE OF THE MINIMUM VARIABLE
CAPCST = UPTIDX(J,1)
INSCST = UPTIDX(J,2)
OMACST = UPTIDX(J,4)
DO 270 M=2,NUINDEX
CAPCST = CAPCST + UPTIDX(J,M+1) - 1.0E38
CONTINUE
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MODUP.FTN /TR:BLOCKS/WR

! C CALCULATE LEASE COSTS
! C

0130  INSCST = INSCST + UPTIDX(J,M+2)*UCTXL(K,M-1)
0131  OMACST = OMACST + UPTIDX(J,M+4)*UCTXL(K,M-1)
0132  LESCST = 0.
0133  DO 290 I=1,HUELEM
0134      TEMP=0.
0135  IF (UCSPTH(I,J).EQ.0) GO TO 290
0136      TEMP = TEMP + UCDAT(I,J)*3)
0137  IF (NUINDEX.EQ.1) GO TO 290
0138  DO 280 M=2,NUINDEX
0139      TEMP = TEMP + UCDAT(I,M)*UCTXL(K,M-1)
0140      IF (TEMP.LT.UCSMIN(J)) TEMP=UCSMIN(J)
0141  LESCST = LESCST +TEMP
0142  290 CONTINUE
0143  ANNL(J) = (CAPCST+INSCST)/AMORT + LESCST + OMACST
0144  COMPARE ANNUALIZED COST WITH BEST PREVIOUS PATH
0145  IF (REPNUM(8).NE.1) GO TO 300
0146  IF (INDIC.EQ.0) WRITE (3.1035) (UCTNAM(K),K=1,16),J,
0147    CAPCST,INSCST,LESCST,OMACST,ANNL(J)
0148  IF (INDIC.EQ.1) WRITE (3.1036) J,
0149    CAPCST,INSCST,LESCST,OMACST,ANNL(J)
0150  300 CONTINUE
0151  N=NUPREF(K)
0152  DO 340 L=1,N
0153      UCOSTX(K,L) = UPTIDX(N+1,L)
0154  IF (NUINDEX.EQ.1) GO TO 330
0155  DO 320 M=2,NUINDEX
0156      UCOSTX(K,L) = UCOSTX(K,L) + UPTIDX(K,M)*UCTXL(K,M-1)
0157  CONTINUE
0158  UCOSTX(K,L) = UCOSTX(K,L) + UCOSTX(K,L)
0159  330 CONTINUE
0160  CONTINUE
0161  UCOSTX(K,3) = Bottom-UCOSTX(K,4)-UCOSTX(K,1)+UCOSTX(K,3))/AMORT
0162  TCOST(1,3) = TCOST(1,3) + UCOSTX(K,3)
0163  TCOST(1,5) = TCOST(1,5) + Bottom
0164  350 CONTINUE
0165  NO COST ALLOCATION CALCULATIONS
0166  IF (NUMORG.EQ.0) GO TO 410
0167  DO 400 I=1,NUCITY
0168      TOTWGT=0.
0169  DO 380 J=1,NUCITY
0170  IF (UCTNAM(I,J).NE.UCTNAM(J,K)) GO TO 380
0171  CONTINUE
0172  IF (USTCOD(I,1).NE.USTCOD(J,1)) OR.
0173      TOTWGT = TOTWGT + WSTAAR(J)
0174  IF (I.EQ.J) GO TO 380
0175  DO 370 L=1,4

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MODUP.FTN  /TRIBLOCKS/WR

0176  370  UCOSTX(JrL) = UCOSTX(IrL)
0177  380  CONTINUE
0178  390  N = UCTORG(I);
0179  DO 390 L=1,N
0180  390  UORGCS(N+L) = UORGCS(N)+UCOSTX(I)+WGTARR(I)/TOTWGT
0181  400  CONTINUE

C UTFLX SUMMARY REPORT
C
0182  410  IF (REPNUM(9).NE.1) RETURN
0183  WRITE (3+1001) (TITLE(I),I=1,72)
0184  WRITE(3+1010) UPORDN(1,1), UPORDN(1,2)
0185  DO 420 I=1,NUCITY
0186  IF (UCITYV(I).LT.0) 00 TO 420
0187  WRITE (3+1011)
0188  YEARLY = (UCOSTX(I,1)+UCOSTX(I,2))/AMORT+UCOSTX(I,3)+UCOSTX(I,4)
0189  WRITE(3+1012) (UCTNM(I,J),J=1,16), YEARLY
0190  IF (NUINDEX.GT.1) WRITE (3+1013) ((UCINDEX(K,Q),Q=1,8),K=1,NUINDEX)
0191  IF (NUINDEX.GT.1) WRITE (3+1014) (UCTXVL(I,J),J=1,NUINDEX-1)
0192  420  CONTINUE
0193  WRITE(3+1015) (UPORDN(1,K),K=1,2), (TCOST(I,K),K=1,5)
0194  RETURN

C FORMAT STATEMENTS
C
0195  1001  FORMAT (1H1,72A1)
0196  1002  FORMAT (1H0,17X,2A4,' COST ELEMENT DATA'//)
0197  1010  FORMAT(1H0,26X,' COSTS BY CITY')
0198  1011  FORMAT(1H0,3X,'CITY',15X,'CAPITAL',4X,'INSTALL',6X,'LEASE',6X,'0&M',2X,'ANNUALIZED')
0199  1012  FORMAT(1H0,16A1,2X,5F11.0)
0200  1013  FORMAT(1H0,18X,5(3X,8A1))
0201  1014  FORMAT(1H0,18X,5F11.0)
0202  1015  FORMAT(1H0,'/3X,2A4,7X,TOTAL',2X,5F11.0)
0203  1020  FORMAT(1H0,11X,'SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS--',
2  2A4,//)
0204  1021  FORMAT(1H0,'PATH ',2A4,' TOTAL',20A1)
0205  1022  FORMAT(1H0,20X,5(7X,4A4))
0206  1023  FORMAT(1H0,20X,5(7X,4A4))
0207  1024  FORMAT(1H0,20X,5(7X,4A4))
0208  1034  FORMAT(1H0,20X,'COST OF EACH PATH--',2A4,7X,'CITY',
2  10X,'PATH',5X,'CAPITAL',4X,'INSTALL',6X,'LEASE',6X,'0&M',2X,'ANNUALIZED'//)
0209  1035  FORMAT(1H0,16A1,14,F13.0,3F11.0,F12.0)
0210  1036  FORMAT(1H0,16A1,14,F13.0,3F11.0,F12.0)
0211  END

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SUBROUTINE MODDN
  THIS SUBROUTINE PERFORMS THE CALCULATIONS FOR THE DOWNLINK
  SEGMENT OF THE MODEL

  SUBROUTINE CALLS: REPRTR, VANDH

INCLUDE 'DK2:CCMBLK.FTN/NOLIST'
INCLUDE 'DK2:MODBLK.FTN/NOLIST'

C COST ELEMENT DATA
  IF (REPNUM(10).NE.1) GO TO 200
  WRITE (3,1001) (TITLE(I),I=1,72)
  WRITE (3,100) UPORDN(21),UPORDN(22)
  DO 100 I=1,NDELEM
       CALL REPRTR (I)
  100 CONTINUE

C PRINT COST/FATH MATRIX
  IF (REPNUM(11) .EQ. 0) GO TO 225
  WRITE (3,1001) (TITLE(I),I=1,72)
  CALL REPRTR(21)

C PATH/CITY MATRIX
  IF (REPNUM(12) .EQ. 0) GO TO 250
  WRITE (3,1001) (TITLE(I),I=1,72)
  CALL REPRTR(41)

C CITY COST INDEXES
  IF (REPNUM(13) .EQ. 0) GO TO 275
  WRITE (3,1001) (TITLE(I),I=1,72)
  CALL REPRTR(51)

C CALCULATE COSTS OF DOWNLINK FATHS, BY COST INDEX
  DO 400 J=1,NDPATH
       DO 400 I=1,NDELEM
            DO 300 L=1,4
                N = DCSPTH(I,J)
                DPTIDX(J,M,L) = DPTIDX(J,M,L) + FLOAT(N)*DCSDAT(I,M,L)
            300 CONTINUE
            DPTIDX(J,M,5) = DPTIDX(J,M,5) + FLOAT(N)*
                              2 *(DCSDAT(I,M,1)+DCSDAT(I,M,2))/AMORT+DCSDAT(I,M,3)+DCSDAT(I,M,4)
  400 CONTINUE

C COST SENSITIVITY REPORT
  IF (REPNUM(14).NE.1) GO TO 700
  WRITE (3,1001) (TITLE(I),I=1,72)
  WRITE (3,1020) UPORDN(21),UPORDN(22)
  DO 600 I=1,NDPATH
       WRITE (3,1021) J,(DPTHNM(I,J)*J=1,20)
  600 CONTINUE
  IF (NDINDX.GT.1) WRITE (3,1022) (PER,J=2,NDINDX)
0085 WRITE (3,1023) ((DCINDEX(J,K),K=1,NDINDX),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 C IF COST ALLOCATION SPECIFIED, REMOVE MULTIPLE CITY LISTINGS
0090 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)
0096 900 IF (K.EQ.1) GO TO 1500
0097 DO 1400 J=1,K-1
0098 C OMIT LEASE CALCULATIONS, BECAUSE OF THE MINIMUM VARIABLE
0099 IF (DCTNAM(K,J).NE.DCTNAM(I,J)) GO TO 1400
0100 1000 CONTINUE
0101 DO 1100 J=1,K-1
0102 1100 DCTXVL(I,J) = DCTXVL(I,J) + DCTXVL(K,J)
0103 DO 1200 J=NDCITY
0104 TALKBK(I,J) = TALKBK(I,J) + TALKBK(K,J)
0105 DO 1300 J=NDPATH
0106 DPTHCY(I,J) = DPTHCY(I,J) + DPTHCY(K,J)
0107 DCITYV(K) = -1
0108 GO TO 1500
0109 1400 CONTINUE
0110 1500 CONTINUE
0111 C CALCULATE COSTS FOR DOWNLINK PATHS BY CITY, AND CHOOSE THE BEST
0112 IF (REPNUM(15).LE.0) GO TO 1650
0113 WRITE (3,1001) (TITLE(I),I=1,72)
0114 WRITE (3,1034)UPORDN(2,1),UPORDN(2,2)
0115 DO 1650 K=1,NDCITY
0116 INDIC = 0
0117 IF (DCITYV(K).LT.0) CALL VANDH (DCITYV(K),DCITYH(K))
0118 BOTTOM = 1,E38
0119 DO 2100 J=1,NDPATH
0120 IF (DPTHCY(J,K).EQ.0) GO TO 2100
0121 CAPCST = DPTIDX(J,1,1)
0122 INSCST = DPTIDX(J,1,2)
0123 OMACST = DPTIDX(J,1,4)
0124 DO 1800 K=1,NDINDX
0125 1800 LESCST = 0.
0126 C CALCULATE LEASE COSTS
MODDN.FTN /TR:BLOCKS/WR

0130 DO 1900 I=1,NDELEM
0131 TEMP=0.
0132 IF (DCSPTH(I,J).EQ.0) GO TO 1500
0133 TEMP = TEMP + DCSDAT(I,1,3)
0134 IF (NDINDX.EQ.1) GO TO 1900
0135 DO 1850 M=2,NDINDX
0136 TEMP = TEMP + DCSDAT(I,M,3)*DCTXVL(K,M-1)
0137 IF (TEMP.LT.DCSMIN(I)) TEMP=DCSMIN(I)
0138 LESCST = LESCST + TEMP
0139 CONTINUE
0140 ANNL(J) = (CAPCST+INSCST)/AMORT + LESCST + OMACST
0141 IF (REPNUM(15).NE.1) GO TO 2000
0142 IF (INDIC.EQ.0) WRITE (3,1035) (DCTNAM(K,M),M=1,16),J+CAPCST,INSCST,LESCST,OMACST,ANNL(J)
0143 IF (INDIC.EQ.1) WRITE (3,1036) J+CAPCST,INSCST,LESCST,OMACST,ANNL(J)
0144 CONTINUE
0145 IF (ANNL(J).GE.BOTTOM) GO TO 2100
0146 NUPREF(K) = J
0147 BOTTOM = ANNL(J)
0148 CONTINUE
0149 N=NUPREF(K)
0150 DO 2400 L=1,4
0151 DCOSTX(K,L) = DPTIDX(N,L)
0152 IF (NDINDX.EQ.1) GO TO 2300
0153 DO 2200 M=2,NDINDX
0154 DCOSTX(K,M) = DCOSTX(K,M-1) + DPTIDX(N,M,L)*DCTXVL(K,M-1)
0155 CONTINUE
0156 DO 2300 IF (L.EQ.3) TCOST(2,L) = TCOST(2,L) + DCOSTX(K,L)
0157 CONTINUE
0158 DCOSTX(K,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 CONTINUE
C
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 CONTINUE
0169 IF (DSTC(1,J).NE.DSTC(1,I)) GO TO 2900
0170 TOTWGT = TOTWGT + WGTARR(I)
0171 IF (I.EQ.J) GO TO 2900
0172 DO 2700 L=1,4
0173 DO 2700 DCOSTX(J,L) = DCOSTX(I,L)
0174 CONTINUE
0175 N = DCTORG(I)
0176 DO 2900 L=1,4
0177 DO 2900 DORGCS(N,L) = DORGCS(N,L) + DCOSTX(I,L)*WGTARR(I)/TOTWGT
0178 CONTINUE

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DOWNLINK SUMMARY REPORT

0179 IF (REPNUM(16).NE.1) RETURN
0180 WRITE (3,1001) (TITLE(I),I=1,72)
0181 WRITE(3,1010) UPORDN(2,1), UFORDN(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=IYNDINDX-1)
0189 3200 CONTINUE
0190 WRITE(3,1015) (UPORDN(2,K),K=1,2), (TCOST(2,K),K=1,5)
0191 RETURN

FORMAT STATEMENTS

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,B41))
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,B41))
0204 1024 FORMAT (1H0,'3X,2A4,6F11.0')
0205 1034 FORMAT (1H0,'25X,' COST OF EACH PATH--',2A4,//4X,'CITY',
2  10X,'PATH ','5X,'CAPITAL',4X,'INSTALL',6X,'LEASE',6X,'O&M',
3 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.

0002 INCLUDE 'DK2:COMBLK.FTN/NOLIST'
0040 INCLUDE 'DK2:MODBLK.FTN/NOLIST'
0057 REAL*4 BPVTPBWATSFBDDD
0058 DATA BPVTP /'PVT '/, BWATS /'WATS'/, BDDD /'DDD' /

PREPARE AND PRINT TABLE FOR VOICE TALKBACK SYSTEM COSTS

0059 DO 1700 J=1,NUCITY
0060 IF (UCITYV(J).EQ.-1) GO TO 1700
0061 T = 0.
0062 DO 100 I=1,NDCITY
0063 T = T + TALKBK(I,J)
0064 100 CONTINUE
0065 IF (T.EQ.0.0) GO TO 1700
0066 IF (REPNUM(17).EQ.0) GO TO 150
0067 WRITE (3,1015) (UCTNAM(JPN),N=1,16)
0068 WRITE (3,1001) (TITLE(K),K=1,72)
0069 150 DO 1600 I=1,NDCITY
0070 IF (DCITYV(I).EQ.-1) GO TO 1600
0071 TOTWGT = 0.
0072 IF (TALKBK(I+J).GT.0.AND.DCTLVL(I).EQ.3) GO TO 200
0073 200 DIST=1.E38
0074 DO 400 K=1,NDCITY
0075 IF (K.EQ.I) GO TO 400
0076 IF (DCTLVL(K)-2) 400,300,400
0077 300 X = DCITYV(K) - DCITYV(I)
0078 Y = DCITYH(K) - DCITYH(I)
0079 DIST = MIN1((X**2+Y**2)/10.,)
0080 400 CONTINUE
0081 GO TO 600
0082 IF (T.EQ.0.0) GO TO 1700
0083 DO 400 K=1,NDCITY
0084 IF (K.EQ.I) GO TO 400
0085 DIST = SQRT((X**2+Y**2)/10.)
0086 400 HOURS = TALKBK(I,J)
0087 PLEASE = MIN1(WATLES+WATCHAT/HOURS,WATMAX)
0088 500 PLEASE = PVTFIX+DIST*PVTMIL
0089 DDLEAS = DDDCFH*HOURS
0090 TCOST(3,1) = TCOST(3,1) + TALKCAF
0091 IF (PLEASE-PLEASE) 700,800,800
0092 700 IF (PLEASE.GT.DDLEAS) GO TO 900
0093 TALK = BWATS
0094 INSCST = WATINS
0095 LESCST = PLEASE*12.
0096 GOTO 1000

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0097 800 IF(PLEASE.GT.DDLEAS) GO TO 900
0098   TALK=PUT
0099   INSCST = PUTINS
0100   LESCST = PLEASE*12.
0101   GO TO 1000
0102  900 TALK=DDDD
0103   INSCST = DDDINS
0104   LESCST = DDLEAS*12.
0105 1000 TCGST(3,2) = TCGST(3,2) + INSCST
0106   TCGST(3,3) = TCGST(3,3) + LESCST
0107   TCGST(3,5) = TCGST(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.
0114   2 DSTCOD(I+2).NE.DSTCOD(L+2)) GO TO 1200
0115   TOTWGT = TOTWGT + WGTARR(L)
0116   1200 CONTINUE
0117   DO 1400 I=1,NDCITY
0118   N = DCTORG(I)
0119   DO 1600 L=1,4
0120   AORGCS(N+L) = AORGCS(N+L) + R3ANDAD(L)*WGTARR(I)/TOTWGT
0121   1600 CONTINUE
0122   1400 CONTINUE
C TALKBACK REPORT
C
0127 IF (REPNUM(17).EQ.1) WRITE(3,1016)(DCTNAM(I),I=1,16),DCTLVL(I),2 HOURS,DST,WAYINS,WLEAS,PUTINS,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   AORGCS(N,L) = AORGCS(N,L) + BANDAD(L)*WGTARR(I)/TOTWGT
0139   2000 CONTINUE
C
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MODTK.FTN /TR:BLOCKS/WR

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)
0148 2 + UORGCS(I,4)
0149 2300 ANNL(J) = ANNL(J) + UORGCS(I,J)
0150 ANNL(J) = ANNL(J) + UORGCS(I,J)
0151 WRITE (3+1027) (UORGAM(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)
0157 2 + DORGCS(I,4)
0158 2500 ANNL(J) = ANNL(J) + DORGCS(I,J-5)
0159 ANNL(J) = ANNL(J) + DORGCS(I,J-5)
0160 WRITE (3+1027) (DORGAM(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)
0166 2 + TORGCS(I,4)
0167 2700 ANNL(J) = ANNL(J) + TORGCS(I,J-10)
0168 ANNL(J) = ANNL(J) + TORGCS(I,J-10)
0169 WRITE (3+1027) (TORGAM(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)
0175 2 + AORGCS(I,4)
0176 2900 ANNL(J) = ANNL(J) + AORGCS(I,J-20)
0177 ANNL(J) = ANNL(J) + AORGCS(I,J-20)
0178 WRITE (3+1027) (AORGAM(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)+UORGCS(I,J)+TORGCS(I,J)+AORGCS(I,J)
0185 ANNL(J+15) = ANNL(J+15) + XORGCS(I,J)
0186 3100 CONTINUE
0187 WRITE (3+1027) (XORGAM(I,J),J=1,20), XORGCS(I,J),J=1,5)
0188 3200 CONTINUE
0189 WRITE (3+1028) (ANNL(J),J=16,20)}
C
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,J) = (TCOST(4,1) + TCOST(4,2)) / AMORT + TCOST(4,3) + TCOST(4,4)
0196 TCOST(5,J) = TCOST(5,J) / 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
C FORMAT STATEMENTS
C
0209 1001 FORMAT (1H1+72A1)
0210 1004 FORMAT (1H0+///////30X,'OVERALL COST SUMMARY',///,20X,
2 'CAPITAL' 3X,'PLANNING AND',7X,'ANNUAL',7X,'ANNUAL',
3 3X,'ANNUALIZED',17X,'EXPENDITURES',1X,'INSTALLATION',
4 7X,'LEASE',8X,'01%A',7X,'COST')
0211 1005 FORMAT (1H0+/'UPLINK'9X,5F13.0,/'ODOWNLINK'7X,5F13.0,
2/,'VOICE TALKBACK'9X,5F13.0,,'ADMINISTRATIVE',1X,5F13.0,
3/,' TOTALS',6X,5F13.0,,'ANNUALIZED COST',5F13.0)
0212 1006 FORMAT (///,1X,'EFFECTIVE YEARLY COSTS FOR',12X,'YEAR',',',F5.2,
2 PERCENT AMORTIZATION ---', F9.0)
0213 1015 FORMAT (1H0+27X,' TALKBACK SYSTEM LEASE COSTS',///,35X,'T0',16A1///,
2 21X,'HOURS',8X,'WATS COSTS',4X,'PRIVATE LINE',3X,
3 'DIRECT DIAL',5X,'CITY',6X,'LEVEL',1X,'UTIL',1X,'DIST',1X,
4 'INSTALL LEASE',2X,'INSTALL LEASE',2X,'INSTALL LEASE',2X,
5 'BEST')
0214 1014 FORMAT (1H0+14A1,13F5.0,F6.0,F8.0,F9.0),16A1///,
2 21X,'HOURS',8X,'WATS COSTS',4X,'PRIVATE LINE',3X,
3 'DIRECT DIAL',5X,'CITY',6X,'LEVEL',1X,'UTIL',1X,'DIST',1X,
4 'INSTALL LEASE',2X,'INSTALL LEASE',2X,'INSTALL LEASE',2X,
5 'BEST')
0215 1025 FORMAT (1H0+28X,'NETWORK COST ALLOCATION',///,30X,'CAPITAL',4X,
2 'INSTALL',6X,'LEASE',8X,'01%A',1X,'ANNUALIZED')
0216 1026 FORMAT (1H0+/, 'UPLINK',/)
0217 1027 FORMAT (1H+13,1X,20A1,1X,5F11.0)
0218 1028 FORMAT (1H0+8X,'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

LOCAL VARIABLES

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)

DATA SATCODD

DATA.numSAT

DATA numup

DATA BIGREC

DATA NUELEM

DATA DOWNUP
C CALL READIN
C OPEN (UNIT=2,TYPE='OLD',NAME='SY: EARTH.DAT'
C CARRIAGECONTROL='LIST',ERR=9010)
C
C SINCE THE COMMON AREA WILL BE USED TO STORE THE EARTH TERMINAL
C RECORDS, SOME OF THE COMMON VARIABLES WILL HAVE TO BE SAVED AS
C LOCAL VARIABLES.
C
UCITY=NUCITY
DCITY=NDCITY
ORGNUM=NORGNO
DO 5 I=1,72
HEADER(I)=TITLE(I)
CONTINUE
5
DO 30 I=1,DCITY
VDCITY(I)=DCITYV(I)
MDCITY(I)=DCITYH(I)
DO 10 J=1,16
NAMDC(I,J)=DCTNM(I,J)
10 CONTINUE
20 CONTINUE
30 CONTINUE
DO 60 I=1,UCITY
VUCITY(I)=UCITYV(I)
HUCITY(I)=UCITYH(I)
DO 40 J=1,16
NAMUCT(I,J)=UCTNM(I,J)
40 CONTINUE
30 CONTINUE
60 CONTINUE
DO 130 K=2,UCITY
DO 90 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
90 CONTINUE
GO TO 90
DO 80 I=1,K-1
80 CONTINUE
GO TO 90
DO 130 K=2,DCITY
DO 120 I=1,K-1
DO 110 J=1,16
110 CONTINUE
GO TO 120
130 CONTINUE
EARTH.FTN

/TRIBLOCKS/WR

0098 110 IF (NAMDCT(K,J).NE.NAMDCT(I,J)) GO TO 120
0099 110 CONTINUE
0100 VDCITY(K)=1
0101 GO TO 130
0102 120 CONTINUE
0103 130 CONTINUE

C
C NOW, CLEAR OUT THE COMMON BY FILLING THE SIGREC ARRAY WITH BLANKS
C
0104 140 DO 160 1=1,320
0105 150 DO 150 J=1,82
0106 160 CONTINUE

C
C WRITE (1,6) 'ENTER THE MAXIMUM ACCEPTABLE DISTANCE (IN MILES)'
0110 WRITE (1,6) 'BETWEEN AN EARTH STATION AND A CITY'
0111 170 ASSIGN 170 TO BAD
0112 DO (1,*,ERR=9900) DISTNC
0113 IF (DISTNC.GT.0.AND.DISTNC.LE.50.) GO TO 200

C DISTANCE OUT OF RANGE
C
0114 WRITE (1,6) 'DISTANCE MUST BE LESS THAN 50 MILES'
0115 GO TO 170
C
C ENTER SATELLITE
C
0116 200 WRITE (1,6) 'ENTER THE SATELLITE OF INTEREST BY CALL NUMBER'
0117 READ (1,210) (SATLIT(I),I=1,5)
0118 210 FORMAT (5A1)
0119 IF (SATLIT(1).EQ.'A'.AND.SATLIT(2).EQ.'L'.AND.SATLIT(3).EQ.'L') GO TO 400
0120 CALL CODCHK(SATLIT,NUMSAT,SATNAM,POS)
0121 IF (POS.NE.0) GO TO 500
0122 WRITE (1,220) (SATLIT(I),I=1,5)
0123 220 FORMAT (5X, 'INVALID SATELLITE CALL NUMBER ',5A1/)
0124 WRITE (1,6) 'VALID SATELLITES ARE...
0125 230 FORMAT (1X,5A1,2X, 'WESTAR II ',/)
0126 230 FORMAT (1X,5A1,2X, 'WESTAR III ',/)
0127 230 FORMAT (1X,5A1,2X, 'COMSTAR D-1 ',/)
0128 230 FORMAT (1X,5A1,2X, 'COMSTAR D-2 ',/)
0129 230 FORMAT (1X,5A1,2X, 'COMSTAR D-3 ',/)
0130 230 FORMAT (1X,5A1,2X, 'COMSTAR D-4 ',/)
0131 230 FORMAT (1X,5A1,2X, 'COMSTAR I ',/)
0132 230 FORMAT (1X,5A1,2X, 'COMSTAR II ',/)
0133 230 FORMAT (1X,5A1,2X, 'COMSTAR III ',/)
0134 230 FORMAT (1X,5A1,2X, 'CANADIAN TELESAT SATELLITES ',/)
0135 230 FORMAT (1X,5A1,2X, 'MARISAT I ',/)
0136 230 FORMAT (1X,5A1,2X, 'MARISAT II ',/)
0137 230 FORMAT (1X,5A1,2X, 'MARISAT III ',/)
0138 230 FORMAT (1X,5A1,2X, 'INTELSAT I ',/)

C
C D-67
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EARTH:FTN /TRIBLOCKS/UR

0127 C GO TO 200
0128 400 BYPASS=1
0129 500 UPDOWN=0
0130 C READ THE DATA BASE

0131 520 READ (2,530=ERR=9020,END=580),(CALBIN(I),I=1,5),(LICENSE(I),I=1,40),
0132 530 FORMAT (5A1,40A1,1X,20A1,1X,2A1,4X,A1)
0133 C READ (2,535=ERR=9020,END=580),(SERVIS(I),I=1,18),(BAND(I),J=1,2),

C LOOK FOR SATELLITE
0135 C IF (BYPASS.EQ.1) GO TO 536
0136 CALL CODCHK(5,SATLIT,SAT,POS)
0137 IF (POS.EQ.0) GO TO 520

C CALCULATE V AND H COORDINATES
0138 536 LAT=LAT
0139 CALL VANDH(LAT,LON)

C CALCULATE DISTANCE FROM UPLINK CITIES
0140 542 UPTOWN=2
0141 IF (SERVIS(B).NE.'Y') GO TO 557
0142 DO 545 I=1,UACITY
0143 Y=UACITY(I)-LAT
0144 X=UACITY(I)-LON
0145 DIST=(X*X+Y*Y)/10.
0147 DIST=SQRT(DIST)
0148 IF (DIST.GT.DISTNC) GO TO 545
0149 IF (NUMREC.EQ.750) GO TO 570
0150 NUMREC=NUMREC+1
0151 CALL MOVREC(I,NUMREC)
0152 UCTARY(I)=UCTARY(I)+1
0153 545 CONTINUE

C CALCULATE DISTANCE FROM DOWNLINK CITIES
0154 "57 UPDOWN=2
CMT). FTH /Tits 91.001t8/w*.

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)-LONG

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

560 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

CLOSE (UNIT=2)

MLESSI=NUMREC-1

DO 800 I=1, MLESSI

IPLUSI=I+1

IF (BIGREC(J-1).OT.BIGREC(I+1)) GO TO 700

IF (BIGREC(J-1).LT.BIGREC(I+1)) GO TO 600

IF (BIGREC(J-2).OT.BIGREC(I+2)) GO TO 700

OTHERWISE SWAP

DO 610 L=1, 82

TMPARY(L)=BIGREC(J+L)

DO 620 L=1, 82

BIGREC(J+L)=BIGREC(I+L)

DO 630 L=1, 82

BIGREC(I+L)=TMPARY(L)

CONTINUE

PRINT THE REPORT

WRITE (3, 4100) (HEADER(I).I=1,72)

4100 FORMAT ('1'*72A1)

IDIST=DISTNC

WRITE (3, 4600) DOWNUP(2), IDIST,(SATLIT(I). I=1,5)

4600 FORMAT ('/1 X',4A, 'LINK CITIES--EARTH STATIONS WITHIN ', 13,

2 'MILES AND LICENSED TO POINT TO ', 5A1/)
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

WRITE (3,4745) (NAMDUCT(I,L),L=1,16), (CODDST(I,L),L=1,2)

FORMAT (/1X,'NO EARTH STATIONS NEAR ',16A1,2X,2A1)

CONTINUE

C

DOWNLINK PART OF REPORT

C

DO 5750 I=1,DCITYN

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

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

WRITE (3,4730) (NAMDUCT(I,J),J=1,16), (CODDST(I,J),J=1,2)

LAST=FIRST+DCTARY(I)-1

DO 5735 K=FIRST,LAST

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

CONTINUE

FIRST=LAST+1

GO TO 5750

WRITE (3,4745) (NAMDUCT(I,L),L=1,16), (CODDST(I,L),L=1,2)

CONTINUE

C

GO TO 9900

C

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

GO TO BAD

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

GO TO 9900

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

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 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 'SYO:COMBLK,FTN/NOLIST'

LOGICAL*1 PAD(12460)
COMMON PAD
LOGICAL*1 CALSIN(5),LICNSE(40),CITY(20),
   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(I,I),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)
               50 CONTINUE
            40 CONTINUE
         30 CONTINUE
   20 CONTINUE
10 CONTINUE

RETURN
END
SECTION 4. GENERAL UTILITY SUBROUTINES

Section 4 includes listings for the general utility subroutines used by all of the module:

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

C CALLED BY: BUILD, MODEL, EARTH

0001 SUBROUTINE READIN
0002 INCLUDE 'SYO:COMBLK.FTN/NOLIST'
0040 LOGICAL*1 INNAME(16)
0041 REAL*4 PROBLM(398)
0042 DATA INNAME
0043 DATA PROBLM	 'SCALAR', 'RKL', 'NK C', 'STELE',
2 'UPLO', 'NK P', 'ATHS', 'UPLO', 'NK C', 'ITY', 'DNLI', 'NK C', 'STELE',
3 'DNLI', 'NK P', 'ATHS', 'DNLI', 'NK C', 'ITY', 'TALK', 'BACK', '/

C OPEN INPUT SCENARIO FILE

0044 WRITE(1r*) 'ENTER NAME OF SCENARIO FILE'
0045 READ(14001rERR=5030) (INNAME(I)I=5,10)
0046 OPEN (UNIT=2, TYPE='OLD', NAME=INNAME, CARRIAGECONTROL='LIST',
2 ERR=5020)

C HEADER RECORD

0047 JERROR=1
0048 READ(2,5001,ERR=5030) (TITLE(I),I=1,72)
0049 5001 FORMAT(72A1)

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

0050 READ(2,5002,ERR=5030) NUELEM, NDELEM, NUINDX, NINDX, NCITY, NDCITY,
2 NUPATH, NDPATH, NUMORG
0051 5002 FORMAT(9I4)

C ALL OTHER SCALARS

0052 READ(2,5003,ERR=5030) DDCPM, DDING, ADDLES, ECIPLF, PVTLF, PVTFIX,
2 PUTING, PUTMIL, DICE, TDCAP, WATINS, WATLES
0053 5003 FORMAT(F5.2,2F6.2,F5.1,3F7.2,F6.3,F5.1,F6.2,F7.2,F6.2)
0054 READ (2,5050,ERR=5030) WATMAX, WATCPH, (GANDAD(I),I=1,4)
0055 5050 FORMAT(2F8.2,4F12.2)

C COST ALLOCATION ORGANIZATION NAMES, IF APPLICABLE

0056 IF(NUMORG.EQ.0) GO TO 510
0057 LI = 1
0058 501 L2 = MIN(NUMORG,L1+3)
0059 READ(2,5004,ERR=5030) ((ORGNAM(I,J),J=1,20),I=L1,L2)
0060 5004 FORMAT (4(2OA1))
0061 LI = L2 + 1
0062 IF (LI.LE.NUMORG) GO TO 501

C UPLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS

PRECEDING PAGE LEFT NOT FILMED

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C
0063 510 IF (NUINDEX.GE.2)
2      READ(2,5005,ERR=5030) ((UCINDX(I,J),J=1,8),I=1,NUINDEX)
0064 5005 FORMAT (5(BAIIX))
0065 5006 IF (NUMORG.GT.0) READ(2,5006,ERR=5030) (UHXWHT(I),I=1,NUINDEX)
0066 5006 FORMAT (6(F7.3))

UPPLINK COST ELEMENT DATA

0067 JERROR=2
0068 DO S30 I = 1,NUELEM
0069     READ(2,5007,ERR=5030) (UCSCOD(I,J),J=1,2),(UCSNAM(I,J),J=1,20),
2      UCSCMIN(I),(UCSDAT(I,1:K),K=1,4)
0070 5007 FORMAT (2A1,IX,20A1,7X,5F10.3)
0071 IF (NUINDEX.GE.1) GO TO 540
0072 J = 0
0073 518 J = J + 2
0074 IF (J - NUINDEX) 520,530
0075 520 JJ = J + 1
0076 READ(2,5008,ERR=5030) (UCSDAT(I,1:K),K=1,4) (UCSDAT(I,J,J,K),K=1,4)
0077 5008 FORMAT (8F10.3)
0078 GO TO 518
0079 525 READ(2,5009,ERR=5030) (UCSDAT(I,J,K),K=1,4)
0080 530 CONTINUE

UPPLINK PATH DATA

0081 JERROR=3
0082 DO 540 ISL = 1,NUPATH
0083      READ(2,5010,ERR=5030) (UPTHNM(1,J),J=1,20), (UCSPTH(J,I),J=1,NUELEM)
0084 5010 FORMAT (20AIMP1511)
0085 540 CONTINUE

UPPLINK CITY DATA

0086 JERROR=4
0087 IF (NUCITY.EQ.0) GO TO 555
0088 DO 550 I=1,NUCITY
0089     READ(2,5010,ERR=5030) (UCTNM(I,J),J=1,16), (UCTCOD(I,J),J=1,2),
2      UCTCV(I),UCCITY(I),UCTCHN(I),UCTORG(I),UPTHY(I,J),J=1,NUPATH
0090 5010 FORMAT (16A1,IX,2A1,2I8,5X,10I1)
0091 IF (NUINDEX.GT.1) READ(2,5008,ERR=5030) (UCTVL(1,J),J=1,NUINDEX-1)
0092 550 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=1,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     READ(2,5007,ERR=5030) (DCSCOD(I,J),J=1,2), (DCSNAM(I,J),J=1,20),
2      DCSCMIN(I),(DCSDAT(I,1:K),K=1,4)
READIN.FTN /TR1$LOCKS/WR

0098 IF (NDINDX.EQ.1) GO TO 640
0099 J = 0
0100 418 J = J + 2
0101 IF (J - NDINDX) 620, 625, 630
0102 620 JJ = J + 1
0103 READ(2,5008,ERR=5030) (DCSDAT(I,J,K),K=1,4),(DCSDAT(I,J,J,K),K=1,4)
0104 GO TO 618
0105 625 READ(2,5009,ERR=5030) (DCSDAT(I,J,K),K=1,4)
0106 630 CONTINUE

C
C DOWNLINK PATH DATA
C
0107 JERROR=4
0108 DO 640 I=1,NDPATH
0109 READ(2,5009,ERR=5030) (DPTHNM(I,J),J=1,20),(DCSPTH(I,J),J=1,NDELEM)
0110 640 CONTINUE

C
C DMALINK CITY DATA
C
0111 JERROR=7
0112 IF (NDCITY.EQ.0) 00 TO 690
0113 DO 650 I=1,NDCITY
0114 READ(2,5010,ERR=5030) (DCTNAM(I,J),J=1,16),(DSTCOD(I,J),J=1,2),
2 DCITYV(I),DCITYH(I),DCTVL(I),DCTORG(I),DPTHCM(I,J),J=1,NDPATH
0115 IF (NDINDX.GT.1) READ(2,5008,ERR=5030) (DCTXVL(I,J),J=1,NDINDX-1)
0116 650 CONTINUE

C
C TALKBACK INFORMATION
C
0117 JERROR=8
0118 IF (NUCITY.EQ.0) GO TO 690
0119 DO 680 J=1,NUCITY
0120 L2 = 0
0121 660 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),I=L1,L2)
0126 5011 FORMAT (13F6.1)
0127 GO TO 660
0128 680 CONTINUE
0129 690 CLOSE (UNIT=2)
0130 RETURN

C
C IF ERRORS OCCUR WHILE READING THE INPUT FILE
C
0131 5020 WRITE(1;5025) (INNAME(I),I=1,16)
0132 5025 FORMAT(1H,'ERROR IN OPENING FILE ','16A1)
0133 GO TO 5040
0134 5030 WRITE(1;5035) (PROBLM(I,JERROR),I=1,3)
0135 5035 FORMAT(1H,'ERROR READING ','3A4,' DATA')
0136 5040 WRITE (1;8) 'PROGRAM TERMINATED'
0137 CLOSE (UNIT=2)
0138 STOP
0139 END

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SUBROUTINE RITOUT

CALLED BY: BUILD

INCLUDE 'SYO:COMBLK.FTN/NO LIST'

COMMON ARRAY VARIABLES

LOGICAL INAME(16)
REAL PROBLM(36)
DATA INAME /'S'r'Y'r'0'
DATA PROBLM /'UPLI','NK P','ATHS','UPLI','NK C','STEL',
,'UPLI','NK P','ATHS','UPLI','NK C','STEL',
,'DNLI','NK P','ATHS','DNLI','NK C','ITY','TALK','BACK'/'

OPEN OUTPUT SCENARIO FILE

WRITE(1,'(A7)') 'ENTER NEW 6 CHARACTER NAME FOR THE SCENARIO FILE JUST CREATED'
READ(1,5001,ERR=5030) INNAME(I),I=5,10
OPEN (UNIT=2,TYPE='NEWT NAME=INNAMECARRIAGECONTROL='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) NUMELE,NUDELE,NUINDX,NDINDX,NUCITY,NDCITY,
2 NUPATH,NDPATH,NUMORG
5002 FORMAT(9I4)

ALL OTHER SCALARS

WRITE(2,5003,ERR=5030) DDDCPH,DDDINS,DDDLES,EOLIF,PUTLES,PUTFIX,
2 PUTINS,PTMIL,DISCNT,TLKCAP,WTWINS,WTATL

WRITE(2,5050,ERR=5030) WATMAX,WTWPH,(GANDAD(I),I=1,4)
5050 FORMAT(2F8.2,4F12.2)

COST ALLOCATION ORGANIZATION NAMES, IF APPLICABLE

IF(NUMORG.EQ.0) GO TO 510
L1 = 1
501 L2 = MIN(NUMORG,L1+3)
WRITE(2,5004,ERR=5030) (GDNAM(I,J),J=1,20),I=L1,L2
5004 FORMAT (4(20A1))
RUTOUT.FTN

0041 L1 = L2 + 1
0042 IF (L1.LE.NUMORG) GO TO 501

C UPLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS

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

C UPLINK COST ELEMENT DATA

0047 JERROR=2
0048 DO 530 I = 1,NUELEM
0049 WRITE(2,5007) (UCSDAT(I,J),J=1,20), (UCSDAT(I,J),J=1,20),
0050 5007 FORMAT(2A1,1X,20A1,7X,5F10.3)
0051 IF (NUINDEX.EQ.1) GO TO 540
0052 J = 0
0053 518 J = J + 1
0054 IF (J = NUINDEX) 520,525,530
0055 520 JJ = J + 1
0056 WRITE(2,5008) (UCSDAT(I,J),J=1,4), (UCSDAT(I,2,J),J=1,4),
0057 5008 FORMAT(20A1,5X,15I1)
0058 540 CONTINUE

C UPLINK PATH DATA

0062 JERROR=3
0063 DO 540 I = 1,NUPATH
0064 WRITE(2,5009) (UCPHTM(I,J),J=1,20), (UCPHTM(I,J),J=1,20),
0065 5009 FORMAT(20A1,5X,15I1)
0066 540 CONTINUE

C UPLINK CITY DATA

0068 JERROR=4
0069 IF (NUINDEX.EQ.0) GO TO 555
0070 DO 550 I = 1,NUCITY
0071 WRITE(2,5010) (UCTNM(I,J),J=1,16), (UCTNM(I,J),J=1,16),
0072 5010 FORMAT(16A1,1X,2A1,2I2,5X,10I1)
0073 550 CONTINUE

C DOWNLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS

0093 JERROR=5
0094 IF (NDINDEX.EQ.2) 2, WRITE(2,5050) (DDCINDX(I,J),J=1,8),I=2,NDINDEX)
0095 5050 IF (NUMORG.GT.0) WRITE(2,5050) (DDXWHT(I),I=1,NDINDEX)

D-79
C  DOWNLINK COST ELEMENT DATA
0094 DO 630 I = 1, NDLEM
0095 WRITE(2, 5007) (DCSCOD(I), J=1, 2) (DCSNAM(I), J=1, 20),
2 DCSCMIN(I), (DCSDAT(I, K), K=1, 4)
0098 IF (NDINDX.GT.1) GO TO 640
0099 J = 0
0100 IF (J .LE. NDINDX) 420, 425, 630
0101 JJ = J + 1
0102 WRITE(2, 5008) (DCSDAT(I, J), K=1, 4) (DCSDAT(I, JJ), K=1, 4)
0106 CONTINUE
C  DOWNLINK PATH DATA
0107 JERROR = 6
0108 DO 640 I = 1, NDPATH
0109 WRITE(2, 5009) (DPTHNM(I, J), J=1, 20) (DCSPTH(I, J), J=1, 4)
0110 CONTINUE
C  DOWNLINK CITY DATA
0111 JERROR = 7
0112 IF (NDCITY.GT.0) GO TO 690
0113 DO 650 I = 1, NDCITY
0114 WRITE (2, 5010) (DCTNM (I, J), J=1, 16) (DCTCOD (I, J), J=1, 2),
2 DCTVL (I, J), DCTOR (I, J), DCTOR (I, J), J=1, NDPATH
0115 IF (NDINDX.GT.1) WRITE (2, 5008) (DCXVL (I, J), J=1, NDINDX-1)
0116 CONTINUE
C  TALKPACK INFORMATION
0117 JERROR = 8
0118 IF (NUCITY.EQ.0) GO TO 690
0119 DO 680 J = 1, NUCITY
0120 L2 = 0
0121 LI = L2 + 1
0122 L2 = LI + 12
0123 IF (LI .LT. NDCITY) GO TO 680
0124 IF (L2 .LT. NDCITY) L2 = NDCITY
0125 WRITE (2, 5011) (TALKBK(I, J), J=1, L2)
0126 5011 FORMAT (13F6-1)
0127 GO TO 660
0128 CONTINUE
0129 680 CLOSE (UNIT=2)
0130 RETURN

C IF ERRORS OCCUR WHILE WRITING THE OUTPUT FILE
C
0131 5020 WRITE (1, 5025) (INNAME(I), I=1, 16)
0132 5025 FORMAT (1H ERROR OPENING FILE ',16A1)
GO TO 5040
5030 WRITE(1,5035) (PROBLM(I,ERROR), I=1,3)
5035 FORMAT(1X, 'ERROR WRITING ',3A4,' DATA')
5040 WRITE (1,5) 'BUILD TERMINATED'
CLOSE (UNIT=2)
STOP
END
SUBROUTINE YESNO

CALL SYU, BUILD, COST, PATH, CITY, RATE, MODEL

YESNO determines if the response to a question is 'Yes' or 'No'
and sets the appropriate flag - only the first character of the response is checked.

SUBROUTINE YESNO
INCLUDE 'SYU:COMBK.FTN/NOLIST'
YESNO = 3 READ(1,10,ERR=20) INDATA(1)
10 FORMAT (A1)
IF (INDATA(1),EQ.'Y') YESNO = 1
IF (INDATA(1),EQ.'N') YESNO = 2
20 IF (YESNO.EQ.3) WRITE (1,*),'ANSWER MUST BE 'YES' OR 'NO'
RETURN
END
SUBROUTINE UPDOWN

C 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 UPDOWN = 3
0041 READ(1,10) INDATA(1)
0042 10 FORMAT(A1)
0043 IF (INDATA(1).EQ.'U') UPPDOWN = 1
0044 IF (INDATA(1).EQ.'D') UPPDOWN = 2
0045 20 IF (UPPDWN.EQ.3) WRITE (1,'(A)') 'ANSWER MUST BE 'UP' OR 'DOWN''
0046 RETURN
0047 END
SUBROUTINE CODCHK

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

CODCHK CHECKS AN INPUT ARGUMENT AGAINST A LIST OF VALID ARGUMENTS

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

INTEGER NCHAR, NCOMPR, POSIT, I, J, NMATCH
LOGICAL INCMPAR(NCOMPR, NCHAR)

POSIT = 0
NMATCH = 0
DO 10 I = 1, NCOMPR
   DO 20 J = 1, NCHAR
      IF (INDATA(J) .EQ. CMPARR(I, J)) GO TO 20
   CONTINUE
   NMATCH = NMATCH + 1
   POSIT = I
20 CONTINUE

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

IF (NMATCH .LT. 1) POSIT = -1
RETURN
END
SUBROUTINE GETTER

SUBROUTINE CALLS: CCOUNT

THIS SUBROUTINE RETRIEVES THE NEXT ARGUMENT ON THE COMMAND LINE

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

CASE WHERE WHOLE LINE IS EMPTY

CHECK EACH CHARACTER

SEMICOLON ENCOUNTERED

IF CHARACTER COUNT IS ZERO

D-85
GO TO 90

IF COMMA IS ENCOUNTERED
   IF (INDATA(I).NE.COMMA) GO TO 70
   NCHAR = I - NSTART
   IF (NCHAR.EQ.0)
      WRITE(1,*)'NULL ARGUMENT SPECIFIED--IT WILL BE IGNORED.'
   SCAN REMAINDER OF LINE TO SEE IF THIS IS THE LAST ARGUMENT
      DO 60 J = NSTART+80
         IF (INDATA(J).NE.BLANK) GO TO 90
         CONTINUE
      CONTCD = 0
      NSTART = 1
   END OF INPUT LINE REACHED
      CONTCD = 0
      NSTART = 1
      CALL CCOUNT(ARG,NCHAR)
      RETURN
END
SUBROUTINE CCOUNT

CALLED BY:

THIS SUBROUTINE COUNTS CHARACTERS IN AN INPUT ARGUMENT UNTIL IT SEES A SEMICOLON OR COMMA. TRAILING BLANKS ARE IGNORED.

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
RETURN
END
SUBROUTINE DISAPR

CALLED BY: COST, PATH, CITY

THIS SUBROUTINE DELETES A COST ELEMENT, PATH, OR CITY FROM THE DATA BASE. ARGUMENTS:

CODE = CODE INDICATING TYPE OF DELETION

1 = UPLINK COST ELEMENT

3 = UPLINK PATH

5 = UPLINK CITY

INDEX = POSITION IN ARRAYS TO BE DELETED

SUBROUTINE DISAPR(CODE, INDEX)

INCLUDE 'SYO:COMBLK.FTN/NOLIST'

INTEGER*2 CODE, INDEX
LOGICAL*1 BLANK

DATA BLANK /'/' /

GO TO (100, 200, 300, 400, 500, 600) CODE

IF (INDEX.EQ.NUELEM) GO TO 190
II = INDEX + 1
DO 110 K = 1, NUIINDEX
DO 110 J = 1, NUELEM
UCSDAT(I - 1, J, K) = UCSDAT(I, J, K)
110 CONTINUE
UCSCOD(NUELEM, I) = BLANK
UCSNAM(NUELEM, I) = BLANK
NUELEM = NUELEM - 1
RETURN

IF (INDEX.EQ.NDELEM) GO TO 290
II = INDEX + 1
DO 210 K = 1, NIIINDEX
DO 210 J = 1, NDELEM
UCSDAT(I, J, K) = UCSDAT(I, J, K)
210 CONTINUE
UCSCOD(NUELEM, I) = BLANK
UCSNAM(NUELEM, I) = BLANK
NUELEM = NUELEM - 1
RETURN

GO TO (100, 200, 300, 400, 500, 600) CODE
0069  210  DCSDAT(I-1,J,K) = DCSDAT(I,J,K)
0070  220  DO  220  I=1,NDELEM
0071  230  DCSMIN(I-1) = DCSMIN(I)
0072  240  DO  240  I = 1,NDELEM
0073  250  DC=30  J = 1,2
0074  260  DCSNAM(I-1,J) = DCSNAM(I,J)
0075  270  DO  270  J = 1,NDPATH
0076  280  NDELEM = NDELEM - 1
0077  290  RETURN

C
C  UPLINK PATH
C

0084  300  IF (INDEX.EQ.NUPATH) GO TO 390
0085  310  I1 = INDEX+1
0086  320  DO  320  I = I1,NUPATH
0087  330  J = 1,NDELEM
0088  340  UCSPTH(J-1) = UCSPTH(J)
0089  350  DO  350  J = 1,NUCITY
0090  360  UPTHCY(I-1,J) = UPTHCY(I,J)
0091  370  DO  370  J = 1,20
0092  380  UPTHNM(I-1,J) = UPTHNM(I,J)
0093  390  CONTINUE
0094  400  NUPATH = NUPATH-1
0095  410  RETURN

C
C  DOWNLINK PATH
C

0097  420  IF (INDEX.EQ.NDPATH) GO TO 490
0098  430  I1 = INDEX+1
0099  440  DO  440  I = I1,NDPATH
0100  450  J = 1,NDELEM
0101  460  DCSPTH(J-1) = DCSPTH(J)
0102  470  DO  470  J = 1,NUCITY
0103  480  DPTHCY(I-1,J) = DPTHCY(I,J)
0104  490  DO  490  J = 1,20
0105  500  DPTHNM(I-1,J) = DPTHNM(I,J)
0106  510  CONTINUE
0107  520  NDPATH = NDPATH-1
0108  530  RETURN

C
C  UPLINK CITY
C

0110  540  IF (INDEX.EQ.NUCITY) GO TO 590
0111  550  I1 = INDEX + 1
0112  560  DO  560  I = I1,NUCITY
0113  570  UCITYV(I-1) = UCITYV(I)
UCITYN(I-1) = UCITYN(I)
UCTCHN(I-1) = UCTCHN(I)
IF ( NUMORG .GT. 0 ) UCTORG(I-1) = UCTORG(I)
DO 510 J=1,16
   UCTNAM(I-1,J) = UCTNAM(I,J)
   DO 520 J=1,NUINDEX
      UCTXVL(I-1,J) = UCTXVL(I,J)
   DO 530 J=1,2
      USTCOD(I-1,J) = USTCOD(I,J)
   DO 540 J=1,NDCITY
      TALKBK(J,I-1) = TALKBK(J,I)
   DO 550 J=1,NUPATH
      UPTHCY(J,I-1) = UPTHCY(J,I)
CONTINUE
UCITYN(NUCITY+1) = BLANK
NDCITY = NDCITY-1
RETURN
C
C DOWNLINK CITY
C
C
IF ( INDEX .EQ. NDCITY ) GO TO 690
I1 = INDEX + 1
DO 660 I=I1,NDCITY
   DCITYN(I-1) = DCITYN(I)
   DCITYV(I-1) = DCITYV(I)
   DCTLVL(I-1) = DCTLVL(I)
   IF ( NUMORG .GT. 0 ) DCTORG(I-1) = DCTORG(I)
   DO 610 J=1,16
      DCITYV(I-1,J) = DCITYV(I,J)
      DCTXVL(I-1,J) = DCTXVL(I,J)
   DO 630 J=1,2
      DSTCOD(I-1,J) = DSTCOD(I,J)
   DO 640 J=1,NDCITY
      TALKBK(J,I-1) = TALKBK(J,I)
   DO 650 J=1,NUPATH
      DPTHCY(J,I-1) = DPTHCY(J,I)
CONTINUE
DCITYV(NDCITY+1) = BLANK
NDCITY = NDCITY-1
RETURN
END
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/NOLIST'

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

CALLED BY: RATE

SUBROUTINE RATECK (LOW, UP, XDAT)

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

0041 POSITN=0
0042 IF (XDAT.LT.LOW.OR.XDAT.GT.UP) GO TO 10
0043 POSITN=XDAT
0044 GO TO 20

10 WRITE (1,*) 'NUMBER OUT OF RANGE - PLEASE RETYPE'
0046 20 RETURN
0047 END
SUBROUTINE CTYCHK

C CALLED BY: CITY, MATMOD
C
C THIS SUBROUTINE WILL DETERMINE IF A CITY/ORGANIZATION PAIR EXISTS
C AND IF SO, WILL RETURN THE INDEX TO THAT PAIR. ORGANIZATION WILL BE
C IGNORED IF COST ALLOCATION HAS NOT BEEN SELECTED.
C
SUBROUTINE CTYCHK(POSP, ORG)
INCLUDE 'SYOSCOMBLK.FTN/NOLIST'
INTEGER*2 ORG, NMATCH, LIMIT, POS2

POSS = 0
ORG = 0
POS2 = 0
NMATCH = 0

IF (NCHAR.EQ.1 OR ARG(NCHAR).NE./') GO TO 100
ORG = ARG(NCHAR) - 48

IF (ORG.LE.0 OR ORG.GT.NUMORG) GO TO 1001

NCHAR = NCHAR - 2

100 IF (ORG.EQ.0 AND NUMORG.GT.0) GO TO 1000

IF (UPPDWN.EQ.1) LIMIT = 600000
IF (UPPDWN.EQ.2) LIMIT = XDCITY

DO 130 I = LIMIT + 1

DO 110 J = 1, NCHAR

IF (UPPDWN.EQ.1 AND ARG(J).NE.UCTNAM(I,J)) OR
2 IF (UPPDWN.EQ.2 AND ARG(J).NE.DCTNAM(I,J)) GO TO 130

110 CONTINUE

C MATCH FOUND

POS2 = 1

IF (ORG.EQ.UCTORG(I) AND ORG.EQ.DCTORG(I) AND ORG.EQ.DCTORG(I) AND ORG.EQ.DCTORG(I) AND ORG.EQ.DCTORG(I)) GO TO 120

130 CONTINUE

IF (NMATCH.GT.1) WRITE (1,*) 'SPECIFIED CITY NOT UNIQUE - ENTER MORE INFORMATION'

IF (NMATCH.GT.1) POS = -1

IF (NMATCH.EQ.1) ORG = 0

IF (NMATCH.EQ.0) POS = POS2

RETURN

WRITE (1,*) 'AN ORGANIZATION CODE MUST BE SPECIFIED'
GO TO 1002
WRITE (1,*) 'INVALID ORGANIZATION CODE'
POS = -2
RETURN

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

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

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=0.402786*SIN(A)+0.757542*COS(A)*COS(1.29144-B)
THETA=(SIN(A)-ALPHA*.652786)/(0.757542*SQRT(1.-ALPHA*ALPHA))
THETA=ACOS(T H E T A)
IF(B.GT.1.29144)THETA=6.283185-THETA
DIST=12510.25*ACOS(ALPHA)
M=IFIX(4995.-DIST*SIN(BETA))
N=IFIX(1408.-DIST*COS(BETA))
RETURN
END
SUBROUTINE MATMOD

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

GO TO (100, 100, 200, 200, 200, 200, 200, 300), CODE

COST ELEMENTS SPECIFIED

CALL GETTER

IF (ARG(1).EQ.'A'.AND.ARG(2).EQ.'L'.AND.ARG(3).EQ.'L') GO TO 190
IF (NCHREQ.0) GO TO 170
IF (CODE.EQ.1) UCSPTH(POSITN, MODPOS) = ONOFF
IF (CODE.EQ.2) DCSPTH(POSITN, MODPOS) = ONOFF
IF (CONTCD.0) GO TO 100
IF (CONTCD.0) GO TO 105

IF ERRORS HAVE OCCURRED

WRITE (1,*) 'INVALID COST ELEMENT CODE'
WRITE (1,*) 'VALID COST ELEMENTS ARE...'
CALL REPRTR(9, 1)
GO TO 100
DO 195 I = 1, NELEM(UPPDWN)
0059   IF (CODE.EQ.1) UCSPTH(I, MODPOS) = ONOFF
0060   IF (CODE.EQ.2) DCSPTH(I, MODPOS) = ONOFF
0061   CONTINUE
0062   RETURN
C
C PATHS SPECIFIED
C
0064 200 WRITE (1,*) 'ENTER PATH NAMES: ALL OR 1'
0065 205 READ(1,900) (INDATA(I), I = 1, 80)
0066 205 CALL GETTER
0067 IF (ARG(1).EQ. 'I') RETURN
0068 IF (ARG(1).EQ. 'A'.AND.ARG(2).EQ. 'L'.AND.ARG(3).EQ. 'L') GO TO 295
0069 IF (NCHAR.EQ. 0) GO TO 270
0070 IF (UPPDWN.EQ.1) CALL CODCHK(NCHAR, MODPOS, UPTHN, POSITN)
0071 IF (UPPDWN.EQ.2) CALL CODCHK(NCHAR, MODPOS, DPTHNM, POSITN)
0072 IF (POSITN.EQ. 0) GO TO 280
0073 IF (POSITN .LT. 0) GO TO 290
0074 IF (POSITN.EQ. 0) UPTHCY(POSITN, MODPOS) = ONOFF
0075 IF (POSITN.EQ. 0) DPTHCY(POSITN, MODPOS) = ONOFF
0076 IF (POSITN.EQ. 0) UPTHCY(POSITN, MODPOS) = ONOFF
0077 IF (POSITN.EQ. 0) DPTHCY(POSITN, MODPOS) = ONOFF
0078 270 IF (CONTC.D.EQ.0) GO TO 200
0079 IF (CONTC.D.NE.0) GO TO 205
C
C IF ERRORS HAVE OCCURRED
C
0080 280 WRITE (1,*) 'PATH DOES NOT EXIST. VALID PATHS ARE...
0081 CALL REPRTR(3,1)
0082 GO TO 200
0083 290 WRITE (1,*) 'SPECIFIED PATH NOT UNIQUE -- ENTER MORE INFORMATION'
0084 GO TO 200
C
0085 295 DO 297 I = 1, NPATH(UPPDWN)
0086 IF (CODE.EQ.3) UCSPTH(MODPOS, POSITN) = ONOFF
0087 IF (CODE.EQ.4) DCSPTH(MODPOS, POSITN) = ONOFF
0088 IF (CODE.EQ.5) UPTHCY(POSITN, MODPOS) = ONOFF
0089 IF (CODE.EQ.6) DPTHCY(POSITN, MODPOS) = ONOFF
0090 297 CONTINUE
0091 RETURN
C
C CITIES SPECIFIED
C
0092 300 WRITE (1,*) 'ENTER CITY NAMES: ALL OR 1'
0093 READ(1,900) (INDATA(I), I = 1, 80)
0094 305 CALL GETTER
0095 IF (ARG(1).EQ. 'I') RETURN
0096 IF (ARG(1).EQ. 'A'.AND.ARG(2).EQ. 'L'.AND.ARG(3).EQ. 'L') GO TO 390
0097 IF (NCHAR.EQ. 0) GO TO 370
0098 CALL CTYCHK(POSITN, ORG)
0099 IF (POSITN.EQ.0) GO TO 380
0100 IF (POSITN.LT.0) GO TO 370
0101 IF (NUMORG.GT.0.AND.ORG.NE.0) GO TO 380
0102 IF (CODE.EQ.7) UPTHCY(MODPOS, POSITN) = ONOFF
0103 IF (CODE.EQ.8) DPTHCY(MODPOS, POSITN) = ONOFF
0104 370 IF (CONTC.D.EQ.0) GO TO 300
C 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 395 I=1,NCITY(UPPDWN)
0111 IF (CODE.EQ.7) UPTHCY(MODPOS+1)=ONOFF
0112 IF (CODE.EQ.8) DPTHCY(MODPOS+1)=ONOFF
0113 395 CONTINUE
0114 RETURN
C
0115 900 FORMAT(80A1)
0116 END
SUBROUTINE REPRTR

CALLED BY: COST+, PATH#, CITY#, RATE+, METHOD+, MODEL+, MODUP+, MODCN

THIS SUBROUTINE CONTAINS THE REPORT FORMATS USED IN THE MODEL

SUBROUTINE REPRTR (REPTYP+, POS)

INCLUDE 'SYOICOMPLK.FTN/NOLIST'

INTEGER# REPTYP+, POS#, PLANK+, STAR, OUTARR(30)

REAL# PER#, CTYPE(4), LINK#, UPDOWN(2)

DATA PER /'PER 	 '/#, BLANK /'	 '/9, STAR /'	 'I'/9, LINK/'LINK'/

DATA UPDOWN/' 	 UP'9'DOWN'/

DATA CTYPE /'CAP 	 '.'INS	 '9'LES	 '#'OMA/

0045 GO TO (1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 10000), 2 REPTYP

1000 IF (UPPDWN.EQ.2) GO TO 1500

UPLINK COST ELEMENT REPORT

WRITE (3, 1400) (UCSCOD(POS+, J), J=1, 2), (UCSNAM(POS+, J), J=1, 20)

WRITE (3, 1400) FORMAT (1HO9'DATA FOR COST ELEMENT 	 '92A19'	 --	 '92041)

IF (NUINDX.OE.2) WRITE (3, 1410) (PER9I*29NUINDX)

WRITE (391420) ((UCINDX(19J)9JN1.8)92o1#NUINDX)

WRITE (:91470) (UCSMIN(POS))

GO TO 99999

DOWNLINK COST ELEMENT REPORT

WRITE (3, 1440) (DCSCOD(POS+, J), J=1, 2), (DCSNAM(POS+, J), J=1, 20)

WRITE (3, 1440) IF (NDINDX.GE.2) WRITE (3, 1410) (PER9I*29NUINDX)

WRITE (391420) ((DCINDX(I#J), J=1, 8), I=1, NUINDX)

WRITE (391470) DCSMIN(POS)

GO TO 99999

MATRIX OF UPLINK COST ELEMENTS ASSOCIATED WITH EACH PATH

WRITE (3, 1420) Format (1H9'MINIMUM LEASE COST ='9F9.2/)

GO TO 99999

WRITE (3, 1800) UPDOWN(I)9LINK

WRITE (3, 1900) ((UCSCOD(I,J), J=1, 2), I=1, NUELEM)
C MATRIX OF DOWNLINK COST ELEMENTS ASSOCIATED WITH EACH PATH
C
0082 2500 WRITE (3,1800) UPDOWN(2),LINK
0083 2500 WRITE (3,1900) ((DCSCOD(I,J),J=1,2),I=1,NDELEM)
0084 DO 2600 J=1,NDELEM
0085 OUTARR(I) = BLANK
0086 IF (DCSPTH(I,J).EQ.1) OUTARR(I) = STAR
0087 2590 CONTINUE
0088 2600 CONTINUE
0089 2600 CONTINUE
0090 2600 CONTINUE
0091 GO TO 99999
C
C LIST OF UPLINK PATH NUMBERS AND NAMES
C
0092 3000 IF (UPPDWN.EQ.2) GO TO 3500
0093 WRITE (3,3010)
0094 3010 FORMAT(1H0,' NO.'r6Xr'PATH NAME'/)
0095 DO 3100 I=1,NUPATH
0096 WRITE (3,3090) UPTHNM(I,J)
0097 3090 FORMAT(1H0,20A1)
0098 3100 CONTINUE
0099 GO TO 99999
C
C MATRIX OF DOWNLINK PATH NUMBERS AND NAMES
C
0100 3500 WRITE (3,3010)
0101 DO 3600 I=1,NDPATH
0102 WRITE (3,3090) DPTHNM(I,J),J=1,20
0103 3600 CONTINUE
0104 GO TO 99999
C
C MATRIX OF UPLINK PATHS AND CITIES
C
0105 4000 IF (NCITY(UPPDWN).EQ.0) GO TO 4600
0106 WRITE (3,4010) UPDOWN(UPPDWN),LINK
0107 4010 FORMAT (1H0,'/1H0,'MATRIX OF PATHS AND CITIES--'r2A4)
0108 J1 = 1
0109 J2 = MIN(NPATH(UPPDWN),16)
0110 WRITE (3,4030) (J,J=J1,J2)
0111 4030 FORMAT(1H0,' CITY',I3X,'ORG ',I6I3)
0112 IF (UPPDWN.EQ.2) GO TO 4500
0113 DO 4080 J=1,NUCITY
0114 IF (UCITYV(I).EQ.-1) GO TO 4080
0115 DO 4070 J=J1,J2

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OUTARR(J) = BLANK
0117 IF (UPTHCY(JrI).EQ.1) OUTARR(J) = STAR
0118 CONTINUE
0119 IF (NUMORG.EQ.0)
0120 WRITE (3+4075) (UCTNAM(IrJ)rJ=1x16), (OUTARR(J-J1+1)rJ=J1rJ2)
0121 IF (NUMORG.GT.0) WRITE (3+4076) (UCTNAM(IrJ),J=1,16), UCTORG(I),
0122 (OUTARR(J-J1+1),J=J1J2)
0123 CONTINUE
0124 GO TO 99999
C
C MATRIX OF DOWNLINK PATHS AND CITIES
C
0125 DO 4580 I=1,NDCTY
0126 IF (DCITYV(I).EQ.-1) GO TO 4580
0127 DO 4570 J-J1rJ2
0128 OUTARR(J) = BLANK
0129 IF (DPTHCY(JrI).LE.1) OUTARR(J) = STAR
0130 CONTINUE
0131 IF (NUMORG.EQ.0)
0132 WRITE (3.4075) (DCTNAM(IrJ)rJ=1x16)r (OUTARR(J-J1+1)rJ2)
0133 IF (NUMORG.GT.0) WRITE (3x4076) (DCTNAM(IrJ)rJ=1x16)d DCTORG(I),
0134 (OUTARR(J-J1+1),J=J1rJ2)
0135 4580 CONTINUE
0136 GO TO 99999
C
C UPLINK CITIES AND ASSOCIATED COST INDEX VALUES
C
0137 DO 5050 I=1,NUCITY
0138 WRITE (3,5060) (UCTNAM(IrJ)rJ=1x16)r UCTORG(I)
0139 WRITE (3+5075) (UCINDX(KrJ)xJ=1x8)xK=2,NUINDX)
0140 IF (UCITYV(I).EQ.-1) GO TO 5050
0141 WRITE (3.5100) (UCTXVL(IxJ)xJ=1rNUINDX-1)
0142 5050 CONTINUE
0143 GO TO 99999
C
C DOWNLINK CITIES AND ASSOCIATED COST INDEXES
C
0150 DO 5800 I=1,NDCTY
0151 WRITE (3,5060) (DCTNAM(IrJ),J=1,16), DCTORG(I)
0152 WRITE (3,5100) (DCXVL(I,K)xK=1,NDINDEX-1)
0153 IF (DCITYV(I).EQ.-1) GO TO 5800
0154 WRITE (3,5100) (DCTXVL(I,K)xK=1,NDINDEX-1)

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0155  5800 CONTINUE

0156  GO TO 99999

C

C TALKBACK MATRIX BETWEEN UPLINK AND DOWNLINK CITIES
C

0157  6000 IF (NDCITY.EQ.0) GO TO 6600
0158  6050 FORMAT(1H0,'MATRIX OF TALKBACK REQUIREMENTS',/,,
2 'DOWNLINK CITIY ORG ',10(2X,3A1))
0159  6100 FORMAT (2I15/)  
0160  DO 6500 I=1,NDCITY
0161  6150 FORMAT (1H16A1,I2,3X,10(IX,F4.1),///)
0162  6500 CONTINUE
0163  GO TO 99999
0164  6600 WRITE (3,*) 'THERE ARE NO DOWNLINK CITIES IN THIS SEGMENT'
0165  GO TO 99999

C

C ORGANIZATION NAMES AND NUMBERS
C

0169  7000 IF (NUMORG.EQ.0) GO TO 7200
0170  7025 FORMAT ('O','ORGANIZATION NAMES AND NUMBERS'/)
0171  DO 7100 I = 1,NUMORG
0172  7050 FORMAT (1X,20A1,5X,I1)
0173  7100 CONTINUE
0174  GO TO 99999
0175  7200 WRITE (3,*) 'THERE ARE NO ORGANIZATIONS IN THIS SCENARIO'
0176  GO TO 99999

C

C AUXILIARY PARAMETERS
C

0179  8000 WRITE (3,8010) DDDINS, WATINS, PUTINS,
2 DDDLES, WATLES, PUTFIX,
3 PVTHIL,
4 DDDCPH, WATCPH,
5 WATMAX,
6 DISCNT,EOPLIF, (CTYPE(I), GANDAD(I), I=1,4),TLKCAP
0180  8010 FORMAT (1H0,/'AUXILIARY PARAMETERS',/,,
2 'TALKBACK',24X,'DDD',8X,'WATS',8X,'PUT',/,,
3 'INSTALLATION',13X,F10.2,2X,F10.2/,
4 'ZERO UC GE CHARGE/MO.',4X,F10.2,F10.2/,
5 'MILEAGE CHARGE',32X,F10.2/, 
6 'HOURLY CHARGE',12X,F10.2,2X,F10.2/,,
7 'MAXIMUM CHARGE',23X,F10.2,/,,
8 'AMORTIZATION',/,,

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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,20A1)
0188 9200 CONTINUE
0189 9300 GO TO 99999
0190 DO 9400 I=1,NDELEM
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),
0199 (USTCOD(I,J),J=1,2)
0200 10100 FORMAT (1X,16A1,2X,I1,4X,2A1)
0201 10200 CONTINUE
0202 DO 10300 I=1,NDCITY
0203 WRITE (3,10100) (DCTNAM(I,J),J=1,16),DCTORG(I),
0204 (DSTCOD(I,J),J=1,2)
0205 10100 FORMAT (1X,16A1,2X,I1,4X,2A1)
0206 10200 CONTINUE
0207 99999 WRITE (3,*) ''
0208 RETURN
0209 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-AO
AO: .FCTR RDCOST-RATECK
.END

MODEL.ODL

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

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 cost reflect the costs of building scenarios, processing the earth terminal data base, 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>Time and Dollar Expenditure</th>
<th>Commercial Time-Sharing Service</th>
<th>Government-owned or Privately owned PDP-11 Minicomputer</th>
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<tr>
<td>Installation</td>
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<td></td>
<td></td>
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<tr>
<td>Manpower</td>
<td>2 man-weeks</td>
<td>2 man-days</td>
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<tr>
<td>Computer Charges</td>
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<tr>
<td>Software Maintenance</td>
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<tr>
<td>Familiarization</td>
<td>2 man-days*</td>
<td>2 man-weeks</td>
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<tr>
<td>Monthly Maintenance</td>
<td>3 man-days</td>
<td>3 man-days</td>
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</tr>
<tr>
<td>Computer Charges</td>
<td>$100</td>
<td>$0</td>
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</tr>
<tr>
<td>Monthly On-Line Storage Charges</td>
<td>$500</td>
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<tr>
<td>Hardware Maintenance</td>
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<td>0-$600**</td>
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<tr>
<td>Customer Service</td>
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</tr>
<tr>
<td>Model Assistance</td>
<td>3 man-days per month</td>
<td>Same</td>
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</tr>
<tr>
<td>(depends on model usage)</td>
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<td>Network Consulting</td>
<td>As required, directly billable</td>
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<tr>
<td>Administration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Billing</td>
<td>2 man-days per month</td>
<td>2 man-days per month</td>
<td>$244 for 10 hours and $18.31 for each additional hour 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>
<td></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).