

## AURAL SERVICES FOR THE FM BAND

Frank A. Genochio

CATEL  
Sunnyvale, California

**ABSTRACT**—Most CATV systems carry FM signals from direct "off air" or microwave delivered sources. This paper reviews several additional services which can contribute toward the development of a total CAFM (Community Antenna FM) concept. Included is a discussion of the local origination of monaural, stereo and quadraphonic programming TV/FM simulcasts, and special services, such as, standard time, weather and international short wave rebroadcast.

Most CATV operators carry "off air" or microwave delivered FM broadcast signals on their systems. Traditionally, FM has been treated as an incidental service to television. This is understandable, but with CATV systems now reaching a high level of technical performance, and with the need to find new revenue sources, many operators are now placing greater emphasis on FM services. With 80% of all U.S. homes equipped with an FM receiver<sup>(1)</sup> and a music oriented public, the CAFM (Cable FM) concept ideally complements CATV.

Since this session deals primarily with local origination, and on the specific topic of Aural Services for the FM Band, the discussion will be limited to services in the 88-108 MHz. frequency range, although there are tempting opportunities for use of aural signals in other parts of the spectrum.

An effort will be made to acquaint you with special aural services, which are being used, or can be used, to offer new personal and community benefits as a means of attracting and maintaining subscribers on a cable system.

The objective of an effective CAFM program, as with cable television, is that of offering signals of a variety and quality not readily available to the subscriber on a direct pick up basis. The following are some examples of aural programming which can meet that objective:

An activity which is growing very rapidly is that of CAFM cablecasting by colleges, universities and other schools. A recent article<sup>(2)</sup> in the *Journal of College Radio* indicated that there are approximately 50 such stations now operating, with an estimate that this number will reach 75 by the end of 1974. In 1970 there were only 10 stations.

There are hundreds of campus radio stations using carrier current for on campus broadcasting. Since these stations have audio equipment, and regular operating schedules, all they require to expand their coverage to the local community is the addition of an FM modulator and the cooperation of the local cable system operator. Most of the school stations use the combined carrier current - CAFM technique.

In the IBS survey it was shown that 31% of the stations are operating in stereo. Of the college radio stations using "on air" broadcasting with 10 Watt (Class D) stations, only 5% are using stereo. Over 3/4 of the schools own the origination equipment, and all of them report that they pay rental of telephone lines when required, to the CATV "head end". It is apparent that the CAFM approach makes it economically possible to offer stereo and also, and perhaps most important, the signal-to-noise, problems with a 10 Watt transmitter have limited most stations to monaural programming.

For the cable operator who is looking for a first step beyond "off air" signal carriage, he should look to local schools where he will often find active interest, talent, and in many cases; the equipment to begin CAFM origination.

The high level of student interest in programming, originating from their school, insures many additional FM "hook ups" to the cable system.

Connection with the CATV system usually involves special telephone lines from the campus station to the FM Modulator at the "head end", although in some cases direct access is provided through the cable system. This latter approach is especially attractive for stereo origination where dual line charges may be beyond the limited school budgets.

Recent changes in telephone tariffs offer a concept of community "cable radio" services which should be considered in any CAFM aural origination program. Under these tariffs it is possible to use direct dial lines for remote radio broadcasts, so access from any location in the community can be offered, simply and inexpensively, for any "voice grade" programming.

There are many relatively inexpensive remote units being used by broadcast stations. One, which also serves as a conference telephone, can be leased from most phone companies for approximately \$15 per month, plus an initial installation charge. A direct dial remote can provide access to the FM Modulator, from the local football field, little league ball park, mayor's office, church, service club meeting room or law enforcement headquarters. A number of police headquarters are now linked with other agencies using direct or telephone interface with the cable system.

This highly flexible system of community "cable radio" is available as one of the very inexpensive services which can increase subscriber interest and, as an extra benefit, perhaps reduce demands for television remotes. Just as cable television origination can serve a narrower area of interest than broadcast television, cable radio can economically reach an even smaller segment. One can envision serving special interest groups of only a few members, where cost of origination equipment would make television prohibitive.

When looking at cable FM origination it is well to consider some of the technical factors which make cable a potentially superior means of transmitting high fidelity musical programming.

Most of us have experienced the rather dramatic difference between a musical performance heard in a concert hall, with that received in the home or automobile FM receiver. This difference is especially evident when an attempt is made to record "off air" musical programs. The "flatness" or "lack of brilliance" of the sound reproduction is a problem in dynamic range, where the sound recording and transmission system cannot match the capability of the human ear to discern differences in level.

The sound intensity range of the large symphony orchestra can be as high as 70 dB (a power ratio of 10 million to 1) and a good high fidelity

amplifier has a range of 60 dB, so the problem is in the transmission medium, or more precisely, what is done to the original signal before it reaches your ears.

In an article entitled "Who's Monkeying With Your FM Signals?"<sup>(3)</sup>, Peter E. Sutheim of Radio Station KPFFK, Los Angeles, speaks of the many signal processing steps which occur between a live performance and the human ear as "tinkering" with the sound beyond the straight amplification and transmission of the musical signal.

The reason for this "tinkering" is the economic pressure on an FM broadcaster to achieve maximum coverage, approximately (4.5 million units sold in 1973)<sup>(3)</sup> especially to the growing number of listeners using automobile FM Stereo receivers. In the conflict between fidelity and marketing, it is understandable that concessions will be made in fidelity, except in the case of non-profit broadcasters who, being less subject to economic pressure, often can offer a level of fidelity superior to their commercial counterparts. Mr. Sutheim points out that the effort to be the loudest station results in "tinkering" with gain and frequency response to achieve an increase in apparent loudness while not overmodulating the transmitter. Since it is estimated that maximum useful dynamic range for listening to music in an automobile is only 20 dB, and with much of the FM stations market on wheels - the compromise with fidelity is understandable.

Using cable for origination makes possible the transmission of music with no need for processing beyond the normal pre-emphasis to be compatible with long standing FM broadcast requirements. Compression and special limiting techniques, to achieve maximum coverage, are not necessary in FM cablecasting, so truly high fidelity transmission is possible, for the home recording enthusiast, or for the critical listener, whether of Rock or Bach.

Thus far, we have spoken only of the transmission of mono and stereo, by cable. With the high fidelity industry actively promoting quadraphonic (4 channel) sound, we are certainly faced with this kind of transmission as part of the future aural services from cable. Cable transmission, with its capability of providing good signal to noise and freedom from multi-path interference, can offer improved stereo, as compared to "off air" broadcasts. For the same reasons it is expected that quadraphonic signals, with even more critical demands on precise phase and level relationships, can be better delivered by a cable system than received "off air".

Although we are not in a position to get involved in the matrix vs discrete quadraphonic issue, our company has, for the past year or so, been demonstrating the origination of matrix(SQ)

quad at various CATV conventions. We are now involved with a consumer products manufacturer and a major west coast cable system in testing CD-4 (Discrete) quadrasonic transmission by cable.

So much for cable FM origination---How about some ways in which aural services can add to the effectiveness of Cable television origination?

Not being directly involved with the problems of television origination perhaps limits our perspective, but it is difficult to understand why TV/FM simulcasts, with the audio portion of TV origination carried simultaneously as Hi-Fi mono, or stereo, along with its' conventional mode, has not been used by system operators.

Every business man agrees that for any product to be successful, it must be capable of satisfying a need. We think that TV/FM simulcasts - in CATV origination, have an opportunity of doing just that - for a high fidelity conscious audience.

With the high level of perfection of the picture quality of TV color presentations, the remaining weak spot in television is the sound. Although the television broadcast industry is looking at ways to improve sound, any change will involve much time with perhaps a whole new generation of TV receivers, and certainly CATV doesn't need any more long pay off items. In the early days of FM stereo, simulcasts, in which the AM station transmitted one channel and the FM another, proved quite popular, to this suggests an approach for cable. In this case, however, we are not suggesting splitting the channels for stereo, but rather simultaneous sound transmission on TV and any 88 to 108 MHz channel.

The reported success of the ABC Network, "Wide World of Entertainment" rock concerts, and some special classical music programming, where the TV station carries the conventional sound and picture, and a local FM station carries the stereo sound - has demonstrated the public wants this kind of programming. CATV is in a position to offer television high fidelity on a regular basis. A simple and relatively inexpensive FM modulator makes it possible to give the subscriber a service that is not regularly available from "off air" sources. Putting the local origination audio on the FM band as a monaural signal can greatly improve programs with high musical content, although stereo would, of course, be preferred. Also, using simulcast, pay television can offer greater appeal by providing "theater like" sound, instead of limiting the sound portion of a movie to the capability of the audio and acoustical system in the TV set.

In addition to local origination, we feel that "off air" television should be carried on a cable simulcast basis - to offer an option to those who want to use their high fidelity equipment to listen to the Boston Pops, Lawrence Welk, or a

Broadway Show as a TV "Special". This, however, would get us off into a discussion that is not part of local origination - and possibly a commercial emphasis not appropriate for this paper.

The CAFM origination ideas we have presented involve people and equipment which can represent a substantial investment in getting started, as well as in sustaining the program. There are, however, a number of excellent aural services that can be added to your FM system that are available with a minimum of equipment, and that don't require continuing "people" involvement.

The National Oceanic and Atmospheric Administration, National Weather Service, now provides 24 hour per day weather broadcasts in most major coastal areas. This service is being rapidly expanded to other key population centers. These broadcasts are on VHF-FM frequencies which are not regularly available, without the use of special receivers. Many consumer goods manufacturers are offering the weather channel options, in new models, and this provides verification of public interest in "radio weather".

By converting the weather broadcasts to the standard 88-108 MHz FM band and carrying the signal on an unused FM channel, this extremely useful public service is made available to thousands of additional homes. Also, since the weather broadcasts include signals which may be used to alert the listener to weather emergencies the cable system can provide a means of using these signals to initiate warning procedures and to insert weather and civil emergency information.

For many years the National Bureau of Standards has broadcast time and frequency information by high frequency radio station WWV. Although the transmissions have been widely used by those who had a specialized need for such information, the use by the public has been limited because of the relatively high cost of receiving equipment and the amount of technical knowledge required to properly interpret the signals. Recently the format of the standard broadcasts has been changed with features such as precise time announcements each minute and the elimination of some of the encoded information which was confusing to the public. Like most everything else in our changing world, however, the WWV broadcasts show a new image in announcing time as "Coordinated Universal Time" instead of the Greenwich Mean Time (GMT) reference we have known through the years.

Now that watches are being sold which use quartz crystals and even digital readout, it would seem that the ultimate step in "conspicuous consumption" is that of knowing that ones precision time piece was checked daily - using a reference standard that is accurate to approxi-

mately one part in  $10^{11}$ . Seriously, the availability of a readily available time standard has proven of subscriber interest in a number of systems, as have the weather, propagation forecasts and standard audio tones available from WWV.

To add the time broadcasts to the FM band, the cable operator needs a high frequency receiver, appropriate antenna system, and an FM modulator. Simultaneous monitoring of night time and day time frequencies, with automatic change over to the best signal would be desirable, but CATV systems, using the standard time broadcasts, are realizing satisfactory results using a manual change to the best channel, for a given distance from the transmitter, and the time of day and year. A satellite transmission system to provide relay on a VHF frequency has been tested by the Bureau of Standards and will no doubt simplify reception problems in the future.

In spite of the tremendous educational and cultural content of international short wave broadcasts, and the long history of such services, their use has been limited to a relatively small segment of our population who have the equipment and the knowledge to cope with the complexity of high frequency signal propagation. An estimate by the publishers of World Radio/TV Handbook shows 1300 short wave broadcast transmitters currently operating world wide with 40 Million receivers in daily use. Out of an estimate of the 140,000,000 receivers capable of short wave reception, there are only 2,500,000 in the U.S., yet our diverse backgrounds would suggest a high degree of interest in foreign broadcasts. By using a high frequency receiver and proper antennas, with appropriate equipment for the re-transmission of signals, the cable operator can add a virtually unlimited variety of special interest programming for his subscribers.

Along with time and weather broadcasts, Buckeye Cablevision of Toledo (a system which deserves much credit for pioneering effort in special FM services) carry BBC - London, Radio Berlin and Radio Moscow on the cable. In this case, their hub distribution plan includes carriage of the special services via microwave, so only one receiving location is required.

Another area closely related to cable origination is that of background music services that can take advantage of the unique capability of cable.

At present, background music is monaural, using SCA or wire lines for distribution. In addition to the transmission limitations, speaker placement problems and economic considerations, the specialists in this field tell us that the whole idea of background music is to minimize involvement on the part of the listener, so stereo is not used. Since total involvement with music would

seem to best satisfy the needs of the listener in the dentists, or doctors office, or in fact most waiting rooms, it would appear that at least part of the argument for mono lies in the huge investment in monaural music libraries and equipment on the part of the music service operators.

I would like to go into other areas, such as point-to-point voice and data links, remote control of surveillance cameras, transmission of slow scan television and facsimile which involve signals of an aural nature, but realize that to deal with these would be going beyond the limits assigned for this paper.

The stated purpose of this paper was to acquaint you with some of the ideas that are being currently used, and others that are not presently used but readily available as aural services in the FM band. Only time will tell the ultimate success of some of these concepts, but they do represent simple and relatively inexpensive services which bear the serious consideration of cable operators who see CAFM as part of their future.

#### REFERENCES

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