

COM/TECH

RADIO SUBCARRIER SERVICES

How To Make Dollars and Sense
Out of New Business Opportunities



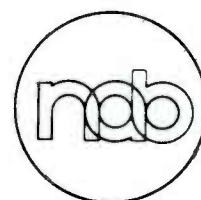
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RADIO SUBCARRIER SERVICES

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Out of New Business Opportunities

COM/TECH REPORT
VOL. 2, NO. 1

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Reference Note:

Shooshan & Jackson Inc. is a Washington consulting firm specializing in the communications industry. The firm is especially skilled in helping clients develop new ventures and sound business strategies for today's rapidly changing technical and regulatory environment. The organization combines legal, engineering, economic and public policy skills and offers an experienced multidisciplinary team with "hands-on" business experience and a background in the legislative and regulatory arenas. The firm has an extensive background in broadcasting, telephone regulation and pricing, cable television, videotex, cellular mobile radio, DTS and low power television and has conducted major policy studies in the areas of cable television regulation, copyright, the regulatory and legal problems related to videotex.

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Preface

One view of the business potential of broadcast subcarriers is given by the industry association for the current paging companies:

“...Obviously, by virtue of the different engineering philosophies in the two services, the broadcasters would have an enormous, inherent, and egregiously unfair competitive advantage over RCC's in the provision of paging service.”

Comments of Telocator Network of America
(FCC Docket BC 82-526, December 1982)

What is the Telocator Network of America? What is an RCC? And why were they so afraid of broadcasters and of broadcasters' use of subcarriers?

This study attempts to answer these and other questions about ancillary uses of broadcast signals. In the past regulatory rules have severely restricted the use of audio subcarrier capacity, strictly limiting it to broadcast related services. Recently, however, the Federal Communications Commission has “taken the wraps off” and has removed most of its restrictions on FM subcarriers, as well as approved the use of similar ancillary capacity for AM broadcast facilities.

In its recent rulemaking on subsidiary communication services, the FCC decided to impose common carrier regulation on certain FM subcarrier uses. NAB has urged the FCC to refrain from imposing formal common carrier regulation on these new services and to limit the imposition of additionally restrictive state common carrier regulation. At the time of this publication, NAB is preparing to file a petition asking the FCC to reconsider the common carrier-related elements in its recent decision.

Our goal in preparing this report is to provide the fundamental information a broadcaster needs in order to pursue intelligently the various business opportunities ancillary AM and FM signals make possible.

Introduction

Everyone knows that there is no such thing as a free lunch — but ancillary uses of a broadcaster's signal are the closest thing to a free lunch available today. Radio broadcast signals, both AM and FM, have unused signal carrying capacity. And, this capacity can be applied to a host of valuable applications at little additional expense to the broadcaster. He uses the same transmitter, the same antenna, the same cables as always. Some additional investment in electronics is needed to transmit these additional signals — but very little — perhaps a few thousand dollars worth of hardware.

The real costs of using ancillary signals aren't the hardware costs and they aren't the costs of testing and maintaining transmitter equipment to tighter standards. Rather, they are the costs of organizing to go after new markets. In short, they are marketing costs associated with promotion, sales and billing needed to run an additional business.

It should be pointed out, however, that in today's world, there is an even greater cost related to ancillary services for most broadcasters — specifically those broadcasters who don't pursue these markets — and that is **the cost of lost opportunities**. As we'll discuss later, in a city of moderate size, an FM broadcaster can receive \$3,500 per month for the use of his subcarrier channel — and the customer may even supply the needed hardware. Loss of profits from these missed opportunities is the biggest cost of all.

This report discusses the range of opportunities open to broadcasters — both FM and AM — to provide additional services and thereby gain additional revenues by transmitting ancillary signals along with their regular programming. The discussion below consists of four major divisions, followed by a final section summarizing our conclusions and recommendations. The first part is a general overview of the legal and regulatory environment in which subcarrier services operate. The second is a technical review designed to place the technical issues in their proper perspective. It is followed by a discussion of the markets served by ancillary signals today and of some of the markets these signals could serve in the future. The fourth section considers, at length, different strategies and approaches broadcasters can

take towards these markets and provides a review of the costs and revenues associated with these various business opportunities. The final section contains conclusions and recommendations and is followed by several appendices listing potential large scale customers for ancillary services, hardware suppliers and other reference material on subcarrier operations.

I. Legal and Regulatory Issues Affecting the Use of Radio Subcarrier Services

Broadcasters should not be surprised to learn that the FCC has a lot to say about the business opportunities associated with the AM carrier and with the FM subcarrier. In the past, the Commission has severely restricted the use of this capacity by broadcasters. Recently, however, the FCC has "taken the wraps off" and has decided to remove its restrictions completely.

Broadcasters should be aware of what their options are today and of how those options would be expanded by recent deregulatory decisions at the FCC.

AM Auxiliary Carrier Services

Let's take a look at the AM "carrier." Right now the AM carrier can only be used for utility load management. The FCC decided to permit this type of use last year after earlier authorizing the use of FM subcarriers for this purpose. There are some regulations that AM broadcasters should know about if they decide to use the AM carrier to provide this service to utility companies.

First, the use may not disrupt or degrade the station's own programming or the programming of other broadcast stations. This rule makes it clear that the Commission sees AM carrier services as secondary to the broadcaster's primary broadcast service. However, as we discuss in a later section, an AM carrier system can be easily engineered to avoid such interference.

Second, the broadcaster must retain control over the content of what is transmitted and must retain the right to reject "inappropriate or undesirable material." In effect, this is the FCC's way of reminding broadcasters of

their fundamental responsibility for what is transmitted over their facilities. As a practical matter, it's hard to imagine how this rule would impair the use of the AM carrier for utility load management. However, a broadcaster should bear this obligation in mind when entering into any contract with a local utility company to provide AM carrier service.

Third, the modifications of the transmitter needed to provide this service must meet certain technical requirements.

The FCC is currently considering allowing broadcasters to use the AM carrier for any purpose. On January 21, 1983, Altran Electronics, one of the major equipment suppliers, asked the FCC to remove its restrictions on AM carriers. The Altran petition has been supported in comments filed by the NAB and by CBS. Altran suggests that the AM carrier could be used for a host of services in addition to utility load management, including transmitting emergency alert messages, control of remote sensors for agricultural irrigation, and data transmission of various types.

It is unlikely that the FCC will act on the Altran petition before next summer. There is compelling argument that AM broadcasters should be allowed to pursue the same business opportunities as their FM colleagues.

FM Subcarrier Services

Now, let's turn to the FM subcarrier. Until last year, the FCC restricted the use of FM subcarrier services to transmitting material that was of a "broadcast nature." In other words, broadcasters could not use their subcarriers for point-to-point services. As a result of this limitation, most FM subcarriers are used to provide background music services, such as Muzak, which are transmitted to many points at the same time.

However, in 1982, the Commission took two important deregulatory steps. First, it modified its rules to permit the use of the subcarrier for utility load management. Second, it proposed to drop all of the non-technical restrictions on the use of the subcarrier, including the requirement that subcarrier operations must take place during periods when the main channel is being used and that program logs be kept. The Commission proposed doing away with its requirement

that broadcasters file a special application for permission to use their subcarrier. The FCC also began considering changes in its technical rules which would expand the capacity for multiple subcarrier services. For example, some public radio stations want to be able to use one subcarrier for a public service (such as a reading service for the blind) and another for a revenue-producing service. This could be done while still enabling a station to operate in stereo.

Most of the opposition to deregulating the use of FM subcarriers has come from companies which are concerned about having broadcasters as competitors — and especially as unregulated competitors. The radio common carriers urged the FCC to restrict the use of subcarriers for offering paging service in an effort to protect their lucrative market. The vigor with which the radio common carriers have fought competition may say more than any market studies about how potentially valuable use of the subcarrier might be for paging. AT&T took a slightly different tack, but with the same goal in mind. Bell suggested that, if broadcasters provide a service similar to that being provided by a common carrier, they should be regulated like a common carrier. While regulation as a common carrier would certainly not preclude use of the subcarrier by a broadcast station, it would create regulatory problems that might deter some broadcasters from competing in those markets.

On April 7, 1983, the Commission unanimously voted to deregulate the use of FM subcarriers. The Commission determined that "restrictions imposed by its rules artificially limited the use of subcarriers" and resulted in "underutilization of this valuable resource."

In a major victory for the broadcasting industry, the FCC decided to allow use of the FM subcarrier for "any legitimate communications purpose, whether or not broadcast related." The decision allows FM broadcasters to use their subcarrier at any time whether or not the main channel is in operation. The requirement for a special application (Form 318) and for program logs have been dropped. In addition, non-commercial FM stations are permitted to use or lease their subcarrier for commercial services.

On the technical side, the FCC decided to expand the FM baseband from 75 kHz to 99

kHz, thus enabling most broadcasters to offer two subcarrier channels. It should be noted that broadcasters within 199 miles of the U.S./Mexico border cannot transmit subcarriers above 75 kHz under terms of the U.S.-Mexico FM Broadcasting Agreement. While there are no treaty restrictions involving Canada, the FCC indicated that it will request concurrence of Canada in these changes. The Commission also said that any type of modulation (AM, FM, PCM, FSK, etc.) can be used for the subcarrier but that it would monitor the provision of any non-aural or "visual" service to make certain that it did not create any degradation or interference.

The Commission also dealt with several policy issues in its decision on April 7. A number of the Commissioners expressed concern about new subcarrier uses displacing reading services for the blind. In a separate decision, the Commission said that, while it would not reserve a subchannel for "public telecommunications services such as radio reading services," it expects noncommercial FM broadcasters to accommodate the needs of reading services. The Commission expects noncommercial broadcasters who are now providing these services to continue to do so on one of their subcarrier channels. This is especially important where the noncommercial broadcaster intends to use one of his channels for "remunerative subcarrier activities." Failure to meet these needs would certainly become a renewal issue.

The Commission's decision leaves it to the broadcaster to determine the manner in which his subcarrier will be used or, indeed, whether it will be used at all. However, if a broadcaster elects to use the subcarrier, he must meet the FCC technical requirements. The broadcaster remains responsible for technical compliance even if he leases his channels to someone else to use.

In its original Notice of Proposed Rule Making, the FCC had concluded that "it does not appear that a broadcast station's subcarrier use should be regulated according to common carrier principles, even when it engages in uses that compete with common carriers." Faced with opposition from AT&T and radio common carriers, the Commission backed away from this position. If broadcasters offer a service which meets the test of common carriage, they will be regulated

as common carriers. Traditionally, the FCC and the courts have decided that to be a common carrier, "one must hold oneself out indiscriminately" to serve the public.

An entity will not be a common carrier "where its practice is to make individualized decisions. . . whether, and on what terms to deal." Broadcasters offering common carrier service must seek authorization from the Common Carrier Bureau to offer the service as required under FCC rules. Each request will go on public notice to allow for comment after which the Commission will decide whether or not to approve the service. The Commission noted that there will be a presumption in favor of these service offerings. Under some circumstances state certification may also be required.

The FCC emphasized that even if a subcarrier service is considered to be common carriage, the offering of such service would not affect the primary FM station license. In other words, common carrier regulation would apply only to the common carriage use of the subchannel.

Broadcasters can structure their subcarrier services to avoid common carrier regulation. If a service is provided based on individual decisions by the broadcasters as to whom to serve and on private contracts with those users, that service is unlikely to be considered common carriage.

Paging service is treated differently, however. If a paging service is offered as a private service, rather than as a common carrier service, connection with the telephone network is governed by Section 331 of the Communications Act which substantially reduces the attractiveness of the service. This section permits a multiple licensed or shared private land station to interconnect with the telephone network only if **each user** or the licensees jointly obtain the interconnection directly from the telephone company. Thus, the effect of the FCC's decision may be to force broadcasters to offer paging as a common carrier service.

The FCC also dropped the previous requirement that subcarrier signals not be used to "mute" or "suppress" commercials. Thus, broadcasters will be able to offer background music services which consist of their main program service minus the commercials, news and voice announcements.

Equipment allowing broadcasters to provide this service should become available within the year.

So while it is impossible to predict the **exact** market outcome of the various proceedings to liberalize use of the AM carrier and FM subcarrier, it does appear that the FCC is firmly committed to allowing broadcasters to expand their activities. The technology exists to permit broadcasters to move into these secondary markets at relatively little additional cost and without degrading their basic service. Broadcasters should be aware of many exciting business opportunities and be poised to take advantage of them in light of the favorable action by the Commission.

The door has been opened.

II. General Technical Background

The terminology used to discuss radio subcarriers very often is confusing. The FCC's rules now permit FM broadcasters to use, for a variety of purposes, the subcarrier capabilities of their FM station. Sometimes the equipment used for subcarriers is called SCA equipment or SCA generators, in reference to the FCC's past rules for subsidiary communications authorizations (SCAs). For consistency's sake, we have avoided using "SCA." Instead we have used the term subcarrier in discussing both FM and related AM carrier services.

Broadcast signals, both AM and FM, have unused signal carrying capacity. Until a few years ago, such capacity was used primarily to transmit background music services over FM subcarriers. But while background music is still important, modern technology, especially modern digital integrated circuits, has vastly expanded the range of services which can be offered over FM subcarriers. In a nutshell, broadcast subcarriers have the following technical characteristics:

For FM:

A subcarrier can carry:

- One audio (music) signal — with roughly the quality of AM radio, or
- a data signal at rates from 300 to 9,600 bits per second, or
- a combination of a reduced quality aural service and a data signal at speeds from 300 to 4,800 bits per second.

For AM:

A "subcarrier" can carry a slow data signal say 5 or 10 characters per second. (The theoretical limit on AM data transmission rate is much higher.)

For both AM and FM, a subcarrier can reach as far as the station's main signal if users of subcarriers go to the trouble and expense of putting in a dedicated outside, directional antenna. In such situations, especially if the receiving antenna is on top of an office building or a grain elevator, reliable service has been reported in ranges of more than 100 miles from a Class C FM transmitter.

It is recognized that subcarriers are only a small part of the main FM signal, and the higher the subcarrier is on the baseband, the more difficult it is to receive an interference-free subcarrier signal. In actual operation, the relative strength of the subcarrier may only be equivalent to a 50 watt transmitter compared to a 50 kW for the main signal. The effect of this technical consideration on various non-fixed subcarrier services and receivers, including paging, is not clearly established at this time.

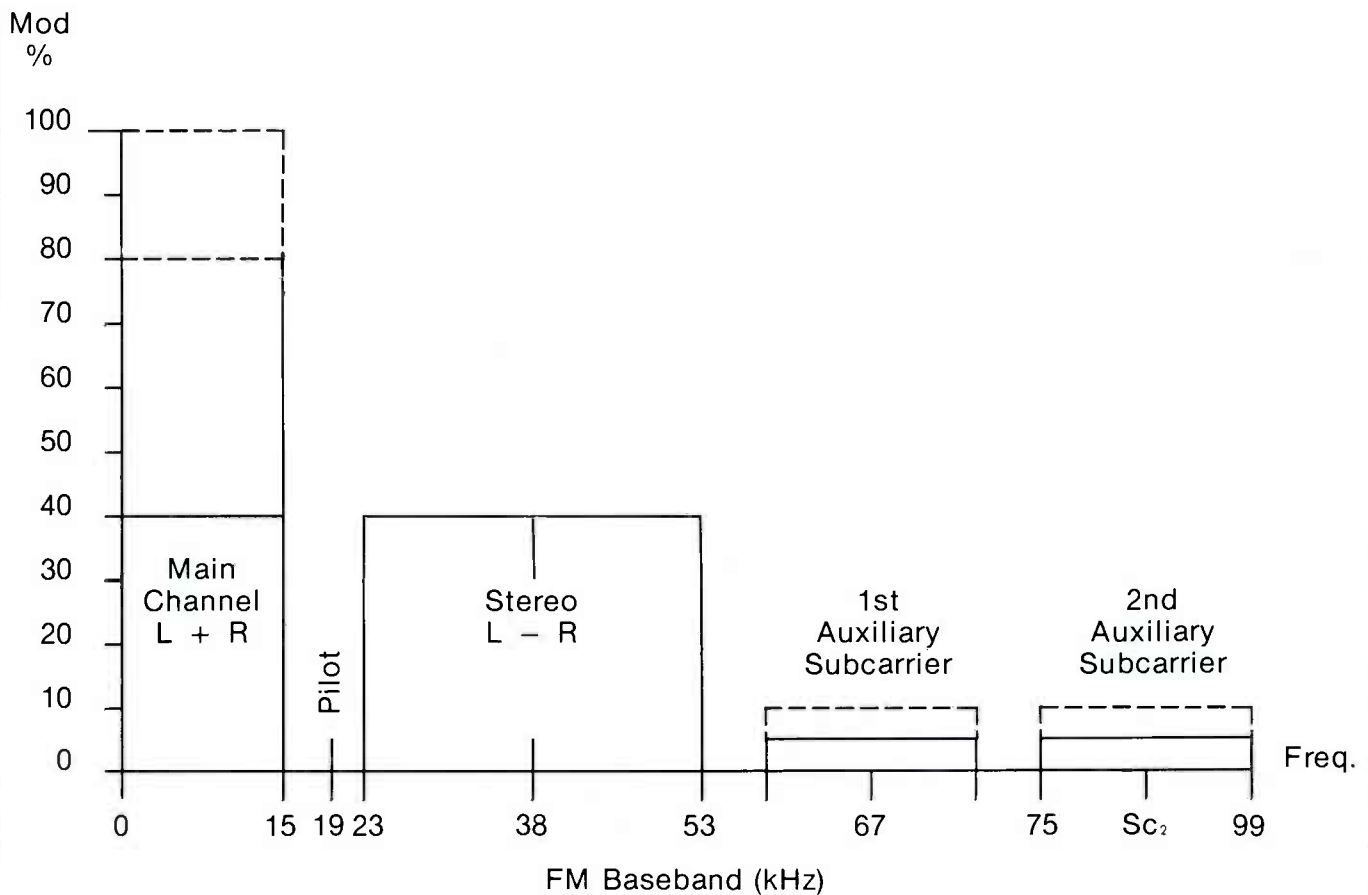
In addition to other considerations mentioned above, it should also be noted that providing ancillary services on either an AM or FM station may require transmitting on a continuous 24-hour basis. Transmitter operations typically require regular maintenance but customers, or subscribers, also demand fair service. As a result, stations may have to beef up their maintenance or add backup equipment to their facilities. The luxury of having six hours each night for maintenance will disappear when ancillary services require efficient and continuous signal access.

Technical Considerations: FM

Signal Coverage

Use of an FM subcarrier requires a reduction in deviation of the main channel by as much as 10%. **This 10% reduction does not transfer into a 10% reduction in range of the main signal or in coverage by the main signal.** Rather, this 10% reduction corresponds to a **theoretical** 0.92 dB reduction in the signal-to-noise ratio of the output of the home or car receiver when tuned to the main signal of the FM station. This reduction isn't serious since very few people can hear a

Table 1
FM Composite Baseband
Signal



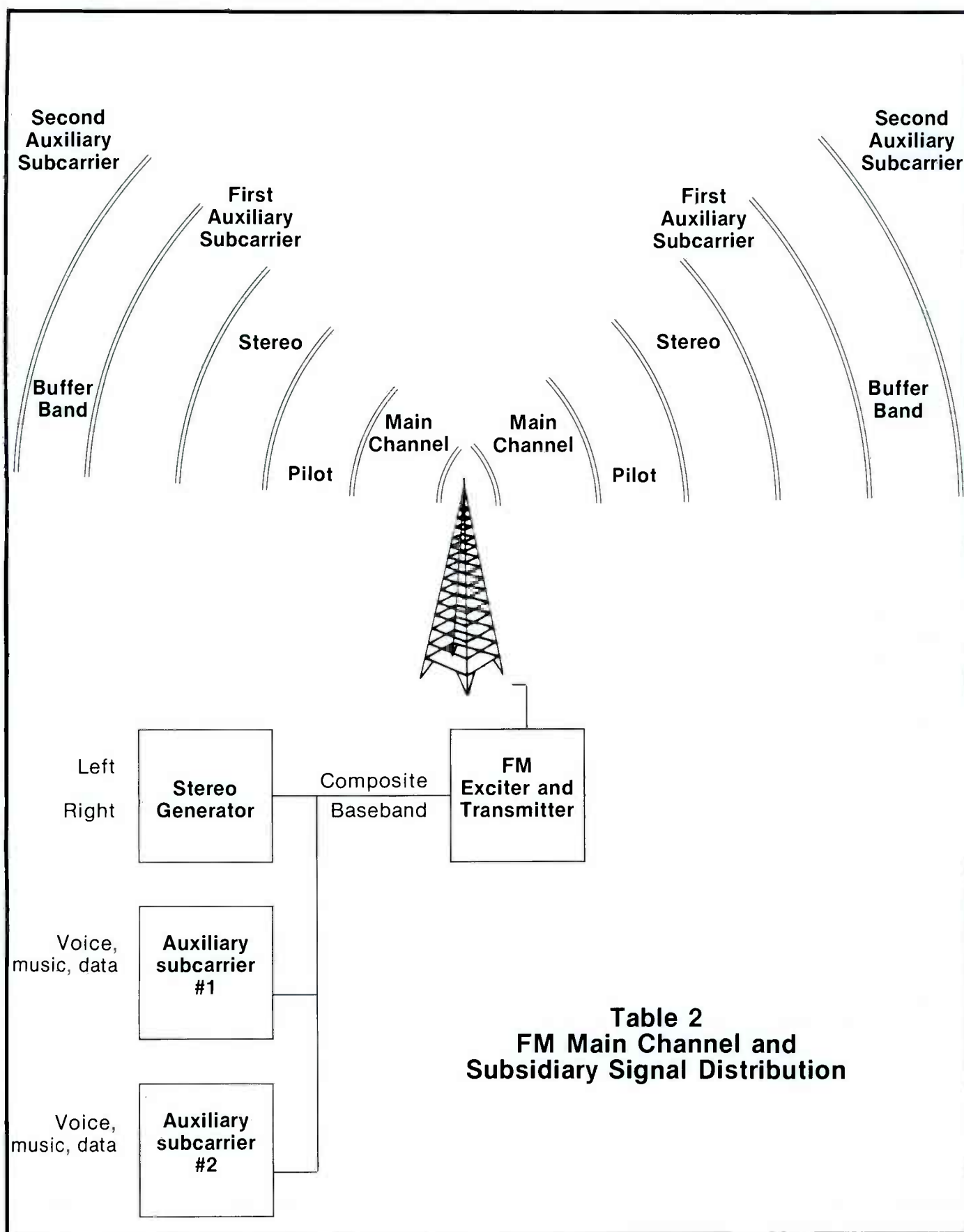
L = left channel
R = right channel

L + R = mono

L - R = stereo difference signal

Sc₂ = Second auxiliary subcarrier frequency between 75 - 95 kHz

Total modulation is the sum of all components in the FM signal.



change of less than 1 dB. In theory and in practice, use of a subcarrier does not materially affect coverage. This is in contrast to the change over from mono to stereo transmission on FM which **does** reduce coverage.

Interference

While coverage reduction caused by subcarrier operation is a false issue, the problem of interference between the subcarrier signal and the main channel signal is a real issue. FM subcarrier operations can, but need not, create interference to the programming on the main channel signal. The interference issue is complex and confusing — but one point is clear — careful engineering can eliminate such interference.

The problem arises from what engineers refer to as “non-linearity” or what station managers sometime refer to as sloppy engineering. Any non-linearity in the total transmission system — exciter, cable and antenna, or receiver — can mix the subcarrier signal with the other signals present in the total FM signal and cause audible interference. Such non-linearities should never be present at an FM transmitter. But, sometimes they are! Such non-linearities usually can be detected using a subcarrier generator and a spectrum analyzer.

The difficulty of removing them at a particular station varies with their cause. If the cause of the problem is a mismatch in the transmission system, it can usually be corrected fairly easily. If the non-linearity is in the transmitter — a condition which sometimes occurs in older transmitters — correcting it may be more difficult. One beneficial side effect of using an FM subcarrier is to force a station, if it proves necessary, to clean up its transmitter. Main channel sound can sometimes be improved by adding a subcarrier when it causes such side effects.

Receivers

Receiver problems are, of course, beyond the control of the broadcaster. Some FM receivers do not function properly when processing an FM signal which contains a multiplexed subcarrier signal. Such receivers are mostly older units from the late sixties and early seventies. As the older units are replaced and uses of subcarriers expand, these problems with receivers will vanish completely. But, if a broadcaster was first

exposed to a subcarrier signal by listening to the main channel over one of these defective receivers, he naturally will have a negative impression of the effects of subcarrier operation. If that last sentence describes you, you should try and listen to the subcarrier operation on WCLR in Skokie, IL, or WETA in Washington, D.C.. For example, WETA-FM is a non-commercial station which broadcasts primarily classical music. Like most non-commercial stations, it depends upon its listeners for a large part of its support. If subcarrier operation had any significant impact on the quality of the main channel signal, it's hard to believe that a “listener supported” station serving classical music fans would carry a subcarrier.

The FCC now currently allows use of two subcarriers on FM. McMartin Industries, a major manufacturer of subcarrier equipment suggests that the bandwidth on each subcarrier can possibly accommodate up to 5 subchannels, for a total of ten narrow band (5 kHz) channels. If a full subcarrier is used at 67 kHz, up to 3 narrow band channels can be made available between 75 kHz and 99 kHz for low quality audio, slow speed data or paging services.

Technical Considerations: AM

Although people normally think of subcarrier operations as an option only for FM broadcasters, a similar option has recently been made available to AM broadcasters. In this case, a subchannel is created by modulating the phase of the AM signal at the same time as the ordinary AM signal is transmitted.

Technically speaking, there is no subcarrier involved. Rather, the AM carrier is phase-modulated by a data stream. Phase modulation of the carrier does not affect the amplitude of the carrier.

Hence, the ordinary AM receiver which is looking for changes in the amplitude of the AM signal does not detect the phase modulation of the carrier. Yet, the carrier is still present in the proper form to allow ordinary AM receivers to detect the program signal. In a sense, AM multiplex techniques are similar to AM Stereo where a second signal is transmitted along with the AM signal in a compatible fashion.

To our knowledge, only one firm, Altran Electronics, a division of McGraw Edison, currently sells equipment for multiplexing data

onto an AM carrier. Its equipment currently transmits at a low data rate — 16 bits per second — without interfering with the main signal. Theoretically, far higher data rates may be possible up to the range of several hundred or thousand bits per second. However, use of data rates higher than 50 or 100 bits per second would probably conflict with the use of AM stereo by the station.

III. Markets Served by Subcarrier Services

The uses — current and potential — of subcarriers are as varied as is broadcasting itself. Some broadcasters use FM subcarriers to carry programming from their FM station to an AM station they own down the road in order to save on telephone line charges. Many non-commercial stations use the FM subcarrier to carry a reading service for the blind. About 300 FM stations are Muzak affiliates and distribute Muzak on their subcarrier. Over the last few years, several FM stations have begun carrying data transmissions, typically commodity trading information, on their subcarrier.

We see three major and quite natural divisions of the subcarrier market:

- Audio Services (e.g. Muzak)
- Text Services (e.g. Commodity quotations, financial/retail data)
- Other (e.g. paging or utility load management)

These subdivisions aren't perfect — for example, paging might include some text transmission. But, they are fairly natural subdivisions of the overall subcarrier market. The following sections look at each of these divisions in turn.

Audio Services

Audio services are by far the oldest and most familiar of the uses of the FM subcarrier. And only FM stations can provide these services since current technology cannot provide audio "subcarrier" services over AM signals. An FM subcarrier can transmit a good audio signal with roughly the quality of an AM signal. The subcarrier audio is limited to about 5 kHz of bandwidth thus technically precluding the possibility of stereo transmission. But, a channel with this quality can provide excellent voice transmission and reasonable

music transmission. Thus, background music services are a natural application of the technology.

Besides background music, uses of the audio channel include a voice service for physicians, spoken reports of trading on the commodity markets, and carriage of programming to AM stations. Most audio services are provided by a service organization — such as Muzak — which markets the service, installs the receivers, buys use of a subcarrier from an FM station, and bills the customers. The broadcaster's role is limited to keeping his equipment working properly. He has to give up a small amount of space for the subcarrier equipment, and he must allow for the connection of the program source to the subcarrier equipment. The broadcaster collects a fee for the use of his facilities and subcarrier. That fee may be either a flat fee or a share of the sales generated by the service organization. A typical share would lie in the ballpark of 10%. If there were a minimum guarantee, say \$800/month, then the share might be reduced to 8%. A fixed monthly fee in a city of 250,000 might be around \$2,500 to \$3,000. Specific fees vary widely depending upon competition in the market, bargaining savvy of the parties, and the attractiveness of the market to the service provider.

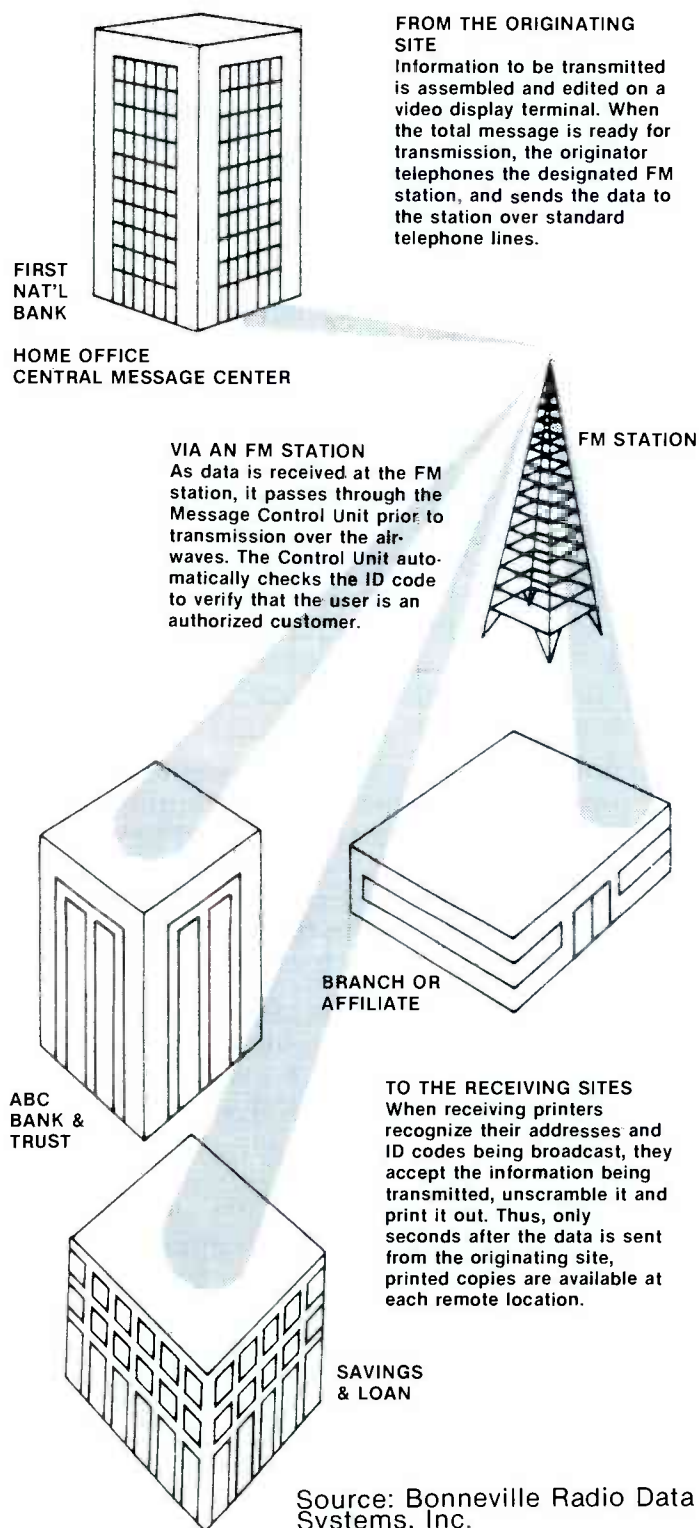
While most audio services treat the broadcaster as a more or less passive carrier, it is possible for the broadcaster to take a more active role. The broadcaster could define a needed audio service for his market area, put together the programming on the subcarrier, and bill the customers. This, of course, is a far more complex and difficult task than just renting out a subcarrier.

Text/Data Services

For a lot of people, the word data conjures up images of long lists of numbers and statistics or images of computers and data processing activities. The kind of data we are talking about for subcarrier applications is a little different, although it uses digital technology just like modern computers.

Perhaps it's best to think of this as "text" broadcasting. An FM subcarrier can carry data at high rates — up to about one thousand written characters per second, although current speeds in the range of 30 to 120 characters per second are more

Table 3
Banking Data/Text Delivery
via FM Subcarrier



common. By far the most common use of data communications on subcarriers is to transmit text — written documents to the customers of the service provider. Most widespread is the use of data transmissions to carry financial information — commodity quotations, currency prices or stock market reports to subscribers who value such information enough to pay for the cost of the information and the special equipment needed to receive the subcarrier signal and display the information. Not everyone needs such a service, but there are a lot of grain elevator operators in the Midwest who are willing to pay the two or three hundred dollars a month it takes to give them a current reading of the market.

Text services can also be used to provide interoffice bulletins to all the branches of a bank or supermarket in a community, to provide updated real estate listings to all the realtors subscribing to a multiple listing service, or to provide quick distribution of detailed weather forecasts to farmers.

Data communication also allows for easy subdivision of the data channel into many subcarriers through new sophisticated techniques such as packet transmission or time-division multiplexing (TDMA). Thus, a subcarrier devoted to data services can, if the right equipment is used, carry a financial news service and also transmit interoffice bulletins for a bank.

The text market is newer than the audio market. There is no dominant Muzak-like firm in the text or data business. Instead, a number of new firms like Bonneville's Radio Data Systems or Market Information Inc. are just now developing that market. Because of the wide range of uses for data

Typical Banking Applications

- Fraudulent check reports
- Counterfeit bills
- Check theft reports
- Credit card alerts
- Emergency situations
- Time sensitive messages
- Electronic mail

transmissions, it is unlikely that the data transmission business will ever be concentrated in one firm the way background music is dominated by Muzak.

While several firms are developing "networks" for text and data services, the broadcaster most active in text transmission over FM is Bonneville through its subsidiary Radio Data Systems. Radio Data Systems has a commodity news service which it distributes to FM stations by satellite, and the FM stations then retransmit the data information to Radio Data's subscribers. Radio Data Systems is also trying to develop the point to multi-point message market using FM subcarriers.

Other Subcarrier Uses

This catch-all category could include almost anything which can be done by telecommunications. But, there are two applications in this category, paging and utility load management, where subcarrier communications can be highly valuable. Paging — pocket beepers or buzzers which signal doctors or repairmen — is currently done using dedicated frequencies by radio common carrier firms (RCC). The coverage area of a high power FM station, however, is frequently equal or superior to the coverage of a paging station. In addition, an FM subcarrier has sufficient capacity to serve many thousands of paging subscribers. Given the potential capacity of FM stations, it's no wonder that the industry association of the current paging companies was impassioned in its opposition at the FCC to letting broadcasters provide such services! Of course, those technical attributes which the established industry sees as giving the broadcasters an unfair competitive advantage translate directly into better service for the consumer.

Utility load management also presents a very attractive business opportunity for the broadcaster. Many electrical utilities either have limited peak-load capacity or pay a significantly higher price to obtain additional electric power from other power grid sources during peak periods. One way utilities have to deal with limited peak capacity is to institute brownouts or even temporary blackouts. But, brownouts and blackouts impose terrible inconveniences on the public and have negative impacts for the utility. Rather

than turn off all the electricity in town — including electricity for the hospital and everybody's freezer — it makes more sense to selectively turn off electricity to water heaters and air conditioners. The way our electrical system is currently designed, such detailed load control is impossible.

However, subcarrier technology and micro-electronics provide a partial solution. The electrical utility can install small receivers and controllers at each major load point — say, water heaters and air conditioners. When peak demand rises too high, the utility can send command tones or digitally encoded signals to some controllers to temporarily cycle down their associated loads. Of course, more complex strategies are possible using the subcarrier transmission path. For example, utilities can install peak-load pricing meters which start charging more when load demands are high. But, the key to doing all this is the ability to efficiently get signals to the controllers and meters. Radio subcarriers are an excellent vehicle to accomplish this task. They are much more convenient to hook up than cable television or telephone based systems and subcarrier based systems can also offer reliability and low cost advantages.

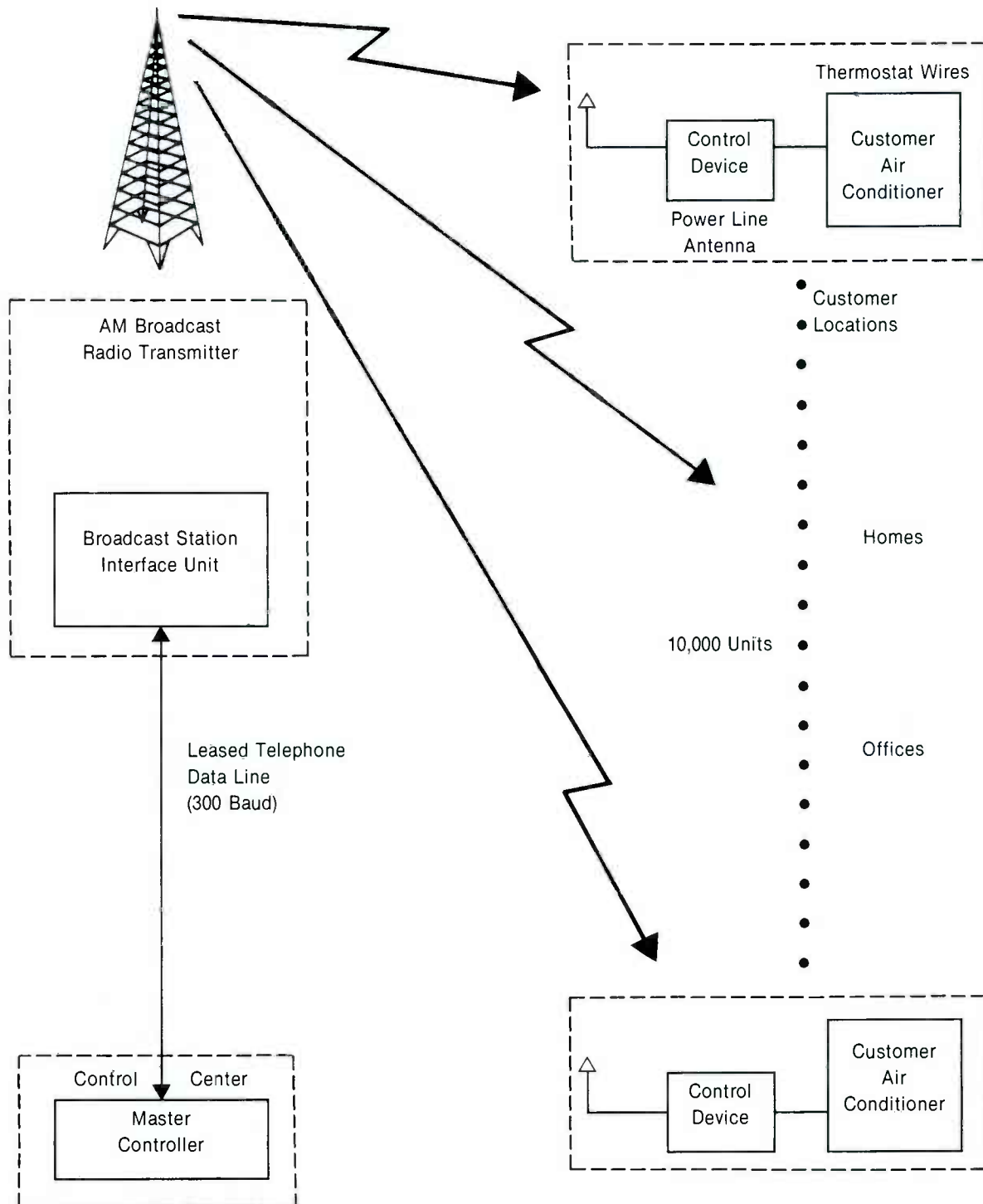
Electrical utility service is about an \$80 billion a year business in this country. In contrast, radio advertising is about \$3 billion a year. If radio stations can help improve the efficiency of the local utility by only a few percent, a fair profit for the station might rival its advertising revenues.

Subcarrier technology can also be applied to controlling traffic lights, transmitting emergency warnings or any other low data rate message which must be sent to many points.

Markets AM Can Serve

Right now the FCC only allows AM facilities to be used for utility load control services. However, they could be used for traffic lights, some paging, emergency alerting services and perhaps some text transmission. The market AM serves best today are those requiring reliable coverage and only a low data rate. Traffic lights, for example, require adjustments in their settings to allow for changing traffic patterns during the day. But these changes are simple and don't occur too often. Hence, they can be transmitted

Table 4
Delivery of Utility Load Signals
via AM Carriers



Source: Altran Electronics

Table 5
Subcarrier Service Options

- | | |
|--|---|
| <ul style="list-style-type: none"> • Audio Music Services • Digital Data Transmission • Paging Services • Utility Load Management • Text Transmissions • Facsimile Services • Stock and Commodity Quotation and Trading Services • Video Game Downloading to Personal Home Computers • Retail/Grocery Data Transmission • Banking and Brokerage Transaction Information • Wire Services | <ul style="list-style-type: none"> • Medical/Financial Information Networks • Foreign Language Simultaneous Transmissions • Dispatching for Fleet Services • Traffic Signal Control • Station Telemetry • Electronic Mail Delivery • Police and Local Government Communications • Computer Software and Data Base Updating • Slow Scan Video • Reading Services |
|--|---|

over the AM subcarrier. But, the AM subcarrier, at least with today's technology, cannot effectively carry commodity news — the news comes too fast for the subcarrier to keep up.

IV. Going After New Subcarrier Markets: Dollars and Sense

The first step in going after these new subcarrier service markets is to choose the specific market you are interested in — that is, to define the product you are going to sell. Recognize first that several important elements of the definition of the product have already been made for you — whether you will be AM or FM, where your signal will reach and where you will be located.

Your options may be more varied if you have a Class C FM with a high tower in a community of 500,000 than if you have a Class IV AM in a community of 50,000. It is important to underscore the point that a subcarrier service tailored to your specific facility and area can be a lucrative, viable profit center for your station.

Strategies for Broadcasters

We see four fundamental strategies for the broadcaster in pursuing the subcarrier market.

I. Action Strategy:

Define a product, and sell it.

II. Active/Waiting:

Get your station up to speed on the technology; borrow some subcarrier equipment; make sure your station is ready for subcarrier operation; find out about pricing in your market; promote the availability of your subcarrier and be prepared for the day someone calls.

III. Passive/Waiting:

Get some manufacturer's literature on subcarrier equipment; read it (or have your engineer read it); and find out about pricing in your community.

IV. Do Nothing:

File this report for future reference.

Bonneville has been pursuing the active strategy through its subsidiary Radio Data Systems and its FM stations.

Jim Wychor, KWOA-FM in Worthington, MN, provides a successful example of the second strategy. He is now leasing his subcarrier to a market information service, and making a very fair return on his investment.

Defining Your Market and Your Product

Your choice of a product boils down to a choice of organization. Are you going to operate like a passive carrier — and wait until someone comes to you and asks to rent your subcarrier? Or, are you going to define a subcarrier service yourself and actively pursue it? Or, are you going to do something in between?

We see three primary organizational choices or options open to a station which we classify as:

- Option A: Passive provider
- Option B: Provider/promoter
- Option C: Service supplier

Passive Provider

The simplest option facing the broadcaster is the option of being simply a passive provider or conduit for signals provided by someone else. The additional costs are minimal, yet the profits can be significant. Perhaps best of all, the passive provider option puts no demand on the broadcaster to set up a new business or to have his staff learn new technical skills. This option might be especially attractive to the stations with superior coverage (e.g., a Class C FM with a high tower) which will be the first to be sought out by the various services needing access to subcarriers.

Provider/Promoter

A second option for the broadcaster is to fill two roles — to provide both the conduit and the local sales and support office for someone else's service. This is similar to the role played by a cable system in both carrying a pay service like HBO and selling that service to consumers. It's the role played by a radio station which acts as both the delivery system for Muzak and as the local agent or "affiliate" for Muzak. This option is more complicated than the first option since it places additional demands on the organization. But, it may be an excellent strategy for a station which has excellent coverage, although not the best in the market, and which wants to be able to offer something extra in order to attract a customer for the subcarrier.

Service Supplier

A third option is to become the actual service supplier. By this we mean putting together the package of services provided over the subcarrier and marketing it. This option

places the most demands on the broadcaster and is the most difficult to implement successfully. It makes sense only for broadcasters who are financially sound and have good technical and marketing people. Furthermore, this option requires a stand-alone service package; that is, a service package which makes business sense when offered over the facilities of the broadcaster's station and does not require outlets in many locations. Such stand-alone services might include a background music service in a community without one or a point-to-multipoint data distribution service for a single community. This strategy may fit a broadcaster who has a good signal covering an urban business district but without the reach into the surrounding area of some of his competitors. If the station puts a good signal down over all the branches of a bank, then it's good enough to provide a data service for that bank. Of course, broadcasters may develop services and offer them first over their own stations and later over a network of many stations.

Business Considerations: Pricing, Costs and Revenues

Once you have defined how you want to package your subcarrier service, you'll have to decide how to sell it.

The toughest issue here is pricing. What's a fair price for the use of the subcarrier? Realistically, that depends upon the market and the service being offered. There is no "rate card" for subcarrier service options. You can't expect to charge more than it's worth to your customer — otherwise he won't pay. You shouldn't charge less than it costs you to let someone else use the subcarrier, but the range in between the two values can be pretty wide. Remember that it costs hardly anything to let someone use your subcarrier. Yet, some businesses are vitally dependent upon the use of subcarriers because alternate technologies such as telephone lines, cable systems or satellites are just too expensive.

Finally, the price you charge today will influence the growth of the industry using subcarriers. If every broadcaster tries to squeeze as much as possible out of subcarrier users over the next 36 months, they may wind up killing the goose with the golden eggs. The most profitable price, in the long run, may be one which allows your customer

to get up and running. In particular, an arrangement to share in the sales of your customer, with no monthly minimum, will do the most to help him grow in the critical start-up period.

To determine the price to charge you must consider the following issues:

- How does your **coverage** compare with other local stations?
- What other **competitive choices** are available to your customer?
- How **valuable** is your subcarrier to your customer?
- What are **other stations** in the market **charging** for their subcarrier?
- How **long** are you going to be locked into a deal?
- What **other customers** might you line up?
- How will your customer **grow**?

Typical hardware costs for audio FM subcarrier equipment are shown below:

Equipment	Price
Subcarrier Generator	\$1,500 - 3,000
Audio Receiver (deluxe)	200
Audio Receiver (economy)	75

When you look at those costs you see that the significant costs are in the subscriber equipment. Even with only ten or twenty subscribers, subscriber equipment costs exceed station equipment costs. If you add installation costs, external antenna, and so on, the comparison becomes even more one-sided.

It should be pointed out that a station's cost to add subcarriers should also include origination, studio to transmitter links and monitoring facilities. The FCC in its revised rules requires stations to be able to monitor the subcarrier(s) to determine injection and modulation levels. (See Appendix 3 for rules.) Further it is just good practice to be able to monitor at the studio the various signals being transmitted. Finally, the cost of subcarrier origination equipment varies widely with the type of modulation, transmitter, and degree of service reliability (i.e.,

for data transmissions) required for particular subcarrier services.

For AM, the cost picture is slightly different since the ALTRAN transmit site equipment is designed only for utility load monitoring and includes a computer and uninterruptable power supply. Thus, that equipment costs around \$20,000 with these costs varying, depending upon the option chosen.

We have heard a wide variety of prices and arrangements for the use of subcarriers. The highest figure reported to us was about \$10,000 per month for a background music service in one of the nation's largest cities. At the low end, we have heard reports of \$300 per month for a FM subcarrier in a small market. We have heard low prices in big markets and we have heard of broadcasters trying to get high prices, say \$5,000 per month, in small markets.

Since new technology has allowed new entrants into the market, nobody really seems to know what to charge or what to pay. However, we have consistently heard, from broadcasters and subcarrier users alike, that the revenues to the broadcaster far exceed his costs. Pricing requires careful thought and consideration. It's a key decision.

V. Conclusion and Recommendations

Subcarriers present a money making opportunity for the broadcaster. It is strongly suggested that every broadcaster, especially FM broadcasters should identify his market opportunities — assessing how the signal coverage offered by his station fits into the local market for subcarrier services. He should think hard about how he wants to pursue this market and be prepared for the day someone calls him and wants to rent his subcarrier.

All in all, subcarriers are a unique opportunity for broadcasters — a new market which, if approached properly, can provide profits with essentially no downside risk.

APPENDIX 1

Subcarrier "Networks"*

Commodity News Service P.O. Box 6053 Leawood, Kansas 66206	(913) 642-7373
Dow Jones Radio II, Inc. Dow Alert P.O. Box 300 Princeton, New Jersey 08540	(800) 257-0437
Market Information, Inc. 11414 West Center Road Omaha, Nebraska 68144	(402) 333-6633
Muzak (Group W) 888 7th Avenue New York, New York 10106	(212) 247-3333
Physicians Radio Network 15 Columbus Circle New York, New York 10023	(212) 541-8384
Radio Data Systems, Inc. 669 North 10th West Centerville, Utah 84014	(801) 298-3322

* This listing is not intended to be a complete directory of all such organizations and the inclusion of a particular firm on this list does not constitute an endorsement by the authors or by NAB.

APPENDIX 2

Manufacturers of Subcarrier Equipment*

Altran Electronics
A McGraw Edison Company
17021 Kingsview Avenue
Carson, California 90746
(213) 323-8020

Belar Electronics Lab
Lancaster Avenue at Dorset
Devon, Pennsylvania 19333
(215) 687-5550

Colorado Video Inc.
Box 928
Boulder, Colorado 80306
(303) 444-3972

Emergency Alert Receiver Inc.
1 West 30th Street
New York, New York 10001
(212) 695-4767

HF Signalling Inc.
Box 17510
Kansas City, Missouri 64130
(816) 861-4448

Harris Corporation
Broadcast Microwave
1680 Bayport Avenue
San Carlos, California 94070
(415) 595-3500

Johnson Electronics
Box 7
Cassellberry, Florida 32707
(305) 339-2111

Marti Electronics
Box 661
Cleburne, Texas 76031
(817) 645-9163

McMartin Industries, Inc.
4500 South 76th Street
Omaha, Nebraska 68127
(402) 331-2000

M/A-COM
63 Third Avenue
Burlington, Massachusetts 01803
(617) 272-3100

Modulation Associates, Inc.
897 Independence Avenue
Mountain View, California 94043
(415) 962-8000

AM "subcarrier" equipment, electric
utility load management and time-of-day
pricing systems

Subcarrier frequency and modulation
monitors

Subcarrier equipment

Subcarrier equipment

Subcarrier equipment

Subcarrier equipment

FM/Subcarrier tuners, receivers, data
reception system utilizing subcarrier

Subcarrier equipment

FM/subcarrier equipment

Subcarrier equipment

Subcarrier equipment

Modulation Sciences, Inc.
99 Myrtle Avenue
Brooklyn, New York 11201
(212) 625-7333

Subcarrier synthesizer

Moseley Associates, Inc.
111 Castillian Drive
Goleta, California 93117
(805) 968-9621

Subcarrier generators

Northwest Monitoring Service
P.O. Box 1042
Pendleton, Oregon 97801
(503) 276-2281

Sale or lease of subcarrier frequency standards

Reach Communications Corporation
301 South 68th Street
Lincoln, Nebraska 68510
(402) 489-2337

FM subcarrier equipment, utility load control, paging, data

TFT Inc.
3090 Oakmead Village Drive
Santa Clara, California 95051
(408) 727-7272

Subcarrier equipment

Tepco Corporation
Box 680
Rapid City, South Dakota 57709
(605) 343-7200

Subcarrier equipment

* This listing is not intended to be a complete directory of all such organizations and the inclusion of a particular firm on this list does not constitute an endorsement by the authors or by NAB.

APPENDIX 3

Current FCC Rules for FM Multiplex Subcarriers

Included below are pertinent sections of the FCC's new rules and regulations for FM subcarrier services. The Rules reflect changes made according to the FCC's First Report and Order on FM subcarriers released on May 19, 1983 and effective as of June 27, 1983.

Title 47 U.S.C. - Parts 2 and 73 — Telecommunications

Section 2.1001 **Changes in Type Accepted Equipment**

- (New) (h) The addition of FM broadcast subcarrier generators under the provisions of Sec. 73.293, 73.319, and 73.1690 of Part 73 of the Rules to a type accepted FM broadcast transmitter is considered a Class I permissive change described paragraph (b)(1) of this Section, provided the transmitter exciter is designed for subcarrier operation without mechanical or electrical alterations to the exciter or other transmitter circuits.
- (New) (i) The addition of FM stereophonic sound generators under the provisions of Sec. 73.297, 73.597 and 73.1690 of Part 73 of the Rules to an FM broadcast transmitter type accepted for stereophonic operation is considered a Class I permissive change described in paragraph (b)(1) of this Section, provided the transmitter exciter is designed for stereophonic sound operation without mechanical or electrical alterations to the exciter or other transmitter.

Section 73.253 **Modulation Monitors**

- (Unchanged) (a)(2) If the station is using subcarriers for SCA operation or for remote control or automatic transmission system telemetry, the licensee must have a modulation monitor of a type approved by the FCC for monitoring subcarrier transmissions.
- (New) **Note:** Until such time as the proceeding in BC Docket No. 81-698 addressing the requirements for modulation monitors is concluded, stations transmitting subcarriers within the range of 75-99 kHz, or using other than frequency modulation of the subcarrier(s) need not have a type approved subcarrier modulation monitor for such transmissions. Stations using subcarriers for which type approved modulation monitors are not available must have appropriate measuring equipment to determine that the subcarrier injection levels and modulation conforms to the limitations in this Part for such transmissions.

Section 73.277 **Permissible Transmissions**

- (Unchanged) (a) No FM broadcast licensee or permittee shall enter into any agreement, arrangement or understanding, oral or written, whereby it undertakes to supply, or receives consideration for supplying, on its main channel a functional music, background music, or other subscription service (including storecasting) for reception in the place or places of business of any subscriber.
- (Revised) (b) The transmission (or interruption) of radio energy in the FM broadcast band is permissible only pursuant to a station license, program test authority, construction permit, or experimental authorization and the provisions of this Part of the Rules.

Section 73.293

(Entirely Revised)

Use of FM Multiplex Subcarriers

Licensees of FM broadcast stations may transmit without further authorization from the FCC subcarriers within the composite baseband signals for the following purposes:

- (a) Stereophonic (biphonic, quadraphonic, etc.) sound programs under the provisions of Sec. 73.297 or 73.597.
- (b) Transmission of signals relating to the operation of FM stations such as relaying broadcast materials to other stations, remote cueing and order messages, and control and telemetry signals for the transmitting system.
- (c) Transmission of pilot or control signals to enhance the station's program service such as those to activate noise reduction decoders in receivers, for program alerting and program identification.
- (d) Subsidiary communications services.

Section 73.295

(Entirely Revised)

FM Subsidiary Communication Services

- (a) Subsidiary communications services are those transmitted on a subcarrier within the FM baseband signal, but do not include services which enhance the main program broadcast service (see Sec. 73.293(a)(d)) or exclusively relate to station operations (see Sec. 73.293(c)). Subsidiary communications include, but are not limited to services such as functional music, specialized foreign language programs, radio reading services, utility load management, market and financial data and news, paging and calling, traffic control signal switching, bilingual television audio, and point to point multipoint messages.
- (b) FM subsidiary communications services that are common carrier in nature are subject to common carrier regulation. Licensees operating such services are required to apply to the FCC for the appropriate authorization and to comply with all policies and rules applicable to the service. Responsibility for making the initial determinations of whether a particular activity is common carriage rests with the FM station licensee. Initial determinations by licensees are subject to FCC examination and may be reviewed at the FCC's discretion.
- (c) Subsidiary communications services are of a secondary nature under the authority of the FM station authorization, and the authority to provide such communications services may not be retained or transferred in any manner separate from the station's authorization. The grant or renewal of an FM station permit or license is not furthered or promoted by proposed or past services. The permittee or licensee must establish that the broadcast operation is in the public interest wholly apart from the subsidiary communications services provided.
- (d) The station identification, delayed recording, and sponsor identification announcements required by Sec. 73.1201, 73.1208, and 73.1212 are not applicable to leased communications services transmitted via subcarriers that are not of a general broadcast program nature.
- (e) The licensee or permittee must retain control over all material transmitted in a broadcast mode via the station's facilities, with the right to reject any material that it deems inappropriate or undesirable.

- (f) A daily record of the use of subcarrier transmissions used for subsidiary communications services exceeding 15 minutes duration, showing the time the subcarrier modulation is turned on and off must be entered in the station operating log.

Section 73.297

FM Stereophonic Sound Broadcasting

(Revised)

- (a) An FM broadcast station may, without specific authority from the FCC, transmit stereophonic (biphonic, quadraphonic, etc.) sound programs upon installation of stereophonic sound transmitting equipment under the provisions of Sec. 2.1001, 73.322, and 73.1590 of the Rules. Prior to commencement of stereophonic sound broadcasting, equipment performance measurements must be made to ensure that the transmitted signal complies with all applicable rules and standards.

(Unchanged)

- (b) Each licensee or permittee engaging in stereophonic broadcasting shall measure the pilot subcarrier frequency as often as necessary to ensure that it is kept at all times within 2 Hz of the authorized frequency. However, in any event, the measurement shall be made at least once each calendar month with not more than 40 days expiring between successive measurements.

Section 73.319

FM Multiplex Subcarrier Technical Standards

(Entirely Revised)

- (a) The technical specifications in this Section apply to all transmissions of FM multiplex subcarriers except those used for stereophonic sound broadcasts under the provisions of Sec. 73.322.
- (b) **Modulation.** Any form of amplitude modulation, (DSB, SSB, etc.), angle modulation (FM or PM), or frequency shift keying of a multiplex subcarrier or any combination thereof may be used.
- (c) **Subcarrier baseband.**
 - (1) During monophonic program transmissions, multiplex subcarriers and their significant sidebands must be within the range of 20 kHz to 99 kHz.
 - (2) During stereophonic sound program transmissions (see Sec. 73.322), multiplex subcarriers and their significant sidebands must be within the range of 53 kHz to 99 kHz.
 - (3) During periods when broadcast programs are not being transmitted, multiplex subcarriers and their significant sidebands must be within the range of 20 kHz to 99 kHz.

Note: Stations with transmitter sites located within 320 kilometers (199 miles) of the common United States-Mexico border may use subsidiary communications subcarriers only within the range of 20 kHz to 75 kHz until such time as the Commission issues a notice that the bilateral agreement with Mexico on FM Broadcasting is amended to permit use of subcarriers to 99 kHz.

- (d) **Subcarrier injection.**

- (1) During monophonic program transmissions, modulation of the carrier by the arithmetic sum of all subcarriers above 75 kHz may not exceed the carrier by more than 10%, and modulation of the carrier by the arithmetic sum of all subcarriers may not exceed 30%, referenced to 75 kHz deviation.
- (2) During stereophonic sound program transmissions, modulation of

the carrier by the arithmetic sum of subcarriers above 75 kHz may not exceed 10%, and modulation of the carrier by the arithmetic sum of all subcarriers may not exceed 10%, referenced to 75 kHz deviation.

(3) Reserved.

(4) During periods when no broadcast program service is transmitted, modulation of the carrier by the arithmetic sum of all subcarriers above 75 kHz may not exceed 10%, and modulation of the carrier by the arithmetic sum of all subcarriers may not exceed 30%, referenced to 75 kHz deviation.

(e) **Cross-talk noise.**

(1) During monophonic program transmissions, the cross-talk within the main program channel (50 Hz to 15,000 Hz) caused by communications subcarriers must be at least 60 dB (measured as RMS noise) below 100% modulation reference.

(2) During stereophonic sound program transmissions, the cross-talk within the range of 50 Hz to 53,000 Hz caused by communications subcarriers must be at least 60 dB (measured as RMS noise) below 100% modulation reference.

(f) The use of multiplex subcarriers may not cause the radiated signal to exceed the band limitations specified in Sec. 73.317(a)(12) and (13).

(g) Subcarrier generators may be installed and used with a type accepted FM broadcast transmitter without specific authorization from the FCC provided the generator can be connected to the transmitter without requiring any mechanical or electrical modifications in the transmitter FM exciter circuits.

(h) Stations installing multiplex subcarrier transmitting equipment must make such equipment performance measurements as necessary to determine compliance with the provisions of this Section. If the method of a subcarrier modulation being used causes the station's transmission to not comply with the provisions of this Section or causes harmful interference to other communications services, the FCC may require the licensee to correct the problem and verify the results by measurements. Reports of measurement data are to be retained at the station and made available to the FCC upon request.

(i) Stations transmitting subsidiary communications subcarriers must have the facilities at the transmitter control point to determine that the transmissions are in compliance with all applicable rules and policies.

Section 73.322

FM Stereophonic Sound Transmission Standards

(Unchanged)

(a) The modulating signal for the main channel shall consist of the sum of the left and right signals.

(Unchanged)

(b) A pilot subcarrier at 19,000 Hz plus or minus 2 Hz shall be transmitted that shall frequency modulate the main carrier between the limits of 8 and 10 percent.

(Unchanged)

(c) The stereophonic subcarrier shall be the second harmonic of the pilot subcarrier and shall cross the time axis with a positive slope simultaneously with each crossing of the time axis by the pilot subcarrier.

(Unchanged)	(d)	Amplitude modulation of the stereophonic subcarrier shall be used.
(Unchanged)	(e)	The stereophonic subcarrier shall be suppressed to a level less than one percent modulation of the main carrier.
(Revised)	(f)	Stereophonic sound subcarriers must be capable of accepting audio frequencies from 50 Hz to 15,000 Hz.
(Unchanged)	(g)	The modulating signal for the stereophonic subcarrier shall be equal to the difference of the left and right signals.
(Unchanged)	(h)	The pre-emphasis characteristics of the stereophonic subchannel shall be identical with those of the main channel with respect to phase and amplitude at all frequencies.
(Revised)	(i)	The following modulation levels apply to stereophonic sound transmissions: (1) When a signal exists in only one channel of a two channel (biphonic) sound transmission, modulation of the carrier by audio components within the baseband range of 50 Hz to 15,000 Hz may not exceed 45% and modulation of the carrier by the sum of the amplitude modulated subcarrier in the baseband range of 23 kHz to 53 kHz may not exceed 45%. (2) When a signal exists in only one channel of a stereophonic sound transmission having more than one stereophonic subcarrier in the baseband, the modulation of the carrier by audio components within the audio baseband of 50 Hz to 15,000 Hz may not exceed 37% and modulation of the carrier by the sum of all subchannel components within the baseband range of 23 kHz to 99 kHz may not exceed 53%.
(Revised)	(j)	Total modulation of the main carrier including pilot subcarriers and all stereophonic sound subcarriers must comply with the requirements of Sec. 73.1570 with the maximum modulation of the main carrier by all subsidiary communications subcarriers limited to 10%.
(Unchanged)	(k)	At the instant when only a positive left signal is applied, the main channel modulation shall cause an upward deviation of the main carrier frequency; and the stereophonic subcarrier and its sidebands signal shall cross the time axis simultaneously and in the same direction.
(Unchanged)	(l)	The ratio of peak main channel deviation to peak stereophonic subchannel deviation when only a steady state left (or right) signal exists shall be within plus or minus 3.5 percent of unity for all levels of this signal and all frequencies from 50 to 15,000 Hz.
(Unchanged)	(m)	The phase difference between the zero points of the main channel signal and the stereophonic subcarrier sidebands envelope, when only a steady state left (or right) signal exists, shall not exceed plus or minus 3 degrees for audio modulating frequencies from 50 to 15,000 Hz.
(Revised)	(n)	The separation between any two channels of a stereophonic transmission system must exceed 29.7 dB for all audio modulating frequencies between 50 Hz and 15,000 Hz. This separation will indicate compliance with paragraphs (l) and (m) of this Section.
(Revised)	(o)	Non-linear cross-talk into the main program channel caused by signals in the stereophonic broadcast subchannel must be attenuated at least

40 dB (measured as RMS noise) below 90% modulation. Non-linear cross-talk into the stereophonic broadcast subchannels caused by signals in the main channel must be attenuated at least 40 dB (measured as RMS noise) below 90% modulation. (Non-linear cross-talk does not include effects of phase delay differences in program audio circuits. These effects are represented by loss of channel separation, and also by amplitude distortion in the monophonic reception of stereophonic programs).

(Revised) (p) Equipment performance measurements procedures (see Sec. 73.1690) for stereophonic operation have not been established. However, when measurements are required for stereophonic equipment under the provisions of this Part, measurement data must be obtained to demonstrate compliance with this Section.

(Revised) (q) The transmitter performance standards of Sec. 73.317 (a)(2), (3), (4), and (5) apply to the main channel and stereophonic subchannels alike, except that the 100% reference modulation level includes the pilot subcarrier.

Note: Stations with transmitter sites located within 320 kilometers (199 miles) of the common United States-Mexico border may use multichannel sound subcarriers only within the range of 23 kHz to 75 kHz until such time as the Commission issues a notice that the bilateral agreement with Mexico on FM Broadcasting is amended to permit use of multiplex subcarriers in the band 75-99 kHz.

Section 73.332

Requirements for Type Approval of FM Modulation Monitors

(Revised) (a) Procedures for obtaining type approval of FM modulation monitors are contained in Sec. 73.1668 and Subpart J of Part 2 of the FCC Rules.

(Unchanged) Sections (b) through (g)

(New) Note following subpart (g):
Until such time as the Commission concludes the proceeding in Docket 81-698 concerning the requirements for modulation monitors, no standards are established for monitors for stereophonic sound transmissions using subcarrier sidebands above 53 kHz, for subsidiary communications multiplex subcarriers between 75 kHz and 99 kHz or for subcarriers using other than frequency modulation. Although type approval of modulation monitors for transmissions of such subcarriers are not required, licensees transmitting such subcarriers are required to have appropriate modulation measuring equipment to ensure that the transmissions comply with the provisions of Sec. 73.319, 73.322 and 73.1570(b).

Section 73.553

Modulation Monitors

(Entirely Revised) (a) The provisions of Sec. 73.254 apply to noncommercial educational FM stations authorized to operate with transmitter output power exceeding 0.1 kW.

(b) The licensee of each noncommercial educational FM station licensed to operate with powers of 0.1 kW or less must provide an operating percentage modulation indicator or a calibrated program level meter from which the total percentage of modulation of the transmitter can be determined and maintained by the station duty operator.

Section 73.594

(Removed)

Nature of the SCA**Section 73.595**

(Removed)

Use of Multiplex Subcarriers**Section 73.597**

(Revised)

FM Stereophonic Sound Broadcasting

- (a) A noncommercial educational FM broadcast station may, without specific authority from the FCC, transmit stereophonic sound programs upon installation of stereophonic sound transmitting equipment under the provisions of Sec. 2.1001, 73.322 and 73.1590 of the Rules. Prior to commencement of stereophonic sound broadcasting, equipment performance measurements must be made to ensure that the transmitted signal complies with all applicable rules and standards.

(Unchanged)

Section (b)

Section 73.1207

(Unchanged)

Rebroadcasts

Sections (a) and (b)(1)

(Revised)

- (b)(2) Permission must be obtained from the originating station to rebroadcast any subsidiary communications transmitted by means of a multiplex subcarrier or the vertical blanking interval of a television signal.

(Unchanged)

Sections (c) through (e)

Section 73.1226

(Unchanged)

Availability to FCC of Station Logs and Records

Sections (a) and (b)

(Revised)

- (c) The following contracts, agreements, or understandings, which need not be filed with the FCC (per Sec. 73.3613, Filing of contracts), must be kept at the station and made available for inspection by any authorized representative of the FCC upon request:
- (1) Contracts relating to the sale of broadcast time to "time brokers" for resale.
 - (2) FM subchannel leasing agreements for subsidiary communications.
 - (3) Time sales contracts with the same sponsor for 4 or more hours per day, except where the length of the events (such as athletic contests, musical programs, and special events) broadcast pursuant to the contract is not under control of the station.
 - (4) Contracts with chief operators or other engineering personnel.

Section 73.1830

(Removed)

Maintenance Logs

Section (a)(3)iii Subcarrier maintenance logging rules.

Section 73.3500

(Removed)

Request For Subsidiary Communications Authorizations

FCC Form 318

A complete copy of all Rules included in Parts 2 and 73 of Title 47 U.S.C. is available from the Federal Communications Commission.

COM/TECH Reports

The new COM/TECH report series is designed to respond to the needs of NAB members for more business-oriented information about new communications technologies, their growing impact on the industry, and the potential business opportunities arising from their implementation in the marketplace.

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