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CITEL

GUIDE ON RESULTS OF THE CITEL STUDY TO QUANTIFY ISSUES OF INCOMPATIBILITY BETWEEN FWA AND PCS ON THE 1850-1990 MHz BAND

Permanent Consultative Committee III: Radiocommunications
PCC.III
Washington, D.C.
2000

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FOREWORD OF THE CHAIR OF THE PERMANENT CONSULTATIVE COMMITTEE III: RADIOCOMMUNICATION

Ms. Salma Jalife

The Inter-American Telecommunication Commission of the Organization of American States is pleased to present the CITEL Guide on “Results of the CITEL study to quantify issues of incompatibility between FWA and PCS on the 1850-1990 MHz band”.

From 1996 to 1998, the Working Group "to quantify any incompatibility issues between FWA and PCS Systems on the 1850-1990 MHz band" developed several documents. Let's do a brief overview of the contents of this Guide that is divided in Parts.

Part I includes document PCC.III/doc.935/97 “Report of the Interference Experts Group on the Quantification of Incompatibility Issues between FWA and PCS in the 1850-1990 MHz Band” approved at the IXth meeting of PCC.III (22-26 September 1997, Mexico City, Mexico). The report describes the interference between Fixed Wireless Access (FWA) in the 1910-1930 MHz band and Personal Communications Services (PCS), it proposes an analysis methodology and provides results in terms of the minimum separation distances required between the transmitter of one wireless technology and the receiver of another to prevent a given rise in the noise floor in an adjacent-channel receiver.

Part II includes document PCC.III/doc.1077/98 (XI-98) “Comments on document PCC.III/doc.935/97 by the Interference Experts Group” considered at the XIth meeting of PCC.III (14-18 September 1998, Lima, Peru). This document is the result of the consensus work that was done between the Xth and the XIth meeting of PCC.III by the Experts and includes any existing differences of views.

Part III includes document PCC.III/doc.922/97 “Coexistence between FWA and UPCS isochronous equipment in the 1910-1930 MHz band” that was presented by the Interference Experts Group at the IXth meeting of PCC.III.

Part IV includes the presentations of the Seminar “Results of the CITEL study to quantify issues of incompatibility between FWA and PCS in the 1850-1990 MHz band” that was held at the Xth meeting of PCC.III (8-12 June, Natal, Brazil).

In reviewing the results presented here, the reader must bear in mind that analysis of radio interference between different systems is an inherently complex problem. The contents include detailed explanations and references that can be consulted for additional details.

The purpose of this Guide is to assist in the decision-making process involving planning, engineering and deployment of these systems. It should also provide adequate information that will assist in training engineers and planners. I thank all participants for their excellent work.

Salma Jalife
Chair PCC. III

Message of the Chair of the Working Group to quantify any incompatibility issues between FWA and PCS in the range 1850-1990 MHz

Mr. Héctor Budé

At the meeting held in Mexico City in August 1995, the Permanent Consultative Committee III (PCC.III) began work on recommendations concerning the allocation of spectrum in the 1900 MHz band, and since then has produced documents such as recommendations 11/95 and 12/95 which deal with so-called Personal Communication Services (PCS). Subsequently, it was observed that certain administrations were using fixed wireless access technologies on that frequency band, and it was felt that it was important and appropriate to quantify any incompatibility between Fixed Wireless Access Systems (FWA) and Personal Communication Systems in the 1850 - 1990 MHz range.

That task began in December 1996, and, since it involved various aspects and was not a purely technical initiative, there was a slight possibility that there would be some delay in obtaining the results, as did in fact occur.

Today, however, all participants who have directly and indirectly assisted–firms and administrations–can see that the effort was productive. Although not everyone, particularly the firms, is satisfied with it, this report should be consulted by administrations when they evaluate the allocation spectrum for various technologies on the 1850-1990 MHz band.

I therefore wish to thank all participants for their dedication and collaboration in preparing this document. To the Vice Chairs of the Working Group, Mr. Michael Lynch (Nortel) and Mr. Marco Rodolfo Perez (Ericsson Colombia), and the experts, a special vote of thanks.

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Héctor Budé
Chair of the Working Group

Part 1

REPORT OF PCC.III INTERFERENCE EXPERTS GROUP ON INCOMPATIBILITY ISSUES BETWEEN FWA AND PCS SYSTEMS

Document PCC.III/doc. 935/97 (IX-97)

IX MEETING OF PERMANENT
CONSULTATIVE COMMITTEE III:
RADIOCOMMUNICATIONS
September 22 to 26, 1997
Mexico City, Mexico

Part 1.

EXECUTIVE SUMMARY OF THE REPORT OF THE PCC.III INTERFERENCE EXPERTS GROUP ON INCOMPATIBILITY ISSUES BETWEEN FWA AND PCS SYSTEMS

This report discusses the analysis of the PCC.III Interference Experts Group regarding interference between Fixed Wireless Access (FWA) in the 1910-1930 MHz band and Personal Communications Services (PCS). For licensed PCS, which operates in the bands 1850-1910 MHz and 1930-1990 MHz, it is the potential for adjacent channel interference that is of concern. The results of the Group's analysis are presented in terms of the minimum separation distances required between the transmitter of one wireless technology and the receiver of another to prevent a given rise in the noise floor in an adjacent-channel receiver. For unlicensed PCS (UPCS), which operates in the 1910-1930 MHz band, the concern is the potential for cochannel interference between FWA and UPCS. Due to time constraints, the Group was unable to arrive at closure on the FWA/UPCS issue, and the reader is referred to two contributions submitted to the Group on this topic.[1]

In reviewing the results presented here, the reader must bear in mind that analysis of radio interference between different systems is an inherently complex problem. However, time constraints did not allow for a more detailed assessment. In fact, the time pressure was such that changes to the numerical calculations and parameters were still being made on the day that this report was released. Some specific areas of investigation which might warrant additional work are identified in Section IV. The reader is encouraged to review that section to better understand the context of the results and the summary table. The reader is also encouraged to consult the detailed calculations and results for each case, which show the rise in noise floor vs. separation distance for adjacent-channel interference.

[1] PCC.III-918/97, "Analysis of Cochannel Interference from DECT FWA Systems to Isochronous UPCS" and PCC.III-922/97,"Coexistence Between FWA and Isochronous UPCS Equipment on the Band 1910-1930 MHz"

1. INTRODUCTION

1.1. OBJECTIVE

The objective of this report is to quantify the interference between:

- FWA TDD systems (1910-1930 MHz) and PCS systems operating in adjacent bands (1850-1990 MHz)
- FWA TDD systems and UPCS systems operating in the same band (1910-1930 MHz)

As a reference, a secondary priority is to quantify the interference between:

- PCS systems and PCS systems operating in adjacent frequency sub-bands (1850-1910, 1930-1990 MHz)
- FWA TDD systems and FWA TDD systems operating in the same band (1910-1930 MHz)

1.2. SCOPE

The following systems were analyzed:

- PCS systems: PCS1900, IS-95 CDMA, IS-136 TDMA
- FWA systems: DECT, PHS
- UPCS systems: PCI, PACS-UA, PACS-UB, PWT (the Etiquette Rules allow us to perform a common analysis, treating all the UPCS systems as a common technology)

1.3. BACKGROUND

Before the creation of this Experts Group, several individual contributions were presented to CITEL PCC.III by CITEL members. These contributions attempted to highlight interference issues, however, they used different assumptions and therefore the Experts Group was created to quantify interference using a consistent set of parameters, assumptions and methodologies.

This Experts Group met three times coinciding with the CITEL PCC.III meetings in Cartagena de Indias, Brasilia and Mexico City. They have also conducted 5 audio teleconferences as well as numerous e-mail exchanges.

2. PCS-PCS AND PCS-FWA CASE

2.1. METHODOLOGY AND PARAMETERS

This section provides the methodology and parameters for the analysis of PCS-PCS and PCS-FWA coexistence in adjacent frequency bands.

2.1.1. Methodology

The methodology described here has been generally agreed by all the Interference Experts Group participants. However, there were some disagreements, in these cases the different approaches are also described.

The methodology is based on the following assumptions:

- The basic threshold parameter to analyse the interference is the Rise In The Noise Floor which occurrs when external interference appears.
- This methodology calculates:
    - the required minimum signal attenuation in the air interface,
    - and by applying the chosen propagation model, the corresponding minimum distance .

for each scenario between a single interfering TX and victim RX device.

- The methodology assumes that both victim and interferer are operating at the closest possible adjacent channels.
- This methodology only uses emissions due to the modulation mask and does not consider other emissions such as out-of-band emissions, spurious emissions, etc.. For the calculations these masks have been extended beyond the immediate channel from the carrier. The emissions due to modulation were chosen as highest priority.
- This methodology does not take into account the probability of interference.
- The methodology uses the following steps:
    1. Calculate the maximum level of the interfering TX at the antenna output. To do that, it is assumed that TX is working at the adjacent carrier to the victim system, at maximum power and with the two TX antenna alignments relative to the victim RX position.
    2. Calculate the maximum level of the interfering signal which can be tolerated at the victim RX antenna. The interference is calculated when the RX is working at the minimum operating threshold level, , and assuming a specific Rise in the Noise Floor. Two RX antenna alignments relative to the interfering TX position have been assumed.
    3. The Path Loss difference between above two values gives the required isolation in the air interface. Then, propagation model is applied to obtain the required minimum separation distance between interfering TX and victim RX devices.
- The above calculations assume only one single interfering signal. There was a disagreement within the group about this matter. The two main views were:
    a) The effect of any other interfering signal is negligible.
    b) The effect of multiple interfering signals needs to be considered. Due to shortage of time, this approach was not investigated.
- The group could not agree on whether to include or not include Rayleigh fading margin for the wanted signal in the calculation. Both approaches have been used.

2.1.2. Formulae and Variable Description

The following agreed variables have been defined to be used in calculations.
By convention, terms are presented in two ways: without any prime symbol ' it represents analog value (e.g. watts or power ratios) and with a prime symbol ' it represents the logarithmic equivalence (e.g. dB, or dBm)

2.1.2.1 Transmitter Path

Parameter		**Description**
Analog form	**logarith. form**	
P_L (Mw)	P'_L (dBm)	Launch power of the interfering device at TX antenna output. Its value is obtained by calculation (see formulae)
P_{max} (mW)	P'_{max} (dBm)	Peak power of the interfering transmitter during active burst (value given in systems specifications)
	G'_{tx} (dB)	Gain due to TX antenna system, including feeder effects. Its value is obtained by calculation (see formulae)
	L'_{mask} (dB)	Losses due to the TX emission mask. This value is obtained as the relative difference between P'_{max} and the power level (in dBm) of the TX emission mask due to modulation (as specified in the standards), at a given frequency offset and adjusting the measurement bandwidth of the mask to the victim RX bandwidth.
	G'_{txant} (dBi)	Isotropic gain of TX antenna. A reference value was agreed by the Experts group for each system taken into account actual deployments
	L'_{txant} (dB)	Losses due to the directivity of TX antenna. Both horizontal and Vertical radiation patterns have been taken into account. Reference values have been agreed by Experts Group based on actual deployments.
	$L'_{txfeeder}$ (dB)	Losses due to the antenna feeder. Reference values have been agreed by Experts Group based on actual deployments.

2.1.2.2 Receiver path

Parameter		Description
analog form	**logarith. form**	
P_R (mW)	P'_R (dBm)	Maximum allowed interfering signal at the RX antenna.
D (ratio)	D' (dB)	Rise in the Noise Floor (also called "desentization"). It is the basic interference threshold assumed in calculations (see formulae)
$RX_{sensitivity}$ (mW)	$RX'_{sensitivity}$ (dBm)	RX sensitivity level to assure a BER < 10^{-3} performance. Its value is defined in the corresponding systems specifications
CIR	CIR' (dB)	Specific C/I ratio defined in system specifications for a system alone (i.e. without external interference). It has been agreed the assumption that this ratio is constant for the whole range of received useful signal.
	F'_{margin} (dB)	Fading Margin used in power budget calculations in normal system deployments. Its value has been agreed by Experts Group for each system
	G'_{rx} (dB)	Gain due to RX antenna system, including feeder effects. Its value is obtained by calculation (see formulae)
	G'_{rxant} (dBi)	Isotropic gain of RX antenna. A reference value was agreed by the Experts group for each system taken into account actual deployments
	L'_{rxant} (dB)	Losses due to the directivity of RX antenna. Both horizontal and Vertical radiation patterns have been taken into account. Reference values have been agreed by Experts Group based on actual deployments.
	$L'_{rxfeeder}$ (dB)	Losses due to the antenna feeder. Reference values have been agreed by Experts Group based on actual deployments.

2.1.2.3 Propagation Model

The propagation model used, is the two-slope model, which has been chosen for simplicity. This model can be expressed as:

$L'(dB) = 38 + 20 \log(d)$, for $1 < d < 4h_{tx}h_{rx}/\lambda$ (in meters) (1a)

$L'(dB) = 38 - 20 \log(4h_{tx}h_{rx}/\lambda) + 40 \log(d)$, for $d \geq 4h_{tx}h_{rx}/\lambda$ (in meters)(1b) where, h_{tx} and h_{rx} are the TX and RX antenna heights and λ is the wavelength.

2.1.2.4 Formulae

- For the transmitter path two simple equations have to be taken into account:

$$P'_L \text{ (dBm)} = P'_{max} \text{ (dBm)} + G'_{tx} \text{ (dB)} - L'_{mask} \text{ (dB)} \quad (2)$$

where,

$$G'_{tx} \text{ (dB)} = G'_{txant} \text{ (dBi)} - L'_{txant} \text{ (dB)} - L'_{txfeeder} \text{ (dB)} \quad (3)$$

- For the receiver path some more complex calculation should be made:

The fundamental philosophy that has been adopted is that the effect of interference can be modelled (at least for our purposes) as an increase in received interference power. The primary interference metric agreed is the rise in the noise floor D, i.e. the increase in noise+interference power compared to the original noise+interference power:

$$D = (N + I_{act} + I_{ext}) / (N + I_{int}) \quad (4a)$$

or, in dB,

$$D' = 10 \log(N + I_{act} + I_{ext}) - 10 \log(N + I_{int}) \quad (4b)$$

where,

N = an equivalent noise power in the receiver and includes allowance for receiver implementation and, sometimes, fading threshold as well as pure thermal noise.

I_{int} = the internal (expected) interference power from the victim system itself - both same cell/sector and adjacent cell/sector, before any external interference is applied

I_{act} = the internal (expected) interference power from the victim system itself - both same cell/sector and adjacent cell/sector, after any external interference is applied. Note that in same cases $I_{act} = I_{int}$

I_{ext} = the incremental external interference power received from the interfering system

If we assume that interference is a single event, that is assuming only a worst case of single interference, it can be assumed that $I_{act} = I_{int}$. Then re-writing (4a):

$$D = 1 + I_{ext} / (N + I_{int}) \quad (5)$$

In other hand, a fundamental relationship between C and I and N can be modeled as:

$$M = C / (N+I) \quad (6)$$

where

C = the received carrier power level on the channel
N = an equivalent noise power in the receiver (as before defined)
I = the same-channel received interference power
M = the specified minimum carrier-to-noise+interference ratio needed to guarantee the specified performance. M is colloquially referred to as the C-to-I (C/I) ratio.

then, this basic relationship can be applied to our analysis, assuming a C value equal to C_{ref} (minimum operative RX level) and I value equal to I_{int}, as follows

$$M = CIR = C_{ref} / (N+I_{int}) \quad (7a)$$

or,

$$N+I_{int} = C_{ref} / M = C_{ref} / CIR \qquad (7b)$$

Then substituting ($N + I_{int}$) in (5):

$$D = 1 + I_{ext} / (C_{ref} / CIR) \qquad (8)$$

And from this equation, the maximum external interference level allowed by the receiver can be deduced:

$$I_{ext} = C_{ref} * (D - 1) / CIR \qquad (9a)$$

$$I'_{ext} = C'_{ref} - CIR' + 10 \log(10^{0.1 D'} - 1) \qquad (9b)$$

Finally, it is also necessary to define what is the C_{ref} value. There is a disagreement within the Experts group regarding "Rayleigh fading margin". If the approach is to include fading, then the value of C_{ref} should be the Receiver Sensitivity with Rayleigh Fading (as indicated in section 2.2.2). If the approach is to remove fading, the value of C_{ref} should be the Receiver Sensitivity with No Fading (as indicated in section 2.2.2).

Therefore two equations are obtained for the receiver path (note that RX antenna effects have been already included):

- Including fading margin in calculations:

$$P'_R\,(dBm) = RX'_{sensitivity\ w\ Fading}\,(dBm) - (C'/I') + 10\log(10^{0.1D'}-1) - G_{rx} \qquad (10a)$$

- Excluding fading margin in calculations:

$$P'_R\,(dBm) = RX'_{sensitivity\ w/o\ Fading}\,(dBm) - (C'/I') + 10\log(10^{0.1D'}-1) - G_{rx} \qquad (10b)$$

in both cases:

$$G'_{rx}\,(dB) = G'_{rxant}\,(dBi) - L'_{rxant}\,(dB) - L'_{rxfeeder}\,(dB) \qquad (11)$$

- Final formulae:

According to point 2.1.2.3 and the above formulae (2) and (10a, 10b), the final power calculation should comply with the following rule:

$$L'\,(dB) \geq P'_L\,(dBm) - P'_R\,(dBm) \qquad (12)$$

and then, the minimum required distance can be calculated by (1a) and (1b) assuming a single interferer.

2.1.3. Probability Estimation

This methodology does not take into account the probability of interference. The Group has discussed this issue, but no agreement on how to assess the probability has been reached.

2.1.4. Other Considerations

- All the systems considered in the analysis include a set of mechanisms to avoid interference. These mechanisms have not been considered in the quantitative calculation performed. These mechanisms are Power Control, Frequency Hopping, Intracell and Intercell handover, Dynamic Channel Allocation, etc.
- The methodology does not highlight some other issues, such as: cell radius of victim and interferer systems, site engineering, etc
- The Experts Group has implemented the methodology in an Excel Spreadsheet tool, which allows anyone to perform the calculation in an easy way by simply inputing basic parameters (involved systems, desired guard-band, desired desentization parameter, option to include or

not the fading margin, etc.). This tool has been used to obtain the results (see section 2.3) of these calculations.

2.2. SYSTEM DESCRIPTION AND PARAMETERS

It is not the aim of this report to describe each analyzed technology but only give the values of the parameters which have been agreed for calculation.

Most of these parameters were set in the second meeting of the Experts Group [3], some improvements and additional settings have been made during following audio teleconferences.
In some cases, the Group was unable to chose whether to use a typical, best or worst value for a parameter. Therefore a plausible value was chosen and called the "reference" value. A range of values for some system parameters was also selected. The analysis will initially assume the "reference" value and any further sensitivity analysis would encompass other values within the range as appropriate for the technology.

For example, the Group considers the interference threshold "reference" value of 1dB within a range between 0.5 to 3 dB.

2.2.1. Frequency data

System	TX/RX nominal BW (kHz)	Nominal Carrier Spacing (kHz)	3dB Receiver BW (kHz)	Inband Ref. BW for mask (kHz)
PCS1900	200	200	230	30
IS-95	1228,8	1250,0	1228,8	10
IS-136	30	30	34	0,3
DECT	1728	1728	1000	1000
PHS	192	300	192	1

(data in kHz)

2.2.2. Transmitter and Receiver Data

System	Device	Transmit Power (dBm)	Receiver Sensitivity with Rayleigh Fading (dBm) (*1*)	Receiver Sensitivity with No Rayleigh Fading (dBm) (*2*)	Receiver C/I (dB)
PCS1900	**Base**	46	-104	[-111]	9
	Terminal	33	-102	[-109]	9
IS-95	**Base**	43	-120	[-127]	-12
	Terminal	23	-105	[-112]	-9
IS-136	**Base**	47	-103	[-110]	17
	Terminal	30	-103	[-110]	17
DECT	**Base**	24	[-76]	-86	10
	Terminal	24	[-76]	-86	10
PHS	**Base**	22 [2]	[-78]	-88 [1]	12
	Terminal	19	[-78]	-88 [1]	12

Notes: Receiver Sensitivity Numbers between brackets [ ]are not the standard values (they are estimations)

- Column (*1*) should be used if the approach of including Rayleigh fading is selected
- Column (*2*) should be used if the approach of removing any Rayleigh fading is selected

The effects of shadow fading are not included in this table and will be addressed elsewhere.

1 The PHS Standard specifies 16 dBμ for BER = 10^{-2}. However this level is too low to ensure system operation, so -88 dBm was set by the PHS MoU as the minimum operational level.

2 According to RCR-28, the maximum base transmitter power is 4W (+36 dBm). We have used +22 dBm in the calculations as this is a normal maximum power.

2.2.3. Antenna and Feeder Parameters

System	Device	Antenna Height (m)	TX/RX Gain (dBi)	Horiz. Beamw. (º)	Vert. Beamw. (º)	Downtilt (º)	Feeder Losses (dB)
PCS1900	**Base**	25	17	105	9	-3	2
	Terminal	1,5	0	omni	omni	0	0
IS-95	**Base**	25	17	105	9	-3	2
	Terminal	1,5	0	omni	omni	0	0
IS-136	**Base**	25	17	105	9	-3	2
	Terminal	1,5	0	omni	omni	0	0
DECT	**Base**	15	12	120	17	-7	1
	Terminal	8	10	60	60	2	1
PHS	**Base**	15	10	omni	8	-7	1
	Terminal	8	10	60	60	2	1

Transmitter and receiver antennae should assume a 1dB loss when on-horizontal-beam and 25 dB losses when off-horizontal-beam relative to the gain values. It gives four different scenarios to be treated:

Case 1A: Both TX and RX antennae are on-beam (total losses of 1+1 dB)

Case 1B: RX antenna is on TX beam, but TX antenna is out of RX beam (total losses 1+25 dB)

Case 2A: TX antenna is on RX beam, but RX antenna is out of TX beam (total losses 25+1 dB)

Case 2B: Both TX and RX antennae are off-beam (total losses 25+25 dB)

Related to the vertical radiation antenna pattern additional losses relative to the gain values have been also assumed according to the typical vertical patterns and as a function of the distance between interfering TX and victim RX.

Only reference values for antenna patterns were used.

2.2.4. Transmitter modulation masks

2.2.4.1 PCS-1900

Frequency Offset (kHz)		**BASE STATION**		**TERMINAL (MOBILES)**	
from	**To**	**Measurem. bandwidth (kHz)**	**TX Noise Floor at offset (dBc)**	**Measurem. bandwidth (kHz)**	**TX Noise Floor at offset (dBc)**
100	200 (*)	30	0,5	30	0,5
200	250 (*)	30	-30,0	30	-30,0
250	400 (*)	30	-33,0	30	-33,0
400	600 (*)	30	-60,0	30	-60,0
600	1200 (**)	30	-70,0	30	-60,0
1200	1800 (**)	30	-73,0	30	-60,0
1800	6000 (**)	100	-75,0	100	-68,0
>6000	(**)	100	-80,0	100	-76,0

(*) For frequency offset values within this margin the TX Noise Floor should be linearly interpolated

(**) For frequency offset values within this margin the TX Noise Floor is constant

2.2.4.2 IS-95 CDMA

Frequency Offset (kHz)		**BASE STATION**		**TERMINAL (MOBILES)**	
from	**To**	**Measurem. bandwidth (kHz)**	**TX Noise Floor at offset (dBc)**	**Measurem. bandwidth (kHz)**	**TX Noise Floor at offset (dBc)**
590	885 (*)	30	0.0	30	0.0
885	1250 (*)	30	-29.0	30	-11,6
1250	1980 (**)	30	-29.0	30	-26,0
1980	2250 (**)	30	-39.0	30	-34,0
>2250	(**)	30	-52.0	30	-35,0

(*) For frequency offset values within this margin the TX Noise Floor should be linearly interpolated

(**) For frequency offset values within this margin the TX Noise Floor is constant

2.2.4.3 IS-136 TDMA

Frequency Offset (kHz)		**BASE STATION**		**TERMINAL (MOBILES)**	
from	**to**	**Measurem. bandwidth (kHz)**	**TX Noise Floor at offset (dBc)**	**Measurem. bandwidth (kHz)**	**TX Noise Floor at offset (dBc)**
30	60 (**)	0,3	-26,0	0,3	-26,0
60	90 (**)	0,3	-45,0	0,3	-45,0
>90	(**) (***)	0,3	-60,0	0,3	-45,0

(**) For frequency offset values within this margin the TX Noise Floor is constant

(***) Specs of the TX Noise Floor if RX victim is in the 1910-1930 MHz range is fixed to -48,29 dBm (-95,29 dBc) @ 300 Hz

2.2.4.4 DECT

Frequency Offset (kHz)		**BASE STATION**		**TERMINAL (MOBILES)**	
from	**to**	**Measurem. bandwidth (kHz)**	**TX Noise Floor at offset (dBc)**	**Measurem. bandwidth (kHz)**	**TX Noise Floor at offset (dBc)**
1228	2956 (*)	1000	-32,0	1000	-32,0
2956	4684 (*)	1000	-54,0	1000	-54,0
4684	6412 (*)	1000	-68,0	1000	-68,0
>6412	(**)	1000	-71,0	1000	-71,0

(*) For frequency offset values within this margin the TX Noise Floor should be linearly interpolated

(**) For frequency offset values within this margin the TX Noise Floor is constant

2.2.4.5 PHS

Frequency Offset (kHz)		BASE STATION		TERMINAL (MOBILES)	
from	**to**	**Measurem. bandwidth (kHz)**	**TX Noise Floor at offset (dBc)**	**Measurem. bandwidth (kHz)**	**TX Noise Floor at offset (dBc)**
0	300 (*)	1	0,0	1	0,0
300	600 (*)	1	-30,0	1	-30,0
600	750 (*)	1	-53,0	1	-53,0
750	900 (*)	1	-60,0	1	-60,0
>900	(**)	1	-65,0	1	-65,0

(*) For frequency offset values within this margin the TX Noise Floor should be linearly interpolated

(**) For frequency offset values within this margin the TX Noise Floor is constant

2.2.5. Adjacent frequency bands

- PCS BS interfering PCS Terminal: selected adjacent bands are A and D, respectively
- PCS Terminal interfering PCS BS: selected adjacent bands are F and C, respectively
- PCS BS interfering FWA: selected adjacent bands are A and 1910-1930 MHz, respectively
- PCS Terminal interfering FWA: selected adjacent bands are C and 1910-1930 MHz, respectively
- FWA interfering PCS BS: selected adjacent bands are 1910-1930 MHz and C respectively
- FWA interfering PCS Terminal: selected adjacent bands are 1910-1930 MHz and A, respectively

Within these assumed frequency bands following adjacent frequencies are considered:

(data in MHz)		If victim receiver is a Base Station of …									
Interfering TX		**PCS1900**		**IS-95**		**IS-136**		**DECT**		**PHS**	
System	**Device**	**TX freq.**	**RX freq.**	**TX freq.**	**RX freq.**	**TX freq.**	**RX freq.**	**TX freq.**	**RX freq.**	**TX freq.**	**RX freq.**
PCS1900	**Base**	n/a		n/a		n/a		1930,200	1928,448	1930,200	1929,350
	Terminal	1894,800	1895,200	1894,800	1896,250	1894,800	1895,400	1909,800	1912,896	1909,800	1910,450
IS-95	**Base**	n/a		n/a		n/a		1931,250	1928,448	1931,250	1929,350
	Terminal	1893,750	1895,200	1893,750	1896,250	1893,750	1895,400	1908,750	1912,896	1908,750	1910,450
IS-136	**Base**	n/a		n/a		n/a		1930,080	1928,448	1930,080	1929,350
	Terminal	1894,920	1895,200	1894,920	1896,250	1894,920	1895,400	1909,920	1912,896	1909,920	1910,450
DECT	**Base**	1912,896	1909,800	1912,896	1908,750	1912,896	1909,920	n/a		n/a	
	Terminal	1912,896	1909,800	1912,896	1908,750	1912,896	1909,920	n/a		n/a	
PHS	**Base**	1910,450	1909,800	1910,450	1908,750	1910,450	1909,920	n/a		n/a	
	Terminal	1910,450	1909,800	1910,450	1908,750	1910,450	1909,920	n/a		n/a	

(data in MHz)		If victim receiver is a Terminal of …									
Interfering TX		**PCS1900**		**IS-95**		**IS-136**		**DECT**		**PHS**	
System	**Device**	**TX freq.**	**RX freq.**	**TX freq.**	**RX freq.**	**TX freq.**	**RX freq.**	**TX freq.**	**RX freq.**	**TX freq.**	**RX freq.**
PCS1900	**Base**	1944,800	1945,200	1944,800	1946,250	1944,800	1945,080	1930,200	1928,448	1930,200	1929,350
	Terminal	n/a		n/a		n/a		1909,800	1912,896	1909,800	1910,450
IS-95	**Base**	1943,750	1945,200	1943,750	1946,250	1943,750	1945,080	1931,250	1928,448	1931,250	1929,350
	Terminal	n/a		n/a		n/a		1908,750	1912,896	1908,750	1910,450
IS-136	**Base**	1944,960	1945,200	1944,960	1946,250	1944,960	1945,080	1930,080	1928,448	1930,080	1929,350
	Terminal	n/a		n/a		n/a		1909,920	1912,896	1909,920	1910,450
DECT	**Base**	1928,448	1930,200	1928,448	1931,250	1928,448	1930,080	n/a		n/a	
	Terminal	1928,448	1930,200	1928,448	1931,250	1928,448	1930,080	n/a		n/a	
PHS	**Base**	1929,350	1930,200	1929,350	1931,250	1929,350	1930,080	n/a		n/a	
	Terminal	1929,350	1930,200	1929,350	1931,250	1929,350	1930,080	n/a		n/a	

2.3. RESULTS

2.3.1. Results of the quantitative calculation of required distances in the interference analysis between PCS and/or FWA applications

The results are attached to this document. An extract with Tx and RX antennae on-beam for 1dB rise in the noise floor is given below for:

- "Required Distance" with Rayleigh fading
- "Required Distance" without Rayleigh fading
- "Path Loss" with Rayleigh fading
- "Path Loss" without Rayleigh fading

It has been also assumed that there are no extra guard-bands, i.e. the adjacent frequencies are used. No improvements on the TX emission masks were assumed.

These kinds of results could be insufficient to make an interpretation of the absolute level of interference. But it could be used to perform a comparative analysis or a cell-size normalized analysis of each scenario.

2.3.2. Minimum Distances for 1 dB of the Rise in the Noise Floor

Following tables show the minimum required distances if 1 dB of Rise in the Noise Floor is allowed for the case when both transmit and receive antennas are on-beam.

2.3.2.1 Assuming that fading is included in calculations

Minimum Distance if 1dB interference (rise in noise floor) allowed (in meters)		**PCS 1900 PCS Victim**	**PCS 1900 PCS Victim**	**IS-95 CDMA PCS Victim**	**IS-95 CDMA PCS Victim**	**IS-136 TDMA PCS Victim**	**IS-136 TDMA PCS Victim**	**DECT FWA Victim**	**DECT FWA Victim**	**PHS FWA Victim**	**PHS FWA Victim**
PCS Interferer		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS 1900	BS	†	2724	†	824	†	9642	690	748	2	585
	Terminal	1480	†	1747	†	1378	†	3	33	5	84
IS-95 CDMA	BS	†	6438	†	1191	†	6726	1248	1385	4064	6963
	Terminal	2715	†	1999	†	2647	†	245	209	250	310
IS-136 TDMA	BS	†	4530	†	3008	†	4733	109	150	0.3	0.7
	Terminal	4530	†	5349	†	4218	†	0.4	0.6	0.2	0.3
FWA Interferer		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
DECT FWA	BS	1123	914	588	158	1088	1043	*	*	*	*
	Terminal	1217	648	652	127	1180	740	*	*	*	*
PHS FWA	BS	971	175	366	4.3	2347	268	*	*	*	*
	Terminal	1916	133	919	47	3850	237	*	*	*	*

* Analysis not completed

† Not critical

2.3.2.2 Assuming that fading is removed from calculation

Minimum Distance if 1dB interference (rise in noise floor) allowed (in meters)		**PCS 1900 PCS Victim**	**PCS 1900 PCS Victim**	**IS-95 CDMA PCS Victim**	**IS-95 CDMA PCS Victim**	**IS-136 TDMA PCS Victim**	**IS-136 TDMA PCS Victim**	**DECT FWA Victim**	**DECT FWA Victim**	**PHS FWA Victim**	**PHS FWA Victim**
PCS Interferer		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS 1900	BS	†	3982	†	1310	†	14427	2133	2158	605	1765
	Terminal	2214	†	2614	†	2061	†	140	110	231	270
IS-95 CDMA	BS	†	9633	†	1782	†	10064	3947	3993	11138	12383
	Terminal	4062	†	2857	†	3783	†	638	452	541	552
IS-136 TDMA	BS	†	6778	†	4500	†	7082	486	552	1.1	298
	Terminal	6778	†	8003	†	6312	†	1.1	3	0.5	1.0
FWA Interferer		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
DECT FWA	BS	2456	1367	1286	319	2381	1533	*	*	*	*
	Terminal	2485	970	1426	288	2409	1107	*	*	*	*
PHS FWA	BS	2497	308	996	158	5253	500	*	*	*	*
	Terminal	4096	301	1965	108	6628	407	*	*	*	*

* Analysis not completed

† Not critical

2.3.3. Minimum Required Path Loss (dB) for 1 dB in Rise in the Noise Floor

Following tables show the minimum required path loss (in dB) if 1 dB of Rise in the Noise Floor is allowed for the case when both transmit and receive antennas are on-beam.

2.3.3.1 Assuming that fading is included in calculations

Minimum Path Loss if 1dB interference (rise in noise floor) allowed (in meters)		**PCS 1900 PCS Victim**	**PCS 1900 PCS Victim**	**IS-95 CDMA PCS Victim**	**IS-95 CDMA PCS Victim**	**IS-136 TDMA PCS Victim**	**IS-136 TDMA PCS Victim**	**DECT FWA Victim**	**DECT FWA Victim**	**PHS FWA Victim**	**PHS FWA Victim**
PCS Interferer		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS 1900	BS	†	115,9	†	97	†	137.8	94.9	95.6	44.7	93.5
	Terminal	105.3	†	108.2	†	104.0	†	46.0	68.4	52.7	76.6
IS-95 CDMA	BS	†	131	†	102	†	132	100	101	110	118
	Terminal	116	†	111	†	115	†	86	85	86	88
IS-136 TDMA	BS	†	124.7	†	118	†	125.5	78.9	81.7	28.6	34.9
	Terminal	124.7	†	127.6	†	123.5	†	29.2	33.5	22.6	27.9
FWA Interferer		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
DECT FWA	BS	99.1	101.3	93.4	82	98.8	103.6	*	*	*	*
	Terminal	99.8	100.8	94.3	80	95.5	103.1	*	*	*	*
PHS FWA	BS	98	83	89	51	106	87	*	*	*	*
	Terminal	104	81	97	72	110	86	*	*	*	*

* Analysis not completed
† Not critical

2.3.3.2 Assuming that fading is removed from calculation

Minimum Path Loss if 1dB interference (rise in noise floor) allowed (in meters)		**PCS 1900 PCS Victim**	**PCS 1900 PCS Victim**	**IS-95 CDMA PCS Victim**	**IS-95 CDMA PCS Victim**	**IS-136 TDMA PCS Victim**	**IS-136 TDMA PCS Victim**	**DECT FWA Victim**	**DECT FWA Victim**	**PHS FWA Victim**	**PHS FWA Victim**
PCS Interferer		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS 1900	BS	†	122.5	†	103	†	144.8	104.7	104.8	93.8	103.1
	Terminal	112.3	†	115.2	†	111.0	†	81.0	78.9	85.3	86.7
IS-95 CDMA	BS	†	138	†	109	†	139	110	110	120	128
	Terminal	123	†	117	†	122	†	95	95	93	98
IS-136 TDMA	BS	†	131.7	†	125	†	132.5	91.9	93.0	38.6	87.6
	Terminal	131.7	†	134.6	†	130.5	†	39.2	48.1	32.6	37.9
FWA Interferer		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
DECT FWA	BS	105.9	108.3	100.2	88	105.6	110.3	*	*	*	*
	Terminal	106.0	107.8	101.1	87	105.7	110.1	*	*	*	*
PHS FWA	BS	106	88	98	82	113	92	*	*	*	*
	Terminal	110	88	104	79	117	93	*	*	*	*

* Analysis not completed

† Not critical

3. COEXISTENCE ANALYSIS BETWEEN UNLICENSED PCS AND FWA TDD APPLICATIONS WITHIN THE 1910-1930 MHZ BAND

The analysis of UPCS and FWA systems operating in the same band remains an open issue and needs further study. The Experts Group received two contributions analysing the interference between UPCS and FWA systems operating in the same frequency band 1910-1930 MHz, however, they were not addressed by the Experts Group, because of lack of time. These documents are:

1. PCC.III-918/97 "Analysis of Co-Channel Interference from DECT FWA Systems to Isochronous UPCS"
2. PCC.III-922/97 "Coexistence between FWA and Isochronous UPCS Equipment on the band 1910-1930 MHz"

It is recommended that administrations read these contributions for further information on the interference between FWA systems and UPCS systems operating in the same band 1910-1930 MHz.

4. DISCUSSION / SUMMARY

4.1. INTRODUCTION

The Experts' Group has been unable to reach agreement on many issues, and in such cases the comments presented below attempt to objectively reflect this. Overall because there are so many fundamental issues and unanswered questions, it is not possible to fully assess the risk level for the interference between any pair of technologies. In some cases, it might be argued that the original Terms of Reference did not fully reflect the scope and complexity of the different technologies. The Group has consequently identified a list of issues which require additional comment and/or study.
This section addresses these important issues, which may be categorized into the following broad categories:

- topics which are related to, or should be added to, the subjects addressed in the preceding main body of this report in the interests of completeness and objectivity. In particular, there is considerable concern as to the adequacy of the underlying assumptions and simplifying criteria used in the interference scenarios.
- topics which relate to the results tabulated in the preceding main body of the report. Considerable effort has been expended in attempts to present guidance to the reader in the interpretation of the raw output data.
- any other topics which the Group considers worthy of further consideration, and arising as a result of the extensive discussions

4.2. HOW TO READ THE TABLES

The Group could not agree on how CITEL members should read the tables below. Therefore, both alternative views are presented:

(a) Each column in the tables contains the effect of different interfering devices in terms of required separation between interfering and victim devices. Since calculations have been made under the same assumptions, independently of any other considerations (cell sizes, co-site assumptions, probabilities, etc.), each column shows a comparative level of interference between all the considered interfering devices. This comparison should be interpreted in the following way:

- for each column, higher values of required distance correspond to higher emitted interference levels
- if values for FWA-PCS scenarios are comparable or lower than the values for PCS-PCS scenarios this implies no harmful interference.

(b) Each value in the table should be compared with the actual deployment of each technology. For example, typical PCS cells (PCS1900, IS-136, IS-95) are over 10 000 meters in diameter, while typical FWA cells (DECT, PHS) are 500 to 1500 meters in diameter. The value on the table should not be greater than the cell size for the particular technology.

4.3. ISSUES ASSOCIATED WITH MOBILITY (NO MOBILITY ASSUMPTION)

This study was based on the assumption that no unlicensed mobility services would ever be provided in the 1910 - 1930 MHz band. The inclusion of these services would introduce additional issues and complexity that were not addressed here. For example, if DECT mobiles and DECT fixed (FWA) terminals were to coexist in this 1910 - 1930 MHz band, the emissions from these terminals - and indeed those from the base stations - would be changed because the different corresponding gains and antenna patterns could lead to be radically worse interference levels. The Group did not include the effect of Public services.

4.4. CO-LOCATED PCS BASE STATIONS

Co-location of PCS base stations is a routine measure to reduce interference, but this study has not taken this into account.

Although the separation distances for PCS systems listed in the tables indicate that the separation distance for 1dB desensitization is large, this is not how PCS to PCS adjacent channel interference is managed. For interference between PCS systems which are FDD systems, co-location of PCS base stations will normally overcome the adjacent channel noise interference between PCS systems. This happens because when a mobile station is far from its desired PCS base site it is also far from the co-located adjacent channel interfering PCS base site.

It is argued that the desired signal is therefore weak, but the undesired interference is also weak. Also when the PCS mobile is near the potentially interfering undesired PCS base station, it is simultaneously near its desired PCS base, so that the stronger desired PCS base signal can overcome the additional interference noise at the PCS mobile receiver. Similarly, when the PCS mobile is close to its own PCS base station, it is commanded by its own base station to transmit at a reduced power, and since the out-of-band noise power is also reduced, then the PCS mobile transmitter does not interfere with the co-located adjacent channel PCS base station receiver.

The acceptable alternative for locating an adjacent channel interferer is to locate the interferer at least the distance indicated in the table away from the potential victim receiver to prevent desensitization. This is easily achievable since all the distances in the table for PCS systems is less than the cell radius for these systems under the same conditions.

On the other hand, it is argued that different PCS technologies as well as different PCS applications (macrocellular, microcellular) have very different cell sites; therefore co-location of sites cannot be assured and the assumption that the interfering and victim cells are co-located is not true and the values in the table can be used.

4.5. NEAR-FAR INTERFERENCE

The notion of near-far, means that the source of interference is relatively near to the victim receiver, while the victim receiver is simultaneously far from its desired transmitted source. The two slope models are useful as a first approximation, but in reality, each base station site must be considered individually with much greater care.

It is also argued that to recognize that near-far really means, the relative signal strengths of the two sources, which usually corresponds to their relative distances. Different PCS technologies have different link budgets, resulting in possible different cell sizes, which may make co-location of PCS systems difficult. It may not be necessary or possible to exactly co-locate FDD PCS systems. For FDD PCS systems, an acceptable *maximum* base-to-base separation distance exists where the two PCS bases are located close enough to each other, so that the carrier to interference for both systems remains acceptable. A precise analysis for this will have to be performed to determine what is the maximum allowable base-to-base separation distance for no system desensitization, or acceptable system desensitization (1dB). Therefore, PCS to PCS site coordination needs to be studied.

Co-ordination procedures between systems

Co-ordination procedures are available from the National Spectrum Managers Association are recommended to co-ordinate PCS systems. Additional procedures are required to co-ordinate mixed deployments of FWA and PCS.

4.6. REMAINING ISSUES

Unfortunately, despite intensive efforts the Group was unable to reach consensus, and it has been agreed that the remaining issues be presented in the following two self-contained sub-sections, A and B, providing the somewhat conflicting views and considerations. Due to time constraints, the format of sections A and B have not been harmonized or optimized, but the Group nevertheless has agreed that it is important to include all these comments in the interests of objectivity and to help the reader understand better the issues involved.

4.6.1. 'DECT Proponents'

From calculation results, the following conclusions were obtained:

4.6.1.1 Probabilities

The experience says that a PCS system can coexist with any other PCS system, however results show that this was not possible because they shows significant separation distances. This inconsistency with the actual deployments are only justified if we assume a very low probability value. This low probability value is applicable to any scenario, then the results obtained should be interpreted under the comparative frame that they provide, instead of the absolute values that they show.

4.6.1.2 Comparative Analysis of the results for PCS and FWA TDD systems

Normal PCS deployments have other FDD PCS systems on adjacent bands. Since there are always some interference between adjacent systems it is of interest to compare the potential interference from PCS to PCS with FWA to PCS (as stated in the methodology explanation).

The results show different scenario combinations and for all of them the worst interference figures are obtained by PCS to PCS. Therefore, since PCS to PCS can coexist it is reasonable to assume that FWA and PCS will coexist with less interference problems.

Regarding the case of FWA base station to PCS base station scenario combination (which is regarded as the most critical combination), it can be noted the following:

In practice it is often possible to have as close separation distances as 100 meters between FWA and PCS base stations, but here uplink power control of PCS should be considered in capacity limited scenarios (it should be noted that this mechanism is not considered in performed calculations).

As example, for a DECT base station -110 dBm interfering power could be radiated at 100 m distance to the victim receiver. This power is related to 1 MHz. IS136 Base Stations have uplink power control set to -80 dBm. After correction for the different bandwidths the interference

from DECT BS will provide C/I about 30 dB related to the value of -80 dBm, and IS136 only requires 17 dB of C/I. If the distance is 300 m. another 10 dB margin is provided.
A similar calculation can be done for PCS1900 BS as victim, using its typical value for uplink power control, obtaining similar results as above.

For IS95 scenario the mechanism is somewhat different. In this case (with 100 m distance) we can suppose that one DECT BS is the dominant interferer. Typically DECT BS are separated by 1500 m. to 7 km. Cose separation cases down to 600 m occur seldom (300E/sqm). The maximum traffic which can be seen in one sector from the closest base station is 14E. This traffic is spread over 10 carriers, therefore in average only 1.5 time slots (of 24) are used in the interfering closest carrier. This gives an activity factor of 1.5/24 slots equal to 6,3%. Thus in a high capacity IS95 scenario if the DECT interference arrives with the same power as the power from IS95 terminal the extra traffic load from the DECT interference only corresponds to a 1/7 of an IS95 connection with activity factor 0.4. Therefore the total capacity reduction of the IS95 system is only a very small fraction of the total capacity.

4.6.1.3 Interference mechanisms

Within the calculations existing interference avoidance mechanisms for each technology have not been considered. However, it is clear than these mechanisms (Power Control, DCA, Intracell handover, Frequency hopping, Error correction, etc.) are powerful enough to avoid the interfering cases that are shown in the calculation.

4.6.1.4 Operation and Maintenance

During the Operation and Maintenance of a radio system is possible (and it is a normal operation activity) to reassign and modify the parameters of the cells according to new situations of traffic, insertion of new cells, detected interference or increase of traffic demands. Thus, it should be noted that this continuous monitoring of the system behavior could also help to solve the undesirable (and unlikely) external interference situations.

4.6.2. Others' View

4.6.2.1 Agreement of modeled parameters

As explained earlier, plausible Reference values were selected for such parameters as antenna heights, antenna gains, antenna tilts, fade margins etc. In addition, as far as possible, the basic parameter data (transmit power, receive sensitivity, bandwidth, etc) was extracted from the appropriate technology standards. Nevertheless, due to time constraints and some difficulty in the interpretation of data expressed in different formats for the various standards, there is some concern that not every parameter in the Reference models are absolutely correct.

4.6.2.2 Spurious, out of band, unwanted emissions vs mod. Mask

The analysis presented before has taken as input the appropriate modulation mask for the technology in question. It is argued by some that this is not entirely adequate since in general all the normally specified spectrum components should be included viz. spurious and out - of - band emissions (together termed unwanted emissions) and also the fast transient components. On the other hand some have argued that there is no need to include these other components, and for simplicity the analysis is based on this assumption.

4.6.2.3 Sensitivities

Interference levels are *highly* sensitive to assumed relative positioning between interfering devices and victims. Interference levels are also *highly* sensitive to antenna choices, heights, and sectorization. An interference sensitivity analysis is needed before recommendations can be made.

4.6.2.4 DECT, PHS, PCS1900, IS-95, IS136 capacity

In general it is necessary to fully account for the interaction between antenna sectorisation and choices, cell sizes and traffic capacities. There is some doubt expressed here since the analysis presented earlier has not properly reflected this need.

In the detailed engineering analysis that was performed for both the co-channel and adjacent channel interference cases, the ETSI Technical Report on capacity considerations in DECT, ETR 310 of August '96, was used for the ETSI - defined model for DECT FWA.

Despite the fact that the ETSI Technical Report clearly states the expected traffic loads for various environments, including the specific loading of 300 Erlangs per square kilometre for developing countries . This ETSI Report was disputed as not necessarily valid by some DECT experts.

4.6.2.5 Pulsed interferers versus continuous interferers

FWA systems are pulsed interferers and they need to be considered as to how they will affect different PCS systems in different ways. Continuous receive systems like IS-95 CDMA will be interfered with during each transmission. TDMA systems like PCS-1900 and IS-136 will have precessional frame rates and will only be interfered with periodically. In the opposite direction, continuous PCS transmitters will interfere continously during FWA receive time slots

4.6.2.6 Mixed TDD and FDD deployments

Mixed TDD and FDD deployments will result in two additional interference paths that are eliminated by FDD deployments. Base to subscriber terminal and subscriber terminal to base are the only paths of possible interference for FDD systems. When mixing TDD systems, base to base and terminal to terminal paths also exist. These additional interference modes create another set of exclusion zone distances to avoid interference between other systems. The TDD terminal may be near another FDD receiver and be transmitting on adjacent channels, without any knowledge of the interference that it may cause.

TDD FWA systems will suffer interference if co-located with PCS systems. Further, there may not be an acceptable *minimum* base-to-base separation distance, especially if the cell radius is less than the acceptable minimum base-to-base separation distance.

PCS systems will suffer interference if co-located with TDD DECT FWA systems. There may not be an acceptable *minimum* base-to-base separation distance, especially if the cell radius is less than the acceptable minimum base-to-base separation distance.

4.6.2.7 Low traffic installations (space for guard-bands)

The PHS FWA recommndation recognizes the need for guardbands at the 1910 and 1930 MHz band edge. A similar recommendation for DECT FWA systems was not accepted by DECT experts. However, in cases where low traffic is anticipated DECT channels 1 and 10 could be turned off to reduce the probability of interference from licensed PCS.

4.6.2.8 Base station siting

Base station siting aspects have not been considered in this report. Without knowing where the other PCS and FWA operators' sites are located, interference can only be generalized. Assumptions for site locations, as well as antenna heights, gains, patterns, power outputs, frequency plans, propagation models, etc., must be made to determine the expected levels of interference. Overcoming the additive noise due to interference between systems will require careful placement of PCS sites and FWA sites. The generalized approach described clearly differs from real world deployment scenarios.

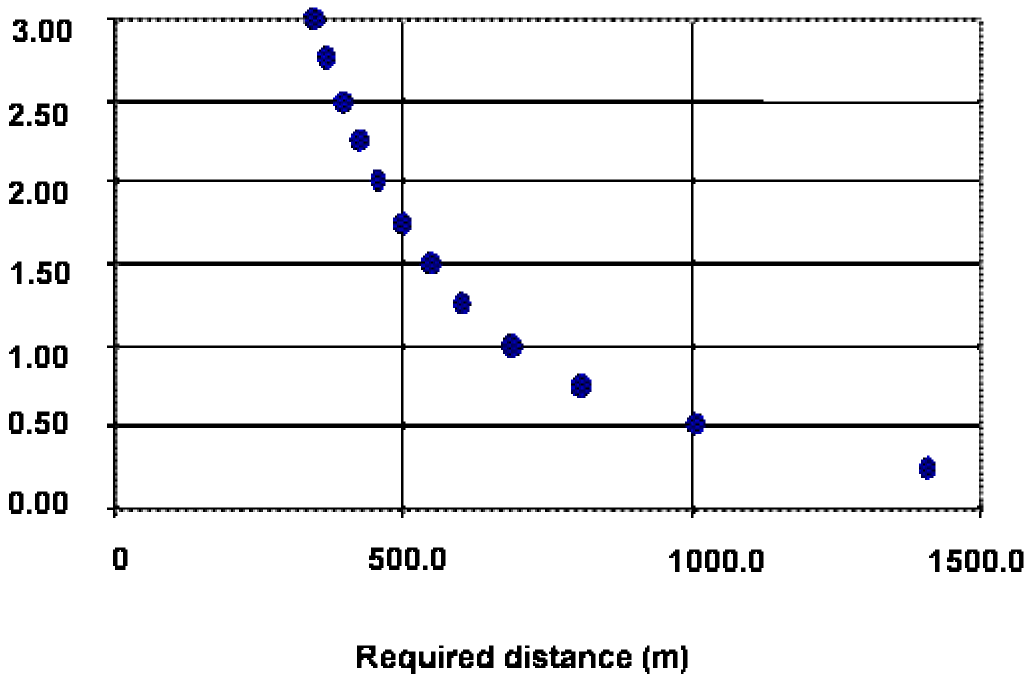
4.6.2.9 Probability Of Interference

Probability is an often misused tool. Predictions of interference often use subscribers randomly distributed over the cell area to predict probability of interference. There are some deterministic examples that need to be considered, that are sometimes better descriptions of "probability" than subscribers randomly distributed over a cell area. Consider a highway, with nothing on either side. The users within this cell are essentially uniformly distributed along a line. If the interfering base station is located at a fixed location along the highway, what is the probability that a user is interfered with as the user passes this base station? What is the probability he is interfered with if he has to stop at this point due to traffic lights or traffic? What is the probability of interference with DECT FWA within 500 meters of any PCS base stations? From the tables of adjacent channel desensitization separation distances, it appears that there is 100% probability of PCS base station desensitization.

4.6.2.10 Further guidance on how to read the table

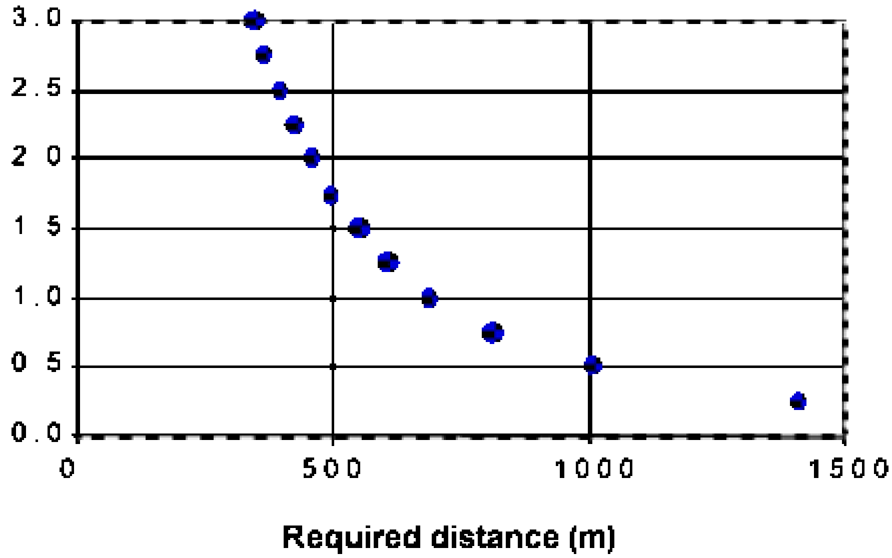
The table omits interference between PCS base stations and between PCS handsets. This is omitted because it was agreed that this is not a mode of interference for FDD systems. Note that the interference distances for the FDD PCS systems only describe the minimum separation distances between adjacent channel usage for neighboring cells. Within the same cell, as long as the two cells are close enough to co-located, the interference is overcome by the larger desired signals. Co-location of FDD PCS base stations with adjacent channel FWA TDD systems does not improve the interference, but actually increases the interference to the PCS base station receiver.

4.6.2.11 Interpretation of Results



1. Select a condition based on the actual or expected deployment:
   - (a) Choose the level of interference you are willing to accept
   - (b) Choose the distance between the two systems, based on the relative cell sizes

   The point where they intersect is the "selected condition."
2. If the point falls below the curve (X), the selected condition is not feasible
3. If the point falls above the curve (Y), the selected condition is feasible



4.6.2.12 Co-located FWA and PCS Base Stations

Only one case from the tables of adjacent channel desensitization allow PCS base stations to be colocated with FWA systems. Therefore, most adjacent channel FWA systems will have to be further away than the distances listed in the tables and cannot be co-located. Simultaneously, the FWA subscriber units will have to be far enough away from the PCS base stations to prevent PCS desensitization.

4.6.2.13 Site engineering

Site engineering practices can improve the interference between systems. However, the limitations of site practices are dependent on economics and the practical realities of installation practices. Good site engineering will reduce unnecessary interference, but cannot eliminate basic system incompatibilities. Real world sites have non-ideal surroundings that may reflect signals that might otherwise be reduced by nulls in antenna patterns. Examples of this are objects like; nearby buildings that produce significant reflection back to the cell site, air conditioning or elevator structures on top of building cell sites. In practice, these objects should be avoided as much as practical to improve cell performance and reduce undesired effects.

When the current interference methodology is enhanced to include traffic considerations, antenna and sectorization choices need to be defined to model low and high traffic density conditions.

4.6.2.14 Propagation models for outdoor and indoor

There is agreement on the use of the two break point pathloss model for fixed terminal and base station (outdoor) interference calculations. For interference between indoor and outdoor systems, a 15 dB building penetration loss is assumed.

4.6.2.15 Non-rural morphology vs. rural morphology

The worst case interference is presently defined in terms of the frequency separation between DECT and PCS systems (the DECT carrier closest to the PCS receive block interferes the most). The worst case should also be extended to include multiple interferers under Non Rural RF conditions.

4.6.2.16 Figures of merit

The two figures of merit defined so far are a) separations distances between a single interferer and a victim that generates a one dB rise in base station noise floor and b) rise in noise floor as a function of interferer cell radius. Other figures of merit need to be identified and evaluated to better answer service operator questions. Some examples are a) what is the reduction in handoff zones, b) how much more infrastructure is needed to offset the losses in coverage area, and c) what frequency and siting coordination arrangements between operators will allow them to co-exist.

4.6.2.17 Worst case analysis

There is no common agreement on the definition of worst case.

4.6.2.18 Omni PCS vs. sectored antennas

Omni PCS antenna configurations are more vulnerable to interference because interferers in every direction can interfere. Omni configurations should be included in the definition of "worst case".

4.6.2.19 Technology aspects

The current methodology treats each technology identically which overlooks some technology unique characteristics. Some of these must be integrated into the interference analysis as required. Some examples are DCA, soft handoff, and systems that use fixed frequency reuse plans.

The quantitative results of this report are stated in terms of the minimum separation distances between the transmitter of one wireless technology and the receiver of another to prevent a rise in the receiver noise floor more than 1 dB. However, in using the summary tables, in must be kept in mind that there are a number of factors which this method of analysis accounts for only in part, or not at all. The following is at least a partial list and brief discussion of those factors:

Cell radius: Systems using different technologies will in general have different cell radii, since the cell radius depends not only on factors specific to the air interface (such as the required C/I ratio), but also on the user density served by the system. The required separation distances therefore must be viewed in the context of the cell radius of the interfering system. For example, if a transmitter from system X must be within 1 km of a receiver of system Y to cause interference, and the cell radius of system X is 400 m, there clearly is a significant potential for interference. If the cell radius of system X is 5 km, the interference potential is correspondingly reduced.

Probability of Interference: Since the occurrence of interference above some threshold depends on the relative positions of the interfering transmitter and the victim receiver, the most accurate and complete way to quantify interference is by calculating the probability that the interference exceeds some level. Doing such a calculation for a range of interference levels yields the probability distribution function for the interference, which is necessary for a complete characterization. The Expert's Group has not reached agreement on the appropriate way to factor interference probability into the analysis.

Multiple Interferers vs. Single Interferer: In general, in a real-world deployment scenario, the interference into a victim receiver will be the power sum of contributions from multiple interfering transmitters. Therefore, an complete analysis of the interference probability must account for multiple interference sources, which the current analysis does not do.

4.6.2.20 Cochannel Interference from Fixed Wireless Access systems to Unlicensed Personal Communications Systems

The sharing of the 1910-1930 MHz band between FWA and UPCS is being contemplated, which clearly introduces the potential for cochannel (as well as adjacent channel) interference between FWA and UPCS. Due to time constraints, the Group was unable to reach closure on this issue and it requires further study. However, the Group received two contributions on this topic which represent the two different schools of thought which have emerged. These documents are:

1. PCC.III-918/97, entitled "Analysis of Cochannel Interference from DECT FWA Systems to Isochronous UPCS"
2. PCC.III-922/97, entitled "Coexistence Between FWA and Isochronous UPCS Equipment on the Band 1910-1930 MHz"

It is recommended that administrations review these contributions for further information on the potential for interference between FWA systems and UPCS systems operating in the same band.

4.6.2.21 Frequency Reuse Model for Dynamic Channel Assignment (also call Dynamic Channel Selection)

The original analog cellular systems used fixed frequency reuse plans, whereby the available channels were divided into N frequency groups and each cell or sector was assigned one of the N groups. The frequency reuse in that case is 1/N; that is, on average, each channel is used in 1 out of N cells. While systems using DCA (e.g., DECT) also have a frequency reuse factor, it is less straightforward to calculate, but it can be calculated by finding the probability distribution of the interference power on the least-interfered channel which would yield the desired grade of service at the objective quality level (e.g., some required bit error rate), given the carrier-to-interference ratio required to achieve that quality level, fading characteristics, and path loss model. This can be efficiently done using Monte Carlo techniques. Although frequency reuse of a given interfering FWA channel has not been modeled in the current analysis, such modeling could be used to determine bounds on the interference from FWA to PCS given some assumed FWA user density.

4.6.2.22 Multipath and Shadow Fading

The "local mean" received signal level is the received power with multipath variations averaged out over a small area (e.g., 5-10 wavelengths). The local mean varies due to variations in the transmitter-to-receiver distance and shadow fading, which is typically modeled as a lognormal variation about the median received signal power. The median is typically modeled (in dB) as A + B log r, where r is the distance from the transmitter to the receiver, and A and B are constants that depend on the path loss model used. The variations due to multipath are then superimposed on the local mean. If there is no line-of-sight path, the signal envelope distribution is typcially Rayleigh, so the received signal power is exponentially-distributed with a mean equal to the local mean. If there is a line-of-sight path plus scattered paths, a Rician model is often used. With Rayleigh fading, a fade margin on the order of 10-17 dB must be incorporated into the link budget, with the exact value depending on whether diversity is use, and the desired percentile point on the distribution. For example, with no diversity, 17 dB corresponds to the 2% point, meaning that with a 17-dB margin, there is a 2% probability that fading will drive the C/I or C/N below its threshold.

4.6.2.23 Building Illumination by Fixed Transmitters

A building housing a UPCS system may be illuminated on all sides by energy from FWA transmitters. However, a receiver on one side of the building will not "see" all of this interference to the same degree, and the interference illuminating one face (or possibly two, if the receiver is near a building corner) will dominate.

4.6.2.24 Building Penetration Loss

An interfering signal illuminating a building will normally experience some attenuation in penetrating the building's exterior wall. It is estimated that this loss will typically be in the range of 5-15 dB, with perhaps a mean value of 10 dB.

4.6.2.25 User Distribution Within a Building

If a square building is D meters on a side, then more than half the total area of the building is within 0.15D meters of the nearest exterior wall, from simple geometry. This means that additional propagation loss due to in-building obstructions cannot be relied upon to significantly attenuate the interference received by in-building receivers from outdoor transmitters in a typical case.

4.6.2.26 Spectrum Overlay vs. Segmentation

Multiple air interfaces are to be accommodated within a block of spectrum. If they are relatively compatible with respect to frame format, frequency channelization, etc. (i.e., the "mesh" efficiently), it may be more efficient to allow them to share the entire block, due to the resulting trunking efficiencies. Conversely, if the air interfaces use different frame structures, or are significantly different in other ways, it may be more efficient to segment the band and assign each a separate segments.

4.6.2.27 Radius of cell coverage

In determining the acceptable value of the minimum required separation distance, it is important to reference the values to the cell radius of the system. Generally, when the system with bigger cell coverage is tend to have larger cells separation in distance, consequently, it would tolerate a larger required space separation between the interferers and the victim receivers. Contrary, when a system operating with smaller cell radius will need more BSs in a given area, i.e. more potential interference sources, such that will require smaller allowable separation distance for same degree of performance impact as its counter part. In the case when the required minimum separation distance is larger than the cell radius, interfering with adjacent systems becomes inevitable.

4.6.2.28 Influence of power control (up and down (?) link)

For the purpose of simplifying the calculation, no power control are assumed in this report which means all the systems are operating in their maximum output power. However, for the system like IS-95 where the accurate power control on both down and up links is essential for its normal operation, the assumption of no power control will result in a over pessimistic estimation for the system. Therefore, it is recommended that the power control shall be taken into the account in the interference analysis for more accurate results.

4.6.2.29 Dynamic vs. fixed guard-band

In this study, only the channel located in the band edge for FWA systems is considered to be "harmful" to systems operating in adjacent frequency. To mitigate the potential interference caused by FWA systems, a guardband which prohibit the FWA to operate at the band edge should be considered. Since the DCA scheme used by FWA is incapable of detecting the existence of the victim receivers nor switch to other channel in heavy loaded condition when interference is detected, the dynamic guardband provided by DCA will not be a reliable means to avoid interference to occur. Consequently, a fixed guardband which provides a more reliable protection against the interference should be considered.

4.6.2.30 In-Building Propagation and Losses

In-building propagation and losses are highly dependent on the interior construction of the building. Many office buildings have low cubical-type wall construction in the center part of the building. The offices facing the windows often have full-height metal panneled walls and solid wooden doors. Although these offices would seem to have high attenuation, in fact they do not.

This is due to the slot antenna effect of the small gaps between pannels. One propagation model (ETR 310, page 45) for semi-high soft partitions, but without interior walls, is:

$$L = 41 + 20 \log s + \Gamma \times \max [0, (s - 10)] \text{ dB}$$

where Γ is 0.37 dB/m or 0.59 dB/m, depending on the density of the partitions.

Another alternative is to use complex computer modeling software tools that are readily available on the market, where exact models for real building layouts, floor by floor, can be modeled using ray-tracing techniques. If time had permitted, several examples of real building interior propagation and losses could have been submitted. These modeling software tools could also be used for real urban area simulations.

4.6.2.31 Noise Floor Rise vs. Separation

The noise floor increase versus distance between the interfering transmitter and victim receiver is considered to be more useful in a practical sense than simply knowing what distance is required to achieve a 1-dB rise in the noise floor. In the practical application of the table, a system provider trying to set up a site knows that there are potential interferers some distances away. Most of the time, the provider does note have control over how far away the interferer will be, and needs to know how much the noise floor will be increased by the interferer, to design the system to work in the presence of the interference. Although the summary table shows only the separation distance required for a 1-dB rise in the noise floor, the noise floor increase vs. distance is more useful for a system operator and is shown in the detailed results for each case.

4.6.2.32 Spurious, out of band, unwanted emissions vs. modulation mask

In this study, only one interference component, i.e. emission due to modulation, is considered for some technologies (e.g. FWA), while spurious emission is considered in other technologies (e.g. IS-95). For better estimate the interference scenario, all the unwanted emission should be considered.

4.6.2.33 Space for guard-bands

The PHS FWA recommendation recognize the need for guard-bands at the 1910 and 1930 MHz band edge. A similar recommendation for DECT FWA systems was not accepted by DECT experts. However, in cases where low traffic is anticipated DECT channels 1 and 10 could be turned off to reduce the probability of interference from licensed PCS.

4.6.2.34 Antenna sectorisation, traffic

In general it is necessary to fully account for the interaction between antenna sectorisation and choices, cell sizes and traffic capacities. There is some doubt expressed here since the analysis presented earlier has not properly reflected this need.

In the detailed engineering analysis that was performed for both the co-channel and adjacent channel interference cases, the ETSI Technical Report on capacity considerations in DECT, ETR 310 of August '96, was used for the ETSI - defined model for DECT FWA.

Despite the fact that the ETSI Technical Report clearly states the expected traffic loads for various environments, including the specific loading of 300 Erlangs per square kilometre for developing countries . This ETSI Report was disputed as not necessarily valid by some DECT experts.

4.6.2.35 Mitigation techniques

In some situations for some technology permutations, the levels of interference - or alternatively the required separation distances - can be mitigated against in an intrinsic fashion. In particular the DCA features of DECT

5. REFERENCES

[1] Report of Ad-hoc FWA/PCS Interference Experts Group. April 9th 1997. Cartagena de Indias

[2] PCC.III Interference Experts Teleconference 5/6/1997î. Meeting Notes. A. McGregor, Nortel. (These meeting notes were approved in the second meeting of the Experts Group in Brasilia, see reference [3] PCC.III-770/97 rev.2. Report covering the second work group meeting on the quantification of incompatibility issues between Fixed Wireless Access and PCS systems in the 1850-1990 MHz band June 20th, 1997

[4] Set of results of interference calculation obtained by the Experts Group Excel Spreadsheet Tool. September 1997.

[5] Sensitivity Methodology. A. McGregor. Nortel Canada. August 22nd 1997.

6. INDEX OF RESULTS

The following is an index to the detailed results.

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**PCS1900**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1894,800	1895,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	200	
TX/RX frequency Offset (KHz)	400,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***** See Note *****		-104
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

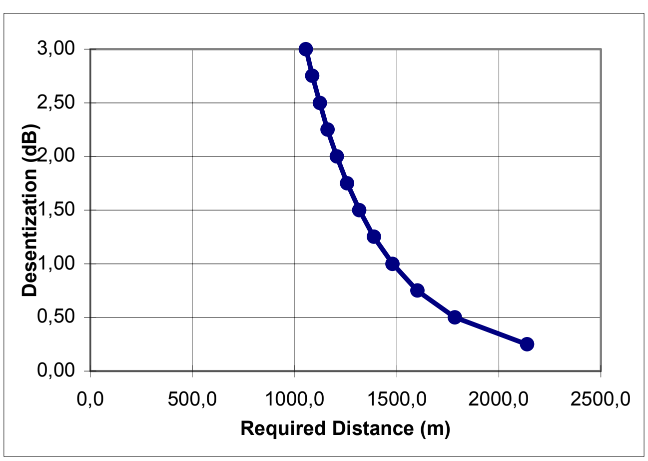
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1479,6
When only RX is on TX antenna 3dB-beamwidth	8,8
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2139,3
0,50	1785,8
0,75	1601,8
1,00	**1479,6**
1,25	1388,9
1,50	1317,0
1,75	1257,5
2,00	1206,9
2,25	1162,8
2,50	1123,7
2,75	1088,6
3,00	1056,7

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**IS95**	**PCS1900**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1893,750	1895,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	725	
TX/RX frequency Offset (KHz)	1450,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***** See Note *****		-104
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

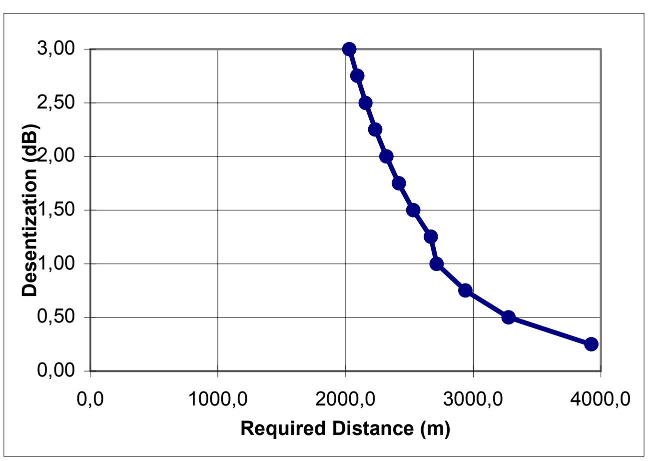
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	2714,9
When only RX is on TX antenna 3dB-beamwidth	563,1
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	3925,3
0,50	3276,7
0,75	2939,1
1,00	**2714,9**
1,25	2668,5
1,50	2530,4
1,75	2416,2
2,00	2318,9
2,25	2234,1
2,50	2159,1
2,75	2091,6
3,00	2030,3

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	PCS1900
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1894,920	1895,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	165	
TX/RX frequency Offset (KHz)	280,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***** See Note *****		-104
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beam width (°)	omni	105
Antenna Vertical Beam width (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

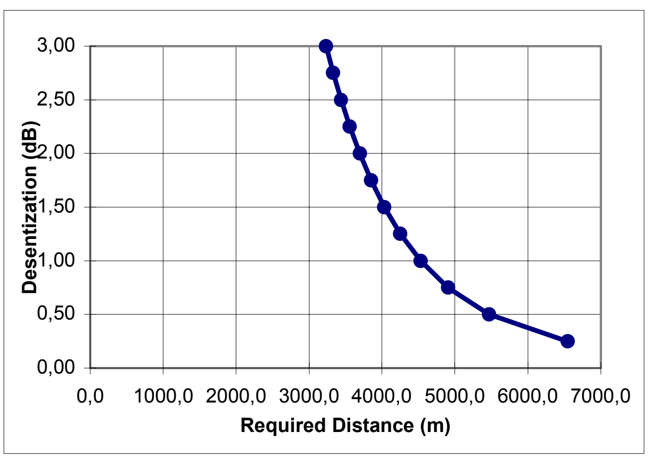
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	4530,3
When only RX is on TX antenna 3dB-beam width	1191,6
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	6550,0
0,50	5467,8
0,75	4904,4
1,00	**4530,3**
1,25	4252,4
1,50	4032,3
1,75	3850,3
2,00	3695,3
2,25	3560,3
2,50	3440,6
2,75	3333,1
3,00	3235,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**PCS1900**
Device	**Base Station**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1912,896	1909,800
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2132	
TX/RX frequency Offset (KHz)	3096,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-104
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	15,0	25,0
Antenna Gain (dBi)	12,0	17,0
Antenna Horizontal Beam width (°)	120	105
Antenna Vertical Beam width (°)	17	9
Antenna Downtilt (°)	-7	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

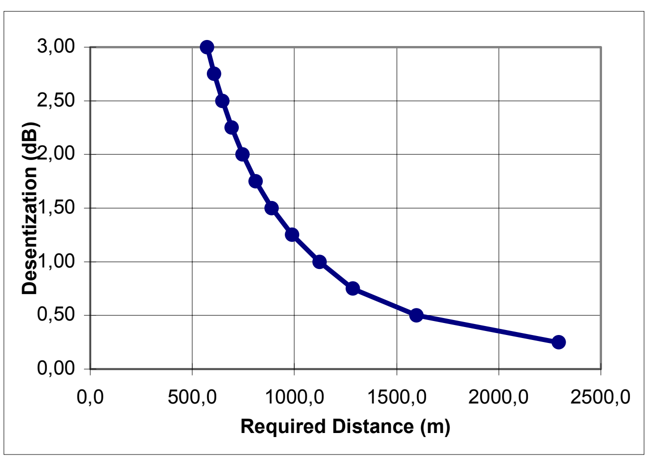
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	1122,7
When only RX is on TX antenna 3dB-beam width	0,3
When only TX is on RX antenna 3dB-beam width	0,3
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2293,6
0,50	1598,3
0,75	1285,9
1,00	**1122,7**
1,25	989,2
1,50	889,5
1,75	811,0
2,00	747,0
2,25	693,4
2,50	647,6
2,75	607,8
3,00	572,7

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**PCS1900**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1912,896	1909,800
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2132	
TX/RX frequency Offset (KHz)	3096,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-104
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	8,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beamwidth (°)	60	105
Antenna Vertical Beamwidth (°)	60	9
Antenna Downtilt (°)	2	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

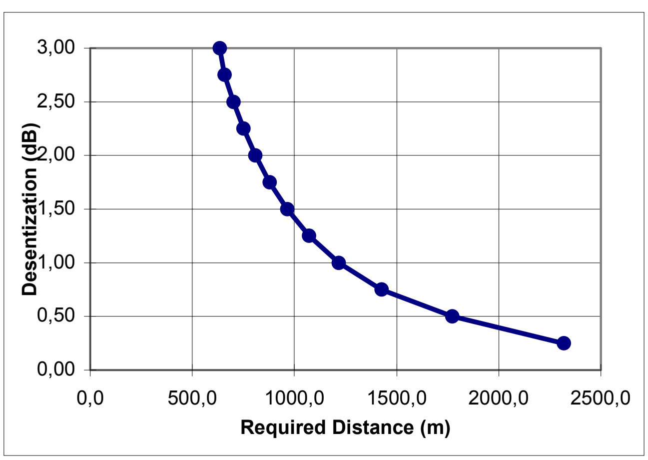
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1217,0
When only RX is on TX antenna 3dB-beamwidth	0,6
When only TX is on RX antenna 3dB-beamwidth	0,6
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2320,1
0,50	1772,8
0,75	1426,3
1,00	**1217,0**
1,25	1072,3
1,50	964,1
1,75	879,1
2,00	809,7
2,25	751,6
2,50	701,9
2,75	658,8
3,00	635,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**PCS1900**
Device	**Base Station**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1910,450	1909,800
Number of guard channels	0	0
Guard Band between channel edges (KHz)	400	
TX/RX frequency Offset (KHz)	650,0	
System Data		
TX Power (dBm)	22	
RX sensitivity (dBm) ***** See Note *****		-104
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	15,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	8	9
Antenna Downtilt (°)	-7	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

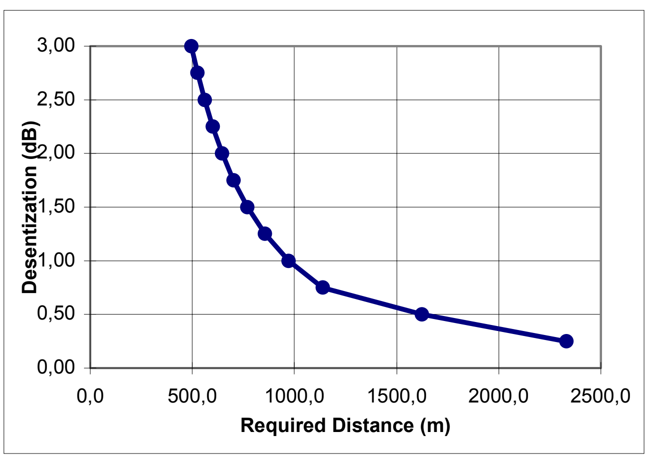
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	971,4
When only RX is on TX antenna 3dB-beamwidth	0,7
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2331,5
0,50	1624,7
0,75	1138,5
1,00	**971,4**
1,25	855,9
1,50	769,6
1,75	701,7
2,00	646,3
2,25	600,0
2,50	560,3
2,75	525,8
3,00	495,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**PCS1900**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1910,450	1909,800
Number of guard channels	0	0
Guard Band between channel edges (KHz)	400	
TX/RX frequency Offset (KHz)	650,0	
System Data		
TX Power (dBm)	19	
RX sensitivity (dBm) ***** See Note *****		-104
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	8,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beamwidth (°)	60	105
Antenna Vertical Beamwidth (°)	60	9
Antenna Downtilt (°)	2	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

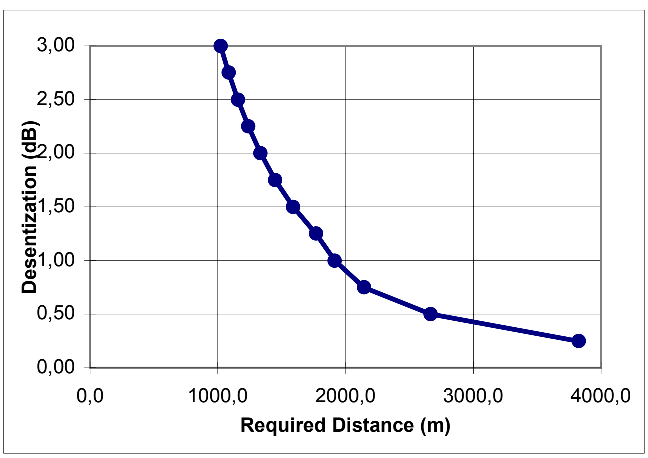
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1916,0
When only RX is on TX antenna 3dB-beamwidth	1,0
When only TX is on RX antenna 3dB-beamwidth	1,0
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,1

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	3825,0
0,50	2665,5
0,75	2144,5
1,00	**1916,0**
1,25	1767,8
1,50	1589,5
1,75	1449,3
2,00	1334,9
2,25	1239,1
2,50	1157,2
2,75	1086,0
3,00	1023,3

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PCS1900	PCS1900
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1944,800	1945,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	200	
TX/RX frequency Offset (KHz)	400,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) ***See Note***		-102
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

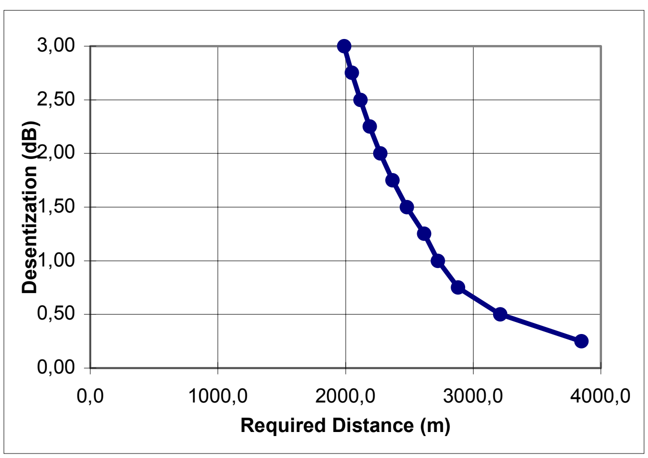
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	2723,6
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	533,4
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	3848,2
0,50	3212,4
0,75	2881,5
1,00	**2723,6**
1,25	2616,1
1,50	2480,7
1,75	2368,7
2,00	2273,4
2,25	2190,3
2,50	2116,7
2,75	2050,6
3,00	1990,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	PCS1900
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1943,750	1945,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	725	
TX/RX frequency Offset (KHz)	1450,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ** *See Note* **		-102
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

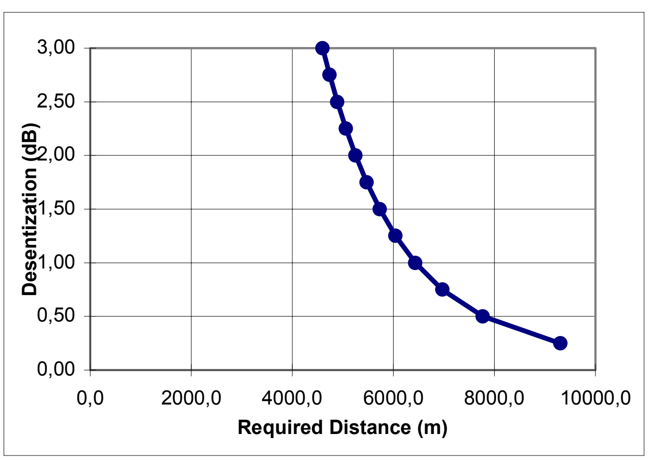
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	6438,0
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	1693,4
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	9308,3
0,50	7770,4
0,75	6969,8
1,00	**6438,0**
1,25	6043,2
1,50	5730,4
1,75	5471,7
2,00	5251,4
2,25	5059,5
2,50	4889,5
2,75	4736,7
3,00	4597,9

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**IS136**	**PCS1900**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1944,960	1945,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	125	
TX/RX frequency Offset (KHz)	240,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) ***** See Note *****		-102
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

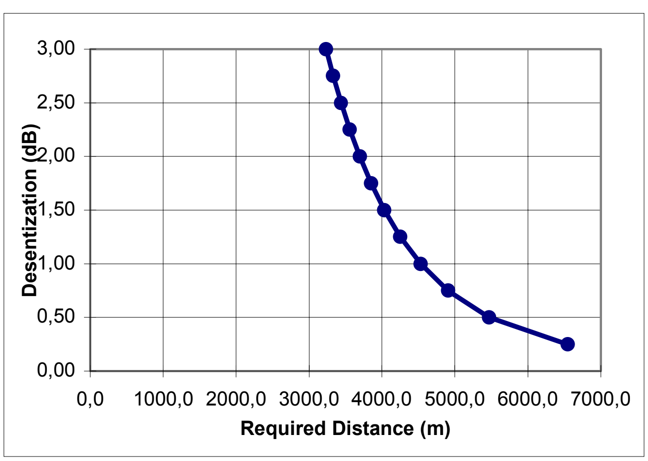
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	4530,3
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	1191,6
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	6550,0
0,50	5467,8
0,75	4904,4
1,00	**4530,3**
1,25	4252,4
1,50	4032,3
1,75	3850,3
2,00	3695,3
2,25	3560,3
2,50	3440,6
2,75	3333,1
3,00	3235,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**PCS1900**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1928,448	1930,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	788	
TX/RX frequency Offset (KHz)	1752,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-102
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	15,0	1,5
Antenna Gain (dBi)	12,0	0,0
Antenna Horizontal Beamwidth (°)	120	omni
Antenna Vertical Beamwidth (°)	17	omni
Antenna Downtilt (°)	-7	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

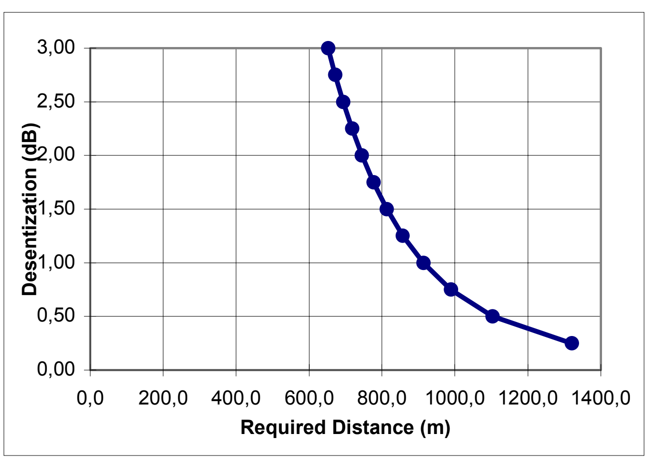
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	913,8
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	108,1
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1321,2
0,50	1102,9
0,75	989,3
1,00	**913,8**
1,25	857,7
1,50	813,3
1,75	776,6
2,00	745,4
2,25	718,1
2,50	694,0
2,75	672,3
3,00	652,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**PCS1900**
Device	**Terminal**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1928,448	1930,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	788	
TX/RX frequency Offset (KHz)	1752,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-102
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	8,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	60	omni
Antenna Vertical Beamwidth (°)	60	omni
Antenna Downtilt (°)	2	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

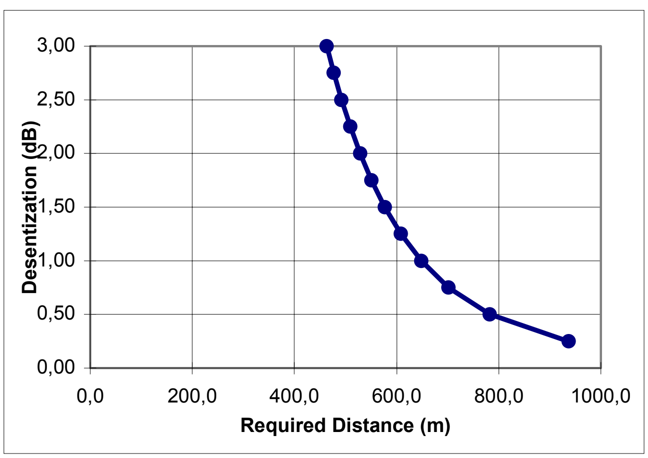
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	648,4
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	84,9
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	937,5
0,50	782,6
0,75	702,0
1,00	**648,4**
1,25	608,6
1,50	577,1
1,75	551,1
2,00	528,9
2,25	509,6
2,50	492,4
2,75	477,1
3,00	463,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**PCS1900**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1929,350	1930,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	600	
TX/RX frequency Offset (KHz)	850,0	
System Data		
TX Power (dBm)	22	
RX sensitivity (dBm) ***** See Note *****		-102
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	15,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beam width (°)	omni	omni
Antenna Vertical Beam width (°)	8	omni
Antenna Downtilt (°)	-7	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

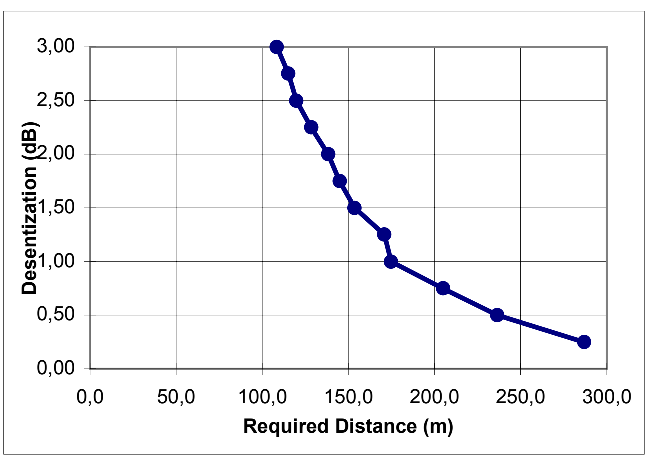
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	174,9
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	287,1
0,50	236,4
0,75	205,0
1,00	**174,9**
1,25	170,9
1,50	153,7
1,75	145,1
2,00	138,3
2,25	128,4
2,50	119,9
2,75	115,1
3,00	108,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PHS	PCS1900
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1929,350	1930,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	600	
TX/RX frequency Offset (KHz)	850,0	
System Data		
TX Power (dBm)	19	
RX sensitivity (dBm) ***** See Note *****		-102
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	8,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	60	omni
Antenna Vertical Beamwidth (°)	60	omni
Antenna Downtilt (°)	2	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

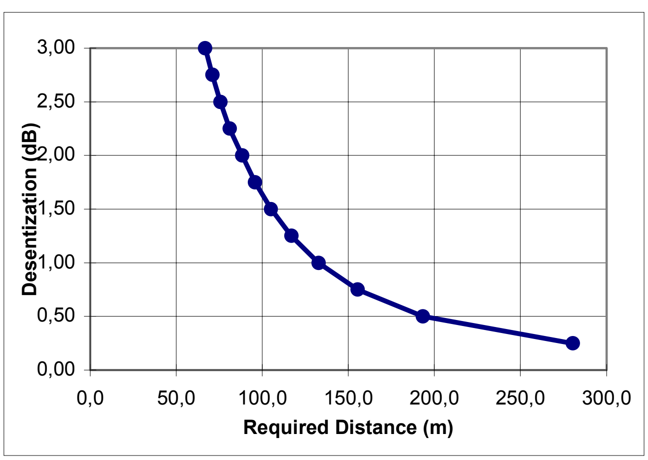
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	132,7
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	1,0
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	280,6
0,50	193,3
0,75	155,5
1,00	**132,7**
1,25	116,9
1,50	105,1
1,75	95,8
2,00	88,3
2,25	81,0
2,50	75,6
2,75	71,0
3,00	66,9

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**IS95**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1894,800	1896,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	725	
TX/RX frequency Offset (KHz)	1450,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***** See Note *****		-120
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beam width (°)	omni	105
Antenna Vertical Beam width (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

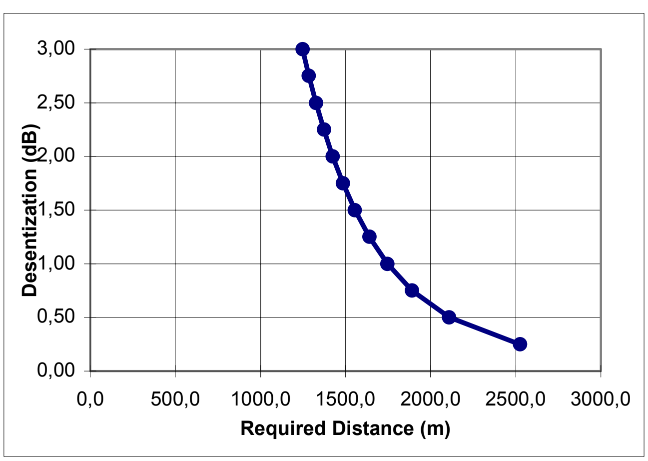
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	1746,9
When only RX is on TX antenna 3dB-beam width	12,2
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2525,7
0,50	2108,4
0,75	1891,1
1,00	**1746,9**
1,25	1639,7
1,50	1554,8
1,75	1484,7
2,00	1424,9
2,25	1372,8
2,50	1326,7
2,75	1285,2
3,00	1247,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	IS95
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1893,750	1896,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1250	
TX/RX frequency Offset (KHz)	2500,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***** See Note *****		-120
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

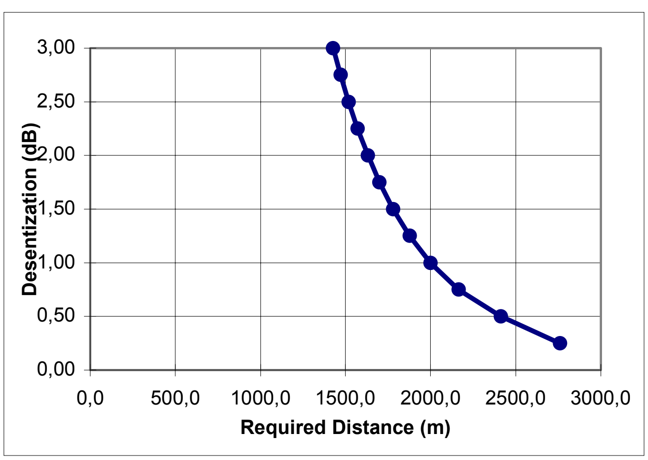
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1999,2
When only RX is on TX antenna 3dB-beamwidth	242,4
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	2760,5
0,50	2413,0
0,75	2164,4
1,00	**1999,2**
1,25	1876,6
1,50	1779,5
1,75	1699,2
2,00	1630,8
2,25	1571,2
2,50	1518,4
2,75	1470,9
3,00	1427,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	IS95
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1894,920	1896,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	690	
TX/RX frequency Offset (KHz)	1330,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***** See Note *****		-120
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

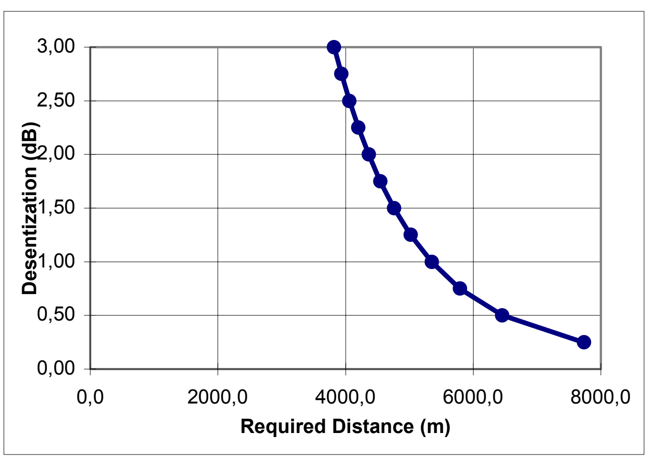
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	5348,6
When only RX is on TX antenna 3dB-beamwidth	1406,8
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	7733,1
0,50	6455,4
0,75	5790,3
1,00	**5348,6**
1,25	5020,5
1,50	4760,6
1,75	4545,8
2,00	4362,8
2,25	4203,3
2,50	4062,1
2,75	3935,1
3,00	3819,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**IS95**
Device	**Base Station**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 -1930 MHz	C (lower part)
Working Frequency (MHz)	1912,896	1908,750
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2657	
TX/RX frequency Offset (KHz)	4146,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-120
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	15,0	25,0
Antenna Gain (dBi)	12,0	17,0
Antenna Horizontal Beam width (°)	120	105
Antenna Vertical Beam width (°)	17	9
Antenna Downtilt (°)	-7	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

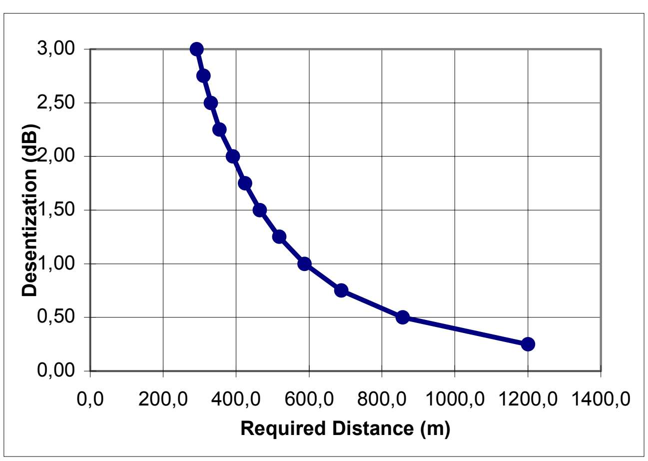
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	587,8
When only RX is on TX antenna 3dB-beam width	0,2
When only TX is on RX antenna 3dB-beam width	0,2
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1200,8
0,50	856,3
0,75	688,9
1,00	**587,8**
1,25	517,9
1,50	465,7
1,75	424,6
2,00	391,1
2,25	354,8
2,50	331,3
2,75	311,0
3,00	293,0

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**IS95**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1912,896	1908,750
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2657	
TX/RX frequency Offset (KHz)	4146,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-120
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	8,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beam width (°)	60	105
Antenna Vertical Beam width (°)	60	9
Antenna Downtilt (°)	2	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

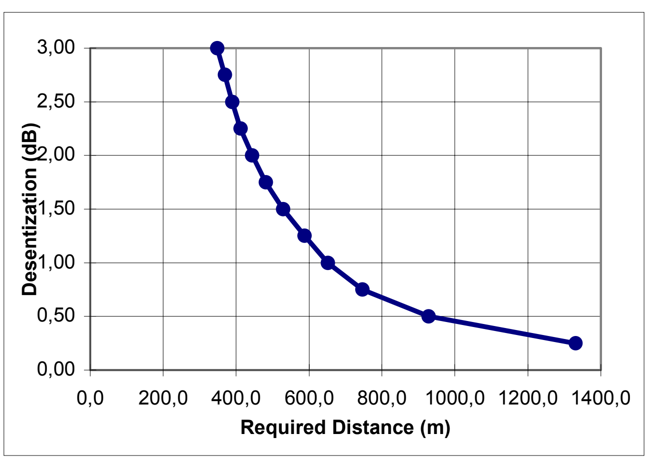
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB :

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	652,0
When only RX is on TX antenna 3dB-beam width	0,3
When only TX is on RX antenna 3dB-beam width	0,3
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1331,9
0,50	928,1
0,75	746,7
1,00	**652,0**
1,25	587,9
1,50	528,6
1,75	481,9
2,00	443,9
2,25	412,1
2,50	389,3
2,75	369,6
3,00	348,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**IS95**
Device	**Base Station**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lowerpart)
Working Frequency (MHz)	1910,450	1908,750
Number of guard channels	0	0
Guard Band between channel edges (KHz)	925	
TX/RX frequency Offset (KHz)	1700,0	
System Data		
TX Power (dBm)	22	
RX sensitivity (dBm) ***** See Note *****		-120
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	15,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	8	9
Antenna Downtilt (°)	-7	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

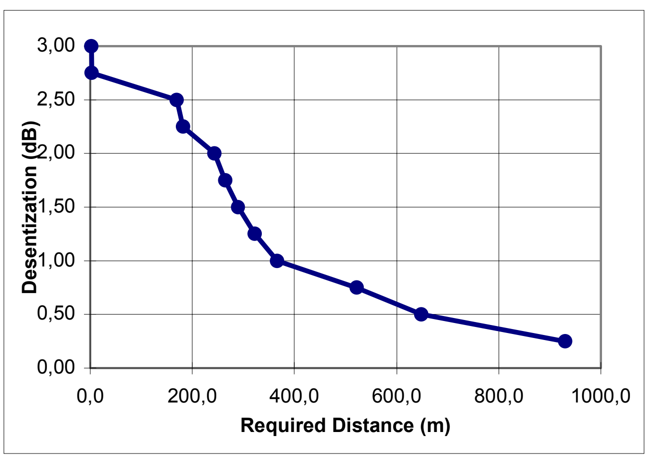
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	365,9
When only RX is on TX antenna 3dB-beamwidth	0,3
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	930,2
0,50	648,2
0,75	521,5
1,00	**365,9**
1,25	322,4
1,50	289,9
1,75	264,3
2,00	243,5
2,25	181,6
2,50	169,6
2,75	2,7
3,00	2,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**IS95**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1910,450	1908,750
Number of guard channels	0	0
Guard Band between channel edges (KHz)	925	
TX/RX frequency Offset (KHz)	1700,0	
System Data		
TX Power (dBm)	19	
RX sensitivity (dBm) ***** See Note *****		-120
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	8,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beamwidth (°)	60	105
Antenna Vertical Beamwidth (°)	60	9
Antenna Downtilt (°)	2	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

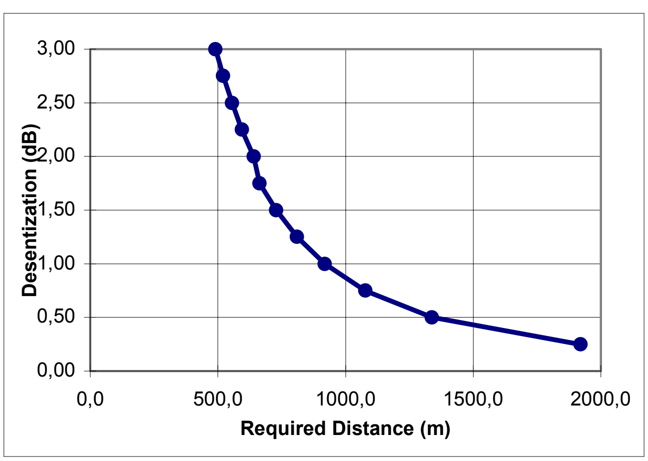
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	919,1
When only RX is on TX antenna 3dB-beamwidth	0,5
When only TX is on RX antenna 3dB-beamwidth	0,5
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1921,3
0,50	1338,9
0,75	1077,2
1,00	**919,1**
1,25	809,8
1,50	728,1
1,75	663,9
2,00	640,3
2,25	594,4
2,50	555,1
2,75	521,0
3,00	490,9

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**IS95**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1944,800	1946,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	725	
TX/RX frequency Offset (KHz)	1450,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) ***** See Note *****		-105
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

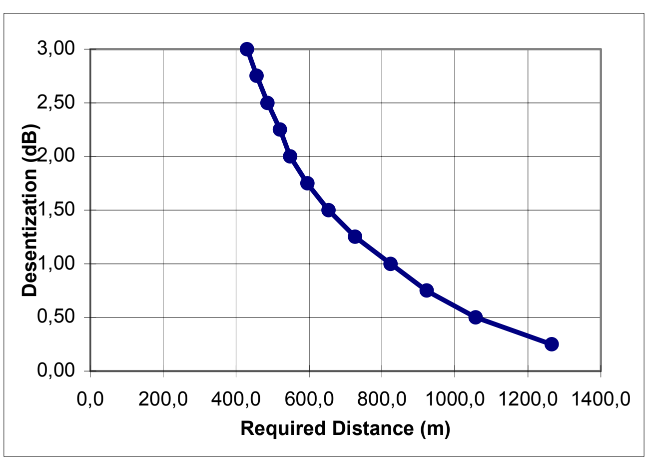
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	824,2
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	3,0
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1265,8
0,50	1056,7
0,75	922,5
1,00	**824,2**
1,25	726,2
1,50	653,0
1,75	595,4
2,00	548,4
2,25	520,9
2,50	486,5
2,75	456,6
3,00	430,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	IS95
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1943,750	1946,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1250	
TX/RX frequency Offset (KHz)	2500,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ** See Note **		-105
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

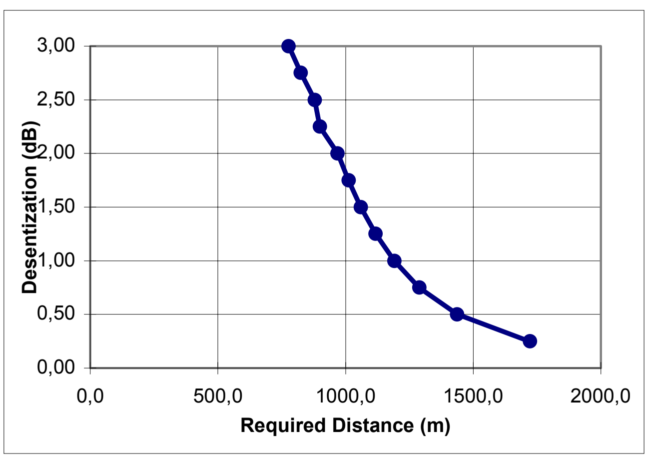
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	1190,9
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	5,5
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1721,8
0,50	1437,3
0,75	1289,2
1,00	**1190,9**
1,25	1117,8
1,50	1060,0
1,75	1012,1
2,00	969,0
2,25	899,5
2,50	879,6
2,75	825,5
3,00	777,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	IS95
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1944,960	1946,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	650	
TX/RX frequency Offset (KHz)	1290,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) ***See Note***		-105
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beam width (°)	105	omni
Antenna Vertical Beam width (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

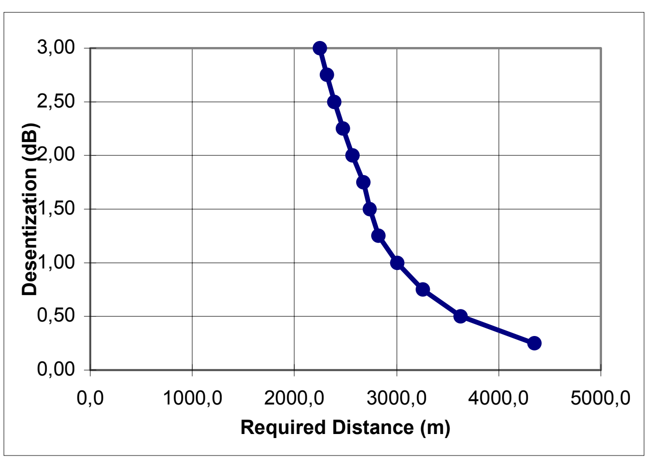
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	3007,7
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	673,0
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	4348,6
0,50	3630,1
0,75	3256,1
1,00	**3007,7**
1,25	2823,3
1,50	2739,5
1,75	2676,8
2,00	2569,0
2,25	2475,1
2,50	2391,9
2,75	2317,2
3,00	2249,3

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	DECT	IS95
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1928,448	1931,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1313	
TX/RX frequency Offset (KHz)	2802,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-105
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	15,0	1,5
Antenna Gain (dBi)	12,0	0,0
Antenna Horizontal Beamwidth (°)	120	omni
Antenna Vertical Beamwidth (°)	17	omni
Antenna Downtilt (°)	-7	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

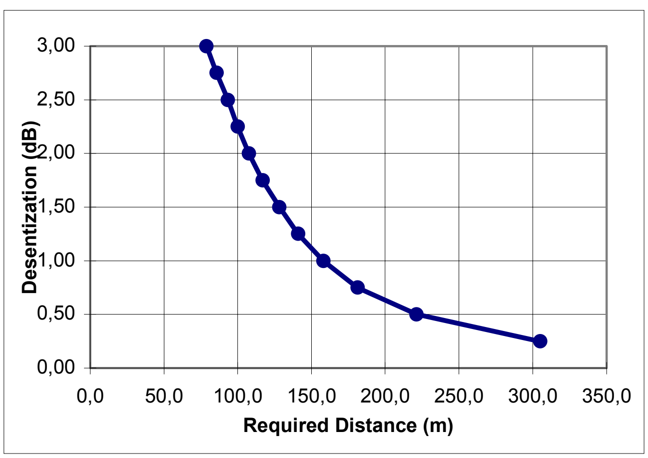
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	158,2
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	0,6
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	305,1
0,50	221,3
0,75	181,2
1,00	**158,2**
1,25	141,0
1,50	128,2
1,75	116,9
2,00	107,7
2,25	100,0
2,50	93,4
2,75	85,6
3,00	78,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	DECT	IS95
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	1910 -1930 MHz	A (upper part)
Working Frequency (MHz)	1928,448	1931,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1313	
TX/RX frequency Offset (KHz)	2802,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-105
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	8,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	60	omni
Antenna Vertical Beamwidth (°)	60	omni
Antenna Downtilt (°)	2	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

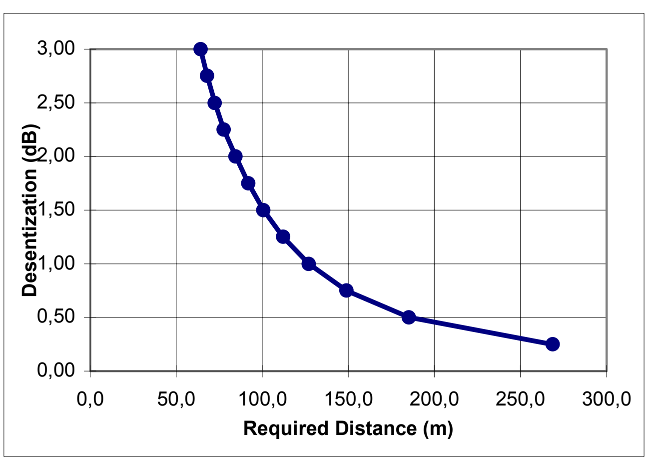
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	127,1
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	0,9
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	268,8
0,50	185,2
0,75	149,0
1,00	**127,1**
1,25	112,0
1,50	100,7
1,75	91,8
2,00	84,6
2,25	77,6
2,50	72,5
2,75	68,0
3,00	64,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PHS	IS95
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1929,350	1931,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1125	
TX/RX frequency Offset (KHz)	1900,0	
System Data		
TX Power (dBm)	22	
RX sensitivity (dBm) ***** See Note *****		-105
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	15,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	omni	omni
Antenna Vertical Beamwidth (°)	8	omni
Antenna Downtilt (°)	-7	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

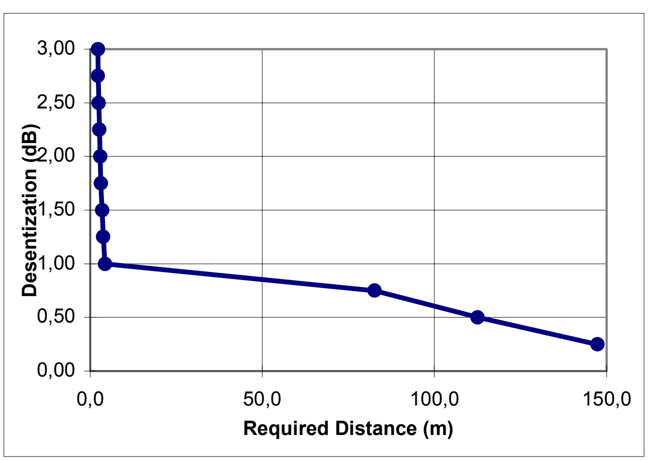
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB :

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	4,3
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	147,4
0,50	112,6
0,75	82,6
1,00	**4,3**
1,25	3,8
1,50	3,4
1,75	3,1
2,00	2,9
2,25	2,7
2,50	2,5
2,75	2,4
3,00	2,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PHS	IS95
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1929,350	1931,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1125	
TX/RX frequency Offset (KHz)	1900,0	
System Data		
TX Power (dBm)	19	
RX sensitivity (dBm) ***** See Note *****		-105
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	8,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	60	omni
Antenna Vertical Beamwidth (°)	60	omni
Antenna Downtilt (°)	2	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

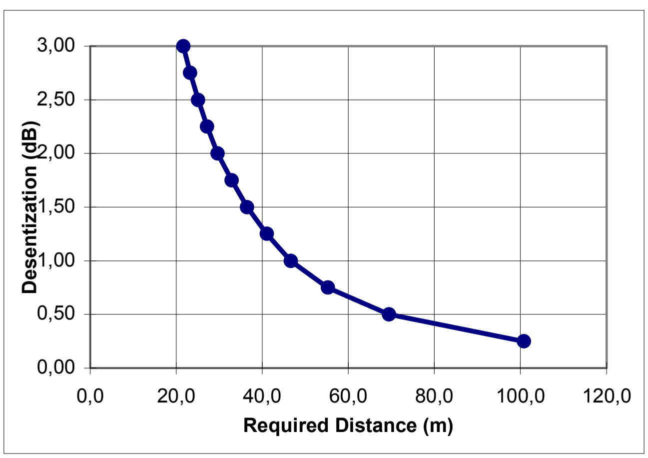
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	46,6
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	0,4
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	100,8
0,50	69,4
0,75	55,2
1,00	**46,6**
1,25	41,0
1,50	36,5
1,75	32,9
2,00	29,6
2,25	27,2
2,50	25,1
2,75	23,3
3,00	21,7

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PCS1900	IS136
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1894,800	1895,400
Number of guard channels	0	0
Guard Band between channel edges (KHz)	485	
TX/RX frequency Offset (KHz)	600,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***See Note***		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beam width (°)	omni	105
Antenna Vertical Beam width (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

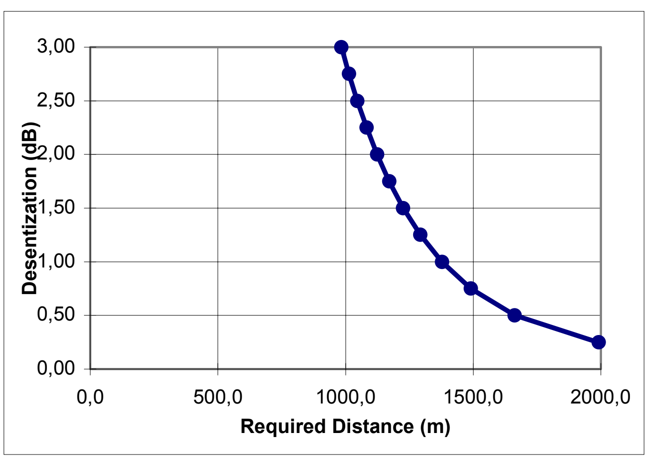
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	1377,7
When only RX is on TX antenna 3dB-beam width	7,6
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1992,0
0,50	1662,9
0,75	1491,5
1,00	**1377,7**
1,25	1293,3
1,50	1226,3
1,75	1171,0
2,00	1123,8
2,25	1082,7
2,50	1046,4
2,75	1013,7
3,00	984,0

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	IS136
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1893,750	1895,400
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1010	
TX/RX frequency Offset (KHz)	1650,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***** See Note *****		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beam width (°)	omni	105
Antenna Vertical Beam width (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

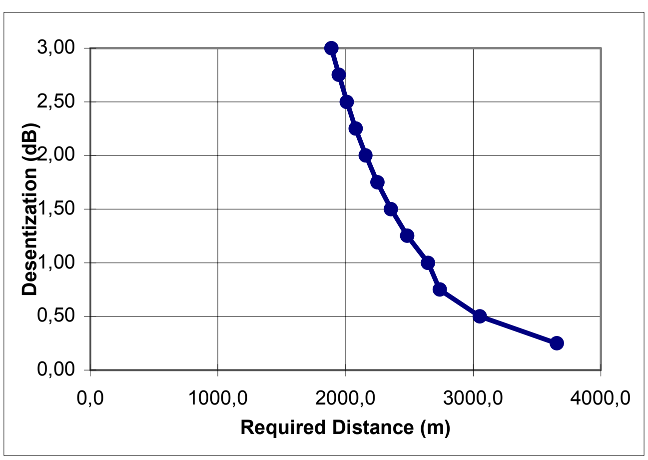
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB :

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	2647,1
When only RX is on TX antenna 3dB-beam width	499,6
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	3655,0
0,50	3051,2
0,75	2736,8
1,00	**2647,1**
1,25	2484,8
1,50	2356,2
1,75	2249,8
2,00	2159,2
2,25	2080,3
2,50	2010,4
2,75	1947,6
3,00	1890,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	IS136
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1894,920	1895,400
Number of guard channels	0	0
Guard Band between channel edges (KHz)	450	
TX/RX frequency Offset (KHz)	480,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) **** See Note ****		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

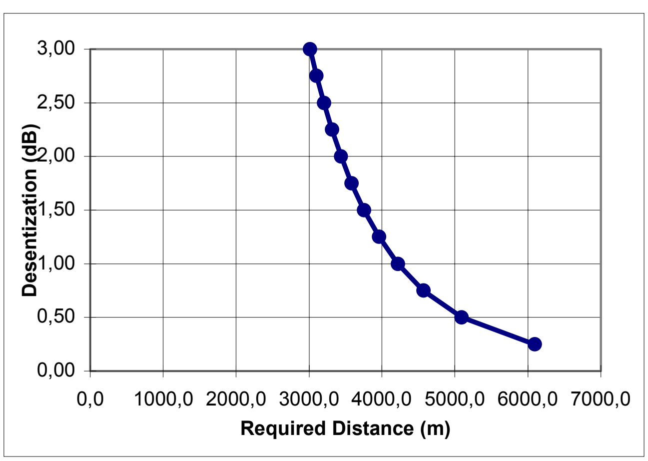
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	4218,4
When only RX is on TX antenna 3dB-beamwidth	1109,6
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	6099,0
0,50	5091,4
0,75	4566,8
1,00	**4218,4**
1,25	3959,7
1,50	3754,7
1,75	3585,2
2,00	3440,9
2,25	3315,2
2,50	3203,7
2,75	3103,6
3,00	3012,7

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**IS136**
Device	**Base Station**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 -1930 MHz	C (lower part)
Working Frequency (MHz)	1912,896	1909,920
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2097	
TX/RX frequency Offset (KHz)	2976,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***See Note** **		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	15,0	25,0
Antenna Gain (dBi)	12,0	17,0
Antenna Horizontal Beam width (°)	120	105
Antenna Vertical Beam width (°)	17	9
Antenna Downtilt (°)	-7	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

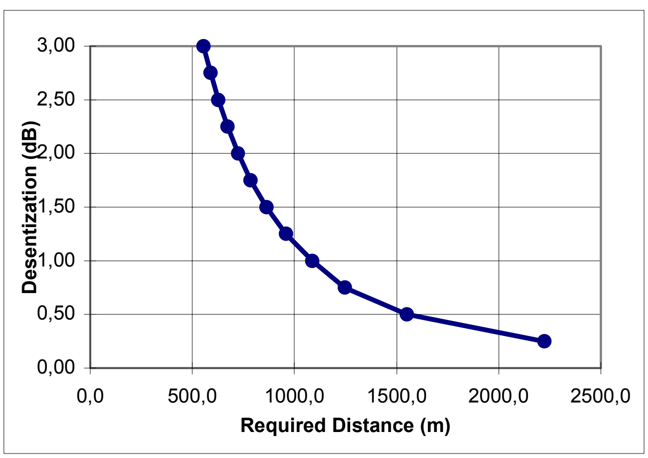
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	1088,4
When only RX is on TX antenna 3dB-beam width	0,3
When only TX is on RX antenna 3dB-beam width	0,3
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	2223,4
0,50	1549,4
0,75	1246,6
1,00	**1088,4**
1,25	959,0
1,50	862,3
1,75	786,2
2,00	724,2
2,25	672,2
2,50	627,8
2,75	589,2
3,00	555,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**IS136**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1912,896	1909,920
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2097	
TX/RX frequency Offset (KHz)	2976,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	8,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beamwidth (°)	60	105
Antenna Vertical Beamwidth (°)	60	9
Antenna Downtilt (°)	2	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

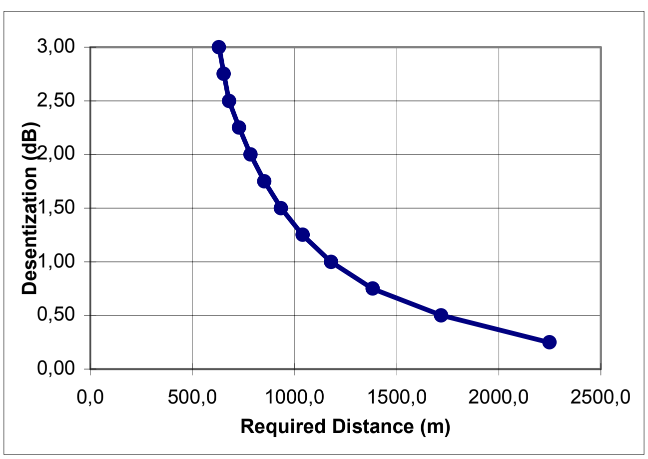
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1179,8
When only RX is on TX antenna 3dB-beamwidth	0,6
When only TX is on RX antenna 3dB-beamwidth	0,6
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	2249,2
0,50	1718,6
0,75	1382,7
1,00	**1179,8**
1,25	1039,5
1,50	934,7
1,75	852,2
2,00	785,0
2,25	728,6
2,50	680,5
2,75	653,5
3,00	630,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PHS	IS136
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1910,450	1909,920
Number of guard channels	0	0
Guard Band between channel edges (KHz)	365	
TX/RX frequency Offset (KHz)	530,0	
System Data		
TX Power (dBm)	22	
RX sensitivity (dBm) ***See Note***		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	15,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beam width (°)	omni	105
Antenna Vertical Beam width (°)	8	9
Antenna Downtilt (°)	-7	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

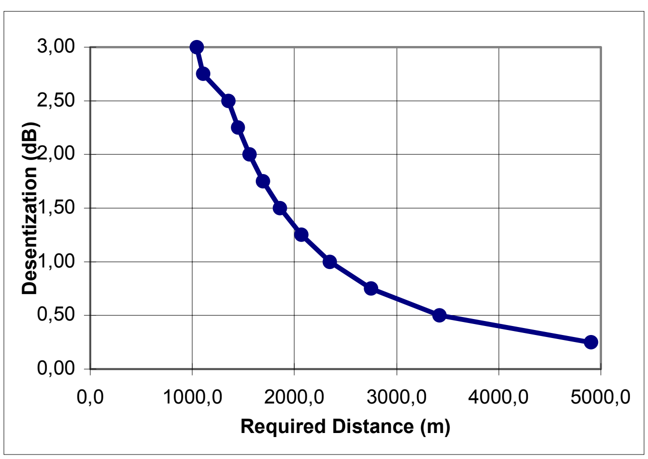
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	2346,5
When only RX is on TX antenna 3dB-beam width	1,4
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	4905,1
0,50	3418,2
0,75	2750,1
1,00	**2346,5**
1,25	2067,5
1,50	1859,0
1,75	1695,0
2,00	1561,2
2,25	1449,2
2,50	1353,4
2,75	1106,3
3,00	1042,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**IS136**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 -1930 MHz	C (lower part)
Working Frequency (MHz)	1910,450	1909,920
Number of guard channels	0	0
Guard Band between channel edges (KHz)	365	
TX/RX frequency Offset (KHz)	530,0	
System Data		
TX Power (dBm)	19	
RX sensitivity (dBm) ***** See Note *****		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	8,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beam width (°)	60	105
Antenna Vertical Beam width (°)	60	9
Antenna Downtilt (°)	2	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

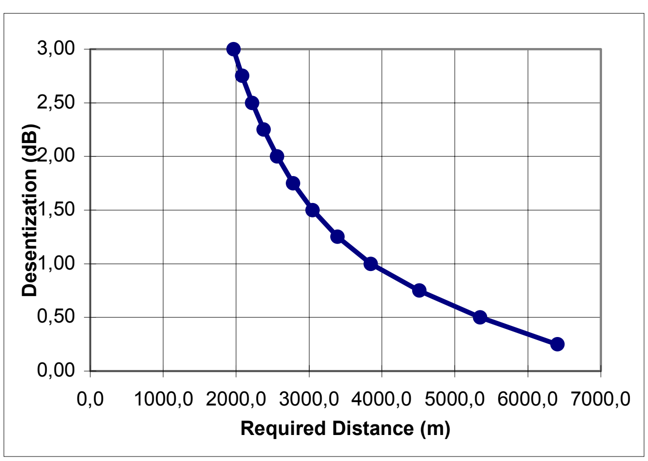
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	3849,6
When only RX is on TX antenna 3dB-beam width	285,4
When only TX is on RX antenna 3dB-beam width	285,4
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,1

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	6404,2
0,50	5346,1
0,75	4511,8
1,00	**3849,6**
1,25	3391,9
1,50	3049,8
1,75	2780,7
2,00	2561,3
2,25	2377,6
2,50	2220,4
2,75	2083,8
3,00	1963,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**IS136**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1944,800	1945,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	165	
TX/RX frequency Offset (KHz)	280,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) ***** See Note *****		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beam width (°)	105	omni
Antenna Vertical Beam width (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

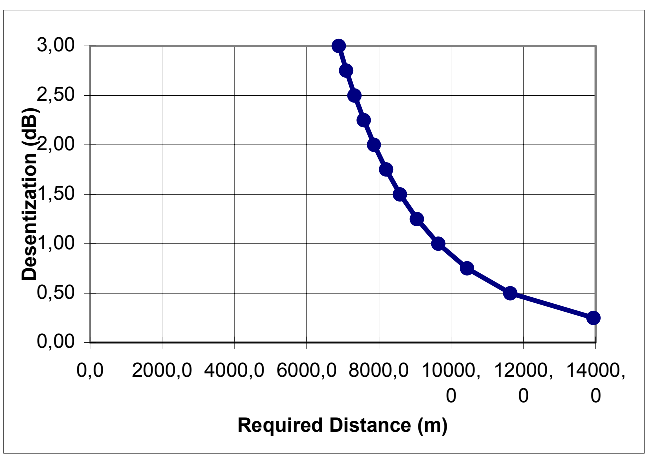
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	9642,1
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	2536,1
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	13940,7
0,50	11637,4
0,75	10438,4
1,00	**9642,1**
1,25	9050,7
1,50	8582,2
1,75	8194,9
2,00	7864,9
2,25	7577,5
2,50	7322,8
2,75	7094,0
3,00	6886,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	IS136
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1943,750	1945,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	690	
TX/RX frequency Offset (KHz)	1330,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ***** See Note *****		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

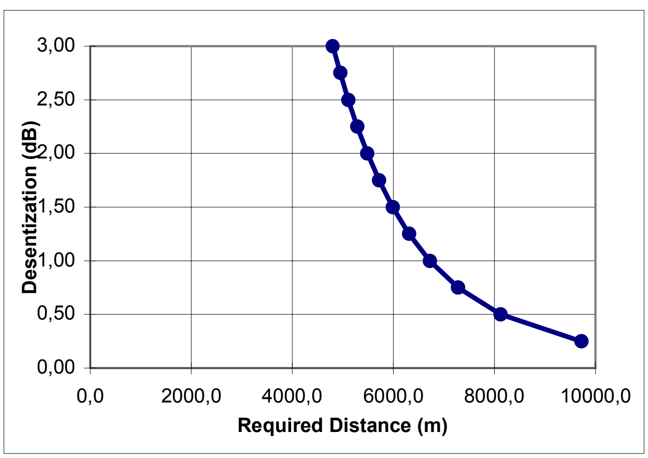
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	6726,3
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	1769,2
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	9725,0
0,50	8118,3
0,75	7281,8
1,00	**6726,3**
1,25	6313,8
1,50	5986,9
1,75	5716,7
2,00	5486,6
2,25	5286,1
2,50	5108,4
2,75	4948,8
3,00	4803,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	IS136
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1944,960	1945,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	90	
TX/RX frequency Offset (KHz)	120,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) ***** See Note *****		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

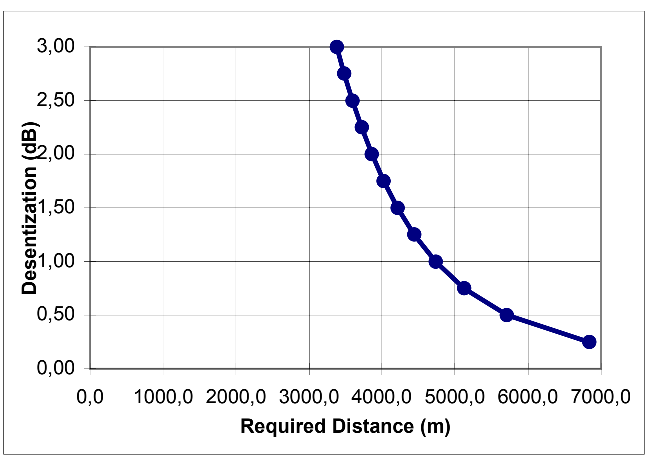
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	4733,1
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	1244,9
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	6843,2
0,50	5712,6
0,75	5124,0
1,00	**4733,1**
1,25	4442,8
1,50	4212,8
1,75	4022,7
2,00	3860,7
2,25	3719,7
2,50	3594,7
2,75	3482,3
3,00	3380,3

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	DECT	IS136
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1928,448	1930,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	753	
TX/RX frequency Offset (KHz)	1632,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***See Note***		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	15,0	1,5
Antenna Gain (dBi)	12,0	0,0
Antenna Horizontal Beamwidth (°)	120	omni
Antenna Vertical Beamwidth (°)	17	omni
Antenna Downtilt (°)	-7	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

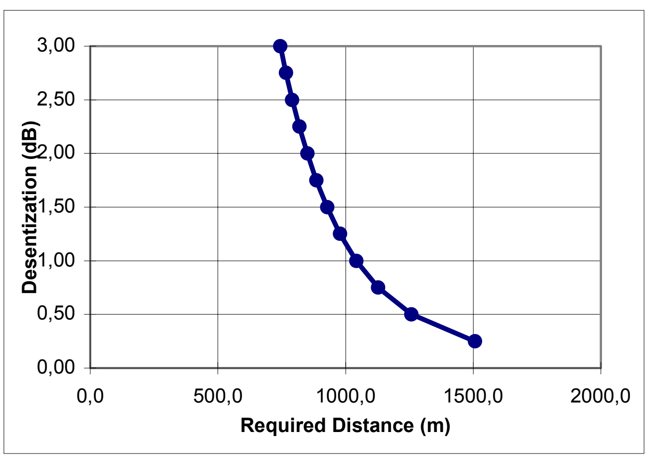
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1042,6
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	140,7
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1507,4
0,50	1258,4
0,75	1128,7
1,00	**1042,6**
1,25	978,7
1,50	928,0
1,75	886,1
2,00	850,4
2,25	819,4
2,50	791,8
2,75	767,1
3,00	744,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	DECT	IS136
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1928,448	1930,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	753	
TX/RX frequency Offset (KHz)	1632,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	8,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	60	omni
Antenna Vertical Beamwidth (°)	60	omni
Antenna Downtilt (°)	2	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

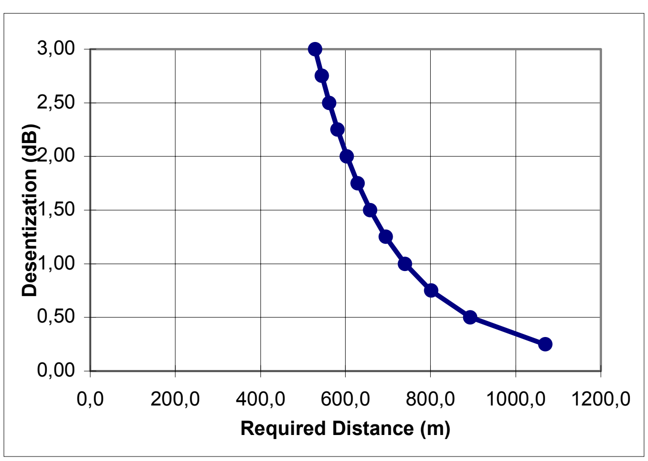
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	739,8
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	110,5
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1069,6
0,50	892,9
0,75	800,9
1,00	**739,8**
1,25	694,4
1,50	658,5
1,75	628,8
2,00	603,4
2,25	581,4
2,50	561,9
2,75	544,3
3,00	528,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**IS136**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1929,350	1930,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	565	
TX/RX frequency Offset (KHz)	730,0	
System Data		
TX Power (dBm)	22	
RX sensitivity (dBm) ***** See Note *****		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	15,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	omni	omni
Antenna Vertical Beamwidth (°)	8	omni
Antenna Downtilt (°)	-7	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

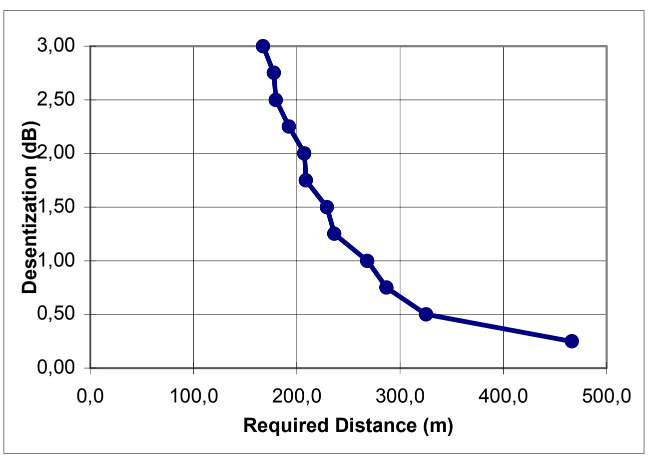
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	268,4
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	466,8
0,50	325,3
0,75	286,9
1,00	**268,4**
1,25	236,5
1,50	229,2
1,75	209,0
2,00	207,4
2,25	192,6
2,50	179,8
2,75	177,7
3,00	167,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**IS136**
Device	**Terminal**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	1910 -1930 MHz	A (upper part)
Working Frequency (MHz)	1929,350	1930,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	565	
TX/RX frequency Offset (KHz)	730,0	
System Data		
TX Power (dBm)	19	
RX sensitivity (dBm) ***** See Note *****		-103
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	8,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beam width (°)	60	omni
Antenna Vertical Beam width (°)	60	omni
Antenna Downtilt (°)	2	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

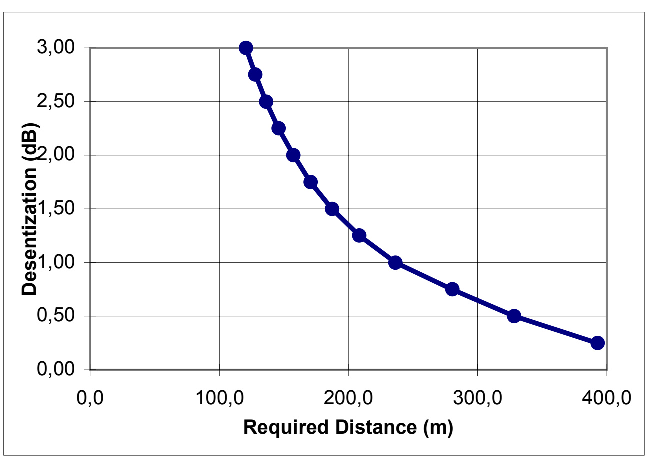
Note: This is the Receiver Sensitivity with Rayleigh Fading (7 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	236,5
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	2,0
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	393,1
0,50	328,2
0,75	280,4
1,00	**236,5**
1,25	208,4
1,50	187,4
1,75	170,8
2,00	157,4
2,25	146,1
2,50	136,4
2,75	128,0
3,00	120,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**DECT**
Device	**Base Station**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,200	1928,448
Number of guard channels	0	0
Guard Band between channel edges (KHz)	788	
TX/RX frequency Offset (KHz)	1752,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) ***** See Note *****		-76
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	25,0	15,0
Antenna Gain (dBi)	17,0	12,0
Antenna Horizontal Beam width (°)	105	120
Antenna Vertical Beam width (°)	9	17
Antenna Downtilt (°)	-3	-7
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

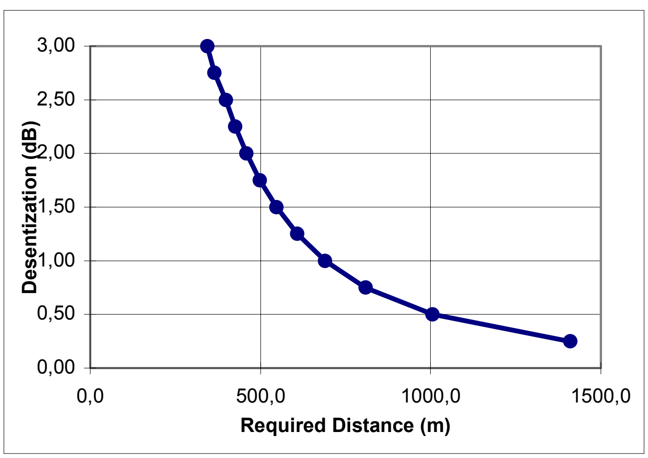
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	690,4
When only RX is on TX antenna 3dB-beam width	0,2
When only TX is on RX antenna 3dB-beam width	0,2
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1410,3
0,50	1005,7
0,75	809,1
1,00	**690,4**
1,25	608,3
1,50	546,9
1,75	498,7
2,00	459,3
2,25	426,4
2,50	398,2
2,75	365,2
3,00	344,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**DECT**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1909,800	1912,896
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2132	
TX/RX frequency Offset (KHz)	3096,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***** See Note *****		-76
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	1,5	15,0
Antenna Gain (dBi)	0,0	12,0
Antenna Horizontal Beam width (°)	omni	120
Antenna Vertical Beam width (°)	omni	17
Antenna Downtilt (°)	0	-7
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

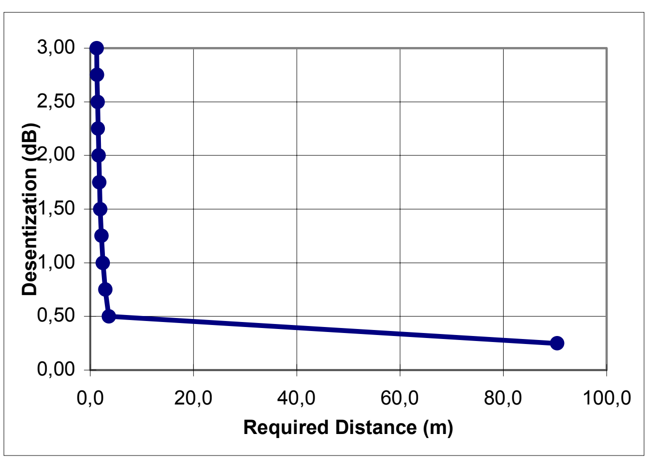
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	2,5
When only RX is on TX antenna 3dB-beam width	0,2
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	90,4
0,50	3,6
0,75	2,9
1,00	**2,5**
1,25	2,2
1,50	2,0
1,75	1,8
2,00	1,7
2,25	1,5
2,50	1,4
2,75	1,3
3,00	1,3

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	DECT
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1931,250	1928,448
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1313	
TX/RX frequency Offset (KHz)	2802,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ***See Note***		-76
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	25,0	15,0
Antenna Gain (dBi)	17,0	12,0
Antenna Horizontal Beam width (°)	105	120
Antenna Vertical Beam width (°)	9	17
Antenna Downtilt (°)	-3	-7
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	0,3	

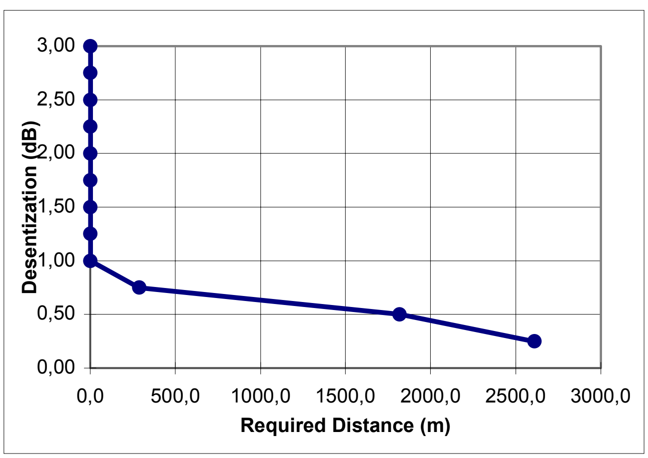
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 0,25 dB :

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	1248,2
When only RX is on TX antenna 3dB-beam width	0,4
When only TX is on RX antenna 3dB-beam width	0,4
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2609,3
0,50	1818,3
0,75	287,6
1,00	**2,5**
1,25	2,2
1,50	2,0
1,75	1,8
2,00	1,7
2,25	1,5
2,50	1,4
2,75	1,3
3,00	1,3

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	DECT
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	C (lowerpart)	1910 - 1930 MHz
Working Frequency (MHz)	1908,750	1912,896
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2657	
TX/RX frequency Offset (KHz)	4146,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***** See Note *****		-76
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	1,5	15,0
Antenna Gain (dBi)	0,0	12,0
Antenna Horizontal Beamwidth (°)	omni	120
Antenna Vertical Beamwidth (°)	omni	17
Antenna Downtilt (°)	0	-7
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

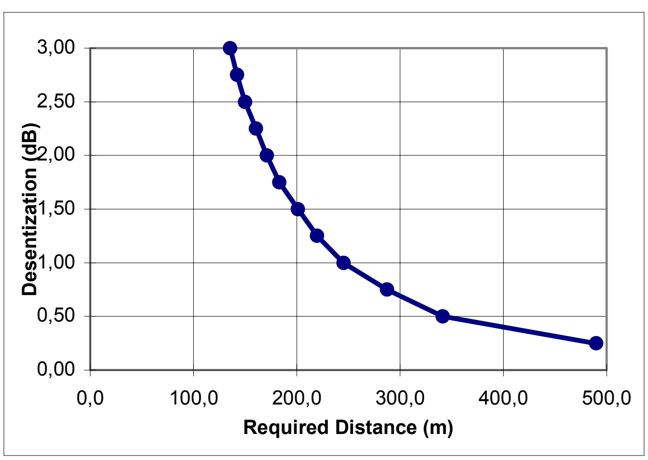
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	245,4
When only RX is on TX antenna 3dB-beamwidth	0,9
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	489,8
0,50	341,3
0,75	287,6
1,00	**245,4**
1,25	220,0
1,50	201,2
1,75	183,5
2,00	170,9
2,25	160,5
2,50	149,9
2,75	142,3
3,00	135,7

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	DECT
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,080	1928,448
Number of guard channels	0	0
Guard Band between channel edges (KHz)	753	
TX/RX frequency Offset (KHz)	1632,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) ** *See Note* **		-76
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	25,0	15,0
Antenna Gain (dBi)	17,0	12,0
Antenna Horizontal Beamwidth (°)	105	120
Antenna Vertical Beamwidth (°)	9	17
Antenna Downtilt (°)	-3	-7
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

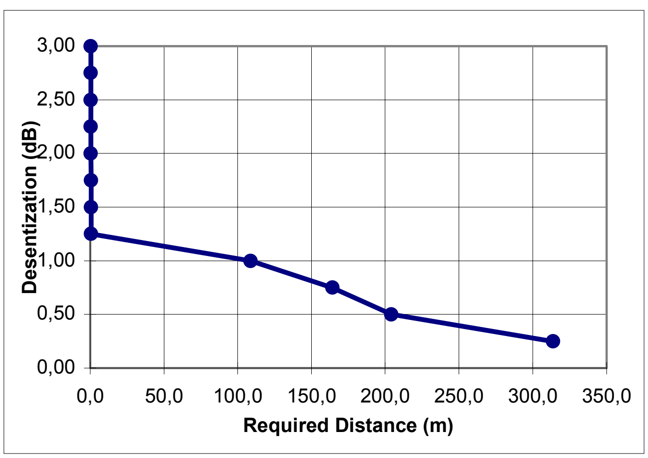
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	108,8
When only RX is on TX antenna 3dB-beamwidth	0,0
When only TX is on RX antenna 3dB-beamwidth	0,0
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	313,9
0,50	204,1
0,75	164,2
1,00	**108,8**
1,25	0,6
1,50	0,6
1,75	0,5
2,00	0,5
2,25	0,4
2,50	0,4
2,75	0,4
3,00	0,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	DECT
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	C (lowerpart)	1910 - 1930 MHz
Working Frequency (MHz)	1909,920	1912,896
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2097	
TX/RX frequency Offset (KHz)	2976,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***** See Note *****		-76
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	1,5	15,0
Antenna Gain (dBi)	0,0	12,0
Antenna Horizontal Beamwidth (°)	omni	120
Antenna Vertical Beamwidth (°)	omni	17
Antenna Downtilt (°)	0	-7
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

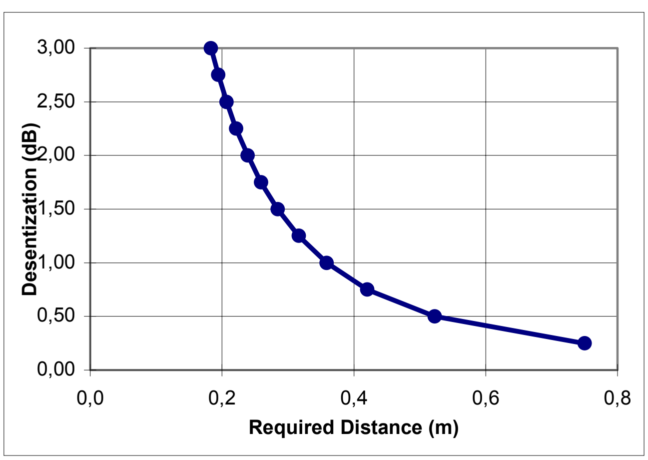
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	0,4
When only RX is on TX antenna 3dB-beamwidth	0,0
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	0,8
0,50	0,5
0,75	0,4
1,00	**0,4**
1,25	0,3
1,50	0,3
1,75	0,3
2,00	0,2
2,25	0,2
2,50	0,2
2,75	0,2
3,00	0,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PCS1900	DECT
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,200	1928,448
Number of guard channels	0	0
Guard Band between channel edges (KHz)	788	
TX/RX frequency Offset (KHz)	1752,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) ***** See Note *****		-76
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	25,0	8,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beam width (°)	105	60
Antenna Vertical Beam width (°)	9	60
Antenna Downtilt (°)	-3	2
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

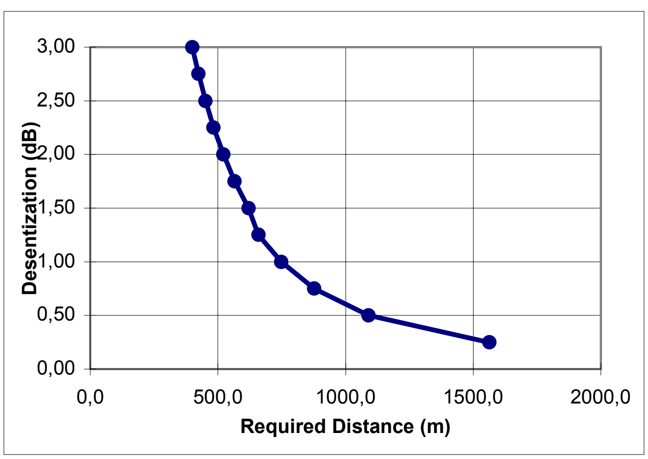
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB :

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	748,3
When only RX is on TX antenna 3dB-beam width	0,4
When only TX is on RX antenna 3dB-beam width	0,4
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,0

Required distances when TX and RX antennae are on-beam , for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	1564,2
0,50	1090,1
0,75	877,0
1,00	**748,3**
1,25	659,3
1,50	620,8
1,75	566,0
2,00	521,3
2,25	483,9
2,50	452,0
2,75	424,2
3,00	399,7

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PCS1900	DECT
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	C (lowerpart)	1910 -1930 MHz
Working Frequency (MHz)	1909,800	1912,896
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2132	
TX/RX frequency Offset (KHz)	3096,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***** See Note *****		-76
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	1,5	8,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beamwidth (°)	omni	60
Antenna Vertical Beamwidth (°)	omni	60
Antenna Downtilt (°)	0	2
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

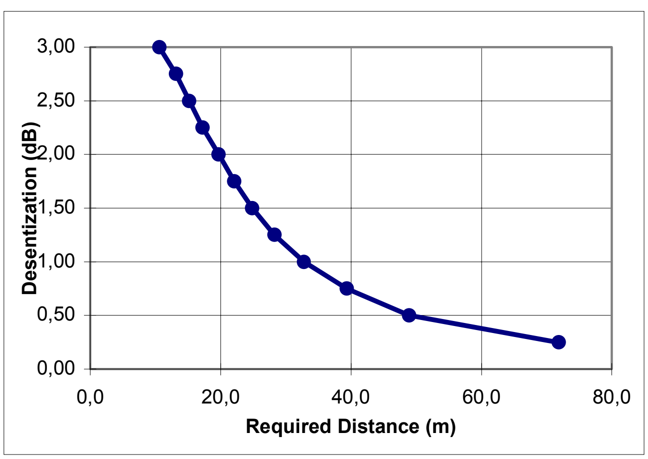
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	32,8
When only RX is on TX antenna 3dB-beamwidth	0,3
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	71,8
0,50	48,9
0,75	39,4
1,00	**32,8**
1,25	28,3
1,50	24,8
1,75	22,1
2,00	19,7
2,25	17,3
2,50	15,2
2,75	13,2
3,00	10,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	DECT
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1931,250	1928,448
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1313	
TX/RX frequency Offset (KHz)	2802,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ***** See Note *****		-76
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	25,0	8,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	60
Antenna Vertical Beamwidth (°)	9	60
Antenna Downtilt (°)	-3	2
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

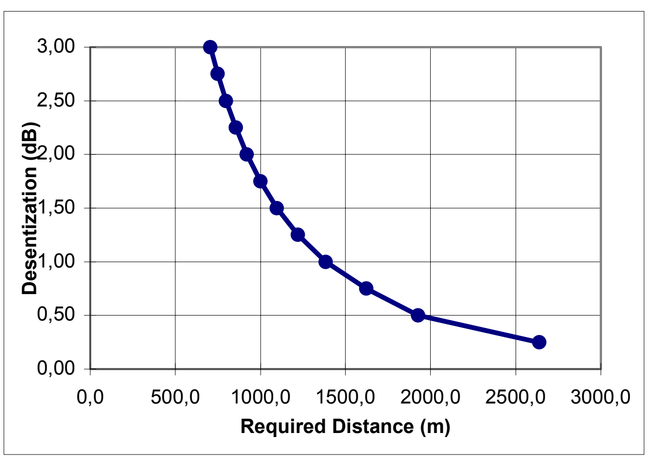
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1384,5
When only RX is on TX antenna 3dB-beamwidth	0,7
When only TX is on RX antenna 3dB-beamwidth	0,7
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2639,5
0,50	1926,0
0,75	1622,6
1,00	**1384,5**
1,25	1219,9
1,50	1096,8
1,75	1000,1
2,00	921,2
2,25	855,1
2,50	798,6
2,75	749,4
3,00	706,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**IS95**	**DECT**
Device	**Terminal**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1908,750	1912,896
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2657	
TX/RX frequency Offset (KHz)	4146,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***** See Note *****		-76
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	1,5	8,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beam width (°)	omni	60
Antenna Vertical Beam width (°)	omni	60
Antenna Downtilt (°)	0	2
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

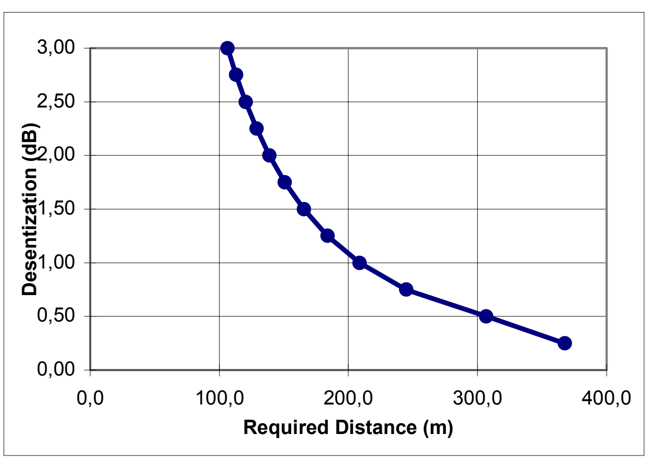
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	208,8
When only RX is on TX antenna 3dB-beam width	1,6
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	367,8
0,50	307,0
0,75	244,8
1,00	**208,8**
1,25	184,0
1,50	165,4
1,75	150,9
2,00	138,9
2,25	129,0
2,50	120,5
2,75	113,0
3,00	106,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	DECT
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,080	1928,448
Number of guard channels	0	0
Guard Band between channel edges (KHz)	753	
TX/RX frequency Offset (KHz)	1632,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) ***** See Note *****		-76
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	25,0	8,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	60
Antenna Vertical Beamwidth (°)	9	60
Antenna Downtilt (°)	-3	2
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

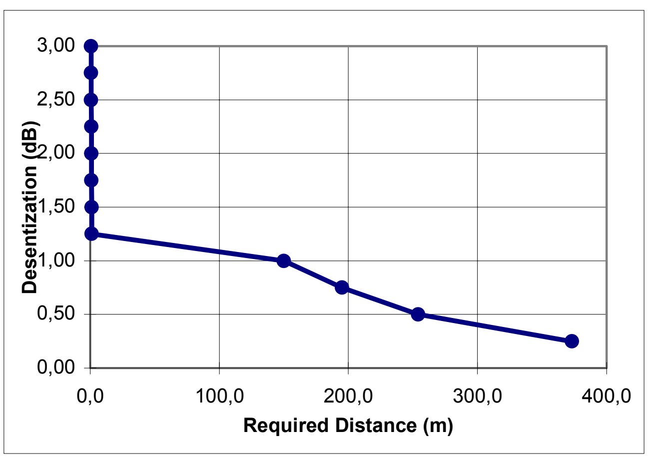
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	150,2
When only RX is on TX antenna 3dB-beam width	0,1
When only TX is on RX antenna 3dB-beam width	0,1
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	373,0
0,50	254,0
0,75	195,2
1,00	**150,2**
1,25	1,2
1,50	1,0
1,75	0,9
2,00	0,9
2,25	0,8
2,50	0,8
2,75	0,7
3,00	0,7

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	DECT
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1909,920	1912,896
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2097	
TX/RX frequency Offset (KHz)	2976,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***** See Note *****		-76
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	1,5	8,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beam width (°)	omni	60
Antenna Vertical Beam width (°)	omni	60
Antenna Downtilt (°)	0	2
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

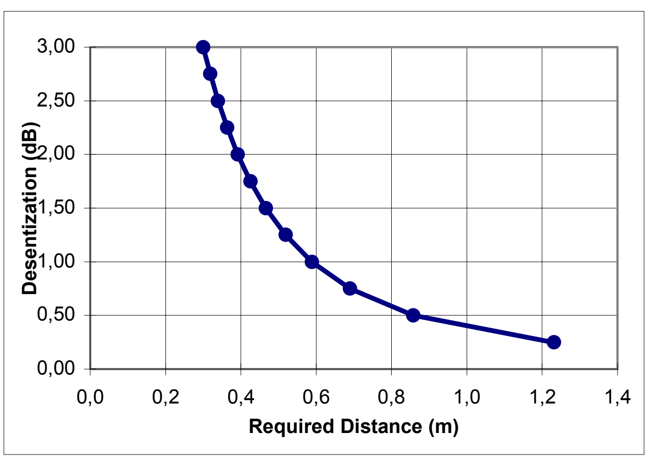
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB :

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	0,6
When only RX is on TX antenna 3dB-beam width	0,0
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1,2
0,50	0,9
0,75	0,7
1,00	**0,6**
1,25	0,5
1,50	0,5
1,75	0,4
2,00	0,4
2,25	0,4
2,50	0,3
2,75	0,3
3,00	0,3

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**PHS**
Device	**Base Station**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,200	1929,350
Number of guard channels	0	0
Guard Band between channel edges (KHz)	600	
TX/RX frequency Offset (KHz)	850,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) ***** See Note *****		-78
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	25,0	15,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beam width (°)	105	omni
Antenna Vertical Beam width (°)	9	8
Antenna Downtilt (°)	-3	-7
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

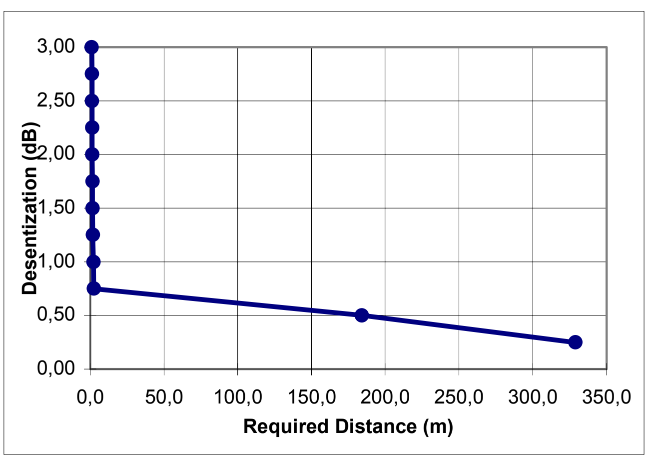
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	2,1
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	0,1
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	328,8
0,50	184,1
0,75	2,5
1,00	**2,1**
1,25	1,9
1,50	1,7
1,75	1,5
2,00	1,4
2,25	1,3
2,50	1,2
2,75	1,1
3,00	1,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**PHS**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	C (lowerpart)	1910 -1930 MHz
Working Frequency (MHz)	1909,800	1910,450
Number of guard channels	0	0
Guard Band between channel edges (KHz)	400	
TX/RX frequency Offset (KHz)	650,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***** See Note *****		-78
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	15,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beamwidth (°)	omni	omni
Antenna Vertical Beamwidth (°)	omni	8
Antenna Downtilt (°)	0	-7
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

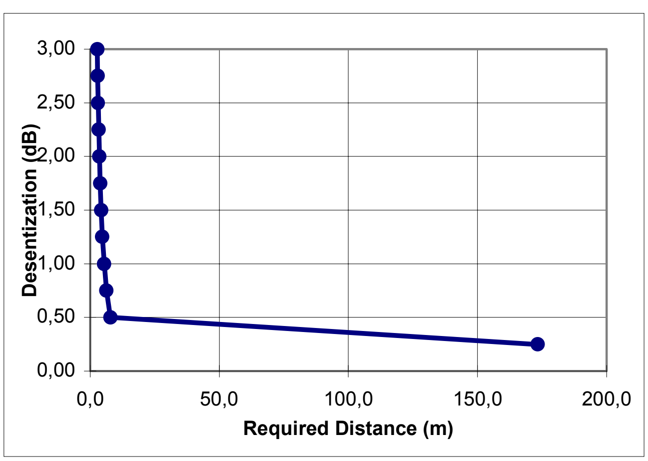
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	5,4
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	173,3
0,50	7,8
0,75	6,3
1,00	**5,4**
1,25	4,7
1,50	4,3
1,75	3,9
2,00	3,6
2,25	3,3
2,50	3,1
2,75	2,9
3,00	2,7

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**IS95**	**PHS**
Device	**Base Station**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1931,250	1929,350
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1125	
TX/RX frequency Offset (KHz)	1900,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ***** See Note *****		-78
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	25,0	15,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	8
Antenna Downtilt (°)	-3	-7
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

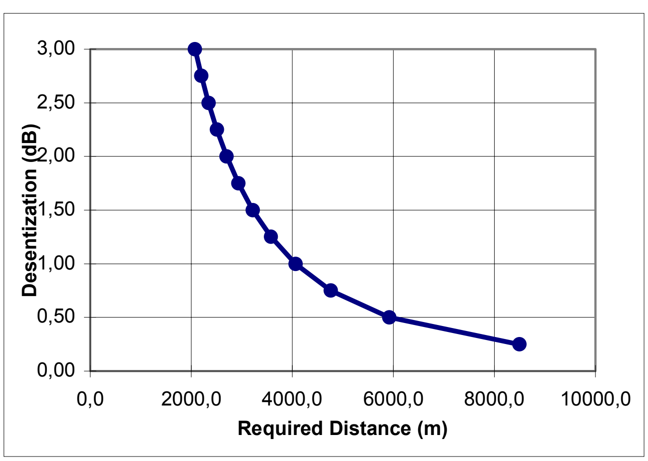
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	4064,1
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	2,5
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	8495,5
0,50	5920,2
0,75	4763,1
1,00	**4064,1**
1,25	3580,9
1,50	3219,7
1,75	2935,7
2,00	2704,0
2,25	2510,0
2,50	2344,1
2,75	2199,9
3,00	2072,9

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**IS95**	**PHS**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1908,750	1910,450
Number of guard channels	0	0
Guard Band between channel edges (KHz)	925	
TX/RX frequency Offset (KHz)	1700,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***** See Note *****		-78
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	15,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beamwidth (°)	omni	omni
Antenna Vertical Beamwidth (°)	omni	8
Antenna Downtilt (°)	0	-7
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

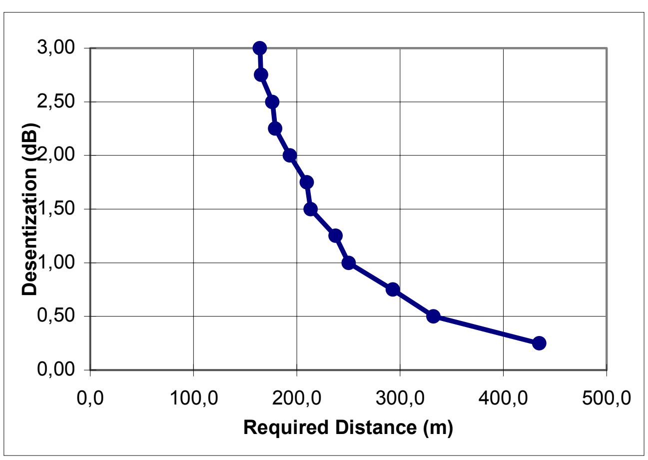
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	250,2
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	435,0
0,50	332,4
0,75	293,2
1,00	**250,2**
1,25	237,6
1,50	213,6
1,75	209,9
2,00	193,3
2,25	179,5
2,50	176,5
2,75	165,6
3,00	164,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	PHS
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,080	1929,350
Number of guard channels	0	0
Guard Band between channel edges (KHz)	565	
TX/RX frequency Offset (KHz)	730,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) ** *See Note* **		-78
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	25,0	15,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	8
Antenna Downtilt (°)	-3	-7
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

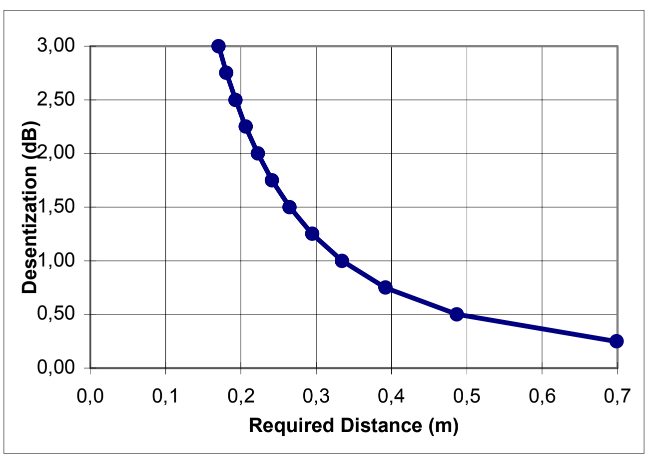
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	0,3
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	0,0
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	0,7
0,50	0,5
0,75	0,4
1,00	**0,3**
1,25	0,3
1,50	0,3
1,75	0,2
2,00	0,2
2,25	0,2
2,50	0,2
2,75	0,2
3,00	0,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	PHS
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1909,920	1910,450
Number of guard channels	0	0
Guard Band between channel edges (KHz)	365	
TX/RX frequency Offset (KHz)	530,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***** See Note *****		-78
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	15,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beamwidth (°)	omni	omni
Antenna Vertical Beamwidth (°)	omni	8
Antenna Downtilt (°)	0	-7
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

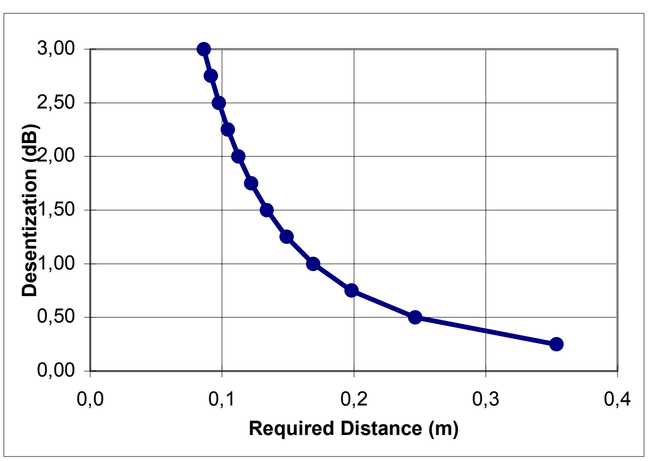
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB :

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	0,2
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	0,4
0,50	0,2
0,75	0,2
1,00	**0,2**
1,25	0,1
1,50	0,1
1,75	0,1
2,00	0,1
2,25	0,1
2,50	0,1
2,75	0,1
3,00	0,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**PHS**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,200	1929,350
Number of guard channels	0	0
Guard Band between channel edges (KHz)	600	
TX/RX frequency Offset (KHz)	850,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) ***** See Note *****		-78
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	25,0	8,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	60
Antenna Vertical Beamwidth (°)	9	60
Antenna Downtilt (°)	-3	2
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

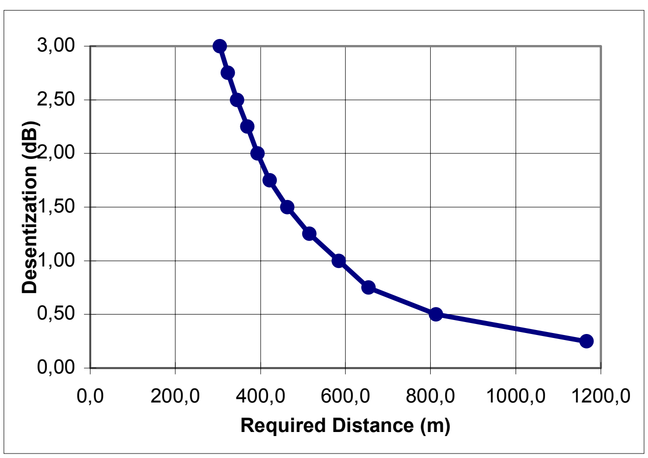
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	584,5
When only RX is on TX antenna 3dB-beamwidth	0,3
When only TX is on RX antenna 3dB-beamwidth	0,3
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1166,7
0,50	813,1
0,75	654,1
1,00	**584,5**
1,25	515,0
1,50	463,0
1,75	422,2
2,00	393,4
2,25	369,4
2,50	345,0
2,75	323,7
3,00	305,0

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**PHS**
Device	**Terminal**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	C (lowerpart)	1910 - 1930 MHz
Working Frequency (MHz)	1909,800	1910,450
Number of guard channels	0	0
Guard Band between channel edges (KHz)	400	
TX/RX frequency Offset (KHz)	650,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***** See Note *****		-78
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	8,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beamwidth (°)	omni	60
Antenna Vertical Beamwidth (°)	omni	60
Antenna Downtilt (°)	0	2
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

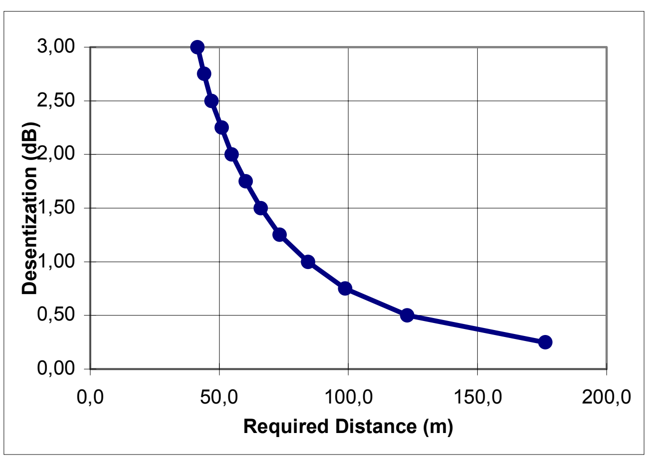
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	84,3
When only RX is on TX antenna 3dB-beamwidth	0,6
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	176,3
0,50	122,9
0,75	98,8
1,00	**84,3**
1,25	73,5
1,50	66,1
1,75	60,2
2,00	54,8
2,25	50,9
2,50	47,0
2,75	44,1
3,00	41,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	PHS
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upperpart)	1910 -1930 MHz
Working Frequency (MHz)	1931,250	1929,350
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1125	
TX/RX frequency Offset (KHz)	1900,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ***See Note***		-78
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	25,0	8,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beam width (°)	105	60
Antenna Vertical Beam width (°)	9	60
Antenna Downtilt (°)	-3	2
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

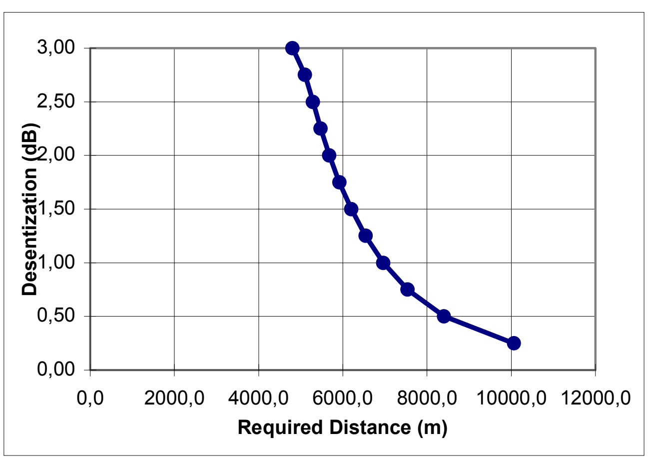
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	6963,4
When only RX is on TX antenna 3dB-beam width	651,6
When only TX is on RX antenna 3dB-beam width	651,6
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,3

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	10067,8
0,50	8404,4
0,75	7538,5
1,00	**6963,4**
1,25	6536,3
1,50	6198,0
1,75	5918,2
2,00	5680,0
2,25	5472,4
2,50	5288,5
2,75	5098,1
3,00	4803,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	PHS
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1908,750	1910,450
Number of guard channels	0	0
Guard Band between channel edges (KHz)	925	
TX/RX frequency Offset (KHz)	1700,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***See Note***		-78
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	8,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beamwidth (°)	omni	60
Antenna Vertical Beamwidth (°)	omni	60
Antenna Downtilt (°)	0	2
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

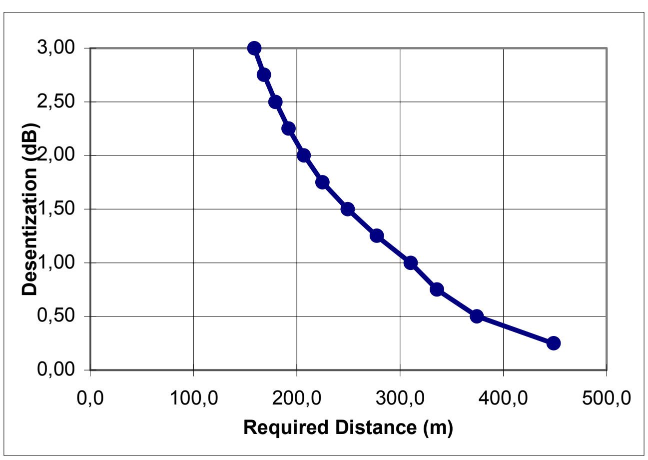
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	310,4
When only RX is on TX antenna 3dB-beamwidth	14,7
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	448,8
0,50	374,6
0,75	336,0
1,00	**310,4**
1,25	277,5
1,50	249,5
1,75	224,9
2,00	207,2
2,25	192,3
2,50	179,6
2,75	168,5
3,00	158,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	PHS
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 -1930 MHz
Working Frequency (MHz)	1930,080	1929,350
Number of guard channels	0	0
Guard Band between channel edges (KHz)	565	
TX/RX frequency Offset (KHz)	730,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) ***See Note***		-78
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	25,0	8,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	60
Antenna Vertical Beamwidth (°)	9	60
Antenna Downtilt (°)	-3	2
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

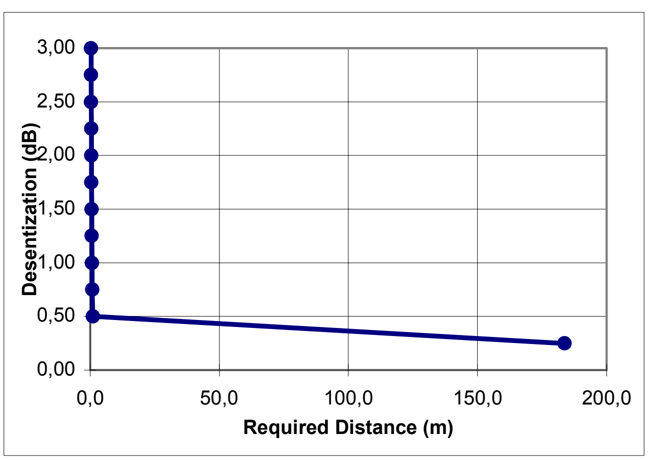
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	0,7
When only RX is on TX antenna 3dB-beamwidth	0,0
When only TX is on RX antenna 3dB-beamwidth	0,0
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	183,8
0,50	1,0
0,75	0,8
1,00	**0,7**
1,25	0,6
1,50	0,5
1,75	0,5
2,00	0,5
2,25	0,4
2,50	0,4
2,75	0,4
3,00	0,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	PHS
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1909,920	1910,450
Number of guard channels	0	0
Guard Band between channel edges (KHz)	365	
TX/RX frequency Offset (KHz)	530,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***** See Note *****		-78
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	8,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beamwidth (°)	omni	60
Antenna Vertical Beamwidth (°)	omni	60
Antenna Downtilt (°)	0	2
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

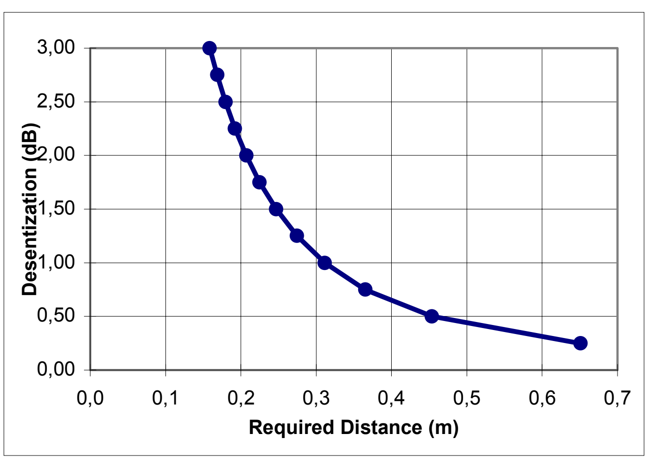
Note: This is the Receiver Sensitivity with Rayleigh Fading (10 dB)

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	0,3
When only RX is on TX antenna 3dB-beamwidth	0,0
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	0,7
0,50	0,5
0,75	0,4
1,00	**0,3**
1,25	0,3
1,50	0,2
1,75	0,2
2,00	0,2
2,25	0,2
2,50	0,2
2,75	0,2
3,00	0,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PCS1900	PCS1900
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1894,800	1895,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	200	
TX/RX frequency Offset (KHz)	400,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) **** See Note ****		-111
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beam width (°)	omni	105
Antenna Vertical Beam width (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

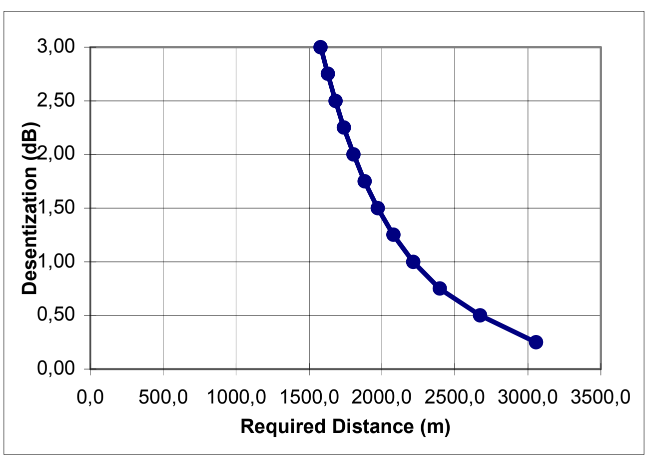
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	2213,8
When only RX is on TX antenna 3dB-beam width	341,5
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	3056,8
0,50	2672,0
0,75	2396,7
1,00	**2213,8**
1,25	2078,1
1,50	1970,5
1,75	1881,6
2,00	1805,8
2,25	1739,8
2,50	1681,3
2,75	1628,8
3,00	1581,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**IS95**	**PCS1900**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1893,750	1895,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	725	
TX/RX frequency Offset (KHz)	1450,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***** See Note *****		-111
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

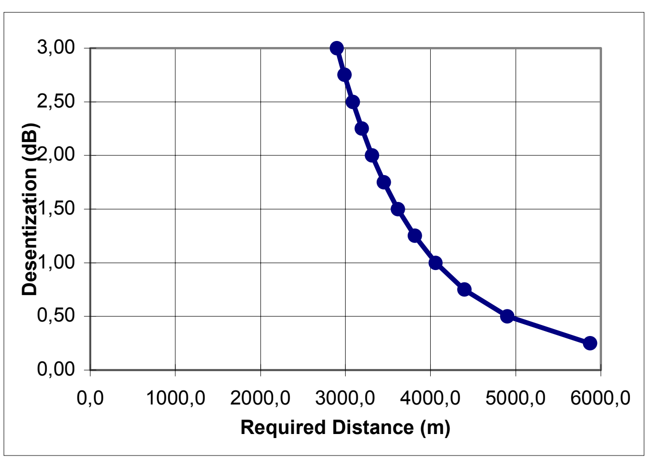
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	4062,1
When only RX is on TX antenna 3dB-beamwidth	1068,4
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	5873,1
0,50	4902,8
0,75	4397,6
1,00	**4062,1**
1,25	3813,0
1,50	3615,6
1,75	3452,4
2,00	3313,4
2,25	3192,4
2,50	3085,1
2,75	2988,7
3,00	2901,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	PCS1900
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	F (lowerpart)	C (lowerpart)
Working Frequency (MHz)	1894,920	1895,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	165	
TX/RX frequency Offset (KHz)	280,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***** See Note *****		-111
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

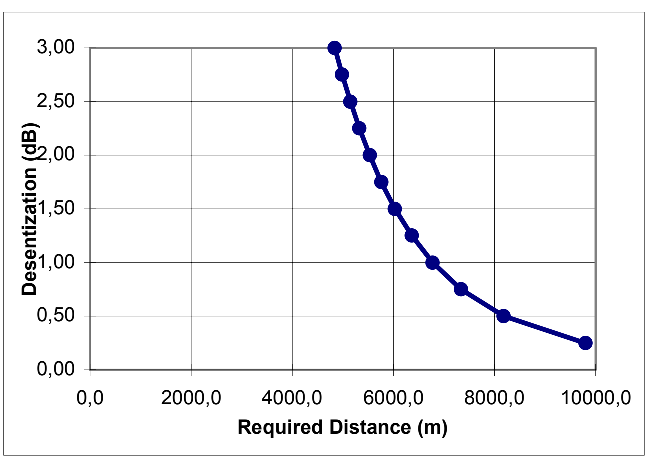
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	6778,4
When only RX is on TX antenna 3dB-beamwidth	1782,9
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	9800,3
0,50	8181,1
0,75	7338,2
1,00	**6778,4**
1,25	6362,6
1,50	6033,3
1,75	5761,0
2,00	5529,0
2,25	5327,0
2,50	5147,9
2,75	4987,1
3,00	4841,0

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	DECT	PCS1900
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1912,896	1909,800
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2132	
TX/RX frequency Offset (KHz)	3096,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-111
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	15,0	25,0
Antenna Gain (dBi)	12,0	17,0
Antenna Horizontal Beam width (°)	120	105
Antenna Vertical Beam width (°)	17	9
Antenna Downtilt (°)	-7	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

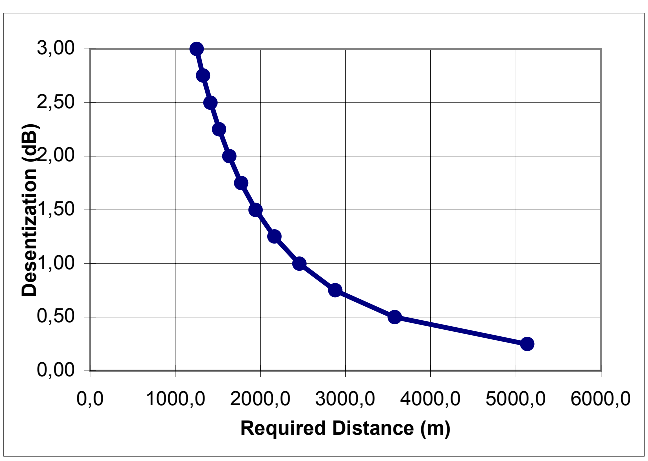
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	2456,3
When only RX is on TX antenna 3dB-beam width	0,7
When only TX is on RX antenna 3dB-beam width	0,7
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	5134,6
0,50	3578,1
0,75	2878,8
1,00	**2456,3**
1,25	2164,2
1,50	1946,0
1,75	1774,3
2,00	1634,3
2,25	1517,0
2,50	1416,8
2,75	1329,6
3,00	1252,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**PCS1900**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1912,896	1909,800
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2132	
TX/RX frequency Offset (KHz)	3096,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-111
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	8,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beam width (°)	60	105
Antenna Vertical Beam width (°)	60	9
Antenna Downtilt (°)	2	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

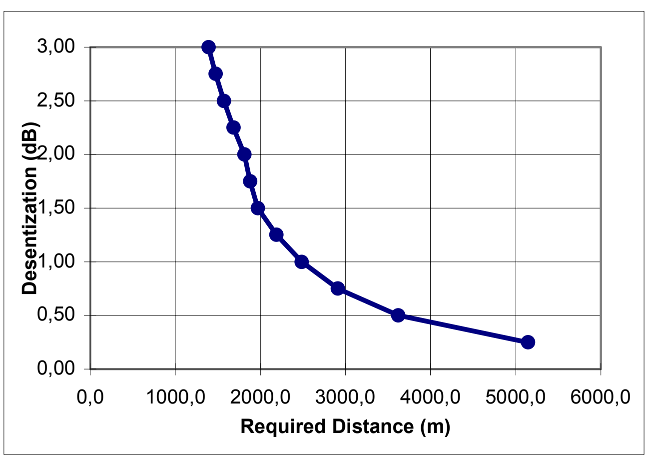
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	2484,7
When only RX is on TX antenna 3dB-beam width	155,0
When only TX is on RX antenna 3dB-beam width	155,0
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,1

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	5145,0
0,50	3619,5
0,75	2912,1
1,00	**2484,7**
1,25	2189,3
1,50	1968,5
1,75	1879,4
2,00	1812,7
2,25	1682,7
2,50	1571,4
2,75	1474,8
3,00	1389,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PHS	PCS1900
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1910,450	1909,800
Number of guard channels	0	0
Guard Band between channel edges (KHz)	400	
TX/RX frequency Offset (KHz)	650,0	
System Data		
TX Power (dBm)	22	
RX sensitivity (dBm) ***** See Note *****		-111
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	15,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	8	9
Antenna Downtilt (°)	-7	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

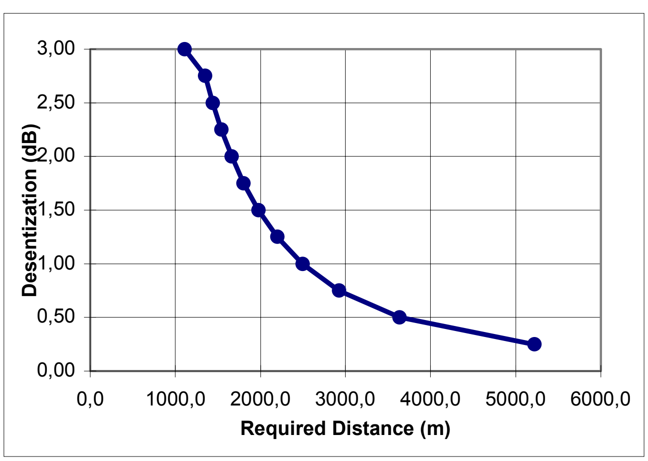
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	2496,9
When only RX is on TX antenna 3dB-beamwidth	1,5
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	5219,5
0,50	3637,3
0,75	2926,4
1,00	**2496,9**
1,25	2200,0
1,50	1978,1
1,75	1803,6
2,00	1661,3
2,25	1542,1
2,50	1440,2
2,75	1351,6
3,00	1109,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**PCS1900**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1910,450	1909,800
Number of guard channels	0	0
Guard Band between channel edges (KHz)	400	
TX/RX frequency Offset (KHz)	650,0	
System Data		
TX Power (dBm)	19	
RX sensitivity (dBm) ***** See Note *****		-111
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	8,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beam width (°)	60	105
Antenna Vertical Beam width (°)	60	9
Antenna Downtilt (°)	2	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

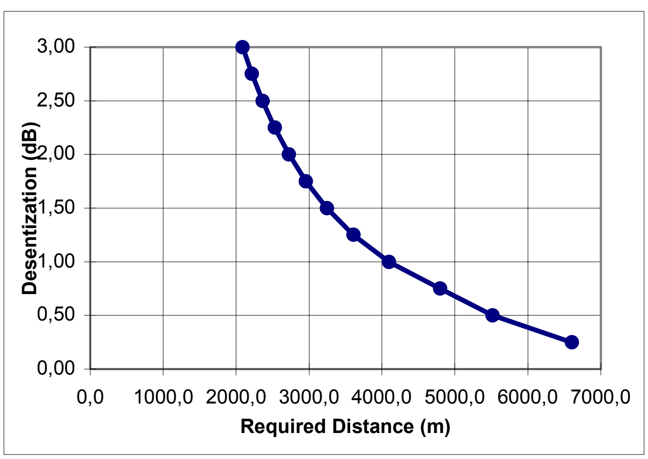
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	4096,4
When only RX is on TX antenna 3dB-beam width	303,7
When only TX is on RX antenna 3dB-beam width	303,7
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,1

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	6606,1
0,50	5514,6
0,75	4801,0
1,00	**4096,4**
1,25	3609,3
1,50	3245,3
1,75	2959,0
2,00	2725,5
2,25	2530,0
2,50	2362,8
2,75	2217,4
3,00	2089,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**PCS1900**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1944,800	1945,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	200	
TX/RX frequency Offset (KHz)	400,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) ***** See Note *****		-109
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beam width (°)	105	omni
Antenna Vertical Beam width (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

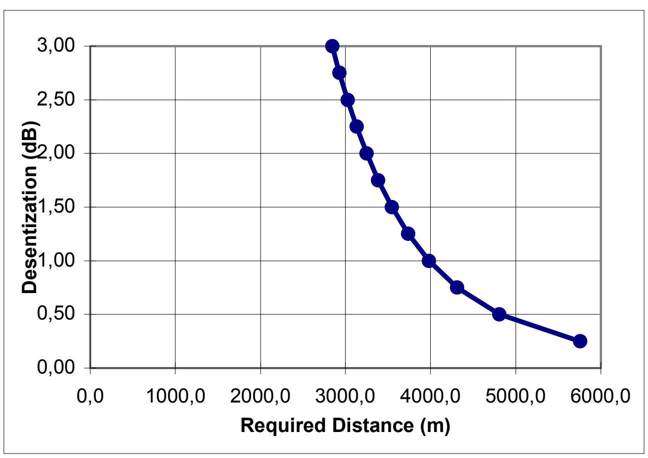
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	3982,4
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	1047,5
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	5757,9
0,50	4806,6
0,75	4311,3
1,00	**3982,4**
1,25	3738,2
1,50	3544,7
1,75	3384,7
2,00	3248,4
2,25	3129,7
2,50	3024,5
2,75	2930,0
3,00	2844,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	PCS1900
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1943,750	1945,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	725	
TX/RX frequency Offset (KHz)	1450,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) *** See Note ***		-109
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

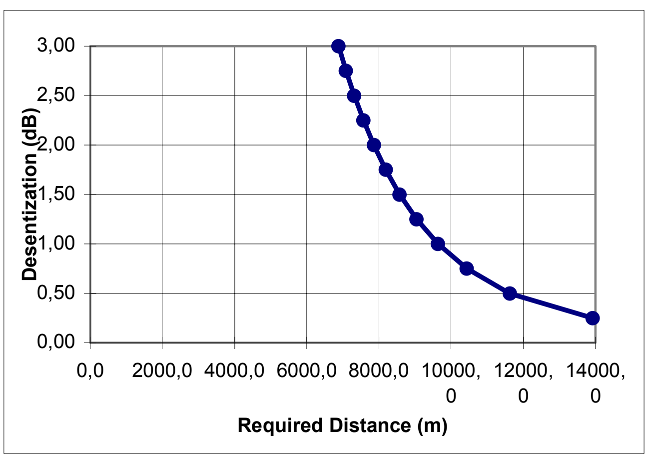
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB :

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	9632,8
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	2533,7
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	13927,4
0,50	11626,3
0,75	10428,4
1,00	**9632,8**
1,25	9042,0
1,50	8574,0
1,75	8187,0
2,00	7857,4
2,25	7570,3
2,50	7315,8
2,75	7087,2
3,00	6879,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	PCS1900
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1944,960	1945,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	125	
TX/RX frequency Offset (KHz)	240,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) *** See Note ***		-109
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

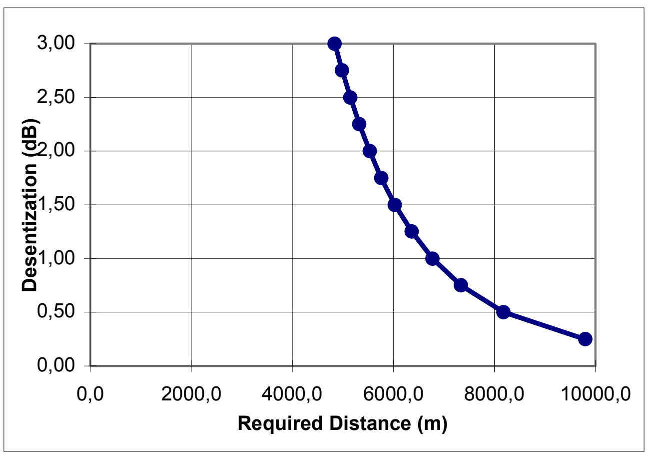
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	6778,4
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	1782,9
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	9800,3
0,50	8181,1
0,75	7338,2
1,00	**6778,4**
1,25	6362,6
1,50	6033,3
1,75	5761,0
2,00	5529,0
2,25	5327,0
2,50	5147,9
2,75	4987,1
3,00	4841,0

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**PCS1900**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1928,448	1930,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	788	
TX/RX frequency Offset (KHz)	1752,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-109
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	15,0	1,5
Antenna Gain (dBi)	12,0	0,0
Antenna Horizontal Beamwidth (°)	120	omni
Antenna Vertical Beamwidth (°)	17	omni
Antenna Downtilt (°)	-7	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

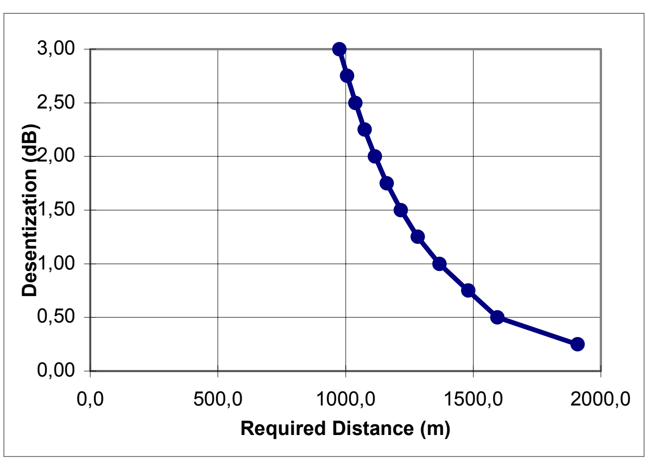
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1367,2
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	223,2
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1909,7
0,50	1594,2
0,75	1480,2
1,00	**1367,2**
1,25	1283,4
1,50	1216,9
1,75	1162,0
2,00	1115,2
2,25	1074,5
2,50	1038,4
2,75	1005,9
3,00	976,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**PCS1900**
Device	**Terminal**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1928,448	1930,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	788	
TX/RX frequency Offset (KHz)	1752,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-109
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	8,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beam width (°)	60	omni
Antenna Vertical Beam width (°)	60	omni
Antenna Downtilt (°)	2	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

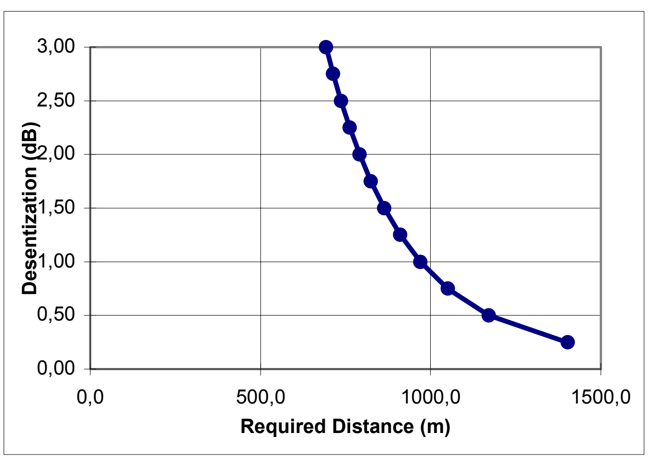
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	970,2
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	190,0
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1402,7
0,50	1170,9
0,75	1050,3
1,00	**970,2**
1,25	910,7
1,50	863,5
1,75	824,5
2,00	791,3
2,25	762,4
2,50	736,8
2,75	713,8
3,00	692,9

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**PCS1900**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1929,350	1930,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	600	
TX/RX frequency Offset (KHz)	850,0	
System Data		
TX Power (dBm)	22	
RX sensitivity (dBm) ***** See Note *****		-109
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	15,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	omni	omni
Antenna Vertical Beamwidth (°)	8	omni
Antenna Downtilt (°)	-7	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

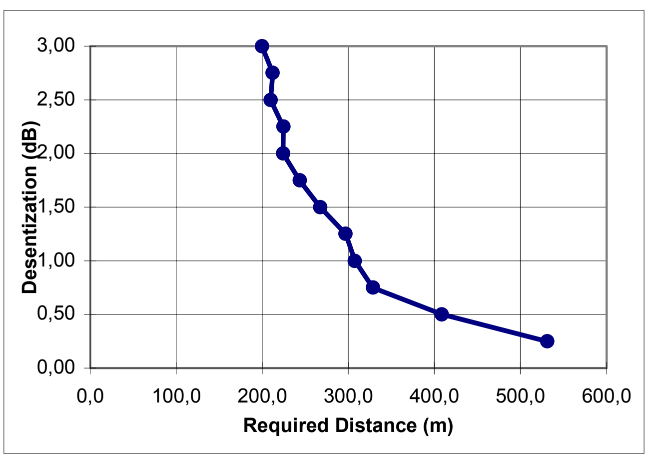
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	307,5
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	531,5
0,50	408,5
0,75	328,6
1,00	**307,5**
1,25	297,0
1,50	267,1
1,75	243,5
2,00	224,3
2,25	224,4
2,50	209,6
2,75	211,9
3,00	199,7

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PHS	PCS1900
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1929,350	1930,200
Number of guard channels	0	0
Guard Band between channel edges (KHz)	600	
TX/RX frequency Offset (KHz)	850,0	
System Data		
TX Power (dBm)	19	
RX sensitivity (dBm) ***** See Note *****		-109
Specific C/I value for Receiver Victim System (dB)		9
Antenna and Feeder Data		
Antenna heigth (m)	8,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	60	omni
Antenna Vertical Beamwidth (°)	60	omni
Antenna Downtilt (°)	2	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

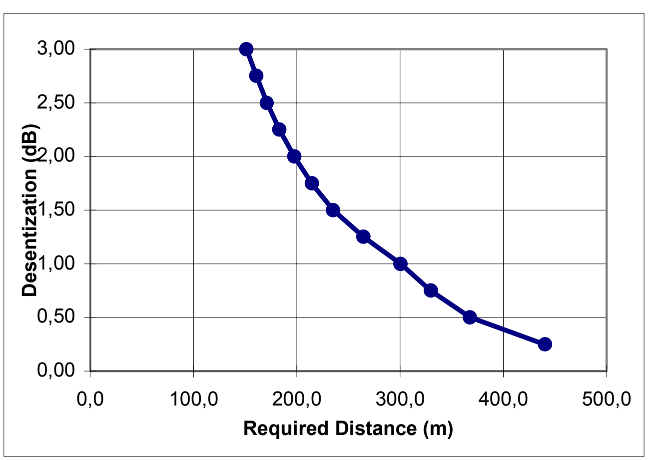
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	300,5
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	12,8
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	440,6
0,50	367,8
0,75	329,9
1,00	**300,5**
1,25	264,7
1,50	235,3
1,75	214,6
2,00	197,6
2,25	183,4
2,50	171,3
2,75	160,8
3,00	151,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PCS1900	IS95
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1894,800	1896,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	725	
TX/RX frequency Offset (KHz)	1450,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***See Note***		-127
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beam width (°)	omni	105
Antenna Vertical Beam width (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

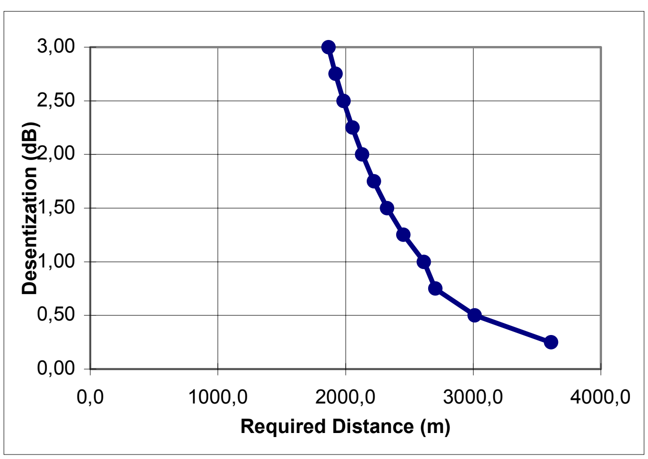
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	2613,7
When only RX is on TX antenna 3dB-beam width	486,8
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	3608,9
0,50	3012,6
0,75	2702,2
1,00	**2613,7**
1,25	2453,4
1,50	2326,4
1,75	2221,4
2,00	2132,0
2,25	2054,1
2,50	1985,0
2,75	1923,0
3,00	1866,7

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	IS95
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1893,750	1896,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1250	
TX/RX frequency Offset (KHz)	2500,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***** See Note *****		-127
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beam width (°)	omni	105
Antenna Vertical Beam width (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

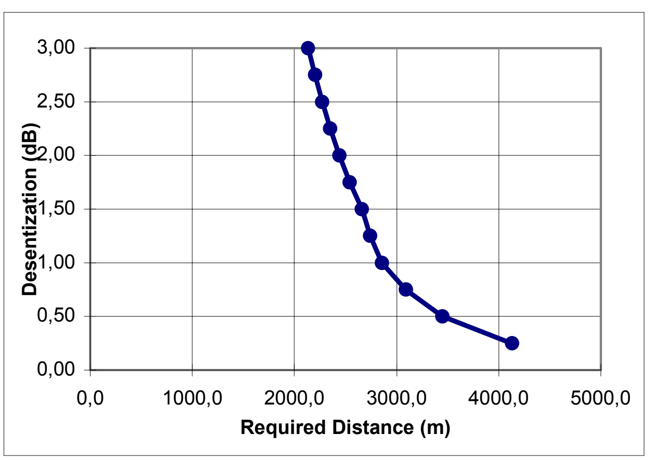
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	2856,7
When only RX is on TX antenna 3dB-beam width	623,1
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	4130,3
0,50	3447,9
0,75	3092,7
1,00	**2856,7**
1,25	2744,0
1,50	2662,5
1,75	2542,4
2,00	2440,0
2,25	2350,8
2,50	2271,8
2,75	2200,8
3,00	2136,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	IS95
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1894,920	1896,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	690	
TX/RX frequency Offset (KHz)	1330,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***See Note***		-127
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

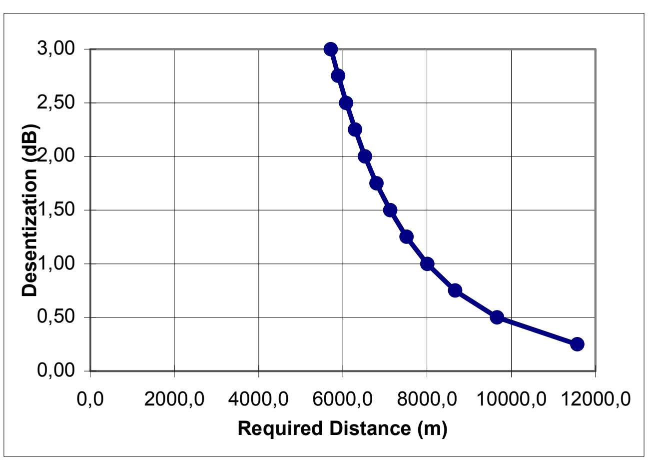
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	8002,7
When only RX is on TX antenna 3dB-beamwidth	2104,9
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	11570,5
0,50	9658,8
0,75	8663,7
1,00	**8002,7**
1,25	7511,9
1,50	7123,0
1,75	6801,6
2,00	6527,7
2,25	6289,2
2,50	6077,8
2,75	5887,9
3,00	5715,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	DECT	IS95
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1912,896	1908,750
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2657	
TX/RX frequency Offset (KHz)	4146,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***See Note***		-127
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	15,0	25,0
Antenna Gain (dBi)	12,0	17,0
Antenna Horizontal Beam width (°)	120	105
Antenna Vertical Beam width (°)	17	9
Antenna Downtilt (°)	-7	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

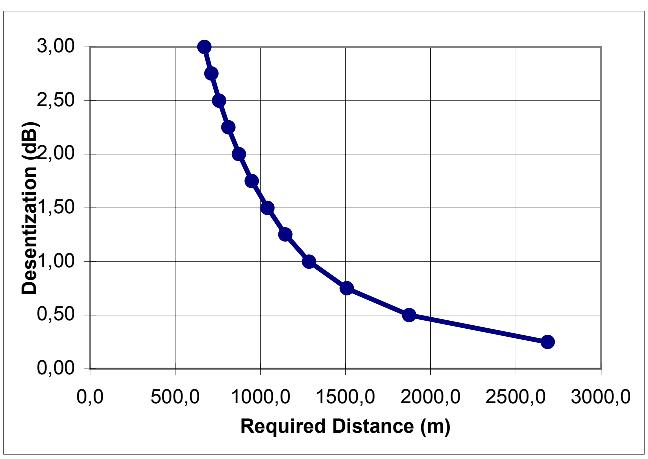
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	1286,0
When only RX is on TX antenna 3dB-beam width	0,4
When only TX is on RX antenna 3dB-beam width	0,4
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2688,3
0,50	1873,3
0,75	1507,2
1,00	**1286,0**
1,25	1146,2
1,50	1042,6
1,75	950,6
2,00	875,6
2,25	812,8
2,50	759,0
2,75	712,3
3,00	671,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**IS95**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 -1930 MHz	C (lower part)
Working Frequency (MHz)	1912,896	1908,750
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2657	
TX/RX frequency Offset (KHz)	4146,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-127
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	8,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beam width (°)	60	105
Antenna Vertical Beam width (°)	60	9
Antenna Downtilt (°)	2	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

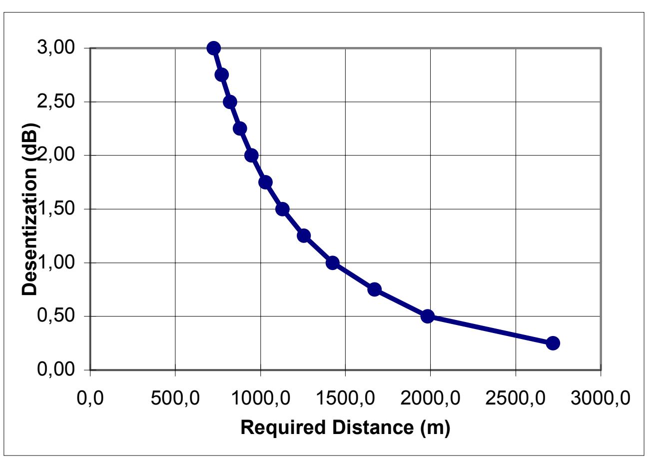
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	1426,4
When only RX is on TX antenna 3dB-beam width	0,7
When only TX is on RX antenna 3dB-beam width	0,7
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2719,4
0,50	1984,3
0,75	1671,8
1,00	**1426,4**
1,25	1256,8
1,50	1130,1
1,75	1030,4
2,00	949,1
2,25	881,0
2,50	822,7
2,75	772,1
3,00	727,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PHS	IS95
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1910,450	1908,750
Number of guard channels	0	0
Guard Band between channel edges (KHz)	925	
TX/RX frequency Offset (KHz)	1700,0	
System Data		
TX Power (dBm)	22	
RX sensitivity (dBm) ***** See Note *****		-127
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	15,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	8	9
Antenna Downtilt (°)	-7	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

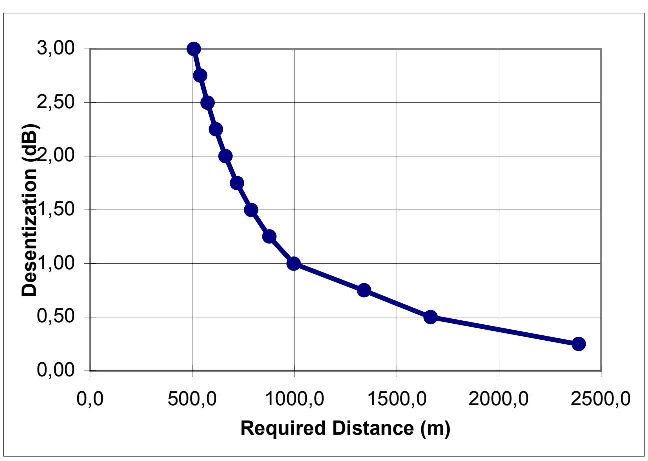
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB :

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	996,2
When only RX is on TX antenna 3dB-beam width	0,7
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2391,1
0,50	1666,2
0,75	1340,6
1,00	**996,2**
1,25	877,8
1,50	789,3
1,75	719,6
2,00	662,8
2,25	615,3
2,50	574,6
2,75	539,3
3,00	508,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**IS95**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1910,450	1908,750
Number of guard channels	0	0
Guard Band between channel edges (KHz)	925	
TX/RX frequency Offset (KHz)	1700,0	
System Data		
TX Power (dBm)	19	
RX sensitivity (dBm) ***** See Note *****		-127
Specific C/I value for Receiver Victim System (dB)		-12
Antenna and Feeder Data		
Antenna heigth (m)	8,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beam width (°)	60	105
Antenna Vertical Beam width (°)	60	9
Antenna Downtilt (°)	2	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

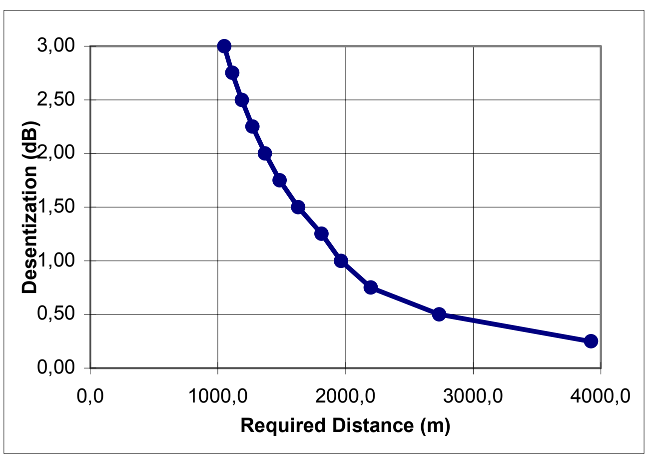
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	1965,0
When only RX is on TX antenna 3dB-beam width	1,0
When only TX is on RX antenna 3dB-beam width	1,0
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,1

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	3922,8
0,50	2733,6
0,75	2199,3
1,00	**1965,0**
1,25	1813,0
1,50	1630,1
1,75	1486,3
2,00	1369,0
2,25	1270,8
2,50	1186,8
2,75	1113,8
3,00	1049,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**IS95**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1944,800	1946,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	725	
TX/RX frequency Offset (KHz)	1450,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) ***** See Note *****		-112
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

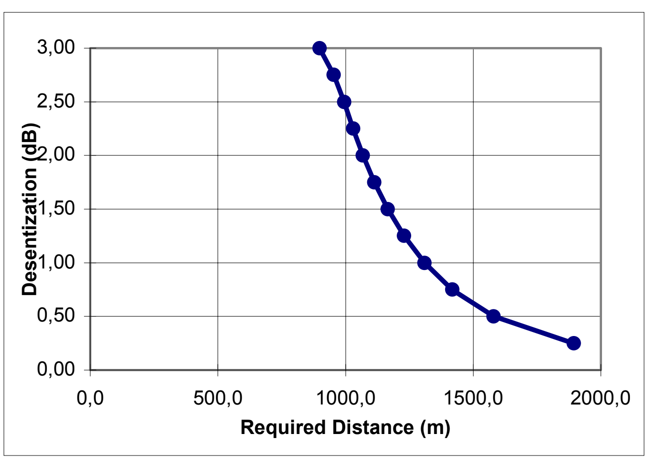
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1310,0
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	6,7
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1894,0
0,50	1581,1
0,75	1418,2
1,00	**1310,0**
1,25	1229,6
1,50	1166,0
1,75	1113,3
2,00	1068,5
2,25	1029,5
2,50	994,9
2,75	953,9
3,00	898,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	IS95
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1943,750	1946,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1250	
TX/RX frequency Offset (KHz)	2500,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ***** See Note *****		-112
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

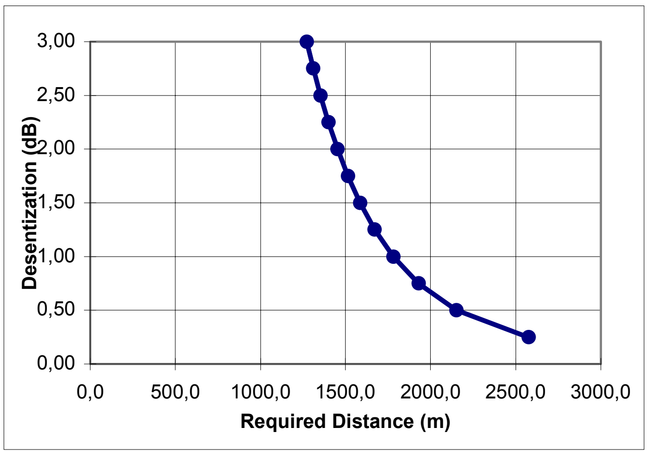
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1781,8
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	12,4
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2576,2
0,50	2150,6
0,75	1929,0
1,00	**1781,8**
1,25	1672,6
1,50	1586,0
1,75	1514,4
2,00	1453,4
2,25	1400,3
2,50	1353,2
2,75	1311,0
3,00	1272,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	IS95
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1944,960	1946,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	650	
TX/RX frequency Offset (KHz)	1290,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) ***** See Note *****		-112
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

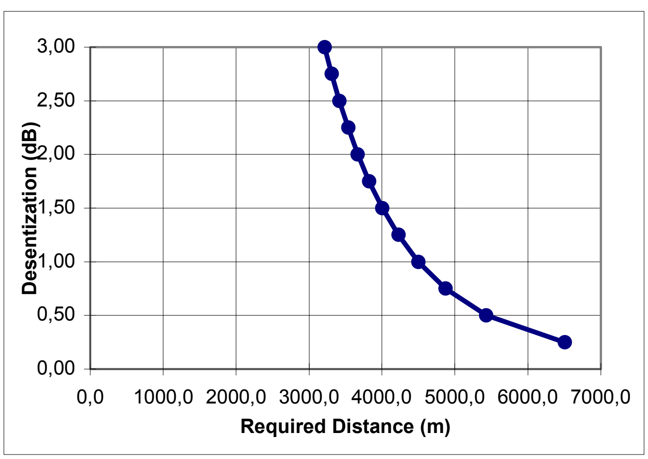
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	4500,3
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	1183,7
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	6506,6
0,50	5431,6
0,75	4871,9
1,00	**4500,3**
1,25	4224,3
1,50	4005,6
1,75	3824,8
2,00	3670,8
2,25	3536,7
2,50	3417,8
2,75	3311,0
3,00	3214,0

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	DECT	IS95
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	1910 -1930 MHz	A (upper part)
Working Frequency (MHz)	1928,448	1931,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1313	
TX/RX frequency Offset (KHz)	2802,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ** *See Note* **		-112
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	15,0	1,5
Antenna Gain (dBi)	12,0	0,0
Antenna Horizontal Beamwidth (°)	120	omni
Antenna Vertical Beamwidth (°)	17	omni
Antenna Downtilt (°)	-7	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

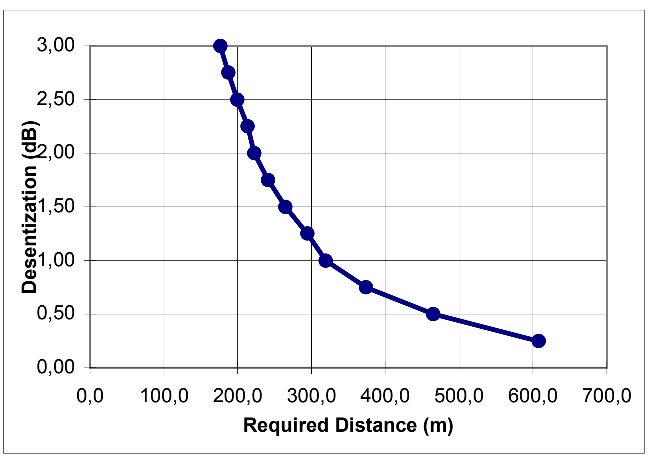
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	319,3
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	1,3
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	607,9
0,50	465,1
0,75	374,2
1,00	**319,3**
1,25	294,6
1,50	264,9
1,75	241,5
2,00	222,4
2,25	213,7
2,50	199,6
2,75	187,3
3,00	176,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	DECT	IS95
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1928,448	1931,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1313	
TX/RX frequency Offset (KHz)	2802,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-112
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	8,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	60	omni
Antenna Vertical Beamwidth (°)	60	omni
Antenna Downtilt (°)	2	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

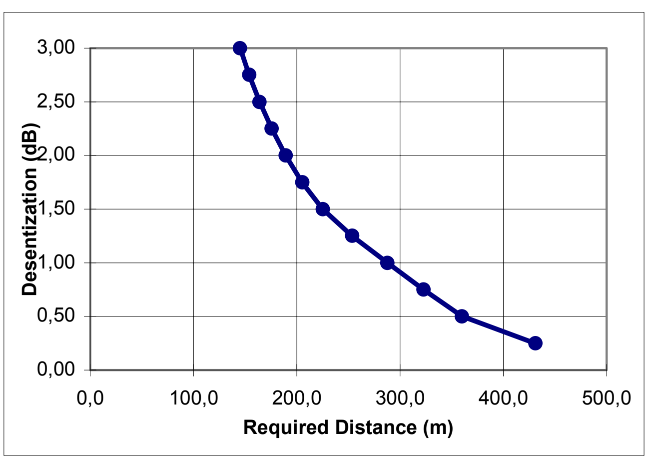
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	287,8
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	11,1
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	431,3
0,50	360,1
0,75	323,0
1,00	**287,8**
1,25	253,6
1,50	225,4
1,75	205,5
2,00	189,3
2,25	175,7
2,50	164,1
2,75	154,0
3,00	145,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PHS	IS95
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1929,350	1931,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1125	
TX/RX frequency Offset (KHz)	1900,0	
System Data		
TX Power (dBm)	22	
RX sensitivity (dBm) ***See Note***		-112
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	15,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	omni	omni
Antenna Vertical Beamwidth (°)	8	omni
Antenna Downtilt (°)	-7	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

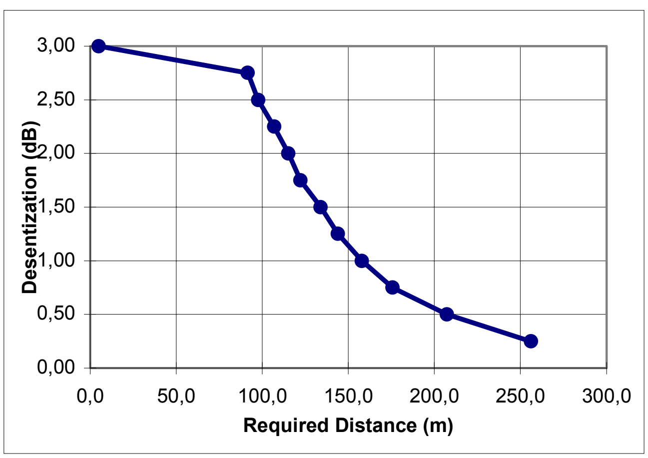
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	157,9
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	256,2
0,50	207,3
0,75	175,7
1,00	**157,9**
1,25	144,0
1,50	134,0
1,75	122,2
2,00	115,2
2,25	106,9
2,50	97,6
2,75	91,6
3,00	5,0

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**IS95**
Device	**Terminal**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1929,350	1931,250
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1125	
TX/RX frequency Offset (KHz)	1900,0	
System Data		
TX Power (dBm)	19	
RX sensitivity (dBm) ***** See Note *****		-112
Specific C/I value for Receiver Victim System (dB)		-9
Antenna and Feeder Data		
Antenna heigth (m)	8,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	60	omni
Antenna Vertical Beamwidth (°)	60	omni
Antenna Downtilt (°)	2	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

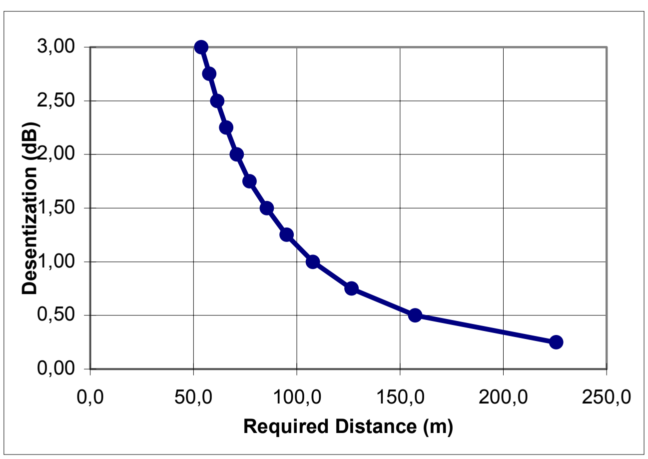
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB :

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	108,0
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	0,8
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization :



Desentization (dB)	Req. Distance (m)
0,25	225,7
0,50	157,3
0,75	126,5
1,00	**108,0**
1,25	95,1
1,50	85,5
1,75	77,1
2,00	71,0
2,25	65,9
2,50	61,6
2,75	57,8
3,00	53,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**IS136**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1894,800	1895,400
Number of guard channels	0	0
Guard Band between channel edges (KHz)	485	
TX/RX frequency Offset (KHz)	600,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***See Note***		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

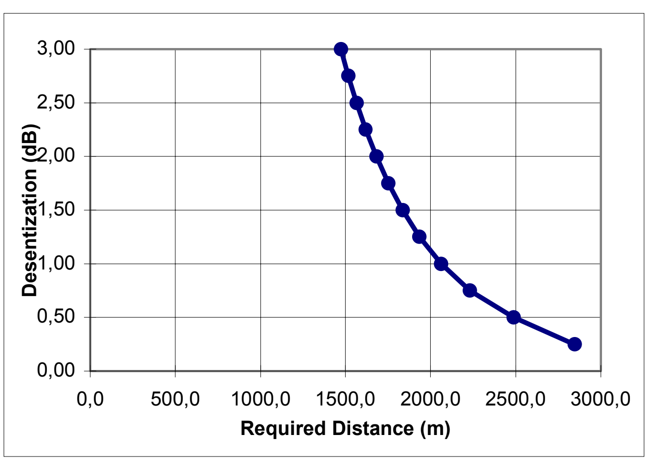
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	2061,4
When only RX is on TX antenna 3dB-beamwidth	282,7
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2846,3
0,50	2488,0
0,75	2231,7
1,00	**2061,4**
1,25	1935,0
1,50	1834,8
1,75	1752,0
2,00	1681,5
2,25	1620,0
2,50	1565,6
2,75	1516,7
3,00	1472,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	IS136
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	F (lowerpart)	C (lowerpart)
Working Frequency (MHz)	1893,750	1895,400
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1010	
TX/RX frequency Offset (KHz)	1650,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***See Note**		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

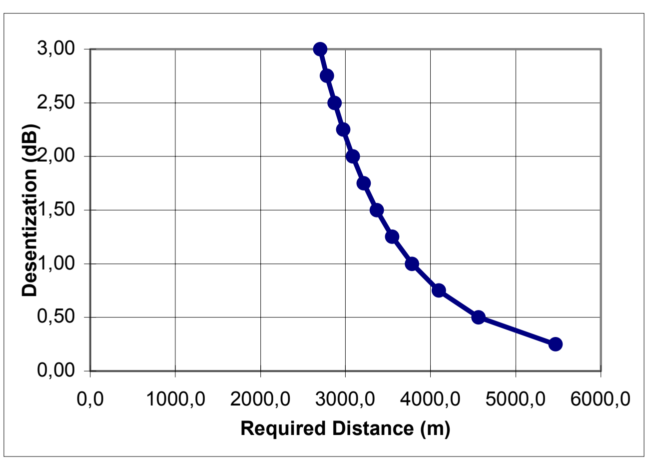
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	3782,5
When only RX is on TX antenna 3dB-beam width	994,9
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	5468,8
0,50	4565,2
0,75	4094,9
1,00	**3782,5**
1,25	3550,5
1,50	3366,7
1,75	3214,8
2,00	3085,3
2,25	2972,6
2,50	2872,7
2,75	2782,9
3,00	2701,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	IS136
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	F (lower part)	C (lower part)
Working Frequency (MHz)	1894,920	1895,400
Number of guard channels	0	0
Guard Band between channel edges (KHz)	450	
TX/RX frequency Offset (KHz)	480,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***** See Note *****		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	1,5	25,0
Antenna Gain (dBi)	0,0	17,0
Antenna Horizontal Beamwidth (°)	omni	105
Antenna Vertical Beamwidth (°)	omni	9
Antenna Downtilt (°)	0	-3
Feeder Losses (dB)	0,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

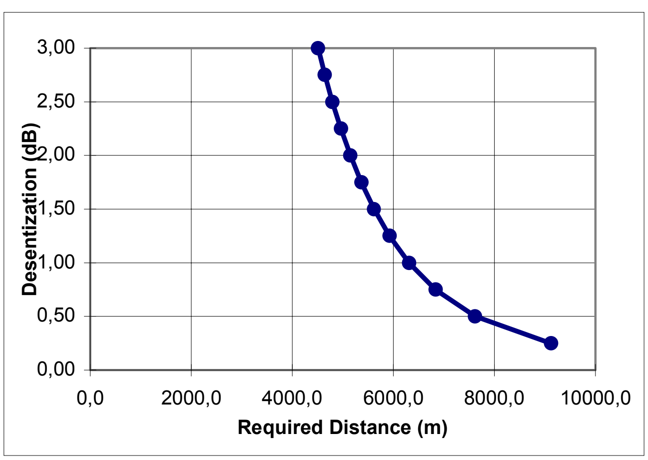
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	6311,7
When only RX is on TX antenna 3dB-beamwidth	1660,1
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	9125,6
0,50	7617,9
0,75	6833,0
1,00	**6311,7**
1,25	5924,6
1,50	5617,9
1,75	5364,4
2,00	5148,4
2,25	4960,3
2,50	4793,5
2,75	4643,8
3,00	4507,7

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	DECT	IS136
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1912,896	1909,920
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2097	
TX/RX frequency Offset (KHz)	2976,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***See Note***		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	15,0	25,0
Antenna Gain (dBi)	12,0	17,0
Antenna Horizontal Beamwidth (°)	120	105
Antenna Vertical Beamwidth (°)	17	9
Antenna Downtilt (°)	-7	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

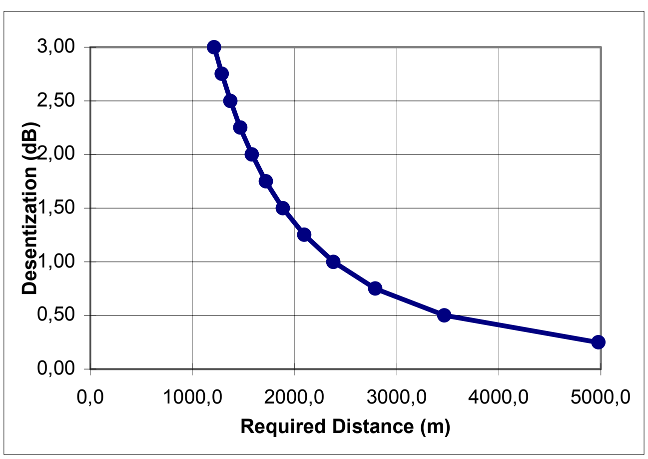
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	2381,2
When only RX is on TX antenna 3dB-beamwidth	0,7
When only TX is on RX antenna 3dB-beamwidth	0,7
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	4977,7
0,50	3468,7
0,75	2790,8
1,00	**2381,2**
1,25	2098,1
1,50	1886,5
1,75	1720,0
2,00	1584,3
2,25	1470,7
2,50	1373,5
2,75	1289,0
3,00	1214,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**IS136**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1912,896	1909,920
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2097	
TX/RX frequency Offset (KHz)	2976,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	8,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beamwidth (°)	60	105
Antenna Vertical Beamwidth (°)	60	9
Antenna Downtilt (°)	2	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

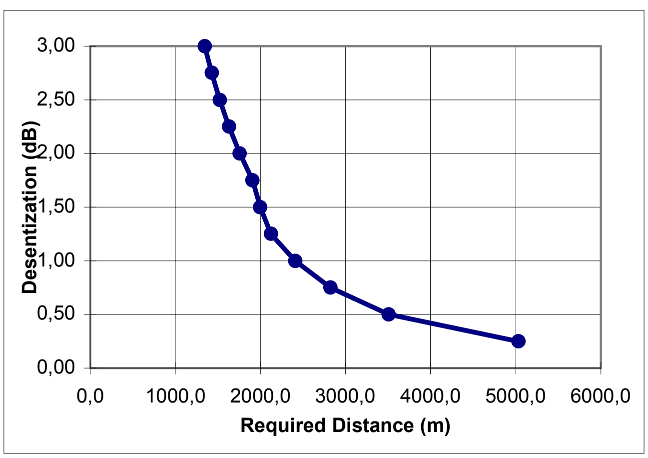
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	2408,8
When only RX is on TX antenna 3dB-beamwidth	150,2
When only TX is on RX antenna 3dB-beamwidth	150,2
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,1

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	5035,3
0,50	3508,9
0,75	2823,1
1,00	**2408,8**
1,25	2122,4
1,50	1998,3
1,75	1907,8
2,00	1757,3
2,25	1631,2
2,50	1523,4
2,75	1429,7
3,00	1347,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PHS	IS136
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	1910 -1930 MHz	C (lowerpart)
Working Frequency (MHz)	1910,450	1909,920
Number of guard channels	0	0
Guard Band between channel edges (KHz)	365	
TX/RX frequency Offset (KHz)	530,0	
System Data		
TX Power (dBm)	22	
RX sensitivity (dBm) **** See Note ****		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	15,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beam width (°)	omni	105
Antenna Vertical Beam width (°)	8	9
Antenna Downtilt (°)	-7	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

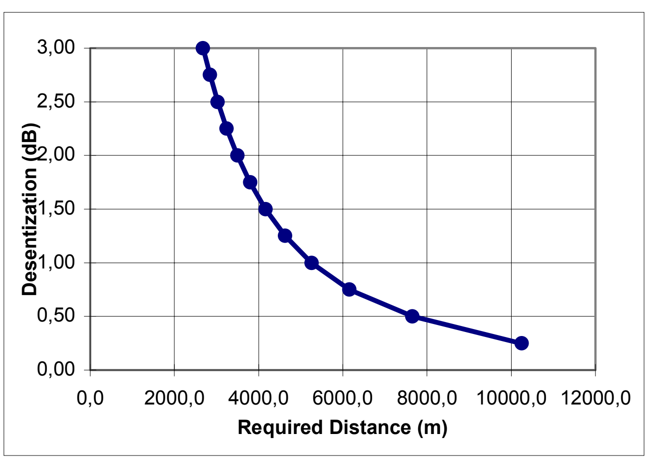
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	5253,1
When only RX is on TX antenna 3dB-beam width	237,4
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	10243,9
0,50	7652,3
0,75	6156,7
1,00	**5253,1**
1,25	4628,5
1,50	4161,7
1,75	3794,6
2,00	3495,2
2,25	3244,4
2,50	3030,0
2,75	2843,6
3,00	2679,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**IS136**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	C (lower part)
Working Frequency (MHz)	1910,450	1909,920
Number of guard channels	0	0
Guard Band between channel edges (KHz)	365	
TX/RX frequency Offset (KHz)	530,0	
System Data		
TX Power (dBm)	19	
RX sensitivity (dBm) ***See Note***		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	8,0	25,0
Antenna Gain (dBi)	10,0	17,0
Antenna Horizontal Beam width (°)	60	105
Antenna Vertical Beam width (°)	60	9
Antenna Downtilt (°)	2	-3
Feeder Losses (dB)	1,0	2,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

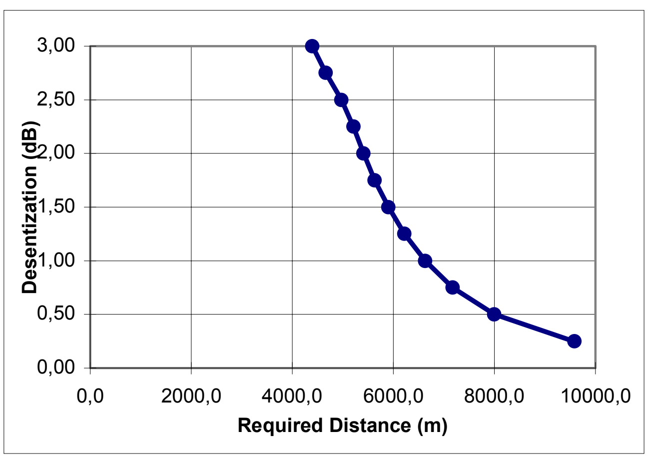
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	6627,5
When only RX is on TX antenna 3dB-beam width	624,3
When only TX is on RX antenna 3dB-beam width	624,3
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,3

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	9582,2
0,50	7999,1
0,75	7174,9
1,00	**6627,5**
1,25	6221,1
1,50	5899,0
1,75	5632,8
2,00	5406,0
2,25	5208,5
2,50	4970,9
2,75	4665,2
3,00	4395,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PCS1900	IS136
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1944,800	1945,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	165	
TX/RX frequency Offset (KHz)	280,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) **** See Note ****		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

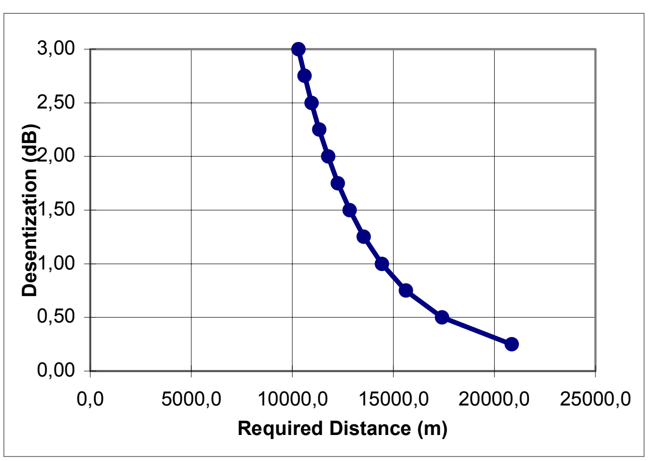
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	14426,8
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	3623,8
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	20858,6
0,50	17412,3
0,75	15618,3
1,00	**14426,8**
1,25	13542,0
1,50	12841,0
1,75	12261,4
2,00	11767,8
2,25	11337,8
2,50	10956,7
2,75	10614,4
3,00	10303,4

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	IS136
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1943,750	1945,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	690	
TX/RX frequency Offset (KHz)	1330,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ** *See Note* **		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

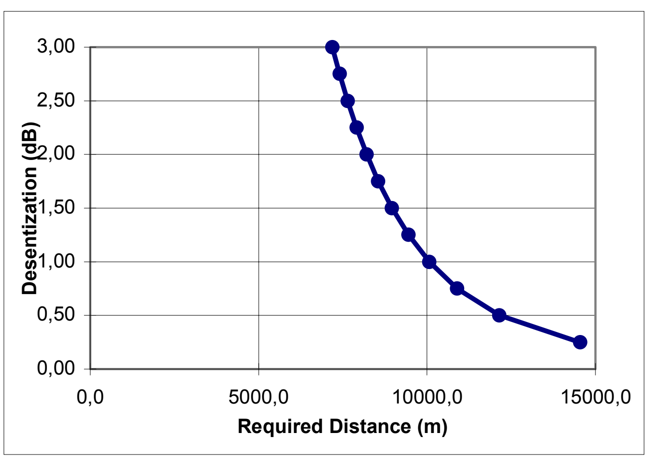
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	10064,1
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	2647,1
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	14551,0
0,50	12146,9
0,75	10895,4
1,00	**10064,1**
1,25	9446,9
1,50	8957,9
1,75	8553,6
2,00	8209,2
2,25	7909,2
2,50	7643,4
2,75	7404,6
3,00	7187,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	IS136
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	D (upper part)
Working Frequency (MHz)	1944,960	1945,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	90	
TX/RX frequency Offset (KHz)	120,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) **** See Note ****		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	25,0	1,5
Antenna Gain (dBi)	17,0	0,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	omni
Antenna Downtilt (°)	-3	0
Feeder Losses (dB)	2,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

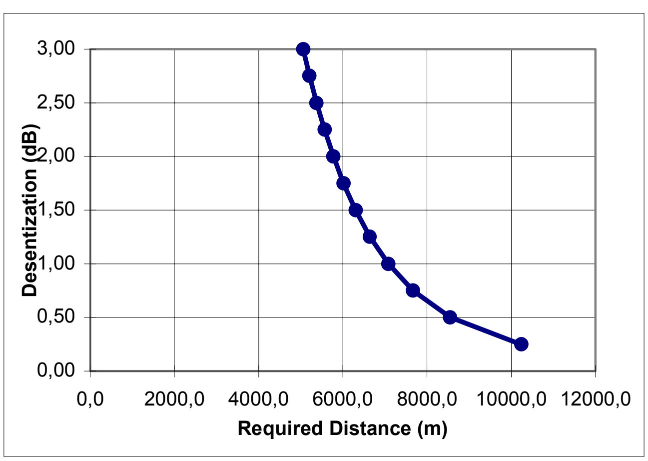
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	7081,9
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	1862,7
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	10239,1
0,50	8547,4
0,75	7666,8
1,00	**7081,9**
1,25	6647,5
1,50	6303,4
1,75	6018,9
2,00	5776,6
2,25	5565,5
2,50	5378,4
2,75	5210,4
3,00	5057,7

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**DECT**	**IS136**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1928,448	1930,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	753	
TX/RX frequency Offset (KHz)	1632,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	15,0	1,5
Antenna Gain (dBi)	12,0	0,0
Antenna Horizontal Beamwidth (°)	120	omni
Antenna Vertical Beamwidth (°)	17	omni
Antenna Downtilt (°)	-7	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

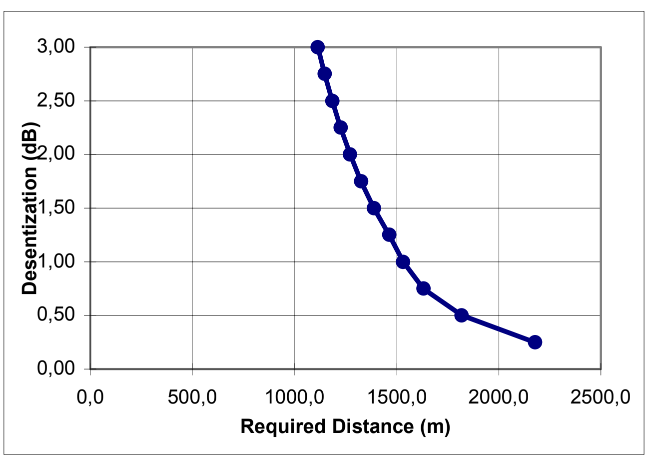
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1533,3
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	290,6
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2178,9
0,50	1818,9
0,75	1631,5
1,00	**1533,3**
1,25	1464,3
1,50	1388,5
1,75	1325,8
2,00	1272,5
2,25	1226,0
2,50	1184,8
2,75	1147,7
3,00	1114,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	DECT	IS136
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	1910 -1930 MHz	A (upper part)
Working Frequency (MHz)	1928,448	1930,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	753	
TX/RX frequency Offset (KHz)	1632,0	
System Data		
TX Power (dBm)	24	
RX sensitivity (dBm) ***** See Note *****		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	8,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	60	omni
Antenna Vertical Beamwidth (°)	60	omni
Antenna Downtilt (°)	2	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

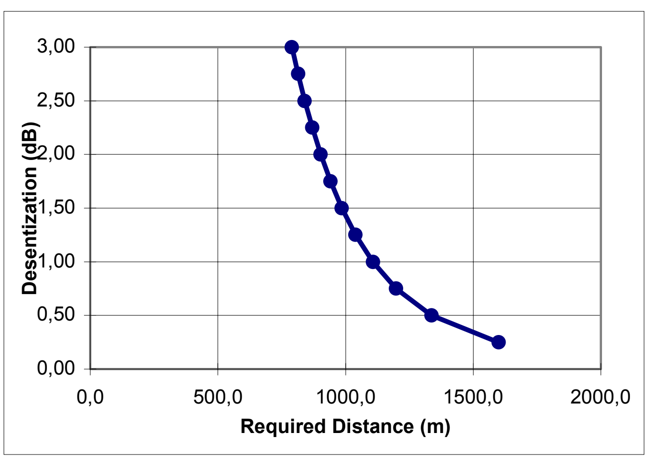
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1106,9
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	250,2
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1600,4
0,50	1336,0
0,75	1198,3
1,00	**1106,9**
1,25	1039,0
1,50	985,2
1,75	940,8
2,00	902,9
2,25	869,9
2,50	840,7
2,75	814,4
3,00	790,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**IS136**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1929,350	1930,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	565	
TX/RX frequency Offset (KHz)	730,0	
System Data		
TX Power (dBm)	22	
RX sensitivity (dBm) *** See Note ***		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	15,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beamwidth (°)	omni	omni
Antenna Vertical Beamwidth (°)	8	omni
Antenna Downtilt (°)	-7	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

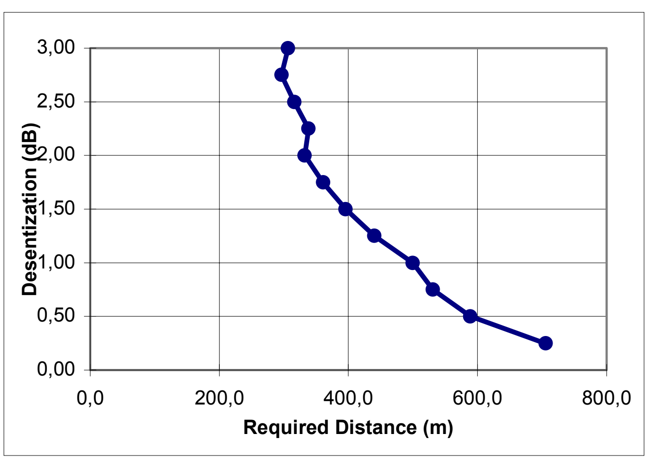
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	499,9
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	705,6
0,50	589,0
0,75	531,2
1,00	**499,9**
1,25	440,4
1,50	396,0
1,75	361,1
2,00	332,6
2,25	338,5
2,50	316,1
2,75	296,7
3,00	306,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PHS**	**IS136**
Device	**Terminal**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	1910 - 1930 MHz	A (upper part)
Working Frequency (MHz)	1929,350	1930,080
Number of guard channels	0	0
Guard Band between channel edges (KHz)	565	
TX/RX frequency Offset (KHz)	730,0	
System Data		
TX Power (dBm)	19	
RX sensitivity (dBm) ***** See Note *****		-110
Specific C/I value for Receiver Victim System (dB)		17
Antenna and Feeder Data		
Antenna heigth (m)	8,0	1,5
Antenna Gain (dBi)	10,0	0,0
Antenna Horizontal Beam width (°)	60	omni
Antenna Vertical Beam width (°)	60	omni
Antenna Downtilt (°)	2	0
Feeder Losses (dB)	1,0	0,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

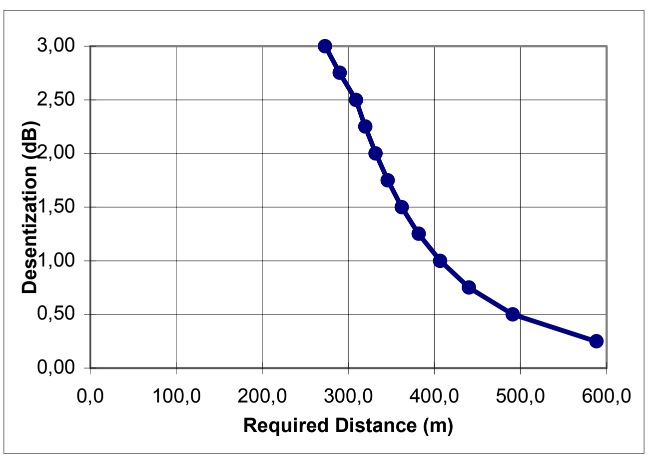
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	406,8
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	31,2
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	588,2
0,50	491,0
0,75	440,4
1,00	**406,8**
1,25	381,9
1,50	362,1
1,75	345,8
2,00	331,9
2,25	319,7
2,50	308,9
2,75	289,9
3,00	273,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**DECT**
Device	**Base Station**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,200	1928,448
Number of guard channels	0	0
Guard Band between channel edges (KHz)	788	
TX/RX frequency Offset (KHz)	1752,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) ***** See Note *****		-86
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	25,0	15,0
Antenna Gain (dBi)	17,0	12,0
Antenna Horizontal Beamwidth (°)	105	120
Antenna Vertical Beamwidth (°)	9	17
Antenna Downtilt (°)	-3	-7
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

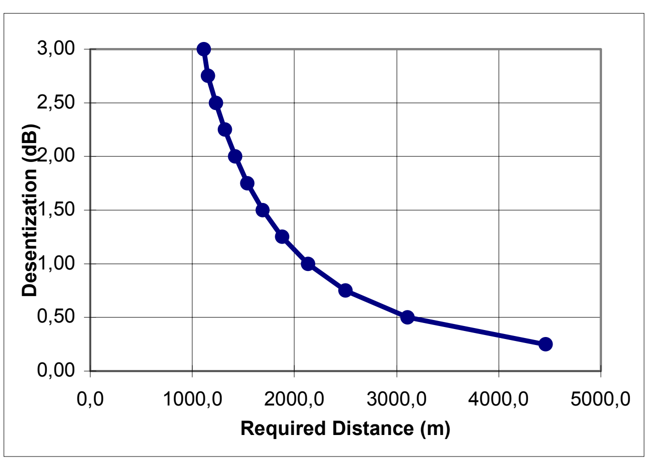
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	2133,4
When only RX is on TX antenna 3dB-beamwidth	0,6
When only TX is on RX antenna 3dB-beamwidth	0,6
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	4459,7
0,50	3107,8
0,75	2500,4
1,00	**2133,4**
1,25	1879,7
1,50	1690,2
1,75	1541,0
2,00	1419,5
2,25	1317,6
2,50	1230,5
2,75	1154,8
3,00	1113,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**DECT**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1909,800	1912,896
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2132	
TX/RX frequency Offset (KHz)	3096,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***** See Note *****		-86
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	1,5	15,0
Antenna Gain (dBi)	0,0	12,0
Antenna Horizontal Beamwidth (°)	omni	120
Antenna Vertical Beamwidth (°)	omni	17
Antenna Downtilt (°)	0	-7
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

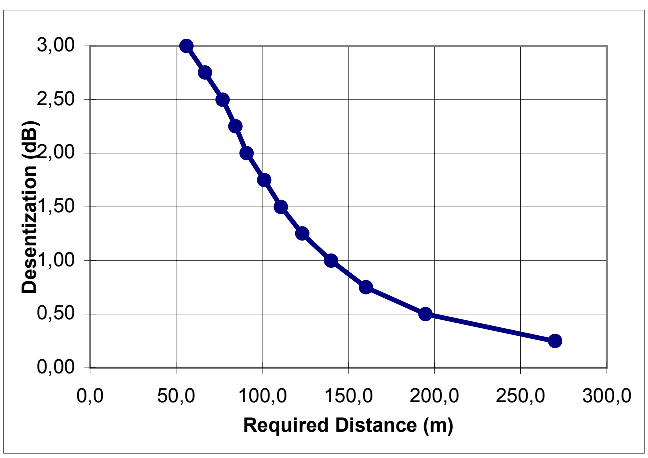
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	140,0
When only RX is on TX antenna 3dB-beamwidth	0,5
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	270,0
0,50	194,8
0,75	160,4
1,00	**140,0**
1,25	123,4
1,50	110,9
1,75	101,1
2,00	91,0
2,25	84,5
2,50	77,1
2,75	66,8
3,00	56,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**IS95**	**DECT**
Device	**Base Station**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	A (upperpart)	1910 - 1930 MHz
Working Frequency (MHz)	1931,250	1928,448
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1313	
TX/RX frequency Offset (KHz)	2802,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ***** See Note *****		-86
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	25,0	15,0
Antenna Gain (dBi)	17,0	12,0
Antenna Horizontal Beam width (°)	105	120
Antenna Vertical Beam width (°)	9	17
Antenna Downtilt (°)	-3	-7
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

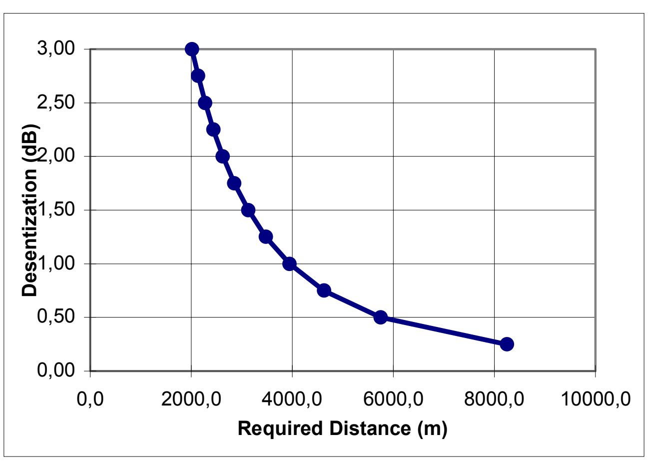
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	3947,2
When only RX is on TX antenna 3dB-beam width	249,0
When only TX is on RX antenna 3dB-beam width	249,0
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,1

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	8251,2
0,50	5749,9
0,75	4626,1
1,00	**3947,2**
1,25	3477,9
1,50	3127,1
1,75	2851,2
2,00	2626,2
2,25	2437,8
2,50	2276,7
2,75	2136,7
3,00	2013,3

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	DECT
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	C (lowerpart)	1910 -1930 MHz
Working Frequency (MHz)	1908,750	1912,896
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2657	
TX/RX frequency Offset (KHz)	4146,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***See Note***		-86
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	1,5	15,0
Antenna Gain (dBi)	0,0	12,0
Antenna Horizontal Beamwidth (°)	omni	120
Antenna Vertical Beamwidth (°)	omni	17
Antenna Downtilt (°)	0	-7
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

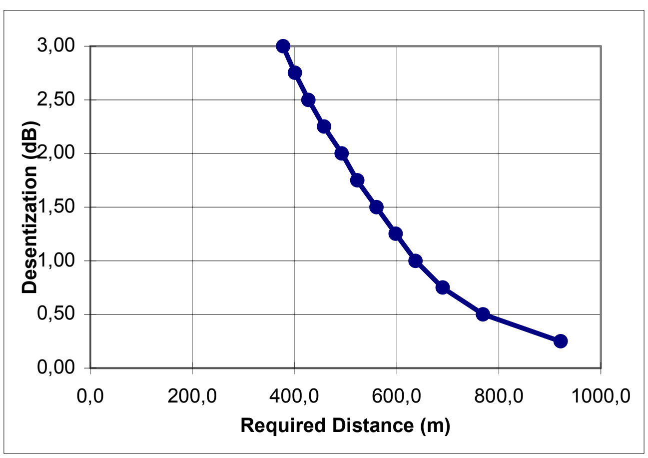
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req.distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	637,5
When only RX is on TX antenna 3dB-beamwidth	3,0
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req.Distance (m)
0,25	921,7
0,50	769,4
0,75	690,1
1,00	**637,5**
1,25	598,4
1,50	560,6
1,75	523,1
2,00	493,0
2,25	457,6
2,50	427,4
2,75	401,1
3,00	377,9

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	DECT
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 -1930 MHz
Working Frequency (MHz)	1930,080	1928,448
Number of guard channels	0	0
Guard Band between channel edges (KHz)	753	
TX/RX frequency Offset (KHz)	1632,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) ***** See Note *****		-86
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	25,0	15,0
Antenna Gain (dBi)	17,0	12,0
Antenna Horizontal Beam width (°)	105	120
Antenna Vertical Beam width (°)	9	17
Antenna Downtilt (°)	-3	-7
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

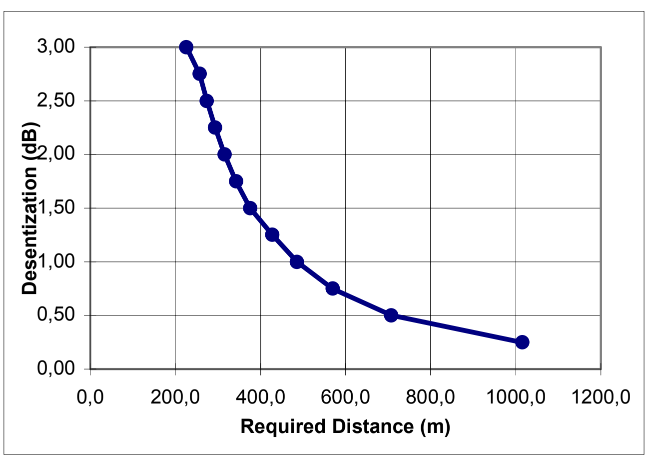
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	485,9
When only RX is on TX antenna 3dB-beam width	0,1
When only TX is on RX antenna 3dB-beam width	0,1
When both TX and RX are out of RX and TX antenna 3dB-beam width	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1015,7
0,50	707,8
0,75	569,5
1,00	**485,9**
1,25	428,1
1,50	376,2
1,75	343,0
2,00	315,9
2,25	293,3
2,50	273,9
2,75	257,0
3,00	226,0

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	DECT
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1909,920	1912,896
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2097	
TX/RX frequency Offset (KHz)	2976,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***** See Note *****		-86
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	1,5	15,0
Antenna Gain (dBi)	0,0	12,0
Antenna Horizontal Beamwidth (°)	omni	120
Antenna Vertical Beamwidth (°)	omni	17
Antenna Downtilt (°)	0	-7
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

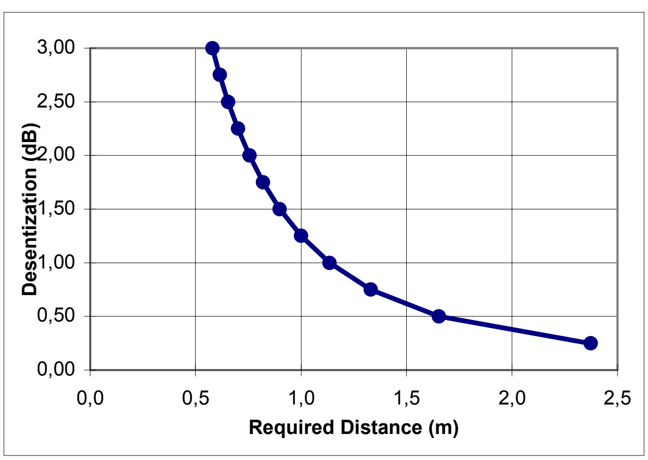
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	1,1
When only RX is on TX antenna 3dB-beam width	0,1
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2,4
0,50	1,7
0,75	1,3
1,00	**1,1**
1,25	1,0
1,50	0,9
1,75	0,8
2,00	0,8
2,25	0,7
2,50	0,7
2,75	0,6
3,00	0,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**DECT**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,200	1928,448
Number of guard channels	0	0
Guard Band between channel edges (KHz)	788	
TX/RX frequency Offset (KHz)	1752,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) ***** See Note *****		-86
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	25,0	8,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	60
Antenna Vertical Beamwidth (°)	9	60
Antenna Downtilt (°)	-3	2
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

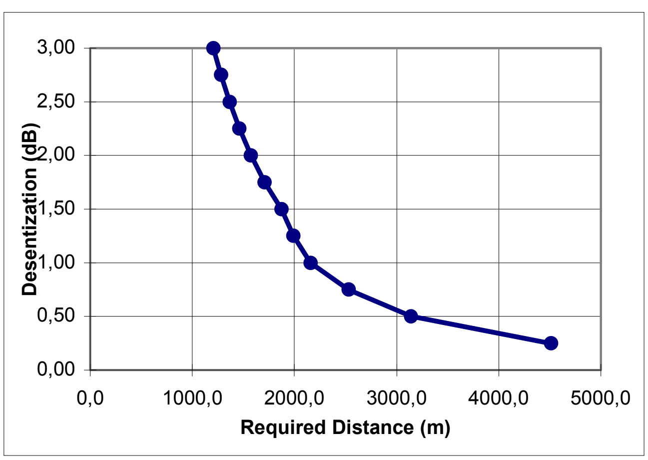
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	2158,1
When only RX is on TX antenna 3dB-beamwidth	1,4
When only TX is on RX antenna 3dB-beamwidth	1,4
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,1

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	4511,3
0,50	3143,7
0,75	2529,3
1,00	**2158,1**
1,25	1991,1
1,50	1874,7
1,75	1709,3
2,00	1574,4
2,25	1461,5
2,50	1364,9
2,75	1280,9
3,00	1207,0

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**DECT**
Device	**Terminal**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1909,800	1912,896
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2132	
TX/RX frequency Offset (KHz)	3096,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***** See Note *****		-86
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	1,5	8,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beam width (°)	omni	60
Antenna Vertical Beam width (°)	omni	60
Antenna Downtilt (°)	0	2
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

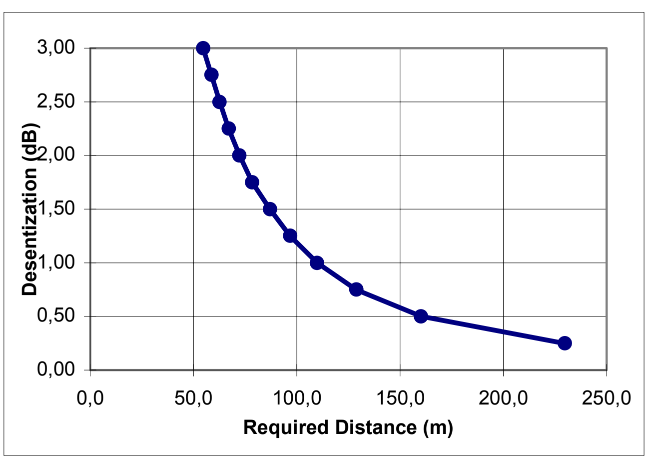
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	109,9
When only RX is on TX antenna 3dB-beam width	0,8
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	229,8
0,50	160,1
0,75	128,8
1,00	**109,9**
1,25	96,9
1,50	87,1
1,75	78,5
2,00	72,3
2,25	67,1
2,50	62,7
2,75	58,8
3,00	54,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	DECT
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1931,250	1928,448
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1313	
TX/RX frequency Offset (KHz)	2802,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ***** See Note *****		-86
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	25,0	8,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	60
Antenna Vertical Beamwidth (°)	9	60
Antenna Downtilt (°)	-3	2
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

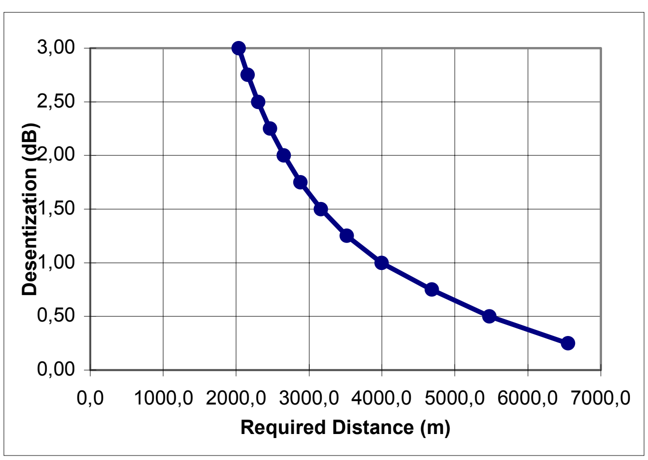
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	3992,9
When only RX is on TX antenna 3dB-beamwidth	296,0
When only TX is on RX antenna 3dB-beamwidth	296,0
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,1

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	6553,8
0,50	5471,0
0,75	4679,7
1,00	**3992,9**
1,25	3518,1
1,50	3163,3
1,75	2884,2
2,00	2656,7
2,25	2466,0
2,50	2303,1
2,75	2161,4
3,00	2036,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	DECT
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1908,750	1912,896
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2657	
TX/RX frequency Offset (KHz)	4146,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***** See Note *****		-86
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	1,5	8,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beamwidth (°)	omni	60
Antenna Vertical Beamwidth (°)	omni	60
Antenna Downtilt (°)	0	2
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

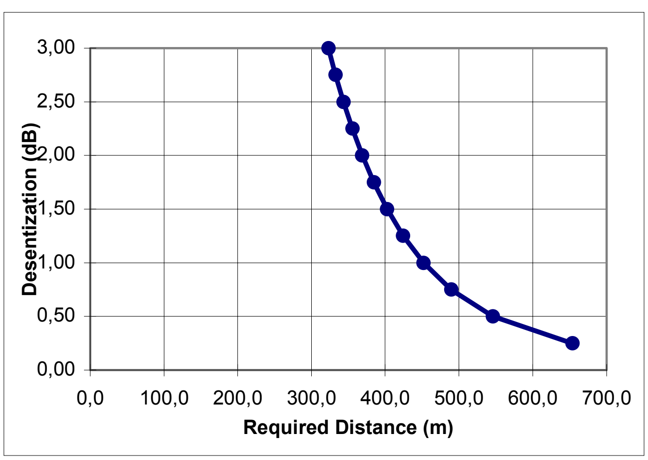
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	452,3
When only RX is on TX antenna 3dB-beamwidth	40,3
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	654,0
0,50	545,9
0,75	489,7
1,00	**452,3**
1,25	424,6
1,50	402,6
1,75	384,4
2,00	369,0
2,25	355,5
2,50	343,5
2,75	332,8
3,00	323,0

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	DECT
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,080	1928,448
Number of guard channels	0	0
Guard Band between channel edges (KHz)	753	
TX/RX frequency Offset (KHz)	1632,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) ***See Note**		-86
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	25,0	8,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	60
Antenna Vertical Beamwidth (°)	9	60
Antenna Downtilt (°)	-3	2
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

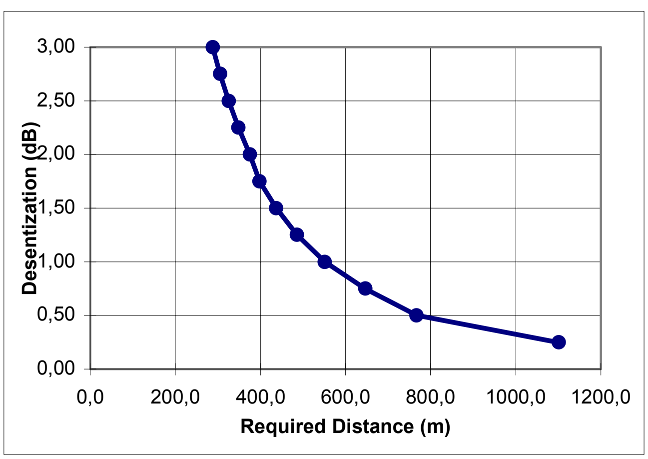
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	551,5
When only RX is on TX antenna 3dB-beamwidth	0,3
When only TX is on RX antenna 3dB-beamwidth	0,3
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1100,9
0,50	767,2
0,75	646,3
1,00	**551,5**
1,25	485,9
1,50	436,9
1,75	398,4
2,00	375,5
2,25	348,5
2,50	325,5
2,75	305,5
3,00	287,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	DECT
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1909,920	1912,896
Number of guard channels	0	0
Guard Band between channel edges (KHz)	2097	
TX/RX frequency Offset (KHz)	2976,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***** See Note *****		-86
Specific C/I value for Receiver Victim System (dB)		10
Antenna and Feeder Data		
Antenna heigth (m)	1,5	8,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beamwidth (°)	omni	60
Antenna Vertical Beamwidth (°)	omni	60
Antenna Downtilt (°)	0	2
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

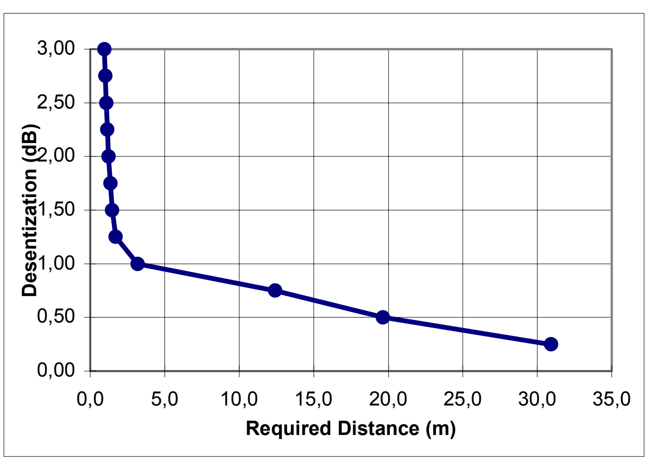
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	3,2
When only RX is on TX antenna 3dB-beamwidth	0,1
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	30,9
0,50	19,7
0,75	12,4
1,00	**3,2**
1,25	1,7
1,50	1,5
1,75	1,3
2,00	1,2
2,25	1,2
2,50	1,1
2,75	1,0
3,00	0,9

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**PHS**
Device	**Base Station**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,200	1929,350
Number of guard channels	0	0
Guard Band between channel edges (KHz)	600	
TX/RX frequency Offset (KHz)	850,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) ***** See Note *****		-88
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	25,0	15,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beam width (°)	105	omni
Antenna Vertical Beam width (°)	9	8
Antenna Downtilt (°)	-3	-7
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

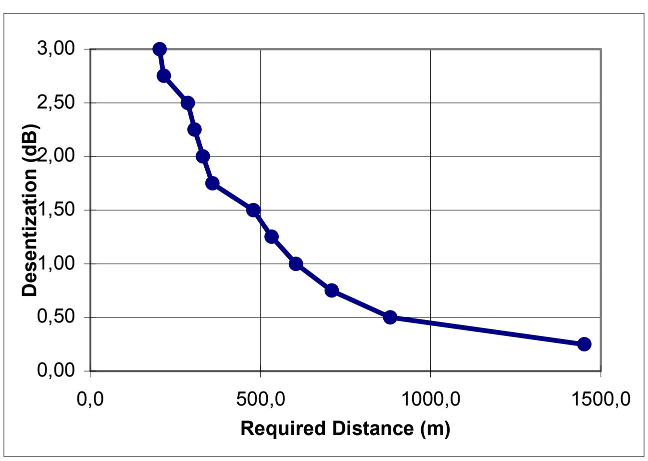
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	605,0
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	0,4
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1452,0
0,50	881,3
0,75	709,1
1,00	**605,0**
1,25	533,1
1,50	479,3
1,75	359,3
2,00	331,0
2,25	307,2
2,50	286,9
2,75	216,4
3,00	203,9

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	PCS1900	PHS
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1909,800	1910,450
Number of guard channels	0	0
Guard Band between channel edges (KHz)	400	
TX/RX frequency Offset (KHz)	650,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***** See Note *****		-88
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	15,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beamwidth (°)	omni	omni
Antenna Vertical Beamwidth (°)	omni	8
Antenna Downtilt (°)	0	-7
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

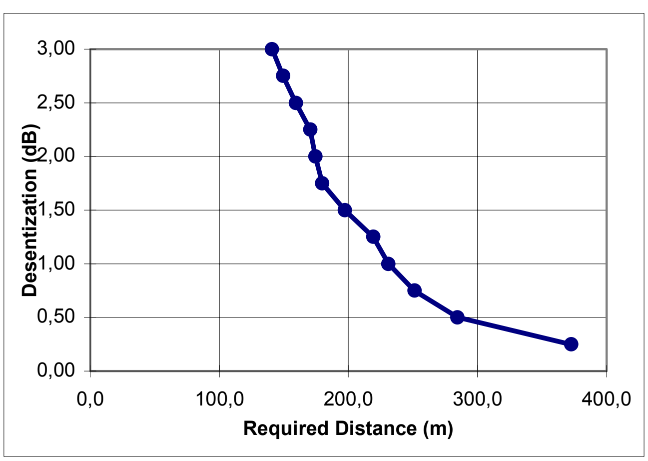
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	231,0
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	372,6
0,50	284,7
0,75	251,2
1,00	**231,0**
1,25	219,3
1,50	197,2
1,75	179,8
2,00	174,4
2,25	170,5
2,50	159,2
2,75	149,4
3,00	140,8

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	PHS
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1931,250	1929,350
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1125	
TX/RX frequency Offset (KHz)	1900,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ***** See Note *****		-88
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	25,0	15,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	8
Antenna Downtilt (°)	-3	-7
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

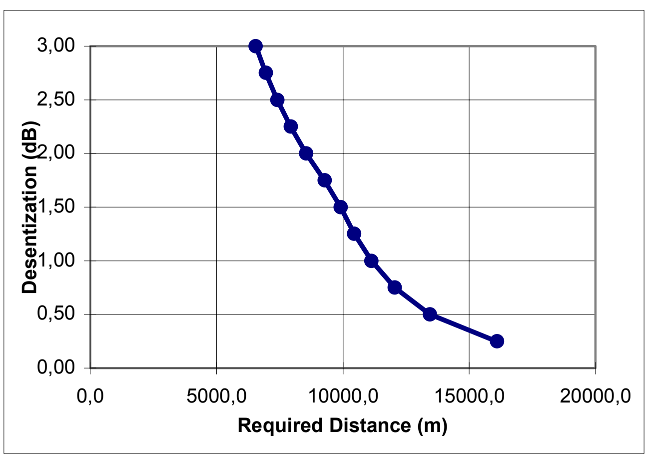
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	11138,4
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	706,3
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	16104,1
0,50	13443,4
0,75	12058,3
1,00	**11138,4**
1,25	10455,3
1,50	9914,0
1,75	9283,4
2,00	8550,9
2,25	7937,4
2,50	7412,8
2,75	6956,8
3,00	6555,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	PHS
Device	Terminal	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1908,750	1910,450
Number of guard channels	0	0
Guard Band between channel edges (KHz)	925	
TX/RX frequency Offset (KHz)	1700,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) *** See Note ***		-88
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	15,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beam width (°)	omni	omni
Antenna Vertical Beam width (°)	omni	8
Antenna Downtilt (°)	0	-7
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

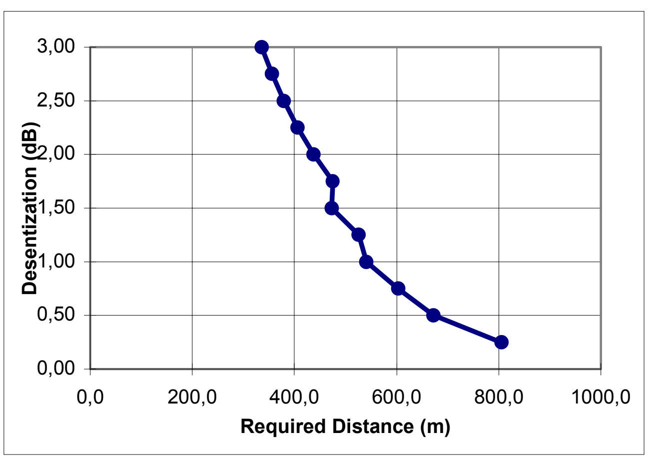
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB :

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	541,0
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	805,4
0,50	672,3
0,75	603,1
1,00	**541,0**
1,25	525,7
1,50	472,7
1,75	475,3
2,00	437,8
2,25	406,4
2,50	379,5
2,75	356,2
3,00	335,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	PHS
Device	Base Station	Base Station
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,080	1929,350
Number of guard channels	0	0
Guard Band between channel edges (KHz)	565	
TX/RX frequency Offset (KHz)	730,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) ***** See Note *****		-88
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	25,0	15,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	omni
Antenna Vertical Beamwidth (°)	9	8
Antenna Downtilt (°)	-3	-7
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

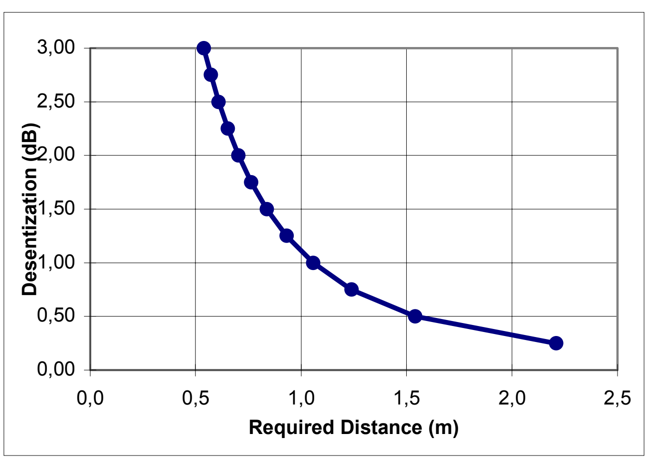
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1,1
When only RX is on TX antenna 3dB-beamwidth	not applicable
When only TX is on RX antenna 3dB-beamwidth	0,1
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	2,2
0,50	1,5
0,75	1,2
1,00	**1,1**
1,25	0,9
1,50	0,8
1,75	0,8
2,00	0,7
2,25	0,7
2,50	0,6
2,75	0,6
3,00	0,5

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**IS136**	**PHS**
Device	**Terminal**	**Base Station**
Frequency Data		
1850-1990 MHz Frequency Block	C (lowerpart)	1910 - 1930 MHz
Working Frequency (MHz)	1909,920	1910,450
Number of guard channels	0	0
Guard Band between channel edges (KHz)	365	
TX/RX frequency Offset (KHz)	530,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***** See Note *****		-88
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	15,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beam width (°)	omni	omni
Antenna Vertical Beam width (°)	omni	8
Antenna Downtilt (°)	0	-7
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

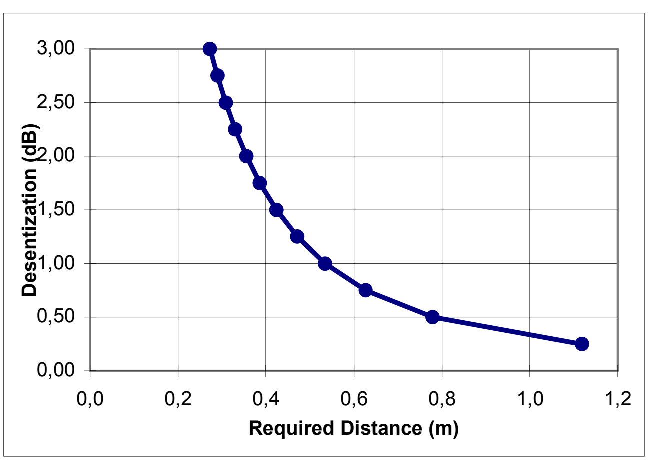
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	0,5
When only RX is on TX antenna 3dB-beam width	not applicable
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	1,1
0,50	0,8
0,75	0,6
1,00	**0,5**
1,25	0,5
1,50	0,4
1,75	0,4
2,00	0,4
2,25	0,3
2,50	0,3
2,75	0,3
3,00	0,3

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**PHS**
Device	**Base Station**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,200	1929,350
Number of guard channels	0	0
Guard Band between channel edges (KHz)	600	
TX/RX frequency Offset (KHz)	850,0	
System Data		
TX Power (dBm)	46	
RX sensitivity (dBm) **** See Note ****		-88
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	25,0	8,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	60
Antenna Vertical Beamwidth (°)	9	60
Antenna Downtilt (°)	-3	2
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

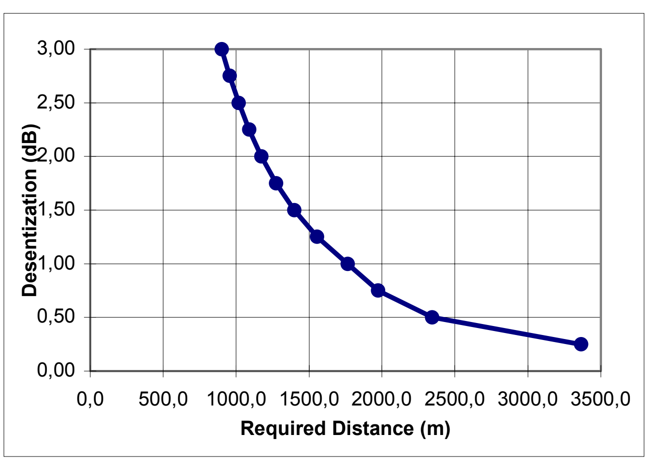
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	1765,0
When only RX is on TX antenna 3dB-beamwidth	0,9
When only TX is on RX antenna 3dB-beamwidth	0,9
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,1

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	3364,9
0,50	2344,9
0,75	1975,5
1,00	**1765,0**
1,25	1555,2
1,50	1398,3
1,75	1274,9
2,00	1174,3
2,25	1090,1
2,50	1018,0
2,75	955,4
3,00	900,3

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	**PCS1900**	**PHS**
Device	**Terminal**	**Terminal**
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1909,800	1910,450
Number of guard channels	0	0
Guard Band between channel edges (KHz)	400	
TX/RX frequency Offset (KHz)	650,0	
System Data		
TX Power (dBm)	33	
RX sensitivity (dBm) ***** See Note *****		-88
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	8,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beamwidth (°)	omni	60
Antenna Vertical Beamwidth (°)	omni	60
Antenna Downtilt (°)	0	2
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

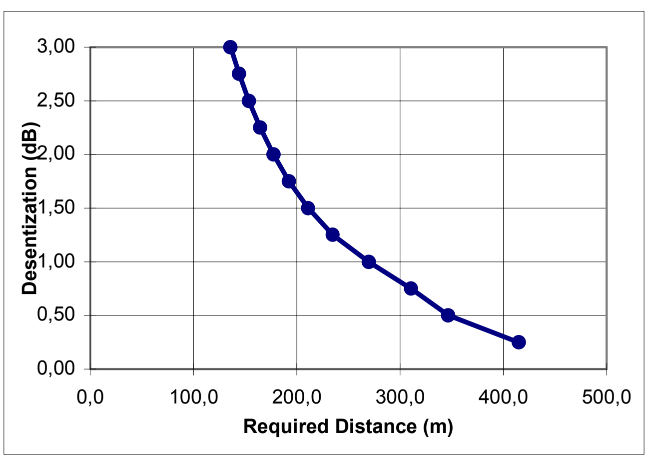
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	269,8
When only RX is on TX antenna 3dB-beamwidth	6,3
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	415,3
0,50	346,7
0,75	311,0
1,00	**269,8**
1,25	235,0
1,50	211,3
1,75	192,6
2,00	177,4
2,25	164,7
2,50	153,8
2,75	144,4
3,00	136,0

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	PHS
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1931,250	1929,350
Number of guard channels	0	0
Guard Band between channel edges (KHz)	1125	
TX/RX frequency Offset (KHz)	1900,0	
System Data		
TX Power (dBm)	43	
RX sensitivity (dBm) ** *See Note* **		-88
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	25,0	8,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beam width (°)	105	60
Antenna Vertical Beam width (°)	9	60
Antenna Downtilt (°)	-3	2
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

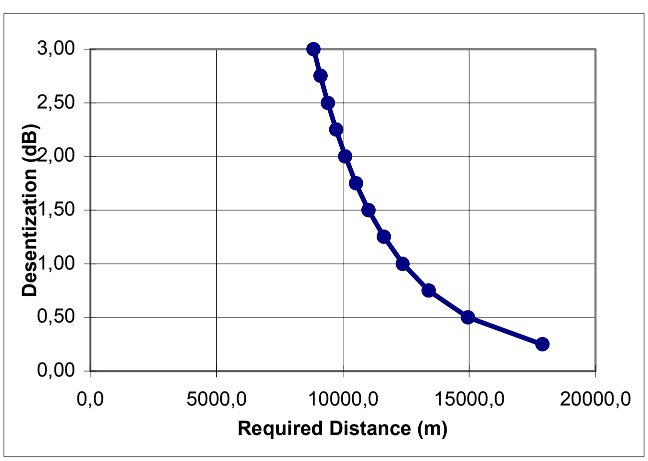
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	12382,9
When only RX is on TX antenna 3dB-beam width	1967,7
When only TX is on RX antenna 3dB-beam width	1967,7
When both TX and RX are out of RX and TX antenna 3dB-beam width	1,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	17903,4
0,50	14945,4
0,75	13405,6
1,00	**12382,9**
1,25	11623,4
1,50	11021,7
1,75	10524,3
2,00	10100,6
2,25	9731,5
2,50	9404,4
2,75	9110,6
3,00	8843,6

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS95	PHS
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	C (lower part)	1910 - 1930 MHz
Working Frequency (MHz)	1908,750	1910,450
Number of guard channels	0	0
Guard Band between channel edges (KHz)	925	
TX/RX frequency Offset (KHz)	1700,0	
System Data		
TX Power (dBm)	23	
RX sensitivity (dBm) ***** See Note *****		-88
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	8,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beamwidth (°)	omni	60
Antenna Vertical Beamwidth (°)	omni	60
Antenna Downtilt (°)	0	2
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

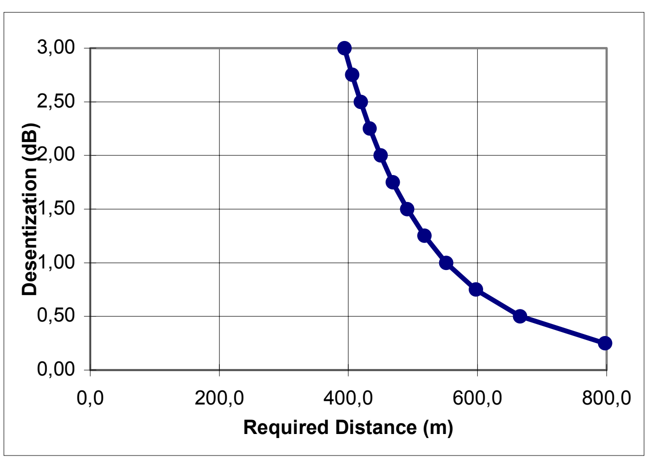
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	551,9
When only RX is on TX antenna 3dB-beamwidth	61,4
When only TX is on RX antenna 3dB-beamwidth	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	798,0
0,50	666,2
0,75	597,5
1,00	**551,9**
1,25	518,1
1,50	491,3
1,75	469,1
2,00	450,2
2,25	433,8
2,50	419,2
2,75	406,1
3,00	394,2

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	PHS
Device	Base Station	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	A (upper part)	1910 - 1930 MHz
Working Frequency (MHz)	1930,080	1929,350
Number of guard channels	0	0
Guard Band between channel edges (KHz)	565	
TX/RX frequency Offset (KHz)	730,0	
System Data		
TX Power (dBm)	47	
RX sensitivity (dBm) ***** See Note *****		-88
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	25,0	8,0
Antenna Gain (dBi)	17,0	10,0
Antenna Horizontal Beamwidth (°)	105	60
Antenna Vertical Beamwidth (°)	9	60
Antenna Downtilt (°)	-3	2
Feeder Losses (dB)	2,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

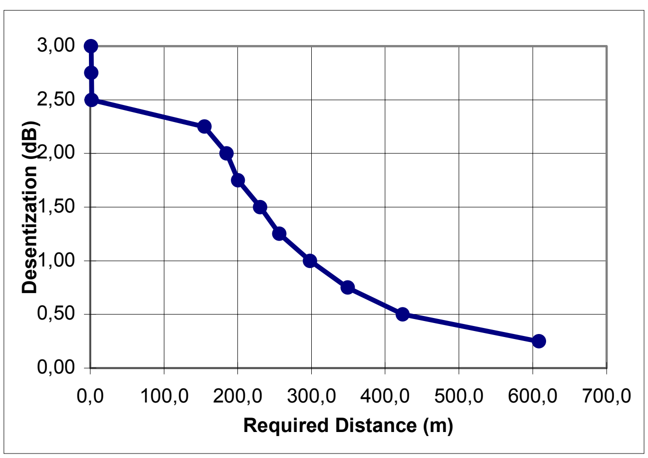
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beamwidth	298,0
When only RX is on TX antenna 3dB-beamwidth	0,1
When only TX is on RX antenna 3dB-beamwidth	0,1
When both TX and RX are out of RX and TX antenna 3dB-beamwidth	0,0

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	608,7
0,50	424,2
0,75	349,2
1,00	**298,0**
1,25	256,6
1,50	230,7
1,75	200,9
2,00	185,0
2,25	154,9
2,50	1,9
2,75	1,4
3,00	1,1

INTERFERENCE ANALYSIS CASE

Parameter	Interfering TX	Victim RX
System	IS136	PHS
Device	Terminal	Terminal
Frequency Data		
1850-1990 MHz Frequency Block	C (lowerpart)	1910 - 1930 MHz
Working Frequency (MHz)	1909,920	1910,450
Number of guard channels	0	0
Guard Band between channel edges (KHz)	365	
TX/RX frequency Offset (KHz)	530,0	
System Data		
TX Power (dBm)	30	
RX sensitivity (dBm) ***** See Note *****		-88
Specific C/I value for Receiver Victim System (dB)		12
Antenna and Feeder Data		
Antenna heigth (m)	1,5	8,0
Antenna Gain (dBi)	0,0	10,0
Antenna Horizontal Beam width (°)	omni	60
Antenna Vertical Beam width (°)	omni	60
Antenna Downtilt (°)	0	2
Feeder Losses (dB)	0,0	1,0
Other Calculation Inputs		
Improvement on TX mask specification (dB)	0,0	
Allowed Rx Desensitization (dB)	1,0	

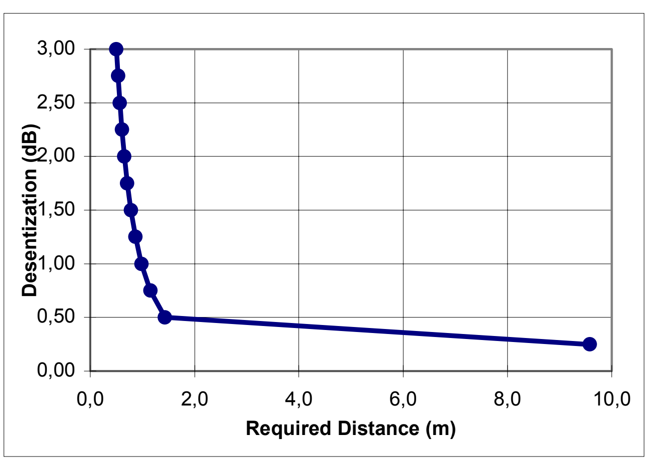
Note: This is the Receiver Sensitivity with No Rayleigh Fading

RESULTS

Required distances for Desentization equal to 1 dB:

	Req. distance (m)
When both TX and RX are on RX and TX antenna 3dB-beam width	1,0
When only RX is on TX antenna 3dB-beam width	0,1
When only TX is on RX antenna 3dB-beam width	not applicable
When both TX and RX are out of RX and TX antenna 3dB-beam width	not applicable

Required distances when TX and RX antennae are on-beam, for different Desentization:



Desentization (dB)	Req. Distance (m)
0,25	9,6
0,50	1,4
0,75	1,2
1,00	**1,0**
1,25	0,9
1,50	0,8
1,75	0,7
2,00	0,7
2,25	0,6
2,50	0,6
2,75	0,5
3,00	0,5

Part 2

COMMENTS ON THE REPORT OF THE PCC. III INTERFERENCE EXPERTS GROUP ON INCOMPATIBILITY ISSUES BETWEEN FWA AND PCS SYSTEMS (DOCUMENT PCC.III/DOC.935/97 (IX-97)) BY THE INTERFERENCE EXPERTS GROUP

Document PCC.III/doc.1077/98 (XI-98)

XI MEETING OF PERMANENT
CONSULTATIVE COMMITTEE III:
RADIOCOMMUNICATIONS
September 14 to 18, 1998
Lima, Perú

Part 2.

EXECUTIVE SUMMARY OF THE DOCUMENT ON COMMENTS ON THE REPORT OF THE PCC.III INTERFERENCE EXPERTS GROUP ON INCOMPATIBILITY ISSUES BETWEEN FWA AND PCS SYSTEMS

During 1996 and 1997, the Interference Expert Group studied “Incompatibility Issues between FWA and PCS Systems”. This resulted in a document (PCC.III-935/97) [1] at the September 1997 PCC.III meeting in Mexico City. This document described the interference problem, proposed an analysis methodology and provided some results including coordination distances for FWA-PCS and PCS-PCS scenarios. The document also listed 14 pages of comments made by the two sub-group of experts (PHS/DECT proponents and PCS proponents).

A seminar on the results was held at the Xth PCC.III meeting in Natal, Brazil and a brief meeting of the Experts was held to try and resolve outstanding differences. Their report (PCC.III-1047/98) included a proposal to work during the summer by email to resolve the issues OR document the outstanding differences clearly. The fourth plenary meeting (PCC.III-1052/98 rev 1) accepted a Canadian proposal: “The Expert Group should try to achieve consensus on as many outstanding issues as possible and submit a report of its work, including any differences of views, to the Working Group” in Lima Peru in September 1998. This report is the result of this consensus process and is the combined output of email exchanges . This report was decided to be the last task for the Experts group and concludes the interference studies.

The following comments are annotated as “AENS View” or “LMNQ View” depending on which group of companies was the source of the text. There were basically two views expressed

- Lucent, Motorola, Nortel and Qualcomm (the “LMNQ View”) believe that PCC.III-935/97 is a valuable starting point and indicates a significant level of interference can occur, however they believe that there were several substantive calculation errors (especially for interference from DECT or from IS-136) and there were also several substantive improvements needed (e.g. allowing for multiple interferers) and that a new document should be prepared which consolidates these corrections with PCC.III-935/97. A revised methodology LMNQcalc.xls should be used.

  Given the information presented here and in PCC.III-935/97, the LMNQ experts have major concerns over the potential for interference from TDD FWA systems operating in the 1910-1930 MHz band to both UPCS systems and to licensed PCS systems in adjacent bands. LMNQ therefore urge administrations who intend permitting FWA in 1910-1930 MHz to carefully review the comments of the experts and carry out their own interference study using the spreadsheet developed by the PCC.III experts and other analysis methods.

  If such a study is not deemed desirable, then we suggest that rigid frequency or distance separation guardbands be established to protect the licensed or unlicensed PCS services. In any location, where both FWA and PCS systems offer service, we recommend a minimum 5

MHz frequency separation between the closest channel edge frequencies of the different systems. If frequency guardbands are not used, then we recommend that the coverage area of the FWA and PCS systems should not overlap in any part of their authorized territory.

- Alcatel, Ericsson, NEC and Siemens (the "AENS View") believe that the report PCC.III/935/97 [1] is complete and provides enough information to conclude on the interference behaviour of PCS and FWA TDD scenarios compared with PCS to PCS scenarios.

  From this comparative analysis it can be clearly deduced that there is not any special problem of interference between FWA TDD applications in 1910-1930 MHz band and PCS systems in adjacent bands. The interference potential for FWA-PCS is of the same order or less than for PCS-PCS systems. The current document strengthens this position which was already defended in previous opportunities.

  Therefore the Experts group has finished its task. No more studies are required. No specific guardbands need to be recommended besides the natural guardbands that have been used in [1]. Local site engineering, if required, will not need more effort than between PCS-PCS systems, and is outside the scope for this study in PCC.III.

  Regarding to the UPCS and FWA TDD coexistence in 1910-1930 MHz it is also noted the different criteria for analysis described in documents [18] and [16]. Anyhow, from the analysis of both documents it can be also deduced that FWA TDD, private DECT and Isochronous UPCS systems can coexist in the 1920-1930 MHz.

  Though above discussions could be avoided (since most of them was already made in previous meetings of the Experts Group) the content of this document will be very useful for CITEL members, because it gives further information not only about the results expressed in [1] but also about how the discussions were carried out within the experts group, enlarging the knowledge about interference and compatibility issues which is the main term of reference of the specific CITEL PCC.III Working Group from where Experts Group belongs to.

1. CHANGES TO CALCULATION METHODOLOGY

1.1. DECT MASK DATA

LMNQ are concerned that the DECT mask used in PCC.III-935/97 does not correctly reflect the DECT standard.

Here is an extract of the DECT standard ETS 300 175-2 [9] related to the emissions due to modulation, where it can be seen that the DECT standard provides the power requirements for adjacent channels:

Extract from ETSI document ETS 300 175-2 (June 1996) Section 5.5.1 "Emissions due to Modulation"

Emissions on RF channel "Y"	Maximum Power Level	
Y = M ± 1	160 μW	-8.0 dBm
Y = M ± 2	1 μW	-30.0 dBm
Y = M ± 3	40 nW	-44.0 dBm
Y = Any other DECT channel	20 nW	-47.0 dBm
NOTE: For Y = "any other DECT channel", the maximum power level shall be less than 20 nW except for one instance of a 500 nW signal		

The power in RF channel Y is defined by integration over a bandwidth of 1 MHz centered on the nominal centre frequency , Fy.

Table 1.1 DECT Modulation Mask
[dBm column added by PCC.III experts editor]

1.1.1. LMNQ View

LMNQ [4, 15] agree that the DECT data given in the original report [1] is correct, BUT the **implementation** in the spreadsheet is wrong by 2.4 dB, and the changes proposed below to the mask will correct the current error in the spreadsheet.
For DECT, PCC.III/doc 935/97 indicated

- in section II.B.2, that the max transmit power from a DECT transceiver (base or terminal) was 24 dBm (in a 1728 kHz channel),
- used -32 dBc (24+8) as the appropriate mask value on the first adjacent channel, based on a max power level of –8 dBm (see Table 1.1 above),

- Converting the channel bandwidth (1728 kHz) to the measurement bandwidth (1000 kHz) causes a 2.4 dB correction, which was unfortunately included twice (once in the Interference cell C45, and once in the spectrum mask). The extract from the DECT specification shows that the power on the first adjacent channel must be 29.6 dB (21.6+8) down from the power on the carrier IN THE SAME MEASUREMENT BANDWIDTH

Proof: In the **original** (September 1997) spreadsheet, if we calculate the power centered on the first adjacent DECT carrier (with a DECT interferer, force cell C43 to 1728 kHz), the spreadsheet calculates a power (cell C47) of -70.4 dBm/Hz i.e. -10.4 dBm in 1 MHz, whereas the DECT spec is 160 µW in 1 MHz (-8 dBm). This 2.4 dB error is due to double calculation for the frequency allowance – once explicitly in cell C45 and then also implicitly in the spectrum mask. If we force a corresponding change to the revised spreadsheet [5] distributed in mid July (force cell C43 to 1228 and cell C44 to 2228), the result (cell C48) shows the correct –8 dBm result.

RECOMMENDATION: Use the revised mask proposed below with the 2.4 dB correction factor to conform with the ETSI specs i.e. change the spectrum mask to -29.6 dB in a 1000 kHz and corresponding changes on other channel offsets

1.1.2. AENS View

From the AENS viewpoint the DECT mask included in [1] is correct. Further details will be found in section 1.2.2.

1.2. DECT MASK SLOPE OR CONSTANT DATA

In PCC.III-935/97 the DECT mask was a series of slopes, not a series of constant step values as stated in Table 1.1.

1.2.1. LMNQ View

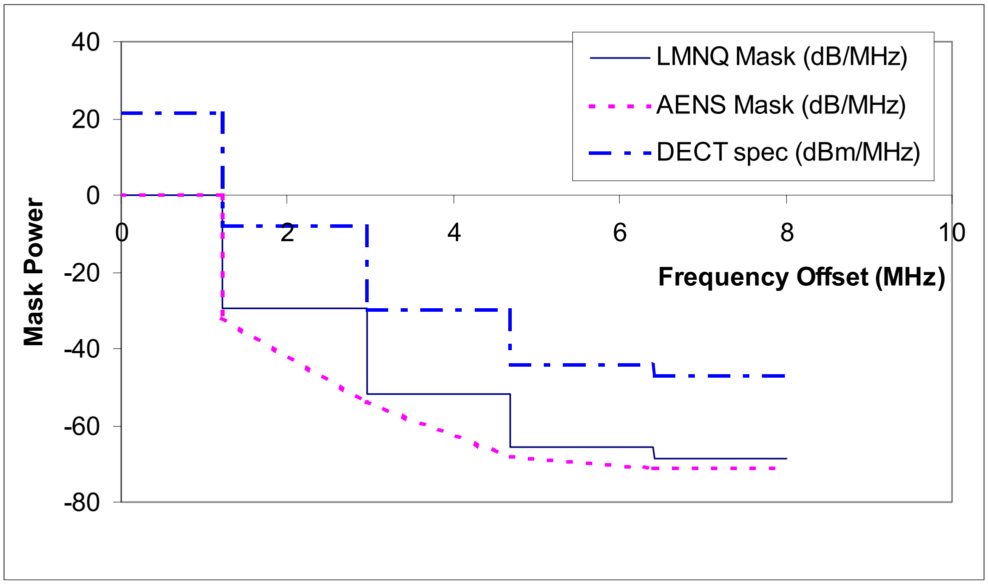


Figure 1.1 Different interpretations of DECT Masks

LMNQ believes that constant data steps for DECT are correct for the following reasons, which counter the following AENS arguments:

- By observation of the Figure 1.1, it can be seen that the data from the DECT specs (plotted in dBm/MHz) is identical to the mask proposed by LMNQ (plotted in dB/MHz) (with an offset due to carrier power) and significantly different from the mask proposed by AENS.
- While PCS1900/GSM explicitly specify an emission mask, IS-136, IS-95 and DECT all specify their modulation mask implicitly in terms of the power in the adjacent channels, therefore the treatment for all three technologies **MUST** be the same.
- In the Experts Group discussions in 1997 [7], we acknowledged that specific manufacturer's equipment would be better than the official specification, but we agreed that we MUST use the specification data as a minimum. Extract from [7]:

  > "… any typical data should be used IN ADDITION to the specification data and that there was a need for strong caveats on such results"

- In the AENS view below, it is stated that DECT TBR 06 section "f)" indicates that the "highest recorded value" shall be used. Neither the January 1997 version [10] of TBR 06 nor the draft February 1998 version [11] contains the reference within section 12.2 "Emissions due to Modulation". Similar text does exist in section 12.3.3 g), which refers to "Emissions due to Transmitter Transients". Nortel indicated in [4] section 2 that Transients (whose permitted emissions are significantly higher – see Section 2.1) should be included in any future work, but this is beyond the scope of the current activities.

- ETS 300 175-2 [8, 9] and TBR 06 [10, 11] clearly indicate that measurements should be **integrated** over a 1 MHz bandwidth centered on the nominal carrier center and thus explicitly not use a single highest value as suggested by AENS.

    Extract from TBR 06 section 12.2.3

    The analysing system in the LT shall be operated under the following conditions:

frequency sweep:	1 MHz;
resolution bandwidth:	100 kHz;
video bandwidth:	greater than resolution bandwidth;
integration:	across the frequency sweep;
peak hold:	on;
sweep time:	greater than 12 seconds;
filtering type:	synchronously tuned.

    Extract from ETSI ETS 300 175-2

    The power in RF channel Y is defined by integration over a bandwidth of 1 MHz centered on the nominal centre frequency , Fy.

- Modifying the Nortel spreadsheet [5] for slopes in the DECT mask rather than constant steps and forcing the same examination of a DECT adjacent channel as above (force cell C43 to 1228 and cell C44 to 2228), the result (cell C48) shows the value -12.9 dBm rather than the correct –8dBm of the specification i.e. the proposal from Alcatel in the following section to use a slope will artificially and **incorrectly** reduce emissions on the first adjacent channel by 4.9 dB.

- The sentence following Table 1.1, shows that the specified power is integrated over a 1 MHz measurement bandwidth centered on the adjacent carriers. Thus we must assume that the power distribution is either constant at the specified level (e.g. –29.6 dBc) OR, if sloped, the power distribution is significantly higher than specified at some points (probably closer to the main carrier). The text in PCC.III-935/97 assumed the specified value at the closest frequency to the carrier and slope down to the next channel (see Figure 1.1). **Suggested Solution:** assume the specified power is a constant level over the channel and NOT linearly interpreted.

LMNQ RECOMMENDATION: Use the following revised DECT with constant step sizes as per the ETSI specs for the table in section II.B.4.4.

Frequency Offset (kHz)		BASE STATION		TERMINAL (MOBILES)	
from	**to**	**Measurement bandwidth (kHz)**	**TX Noise Floor at offset (dBc)**	**Measurement bandwidth (kHz)**	**TX Noise Floor at offset (dBc)**
0	1227	1000	0.0	1000	0.0
1228	2956	1000	-29.6	1000	-29.6
2956	4684	1000	-51.6	1000	-51.6
4684	6412	1000	-65.6	1000	-65.6
>6412		1000	-68.6	1000	-68.6

For all frequency offset values the TX Noise Floor is constant

Table 1.2 Proposed LMNQ Mask for DECT

1.2.2. AENS View

AENS believe that the use of a sloped mask as in [1] is correct.

The DECT standard does not provide a specification of a modulation mask as the PCS standards but only gives power requirements for all the adjacent channels. Therefore an estimation has to be made of a proper spectrum mask, and in that sense the values used in the Expert Group Report [1] are not only valid but even very CONSERVATIVES, since the actual values of DECT equipment are much lower than those used in calculations: THE DECT EQUIPMENT PROVIDES TYPICALLY 10 dB LESS INTERFERENCE THAN ACCORDING TO THE MASK USED IN THE REPORT [1], as we can see in the following figure, which represents the actual measured modulation mask for DECT transmitter, compared to the mask used in report [1], and where positions of the adjacent PCS carriers are also showed.

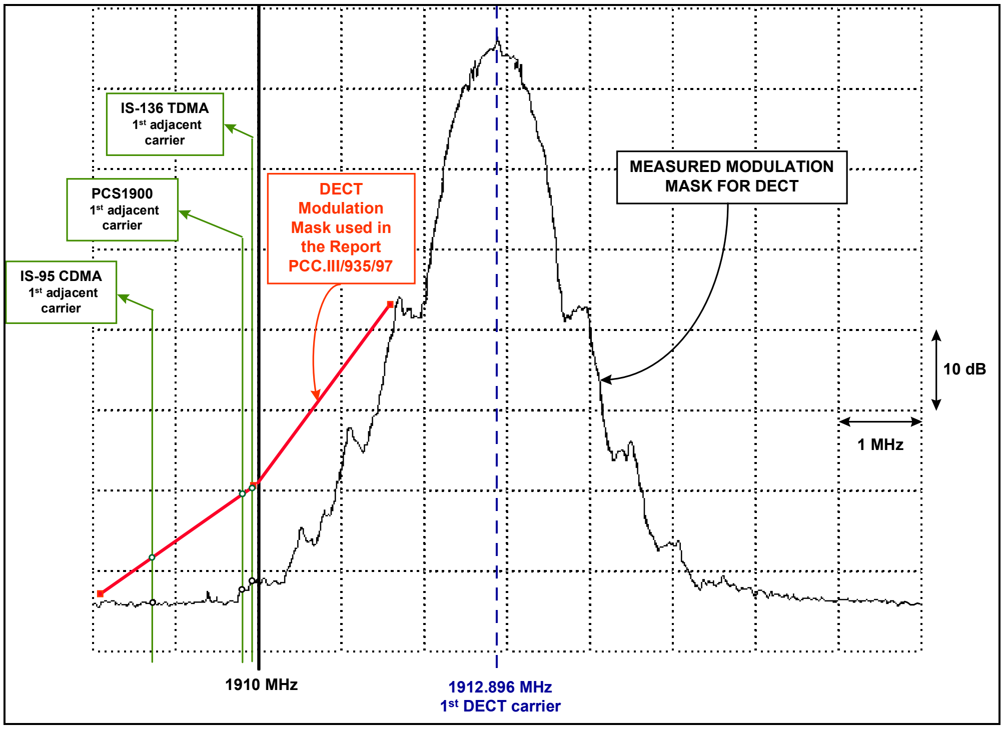


Figure 1.2: Actual modulation mask for DECT compared to the used one in Report PCC.III/935/97

From the point of view of DECT/PHS proponents, there is not any error in Report [1] regarding to these matters. Moreover, it is noted that the values used in Report [1] are very CONSERVATIVE and they are in line with the assumption of the "worst case analysis".

According to Table 1.1 and taken into account the nominal DECT transmit power (24 dBm), the assumed DECT mask in Report [1] has been the showed in following figure (already presented in the CITEL PCC.III seminar of Natal, see PCC.III/1035/98):

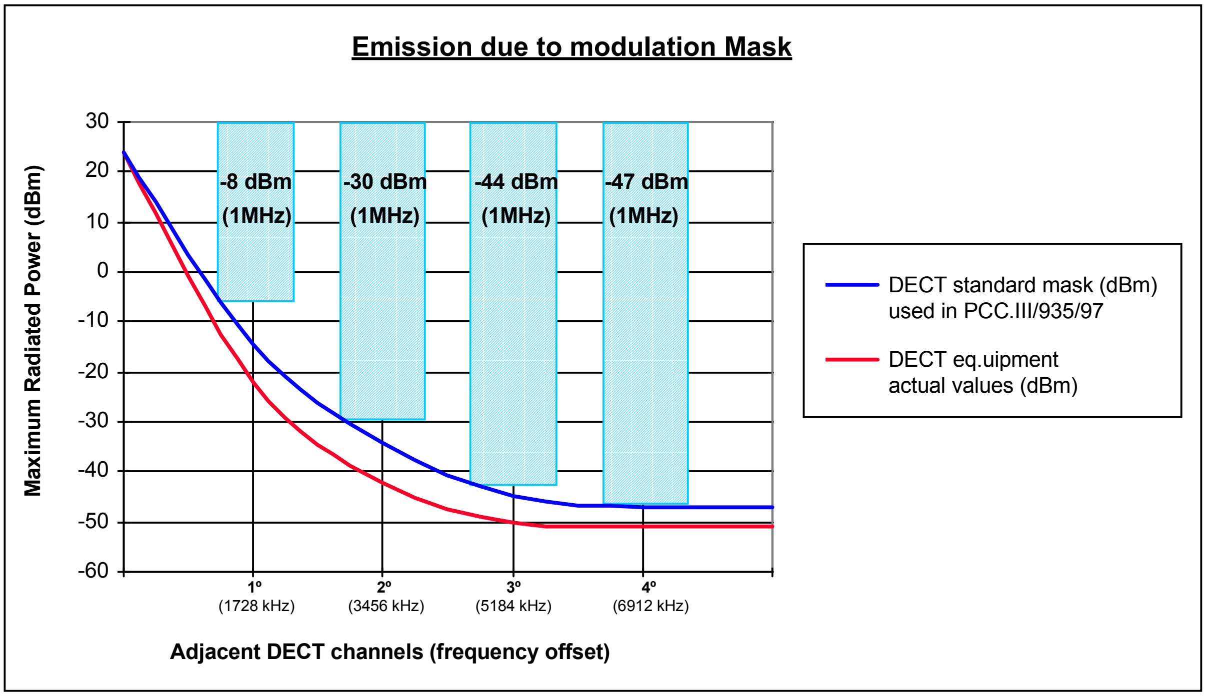


Figure 1.3: Approximation of the DECT modulation mask used in Report PCC.III/935/97 according to the DECT standard and compared to the actual DECT equipment values

Assuming that actual emission masks are sloped (see[3], figure 1), the best approximation should be the linear interpolation between points indicated in the standard, and not to assume a constant power distribution as proposed by A.McGregor in [4].

According to the method of measurement specified in the ETSI standard TBR 06, where it is indicated that:

"f) ... the LT shall select the highest recorded value within the sweep [1 MHz]. *This value shall be compared with the verdict criteria"*

since the closest frequency offset will present always higher power values, the frequency point to be considered for the mask within the 1 MHz measurement bandwidth must be the corresponding to the lower frequency offset within the sweep of 1 MHz, i.e. 500 kHz below the centre frequency, as stated in [1] and [3].

The LMNQ proposal introduces higher errors, since the proposed transmission mask is farther to the actual emission mask than the included one in [1] , as indicated in figures 1.2 & 1.3 above.

If we want to be as accurate as possible we must keep the standard DECT mask data as indicated in [1] which represents the lowest possible error respect to the actual equipment.

Suggested procedure:

- NO CHANGES ARE NEEDED IN [1] REGARDING TO DECT MASK DATA.
- NO CHANGES ARE NEEDED IN REGARDING TO THE DECT/PHS OPINION ABOUT THE DECT SPECTRAL MASK

1.3. INTERPRETATION OF ALL MASKS

The transmitter masks used are a contiguous set of straight lines or discrete steps. It is possible that the receiver bandwidth will encompass parts of more than one such segment (see the following diagrams). The methodology used for PCC.III-935/97 estimated the transmitted power on the receiver carrier frequency and assumed that this value could accurately describe the total received power. This methodology will be accurate only if the receiver bandwidth encompasses a single transmitter mask segment which has a constant power density (i.e. the first of the four diagrams).

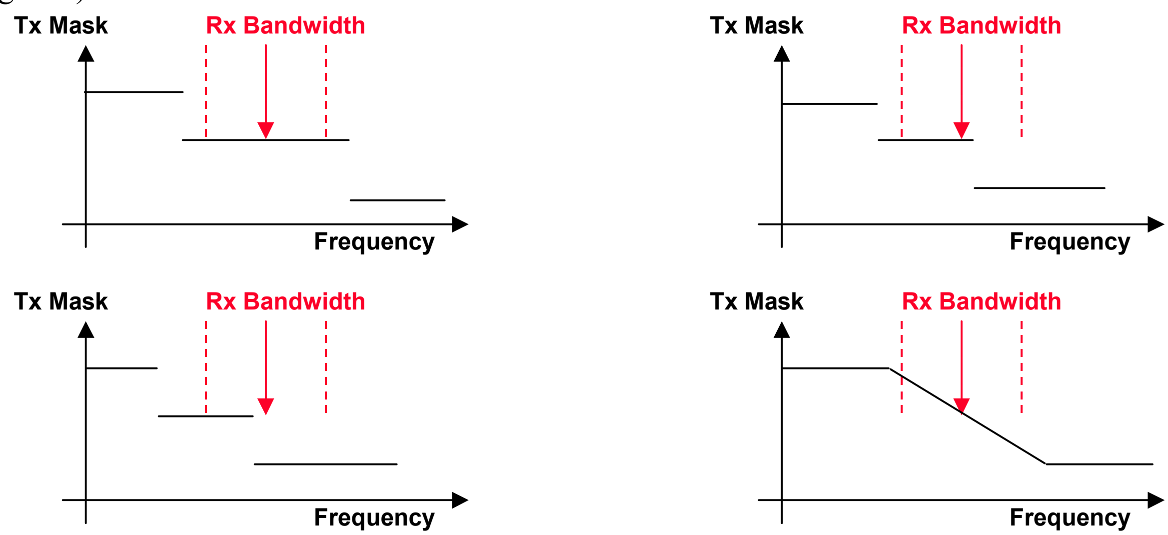


Figure 1.4 Possible Mask Scenarios

Proposed Solution: It is recommended that the methodology should instead use mathematical integration of the actual mask value over the receiver bandwidth at the proper frequency offset. This should be done by evaluating any component within each mask segment and linearly summing the power from those components.

1. The cases shown in the first three diagrams above have constant power density and the total power (mW) is:

$10^{0.1P} \times (f_4 - f_3) / BW_{measure}$

where P dBm is the constant power density measured in a bandwidth of $BW_{measure}$
the band of interest is between frequency f_3 and frequency f_4 ($f_3 < f_4$)

2. For the final case, where the logarithmic power density is falling linearly with frequency, the total power (mW) is ("Interference Calculation Methodology" Andy McGregor, 7th July 1997):

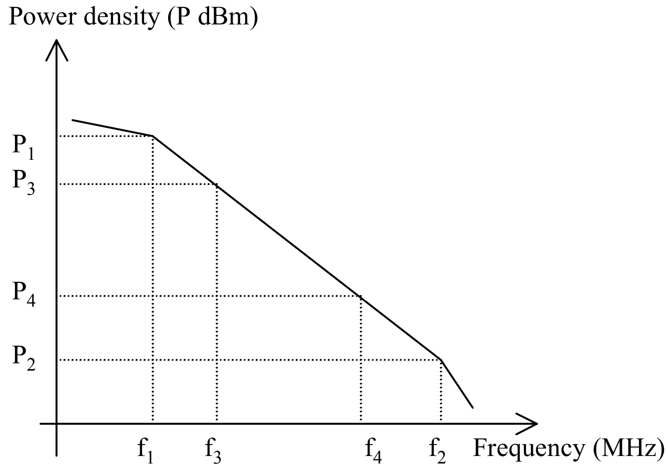


Figure 1.5 Power Vs Frequency

$(\exp[0.1 * (a*f_4+b) * \ln(10)] - \exp[0.1 * (a*f_3+b) * \ln(10)]) / (0.1 * a * \ln(10) * BW_{measure})$

where P_1 dBm is the power density measured in a bandwidth of $BW_{measure}$ at frequency f_1
P_2 dBm is the power density measured in a bandwidth of $BW_{measure}$ at frequency f_2
$(f_1 < f_2)$
$a = (P_2 - P_1) / (f_2 - f_1)$ the slope of the power density line
$b = P_1 - f_1 * a$ the constant of the power density line
the band of interest is between frequency f_3 and frequency f_4 $(f_3 < f_4)$

1.3.1. Consensus View

AENS [6] and LMNQ [4, 15] agree that proper integration should be used and the method advocated by Nortel [4] and corrected by Alcatel [6] should be used.

1.4. PHS TO DECT INTERFERENCE

The Experts Group agreed that for this analysis, the worst-case effects should be used which by definition ignores the effects of dynamic channel allocation and thus the model can be used – the only debate should be over the precise band edge channels for each technology. As AENS [6] noted, a decision at the Natal PCC.III meeting decided not to pursue these scenarios, but this does not mean that they cannot be calculated given that the process is in place.

1.4.1. LMNQ View

The experts had agreed previously that worst case analysis should be used which deliberately ignores potential improvements due to dynamic channel allocation. Unlock the cells as the absence of data may be interpreted wrongly as no interference. There are no negative aspects of displaying this information.

There is no reason that the current spreadsheet can not be used to estimate potential interference between DECT and PHS, if suitable frequencies can be defined. Reusing the existing channel bands in the spreadsheet to permit DECT to operate in 1910-1920 MHz and PHS to operate in 1920-1930 MHz using their frequency plans already identified.

1.4.2. AENS View

The spreadsheet is NOT suitable for calculation of the DECT and PHS interference, since the main feature for this coexistence (the dynamic channel allocation in a shared TDD band) is not included as input parameter for the used methodology in [1].

In addition, as stated in the last PCC.III meeting, the DECT/PHS interference analysis have been already "closed", and it is out of the scope of the current discussions.

Maintain the lockout on the spreadsheet evaluation of interference between PHS and DECT FWA technologies.

1.5. STEP SIZE DIFFERENTIATION

To differentiate between constant power density steps from linearly falling mask data, the earlier spreadsheet set the upper bound of a constant step to be 1kHz below the actual value. This typically causes minimal error for wideband technologies (e.g. DECT, IS-95), but could be significant for narrowband technologies (e.g. IS-136). **Proposed Solution**: use 0.1 kHz between the upper frequency of a constant step from the lower frequency of the next step.

1.5.1. Consensus View

AENS [6] and LMNQ [4, 15] agree that improved step size should be used.

1.6. SPURIOUS INTERFERENCE FROM IS-136

The spreadsheet for [1] used special limits for interference from IS-136 to the 1910-1930 MHz band.

1.6.1. Consensus View

AENS [6] and LMNQ [4, 15] agree that a minor error (using –48.229 dBm/300Hz instead of –48.29 dBm/300Hz) should be corrected.

1.6.2. LMNQ View

The Experts agreed [7] to follow official specs. Neither the current mobile spec IS-137A [12] nor the base spec IS-138A [13] place explicit limits on the 1910-1930 MHz band.

The following extracts from the Mobile station spec IS-137A [12] apply:

“3.4.1.2.1 Spectrum Noise Suppression – Broadband” The emission power in either second alternate channel centered ±90 kHz from the center frequency, shall not exceed a level of 45 dB below the mean output power or -13 dBm, whichever is the lower power.

“3.4.3.2.3 Harmonic and Spurious Emissions (Radiated)” and also “3.4.2.2.3 Harmonic and Spurious Emissions (Conducted)” The peak power level of any emissions within the mobile transmit band, measured using a 30 kHz bandwidth centered 120 kHz or more from the carrier frequency, shall not exceed 45 dB below the mean carrier output power or -13 dBm, whichever is the lower power.

Thus for frequencies > 90 kHz from a TDMA carrier, IS-137A provides a limit for mobile terminals of the lower value between 45 dB attenuation or -13 dBm on a 30kHz channel. For a +30 dBm transmit power, the limit for our case is –15 dBm / 30 kHz which is equivalent to –35 dBm / 300 Hz.

The following extracts from the Base station spec IS-138A [13] apply:

“3.4.1.2.3 Spectrum Noise Suppression – Broadband” For output powers greater than 50 W, the emission power in either second alternate channel, centered ?90 kHz from the carrier frequency, shall not exceed a level of 60 dB below the mean output power.

“3.4.2.2.3.2 Harmonic and Spurious Emissions (Conducted)” and also “3.4.3.2.3.2 Harmonic and Spurious Emissions (Radiated)” The peak power level of conducted spurious emissions shall not exceed a level of 80 dB below the mean carrier output power or -13 dBm, whichever is higher, measured in a 1 MHz bandwidth. For output powers greater than 50 W, the peak power level of any emissions within the base station transmit band between 1930 - 1990 MHz, measured using a 30 kHz bandwidth centered 120 kHz or more from the carrier frequency, shall not exceed a level of 60 dB below the mean carrier output power.

Thus IS-138A provides a limit for base stations of

- 90 – 120 kHz from carrier, the limit is 60 dB attenuation on a 30 kHz channel. For a +47 dBm transmit power -13 dBm / 30kHz equivalent to –33 dBm / 300 Hz.
- > 135 kHz from carrier, the higher value between 80 dB attenuation or –13 dBm in 1 MHz. For a +47 dBm transmit power -13 dBm / 1 MHz equivalent to –48.229 dBm / 300 Hz.

RECOMMENDATION: Since there is no dependency on the 1910-1930 MHz band, apply these limits as a revised mask to the spreadsheet. For the base mask, -48.229 dBm / 300 Hz versus the carrier power (+47-20 dBm / 300Hz) gives –75.229 dB. For the mobile, the existing –45dB spec is tighter than the –13dBm limit.

Frequency Offset (kHz)		**BASE STATION**		**TERMINAL (MOBILES)**	
Lower Limit	**Upper limit**	**Measurem. bandwidth (kHz)**	**TX Noise Floor at offset (dB)**	**Measurem. bandwidth (kHz)**	**TX Noise Floor at offset (dB)**
0	29.9	0.3	0.0	0.3	0.0
30	59.9	0.3	-26.0	0.3	-26.0
60	89.9	0.3	-45.0	0.3	-45.0
90	134.9	0.3	-60.0	0.3	-45.0
135	any other	0.3	-75.229	0.3	-45.0

1.6.3. AENS View

AENS believe that in the IS-136 TDMA standard and the FCC rules, the limit of -13 dBm in a 1MHz measurement bandwidth applies to both Base Stations and Mobiles, in the 1910-1930 MHz band.

AENS agree that there are two implementation errors in Report [1] and in the original spreadsheet:

- The value of -13 dBm/1MHz is equivalent to -48.229dBm/300 Hz instead of -48.29dBm/300 Hz
- In the original spreadsheet, it was included in cell C44 the correction assuming certain dBc related to the IS-136 Base Station TX power (47 dBm), but this value was also used for Mobiles, where the TX power is lower (30 dBm)

1.7. PROPOSED CHANGES TO SPREADSHEET

A new "Results" worksheet has been added to the spreadsheet along with a command macro. This will provide matrices such as in II.C.2 and II.C.3 directly, by iteratively calling the main spreadsheet calculations. The choice of desensitization value and of including or excluding fading are manually selectable.

Based on the above, spreadsheet AENScalc.xls (AENS view) or LMNQcalc.XLS (LMNQ view) have been created and should be used for the calculations and corrected summary results tables replacing tables II.C.2.1, II.C.2.2, II.C.3.1 and II.C.3.2 in [1] are attached (see Appendix).

2. SPURIOUS AND OUT-OF-BAND EMISSIONS

Report [1], section IV.F.2.2, states:

"The analysis presented before has taken as input the appropriate modulation mask for the technology in question. It is argued by some that this is not entirely adequate since in general all the normally specified spectrum components should be included viz. spurious and out - of - band emissions (together termed unwanted emissions) and also the fast transient components. On the other hand some have argued that there is no need to include these other components, and for simplicity the analysis is based on this assumption".

2.1. LMNQ VIEW

The analysis presented in PCC.III-935/97 has taken as input the appropriate modulation mask for the technology in question. The modulation mask usually identifies emissions thought essential for the communication function. However, in reality, any regularly occurring emission will potentially impact a victim and should be included.

For some technologies, the simple modulation mask may not be entirely adequate since spurious and out - of - band emissions (together termed unwanted emissions) and also the fast transient components may be regular and of significant magnitude. For example, the DECT specification, shows that the transmitter transient emissions may be significantly higher than the normal modulation emissions with corresponding impact on victim systems and thus the basic modulation mask is not worst case as suggested by AENS below.

Extract from ETSI document ETS 300 175-2 Sections 5.5.1 & 5.5.2

Emissions on RF channel "Y"	Maximum Power Level from Transients	Maximum Power Level from Modulation
Y = M ± 1	250 µW	160 µW
Y = M ± 2	40 µW	1 µW
Y = M ± 3	4 µW	40 nW
Y = Any other DECT channel	1 µW	20 nW

The power in RF channel Y is defined by integration over a bandwidth of 1 MHz centered on the nominal centre frequency , Fy. …….

Table 2.1 Permitted DECT Transient and Modulation Power Levels

These transients can occur whenever emissions start or stop e.g., at the beginning and end of EVERY burst of timeslots. For synchronized, compatible TDMA systems, timeslot guard bands can minimize the impact, but for any other victim technology, the impact may be more severe than the impact predicted in the previous spreadsheet due to modulation. **Proposed Solution**: Any future calculation should include some allowance for ALL regular emissions.

2.2. AENS VIEW

This issue was largely discussed within the experts group meetings, and the agreed conclusion was to use only the emission mask due to modulation as the main interference mechanism.

The reason for that is not only the simplicity, but because it is the worst case of all the possible interfering mechanisms:

- Spurious emissions: though isolation values that could be obtained by using the spurious emissions specifications may be, in some cases, higher that those due to emissions due to modulation, the spurious signals will appear at a few specific frequencies, and therefore those problems could be solved by Dynamic Channel Selection in FWA TDD systems and by intracell/intercell handovers in PCS systems. In addition, spurious emissions are not wide band noise floor signals and the probability of occurrence is negligible compared to emissions due to modulation. Moreover, it should be considered that FCC rules define for PCS a limit for spurious emissions which is, at least, 13 dB and 17 dB higher than maximum allowed spurious levels defined for PHS and DECT, respectively. This fact confirms that considering spurious emissions, the results obtained by FWA TDD-PCS scenarios will be much better, compared to PCS-PCS scenarios, than the obtained ones in [1] by using only emissions due to modulation.
- Switching transients: In practice, transients are not very high, and they are very short. Their average energy is extremely low and any error correction technique (as those presented in PCS systems) are able to withstand occasional single bit errors.
- Intermodulation products: for the analysed cases, the most likely interference resulting from unwanted intermodulation effects in victim receivers is the third order product which will occur only in a partial spectrum of the PCS band. Since the probability of IM interference is low, and the interference values are not so high, these problems could be also easily solved by intracell/intercell handovers in PCS systems and by DCS mechanisms in FWA TDD systems.

As stated and agreed in report [1], section II.A.1. "Methodology", the point of view of DECT and PHS proponents is to use (as made in [1]) only the Emissions Due to Modulation as the main interference mechanisms. The rests of interference mechanisms are not relevant as explained in above.

3. ALLOWANCE FOR FADING

3.1. LMNQ VIEW

Normal planning rules for any wireless technology is based on a link budget formula such as:

$$P_{tx} = (I + N_0) * CI / (L_{mean} * L_{shadow} * L_{multipath})$$

where P_{tx} = Maximum Useable Transmit Power
I = Interference (typically from Internal System Sources)
N_0 = Thermal Noise Power
CI = minimum Carrier to Interference Ratio
L_{mean} = mean Path Loss from propagation attenuation
L_{shadow} = mean Shadow loss
$L_{multipath}$ = Multipath loss

The L_{mean} "local mean" path loss is an attenuation factor which is averaged in time and over a small area (e.g., 5-10 wavelengths ~1m @ 2GHz) to remove multipath variations. The path loss is typically a function like aR^{-k} where k is usually 2 for line-of-sight and between 2 and 6 for non-line-of-sight, and R is the transmitter-to-receiver distance and typically is used to define the maximum cell size.

L_{shadow} is typically due to static obstacles in the propagation path e.g., buildings, and the value changes slowly due to mobility of the obstacle, transmitter or receiver.

Multipath fading is caused by the self-interference of reflected signal paths and are typically rapidly varying in time (potentially <10 milliseconds between peaks) and in position. If there is no line-of-sight path, the multipath fading distribution is typically Rayleigh, so the received signal power is exponentially-distributed with a mean equal to the local mean power. If there is a line-of-sight path plus scattered paths, a Rician model is often used. With Rayleigh fading, a fade margin on the order of 10-17 dB must be incorporated into the link budget, with the exact value depending on whether diversity is use, and the desired percentile point on the distribution. For example, with no diversity, 17 dB corresponds to the 2% point, meaning that with a 17 dB margin, there is a 2% probability that fading will drive the C/I or C/N below its threshold.

NOTE THAT USING THE SAME LINK BUDGET DESIGN GIVES A "GUARANTEE" OF SUCCESSFUL INTERFERENCE DELIVERY i.e. a guarantee that the interference will be higher than calculated for 98% of the time.

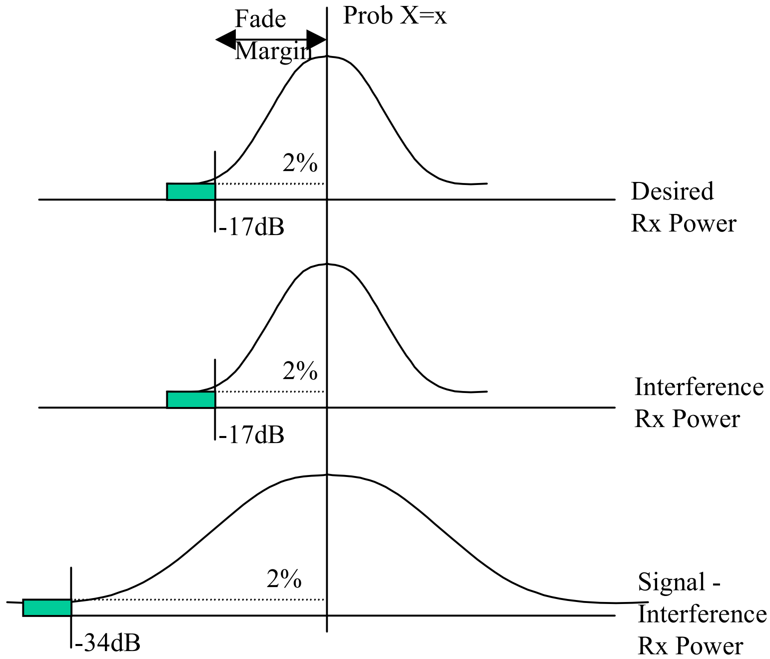


Figure 3.1 Desired and Interference Power

In general, the interfering signal will be totally independent from the desired signal but may follow a similar probability distribution. Normal statistical theory suggests that when two identical random distributions are subtracted, then the mean values can be subtracted (as done in the spreadsheet calculation), but the variances are added. Thus if a desired and interfering signal are both designed with a 17 dB fade margin (i.e., the victim provides a 2% probability of fading without interference), then a 34 dB (17 + 17) margin will be needed for 2% probability of fade OR interference of 1 dB.

Note that this interference is occurring in a millisecond time frame, thus even a 2% interference rate probably implies that the majority of radio frames transmitted will be impacted – some of them very severely.

The spreadsheet calculation should increase the required path loss by a value equivalent to the sum fade margin for both the desired and interfered signals. For the spreadsheet calculation, it is easier to remove the fading component on both signals i.e. 0 dB fade margin & thus 2 * 0 dB fade + interference margin and calculate the case for the desired de-sensitization level.

Proposed Solution: In the spreadsheet, use the "Fading is Removed" cases exclusively. The alternative is to require an increase in path loss equivalent to the sum of the two fade margins.

3.2. AENS VIEW

From the point of view of AENS, the Rayleigh fading of the desired signal (not the interfering one) should be always included in calculations. Following text, extracted from a contribution from the Alcatel representative to the Experts Group discussions, summarises the DECT/PHS proponents' view about this matter, and details why Fading margin for the useful signal should be included in calculations:

"[…] fading margin allows to system operators to use a margin above the minimum Operational RX Power in the planning to assure that most of the RXs (e.g. 99% of availability) receive a useful signal at a level which have been indicated […] as "Mean RX Power" in order to prevent the fade occurrences.

This is the actual way to design a system. Therefore we can assume that it is very likely that a RX in a system, located at any place of the system coverage, is operating over a minimum received useful signal equal to this "Mean RX Power" (i.e. including fading margin), because system deployment has been designed to met this performance.

[…] if Fading Margin is removed from our calculation we can assure that only in an small percentage (e.g. 1%) of time, the RXs can be affected by the anticipated interference level.

The interpretation of this affirmation is that, if we remove fading margin from calculation, it is practically unlikely (e.g. a very few probability of 1%) that the anticipated interference will be still harmful to a victim RX. While, if fading margin is not removed, there will be a probability of 50% (<u>at the cell edge</u>) that the anticipated interference is still harmful to a victim RX.

HOWEVER THIS INTERPRETATION IS ALSO VALID WHEN SYSTEM IS ALONE AND THERE IS ONLY INTERNAL INTERFERENCE.

Then, which approach should be applied?

I think that we have to follow the same approach than the used when system is alone and external interference does not exist.

If system is alone, when experiencing a say x dB fade of the desired signal, it is equally probable than internal interferer signal is unfaded and would be x dB higher than the anticipated level. Then system USES its mechanisms against interference (e.g. handover, dynamic channel allocation, etc.) to avoid the undesired situation.

THIS IS THE NORMAL BEHAVIOUR OF A SYSTEM. When analysing the effect of External Interference, the behaviour SHOULD BE the same. The effect of the external interference is already taken into account by increasing the margin for interference (C/I), but removing the fading margin we are ARTIFICIALLY increasing the constrains to the level of external interference. Note that this constrain IS NOT applicable to the Internal Interference when system in working alone.

There are several reasons why the fading margin is considered when system is working alone (and it is not removed from any link power budget calculation) . These reasons <u>are equally applicable</u> when an external interference appears. Some of these reasons are:

- *The majority of RXs (typically terminals) are working over the "Mean RX power" (i.e. with fading margin included). Only at cell edges, fade could cause problems in terms of C/I ratio (by definition 50% of time), but there it is very likely that a simple handover could solve the problem. Note that a normal deployment of a PCS or FWA system tries to overlap the cells in order to avoid this "bad" power budget at the cell borders.*

- *The probability of 50% is only defined and applicable for the cell edges areas and* <u>*mainly*</u> *applicable to receiver terminals (i.e. mobiles) located within this small area. Base Stations are not normally affected by this constrain (except for some very few call connections in extremely bad conditions).*

- *The 50% of RXs in this "unfavourable situation" at the cell edges is translated to a much lower percentage of RXs over the complete population of RXs within the cell coverage, and then this "bad" situation does not affect to the 50% of the total RXs, but a much fewer percentage of them. Additionally, the overlapping of cells also decrease this percentage up to a value that can be considered insignificant.*

Maybe it will exists more reasons, but, for me, it is enough with the above ones. […]

I think that we all agree that we should normally analyse the interference in a worst case basis. However, this "worst case" analysis should always contains certain intuitive possibility to be also a "enough probable case". This methodology' approach has been systematically applied for all our reasoning and this is the reason why we have included in our analysis, for example, the possibility to have TX and RX antennae on-beam or off-beam (the worst case of analysis is to consider only both TX and RX antennae "on-beam" but we agreed that is not the most likely situation). Many other assumptions has been agreed under this "enough probable case" approach.

If we remove Fading Margin from our calculation we are not respecting this "enough probable case" rule, because we are putting our analysis in a case that is more than a "worst case", it will be a "quasi-impossible case" since the probability weights will be continuously decreasing up to a completely negligible value, and then, What are the applicability of calculated required distances? […]"

4. LEVEL OF DESENSITIZATION

The report [1] assumed a 1 dB victim desensitization value – is this correct?

4.1. LMNQ VIEW

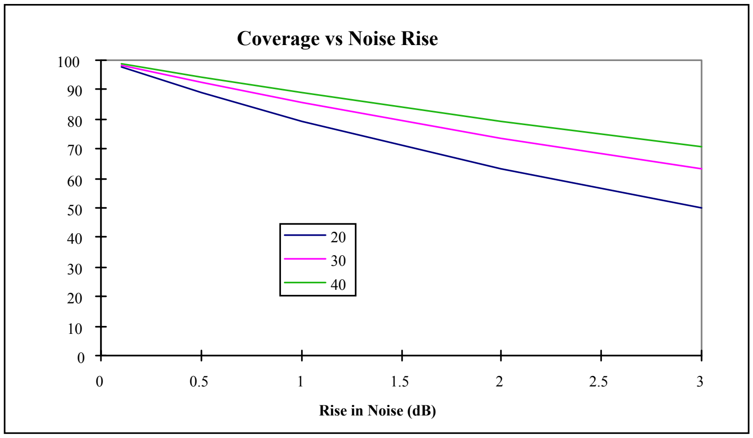


Figure 4.1 Percent Reduction in Cell Area Vs Desensitization

Received power = a - k * log(R) (dB) where a is a constant and k is the propagation constant

Desensitization D (dB) = required increase in Desired Received Power to overcome the extra

$= (a - 10 * k * \log(R_{new})) - (a - 10 * k * \log(R_{orig})) = 10 * k * \log (R_{orig}/ R_{new})$

Therefore $R_{orig}/ R_{new} = 10^{(D/10k)}$

If coverage $= \pi * R^2$

Then change in Coverage $= (\pi * R_{new}^2) / (\pi * R_{orig}^2) = (R_{new} / R_{orig})^2 = 10^{(-2*D/10k)}$

Thus, the change in coverage (%) is given in Figure 4.1 and in Table 4.1.

Desensitization (dB)	Propagation Constant		
	2	3	4
0.1	97.7	98.5	98.9
0.5	89.1	92.6	94.4
1	79.4	85.8	89.1
2	63.1	73.6	79.4
3	50.1	63.1	70.8

Table 4.1 Percent Reduction in Cell Area Vs Desensitization

While the decision of tolerable desensitization is an operator and regulator decision, it can be seen that a 1 dB desensitization causes 11-21% reduction in coverage, which is very severe.

Proposed Solution: The impact on coverage should be limited to a maximum of 10% and preferably 5%, this implies that the maximum desensitization should be 0.5 dB and the spreadsheet should be recalculated appropriately.

The results with 0.5 dB de-sensitization are shown in the Appendix:

4.2. AENS VIEW

Basically, the calculations proposed by PCS proponents are correct. However, as stated in [22], the value of *k* to be considered is only *k*=40 since the cell reduction, according to the made assumptions, is applied to the cell border where only the second "slope" of the propagation model (i.e., *propagation constant = 4*) is normally assumed.

The text also suffers from a complete "physical" meaning of this reduction since, as included in [22], it is not considered neither the combined effect with the overlapping of adjacent cells (normally much higher than the obtained cell coverage reduction) nor the indication that this coverage reduction is only applicable to the single cell where the rise in the noise floor takes place and not to the whole system.

On the other hand, the cellular planning imposes certain grade of overlapping between adjacent cells to assure the service continuity along the whole covered area.

In an ideal planning scheme, where all the cells are considered as hexagons in order to cover all the service area without any "hole", since the real coverage area is a circle, there is a minimum overlapping defined by the ratio between the areas of the hexagon and the circle:
Minimum overlapping (%) = 100 * (1 - (Hexagon area / Circle area)) = 17 %

In practice, actual deployments of cellular systems use higher overlapping areas in order to prevent from the ideal and theoretical situations which rarely occur. In fact the most typical cell overlapping factor is about **30%**, it means that 30% of EACH cell at its border is overlapped by other cells.

Then, as the external interference effect is applied to a limited number of cells or sectors, it is very likely that if one cell (i.e. one base station) or sector is affected by an external interference, its adjacent cells or sectors are not.

Thus, since the overlapping factor is always higher than any of the cell coverage reduction given in above table, the service continuity along the whole coverage area can be still assured within a range of desensitization between 0.5 and 3 dB. Obviously, for higher values of desensitization (e.g. higher than 2 dB), the situation could be more critical since the cell reduction factor is closer to the overlapping area (even higher than the minimum overlapping area of 17%).

The conclusion is that THE IMPACT OF A RISE IN THE NOISE FLOOR BETWEEN 0.5 AND 3 dB OVER THE VICTIM SYSTEM IS NOT CRITICAL, that is a reason why in report [1] a range from 0.5 to 3 dB was considered, and within this range the reference value was chosen equal to 1 dB in order to select a very pessimistic value (worst case analysis approach).

The above analysis shows that selected criteria of 0.5 to 3 dB rise in the noise floor is a relevant choice for a comparative analysis [1]. That this criteria also represents a very pessimistic worst case scenario in absolute terms for a real deployment, is further demonstrated by the analysis in [21], where as low as 100m separation between FWA base and PCS base have almost no influence on the PCS system traffic.

5. UPCS AND FWA ISSUES

5.1. LMNQ VIEW

This subsection contains two studies of the effect of co-channel interference to UPCS from FWA systems both applications were to share the use of the 1910-1930 MHz band. The first study was submitted to the PCC.III meeting in Mexico [17] and the second is a response [16] to comments received at the meeting in Mexico. These studies show that there is a significant deterioration of UPCS service cause be FWA systems and recommends that the two types of applications be allocated difference frequency bands of operation to prevent interference to UPCS systems.

5.1.1. Analysis of Cochannel Interference from DECT FWA Systems to Isochronous UPCS [17]

5.1.1.1 Introduction and abstract

PCC.III is studying the feasibility of operating fixed wireless access (FWA) systems and unlicensed personal communications systems (UPCS) in the 1910-1930 MHz band simultaneously in the same geographic area.

One important question is whether FWA and UPCS can coexist in the same band, from an interference perspective. The purpose of this contribution is to provide an analysis of the interference from FWA systems that would be experienced by UPCS systems. For simplicity, the analysis focuses on cochannel interference only, and assumes that the UPCS systems would use some form of dynamic channel assignment (DCA) to select the least-interfered channel, or at least one with an acceptably low interference level.

The purpose here is not to perform an exhaustive study of all possible combinations of FWA and UPCS configurations, but rather to understand the potential magnitude of the interference and its effect on the UPCS systems.

It is clear from the results that for geographic areas in which the demand for FWA is likely to be high (i.e., urban and high-density suburban environments), the interference can be quite high, severely impairing operation of UPCS systems. For a FWA traffic density of 300 Erlangs per square kilometer,[2] the interference power inside a building, on the least-interfered FWA frequency/timeslot, is found to be roughly −65.6 dBm, which exceeds the thermal noise floor by about 46 dB, and exceeds expected receiver noise (assuming a 10-dB noise figure) by 36 dB. With such a high interference level, UPCS system performance would be severely impaired. As a reference point, the UPCS rules in the U.S. prohibit a device from using a channel if the monitored interference is 50 dB or more about the thermal noise floor.

The effective interference on the least-interfered channel becomes larger if the lack of synchronization between UPCS and FWA, and the possibility of UPCS systems that use frames structures different from that of the FWA system, are taken into account. Moreover, the analysis does not account for adjacent-frequency interference or interference from the FWA uplink. Including these factors would increase the calculated interference.

The distribution of UPCS users within a building is considered, and it is concluded that from geometric considerations, most users will be relatively near an outside wall. Further, those at the upper levels of corporate management hierarchies, who are most likely to be provided with wireless handsets, are also most likely to have offices along external walls, with windows. For these reasons, it seems unlikely that interior path loss within a building can be relied upon to mitigate the interference problem.

It is concluded that spectrum-sharing between FWA and UPCS is generally impractical, due to the interference problems that would result. An exception might be in very low-density (i.e., rural) areas, where the traffic density of both FWA and UPCS would likely be relatively low.

[2] The 300 E/km^2 figure is from ETSI Technical Report (ETR) 310, [23] page 28.

5.1.1.2 Model and assumptions

The FWA system is assumed to serve a traffic density of ρ_{FWA} Erlangs/km^2 using a network (or multiple networks, if there are multiple operators) of elevated base stations which communicate via the DECT air interface with fixed terminals. These fixed terminals are also elevated (e.g., rooftop- or poletop-mounted) and oriented to provide a line-of-sight path to a base station. The UPCS systems are assumed to be deployed indoors, primarily in office buildings.

5.1.1.2.1 Propagation Model

The propagation model used here is the "two-slope" model adopted by the PCC.III Interference Experts Group [19], which is:

$$L(r) = \begin{cases} \left(\dfrac{4\pi r}{\lambda}\right)^2 & r \le r_b \\ \left(\dfrac{4\pi r^2}{\lambda r_b}\right)^2 & r \ge r_b \end{cases} \qquad \text{with} \quad r_b = \frac{4h_t h_r}{\lambda} \tag{5.1}$$

where r is the distance between transmitter and receiver, λ is the wavelength (0.156m for a 1920 MHz carrier), and h_t and h_r are the respective elevations of the transmit and receive antennas. The attenuation into the building which houses the UPCS system is assumed to be 15 dB.[3]

5.1.1.2.2 Power Output, Antenna Elevation, and Gain

From [19], the RF power output of the DECT FWA transmitter is assumed to be 24 dBm, and the antenna gain is assumed to be 12 dB with a 120° azimuthal beamwidth for a "macro" FWA base station, and 10 dB with an omnidirectional (in azimuth) antenna for a "micro" FWA base. The elevations for the macro and micro bases are assumed to range from 20-80 meters and 20-40m respectively, with respective reference levels of 40m and 20m.

5.1.1.2.3 Average Number of FWA Transmissions per Channel

Consider a UPCS receiver centered on a circle of radius d. The average active number of FWA transmissions within that circle is $\pi\left(d^2 - r_{\min}^2\right)\rho_{FWA}$, where $r_{\min}$ is the minimum possible distance between the FWA transmitter and the UPCS receiver. If there are N FWA channels (frequency/timeslot combinations), then the average number of transmissions within the circle per channel is

$$K = \frac{\pi\left(d^2 - r_{\min}^2\right)\rho_{FWA}}{N}. \tag{5.2}$$

For purposes of computing interference, K must be adjusted to account for antenna directivity and orientation, as well as the fact that a UPCS receiver near one side of the building will tend to be more sensitive to transmissions originating on that side. Thus, $K_{eff} = \chi K$ is the effective

[3] The 15dB figure for external wall attenuation is taken from ETR 310 [23] page 32.

value of K for interference calculations, where the factor χ accounts for the fact that the UPCS receiver may not "see" FWA transmissions originating from some directions, or from some antenna orientations. Clearly, $\chi \le 1$.

5.1.1.2.4 Interference Model

The actual number of transmissions within the circle on a given channel at a given time is of course random, and can be modeled as a Poisson-distributed random variable with a mean value of K_{eff}, in which case the probability that there are J transmissions on a given frequency/timeslot is:

$$P(J) = e^{-K_{eff}} \frac{K_{eff}^J}{J!}. \tag{5.3}$$

If the distribution of transmitters over the area within the circle is uniform, then the probability density function (pdf) of the distance r_j between the jth FWA transmitter and the UPCS receiver is:

$$f_{r_j}(r) = \frac{2r}{d^2 - r_{\min}^2}. \qquad r_{\min} \le r \le d \tag{5.4}$$

The power into the UPCS receiver, in dBm, is:

$$I_{j,\text{dBm}} = P_t + G_t + G_r - 10\log L(r_j) - 15\,\text{dB} \tag{5.5}$$

where P_t is the RF power output of the FWA transmitter, G_t is the power gain of the FWA antenna, and G_r is the power gain of the UPCS antenna. The 15 dB additional loss accounts for attenuation into the building.

The total interference power from FWA transmissions into the UPCS receiver on a given FWA channel is:

$$I = \sum_{j=1}^{J} I_j \ \text{(mW)}. \tag{5.6}$$

Clearly, the aggregate interference power I must be modeled as a random variable, since it is the sum of interference contributions from a random number of randomly-positioned transmitters. Therefore, to understand the impact of the FWA interference on the UPCS receiver, it is necessary to determine the cumulative distribution function (CDF) of I, which is denoted by:

$$F_I(x) = \Pr\{I < x\}. \tag{5.7}$$

Assuming that there are N channels (for DECT, N = 120), and the received interference power levels on different channels are statistically independent, the CDF of the interference power $I_{\min}$ on the least-interference channel is:

$$F_{I_{\min}}(x) = \Pr\{I_{\min} < x\} = 1 - [1 - F_I(x)]^N. \tag{5.8}$$

That is, $I_{\min} < x$ if and only if $I_n < x$ for all n, where I_n is the total power from the FWA transmissions at the UPCS receiver, on the nth FWA channel. Not surprisingly, the CDF for $I_{\min}$

depends on the lower tail of the CDF of I (i.e., the value of the distribution at low interference levels). Hence, for analysis of systems using DCA, it is the lower tail of the interference CDF that is important.

5.1.1.3 Computing the CDF of the interference

5.1.1.3.1 Monte Carlo Procedure

It is a simple matter to find the CDF of I using the Monte Carlo technique, whereby a large number of computer-generated samples is used to infer the distribution. In this case the procedure is:

1. Input the desired parameter values (d, $r_{\min}$, r_b, ρ_{FWA}, etc.) and the number of samples desired. The more samples, the more accurate the distribution at the upper and lower tails.
2. Calculate K_{eff}.
3. For each sample generate a Poisson-distributed random number J with a mean of K_{eff}.
4. For each of the J interfering transmitters, generate random number representing its distance from the UPCS receiver. If u is a random number which is uniformly-distributed between 0 and 1, the transformation $r = \sqrt{u\left(d^2 - r_{\min}^2\right) + r_{\min}^2}$ will yield a random number between $r_{\min}$ and d which is distributed according to (5.4).
5. Using (5.1) and (5.5), compute the power received from each of the J transmitters (in mW) and sum them. The result is a single sample of the total interference received from the FWA transmissions, on an arbitrary FWA frequency/timeslot.
6. Increment the each distribution bin which corresponds to values greater than the computed sample.
7. Repeat steps 2-6 for a total of at least 10 000 samples and divide the final count in each distribution bin by the total number of samples. The result is the fraction of the samples that were less than the interference level corresponding to that bin, which is the desired distribution.

5.1.1.3.2 Input Parameters

Using the Monte Carlo approach, the CDF of I was found, for the following parameters:

- $\rho_{FWA} = 300$ Erlangs/km^2. This traffic density is taken from subsection 6.4.2 of ETSI Technical Report (ETR) 310, which discusses coexistence of various potential DECT applications, including FWA, known as radio local loop (RLL) in ETSI terminology [23].
- FWA downlink transmissions originate from a network of micro base stations with 20m elevation, $G_t = 10$ dBi antenna gain, and omni-directional coverage in azimuth.
- The elevation of the UPCS receiver is 10m and its antenna gain is $G_r = 3$ dBi.
- The radius of interference is d = 5 km. Since this is less than r_b for $h_t = 20$ m and $h_r = 10$ m, propagation from all transmitters was taken as free-space. Since contributions from

transmitters outside the 5-km radius are ignored, the results will somewhat understate the interference at the lower tail of the distribution.

- Since a UPCS transmitter near one side of the building will "see" the FWA transmitters over only about 180° rather than the full 360°, the adjustment factor for K was taken as $\chi = 0.5$.[4]
- Distributions for both $r_{\min} = 10\,\text{m}$ and $r_{\min} = 100\,\text{m}$ were computed to verify the insensitivity of the lower tail to $r_{\min}$.
- For purposes of computing the CDF of $I_{\min}$, it was assumed that $N = 120$ channels.
- Only downlink cochannel interference was considered. Interference from the fixed terminals was ignored, as was adjacent-channel interference.

5.1.1.3.3 Discussion of Results

Figure 5.1 shows the CDFs of I and $I_{\min}$, from the Monte Carlo computations with 100 000 samples. Note the lack of sensitivity of the lower part of the distribution to $r_{\min}$. This is simply because nearby interferers correspond to high receiver interference levels, and hence to the upper portion of the distribution. Note also that the distribution of $I_{\min}$ derives from the lower tail of the distribution of I. For example, the 99th percentile of the CDF of $I_{\min}$ corresponds to the same value of the abscissa x as the 3.76% point on the distribution of I, since $1-(1-0.99)^{1/120} = 0.0376$. Therefore, $r_{\min}$ is unimportant (within limits) in determining the interference power on the least-interfered channel. Stated another way, coexistence of FWA and UPCS systems using DCA cannot be assessed on the basis of the minimum separation, except for extreme cases in which front-end overload might result.

On the probability scale used for the ordinate in Fig. 5.1, a Gaussian distribution would appear as a straight line, so the distribution of $I_{\min}$ (in dB) is nearly Gaussian, which allows its mean and standard deviation to be estimated directly from the plot. The median is about $-65.6\,\text{dBm}$. The standard deviation appears to be roughly 0.5 dB, so $I_{\min}$ can effectively be regarded as a constant with a value of $-65.6\,\text{dBm}$.

[4] Locations near the corners of the building will see interference over more than 180°.

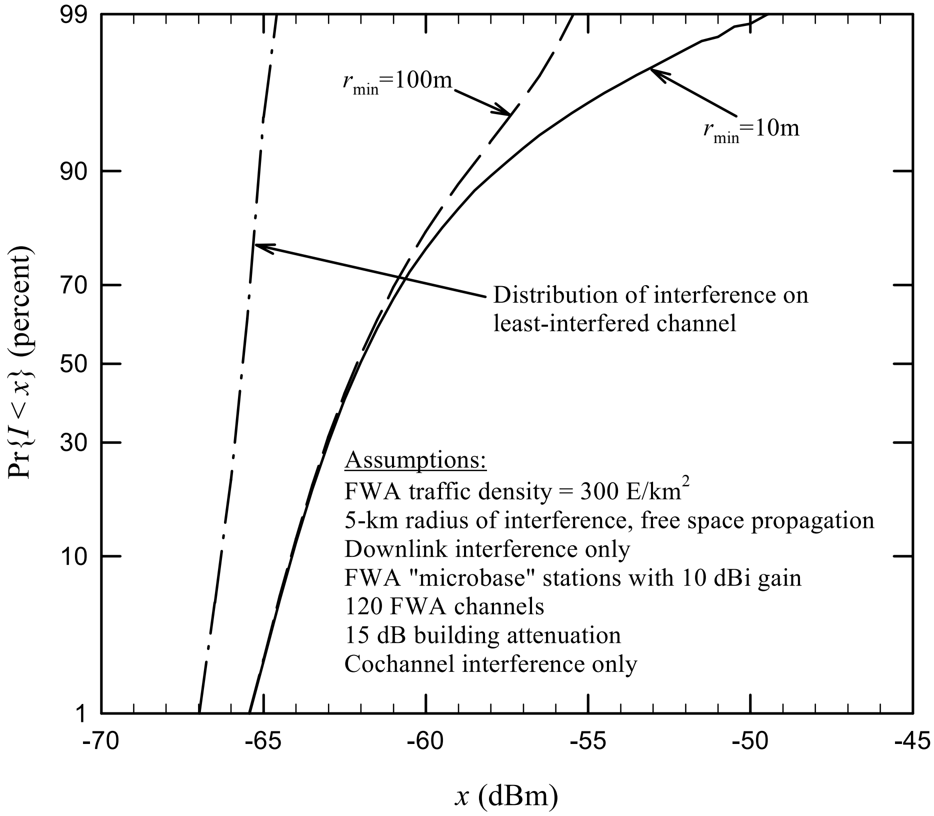


Figure 5.1: *CDF of interference power from DECT FWA to UPCS on an arbitrary frequency/timeslot, and on the least interfered frequency/timeslot computed using Monte Carlo with 100 000 samples.*

5.1.1.4 Impact on UPCS

The interference distribution shown in Fig. 5.1 represents the interference on a DECT FWA channel (frequency/timeslot). Since the various UPCS air interfaces use different channel plans and will in general not be frame-synchronized to the FWA transmissions, adjustments must be made. Also, the effect of additional path loss inside the building must be considered. This section deals with those issues.

5.1.1.4.1 Noise Floor Increase

As a starting point, consider frequency-domain channelization. For a UPCS carrier that overlaps only a single DECT carrier, the interference can be represented as an increase in the noise floor. Approximating the DECT emission spectrum as square with a bandwidth of 1.7 MHz, the power spectral density on the least interfered channel is −65.6 dBm $-10\log 1.7\times10^6$ = −128 dBm/Hz. Without interference, and allowing for a 10-dB receiver noise figure, the receiver noise floor is −164 dBm/Hz. Hence, the FWA interference has effectively raised the noise floor on the least-interfered channel by 36 dB. It is also noteworthy that it has raised the noise floor 46 dB above thermal noise (−174 dBm/Hz). This is perilously close to the "upper threshold" for UPCS devices (Subpart D of FCC Part 15), which is 50 dB above thermal noise. A UPCS device is not allowed to use a channel on which the monitored signal level is 50 dB or more above thermal noise (*kT*, where *k* is Boltzman's constant, 1.38×10^{-23} watts/Hz/°*K* and *T* is the reference temperature, often taken as 290°*K*.

5.1.1.4.2 Effect of Interior Building Loss

For UPCS systems sufficiently far away from the exterior walls of the building, the interference from the FWA transmissions will tend to be reduced somewhat, but the degree of the attenuation will be highly dependent on the interior construction of the building. Many modern office buildings use an interior "landscape" arrangement consisting largely of soft partitions which often do not extend fully to the ceiling. In such cases, RF attenuation within the building will be relatively small, as represented by the propagation model provided in [23] (page 45) for office environments with "semi-high soft partitions, but without interior walls":

$$L = 41 + 20\log s + \Gamma \times \max[0, (s-10)] \text{ dB}, \tag{5.9}$$

where Γ is 0.37 dB/m or 0.59 dB/m depending on the density of the partition. This model could be applied to the current problem, with *s* representing the distance inside the building from the nearest exterior wall. As can be seen, it is basically a free-space model with additional loss/meter (after the first 10m) added to represent the effect of the partitions.

A relevant question of how the distance from the nearest exterior wall is distributed. If the building is assumed to be a square *D* meters on a side, it is easily shown (see 5.1.1.6 Annex) that if UPCS receivers are uniformly-distributed over area, the CDF for the distance *s* from a UPCS receiver to the nearest exterior wall is:

$$F_s(x) = \Pr\{s < x\} = 4\left(\frac{x}{D} - \frac{x^2}{D^2}\right), \quad 0 \le x \le \frac{D}{2} \tag{5.10}$$

and the mean value is

$$\bar{s} = \frac{D}{6} \ . \tag{5.11}$$

The table below shows the CDF of *s* for a few points on the distribution.

x/D	Pr{*s*<*x*}
0.1	36%
0.15	51%
0.2	64%
0.3	84%
0.4	96%

As an example, consider the 100m × 100m reference building used in the coexistence analyses of ETR 310 [23]. With *D* = 100m, the average distance to the nearest exterior wall is about 16m, and half of the UPCS receivers will be within 15m of the nearest exterior wall. For these, the additional loss due to propagation inside the building using (5.9) will be less than 1.9 dB, or less than 3 dB, depending on which value is used for Γ.

Obviously, the specific numbers for additional loss will be different if other in-building propagation models are used, but the distribution of the distance to the nearest exterior wall will be unaffected, and it is clear than a significant fraction of the building's occupants will tend to be fairly near an exterior wall, which minimizes the effect of loss due to interior building obstructions. The main point is that path loss inside a building cannot be assumed to significantly reduce the effect of interference from the FWA transmissions. Moreover, UPCS in office buildings will tend to be used by those employees at the upper strata of the management hierarchy, who will also tend to have offices with windows; i.e., along the exterior of the building. Hence, for both geometric and demographic reasons, UPCS usage will tend to be the greatest toward the outer walls of the building, where the interference is the highest.

5.1.1.4.3 Synchronization and Frame Structure Issues

In calculating the distributions shown in Fig. 5.1, only downlink interference was taken into account, and it was assumed that all FWA transmissions were frame-synchronized. However, the UPCS systems will in general not be synchronized with the FWA systems. Even if a UPCS carrier overlaps only a single DECT FWA carrier and has the same frame structure as DECT, the UPCS timeslot will in general receive interference from first one FWA slot, then another. The effect of the interference on the UPCS communication link will be determined by the maximum of the interference on the two overlapping slots. This maximum will have a CDF given by:

$$F_{I_{max}}(x) = \Pr\left\{\max\left(I_1, I_2\right) < x\right\} = \Pr\left\{I_1 < x\right\} \times \Pr\left\{I_2 < x\right\} = F_I^2(x) \tag{5.12}$$

The CDF of the least-interfered channel is then found from (5.8), but substituting $F_I^2(x)$ for $F_I(x)$. As shown in Fig. 5.2, the net result is to increase the effective interference on the least-interfered channel by a little more than 1 dB. The implicit assumption is that the victim UPCS receiver has a 10-msec frame, as does the DECT FWA system.

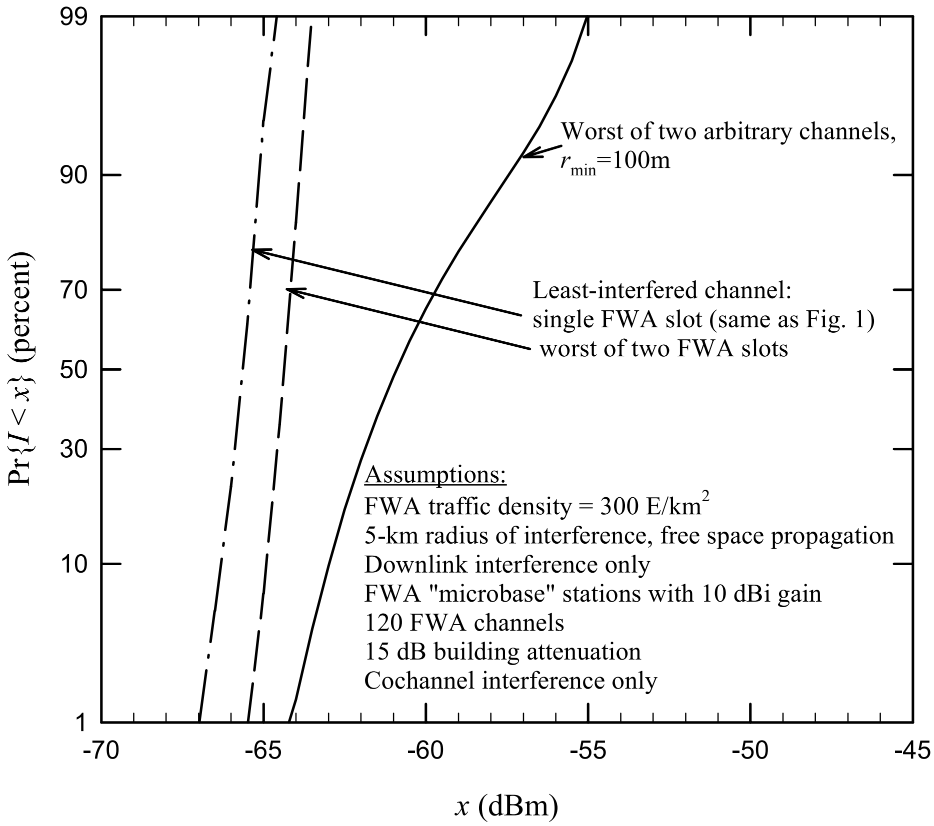


Figure 5.2: *Effective cochannel interference to a UPCS system that has the same frame structure as the FWA system, but is not synchronized with it.*

For a UPCS system with a frame structure different than that of the FWA system, the problem is aggravated. For example, a PACS-UB system has a 2.5 msec frame, so two uplink and two downlink transmissions occur during the 5-msec FWA downlink. Therefore, a given PACS-UB slot pair can receive interference from up to eight FWA downlink slots, and the effective interference on the PACS-UB channel will be the worst of these (i.e., highest interference). Figure 5.3 illustrates the concept, and Figure 4 shows the corresponding effect on the interference distribution.

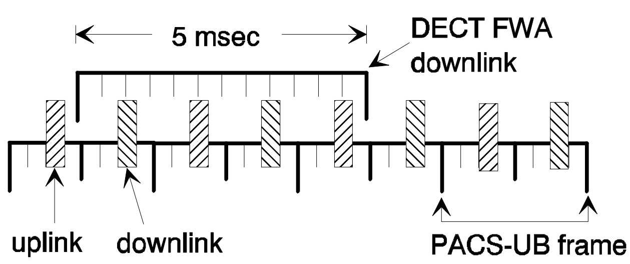


Figure 5.3: *Illustrative example of slot coincidence for DECT and PACS-UB*

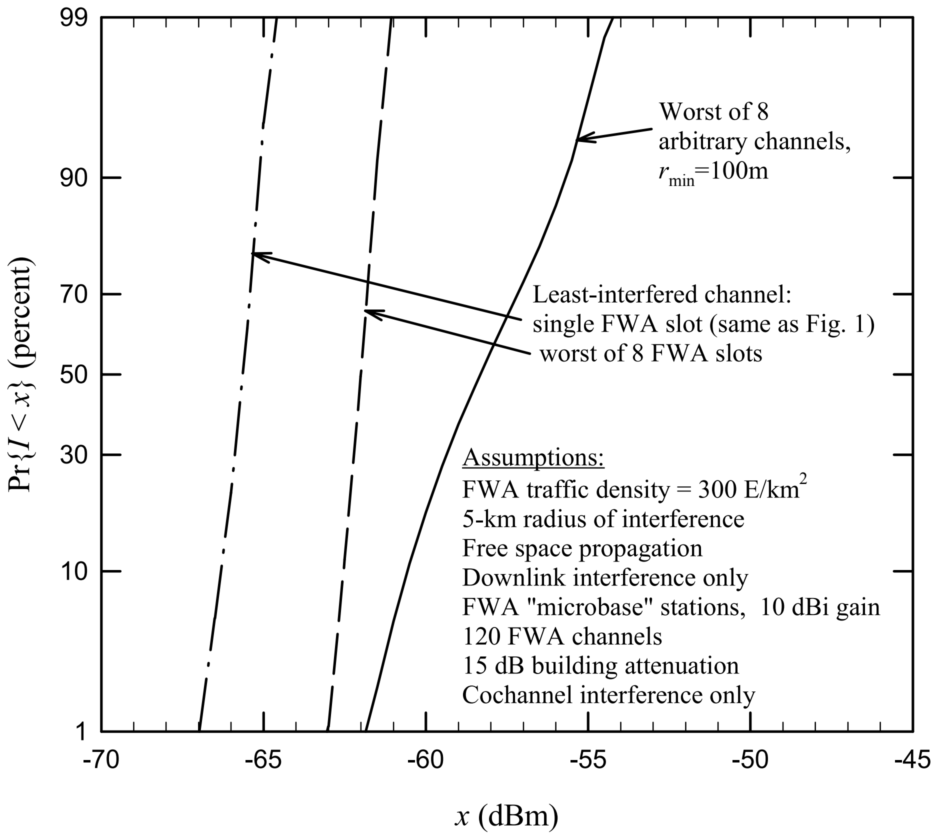


Figure 5.4: *Effective cochannel interference to a UPCS channel pair which overlaps eight DECT FWA slots.*

As can be seen, the effective increase in the interference on the least-interfered channel is about 3.5 dB compared to the base case in Fig. 5.1.

5.1.1.5 Conclusion

It is clear from the analysis provided here that if FWA and UPCS share spectrum, the interference from the FWA transmissions to the UPCS systems will be so great as to severely impair the operation of UPCS systems. It has been assumed that UPCS systems use some form of dynamic channel assignment, and can select the least-interfered channel. In that case, it is the lower tail of the cumulative distribution function that is of interest, and the distances to nearby interference sources are irrelevant, since the channels used by those sources will not be selected.

It has been found that with a FWA traffic density of 300 Erlangs/km^2, the received power on the least-interfered FWA frequency-timeslot is about −65.6dBm over the DECT carrier bandwidth. That is, at the UPCS receiver, the interference on all FWA frequencies and timeslots will be at least this high. While the actual power level received by a given UPCS system will depend on its bandwidth in relation to the DECT transmission bandwidth, the increase in the noise floor due to the FWA transmission is about 46 dB, or about 36 dB above receiver noise (assuming a 10-dB noise figure). This is nearly high enough to prohibit a UPCS device from accessing the channel, as specified by Part 15 of the FCC Rules, Subpart D, which governs the operation of UPCS devices in the U.S.

The effective interference may be several dB higher than this, if the UPCS device has a frame structure different than DECT, and/or if it is not synchronized to the FWA frame, as would likely be the case. Moreover, the analysis described here did not account for adjacent-channel interference or interference from the FWA uplink. Including these factors would increase the calculated interference.

Interior RF path loss inside the buildings which house the UPCS systems is not expected to mitigate the interference problem significantly. As has been shown here, from simple geometry, the majority of a building's area is relatively near an exterior wall. Moreover, those in the management hierarchy of a company who are likely to be provided wireless telephones are also likely to have offices with windows. Finally, many modern offices use an open "landscape" interior design that uses soft partitions rather than floor-to-ceiling walls. In such environments, the radio signal is attenuated relatively little with distance.

Overall, the potential for interference from FWA to UPCS will make spectrum sharing impractical, except perhaps in rural, low-density areas, where the traffic demand per km^2 will be light for both FWA and UPCS.

5.1.1.6 Annex: CDF of the distance from a point inside a building to nearest outside wall

Consider a square building *D* meters on a side as shown in Fig. 5-5. If the building area is divided into four equal triangles as shown, then any point in the building will be inside the triangle whose base is the outside wall nearest to the point.

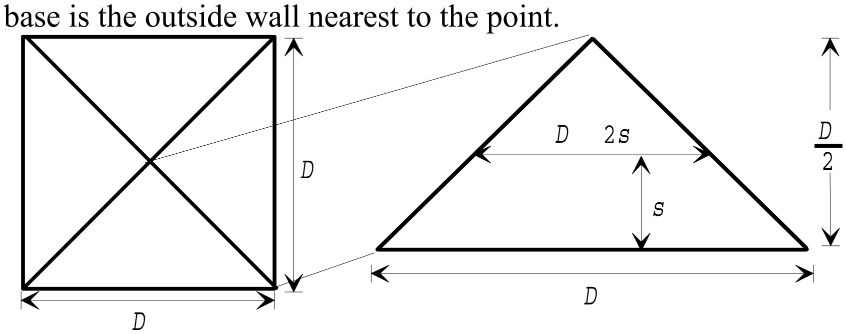


Figure 5-5: *Assumed building geometry*

If the probability that a randomly located point is within some incremental area *dA* is proportional to *dA* (i.e., the spatial distribution is uniform), then the probability that a point is within some incremental distance *ds* of the nearest outside wall is $k \cdot ds \cdot (D-2s)$,
where *k* is a constant to be determined. Therefore, the pdf of *s* is $f_s(\alpha) = k(D-2\alpha)$.

Since $0 \le s \le D/2$ and total probability must sum to 1, $k\int_0^{D/2}(D-2\alpha)d\alpha = 1$, so $k = 4/D^2$ and

$$f_s(\alpha) = \frac{4}{D} - \frac{8\alpha}{D^2}. \tag{5-13}$$

The average value of s is

$$\bar{s} = \int_0^{D/2} \alpha f_s(\alpha) d\alpha = \frac{D}{2} - \frac{D}{3} = \frac{D}{6} \qquad (5\text{-}14)$$

and the CDF is

$$F_s(x) = \Pr\{s < x\} = \int_0^x f_s(\alpha) d\alpha = 4\left[\frac{x}{D} - \frac{x^2}{D^2}\right], \quad 0 \le x \le \frac{D}{2}. \qquad (5\text{-}15)$$

5.1.2. Response [16] to Comments on PCC.III-919/97 [17]

5.1.2.1 Summary of the PCC.III Interference Experts Group

The PCC.III Interference Experts Group was committed to releasing a report on issues of incompatibility between FWA and PCS interference at the September meeting of PCC.III in Mexico City. Throughout its work program, most of the Group's efforts focused on the problem of adjacent-channel interference between Licensed PCS and FWA. As a result, there was insufficient time before the report deadline to include material on cochannel interference between FWA and UPCS in the report, which refers the reader to the two contributions (one from Lucent [17] (reproduced in section 5.1.1) and one from Ericsson[18]) that were submitted on the FWA/UPCS issue. These will henceforth be referred to as the "Lucent contribution" and the "Ericsson contribution." Both contributions were provided with the Report to members of the PCC.III Plenary.

It is noteworthy that in assessing the adjacent-channel interference between FWA and Licensed PCS, the Experts Group used a 1-dB rise in the noise floor as the interference criterion, and computed the separation distances required to prevent the interference from exceeding that level. It is also noteworthy that during the course of its work, the Group developed a table of system parameters, and also adopted a propagation model. These are documented in the Group's meeting report from the Brasilia meeting (June, 1997).

Both the Ericsson and Lucent contributions were presented orally as well as in written form to the Experts Group in Mexico City. There was significant discussion and debate, although agreement could not be reached between the "DECT Proponents" and the other participants. In the next section of this paper the main points of debate will be summarized and addressed.

5.1.2.2 Summary of the Contributions

The Lucent and Ericsson contributions take fundamentally different approaches to evaluating the interference from Fixed Wireless Access systems to UPCS. Those approaches can be summarized as follows:

- The Ericsson contribution considers the effect of a single FWA base site on a nearby office building, and subtracts the channel usage (in Erlangs) of the FWA site from the total available. The contribution claims that the remaining capacity is available to UPCS systems, so that coexistence is not a problem.
- The Lucent contribution considers the aggregate interference from multiple FWA sites and computes the probability distribution of the interference power per channel, and also for the least-interfered channel. This calculation yields the effective increase in the noise floor as seen by the UPCS system.

Comments were made on both contributions by members of the Experts Group.

Comments on the Lucent contribution included:

- A macrobase (sectored) FWA base model should be used, rather than microbases.
- The assumed FWA Erlang density was too high.
- The UPCS system can accommodate the FWA interference by making the UPCS cells smaller.

Comments on the Ericsson contribution included:

- The analysis was over-simplified and misleading.
- The interference from the nearby FWA site is irrelevant, since those channels would never be selected by the UPCS system.
- It ignores the noise floor increase on "available" channels used by further-away FWA sites.

5.1.2.3 Comments on the Lucent Contribution Addressed

5.1.2.3.1 FWA Macrobase Model

The model used in the Lucent contribution can easily be applied to an FWA "macrobase" scenario. The FWA base station uses six overlapping sectors, each with a beamwidth of roughly 90°, providing some degree of redundancy. Each sector corresponds to a single radio (12 timeslots, for DECT). With this configuration, a given face of an office building would "see" one out of every six transmissions, on average.

Figure 5.6 shows the probability distribution of the interference on an arbitrary channel (frequency/timeslot), and on the least-interfered channel.

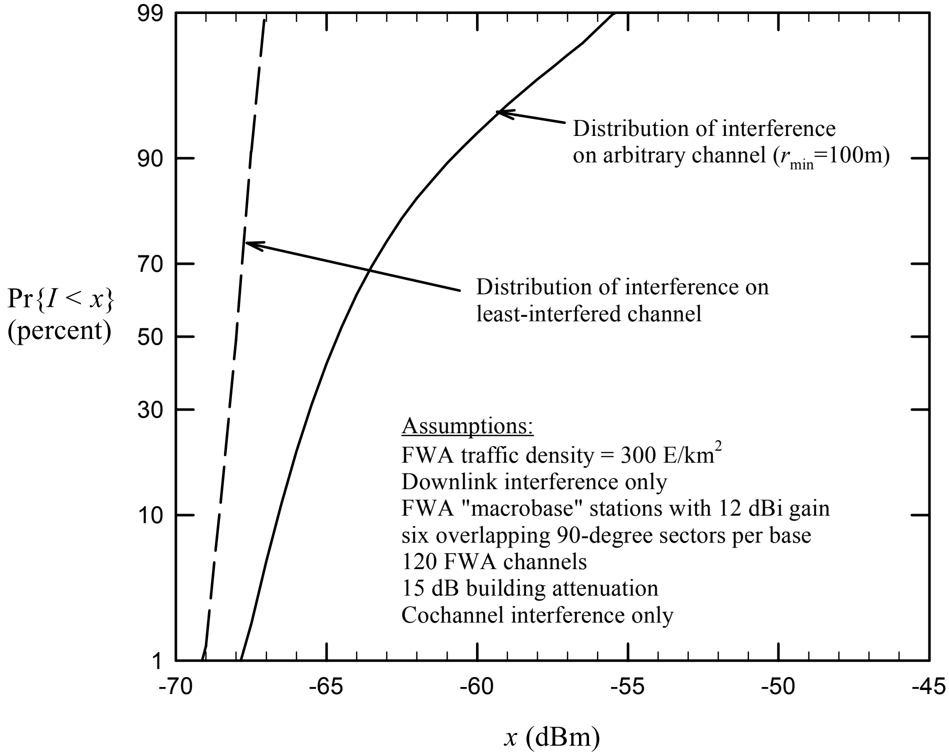


Figure 5.6: *Cumulative probability distribution of the interference power from 6-sector "macro" FWA base site to an in-building UPCS receiver.*

The curves in Fig. 5.6 were computed using the approach discussed in the Lucent contribution. As can be seen, the median interference on the least-interfered channel is about −68 dBm.

5.1.2.3.2 Verification of Results

Critics of the Lucent contribution suggested that the analysis was too complicated. This section offers a simple calculation that can be used to check the Monte Carlo results for plausibility.

Assume that the FWA network is arranged as a grid of hexagonal cells, with each cell site serving a capacity of 40 Erlangs (per ETR 310 [23], p. 52). With a total capacity of 300 E/km^2, the area covered by a single site is 0.133 km^2. A hexagon with this area has a radius (to vertices) of 226m.

Since there are 120 channels, the reuse factor is 40/120=1/3 (i.e., on average, a given channel is use in every third base site). Note that this does not imply any fixed frequency assignments; the FWA system is assumed to use some form of dynamic channel selection. The reuse factor simply follows from the stated site capacity.

With hexagonal geometry, if r is the cell radius and d is distance to the center of the nearest cochannel cell, $d/r = \sqrt{3/F_R}$, where F_R is the reuse factor. If $F_R = 1/3$, then $d = 3r =$ 678 meters. This means that the weakest received power levels among the 120 channels (frequency/timeslots) will tend to emanate from antennas $2r$ to $3r$ (452 to 678m) away. The corresponding path losses are 91.1 dB and 94.6 dB. With 24 dBm transmit power and 12 dBi transmit antenna gain, 3 dBi receive antenna gain (UPCS), and 15 dB building penetration loss, the received power levels are −67.1 dBm and −70.6 dBm. Thus, the Monte Carlo results and the rough "hexagonal geometry" calculations agree closely.

5.1.2.3.3 Lack of Synchronization between FWA and UPCS

As discussed in the Lucent contribution, the UPCS system will generally not be frame-synchronized with the FWA system, so a given UPCS timeslot will often suffer interference from two different FWA slots (first one, then the other), and it is the worst of the two that will determine the effect of the interference on the performance of the UPCS system. Fig. 5.7 shows the effect of unsynchronized operation on the interference probability distribution. The lack of synchronization is seen to increase the median interference on the least-interfered channel by about 1dB.

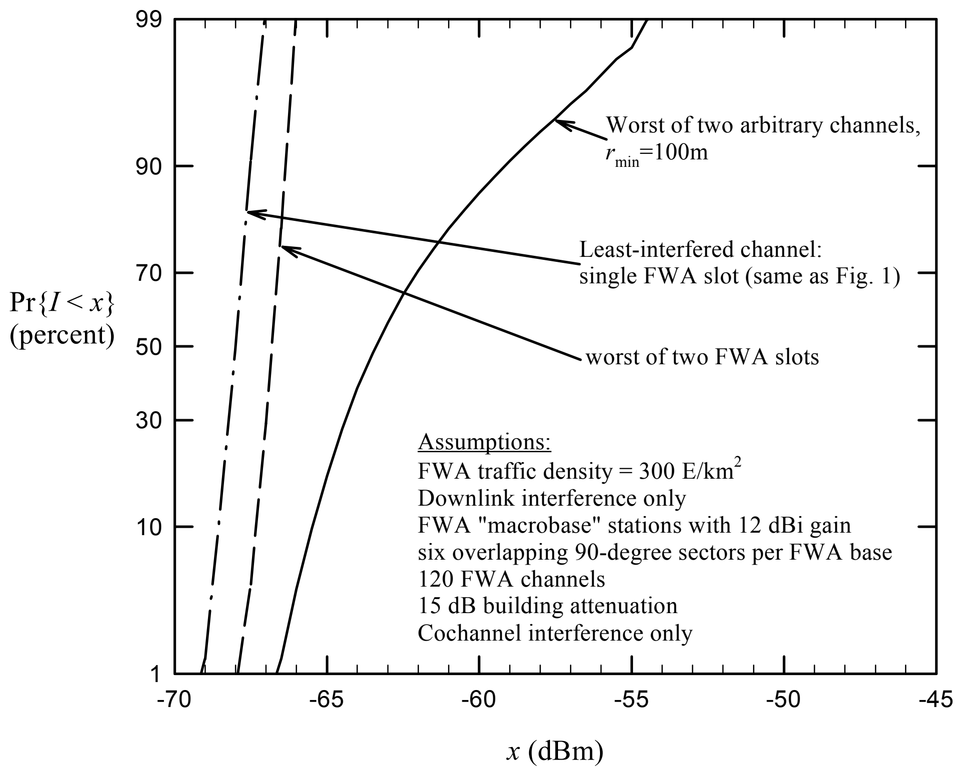


Figure 5.7: *Effective interference from FWA downlinks to an unsynchronized UPCS receiver*

5.1.2.3.4 Interference vs. FWA Traffic Density

ETR 310 [23] (pp. 27-28), discusses FWA traffic densities for various situations. The following passage from that report discusses FWA traffic densities for urban areas:

> **"We may conclude that a traffic capacity of 100 - 150 E/km^2 is required to support speech RLL [Radio Local Loop] services.**
>
> **"These traffic densities are estimated to be doubled within a few years to 200 - 300 E/km^2 due to emerging increase of data services.**

"In developing countries may be up to 30% of the metropolitan traffic (mainly speech) will need to be served by RLL. This corresponds to 300 E/km^2."

For rural areas, the report projects FWA traffic densities of 0.35-3.5 E/km^2.

Fig. 5.8 shows the median interference (as an increase in the noise floor) on the least-interfered channel vs. FWA traffic load. The FWA sites were assumed to be "macrobases" as discussed above, with an elevation of 40 meters. The UPCS victim receiver was assumed to be elevated 10 meters, and the attenuation through the building exterior was assumed to be 15 dB. The propagation model adopted by the PCC.III Interference Experts Group was used.

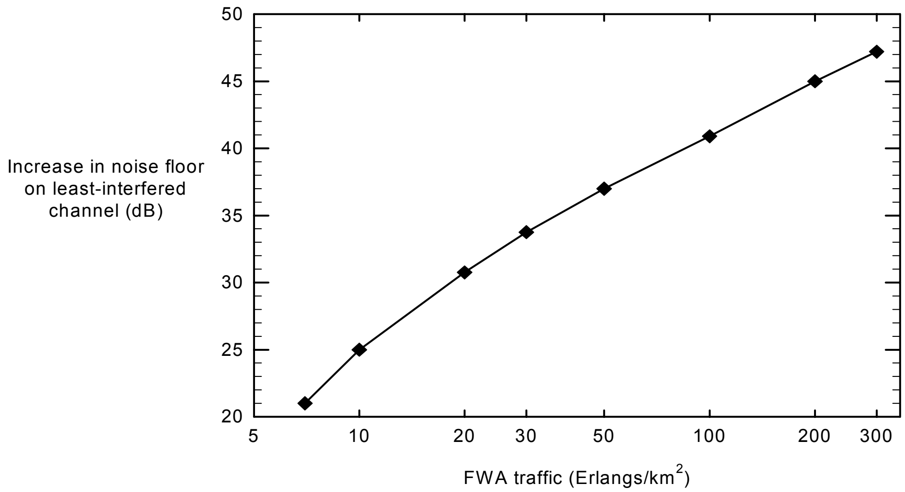


Figure 5.8: *FWA-to-UPCS interference (vs. FWA traffic density).*

5.1.2.3.5 Effect of the Interference on UPCS

In light of the 1-dB noise floor increase criterion adopted by the Experts Group to calculate separation distances between FWA and Licensed PCS, the increases shown in Fig. 5.8 are enormous for FWA traffic densities expected in urban areas. However, one participant in the Experts Group noted that UPCS systems could withstand such interference levels by simply making the cells sufficiently small.

To test this claim, the effect of FWA interference on a Personal Wireless Telecommunications (PWT) system was investigated. For indoor propagation between the PWT base and handset, the "Ericsson" indoor propagation model was used (see ETR 310 [23], p. 43). The results are shown in Fig. 5.9; calculation details are in the Annex.

As can be seen, the impact on PWT cell coverage area for FWA traffic densities of 10 E/km^2 is significant, and for more than 20 E/km^2 the reduction in cell coverage is quite severe. Clearly, it seems impractical to operate a UPCS system in the presence of interference from FWA systems carrying the load levels expected in urban areas.

However, in rural areas, there would be little or no effect on the UPCS cell coverage area (with no interference the coverage area is roughly 24,000 square feet). This suggests that one spectrum-sharing possibility would be to allow FWA systems to operate in the 1910-1930 MHz band in rural areas only.

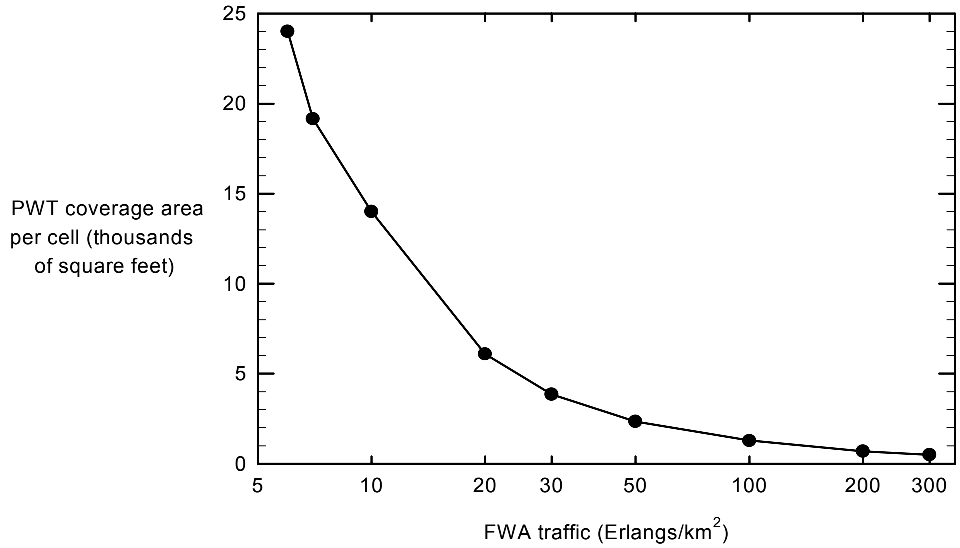


Figure 5.9: *PWT coverage are per cell vs. FWA traffic density*

5.1.2.4 Conclusions and Recommendations

This paper has extended the analysis provided in the Lucent contribution to the Mexico City PCC.III meeting in September 1997, and has addressed the comments on that contribution offered by the members of the Interference Experts Group. It is clear from the results presented here that unless the FWA traffic density is low (less than 10 E/km^2), the impact of the FWA interference on a UPCS system will be significant. Therefore, UPCS systems will be able to coexist with FWA systems only in low-density environments, such as rural areas, without a severe reduction in cell coverage area.

This conclusion suggests that to ensure successful operation of UPCS systems, FWA systems should not be allowed to operate within 1910-1930 MHz except in low-density (rural) areas. For urban areas, one of the other bands identified by CITEL should be used for FWA systems.

5.1.2.5 Annex: UPCS coverage calculations

The PWT system is assumed to require a carrier-to-noise ratio of 13 dB plus 12 dB multipath fade margin, for a total local mean C/N of 25 dB. The thermal noise floor (not including the receiver noise figure) is assumed to be −115 dBm. If N_{FWA} is the increase in the noise floor in dB due to the FWA system (shown in Fig. 5.8), then the noise floor, in dBm, seen by the PWT system is $N = -115 + N_{FWA}$.

The propagation model used here to calculate the path loss between the PWT base and handset indoors is the “Ericsson” model (see ETR 310 [23], p. 43), given by:

$L(d) = 38 + 30\log d \qquad d < 20$ m

$L(d) = -1 + 60\log d \qquad 20 \text{ m} \le d < 40$ m

$L(d) = -97 + 120\log d \qquad d \ge 40$ m

where d is the distance in meters between the PWT base and handset and $L(d)$ is the median path loss is dB. For this model, shadow fading is assumed to be lognormal with $\sigma = 8\,\text{dB}$. For 90th percentile coverage, a shadow fade margin of $1.29\sigma \cong 10$ dB must be included in the link budget. The maximum median path loss therefore is:

$$L_{\max} = P_{TX} + G_{base} + G_{handset} - (-115 + N_{FWA} + 25) - 10,$$

where P_{TX} is the PWT transmit power (assumed 19.6 dBm), G_{base} is the PWT base antenna gain (assumed 3 dBi), and $G_{handset}$ is the PWT handset antenna gain (assumed 0 dBi). The effective cell radius is then computed from the Ericsson path loss formula above.

5.2. AENS VIEW

The above LMNQ text, submitted in the X meeting of PCC.III in Natal, is a re-edition of document PCC.III/919/97 [17] which was already submitted in the IX meeting of PCC.III in Mexico, and it contains exactly the same information.

Even when in Mexico, the experts group already discussed partly the document [17], and some useful comments were provided to Lucent about this report, none of those comments have been included in this new edition and then, the paper still contains the same errors that those indicated in Mexico.

These errors are mainly related to the input parameters and assumptions used for calculations:

- The above text [16], it is assumed a traffic of 300 Erlangs/Km^2, and an area around the UPCS receiver of 5km of radio (d=5km), where FWA transmitters can be located randomly. This is an unrealistic scenario:
  - Such traffic density, though effectively indicated in ETSI ETR 310 as mentioned in [16], is related to the TOTAL FORESEEN TRAFFIC INCLUDING FUTURE DATA SERVICES FOR ALL THE RLL (FWA) SYSTEMS, but not for an unique DECT system!!.
  - Moreover, if we assume this managed traffic in such area (d=5km means about 78.5 km^2), we will have a total of near to 300000 FWA subscribers (with an average of 80 mE/subscriber) in a circle of 5 Km^2 !!!. Where is it foreseen such so optimistic scenario for a single DECT operator ?!!.

  Obviously, this is a misunderstanding of the ETSI ETR 310 document. The current FWA world-wide contracts are based on traffic about 30 Erl/Km^2 in wide urban areas. Sometimes, obviously, higher traffics can be considered, but never in such large area.
- In [16], it is assumed a micro-base station DECT deployment with omnidirectional antennas in high urban scenario. This is, again, an error: in this kind of scenarios (and, in general, in

most of the DECT deployments) the sites are sectorized (typically 6 sectors, with antennas of maximum 60º). This last real value will decrease (at least in 1/6) the number of FWA transmitter which can cause interference to an UPCS system, and therefore the calculations made in [16] are wrong.

- The methodology used in [16] does not contemplate the fact that re-use of co-channel interferers within the DECT FWA system is not random (uniform distribution of interferers), since the same frequency/time-slot will not be used if it is already used, for example, in any adjacent sector due to the own interference avoidance mechanisms (DCS) of the DECT FWA system. Therefore, the assumption of uniform distribution of FWA interference transmitters (co-channel) is not well used in [16].
- In addition, it is only considered the LOS free-space propagation condition (since the Fresnel breakpoint is too far from UPCS systems due to antenna heights assumptions -which are different than those agreed by the Experts Group-), and this is not a typical situation specially in high traffic urban areas as described in [16].

In the other hand it is important to remark that making reference to ETSI ETR 310 report, as made in [16], it should be mentioned that in this ETSI report is clearly indicated that coexistence between any DECT system and North American Personal Wireless Telecommunication (PWT) systems in a common spectrum is completely feasible, giving an argument against the own conclusions of [16], since PWT is an Isochronous UPCS device.

As a conclusion, the document [16] contains an enough number of errors to consider it as an invalid document to analyse the interference between FWA TDD and UPCS systems. In addition, it does not contemplate all the cases of FWA TDD and UPCS systems and therefore it is not only incorrect but also incomplete.

Nevertheless, it should be noted that even with all the wrong and pessimistic assumptions made in [16] the results ARE CLEARLY BELOW THE LIMITS OF THE ALLOWED INTERFERENCE, and therefore the conclusion is also wrong.

Note: Related to the multiple interference analysis made in [16] and appointed as an "open issue" by PCS proponents, it is important to say that since this matter will be treated later in Section 6, is not included here, in order to avoid repetitions.

As already indicated in report PCC.III/935/97 [1], the DECT/PHS proponents' viewpoint regarding to the coexistence between FWA TDD and UPCS systems in the 1910-1930 MHz is reflected in document **PCC.III/922/97 [18].** It is not intended to repeat here what was already indicated in document [18], but just to comment some important remarks and conclusions.

This document [18] shows that private office and residential systems could be allowed on secondary bases in the band 1920 - 1930 MHz, if a regulator so wishes. Additional considerations were discussed in the Interference Expert Group in both Brasilia and Mexico meetings, and could have made the report [1] very conclusive, if the political will had been present.

The content of document [18] is complete (it is applicable for all cases of FWA TDD and UPCS) and it contains a simple but definitive and accurate methodology to analyse the possible interference between FWA TDD applications and UPCS Isochronous private systems in 1920-1930 MHz band.

The conclusion of [18] is:
The FCC "etiquette" contains one set of incompatible rules, one for ASYNCHRONOUS devices in 1910-1920 MHz, and one set for ISOCHRONOUS devices in 1920-1930 MHz.
All equipment that meet the DECT TBR6 or US FCC Part 15 D ISOCHRONOUS or PHS RCR-STD28 requirements can operate and coexist a) with each other in the 1920-1930 MHz band and b) on a secondary basis with FWA, that is operating in the band 1910 - 1930 MHz. This possibility also avoids unwanted trade barriers for private cordless systems. A secondary conclusion is that illegal imports of FCC Part 15 D ISOCHRONOUS devices will not cause interference problems.

Equipment meeting the FCC Part 15 D ASYNCHRONOUS rules does not coexist with DECT, PHS or FCC Part 15 D Isochronous devices. No Part 15 D ASYNCHRONOUS devices have been developed.

Note also that the Interference Experts Group already in Brasilia (VIII meeting of CITEL PCC.III) has written down and discussed a preliminary statement for the group in line with the conclusions of [18]. From the Group's official meeting report [19] the following is extracted:

"[...] Document 12: It was explained that the etiquette minimizes impairments and stated that DECT, PWT & PHS can coexist. However the access channel mechanisms for asynchronous UPCS devices (1910-1920 MHz) are not compatible with the access channel mechanism for Isochronous UPCS devices (1920-1930 MHz). The group discussed the following strawman text:

> *DECT, PHS and Isochronous UPCS Etiquette devices use the same basic channel access mechanisms. These channel access mechanisms are designed to permit sharing of spectrum in a frequency and time domain.*
>
> - *listen for 10 ms before talking*
> - *frame duration is a sub-multiple of 10 ms*
> - *access channels are defined as a frequency & timeslot combination [...]"*

Comparing the results from [16] and [18]

The analysis in [18] supposes that the dominating interference comes from the closest DECT FWA base. The analysis in [16] addresses the case when an office can see many DECT FWA bases. This latest analysis regards a very worst case, where it is supposed that all bases can be seen with a line of sight condition, and that the FWA traffic is 300 Erlangs/Km^2, which is 10 times higher than typical applications (as already mentioned).

Even for this worst case, the total interference from all DECT FWA bases will not cause problem if the office system described in [18] is used. This office system is a PWT or DECT office system with 20 m base station separation. The capacity is large enough to support cordless service to all employees of the office. The interference level on available access channels calculated in [16] will be about -70 dBm[5] or less with correction for 6 sector DECT base antennas.

This is below the maximum allowed channel set-up threshold for PWT defined in the FCC UPCS rules. The wanted PWT or DECT signal is above -48 dBm at the 10 m cell border [18], which will always make C/I >22 dB for the office system. These 22 dB are more than required for a reliable service.

Thus, the above methods, [16] and [18], confirm that private systems can coexist with FWA systems. However, the last analysis [16] shows that there may be occasional "hot spots", where we may need to add some cost for making the office infrastructure dense enough (20 m base station separation), since for low traffic office systems, the base station separation is typically 30-40 m. This need for extra cost, will occur very seldom, and does not make the use of private system uneconomical.

6. MULTIPLE INTERFERING TRANSMITTERS

Section III of PCC.III/966/98 [14], and section IV.F.2.19 of the Experts Report [1] identify this issue:

"Interference models used in the analysis are overlay simplified which may not applicable to the environment of real implementations. For example, only single interference source is considered in the interference study" (PCC.III/966/98, [14])

"Multiple Interferers vs. Single Interferer: In general, in a real-world deployment scenario, the interference into a victim receiver will be the power sum of contributions from multiple interfering transmitters. Therefore, an complete analysis of the interference probability must account for multiple interference sources, which the current analysis does not do" (PCC.III/935/97, [1])

In addition, documents [17], [20] and [16], implicitly, recommend also to use a "multiple interference" analysis (i.e. by means of Monte-Carlo technique simulations) instead of a "single interference" analysis.

6.1. LMNQ VIEW

The typical FWA cell is 1/10th the radius of a typical PCS cell and thus there could be 100 times the number of FWA cells (and thus interfering sources) than PCS cells. Clearly from the different cell geometries (see Figure17.1) for FWA and PCS, it is highly likely that multiple

[5] at least another 5 dB lower interference levels for proper propagation model and proper wall attenuation from side walls compared with the front wall. In reality, the worst case calculations in [16] is probably up to 15 dB too pessimistic.

FWA transmitters will impact a PCS macrocell covering that area. If interfering signals from multiple, say 10, independent sources at approximately the same distance arrive at the victim receiver, then the cumulative interference may easily be 10dB higher than from a single interferer. The spreadsheet calculation can be adjusted for 10 interferers by changing the permitted tolerable desensitization value from 1 dB to 0.1 dB.

Based on [20], section 17.1 documents the impact of multiple interferers. Figure 17.4 indicates that for DECT to IS-95 interference, there is a 90% probability that a >35dB rise in noise floor will result. This is clearly a major impact on an IS-95 system, with a 35dB reduction in pathloss and potentially causing a reduction in cell size diameter by a factor of 7 or an additional 35dB dynamic range of power amplifiers. . Figure 6.1 indicates that for DECT to IS-136 interference, there is a 90% probability that a >45dB rise in noise floor will result. This simulation (Figure 6.1) also shows that this type of statistic is not very sensitive to traffic density (50E/km^2 to 150E/km^2 for business area).

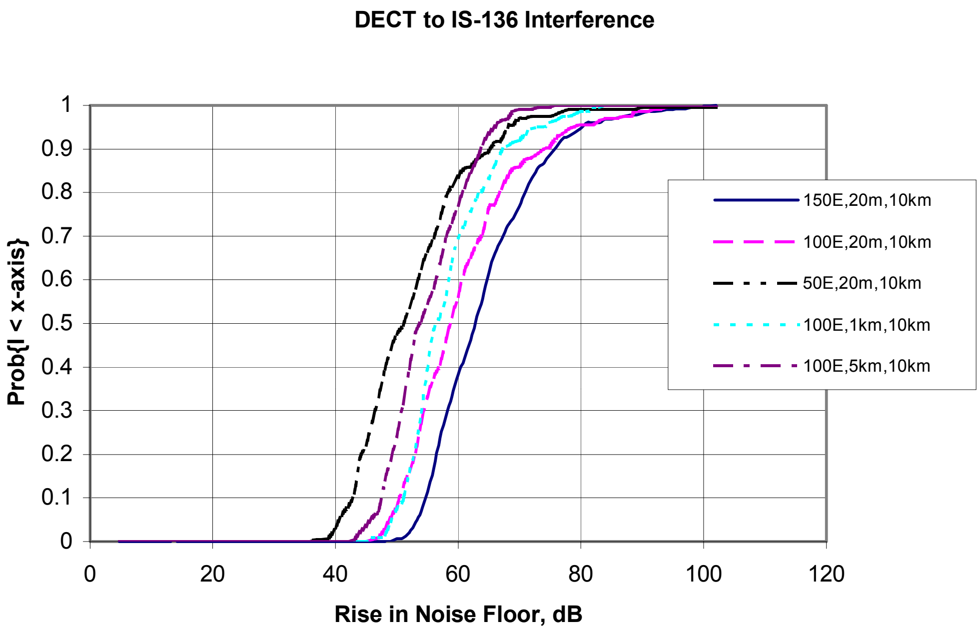


Figure 6.1: Simulations Results for Impact of DECT on IS-136

The following is taken from the results and conclusions in 17.1:

> Similarly, the results show that both the IS-95 and IS-136 PCS will be unable to co-exist with the DECT FWA applications unless the DECT FWA systems are serving in a very light traffic density areas with a large separate distance to PCS receiver.
>
> From the simulation results we conclude that the system performance of the FDD PCS is expected to be greatly impaired by the neighboring DECT FWA while they are operating in the adjacent frequency bands. A guard band or wide geographical separation may be needed.

6.2. AENS VIEW

This item was also discussed within the Experts Group meeting in Mexico. It was stated by DECT/PHS proponents that the study carried out in Report [1] was based on a "worst case" analysis and that within this "worst case" analysis it was considered a single interfering signal which contemplates the worst conditions for interfering. SUCH A "SINGLE" SIGNAL IS ALWAYS MUCH WORSE THAN ANY SUM OF "REAL & MULTIPLE" INTERFERING SIGNALS. In fact, it is very unlikely (quite impossible) that any other interfering signal could exist in the same pessimistic conditions than the considered one in the analysis contained in Report [1].
Moreover, it is well known than when analysing the interference by means of the single worst interfering signal the obtained results are always more pessimistic than a when analysing it by a more real approached based on simulations of multiple interfering signals (as for example by a Monte Carlo technique). Thus, since the objective of the analysis performed in [1] is not just to calculate the actual interference values but to compare several interference scenarios (and make further comparison analysis), the selected approached (with a single worst signal) is very appropriate because it provides a simple, coherent and homogeneous method to calculate a great amount of scenarios and to carry out the correct comparative analysis.

From the point of view of DECT/PHS proponents, the selected methodology regarding to the consideration of a worst single interfering signal is a very powerful method to achieve the target of the analysis. It could be simpler than other suggested methods, but for this case, the simplicity does not means inconsistency with the obtained results in terms of scenarios comparison which is the main way to interpret the obtained results of the Report [1], as agreed in its section II.C.1. (Results of the quantitative calculation):

"These kind of results could be insufficient to make an interpretation of the absolute level of interference. But it could be used to perform a comparative analysis or a cell-size normalized analysis of each scenario"

7. IMPACT OF LOCATION AND SITING OF PCS BASE STATIONS AND FWA

There are several references (PCC.III/966/98 [14], PCC.III/1037/98, PCC.III/1049/98, PCC.III/1036/98, etc.) and also in the Experts Group Report [1], in sections IV.F.2.8. and IV.F.2.12, where, basically, it is defended that due to the large differences between PCS and FWA TDD systems, the required co-ordination distances can not be managed without disturbing the performance of the systems, and, it is also noted that thanks to the similar cell sizes of PCS cells, the PCS to PCS interference can be properly avoided due to FDD operation and by a careful planning which could include the co-location of sites.

7.1. LMNQ VIEW

Note that the worst case of interference will typically occur when a victim is close to the interfering source and simultaneously far from his own communication partner. If the interfering base station and the desired base station are approximately collocated, then this worst case is unlikely to occur. If CITEL continues investigation of interference matters, this issue should be further quantified. NOTE that with frequency division duplexing (FDD), it is unlikely that bases interfere with bases or that mobiles interfere with mobiles due to the frequency duplexing. Thus it is viable for FDD bases to be collocated and minimize interference. TDD systems cannot be collocated with other TDD or FDD systems without causing significant interference, thus this collocation option for mitigating problems is NOT available for FWA.

The correct interpretation of the results of [1] should include the consideration of large PCS cells (e.g. 10 km of diameter) and small FWA TDD cells (diameter of 500-1500 m). It is suggested (in [1] section IV.B - option b) that:
"The value on the table [co-ordination distances table] *should not be greater than the cell size for the particular technology"*

7.2. AENS VIEW

As stated in [22], the above argumentation is wrong.

According to the carried out analysis in [1], the interference level of each scenario is measured in terms of co-ordination distance between an interfering TX and a victim RX. It is obvious that the interference level is higher when higher co-ordination distance is obtained. The cell sizes and location and siting of PCS and FWA base stations will have only influence on the probability of interference, but since this probability is already low enough due to the worst case considerations, the effect of the cell sizes and location of base stations is absolutely negligible.

Moreover, the assumed cell sizes for the comparison of the effect of interference between the PCS-PCS and PCS-FWA scenarios are intentionally incorrect. A more accurate assumption about the correct cell sizes for PCS systems in dense urban areas (where the worst case analysis is applied due to the high traffic load assumption) is made in document PCC.III/1042/98 (contribution of NEC to the Seminar in Natal), where values of PCS cell diameters are about 1,5 Km, which are more similar to the DECT/PHS cells diameters. This more accurate values makes irrelevant the argumentation of the PCS proponents regarding this matter because it minimises the effect of the cell sizes in the interference probability between PCS-PCS and PCS-FWA scenarios, as defended by the FWA TDD proponents.

On the other hand, it is true that some base station location and siting engineering may minimise the effect of undesired interference, however these kind of planning engineering may be applied to all scenarios (not only PCS to PCS, but also FWA to PCS), and then, it can not be argued in favour of some scenarios with large obtained distances (PCS-to-PCS) and against others with shorter obtained distances (FWA-to-PCS), where, in reality, the interference will be always lower (or, at least, in the same range). The PCS proponents argumentation is clearly biased.

Apart of the argumentation given in the above paragraph, document [21] includes also a clear demonstration that co-ordination distances as low as 100 m. between DECT FWA BS and PCS BS are also possible.

As already mentioned some lines before, it was agreed within the experts group that:
"[…]These kind of results could be insufficient to make an interpretation of the absolute level of interference[…]".

According to the above sentence, the co-ordination distances can not be seen as absolute values of required separation between devices of different systems, but only as a COMPARATIVE MEASUREMENT OF THE INTERFERENCE LEVEL OF EACH SCENARIO.

What it is important for the readers of [1] is not just the values of co-ordination distances (which will be very sensitive to the assumed input parameters) but the comparison between the values obtained in several scenarios, from which two important conclusions can be deduced:

1.- When comparing the obtained values of co-ordination distances with the reality of the PCS-to-PCS scenarios (which effectively can coexist without any special co-ordination measurement), the immediate conclusion is: "THE OBTAINED RESULTS CAN BE ONLY EXPLAINED UNDER THE ASSUMPTION OF A NEGLIGIBLE PROBABILITY OF OCURRENCE", if not, PCS/PCS scenarios could never coexist.

2.- When comparing the obtained values of co-ordination distances between PCS/PCS and FWA/PCS scenarios, the immediate conclusion is: "THE FWA/PCS SCENARIOS WILL PROVIDE LESS INTERFERENCE PROBLEMS THAN THE PCS/PCS SCENARIOS"

And the logical join conclusion (from the two above) is:

FWA TDD APPLICATIONS WILL NOT CAUSE INTERFERENCE PROBLEMS TO PCS SYSTEMS IN ADJACENT BANDS, AND VICEVERSA.

Any intention to interpret the results (obtained co-ordination distances) as ACTUAL REQUIRED DISTANCES is completely wrong. The merit of the used methodology is, precisely, to provide a coherent method not to obtain exact required distance but to obtain an accurate method to determine if not-well-experienced scenarios (i.e. FWA/PCS scenarios) can provide more or less interference that other well-experienced scenarios (i.e. PCS/PCS scenarios), and from this viewpoint the carried out analysis is COMPLETE AND CONCLUSIVE.

8. IMPACT OF DEPLOYING GUARDBANDS - DYNAMIC OR FIXED

As suggested in report [1], section IV.F.2.29:
"In this study, only the channel located in the band edge for FWA systems is considered to be "harmful" to systems operating in adjacent frequency. To mitigate the potential interference caused by FWA systems, a guard band which prohibit the FWA to operate at the band edge

should be considered. Since the DCA scheme used by FWA is incapable of detecting the existence of the victim receivers nor switch to other channel in heavy loaded condition when interference is detected, the dynamic guard band provided by DCA will not be a reliable means to avoid interference to occur. Consequently, a fixed guard band which provides a more reliable protection against the interference should be considered"

8.1. LMNQ VIEW

One traditional, major tool to mitigate interference is obviously to keep the interferer at a frequency remote from the victim frequency i.e., use a separation frequency guardband. This guardband should be large enough to suppress emissions well below the power on the carrier frequency, which will typically occur between 5 and 10 channel bandwidths from the carrier. This implies guardbands should be at least 2 MHz – 5 MHz for the technologies discussed here.

Using DCA, FWA systems claim the ability to dynamically create and destroy guardbands as needed. The DCA is claimed to detect any interference and avoid those channels and thus be a good neighbour by not causing interference. The reality however is that most FWA systems use relatively high receive powers and would not be able to detect a useable low-power PCS signal near the PCS cell edge, and would thus cause significant interference to the PCS system.

The ability of DCA to change to a quiet channel is clearly dependent on the existence of spare channels and low traffic conditions – this is unlikely in busy urban and suburban areas.
To avoid major impact to PCS systems, significant **static** guardbands will be essential if geographic separation is not available.

8.2. AENS VIEW

Above paragraphs assumes incorrect conclusions from report [1], and, in some sense, also from the powerfully Dynamic Channel Allocation mechanism.

Primarily, the report [1] does not conclude that interference produced by the FWA TDD adjacent channel to PCS systems would be harmful, but exactly the opposite: the unique correct conclusion which can be deduced from the experts group report [1] is that FWA TDD adjacent channels will not generate harmful interference to PCS systems, and therefore, THERE IS NOT NEED OF ANY EXTRA FIXED GUARD BAND AT THE EDGES OF THE 1910-1930 MHz BAND FOR FWA TDD APPLICATIONS TO PRESERVE THE PCS SYSTEMS IN BAND A OR C.

On the other hand, the DCA mechanism, though it is primary designed to protect the own system (FWA TDD) from undesired interference, it could have also a positive effect to protect also to adjacent systems (PCS). This is because, when one system (e.g. FWA TDD) produce interference to an adjacent one (e.g. PCS) it is obvious that the inverse interference path could also occur, and then the DCA facilities of the first system (i.e. FWA TDD) will try to avoid the use of the interfered channel (the adjacent one), eliminating or minimising the possibility of interference.

The above reasoning is specially applicable if the interference levels of the PCS-to-FWA TDD path are higher than those of the FWA TDD-to-PCS path, because in this case the probability for the FWA TDD system to detect the interfering signal will be higher. Since in report [1] it is shown higher values of interfering signal coming from PCS to FWA TDD that from FWA TDD to PCS, the DCA mechanism could (probably, but not sure) have positive effect also to protect the adjacent PCS system (it is also more probable for the case of the IS-95 CDMA system with continuous emission).

AENS state that THE PROVISION OF EXTRA FIXED GUARDBANDS BETWEEN FWA TDD AND PCS ADJACENT SYSTEMS IS NOT REQUIRED.

9. PROBABILITY OF INTERFERENCE

Some input documents have suggested defining interference probabilities, however the viability has been questioned.

9.1. LMNQ VIEW

Any external interference is undesirable. If unavoidable, it is **essential** that the interference probability be minimized and the level of impact (when it occurs) should be tightly constrained.
Section 17.1 clearly shows that with multiple interferers, there is a high probability of major (35dB) interference.

A PCS user will be unhappy if his call suffers interference several times during a conversation i.e., any probability discussion should apply to how many interference events occur during a typical phonecall (120-180 minutes). The probability should possibly be considered similar to an "outage" constraint – e.g. number of errored seconds.

- While some occasional short term interference may be overcome by internal PCS error correction, this should not be assumed. Note that the error correction is designed to protect from propagation artifacts and any additional interference will degrade the call below acceptable levels.
- Similarly, since the various PCS and FWA systems are unlikely to be synchronized, interference may be bursty, but impact short periods of EVERY frame and completely kill a call.
- Note that the interference may be coming from multiple sources (possibly on different timeslots) and it is the cumulative probability which applies.

Part of the following AENS view highlights the problem and a clear misuse of probability:

- the probability of two antennas pointing at each other. - for universal coverage, someone is almost certainly pointing at someone else all of the time and "arbitrary orientations" should not be used – only the worst case orientation. i.e. the probability is 100% not 4.8%.
- the probability of an adjacent carrier being 10% - this may be true on long-term average, but there is clearly a much higher probability that part of a call is impacted by an adjacent carrier.

9.2. AENS VIEW

Regarding to the section IV.F.2.9. of [1], where it is indicated that *"the probability is an often misused tool"* and it is mentioned that *"there are some deterministic examples that need to be considered"* like the included example in that section, it must be indicated that the "misuse" of the probability concept is precisely within the given example in section IV.F.2.9. of [1], because though the explained situation could be real, neither is very common nor it implies that interference will happen always as described (it will imply that the interfering signal from the DECT FWA system is being continuously emitted and that the "unfortunate" PCS user is always connected to the same interfered channel, it is senseless). In addition, the described example could be equally applicable to a PCS to PCS interference, and in the reality it does not happen.

The fact that the probability of interference will be very low (as implicitly assumed in the example) does not mean that it would be completely impossible, but what it is defended by FWA TDD proponents is that this very low value of probability does not justify any especial co-ordination measurement.

An analogous example is written in [22]: *"A person winning a lot of money in the lottery have a very low probability, and though many people win millions in lottery it does not mean that the best way to be a millionaire is to play lottery. This is, really, a misuse on the probability concept"*, and this situation is very similar than the suggested one in the example given in IV.F.2.9. of [1].

As indicated in [1], section II.A.3, the methodology does not include the probability of interference. This matter was discussed within the group but it was not agreement in how to assess the probability since none of the input contributions (always coming from DECT/PHS part) were accepted by PCS proponents (which have never contributed to this matter).

From the discussions, however, there is a common understanding or feeling that the interference probability would be low (the difficulty is how to quantify it). This understanding is supported by the following two arguments:

a) all the contributions presented very low probabilities. Even when these contained minor errors or were incomplete or were disagreed, the final results always included very low values of interference probabilities. As example, the following simple calculation gives an idea of the possible values of interference probability according to the assumptions of worst case:
    - the probability of one 60º DECT antenna is pointed towards a 105º PCS base station antenna, if both systems have an arbitrary orientation is equal to 4.8% (=[60/360]*[105/360])
    - the probability to use the DECT adjacent carrier (assuming that DCA is not working, and each carrier can be selected randomly) is equal to 10% (=1/10 DECT carriers)
    - The combination of above two probabilities gives a probability **of ONLY 0.48%** (=4.8%*10% due to uncorrelated events)**,** and obviously it is not considered many other

parameters which will reduce the probability to a more negligible value, as the probability to victim RX working at minimum reception level, or the probability that interfering signal is not affected by fading, or the probability it will be not only frequency collision but also time collision (both systems being TDMA for example), etc.

b) The obtained values in report [1] can be only justified by a very low value of probability of interference, if not, the values of co-ordination distances for PCS to PCS scenarios (tenths of km., in some cases) will make impossible the coexistence between two PCS systems, and actually, as the experience demonstrates, these scenarios exists.

Though the final assessment of the interference probabilities could not be agreed within the experts group, the evidence demonstrates that the values of PROBABILITY MUST BE NEGLIGIBLE. It is not necessary to detail a methodology to assess the probability: the submitted documents as well as the discussions performed within the group and obtained results in [1] gives enough information to conclude that PROBABILITY IS LOW ENOUGH TO CONSIDER THAT HARMFUL INTERFERENCE BETWEEN ADJACENT SYSTEMS (PCS/PCS & FWA/PCS) IS INSIGNIFICANT.

10. INTERFERENCE AVOIDANCE MECHANISMS

10.1. LMNQ VIEW

The experts agreed not to include interference avoidance mechanisms for two reasons:

- the experts agreed to do a worst-case analysis
- consideration of such mechanisms would be very complicated and not viable during the short timescales available
- many of the mechanisms would be covered if a **good** probability analysis was performed

10.2. AENS VIEW

Regarding to this item, the viewpoint form DECT/PHS proponents was already included in report [1], section IV.F.1.3, where it is said:

"Within the calculations existing interference avoidance mechanisms for each technology have not been considered. However, it is clear than these mechanisms (Power Control, DCA, Intracell handover, Frequency hopping, Error correction, etc.) are powerful enough to avoid the interfering cases that are shown in the calculation."

11. ASSUMPTIONS AND SIMPLIFYING CRITERIA

In report [1], section IV.F.2.1, some generic concern was expressed:

"As explained earlier, plausible Reference values were selected for such parameters as antenna heights, antenna gains, antenna tilts, fade margins etc. In addition, as far as possible, the basic parameter data (transmit power, receive sensitivity, bandwidth, etc.) was extracted from the

appropriate technology standards. Nevertheless, due to time constraints and some difficulty in the interpretation of data expressed in different formats for the various standards, there is some concern that not every parameter in the Reference models are absolutely correct".

11.1. LMNQ VIEW

Although the experts determined a set of plausible values during the PCC.III meeting in Brasilia, most of these were derived from the memory of participants, rather than by careful study of typical scenarios. In Mexico City when PCC.III-935/97 was created, only a single value for each parameter (rather than the complete range determined in Brasilia) was actually used. The errors listed in Section 1 are typical of the items which would have been found if the values had been validated.

The issue is thus that for adequate analysis, the plausible values must be validated as correct and several values with the accepted range for each parameter needs to be used. This could be a major task.

11.2. AENS VIEW

From our point of view the concern expressed in above text has no sense. Though some of the mentioned "plausible reference values" may be questioned, since they are possible (plausible) they are as good as any other. It is important to remark that the merit of the used methodology is not the absolute obtained results, which effectively depends a lot of the input parameters, but the coherence of the calculation and homogeneity of the assumptions for all the scenarios. From this point of view the use of one set of plausible values or another different set is not relevant. The relevance of the methodology is the uniformity of using these input parameters in order to obtain a reliable set of results which allow a feasible comparative analysis.

On the other hand, it is not understood why this concern exists when all the parameters were agreed for all the Experts Group members, and there was not any "time constraint", as above mentioned: Almost parameters set were initially agreed in the Brasilia meeting (see document [19]), and we had time to review them (as it was done) during 3 months, including the meeting in Mexico.

It is important to remark that this concern (as well as the rest of proposed "open items") appeared just when, after the input parameters and methodology were agreed, the obtained results were not favourable to the interest of the PCS proponents, and the comparative analysis showed than FWA TDD technologies do not present any interference problem to PCS systems in adjacent bands, contrarily to the defended position of PCS proponents before the Experts Group creation.

The establishment and agreement of the reference values and the methodology took the main part of the Experts Group work.

According to this work, and thanks to the selected methodology which allows a reliable comparative analysis between several scenarios, the sensitivity of the selected parameters among a set of plausible values does not take relevance if the application of these parameters is homogeneous through all the analysed scenarios.

Therefore, even when any other set of parameters or reference values could be taken, the comparative results will not change, and the report [1] is equally valid. The most reliable test of this affirmation is also included in the report [1] itself, where after applying two different set of input parameters (i.e. calculations with and without fading margin), it is obtained THE SAME SET OF RELATIVE RESULTS which allows a FEASIBLE COMPARATIVE ANALYSIS, even when, obviously, the absolute values are different.

The above consideration is valid not only for the input parameters (or reference values) but also for the methodology itself.

12. PLANNING AND USE OF THE OPERATIONS & MAINTENANCE SYSTEMS

Section IV.F.2.13 of report [1], about site engineering, state:

"Site engineering practices can improve the interference between systems. However, the limitations of site practices are dependent on economics and the practical realities of installation practices. Good site engineering will reduce unnecessary interference, but cannot eliminate basic system incompatibilities. Real world sites have non-ideal surroundings that may reflect signals that might otherwise be reduced by nulls in antenna patterns. Examples of this are objects like; nearby buildings that produce significant reflection back to the cell site, air conditioning or elevator structures on top of building cell sites. In practice, these objects should be avoided as much as practical to improve cell performance and reduce undesired effects.
When the current interference methodology is enhanced to include traffic considerations, antenna and sectorization choices need to be defined to model low and high traffic density conditions."

12.1. LMNQ VIEW

Some of the O&M issues would be addressed by careful assessment of the probability analysis. LMNQ advocate the use of guardbands or geographic separation which are aspects of O&M planning.

12.2. AENS VIEW

The reality of O&M is often different than any theoretical analysis as the described in report [1], but it is not possible to contemplate all real cases in one single analysis. Report [1] could serve as a helping tool for planners, but to consider the used methodology as the one which can explain all the complex real world has no sense. Neither the used methodology nor any other can be consider as definitive but only approximations to the most common situations.

Additional information was already provided by DECT/PHS proponents in Report [1], section IV.F.1.4:

"During the Operation and Maintenance of a radio system it is possible (and it is a normal operation activity) to reassign and modify the parameters of the cells according to new situations of traffic, insertion of new cells, detected interference or increase of traffic demands. Thus, it should be noted that this continuous monitoring of the system behaviour could also help to solve the undesirable (and unlikely) external interference situations."

13. INTERFERENCE SENSITIVITY ANALYSIS

The reference text associated to this item is contained in section IV.F.2.3 of report [1]:
"Interference levels are highly sensitive to assumed relative positioning between interfering devices and victims. Interference levels are also highly sensitive to antenna choices, heights, and sectorization. An interference sensitivity analysis is needed before recommendations can be made."

13.1. LMNQ VIEW

As indicated above in section 11, the intent at Brasilia was to undertake a study of many scenarios – this is a sensitivity analysis. The reality of Mexico City was to study only a couple of scenarios. This item is completely open and crucial for proper evaluation of several of the preceding issues.

13.2. AENS VIEW

The above reference text is correct (we agree on that). However this item could not be considered as an "open issue", since the report [1] does not limit its scope to give a set of results but to detail which are the made assumptions and to describe the used methodology.

Thanks to these details, it is possible for a reader of report [1] to perform any sensitivity analysis. In fact, the sensitivity of some input parameters, like antenna orientation or the fading margin, is implicitly included in report [1] since the calculations have been made for several assumptions of these parameters.

Trying to include all the possible absolute results varying all the input parameters has not sense. The used methodology, as well as the spreadsheet created to perform calculations, can be used by anyone to analyse the sensitivity of certain parameters in a case by case basis.

On the other hand, the above text confirms what was said in section 11.2 related to the accuracy of the methodology, where it is indicated that absolute results are not relevant (since they are very sensible to the made assumptions) but the relevance is in the comparison of values for different scenarios when using homogeneous input parameters for all of them.

14. INTERACTION BETWEEN ANTENNA SECTORIZATION AND CELL SIZES AND TRAFFIC CAPACITIES

Text on this item is contained in section IV.F.2.34 of report [1]:

"In general it is necessary to fully account for the interaction between antenna sectorization and choices, cell sizes and traffic capacities. There is some doubt expressed here since the analysis presented earlier has not properly reflected this need.

In the detailed engineering analysis that was performed for both the co-channel and adjacent channel interference cases, the ETSI Technical Report on capacity considerations in DECT, ETR 310 of August '96, was used for the ETSI - defined model for DECT FWA.

Despite the fact that the ETSI Technical Report clearly states the expected traffic loads for various environments, including the specific loading of 300 Erlangs per square kilometre for developing countries . This ETSI Report was disputed as not necessarily valid by some DECT experts."

14.1. LMNQ VIEW

This should be addressed as part of the sensitivity analysis (Section 13).

14.2. AENS VIEW

Regarding to the requirement of fully account for the interaction between different parameters to be taken into account for a proper interference analysis, comments and discussions made for Sections 11 and 13 can be applied. Again, our opinion is that it is not an "open issue", and it does not require any further work of the Experts Group.

Regarding to the consideration made about the traffic for DECT FWA applications and the mentioned reference DECT ETR 310, it is necessary to remark, again, the incorrect interpretation made by PCS proponents about the content of such ETSI Technical Report as it has been already explained in section 5.2.

Note however, that the analysis for a real deployment in [21], where as low as 100m separation between FWA base and PCS base have almost no influence on the PCS system traffic, is valid also for traffic capacities of 100-300 E/Km^2.

15. IMPACT OF PULSED VS. CONTINUOUS INTERFERERS

Text on this item is contained in section IV.F.2.5 of report [1]:

"FWA systems are pulsed interferers and they need to be considered as to how they will affect different PCS systems in different ways. Continuous receive systems like IS-95 CDMA will be interfered with during each transmission. TDMA systems like PCS-1900 and IS-136 will have precessional frame rates and will only be interfered with periodically. In the opposite direction, continuous PCS transmitters will interfere continuously during FWA receive time slots"

15.1. LMNQ VIEW

As noted, systems with a TDM structure will typically periodic interference due to precessing of the asynchronous frames. However the suggestion that interference can be "scaled" to reduce the probability is very simplistic and probably erroneous. As indicated in section 9.1 Probability of Interference, the likely parameters of interest are the number of errored seconds or hits within a phonecall, which are not scaleable.

15.2. AENS VIEW

In general, the above text contains a correct consideration. In addition, following two comments should be also taken into account:

- For TDMA systems (PCS1900, IS-136, DECT or PHS), the above effect provides another factor which reduces the interference probability, since the interference will happen only if there is a collision in the time domain between the interfering TX and the victim RX. Due to impairments between the frames and differences between time slot duration of the interfering and victim systems, the probability of "time collision" is low, reducing the total probability of interference down to negligible values.
- For CDMA systems (IS-95) it should be noted that according to the obtained results, and comparing scenarios, the CDMA systems will generate higher interference levels over FWA TDD systems than vice-versa. Thus, since the CDMA emission is continuous it will be very likely that a FWA TDD system will be able to detect its interfering signal before selecting the adjacent channel (thanks to the Dynamic Channel Allocation mechanism) avoiding, as much as possible, the use of this carrier, and then reducing also the probability of interference from FWA TDD towards CDMA.

It is also noted that the above mentioned comment (for CDMA) can not be applied when analysing the interference between CDMA and PCS TDMA systems, since PCS TDMA systems (PCS1900 and IS-136) are not able to select dynamically the carrier in advance (no DCA mechanism, but can perform intracell handover interference escapes in the frequency domain).

This fact strengthens the already mentioned conclusion that interference problems from FWA TDD towards PCS systems are lower than the interference between two PCS systems.

Moreover, the continuous emission of CDMA systems will affect mainly to PCS TDMA systems but not to FWA TDD systems which are able to avoid this "continuous" interfering signal by means of the Dynamic Channel Allocation.

16. IMPACT OF MIXED TDD AND FDD DEPLOYMENTS

Text on this item is contained in section IV.F.2.6 of report [1]:

"Mixed TDD and FDD deployments will result in two additional interference paths that are eliminated by FDD deployments. Base to subscriber terminal and subscriber terminal to base are the only paths of possible interference for FDD systems. When mixing TDD systems, base to base and terminal to terminal paths also exist. These additional interference modes create another set of exclusion zone distances to avoid interference between other systems. The TDD terminal may be near another FDD receiver and be transmitting on adjacent channels, without any knowledge of the interference that it may cause.

TDD FWA systems will suffer interference if co-located with PCS systems. Further, there may not be an acceptable minimum base-to-base separation distance, especially if the cell radius is less than the acceptable minimum base-to-base separation distance.

PCS systems will suffer interference if co-located with TDD DECT FWA systems. There may not be an acceptable minimum base-to-base separation distance, especially if the cell radius is less than the acceptable minimum base-to-base separation distance."

16.1. LMNQ VIEW

As noted in section 7.1 on base station location, there are some interference mitigation options available to FDD-only scenarios which are not available to TDD-only or TDD/FDD scenarios.
In any system, a base may interfere with another base or a terminal. Similarly, a terminal may interfere with a base or another terminal. Take the simple case of a single victim base plus single victim terminal system and a single interfering base and a single interfering terminal system:

- In a FDD-only pair of systems, the likelihood of a base interfering with a base or a terminal interfering with a terminal will be extremely low due to the guaranteed high signal loss in two of the four cases i.e. there are two mechanisms only and any device will only see one of the mechanisms
- In a mixed TDD/FDD pair of systems, both TDD base and TDD Terminal will interfere with EITHER the FDD base or the FDD terminal i.e. one of the FDD devices will see no interference while the other will see two mechanisms
- In a TDD-only pair of systems, co-frequency or adjacent frequency bases and terminals will all interfere with each other i.e. there are four mechanisms

Thus in the first case, one "unit of interference" occurs. In the second case, either two or zero "units of interference" (this does NOT "average" to one unit). In the third case there are three "units of interference".

16.2. AENS VIEW

Apart of the indications made in the last two paragraphs of above reference text regarding to the "un-existence" close-relationship between co-ordination distances and base-to-base separation, which has been already discussed in section 7.2, THE ABOVE TEXT CONTAINS THE MOST TYPICAL ERROR WHICH IS USED TO BE ARGUED BY FDD SYSTEMS PROPONENTS AGAINST TDD SYSTEMS.

The "MYTH" that "*Mixed TDD and FDD deployments will result in two additional interference paths"* is ERRONEOUS.

The correct sentence should be "Mixed TDD and FDD deployments will result in two DIFFERENT interference paths than those associated to FDD alone deployments", BUT NOT ADDITIONAL: THERE ARE THE SAME QUANTITY OF INTERFERENCE PATHS BUT THEY ARE DIFFERENT.

In a FDD-FDD deployment there will be only two interference paths: Base-to-Terminal and Terminal-to-Base.

In a mixed FDD-TDD deployment there will be ALSO ONLY two interference paths: EITHER Base-to-Terminal and Terminal-to-Terminal, OR Base-to-Base and Terminal-to-Base. BUT ONLY ONE OF THE TWO ABOVE POSSIBILITIES EXISTS DEPENDING ON THE ALLOCATION OF THE FDD AND TDD BANDS. THAT IS, ONLY TWO PATHS, AS FOR THE CASE OF FDD-FDD deployments.

In the case of 1910-1930 MHz TDD band, since it is between two FDD sub-bands (C band in the lower limit and A band in the upper one), obviously there will be four interference paths, BUT TOWARDS TWO DIFFERENT SYSTEMS (in A band and in C band). It will be exactly the same if a FDD systems is allocated in a sub-band adjacent to two other FDD sub-bands. For example:

- Mixed FDD-TDD deployment in 1850-1990 MHz band (TDD in 1910-1930 MHz band). In this case there will be two interference scenarios caused by the TDD system:
  1. Interference paths from TDD systems to a FDD system in A band:
     a) TDD BASE to FDD (A band) TERMINAL
     b) TDD TERMINAL to FDD (A band) TERMINAL
     That is, no FDD base station in A-band is affected by interference from TDD system
  2. Interference paths from TDD systems to a FDD system in C band:
     a) TDD BASE to FDD (C band) BASE
     b) TDD TERMINAL to FDD (C band) BASE
     That is, no FDD terminal in C-band is affected by interference from TDD system
- FDD-only deployment in 1850-1990 MHz band. In this case there will be also two interference scenarios caused by any FDD system (for example FDD in B-band):
  1. Interference paths from FDD system in B-band to a FDD system in D band:

a) FDD BASE (B-upper band) to FDD TERMINAL (D-upper band)
b) FDD TERMINAL (B-lower band) to FDD BASE (D-lower band)

That is both base stations and terminals of D-band system are affected by interference

2. Interference paths from FDD system in B-band to a FDD system in E band:
   a) FDD BASE (B-upper band) to FDD TERMINAL (E-upper band)
   b) FDD TERMINAL (B-lower band) to FDD BASE (E-lower band)

   That is both base stations and terminals of E-band system are affected by interference

As shown in above example, not only it has been demonstrated that mixed FDD-TDD deployments do not provide any additional interference path (quantitatively) but also it has been demonstrated that mixed FDD-TDD deployments provides the possibility that one of the two devices (base station or terminal) of the FDD system IS COMPLETELY FREE OF INTERFERENCE FROM FWA TDD SYSTEM.

According with the argumentation given above, the Mixed FDD-TDD deployments do not introduce any additional interference possibility, moreover, opposite to FDD-FDD deployments, this kind of mixed FDD-TDD deployments allow to a base stations or terminals of the FDD systems to be interference free.

17. ADJACENT CHANNEL INTERFERENCE

The reference text, PCC.III/964/98 [20], was submitted by Lucent in the last Experts Group meeting in Natal and this text presents an alternative methodology to analyse the interference between FWA TDD applications in 1910-1930 MHz band and PCS systems in adjacent bands.
The methodology presented is based on a simulation approach using the Monte Carlo technique, and tries to quantify the effect of multiple interferers from a DECT FWA system to a PCS (IS-95 and IS-136) Base station. As indicated in [20]:

"The goal of this report is to analyze the impacts of the adjacent channel interference from Time Division Duplex DECT FWA to Frequency Division Duplex PCS by using the Monte Carlo computer simulation and the statistic models derived from large scale implementations. To ensure the simulation better represent the real situation, additional implementation specific considerations such as antenna sectorizations and orientation, as well as channel fading are also included in this study"

17.1. LMNQ VIEW

As there was no opportunity to discuss PCC.III-964/98 in Natal, it is reproduced here.

17.1.1. Introduction

In the frequency 1850-1990 MHz, numbers of personal communication systems(PCS) and unlicensed personal communications systems(UPCS) are starting to be deployed. With multiple operators overlapping their service area by using adjacent frequency bands, interference among systems becomes inevitable.

In the efforts of attempting to quantify the interference among the systems operating in the PCS band (1850-1910 MHz and 1930-1990 MHz), and the UPCS band (1910-1930 MHz), several studies have been conducted by various groups and the results were reported[1, 27, 28]. However, most of the interference analyses provided so far are based on some simplified models, e.g. one interfering transmitter vs. one affected receiver scenario, rather than more realistic full scale implementations of multiple interferers because of complexity, a lack of data to support various radio technologies and a wide range of the system operating environments. Consequently, the proposed methodologies are usually fail to provide necessary accuracy on the interference assessments in real implementation scenarios.

It is known that in real system the radio traffics and the propagation path losses are relatively random, and their characteristics have been recognized and can be regenerated by computer simulations. Thus, a study [16] adopting the statistic properties of a typical large scale Fixed Wireless Access(FWA) operation and the *Monte Carlo* computer simulation procedure to analyze the co-channel interference from DECT FWA systems to isochronous UPCS was first reported in PCC.III.

The goal of this report is to analyze the impacts of the adjacent channel interference from Time Division Duplex DECT FWA to Frequency Division Duplex PCS by using the related statistic models and computer simulations. To ensure the simulation better represents the real situation, additional implementation specific considerations such as antenna sectorizations and orientation, as well as channel fading are also included in this study.

17.1.2. DECT to PCS Base Station Interference Analysis

It is assumed that PCS and DECT FWA are deployed at the overlapping geographical area, and the PCS is assigned to block A (1850-1865 MHz and 1930 1945 MHz) while the DECT is operating in UPCS band (1920-1930 MHz). Parameters reflecting various DECT FWA applications are taking into account in the analysis, and some of them are provided in Table 17.1[23, 24].

Table 17.1. Parameters for DECT:

Area (Traffic density, ρ)	Antenna Parameters Gain (RFP/CRFP)	Height	Directivity	Tx Power
Rural (3.5 E/km^2)	(12 / 10) dBi	10 m	90°	27 dBm
Business (150 E/km^2)	(12 / 10) dBi	10 m	90°	19.5 dBm
Urban Residential (280 E/km^2)	(12 / 10) dBi	10 m	90°	19.5 dBm

The radio propagation model used in the analysis in computing the radio propagation loss is based on the two-slop model adopted by the PCC.III Interference Experts Group[1]

$$PL(d) = 38 + 20\log(d) + \mathit{fading}, \quad d < 4h_t h_r/\lambda \tag{17.1}$$

$$PL(d) = 38 - 20\log(4h_t h_r/\lambda) + 40\log(d) + \mathit{fading}, \; d \geq 4h_t h_r/\lambda \tag{17.2}$$

where h_t and h_r are the transmitter and receiver antenna heights, and λ is the wavelength.

Additional to the propagation loss, a log-normal fading with 8 dB deviation is also considered. It is assumed that each of the Fixed Part(FP) and Cordless Terminal Adapter(CTA) is equipped with a directional antenna with a 90° azimuth angle, while the transmissions of Wireless Relay Station(WRS) is not considered in our study cases. If the signals emitted by the WRS were included, the interference level from DECT FWA is expected to increase proportionally.

To compute the interference level in IS-95 PCS BS, we first must determine the radio transmission density between FP and CTA. Using the parameters listed in Table 17.1, an expected number of radio transmissions in each time slot on a given frequency within distance R from a PCS base station(BS) is found [1]

$$K = \alpha_f \alpha_P \frac{\pi\left(R^2 - r^2\right)\rho}{N_E} \tag{17.3}$$

where ρ is the FWA traffic density at the service area (E/km^2), N_E is the total available FWA channels, and α_f, α_p are the antenna factors for FWA and PCS systems, respectively. The factors α_f and α_p provide adjustments to account for antenna directivity and sectorization. For instance, when an antenna with 120° azimuth angle is used, the antenna factors will be approximately equal to 1/3. In addition, we assume the area within r meter from the PCS antenna tower is of the "blind spot" where the PCS antenna normally shows a deep notch on its antenna gain. An example depicts the PCS and FWA overlapping scenario is illustrated in Figure 17.1. Note that if the WRSs are used to relay the signals between the FP and CTA or PP, the number of radio transmissions K calculated in Equation (17.3) will be increased.

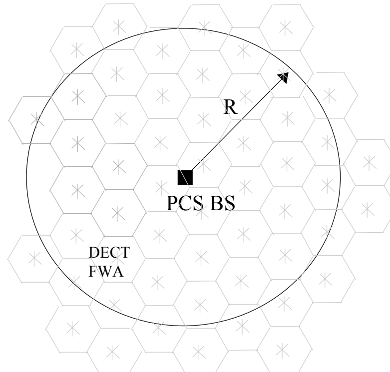


Figure 17.1 PCS and FWA Overlapping Scenario

To estimate the interference intensity, first, we need to understand the statistical properties of the radio traffics in FWA. In general, the call arrival rate per user is random and fairly small, but the total average arrival rate from the entire population, λ, may be large and could be modeled as the Poisson-distribution.

In characterizing the statistic model of the radio traffics and computing the distribution of the emitted interference intensity, it is necessary to determine the expected number of the calls been made simultaneously in the service area and how often other cases may occur. Applying the mean traffic value K (in Erlang) to the Poisson formula, the probability that there are m radio transmissions at a give time slot for a given frequency then can be found

$$P(m) = e^{-K}\frac{K^m}{m!} \tag{17.4}$$

With the given parameters such as the transmitter and receiver antenna gains, G_{tx} and G_{rx}, transmitter output power P_{tx} and the propagation loss at distance d_j, $L_{p(}d_{j)}$, we now are able to calculate the interference level received by the PCS BS,

$$I_j(dBm) = P_{tx}(dBm) - M(dBm) + 10\log_{10}\left(W_{pcs} / W_{fwa}\right) + G_{tx}(dBm) + G_{rx}(dBm) - L_p(d_j)(dBm) \tag{17.5}$$

where M is the attenuation for out-of-band transmission mask, W_{pcs} and W_{fwa} are the measurement bandwidths of PCS and FWA systems, respectively. The minimum requirements of several DECT unwanted RF emissions are listed in [25] including emissions due to modulation, emissions due to transmitter transients, emissions due to intermodulation and spurious emissions. For simplification purpose, we only consider the component of emissions due to modulation. However, it is not suggesting that other unwanted emissions are insignificant and can be ignored. The minimum requirements of emissions due to modulation are shown in Table 1.1 on Page 1

From Table 1.1 we notice that the level of interference received by the PCS receiver is most likely to be dominated by the emissions from the channel closest to PCS receiving band based on the assumption that the channel assignments and transmitter's location of DECT are uniformly distributed. Thus, only the transmissions due to modulation from DECT band edge channel is considered in this study. We have to keep in mind that these assumptions are for simplification purpose and may not be universal applicable for other cases and scenarios. For the DECT FWA operating in frequency 1910 MHz - 1930 MHz [1], the DECT carrier frequencies at two band edges are 1912.896 MHz and 1928.448 MHz, and the occupied bandwidth of each DECT channel is 1.728 MHz.

Assuming the FWA transmitters are uniformly distributed over the service area, the probability density function(pdf) of the separate distance between the j-th FWA transmitter and the PCS BS receiver can be approximated by [16]

$$\Pr(d_j) = \frac{2d_j}{R^2 - r^2}, \qquad r \le d_j \le R \tag{17.6}$$

The total interference power received by the PCS BS receiver from FWA is the sum of each individual FWA transmission I_j (in linear scale) from equation (17.5).

One of the indexes that is commonly used [1, 26, 27] in assessing the receiver performance degradation from external noise is the *rise in noise floor*. The rise in the affected receiver noise floor is defined as the ratio of the affected receiver noise floor plus the received external interference power to the noise floor. The noise floor includes thermal noise floor, noise figure and internal (self) interference. The index provides a good indication showing how much the receiver performance is suffered due to the increase of the external interference. The larger of the value the more performance degradation the system experiences.

The equations in determining the affective receiver noise floor for PCS IS-95 BS and PCS IS-136 BS are provided in [26]

$$N_{CDMAB} = N_T W_{CDMA} F_{CDMAB} M_I \tag{17.7}$$

and

$$N_{TDMAB} = N_T W_{TDMA} F_{TDMAB} \tag{17.8}$$

where N_T (-174 dBm/Hz) = thermal noise density,

F_{CDMAB} (6.2 dB [1]) = CDMA base noise figure referenced to the antenna connector,

M_I (3.8 dB corresponding to typical 58.3% loading) = receiver interference margin, a rise in the noise floor due to the interference from other CDMA users,

F_{TDMAB} (6.2 dB) = TDMA base noise figure referenced to the antenna connector,

W_{CDMA} (1.23 MHz) = IS-95 CDMA bandwidth,

W_{TDMA} (30 kHz) = IS-136 TDMA bandwidth.

The noise floor for CDMA and TDMA based on equation (17.8) are -103 dBm and -123 dBm, respectively. Using Equations (17.5) through (17.8), the rise in the base station noise floor can be expressed as a function of the user call density as well as geographic and frequency separations between the interfering sources and victim receiver.

17.1.3. Simulation Results

The first case is to study the interference impacts of the DECT FWA system to IS-136 PCS receiver with various maximum receivable distance, *R*. In real implementations, *R* could be varied by several factors like receiver sensitivity, interferer's output power, antenna design and channel conditions, etc. The parameters used to be applied to the simulations are shown in Table 17.1 and the following:
IS-136 PCS receiver[1]:

- PCS Rx band: 1930-1945 MHz
- FWA Tx Band: 1910-1930 MHz
- N_E: 120 Channels
- antenna gain: 15 dBi
- antenna height: 25 m
- minimum receivable range, *r*: 20 m

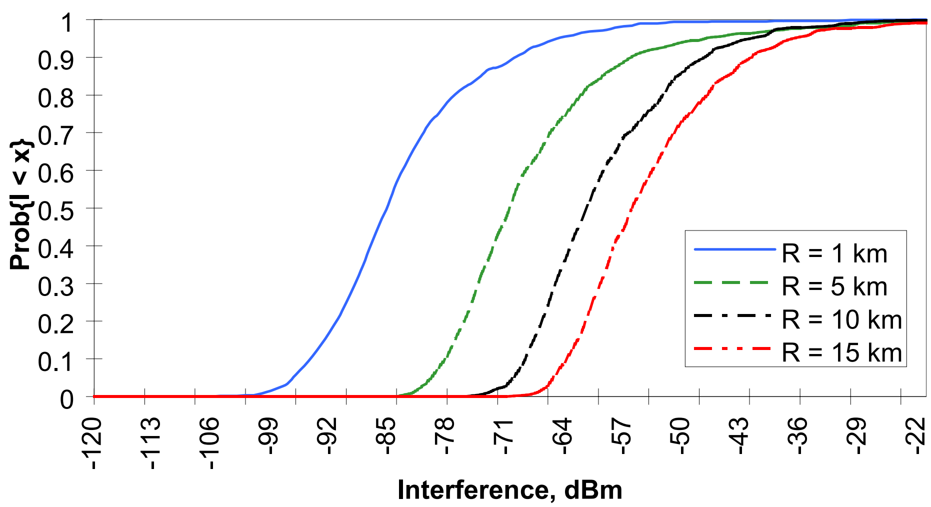


Figure 17.2 Interference CDF for business area

Simulations with different base station maximum receivable distance *R* ranged from 1 km to 15 km in the business area are performed. The cumulative distribution functions (CDF) of the interference are shown in Figure 17.2.

From Figure 17.2 we note that the interference level rises as the maximum receivable distance *R* increases, and gradually flatten out when R reaches to a relatively large value. This makes sense because the number of the transmissions 'seen' by the PCS receiver increases when *R* becomes larger. When the maximum receivable distance extends to a large range the additional interference sources located in far side become less significant such that they have very little effects on the total interference. The Monte Carlo analysis also shows that even with the case where the PCS receiver can only be interfered by DECT transmitters located no further than 1 km of distance, the interference level impinges upon the PCS receiver is still several tens of decibels higher than its affective receiver noise floor(see Equation (17.8)). For example, the mean values of the received interference for *R*=1, 5, 10, 15 km cases are 85, 71, 62 and 56 dBm respectively. This corresponds to a rise of 38, 52, 61 and 67 dB, respectively, in the receiver noise floor for IS-136. An increase on the receiver noise floor means less sensitivity in the receiver RF frond end which will result in the reduction on the service quality(QoS) and the service coverage area.

To analyze the adjacent channel interference for different service areas, a computer simulation with *R*=5 km is performed and the results are illustrated in Figure 17.3. It is clear from the results that the interference received by PCS receiver antenna is proportional to the FWA serving traffic density and has similar probability density functions in different service areas.

Compare the simulation results shown in Figure 17.3 and the value of the affective noise floor we notice that even in the area with very light traffic, e.g. rural area, 99% of the time that the IS-136 BS receiver suffers significant increases in its receiver noise floor caused by the out-of-band DECT FWA transmissions. Consequently, unless additional isolation between DECT FWA and PCS IS-136 is provided, the Grade-of-Service(GoS) of PCS systems will be greatly sacrificed.
In the study of how the wider frequency separation might affect the received interference, a scenario assuming an one MHz guard band is inserted into the DECT FWA is simulated. The simulation results show that the average interference received at IS-136 receiver in the business area drops about 22 dB.

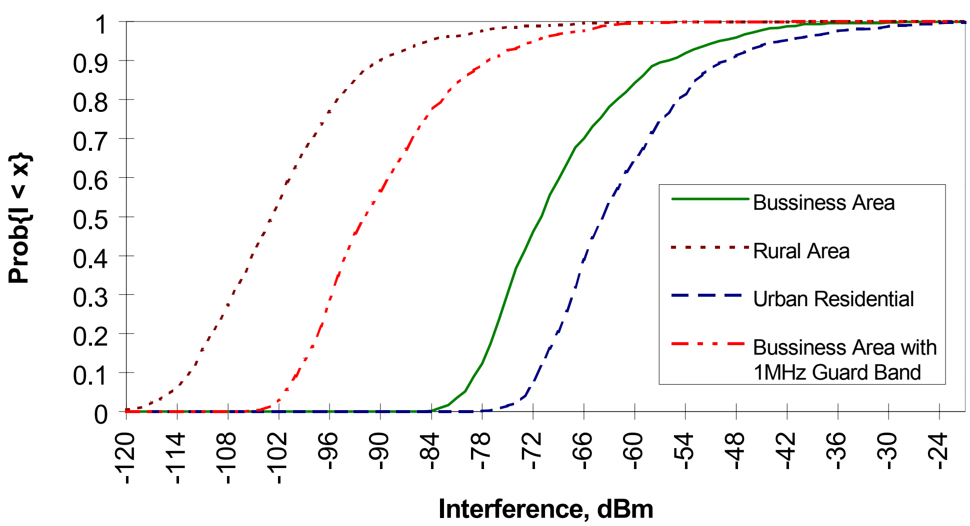


Figure 17.3 Interference CDF for varied service areas

It is a common practice and beneficial to calculate the rise in receiver noise floor while evaluating the receiver performance degradation caused by external interference. Results of the rise in receiver noise floor for IS-95 CDMA BS and IS-136 TDMA BS in the business area with the maximum receivable range R = 5 km are provided in Figure 17.4. In each case, total of 100,000 “snap shots” are taken during the simulations.

Similarly, the results show that both the IS-95 and IS-136 PCS will be unable to co-exist with the DECT FWA applications unless the DECT FWA systems are serving in a very light traffic density areas with a large separate distance to PCS receiver.

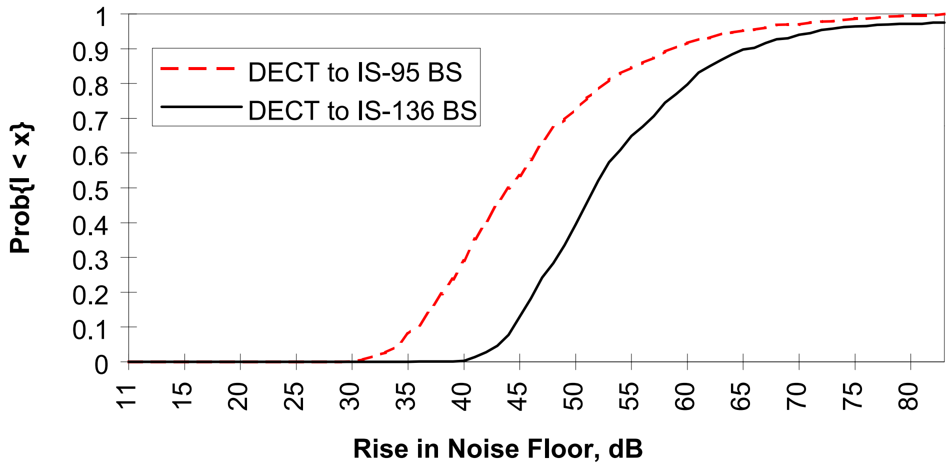


Figure 17.4 Rise in PCS BS receiver Noise Floor

17.1.4 Conclusions

An analysis uses the statistic properties of the large scale FWA operations combining with *Monte Carlo* simulations to study the adjacent channel interference from DECT FWA to PCS BS is provided in this report.

Simulation results based on various system specifications such as different service areas and maximum receivable distance are generated. In addition, the rise in receiver noise floor for IS-95 and IS-136 for a typical business area are also presented.

From the simulation results we conclude that the system performance of the FDD PCS is expected to be greatly impaired by the neighboring DECT FWA while they are operating in the adjacent frequency bands. A guard band or wide geographical separation may be needed.

To complete the study, future work on the interference analyses for PCS mobiles is also required.

17.2. AENS VIEW

Apart of the great amount of errors, inaccuracy and wrong assumptions made in the calculation process included in report [20], which will be detailed later, the main point against this report is that it includes a non-agreed methodology, not only related to the quantification calculation method (Monte Carlo technique) but, mainly, because it includes neither agreed assumptions nor a complete set of scenarios to make comparisons among them (it just analyses the scenario of DECT as interferer and IS-95 and IS-136 base stations as victims).

It is obvious that Monte Carlo simulation technique is one the possibilities to analyse the interference between two systems, however, depending on how to implement it, it could be more or less efficient and accurate than any other. In our opinion, the "worst case analysis" which is included in report [1] is more accurate than the proposed one in [20], specially if taken into account the considerably number of errors contained in [20]. The accuracy of [1] is much higher because it allows a coherent comparative analysis that can not be done by the data contained in [20]. It should be note that in both methodologies ([1] and [20]) the absolute values of the interference levels are approximations to the reality, thus the accuracy can appear only if a comparative analysis between different scenarios (some of then well-known and experienced, i.e. PCS-to-PCD interference) can be carried out.

From this point of view, it is not necessary to implement a new methodology as proposed in [20], and no further work by the Experts Group is needed.

Errors in report PCC.III/964/98 [20]

NOTE: It is not intention of the DECT/PHS proponents that the description of the following errors serve to validate the methodology described in [20] by correcting them. Even when following errors were corrected, in our opinion the use of this methodology is not required. The following errors list tries only to show what different results can be obtained applying the same (or similar) methodology to a different set of assumptions, and to demonstrate that only a comparative analysis can provide a reliable conclusion.

The following errors and incorrect assumptions have been found in [20]:

- The analysis tries to quantify the interference from DECT FWA system towards PCS base stations, and to do that, it assumes that PCS system is located in A-band. This is an great error, since the PCS base stations in A-band does not suffer any interference from any TDD system located in 1910-1930 MHz band. THE RECEPTION BAND FOR A PCS BASE STATION ALLOCATED IN THE A-BAND IS 1850-1865 MHz WHICH IS FARTHER ENOUGH TO AVOID INTERFERENCE FROM 1910-1930 MHz. (In document it is said the PCS RX band is 1930-1945 MHz, which is only valid for PCS terminals allocated in A-band). It could be a simple typographic mistake, but in that case:
  1. If the intention is to analyse the interference on the PCS mobiles, instead of on the PCS base stations, then the value of the RX antenna gain for PCS can not be 15 dB as stated in document but 0 dB, and the RX antenna height can not be 25 m, as stated in document but 1.5m, which reduces drastically the Fresnel breakpoint (from about 6300m. down to 380m), and it means that propagation losses will be much higher since the "slope" with factor 4 in the propagation model is achieve much before.
  2. If the intention is to analyse the interference on the PCS base station, but in C-band, instead of in A-band, that is, in the PCS RX band 1985-1910 MHz, then the adjacent DECT channel should be 1912.896 MHz, instead of 1928.488. It means a frequency separation which is 1.384 MHz larger than the considered in [20], and it could provide around 15 dB additional attenuation for interfering signal due to the DECT mask, than the used in calculations in [20].

3. IN ANY OF ABOVE CASES, THE RESULT FOR INTERFERING SIGNAL WILL BE, AT LEAST, 15 dB LOWER, BUT PROBABLY HIGHER DIFFERENCE WOULD BE OBTAINED, AND JUST ONLY FOR THIS CORRECTION.

- The TX power values for DECT described used in table 1 of document [20] are wrong. The nominal transmission power for DECT, FOR ALL SCENARIOS, is equal to 24 dBm (as used in report [1]).
- The values assumed for traffic density in Business and Residential areas are excessive (as already explained in section 1b. of the current document). It is likely than the real values for this parameter will be about 5 to 10 times lower than the expressed ones in [20], specially taken into account that such proposed traffic values can not be applied in areas with 5, 10 or 15 Km. or radius from the victim receiver, as used in graphics of [20].
- The provided graphics seems not to take into account the probability of having "m" simultaneous transmissions (i.e., probability given by equation 2.4). As a example of the effect of this equation see the following:
  - Assume a traffic density of 150 Erl/km^2 for business area as stated in [20]
  - Assume antenna beam-width of 90º for DECT as stated in [20]
  - Assume antenna beam-width of 105º for PCS BS as stated in [1]
  - Assume a value of r=20 m., as stated in [20]
  - Assume a value of R=1 Km. as one proposed in [20]
  - With N=120 DECT channels, the value of K, as stated in equation 2.3 of [20] will be equal to **K = 0.29**
  - With this value of K, the equation 2.4 of [20] gives the following probabilities:
    - ➢ P(0) = **75.11 % = probability of having 0 !! transmissions**
    - ➢ P(1) = 21.50 % = probability of having only 1 transmission
    - ➢ P(2) = 3.08 % = probability of exactly 2 simultaneous transmissions
    - ➢ P(>2) = 0.31% = probability of > 2 simultaneous transmissions
  - Thus the MOST PROBABLE CASE (75.11%) IS THAT THERE IS NOT ANY INTERFERING TRANSMISSION, which is a complete different information than the one shown in graphic 3.1 of [20].
- The calculations in [20] do not take into account several relevant radio parameters which have been taken into account in [1], such as: Losses due to vertical radiation pattern of antennas (which could be very high, specially in short distances), losses due to horizontal radiation patterns (even when both antennas are on-beam, there could be up to 6 dB of losses, 3 dB per antenna TX and RX. In [1] it was assumed 1+1 dB, for this reason), feeder losses, in-band reference bandwidth for emission masks, Receiver sensitivity of the victim device, C/I ratio of the victim system, etc.
- The values of noise floor for PCS IS-95 BS and PCS IS-136 BS given in [20] are not agreed by Experts Group. Moreover, in the calculation of rise in the noise floor, made in [20], it had not taken into account properly the internal interference of the own PCS system. This is the reason for the excessive values of rise in the noise floor given in the paper [20]
- It is mentioned in [20] that *"if WRS is used to relay the signals between FP and CTA or PP, the number of transmissions K calculated in (2.3) should be doubled"*. This statement is false, since the use of WRS is just to cover special areas where normally BS transmissions do not cover (or it is desired to not be covered due to traffic considerations), and then, the total

generated traffic is almost equal (probably higher due to WRS management traffic, but never the double)

The above list of errors are enough to invalidate any conclusion as the reported ones in [20] (obviously, calculations in [20] are clearly tendentious), but, essentially, they demonstrates that analysis performed in [1] is more accurate that the proposed by this document.

As already mentioned above, in our opinion, the “worst case analysis” which is included in report [1] is more accurate than the proposed one in [20], specially if taken into account the considerably number of errors contained in [20].

The accuracy of [1] is much higher because it allows a coherent comparative analysis, independent of the absolute values which could be calculated by any methodology. The main condition for any methodology is to be coherent and to use a homogeneous set of parameters for all the scenarios.

FROM THIS POINT OF VIEW, IT IS NOT NECESSARY TO IMPLEMENT A NEW METHODOLOGY AS PROPOSED IN [20], AND NO FURTHER WORK BY THE EXPERTS GROUP IS NEEDED.

However, and trying to provide the maximum information as possible, an alternative viewpoint about the interference from DECT systems to IS-95 and IS-136 systems is also provided in document PCC.III/998/98 [21], which presents, as additional information to report [1], a more detailed study regarding this matter. It analyses in absolute terms a real scenario where the effect of the activity factor of the DECT interferer and up-link power control of the PCS system is included. In this scenario [21], as low as 100m separation between FWA base and PCS base have almost no influence on the PCS system traffic.

18. APPENDIX: RESULTS

18.1. LMNQ VIEW

Table II.C.3.2 Assuming that fading is removed from calculation

Path Loss	Victim->	PCS1900	PCS1900	IS95	IS95	IS136	IS136	DECT	DECT	PHS	PHS
InterfererV		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS1900	BS	NA	131.4	NA	103.6	NA	145.1	103.7	104.2	93.8	103.1
PCS1900	Term	120.5	NA	114.1	NA	111.0	NA	81.0	78.9	85.3	86.7
IS95	BS	NA	137.8	NA	120.8	NA	138.6	119.5	119.6	120.0	127.3
IS95	Term	122.8	NA	118.7	NA	121.6	NA	95.1	94.6	92.7	98.0
IS136	BS	NA	116.5	NA	110.2	NA	132.5	111.7	111.8	97.8	106.3
IS136	Term	131.7	NA	134.6	NA	130.5	NA	112.4	112.5	101.6	106.9
DECT	BS	109.4	116.8	112.0	108.3	108.2	117.6	134.9	135.0	99.3	106.6
DECT	Term	109.5	116.9	112.1	107.8	108.3	117.7	135.0	135.1	99.4	106.7
PHS	BS	107.2	88.4	98.0	82.1	112.5	92.2	79.8	83.6	102.4	109.7
PHS	Term	111.5	88.2	103.9	78.8	116.8	92.8	85.1	84.2	106.7	114.0

Table II.C.2.2 Assuming that fading is removed from calculation **Fading Removed=** **yes** **Desensitization=** **1.0**

Distance	Victim->	PCS1900	PCS1900	IS95	IS95	IS136	IS136	DECT	DECT	PHS	PHS
InterfererV		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS1900	BS	NA	6651.5	NA	1345.6	NA	14661.2	1898.3	2010.8	604.9	1764.6
PCS1900	Term	3555.7	NA	2461.3	NA	2061.4	NA	140.1	110.0	230.9	269.7
IS95	BS	NA	9633.3	NA	3616.4	NA	10064.1	10623.7	7803.3	10921.4	12141.6
IS95	Term	4062.3	NA	3208.3	NA	3782.5	NA	637.3	452.2	540.9	551.9
IS136	BS	NA	2821.0	NA	1960.6	NA	7077.8	4784.3	4839.7	959.6	2553.4
IS136	Term	6778.7	NA	8001.1	NA	6311.7	NA	1724.7	1266.8	929.4	920.9
DECT	BS	3687.8	2226.3	4988.9	1361.7	3197.0	2325.9	19979.6	14675.3	1149.3	2663.4
DECT	Term	3730.5	1635.3	5046.6	966.2	3234.0	1708.4	14675.3	10779.2	1162.6	2101.8
PHS	BS	2873.3	326.8	995.7	157.8	5282.7	501.0	121.7	188.4	1646.8	3424.9
PHS	Term	4714.0	314.2	1963.9	107.9	6646.2	407.3	223.9	201.9	2701.6	3203.7

Table II.C.3.1 Assuming that fading is included in calculation

Path Loss	Victim->	PCS1900	PCS1900	IS95	IS95	IS136	IS136	DECT	DECT	PHS	PHS
InterfererV		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS1900	BS	NA	124.4	NA	97.0	NA	138.1	93.9	94.6	44.7	93.5
PCS1900	Term	114.3	NA	107.1	NA	104.0	NA	46.0	68.4	52.7	76.6
IS95	BS	NA	130.8	NA	114.6	NA	131.6	109.5	109.6	110.0	117.3
IS95	Term	115.8	NA	112.5	NA	115.4	NA	85.9	84.5	86.0	88.0
IS136	BS	NA	110.3	NA	103.2	NA	125.5	101.7	102.6	84.2	97.1
IS136	Term	124.7	NA	127.6	NA	123.5	NA	103.0	102.5	92.5	96.9
DECT	BS	102.4	110.4	105.0	101.3	101.2	110.6	124.9	125.0	89.3	96.6
DECT	Term	103.3	109.9	105.1	100.8	102.1	110.7	125.0	125.1	91.4	96.7
PHS	BS	99.0	83.5	89.3	50.9	105.5	86.8	69.8	77.0	92.4	99.7
PHS	Term	104.5	81.1	97.3	71.5	109.8	85.7	76.0	74.2	96.7	104.0

Table II.C.2.1 Assuming that fading is included in calculation — **Fading Removed=** **no** — **Desensitization=** **1.0**

Distance	Victim->	PCS1900	PCS1900	IS95	IS95	IS136	IS136	DECT	DECT	PHS	PHS
InterfererV		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS1900	BS	NA	4445.5	NA	869.7	NA	9798.7	614.3	665.8	2.1	584.3
PCS1900	Term	2488.4	NA	1645.0	NA	1377.7	NA	2.5	32.8	5.4	84.3
IS95	BS	NA	6438.4	NA	2530.9	NA	6726.3	3698.9	3741.8	3907.3	6827.7
IS95	Term	2715.0	NA	2245.3	NA	2647.1	NA	245.2	208.7	250.1	310.3
IS136	BS	NA	1974.2	NA	1310.4	NA	4730.4	1512.9	1678.1	200.5	885.3
IS136	Term	4530.5	NA	5347.5	NA	4218.4	NA	1004.0	712.4	525.3	517.9
DECT	BS	1647.3	1540.2	2228.4	910.1	1428.0	1554.5	11235.4	8252.5	363.4	842.2
DECT	Term	1827.1	1092.9	2254.3	645.8	1583.9	1141.8	8252.5	6061.6	462.8	852.0
PHS	BS	1117.9	185.9	365.7	4.3	2359.7	269.0	38.5	87.6	520.7	1206.8
PHS	Term	2105.6	141.0	918.6	46.6	3871.3	237.0	78.5	63.8	854.3	1801.5

Table II.C.3.2 Assuming that fading is removed from calculation (0.5 dB desense)

Path Loss	Victim->	PCS1900	PCS1900	IS95	IS95	IS136	IS136	DECT	DECT	PHS	PHS
InterfererV		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS1900	BS	NA	134.6	NA	106.9	NA	148.4	107.0	107.1	97.1	105.6
PCS1900	Term	123.8	NA	116.6	NA	114.3	NA	83.9	82.2	87.2	90.0
IS95	BS	NA	141.1	NA	124.1	NA	141.8	122.8	122.9	123.3	130.6
IS95	Term	126.1	NA	122.0	NA	124.8	NA	98.3	97.8	96.0	101.3
IS136	BS	NA	119.7	NA	113.4	NA	135.7	115.0	115.1	102.3	109.6
IS136	Term	135.0	NA	137.9	NA	133.7	NA	115.6	115.7	104.9	110.2
DECT	BS	112.7	120.1	115.3	110.9	111.4	120.8	138.2	138.3	102.6	109.9
DECT	Term	112.8	120.2	115.4	111.0	111.5	120.9	138.3	138.4	102.7	110.0
PHS	BS	110.5	90.9	102.5	84.5	115.8	93.7	83.1	86.0	105.7	113.0
PHS	Term	114.8	91.5	106.8	82.1	120.1	96.0	88.0	87.5	110.0	117.3

Table II.C.2.2 Assuming that fading is removed from calculation (0.5 dB desense **Fading Removed=** **yes** **Desensitization=** **0.5**

Distance	Victim->	PCS1900	PCS1900	IS95	IS95	IS136	IS136	DECT	DECT	PHS	PHS
InterfererV		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS1900	BS	NA	8028.0	NA	1624.1	NA	17695.3	2765.3	2797.3	881.1	2344.4
PCS1900	Term	4291.5	NA	2837.0	NA	2488.0	NA	194.9	160.2	284.6	346.7
IS95	BS	NA	11626.9	NA	4364.8	NA	12146.9	12822.2	9418.1	13181.5	14654.2
IS95	Term	4903.0	NA	3872.3	NA	4565.2	NA	769.2	545.8	672.3	666.1
IS136	BS	NA	3404.7	NA	2366.4	NA	8542.5	6969.3	6023.3	1605.0	3719.5
IS136	Term	8181.5	NA	9656.8	NA	7617.9	NA	2081.7	1529.0	1121.8	1111.5
DECT	BS	5372.0	2687.0	7267.4	1587.7	4657.1	2807.2	24114.3	17712.2	1674.2	3453.6
DECT	Term	5262.6	1973.7	6119.2	1166.2	4711.0	2061.9	17712.2	13009.9	1693.6	2536.7
PHS	BS	4185.6	434.2	1665.3	207.2	7695.4	589.6	177.2	248.9	2398.8	4133.7
PHS	Term	5915.7	379.2	2732.1	157.2	8021.6	491.6	311.5	294.1	3478.0	3866.6

18.2. AENS VIEW

ANNEX. Results Summary Tables obtained with the Spreadsheet AENScalc.XLS, with 1 dB of desensitization

II.C.2.1. Required distances assuming that fading is included in calculations (in m.)

Distance	Victim →	**PCS1900**		**IS95**		**IS136**		**DECT**		**PHS**	
Interferer ↓		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS1900	BS	†	4445	†	870	†	9799	614	666	2,1	584
	Term	2488	†	1645	NA	1378	†	2,5	33	5,4	84
IS95	BS	†	6438	†	2531	†	6726	3699	3742	3907	6828
	Term	2715	†	2245	NA	2647	†	245	209	250	310
IS136	BS	†	4531	†	3007	†	4733	110	151	0,3	0,7
	Term	4531	†	5347	NA	4218	†	2,6	34	1,2	13
DECT	BS	1125	917	653	199	1088	1043	*	*	*	*
	Term	1220	651	708	164	1180	740	*	*	*	*
PHS	BS	1118	186	366	4,3	2360	269	*	*	*	*
	Term	2106	141	919	47	3871	237	*	*	*	*

* Not applicable

† Not critical

II.C.2.2. Required distances assuming that fading is removed from calculation (in m.)

Distance	Victim →	**PCS1900**		**IS95**		**IS136**		**DECT**		**PHS**	
Interferer ↓		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS1900	BS	†	6652	†	1346	†	14661	1898	2011	605	1765
	Term	3556	†	2461	NA	2061	†	140	110	231	270
IS95	BS	†	9633	†	3616	†	10064	10624	7803	10921	12142
	Term	4062	†	3208	NA	3782	†	637	452	541	552
IS136	BS	†	6779	†	4499	†	7082	489	555	1,1	300
	Term	6779	†	8001	NA	6312	†	142	113	3,8	59
DECT	BS	2462	1372	1429	412	2381	1533	*	*	*	*
	Term	2490	974	1585	339	2408	1107	*	*	*	*
PHS	BS	2873	327	996	158	5283	501	*	*	*	*
	Term	4714	314	1964	108	6646	407	*	*	*	*

* Not applicable

† Not critical

II.C.3.1. Path Losses assuming that fading is included in calculations (in dB)

Path Loss Victim →		**PCS1900**		**IS95**		**IS136**		**DECT**		**PHS**	
Interferer ↓		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS1900	BS	†	124,4	†	97,0	NA	138,1	93,9	94,6	44,7	93,5
	Term	114,3	†	107,1	†	104,0	†	46,0	68,4	52,7	76,6
IS95	BS	†	130,8	†	114,6	NA	131,6	109,5	109,6	110,0	117,3
	Term	115,8	†	112,5	†	115,4	†	85,9	84,5	86,0	88,0
IS136	BS	†	124,7	†	117,6	NA	125,5	78,9	81,7	28,7	35,0
	Term	124,7	†	127,6	†	123,5	†	46,2	68,6	39,7	60,5
DECT	BS	99,1	101,4	94,4	84,2	98,8	103,6	*	*	*	*
	Term	99,8	100,9	95,1	82,5	99,5	103,1	*	*	*	*
PHS	BS	99,0	83,5	89,3	50,9	105,5	86,8	*	*	*	*
	Term	104,5	81,1	97,3	71,5	109,8	85,7	*	*	*	*

* Not applicable

† Not critical

II.C.3.2.Path Losses assuming that fading is removed from calculation (in dB)

Path Loss Victim →		**PCS1900**		**IS95**		**IS136**		**DECT**		**PHS**	
Interferer ↓		BS	Term	BS	Term	BS	Term	BS	Term	BS	Term
PCS1900	BS	†	131,4	†	103,6	NA	145,1	103,7	104,2	93,8	103,1
	Term	120,5	†	114,1	†	111,0	†	81,0	78,9	85,3	86,7
IS95	BS	†	137,8	†	120,8	NA	138,6	119,5	119,6	120,0	127,3
	Term	122,8	†	118,7	†	121,6	†	95,1	94,6	92,7	98,0
IS136	BS	†	131,7	†	124,6	NA	132,5	91,9	93,0	38,7	87,7
	Term	131,7	†	134,6	†	130,5	†	81,1	79,1	49,7	73,5
DECT	BS	105,9	108,4	101,2	90,5	105,6	110,3	*	*	*	*
	Term	106,0	107,9	102,1	89,6	105,7	110,1	*	*	*	*
PHS	BS	107,2	88,4	98,0	82,1	112,5	92,2	*	*	*	*
	Term	111,5	88,2	103,9	78,8	116,8	92,8	*	*	*	*

* Not applicable

† Not critical

19. TABLE OF REFERENCES

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Part 3

COEXISTENCE BETWEEN FWA AND UPCS ISOCHRONOUS EQUIPMENT IN THE 1910-1930 MHZ BAND

Document PCC.III/doc.922/97 (IX-97)

IX MEETING OF PERMANENT
CONSULTATIVE COMMITTEE III:
RADIOCOMMUNICATIONS
September 22 to 26, 1997
México City, México

Part 3.

COEXISTENCE BETWEEN FWA AND ISOCHRONOUS UPCS EQUIPMENT ON THE BAND 1910-1930 MHZ

1. INTERFERENCE ANALYSIS BETWEEN UPCS AND FWA

1.1. THE FCC UPCS ETIQUETTE RULES CONSIST OF TWO INCOMPATIBLE SETS OF RULES

The FCC UPCS Etiquette contains two etiquette rules, one for asynchronous devices (1910 - 1920 MHz) and one for isochronous devices (1920 - 1930 MHz). These rules are so incompatible that if for instance an asynchronous (data) device and an isochronous device (speech) are used on the same desk in an office, the speech service will be severely interfered all the time. This is a fact widely recognised, and is further amplified by the unfortunate (isochronous) packing rules. EIA/TIA 41.6 is studying this matter, to see which improvements to propose.

Besides, the Asynchronous rules are really not needed to support data, since modern standards do not need separate rules to support both speech and data. DECT and PWT support both speech and packet data up to 552 kbps. Furthermore, there seems to be no asynchronous devices developed for the 1910 - 1920 MHz band. Instead asynchronous devices have been developed for the 2.4 and 5 GHz bands where more free bandwidth is available. Therefore, we do not foresee Asynchronous devices in the 1910 - 1930 MHz to occur in Latin America, nor legally or illegally.

1.2. COEXISTENCE BETWEEN FWA AND UPCS ISOCHRONOUS DEVICES

Analysing the interference between FWA with Dynamic Channel Selection , DCS; and isochronous UPCS is much simpler than between FWA and PCS or PCS and PCS.

The reasons are

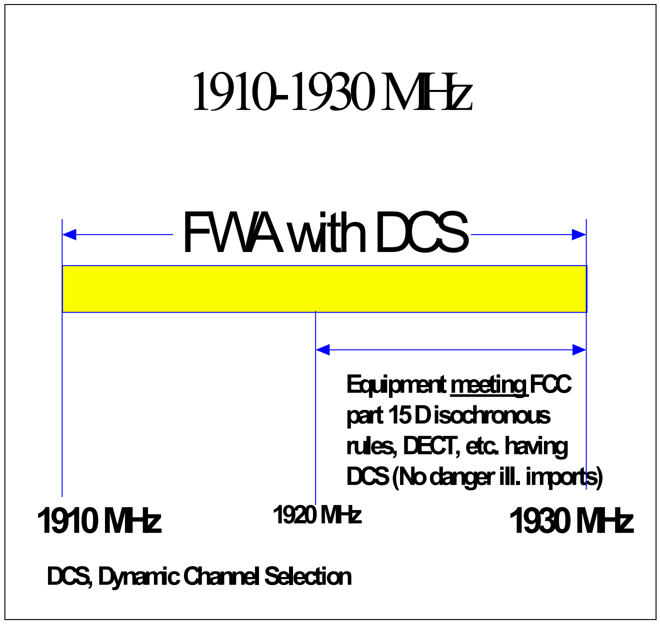
a) that both FWA with DCS and the isochroconous UPCS systems are designed to provide reliable services in an environment with several systems charring the same spectrum, and
b) that DECT, PHS(traffic channels) and isochronous UPCS Etiquette devices use the same basic channel access mechanisms. These channel access mechanisms are designed to permit sharing of spectrum in a frequency and time domain.

- listen for 10 ms before talking
- frame duration is a sub-multiple of 10 ms
- access channels are defined as a frequency & time slot combination

Therefore DECT, PHS(traffic channels) and isochronous UPCS Etiquette approved devices can coexist on the band 1920-1930 MHz. The figure below illustrates this.

This means that Private Cordless equipment meeting the FCC Part 15 Isochronous rules, the DECT standard or the PHS standard can coexist (except for the PHS control channel) in the band 1920 - 1939 MHz, and they can also coexist with FWA systems, if the FWA systems comply to the DECT, PWT(E) or PHS standards (except for the PHS control channel). A frequency hopping FWA system (as the Multigain

Tadiran TDD FWA technology) can not coexist, since DCS is not used. DECT and PWT/PWT(E) coexist so well, that no efficiency loss occur.

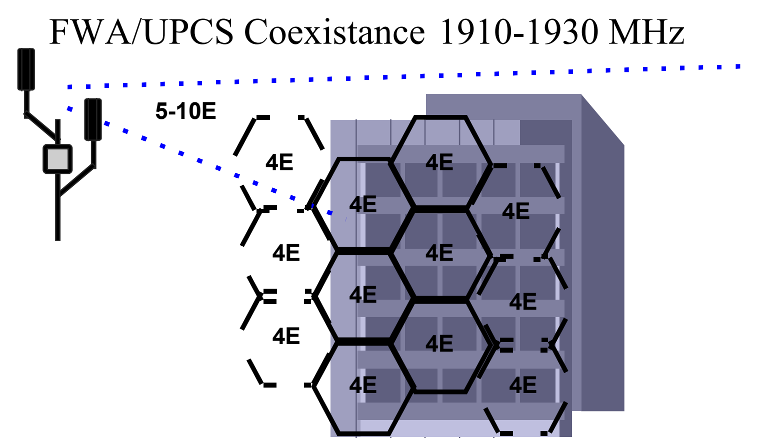


1.2.1. Coexistence between Public and Private Systems, all Using DCS

Coexistence between Public and Private Systems, all Using DCS, is no new idea. It is implemented and proven by both the DECT standard and the PHS standard. The figure below gives a simple example illustrating this.

A high density DECT base with 6 sector antenna arrangement, could typically radiate the wall of a high building with 10-15 E average traffic. Half of those will fall in the band 1920 - 1930 MHz. Therefore 5-10 E has been indicated in the figure.

The Private systems have been designed to cover very large buildings by many rows of cells in three dimensions. ***The figure below illustrates that the interference from a nearby FWA DECT base does not interfere more than an other row of internal cells, which the private system anyhow is designed to coexist with.***



FWA interferes less than another row of UPCS cells does. FWA site with 6 sector antenae arragement with totally 60E as an example.

2. ANALYSIS

Suppose the closest DECT Base is only 100m away and one side of a building is directly in the beam. Since the base is so close by, we can assume that the contribution from other bases can be disregarded.
The power from the DECT base just inside the wall is:
24 dBm (Tx power)+ 12 dBm (antenna gain) -38 dB -40 dB (line of sight) + 15 dB (wall penetration) = -57 dBm.

The power from an indoor cell will be:
20 dBm (PWT) + 3dB (antenna gain) -38 dB - 30logd. This indoor cell will give the same power as the DECT base (-57 dBm) for d = 25 m. In an open indoor shopping centre d could approach 100m.

If every person in an office has a cordless phone, the traffic density will be about 0.2 E per 20 sqm. PWT can support 4 E per base in an infinite grid. To provide this traffic density the PWT base station separation will be 20 m in a rectangular grid, and cell radii of about 10 m. It is quite obvious that the radiation from the FWA DECT system is lower that from a row of internal cells. Therefore interference from FWA to Private office systems is not critical.

Similarly, interference from a private system to FWA will not be critical, since if a specific sector has a high close by building full with cordless phone facing it, it will not be hard for this sector to find say 5 escape channels in the 1910 - 1920 MHz band where no private systems exist.

3. CONCLUSION

Applying DECT or PHS FWA in the band 1910 - 1930 MHz, does not from a coexistence perspective prevent a regulator to allow private Cordless systems in the band 1920 - 1930 MHz, if this private equipment conforms to the DECT standard TBR06, the FCC Part 15 Isochronous rules, or the PHS standard RCR-STD28.

This conclusion avoids unwanted trade barriers without compromising coexistence between private systems. This also means that illegal imports of UPCS equipment from the US will not cause coexistence problems for FWA systems operating in the band 1910-1930 MHz.

Part 4

SEMINAR ON "RESULTS OF THE CITEL STUDY TO QUANTIFY ISSUES OF INCOMPATIBILITY BETWEEN FWA AND PCS IN THE 1850-1990 MHZ BAND"

Thursday, June 11, 1998

Coordinators:

Mr. Gustavo Miranda (Costa Rica)
Mr. Charles Breig (United States of America)

Note: Documents are printed in the original Language.

X MEETING OF PERMANENT CONSULTATIVE COMMITTEE III: RADIOCOMMUNICATIONS
June 8 to 12, 1998
Natal, Brazil

Part 4.

CALENDAR SEMINAR "RESULTS OF THE CITEL STUDY TO QUANTIFY ISSUES OF INCOMPATIBILITY BETWEEN FWA AND PCS IN THE 1850-1990 MHZ BAND"

Thursday June 11, 1998 2:30-6:30 pm

First Part

1. **Opening**
   Mr. Gustavo Miranda (Costa Rica) *(5 minutes)*

2. **Introduction by the Chair of the Working Group**
   Mr. Héctor Budé (Uruguay) *(15 minutes)*

3. **General Technical Report by the Chair of the Experts Group**
   Mr. William Cruz (Lucent Technologies) *(20 minutes)*

4. **Interpretation of Results in Document PCC.III/doc.935/97**

   4.1 **Point of View of FWA-DECT**
   Mr. Alexander Carrizo (Ericsson) *(20 minutes)*

   4.2 **Point of View of FWA PHS**
   Mr. Toru Hojo (NEC) *(20 minutes)*

   4.3 **Point of View of PCS**
   Mr. Juan Santiago (Motorola) *(20 minutes)*

Second Part

5. **Analytical Methodology applied by the experts. Models, parameters, methods and tools**
   Mr. Arturo Custodio (Alcatel) *(20 minutes)*
   Mr. Andy Mc Gregor (NORTEL) *(20 minutes)*

6. **Additional issues (low-power PCS-FWA and others)**

   6.1 **FWA Vision**
   Mr. Günter Kleindl (Siemens) *(20 minutes)*

   6.2 **Low power PCS vision**
   Mr. William Cruz (Lucent Technologies) *(20 minutes)*

7. **End of the Seminar, Questions and Answers** *(15 minutes)*

Presentation: Introduction of the Chair of the Working Group

Presentación: Introducción por el Presidente del Grupo de Trabajo

Mr. Héctor Budé
(Uruguay)

(Document CCP.III/doc.1045/98)

GRUPO DE TRABAJO PARA CUANTIFICAR CUALQUIER TEMA DE INCOMPATIBILIDAD ENTRE FWA Y PCS EN LA BANDA 1850-1990 MHz.

ANTECEDENTES

- DONDE?????
- Grupo de Trabajo sobre Servicios Móviles Terrestres

- CUANDO???
- Marzo 1995 - Paraguay
- Agosto 1995 - Brasil

CREACION

- Diciembre 1996 - Acapulco, México
- Autoridades:
- - 1 PRESIDENTE
  - 2 VICEPRESIDENTES -
    - » Michael Lynch - Nortel
    - » Marco Rodolfo Perez - Ericsson Colombia

TERMINOS DE REFERENCIA

- Proporcionar la información resultante de los estudios de incompatibilidad entre FWA y PCS en la banda 1850-1990 MHz.

TERMINOS DE REFERENCIA

- Se incluirán los siguientes temas, aunque no se limitarán a los mismos:
- a.- asuntos relacionados con el uso de tecnologías FWA y PCS en bandas adyacentes
- b.- asuntos relacionados con el uso compatible de la banda 1910-1930 MHz. por los sistemas FWA y UPCS.

TERMINOS DE REFERENCIA

- c.- asuntos relacionados al uso compatible de tecnologías FWA en la misma banda.

En otras palabras:

FWA-PCS

FWA-UPCS

FWA-FWA

IMPORTANTE

- RECOMENDACIONES 11 y 12 - AGOSTO 1995 (III-95) Uso banda 1850-1990 para PCS
- RECOMENDACION 26 - SETIEMBRE 1997 (VI-97) Uso diversas bandas para FWA

REUNIONES LLEVADAS A CABO

- 1997

Isla Margarita - marzo.

Se decidió la creación del Grupo de Expertos

» Brasil - junio

» Mexico - setiembre

RESULTADOS OBTENIDOS
HASTA EL MOMENTO

DOCUMENTO 935

RESULTADOS OBTENIDOS

Beneficios para la región.

Presentation: Incompatibility Issues between FWA and PCS Systems Report

Mr. William Cruz
(Lucent Technologies)

(Document PCC.III/doc.1037/98)

Incompatibility Issues between FWA and PCS Systems Report

William Cruz
Chair of Interference Experts Group
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wcruz@lucent.com

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Overview

- Background
- Objective and Scope
- Methodology
- Results
- Open Issues

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Background

- March 1997 Meeting in Cartagena there were multiple contributions
  - calculating the separation distances needed between FWA and PCS devices to prevent interference. (PCC.III-609 (US),633,634 (NEC)).
  - On co-channel interference between UPCS and FWA
- Problem: The contributions used different models and assumptions and led to different results.
- Solution: Establishment of the Working Group to Quantify any incompatibility Issues between FWA and PCS in the range of 1850-1990.

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Background

Terms of reference:

- To provide a report on the results of the study on incompatibility between FWA and PCS in the 1850-1990 MHz band. The following topics shall be included:
  - Issues related to the use of FWA and PCS in adjacent bands.
  - Issues related to the compatible use of the 1910-1930 MHz band by both FWA and UPCS systems.
  - Issues related to the compatible use of FWA technologies in the same band.

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Report

- The report PCC.III-935/97 starts to address the first item of the terms of reference:
  - Issues related to the use of FWA and PCS in adjacent bands
  - work is incomplete.
- The report PCC.III-935/97 does not address the following two items in the terms of reference:
  - Issues related to the compatible use of the 1910-1930 MHz band by both FWA and UPCS systems
  - Issues related to the compatible use of FWA technologies in the same band.

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Objective

- Quantify the Interference between:
  - FWA TDD systems in 1910-1930 MHz and PCS Systems operating in 1850-1910, 1930-1990 MHz
  - FWA TDD system and UPCS Systems operating in the same band, 1910-1930 MHz.
- A second priority is to quantify the interference between:
  - PCS systems and PCS systems operating in adjacent frequency sub-bands (1850-1910, 1930-1990 MHz)
  - FWA TDD systems and FWA TDD systems operation in the same band (1910-1930 MHz)
- Items (1) and (3) have started to be addressed.

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Scope

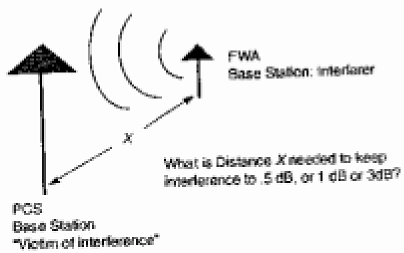
The following Systems were targeted for analysis:

- PCS Systems
  - PCS1900
  - IS-95 (CDMA)
  - IS-136 (TDMA)
- FWA Systems
  - DECT
  - PHS
- UPCS Systems
  - PCI
  - PACS-UA,PAC-UB
  - PWT

Methodology for adjacent Channel Interference

- Chose a level in the "Rise in the Noise Floor"(Examples+ .5 dB, 1 dB or 3 dB)
- Calculate the signal attenuation required on the air interface to get the chosen level in "Rise in Noise Floor"
- Calculate the minimum distance separation needed to achieve this signal attenuation.

Methodology



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Methodology for adjacent Channel Interference

- Assumes the two systems are using the adjacent channel
- Uses emissions due to the modulation mask.
  - Does not consider:
    - out of band emissions
    - spurious emission
    - etc.
- Considers only one interferer
- There was disagreement on this point. The two views were:
  - The analysis needs to consider interference from other Base stations
  - the effect of other interfering signals is negligible

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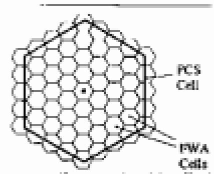
Typical Overlap in Cells between FWA and PCS

- FWA Cell Site separation is .43 km for urban settings where 300 Erlangs/km2 for DECT Base Stations according to ETSI Technical Report ETR 310 Pg 28
- A typical PCS cell site Separation is 10 km



ETR 310, "DECT; Traffic Capacity and Spectrum requirements for multi-system and multi-service DECT applications co-existing in a Common Frequency Band.

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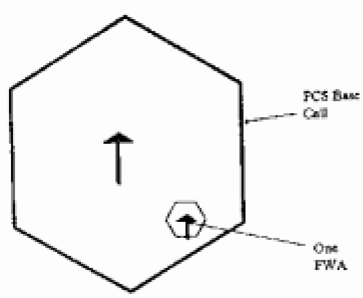
Analyzed only One Interfering Cell



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Methodology for adjacent Channel Interference

- Calculate the Power at the transmitter

  - P'_{L} (dBm) = P'_{max} (dBm) + G'_{tx} (dB) - L'_{mask}
    where,
    G'_{tx} (dB) = G'_{txant} (dBi) - L'_{txant} (dB) - $L'_{txfeeder}$

- Propagation Model

  - 2 slope model
    L'(dB) = 38 + 20 log (d) ,   for 1< d < 4htxhrx/
    L'(dB) = 38 - 20 log (4htxhrx/) + 40 log (d) for d >= 4htxhrx/

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Methodology

- Calculate the receive power
  - The group could not agree to include or exclude the Rayleigh fading margin in the signal calculation. Calculation for both are included.
- Including fading margin in calculations:
  - P'R (dBm) = RX'sens w Fading (dBm) - (C'/I') + 10log(100.1C'/-1) - Grx
- Excluding fading margin in calculations:
  - P'R (dBm) = RX'sens w/o Fading (dBm) - (C'/I') + 10log(100.1C'/-1) - Grx
    - G'rx (dB) = G'_{rxant} (dBi) - L'_{rxant} (dB) - $L'_{rxfeeder}$ (dB)
- Calculate the Path loss for singe interferer:
  - L' >= P''_{L} (dBm) - P''_{R}

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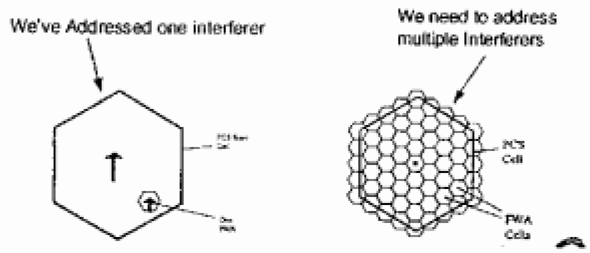
Open Issues

- Have not completely addressed adjacent band interference



Open Issues

- The report does not address worse case situations:
  - Values chosen are one value in a range:
    - antenna height
    - sectorization
    - transmit power
    - propagation loss formula
    - local mean value was chosen instead of 90% value
- Needs to address Spread Spectrum FWA systems in 1910-1930 MHz such as Tadiran's system
- Report needs to address Out of Band Emissions and Spurious Emissions. No agreement here.
- Needs to address a probabilistic model.

Summary

- The report calculates separation distances needed to avoid adjacent channel interference.
- The report does not address all of the items in the terms of reference.
- Adjacent channel interference analysis has open issues.

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Presentation: Results by the Group of Experts of CITEL, DECT Group's View

Presentación: Resultados del Grupo de Expertos de la CITEL. Punto de Vista de DECT

Mr. Dag Akerberg
Mr. Alexander Carrizo
(Ericsson)

(Document PCC.III/doc.1048/98)

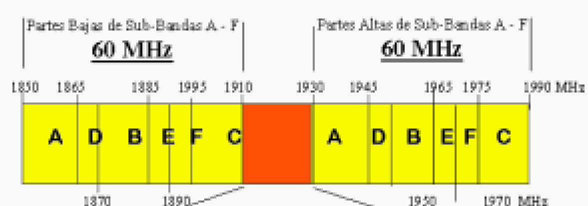
Presentación de Resultados del Grupo de Expertos de CITEL

Dag Åkerberg
Alexander Carrizo

Ericsson Radio Systems, AB

Junio, 1998

Rec. 32 Banda de 1850-1990 de acuerdo CITEL



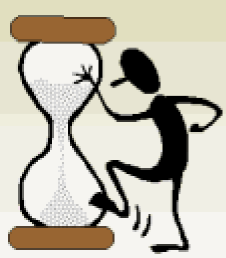
20 MHz

14% del espectro de PCS

De acuerdo a necesidades y regulación de cada estado miembro puede ser para:
- Acceso Inalámbrico Fijo,
- Acceso Inalámbrico de baja movilidad,
- Equipos de voz y datos de baja potencia
- Combinación de los anteriores

Un poco de Historia...

Erase una vez...

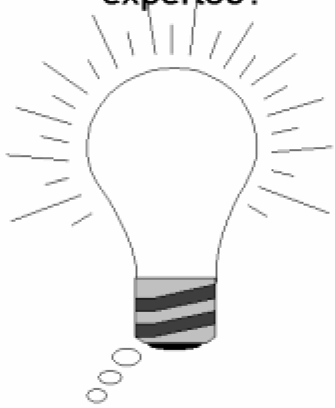


Resultados

Drásticamente Distintos

A continuación...

Quienes ha participado en el grupo de expertos?



- ⇒ALCATEL
- ⇒LUCENT
- ⇒MOTOROLA
- ⇒QUALCOMM
- ⇒NORTEL
- ⇒ERICSSON
- ⇒SIEMENS
- ⇒NEC
- ⇒ZETAX

Antecedentes

Antes de la creación del grupo de Expertos, se presentaron varias contribuciones a la CITEL por parte de los miembros asociados. Estas contribuciones estaban relacionadas con aspectos de interferencias, sin embargo, éstas empleaban diferentes enfoques y por lo tanto se creó el grupo de expertos para cuantificar interferencias, empleando un grupo consistente y común de parámetros, enfoques y metodologías.

El grupo de expertos generó un informe "CONCLUYENTE" sobre interferencias entre sistemas:

FWA TDD (1910-1930 MHz) y PCS en bandas adyacentes

•PCS-PCS operando en bandas adyacentes en 1850-1910 / 1930-1990 MHz

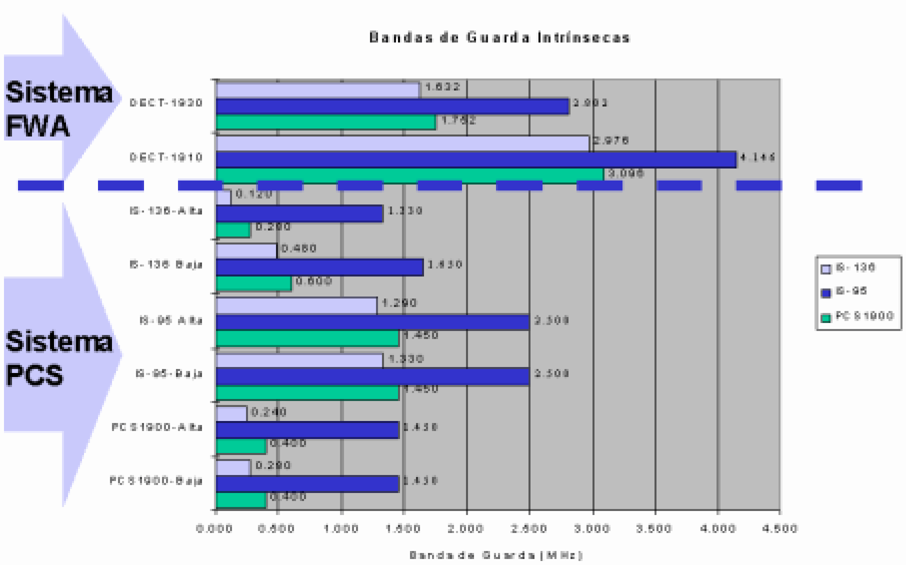
Alcance de los estudios,

Los siguientes sistemas fueron estudiados,

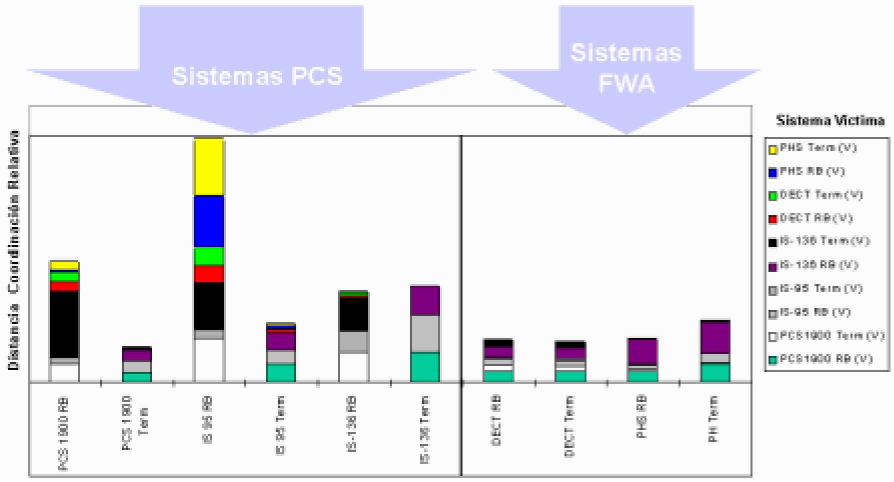
Sistemas PCS:	PCS1900, IS-95 CDMA, IS-136
Sistemas FWA:	DECT, PHS
Sistemas Privados:	PCI, PACS-UA, PACS-UB, PWT (La etiqueta de la FCC para sistemas UPCS, permite realizar un análisis comun para estos sistemas como una sola tecnología), DECT, PHS Ver documentos PCCIII 919, 922

Variables y Formulas acordadas dentro del grupo de expertos para ser usadas en los cálculos:

- Modelos de propagación para trayectoria del Transmisor
- Modelos de propagación para Trayectoria del Receptor
- Parámetros de cada sistema a estudiar como información relacionada con potencias de Tx, Sensibilidad, C/I, anchos de banda nominal, separación entre portadoras, máscara espectral



Distancias mínimas de coordinación entre bandas adyacentes



Sistemas Interferentes

Nota:

Las tablas presentadas anteriormente para distancias de coodinación presentan "el peor de los casos teóricos" de interferencias.

Resulta interesante mencionar que los valores presentados no consideran probabilidades, ni mecanismos de protección, ni ajustes de coordinación.

Cómo se interpretan estos resultados?

•Los valores mayores de distancia de coordinación corresponden a niveles de interferencia mas altos

•Si los valores para los escenarios FWA-PCS son comparables o mas bajos que los escenarios PCS-PCS, esto significa que no existen interferencias perjudiciales entre FWA y PCS.

Por lo tanto DECT-FWA no causa mayor interferencia a sistemas PCS en bandas adyacentes, comparada con la generada entre dos sistemas PCS contiguos!

Conclusiones

- Probabilidades:

  Los escenarios PCS-PCS están presentes y coexisten a pesar de los valores elevados (superiores a FWA-PCS) presentados en las tablas anteriores de distancias de coordinación. Esto significa, que en la práctica la probabilidad de interferencia es baja y aplicable a cualquiera de estos escenarios. (PCS1900 es un sistema GSM y coexiste en 110 países con 80 millones de suscriptores)

- Análisis comparativo de resultados para PCS-PCS y sistemas DECT-FWA,

  Las peores figuras par interferencia se obtienen entre escenarios PCS-PCS (cualquier combinación) y coexisten en la actualidad, es por lo tanto razonable concluir que PCS-FWA coexiste con menos problemas de interferencia.

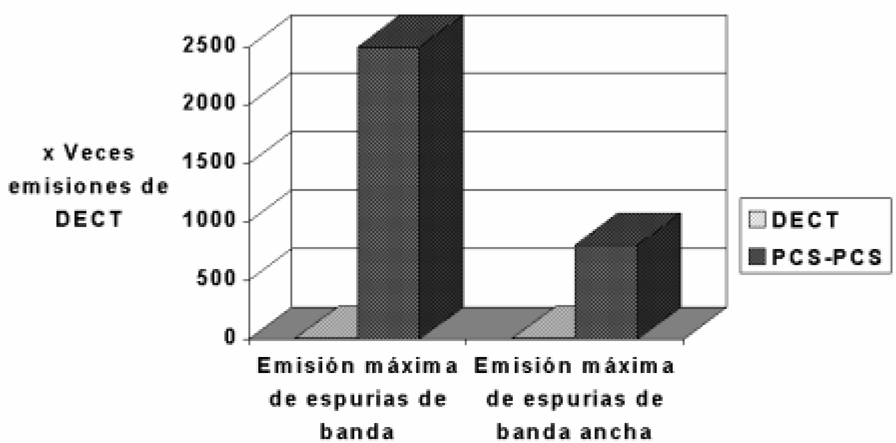
Conclusiones

- Emisiones espurias fuera de banda

  A Efectos de cálculos de interferencia se emplea la máscara espectral de potencia. Las emisiones espurias rara vez ocurren. Sin embargo, vale la pena mencionar que las especificaciones para emisión espuria de DECT es 20 dB más estricta que lo especificado para sistemas PCS. DECT ha sido diseñado bajo las estrictas normas de ETSI.

  A nivel de la CITEL, se encuentra documentado el tema de las especificaciones espurias en doc. 658.

Comparación a nivel de emisiones espurias (fuera de banda)



Conclusiones

- Bandas de Guarda:

  NO SE REQUIEREN BANDAS DE GUARDA ADICIONALES. *Cada una de las tecnologías estudiadas tiene su previsión de banda de guarda intrínseca. Por lo tanto, no tiene sentido en términos generales definir bandas de guarda adicionales.*

- Mecanismos de protección de cada tecnología,

  Los escenarios PCS-PCS y PCS-FWA coexisten a pesar que los resultados presentados no consideran los mecanismos de protección como el control de potencia, selección dinámica de canal, handover dentro de celda, y similares.

  Eso significa que la situación de coexistencia mejora aun más al considerar estos mecanismos.

El Acceso Inalámbrico Fijo DECT es la alternativa "real" para satisfacer las necesidades de desarrollo de Latino América

Presentation: Interpretation of Interference Expert Group Study Report, PHS Group's View

Mr. Toru Hojo
(NEC)

(Document PCC.III/doc.1042/98)

CITEL PCC-III Interpretations of Interference Expert Group Study Report

NEC

Interpretation of Interference Expert Group Study Report

PHS Group´s View

CITEL PCC-III Xth Meeting, Natal in Brazil

NEC do Brasil S.A.

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CITEL PCC-III Interpretations of Interference Expert Group Study Report

NEC

1. **Expert Group Study Results**
   Is the Interference Harmful?
2. **Methodology and Parameters**
3. **Conclusions obtained through the study**
4. **Coordination**
5. **TDD FWA and UPCS Compatibility in 1910-1930 MHz Band**

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CITEL PCC-III Interpretations of Interference Expert Group Study Report

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1. Expert Group Study Results

1) Minimum Distance for 1dB of the Rise in the Noise Floor
(PCC III-935/97, section II.C.2.1)
See attached table

2) Is the Interference Harmful?
See attached figures

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Minimum distance for 1dB of the Rise in the Noise Floor
(PCC III - 935/97, section II.C.2.1)

Interferer \ Victim			PCS Sistems						FWA Sistems			
			PCS 1900		IS-95 CDMA		IS-136 TDMA		DECT		PHS	
			Base	Terminal	Base	Terminal	Base	Terminal	Base	Terminal	Base	Terminal
PCS Sistems	PCS 1900	Base	†	2.724	†	824	†	9.642	690	740	2	585
		Terminal	1.480	†	1.747	†	1.378	†	3	33	5	84
	IS-95 CDMA	Base	†	6.430	†	1.191	†	6.726	1.240	1.305	4.064	6.963
		Terminal	2.715	†	1.999	†	2.647	†	245	209	250	310
	IS-136 TDMA	Base	†	4.530	†	3.000	†	4.733	109	150	0,3	0,7
		Terminal	4.530	†	5.349	†	4.210	†	0,4	0,6	0,2	0,3
FWA Sistems	DECT	Base	1.123	914	588	158	1.088	1.043	*	*	*	*
		Terminal	1.217	648	652	127	1.180	740	*	*	*	*
	PHS	Base	971	175	366	4,3	2.347	268	*	*	*	*
		Terminal	1.916	133	919	47	3.850	237	*	*	*	*

† Not Critical
* Out of Scope

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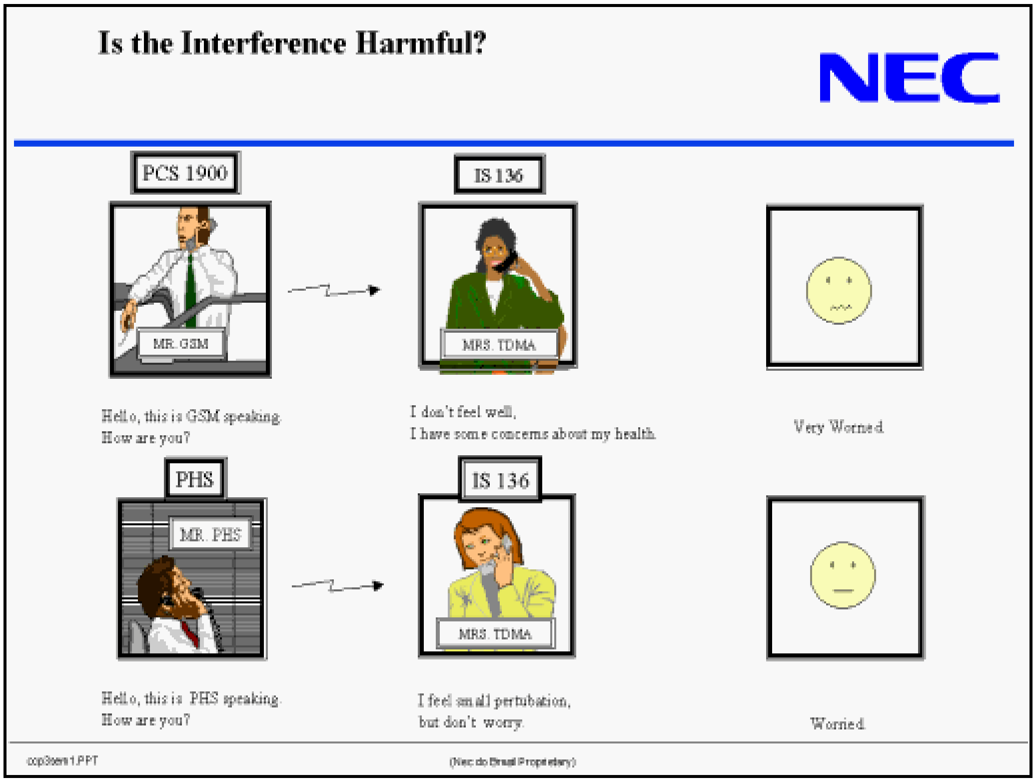
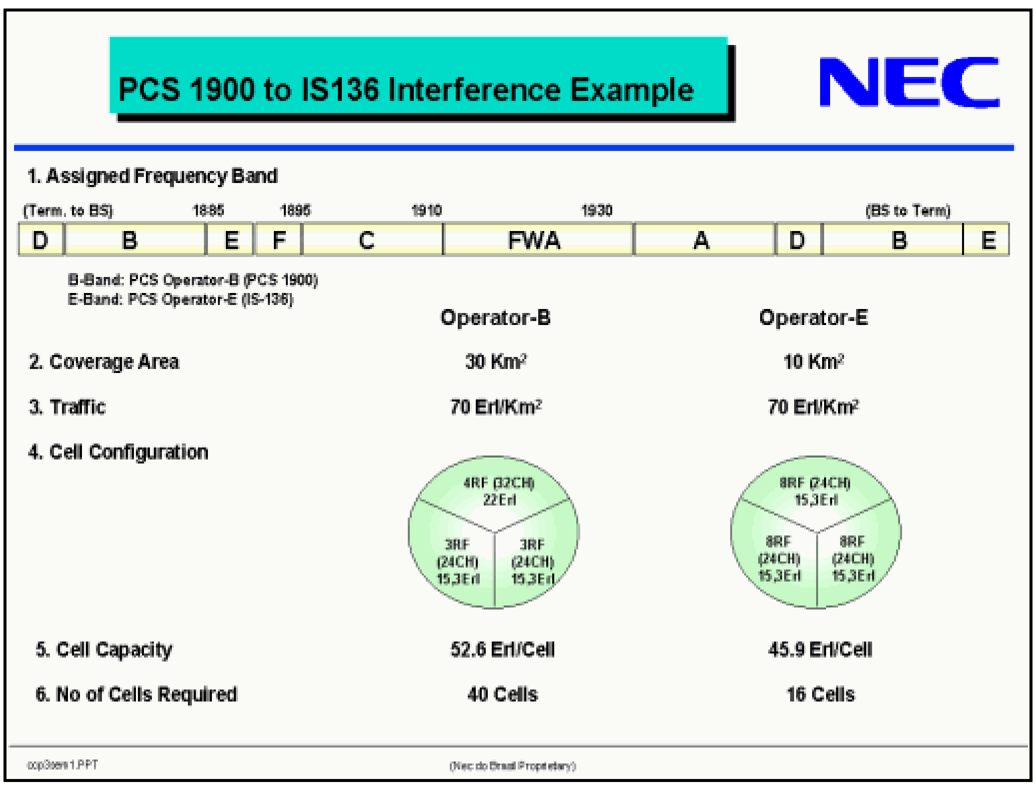
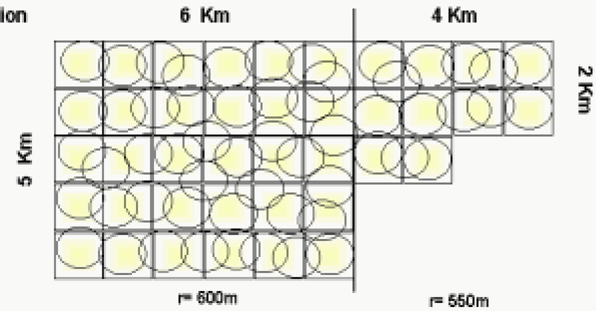

Is the Interference Harmful?
NEC
PCS 1900
IS 136
MR. GSM
MRS. TDMA
Hello, this is GSM speaking.
How are you?
I don't feel well,
I have some concerns about my health.
Very Worried
PHS
IS 136
MR. PHS
MRS. TDMA
Hello, this is PHS speaking.
How are you?
I feel small pertubation,
but don't worry.
Worried
cop3sem1.PPT
(Nec do Brasil Proprietary)


PCS 1900 to IS136 Interference Example
NEC
1. Assigned Frequency Band
(Term. to BS)
1885
1895
1910
1930
(BS to Term)
D
B
E
F
C
FWA
A
D
B
E
B-Band: PCS Operator-B (PCS 1900)
E-Band: PCS Operator-E (IS-136)
Operator-B
Operator-E
2. Coverage Area
30 Km²
10 Km²
3. Traffic
70 Erl/Km²
70 Erl/Km²
4. Cell Configuration
4RF (32CH) 22Erl
3RF (24CH) 15,3Erl
3RF (24CH) 15,3Erl
8RF (24CH) 15,3Erl
8RF (24CH) 15,3Erl
8RF (24CH) 15,3Erl
5. Cell Capacity
52.6 Erl/Cell
45.9 Erl/Cell
6. No of Cells Required
40 Cells
16 Cells
cop3sem1.PPT
(Nec do Brasil Proprietary)

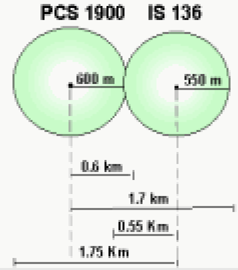
PCS 1900 to IS136 Interference Example

NEC

7. Coverage Area and Cell Configuration



8. Distance between PCS1900 and IS136 Cells



Calculation Results for 1dB Rise in the Noise Floor

PCS1900 BS to IS136 Tem. Interference	9642 m
PCS 1900 Term. to IS 136 BS Interference	1378 m

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CITEL PCC-III Interpretations of Interference Expert Group Study Report

NEC

2. The Methodology and Parameters

1) The **methodology** adopted was discussed deeply and agreed by all the expert group members. It is considered **coherent** and applicable for the real cases.

2) Various **interference mechanisms** were discussed and **pessimistic patterns** and **dominant interference sources** were adopted in the calculations.

3) The **Parameters** adopted were examined by the experts and can be considered quite **homogenious** for all technologies. The values selected, called reference values, are mostly **specified or pessimistic** ones except some plausible values related to antenna.

4) Then, the **results obtained** based on the methodology and those parameters are quite **reasonable and credible**, and also these values can be considered **quasi-worst case ones**.

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3. Conclusions Obtained through the Study :

1) Calculation Results of PCS to PCS Interferences :

Significant Separation Distance is required for PCS to PCS Interference.

2) Experience says that :

PCS system can coexist with any other PCS systems in adjacent bands, even though there are always some interferences between the adjacent systems.

Conclusion-1 This inconsistency can be explained only assuming a low probability value.

3) The results obtained are quasi-worst cases, therefore the absolute values of the calculated separation distance could be exaggerated much more than the real cases which indicate a low interference probability.

Conclusion-2 The low probability value is applicable to any scenario

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CITEL PCC-III Interpretations of Interference Expert Group Study Report

NEC

4) The calculated results show the quasi-worst case examples and they are quite credible ones.

5) Actual parameters of the real world will reduce drastically the absolute values obtained, but the relative difference between the values should be maintained proportionally.

Conclusion-3 Results obtained should be interpreted under the comparative frame

6) Comparative Analysis Results show that:

- Worst Interference figures are obtained by PCS to PCS scenarios.
- TDD FWA to PCS Interference figures are smaller than PCS to PCS scenarios.
- Experiences say that PCS can coexist with any other PCS in the adjacent band.

Conclusion-4 FWA and PCS will coexsist with less interference problems.

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CITEL PCC-III Interpretations of Interference Expert Group Study Report

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7) A very clear conclusion was obtained through the study, and it will give for the regulators and operators a practical and useful guidance.

8) Expert Group Report, PCC.III-935/97, provides sufficient information and an effective tool for the regulators and operators who want to implement FWA or PCS systems.

Coclusion-5 Mission of the Expert Group has been already completed.

ccp3sem1.PPT (Nec do Brasil Proprietary)

CITEL PCC-III Interpretations of Interference Expert Group Study Report

NEC

4. Coordination

1) Since the interference probability is very low as the current PCS experiences showed, in principle, **there is no need of any special coordination**.

2) However, it is possible to get better figures with a small coordination.

3) Possible Cordinations : (a) Guard Channels
(b) Improvement of Emission Mask

4) Recommendable coordination : **Guard channel(s) in the Interferer side**.

In case of PHS system, such coordination can be realized very easily without significant capacity reduction (almost negligible).

ccp3sem1.PPT (Nec do Brasil Proprietary)

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Example :

If we consider additional one guard channel in the lower edge of FWA band, the separation distance for PHS to PCS interference shown in the PCC.III-935/97can be reduced as follows.

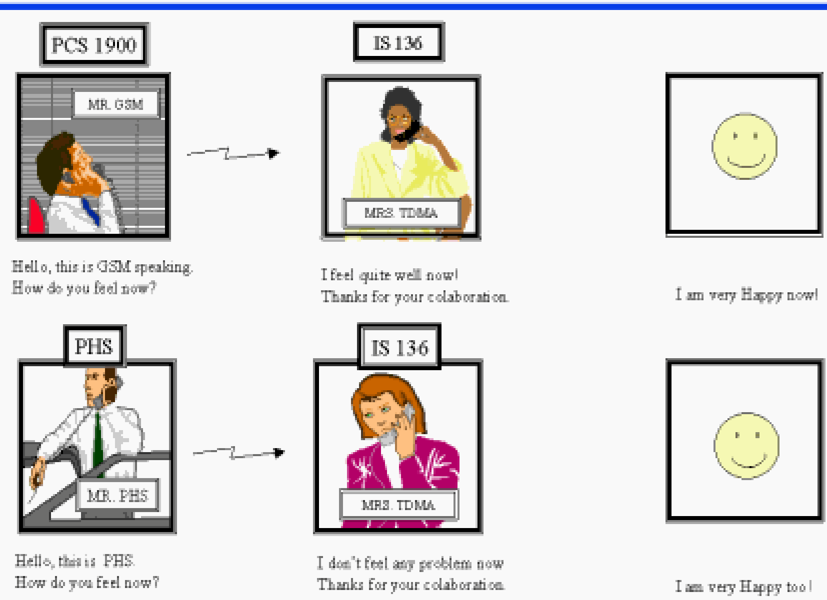
Minimum distance for 1 dB of the Rise in the Noise Floor

Interferer \ Victim			PCS1900		IS-95		IS-136	
			Base	Term	Base	Term	Base	Term
PHS	PCC.III -935/97	Base	971	175	366	4,3	2.347	268
		Term	1.916	133	919	47	3.850	237
	with one guard-ch	Base	262	175	366	4,3	297	268
		Term	659	133	919	47	747	237

ccp3term1.PPT (Nec do Brasil Proprietary)

Is the Interference Harmful? After small coordination.

NEC



ccp3term1.PPT (Nec do Brasil Proprietary)

CITEL PCC-III Interpretations of Interference Expert Group Study Report

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5. TDD FWA and UPCS Compatibility in 1910-1930 MHz Band

1) Expert Group discussed and identified that :

- Asynchronous UPCS in 1910-1920 MHz and Isochronous UPCS in 1920-1930 MHz can not co-exsists.
- Asynchronous UPCS devices to operate in 1910-1920 MHz do not exsist today and will not exist in future.
- TDD FWA and Isochronous UPCS have the same access mechanism (Listen before Talk)
- Co-channel interference between Isochronous UPCS and FWA in 1910-1930 MHz could be the issue, if there is no interference avoidance mechanism like Dynamic Channel Assignment (DCA).

ccp3sem1.PPT (Nec do Brasil Proprietary)

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2) Two contributions were presented and discussed in the Expert Group meeting :

- PCC.III-919/97 (Lucent)
  - a) UPCS Rules (Part 15 of FCC Rule, Subpart D) :
    Monitored interference: Not more than 50 dB above the thermal noise floor
  - b) Total interference power from DECT FWA: -65.6dBm (46 dB above the noise floor) assuming **Extremely High Traffic scenario (300 Erl/km^2)**
  - c) Interference from FWA to UPCS will make spectrum sharing impractical, except where the traffic demand per km^2 is light for both FWA and UPCS.

Obs : Even though this unrealistic traffic, interference is still within the limit.

- PCC.III-922/97 (Ericsson)and an annex to the PCC.III-919/97
  - a) Receive power of PWT at the cell edge : approx. -48 dBm
    Traffic of PWT office system: 0.2 Erl/20m^2 (10m radius grid cell)
  - b) Interference from DECT FWA for the above exaggerated case: 300 Erl/km^2 :
    -70 dBm : Low enough for office system (CIR = 22 dB or more)
  - c) Therefore the **Interference from FWA to Private office system is not critical** and also Private office to FWA is not critical.

ccp3sem1.PPT (Nec do Brasil Proprietary)

CITEL PCC-III Interpretations of Interference Expert Group Study Report

d) From the coexsistence perspective, the usage of **DECT or PHS FWA** in the band 1910-1930 MHz, **does not restrict the utilization of UPCS** (private wireless systems) **in the band 1910-1930 MHz**, if these private equipment conforms to **DECT standard TBR06, PHS standard RCR-28 , or the FCC Part 15 Isochronous rules**.

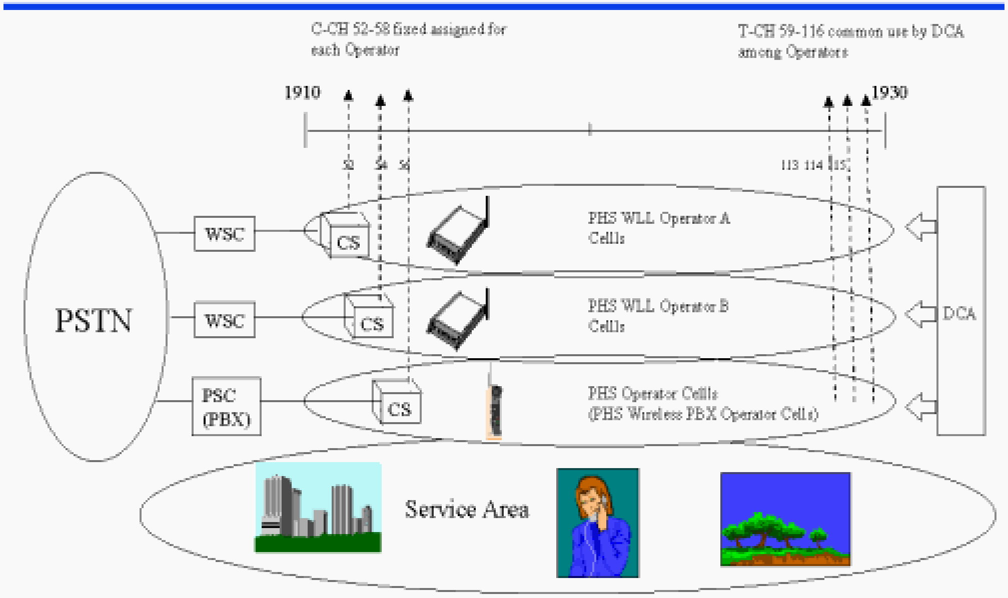
3) In case of PHS in Japan, Public PHS (or PHS FWA) is permitted to use the frequency band assigned for private PHS (PACS UA UPCS equivalent) in addition to the own assign-ed band. Thus, **PHS FWA and Private PHS are designed to assure the coexistence between them.**

	1893.5MHz	1906.1MHz	1919.6MHz
Private	I##########################I		
Public	I##########################I##############################I		

4) Conclusion : **TDD FWA (DECT/PHS) in 1910-1930 MHz and Isochronous UPCS in 1910 to 1930 MHZ can coexist.**

ccp3em1.PPT (Nec do Brasil Proprietary)

MULTIPLE OPERATORS CO-EXISTENCE EXAMPLE



ccp3em1.PPT (Nec do Brasil Proprietary)

Presentation: Practical Guide to understand the Report of Interference in 1910-1930 MHz

Presentación: Guía Práctica para entender el Reporte de Interferencia alrededor de 1910-1930 MHz

Mr. Juan Carlos Santiago
(Motorola)

(Document PCC.III/doc.1049/98)

Guía Práctica para Entender el Reporte de Interferencia alrededor de 1910-1930 MHz

El documento que sigue presenta a las administraciones una guía práctica, no técnica, para entender a un nivel básico el Reporte de Expertos de Interferencia en 1910-1930 MHz. Este documento fue presentado en el "Seminario sobre los Estudios del Grupo de Trabajo para Cuantificar la Incompatibilidad de Acceso Fijo Inalámbrico junto a PCS en la banda 1850-1990 MHz", en la X Reunión del CCP.III en Natal, Brasil, la semana del 8 al 12 de junio de 1998.

Puntos claves:

- Ya existe un documento que contesta la pregunta fundamental: ¿Hay o no hay interferencia?
- Este documento, el Reporte de Expertos, tiene suficiente información para tomar una decisión.
- El Reporte presenta la interferencia en términos de una distancia mínima necesaria entre dos sistemas. Así que para contestar la pregunta ¿Hay o no hay interferencia? , uno se debe preguntar **¿Se necesita establecer una distancia mínima entre los dos sistemas?**
- Si no se necesita establecer una distancia mínima entre los dos sistemas, entonces las torres de cada sistema se pueden localizar en cualquier lugar y no existe interferencia. Esto quiere decir que la distancia mínima entre dos sistemas es CERO. El reporte claramente refleja que ciertas distancias son necesarias entre los dos sistemas.
- La interferencia se manifiesta en varias formas, incluyendo ruido en la línea, pérdida de área de cobertura en el sistema, y pérdida de capacidad de usuarios en el sistema.
- Por cada dB de interferencia que se acepta, la cobertura de una celda se reduce por aproximadamente 20%.
- DCA solamente ayuda cuando los sistemas están relativamente vacíos y hay canales disponibles para dónde los usuarios puedan brincar.
- La interpretación de otros que dicen que la distancia mínima es relativa fue introducida para crear confusión en cuanto a qué es lo que dice el Reporte de Expertos. Si se necesita establecer una distancia mínima quiere decir que existe interferencia.
- Las torres de PCS se pueden localizar junto a otras torres PCS (distancia mínima es cero) porque la interferencia es solo de base a móvil. Esto significa que mientras el móvil se acerca a las dos torres, la interferencia del otro sistema es más fuerte, pero también es la señal deseada. En sistemas TDD como FWA en 1910-1930 MHz, las unidades de usuario fijas transmiten desde cualquier punto en el área de cobertura.
- Las administraciones deben mirar si se necesita coordinar la distancia mínima entre los sistemas para determinar si existe la interferencia o no.

Estimados Señoras y Señores delegados,

Yo estoy cansado. Creo que ustedes las administraciones están cansados también… de este largo debate que no parece tener fin.

Ya se irán a hacer más estudios, con más detalles, pero muchos están perdiendo la fe de que estos estudios brindarán un resultado concreto el cual les dará la información necesaria para tomar las decisiones que tienen que tomar en cada país. Aunque se podría esperar por tener absolutamente todos los últimos puntos y detalles antes de tomar una decisión, yo creo que ya está disponible la información necesaria para juzgar por ustedes mismos la verdad de este debate. Esta información se llama El Reporte de Expertos.

El problema con el Reporte de Expertos es que es muy técnico, muy largo, y muy difícil de entender. Cada lado del debate parece tener su propia interpretación de los resultados, la cual beneficia sus intereses comerciales. Lo que quiero ilustrar hoy es una manera de elevar este documento por encima de sus detalles técnicos, y proveer una guía práctica para las administraciones y reguladores mismos puedan entender los resultados que se encuentran ya en el Reporte de Expertos y poder tomar sus propias decisiones

Señoras y señores, les presento la

Guía Práctica para Entender el Reporte de Interferencia
del Grupo de Expertos en 1910-1930 MHz.

Esta guía les permitirá contestar por ustedes mismos la pregunta que ha estado en sus mentes desde el principio:

¿Hay o no hay interferencia?

En otras palabras, *¿se requiere coordinar la distancia entre los dos tipos de sistemas?*

Respetuosamente,

Ing. Juan Carlos Santiago

CITEL

Guía Práctica para Entender el Reporte del Grupo de Expertos de Interferencia en 1910-1930 MHz

Ing. Juan Carlos Santiago, BSEE, MSEE, MBA
Miembro del Grupo de Expertos
Empresa Motorola de los Andes

X Reunión CCP-III de CITEL — Natal, Brasil - Junio 1998

CITEL

¿Qué es Interferencia?

La Interferencia no es necesariamente que los sistemas dejan de funcionar...

...Pero sus efectos son daÒinos:

- Ruido en la lÌnea
- Celdas mas pequeÒas
- Menor capacidad en los sistemas

...y representan costos adicionales significantes!

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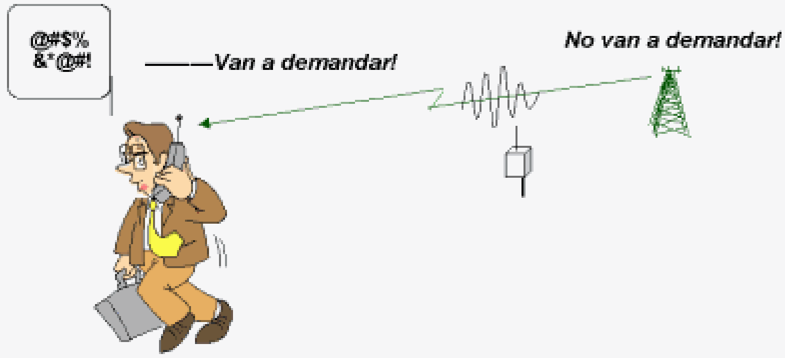
Ruido en la Línea



- Quejas de usuarios
- Mensajes mal entendidos
- Llamadas se caen

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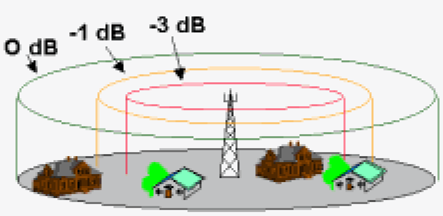
Celdas más Pequeñas

- La interferencia se mide en dB
- Por geometría, hay una relación directa entre el incremento en interferencia y la reducción del área de cobertura de cada celda



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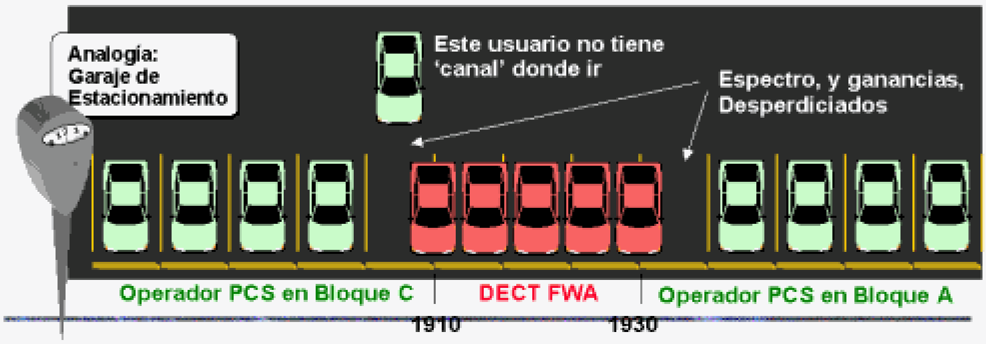
Menor Capacidad en los Sistemas

- El teléfono suena ocupado y no se puede llamar
- DCA solo ayuda cuando hay frecuencias a donde brincar, no si el sistema tiene muchos usuarios



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El Grupo de Expertos de CITEL

- El Grupo de Expertos es parte de el Grupo de Trabajo para <u>Cuantificar</u> la Incompatibilidad de Acceso Fijo Inal·mbrico y PCS en la banda 1850 a 1990 MHz
  - La interferencia existe…La pregunta cu·nta es y cu·n daÒo hace
- El Grupo de Expertos cuantificÛ la interferencia causada por sistemas DECT y PHS en la banda 1910-1930 MHz a sistemas PCS

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El Reporte del Grupo de Expertos

- El Reporte contiene:
  - Un resumen ejecutivo de una página explicando que se hizo
  - Más de 20 páginas explicando como el problema fue analizado
  - 4 tablas resumiendo los resultados
  - Y sobre 200 páginas de resultados actuales!
- El Reporte no hace ninguna recomendación
  - Solo provee números y gráficas con valores de interferencia
- La decisión de que hacer con estos valores de interferencia cae en cada entidad reguladora miembro de CITEL

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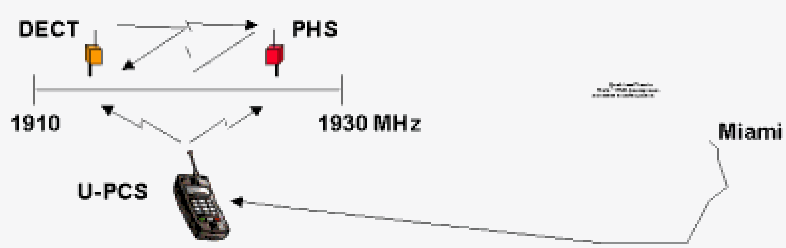
¿Qué Quedó por Estudiar?

- 2 de los 3 mandatos en los Términos de Referencia NO fueron completados:
- Interferencia causada a DECT por PHS y viceversa



- Interferencia causada a DECT o PHS por equipos de consumidor U-PCS que entran al país sin detectarse

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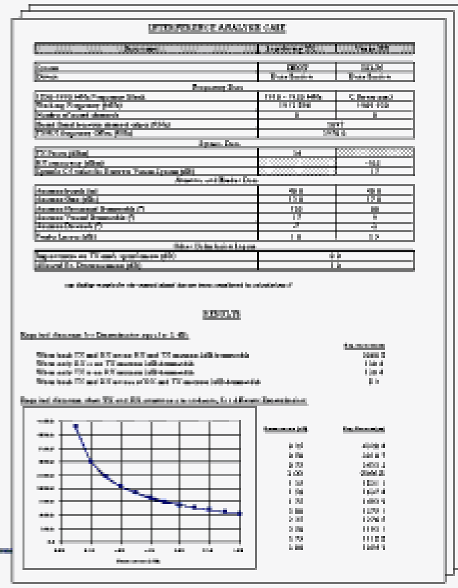
Estos son los Resultados



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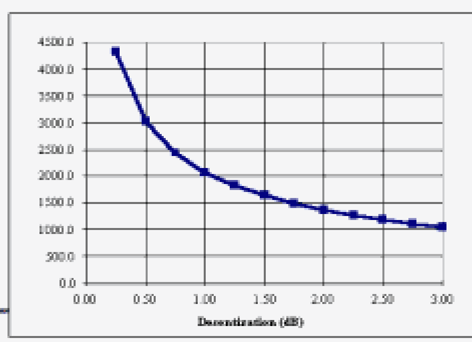
Cómo Leer los Resultados

- Cada página de resultados representa un escenario para un par de tecnologías
  - Ejemplo:
    Estación base DECT interfiriendo a una estación base IS-136
- La gráfica en cada página enseña los resultados de cada escenario



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Cómo Interpretar los Resultados

- El eje horizontal de la gráfica muestra la interferencia adicional causada por el sistema DECT a el sistema IS-136, entendiendo que cada incremento en interferencia (dB) causa pérdida en área de cobertura:
- 0.1 dB = 2% pérdida de área de cobertura
  - 1 dB = 20% pérdida de área de cobertura
  - 3 dB = 50% pérdida de área de cobertura
- El eje vertical es la distancia entre los dos sistemas
- Escoja un punto basado en la pérdida permisible por el operador PCS y la distancia actual entre los sistemas
  - Si el punto cae sobre la curva, la interferencia es tolerable
  - Si el punto cae bajo la curva, la interferencia es peor que la máxima y no es tolerable

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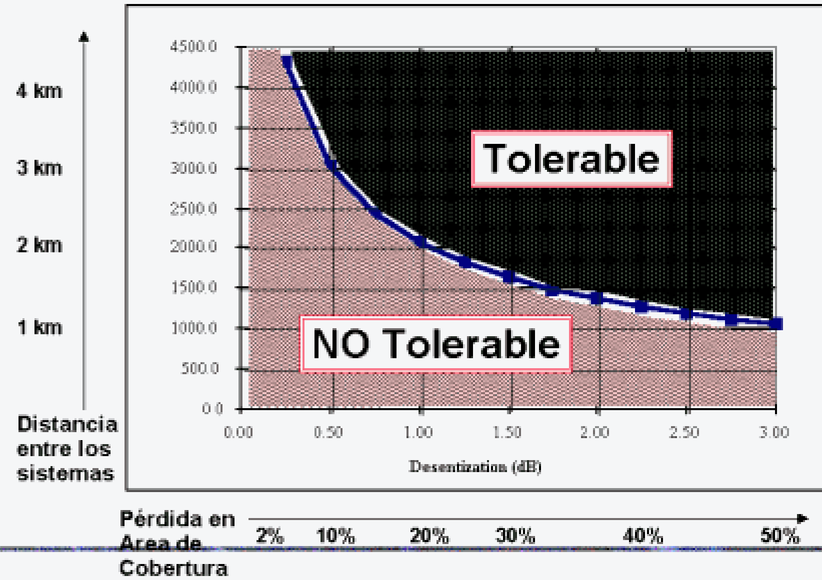
Base DECT Interfiriendo a Base IS-136



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Las Tablas de Resumen

- Las Tablas de Resumen asumen que los operadores PCS aceptarán 1dB de interferencia, o una pérdida de 20% en sus áreas de cobertura
- La selección de 1 dB como nivel de interferencia aceptable es completamente arbitraria
- Cada operador debe decidir por sí mismo cuánta interferencia es aceptable a sus operaciones basado en su estrategia y posición en el mercado relativo a su:
- Costos de equipos de infraestructura y renta de sitios,
  - Capacidad del sistema,
  - Cobertura del área deseada,
  - Calidad de voz y servicio, y
  - Precio pagado por el espectro

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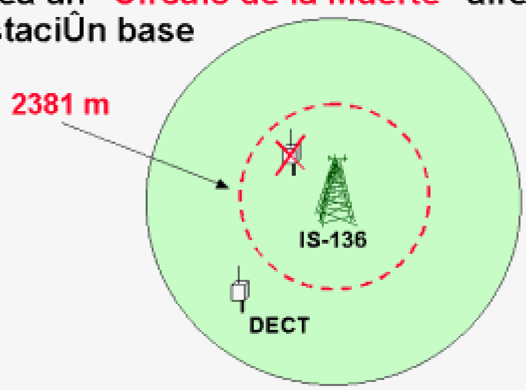
La Interpretación de las Tablas de Resumen

- Al escoger la interferencia aceptable de 1 dB, se crea un "Circulo de la Muerte" alrededor de la estaciÛn base



En el ejemplo, para que la celda IS-136 no pierda más de 1 dB, o 20% de cobertura, la estación DECT debe estar a más de 2 km de distancia

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Las Tablas de Resumen

Minimum Distance if 1dB interference (rise in noise floor) allowed (in meters)		PCS 1900 PCS Victim	PCS 1900 PCS Victim	IS-95 CDMA PCS Victim	IS-95 CDMA PCS Victim	IS-136 TDMA PCS Victim	IS-136 TDMA PCS Victim	DECT FWA Victim
PCS Interferer		BS	Term	BS	Term	BS	Term	BS
PCS 1900	BS	†	3982	†	1310	†	14427	2133
	Terminal	2214	†	2614	†	2061	†	140
IS-95 CDMA	BS	†	9633	†	1782	†	10064	3947
	Terminal	4062	†	2857	†	3783	†	638
IS-136 TDMA	BS	†	6778	†	4500	†	7082	486
	Terminal	6778	†	8003	†	6312	†	1.1
FWA Interferer		BS	Term	BS	Term	BS	Term	BS
DECT FWA	BS	2456	1367	1286	319	2381	1533	*
	Terminal	2485	970	1426	288	2409	1107	*
PHS FWA	BS	2497	308	996	158	5253	500	*
	Terminal	4096	301	1965	108	6628	407	*

* Analysis not completed

† Not critical

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Interpretación Incorrecta de las Tablas de Resumen

- Los que interesan vender FWA en 1910-1930 MHz dir·n:
  “DECT y PHS causan interferencia, pero es comparable a la interferencia causada por otros sistemas PCS”
- Esta interpretaciÛn es simplemente incorrecta porque compara “peras con manzanas”
- PCS tiene celdas mucho m·s grandes que DECT y PHS, asÌ que el CÌrculo de la Muerte es pequeÒo relativo a el tamaÒo de la celda
- DECT y PHS no pueden tener cobertura contigua sin caer dentro de el CÌrculo de la Muerte

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Tabla de Resúmen

Minimum Distance if 1dB interference (rise in noise floor) allowed (in meters)		PCS 1900 PCS Victim	PCS 1900 PCS Victim	IS-95 CDMA PCS Victim	IS-95 CDMA PCS Victim	IS-136 TDMA PCS Victim	IS-136 TDMA PCS Victim	DECT FWA Victim
PCS Interferer		BS	Term	BS	Term	BS	Term	BS
PCS 1900	BS	†	3982	†	1310	†	14427	2133
	Terminal	2214	†	2614	†	2061	†	140
IS-95 CDMA	BS	†	9633	†	1782	†	10064	3947
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	Terminal	4096	301	1965	108	6628	407	*

* Analysis not completed

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Ejemplo

- Las celdas de PCS son típicamente sobre 10 000 metros en diámetro, mientras que las celdas de DECT/PHS FWA son 500 a 1500 metros en diámetro (*Ref. ETSI-ETR-310*)
- Así que una distancia de 2381 metros entre DECT y IS-136 es imposible porque las celdas de DECT siempre van a caer dentro de 500-1500 metros de una celda de IS-136 para el sistema tener cobertura contigua
- En la otra mano, una distancia de 2061 metros entre PCS-1900 y IS-136 es posible porque las celdas están a más de 10 000 metros de separación

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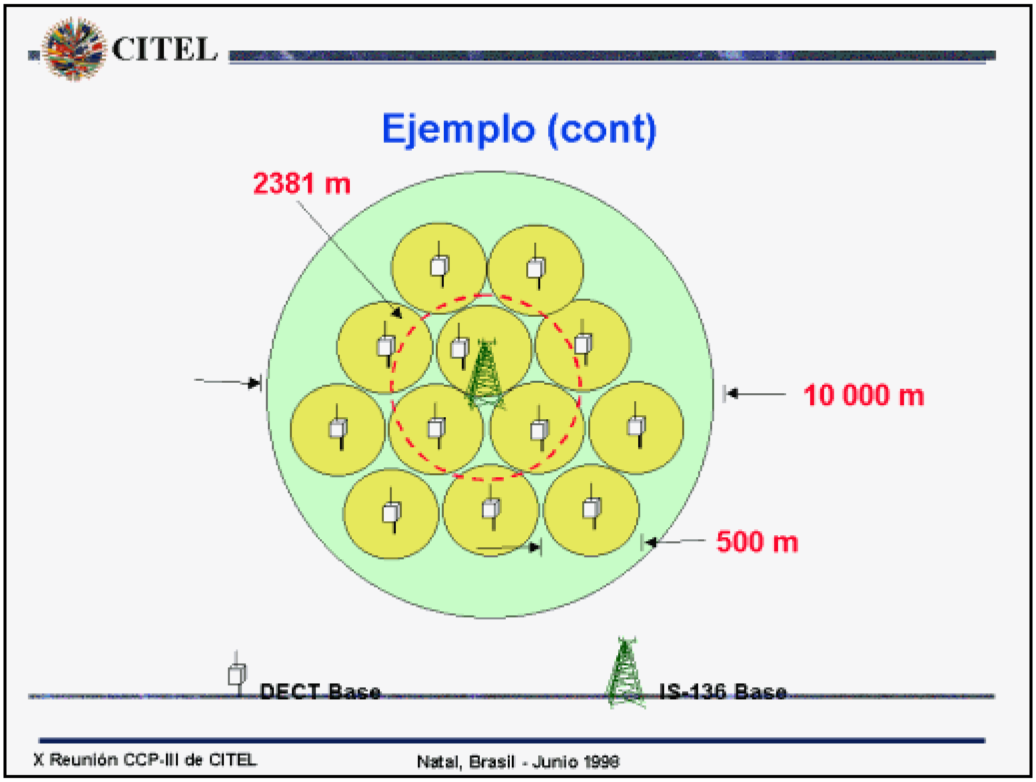
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Ejemplo (cont)
2381 m
10 000 m
500 m
DECT Base
IS-136 Base
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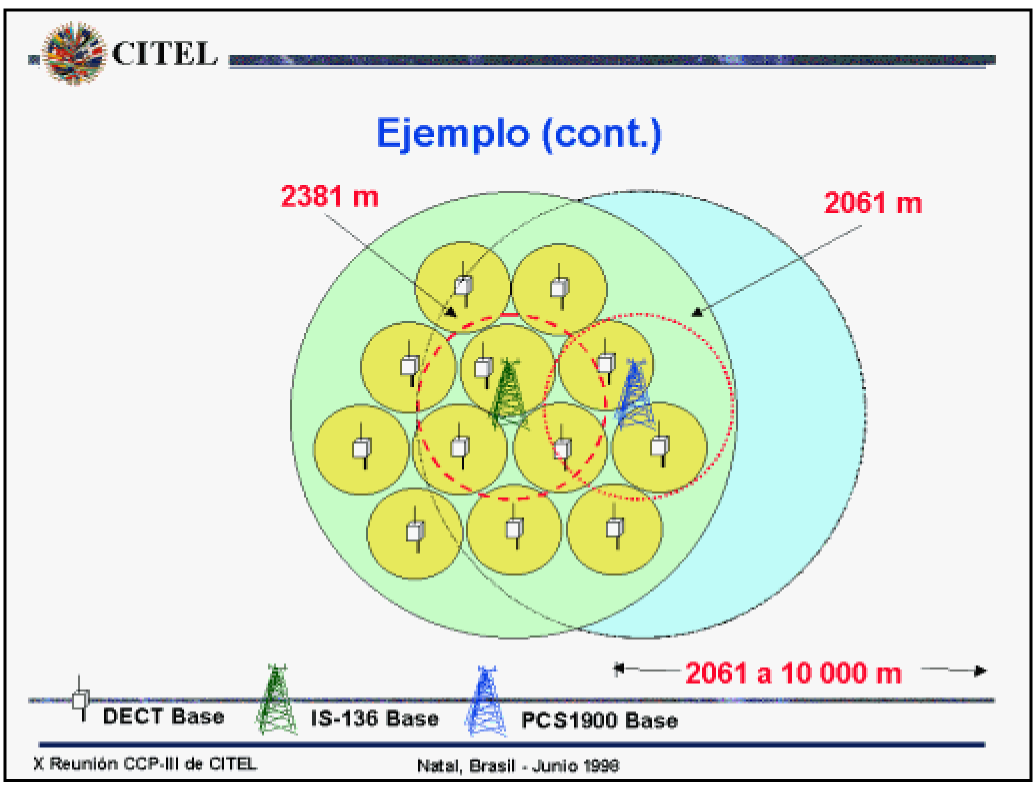
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Ejemplo (cont.)
2381 m
2061 m
2061 a 10 000 m
DECT Base
IS-136 Base
PCS1900 Base
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Otras Consideraciones

- Los que quieren vender FWA en 1910-1930 MHz dir·n:
  “Las distancias mÌnimas resultantes son m·s grandes para PCS-PCS que para PCS-DECT o PCS-PHS”
- En PCS, la interferencia de Base a Base no existe ya que transmiten y reciben en bandas diferentes
- En actualidad, mientras menos distancia entre Bases PCS (en la misma torre o cercana), provee mejor protecciÛn contra la interferencia a el mÛvil

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Co-Localización

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Co-Localización

- La co-localización de sitios actualmente ayuda a mitigar la interferencia:
  - (a) la distancia entre las estaciones bases de una celda y otra son <u>máximas</u>,
  - (b) para los móviles, mientras más se acercan al sitio, la señal de interferencia es más fuerte, <u>pero también es la señal deseada</u>!
- Esta protección ocurre cuando los diámetros de las celdas son relativamente equivalentes.
- En el caso de DECT y PHS, las celdas son mucho más pequeñas que las celdas de PCS, así que hay una probabilidad mucho mayor de que el móvil se encuentre mucho más cerca de la señal de interferencia (DECT o PHS) que de la señal deseada (PCS)

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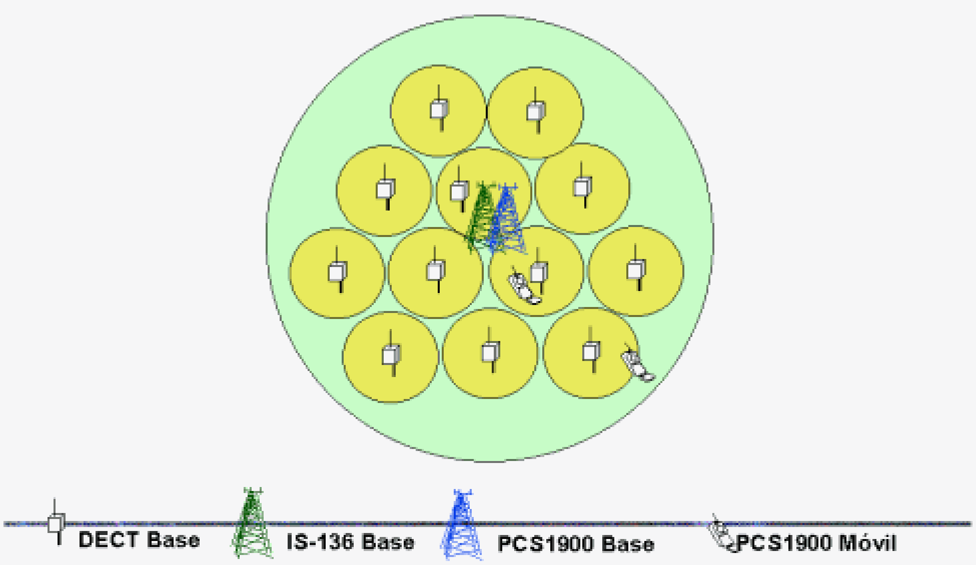
Co-Localización



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Otras Consideraciones

- Una montaña de evidencia de que DECT y PHS causan interferencia:
  - Reporte del Grupo de Expertos CITEL
  - Estudio de CEPT en Europa que recomendó bandas de guardia de 5 MHz y separación geográfica con DECT para que no interfiera con servicios DCS (PCS) en la banda 1800
  - Contribución de Japón a la UIT que demuestra que sistemas PHS móviles y fijos deben tener una separación de 30 km
  - Evidencia que el MPT de Japón subirá la potencia permitida para rescatar a la industria de su desastre económico
  - Experiencia de campo con problemas con DECT y PHS en Colombia, Uruguay y Argentina

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Conclusiones

- No queda ninguna duda de que sistemas FWA DECT y PHS en 1910-1930 MHz causan interferencia adicional a los sistemas PCS
- CITEL no ha hecho ninguna determinación o recomendación en cuanto a si la banda 1910-1930 MHz se puede usar para FWA sin causar interferencia dañina a los sistemas PCS
- 936 solo recomienda que si deciden poner FWA en 1910-1930 , entonces vendrán las consecuencias.
- Más estudios son necesarios.

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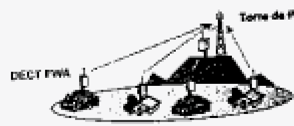
Guía para Reguladores

- Como entidad reguladora, solo pueden controlar:
  - Separación en <u>frecuencia</u> (bandas de guardia, etc.)
  - Separación es <u>Espacio</u> (ciudades o regiones separadas, etc.)
- Dentro de una ciudad o región, es muy difícil controlar dónde los operadores sitúan sus sitios de celdas
- Tampoco se puede controlar si las antenas están apuntadas directamente una a la otra o no



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Opciones para Reguladores

- Si deciden no ignorar el Reporte de Expertos de CITEL, entonces pueden optar por separar los sistemas o en frecuencia o Espacio:
  - Por frecuencia (bandas de guarda o atribuir FWA a otros bloques de PCS)
    - » + Funciona a nivel nacional
    - » - Bandas de Guardia son difíciles de esforzar y desperdician espectro
  - Por espacio (distancia entre los sistemas)
    - » + Efectivo
    - » + Más fácil de implementar
- Cómo decidir la separación de Espacio
  - Por ciudad, Estado o Región del País
  - Por zona Urbana o Zona Rural
  - Por Topología Natural (cordilleras, etc.)
  - Por Centros de Población y Comercio

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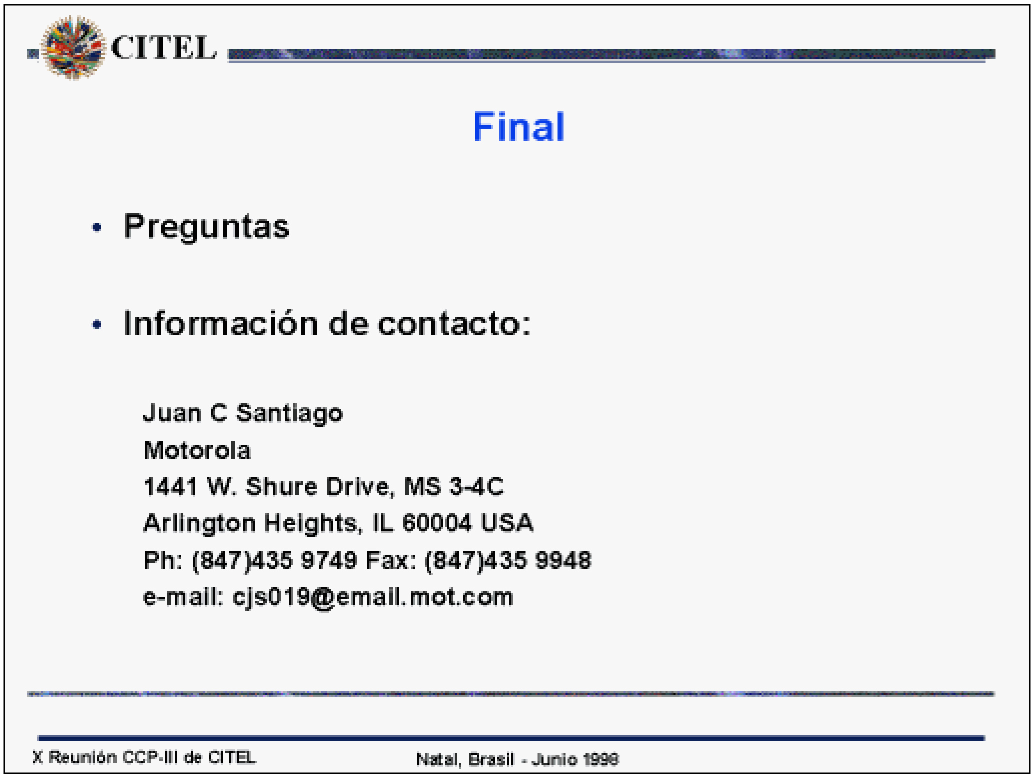
CITEL
Final
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Presentation: Comments on the Methodology applied in the Report of the Group of Experts on Interference (PCC.III/doc.935/97)

Presentación: Comentarios sobre la metodología empleada en el Informe del Grupo de Expertos sobre Interferencias (PCC.III/doc.935/97)

Mr. Arturo Custodio
(Alcatel)

(Document PCC.III/doc.1035/98)

ALCATEL

COMENTARIOS SOBRE LA METODOLOGÍA EMPLEADA EN EL INFORME DEL GRUPO DE EXPERTOS SOBRE INTERFERENCIAS (PCC.III/doc.935/97)

Arturo Custodio

Alcatel

Experto del Grupo de Trabajo sobre Interferencias de CITEL CCP.III

Junio, 1998

CITEL CCP.III 1

ALCATEL

Conclusiones de la IX reunión del CCP.III

- **LA RECOMENDACION 32 (IX-97) PERMITE EL USO DE LA BANDA 1910-1930 MHz PARA APLICACIONES FIJAS INALÁMBRICAS TDD**
  - Se reconocen las capacidades de coexistencia
  - Se corrobora la Rec.26 (VI-96) de la reunión del CCP.III en Acapulco
- **EL INFORME DEL GRUPO DE EXPERTOS (PCC.III/935/97) SE SUGIERE COMO DOCUMENTO TÉCNICO DE REFERENCIA**
  - El informe demuestra la inexistencia de problemas de interferencias
  - Se detalla una metodología homogénea, coherente y consensuada
- **SE PROPONE LA REALIZACIÓN DE UN SEMINARIO ESPECÍFICO QUE AYUDE A CLARIFICAR LOS ASPECTOS DEL INFORME**

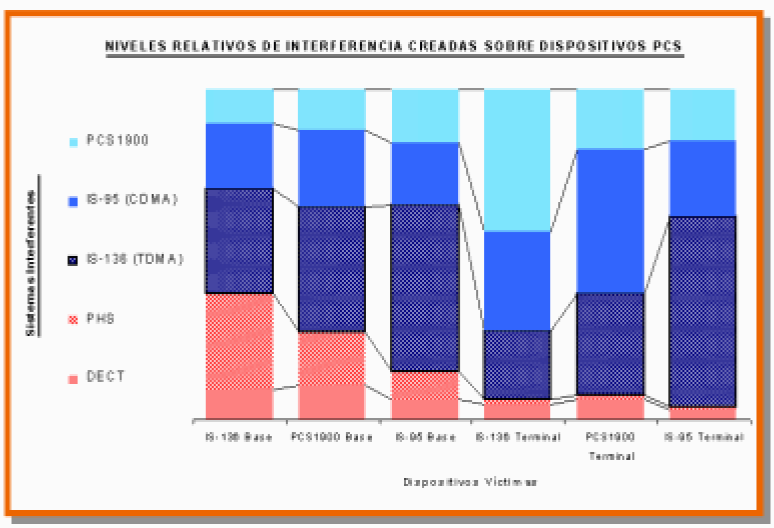
CITEL CCP.III 2

El Informe del Grupo de Expertos

- **EL INFORME SE CENTRA EN UN ANÁLISIS DE INTERFERENCIAS BASADO EN EL CÁLCULO DE DISTANCIAS DE COORDINACIÓN:**
  - Entre sistemas PCS y aplicaciones FWA TDD en bandas adyacentes
  - Entre dos sistemas PCS en bandas adyacentes
- **LA METODOLOGÍA EMPLEADA PERMITE INTERPRETAR LOS RESULTADOS MEDIANTE UN ANÁLISIS COMPARATIVO**
- **LOS RESULTADOS DEMUESTRAN CLARAMENTE QUE LOS SISTEMAS FWA TDD GENERAN MENOS INTERFERENCIAS QUE LOS SISTEMAS PCS Y, ADEMÁS, SON MAS INMUNES.**

CITEL CCP.III 3

Análisis Comparativo de los Resultados



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Consideraciones sobre la Metodología:
"La aportación del Grupo de Expertos"

- **Antes de la creación del Grupo de Expertos:**
  - Numerosas aportaciones con diferentes análisis y metodologías
  - Resultados contradictorios y parciales
  - Análisis incompletos
  - ⇒ LA METODOLOGÍA USADA SIRVE AL PROPÓSITO DE JUSTIFICAR UN RESULTADO DESEADO
- **Después de la creación del Grupo de Expertos:**
  - Se unifican los criterios metodológicos
  - Se consensuan los parámetros que intervienen en el estudio
  - Se desarrolla una herramienta de cálculo común
  - ⇒ LA METODOLOGÍA SE DISEÑA PARA OBTENER UNOS RESULTADOS COHERENTES Y HOMOGÉNEOS

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Consideraciones sobre la Metodología:
"Las claves para entender los resultados"

- **La metodología permite un ANÁLISIS COMPARATIVO COHERENTE**
  - Permite COMPARAR resultados de distintos escenarios
  - Los resultados relativos de esta comparación son FIABLES
  - Los resultados absolutos son PRECISOS en cuanto a las HIPÓTESIS Y PARÁMETROS de entrada
- **En la realidad, los valores de interferencia son mucho MENORES**
  - El análisis de PROBABILIDAD mejora la interpretación de resultados
  - La metodología se aplica al CASO PEOR (bastante improbable)
  - Los PARÁMETROS REALES superan los estándares
  - El límite de interferencia exigido supone una NULA DEGRADACIÓN de los sistemas víctimas

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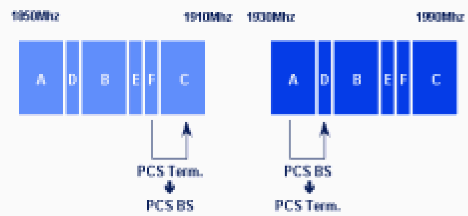
Metodología:
Los escenarios planteados

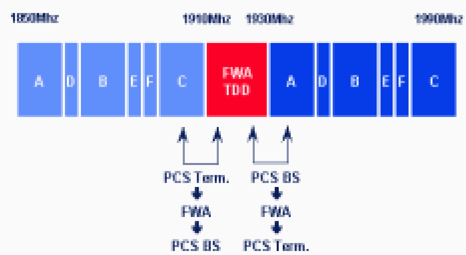
Interferencias entre sistemas PCS:

PCS1900	➔	PCS1900,IS-95,IS-136
IS-95	➔	PCS1900,IS-95,IS-136
IS-136	➔	PCS1900,IS-95,IS-136



Interferencias entre PCS y FWA:

DECT	➔	PCS1900,IS-95,IS136
PHS	➔	PCS1900,IS-95,IS136
PCS1900	➔	DECT, PHS
IS-95	➔	DECT, PHS
IS-136	➔	DECT, PHS



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Metodología:
Análisis para el CASO PEOR

▼ **El estudio de interferencias se realiza para el CASO PEOR:**

- Interferente y víctima trabajan sólo en FRECUENCIAS ADYACENTES
- El TX interferente emite a la MÁXIMA POTENCIA
- El RX víctima solo puede trabajar en su UMBRAL DE RECEPCIÓN
- Las antenas interferente y víctima están ENFRENTADAS
- La señal interferente no está sometida a desvanecimiento (FADING)
- Modelo de PROPAGACIÓN PESIMISTA
- No se consideran mejoras sobre las ESPECIFICACIONES ESTÁNDAR
- Se consideran condiciones de ALTO TRÁFICO
- NO se consideran los MECANISMOS DE PROTECCIÓN existentes

... Y TODOS ESTOS FACTORES SE PRODUCEN EN EL MISMO INSTANTE

¡¡ LA PROBABILIDAD DE QUE ESTO OCURRA ES MÍNIMA !!

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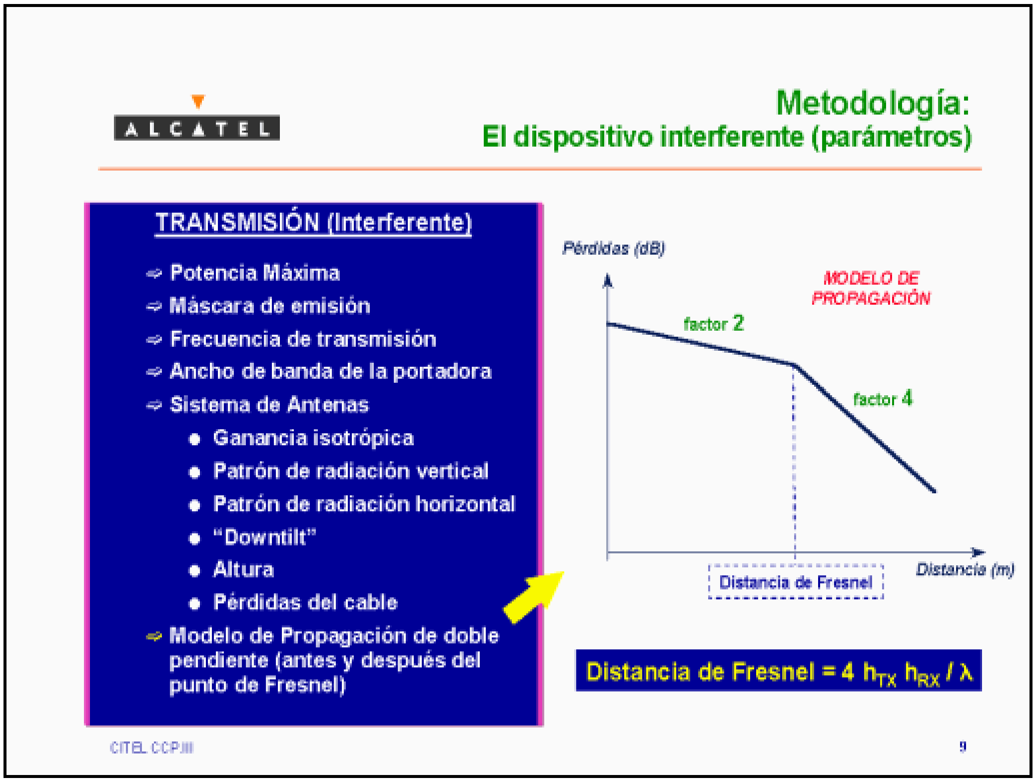
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Metodología:
El dispositivo interferente (parámetros)
TRANSMISIÓN (Interferente)
Potencia Máxima
Máscara de emisión
Frecuencia de transmisión
Ancho de banda de la portadora
Sistema de Antenas
Ganancia isotrópica
Patrón de radiación vertical
Patrón de radiación horizontal
"Downtilt"
Altura
Pérdidas del cable
Modelo de Propagación de doble pendiente (antes y después del punto de Fresnel)
Pérdidas (dB)
MODELO DE PROPAGACIÓN
factor 2
factor 4
Distancia de Fresnel
Distancia (m)
Distancia de Fresnel = 4 h_{TX} h_{RX} / λ
CITEL CCP.III
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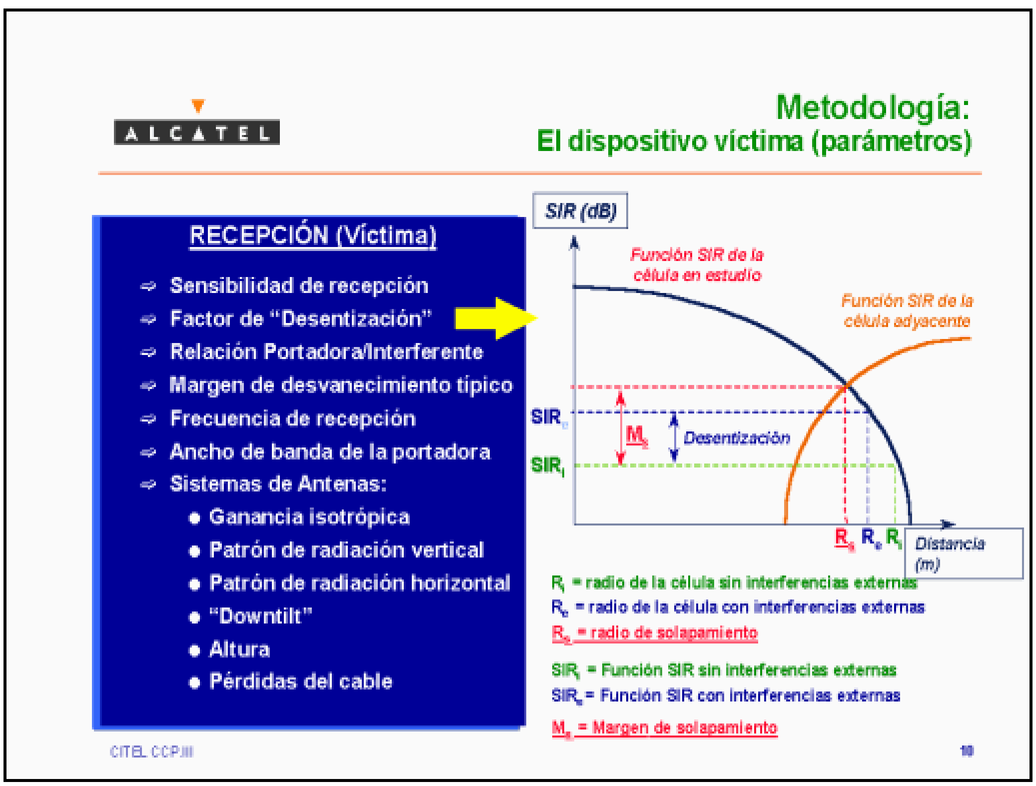
ALCATEL
Metodología:
El dispositivo víctima (parámetros)
RECEPCIÓN (Víctima)
Sensibilidad de recepción
Factor de "Desentización"
Relación Portadora/Interferente
Margen de desvanecimiento típico
Frecuencia de recepción
Ancho de banda de la portadora
Sistemas de Antenas:
Ganancia isotrópica
Patrón de radiación vertical
Patrón de radiación horizontal
"Downtilt"
Altura
Pérdidas del cable
SIR (dB)
Función SIR de la célula en estudio
Función SIR de la célula adyacente
SIR_e
SIR_i
M_s
Desentización
R_s R_e R_i
Distancia (m)
R_i = radio de la célula sin interferencias externas
R_e = radio de la célula con interferencias externas
R_s = radio de solapamiento
SIR_i = Función SIR sin interferencias externas
SIR_e = Función SIR con interferencias externas
M_s = Margen de solapamiento
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Metodología:
Modelo Matemático

- **Potencia interferente máxima emitida:**

$$P_L(dBm) = P_{max}(dBm) + G_{TX}(dB) - L_{mask}(dB)$$

- **Límite de Interferencia** *(factor de "Desentización")*:

$D = (N+I_{act}+I_{ext}) / (N+I_{int})$, considerando interferencia simple (caso peor) $\Rightarrow I_{act} = I_{int}$, entonces:

$D = 1 + (I_{ext} / (N+I_{int}))$, y como $C/I = C_{ref} / (N+I_{int})$, tenemos que para $C_{ref\,MIN} = RX_{sens}$

$$I_{ext\,MAX}(dBm) = RX_{sens}(dBm) - C/I\,(dB) + 10 \log(10^{0,1\,D(dB)} - 1)$$

- **Máxima potencia interferente permitida en recepción**

$$P_R(dBm) = I_{ext\,max}(dBm) - G_{RX}(dB)$$

- **CONDICION A CUMPLIR:**

$$L = \text{Pérdidas de propagación} \geq P_L - P_R = f(\text{distancia})$$

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Metodología:
Límite de interferencias permitido

- **El factor de "Desentización" supone una reducción de cobertura**
- **Siempre que esta reducción no supere ampliante el Margen de Solapamiento de células, la interferencia creada no será nociva**
- **En redes celulares, el valor típico de solapamiento es del 30% (el valor mínimo es del 17%)**

		¿ES NOCIVA LA INTERFERENCIA?	
Desentización (dB)	Reducción de Cobertura (%)	Con solapamiento Mínimo (17%)	Con solapamiento Típico (30%)
0.5	5.6 %	NO	NO
1.0	10.9 %	NO	NO
1.5	15.9 %	NO	NO
2.0	20.6 %	SI	NO
2.5	25.0 %	SI	NO
3.0	29.2 %	SI	NO

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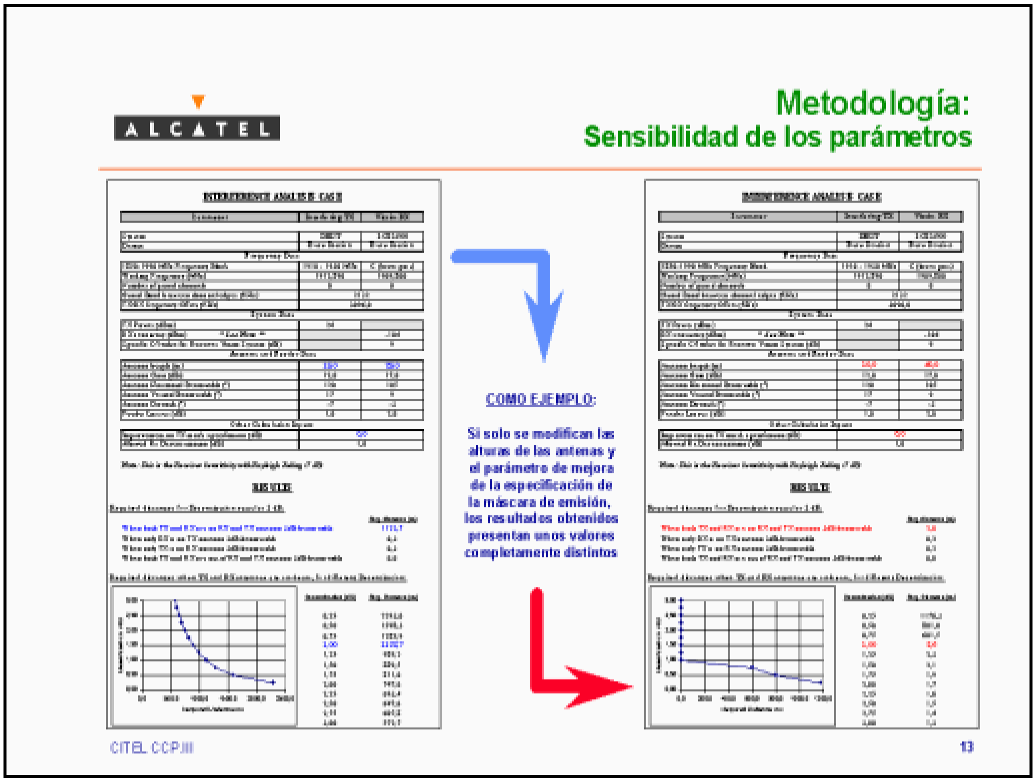
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Metodología:
Sensibilidad de los parámetros
INTERFERENCE ANALYSIS CASE
RESULTS
COMO EJEMPLO:
Si solo se modifican las alturas de las antenas y el parámetro de mejora de la especificación de la máscara de emisión, los resultados obtenidos presentan unos valores completamente distintos
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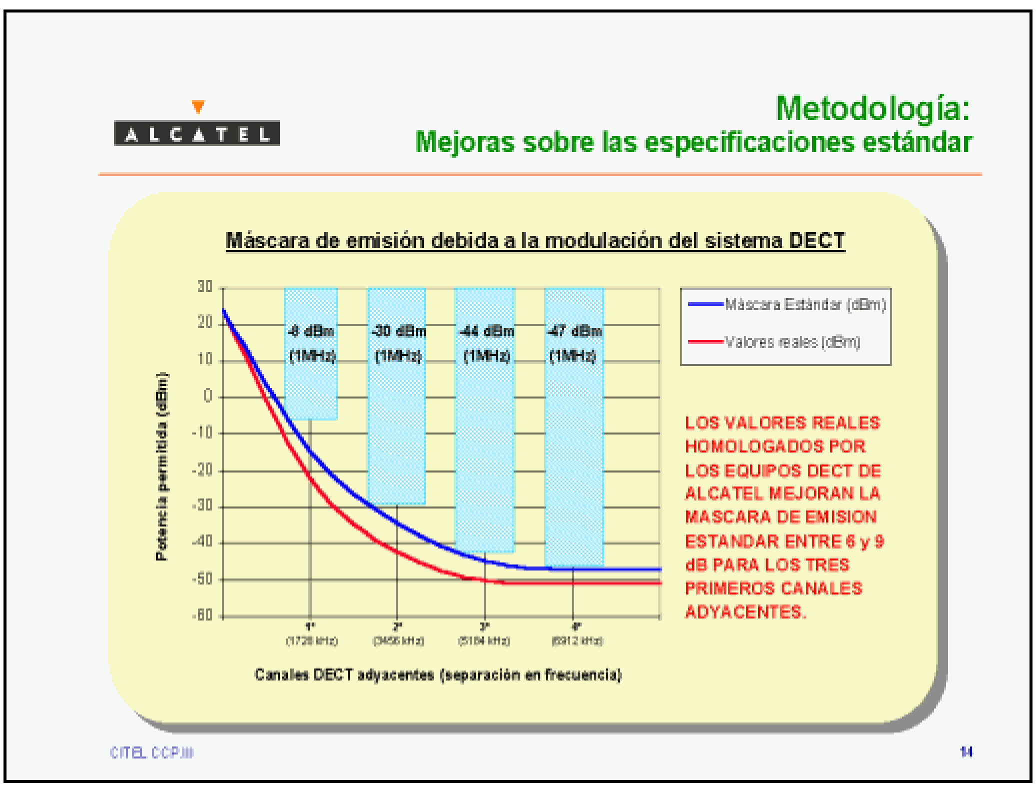
13


ALCATEL
Metodología:
Mejoras sobre las especificaciones estándar
Máscara de emisión debida a la modulación del sistema DECT
30
20
10
0
-10
-20
-30
-40
-50
-60
Potencia permitida (dBm)
-8 dBm (1MHz)
-30 dBm (1MHz)
-44 dBm (1MHz)
-47 dBm (1MHz)
Máscara Estándar (dBm)
Valores reales (dBm)
1º (1728 kHz)
2º (3456 kHz)
3º (5184 kHz)
4º (6912 kHz)
Canales DECT adyacentes (separación en frecuencia)
LOS VALORES REALES HOMOLOGADOS POR LOS EQUIPOS DECT DE ALCATEL MEJORAN LA MASCARA DE EMISION ESTANDAR ENTRE 6 y 9 dB PARA LOS TRES PRIMEROS CANALES ADYACENTES.
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Metodología: CONCLUSIONES

- La metodología es homogénea y coherente
- El análisis comparativo muestra valores de interferencia mucho menores para los escenarios PCS-FWA TDD que para los escenarios PCS-PCS en bandas adyacentes
- Los escenarios PCS-PCS existentes en el mundo (reales) no presentan problemas de interferencia
- Como conclusión:
- LAS APLICACIONES FWA TDD BASADAS EN DECT, EN LA BANDA 1910-1930 MHz, NO PRESENTA NINGUN PROBLEMA DE INTERFERENCIA CON SISTEMAS PCS EN LAS BANDAS ADYACENTES

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Coexistencia entre aplicaciones FWA TDD DECT y sistemas privados UPCS en la banda 1910-1930 MHz

- Puntos de CONSENSO EN EL GRUPO DE EXPERTOS
  - Incompatibilidad entre sistemas UPCS Asíncronos e Isócronos
  - Inexistencia actual de equipos UPCS Asíncronos
  - Técnica de acceso común para sistemas FWA TDD y UPCS Isócrono
- Solo es requerida la COMPATIBILIDAD ENTRE APLICACIONES FWA TDD Y SISTEMAS UPCS ISÓCRONOS (1920-1930 MHz)
- Dos enfoques metodológicos fueron debatidos:
  - PCC.III/919/97 (Lucent)
  - PCC.III/922/97 (Ericsson)
- De ambos enfoques se puede concluir que: LAS INTERFERENCIAS SE MANTIENEN POR DEBAJO DE LOS LÍMITES PERMIDOS

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Aspectos cualitativos a considerar

- **La medida de PROBABILIDAD mejora los resultados obtenidos:**
  - El CASO PEOR es muy improbable: Las aportaciones realizadas al grupo de expertos para cuantificar la probabilidad de interferencia mostraban valores por debajo del 1%
  - Aunque la realidad muestra múltiples señales interferentes, la consideración del CASO PEOR de señal única es siempre dominante
- **MECANISMOS de PROTECCION contra interferencias:**
  - Asignación dinámica del canal
  - Traspasos (handover) entre células y en la propia célula
  - Saltos de frecuencia
  - Control de Potencia
  - Corrección de errores
  - etc.

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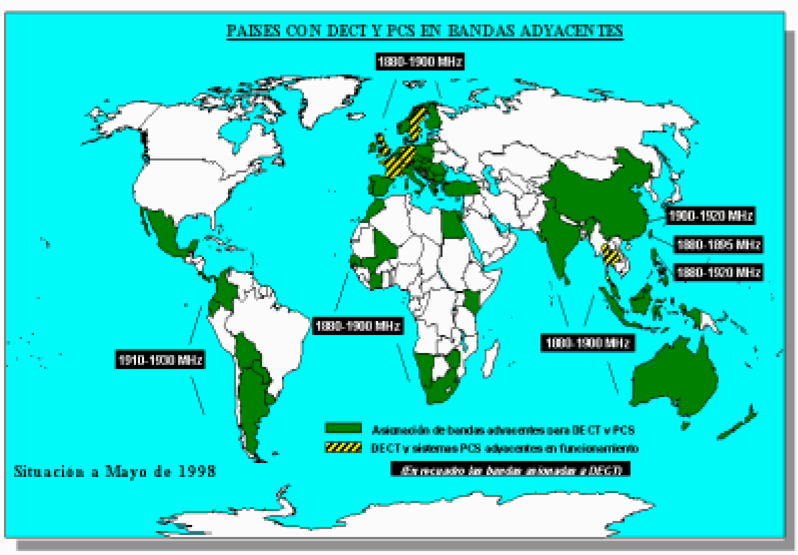
La coexistencia DECT y PCS en el mundo



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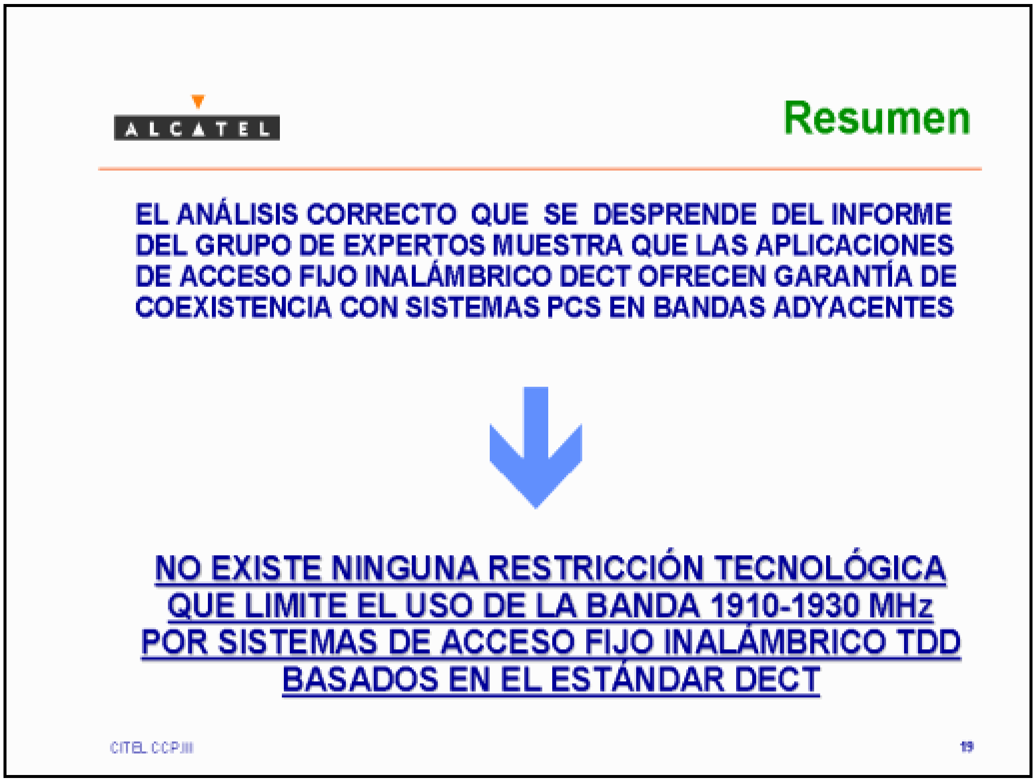
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Resumen
EL ANÁLISIS CORRECTO QUE SE DESPRENDE DEL INFORME DEL GRUPO DE EXPERTOS MUESTRA QUE LAS APLICACIONES DE ACCESO FIJO INALÁMBRICO DECT OFRECEN GARANTÍA DE COEXISTENCIA CON SISTEMAS PCS EN BANDAS ADYACENTES
NO EXISTE NINGUNA RESTRICCIÓN TECNOLÓGICA QUE LIMITE EL USO DE LA BANDA 1910-1930 MHz POR SISTEMAS DE ACCESO FIJO INALÁMBRICO TDD BASADOS EN EL ESTÁNDAR DECT
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19

Presentation: Interference Aspects

Mr. Andy McGregor
(NORTEL Canada)

(Document PCC.III/doc.1036/98)

NORTEL NORTHERN TELECOM

Interference Aspects

- Methodology Issues
- Technology Issues

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Interference Methodology

NORTEL NORTHERN TELECOM

- Interference is generally a tough problem
- PCC.III/doc.935/97 attempts to provide impartial comparison between technologies
- Data
  - ✶Crucial to obtain accurate data for each technology
  - ✶Standards all have different basis
  - ✶Data must use common measurements
  - ✶Assessment very difficult
- Algorithms
  - ✶Important to be relatively accurate
  - ✶Important for concepts to be understandable & usable
  - ✶Currently a balance between simplicity and accuracy

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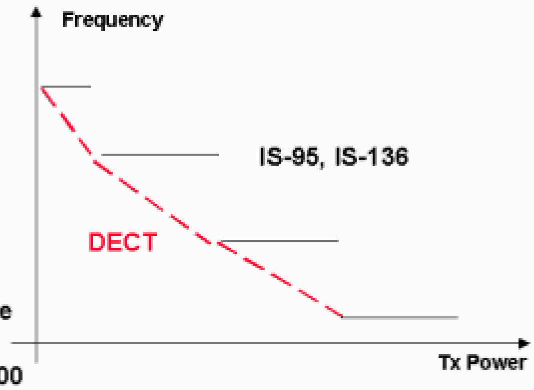
Methodology - Data

NORTEL NORTHERN TELECOM

- Data used for DECT interferor was mis-interpreted
  - ✶IS-95, IS-136, DECT define their out-of-band emissions similarly: xx dB in adjacent channel, yy dB in next channel, etc
  - ✶IS-95, IS-136 used stepped waveform
  - ✶DECT calculations used smooth waveform



Interference from DECT was underestimated

- ✶DECT Base/Terminal now causes 1dB inteference to IS95 at > 5km
  - ➢ 4 times worse than before
  - ➢ 2 times worse than interference from PCS1900

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Methodology - Fading

NORTEL NORTHERN TELECOM

- normal propagation equations include budgets for slow-fading and other propagation artifacts
  - ✶ensure high reliability (e.g. ensure that 90% of time signal will be above threshold - doesn't matter how much higher)
- desired and interfering signals arrive independently
  - ✶experience independent fading conditions (possible exception if both are line-of-sight)
- interference reduces design budget unexpectedly
  - ✶interference will destroy poor signals and change acceptable conditions to poor conditions
    - ➢ don't use desired signal fade budget to protect from interference
  - ✶concern any time interference exceeds assumed threshold
    - ➢ fading can increase the interfered signal and should not normally included in interference calculation

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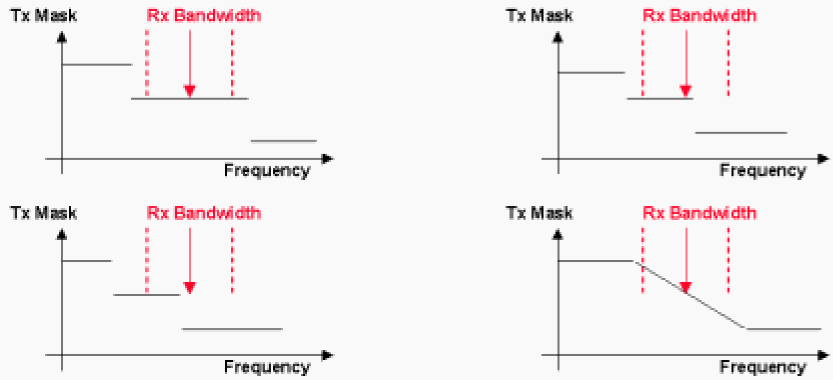
Methodology - Algorithm

NORTEL NORTHERN TELECOM

- current algorithm calculates the transmitted noise power at the victim carrier frequency
  - ✶assumes that this is representative of the complete receive band
  - ✶doesn't allow for rapid changes or discontinuities in transmit mask
  - ✶can seriously underestimate or overestimate interference



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RF Channels

NORTEL NORTHERN TELECOM

- For PCS1900, IS-95 and IS-136
  - ✶standards are available documenting 1850-1990 MHz frequencies
  - ✶all vendors have obligation to follow standards
- For DECT & PHS
  - ✶no standard frequencies or guardbands defined in Citel
  - ✶no guarantee that vendors would follow the same frequencies or guardbands
    - ➢ guardbands assumed in PCC.III/doc.935/97 may not apply
    - ➢ DECT: 2 MHz at 1910 MHz, 688 kHz at 1930 MHz
    - ➢ PHS: 300 kHz at 1910 MHz, 500 kHz at 1930 MHz

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FDD/TDD

NORTEL NORTHERN TELECOM

- PCS1900, IS-95, IS-136
  - ✶Similar (large) cellsizes
    - ➢ Similar transmit power and receiver sensitivities
  - ✶Simple interference aspects
    - ➢ FDD avoids mobile-mobile and base-base interference
    - ➢ base colocation can minimize most interference
- PHS, DECT
  - ✶Similar (much smaller) cellsizes
    - ➢ Similar lower transmit power and poorer receiver sensitivities
  - ✶Complex interference aspects
    - ➢ TDD permits mobile-mobile and base-base as well as mobile-base and base-mobile interference
    - ➢ base colocation cannot be deployed for interference reduction unless technology is the same and frame synchronization enforced

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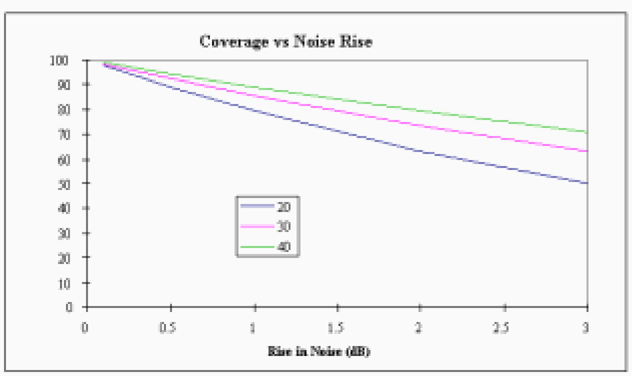
Desensitization

NORTEL NORTHERN TELECOM

- What value of de-sensitization is tolerable?
  - ✶0.1 dB causes 1.1-2.3 % reduction in coverage
  - ✶1 dB causes 11-21% reduction in coverage
  - ✶3 dB causes 29-50% reduction in coverage



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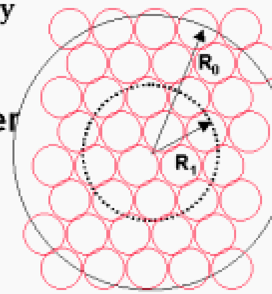
Cell Sizes

- large cells interfering with large cells typified by one user impacting one base (one-to-one)
- small cells interfering with small cells typified by one user impacting one base (one-to-one)
- small cells interfering with large cells typified by many users impacting one base (many-to-one)
  - ✶many interfering microcells within boundary
  - ✶many users per microcell
- PCC.III/doc.935/97 assumes 1 interferer
  - ✶valid for same sizes e.g. PCS1900 to IS-95
  - ✶likely underestimates different cellsizes e.g. PHS/DECT to IS-95



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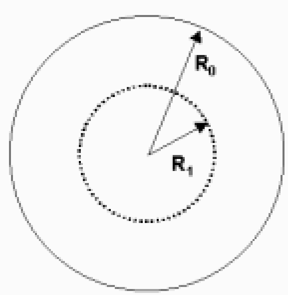
Multiple interferers

- PCC.III/doc.935/97 uses 1 dB desensitization from 1 interferer
  - ✶for 10 equal distance interferers - equivalent to calculating for 0.1dB desensitization with 1 interferer
  - ✶high-capacity microcell is equivalent to a single powerful interferer
  - ✶for uniform or randomly distributed interferers is extremely complicated - need simulation



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Conclusion

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NORTHERN TELECOM

- Interference requires careful analysis
- Interference can cause major impact on performance
- Current tool needs more development
- Interference is a tough problem for any co-channel or adjacent channel problem

NOT JUST THE PCS BAND

PCC.III, Natal, Brazil, 8-12 June 1998

A.McGregor, Nortel Canada - 11

Presentation: Considerations on CITEL PCC.III Interference Expert Group Report

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Document PCC.III/doc.1019/98

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Considerations on CITEL PCC III interference expert group report

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Outline of Presentation

- History
- Agreements which were reached in the report of the interference expert group
- Issues that were raised
- Answer to the questions
- Summary of the main conclusions

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History

In the past many contributions regarding interference have been received. They were all using different assumptions and therefore the results could not be compared.

At the Acapulco meeting 12/96 the interference working group was created to analyse the interference scenarios and to generate a consistent report, which can be agreed by all parties.

The working group created an expert group to perform the technical analysis.

Due to the very high engagement of the participants the report could be delivered at the meeting in Mexico City 9/97.

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Achievements

The group agreed on the methodology to be used for the interference calculations.

The group agreed on the parameters of all the considered systems to be used.

A tool (Excel spread sheet) has been developed for performing the calculations.

A large number of interference scenarios have been considered.

The methodology, selected parameters and results are described and summarised in the report PCC.III/doc.935/97.

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Issues raised

On the last day of the expert group meeting a list with various different issues was input to the group. Due to the very late time of the contribution it was not possible to discuss all the points, but is was agreed to include the complete list in the report.

This contribution contains replys to the issues which are raised in this list.

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Selected Parameters (issues 1,3,13)

not every parameter is absolutely correct
sensitivity to parameter variations

Reply:
The used parameters have been agreed. Changing the parameters will result in different absolute values of the results, but the relative values will be similar. Therefore it has been proposed, not to argue about the absolute values, but to perform a comparison between the various systems.

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Type of Unwanted emission (issues 2 & 32)

There was agreement in the expert group, that the emission due to modulation is that emission, which is relevant for the calculations.

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Antenna, cell size, traffic, siting (issues 4, 8, 13, 34)

Reply:

For the performed analysis the expert group has agreed on the parameters to be used (antennas, antenna heights, gains, patterns, power outputs, propagation models).

The cell sizes, traffic capacities and base station siting are not an input parameter for the selected methodology and therefore not required.

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What is the meaning of ‘Required Distance‘ ?

The report of the interference expert group contains the ‘Minimum Required Distance for x dB of the Rise in the Noise Floor‘.

Possibility A: Make a comparison of the interference scenarios, by considering the relative values.

Possibility B: Be aware that the absolute value is a result obtained for the selected set of parameters and consider the effect on the active links (as explained in the following).

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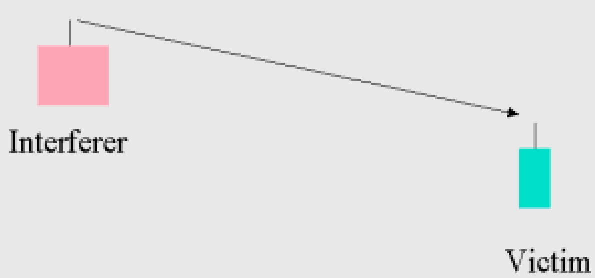
What is the meaning of ‘Required Distance‘ ?



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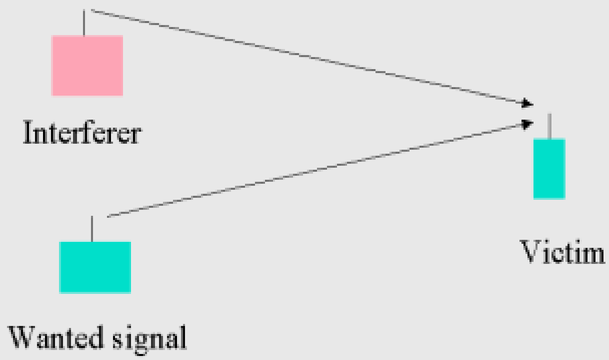
What is the meaning of 'Required Distance' ?



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Example scenario for 'Required Distance'

Interferer: PCS 1900 base station

Victim: DECT terminal
Required S/I=10 dB

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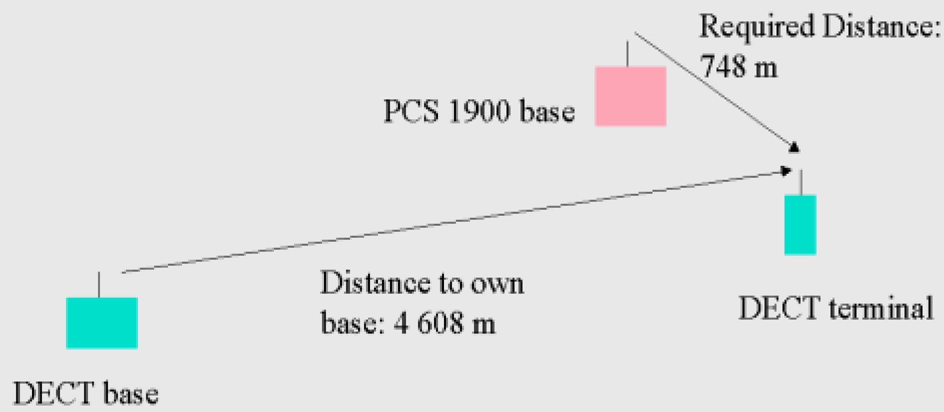
Required Distance to PCS 1900 base = 748 m



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Mixed FDD and TDD deployments (Issues 5, 10)

Reply:

- The FWA system can only be adjacent either to the down-link or to the up-link band of a PCS system. If the FWA system is adjacent to the down-link band, then none of the PCS base stations will be interfered, by the FWA system. If the FWA system is adjacent to the up-link band, then none of the PCS mobile stations will be interfered, by the FWA system.
- It does not matter, which combination of two adjacent systems you consider, there are always two interference paths for the victim.

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Guard Bands (Issues 7, 29, 33)

Reply:

- The Dynamic Channel Allocation of DECT is very reliable. A fixed guard-band would be very inefficient and a waste of capacity.

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Probability (Issues 9)

Reply:

- Probability calculations have not been included in the report, but input was available at the meetings, showing the low probability of interference.

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Propagation models (Issues 14, 24, 25, 30)

Reply:

- Many different pathloss models could be used, but there was no need to add an other one in the report. Therefore no additional model has been agreed.

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Technology, multiple interferers (Issues 15, 19, 27)

Reply:

- For a portable, which can be at any position, the cell radius is not relevant.
- Multiple interferers can be replaced by one cumulative interferer and then the proposed methodology can be used again.

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Figures of merit (Issue 16)

Reply:

- The reply contains the agreed figures of merit. The results could be presented in many different ways.

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Issues 20, 21, 22, 23, 26, 31, 35

These statements are in line with the agreements and the report.

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Power control (Issue 28)

For the calculation of the co-ordination distances we agreed to use the maximum power levels (worst case). Lower levels will result in lower distances.

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Summary

- The report of the interference expert group contains an objective comparison of the concerned systems.
- The calculated distances are rather worst case values.
- An interferer may be much closer than the calculated distance and still have no practical negative effect on the victim system.
- Modern systems should use interference mitigation techniques to escape from local interference.
- The obtained results should be used to compare the relative effects of the systems.

Presentation: Interference from DECT Fixed Wireless Access (FWA) to Unlicensed Personal Communication Services (UPCS)

Mr. William Cruz
(Lucent Technologies)

(Document PCC.III/doc.1038/98)

INTERFERENCE FROM DECT FIXED WIRELESS ACCESS (FWA) TO UNLICENSED PERSONAL COMMUNCIATIONS SERVICES (UPCS)

IX Meeting of the Permanent Consultative Committee III: Radio Communications
September 22-26, 1997
Mexico City, Mexico

Dr. Jay E. Padgett
Lucent Technologies Bell Laboratories

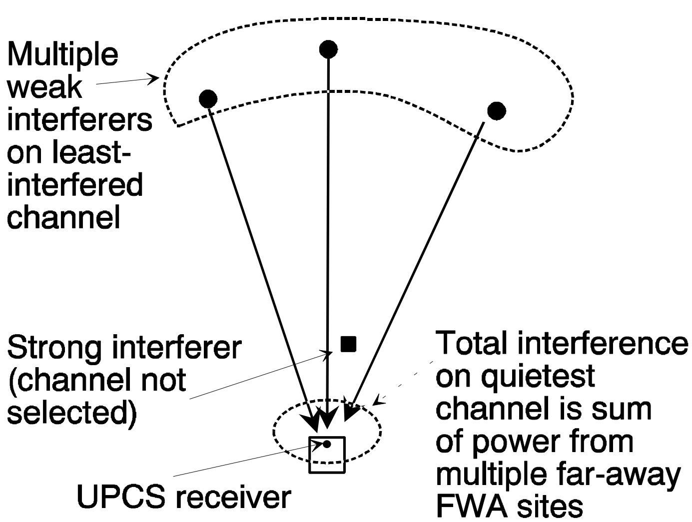
BACKGROUND

- PCC-III Interference Experts Group is working to understand interference impact of fixed wireless access (FWA) operating in the 1910-1930 MHz band.
- In the U.S., 1910-1930 MHz is allocated to Unlicensed Personal Communications Services (UPCS).
- One question is whether, from an interference perspective, UPCS and FWA can coexist in the same band.
- Most of the Group's efforts thus far have concentrated in interference from FWA to Licensed PCS in bands adjacent to 1910 and 1930 MHz.
- This contribution analyzes the cochannel interference from FWA to UPCS based on the parameters and propagation model previously adopted by the Group, and assuming the UPCS system uses Dynamic Channel Selection to choose the least-interfered channel.

ASSUMPTIONS

- FWA and UPCS systems use dynamic channel selection (DCS)
- Two-slope propagation model adopted by PCC-III
- 300 Erlang/km^2 FWA traffic density (per ETSI Technical Report 310, p. 28)
- 15 dB loss through exterior wall of building
- Only cochannel interference considered (adjacent-channel interference ignored)
- Only interference from the FWA downlink is considered
- FWA operating parameters taken from Interference Experts Group Meeting Report, 16-20 June, 1997 PCC-III meeting (Brasilia)

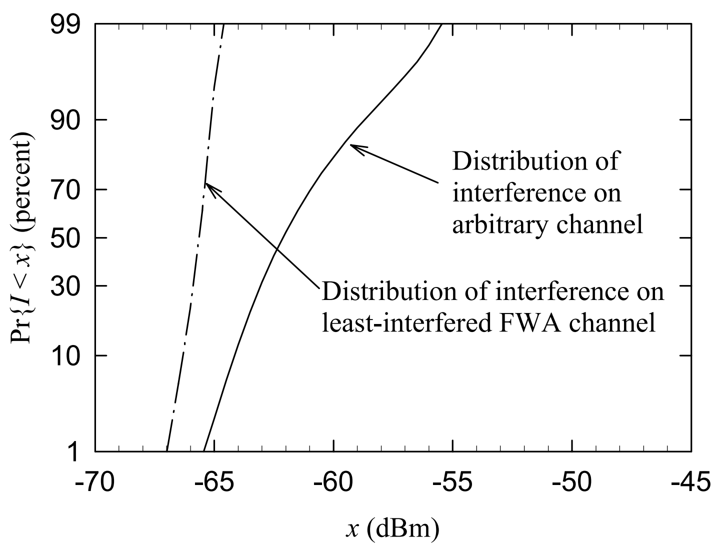
DCS AND THE LEAST-INTERFERED CHANNEL



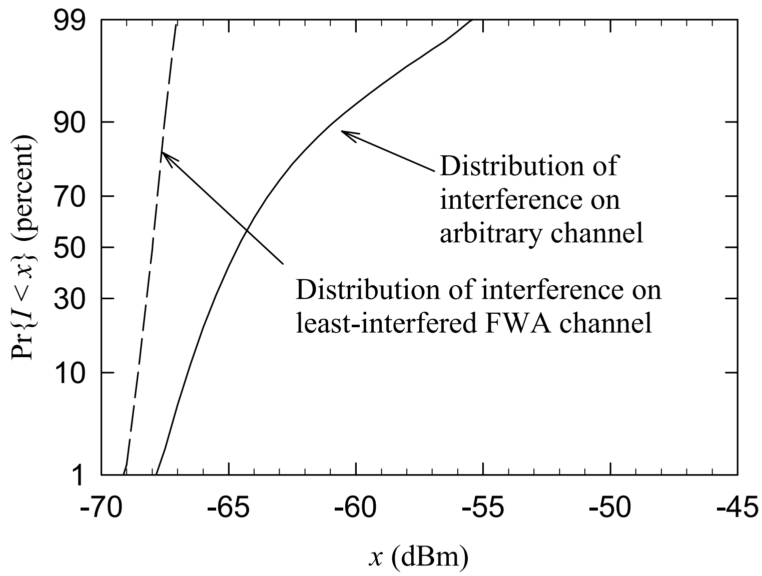
ANALYTICAL APPROACH

- It is the least-interfered channel that is of interest, NOT the interference from neighboring FWA sites.
- The effect of FWA therefore cannot in general be analyzed by simply subtracting the Erlangs used by the nearest FWA from the total "available Erlangs"; that would ignore the effect of all but the nearest FWA transmitters.
- The actual interference power on the least-interfered channel must be computed.
- This is easily done using standard Monte Carlo techniques as described in the paper.

INTERFERENCE DISTRIBUTION - MICROBASES



INTERFERENCE DISTRIBUTION - MACROBASES



VERIFICATION (1): CHECKING THE AVERAGE

The probability density function for the distance between the victim receiver and a randomly-positioned interference source (assuming uniform distribution over area) is:

$$f_d(r) = \frac{2r}{d_{\max}^2 - d_{\min}^2}$$

If the received power is k/r^2 then the average power from one source is

$$\overline{P_{RX}} = \frac{\pi\rho\chi}{N}\left(d_{\max}^2 - d_{\min}^2\right)\int_{d_{\min}}^{d_{\max}} f(r)\cdot\frac{k}{r^2}dr = \frac{2k\pi\rho\chi}{N}\left(\ln d_{\max} - \ln d_{\min}\right)$$

where ρ is the density of active interfering channels (E/km^2), χ is the fraction of interfering transmitters "seen" by the victim receiver, and N is the number of channels. This is easily checked against the Monte Carlo results.

VERIFICATION (2): THE ASYMPTOTIC CLOSED-FORM SOLUTION

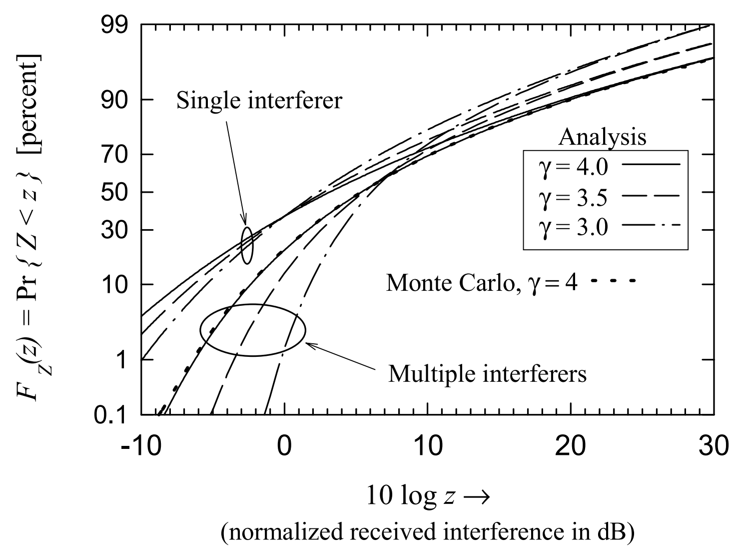
The soundness of the Monte Carlo routine can be verified by comparing the distribution against the asymptotic distribution for
$d_{\min} \to 0$, $d_{\max} \to \infty$.

Distance is normalized such that the density of interfering transmitters is 1/π, and the normalized interference is taken as $d^{-\gamma}$. Letting $\upsilon = 2/\gamma$, the cumulative distribution function of the normalized interference is:

$$F_Y(y) = \Pr\{Y < y\} = 1 - \frac{1}{\pi}\sum_{k=1}^{\infty}\frac{\Gamma(k\upsilon)}{k!}\left[\frac{\Gamma(1-\upsilon)}{y^{\upsilon}}\right]\sin k\pi(1-\upsilon), \quad y > 0, \upsilon < 1$$

where $\Gamma(\cdot)$ is the Gamma function.

CLOSED-FORM VS. MONTE CARLO RESULTS



VERIFICATION (3): A ROUGH SANITY CHECK

- Assume 40 Erlangs per DECT Access Site (DAS) for FWA (6 overlapping 90° sectors per ETR 310).
- With 300 Erlangs/km^2, the area covered by a DAS is 0.133 km^2.
- A hexagon with this area has a radius (to vertices) of 226 m.
- Since there are 120 channels, the reuse factor is 40/120 = 1/3 (i.e, on average, a given channel is used in every third DAS).
- With hexagonal geometry, $d/r = \sqrt{3/R}$, where r is the cell radius and d is the distance to the center of the nearest cochannel cell. Hence $d = 3r = 678$ m.
- The weakest received power levels among the 120 channels will tend to emanate from antennas $2r$ to $3r$ (452 m to 678 m) away.
- The corresponding path losses are 91.1 dB and 94.6 dB. With 24 dBm TX power, 12 dBi TX gain, 3 dBi RX gain and 15 dB building loss, the received power levels are −67.1 dBm and −70.6 dBm.
- Monte Carlo results give a median level of −68 dBm on the least-interfered channel.

SUMMARY OF RESULTS

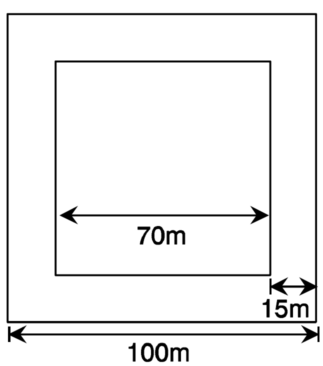
- The average interference on the least-interfered FWA frequency/timeslot is about –68 to –65.6 dBm (depending on the mix of micro- and macro-bases), which is about 44.2 dB to 46.5 dB above the thermal noise floor.
- Since the UPCS system will not be synchronized with the FWA system, the interference on the least-interfered UPCS channel will be about 1 dB to 3.5 dB higher, depending on the frame structure of the UPCS system.
- Only the FWA downlink was considered here; the interference would be higher if the uplink was also considered (effective interference would be the worst of the uplink and downlink).
- Only cochannel interference was considered; adding adjacent-channel interference would also increase the interference somewhat.
- With a lower exterior building loss (e.g., for glass exteriors), the interference will be greater.

EFFECT OF INTERIOR BUILDING LOSS

- For a 100m × 100m building, half the locations within the building are within 15m of an exterior wall.
- 64% of the locations are within 20m and 84% are within 30m of an outside wall.
- With modular soft-partition construction of many modern offices, additional path loss will be small (less than 2-3 dB for 15m) based on propagation model in ETR-310 (p. 45).
- Many higher-level managers who have wireless phones will also have offices with windows, along the outside wall of the building.
- CONCLUSION: Interior building loss will in general not significantly reduce the FWA interference.

BUILDING AREA DISTRIBUTION:

ILLUSTRATIVE EXAMPLE



- The area of the building is 10 000 m^2
- The points outside the inner square are within 15m of an outside wall
- The area of the inner square is 4900 m^2
- **More than half the overall area of the building is within 15m of an exterior wall.**

SUMMARY AND CONCLUSIONS

- With dynamic channel assignment (DCA), the interference power on the least-interfered channel must be studied to determine the effect of interference.
- A simple teletraffic model based on Erlangs used by nearby FWA sites is inadequate.
- The FWA transmitters will result in interference to the UPCS system that can approach 50 dB above the thermal noise floor, ***on the least-interfered channel***.
- Interior building loss will in general not alleviate the problem.
- The FWA interference will severely impair the operation of UPCS systems.

TWO-SLOPE PROPAGATION MODEL ADOPTED BY PCC-III INTERFERENCE EXPERTS GROUP

$$L(r) = \begin{cases} \left(\dfrac{4\pi r}{\lambda}\right)^2 & r \le r_b \\ \left(\dfrac{4\pi r^2}{\lambda r_b}\right)^2 & r \ge r_b \end{cases} \qquad \text{with} \quad r_b = \frac{4h_t h_r}{\lambda}$$

h_t and h_r are transmit and receive antenna elevations (m)

λ is wavelength (assumed 0.156 m)

r is distance between transmit and receive antenna (m)

FWA MICROBASE ANALYSIS WITH 15M ELEVATION