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Publication 1358-01-3-2238

NASA CR-160020

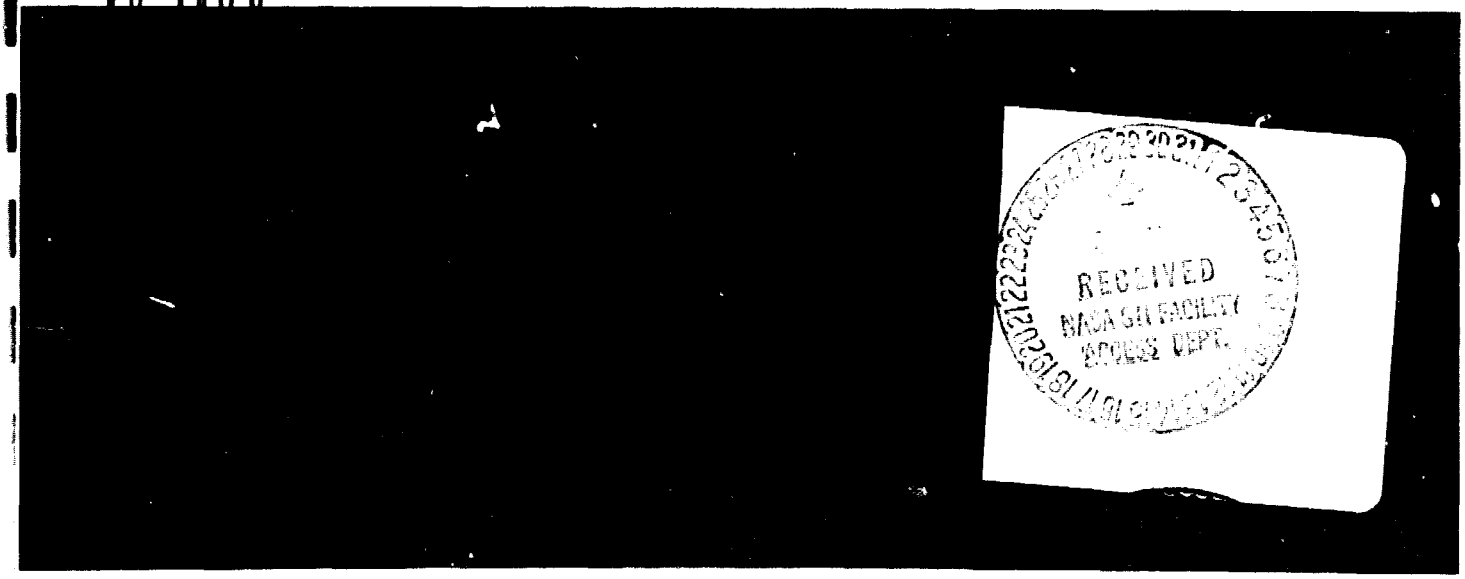
FINAL REPORT

VIDEO DISTRIBUTION SYSTEM COST MODEL

July 1980

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

ARINC RESEARCH CORPORATION



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by

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Publication 1358-01-3-2238

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 (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.
3. Washington-Alaska-Montana-Idaho (WAMI) - 15 sites in northwest United States and Alaska. The WAMI network is used for medical education. Programming originates from Seattle, Washington.
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.

Table S-1. SUMMARY OF TEST RUN RESULTS

Case	Number of Organizations	Number of Sites	Uplink Hours	Total Annualized Cost ($ Thousands)	Average Cost per Uplink Hour per Site (Dollars)
Federal Cities	1	15	1,612	932*	38.53
Appalachian Educational Satellite Project (AESP)	1	45	1,040	891*	19.02
Washington-Alaska-Montana-Idaho (WAMI)	1	15	1,664	1,120*	44.87
"East" Case	3	95	3,932	2,040**	5.46
"West" Case	7	86	6,812	3,638**	6.21
SMSA Cases					
a.	1	10	1,300	481†	37.00
b.	1	22	1,300	517†	18.08
c.	1	64	1,300	689†	8.28
d.	1	78	1,300	763†	7.52
Full Duplex Federal Regions	1	78	1,300	813†	8.02
Cost Allocation Case					
Overall	2	22	2,340	952†	18.49
Federal Regions	1	10	1,300	332†	25.54
Top 20 SMSAs	1	20	1,040	620†	29.81

*Based on 5-year amortization at 10 percent rate.
**Based on 8-year amortization at 10 percent rate.
†Based on 8-year amortization at 12 percent rate.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

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

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

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

There are several issues to be considered in establishing a shared-use network for one-way video. A number of earth stations that are interconnected by Western Union's WESTAR satellite or RCA's SATCOM have already been

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

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

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

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

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*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 appendexes:

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

- Appendix E - Model Installation. The procedures required to install the model on a minicomputer are explained.
- Appendix F - Operational Costs and Management Considerations. The feasibility of offering access to the model to a large community of users is assessed and presented in terms of the costs required to support the model.

CHAPTER TWO

MODEL OVERVIEW

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

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

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

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

The model can also be used to highlight the cost benefits of sharing facilities. Two or more organizations that individually cannot use a facility effectively might find that sharing the facility would be mutually beneficial. Multiple organizations sharing earth terminals or recording studios, for example, provide substantial cost benefits to the users. The

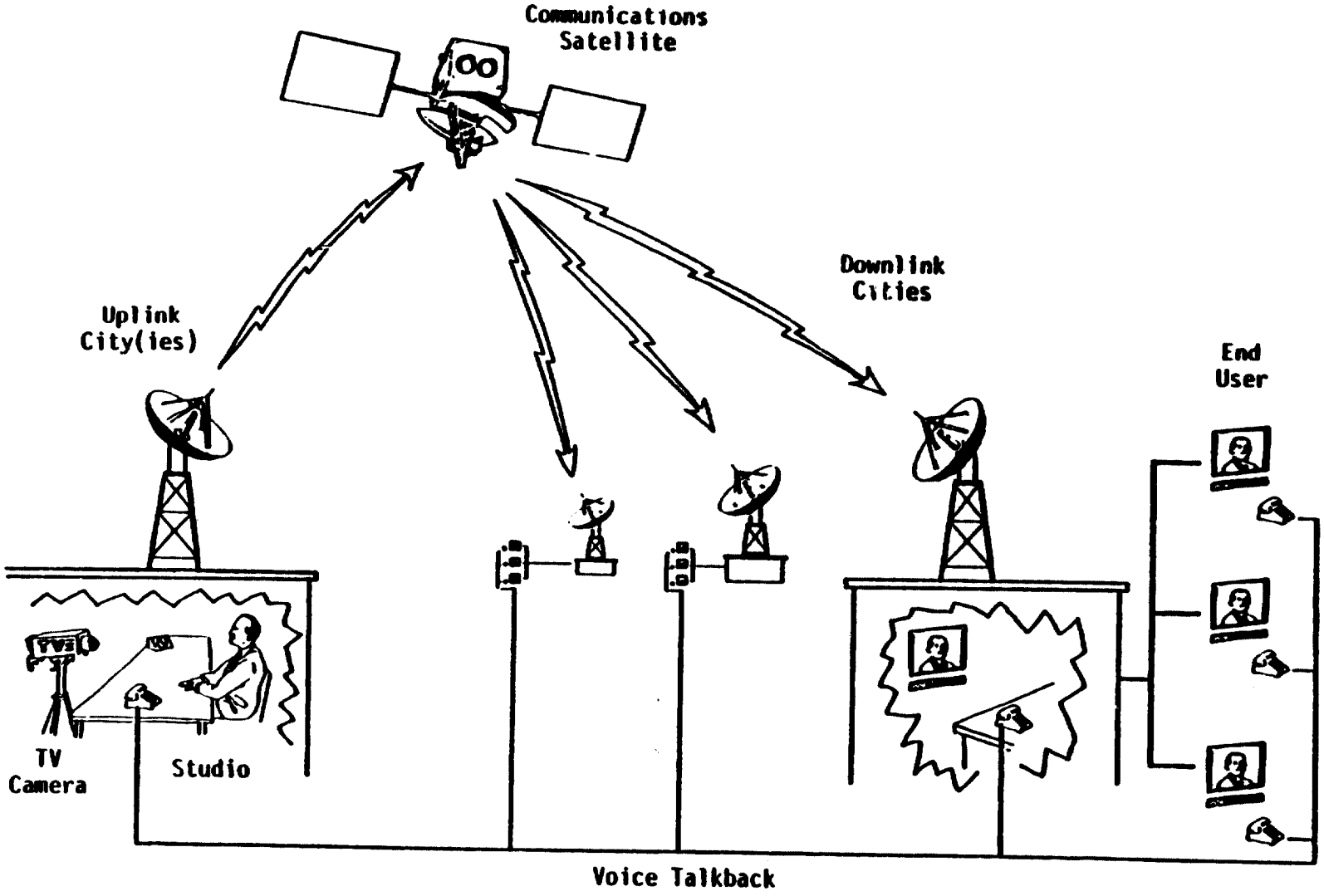

Figure 2-1. TYPICAL VIDEO DISTRIBUTION SYSTEM

savings limit would be reached when the shared facility became fully used. The model allows the user to establish his own cost allocation methodology by specifying the member organizations that will share the cost and applying weighting factors to the various cost items (e.g., peak versus off-peak usage) that affect each organization's share.

2.1 OVERALL MODEL STRUCTURE

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

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

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

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

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

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

For each of the major cost segments other than "Administrative," the model user must specify a set of available options, or "paths," that define the various means of sending the information through that particular link of the system. The model will calculate the cost of each feasible option

and choose the least expensive, option for each city under consideration. Because of variations in hourly utilization, distances between cities, and other factors, the optional path will not necessarily be the same in each city.

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

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

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

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

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

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

2.2 UPLINK FORMULATION

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

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

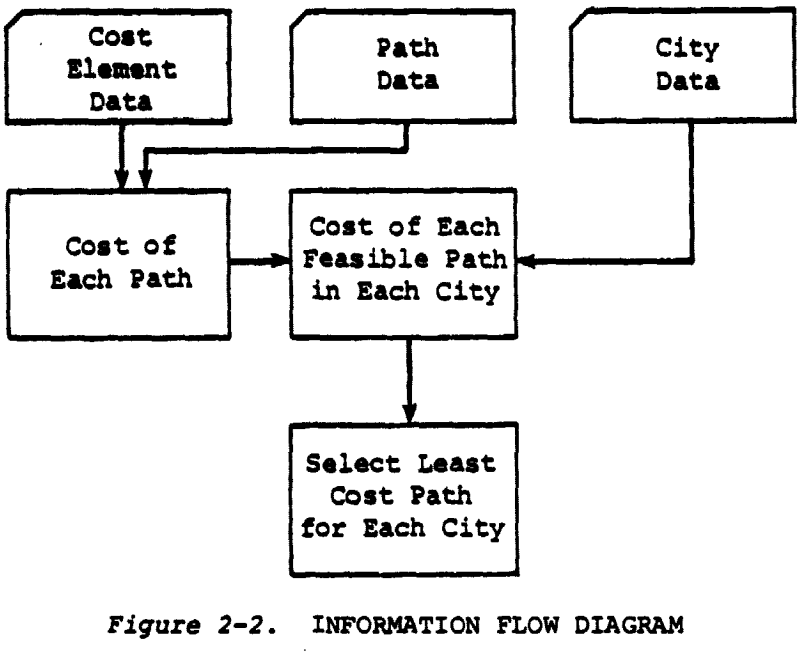

Figure 2-2. INFORMATION FLOW DIAGRAM

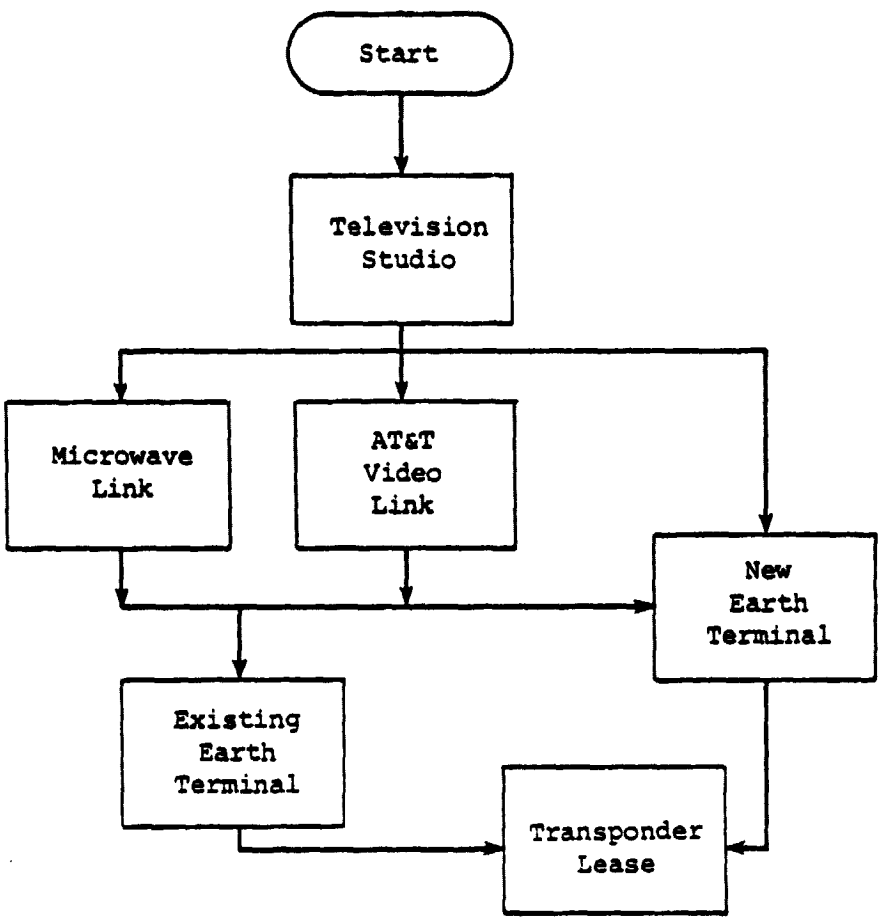

Figure 2-3. UPLINK PATHS

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

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

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

2.3 DOWNLINK FORMULATION

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

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

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

The private earth terminal could also be colocated with one of the audience sites. If there is only one audience organization associated with a particular downlink city, there will be no need for a local transmission system as well. With multiple receiving organizations, it will be necessary to establish a local distribution system through a CATV or ITFS network. In cases where the receiver must also be used as a transmitter, either for a two-way video communications or for one-way transmission at a different hour of the day, a single two-way earth terminal could suffice

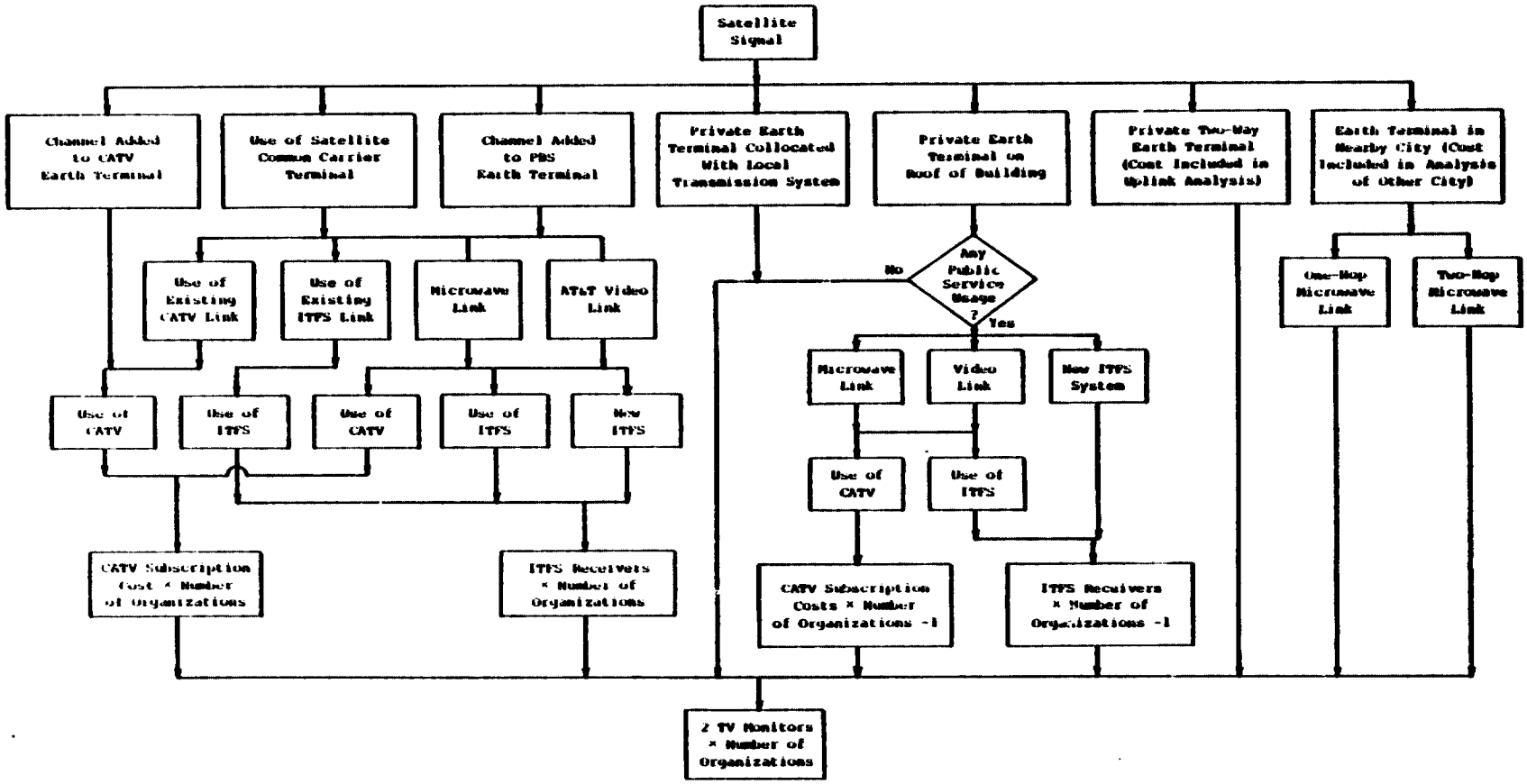

Figure 2-4. LOCAL DISTRIBUTION OPTIONS

for the downlink. A final alternative is to receive the signal by using an earth terminal in a nearby city and then running a one- or two-hop microwave link between the earth terminal and the viewing site.

2.4 VOICE TALKBACK FORMULATION

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

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

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

2.5 ADMINISTRATIVE COSTS

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

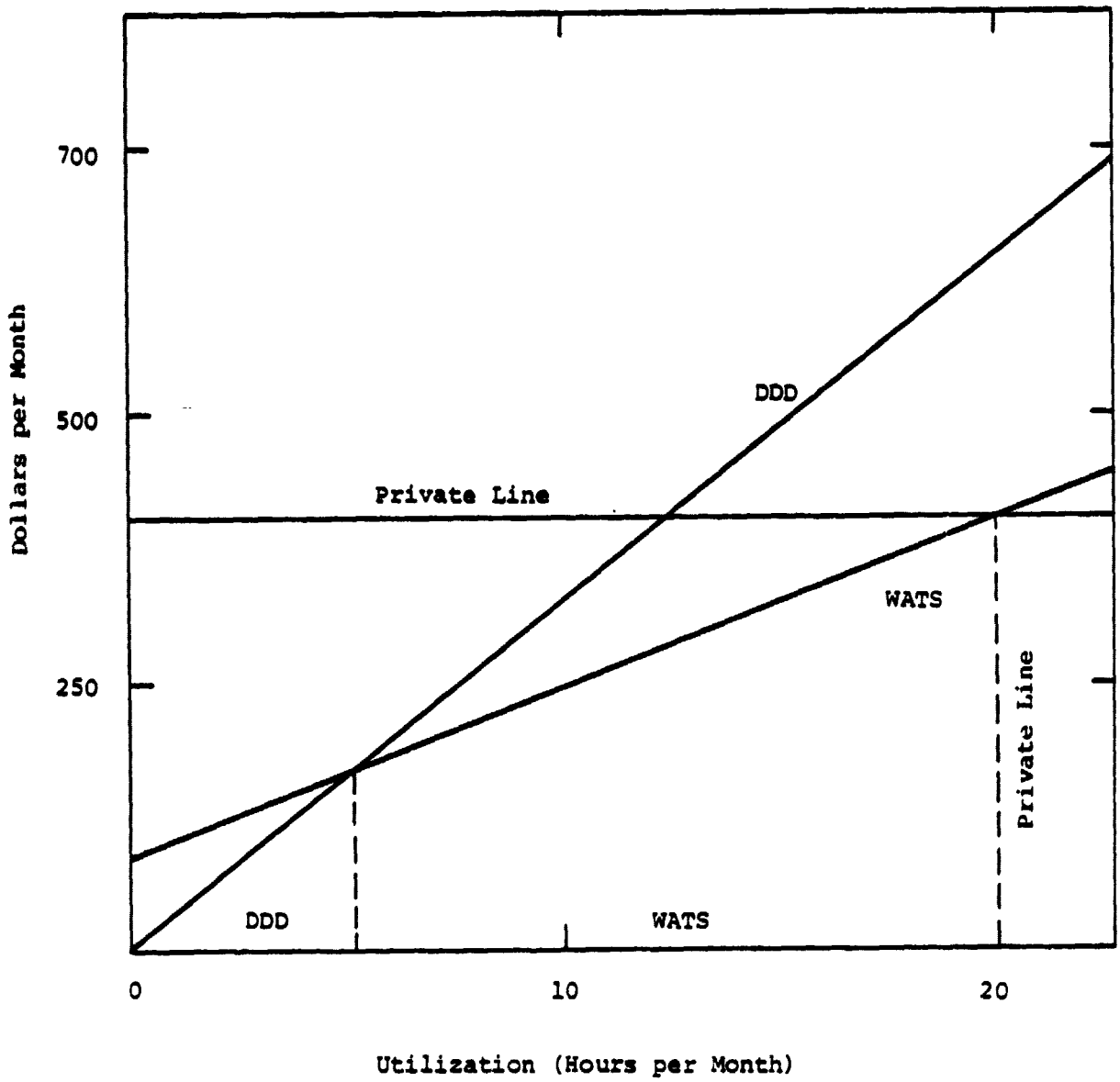

Figure 2-5. COMPARISON OF WATS, DDD, AND PRIVATE LINE (WASHINGTON TO CHICAGO)

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.

Fields Included	Example
• Call Sign	KB20
• Licensee	Teleprompter
• City	Anaheim
• State	CA
• Service	DFS-FES-D-TR*
• Latitude	37-37-02
• Longitude	121-49-51
• Antenna Size	4.5 Meter
• Licensed Points of Communication	KS20, KS21**

*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:

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

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

3. Washington - Alaska - Montana - Idaho (WAMI) - 15 sites in the northwest continental United States and Alaska. The WAMI network is used for medical education. Programming originates from Seattle, Washington.

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

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

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

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

Cost Summary

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

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

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

3.2 APPALACHIAN EDUCATIONAL SATELLITE PROJECT (AESP)

AESP is a network of about 45, mostly small, cities and towns in or near the Appalachian Mountains between New York and Alabama. Each downlink organization, many of which are small colleges, receives community service programming originating in Lexington, Kentucky. In some cities, programming is locally distributed through a CATV outlet.

Each city in the network was assigned to one of three "levels" depending on its role in the network hierarchical structure. Level 1 denoted an uplink site. Levels 2 and 3 were assigned on the basis of the city's role in the voice talkback subsystem: level-2 cities were equipped to call Lexington directly, while level-3 cities could talk only to the nearest level-2 city. In an actual programming environment, the level-2 cities would receive questions or comments from viewers in the level-3 cities, screen them, and relay them to Lexington, possibly adding a few comments of their own. An algorithm was programmed into the model to search through the level-2 cities to find the closest one to a given level-3 city. Only Lexington was assigned level 1; 22 cities were assigned to level 2 and 22 to level 3.

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

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

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

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

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

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

Table 3-3. APPALACHIAN EDUCATIONAL SATELLITE PROJECT

Available Option			
City	Uplink	Downlink	Voice Talkback
Guntersville, AL*	--	Private Earth Terminal	Private Line
Rainsville, AL*	--	Private Earth Terminal	Private Line
Gadsden, AL	--	Private Earth Terminal	Private Line
Huntsville, AL	--	Private Earth Terminal	Private Line
Clayton, GA*	--	Private Earth Terminal	Private Line
Rome, GA*	--	Private Earth Terminal	Private Line
Gainesville, GA	--	Private Earth Terminal	Private Line
Hazard, KY	--	Private Earth Terminal	Private Line
Lexington, KY	Private Earth Terminal colocated with studio	Monitors Only	None
Morehead, KY	--	Private Earth Terminal	Private Line
Somerset, KY	--	Private Earth Terminal	Private Line
Hagerstown, MD*	--	Private Earth Terminal	Private Line
Cumberland, MD	--	Private Earth Terminal	Private Line
McHenry, MD	--	Private Earth Terminal	Private Line
Booneville, MS*	--	Private Earth Terminal	Private Line
Tupelo, MS	--	Private Earth Terminal	Private Line
Scooba, MS	--	Private Earth Terminal	Private Line
Alfred, NY*	--	Private Earth Terminal	Private Line
Fredonia, NY	--	Private Earth Terminal	Private Line
Olean, NY	--	Private Earth Terminal	Private Line
Boone, NC*	--	Private Earth Terminal	Private Line
Marion, NC*	--	Private Earth Terminal	Private Line
Morganton, NC*	--	Private Earth Terminal	Private Line
Sylva, NC	--	Private Earth Terminal	Private Line
Athens, OH	--	Private Earth Terminal	Private Line
Ebensburg, PA*	--	Private Earth Terminal	Private Line
Edinboro, PA*	--	Private Earth Terminal	Private Line
Smethport, PA*	--	Private Earth Terminal	Private Line
Pittsburgh, PA	--	Private Earth Terminal	Private Line
Columbia, SC*	--	Private Earth Terminal	Private Line
Greenville, SC	--	Private Earth Terminal	Private Line

*Level 2 cities.

Table 3-3. (continued)

Available Option (continued)

City	Uplink	Downlink	Voice Talkback
Spartanburg, SC	--	Private Earth Terminal	Private Line
Chattanooga, TN*	--	Private Earth Terminal	Private Line
McMinnville, TN*	--	Private Earth Terminal	Private Line
Johnson City, TN*	--	Private Earth Terminal	Private Line
Tazewell, TN*	--	Private Earth Terminal	Private Line
Cookeville, TN	--	Private Earth Terminal	Private Line
LaFollette, TN	--	Private Earth Terminal	Private Line
Stickleyville, VA*	--	Private Earth Terminal	Private Line
Dublin, VA	--	Private Earth Terminal	Private Line
Norton, VA	--	Private Earth Terminal	Private Line
Petersburg, WV*	--	Private Earth Terminal	Private Line
Wheeling, WV*	--	Private Earth Terminal	Private Line
Romney, WV*	--	Private Earth Terminal	Private Line
Bethany, WV	--	Private Earth Terminal	Private Line

Cost Summary

Model Segment	Capital Expenditures	Planning and Installation	Annual Lease	Annual O&M&A	Annualized Cost
Uplink	285,000	5,000	133,225	66,000	275,726
Downlink	705,000	0**	0	132,000	317,977
Voice Talkback	88,000	4,752	134,257	0	158,722
Administrative	0	160,100	0	96,500	138,734
Totals	1,078,000+	169,852+	267,482	294,500	891,159
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 3-4. WASHINGTON-ALASKA-MONTANA-IDAHO (WAMI) NETWORK

Available Option

City	Uplink	Downlink	Voice Talkback
Seattle, WA	Private Earth Terminal	Monitors Only	--
Fairbanks, AK	Private Earth Terminal	Monitors Only	--
Bozeman, MT	Private Earth Terminal	Monitors Only	--
Boise, ID	Private Earth Terminal	Monitors Only	--
Spokane, WA	--	Private Earth Terminal	Private Line
Pullman, WA	--	Private Earth Terminal	Private Line
Anchorage, AK	--	Private Earth Terminal	Private Line
Billings, MT	--	Private Earth Terminal	Private Line
Ketchikan, AK	--	Private Earth Terminal	Private Line
Whitefish, MT	--	Private Earth Terminal	Private Line
Anacortes, WA	--	Private Earth Terminal	Private Line
Pocatello, ID	--	Private Earth Terminal	Private Line
Bethel, AK	--	Private Earth Terminal	WATS
Missoula, MT	--	Private Earth Terminal	Private Line
Great Falls, MT	--	Private Earth Terminal	Private Line

Cost Summary

Model Segment	Capital Expenditures	Planning and Installation	Annual Lease	Annual O&M&A	Annualized Cost
Uplink	1,140,000	20,000	266,450	264,000	836,455
Downlink	180,000	0*	0	33,000	80,483
Voice Talkback	22,000	1,105	58,572	0	64,667
Administrative	0	160,100	0	96,500	138,734
Totals	1,342,000**	181,205**	325,022	393,500	1,120,339
Total Annualized Cost	354,016	47,801	325,022	393,500	1,120,339

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

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

Five paths are feasible in the downlink segment: (1) A private earth terminal colocated with monitors is available in all cities. (2) If a CATV earth terminal is located within 20 miles, the signal may be received and distributed through the cable systems. (The 20-mile figure is based

on estimated "range" of a CATV network beyond the earth terminal.) For this case, the only costs would be for equipment to receive the additional frequency at the earth terminal and feed it into the local distribution network, and for user subscription charges. (3) One-hop microwave from an existing terminal is a feasible option if the sites are less than 20 miles apart; (4) two-hop microwave is feasible if they are less than 100 miles apart. (5) If a downlink city is also an uplink city (Lexington, for example), the cost of the earth terminal has already been allocated in the uplink segment; therefore, earth terminal costs will not be counted in the downlink segment as well.

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

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

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

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

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

Table 3-5. "EAST" CASE

Selected Options

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

Cost Summary

Model Segment	Capital Expenditures	Planning and Installation	Annual Lease	Annual O&M&A	Annualized Cost
Uplink	3,585,000	189,000	393,200	300,000	1,400,612
Downlink	915,000	109,200	7,920	129,300	329,347
Voice Talkback	136,000	1,479	158,118	0	183,887
Administrative	0	160,100	0	96,500	126,510
Totals	4,636,800	459,779	559,238	525,800	2,040,353
Total Annualized Cost	**869,139***	**86,183***	559,238	525,800	2,040,359

***Effective yearly costs for 8-year, 10.00 percent amortization.**

Table 3-5. (continued)

DEFINITION OF CITY GROUPS AND AVAILABLE OPTIONS

GROUP A: Private earth terminal downlink only

Dublin, GA
Fayetteville, NC
Salisbury, NC
Oteen, NC
Altoona, PA
Wilkes-Barre, PA
Johnson City, TN
Clarksburg, WV
Guntersville, AL
Rainsville, AL
Clayton, GA
Rome, GA
Boone, NC
Marion, NC
Morganton, NC
Ebensburg, PA
Edinboro, PA
Smethport, PA
Tazewell, TN
Petersburg, WV
Stickleyville, VA
Romney, WV
Scooba, MS
Alfred, NY
Morehead, KY

GROUP B: Private earth terminal or two-hop microwave

Hazard, KY
Somerset, KY
McHenry, MD
Tupelo, MS
Fredonia, NY

GROUP B: (continued)

Sylva, NC
Athens, OH
Pittsburgh, PA

GROUP C: Private earth terminal or one- or two-hop microwave

Olean, NY
Dublin, VA
Bethany, WV

GROUP D: Private earth terminal or CATV Link

Salem, VA
Beckley, WV
Hagerstown, MD
Booneville, MS
Chattanooga, TN
McMinnville, TN
Columbia, SC
Wheeling, WV

GROUP E: Private earth terminal, CATV Link, or two-hop microwave

Gadsden, AL
Huntsville, AL
Cumberland, MD
Greenville, SC
Spartanburg, SC
Cookeville, TN
LaFollette, TN
Norton, VA
Gainesville, GA

GROUP F: Private earth terminal, CATV Link, or two-hop microwave; no talkback required

Florence, AL
Decatur, AL
Birmingham, AL
Chatsworth, GA
Dalton, GA
Barbourville, KY
Crooksville, OH
Elkins, WV
Wytheville, VA
Sparta, TN
Crossville, TN
Oak Ridge, TN
New Albany, MS
Anderson, SC
N. Wilkesboro, NC
Corinth, MS

GROUP G: Private earth terminal, CATV Link, one- or two-hop microwave; no talkback required

Cumberland, KY
Frostburg, MD
Salamanca, NY
Erie, PA
Emporium, PA
Nelsonville, OH
New Lexington, OH
Moundsville, WV
Wellsburg, WV

3.5 "WEST" CASE

The "West" case is a hypothetical aggregation of several smaller networks. It includes the Federal Cities network, the WAMI network, and 32 VA hospitals. Also included is the Denver Research Institute (DRI), a network of 10 sites in Colorado, Montana, and Utah. There are three California

networks included: Project Interchange (5 sites), Education (27 sites), and Conferencing (3 sites). There is considerable overlap among the various subnetworks, the 106 sites representing only 82 downlink cities.

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

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

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

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

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

Table J-6. "WEST" CASE

Selected Options

City	Uplink	Downlink	Voice Talkback
Seattle, WA	Private Earth Terminal; link required	Monitors Only	Private Line
Fairbanks, AK	Private Earth Terminal; no link required	Monitors Only	--
Bozeman, MT	Private Earth Terminal; no link required	Monitors Only	DDD
Boise, ID	Private Earth Terminal; no link required	Monitors Only	DDD
Moffett Field, CA	Private Earth Terminal; link required	--	--
Sacramento, CA	Private Earth Terminal; link required	--	--
Los Angeles, CA	Private Earth Terminal; link required	Monitors Only	Private Line
Denver, CO	Private Earth Terminal; link required	Monitors Only	Private (to Seattle) WATS (to Washington)
Washington, DC	Private Earth Terminal; link required	--	--
11 Federal Cities	--	Private Earth Terminals	Private Line
Grand Junction, CO	--	CATV Link	DDD
Menlo Park, CA	--	Private Earth Terminals	DDD
Group A (48)	--	Private Earth Terminals	DDD
Group B (16)	--	CATV Link	DDD

Cost Summary

Model Segment	Capital Expenditures	Planning and Installation	Annual Lease	Annual O&M&A	Annualized Cost
Uplink	7,430,000	442,000	681,200	774,000	2,930,756
Downlink	867,300	121,700	3,780	154,200	343,360
Voice Talkback	180,000	2,036	202,888	0	237,007
Administrative	0	160,100	0	96,500	126,510
Totals	8,477,300	725,836	887,867	1,024,700	3,637,630
Total Annualized Cost	1,589,016*	136,053*	887,867	1,024,700	3,637,636

*Effective yearly costs for 8-year, 10.00 percent amortization.

Table 3-6. (continued)

DEFINITION OF CITY GROUPS			
GROUP A: Private downlink earth terminal			GROUP B: CATV Link
Pullman, WA	Fresno, CA	Laverne, CA	Spokane, WA
Anchorage, AK	Livermore, CA	La Mirada, CA	Billings, MT
Ketchikan, AK	Long Beach, CA	Newhall, CA	Anacortes, WA
Whitefish, MT	Martinez, CA	Pomona, CA	Pocatello, ID
Bethel, AK	Sepulveda, CA	Orange, CA	Missoula, MT
Phoenix, AZ	Portland, OR	Moraga, CA	Great Falls, MT
Tucson, AZ	Chico, CA	Redlands, CA	Albuquerque, NM
Sheridan, WY	Torrance, CA	San Raphael, CA	Prescott, AZ
Fort Lyon, CO	Angwin, CA	San Luis Obispo, CA	Cheyenne, WY
American Lake, WA	Arcata, CA	Stockton, CA	Salt Lake City, UT
Vancouver, WA	Azuza, CA	Thousand Oaks, CA	Palo Alto, CA
Walla Walla, WA	Belmont, CA	Whittier, CA	Reno, NV
Roseburg, OR	Dominiguez, CA	Vallejo, CA	Hayward, CA
White City, OR	Claremont, CA	Pueblo, CO	Turlock, CA
Fort Harrison, MT	Costa Mesa, CA	Logan, UT	Helena, MT
Miles City, MT	Irvine, CA	Moab, UT	Kalispell, MT

3.6 SMSA CASES

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

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

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

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

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

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

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

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

Table 3-7. SMSA CASES

City/State	private E-T	Microwave from E-T	Cable TV E-T	Monitors Only	Selected Path	a	b	c	d
Boston, MA	X	X	X		CATV link	X	X	X	X
New York, NY	X	X	X		CATV link	X	X	X	X
Philadelphia, PA	X	X	X		CATV link	X	X	X	X
Atlanta, GA	X	X	X		CATV link	X	X	X	X
Chicago, IL	X	X	X		CATV link	X	X	X	X
Dallas, TX	X	X	X		CATV link	X	X	X	X
Kansas City, MO	X	X	X		CATV link	X	X	X	X
Denver, CO	X	X	X		CATV link	X	X	X	X
San Francisco, CA	X	X	X		CATV link	X	X	X	X
Seattle, WA	X	X	X		CATV link	X	X	X	X
Los Angeles, CA	X	X	X		CATV link		X	X	X
Detroit, MI	X	X	X		CATV link		X	X	X
Pittsburgh, PA	X	X	X		CATV link		X	X	X
St. Louis, MO	X	X	X		CATV link		X	X	X
Baltimore, MD	X	X	X		CATV link		X	X	X
Cleveland, OH	X	X	X		CATV link		X	X	X
Houston, TX	X	X	X		CATV link		X	X	X
Newark, NJ	X	X	X		CATV link		X	X	X
Minneapolis, MN	X	X	X		CATV link		X	X	X
Orange County, CA	X	X	X		CATV link		X	X	X
Milwaukee, WI	X	X	X		CATV link		X	X	X
Washington, DC	X	X	X	X	Monitors		X	X	X
Tacoma, WA	X	X	X		CATV link			X	X
Salem, OR	X	X	X		CATV link			X	X
Sacremento, CA	X	X			Private E-T			X	X
Reno, NV	X	X			Private E-T			X	X
Boise, ID	X	X	X		CATV link			X	X
Great Falls, MT	X				Private E-T			X	X
Salt Lake City, UT	X	X	X		CATV link			X	X
Phoenix, AZ	X	X	X		CATV link			X	X
Albuquerque, NM	X	X	X		CATV link			X	X
Fargo, ND	X	X	X		CATV link			X	X
Sioux Falls, SD	X	X	X		CATV link			X	X
Lincoln, NE	X				Private E-T			X	X
Topeka, KS	X				Private E-T			X	X
Oklahoma City, OK	X	X	X		CATV link			X	X
Austin, TX	X	X	X		CATV link			X	X
Des Moines, IO	X	X	X		CATV link			X	X
Little Rock, AR	X	X	X		CATV link			X	X
Baton Rouge, LA	X	X	X		CATV link			X	X
Madison, WI	X	X	X		CATV link			X	X
Springfield, IL	X	X	X		CATV link			X	X
Jackson, MS	X	X	X		CATV link			X	X
Lansing, MI	X	X	X		CATV link			X	X
Indianapolis, IN	X	X	X		CATV link			X	X
Lexington, KY	X	X	X		CATV link			X	X
Nashville, TN	X	X	X		CATV link			X	X
Montgomery, AL	X	X	X		CATV link			X	X
Tallahassee, FL	X	X			Private E-T			X	X

(continued)

Table 3-7. (continued)

City/State	Private E-T	Microwave from E-T	Cable TV E-T	Monitors Only	Selected Path	a	b	c	d
Columbus, OH	X	X	X		CATV link			X	X
Columbia, SC	X	X	X		CATV link			X	X
Raleigh, NC	X	X	X		CATV link			X	X
Richmond, VA	X	X	X		CATV link			X	X
Charleston, SC	X	X	X		CATV link			X	X
Wilmington, DE	X	X	X		CATV link			X	X
Harrisburg, PA	X	X	X		CATV link			X	X
Trenton, NJ	X	X			Private E-T			X	X
Albany, NY	X	X	X		CATV link			X	X
Hartford, CT	X	X	X		CATV link			X	X
Providence, RI	X	X			Private E-T			X	X
Manchester, NH	X	X	X		CATV link			X	X
Lewiston, ME	X	X	X		CATV link			X	X
Honolulu, HI	X				Private E-T			X	X
Bismarck, ND	X	X	X		CATV link			X	X
Olympia, WA	X	X	X		CATV link				X
Carson City, NV	X	X			Private E-T				X
Helena, MT	X				Private E-T				X
Santa Fe, NM	X	X	X		CATV link				X
Pierre, SD	X	X	X		CATV link				X
Frankfort, KY	X	X	X		CATV link				X
Dover, DE	X	X			Private E-T				X
Concord, NH	X	X	X		CATV link				X
Augusta, ME	X				Private E-T				X
Cheyenne, WY	X				Private E-T				X
Jefferson City, MO	X				Private E-T				X
Annapolis, MD	X	X	X		CATV link				X
Montpelier, VT	X	X			Private E-T				X
Juneau, AK	X	X	X		CATV link				X

3.7 FEDERAL REGIONAL PROGRAMMING

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

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

Table 3-8(a). **OVERALL COST SUMMARY -- SMSA CASE 1**

FEDERAL REGIONAL OFFICES

OVERALL COST SUMMARY

	CAPITAL EXPENDITURES	PLANNING AND INSTALLATION	ANNUAL LEASE	ANNUAL O&M&A	ANNUALIZED COST
UPLINK	199400.	51000.	180000.	101000.	331406.
DOWNLINK	77000.	3000.	1800.	1000.	18904.
VOICE TALKBACK	145.	400.	13478.	0.	13588.
ADMINISTRATIVE	0.	160000.	0.	85000.	117208.
TOTALS	276545.	214400.	195278.	187000.	481107.
ANNUALIZED COST	55669.	43159.	195278.	187000.	481107.

EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $ 481107.

Table 3-8(b). **OVERALL COST SUMMARY -- SMSA CASE 2**

FEDERAL REGIONAL OFFICES AND TOP 20 SMSA'S

OVERALL COST SUMMARY

	CAPITAL EXPENDITURES	PLANNING AND INSTALLATION	ANNUAL LEASE	ANNUAL O&M&A	ANNUALIZED COST
UPLINK	199400.	51000.	180000.	101000.	331406.
DOWNLINK	162700.	6300.	3780.	2200.	40000.
VOICE TALKBACK	305.	840.	28305.	0.	28535.
ADMINISTRATIVE	0.	160000.	0.	85000.	117208.
TOTALS	362405.	218140.	212085.	188200.	517150.
ANNUALIZED COST	72953.	43912.	212085.	188200.	517150.

EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $ 517150.

Table 3-8(c). **OVERALL COST SUMMARY -- SMSA CASE 3**

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

OVERALL COST SUMMARY

	CAPITAL EXPENDITURES	PLANNING AND INSTALLATION	ANNUAL LEASE	ANNUAL O&M&A	ANNUALIZED COST
UPLINK	199400.	51000.	180000.	101000.	331406.
DOWNLINK	551800.	72000.	9720.	19900.	155193.
VOICE TALKBACK	914.	2520.	84914.	0.	85605.
ADMINISTRATIVE	0.	160000.	0.	85000.	117208.
TOTALS	752114.	285520.	274634.	205900.	689413.
ANNUALIZED COST	151403.	57476.	274634.	205900.	689413.

EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $ 689413.

Table 3-8(d). **OVERALL COST SUMMARY -- SMSA CASE 4**

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

OVERALL COST SUMMARY

	CAPITAL EXPENDITURES	PLANNING AND INSTALLATION	ANNUAL LEASE	ANNUAL O&M&A	ANNUALIZED COST
UPLINK	199400.	51000.	180000.	101000.	331406.
DOWNLINK	710700.	117500.	10980.	31800.	209499.
VOICE TALKBACK	1117.	3080.	103784.	0.	104629.
ADMINISTRATIVE	0.	160000.	0.	85000.	117208.
TOTALS	911217.	331580.	294764.	217800.	762742.
ANNUALIZED COST	183430.	66748.	294764.	217800.	762742.

EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $ 762742.

Results for this case are shown in Tables 3-9 and 3-10. Table 3-9 shows the results for the uplink segment, and Table 3-10 may be compared with Table 3-8d, 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

FEDERAL REGIONAL PROGRAMMING

UPLINK COSTS BY CITY

CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
BOSTON	59400.	16000.	18000.	11700.	44878.
	PEAK HR	OFFPK HR	STUDIO	GRD LINK	
	0.	130.	1.	1.	
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
NEW YORK	59400.	16000.	18000.	11700.	44878.
	PEAK HR	OFFPK HR	STUDIO	GRD LINK	
	0.	130.	1.	1.	
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
PHILADELPHIA	262900.	46000.	18000.	106700.	186882.
	PEAK HR	OFFPK HR	STUDIO	GRD LINK	
	0.	130.	1.	1.	
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
ATLANTA	59400.	16000.	18000.	11700.	44878.
	PEAK HR	OFFPK HR	STUDIO	GRD LINK	
	0.	130.	1.	1.	
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
CHICAGO	262900.	46000.	18000.	106700.	186882.
	PEAK HR	OFFPK HR	STUDIO	GRD LINK	
	0.	130.	1.	1.	
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
DALLAS	262900.	46000.	18000.	106700.	186882.
	PEAK HR	OFFPK HR	STUDIO	GRD LINK	
	0.	130.	1.	1.	
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
KANSAS CITY	59400.	16000.	18000.	11700.	44878.
	PEAK HR	OFFPK HR	STUDIO	GRD LINK	
	0.	130.	1.	1.	
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
DENVER	59400.	16000.	18000.	11700.	44878.
	PEAK HR	OFFPK HR	STUDIO	GRD LINK	
	0.	130.	1.	1.	
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
SAN FRANCISCO	262900.	46000.	18000.	106700.	186882.
	PEAK HR	OFFPK HR	STUDIO	GRD LINK	
	0.	130.	1.	1.	
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
SEATTLE	262900.	46000.	18000.	106700.	186882.
	PEAK HR	OFFPK HR	STUDIO	GRD LINK	
	0.	130.	1.	1.	
UPLINK TOTAL	1611500.	310000.	180000.	592000.	1158804.

Table 3-10. OVERALL COST SUMMARY -- FFDERAL REGIONAL PROGRAMMING

OVERALL COST SUMMARY

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

EFFECTIVE YEARLY COSTS FOR 8 YEAR, 12.00 PERCENT AMORTIZATION --- $ 1522873.

Table 3-11. NETWORK COST ALLOCATION -- COST ALLOCATION CASE

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

NETWORK COST ALLOCATION

	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
UPLINK					
1 FEDERAL OFFICES	143165.	36617.	162500.	72516.	271206.
2 SMSA'S	255635.	65383.	290160.	129484.	484266.
TOTAL	398800.	102000.	452660.	202000.	755472.
DOWNLINK					
1 FEDERAL OFFICES	50200.	1800.	1800.	1000.	13268.
2 SMSA'S	142400.	22200.	2880.	6500.	42514.
TOTAL	192600.	24000.	4680.	7500.	55782.
VOICE TALKBACK					
1 FEDERAL OFFICES	87.	240.	8611.	0.	8677.
2 SMSA'S	218.	600.	14976.	0.	15141.
TOTAL	305.	840.	23587.	0.	23818.
ADMINISTRATIVE					
1 FEDERAL OFFICES	0.	53333.	0.	28333.	39069.
2 SMSA'S	0.	106667.	0.	56667.	78139.
TOTAL	0.	160000.	0.	85000.	117208.
TOTAL NETWORK					
1 FEDERAL OFFICES	193452.	91990.	172911.	101849.	332221.
2 SMSA'S	398253.	194850.	308016.	192651.	620060.
TOTAL	591705.	286840.	480927.	294500.	952281.

FEDERAL REGIONAL PROGRAMMING

CHAPTER FOUR

CONCLUSIONS

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

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

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

generated by efficient scheduling of transponder time. Sharing of downlink equipment showed substantial, although less significant, savings.

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

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

APPENDIX A

DATA ASSUMPTIONS

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

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

VIDEO STUDIO COSTS

Simple Studio

Capital

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

Room modifications	$ 5,000	
Installation costs	5,000	
Total Capital		$42,000

Operating

"Production"	--	
Scheduling	5,000	
Maintenance	4,200	
Recurring Costs		$ 9,200

More Complex Studio (Not Full Production Quality)

Capital

Cameras	40,000	
Remote control	3,000	
Switching	6,000	
Lighting	3,000	
Microphones 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	
Total Capital		$92,500

Operating

Production Writing Scheduling	25,000	
Maintenance 10 percent	9,250	
Recurring Costs		$34,250

Production Studio (Campus Production)

Capital

Cameras (3)	$75,000	
Synch generator	3,000	
Switching	10,000	
Character generator	6,000	
Lighting	5,000	
Microphones, audio mixing	7,500	
Video monitors	14,000	
1 inch helical record/playback/edit	50,000	
Audio monitors	1,500	
Room modifications	30,000	
Installation	15,000	
Total Capital		$217,000

Operating

Producer/Director	25,000	
Cameras (3)	45,000	
Maintenance (1)	17,500	
Coordinator	11,000	
Recurring Costs		$ 98,500

LINE OF SIGHT MICROWAVE LINK COSTS

Single Hop Link

Equipment is Housed in Existing Building

Tower stubs (2)	2,000
Transmit and receive electronics	21,000
Waveguide 250 feet	1,500
Antenna and feed (2)	1,000
Pressurizing system (2)	900
Miscellaneous	1,000

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)

Occasional Service	Cannot Be Preempted		Can Be Preempted
	Peak*	Off-Peak*	Anytime
	$750/hr	$650/hr	$350/hr

Fixed Term	Protected		Unprotected	
	Peak	Off-Peak	Peak	Off-Peak
5 hour/day	$279/hr	$125/hr	$215/hr	$100/hr
10 hour/day	$266/hr	$125/hr	$203/hr	$100/hr

*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)

Occasional Service	Earlybird*	Daytime*	Primetime*
	$90/hr	$200/hr	$450/hr
Monthly Scheduled	$90/hr	$195/hr	$425
Long-Term Scheduled		Anytime	
		$300/hr	

Broker of Western Union Services

Occasional Service	Earlybird	Daytime	Primetime
	$100/hr	$170/hr	$200/hr

FEES FOR USE OF EXISTING CATV AND ITFS SYSTEMS

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

CATV

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

-- $30/hour

ITFS

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

-- $10/hour

---

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

EARTH STATION COSTS

Receive-Only Earth Station

4.5 meter antenna system	$ 6,000	
GaAs FET low noise amplifier	3,000	
Downconverter/Demodulator	5,000	
Frequency coordination	1,200	
Installation*	5,000	
Total		$20,200
Operations and maintenance (per year)		1,500

Two-Way Earth Station

10 meter antenna system	$50,000	
GaAs FET low noise amplifier	3,000	
HPA system	50,000	
Receive chain	7,500	
Transmit chain	13,000	
Baseband monitoring	5,000	
Test equipment	40,000	
Spares	20,000	
Shelter	15,000	
Site development	10,000	
Installation and engineering	20,000	
Total		$233,500
Maintenance and operations (per year) (2 people and parts)		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.

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

Typical Charges:

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

AT&T VIDEO LINK

Local Video Link, Less Than 20 Miles

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

VOICE TALKBACK COSTS

Talkback Capital Costs

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

Direct Dial Costs

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

WATS Costs

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

Private Line Costs

Based on MPL tariff	
First two terminations	$215.00 per month
Each additional termination	$ 40.00
Mileage charge	$ 0.52 per mile per month

ADMINISTRATIVE COSTS*

INSTALLATION AND PLANNING

Salaries	$47,100
Travel & Expenses	29,000
Management	25,000
Overhead	59,000
TOTAL	$160,100

OPERATIONS & MAINTENANCE (per year)

Salaries	$33,900
Travel & Expenses	21,000
Overhead	41,600
TOTAL	$96,500

*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

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	0.00	0.00	0.00	0.00	0.00
INS	0.00	0.00	0.00	0.00	0.00
LES	0.00	279.00	125.00	0.00	0.00
OMA	0.00	0.00	0.00	0.00	0.00

MINIMUM LEASE COST =180000.00

DATA FOR COST ELEMENT S3 -- CASE 3 STUDIO COSTS

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	0.00	0.00	0.00	172000.00	0.00
INS	0.00	0.00	0.00	45000.00	0.00
LES	0.00	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	98500.00	0.00

MINIMUM LEASE COST = 0.00

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	0.00	0.00	0.00	0.00	27400.00
INS	0.00	0.00	0.00	0.00	6000.00
LES	0.00	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	0.00	2500.00

MINIMUM LEASE COST = 0.00

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	0.00	0.00	0.00	0.00	0.00
INS	0.00	0.00	0.00	0.00	2500.00
LES	0.00	0.00	0.00	0.00	12000.00
OMA	0.00	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	203500.00	0.00	0.00	0.00	0.00
INS	30000.00	0.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00	0.00
OMA	95000.00	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT S1 -- CASE 1 STUDIO COSTS

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	0.00	0.00	0.00	32000.00	0.00
INS	0.00	0.00	0.00	10000.00	0.00
LES	0.00	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	9200.00	0.00

MINIMUM LEASE COST = 0.00

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	0.00	0.00	0.00	52350.00	0.00
INS	0.00	0.00	0.00	9500.00	0.00
LES	0.00	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	3300.00	0.00

MINIMUM LEASE COST = 0.00

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

DOWNLINK COST ELEMENTS:

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	5000.00	0.00	0.00	0.00
INS	0.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT CT -- RENT COM CARR E-T

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	0.00	0.00	0.00	0.00
INS	0.00	0.00	0.00	0.00
LES	0.00	35.00	35.00	0.00
OMA	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT PT -- PVT EARTH TERMINAL

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	9000.00	0.00	0.00	5000.00
INS	6200.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00
OMA	1500.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	27400.00	0.00	0.00	0.00
INS	6000.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00
OMA	2500.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	0.00	0.00	0.00	0.00
INS	2500.00	0.00	0.00	0.00
LES	12000.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT CU -- USAGE OF CATV SYSTEM

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	1700.00	0.00	0.00	0.00
INS	300.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT CC -- CATV SUBSCRIPTIONS

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	0.00	0.00	0.00	0.00
INS	0.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	180.00
OMA	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT MT -- TV MONITORS

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	0.00	0.00	0.00	1000.00
INS	0.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	100.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT M2 -- TWO-HOP MICROWAVE

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	52350.00	0.00	0.00	0.00
INS	9500.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00
OMA	3300.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	0.00	0.00	0.00	0.00
INS	0.00	0.00	0.00	0.00
LES	-180.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	0.00

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.

TALKBACK:	DDD	WATS	PVT
INSTALLATION	40.00	30.00	60.00
ZERO USAGE CHARGE/MO.	0.00	60.00	215.00
MILEAGE CHARGE			0.52
HOURLY CHARGE	31.20	18.00	
MAXIMUM CHARGE		1200.00	

AMORTIZATION:

INTEREST RATE	12.00 PERCENT
EQUIPMENT LIFE	8.00 YEARS

GENERAL AND ADMINISTRATIVE:

CAP	0.00
INS	160000.00
LES	0.00
OMA	85000.00

TALKBACK CAPITAL EXPENDITURES:

14.50

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).

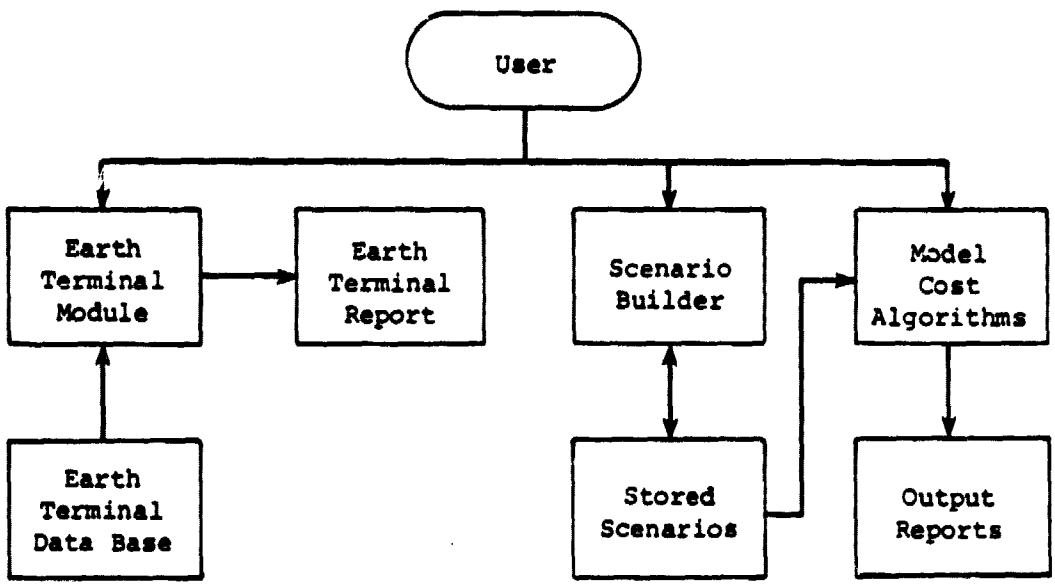

Figure B-1. MODEL ARCHITECTURE

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

Called By: BUILD

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

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

Called By: BUILD

Calls: YESNO, GETTER, CODCHK, RATECK, REPRTR

- -

MODEL - COST ALGORITHMS

- -

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

Calls: MODUP MODDN, MODTK, READIN, GETTER, CODCHK, REPRTR

MODUP — Executes the cost algorithms for the uplink segment of the model.

Called By: MODEL

Calls: REPRTR, VANDH

MODDN — Executes the cost algorithms for the downlink segment of the model.

Called By: MODEL

Calls: REPRTR, VANDH

MODTK — Executes the cost algorithms for the talkback segment of the model.

Called By: MODEL

EARTH - EARTH TERMINAL MODULE

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

Calls: MOVREC, CODCHK, VANDH, READIN

MOVREC — This subroutine sets up the array of selected earth terminals which will then be sorted and printed.

Parameters: i - index into city array
j - index into earth terminal array

Called By: EARTH

GENERAL UTILITIES

READIN — Reads the scenario data file into an unnamed common.

Called By: BUILD, MODEL, EARTH

RITOUT — Writes out the scenario data into a new file.

Called By: BUILD

YESNO — Determines if the responses to a question is "YES" or "NO" or in error and sets the appropriate flag.

Called By: BUILD, COST, PATH, CITY, RATE

UPDOWN — Determines if the response to a question is "UPLINK" or "DOWNLINK" or in error and sets the appropriate flag.

Called By: COST, PATH, CITY

CODCHK — Checks an input argument against a list of valid arguments.

Parameters: NCHAR - number of characters in input argument
INDATA - array containing input argument
NCOMPR - number of possible values
CMPARR - array containing list of possible values
POSTN - position in the array where input argument matched a possible value

Called By: COST, PATH, CITY, RATE, RDCOST, MATMOD, MODEL, EARTH

GETTER — Retrieves the next argument on the command line.

Called By: COST, PATH, CITY, RATE, RDCOST, MATMOD, MODEL

Calls: CCOUNT

CCOUNT — Counts characters in an input argument.

Parameters: ARG - argument to be counted
NCHAR - number of characters (computed)

Called By: GETTER

DISAPR — Deletes a cost element, path, or city from the scenario data.

Parameters: Code - type of deletion
Index - position in arrays to be deleted

Called By: COST, PATH, RATE

RDCOST — Reads in an input argument and tests for a cost element code.

Called By: COST

Calls: GETTER, CODCHK

RATECK — Performs a range check of a data element.

Parameters: LOW - lower limit
UP - upper limit
XDAT - data element

Called By: RATE

CTYCHK — Determines if a city exists and, if it does, returns the index in the appropriate array.

Parameters: POS - position in city array
ORG - member organization

Called By: CITY, MATMOD

VANDH — Converts latitude/longitude to Bell System V and H coordinates (provides a simpler means of estimating the distance between two cities).

Parameters: M - latitude
N - longitude

Called By: CITY, MODUP, MODDN, EARTH

MATMOD — Associates (disassociates) a path with a city or cost element.

Parameters: CODE - type of modify
ONOFF - direction (1 or Ø)
MODPOS - index of element being modified

Called By: COST, PATH, CITY

Calls: GETTER, CODCHK, REPRTR, CTYCHK

REPRTR — Prepares reports on scenario data -- cost elements, cost element/path matrix, paths, path/city matrix, cities and cost index values, uplink/downlink talkback matrix, member organizations, and rates.

Parameters: REPTYP - report type
POS - index into arrays

Called By: COST, PATH, CITY, RATE, MATMOD, MODEL, MODUP, MODDN

3. PARAMETER AND VARIABLE DEFINITIONS

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

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

BADD	Statement label to go to after processing an error.
BLANK	Holds four blank characters for use in output reports.
CAPCST	Capital cost of least-cost path.
CILO(5,2)	Literals for 'CAPITAL', 'INSTALL', 'LEASE', 'O&M&A', 'ANNUALZD' - used in output records.
CONTCD	Code indicating the presence of an additional argument in the user's input buffer.
DCINDX(NDINDX,8)	8-character downlink cost index names.
DCITYH(NDCITY)	Downlink city location -- H Coordinate.
DCITYV(NDCITY)	Downlink city location -- V Coordinate.
DCOSTX(NDCITY,4)	Capital, installation, lease, and OMA cost for each downlink city.
DCSCOD(NDELEM,2)	2-character downlink cost element code.
DCSDAT(NDELEM,NDINDX,4)	Capital, installation, lease, and OMA costs for a given downlink cost element and cost index.
DCSMIN(NDELEM)	Minimum lease cost for a given downlink cost element.
DCSNAM(NDELEM,20)	20-character downlink cost element name.
DCSPTH(NDELEM,NDPATH)	Matrix of cost elements for each downlink path.
DCTLVL(NDCITY)	Hierarchical level number for downlink city.
DCTNAM(NDCITY,16)	16-character downlink city name.
DCTORG(NDCITY)	Organization code for each downlink city.
DCTXVL(NDCITY,5)	Downlink city cost index values.
DDDCPH	Direct dial cost per hour.
DDDINS	Direct dial installation cost.
DDDLES	Direct dial less cost per month.
DDXWHT(NDINDX)	Weighting factors for each downlink cost index.
DISCNT	Discount rate for amortization.
DORGCS(NUMORG,5)	Downlink capital, installation, lease, OMA, annualized costs by member organization.
DPTHCY(NDPATH,NDCITY)	Array of feasible paths for a downlink city.
DPTHNM(NDPATH,20)	20-character downlink path name.
DPTIDX(NDPATH,NDINDX,5)	Downlink capital, installation, lease, OMA, annualized costs for a given cost index and a given path.
DSTCOD(NDCITY,2)	2-character state code for downlink city.

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

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

UPPDWN	Flag indicating the response to an uplink/ downlink question (1 - uplink, 2 - downlink).
UPTHCY(NUPATH,NUCITY)	Array of feasible paths for an uplink city.
UPTHNM(NUPATH,20)	20-character uplink path name.
UPTIDX(NUPATH,NUINDX,5)	Uplink capital, installation, lease, OMA, annualized costs for a given cost index and a given path.
USTCOD(NUCITY,2)	2-character state code for an uplink city.
WATCPH	WATS charge per hour of utilization.
WATINS	WATS installation charge.
WATLES	WATS lease charge per month.
WATMAX	Maximum monthly charges for WATS.
WGTARR(NDCITY)	Weight factors for cost allocation.
XDATA(NDINDX)	Temporary storage for cost index data.
XORGCS(NUMORG,5)	Total capital, installation, lease, OMA, annualized cost by member organization.
YESSNO	Flag indication 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 segement 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.

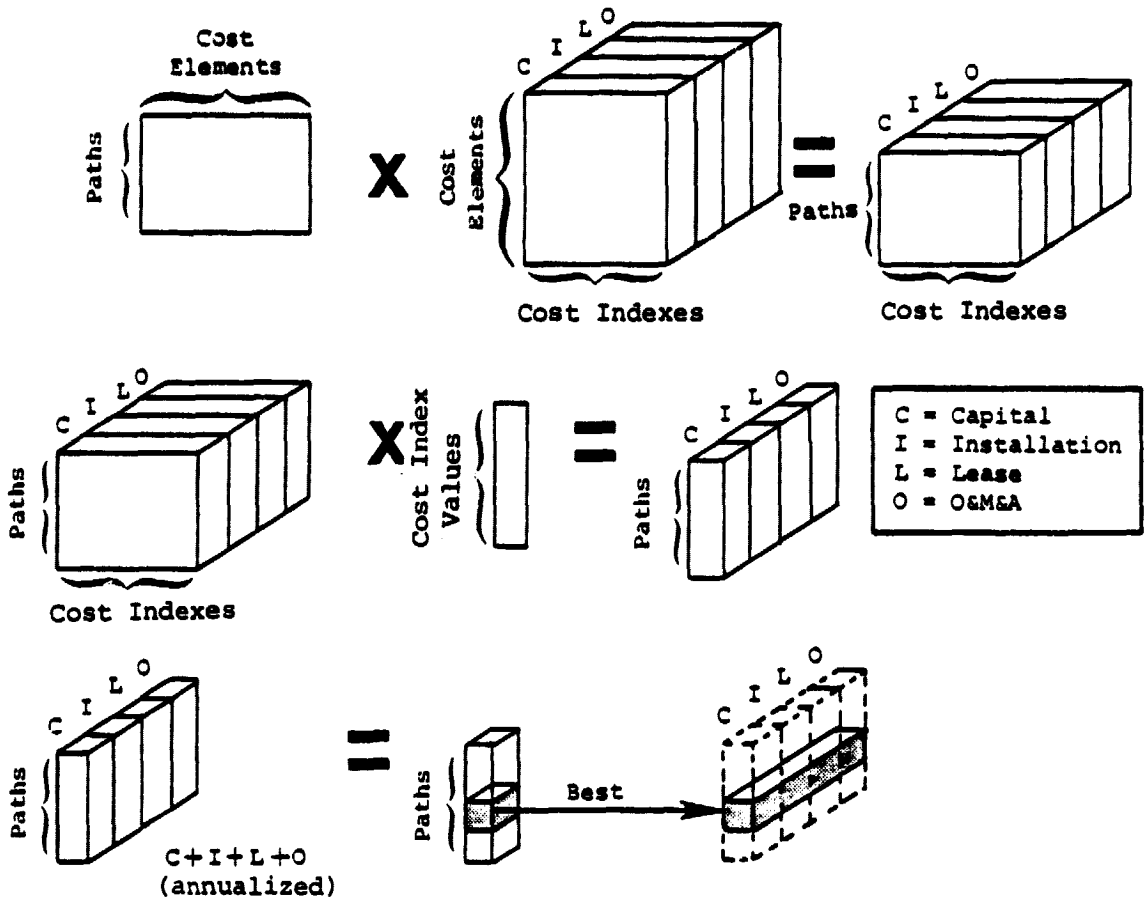

Figure B-2. MATRIX CALCULATIONS IN THE UPLINK AND DOWNLINK SEGMENTS

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

$$UPTIDX(I,K,L) = \sum_{J=1}^{NUELEM} UCSPTH(J,I) \times UCSDAT(J,K,L)$$

where

I = path number

J = cost element subscript

K = cost index subscript

L = cost categories (1 = capital, 2 = installation, 3 = lease, 4 = 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 matrixes resulting from this calculation would apply to any of the cities.

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

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

where

I = path number

K = cost index subscript

M = city subscript

UCTXVL(M,K) = the value of the Kth cost index (e.g., hours, studios) for city M

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

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

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

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

DOWNLINK SEGMENT

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

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

1. Calculate Cost Parameters for Each Path

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

where

I = path number

J = cost element subscript

K = cost index subscript

L = cost categories

2. Calculate Cost of Each Path in Each City

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

3. Calculate Annualized Cost by Path

ANNL(I) = (CAPCST + INSCST)/AMORT + LESCST + 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 by entered during the "city" portion of the scenario builder.

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

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

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

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

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

11. Matrix of Cost Elements and Paths -- Downlink. Downlink equivalent of report 3.

12. Matrix of Paths and Cities -- Downlink. Downlink equivalent of report 4.

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

14. Sensitivity of Path Costs to Network Parameters -- Downlink. Downlink equivalent of report 7.

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.

18. Network Cost Allocation. Presents total network costs by model segment (uplink, downlink, voice talkback, and administrative) and by member organization. (A discussion of cost allocation appears in the Cost Model User's Guide - ARINC Research Publication 1358-01-TR-2234).

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

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

a. Satellites are represented by the following identifiers:

KS20 - WESTAR I
KS21 - WESTAR II
KS22 - WESTAR III
KS26 - COMSTAR D-1
KS27 - COMSTAR D-2
KS28 - COMSTAR D-3
KS29 - COMSTAR D-4
KS30 - SATCOM I
KS31 - SATCOM II
KS32 - SATCOM III

ANIK1 - Canadian Telesat Satellites
ANIK2
ANIK3

MR1 - Marisat I
MR2 - Marisat II
MR3 - Marisat III

IN1 - Intelsat I
IN2 - Intelsat II
IN3 - Intelsat III
IN4 - Intelsat IV
IN4A - Intelsat IV-A
IN5 - Intelsat V

KS36 - SBS I
KS37 - SBS II
KS38 - SBS III

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

Type of Service

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

Class of Station

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

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

TALKBACK:	DDD	WATS	PVT
INSTALLATION	40.00	30.00	60.00
ZERO USAGE CHARGE/MO.	0.00	60.00	215.00
MILEAGE CHARGE			0.52
HOURLY CHARGE	31.20	18.00	
MAXIMUM CHARGE		1200.00	

AMORTIZATION:

INTEREST RATE	12.00 PERCENT
EQUIPMENT LIFE	8.00 YEARS

GENERAL AND ADMINISTRATIVE:

CAP	0.00
INS	160000.00
LES	0.00
OMA	85000.00

TALKBACK CAPITAL EXPENDITURES:
14.50

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	0.00	0.00	0.00	0.00	0.00
INS	0.00	0.00	0.00	0.00	0.00
LES	0.00	279.00	125.00	0.00	0.00
OMA	0.00	0.00	0.00	0.00	0.00

MINIMUM LEASE COST =180000.00

DATA FOR COST ELEMENT S3 -- CASE 3 STUDIO COSTS

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	0.00	0.00	0.00	172000.00	0.00
INS	0.00	0.00	0.00	45000.00	0.00
LES	0.00	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	98500.00	0.00

MINIMUM LEASE COST = 0.00

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	0.00	0.00	0.00	0.00	27400.00
INS	0.00	0.00	0.00	0.00	6000.00
LES	0.00	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	0.00	2500.00

MINIMUM LEASE COST = 0.00

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	0.00	0.00	0.00	0.00	0.00
INS	0.00	0.00	0.00	0.00	2500.00
LES	0.00	0.00	0.00	0.00	12000.00
OMA	0.00	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

(continued)

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	203500.00	0.00	0.00	0.00	0.00
INS	30000.00	0.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00	0.00
OMA	95000.00	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT S1 -- CASE 1 STUDIO COSTS

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	0.00	0.00	0.00	32000.00	0.00
INS	0.00	0.00	0.00	10000.00	0.00
LES	0.00	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	9200.00	0.00

MINIMUM LEASE COST = 0.00

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAP	0.00	0.00	0.00	52350.00	0.00
INS	0.00	0.00	0.00	9500.00	0.00
LES	0.00	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	3300.00	0.00

MINIMUM LEASE COST = 0.00

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

MATRIX OF COST ELEMENTS AND PATHS-- UPLINK

	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	*	*		*	*		

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

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

MATRIX OF PATHS AND CITIES-- UPLINK

CITY	ORG	1	2	3	4	5
WASHINGTON	1	*	*		*	*
WASHINGTON	2	*	*		*	*

REPORT 4 - MATRIX OF PATHS AND CITIES -- UPLINK

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

UPLINK COST INDEX VALUES

WASHINGTON	1			
PEAK HR		OFFPK HR	STUDIO	GRD LINK
0.00		1300.00	1.00	1.00
WASHINGTON	2			
PEAK HR		OFFPK HR	STUDIO	GRD LINK
1040.00		0.00	1.00	1.00

REPORT 5 - UPLINK COST INDEX VALUES

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

MATRIX OF TALKBACK REQUIREMENTS

DOWNLINK CITY	ORG	WAS 1	WAS 2
BOSTON	1	2.5	0.0
PHILADELPHIA	1	2.5	0.0
NEW YORK	1	2.5	0.0
ATLANTA	1	2.5	0.0
CHICAGO	1	2.5	0.0
DALLAS	1	2.5	0.0
KANSAS CITY	1	2.5	0.0
DENVER	1	2.5	0.0
SAN FRANCISCO	1	2.5	0.0
SEATTLE	1	2.5	0.0
LOS ANGELES	2	0.0	2.0
DETROIT	2	0.0	2.0
PITTSBURGH	2	0.0	2.0
ST. LOUIS	2	0.0	2.0
BALTIMORE	2	0.0	2.0
CLEVELAND	2	0.0	2.0
HOUSTON	2	0.0	2.0
NEWARK	2	0.0	2.0
MINNEAPOLIS	2	0.0	2.0
ORANGE COUNTY	2	0.0	2.0
MILWAUKEE	2	0.0	2.0
WASHINGTON	2	0.0	0.0
BOSTON	2	0.0	2.0
NEW YORK	2	0.0	2.0
PHILADELPHIA	2	0.0	2.0
ATLANTA	2	0.0	2.0
CHICAGO	2	0.0	2.0
DALLAS	2	0.0	2.0
SAN FRANCISCO	2	0.0	2.0
SEATTLE	2	0.0	2.0

REPORT 6 - MATRIX OF TALKBACK REQUIREMENTS

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

SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS-- UPLINK

PATH 1 -- MICROWAVE TO E-T

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAPITAL	0.	0.	0.	172000.	27400.
INSTALL	0.	0.	0.	45000.	6000.
LEASE	0.	279.	125.	0.	0.
O&M&A	0.	0.	0.	98500.	2500.
ANNUALZD	0.	279.	125.	142183.	9224.

PATH 2 -- VIDEO LINK TO E-T

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAPITAL	0.	0.	0.	172000.	0.
INSTALL	0.	0.	0.	45000.	2500.
LEASE	0.	279.	125.	0.	12000.
O&M&A	0.	0.	0.	98500.	0.
ANNUALZD	0.	279.	125.	142183.	12503.

PATH 3 -- USE OWN E-T

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAPITAL	203500.	0.	0.	172000.	0.
INSTALL	30000.	0.	0.	45000.	0.
LEASE	0.	279.	125.	0.	0.
O&M&A	95000.	0.	0.	98500.	0.
ANNUALZD	142004.	279.	125.	142183.	0.

PATH 4 -- MICROWAVE TO OWN E-T

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAPITAL	203500.	0.	0.	172000.	27400.
INSTALL	30000.	0.	0.	45000.	6000.
LEASE	0.	279.	125.	0.	0.
O&M&A	95000.	0.	0.	98500.	2500.
ANNUALZD	142004.	279.	125.	142183.	9224.

PATH 5 -- VIDEO LK TO OWN E-T

	FIXED	PER PEAK HR	PER OFFPK HR	PER STUDIO	PER GRD LINK
CAPITAL	203500.	0.	0.	172000.	0.
INSTALL	30000.	0.	0.	45000.	2500.
LEASE	0.	279.	125.	0.	12000.
O&M&A	95000.	0.	0.	98500.	0.
ANNUALZD	142004.	279.	125.	142183.	12503.

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

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

COST OF EACH PATH-- UPLINK

CITY	PATH	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
WASHINGTON	1	398800.	102000.	452660.	202000.	755472.
	2	344000.	95000.	476660.	197000.	762032.
	4	602300.	132000.	452660.	297000.	897477.
	5	547500.	125000.	476660.	292000.	904036.

REPORT 8 - COST OF EACH PATH -- UPLINK

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

UPLINK COSTS BY CITY

CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
WASHINGTON	398800.	102000.	452660.	202000.	755472.
	PEAK HR	OFFPK HR	STUDIO	GRD LINK	
	1040.	1300.	2.	2.	
UPLINK TOTAL	398800.	102000.	452660.	202000.	755472.

REPORT 9 - UPLINK COSTS BY CITY

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

DOWNLINK COST ELEMENT DATA

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	5000.00	0.00	0.00	0.00
INS	0.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT CT -- RENT COM CARR E-T

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	0.00	0.00	0.00	0.00
INS	0.00	0.00	0.00	0.00
LES	0.00	35.00	35.00	0.00
OMA	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT PT -- PVT EARTH TERMINAL

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	9000.00	0.00	0.00	5000.00
INS	6200.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00
OMA	1500.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	27400.00	0.00	0.00	0.00
INS	6000.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00
OMA	2500.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

(continued)

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	0.00	0.00	0.00	0.00
INS	2500.00	0.00	0.00	0.00
LES	12000.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT CU -- USAGE OF CATV SYSTEM

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	1700.00	0.00	0.00	0.00
INS	300.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT CC -- CATV SUBSCRIPTIONS

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	0.00	0.00	0.00	0.00
INS	0.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	180.00
OMA	0.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT MT -- TV MONITORS

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	0.00	0.00	0.00	1000.00
INS	0.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	100.00

MINIMUM LEASE COST = 0.00

DATA FOR COST ELEMENT M2 -- TWO-HOP MICROWAVE

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	52350.00	0.00	0.00	0.00
INS	9500.00	0.00	0.00	0.00
LES	0.00	0.00	0.00	0.00
OMA	3300.00	0.00	0.00	0.00

MINIMUM LEASE COST = 0.00

(continued)

REPORT 10 - (continued)

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

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAP	0.00	0.00	0.00	0.00
INS	0.00	0.00	0.00	0.00
LES	-180.00	0.00	0.00	0.00
OMA	0.00	0.00	0.00	0.00

MINIMUM LEASE COST =-10000.00

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

MATRIX OF COST ELEMENTS AND PATHS--DOWNLINK

	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		*				*	*	*		

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

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

MATRIX OF PATHS AND CITIES--DOWNLINK

CITY	ORG	1	2	3	4	5	6	7
BOSTON	1	*	*	*	*			*
PHILADELPHIA	1	*	*	*	*			*
NEW YORK	1	*	*	*	*			*
ATLANTA	1	*	*	*	*			*
CHICAGO	1	*	*	*	*			*
DALLAS	1	*	*	*	*			*
KANSAS CITY	1	*	*	*	*			*
DENVER	1	*	*	*	*			*
SAN FRANCISCO	1	*	*	*	*			*
SEATTLE	1	*	*	*	*			*
LOS ANGELES	2	*	*	*	*			*
DETROIT	2	*	*	*	*			*
PITTSBURGH	2	*	*	*	*			*
ST. LOUIS	2			*	*			
BALTIMORE	2	*	*	*	*			*
CLEVELAND	2	*	*	*	*			*
HOUSTON	2	*	*	*	*			*
NEWARK	2	*	*	*	*			*
MINNEAPOLIS	2	*	*	*	*			*
ORANGE COUNTY	2			*	*			
MILWAUKEE	2			*	*			
WASHINGTON	2	*	*	*	*		*	*
BOSTON	2	*	*	*	*			*
NEW YORK	2	*	*	*	*			*
PHILADELPHIA	2	*	*	*	*			*
ATLANTA	2	*	*	*	*			*
CHICAGO	2	*	*	*	*			*
DALLAS	2	*	*	*	*			*
SAN FRANCISCO	2	*	*	*	*			*
SEATTLE	2	*	*	*	*			*

REPORT 12 - MATRIX OF PATHS AND CITIES -- DOWNLINK

C-2

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

DOWNLINK COST INDEX VALUES

BOSTON	1		
	PEAK HR	OFFPK HR	ORGNZTN
	0.00	1300.00	1.00
PHILADELPHIA	1		
	PEAK HR	OFFPK HR	ORGNZTN
	0.00	1300.00	1.00
NEW YORK	1		
	PEAK HR	OFFPK HR	ORGNZTN
	0.00	1300.00	1.00
ATLANTA	1		
	PEAK HR	OFFPK HR	ORGNZTN
	0.00	1300.00	1.00
CHICAGO	1		
	PEAK HR	OFFPK HR	ORGNZTN
	0.00	1300.00	1.00
DALLAS	1		
	PEAK HR	OFFPK HR	ORGNZTN
	0.00	1300.00	1.00
KANSAS CITY	1		
	PEAK HR	OFFPK HR	ORGNZTN
	0.00	1300.00	1.00
DENVER	1		
	PEAK HR	OFFPK HR	ORGNZTN
	0.00	1300.00	1.00
SAN FRANCISCO	1		
	PEAK HR	OFFPK HR	ORGNZTN
	0.00	1300.00	1.00
SEATTLE	1		
	PEAK HR	OFFPK HR	ORGNZTN
	0.00	1300.00	1.00
LOS ANGELES	2		
	PEAK HR	OFFPK HR	ORGNZTN
	1040.00	0.00	1.00
DETROIT	2		
	PEAK HR	OFFPK HR	ORGNZTN
	1040.00	0.00	1.00
PITTSBURGH	2		
	PEAK HR	OFFPK HR	ORGNZTN
	1040.00	0.00	1.00
ST. LOUIS	2		
	PEAK HR	OFFPK HR	ORGNZTN
	1040.00	0.00	1.00

(continued)

REPORT 13 - DOWNLINK COST INDEX VALUES

BALTIMORE	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
CLEVELAND	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
HOUSTON	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
NEWARK	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
MINNEAPOLIS	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
ORANGE COUNTY	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
MILWAUKEE	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
WASHINGTON	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
BOSTON	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
NEW YORK	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
PHILADELPHIA	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
ATLANTA	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
CHICAGO	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
DALLAS	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
SAN FRANCISCO	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00
SEATTLE	2		
PEAK HR		OFFPK HR	ORGNZTN
1040.00		0.00	1.00

REPORT 13 - (continued)

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

SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS--DOWNLINK

PATH 1 -- DIRECT LINK TO CATV

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAPITAL	6700.	0.	0.	1000.
INSTALL	300.	0.	0.	0.
LEASE	0.	0.	0.	180.
O&M&A	0.	0.	0.	100.
ANNUALZD	1409.	0.	0.	481.

PATH 2 -- OWN LINK TO CATV SYS

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAPITAL	38100.	0.	0.	6000.
INSTALL	12500.	0.	0.	0.
LEASE	0.	0.	0.	180.
O&M&A	4000.	0.	0.	100.
ANNUALZD	14186.	0.	0.	1488.

PATH 3 -- PRIVATE EARTH TERM

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAPITAL	9000.	0.	0.	6000.
INSTALL	6200.	0.	0.	0.
LEASE	0.	0.	0.	0.
O&M&A	1500.	0.	0.	100.
ANNUALZD	4560.	0.	0.	1308.

PATH 4 -- MICROWAVE TO USER

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAPITAL	27400.	0.	0.	1000.
INSTALL	6000.	0.	0.	0.
LEASE	0.	35.	35.	0.
O&M&A	2500.	0.	0.	100.
ANNUALZD	9224.	35.	35.	301.

PATH 5 -- 2-HOP MCRWV TO USER

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAPITAL	52350.	0.	0.	1000.
INSTALL	9500.	0.	0.	0.
LEASE	0.	35.	35.	0.
O&M&A	3300.	0.	0.	100.
ANNUALZD	15751.	35.	35.	301.

(continued)

PATH 6 -- MONITOR ONLY

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAPITAL	0.	0.	0.	1000.
INSTALL	0.	0.	0.	0.
LEASE	0.	0.	0.	0.
O&M&A	0.	0.	0.	100.
ANNUALZD	0.	0.	0.	301.

PATH 7 -- RENTED E-T TO CATV

	FIXED	PER PEAK HR	PER OFFPK HR	PER ORGNZTN
CAPITAL	1700.	0.	0.	1000.
INSTALL	300.	0.	0.	0.
LEASE	0.	35.	35.	180.
O&M&A	0.	0.	0.	100.
ANNUALZD	403.	35.	35.	481.

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

COST OF EACH PATH--DOWNLINK

CITY	PATH	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
BOSTON	1	8700.	300.	360.	200.	2372.
	2	50100.	12500.	360.	4200.	17162.
	3	21000.	6200.	0.	1700.	7175.
	4	29400.	6000.	81900.	2700.	91726.
	5	54350.	9500.	81900.	3500.	98253.
	7	3700.	300.	82260.	200.	83265.
PHILADELPHIA	1	8700.	300.	360.	200.	2372.
	2	50100.	12500.	360.	4200.	17162.
	3	21000.	6200.	0.	1700.	7175.
	4	29400.	6000.	81900.	2700.	91726.
	5	54350.	9500.	81900.	3500.	98253.
	7	3700.	300.	82260.	200.	83265.
NEW YORK	1	8700.	300.	360.	200.	2372.
	2	50100.	12500.	360.	4200.	17162.
	3	21000.	6200.	0.	1700.	7175.
	4	29400.	6000.	81900.	2700.	91726.
	5	54350.	9500.	81900.	3500.	98253.
	7	3700.	300.	82260.	200.	83265.
ATLANTA	1	8700.	300.	360.	200.	2372.
	2	50100.	12500.	360.	4200.	17162.
	3	21000.	6200.	0.	1700.	7175.
	4	29400.	6000.	81900.	2700.	91726.
	5	54350.	9500.	81900.	3500.	98253.
	7	3700.	300.	82260.	200.	83265.
CHICAGO	1	8700.	300.	360.	200.	2372.
	2	50100.	12500.	360.	4200.	17162.
	3	21000.	6200.	0.	1700.	7175.
	4	29400.	6000.	81900.	2700.	91726.
	5	54350.	9500.	81900.	3500.	98253.
	7	3700.	300.	82260.	200.	83265.
DALLAS	1	8700.	300.	360.	200.	2372.
	2	50100.	12500.	360.	4200.	17162.
	3	21000.	6200.	0.	1700.	7175.
	4	29400.	6000.	81900.	2700.	91726.
	5	54350.	9500.	81900.	3500.	98253.
	7	3700.	300.	82260.	200.	83265.
KANSAS CITY	1	7700.	300.	180.	100.	1890.
	2	44100.	12500.	180.	4100.	15674.
	3	15000.	6200.	0.	1600.	5868.
	4	28400.	6000.	45500.	2600.	55025.
	5	53350.	9500.	45500.	3400.	61552.
	7	2700.	300.	45680.	100.	46384.
DENVER	1	7700.	300.	180.	100.	1890.
	2	44100.	12500.	180.	4100.	15674.
	3	15000.	6200.	0.	1600.	5868.
	4	28400.	6000.	45500.	2600.	55025.
	7	2700.	300.	45680.	100.	46384.

(continued)

REPORT 15 - COST OF EACH PATH -- DOWNLINK

SAN FRANCISCO	1	8700.	300.	360.	200.	2372.
	2	50100.	12500.	360.	4200.	17162.
	3	21000.	6200.	0.	1700.	7175.
	4	29400.	6000.	81900.	2700.	91726.
	7	3700.	300.	82260.	200.	83265.
SEATTLE	1	8700.	300.	360.	200.	2372.
	2	50100.	12500.	360.	4200.	17162.
	3	21000.	6200.	0.	1700.	7175.
	4	29400.	6000.	81900.	2700.	91726.
	7	3700.	300.	82260.	200.	83265.
LOS ANGELES	1	7700.	300.	180.	100.	1890.
	2	44100.	12500.	180.	4100.	15674.
	3	15000.	6200.	0.	1600.	5868.
	4	28400.	6000.	36400.	2600.	45925.
	7	2700.	300.	36580.	100.	37284.
DETROIT	1	7700.	300.	180.	100.	1890.
	2	44100.	12500.	180.	4100.	15674.
	3	15000.	6200.	0.	1600.	5868.
	4	28400.	6000.	36400.	2600.	45925.
	7	2700.	300.	36580.	100.	37284.
PITTSBURGH	1	7700.	300.	180.	100.	1890.
	2	44100.	12500.	180.	4100.	15674.
	3	15000.	6200.	0.	1600.	5868.
	4	28400.	6000.	36400.	2600.	45925.
	7	2700.	300.	36580.	100.	37284.
ST. LOUIS	3	15000.	6200.	0.	1600.	5868.
	4	28400.	6000.	36400.	2600.	45925.
BALTIMORE	1	7700.	300.	180.	100.	1890.
	2	44100.	12500.	180.	4100.	15674.
	3	15000.	6200.	0.	1600.	5868.
	4	28400.	6000.	36400.	2600.	45925.
	7	2700.	300.	36580.	100.	37284.
CLEVELAND	1	7700.	300.	180.	100.	1890.
	2	44100.	12500.	180.	4100.	15674.
	3	15000.	6200.	0.	1600.	5868.
	4	28400.	6000.	36400.	2600.	45925.
	7	2700.	300.	36580.	100.	37284.
HOUSTON	1	7700.	300.	180.	100.	1890.
	2	44100.	12500.	180.	4100.	15674.
	3	15000.	6200.	0.	1600.	5868.
	4	28400.	6000.	36400.	2600.	45925.
	7	2700.	300.	36580.	100.	37284.
NEWARK	1	7700.	300.	180.	100.	1890.
	2	44100.	12500.	180.	4100.	15674.
	3	15000.	6200.	0.	1600.	5868.
	4	28400.	6000.	36400.	2600.	45925.
	7	2700.	300.	36580.	100.	37284.
MINNEAPOLIS	1	7700.	300.	180.	100.	1890.
	2	44100.	12500.	180.	4100.	15674.
	3	15000.	6200.	0.	1600.	5868.
	4	28400.	6000.	36400.	2600.	45925.
	7	2700.	300.	36580.	100.	37284.

(continued)

ORANGE COUNTY	3	15000.	6200.	0.	1600.	5868.
	4	28400.	6000.	36400.	2600.	45925.
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.	1600.	5868.
	4	28400.	6000.	36400.	2600.	45925.
	6	1000.	0.	0.	100.	301.
	7	2700.	300.	36580.	100.	37284.

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

DOWNLINK COSTS BY CITY

CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
BOSTON	8700.	300.	360.	200.	2372.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	1300.	2.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
PHILADELPHIA	8700.	300.	360.	200.	2372.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	1300.	2.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
NEW YORK	8700.	300.	360.	200.	2372.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	1300.	2.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
ATLANTA	8700.	300.	360.	200.	2372.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	1300.	2.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
CHICAGO	8700.	300.	360.	200.	2372.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	1300.	2.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
DALLAS	8700.	300.	360.	200.	2372.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	1300.	2.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
KANSAS CITY	7700.	300.	180.	100.	1890.
	PEAK HR	OFFPK HR	ORGNZTN		
	0.	1300.	1.		

(continued)

REPORT 16 - DOWNLINK COSTS BY CITY

CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
DENVER	7700.	300.	180.	100.	1890.
	PEAK HR	OFFPK HR	ORGNZTN		
	0.	1300.	1.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
SAN FRANCISCO	8700.	300.	360.	200.	2372.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	1300.	2.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
SEATTLE	8700.	300.	360.	200.	2372.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	1300.	2.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
LOS ANGELES	7700.	300.	180.	100.	1890.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	0.	1.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
DETROIT	7700.	300.	180.	100.	1890.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	0.	1.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
PITTSBURGH	7700.	300.	180.	100.	1890.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	0.	1.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
ST. LOUIS	15000.	6200.	0.	1600.	5868.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	0.	1.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
BALTIMORE	7700.	300.	180.	100.	1890.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	0.	1.		

(continued)

REPORT 16 (continued)

CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
CLEVELAND	7700.	300.	180.	100.	1890.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	0.	1.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
HOUSTON	7700.	300.	180.	100.	1890.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	0.	1.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
NEWARK	7700.	300.	180.	100.	1890.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	0.	1.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
MINNEAPOLIS	7700.	300.	180.	100.	1890.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	0.	1.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
ORANGE COUNTY	15000.	6200.	0.	1600.	5868.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	0.	1.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
MILWAUKEE	15000.	6200.	0.	1600.	5868.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	0.	1.		
CITY	CAPITAL	INSTALL	LEASE	O&M&A	ANNUALIZED
WASHINGTON	1000.	0.	0.	100.	301.
	PEAK HR	OFFPK HR	ORGNZTN		
	1040.	0.	1.		
DOWNLINK TOTAL	192600.	24000.	4680.	7500.	55782.

REPORT 16 (continued)

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

TALKBACK SYSTEM LEASE COSTS
TO WASHINGTON

CITY	LEVEL	HOURS UTIL.	DIST	WATS COSTS INSTALL	WATS COSTS LEASE	PRIVATE LINE INSTALL	PRIVATE LINE LEASE	DIRECT DIAL INSTALL	DIRECT DIAL LEASE	BEST
BOSTON	2	5.	394.	30.	141.	60.	420.	40.	140.	DDD
PHILADELPHIA	2	5.	123.	30.	141.	60.	279.	40.	140.	DDD
NEW YORK	2	5.	202.	30.	141.	60.	320.	40.	140.	DDD
ATLANTA	2	5.	541.	30.	141.	60.	497.	40.	140.	DDD
CHICAGO	2	5.	594.	30.	141.	60.	524.	40.	140.	DDD
DALLAS	2	5.	1182.	30.	141.	60.	830.	40.	140.	DDD
KANSAS CITY	2	2.	941.	30.	105.	60.	704.	40.	78.	DDD
DENVER	2	2.	1488.	30.	105.	60.	989.	40.	78.	DDD
SAN FRANCISCO	2	5.	2434.	30.	141.	60.	1481.	40.	140.	DDD
SEATTLE	2	5.	2321.	30.	141.	60.	1422.	40.	140.	DDD
LOS ANGELES	2	2.	2293.	30.	96.	60.	1407.	40.	62.	DDD
DETROIT	2	2.	395.	30.	96.	60.	420.	40.	62.	DDD
PITTSBURGH	2	2.	190.	30.	96.	60.	314.	40.	62.	DDD
ST. LOUIS	2	2.	708.	30.	96.	60.	583.	40.	62.	DDD
BALTIMORE	2	2.	35.	30.	96.	60.	233.	40.	62.	DDD
CLEVELAND	2	2.	304.	30.	96.	60.	373.	40.	62.	DDD
HOUSTON	2	2.	1217.	30.	96.	60.	848.	40.	62.	DDD
NEWARK	2	2.	197.	30.	96.	60.	318.	40.	62.	DDD
MINNEAPOLIS	2	2.	923.	30.	96.	60.	695.	40.	62.	DDD
ORANGE COUNTY	2	2.	2281.	30.	96.	60.	1401.	40.	62.	DDD
MILWAUKEE	2	2.	635.	30.	96.	60.	545.	40.	62.	DDD

REPORT 17 - TALKBACK SYSTEM LEASE COSTS

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

NETWORK COST ALLOCATION

	CAPITAL	INSTALL	LEASE	O&MSA	ANNUALIZED
UPLINK					
1 FEDERAL OFFICES	143165.	36617.	162500.	72516.	271206.
2 SMSA'S	255635.	65383.	290160.	129484.	484266.
TOTAL	398800.	102000.	452660.	202000.	755472.
DOWNLINK					
1 FEDERAL OFFICES	50200.	1800.	1800.	1000.	13268.
2 SMSA'S	142400.	22200.	2880.	6500.	42514.
TOTAL	192600.	24000.	4680.	7500.	55782.
VOICE TALKBACK					
1 FEDERAL OFFICES	87.	240.	8611.	0.	8677.
2 SMSA'S	218.	600.	14976.	0.	15141.
TOTAL	305.	840.	23587.	0.	23818.
ADMINISTRATIVE					
1 FEDERAL OFFICES	0.	53333.	0.	28333.	39069.
2 SMSA'S	0.	106667.	0.	56667.	78139.
TOTAL	0.	160000.	0.	85000.	117208.
TOTAL NETWORK					
1 FEDERAL OFFICES	193452.	91990.	172911.	101849.	332221.
2 SMSA'S	398253.	194850.	308016.	192651.	620060.
TOTAL	591705.	286840.	480927.	294500.	952281.

REPORT 18 - NETWORK COST ALLOCATION

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

OVERALL COST SUMMARY

	CAPITAL EXPENDITURES	PLANNING AND INSTALLATION	ANNUAL LEASE	ANNUAL O&M&A	ANNUALIZED COST
UPLINK	398800.	102000.	452660.	202000.	755472.
DOWNLINK	192600.	24000.	4680.	7500.	55782.
VOICE TALKBACK	305.	840.	23587.	0.	23818.
ADMINISTRATIVE	0.	160000.	0.	85000.	117208.
TOTALS	591705.	286840.	480927.	294500.	952281.
ANNUALIZED COST	119112.	57742.	480927.	294500.	952281.

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

REPORT 19 - OVERALL COST SUMMARY

FEDERAL REGIONAL OFFICES AND TOP 20 SMSA'S

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

CALL SIGN	LICENSEE	CITY	STATE	SERVICE	SIZE
********** WASHINGTON					
WM43	NATIONAL CABLE SATELLITE CORP.	BREN MAR	VA	DFSFESPTR	0100
WE74	AMERICAN SATELLITE CORPORATION	GREENBELT	MD	DFSFESCTR	0100

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

CALL SIGN	LICENSEE	CITY	STATE	SERVICE	SIZE
********** BOSTON	MA				
WU57	WARNER CABLE CORP.	SALEM	MA	DFSFESPRO	0050
WT25	NEW BOSTON TELEVISION, INC.	BOSTON	MA	DFSFESPRO	0100
WQ70	WARNER CABLE CORP.	MEDFORD	MA	DFSFESPRO	0050
WH23	THE CHRISTIAN BROADCASTING NETWORK,	BOSTON	MA	DFSFESPTR	0100
********** PHILADELPHIA	PA				
WX82	SOUTHEASTERN CABLEVISION, CO.	ASTON TOWNSHIP	PA	DFSFESPRO	0050
WT28	AMERICAN CABLEVISION OF PENNSYLVANI	CHESTER	PA	DFSFESPRO	0050
WS30	CITY LINE ASSOCIATES	PHILADELPHIA	PA	DFSFESPRO	0050
WQ72	WPHL-TV, INC.	PHILADELPHIA	PA	DFSFESPRO	0045
WQ58	GLOUSTER COUNTY CATV ASSOCIATES	WOODBURY	NJ	DFSFESPRO	0045
WQ47	TELECABLE OF SPRINGFIELD, INC.	FLOURTOWN	PA	DFSFESPRO	0045
WP58	COMCAST CORPORATION	WILLOW GROVE	PA	DFSFESPRO	0050
WK51	CPI SATELLITE TELECOMMUNICATIONS, I	UPPER DARBY	PA	DFSFESCRO	0060
WK37	ULTRACOM OF DELAWARE VALLEY, INC.	MARPLE TOWNSHIP	PA	DFSFESPRO	0043
WJ94	CABLE SYSTEMS, INC.	AUDUBON	NJ	DFSFESPRO	0050
WJ81	BLUE RIDGE CABLE TELEVISION, INC.	STROUDSBURG	PA	DFSFESPRO	0045
WJ65	MAPLE SHADE CABLE CO., INC.	MAPLE SHADE	NJ	DFSFESPRO	0050
WE22	RADIO BROADCASTING COMPANY	PHILADELPHIA	PA	DFSFESCRO	0050

(continued)

********** NEW YORK	NY				
WZ21	CABLEVISION OF BAYONNE	BAYONNE	NJ	DFSFESPRO	0045
WU34	CABLESYSTEMS OF NEW JERSEY	BERGENFIELD	NJ	DFSFESPRO	0045
WS24	SUBURBAN CABLEVISION	EAST ORANGE	NJ	DFSFESPRO	0050
WL57	TELEPROMPTER CORP.	MANHATTAN	NY	DFSFESPRO	0045
********** ATLANTA	GA				
WU75	STORER BROADCASTING COMPANY	ATLANTA	GA	DFSFESPRO	0050
WR87	CLAYTON COUNTY CABLE COMMUNICATIONS	CLAYTON	GA	DFSFESPRO	0050
WR77	WOMETCO CABLE TV OF GEORGIA, INC.	MAPLETON	GA	DFSFESPRO	0050
WM48	CABLE HOLDINGS OF GEORGIA, INC. DBA	SMYRNA	GA	DFSFESPRO	0050
WL91	COX CABLE COMMUNICATIONS, INC.	ATLANTA	GA	DFSFESPRO	0050
WK35	DEKALB CABLEVISION CORP.	DECATUR	GA	DFSFESPRO	0050
WH25	THE CHRISTIAN BROADCASTING NETWORK,	ATLANTA	GA	DFSFESPRO	0100
WG73	UNITED CABLEVISION CORP	CHAMBLEE	GA	DFSFESPRO	0500
WD34	RCA AMERICAN COMMUNICATIONS, INC.	ATLANTA	GA	DFSFESCTR	0100
********** CHICAGO	IL				
WX83	CABLEVISION OF CHICAGO	FOREST PARK	IL	DFSFESPRO	0045
WQ40	WGN CONTINENTAL BROADCASTING CO.	CHICAGO	IL	DFSFESPRO	0100
WL95	TELEPROMPTER CORP.	CHICAGO	IL	DFSFESCRO	0045
********** DALLAS	TX				
KZ24	SILVER SCREEN, INC.	DALLAS	TX	DFSFESPRO	0045
KX69	SAMMONS COMMUNICATIONS, INC.	DUNCANVILLE	TX	DFSFESPRO	0050
KW98	VIDEO INTERNATIONAL PRODUCTIONS, IN	DALLAS	TX	DFSFESPRO	0050
KU37	STORER CABLE TV OF TEXAS, INC.	GARLAND	TX	DFSFESPRO	0050
KT49	SAMMONS COMMUNICATIONS, INC.	UNIVERSITY PARK	TX	DFSFESPRO	0043
KR56	CABLESYSTEMS OF ADDISON, INC.	ADDISON	TX	DFSFESPRO	0050
KR52	STORER CABLE TV OF TEXAS INC.	GRAND PRAIRIE	TX	DFSFESPRO	0050
KQ84	THE CHRISTIAN BROADCASTING NETWORK,	DALLAS	TX	DFSFESPRO	0100

(continued)

********** KANSAS CITY	MO				
KZ43	HI-NET COMMUNICATIONS, INC.	KANSAS CITY TOWE	KS	DFSFESPRO	0050
KZ32	AMERICAN CABLEVISION OF KANSAS CITY	KANSAS CITY	MO	DFSFESPRO	0050
KZ31	AMERICAN CABLEVISION OF KASAS CITY,	KANSAS CITY	MO	DFSFESPRO	0050
KZ20	AMERICAN CABLEVISION OF KANSAS CITY	KANSAS CITY	MO	DFSFESPRO	0050
KY55	HI-NET COMMUNICATIONS, INC.	KANSAS CITY-NE	MO	DFSFESPRO	0050
KY54	HI-NET COMMUNICATIONS, INC.	MISSION	KS	DFSFESPRO	0050
KL20	SIX STAR CABLEVISION MANAGEMENT COR	KANSAS CITY	KS	DFSFESPRO	0045
KJ25	JACKSON COUNTY CABLE SYSTEMS	INDEPENDENCE	MO	DFSFESPRO	0060
KG63	CLAY-PLATTE HOME THEATRE, INC.	PARKVILLE	MO	DFSFESPRO	0050
KF38	TRANSPONDER CORPORATION	KANSAS CITY	KS	DFSFESCTR	0100
********** DENVER	CO				
KZ42	HI-NET COMMUNICATIONS, INC.	DENVER COLORADO	CO	DFSFESPRO	0046
KV31	JAC COMMUNICATIONS ASSOCIATES	DENVER	CO	DFSFESPRO	0050
KU50	UNITED CABLE TELEVISION CORP. DBA M	DENVER	CO	DFSFESPRO	0061
KT43	PUBLIC SERVICE SATELLITE CONSORTIUM	MORRISON	CO	DFSFESPTR	0110
KP77	TRINITY BROADCASTING OF DENVER, INC	DENVER	CO	DFSFESPRO	0050
KJ99	COMMUNITY TCI OF COLORADO, INC.	LAKEWOOD	CO	DFSFESPRO	0050
KG75	AMERICAN TELEVISION AND COMMUNICATI	ENGLEWOOD	CO	DFSFESPRO	0050
********** SAN FRANCISCO	CA				
KX30	HI-NET COMMUNICATIONS, INC.	SAN FRANCISCO-WH	CA	DFSFESPRO	0046
KX29	HI-NET COMMUNICATIONS, INC.	OAKLAND-METRO AI	CA	DFSFESPRO	0046
KK86	ATHENA CABLEVISION CORP.	RICHMOND	CA	DFSFESPRO	0050
KH91	WESTERN TV CABLE	S. SAN FRANCISCO	CA	DFSFESPRO	0045
********** SEATTLE	WA				
KY50	HI-NET COMMUNICATIONS, INC.	SEATTLE BOEING F	WA	DFSFESPRO	0046
KY49	HI-NET COMMUNICATIONS, INC.	SEATTLE-TACOMA A	WA	DFSFESPRO	0046
KX73	OLYMPIC TV CABLE, INC.	PORT ORCHARD	WA	DFSFESPRO	0050
KW96	TELE-VUE SYSTEMS, INC. DBA VIACOM	SEATTLE	WA	DFSFESPRO	0050
KP48	TRINITY BROADCASTING OF SEATTLE, IN	SEATTLE	WA	DFSFESPRO	0050
KM61	NATION WIDE CABLEVISION, INC.	BREMERTON	WA	DFSFESPRO	0050

(continued)

********** LOS ANGELES	CA				
KZ48	HI-NET COMMUNICATIONS, INC.	LOS ANGELES-AIRP	CA	DFSFESPRO	0050
KU38	R F W SATELLITE SERVICES	HOLLYWOOD	CA	DFSFESPTR	0100
KR65	SIX STAR CABLEVISION MANAGEMENT COR	INGLEWOOD	CA	DFSFESPRO	0045
KR53	KTS CORP. DBA KINNELOA TELEVISION S	PASADENA	CA	DFSFESPRO	0045
KR30	SAMMONS COMMUNICATIONS, INC.	GLENDALE	CA	DFSFESPRO	0043
KQ77	THE CHRISTIAN BROADCASTING NETWORK,	LOS ANGELES	CA	DFSFESPRO	0100
KL76	DOUGLAS TELEVISION COMPANY, INC.	PAYSON	AZ	DFSFESPRO	0050
KL47	KING VIDEOCABLE COMPANY	LOS ANGELES	CA	DFSFESPRO	0050
KJ86	SPANISH INTERNATIONAL COMMUNICATION	HOLLYWOOD	CA	DFSFESPTR	0100
KG94	THETA CABLE OF CALIFORNIA	SANTA MONICA	CA	DFSFESPRO	0045
KG72	RCA AMERICAN COMMUNICATIONS, INC.	PASADENA	CA	DFSFESCTR	0100
********** DETROIT	MI				
WX85	COX CABLE COMMUNICATIONS, INC.	ST. CLAIR SHORES	MI	DFSFESPRO	0050
WX69	RCA AMERICOM	SOUTHFIELD	MI	DFSFESDRO	0070
WX56	THE CHRISTIAN BROADCASTING NETWORK,	DETROIT	MI	DFSFESPRO	0050
WV80	CONTINENTAL CABLEVISION OF MACOMB	ROSEVILLE	MI	DFSFESPRO	0050
WV61	HI-NET COMMUNICATIONS, INC.	LIVONIA	MI	DFSFESPRO	0050
WV60	HI-NET COMMUNICATIONS, INC.	WARREN	MI	DFSFESPRO	0050
WH30	GREATER STAR LINK CORP.	DETROIT	MI	DFSFESCTR	0100
********** PITTSBURGH	PA				
WZ61	WESTINGHOUSE BROADCASTING CO.	ALLISON PARK	PA	DFSFESCTR	0100
WX84	AMERICAN CABLEVISION OF MONROEVILLE	MONROEVILLE	PA	DFSFESPRO	0050
WV73	ANTHONY MANCINI	PITTSBURGH	PA	DFSFESPRO	0046
WV70	ANGELO VALENT CABLE TV	OAKDALE	PA	DFSFESPRO	0050
WS31	CENTRE VIDEO INC.	PENN HILLS TWP	PA	DFSFESPRO	0050
WR27	WESTERN PENNSYLVANIA CHRISTIAN BROA	WALL BOROUGH	PA	DFSFESPRO	0060
WG87	BAISLEY TV & CABLE CO., INC.	CANONSBURG	PA	DFSFESPRO	0045

(continued)

********** ST. LOUIS - MO					
KZ26	HORIZON COMMUNICATIONS CORP. OF	HAZELWOOD	MO	DFSFESPRO	0050
KY76	HI-NET COMMUNICATIONS, INC.	CLAYTON	MO	DFSFESPRO	0050
KY52	HI-NET COMMUNICATIONS, INC.	ST. LOUIS-NO.	MO	DFSFESPRO	0050
KV60	EVANS BROADCASTING CORP.	SHREWSBURY	MO	DFSFESPRO	0050
KU94	THE CHRISTIAN BROADCASTING NETWORK,	ST. LOUIS	MO	DFSFESPRO	0050
KJ37	CINEMA 8 PRODUCTIONSINC.	ST LOUIS	MO	DFSFESPRO	0045
********** BALTIMORE MD					
WK31	HOWARD CABLE TELEVISION ASSOCIATES,	ELLICOTT CITY	MD	DFSFESPRO	0050
WJ49	CALVERT TELECOMMUNICATIONS CORP.	CANTONSVILLE	MD	DFSFESPRO	0050
WH37	GENESEE PROPERTIES	ANNA ARUNDEL	MD	DFSFESPRO	0045
********** CLEVELAND OH					
WT44	STORER BROADCASTING CO.	PARMA	OH	DFSFESPRO	0050
WP65	COX CABLE COMMUNICATIONS, INC.	PARMA	OH	DFSFESPRO	0050
WG76	TELERAMA, INC.	BEACHWOOD	OH	DFSFESPRO	0600
********** HOUSTON TX					
WE79	GULF COAST-BELLAIR CABLE TELEVISIO	BELLAIRE	TX	DFSFESPRO	0060
KV48	WESTLAND CATV, LTD.	HOUSTON	TX	DFSFESPRO	0070
KR51	VIDEO VISTA	NORTH HOUSTON	TX	DFSFESPRO	0046
KR40	VIDEO VISTA	WEST HOUSTON	TX	DFSFESPRO	0046
KJ32	MULTIPOINT-TEXAS COMPANY	HOUSTON	TX	DFSFESPRO	0045
********** NEWARK NJ					
WZ21	CABLEVISION OF BAYONNE	BAYONNE	NJ	DFSFESPRO	0045
WS24	SUBURBAN CABLEVISION	EAST ORANGE	NJ	DFSFESPRO	0050
********** MINNEAPOLIS MN					
KX31	HI-NET COMMUNICATIONS, INC.	BLOOMINGTON CENT	MN	DFSFESPRO	0046
KU45	UNITED TELEVISION, INC.	EDINA	MN	DFSFESPRO	0050
KT98	NORTHERN CABLEVISION, INC.	ST. LOUIS PARK	MN	DFSFESPRO	0050
KN70	NORTHERN CABLEVISION, INC.	BLOOMINGTON	MN	DFSFESPRO	0050
KK64	FIRST TELEVISION CORP.	FRIDLEY	MN	DFSFESCRO	0050

(continued)

********** ORANGE COUNTY	CA				
KZ44	HI-NET COMMUNICATIONS, INC.	LONG BEACH	CA	DFSFESPRO	0050
********** MILWAUKEE	WI				
WX98	HI-NET COMMUNICATIONS, INC.	MILWAUKEE-WEST	WI	DFSFESPRO	0046
WX74	HI-NET COMMUNICATIONS, INC.	MILWAUKEE-N.E.	WI	DFSFESPRO	0046
WT41	WITI-TV, INC.	BROWN DEER VILLA	WI	DFSFESPRO	0050
KX28	HI-NET COMMUNICATIONS, INC.	MILWAUKEE-SO AIR	WI	DFSFESPRO	0046
********** WASHINGTON	DC				
WU31	MARQUEE TELEVISION NETWORK, INC.	BETHESDA	MD	DFSFESPRO	0050
WM43	NATIONAL CABLE SATELLITE CORP.	BREN MAR	VA	DFSFESPTR	0100
WH49	ARLINGTON TELECOMMUNICATIONS CORP.	ARLINGTON	VA	DFSFESPRO	0045
WE87	RCA AMERICAN COMMUNICATIONS, INC.	SUITLAND	MD	DFSFESCRO	0110
WE74	AMERICAN SATELLITE CORPORATION	GREENBELT	MD	DFSFESCTR	0100

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

```
C
C     THIS IS THE COMMON AREA 'INCLUDED' IN THE SCENARIO BUILDER AND
C     MODEL PROGRAMS. THE FILE NAME IS 'COMBLK'.
C
      INTEGER*2 NUELEM,NDELEM,NUINDX,NDINDX,NUCITY,NDCITY,NUPATH,NDPATH
      COMMON    NUELEM,NDELEM,NUINDX,NDINDX,NUCITY,NDCITY,NUPATH,NDPATH
      INTEGER*2 NELEM(2),NINDX(2),NCITY(2),NPATH(2)
      EQUIVALENCE (NUELEM,NELEM(1)), (NUINDX,NINDX(1))
      EQUIVALENCE (NUCITY,NCITY(1)), (NUPATH,NPATH(1))
      INTEGER*2 NUMORG,MAXUCS,MAXDCS,MAXUPA,MAXDPA,MAXUCT,MAXDCT,BADD
      COMMON    NUMORG,MAXUCS,MAXDCS,MAXUPA,MAXDPA,MAXUCT,MAXDCT,BADD
      INTEGER*2 MAXCS(2),MAXPA(2),MAXCT(2)
      EQUIVALENCE (MAXUCS,MAXCS(1)),(MAXUPA,MAXPA(1)),(MAXUCT,MAXCT(1))
      INTEGER*2 UCITYU(10),UCITYH(10),DCITYU(80),DCITYH(80)
      COMMON    UCITYU,    UCITYH,    DCITYU,    DCITYH
      INTEGER*2 NCHAR,NSTART,CONTCD,YESSNO,UPPDWN,POSITN
      COMMON    NCHAR,NSTART,CONTCD,YESSNO,UPPDWN,POSITN
      REAL*4 DDDCPH,DDDINS,DDDLES,EQPLIF,PUTLES,PUTFIX,PUTINS,PUTMIL
      COMMON DDDCPH,DDDINS,DDDLES,EQPLIF,PUTLES,PUTFIX,PUTINS,PUTMIL
      REAL*4 DISCNT,TLKCAP,WATINS,WATLES,WATCPH,WATMAX
      COMMON DISCNT,TLKCAP,WATINS,WATLES,WATCPH,WATMAX
      REAL*4 UCSDAT(15,6,4),DCSDAT(30,6,4),GANDAD(4)
      COMMON UCSDAT,        DCSDAT,        GANDAD
      REAL*4 UCSMIN(15),DCSMIN(30),UCTXVL(10,5),DCTXVL(80,5)
      COMMON UCSMIN,    DCSMIN,    UCTXVL,      DCTXVL
      REAL*4 UDXWHT(6),DDXWHT(6),TALKBK(80,10),XDATA(6)
      COMMON UDXWHT,   DDXWHT,   TALKBK,       XDATA
      LOGICAL*1 UCSCOD(15,2),DCSCOD(30,2),UCSNAM(15,20),DCSNAM(30,20)
      COMMON    UCSCOD,      DCSCOD,      UCSNAM,       DCSNAM
      LOGICAL*1 UCSPTH(15,10),DCSPTH(30,20),UPTHCY(10,10),DPTHCY(20,80)
      COMMON    UCSPTH,       DCSPTH,       UPTHCY,       DPTHCY
      LOGICAL*1 UCTNAM(10,16),DCTNAM(80,16),USTCOD(10,2),DSTCOD(80,2)
      COMMON    UCTNAM,       DCTNAM,       USTCOD,       DSTCOD
      LOGICAL*1 INDATA(80),ORGNAM(9,20),UCINDX(6,8),DCINDX(6,8)
      COMMON    INDATA,    ORGNAM,      UCINDX,     DCINDX
      LOGICAL*1 UPTHNM(10,20),DPTHNM(20,20),ARG(80)
      COMMON    UPTHNM,       DPTHNM,       ARG
      LOGICAL*1 UCTORG(10),DCTORG(80),UCTCHN(10),DCTLVL(80)
      COMMON    UCTORG,    DCTORG,    UCTCHN,    DCTLVL
      LOGICAL*1 TITLE(72)
      COMMON    TITLE
```

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FORTRAN IV-PLUS V02-51C          10:16:49     11-JUN-80          PAGE 1
BUILD.FTN       /TR:BLOCKS/WR

        C     THIS IS THE MAIN PROGRAM FOR THE MODEL
        C
        C SUBROUTINE CALLS: READIN, COST, PATH, CITY, RATE, YESNO, RITOUT
        C
        C VARIABLES
        C
        C MAXUCS - MAXIMUM NUMBER OF UPLINK COST INDEXES
        C MAXDCS -                   DOWNLINK
        C
        C MAXUPA - MAXIMUM NUMBER OF UPLINK PATHS
        C MAXDPA -                   DOWNLINK
        C
        C MAXUCT - MAXIMUM NUMBER OF UPLINK CITIES
        C MAXDCT -                   DOWNLINK
        C
        C UCINDX - THE 'FIXED' UPLINK COST INDEX
        C DCINDX -             DOWNLINK
        C
0001            INCLUDE 'SY0:COMBLK.FTN/NOLIST'
0039            DATA MAXUCS /15/, MAXDCS /30/, MAXUPA /10/, MAXDPA /20/
0040            DATA MAXUCT /10/, MAXDCT /80/
0041            DATA UCINDX /'F',5*' ','I',5*' ','X',5*' ','E',5*' ','D',23*' '/
0042            DATA DCINDX /'F',5*' ','I',5*' ','X',5*' ','E',5*' ','D',23*' '/
        C
        C   OPEN AND READ USER-SELECTED SCENARIO FILE
        C
0043            CALL READIN
0044            WRITE (1,*) 'SCENARIO TITLE IS...'
0045            WRITE (1,10) (TITLE(I),I=1,72)
0046    10      FORMAT ('0',72A1/)
0047    20      WRITE (1,*) 'DO YOU WANT TO ENTER A NEW TITLE?'
0048            CALL YESNO
        C                 YES NO ERR
0049            GO TO (30, 50, 20) YESSNO
0050    30      WRITE (1,*) 'ENTER NEW SCENARIO TITLE'
0051            READ (1,40) (TITLE(I),I=1,72)
0052    40      FORMAT (72A1)
        C
        C   CALL SUBROUTINES TO EDIT COST, PATH, CITY, AND RATE INFORMATION
        C
0053    50      CALL COST
0054            CALL PATH
0055            CALL CITY
0056            CALL RATE
        C
0057    100     WRITE (1,*)'DO YOU HAVE ANY MORE MODIFICATIONS TO MAKE TO THE SCEN
               2ARIO?'
0058            CALL YESNO
        C                 YES NO   ERR
0059            GO TO ( 50, 500, 100) YESSNO
        C
        C SAVE MODIFICATIONS IN A NEW SCENARIO FILE
        C
0060    500     CALL RITOUT
0061            STOP
0062            END
```

```
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COST.FTN         /TR:BLOCKS/WR

0001           SUBROUTINE COST
               C
               C                          COST MODULE
               C
               C THE COST MODULE IS USED TO ADD TO OR MODIFY DATA FOR THE
               C UPLINK OR DOWNLINK COST ELEMENTS.  THE USER HAS THE CAPABILITY
               C TO DEFINE ADDITIONAL COST ELEMENTS, ADD DATA FOR THEM, AND
               C INCLUDE THEM IN ONE OR MORE PATHS.  COST ELEMENT DATA CONSISTS
               C OF CAPITAL, INSTALLATION, LEASE, AND OPERATIONS AND MAINTENANCE
               C COSTS FOR EACH COST ELEMENT ( PIECE OF EQUIPMENT OR NON-HARDWARE
               C COST UNIT) USED IN THE ANALYSIS.  A SINGLE COST ELEMENT MAY CONSIST OF
               C MANY INDIVIDUAL ITEMS AS LONG AS THEY ARE ALWAYS CONSIDERED TOGETHER.
               C THE USER ALSO HAS THE CAPABILITY TO SET UP A COST ALLOCATION
               C METHODOLOGY.
               C
               C ARRAY VARIABLES
               C
               C   UCSCOD - 2 CHARACTER UPLINK COST ELEMENT CODE
               C   DCSCOD -              DOWNLINK
               C
               C   UCSNAM - 20 CHARACTER UPLINK COST ELEMENT NAME
               C   DCSNAM -              DOWNLINK
               C
               C   UCSDAT - CAPITAL, INSTALLATION, LEASE, AND OMA COSTS FOR EACH UPLINK
               C           COST ELEMENT AND COST INDEX
               C   DCSDAT -                                                  DOWNLINK
               C
               C   UCSMIN - MINIMUM LEASE CHARGE FOR EACH UPLINK COST ELEMENT
               C   DCSMIN -                                  DOWNLINK
               C
               C   UCSPTH - MATRIX OF COST ELEMENTS FOR EACH UPLINK PATH
               C   DCSPTH -                                  DOWNLINK
               C
               C   ORGNAM - 20 CHAR NAMES OF MEMBER ORGANIZATIONS FOR ALLOCATING COSTS
               C
               C   UCINDX - 8 CHARACTER COST INDEX NAMES FOR UPLINK
               C   DCINDX -                                  DOWNLINK
               C
               C   UDXWHT - WEIGHTING FACTORS FOR COST ALLOCATION OF UPLINK COSTS
               C   DDXWHT -                                          DOWNLINK
               C
               C   CSTCMD - ARRAY OF COMMANDS FOR USE IN THE COST MODULE
               C
               C   CSMCMD - ARRAY OF SUBCOMMANDS USED IN THE COST MODULE
               C
               C SCALAR VARIABLES
               C   NUELEM - NUMBER OF UPLINK COST ELEMENTS
               C   NDELEM -            DOWNLINK
               C
               C   NUINDX - NUMBER OF UPLINK COST INDEXES
               C   NDINDX -            DOWNLINK
               C
               C   UPPDWN - FLAG SET TO SPECIFY UPLINK OR DOWNLINK PROCESSING
               C
               C   XDAT, XDATA - VARIABLES USED TO READ USER RESPONSE INTO
               C
```

```
        C
        C SUBROUTINE CALLS: GETTER, CODCHK, DISAPR, REPRTR
        C                   YESNO,  UPDOWN, RDCOST, MATMOD
        C
        C THIS ROUTINE CALLED BY: BUILD
        C
0002            INCLUDE 'SY0:COMBLK.FTN/NOLIST'
        C
        C   LOCAL VARIABLES
        C
0040            LOGICAL*1 MODFLG,CSTCMD(5,3),CSMCMD(9,3)
0041            REAL*4 PER,INPUT2
0042            DATA PER /'PER '/
0043            DATA CSTCMD /'E','A','M','D','L',
                2            'X','D','O','E','I',
                3            'I','D','D','L','S'/
0044            DATA CSMCMD /'C','I','L','O','C','N','A','R','E',
                2            'A','N','E','M','O','A','D','E','X',
                3            'P','S','S','A','D','M','D','M','I'/
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C ASK FOR COST INFORMATION
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0045    10      WRITE (1,* )'DO YOU HAVE COST INFORMATION TO ENTER? '
0046            CALL YESNO
        C            YES NO ERR
0047            GO TO(50,950,10), YESSNO
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C COST INFORMATION PROCESSING
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0048    50      WRITE ( 1,* ) 'DO YOU WANT TO CHANGE YOUR COST ALLOCATION?'
0049            CALL YESNO
        C             YES NO ERR
0050            GO TO (70,97,50),YESSNO
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C COST ALLOCATION PROCESSING
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0051    70      NUMORG = 0
0052    75      WRITE ( 1,* ) 'ENTER LIST OF MEMBERS TO SHARE COSTS - ; TO END'
0053    78      READ (1,101?) (INDATA(I), I=1,80)
0054    80      CALL GETTER
0055            IF ( ARG (1) .NE. ';' ) GO TO 85
0056            IF (NUMORG.EQ.0) WRITE(1,*) 'WARNING: NO ORGANIZATIONS SPECIFIED.'
0057            IF (NUMORG.EQ.0) WRITE(1,*) 'COST ALLOCATION IGNORED.'
0058            GO TO 97
```

```
0059     85     IF (NCHAR.EQ.0) GO TO 88
0060            IF (NUMORG.EQ.10) GO TO 95
0061            NUMORG = NUMORG + 1
0062            DO 86 J=1,20
0063     86     ORGNAM(NUMORG,J) = ARG(J)
0064     88     IF ( CONTCD .EQ. 0 ) GO TO 75
0065            IF ( CONTCD .NE. 0 ) GO TO 80
         C
         C TOO MANY MEMBERS
         C
0066     95     WRITE (1,*) 'ONLY 9 ORGANIZATIONS CAN BE SPECIFIED'
         C
         CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
         C
         C   ASK FOR UPLINK OR DOWNLINK PROCESSING
         C
         CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
         C
0067     97     WRITE(1,*) 'DO YOU WANT TO EDIT UPLINK OR DOWNLINK COST DATA?'
0068            WRITE(1,*) '(UP OR DOWN)'
0069            CALL UPDOWN
0070            IF (UPPDWN.EQ.3) GO TO 97
         C
         CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
         C
         C MODIFY COST INDEXES
         C
         CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
         C
0071     100    WRITE ( 1,* ) 'DO YOU WANT TO MODIFY COST INDEXES?'
0072            CALL YESNO
         C                YES  NO  ERR
0073            GO TO (120,280,100), YESSNO
0074     120    NINDX(UPPDWN) = 1
0075     122    WRITE (1,*) 'ENTER NEW LIST OF COST INDEX NAMES'
0076     125    READ (1,1010) (INDATA(I),I=1,80)
0077     130    CALL GETTER
0078            IF ( ARG(1) .EQ. '!' ) GO TO 150
0079            IF (NCHAR.EQ.0) GO TO 138
0080            IF (NINDX(UPPDWN).EQ.6) GO TO 145
0081            NINDX(UPPDWN) = NINDX(UPPDWN) + 1
0082            DO 133 J=1,8
0083            IF (UPPDWN.EQ.1) UCINDX(NUINDX,J) = ARG(J)
0084            IF (UPPDWN.EQ.2) DCINDX(NDINDX,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
0088     145    WRITE (1,*) 'ONLY 6 COST INDEXES CAN BE SPECIFIED'
         C
         CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
         C
         C ENTER COST INDEX WEIGHTING FACTORS
         C
```

```
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
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),UPPDWN
0093    152   WRITE (1,1200) ((UCINDX(I,J),J=1,8),I=1,NUINDX)
0094          READ (1,*,ERR=170 ) (XDATA(I),I=1,NUINDX)
0095          DO 155 I=1,NUINDX
0096    155   UDXWHT(I) = XDATA(I)
0097          GO TO 280
0098    160   WRITE (1,1200) ((DCINDX(I,J),J=1,8),I=1,NDINDX)
0099          READ (1,*,ERR=170) (XDATA(I),I=1,NDINDX)
0100          DO 165 I=1,NDINDX
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
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C   COST COMMAND PROCESSING
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C
        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,5,CSTCMD,POSITN)
        C
        C                                      EXI ADD DEL MOD LIS
0109          IF ( POSITN .NE. 0 ) GO TO (900,400,500,705,800), POSITN
0110          WRITE (1,*) 'INVALID COST COMMAND'
0111          WRITE(1,*)'VALID COMMANDS ARE: EXI,ADD,DEL,MOD,LIS'
0112          GO TO 280
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C ADD COST ELEMENT
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0113    400   WRITE ( 1,* ) 'ENTER NEW COST ELEMENT CODE - 2 CHARACTERS'
0114          ASSIGN 400 TO BADD
0115          CALL RDCOST
```

```
0116          IF (NCHAR.EQ.1.AND.ARG(1).EQ.'!') GO TO 280
0117          IF ( POSITN .EQ. 0 ) GO TO 410
0118     405  WRITE (1,*) 'COST ELEMENT CODE ALREADY EXISTS'
0119          WRITE (1,*) 'USE A DIFFERENT CODE'
0120          GO TO BADD
              C
              C ERROR -- TOO MANY COST ELEMENTS
              C
0121     410  IF (NELEM(UPPDWN) .LT. MAXCS(UPPDWN)) GO TO 415
0122          WRITE (1,*)'ONLY ',MAXCS(UPPDWN),' COST ELEMENTS CAN BE SPECIFIED'
0123          GO TO 280
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C ADD NEW ELEMENT CODE TO ARRAY
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
0124     415  NELEM(UPPDWN) = NELEM(UPPDWN) + 1
0125          NCSTEL=NELEM(UPPDWN)
0126          IF (NCSTEL .EQ. MAXCS(UPPDWN))
             2    WRITE(1,*)'THIS IS THE LAST COST ELEMENT WHICH MAY BE ADDED'
0127     416  DO 417 I=1,2
0128             IF (UPPDWN.EQ.1) UCSCOD(NCSTEL,I)=ARG(I)
0129             IF (UPPDWN.EQ.2) DCSCOD(NCSTEL,I)=ARG(I)
0130     417  CONTINUE
0131          IF ( MODFLG .EQ. 1 ) GO TO 523
              C
              CCCCCCCCCCCCCCCCCCCCCC
              C
              C ADD COST ELEMENT NAME
              C
              CCCCCCCCCCCCCCCCCCCCCC
              C
0132     420  WRITE ( 1,* ) 'ENTER NEW COST ELEMENT NAME'
0133          ASSIGN 420 TO BADD
0134          READ (1,1010) (INDATA(I),I=1,20)
0135          CALL GETTER
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     425  WRITE (1,*) 'COST ELEMENT NAME ALREADY EXISTS'
0140          WRITE (1,*) 'USE A DIFFERENT NAME'
0141          GO TO BADD
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C   MOVE NEW NAME TO ITS ARRAY
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
0142     430  DO 429 J=1,20
0143          IF (UPPDWN.EQ.1) UCSNAM(NCSTEL,J) = ARG(J)
0144          IF (UPPDWN.EQ.2) DCSNAM(NCSTEL,J) = ARG(J)
0145     429  CONTINUE
0146          IF ( MODFLG .EQ. 1 ) GO TO 523
```

```
        C
        C
        CCCCCCCCCCCCCCCCCCCC
        C
        C ENTER COSTS FOR EACH COST INDEX - CAP, INS, LES, OMA
        C
        CCCCCCCCCCCCCCCCCCCC
        C
        C
0147            WRITE ( 1,* ) 'COST INDEXES ARE:'
0148            IF (UPPDWN.EQ.1) WRITE (1,1200) ((UCINDX(I,J), J=1,8),I=1,NUINDX)
0149            IF (UPPDWN.EQ.2) WRITE (1,1200) ((DCINDX(I,J), J=1,8),I=1,NDINDX)
0150    432     WRITE ( 1,* ) 'ENTER CAPITAL COST (ENTER A VALUE FOR EACH COST IND
               2EX)'
0151            ASSIGN 432 TO BADD
0152            READ (1,*,ERR=170 ) (XDATA(I),I=1,NINDX(UPPDWN))
0153            DO 434 J=1,NINDX(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
        CCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C ENTER INSTALLATION COSTS
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C
0157    440     WRITE ( 1,* ) 'ENTER INSTALLATION COSTS'
0158            ASSIGN 440 TO BADD
0159            READ (1,*,ERR=170 ) (XDATA(I),I=1,NINDX(UPPDWN))
0160            DO 443 J=1,NINDX(UPPDWN)
0161            IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J,2) = XDATA(J)
0162            IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J,2) = XDATA(J)
0163    443     CONTINUE
        C
        C
        CCCCCCCCCCCCCCCCCCC
        C
        C ENTER LEASE COSTS
        C
        CCCCCCCCCCCCCCCCCCC
        C
0164    450     WRITE ( 1,* ) 'ENTER LEASE COSTS'
0165            ASSIGN 450 TO BADD
0166            READ (1,*,ERR=170) (XDATA(I),I=1,NINDX(UPPDWN))
0167            DO 455 J=1,NINDX(UPPDWN)
0168            IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J,3) = XDATA(J)
0169            IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J,3) = XDATA(J)
0170    455     CONTINUE
        C
        C
        CCCCCCCCCCCCCCCCC
        C
        C ENTER OMA COSTS
```

```
        C
        CCCCCCCCCCCCCCCCC
        C
        C
0171    465   WRITE (1,* ) 'ENTER OPERATIONS AND MAINTENANCE COSTS'
0172          ASSIGN 465 TO BADD
0173          READ (1,*,ERR=170 ) (XDATA(I),I=1,NINDX(UPPDWN))
0174          DO 470 J=1,NINDX(UPPDWN)
0175          IF (UPPDWN.EQ.1) UCSDAT(NCSTEL,J,4) = XDATA(J)
0176          IF (UPPDWN.EQ.2) DCSDAT(NCSTEL,J,4) = XDATA(J)
0177    470   CONTINUE
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C   ENTER MINIMUM LEASE COST, IF APPLICABLE
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        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
        C
        CCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C   ENTER PATH INFORMATION
        C
        CCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C
0187    480   WRITE ( 1,* ) 'ENTER PATH NAMES TO WHICH THIS COST ELEMENT IS TO B
             2E ADDED'
0188          J = UPPDWN + 2
0189          CALL MATMOD(J,1,NCSTEL)
0190          IF ( MODFLG .EQ. 1 ) GO TO 523
0191          GO TO 280
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C MODIFY COST ELEMENT
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0192    500   WRITE ( 1,* )'ENTER COST ELEMENT CODE TO BE MODIFIED'
0193          CALL RDCOST
0194          IF ( POSITN .NE. 0 ) GO TO 510
0195          WRITE (1,*) 'COST ELEMENT CODE DOES NOT EXIST'
0196          GO TO 280
```

```
        C
        CCCCCCCCCCCCCCCCCCCCC
        C
        C   ENTER MODIFIED CODE
        C
        CCCCCCCCCCCCCCCCCCCCCC
        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   (DCSCOD(POSITN,J),J=1,2),(DCSNAM(POSITN,J),J=1,20)
        C
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,9,CSMCMD,POSITN )
0206          IF ( POSITN .NE. 0 ) GO TO 530
0207          WRITE (1,*) 'INVALID SUBCOMMAND.'
0208          WRITE ( 1,1270)((CSMCMD(I,J),J=1,3),I=1,9)
0209          GO TO 523
        C
        C   BRANCH TO MODIFY COST SUBCOMMAND
        C
        C            CAP INS LES OMA COD NAM ADD REM EXI
0210    530   GO TO (540,540,540,540,620,640,660,680,280),POSITN
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C   MODIFY CAPITAL, INSTALL, LEASE, OR O+M COSTS
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        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              (UCSNAM(NCSTEL,J),J=1,20)
0213          IF (NUINDX.GE.2) WRITE(1,1220) (PER, J=2,NUINDX)
0214          WRITE (1,1230) ((UCINDX(I,J),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
        C
        C   DOWNLINK MODIFY
        C
```

```
0227    561   WRITE (1,1210) (INDATA(J),J=1,3),(DCSCOD(NCSTEL,J),J=1,2),
             2              (DCSNAM(NCSTEL,J),J=1,20)
0228          IF (NDINDX.GE.2) WRITE(1,1220) (PER. J=2,N INDX)
0229          WRITE (1,1230) ((DCINDX(I,J),J=1,8),I=1,NDINDX)
0230          WRITE (1,1240)  (DCSDAT(NCSTEL,J,POSITN),J=1,NDINDX)
0231          WRITE(1,1280)
0232    565   WRITE (1,*) 'ENTER CHANGE - N,VALUE   OR    0,0 TO END'
0233          ASSIGN 565 TO BADD
0234    570   READ (1,*,ERR=170) K,INPUT2
0235          IF (K.LE.0) WRITE(1,1240) (DCSDAT(NCSTEL,J,POSITN),J=1,NDINDX)
0236          IF (K.LE.0) GO TO 523
0237          IF (K.LE.NDINDX) GO TO 580
0238          WRITE (1,1250) K
0239          GO TO 565
0240    580   DCSDAT(NCSTEL,K,POSITN) = INPUT2
0241          GO TO 565
              C
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C MODIFY COST ELEMENT CODE
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C
0242    620   WRITE ( 1,* ) 'ENTER NEW COST ELEMENT CODE'
0243          ASSIGN 620 TO BADD
0244          CALL RDCOST
0245          IF (POSITN.NE.0) GO TO 405
0246          MODFLG=1
0247          GO TO 416
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C MODIFY COST ELEMENT NAME
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
0248    640   WRITE ( 1,* ) 'ENTER COST ELEMENT NAME (20 CHARACTERS MAXIMUM)'
0249          ASSIGN 640 TO BADD
0250          READ (1,1010) (INDATA(I),I=1,80)
0251          CALL GETTER
0252          IF (UPPDWN.EQ.1) CALL CODCHK (20,ARG,MAXUCS,UCSNAM,POSITN)
0253          IF (UPPDWN.EQ.2) CALL CODCHK (20,ARG,MAXDCS,DCSNAM,POSITN)
0254          IF (POSITN.NE.0) GO TO 425
0255          MODFLG=1
0256          GO TO 430
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C ADD A COST ELEMENT TO A PATH
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
0257    660   MODFLG=1
0258          GO TO 480
```

```
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C REMOVE A COST ELEMENT FROM A PATH
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0259    680   WRITE ( 1,* ) 'ENTER PATH NAMES FROM WHICH THIS COST ELEMENT IS TO
             2 BE REMOVED'
0260          J = UPPDWN + 2
0261          CALL MATMOD(J,0,NCSTEL)
0262          GO TO 523
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C   DELETE COMMAND
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0263    705   WRITE ( 1,* )'ENTER COST ELEMENT CODE TO BE DELETED'
0264          CALL RDCOST
0265          IF ( ARG(1) .EQ. ';') GO TO 280
0266          IF ( POSITN .EQ. 0 ) GO TO 710
0267    706   IF ( UPPDWN .EQ. 1) WRITE(1,1260)(UCSNAM(POSITN,I),I=1,20)
0268          IF ( UPPDWN .EQ. 2) WRITE(1,1260)(DCSNAM(POSITN,I),I=1,20)
0269          CALL YESNO
        C
        C             YES  NO   ERR
0270          GO TO (708, 280, 706) YESSNO
0271    708   CALL DISAPR (UPPDWN, POSITN)
0272          IF(NELEM(UPPDWN) .GT. 0 ) GO TO 280
0273          WRITE(1,*)'**********************  WARNING  **********************'
0274          WRITE(1,*)'           ALL COST ELEMENTS HAVE BEEN DELETED'
0275          WRITE(1,*)'                      IN THIS SEGMENT'
0276          WRITE(1,*)'THE MODEL WILL NOT WORK UNLESS AN ELEMENT IS ADDED'
0277          WRITE(1,*)'************************************************************'
0278          GO TO 280
        C
        C ERROR IN COST CODE
        C
0279    710   WRITE (1,*) 'COST ELEMENT CODE DOES NOT EXIST'
0280          GO TO 280
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C LIST COST ELEMENT INFORMATION
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0281    800   WRITE ( 1,* )'ENTER LIST SPECIFICATION'
0282          N=0
0283          READ ( 1,1010 ) (INDATA(I),I=1,80)
```

```
0284    803   CALL GETTER
0285          IF (NCHAR.EQ.0) GO TO 804
0286          IF( ARG(1) .EQ. 'A' .AND. ARG(2) .EQ. 'L' .AND. ARG(3) .EQ. 'L')
             * GO TO 820
0287          IF( ARG(1) .EQ. 'P' .AND. ARG(2) .EQ. 'A' .AND. ARG(3) .EQ. 'T')
             2 GO TO 840
0288          IF( ARG(1) .EQ. 'C' .AND. ARG(2) .EQ. 'O' .AND. ARG(3) .EQ. 'S')
             2 GO TO 860
0289          IF (ARG(1).EQ.'$') GO TO 280
0290          IF (UPPDWN.EQ.1) CALL CODCHK (2,ARG,MAXUCS,UCSCOD,POSITN )
0291          IF (UPPDWN.EQ.2) CALL CODCHK (2,ARG,MAXDCS,DCSCOD,POSITN)
0292          IF ( POSITN .EQ. 0 ) GO TO 810
0293          CALL REPRTR (1,POSITN)
0294    804   IF (CONTCD.EQ.0) GO TO 800
0295          IF (CONTCD.NE.0) GO TO 803
        C
        C ERROR - INVALID RESPONSE OR CODE DOESN'T EXIST
        C
0296    810   WRITE (1,*) 'INVALID LIST OPTION'
0297          WRITE(1,*)'LIST OPTIONS ARE: ALL, COST, PATH, A COST ELEMENT CODE,
             2 OR $'
0298          GO TO 800
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C PRINT PATH MATRIX AND COST INFORMATION
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0299    820   DO 830 I = 1,NELEM(UPPDWN)
0300          CALL REPRTR (1,I)
0301    830   CONTINUE
        C
        CCCCCCCCCCCCCCCCCCCCCCCC
        C
        C PRINT PATH MATRIX ONLY
        C
        CCCCCCCCCCCCCCCCCCCCCCCC
        C
0302    840   CALL REPRTR (2,1)
0303          GO TO 280
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C PRINT COST ELEMENT CODES AND NAMES
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0304    860   CALL REPRTR(9,1)
0305          GO TO 280
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C   EXIT COMMAND
        C
```

```
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
0306  900   IF (UPPDWN.EQ.2) GO TO 950
0307        WRITE (1,*) 'DO YOU WANT TO MODIFY DOWNLINK COST DATA?'
0308        CALL YESNO
      C             YES NO  ERR
0309        GO TO (910,950,900), YESSNO
0310  910   UPPDWN = 2
0311        GO TO 100
0312  950   RETURN
      C
      C
0313  1010  FORMAT ( 80A1)
0314  1020  FORMAT (1H ,2A1,' -- ',20A1,/)
0315  1200  FORMAT (1X,6(8A1,2X))
0316  1210  FORMAT(1HO,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(1HO,'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
```

```
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PATH.FTN        /TR:BLOCKS/WR

0001          SUBROUTINE PATH
        C
        C                              PATH MODULE
        C
        C THE PATH MODULE DEFINES OR MODIFIES DATA FOR UPLINK OR DOWNLINK
        C PATHS.  PATHS ARE OPTIONS FOR TRANSMITTING THE VIDEO SIGNAL
        C THROUGH A PARTICULAR SEGMENT OF THE MODEL.  THE USER CAN ADD OR
        C DELETE PATHS, CHANGE THE COST ELEMENTS ASSOCIATED WITH ANY OF THE
        C PATHS OR SPECIFY THE CITIES FOR WHICH A PATH IS VALID.
        C
        C ARRAY VARIABLES
        C
        C UPTHCY - ARRAY OF UPLINK CITIES FOR WHICH A PATH IS FEASIBLE
        C DPTHCY -          DOWNLINK
        C
        C UPTHNM - 20 CHARACTER ARRAY OF UPLINK PATH NAMES
        C DPTHNM -                         DOWNLINK
        C
        C UPTIDX - CAPITAL, INSTALLATION, LEASE, OMA, ANNUALIZED COST FOR A
        C          GIVEN COST INDEX AND PATH - UPLINK
        C DPTIDX -                             DOWNLINK
        C
        C SCALAR VARIABLES
        C
        C NUPATH - NUMBER OF UPLINK PATHS
        C
        C NDPATH - NUMBER OF DOWNLINK PATHS
        C
        C MAXUPA - MAXIMUM NUMBER OF UPLINK PATHS
        C
        C MAXDPA - MAXIMUM NUMBER OF DOWNLINK PATHS
        C
        C SUBROUTIN CALLS: GETTER, YESNO, CODCHK, DISAPR,
        C                  REPRTR, UPDOWN, MATMOD
        C
        C CALLED BY: BUILD
        C
0002          INCLUDE 'SYO:COMBLK.FTN/NOLIST'
        C
        C LOCAL VARIABLES
        C
0040          INTEGER*2 CURENT,ORG
0041          LOGICAL*1 PTHLST(4,2), PTHCMD(8,5), PTHCMD(5,3)
0042          DATA PTHCMD /'E','A','M','D','L',
             2             'X','D','O','E','I',
             3             'I','D','D','L','S'/
0043          DATA PTHLST /'C','C','P','#',
             2             'O','I','A',' '/
0044          DATA PTHCMD /'A','D','N','A','D','N','N','E',
             2             'D','E','E','D','E','E','E','X',
             3             'D','L','W','D','L','W','W','I',
             4             'C','C','C','C','L','C','N','T',
             5             'O','O','O','I','I','I','A',' '/
        C
        C ASK IF THE USER WANTS TO ENTER PATH DATA
        C
```

```
0045    3000  WRITE (1,*)'DO YOU HAVE PATH INFORMATION TO ENTER?'
0046          CALL YESNO
        C             YES  NO   ERR
0047          GO TO (3010,3720,3000), YESSNO
        C
0048    3010  WRITE ( 1,* )'UPLINK OR DOWNLINK?'
0049          CALL UPDOWN
0050          IF(UPPDWN .EQ. 3) GO TO 3010
        C
        C PATH COMMAND PROCESSING
        C
0051    3015  WRITE ( 1,* )'ENTER PATH COMMAND'
0052          READ ( 1,4910 ) (INDATA(I),I=1,80)
0053          CALL CODCHK (3,INDATA,5,PTHCMD,POSITN)
0054          IF ( POSITN .EQ. 0 ) GO TO 3020
        C
        C BRANCH ON PATH COMMAND
        C
        C              EXIT ADD  MOD   DEL   LIST
0055          GO TO ( 3700,3100,3300, 3500, 3600), POSITN
        C
        C NO SUCH COMMAND
        C
0056    3020  WRITE (1,*) 'INVALID PATH COMMAND'
0057          WRITE ( 1,*)'VALID COMMANDS: EXIT,ADD,MOD,DEL,LIST'
0058          GO TO 3015
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C   ADD COMMAND
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C CHECK FOR TOO MANY PATHS
        C
0059    3100  IF (NPATH(UPPDWN) .LT. MAXPA(UPPDWN)) GO TO 3110
0060    3105  WRITE (1,*) 'ONLY ',MAXPA(UPPDWN),' PATHS CAN BE SPECIFIED'
0061          GO TO 3015
        C
        CCCCCCCCCCCCCCCCCCC
        C
        C REQUEST PATH NAME
        C
        CCCCCCCCCCCCCCCCCCC
        C
0062    3110  WRITE ( 1,* ) 'ENTER NEW PATH NAME'
0063          ASSIGN 3110 TO BADD
0064          READ ( 1,4910 ) ( INDATA(I),I=1,80)
0065          IF (ARG(1).EQ.'$') GO TO 3015
0066          CALL GETTER
0067          IF (UPPDWN.EQ.1) CALL CODCHK (16,ARG,MAXUPA,UPTHNM,POSITN)
0068          IF (UPPDWN.EQ.2) CALL CODCHK (16,ARG,MAXDPA,DPTHNM,POSITN)
0069          IF ( POSITN .EQ. 0 ) GO TO 3120
        C
```

```
        C DUPLICATE PATH NAME
        C
0070    3115  WRITE (1,*) 'PATH NAME ALREADY EXISTS'
0071        WRITE (1,*) 'ENTER A DIFFERENT NAME'
0072        GO TO 8ADD
        C
        C MOVE NAME TO NEW ARRAY
        C
0073    3120  NPATH(UPPDWN) = NPATH(UPPDWN) + 1
0074        DO 3125 I=1,20
0075        IF (UPPDWN.EQ.1) UPTHNM(NUPATH,I) = ARG(I)
0076        IF (UPPDWN.EQ.2) DPTHNM(NDPATH,I) = ARG(I)
0077    3125  CONTINUE
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C ADD LIST OF COST ELEMENTS WHICH COMPRISE THIS PATH
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0078    3130  WRITE (1,*) 'ENTER LIST OF COST ELEMENT CODES FOR THIS PATH'
0079        CALL MATMOD(UPPDWN,1,NPATH(UPPDWN))
        C
        C   REQUEST CITY NAMES FOR WHICH THIS PATH IS FEASIBLE
        C
0080    3145  WRITE (1,*) 'ENTER LIST OF CITY NAMES (/ORG) FOR WHICH THIS PATH
       *IS FEASIBLE'
0081        J = 6 + UPPDWN
0082        CALL MATMOD(J,1,NPATH(UPPDWN))
0083        GO TO 3015
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C   MODIFY COMMAND
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0084    3300  WRITE (1,*) 'ENTER PATH NAME YOU WANT TO MODIFY'
0085        READ (1,4910) (INDATA(I),I=1,80)
0086        CALL GETTER
0087        IF (UPPDWN.EQ.1) CALL CODCHK (NCHAR,ARG,MAXUPA,UPTHNM,POSITN)
0088        IF (UPPDWN.EQ.2) CALL CODCHK (NCHAR,ARG,MAXDPA,DPTHNM,POSITN)
0089        IF (POSITN .EQ. 0) GO TO 3310
0090        IF(POSITN .EQ. -1 .AND. UPPDWN .EQ. 1 )CALL CODCHK(20,ARG,MAXUPA,
       *UPTHNM,POSITN)
0091        IF(POSITN .EQ. -1 .AND. UPPDWN .EQ. 2 )CALL CODCHK(20,ARG,MAXDPA,
       *DPTHNM,POSITN)
0092        IF(POSITN .EQ. -1) GO TO 3315
0093        IF POSITN .EQ. 0) GO TO 3310
0094        CURENT = POSITN
0095        GO TO 3320
        C
        C ERROR - PATH DOES NOT EXIST
        C
```

```
0096    3310  WRITE (1,*) 'PATH DOES NOT EXIST'
0097          GO TO 3015
0098    3315  WRITE (1,*) 'SPECIFIED PATH NOT UNIQUE - ENTER MORE INFORMATION'
0099          GO TO 3300
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C BRANCH TO MODIFY SUBCOMMAND
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0100    3320  WRITE ( 1,* )'ENTER PATH MODIFY SUBCOMMAND'
0101          READ ( 1,4910 ) (INDATA(I),I=1,80)
0102          CALL GETTER
0103          CALL CODCHK (5,ARG, 8,PTMCMD,POSITN )
0104          IF ( POSITN .EQ. 0 )  GO TO 3335
        C
        C             ADCO,DLCO,NWCO,ADCY,DLCY,NWCY,NWNM,EXIT
0105          GO TO (3340,3360,3380,3400,3420,3440,3460,3015),POSITN
        C
        C NO SUCH COMMAND
        C
0106    3335  WRITE (1,*) 'INVALID SUBCOMMAND. VALID SUBCOMMANDS ARE...'
0107          WRITE ( 1,4920)((PTMCMD(I,J),J=1,5),I=1,8)
0108          GO TO 3320
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C ADD A COST ELEMENT TO PATH
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0109    3340  WRITE ( 1,* )'ENTER LIST OF COST ELEMENT CODES TO ADD TO PATH'
0110          CALL MATMOD(UPPDWN,1,CURENT)
0111          GO TO 3320
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C DELETE A COST ELEMENT FROM PATH
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0112    3360  WRITE (1,* )'ENTER LIST OF COST ELEMENT CODES TO DELETE FROM PATH'
0113          CALL MATMOD(UPPDWN,0,CURENT)
0114          GO TO 3320
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C REPLACE COST ELEMENTS FOR PATH
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0115    3380  DO 3390 I=1,NELEM(UPPDWN)
0116          IF (UPPDWN.EQ.1) UCSPTH(I,CURENT) = 0
0117          IF (UPPDWN.EQ.2) DCSPTH(I,CURENT) = 0
0118    3390  CONTINUE
```

```
0119          WRITE ( 1,* ) 'ENTER NEW LIST OF COST ELEMENT CODES FOR PATH'
0120          CALL MATMOD(UPPDWN,1,CURENT)
0121          GO TO 3320
              C
              CCCCCCCCCCCCCCCCCCC
              C
              C ADD A CITY TO PATH
              C
              CCCCCCCCCCCCCCCCCCC
              C
0122     3400 WRITE(1,*)'ENTER LIST OF CITY NAMES (/ORG) TO ADD THIS PATH TO '
0123          J = 6 + UPPDWN
0124          CALL MATMOD (J,1,CURENT)
0125          GO TO 3320
              C
              CCCCCCCCCCCCCCCCCCCCCCCC
              C
              C DELETE A CITY FROM PATH
              C
              CCCCCCCCCCCCCCCCCCCCCCCC
              C
0126     3420 WRITE(1,*)'ENTER LIST OF CITY NAMES (/ORG) TO DELETE FROM THIS PAT
                  2H'
0127          J = 6 + UPPDWN
0128          CALL MATMOD (J,0,CURENT)
0129          GO TO 3320
              C
              CCCCCCCCCCCCCCCCCCCCCCCC
              C
              C REPLACE CITIES FOR PATH
              C
              CCCCCCCCCCCCCCCCCCCCCCCC
              C
0130     3440 DO 3450 J=1,NCITY(UPPDWN)
0131          IF (UPPDWN.EQ.1) UPTHCY(CURENT,J) = 0
0132          IF (UPPDWN.EQ.2) DPTHCY(CURENT,J) = 0
0133     3450 CONTINUE
0134          WRITE ( 1,* )'ENTER NEW LIST OF CITIES (/ORG) FOR THIS PATH'
0135          J = 6 + UPPDWN
0136          CALL MATMOD (J,1,CURENT)
0137          GO TO 3320
              C
              CCCCCCCCCCCCCCCCCC
              C
              C REPLACE PATH NAME
              C
              CCCCCCCCCCCCCCCCCC
              C
              C
0138     3460 WRITE ( 1,* )'ENTER THE NEW NAME FOR PATH'
0139          ASSIGN 3460 TO BADD
0140          READ ( 1,4910) (INDATA(I),I=1,80)
0141          CALL GETTER
0142          IF (UPPDWN.EQ.1) CALL CODCHK (20,ARG,MAXUPA,UPTHNM,POSITN)
0143          IF (UPPDWN.EQ.2) CALL CODCHK (20,ARG,MAXDPA,DPTHNM,POSITN)
0144          IF ( POSITN .NE. 0 ) GO TO 3115
```

```
0145          DO 3465 I = 1,20
0146          IF (UPPDWN.EQ.1) UPTHNM ( CURENT,I) = ARG (I)
0147          IF (UPPDWN.EQ.2) DPTHNM ( CURENT,I) = ARG (I)
0148     3465 CONTINUE
0149          GO TO 3320
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C DELETE A PATH FROM SCENARIO
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
0150     3500 WRITE ( 1,* )'ENTER PATH NAME TO DELETE FROM SCENARIO'
0151          READ ( 1,4910 ) (INDATA(I),I=1,80)
0152          CALL GETTER
0153          IF (ARG(1).EQ.';') GO TO 3015
0154          IF (UPPDWN.EQ.1) CALL CODCHK(NCHAR,ARG,MAXUPA,UPTHNM,POSITN )
0155          IF (UPPDWN.EQ.2) CALL CODCHK(NCHAR,ARG,MAXDPA,DPTHNM,POSITN )
0156          IF(POSITN .EQ. -1 .AND. UPPDWN .EQ. 1)CALL CODCHK(20,ARG,MAXUPA,
             2UPTHNM,POSITN)
0157          IF(POSITN .EQ. -1 .AND. UPPDWN .EQ. 2)CALL CODCHK(20,ARG,MAXDPA,
             2DPTHNM,POSITN)
0158          IF(POSITN .EQ. -1) GO TO 3515
0159          IF(POSITN .EQ. 0 ) GO TO 3310
0160          J = 2 + UPPDWN
0161          CALL DISAPR (J,POSITN )
0162          IF(NPATH(UPPDWN) .GT. 0) GO TO 3015
0163          WRITE(1,*)'*****************  WARNING  **************'
0164          WRITE(1,*)'     ALL PATHS DELETED FROM THIS SECTOR'
0165          WRITE(1,*)'MODEL WILL NOT WORK UNLESS A PATH IS ADDED'
0166          WRITE(1,*)'*******************************************'
0167          GO TO 3015
0168     3515 WRITE (1,*) 'SPECIFIED PATH NOT UNIQUE - ENTER MORE INFORMATION'
0169          GO TO 3500
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C LIST PATH INFORMATION
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
0170     3600 WRITE ( 1,* )'ENTER LIST SPECIFICATION '
0171          READ ( 1, 4910 ) ( INDATA(I),I=1,80)
0172          CALL GETTER
0173          CALL CODCHK (2,ARG,4,PTHLST,POSITN )
0174          IF ( POSITN .EQ. 0 ) GO TO 3610
              C
              C             COST  CITY PATH  ;
0175          GO TO ( 3620, 3630,3640,3015) POSITN
              C
              C NO SUCH COMMAND
              C
```

```
0176    3610  WRITE (1,*) 'INVALID LIST OPTION'
0177          WRITE ( 1,*)'VALID COMMANDS:  COST, CITY, PATH'
0178          GO TO 3600
              C
              CCCCCCCCCCCCCCCCCCCCCCC
              C
              C PRINT PATH/COST MATRIX
              C
              CCCCCCCCCCCCCCCCCCCCCCC
              C
0179    3620  CALL REPRTR (2,1)
0180          GO TO 3015
              C
              CCCCCCCCCCCCCCCCCCCCCCC
              C
              C PRINT PATH/CITY MATRIX
              C
              CCCCCCCCCCCCCCCCCCCCCCC
              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
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C EXIT FROM PATH MODULE
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              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), YESSNO
0189    3710  UPPDWN = 2
0190          GO TO 3015
0191    3720  RETURN
0192    4910  FORMAT (80A1)
0193    4920  FORMAT(1X,'COMMANDS: ',8(1X,5A1))
0194          END
```

```
        C                                   CITY MODULE
0001          SUBROUTINE CITY
        C
        C THE CITY MODULE IS USED TO DEFINE OR MODIFY THE CHARACTERISTICS
        C OF THE CITIES WHICH COMPRISE THE NETWORK UNDER CONSIDERATION.
        C THE USER CAN ADD, MODIFY OR DELETE CITIES FROM THE NETWORK
        C AND ASSOCIATE PATHS WITH CITIES. CITY DATA INCLUDES NAME (AND
        C MEMBER ORGANIZATION IF APPLICABLE), STATE, LOCATION (LATITUDE/
        C LONGITUDE OR BELL SYSTEM V AND H COORDINATES), CHANNEL NUMBER
        C (FOR UPLINK CITIES), HIERARCHICAL LEVEL (FOR DOWNLINK CITIES),
        C COST INDEX VALUES, AND FEASIBLE PATHS.
        C
        C ARRAY VARIABLES
        C
        C UCTXVL - VALUES ASSOCIATED WITH UPLINK COST INDEXES
        C DCTXVL -                              DOWNLINK
        C
        C UCTNAM - ARRAY OF UPLINK CITY NAMES - 16 CHARACTERS EACH
        C DCTNAM -           DOWNLINK
        C
        C USTCOD - ARRAY OF 2 CHARACTER STATE CODES CORRESPONDING TO UPLINK
        C          CITIES
        C DSTCOD -                                                    DOWNLINK
        C
        C UCITYV - VERTICAL COORDINATES FOR UPLINK CITIES
        C DCITYV -                                DOWNLINK
        C
        C
        C UCITYH - HORIZONTAL COORDINATES FOR UPLINK CITIES
        C DCITYH -                                  DOWNLINK
        C
        C DCTLVL - THE HEIRARCHICAL LEVEL OF EACH DOWNLINK CITY
        C
        C UCTCHN - THE CHANNEL ASSIGNED TO EACH UPLINK CITY
        C
        C TALKBK - THE HOURS OF TALKBACK NEEDED FROM EACH DOWNLINK CITY
        C          TO THE ORIGINATING CITY
        C
        C SCALAR VARIABLES
        C
        C NUCITY - NUMBER OF UPLINK CITIES
        C
        C NDCITY - NUMBER OF DOWNLINK CITIES
        C
        C LATLON - FLAG TO TELL THE PROGRAM WHEN V AND H COORDINATES ARE
        C          INPUT IN TERMS OF LATITUDE AND LONGITUDE
        C
        C SUBROUTINE CALLS: GETTER, YESNO,  CODCHK, DISAPR, REPRTR,
        C                   UPDOWN, MATMOD, CTYCHK, VANDH
        C
        C CALLED BY: BUILD
        C
0002          INCLUDE 'SYO:COMBLK.FTN/NOLIST'
        C
        C LOCAL VARIABLES
        C
```

```
0040          LOGICAL*1 MODFLG,BYPASS,CTYCMD(6,3),CTLSTS(8,4),MODSUB(10,4),
             2          BLANK
0041          INTEGER*2 ORGNUM,CURENT,LAT,LON
0042          REAL*4 UD
0043          DATA CTYCMD/'A','O','M','D','L','E',
             *            'D','V','O','E','I','X',
             *            'D','E','D','L','S','I'/
0044          DATA CTLSTS/'I','P','P','T','O','A','C',' ',
             *            'N','A','N','A','R','L','I',' ',
             *            'D','T','A','L','G','L','T',' ',
             *            'E','H','M','K','S',' ','Y',' '/
0045          DATA MODSUB /'V','C','C','I','A','D','C','C','T','E',
             2             'A','H','H','N','D','E','H','H','A','X',
             3             'N','A','L','D','D','L','G','G','L','I',
             4             'D','N','V','E','P','P','P','N','K','T'/
0046          DATA BLANK/' '/
      C
0047    6000  WRITE ( 1,* )'DO YOU HAVE CITY INFORMATION TO ENTER?'
0048          CALL YESNO
      C               YES   NO    ERR
0049          GO TO ( 6010, 6980, 6000 ) YESSNO
0050    6010  WRITE ( 1,* )'UPLINK OR DOWNLINK?'
0051          CALL UPDOWN
0052          IF ( UPPDWN .EQ. 3 ) GO TO 6010
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
      C  CITY PROCESSING
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
0053    6015  WRITE ( 1,* )'ENTER CITY COMMAND'
0054          READ ( 1,7990) (INDATA(I),I=1,80)
0055          CALL GETTER
0056          BYPASS = 0
0057          CALL CODCHK ( 3,ARG, 6, CTYCMD,POSITN )
0058          IF ( POSITN .EQ. 0 ) GO TO 6020
      C
      C BRANCH ON UPLINK CITY COMMAND
      C
      C             ADD   OVER  MOD   DEL   LIST   EXIT
0059          GO TO (6100, 6050, 6300, 6700, 6800, 6900 ) POSITN
      C
      C ERROR IN RESPONSE
      C
0060    6020  WRITE (1,*) 'INVALID CITY COMMAND'
0061          WRITE (1,*)'VALID COMMANDS ARE: ADD,OVER,MOD,DEL,LIST,EXIT'
0062          GO TO 6015
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
      C ADD OR OVERLAY COMMANDS
      C
```

```
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        CCCCCCCCCCCCCCCCC
        C
        C OVERLAY CITIES
        C
        CCCCCCCCCCCCCCCCC
        C
0063    6050  BYPASS = 1
0064          IF ( NUMORG .GT. 0 ) GO TO 6100
        C
        C NO COST ALLOCATION - INVALID COMMAND IN THIS CASE
        C
0065          WRITE (1,*)'INVALID COMMAND UNLESS COST ALLOCATION IS USED'
0066          BYPASS = 0
0067          GO TO 6015
0068    6100  WRITE ( 1,*)'ENTER CITY NAME (/ORG)'
0069          ASSIGN 6100 TO BADD
0070          READ ( 1,7990) (INDATA(I),I=1,80)
0071          MODFLG = 0
0072          CALL GETTER
0073          IF(ARG(1) .EQ. ';') GO TO 6015
0074          CALL CTYCHK ( POSITN,ORGNUM )
        C
        C POSITN < 0                    - ERROR - START OVER
        C
        C POSITN = 0 AND ORGNUM = 0     - ERROR UNLESS NO COST ALLOCATION - NO CITY
        C                                  MATCH AND NO ORGANIZAION MATCH
        C
        C POSITN > 0 AND ORGNUM = 0     - CITY MATCH AND ORG MATCH
        C                                 THIS SITUATION IS ONLY VALID FOR
        C                                 MODIFY OR DELETE
        C
        C POSITN > 0 AND ORGNUM > 0     - EXISTING CITY AND NEW ORGANIZATION
        C                                 VALID FOR OVERLAY ONLY
        C
        C POSITN = 0 AND ORGNUM > 0     - NEW CITY AND NEW ORGANIZATION
        C                                 VALID FOR ADD ONLY
        C
        C ERROR - RETURNED NEGATIVE POSITN
        C
0075          IF ( POSITN .LT. 0 ) GO TO BADD
        C
        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
        C NOT VALID FOR ADD OR OVERLAY
        C
        C
0077          IF ( POSITN .GT. 0  .AND.  ORGNUM .EQ. 0 ) GO TO 6322
        C
        C OVERLAY
```

```
C
0078          IF ( BYPASS .EQ. 1  .AND.
     2        POSITN .GT. 0  .AND.
     3        ORGNUM .GT. 0 )      GO TO 6102
C
C ADD
C
C
0079          IF ( BYPASS .NE. 1  .AND.
     2        POSITN .EQ. 0  .AND.
     3        ORGNUM .GT. 0  .AND.
     4        NUMORG .GT. 0 ) GO TO 6102
C
0080          IF ( POSITN .EQ. 0 ) GO TO 6315
0081          IF(POSITN .GT. 0) GO TO 6322
C
C
C
0082     6101 WRITE (1,*)'INVALID RESPONSE - PLEASE RE-ENTER'
0083          GO TO 6015
C
0084     6102 IF ( NCITY(UPPDWN) .LT. MAXCT(UPPDWN)) GO TO 6103
0085          WRITE (1,*) 'ONLY ',MAXCT(UPPDWN),' CITIES CAN BE SPECIFIED'
0086          GO TO 6015
C
0087     6103 NCITY(UPPDWN) = NCITY(UPPDWN) + 1
0088          UD = 'DOWN'
0089          IF ( UPPDWN .EQ. 1 ) UD = '  UP'
0090          IF ( NCITY(UPPDWN) .EQ. MAXCT(UPPDWN)) WRITE (1,7992) UD
0091     7992 FORMAT (1X,'THIS IS THE LAST CITY YOU MAY ADD TO ',A4,'LINK')
0092          IF ( UPPDWN .EQ. 1 ) GO TO 6104
0093          CURENT = NCITY(UPPDWN)
0094          IF(NUMORG .GT. 0 ) DCTORG(CURENT) = ORGNUM
0095          GO TO 6105
0096     6104 CURENT = NCITY(UPPDWN)
0097          IF ( NUMORG .GT. 0 ) UCTORG(CURENT) = ORGNUM
0098     6105 DO 6106 I=1,NCHAR
0099               IF ( UPPDWN .EQ. 1 ) UCTNAM(CURENT,I) = ARG(I)
0100               IF ( UPPDWN .EQ. 2 ) DCTNAM(CURENT,I) = ARG(I)
0101     6106 CONTINUE
0102          IF ( NCHAR .GE. 16 ) GO TO 6110
0103          NCHAR = NCHAR + 1
0104          DO 6107 I=NCHAR,16
0105               IF ( UPPDWN .EQ. 1 ) UCTNAM(CURENT,I) = BLANK
0106               IF ( UPPDWN .EQ. 2 ) DCTNAM(CURENT,I) = BLANK
0107     6107 CONTINUE
0108     6110 IF ( BYPASS .EQ. 1 ) GO TO 6175
C
CCCCCCCCCCCCCCCC
C
C ADD STATE CODE
C
CCCCCCCCCCCCCCCC
C
0109     6115 WRITE ( 1,* )'ENTER THE 2 CHARACTER STATE CODE FOR THIS CITY'
0110          READ ( 1,7990) (INDATA(I),I=1,2)
```

```
0110          DO 6120 I=1,2
0111             IF (UPPDWN.EQ.1) USTCOD(CURENT,I)=INDATA(I)
0112             IF (UPPDWN.EQ.2) DSTCOD(CURENT,I)=INDATA(I)
0113     6120  CONTINUE
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C ENTER V AND H COORDINATES
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCC
              C
0114     6130  WRITE (1,*) 'ENTER V COORDINATE OR LATITUDE (-DDMM) FOR THIS CITY'
0115           ASSIGN 6130 TO BADD
0116           READ ( 1,*,ERR=7000) LON
0117           IF ( LON .LT. 0 ) GO TO 6135
0118           IF ( LON .GT. 15000 ) GO TO 7100
0119           IF (UPPDWN.EQ.1) UCITYV(CURENT)=LON
0120           IF (UPPDWN.EQ.2) DCITYV(CURENT)=LON
0121           GO TO 6160
              C
              C V COORDINATE INPUT AS LATITUDE
              C
0122     6135  LAT = LON
0123           LATLON = 1
              C
              C ENTER H COORDINATE AS LONGITUDE
              C
0124     6145  WRITE ( 1,* )'ENTER THE POSITIVE LONGITUDE (DDDMM) FOR THIS CITY'
0125           ASSIGN 6145 TO BADD
0126           READ ( 1,*,ERR=7000) LON
0127           IF ( LON .LT. 0 ) GO TO 7100
0128           CALL VANDH(LAT,LON)
0129           IF ( UPPDWN .EQ. 2 ) GO TO 6150
0130           UCITYV(CURENT) = LAT
0131           UCITYH(CURENT) = LON
0132           GO TO 6155
0133     6150  DCITYV(CURENT) = LAT
0134           DCITYH(CURENT) = LON
0135     6155  IF ( MODFLG .EQ. 1 ) GO TO 6525
0136           GO TO 6180
              C
              C ENTER HORIZONTAL COORDINATE
              C
0137     6160  WRITE ( 1,* )'ENTER HORIZONTAL COORDINATE FOR THIS CITY'
0138           ASSIGN 6160 TO BADD
0139           READ ( 1,*,ERR=7000) LON
0140           IF ( LON .GT. 15000 .OR. LON .LT. 0 ) GO TO 7100
0141           IF (UPPDWN.EQ.1) UCITYH(CURENT)=LON
0142           IF (UPPDWN.EQ.2) DCITYH(CURENT)=LON
0143     6170  IF ( MODFLG .EQ. 1 ) GO TO 6525
0144           GO TO 6180
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C OVERLAY COMMAND WITH EXISTING CITY
              C
```

```
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C
        C SET STATE, V AND H, AND ORGANIZATION FROM PREVIOUS CITY DEFINITION
        C
0145    6175  IF ( UPPDWN .EQ. 2 ) GO TO 6177
0146          UCTORG(CURENT) =ORGNUM
0147          USTCOD(CURENT,1) = USTCOD(POSITN,1)
0148          USTCOD(CURENT,2) = USTCOD(POSITN,2)
0149          UCITYV(CURENT) = UCITYV(POSITN)
0150          UCITYH(CURENT) = UCITYH(POSITN)
0151          GO TO 6180
0152    6177  DCTORG(CURENT) = ORGNUM
0153          DSTCOD(CURENT,1) = DSTCOD(POSITN,1)
0154          DSTCOD(CURENT,2) = DSTCOD(POSITN,2)
0155          DCITYV(CURENT) = DCITYV(POSITN)
0156          DCITYH(CURENT) = DCITYH(POSITN)
        C
        CCCCCCCCCCCCCCCCCCCCCCC
        C
        C ENTER CHANNEL NUMBER
        C
        CCCCCCCCCCCCCCCCCCCCCCC
        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(CURENT) = LON
        C
0163          IF ( MODFLG .EQ. 1 ) GO TO 6525
0164          GO TO 6195
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C ENTER HIERARCHICAL LEVEL
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCC
        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          DCTLVL(CURENT) = LON
0170          IF ( MODFLG .EQ. 1 ) GO TO 6525
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C ENTER VALUES FOR COST INDEXES
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0171    6195  IF ( UPPDWN .EQ. 2 ) GO TO 6205
0172          IF(NUINDX .EQ. 1 ) GO TO 6213
0173          DO 6200 I=2,NUINDX
```

```
0174    6196  WRITE (1,*) 'ENTER THE VALUE FOR NUMBER OF...'
0175          ASSIGN 6196 TO BADD
0176          WRITE (1,6197) (UCINDX(I,J),J=1,8)
0177    6197  FORMAT (2X,8A1)
0178          READ (1,*,ERR=7000) UCTXVL(CURENT,I-1)
      C
0179    6200  CONTINUE
0180          GO TO 6213
      C
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(I,J),J=1,8)
0186             READ (1,*,ERR=7000) DCTXVL(CURENT,I-1)
0187    6212  CONTINUE
      C
0188    6213  IF ( MODFLG .EQ. 1 ) GO TO 6525
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
      C ENTER LIST OF PATHS FEASIBLE FOR THIS CITY
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
0189    6215  WRITE ( 1,* ) 'ENTER LIST OF PATH NAMES FEASIBLE FOR THIS CITY'
0190          J = UPPDWN +4
0191          CALL MATMOD ( J,1, CURENT)
0192          IF ( MODFLG .EQ. 1 ) GO TO 6525
0193    6225  IF(UPPDWN .EQ. 1) GO TO 6015
      C
      CCCCCCCCCCCCCCCCCCCCCC
      C
      C ENTER TALKBACK HOURS
      C
      CCCCCCCCCCCCCCCCCCCCCC
      C
0194          DO 6240 I=1,NUCITY
0195    6235  WRITE (1,6236) (UCTNAM(I,J),J=1,16),UCTORG(I)
0196    6236  FORMAT (1X,'ENTER TALKBACK HOURS TO: ',16A1,'/',I1)
0197          ASSIGN 6235 TO BADD
0198          READ(1,*,ERR=7000)TALKBK(CURENT,I)
0199    6240  CONTINUE
0200          GO TO 6015
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
      C MODIFY PARAMETERS FOR CITY
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
0201    6300  WRITE ( 1,* )'ENTER NAME OF CITY (/ORG) TO MODIFY'
0202          ASSIGN 6015 TO BADD
0203          READ ( 1,7990) (INDATA(I),I=1,80)
```

```
0204          CALL GETTER
0205          IF ( ARG(1) .EQ. '$' ) GO TO 6015
0206          CALL CTYCHK ( POSITN,ORGNUM )
0207          IF ( POSITN .GT. 0 .AND. ORGNUM .EQ. 0 ) GO TO 6325
0208          IF(POSITN .GT. 0 ) GO TO 6320
        C
0209          IF ( POSITN .LT. 0 ) GO TO 6300
0210    6305  IF ( ORGNUM .GT. 0 ) GO TO 6320
        C
        C CHECK FOR EXISTANCE OF CITY/ORGANIZATION COMBINATION
        C
        C CITY DOES NOT EXIST
        C
0211    6315  WRITE (1,*) 'CITY DOES NOT EXIST'
0212          GO TO 6015
        C
        C CITY/ORGANIZATION COMBO DOES NOT EXIST
        C
0213    6320  WRITE (1,*) 'CITY/ORG COMBINATION DOES NOT EXIST'
0214          GO TO 6015
        C
        C
0215    6322  WRITE ( 1,*)'CITY AND ORG COMBINATION ALREADY EXIST'
0216          GO TO 6015
        C
        CCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C ENTER MODIFY SUBCOMMAND
        C
        CCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C
0217    6325  CURENT = POSITN
0218    6327  WRITE ( 1,* ) 'ENTER CITY MODIFY SUBCOMMAND'
0219          MODFLG = 0
0220          READ ( 1,7990) (INDATA(I),I=1,80)
0221          CALL GETTER
0222          CALL CODCHK ( 4,ARG,10,MODSUB,POSITN)
0223          IF ( POSITN .EQ. 0 ) GO TO 6330
        C
        C BRANCH ON MODIFY SUBCOMMAND
        C
0224          MODFLG=1
        C               VAND CHAN CHLV INDE ADDP DELP CHGP CHGN TALK EXIT
0225          GO TO ( 6130,6380,6390,6195,6215,6330,6600,6625,6630,6015) POSITN
        C
        C NO SUCH MODIFY COMMAND
        C
0226    6330  WRITE (1,*) 'INVALID SUBCOMMAND'
0227          WRITE(1,*)'COMMANDS ARE: VAND,CHAN,CHLV,INDE,ADDP,DELP,CHGP,TALK,E
              2XIT'
0228          GO TO 6327
        C
        CCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C CHANGE CHANNEL ASSIGNMENT
```

```
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0229    6380  IF ( UPPDWN .NE. 2 ) GO TO 6180
0230          WRITE (1,*)'THIS COMMAND VALID ONLY FOR UPLINK CITIES'
0231          GO TO 6327
        C
        CCCCCCCCCCCCC
        C
        C CHANGE LEVEL
        C
        CCCCCCCCCCCCCC
        C
0232    6390  IF ( UPPDWN .NE. 1 ) GO TO 6185
0233          WRITE (1,*)'THIS COMMAND VALID ONLY FOR DOWNLINK CITIES'
0234          GO TO 6327
        C
        C
        C FINISHED WITH MODIFY - RESET FLAG AND ASK FOR ANOTHER COMMAND
        C
0235    6525  MODFLG=0
0236          GO TO 6327
        C
        CCCCCCCCCCCCCCC
        C
        C DELETE A PATH
        C
        CCCCCCCCCCCCCCC
        C
0237    6550  WRITE ( 1,* )'ENTER LIST OF PATH NAMES TO DELETE FROM THIS CITY'
0238          J=UPPDWN + 4
0239          CALL MATMOD ( J,0,CURENT )
0240          GO TO 6327
        C
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C CHANGE PATHS ( REPLACE PATHS )
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C
0241    6600  DO 6610 I = 1, NUPATH
0242    6610      UPTHCY ( I, CURENT ) = 0
0243          WRITE (1,* )'ENTER A NEW LIST OF PATH NAMES FOR THIS CITY'
0244          J=UPPDWN + 4
0245          CALL MATMOD ( J,1,CURENT)
0246          MODFLG = 1
0247          GO TO 6327
        C
        CCCCCCCCCCCCCCCCC
        C
        C CHANGE CITY NAME
        C
        CCCCCCCCCCCCCCCCC
        C
```

```
      6625  WRITE ( 1,*)'ENTER NEW NAME FOR THIS CITY'
            ASSIGN 6625 TO BADD
            READ (1,7990)(INDATA(I),I=1,80)
            CALL GETTER
            IF ( UPPDWN .EQ. 1)CALL CODCHK(NCHAR,ARG,MAXUCT,UCTNAM,POSITN)
            IF(UPPDWN .EQ. 2 ) CALL CODCHK(NCHAR,ARG,MAXDCT,DCTNAM,POSITN)
            IF ( POSITN .GT.0) GO TO 6322
            IF ( UPPDWN .EQ. 2) GO TO 6628
            DO 6627 I=1,NCHAR
      6627  UCTNAM(CURENT,I) = ARG(I)
            GO TO 6630
      6628  DO 6629 I=1,NCHAR
      6629  DCTNAM(CURENT,I) = ARG(I)
      6630  IF ( NCHAR .GE. 16 ) GO TO 6640
            NCHAR=NCHAR+1
            DO 6640 I=NCHAR,16
               IF (UPPDWN.EQ.1) UCTNAM(CURENT,I)=BLANK
               IF (UPPDWN.EQ.2) DCTNAM(CURENT,I)=BLANK
      6640  CONTINUE
            GO TO 6327
      C
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
      C CHANGE TALKBACK PARAMETERS
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
      C
      6650  IF ( UPPDWN .EQ. 1 ) GO TO 6390
      6651  WRITE ( 1,*)'ENTER UPLINK CITY NAME (/ORG)'
            ASSIGN 6651 TO BADD
            READ ( 1,7990) (INDATA(I),I=1,80)
            CALL GETTER
            IF ( ARG(1) .EQ. '!' ) GO TO 6327
      C
      C UPPDWN MUST BE 1 TO CHECK UPLINK CITIES
      C
            UPPDWN = 1
            CALL CTYCHK(POSITN,ORGNUM)
            UPPDWN=2
            IF(POSITN .LT. 0 ) GO TO 6651
            IF (POSITN .EQ. 0 ) GO TO 6315
            IF ( POSITN .GT. 0 .AND. ORGNUM .EQ. 0 ) GO TO 6652
            GO TO 6320
      6652  TALKBK(POSITN,CURENT) = 0
      6653  WRITE ( 1,* )'ENTER TALKBACK HOURS'
            ASSIGN 6653 TO BADD
            READ ( 1,*,ERR=7000) XLON
            IF(XLON .LT. 0 .OR. XLON .GT. 9999.9) GO TO 7100
            TALKBK(CURENT,POSITN ) = XLON
            GO TO 6327
      C
      C NO SUCH CITY
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
```

```
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C DELETE A CITY FROM THE SCENARIO
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0288    6700  WRITE ( 1,* ) '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(ARG(1) .EQ. '$') GO TO 6015
0293        CALL CTYCHK ( 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 DISAPR ( J,POSITN )
0301        IF (UPPDWN.EQ.1.AND.NUCITY.EQ.0.OR.UPPDWN.EQ.2.AND.NDCITY.EQ.0)
           2    GO TO 6806
0302        GO TO 6015
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C LIST INFORMATION PERTAINING TO CITY
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        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,*)'ENTER CITY LIST SPECIFICATION'
0305        READ ( 1,7990) (INDATA(I),I=1,80)
0306        CALL GETTER
0307        CALL CODCHK(4,ARG,8,CTLSTS,POSITN)
0308        IF ( POSITN .EQ. 0) GO TO 6805
        C
        C             INDE  PATH  PNAM  TALK  ORGS  ALL   CITY   ;
0309        GO TO ( 6810, 6830, 6840, 6850, 6860, 6870, 6865, 6015) POSITN
        C
        C NO SUCH COMMAND
        C
0310    6805  WRITE (1,*) 'INVALID LIST OPTION'
0311        WRITE(1,*)'VALID COMMANDS: INDE, PATH, PNAM, TALK, ORGS, ALL, CITY
           2'
0312        GO TO 6800
        C
0313    6806  WRITE (1,*) 'ALL CITIES HAVE BEEN DELETED'
0314        GO TO 6015
        CCCCCCCCC
        C
        C INDEXES
        C
```

```
        CCCCCCCCC
        C
0315    6810      CALL REPRTR ( 5, 1 )
0316          GO TO 6015
        C
        CCCCCCC
        C
        C PATHS
        C
        CCCCCCC
        C
0317    6830  CALL REPRTR (4,1)
0318          GO TO 6015
        C
0319    6840  CALL REPRTR (3,1)
0320          GO TO 6015
        C
        CCCCCCCCCC
        C
        C TALKBACK
        C
        CCCCCCCCCC
        C
0321    6850  CALL REPRTR(6,1)
0322          GO TO 6015
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C ORGANIZATION NAMES AND NUMBERS
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0323    6860  CALL REPRTR ( 7,1)
0324          GO TO 6015
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C PRINT CITY NAMES, ORGANIZATIONS, AND STATES
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0325    6865  CALL REPRTR(10,1)
0326          GO TO 6015
        C
        CCCCCCCCCCCCCCCCCC
        C
        C ALL OF THE ABOVE
        C
        CCCCCCCCCCCCCCCCCC
        C
0327    6870  CALL REPRTR ( 5,1 )
0328          CALL REPRTR ( 4,1 )
0329          CALL REPRTR ( 6,1 )
0330          CALL REPRTR ( 7,1 )
0331          CALL REPRTR ( 10,1 )
0332          GO TO 6015
```

```
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C EXIT FROM CITY
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0333    6900  IF(UPPDWN .EQ. 2 ) GO TO 6980
0334          WRITE (1,*)'DO YOU WANT TO MODIFY DOWNLINK CITY DATA?'
0335          CALL YESNO
        C
        C               YES   NO    ERR
0336          GO TO ( 6910, 6980, 6900) YESSNO
0337    6910  UPPDWN = 2
0338          GO TO 6015
0339    6980  RETURN
0340    7000  WRITE (1,*) 'ERROR IN NUMERICAL READ -- PLEASE RETYPE'
0341          GO TO BADD
0342    7100  WRITE (1,*) 'SPECIFIED VALUE IS OUT OF RANGE:',LON
0343          GO TO BADD
0344    7990  FORMAT ( 80A1)
0345    7991  FORMAT(1X,'COMMANDS: ',12(1X,4A1))
0346          END
```

```
FORTRAN IV-PLUS V02-51C          13:06:14     10-JUN-80          PAGE 1
RATE.FTN        /TR:BLOCKS/WR

0001            SUBROUTINE RATE
                C
                C                              RATE MODULE
                C
                C THE RATE MODULE IS FOR THE PURPOSE OF ADDING OR MODIFYING
                C TELEPHONE CHARGES, INTEREST RATES, OR GENERAL AND ADMINISTRATIVE
                C COSTS.  THE INTEREST AND G AND A RATES PERTAIN TO THE NETWORK(S)
                C AS A WHOLE AND THUS ARE NOT DIVIDED BETWEEN UPLINK AND DOWNLINK.
                C
                C VARIABLES
                C
                C DDDCPH - DIRECT DIAL COST PER HOUR
                C
                C DDDINS - DIRECT DIAL INSTALLATION COST
                C
                C DDDLES - DIRECT DIAL LEASE COST PER MONTH
                C
                C DISCNT - DISCOUNT RATE FOR AMORTIZATION
                C
                C EQPLIF - NUMBER OF YEARS OF EQUIPMENT LIFE (FOR AMORTIZING
                C          CAPITAL EXPENDITURES)
                C
                C GANDAD - ARRAY OF THE FOUR COSTS FOR GENERAL AND
                C          ADMINISTRATIVE COSTS FOR CAPITAL, LEASE, INSTALLATION
                C          AND OPERATIONS AND MAINTENANCE
                C
                C PVTLES - PRIVATE LINE MONTHLY LEASE CHARGE FOR A
                C          GIVEN CITY PAIR IN TALKBACK SEGMENT
                C
                C PVTFIX - PRIVATE LINE ZERO MILEAGE MONTHLY CHARGE
                C
                C PVTINS - PRIVATE LINE INSTALLATION CHARGE
                C
                C PVTMIL - PRIVATE LINE MONTHLY LEASE CHARGE PER MILE
                C
                C TLKCAP - ADDED CAPITAL EXPENDITURES REQUIRED FOR ADDING VOICE
                C          TALKBACK
                C
                C WATINS - WATS INSTALLATION CHARGE
                C
                C WATCPH - WATS CHARGE PER HOUR OF UTILIZATION
                C
                C WATLES - WATS LEASE CHARGE PER MONTH
                C
                C WATMAX - MAXIMUM MONTHLY CHARGE FOR WATS
                C
                C SUBROUTINE CALLS: GETTER, CODCHK, YESNO, RATECK, REPRTR
                C
                C CALLED BY: BUILD
                C
0002                INCLUDE 'SYO:COMBLK.FTN/NOLIST'
                C
                C LOCAL VARIABLES
                C
0040                LOGICAL*1 RATECD(8,4)
0041                INTEGER*2 XDAT
```

```
0042          DATA RATECD/'P','W','D','I','G','T','L','E',
             2            'R','A','D','N','A','A','I','X',
             3            'I','T','D','T',' ','L','S','I',
             4            'V','S',' ',' ',' ','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 ) YESSNO
0046     8010  WRITE ( 1,* )'ENTER RATE COMMAND'
0047          READ ( 1,8990) (INDATA(I),I=1,80)
0048          CALL GETTER
0049          CALL CODCHK (4,ARG,8,RATECD,POSITN)
0050          IF ( POSITN .EQ. 0 ) GO TO 8015
      C
      C BRANCH ON RATE COMMAND
      C
      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
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
      C MODIFY PRIVATE LINE COSTS
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
0055     8100  WRITE ( 1,* )'PRIVATE LINE CHARGES'
0056          WRITE ( 1,* )'  INSTALLATION   ZERO CHG/MO   CHG/MILE/MO'
0057          WRITE ( 1,8991) PVTINS,PVTFIX,PVTMIL
0058          WRITE ( 1,* )'N=     1              2              3'
0059     8105  WRITE ( 1,* )'ENTER CHANGE :  N,VALUE  OR 0,0 TO END'
0060          ASSIGN 8105 TO BADD
0061          READ ( 1,* ,ERR=8115) XDAT, XDATA(2)
0062          IF ( XDAT .EQ. 0  .AND. XDATA(2) .EQ. 0 ) GO TO 8010
0063          CALL RATECK ( 1,3,XDAT )
0064          IF (POSITN .EQ. 0 ) GO TO 8105
      C
      C               INS   FIX   MIL
0065          GO TO ( 8120, 8140, 8160 ) XDAT
      C
      C ERROR IN RESPONSE
      C
0066     8115  WRITE (1,*)'ERROR IN NUMERICAL READ - PLEASE RETYPE'
0067          GO TO BADD
0068     8120  PVTINS=XDATA(2)
0069          GO TO 8105
0070     8140  PVTFIX=XDATA(2)
0071          GO TO 8105
0072     8160  PVTMIL=XDATA(2)
```

```
0073          GO TO 8105
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C MODIFY WATS CHARGES
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
0074     8200 WRITE ( 1,* )'WATS CHARGES'
0075          WRITE ( 1,* )'  INSTALLATION  ZERO CHG/MO     CHG/HR       MAX CHG'
0076          WRITE ( 1,8992) WATINS,WATLES,WATCPH,WATMAX
0077          WRITE ( 1,* )'N=      1              2              3            4'
0078     8205 WRITE ( 1,* )'ENTER CHANGE:  N,VALUE  OR 0,0 TO END'
0079          ASSIGN 8205 TO BADD
0080          READ ( 1,* ,ERR=8115) XDAT, XDATA(2)
0081          IF ( XDAT .EQ. 0  .AND. XDATA(2) .EQ. 0 ) GO  TO 8010
0082          CALL RATECK ( 1,4, XDAT )
0083          IF ( POSITN .EQ. 0 ) GO TO 8205
              C
              C              INS   LES   CPH   MAX
0084          GO TO( 8220, 8240, 8260, 8280 ) XDAT
              C
0085     8220 WATINS=XDATA(2)
0086          GO TO 8205
0087     8240 WATLES=XDATA(2)
0088          GO TO 8205
0089     8260 WATCPH=XDATA(2)
0090          GO TO 8205
0091     8280 WATMAX=XDATA(2)
0092          GO TO 8205
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
              C MODIFY DIRECT DIAL CHARGES
              C
              CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
              C
0093     8300 WRITE ( 1,* )'DIRECT DIAL CHARGES'
0094          WRITE ( 1,* )'  INSTALLATION   PER MINUTE    ZERO CHG/MO'
0095          WRITE (1,8991) DDDINS, DDDCPM, DDDLES
0096          WRITE ( 1,* )'N=        1             2             3'
0097     8305 WRITE ( 1,* )'ENTER CHANGE:   N,VALUE  OR  0,0 TO END'
0098          ASSIGN 8305 TO BADD
0099          READ ( 1,*,ERR=8115) XDAT, XDATA(2)
0100          IF ( XDAT .EQ. 0  .AND.  XDATA(2) .EQ. 0 ) GO TO 8010
0101          CALL RATECK ( 1,3,XDAT)
0102          IF ( POSITN .EQ. 0 ) GO TO 8305
              C
              C             DDINS DDCPM DDLES
0103          GO TO ( 8320, 8340, 8360 ) XDAT
              C
0104     8320 DDDINS=XDATA(2)
0105          GO TO 8305
0106     8340 DDDCPM=XDATA(2)
0107          GO TO 8305
0108     8360 DDDLES=XDATA(2)
```

```
0109          GO TO 8305
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C MODIFY INTEREST INFORMATION
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0110    8400  WRITE ( 1,* )'INTEREST RATES'
0111          WRITE ( 1,* )'  EQUIPMENT LIFE (YEARS)     DISCOUNT (%)'
0112          WRITE ( 1,8993) EQPLIF,DISCNT
0113          WRITE ( 1,* )'N=         1                        2'
0114    8405  WRITE ( 1,* )'ENTER CHANGE:  N,VALUE  OR 0,0 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              EQUIP  DISCNT
0120          GO TO ( 8420, 8430 ) XDAT
        C
0121    8420  EQPLIF=XDATA(2)
0122          GO TO 8405
0123    8430  DISCNT=XDATA(2)
0124          GO TO 8405
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C MODIFY GENERAL AND ADMINISTRATIVE EXPENSES
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0125    8500  WRITE ( 1,* )'GENERAL AND ADMINISTRATIVE EXPENSES'
0126          WRITE (1,*)'  CAPITAL      INSTALLATION     LEASE       OP AND MAIN
             2T'
0127          WRITE ( 1,8992) (GANDAD(I),I=1,4)
0128          WRITE (1,*)'N=   1              2             3              4'
0129    8505  WRITE ( 1,* )'ENTER CHANGE:   N,VALUE  OR 0,0 TO END'
0130          ASSIGN 8505 TO BADD
0131          READ ( 1,*,ERR=8115) XDAT, XDATA(2)
0132          IF ( XDAT .EQ. 0  .AND.  XDATA(2) .EQ. 0 ) GO TO 8010
0133          CALL RATECK ( 1,4,XDAT)
0134          IF ( POSITN .EQ. 0 ) GO TO BADD
        C
0135          GANDAD(XDAT)=XDATA(2)
0136          GO TO 8505
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C MODIFY TALKBACK CAPITAL EXPENDITURES
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0137    8600  WRITE ( 1,* )'TALKBACK CAPITAL COSTS'
0138          WRITE ( 1,8994) TLKCAP
```

```
0139     8605  WRITE ( 1,* )'ENTER NEW VALUE'
0140           ASSIGN 8605 TO BADD
0141           READ ( 1,*,ERR=8115)TLKCAP
0142           GO TO 8010
         C
         CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
         C
         C LIST RATE INFORMATION
         C
         CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
         C
0143     8700  CALL REPRTR ( 8)
0144           GO TO 8010
         C
         CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
         C
         C EXIT FROM RATE
         C
         CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
         C
0145     8800  RETURN
0146     8990  FORMAT ( 80A1)
0147     8991  FORMAT ( 2X,3(2X, F9.2, 3X ))
0148     8992  FORMAT ( 2X,4( 2X, F9.2, 3X))
0149     8993  FORMAT ( 2X,2(6X, F9.2, 5X ))
0150     8994  FORMAT ( F9.2)
0151           END
```

SECTION 2. MODEL MODULE

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

MODUP
MODDN
MODTK

```
C
C     THIS IS THE EXTENSION TO THE COMMON AREA 'INCLUDED' IN THE MODEL
C     PROGRAMS. THE FILE NAME IS 'MODBLK'.
C
      INTEGER*2 NUPREF(80)
      COMMON    NUPREF
      REAL*4 UORGCS(9,5),DORGCS(9,5),TORGCS(9,5),AORGCS(9,5),XORGCS(9,5)
      COMMON UORGCS,     DORGCS,     TORGCS,     AORGCS,     XORGCS
      REAL*4 WGTARR(80)
      COMMON WGTARR
      REAL*4 UPTIDX(10,6,5),DPTIDX(20,6,5),UCOSTX(10,4),DCOSTX(80,4)
      COMMON UPTIDX,        DPTIDX,        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
```

```
FORTRAN IV-PLUS V02-51C          10:08:41     30-JUN-80          PAGE 1
MODEL.FTN        /TR:BLOCKS/WR

        C
        C     THIS IS THE MAIN PROGRAM FOR THE COST SECTION OF THE MODEL
        C
        C  SUBROUTINE CALLS: READIN, GETTER, REPRTR, CODCHK,
        C                    MODUP, MODDN, MODTK
        C
0001            INCLUDE 'DK2:COMBLK.FTN/NOLIST'
0039            INCLUDE 'DK2:MODBLK.FTN/NOLIST'
0056            LOGICAL*1 LBLANK
        C
        C    DATA INITIALIZATIONS
        C
0057            DATA LBLANK /' '/
0058            DATA BPVT /'PVT '/, BWATS /'WATS'/, BDDD /'DDD '/
0059            DATA CILO /'CAPI','INST','LEAS','O&M$','ANNU',
               2           'TAL ','ALL ','E   ','A   ','ALZD'/
0060            DATA PER /'PER '/, BLANK /'    '/
0061            DATA UPORDN /'  UP','DOWN','LINK','LINK'/
0062            DATA UCINDX /'F',5*' ','I',5*' ','X',5*' ','E',5*' ','D',23*' '/
0063            DATA DCINDX /'F',5*' ','I',5*' ','X',5*' ','E',5*' ','D',23*' '/
0064            DATA REPLST /'1','2','3','4','5','6','7','8','9',10*'1','A',
               2           9*' ','0','1','2','3','4','5','6','7','8','9','L'/
0065            DATA REPNUM /20*0/
0066            DATA MAXUCS,MAXDCS,MAXUPA,MAXDPA,MAXUCT,MAXDCT /15,30,10,20,10,80/
0067            DATA UORGCS /45*0./, DORGCS /45*0./, TORGCS /45*0./, XORGCS/45*0./
0068            DATA WGTARR /80*0./
0069            DATA UPTIDX /300*0./, DPTIDX /600*0./
0070            DATA UCOSTX /40*0./, DCOSTX /320*0./, TCOST /30*0./
        C
        C    READ IN SCENARIO
        C
0071            CALL READIN
        C
        C    NOW DETERMINE WHICH REPORTS ARE REQUESTED
        C
0072    160     WRITE(1,*) 'INDICATE THE REPORT NUMBERS YOU WISH TO SEE'
0073            WRITE (1,*) 'ENTER THE NUMBERS (1-19) SEPARATED BY COMMAS AND'
0074            WRITE (1,*) 'TERMINATE WITH A ";" OR SIMPLY ENTER "ALL" FOR ALL RE
               2PORTS'
0075            READ(1,1000) (INDATA(I),I=1,80)
0076    170     CALL GETTER
0077            IF (ARG(1).EQ.';') GO TO 220
0078            IF (NCHAR.EQ.1) ARG(2) = LBLANK
0079            CALL CODCHK (2,ARG,20,REPLST,POSITN)
0080            IF (POSITN.LE.0) GO TO 190
0081            IF (POSITN.EQ.20) GO TO 200
0082            REPNUM(POSITN) = 1
0083    180     IF (CONTCD.EQ.0) GO TO 160
0084            IF (CONTCD.EQ.1) GO TO 170
        C
        C    ERROR--INVALID REPORT SPECIFIED
        C
0085    190     WRITE (1,1001) ARG(1),ARG(2)
0086            GO TO 180
        C
        C    ALL REPORTS DESIRED
```

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

```
0001            SUBROUTINE MODUP
                C
                C   THIS SUBROUTINE DOES THE CALCULATIONS FOR THE UPLINK SEGMENT
                C   OF THE MODEL.
                C
                C   SUBROUTINE CALLS: REPRTR, VANDH
                C
0002            INCLUDE 'DK2:COMBLK.FTN/NOLIST'
0040            INCLUDE 'DK2:MODBLK.FTN/NOLIST'
                C
                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(1,1),UPORDN(1,2)
0060            DO 100 I=1,NUELEM
0061            CALL REPRTR (1,I)
0062    100     CONTINUE
                C
                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
                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
                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
                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
                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,NUINDX
0078            DO 120 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
                C   COST SENSITIVITY REPORT
                C
```

```
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      140   WRITE (3,1024) CILO(J,1),CILO(J,2),(UPTIDX(I,K,J),K=1,NUINDX)
0091      150   CONTINUE
          C
          C   IF COST ALLOCATION SPECIFIED, REMOVE MULTIPLE CITY LISTINGS
          C
0092      160   IF (NUMORG.EQ.0) GO TO 250
0093            DO 240 K=1,NUCITY
0094            WGTARR(K) = UDXWHT(1)
0095            IF (NUINDX.EQ.1) GO TO 180
0096            DO 170 L=2,NUINDX
0097      170    WGTARR(K) = WGTARR(K) + UCTXVL(K,L-1)*UDXWHT(L)
0098            IF (WGTARR(K).LE.0.0) WGTARR(K) = 1.0
0099      180    IF (K.EQ.1) GO TO 240
0100            DO 230 I=1,K-1
0101            DO 190 J=1,16
0102            IF (UCTNAM(K,J).NE.UCTNAM(I,J)) GO TO 230
0103      190    CONTINUE
0104            DO 200 J=1,NUINDX-1
0105      200   UCTXVL(I,J) = UCTXVL(I,J) + UCTXVL(K,J)
0106            DO 210 J=1,NDCITY
0107      210    TALKBK(J,I) = TALKBK(J,I) + TALKBK(J,K)
0108            DO 220 J=1,NUPATH
0109      220   UPTHCY(I,J) = UPTHCY(I,J) .OR. UPTHCY(K,J)
0110            UCITYV(K) = -1
0111            GO TO 240
0112      230   CONTINUE
0113      240    CONTINUE
          C
          C   CALCULATE COSTS FOR UPLINK PATHS BY CITY, AND CHOOSE THE BEST
          C   ONE.  THEN ADD 'CHOSEN' PATH COSTS TO TOTALS FOR SUMMARY TABLE
          C
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.E38
0122            DO 310 J=1,NUPATH
0123            IF (UPTHCY(J,K).EQ.0) GO TO 310
          C   OMIT LEASE CALCULATIONS, BECAUSE OF THE MINIMUM VARIABLE
0124            CAPCST = UPTIDX(J,1,1)
0125            INSCST = UPTIDX(J,1,2)
0126            OMACST = UPTIDX(J,1,4)
0127            IF (NUINDX.EQ.1) GO TO 270
0128            DO 260 M=2,NUINDX
0129            CAPCST = CAPCST + UPTIDX(J,M,1)*UCTXVL(K,M-1)
```

```
0130            INSCST = INSCST + UPTIDX(J,M,2)*UCTXVL(K,M-1)
0131      260   OMACST = OMACST + UPTIDX(J,M,4)*UCTXVL(K,M-1)
          C
          C   CALCULATE LEASE COSTS
          C
0132      270   LESCST = 0.
0133            DO 290 I=1,NUELEM
0134            TEMP=0.
0135            IF (UCSPTH(I,J).EQ.0) GO TO 290
0136            TEMP = TEMP + UCSDAT(I,1,3)
0137            IF (NUINDX.EQ.1) GO TO 290
0138            DO 280 M=2,NUINDX
0139      280   TEMP = TEMP + UCSDAT(I,M,3)*UCTXVL(K,M-1)
0140            IF (TEMP.LT.UCSMIN(I)) TEMP=UCSMIN(I)
0141            LESCST = LESCST +TEMP
0142      290   CONTINUE
0143            ANNL(J) = (CAPCST+INSCST)/AMORT + LESCST + OMACST
          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,M),M=1,16),J,
               2                CAPCST,INSCST,LESCST,OMACST,ANNL(J)
0146            IF (INDIC.EQ.1) WRITE (3,1036) J,
               2                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=1,4
0154            UCOSTX(K,L) = UPTIDX(N,1,L)
0155            IF (NUINDX.EQ.1) GO TO 330
0156            DO 320 M=2,NUINDX
0157            UCOSTX(K,L) = UCOSTX(K,L) + UPTIDX(N,M,L)*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
          C   DO COST ALLOCATION CALCULATIONS
          C
0165            IF (NUMORG.EQ.0) GO TO 410
0166            DO 400 I=1,NUCITY
0167            TOTWGT=0.
0168            DO 380 J=1,NUCITY
0169            DO 360 K=1,16
0170            IF(UCTNAM(I,K).NE.UCTNAM(J,K)) GO TO 380
0171      360   CONTINUE
0172            IF (USTCOD(I,1).NE.USTCOD(J,1).OR.
               2    USTCOD(I,2).NE.USTCOD(J,2)) GO TO 380
0173            TOTWGT = TOTWGT + WGTARR(J)
0174            IF (I.EQ.J) GO TO 380
0175            DO 370 L=1,4
```

```
0176    370   UCOSTX(J,L) = UCOSTX(I,L)
0177    380   CONTINUE
0178          N = UCTORG(I)
0179          DO 390 L=1,4
0180    390   UORGCS(N,L) = UORGCS(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) GO 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,J),J=1,16),(UCOSTX(I,J),J=1,4),YEARLY
0190          IF (NUINDX.GT.1) WRITE (3,1013) ((UCINDX(K,J),J=1,8),K=2,NUINDX)
0191          IF (NUINDX.GT.1) WRITE (3,1014) (UCTXVL(I,J),J=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,
     2         'O&M&A',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,' TOTAL',2X,5F11.0)
0203    1020  FORMAT(1H0,11X,'SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS--',
     2  2A4,//)
0204    1021  FORMAT (1H0,'PATH ',I2,' -- ',20A1)
0205    1022  FORMAT (1H0,20X,5(7X,A4))
0206    1023  FORMAT (1H ,11X,6(3X,8A1))
0207    1024  FORMAT(1H ,3X,2A4,6F11.0)
0208    1034  FORMAT(1H0,25X,'COST OF EACH PATH--',2A4,///,4X,'CITY',
     2        10X,'PATH',5X,'CAPITAL',4X,'INSTALL',6X,'LEASE',6X,'O&M&A',
     3 2X,'ANNUALIZED',/)
0209    1035  FORMAT(1H0,16A1,I4,F13.0,3F11.0,F12.0)
0210    1036  FORMAT(1H ,16X, I4,F13.0,3F11.0,F12.0)
0211          END
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FORTRAN IV-PLUS V02-51C          10:16:10     30-JUN-80          PAGE 1
MODDN.FTN        /TR:BLOCKS/WR

0001            SUBROUTINE MODDN
                C
                C   THIS SUBROUTINE PERFORMS THE CALCULATIONS FOR THE DOWNLINK
                C   SEGMENT OF THE MODEL
                C
                C   SUBROUTINE CALLS: REPRTR, VANDH
                C
0002            INCLUDE 'DK2:COMBLK.FTN/NOLIST'
0040            INCLUDE 'DK2:MODBLK.FTN/NOLIST'
                C
                C   COST ELEMENT DATA
                C
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,NDELEM
0061            CALL REPRTR (1,I)
0062    100     CONTINUE
                C
                C   PRINT COST/PATH MATRIX
                C
0063    200     IF (REPNUM(11) .EQ. 0) GO TO 225
0064            WRITE (3,1001) (TITLE(I),I=1,72)
0065            CALL REPRTR(2,1)
                C
                C   PATH/CITY MATRIX
                C
0066    225     IF (REPNUM(12) .EQ. 0) GO TO 250
0067            WRITE (3,1001) (TITLE(I),I=1,72)
0068            CALL REPRTR(4,1)
                C
                C   CITY COST INDEXES
                C
0069    250     IF (REPNUM(13) .EQ. 0) GO TO 275
0070            WRITE (3,1001) (TITLE(I),I=1,72)
0071            CALL REPRTR(5,1)
                C
                C   CALCULATE COSTS OF DOWNLINK PATHS, BY COST INDEX
                C
0072    275     DO 400 J=1,NDPATH
0073            DO 400 I=1,NDELEM
0074            DO 400 M=1,NDINDX
0075            DO 300 L=1,4
0076            N = DCSPTH(I,J)
0077    300     DPTIDX(J,M,L) = DPTIDX(J,M,L) + FLOAT(N)*DCSDAT(I,M,L)
0078    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
                C   COST SENSITIVITY REPORT
                C
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,(DPTHNM(I,J),J=1,20)
0084            IF (NDINDX.GT.1) WRITE (3,1022) (PER,J=2,NDINDX)
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0085          WRITE (3,1023) ((DCINDX(J,K),K=1,8),J=1,NDINDX)
0086          DO 500 J=1,5
0087     500     WRITE (3,1024) CILO(J,1), CILO(J,2), (DPTIDX(I,K,J),K=1,NDINDX)
0088     600  CONTINUE
         C
         C   IF COST ALLOCATION SPECIFIED, REMOVE MULTIPLE CITY LISTINGS
         C
0089     700  IF (NUMORG.EQ.0) GO TO 1600
0090          DO 1500 K=1,NDCITY
0091          WGTARR(K) = DDXWHT(1)
0092          IF (NDINDX.EQ.1) GO TO 900
0093          DO 800 L=2,NDINDX
0094     800  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.EQ.1) GO TO 1500
0097          DO 1400 I=1,K-1
0098          DO 1000 J=1,16
0099          IF (DCTNAM(K,J).NE.DCTNAM(I,J)) GO TO 1400
0100     1000 CONTINUE
0101          DO 1100 J=1,NDINDX-1
0102     1100 DCTXVL(I,J) = DCTXVL(I,J) + DCTXVL(K,J)
0103          DO 1200 J=1,NUCITY
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) .OR. DPTHCY(K,J)
0107          DCITYV(K) = -1
0108          GO TO 1500
0109     1400 CONTINUE
0110     1500 CONTINUE
         C
         C   CALCULATE COSTS FOR DOWNLINK PATHS BY CITY, AND CHOOSE THE BEST
         C   ONE.  THEN ADD 'CHOSEN' PATH COSTS TO TOTALS FOR SUMMARY TABLE
         C
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     1650 DO 2500 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.E38
0119          DO 2100 J=1,NDPATH
0120          IF (DPTHCY(J,K).EQ.0) GO TO 2100
         C   OMIT LEASE CALCULATIONS, BECAUSE OF THE MINIMUM VARIABLE
0121            CAPCST = DPTIDX(J,1,1)
0122            INSCST = DPTIDX(J,1,2)
0123            OMACST = DPTIDX(J,1,4)
0124            IF (NDINDX.EQ.1) GO TO 1800
0125            DO 1700 M=2,NDINDX
0126            CAPCST = CAPCST + DPTIDX(J,M,1)*DCTXVL(K,M-1)
0127            INSCST = INSCST + DPTIDX(J,M,2)*DCTXVL(K,M-1)
0128     1700   OMACST = OMACST + DPTIDX(J,M,4)*DCTXVL(K,M-1)
         C
         C   CALCULATE LEASE COSTS
         C
0129     1800 LESCST = 0.
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```
0130           DO 1900 I=1,NDELEM
0131           TEMP=0.
0132           IF (DCSPTH(I,J).EQ.0) GO TO 1900
0133           TEMP = TEMP + DCSDAT(I,1,3)
0134           IF (NDINDX.EQ.1) GO TO 1900
0135           DO 1850 M=2,NDINDX
0136     1850  TEMP = TEMP + DCSDAT(I,M,3)*DCTXVL(K,M-1)
0137           IF (TEMP.LT.DCSMIN(I)) TEMP=DCSMIN(I)
0138           LESCST = LESCST + TEMP
0139     1900  CONTINUE
0140           ANNL(J) = (CAPCST+INSCST)/AMORT + LESCST + OMACST
               C   COMPARE ANNUALIZED COST WITH BEST PREVIOUS PATH
0141           IF (REPNUM(15).NE.1) GO TO 2000
0142           IF (INDIC.EQ.0) WRITE (3,1035) (DCTNAM(K,M),M=1,16),J,
              2                    CAPCST,INSCST,LESCST,OMACST,ANNL(J)
0143           IF (INDIC.EQ.1) WRITE (3,1036) J,
              2                    CAPCST,INSCST,LESCST,OMACST,ANNL(J)
0144     2000  INDIC = 1
0145           IF (ANNL(J).GE.BOTTOM) GO TO 2100
0146           NUPREF(K) = J
0147           BOTTOM = ANNL(J)
0148     2100  CONTINUE
0149           N=NUPREF(K)
0150           DO 2400 L=1,4
0151           DCOSTX(K,L) = DPTIDX(N,1,L)
0152           IF (NDINDX.EQ.1) GO TO 2300
0153           DO 2200 M=2,NDINDX
0154           DCOSTX(K,L) = DCOSTX(K,L) + DPTIDX(N,M,L)*DCTXVL(K,M-1)
0155     2200  CONTINUE
0156     2300  IF (L.NE.3) TCOST(2,L) = TCOST(2,L) + DCOSTX(K,L)
0157     2400  CONTINUE
0158           DCOSTX(K,3)=BOTTOM-DCOSTX(K,4)-(DCOSTX(K,1)+DCOSTX(K,2))/AMORT
0159           TCOST(2,3) = TCOST(2,3) + DCOSTX(K,3)
0160           TCOST(2,5) = TCOST(2,5) + BOTTOM
0161     2500  CONTINUE
               C
               C   DO COST ALLOCATION CALCULATIONS
               C
0162           IF (NUMORG.EQ.0) GO TO 3100
0163           DO 3000 I=1,NDCITY
0164           TOTWGT=0.
0165           DO 2800 J=1,NDCITY
0166           DO 2600 K=1,16
0167           IF(DCTNAM(I,K).NE.DCTNAM(J,K)) GO TO 2800
0168     2600  CONTINUE
0169           IF (DSTCOD(I,1).NE.DSTCOD(J,1).OR.
              2    DSTCOD(I,2).NE.DSTCOD(J,2)) GO TO 2800
0170           TOTWGT = TOTWGT + WGTARR(J)
0171           IF (I.EQ.J) GO TO 2800
0172           DO 2700 L=1,4
0173     2700  DCOSTX(J,L) = DCOSTX(I,L)
0174     2800  CONTINUE
0175           N = DCTORG(I)
0176           DO 2900 L=1,4
0177     2900  DORGCS(N,L) = DORGCS(N,L) + DCOSTX(I,L)*WGTARR(I)/TOTWGT
0178     3000  CONTINUE
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        C
        C   DOWNLINK SUMMARY REPORT
        C
0179    3100  IF (REPNUM(16).NE.1) RETURN
0180          WRITE (3,1001) (TITLE(I),I=1,72)
0181          WRITE(3,1010) UPORDN(2,1), UPORDN(2,2)
0182          DO 3200 I=1,NDCITY
0183          IF (DCITYV(I).LT.0) GO TO 3200
0184          WRITE (3,1011)
0185          YEARLY = (DCOSTX(I,1)+DCOSTX(I,2))/AMORT+DCOSTX(I,3)+DCOSTX(I,4)
0186          WRITE(3,1012) (DCTNAM(I,J),J=1,16),(DCOSTX(I,J),J=1,4),YEARLY
0187          IF (NDINDX.GT.1) WRITE (3,1013) ((DCINDX(K,J),J=1,8),K=2,NDINDX)
0188          IF (NDINDX.GT.1) WRITE (3,1014) (DCTXVL(I,J),J=1,NDINDX-1)
0189    3200  CONTINUE
0190          WRITE(3,1015) (UPORDN(2,K),K=1,2), (TCOST(2,K),K=1,5)
0191          RETURN
        C
        C   FORMAT STATEMENTS
        C
0192    1001  FORMAT (1H1,72A1)
0193    1002  FORMAT (1H0,17X,2A4,' COST ELEMENT DATA',//)
0194    1010  FORMAT(1H0,26X,2A4,' COSTS BY CITY')
0195    1011  FORMAT (1H0,3X,'CITY',15X,'CAPITAL',4X,'INSTALL',6X,'LEASE',6X,
              2         'O&M&A',2X,'ANNUALIZED')
0196    1012  FORMAT(1H0,16A1,2X,5F11.0)
0197    1013  FORMAT (1H0,18X,5(3X,8A1))
0198    1014  FORMAT (1H0,18X,5F11.0/)
0199    1015  FORMAT(1H0,//7X,2A4,' TOTAL',2X,5F11.0)
0200    1020  FORMAT(1H0,11X,'SENSITIVITY OF PATH COSTS TO NETWORK PARAMETERS--',
              2  2A4,//)
0201    1021  FORMAT (1H0,'PATH ',I2,' -- ',20A1)
0202    1022  FORMAT (1H0,20X,5(7X,A4))
0203    1023  FORMAT (1H ,11X,6(3X,8A1))
0204    1024  FORMAT(1H ,3X,2A4,6F11.0)
0205    1034  FORMAT(1H0,25X,'COST OF EACH PATH--',2A4,///,4X,'CITY',
              2       10X,'PATH',5X,'CAPITAL',4X,'INSTALL',6X,'LEASE',6X,'O&M&A',
              3 2X,'ANNUALIZED',/)
0206    1035  FORMAT(1H0,16A1,I4,F13.0,3F11.0,F12.0)
0207    1036  FORMAT(1H ,16X, I4,F13.0,3F11.0,F12.0)
0208          END
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0001            SUBROUTINE MODTK
                C
                C   THIS SUBROUTINE PERFORMS THE CALCULATION FOR THE TALKBACK SEGMENT
                C   OF THE MODEL.  IT ALSO PRODUCES THE GRAND SUMMARY REPORT.
                C
0002            INCLUDE 'DK2:COMBLK.FTN/NOLIST'
0040            INCLUDE 'DK2:MODBLK.FTN/NOLIST'
0057            REAL*4 BPVT,BWATS,BDDD
0058            DATA BPVT /'PVT '/, BWATS /'WATS'/, BDDD /'DDD '/
                C
                C   PREPARE AND PRINT TABLE FOR VOICE TALKBACK SYSTEM COSTS
                C
0059            DO 1700 J=1,NUCITY
0060            IF (UCITYV(J).EQ.-1) GO TO 1700
                C
                C   CHECK FOR NO TALKBACK REQUIREMENT AND SET V AND H COORDINATES
                C
0061            T = 0.
0062            DO 100 I=1,NDCITY
0063            T = T + TALKBK(I,J)
0064    100     CONTINUE
0065            IF (T.EQ.0.0) GO TO 1700
                C
                C   REPEAT FOR EACH COMBINATION OF UPLINK AND DOWNLINK CITY
                C
0066            IF (REPNUM(17).EQ.0) GO TO 150
0067               WRITE (3,1001) (TITLE(K),K=1,72)
0068               WRITE (3,1015) (UCTNAM(J,N),N=1,16)
0069    150     DO 1600 I=1,NDCITY
0070            IF (DCITYV(I).EQ.-1) GO TO 1600
0071            TOTWGT = 0.
0072            IF (TALKBK(I,J).GT.0.AND.DCTLVL(I).EQ.3) GO TO 200
0073            IF (TALKBK(I,J))1600,1600,500
0074    200     DIST=1.E38
0075            DO 400 K=1,NDCITY
0076            IF (K.EQ.I) GO TO 400
0077            IF (DCTLVL(K)-2) 400,300,400
0078    300     X = DCITYV(K) - DCITYV(I)
0079            Y = DCITYH(K) - DCITYH(I)
0080            DIST=MIN1(DIST,SQRT((X**2+Y**2)/10.))
0081    400     CONTINUE
0082            GO TO 600
0083    500     X = UCITYV(J) - DCITYV(I)
0084            Y = UCITYH(J) - DCITYH(I)
0085            DIST = SQRT ((X**2+Y**2)/10.)
0086    600     HOURS = TALKBK(I,J)
0087            WLEASE=MIN1(WATLES+WATCPH*HOURS,WATMAX)
0088            PLEASE=PVTFIX+DIST*PVTMIL
0089            DDLEAS=DDDCPH*HOURS
0090            TCOST(3,1)=TCOST(3,1)+TLKCAP
0091            IF(WLEASE-PLEASE)700,800,800
0092      700   IF(WLEASE.GT.DDLEAS) GO TO 900
0093            TALK=BWATS
0094            INSCST = WATINS
0095            LESCST = WLEASE*12.
0096            GOTO 1000
```

```
0097      800 IF(PLEASE.GT.DDLEAS) GO TO 900
0098          TALK=BPVT
0099          INSCST = PVTINS
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
              C   DO COST ALLOCATION CALCULATIONS, IF APPLICABLE
              C
0108          IF (NUMORG.EQ.0) GO TO 1500
0109          DO 1200 L=1,NDCITY
0110          DO 1100 K=1,16
0111          IF(DCTNAM(I,K).NE.DCTNAM(L,K)) GO TO 1200
0112     1100 CONTINUE
0113          IF (DSTCOD(I,1).NE.DSTCOD(L,1).OR.
             2    DSTCOD(I,2).NE.DSTCOD(L,2)) GO TO 1200
0114          TOTWGT = TOTWGT + WGTARR(L)
0115     1200 CONTINUE
0116          DO 1400 L=I,NDCITY
0117          DO 1300 K=1,16
0118          IF (DCTNAM(I,K).NE.DCTNAM(L,K)) GO TO 1400
0119     1300 CONTINUE
0120          IF (DSTCOD(I,1).NE.DSTCOD(L,1).OR.
             2    DSTCOD(I,2).NE.DSTCOD(L,2)) GO TO 1400
0121          N = DCTORG(L)
0122          TORGCS(N,1) = TORGCS(N,1) + TLKCAP*WGTARR(L)/TOTWGT
0123          TORGCS(N,2) = TORGCS(N,2) + INSCST*WGTARR(L)/TOTWGT
0124          TORGCS(N,3) = TORGCS(N,3) + LESCST*WGTARR(L)/TOTWGT
0125          TORGCS(N,4) = 0.
0126     1400 CONTINUE
              C
              C   TALKBACK REPORT
              C
0127     1500 IF (REPNUM(17).EQ.1) WRITE(3,1016)(DCTNAM(I,K),K=1,16),DCTLVL(I),
             2    HOURS,DIST,WATINS,WLEASE,PVTINS,PLEASE,DDDINS,DDLEAS,TALK
0128     1600 CONTINUE
0129     1700 CONTINUE
              C
              C   ALLOCATE ADMINISTRATIVE COSTS
              C
0130          IF (NUMORG.EQ.0) GO TO 3300
0131          TOTWGT=0.
0132          DO 1800 I=1,NDCITY
0133          TOTWGT=TOTWGT+WGTARR(I)
0134     1800 CONTINUE
0135          DO 2000 I=1,NDCITY
0136          N=DCTORG(I)
0137          DO 1900 L=1,4
0138     1900 AORGCS(N,L) = AORGCS(N,L) + GANDAD(L)*WGTARR(I)/TOTWGT
0139     2000 CONTINUE
              C
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      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,(ORGNAM(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,(ORGNAM(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,(ORGNAM(I,J),J=1,20),(TORGCS(I,J),J=1,5)
0170  2800  CONTINUE
0171        WRITE (3,1028) (ANNL(J),J=11,15)
0172        WRITE (3,1032)
0173        DO 3000 I=1,NUMORG
0174        AORGCS(I,5) = (AORGCS(I,1)+AORGCS(I,2))/AMORT + AORGCS(I,3)
           2            +  AORGCS(I,4)
0175        DO 2900 J=21,24
0176  2900  ANNL(J) = ANNL(J) + AORGCS(I,J-20)
0177        ANNL(25) = ANNL(25) + AORGCS(I,5)
0178        WRITE (3,1027) I,(ORGNAM(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  3100  CONTINUE
0187        WRITE (3,1027) I,(ORGNAM(I,J),J=1,20),(XORGCS(I,J),J=1,5)
0188  3200  CONTINUE
0189        WRITE (3,1028) (ANNL(J),J=16,20)
```

```
        C
        C   CALCULATE AND PRINT TOTAL COSTS FOR GRAND SUMMARY TABLE
        C
0190    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(4,5)=(TCOST(4,1)+TCOST(4,2))/AMORT + TCOST(4,3) + TCOST(4,4)
0196          TCOST(6,1)=TCOST(5,1)/AMORT
0197          TCOST(6,2)=TCOST(5,2)/AMORT
0198          TCOST(6,3)=TCOST(5,3)
0199          TCOST(6,4)=TCOST(5,4)
0200          TCOST(5,5)=(TCOST(5,1)+TCOST(5,2))/AMORT+TCOST(5,3)+TCOST(5,4)
0201          TCOST(6,5)=TCOST(6,1) + TCOST(6,2) + TCOST(6,3) + TCOST(6,4)
0202          IF (REPNUM(19).NE.1) RETURN
0203          WRITE (3,1001) (TITLE(I),I=1,72)
0204          WRITE(3,1004)
0205          WRITE(3,1005)((TCOST(I,J),J=1,5),I=1,6)
0206          NYEARS = IFIX(EQPLIF)
0207          WRITE(3,1006)NYEARS,DISCNT,TCOST(6,5)
0208          RETURN
        C
        C
        C   FORMAT STATEMENTS
        C
0209    1001  FORMAT (1H1,72A1)
0210    1004  FORMAT(1H0,/////,30X,'OVERALL COST SUMMARY',////,20X,
             2       'CAPITAL',3X,'PLANNING AND',7X,'ANNUAL',7X,'ANNUAL',
             3        3X,'ANNUALIZED',/,17X,'EXPENDITURES',1X,'INSTALLATION',
             4        7X,'LEASE',8X,'O&M&A',7X,'COST'/)
0211    1005  FORMAT(1H0,'UPLINK',9X,5F13.0/,'0DOWNLINK',7X,5F13.0,
             2/,  '0VOICE TALKBACK',1X,5F13.0/,  '0ADMINISTRATIVE',1X,5F13.0,
             3//,'0   TOTALS',6X,5F13.0///,'0ANNUALIZED COST',5F13.0)
0212    1006  FORMAT(////,1X,'EFFECTIVE YEARLY COSTS FOR ',I2,' YEAR, ',F5.2,
             2' PERCENT AMORTIZATION ---  $',F9.0)
0213    1015  FORMAT(1H0,27X,'TALKBACK SYSTEM LEASE COSTS',/,35X,'TO ',16A1,////
             2       21X,'HOURS',8X,'WATS COSTS',4X,'PRIVATE LINE',3X,
             3     'DIRECT DIAL',/,5X,'CITY',6X,'LEVEL',1X,'UTIL.',1X,'DIST',1X,
             4       'INSTALL LEASE',2X,'INSTALL LEASE',2X,'INSTALL LEASE',2X,
             5       'BEST'/)
0214    1016  FORMAT (1H0,16A1,I3,F5.0,F6.0,F8.0,F6.0,F9.0,F6.0,F9.0,F6.0,2X,A4)
0215    1025  FORMAT(1H0,28X,'NETWORK COST ALLOCATION',///,30X,'CAPITAL',4X,
             2       'INSTALL',6X,'LEASE',6X,'O&M&A',1X,'ANNUALIZED')
0216    1026  FORMAT(1H0,/,' UPLINK',/)
0217    1027  FORMAT (1H ,I3,1X,20A1,1X,5F11.0)
0218    1028  FORMAT(1H0,8X,'TOTAL',12X,5F11.0)
0219    1029  FORMAT(1H0,/,' DOWNLINK'./)
0220    1030  FORMAT(1H0,/,' VOICE TALKBACK'/)
0221    1031  FORMAT(1H0,/,' TOTAL NETWORK'/)
0222    1032  FORMAT(1H0,/,' ADMINISTRATIVE'/)
0223          END
```

SECTION 3. EARTH MODULE

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

MOVREC

```
        C               EARTH STATION REPORT PROGRAM
        C
        C THIS PROGRAM PRODUCES A REPORT OF ALL EARTH STATIONS THAT ARE
        C WITHIN A GIVEN DISTANCE FROM AN UPLINK OR DOWNLINK CITY THAT
        C IS IN A USER'S SCENARIO. THE REPORT MAY BE LIMITED BY SPECIFYING
        C A UNIQUE SATELLITE THAT THE EARTH TERMINAL MUST BE LICENSED TO
        C POINT TO.
        C
        C SUBROUTINE CALLS: READIN, VANDH, MOVREC, CODCHK
        C
0001            INCLUDE 'SYO:COMBLK.FTN/NOLIST'
0039            LOGICAL*1 PAD(12460)
0040            COMMON PAD
        C
0041            LOGICAL*1 CALSIN(5),LICNSE(40),CITY(20),STATE(2),SERVIS(18)
0042            LOGICAL*1 BAND(4,2),SIZE(4)
0043            INTEGER*2 UPDOWN
0044            COMMON /ESTATN/ UPDOWN,CALSIN,LICNSE,CITY,STATE,SERVIS,BAND,SIZE
        C
        C  LOCAL VARIABLES
        C
0045            LOGICAL*1 SATLIT(5),AUTHCD,INCHAR(5)
0046            LOGICAL*1 SATCOD(25,5),HEADER(72),TMPARY(82),SAT(5,5)
0047            LOGICAL*1 NAMUCT(10,16),NAMDCT(80,16),CODUST(10,2),CODDST(80,2)
0048            INTEGER*2 BAD,LAT,LON,UCTARY(10),DCTARY(80),NUMCHR,NUMSAT
0049            INTEGER*2 POS,UCITYN,DCITYN,NUMREC,I,J,FIRST,LAST
0050            INTEGER*2 ORGNUM,VUCITY(10),HUCITY(10),VDCITY(80),HDCITY(80)
0051            REAL*4 DIST,DISTNC,DOWNUP(2),X,Y
        C
        C       TO PROVIDE CONSISTENCY BETWEEN THE BUILD, MODEL, AND EARTH
        C       MODULES, THE SUBROUTINE READIN IS USED TO READ THE USER'S
        C       SCENARIO. SINCE THIS REQUIRES A LOT OF OVERHEAD IN TERMS OF
        C       DATA THEAT IS NOT REQUIRED FOR THIS MODULE, THOSE VARIABLES
        C       THAT ARE NEEDED ARE SAVED IN LOCAL ARRAYS AND THE EARTH
        C       TERMINAL ARRAY IS OVERLAYED ON TOP OF THE COMMON. TO
        C       PROTECT AGAINST WRITING OVER OTHER VARIABLES, THE COMMON
        C       MUST BE 'PADDED' OUT TO ASSUME THE SIZE OF THE EARTH TERMINAL
        C       ARRAY. THE FORMULA FOR DOING THIS IS:
        C
        C          SIZE OF PAD = 78 + 82 * (NUMBER OF RECORDS IN ARRAY - 199)
        C
0052            LOGICAL*1 BIGREC(350,82)
0053            EQUIVALENCE (BIGREC(1,1),NUELEM)
        C
0054            DATA NUMSAT /25/
0055            DATA DOWNUP /'DOWN','  UP'/
        C
0056            DATA SATCOD /'K','K','K','K','K','K','K','K','K','A','A','A',
               2             'M','M','M','I','I','I','I','I','I','K','K','K','S',
               3             'S','S','S','S','S','S','S','S','S','N','N','N','R',
               4             'R','R','N','N','N','N','N','N','S','S','S','2','2',
               5             '2','2','2','2','2','3','3','3','I','I','I','1','2',
               6             '3','1','2','3','4','4','5','3','3','3','0','1','2',
               7             '6','7','8','9','0','1','2','K','K','K',' ',' ',' ',
               8             ' ',' ',' ',' ',' ','A',' ',' ','6','7','8',' ',' ',' ',' ',' ',
               9             ' ',' ',' ',' ',' ',' ',' ',' ','1','2','3',' ',' ',' ',' ',
```

```
                1            ' ',' ',' ',' ',' ',' ',' ',' ',' '/
      C
0057           CALL READIN
0058           OPEN (UNIT=2,TYPE='OLD',NAME='SY0:EARTH.DAT',
              2     CARRIAGECONTROL='LIST',ERR=9010)
      C
      C      SINCE THE COMMON AREA WILL BE USED TO STORE THE EARTH TERMINAL
      C      RECORDS, SOME OF THE COMMON VARIABLES WILL HAVE TO BE SAVED AS
      C      LOCAL VARIABLES.
      C
0059           UCITYN=NUCITY
0060           DCITYN=NDCITY
0061           ORGNUM=NUMORG
0062           DO 5 I=1,72
0063              HEADER(I)=TITLE(I)
0064      5    CONTINUE
0065           DO 30 I=1,DCITYN
0066              VDCITY(I)=DCITYV(I)
0067              HDCITY(I)=DCITYH(I)
0068              DO 10 J=1,16
0069                 NAMDCT(I,J)=DCTNAM(I,J)
0070     10       CONTINUE
0071              DO 20 J=1,2
0072                 CODDST(I,J)=DSTCOD(I,J)
0073     20       CONTINUE
0074     30    CONTINUE
0075           DO 60 I=1,UCITYN
0076              VUCITY(I)=UCITYV(I)
0077              HUCITY(I)=UCITYH(I)
0078              DO 40 J=1,16
0079                 NAMUCT(I,J)=UCTNAM(I,J)
0080     40       CONTINUE
0081              DO 50 J=1,2
0082                 CODUST(I,J)=USTCOD(I,J)
0083     50       CONTINUE
0084     60    CONTINUE
      C
      C      ELIMINATE UPLINK DUPLICATE CITIES IF THERE IS COST ALLOCATION
      C
0085           IF (ORGNUM.EQ.0) GO TO 140
0086           DO 90 K=2,UCITYN
0087              DO 80 I=1,K-1
0088                 DO 70 J=1,16
0089                    IF (NAMUCT(K,J).NE.NAMUCT(I,J)) GO TO 80
0090     70          CONTINUE
0091                 VUCITY(K)=-1
0092                 GO TO 90
0093     80       CONTINUE
0094     90    CONTINUE
      C
      C      ELIMINATE DOWNLINK DUPLICATE CITIES IF THERE IS COST ALLOCATION
      C
      C
0095           DO 130 K=2,DCITYN
0096              DO 120 I=1,K-1
0097                 DO 110 J=1,16
```

```
0098                    IF (NAMDCT(K,J).NE.NAMDCT(I,J)) GO TO 120
0099     110          CONTINUE
0100                  VDCITY(K)=-1
0101                  GO TO 130
0102     120        CONTINUE
0103     130    CONTINUE
               C
               C     NOW, CLEAR OUT THE COMMON BY FILLING THE BIGREC ARRAY WITH BLANKS
               C
0104     140    DO 140 I=1,350
0105               DO 150 J=1,82
0106                  BIGREC(I,J)=' '
0107     150       CONTINUE
0108     160    CONTINUE
               C
0109     170    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=9000) DISTNC
0113            IF (DISTNC.GT.0.AND.DISTNC.LE.50.) GO TO 200
               C
               C     DISTANCE OUT OF RANGE
               C
0114            WRITE (1,*) 'DISTANCE MUST BE LESS THAN 50 MILES'
0115            GO TO 170
               C
               C     ENTER SATELLITE
               C
0116     200    WRITE (1,*) 'ENTER THE SATELLITE OF INTEREST BY CALL NUMBER'
0117            READ (1,210) (SATLIT(I),I=1,5)
0118     210    FORMAT (5A1)
0119            IF (SATLIT(1).EQ.'A'.AND.SATLIT(2).EQ.'L'.AND.SATLIT(3).EQ.'L')
              2    GO TO 400
0120            CALL CODCHK(5,SATLIT,NUMSAT,SATCOD,POS)
0121            IF (POS.NE.0) GO TO 500
0122            WRITE (1,220) (SATLIT(I),I=1,5)
0123     220    FORMAT (1X,'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     230    FORMAT (/,1X,5A1,2X,'WESTAR I',/,
              2          1X,5A1,2X,'WESTAR II',/,
              3          1X,5A1,2X,'WESTAR III',/,
              4          1X,5A1,2X,'COMSTAR D-1',/,
              5          1X,5A1,2X,'COMSTAR D-2',/,
              6          1X,5A1,2X,'COMSTAR D-3',/,
              7          1X,5A1,2X,'COMSTAR D-4',/,
              8          1X,5A1,2X,'SATCOM I',/,
              9          1X,5A1,2X,'SATCOM II',/,
              1          1X,5A1,2X,'SATCOM III',/,
              1          1X,5A1,2X,'CANADIAN TELESAT SATELLITES',/,
              2          1X,5A1,/,
              3          1X,5A1,/,
              4          1X,5A1,2X,'MARISAT I',/,
              5          1X,5A1,2X,'MARISAT II',/,
              6          1X,5A1,2X,'MARISAT III',/,
              7          1X,5A1,2X,'INTELSAT I',/,
```

```
                8           1X,5A1,2X,'INTELSAT II',/,
                9           1X,5A1,2X,'INTELSAT III',/,
                1           1X,5A1,2X,'INTELSAT IV',/,
                1           1X,5A1,2X,'INTELSAT IV-A',/,
                2           1X,5A1,2X,'INTELSAT V',/,
                3           1X,5A1,2X,'SBS I',/,
                4           1X,5A1,2X,'SBS II',/,
                5           1X,5A1,2X,'SBS III',//)
        C
0127            GO TO 200
        C
0128    400     BYPASS=1
0129    500     UPDOWN=0
0130            NUMREC=0
        C
        C       READ THE DATA BASE
        C
0131    520     READ (2,530,ERR=9020,END=580)(CALSIN(I),I=1,5),(LICNSE(I),I=1,40),
               2     (CITY(I),I=1,20),(STATE(I),I=1,2),AUTHCD
0132    530     FORMAT (5A1,1X,40A1,1X,20A1,1X,2A1,4X,A1)
        C
0133            READ(2,535,ERR=9020,END=580)(SERVIS(I),I=1,18),((BAND(I,J),J=1,2),
               2     I=1,4),(SIZE(I),I=1,4),LAT,LON,((SAT(I,J),J=1,5),I=1,5)
0134    535     FORMAT (6X,18A1,4(2A1),4A1,I4,2X,I5,2X,5(5A1))
        C
        C       LOOK FOR SATELLITE
        C
0135            IF (BYPASS.EQ.1) GO TO 536
0136            CALL CODCHK(5,SATLIT,5,SAT,POS)
0137            IF (POS.EQ.0) GO TO 520
        C
        C       CALCULATE V AND H COORDINATES
        C
0138    536     LAT=-LAT
0139            CALL VANDH(LAT,LON)
        C
        C       CALCULATE DISTANCE FROM UPLINK CITIES
        C
0140    542     UPDOWN=1
0141            IF (SERVIS(8).NE.'Y') GO TO 557
0142            DO 545 I=1,UCITYN
0143               IF (VUCITY(I).EQ.-1) GO TO 545
0144               X=VUCITY(I)-LAT
0145               Y=HUCITY(I)-LON
0146               DIST=(X**2+Y**2)/10.
0147               DIST=SQRT(DIST)
0148               IF (DIST.GT.DISTNC) GO TO 545
0149               IF (NUMREC.EQ.350) GO TO 570
0150               NUMREC=NUMREC+1
0151               CALL MOVREC(I,NUMREC)
0152               UCTARY(I)=UCTARY(I)+1
0153    545     CONTINUE
        C
        C       CALCULATE DISTANCE FROM DOWNLINK CITIES
        C
0154    557     UPDOWN=2
```

```
0155            IF (SERVIS(8).NE.'R'.AND.SERVIS(9).NE.'R') GO TO 520
0156            DO 560 I=1,DCITYN
0157               IF (VDCITY(I).EQ.-1) GO TO 560
0158               X=VDCITY(I)-LAT
0159               Y=HDCITY(I)-LON
0160               DIST=(X**2+Y**2)/10.
0161               DIST=SQRT(DIST)
0162               IF (DIST.GT.DISTNC) GO TO 560
0163               IF (NUMREC.EQ.350) GO TO 570
0164               NUMREC=NUMREC+1
0165               CALL MOVREC(I,NUMREC)
0166               DCTARY(I)=DCTARY(I)+1
0167     560    CONTINUE
0168            GO TO 520
               C
0169     570    WRITE (1,*) '***** OVER 350 EARTH STATIONS QUALIFY *****'
0170            WRITE (1,*) 'ONLY A PARTIAL REPORT WILL BE CREATED'
0171            WRITE (1,*) 'USE A SMALLER DISTANCE FOR A FULL REPORT'
               C
               C     CLOSE THE EARTH TERMINAL FILE AND SORT THE ARRAY
               C
0172     580    CLOSE (UNIT=2)
0173            NLESS1=NUMREC-1
0174            DO 800 I=1,NLESS1
0175               IPLUS1=I+1
0176               DO 700 J=IPLUS1,NUMREC
0177                  IF (BIGREC(J,1).GT.BIGREC(I,1)) GO TO 700
0178                  IF (BIGREC(J,1).LT.BIGREC(I,1)) GO TO 600
0179                  IF (BIGREC(J,2).GT.BIGREC(I,2)) GO TO 700
               C
               C     OTHERWISE SWAP
               C
0180     600          DO 610 L=1,82
0181     610             TMPARY(L)=BIGREC(J,L)
0182                  DO 620 L=1,82
0183     620             BIGREC(J,L)=BIGREC(I,L)
0184                  DO 630 L=1,82
0185     630             BIGREC(I,L)=TMPARY(L)
               C
0186     700       CONTINUE
0187     800    CONTINUE
               C
               C     PRINT THE REPORT
               C
0188     4000   WRITE (3,4100)(HEADER(I),I=1,72)
0189     4100   FORMAT ('1',72A1/)
0190            IDIST=DISTNC
0191            WRITE (3,4600) DOWNUP(2),IDIST,(SATLIT(I),I=1,5)
0192     4600   FORMAT (//,1X,A4,'LINK CITIES--EARTH STATIONS WITHIN ',I3,
              2         ' MILES AND LICENSED TO POINT TO ',5A1//)
               C
0193            WRITE (3,4620)
0194     4620   FORMAT (1X,'CALL SIGN',11X,'LICENSEE',21X,'CITY',6X,'STATE',2X,
              2         'SERVICE',3X,'SIZE')
               C
0195            FIRST=1
```

```
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 (/,'************** ',16A1,2X,2A1/)
0201               LAST=FIRST+UCTARY(I)-1
0202               DO 4735 K=FIRST,LAST
0203                  WRITE (3,4731) (BIGREC(K,L),L=3,82)
0204     4731         FORMAT (1X,80A1/)
0205     4735       CONTINUE
0206               FIRST=LAST+1
0207               GO TO 4750
0208     4740      WRITE (3,4745) (NAMUCT(I,L),L=1,16),(CODUST(I,L),L=1,2)
0209     4745      FORMAT (/,1X,'NO EARTH STATIONS NEAR ',16A1,2X,2A1)
0210     4750    CONTINUE
         C
         C        DOWNLINK PART OF REPORT
         C
0211     5000    WRITE (3,4600) DOWNUP(1),IDIST,(SATLIT(I),I=1,5)
0212             WRITE (3,4620)
0213             DO 5750 I=1,DCITYN
0214                IF (VDCITY(I).EQ.-1) GO TO 5750
0215                IF (DCTARY(I).EQ.0) GO TO 5740
0216                WRITE (3,4730) (NAMDCT(I,J),J=1,16),(CODDST(I,J),J=1,2)
0217                LAST=FIRST+DCTARY(I)-1
0218                DO 5735 K=FIRST,LAST
0219                   WRITE (3,4731) (BIGREC(K,L),L=3,82)
0220     5735       CONTINUE
0221                FIRST=LAST+1
0222                GO TO 5750
0223     5740       WRITE (3,4745) (NAMDCT(I,L),L=1,16),(CODDST(I,J),L=1,2)
0224     5750    CONTINUE
         C
0225             GO TO 9900
         C
0226     9000    WRITE (1,*) 'ERROR IN NUMERICAL READ - PLEASE REENTER'
0227             GO TO BAD
0228     9010    WRITE (1,*) 'ERROR OPENING EARTH TERMINAL FILE'
0229             GO TO 9900
0230     9020    WRITE (1,*) 'ERROR READIN EARTH TERMINAL FILE'
0231     9900    STOP
0232             END
```

MOVREC.FTN /TR:BLOCKS/WR

```
0001            SUBROUTINE MOVREC(I,J)
                C
                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 'SY0:COMBLK.FTN/NOLIST'
                C
0040            LOGICAL*1 PAD(12460)
0041            COMMON PAD
                C
0042            LOGICAL*1 CALSIN(5),LICNSE(40),CITY(20),
                2         STATE(2),BAND(4,2),SIZE(4),SERVIS(18)
0043            INTEGER*2 UPDOWN,I,J
                C
0044            COMMON /ESTATN/ UPDOWN,CALSIN,LICNSE,CITY,STATE,SERVIS,BAND,SIZE
                C
0045            LOGICAL*1 BIGREC(350,82)
0046            EQUIVALENCE (BIGREC(1,1),NUELEM)
                C
0047            BIGREC(J,1)=UPDOWN
0048            BIGREC(J,2)=I
0049            DO 10 K=3,7
0050    10      BIGREC(J,K) = CALSIN(K-2)
0051            DO 20 K=9,43
0052    20      BIGREC(J,K) = LICNSE(K-8)
0053            DO 30 K=46,61
0054    30      BIGREC(J,K) = CITY(K-45)
0055            DO 40 K=64,65
0056    40      BIGREC(J,K) = STATE(K-63)
0057            DO 50 K=68,76
0058    50      BIGREC(J,K) = SERVIS(K-67)
0059            DO 60 K=79,82
0060    60      BIGREC(J,K) = SIZE(K-78)
                C
0061            RETURN
0062            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
CCOUNT
DISAPR
RDCOST
RATECK
CTYCHK
VANDH
MATMOD
REPRTR

```
             C
             CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
             C
             C                           SUBROUTINE READIN
             C
             CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
             C
             C CALLED BY: BUILD, MODEL, EARTH
             C
0001               SUBROUTINE READIN
0002               INCLUDE 'SY0:COMBLK.FTN/NOLIST'
0040               LOGICAL*1 INNAME(16)
0041               REAL*4 PROBLM(3,8)
0042               DATA INNAME /'S','Y','0',':',6*'X','.','D','A','T',0,0/
0043               DATA PROBLM          /'  SC','ALAR','    ','UPLI','NK C','STEL',
                 2 'UPLI','NK P','ATHS','UPLI','NK C','ITY','DNLI','NK C','STEL',
                 3 'DNLI','NK P','ATHS','DNLI','NK C','ITY','TALK','BACK',' '/
             C
             C   OPEN INPUT SCENARIO FILE
             C
0044               WRITE(1,*) 'ENTER NAME OF SCENARIO FILE'
0045               READ(1,5001,ERR=5030) (INNAME(I),I=5,10)
0046               OPEN (UNIT=2,TYPE='OLD',NAME=INNAME,CARRIAGECONTROL='LIST',
                 2      ERR=5020)
             C
             C   HEADER RECORD
             C
0047               JERROR=1
0048               READ(2,5001,ERR=5030) (TITLE(I),I=1,72)
0049         5001  FORMAT(72A1)
             C
             C   NUMBER OF COST ELEMENTS,INDEXES,CITIES,PATHS,COST ALLOCATION ORGS
             C
0050               READ(2,5002,ERR=5030) NUELEM,NDELEM,NUINDX,NDINDX,NUCITY,NDCITY,
                 2                       NUPATH,NDPATH,NUMORG
0051         5002  FORMAT(9I4)
             C
             C   ALL OTHER SCALARS
             C
0052               READ(2,5003,ERR=5030) DDDCPH,DDDINS,DDDLES,EQPLIF,PVTLES,PVTFIX,
                 2                       PVTINS,PVTMIL,DISCNT,TLKCAP,WATINS,WATLES
0053         5003  FORMAT(F5.2,2F6.2,F5.1,3F7.2,F6.3,F5.1,F6.2,F7.2,F8.2)
0054               READ (2,5050,ERR=5030) WATMAX,WATCPH,(GANDAD(I),I=1,4)
0055         5050  FORMAT(2F8.2,4F12.2)
             C
             C   COST ALLOCATION ORGANIZATION NAMES, IF APPLICABLE
             C
0056               IF(NUMORG.EQ.0) GO TO 510
0057               L1 = 1
0058         501   L2 = MIN(NUMORG,L1+3)
0059               READ(2,5004,ERR=5030) ((ORGNAM(I,J),J=1,20),I=L1,L2)
0060         5004  FORMAT (4(20A1))
0061               L1 = L2 + 1
0062               IF (L1.LE.NUMORG) GO TO 501
             C
             C   UPLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS
```

```
      C
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(8A1,1X))
0065        IF (NUMORG.GT.0) READ(2,5006,ERR=5030) (UDXWHT(I),I=1,NUINDX)
0066  5006  FORMAT(6F7.3)
      C
      C   UPLINK COST ELEMENT DATA
      C
0067        JERROR=2
0068        DO 530 I = 1,NUELEM
0069        READ(2,5007,ERR=5030) (UCSCOD(I,J),J=1,2),(UCSNAM(I,J),J=1,20),
           2     UCSMIN(I),(UCSDAT(I,1,K),K=1,4)
0070  5007  FORMAT(2A1,1X,20A1,7X,5F10.3)
0071        IF (NUINDX.EQ.1) GO TO 540
0072        J = 0
0073  518   J = J + 2
0074        IF (J - NUINDX) 520,525,530
0075  520   JJ = J + 1
0076        READ(2,5008,ERR=5030)(UCSDAT(I,J,K),K=1,4),(UCSDAT(I,JJ,K),K=1,4)
0077  5008  FORMAT(8F10.3)
0078        GO TO 518
0079  525   READ(2,5008,ERR=5030) (UCSDAT(I,J,K),K=1,4)
0080  530   CONTINUE
      C
      C   UPLINK PATH DATA
      C
0081        JERROR=3
0082        DO 540 I=1,NUPATH
0083        READ(2,5009,ERR=5030)(UPTHNM(I,J),J=1,20),(UCSPTH(J,I),J=1,NUELEM)
0084  5009  FORMAT(20A1,5X,15I1)
0085  540   CONTINUE
      C
      C   UPLINK CITY DATA
      C
0086        JERROR=4
0087        IF (NUCITY.EQ.0) GO TO 555
0088        DO 550 I=1,NUCITY
0089        READ(2,5010,ERR=5030) (UCTNAM(I,J),J=1,16),(USTCOD(I,J),J=1,2),
           2 UCITYV(I),UCITYH(I),UCTCHN(I),UCTORG(I),(UPTHCY(J,I),J=1,NUPATH)
0090  5010  FORMAT(16A1,1X,2A1,2I6,2I2,5X,10I1)
0091        IF (NUINDX.GT.1) READ(2,5008,ERR=5030) (UCTXVL(I,J),J=1,NUINDX-1)
0092  550   CONTINUE
      C
      C   DOWNLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS
      C
0093  555   JERROR=5
0094        IF (NDINDX.GE.2)
           2   READ(2,5005,ERR=5030) ((DCINDX(I,J),J=1,8),I=2,NDINDX)
0095        IF (NUMORG.GT.0) READ(2,5006,ERR=5030) (DDXWHT(I),I=1,NDINDX)
      C
      C   DOWNLINK COST ELEMENT DATA
      C
0096        DO 630 I = 1,NDELEM
0097        READ(2,5007,ERR=5030) (DCSCOD(I,J),J=1,2),(DCSNAM(I,J),J=1,20),
           2       DCSMIN(I),(DCSDAT(I,1,K),K=1,4)
```

```
0098            IF (NDINDX.EQ.1) GO TO 640
0099            J = 0
0100      618   J = J + 2
0101            IF (J - NDINDX) 620,625,630
0102      620   JJ = J + 1
0103            READ(2,5008,ERR=5030)(DCSDAT(I,J,K),K=1,4),(DCSDAT(I,JJ,K),K=1,4)
0104            GO TO 618
0105      625   READ(2,5008,ERR=5030) (DCSDAT(I,J,K),K=1,4)
0106      630   CONTINUE
          C
          C     DOWNLINK PATH DATA
          C
0107            JERROR=6
0108            DO 640 I=1,NDPATH
0109            READ(2,5009,ERR=5030)(DPTHNM(I,J),J=1,20),(DCSPTH(J,I),J=1,NDELEM)
0110      640   CONTINUE
          C
          C   DOWNLINK CITY DATA
          C
0111            JERROR=7
0112            IF (NDCITY.EQ.0) GO TO 690
0113            DO 650 I=1,NDCITY
0114            READ(2,5010,ERR=5030) (DCTNAM(I,J),J=1,16),(DSTCOD(I,J),J=1,2),
               2 DCITYV(I),DCITYH(I),DCTLVL(I),DCTORG(I),(DPTHCY(J,I),J=1,NDPATH)
0115            IF (NDINDX.GT.1) READ(2,5008,ERR=5030) (DCTXVL(I,J),J=1,NDINDX-1)
0116      650   CONTINUE
          C
          C   TALKBACK INFORMATION
          C
0117            JERROR=8
0118            IF (NUCITY.EQ.0) GO TO 690
0119            DO 680 J=1,NUCITY
0120            L2 = 0
0121      660   L1 = L2 + 1
0122            L2 = L1 + 12
0123            IF(L1.GT.NDCITY) GO TO 680
0124            IF(L2.GT.NDCITY) L2=NDCITY
0125            READ(2,5011,ERR=5030) (TALKBK(I,J),I=L1,L2)
0126      5011  FORMAT (13F6.1)
0127            GO TO 660
0128      680   CONTINUE
0129      690   CLOSE (UNIT=2)
0130            RETURN
          C
          C   IF ERRORS OCCUR WHILE READING THE INPUT FILE
          C
0131      5020  WRITE(1,5025) (INNAME(I),I=1,16)
0132      5025  FORMAT(1H ,'ERROR IN OPENING FILE ',16A1)
0133            GO TO 5040
0134      5030  WRITE(1,5035)(PROBLM(I,JERROR),I=1,3)
0135      5035  FORMAT(1H ,'ERROR READING ',3A4,' DATA')
0136      5040  WRITE (1,*) 'PROGRAM TERMINATED'
0137            CLOSE (UNIT=2)
0138            STOP
0139            END
```

```
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C                     SUBROUTINE RITOUT
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C CALLED BY: BUILD
        C
0001          SUBROUTINE RITOUT
0002          INCLUDE 'SY0:COMBLK.FTN/NOLIST'
        C
        C   NON-COMMON ARRAY VARIABLES
        C
0040          LOGICAL*1 INNAME(16)
0041          REAL*4 PROBLM(3,8)
0042          DATA INNAME /'S','Y','0',':',6*'X','.','D','A','T',0,0/
0043          DATA PROBLM         /'  SC','ALAR','    ','UPLI','NK C','STEL',
             2 'UPLI','NK P','ATHS','UPLI','NK C','ITY','DNLI','NK C','STEL',
             3 'DNLI','NK P','ATHS','DNLI','NK C','ITY','TALK','BACK',' '/
        C
        C   OPEN OUTPUT SCENARIO FILE
        C
0044          WRITE(1,*)'ENTER NEW 6 CHARACTER NAME FOR THE SCENARIO FILE JUST
             2 CREATED'
0045          READ(1,5001,ERR=5030) (INNAME(I),I=5,10)
0046          OPEN (UNIT=2,TYPE='NEW',NAME=INNAME,CARRIAGECONTROL='LIST',
             2       ERR=5020)
        C
        C   HEADER RECORD
        C
0047          JERROR=1
0048          WRITE(2,5001,ERR=5030) (TITLE(I),I=1,72)
0049    5001  FORMAT(72A1)
        C
        C   NUMBER OF COST ELEMENTS,INDEXES,CITIES,PATHS,COST ALLOCATION ORGS
        C
0050          WRITE(2,5002,ERR=5030) NUELEM,NDELEM,NUINDX,NDINDX,NUCITY,NDCITY,
             2                       NUPATH,NDPATH,NUMORG
0051    5002  FORMAT(9I4)
        C
        C   ALL OTHER SCALARS
        C
0052          WRITE(2,5003,ERR=5030) DDDCPH,DDDINS,DDDLES,EQPLIF,PVTLES,PVTFIX,
             2                       PVTINS,PVTMIL,DISCNT,TLKCAP,WATINS,WATLES
0053    5003  FORMAT(F5.2,2F6.2,F5.1,3F7.2,F6.3,F5.1,F6.2,F7.2,F8.2)
0054          WRITE(2,5050,ERR=5030)WATMAX,WATCPH,(GANDAD(I),I=1,4)
0055    5050  FORMAT(2F8.2,4F12.2)
        C
        C   COST ALLOCATION ORGANIZATION NAMES, IF APPLICABLE
        C
0056          IF(NUMORG.EQ.0) GO TO 510
0057          L1 = 1
0058    501   L2 = MIN(NUMORG,L1+3)
0059          WRITE(2,5004,ERR=5030) ((ORGNAM(I,J),J=1,20),I=L1,L2)
0060    5004  FORMAT (4(20A1))
```

```
0061            L1 = L2 + 1
0062            IF (L1.LE.NUMORG) GO TO 501
                C
                C   UPLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS
                C
0063    510     IF (NUINDX.GE.2)
               2    WRITE(2,5005,ERR=5030) ((UCINDX(I,J),J=1,8),I=2,NUINDX)
0064    5005    FORMAT (5(8A1,1X))
0065            IF (NUMORG.GT.0) WRITE(2,5006,ERR=5030) (UDXWHT(I),I=1,NUINDX)
0066    5006    FORMAT(6F7.3)
                C
                C   UPLINK COST ELEMENT DATA
                C
0067            JERROR=2
0068            DO 530 I = 1,NUELEM
0069            WRITE(2,5007,ERR=5030) (UCSCOD(I,J),J=1,2),(UCSNAM(I,J),J=1,20),
               2     UCSMIN(I),(UCSDAT(I,1,K),K=1,4)
0070    5007    FORMAT(2A1,1X,20A1,7X,5F10.3)
0071            IF (NUINDX.EQ.1) GO TO 540
0072            J = 0
0073    518     J = J + 2
0074            IF (J - NUINDX) 520,525,530
0075    520     JJ = J + 1
0076            WRITE(2,5008,ERR=5030)(UCSDAT(I,J,K),K=1,4),(UCSDAT(I,JJ,K),
               2                    K=1,4)
0077    5008    FORMAT(8F10.3)
0078            GO TO 518
0079    525     WRITE(2,5008,ERR=5030) (UCSDAT(I,J,K),K=1,4)
0080    530     CONTINUE
                C
                C   UPLINK PATH DATA
                C
0081            JERROR=3
0082            DO 540 I=1,NUPATH
0083            WRITE(2,5009,ERR=5030)(UPTHNM(I,J),J=1,20),(UCSPTH(J,I),J=1,
               2     NUELEM)
0084    5009    FORMAT(20A1,5X,15I1)
0085    540     CONTINUE
                C
                C   UPLINK CITY DATA
                C
0086            JERROR=4
0087            IF (NUCITY.EQ.0) GO TO 555
0088            DO 550 I=1,NUCITY
0089            WRITE(2,5010,ERR=5030) (UCTNAM(I,J),J=1,16),(USTCOD(I,J),J=1,2),
               2 UCITYV(I),UCITYH(I),UCTCHN(I),UCTORG(I),(UPTHCY(J,I),J=1,NUPATH)
0090    5010    FORMAT(16A1,1X,2A1,2I6,2I2,5X,10I1)
0091            IF (NUINDX.GT.1) WRITE(2,5008,ERR=5030) (UCTXVL(I,J),J=1,NUINDX-1)
0092    550     CONTINUE
                C
                C   DOWNLINK COST INDEX NAMES AND COST ALLOCATION WEIGHTS
                C
0093    555     JERROR=5
0094            IF (NDINDX.GE.2)
               2    WRITE(2,5005,ERR=5030) ((DCINDX(I,J),J=1,8),I=2,NDINDX)
0095            IF (NUMORG.GT.0) WRITE(2,5006,ERR=5030) (DDXWHT(I),I=1,NDINDX)
```

```
        C
        C   DOWNLINK COST ELEMENT DATA
        C
0096          DO 630 I = 1,NDELEM
0097          WRITE(2,5007,ERR=5030) (DCSCOD(I,J),J=1,2),(DCSNAM(I,J),J=1,20),
             2       DCSMIN(I),(DCSDAT(I,1,K),K=1,4)
0098          IF (NDINDX.EQ.1) GO TO 640
0099          J = 0
0100    618   J = J + 2
0101          IF (J - NDINDX) 620,625,630
0102    620   JJ = J + 1
0103          WRITE(2,5008,ERR=5030)(DCSDAT(I,J,K),K=1,4),(DCSDAT(I,JJ,K),
             2       K=1,4)
0104          GO TO 618
0105    625   WRITE(2,5008,ERR=5030) (DCSDAT(I,J,K),K=1,4)
0106    630   CONTINUE
        C
        C     DOWNLINK PATH DATA
        C
0107          JERROR=6
0108          DO 640 I=1,NDPATH
0109          WRITE(2,5009,ERR=5030)(DPTHNM(I,J),J=1,20),(DCSPTH(J,I),J=1,
             2       NDELEM)
0110    640   CONTINUE
        C
        C   DOWNLINK CITY DATA
        C
0111          JERROR=7
0112          IF (NDCITY.EQ.0) GO TO 690
0113          DO 650 I=1,NDCITY
0114          WRITE(2,5010,ERR=5030) (DCTNAM(I,J),J=1,16),(DSTCOD(I,J),J=1,2),
             2 DCITYV(I),DCITYH(I),DCTLVL(I),DCTORG(I),(DPTHCY(J,I),J=1,NDPATH)
0115          IF (NDINDX.GT.1) WRITE(2,5008,ERR=5030) (DCTXVL(I,J),J=1,NDINDX-1)
0116    650   CONTINUE
        C
        C   TALKBACK INFORMATION
        C
0117          JERROR=8
0118          IF (NUCITY.EQ.0) GO TO 690
0119          DO 680 J=1,NUCITY
0120          L2 = 0
0121    660   L1 = L2 + 1
0122          L2 = L1 + 12
0123          IF(L1.GT.NDCITY) GO TO 680
0124          IF(L2.GT.NDCITY) L2=NDCITY
0125          WRITE(2,5011,ERR=5030) (TALKBK(I,J),I=L1,L2)
0126    5011  FORMAT (13F6.1)
0127          GO TO 660
0128    680   CONTINUE
0129    690   CLOSE (UNIT=2)
0130          RETURN
        C
        C   IF ERRORS OCCUR WHILE WRITING THE OUTPUT FILE
        C
0131    5020  WRITE(1,5025) (INNAME(I),I=1,16)
0132    5025  FORMAT(1H ,'ERROR OPENING FILE ',16A1)
```

```
0133            GO TO 5040
0134      5030  WRITE(1,5035)(PROBLM(I,JERROR),I=1,3)
0135      5035  FORMAT(1H ,'ERROR WRITING ',3A4,' DATA')
0136      5040  WRITE (1,*) 'BUILDER TERMINATED'
0137            CLOSE (UNIT=2)
0138            STOP
0139            END
```

```
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
      C                        SUBROUTINE YESNO
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
      C CALLED BY: BUILD, COST, PATH, CITY, RATE, MODEL
      C
      C
      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.
      C
0001        SUBROUTINE YESNO
0002        INCLUDE 'SYS:COMBLK.FTN/NOLIST'
0040        YESSNO = 3
0041        READ(1,10,ERR=20) INDATA(1)
0042   10   FORMAT (A1)
0043        IF (INDATA(1).EQ.'Y') YESSNO = 1
0044        IF (INDATA(1).EQ.'N') YESSNO = 2
0045   20   IF (YESSNO.EQ.3) WRITE (1,*) 'ANSWER MUST BE 'YES' OR 'NO''
0046        RETURN
0047        END
```

```
FORTRAN IV-PLUS V02-51C          13:30:55     10-JUN-80           PAGE 1
UPDOWN.FTN       /TR:BLOCKS/WR

        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C                    SUBROUTINE UPDOWN
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C CALLED BY: COST, PATH, CITY, RATE
        C
        C
        C UPDOWN DETERMINES IF THE RESPONSE TO A QUESTION IS 'UPLINK' OR
        C 'DOWNLINK' OR IN ERROR AND SETS THE APPROPRIATE FLAG - ONLY THE
        C FIRST CHARACTER OF THE RESPONSE IS CHECKED.
        C
0001            SUBROUTINE UPDOWN
0002            INCLUDE 'SYS:COMBLK.FTN/NOLIST'
0040            UPPDWN = 3
0041            READ(1,10,ERR=20) INDATA(1)
0042    10      FORMAT(A1)
0043            IF (INDATA(1).EQ.'U') UPPDWN = 1
0044            IF (INDATA(1).EQ.'D') UPPDWN = 2
0045    20      IF (UPPDWN.EQ.3) WRITE (1,*) 'ANSWER MUST BE 'UP' OR 'DOWN''
0046            RETURN
0047            END
```

```
FORTRAN IV-PLUS V02-51C          13:31:52    10-JUN-80          PAGE 1
CODCHK.FTN       /TR:BLOCKS/WR

        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C                        SUBROUTINE CODCHK
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C CALLED BY: COST, PATH, CITY, RATE, MATMOD, RDCOST, MODEL, EARTH
        C
        C   CODCHK CHECKS AN INPUT ARGUMENT AGAINST A LIST OF VALID ARGUMENTS
        C
0001            SUBROUTINE CODCHK(NCHAR,INDATA,NCOMPR,CMPARR,POSITN)
        C
        C   ARGUMENTS:
        C      NCHAR = NUMBER OF CHARACTERS IN INPUT ARGUMENT
        C      INDATA = ARRAY CONTAINING INPUT ARGUMENT
        C      NCOMPR = NUMBER OF POSSIBLE VALUES
        C      CMPARR = ARRAY CONTAINING LIST OF POSSIBLE VALUES
        C      POSITN = POSITION IN THE ARRAY WHERE INPUT ARGUMENT MATCHED
        C               A POSSIBLE VALUE.
        C
0002            INTEGER*2 NCHAR,NCOMPR,POSITN,I,J,NMATCH
0003            LOGICAL*1 INDATA(1),CMPARR(NCOMPR,1)
        C
0004            POSITN  = 0
0005            NMATCH = 0
0006            DO 20 I=1,NCOMPR
0007               DO 10 J=1,NCHAR
0008                  IF (INDATA(J).NE.CMPARR(I,J)) GO TO 20
0009    10         CONTINUE
0010            NMATCH = NMATCH + 1
0011            POSITN = I
0012    20      CONTINUE
        C
        C   USER'S RESPONSE CONTAINED TOO FEW CHARACTERS TO MAKE A UNIQUE MATCH
        C
0013            IF (NMATCH.GT.1) POSITN = -1
0014            RETURN
0015            END
```

```
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C                          SUBROUTINE GETTER
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C SUBROUTINE CALLS: CCOUNT
C
C CALLED BY: MAIN, COST, PATH, CITY, RATE, RDCOST, MATMOD, MODEL
C
C   THIS SUBROUTINE RETRIEVES THE NEXT ARGUMENT ON THE COMMAND LINE
C
0001          SUBROUTINE GETTER
0002          INCLUDE 'SYS:COMBLK.FTN/NOLIST'
0040          LOGICAL*1 BLANK, COMMA, SEMIC
0041          DATA BLANK /' '/, COMMA /','/, SEMIC /';'/
0042          DATA NSTART /1/
C
C   GET RID OF LEADING BLANKS IN INPUT ARGUMENT AND CLEAR ARG ARRAY
C
0043          NCHAR = 0
0044          CONTCD = 1
0045          DO 10 I = 1,80
0046             ARG(I) = BLANK
0047    10    CONTINUE
0048          DO 20 I=NSTART,80
0049             IF (INDATA(I).NE.BLANK) GO TO 30
0050             NSTART = NSTART+1
0051    20    CONTINUE
C
C   CASE WHERE ENTIRE LINE IS EMPTY
C
0052          CONTCD = 0
0053          NSTART = 1
0054          RETURN
C
C   CHECK EACH CHARACTER
C
0055    30    DO 80 I=NSTART,80
0056             IF (INDATA(I).NE.SEMIC) GO TO 50
C
C   SEMICOLON ENCOUNTERED
C
0057              NCHAR = I - NSTART
0058              IF (NCHAR.NE.0) GO TO 40
C
C   IF CHARACTER COUNT IS ZERO
C
0059              NCHAR = 1
0060              ARG(1) = SEMIC
0061              CONTCD = 0
0062              NSTART = 1
0063              RETURN
C
0064    40        NSTART = I
```

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


C3

```
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C                    SUBROUTINE CCOUNT
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C CALLED BY: GETTER
C
C   THIS SUBROUTINE COUNTS CHARACTERS IN AN INPUT ARGUMENT UNTIL
C   IT SEES A SEMICOLON OR COMMA. TRAILING BLANKS ARE IGNORED.
C
      SUBROUTINE CCOUNT (ARG,NCHAR)
      LOGICAL*1 ARG(1),COMMA,BLANK,SEMIC
      INTEGER*2 NCHAR
      DATA COMMA /','/, SEMIC /';'/, BLANK /' '/
C
C   ARGUMENTS:
C      ARG   = ARGUMENT TO BE COUNTED
C      NCHAR = NUMBER OF CHARACTERS (COMPUTED)
C
      DO 20 I = 1,24
         IF (ARG(I).EQ.BLANK) GO TO 20
         IF (ARG(I).NE.SEMIC.AND.ARG(I).NE.COMMA) GO TO 10
         NCHAR = I - 1
         RETURN
10       NCHAR = I
20    CONTINUE
      RETURN
      END
```

```
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C                             SUBROUTINE DISAPR
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C CALLED BY: COST, PATH, CITY
C
C   THIS SUBROUTINE DELETES A COST ELEMENT, PATH, OR CITY FROM THE
C   DATA BASE.  ARGUMENTS:
C
C   CODE=CODE INDICATING TYPE OF DELETION
C             1=UPLINK COST ELEMENT        2=DOWNLINK COST ELEMENT
C             3=UPLINK PATH                4=DOWNLINK PATH
C             5=UPLINK CITY                6=DOWNLINK CITY
C   INDEX=POSITION IN ARRAYS TO BE DELETED
C
      SUBROUTINE DISAPR(CODE,INDEX)
      INCLUDE 'SY0:COMBLK.FTN/NOLIST'
      INTEGER*2 CODE,INDEX
      LOGICAL*1 BLANK
      DATA BLANK /' '/
C
      GO TO (100,200,300,400,500,600), CODE
C
C   UPLINK COST ELEMENT
C
100   IF (INDEX.EQ.NUELEM) GO TO 190
      I1 = INDEX + 1
      DO 110 K=1,4
      DO 110 J=1,NUINDX
      DO 110 I=I1,NUELEM
110   UCSDAT(I-1,J,K) = UCSDAT(I,J,K)
      DO 120 I=I1,NUELEM
120   UCSMIN(I-1) = UCSMIN(I)
      DO 160 I = I1,NUELEM
      DO 130 J = 1,2
130   UCSCOD(I-1,J) = UCSCOD(I,J)
      DO 140 J = 1,20
140   UCSNAM(I-1,J) = UCSNAM(I,J)
      DO 150 J=1,NUPATH
150   UCSPTH(I-1,J) = UCSPTH(I,J)
160   CONTINUE
190   UCSCOD(NUELEM,1) = BLANK
      UCSNAM(NUELEM,1) = BLANK
      NUELEM = NUELEM - 1
      RETURN
C
C   DOWNLINK COST ELEMENT
C
200   IF (INDEX.EQ.NDELEM) GO TO 290
      I1 = INDEX + 1
      DO 210 K=1,4
      DO 210 J=1,NDINDX
      DO 210 I=I1,NDELEM
```

```
0069     210   DCSDAT(I-1,J,K) = DCSDAT(I,J,K)
0070           DO 220 I=I1,NDELEM
0071     220   DCSMIN(I-1) = DCSMIN(I)
0072           DO 260 I = I1,NDELEM
0073           DO 230 J = 1,2
0074     230   DCSCOD(I-1,J) = DCSCOD(I,J)
0075           DO 240 J = 1,20
0076     240   DCSNAM(I-1,J) = DCSNAM(I,J)
0077           DO 250 J=1,NDPATH
0078     250   DCSPTH(I-1,J) = DCSPTH(I,J)
0079     260   CONTINUE
0080     290   DCSCOD(NDELEM,1) = BLANK
0081           DCSNAM(NDELEM,1) = BLANK
0082           NDELEM = NDELEM - 1
0083           RETURN
               C
               C   UPLINK PATH
               C
0084     300   IF (INDEX.EQ.NUPATH) GO TO 390
0085           I1 = INDEX+1
0086           DO 360 I=I1,NUPATH
0087           DO 310 J=1,NUELEM
0088     310   UCSPTH(J,I-1) = UCSPTH(J,I)
0089           DO 320 J=1,NUCITY
0090     320   UPTHCY(I-1,J) = UPTHCY(I,J)
0091           DO 330 J=1,20
0092     330   UPTHNM(I-1,J) = UPTHNM(I,J)
0093     360   CONTINUE
0094     390   UPTHNM(NUPATH,1) = BLANK
0095           NUPATH = NUPATH-1
0096           RETURN
               C
               C   DOWNLINK PATH
               C
0097     400   IF (INDEX.EQ.NDPATH) GO TO 490
0098           I1 = INDEX+1
0099           DO 460 I=I1,NDPATH
0100           DO 410 J=1,NDELEM
0101     410   DCSPTH(J,I-1) = DCSPTH(J,I)
0102           DO 420 J=1,NDCITY
0103     420   DPTHCY(I-1,J) = DPTHCY(I,J)
0104           DO 430 J=1,20
0105     430   DPTHNM(I-1,J) = DPTHNM(I,J)
0106     460   CONTINUE
0107     490   DPTHNM(NDPATH,1) = BLANK
0108           NDPATH = NDPATH-1
0109           RETURN
               C
               C
               C UPLINK CITY
               C
               C
0110     500   IF ( INDEX .EQ. NUCITY ) GO TO 590
0111           I1 = INDEX + 1
0112           DO 560 I = I1,NUCITY
0113               UCITYV(I-1) = UCITYV(I)
```

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

```
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C                                SUBROUTINE RDCOST
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C SUBROUTINE CALLS: GETTER, CODCHK
C
C CALLED BY: COST
C
C   THIS SUBROUTINE READS IN AN INPUT ARGUMENT AND TESTS FOR A COST
C   ELEMENT CODE.
C
      SUBROUTINE RDCOST
      INCLUDE 'SY0:COMBLK.FTN/NOLIST'
C
      READ (1,1000) (INDATA(I),I=1,80)
1000  FORMAT (80A1)
      CALL GETTER
      IF (UPPDWN.EQ.1) CALL CODCHK(2,ARG,MAXUCS,UCSCOD,POSITN)
      IF (UPPDWN.EQ.2) CALL CODCHK(2,ARG,MAXDCS,DCSCOD,POSITN)
      RETURN
      END
```

```
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C                         SUBROUTINE RATECK
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C CALLED BY: RATE
        C
0001          SUBROUTINE RATECK ( LOW, UP, XDAT)
        C
        C THIS ROUTINE CHECKS THE VALUE INDEXES FOR THE RATE MODULE
        C TO MAKE SURE THEY ARE IN RANGE.
        C
        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 ( 1,* ) 'NUMBER OUT OF RANGE - PLEASE RETYPE'
0046    20    RETURN
0047          END
```

```
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
      C                       SUBROUTINE CTYCHK
      C
      CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      C
      C CALLED BY: CITY, MATMOD
      C
      C   THIS SUBROUTINE WILL DETERMINE IF A CITY/ORGANIZATION PAIR EXISTS
      C   AND IF SO, WILL RETURN THE INDEX TO THAT PAIR. ORGANIZATION WILL BE
      C   IGNORED IF COST ALLOCATION HAS NOT BEEN SELECTED.
      C
            SUBROUTINE CTYCHK(POS,ORG)
            INCLUDE 'SY0:COMBLK.FTN/NOLIST'
            INTEGER*2 ORG,NMATCH,LIMIT,POS,POS2
      C
            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.0.AND.NUMORG.GT.0) GO TO 1000
            IF (UPPDWN.EQ.1) LIMIT=NUCITY
            IF (UPPDWN.EQ.2) LIMIT=NDCITY
            DO 130 I=1,LIMIT
               DO 110 J=1,NCHAR
                  IF (UPPDWN.EQ.1.AND.ARG(J).NE.UCTNAM(I,J).OR.
           2          UPPDWN.EQ.2.AND.ARG(J).NE.DCTNAM(I,J)) GO TO 130
      110      CONTINUE
      C
      C   MATCH FOUND
      C
               POS2 = I
               IF (ORG.EQ.UCTORG(I).AND.UPPDWN.EQ.1.OR.
           2       ORG.EQ.DCTORG(I).AND.UPPDWN.EQ.2) GO TO 120
                GO TO 130
      120    NMATCH=NMATCH + 1
             POS = I
      130   CONTINUE
      C
            IF (NMATCH.GT.1) WRITE (1,*) 'SPECIFIED CITY NOT UNIQUE - ENTER MO
           2RE INFORMATION'
            IF (NMATCH.GT.1) POS=-1
            IF (NMATCH.EQ.1) ORG=0
            IF (NMATCH.EQ.0) POS=POS2
            RETURN
      1000  WRITE (1,*) 'AN ORGANIZATION CODE MUST BE SPECIFIED'
            GO TO 1002
      1001  WRITE (1,*) 'INVALID ORGANIZATION CODE'
      1002  POS=-2
            RETURN
            END
```

```
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C                       SUBROUTINE VANDH
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C  CALLED BY: CITY, MODUP, MODDN, EARTH
        C
        C     THIS SUBROUTINE CONVERTS LATITUDE/LONGITUDE TO BELL SYSTEM V AND
        C     H COORDINATES (PROVIDES A SIMPLER MEANS OF ESTABLISHING THE
        C     DISTANCE BETWEEN TWO CITIES).
        C
        C  PARAMETERS: M - NEGATIVE OF THE LATITUDE IN DDMM FORMAT
        C              N - LONGITUDE IN DDDMM FORMAT
        C
0001          SUBROUTINE VANDH(M,N)
0002          INTEGER*4 I,J
        C
        C     COMPUTE 'A' WHICH IS THE LATITUDE IN RADIANS AND FRACTIONS OF A
        C     RADIAN
        C
0003          I=((-1)*M)/100
0004          J=(M+I*100)*(-1)
0005          A=FLOAT(I)/57.2958+FLOAT(J)/3437.75
        C
        C     COMPUTE 'B' WHICH IS THE LONGITUDE IN THE SAME UNITS
        C
0006          I=N/100
0007          J=N-I*100
0008          B=FLOAT(I)/57.2958+FLOAT(J)/3437.75
        C
        C     THE FOLLOWING CALCULATIONS ARE A GEOMETRIC APPROXIMATION TO A
        C     BELL SYSTEM PROPRIETARY ALGORITHM. A KNOWN POINT IN BOTH SYSTEMS
        C     IS USED AS A REFERENCE (IN THIS CASE, NEW YORK CITY WHICH HAS
        C     A V AND H OF 4995,1408). SPHERICAL TRIGONOMETRY IS USED TO
        C     DETERMINE THE AZIMUTH AND DISTANCE TO THE UNKNOWN POINT.
        C     AZIMUTH AND DISTANCE FORM A VECTOR USED TO COMPUTE THE V AND H
        C     COORDINATE.
        C
0009          ALPHA=0.652786*SIN(A)+0.757542*COS(A)*COS(1.29144-B)
0010          THETA=(SIN(A)-ALPHA*0.652786)/(0.757542*SQRT(1.-ALPHA*ALPHA))
0011          THETA=ACOS(THETA)
0012          IF(B.GT.1.29144)THETA=6.283185-THETA
0013          BETA=2.22013-THETA
0014          DIST=12510.25*ACOS(ALPHA)
0015          M=IFIX(4995.-DIST*SIN(BETA))
0016          N=IFIX(1408.-DIST*COS(BETA))
0017          RETURN
0018          END
```

```
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C                                SUBROUTINE MATMOD
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC CCCCCCCC
        C
        C SUBROUTINE CALLS: GETTER, CODCHK, CTYCHK, REPRTR
        C
        C CALLED BY: COST, PATH, CITY
        C
        C   THIS SUBROUTINE CHANGES THE MATRICES OF 1'S AND 0'S.  IT READS A
        C   LIST OF COST ELEMENTS, PATHS, OR CITIES, AND MAKES APPROPRIATE
        C   CHANGES IN UCSPTH,DCSPTH,UPTHCY, AND DPTHCY.  ARGUMENTS:
        C
        C   CODE=TYPE OF CHANGE
        C      1=READ UPLINK COST ELEMENTS, MODIFY COST ELEMENT/PATH MATRIX
        C      2=READ DNLINK COST ELEMENTS, MODIFY COST ELEMENT/PATH MATRIX
        C      3=READ UPLINK PATHS,         MODIFY COST ELEMENT/PATH MATRIX
        C      4=READ DNLINK PATHS,         MODIFY COST ELEMENT/PATH MATRIX
        C      5=READ UPLINK PATHS,         MODIFY PATH/CITY MATRIX
        C      6=READ DNLINK PATHS,         MODIFY PATH/CITY MATRIX
        C      7=READ UPLINK CITIES,        MODIFY PATH/CITY MATRIX
        C      8=READ DNLINK CITIES,        MODIFY PATH/CITY MATRIX
        C   ONOFF=1 OR 0, DEPENDING ON WHETHER THE MATRIX IS TO BE SET ON OR OFF
        C   MODPOS=ELEMENT IN THE MATRIX WHICH IS NOT BEING READ IN
        C
0001          SUBROUTINE MATMOD(CODE,ONOFF,MODPOS)
0002          INCLUDE 'SY0:COMBLK.FTN/NOLIST'
0040          INTEGER*2 MODPOS,CODE,ONOFF,POS,ORG
        C
0041          GO TO (100,100,200,200,200,200,300,300), CODE
        C
        C   COST ELEMENTS SPECIFIED
        C
0042    100   WRITE (1,*) 'ENTER COST ELEMENT CODES, ALL, OR $'
0043          READ(1,900) (INDATA(I),I=1,80)
0044    105   CALL GETTER
0045          IF (ARG(1).EQ.'$') 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,ARG,MAXUCS,UCSCOD,POSITN)
0049          IF (CODE.EQ.2) CALL CODCHK(2,ARG,MAXDCS,DCSCOD,POSITN)
0050          IF (POSITN.EQ.0) GO TO 180
0051          IF (CODE.EQ.1) UCSPTH(POSITN,MODPOS) = ONOFF
0052          IF (CODE.EQ.2) DCSPTH(POSITN,MODPOS) = ONOFF
0053    170   IF (CONTCD.EQ.0) GO TO 100
0054          IF (CONTCD.NE.0) GO TO 105
        C
        C   IF ERRORS HAVE OCCURRED
        C
0055    180   WRITE (1,*) 'INVALID COST ELEMENT CODE'
0056          WRITE (1,*) 'VALID COST ELEMENTS ARE...'
0057          CALL REPRTR(9,1)
0058          GO TO 100
        C
```

```
0059    190   DO 195 I=1,NELEM(UPPDWN)
0060             IF (CODE.EQ.1) UCSPTH(I,MODPOS)=ONOFF
0061             IF (CODE.EQ.2) DCSPTH(I,MODPOS)=ONOFF
0062    195   CONTINUE
0063          RETURN
          C
          C   PATHS SPECIFIED
          C
0064    200   WRITE (1,*) 'ENTER PATH NAMES, ALL, OR $'
0065          READ(1,900) (INDATA(I),I=1,80)
0066    205   CALL GETTER
0067          IF (ARG(1).EQ.'$') RETURN
0068          IF (ARG(1).EQ.'A'.AND.ARG(2).EQ.'L'.AND.ARG(3).EQ.'L') GO TO 295
0069          IF (NCHAR.EQ.0) GO TO 270
0070          IF (UPPDWN.EQ.1) CALL CODCHK(NCHAR,ARG,MAXUPA,UPTHNM,POSITN)
0071          IF (UPPDWN.EQ.2) CALL CODCHK(NCHAR,ARG,MAXDPA,DPTHNM,POSITN)
0072          IF (POSITN.EQ.0) GO TO 280
0073          IF (POSITN.LT.0) GO TO 290
0074          IF (CODE.EQ.3) UCSPTH(MODPOS,POSITN) = ONOFF
0075          IF (CODE.EQ.4) DCSPTH(MODPOS,POSITN) = ONOFF
0076          IF (CODE.EQ.5) UPTHCY(POSITN,MODPOS) = ONOFF
0077          IF (CODE.EQ.6) DPTHCY(POSITN,MODPOS) = ONOFF
0078    270   IF (CONTCD.EQ.0) GO TO 200
0079          IF (CONTCD.NE.0) GO TO 205
          C
          C   IF ERRORS HAVE OCCURRED
          C
0080    280   WRITE (1,*) 'PATH DOES NOT EXIST. VALID PATHS ARE...'
0081          CALL REPRTR(3,1)
0082          GO TO 200
0083    290   WRITE (1,*) 'SPECIFIED PATH NOT UNIQUE - ENTER MORE INFORMATION'
0084          GO TO 200
          C
0085    295   DO 297 I=1,NPATH(UPPDWN)
0086             IF (CODE.EQ.3) UCSPTH(MODPOS,I)=ONOFF
0087             IF (CODE.EQ.4) DCSPTH(MODPOS,I)=ONOFF
0088             IF (CODE.EQ.5) UPTHCY(I,MODPOS)=ONOFF
0089             IF (CODE.EQ.6) DPTHCY(I,MODPOS)=ONOFF
0090    297   CONTINUE
0091          RETURN
          C
          C   CITIES SPECIFIED
          C
0092    300   WRITE (1,*) 'ENTER CITY NAMES, ALL, OR $'
0093          READ(1,900) (INDATA(I),I=1,80)
0094    305   CALL GETTER
0095          IF (ARG(1).EQ.'$') RETURN
0096          IF (ARG(1).EQ.'A'.AND.ARG(2).EQ.'L'.AND.ARG(3).EQ.'L') GO TO 390
0097          IF (NCHAR.EQ.0) GO TO 370
0098          CALL CTYCHK(POSITN,ORG)
0099          IF (POSITN.EQ.0) GO TO 380
0100          IF (POSITN.LT.0) GO TO 370
0101          IF (NUMORG.GT.0.AND.ORG.NE.0) GO TO 380
0102          IF (CODE.EQ.7) UPTHCY(MODPOS,POSITN) = ONOFF
0103          IF (CODE.EQ.8) DPTHCY(MODPOS,POSITN) = ONOFF
0104    370   IF (CONTCD.EQ.0) GO TO 300
```

```
0105            IF (CONTCD.NE.0) GO TO 305
                C
                C   IF ERRORS HAVE OCCURRED
                C
0106    380     WRITE (1,*) 'CITY DOES NOT EXIST'
0107            WRITE (1,*) 'VALID CITIES ARE...'
0108            CALL REPRTR(10,1)
0109            GO TO 300
                C
0110    390     DO 395 I=1,NCITY(UPPDWN)
0111               IF (CODE.EQ.7) UPTHCY(MODPOS,I)=ONOFF
0112               IF (CODE.EQ.8) DPTHCY(MODPOS,I)=ONOFF
0113    395     CONTINUE
0114            RETURN
                C
0115    900     FORMAT(80A1)
0116            END
```

```
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C                    SUBROUTINE REPRTR
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
        C CALLED BY: COST, PATH, CITY, RATE, MATMOD, MODEL, MODUP, MODDN
        C
        C   THIS SUBROUTINE CONTAINS THE REPORT FORMATS USED IN THE MODEL
        C
0001            SUBROUTINE REPRTR (REPTYP, POS)
0002            INCLUDE 'SYO:COMBLK.FTN/NOLIST'
0040            INTEGER*2 REPTYP, POS,BLANK,STAR,OUTARR(30)
0041            REAL*4 PER, CTYPE(4), LINK, UPDOWN(2)
0042            DATA PER /'PER '/, BLANK /'  '/, STAR /' *'/, LINK/'LINK'/
0043            DATA UPDOWN/'  UP','DOWN'/
0044            DATA CTYPE /'CAP ','INS ','LES ','OMA '/
        C
0045            GO TO (1000,2000,3000,4000,5000,6000,7000,8000,9000,10000),
                2 REPTYP
        C
0046    1000    IF (UPPDWN.EQ.2) GO TO 1500
        C
        C   UPLINK COST ELEMENT REPORT
        C
0047            WRITE (3,1400) (UCSCOD(POS,J),J=1,2),(UCSNAM(POS,J),J=1,20)
0048    1400    FORMAT (1H0,'DATA FOR COST ELEMENT ',2A1,' -- ',20A1)
0049            IF (NUINDX.GE.2) WRITE (3,1410) (PER,I=2,NUINDX)
0050    1410    FORMAT (1H0,15X,5(7X,A4))
0051            WRITE (3,1420) ((UCINDX(I,J),J=1,8),I=1,NUINDX)
0052    1420    FORMAT (1H ,6X,6(3X,8A1))
0053            WRITE (3,*) ' '
0054            DO 1450 K=1,4
0055    1450    WRITE (3,1460) CTYPE(K), (UCSDAT(POS,J,K),J=1,NUINDX)
0056    1460    FORMAT (1H ,A4,6F11.2)
0057            WRITE (3,1470) UCSMIN(POS)
0058    1470    FORMAT (1H ,'MINIMUM LEASE COST =',F9.2/)
0059            GO TO 99999
        C
        C   DOWNLINK COST ELEMENT REPORT
        C
0060    1500    WRITE (3,1400) (DCSCOD(POS,J),J=1,2),(DCSNAM(POS,J),J=1,20)
0061            IF (NDINDX.GE.2) WRITE (3,1410) (PER,I=2,NDINDX)
0062            WRITE (3,1420) ((DCINDX(I,J),J=1,8),I=1,NDINDX)
0063            WRITE (3,*) ' '
0064            DO 1750 K=1,4
0065    1750    WRITE (3,1460) CTYPE(K), (DCSDAT(POS,J,K),J=1,NDINDX)
0066            WRITE (3,1470) DCSMIN(POS)
0067            GO TO 99999
        C
        C   MATRIX OF UPLINK COST ELEMENTS ASSOCIATED WITH EACH PATH
        C
0068    2000    IF (UPPDWN.EQ.2) GO TO 2500
0069            WRITE (3,1800) UPDOWN(1),LINK
0070    1800    FORMAT (1H0,/,1H ,'MATRIX OF COST ELEMENTS AND PATHS--',2A4)
0071            WRITE (3,1900) ((UCSCOD(I,J),J=1,2),I=1,NUELEM)
```

```
0072    1900  FORMAT (1HO,20X,15(1X,2A1))
0073          DO 1600 J=1,NUPATH
0074          DO 1590 I=1,NUELEM
0075          OUTARR(I) = BLANK
0076          IF (UCSPTH(I,J).EQ.1) OUTARR(I) = STAR
0077    1590  CONTINUE
0078          WRITE (3,1910) (UPTHNM(J,K),K=1,20),(OUTARR(I),I=1,NUELEM)
0079    1910  FORMAT(1HO,20A1,15(1X,A2))
0080    1600  CONTINUE
0081          GO TO 99999
        C
        C   MATRIX OF DOWNLINK COST ELEMENTS ASSOCIATED WITH EACH PATH
        C
0082    2500  WRITE (3,1800) UPDOWN(2),LINK
0083          WRITE (3,1900) ((DCSCOD(I,J),J=1,2),I=1,NDELEM)
0084          DO 2600 J=1,NDPATH
0085          DO 2590 I=1,NDELEM
0086          OUTARR(I) = BLANK
0087          IF (DCSPTH(I,J).EQ.1) OUTARR(I) = STAR
0088    2590  CONTINUE
0089          WRITE (3,1910) (DPTHNM(J,K),K=1,20),(OUTARR(I),I=1,NDELEM)
0090    2600  CONTINUE
0091          GO TO 99999
        C
        C   LIST OF UPLINK PATH NUMBERS AND NAMES
        C
0092    3000  IF (UPPDWN.EQ.2) GO TO 3500
0093          WRITE (3,3010)
0094    3010  FORMAT(1HO,/,' NO.',6X,'PATH NAME'/)
0095          DO 3100 I=1,NUPATH
0096          WRITE (3,3090) I,(UPTHNM(I,J),J=1,20)
0097    3090  FORMAT(1H ,I3,5X,20A1)
0098    3100  CONTINUE
0099          GO TO 99999
        C
        C   MATRIX OF DOWNLINK PATH NUMBERS AND NAMES
        C
0100    3500  WRITE (3,3010)
0101          DO 3600 I=1,NDPATH
0102          WRITE (3,3090) I,(DPTHNM(I,J),J=1,20)
0103    3600  CONTINUE
0104          GO TO 99999
        C
        C   MATRIX OF UPLINK PATHS AND CITIES
        C
0105    4000  IF (NCITY(UPPDWN).EQ.0) GO TO 4600
0106          WRITE (3,4010) UPDOWN(UPPDWN),LINK
0107    4010  FORMAT (1HO,/,1H ,'MATRIX OF PATHS AND CITIES--',2A4)
0108          J1 = 1
0109          J2 = MIN(NPATH(UPPDWN),16)
0110          WRITE (3,4030) (J,J=J1,J2)
0111    4030  FORMAT(1HO,'  CITY',13X,'ORG ',16I3/)
0112          IF (UPPDWN.EQ.2) GO TO 4500
0113          DO 4080 I=1,NUCITY
0114          IF (UCITYV(I).EQ.-1) GO TO 4080
0115          DO 4070 J=J1,J2
```

```
0116           OUTARR(J) = BLANK
0117           IF (UPTHCY(J,I).EQ.1) OUTARR(J) = STAR
0118     4070  CONTINUE
0119           IF (NUMORG.EQ.0)
              2   WRITE (3,4075) (UCTNAM(I,J),J=1,16), (OUTARR(J-J1+1),J=J1,J2)
0120     4075  FORMAT('0',16A1,7X,16(1X,A2))
0121           IF (NUMORG.GT.0)  WRITE (3,4076) (UCTNAM(I,J),J=1,16),UCTORG(I),
              2   (OUTARR(J-J1+1),J=J1,J2)
0122     4076  FORMAT('0',16A1,I5,2X,16(1X,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           IF (DCITYV(I).EQ.-1) GO TO 4580
0127           DO 4570 J=J1,J2
0128           OUTARR(J) = BLANK
0129           IF (DPTHCY(J,I).EQ.1) OUTARR(J) = STAR
0130     4570  CONTINUE
0131           IF (NUMORG.EQ.0)
              2   WRITE (3,4075) (DCTNAM(I,J),J=1,16), (OUTARR(J-J1+1),J=J1,J2)
0132           IF (NUMORG.GT.0)  WRITE (3,4076) (DCTNAM(I,J),J=1,16),DCTORG(I),
              2   (OUTARR(J-J1+1),J=J1,J2)
0133     4580  CONTINUE
0134           GO TO 99999
         C
0135     4600  WRITE (3,*) 'THERE ARE NO CITIES IN THIS SEGMENT'
0136           GO TO 99999
         C
         C
         C UPLINK CITIES AND ASSOCIATED COST INDEX VALUES
         C
0137     5000  WRITE (3,5050) UPDOWN(UPPDWN), LINK
0138     5050  FORMAT ('0',24X,2A4,' COST INDEX VALUES',///)
0139           IF (UPPDWN.EQ.2) GO TO 5500
0140           DO 5275 I=1,NUCITY
0141           WRITE (3,5060) (UCTNAM(I,J),J=1,16),UCTORG(I)
0142     5060  FORMAT ('0',16A1,I3)
0143           WRITE (3,5075) ((UCINDX(K,J),J=1,8),K=2,NUINDX)
0144     5075  FORMAT (6X,5(4X,8A1))
0145           IF (UCITYV(I).EQ.-1) GO TO 5275
0146           WRITE (3,5100) (UCTXVL(I,J),J=1,NUINDX-1)
0147     5100  FORMAT (9X,F8.2,4(4X,F8.2))
0148     5275  CONTINUE
0149           GO TO 99999
         C
         C
         C DOWNLINK CITIES AND ASSOCIATED COST INDEXES
         C
         C
0150     5500  DO 5800 I=1,NDCITY
0151           WRITE (3,5060) (DCTNAM(I,J),J=1,16),DCTORG(I)
0152           WRITE (3,5075) ((DCINDX(K,J),J=1,8),K=2,NDINDX)
0153               IF (DCITYV(I).EQ.-1) GO TO 5800
0154               WRITE (3,5100) ( DCTXVL(I,K),K=1,(NDINDX-1))
```

```
0155    5800  CONTINUE
0156          GO TO 99999
              C
              C
              C
              C TALKBACK MATRIX BETWEEN UPLINK AND DOWNLINK CITIES
              C
              C
              C
0157    6000  IF (NDCITY.EQ.0) GO TO 6600
0158          WRITE (3,6050) ((UCTNAM(I,J),J=1,3),I=1,NUCITY)
0159    6050  FORMAT(1H0,'MATRIX OF TALKBACK REQUIREMENTS',//,
             2 ' DOWNLINK CITY   ORG  ', 10(2X,3A1))
0160          WRITE (3,6100) (UCTORG(I),I=1,NUCITY)
0161    6100  FORMAT (21X,10I5,/)
0162          DO 6500 I=1,NDCITY
0163          WRITE (3,6150) (DCTNAM(I,J),J=1,16), DCTORG(I),
             2               (TALKBK(I,J),J=1,NUCITY)
0164    6150  FORMAT (1H ,16A1,I2,3X,10(1X,F4.1),///)
0165    6500  CONTINUE
0166          GO TO 99999
              C
0167    6600  WRITE (3,*) 'THERE ARE NO DOWNLINK CITIES IN THIS SEGMENT'
0168          GO TO 99999
              C
              C
              C ORGANIZATION NAMES AND NUMBERS
              C
0169    7000  IF (NUMORG.EQ.0) GO TO 7200
0170          WRITE (3,7025)
0171    7025  FORMAT ('0','ORGANIZATION NAMES AND NUMBERS'/)
0172          DO 7100 I = 1,NUMORG
0173              WRITE (3,7050) (ORGNAM(I,J),J=1,20),I
0174    7050      FORMAT ( 1X, 20A1, 5X, I1)
0175    7100  CONTINUE
0176          GO TO 99999
              C
0177    7200  WRITE (3,*) 'THERE ARE NO ORGANIZATIONS IN THIS SCENARIO'
0178          GO TO 99999
              C
              C   AUXILIARY PARAMETERS
              C
0179    8000  WRITE (3,8010) DDDINS, WATINS, PVTINS,
             2                DDDLES, WATLES, PVTFIX,
             3                                PVTMIL,
             4                DDDCPH, WATCPH,
             5                        WATMAX,
             6 DISCNT,EQPLIF, (CTYPE(I), GANDAD(I), I=1,4),TLKCAP
0180    8010  FORMAT (1H0,/,17X,'AUXILIARY PARAMETERS',//,
             2 ' TALKBACK:',24X,'DDD',8X,'WATS',8X,'PVT',/,
             3 3X,'INSTALLATION',          13X,F10.2,2X,2F10.2/
             4 3X,'ZERO USAGE CHARGE/MO.',4X,F10.2,F12.2,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:',/, 4(3X,A4,5X,F12.2,/),///,
     C ' TALKBACK CAPITAL EXPENDITURES:',/,2X,F10.2, //)
0181       GO TO 99999
      C
      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
      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),
     2                       (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),
     2                       (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).

APPENDIX F

OPERATIONAL COSTS AND MANAGEMENT CONSIDERATIONS

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

1. INSTALLATION

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

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

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

Installation on other computers or on a commercial time-sharing service could be a costly proposition. Compatibility with DEC FORTRAN should be the primary consideration. A minimum of two man-weeks should be allocated for conversion, assuming that the target system is well understood. If a commercial time-sharing service is the target system, a minimum of $1,500 should be budgeted for the conversion. The advantage of converting the model to a

large computer is that larger scenarios could be developed (more cities, more paths, and more cost elements). In addition, most commercial time-sharing services offer nationwide dial-up access as part of their general services.

2. SOFTWARE MAINTENANCE

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

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

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

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

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

3. HARDWARE MAINTENANCE

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

4. CUSTOMER SERVICE

The user's guide should answer most questions about the model, but it will not be of much help in answering application-dependent inquiries. Therefore, it would be most useful for the organization that maintains the

model to have staff available to assist in user applications or refer users to another organization. Service can be provided on a consulting basis (user charged by the hour) for complex questions or handled under an overhead account for simple questions. The amount of time required to perform this activity is proportional to the number of user requests for assistance, but it can be billed on a cost-reimbursement basis.

5. COSTS AND BILLING

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

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

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

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

6. SUMMARY AND RECOMMENDATIONS

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

---

*Assumes a two-hour hookup to computer.

Table F-1. COST SUMMARY BY TASK

Task	Time and Dollar Expenditure	
	Commercial Time-Sharing Service	Government-owned or Privately owned PDP-11 Minicomputer
Installation		
Manpower	2 man-weeks	2 man-days
Computer Charges	$1,500	$0
Software Maintenance		
Familiarization	2 man-days*	2 man-weeks
Monthly Maintenance	3 man-days	3 man-days
Computer Charges	$100	$0
Monthly On-Line Storage Charges	$500	$0
Hardware Maintenance	$0	0-$600**
Customer Service		
Model Assistance	3 man-days per month (depends on model usage)	Same
Network Consulting	As required, directly billable	
Administration		
Billing	2 man-days per month	2 man-days per month
Nationwide Dial-up Access	$0	$244 for 10 hours and $18.31 for each additional hour per month

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