Recommendation WG 14.87.011

MIXED HIGH-LOW FREQUENCY PLANS
and
REFLECTION INTERFERENCE

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Source: Working Group 14

RECOMMENDATION

Subject Area: Reflection Interference

Title: Mixed High-Low Frequency Plans and Reflection Interference

Synopsis

This recommendation addresses coordination procedures that should be used to minimize reflection interference problems involving the mixing of high and low frequency plans, particularly in urban areas. Frequency planners should make strong efforts to use the conventional frequency plans, where such convention exists, in areas prone to reflection interference. If the introduction of a mixed (i.e., opposite) plan is necessary, the initiating coordinator should work closely with other coordinators to predict and measure, as far as practicable, any potential reflection problems and avoid them in advance of construction. These same prediction/measurement procedures should be used by coordinators in areas where mixed high-low plans already exist. After a facility has been constructed, if it causes immediate interference, the constructor is generally responsible to resolve the problem, consistent with the "first come, first served" principle. If no interference is reported, the new facility derives the same continuing interference protection rights as any other successfully coordinated and licensed facility.

Background

The basic goal of frequency coordination is to enable the construction of new radio facilities with reasonable assurances of avoiding excessive interference, either suffered or caused by the new facility and involving other previously licensed or coordinated facilities. The prior coordination notification-and-response process represents an analytical attempt, sometimes supplemented by physical measurements, to control the predictable levels of interference.

Unfortunately, not all interference mechanisms are clearly predictable. Among other things, reflections from buildings or other objects are well known but generally unpredictable contributors to interference. Because of the extreme difficulty of quantifying reflection problems in advance, these types of problems have not typically been addressed during the prior coordination stage. It is generally considered that if reflection interference is found to occur following construction, the "last party in" (i.e., the last constructor) should assume responsibility for resolving the problem. This is consistent with the traditional "first come, first served" principle of frequency coordination and interference protection. Often the necessary modifications are expensive and, in some cases, newly constructed facilities may have to be completely redesigned or relocated. If and when the FCC is asked to assist in resolving reflection interference problems, the initial approach taken usually involves an attempt to have all affected parties somehow share the resolution burden. Operators of previously licensed facilities thus may face unexpected expense or new limitations on their abilities to expand their systems to their maximum capacities. In those cases in which no reasonable cooperative solution is available, the FCC will in the end usually require the "last party in" to assume sole responsibility for correcting the problem.

Microwave stations in urban areas are subject to a higher potential for reflection interference because of the existence of many tall buildings. Recognizing this fact, designers of microwave stations in urban areas have in the past often gravitated toward the use of frequency plans that avoid transmitting on the same frequencies that other urban area stations use for receiving. This minimizes the potential for

relatively high-powered transmit signals to reflect off nearby buildings and interfere with relatively low-powered signals on the same frequency received by other urban area stations.

It is important to recognize that mixed plan reflections result in interference to the stations at the distant ends of the paths terminating in the urban area.

In this regard, frequency planners often consider an urban area to be equivalent to a junction station. (Only under great duress would a planner attempt to use the same frequency for both transmission and reception (even on different paths) at a junction station.)

The term "high-low plan" is generally used to relate to the use of different sets of frequencies for transmission and reception. In each of the 2, 4, 6 and 11 GHz bands, high-low plans have been developed and are in common use. (Note that not all high-low plans actually involve the exclusive use of the high or low portion of a frequency band The plans used in the 4 GHz band serve as an example of such an exception. However, the high-low principle described herein holds true in each band.)

Increasing microwave congestion in some urban areas had made it difficult to design new systems which conform to the high-low plan conventionally used there by existing operators. As a result, proposals for new facilities using the opposite frequency plan have grown more popular and have attracted much attention from existing licensees who are concerned over the associated increase in potential for reflection interference.

It is worth noting at this point that in a majority of large metropolitan areas a mix of high-low plans currently exists.

Reflection problems can occur as a new system is turned up or, for a variety of reasons, they can occur or be identified much later. For example, new building construction may create new reflection interference paths. In addition, the tearing down of an old building may create a reflection problem if the building formerly blocked a potential reflection path. Moreover, potential victims of reflection interference may not realize it if they are not yet using the particular frequencies of interest. Generally speaking, the later a reflection problem is identified, the more difficult and complex is its resolution.

While these problems can exist with consistent use of a high-low frequency plan, the use of a mix of opposite plans significantly raises the potential for harmful reflection interference to other nearby systems. In addition, where mixed plans exist, subsequent coordination and construction of new facilities is more difficult, expensive and, because of the possibility of unpredicted reflection interference, more risky.

It is thus to the mutual benefit of all potentially affected operators to make special efforts during the prior coordination stage to address and avoid reflection interference problems. In addition to the problems of reflection prediction, there are often difficulties associated with detection and measurement of reflection interference. (These latter issues are the subject of NSMA Working Group 4. Working Group 8 is addressing modeling techniques for predicting reflection interference.)

Recommendation

Recognizing these problems, we recommend that frequency planners make strong efforts to avoid introducing an opposite high-low plan in an urban area where a consistent plan is in place. However, after exhausting conventional design alternatives (including different antennas, sites, frequency bands, etc.), a planner may find it necessary to propose the use of the opposite plan. In such a case, he should

attempt to identify and quantify potential reflection problems and discuss them with other affected operators, either before or during the prior coordination stage. In addition, the potentially affected operators should themselves attempt similar analyses. In particular, if a reflection-related interference objection is made in response to a prior coordination notification, the objector should quantify the predicted interference level. It should be recognized that, regardless of the particular frequency plan, once a facility has been successfully coordinated, constructed and found not to cause immediate interference, it deserves the same coordination protection considerations as other facilities. With this in mind, and noting that many urban areas already have mixed frequency plans in use, planners of new facilities in already mixed urban areas should follow the identification-and-analysis guidelines described above. In addition, should a reflection problem subsequently result solely from changes in the physical environment (as opposed to radio construction), the affected radio operators should cooperatively assume responsibility for resolving the problem.

The following sections summarize the responsibilities of the different parties, both during coordination and following turn-up of a new facility that might involve reflection interference:

During the prior coordination stage:

Responsibilities of the initiating coordinator:

- To make strong efforts to avoid introducing a mixed plan in an urban area where a conventional plan exists.

- If the introduction of a mixed plan appears necessary, to work closely with other coordinators to predict and measure, as far as practicable, any potential reflection interference problems and avoid them in advance of construction.

Responsibilities of receiving coordinator:

-To attempt to predict and quantify, to the extent practicable, potential reflection problems related to the use of mixed frequency plans. This analysis should include existing facilities as well as any previously coordinated (future) channels or systems.

Testing may be proposed by either party.

Following construction of the new facility:

- Any reflection interference experienced should be promptly brought to the attention of the initiating coordinator or operator, who generally bears responsibility to resolve any reflection interference problems in the physical environment as it exists at the time of new system turn-up.

- Should any subsequent building construction (or destruction) activity result in reflection interference, the affected parties should resolve the problem on a cooperative basis.

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