AN AUTOMATED PROGRAMMING CONTROL SYSTEM FOR CABLE TV

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The growth in video sources available, plus the growth in active channels poses a formidable operations problem for the cablecaster. This paper describes an automation system, specifically designed for Programming Control in a Cable TV System. The system provides for off-line preparation of daily program schedules, storage of the schedule on a magnetic disc file, automatic selection of input devices or feeds, automatic control of machines, and development of five printed reports: program schedule, program log, machine-tape status, channel schedules and source-machine status reports.

The system was designed in conjunction with management and operating personnel at Manhattan Cable TV, and is currently under development by 3M.

More and more channels! Whenever we hear of a new proposal for a cable television system, of new equipment for cable television systems, or of new requirements for cable television systems, it always includes more and more channels!

The source of programs on cable TV has now turned the corner. A far larger number of channels are locally originated or controlled than are picked up off-the-air! More flexibility and more precision are required in the programming of a cable television system than ever before, and the complexity increases daily.

This conference has heard it and seen it as well. Forty channels, 50 channels, 58 channels, 100 channels, even 125 channels have been talked about. Each of these channels must be programmed with care, creativity and continuity. What the viewer sees on every channel should be a professionally orchestrated series of programs, interludes, bridges, identifications and commercial arrangements.

In 1978 Manhattan Cable TV retained Stern Telecommunications Corporation to study its transmission facilities and to make recommendations for both near and long term improvements. At that time Manhattan Cable TV was originating or controlling programming on ten different channels from a variety of facilities located at their East 23rd Street facility and at the Gulf and Western Building head end, thirty-seven city blocks north. Program material originated from three-quarter inch cassettes, from half-inch reel-to-reel tape, from remotely located studios, and from a variety of character generators, microwave feeds, AML feeds, and switched antenna feeds at remote locations. At that time these signals were switched by turning modulators located at 23rd street on and off, or by touchtone telephone signalling to the head end. These cumbersome techniques were also being used for the insertion of commercials and will continue to be in use until the facility I'm about to describe is put into operation.

The existing facilities were not designed or installed as a transmission center; they simply evolved from what was assembled to serve as a public access facility. This public access facility was accepting a variety of tape from a variety of sources and it just grew to meet every increasing but unplanned need. It was a tribute, and still is, to the MCTV operations personnel that the facility worked as well as it did. As a matter of fact, it is a tribute to the operations personnel that it works at all.

All the machines are manually operated (see Figure 1) and the operator has to race between machines to load them as well as to start them. Machines are started in sequence and then the operator runs back to his audio-video switching facility and operates a "salvo" switcher to make the "break". The same operator, after running from the machines, goes to an audio mixer and opens a live mike at the control console and personally makes the disclaimers required on individual channels. One of the most important attributes of an operator for this facility is physical agility, and a very good memory.

It was obvious that with ten channels being sort of programmed and more programmed channels being planned, there was need for a major change in philosophy as well as a major change in equipment. (See Figure 2)

A study of the transmission facilities' requirements of MCTV showed needs comparable to those of a telephone company video-technical operations center. And the type of switching equipment that might be installed if all CBS, NBC and ABC network control facilities were located in the same room. The variety of signals being generated or switched exceeded that normally controlled by any single commercial broadcast station. In 1978 between 85 and 100 transmission switching functions were being executed on any of six channels in an average 12-hour day (as illustrated in Figure 3) The number of switching functions have already doubled from those which were considered in the initial study. Even as the facility was being designed, new satellite feeds were being considered, and at the last reading, plans provided for 1000 hours of programming weekly, exclusive of alpha-numeric channels.

Within the 1000 hours of programming there's a requirement of channel identification, programming promotion, public service announcements, interludes or bridges, and commercials. In some cases we find that as many as 25 separate switches would take place in 2½ minutes of break time. If you consider that the facility is planning to program 10 channels and has a break every ½ hour, we find something in the neighborhood of 250 switches possibly taking place every 30 minutes. Each of these switches can involve the start and/or of a videotape machine, an audio cartridge machine, a slide scanner, an audio feed from an FM receiver, a switch to a live pickup, a feed from a character generator, audio/video switching and head end switching.

To do all this and present a professional image, some form of automated system is obviously indicated.

The major goals of a redesign was to provide for simplicity of operation, a high degree of consistency or continuity, a level of quality which was cost effective and the ability of the facility to expand in an anti-obsolescent manner, providing both for flexibility and for future growth.

It was decided to study a number of approaches including:

1) manual operation of all facilities, utilizing remote control for all major machines
2) installation of video cassette changers for some channels and manual operation on others
3) automatic operation of selected channels on a time and/or cue tone basis with manual operation for others
4) complete micro-processor computer control of programming and of machines.

In addition to these operating approaches being studied, there were a number of other facilities which were not involved in a study but were simply involved in a decision-making process. They included:

1) provision of time-base correction on all program channels
2) provision of a centralized multi-channel output character generating system
3) provision of full preview facilities for all outside sources as well as inside sources
4) provision of production program control rooms
5) provision of automated remote control audio-cartridge facilities, and
6) doubling of editing facilities.

The study showed that there was significant benefits to be achieved through the use of a micro-processor control system. The amount of programming and the flexibility required made it impossible to work on a time and/or cue tone basis. The constant additions of programming sources made it impossible to work on a manual basis. As an end result of the study, we began searching for suppliers of the type of equipment we required.

We were looking for a system which could be programmed and could also be interrupted. We were looking for a system which would give the operators reports and also print a log. We were looking at a system which could be interfaced with human beings very easily.

Reviewing potential suppliers of equipment, we elected to utilize a system jointly developed with the Mincom Division of 3M. A contract was signed for the provision of a complete program automation system consisting of a number of hardware elements arranged in two major subsystems:

1) An on-line Automation System, and
2) An off-line Disc Preparation System.

The on-line Automation System is the day-to-day, active operating system, and provides control of both video switching and machine functions in accordance with the daily Program Schedule.

The Program Schedule is stored in a floppy diskette and is loaded into the Disc Transport (Figure 4). An associated Zenith micro-computer interfaces the Disc Transport with a 3M, Model 6500 Micro-Controller (Figure 5). The micro-computer contains the on-line program instructions, or software, which enable it to control the system. It reads the Program Schedule information from the diskette on a time sequence basis, and transfers control commands to the Model 6500 Micro-Controller.

The Model 6500 Micro-Controller performs the actual video switching and machine control tasks. Video switching commands are sent to a 3M, Model 40X Routing Switcher (Figure 6). The routing switcher will accommodate up to 40 different video and 80 audio inputs from various sources. These can be inputs from video cassette player/recorders, film chains, audio cart machines, off-line feeds, or locally generated TV signals. The 40 different inputs can be selectively switched (or routed) to any one of 20 different outputs, or designated channels.

In addition to video switching control, the 6500 Micro-Controller feeds a machine control interface unit (Figure 7). The machine control interface unit provides interconnection between the Model 6500 Micro-Controller and any variety of "machines", such as video tape recorders, audio carts, film chains, and so forth.

In this MCTV system, the machine control interface unit contains special circuits for sensing the control track pulses, the system can accurately search for different program material and commercials recorded on one tape; pre-roll a tape to a specific program; or rewind a tape to a previous segment. The result, essentially, is random-access to the contents of a video tape, under full system control.

Additional system elements include a Printer (Figure 8) for automatic log preparation, and a video terminal (Figure 9) for checking the status of the system and for making manual entries -- such as correction or schedule changes -- as required.

The following block diagram (Figure 10), shows the various system elements as they are interconnected in the system:

1) The diskette with stored Program Schedule information;

2) Disk transport;

3) Computer and Model 6500 Micro-Controller;

4) The Model 40X Routing Switcher;

5) Machine Control Interface and the machine under control;

6) Logging Printer;

7) Video terminal, and, not yet mentioned;

8) An external master clock for synchronizing the system.

The second sub-system mentioned earlier was the Disc-Preparation System (Figure 11). This is called an "off-Line" system, since it does not directly control the switches or machines. The Disc-Preparation System allows composition of the program schedule away from the operating system. The primary product of the system is a diskette containing the Program Schedule arranged in a time-sequence fashion.

Let us now take a look at how the work will flow (Figure 12); how we make an advance preparation for this complex operation at MCTV.

Program coordinators prepare traffic cards from the Program Producer's inputs. These cards include program titles, producer identification and planned channel and broadcast date and time. These traffic cards are routed to the Tape Library where a multi-part traffic scheduling form is completed including such information as channel assignment, Program ID, Tape ID, date and time of play, and indication if duping or editing is required.

The traffic forms are sent to the equipment room with the tapes. Here the tapes are timed, having their control track counted. All timing is then recorded on the traffic form.

The form and tape are then returned to the Tape Library and one part of the form stays with the tape and all other parts go to the coordinator. (See Figure 13)

The coordinator now prepares a work sheet from the schedule traffic form. This work sheet includes fillers, commercials, channel ID's and PSA's.

Next, there is a daily conference including the Programming and Promotion Departments which includes:

a) Placement of all spots on all channels are discussed.

b) Requests for production of program highlights.

c) Reports from Promotion on new spots.

d) Audio announcements and request for fillers.

e) Last minute scheduling changes.

f) Crawls written for 6 channels: A, D, I, K, L, K, 12.

g) Review of Transmission Reports.

At the end of the conference, work sheets are distributed, spots or interludes are then edited, and this includes audio cartridges, commercials, program highlights and promotion. These can be produced on individual tapes or made up on "spot reels".

Next, the Transmission Supervisor receives the adjusted work sheets and completes the channel-by-channel work sheets indicating the tape deck assignments. He completes the information in the control column (manual, time, cue track, open, stop and rewind, etc.) The complete schedule then goes to the Scheduling Department where it is entered into the computer terminal and a disc prepared for a future programming day. The program schedule is entered at the video terminal channel-by-channel, in either a time sequence or random fashion. After the information is entered, the computer automatically sorts the data and prepares a time-sequence schedule. If scheduling errors are found, the computer will note these and present an "error listing" to the operator. The system software will automatically check the data entered for:

1) Open segments
2) Overlapping times, and
3) Duplication of programming

In addition, warnings are provided when

4) Manual control of the system is required.

The final result is a correctly prepared list of a day's programming stored on a floppy diskette which forms the input for the on-line automation system.

In addition to the program schedule diskette, the off-line system also provides four different printed reports. These reports are generated from the data entered into the computer by the operator during preparation of the program schedule. The four reports are:

1) Program schedule
2) Machine-tape status report
3) Channel-by-Channel Schedule report
4) Source-machine status report

A fifth printed report, the Program Log, is generated as a by-product of the on-line automation system.

These reports constitute an important set of information for the operating staff. They allow the staff to:

1) Plan and make scheduling changes to the daily program in advance.

2) Assign or re-assign machines as required.

3) Review the entire schedule at one time.

4) Review each individual channel schedule.

5) Monitor present and future machine assignments and machine availability.

6) They free the staff from the requirement of manually recording the program log.

To better understand the capability of the Automation System, let's review the printed reports. All reports are based on the same general format (Figure 14). All reports require a report title and a time display. There are ten (10) different columns across the report, and a total of 80 character spaces available. The column headings shown are:

Start - Indicates the start time of an event

DST - Channel destination of the event video output

Program - Description of the program material

Tape - Identification of the tape to be played

Source - Identification of source video and source audio

Duration - Length of the event

C-Track - The VTR control track number at which the material is located

SM - Stop mode of the source VTR or audio cart

TL - Tape loaded, for equipment from operator entry

C - Type of control - manual or timed.

Here is an example of the printed Program Schedule (Figure 15). The events shown are scheduled to occur between 7:00 p.m. and 7:29:30 p.m. Reading across line 1:

at 7 p.m., on Channel 10, audio interlude number 1, from tape #TJ01, will be played with video from source 13 and audio from source C3, for a duration of 15 seconds. The control column at the right indicates "T" for Timed control.

At 7:00:15 p.m., on the same Channel 10, the program "Music Is", video tape #6539, will play on source VTR 14 (both video and audio), for 28 minutes. The program starts at Control Track #001234. The instruction SRE means that at the end of the program the tape machine should stop (S), rewind (R), and eject (E) the tape.

Note that at 7:27:45 p.m. two events are occurring: one on channel C and another on channel D. The system will scan and implement the channel C event first, followed by the event for channel D. The time delay between the two "simultaneous" events is only a matter of one or two seconds maximum. Also note the commercial events at 7:13:30; 7:14:00; 7:14:30; 7:28:30; and 7:29:00 p.m. These events are always using video tape units 1111, 2222 and 3333. The commercials, in this instance, are recorded serially on these recorders and accessed in sequence via the control track number entered into the Program Schedule.

The Machine-Tape Status report (Figure 16) is for the convenience of the equipment room operator, to aid in loading tapes onto the proper machines. It's a slightly shorter report, containing only six columns rather than ten. From the event start time of 7:44:00 p.m., for example, the operator knows that he must have tape #2222 loaded into tape machine 26 before 7:44:00 p.m. or the event will not play. While keeping the machines loaded with the proper tapes is a manual task, the automation system helps by providing tape and machine loading information, and automatically controlling machine functions, simplifying the job as much as possible.

The Channel-by-Channel Schedule (Figure 17), is a display of events scheduled on a single channel for either the entire day, or from the requested time forward. The report allows an operator the ability to look at each channel's schedule for programming detail.

The Source-Machine Status report (Figure 18) presents a listing of sources -- machines, incoming feeds, local feeds, etc. -- arranged according to their destination. Presented this way, it makes it easy to see and verify the scheduled activity per source.

The final report, the Program Log (Figure 19), is a listing of events as they actually occurred. If an event did not take place at a scheduled time, the log will indicate the actual time it did occur. One thing the system cannot do, however, is verify if the tape actually loaded was correct. This error would have to be caught by the operator and so noted.

All this automation, logging, report printing and error correction is possible due to the use of computers, micro-processors and software. Indeed, the system software - or programming - is truly the crucial part of the system. The system described utilizes a PL/65 "high level" computer language for the 3M, Model 6500 micro-controller, and Basic/Fortran for the disk system. Standard data elements are designed for use throughout the system whether generating reports, controlling the switcher, processing disc information, or displaying system status. Because of these standard data elements the system can operate without the disc system using available memory in the 6500 micro-controller, or with the disc system which provides a larger schedule capacity. The software system consists of the programming building blocks as shown in Figure 20.

To start a day's Program Schedule, the Transmission Room operator places the proper Program Schedule diskette into the Automation System Disc Transport and types "START" at the terminal (Figure 21). The system then proceeds to operate on the Program Schedule diskette information, and provides the required automated switching and remote machine control.

Video terminals are located in both the Transmission Room and the Equipment Room. The Equipment Room operator is responsible for manually loading the proper tapes on the proper machines. When loaded, the Equipment Room operator types in the tape number at the Equipment Room terminal followed by the word "loaded". This data is forwarded to the computer, which inserts it into the schedule for proper logging. If a machine is out of service, the Equipment Room operator manually re-assigns machines using the terminal. The Equipment Room terminal is restricted to making tape-loaded comments and machine re-assignments.

The Transmission Room operator has more complete control over the system, and can initiate Program Schedule changes in addition to machine re-assignments, and can also take manual control over a timed event if required. The Program Log is printed out in the Transmission Room, at the printer terminal.

The facility is under construction. The equipment checkout starts this week. Full air conditioning will be ready in two more weeks. We are planning to cut over to

partial automation the first week of July and we are planning to have the complete system, as has been described here, in operation this Fall.