Recommendation WG 20.97.048, Rev. 1.0

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INTER-PCS Co-BLOCK COORDINATION PROCEDURES

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NSMA – Working Group 20

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1.0 Preface

The Memorandum Opinion and Order (MO&O) in Federal Communications Commission (FCC, or the Commission) Docket 90-314 adopted June 9, 1994, represented the culmination of a four year regulatory process to establish broad band personal communications services (PCS). The Commission does not address the issue of inter-PCS coordination in Title 47, Part 24 of the U.S. Code of Federal Regulations (47 CFR 24). The purpose of this document is to provide to the industry recommended practices regarding inter-PCS coordination. This recommendation is based on the applicable rules from 47 CFR as of the date of this recommendation.

2.0 Background

Part 24 of the Commission's rules does not include inter-PCS coordination requirements. This recommendation uses some Part 24 rules, Telecommunications Industry Association Telecommunications Systems Bulletin 84 (TIA TSB-84), and standard cellular industry coordination procedures as guidelines to develop a functional inter-PCS coordination process.

47 CFR 24.238(a), (b) and (e) state:

(a) "On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB."[1]

(b) "Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

…

(e) "When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section."

[1] This emission limit always computes to –13 dBm regardless of what P is. The total transmitter power, P, is defined in 47 CFR 24.232.

Assuming uniform power distribution, the ratio of power in a 1 Hz bandwidth to a 1 MHz bandwidth is:

$$10 \log(1/10^6) = -60 \text{ dB}.$$

Therefore, the FCC limit for power spectral density (PSD) more than 1 MHz removed from the frequency block is:

$$-13 \text{ dBm} - 60 \text{ dB} = -73 \text{ dB(mW/Hz)} = -37 \text{ dB(mW/4 kHz)}.$$

Within the first MHz outside the licensee frequency block, the out-of-block emission limits depend on the transmitter emission bandwidth (not the out-of-block licensee's receiver bandwidth). For the various technologies (narrowest to widest bandwidths):

Technology	**Emission Bandwidth**	**FCC Limit**
Analog N-AMPS	< 10 kHz	–33 dB(mW/Hz)
IS-136 TDMA & AMPS	< 30 kHz	–38 dB(mW/Hz)
IS-713 Upbanded AMPS	< 30 kHz	–38 dB(mW/Hz)
J-STD-007 PCS1900(GSM)	< 200 kHz	–48 dB(mW/Hz)
J-STD-014 PACS	< 300 kHz	–46 dB(mW/Hz)
IS-95 CDMA	< 1.25 MHz	–54 dB(mW/Hz)
SP-3614 PWT-E*	< 1.25 MHz	–54 dB(mW/Hz)
IS-661 CCT*	< 1.875 MHz	–56 dB(mW/Hz)
J-STD-015 W-CDMA	< 5 MHz	–60 dB(mW/Hz)

* These technologies may employ Time Division Duplexing (TDD). Coordination with TDD systems is not addressed in this document.

Another rule to consider is contained in 47 CFR 24.236. This rule defines the field strength limit at the border of an operator's licensed service area. This rule only limits signal strengths at service area boundaries. It does not provide sufficient information for co-block interference coordination. 47 CFR 24.236 states:

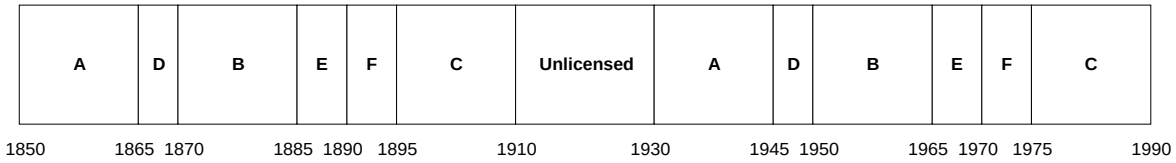
> "The predicted or measured median field strength at any location on the border of the PCS service area shall not exceed 47 dBμV/m unless the parties agree to a higher field strength."[2]
>
> Also, 47 CFR 22.907 presently requires cellular operators to coordinate channel usage. The cellular coordination process is established and works well throughout the industry.

[2] 47 dBμV/m = –98 dB(W/m^2) = –96 dBm at the terminals of a 50 Ω isotropic receiving antenna at 1960 MHz (middle of base transmit band). It is assumed that 47 dBμV/m refers to the field strength of a base station transmitter measured at the geographic edge of a license, by a mobile station antenna at typical mobile station antenna heights (typically assumed to be 1.5 m). Any other interpretation of this field strength limit leads to unrealistic interpretations, which do not provide interference protection to other licenses or else do not provide service capability at the edge of the license. For example: If a handset is located at the geographic border of a license, it must transmit at near full output power to reach a distant base station inside the license. However, measured just across the geographic border, the handset's field strength will certainly exceed 47dBμV/m. Other cases yield similar unrealistic interpretations.

3.0 Terms and Definitions

Block -- The PCS licensee frequency pairs designated A, D, B, E, F, or C as defined by the FCC in 47 CFR 24. A radio frequency block is usually divided into a number of different radio frequency channels. Figure 1 depicts the designated blocks and frequencies.

Figure 1 PCS Frequency Blocks



Channel -- Specifically, a radio channel, means the radio frequencies centered on a carrier frequency, with a bandwidth equal to the channel spacing for the appropriate technology.

Co-block -- The term co-block refers to the complete block of radio frequencies (Licenses A through F) that is shared in common between two operators (For example: A block to A block, or D block to D block) along geographic (MTA to MTA, or BTA to BTA) boundaries.

Co-channel -- The term co-channel refers to the use of the same radio frequency channel. Although the channel plans and channel bandwidths deployed by various PCS operators may not be the same, the potential for co-channel interference results when at least a portion of the one operator's channel overlaps another operator's channel. Two or more operators at some geographic MTA or BTA boundaries may contribute co-channel signals.

Coordination Notice -- A communication from one PCS provider to another that contains the technical details listed in Appendix A of this document, and furnished for the purpose of interference coordination. The format of the communication (written, electronic, or otherwise) must be mutually agreed to by the PCS providers. If no method is agreed upon the electronic method in Appendix A should be used.

CN -- Abbreviation for Coordination Notice

Coordination Distance -- A distance defined from the border of one licensed area to another licensed area in which the licensees are required to coordinate cell sites. Mostly the borders will be defined by MTA and BTA boundaries, except in cases where the market has been partitioned.

Environmental Change -- The addition or removal of an obstruction that will affect the radiation pattern on any azimuth. **PCS Operator and Operator** -- Terms used interchangeably throughout this document to mean the licensee and/or managing company of a BTA or MTA.

4.0 Recommended Coordination Process

Coordination notices should be delivered on a quarterly basis, or four times annually, to the co-block operator in a neighboring market. If the operators agree that coordination is necessary prior to base station activation, then coordination should occur before the PCS operator initiates commercial operation from any base station within the coordination distance. The coordination notice should include the coordination information included in Appendix A for all sites within the coordination distance whether or not changes have been made since the previous coordination. The coordination distance for all PCS technologies is 35 miles (56 km). Appendix B contains the derivation of the coordination distance.

The coordinating PCS operators are to resolve problems which arise during the coordination process. Coordination does not relieve the notifying PCS operator of any harmful interference that may occur. Nor does coordination relieve the PCS operators of requirements set forth in 47 CFR 24.238. Table 1 indicates the required coordination recipients for co-block coordination.

Table 1 Coordination with Co-block Licensees

Coordination Recipient	PCS Operator Sending a Coordination Notice					
	A	**D**	**B**	**E**	**F**	**C**
A	✘					
D		✘				
B			✘			
E				✘		
F					✘	
C						✘

Coordination procedures for PCS licensees operating in different frequency blocks are not yet defined. Until the procedures are defined, licensees are encouraged to exchange coordination data early during the planning phase. If non-co-block interference occurs, the operators should make every reasonable effort to resolve the interference.[3]

5.0 Considerations for Calculating Interference Levels Between Co-Block Systems

5.1 Allowable System Degradation Due To External System Interference

Each PCS operator should insure that the noise threshold, as defined in Section B.5 of Appendix B, of a geographically neighboring PCS system receiver is not degraded by more

[3] Preliminary studies, provided in TIA TSB-84, indicate that PCS licensees operating in different frequency blocks may cause harmful interference to each other, even when standard guard bands are employed. The frequency plans and channel spacings of each technology are designed with guard bands. These guard bands will aid in avoiding non-co-block interference, but will not prevent all occurrences. For example, guard bands sufficient for wide band technologies are greater than those sufficient for narrow band technologies.

than 1 dB as a result of that operator's co-block interference. The 1 dB limit may be modified by agreement between (or among) neighboring operators as conditions warrant.

5.2 Transceiver Characteristics and Methods for Calculating Interference

Transceiver Characteristics and methods for calculating inter-PCS system interference are contained in TIA TSB-84.

5.3 Transmitter Power Spectral Density

If agreed to by both operators, Power Spectral Density (PSD) curves specific to the equipment utilized by the neighboring PCS operators may be used for coordination purposes. In the absence of mutually acceptable equipment specific PSD curves, transmitter masks provided in TIA TSB-84 may be used.

5.4 Receiver Performance Characteristics

If agreed to by both operators, receiver performance characteristics specific to the equipment utilized by the neighboring PCS operators may be used for coordination purposes. In the absence of mutually acceptable equipment specific receiver performance characteristics, performance characteristics provided in TIA TSB-84 may be used.

6.0 Transborder Coordination

6.1 Canada

The U.S. and Canada concluded an interim sharing arrangement for 1.9 GHz broadband PCS on November 14, 1994 . Section 5 of this agreement details the requirements for inter-PCS coordination:

> "5.0 Coordination between Licensed PCS Operations
>
> "5.1 Both Administrations agree that the following or a similar clause should appear on all authorization documents for PCS base station facilities within 72 km (45 miles) of the border:
>
> > 'This authorization is subject to the condition that, in the event that systems using the same frequencies as granted herein are authorized in an adjacent foreign territory (Canada/United States), future coordination of any base station transmitters within 72 km (45 miles) of the United States/Canada border shall be required to eliminate any harmful interference to operations in the adjacent foreign territory and to ensure continuance of equal access to the frequencies by both countries.'
>
> "5.3 Both Administrations agree that compatible independent operation of PCS systems on either side of the border will be best assured through coordination of pertinent system

operating and technical parameters by the PCS system operators. PCS systems operators shall carry out such coordination and the FCC and Industry Canada shall be notified of any arrangements agreed to, or in the event that a satisfactory arrangement is not reached. In any case, the arrangements reached by the operators will be subject to review by the Administrations."

6.2 Mexico

The U.S. and Mexico concluded a coordination agreement for 1.9 GHz broadband PCS on May 16, 1995. Similar to the agreement with Canada, this agreement requires inter-PCS coordination. Section 5 of the Arrangement states:

> "5.0 Coordination between PCS Operations in the Bands 1850–1910 MHz and 1930–1990 MHz.
>
> "5.1 Both Administrations agree that, in the event that PCS systems authorized under this Protocol by one Administration use the same frequencies as those used by systems authorized by the other Administration, coordination of PCS base station transmitters located within 72 km (45 miles) of the common border shall be required to eliminate any harmful interference to operations in the territory of the other country, and to ensure that both countries continue to have equal access to the frequencies covered in this Protocol.
>
> "5.2 Both Administrations agree to take appropriate measures to eliminate harmful interference."

7.0 Confidentiality

Specific privacy and data confidentiality requirements and the methods to invoke them are left to the discretion of the parties involved in the coordination. Any additional language concerning confidentiality may be addressed in the coordination notice from the PCS operator.

Appendix A Coordination Information and Data Transfer

A.1 Introduction

This Appendix describes the recommended format for the electronic transfer of inter-PCS Coordination Notices (CN). The intent is to simplify and expedite the process of developing and verifying software to exchange and use this data. Another objective has been to maintain consistency with other NSMA data exchange formats. Therefore this format is derived in part from the EPCN formats defined for the PCS-to-MW Electronic Prior Coordination Notice (WG20.95.045, Rev. 3.0) and the Terrestrial Microwave Prior Coordination Notice (WG1.92.034).

Some key aspects of this Appendix are:

- The number of data elements has been kept to a minimum, as well as the number of different types of records.
- The e-mail format is not defined in this document, because it is well-defined and implemented widely in commercial software packages. Simply, the CN can be transferred as an e-mail attachment.
- Similarly, no uuencoding, compression or encryption is defined; the CN is a plain ASCII text file.
- The CN Header and Trailer (or Footer) records have been kept consistent with other EPCNs.
- No response or acknowledgment CN types have been defined, just the basic CN.

A.2 General Format Information

Electronic Coordinations are plain ASCII text files, with one record per line, and comma-separated fields. DOS line ending conventions are used. A recommended suffix of ".ECN" for file names may simplify the recipient's processing of incoming Coordination Notices.

Fields are separated with a comma (,) and are not justified or padded. There must be one delimiter (,) per field, even if the field is empty. All non-numeric fields must be surrounded by double quotes (e.g. `...,123,"This field has a comma, and 1 number",...`). Only printable ASCII characters (decimal values 32 – 126, inclusive) may be used for data. All records are terminated by a carriage return and line feed. No blank lines are allowed.

For increased readability, use both upper and lower case letters for descriptions and narratives.

A.3 Coordination Notice File Transfer

The primary exchange mechanism for Coordination Notices is e-mail, as MIME attachment. This is consistent with a wide variety of commercially available software on all major hardware and software platforms.

Individual parties may agree to additional compression or encryption of the CN prior to attaching it to the e-mail.

As an alternative to e-mail, files may be placed on a DOS formatted disk.

A.4 Types of Records

Four types of records are defined in the electronic Coordination Notice. Each record type is identified by the first field in the record. The following table shows the defined Record Types and the associated identifier:

Record Type	**Identifier**
Header	$ (dollar sign)
Trailer	$ (dollar sign)
Administrative	ADMIN
Sector	SECT

The Header Record identifies the beginning of the CN data file. The Trailer identifies the end of the file. Thus, a computer reading the message can extract the CN data from any other data in which it may be embedded.

The Administrative Record contains information applicable to the entire notice, such as who is sending it, the contact person, etc. The Sector record contains all technical data necessary to perform an interference analysis.

A.5 Detailed Record Descriptions

Each Record Type is described in tabular form below. For each field, the type of data (character or numeric), maximum length, and a description are provided. Each field is also marked as Required, Optional.

The Description column may additionally define a required format or specific literal values for the field. Literal values are listed in **bold**, and must be entered exactly as provided. When a numeric format is provided, a dash (–) indicates that a negative sign may be used. Insignificant leading or trailing zeros may be suppressed.

A.5.1 Header Record

The Header Record contains the text format, the type of data (inter-PCS Coordination Notice), format version number, the serial number of the CN, the revision number of the CN, and the revision date. It is consistent with other NSMA EPCN formats.

Field	Data Type	Maximum Length	Description	Req/Opt
1	Character	1	Record Type	Req
			$ (dollar sign): Header or Trailer	
2	Character	5	Text format	Req
			ASCII: indicates a plain ASCII file	
3	Character	9	Type of the CN and the format version	Req
			IPCN1.0: Inter-PCS Coordination Notice, Version 1.0	
4	Character	12	CN data being sent	Req
			CN: Coordination Notice	
5	Character	10	CN Internal ID (serial or coordination #)	Req
			- Unique to the originating coordinator	
6	Numeric	2	Revision number of this CN serial number	Req
			– 0 to 99	
7	Numeric	8	Date of this revision	Req
			Format: YYYYMMDD	
8	Character	1	End-of-record marker	Req
			$ (dollar sign): Retained for compatibility with other NSMA formats	

A.5.2 Trailer Record

The Trailer is merely: **"$","EPCN End","$"**

Field	Data Type	Maximum Length	Description	Req/Opt
1	Character	1	Record Type	Req
			$ (dollar sign): Header or Trailer	
2	Character	5	End-of-file marker	Req
			EPCN End	
3	Character	1	End-of-record marker	Req
			$ (dollar sign): Retained for compatibility with other NSMA formats	

A.5.3 Administrative Record

The Administrative record contains data describing the entire CN, including the owner, contact information, etc.

Field	Data Type	Maximum Length	Description	Req/Opt
1	Character	5	Record Type	Req
			ADMIN: Administrative Record	
2	Character	40	PCS Licensee/Operator Name	Req
3	Character	40	Contact Name	Req
4	Character	20	Phone Number	Req
5	Character	20	Fax Number	Req
6	Character	40	Internet E-mail Address	Req
7	Character	20	Market Name (e.g. Tulsa MTA)	Req
8	Character	10	PCS Technology N-AMPS (Analog N-AMPS) IS-136 (IS-136 TDMA & AMPS) IS-713 (IS-713 Upbanded AMPS) GSM (J-STD-007 PCS1900(GSM)) PACS (J-STD-014 PACS) IS-95 (IS-95 CDMA) PWT-E (SP-3614 PWT-E) IS-661 (IS-661 CCT) W-CDMA (J-STD-015 W-CDMA)	Req
9	Numeric	1	Lat/Lon flag 1: NAD 83 datum 2: NAD 27 datum	Req
10	Numeric	5	Total number of Sector records	Req
11	Character	60	Comments	Opt

A.5.4 Sector Record

The Sector record provides details of the PCS base station location and each sector that it covers.

This is a variable length record. The Frequency field is repeated for each carrier in the sector. The end of this list of frequencies is indicated by a field containing only an asterisk.

Field	Data Type	Maximum Length	Description	Req/Opt
1	Character	5	Record Type	Req
			SECT: Sector Record	
2	Character	20	Sector ID - A unique identifier for a given transmitting antenna (sector)	Req
3	Character	20	Site Name/ID	Req
4	Numeric	3	Latitude Degrees (North) Format: –NN	Req
5	Numeric	2	Latitude Minutes Format: NN	Req
6	Numeric	5	Latitude Seconds Format: NN.NN	Req
7	Numeric	4	Longitude Degrees (East) Format: –NNN	Req
8	Numeric	2	Longitude Minutes Format: NN	Req
9	Numeric	5	Longitude Seconds Format: NN.NN	Req
10	Numeric	7	Ground Elevation (meters) - Elevation of terrain AMSL at the base of the site Format: –NNNN.N	Req
11	Character	40	Transmitter Manufacturer	Req
12	Character	20	Transmitter Model Number	Req
13	Character	40	Transmit Antenna Manufacturer	Req
14	Character	20	Transmit Antenna Model Number	Req
15	Character	20	Transmit Antenna NSMA/FCC Code	Opt
16	Numeric	3	Transmit Antenna Azimuth (degrees) - The direction in the horizontal plane with respect to true north that the boresight of the antenna is pointed; for omni use 0 Format: NNN	Req
17	Numeric	6	Transmit Antenna Centerline Height AGL (meters) Format: –NNN.N	Req

Sector Record Continued				
Field	Data Type	Maximum Length	Description	Req/Opt
18	Numeric	5	Mechanical Downtilt (degrees) - The angle (+ or –) from the horizontal plane that the direction of the maximum radiation is pointed (e.g., –4.0 = 4 degrees below the horizontal plane) Format: –NN.N	Req
19	Numeric	5	Electrical Downtilt (degrees) - The angle (+ or –) from the horizontal plane that the direction of the maximum radiation is pointed (e.g., –4.0 = 4 degrees below the horizontal plane) Format: –NN.N	Req
20	Numeric	5	EIRP (dBm) - Maximum EIRP of any channel in this sector Format: –NN.N	Req
NN	Numeric	8	Frequency (MHz) - Center frequency of each carrier used in this sector; repeated for each carrier Format: NNNN.NNN	Req
Last field	Character	1	End of frequency list marker * (asterisk)	Req

A.6 Record Order

The first record of the file must be the Header record. It is followed by an Administrative record. The last record of the file must be the Trailer record. These three record types do not appear anywhere else in the file. Sector records associated with the same site must be grouped together. Thus the order of the data records is as follows:

Header Record
Administrative Record
Sector Record (site 1, sector 1)
Sector Record (site 1, sector 2)
Sector Record (site 1, sector 3)
Sector Record (site 2, sector 1)
…
Sector Record (site N, sector 3)
Trailer Record

A.7 Example Coordination Notice Data File

The following example shows a Coordination Notice for a single site with a sectored antenna. Continuations are shown indented, for ease of viewing.

```
"$","ASCII","IPCN1.0","CN","9710090-01",0,19971009,"$"<CR><LF>
"ADMIN","ABC PCS Company","John Doe","(301)555-1212","(301)555-1213",
      "john.doe@abcpcsco.com","Seattle MTA","IS-95",2,3,"This is a comment"<CR><LF>
"SECT","01-01","Site 1, Sector 1",47,41,12.34,-122,22,31.33,55.2,"Tx Make",
      "Tx Model","Northern Telecom","CELLPLUS","999999",0,45.7,0,0,46,1931.250,
      1935,1938.75,"*"<CR><LF>
"SECT","01-02","Site 1, Sector 2",47,41,12.34,-122,22,31.33,55.2,"Tx Make",
      "Tx Model","Northern Telecom","CELLPLUS","999999",120,45.7,0,0,46,1932.5,
      1936.250,1940,"*"<CR><LF>
"SECT","01-03","Site 1, Sector 3",47,41,12.34,-122,22,31.33,55.2,"Tx Make",
      "Tx Model","Northern Telecom","CELLPLUS","999999",240,45.7,0,0,46,1931.250,
      1935,1938.75,"*"<CR><LF>
"$","EPCN End","$"<CR><LF>
```

Appendix B Derivation of 35-Mile Coordination Distance

B.1 Introduction

The 35-mile coordination distance is based upon a set of assumptions believed to represent realistic operating parameters, rather than a "worst-case" interference scenario. Based on calculations and on limited evidence from PCS systems currently in operation, it is believed that the 35-mile coordination distance will be sufficient to trigger coordination for most cases of potential interference, while not being administratively burdensome to PCS providers.

B.2 Interference Metric

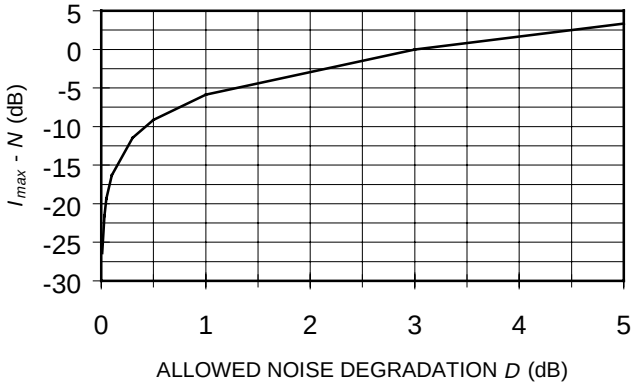
Initial calculations have shown that the controlling interference scenario is a victim mobile handset being interfered with by a co-block base station. The coordination distance is defined as the distance at which the noise level (or outage threshold level) of a victim handset is degraded by 1 dB due to the operation of the co-block base station. The 1 dB degradation metric is commonly employed by the microwave industry (TIA TSB-10F) for interference coordination into digital microwave receivers from other microwave stations and from PCS transmitters operating in the shared 1.9 GHz band.

For a receiver noise power N (dBm) and allowed threshold degradation D (dB), the maximum allowable interference power, I_{max} (dBm), at the input to the victim receiver is

$$I_{\max} = N + 10\log\left(10^{D/10} - 1\right)$$

Using this formula, I_{max} must be more than approximately 6 dB below the existing noise level to meet the 1 dB noise degradation objective. Note that I_{max} decreases rapidly as the degradation objective decreases, as evident from the following figure:

FIGURE B1



In Figure B1, the *y*-axis indicates how far below the existing noise level the interfering signal must be in order to meet the noise degradation objective indicated on the *x*-axis. The conclusion

is that the allowable interference level decreases asymptotically as the allowed noise degradation becomes much smaller than 1 dB.

B.3 Propagation Model

For the purpose of coordination distance calculations, it is assumed that most interference cases will arise at PCS service area boundaries, which generally pass through rural areas. For this reason, a rural (open area) propagation model has been assumed. Specifically, the Hata-COST 231 open area model is employed. The assumed parameters are as follows: frequency f = 1960 MHz (center of PCS band); base station height h_b = 50 meters; and mobile height h_m = 1.5 meters. The propagation loss L (dB) over a distance d (km) is

$$L = 46.56 + 33.79\log(f) - 4.78\left[\log(f)\right]^2 - 13.82\log(h_b) - \left[1.1\log(f) - 0.7\right]h_m + \left[44.9 - 6.55\log(h_b)\right]\left[\log(d)\right]^{\alpha}$$

$$\alpha = \begin{cases} 1 & d \le 20 \text{ km} \\ 1 + \left(0.14 + 1.87\times10^{-4} f + 1.07\times10^{-3} h_b\right)\left[\log(d/20)\right]^{0.8} & d > 20 \text{ km} \end{cases}$$

As written above, the model is valid for frequencies between 1500 and 2000 MHz, for base heights between 30 and 200 meters, mobile heights between 1 and 10 meters, and distances between 1 and 100 km.

Upon inserting the assumed values for f (1960 MHz), h_b (50 m), and h_m (1.5 m),

$$L = 102 + 33.8\left[\log(d)\right]^{\alpha}$$

$$\alpha = \begin{cases} 1 & d \le 20 \text{ km} \\ 1 + 0.56\left[\log(d/20)\right]^{0.8} & d > 20 \text{ km} \end{cases}$$

B.4 Base Transmit Power

The maximum transmit EIRP allowed by the FCC rules is 1640 W (62 dBm) for base stations and 2 W (33 dBm) for mobile stations. However, considerations of link balance in which the forward- and reverse-link signal-to-noise ratios are the same dictate that the forward link EIRP is significantly less than 1640 W.

The link balance calculations are:

$$P_{R,B} = P_M - LL_M - D_M + G_M - BL - PL + DV_B + G_B + LNA_B - LL_B - CD_B,$$
$$P_{R,M} = P_B - CD_B - LL_B + G_B - PL - BL + G_M - LL_M - D_M,$$

Where:

$P_{R,B}$ = Power received at base station from mobile station
$P_{R,M}$ = Power received at mobile station from base station
P_M = Mobile transmit power
P_B = Base transmit power
LL_M = Line loss within the mobile handset
D_M = Mobile duplexer loss
G_M = Gain of mobile antenna
BL = Loss due to body of mobile user
PL = Propagation loss between base and mobile
DV_B = Diversity gain at base station
G_B = Base station antenna gain
LNA_B = Gain of low noise amplifier used on base receive antenna
LL_B = Line loss of base station
CD_B = Loss due to combiner/duplexer at base station

From a signal-to-noise point of view, link balance requires that

$$P_{R,B} = P_{R,M} - \Delta NF,$$

where ΔNF is the improvement in noise figure of the base station over that of the mobile station. This relation, combined with the expressions above, yields

$$P_B = P_M + LNA_B + DV_B + \Delta NF.$$

The EIRP of the base station then becomes

$$\begin{aligned} EIRP_B &= P_B - CD_B - LL_B + G_B \\ &= P_M + LNA_B + DV_B + \Delta NF - CD_B - LL_B + G_B. \end{aligned}$$

Using the following values:

P_M = 31 dBm (allows for $G_M \leq 2$ dB)
LNA_B = $CD_B + LL_B$ (i.e., amplifier compensates for fixed losses)
DV_B = 0 dB (rural area; diversity techniques less efficient and less likely to be used)
ΔNF = 4 dB
G_B = 18 dB

Yields

$$EIRP_B = 31 + 4 + 0 + 18 = 53 \text{ dBm} = 200 \text{ W}.$$

B.5 Noise Threshold

The noise threshold in the absence of external co-block interference is

$$N\,(\text{dBm}) = N_T + NF + I_S$$
$$= -144 + 10\log\left(BW_{kHz}\right) + NF + I_S$$

where $N_T = -144 + 10\log(BW_{kHz})$ is the thermal noise power (dBm) in a bandwidth BW (kHz), NF is the system noise figure (dB), and I_S is the self-interference contribution (dB). The following mobile station parameters were used:

Table B1 Noise Threshold Assumptions

TECHNOLOGY	***BW* (kHz)**	***NF* (dB)**	**I_S (dB)**
IS-95 CDMA	1250	5	10
J-STD-007 PCS1900/GSM	200	5	4
IS-136 TDMA	30	5	7

B.6 Multiple Exposure Allowance

In theory, a given victim technology may be subject to more than one interfering signal. In the case of IS-95 CDMA, for example, as many as 42 separate IS-136 TDMA carriers fit within a single 1.25 MHz IS-95 CDMA bandpass. Also, because of frequency re-use, more than one interfering carrier at a particular frequency may contribute to the interference level.

For the purpose of this computation, however, a multiple exposure allowance of 0 dB is assumed for the following reasons:

- Because of the relatively rapid fall-off in received signal level with distance, and due to the sparseness of base stations within rural areas, interference into the victim receiver will likely be dominated by a single interfering base station.

- Although the single interfering base station may be capable of operating on several frequencies at one time, only one frequency will dominate the interference. This is based on the low usage level in rural areas and the fact that most signals will not be beamed directly towards the victim (assuming the base station has three or more sectors).

B.7 Computation Results

Using the parameters and methods outlined in the previous sections, the distance at which a victim mobile receiver will have its noise threshold degraded 1 dB by an interfering base station is summarized in the following table:

Table B2 Coordination Distance in Kilometers/Miles

	INTERFERING BASE TECHNOLOGY		
VICTIM MS TECHNOLOGY	*IS-95 CDMA*	*J-STD-007 PCS1900(GSM)*	*IS-136 TDMA*
IS-95 CDMA	33/21	33/21	33/21
J-STD-007 PCS1900/GSM	42/26	55/34	55/34
IS-136 TDMA	37/23	49/30	64/40

The maximum coordination distance is 64 km, or 40 miles. To keep from being overly conservative, a representative distance of 56 km/35 miles is the recommended coordination distance.