

QUEEN
P

91
.C655
B68
1971
v.2

Communications
Canada

THE WIRED SCIENTIFIC CITY STUDY

2nd Interim Report

COMMUNICATIONS FACILITIES

by B.A. Bowen, D.C. Coll, and
D.A. George

91
.C655
B68
1971
v.2

Industry Canada
Library Queen
JUN 23 1998
Industrie Canada
Bibliothèque Queen

THE WIRED SCIENTIFIC CITY STUDY

2nd Interim Report

COMMUNICATIONS FACILITIES

by B.A. Bowen, D.C. Coll, and
D.A. George

~~Industry Canada
Library - Queen
SEP 18 1995
Industrie Canada
Bibliothèque - Queen~~

THE WIRED SCIENTIFIC CITY STUDY

2nd Interim Report

31 August 1971

B.A. Bowen, D.C. Coll, and D.A. George

Division of Systems Engineering

Carleton University

Ottawa, Canada

prepared for

Department of Communications

under

Research Contract OLG.R.36100-1-0096

Report Schedule

1st Interim - July 31

Final - October 31.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the continuing contributions to this study of our advisory committee.

Dr. John B. de Mercado - Project Officer
Director,
Terrestrial Systems and Technology Planning
Department of Communications.

Mr. Colin A. Billowes
Manager,
Wide Band Systems
Bell-Northern Research.

Dr. Jack Chambers
Information Science Group,
Communications Research Centre.

Dr. A. Roger Kaye
Communication Systems Studies Group,
Communications Research Centre.

Dr. Clement Lemyre
Chairman,
Department of Electrical Engineering,
University of Ottawa.

In addition, the authors gratefully acknowledge a most useful discussion with Mr. Ken Narraway of Electronics Inc. concerning practical network designs. Discussions were also held with Mr. D.M. Atkinson, and Mr. R. Lindsay of the Bell-Canada concerning their broad-band network capabilities.

A related project under our direction has yielded considerable experience with multi-station television conferences due to the enthusiasm, and dedication of Mr. John A. Chenier, Mr. Pasteur Ntake, Mr. Rick Parson, and Miss Charlotte Reed which is gratefully acknowledged.

TABLE OF CONTENTS

Preface

Summary

Introduction

Chapter 1 A Spectrum of Networks

1.1 Descriptions of Possibilities

1.2 Networks

1.2.1 The Central Distribution Network

1.2.2 The Loop, or Decentralized Network

1.2.3 East-West Video Trunks

1.2.4 A Coaxial Cable Distributed Network

Chapter 2 Terminal Configurations

2.1 Studio Classroom

2.2 Conference

2.3 Relative Costs

Chapter 3 Summary

Appendix 1: A Control Algorithm

Appendix 2: Preliminary Report on Teleconferencing Experiments at Carleton

Appendix 3: Plans for Local System Developments and Research

Appendix 4: Image Interleaving for Writing Space Distribution

Appendix 5: Facsimile - A Medium for a Writing Space

Appendix 6: Terminal Configurations for the Many-to-Many Conference.

PREFACE

This second interim report describes, in a preliminary fashion, the work done thus far in Phase II of a study being conducted by:

Dr. D.A. George, Dean of the Faculty of Engineering

Dr. B.A. Bowen, Professor of Engineering

Dr. D.C. Coll, Associate Professor of Engineering

of the Systems Engineering Division of the Faculty of Engineering of Carleton University, Ottawa, contracted by the Department of Communications, Ottawa in Contract OGR1-66, with Dr. J.B. de Mercado, Director of Terrestrial Systems and Technology Planning.

This contract states:

"Service to be Performed

To conduct a study, on behalf of the Department of Communications, Material Management Division, to determine the feasibility of and develop a plan for creating an economical and efficient teaching/research broadband communications network between Ottawa and Carleton Universities and certain Government and Industrial Research establishments in Canada, for the period of April 1, 1971 to October 31, 1971."

Phase I consisted of:

1. a) Survey of potential users and their information requirements, facilities, and potential applications.
 - b) Survey of available facilities and systems including common-carrier, and other experiment facilities under development.
 - c) Survey of terminal equipment, including television, audio, hard-copy devices, writing tablets, computer graphics, and studio facilities.
2. Definition of the objectives and purposes of a research/teaching network.

Concerning Phase II the contract states:

"Phase II of the study will consist of the specification of a practicable pilot network, including cost estimates, and development and installation time estimates and possible management structures."

SUMMARY

Certain polarizations with respect to the "Wired Scientific City" are beginning to form at this time. To expose these points of view and to elicit discussions it is deemed worthwhile to explicitly list them; these are not recommendations as such and modifications may evolve as the work progresses. Thus:

- 1) A significant, community exists in Ottawa within government, industry and University in which telecommunications can play a significant role in enhancing the communications process.
- 2) The functions that telecommunications must support are:
 - a) Lectures and seminars
 - b) Collaborations, and
 - c) Conferences and discussions;with the ability to interact with information retrieval systems as they develop.
- 3) Two types of terminals should be available in the pilot network: the conference and the classroom terminal.
- 4) While multi-station television conferences are practical, effective and efficient, many questions related to the audio loop, common writing space, video resolution and terminal design remain to be resolved.
- 5) For implementation of a pilot network it appears most important that the users and experimenters have control over the full bandwidth of the network. This control is necessary

so that a wide variety of experiments and uses can be planned without regard to interference with other conventional communications activities.

- 6) To implement 5) a dual coaxial cable is the most attractive, combining low cost per channel and total isolation from social communications activities.

The final report on this study, to be issued on 31 October 1971, will include the results of the studies to date as well as further material about the community, detailed designs of the pilot network and its terminals; and the use of the pilot network by the research/teaching community and others. Of particular importance is the evaluation of an arrangement for managing the network to insure that all aspects of its capabilities are explored. Some form of cooperative arrangement or management committee will be necessary and our recommendations in this area will be presented in the final report.

INTRODUCTION

In the 1st interim report, submitted on July 31, 1971, the general characteristics of a communications system appropriate to a pilot "wired scientific city" were discussed. It was argued therein that a communications system for a research/teaching community should provide for lectures and seminars, collaboration and general discussions. The system should thus be designed to operate in three modes:

- 1) The one-to-one mode,
to provide for discussions and working sessions between two individuals.
- 2) The one-to-many mode,
with a limited talk-back capability; to provide for conventional lecture series and seminars.
- 3) The many-to-many mode,
to bring all users into a "common space"; to provide for group discussions.

It was emphasized that the immediate concern of the authors was primarily with a system based on human-to-human interaction, but that man-machine and machine-machine interactions were vital components of scientific communications. It was and is of concern in our deliberations that proposals for a pilot network will be:

- 1) economically feasible
- 2) technically feasible, and
- 3) acceptable to the users.

As noted above, Phase I was concerned with "definitions of objectives" and "definition of purposes of a teaching/research network". During this phase, surveys were being made of potential users, their information requirements, facilities, and potential applications; of available facilities; and of terminal equipment. As well, the nature of the communications services that a network should provide to the teaching/research community in Ottawa were defined and the rationale of the network discussed. This phase was reported in interim report number one dated July 31, 1971.

This report is concerned with two main things. The first is the presentation of various network designs which would provide a practical implementation of the pilot network. The second is a description of various terminal configurations which are considered desirable. Preliminary estimates of costs are given with the exception of a network based on Bell-Canada facilities, which, it is hoped, will be available for the final report.

Finally, it is recalled from the first interim report that the main medium would be television, with all signals from all nodes being available at each. A wide variety of possible sub-video systems and services was described in phase I, but will not be considered further in this report.

In considering the "Wired City" one tends to think of a dial-up system similar to the telephone. This type of system is well-suited for one-to-one communications; however the inherent difficulties of conference switching and network matching indicate that this may not be the direction in which a video system should evolve. In any event we are concerned with the possibilities of implementation with present technology and have, therefore, not concerned ourselves with techniques which are not yet developed.

The pilot network will provide a wideband communications facility for its users; giving implementation, operational, and applications experience to communication system planners and engineers, as well as providing an experimental resource for engineers, social scientists, and urban planners. For this reason the pilot network must be flexible and functionally versatile. These features are inherent in a broadband coaxial cable network linking the nodes, with all switching occurring at the nodes. At this stage in the study, the preferred implementation of the "wired scientific city" would consist of a pair of coaxial cables, carrying up to twenty channels each, with video switching at the nodes controlled by a small computer.

Three networks are discussed in this report, the above coaxial system being a particular realization of the second network discussed.

The first network has a central distribution point linked either by radio or line to each node. This proposed network could become a switched system in the future.

The second is a loop-distribution system which fulfills all our requirements. It has some node-switching characteristics which could be controlled by a mini-computer. An illustrative algorithm for such control was programmed and is included.

The final network provides a link for two sub-systems now in the planning and implementation stage. At this time, the Communications Research Centre and Bell-Northern Research are being linked by cable

to provide full duplex video. In addition, funds have been received by Carleton University to plan and possibly implement a similar link to the University of Ottawa. The joining of these systems by an east-west trunk which could include Department of Communications headquarters, would implement the proposed pilot network.

The pilot network is, of course, a connector between nodes. The nodes contain local systems which may evolve with considerable diversity depending on financial and other constraints. We have attempted to synthesize our observations of existing systems and two in-house experiments into three classes of local studio configurations. The three represent a classroom, a conference, and a seminar facility, which are the functions most likely to be utilized by the participants in the "wired scientific city".

Finally, certain aspects of the system which particularly appeal to us as most feasible are discussed.

Material relevant to the study, including some experimental interactive television conferencing, is presented in a series of appendices.

CHAPTER 1

ALTERNATIVE NETWORK PROPOSALS

1.1 Network Possibilities

This chapter describes a series of three possible networks for the "wired scientific city" pilot project. Each of the networks described can provide the same services, and all are based on the origination of two video signals at each node.*

The network of the pilot project may or may not include switching. Switching, whether it occurs in a centralized exchange, or is distributed throughout the network, may be used to control the connections in existence at any one time. An unswitched network is essentially a distribution system with all signals available at all nodes at all times, as a cable television network has. In this case, the user at the node may select the signals he wishes. He, presumably, may also insert the signals he wishes for distribution. However, if it is desirable to make use of part of the network for some purpose, and to exclude others from participating, then controlled switching is required. Switching is also required if existing channels are to be used to carry the traffic of an expanded network. The inclusion of centralized switching, as opposed to distributed switching or message selection and insertion at the nodes, is a costly option for a pilot network. An unswitched pilot network can provide the functions of the "wired scientific city" through cooperative use.

* As outlined previously, one of the video signals depicts the writing surface at each node. These, of course, are very slowly varying images and is wasteful in a sense to devote television cameras and bandwidths to their display. A brief description of a more efficient use of the video writing space is given in Appendix 4.

The networks fall into the following categories:

- i) central distribution, with and without control;
- ii) loop distribution, with and without control; and
- iii) an east-west trunk.

The concern of this chapter is with video channels. The networks described provide for communications between nodes, and are not concerned with local distribution at the nodes. Inquiries regarding plans for local systems at the Communications Research Centre and Bell-Northern Research have not yet been answered. The universities' plans are described in Appendix 3.

It is assumed that appropriate voice facilities can be provided either through telephone conference circuits, audio channels associated with the video, or a separate network. This assumption is based on an awareness of severe technical problems in the audio portions of multi-station networks, and of the balancing required in telephone conference circuits or "hot-line" audio networks. Research is presently in progress at Carleton University into methods of automatically altering the open-loop impedance of audio loops to suppress oscillations.

It is well recognized that many services may be provided by conventional voice frequency telephone circuits, as was discussed in Chapter 3 of the 1st interim report. However, networks without video will not be discussed further in this chapter.

The means by which any configuration should be implemented is not specifically defined in this interim report; it is considered that

two primary means exist, viz., cable and microwave radio. The networks will be specified in terms of costs provided by the common carriers, in the case of cable, and in terms of equipment and estimated costs in the case of microwave. Costs related to the provision of channels by the common carriers depend to a large extent on the state of the current common carrier plant and their estimation of the potential for continued use of any channels installed as a result of the pilot project. Response to inquiries related to the Bell Canada capabilities for video service in the Ottawa area are outstanding at this time.

A map of the Ottawa area, with possible sites of the pilot project indicated, is shown in Figure 1. Of particular interest is the "linear" geometry of Ottawa: from the Communications Research Centre and Bell-Northern Research in the west, to the National Research Council in the east, the sites fall almost in a straight line.

1.2.1 The Central Distribution Network

This network, shown schematically in Figure 2, comprises the transmission of two channels from each node to a central distribution point, from whence all required signals are distributed to each node. The central point, which corresponds to the central office (or offices) found in common carrier systems, may or may not contain switching. If it does not, then all signals are always available at each node. Privacy, and isolation of nodes of the network, can be achieved with switching, scrambling or various combinations of these three.

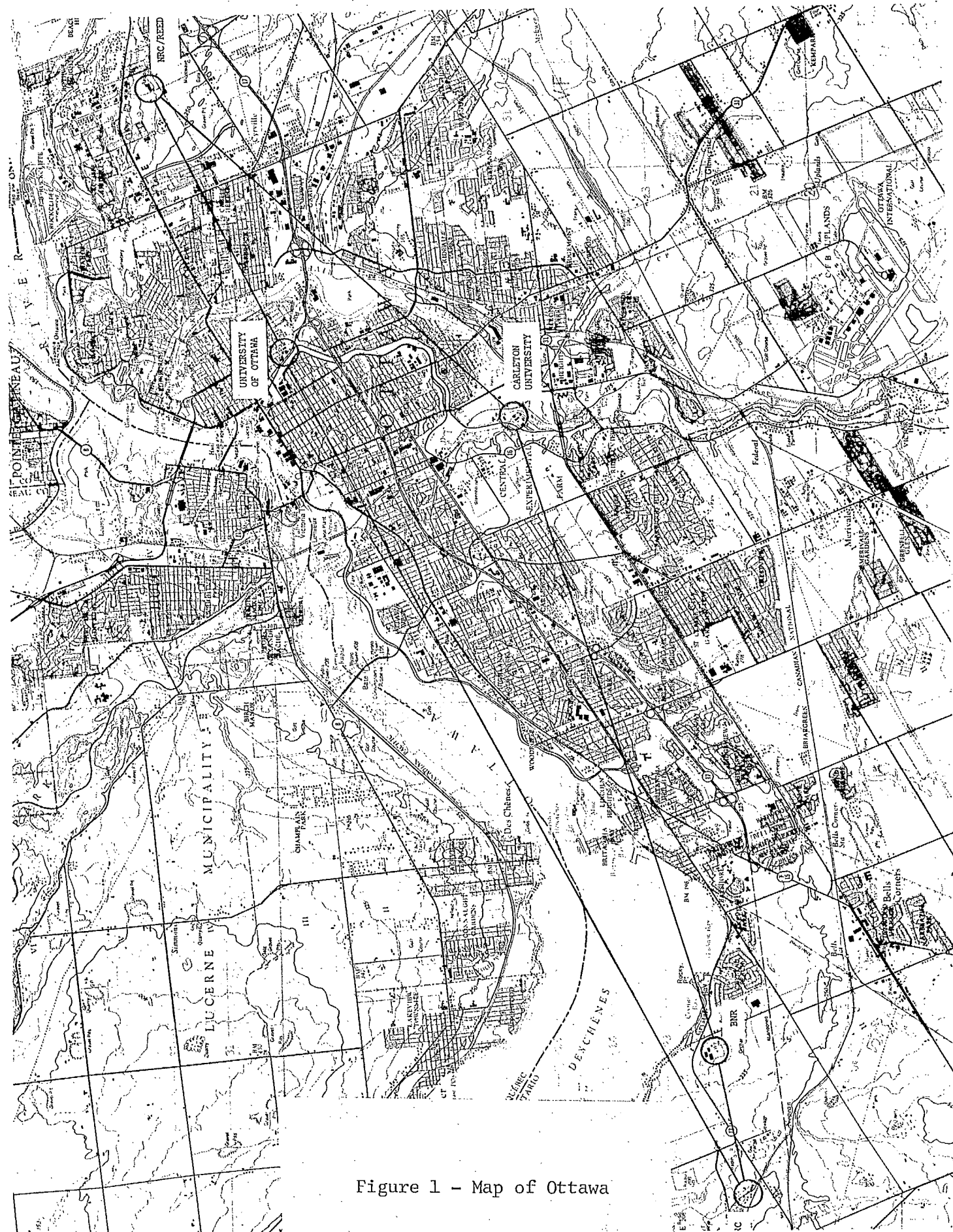


Figure 1 - Map of Ottawa

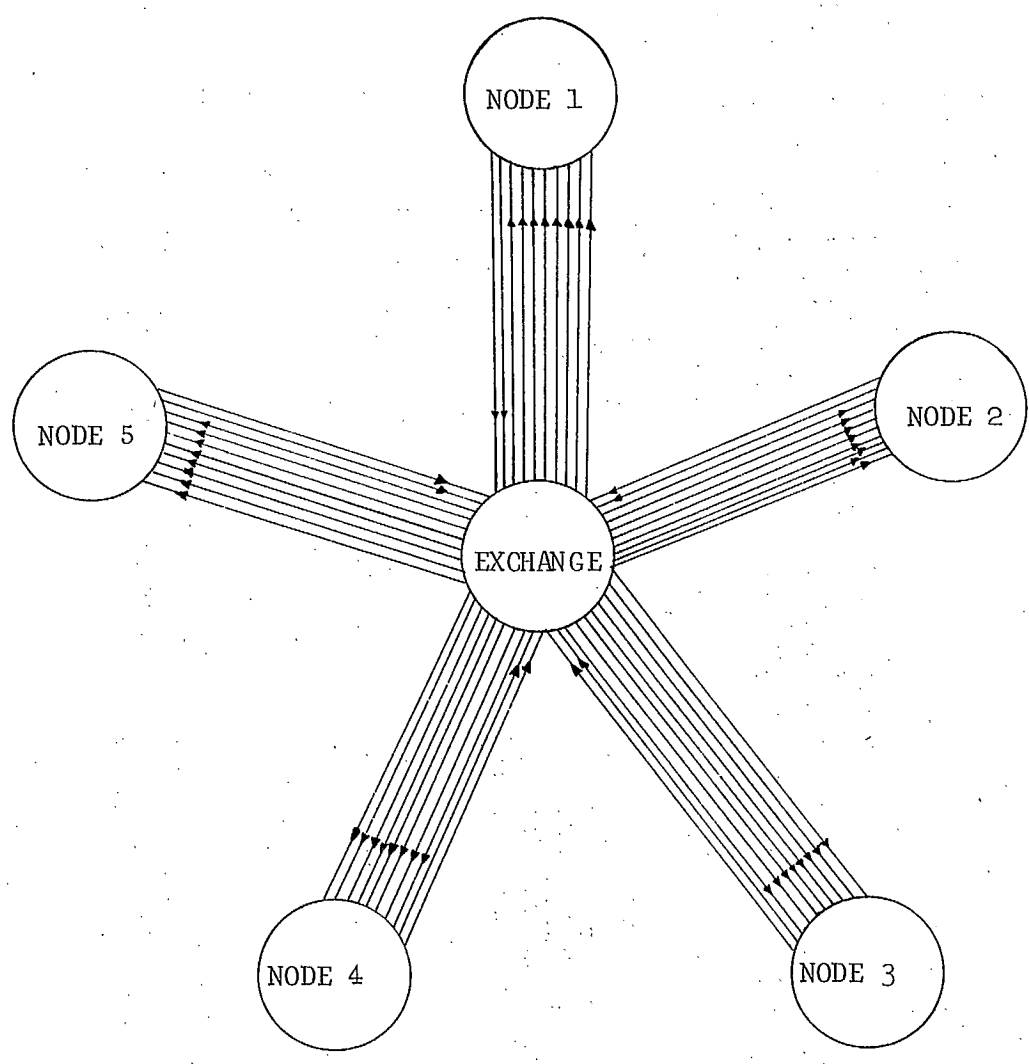


Figure 2

The Central Distribution
Network

With reference to the map, Figure 1, the implementation of this network in a five-node pilot network might be achieved as shown in Figure 3. Note that the signals from the Communications Research Centre pass through Bell-Northern Research and that Bell-Northern acts as an auxiliary distribution point. In absence of any information to the contrary, it is assumed, rather arbitrarily, that the main distribution point is located in downtown Ottawa. This network contains approximately 185 channel (air) miles or 260 channel (street) miles. The distances involved in a 4-node network, excluding the National Research Council, are 140 to 200 channel miles. Department of Communications headquarters could be included at the cost of an additional mile per channel.

This network configuration lends itself to operation in a "broadcast" mode. In particular, the geometry of the Ottawa area is such that a microwave distribution centre located at the Communications Research Centre could receive and transmit signals from any site in the Ottawa area. Such a radio system would contain

i) for a 5-node network:

- 4 two channel transmitters,
- 5 eight channel receivers, and
- 1 ten channel transmitter;

at a cost of approximately \$163,000.

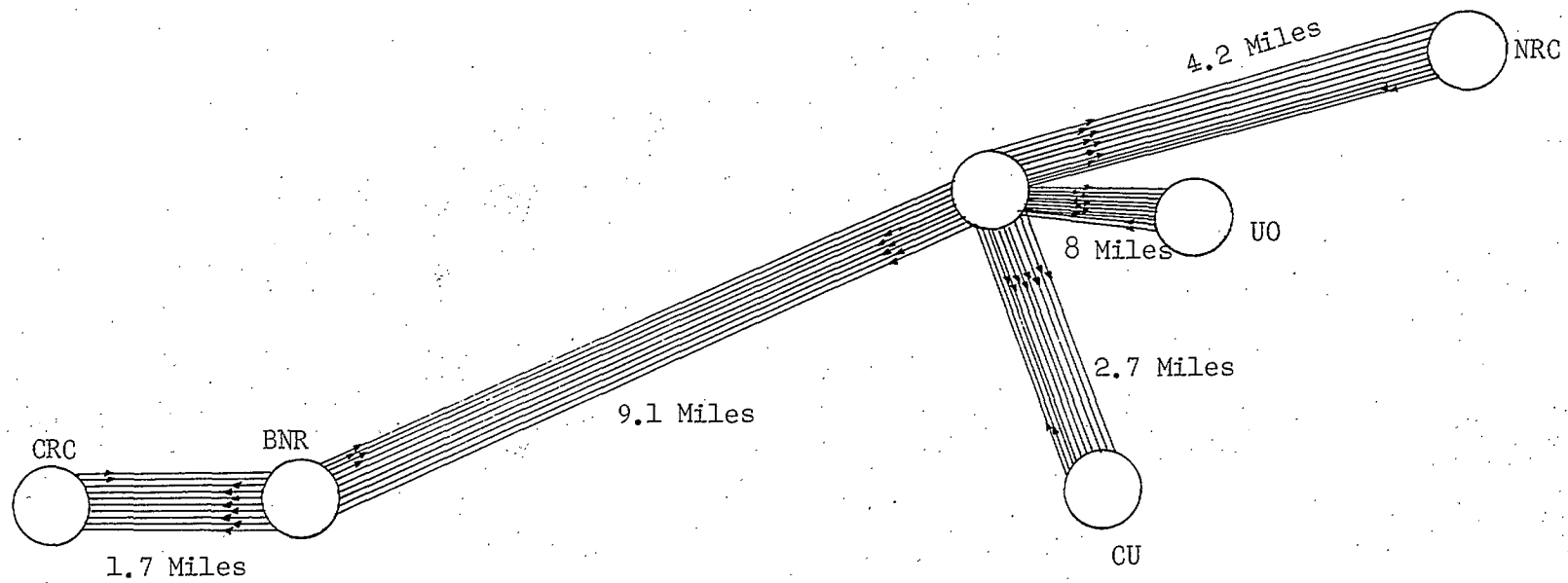
ii) for a 4-node network:

- 3 two channel transmitters,
- 4 six channel receivers, and
- 1 eight channel transmitter;

at a catalogue cost of approximately \$123,000.

These prices are based on microwave equipment operating in the 2500 MHz ITFS band and Department of Communications authorization for use would be necessary.

Figure 3
Central Distribution, Ottawa



1.2.2 The Loop, or Decentralized, Network

This network, shown schematically in Figure 4, involves a series of one-way channels connecting the nodes in an endless loop. Control of the distribution of signals can be implemented in this network by the use of simple switches located at the nodes. One such switch is shown in Figure 5. A possible set of connections for a four-way conference on a four-node network are shown in Figure 6. Note that each channel in these figures represents the two video signals originating from each node. Note also that for an n-node loop network $k(n-1)$ channels are required, where k is the number of signals originating at each node. Hence, a four-node loop network requires six one-way channels between each node. A control program for a loop network is illustrated in Appendix 1.

In the particular Ottawa pilot network the loop configurations are shown diagrammatically in Figure 7 for 5- and 4-node networks. The channel miles involved are 245 to 345 and 140 to 200 respectively.* Another configuration involving two-way use of the interconnecting links is shown in Figure 8. The channel mileages are 155 to 225 for 5-nodes, and 100 to 140 for 4-nodes. The costs if implemented by radio would be approximately \$273,000 for a 5-node loop and \$172,000 for a 4-node loop.

* The first figure in each pair represents straight-line, or "air" channel miles, the second "street" channel miles or $\sqrt{2}$ times the number of "air" miles.

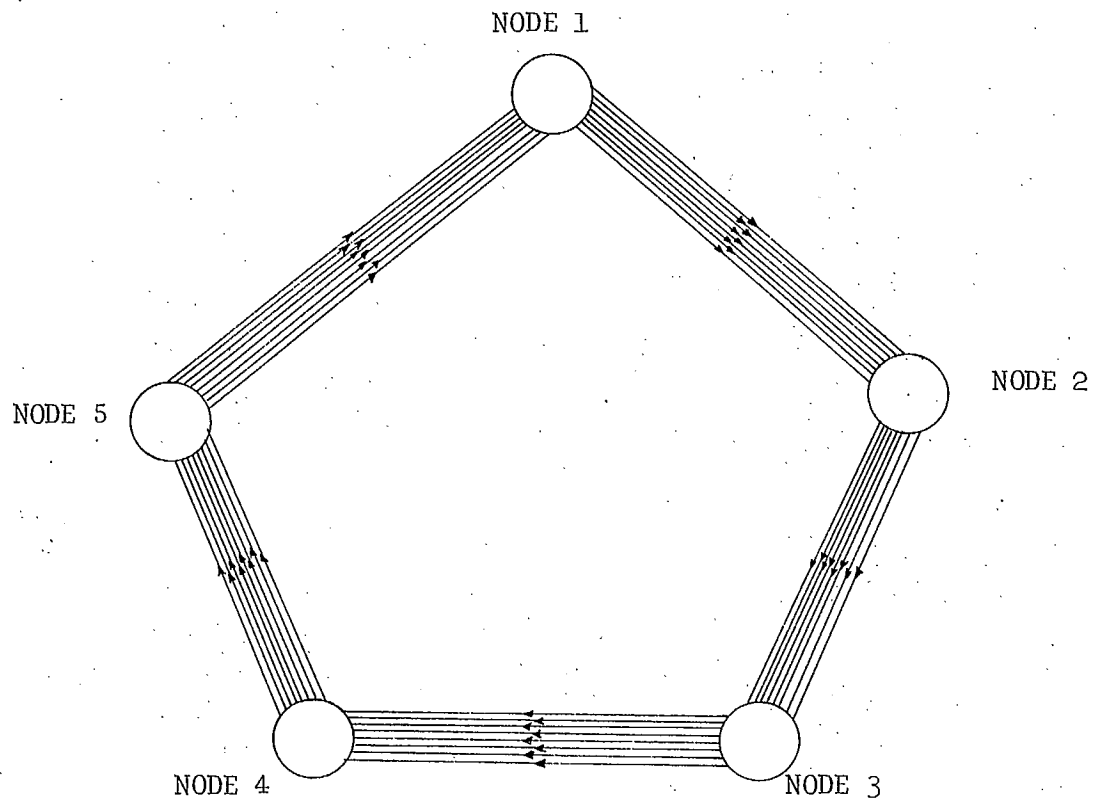


Figure 4
The Loop Network

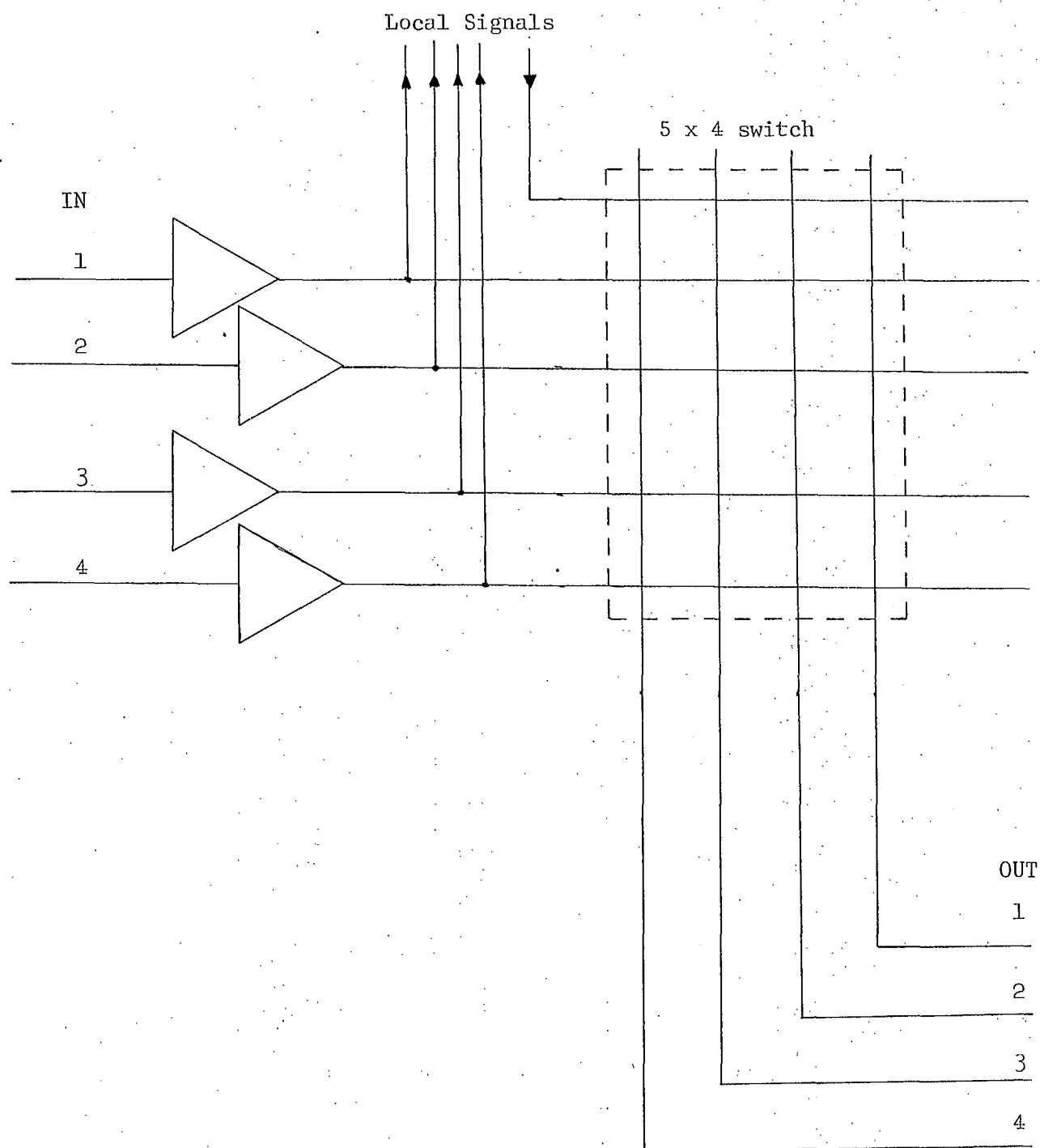


Figure 5(a)
Node Switch (5 Nodes)

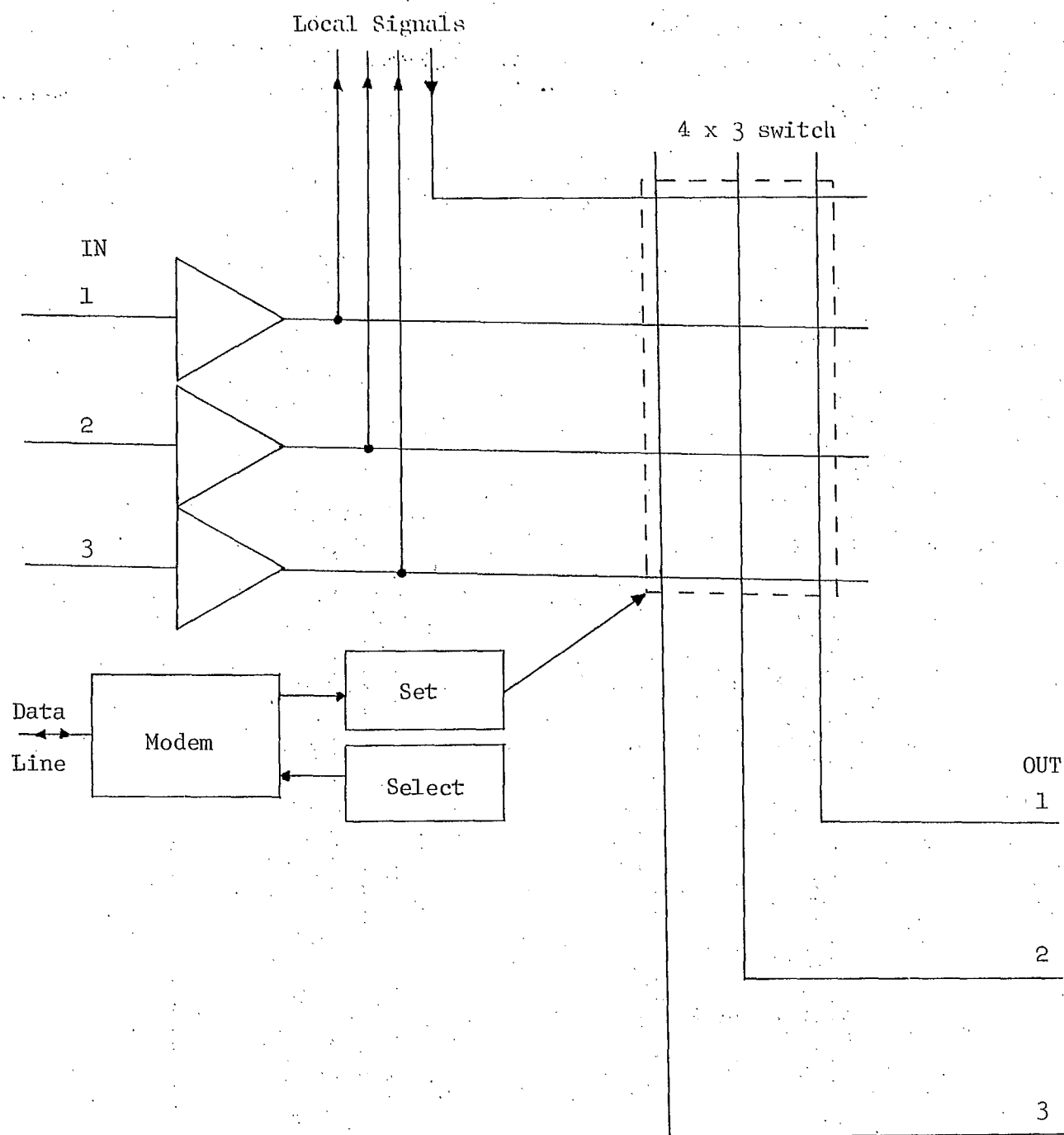


Figure 5(b)
Node Switch for 4 Node Network

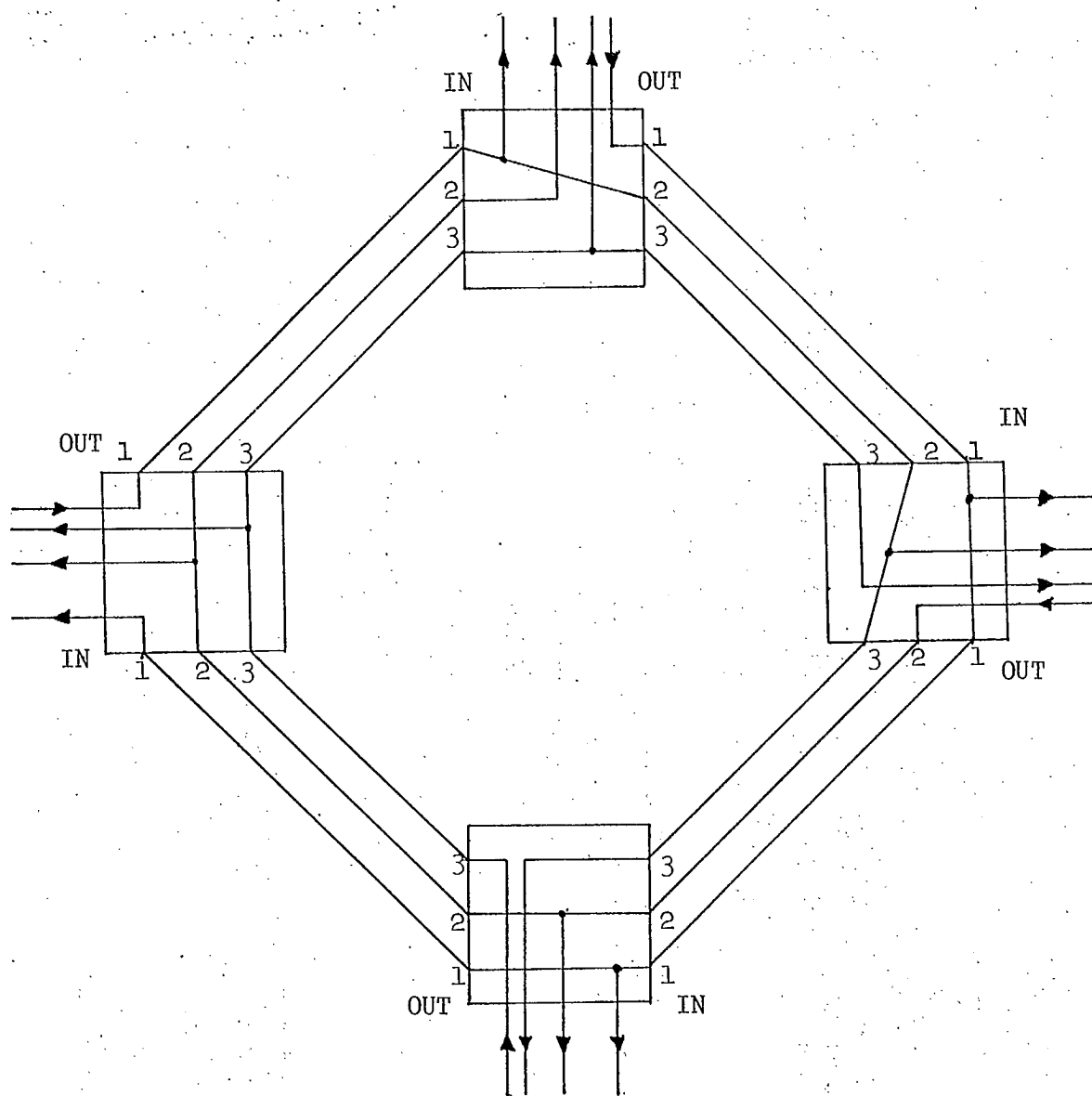


Figure 6
4 Nodes: 4 Way Conference

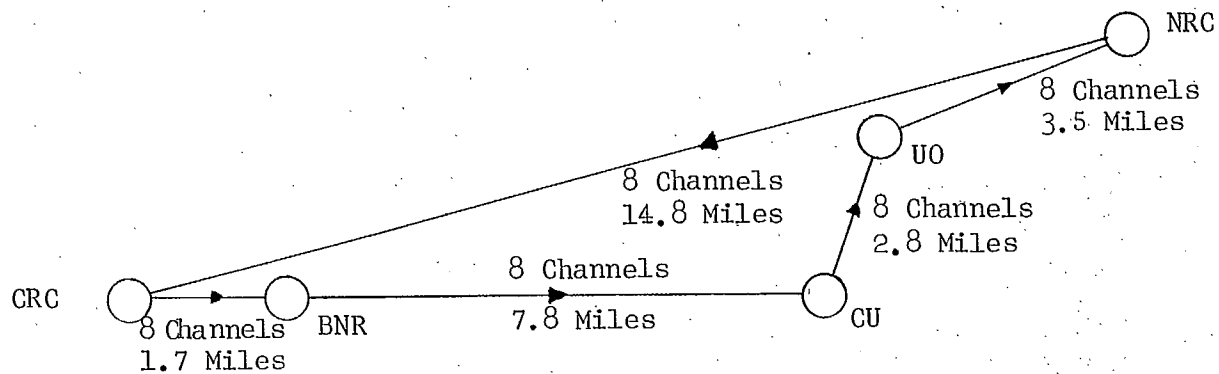


Figure 7(a)

5 Nodes

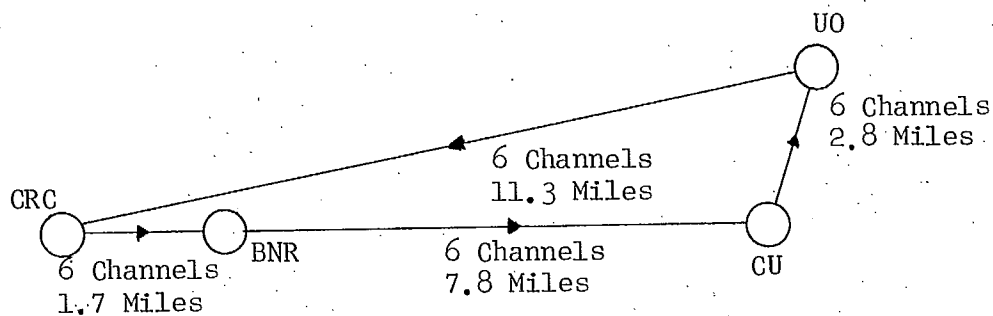


Figure 7(b)

4 Nodes

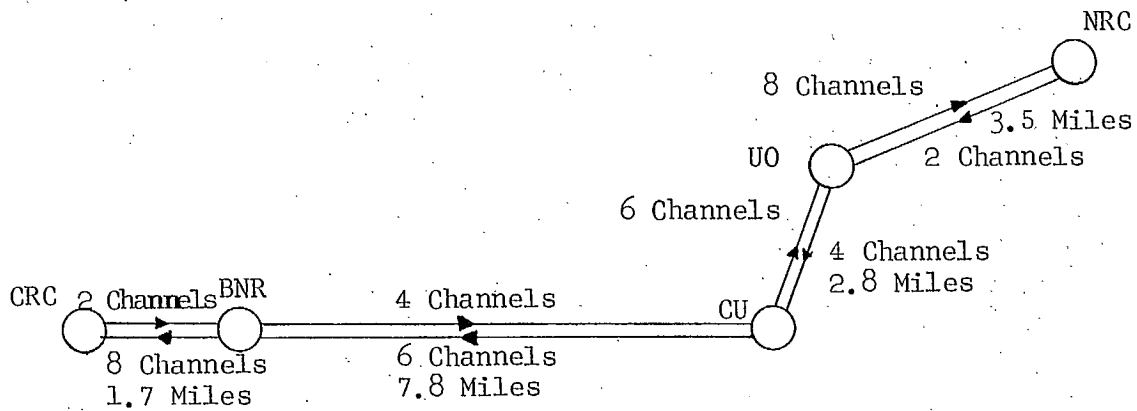


Figure 8(a)

5 Nodes

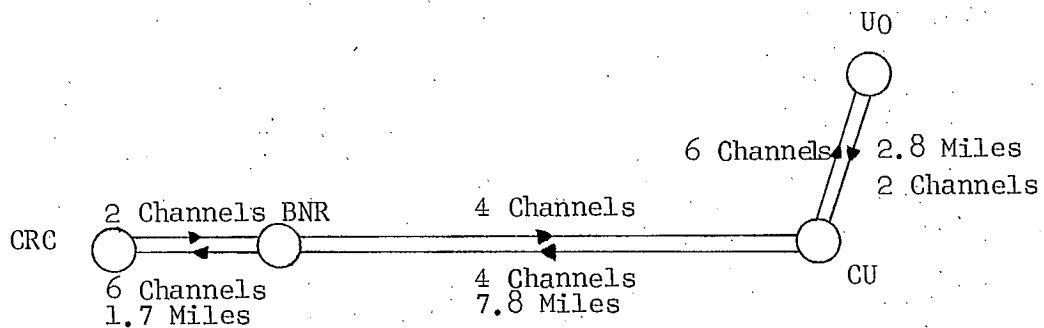


Figure 8(b)

4 Nodes

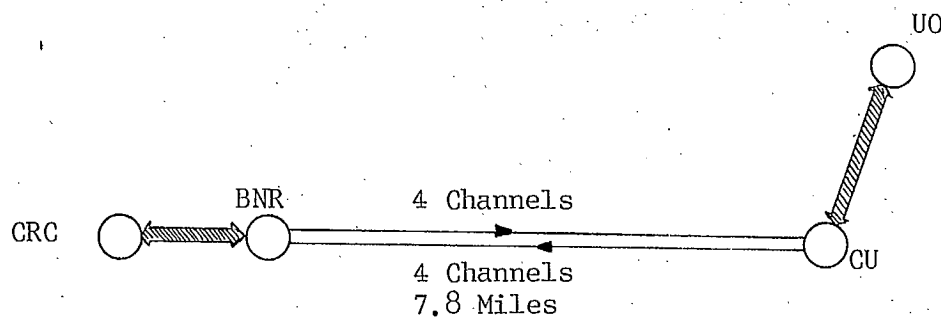


Figure 9
East-West Trunk

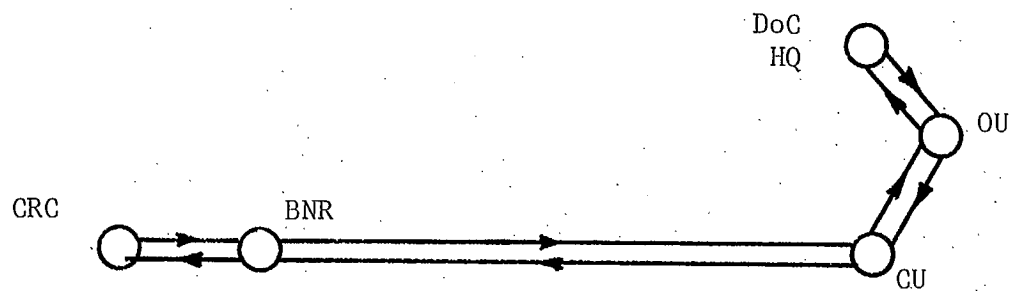


Figure 10. Coaxial cable distribution system.

1.2.3 East-West Video Trunks

This network configuration is predicated on the independent development of video channels between the Communications Research Centre and Bell-Northern Research on one hand, and between Carleton University and the University of Ottawa, on the other. These connections are likely to develop during the period that is of concern to the "Wired Scientific City" pilot project, due to:

- 1) extension of Project 91 from Bell-Northern Research to the Communications Research Centre and other cooperative ventures between those institutions, and
- ii) cooperative teaching between the two universities in conjunction with developments which have received support from the Department of University Affairs of Ontario.

Assuming that these trunks exist, a viable 4-node realization of the "Wired Scientific City" could be formed by the provision of four two-way channels between Carleton University and Bell-Northern Research. Appropriate equipment would be provided at these locations to "patch through" signals from the outer nodes. As shown in Figure 9, the requirement is for 60 channel air miles or approximately 85 street miles.

This network, which is primarily a single trunk or point-to-point system, lends itself very readily to implementation with microwave radio or laser communications, as well as cable. The costs of a radio system in one 2500 MHz band (ITFS) would be approximately \$60,000.

Extension of the network to the National Research Council could easily be incorporated if it were to act primarily as a receive-only node for lectures; and channels "belonging" to the central structure, i.e. the two universities, could be temporarily assigned to the National Research Council whenever they originated video signals.

1.2.4 A Coaxial Cable Distributed Network

A network of current interest is a coaxial cable connecting the Communication Research Centre, Bell-Northern Research, the universities, and the Department of Communications headquarters. This network serves four important functions:

- i) administrative conferencing; e.g. between the Department of Communications headquarters and the Communication Research Centre or any other nodes*,
- ii) the lecture, seminar and discussion of the "wired scientific city.
- iii) experimental projects in all forms of broad-band communications systems.
- iv) introduction of non-engineering experimentation into the utilization and impact of these future forms of communication.

By use of a pair of coaxial cables, it would be possible to provide

for up to twenty full duplex video channels using CATV technology.

Switching, located at the nodes as described in Appendix 1, could be used under computer control to provide:

- i) fixed private full-duplex channel assignments, e.g. four channels between D of C and CRC; and
- ii) free assignments of other channels on demand or by reservation with the computer.

The cost of this network, which is shown schematically in Figure 10, is approximately \$180,000. This price is based on the following items:

* Conference terminals suitable for this many-to-many mode are suggested in Appendix 6.

i) Trunk cost		
27 miles of coaxial cable	at \$750/mile	\$20,250
70 line amplifiers	at \$600	42,000
		<u>\$62,250</u>
Installation	at 30%	\$18,675
		<u>\$80,925</u>
ii) Computer and modems		<u>\$30,000</u>
iii) Channel modems and node switching per node (for an initial 5 channel system)		
Switch (10 X 5)	at 4500	
Switch control	at 1000	
Modems	at 5000	
	<u>\$10,500</u> per node	\$52,500
Installation at 30%		<u>\$15,750</u>
		<u>\$68,250</u>
Total		<u>\$179,175</u>

The operating cost is estimated to be approximately \$30,000 per year. The installation could be undertaken by Bell-Canada and the above costs may or may not reflect their pricing policy.

In the event that the Carleton University to University of Ottawa and the BNR to CRC links were already established, approximately \$25,000 could be deducted from these estimates.

The advantages of such a scheme are:

- i) its low cost per channel
- ii) its simplicity
- iii) its flexibility with respect to channel allocations.

This realization offers also the possibility of immediate practical use in addition to full experimental capability for a wide spectrum of diverse investigations.

1.3 SummaryChannel Miles of the Networks

Network	5 node air miles	4 node air miles
Central	185	140
Loop one way	245	140
two way	155	100
Trunk	-	60

Capital Cost Comparisons of 5 Node Network Communications facilities -
excluding terminals and switching

Network	Originating** Capacity per node	Cost	Cost per channel
Central	2	\$163,000	81,500
Loop	2	273,000	136,500
Trunk*	2	60,000	30,000
Coaxial	8	80,925	10,119

* Between Carleton University and BNR

** All nodes could receive all other nodes if desired.

CHAPTER 2

TERMINAL CONFIGURATIONS

In this chapter two possible terminal configurations are presented for use at the nodes on the pilot network. The application of these depends on the proposed function of the network by which they are interconnected. One of the configurations is called the basic conference terminal whereas the other, that serves a different purpose, shall be referred to as the classroom terminal.

It was noted in chapter 2 of the first interim report that the network will allow the following:

1. One-to-one communications;
2. Many-to-many communications;
3. One-to-many communications, such as a lecture;
4. A seminar, as described in chapter 2.2 of the first interim report.

The conference terminal to be described below could accommodate 1, 2, and 4 of the above functions and also, though not at a maximum level of efficiency, could be used to perform function 3.

The classroom terminal is designed specifically to perform function 3 and would be sufficient for function 4 if one way video and two way audio were used as described in the first interim report (chapter 2.2).

2.1 Conference Terminal

For the purposes of illustration, it is assumed that there are five nodes on the network and the possibility of five way conferencing exists.

The conference terminal, with various technical changes, will be similar to the one described in Appendix 2. Each conference terminal consists of two cameras, one of which is trained at the writing space and the other usually transmits a "head and shoulder" picture of the individual using the node. Both of these video signals are distributed throughout the net.

Figure 10 shows a possible configuration of a conference node. The video signals which appear on the ten small monitors consists of the two locally generated pictures plus a pair of signals originating from each of the other nodes. It is recommended that the users writing space appear on a monitor the same side as the users writing hand for quick reference. In conjunction with this the special effects monitor (to be explained below) should likewise appear on the left hand side for a left-handed person or vice versa if right-handed. The video signals which appear on the larger monitors are selected by the node user by pushing the buttons which appear above and below the small monitors (Figure 10). The large monitors serve two purposes; one of them provides for an enlargement of a particular picture while the other enables the overlaying of writing spaces or simple split-screen techniques.

The audio portion of the network is assumed to be a shared common channel in which the signals are mixed and distributed throughout the net. Two methods have been used for the reception of the audio signal during the teleconferencing experiments (Appendix 2). The first

FIG. 10

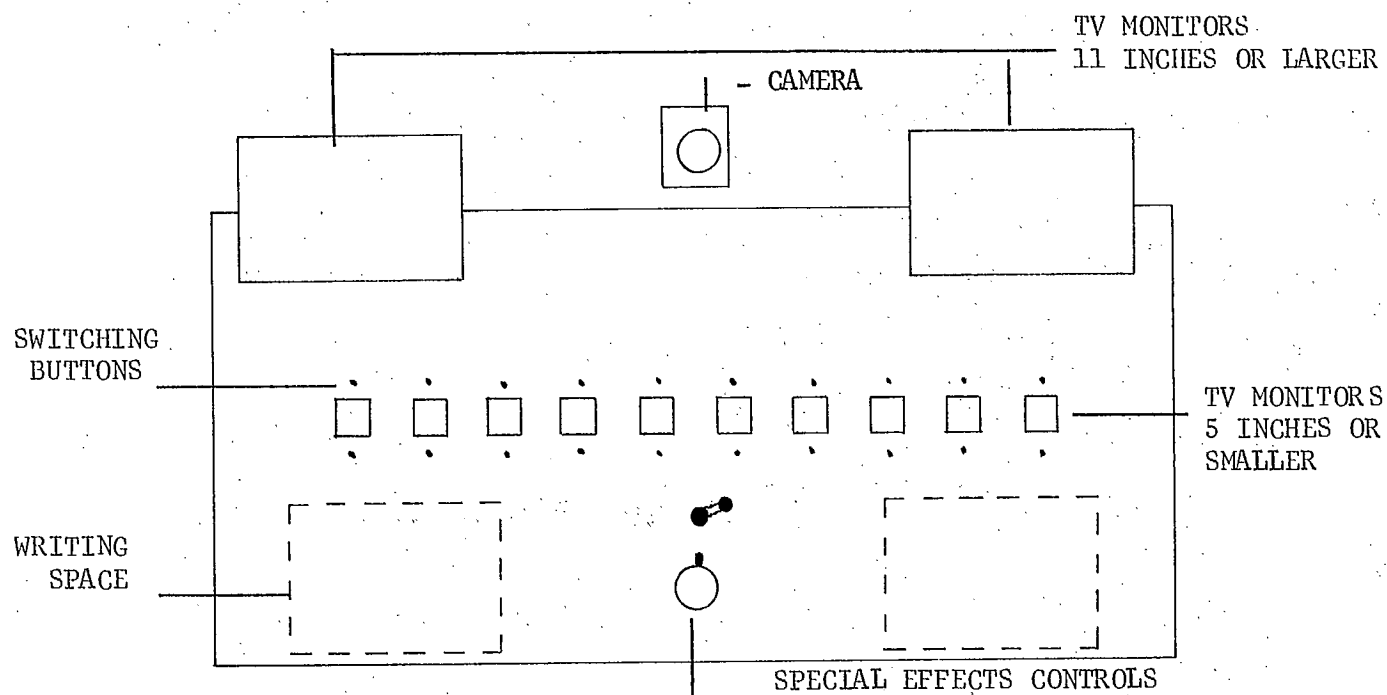
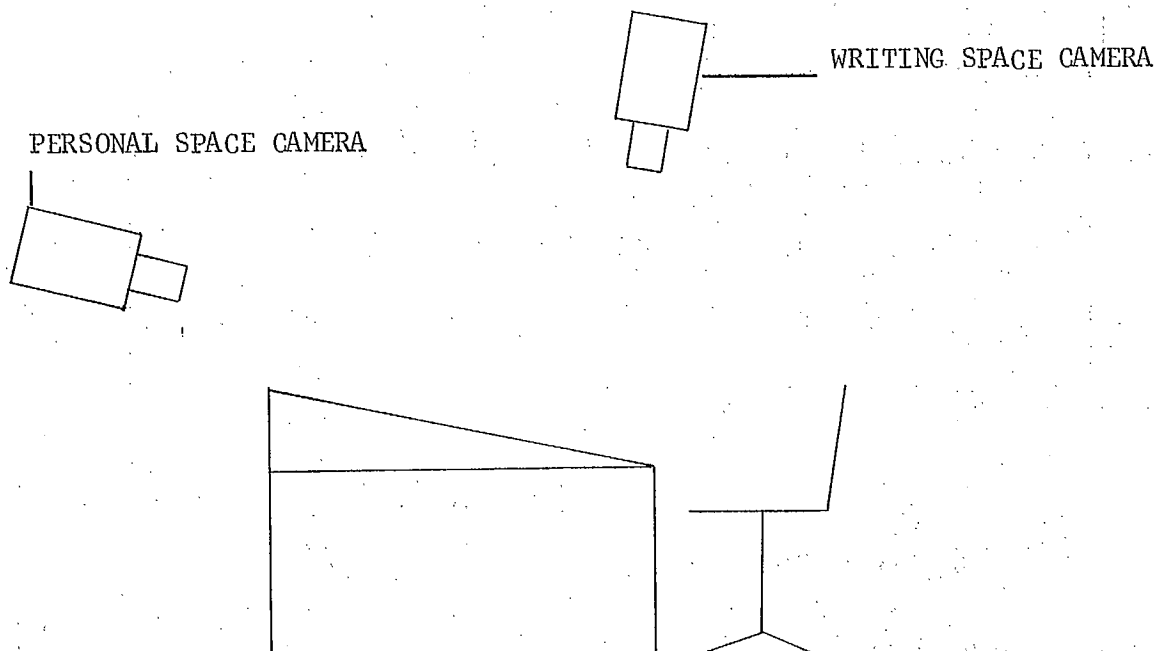
CONFERENCE TERMINAL

FIG. 10(A)

SIDE VIEW

method consisted of open microphones and speakers. It was found that the resulting feedback problems could be overcome by "fiddling" with volume controls of both microphones and speakers. Any significant change in conditions at the nodes upset the delicate adjustment of the "open" audio system (painfully). The utilization of headsets, which was the other method employed, eliminated the oscillation problem, but caused some discomfort to the user.

2.2 Classroom Terminal

The classroom terminal is designed to provide outgoing video signals to a receptive audience and receive feed-back from the latter via audio talk-back. Its function, as previously described in this and the first interim report, is to simulate the physical transportation of the remote viewers into the classroom.

Figure 11 shows a layout of such a classroom. It requires two cameras; one is focused on a writing space and the other on the lecturer. These cameras may be operated remotely by either the lecturer or an operator in a booth at the back of the classroom. The monitor arrangement is as follows:

1. The lecturer has two monitors, one for each camera.
2. In the "actual" classroom there is one monitor for every two students. The picture that appears on these monitors is selected by the person operating the cameras.

FIG. 11

STUDIO CLASSROOM

29

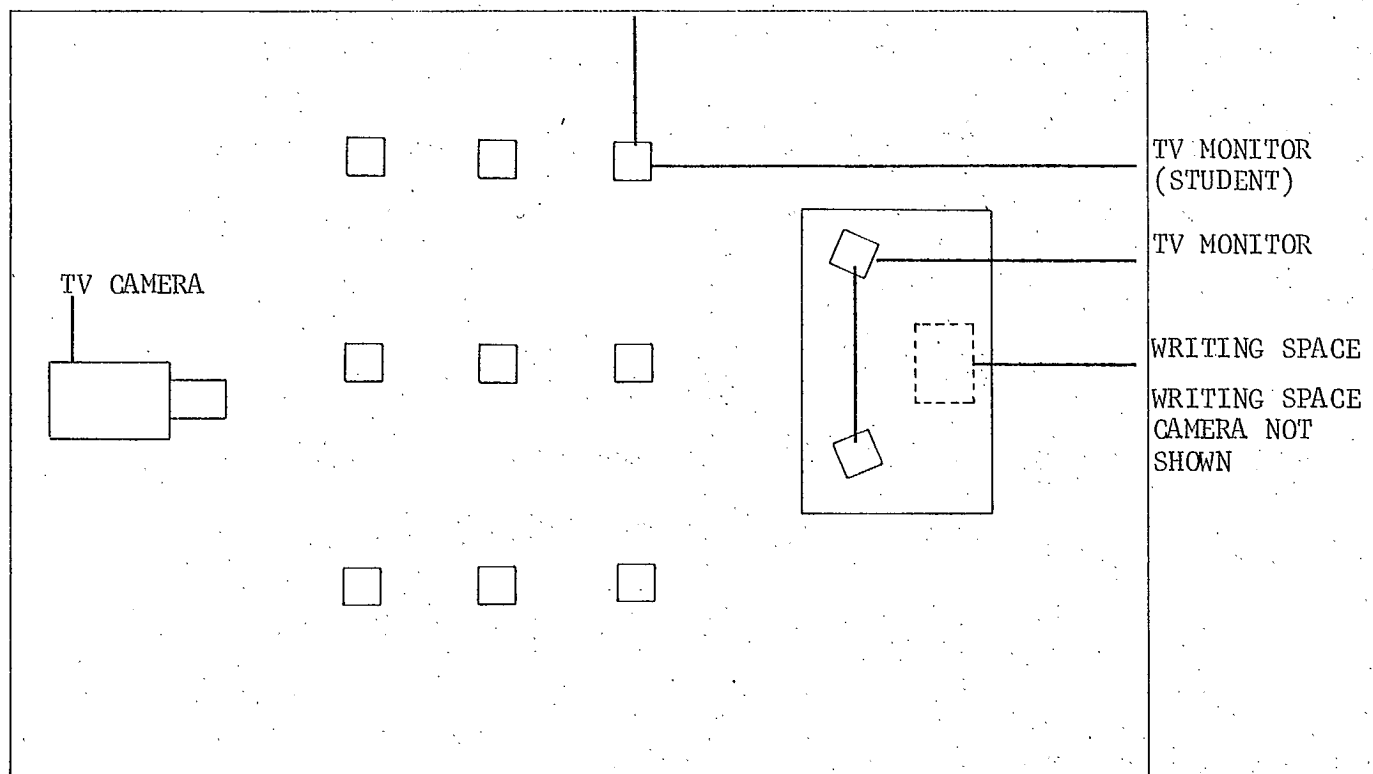


FIG. 12

REMOTE CLASSROOM

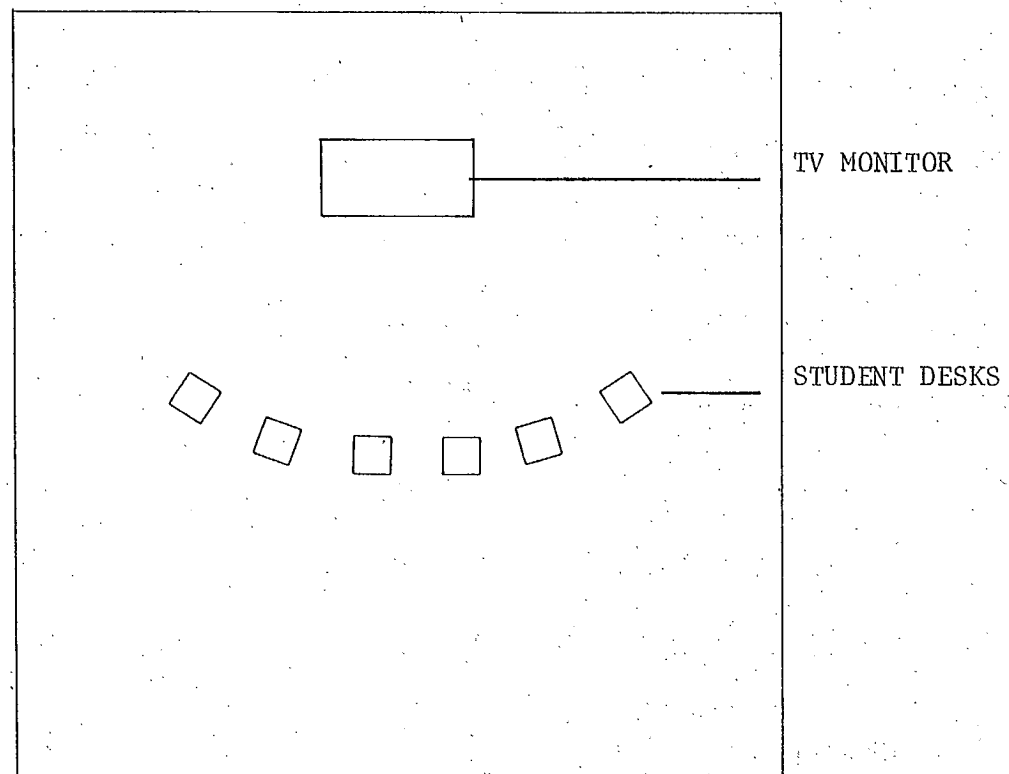


Figure 12 shows one of the variations of one of the "remote" classroom. As in 2 of above the picture appearing on the monitor is selected by the camera operator. It should be noted that the classroom as described in figure 12 is designed to accommodate a maximum of six to eight students, and that an increase in number of students should be directly followed by:

- 1) An increase in number of monitors, and
- 2) A new arrangement for the placement of these monitors*.

The audio system is a "push to talk" arrangement which limits the audio channel to one user at any one instant.

2.3 Relative Costs

The following is an estimate of the cost of setting up the terminals as described above. The pricing of these follows closely the models as described in figures 10 and 11.¹

* Many forms of writing space may be employed (e.g. cellophane, blackboard, roll of paper etc.). Also, all previous statements concerning the classroom terminal (first interim report) should be considered.

1 It should be noted, however, that the above prices will vary significantly depending on the quality of picture required. Further, the prices above are correct to within $\pm 10\%$. The prices quoted above are federal and provincial tax exempted.

Conference Configuration

No.	Quantity	Description	Unit price	Total
1	2	Black and white Cameras complete with camera control units, camera cable, view-finder	2,800	5,600
2	2	Zoom lenses 10:1 with capability of being remoted	1,100	2,200
3	10	5" monitors (black and white)	200	1,000
4	2	11" monitors (black and white)	250	500
5	1	Video programming switcher with limited special effects, and mixing capability	1,600	1,600
6	-	Miscellaneous (Video distribution amps, (2) sync generator, cables) (NOTE: This particular pricing is very conservative it may range anywhere from above to say \$5,000 or more.)	2,000	2,000
7		Remote control units (camera and lens)	2,000	2,000
Total cost of conference terminal				14,900

Classroom Terminal

No.	Quantity	Description	Unit price	Total
1	2	Cameras (same as above)	2,800	5,600
2	1	Telectern ² This is a custom made instructors desk ready with two monitors and a writing space, and one camera	7,400	7,400
3	2	Zoom 10:1 lenses with remote control capability	1,100	2,200
4	12	11" monitors	250	2,750
5	-	Miscellaneous (includes camera stands, cable and so on)	2,000	2,000
6	-	Remote control units (camera and lens)	2,000	2,000
Total cost of classroom terminal				20,950

2 Note, that the instructors desk can be several orders of magnitude cheaper if locally designed and made by the user. See the picture of the Telectern in Figure 13.

Zoom Lens: Angenieux 10:1, 15-150mm increased to 30-300mm focal length with close-up adapter supplied. F/2.8-22.

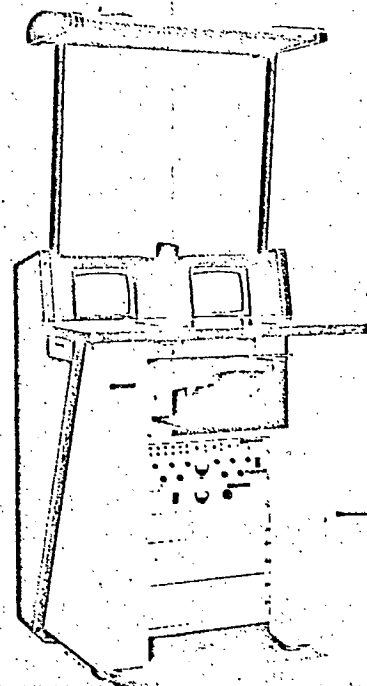
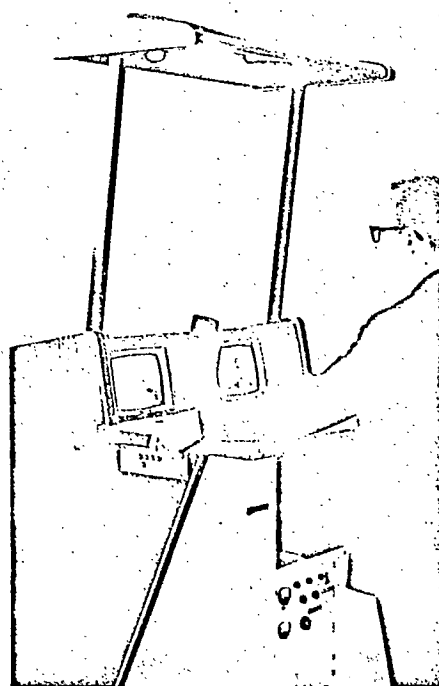
Monitor(s): Solid-state, 9" video monitors with off-air receiver and tuner features. Ultra-compact, these monitors are custom-mounted in the TELECTERN® fiberglass housing for neat, functional service.

Optional TELECTERN® Accessories

TMV-307 EIA TELECTERN® Video Switcher:

The TMV-307 provides five synchronous or non-synchronous video inputs controlled by momentary contact pushbuttons on the switcher control panel. A sixth button, when depressed, superimposes the TELECTERN® camera video over any previously selected synchronous video source. The "Super" is released by depressing any selector button. Automatic pedestal correction is achieved in the "Super" mode by adjustment of a front panel control. The TMV-307 mounts in the TELECTERN® 19" rack and requires 3½" vertical space. It is supplied with a front panel video level meter which conveniently assists setup of sync, pedestal and video levels. Three source-terminated video outputs are provided, each with optional strapping for "sync add." All inputs are high impedance looping and complete control of the input selector switches may be remotely operated up to 1000 feet.

TMV-600 CABLECASTER™ Video Control Center. Combines TELECTERN® with up to five additional video sources. Slaves all cameras to one sync generator or optionally converts



all cameras to full EIA standards. Includes solid-state switcher, video level meter, control panel, amplified intercom and video processor.

TMV-650 MULTICASTER™ Video Control Center. Same as above but including mixer/fader assembly and additional program bus.

SG-600 Digital EIA Sync Generator. Converts TMV-600/650 to EIA operation.

T-650 Custom Eastman 2"x2" Slide Projector with Mirror Assembly. Carousel-type 35mm slide projector specially modified and mounted on mirror assembly base for TELECTERN® operation. Accepts 81 slides.

TSG-1000/2000 Series EIA Sync Generators. All digital, IC design provides exceptionally stable performance for monochrome or color transmission. Plug-in modules are available to provide

genlock, colorlock, bar dot and sync changeover (2000 Series only).

NOTE: TELECTERN® systems incorporate only certain standard makes of some equipment. This is necessary because of strict tolerances in the optical-mechanical design of the console. Complete technical specifications and prices are available for all TELECTERN® standard components and optional accessories. Please request this information directly from TeleMation, or ask your local distributor.



TELEMATION, INC.

2275 South West Temple
Salt Lake City, Utah 84115
(801) 486-7564

All prices and specifications subject to change without notice

APPENDIX 1

CONTROL OF THE LOOP NETWORK

It is assumed that a switch of the type shown in Figure A-1 is available at each node. Each incoming channel is diverted to a local termination and to one line in a crossbar type switch. The local connection may be connected to a local output or terminated within the switch. Locally originated signals are also applied to the crossbar switch. An output may thus be connected to any input channel or the locally originated channels. No output may be connected to more than one input, and no input may be connected to more than one output channel.

The condition of each switch may be controlled by command words transmitted to a command buffer from a central computer in response to conference requests from any node. The control network may also be used for data transmission between nodes, with the computer acting as a central store-and forward message switching centre.

The state of the network may be easily described by a table of the form shown in Figure A-2. The conference, the circuits involved in that conference, and the terminations are shown for each channel at each node. This table is for a 5-node network with four channels.

In the example there are three conferences in progress, as indicated in the Conference Summary. Conference 1, among nodes 1, 3, and 5 uses channels 1 and 3. This conference requires three circuits, one from 1 to 3 to 5, one from 3 to 5 to 1, and one from 5 to 1 to 3. These circuits are designated 11, 12, and 13 in the State Table. This conference may be traced as follows:

Circuit		Node	Channel	
11	starts (S)	1	1	OUT
	through	2	1	-
	to	3	1	IN, Drop (D)
	to	3	1	OUT
	through	4	1	-
12	to	5	1	IN, Term (T)
	starts (S)	3	3	OUT
	through	4	3	-
	to	5	3	IN, Drop (D)
	to	5	1	OUT
13	to	1	1	IN, Term (T)
	starts (S)	5	3	OUT
	to	1	3	IN, Drop (D)
	to	1	3	OUT
	through	2	3	-
13	to	3	3	IN, Term (T)

A linked list is used to record the nodes involved in each conference and is illustrated by the Conference Table in Figure A-2.

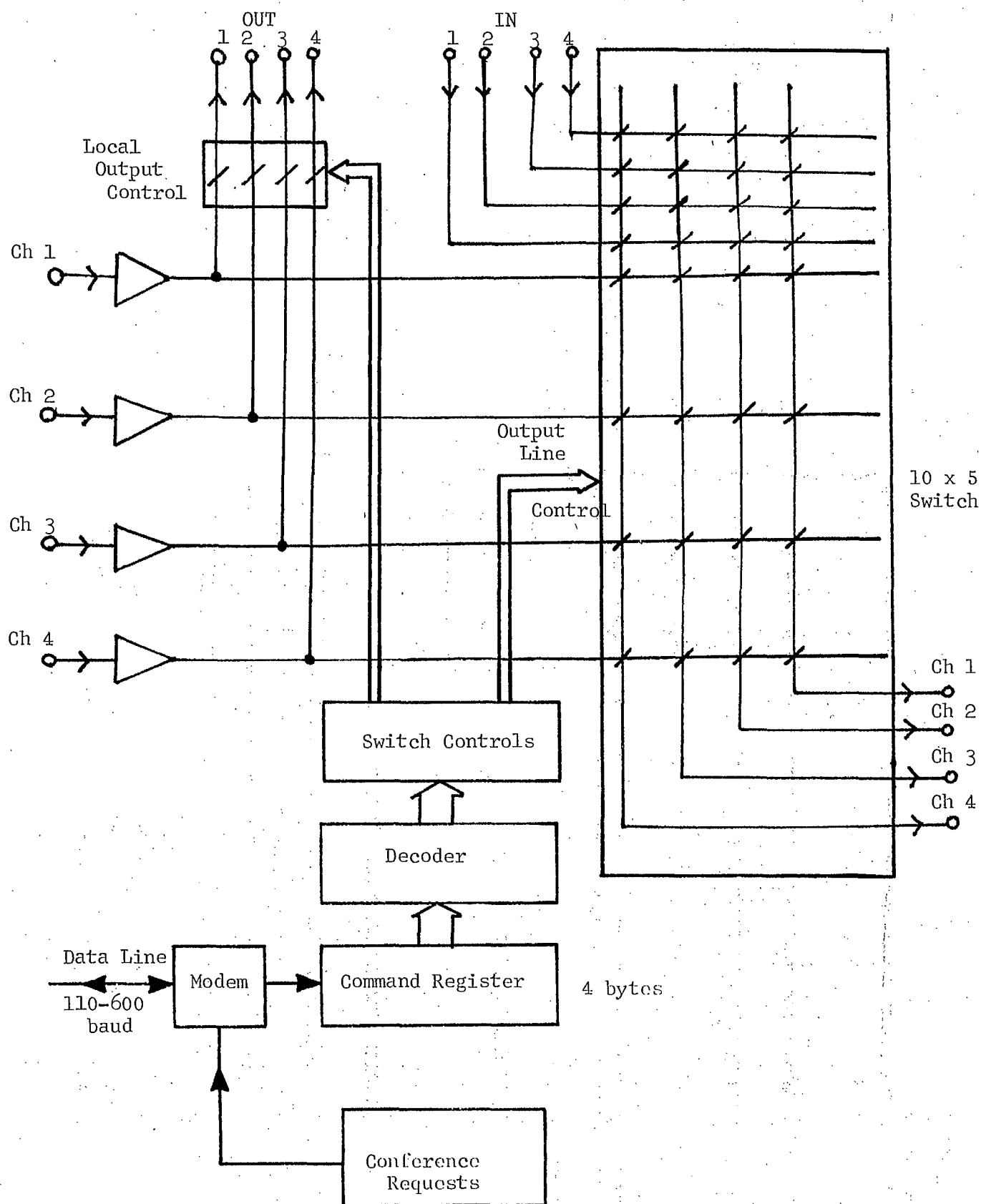


Figure A-1. Multiple Input Node Switch, with Computer Control. This example shows a switch in which both the local outputs and the line outputs are controlled by data received from a central computer.

NODE	CHANNELS							
	1		2		3		4	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
1	12T	11S	22	22	13D	13	42T	41S
2	11	11	22	22	13	13	41	41
3	11D	11	22T	21S	13T	12S	41T	42S
4	11	11	21T	22S	12	12	42	42
5	11T	12	22	22	12D	13S	42	42

State Table for 5-Node Loop

CONF	1	NODES	1	3	5	CHANNELS	1	3
CONF	4	NODES	1	3		CHANNELS	4	
CONF	2	NODES	3	4		CHANNELS	2	

Conference Summary

CONF	NODE					LINK
	1	2	3	4	5	
1	1	0	1	0	1	4
2	0	0	1	1	0	1
0	0	0	0	0	0	0
4	1	0	1	0	0	2

Conference Table

Figure A-2. Network State Tables

It is a simple matter to write a program that will complete or cancel conferences. The attached FORTRAN program will allow the addition or cancellation of conferences on a five-node, 4-channel, loop network, and produces status information similar to that shown in Figure A-2 after each change. This program does not preclude the possibility of any one node being included in a number of different conferences simultaneously. As seen in Figure A-2, node 3 is in three conferences. This implies that many separate inputs can be available at each node, to a maximum of $(n-1)$ on an n -node network. The actual connections involved in the example are shown schematically in Figure A-3.

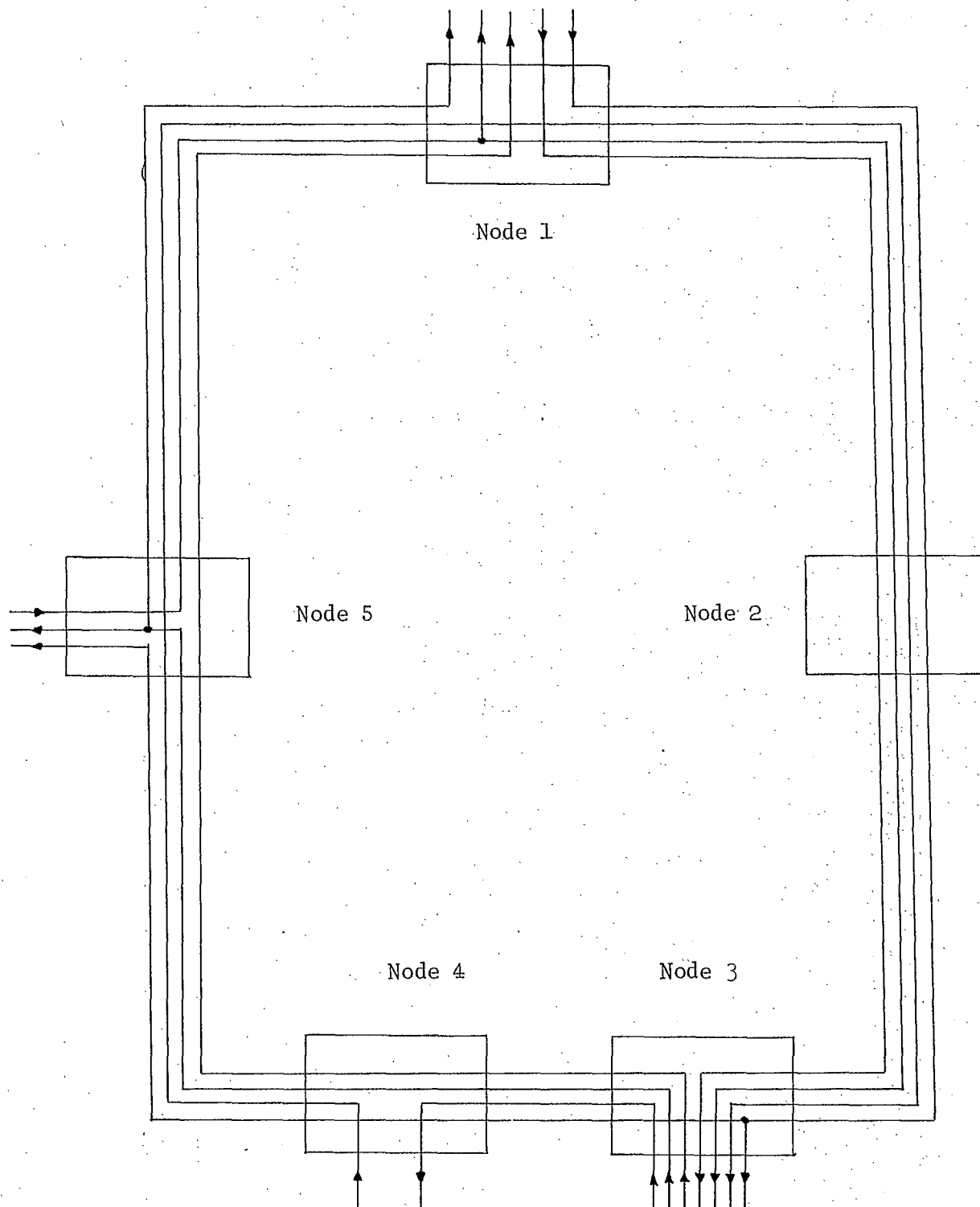


Figure A-3. Connections for Conferences in Example.

```

1.000 C      LOOP NETWORK PATHS
2.000      IMPLICIT INTEGER (A-Z)
3.000      COMMON N,T(9,7)
4.000      DIMENSION CI(5,4,2),CO(5,4,2),NN(5)
5.000      DATA ID,IT,BLANK,S,R,C,A/'D','T',' ','S','R','C','A'/
8.000      NT=5
9.000      NC=4
9.100      NODE=1
9.500      GO TO 100
10.000      15 CONTINUE
14.000      WRITE(105,101)
15.000      101 FORMAT(1H0,'R,C,OR,A')
16.000      READ(105,102)X
17.000      102 FORMAT(A1)
18.000      IF(X.EQ.R) GO TO 100
19.000      IF(X.EQ.C) GO TO 200
20.000      IF(X.EQ.A) GO TO 25
21.000      200 WRITE(105,201)
22.000      201 FORMAT(1H,'CONNECTION TO BE CANCELLED')
23.000      READ(105,202)Y
24.000      202 FORMAT(I1)
25.000      205 DO 210 I=1,NT
26.000      DO 210 J=1,NC
27.000      IF(CI(I,J,1)/10.NE.Y) GO TO 220
28.000      CI(I,J,1)=0
29.000      CI(I,J,2)=BLANK
30.000      220 IF(CO(I,J,1)/10.NE.Y) GO TO 210
31.000      CO(I,J,1)=0
32.000      CO(I,J,2)=BLANK
33.000      210 CONTINUE
34.000      CALL CANT(Y)
35.000      GO TO 70
36.000      100 DO 10 I=1,5
37.000      DO 10 J=1,4
38.000      CI(I,J,1)=0
39.000      CO(I,J,1)=0
40.000      CI(I,J,2)=BLANK
41.000      CO(I,J,2)=BLANK
42.000      10 CONTINUE
43.000      CALL REST
44.000      GO TO 15
45.000      25 WRITE(105,22)
46.000      22 FORMAT(' ENTER DATA')
47.000      READ(105,1)L,M,(NN(I),I=1,M)
48.000      IF(M.LE.1.OR.M.GT.9) GO TO 25
49.000      1 FORMAT(7I1)
50.000      310 WRITE(105,2)L,(NN(I),I=1,M)
51.000      CALL ADDT(L,NN,M)
52.000      2 FORMAT(1H1,5HCONF ,12,5X,6HNODES ,5I2)
53.000      II=1
54.000      20 I=1
55.000      K=NN(I)
56.000      30 J=1
57.000      35 IF(CO(K,J,1).EQ.0)GO TO 40
58.000      37 J=J+1
59.000      IF(J.GT.NC)GO TO 300
60.000      GO TO 35

```

```

61.000      40 C0(K,J,1)=L*10+II
62.000      IF(K.EQ.NN(1)) C0(K,J,2)=S
63.000      K=MOD((K+1),(NT+1))
64.000      IF(K.EQ.0) K=K+1
65.000      IF(CI(K,J,1).EQ.0) GO TO 50
66.000      K=K-1
67.000      IF(K.EQ.0) K=M
68.000      C0(K,J,1)=0
69.000      C0(K,J,2)=BLANK
70.000      K=K+1
71.000      GO TO 37
72.000      50 CI(K,J,1)=L*10+II
73.000      IF(K.NE.NN(I+1)) GO TO 30
74.000      IF(K.EQ.NN(M)) GO TO 60
75.000      CI(K,J,2)=ID
76.000      I=I+1
77.000      GO TO 30
78.000      60 CI(K,J,2)=IT
79.000      II=II+1
80.000      IF(II.GT.M) GO TO 70
81.000      IY=NN(1)
82.000      I=I-1
83.000      DO 65 JJ=1,MM1
84.000      65 NN(JJ)=NN(JJ+1)
85.000      NN(M)=IY
86.000      GO TO 20
87.000      70 WRITE(108,5) (((CI(I,J,1),CI(I,J,2),C0(I,J,1),C0(I,J,2))
88.000      1,J=1,NC),I=1,NT)
89.000      WRITE(108,6)
90.000      6 FORMAT(1H0)
91.000      5 FORMAT((1H ,4(2(I2,A1,3X))))
92.000      CALL LIST(CI)
93.000      GO TO 15
94.000      800 WRITE(108,7)
95.000      7 FORMAT(1H1,18HNO PATHS AVAILABLE)
96.000      Y=L
97.000      GO TO 205
98.000      END
99.000      SUBROUTINE ADDT(L,NN,M)
100.000      IMPLICIT INTEGER (A-Z)
101.000      COMMON N,T(9,7)
102.000      DIMENSION NN(5)
103.000      IF(N.NE.0) GO TO 100
103.500      T(1,1)=L
103.700      T(1,7)=1
104.000      N=1
104.200      G=1
104.500      160 DO 110 I=1,M
105.000      110 T(G,NN(I)+1)=1
105.500      RETURN
106.000      100 DO 120 I=1,9
106.500      IF(T(I,7).EQ.0) GO TO 120
107.000      F=I
107.500      GO TO 130
108.000      120 CONTINUE
108.500      130 DO 140 I=1,9
109.000      IF(T(I,1).NE.0) GO TO 140

```



```

109.500      G=I
110.000      GO TO 150
110.500      140 CONTINUE
111.000      WRITE(108,200)
111.500      200 FORMAT(1H,'TABLE FULL')
112.000      RETURN
112.500      150 T(G,7)=T(F,7)
113.000      T(F,7)=G
113.100      T(G,1)=L
113.500      N=N+1
114.000      GO TO 160
114.500      END
126.000      SUBROUTINE CANT(Y)
127.000      IMPLICIT INTEGER (A-Z)
128.000      COMMON N,T(9,7)
129.000      IF(N.EQ.0) RETURN
129.500      DO 100 I=1,9
130.000      IF(T(I,1).NE.Y) GO TO 100
130.500      F=I
131.000      GO TO 110
131.500      100 CONTINUE
132.000      110 IF(N.EQ.1) GO TO 200
132.500      DO 120 I=1,9
133.000      IF(T(I,7).NE.F) GO TO 120
133.500      G=I
134.000      GO TO 130
134.500      120 CONTINUE
135.000      130 T(G,7)=T(F,7)
135.500      200 DO 210 J=1,7
136.000      210 T(F,J)=0
136.500      N=N-1
137.000      RETURN
137.500      END
138.000      SUBROUTINE REST
138.500      IMPLICIT INTEGER (A-Z)
139.000      COMMON N,T(9,7)
139.500      DO 100 I=1,9
140.000      DO 100 J=1,7
140.500      100 T(I,J)=0
141.000      N=0
141.500      RETURN
149.000      END
150.000      SUBROUTINE LIST(CI)
151.000      IMPLICIT INTEGER (A-Z)
152.000      COMMON N,T(9,7)
153.000      DIMENSION X(5),C(5),CI(5,4,2)
153.200      P=N
154.000      IF(N.EQ.0) WRITE (108,200)
154.500      200 FORMAT(1H,'NULL NET')
155.000      DO 110 I=1,9
155.500      IF(T(I,1).EQ.0) GO TO 110
156.000      F=I
156.500      GO TO 120
157.000      110 CONTINUE
157.500      RETURN
158.000      120 CONF=T(F,1)
158.500      I=0

```

```

159.000      DO 130 J=2,6
159.500      IF(T(F,J).NE.1) GO TO 130
160.000      I=I+1
160.500      X(I)=J-1
161.000      130 CONTINUE
161.050      MM=0
161.100      DO 300 J=1,4
161.150      IF(CI(1,J,1)/10.NE.CONF) GO TO 300
161.180      MM=MM+1
161.200      C(MM)=J
161.300      300 CONTINUE
161.500      WRITE(108,210) CONF,I,(X(K),K=1,I),(C(K),K=1,MM)
162.000      210 FORMAT(1H,'CONF ',I2,' NODES ',NI2,' CHANNELS',5I2)
162.500      F=T(F,7)
163.000      P=P-1
163.500      IF(P.EQ.0) GO TO 140
163.700      GO TO 120
163.800      140 WRITE(108,220)((T(I,J),J=1,7),I=1,4)
163.850      220 FORMAT(1H,7I2)
163.900      RETURN
164.000      END

```

APPENDIX 2

PRELIMINARY REPORT ON TELECONFERENCING EXPERIMENTS

During the past several months two experiments in teleconferencing have been carried on at Carleton University with the financial support of the Department of University Affairs of Ontario. These experiments were not a direct activity of the "Wired Scientific City Study", however, the results are pertinent. The purpose of this appendix is to report on the existence of the work; a separate report will describe the experiments and the results thereof in some detail.

The purposes of the experiments were two-fold:

- (a) to determine individual and collective reactions to, and subjective impressions of, communicating via this medium; and
- (b) to determine techniques for efficient and lively cooperation in the performance of tasks.

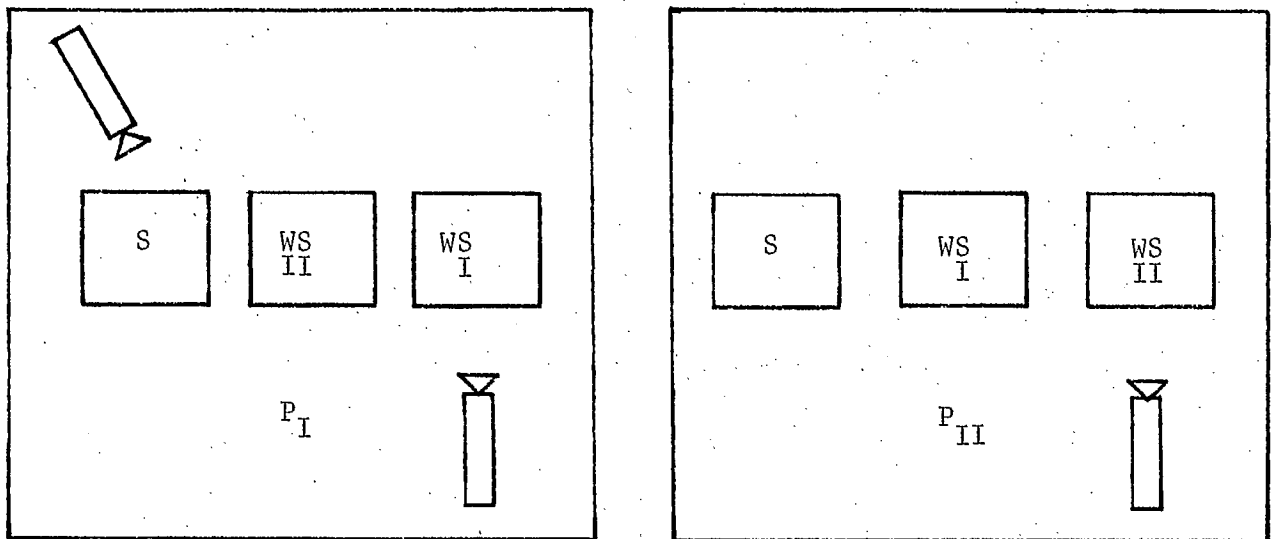
Equipment was borrowed from Carleton University television and, while a rather ad-hoc situation resulted, which was far from ideal in many cases, real experience was gained with television communications.

Experiment Number 1.

A two-way communications link was established between two separate offices (See Figure A-4). Lack of equipment restricted this set-up so that only one participant could be viewed rather than both participants. By means of three television monitors, each participant was able to view: (a) his own writing space (i.e. his own writing pad or whatever visual display he wished to use), (b) the writing space of the other participant, and (c) several different pictures as displayed on the switched monitor. (For a list of possible pictures see Figure A-4). It should be noted, however, that the participant was not able to select the picture he wished to view on the switched monitor. Rather, a technician did the switching at the main control unit, which was located in a third room.

Subjective impressions of the participants were favorable. They were able to communicate quite well, and in a useful fashion. The superimposed images making up a "common" writing space seemed to facilitate the task at hand: organizing and writing a report. The main conclusions of the experiment were that

- a) the system was easy to use;
- b) it fostered intense concentration on the task at hand; and
- c) that much work remained to be done on the design of proper conferencing terminals.



Participant I:

P_I was able to see his own writing space, the writing space of P_{II} as well as a switched monitor which enabled him to view:

- (1) himself
- (2) his own writing space
- (3) the writing space of P_{II}
- (4) a superimposed image of both writing spaces to produce the "common" or "shared" writing space
- (5) by means of split screen techniques, a combination of the above.

Participant II:

P_{II} was able to see his own writing space, the writing space of P_I as well as a switched monitor which enabled him to view:

- (1) P_I
- (2) his own writing space
- (3) the writing space of P_I
- (4) a superimposed image of both writing spaces to produce a "common" or "shared" writing space
- (5) by means of split screen techniques, a combination of the above.

FIGURE A-4: A TWO-WAY COMMUNICATIONS LINK

Experiment Number 2.

At a later stage, a three-way communications network was set up in a laboratory (See Figure A-5) to explore the subjective impressions and task facilitation of communicating by means of television. With six television monitors, each participant was able to view the other two participants (i.e. viewing spaces) and three writing spaces which included his own. A switched monitor provided various combinations of pictures but was at the control of the technician or the experimenter.

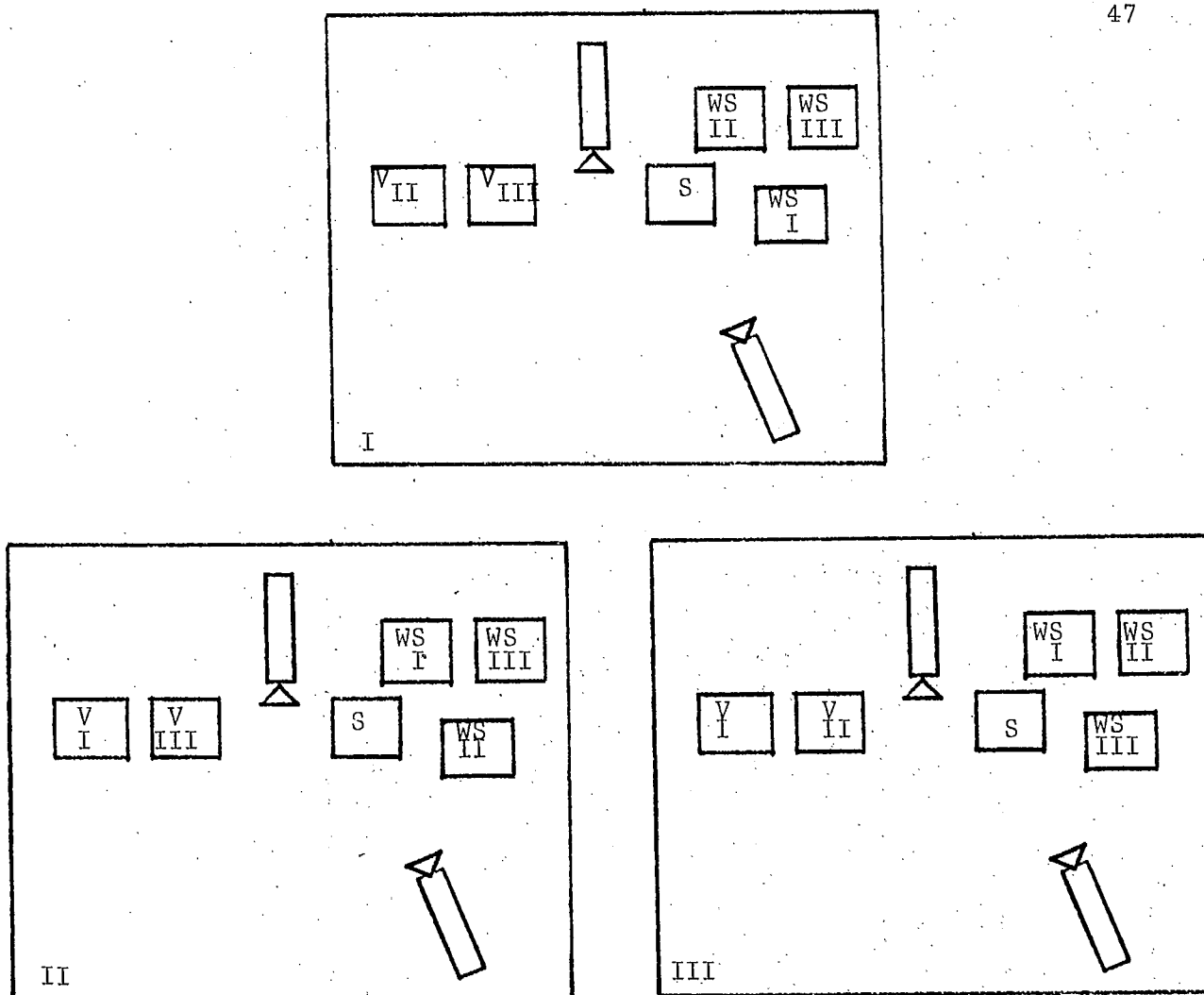
The investigators were also interested in gathering information about the participants' use of the writing space as compared to the viewing space: when they used it and why they used it.

Observations were made by means of videotaping each of the participants during the sessions, and eliciting responses to questions asked of the participants after the sessions. The observations made and the opinions collected, when examined, will have implications for further research. This examination is not complete at this time.

Two immediate general reactions to the experimental set-up on the part of the participants were:

- (a) the screens were too widely separated for comfortable viewing. (Separation was essential for purposes of recording by means of videotape for later analysis.)
- (b) headsets were most annoying at times and distracting. (Headsets were necessary due to the high level of noise from the air conditioning in the laboratory, and to reduce the possibility of feedback).

Again, the experimental system was considered effective and relatively easy to use.



Each participant was able to view:

- (a) Both of the other participants
- (b) His own writing space
- (c) The writing spaces of the other participants
- (d) By means of the switched monitor under the control of the technician or investigator:
 - (a) Himself
 - (b) Himself and one other participant
 - (c) Both of the other participants
 - (d) Superimposed image of all three participants
 - (e) His own writing space
 - (f) His own writing space plus that of another participant
 - (g) The writing spaces of the other two participants
 - (h) Superimposed image of the three writing spaces
 - (i) Combinations of the above.

FIGURE A-5: A THREE-WAY COMMUNICATIONS LINK

The investigators at no time have attempted to set-up an environment that could be foreseen as the "typical" terminal of the wired city complex. Rather, they made use of available television equipment in a limited pilot study in an effort to determine reactions to communicating via television in order to ascertain information and clarify their ideas for incorporation into directives for future research.

APPENDIX 3

PLANS FOR LOCAL SYSTEMS DEVELOPMENT AND RESEARCH

UNIVERSITY MEDIA CENTRE PLANS

The local television systems at both the University of Ottawa and Carleton University are related to the University Media Centres. The Centres are concerned with the full range of audio-visual material and equipment, as well as television distribution.

At the University of Ottawa, the Media Centre will be located in the new Central Library. Sufficient conduits will be placed in all future buildings (and is being placed in all now under construction) to ensure that televised material may reach any location in which it may ever be desired. The conduits in each building will terminate in an equipment room close to the service tunnels which interconnect all buildings. It is the intention of the Media Centre to convert all of the present visual material now on slide-tapes and films to video tape recordings and to institute a demand disbursement scheme similar to IRTV.

The Media Centre at Carleton University is presently in the planning stages. It will serve the functions of the present Instruction Aids Department, Carleton University TV, and the educational requirements of the School of Journalism. The Centre will include two television studios, one containing the present black and white equipment, while the second will be colour equipped. The Centre will also contain facilities for the storage and distribution of audio-visual materials and equipment and auxiliary services associated with television and film production.

Carleton's Media Centre will also be the central distribution point for a video cable system, which presently exists in a rudimentary form. Other than course broadcasts, suggested uses for a two-way video system have included joint experiments in speech processing, counselling services associating with the Computing Centre, and distribution of computer graphics from the video-desk system associated with the central computer.

COMMUNICATIONS RESEARCH CENTRE

The Communications Research Centre is developing plans for the pursuit of activities in two directions, via, digital communication networks and video graphics. The establishment of a wide-band network for the wired city would allow experimental digital networks to be interfaced with and to make use of this facility for experimental purposes. In the longer term experimental work in digital communications could be combined with studies of terminal equipment in the video graphics programme.

A complementary interest exists in evaluating the effectiveness of various video graphic terminal equipment and techniques in promoting the effective transfer and use of information. This applies on one hand to computer oriented application such as in interactive loop systems and on the other hand to more direct communications between individuals via such facilities as video phones in teleconferencing hookups, remote seminars etc.

If the Wired Scientific City proposal were implemented as well as using the network to promote research activities with other participating organizations, CRC could establish improved communications between Shirley's Bay and Department of Communications headquarters in Ottawa and explore such things as remote attendance at universities and remote participation at seminars.

RESEARCH IN INFORMATION SYSTEMS AT CARLETON UNIVERSITY

The Systems Engineering Division of the Faculty of Engineering at Carleton University has had a research program in communications, control, digital systems, and computers for several years. The Division has had common interests in optimization, signal processing, and computer applications, and is responsible for the Computer Science program.

The present theme of the Division's research may be described as Information Systems Engineering. In addition to the "Wired Scientific City Study" members of the Division are engaged in document retrieval systems with Energy, Mines, and Resources; experiments with Project 91 at Bell-Northern Research; communications research with the Communications Research Centre; multistation television conferencing experiments; audio loop equalization research; writing tablet development; talkback television teaching systems and other activities supported by the Ontario Department of University Affairs; speech processing; and animated computer graphics.

APPENDIX 4

IMAGE INTERLEAVING FOR WRITING SPACE DISTRIBUTION

Since images of writing surfaces are usually displayed for considerable lengths of time without being changed; and since it is often desirable to meld several images together, the following scheme has been proposed to make more efficient use of the available video channels.

Each writing surface is televised in the normal manner, but frames from each camera are successively transmitted, in a time-division multiplex manner. Thus, a single video channel can be used for the writing space, and relatively inexpensive television equipment may still be used. These techniques are used in some closed circuit television systems now, as at the MITRE Corporation, Bedford, Mass.

Technical problems arise in the synchronization of the multiplexing and demultiplexing, but these may be overcome in any number of ways, e.g. by use of a synchronizing signal transmitted sub-audio on the voice circuits. Such a signal would undoubtedly facilitate the operation of the entire network in any event. Other problems arise in the matter of user acceptance: resolution, intensity and contrast, flicker rate, stroboscopic effects, and so on.

Image multiplexing and other means of creating a common writing space are subjects for continuing investigation in Carleton's telesynthesis research program.

APPENDIX 5

FACSIMILE: A MEDIUM FOR A WRITING SPACE

Video writing spaces, in various configurations, as well as modifications to such, have been discussed previously (See Appendices 2, 4). The following are suggestions for alternative and/or supplementary writing spaces.

Two of the most popular (and available devices at the moment are the telewriter (Telescript)¹ and the telecopier (Xerox), which are described in the included data sheets.

The telewriter uses ordinary phone lines to transmit a message from one paper to another; a movement of the pen on the sender's pad is duplicated by the writing arms on the receivers' pads.

At the present time, the telewriter could be used as a writing space; however, replacement of the video writing space by the telewriter is not advisable for the following reasons:

- 1) Only one person can be transmitting at any one time.
- 2) Some control would have to be exercised on the net, which would approximate the "switching" of humans (e.g. "O.K. John it's your turn now."). This could prove to be distracting and inhibiting.
- 3) It is not accurate enough to perform all the functions that are required in the pilot network.

The Xerox facsimile transceiver (telecopier) takes approximately two minutes to transmit an image of the same size as the video writing space². This delay, coupled with the further disadvantage of allowing

¹ Telescript is the registered trademark of Bell Telephone Company's telewriter.

² In the experiments conducted at Carleton (See Appendix 2), best results were obtained if a sheet of paper 8 $\frac{1}{2}$ wide by 5 $\frac{1}{2}$ inches long filled the screen.

Telescript SERVICE

TELESCRIPT TRANSCIVER

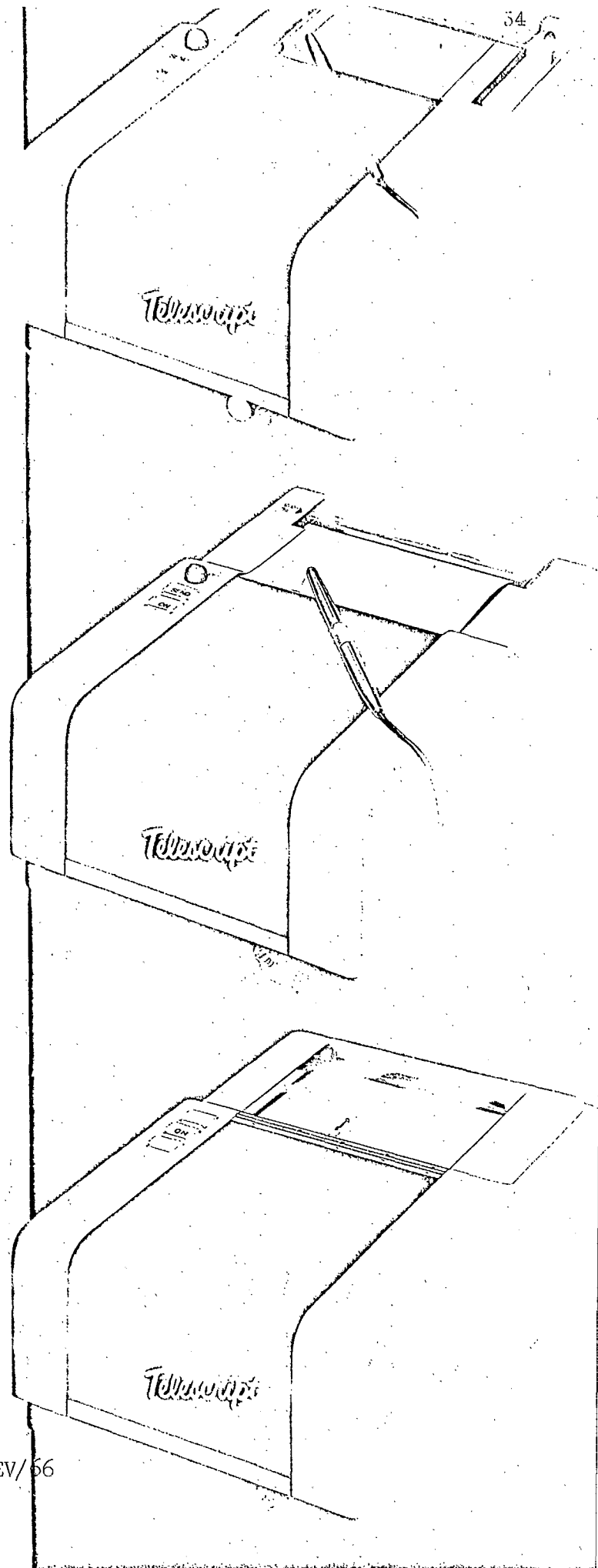
- a compact new unit that both transmits and receives messages.
- costs less than a two-unit transmitter and receiver.
- provides a permanent written record of the original message and its reply.
- ideal for two-way instantaneous written communications.

TELESCRIPT TRANSMITTER

- speeds one-way communications as you write — handwritten messages, sketches, orders sent anywhere — any distance — to a number of receiving units.

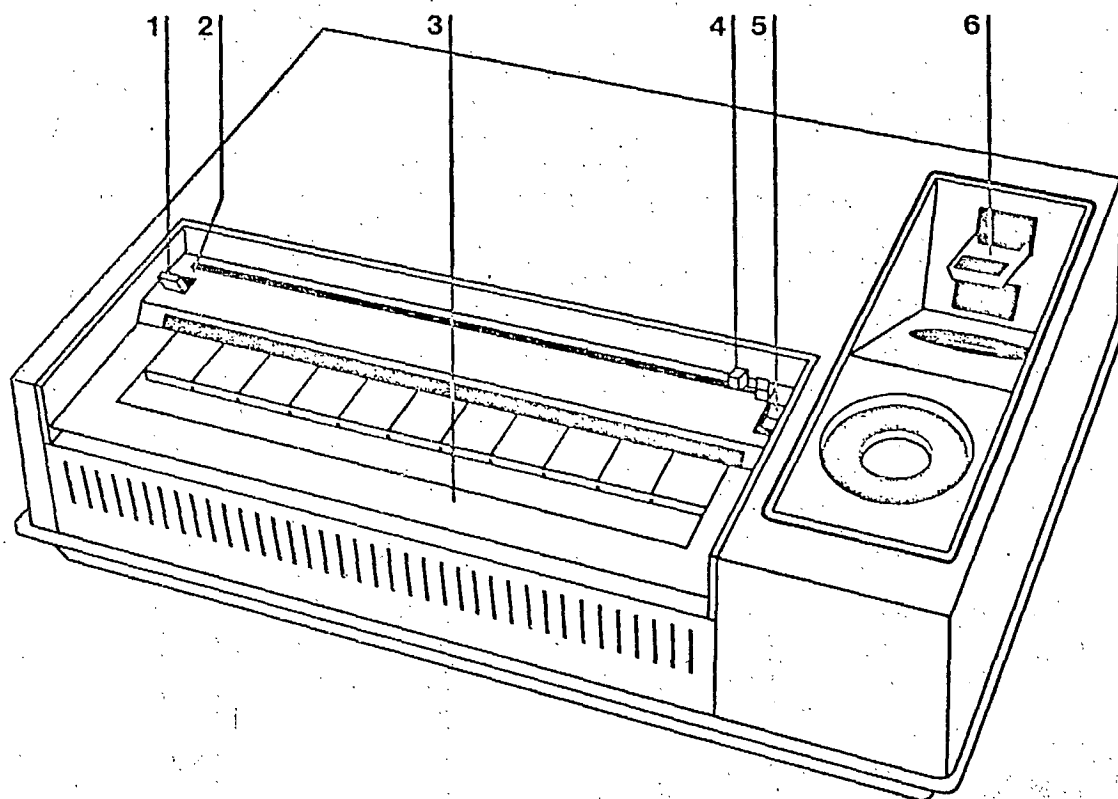
TELESCRIPT RECEIVER

- automatically and accurately reproduces any message or sketch instantly as it is being written.
- non-attended feature frees personnel for other duties.



Xerox 400 Telecopier

1. **Send/Receive Switch.** One touch readies the 400 for transmission or reception.
2. **End-of-Message Signal.** A special sensor activates this repetitive buzzing signal, to advise you transmission has been completed.
3. **Front Cover.** Easily opens for insertion of original document before transmission, or recording paper before reception.
4. **Copy Position Indicator.** Shows exact point on document where copy is being transmitted or received. Simplifies transmission of partial-page documents.
5. **Speed Mode Switch.** A touch readies the 400 for six-minute or four-minute operation.
6. **Telecoupler.** Insertion of a standard telephone handset activates automatic transmission or reception. Removal of the handset deactivates the unit.



Specifications

Width, 18 $\frac{3}{8}$ "; Depth, 13 $\frac{3}{8}$ "; Height, 4 $\frac{5}{8}$ "; Weight, 18 lbs.

Electrical Requirements: 120 volts AC, 60 cycles, single phase, 2 wire plus ground.

Input Material: 8 $\frac{1}{2}$ " x 11" maximum; no minimum.

Output Material: Standard-size 8 $\frac{1}{2}$ " x 11" recording paper.

Transceiving Speed: Three inches per minute (up to 280

words of single-spaced typewritten information, or graphic matter of comparable size), producing an 8 $\frac{1}{2}$ " x 11" page in four minutes. Partial-page documents require proportionately less time. Unit also operates at six minute speed, providing compatibility with all Xerox Telecopier models.

Performance Verification: A handy self-test feature permits spot checks to verify machine performance.

XEROX

Business Products Group, Rochester, New York 14603
Xerox, Telecopier and Telecoupler are registered trademarks of Xerox Corporation.
© 400 is a trademark of Xerox Corporation.

Printed in U.S.A. 610P3830

only one person to transmit at any one time, relegates the use of the telecopier as a supplement to rather than a replacement for the video writing space. This facility would be desirable, in any event, for the distribution of a hard copy of information pertinent to a conference or lecture.

Although it appears that the "video space" is superior to the telewriter or the telecopier, it has a serious handicap which limits its effectiveness --- it cannot produce a hard copy of a composite television image without the use of rather expensive equipment, such as the Tektronix 4602 Video Hard Copy Unit.

Chart 5.1 compares the features of the three writing spaces and suggests the desired capabilities which should be incorporated in a highly versatile writing space.

features	Telecopier	Telewriter	Television	Tele_____
hard copy	yes	yes	no	yes
bandwidth	narrow	narrow	wide	narrow
versatility	low	low	high	high
simultaneous interaction	no	no	yes	yes
speed of interaction	very slow	slow	fast	fast
price	moderate	moderate	high	moderate

A writing system comprising slow-scan television with storage oscilloscope displays and moderately priced hard copy units would provide many of the desired features.

APPENDIX 6

TERMINAL CONFIGURATIONS FOR THE MANY-TO-MANY CONFERENCE

Suggestions are made in this appendix for conference terminal configurations suitable for point-to-point conferences involving up to eight participants at each node.

Terminal 1, Figure 6-1, is the simplest to implement and the least interactive. It is the closest to a normal conference room in arrangement. There are several options, for example,

Option 1.1

Camera 1 (operator controlled) is used for close-ups on the speaker. Camera 2 is used for blackboard viewing or the viewing of written material by the insertion of a mirror in the viewing path. Large monitors, on video projectors, display the corresponding images from the other conference room.

Option 1.2

Camera 3 is introduced to provide separate writing space.

Option 1.3

Camera 4 is added to provide a continuous wide angle view of participants.

Option 1.4

Video switching and mixing capability is introduced to allow superposition of these images and/or incoming images.

Option 1.5

The large monitors are replaced by a set of small monitors for every two participants.

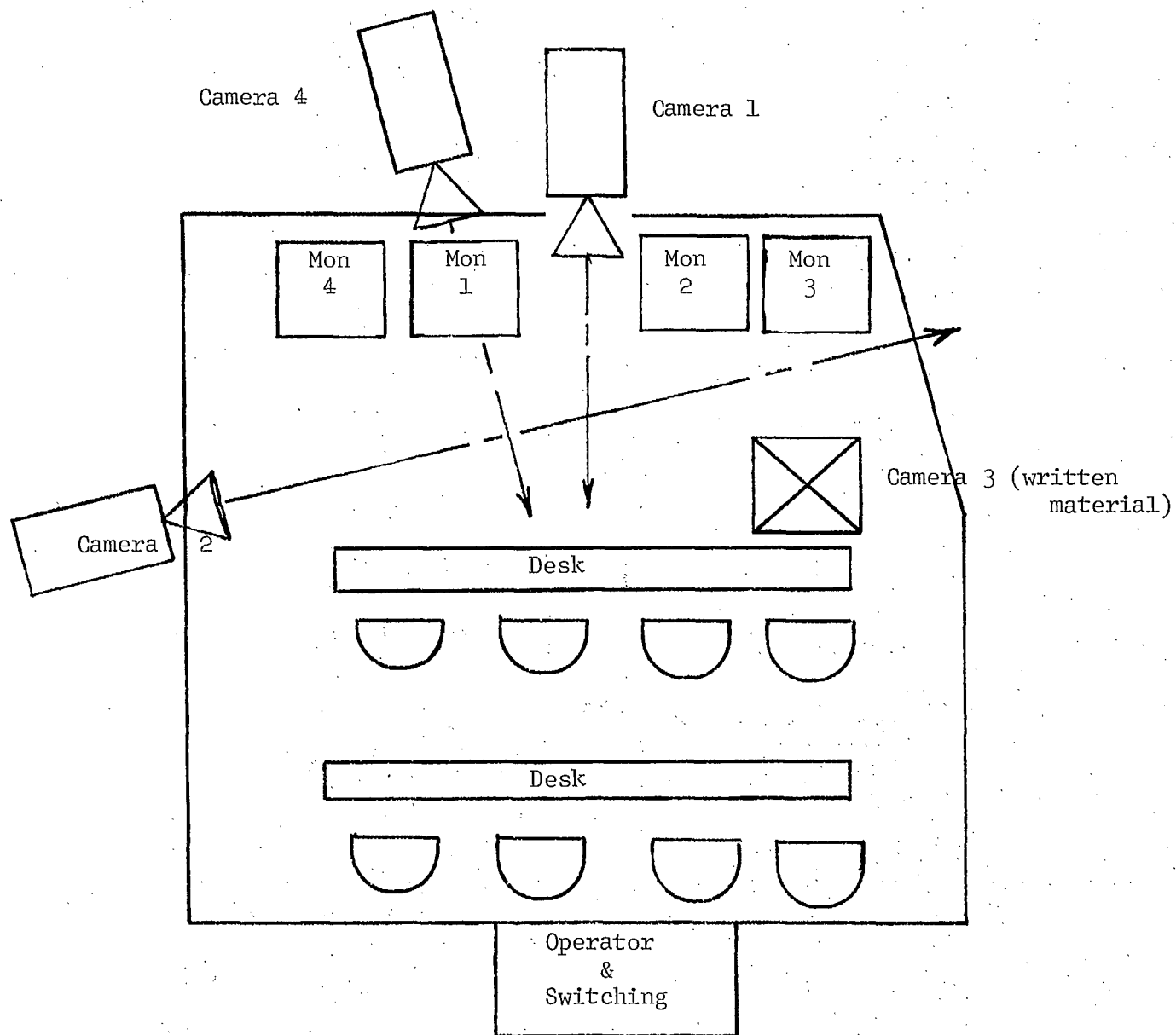


Figure 6-1. Many-to-many conference terminal: Option 1.

Cost of Option 1.1

Cameras	2	at	3900	\$ 7,800
Monitors	2	at	250	500
				<hr/> 8,300
Audio: microphones	4	at	50	200
mixer				500
amplifiers				750
				<hr/> 1,450
				<hr/>
Total				\$ 9,750

Cost of Option 1.4

Cameras	2	at	3900	\$ 7,800
	2	at	2800	5,600
Monitors	4	at	250	1,000
Video switch				1,600
Remote control				1,500
Audio				1,450
				<hr/> \$ 18,950
Total				

Terminal 2, Figure 6-2, a different arrangement of the desks and two cameras, 1 and 2, viewing the four participants at each desk. Camera 3 provides an image of the blackboard (or rear-projection screen) and written material. Three small monitors provide the corresponding images from the remote conference room for every pair of participants.

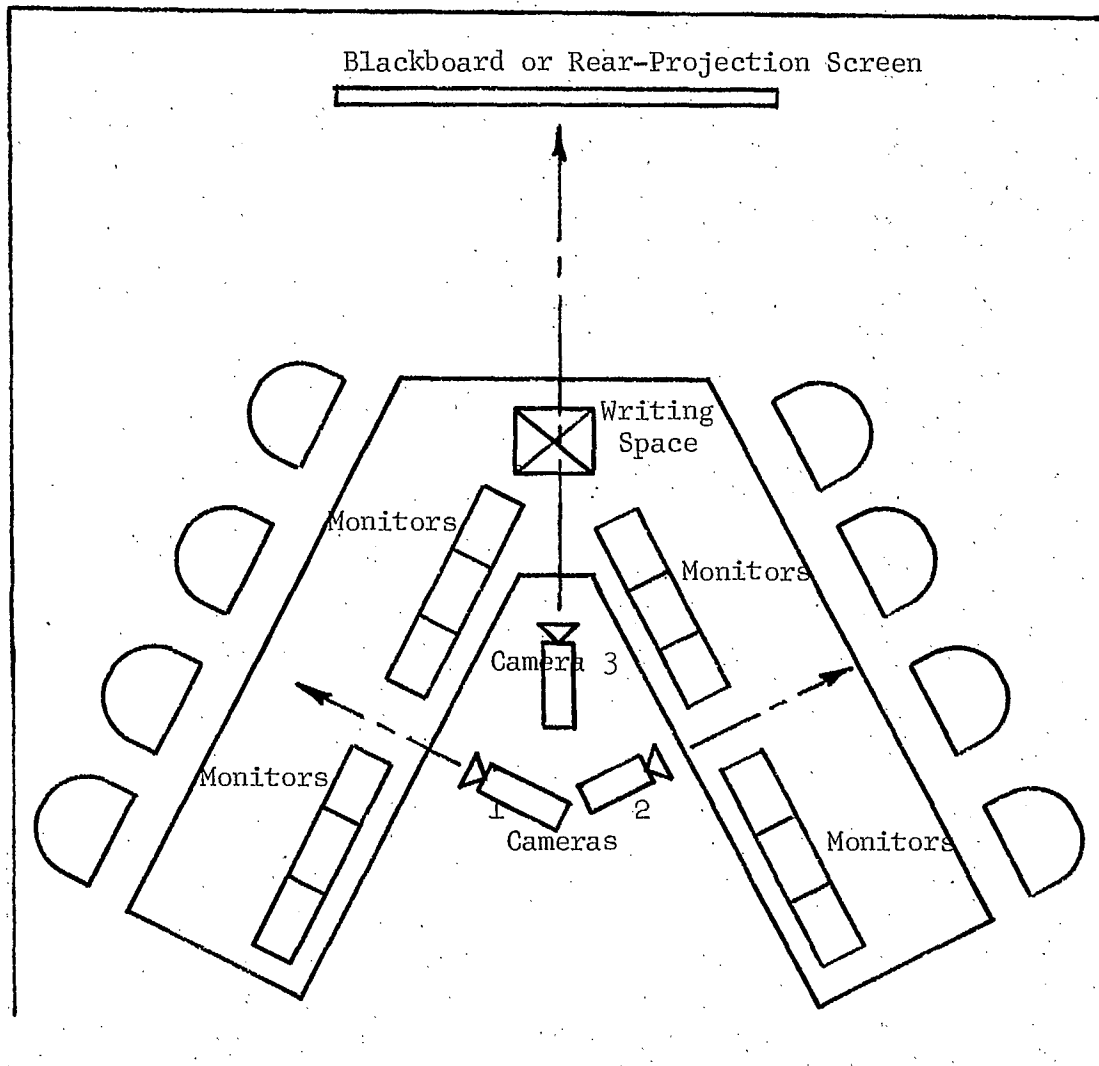


Figure 6-2. Many-to-many conference terminal: Option 2.

Cost:

Cameras	3	at	3900	\$ 11,700
Monitors	12	at	200	2,400
Distribution Amplifiers	3	at	150	450
Audio				1,450
				<hr/>
Total				\$ 16,000
				<hr/>

Obviously, there are many configurations. Little is known about the effectiveness of these configurations, the ideal number of cameras or monitors. Notice, however, that neither of the two suggested terminals place the control of a single image in the hands of the conference chairman or of the speaker. All participants are in view at all times in all but Options 1-1 and 1-2. This is based on a different "meeting model" than that used by the designers of "Videophone" conferences and which is believed to be more useful than capture of the single image by the loudest speaker.

