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FINAL REPORT

VIDEO DISTRIBUTION SYSTEM COST MODEL

July 1980

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


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ARINC RESEARCH CORPORATION
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by

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ABSTRACT

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

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

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

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

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

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

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

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

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

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

1.3 REPORT ORGANIZATION

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

- 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**

```
Start

Television Studio

Microwave Link

AT&T Video Link

New Earth Terminal

Existing Earth Terminal

Transponder Lease
```

**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</td>
<td>KS20, KS21**</td>
</tr>
<tr>
<td>Communication</td>
<td></td>
</tr>
</tbody>
</table>

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

Figure 2-6. SAMPLE EARTH TERMINAL RECORD
CHAPTER THREE

CASES ANALYZED

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


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


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

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

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

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

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

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

3.1 **FEDERAL CITIES NETWORK**

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

Washington is the only uplink city; however, a separate studio and video link is required for each department. These are necessary to originate the programming and transmit it to a single uplink facility located in the Washington area. Transmission to the uplink terminal could be accomplished by either a leased video line or a microwave link. Principally because of the lower operating costs, microwave links were found to be less expensive than AT&T video lines.
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>NWH</td>
<td>Secretary</td>
<td>8</td>
<td>2 hrs/wk</td>
<td>Office of the Secretary</td>
</tr>
<tr>
<td></td>
<td>SSA</td>
<td>9</td>
<td>5 hrs/wk</td>
<td>Social Security Administration</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></td>
<td>10</td>
<td>32 hrs/mo</td>
<td>Congressmen discussions with constituents</td>
</tr>
<tr>
<td>U.S. Senate</td>
<td></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>Available Option</th>
<th>Uplink</th>
<th>Downlink</th>
<th>Voice Talkback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanta, GA</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Boston, MA</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Chicago, IL</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Cleveland, OH</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Dallas, TX</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Denver, CO</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>WATS</td>
</tr>
<tr>
<td>Fort Worth, TX</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Houston, TX</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Kansas City, MO</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>New York, NY</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>San Diego, CA</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>--</td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Washington, DC</td>
<td>Private Earth Terminal, studio, microwave links</td>
<td>--</td>
<td>--</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>931,944</td>
</tr>
<tr>
<td><strong>Total Annualized Cost</strong></td>
<td>210,510**</td>
<td>61,077**</td>
<td>311,857</td>
<td>348,500</td>
<td>931,944</td>
</tr>
</tbody>
</table>

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

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

### 3.2 APPALACHIAN EDUCATIONAL SATELLITE PROJECT (AESP)

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

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

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

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

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

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

**This was an early estimate of AESP talkback that was later revised.

3-5
### Table 3-3. APPALACHIAN EDUCATIONAL SATELLITE PROJECT

<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>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td></td>
<td></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 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>66,000</td>
<td>275,726</td>
</tr>
<tr>
<td>Downlink</td>
<td>705,000</td>
<td>0**</td>
<td>0</td>
<td>317,977</td>
</tr>
<tr>
<td>Voice Talkback</td>
<td>88,000</td>
<td>4,752</td>
<td>0</td>
<td>158,722</td>
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<tr>
<td>Administrative</td>
<td>0</td>
<td>160,100</td>
<td>0</td>
<td>138,734</td>
</tr>
<tr>
<td>Totals</td>
<td>1,078,000</td>
<td>169,852</td>
<td>294,500</td>
<td>891,159</td>
</tr>
</tbody>
</table>

Total Annualized Cost

| Total Annualized Cost | 284,373 | 44,806 | 267,482 | 294,500 | 891,161 |

*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>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle, WA</td>
<td></td>
<td>Private Earth Terminal</td>
<td>Monitors Only</td>
<td>--</td>
</tr>
<tr>
<td>Fairbanks, AK</td>
<td></td>
<td>Private Earth Terminal</td>
<td>Monitors Only</td>
<td>--</td>
</tr>
<tr>
<td>Boise, ID</td>
<td></td>
<td>Private Earth Terminal</td>
<td>Monitors Only</td>
<td>--</td>
</tr>
<tr>
<td>Spokane, WA</td>
<td></td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Pullman, WA</td>
<td></td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Anchorage, AK</td>
<td></td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Billings, MT</td>
<td></td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Ketchikan, AK</td>
<td></td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Whitefish, MT</td>
<td></td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Anacortes, WA</td>
<td></td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Pocatello, ID</td>
<td></td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Bethel, AK</td>
<td></td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>WATS</td>
</tr>
<tr>
<td>Missoula, MT</td>
<td></td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
<tr>
<td>Great Falls, MT</td>
<td></td>
<td>--</td>
<td>Private Earth Terminal</td>
<td>Private Line</td>
</tr>
</tbody>
</table>

### Cost Summary

<table>
<thead>
<tr>
<th>Model Segment</th>
<th>Capital Expenditures</th>
<th>Planning and Installation</th>
<th>Annual Lease</th>
<th>Annual O&amp;M&amp;A</th>
<th>Annualized Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uplink</td>
<td>1,140,000</td>
<td>20,000</td>
<td>266,450</td>
<td>264,000</td>
<td>836,455</td>
</tr>
<tr>
<td>Downlink</td>
<td>180,000</td>
<td>0</td>
<td>33,000</td>
<td>60,483</td>
<td>80,483</td>
</tr>
<tr>
<td>Voice Talkback</td>
<td>22,000</td>
<td>1,105</td>
<td>58,572</td>
<td>0</td>
<td>64,667</td>
</tr>
<tr>
<td>Administrative</td>
<td>0</td>
<td>160,100</td>
<td>96,500</td>
<td></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
estimated "range" of a CATV network beyond the earth terminal.) For this case, the only costs would be for equipment to receive the additional frequency at the earth terminal and feed it into the local distribution network, and for user subscription charges. (3) One-hop microwave from an existing terminal is a feasible option if the sites are less than 20 miles apart; (4) two-hop microwave is feasible if they are less than 100 miles apart. (5) If a downlink city is also an uplink city (Lexington, for example), the cost of the earth terminal has already been allocated in the uplink segment; therefore, earth terminal costs will not be counted in the downlink segment as well.

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

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

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

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

The total network required a one-time investment of about $5.1 million and incurred annual lease and maintenance costs of about $1.1 million. Assuming an amortization rate of 10 percent for 8 years, annual expenses were about $2.0 million. Only about 7 percent of this figure is saved as a result of sharing. In the next case to be discussed, the "West" Case, there is much more overlap between the subnetworks and consequently more significant savings.
## Table 3-5. "EAST" CASE

### Selected Options

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

### Cost Summary

<table>
<thead>
<tr>
<th>Model Segment</th>
<th>Capital Expenditures</th>
<th>Planning and Installation</th>
<th>Annual Lease</th>
<th>Annual O&amp;M&amp;A</th>
<th>Annualized Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uplink</td>
<td>1,585,000</td>
<td>180,000</td>
<td>393,200</td>
<td>300,000</td>
<td>1,400,612</td>
</tr>
<tr>
<td>Downlink</td>
<td>915,000</td>
<td>109,200</td>
<td>7,020</td>
<td>129,300</td>
<td>129,347</td>
</tr>
<tr>
<td>Voice Talkback</td>
<td>136,000</td>
<td>1,479</td>
<td>158,118</td>
<td>0</td>
<td>183,887</td>
</tr>
<tr>
<td>Administrative</td>
<td>0</td>
<td>160,100</td>
<td>0</td>
<td>96,500</td>
<td>126,510</td>
</tr>
<tr>
<td>Totals</td>
<td>4,636,000</td>
<td>450,778</td>
<td>559,380</td>
<td>525,800</td>
<td>2,040,351</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>GROUP A: Private earth terminal downlink only</th>
<th>GROUP B: (continued)</th>
<th>GROUP F: Private earth terminal, CATV Link, or two-hop microwave; no talkback required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dublin, GA</td>
<td>Sylva, NC</td>
<td>Florence, AL</td>
</tr>
<tr>
<td>Fayetteville, NC</td>
<td>Athens, OH</td>
<td>Decatur, AL</td>
</tr>
<tr>
<td>Salisbury, NC</td>
<td>Pittsburgh, PA</td>
<td>Birmingham, AL</td>
</tr>
<tr>
<td>Copley, NC</td>
<td></td>
<td>Chatsworth, GA</td>
</tr>
<tr>
<td>Altoona, PA</td>
<td></td>
<td>Dalton, GA</td>
</tr>
<tr>
<td>Wilkes-Barre, PA</td>
<td></td>
<td>Barbourville, KY</td>
</tr>
<tr>
<td>Johnson City, TN</td>
<td></td>
<td>Crooksville, OH</td>
</tr>
<tr>
<td>Clarksville, WV</td>
<td></td>
<td>Elkins, WV</td>
</tr>
<tr>
<td>Guntersville, AL</td>
<td></td>
<td>Wytheville, VA</td>
</tr>
<tr>
<td>Rainelle, AL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rainsville, AL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clayton, GA</td>
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<tr>
<td>Rome, GA</td>
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<tr>
<td>Boone, NC</td>
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</tr>
<tr>
<td>Marion, NC</td>
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</tr>
<tr>
<td>Morganton, NC</td>
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<tr>
<td>Ebensburg, PA</td>
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<tr>
<td>Edinboro, PA</td>
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<td></td>
</tr>
<tr>
<td>Smethport, PA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tazewell, TN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petersburg, WV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stickletyville, VA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Romney, WV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scooba, MS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alfred, NY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morehead, KY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP B: Private earth terminal or two-hop microwave</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazard, KY</td>
<td>Gadsden, AL</td>
<td>Cumberland, KY</td>
</tr>
<tr>
<td>Somerset, KY</td>
<td>Huntsville, AL</td>
<td>Frostburg, MD</td>
</tr>
<tr>
<td>McHenry, MD</td>
<td>Cumberland, MD</td>
<td>Salamanca, NY</td>
</tr>
<tr>
<td>Tupelo, MS</td>
<td>Greenville, SC</td>
<td>Erie, PA</td>
</tr>
<tr>
<td>Fredonia, NY</td>
<td>Spartanburg, SC</td>
<td>Emporium, PA</td>
</tr>
<tr>
<td></td>
<td>Cookeville, TN</td>
<td>Nelsonville, OH</td>
</tr>
<tr>
<td></td>
<td>LaFollette, TN</td>
<td>New Lexington, OH</td>
</tr>
<tr>
<td></td>
<td>Norton, VA</td>
<td>Moundsville, WV</td>
</tr>
<tr>
<td></td>
<td>Gainesville, GA</td>
<td>Wellsburg, WV</td>
</tr>
</tbody>
</table>

**3.5 "WEST" CASE**

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

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

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

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

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

Savings resulting from sharing occur in all three major segments of the model. In the uplink, only three transponder frequencies are required to serve the member networks, instead of the nine frequencies that would be required without sharing. This reduction in the number of frequencies saves approximately $940,000 annually. Sharing downlink equipment eliminates the need for 24 earth terminals and video links, which results in annual savings of approximately $78,000. Common talkback facilities could save about $7,600 per year; these savings would occur primarily on equipment expenditures.
Table 3-6. "WEST" CASE

Selected Options

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<thead>
<tr>
<th>City</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; 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>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>
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<td>--</td>
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<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) WATS (to Washington)</td>
</tr>
<tr>
<td>Washington, DC</td>
<td>Private Earth Terminal; link required</td>
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<td>--</td>
</tr>
<tr>
<td>11 Federal Cities</td>
<td>--</td>
<td>Private Earth Terminals</td>
<td>Private Line</td>
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<td>Grand Junction, CO</td>
<td>--</td>
<td>CATV Link</td>
<td>DDD</td>
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<td>Menlo Park, CA</td>
<td>--</td>
<td>Private Earth Terminals</td>
<td>DDD</td>
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<td>Group A (48)</td>
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<td>Private Earth Terminals</td>
<td>DDD</td>
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<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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<td>442,000</td>
<td>681,200</td>
<td>774,000</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>202,886</td>
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<td>160,100</td>
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<tr>
<td>Totals</td>
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<td>725,836</td>
<td>987,867</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.
DEFINITION OF CITY GROUPS

<table>
<thead>
<tr>
<th>GROUP A: Private downlink earth terminal</th>
<th>GROUP B: CATV Link</th>
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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 collocated 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 collocated 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.
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<th>Microwave from E-T</th>
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<th>Selected Path</th>
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<th>b</th>
<th>c</th>
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</tbody>
</table>

(continued)
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 1,500 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 3-7. (continued)

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<th>City/State</th>
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<th>Cable TV E-T</th>
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Table 3-8(a). OVERALL COST SUMMARY -- SMSA CASE 1

FEDERAL REGIONAL OFFICES

OVERALL COST SUMMARY

<table>
<thead>
<tr>
<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>
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<tbody>
<tr>
<td>UPLINK</td>
<td>199400.</td>
<td>51000.</td>
<td>180000.</td>
<td>101000.</td>
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<tr>
<td>DOWNLINK</td>
<td>77000.</td>
<td>3000.</td>
<td>1800.</td>
<td>1000.</td>
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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**

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<thead>
<tr>
<th></th>
<th>Capital Planning and Expenditures</th>
<th>Annual Installation</th>
<th>Annual Leases</th>
<th>Annual O&amp;M</th>
<th>Annualized Cost</th>
</tr>
</thead>
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<td><strong>212085.</strong></td>
<td><strong>188200.</strong></td>
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<tr>
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<td><strong>43912.</strong></td>
<td><strong>212085.</strong></td>
<td><strong>188200.</strong></td>
<td><strong>517150.</strong></td>
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</table>

**EFFECTIVE YEARLY COSTS FOR 8 YEAR; 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>
<td>UPLINK</td>
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<td>180,000</td>
<td>101,000</td>
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<td>2,520</td>
<td>84,914</td>
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<td>285,520</td>
<td>274,634</td>
<td>205,900</td>
<td>689,413</td>
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</table>

ANNUALIZED COST  

151,403  57,476  274,634  205,900  689,413

EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $ 689,413.
Table 3-8(d). OVERALL COST SUMMARY -- SMSA CASE 4

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

OVERALL COST SUMMARY

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

3.8 COST ALLOCATION CASE

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

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

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

Table 3-11 shows the results of this scenario. Because the SMSA network has more sites than the Federal network and since it must pay peak-hour surcharges in addition, it is allocated about 65 percent of the total network cost. The allocated Federal network cost of $332,221 is lower than the $481,107 cost estimated for the Federal network alone in Case 1 of the SMSA cases.
# Table 3-9. Uplink Costs by City — Federal Regional Programming

<table>
<thead>
<tr>
<th>City</th>
<th>Capital</th>
<th>Install</th>
<th>Lease</th>
<th>O&amp;M</th>
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<td>1.1</td>
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<tr>
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<td>59400</td>
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<td>11700</td>
<td>44878</td>
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<tr>
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<td>104700</td>
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<td>1.1</td>
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<td></td>
</tr>
</tbody>
</table>

**Uplink Total**: 1611500. 310000. 180000. 592000. 1158804.
Table 3-10. OVERALL COST SUMMARY — FEDERAL REGIONAL PROGRAMMING

OVERALL COST SUMMARY

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

ANNUALIZED COST  455525. 118269. 240279. 708800. 1522873.

EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION —— $1522873.
<table>
<thead>
<tr>
<th></th>
<th>CAPITAL</th>
<th>INSTALL</th>
<th>LEASE</th>
<th>O&amp;M ANNUALIZED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UPLINK</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 FEDERAL OFFICES</td>
<td>143165</td>
<td>36617</td>
<td>162500</td>
<td>72516</td>
</tr>
<tr>
<td>2 SMSA'S</td>
<td>255635</td>
<td>65383</td>
<td>290160</td>
<td>129484</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>398800</td>
<td>102000</td>
<td>452660</td>
<td>202000</td>
</tr>
<tr>
<td><strong>DOWNLINK</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 FEDERAL OFFICES</td>
<td>50200</td>
<td>1800</td>
<td>1800</td>
<td>1000</td>
</tr>
<tr>
<td>2 SMSA'S</td>
<td>142400</td>
<td>22200</td>
<td>2880</td>
<td>6500</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>192600</td>
<td>24000</td>
<td>4680</td>
<td>7500</td>
</tr>
<tr>
<td><strong>VOICE TALKBACK</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 FEDERAL OFFICES</td>
<td>87</td>
<td>240</td>
<td>8611</td>
<td>0</td>
</tr>
<tr>
<td>2 SMSA'S</td>
<td>218</td>
<td>600</td>
<td>14976</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>305</td>
<td>840</td>
<td>23587</td>
<td>0</td>
</tr>
<tr>
<td><strong>ADMINISTRATIVE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 FEDERAL OFFICES</td>
<td>0</td>
<td>53333</td>
<td>0</td>
<td>28323</td>
</tr>
<tr>
<td>2 SMSA'S</td>
<td>0</td>
<td>106667</td>
<td>0</td>
<td>56667</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>0</td>
<td>160000</td>
<td>0</td>
<td>85000</td>
</tr>
<tr>
<td><strong>TOTAL NETWORK</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 FEDERAL OFFICES</td>
<td>193452</td>
<td>91990</td>
<td>172911</td>
<td>101849</td>
</tr>
<tr>
<td>2 SMSA'S</td>
<td>398253</td>
<td>194850</td>
<td>308016</td>
<td>192651</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>591705</td>
<td>286840</td>
<td>480927</td>
<td>294500</td>
</tr>
</tbody>
</table>

**FEDERAL REGIONAL PROGRAMMING**

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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

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameras: 2 Cameras (modest quality)</td>
<td>$16,000</td>
</tr>
<tr>
<td>Remote controls on cameras</td>
<td>3,000</td>
</tr>
<tr>
<td>Switching</td>
<td>3,000</td>
</tr>
<tr>
<td>Lighting</td>
<td>1,500</td>
</tr>
<tr>
<td>Microphones</td>
<td>1,500</td>
</tr>
<tr>
<td>Mixer</td>
<td>1,500</td>
</tr>
<tr>
<td>Video monitors</td>
<td>2,000</td>
</tr>
<tr>
<td>Audio monitors</td>
<td>500</td>
</tr>
<tr>
<td>Echo suppressor</td>
<td>3,000</td>
</tr>
<tr>
<td>Synch generator</td>
<td>1,500</td>
</tr>
</tbody>
</table>
### 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><strong>$42,000</strong></td>
</tr>
</tbody>
</table>

### Operating Costs

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

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recurring Costs</strong></td>
<td><strong>$9,200</strong></td>
</tr>
</tbody>
</table>

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

#### Capital Costs

- Cameras: 40,000
- Remote control: 3,000
- Switching: 6,000
- Lighting: 3,000
- Microphones: 5,000
- Mixer (audio): 5,000
- Synch generator: 2,500
- Video monitors: 2,000
- Large screen display: 4,000
- Video cassette machine: 4,000
- Audio monitors: 1,500
- Echo suppressor: 3,000
- Character generator capability: 3,500
- Room modifications: 7,500
- Installation costs: 7,500

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Capital</strong></td>
<td><strong>$92,500</strong></td>
</tr>
</tbody>
</table>

#### Operating Costs

- Production
- Writing: 25,000
- Scheduling
- Maintenance 10 percent: 9,250

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recurring Costs</strong></td>
<td><strong>$34,250</strong></td>
</tr>
</tbody>
</table>

---

A-2
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>
</tbody>
</table>

Operating

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer/Director</td>
<td>25,000</td>
</tr>
<tr>
<td>Cameras (3)</td>
<td>45,000</td>
</tr>
<tr>
<td>Maintenance (1)</td>
<td>17,500</td>
</tr>
<tr>
<td>Coordinator</td>
<td>11,000</td>
</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>
</tbody>
</table>
Installation $5,000
Licensing, frequency coordination 1,000
Total $33,400
Operations and maintenance (per year) 2,500

Double Hop Link

Tower stubs (3) $3,000
Transmit and receive electronics 36,000
Shelter (at midpoint) 5,000
Waveguide 500 feet 3,000
Antenna and feed (4) 2,000
Pressurizing system (3) 1,350
Miscellaneous 2,000
Installation 7,500
Licensing, frequency coordination 2,000
Total $61,850
Operations and maintenance (per year) 3,300

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>Peak*</td>
<td>Off-Peak*</td>
<td>Anytime</td>
</tr>
<tr>
<td>$750/hr</td>
<td>$650/hr</td>
<td>$350/hr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fixed Term</th>
<th>Protected</th>
<th>Unprotected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak</td>
<td>Off-Peak</td>
<td>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></td>
<td>Anytime</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$300/hr</td>
<td></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
EARTH STATION COSTS

Receive-Only Earth Station

<table>
<thead>
<tr>
<th>Component</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>
</tbody>
</table>

Total $20,200

Operations and maintenance (per year)

Total 1,500

Two-Way Earth Station

<table>
<thead>
<tr>
<th>Component</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>
</tbody>
</table>

Total $233,500

Maintenance and operations (per year)

(2 people and parts)

Total 95,000

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.

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any particular location is to construct an extensive data base. (The PSSC is currently undertaking this task.)

**Typical Charges:**

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

**AT&T VIDEO LINK**

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

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

**VOICE TALKBACK COSTS**

**Talkback Capital Costs**

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

**Direct Dial Costs**

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

**WATS Costs**

- Based on interstate tariff "L"  
  First ten hours (per month)  
  $240.00  
  Each additional hour  
  $18.00

**Private Line Costs**

- Based on MPL tariff  
  First two terminations  
  $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>
<td>Management</td>
<td>$25,000</td>
</tr>
<tr>
<td>Overhead</td>
<td>$59,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$160,100</strong></td>
</tr>
</tbody>
</table>

### Operations & Maintenance (per year)

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

*PSSC Estimates
SAMPLE SCENARIO

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

TITLE - Sample Scenario Containing Nominal Costs

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

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

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

UPLINK COST ELEMENTS:

DATA FOR COST ELEMENT SU -- SATELLITE USAGE

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MINIMUM LEASE COST = $180000.00

DATA FOR COST ELEMENT S3 -- CASE 3 STUDIO COSTS

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MINIMUM LEASE COST = $0.00
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### DATA FOR COST ELEMENT VL -- AT&T VIDEO LK TO TOC

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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*
UPLINK COST/PATH MATRIX:

SU S3 M1 VL T2 S1 M2

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

DOWNLINK COST INDEXES - fixed, per peak hour, per off-peak hour, organization.

DOWNLINK COST INDEX WEIGHING 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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DATA FOR COST ELEMENT CT -- RENT COM 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

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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

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

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MINIMUM LEASE COST = 0.00

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

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MINIMUM LEASE COST = -10000.00

DOWNLINK COST/PATH MATRIX:

CH CT PT M1 VL CU CC MT M2 NC

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

UPLINK CITIES - There are no uplink cities.

DOWNLINK CITIES - There are no downlink cities.

AUXILIARY PARAMETERS - see below.

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<td>MAXIMUM CHARGE</td>
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<td>1200.00</td>
</tr>
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</table>

AMORTIZATION:

| INTEREST RATE | 12.00 PERCENT |
| EQUIPMENT LIFE | 8.00 YEARS |

A-13
GENERAL AND ADMINISTRATIVE:

<p>| | |</p>
<table>
<thead>
<tr>
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<th></th>
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<tr>
<td>CAP</td>
<td>0.00</td>
</tr>
<tr>
<td>INS</td>
<td>160000.00</td>
</tr>
<tr>
<td>LES</td>
<td>0.00</td>
</tr>
<tr>
<td>OHA</td>
<td>85000.00</td>
</tr>
</tbody>
</table>

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](image)

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

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

2. SOFTWARE STRUCTURE

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

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

-------------------------------

BUILD - SCENARIO BUILDER

-------------------------------

BUILD

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

Calls: COST, PATH, CITY, RATE, READIN, RITOUT, YESNO.
COST

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

Called By: BUILD

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

PATH

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

Called By: BUILD

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

CITY

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

Called By: BUILD

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

RATE

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

Called By: BUILD

Calls: YESNO, GETTER, CODCHK, RATECK, REPRTR

MODEL

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

MODEL - COST ALGORITHMS
MODUP  Execute 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-specific 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, GIDCHK, 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).
NZINDX(2)  Number of cost indexes (overlay).
NPATH(2)  Number of paths (overlay).
NSTART  Pointer into input buffer.
NUCITY  Number of uplink cities (10).
NUELEM  Number of uplink cost elements (15).
NUINDX  Number of uplink cost indexes (6).
NUMORG  Number of member organizations (9).
NUPATH  Number of uplink paths (10).
NUPREF(NDCITY)  Preferred path for each city.
OMACST  OMA cost of least-cost path.
ORGNAM(NUMORG,20)  20-character member organization name.
PER  Literal 'PER'.

B-8
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSITN</td>
<td>General index pointer into an array</td>
</tr>
<tr>
<td>PVTFIX</td>
<td>Private line zero-mileage monthly charge.</td>
</tr>
<tr>
<td>PVTINS</td>
<td>Private line installation charge.</td>
</tr>
<tr>
<td>PVTLES</td>
<td>Private line monthly lease charge for a given city pair in talkback segment.</td>
</tr>
<tr>
<td>PVTMIL</td>
<td>Private line monthly lease charge per mile.</td>
</tr>
<tr>
<td>REPLST(20,2)</td>
<td>Literal numbering for output reports.</td>
</tr>
<tr>
<td>REPNUM(20)</td>
<td>On/off array for report requests.</td>
</tr>
<tr>
<td>RUNSEC(4)</td>
<td>On/off array for execution of the different segments of the model.</td>
</tr>
<tr>
<td>TALKBK</td>
<td>Number of talkback hours for a given city pair.</td>
</tr>
<tr>
<td>TCOST(6,5)</td>
<td>Total cost array for a network.</td>
</tr>
<tr>
<td>TITLE(72)</td>
<td>72-character title for output reports.</td>
</tr>
<tr>
<td>TLKCAP</td>
<td>Added capital expenditures required for adding voice talkback.</td>
</tr>
<tr>
<td>TORGCS</td>
<td>Talkback capital, installation, lease, OMA costs by member organization.</td>
</tr>
<tr>
<td>UCINDX(NUINDEX,8)</td>
<td>8-character uplink cost index name.</td>
</tr>
<tr>
<td>UCITYH(NUCITY)</td>
<td>Uplink city location -- H coordinate.</td>
</tr>
<tr>
<td>UCITYV(NUCITY)</td>
<td>Uplink city location -- V coordinate.</td>
</tr>
<tr>
<td>UCOSTX(NUCITY,4)</td>
<td>Capital, installation, lease, OMA costs for each uplink city.</td>
</tr>
<tr>
<td>UCSCOD(NUELEM,2)</td>
<td>2-character uplink cost element code.</td>
</tr>
<tr>
<td>UCSDAT(NUELEM,NUINDEX,4)</td>
<td>Capital, installation, lease, OMA costs for a given uplink cost element and cost index.</td>
</tr>
<tr>
<td>UCSMIN(NUELEM)</td>
<td>Minimum lease cost for a given uplink cost element.</td>
</tr>
<tr>
<td>UCSNAM(NUELEM,20)</td>
<td>20-character uplink cost element name.</td>
</tr>
<tr>
<td>U CSPTH(NUELEM,NUPATH)</td>
<td>Matrix of cost elements for each uplink path.</td>
</tr>
<tr>
<td>UCTCNH(NUCITY)</td>
<td>Uplink city channel assigned.</td>
</tr>
<tr>
<td>UCTNAM(NUCITY,16)</td>
<td>16-character uplink city name.</td>
</tr>
<tr>
<td>UCTORG(NUCITY)</td>
<td>Organization code for each uplink city.</td>
</tr>
<tr>
<td>UCTXVL(NUCITY,5)</td>
<td>Uplink city cost index values.</td>
</tr>
<tr>
<td>UDXWHT(NUINDEX)</td>
<td>Weighting factor for each uplink cost index.</td>
</tr>
<tr>
<td>UORGCS(NUMORG,5)</td>
<td>Uplink capital, installation, lease, OMA, annualized by member organization.</td>
</tr>
<tr>
<td>UPORDN(2,2)</td>
<td>Literal -- 'UPLINK', 'DOWNLINK'.</td>
</tr>
</tbody>
</table>
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,NUINDEX,5): Uplink capital, installation, lease, OMA, annualized costs for a given cost index and a given path.

USTCUD(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.

WGTPARR(NDCITY): Weight factors for cost allocation.

XDATA(NDINDEX): 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.
Figure B-2. MATRIX CALCULATIONS IN THE UPLINK AND DOWNLINK SEGMENTS

The first step in the computation process is to calculate the capital, installation, lease, and O&M cost of each path. That is,

\[ \text{NUELEM} \]

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

where

I = path number  
J = cost element subscript  
K = cost index subscript  
L = cost categories (1 = capital, 2 = installation, 3 = lease, 4 = OMA)
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,

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

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:

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

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

**DOWNLINK SEGMENT**

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

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

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

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

\[ \begin{align*}
I &= \text{path number} \\
J &= \text{cost element subscript} \\
K &= \text{cost index subscript} \\
L &= \text{cost categories}
\end{align*} \]

2. Calculate Cost of Each Path in Each City

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

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.
APPENDIX C

SAMPLE OUTPUTS

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:

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

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

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

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

Regulatory Classification

C - Common carrier
P - Private
D - Developmental

Type of Earth Station Facility

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

c. Size is the antenna size expressed in tenths of a meter.
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

AUXILIARY PARAMETERS

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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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DATA FOR COST ELEMENT S3 -- CASE 3 STUDIO COSTS

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

### MATRIX OF COST ELEMENTS AND PATHS -- UPLINK

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<th>M1</th>
<th>VL</th>
<th>T2</th>
<th>S1</th>
<th>M2</th>
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**Report 3 - Matrix of Cost Elements and Paths -- UPLINK**
### Matrix of Paths and Cities -- Uplink

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

UPLINK COST INDEX VALUES

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<th>Studio</th>
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REPORT 5 - UPLINK COST INDEX VALUES
### FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

#### MATRIX OF TALKBACK REQUIREMENTS

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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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<th>Studio</th>
<th>Grid Link</th>
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### PATH 2 -- VIDEO LINK TO E-T

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### PATH 3 -- USE OWN E-T

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### PATH 4 -- MICROWAVE TO OWN E-T

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<th>Peak HR</th>
<th>Off Peak HR</th>
<th>Studio</th>
<th>Grid Link</th>
</tr>
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</tr>
<tr>
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<td>125.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>95000.</td>
<td>0.0</td>
<td>0.0</td>
<td>98500.</td>
<td>2500.0</td>
</tr>
<tr>
<td>142004.</td>
<td>279</td>
<td>125.0</td>
<td>142183.0</td>
<td>9224.0</td>
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</tbody>
</table>

### PATH 5 -- VIDEO LK TO OWN E-T

<table>
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<th>Studio</th>
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<tr>
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</tr>
<tr>
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<td>45000.</td>
<td>2500.0</td>
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<td>0.0</td>
<td>279</td>
<td>125.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>95000.</td>
<td>0.0</td>
<td>0.0</td>
<td>98500.</td>
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</tr>
<tr>
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REPORT 7 - SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS -- UPLINK

C-12
<table>
<thead>
<tr>
<th>CITY</th>
<th>PATH</th>
<th>CAPITAL</th>
<th>INSTALL</th>
<th>LEASE</th>
<th>OIM&amp;A</th>
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REPORT 8 - COST OF EACH PATH -- UPLINK
### UPLINK COSTS BY CITY

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<th>O&amp;M&amp;A</th>
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<tr>
<td>STUDIO</td>
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<tr>
<td>GRID LINK</td>
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### DATA FOR COST ELEMENT CT -- RENT COM CARR L-T

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

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

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**MINIMUM LEASE COST = 0.00**

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

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**MINIMUM LEASE COST = 0.00**

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

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**MINIMUM LEASE COST = 0.00**

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

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

### DATA FOR COST ELEMENT M2 -- TWO-HOP MICROWAVE

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

(continued)
DATA FOR COST ELEMENT NC -- CATV COLOC WITH E-T

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<td>INS</td>
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MINIMUM LEASE COST = -10000.00

REPORT 10 - (continued)
### Matrix of Cost Elements and Paths -- Downlink

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<th>M</th>
<th>P</th>
<th>T</th>
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<th>V1</th>
<th>C1</th>
<th>C2</th>
<th>M2</th>
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<td>Own Link to CATV Sys</td>
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<td>13</td>
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<td>Private Earth Term</td>
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<td>Microwave to User</td>
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**Report 11 - Matrix of Cost Elements and Paths -- Downlink**

C-18
### 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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REPORT 13 - (continued)
### FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

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

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REPORT 14 (continued)

C-23
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

COST OF EACH PATH--DOWNLINK

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REPORT 15 - COST OF EACH PATH -- DOWNLINK

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| MILWAUKEE    | 3 | 15000 | 6200 | 0 | 1600 | 5868 |
|              | 4 | 28400 | 6000 | 36400 | 2600 | 45925 |
| WASHINGTON   | 1 | 7700 | 300 | 180 | 100 | 1890 |
|              | 2 | 44100 | 12500 | 180 | 4100 | 15674 |
|              | 3 | 15000 | 6200 | 0 | 1400 | 5868 |
|              | 4 | 28400 | 6000 | 36400 | 2600 | 45925 |
|              | 6 | 1000 | 0 | 0 | 100 | 301 |
|              | 7 | 2700 | 300 | 36580 | 100 | 37284 |

REPORT 15 - (continued)
### FEDERAL REGIONAL OFFICES: TOP 20 SMSA'S -- COST ALLOCATION CASE

**DOWNLINK COSTS BY CITY**

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

NETWORK COST ALLOCATION

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REPORT 18 - NETWORK COST ALLOCATION
FEDERAL REGIONAL OFFICES, TOP 20 SMSA'S -- COST ALLOCATION CASE

OVERALL COST SUMMARY

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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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DOWNLINK CITIES--EARTH STATIONS WITHIN 15 MILES AND LICENSED TO POINT TO KS30

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REPORT 20 - (continued)
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<td>KING VIDEOCABLE COMPANY</td>
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<td>PITTSBURGH</td>
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<td></td>
<td>ANTHONY MANCINI</td>
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<td>ANGELO VALENTE CO.</td>
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<td>CENTRE VIDEO INC.</td>
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<td>WESTERN PENNSYLVANIA CHRISTIAN BROA</td>
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### St. Louis - MO

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<tr>
<td>KZ26</td>
<td>Horizon Communications Corp. of H Hazelwood</td>
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<tr>
<td>KY76</td>
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<td>KV60</td>
<td>Evans Broadcasting Corp.</td>
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<td>KU94</td>
<td>The Christian Broadcasting Network</td>
<td>St. Louis</td>
<td>MO</td>
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<td>Cinema 8 Productions Inc.</td>
<td>St Louis</td>
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<td>WK31</td>
<td>Howard Cable Television Associates</td>
<td>Ellicott City</td>
<td>MD</td>
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<td>WJ49</td>
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<td>Cantonsville</td>
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<td>WM37</td>
<td>Genese Properties</td>
<td>Anna Arundel</td>
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<td>KR51</td>
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<td>KR40</td>
<td>Video Vista</td>
<td>West Houston</td>
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<td>MultiPoint-Texas Company</td>
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<td>WS24</td>
<td>Suburban Cablevision</td>
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<td>United Television, Inc.</td>
<td>Edina</td>
<td>MN</td>
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<td>KT98</td>
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REPORT 20 - (continued)

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APPENDIX D

PROGRAM LISTINGS

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

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

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

INTEGER*2 NUELEM, NDELEM, NUINDEX, NDINDEX, NUCITY, NDCITY, NUPATH, NDPATH
COMMON NUELEM, NDELEM, NUINDEX, NDINDEX, NUCITY, NDCITY, NUPATH, NDPATH
INTEGER*2 NELEM(2), NDELEM(2), NUINDEX(2), NDINDEX(2)
EQUIVALENCE (NUELEM, NELEM(1)), (NUINDEX, NDINDEX(1))
EQUIVALENCE (NUCITY, NUCITY(1)), (NUPATH, NUPATH(1))
INTEGER*2 NUMOR, MAXUCS, MAXDCS, MAXUQA, MAXDPA, MAXUCT, MAXDCT, BADD
COMMON NUMOR, MAXUCS, MAXDCS, MAXUQA, MAXDPA, MAXUCT, MAXDCT, BADD
INTEGER*2 MAXUCS(2), MAXDCS(2), MAXUCT(2)
EQUIVALENCE (MAXUCS, MAXUCS(1)), (MAXDCS, MAXDCS(1)), (MAXUCT, MAXUCT(1))
INTEGER*2 UCITYV(10), UCITYH(10), DCITYV(80), DCITYH(80)
COMMON UCITYV, UCITYH, DCITYV, DCITYH
INTEGER*2 NCHAR, NSTART, POSITN, YESSNO, CPPDWNP, POSITN
COMMON NCHAR, NSTART, POSITN, YESSNO, CPPDWNP, POSITN
REAL*4 UCSDAT(15), UCSDAT(30), UCSMIN(15), UCSMIN(30)
COMMON UCSDAT, UCSDAT, UCSMIN, UCSMIN
REAL*4 UCXWMT(6), UCXWMT(6), UDXWHT(6), DDXWHT(6), TALKBK(80,10), XDATA(6)
COMMON UDXWHT, DDXWHT, TALKBK, XDATA
LOGICAL*1 UCSCOD(1S), UCSCOD(30), UCSCOD(15), UCSCOD(30)
COMMON UCSCOD, UCSCOD, UCSCOD
LOGICAL*1 UCSPTH(15,10), UCSPTH(30,20), UCSPTH(15,10), UCSPTH(30,20)
COMMON UCSPTH, UCSPTH, UCSPTH, UCSPTH
LOGICAL*1 UCSTNM(10,16), UCSTNM(30,2), UCSTNM(10,16), UCSTNM(30,2)
COMMON UCSTNM, UCSTNM, UCSTNM, UCSTNM
LOGICAL*1 INDATA(80), INDATA(80), INDATA(9,20), UCINDEX(6,8)
COMMON INDATA, INDATA, ORGNAM, UCINDEX
LOGICAL*1 UPTNMN(10,20), UPTNMN(20,20), UPTNMN(10,20), UPTNMN(20,20)
COMMON UPTNMN, UPTNMN, UPTNMN, UPTNMN
LOGICAL*1 CTORG(10), CTORG(80), CTORG(10), CTORG(80)
COMMON CTORG, CTORG, CTORG, CTORG
LOGICAL*1 TITLE(72)
COMMON TITLE
THIS IS THE MAIN PROGRAM FOR THE MODEL

SUBROUTINE CALLS: READIN, COST, PATH, CITY, KATE, 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

0001 Include 'SYO:COMBLK.FTN/NOLIST'
0039 DATA MAXUCS /15/, MAXDCS /30/, MAXUPA /10/, MAXDPA /20/
0040 DATA MAXUCT /90/, MAXDCT /90/
0041 DATA UCINDX /'F'95*, 'P'I'PS*, 'r'X'#5*, 'P'E'PS*, 'r'D'#23*
0042 DATA DCINDX /'F'#$*, 'P'I'PS*, 'r'X'.5*, 'P'E'PS*, 'r'D'.23*

OPEN AND READ USER-SELECTED SCENARIO FILE

CALL READIN
WRITE (1,8) 'SCENARIO TITLE IS...'
WRITE (1,10) (TITLE(I),I=1,72)
10 FORMAT ('O'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 (1,8) '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 (1,8) '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
SUBROUTINE COST

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
DSCCOD - 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
ORGNAM - 20 CHAR NAMES OF MEMBER ORGANIZATIONS FOR ALLOCATING COSTS
UCINDX - 8 CHARACTER COST INDEX NAMES FOR UPLINK
DCINDX - DOWNLINK
UDXWHT - WEIGHTING FACTORS FOR COST ALLOCATION OF UPLINK COSTS
DDXWHT - DOWNLINK
CSTCMD - ARRAY OF COMMANDS FOR USE IN THE COST MODULE
CBMCMD - ARRAY OF SUBCOMMANDS USED IN THE COST MODULE

SCALAR VARIABLES

NUELEM - NUMBER OF UPLINK COST ELEMENTS
NDELEM - DOWNLINK
NUINDX - NUMBER OF UPLINK COST INDEXES
NDINDX - DOWNLINK
UPPDWN - FLAG SET TO SPECIFY UPLINK OR DOWNLINK PROCESSING
XDAT, XDATA - VARIABLES USED TO READ USER RESPONSE INTO
C
SUBROUTINE CALLS: GETTER, CODCHECK, DISAPPR, REPTR
YESNO, UPDOWN, RDCOST, MATHMOD

THIS ROUTINE CALLED BY: BUILD

INCLUDE 'SYOICOMBLK.FTN/NOLIST'

LOCAL VARIABLES

LOGICAL: MODFLG,CSTMND(S,3),CSTMND(9,3)
REAL: PER,INPUTZ
DATA PER,'/'/PER,'/
DATA CSTCMD,'/E','I','A','N','D','L'/'
2,'I','D','D','E','L','S'
DATA CSTMND,'/C','I','L','O','M','O','N','R','E'
2,'A','E','R','O','A','D','X','N','I'/

LOCAL VARIAMS

0040  NUMORG  = 0
0050  IF ( NUMORG.EQ.0 ) WRITE(1,'(A)') 'NO ORGANIZATIONS SPECIFIED.'
0055  IF ( NUMORG.EQ.0 ) WRITE(1,'(A)') 'COST ALLOCATION IGNORED.'
C TOO MANY MEMBERS
C
0066 95 WRITE (1,9) 'ONLY 9 ORGANIZATIONS CAN BE SPECIFIED'
C
C
C ASK FOR UPLINK OR DOWNLINK PROCESSING
C
C
C
0067 97 WRITE(1,9) 'DO YOU WANT TO EDIT UPLINK OR DOWNLINK COST DATA?'
0068 WRITE(1,9) ' (UP OR DOWN)'
0069 CALL UPDOWN
0070 IF (UPDOWN.EQ.3) GO TO 97
C
C
C MODIFY COST INDEXES
C
C
C
0071 100 WRITE (1,9) 'DO YOU WANT TO MODIFY COST INDEXES?'
0072 CALL YESNO
C
0073 106 GO TO (120,280,100) YESNO
0074 120 NINDEX(UPDOWN) = 1
0075 122 WRITE (1,9) 'ENTER NEW LIST OF COST INDEX NAMES'
0076 125 READ (1,1010) (INDATA(I),I=1,80)
0077 130 CALL GETTER
0078 132 IF (ARG(1).EQ. '1') GO TO 150
0079 IF (NINDEX(UPDOWN).EQ.0) GO TO 130
0080 IF (NINDEX(UPDOWN).EQ.6) GO TO 145
0081 NINDEX(UPDOWN) = NINDEX(UPDOWN) + 1
0082 DO 133 J=1,8
0083 IF (UPDOWN.EQ.1) UCINDEX(NINDEX,J) = ARG(J)
0084 IF (UPDOWN.EQ.2) DCINDEX(NINDEX,J) = ARG(J)
0085 133 CONTINUE
0086 138 IF (CONTCD.EQ.0) GO TO 122
0087 IF (CONTCD.NE.0) GO TO 130
C
C TOO MANY INDEXES: INPUT
C
C
C
0090 145 WRITE (1,9) 'ONLY 6 COST INDEXES CAN BE SPECIFIED'
C
C
C ENTER COST INDEX WEIGHTING FACTORS
C
C
D-9
COST.FTN

0089 150 IF (NUMORG.EQ.0) GO TO 280
0090  WRITE (1,*,'ENTER WEIGHTING FACTORS FOR COST INDEXES')
0091  ASSIGN 150 TO BADD
0092  GO TO (152,160) UPDPWN
0093 152 WRITE (1,1200) (UCINDX(I,J),J=1,8),I=1,NUINDEX)
0094  READ (1,*,'ERR=170') (XDATA(I),I=1,NUINDEX)
0095  DO 155 I=1,NUINDEX
0096  155 UDXWHT(I) = XDATA(I)
0097  GO TO 280
0098 160 WRITE (1,1200) (DCINDX(I,J),J=1,8),I=1,NDINDEX)
0099  READ (1,*,'ERR=170') (XDATA(I),I=1,NDINDEX)
0100  DO 165 I=1,NDINDEX
0101  165 DDXWHT(I) = XDATA(I)
0102  GO TO 280

C C ERROR IN READ
C
0103 170 WRITE(1,*,'ERROR IN READING NUMERICAL DATA--PLEASE RE-ENTER')
0104  GO TO BADD

C C COST COMMAND PROCESSING
C
0105 280 WRITE (1,*,'ENTER COST COMMAND')
0106  READ (1,1010) (INDATA(I),I=1,80)
0107  CALL GETTER
0108  CALL CODCHK (3,ARG,CSTCMD,POSITN)
0109  IF (POSITN .NE. 0 ) GO TO (900,400,705,900) POSITN
0110  WRITE (1,*,'INVALID COST COMMAND')
0111  WRITE(1,*,'VALID COMMANDS ARE: EXI,ADD,DEL,MOD,LIS')
0112  GO TO 280

C C ADD COST ELEMENT
C
0113 400 WRITE (1,*,'ENTER NEW COST ELEMENT CODE - 2 CHARACTERS')
0114  ASSIGN 400 TO BADD
0115  CALL RDCOST
L-A
COST,FTN
/TRYLOCKS/WR
0116 IF (NCHAR.EQ.1.AND.ARG(1).EQ.'I') GO TO 280
0117 IF (POSITN.EQ.0) GO TO 410
0118 WRITE (1,*) 'COST ELEMENT CODE ALREADY EXISTS'
0119 WRITE (1,*) 'USE A DIFFERENT CODE'
0120 GO TO BADD
C
C ERROR -- TOO MANY COST ELEMENTS
C
0121 IF (NELEM(UPPDWN) .LT. MAXCS(UPPDWN)) GO TO 415
0122 WRITE (1,*) 'ONLY 'MAXCS(UPPDWN)' COST ELEMENTS CAN BE SPECIFIED'
0123 GO TO 280
C
CCCCC staple:ADD NEW ELEMENT CODE TO ARRAY
C
0124 NELEM(UPPDWN) = NELEM(UPPDWN) + 1
0125 NCSTEL = NELEM(UPPDWN)
0126 IF (NCSTEL.EQ. MAXCS(UPPDWN))
0127 DO 417 I=1,2
0128 WRITE (1,*) 'THIS IS THE LAST COST ELEMENT WHICH MAY BE ADDED'
0129 CONTINUE
0130 CONTINUE
0131 IF (MODFLG.EQ.1) GO TO 523
C
CCCCC staple:ADD COST ELEMENT NAME
C
0132 WRITE (1,*) 'ENTER NEW COST ELEMENT NAME'
0133 ASSIGN 420 TO BADD
0134 READ (1,1010) (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 (POSITN.EQ.0) GO TO 430
0139 WRITE (1,*) 'COST ELEMENT NAME ALREADY EXISTS'
0140 WRITE (1,*) 'USE A DIFFERENT NAME'
0141 GO TO BADD
C
CCCCC staple:MOVE NEW NAME TO ITS ARRAY
C
0142 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 CONTINUE
0146 IF (MODFLG.EQ.1) GO TO 523

D-11
C COST.FTN /TR:BLOCKS/WR

C CCCCCCCCCCCCCCCCCCCC
C C ENTER COSTS FOR EACH COST INDEX - CAP, INS, LES, OMA
C C CCCCCCCCCCCCCCCCCCCC
C
0147 WRITE ( 1,18 ) 'COST INDEXES ARE:'
0148 IF (UPPDWN.EQ.1) WRITE (1,1200) ((UCINDX(I,J), J=1,8), I=1,NUINDX)
0149 IF (UPPDWN.EQ.2) WRITE (1,1200) ((DCINDX(I,J), J=1,8), I=1,NDINDEX)
0150 432 WRITE (1,18) 'ENTER CAPITAL COST (ENTER A VALUE FOR EACH COST INDEX)
0151 ASSIGN 432 TO BADD
0152 READ (1,18,ERR=170) (XDATA(I),I=1,NINDEX(UPPDWN))
0153 DO 434 J=INPINDEX(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 C CCCCCCCCCCCCCCCCCCCC
C C ENTER INSTALLATION COSTS
C C CCCCCCCCCCCCCCCCCCCC
C
0157 440 WRITE (1,18) 'ENTER INSTALLATION COSTS'
0158 ASSIGN 440 TO BADD
0159 READ (1,18,ERR=170) (XDATA(I),I=1,NINDEX(UPPDWN))
0160 DO 434 J=INPINDEX(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 C CCCCCCCCCCCCCCCCCCCC
C C ENTER LEASE COSTS
C C CCCCCCCCCCCCCCCCCCCC
C
0164 450 WRITE (1,18) 'ENTER LEASE COSTS'
0165 ASSIGN 450 TO BADD
0166 READ (1,18,ERR=170) (XDATA(I),I=1,NINDEX(UPPDWN))
0167 DO 434 J=INPINDEX(UPPDWN)
0168 IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J,3) = XDATA(J)
0169 IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J,3) = XDATA(J)
0170 434 CONTINUE
C C CCCCCCCCCCCCCCCCCCCC
C C ENTER OMA COSTS

D-12
C   C CCCCCCCCCCCCCCCCCCCCCCCCC
C 0171 465 WRITE (1,*) 'ENTER OPERATIONS AND MAINTENANCE COSTS'
0172   ASSIGN 465 TO BADD
0173   DO 470 J=1,HINDX(UPFDWN)
0174       IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J+4) = XDATA(J)
0175       IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J+4) = XDATA(J)
0176   470 CONTINUE
C   C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C 0178   471 WRITE (1,*)'ENTER MINIMUM LEASE COST (IF APPLICABLE, OTHERWISE 0)'  
0179       ASSIGN 471 TO BADD
0180   READ (1,*ERR=170) XDATA(1)
0181       IF (UPPDWN.EQ.1) UCSMIN(NCSTEL) = XDATA(1)
0182       IF (UPPDWN.EQ.2) DCSMIN(NCSTEL) = XDATA(1)
0183   DO 475 I=1,NPATH(UPPDWN)
0184       IF (UPPDWN.EQ.1) UCSPTH(NCSTEL,J) = 0
0185       IF (UPPDWN.EQ.2) DCSPTH(NCSTEL,J) = 0
0186   475 CONTINUE
C 0187   WRITE (1,*) 'ENTER PATH NAMES TO WHICH THIS COST ELEMENT IS TO BE ADDED'
0188   J = UPPDWN + 2
0189   CALL MATMOD(J+NCSTEL)
0190   IF (.MODFLG .EQ. 1 ) GO TO 523
0191   GO TO 280
C   C CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C 0192   500 WRITE (1,*)'ENTER COST ELEMENT CODE TO BE MODIFIED'
0193   CALL RDGOST
0194   IF ( POSIT .NE. 0 ) GO TO 510
0195   WRITE (1,*) 'COST ELEMENT CODE DOES NOT EXIST'
0196   GO TO 280

D-13
C
C ENTER MODIFIED CODE
C
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 UCSCOD(POSITN,J),J=1,2))UCSNAM(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) (UCSNAM(INDATA(I),J),J=1,20)
0209 GO TO 523
C
C BRANCH TO MODIFY COST SUBCOMMAND
C
0210 530 GO TO (540,540,540,540,540,620,640,660,680,700),POSITN
C
C MODIFY CAPITAL, INSTALL, LEASE, OR O+M COSTS
C
0211 540 GO TO (541,561),UPPDWN
0212 541 WRITE (1,1210) (INDATA(J),J=1,3),(UCSCOD(NCSTEL,J),J=1,2),
2 UCSCOD(NCSTEL,J),J=1,20)
0213 IF (NUINDX.GE.2) WRITE(1,1220) (PER, J=2,NUINDX)
0214 WRITE (1,1230) (UCINDEX(I),J=1,8),I=1,NUINDX)
0215 WRITE (1,1240) (UCSDAT(NCSTEL,J),POSITN),J=1,NUINDX)
0216 WRITE (1,1280)
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

D-14
WRITE (1, 1210) (INDATA(J), J=1,3), (DCSCOD(NCSTEL,J), J=1,2),  
2  (DCSNAM(NCSTEL,J), J=1,20)  
IF (NDINDX .GE. 2) WRITE(1, 1220) (PER-DX(J), J=1,NDINDX)  
WRITE (1, 1230) (DCINDX(I,J), J=1,8), I=1,NDINDX)  
WRITE (1, 1240) (DCSDAT(NCSTEL,J,POSITN, J=1,NDINDX)  
WRITE (1, 1280)  
WRITE (1, 1290) 'ENTER CHANGE - N+VALUE OR 0+0 TO END'  
ASSIGN 565 TO BADD  
READ (1, *, ERR=170) KINPUT2  
IF (K .LE. 0) WRITE(1, 1240) (DCSDAT(NCSTEL,J,POSITN), J=1,NDINDX)  
IF (K .LE. 0) 00 TO 523  
IF (K .LE. NDINDX) 00 TO 580  
WRITE (1, 1250) K  
GO TO 545  
DCSDAT(NCSTEL,K,POSITN) = INPUT2  
GO TO 545  
C  
C MODIFY COST ELEMENT CODE  
C  
C MODIFY COST ELEMENT NAME  
C  
C ADD A COST ELEMENT TO A PATH  
C
C
C REMOVE A COST ELEMENT FROM A PATH
C
C
C 0259 WRITE ( 1,* ) 'ENTER PATH NAMES FROM WHICH THIS COST ELEMENT IS TO 2 BE REMOVED'
C
0260 J = UPFDWN + 2
C
0261 CALL MATMOD(JPOPNCSTEL)
C
C
C DELETE COMMAND
C
C
C 0263 WRITE ( 1,* ) 'ENTER COST ELEMENT CODE TO BE DELETED'
C
0264 CALL RDCOST
C
0265 IF ( ARG(1) .EG. '3') GO TO 280
C
0266 IF ( POSITION .E0. 0 ) GO TO 710
C
0267 WRITE(1,1260)(UCSNAM(POSITION(I)),I=1,20)
C
0268 WRITE(1,1260)(DCSNAM(POSITION(I))+1,20)
C
0269 CALL YESNO
C
C YES NO ERR
C
0270 GO TO (708, 280, 706) YESNO
C
0271 708 CALL DISAPR(UPPDWN, POSITION)
C
0272 WRITE(1,*),'****************** WARNING **********************'
C
0273 WRITE(1,*),'ALL COST ELEMENTS HAVE BEEN DELETED'
C
0274 WRITE(1,*),'IN THIS SEGMENT'
C
0275 WRITE(1,*),'THE MODEL WILL NOT WORK UNLESS AN ELEMENT IS ADDED'
C
0276 WRITE(1,*),'****************** ERROR IN COST CODE ******************'
C
0277 GO TO 280
C
C ERROR IN COST CODE
C
C
0279 WRITE (1,* ) 'COST ELEMENT CODE DOES NOT EXIST'
C
0280 GO TO 280
C
C LIST COST ELEMENT INFORMATION
C
C
C 0281 WRITE ( 1,* ) 'ENTER LIST SPECIFICATION'
C
0282 N=0
C
0283 READ ( 1,1010 ) (INDATA(I),I=1,80)

D-16
CALL GETER
IF (NCHAR.EQ.0) GO TO 804
IF (ARG(1).EQ.'A' .AND. ARG(2).EQ.'L'.AND. ARG(3).EQ.'L')
* GO TO 820
IF (ARG(1).EQ.'P' .AND. ARG(2).EQ.'A' .AND. ARG(3).EQ.'T')
2 GO TO 840
IF (ARG(1).EQ.'C' .AND. ARG(2).EQ.'O' .AND. ARG(3).EQ.'S')
2 GO TO 860
IF (ARG(1).EQ.'I') GO TO 800
IF (UPPDWN.EQ.1) CALL CODCHK (2#AKG#MAXUCS#UCSCOD#POSITN )
IF (UPPDWN.EQ.2) CALL CODCHK (2#ARG#MAXDCS#DCSCOD#POSITN )
IF (POSITN .EQ. 0 ) GO TO 810
CALL REPRTR (1#POSITN )
CALL REPRTR (1#POSITN)
IF (CONTCD.EQ.0) GO TO 800
IF (CONTCD.NE.0) GO TO 803
WRITE (1#*)'INVALID LIST OPTION'
WRITE (1#*)'LIST OPTIONS ARE: ALL, COST, PATH, A COST ELEMENT CODE,' 2 OR I'
GO TO 800
DO 830 I = 1#NELEM(UPPDWN) 820
CALL REPRTR (1#I)
CONTINUE
CALL REPRTR (2#1) 840
GO TO 280
CALL REPRTR (9#1) 860
GO TO 280
EXIT COMMAND
0306  900  IF (UPPDWN.EQ.2) GO TO 950
0307         WRITE (lr*) 'DO YOU WANT TO MODIFY OWNLINK COST DATA?'
0308         CALL YESNO
0309         C
0310         GO TO (910,950,900), YESNO
0311  910  UPPDWN = 2
0312  950  RETURN

0313  1010  FORMAT (80A1)
0314  1020  FORMAT (1H ,2A1,' -- ',20A1/)
0315  1200  FORMAT (1X,6(8A1,2X))
0316  1210  FORMAT (1M0,3A1,' COSTS FOR ',2A1,' -- ',20A1)
0317  1220  FORMAT (1H ,19X,5(7X,A4))
0318  1230  FORMAT (1H ,8X,6(3X,8A1))
0319  1240  FORMAT (1H ,6X,6F11.2)
0320  1250  FORMAT (1M0, 'SPECIFIED SUBSCRIPT TOO LARGE:' , I10)
0321  1260  FORMAT (1X,'COST ELEMENT TO DELETE IS ',20A1, ' Y OR N')
0322  1270  FORMAT (1X,'VALID COMMANDS: ',9(1X,3A1))
0323  1280  FORMAT (1X,'N = 1 2 3 4
2 5 6')
0324  END
PATH.FTN  

0001 SUBROUTINE PATH

PATH MODULE

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

ARRAY VARIABLES

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

SCALAR VARIABLES

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

SUBROUTIN CALLS: GETTER, YESNO, CODCHK, DISAPR, REPTR, UFDOWN, MATMOD

CALLED BY: BUILD

INCLUDE 'SYC:COMBLK.FTN/NOLIST'

LOCAL VARIABLES

INTEGER*2 CURENTrORG
LOGICAL*1 PTHLST(4,2), PTHCMD(8,5), PTHCMD(5,3)
DATA PTHCMD /'E','A','N','D','L,'
   2 'X','D','O','E','I'
   3 'I','D','D','L','S'
DATA PTHLST /'C','C','P','A','I'
   2 'D','T','A','A','I'
DATA PTHCMD /'A','D','N','A','D','N','E','E'
   2 'D','E','E','D','E','E','E','X'
   3 'D','L','W','D','L','W','W','I'
   4 'C','C','C','L','C','N','T'
   5 'O','O','O','I','I','A','I'

ASK IF THE USER WANTS TO ENTER PATH DATA

C
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PATH.FTN /

0045 3000 WRITE (1,*),'DO YOU HAVE PATH INFORMATION TO ENTER?
0046 CALL YESNO
0047 C YES NO ERR
0048 3010 WRITE (1,*),'UPLINK OR DOWNLINK?'
0049 CALL UPDOWN
0050 IF(UPPDWN.EQ.3) GO TO 3010
0051 C PATH COMMAND PROCESSING
0052 3015 WRITE (1,*),'ENTER PATH COMMAND'
0053 READ (1,4910) (INDATA(I),I=1,80)
0054 CALL CODCHK (3,INDATA(5:PT+CMD,POSITN))
0055 IF (POSITN.EQ.0) GO TO 3020
0056 C BRANCH ON PATH COMMAND
0057 3020 WRITE (1,*),'INVALID PATH COMMAND'
0058 GO TO 3015
0059 C CHECK FOR TOO MANY PATHS
0060 3100 IF (NPATH(UPPDWN).LT.MAXPA(UPPDWN)) GO TO 3110
0061 3105 WRITE (1,*),'ONLY MAXPA(UPPDWN) PATHS CAN BE SPECIFIED'
0062 C ADD COMMAND
0063 3110 IF (ARG(1).EQ.')') GO TO 3015
0064 CALL GETTER
0065 IF (UPPDWN.EQ.1) CALL CODCHK (16,ARG(MAXUPA,UPTDNM,POSITN))
0066 IF (UPPDWN.EQ.2) CALL CODCHK (16,ARG(MAXDPA,DPTDNM,POSITN))
0067 IF (POSITN.EQ.0) GO TO 3120

D-20
C OR
"IT - AN: V-'LU. 0. "] ..
PATH.FTN

0096 3310 WRITE (1,8) 'PATH DOES NOT EXIST'
0097 3315 WRITE (1,8) 'SPECIFIED PATH NOT UNIQUE - ENTER MORE INFORMATION'
0099 GO TO 3300

C

C BRANCH TO MODIFY SUBCOMMAND
C

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

C

C ADCD,DLCD,MHC,ADCC,DLCC,MHCC,MHCC,EXIT
0105 GO TO (3340,3360,3380,3380,3390,3420,3440,3460,3480,3480,3500,3510,POSITN

C

C NO SUCH COMMAND
C

0106 3333 WRITE (19*) 'INVALID SUBCOMMAND. VALID SUBCOMMANDS ARE...
0107 WRITE (19,29)((PTMCMD(I,J),J=1,5),I=1,8)
0108 GO TO 3320

C

C ADD A COST ELEMENT TO PATH
C

0109 3340 WRITE (1,8) 'ENTER LIST OF COST ELEMENT CODES TO ADD TO PATH'
0110 CALL MATMOD(UPPDWN,1,CURRENT)
0111 GO TO 3320

C

C DELETE A COST ELEMENT FROM PATH
C

0112 3360 WRITE (1,8) 'ENTER LIST OF COST ELEMENT CODES TO DELETE FROM PATH'
0113 CALL MATMOD(UPPDWN,0,CURRENT)
0114 GO TO 3320

C

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
PATH.FTN

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

C CCCCCCCCCCCCCCCCCCCCCC
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 + UPPDOWN
0124 CALL MATMOD (J+1,CURRENT)
0125 GO TO 3320

C CCCCCCCCCCCCCCCCCCCCCC
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 + UPPDOWN
0128 CALL MATMOD (J,0,CURRENT)
0129 GO TO 3320

C CCCCCCCCCCCCCCCCCCCCCC
C REPLACE CITIES FOR PATH
C CCCCCCCCCCCCCCCCCCCCCC

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

C CCCCCCCCCCCCCCCCCCCCCC
C REPLACE PATH NAME
C CCCCCCCCCCCCCCCCCCCCCC

0138 3460 WRITE (1,*),'ENTER THE NEW NAME FOR PATH'
0139 ASSIGN 3460 TO BADD
0140 READ (1,4910) (INDATA(I),I=1,BO)
0141 CALL GETTER
0142 IF (UPPDWN.EQ.1) CALL CODCHK (20,ARGP,MAXUFAP,DPTHNM,POSITN)
0143 IF (UPPDWN.EQ.2) CALL CODCHK (20,ARGP,MAXDFP,DPTHNM,POSITN)
0144 IF (POSITN.NE.0) GO TO 3115
0145  DO 3465 I = 1,20
0146   IF (UPPDWN.EQ.1) UPTHNM (CURRENT9I) = ARG (I)
0147   IF (UPPDWN.EQ.2) DPTHNM (CURRENT9I) = ARG (I)
0148  CONTINUE
0149  GO TO 3320
0150  WRITE ( 19* )'ENTER PATH NAME TO DELETE FROM SCENARIO'
0151  READ ( 19910 ) (INDATA(I)rI=1,80)
0152  CALL GETTER
0153  IF (ARG(1).EQ.'i') GO TO 3015
0154  IF (UPPDWN.EQ.1) CALL CODCHK(NCHAR9ARG9MAXUPA9UP(HNM9POSITN )
0155  IF (UPPDWN.EQ.2) CALL CODCHK(NCHAR9ARG9MAXDPA9DPTHNM9POSITN )
0156  IF (POSITN .EQ. -1 .AND. UPPDWN .EQ. 1) CALL CODCHK(20vARG9MAXUPAr
2UPTHNM9POSITN)
0157  IF (POSITN .EQ. -1 .AND. UPPDWN .EQ. 2) CALL CODCHK(209ARG9MAXDPA92
DPTHNM9POSITN)
0158  IF (POSITN .EQ. -1) GO TO 3515
0159  IF (POSITN .EQ. 0 ) GO TO 3310
0160  J = 2 + UPPDWN
0161  CALL DISAPR (J9POSITN )
0162  IF (NPATH(UPPDWN) .GT. 0) GO TO 3015
0163  WRITE(19*)'**************dolt* WARNING ##************'
0164  WRITE(19*)'
MODEL WILL NOT WORK UNLESS A PATH IS ADDED'
0165  WRITE(19*)'****#**#**********************************'
0166  GO TO 3015
0167  3515 WRITE (19*) 'SPECIFIED PATH NOT UNIQUE - ENTER MORE INFORMATION'
0168  GO TO 3500
0169  C
0170  3600 WRITE ( 19* )'ENTER LIST SPECIFICATION ' 
0171  READ ( 194910 ) (INDATA(I),I=1,80)
0172  CALL GETTER
0173  CALL CODCHK (29ARG949PTHLST9POSITN )
0174  IF ( POSITN .EQ. 0 ) GO TO 3610
0175  C
0176  3615 WRITE (19*)'COST CITY PATH :'
0177  3616 GO TO ( 3620, 3630, 3640, 3015) POSITN
0178  C
0179  3620 COST CITY PATH :
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PATH.FTN  /TR:BLOCKS/WR

0176  3610  WRITE (1,*), 'INVALID LIST OPTION'
0177    WRITE (1,*), 'VALID COMMANDS: COST, CITY, PATH'
0178    GO TO 3600
C
CCCCCCCCCCCCCCCCCCCCCCCC
C
C PRINT PATH/COST MATRIX
C
CCCCCCCCCCCCCCCCCCCCCCCC
C
0179  3620  CALL REPRTR (2,1)
0180    GO TO 3015
C
CCCCCCCCCCCCCCCCCCCCCCCC
C
C PRINT PATH/CITY MATRIX
C
CCCCCCCCCCCCCCCCCCCCCCCC
C
0181  3630  CALL REPRTR (4,1)
0182    GO TO 3015
C
CCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C PRINT PATH NAMES AND NUMBER
C
CCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0183  3640  CALL REPRTR (3,1)
0184    GO TO 3015
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C EXIT FROM PATH MODULE
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
0185  3700  IF (UPPDWN.EQ.2) GO TO 3720
0186    WRITE (1,*), 'DO YOU WANT TO MODIFY DOWNLINK PATH DATA?'
0187    CALL YESNO
0188    GO TO (3710,3720,3700), YESNO
0189  3710  UPPDWN = 2
0190    GO TO 3015
0191  3720  RETURN
0192  4910  FORMAT (8OA1)
0193  4920  FORMAT (1X,COMMANDS: ',8(1X,A1))
0194    END

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CITY MODULE

SUBROUTINE CITY

THE CITY MODULE IS USED TO DEFINE OR MODIFY THE CHARACTERISTICS
OF THE CITIES WHICH COMPREHEND THE NETWORK UNDER CONSIDERATION.
The user can add, modify or delete cities from the network
AND ASSOCIATE PATHS WITH CITIES. CITY DATA INCLUDES NAME (AND
MEMBER ORGANIZATION IF APPLICABLE), STATE, LOCATION (LATITUDE/
LONGITUDE OR BELL SYSTEM V AND H COORDINATES), CHANNEL NUMBER
(FOR UPLINK CITIES), HIERARCHICAL LEVEL (FOR DOWNLINK CITIES),
COST INDEX VALUES, AND FEASIBLE PATHS.

ARRAY VARIABLES

UCXVL - VALUES ASSOCIATED WITH UPLINK COST INDEXES
DCTXVL - DOWNLINK

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

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

UCITYV - VERTICAL COORDINATES FOR UPLINK CITIES
DCITYV - DOWNLINK

UCITYH - HORIZONTAL COORDINATES FOR UPLINK CITIES
DCITYH - DOWNLINK

DCTVL - THE HIERARCHICAL LEVEL OF EACH DOWNLINK CITY

UCTCHN - THE CHANNEL ASSIGNED TO EACH UPLINK CITY

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

SCALAR VARIABLES

NUCITY - NUMBER OF UPLINK CITIES
NDCITY - NUMBER OF DOWNLINK CITIES

LATLON - FLAG TO TELL THE PROGRAM WHEN V AND H COORDINATES ARE
INPUT IN TERMS OF LATITUDE AND LONGITUDE

SUBROUTINE CALLS: GETTER+, YESNO+, CODCHN+, DISAPR+, REPRTR,
UPDOWN+, MATMOD+, CTYCHN+, VANDH

CALLED BY: BUILD

INCLUDE 'SYO:COMBLK.FTN/NOLIST'

LOCAL VARIABLES
LOGICAL*1 MODFLG, BYPASS, CTYCMD(6:3), CTLSTS(8:4), MODSUB(10:4), BLANK
INTEGER*2 ORGNUM, CURRENT, LAT, LON
REAL*4 UD
DATA BLANK/’/"

DO YOU HAVE CITY INFORMATION TO ENTER?

 validating COMMANDS ARE: ADD, OVER, MOD, DEL, LIST, EXIT

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

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

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

ERROR IN RESPONSE

INVALID CITY COMMAND
valid COMMANDS ARE: ADD, OVER, MOD, DEL, LIST, EXIT

ADD OR OVERLAY COMMANDS
CITY.FTN	 /TR:BLOCKS/WR

OVERLAY CITIES

0063  6050  BYPASS = 1
0064  IF ( NUMORG .GT. 0 ) GO TO 6100
C   NO COST ALLOCATION - INVALID COMMAND IN THIS CASE
C  WRITE (1,*)'INVALID COMMAND UNLESS COST ALLOCATION IS USED'
0066  BYPASS = 0
0067  GO TO 6015
0068  6100  WRITE (1,*)'ENTER CITY NAME (/ORG)'
0069  ASSIGN 6100 TO BADD
0070  READ ( 1,7990) (INDATA(I)+IO3.80)
0071  MODFLG = 0
0072  CALL GETTER
0073  IF(ARGV(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 ORGANIZAION 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
C 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
C 0077  IF ( POSITN .GT. 0 .AND. ORGNUM .EQ. 0 ) GO TO 6322
C OVERLAY

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C
IF ( BYPASS .EQ. 1 .AND. 
POSITN .GT. 0 .AND. 
ORDNUM .GT. 0 ) GO TO 6102
C
ADD
C
IF ( BYPASS .NE. 1 .AND. 
POSITN .EQ. 0 .AND. 
ORDNUM .GT. 0 .AND. 
NUMORG .GT. 0 ) GO TO 6102
C
IF ( POSITN .EQ. 0 ) GO TO 6315
IF ( POSITN .GT. 0 ) GO TO 6322
C
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) .EQ. 1 ) UD = 'UP'
WRITE (1,*)'THIS IS THE LAST CAY YOU MAY ADD TO:'
FORMAT (1X,'A4,'LINK')
IF ( UPPDOWN .EQ. 1 ) GO TO 6104
CURREN = NCITY(UPPDWN)
IF ( NUMORG .GT. 0 ) DCTORG(CURRENT) = ORGNUM
GO TO 6105
C
6104 CURRENT = NCITY(UPPDWN)
6105 IF ( NUMORG .EQ. 0 ) UCTORG(CURRENT) = ORGNUM
DO 6106 I=1,NCHAR
IF ( UPPDOWN .EQ. 1 ) UCTNM(CURRENT,I) = ARG(I)
IF ( UPPDOWN .EQ. 2 ) DCTNM(CURRENT,I) = ARG(I)
6106 CONTINUE
IF ( NCHAR .EQ. 15 ) GO TO 6110
NCHAR = NCHAR + 1
DO 6107 I=NCHAR,16
IF ( UPPDOWN .EQ. 1 ) UCTNM(CURRENT,I) = BLANK
IF ( UPPDOWN .EQ. 2 ) DCTNM(CURRENT,I) = BLANK
6107 CONTINUE
IF ( BYPASS .EQ. 1 ) GO TO 6175
C
READ (1,7777) (INDATA(I),I=1,2)
0110 DO 6120 I=1,2
0111 IF (UPPDWN.EQ.1) USTCOD(CURRENT,I)=INDATA(I)
0112 IF (UPPDWN.EQ.2) DSTCOD(CURRENT,I)=INDATA(I)
0113 6120 CONTINUE

C ENTER V AND H COORDINATES

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) GO TO 6135
0118 IF (LON .LT. 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 V COORDINATE INPUT AS LATITUDE

0122 6135 LAT = LON
0123 LATLON = 1

C ENTER H COORDINATE AS LONGITUDE

0124 6145 WRITE (1,#) 'ENTER THE POSITIVE LONGITUDE (0DDMM) FOR THIS CITY'
0125 ASSIGN 6145 TO PADD
0126 READ (1,*ERR=7000) LON
0127 IF (LON .LT. 0) GO TO 6135
0128 IF (UPPDWN .EQ. 2) GO TO 6150
0129 UCITYV(CURRENT)=LAT
0130 UCITYH(CURRENT)=LON
0131 GO TO 6155
0132 6150 DCITYV(CURRENT)=LAT
0133 DCITYH(CURRENT)=LON
0134 6155 IF (MODFLG .EQ. 1) GO TO 6525
0135 GO TO 6155

C ENTER HORIZONTAL COORDINATE

0136 6160 WRITE (1,#) 'ENTER HORIZONTAL COORDINATE FOR THIS CITY'
0137 ASSIGN 6160 TO PADD
0138 READ (1,*ERR=7000) LON
0139 IF (LON .GT. 15000 .OR. LON .LT. 0) GO TO 7100
0140 IF (UPPDWN.EQ.1) UCITYH(CURRENT)=LON
0141 IF (UPPDWN.EQ.2) DCITYH(CURRENT)=LON
0142 GO TO 6150
0143 6170 IF (MODFLG .EQ. 1) GO TO 6525
0144 GO TO 6180

C OVERLAY COMMAND WITH EXISTING CITY
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    USTDOD(CURRENT,1) = USTDOD(PO\$ITN,1)
0148    USTDOD(CURRENT,2) = USTDOD(PO\$ITN,2)
0149    UCITYV(CURRENT) = UCITYV(PO\$ITN)
0150    UCITYH(CURRENT) = UCITYH(PO\$ITN)
0151    GO TO 6180
0152  6177 DCTORG(CURRENT) = ORGNUM
0153    DSTDOD(CURRENT,1) = DSTDOD(PO\$ITN,1)
0154    DSTDOD(CURRENT,2) = DSTDOD(PO\$ITN,2)
0155    DCITYV(CURRENT) = DCITYV(PO\$ITN)
0156    DCITYH(CURRENT) = DCITYH(PO\$ITN)
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    UCTCHN(CURRENT) = LON
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    DCTRLVL(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
/TR:BLOCKS/WR

0174 6196 WRITE (1,*),'ENTER THE VALUE FOR NUMBER OF...'
0175         ASSIGN 6196 TO BADD
0176         WRITE (1,6197) (UCINDX(I,J),J=1,J)
0177 6197 FORMAT (2X,4AI)
0178         READ (1,*,ERR=7000) UCTXVL(CURENT,I-1)

0179 6200 CONTINUE
0180         GO TO 6213

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

0188 6213 IF ( MODFLG .EQ. 1 ) GO TO 6525

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

0194 6240 CONTINUE
0195         GO TO 6015

0196 6235 WRITE (1,6236) (UCTNAM(I,J),J=1,16),UCTORG(I)
0197 6236 FORMAT (1X,'ENTER TALKBACK HOURS TO: ',16A1,'/',I1)
0198         ASSIGN 6235 TO BADD
0199         READ(1,*,ERR=7000) TALKBK(CURENT,I)

0200 6240 CONTINUE

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
IF ( ARG(I) .EQ. 'I' ) GO TO 6015
CALL CTYCHK ( POSITN, ORGNUM )
IF ( POSITN .GT. 0 .AND. ORGNUM .EQ. 0 ) GO TO 6325
IF ( POSITN .LT. 0 ) GO TO 6300
IF ( ORGNUM .GT. 0 ) GO TO 6320

C

CHECK FOR EXISTANCE OF CITY/ORGANIZATION COMBINATION
C
C CITY DOES NOT EXIST
C
WRITE (19*) 'CITY DOES NOT EXIST'
GO TO 6015
C
C CITY/ORGANIZATION COMBO DOES NOT EXIST
C
WRITE (1r*) 'CITY/ORG COMBINATION DOES NOT EXIST'
GO TO 6015
C
WRITE (1r*) 'CITY AND ORG COMBINATION ALREADY EXIST'
GO TO 6015
C
C
C CURRENT = POSITN
MODFLG = 0
READ (1,7990) (INDATA(I),I=1,80)
CALL GETTER
CALL CODCHK ( 4, ARG(I), MODSUB, POSITN )
IF ( POSITN .EQ. 0 ) GO TO 6330
C
BRANCH ON MODIFY SUBCOMMAND
C
MODFLG = 1
VAND CHAN CHLV INDE ADDP DELP CHGP CHGN TALK EXIT
GO TO ( 6130, 6390, 6195, 6215, 6550, 6600, 6625, 6630, 6015 ) POSITN
C
NO SUCH MODIFY COMMAND
C
WRITE (1r*) 'INVALID SUBCOMMAND'
WRITE (1r*) 'COMMANDS ARE: VAND, CHAN, CHLV, INDE, ADDP, DELP, CHGP, CHGN, TALK, EXIT'
GO TO 6330
C
CHANGE CHANNEL ASSIGNMENT
CITY.FTN /TR:LOCKS/WR

0229 6380 IF ( UPPDWN .NE. 2 ) GO TO 6180
0230 WRITE (1,*)'THIS COMMAND VALID ONLY FOR UPLINK CITIES'
0231 GO TO 6327

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

C FINISHED WITH MODIFY - RESET FLAG AND ASK FOR ANOTHER COMMAND

0235 6525 MODFLG=0
0236 GO TO 6327

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

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,1,CURRENT )
0246 MODFLG = 1
0247 GO TO 6327

C CHANGE LEVEL
C

C CHANGE PATHS ( REPLACE PATHS )
C

C CHANGE CITY NAME
C

C
0249 6625 WRITE (1,*)'ENTER NEW NAME FOR THIS CITY'
0250 ASSGN 6625 TO BADD
0251 READ (1,7990)(INDATA(I),I=1,10)
0252 CALL GETTER
0253 IF (UPPDWN.EQ.1) CALL LDCCHK(NCHAR,ARG,MAXUCT,UCTNAM,POSITN)
0254 IF (UPPDWN.EQ.2) CALL CDCHCK(NCHAR,ARG,MAXC,CTNAM,POSITN)
0255 IF (POSITN.GT.0) GO TO 6322
0256 IF (UPPDWN.EQ.2) GO TO 6628
0257 DO 6627 I=1,NCHAR
0258 6627 UCTNAM(CURRENT(I)) = ARG(I)
0259 GO TO 6630
0260 6628 DO 6629 I=1,NCHAR
0261 6629 DCTNAM(CURRENT(I)) = ARG(I)
0262 NCHAR=NCHAR+1
0263 DO 6627 I
0264 IF (UPPDWN.EQ.1) UCTNAM(CURRENT(I))=BLANK
0265 IF (UPPDWN.EQ.2) DCTNAM(CURRENT(I))=BLANK
0266 CONTINUE
0267 6640 CONTINUE
0268 GO TO 6327

C
C CHANGE TALKBACK PARAMETERS
C
0269 6650 IF (UPPDWN.EQ.1) GO TO 6390
0270 6651 WRITE (1,*)'ENTER UPLINK CITY NAME (/ORG)'
0271 ASSGN 6651 TO BADD
0272 READ (1,7990)(INDATA(I),I=1,80)
0273 CALL GETTER
0274 IF (ARG(1).EQ.'1') GO TO 6327

C UPPDWN MUST BE 1 TO CHECK UPLINK CITIES
C
0275 UPPDWN = 1
0276 CALL CITCHK(POSITN,ORGNUM)
0277 UPPDWN=2
0278 IF (POSITN.LT.0) GO TO 6651
0279 IF (POSITN.EQ.0) GO TO 6315
0280 IF (POSITN.GT.0 AND. ORGNUM.EQ.0) GO TO 6652
0281 GO TO 6320
0282 TALKBK(POSITN,CURRENT) = 0
0283 6653 WRITE (1,*)'ENTER TALKBACK HOURS'
0284 ASSIGN 6653 TO BADD
0285 READ (1,*,ERR=7000)(XLON)
0286 IF (XLON.LT.0 OR. XLON.GT.9999.9) GO TO 7100
0287 TALKBK/CURRENT,POSITN) = XLON
0288 GO TO 6327

C
C NO SUCH CITY
C
DELETE A CITY FROM THE SCENARIO

C
C

0288  6700  WRITE ( 1,8 ) 'ENTER CITY (/ORG) 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') GO TO 6015
0293  CALL CTRCK( POSITN,ORGNUM )
0294  IF ( POSITN .LT. 0 ) GO TO 6700
0295  IF ( POSITN .EQ. 0 .OR. ORGNUM .NE. 0 ) GO TO 6320
0296  IF ( POSITN .GT. 0 .AND. ORGNUM .EQ. 0 ) GO TO 6710
0297  IF(POSITN .GT. 0 ) GO TO 6700
0298  GO TO 6305
0299  6710  J=UPPDWN +4
0300  CALL DISAPP( 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
C
C LIST INFORMATION PERTAINING TO CITY
C
C
0303  6800  IF (UPPDWN.EQ.1.AND.NUCITY.EQ.0.OR.UPPDWN.EQ.2.AND.NDCITY.EQ.0)
2 GO TO 6806
0304  WRITE ( 1,9 ) 'ENTER CITY LIST SPECIFICATION'
0305  READ (1,7990) (INDATA(I),I=1,80)
0306  CALL GETTER
0307  CALL CTRCH(4,ARG,B,CTLSTS,POSITN)
0308  IF ( POSITN .EQ. 0 ) GO TO 6805
C
C INDE PATH PNAM TALK ORGS ALL CITY 
C
0309  GO TO ( 6810, 6830, 6840, 6850, 6860, 6870, 6880, 6015) POSITN
C
C NO SUCH COMMAND
C
C
0310  6805  WRITE (1,8) 'INVALID LIST OPTION'
0311  WRITE(1,8) 'VALID COMMANDS: INDE, PATH, PNAM, TALK, ORGS, ALL, CITY 
2 GO TO 6800
C
C
0312  GO TO 6800
C
C
0313  6806  WRITE (1,8) 'ALL CITIES HAVE BEEN DELETED'
0314  GO TO 6015
C
C INDEXES
C
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CITY.FTN /TR:BLOCKS/WR

0315 6810 CALL REPRTR (5, 1)
0316 00 TO 6015

0317 6830 CALL REPRTR (4, 1)
0318 00 TO 6015

0319 6840 CALL REPRTR (3, 1)
0320 00 TO 6015

0321 6850 CALL REPRTR (6, 1)
0322 00 TO 6015

0323 6860 CALL REPRTR (7, 1)
0324 00 TO 6015

0325 6865 CALL REPRTR (10, 1)
0326 00 TO 6015

0327 6870 CALL REPRTR (5, 1)
0328 00 TO 6015

0329 6871 CALL REPRTR (4, 1)
0329 00 TO 6015

0330 6872 CALL REPRTR (6, 1)
0331 00 TO 6015

0332 6873 CALL REPRTR (7, 1)
0333 00 TO 6015
C

EXIT FROM CITY

C

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

C

0336       6910 IF(UPPDWN = 2) GO TO 6980
0337       6915 UPPDWN = 2
0338       6980 RETURN
0340       7000 WRITE (1,'(1,*)'ERROR IN NUMERICAL READ -- PLEASE RETYPE'
0341       7100 WRITE (1,'(1,*)'SPECIFIED VALUE IS OUT OF RANGE:'
0342       7990 FORMAT ( 80A1)
0343       7991 FORMAT(1X,'COMMANDS: ',12(1X,A1))
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

DDDCPH - DIRECT DIAL COST PER HOUR
DDDINS - DIRECT DIAL INSTALLATION COST
DDDLES - DIRECT DIAL LEASE COST PER MONTH
DISCNT - DISCOUNT RATE FOR AMORTIZATION
EGPLIF - NUMBER OF YEARS OF EQUIPMENT LIFE (FOR AMORTIZING CAPITAL EXPENDITURES)
GANDAD - ARRAY OF THE FOUR COSTS FOR GENERAL AND ADMINISTRATIVE COSTS FOR CAPITAL, LEASE, INSTALLATION AND OPERATIONS AND MAINTENANCE
PVTLES - 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, REPRTR

CALLED BY: BUILD

INCLUDE 'SYO:COMBLK.FTN/NOLIST'

LOCAL VARIABLES

LOGICAL*1 RATECD(8,4)
INTEGER*2 XDAT
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RATE.FTN /TR:&LOCKS/WR

0042 DATA RATECD/'P','W','D','I','G','T','L','E',
2 'R','A','N','A','A','I','X',
3 'I','T','D','T','T','L','S','I',
4 'V','B','L','K','T','T'/
C
0043 8000 WRITE (1,*),'DO YOU HAVE RATE INFORMATION TO ENTER?'
0044 CALL YESNO
C
C YES NO ERR
0045 GO TO (8010, 8800, 8000) YESNO
0046 8010 WRITE (1,*),'ENTER RATE COMMAND'
0047 CALL GETTER
0048 CALL CODCHK (4,ARG,6,RATECD,POSITN)
0049 IF (POSITN .EQ. 0) GO TO 8015
C
C BRANCH ON RATE COMMAND
C PRIV WATS DDD INT GA TALK LIST EXIT
0051 GO TO (8100,8200,8300,8400,8500,8600,8700,8800) POSITN
C
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
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,PVTHIL
0058 WRITE (1,*),'N VALUE 1 2 3'
0059 8105 WRITE (1,*),'ENTER CHANGE: N,VALUE OR 0,0 TO END'
0060 CALL RATECK (1,3,XDAT)
0061 IF (XDAT .EQ. 0) CALL RATECK (1,3,XDAT)
0062 CALL RATECK (1,3,XDAT)
0063 IF (POSITN .EQ. 0) GO TO 8105
C
C ERROR IN RESPONSE
C
0064 8115 WRITE (1,*),'ERROR IN NUMERICAL READ - PLEASE RETYPE'
0065 GO TO 8115
0066 8120 PUTINS=XDATA(2)
0067 8140 PUTFIX=XDATA(2)
0068 8160 PVTHIL=XDATA(2)

D-40
DECLARE WATS CHARGES

8200 WRITE ( 1*,*)'WATS CHARGES'
8205 WRITE ( 1*,*)'INSTALLATION ZERO CHG/MO CMG/HR MAX CHG'
8092 WRITE ( 1*:999) WATINS, WATLES, WATCPH, WATMAX
8077 WRITE ( 1*:999) 'N= 1 2 3 4'
8078 WRITE ( 1*:999) 'ENTER CHANGE: N+VALUE OR 0=0 TO END'

CALL RATECK ( 14999 XDAT )
IF ( POSITN .EQ. 0 ) GO TO 8205
GO TO ( 82209 82409 82609 8280 ) XDAT

DECLARE DIRECT DIAL CHARGES

8300 WRITE ( 1*,*)'DIRECT DIAL CHARGES'
8305 WRITE ( 1*,*)'INSTALLATION PER MINUTE ZERO CHG/MO'
8092 WRITE ( 1*:99999 ) DDDINS, DDDCPM, DDDLES
8077 WRITE ( 1*:99999) 'N= 1 2 3 4'
8078 WRITE ( 1*:99999) 'ENTER CHANGE: N+VALUE OR 0=0 TO END'

CALL RATECK ( 14999 XDAT )
IF ( POSITN .EQ. 0 ) GO TO 8305
GO TO ( 83209 83409 83609 8380 ) XDAT
C
C MODIFY INTEREST INFORMATION
C
C
0110 8400 WRITE (1,*)'INTEREST RATES'
0111 WRITE (1,*)'EQUIPMENT LIFE (YEARS)  DISCOUNT (%)'
0112 WRITE (1,8993) EPLIF,DISCNT
0113 WRITE (1,*)'N= 1 2'
0114 8405 WRITE (1,*)'ENTER CHANGE: N*VALUE OR 0*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
C
C
0120 8500 WRITE (1,*)'GENERAL AND ADMINISTRATIVE EXPENSES'
0121 WRITE (1,*)'CAPITAL INSTALLATION LEASE OP AND MAIN 2T'
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*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
C
C
0130 8600 WRITE (1,*)'TALKBACK CAPITAL COSTS'
0131 WRITE (1,8994) TLKCAP

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

C
C LIST RATE INFORMATION
C

0143  8700  CALL REPLTR ( 8)
0144       GO TO 8010

C
C EXIT FROM RATE
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 NUFREF(80)
COMMON NUFREF
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 WGTARR(80)
COMMON WGTARR
REAL*4 UFTIDX(10,6,5), DFTIDX(20,6,5), UCOSTX(10,4), DCOSTX(80,4)
COMMON UFTIDX, DFTIDX, UCOSTX, DCOSTX
REAL*4 CAPCST, INSCST, LESCST, OMACST, AMORT
COMMON CAPCST, INSCST, LESCST, OMACST, AMORT
REAL*4 ANNL(80), TCOST(6,5)
COMMON ANNL, TCOST
REAL*4 CILO(5,2), PER, BLANK, 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, MODTK

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

DATA INITIALIZATIONS
DATA LBLANK / ' '/
DATA BPVT / 'PVT '/, BWATS / 'WATS'/, BDDD / 'DDD '/
DATA CILO / 'CAPI'/, 'INST'/, 'LEAS'/, 'D1M'/, 'ANNU'/
2 / 'TAL'/, 'ALL'/, 'E'/, 'A'/, 'ALZD'/
DATA PER / 'PER'/, BLANK / ' '
DATA UPORDN / 'UP'/, 'DOWN'/, 'LINK'/, 'LINK'/
DATA UCINDX / 'F'/, 'I'/, 'X'/, 'E'/, 'D'/, '23'/
DATA DCINDX / 'F'/, 'I'/, 'X'/, 'E'/, 'D'/, '23'/
DATA REFLST / '1'/, '2'/, '3'/, '4'/, '5'/, '6'/, '7'/, '8'/, '9'/, '10'/, '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 UORDCS / '450'/, DORDCS / '450'/, TORCS / '450'/, XORCS / '450'/
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(1,9) 'INDICATE THE REPORT NUMBERS YOU WISH TO SEE'
WRITE (1,9) 'ENTER THE NUMBERS (1-19) SEPARATED BY COMMAS AND'
WRITE (1,9) 'TERMINATE WITH 'I' OR SIMPLY ENTER 'ALL' FOR ALL RE-

IF (ARG(1).EQ.1) GO TO 220
IF (ARG(2) .EQ. LBLANK) GO TO 190
IF (ARG(2).GT.20) GO TO 200
REPNUM(POSITN) = 1
READ(1,1000) (INDATA(I), I=1,180)
CALL GETTER
IF (ARG(1).EQ.1) GO TO 220
IF (NCHAR.EQ.1) ARG(2) = LBLANK
CALL CODCHK (2; ARG=20; REFLST; POSITN)
IF (POSITN.LE.0) GO TO 190
IF (POSITN.EQ.20) GO TO 200
IF (POSITN.EQ.1) GO TO 190
IF (CONTCD.EQ.0) GO TO 160
IF (CONTCD.EQ.1) GO TO 170

ERROR--INVALID REPORT SPECIFIED

WRITE (1,9) (ARG(1), ARG(2))
GO TO 180

ALL REPORTS DESIRED

D-48
C

0087     200    DO 210 I=1,19
0088     210    REPNUM(I) = 1
C
C   CALCULATE INTEREST RATE AMORTIZATION FACTOR
C
0089     220    NYEARS = IFIX(EQPLIF)
0090     0090    AMORT = 0.
0091     230    DO 230 I=1,NYEARS
0092     230    AMORT = (AMORT + 1.)/(1. + DISCNT/100.)
C
C   INTEREST RATE, EQUIP. LIFE, AND MISC. ASSUMPTIONS REPORT
C
0093    IF (REPNUM(1).EQ.0) GO TO 240
0094     0094    WRITE (3,1002) (TITLE(I),I=1,72)
0095     0095    CALL REPRTR (8,1)
C
C   UPLINK SEGMENT
C
0096     240    UPPDWN = 1
0097     0097    CALL MODUP
C
C   DOWNLINK SEGMENT
C
0098     250    UPPDWN = 2
0099     0099    CALL MODDN
C
C   VOICE TALKBACK AND SUMMARY
C
0100     0100    CALL MODTK
0101     0101    STOP
C
C   FORMAT STATEMENTS
C
0102     1000    FORMAT (80A1)
0103     1001    FORMAT (1H0,'INVALID REPORT NUMBER: ',2A1,/) 
0104     1002    FORMAT (1H1,72A1)
0105     1005    END
MODUP.FTN	/TRIBLOCKS/WR

0001 SUBROUTINE MODUP

C
C THIS SUBROUTINE DOES THE CALCULATIONS FOR THE UPLINK SEGMENT
C OF THE MODEL.
C
C SUBROUTINE CALLS: REPRTR, VANDH

0002 INCLUDE 'DK2:COMBLK.FTN/NOLIST'
0040 INCLUDE 'DK2:MODBLK.FTN/NOLIST'

C COST ELEMENT DATA

C
0057 IF (REPNUM(2).NE.1) GO TO 110
0058 WRITE (3,1001) (TITLE(I),I=1,72)
0059 WRITE(3+1002) UPORDN(1),UPORDN(2)
0060 DO 100 I=1,NUELEM
0061 CALL REPRTR (I,1)
0062 100 CONTINUE

C PRINT COST/PATH MATRIX

C
0063 110 IF (REPNUM(3) .EQ. 0) GO TO 112
0064 WRITE (3,1001) (TITLE(I),I=1,72)
0065 CALL REPRTR (2,1)

C PATH/CITY MATRIX

C
0066 112 IF (REPNUM(4) .EQ. 0) GO TO 114
0067 WRITE (3,1001) (TITLE(I),I=1,72)
0068 CALL REPRTR (4,1)

C CITY COST INDEXES

C
0069 114 IF (REPNUM(5) .EQ. 0) GO TO 116
0070 WRITE (3,1001) (TITLE(I),I=1,72)
0071 CALL REPRTR (5,1)

C MATRIX OF TALKBACK REQUIREMENTS

C
0072 116 IF (REPNUM(6) .EQ. 0) GO TO 118
0073 WRITE (3,1001) (TITLE(I),I=1,72)
0074 CALL REPRTR (6,1)

C CALCULATE COSTS OF UPLINK PATHS, BY COST INDEX

C
0075 118 DO 130 J=1,NUPATH
0076 DO 130 I=1,NUELEM
0077 DO 130 M=1,NUINDEX
0078 DO 130 L=1,4
0079 N = UCSPTH(I,J)
0080 120 UPTIDX(J,M,L) = UPTIDX(J,M,L) + FLOAT(N)*UCSDAT(I,M,L)
0081 130 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 COST SENSITIVITY REPORT

D-50
MODUP.FTN /TR:BLOCKS/WR

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

C IF COST ALLOCATION SPECIFIED: REMOVE MULTIPLE CITY LISTINGS

0092 160 IF (NUMORG.EQ.0) GO TO 250
0093 DO 240 K=1:NUCITY
0094 WGTARR(K) = UDXWHT(1)
0095 IF (NUINDX.EQ.1) GO TO 180
0096 DO 170 L=2,NUINDX
0097 WGTARR(K) = WGTARR(K) + UCTXVL(K,L-1)*UDXWHT(L)
0099 IF (WGTARR(K) .LT. 0.0) WGTARR(K) = 1.0
0100 180 IF (K.EQ.I) GO TO 240
0101 DO 190 J=1:16
0102 IF (UCTNAM(K,J).NE.UCTNAM(I,J)) GO TO 230
0103 190 CONTINUE
0104 DO 200 J=1,NUINDX-1
0105 UCTXVL(I,J) = UCTXVL(I,J) + UCTXVL(K,J)
0106 DO 210 J=1,NDCITY
0107 TALKBK(I,J) = TALKBK(I,J) + TALKBK(J,K)
0108 DO 220 J=1,NUPATH
0109 UPTHCY(I,J) = UPTHCY(I,J) + UPTHCY(J,K)
0110 UCITYV(K) = -1
0111 GO TO 240
0112 230 CONTINUE
0113 240 CONTINUE

C CALCULATE COSTS FOR UPLINK PATHS BY CITY, AND CHOOSE THE BEST ONE. THEN ADD 'CHOSEN' PATH COSTS TO TOTALS FOR SUMMARY TABLE

0114 250 IF (REPNUM(8).EQ.0) GO TO 255
0115 WRITE (3,1001) (TITLE(I),I=1,72)
0116 WRITE (3,1034) UPORDN(1:1),UPORDN(1:2)
0117 255 DO 350 K=1,NUCITY
0118 INDIC = 0
0119 IF (UCITYV(K),EQ.-1) GO TO 350
0120 IF (UCITYV(K),LT.0) CALL VANDH(UCITYV(K),UCITYH(K))
0121 BOTTOM=1.0E38
0122 DO 310 J=1,K,1
0123 IF (UPTHCY(J,K),EQ.0) GO TO 310
0124 CAPCST = UPTIDX(J+1)
0125 INSCST = UPTIDX(J+2)
0126 OMCST = UPTIDX(J+4)
0127 IF (NUINDX.EQ.1) GO TO 270
0128 DO 260 M=2,NUINDX
0129 CAPFST = CAPCST + UPTIDX(J+1)*UCTXVL(K,M-1)

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

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

C COMPARE ANNUALIZED COST WITH BEST PREVIOUS PATH
0144 IF (REPNUM(8).NE.1) GO TO 300
0145 IF (INDIC.EQ.0) WRITE (3,1035) (UCTNAM(K),K=1,N)
0146 IF (INDIC.EQ.1) WRITE (3,1036) J, CAPCST, INSCST, LESCST, OMACST, ANNL(J)
0147 300 INDIC = 1
0148 IF (ANNL(J).GE.BOTTOM) GO TO 310
0149 NUPREF(K) = J
0150 BOTTOM = ANNL(J)
0151 310 CONTINUE
0152 N=NUPREF(K)
0153 DO 340 L=1,N
0154 UCOSTX(K,L) = UPTIDX(N+1,L)
0155 IF (NUINDEX.EQ.1) GO TO 330
0156 DO 320 M=2,NUINDEX
0157 UCOSTX(K,L) = UCOSTX(K,L) + UPTIDX(K,M)*UCTXVL(K,M-1)
0158 320 CONTINUE
0159 330 IF (L.NE.3) TCOST(1,L) = TCOST(1,L) + UCOSTX(K,L)
0160 340 CONTINUE
0161 UCOSTX(K,3) = BOTTOM-UCOSTX(K,4)-(UCOSTX(K,1)+UCOSTX(K,2))/AMORT
0162 TCOST(1,3) = TCOST(1,3) + UCOSTX(K,3)
0163 TCOST(1,5) = TCOST(1,5) + BOTTOM
0164 350 CONTINUE

C DO COST ALLOCATION CALCULATIONS
C
0165 IF (NUMORO.EQ.0) GO TO 410
0166 DO 400 I=1,NUCITY
0167 TOTWGT=0.
0168 DO 380 J=1,NUCITY
0169 DO 360 K=1,N
0170 IF (UCTNAM(I,K).NE.UCTNAM(J,K)) GO TO 380
0171 360 CONTINUE
0172 IF (USTCUD(I,1).NE.USTCUD(J,1)) OR.
0173 2 USTCUD(I,2).NE.USTCUD(J,2)) GO TO 380
0174 TOTWGT = TOTWGT + WGTARR(J)
0175 IF (I.EQ.J) GO TO 380
0176 DO 370 L=1,N

D-52
0176 370 UCOSTX(JrL) = UCOSTX(I, L)
0177 380 CONTINUE
0178 N = UCTORG(I);
0179 DO 390 L = 1, 4
0180 UDCRS(N, L) = UDRCS(N, L) + UCOSTX(I, L) * WGTARR(I) / TOTWGT
0181 400 CONTINUE
C
C UPLINK 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) (UCTNAM(I), I = 1, 6)
0190 IF (NUINDX(1, 1)) WRITE (3, 1013) (UCINDX(K, J), K = 1, 2, J = 1, NUINDX)
0191 IF (NUINDX(1, 1)) WRITE (3, 1014) (UCTXVL(I, K), K = 1, NUINDX-1)
0192 420 CONTINUE
0193 WRITE(3, 1015) (UPORDN(1, K), K = 1, 2), (TCOST(1, K), K = 1, 5)
0194 RETURN
C
C FORMAT STATEMENTS
C
0195 1001 FORMAT (1H1, 72A1)
0196 1002 FORMAT (1H0, 17X, 2A4, ' COST ELEMENT DATA',//)
0197 1010 FORMAT (1H0, 26X, 2A4, ' COSTS BY CITY')
0198 1011 FORMAT (1H0, 3X, ' CITY', 15X, ' CAPITAL', 4X, ' INSTALL', 6X, ' LEASE', 6X, ' DIM$1', 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, 12X, ' TOTAL', 2X, 5F11.0)
0203 1020 FORMAT (1H0, 11X, 'Sensitivity of Path Costs to Network Parameters--', 2, 26X,/) 2 26X(/)
0204 1021 FORMAT (1H0, 'PATH', 'L2', --', 20A1)
0205 1022 FORMAT (1H0, 20X, 5(7X, A4))
0206 1023 FORMAT (1H0, 12X, 5(7X, A4))
0207 1024 FORMAT (1H0, 3X, 2A4, 6F11.0)
0209 1035 FORMAT (1H0, 16A1, 14, F13.0, 3F11.0, F12.0)
0210 1036 FORMAT (1H0, 16X, 14, F13.0, 3F11.0, F12.0)
0211 1036 END
0001 SUBROUTINE MODDN

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

C SUBROUTINE CALLS: REPRTR, VANDH

0002 INCLUDE 'DK2:CCMBLK.FTN/NOLIST'

0003 INCLUDE 'DK2:MODBLK.FTN/NOLIST'

C COST ELEMENT DATA

0057 IF (REPNUM(10).NE.1) GO TO 200

0058 WRITE (3,1001) (TITLE(I),I=1,72)

0059 WRITE (3,1002) UPORDN(2,1),UPORDN(2,2)

0060 DO 100 I=1,NDINDX

0061 CALL REPRTR(I)

100 CONTINUE

C PRINT COST/PATH MATRIX

0063 IF (REPNUM(11).EQ.0) GO TO 225

0064 WRITE (3,1001) (TITLE(I),I=1,72)

0065 CALL REPRTR(2)

C PATH/CITY MATRIX

0066 IF (REPNUM(12).EQ.0) GO TO 250

0067 WRITE (3,1001) (TITLE(I),I=1,72)

0068 CALL REPRTR(4)

C CITY COST INDEXES

0069 IF (REPNUM(13).EQ.0) GO TO 275

0070 WRITE (3,1001) (TITLE(I),I=1,72)

0071 CALL REPRTR(5)

C CALCULATE COSTS OF DOWNLINK PATHS BY COST INDEX

0072 DO 400 J=1,NDPATH

0073 DO 400 I=1,NDINDX

0074 DO 300 L=1,4

0075 N = DCSPTH(I,J)

0076 DO 300 DPTIDX(J,M,L) = DPTIDX(J,M,L) + FLOAT(N)*DCSDAT(I,M,L)

0077 DO 400 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)

C COST SENSITIVITY REPORT

0079 IF (REPNUM(14).NE.1) GO TO 700

0080 WRITE (3,1001) (TITLE(I),I=1,72)

0081 WRITE (3,1020) UPORDN(2,1),UPORDN(2,2)

0082 DO 600 I=1,NDPATH

0083 WRITE (3,1021) I,NPTHNM(I,J),J=1,20

0084 IF (NDINDX.GT.1) WRITE (3,1022) (PER,J=2,NDINDX)
MODDN.FTN /TRSBLOCKS/WR

0085 WRITE (3,1023) ((DCINDEX(J,K),K=1,NDINDEX),J=1,NDCITY)
0086 DO 500 J=1,5
0087 500 WRITE (3,1024) CILO(J,1), CILO(J,2), (DPTIDX(I,K,J),K=1,NDINDEX)
0088 CONTINUE

C IF COST ALLOCATION SPECIFIED, REMOVE MULTIPLE CITY LISTINGS

0089 700 IF (NUMORG.EQ.0) GO TO 1600
0090 DO 1500 K=1,NDCITY
0091 WGTARR(K) = DDXWHT(1)
0092 IF (NDINDEX.EQ.1) GO TO 900
0093 DO 800 L=2,NDINDEX
0094 WGTARR(K) = WGTARR(K) + DCTXVL(K,L-1)*DDXWHT(L)
0095 IF (WGTARR(K).LE.0.0) WGTARR(K) = 1.0
0096 900 IF (K.LE.1) 00 TO 1500
0097 DO 1400 I=1,K-1
0098 DO 1000 J=1,16
0099 IF (DCTNAM(K,J).NE.DCTNAM(I,J)) GO TO 1400
0100 1000 CONTINUE
0101 DO 1100 J=1,NDINDEX-1
0102 1100 DCTXVL(I,J) = DCTXVL(I,J) + DCTXVL(K,J)
0103 DO 1200 J=1,NDCITY
0104 1200 TALKBK(I,J) = TALKBK(I,J) + TALKBK(K,J)
0105 DO 1300 J=1,NDPATH
0106 1300 DPTHCY(I,J) = DPTHCY(I,J) + DPTHCY(K,J)
0107 DCITYV(K) = 0
0108 GO TO 1500
0109 CONTINUE
0110 1500 CONTINUE

C CALCULATE COSTS FOR DOWNLINK PATHS BY CITY, AND CHOOSE THE BEST

0111 1600 IF (REPNUM(15).EQ.0) GO TO 1650
0112 WRITE (3,1001) (TITLE(I),I=1,72)
0113 WRITE (3,1034) UPORDN(2,1),UPORDN(2,2)
0114 DO 1650 K=1,NDCITY
0115 INDIC = 0
0116 IF (DCITYV(K).EQ.-1) GO TO 2500
0117 IF (DCITYV(K).LT.0) CALL VANDH (DCITYV(K),DCITYH(K))
0118 BOTTOM=1.0E38
0119 DO 2100 J=1,NDPATH
0120 IF (DPTHCY(J,K).EQ.0) GO TO 2100
0121 C OMIT LEASE CALCULATIONS, BECAUSE OF THE MINIMUM VARIABLE
0122 CAPCST = DPTIDX(J,1,1)
0123 INSCST = DPTIDX(J,1,2)
0124 OMACST = DPTIDX(J,1,4)
0125 IF (NDINDEX.EQ.1) GO TO 1800
0126 DO 1700 M=2,NDINDEX
0127 CAPCST = CAPCST + DPTIDX(J,M,1)*DCTXVL(K,M-1)
0128 OMACST = OMACST + DPTIDX(J,M,4)*DCTXVL(K,M-1)
0129 CONTINUE

C CALCULATE LEASE COSTS

0129 1800 LESCST = 0.
DO 1900 I=1,NDELEM
   TEMP=0.
   IF (DCSPHTH(I,J).EQ.0) GO TO 1500
   TEND = TEMP + DCSDAT(I,1,3)
   IF (NDINDEX.EQ.1) GO TO 1900
   DO 1850 M=2,NDINDEX
      TEMP = TEMP + DCSDAT(1,M,3)*DCTXVL(K,M-1)
   IF (TEMP.LT.DCSMIN(I)) TEMP=DCSMIN(I)
   LESCST = LESCST + TEMP
   1900 CONTINUE
   ANNL(J) = (CAPCST+INSCST)/AMORT + LESCST + OMACST
   COMPARE ANNUALIZED COST WITH PREVIOUS PATH
   IF (REPNUM(15).NE.1) GO TO 2000
   IF (INDIC.EQ.0) WRITE (3+1035) (DCTNAM(K,M),M=1,16),J+2
      CAPCST,INSCST,LESCST,OMACST,ANNL(J)
   IF (INDIC.EQ.1) WRITE (3,1036) J+2
      CAPCST,INSCST,LESCST,OMACST,ANNL(J)
   2000 INDIC = 1
   IF (ANNL(J).GE.BOT) GO TO 2100
   N+1=N+1
   BOTTOM = ANNL(J)
   2100 CONTINUE
   IF (NUMORG.EQ.0) GO TO 2300
   DO 3000 I=1,NDCITY
      TOTWG=0.
      DO 2800 J=1,NDCITY
         DO 2600 K=1,16
            IF (DCTNAM(I,K).NE.DCTNAM(J,K)) GO TO 2800
         2600 CONTINUE
            IF (DSTCOD(I,J).NE.DSTCOD(J,K)) GO TO 2800
         2800 CONTINUE
            TOTWG = TOTWG + WGTAR(J)
         2900 CONTINUE
      TOTWG = TOTWG + WGTAR(J)
   3000 CONTINUE
   C
   C DO COST ALLOCATION CALCULATIONS
   C
      IF (NUMORG.EQ.0) GO TO 3100
      DO 3000 I=1,NDCITY
      TOTWG=0.
      DO 2800 J=1,NDCITY
         DO 2600 K=1,16
            IF (DCTNAM(I,K).NE.DCTNAM(J,K)) GO TO 2800
         2600 CONTINUE
            IF (DSTCOD(I,J).NE.DSTCOD(J,K)) GO TO 2800
         2800 CONTINUE
            TOTWG = TOTWG + WGTAR(J)
         2900 CONTINUE
      TOTWG = TOTWG + WGTAR(J)
   3000 CONTINUE

D-56
C DOWNLINK SUMMARY REPORT

C

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),UPORDN(2,2), YEARLY
0187 IF (NDINDX.GT.1) WRITE (3,1013) ((DCINDX(K,J),J=1,16,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

C FORMAT STATEMENTS

C 0192 1001 FORMAT (1H1*72A1)
0193 1002 FORMAT (1H0*:17X*2A4,* COST ELEMENT DATA'//)
0194 1010 FORMAT(1H0:26X*2A4,* COSTS BY CITY')
0195 1011 FORMAT (1H0:3X*CITY*,15X*CAPITAL*,4X*INSTALL*,6X*LEASE*,6X,*'

2*0&MIA*,2X*ANNUALIZED'

0196 1012 FORMAT(1H0:16A1,2X*5F11.0)
0197 1013 FORMAT (1H0:18X*5(3X*BA1))
0198 1014 FORMAT (1H0:18X*5F11.0/

0199 1015 FORMAT(1H0://X*2A4,* TOTAL',2X*5F11.0)
0200 1020 FORMAT(1H0:11X*Sensitivity of path costs to network parameters--'

2*2A4/',

0201 1021 FORMAT (1H0:*PATH'*,12', -- ',20A1)
0202 1022 FORMAT (1H0:*20X*,5(7X,A4))
0203 1023 FORMAT (1H0:11X*6(3X*BA1))
0204 1024 FORMAT (1H0:1X*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*0&MIA',

3 2X*ANNUALIZED'//)
0206 1035 FORMAT(1H0:16A1*I4*F13.0*3F11.0*F12.0)
0207 1036 FORMAT(1H0:16X, I4*F13.0*3F11.0*F12.0)
0208 END
SUBROUTINE MODTK

C THIS SUBROUTINE PERFORMS THE CALCULATION FOR THE TALKBACK SEGMENT
C OF THE MODEL. IT ALSO PRODUCES THE GRAND SUMMARY REPORT.
C
C INCLUDE 'DK2:COMBLK.FTN/NOLIST'
C INCLUDE 'DK2:MODBLK.FTN/NOLIST'
C REAL*4 BPVTPBWATSFBDDD
C DATA BPVTP /'PVT '/, BWATS /'WATS'/, BDDD /

C PREPARE AND PRINT TABLE FOR VOICE TALKBACK SYSTEM COSTS
C
C DO 1700 J=1,NUCITY
C IF (UCITYV(J).EQ.-1) GO TO 1700
C
C CHECK FOR NO TALKBACK REQUIREMENT AND SET V AND H COORDINATES
C
T = 0.
DO 100 I=1,NDCITY
T = T + TALKBK(I,J)
100 CONTINUE
IF (T.EQ.0.0) GO TO 1700
C
C REPEAT FOR EACH COMBINATION OF UPLINK AND DOWNLINK CITY
C
IF (REPNUM(17).EQ.0) GO TO 150
WRITE (3+1001) (TITLE(K),K=1,72)
WRITE (3,1015) (UCTNAM(JPN),N=1,16)
150 DO 1600 I=1,NDCITY
IF (DCITYV(I).EQ.-1) GO TO 1600
TOTWGT = 0.
IF (TALKBK(I,J).GT.0.AND.DCTLVL(I).GT.3) GO TO 200
IF (TALKBK(I,J))1600.1600+500
200 DIST=1.E38
DO 400 K=1,NDCITY
IF (K.EQ.I) GO TO 400
IF (DCTLVL(K)-2) 400.300+400
300 X = DCITYV(K) - DCITYV(I)
Y = DCITYH(K) - DCITYH(I)
DIST = MIN1(DIST,SORT((X**2+Y**2)/10.))
400 CONTINUE
GO TO 600
500 X = UCITYV(J) - DCITYV(I)
Y = UCITYH(J) - DCITYH(I)
DIST = SORT((X**2+Y**2)/10.)
600 HOURS = TALKBK(I,J)
PLEASE=MIN1(WATLES+WATCHMAX,HOURS*WATMAX)
PỰCST=PUFIX+DIST*PUTML
DDEAS=DODCFH*HOURS
TCOST(3,1)=TCOST(3,1)+TLCAP
IF (PLEASE.GT.DDEAS) GO TO 900
TALK=BWATS
INSCST = WATINS
LESCST = PLEASE*12.
900 GOTO 1000
MODTK: N  /TR:BLOCKS/WR

0097  800 IF(PLEASE.GT.DDLEAS) GO TO 900
0098       TALK=BPUT
0099       INSCST = FUTINS
0100       LESCST = PLEASE*12.
0101       GO TO 1000
0102  900 TALK=BDDD
0103       INSCST = DDDINS
0104       LESCST = DDLEAS*12.
0105  1000 TCOST(3+2) = TCOST(3,2) + INSCST
0106       TCOST(3,3) = TCOST(3,3) + LESCST
0107       TCOST(3,5) = TCOST(3,5) + TLKCAP/AMORT + INSCST/AMORT + LESCST

C  DO COST ALLOCATION CALCULATIONS, IF APPLICABLE
C
0108       IF (NUMORG.EQ.0) GO TO 1500
0109       DO 1200 L=1,NDCITY
0110          DO 1100 K=1,16
0111             IF(DCTNAM(I+K).NE.DCTNAM(L+K)) GO TO 1200
0112          1100 CONTINUE
0113             IF (DSTCOD(I+L).NE.DSTCOD(L+L)) OR.
0114                DSTCOD(I+L).NE.DSTCOD(L+L)) GO TO 1200
0115          1200 CONTINUE
0116          DO 1400 I=1,NDCITY
0117             N=DCTORG(I)
0118             DO 1900 L=1,4
0119                AORGCS(N+L) = AORGCS(N+L) + WGTARR(I)/TOTWGT
0120             1900 CONTINUE
0121
C  TALKBACK REPORT

0122       IF (REPNUM(17).EQ.1) WRITE(3,1016)(DCTNAM(I+K),K=1,16),DCTNAM(L+K)
0123          HOURSPDISTPWATINSPWPLEASEPPVTINSPF'LEASE+DDDINS+DDLEAS+TALK
0124          1016 CONTINUE
0125          1017 CONTINUE

C  ALLOCATE ADMINISTRATIVE COSTS
C
0126       IF (NUMORG.EQ.0) GO TO 3300
0127       TOTWGT=0.
0128       DO 1800 I=1,NDCITY
0129          AORGCS(N+L) = AORGCS(N+L) + WGTARR(I)/TOTWGT
0130          1800 CONTINUE
0131
C  REWRITE TOOLS
C COST ALLOCATION TABLE
C
0140 2100 IF (REPNUM(18).NE.1.OR.NUMORG.EQ.0) GO TO 3300
0141 WRITE (3,1001) (TITLE(I),I=1,72)
0142 WRITE (3,1025)
0143 WRITE (3,1026)
0144 DO 2200 I=1,25
0145 2200 ANNL(I) = 0.
0146 DO 2400 I=1,NUMORG
0147 UORGCS(I,5) = (UORGCS(I,1) + UORGCS(I,2))/AMORT + UORGCS(I,3) 2 + UORGCS(I,4)
0148 DO 2300 J=1,4
0149 2300 ANNL(J) = ANNL(J) + UORGCS(I,J)
0150 ANNL(5) = ANNL(5) + UORGCS(I,5)
0151 WRITE (3,1027) I,(ORGNUM(I,J),J=1,20),(UORGCS(I,J),J=1,5)
0152 2400 CONTINUE
0153 WRITE (3,1028) (ANNL(J),J=1,5)
0154 WRITE (3,1029)
0155 DO 2600 I=1,NUMORG
0156 DORGCS(I,5) = (DORGCS(I,1) + DORGCS(I,2))/AMORT + DORGCS(I,3) 2 + DORGCS(I,4)
0157 DO 2500 J=6,9
0158 2500 ANNL(J) = ANNL(J) + DORGCS(I,J-5)
0159 ANNL(10) = ANNL(10) + DORGCS(I,5)
0160 WRITE (3,1027) I,(ORGNUM(I,J),J=1,20),(DORGCS(I,J),J=1,5)
0161 2600 CONTINUE
0162 WRITE (3,1028) (ANNL(J),J=6,10)
0163 WRITE (3,1030)
0164 DO 2800 I=1,NUMORG
0165 TORGCS(I,5) = (TORGCS(I,1) + TORGCS(I,2))/AMORT + TORGCS(I,3) 2 + TORGCS(I,4)
0166 DO 2700 J=11,14
0167 2700 ANNL(J) = ANNL(J) + TORGCS(I,J-10)
0168 ANNL(15) = ANNL(15) + TORGCS(I,5)
0169 WRITE (3,1027) I,(ORGNUM(I,J),J=1,20),(TORGCS(I,J),J=1,5)
0170 2800 CONTINUE
0171 WRITE (3,1028) (ANNL(J),J=11,15)
0172 WRITE (3,1032)
0173 DO 3000 I=1,NUMORG
0174 AORGCS(I,5) = (AORGCS(I,1) + AORGCS(I,2))/AMORT + AORGCS(I,3) 2 + AORGCS(I,4)
0175 DO 2900 J=11,24
0176 2900 ANNL(J) = ANNL(J) + AORGCS(I,J-20)
0177 ANNL(25) = ANNL(25) + AORGCS(I,5)
0178 WRITE (3,1027) I,(ORGNUM(I,J),J=1,20),(AORGCS(I,J),J=1,5)
0179 3000 CONTINUE
0180 WRITE (3,1028) (ANNL(J),J=21,25)
0181 WRITE (3,1031)
0182 DO 3200 I=1,NUMORG
0183 DO 3100 J=1,5
0184 XORGCS(I,J) = UORGCS(I,J) + DORGCS(I,J) + TORGCS(I,J) + AORGCS(I,J)
0185 ANNL(J+15) = ANNL(J+15) + XORGCS(I,J)
0186 DO 3100 CONTINUE
0187 WRITE (3,1027) I,(ORGNUM(I,J),J=1,20),(XORGCS(I,J),J=1,5)
0188 3200 CONTINUE
0189 WRITE (3,1028) (ANNL(J),J=16,20)

D-60
C
C CALCULATE AND PRINT TOTAL COSTS FOR GRAND SUMMARY TABLE
C

0190 3300 DO 3500 K=1,5
0191  DO 3400 J=1,4
0192  TCOST(4,J) = GANDAD(J)
0193 3400 TCOST(5,K) = TCOST(5,K)+TCOST(J,K)
0194 3500 CONTINUE
0195  TCOST(4,J) = (TCOST(4,1)+TCOST(4,2))/AMORT + TCOST(4,3) + TCOST(4,4)
0196  TCOST(6,1) = TCOST(5,1)/AMORT
0197  TCOST(6,2) = TCOST(5,2)/AMORT
0198  TCOST(6,3) = TCOST(5,3)
0199  TCOST(6,4) = TCOST(5,4)
0200  TCOST(5,5) = (TCOST(5,1)+TCOST(5,2))/AMORT + TCOST(5,3) + TCOST(5,4)
0201  TCOST(6,5) = TCOST(6,1) + TCOST(6,2) + TCOST(6,3) + TCOST(6,4)
0202 IF (REPNUM(19).NE.1) RETURN
0203 WRITE (3,1001) (TITLE(I),I=1,72)
0204 WRITE(391004)
0205 WRITE(391005)((TCOST(I,J),J=1,5),I=1,6)
0206 NYEARS = IFIX(EGPLIF)
0207 WRITE(3,1006)NYEARS,DISCNT.TCGST(6,5)
0208 RETURN

C
C FORMAT STATEMENTS
C

0209 1001 FORMAT (1H1,72A1)
0210 1004 FORMAT (1H0,130X,'OVERALL COST SUMMARY',/30X,'CAPITAL',/7X,'PLANNING AND',/7X,'ANNUAL',/7X,'ANNUAL',/7X,'AMORTIZATION',/7X,'COST')
0211 1005 FORMAT (1H0,130X,'UPLINK',/7X,'DOWNLINK',/7X,'ADMINISTRATIVE',/7X,'ANNUALIZED COST',/7X,'TOTALS')
0212 1006 FORMAT (1H0,130X,'UPLINK',/7X,'DOWNLINK',/7X,'ADMINISTRATIVE',/7X,'TOTALS',/7X,'EFFECTIVE YEARLY COSTS FOR',/7X,'YEAR',/7X,'F5.2',/7X,'PERCENT AMORTIZATION -- $F9.0')
0213 1015 FORMAT (1H0,130X,'TALKBACK SYSTEM LEASE COSTS',/35X,'T0',/16A1,/)21X,'HOURS',/8X,'WATS COSTS',/4X,'PRIVATE LINE',/3X,'DIRECT DIAL',/5X,'CITY',/6X,'LEVEL',/1X,'UTIL',/1X,'DIST',/1X,'INSTALL LEASE',/2X,'INSTALL LEASE',/2X,'BEST')
0214 1016 FORMAT (1H0,130X,'CAPITAL',/4X,'ANNUALIZED')
0215 1025 FORMAT (1H0,28X,'NETWORK COST ALLOCATION',/30X,'CAPITAL',/4X,'ANNUALIZED')
0216 1026 FORMAT (1H0, /'UPLINK',/)
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 SATEST /25/
CALL READIN
OPEN (UNIT=2, TYPE='OLD', NAME='SYO:EARTH.DAT',
      CARRIAGECONTROL='LIST', ERR=9010)

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

UCITY=NUCITY
DCITY=NDCITY
ORGNUM=NUMORG

DO 5 I=1,72
    HEADER(I)=TITLE(I)
    5 CONTINUE

DO 30 I=1,DCITY
    VDCITY(I)=DCITY(I)
    MDCITY(I)=DCITYH(I)
    DO 10 J=1,16
        NAMDCT(I,J)=DCTNAM(I,J)
    10 CONTINUE
    DO 20 J=1,2
        CODDST(I,J)=DCST(I,J)
    20 CONTINUE
    30 CONTINUE

DO 60 I=1,UCITY
    VUCITY(I)=UCITYH(I)
    HUCITY(I)=UCITY(I)
    DO 40 J=1,16
        NAMUCT(I,J)=UCTNAM(I,J)
    40 CONTINUE
    DO 80 J=1,2
        CODUST(I,J)=USTST(I,J)
    80 CONTINUE
    60 CONTINUE

ELIMINATE UPLINK DUPLICATE CITIES IF THERE IS COST ALLOCATION

IF (ORGNUM.EQ.0) GO TO 140

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

ELIMINATE DOWNLINK DUPLICATE CITIES IF THERE IS COST ALLOCATION

DO 130 K=2,DCITY
    DO 120 I=1,K-1
        MDCITY(I)=MDCITY(I)+1
    120 CONTINUE
    If (NAMDCT(K,J).NE.NAMDCT(I,J)) GO TO 130
    CONTINUE

D-66
EARTH.FTN

0090 IF (NAMDC(I).NE.NAMDC(J)) GO TO 120
0099 CONTINUE
0100 VDCITY(K) = -1
0101 GO TO 130
0102 CONTINUE
0103 CONTINUE

C
C
C
C
C
C

0104 DO 140 I=1,350
0105 DO 150 J=1,82
0106 BIGREC(I, J) = '
0107 CONTINUE
0108 CONTINUE

0109 WRITE (1*) 'ENTER THE MAXIMUM ACCEPTABLE DISTANCE (IN MILES)'
0110 WRITE (1*) 'BETWEEN AN EARTH STATION AND A CITY'
0111 ASSIGN 170 TO BAD
0112 READ (1*,ERR=9900) DISTNC
0113 IF (DISTNC.GT.0.AND.DISTNC.LE.50.) GO TO 200

C
C
C
C
C

0114 WRITE (1*) 'DISTANCE MUST BE LESS THAN 40 MILES'
0115 GO TO 170

C
C
C
C
C

0116 WRITE (1*) 'ENTER THE SATELLITE OF INTEREST CALL NUMBER'
0117 READ (1*,210) (SATLIT(I), I=1,5)
0118 FORMAT (5A1)
0119 IF (SATLIT(1).EQ.'A' .AND. SATLIT(2).EQ.'B'. .AND. SATLIT(3).EQ.'C') THEN
0120 CALL CODCHK(SATLIT, NUMSAT, SATCOD, POS)
0121 IF (POS.NE.0) GO TO 500
0122 WRITE (1*,220) (SATLIT(I), I=1,5)
0123 FORMAT (5A1) ('INVALID SATELLITE CALL NUMBER ','5A1')
0124 WRITE (1*) ('VALID SATELLITES ARE...
0125 WRITE (1*,230) ((SATCOD(I,J), J=1,5), I=1,25)
0126 FORMAT (5X,5A1,2X, 'WESTAR I',/)
0127 3 1X,5A1,2X, 'WESTAR II',/)
0128 4 1X,5A1,2X, 'WESTAR III',/)
0129 5 1X,5A1,2X, 'COMSTAR D-1',/)
0130 6 1X,5A1,2X, 'COMSTAR D-2',/)
0131 7 1X,5A1,2X, 'COMSTAR D-3',/)
0132 8 1X,5A1,2X, 'COMSTAR D-4',/)
0133 9 1X,5A1,2X, 'SATCOM I',/)
0134 10 1X,5A1,2X, 'SATCOM II',/)
0135 11 1X,5A1,2X, 'SATCOM III',/)
0136 12 1X,5A1,2X, 'CANADIAN TELESAT SATELLITES',/)
0137 3 1X,5A1,2X, 'SATCOM',/)
0138 4 1X,5A1,2X, 'MARISAT I',/)
0139 5 1X,5A1,2X, 'MARISAT II',/)
0140 6 1X,5A1,2X, 'MARISAT III',/)
0141 7 1X,5A1,2X, 'INTELSAT I',/)

D-67
C 0127 GO TO 200
C 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),(LICN5E(I),I=1,40), 
2 (CITY(I),I=1,20),(STATE(I),I=1,2),AUTHCD 
0132 530 FORMAT (5AI,4A1,1X,20A1,1X,2A1,4X,1A1)
C READ (2,535=ERR=9020,END=580)(SERVIS(I),I=1,10),(BAND(I),I=1,2), 
2 I=1,4),(SIZE(I),I=1,4),LAT,LON,((SAT(I),J=1,5),I=1,5) 
0134 535 FORMAT (6X,1BAI,4A1,1A1,4A1,2X,15,2X,5,1A1) 
C LOOK FOR SATELLITE
0135 IF (BYPASS.EQ.1) GO TO 536
0136 CALL CODCHK(5,5ATL1,5,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 UPDOWN=1 
0141 IF (SERVIS(8).NE.'Y') GO TO 537 
0142 DU 545 U=1,U=UCITY 
0143 IF (UCITY(I),E0.0,-1) GO TO 545 
0144 X=UCITY(I)-LAT 
0145 Y=U=UCITY(I)-LON 
0146 DIQT=(X**2+Y**2)+/10. 
0147 DIST=QRT(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
IF (SERVIS(N) .NE. 'R', AND. SERVIS(9).NE. 'R') GO TO 520
DO 560 I=1,DCITYN
      IF (VDCITY(I).EQ.-1) GO TO 540
      X=VDCITY(I)-LAT
      Y=VDCITY(I)-LON
      DIST=(X**2+Y**2)/10.
      DIST=SORT(DIST)
      IF (DIST.OT.DISTNC) GO TO 560
      IF (NUMREC. EQ. 350) GO TO 530
      NUMREC=NUMREC+1
      CALL MOVREC(I,NUMREC)
      DCITY(I)=DCITY(I)+I
      CONTINUE
GO TO 520
WRITE (1*) '***** OVER 350 EARTH STATIONS QUALIFY *****'
WRITE (1*) 'ONLY A PARTIAL REPORT WILL BE CREATED'
WRITE (1*) 'USE A SMALLER DISTANCE FOR A FULL REPORT'
CLOSE THE EARTH TERMINAL FILE AND SORT THE ARRAY
DO 580 J=1,NUMREC
       IF (DIGREC(J).OT.DIGREC(I)) GO TO 700
       IF (DIGREC(J).LT.DIGREC(I)) GO TO 600
       IF (DIGREC(J).GT.DIGREC(I)) GO TO 700
       IF (DIGREC(J).EQ.DIGREC(I)) GO TO 700
       DO 610 J=I+1,NUMREC
             TMPARY(L)=9IGREC(J;L)
             DO 620 L=I+1,NUMREC
                    VREC(J,L)=VREC(I,L)
             CONTINUE
WRITE (3#4620) (CALL S!GN, I, LICENSEE, CITY, STATE, \ 
               SERVICE, 'X', 9IZE)
CONTINUE
PRINT THE REPORT
WRITE (3#4600) (HEADER(I), I=1,72)
4100 FORMAT ('1',72A1)
4090 FORMAT (500) DOWNUP(2), IDIST (SATLIT(I), I=1,5)
4092 FORMAT (10X,A4,9LINK CITIES--EARTH STATIONS WITHIN ',13, \ 
               'MILES AND LICENSED TO POINT TO ',5A1))
WRITE (3#4620)
4420 FORMAT ('X', 'CALL SIGN', 'X', 'LICENSEE', 'X', 'CITY', \ 
               'X', 'STATE', 'X', 'SERVICE', 'X', 'SIZE')
FIRST=1
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EARTH.FTN /TRIBLOCKS/WR

0196      DO 4750 I=1,UCITYN
0197            IF (VUCITY(I).EQ.-1) GO TO 4750
0198            IF (UCTARY(I).EQ.0) GO TO 4740
0199      WRITE (3,4730) (NAMUCT(I,J),J=1,16),(CODUST(I,J),L=1,2)
0200      4730      FORMAT (/*''H':'''16A1,2X,2A1/)
0201            LAST=FIRST+UCTARY(I)-1
0202      DO 4735 K=FIRST,4750
0203            WRITE (3,4731) (BIGREC(K,L),L=3,82)
0204      4731      FORMAT (1X,'NO EARTH STATIONS NEAR ',16A1,2X,2A1)
0205      4735      CONTINUE
0206      4740      WRITE (3,4745) (NAMUCT(I,L),L=1,16),(CODUST(I,L),L=1,2)
0207      4745      FORMAT (/sIX.'ERROR IN NUMERICAL READ PLEASE REENTER'
0208      4750      CONTINUE
0209            CONTINUE
0210            C
0211            C            DOWNLINK PART OF REPORT
0212      5000      WRITE (3,4600) DOWNUP(I),IDIST,(SATLIT(I),I=1,5)
0213      4600      WRITE (3,4620)
0214      4620      DO 5750 I=1,DCITYN
0215            IF (VDCITY(I).EQ.-1) GO TO 5750
0216            IF (DCTARY(I).EQ.0) GO TO 5740
0217      WRITE (3,4730) (NAMDCT(I,J),J=1,16),(CODDST(I,J),J=1,2)
0218      4730      FORMAT (/*''H':'''16A1,2X,2A1/)
0219      4731      WRITE (3,4731) (BIGREC(K,L),L=3,82)
0220      4731      CONTINUE
0221      4735      FIRST=LAST+1
0222      4740      WRITE (3,4745) (NAMDCT(I,L),L=1,16),(CODDST(I,L),L=1,2)
0223      4745      FORMAT (/sIX.'ERROR IN NUMERICAL READ PLEASE REENTER'
0224      4750      CONTINUE
0225      5735      CONTINUE
0226      5740      WRITE (3,4745) (NAMDCT(I,L),L=1,16),(CODDST(I,L),L=1,2)
0227      5750      CONTINUE
0228            C
0229            C
0230            C
0231            C
0232            C
0233      9000      WRITE (1,*) 'ERROR IN NUMERICAL READ PLEASE REENTER'
0234      9010      WRITE (1,*) 'ERROR OPENING EARTH TERMINAL FILE'
0235      9020      WRITE (1,*) 'ERROR READIN EARTH TERMINAL FILE'
0236      9030      STOP
SUBROUTINE MOVREC(I,J)

C THIS ROUTINE MOVES THE EARTH TERMINAL INFORMATION INTO AN ARRAY
C WHICH IS PRINTED IN THE PROGRAM EARTH.
C
C CALLED BY: EARTH
C
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
C I - INDEX OF THE UPLINK OR DOWNLINK CITY
C
C J - INDEX OF THE BIGREC
C
C UPDOWN - 1 = UPLINK, 2=DOWNLINK
C
0002 INCLUDE 'SYO:COMBLK,FNT/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+1),NUELEM)

BIGREC(J,1)=UPDOWN
BIGREC(J,2)=I

DO 10 K=3,7

BIGREC(J,K) = CALSIN(K-2)

DO 20 K=9,43

BIGREC(J,K) = LICNSE(K-8)

DO 30 K=46,61

BIGREC(J,K) = CITY(K-45)

DO 40 K=64,65

BIGREC(J,K) = STATE(K-63)

DO 50 K=68,76

BIGREC(J,K) = SERVIS(K-67)

DO 60 K=79,82

BIGREC(J,K) = SIZE(K-78)

RETURN

END
SECTION 4. GENERAL UTILITY SUBROUTINES

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

READIN
RITOUT
YESNO
UPDOWN
CODCHK
GETTER
COUNT
DISAPR
RCOST
RATECK
CTYCHK
VANDH
MINTMOD
REPRTR
SUBROUTINE READIN

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
0004 READ(1,5001,ERR=5030) NUELEMrNDELEM
0050 READ(2,5002,ERR=5030) NUELEMrNDELEM
0051 5002 FORMAT(9I4)
0052 5003 FORMAT(F5.2,F6.2,F5.1,3F7.2,F6.3,F5.1,F6.2,F7.2,F8.2)
0053 5004 READ (2,5050,ERR=5030) WATMAX,WATCPH,(GANDAD(I),I=1,4)
0055 5050 FORMAT(2F8.2,4F12.2)
0056 IF(NUMORG.EQ.0) GO TO 510
0057 IF (LI.EQ.1) GO TO 510
0058 IF (LJ.EQ.1) GO TO 510
0059 IF (LI.LT.LJ) GO TO 510
0060 IF (LI.LE.LJ) GO TO 510
0061 IF (LI.LT.LJ) GO TO 510
0062 IF (LI.LE.LJ) GO TO 510

COST ALLOCATION ORGANIZATION NAMES; IF APPLICABLE

C UPLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS
0063      510     IF (NUINDX.GE.2)
            2       READ (2,5005,ERR=5030) ((UCINDX(I,J),J=1,8),I=2,NUINDX)
0064      5005     FORMAT (5(8AI,1X))
0065      5006     IF (NUMORG.GT.0) READ (2,5006,ERR=5030) (UDXWHT(I),I=1,NUINDX)
0066      5006     FORMAT (6(F7.3)

---

**UPLINK 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       (UCMIN(I),UCSDAT(I,J,K),K=1,4)
0070      5007     FORMAT (2A1,IX,20A1,7X,5F10.3)
0071      5008     IF (NUINDX.EQ.1) GO TO 540
0072      J = 0
0073      S18     J = J + 2
0074      520     IF (J .GT. NUINDX) 525
0075      525     READ (2,5008,ERR=5030) (UCSDAT(IPJ),IPJ=1,NUINDX)
0076      5008     FORMAT (8F10.3)
0077      525     GO TO 518
0078      S25     READ (2,5008,ERR=5030) (UCSDAT(I,J,K),K=1,4)
0079      S30     CONTINUE

---

**UPLINK PATH DATA**

0081      JERROR=3
0082 DO S540 I = 1,NUPATH
0083 READ (2,5009,ERR=5030) (UPTHNM(IPJ),IPJ=1,NUELEM)
0084      5009     FORMAT (35AI9L1X,15AI2L)
0085      540     CONTINUE

---

**UPLINK 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) (UCSNAM(I,J),J=1,16), (USTCOD(I,J),J=1,2),
             2       (UCITYV(IPJ),UCITYH(IPJ),UCTCH(IPJ),UCORT(IPJ),UPTHY(IPJ),J=1,NUPATH)
0090      5010     FORMAT (16AI9L1X,2AI2L,16AI9L1X,15AI1)
0091      550     CONTINUE

---

**DOWNLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS**

0093      S55     JERROR=5
0094 IF (NDINDX.GE.2)
            2       READ (2,5005,ERR=5030) ((DCINDX(I,J),J=1,8),I=2,NDINDX)
0095      5005     IF (NUMORG.GT.0) READ (2,5006,ERR=5030) (DDXWHT(I),I=1,NDINDX)

---

**DOWNLINK COST ELEMENT DATA**

0096      630     I = 1,NDELEM
0097 READ (2,5007,ERR=5030) (DCSCOD(I,J),J=1,2), (DCSNAM(I,J),J=1,20),
             2       (DCMIN(I),DCSDAT(I,J,K),K=1,4)

---

D-76
READIN.FTN

READ(2,5008,ERR=5030) (DCSDAT(I,J,K),K=1,4) (DCSDAT(I,J,J),J=1,4)
GO TO 618
READ(2,5008,ERR=5030) (DCSDAT(I,J,K),K=1,4)
CONTINUE

DOWNLINK PATH DATA
JERROR=6
DO 640 I=1,NDPATH
READ(2,5009,ERR=5030) (DPTHNM(I,J),J=1,20) (DCSPTH(I,J),J=1,NDPATH)
640 CONTINUE

DOWNLINK CITY DATA
JERROR=7
IF (NDCITY.EQ.0) 00 TO 690
DO 650 I=1,NDCITY
READ(2,5010,ERR=5030) (DCTNAM(I,J),J=1,16) (DSTCOD(I,J),J=1,2)
2 DCITYV(I),DCITYM(I),DCTLVL(I),DCTORG(I) (DPTHY(I,J),J=1,NDPATH)
IF (NDINDX.GT.1) READ(2,5008,ERR=5030) (DCTXVL(I,J),J=1,NDPATH-1)
650 CONTINUE

TALKBACK INFORMATION
JERROR=8
IF (NUCITY.EQ.0) GO TO 690
DO 680 J=1,NUCITY
L2 = 0
L1 = L2 + 1
L2 = L1 + 12
IF(L1.GT.NDCITY) GO TO 680
IF(L2.GT.NDCITY) L2=NDPATH
READ(2,5011,ERR=5030) (TALKB(I,J),I=L1,L2)
FORMAT (13F6.1)
GO TO 660
680 CONTINUE
690 CLOSE (UNIT=2)
RETURN

IF ERRORS OCCUR WHILE READING THE INPUT FILE
WRITE(1,5020) (INNAME(I),I=1,16)
FORMAT (1H 'ERROR IN OPENING FILE ',16A1)
GO TO 5040
WRITE(1,5030) (PROB1(I,JERROR),I=1,3)
FORMAT (1H 'ERROR READING ' ,3A4, ' DATA')
WRITE (1,'(1X) ' 'PROGRAM TERMINATED'
CLOSE (UNIT=2)
STOP
END
SUBROUTINE RITOUT

CALLED BY: BUILD

INCLUDE 'SYO:COMBLK.FTN'

LOGICAL INNAME(16)
REAL PROBLM(398)
DATA IMMAME /'S'r'Y'r'0'
DATA PROBLM	 J'	 SC'r'ALAR'P'	 'r'UPLI'

OPEN OUTPUT SCENARIO FILE
WRITE(Ir*) 'ENTER NEW 6 CHARACTER NAME FOR THE SCENARIO FILE JUST 2 CREATED'
READ(1r5001PERR-5030) (INNAME(I)rI=1910)
OPEN (UNIT=2,TYPE='NEWT NAME=INNAMEPCARRIAOECONTROL

JERROR=1
WRITE(2r5001rERR-5030) (TITLE(I)rI=1r72)
5002 FORMAT(9I4)
WRITE(29505OPERR=5030)WATMAXPWATCPHP(GANDAD(I)PI-lr4)
5050 FORMAT(2F8.2r4Fi2.2)

COST ALLOCATION ORGANIZATION NAMES, IF APPLICABLE
IF(NUMORG.EQ.0) GO TO 510
LI = 1
MIN(NUMORG,L1+3)
WRITE(2,5004rERR=5030) ((ORONAM(I,J)rJ=1r20),I=L1,L2)
5004 FORMAT (4(20A1))
RITOUT.FTN /TR2b2.00KS/WR

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

C   UPLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS

0043  510  IF (NUINDEX.GE.2) WRITE(2,5005) ((UCINDEX(I,J),J=1,8),I=2,NUMINDEX)
0044  5005  FORMAT (5(BA1;1X))
0045  IF (NUMORG.GT.0) WRITE(2,5006) (UWXHT(I),I=1,NUMINDEX)
0046  5006  FORMAT (6F7.3)

C   UPLINK COST ELEMENT DATA

0047  JERROR=2
0048  DO 520 I = 1,NULEM
0049     WRITE(2,5007) (UCINDEX(I,J),J=1,2), (UCSNAM(I,J),J=1,20),
0050             UCINDEX(I,J),UCSNAM(I,J),K=1,4)
0051  5007  FORMAT (2A1;1X;20A1;1X;4F7.3)
0052  IF (NUINDEX.GE.1) GO TO 540
0053  J = 0
0054  518  J = J + 2
0055  IF (J.NE.NUMINDEX) 525,525,530
0056  520  JJ = J + 1
0057  525  WRITE(2,5008) (UCINDEX(I,J),J=1,2), (UCSNAM(I,J),J=1,20),
0058             UCINDEX(I,J),UCSNAM(I,J),K=1,4)
0059  5008  FORMAT (2A1;1X;20A1;1X;4F7.3)
0060  IF (NUINDEX.LE.1) WRITE(2,5008) (UCINDEX(I,J),J=1,2), (UCSNAM(I,J),J=1,20),
0061             UCINDEX(I,J),UCSNAM(I,J),K=1,4)
0062  518  J = J + 2
0063  IF (J.NE.NUMINDEX) 525,525,530
0064  520  JJ = J + 1
0065  525  WRITE(2,5008) (UCINDEX(I,J),J=1,2), (UCSNAM(I,J),J=1,20),
0066             UCINDEX(I,J),UCSNAM(I,J),K=1,4)
0067  5008  FORMAT (2A1;1X;20A1;1X;4F7.3)
0068  530 CONTINUE

C   UPLINK PATH DATA

0069  JERROR=3
0070  DO 550 I=1,NUPATH
0071     WRITE(2,5009) (UPTHNM(I,J),J=1,2), (UCSPTH(I,J),J=1,20),
0072             UCSPTH(I,J),I=1,NULEM)
0073  5009  FORMAT (2A1;1X;20A1;1X;2I2;5X;10I1)
0074  550 CONTINUE

C   UPLINK CITY DATA

0075  JERROR=4
0076  IF (NUCITY.EQ.0) GO TO 555
0077  DO 550 I=1,NUCITY
0078     WRITE(2,5010) (UCTNAM(I,J),J=1,16), (UCSTCOD(I,J),J=1,2),
0079             UCCTYU(I),UCITYU(I),UCCTYU(I),UCITYU(I),I=1,NUPATH)
0080  5010  FORMAT (16A1;1X,2A1,2I2;5X,10I1)
0081  550 CONTINUE

C   DOWNLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS

0082  JERROR=5
0083  IF (NINDEX.EQ.2) GO TO 555
0084  DO 550 I=1,NINDEX
0085     WRITE(2,5005) ((DCINDEX(I,J),J=1,8),I=2,NINDEX)
0086  5005  FORMAT (5(BA1;1X))
0087  550 CONTINUE
0088  555 JERROR=5
0089  IF (NINDEX.GE.2) GO TO 555
0090  5005  FORMAT (5(BA1;1X))
0091  555 CONTINUE

D-79
C DOWNLINK COST ELEMENT DATA

0096 DO 630 I = 1,NDELEM
0097 WRITE(2,5007,ERR=5030) (DCSCOD(I,J),J=1,2),
                 (DCSNAM(I,J),J=1,20),
                 DCSCMIN(I),
                 (DCSDAT(I,J,K),K=1,4)
0098 IF (NDINDX.EQ.1) GO TO 640
0099 J = 0
0100 418 J = J + 2
0101 IF (J - NDINDX) 620,625,630
0102 JJ = J + 1
0103 WRITE(2,5008,ERR=5030) (DCSDAT(I,J,K),K=1,4)
0104 GO TO 418
0105 WRITE(2,5009,ERR=5030) (DCSDAT(I,J,K),K=1,4)
0106 CONTINUE

C DOWNLINK PATH DATA

0107 JERROR=6
0108 DO 640 I = 1,NDPATH
0109 WRITE(2,5009,ERR=5030) (DCPTHM(I,J),J=1,20),
                 (DCSPTH(I,J),J=1,2)
0110 CONTINUE

C DOWNLINK CITY DATA

0111 JERROR=7
0112 IF (NDCITY.EQ.0) GO TO 690
0113 DO 650 I=NDCITY
0114 WRITE(2,5010,ERR=5030) (DCTNAM(I,J),J=1,16),
                 (DCCTCOD(I,J),J=1,2),
                 DCITYV(I),DCITYN(I),DCITYO(I),
                 (DPTHCY(J,I),J=1,NDPATH)
0115 IF (NDINDX.GT.1) WRITE(2,5009,ERR=5030) (DCTXVL(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 660 L1 = L2 + 1
0122 L2 = L1 + 1
0123 IF(L1.GT.NUCITY) GO TO 680
0124 IF(L2.GT.NUCITY) L2=NUCITY
0125 WRITE(2,5011,ERR=5030) (TALKBK(I,J),I=L1:L2)
0126 FORMAT (13F6-1)
0127 GO TO 660
0128 CONTINUE
0129 690 CLOSE (UNIT=2)
0130 RETURN

C IF ERRORS OCCUR WHILE WRITING THE OUTPUT FILE

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(1H,'ERROR WRITING ',3A4,' DATA')
5040 WRITE (1,8) 'RUNNER TERMINATED'
CLOSE (UNIT=2)
STOP
END
SUBROUTINE YESNO

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

0001 SUBROUTINE YESNO
0002 INCLUDE 'SY0:COMBLK.FTN/NOLIST'
0040 YESNO = 3
0041 READ(1,10,ERR=20) INDATA(1)
0042 10 FORMAT (A1)
0043 IF (INDATA(1).EQ.'Y') YESNO = 1
0044 IF (INDATA(1).EQ.'N') YESNO = 2
0045 20 IF (YESNO.EQ.3) WRITE (1,8) 'ANSWER MUST BE 'YES' OR 'NO'
0046 RETURN
0047 END
SUBROUTINE UPDOWN

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

0001 SUBROUTINE UPDOWN
0002 INCLUDE 'SYO4.COMBLK.FTN/NOLIST'
0040 UPDOWN = 3
0041 READ(1,10,IER=20) INDATA(1)
0042 10 FORMAT(A1)
0043 IF (INDATA(1).EQ.'U') UPDOWN = 1
0044 IF (INDATA(1).EQ.'D') UPDOWN = 2
0045 20 IF (UPDOWN.EQ.3) WRITE (1,*,'(A)') 'ANSWER MUST BE 'UP' OR 'DOWN'
0046 RETURN
0047 END
SUBROUTINE CODCHK

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

CODCHK CHECKS AN INPUT ARGUMENT AGAINST A LIST OF VALID ARGUMENTS

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

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

INTEGER NCHAR,NCOMPR,POSITION,I,J,NMATCH
LOGICAL INDATA(NCHAR),CMPARR(NCOMPR,1)

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

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

IF (NMATCH.GT.1) POSITION = -1
RETURN
END
SUBROUTINE GETTER

THIS SUBROUTINE RETRIEVES THE NEXT ARGUMENT ON THE COMMAND LINE

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

CASE WHERE ENTIRE LINE IS EMPTY

CHECK EACH CHARACTER

SEMICOLON ENCOUNTERED

IF CHARACTER COUNT IS ZERO

C-85
C IF COMM IS ENCOUNTERED
  50 IF (INDATA(I).NE.COMMA) GO TO 70
  NCHAR = I - NSTART
  NSTART = I + 1
  IF (NCHAR.EQ.0)
    2 WRITE(1,*) 'NULL ARGUMENT SPECIFIED--IT WILL BE IGNORED.'
C 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
  80 CONTINUE
C IF CHARACTER (OTHER THAN BLANK, COMMA, SEMICOLON) ENCOUNTERED
  70 NCHAR = NCHAR + 1
  ARG(NCHAR) = INDATA(I)
  CONTINUE
C END OF INPUT LINE REACHED
  CONTCD = 0
  NSTART = 1
  90 CALL CCOUNT(ARG,NCHAR)
  RETURN
  END
SUBROUTINE CCOUNT

CALLED BY: GETTER

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

0001 SUBROUTINE CCOUNT (ARG,NCHAR)
0002 LOGICAL*1 ARG(1),COMMA,BLANK,SEMIC
0003 INTEGER*2 NCHAR
0004 DATA COMMA /'r'/, SEMIC /'i'/, BLANK /'/

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

0005 DO 10 I = 1,24
0006 IF (ARG(I).EQ.BLANK) GO TO 20
0007 IF (ARG(I).NE.SEMIC.AND.ARG(I).NE.COMMA) GO TO 10
0008 NCHAR = I - 1
0009 RETURN
0010 10 NCHAR = I
0011 20 CONTINUE
0012 RETURN
0013 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
2=DOWNLINK COST ELEMENT
3=UPLINK PATH
4=DOWNLINK PATH
5=UPLINK CITY
6=DOWNLINK CITY

INDEX=POSITION IN ARRAYS TO BE DELETED

0001 SUBROUTINE DISAPR(CODE,INDEX)
0002 INCLUDE 'SYO:COMBLK.FTN/NOLIST'
0040 INTEGER*2 CODE,INDEX
0041 LOGICAL*1 BLANK

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

100 IF (INDEX.EQ.NUELEM) GO TO 190
0045 II = INDEX + 1
0046 DO 110 K=1,NDINDEX
0047 DO 110 J=1,NUPATH
0048 UCSDAT(I,J,K) = UCSDAT(I,J,K)
0049 DO 120 I=II,NUELEM
0050 UCSMIN(I) = UCSMIN(I)
0051 UCSCOD(I,J) = UCSCOD(I,J)
0052 UCSNAM(I,J) = UCSNAM(I,J)
0053 UCSPTH(I,J) = UCSPTH(I,J)
0054 CONTINUE
0055 UCSCOD(NUELEM+1) = BLANK
0056 UCSNAM(NUELEM+1) = BLANK
0057 NUELEM = NUELEM - 1

190 UCSCOD(NUELEM+1) = BLANK
0060 CONTINUE
0061 UCSNAM(NUELEM+1) = BLANK

200 IF (INDEX.EQ.NDELEM) GO TO 290
0065 II = INDEX + 1
0066 DO 210 K=1,NDINDEX
0067 DO 210 J=1,NUPATH
0068 UCSNAM(I,J) = UCSNAM(I,J)
0069 UCSPTH(I,J) = UCSPTH(I,J)

RETURN

290 UCSNAM(NUELEM+1) = BLANK
0061 UCSNAM(NUELEM+1) = BLANK
0062 NUELEM = NUELEM - 1

RETURN

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DISAPR.FTH

0049 210 DCSDAT(I-1,J,K) = DCSDAT(I,J,K)
0070 220 DO 220 I = I1,NDELEM
0071 220 DCBMIN(I-1) = DCBMIN(I)
0072 220 DO 240 J = J1,NDELEM
0073 220 DO 230 J = J1,2
0074 230 DCSCOD(I-1,J) = DCSCOD(I,J)
0075 230 DO 250 J = J1,20
0076 240 DCSNMAM(I-1,J) = DCSNMAM(I,J)
0077 240 DO 260 J = J1,NDPATH
0078 250 DCSPTH(I-1,J) = DCSPTH(I,J)
0079 260 CONTINUE
0080 290 DCSCOD(NDELEM-1) = BLANK
0081 DCSNMAM(NDELEM-1) = BLANK
0082 NDELEM = NDELEM - 1
0083 RETURN

C

C UPLINK PATH

C

0084 300 IF (INDEX .EQ. NUPATH) GO TO 390
0085 310 I1 = INDEX + 1
0086 DO 360 I = I1,NUPATH
0087 DO 310 J = J1,NUELEM
0088 310 UCSPTH(J-I) = UCSPTH(J,I)
0089 DO 320 J = J1,NUCITY
0090 320 UPTHCY(I-J) = UPTHCY(I,J)
0091 DO 330 J = J1,20
0092 330 UPTHNM(I-J) = UPTHNM(I,J)
0093 360 CONTINUE
0094 390 UPTHNM(MPATH-1) = BLANK
0095 NUPATH = NPATH - 1
0096 RETURN

C

C DOWNLINK PATH

C

0097 400 IF (INDEX .EQ. NDPATH) GO TO 490
0098 410 I1 = INDEX + 1
0099 DO 460 I = I1,NDPATH
0100 DO 410 J = J1,NDELEM
0101 410 DCSPTH(J-I) = DCSPTH(J,I)
0102 DO 420 J = J1,NDCITY
0103 420 DPTHCY(I-J) = DPTHCY(I,J)
0104 DO 430 J = J1,20
0105 430 DPTHNM(I-J) = DPTHNM(I,J)
0106 460 CONTINUE
0107 490 DPTHNM(MPATH-1) = BLANK
0108 NDPATH = NDPATH - 1
0109 RETURN

C

C UPLINK CITY

C

0110 500 IF (INDEX .EQ. NUCITY) GO TO 590
0111 510 I1 = INDEX + 1
0112 DO 560 I = I1,NUCITY
0113 UCITYV(I-I) = UCITYV(I)

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

D-90
SUBROUTINE RDCOST

SUBROUTINE CALLS: GETTER, CODCHK

CALLED BY: COST

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

SUBROUTINE RDCOST

INCLUDE 'SYO:COMBLK.FTN/NOLIST'

READ (Sr1000) (INDATA(I)+Is1rBO)
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
C
C
C SUBROUTINE RATECK
C
C CALLED BY: RATE
C
0001 SUBROUTINE RATECK (LOW, UP, XDAT)
C THIS ROUTINE CHECKS THE VALUE INDEXES FOR THE RATE MODULE
C TO MAKE SURE THEY ARE IN RANGE.
C
0002 INCLUDE 'SY0:COMBLK.FTN/NOLIST'
0040 INTEGER*2 XDAT,LOW,UP
C
0041 POSITN=0
0042 IF ( XDAT .LT. LOW .OR. XDAT .GT. UP) GO TO 10
0043 POSITN=XDAT
0044 GO TO 20
C
0045 10 WRITE ( I* ) 'NUMBER OUT OF RANGE - PLEASE RETYPE'
0046 20 RETURN
0047 END
SUBROUTINE CTYCHK

CALLED BY: CITY, MATMOD

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

SUBROUTINE CTYCHK(POSPORG)

INCLUDE 'SYOICOMBLK.FTN/NOLIST'

INTEGER*2 ORG, NMATCH, LIMIT, POS, POS2

POS = 0
ORG = 0
POS2 = 0
NMATCH = 0

IF (NCHAR.EQ.1 .OR. ARG(NCHAR-1).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.ORG(1).AND.UPPDWN.EQ.1) 1000 AND (ORG.EQ.DCTORG(1).AND.UPPDWN.EQ.2)
NMATCH = NMATCH + 1
POS = I

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-I*100)*(-1)
A=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=0.62786*SIN(A)+0.757542*COS(A)*COS(1.29144-B)
THETA=(SIN(A)-ALPHA*0.652786)/(0.757542*SQR(1.-ALPHA*ALPHA))
IF(B.GT.1.29144)THETA*6.:83185-THETA
BETA=2.22013-THETA
DIST=12510.25*ACOS(ALPHA)
M=IFIX(4995.-DIST*SIN(BETA))
N=IFIX(1402.-DIST*COS(BETA))
RETURN
END
SUBROUTINE MATMOD

CALL 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 DNLLINK COST ELEMENTS, MODIFY COST ELEMENT/PATH MATRIX
3 = READ UPLINK PATHS, MODIFY COST ELEMENT/PATH MATRIX
4 = READ DNLLINK PATHS, MODIFY COST ELEMENT/PATH MATRIX
5 = READ UPLINK PATHS, MODIFY PATH/CITY MATRIX
6 = READ DNLLINK PATHS, MODIFY PATH/CITY MATRIX
7 = READ UPLINK CITIES, MODIFY PATH/CITY MATRIX
8 = READ DNLLINK 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

0001 SUBROUTINE MATMOD(CODE,ONOFF,MODPOS)
0002 INCLUDE 'SYO:COMBLK.FTN/NOLIST'
0004 INTEGER*2 MODPOS, CODE, ONOFF, POSrORG

0041 GO TO (100,100,200,200,100,300,300), CODE

C COST ELEMENTS SPECIFIED

0042 100 WRITE (1,*) 'ENTER COST ELEMENT CODES; ALL, OR 1'
0043 READ(1,900) (INDATA(I),I=1,80)
0044 CALL GETTER
0045 IF (ARG(1).EQ.'L') RETURN
0046 IF (ARG(1).EQ.'A' .AND. ARG(2).EQ.'L' .AND. ARG(3).EQ.'L') GO TO 190
0047 IF (NCHAR.EQ.0) GO TO 170
0048 IF (CODE.EQ.1) CALL CODCHK(2,AUXUCS,AUXCOD,POSITION)
0049 IF (CODE.EQ.2) CALL CODCHK(2,AUXUCS,AUXCOD,POSITION)
0050 IF (POSITION.EQ.0) GO TO 180
0051 IF (CODE.EQ.1) UCSPTH(POSITION,MODPOS) = ONOFF
0052 IF (CODE.EQ.2) DCSPTH(POSITION,MODPOS) = ONOFF
0053 170 IF (CONTCD.EQ.0) GO TO 100
0054 IF (CONTCD.NE.0) GO TO 105

C IF ERRORS HAVE OCCURRED

0055 180 WRITE (1,*) 'INVALID COST ELEMENT CODE'
0056 WRITE (1,*) 'VALID COST ELEMENTS ARE...
0057 CALL REPRTR(9,1)
0058 GO TO 100

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

PATHS SPECIFIED
WRITE (1,*), 'ENTER PATH NAMES: ALL, OR I'
READ(1,900) (INDATA(I),I=1,80)
CALL GETTER
IF (ARG(1).EQ.'I') RETURN
IF (ARG(1).EQ.'A'.AND.ARG(2).EQ.'L'.AND.ARG(3).EQ.'L') GO TO 295
IF (NCHAR.EQ.0) GO TO 270
IF (UPPDWN.EQ.1) CALL CODCHK(NCHAR,ARG,MAXUPA,UPTHCN,POSITN)
IF (UPPDWN.EQ.2) CALL CODCHK(NCHAR,ARG,MAXDPD,DPTHCN,POSITN)
IF (POSITN.EQ.0) GO TO 280
IF (POSITN.EQ.0) GO TO 200
IF (CODE.EQ.3) UCSPTH(MODPOS,POSITN)=ONOFF
IF (CODE.EQ.4) DCSPTH(MODPOS,POSITN)=ONOFF
IF (CODE.EQ.5) UPTHCY(POSITN,MODPOS)=ONOFF
IF (CODE.EQ.6) DPTHCY(POSITN,MODPOS)=ONOFF
IF (CONTCD.EQ.0) GO TO 200
IF (CONTCD.EQ.0) GO TO 203
WRITE (1,*), 'PATH DOES NOT EXIST. VALID PATHS ARE...
CALL REPRTR(3,1)
IF (ARG(1).EQ.'I') RETURN
IF (ARG(1).EQ.'A'.AND.ARG(2).EQ.'L'.AND.ARG(3).EQ.'L') GO TO 390
IF (NCHAR.EQ.0) GO TO 370
CALL CTYCHK(POSITN,ORG)
IF (POSITN.EQ.0) GO TO 380
IF (POSITN.EQ.0) GO TO 300
IF (CODE.EQ.7) UPTHCY(I,MODPOS)=ONOFF
IF (CODE.EQ.8) DPTHCY(I,MODPOS)=ONOFF
IF (CONTCD.EQ.0) GO TO 300
RETURN

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

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IF (CONTCD.NE.0) GO TO 305

C IF ERRORS HAVE OCCURRED
C

WRITE (1,*) 'CITY DOES NOT EXIST'
WRITE (1,*) 'VALID CITIES ARE...
CALL REPRIR(10:1)
GO TO 300

DO 395 I=1,NCITY(UPPDWN)
   IF (CODE.EQ.7) UPTHCY(MODPOS+I)=ONOFF
   IF (CODE.EQ.8) DPTHCY(MODPOS+I)=ONOFF
CONTINUE
RETURN

FORMAT(80A1)
END
SUBROUTINE REPRTR

CALL SUBROUTINE CONTENTS THE REPORT FORMATS USED IN THE MODEL

0001 SUBROUTINE REPRTR (REPTYP, POS)
0002 INCLUDE 'SYOICOMPLK.FTN/NOLIST'
0040 INTEGER REPTYP, POS, BLANK, STAR, OUTARR(30)
0041 REAL PER, CTYPE(4), UPDOWN(2)
0042 DATA PER /'PER '9 BLANK /' /9 STAR /' '/9 LINK//
0043 DATA UPDOWN/ 'UP', 'DOWN' /
0044 DATA CTYPE /'CAP ', 'INS ', 'LES ', 'OMA '/
0045 GO TO (1000,2000,3000,4000,5000,6000,7000,8000,9000,10000), 2 REPTYP
0046 1000 IF (UPPDWN.EQ.2) GO TO 1500
0047 C UPLINK COST ELEMENT REPORT
0048 WRITE (3, 1400) (UCSCOD(POS J), J=1,2), (UCSNAM(POS J), J=1,20)
0049 1400 FORMAT (1HO, 'DATA FOR COST ELEMENT', 2A1, '' , 20A1)
0050 IF (NUINDX.GT.2) WRITE (3, 1440) (PER I, I=1,NUINDX)
0051 1440 FORMAT (1H0915x95(7X9A4))
0052 WRITE (3, 1450) ((UCINDX(I,J), J=1,8) , I=1,NUINDX)
0053 ':fi2T€
0054 DO 1450 K=1,4
0055 1440 WRITE (3, 1460) CTYPE(K), (UCSDAT(POS J,K), J=1,NUINDX)
0056 WRITE (3, 1470) UCMN(POS)
0057 1470 FORMAT (1H 'MINIMUM LEASE COST', F9.2)
0058 00 TO 99999
0059 C DOWNLINK COST ELEMENT REPORT
0060 1500 WRITE (3, 1400) (DCSCOD(POS J), J=1,2), (DCSNAM(POS J), J=1,20)
0061 IF (NDINDX.GT.2) WRITE (3, 1440) (PER I, I=1,NDINDX)
0062 1440 FORMAT (1H0915x95(7X9A4))
0063 WRITE (3, 1450) ((DCINDX(I,J), J=1,8) , I=1,NDINDX)
0064 ':fi2T€
0065 DO 1450 K=1,4
0066 1440 WRITE (3, 1460) CTYPE(K), (DCSDAT(POS J,K), J=1,NDINDX)
0067 WRITE (3, 1470) DCMN(POS)
0068 1470 FORMAT (1H 'MINIMUM LEASE COST', F9.2)
0069 00 TO 99999
0070 C MATRIX OF UPLINK COST ELEMENTS ASSOCIATED WITH EACH PATH
0070 2000 IF (UPPDWN.EQ.2) GO TO 2500
0071 WRITE (3, 1800) UPDOWN(1)*LINK
0072 1800 FORMAT (1H091H 'MATRIX OF COST ELEMENTS AND PATHS--', 2A4)
0073 WRITE (3, 1900) (UCSCOD(I,J), J=1,2), I=1,NUELEM;
DO 1590 I = 1, NUELEM

IF (UCSPTH(I,J) .EQ. 1) OUTARR(I) = STAR

1590 CONTINUE

WRITE (3,1910) (UPTHNM(J+K), K = 1, 30) / (OUTARR(I), I = 1, NUELEM)

1910 FORMAT (1H0, 20X, 15(1X, A1))

C MATRIX OF DOWNLINK COST ELEMENTS ASSOCIATED WITH EACH PATH

C

DO 2600 J = 1, NDELEM

OUTARR(I) = BLANK

IF (DCSPTH(I,J) .EQ. 1) OUTARR(I) = STAR

2590 CONTINUE

WRITE (3, 2600) (DPTHNM(J,K), K = 1, 20) / (OUTARR(I), I = 1, NDELEM)

2600 CONTINUE

GO TO 99999

C LIST OF UPLINK PATH NUMBERS AND NAMES

C

IF (UPPDWN .EQ. 2) GO TO 3500

WRITE (3, 3010) Format (1H0, /, 'NO.', 6X, 'PATH NAME')

DO 3100 I = 1, NUPATH

WRITE (3, 3090) (UPTHNM(I,J), J = 1, 20)

3090 FORMAT (1H0, 135X, A1)

3100 CONTINUE

GO TO 99999

C MATRIX OF DOWNLINK PATH NUMBERS AND NAMES

C

IF (NCITY(UPPDWN) .EQ. 0) GO TO 4600

WRITE (3, 4010) UPDOWN(UPPDWN), LINK

34010 FORMAT (1H0, /, 'MATRIX OF PATHS AND CITIES--', 2A4)

J1 = 1

J2 = MIN(NPATH(UPPDWN), 16)

WRITE (3, 4030) (J, J = J1, J2)

4030 FORMAT (1H0, ' CITY', 13X, 'ORG', '16I3')

DO 4080 I = 1, NUCITY

IF (UCITYV(I, .EQ. -1) GO TO 4080

DO 4070 J = J1, J2

4070 CONTINUE

GO TO 4080

4080 CONTINUE

GO TO 99999
0116  OUTARR(J) = BLANK
0117  IF (UPTHCY(J1).EQ.1) OUTARR(J) = STAR
0118  CONTINUE
0119  IF (NUMORG.EQ.0)  
               2 WRITE (3+4075) (UCTNAM(I),J=1,16),  
               (OUTARR(J-J1+1),J=J1,J2)
0120  4075  FORMAT('O'x16A1x7Xx16(IX+A2))
0121  IF (NUMORG.GT.0) WRITE (3+4076) (UCTNAM(I),J=1,16),UCT0RG(I),  
               2  (OUTARR(J-J1+1),J=J1,J2)
0122  4076  FORMAT('O'x16A1x5,2Xx16(I*+A2))
0123  4080  CONTINUE
0124  GO TO 99999
C
C MATRIX OF DOWNLINK PATHS AND CITIES
C
0125  4500  DO 4580 I=1,NDCITY
0126  4570 DO J1,J2
0127  4560 OUTARR(J) = BLANK
0128  4570 CONTINUE
0129  IF (NUMORG.EQ.0)  
               2 WRITE (3+4075) (DCTNAM(I),J=1,16),  
               (OUTARR(J-J1+1),J=J1,J2)
0130  4580 CONTINUE
0131  IF (NUMORG.GT.0) WRITE (3x4076) (DCTNAM(I),J=1,16),DCT0RG(I),  
               2  (OUTARR(J-J1+1),J=J1,J2)
0132  GO TO 99999
C
C UPLINK CITIES AND ASSOCIATED COST INDEX VALUES
C
0133  5000  WRITE (3+5050) UPDOWN(UPPDWN)x LINK
0134  5050 FORMAT ('O'r24Xr2A4x' COST INDEX VALUES' )
0135  IF (UPPDWN.EQ.2) GO TO 5500
0136  DO 5275 I=1,NUCITY
0137  WRITE (3+5060) (UCTNAM(I),J=1,16),UCT0RG(I)
0138  5060 FORMAT('O'x16A19I3)
0139  WRITE (3+5075) (UCINDX(K),J=1,8)xK=2+NDINDX)
0140  5075 FORMAT(6Xr5(zX+8A1))
0141  IF (UCITYV(I).EQ.-1) GO TO 5275
0142  WRITE (3+5100) (UCTXVL(I),K=1,NDINDEX-1)
0143  5100 FORMAT(9XrF8.24r4(4XrF6.2))
0144  5275 CONTINUE
0145  GO TO 99999
C
C DOWNLINK CITIES AND ASSOCIATED COST INDEXES
C
0150  5500  DO 5800 I=1,NDCITY
0151  WRITE (3+5060) (DCTNAM(I),J=1,16),DCT0RG(I)
0152  WRITE (3+5075) (DCINDX(K),J=1,8)x=2+NDINDX)
0153  IF (DCITYV(I).EQ.-1) GO TO 5800
0154  WRITE (3+5100) (DCTXVL(I),K=1,NDINDEX-1)
0155  GO TO 99999
C
C D-100
CC

TALKBACK MATRIX BETWEEN UPLINK AND DOWNLINK CITIES
CC

0157 6000 IF (NDCITY.EQ.0) GO TO 6600
0158 6050 FORMAT (1H0, 'MATRIX OF TALKBACK REQUIREMENTS', ///,
       2 'DOWNLINK CITY ORG ', 10(2X,3A1))
0159 6100 WRITE (3,6100) (UCTORG(I), I=1,NUCITY)
0160 6150 FORMAT (21X, 10I5) / 
0161 6150 CONTINUE
0162 GO TO 99999
0163 WRITE (3,6150) (DCTNAM(I,J), J=1,16), DCTORG(I),
       2 (TALKBK(I,J), J=1,NUCITY)
0164 6150 FORMAT (1H16A1, 10I5) /
0165 6600 WRITE (3,*) 'THERE ARE NO DOWNLINK CITIES IN THIS SEGMENT'
0166 GO TO 99999
0167 6600 WRITE (3,*) 'THERE ARE NO DOWNLINK CITIES IN THIS SEGMENT'
0168 GO TO 99999

C

ORGANIZATION NAMES AND NUMBERS
C

0169 7000 IF (NUMORG.EQ.0) GO TO 7200
0170 7025 WRITE (3,7025)
0171 7025 FORMAT (1H0, 'ORGANIZATION NAMES AND NUMBERS' )
0172 7100 DO 7100 I = 1,NUMORG
0173 7050 FORMAT (1X, 20A1, 5X, I1)
0174 7100 CONTINUE
0175 7100 CONTINUE
0176 GO TO 99999
0177 7100 CONTINUE
0178 GO TO 99999

C

AUXILIARY PARAMETERS
C

0179 8000 WRITE (3,8000) DDDINS, WATINS, PUTINS,
       2 DDDLES, WATLES, PUTFIX,
       3 PUTMIL,
       4 DDCPH, WATCPH,
       5 WATMAX,
0180 8010 FORMAT (1H0, /, 17X, 'AUXILIARY PARAMETERS' )
       2 'TALKBACK': 24X, 'DDD'-B-8X, 'WAT'-8X, 'PUT'-8X,
       3 3X, 'INSTALLATION': 13X, F10.2, 2X, F10.2,
       4 3X, 'ZERO U.C. CHARGE/MO.': 4X, F10.2, F10.2,
       5 3X, 'MILEAGE CHARGE': 33X, F10.2,
       6 3X, 'HOURLY CHARGE': 12X, F10.2, 2X, F10.2,
       7 3X, 'MAXIMUM CHARGE': 23X, F10.2,
       8 'AMORTIZATION': ///,
9 3X,'INTEREST RATE',7X,F5.2,' PERCENT'/,
A 3X,'EQUIPMENT LIFE',6X,F5.2,' YEARS'/,
B 'GENERAL AND ADMINISTRATIVE':/,
C 'TALKBACK CAPITAL EXPENDITURES'/,

0181 GO TO 99999
C LIST COST ELEMENTS AND COST ELEMENT CODES
C
0182 9000 WRITE (3,9050)
0183 9050 FORMAT ('0','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 GO TO 99999
0190 9300 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 ('0','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),
(USTCOD(I,J),J=1,2)
0199 10100 FORMAT (1X,16A1,2X,I1,4X,2A1)
0200 10200 CONTINUE
0201 GO TO 99999
0202 10300 DO 10400 I=1,NDCITY
0203 WRITE (3,10100) (DCTNAM(I,J),J=1,16),DCTORG(I),
(DSTCOD(I,J),J=1,2)
0204 10400 CONTINUE
0205 99999 WRITE (3,'')
0206 RETURN
0207 END
APPENDIX E

MODEL INSTALLATION

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

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

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

BUILD.ODL

.ROOT BUILD-REPRTR-SUBS-VANDH-* (READIN,COST,PATH,CITY,RATE,RITOUT)
SUBS: .FCTR YESNO-UPDOWN-CCOUNT-MATMOD-GETTER-CODCHK-CTYCHK-DISAPR-AØ
AØ: .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).
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 database, executing the cost algorithms, and preparing the output reports. The indirect processing costs include the software maintenance activities of program changes, backup activities, and earth terminal file updates and the on-line costs that accumulate. The administrative costs reflect the manpower required to perform the software maintenance activities, the user interface, and the billing process, as well as overhead items such as telephone and equipment rentals.

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

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

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

6. SUMMARY AND RECOMMENDATIONS

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

---

*Assumes a two-hour hookup to computer.
### Table F-1. COST SUMMARY BY TASK

<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>
</tr>
</thead>
<tbody>
<tr>
<td>Installation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manpower</td>
<td>2 man-weeks</td>
<td>2 man-days</td>
<td></td>
</tr>
<tr>
<td>Computer Charges</td>
<td>$1,500</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>Software Maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Familiarization</td>
<td>2 man-days*</td>
<td>2 man-weeks</td>
<td></td>
</tr>
<tr>
<td>Monthly Maintenance</td>
<td>3 man-days</td>
<td>3 man-days</td>
<td></td>
</tr>
<tr>
<td>Computer Charges</td>
<td>$100</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>Monthly On-Line</td>
<td>$500</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>Storage Charges</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardware Maintenance</td>
<td>0</td>
<td>0-$600**</td>
<td></td>
</tr>
<tr>
<td>Customer Service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model Assistance</td>
<td>3 man-days per month</td>
<td>Same</td>
<td></td>
</tr>
<tr>
<td>(depends on model usage)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network Consulting</td>
<td>As required, directly billable</td>
<td></td>
<td></td>
</tr>
<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></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).