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on

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PREFACE

This paper provides a general introduction to the radio frequency coordination procedures used by common carrier microwave system operators and by operators of satellite earth stations which use the so-called common carrier frequency bands. The procedures are based on FCC coordination and licensing requirements, as well as related industry practices that have evolved over the years. The same procedures are used by operators in several other radio services which use the same frequency bands as common carrier microwave systems.

The paper includes a brief description of the types of radio services which require prior frequency coordination, along with a discussion of some of the technical factors associated with interference analysis. The major portion of the paper focuses on the specific steps involved in the coordination notification-and-response procedure which is generally described in FCC Rules Section 21.100(d). It is strongly recommended that, following this paper, the reader review the key FCC rules regarding coordination requirements. For convenience, we have included as Attachment A a copy of the current version of Section 21.100(d),[1] annotated to illustrate current interpretation and related industry practice. The reader should be aware that a considerable body of industry practice—most of it unwritten—has developed to cover the gray areas in the FCC's coordination guidelines.

The job of coordination involves an interesting blend of science, law and art. Coordinators are their companies' "front-line" in the day-to-day competition for frequency protection rights. The competition often has a hard edge, and yet the coordination process must be basically cooperative in nature. A good coordinator, facing the competition/cooperation dichotomy, must be well-trained in the basics of the science and law involved. We hope to provide some of that training here. The most effective coordinator, however, is the one who can deal with these challenges by blending science and law with an art that unfortunately can only be learned through experience.

Special thanks is appropriate for my colleagues who reviewed and helped edit this paper. Notable among them are Tim Hardy, Hal Selvin, Mike Comiskey, Chuck Rice and Larrie Sutliff.

Daniel J. Collins
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[1] Editorial Note, April 2004: See Attachment A for the new Section 101.103 that replaced Section 21.100(d).

INTRODUCTION

Radio frequency coordination is the term given to procedures followed by users of a common band of radio frequencies to minimize and control potential interference between systems. The key aspect of the procedure involves cooperative (or at least informed) radio frequency planning.

Radio systems should be designed in such a manner as not to cause or suffer objectionable interference with other existing or planned systems using the same frequency band. This coordination is facilitated by sharing coordination data among users, so that accurate and up-to-date information is available with which estimates of potential interference can be made during the system design stage. Radio frequency interference studies and frequency coordination are necessary not only when designing a new system, but also when he studies the potential interference effects of other users' radio construction proposals on existing and planned systems. Thus coordination is involved when one party initiates construction plans as well as when reacting to other parties' plans.

The FCC, as part of its Specialized Common Carrier decisions during the 1969-71 time frame, established the requirement for common carrier microwave operators to coordinate frequencies in advance of filing related FCC applications. (Because coordination occurs prior to filing applications, it is often referred to as "prior frequency coordination".) Since July of 1971, when the requirement for it was established, prior frequency coordination has proven very effective in permitting the resolution of potential interference problems before applications have been filed or construction has begun. The benefit of prior coordination is clear: it avoids the significant expense involved in correcting interference problems after construction has been completed. Although it doesn't carry the guarantee of "insurance", it does represent a cost-effective form of "assurance".

The frequency coordination process followed by common carrier microwave system operators involves the exchange of technical data, studies of potential interference effects, correspondence between users regarding new proposals and, as necessary, re-design of proposed systems to avoid potential interference problems brought to light during the coordination notification-and-response process. The same basic procedures are followed by operators in other radio services which share the so-called "common carrier" frequencies. Integral to the understanding of frequency coordination is a familiarity with the types of radio systems involved. The following section provides a brief description of these systems.

MICROWAVE RADIO SYSTEMS

Several types of radio systems use microwave frequencies (generally regarded as frequencies greater than 1 GHz). The different systems subject to the prior frequency coordination requirement include common carrier point-to-point microwave radio systems, satellite earth stations, Domestic Public Land Mobile Radio control and repeater stations using the 2 GHz band, and private microwave systems which use the 18 GHz band. A brief description of these systems follows. Other types of common carrier microwave systems that are not strictly subject to the prior coordination requirement are described later in the paper.

Point-To-Point Microwave Radio

Point-to-point microwave radio systems use highly direct antennas to focus radio signals like a beam of light and transmit them over line-of-sight distances. Microwave antennas are mounted on towers or building rooftops and these radio relay sites are generally spaced from a few miles to as many as 40 miles apart, depending on the frequency band used. Each microwave station provides equipment to receive, amplify, and re-transmit the radio signal to the next site, forming a communications chain between distant (terminal) points.

The highly directional nature of the antennas permits frequencies to be re-used by the same system and by different systems operating in the same geographic area. Because of this, along with wide RF channel bandwidths, the ability to overcome difficult terrain, and certain economic advantages, point-to-point microwave systems have assumed a position of considerable importance in the telecommunications field. The wide range of microwave radio uses extends, for instance, from systems providing a small number of telephone circuits over a relatively short distance, to systems carrying several thousand circuits or several television signals over distances up to 4000 miles. Common carrier microwave radio systems currently carry about two-thirds of all the long distance telephone calls in the United States. (This will likely change with the increasing deployment of optical fiber systems, but microwave radio is expected to retain a significant portion of the traffic for many decades. In certain situations, such as those involving difficult terrain, it will remain the most practical and economic means of transmission.)

Point-to-point microwave radio is used by common carriers as well as private entities, although common carrier activity is officially termed the Point-to-Point Microwave Radio Service. (Private microwave use is governed by Part 94 of the Rules and is referred to as the Private Operational Fixed Microwave Service.)

The Point-to-Point Microwave Radio Service is regulated under Part 21 of the FCC Rules and the frequency bands allocated to it include the following:

- the 2 GHz band (2.11 - 2.13 GHz and 2.16 - 2.18 GHz)
- the 4 GHz band (3.7 - 4.2 GHz)
- the 6 GHz band (5.925 - 6.425 GHz)
- the 11 GHz band (10.7- 11.7 GHz)
- the 18 GHz band (17.7 - 19.7 GHz)
- the 23 GHz band (21.2 23.6 GHz)
- the 39 GHz band (38.6 - 40.0 GHz)

Though these bands are shared with various other radio services, they are often referred to as the "common carrier microwave" bands.

The point-to-point microwave radio service also has frequencies allocated in the 10.55-10.68 GHz band which is otherwise used for Digital Termination Systems (DTS). The point-to-point allocation (a total of 30 MHz) is primarily intended for DTS internodal links.

Brief descriptions of the other services of interest in microwave coordination are included in the sections which follow.

Satellite Communications

Satellite communications systems use orbiting satellites as radio repeaters to relay signals between earth stations. Most telecommunications satellites in use today are in geostationary orbit about 22,300 miles above the equator. Satellite systems can be used for one- or two-way, point-to-point or point-to-multipoint transmission of various types of signals, including voice, data and video. Satellite systems are employed for domestic and international communications and they share certain frequency bands with terrestrial (ground- based) systems, such as point-to-point microwave radio, and thus are of concern in frequency coordination.

Transmission from earth station to satellite is referred to as the "up-link"; transmission from satellite to earth station is the " down-link". Among the frequency bands used for uplinks are the 6 GHz band and the 14.0 - 14.5 GHz band. Down-link bands include the 4, 11 and 18 GHz bands, as well as the band 11.7 - 12.2 GHz. Prior coordination is required to cover the following potential interference situations:

- 4, 11 and 18 GHz terrestrial microwave transmit stations causing interference to earth stations receiving in those bands; and
- earth stations transmitting in the 6 GHz band causing interference to terrestrial 6 GHz receivers.

Although the technical data and details of the interference calculations differ with satellite systems, the coordination procedure is the same as for common carrier microwave systems.

Domestic Public Land Mobile Radio Service

The Domestic Public Land Mobile (DPLM) Radio Service provides a means for telephone conversations to originate from, or terminate at, moving vehicles by relaying signals between the portable units and a fixed base station. Although most DPLM radio stations use frequencies in the 35, 150 and 450 MHz bands to communicate between base stations and mobile units, the 2 GHz band (2.11- 2.13 GHz and 2.16 - 2.18 GHz) is also available for use by DPLM control and repeater stations, which basically are point-to-point in nature. Part 22 of the FCC Rules requires DPLM applicants proposing the use of the 2 GHz band, prior to filing applications, to conduct prior coordination with other DPLM stations and point-to-point microwave stations sharing the same band.

Private Microwave Systems

As mentioned earlier, private entities may construct and operate their own point-to-point microwave systems. The official title for this service is the Private Operational Fixed Microwave Service, but it is commonly referred to as private microwave. Part 94 of the FCC Rules governs these activities and specifies that among the available bands is the same 18 GHz band as is used by common carriers. When using that band, private microwave operators are required to follow the common carrier prior coordination procedure outlined in Section 21.100(d) of the FCC Rules.

RADIO FREQUENCY INTERFERENCE

The purpose of frequency coordination is to control potential interference. The following section provides some background on interference problems.

Because microwave radio systems depend on the transmission of electromagnetic energy between antennas, they are subject to potential interference from other systems sharing the same or adjacent frequencies. Microwave antennas are designed to focus radio energy in a single direction as much as possible, but some energy is radiated (or received) in directions other than intended. This "off-angle" radiation (and reception) is the primary mechanism by which radio frequency interference is caused in microwave systems, despite the use of highly directional antennas. A microwave receiver is subject to potential interference from every transmitter within line-of-sight of its antenna as well as from some transmitters which are effectively "over the horizon" or apparently not line-of-sight. Microwave systems are also potentially subject to interference from other systems via signal reflections off buildings or other objects. (This latter category of interference has not traditionally been part of the prior coordination analysis. It is discussed later in the section on unanticipated interference.)

Radio frequency interference is caused by the mixing of the interfering signal with the desired signal resulting in intermodulation products and added noise in the interfered system. If not controlled to acceptable levels, interference can seriously degrade noise performance and system reliability.

Interference Factors

The specific effects of interference to a given system depends on many factors. Among them are:

- the modulation characteristics of the desired and interfering signals
- the extent of channel overlap or frequency separation between the two signals
- the relative difference in signal strengths of the two signals or, in some situations, the relative level of the interference signal with respect to the normal noise level of the interfered system

These factors are discussed in the following paragraphs.

Signal Characteristics: The effect of radio frequency interference varies not only with the type of the interfering signal but also with the nature of the interfered (desired) signal. For example, in analog systems voice signal interference into another voice channel generally results in crosstalk. The effects of this intermodulation noise generally increase with the voice circuit loading on both the interfering and interfered channels. All types of interference to data signals may cause bit errors, with the effects of the interference more severe for more complex digital modulation schemes. Television signals generally have a more severe interfering effect and less interference susceptibility than other types of signals.

Channel Overlap: Generally, interference is most severe when the interfering channel shares the same frequency slot as the interfered channel. This situation is referred to as "co-channel. interference. Because channel filters are not perfect, interference can also occur between channels which do not overlap. This "adjacent channel" interference may occur when channels are directly adjacent in frequency or, in some cases, when they are separated by an amount equivalent to several channel bandwidths.

Relative Interference Level: The amount of noise resulting from interference is generally related to the difference between the received levels of the desired signal and the interfering signal. This ratio, referred to as the "carrier-to-interference" ratio (C/I), may be considered a radio frequency version of signal-to-noise ratio (S/N). In fact, C/I is directly related to baseband (voiceband) S/N in a multichannel analog microwave system. High C/I values correspond to high S/N values. Since circuit noise levels are inversely proportional to S/N, it follows that high C/I values correspond to low interference noise levels. Another and perhaps more direct way of considering interference is to compare it to some absolute level of noise in the system, rather than dealing strictly in ratios. As shall be discussed later, both ratios and absolute levels are used in different situations to control interference.

Control of Interference

The effects of radio frequency interference are controlled by proper equipment design and route design. In equipment design, the principle factors include antenna angular discrimination and cross-polarization discrimination controlled in route design by the prudent selection of radio sites, frequencies, antennas and signal polarizations.

In frequency coordination (a critical step in radio route design), interference is controlled by applying objectives expressed in one of two ways:

- as a minimum carrier- to- interference ratio
- as an absolute value of interfering signal power not to be exceeded for given percentages of time

The interference criteria generally applied in the coordination between terrestrial microwave systems are in the form of minimum C/I objectives. Because various combinations of interfering and interfered signals may exist in different interference situations, a matrix of objectives is generally used to account

for the different possible interference combinations. From this matrix coordinators can select the appropriate objective to apply in specific cases.

The criteria generally applied to control interference between satellite earth stations and terrestrial microwave stations are absolute levels of permissible interference, which are usually set with respect to the level of the thermal noise in the receiver.

COMMON CARRIER PRIOR FREQUENCY COORDINATION PROCEDURES

Historical Perspective

Point-to-point microwave systems have been used to provide common carrier communications since the late 1940s. Until 1971, when the prior coordination requirement was established, microwave applications were filed with the FCC either without any prior frequency coordination or, at best, with some informal coordination with selected parties. Applications accepted for filing by the FCC were listed in its Public Notices, published weekly. When other microwave users reviewed the Public Notices and noted that particular applications might result in objectionable interference to their facilities, coordination studies were conducted. Often, the studies could not be completed within the usual 30-day Public Notice period, and parties filed motions with the FCC to delay Commission action on those applications until coordination studies could be completed. If the studies subsequently showed interference not to be a problem, the FCC was so notified. If, on the other hand, potential interference was found to be objectionable, protests were filed against the application(s) in question. Obviously, this "coordination" process proved cumbersome, both for the microwave users and the FCC.

During the 1960s, AT&T and Western Union, by virtue of their extensive development of microwave radio networks, assumed dominant positions with respect to frequency coordination. Both companies realized that effective radio system planning depends on some form of frequency coordination and accurate information on other companies' radio facilities. AT&T and Western Union each created a catalog of radio stations which listed all pertinent frequency coordination data. (These catalogs were later converted to computer data bases with which interference studies could be automated.) By exchanging these system catalogs, AT&T and Western Union (and later General Telephone) were able to more effectively select "interference-free" frequencies before filing FCC applications for use of those frequencies. In order to maintain the accuracy of their frequency coordination data bases, these companies reached informal agreements to prior- coordinate new proposals and to periodically exchange data on each others' microwave radio network. Since these three organizations represented the most prominent users of microwave systems, their pooling of coordination data greatly facilitated the planning and engineering of new systems.

During this period, other smaller companies attempted frequency coordination using published listings of licensed frequencies or the existing FCC records, which at that time consisted of copies of licenses, radio maps and other files. The effectiveness of this method was limited by the accuracy of the files as well as the large amount of manual research it required. Many applications which were "coordinated" in this manner were the subject of protests of other microwave users claiming interference to their facilities.

During the 1969-1971 time frame, several consulting firms offering frequency coordination services were formed. Many of the smaller users hired these consultants as their frequency coordination agents and this helped reduce the "hit or miss" nature of frequency planning. (Today, several of these consulting agencies handle the large majority of coordination activity outside the BOC’s and AT&T.)

The initial "Specialized Common Carrier" decision by the FCC in 1969 resulted in a dramatic increase in the number of construction permit applications filed. The FCC quickly realized that the process of frequency coordination, which then involved many post-application legal petitions and FCC hearings, had to be improved. Thus the FCC, as part of the Specialized Common Carrier proceeding, made prior frequency coordination of Point-to-Point Microwave Radio applications a requirement as of July 15,

1971. Since that time, prior coordination requirements have also been established for other radio services which share frequencies with the Point-to-Point Microwave Radio Service, such as the Fixed Satellite Service (which includes earth stations operating in the 4, 6, 11 and 18 GHz bands), the Domestic Public Land Mobile Radio Service (which includes some stations operating in the 2 GHz band), and the Private Operational Fixed Microwave Service (which includes stations operating in the 18 GHz band).

The FCC and Frequency Coordination

Two of the FCC's responsibilities are to promote efficient spectrum utilization and to authorize the use of frequencies to radio stations in such a manner as to provide communications services on an "interference-free" basis. Toward these ends, the Commission has established technical standards for each of the radio services and prior coordination requirements for selected services.

The technical standards established by the FCC to promote efficient spectrum utilization include rules specifying frequency allocations, maximum channel bandwidths, maximum transmit power, frequency tolerances and minimum antenna standards. These rules, which are included in Subparts C and I of Part 21, are of interest to frequency coordinators because radio construction proposals must generally conform to the FCC's technical standards and because these standards sometimes form the basis for interference protection.

As part of its technical standards, the FCC has established requirements for frequency coordination prior to filing applications in certain radio services. Prior coordination allows applicants and licensees to more effectively plan and cooperate in the selection and use of frequencies in order to minimize interference and obtain the most effective use of authorized radio facilities. Potential interference problems are expected to be resolved, if possible, by the parties involved during coordination and prior to the time the applicant files with the FCC. On occasion, potential interference problems cannot be resolved amicably and an application is filed "over and above" a coordination-related objection by another party. In such cases, which are rare, the application must describe the problem and the FCC will act to resolve the impasse, sometimes by conducting hearings involving the contending parties before reaching a decision on the application. As a practical matter, however, the Commission's role in day-to-day frequency coordination is rather passive and generally is limited to approving (or occasionally denying, for reasons which mostly do not involve coordination) applications in which there are no interference problems. That this is true is evidence of the effectiveness of the FCC's prior coordination guidelines and the industry practices that have developed from those guidelines.

Some types of potential interference are controlled not by frequency coordination per se, but rather by adherence to certain technical standards prescribed by the FCC. For instance, a terrestrial transmitting antenna which happens to point beyond its intended receiver and toward a satellite may cause objectionable interference to the satellite receiver. The FCC's technical standards, however, limit the power which may be radiated by a terrestrial antenna if it is pointed within two degrees of the geostationary satellite orbital arc and, in this way, the potential interference is controlled to acceptable levels. Another example involves the potential interference from a satellite transmitter to a terrestrial station receiver. This interference exposure is controlled by limiting the amount of power which may be radiated by a satellite transmitter. In each of these examples, a bilateral coordination procedure is not necessary to control the related interference as long as the technical standards are met.

Applicable Parts of the FCC Rules

Several parts of the FCC Rules and Regulations contain requirements and guidelines concerning prior coordination.

Part 2 of the FCC Rules contains the table of FCC frequency allocations as well as definitions of various types of emissions and methods of calculating signal bandwidths.

Part 21 contains the overall procedural guidelines for prior coordination, as well as specific requirements for coordination of point-to-point microwave radio stations with other radio systems sharing the same frequency bands, including other point-to-point microwave systems, stations in the Domestic Public L and Mobile (DPLM) Radio Service, and earth stations in the Fixed Satellite Service. Also in connection with the Fixed Satellite Service, Part 21 includes requirements for certain point-to-point microwave transmitting stations to provide interference protection for the geostationary satellite orbit. Part 21 also includes requirements for certain Multipoint Distribution Service (MDS) applications to include analyses demonstrating that no harmful interference will be caused to other MDS stations or to 2 GHz point-to-point microwave stations in the same geographic area. In addition, Part 21 includes requirements for interference avoidance for operators of Digital Termination Systems (DTS), which are part of the Digital Electronic Message Service (DEMS). (Note, however, that there is no prior coordination notification-response requirement for MDS or DTS/DEMS operators.)

Part 22 of the FCC Rules governs Public Radio Services and includes a requirement for prospective DPLM operation using the 2 GHz band to be prior coordinated with 2 GHz point-to- point microwave stations in the same geographic area. Part 25 of the Rules governs satellite communications and includes prior coordination requirements and technical standards for domestic as well as international satellite earth stations.

Part 94 governs private microwave systems and includes a requirement for systems using the shared 18 GHz band to use the common carrier prior frequency coordination procedure described in Section 21.100(d). Part 94 also includes requirements and technical standards for privately operated DTS systems.

Basic Frequency Coordination Procedures

Besides satisfying an FCC requirement, frequency coordination with other radio users is conducted basically for two reasons: (1) to determine if a proposed system is technically feasible and acceptable to other users from an interference standpoint; and (2) to provide interference protection for the proposed system until applications are filed with the FCC. The FCC Rules state that coordination involves two elements--notification and response. (The process is of course more complicated than this single description implies, but the FCC highlights these two elements in the basic process to emphasize the bilateral nature of frequency coordination.)

Once preliminary design of a new radio system is complete, frequency coordination involves: (1) distribution of a prior coordination notification to all parties who could be affected by the new proposal; (2) analyses by those parties of potential interference (both caused by and caused to the proposed system); and (3) responses by those parties, generally stating agreement or objection to the proposal on the basis of their analyses of potential interference. If all parties agree, the coordination process is considered complete and the proposed system is given interference protection. (Note that prior coordination does not provide absolute assurance that interference will not occur. Reflection interference, which is very difficult to predict, may be caused or experienced only after system turn-up. These types of problems are discussed in the later section on unanticipated interference.)

If certain parties object to the proposed system because of anticipated interference problems, the originating coordinator may find the problems insurmountable and terminate the proposal or he may be able to modify the proposal to resolve the problems. If modifications are possible, a second coordination notification is sent to all parties to determine if the proposed system, as modified, is acceptable. Sometimes a proposed system may be acceptable to a given party as initially coordinated, but subsequent modifications make it unacceptable. The process of modification and subsequent notification and response may continue for some time until the proposal becomes acceptable to all concerned parties. The sections which follow briefly describe some of the technical aspects of interference analysis, and provide more detail on the procedural aspects of coordination. (Section 21.100(d) of the FCC Rules, included in

Attachment A, contains the basic procedural guidelines for coordination and is used as the basis for the latter part of this discussion.)

Interference Analysis

Interference analysis is largely a matter of calculating the worst-case level of interference that may be received by a station, and comparing that level to the appropriate interference objectives. Interference analysis is performed by an initiating coordinator before he issues a coordination notification, and is also performed by other coordinators reacting to other parties' notifications.

The calculation of interference level generally includes the power radiated by the transmitting (interfering) station in the direction of the receiving (interfered) station, propagation losses including the effects of any blocking of the interference signal (e.g., by intermediate terrain or artificial shielding), and the gain of the receiving antenna in the direction of interest. Initial interference studies are generally performed on a rather conservative basis to cull out those cases that may require further analysis. For example, mechanized interference studies usually assume that radio stations utilize an entire block of frequencies rather than whatever specific channels are actually in use. This procedure, commonly referred to as "block coordination", provides for analysis of interference as if all stations were developed to full capacity, thus allowing for existing channels and growth plans. If full development is not planned for certain stations, detailed analysis of particular frequencies may follow the initial mechanized interference study.

In the case of terrestrial coordination, interference objectives take the form of minimum C/I ratios which are developed for each different combination of interfering and interfered signal characteristics. Terrestrial system operators set their own objectives to protect their systems against objectionable interference, and these objectives are generally provided to other terrestrial users for planning and coordination purposes.

In coordination between terrestrial stations and earth stations, interference is controlled on the basis of absolute level, and two types of interference analyses must be performed. The first type, called "great circle" interference, refers to the direct-path interference that would follow essentially the same type of path as interference between two terrestrial stations. The second type, referred to as "precipitation scatter" interference, occurs when the antenna beams of a terrestrial station and earth station intersect geometrically and the existence of precipitation in the intersection volume causes the signal from one station to be scattered and reflected toward the other station.

Part 25 of the FCC Rules includes technical guidelines for the computation and control of both these types of interference exposures. Generalized objectives for interference to terrestrial stations (from transmitting earth stations) have been developed by the FCC and are included in Part 25. Objectives for interference to receiving earth stations (from terrestrial transmit stations) are set by the earth station operator and generally depend on the type of service provided by the earth station. These objectives are included in the technical data provided in earth station prior coordination notifications.

Coordination Notification

The prior coordination notification distributed to other parties should contain sufficient technical information to allow them to accurately assess the potential for interference. Although the specific data necessary for each radio service varies, generally it includes station location, channel frequencies and polarizations, type of emission, transmit power, antenna characteristics (gain and discrimination pattern), antenna centerlines and, if appropriate, interference objectives for the protection of the proposed service.

The parties to whom the coordination notification should be distributed are generally determined during preliminary interference studies that are performed by a prospective applicant prior to his initiating formal coordination. The FCC Rules state that coordination should be conducted with existing users in the area and other applicants with previously filed applications, whose facilities could affect or be affected by the proposed system in terms of interference. Typically, coordination also involves parties with previously coordinated proposals but who haven't yet filed the related FCC applications.

In practice, terrestrial frequency coordination is conducted with operators of stations which share the same frequency band and are located generally within 125 miles of the stations being proposed. Beyond this distance, interference between terrestrial stations is generally considered unlikely.

Coordination between terrestrial stations and earth stations is not based on any such fixed distance, but depends on a coordination contour around the earth station, calculated in accordance with Part 25 of the Rules. The contours depend on the earth station interference characteristics (both transmitting and receiving, as appropriate) in different directions and are developed individually for each earth station. The contours establish around an earth station an area beyond which the possibility of mutual interference is considered negligible. These contours generally extend from one hundred to several hundred miles from the earth station and may or may not be circular, since they depend, among other things, on the earth station antenna gain toward the horizon and on the blocking effects of nearby terrain. Coordination between terrestrial stations and earth stations depends on whether the stations share the same frequency band and whether the terrestrial station is located within the coordination contour of the earth station.

Coordination Response

After interference analysis is completed by the parties who received the coordination notification, responses should be made to the initiating coordinator providing an indication of the results of the interference analysis and either agreeing or objecting to the proposed system. Responses stating agreement, sometimes called "clearances", should be made even though, as explained below, not responding to a coordination notification may be considered equivalent to having no coordination-related objection. Responses involving objections should be made in writing and provide enough details underlying the objection to permit the originating coordinator to attempt to resolve the interference cases reported.

According to the FCC Rules, responses to coordination notifications should be made within 30 days of the receipt of the notification. If no response is made within 30 days, the FCC considers the applicant (initiating coordinator) to have made reasonable efforts to coordinate the proposed system. In effect, not making a response is equivalent to granting coordination clearance for the proposed system. The FCC Rules, however, do not encourage clearances to be granted by virtue of not responding to notifications. Responses stating agreement to the proposal at least "close the coordination loop. and eliminate question as to whether the coordination notification was properly received and analyzed.

An exception may be made to the 30-day response period in the case of coordination involving satellite earth stations. By mutual consent of the parties involved in coordination, the response period may be increased to a maximum of 45 days.

Subsequent Notification and Response

If potential interference problems are reported to the initiating coordinator, he may be able to modify the technical characteristics of the proposed system to resolve those problems. The modifications, however, may create new problems for some other parties who formerly had no objection to the proposal. Therefore, when changes are made in coordination data, additional notifications should be distributed to all the parties originally notified. In some cases the changes may be minor and may have seemingly

negligible impact on some or all of the other parties. However, when any changes are made involving coordination data, notifications should be distributed to give other parties the opportunity to study the changes and to allow them to maintain accurate data on existing and proposed systems for future coordination purposes. Where subsequent coordination notifications involve relatively minor changes, responses should generally be made within 30 days.

Where a number of technical changes are made to a proposed system during the course of coordination, efforts should be made to minimize the number of separate notifications to cover the changes. Where a number of changes are incorporated into a completely revised notification, the items that were changed from the previous notification should be identified.

FCC Filing Requirements

When filing FCC applications for radio construction permits, applicants must certify that prior frequency coordination has been completed. The application must also include a list of parties (licensees and other applicants) with whom coordination was conducted, clearly identifying those parties to whom notification was made but from whom no response was received.

If an interference problem remains unresolved during coordination and it is decided to file an FCC construction permit application over and above the coordination objection of another party, an appropriate explanation of the problem must be included in the application.

Additional filing requirements pertain to certain potential interference cases involving earth stations and terrestrial stations. The FCC Rules require applicants to provide details of potential great circle interference cases where the calculated interference level exceeds objectives or where it meets objectives by a safety margin of less than 5 dB. In addition, applications must request waivers for all beam intersection cases derived using the guidelines stated in Parts 21 and 25 of the Rules.

Interference Protection Considerations

Once a proposed system has been successfully coordinated, it is provided with interference protection for a period of six months. Just as proposed systems are designed to co-exist with the existing interference environment, they must also take into account previously proposed systems. Of course, some flexibility exists in the design of proposed systems until construction is imminent, but for coordination purposes, successfully coordinated proposals are treated as existing systems. Interference protection derived through frequency coordination is provided on a "first come - first served" basis.

Continuing Interference Protection

According to FCC Rules, if applications have not been filed within six months after coordination was completed, other parties may assume, unless notified otherwise, that the proposed frequency use is no longer desired. Once an application is filed, however, the system is given interference protection permanently, unless the FCC subsequently denies or returns the application.

If an application has not been filed within six months of coordination, the initiating coordinator may distribute a notification to other parties indicating his continuing interest In the proposed system. This notification "renews" coordination and extends interference protection for an additional six months. As such, this type of notification is commonly referred to as a "six-month renewal-. Six-month renewals may be repeated as necessary (up to the limit of the "foreseeable future", generally considered to be 10 years) until the initiating coordinator is ready to file an FCC application for the proposed system.

Monitoring FCC Applications

As a follow-up to the prior coordination process, FCC applications by other parties should be monitored to ensure that the technical data in applications agree with that which was discussed during prior coordination and that coordination was properly completed. If coordination has not been properly completed, the FCC should be so advised and requested to hold action on the application until any problems are resolved. Any data discrepancies which are found should be brought to the attention of the FCC and the applicant, so the errors may be suitably corrected before the applications are acted on by the Commission. Most such discrepancies are inadvertent and may be handled informally or with simple letters. Some, however, may pose more serious problems and may be more appropriately handled by filing formal objections with the FCC.

Record Keeping

Because coordination depends so heavily on correspondence and telephone conversations, copies of correspondence and telephone logs should be kept on file for reference purposes. Such records often play a key role in the resolution of coordination disputes.

Unanticipated Interference

A rare occurrence, but one that must be considered, is the situation involving a successfully coordinated system that once constructed, causes harmful interference that was not anticipated during coordination. In most such cases, the interference is caused by a reflection from a building or some other object. When this type of problem occurs, the Commission initially encourages the parties involved to attempt to clear the problem jointly, perhaps by changing signal polarization’s, antenna heights or frequencies. If all reasonable efforts prove unsuccessful the FCC will rely on the " first come - first served" principle and require the "last one in" to correct the problem by any means necessary, including terminating operation

Industry Coordination Practice

Since its establishment of frequency coordination requirements and guidelines, the FCC has assumed a rather passive role in day-to-day coordination. The Commission Staff is occasionally contacted to give its view on specific problems and procedures and to provide interpretations of the Rules. Day-to-day interaction among coordinators is generally in accordance with an industry practice which has developed within the FCC's coordination guidelines.

The National Spectrum Managers Association (NSMA) is a voluntary association of microwave radio and satellite frequency coordinators. Through its working groups composed of volunteer members, the NSMA develops technical and procedural recommendations which guide coordination industry practice.

The Association was formed as a result of an open meeting of coordinators in 1984 and its members represent more than 75 companies involved in coordination. The NSMA structure includes a 15-member Board of Directors, several administrative committees, and the working groups, of which there are currently more than a dozen. Each working group addresses a single issue or related set of issues. They analyze problems and, if agreement can be reached, draft recommendations. The drafts are issued to the general membership for review and comment. Subsequently, the Board of Directors -- elected by the membership -votes on the recommendation. NSMA recommendations are distributed to all members and made available to any other frequency coordinators who might want to use the information or guidelines. NSMA recommendations represent non-mandatory guidelines, rather than requirements per se. However,

the FCC has demonstrated in the past that generally accepted industry practice is an important factor in resolving coordination disputes.

SPECIAL CASES

The following sections describe special coordination cases, including some common carrier radio services which are not subject to prior coordination requirements or are subject only in certain situations and under special conditions.

Temporary Fixed Microwave Operations

Common carriers use point-to-point microwave on a temporary fixed basis to satisfy customer requirements lasting from a few hours to a few months. Often this type of operation is used to satisfy a mobile TV pickup requirement. The frequencies used are the standard common carrier microwave bands -- typically 4, 6 or 11 GHz. According to a strict interpretation of the FCC Rules, prior coordination is required in bands shared with satellite services but, oddly enough, is not required to involve other common carrier microwave systems. Coordinators (as well as the FCC Staff) recognize that it is illogical not to include terrestrial systems in the coordination, but short advance notice problems often preclude the full notification-and-response process. While the full coordination process may not be followed, however, temporary systems are not turned up without at least a unilateral analysis and resolution of potential interference problems.

Unlicensed Receive-Only Earth Stations

In October 1979 the FCC deregulated domestic receive-only earth stations. In doing so, the Commission permitted prospective earth station operators to construct a receive- only station without prior frequency coordination or FCC approval and authorization. Operators who select such an option, however, forego any rights to interference protection for their stations from existing as well as future terrestrial microwave operations. Such unlicensed receive- only earth stations need not be included in subsequent coordination by other parties. (Current estimates of the number of such stations range from 1.5 to 2 million.)

6 GHz Transportable Earth Stations - Developmental Program

In 1981 the FCC approved a developmental program for 6 GHz transportable earth stations to be operated without the full prior coordination notification-and-response requirement. Instead, operators are required only to provide advance notice to 6 GHz terrestrial microwave operators, including the usual technical data as well as a contact phone number to be used if objectionable interference is experienced. It is assumed that the transportable earth station operator will have performed a unilateral analysis of potential interference and resolved all cases.

FCC Developmental programs usually last a year or two. This one, however, has been extended is still in effect.

Multipoint Distribution Service

The Multipoint Distribution Service (MDS) is a one-way non- broadcast radio service with transmission from an omnidirectional antenna to various specified subscriber receivers. Although MDS can be used to provide a variety of one-way radio services (e.g., data, video, facsimile), it is predominantly used to carry subscription (pay) TV programming MDS is commonly thought of as a "radio version of cable TV”.

MDS systems may be operated in the 2.1 GHz or 2.5 GHz bands. In the 2.1 GHz band, three channels are available for assignment to MDS stations: 2150 - 2156 MHz (Channel 1); 2156 -2162 MHz (Channel 2); and 2156 - 2160 MHz (Channel 2A). Channels 1 and 2A are available throughout the country and are of no interest to common carrier microwave coordinators since they do not involve frequencies shared with the Point- to-Point Microwave Service. The same is true of the 2.5 GHz MDS band.

MDS Channel 2, however, is of interest to point-to-point microwave frequency coordinators because the 2160 - 2162 MHz band is shared, on a geographic basis, with point-to-point microwave radio stations. Within 10 miles of the 50 metropolitan areas specified in Section 21.901 of the Rules, MDS is assigned exclusive rights to this shared portion of the 2 GHz band, providing that there is evidence that no harmful interference is caused to point-to-point microwave systems operating in the same general area.

There is no prior coordination requirement for MDS applicants, but the FCC Rules require MDS applications which involve the 2160-2162 MHz band to include an analysis of the potential for harmful interference with any authorized point-to-point stations. (Analysis is typically conducted with a 50-mile coordination contour around the proposed MDS station.) MDS applications are listed on FCC Public Notices and 2 GHz point-to-point operators can analyze potential interference and, if necessary, petition the FCC to deny the MDS application during the 30-day Public Notice period if interference is expected to be objectionable. While point- to-point systems can conversely cause interference to MDS receivers, these is no corresponding requirement for analysis. Presumably, if interference were experienced, the FCC could require the common carrier to correct it. (We are unaware of any situation where this has been a problem) There are only a handful of MDS Channel 2 operations licensed today, and few more are expected since the FCC allocated additional frequencies in the 25 GHz band for MDS.

Digital Termination Systems

In 1981 the FCC created a new service called the Digital Electronic Message Service. The facilities which operate under this service are called Digital Termination Systems (DTS). Common carriers or private entities may operate DTS systems in either of two frequency bands -- 10.6 GHz or in the middle of the 18 GHz band. DTS systems consist of a centrally located "node" station and one or more "user" stations which, in effect, use radio as a substitute for local loops. DTS systems do not share frequencies with other services and, even though they are part of a common carrier microwave service, there is no prior coordination requirement. DTS applicants are simply required to examine potential interference with other existing DTS systems within 50 miles and thus DTS "coordination" is largely a matter of avoiding the use of the same channel frequency within that distance.

Experimental and Developmental Stations

Certain radio systems are experimental or developmental in nature and the FCC distinguishes between these systems and systems authorized on a regular basis. Systems granted experimental or developmental authorizations may involve radio research, the testing of a new technology, the development of new types of equipment for existing radio services, or the developmental testing of a new radio service. Experimental radio systems are covered under Part 5 of the FCC Rules, while developmental systems are regulated under whatever Rules Part applies to the service involved. Such systems may utilize frequencies shared by other services but they may not cause harmful interference to any station authorized on a regular basis and they have no rights to object to interference caused to them by any station authorized on a regular basis.

The FCC may or may not require coordination for experimental systems, depending on the nature of the operation. Developmental stations which transmit signals in the so- called common carrier microwave bands must be prior- coordinated. (The FCC Rules indicate that developmental stations which are "receive-only" must be coordinated but, in practice, the Commission has allowed such applicants to omit coordination since no interference protection is available to these types of stations and little tangible

benefit is derived from coordination.) The Commission considers applicants who omit frequency coordination to forego their rights to be included in future coordination notifications by other parties.

Experimental and developmental operations which have been coordinated should be included in interference studies and distribution of subsequent coordination notifications, at least for the duration of the experimental or developmental authorization. This keeps such operators informed of the potential interference problems they may experience and, in the case of their transmit stations, provides an advance indication of possible preemption of their operation if it is determined that harmful interference would be caused to a proposed service for which a regular FCC authorization will be requested.

Radar Interference

The frequency bands just below the common carrier 4 and 6 GHz bands are allocated to the government and are used for radar. The band below 4 GHz is typically used for FAA radar and the one below 6 GHz is used for Weather Service radar. These radar systems may operate at very high power levels and a significant amount of radar "splatter" may result in interference in the common carrier bands, despite what would appear to be a significant degree of frequency separation in some cases. Moreover, radar may cause this out-of-band interference even though it meets government standards for out-of-band signal suppression.

If radar interference is caused to an existing common carrier system, the radar operator may be persuaded to install an appropriate filter to suppress the splatter signal. In the case of proposed common carrier systems, it is a good idea to use available information on existing radar’s to avoid interference during the design stages.

COMPUTER APPLICATIONS IN COORDINATION

Until the late 1960s, frequency coordination and interference studies were done entirely on a manual basis. Note that this was before the extensive development of satellite communications and at that time terrestrial microwave systems were not as pervasive as they are now. (In fact, prior frequency coordination was then not yet an FCC requirement.) However, it is not difficult to imagine how tedious were interference studies that were based on radio maps and manual calculations, as opposed to today's mechanized studies using computer data bases and interference analysis programs.

Today, computers are used extensively in coordination applications. Coordinators rely on computers for various types of interference analyses, using data bases of microwave stations and relying on support files of frequency codes, antenna and equipment characteristics, and interference objectives. Computers may also be used for the distribution of information among coordinators.

Interference Analysis Programs

Computer programs are available for all common types of interference studies, for example, mutual interference between terrestrial microwave systems and interference between terrestrial systems and satellite earth stations, including both great circle and precipitation scatter interference. A program is also available to determine the degree of protection terrestrial transmitters must provide for satellites in geostationary orbit. In addition, specialized programs exist for analyzing terrestrial system interference involving omnidirectional transmitters, and for estimating the cumulative effect of multiple interference exposures at junction stations. Note that these programs, although very useful do not necessarily provide the final answer in each case, and a certain amount of engineering analysis and judgment must be applied to their outputs.

In addition to programs which analyze interference potential related programs exist to analyze propagation characteristics, specifically the effects of terrain blocking, an important factor in interference studies.

Interference Data Bases

The key to mechanized interference studies is the existence of accurate, up-to-date data bases of radio stations which use the frequency bands of interest.

Two major data bases are typical for common carrier microwave coordination purposes: one catalogs all existing and planned terrestrial systems using the common carrier microwave frequency bands; the other data base lists all existing or planned satellite earth stations which have been frequency-coordinated in the bands shared with common carrier microwave systems. These data bases list, in coded formats, the basic coordination data necessary to perform interference studies.

Support Programs and Files

A variety of computer files (sometimes referred to as "library files") are maintained which relate to the codes used in the station data bases and which provide detailed information on, among other things, radio equipment, antenna characteristics and interference objectives. Support programs have been developed for maintenance and utility operations for these library files as well as for the data bases of microwave systems and earth stations.

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Approved:
To Membership: 03-27-89
Notes: Written by Dan Collins

Attachment A

Frequency Coordination Procedures

This primer on frequency coordination procedures was written in 1987 when the common carrier microwave radio service was regulated under Part 21 of the Federal Communications Commission (the "Commission") and the private operational fixed service was regulated by Part 94. Subsequently, in December 1994 the Commission released a Notice of Proposed Rulemaking (NPRM) for the "Reorganization and Revision of Parts 1, 2, 21, and 94 of the Rules to Establish a New Part 101 Governing Terrestrial Microwave Fixed Radio Services."[1] The purpose of the NPRM was "to simplify the rules for the common carrier and private operational fixed services contained respectively in Parts 21 and 94 of the Commission's Rules, and to consolidate those rules into a new Part 101."[2] The Commission adopted the new Part 101 rules in a Report and Order released in February 1996.[3]

The Commission made some clarifications and proposed additional changes to Part 101 in February 2000.[4] This action resulted in the elimination of other "duplicative, outmoded, and otherwise unnecessary regulations" covering the frequency coordination and licensing of microwave radio fixed services.[5]

The following pages of this attachment contain Section 101.103, Frequency Coordination Procedures, from Part 101 of the Commission's rules.[6] These procedures were formerly contained in Section 21.100 (Part 21) of the rules.

Dennis L. Gross
April 28, 2004

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[1] See FCC NPRM, WT Docket No. 94-148; adopted December 9, 1994; released December 28, 1994.
[2] See NPRM at para. 1.
[3] See FCC Report and Order, WT Docket No. 94-148; adopted February 8, 1996; released February 29, 1996.
[4] See FCC Memorandum Opinion and Order and NPRM, WT Docket No. 00-19, Amendment of Part 101 of the Commission's Rules to Streamline Processing of Microwave Applications in the Wireless Telecommunications Services; adopted February 2, 2000; released February 14, 2000.
[5] See FCC Report and Order, WT Docket No. 00-19; adopted July 18, 2002; released July 31, 2002.
[6] The following pages are from the 10-1-03 edition of Title 47 of the Code of Federal Regulations.

Frequency band (MHz)	Radio service				
	Common carrier (Part 101)	Private radio (Part 101)	Broadcast auxiliary (Part 74)	Other (Parts 15, 21, 22, 24, 25, 74, 78 & 100)	Notes
1850–1990		OFS		PCS.	
2110–2130	CC			PET.	
2130–2150		OFS		PET.	
2150–2160		OFS		MDS.	
2160–2180	CC			ET.	
2180–2200		OFS		PET.	
2450–2500	CC	OFS	TV BAS	ISM	F/M/TF
2650–2690		OFS		MDS/ITFS.	
3700–4200	CC LTTS	OFS		SAT.	
5925–6425	CC LTTS	OFS		SAT.	
6425–6525	LTTS	OFS	TV BAS	CARS	M.
6525–6875	CC	OFS.			
10,550–10,680	CC	OFS DEMS.			
10,700–11,700	CC	OFS		SAT.	
11,700–12,200	LTTS			SAT.	
12,200–12,700	MVDDS	MVDDS, POFS		DBS, NGSO FSS.	
12,700–13,250	CC LTTS	OFS	TV BAS	CARS	F/M/TF.
14,200–14,400	LTTS			SAT.	
17,700–18,580	CC	OFS	TV BAS	SAT CARS.	
17,700–18,300	CC	OFS	TV BAS	CARS.	
18,300–18,580	CC	OFS	TV BAS	CARS SAT.	
18,580–18,820	CC	OFS	Aural BAS	SAT.	
18,820–18,920	CC	OFS		SAT	
18,920–19,160	CC	OFS	Aural BAS	SAT.	
19,160–19,260	CC	OFS		SAT	
19,260–19,700	CC	OFS	TV BAS	CARS SAT.	
21,200–23,600	CC LTTS	OFS			TF.
24,250–25,250	CC	OFS.			
27,500–28,350	LMDS	LMDS.			
29,100–29,250	LMDS	LMDS		SAT.	
31,000–31,300	CC LMDS LTTS	OFS LMDS			F/M/TF.
38,600–40,000	CC	OFS	TV BAS		F/M/TF.

BAS: Broadcast Auxiliary Service—(Part 74)
CARS: Cable Television Relay Service —(Part 78)
CC: Common Carrier Fixed Point-to-Point Microwave Service—(Part 101, Subparts C & I)
DBS: Direct Broadcast Satellite—(Part 100)
DEMS: Digital Electronic Message Service—(Part 101, Subpart G)
ISM: Industrial, Scientific & Medical—(Part 18)
ITFS: Instructional Television Fixed Service—(Part 74)
LTTS: Local Television Transmission Service—(Part 101, Subpart J)
MAS: Multiple Address System—(Part 101)
MDS: Multipoint Distribution Service—(Part 21)
OFS: Private Operational Fixed Point-to-Point Microwave Service—(Part 101, Subparts C & H)
PCS: Personal Communications Service—(Part 24)
PET: Emerging Technologies (per ET Dkt. No. 92–9, not yet assigned)
PRS: Paging and Radiotelephone Service—(Part 22, Subpart E)
SAT: Fixed Satellite Service—(Part 25)
Notes:

F—Fixed
M—Mobile
TF—Temporary Fixed
(1)—Applications for frequencies in the 932.5–935/941.5–944 MHz bands may be filed initially during a one-week period to be announced by public notice. After these applications have been processed, the Commission will announce by public notice a filing date for remaining frequencies. From this filing date forward, applications will be processed on a daily first-come, first-served basis.

[61 FR 26677, May 28, 1996, as amended at 62 FR 23165, Apr. 29, 1997; 62 FR 24582, May 6, 1997; 65 FR 38327, June 20, 2000; 65 FR 54175, Sept. 7, 2000; 65 FR 59357, Oct. 5, 2000; 67 FR 43037, June 28, 2002]

§ 101.103 Frequency coordination procedures.

(a) Assignment of frequencies will be made only in such a manner as to facilitate the rendition of communication service on an interference-free basis in each service area. Unless otherwise indicated, each frequency available for use by stations in these services will be assigned exclusively to a single applicant in any service area. All applicants for, and licensees of, stations in these services must cooperate

in the selection and use of the frequencies assigned in order to minimize interference and thereby obtain the most effective use of the authorized facilities. In the event harmful interference occurs or appears likely to occur between two or more radio systems and such interference cannot be resolved between the licensees thereof, the Commission may specify a time sharing arrangement for the stations involved or may, after notice and opportunity for hearing, require the licensees to make such changes in operating techniques or equipment as it may deem necessary to avoid such interference.

(b)(1) Operations in the bands 31,000–31,075 MHz and 31,225–31,300 MHz licensed prior to March 11, 1997, were licensed on an unprotected basis and are subject to harmful interference from similarly licensed operations in that band.

(i) Operations licensed in the Local Mulitpoint Distribution Service and those operations licensed prior to March 11, 1997, except in the Local Television Transmission Service, operating in these bands are equally protected against harmful interference from each other.

(ii) In the case of operations licensed prior to March 11, 1997, except in the Local Television Transmission Service, that are licensed on a point-to-radius basis, LMDS licensees shall be subject to the protection requirement established in this section in the case of existing links operated by such licensees, and in the case of links added by such licensees in the future in accordance with the terms of their point-to-radius licenses.

(iii) An LMDS licensee may not initiate operations within the point-to-radius area licensed to an operator (other than an operator in the Local Television Transmission Service) prior to March 11, 1997, even if such operator has not initiated operations to the fullest extent of the license. An LMDS licensee, however, may initiate operations at the border of such operator's license area without prior coordination if the LMDS licensee's operations would not cause harmful interference to the other operator's existing operations.

(iv) An operator (other than an operator in the Local Television Transmission Service) licensed on a point-to-radius basis prior to March 11, 1997, may add additional stations within its license area. Such operator shall coordinate with any affected LMDS licensee if its new operations might cause harmful interference to the existing operations of such LMDS licensee.

(v) Operations licensed prior to March 11, 1997, on a point-to-point basis may not be extended or otherwise modified through the addition of point-to-point links. Such operations shall be limited to the use of frequency pairs licensed as of March 11, 1997. Operations licensed in the Local Television Transmission Service as of March 11, 1997, may continue to operate, but such operators may not expand existing operations nor initiate new operations.

(2) Operations in the 31,075–31,225 MHz band licensed prior to March 11, 1997, shall receive no protection against harmful interference from authorized operations in the Local Multipoint Distribution Service in that band.

(3) Non-LMDS operations in the entire 31,000–31,300 MHz band licensed after March 11, 1997, based on applications refiled no later than June 26, 1998 are unprotected with respect to each other and subject to harmful interference from each other.

(i) Such operations and any operations licensed prior to March 11, 1997, in the band are unprotected with respect to each other and subject to harmful interference from each other.

(ii) Such operations are licensed on a secondary basis to LMDS operations licensed in the band, may not cause interference to LMDS operations, and are not protected from interference from LMDS operations.

(iii) Such operations licensed on a point-to-point basis may not be extended or otherwise modified through the addition of point-to-point links. Such operations licensed on a point-to-radius basis may add additional stations within the licensed area.

(c) Frequency diversity transmission will not be authorized in these services in the absence of a factual showing that the required communications cannot practically be achieved by other

means. Where frequency diversity is deemed to be justified on a protection channel basis, it will be limited to one protection channel for the bands 3,700–4,200, 5925–6425, and 6525–6875 MHz, and a ratio of one protection channel for three working channels for the bands 10,550–10,680 and 10,700–11,700 MHz. In the bands 3,700–4,200, 5,925–6,425, and 6525–6875 MHz, no frequency diversity protection channel will be authorized unless there is a minimum of three working channels, except that where a substantial showing is made that a total of three working channels will be required within three years, a protection channel may be authorized simultaneously with the first working channel. A protection channel authorized under such exception will be subject to termination if applications for the third working channel are not filed within three years of the grant date of the applications for the first working channel. Where equipment employing digital modulation techniques with cross-polarized operation on the same frequency is used, the protection channel authorized under the above conditions may be considered to consist of both polarizations of the protection frequency where such is shown to be necessary.

(d) *Frequency coordination.* For each frequency authorized under this part, the following frequency usage coordination procedures will apply:

(1) *General requirements.* Proposed frequency usage must be prior coordinated with existing licensees, permittees and applicants in the area, and other applicants with previously filed applications, whose facilities could affect or be affected by the new proposal in terms of frequency interference on active channels, applied-for channels, or channels coordinated for future growth. Coordination must be completed prior to filing an application for regular authorization, or a major amendment to a pending application, or any major modification to a license. In coordinating frequency usage with stations in the fixed satellite service, applicants must also comply with the requirements of §101.21(f). In engineering a system or modification thereto, the applicant must, by appropriate studies and analyses, select sites, transmitters, antennas and frequencies that will avoid interference in excess of permissible levels to other users. All applicants and licensees must cooperate fully and make reasonable efforts to resolve technical problems and conflicts that may inhibit the most effective and efficient use of the radio spectrum; however, the party being coordinated with is not obligated to suggest changes or re-engineer a proposal in cases involving conflicts. Applicants should make every reasonable effort to avoid blocking the growth of systems as prior coordinated. The applicant must identify in the application all entities with which the technical proposal was coordinated. In the event that technical problems are not resolved, an explanation must be submitted with the application. Where technical problems are resolved by an agreement or operating arrangement between the parties that would require special procedures be taken to reduce the likelihood of interference in excess of permissible levels (such as the use of artificial site shielding) or would result in a reduction of quality or capacity of either system, the details thereof may be contained in the application.

(2) Coordination procedure guidelines are as follows:

(i) Coordination involves two separate elements: notification and response. Both or either may be oral or in written form. To be acceptable for filing, all applications and major technical amendments must certify that coordination, including response, has been completed. The names of the licensees, permittees and applicants with which coordination was accomplished must be specified. If such notice and/or response is oral, the party providing such notice or response must supply written documentation of the communication upon request;

(ii) Notification must include relevant technical details of the proposal. At minimum, this should include, as applicable, the following:

Applicant's name and address.
Transmitting station name.
Transmitting station coordinates.
Frequencies and polarizations to be added, changed or deleted.
Transmitting equipment type, its stability, actual output power, emission designator, and type of modulation (loading).

Transmitting antenna type(s), model, gain and, if required, a radiation pattern provided or certified by the manufacturer.

Transmitting antenna center line height(s) above ground level and ground elevation above mean sea level.

Receiving station name.

Receiving station coordinates.

Receiving antenna type(s), model, gain, and, if required, a radiation pattern provided or certified by the manufacturer.

Receiving antenna center line height(s) above ground level and ground elevation above mean sea level.

Path azimuth and distance.

Estimated transmitter transmission line loss expressed in dB.

Estimated receiver transmission line loss expressed in dB.

For a system utilizing ATPC, maximum transmit power, coordinated transmit power, and nominal transmit power.

NOTE: The position location of antenna sites shall be determined to an accuracy of no less than ±1 second in the horizontal dimensions (latitude and longitude) and ±1 meter in the vertical dimension (ground elevation) with respect to the National Spacial Reference System.

(iii) For transmitters employing digital modulation techniques, the notification should clearly identify the type of modulation. Upon request, additional details of the operating characteristics of the equipment must also be furnished;

(iv) Response to notification should be made as quickly as possible, even if no technical problems are anticipated. Any response to notification indicating potential interference must specify the technical details and must be provided to the applicant, in writing, within the 30-day notification period. Every reasonable effort should be made by all applicants, permittees and licensees to eliminate all problems and conflicts. If no response to notification is received within 30 days, the applicant will be deemed to have made reasonable efforts to coordinate and may file its application without a response;

(v) The 30-day notification period is calculated from the date of receipt by the applicant, permittee, or licensee being notified. If notification is by mail, this date may be ascertained by:

(A) The return receipt on certified mail;

(B) The enclosure of a card to be dated and returned by the recipient; or

(C) A conservative estimate of the time required for the mail to reach its destination. In the last case, the estimated date when the 30-day period would expire should be stated in the notification.

(vi) An expedited prior coordination period (less than 30 days) may be requested when deemed necessary by a notifying party. The coordination notice should be identified as ''expedited'' and the requested response date should be clearly indicated. However, circumstances preventing a timely response from the receiving party should be accommodated accordingly. It is the responsibility of the notifying party to receive written concurrence (or verbal, with written to follow) from affected parties or their coordination representatives.

(vii) All technical problems that come to light during coordination must be resolved unless a statement is included with the application to the effect that the applicant is unable or unwilling to resolve the conflict and briefly the reason therefor;

(viii) Where a number of technical changes become necessary for a system during the course of coordination, an attempt should be made to minimize the number of separate notifications for these changes. Where the changes are incorporated into a completely revised notice, the items that were changed from the previous notice should be identified. When changes are not numerous or complex, the party receiving the changed notification should make an effort to respond in less than 30 days. When the notifying party believes a shorter response time is reasonable and appropriate, it may be helpful for that party to so indicate in the notice and perhaps suggest a response date;

(ix) If, after coordination is successfully completed, it is determined that a subsequent change could have no impact on some parties receiving the original notification, these parties must be notified of the change and of the coordinator's opinion that no response is required;

(x) Applicants, permittees and licensees should supply to all other applicants, permittees and licensees within

their areas of operations, the name, address and telephone number of their coordination representatives. Upon request from coordinating applicants, permittees and licensees, data and information concerning existing or proposed facilities and future growth plans in the area of interest should be furnished unless such request is unreasonable or would impose a significant burden in compilation;

(xi) Parties should keep other parties with whom they are coordinating advised of changes in plans for facilities previously coordinated. If applications have not been filed 6 months after coordination was initiated, parties may assume that such frequency use is no longer desired unless a second notification has been received within 10 days of the end of the 6 month period. Renewal notifications are to be sent to all originally notified parties, even if coordination has not been successfully completed with those parties; and

(xii) Any frequency reserved by a licensee for future use in the bands subject to this part must be released for use by another licensee, permittee or applicant upon a showing by the latter that it requires an additional frequency and cannot coordinate one that is not reserved for future use.

(e) Where frequency conflicts arise between co-pending applications in the Private Operational Fixed Point-to-Point Microwave, Common Carrier Fixed Point-to-Point Microwave and Local Television Transmission Services, it is the obligation of the later filing applicant to amend his application to remove the conflict, unless it can make a showing that the conflict cannot be reasonably eliminated. Where a frequency conflict is not resolved and no showing is submitted as to why the conflict cannot be resolved, the Commission may grant the first filed application and dismiss the later filed application(s) after giving the later filing applicant(s) 30 days to respond to the proposed action.

(f) (1) *Coordination and information sharing between MVDDS and NGSO FSS licensees in the 12.2 GHz to 12.7 GHz band.* Prior to the construction or addition of an MVDDS transmitting antenna in this frequency band, the MVDDS licensee shall provide notice of intent to construct the proposed antenna site to NGSO FSS licensees operating in the 12.2–12.7 GHz frequency band and maintain an Internet web site of all existing transmitting sites and transmitting antennas that are scheduled for operation within one year including the ''in service'' dates. In addition to the location of a proposed new transmitting antenna, MVDDS licensees shall provide to the NGSO FSS licensees a technical description of the operating characteristics of the proposed transmission facility. At a minimum, the following information must be included in each notification:

(i) Name of MVDDS licensee;

(ii) Geographic location (including NAD83 coordinates) of proposed MVDDS transmitting antenna;

(iii) Maximum EIRP per 24 MHz;

(iv) Height above average terrain of the transmitting antenna;

(v) Type of antenna to be utilized;

(vi) Main beam azimuth and altitude orientation for the proposed transmitting antenna;

(vii) Theoretically modeled antenna radiation pattern;

(viii) Type(s) of emissions, and;

(ix) Description of the proposed service area.

(2) If the proposed MVDDS antenna site does not meet the minimum spacing requirements on the date of original notification or on subsequent annual anniversary dates of non-operation as set forth in §101.129, then the MVDDS licensee shall not construct the proposed transmission facility unless all NGSO FSS licensees having active subscribers within the minimum separation distance agree to a shorter spacing. Nothing in this section shall preclude MVDDS and NGSO FSS licensees from agreeing to accept the siting of new MVDDS transmitting antennas that do no meet the minimum distance set forth in §101.129. Incumbent point-to-point licensees' (those not licensed as MVDDS) facilities are to be operated in the band 12,200–12,700 MHz following the procedures, technical standards, and requirements of §101.105 in order to protect stations providing Direct Broadcast Satellite Service.

(g) *Licensees operating in Basic Trading Areas authorized in the Local*

Multipoint Distribution Service. (1) When the transmitting facilities in a Basic Trading Area (BTA) are to be operated in the bands 27,500–28,350 MHz; 29,100–29,250 MHz; and 31,000–31,300 MHz and the facilities are located within 20 kilometers of the boundaries of a BTA, each licensee must complete the frequency coordination process of paragraph (d)(2) of this section with respect to neighboring BTA licensees that may be affected by its operations prior to initiating service. In addition, all licensed transmitting facilities operating in the bands 31,000–31,075 MHz and 31,225–31,300 MHz and located within 20 kilometers of neighboring facilities must complete the frequency coordination process of paragraph (d)(2) of this section with respect to such authorized operations before initiating service.

(2) Response to notification should be made as quickly as possible, even if no technical problems are anticipated. Any response to notification indicating potential interference must specify the technical details and must be provided to the applicant, either electronically or in writing, within the 30-day notification period. Every reasonable effort should be made by all licensees to eliminate all problems and conflicts. If no response to notification is received within 30 days, the licensee will be deemed to have made reasonable efforts to coordinate and commence operation without a response. The beginning of the 30-day period is determined pursuant to paragraph (d)(2)(v) of this section.

(h) *Special requirements for operations in the band 29,100–29,250 MHz.* (1)(i) Local Multipoint Distribution Service (LMDS) receive stations operating on frequencies in the 29,100–29,250 MHz band within a radius of 75 nautical miles of the geographic coordinates provided by a non-GSO–MSS licensee pursuant to §101.113(c)(2) or (c)(3)(i) (the ''feeder link earth station complex protection zone'') shall accept any interference caused to them by such earth station complexes and shall not claim protection from such earth station complexes.

(ii) LMDS licensees operating on frequencies in the 29,100–29,250 MHz band outside a feeder link earth station complex protection zone shall cooperate fully and make reasonable efforts to resolve technical problems with the non-GSO MSS licensee to the extent that transmissions from the non-GSO MSS operator's feeder link earth station complex interfere with an LMDS receive station.

(2) No more than 15 days after the release of a public notice announcing the commencement of LMDS auctions, feeder link earth station complexes to be licensed pursuant to §25.257 of this chapter shall be specified by a set of geographic coordinates in accordance with the following requirements: no feeder link earth station complex may be located in the top eight (8) metropolitan statistical areas (MSAs), ranked by population, as defined by the Office of Management and Budget as of June 1993, using estimated populations as of December 1992; two (2) complexes may be located in MSAs 9 through 25, one of which must be Phoenix, AZ (for a complex at Chandler, AZ); two (2) complexes may be located in MSAs 26 to 50; three (3) complexes may be located in MSAs 51 to 100, one of which must be Honolulu, Hawaii (for a complex at Waimea); and the three (3) remaining complexes must be located at least 75 nautical miles from the borders of the 100 largest MSAs or in any MSA not included in the 100 largest MSAs. Any location allotted for one range of MSAs may be taken from an MSA below that range.

(3)(i) Any non-GSO MSS licensee may at any time specify sets of geographic coordinates for feeder link earth station complexes with each earth station contained therein to be located at least 75 nautical miles from the border of the 100 largest MSAs.

(ii) For purposes of paragraph (h)(3)(i) of this section, non-GSO MSS feeder link earth station complexes shall be entitled to accommodation only if the affected non-GSO MSS licensee preapplies to the Commission for a feeder link earth station complex or certifies to the Commission within sixty days of receiving a copy of an LMDS application that it intends to file an application for a feeder link earth station complex within six months of the date of receipt of the LMDS application.