THE EVOLUTION OF AUDIO/VIDEO SYSTEM FACILITIES AT WARNER AMEX METROPOLITAN CABLE TELEVISION SYSTEMS

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ABSTRACT

This paper traces and illustrates the evolution in the design of Audio/Video systems at Warner Amex Cable Communications. It discusses early approaches based on broadcast techniques followed by the introduction of automation to Master Control Transmission Centers. It concludes by describing latest designs based on operating efficiency and economy in edit suites and TV studio control rooms as well as modern master control transmission centers.

INTRODUCTION

During the past decade, cable television systems have been constructed in numerous major population centers of the United States, the large cities and "bedroom" communities that make up their suburban metropolitan areas. In many of these there is a requirement or desire to produce and cablecast television programs locally, by individual cable companies for presentation in the communities that they serve. Most of these metropolitan cable television systems include therefore, technical facilities for production, post-production, and cablecast origination of locally produced television programs.

Audio/Video facilities necessary to produce and cablecast local programs fall into just exactly those two categories; program production facilities, and cablecast origination facilities. These are individual units that operate independently of each other except in the case of LIVE program cablecasting when the activities of each must be co-ordinated.

Program production facilities consist of: television studios and control rooms; outside or remote cablecast units such as field production and news gathering vehicles and porta-packs; and post-production facilities, typically edit suites where video taped material can be assembled into complete programs. Today, production facilities are used to create two distinct categories of programming: "local origination", general community interest programs produced by the cable company and its staff; and "public access", usually special interest programs produced by individuals or groups within the community but not associated with the cable company or its business. Often, facilities separate from those utilized for local origination program production are provided for public access program production.

Cablecast origination facilities, commonly known as "master control rooms" or "transmission centers", are equipped and operate to cablecast the locally produced programs, both local origination and public access, onto specific channels of the cable TV system in accordance with the daily program schedule. Since the majority of local programs are video taped rather than cablecast live, the principal activities in the master control rooms are playback of video tapes, switching audio/video signals, and monitoring picture quality. Recently, the advent of advertising sales and commercial insertion in some metropolitan cable systems has added commercial video tape playback and insertion as a major master control room activity.

Since 1976, Warner Amex has constructed major cable television systems in seven United States cities and all have been provided with television program production, and master control room cablecast origination facilities. Program production facilities have evolved in essentially a single major step from sophisticated to conservative technical systems and will be described separately following review of cablecast origination systems. Each master control room possesses one or more unique characteristics, however, and tracing these chronologically reveals an informative process of evolution leading to the efficient and cost effective master control room of the most recently completed facilities. Before tracing their history, and the variety of physical and operational characteristics unique to each, a description of the audio/video equipment and operations generally common to all of them is helpful.

The most significant item of equipment in all Warner Amex master control rooms is the video tape player. Each metro cable system is equipped with as many players as are necessary to cablecast local origination and public access programs, and commercial insertion onto some of the advertiser supported satellite networks. Additionally, the QUBE two way interactive technology installed in every Warner Amex Metropolitan cable system provides an opportunity to offer PAY PER VIEW features and movies, and approximately 50% of the video tape players are

utilized for such service. An average of about 35 players are installed for all these playback activities at each metro cable system. 3/4 inch U-Matic format players are universally used for these services at all Warner Amex metro cable systems while in their pursuit of the lucrative broadcast market for expensive machines, the video tape recorder manufacturers continue to ignore cable's need for simple, reliable recorders of excellent picture quality at a reasonable price. Second most important item in the master control room is the audio/video switching equipment necessary to effect changes of program source on certain cable channels. Additionally these "routing switchers" connect any of the average 35 video tape players to the cable system modulators as necessary. The final significant item in the master control room is the informational character generator which provides information in the form of text on several cable channels.

The remaining equipment found in master control rooms functions to support these three major items. Time base correctors and audio and video processors maintain consistent, high quality signals from the video tape playback channels. Picture and waveform monitors, and vectorcopes are included so that picture and signal quality can be monitored and trouble analysis accomplished when necessary.

Principal operations necessary in each master control room are three:

(1) Operation of the video tape players; loading, cueing, rewind and unloading.

(2) Switching; switching programs to certain cable channels according to the daily program schedule, and starting and stopping the video tape players at the appropriate times.

(3) Monitoring; assuring that picture quality is good on every cable channel, assuring that the right program is on the correct channel at the scheduled time.

COLUMBUS

In 1976, Warner Amex constructed its first metropolitan cable system in Columbus, Ohio and equipped it with QUBE two way interactive technology. QUBE allows viewers to participate in the television shows they are watching by providing them means to respond instantaneously to questions and prompts included in the shows via special cable converter boxes installed in their homes. A natural application of QUBE technology is PAY PER VIEW service which allows the viewer to decide and purchase a program instantaneously through his cable converter at home. QUBE and the PAY PER VIEW possibilities it offered was responsible for the design and construction of Warner Amex's first master control room in Columbus.

This first master control room was designed and outfitted originally with just the necessary equipment to fulfill video tape play back, and informational cablecasting requirements. Built into a small area of about 1360 sq. ft., it contains 30 video tape players utilized mostly for playback of PAY PER VIEW features and movies. Three video tape players are dedicated to each playback channel since as many as three one hour long tape reels might be required to contain a single motion picture. Each playback channel is supported by a single time base corrector, audio processor, and a device to automatically start the first and subsequent players in sequence at the conclusion of previous reels. The sequencing devices in each playback channel must be individually programmed at each playback rack.

Although immense by very recent standards, Columbus was equipped with an audio/video routing switcher which would have been considered small compared to those in some Warner Amex master control rooms that immediately followed it. Its rectangular matrix dimension of 40 x 30 provided 1200 available crosspoints. A multi-channel informational character generator was custom constructed and is still in use today in Columbus. This was a forerunner of standard products available for this application today from several manufacturers. Finally, a full complement of picture monitors at the operators console allows continuous observation of all pictures on the cable system.

Arrangement of master control equipment in the room was determined by where it would best fit and staff is deployed where and when necessary to accomplish the required tasks of operation. Except for the video tape player starter/sequencers, all tasks must be accomplished manually. No computers automate or aid in operation of the room.

CINCINNATI

From the arrangement of best fit in Columbus, the next master control room, Cincinnati, contributed an equipment arrangement that was to prevail through the construction of several future master control rooms. In a dedicated room considerably more generous with space: the video tape playback equipment is lined along one wall; routing switcher, informational character generator, and various support equipment along the opposite wall; and a console oriented so the operators face the video tape players is placed on the floor about 2/3 the distance across the room from the video tape players.

Substantive routing switching was introduced in Cincinnati and a switcher with rectangular matrix dimension of 80 x 60, and 4800 total available crosspoints was installed in the master control room. An automation system was acquired

and installed to manage and accomplish the switching of programs onto the cable system. In future master control rooms, this system was to grow and control each video tape player and additional switching but initially in Cincinnati it controlled only the routing switcher and sent simple start signals to each video tape playback channel.

As in Columbus, video tape playback utilized three dedicated players per channel and a device to start and sequence it through reel changes. Similarly, time base correction and audio signal processing were part of each playback channel.

PITTSBURGH AND DALLAS

A broadcast influence bouyed by the cable industry optimism of recent years lead the Cincinnati master control room design to its grandest application in Pittsburgh and Dallas. From areas of 1360 and 1600 sq. ft. respectively in Columbus and Cincinnati, a master control room area of 2275 sq. ft. in Pittsubrgh lead to the 3600 sq. ft. area in Dallas. Other dimensions were to swell to enormous proportions as well. Three routing switchers were installed in Pittsburgh; the main one having a rectangular dimension of 140 x 140, another a dimension of 60 x 40, and yet another with a dimension of 40 x 40. Grand total crosspoints in Pittsburgh reach 23600 available in all of these switchers. All were installed in virtually the same room within feet of each other. Not to be outdone, in Texas where the biggest and best of everything can be found, 24800 total crosspoints were installed in two routing switchers; a main one of 160 x 140 and a "random access" switcher of 60 x 40. These too were installed in the same room.

Finally in Pittsburgh and Dallas, the master control automation system grew to its greatest capability gaining control of an additional "random access" routing switcher and about 40 video tape players as well as the main routing switcher. In this configuration, specific groups of video tape players no longer needed to be dedicated to distinct playback channels and started with a sequencing device. Instead the automation system controls each player individually and assigns it to any playback channel through a "random access" routing switcher located upstream of the main routing switcher. Time base correctors and other signal processing items were placed at the outputs of the "random access" router so video tape player support equipment was no longer dedicated to any single or group of players. In theory this was intended to reduce the number of audio/video signal processor sets needed but in practice usage went from 1 set per 3 players to 1 set per 2 players. In addition to starting the video tape players, the Pittsburgh and Dallas version of automation also controlled their shuttle functions and was designed to cue and park 3/4 inch cassettes at any location on the tape without the use of SMPTE or other time code techniques. Today, these automation systems are being expanded further to accomodate the unique requirements of commercial insertion.

Summarizing, the size, arrangement and technical sophistication of Warner Amex master control facilities culminated in Pittsburgh and Dallas.

HOUSTON

The Houston master control was the first of a series of designs in which sound justification determined technical complexity, and operational considerations began to influence the arrangement of master control rooms. First to be corralled was floor area. The 1475 sq. ft. master control room in Houston consumes 3/5 the space of Pittsburgh's, and 2/5 the space of the Dallas arena. This was accomplished in part by constructing the master control room into only that area necessary to comfortably house the required equipment, and by more space effective arrangement and actual elimination of some equipment used in previous rooms.

A process of stern justification forced a decline from the 24800 switching crosspoints of Dallas to only 5600 total within an 80 x 60 main, and 40 x 20 "random access" routing switcher. Although not yet to the starting number of 1200 in Columbus, Houston returned almost to the Cincinnati level of 4800. Most important, a technical justification process was established which was to reap great rewards in the near future.

The master control room automation system of Pittsburgh and Dallas was installed in its entirety but implementation of an independent commercial insertion system in Houston has precluded expansion of it. The Houston master control room was the last to utilize the arrangement first applied in Cincinnati.

SAINT LOUIS

The traditional equipment arrangement that prevailed from Cincinnati through Houston was abandoned in Saint Louis. Introduction of new front loading, "narrow body" video tape players provided an opportunity to combine what was formerly a wall of players into a single, reasonably compact panel that included monitoring and controls necessary to accomplish all master control tasks. Not only did this trim the area required for master control to a slim 890 sq. ft., it also put all manual operations within the reach of a single operator thereby offering opportunity to trim staff and cost as well.

A new, crosspoint conservative switching scheme was devised but implementation of it was postponed for the Chicago master control due to the availability of an unused traditional routing

switcher. Nevertheless, total crosspoints in Saint Louis were reduced almost to the original Columbus level, summing up to 1600. Only a single main switching system is utilized since no master control automation system was installed, therefore eliminating need for a "random access" routing switcher.

Observation of operations in the previous master control rooms seemed to reveal that A SINGLE PERSON might comfortably operate the room manually and without aid from man or computer if the racks and equipment were placed around him in a good ergonomic design. Instead, several people could usually be found in these hovering around a variety of dislocated attention centers despite the presence of a functioning automation system. The Saint Louis master control room combined all the attention centers together in a single location so only one person would be needed to hover about them, and the automation system was eliminated so that the same single person could function as central processing unit and machine controller. A small home-made switch panel was provided to start any several video tape players simultaneously when necessary.

Previous philosophies of time base correcting ALL video tape playback, and continuously monitoring ALL pictures on the cable system were altered in Saint Louis. Only pay service and video tape playback pictures are continuously monitored, and only premium and pay video tape playback is time base corrected. Video processing amplifiers are substituted for time base correctors in the local origination and public access playback channels so that picture characteristics from marginal tapes can be adjusted before they're cablecast. One standby time base corrector can be patch connected into any playback channel where time base instability is observed. Substitution of processors for time base correctors and elimination of picture monitors saved space, air conditioning, power, and especially capital purchase cost.

CHICAGO

All the lessons learned in Houston and Saint Louis culminated in the Chicago master control room where a compact yet complete, efficient, and ergonomic arrangement was implemented. Although 680 sq. ft. was actually consumed, 575 sq. ft. would have comfortably housed the complete master control equipment complement. Forces not in touch with the pending electronic system design provided 1120 sq. ft. of space for the Chicago master control. Extra effort was applied to designing an equipment arrangement that is especially convenient for a SINGLE person to operate. The one rack of Saint Louis which encompassed ALL video tape players, monitors, and controls was bent to wrap around the operator in a horseshoe like fashion so that everything would be within his reach in just a few short steps. A panel of support equipment not requiring regular attention is installed behind the operator and makes up the rear wall of the master control unit.

Major change in master control switching was made in Chicago and total crosspoints installed there are a mere one hundred sixty (160), a far cry from the 24800 of Dallas. This was achieved by a disciplined justification process which judged each and every switch on its absolute necessity, and the frequency that it would be made. Switches judged unnecessary were eliminated entirely. Only frequent, regular switches are assigned electronic, vertical interval crosspoints. To accomodate infrequent channel changes and realignments, every cable system channel is passed through a simple in-out panel of BNC connectors in the head end. End result of the process is an implementation of just 16 individual 10 x 1 vertical interval switchers for a total of 160 crosspoints.

Elimination of the traditional any input to any output routing swither no longer allowed assignment of any video tape player to any cable channel, and dictated a return to dedicating groups of players to specific cable channels as in Columbus and Cincinnati. Such configuration, however, has no operational disadvantages, is BEST for a human to operate and keep track of, and is inexpensive and technically simple. In fact, some of the automated master control rooms previously described configured their "random access" systems in a dedicated player group manner.

To facilitate simultaneous control of the switchers and video tape players from a central location, an economical, digital, twisted wire pair machine control device was adapted by its manufacturer for use in the Chicago master control room. Now programmed by the operator just before each switching event is to occur, the device is provided with an RS-232 port for connection to a small personal computer should the operator require aid in the future.

FUTURE WARNER AMEX MASTER CONTROL ROOMS

The Chicago master control is the benchmark for future Warner Amex systems. Saint Louis and Chicago revealed that a single person can manually operate a master control system just as well as several people had operated automated master control rooms in previous systems. Should master control requirements remain the same in the future as they are in current operating rooms, new Warner Amex systems will be of a SINGLE operator arrangement similar to Chicago. Nominal floor area will be about 800 sq. ft. and switching should not exceed 250 crosspoints. Switching will as well be accomplished by individual 10 x 1 units rather than traditional rectangular matrix routing switchers.

Introduction of new concepts and equipment might make possible a partially attended master

control. Video tapes might be loaded and cued by simple and reliable auto loaders, and starting and switching them might be controlled by an economical, reliable and repairable PERSONAL COMPUTER. Good electronic devices are available today that can continuously monitor the presence and quality of every picture originating in, or passing through the cable system and alert the staff should a discrepancy arise. Such a master control room need only be attended once or twice a day, perhaps even less, to change video tapes in the auto loaders.

COMMERCIAL INSERTION

All Warner Amex metropolitan systems but Chicago currently insert commercial advertising on some satellite networks that make time available for local advertising. Most use the simple "sequential access" method of video tape commercial spot playback in mini electronic systems that are independent of the master control room systems. They are, however, located in the master control room and operated by its staff. Pittsburgh and Dallas utilize their master control automation systems to insert commercials and consequently have some flexibility in establishing a method of operation due to the real and potential random access capabilities of the automation system.

Today, the normal master control room staff performs the tasks of commercial insertion almost as a function secondary to their program origination chores. In some cable systems, however, advertising sales has matured and grown such that commercial insertion is becoming the principal activity of master control. Should the business continue to develop and grow, it is conceivable that master control rooms will become commercial insertion centers, necessarily manned to cope with cablecasting a high volume of short commericals on many cable channels with short notice changes and special requirements near and dear to every advertising sales manager's heart. As it becomes more automatable, program origination is liable to become the secondary master control activity.

PRODUCTION FACILITIES

The implementation of QUBE two way interactive technology in Columbus made possible unique programming in which the home viewer could participate directly in locally produced shows. In order to exploit the possibilities that QUBE seemed to offer, three television studios were constructed at Columbus to produce and cablecast interactive programs. These were equipped with a full complement of audio, video and lighting equipment, all of modest quality but traditional to the broadcast industry nevertheless. Two ENG vans and an EFP vehicle were added for news and location production outside the studio. When fully operational, Columbus production facilities rivaled those of any broadcaster in a medium size American city.

The broadcast influence prevailed through construction of the Dallas cable system providing Cincinnati and Dallas with fully outfitted TV studios of 40 by 60 foot dimension, and Pittsburgh a whopper of 60 by 80 feet. All were equipped with remote production and news vans many of which sported some of the most popular and costly broadcast ENG and EFP equipment of their days. Each system was fully staffed to make the most of these resources.

A new studio was never built in Houston but the system was equipped with a field production van made up of some of the finest broadcast equipment available. A very small staff produces programs in Houston with the van and a small acquired studio utilizing the van as a control room.

New production facilities were constructed in Saint Louis and Chicago but their design and equipment complement departed radically from those of their predecessors. The broadcast influence was scrapped and instead, modest 30 by 40 foot studios were provided with equipment just correct in quantity and type to produce QUBE programs of very good technical quality. ALL production support equipment is located within the studio control room and arranged so that a single person can comfortably perform all studio control room tasks for the majority of simple programming that is typical of these local origination studios. Integrating video tape recorders and a controller into the system allows the studio control room to double as a quality edit suite during the majority of time that production is not taking place in the studio. Saint Louis and Chicago each have a single remote production vehicle, regular vans that are equipped with high performance but economical audio/video equipment. Whatever is the future of local orignation and QUBE programming, Saint Louis and especially the Chicago production facilities will serve as the benchmark for future production systems in Warner Amex cable systems.

SUMMARY

Both cable origination and program production audio/video facilities within Warner Amex metropolitan cable systems grew from modest beginnings to apparent excess over the construction of the first few systems. Application of a disciplined justification process, careful selection of equipment and integration of it into systems, and design of compact, yet efficient and ergonomic areas achieved a humble but thoroughly functional, effective, and high quality conlcusion in the most recently completed Warner Amex audio/video system facilities. Reward was SUBSTANTIAL saving of capital and construction costs, and most important, significant reduction of annual expenses for cablecast operations.