Tele-Training for Personnel Development

Technological Report

TELE-TRAINING FOR PERSONNEL DEVELOPMENT

TECHNOLOGICAL REPORT

Miller Communication Systems Ltd.
39 Leacock Way
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PUBLIC SERVICE COMMISSION

The Tele-Training for Personnel Development series is edited and published by the Satellite Project Office of the Secretariat Services Branch, Public Service Commission.

The purpose of this series is to document and disseminate information about the design, implementation and results of the Public Service Commission's Communications Technology Satellite (CTS) Project: Staff Training by Satellite. The Communications Technology Satellite was made available for pilot experimental periods by the Canadian Department of Communications.

Michael G. Ryan, Ph.D.

Series Editor

Reports in this series are entitled:

Tele-Training for Personnel Development: Staff Training by Satellite

Téléformation pour le perfectionnement du personnel: Modèle théorique

Tele-Training for Personnel Development: Course Designers'/ Directors' Report

Tele-Training for Personnel Development: Evaluators' Report

Tele-Training for Personnel Development: Technological Report

Tele-Training for Personnel Development: Telecommunication Research

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ACKNOWLEDGEMENTS

Special recognition is extended to those who contributed in so many ways to the success of the project. Their support and co-operation greatly facilitated the work of the project staff.

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* Special acknowledgement goes to Dr. George J. Jull of the Communications Research Center whose early work on interpersonal telecommunications served as the foundation for much of the work in this project.

TABLE OF CONTENTS

FOREWORD

The Technological Report of the Tele-training for Personnel Development series summarizes the technical aspects of the Public Service Commission's Communications Technology Satellite project: Staff Training by Satellite. This three-part report prepared by Miller Communications Systems Ltd. describes their work on the engineering and technical components of the multi-location Staff Training by Satellite project.

The first part, "CTS Experiment-Multiway Interactive Telecommunication System", described the technological configuration of the Ottawa, Ontario and St. John's, Newfoundland, audio and video systems. A most interesting aspect if the operationalization of a video multiplexing system especially designed for this project. Also interesting reading is the description of the custom designed and developed open microphone audio system.

The second part entitled "Report on the PSC-CTS Learning Experiment: Operational Phase", focuses on the modification and improvements that were performed in light of operating requirements of the project.

The final part entitled, "PSC-CTS Learning Experiment: Microwave Link Report", described the configuration of the system which carried the audio-video signals from the downtown Ottawa Learning Center to the ground station of Shirley Bay, Ontario

The contributions of Miller Communications Systems Ltd. to this project have been enormous and thanks to this organization the Public Service Commission was able to use satellite technology in a truly innovative and rewarding fashion.

CTS EXPERIMENT - MULTIWAY INTERACTIVE TELECOMMUNICATIONS SYSTEM

PROJECT REPORT

FINAL

The report contained herein is in partial fulfillment of the work performed under DSS Contract 02PL.D1122-6-0219/6008 Serial No. OPL76-00020 (Contract Officer: Ms Kathy Boyd) for the Public Service Commission, Staff Development Branch (Project Leader: Dr. Michael G. Ryan).

SUBMITTED BY:

Miller Communications Systems Limited
39 Leacock Way,
Kanata, Ontario K2K 1T1

March 1977

Introduction

The purpose of this report is to provide a summary of the work performed by Miller Communications Systems Limited as contractor to the Public Service Commission, Staff Development Branch and is also to comply with Article 16.2 of DSS Contract No. 02PL.D1122-6-0219/6008, Serial No. OPL76-00020.

The text of this report will be in chronological sequence commencing from April 1976 and terminating in March 1977, covering Phases I (April-Sept. 1976), II (June-December 1976) and III (December-March 1977) of the contract.

To provide some reference framework, the Statement of Work (Appendix 'A' of the previously mentioned DSS Contract) is reproduced here in its entirety:

The contractor shall design, develop, build, test, deliver and install a multi-way interactive telecommunications system to enable the Public Service Commission to conduct learning experiments between L'Esplanade Laurier, Ottawa, Ontario and Memorial University, St. John's,Newfoundland.

The communication link for the interactive multi-way telecommunications system shall be furnished via CTS Satellite ground terminals operated by the Communications Research Center in Shirley Bay, Ottawa, Ontario and at St. John's, Newfoundland; a microwave link to be provided between Ottawa and Shirley Bay by a source to be recommended to the PSC by the contractor, local cabling between the satellite ground terminal in St. John's, Newfoundland and the four conference rooms to be provided by Memorial University; cabling from the microwave link in Ottawa and conference room in L'Esplanade Laurier to be

provided by a source to be recommended to the PSC by the contractor.

The project shall have three main phases:

PHASE 1 - Special video and audio system design and acquisition of hardware.

PHASE 2 - All required technical support to PSC simulations at Carleton Place or Ottawa

PHASE 3 - Installation of equipment and system testing.

Phase 1 (April - Sept. '76) the contractor shall design, develop, build, test and deliver the SPECIAL TELEVISION MULTIPLEXING EQUIPMENT as required by the PSC-CTS Experimental Plan F-3 and as listed in attachment 1. He shall also design the layout of all conference rooms, identify and procure the necessary audio system components, specify and identify the types and sources for leasing and/or buying of required cameras and monitors for the conference rooms in Ottawa and St. John's. The contractor shall have the responsibility if required by PSC of insuring that the required equipment is bought and/or leased.

Phase 2: The contractor shall provide all required technical support to the PSC during experimental simulations of the audio portion of the learning configurations which are scheduled to commence at Carleton Place, or Ottawa Ontario, in June 1976 and during the video portions of the simulation which are scheduled to begin during October, 1976. The contractor shall make all alterations and/or modification required by the PSC based on technical and behavioral evaluations of the simulations.

Phase 3 (Dec '76 - Feb '77): The contractor shall install, set up and check out all video and audio equipment in the Ottawa conference room and shall provide all technical direction/instruction to Memorial University personnel to insure proper installation of the PSC facilities in Newfoundland. The contractor shall then test and check out all facilities installed by Memorial University personnel and shall take responsibility for a complete operational system.

Attachment 1* of Appendix 'A'.

VIDEO EQUIPMENT PRODUCED

Qty 1 VITS GENERATOR consisting of: (Ottawa)
- Qty 1 Sync Extractor and Clamper
- Qty 1 Vits Inserter
- Qty 1 Power Supplies and Card Box

Qty 4 VIDEO MULTIPLEXER consisting of: (St. John's)
- Qty 1 Sync Extractor and Clamper
- Qty 1 Video Selector
- Qty 1 Clamper, Vits Detector
- Qty 1 Camera Sync Generator
- Qty 1 Power Supplies and Card Box

Qty 1 VIDEO DEMULTIPLEXER consisting of: (Ottawa)
- Qty 1 Sync Extractor and Clamper
- Qty 4 Video Selector
- Qty 1 Clamper, Vits Detector
- Qty 4 Video Equalizer and Buffer
- Qty 1 Power Supplies and Card Box

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* Deliverable video equipment list amended as per Attachment 1 of this report (reference correspondence K. Boyd - R. Chang December 14, 1976 and Minutes of October 4 Progress Review Meeting).

AUDIO EQUIPMENT

Audio equipment as required to adequately equip the conference rooms in Ottawa, Ontario and St. John's Newfoundland.

TECHNICAL SUPPORT

The contractor shall assist the Public Service Commission with all technical aspects of the learning experiment and shall maintain technical liaison with other outside agencies as required by PSC.

Contract Phases

Phase I (April - Sept. 1976): This phase was a period of fairly intensive activity during which the prototype version of the Video Multiplexer was debugged and necessary circuit modifications made in order to make the multiplexer operational. In addition, certain circuit boards were made multi-functional by incorporating other circuit functions. In so doing, it was possible to provide a number of spare printed circuit boards (PCB) while still remaining within budget constraints.

The prototype video multiplexer with single channel multiplexing capability was made operational during May and was viewed by various individuals from the Communications Research Centre, DOC and Telesat Canada. Demonstrations were terminated in the early part of September.

In early June, the subcontract for the manufacture of the video multiplexer hardware to be used in the actual CTS Experiments was awarded to DG Instruments of Kanata with a projected delivery time of the first week in September.

The video multiplexer equipment was subsequently delivered on September 13. Integration and debugging procedures were initiated shortly thereafter with system integration of the various multiplexer units started during the middle of October.

During May also, an extensive search was launched to locate a source in North America for the long-persistence cathode ray tubes (CRT's) which were to be used in the regeneration process of the multiplexed video signal emanating from St. John's, Newfoundland. However, no manufacturers were located in North America who could provide such CRT's at the price originally projected ($200 each) for such a low quantity (5) and to fit a commercial black and white TV monitor.

Eventually a source was located in England (Thorn-AEI Radio Valves and Tubes Ltd.) and a single CRT was ordered for trial purposes. A Sony CVM-194 black and white TV monitor was fitted with the new long-persistence CRT. The tube functioned well and was nearly a perfect mechanical fit. It was thought at first that the greenish tinge of the long-persistence phosphor coating might prove to be unacceptable but subsequent opinions polled indicated that the green tinge was less 'harsh' and tiring on the eyes when viewing the one-in-four video signal over a prolonged period.

Other activities during this phase included:

a. the definition of an audio teleconferencing system to complement the video system and the identification of specific audio components to be used in that system. A preliminary purchase of key audio components was made in order to carry out abbreviated operational checks of the proposed lightweight, open-air headphones/open microphones audio system. Basically, the short tests indicated that circuit noise might prove to be unacceptable

but any final decisions were postponed until the experimental sessions at Carleton Place.

During September a visit was also made to the University of Wisconsin in Madison to view the commercially available Darome convenors, a voice-switched audio conferencing unit, in operation at the university's remote teaching facility.

b. On July 19, preliminary surveys of the proposed microwave backhaul route between the Communications Research Centre (Building 46) and the west tower of L'Esplanade Laurier in downtown Ottawa were initiated. Preliminary contacts were established with Bell Canada concerning the provision of the two-way microwave link. On-site inspections were carried out by Bell Canada engineers and lease charges (plus construction charges) provided.

A Microwave Link Report embodying the various details, alternatives and recommendations was submitted at the Progress Review Meeting of October 4 in compliance with Article 16.3 of the contractual agreement.

c. Requirements for the conference facilities both in St. John's and in L'Esplanade Laurier were submitted in July and efforts were launched to locate suitable facilities at Memorial University and L'Esplanade Laurier.

Throughout Phase I, close contact was maintained with the Project Leader and progress review meetings held at appropriate intervals.

Phase II (June - Dec. 1976): Activities during this phase centred on the system integration of the video multiplexers and the purchase of audio equipment for the simulations at Carleton Place which occurred during the week of November 15-19.

A 4-node system simulating Ottawa and 3 conference rooms in St. John's was set up using the video multiplexer units and an open-mike/headphone audio system installed. In addition, a voice-switched audio system using the Bell Canada 50A conference units was installed to gauge the participants' reaction to a voice-switched system.

As a result of the simulations, the following conclusions were drawn:

a. The green phosphor of the long-persistence CRT was adequate.

b. The equipment noise (hiss) in the open-mike/headphone arrangement was not too distracting (even though the noise was more pronounced than that present in the short-form tests conducted previously by the contractor) and was offset by the fact that this audio arrangement promoted free flowing discussions amongst the participants.

c. The voice-switched system was unacceptable due to the poor quality of the sound reproduction and the speech clipping that occurred.

d. Although the video multiplexing arrangement functioned, it tended to lapse into 'picture flashing' indicating the need for possible further circuit improvement. It was later discovered that this instability was very likely due to inadequate ventilation in the multiplexer units.

Additional circuitry was incorporated into the Ottawa modem to enable the use of closed-circuit TV (CCTV) cameras in the system.

A short visit was made to Memorial University in the latter part of December to view the available facilities, arrange for the provision of conference room furniture and to arrange for the construction of custom-designed trolleys for housing the audio and video equipment in each conference room.

As before, close contact was maintained with the Project Leader, and a number of progress review meetings held.

Phase III (Dec. - March 1977): Test/demonstrations of the video multiplexer system were first carried out on the CTS satellite during January on three separate occasions. Shortly after the first two sessions, during which picture synchronization loss was experienced, a failure in one of the power supplies for the Ottawa modem was experienced. The correlation between synchronization loss and inadequate ventilation was also established during this interval. Allowances were made for adequate ventilation of the units and the faulty power supply repaired. The third demonstration was flawless. All tests were carried out on-site at Building 46 of the Communications Research Centre.

In addition, the video multiplexer was also demonstrated to TCTS officials at Place Bell Canada in Ottawa.

Field installation and checkout of the Memorial University teleconferencing facilities was undertaken during February 14-21 but was not completed due to clashes in classroom scheduling, incompleted cable installation and lack of secure

storage area for audio and video equipment. One piece of video equipment (CCTV camera) was lost in transit from Ottawa and, to date, still has not been located.

Despite these drawbacks, a 4-node video teleconferencing system linking the VTR Room (ETV Centre) and Rooms E115, E331A and E331 was accomplished successfully. Further installation work will be carried out in early April 1977.

An audio teleconferencing system was also implemented using the Darome 6-input 4-wire teleconferencing bridge for the first time and two Darome Model 611 convenors together with the open-mike/headphone system to provide audio communication between the rooms. An added feature of the teleconferencing bridge is the incorporation of voice-activation circuits (similar to those in the 611 convenors) which may or may not be used. Activation of these circuits would allow the substitution of loud-speakers for the headphones while still preventing acoustic feedback.

Installation of the L'Esplanade Laurier teleconference facility commenced on March 9 with audio and video cables being installed between Rooms 750 (conference room) and 705 (Monitoring and Control) of the West Tower.

The audio and video baseband interface with Bell Canada will be located in Room 705. From Room 705, the audio/video cables (receive/transmit video at 1 volt peak-to-peak; receive/transmit audio) will be routed through the Bell Canada Telephone rooms, located on each floor, up to the microwave link equipment on the roof of the West Tower.

A recent modification to the original equipment configuration in the Monitoring and Control Room is the provision of video distribution amplifiers (VDA's) and a number of 9" monochrome TV monitors and special audio mixer/amplifiers. With these extended facilities, video tape recordings as well as remote viewing of the teleconferencing sessions can be accomplished. All five room video signals (Ottawa plus 4 St. John's rooms) will be available for viewing.

Based on verbal assurances given at the Progress Review Meeting of March 3, 1977, Bell Canada was again contacted and requested to have the microwave link between CRC and L'Esplanade Laurier established by April 13, 1977.

System Description

The overall system configuration for the PSC-CTS Multi-way Interactive Teleconferencing Experiment will be as illustrated in Figure 1. The end terminals of the experiment will be located at L'Esplanade Laurier, West Tower in downtown Ottawa and Memorial University in St. John's Newfoundland.

Audio and video signals originating from the conference room (Room 750) in L'Esplanade Laurier will be directed via the Monitoring and Control Room (Room 705), where remote viewing and video taping can take place, to the Bell Canada microwave equipment located on the roof of the West Tower. The microwave backhaul will provide two-way audio/video services between the West Tower and the 9-metre CTS terminal located near Building 46 of the Communications Research Centre, Shirley Bay.

The other end of the microwave link will be located at the top of a 70 ft. unsupported tower near Building 46 and from there, audio and video baseband signals will be routed to the Experimenters' Baseband Interface Panel located in the Control Room of Building 46. The audio/video signals from Ottawa will be transmitted by the 9-metre terminal via the CTS satellite and received in St. John's by the 3-metre CTS Transportable terminal located on campus at Memorial University. The output of the 3-metre terminal will be baseband audio and video signals which will then be sent to the VTR Room of the ETV Centre, located in the basement of the Arts/Education Building, for distribution to the four conference rooms in the Education Building.

For the return path, the multiplexed video and audio signals originating from the conference rooms in the Education

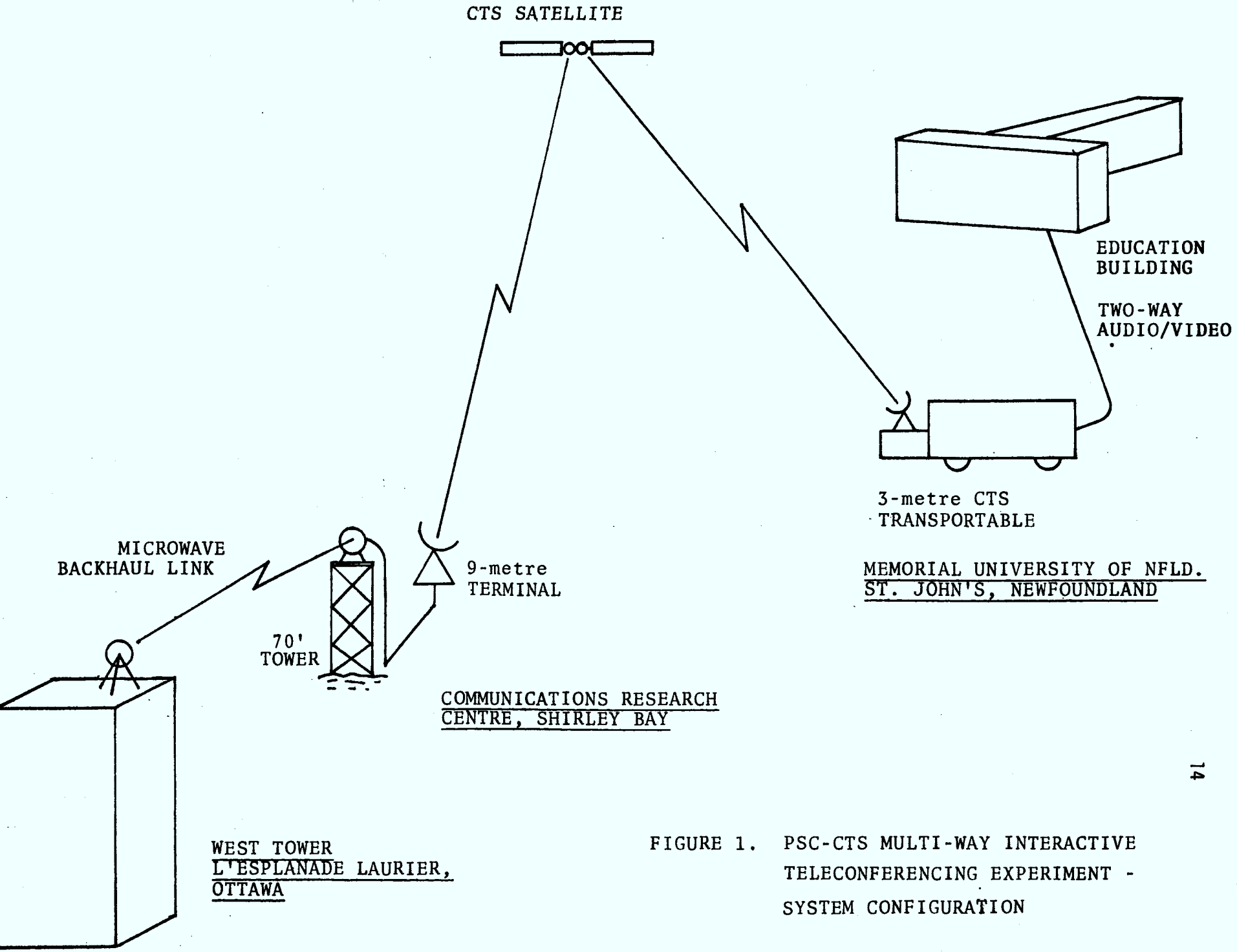


FIGURE 1. PSC-CTS MULTI-WAY INTERACTIVE TELECONFERENCING EXPERIMENT - SYSTEM CONFIGURATION

Building will be directed in the opposite direction but will follow the same route as outlined above. Thus all signal paths shown in Figure 1 will be carrying two-way video and audio services.

In addition, there will be an order-wire provided between the Monitoring and Control Room in L'Esplanade Laurier and the Control Room in Building 46 (CRC) via a telephone co-ordinating channel (TCC). QSK portable telephone sets will be provided at either end of the TCC. It is also expected that this order-wire will be extended to the 3-metre terminal by suitable bridging and the use of one of the three audio subcarriers above video baseband.

Ottawa Teleconferencing Facility

The audio and video equipment configuration for the Ottawa terminal is shown in Figure 2.

The incoming multiplexed video signal from St. John's is fed into a video distribution amplifier (VDA1) which provides one output for a video tape recorder (VTR) and another for the receive side of the Ottawa Video Multiplexer modem. The output of the modem provides the de-multiplexed video signals (one-in-four lines of video) from each of the four rooms in St. John's . The de-multiplexed signals are then routed to VDA's which provide two sets of outputs: one set feeds a bank of 9" Electrohome monochrome monitors located in the M&C room; the other set is connected to the four long-persistence monitors in the conference room.

On the transmit side, there will be two cameras: one will be fitted with a wide-angle lens for viewing the participants (Room Camera) and the other with a zoom lens for viewing a graphics display. Since only one video signal may be trans-

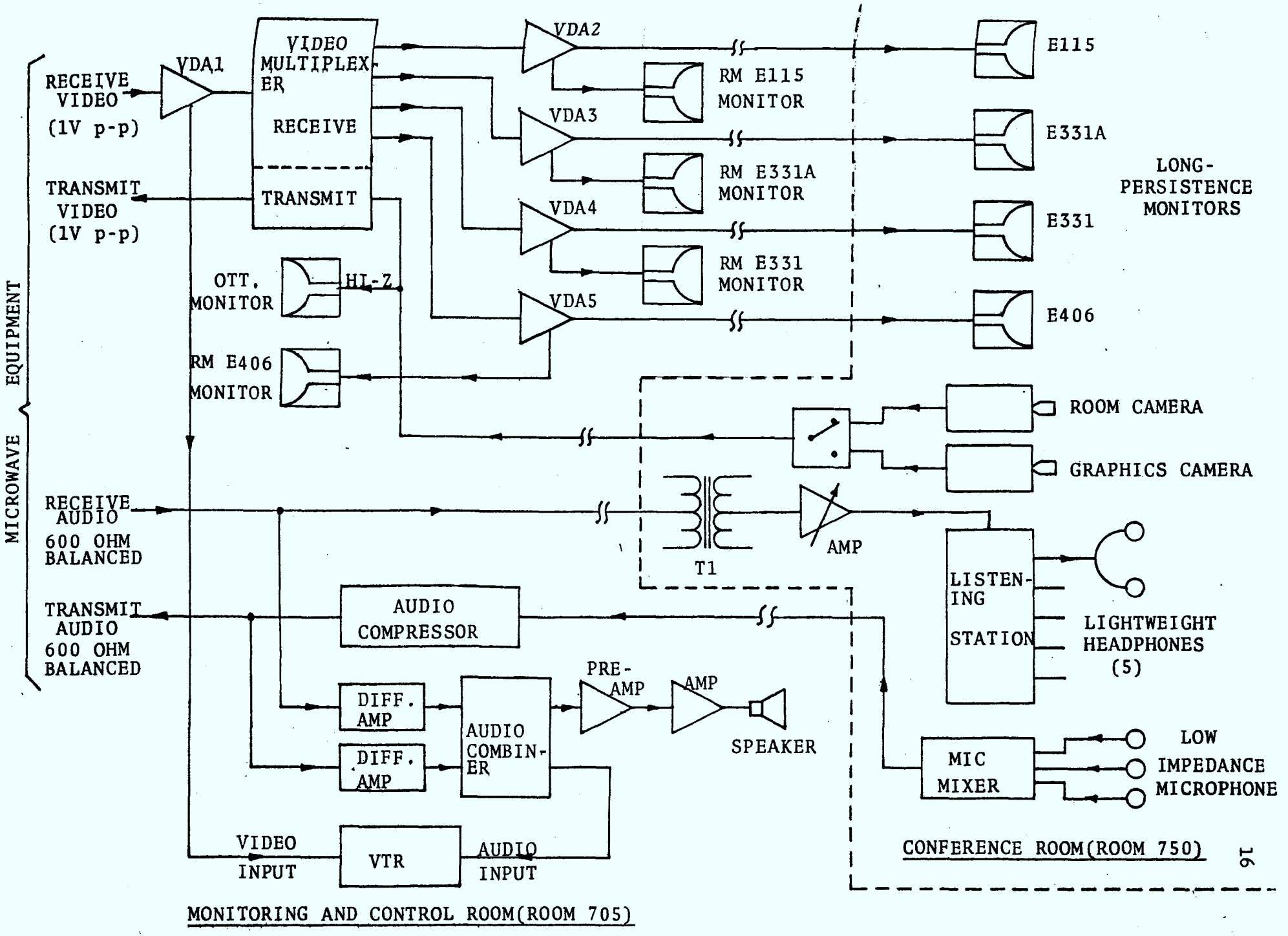


FIGURE 2. AUDIO/VIDEO EQUIPMENT CONFIGURATION(OTTAWA TELECONFERENCING FACILITY)

mitted, a switch for selecting the desired camera will be provided. The timing signal (VITS) for the video multiplexing system is next inserted in the transmit side of the Ottawa modem before being transmitted to St. John's. For monitoring the room video output, a high input impedance monochrome TV monitor is bridged across the video line in the M&C room. All video signals are at a nominal 1 volt peak-to-peak in 75 ohms unbalanced RG-59 cable.

Incoming audio signals from St. John's are amplified, after line impedance transformation by T1, and fed to a listening station. Five lightweight, open-air headphones, one for each participant, with in-line volume controls and 8 ft. cords will be provided for monitoring the incoming audio.

On the transmit side, conversations will be picked up by three low impedance, unidirectional microphones (supported by table stands) and combined in the microphone mixer. The mixer line output is passed through an audio compressor (use is optional) and then routed to the microwave equipment for transmission to St. John's.Audio line impedances are all 600 ohms balanced and two-wire shielded cables will be used in installation.

Audio monitoring facilities are provided by bridging both the transmit and receive audio lines with high input impedance differential amplifiers, the output of which are then combined in the audio combiner. One of the outputs is pre-amplified and then amplified to drive a monitor loudspeaker. A second output provides the drive for the VTR audio input.

Memorial University Teleconferencing Facilities

The audio/video equipment configuration for the Memorial University teleconferencing facilities will be as shown in Figure 3.

The incoming video signal from Ottawa is routed via the VTR Room in the ETV Centre to the first conference room in the chain, Room E115. The video signal is terminated in the first Video Multiplexer in which two different functions occur:

a. The multiplexing of Room E115's video into the Ottawa signal (the first stage of multiplexing) and

b. The deletion of the timing signal in the vertical blanking interval.

The output of the multiplexer resulting from (a) above is sent to Room E331A for the second stage of multiplexing. The Ottawa video with the timing mark deleted (VITS deleted) is re-routed to the VTR Room and thence to the CATV modulator for cable distribution to the four conference rooms.

The output of the camera in each room is terminated in 75 ohms at the CATV modulator input and a high impedance feed is taken to the Video Multiplexer. The high input impedance of the multiplexer ensures that the camera output is not double terminated.

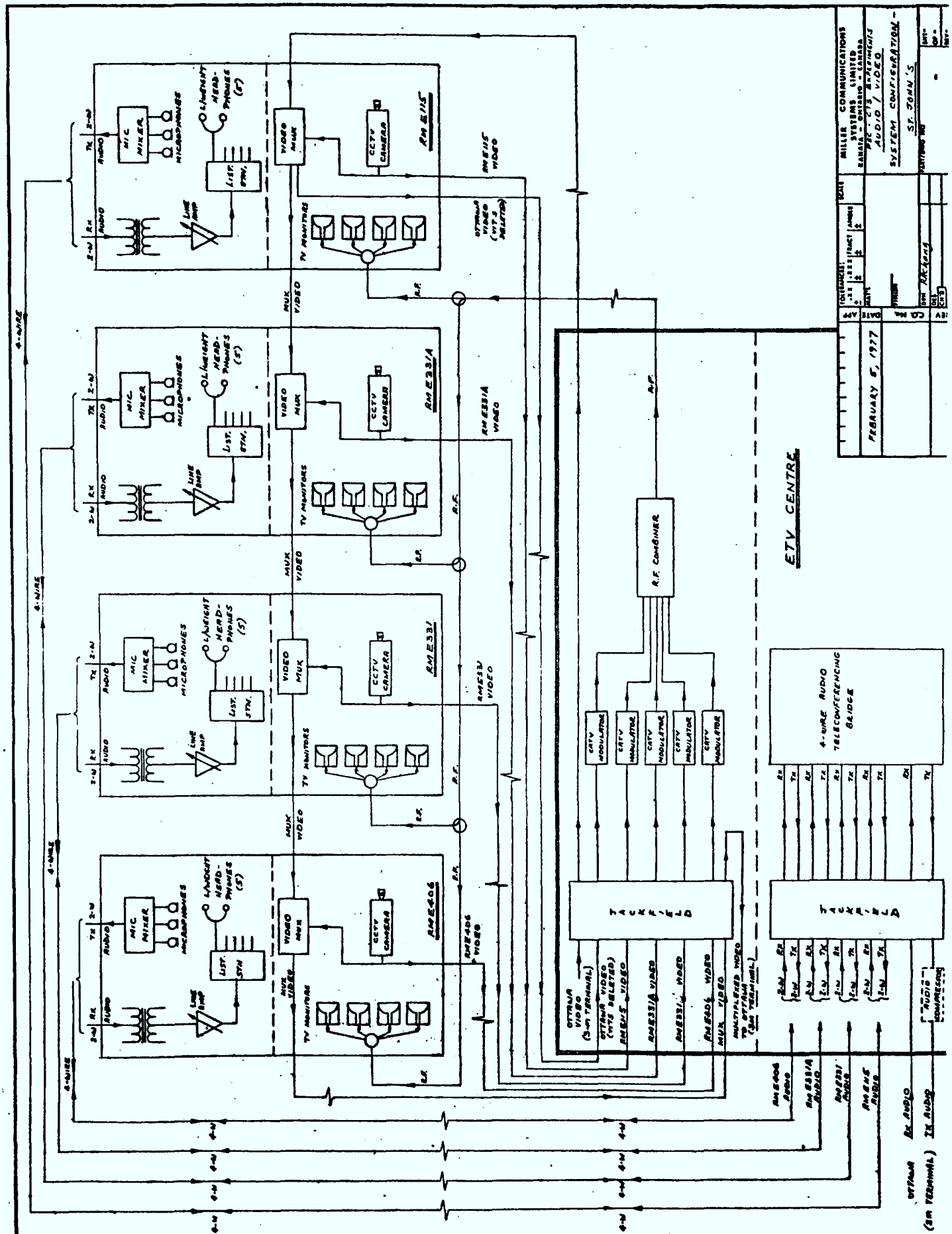
Horizontal and vertical synchronization signals for the camera are derived from the Video Multiplexer in each room.

Rooms E115, E331A, E331 and E406 are connected in tandem for the multiplexing process with the first stage of multiplexing beginning in E115, as mentioned earlier, and the fourth and

FIGURE 3

AUDIO/VIDEO EQUIPMENT CONFIGURATION

(MEMORIAL UNIVERSITY TELECONFERENCING FACILITIES)



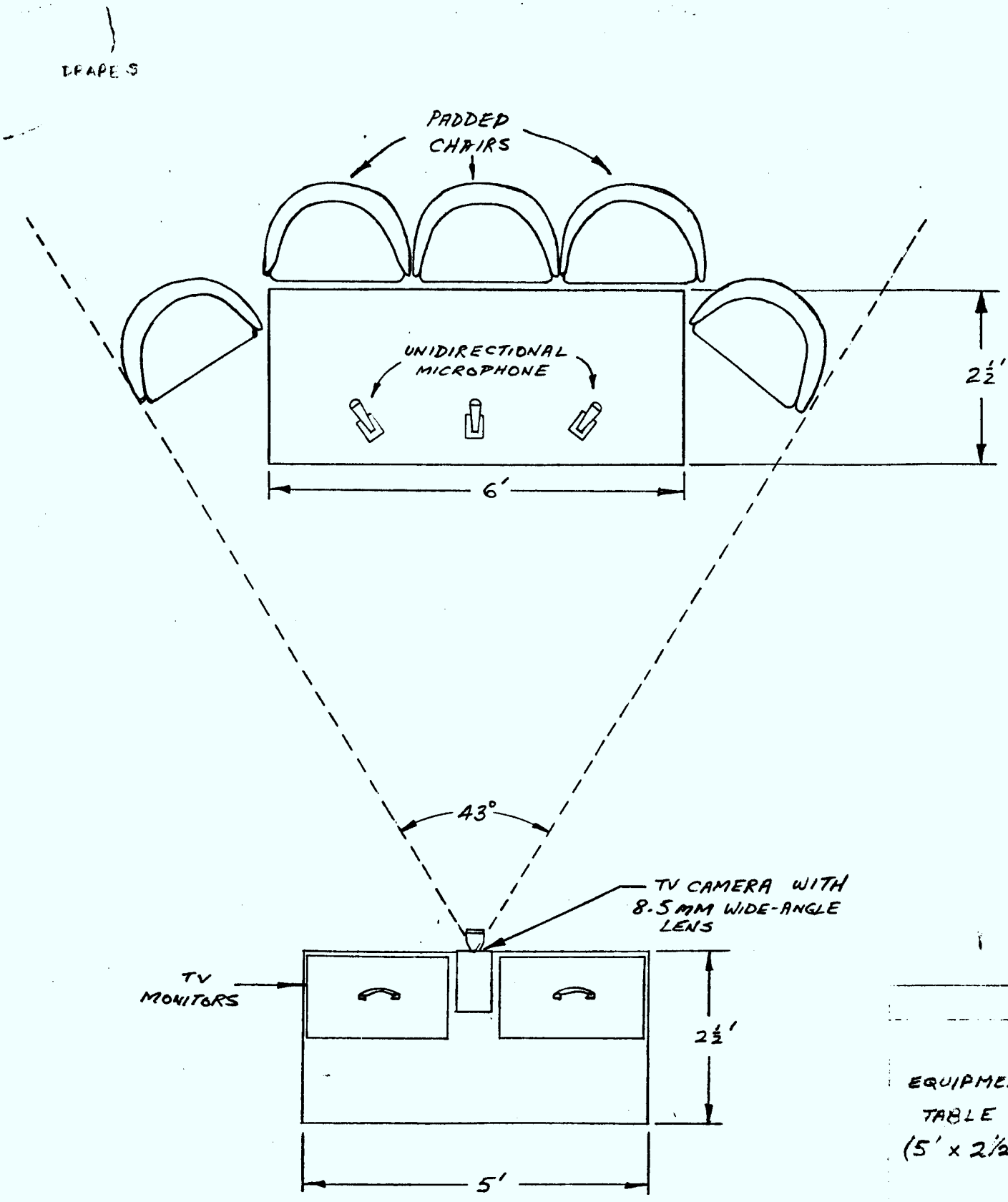
last stage occurring in Room E406. The multiplexed video signal, containing video information from all four rooms, will then be transmitted to Ottawa via the ETV Centre and 3-metre terminal.

The outputs of the five CATV channel modulators are arranged into the normal VHF TV broadcast format and the composite RF signal distributed via cable to each of the four conference rooms where the signal is divided and amplified to provide four 75 ohm signal feeds. The 75 ohm line impedance is altered to 300 ohms, using the normal 75 ohm/300 ohm transformer, in order to be compatible with the impedance of the VHF antenna input on each of the 20" monochrome monitors.

Thus by selecting the appropriate VHF channel on the selector dials, any one room will be able to see Ottawa's video plus the video signals from the other three conference rooms. It should be pointed out that the video signals viewed in St. John's will appear normal. The de-multiplexed video will only be seen in Ottawa.

A typical conference room layout is shown in Figure 4. In St. John's, the audio and video equipment will be mounted on mobile trolleys since the conference rooms at Memorial University cannot be secured. The installation in Ottawa, however, will be fixed.

FIGURE 4 - CONFERENCE ROOM LAYOUT



The addition of voice-switched visual indicators to help identify the room from which speech is originating is being considered.

The audio configuration is the same for each conference room. Room input audio is amplified (after line impedance transformation) and drives a listening station which in turn distributes the audio signals to the lightweight, open-air headphones (quantity 5 in each room).

The open-air feature of the headphone allows speech within a room to be heard without the need for removing the headphone. This is important since the audio teleconferencing bridge does not allow a room to hear its own audio.

On the transmit side, speech is picked up by three low impedance, unidirectional microphones, the outputs of which are then combined in the microphone mixer. Both input and output audio line impedances are 600 ohms balanced and interconnections are accomplished using 2-wire shielded cables.

The input and output audio lines of each room are connected into a 6-input, 4-wire (2-wire transmit; 2-wire receive) audio teleconferencing bridge (only 5 inputs will be used). An added feature of this bridge is the provision of voice-switching circuits which may or may not be activated as desired.

Deliverable Audio/Video Equipment

For a list of deliverable audio and video equipment see Attachment 1 and 2. Equipment for the teleconferencing facilities in Memorial University were delivered during February and is presently in storage there. The remainder

of the equipment is at present being installed in L'Esplanade Laurier.

Conclusions

An historical account of the activities leading up to the implementation of an audio/video teleconferencing system to satisfy the requirements and constraints of the PSC-CTS multi-way interactive communication experiment for remote teaching by satellite has been given.

In addition, a description of the overall system configuration for the experiment together with a description of the audio and video equipment layout and operation for the teleconferencing facilities at L'Esplanade Laurier and Memorial University have also been detailed.

It is expected that the entire system will be made operational by the middle of April 1977 in time for the conference sessions commencing during the latter part of April.

Reference Documents

1. DSS Contract 02PL.D1122-6-0219/6008 Serial No. OPL76-00020.

2. Correspondence K. Boyd - R. Chang dated December 14, 1976.

3. Progress Review Report - August 16, 1976.

4. Progress Review Report - October 4, 1976.

5. Minutes of Meeting - October 4, 1976.

6. Microwave Link Report submitted October 4, 1976.

ATTACHMENT I

TERMINAL	OLD EQUIPMENT LIST	NEW EQUIPMENT LIST
OTTAWA	QTY.1 VITS GENERATOR:	QTY.1 VITS GENERATOR:
	Qty. 1 Clamper/Sync Extractor	Qty. 1 Master Sync Generator (MCS Assemb
	Qty. 1 Vits Inserter	Qty. 1 Clamper/Sync Extractor
	Qty. 1 Card box & Power supplies	Qty. 1 Vits Inserter
		Qty. 1 Card box & Power supplies
	QTY.1 VIDEO DEMULTIPLEXER:	QTY 1 VIDEO DEMULTIPLEXER:
	Qty 1 Clamper/Sync Extractor	Qty 1 Clamper/Sync Extractor
	Qty 4 Video Selector	Qty 1 Vits Generator
	Qty 4 Video Equalizer & Buffer	Qty 1 Video Decoder
	Qty 1 Clamper/Vits Detector	Qty 1 Clamper/Vits Detector
	Qty 1 Card Box & Power Supplies	Deleted
ST. JOHN'S	QTY.4 VIDEO MULTIPLEXER:	QTY.4 VIDEO MULTIPLEXER:
	Qty 1 Clamper/Sync Extractor	Qty 1 Clamper/Sync Extractor
	Qty 1 Video Selector	Qty 1 Vits Generator/Video Selector
	Qty 1 Camera Sync Generator	
	Qty 1 Clamper/Vits Detector	Qty 1 Clamper/Vits Detector
	Qty 1 Card Box & Power supplies	Qty 1 Card box & Power supplies
	PCB SPARES : None	PCB SPARES: Qty. 4 (Ottawa)
		Qty. 3 (St. John's)

ATTACHMENT 2

DELIVERABLE AUDIO EQUIPMENT

QTY	DESCRIPTION
5	Shure M67 Microphone Mixer
2	Shure SE30 Mixer/Compressor
5	Sony TA88 Stereo Amplifier
1	Bogen C-10 Power Amplifier
1	Pair, Sony SS-310 Speakers
12	AKG D-1200E Microphone
1	AKG D-190ES Microphone
12	AKG ST4A Microphone stand
3	Electro-Voice 670C microphone plus carrying case
3	Electro-Voice 422 Microphone stand
25	AKG K16TV Lightweight headphones
4	Koss T/4A Connector box
2	Sennheiser HD414X Stereo headphones
5	Hammond outlet boxes (8 outlets)
5	Hammond outlet boxes (4 outlets)
1	Wollensack A-0484 Listening station
1	Radio Shack Solo-6 speakers
5	Hammond 145J Transformer
2	Darome Model 611 4-wire Mini-convenor
1	Darome 6-input, 4-wire audio teleconferencing bridge
	Miscellaneous audio/video cables plus connectors.

Miscellaneous

QTY	
5	Long-persistence cathode ray tubes

REPORT ON PSC-CTS LEARNING EXPERIMENT

OPERATIONAL PHASE

PROJECT REPORT

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REPORT ON PSC CTS LEARNING EXPERIMENT

OPERATIONAL PHASE

The L'Esplanade Laurier to Memorial University interactive teleconferencing experiment operated from April 26 to June 16, 1977. This report outlines the technical activities during that period.

A. L'Esplanade Laurier Terminal

A.1 Improvements and Changes to the System

a. To identify which room in the system had a speaker at a particular time, a voice activation prototype module was constructed and tested. This device senses the presence of speech and activates a light located within the camera viewing area. Subsequently, four similar units were built and installed in the Memorial University conference rooms.

b. Facilities for video and audio tape recording were set-up and the following taping experiments were conducted:

   i L'Esplanade Laurier video and all rooms combined audio - recordings successful

   ii Single Memorial University room demultiplexed video and all rooms combined audio - recordings successful

iii Multiplexed video from Memorial University rooms and all rooms combined audio - video tape recorder time base not sufficiently accurate for the multiplexed signal, i.e. not successful on play back through the demultiplexer

c. The following changes were made to improve the contrast definition on the video monitors in the conference room:
- reduced room lighting over the monitors
- placement of shroud hoods over the monitors

d. For purposes of subjective comparison a video monitor with a long persistence blue tube was installed in the conference room. In addition, when one of the long persistence green CRT monitors failed, a standard black and white equivalent was substituted. Discussions indicated that a normal black and white type cathode ray tube was as suitable for the application as the long persistence type tubes.

e. A contingency configuration was prepared in the event of failure of the satellite high power tube. For this situation the Ottawa terminal would transmit normal audio and video to St. John's via the 20 watt satellite transponder. The audio portion of the St. John's conference was routed to Ottawa via a terrestrial telephone circuit. Permission was obtained to make hardwire interconnections from the telephone network into the PSC audio equipment. This configuration was used on occasion and performed satisfactorily.

A.2 Problems Encountered

a. Excessive heat build up in control room #705 resulted in stability problems for the video demultiplexing equipment. This problem was eliminated by the use of a circulation fan.

b. A change of audio levels in the system from Ottawa to St. John's caused excessive far-end cross talk to appear back at Ottawa as high level echo. The problem was solved by co-ordinated adjustments of P.S.C. and C.R.C. equipment.

B. Memorial University Terminal

B.1 Improvements and Changes to the System

a. To accomodate the use of a second camera (graphics) on a manually switched basis at L'Esplanade Laurier, reconfiguration of the video system, as detailed in the Final Project Report (March 1977), was necessary to avoid disruption of the multiplexing system due to non-synchronous switching.

To accomplish this, the VITS Generator section of the prototype video multiplexer was installed in Room E115. An RS-170EIA video signal was obtained from a signal generator located in the VTR room (ETV Centre), amplified to compensate for line losses, and then routed into the VITS generator for the insertion of the system timing marker.

The video signal from Ottawa was therefore transmitted to St. John's minus the timing marker and distributed directly over the closed-circuit TV system in the Arts/Education Building.

b. The use of a processing amplifier, loaned by the ETV Centre, was found necessary to 'clean-up' the multiplexed video signal before transmission to Ottawa thus assuring a more reliable system.

c. Audio recordings of all five nodes of the teleconferencing system were made using a 7-track tape recorder provided by CRC.

d. Archive videotape recordings of a single conference room were also made.

PSC-CTS LEARNING EXPERIMENT

MICROWAVE LINK REPORT

PROJECT REPORT

by

Miller Communications Systems Ltd.
39 Leacock Way
Kanata, Ontario
K2K 1T1

The following is a report on the findings and recommendations on the proposed establishment of a two-way microwave backhaul between the 9-meter CTS terminal located at the Communications Research Center, Shirley Bay, and L'Esplanade Laurier, West Tower, in downtown Ottawa.

The microwave backhaul is the end link of a two-way communications channel between Memorial University in St. John's, Newfoundland and L'Esplanade Laurier to be established for the purposes of the PSC - CTS Learning Experiments during the time April/June 1977.

1. INTRODUCTION

During the initial preparation for the submission of the PSC technical brief to CRC for the Interactive Learning Project, the cost of the proposed two-way video link between L'Esplanade Laurier and Shirley Bay was estimated from Bell Canada quotations to be in the region of $20,000.

This link would be temporary in nature lasting only for the period of the experiment, that is, April/June 1977.

This predicted high cost of leasing the service stimulated some thought into finding more cost-effective ways of effecting the two-way transmission from L'Esplanade Laurier to/from the CTS satellite.

Three major options were considered:

1. Buy or lease a microwave link from other than Bell Canada.

2. Construct a transmit/receive earth station on the roof of L'Esplanade Laurier thus completely obviating the need for a microwave link.

3. Use a hybrid system with a one-way microwave link in the direction Ottawa to Shirley Bay and a small receive-only earth terminal on the roof of L'Esplanade Laurier.

This report documents the various approaches, summarizes the results, and makes some recommendations for this experiment and possible future experiments.

2. TRANSMISSION FACILITIES

2.1 Leased Microwave Link

A leased two-way terrestrial microwave link would route audio/video signals from the West Tower of L'Esplanade Laurier in downtown Ottawa to the 9-meter CTS terminal permanently located near Building 46 of the Communications Research Center, Shirley Bay, a line-of-sight distance of approximately 11 miles.

At L'Esplanade Laurier, the microwave antenna(s) would be mounted on the roof top and suitably weighted to withstand high winds while at the CRC end, the antenna(s) would be mounted on a 70 ft. high tower erected near the CTS terminal site.

A preliminary path survey was conducted by MCS to verify that there were no obvious obstructions in the line-of-sight of the proposed microwave link.

A path profile was generated and has been included in this report as an attachment (Attachment I).

Bell Canada was again contacted regarding the provision of leased microwave facilities to meet the requirements of the proposed terrestrial microwave link and has responded with a quotation and a brief description of the services that would be provided (Attachment II).

For a 3-month lease period (inclusive of pre-operational test periods), Bell Canada costs are approximately $8,870 rental charge, $1,075 service charge,and construction charges of $2,200 for a total of $12,145. Tariff and service charges are subject to changes pending the outcome of Bell Canada's rate increase applications.

2.2 Purchased Microwave Link

From discussions with a couple of manufacturers of microwave backhaul equipment, indications are that equipment costs alone will be in the $50K to $60K range for a two-way microwave link. Considering the short duration of the experiments, capital expenditure of this magnitude is prohibitive at this time and effectively eliminates the purchase of the microwave link equipment as a viable option.

2.3 Transmit/Receive Satellite Earth Terminal at L'Esplanade Laurier

An alternative to the use of terrestrial microwave would be to access the CTS satellite directly from downtown Ottawa using a small earth station mounted on the roof of L'Esplanade Laurier. Link budget calculations indicate that a 12-ft. antenna with a 20 watt TWT transmitter would provide good quality two-way audio and video performance working with the 3-meter CTS transportable earth station located on-site at Memorial University in St. John's. However, the electronic subsystems required for such an earth station are not available from CRC's Experimenters' terminals and thus integration of equipment from a variety of sources would be required to achieve operational status.

MCS has contacted various manufacturers and sources to investigate the possibility of loan/lease of equipment and some willingness has been indicated towards the temporary provision of hardware for such an experimental station.

2.4 Combination Microwave Link/ Earth Station at L'Esplanade Laurier

A cost-effective configuration is a hybrid combination of terrestrial microwave and a TV receive-only earth station, a number of which are available for CTS experimenters' use from CRC.

A TV receive-only earth terminal mounted on the roof of L'Esplanade Laurier would receive audio/video signals transmitted from the 3-meter CTS transportable in St. John's via the CTS satellite and outgoing signals from the conference room in L'Esplanade Laurier would be routed to CRC via uni-directional terrestrial microwave and then transmitted to St. John's by the 9-meter CTS terminal.

If such a TV receive-only earth terminal were to be procured as a formal CTS Experimenters' terminal, installation of the terminal would be carried out by CRC personnel and, in addition, a cost-savings of approximately $4,500 would be achieved since only a uni-directional microwave link would then be required resulting in the reduction of the tariff charge for a bi-directional link by one-half.

The temporary loan of an earth terminal from CRC which may be available at the time of the PSC-CTS experiments has also been investigated. A letter of agreement on the loan of a small earth terminal from CRC is attached to this report (Attachment III). The terminal may be either an unused small terminal of the type purchased for CTS experimenters or a terminal currently being designed and constructed by CRC.

3.0 Conclusions and Recommendations

In summary, the high capital costs of microwave equipment eliminates the option of a direct purchase of the equipment and the unavailability of cost-effective 11/14 GHz equipment makes an earth station, with receive/transmit capability located on top of L'Esplanade Laurier, a remote possibility.

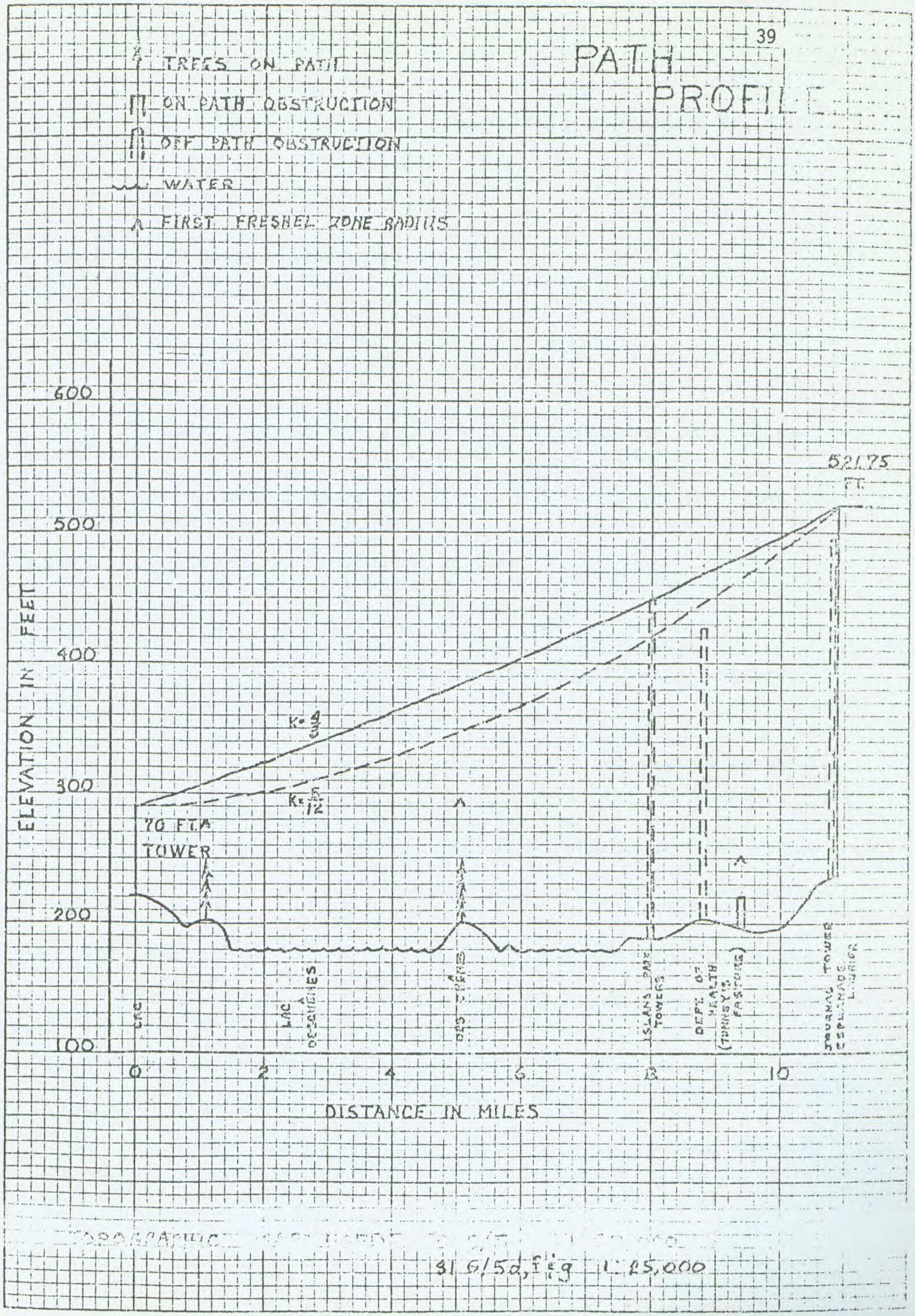
The remaining options are :

(a) Lease a two-way microwave link from a common carrier such as Bell Canada

(b) Procure a formal CTS Experimenters' terminal for the duration of the experiments and lease a one-way microwave link from Bell Canada or other.

It is recommended that option (b) be pursued and a formal application for the procurement of a small TV receive earth terminal be tendered immediately to the CTS Experimenters Co-ordination Department. Failing this, the only remaining option would be to lease a two-way microwave link from Bell Canada.

ATTACHMENT 1



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MONTREAL: September 21, 1976

Mr. Bruce Bailey,
c/o Miller Communication System
39 Leacock Way
Kanata, Ontario
K2T 1T1

Dear Bruce:

Further to our telephone conversation of yesterday I am pleased to provide you with the following information concerning two (2) way video service between L'Esplanade Laurier Tower B, Ottawa and the Communication Research Centre, Shirley Bay.

SERVICES	:	1 video channel 1 video cue channel 1 audio 5 khz 1 audio cue 5 khz 2 QSK sets portable telephone sets 1 TCC telephone coordinating channel
PARAMETERS VIDEO	:	Bandwith 4.2 mhz S/N better than 52 db Output 75 ohms 1 volt peak to peak.
PARAMETER AUDIO	:	See Attachment
MONTHLY RATE	:	Approximately $ 2970.00 for the first month Approximately $ 2950.00 for the subsequent months.
SERVICE CHARGE	:	Approximately $ 375.00 for the first month Approximately $ 350.00 for the subsequent months.
CONSTRUCTION CHARGES	:	To be confirmed as soon as the survey is completed $2,200 (non recurring).

Please note that the monthly rate and the service charge are based on our General Tariff presently in force.

The construction charges are valid until May 1, 1977 and subject to certain changes afterwards.

Thanking you for your inquiry and interest, we hope to have the pleasure to serve you soon.

Truly yours,

Charles Cousineau

C. Cousineau
Assistant Sales Manager
Broadcast Industry

CC/jt
Enclosure

LEGEND

A - APPLIES BETWEEN 40-200Hz
B - APPLIES BETWEEN 200-10KHz
C - APPLIES BETWEEN 10KHz-15KHz

	MINIMUM BANDWIDTH	FREQUENCY RESPONSE REL. 1KHz	SIGNAL TO NOISE PTTG C-MSG WTD OR PSOPHTD	SIGNAL TO NOISE 15KHz FLAT WITH dB	HARMONIC DISTORTION %	TOTAL DISTORTION %	MINIMUM RECEIVE LEVEL dBm	POWER DIFFERENCE LEFT VS RIGHT	LEVEL DIFFERENCE LEFT VS RIGHT	PHASE SHIFT
VOICE GRADE										
LOCAL - OCCASIONAL	350-2500	-4 TO +8	55dB C	N/A	N/A	N/A	-25dBm	N/A	N/A	N/A
LOCAL - PERMANENT	350-2500	-4 TO +8	55dB C							
INTERCITY - OCCASIONAL	350-2500	-4 TO +8	50dB C				-25dBm			
INTERCITY - PERMANENT	350-2500	-4 TO +8	50dB C							
APPROX. 5KHz										
LOCAL - OCCASIONAL *	100 TO 5000 ✓	±4dB ✓	50dB ✓	40dB ✓			-25dBm ✓			
INTERCITY - OCCASIONAL	100 TO 5000	±4dB	45dB	40dB			-25dBm			
PRECISE 5KHz	100 TO 5000									
LOCAL - OCCASIONAL	100 TO 5000	±1.5	55dB	50dB	0.5%	1.0%	-15dBm			
LOCAL - PERMANENT	100 TO 5000	±1.5	55dB	50dB	0.5%	1.0%	-15dBm			
INTERCITY - OCCASIONAL	100 TO 5000	±1.5	50dB	45dB	1.0%	2.5%	-15dBm			
INTERCITY - PERMANENT	100 TO 5000	±1.5	50dB	45dB	1.0%	2.5%	-15dBm			
PRECISE 8KHz	100 TO 8000									
LOCAL - OCCASIONAL	70 TO 8000	±1.5	55dB	50dB	0.5%	1.0%	-15dBm			
LOCAL - PERMANENT	100 TO 8000	±1.5	55dB	50dB	0.5%	1.0%	-15dBm			
INTERCITY - OCCASIONAL	70 TO 8000	±1.5	50dB	45dB	1.0%	2.5%	-15dBm			
INTERCITY - PERMANENT	70 TO 8000	±1.5	50dB	45dB	1.0%	2.5%	-15dBm			
PRECISE 15KHz										
LOCAL - OCCASIONAL	70 TO 15,000	A. -1.0 TO +0.5 B. -0.5 TO 0.5 C. -1.0 TO +0.5	N/A	52dB	0.5%	1.0%	-15dBm			
LOCAL - PERMANENT	40 TO 15,000	A. -1.5 TO 1.0 B. -0.8 TO 0.8 C. -1.5 TO 1.0		52dB	0.5%	1.0%	-15dBm			
INTERCITY - OCCASIONAL	70 TO 15,000	A. -2.0 TO 1.0 B. -0.8 TO 0.8 C. -2.0 TO 1.0		46dB	1.0%	3.0%	-15dBm			
INTERCITY - PERMANENT	40 TO 15,000	A. -3.0 TO 1.0 B. -1.0 TO 1.0 C. -3.0 TO 1.0		46dB	1.0%	3.0%	-15dBm			
15KHz STEREO - PRECISE										
LOCAL - OCCASIONAL	70 TO 15,000	A. -1.0 TO +0.5 B. -0.5 TO +0.5 C. -1.0 TO +0.5		52dB	0.5%	1.0%	-15dBm	A. 10° B. 5° C. 10°	0.5dB 0.5dB 0.5dB	
LOCAL - PERMANENT	40 TO 15,000	A. -1.5 TO +1.0 B. -0.8 TO +0.8 C. -1.5 TO +1.0		52dB	0.5%	1.0%	-15dBm	A. 10° B. 5° C. 10°	0.5dB 0.5dB 0.5dB	
INTERCITY - OCCASIONAL	70 TO 15,000	A. -2.0 TO +1.0 B. -0.8 TO +0.8 C. -2.0 TO +2.0		46dB	1.0%	3.0%	-15dBm	A. 30° B. 20° C. 30°	2.0dB 1.5dB 2.0dB	
INTERCITY - PERMANENT	40 TO 15,000	A. -3.0 TO +1.0 B. -1.0 TO +1.0 C. -3.0 TO +2.0		46dB	1.0%	3.0%	-15dBm	A. 30° B. 20° C. 30°	2.0dB 1.5dB 2.0dB	

ATTACHMENT III

Government of Canada / Gouvernement du Canada

CRC 6090-14 (ST)P

Department of Communications / Ministère des Communications

14 September, 1976

Mr. A.D. Miller,
President,
Miller Communications Systems Limited,
39 Leacock Way,
Kanata, Ont.
K2K 1T1

Dear Mr. Miller,

I have discussed with both N.G. Davies and R.W. Breithaupt, your proposal regarding the temporary loan of the CRC small terminal for your Public Service Commission experiments. I do not foresee any difficulty in temporarily loaning to you one of the small terminals which are or will be available at CRC during April/June 1977 for use in the above experiment. However, any formal agreement will have to be arranged with W.T. Kerr, CTS Experiments Coordinator and I recommend you contact him. Whether you receive specifically the CRC terminal will be decided at a later date.

Yours truly,

R.J. Douville

c.c.-R.W. Breithaupt
N.G. Davies
W.T. Kerr

Tele-training for personnel development.