

BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION

WASHINGTON, D.C.

In the Matter of
AURAL BROADCASTING ON FREQUENCIES ABOVE }
25,000 KILOCYCLES PARTICULARLY RELATING } Docket No. 5805
TO FREQUENCY MODULATION }

REPORT ON FREQUENCY MODULATION

(May 20, 1940)

BY THE COMMISSION :

Frequency modulation is highly developed. It is ready to move forward on a broad scale and on a full commercial basis. On this point there is complete agreement amongst the engineers of both the manufacturing and the broadcasting industries. A substantial demand for FM transmitting stations for full operation exists today. A comparable public demand for receiving sets is predicted. It can be expected, therefore, that this advancement in the broadcast art will create employment for thousands of persons in the manufacturing, installation and maintenance of transmitting and receiving equipment and the programming of such stations.

Experimental stations have been operating over a number of years on frequencies above 25,000 kilocycles for the development of such frequencies for rendering a regular broadcast service. A number of these stations employed frequency modulation and others employed amplitude modulation. After extensive hearings and investigations, the Commission has concluded that frequency modulation has advanced to the stage where broadcasting on a commercial basis is desirable in the public interest. The Commission believes that this is one of the most significant advances that has been made in aural broadcasting in recent years.

Briefly the basic differences between amplitude and frequency modulation are as follows: Modulation is a process of imparting sound or other signal (intelligence) to a transmitted radio wave. The radio wave has two defining characteristics—amplitude and frequency. With amplitude modulation the sound controls the amplitude of the radio wave transmitted, while the frequency remains constant. In contrast, frequency modulation varies the frequency of the radio wave while the amplitude remains constant.

Up to the present, amplitude modulation has been used exclusively for regular as distinguished from experimental radio communication. The principle of frequency modulation has long been known but its practical use was not demonstrated until recently.

The hearing yielded a vast amount of information as to the use of frequency modulation in broadcasting on high frequencies. Each interested party agreed that frequency modulation is superior to amplitude modulation for broadcasting on frequencies above 25,000 kilocycles. The record leaves no doubt of the fact that a regular broadcast service can safely be initiated on high frequencies using frequency modulation.

The use of a wide band of frequencies makes possible a reduction of noise to a greater extent than attained with amplitude modulation. Man-made electrical and atmospheric noises consist primarily of amplitude variations and therefore frequency modulated signals have an inherent advantage in discriminating against noise. Experimental operations assured another advantage for frequency modulation, namely, that broadcasting stations could be operated on the same channel without objectionable interference with much less mileage separation than is possible with amplitude modulation. FM has the ability completely to exclude all except the strongest signal.

The opening of the new band for commercial broadcast will help to correct numerous defects and inequalities now existing in the standard broadcast band. These inequalities result from the scarcity of frequencies, their technical characteristics and the early growth of broadcasting without technical regulation. There is today a lack of stations in some communities and other communities do not have sufficient choice of program service. The establishment of the new broadcast band in the higher frequencies will enable many such communities to have their own broadcast stations. The licensing of classes of stations in the same area with different frequencies and different power has resulted in a wide disparity in the extent of service to the public. The system of classification now employed in the standard broadcast band will not be used for licensing FM stations. In the rules and regulations and engineering standards to be issued in the near future information will be provided whereby applicants may apply for facilities to serve a specified area. Stations will be rated on the basis of coverage rather than power. Competitive broadcast stations in the same center of population will in so far as possible be licensed to serve the same area.

The service range of the new stations while limited will, in many cases, be greater than that obtained from the primary service area of comparable standard broadcast stations. Stations a relatively short distance apart will not create mutual interference of a type that had rendered allocation problems both national and international so difficult in the standard broadcast band.

The coverage will be substantially the same day and night. The present situation of certain stations in the standard broadcast band having large daytime coverage and restricted nighttime coverage on duplicated channels will be avoided. However, FM stations have not demonstrated the long distance coverage properties such as obtain with present high powered clear channel stations. Accordingly, amplitude modulation stations in the standard broadcast band may be required indefinitely for the purpose of giving widespread rural cover-

age. For coverage of centers of population and trade areas, the new class of station offers a distinct improvement.

Experimental FM stations rendering program service have employed a channel of 200 kilocycles. There is testimony to the effect that a band width of less than 200 kilocycles can be used, but this entails a reduction of the noise-discriminating quality which has been established by experimental operations utilizing a channel width of 200 kilocycles. Testimony advocating a narrower band width was not supported by experience in program service. Moreover, the narrower band width would make less feasible multiplexing of facsimile and binaural transmissions on the same channel. In addition, the Commission believes that a regular program service should begin on a 200 kilocycles band basis which can be conveniently reduced if technical developments warrant.

A further question at the hearing was the possible future effect on the service rendered by standard broadcast stations should an additional broadcast band in the high frequencies employing frequency modulation be established. There was agreement that the new and additional service would not supplant the service of standard broadcast stations generally and that, therefore, this service will not make obsolete the receivers now in use. Standard broadcasting is on an entirely different frequency band from that to be occupied by frequency modulation. FM will not interfere with it. Present standard broadcasting will continue, and certainly for a number of years will render full service. The extent to which in future years the listeners will be attracted away from the standard band cannot be predicted. Testimony at the hearing indicated that the manufacturers will provide receiving sets capable of receiving both standard and the FM broadcasts.

The record is clear that the frequency space heretofore allocated to high frequency broadcasting is not sufficient to establish a widespread service employing wide band frequency modulation. The testimony indicates that advantages are to be had by the use of a continuous band for high frequency broadcast stations which includes non-commercial educational stations. Therefore, the Commission deems it in the public interest to allocate a continuous band that will suffice for both commercial and educational stations.

The frequency band of 41,000 to 42,000 kilocycles is now allocated to educational stations on a regular broadcast basis, and most of the activity of experimental stations using frequency modulation has been in the band between 42,000 and 44,000 kilocycles.

There is testimony to the effect that commercial broadcast stations employing frequency modulation should be permitted to operate in the frequency band between 42,000 and 50,000 kilocycles principally for the reason that this band is particularly suited for rendering an FM broadcast service. The effect of sky wave interference will not be known until additional stations are placed in operation in various parts of the country. If later developments should favor the use of higher frequencies, the Commission will consider the facts at that time. In any event, the record of the hearing clearly indicates that

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this particular band offers the best solution of the allocation problems at this time.

Therefore, the Commission is making available for regular high frequency broadcast stations and educational stations the frequency band 42,000 to 50,000 kilocycles, in which band forty 200-kilocycle channels are available. Adequate provision will be made for television service as pointed out in our statement on allocations accompanying Commission Order 67.

The channels made available by Order 67 to FM broadcast stations, including the multiplexing of facsimile transmission simultaneously with aural broadcasting, are assigned to services as follows:

Non-Commercial Educational Broadcast Stations

42,100
42,300
42,500
42,700
42,900

High Frequency Broadcast Stations

43,100	44,500	45,900	47,300	48,700
43,300	44,700	46,100	47,500	48,900
43,500	44,900	46,300	47,700	49,100
43,700	45,100	46,500	47,900	49,300
43,900	45,300	46,700	48,100	49,500
44,100	45,500	46,900	48,300	49,700
44,300	45,700	47,100	48,500	49,900

Under the foregoing allocation for FM broadcast stations, the same number of frequencies previously allocated to educational stations has been retained, the only change being that the band for such stations has been placed 1,000 kilocycles higher in the spectrum. This arrangement provides for educational channels in the regular high frequency broadcast band and thus permits the same receiver to be used for the two services. The 1,000 kilocycles set aside in the lower part of the band allocated to commercial broadcast stations for educational stations not only places the educational stations on an entirely independent basis but also gives them the benefit of the developments in the service rendered by the commercial stations.

The few existing non-commercial educational broadcast stations employ amplitude modulation. It is contemplated that they may continue so to operate with the same equipment in the new frequency band 42,000-43,000 kilocycles. It is not contemplated, however, that applications for new educational broadcast stations proposing amplitude modulation will meet the Commission's requirements in the absence of a showing of special necessity for the use of amplitude modulation.

The bands 25,000-27,000 kilocycles and 116,000-118,000 kilocycles will not hereafter be assigned to FM domestic broadcasting.

There are pending a number of applications for high frequency broadcast stations on an experimental basis, which were filed pursuant to existing rules and regulations. None of these applications is sufficient for the authorization of a regular broadcast station on a full commercial basis nor are any of them sufficient for the limited experimental service to be authorized. Therefore, these applications will be

dismissed, but without prejudice to the filing of new applications for either experimental or regular FM broadcast stations. Rules and regulations for both regular and experimental service will be promulgated by the Commission in the near future.

It also follows that authorization for existing high frequency experimental broadcast stations which contemplate service to the public should be terminated not later than January 1, 1941, without prejudice to the filing of new applications for either type of service.

Applications for FM broadcast stations will be accepted by the Commission when the new rules and regulations for FM broadcast stations, including standards of good engineering practice, and application forms are issued. This will be done promptly.