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TETRA ENHANCED DATA SERVICES (TEDS): COMPATIBILITY STUDIES WITH EXISTING PMR/PAMR AND AIR GROUND AIR (AGA) SYSTEMS IN THE 400 MHz BAND

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EXECUTIVE SUMMARY

This ECC report presents the results obtained in the frame of the TETRA Enhanced Data Services (TEDS) compatibility studies. These studies consist on the evaluation of the impact of TEDS on existing PMR system in the 380-470 MHz frequency band and military applications below 400 MHz. The opposite direction impact from existing PMR system and from military applications on TEDS was also examined in the report.

Compatibility studies with existing PMR systems

Regarding existing PMR systems, the median 410-430 MHz band was considered as representative of the sub-bands contained in the 380-470 MHz band. Analogue FM, TETRA, TETRAPOL and CDMA-PAMR operating in 2-MHz band in this frequency range were considered as the victim or interfere systems. TEDS was considered as operating in a 2-MHz adjacent band. Simulations have been limited to an urban environment which corresponds to the most user-dense environment. Different TEDS channel bandwidths (from 25 kHz to 150 kHz) were considered.

TEDS impacts on PMR systems :

For realistic TEDS interferer density (see section 2.2.3) and for non-CDMA system, SEAMCAT shows interference probability less than 3%. For the same values of interferer density and for victim CDMA system, SEAMCAT also shows a capacity loss less than 0.2% for the CDMA reference cell and less than 0.5% for the CDMA system.

MCL calculations support the SEAMCAT results, however MCL emphasized the scenario in which a TEDS BS interferes to another PMR BS. In these cases, a specific site installation (duplexer filters) and/or the introduction of distance/frequency separation will help to reduce such a local interference.

Additional compatibility studies between TETRA and 25/50 kHz TEDS were performed considering interleaved frequency allocation (section 2.11). These SEAMCAT simulations show similar results whatever the interleaving scheme is. In the worst case (50 kHz TEDS Mobile Station (MS) interfering TETRA Base Station (BS)) interference can reach up to 5% when 50-kHz blocks are alternatively allocated to each system.

PMR systems impacts on TEDS :

For realistic PMR systems interferer density (see section 2.2.3) and for non-CDMA system, SEAMCAT shows interference probability less than 1.5%. For CDMA as interferer system and realistic interferer density, SEAMCAT shows an interference probability smaller than 3%.

MCL calculations support the SEAMCAT results, however MCL emphasized the scenario in which a PMR BS interferes to another TEDS BS. In these cases, a specific site installation (duplexer filters) and/or the introduction of distance/frequency separation will help to reduce such a local interference.

The impact of TETRA on 25/50 kHz TEDS at interleaving bands was also considered. In the worst case (TETRA BS interfering 50 kHz TETRA BS) interference can reach less than 1% when 50-kHz blocks are alternatively allocated to each system.

The report concludes that, as long as the PMR systems are in the same scale as TEDS in terms of sites and users density, TEDS could be deployed within the 380-470 MHz range with existing PMR systems in adjacent channels with negligible risk of interference.

As the simulation results are based on specific assumptions, additional system design factors were presented at section 2.12 in order to be considered by the operators for practical implementation when TEDS and a PMR system share adjacent bands.

Compatibility studies with military applications

Co-channel usage of AGA and TEDS in the parts of the bands 385-390/395-400 MHz used for AGA is considered impracticable in Europe due to the large coordination distance. Usage of TEDS in parts of these bands used for military DPMR is ruled by the results of section 2 of the report and would therefore be subject to coordination between involved countries.

Regarding the 385-390 and 395-400 MHz bands in order to protect military applications, usage of TEDS in these bands in countries that do not deploy military systems could be possible, but would still require coordination in bordering areas (for any TEDS BS within 100 km of the border of a country using military systems in the bands 385-390/395-400 MHz).

Usage of TEDS in 380-385/390-395 MHz bands is possible within Europe, with a guard band at the edges to protect adjacent AGA services. This guard band depends on the TEDS bandwidth, and goes up to 300 kHz for TEDS-150 kHz.

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1 INTRODUCTION

1.1 Scope

The scope of the work detailed in this report was to examine the compatibility studies necessary for the introduction of TETRA Enhanced Data Service (TEDS) regarding the TEDS impacts on identified radio systems in the 400 MHz band (PMR systems and military applications). The opposite direction impact on TEDS was also examined in the report.

This report deals with the simulations performed using MCL calculation methodology and SEAMCAT 3 (www.seamcat.org).

For the PMR applications only the frequency range 410-430 MHz has been considered as representative of the other sub-bands, i.e. 380-400 MHz and 450-470 MHz, where TEDS can be deployed.

Given the current situation of the military use of UHF band 225-400 MHz, it has been agreed that only Air Ground Air (AGA) services in the 385-390 and 395-400 MHz band would be studied. Tactical Radio Relay (TRR) services may tune over the entire military UHF band, but are not foreseen in the 380-400 MHz band in the majority of countries.

For the two cases mentioned above, the report aims at indicating the necessary conditions, if any, for the co-existence of TEDS with existing systems.

2 PMR STUDIES IN THE 400 MHZ BAND

2.1 MCL Calculations & SEAMCAT simulations

Two different methods have been used to perform this coexistence study.

MCL calculations have been performed to define the distance separation between the two considered radio equipments as function of the frequency separation. The computed distance corresponds to blocking and unwanted interferences received at the noise level (defined by sensitivity minus protection ratio), i.e. a 3dB degradation of the noise level.

SEAMCAT has been used to define either the interference probability (for non-CDMA system) or the capacity loss for CDMA system, when CDMA systems are victim of interference from a TEDS radio link.

2.2 Preliminary Considerations

Before discussing the simulations results, some points have to be addressed in order to define the common assumptions.

2.2.1 Frequency allocation

The 410-430 MHz band has been considered as a harmonised band, i.e. uplink band starts from 410 MHz and downlink band starts from 420 MHz as illustrated by the following figure 2-1.

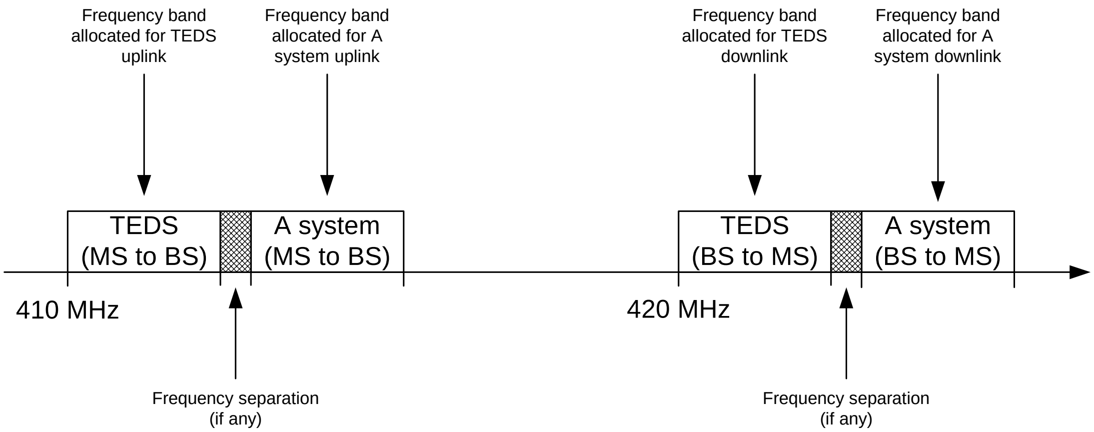

Figure 2-1: Frequency allocation of the 410-430 MHz

SEAMCAT simulations have been performed using 2 MHz allocation per system (Analogue FM, TETRA and TETRAPOL) as illustrated by figure 2-1. Depending on the obtained results a frequency guard band could be considered between two allocated blocks.

MCL calculations have been performed without any consideration of frequency allocation. These MCL calculations do not consider the frequency separation illustrated by figure 2-1.

For CDMA-PAMR system, a 1.25 MHz band has been considered (instead of the 2 MHz mentioned above). Depending on the obtained results a frequency guard band could be considered between two allocated blocks.

2.2.2 Propagation environment

As interferer density has been identified as one of the main parameters to be studied, simulations have been limited to the urban environment which corresponds to the most user-dense environment.

2.2.3 Cell range and interferer density

In order to define the interferer density, cell range calculations at 410 MHz in an urban environment have been performed using the radio parameters of the different system and the extended Hata propagation model as available within SEAMCAT.

For the victim systems, this calculation is useful to define the mobile split around a given BS.
Cell ranges have been calculated in order to guarantee a 90% confidence level on the cell area. This corresponds to a 75% confidence level at the cell fringe.

Any BS antenna height has been set at 30 m and any mobile antenna height has been set at 1.5 m.

2.2.3.1 TEDS cell range

A lot of Mobile Station (MS) and Base Station (BS) powers are listed within the TEDS system reference document. For calculations and simulations a transmission power of 40 dBm has been used for the BS and a transmission power of 35 dBm has been used for the MS. These values correspond to realistic devices.

TEDS sensitivities of the following tables correspond to the dynamic sensitivity achieved using the 16-QAM modulation scheme.

2.2.3.1.1 25 kHz TEDS cell range

Downlink path loss calculation	
BS TX Power (dBm)	40
BS antenna gain (dBi)	9
MS antenna gain (dBi)	0
MS dynamic sensitivity 16 QAM 3% BER (dBm)	-103
Downlink available path loss (dB)	**152**
Up path loss calculation	
MS TX Power (dBm)	35
MS antenna gain (dBi)	0
BS antenna gain (dBi)	9
BS dynamic sensitivity 16 QAM 3% BER (dBm)	-106
Uplink available path loss (dB)	**150**
Balanced path loss	**150**
Cell range for 90% confidence level on the cell area (km)	**5.4**

Table 2-1: 25kHz TEDS cell range calculation

Then, when TEDS BS stations are considered as interferer, the density of interferers is defined by:

$$\text{interferer density} = \frac{1}{\pi (Cellrange)^2},$$

This leads to a value of 0.011 BS/km².

When TEDS MS are considered as interferer, the study will consider 4 simultaneously active interferers per cell. This leads to a density of 0.044 MS per square km.

2.2.3.1.2 50 KHz TEDS cell range

Downlink path loss calculation	
BS TX Power (dBm)	40
BS antenna gain (dBi)	9
MS antenna gain (dBi)	0
MS dynamic sensitivity 16 QAM 3% BER (dBm)	-100
Downlink available path loss (dB)	**149**
Up path loss calculation	
MS TX Power (dBm)	35
MS antenna gain (dBi)	0
BS antenna gain (dBi)	9
BS dynamic sensitivity 16 QAM 3% BER (dBm)	-102
Uplink available path loss (dB)	**146**
Balanced path loss	**146**
Cell range for 90% confidence level on the cell area (km)	**4.2**

Table 2-2: 50kHz TEDS cell range calculation

Then, when TEDS BS stations are considered as interferer, the density of interferer is defined by:

$$\text{interferer density} = \frac{1}{\pi (Cellrange)^2},$$

This leads to a value of 0.018 BS/km².

When TEDS MS are considered as interferer, the study will consider 4 simultaneously active interferers per cell. This leads to a density of 0.072 MS per square km.

2.2.3.1.3 100 KHz TEDS cell range

Downlink path loss calculation	
BS TX Power (dBm)	40
BS antenna gain (dBi)	9
MS antenna gain (dBi)	0
MS dynamic sensitivity 16 QAM 3% BER (dBm)	-97
Downlink available path loss (dB)	**146**
Up path loss calculation	
MS TX Power (dBm)	35
MS antenna gain (dBi)	0
BS antenna gain (dBi)	9
BS dynamic sensitivity 16 QAM 3% BER (dBm)	-100
Uplink available path loss (dB)	**144**
Balanced path loss	**144**
Cell range for 90% confidence level on the cell area (km)	**3.8**

Table 2-3: 100 kHz TEDS cell range calculatio

Then, when TEDS BS stations are considered as interferer, the density of interferer is defined by:

$$\text{interfererdensity} = \frac{1}{\pi (Cellrange)^2}$$

This leads to a value of 0.022 BS/km².

When TEDS MS are considered as interferer, the study will consider 4 simultaneously active interferers per cell. This leads to a density of 0.088 MS per square km.

2.2.3.1.4 150 kHz TEDS cell range

Downlink path loss calculation	
BS TX Power (dBm)	40
BS antenna gain (dBi)	9
MS antenna gain (dBi)	0
MS dynamic sensitivity 16 QAM 3% BER (dBm)	-96
Downlink available path loss (dB)	**145**
Up path loss calculation	
MS TX Power (dBm)	35
MS antenna gain (dBi)	0
BS antenna gain (dBi)	9
BS dynamic sensitivity 16 QAM 3% BER (dBm)	-99
Uplink available path loss (dB)	**143**
Balanced path loss	**143**
Cell range for 90% confidence level on the cell area (km)	**3.5**

Table 2-4: 150 kHz TEDS cell range calculation

Then, when TEDS BS stations are considered as interferer, the density of interferer is defined by:

$$\text{interfererdensity} = \frac{1}{\pi (Cellrange)^2}$$

This leads to a value of 0.026 BS/km².

When TEDS MS are considered as interferer, the study will consider 4 simultaneously active interferers per cell. This leads to a density of 0.104 MS per square km.

Remark: simulation of 4 simultaneously active interferers per cell at SEAMCAT tool is equal to 16 TDMA users of TEDS technology.

2.2.3.2 25 kHz Analogue FM PMR cell range

Downlink path loss calculation	
BS TX Power (dBm)	44
BS antenna gain (dBi)	9
MS antenna gain (dBi)	0
MS sensitivity (dBm)	-107
Downlink available path loss (dB)	**160**
Up path loss calculation	
MS TX Power (dBm)	37
MS antenna gain (dBi)	0
BS antenna gain (dBi)	9
BS sensitivity (dBm)	-110
Uplink available path loss (dB)	**156**
Balanced path loss	**156**
Cell range for 90% confidence level on the cell area (km)	**7.9**

Table 2-5 : 25 kHz analogue FM cell range calculation

Then, when 25 kHz Analogue FM BS stations are considered as interferer, the density of interferer is defined by:

$$\text{interfererdensity} = \frac{1}{\pi (Cellrange)^2}$$

This leads to a value of 0.005 BS/km².

When 25 kHz FM MS are considered as interferer, the study will consider 20 simultaneously active interferers per cell. This leads to a density of 0. 1 MS per square km.

2.2.3.3 TETRA cell range

Downlink path loss calculation	
BS TX Power (dBm)	40
BS antenna gain (dBi)	9
MS antenna gain (dBi)	0
MS dynamic sensitivity (dBm)	-103
Downlink available path loss (dB)	**152**
Up path loss calculation	
MS TX Power (dBm)	35
MS antenna gain (dBi)	0
BS antenna gain (dBi)	9
BS dynamic sensitivity (dBm)	-106
Uplink available path loss (dB)	**150**
Balanced path loss	**150**
Cell range for 90% confidence level on the cell area (km)	**5.4**

Table 2-6 : TETRA cell range calculation

Then, when TETRA BS stations are considered as interferer, the density of interferer is defined by:

$$\text{interfererdensity} = \frac{1}{\pi (Cellrange)^2}$$

This leads to a value of 0.01 BS/km².

When TETRA MS are considered as interferer, the study will consider 20 simultaneously active interferers per cell. This leads to a density of 0. 2 MS per square km.

2.2.3.4 TETRAPOL cell range

Downlink path loss calculation	
BS TX Power (dBm)	38
BS antenna gain (dBi)	9
MS antenna gain (dBi)	0
MS dynamic sensitivity (dBm)	-111
Downlink available path loss (dB)	**158**
Up path loss calculation	
MS TX Power (dBm)	33
MS antenna gain (dBi)	0
BS antenna gain (dBi)	9
BS dynamic sensitivity (dBm)	-113
Uplink available path loss (dB)	**155**
Balanced path loss	**155**
Cell range for 90% confidence level on the cell area (km)	**7.7**

Table 2-7 : TETRAPOL cell range calculation

Then, when TETRAPOL BS stations are considered as interferer, the density of interferer is defined by:

$$\text{interfererdensity} = \frac{1}{\pi(Cellrange)^2}$$

This leads to a value of 0.005 BS/km².

When TETRAPOL MS are considered as interferer, the study will consider 20 simultaneously active interferers per cell. This leads to a density of 0. 1 MS per square km.

2.2.3.5 CDMA-PAMR Cell range

Downlink path loss calculation	
BS TX 15% Control channel Power (dBm)	31
BS antenna gain (dBi)	9
MS antenna gain (dBi)	0
MS Dynamic sensitivity (dBm)	-107
Downlink available path loss (dB)	**147**
Up path loss calculation	
MS TX Power (dBm)	23
MS antenna gain (dBi)	0
BS antenna gain (dBi)	9
BS Dynamic sensitivity 75% system loading (dBm)	-113
Uplink available path loss (dB)	**145**
Balanced path loss	**145**
Cell range for 90% confidence level on the cell area (km)	**4**

Table 2-8 : CDMA-PAMR cell range calculation

Then, when CDMA-PAMR BS stations are considered as interferer, the density of interferer is defined by:

$$\text{interfererdensity} = \frac{1}{\pi(Cellrange)^2}$$

This leads to a value of 0.02 BS/km².

When CDMA-PAMR MS are considered as interferer, the study will consider 20 simultaneously active interferers per cell. This leads to a density of 0. 4 MS per square km.

2.3 25 kHz TEDS impacts on existing PMR systems

This section presents and comments the simulation results obtained by performing MCL calculations and SEAMCAT simulations for the 25 kHz TEDS impact on analogue FM PMR system, TETRA, TETRAPOL and CDMA PAMR systems.

2.3.1 25 kHz TEDS impact on Analogue FM PMR

2.3.1.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance, a 25 kHz TEDS BS operation at 400 kHz from a 25 kHz FM MS shall be set at least at 190 m from this FM mobile station.

Frequency Separation (MHz)	0.025	0.05	0.075	0.1	**0.4**	0.75	1	2	4	5	10
25 kHz TEDS BS on 25 kHz FM BS	13.29	6.91	6.06	4.98	2.59	2.59	2.59	2.59	1.36	1.01	1.00
25 kHz TEDS BS on 25 kHz FM MS	0.97	0.51	0.44	0.36	**0.19**	0.19	0.19	0.19	0.10	0.09	0.08
25 kHz TEDS MS on 25 kHz FM BS	0.85	0.44	0.39	0.32	0.25	0.17	0.17	0.17	0.17	0.08	0.08
25 kHz TEDS MS on 25 kHz FM MS	0.09	0.08	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.05	0.05

Table 2-9 : Distance separation (km) as function of the frequency separation (MHz)

2.3.1.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

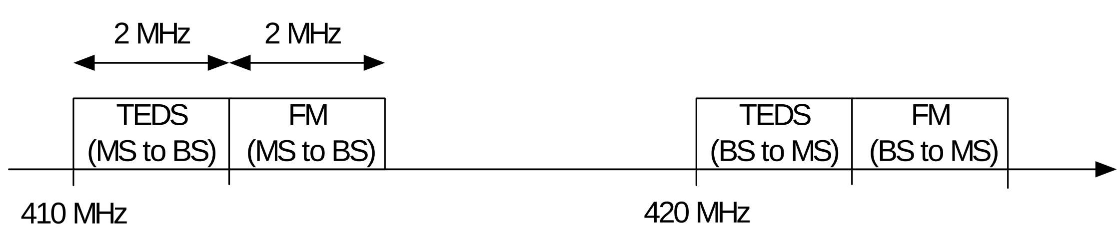

Figure 2-2 : TEDS on FM

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 25 kHz (consideration of 25 kHz TEDS and 25 kHz FM in a first step). For instance, TEDS BS transmits on 420.0125 MHz, 420.0375 MHz and so on.

Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.3.1.2.1 25 kHz TEDS BS on 25 kHz Analogue FM BS

The TEDS BSs transmit between 420 and 422 MHz whereas the analogue FM BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.65 %
0.01	1.59 %
0.02	2.77 %
0.05	7.12 %

Table 2-10 : 25 kHz TEDS BS on 25 kHz analogue FM BS

2.3.1.2.2 25 kHz TEDS BS on 25 kHz Analogue FM mobile station

The TEDS BSs transmit between 420 and 422 MHz whereas the analogue FM MS receive signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.04 %
0.01	0.04 %
0.02	0.09 %
0.05	0.22 %

Table 2-11 : 25 kHz TEDS BS on 25 kHz analogue FM mobile station

2.3.1.2.3 25 kHz TEDS MS on 25 kHz analogue FM BS

The TEDS MS transmit between 410 and 412 MHz whereas the analogue FM BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.04 %
0.05	0.16 %
0.1	0.25 %
0.2	0.57 %
0.5	1.38 %
1	3.06 %

Table 2-12 : 25 kHz TEDS mobile on 25 kHz analogue FM BS

2.3.1.2.4 25 kHz TEDS MS on 25 kHz analogue FM mobile station

The TEDS MS transmit between 410 and 412 MHz whereas the analogue FM MS receive signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0 %
0.2	0 %
0.5	0 %
1	0 %

Table 2-13 : 25 kHz TEDS MS on 25 kHz analogue FM mobile station

2.3.1.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 25 kHz TEDS BS density of 0.011 BS/km² as calculated in section 2.2.3.1.1, we obtain a relatively low interference probability on 25 kHz analogue FM PMR system. Interference probability on FM BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and FM BS.

Considering a density of 0.044 MS per square km as pointed out in section 2.2.3.1.1, we obtain also a low interference probability for TEDS MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

As blocking figures and sensitivities are similar for analogue FM systems independently of the channel bandwidth, 25 kHz TEDS impact on 20 kHz and 12.5 kHz analogue FM are similar than thus obtained for 25 kHz FM analogue FM.

2.3.2 25 kHz TEDS impact on TETRA

2.3.2.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance a 25 kHz TEDS BS operation at 400 kHz from a TETRA MS shall be set at least at 180 m from the TETRA mobile station.

Frequency Separation (MHz)	0.025	0.05	0.075	0.1	**0.4**	0.75	1	2	4	5	10
25 kHz TEDS BS on TETRA BS	12.49	6.40	5.63	4.62	2.42	2.40	2.40	2.40	1.27	0.97	0.96
25 kHz TEDS BS on TETRA MS	0.91	0.47	0.41	0.34	**0.18**	0.18	0.18	0.18	0.10	0.08	0.08
25 kHz TEDS MS on TETRA BS	0.80	0.41	0.36	0.30	0.23	0.15	0.15	0.15	0.15	0.08	0.08
25 kHz TEDS MS on TETRA MS	0.09	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.05	0.05

Table 2-14 : Distance separation (km) as function of the frequency separation (MHz)

2.3.2.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

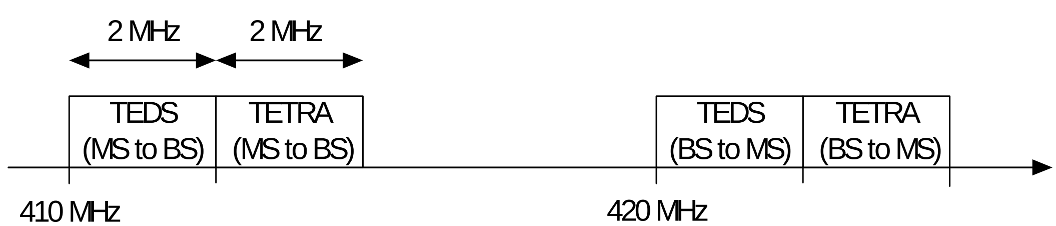

Figure 2-3 : 25 kHz TEDS on TETRA

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 25 kHz. For instance, TEDS BS transmits on 420.0125 MHz, 420.0375 MHz and so on.

Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.3.2.2.1 25 kHz TEDS BS on TETRA BS

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRA BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.66 %
0.01	1.27 %
0.02	2.51 %
0.05	6.49 %

Table 2-15 : 25 kHz TEDS BS on TETRA BS

2.3.2.2.2 25 kHz TEDS BS on TETRA mobile station

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRA MS receive signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0 %
0.01	0 %
0.02	0.01 %
0.05	0 %

Table 2-16 : 25 kHz TEDS BS on TETRA mobile station

2.3.2.2.3 25 kHz TEDS MS on TETRA BS

The TEDS MS transmit between 410 and 412 MHz whereas the TETRA BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.06 %
0.05	0.29 %
0.1	0.51 %
0.2	1.03 %
0.5	2.45 %
1	5.08 %

Table 2-17 : 25 kHz TEDS MS on TETRA BS

2.3.2.2.4 25 kHz TEDS MS on TETRA mobile station

The TEDS MS transmit between 410 and 412 MHz whereas the TETRA MS receive signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0.01 %
0.1	0.02 %
0.2	0.04 %
0.5	0.12 %
1	0.24 %

Table 2-18 : 25 kHz TEDS MS on TETRA mobile station

2.3.2.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 25 kHz TEDS BS density of 0.011 BS/km² as calculated in section 2.2.3.1.1, we obtain a relatively low interference probability on TETRA system. Interference probability on TETRA BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRA BS.

Considering a density of 0.044 MS per square km as pointed out in section 2.2.3.1.1, we obtain also a low interference probability for TEDS MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.3.3 25 KHz TEDS impact on TETRAPOL

2.3.3.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance a 25 kHz TEDS BS operation at 400 kHz from a TETRAPOL MS shall be set at least at 190 m from the TETRAPOL mobile station.

Frequency Separation (MHz)	0.025	0.05	0.075	0.1	**0.4**	0.75	1	2	4	5	10
25 kHz TEDS BS on TETRAPOL BS	11.99	6.36	5.67	4.50	2.39	2.32	2.32	2.32	1.24	0.94	0.94
25 kHz TEDS BS on TETRAPOL MS	0.94	0.50	0.45	0.35	**0.19**	0.18	0.18	0.18	0.10	0.09	0.09
25 kHz TEDS MS on TETRAPOL BS	0.77	0.41	0.36	0.29	0.22	0.15	0.15	0.15	0.11	0.07	0.07
25 kHz TEDS MS on TETRAPOL MS	0.09	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.05	0.05

Table 2-19 : Distance separation (km) as function of the frequency separation (MHz)

2.3.3.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

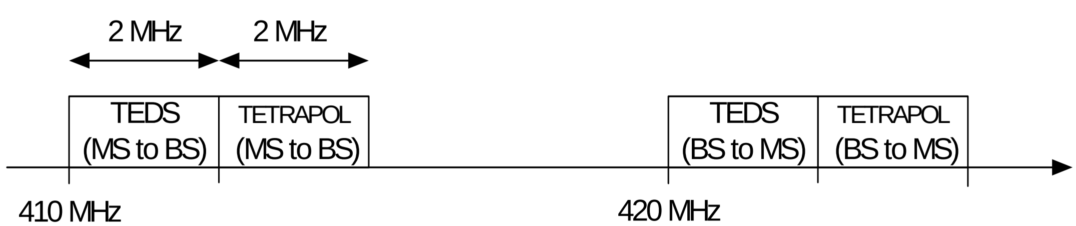

Figure 2-4 : TEDS on TETRAPOL

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 12.5 kHz (TETRAPOL) or 25 kHz (TEDS). For instance, TEDS BS transmits on 420.0125 MHz, 420.0375 MHz and so on.
Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.3.3.2.1 25 kHz TEDS BS on TETRAPOL BS

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRAPOL BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.52 %
0.01	0.95 %
0.02	2.00 %
0.05	5.24 %

Table 2-20 : 25 kHz TEDS BS on TETRAPOL BS

2.3.3.2.2 25 kHz TEDS BS on TETRAPOL mobile station

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRAPOL MS receive signals coming from BS between 422 and 424 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.02 %
0.01	0.05 %
0.02	0.09 %
0.05	0.23 %

Table 2-21 : 25 kHz TEDS BS on TETRAPOL mobile station

2.3.3.2.3 25 kHz TEDS MS on TETRAPOL BS

The TEDS MS transmit between 410 and 412 MHz whereas the TETRAPOL BSs receive signals coming from MS between 412 and 414 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.04 %
0.05	0.29 %
0.1	0.52 %
0.2	0.83 %
0.5	2.50 %
1	4.91 %

Table 2-22 : 25 kHz TEDS mobile on TETRAPOL BS

2.3.3.2.4 25 kHz TEDS MS on TETRAPOL mobile station

The TEDS MS transmit between 410 and 412 MHz whereas the TETRAPOL MS receive signals coming from BS between 422 and 424 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.01 %
0.05	0.01 %
0.1	0.02 %
0.2	0.06 %
0.5	0.06 %
1	0.18 %

Table 2-23 : 25 kHz TEDS MS on TETRAPOL mobile station

2.3.3.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 25 kHz TEDS BS density of 0.011 BS/km² as calculated in section 2.2.3.1.1, we obtain a relatively low interference probability on TETRAPOL system. Interference probability on TETRAPOL BSs could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRAPOL BS.

Considering a density of 0.044 MS per square km as pointed out in section 2.2.3.1.1, we obtain also a low interference probability for TEDS MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.3.4 25 kHz TEDS impact on CDMA-PAMR

2.3.4.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance a 25 kHz TEDS BS operation at 2 MHz from a CDMA-PAMR MS shall be set at least at 90 m from the CDMA-PAMR mobile station.

Frequency Separation (MHz)	0.6375	0.9	1	2	4	5	10
25 kHz TEDS BS on CDMA-PAMR BS	1.20	1.21	1.21	1.21	1.21	0.58	0.58
25 kHz TEDS BS on CDMA-PAMR MS	0.07	0.09	0.09	0.09	0;09	0.09	0.09
25 kHz TEDS MS on CDMA-PAMR BS	0.08	0.08	0.08	0.08	0.08	0,06	0,06
25 kHz TEDS MS on CDMA-PAMR MS	0.05	0,05	0,05	0,05	0,05	0.05	0.05

Table 2-24 : Distance separation (km) as function of the frequency separation (MHz)

2.3.4.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

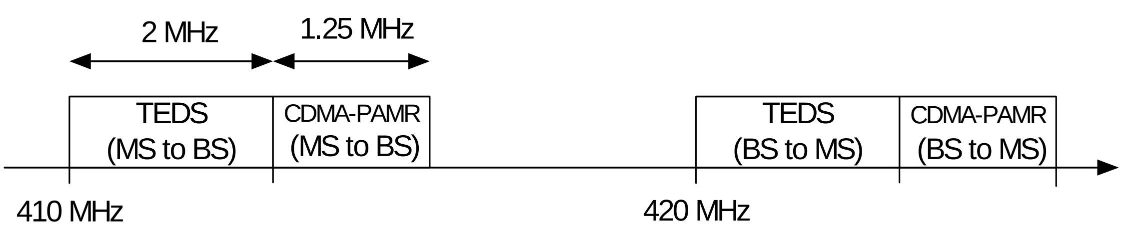

Figure 2-5 : TEDS on CDMA-PAMR

For each sub-case, TEDS transmitters have been split homogeneously over the different bands on channels separated by 25. For instance, TEDS BS transmits on 420.0125 MHz, 420.0375 MHz and so on. Only one CDMA-PAMR duplex frequency has been considered.

2.3.4.2.1 25 kHz TEDS BS on a CDMA-PAMR system

The TEDS BSs transmit between 420 and 422 MHz whereas the CDMA-PAMR system operates at 412.625 MHz (uplink) and at 422.625 (downlink).
The table below gives the average loss capacity of the CDMA-PAMR system as defined within SEAMCAT.

Interferer density (TEDS BS/km²)	CDMA-PAMR system average capacity loss	Average capacity loss in the reference cell
0.005	0.08 %	0 %
0.01	0.09 %	0.01 %
0.02	0.16 %	0.03 %
0.05	0.16 %	0.03 %

Table 2-25 : 25 kHz TEDS BS on CDMA-PAMR system

2.3.4.2.2 25 kHz TEDS MS on a CDMA-PAMR system

The TEDS MS transmit between 410 and 412 MHz whereas the CDMA-PAMR system operates at 412.625 MHz (uplink) and at 422.625 (downlink).
The table below gives the average loss capacity of the CDMA-PAMR system as defined within SEAMCAT.

Interferer density (TEDS BS/km²)	CDMA-PAMR system average capacity loss	Average capacity loss in the reference cell
0.01	0.20 %	0 %
0.05	0.16 %	0.02 %
0.1	0.33 %	0.02 %
0.2	0.40 %	0.07 %
0.5	0.33 %	0.05 %
1	0.32 %	0.03 %

Table 2-26 : 25 kHz TEDS BS on CDMA-PAMR system

2.3.4.3 Analysis

SEAMCAT simulation indicates a quite low capacity loss, if we consider either a 25 kHz TEDS BS or a 25 kHz TEDS MS as interferer.

According to MCL calculation the interference probability on CDMA BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and CDMA BS.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.4 50 kHz TEDS impacts on existing PMR systems

This section presents and comments the simulation results obtained by performing MCL calculations and SEAMCAT simulations for the 50 kHz TEDS impact on analogue FM PMR system, TETRA, TETRAPOL and CDMA PAMR systems.

2.4.1 50 kHz TEDS impact on Analogue FM PMR

2.4.1.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance, a 50 kHz TEDS BS operates at 1 MHz from a 25 kHz FM BS shall be set at least at 2590 m from this Mobile station.

Frequency Separation (MHz)	0.0375	0.0625	0.0875	0.1125	0.4	0.75	1	2	4	5	10
50 kHz TEDS BS on 25 kHz FM BS	13.29	7.88	6.91	4.98	3.59	2.59	2.59	2.59	2.58	0.98	0.98
50 kHz TEDS BS on 25 kHz FM MS	0.97	0.58	0.51	0.36	0.26	0.19	0.19	0.19	0.19	0.08	0.08
50 kHz TEDS MS on 25 kHz FM BS	0.85	0.51	0.44	0.36	0.28	0.19	0.19	0.19	0.19	0.08	0.08
50 kHz TEDS MS on 25 kHz FM MS	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.05	0.05

Table 2-27 : Distance separation (km) as function of the frequency separation (MHz)

2.4.1.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

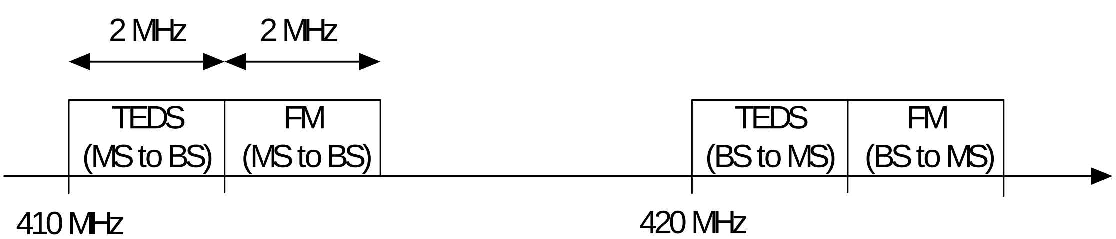

Figure 2-6 : TEDS on FM

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by the relevant channel spacing. For instance, 50Khz TEDS BS transmit on 420.025 MHz, 420.075 MHz and so on. Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.4.1.2.1 50 kHz TEDS BS on 25 kHz Analogue FM BS

The TEDS BSs transmit between 420 and 422 MHz whereas the analogue FM BSs receive signals coming from MS between 412 and 414 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.73 %
0.01	1.32 %
0.02	2.67 %
0.05	6.69 %

Table 2-28 : 50 kHz TEDS BS on 25 kHz analogue FM BS

2.4.1.2.2 50 kHz TEDS BS on 25 kHz Analogue FM mobile station

The TEDS BSs transmit between 420 and 422 MHz whereas the analogue FM MS receive signals coming from BS between 422 and 424 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.04 %
0.01	0.09 %
0.02	0.13 %
0.05	0.29 %

Table 2-29 : 50 kHz TEDS BS on 25 kHz analogue FM mobile station

2.4.1.2.3 50 kHz TEDS MS on 25 kHz analogue FM BS

The TEDS MS transmit between 410 and 412 MHz whereas the analogue FM BSs receive signals coming from MS between 412 and 414 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.02 %
0.05	0.27 %
0.1	0.32 %
0.2	0.74 %
0.5	2.04 %
1	3.88 %

Table 2-30 : 50 kHz TEDS mobile on 25 kHz analogue FM BS

2.4.1.2.4 50 kHz TEDS MS on 25 kHz analogue FM mobile station

The TEDS MS transmit between 410 and 412 MHz whereas the analogue FM MS receive signals coming from BS between 422 and 424 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0 %
0.2	0.04 %
0.5	0.05 %
1	0.16 %

Table 2-31 : 50 kHz TEDS MS on 25 kHz analogue FM mobile station

2.4.1.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 50 kHz TEDS BS density of 0.018 BS/km² as calculated in section 2.2.3.1.2, we obtain a relatively low interference probability on 25 kHz analogue FM PMR system. Interference probability on FM BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and FM BS.

Considering a density of 0.072 MS per square km as pointed out in section 2.2.3.1.2, we obtain also a low interference probability for TEDS MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

As blocking figures and sensitivities are similar for analogue FM systems independently of the channel bandwidth, 50 kHz TEDS impact on 20 kHz and 12.5 kHz analogue FM are similar than thus obtained for 25 kHz FM analogue FM.

2.4.2 50 kHz TEDS impact on TETRA

2.4.2.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance a 50 kHz TEDS BS operation at 1MHz from a TETRA BS shall be set at least at 2400 m from the TETRA BS.

Frequency Separation (MHz)	0.0375	0.0625	0.0875	0.1125	0.4	0.75	1	2	4	5	10
50 kHz TEDS BS on TETRA BS	12.33	7.28	6.39	4.61	3.32	2.40	2.40	2.39	2.39	0.93	0.93
50 kHz TEDS BS on TETRA MS	0.90	0.53	0.47	0.34	0.24	0.18	0.18	0.17	0.17	0.08	0.08
50 kHz TEDS MS on TETRA BS	0.79	0.47	0.41	0.34	0.26	0.18	0.17	0.17	0.17	0.07	0.07
50 kHz TEDS MS on TETRA MS	0.09	0.08	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.04	0.04

Table 2-32 : Distance separation (km) as function of the frequency separation (MHz)

2.4.2.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

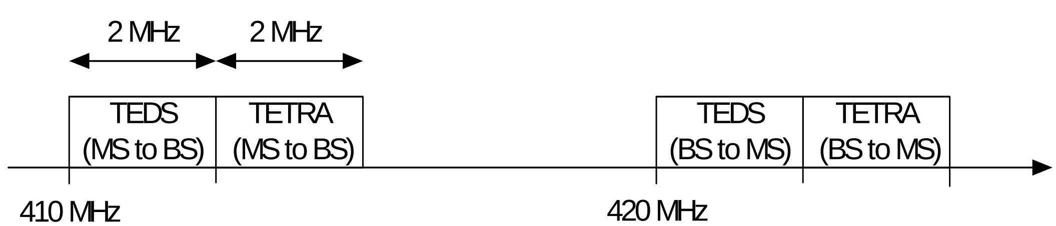

Figure 2-7 : TEDS on TETRA

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by the relevant channel spacing. For instance, 50 kHz TEDS BS transmit on 420.025 MHz, 420.075 MHz and so on.
Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.4.2.2.1 50 kHz TEDS BS on TETRA BS

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRA BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.66 %
0.01	1.41 %
0.02	2.44 %
0.05	6.44 %

Table 2-33 : 50 kHz TEDS BS on TETRA BS

2.4.2.2.2 50 kHz TEDS BS on TETRA mobile station

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRA MS receive signals coming from BS between 422 and 424 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.02 %
0.01	0.02 %
0.02	0.09 %
0.05	0.15 %

Table 2-34 : 50 kHz TEDS BS on TETRA mobile station

2.4.2.2.3 50 kHz TEDS MS on TETRA BS

The TEDS MS transmit between 410 and 412 MHz whereas the TETRA BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.02 %
0.05	0.18 %
0.1	0.38 %
0.2	0.78 %
0.5	1.72 %
1	3.82 %

Table 2-35 : 50 kHz TEDS MS on TETRA BS

2.4.2.2.4 50 kHz TEDS MS on TETRA mobile

The TEDS MS transmit between 410 and 412 MHz whereas the TETRA MS receive signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0.01 %
0.1	0.02 %
0.2	0.03 %
0.5	0.08 %
1	0.2 %

Table 2-36 : 50 kHz TEDS MS on TETRA mobile station

2.4.2.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 50 kHz TEDS BS density of 0.018 BS/km² as calculated in section 2.2.3.1.2, we obtain a relatively low interference probability on TETRA system. Interference probability on TETRA BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRA BS.

Considering a density of 0.072 MS per square km as pointed out in section 2.2.3.1.2, we obtain also a low interference probability for TEDS MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.4.3 50 kHz TEDS impact on TETRAPOL

2.4.3.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance a 50 kHz TEDS BS operation at 1 MHz from a TETRAPOL BS shall be set at least at 2310 m from this TETRAPOL BS.

Frequency Separation (MHz)	0.0375	0.0625	0.0875	0.1125	0.4	0.75	1	2	4	5	10
50 kHz TEDS BS on TETRAPOL BS	11.89	7.06	6.21	4.46	3.22	2.31	2.31	2.31	2.31	0.88	0.88
50 kHz TEDS BS on TETRAPOL MS	0.93	0.55	0.49	0.35	0.25	0.18	0.18	0.18	0.18	0.08	0.08
50 kHz TEDS MS on TETRAPOL BS	0.76	0.45	0.40	0.33	0.25	0.17	0.17	0.17	0.17	0.07	0.07
50 kHz TEDS MS on TETRAPOL MS	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.04	0.04

Table 2-37 : Distance separation (km) as function of the frequency separation (MHz)

2.4.3.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

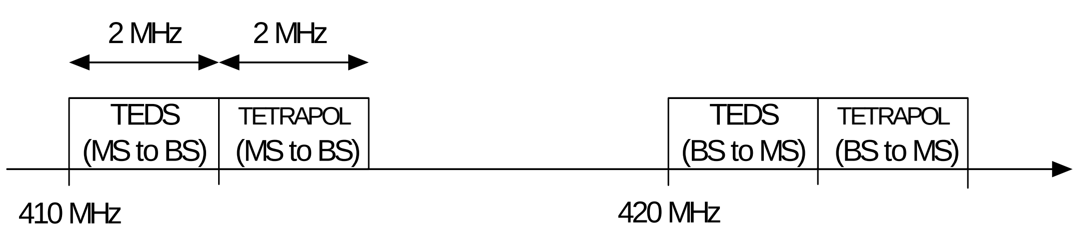

Figure 2-8 : TEDS on TETRAPOL

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 12.5 kHz (TETRAPOL) or 50 kHz (TEDS). For instance, TEDS BS transmits on 420.025 MHz, 420.075 MHz and so on.
Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.4.3.2.1 50 kHz TEDS BS on TETRAPOL BS

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRAPOL BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.59 %
0.01	1.26 %
0.02	2.53 %
0.05	6.37 %

Table 2-38 : 50 kHz TEDS BS on TETRAPOL BS

2.4.3.2.2 50 kHz TEDS BS on TETRAPOL mobile station

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRAPOL MS receives signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.01 %
0.01	0.03 %
0.02	0.06 %
0.05	0.22 %

Table 2-39 : 50 kHz TEDS BS on TETRAPOL mobile station

2.4.3.2.3 50 kHz TEDS MS on TETRAPOL BS

The TEDS MS transmit between 410 and 412 MHz whereas the TETRAPOL BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.03 %
0.05	0.24 %
0.1	0.36 %
0.2	0.73 %
0.5	1.83 %
1	3.32 %

Table 2-40 : 50 kHz TEDS mobile on TETRAPOL BS

2.4.3.2.4 50 kHz TEDS MS on TETRAPOL mobile station

The TEDS MS transmit between 410 and 412 MHz whereas the TETRAPOL MS receive signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.002 %
0.05	0.005 %
0.1	0.02 %
0.2	0.03 %
0.5	0.13 %
1	0.15 %

Table 2-41 : 50 kHz TEDS MS on TETRAPOL mobile station

2.4.3.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 50 kHz TEDS BS density of 0.018 BS/km² as calculated in section 2.2.3.1.2, we obtain a relatively low interference probability on TETRAPOL system. Interference probability on TETRAPOL BSs could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRAPOL BS.

Considering a density of 0.072 MS per square km as pointed out in section 2.2.3.1.2, we obtain also a low interference probability for TEDS MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.4.4 50 kHz TEDS impact on CDMA-PAMR

2.4.4.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance a 50 kHz TEDS BS operation at 1.13 MHz from a CDMA BS shall be set at least at 830 m from this TETRAPOL BS.

Frequency Separation (MHz)	0.6625	0.6875	0.7125	0.7375	0.8875	1.125	4	5.625	10
50 kHz TEDS BS on CDMA-PAMR BS	4.04	2.39	2.10	1.51	1.11	0.83	0.83	0.52	0.52
50 kHz TEDS BS on CDMA-PAMR MS	0.28	0.16	0.14	0.10	0.09	0.09	0.09	0.09	0.09
50 kHz TEDS MS on CDMA-PAMR BS	0.26	0.15	0.13	0.11	0.09	0.06	0.06	0.05	0.05
50 kHz TEDS MS on CDMA-PAMR MS	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Table 2-42 : Distance separation (km) as function of the frequency separation (MHz)

2.4.4.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

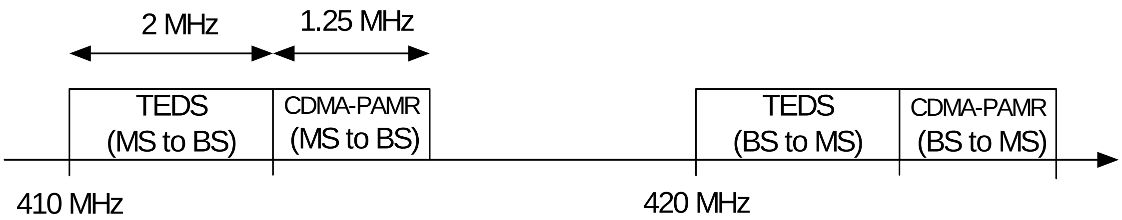

Figure 2-9 : TEDS on CDMA-PAMR

For each sub-case, TEDS transmitters have been split homogeneously over the different bands on channels separated by 25. For instance, TEDS BS transmits on 420.025 MHz, 420.075 MHz and so on. Only one CDMA-PAMR duplex frequency has been considered.

2.4.4.2.1 50 kHz TEDS BS on a CDMA-PAMR system

The TEDS BSs transmit between 420 and 422 MHz whereas the CDMA-PAMR system operates at 412.625 MHz (uplink) and at 422.625 MHz (downlink).

The table below gives the average loss capacity of the CDMA-PAMR system as defined within SEAMCAT.

Interferer density (TEDS BS/km²)	CDMA-PAMR system average capacity loss	Average capacity loss in the reference cell
0.005	0.08 %	0.02 %
0.01	0.08 %	0.02 %
0.02	0.12 %	0.04 %
0.05	0.15 %	0.09 %

Table 2-43 : 50 kHz TEDS BS on CDMA-PAMR system

2.4.4.2.2 50 kHz TEDS MS on a CDMA-PAMR system

The TEDS MS transmit between 410 and 412 MHz whereas the CDMA-PAMR operates at 412.625 MHz (uplink) and at 422.625 (downlink).

The table below gives the average loss capacity of the CDMA-PAMR system as defined within SEAMCAT.

Interferer density (TEDS BS/km²)	CDMA-PAMR system average capacity loss	Average capacity loss in the reference cell
0.01	0.11 %	0.02 %
0.05	0.12 %	0.05 %
0.1	0.10 %	0.05 %
0.2	0.15 %	0.04 %
0.5	0.25 %	0.08 %
1	0.19 %	0.05 %

Table 2-44 : 50 kHz TEDS MS on CDMA-PAMR system

2.4.4.3 Analysis

SEAMCAT simulation indicates a quite low capacity loss, if we consider either a 50 kHz TEDS BS or a 50 kHz TEDS MS as interferer.

According to MCL calculation the interference probability on CDMA BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and CDMA BS.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.5 100 kHz TEDS impacts on existing PMR systems

This section presents and comments the simulation results obtained by performing MCL calculations and SEAMCAT simulations for the 100 kHz TEDS impact on analogue FM PMR system, TETRA, TETRAPOL and CDMA PAMR systems.

2.5.1 100 kHz TEDS impact on Analogue FM PMR

2.5.1.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance, a 100 kHz TEDS BS operation at 1 MHz from a 25 kHz FM BS shall be set at least at 2590 m from the FM BS.

Frequency Separation (MHz)	0.0625	0.0875	0.1125	0.4	0.75	1	2	4	5	10
100 kHz TEDS BS on 25 kHz FM BS	13.29	9.58	9.58	4.98	3.59	2.59	2.59	2.58	0.98	0.97
100 kHz TEDS BS on 25 kHz FM MS	0.97	0.70	0.70	0.50	0.30	0.30	0.30	0.30	0.08	0.08
100 kHz TEDS MS on 25 kHz FM BS	0.85	0.61	0.61	0.44	0.26	0.26	0.26	0.26	0.08	0.08
100 kHz TEDS MS on 25 kHz FM MS	0.09	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.05	0.04

Table 2-45 : Distance separation (km) as function of the frequency separation (MHz)

2.5.1.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

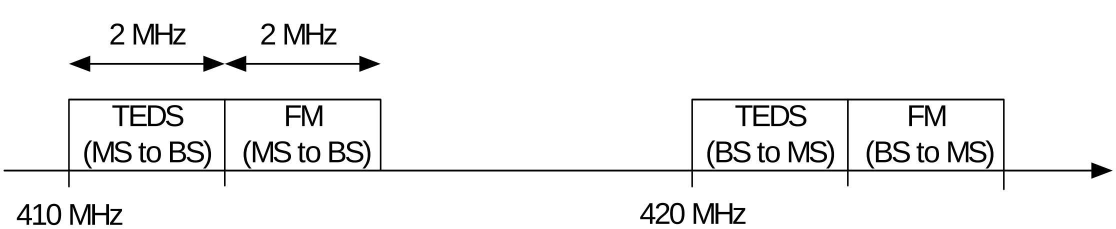

Figure 2-10 : TEDS on FM

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 25 kHz (FM) or 100 kHz (TEDS). For instance, TEDS BS transmits on 420.05 MHz, 420.15 MHz and so on. Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.5.1.2.1 100 kHz TEDS BS on 25 kHz Analogue FM BS

The TEDS BSs transmit between 420 and 422 MHz whereas the analogue FM BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.69 %
0.01	1.42 %
0.02	2.79 %
0.05	7.12 %

Table 2-46 : 100 kHz TEDS BS on 25 kHz analogue FM BS

2.5.1.2.2 100 kHz TEDS BS on 25 kHz Analogue FM mobile station

The TEDS BSs transmit between 420 and 422 MHz whereas the analogue FM MS receives signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.02 %
0.01	0.05 %
0.02	0.06 %
0.05	0.23 %

Table 2-47 : 100 kHz TEDS BS on 25 kHz analogue FM mobile station

2.5.1.2.3 100 kHz TEDS MS on 25 kHz analogue FM BS

The TEDS MS transmit between 410 and 412 MHz whereas the analogue FM BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.07 %
0.05	0.36 %
0.1	0.75 %
0.2	1.68 %
0.5	3.61 %
1	7.52 %

Table 2-48 : 100 kHz TEDS mobile on 25 kHz analogue FM BS

2.5.1.2.4 100 kHz TEDS MS on 25 kHz analogue FM mobile station

The TEDS MS transmit between 410 and 412 MHz whereas the analogue FM MS receives signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0.005 %
0.1	0.016 %
0.2	0.02 %
0.5	0.05 %
1	0.18 %

Table 2-49 : 100 kHz TEDS MS on 25 kHz analogue FM mobile station

2.5.1.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 100 kHz TEDS BS density of 0.022 BS/km² as calculated in section 2.2.3.1.3, we obtain a relatively low interference probability on 25 kHz analogue FM PMR system. Interference probability on FM BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and FM BS.

Considering a density of 0.088 MS per square km as pointed out in section 2.2.3.1.3, we obtain also a low interference probability for TEDS MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

As blocking figures and sensitivities are similar for analogue FM systems independently of the channel bandwidth, 100 kHz TEDS impact on 20 kHz and 12.5 kHz analogue FM are similar than thus obtained for 25 kHz FM analogue FM.

2.5.2 100 kHz TEDS impact on TETRA

2.5.2.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance a 100 kHz TEDS BS operation at 1 MHz from a TETRA BS shall be set at least at 2390 m from the TETRA BS.

Frequency Separation (MHz)	0.0625	0.0875	0.1125	0.4	0.75	1	2	4	5	10
100 kHz TEDS BS on TETRA BS	12.28	8.86	8.86	4.60	3.32	2.39	2.39	2.39	0.91	0.91
100 kHz TEDS BS on TETRA MS	0.90	0.65	0.65	0.34	0.24	0.18	0.17	0.17	0.08	0.08
100 kHz TEDS MS on TETRA BS	0.79	0.57	0.57	0.41	0.24	0.24	0.24	0.24	0.07	0.07
100 kHz TEDS MS on TETRA MS	0.09	0.08	0.08	0.07	0.06	0.06	0.06	0.06	0.04	0.04

Table 2-50 : Distance separation (km) as function of the frequency separation (MHz)

2.5.2.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

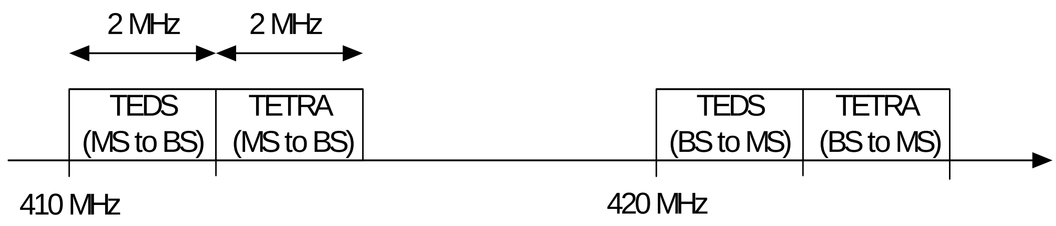

Figure 2-11 : TEDS on TETRA

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 25 kHz (FM) or 100 kHz (TEDS). For instance, TEDS BS transmits on 420.05 MHz, 420.15 MHz and so on. Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.5.2.2.1 100 kHz TEDS BS on TETRA BS

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRA BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.64 %
0.01	1.31 %
0.02	2.58 %
0.05	6.14 %

Table 2-51 : 100 kHz TEDS BS on TETRA BS

2.5.2.2.2 100 kHz TEDS BS on TETRA mobile station

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRA MS receive signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.09 %
0.01	0.12 %
0.02	0.22 %
0.05	0.51 %

Table 2-52 : 100 kHz TEDS BS on TETRA mobile station

2.5.2.2.3 100 kHz TEDS MS on TETRA BS

The TEDS MS transmit between 410 and 412 MHz whereas the TETRA BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.15 %
0.05	0.6 %
0.1	0.92 %
0.2	1.76 %
0.5	3.72 %
1	6.64 %

Table 2-53 : 100 kHz TEDS MS on TETRA BS

2.5.2.2.4 100 kHz TEDS mobile on TETRA mobile

The TEDS MS transmit between 410 and 412 MHz whereas the TETRA MS receives signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0.01 %
0.1	0.02 %
0.2	0.03 %
0.5	0.08 %
1	0.13 %

Table 2-54 : 100 kHz TEDS MS on TETRA mobile station

2.5.2.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 100 kHz TEDS BS density of 0.022 BS/km² as calculated in section 2.2.3.1.3, we obtain a relatively low interference probability on TETRA system. Interference probability on TETRA BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRA BS.

Considering a density of 0.088 MS per square km as pointed out in section 2.2.3.1.3, we obtain also a low interference probability for TEDS MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.5.3 100 kHz TEDS impact on TETRAPOL

2.5.3.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance a 100 kHz TEDS BS operation at 400 kHz from a TETRAPOL BS shall be set at least at 190 m from this TETRAPOL BS.

Frequency Separation (MHz)	0.0625	0.0875	0.1125	0.4	0.75	1	2	4	5	10
100 kHz TEDS BS on TETRAPOL BS	11.87	8.57	8.56	4.45	3.21	2.31	2.31	2.31	0.87	0.87
100 kHz TEDS BS on TETRAPOL MS	0.93	0.67	0.67	0.35	0.25	0.18	0.18	0.18	0.08	0.08
100 kHz TEDS MS on TETRAPOL BS	0.76	0.55	0.55	0.40	0.23	0.23	0.23	0.23	0.07	0.07
100 kHz TEDS MS on TETRAPOL MS	0.09	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.04	0.04

Table 2-55 : Distance separation (km) as function of the frequency separation (MHz)

2.5.3.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

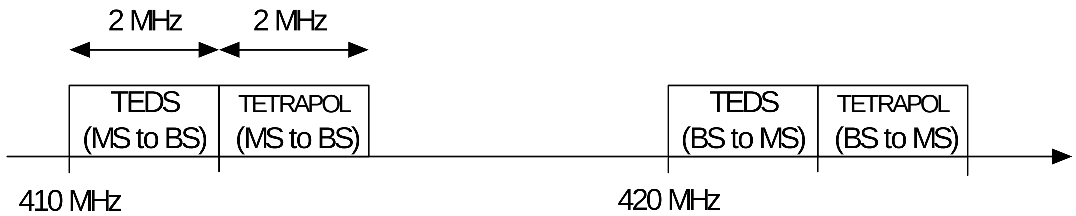

Figure 2-12 : TEDS on TETRAPOL

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 25 kHz (FM) or 100 kHz (TEDS). For instance, TEDS BS transmits on 420.05 MHz, 420.15 MHz and so on. Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.5.3.2.1 100 kHz TEDS BS on TETRAPOL BS

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRAPOL BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.71 %
0.01	1.25 %
0.02	2.55 %
0.05	6.03 %

Table 2-56 : 100 kHz TEDS BS on TETRAPOL BS

2.5.3.2.2 100 kHz TEDS BS on TETRAPOL mobile station

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRAPOL MS receives signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.04 %
0.01	0.04 %
0.02	0.06 %
0.05	0.20 %

Table 2-57 : 100 kHz TEDS BS on TETRAPOL mobile station

2.5.3.2.3 100 kHz TEDS MS on TETRAPOL BS

The TEDS MS transmit between 410 and 412 MHz whereas the TETRAPOL BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.05 %
0.05	0.32 %
0.1	0.53 %
0.2	1.34 %
0.5	3.39 %
1	6.45 %

Table 2-58 : 100 kHz TEDS mobile on TETRAPOL BS

2.5.3.2.4 100 kHz TEDS MS on TETRAPOL mobile station

The TEDS MS transmit between 410 and 412 MHz whereas the TETRAPOL MS receive signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0.005 %
0.1	0.01 %
0.2	0.02 %
0.5	0.09 %
1	0.11 %

Table 2-59 : 100 kHz TEDS MS on TETRAPOL mobile station

2.5.3.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 100 kHz TEDS BS density of 0.022 BS/km² as calculated in section 2.2.3.1.3, we obtain a relatively low interference probability on TETRAPOL system. Interference probability on TETRAPOL BSs could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRAPOL BS.

Considering a density of 0.088 MS per square km as pointed out in section 2.2.3.1.3, we obtain also a low interference probability for TEDS MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.5.4 100 kHz TEDS impact on CDMA-PAMR

2.5.4.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance a 100 kHz TEDS BS operation at 737.5 kHz from a CDMA BS shall be set at least at 2910 m from this CDMA BS.

Frequency Separation (MHz)	0.6875	0.7125	0.7375	0.7625	1.1625	1.625	5.625	10
100 kHz TEDS BS on CDMA-PAMR BS	4.04	2.91	2.91	1.51	1.11	0.83	0.52	0.52
100 kHz TEDS BS on CDMA-PAMR MS	0.28	0.20	0.20	0.10	0.09	0.09	0.08	0.09
100 kHz TEDS MS on CDMA-PAMR BS	0.19	0.13	0.13	0.13	0.06	0.06	0.02	0.04
100 kHz TEDS MS on CDMA-PAMR MS	0.06	0.05	0.05	0.05	0.05	0.05	0.04	0.04

Table 2-60 : Distance separation (km) as function of the frequency separation (MHz)

2.5.4.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

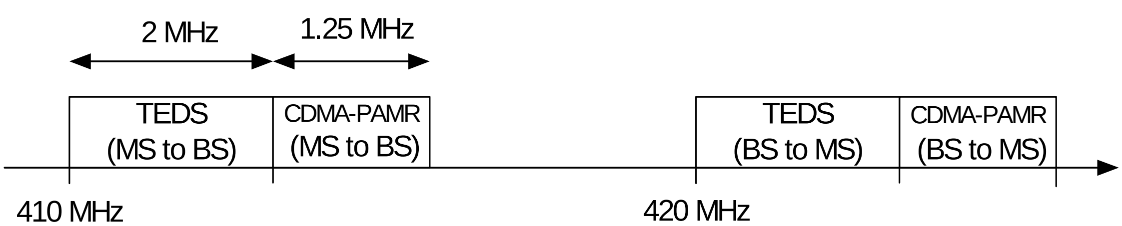

Figure 2-13 : TEDS on CDMA-PAMR

For each sub-case, TEDS transmitters have been split homogeneously over the different bands on channels separated by 25. For instance, TEDS BS transmits on 420.050 MHz, 420.150 MHz and so on. Only one CDMA-PAMR duplex frequency has been considered.

2.5.4.2.1 100 kHz TEDS BS on a CDMA-PAMR system

The TEDS BSs transmit between 420 and 422 MHz whereas the CDMA-PAMR system operates at 412.625 MHz (uplink) and at 422.625 (downlink).
The table below gives the average loss capacity of the CDMA-PAMR system as defined within SEAMCAT.

Interferer density (TEDS BS/km²)	CDMA-PAMR system average capacity loss	Average capacity loss in the reference cell
0.005	0.12%	0.01%
0.01	0.12%	0.01%
0.02	0.09%	0.03%
0.05	0.23%	0.1%

Table 2-61 : 100 kHz TEDS BS on CDMA-PAMR system

2.5.4.2.2 100 kHz TEDS MS on a CDMA-PAMR system

The TEDS MS transmit between 410 and 412 MHz whereas the CDMA-PAMR system operates at 412.625 MHz (uplink) and at 422.625 (downlink).
The table below gives the average loss capacity of the CDMA-PAMR system as defined within SEAMCAT.

Interferer density (TEDS BS/km²)	CDMA-PAMR system average capacity loss	Average capacity loss in the reference cell
0.01	0.09%	0.01%
0.05	0.09%	0.06%
0.1	0.21%	0.05%
0.2	0.30%	0.07%
0.5	0.27%	0.07%
1	0.27 %	0.08 %

Table 2-62 : 100 kHz TEDS MS on CDMA-PAMR system

2.5.4.3 Analysis

SEAMCAT simulation indicates a quite low capacity loss, if we consider either a 100 kHz TEDS BS or a 100 kHz TEDS MS as interferer.

According to MCL calculation the interference probability on CDMA BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and CDMA BS.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.6 150 kHz TEDS impacts on existing PMR systems

This section presents and comments the simulation results obtained by performing MCL calculations and SEAMCAT simulations for the 25 kHz TEDS impact on analogue FM PMR system, TETRA, TETRAPOL and CDMA PAMR systems.

2.6.1 150 kHz TEDS impact on 25 kHz analogue FM PMR

2.6.1.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance, a 150 kHz TEDS BS operation at 1 MHz from a 25 kHz FM MS shall be set at least at 280m from this FM mobile station.

Frequency Separation (MHz)	0.0875	0.1125	0.25	0.5	1	2	4	5	10
150 kHz TEDS BS on 25 kHz FM BS	13.99	10.09	10.09	5.25	3.78	2.73	2.72	1.05	1.05
150 kHz TEDS BS on 25 kHz FM MS	1.02	0.74	0.74	0.38	**0.28**	0.20	0.20	0.08	0.08
150 kHz TEDS MS on 25 kHz FM BS	0.71	0.51	0.51	0.42	0.27	0.27	0.27	0.06	0.06
150 kHz TEDS MS on 25 kHz FM MS	0.09	0.08	0.08	0.08	0.07	0.07	0.07	0.04	0.04

Table 2-63 : Distance separation (km) as function of the frequency separation (MHz)

2.6.1.2 SEAMCAT Simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

Figure 2-14 : 150 kHz TEDS on FM

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 150 kHz (TEDS) or 25 kHz (FM). For instance, TEDS BS transmits on 420.075 MHz, 420.225 MHz and so on. Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.6.1.2.1 150 kHz TEDS BS on 25 kHz Analogue FM BS

The TEDS BSs transmit between 420 and 422 MHz whereas the analogue FM BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.28 %
0.01	0.60 %
0.02	1.47 %
0.05	2.86 %
0.1	6.45 %

Table 2-64 : 150 kHz TEDS BS on 25 kHz analogue FM BS

2.6.1.2.2 150 kHz TEDS BS on 25 kHz Analogue FM mobile station

The TEDS BSs transmit between 420 and 422 MHz whereas the analogue FM MS receives signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.03 %
0.01	0.06 %
0.02	0.10%
0.05	0.25 %
0.1	0.55%

Table 2-65 : 150 kHz TEDS BS on 25 kHz analogue FM mobile station

2.6.1.2.3 150 kHz TEDS MS on 25 kHz analogue FM BS

The TEDS MS transmit between 410 and 412 MHz whereas the analogue FM BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.16 %
0.05	0.93 %
0.1	1.82 %
0.2	3.62 %
0.5	9.03 %
1	18.36 %

Table 2-66 : 150 kHz TEDS mobile on 25 kHz analogue FM BS

2.6.1.2.4 150 kHz TEDS MS on 25 kHz analogue FM mobile station

The TEDS MS transmit between 410 and 412 MHz whereas the analogue FM MS receives signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.01 %
0.05	0.01 %
0.1	0.01 %
0.2	0.03 %
0.5	0.10 %
1	0.18 %

Table 2-67 : 150 kHz TEDS MS on 25 kHz analogue FM mobile station

2.6.1.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 150 kHz TEDS BS density of 0.026 BS/km² as calculated in section 2.2.3.1.4, we obtain a relatively low interference probability on 25 kHz analogue FM PMR system. Interference probability on FM BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and FM BS.

Considering a density of 0.104 MS per square km as pointed out in section 2.2.3.1.4, we obtain also a low interference probability for TEDS MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

As blocking figures and sensitivities are similar for analogue FM systems independently of the channel bandwidth, 100 kHz TEDS impact on 20 kHz and 12.5 kHz analogue FM are similar than thus obtained for 25 kHz FM analogue FM.

2.6.2 150 kHz TEDS impact on TETRA

2.6.2.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance a 150 kHz TEDS BS operation at 1 MHz from a TETRA MS shall be set at least at 240 m from this TETRA mobile station.

Frequency Separation (MHz)	0.0875	0.1125	0.25	0.5	1	2	4	5	10
150 kHz TEDS BS on TETRA BS	12.28	8.86	8.85	4.60	3.32	2.40	2.39	0.97	0.96
150 kHz TEDS BS on TETRA MS	0.90	0.65	0.65	0.34	**0.24**	0.18	0.17	0.08	0.07
150 kHz TEDS MS on TETRA BS	0.63	0.45	0.45	0.37	0.23	0.23	0.23	0.05	0.05
150 kHz TEDS MS on TETRA MS	0.08	0.08	0.08	0.07	0.06	0.06	0.06	0.04	0.04

Table 2-68 : Distance separation (km) as function of the frequency separation (MHz)

2.6.2.2 SEAMCAT Simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

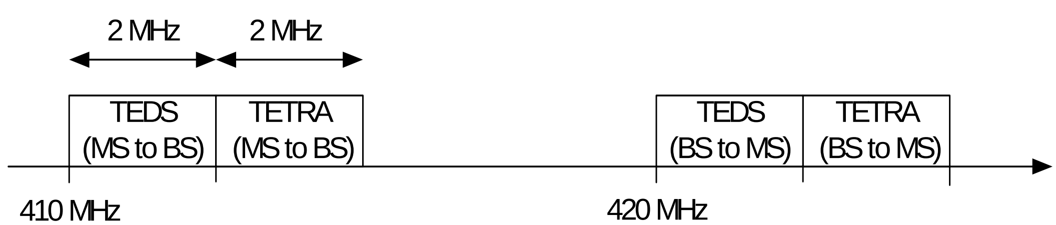

Figure 2-15 : 150 kHz TEDS on TETRA

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 150 kHz (TEDS) or 25 kHz (TETRA). For instance, TEDS BS transmits on 420.075 MHz, 420.225 MHz and so on.
Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.6.2.2.1 150 kHz TEDS BS on TETRA BS

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRA BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.70 %
0.01	1.14 %
0.02	2.70 %
0.05	6.15 %
0.1	12.65 %

Table 2-69 : 150 kHz TEDS BS on TETRA BS

2.6.2.2.2 150 kHz TEDS BS on TETRA mobile station

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRA MS receive signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.02 %
0.01	0.02 %
0.02	0.07 %
0.05	0.17 %
0.1	0.29 %

Table 2-70 : 150 kHz TEDS BS on TETRA mobile station

2.6.2.2.3 150 kHz TEDS MS on TETRA BS

The TEDS MS transmit between 410 and 412 MHz whereas the TETRA BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.15 %
0.05	0.73 %
0.1	1.51 %
0.2	2.88 %
0.5	7.42 %
1	14.46 %

Table 2-71 : 150 kHz TEDS MS on TETRA BS

2.6.2.2.4 150 kHz TEDS mobile on TETRA mobile station

The TEDS MS transmit between 410 and 412 MHz whereas the TETRA MS receive signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0.01 %
0.2	0.01 %
0.5	0.03 %
1	0.07 %

Table 2-72 : 150 kHz TEDS MS on TETRA mobile station

2.6.2.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 150 kHz TEDS BS density of 0.024 BS/km² as calculated in section 2.2.3.1.4, we obtain a relatively low interference probability on TETRA system. Interference probability on TETRA BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRA BS.

Considering a density of 0.104 MS per square km as pointed out in section 2.2.3.1.4, we obtain also a low interference probability for TEDS MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.6.3 150 kHz TEDS impact on TETRAPOL

2.6.3.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance a 150 kHz TEDS BS operation at 1 MHz from a TETRAPOL MS shall be set at least at 250 m from this TETRAPOL mobile station.

Frequency Separation (MHz)	0.08125	0.09375	0.10625	0.25	0.5	1	2	4	5	10
150 kHz TEDS BS on TETRAPOL BS	11.90	8.64	8.57	8.56	4.46	3.21	2.32	2.31	0.94	0.94
150 kHz TEDS BS on TETRAPOL MS	0.93	0.68	0.67	0.67	0.35	0.25	0.18	0.18	0.08	0.09
150 kHz TEDS MS on TETRAPOL BS	0.76	0.55	0.55	0.55	0.45	0.29	0.28	0.28	0.06	0.07
150 kHz TEDS MS on TETRAPOL MS	0.09	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.05	0.05

Table 2-73 : Distance separation (km) as function of the frequency separation (MHz)

2.6.3.2 SEAMCAT Simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

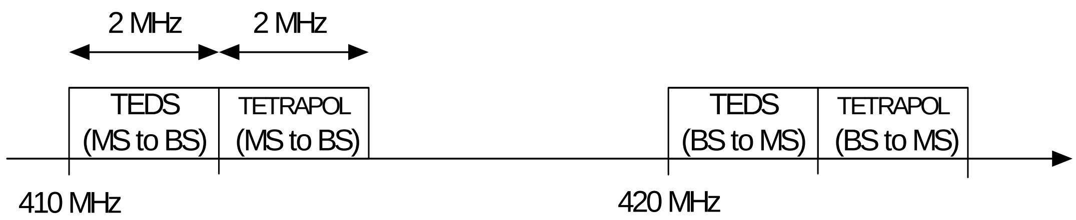

Figure 2-16 : TEDS on TETRAPOL

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 12.5 kHz (TETRAPOL) or 150 kHz (TEDS). For instance, TEDS BS transmits on 420.075 MHz, 420.225 MHz and so on.
Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.6.3.2.1 150 kHz TEDS BS on TETRAPOL BS

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRAPOL BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.66 %
0.01	1.29 %
0.02	2.58 %
0.05	6.52 %
0.1	12.54 %

Table 2-74 : 150 kHz TEDS BS on TETRAPOL BS

2.6.3.2.2 150 kHz TEDS BS on TETRAPOL mobile station

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRAPOL MS receives signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.03 %
0.01	0.09 %
0.02	0.16%
0.05	0.30 %
1	0.71 %

Table 2-75 : 150 kHz TEDS BS on TETRAPOL mobile station

2.6.3.2.3 150 kHz TEDS MS on TETRAPOL BS

The TEDS MS transmit between 410 and 412 MHz whereas the TETRAPOL BSs receive signals coming from MS between 412 and 414 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.15 %
0.05	0.81 %
0.1	1.30 %
0.2	2.90 %
0.5	7.07 %
1	14.17 %

Table 2-76 : 150 kHz TEDS mobile on TETRAPOL BS

2.6.3.2.4 150 kHz TEDS MS on TETRAPOL mobile station

The TEDS MS transmit between 410 and 412 MHz whereas the TETRAPOL MS receive signals coming from BS between 422 and 424 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0.01 %
0.1	0.02 %
0.2	0.03 %
0.5	0.07 %
1	0.13 %

Table 2-77 : 150 kHz TEDS MS on TETRAPOL mobile station

2.6.3.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 150 kHz TEDS BS density of 0.026 BS/km² as calculated in section 2.2.3.1.4, we obtain a relatively low interference probability on TETRAPOL system. Interference probability on TETRAPOL BSs could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRAPOL BS.

Considering a density of 0.104 MS per square km as pointed out in section 2.2.3.1.4, we obtain also a low interference probability for TEDS MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.6.4 150 kHz TEDS IMPACT on CDMA-PAMR

2.6.4.1 MCL calculations

The table below gives the protection distance as function of the frequency separation. For instance a 150 kHz TEDS BS operation at 2 MHz from a CDMA-PAMR MS shall be set at least at 90 m from this CDMA-PAMR mobile station.

Frequency Separation (MHz)	0.7	0.9	1	2	4	5	10
150 kHz TEDS BS on CDMA-PAMR BS	1.66	1.67	1.67	1.21	1.21	0.58	0.58
150 kHz TEDS BS on CDMA-PAMR MS	0.10	0.11	0.11	0.09	0.09	0.09	0.09
150 kHz TEDS MS on CDMA-PAMR BS	0.15	0.15	0.15	0.15	0.15	0,06	0,06
150 kHz TEDS MS on CDMA-PAMR MS	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Table 2-78 : Distance separation (km) as function of the frequency separation (MHz)

2.6.4.2 SEAMCAT simulations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.
For each sub-case, TEDS transmitters have been split homogeneously over the different bands on channels separated by 25. For instance, TEDS BS transmits on 420.075 MHz, 420.225 MHz and so on. Only one CDMA-PAMR duplex frequency has been considered.

2.6.4.2.1 150 kHz TEDS BS on a CDMA-PAMR system

The TEDS BSs transmit between 420 and 422 MHz whereas the CDMA-PAMR operates at 412.625 MHz (uplink) and at 422.625 (downlink).
The table below gives the average loss capacity of the CDMA-PAMR system as defined within SEAMCAT [4].

Interferer density (TEDS BS/km²)	CDMA-PAMR system average capacity loss	Average capacity loss in the reference cell
0.005	0.19 %	0.01 %
0.01	0.16 %	0.01 %
0.02	0.16 %	0.03 %
0.05	0.19 %	0.06 %

Table 2-79 : 25 kHz TEDS BS on CDMA-PAMR system

2.6.4.2.2 150 kHz TEDS BS on a CDMA-PAMR system

The TEDS MS transmit between 410 and 412 MHz whereas the CDMA-PAMR operates at 412.625 MHz (uplink) and at 422.625 (downlink).

The table below gives the average loss capacity of the CDMA-PAMR system as defined within SEAMCAT [4].

Interferer density (TEDS BS/km²)	CDMA-PAMR system average capacity loss	Average capacity loss in the reference cell
0.01	0.32 %	0.01 %
0.05	0.33 %	0.02 %
0.1	0.26 %	0.04 %
0.2	0.32 %	0.06 %
0.5	0.32 %	0.10 %
1	0.26 %	0.12 %

Table 2-80 : 25 kHz TEDS BS on CDMA-PAMR system

2.6.4.3 Analysis

SEAMCAT simulation indicates a quite low capacity loss, if we consider either a 150 kHz TEDS BS or a 150 kHz TEDS MS as interferer.

According to MCL calculation the interference probability on CDMA BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and CDMA BS.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.7 Analogue FM systems impacts on TEDS

This section presents and comments the simulation results obtained by performing MCL calculations and SEAMCAT simulations for the 25 kHz analogue FM systems impact on TEDS.

2.7.1 25 kHz analogue FM system impacts on 25 kHz TEDS

2.7.1.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance, a 25 kHz FM base station operating at 400 kHz from a 25 kHz TEDS mobile station shall be set at least at 140 meters from this TEDS mobile station.

Frequency Separation (MHz)	0.025	0.05	0.075	0.1	**0.4**	0.75	1	2	4	5	10
25 kHz FM BS on 25 kHz TEDS BS	9.96	6.04	6.04	1.97	1.75	1.15	0.90	0.90	0.90	0.90	0.88
25 kHz FM BS on 25 kHz TEDS MS	1.18	0.44	0.44	0.16	**0.14**	0.09	0.08	0.08	0.08	0.08	0.08
25 kHz FM MS on 25 kHz TEDS BS	0.56	0.34	0.34	0.11	0.08	0.06	0.05	0.05	0.05	0.05	0.05
25 kHz FM MS on 25 kHz TEDS MS	0.08	0.07	0.07	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04

Table 2-81 : Distance separation (km) as function of the frequency separation (MHz)

As unwanted emission figures are similar for analogue FM systems independently of the channel bandwidth, impacts on 25 kHz TEDS from 20 kHz and 12.5 kHz analogue FM are similar than thus obtained from 25 kHz FM analogue FM.

2.7.1.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

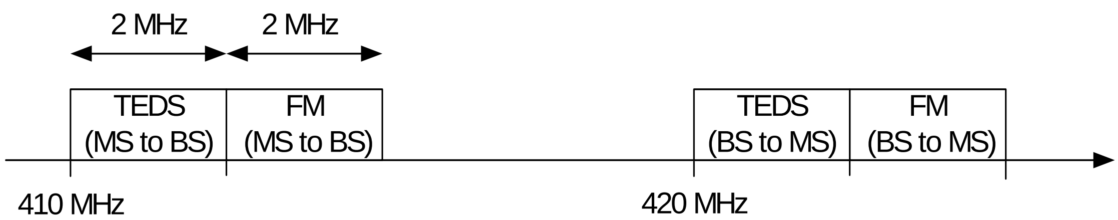

Figure 2-17 : Analogue FM on TEDS

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 25 kHz (consideration of 25 kHz TEDS and 25 kHz FM in a first step). For instance, FM BS transmits on 422.0125 MHz, 422.0375 MHz and so on.
Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.7.1.2.1 25 kHz analogue FM BS on 25 kHz TEDS BS

The 25 kHz analogue FM BSs transmit between 422 and 424 MHz whereas the TEDS BSs receive signals coming from MS between 410 and 412 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM BS/km²)	Interference probability
0.005	0.45 %
0.01	0.95 %
0.02	1.79 %
0.05	4.97 %
0.1	10.59 %

Table 2-82 : 25 kHz analogue FM BS on 25 kHz TEDS BS

2.7.1.2.2 25 kHz analogue FM BS on 25 kHz TEDS mobile station

The analogue FM BSs transmit between 422 and 424 MHz whereas the TEDS MS receive signals coming from BS between 420 and 422 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM BS/km²)	Interference probability
0.005	0 %
0.01	0.01 %
0.02	0.02 %
0.05	0.04 %
0.1	0.06 %

Table 2-83 : 25 kHz analogue FM BS on 25 kHz TEDS mobile station

2.7.1.2.3 25 kHz analogue FM MS on 25 kHz TEDS BS

The analogue FM MS transmit between 412 and 414 MHz whereas the TEDS BSs receive signals coming from MS between 410 and 412 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM MS/km²)	Interference probability
0.01	0.02 %
0.05	0.11 %
0.1	0.19 %
0.2	0.45 %
0.5	1.02 %
1	2.08 %

Table 2-84 : 25 kHz analogue FM mobile on 25 kHz TEDS BS

2.7.1.2.4 25 kHz analogue FM MS on 25 kHz TEDS mobile station

The analogue FM MS transmit between 412 and 414 MHz whereas the TEDS MS receive signals coming from BS between 420 and 422 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM MS/km²)	Interference probability
0.01	0.01 %
0.05	0.04 %
0.1	0.05 %
0.2	0.08 %
0.5	0.19 %
1	0.45 %

Table 2-85 : 25 kHz analogue FM MS on 25 kHz TEDS mobile station

2.7.1.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 25 kHz analogue FM BS density of 0.005 BS/km² as calculated in section 2.2.3.2, we obtain a relatively low interference probability on 25 kHz TEDS system. Interference probability on TEDS BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and FM BS.

Considering a density of 0.1 MS per square km as pointed out in section 2.2.3.2, we obtain also a low interference probability for analogue FM MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

As unwanted emission figures are similar for analogue FM systems independently of the channel bandwidth, impacts on 25 kHz TEDS from 20 kHz and 12.5 kHz analogue FM are similar than thus obtained from 25 kHz FM analogue FM.

2.7.2 25 kHz analogue FM system impacts on 50 kHz TEDS

2.7.2.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance, a 50 kHz TEDS base station operates at 1 MHz from a 25 kHz FM Base station shall be set at least at 1120 meters from this Base station.

Frequency Separation (MHz)	0.0375	0.0625	0.0875	0.1125	0.4	0.75	1	2	4	5	10
25 kHz FM BS on 50 kHz TEDS BS	17.22	17.14	17.12	3.01	2.15	1.56	1.12	1.12	1.12	1.12	1.12
25 kHz FM BS on 50 kHz TEDS MS	2.11	2.11	2.11	0.27	0.19	0.14	0.10	0.10	0.10	0.10	0.10
25 kHz FM MS on 50 kHz TEDS BS	0.97	0.96	0.96	0.17	0.12	0.09	0.06	0.06	0.06	0.06	0.06
25 kHz FM MS on 50 kHz TEDS MS	0.11	0.11	0.11	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05

Table 2-86 : Distance separation (km) as function of the frequency separation (MHz)

2.7.2.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

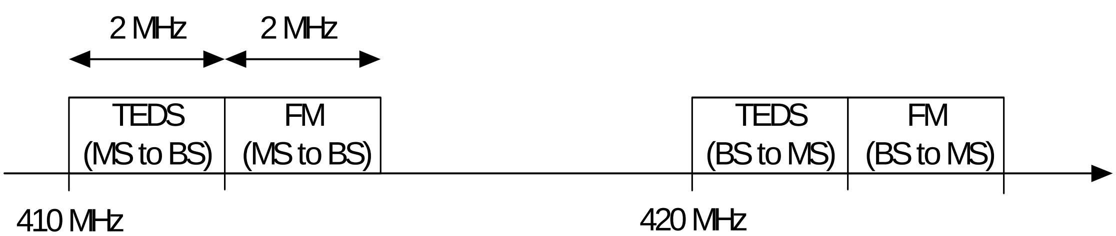

Figure 2-18 : Analogue FM on 50 kHz TEDS

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by the relevant channel spacing. For instance, FM BS transmits on 422.0125 MHz, 422.0375 MHz and so on. Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.7.2.2.1 25 kHz Analogue FM base station on 50 kHz TEDS base station

The FM base stations transmit between 422 and 424 MHz whereas the TEDS base stations receive signals coming from mobiles between 410 and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM BS/km²)	Interference probability
0.005	0.48 %
0.01	1.15 %
0.05	5 %
0.1	10.54 %

Table 2-87 : 25 kHz analogue FM base station on 50 kHz TEDS base station

2.7.2.2.2 25 kHz Analogue FM mobile station on 50 kHz TEDS base station

The FM Mobiles transmit between 412 and 414 MHz whereas the TEDS BS receives signals coming from MS between 410 and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM MS/km²)	Interference probability
0.01	0.005 %
0.05	0.044 %
0.1	0.105 %
0.5	0.46 %
1	0.84 %

Table 2-88 : 25 kHz analogue FM mobile station on 50 kHz TEDS base station

2.7.2.2.3 25 kHz analogue FM base station on 50 kHz TEDS mobile station

The FM base stations transmit between 422 and 424 MHz whereas the TEDS mobiles receive signals coming from base station between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM BS/km²)	Interference probability
0.005	0.016 %
0.01	0.025 %
0.05	0.03 %
0.1	0.04 %

Table 2-89 : 25 kHz analogue FM base station on 50 kHz TEDS mobile

2.7.2.2.4 25 kHz analogue FM mobile station on 50 kHz TEDS mobile station

The analogue FM mobile stations transmit between 412 and 414 MHz whereas the TEDS mobile stations receive signals coming from base station between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM MS/km²)	Interference probability
0.01	0 %
0.05	0.005 %
0.1	0.01 %
0.5	0.026 %
1	0.12 %

Table 2-90 : 25 kHz analogue FM mobile station on 50 kHz TEDS mobile station

2.7.2.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 25 kHz analogue FM BS density of 0.005 BS/km² as calculated in section 2.2.3.2, we obtain a relatively low interference probability on 50 kHz TEDS system. Interference probability on TEDS BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and FM BS.

Considering a density of 0.1 MS per square km as pointed out in section 2.2.3.2, we obtain also a low interference probability for analogue FM MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

As unwanted emission figures are similar for analogue FM systems independently of the channel bandwidth, impacts on 25 kHz TEDS from 20 kHz and 12.5 kHz analogue FM are similar than thus obtained from 25 kHz FM analogue FM.

2.7.3 25 kHz analogue FM system impacts on 100 kHz TEDS

2.7.3.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance, a 100 kHz TEDS base station operation at 1 MHz from a 25 kHz FM base station shall be set at least at 1360 meters from this FM base station.

Frequency Separation (MHz)	0.06	0.09	0.11	0.40	0.75	1.00	2.00	4.00	5.00	10.00
25 kHz FM BS on 100 kHz TEDS BS	25.40	25.36	3.63	2.60	1.88	1.36	1.36	1.36	1.36	1.36
25 kHz FM BS on 100 kHz TEDS BS	3.13	3.13	0.32	0.23	0.17	0.12	0.12	0.12	0.12	0.12
25 kHz FM BS on 100 kHz TEDS BS	1.43	1.43	0.20	0.15	0.11	0.08	0.08	0.08	0.08	0.08
25 kHz FM BS on 100 kHz TEDS BS	0.12	0.12	0.07	0.06	0.05	0.05	0.05	0.05	0.05	0.05

Table 2-91 : Distance separation (km) as function of the frequency separation (MHz)

2.7.3.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

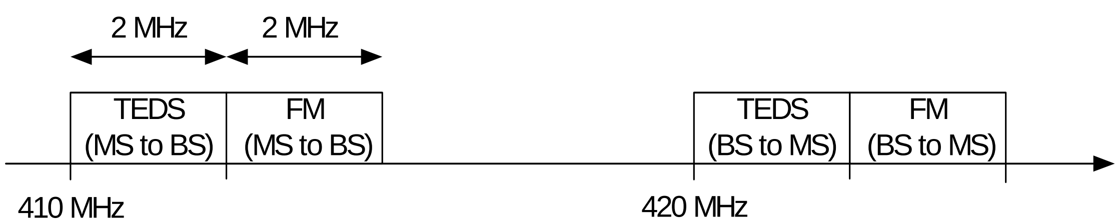

Figure 2-19 : Analogue FM on 100 kHz TEDS

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 25 kHz (FM) or 100 kHz (TEDS). For instance, FM BS transmits on 422.0125 MHz, 422.0375 MHz and so on. Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.7.3.2.1 25 kHz Analogue FM base station on100 kHz TEDS base station

The FM base stations transmit between 422 and 424 MHz whereas the TEDS base stations receive signals coming from mobiles between 410 and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM BS/km²)	Interference probability
0.005	0.815 %
0.01	1.46 %
0.05	8.59 %
0.1	16.48 %

Table 2-92 : 25 kHz analogue FM base station on 100 kHz TEDS base station

2.7.3.2.2 25 kHz Analogue FM mobile station on 100 kHz TEDS base station

The analogue FM mobile stations transmit between 412 and 414 MHz whereas the TEDS BS receives signals coming from MS between 410 and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM MS/km²)	Interference probability
0.01	0.02 %
0.05	0.06 %
0.1	0.07 %
0.5	0.08 %
1	1.23 %

Table2- 93 : 25 kHz analogue FM mobile station on 100 kHz TEDS base station

2.7.3.2.3 25 kHz analogue FM base station on100 kHz TEDS mobile station

The analogue FM base stations transmit between 422 and 424 MHz whereas the TEDS MS receive signals coming from BS between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM BS/km²)	Interference probability
0.005	0.02 %
0.01	0.02 %
0.05	0.08 %
0.1	0.17 %

Table 2-94 : 25 kHz analogue FM base station on 100 kHz TEDS mobile

2.7.3.2.4 25 kHz analogue FM mobile station on 100 kHz TEDS mobile station

The analogue FM mobile stations transmit between 412 and 414 MHz whereas the TEDS mobile stations receive signals coming from base station between 420 and 422 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0.005 %
0.5	0.12 %
1	0.21 %

Table 2- 95 : 25 kHz analogue FM mobile station on 100 kHz TEDS mobile station

2.7.3.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 25 kHz analogue FM BS density of 0.005 BS/km² as calculated in section 2.2.3.2, we obtain a relatively low interference probability on 100 kHz TEDS system. Interference probability on TEDS BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and FM BS.

Considering a density of 0.1 MS per square km as pointed out in section 2.2.3.2, we obtain also a low interference probability for analogue FM MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

As unwanted emission figures are similar for analogue FM systems independently of the channel bandwidth, impacts on 25 kHz TEDS from 20 kHz and 12.5 kHz analogue FM are similar than thus obtained from 25 kHz FM analogue FM.

2.7.4 25 kHz analogue FM system impacts on 150 kHz TEDS

2.7.4.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance, a 25 kHz FM base station operating at 500 kHz from a 150 kHz TEDS mobile station shall be set at least at 140 meters from this TEDS mobile station.

Frequency Separation (MHz)	0.0875	0.25	**0.5**	1	2	4	5	10
25 kHz FM BS on 150 kHz TEDS BS	15.98	2.28	1.64	1.17	0.85	0.85	0.85	0.85
25 kHz FM BS on 150 kHz TEDS MS	1.97	0.20	**0.14**	0.10	0.08	0.08	0.08	0.08
25 kHz FM MS on 150 kHz TEDS BS	1.24	0.13	0.13	0.07	0.05	0.05	0.05	0.05
25 kHz FM MS on 150 kHz TEDS MS	0.10	0.05	0.05	0.05	0.04	0.04	0.04	0.04

Table 2-96 : Distance separation (km) as function of the frequency separation (MHz)

As unwanted emission figures are similar for analogue FM systems independently of the channel bandwidth, impacts on 150 kHz TEDS from 20 kHz and 12.5 kHz analogue FM are similar than thus obtained from 25 kHz FM analogue FM.

2.7.4.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

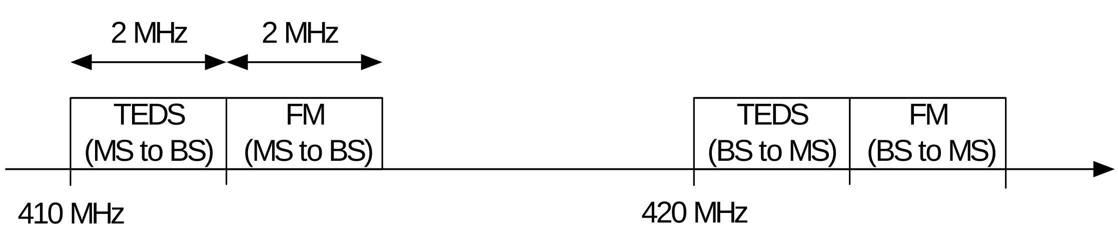

Figure 2-20 : Analogue FM on 150 kHz TEDS

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 25 kHz (FM) or 100 kHz (TEDS). For instance, FM BS transmits on 422.0125 MHz, 422.0375 MHz and so on. Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.7.4.2.1 25 kHz Analogue FM BS on 150 kHz TEDS BS

The 25 kHz analogue FM BS transmit between 422 and 424 MHz whereas the TEDS BS receive signals coming from MS between 410 and 412 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM BS/km²)	Interference probability
0.005	0.50 %
0.01	0.88 %
0.02	1.72 %
0.05	4.27 %
0.1	9.15 %

Table 2-97 : 25 kHz analogue FM BS on 150 kHz TEDS BS

2.7.4.2.2 25 kHz Analogue FM BS on 150 kHz TEDS MS

The 25 kHz analogue FM BS transmit between 422 and 424 MHz whereas the TEDS MS receives signals coming from BS between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM BS/km²)	Interference probability
0.005	0.01 %
0.01	0.02 %
0.02	0.03%
0.05	0.09 %
0.1	0.13 %

Table 2-98 : 25 kHz analogue FM BS on 150 kHz TEDS MS

2.7.4.2.3 25 kHz analogue FM MS on 150 kHz TEDS BS

The 25 kHz analogue FM MS transmit between 412 and 414 MHz whereas the TEDS BSs receive signals coming from MS between 410 and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM MS/km²)	Interference probability
0.01	0 %
0.05	0.05 %
0.1	0.06 %
0.2	0.12 %
0.5	0.27 %
1	0.57 %

Table 2-99 : 25 kHz analogue FM BS on 150 kHz TEDS mobile

2.7.4.2.4 25 kHz analogue FM MS on 150 kHz TEDS MS

The 25 kHz analogue FM MS transmit between 412 and 414 MHz whereas the TEDS MS receives signals coming from BS between 420 and 422 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (Analogue FM MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0 %
0.2	0 %
0.5	0 %
1	0 %

Table 2-100 : 25 kHz analogue FM MS on 150 kHz TEDS MS

2.7.4.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a 25 kHz analogue FM BS density of 0.005 BS/km² as calculated in section 2.2.3.2, we obtain a relatively low interference probability on 150 kHz TEDS system. Interference probability on TEDS BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and FM BS.

Considering a density of 0.1 MS per square km as pointed out in section 2.2.3.2, we obtain also a low interference probability for FM MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

As unwanted emission figures are similar for analogue FM systems independently of the channel bandwidth, impacts on 25 kHz TEDS from 20 kHz and 12.5 kHz analogue FM are similar than thus obtained from 25 kHz FM analogue FM.

2.8 TETRA impacts on TEDS

This section presents and comments the simulation results obtained by performing MCL calculations and SEAMCAT simulations for the TETRA systems impact on TEDS.

2.8.1 TETRA impacts on 25 kHz TEDS

2.8.1.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance, a TETRA base station operating at 400 kHz from a 25 kHz TEDS mobile station shall be set at least at 130 meters from this TEDS mobile station.

Frequency Separation (MHz)	0.025	0.05	0.075	0.1	**0.4**	0.75	1	2	4	5	10
TETRA BS on 25kHz TEDS BS	9.94	4.65	4.65	2.46	1.77	1.28	1.28	1.28	1.27	0.79	0.78
TETRA BS on 25 kHz TEDS MS	0.97	0.34	0.34	0.18	**0.13**	0.10	0.10	0.10	0.10	0.08	0.08
TETRA MS on 25 kHz TEDS BS	0.64	0.30	0.30	0.18	0.13	0.11	0.11	0.11	0.11	0.07	0.07
TETRA MS on 25 kHz TEDS MS	0.09	0.07	0.07	0.06	0.05	0.05	0.05	0.05	0.05	0.04	0.04

Table 2-101 : Distance separation (km) as function of the frequency separation (MHz)

2.8.1.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

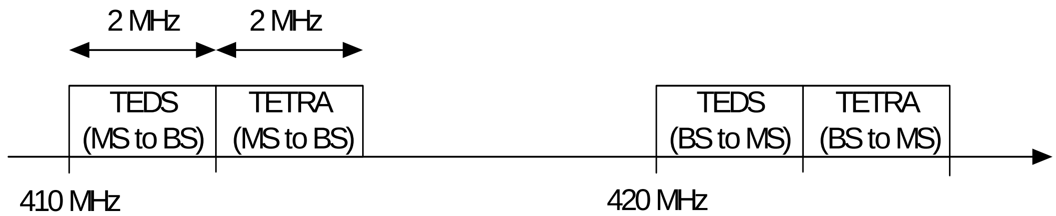

Figure 2-21 : TETRA on 25 kHz TEDS

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 25 kHz. For instance, TETRA BS transmits on 422.0125 MHz, 422.0375 MHz and so on.
Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.8.1.2.1 TETRA BS on 25 kHz TEDS BS

The TETRA BSs transmit between 422 and 424 MHz whereas the TEDS BSs receive signals coming from MS between 410 and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0.34 %
0.01	0.75 %
0.02	1.50 %
0.05	3.32 %
0.1	6.86 %

Table 2-102 : TETRA BS on 25 kHz TEDS BS

2.8.1.2.2 TETRA BS on 25 kHz TEDS MS

The TETRA BSs transmit between 422 and 424 MHz whereas the TEDS MS receive signals coming from BS between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0 %
0.01	0.01 %
0.02	0.01 %
0.05	0.01 %
0.1	0.02 %

Table 2-103 : TETRA BS on 25 kHz TEDS MS

2.8.1.2.3 TETRA MS on 25 kHz TEDS BS

The TETRA MS transmit between 412 and 414 MHz whereas the TEDS BSs receive signals coming from MS between 410 and 412 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0 %
0.05	0.01 %
0.1	0.08 %
0.2	0.17 %
0.5	0.28 %
1	0.74 %

Table 2-104 : TETRA MS on 25 kHz TEDS BS

2.8.1.2.4 TETRA MS on 25 kHz TEDS MS

The TETRA MS transmit between 412 and 414 MHz whereas the TEDS MS receive signals coming from BS between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0 %
0.2	0 %
0.5	0 %
1	0.01 %

Table 2-105 : TETRA MS on 25 kHz TEDS MS

2.8.1.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a TETRA BS density of 0.01 BS/km² as calculated in section 2.2.3.3, we obtain a relatively low interference probability on 25 kHz TEDS system. Interference probability on TEDS BS could be improved by considering specific installation and/or by introducing separation distance between TETRA BS and TEDS BS.

Considering a density of 0.2 MS per square km as pointed out in section 2.2.3.3, we obtain also a low interference probability for TETRA MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.8.2 TETRA impacts on 50 kHz TEDS

2.8.2.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance a 50 kHz TEDS base station operation at 1MHz from a TETRA base station shall be set at least at 2400 meters from this TETRA base station.

Frequency Separation (MHz)	0.0375	0.0625	0.0875	0.1125	0.4	0.75	1	2	4	5	10
TETRA BS on 50 kHz TEDS BS	13.34	12.79	12.54	2.70	1.95	1.40	1.27	0.88	0.88	0.88	0.88
TETRA BS on 50 kHz TEDS MS	1.56	1.55	1.54	0.22	0.16	0.12	0.10	0.08	0.08	0.08	0.08
TETRA MS on 50 kHz TEDS BS	0.86	0.82	0.81	0.22	0.16	0.15	0.15	0.06	0.06	0.06	0.06
TETRA MS on 50 kHz TEDS MS	0.10	0.10	0.10	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05

Table 106 : Distance separation (km) as function of the frequency separation (MHz)

2.8.2.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

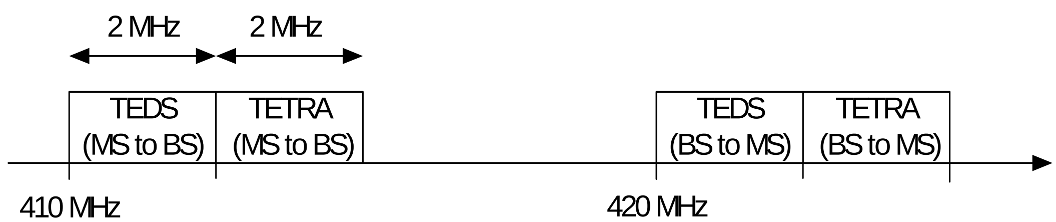

Figure 2- 22 : TETRA on 50 kHz TEDS

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by the relevant channel spacing. For instance, TETRA BS transmits on 422.025 MHz, 420.050 MHz and so on. Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.8.2.2.1 TETRA base station on 50 kHz TEDS base station

The TETRA base stations transmit between 422 and 424 MHz whereas the TEDS base stations receive signals coming from mobile stations between 410 and 412MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0.39 %
0.01	0.8 %
0.05	3.98 %
0.1	8.1 %

Table 2- 107 : TETRA base station on 50 kHz TEDS base station

2.8.2.2.2 TETRA mobile station on 50 kHz TEDS base station

The TETRA mobile stations transmit between 412 and 414 MHz whereas the TEDS BS receive signals coming from MS between 410 and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0.010 %
0.05	0.078 %
0.1	0.25 %
0.5	1.43 %

Table 2- 108 : TETRA mobile station on 50 kHz TEDS base station

2.8.2.2.3 TETRA base station on 50 kHz TEDS mobile station

The TETRA base stations transmit between 422 and 424 MHz whereas the TEDS MS receive signals coming from BS between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0 %
0.01	0.026 %
0.05	0.074 %
0.1	0.079 %

Table 2 - 109 : TETRA base station on 50 kHz TEDS mobile station

2.8.2.2.4 TETRA mobile station on 50 kHz TEDS mobile station

The TETRA mobile stations transmit between 412 and 414 MHz whereas the TEDS mobile stations receive signals coming from base station between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0.01 %
0.5	0.032 %

Table 2 - 110 : TETRA mobile station on 50 kHz TEDS mobile station

2.8.2.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a TETRA BS density of 0.01 BS/km² as calculated in section 2.2.3.3, we obtain a relatively low interference probability on 50 kHz TEDS system. Interference probability on TEDS BS could be improved by considering specific installation and/or by introducing separation distance between TETRA BS and TEDS BS.

Considering a density of 0.2 MS per square km as pointed out in section 2.2.3.3, we obtain also a low interference probability for TETRA MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.8.3 TETRA impacts on 100 kHz TEDS

2.8.3.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance a 100 kHz TEDS base station operation at 1 MHz from a TETRA base station shall be set at least at 1040 meters from this TETRA base station.

Frequency Separation (MHz)	0.0625	0.0875	0.1125	0.4	0.75	1	2	4	5	10
TETRA BS on 100 kHz TEDS BS	18.94	18.67	4.86	2.22	1.60	1.04	1.04	1.04	1.04	1.04
TETRA BS on 100 kHz TEDS MS	2.29	2.29	0.37	0.18	0.13	0.09	0.09	0.09	0.09	0.09
TETRA MS on 100 kHz TEDS BS	1.21	1.20	0.31	0.17	0.16	0.07	0.07	0.07	0.07	0.07
TETRA MS on 100 kHz TEDS MS	0.12	0.11	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.05

Table 2 - 111 : Distance separation (km) as function of the frequency separation (MHz)

2.8.3.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

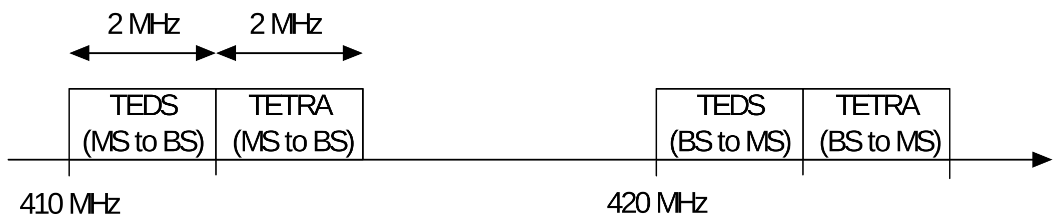

Figure 2- 23 : TETRA on 100 kHz TEDS

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 25 kHz (FM) or 100 kHz (TEDS). For instance, TETRA BS transmits on 422.025 MHz, 422.05 MHz and so on. Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.8.3.2.1 TETRA base station on 100 kHz TEDS base station

The TETRA base stations transmit between 422 and 424 MHz whereas the TEDS base stations receive signals coming from mobile stations between 410 and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0.614 %
0.01	1.3 %
0.05	6 %
0.1	12.9 %

Table 2 - 112 : TETRA base station on 100 kHz TEDS base station

2.8.3.2.2 TETRA mobile station on 100 kHz TEDS base station

The TETRA MS transmit between 412 and 414 MHz whereas the TEDS BS receives signals coming from MS between 410 and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0.045 %
0.05	0.12 %
0.1	0.32 %
0.5	1.76 %

Table 2 - 113 : TETRA mobile station on 100 kHz TEDS base station

2.8.3.2.3 TETRA base station on 100 kHz TEDS mobile station

The TETRA base stations transmit between 422 and 424 MHz whereas the TEDS MS receive signals coming from BS between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0.01 %
0.01	0.02 %
0.05	0.07 %
0.1	0.19 %

Table 2 - 114 : TETRA base station on 100 kHz TEDS mobile station

2.8.3.2.4 TETRA mobile station on 100 kHz TEDS mobile station

The TETRA mobile stations transmit between 412 and 414 MHz whereas the TEDS mobile stations receives signals coming from base station between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0.05 %
0.05	0.06 %
0.1	0.07 %
0.5	0.08 %

Table 2 - 115 : TETRA mobile station on 100 kHz TEDS mobile station

2.8.3.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a TETRA BS density of 0.01 BS/km² as calculated in section 2.2.3.3, we obtain a relatively low interference probability on 100 kHz TEDS system. Interference probability on TEDS BS could be improved by considering specific installation and/or by introducing separation distance between TETRA BS and TEDS BS.

Considering a density of 0.2 MS per square km as pointed out in section 2.2.3.3, we obtain also a low interference probability for TETRA MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.8.4 TETRA impacts on 150 kHz TEDS

2.8.4.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance, a TETRA base station operating at 500 kHz from a 150 kHz TEDS mobile station shall be set at least at 150 meters from this TEDS mobile station.

Frequency Separation (MHz)	0.0875	0.3	**0.5**	1	2	4	5	10
TETRA BS on 150 kHz TEDS BS	12.30	1.82	1.31	1.03	0.88	0.88	0.68	0.68
TETRA BS on 150 kHz TEDS MS	1.51	0.16	**0.15**	0.09	0.07	0.07	0.06	0.06
TETRA MS on 150 kHz TEDS BS	0.79	0.12	0.09	0.07	0.06	0.06	0.04	0.04
TETRA MS on 150 kHz TEDS MS	0.10	0.06	0.06	0.05	0.05	0.05	0.04	0.04

Table 2-116 : Distance separation (km) as function of the frequency separation (MHz)

2.8.4.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

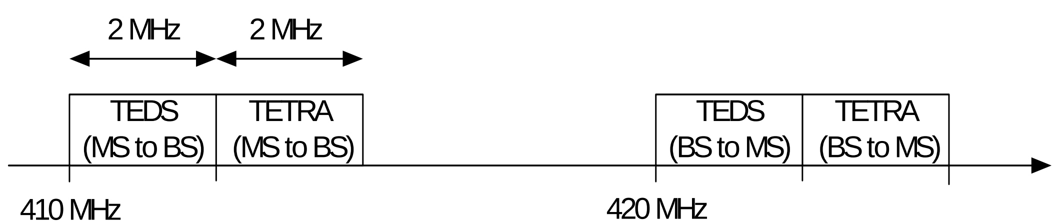

Figure 2-24 : TETRA on 150 kHz TEDS

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 150 kHz (TEDS) or 25 kHz (TETRA). For instance, TETRA BS transmits on 422.0125 MHz, 420.0375 MHz and so on.
Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.8.4.2.1 TETRA BS on 150 kHz TEDS BS

The TETRA BSs transmit between 422 and 424 MHz whereas the 150 kHz TEDS BSs receive signals coming from MS between 410 and 412 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0.40 %
0.01	0.93 %
0.02	1.68 %
0.05	4.79 %
0.1	9.02 %

Table 2-117 : TETRA BS on 150 kHz TEDS BS

2.8.4.2.2 TETRA BS on 150 kHz TEDS MS

The TETRA BSs transmit between 422 and 424 MHz whereas the 150 kHz TEDS MS receive signals coming from BS between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0 %
0.01	0.01 %
0.02	0.01 %
0.05	0.04 %
0.1	0.04 %

Table 2-118 : TETRA BS on 150 kHz TEDS MS

2.8.4.2.3 TETRA MS on 150 kHz TEDS BS

The TETRA MS transmit between 412 and 414 MHz whereas the TEDS BSs receive signals coming from MS between 410 and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0.01 %
0.05	0.02 %
0.1	0.07 %
0.2	0.21 %
0.5	0.35 %
1	0.82 %

Table 2-119 : TETRA MS on 150 kHz TEDS BS

2.8.4.2.4 TETRA MS on 150 kHz TEDS MS

The TETRA MS transmit between 412 and 414 MHz whereas the TEDS MS receive signals coming from BS between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0.01 %
0.05	0.01 %
0.1	0.01 %
0.2	0.03 %
0.5	0.09 %
1	0.18 %

Table 2-120 : TETRA MS on 150 kHz TEDS MS

2.8.4.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a TETRA BS density of 0.01 BS/km² as calculated in section 2.2.3.3, we obtain a relatively low interference probability on 150 kHz TEDS system. Interference probability on TEDS BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRA BS.

Considering a density of 0.20 MS per square km as pointed out in section 2.2.3.3, we obtain also a low interference probability for TETRA MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.9 TETRAPOL impacts on TEDS

This section presents and comments the simulation results obtained by performing MCL calculations and SEAMCAT simulations for the TETRAPOL systems impact on TEDS.

2.9.1 TETRAPOL impacts on 25 kHz TEDS

2.9.1.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance, a TETRAPOL base station operating at 400 kHz from a 25 kHz TEDS mobile station shall be set at least at 90 meters from this TEDS mobile station.

Frequency Separation (MHz)	0.025	0.05	0.075	0.1	**0.4**	0.75	1	2	4	5	10
TETRAPOL BS on 25 kHz TEDS BS	7.10	3.71	3.71	1.98	1.10	0.66	0.66	0.66	0.66	0.66	0.66
TETRAPOL BS on 25 kHz TEDS MS	0.80	0.27	0.27	0.15	**0.09**	0.06	0.06	0.06	0.06	0.06	0.05
TETRAPOL MS on 25 kHz TEDS BS	0.46	0.24	0.24	0.13	0.09	0.05	0.05	0.05	0.05	0.05	0.05
TETRAPOL MS on 25 kHz TEDS MS	0.09	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04

Table 2-121 : Distance separation (km) as function of the frequency separation (MHz)

2.9.1.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

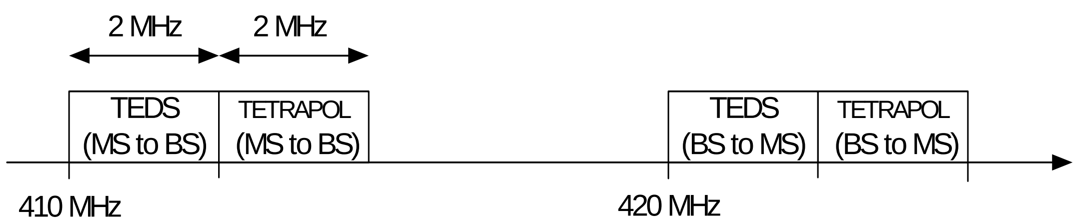

Figure 2-25 : TETRAPOL on 25 kHz TEDS

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 12.5 kHz (TETRAPOL) or 25 kHz (TEDS). For instance, TETRAPOL BS transmits on 422.00625 MHz, 422.01875 MHz and so on.
Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.9.1.2.1 TETRAPOL BS on 25 kHz TEDS BS

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRAPOL BSs receive signals coming from MS between 412 and 414 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL BS/km²)	Interference probability
0.005	0.29 %
0.01	0.65 %
0.02	1.19 %
0.05	2.91 %
0.1	5.88 %

Table 2-122 : TETRAPOL BS on 25 kHz TEDS BS

2.9.1.2.2 TETRAPOL BS on 25 kHz TEDS MS

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRAPOL MS receive signals coming from BS between 422 and 424 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL BS/km²)	Interference probability
0.005	0 %
0.01	0 %
0.02	0 %
0.05	0 %
0.1	0 %

Table 2-123 : TETRAPOL BS on 25 kHz TEDS MS

2.9.1.2.3 TETRAPOL MS on 25 kHz TEDS BS

The TEDS MS transmit between 410 and 412 MHz whereas the TETRAPOL BSs receive signals coming from MS between 412 and 414 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0 %
0.2	0 %
0.5	0 %
1	0 %

Table 2-124 : TETRAPOL MS on 25 kHz TEDS BS

2.9.1.2.4 TETRAPOL MS on 25 kHz TEDS MS

The TEDS MS transmit between 410 and 412 MHz whereas the TETRAPOL MS receive signals coming from BS between 422 and 424 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0 %
0.2	0 %
0.5	0 %
1	0 %

Table 2-125 : TETRAPOL MS on 25 kHz TEDS MS

2.9.1.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a TETRAPOL BS density of 0.005 BS/km² as calculated in section 2.2.3.4, we obtain a relatively low interference probability on 25 kHz TEDS system. Interference probability on 25 kHz BSs could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRAPOL BS.

Considering a density of 0.10 MS per square km as pointed out in section 2.2.3.4, we obtain also a low interference probability for TETRAPOL MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.9.2 TETRAPOL impacts on 50 kHz TEDS

2.9.2.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance a 50 kHz TEDS base station operation at 1 MHz from a TETRAPOL base station shall be set at least at 2310 meters from this TETRAPOL base station.

Frequency Separation (MHz)	0.0375	0.0625	0.0875	0.1125	0.4	0.75	1	2	4	5	10
TETRAPOL BS on 50 kHz TEDS BS	14.73	13.92	13.85	13.85	2.60	1.77	1.24	0.92	0.92	0.92	0.92
TETRAPOL BS on 50 kHz TEDS MS	1.73	1.71	1.71	1.71	0.22	0.16	0.11	0.08	0.08	0.08	0.08
TETRAPOL MS on 50 kHz TEDS BS	0.94	0.89	0.89	0.89	0.17	0.12	0.08	0.06	0.06	0.06	0.08
TETRAPOL MS on 50 kHz TEDS MS	0.11	0.11	0.11	0.11	0.06	0.06	0.05	0.05	0.05	0.05	0.05

Table 2-126 : Distance separation (km) as function of the frequency separation (MHz)

2.9.2.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

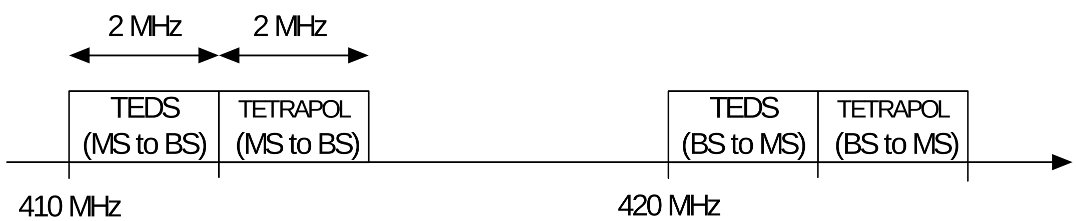

Figure 2-26 : TETRAPOL on 50 kHz TEDS

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 12.5 kHz (TETRAPOL) or 50 kHz (TEDS). For instance, For instance, TETRAPOL BS transmits on 422.00625 MHz, 422.01875 MHz and so on.
Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.9.2.2.1 TETRAPOL base station on 50 kHz TEDS base station

The TETRAPOL base stations transmit between 422 and 424 MHz whereas the TEDS base stations receive signals coming from mobile stations between 410 and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL BS/km²)	Interference probability
0.005	0.34 %
0.01	0.55 %
0.05	2.79 %
0.1	5.81 %

Table 2-127 : TETRAPOL base station on 50 kHz TEDS base station

2.9.2.2.2 TETRAPOL mobile station on 50 kHz TEDS base station

The TETRAPOL Base stations transmit between 422 and 424 MHz whereas the TEDS BS receives signal coming from MS between 410 and 412 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL MS/km²)	Interference probability
0.01	0.01 %
0.05	0.05 %
0.1	0.067 %
0.5	0.4 %
0.1	0.75 %

Table 2 - 128 TETRAPOL mobile station on 50 kHz TEDS base station

2.9.2.2.3 TETRAPOL base station on 50 kHz TEDS mobile station

The TETRAPOL base stations transmit between 422 and 424 MHz whereas the TEDS MS receive signals coming from BS between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL BS/km²)	Interference probability
0.005	0 %
0.01	0 %
0.05	0.045 %
0.1	0.06 %

Table 2- 129 TETRAPOL base station on 50 kHz TEDS mobile

2.9.2.2.4 TETRAPOL mobile station on 50 kHz TEDS mobile station

The TETRAPOL mobile stations transmit between 412 and 414 MHz whereas the TEDS mobile stations receive signals coming from base station between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL MS/km²)	Interference probability
0.01	0 %
0.05	0.01 %
0.1	0.03 %
0.5	0.047 %
1	0.75 %

Table 2 - 130 : TETRAPOL mobile station on 50 kHz TEDS mobile station

2.9.2.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a TETRAPOL BS density of 0.005 BS/km² as calculated in section 2.2.3.4, we obtain a relatively low interference probability on 50 kHz TEDS system. Interference probability on 25 kHz BSs could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRAPOL BS.

Considering a density of 0.10 MS per square km as pointed out in section 2.2.3.4, we obtain also a low interference probability for TETRAPOL MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.9.3 TETRAPOL impacts on 100 kHz TEDS

2.9.3.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance a 100 kHz TEDS base station operation at 400 kHz from a TETRAPOL base station shall be set at least at 2120 meters from this TETRAPOL base station.

Frequency Separation (MHz)	0.055	0.0625	0.0875	0.1125	0.4	0.75	1	2	4	5	10
TETRAPOL BS on 100 kHz TEDS BS	20.93	20.52	20.49	3.07	2.12	1.51	1.10	1.10	1.10	1.10	1.10
TETRAPOL BS on 100 kHz TEDS MS	2.53	2.53	2.52	0.26	0.19	0.13	0.10	0.10	0.10	0.10	0.10
TETRAPOL MS on 100 kHz TEDS BS	1.34	1.32	1.31	0.20	0.14	0.10	0.07	0.07	0.07	0.07	0.07
TETRAPOL MS on 100 kHz TEDS MS	0.12	0.12	0.12	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05

Table 2-131 : Distance separation (km) as function of the frequency separation (MHz)

2.9.3.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

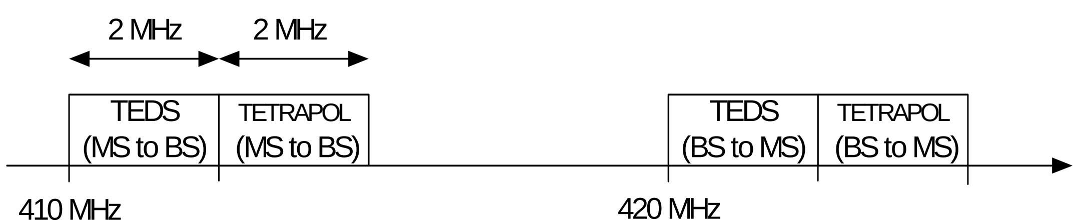

Figure 2-27 : TETRAPOL on 100 kHz TEDS

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 10 kHz (TETRAPOL) or 100 kHz (TEDS). For instance, TETRAPOL BS transmits on 422.00625 MHz, 422.01875 MHz and so on.
Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.9.3.2.1 TETRAPOL base station on 100 kHz TEDS base station

The TETRAPOL base stations transmit between 422 and 424 MHz whereas the TEDS base stations receive signals coming from mobile stations between 410and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL BS/km²)	Interference probability
0.005	0.5 %
0.01	0.79 %
0.05	4.27 %
0.1	8.71 %

Table 2-132 : TETRAPOL base station on 100 kHz TEDS base station

2.9.3.2.2 TETRAPOL mobile station on 100 kHz TEDS base station

The TETRAPOL mobile station transmits between 412 and 414 MHz whereas the TEDS BS receives signals coming from MS between 410 and 412 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL MS/km²)	Interference probability
0.01	0 %
0.05	0.04 %
0.1	0.11 %
0.5	0.69 %
1	1.09 %

Table 2-133 : TETRAPOL mobile station on 100 kHz TEDS base station

2.9.3.2.3 TETRAPOL base station on 100 kHz TEDS mobile station

The TETRAPOL base stations transmit between 422 and 424 MHz whereas the TEDS MS receive signals coming from BS between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL BS/km²)	Interference probability
0.005	0 %
0.01	0.011 %
0.05	0.05 %
0.1	0.15 %

Table 2-134 : TETRAPOL base station on 100 kHz TEDS mobile

2.9.3.2.4 TETRAPOL mobile station on 100 kHz TEDS mobile station

The TETRAPOL mobile stations transmit between 412 and 414 MHz whereas the TEDS mobile stations receive signals coming from base station between 420 and 422 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL MS/km²)	Interference probability
0.01	0.01 %
0.05	0.01 %
0.1	0.012 %
0.5	0.013 %
1	0.15 %

Table 2-135 : TETRAPOL mobile station on 100 kHz TEDS mobile station

2.9.3.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a TETRAPOL BS density of 0.005 BS/km² as calculated in section 2.2.3.4, we obtain a relatively low interference probability on 100 kHz TEDS system. Interference probability on TEDS BS could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRAPOL BS.

Considering a density of 0.10 MS per square km as pointed out in section 2.2.3.4, we obtain also a low interference probability for TETRAPOL MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.9.4 TETRAPOL impacts on 150 kHz TEDS

2.9.4.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance, a TETRAPOL base station operating at 500 kHz from a 150 kHz TEDS mobile station shall be set at least at 100 meters from this TEDS mobile station.

Frequency Separation (MHz)	0.0875	0.3875	**0.5**	1	2	4	5	10
TETRAPOL BS on 150 kHz TEDS BS	10.79	1.54	1.14	0.80	0.59	0.59	0.59	0.59
TETRAPOL BS on 150 kHz TEDS MS	1.33	0.14	**0.10**	0.07	0.05	0.05	0.05	0.05
TETRAPOL MS on 150 kHz TEDS BS	0.69	0.10	0.08	0.05	0.04	0.04	0.04	0.04
TETRAPOL MS on 150 kHz TEDS MS	0.10	0.05	0.05	0.04	0.04	0.04	0.04	0.04

Table 2-136 : Distance separation (km) as function of the frequency separation (MHz)

2.9.4.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

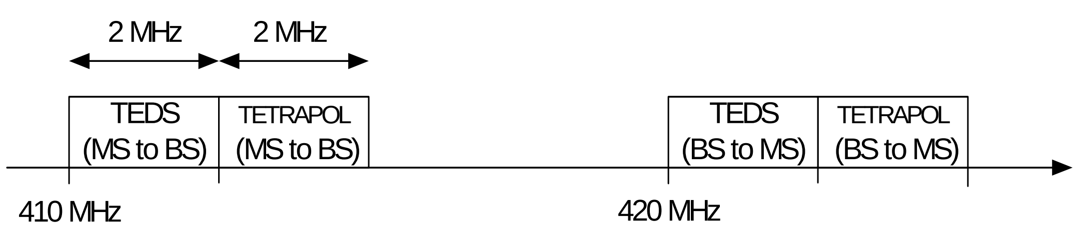

Figure 2-28 : TETRAPOL on 150 kHz TEDS

For each sub-case, transmitters have been split homogeneously over the different bands on channels separated by 12.5 kHz (TETRAPOL) or 150 kHz (TEDS). For instance, TETRAPOL BS transmits on 422.00625 MHz, 422.01875 MHz and so on.
Moreover, 20 interferers have been considered with different interferer densities and for each simulation 20000 SEAMCAT snapshots have been generated.

2.9.4.2.1 TETRAPOL BS on 150 kHz TEDS BS

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRAPOL BSs receive signals coming from MS between 412 and 414 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL BS/km²)	Interference probability
0.005	0.20 %
0.01	0.43 %
0.02	0.99 %
0.05	2.41 %
0.1	5.27 %

Table 2-137 : TETRAPOL BS on 150 kHz TEDS BS

2.9.4.2.2 TETRAPOL BS on 150 kHz TEDS MS

The TEDS BSs transmit between 420 and 422 MHz whereas the TETRAPOL MS receives signals coming from BS between 422 and 424 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL BS/km²)	Interference probability
0.005	0 %
0.01	0 %
0.02	0 %
0.05	0 %
1	0.01 %

Table 2-138 : TETRAPOL BS on 150 kHz TEDS MS

2.9.4.2.3 TETRAPOL MS on 150 kHz TEDS BS

The TEDS MS transmit between 410 and 412 MHz whereas the TETRAPOL BSs receive signals coming from MS between 412 and 414 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0.02 %
0.2	0.03 %
0.5	0.04 %
1	0.11 %

Table 2-139 : TETRAPOL MS on 150 kHz TEDS BS

2.9.4.2.4 TETRAPOL MS on 150 kHz TEDS MS

The TEDS MS transmit between 410 and 412 MHz whereas the TETRAPOL MS receive signals coming from BS between 422 and 424 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRAPOL MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0 %
0.2	0 %
0.5	0 %
1	0 %

Table 2-140 : TETRAPOL MS on 150 kHz TEDS MS

2.9.4.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer and similar value of user density. For a given value of interferer density, the higher interference probability corresponds to the highest separation distance.

If we consider a TETRAPOL BS density of 0.005 BS/km² as calculated in section 2.2.3.4, we obtain a relatively low interference probability on 150 kHz TEDS system. Interference probability on TEDS BSs could be improved by considering specific installation and/or by introducing separation distance between TEDS BS and TETRAPOL BS.

Considering a density of 0.1 MS per square km as pointed out in section 2.2.3.4, we obtain also a low interference probability for TETRAPOL MS as interferer.

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.10 CDMA-PAMR impacts on TEDS

This section presents and comments the simulation results obtained by performing MCL calculations and SEAMCAT simulations for the TETRA systems impact on TEDS.

SEAMCAT calculations have been performed using the SEAMCAT module with the following parameters:
- CDMA-1X; QUALCOMM Europe
- Centre of “infinite” network
- Measure interference from entire cluster
- 20 users per cell
- 2000 samples

2.10.1 CDMA-PAMR impacts on 25 kHz TEDS

2.10.1.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance, a CDMA-PAMR base station operating at 1.125 MHz from a 25 kHz TEDS mobile station shall be set at least at 220 meters from this TEDS mobile station.

Frequency Separation (MHz)	0.75	0.885	**1.125**	2	4	5	10
CDMA-PAMR BS on 25 kHz TEDS BS	11.33	4.25	3.06	1.59	1.59	1.90	1.06
CDMA-PAMR BS on 25 kHz TEDS MS	0.83	0.31	**0.22**	0.12	0.12	0.14	0.08
CDMA-PAMR MS on 25 kHz TEDS BS	NA	0.52	0.33	0.14	0.05	0.06	0.06
CDMA-PAMR MS on 25 kHz TEDS MS	NA	0.08	0.07	0.06	0.04	0.05	0.05

Table 2-141 : Distance separation (km) as function of the frequency separation (MHz)

2.10.1.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

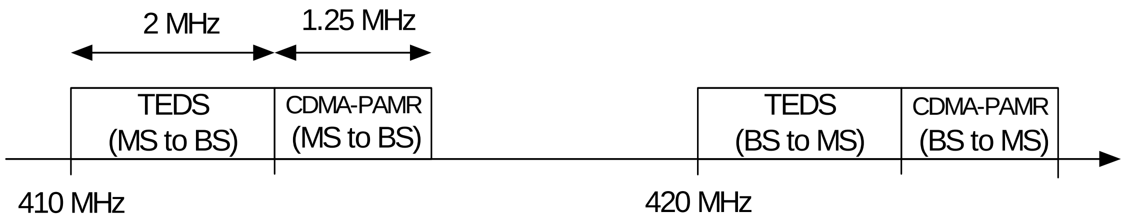

Figure 2-29 : CDMA-PAMR on 25 kHz TEDS

For each sub-case, only one CDMA-PAMR duplex frequency has been considered. CDMA BS transmits on 422.625 and receives on 412.625 MHz. TEDS receivers have been split homogeneously over the different bands on channels separated by 25 kHz. For instance, TEDS BS receives on 410,0125 MHz, 410,0375 MHz and so on. The table below gives the interference probability as defined within SEAMCAT.

Interferer scenario	interference probability
CDMA Downlink on 25 kHz TEDS BS	0.90 %
CDMA Downlink on 25 kHz TEDS MS	1.56 %
CDMA Uplink on 25 kHz TEDS BS	2.19 %
CDMA Uplink on 25 kHz TEDS MS	0 %

Table 2-142 CDMA-PAMR system on 25 kHz TEDS

2.10.1.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer. Low interference probability levels are reached for all kind of interference scenarios.

Interference probability on 25 kHz TEDS could be improved by considering specific installation and/or by introducing separation distance between CDMA and TEDS systems (both MS and BS).

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

Remark: The ECC report 39 called “The technical impact of introducing CDMA-PAMR on 12.5 / 25 kHz PMR/PAMR technologies in the 410-430 and 450-470 MHz bands**”** recommends to have a minimum of 200 kHz guard band between CDMA-PAMR and TETRA systems. Those results were calculated with a previous version of SEAMCAT.

2.10.2 CDMA-PAMR impacts on 50 kHz TEDS

2.10.2.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance a 50 kHz TEDS base station operation at 1.13 MHz from a CDMA base station shall be set at least at 830 meters from this TETRAPOL base station.

Frequency Separation (MHz)	0.65	0.68	0.70	0.75	1.01	1.36	1.61	2.00	4.00	5.00	10.00
CDMA-PAMR BS on 50 kHz TEDS BS	129.69	93.53	48.65	25.30	9.49	6.84	6.84	3.55	1.82	1.82	1.01
CDMA-PAMR BS on 50 kHz TEDS MS	10.11	7.29	3.80	1.97	0.74	0.53	0.53	0.28	0.14	0.14	0.08
CDMA-PAMR MS on 50 kHz TEDS BS	2.92	2.11	1.10	0.57	0.32	0.14	0.14	0.14	0.05	0.06	0.06
CDMA-PAMR MS on 50 kHz TEDS MS	0.13	0.12	0.10	0.08	0.07	0.06	0.06	0.06	0.04	0.07	0.07

Table 2-143 : Distance separation (km) as function of the frequency separation (MHz)

2.10.2.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

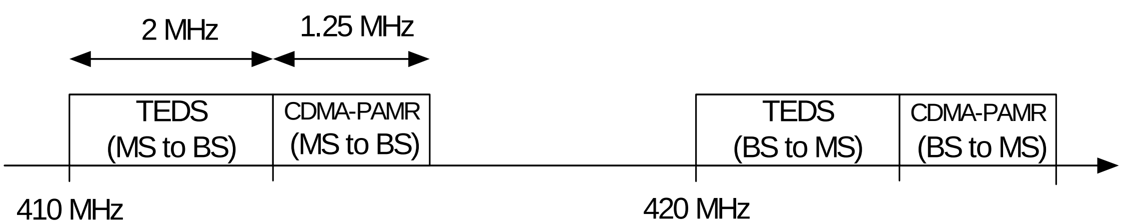

Figure 2-30 : CDMA-PAMR on 50 kHz TEDS

For each sub-case, only one CDMA-PAMR duplex frequency has been considered. CDMA BS transmits on 422.625 and receives on 412.625 MHz. TEDS receivers have been split homogeneously over the different bands on channels separated by 50 kHz. For instance, TEDS BS receives on 410,025 MHz, 410,075 MHz and so on. The table below gives the interference probability as defined within SEAMCAT.

Interferer scenario	interference probability
CDMA Downlink on 50 kHz TEDS BS	1.01 %
CDMA Downlink on 50 kHz TEDS MS	1.75 %
CDMA Uplink on 50 kHz TEDS BS	1.98 %
CDMA Uplink on 50 kHz TEDS MS	0 %

Table 2-144 CDMA-PAMR system on 50 kHz TEDS

2.10.2.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer. Low interference probability levels are reached for all kind of interference scenarios.

Interference probability on 50 kHz TEDS could be improved by considering specific installation and/or by introducing separation distance between CDMA and TEDS systems (both MS and BS).

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.10.3 CDMA-PAMR impacts on 100 kHz TEDS

2.10.3.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance a 100 kHz TEDS base station operation at 2 MHz from a CDMA base station shall be set at least at 3800 meters from this CDMA base station.

Frequency Separation (MHz)	0.675	0.7	0.75	1.0125	1.3625	1.6125	2	4	5	10
CDMA-PAMR BS on 100 kHz TEDS BS	99.91	51.98	27.03	10.14	7.31	7.30	3.80	1.94	1.94	1.08
CDMA-PAMR BS on 100 kHz TEDS MS	7.30	3.80	1.97	0.74	0.53	0.53	0.28	0.14	0.14	0.08
CDMA-PAMR MS on 100 kHz TEDS BS	2.25	1.19	0.61	0.34	0.14	0.14	0.14	0.06	0.07	0.06
CDMA-PAMR MS on 100 kHz TEDS MS	0.12	0.10	0.08	0.07	0.06	0.06	0.06	0.04	0.07	0.07

Table 2-145 : Distance separation (km) as function of the frequency separation (MHz)

2.10.3.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

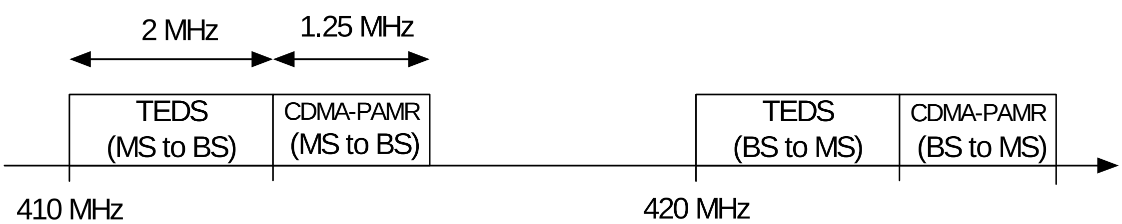

Figure 2-31 CDMA-PAMR on 100 kHz TEDS

For each sub-case, only one CDMA-PAMR duplex frequency has been considered. CDMA Base transmits on 422.625 and receives on 412.625 MHz. TEDS receivers have been split homogeneously over the different bands on channels separated by 100 kHz. For instance, TEDS BS receives on 410.050 MHz, 410.150 MHz and so on. The table below gives the interference probability as defined within SEAMCAT.

Interferer scenario	interference probability
CDMA Downlink on 100 kHz TEDS BS	1.05 %
CDMA Downlink on 100 kHz TEDS MS	1.81 %
CDMA Uplink on 100 kHz TEDS BS	2.63 %
CDMA Uplink on 100 kHz TEDS MS	0 %

Table 2-146 CDMA-PAMR system on 100 kHz TEDS

2.10.3.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer. Low interference probability levels are reached for all kind of interference scenarios.

Interference probability on 25 kHz TEDS could be improved by considering specific installation and/or by introducing separation distance between CDMA and TEDS systems (both MS and BS).

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.10.4 CDMA-PAMR impacts on 150 kHz TEDS

2.10.4.1 MCL Calculations

The table below gives the protection distance as function of the frequency separation. For instance, a CDMA-PAMR base station operating at 1.125 MHz from a 150 kHz TEDS mobile station shall be set at least at 160 meters from this TEDS mobile station.

Frequency Separation (MHz)	0.75	0.885	**1.125**	2	4	5	10
CDMA-PAMR BS on 150 kHz TEDS BS	7.17	2.69	1.94	1.01	1.01	1.21	0.69
CDMA-PAMR BS on 150 kHz TEDS MS	0.60	0.22	**0.16**	0.09	0.08	0.10	0.06
CDMA-PAMR MS on 150 kHz TEDSBS	NA	0.33	0.21	0.09	0.03	0.04	0.04
CDMA-PAMRMS on 150 kHz TEDS MS	NA	0.07	0.06	0.05	0.04	0.04	0.04

Table 2-147 : Distance separation (km) as function of the frequency separation (MHz)

2.10.4.2 SEAMCAT Calculations

For SEAMCAT simulations, frequency allocation has been performed as presented in the figure below.

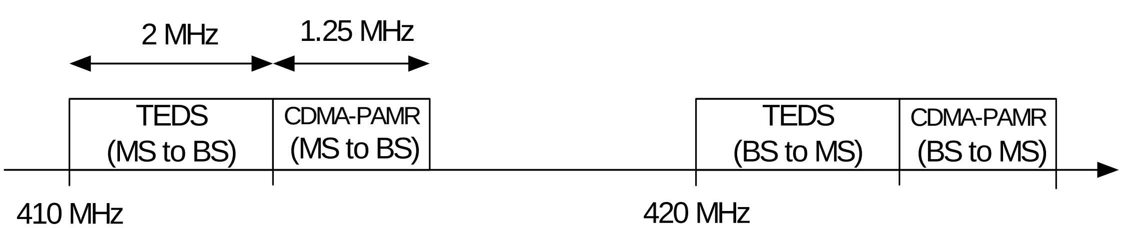

Figure 2-32 CDMA-PAMR on 150 kHz TEDS

For each sub-case, only one CDMA-PAMR duplex frequency has been considered. CDMA Base transmits on 422.625 and receives on 412.625 MHz. TEDS receivers have been split homogeneously over the different bands on channels separated by 100 kHz. For instance, TEDS BS receives on 410.075 MHz, 410.225 MHz and so on.
The table below gives the interference probability as defined within SEAMCAT.

Interferer scenario	interference probability
CDMA Downlink on 150 kHz TEDS BS	1.58 %
CDMA Downlink on 150 kHz TEDS MS	0.16 %
CDMA Uplink on 150 kHz TEDS BS	0.06 %
CDMA Uplink on 150 kHz TEDS MS	0 %

Table 2-148 CDMA-PAMR system on 150 kHz TEDS

2.10.4.3 Analysis

MCL calculations and SEAMCAT results are in line for each kind of interferer. Low interference probability levels are reached for all kind of interference scenarios.

Interference probability on 25 kHz TEDS could be improved by considering specific installation and/or by introducing separation distance between CDMA and TEDS systems (both MS and BS).

Regarding computed values either using MCL methodology or SEAMCAT, the addition of a guard band does not seem necessary.

2.11 TETRA / TEDS compatibility studies

TETRA / TEDS compatibility has done by considering a 1 MHz bandwidth allocated for both systems. Two cases are considered:

Case 1: 250 kHz allocated for TETRA, followed by 250 kHz allocated for TEDS and so on up to 1 MHz.
Case 2: 50 kHz allocated for TETRA, followed by 50 kHz allocated for TEDS and so on up to 1 MHz.

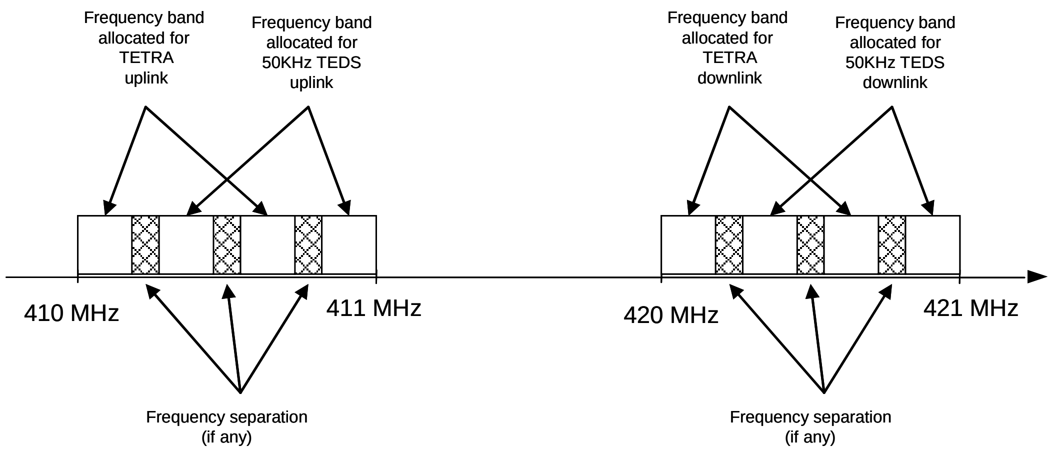

Figure 2-33: Frequency allocation of the 410-430 MHz

SEAMCAT simulations have been performed using 1 MHz allocation per system. Depending on the obtained results a frequency guard band could be considered between two allocated blocks.

2.11.1 CASE 1 - 250 kHz Bandwidth Interleaving

2.11.1.1 25 kHz TEDS on TETRA

The following frequencies list was used in SEAMCAT simulation.

Uplink	Downlink	System		Uplink	Downlink	System
410.0125	420.0125	TETRA		410.5125	420.5125	TETRA
410.0375	420.0375	TETRA		410.5375	420.5375	TETRA
410.0625	420.0625	TETRA		410.5625	420.5625	TETRA
410.0875	420.0875	TETRA		410.5875	420.5875	TETRA
410.1125	420.1125	TETRA		410.6125	420.6125	TETRA
410.1375	420.1375	TETRA		410.6375	420.6375	TETRA
410.1625	420.1625	TETRA		410.6625	420.6625	TETRA
410.1875	420.1875	TETRA		410.6875	420.6875	TETRA
410.2125	420.2125	TETRA		410.7125	420.7125	TETRA
410.2375	420.2375	TETRA		410.7375	420.7375	TETRA
410.2625	420.2625	25k TEDS		410.7625	420.7625	25k TEDS
410.2875	420.2875	25k TEDS		410.7875	420.7875	25k TEDS
410.3125	420.3125	25k TEDS		410.8125	420.8125	25k TEDS
410.3375	420.3375	25k TEDS		410.8375	420.8375	25k TEDS
410.3625	420.3625	25k TEDS		410.8625	420.8625	25k TEDS
410.3875	420.3875	25k TEDS		410.8875	420.8875	25k TEDS
410.4125	420.4125	25k TEDS		410.9125	420.9125	25k TEDS
410.4375	420.4375	25k TEDS		410.9375	420.9375	25k TEDS
410.4625	420.4625	25k TEDS		410.9625	420.9625	25k TEDS
410.4875	420.4875	25k TEDS		410.9875	420.9875	25k TEDS

Table 2-149 : Case 1 - Frequencies list for 25 kHz TEDS

2.11.1.1.1 25 kHz TEDS BS on TETRA BS

The TEDS BSs transmit between 420 and 421 MHz whereas the TETRA BSs receive signals coming from MS between 410 and 411 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.58 %
0.01	1.25 %
0.02	2.50 %
0.05	6. 50 %
0.1	13.04 %

Table 2-150 : 25 kHz TEDS BS on TETRA BS

2.11.1.1.2 25 kHz TEDS BS on TETRA mobile station

The TEDS BSs transmit between 420 and 421 MHz whereas the TETRA MS receive signals coming from BS between 420 and 421 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0 %
0.01	0.01%
0.02	0.05 %
0.05	0.04 %
0.1	0.06 %

Table 2-151 : 25 kHz TEDS BS on TETRA mobile station

2.11.1.1.3 25 kHz TEDS MS on TETRA BS

The TEDS MS transmit between 410 and 411 MHz whereas the TETRA BSs receive signals coming from MS between 410 and 411 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.09 %
0.05	0.62 %
0.1	1.06 %
0.2	2.31 %
0.5	5.53 %
1	10.95 %

Table 2-152 : 25 kHz TEDS MS on TETRA BS

2.11.1.1.4 25 kHz TEDS MS on TETRA mobile station

The TEDS MS transmit between 410 and 411 MHz whereas the TETRA MS receive signals coming from BS between 420 and 421 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0%
0.1	0.02 %
0.2	0.04 %
0.5	0.08 %
1	0.15 %

Table 2-153 : 25 kHz TEDS MS on TETRA mobile station

2.11.1.1.5 Analysis

If we consider a 25 kHz TEDS BS density of 0.011 BS/km² as calculated in section 2.2.3.1.1 and a density of 0.044 MS per square km as pointed out in section 2.2.3.1.1, we obtain a relatively low interference probability of TEDS BS on TETRA MS – section 2.7.1.1.2 and TEDS MS on TETRA MS – section 2.7.1.1.4.

Interference probability of TEDS BS on TETRA BS – section 2.7.1.1.1 and TEDS MS on TETRA BS – section 2.7.1.1.3 could be improved by considering specific installation and/or by introducing separation distance between TEDS and TETRA. Alternatively, collocated sites together with power control enabling on TEDS MS will significantly reduce the interfering probability.

2.11.1.2 50 kHz TEDS on TETRA

The following frequencies list was used in SEAMCAT simulation.

Uplink	Downlink	System		Uplink	Downlink	System
410.0125	420.0125	TETRA		410.5125	420.5125	TETRA
410.0375	420.0375	TETRA		410.5375	420.5375	TETRA
410.0625	420.0625	TETRA		410.5625	420.5625	TETRA
410.0875	420.0875	TETRA		410.5875	420.5875	TETRA
410.1125	420.1125	TETRA		410.6125	420.6125	TETRA
410.1375	420.1375	TETRA		410.6375	420.6375	TETRA
410.1625	420.1625	TETRA		410.6625	420.6625	TETRA
410.1875	420.1875	TETRA		410.6875	420.6875	TETRA
410.2125	420.2125	TETRA		410.7125	420.7125	TETRA
410.2375	420.2375	TETRA		410.7375	420.7375	TETRA
410.275	420.275	50k TEDS		410.775	420.775	50k TEDS
410.325	420.325	50k TEDS		410.825	420.825	50k TEDS
410.375	420.375	50k TEDS		410.875	420.875	50k TEDS
410.425	420.425	50k TEDS		410.925	420.925	50k TEDS
410.475	420.475	50k TEDS		410.975	420.975	50k TEDS

Table 2-154 : Case 1 - Frequencies list for 50 kHz TEDS

2.11.1.2.1 50 kHz TEDS BS on TETRA BS

The TEDS BSs transmit between 420 and 421 MHz whereas the TETRA BSs receive signals coming from MS between 410 and 411 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.58 %
0.01	1.22 %
0.02	2.62 %
0.05	6.42 %

Table 2-155 : 50 kHz TEDS BS on TETRA BS

2.11.1.2.2 50 kHz TEDS BS on TETRA mobile station

The TEDS BSs transmit between 420 and 421 MHz whereas the TETRA MS receive signals coming from BS between 420and 421 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.1 %
0.01	0.25 %
0.02	0.40 %
0.05	0.97 %

Table 2-156 : 50 kHz TEDS BS on TETRA mobile station

2.11.1.2.3 50 kHz TEDS MS on TETRA BS

The TEDS MS transmit between 410 and 411 MHz whereas the TETRA BSs receive signals coming from MS between 410 and 411 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	1.06 %
0.05	2.24 %
0.1	2.73 %
0.2	3.8 %
0.5	9.01 %
1	15.56 %

Table 2-157 : 50 kHz TEDS MS on TETRA BS

2.11.1.2.4 50 kHz TEDS MS on TETRA mobile station

The TEDS MS transmit between 410 and 411 MHz whereas the TETRA MS receive signals coming from BS between 420 and 421 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0.005 %
0.1	0.01 %
0.2	0.04 %
0.5	0.11 %
1	0.16 %

Table 2-158 : 50 kHz TEDS MS on TETRA mobile station

2.11.1.2.5 Analysis

If we consider a 50 kHz TEDS BS density of 0.018 BS/km² and a density of 0.072 MS per square km as pointed out in section 2.2.3.1.2, we obtain a relatively low interference probability of TEDS BS on TETRA MS – section 2.11.1.2.2and TEDS MS on TETRA MS – section 2.11.1.2.4.

Interference probability of TEDS BS on TETRA BS – section 2.11.1.2.1 and TEDS MS on TETRA BS – section 2.11.1.2.3 could be improved by considering specific installation and/or by introducing separation distance between TEDS and TETRA. Alternatively, Collocated sites together with power control enabling on TEDS MS will significantly reduce the interfering probability.

2.11.1.3 TETRA on 25 kHz TEDS

The following frequencies list was used in SEAMCAT simulation.

Uplink	Downlink	System		Uplink	Downlink	System
410.0125	420.0125	TETRA		410.5125	420.5125	TETRA
410.0375	420.0375	TETRA		410.5375	420.5375	TETRA
410.0625	420.0625	TETRA		410.5625	420.5625	TETRA
410.0875	420.0875	TETRA		410.5875	420.5875	TETRA
410.1125	420.1125	TETRA		410.6125	420.6125	TETRA
410.1375	420.1375	TETRA		410.6375	420.6375	TETRA
410.1625	420.1625	TETRA		410.6625	420.6625	TETRA
410.1875	420.1875	TETRA		410.6875	420.6875	TETRA
410.2125	420.2125	TETRA		410.7125	420.7125	TETRA
410.2375	420.2375	TETRA		410.7375	420.7375	TETRA
410.2625	420.2625	25k TEDS		410.7625	420.7625	25k TEDS
410.2875	420.2875	25k TEDS		410.7875	420.7875	25k TEDS
410.3125	420.3125	25k TEDS		410.8125	420.8125	25k TEDS
410.3375	420.3375	25k TEDS		410.8375	420.8375	25k TEDS
410.3625	420.3625	25k TEDS		410.8625	420.8625	25k TEDS
410.3875	420.3875	25k TEDS		410.8875	420.8875	25k TEDS
410.4125	420.4125	25k TEDS		410.9125	420.9125	25k TEDS
410.4375	420.4375	25k TEDS		410.9375	420.9375	25k TEDS
410.4625	420.4625	25k TEDS		410.9625	420.9625	25k TEDS
410.4875	420.4875	25k TEDS		410.9875	420.9875	25k TEDS

Table 2-159 : Case 1 - Frequencies list for 25 kHz TEDS

2.11.1.3.1 TETRA BS on 25 kHz TEDS BS

The TETRA BSs transmit between 420 and 421 MHz whereas the TEDS BSs receive signals coming from MS between 410 and 411 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0.33 %
0.01	0.57 %
0.02	1.39 %
0.05	3.35 %
0.1	7.22 %

Table 2-160 : TETRA BS on 25 kHz TEDS BS

2.11.1.3.2 TETRA BS on 25 kHz TEDS MS

The TETRA BSs transmit between 420 and 421 MHz whereas the TEDS MS receive signals coming from BS between 420 and 421 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0.01 %
0.01	0.01%
0.02	0.03 %
0.05	0.06 %
0.1	0.10 %

Table 2-161 : TETRA BS on 25 kHz TEDS MS

2.11.1.3.3 TETRA MS on 25 kHz TEDS BS

The TETRA MS transmit between 410 and 411 MHz whereas the TEDS BSs receive signals coming from MS between 410 and 411 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0.05 %
0.05	0.07 %
0.1	0.21 %
0.2	0.51 %
0.5	1.04 %
1	2.09 %

Table 2-162 : TETRA MS on 25 kHz TEDS BS

2.11.1.3.4 TETRA MS on 25 kHz TEDS MS

The TETRA MS transmit between 410 and 411 MHz whereas the TEDS MS receive signals coming from BS between 420 and 421 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0 %
0.05	0%
0.1	0 %
0.2	0 %
0.5	0 %
1	0 %

Table 2-163 : TETRA MS on 25 kHz TEDS MS

2.11.1.3.5 Analysis

If we consider a TETRA BS density of 0.01 BS/km² as calculated in section 2.2.3.3 and a density of 0.2 MS per square km as pointed out in section 2.2.3.3, we obtain a relatively low interference probability of TETRA BS on TEDS MS – section 2.11.1.1.2 and TEDS MS on TETRA MS – section 2.11.1.1.4.

Interference probability of TETRA BS on TEDS BS – section 2.11.1.1.1 and TETRA MS on TEDS BS – section 2.11.1.1.3 could be improved by considering specific installation and/or by introducing separation distance between TEDS and TETRA. Alternatively, collocated sites together with power control enabling on TETRA MS will significantly reduce the interfering probability.

2.11.1.4 TETRA on 50 kHz TEDS

The following frequencies list was used in SEAMCAT simulation.

Uplink	Downlink	System		Uplink	Downlink	System
410.0125	420.0125	TETRA		410.5125	420.5125	TETRA
410.0375	420.0375	TETRA		410.5375	420.5375	TETRA
410.0625	420.0625	TETRA		410.5625	420.5625	TETRA
410.0875	420.0875	TETRA		410.5875	420.5875	TETRA
410.1125	420.1125	TETRA		410.6125	420.6125	TETRA
410.1375	420.1375	TETRA		410.6375	420.6375	TETRA
410.1625	420.1625	TETRA		410.6625	420.6625	TETRA
410.1875	420.1875	TETRA		410.6875	420.6875	TETRA
410.2125	420.2125	TETRA		410.7125	420.7125	TETRA
410.2375	420.2375	TETRA		410.7375	420.7375	TETRA
410.275	420.275	50k TEDS		410.775	420.775	50k TEDS
410.325	420.325	50k TEDS		410.825	420.825	50k TEDS
410.375	420.375	50k TEDS		410.875	420.875	50k TEDS
410.425	420.425	50k TEDS		410.925	420.925	50k TEDS
410.475	420.475	50k TEDS		410.975	420.975	50k TEDS

Table 2-164 : Case 1 - Frequencies list for 50 kHz TEDS

2.11.1.4.1 TETRA BS on 50 kHz TEDS BS

The TETRA BSs transmit between 420 and 421 MHz whereas the TEDS BSs receive signals coming from MS between 410 and 411 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0.31 %
0.01	0.46 %
0.02	1.27 %
0.05	3.09 %
0.1	6.72 %

Table 2-165 : TETRA BS on 50 kHz TEDS BS

2.11.1.4.2 TETRA BS on 50 kHz TEDS mobile station

The TETRA BSs transmit between 420 and 421 MHz whereas the TEDS MS receive signals coming from BS between 420and 421 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0 %
0.01	0.01 %
0.02	0.01 %
0.05	0.03 %
0.1	0.08 %

Table 2-166 : 50 kHz TEDS BS on TETRA mobile station

2.11.1.4.3 TETRA MS on 50 kHz TEDS BS

The TETRA MS transmit between 410 and 411 MHz whereas the TEDS BSs receive signals coming from MS between 410 and 411 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0.04 %
0.05	0.09 %
0.1	0.31 %
0.2	0.47 %
0.5	1.32 %
1	2.69 %

Table 2-167 : TETRA MS on 50 kHz TEDS BS

2.11.1.4.4 TETRA MS on 50 kHz TEDS mobile station

The TETRA MS transmit between 410 and 411 MHz whereas the TEDS MS receive signals coming from BS between 420 and 421 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0 %
0.2	0 %
0.5	0 %
1	0.01 %

Table 2-168 : TETRA MS on 50 kHz TEDS mobile station

2.11.1.4.5 Analysis

If we consider a TETRA BS density of 0.01 BS/km² as calculated in section 2.2.3.3 and a density of 0.2 MS per square km as pointed out in section 2.2.3.3, we obtain a relatively low interference probability of TETRA BS on TEDS MS – section 2.11.1.4.2 and TEDS MS on TETRA MS – section 2.11.1.4.4.

Interference probability of TETRA BS on TEDS BS – section 2.11.1.4.1 and TETRA MS on TEDS BS – section 2.11.1.4.3 could be improved by considering specific installation and/or by introducing separation distance between TEDS and TETRA. Alternatively, collocated sites together with power control enabling on TETRA MS will significantly reduce the interfering probability.

2.11.2 CASE 2 - 50 kHz Bandwidth Interleaving

2.11.2.1 25 kHz TEDS on TETRA

The following frequencies list was used in SEAMCAT simulation.

Uplink	Downlink	System		Uplink	Downlink	System
410.0125	420.0125	TETRA		410.5125	420.5125	TETRA
410.0375	420.0375	TETRA		410.5375	420.5375	TETRA
410.0625	420.0625	25k TEDS		410.5625	420.5625	25k TEDS
410.0875	420.0875	25k TEDS		410.5875	420.5875	25k TEDS
410.1125	420.1125	TETRA		410.6125	420.6125	TETRA
410.1375	420.1375	TETRA		410.6375	420.6375	TETRA
410.1625	420.1625	25k TEDS		410.6625	420.6625	25k TEDS
410.1875	420.1875	25k TEDS		410.6875	420.6875	25k TEDS
410.2125	420.2125	TETRA		410.7125	420.7125	TETRA
410.2375	420.2375	TETRA		410.7375	420.7375	TETRA
410.2625	420.2625	25k TEDS		410.7625	420.7625	25k TEDS
410.2875	420.2875	25k TEDS		410.7875	420.7875	25k TEDS
410.3125	420.3125	TETRA		410.8125	420.8125	TETRA
410.3375	420.3375	TETRA		410.8375	420.8375	TETRA
410.3625	420.3625	25k TEDS		410.8625	420.8625	25k TEDS
410.3875	420.3875	25k TEDS		410.8875	420.8875	25k TEDS
410.4125	420.4125	TETRA		410.9125	420.9125	TETRA
410.4375	420.4375	TETRA		410.9375	420.9375	TETRA
410.4625	420.4625	25k TEDS		410.9625	420.9625	25k TEDS
410.4875	420.4875	25k TEDS		410.9875	420.9875	25k TEDS

Table 2-169 : Case 2 - Frequencies list for 25 kHz TEDS

2.11.2.1.1 25 kHz TEDS BS on TETRA BS

The TEDS BSs transmit between 420 and 421 MHz whereas the TETRA BSs receive signals coming from MS between 410 and 411 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.61 %
0.01	1.28 %
0.02	2.60 %
0.05	6.85 %
0.1	12.97 %

Table 2-170 : 25 kHz TEDS BS on TETRA BS

2.11.2.1.2 25 kHz TEDS BS on TETRA mobile station

The TEDS BSs transmit between 420 and 421 MHz whereas the TETRA MS receive signals coming from BS between 420 and 421 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.01 %
0.01	0.01 %
0.02	0.01 %
0.05	0.01 %
0.1	0.10 %

Table 2-171 : 25 kHz TEDS BS on TETRA mobile station

2.11.2.1.3 25 kHz TEDS MS on TETRA BS

The TEDS MS transmit between 410 and 411 MHz whereas the TETRA BSs receive signals coming from MS between 410and 411 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.16 %
0.05	0.81 %
0.1	1.54 %
0.2	3.10 %
0.5	7.59 %
1	14.98 %

Table 2-172 : 25 kHz TEDS MS on TETRA BS

2.11.2.1.4 25 kHz TEDS MS on TETRA mobile station

The TEDS MS transmit between 410 and 411 MHz whereas the TETRA MS receives signals coming from BS between 420 and 421 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0.02 %
0.1	0.03 %
0.2	0.02 %
0.5	0.11 %
1	0.18 %

Table 2-173 : 25 kHz TEDS MS on TETRA mobile station

2.11.2.1.5 Analysis

If we consider a 25 kHz TEDS BS density of 0.011 BS/km² and a density of 0.044 MS per square km as pointed out in section 2.2.3.1.1, we obtain a relatively low interference probability of TEDS BS on TETRA MS – section 2.11.1.2.2 and TEDS MS on TETRA MS – section 2.11.1.2.4.

Interference probability of TEDS BS on TETRA BS – section 2.11.1.2.1and TEDS MS on TETRA BS – section 2.11.1.2.3could be improved by considering specific installation and/or by introducing separation distance between TEDS and TETRA. Alternatively, Collocated sites together with power control enabling on TEDS MS will significantly reduce the interfering probability.

2.11.2.2 50 kHz TEDS on TETRA

The following frequencies list was used in SEAMCAT simulation.

Uplink	Downlink	System		Uplink	Downlink	System
410.0125	420.0125	TETRA		410.5125	420.5125	TETRA
410.0375	420.0375	TETRA		410.5375	420.5375	TETRA
410.075	420.075	50k TEDS		410.575	420.575	50k TEDS
410.1125	420.1125	TETRA		410.6125	420.6125	TETRA
410.1375	420.1375	TETRA		410.6375	420.6375	TETRA
410.175	420.175	50k TEDS		410.675	420.675	50k TEDS
410.2125	420.2125	TETRA		410.7125	420.7125	TETRA
410.2375	420.2375	TETRA		410.7375	420.7375	TETRA
410.275	420.275	50k TEDS		410.775	420.775	50k TEDS
410.3125	420.3125	TETRA		410.8125	420.8125	TETRA
410.3375	420.3375	TETRA		410.8375	420.8375	TETRA
410.375	420.375	50k TEDS		410.875	420.875	50k TEDS
410.4125	420.4125	TETRA		410.9125	420.9125	TETRA
410.4375	420.4375	TETRA		410.9375	420.9375	TETRA
410.475	420.475	50k TEDS		410.975	420.975	50k TEDS

Table 2-174 : Case 2 - Frequencies list for 50kHz TEDS

2.11.2.2.1 50 kHz TEDS BS on TETRA BS

The TEDS BSs transmit between 420 and 421 MHz whereas the TETRA BSs receive signals coming from MS between 410 and 411 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.64 %
0.01	1.27 %
0.02	2.47 %
0.05	6.53 %

Table 2-175 : 50 kHz TEDS BS on TETRA BS

2.11.2.2.2 50 kHz TEDS BS on TETRA mobile station

The TEDS BSs transmit between 420 and 421 MHz whereas the TETRA MS receive signals coming from BS between 420 and 421 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS BS/km²)	Interference probability
0.005	0.52 %
0.01	0.86 %
0.02	1.76 %
0.05	4.16 %

Table 2-176 : 50 kHz TEDS BS on TETRA mobile station

2.11.2.2.3 50 kHz TEDS MS on TETRA BS

The TEDS MS transmit between 410 and 411 MHz whereas the TETRA BSs receive signals coming from MS between 410and 411 MHz.

The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0.83 %
0.05	3.94 %
0.1	7.61 %
0.2	14.15 %
0.5	27.91 %
1	41.1 %

Table 2-177 : 50 kHz TEDS MS on TETRA BS

2.11.2.2.4 50 kHz TEDS mobile on TETRA mobile

The TEDS MS transmit between 410 and 411 MHz whereas the TETRA MS receives signals coming from BS between 420 and 421 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TEDS MS/km²)	Interference probability
0.01	0 %
0.05	0.03 %
0.1	0.04 %
0.2	0.06 %
0.5	0.08 %
1	0.15 %

Table 2-178 : 50 kHz TEDS MS on TETRA mobile station

2.11.2.2.5 Analysis

If we consider a 50 kHz TEDS BS density of 0.018 BS/km² and a density of 0.072 MS per square km as pointed out in section 2.2.3.1.2, we obtain a relatively low interference probability of TEDS BS on TETRA MS – section 2.11.1.2.2and TEDS MS on TETRA MS – section 2.11.1.2.4.

Interference probability of TEDS BS on TETRA BS – section 2.11.1.2.1and TEDS MS on TETRA BS – section 2.11.1.2.3could be improved by considering specific installation and/or by introducing separation distance between TEDS and TETRA. Alternatively, Collocated sites together with power control enabling on TEDS MS will significantly reduce the interfering probability.

2.11.2.3 TETRA on 25 kHz TEDS

The following frequencies list was used in SEAMCAT simulation.

Uplink	Downlink	System		Uplink	Downlink	System
410.0125	420.0125	TETRA		410.5125	420.5125	TETRA
410.0375	420.0375	TETRA		410.5375	420.5375	TETRA
410.0625	420.0625	25k TEDS		410.5625	420.5625	25k TEDS
410.0875	420.0875	25k TEDS		410.5875	420.5875	25k TEDS
410.1125	420.1125	TETRA		410.6125	420.6125	TETRA
410.1375	420.1375	TETRA		410.6375	420.6375	TETRA
410.1625	420.1625	25k TEDS		410.6625	420.6625	25k TEDS
410.1875	420.1875	25k TEDS		410.6875	420.6875	25k TEDS
410.2125	420.2125	TETRA		410.7125	420.7125	TETRA
410.2375	420.2375	TETRA		410.7375	420.7375	TETRA
410.2625	420.2625	25k TEDS		410.7625	420.7625	25k TEDS
410.2875	420.2875	25k TEDS		410.7875	420.7875	25k TEDS
410.3125	420.3125	TETRA		410.8125	420.8125	TETRA
410.3375	420.3375	TETRA		410.8375	420.8375	TETRA
410.3625	420.3625	25k TEDS		410.8625	420.8625	25k TEDS
410.3875	420.3875	25k TEDS		410.8875	420.8875	25k TEDS
410.4125	420.4125	TETRA		410.9125	420.9125	TETRA
410.4375	420.4375	TETRA		410.9375	420.9375	TETRA
410.4625	420.4625	25k TEDS		410.9625	420.9625	25k TEDS
410.4875	420.4875	25k TEDS		410.9875	420.9875	25k TEDS

Table 2-179 : Case 2 - Frequencies list for 25 kHz TEDS

2.11.2.3.1 TETRA BS on 25 kHz TEDS BS

The TETRA BSs transmit between 420 and 421 MHz whereas the TEDS BSs receive signals coming from MS between 410 and 411 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0.38 %
0.01	0.73 %
0.02	1.23 %
0.05	3.66 %
0.1	7.17 %

Table 2-180 : TETRA BS on 25 kHz TEDS BS

2.11.2.3.2 TETRA BS on 25 kHz TEDS MS

The TETRA BSs transmit between 420 and 421 MHz whereas the TEDS MS receive signals coming from BS between 420 and 421 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0.02 %
0.01	0.03 %
0.02	0.07 %
0.05	0.19 %
0.1	0.40 %

Table 2-181 : TETRA BS on 25 kHz TEDS MS

2.11.2.3.3 TETRA MS on 25 kHz TEDS BS

The TETRA MS transmit between 410 and 411 MHz whereas the TEDS BSs receive signals coming from MS between 410and 411 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0.07 %
0.05	0.28 %
0.1	0.41 %
0.2	0.86 %
0.5	2.24 %
1	4.70 %

Table 2-182 : TETRA MS on 25 kHz TEDS BS

2.11.2.3.4 TETRA MS on 25 kHz TEDS MS

The TETRA MS transmit between 410 and 411 MHz whereas the TEDS MS receives signals coming from BS between 420 and 421 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0 %
0.2	0 %
0.5	0 %
1	0 %

Table 2-183 : TETRA MS on 25 kHz TEDS MS

2.11.2.3.5 Analysis

If we consider a TETRA BS density of 0.01 BS/km² and a density of 0.2 MS per square km as pointed out in section 2.2.3.3, we obtain a relatively low interference probability of TETRA BS on TEDS MS – section 2.11.1.2.2 and TETRA MS on TEDS MS – section 2.11.1.2.4.

Interference probability of TETRA BS on TEDS BS – section 2.11.1.2.1and TETRA MS on TEDS BS – section 2.11.1.2.3could be improved by considering specific installation and/or by introducing separation distance between TEDS and TETRA. Alternatively, Collocated sites together with power control enabling on TETRA MS will significantly reduce the interfering probability.

2.11.2.4 TETRA on 50 kHz TEDS

The following frequencies list was used in SEAMCAT simulation.

Uplink	Downlink	System		Uplink	Downlink	System
410.0125	420.0125	TETRA		410.5125	420.5125	TETRA
410.0375	420.0375	TETRA		410.5375	420.5375	TETRA
410.075	420.075	50k TEDS		410.575	420.575	50k TEDS
410.1125	420.1125	TETRA		410.6125	420.6125	TETRA
410.1375	420.1375	TETRA		410.6375	420.6375	TETRA
410.175	420.175	50k TEDS		410.675	420.675	50k TEDS
410.2125	420.2125	TETRA		410.7125	420.7125	TETRA
410.2375	420.2375	TETRA		410.7375	420.7375	TETRA
410.275	420.275	50k TEDS		410.775	420.775	50k TEDS
410.3125	420.3125	TETRA		410.8125	420.8125	TETRA
410.3375	420.3375	TETRA		410.8375	420.8375	TETRA
410.375	420.375	50k TEDS		410.875	420.875	50k TEDS
410.4125	420.4125	TETRA		410.9125	420.9125	TETRA
410.4375	420.4375	TETRA		410.9375	420.9375	TETRA
410.475	420.475	50k TEDS		410.975	420.975	50k TEDS

Table 2-184 : Case 2 - Frequencies list for 50 kHz TEDS

2.11.2.4.1 TETRA BS on 50 kHz TEDS BS

The TETRA BSs transmit between 420 and 421 MHz whereas the TEDS BSs receive signals coming from MS between 410 and 411 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0.42 %
0.01	0.91 %
0.02	1.17 %
0.05	4.12 %
0.1	8.24 %

Table 2-185 : TETRA BS on 50 kHz TEDS BS

2.11.2.4.2 TETRA BS on 50 kHz TEDS mobile station

The TETRA BSs transmit between 420 and 421 MHz whereas the TEDS MS receive signals coming from BS between 420 and 421 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA BS/km²)	Interference probability
0.005	0.01 %
0.01	0.03 %
0.02	0.09 %
0.05	0.27 %
0.1	0.65 %

Table 2-186 : TETRA BS on 50 kHz TEDS mobile station

2.11.2.4.3 TETRA MS on 50 kHz TEDS BS

The TETRA MS transmit between 410 and 411 MHz whereas the TEDS BSs receive signals coming from MS between 410and 411 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0.05 %
0.05	0.22 %
0.1	0.34 %
0.2	0.91 %
0.5	2.70 %
1	5.25 %

Table 2-187 : TETRA MS on 50 kHz TEDS BS

2.11.2.4.4 TETRA mobile on 50 kHz TEDS mobile

The TETRA MS transmit between 410 and 411 MHz whereas the TEDS MS receives signals coming from BS between 420 and 421 MHz.
The table below gives the interference probability as defined within SEAMCAT and calculated for both unwanted and blocking interferences.

Interferer density (TETRA MS/km²)	Interference probability
0.01	0 %
0.05	0 %
0.1	0 %
0.2	0 %
0.5	0.01 %
1	0.01 %

Table 2-188 : TETRA MS on 50 kHz TEDS mobile station

2.11.2.4.5 Analysis

If we consider a TETRA BS density of 0.01 BS/km² and a density of 0.2 MS per square km as pointed out in section 2.2.3.3, we obtain a relatively low interference probability of TETRA BS on TEDS MS – section 2.11.1.2.2and TETRA MS on TEDS MS – section 2.11.1.2.4.

Interference probability of TETRA BS on TEDS BS – section 2.11.1.2.1and TETRA MS on TEDS BS – section 2.11.1.2.3could be improved by considering specific installation and/or by introducing separation distance between TEDS and TETRA. Alternatively, Collocated sites together with power control enabling on TETRA MS will significantly reduce the interfering probability.

2.11.3 Results summary

The following tables show the interference probability evolution as a function of the interleaving scheme and the interferer density close to realistic values defined in 2.2.3.

Interfering link : 25 kHz TEDS (0.01 BS/km² and 0.05 MS/km²)				
	Victim Receiver			
Interleaving scheme	TETRA BS	TETRA MS	TETRA BS	TETRA MS
One 2-MHz block for each system	1.27 %	0 %	0.29 %	0.01 %
250 kHz blocks over 1 MHz	1.25 %	0.01 %	0.65 %	0 %
50 kHz blocks over 1 MHz	1.28 %	0.01 %	0;81 %	0.02 %
Interfering link : 50 kHz TEDS (0.02 BS/km² and 0.05/0.1 MS/km²)				
	Victim Receiver			
Interleaving scheme	TETRA BS	TETRA MS	TETRA BS	TETRA MS
One 2-MHz block for each system	2.44 %	0.02 %	0.18 % / 0.38%	0.01 % / 0.02 %
250 kHz blocks over 1 MHz	2.62 %	0.40 %	2.24 % / 2.73 %	0.005 % / 0.01 %
50 kHz blocks over 1 MHz	2.47 %	0.86 %	3.94 % / 7.61 %	0.03 % / 0.04 %

Table 2-189: TEDS on TETRA summary

In the worst case (50 kHz TEDS MS interfering TETRA BS) interference can reach up to 5% when 50-kHz blocks are alternatively allocated to each system.

Interfering link : TETRA (0.01 BS/km² and 0.05 MS/km²)				
	Victim Receiver			
Interleaving scheme	25 kHz TEDS BS	25 kHz TEDS MS	25 kHz TEDS BS	25 kHz TEDS MS
One 2-MHz block for each system	0.75 %	0.01 %	0.01 %	0 %
250 kHz blocks over 1 MHz	0.57 %	0.01 %	0.07 %	0 %
50 kHz blocks over 1 MHz	0.73 %	0.03 %	0.28 %	0 %
Interfering link : TETRA (0.01 BS/km² and 0.05 MS/km²)				
	Victim Receiver			
Interleaving scheme	50 kHz TEDS BS	50 kHz TEDS MS	50 kHz TEDS BS	50 kHz TEDS MS
One 2-MHz block for each system	0.8 %	0.026 %	0.078 %	0 %
250 kHz blocks over 1 MHz	0.46 %	0.01 %	0.09 %	0 %
50 kHz blocks over 1 MHz	0.91 %	0.03 %	0.22 %	0 %

Table 2-190: TETRA on TEDS summary

In the worst case (TETRA BS interfering 50 kHz TETRA BS) interference can reach less than 1% when 50-kHz blocks are alternatively allocated to each system.

2.12 System Design Factors

Some system design factors (mitigation factors) that hadn't been used in the simulation should be considered in practical implementation.

a. Power Control: The power control reduces the MS transmit power when the MS is close to BS.
b. Duplexing Sites: Using Duplexer (connecting TX & Rx path via one antenna) or separated filters for TX and Rx should reduce the transmitting noise and improve the blocking attenuation at receiver port.
c. Mobile Antenna Gain: Usually, parts of the operator's MS are portable handset. Using a portable handset reduced the effective antenna gain by 8 till 14 db (including body loss) instead the 0dbd antenna gain that was taken in the simulation and MCL calculation.
d. Topographic area: Shadowing losses due to natural or man made barriers should be taken in the interfered link.
e. Intermodulation: Intermodulation effect is independent of TEDS technology. It might take place whenever victim receiver and interfering transmitter share the same or adjacent frequency band and TX combination frequencies "fall" on wanted Rx frequency.
f. Diversity: Using diversity at TEDS increases cell range by approximately 5dB, decreases sites density and interference.
g. Typical Sensitivity: usually, TEDS typical dynamic sensitivities are better than specified in ETSI standard. This leads to extend TEDS' cell range, decreases sites density and interference.

3 MILITARY APPLICATIONS

This section considers the necessary separation between TETRA Enhanced Data Services (TEDS) and Military Air/Ground/Air (AGA) in the 380-400 MHz band. Specifically this paper is aimed at:

1) Defining the necessary geographical separation if systems operate in different areas (e.g. AGA operating in one country and TEDS in a bordering country;
2) Defining the figure of necessary frequency separation if systems would operate in the same geographical area.

The study is done using the minimum coupling loss (MCL) method which provides the attenuation required between the systems to enable interference free operation under specified conditions.
Paragraphs 3.1 and 3.2 show the radio parameters taken into account; paragraphs 4 and 5 give the summary of the results of the MCL study and the conclusion. Appendix A gives the details of the calculations. Appendix B gives the full tabular results.

3.1 Minimum Coupling Loss (MCL) Study

3.1.1 MCL Principle

The Minimum Coupling Loss (MCL) method calculates the isolation required between interferer and victim to ensure that there is no interference. The method is simple to use and in principle does not require a computer for implementation.
Within the context of the study, the victim receiver is assumed to be continually operating at a minimum fixed level above reference sensitivity. The maximum permissible interference level which maintains the victim's protection ratio is calculated. A path loss formula must be chosen to determine how much isolation can be attained through physical separation. The median path loss is used and no account has been taken of fading. There is also no statistical distribution of interferers used by the method.
The calculation cumulates the two main interference mechanisms: unwanted emissions (falling into the receiver pass-band), and receiver blocking (attenuation of the interferer carrier allowed by the receiver filter).

3.1.2 Cases studied

Calculations were performed for the following cases (B=base, M=mobile, A=aircraft):

TEDS	AGA
TEDS 25 class 1	B→B, B→A
TEDS 25 class 4	B→B, B→A, M→B, M→A
TEDS 50 class 1	B→B, B→A
TEDS 50 class 4	B→B, B→A
TEDS 100 class 1	B→B, B→A
TEDS 100 class 4	B→B, B→A, M→B, M→A
TEDS 150 class 1	B→B, B→A
TEDS 150 class 4	B→B, B→A

Table 3-1: Considered cases

3.1.3 Propagation models:

For ground-ground cases, the propagation model was the Hata model for open areas (as implemented in SEAMCAT); a few simulations have also been conducted with Hata for suburban areas; for ground-air and air-ground cases, the propagation model was free space, altered to present a 1dB/km additional attenuation for distances greater than the radio horizon.

3.2 Results

The figures below show some of the results. The complete set of results is at appendix E.

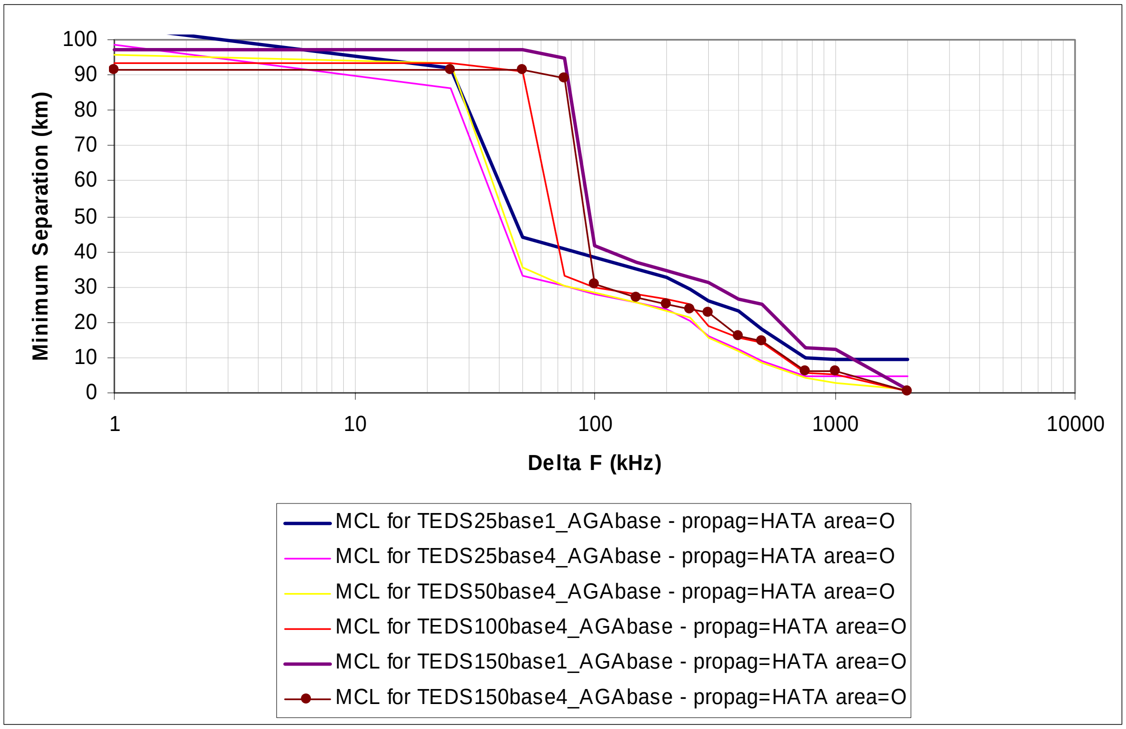

Figure 3-1: TEDS BS interfering to an AGA BS

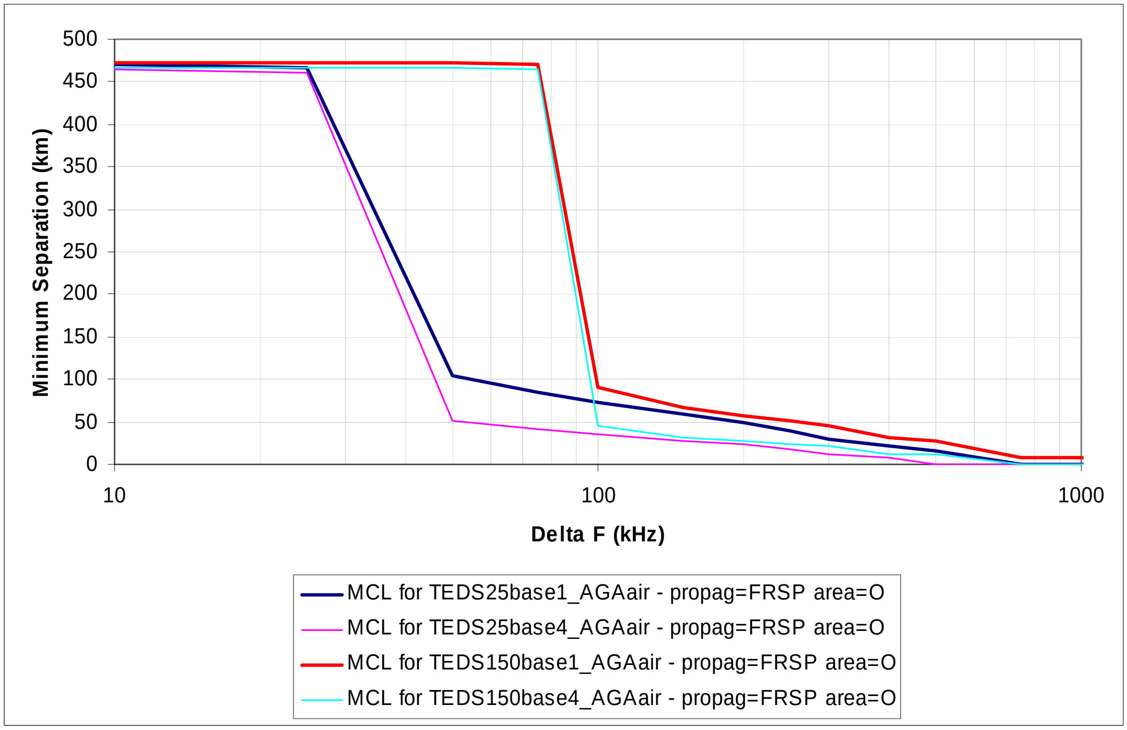

Figure 3-2: TEDS BS interfering to an AGA aircraft station

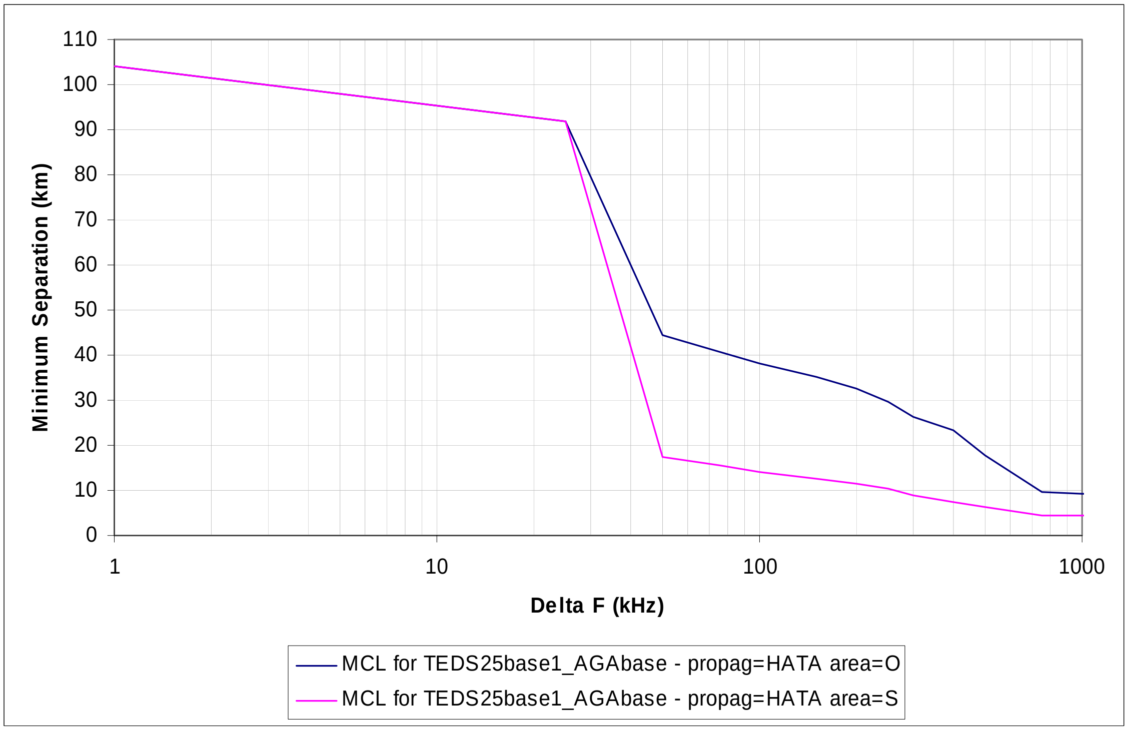

Figure 3-3: Comparison between Open area and Suburban area Hata models (see appendix E for complete results)

3.3 Conclusions

The MCL calculations above show that co-channel operation of AGA and TEDS requires a large geographical separation (in the order of 100 km ground-ground, and in the order of 460 km ground-air). With a 300 kHz frequency separation, the required separation distance (ground-air) drops under 50 km. At 2 MHz separation, the distance is below 10 km.

AGA communications occur in many European countries; they are used for military Air Traffic Control but also for Air Defense. Frequencies are assigned dynamically for each mission. Therefore, according to the MCL results, co-channel usage of AGA and TEDS in the parts of the bands 385-390 / 395-400 MHz used for AGA is considered impracticable due to the large coordination distance. Usage of TEDS in parts of these bands used for military DPMR is ruled by the results of section 2 of the report and would therefore be subject to coordination between involved countries.

Usage of TEDS in these bands in countries not using military systems could be possible, but would still require coordination in bordering areas (for any TEDS BS within 100 km of the border of a country using military systems, such as AGA in the band).

Usage of TEDS in 380-385 / 390-395 MHz bands is possible within Europe, with a guard band at the edges to protect adjacent AGA services. This guard band depends on the TEDS bandwidth, and goes up to 300 kHz for TEDS-150 kHz.

Appendix A. TEDS parameters used for calculations and simulations

TETRA Enhanced Data Services (TEDS) radio parameters have been get from the ETSI system reference document. Additional elements as dynamic sensitivity have been get form WG4.

A.1 Transmission Power

Proposed power classes are the same as EN 300 392-2 except that two lower power classes of +25dBm and +22.5dBm will be added for MS with QAM modulation.

Power class, MS	Nominal power, MS	Power class, BS	Nominal power, BS
1 (30 W)	45 dBm	1(40 W)	46 dBm
1L (17,5 W)	42,5 dBm	2 (25 W)	44 dBm
2 (10 W)	40 dBm	3 (15 W)	42 dBm
2L (5,6 W)	37,5 dBm	4 (10 W)	40 dBm
3 (3 W)	35 dBm	5 (6,3 W)	38 dBm
3L (1,8 W)	32,5 dBm	6 (4 W)	36 dBm
4 (1 W)	30 dBm	7 (2,5 W)	34 dBm
4L (0,56 W)	27,5 dBm	8 (1,6 W)	32 dBm
5 (0.32 W)	25 dBm	9 (1 W)	30 dBm
5L (0.18 W)	22.5 dBm	10 (0,6 W)	28 dBm

Table A.1: Nominal power of QAM transmitters

A.2 Transmission mask

For 25 kHz π/4-DQPSK and π/8-D8PSK modulation spectrum parameters of EN 300 392-2 [1] shall be met.
For QAM carriers the levels given in tables B.2.2, B.2.3, B.2.4 and B.2.5 shall not be exceeded at the listed frequency offsets from the nominal carrier frequency. Measurements are made in the TETRA modulation filter as defined in sub-clause 5.6 of EN 300 392-2 [1].
NOTE: For evaluation of spectrum parameters a 18kHz filter bandwidth is a good approximation to the specified filter

Frequency offset	Maximum level for MS and BS
25 kHz	-55 dBc
50 kHz	-65 dBc
75 kHz	-67 dBc

Table A.2.1: Maximum adjacent power levels for 25 kHz QAM

Frequency offset	Maximum level for MS and BS
37.5 kHz	-55 dBc
62.5 kHz	-63 dBc
87.5 kHz	-65 dBc

Table A.2.2: Maximum adjacent power levels for 50 kHz QAM

Frequency offset	Maximum level for MS and BS
62.5 kHz	-55 dBc
87.5 kHz	-60 dBc
112.5 kHz	-60 dBc

Table A.2.3: Maximum adjacent power levels for 100 kHz QAM

Frequency offset	Maximum level for MS and BS
87.5 kHz	-55 dBc
112.5 kHz	-60 dBc
137.5 kHz	-60 dBc

Table A.2.4: Maximum adjacent power levels for 150 kHz QAM

In any case, no requirement in excess of -36 dBm shall apply.

The specifications assume that the centre frequency is at the above listed frequency offsets from the nominal carrier frequency. The measured values shall be averaged over the useful part of the burst. The scrambled bits shall have a pseudo-random distribution from burst to burst.

A.3 Reception mask

The TEDS receiver will have adjacent channel performance of 40dB C/I_a for MS and 45dB C/I_a for BS in the case of π/4 -DQPSK and π/8-D8PSK. The adjacent channel performance for QAM is given in table A.3.1.

QAM Channel bandwidth	TETRA1 Interferer offset from f_0	TETRA1 Interferer level for MS	TETRA1 Interferer level for BS
25 kHz	25 kHz	-67 dBm	-62 dBm
50 kHz	37.5 kHz	-72 dBm	-67 dBm
100 kHz	62.5 kHz	-75 dBm	-70 dBm
150 kHz	87.5 kHz	-75 dBm	-70 dBm

Table A.3.1: Adjacent channel interferer frequency offsets and mean power levels for QAM

The blocking levels used are the same for QAM and π/4-DQPSK and are the levels already specified in EN 300 392-2 although frequency offsets are adjusted depending on channel bandwidth as shown in tables A.3.2 to A.3.5.

Offset from nominal Rx freq.	Level of interfering signal
50 kHz to 100 kHz	-40 dBm
100 kHz to 200 kHz	-35 dBm
200 kHz to 500 kHz	-30 dBm
> 500 kHz	-25 dBm

Table A.3.2: Blocking levels of the 25 kHz (8 sub channels) QAM receiver

Offset from nominal Rx freq.	Level of interfering signal
100 kHz to 200 kHz	-40 dBm
200 kHz to 400 kHz	-35 dBm
400 kHz to 1000 kHz	-30 dBm
> 1000 kHz	-25 dBm

Table A.3.3: Blocking levels of the 50 kHz (16 sub channels) QAM receiver

Offset from nominal Rx freq.	Level of interfering signal
200 kHz to 400kHz	-40 dBm
400 kHz to 600 kHz	-35 dBm
600 kHz to 1000 kHz	-30 dBm
> 1000 kHz	-25 dBm

Table A.3.4: Blocking levels of the 100 kHz (32 sub channels) QAM receiver

Offset from nominal Rx freq.	Level of interfering signal
300 kHz to 500 kHz	-40 dBm
500 kHz to 800 kHz	-35 dBm
800 kHz to 1000 kHz	-30 dBm
> 1000 kHz	-25 dBm

Table A.3.5: Blocking levels of the 150 kHz (48 sub channels) QAM receiver

The above blocking limits are for in-band blocking. Other PMR standards (e.g. EN 300 113, EN 300 390, EN 301 166) only specify in-band blocking however some standards such as public mobile systems (e.g. GSM, EN 300 910) also specify out-of-band blocking. Similar limits for TETRA, particularly at 800MHz, could be considered.

Intermodulation and spurious response rejection also follow levels already used in EN 300 392-2 [1].

The static reference sensitivity level shall be:

- for MS: π/4 DQPSK modulation -112 dBm;
- for MS: π/8 D8PSK modulation: -107 dBm;
- for BS: π/4 DQPSK modulation -115 dBm;
- for BS: π/8 D8PSK modulation: -110 dBm.

The dynamic reference sensitivity level shall be:

- for MS: π/4 DQPSK modulation -103 dBm;
- for MS: π/8 D8PSK modulation: -97 dBm;
- for BS: π/4 DQPSK modulation -106 dBm;
- for BS: π/8 D8PSK modulation: -100 dBm.

The minimum required static reference sensitivity performance for MS and BS in QAM modes is specified in tables A.3.6 and A.3.7.

Channel BW	Number of sub channels	Noise BW	4 QAM 3% BER Sensitivity	16 QAM 3% BER Sensitivity	64 QAM 3% BER Sensitivity
		[kHz]	[dBm]	[dBm]	[dBm]
25 kHz	8	19.2	-113	-106	-101
50 kHz	16	38.4	-110	-103	-97
100 kHz	32	76.8	-107	-100	-95
150 kHz	48	115.2	-105	-99	-93

Table A.3.6: TEDS Sensitivity levels for MS

Channel BW	Number of sub channels	Noise BW	4 QAM 3% BER Sensitivity	16 QAM 3% BER Sensitivity	64 QAM 3% BER Sensitivity
		[kHz]	[dBm]	[dBm]	[dBm]
25 kHz	8	19.2	-116	-109	-104
50 kHz	16	38.4	-113	-106	-100
100 kHz	32	76.8	-110	-103	-98
150 kHz	48	115.2	-108	-102	-96

Table A.3.7: TEDS Sensitivity levels for BS

Tables A.3.8 to A.3.10 give the dynamic sensitivity for MS and BS.

Channel BW	BS, r = 1/2	MS, r = ½
25 kHz	-111 dBm	-108 dBm
50 kHz	-108 dBm	-105 dBm
100 kHz	-105 dBm	-102 dBm
150 kHz	-104 dBm	-101 dBm

Table A.3.8: 4-QAM BS and MS dynamic reference sensitivity for frequencies below 700 MHz

Channel BW	BS, r = 1/2	MS, r = ½
25 kHz	-106 dBm	-103 dBm
50 kHz	-102 dBm	-100 dBm
100 kHz	-100 dBm	-97 dBm
150 kHz	-99 dBm	-96 dBm

Table A.3.9: 16-QAM BS and MS dynamic reference sensitivity for frequencies below 700 MHz

Channel BW	BS, r = 1/2	BS, r = 2/3	MS, r = 1/2	MS, r = 2/3
25 kHz	-101 dBm	-98 dBm	-98 dBm	-95 dBm
50 kHz	-98 dBm	-94 dBm	-95 dBm	-91 dBm
100 kHz	-95 dBm	-92 dBm	-92 dBm	-88 dBm
150 kHz	-94 dBm	-91 dBm	-91 dBm	-87 dBm

Table A.3.10: 64-QAM BS and MS dynamic reference sensitivity for frequencies below 700 MHz

A.4 Unwanted emissions

For 25 kHz π/4-DQPSK and π/8-D8PSK modulation spectrum parameters of EN 300 392-2 [1] shall be met.
These unwanted emissions are emissions (discrete, wideband noise, modulated or un-modulated) occurring at offsets of equal to, or greater than, 100 kHz from the carrier frequency, measured in the frequency range 9 kHz to 4 GHz.

a) Discrete spurious:

- the maximum allowed power for each spurious emission shall be less than -36 dBm measured in 100 kHz bandwidth in the frequency range 9 kHz to 1 GHz and -30 dBm measured in 1 MHz bandwidth in the frequency range 1 GHz to 4 GHz (1 GHz to 12,75 GHz for equipment capable of operating at frequencies above 470 MHz). Specific measurement method are required both when measuring within
$\pm f_{rb}$ of carrier frequency, due to the presence of wideband noise, and in the lower part of the spectrum.

b) Wideband noise:

- the wideband noise levels, measured through the modulation filter defined in clause 5.6 in EN 300 392-2 should not exceed the limits shown in tables A.4.1 to A.4.4, for the nominal power levels as stated, and at the listed offsets from the nominal carrier frequency. When applicable, relative measurements (dBc) shall refer to the power level measured at the nominal centre frequency as defined in 6.4.8. The requirements apply symmetrically to both sides of the transmitter band.

NOTE: For evaluation of spectrum parameters a 18 kHz filter bandwidth is a good approximation to the specified filter

Frequency offset	Maximum wideband noise level for MS and BS	
	MS nominal power level ≤ 3 W (class 3)	**MS nominal power level ≥ 5,6 W (class 2L) BS all classes**
100 kHz to 250 kHz	-70 dBc	-70 dBc
250 kHz to 500 kHz	-74 dBc	-80 dBc
500 kHz - *2500* kHz	-80 dBc	-80 dBc
2500 kHz - f_{rb} kHz	-80 dBc	-90 dBc
> f_{rb}	-95 dBc	-95 dBc
NOTE: f_{rb} denotes the frequency offset corresponding to the near edge of the receive band or 5 MHz (10 MHz for frequencies above 520 MHz) whichever is greater.		

Table A.4.1: Wideband noise limits 25 kHz QAM

Frequency offset	Maximum wideband noise level for MS and BS	
	MS nominal power level ≤ 3 W (class 3)	**MS nominal power level ≥ 5,6 W (class 2L) BS all classes**
112.5 kHz to 262.5 kHz	-68 dBc	-70 dBc
262.5 kHz to 500 kHz	-72 dBc	-75 dBc
500 kHz - f_{rb} kHz	-78 dBc	-80 dBc
> f_{rb}	-95 dBc	-95 dBc
NOTE: f_{rb} denotes the frequency offset corresponding to the near edge of the receive band or 5 MHz (10 MHz for frequencies above 520 MHz) whichever is greater.		

Table A.4.2: Wideband noise limits 50 kHz QAM

Frequency offset	Maximum wideband noise level for MS and BS	
	MS nominal power level ≤ 3 W (class 3)	**MS nominal power level ≥ 5,6 W (class 2L) BS all classes**
137.5 kHz to 287.5 kHz	-60 dBc	-70 dBc
287.5 kHz to 537.5 kHz	-65 dBc	-70 dBc
537.5 kHz - *1000* kHz	-73 dBc	-75 dBc
1000 kHz - f_{rb} kHz	-73 dBc	-80 dBc
> f_{rb}	-95 dBc	-95 dBc
NOTE: f_{rb} denotes the frequency offset corresponding to the near edge of the receive band or 5 MHz (10 MHz for frequencies above 520 MHz) whichever is greater.		

Table A.4.3: Wideband noise limits 100 kHz QAM

Frequency offset	Maximum wideband noise level for MS and BS	
	MS nominal power level ≤ 3 W (class 3)	**MS nominal power level ≥ 5,6 W (class 2L) BS all classes**
162.5 kHz to 312.5 kHz	-60 dBc	-60 dBc
312.5 kHz to 562.5 kHz	-63 dBc	-70 dBc
562.5 kHz -1500 kHz	-70 dBc	-75 dBc
1500 kHz - f_{rb} kHz	-70 dBc	-80 dBc
> f_{rb}	-95 dBc	-95 dBc
NOTE: f_{rb} denotes the frequency offset corresponding to the near edge of the receive band or 5 MHz (10 MHz for frequencies above 520 MHz) whichever is greater.		

Table A.4.4: Wideband noise limits 150 kHz QAM

All levels in tables A.4.1 to A.4.4 are expressed in dBc relative to the actual transmitted power level, and in any case no limit tighter than -55 dBm for offsets < f_{rb} or -70 dBm for offsets > f_{rb} shall apply.

Appendix B. Analogue FM, TETRA, TETRAPOL and CDMA-PAMR radio parameters used for calculations and simulations

B.1 TETRA

The ETSI standard ETS 300 392-2 has been used to obtain most of the TETRA system parameters. This standard is titled 'Radio Equipment and Systems (RES); Trans-European Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)'. Those parameters which cannot be obtained from the standard are assumed values believed to accurately model operational TETRA systems. Tables B1, B2 and B3 list all of the parameters required by the Monte Carlo simulation to model a TETRA system.

Parameter	Mobile Station	BS
Channel Spacing	25 kHz	25 kHz
Transmit Power	30 dBm, 35 dBm, 40 dBm	40 dBm
Receiver Bandwidth	18 kHz	18 kHz
Antenna Height	1.5 m	30 m
Antenna Gain	0 dBi	9 dBi (12 dBi - 3 dB)
Active Interferer Density Range	Variable	Variable
Receiver Sensitivity	- 103 dBm	- 106 dBm
Receiver Protection Ratio	19 dB	19 dB
TDMA Users / carrier	4	4
Power Control Characteristic	5 dB steps to a minimum of 15 dBm.	not used

Table B.1.1: Parameters used to model the TETRA System

Frequency Offset	30 dBm Mobile Station	35 dBm Mobile Station	40 dBm Mobile Station	40 dBm BS
25 kHz	- 30 dBm	- 25 dBm	- 20 dBm	- 20 dBm
50 kHz	- 36 dBm	- 35 dBm	- 30 dBm	- 30 dBm
75 kHz	- 36 dBm	- 35 dBm	- 30 dBm	- 30 dBm
100 - 250 kHz	- 45 dBm	- 43 dBm	- 40 dBm	- 40 dBm
250 - 500 kHz	- 50 dBm	- 48 dBm	- 45 dBm	- 45 dBm
500 kHz - f_{rb}	- 50 dBm	- 50 dBm	- 50 dBm	- 50 dBm
> f_{rb}	- 70 dBm	- 65 dBm	- 60 dBm	- 60 dBm
At frequency offsets less than 100 kHz no limit tighter than - 36 dBm shall apply At frequency offsets equal to and greater than 100 kHz no limit tighter than - 70 dBm shall apply				

Table B.1.2: Unwanted Emissions for the TETRA System (measurement bandwidth of 18 kHz)

Frequency Offset	30, 35, 40 dBm Mobile Station	40 dBm BS
50 - 100 kHz	- 40 dBm	- 40 dBm
100 - 200 kHz	- 35 dBm	- 35 dBm
200 - 500 kHz	- 30 dBm	- 30 dBm
> 500 kHz	- 25 dBm	- 25 dBm

Table B.1.3: Receiver Blocking for the TETRA System

B.2 25 kHz Analogue FM

The ETSI standards ETS 300 086 and ETS 300 113 have been used to obtain information regarding 25 kHz FM system parameters. Other parameters are assumed values believed to accurately model operational FM systems. Tables B4, B5 and B6 list all of the parameters required by the Monte Carlo simulation to model a 25 kHz FM system.

Parameter	Mobile Station	BS
Channel Spacing	25 kHz	25 kHz
Transmit Power	37 dBm	44 dBm
Receiver Bandwidth	15 kHz	15 kHz
Antenna Height	1.5 m	30 m
Antenna Gain	0 dBi	9 dBi
Active Interferer Density Range	Variable	variable
Receiver Sensitivity	- 107 dBm	- 110 dBm
Receiver Protection Ratio	17 dB	17 dB
Power Control Characteristic	Not used	not used

Table B.2.1: Parameters Assumed for 25 kHz FM Systems

Frequency Offset	Mobile Station	BS
25 kHz	- 33 dBm	- 26 dBm
100 - 250 kHz	- 53 dBm	- 46 dBm
250 - 500 kHz	- 60 dBm	- 53 dBm
500 kHz - 1 MHz	- 64 dBm	- 57 dBm
1 MHz - 10 MHz	- 69 dBm	- 62 dBm
> 10 MHz	- 71 dBm	- 64 dBm
Linear interpolation (in dB) is used between 25 kHz and 100 kHz		

Table B.2.2: Unwanted Emissions for 25 kHz FM Systems (measurement bandwidth of 18 kHz)

Frequency Offset	Mobile Station	BS
any frequency	- 23 dBm	- 23 dBm

Table B.2.3: Receiver Blocking for 25 kHz FM Systems

B.3 20 kHz Analogue FM

The ETSI standards ETS 300 086 and ETS 300 113 have been used to obtain information regarding 20 kHz FM system parameters. Other parameters are assumed values believed to accurately model operational FM systems. Tables B7, B8 and B9 list all of the parameters required by the Monte Carlo simulation to model a 20 kHz FM system.

Parameter	Mobile Station	BS
Channel Spacing	20 kHz	20 kHz
Transmit Power	37 dBm	44 dBm
Receiver Bandwidth	12 kHz	12 kHz
Antenna Height	1.5 m	30 m
Antenna Gain	0 dBi	9 dBi
Active Interferer Density Range	Variable	variable
Receiver Sensitivity	- 107 dBm	- 110 dBm
Receiver Protection Ratio	17 dB	17 dB
Power Control Characteristic	not used	not used

Table B.3.1: Parameters Assumed for 20 kHz FM Systems

Frequency Offset	Mobile Station	BS
20 kHz	- 33 dBm	- 26 dBm
100 - 250 kHz	- 53 dBm	- 46 dBm
250 - 500 kHz	- 60 dBm	- 53 dBm
500 kHz - 1 MHz	- 64 dBm	- 57 dBm
1 MHz - 10 MHz	- 69 dBm	- 62 dBm
> 10 MHz	- 71 dBm	- 64 dBm
Linear interpolation (in dB) is used between 20 kHz and 100 kHz		

Table B.3.2: Unwanted Emissions for 20 kHz FM Systems (measurement bandwidth of 12 kHz)

Frequency Offset	Mobile Station	BS
any frequency	- 23 dBm	- 23 dBm

Table B.3.3: Receiver Blocking for 20 kHz FM Systems

B.4 12.5 kHz Analogue FM

The ETSI standards ETS 300 086 and ETS 300 113 have been used to obtain information regarding 12.5 kHz FM system parameters. Other parameters are assumed values believed to accurately model operational FM systems. Tables B10, B11 and B12 list all of the parameters required by the Monte Carlo simulation to model a 12.5 kHz FM system.

Parameter	Mobile Station	BS
Channel Spacing	12.5 kHz	12.5 kHz
Transmit Power	37 dBm	44 dBm
Receiver Bandwidth	8 kHz	8 kHz
Antenna Height	1.5 m	30 m
Antenna Gain	0 dBi	9 dBi
Active Interferer Density Range	Variable	variable
Receiver Sensitivity	- 107 dBm	- 110 dBm
Receiver Protection Ratio	21 dB	21 dB
Power Control Characteristic	not used	not used

Table B.4.1: Parameters Assumed for 12.5 kHz FM Systems

Frequency Offset	Mobile Station	BS
12.5 kHz	- 23 dBm	- 16 dBm
100 – 250 kHz	- 43 dBm	- 36 dBm
250 – 500 kHz	- 60 dBm	- 53 dBm
500 kHz - 1 MHz	- 64 dBm	- 57 dBm
1 MHz – 10 MHz	- 69 dBm	- 62 dBm
> 10 MHz	- 71 dBm	- 64 dBm
Linear interpolation (in dB) is used between 12.5 kHz and 100 kHz		

Table B.4.2: Unwanted Emissions for 12.5 kHz FM Systems (measurement bandwidth of 8 kHz)

Frequency Offset	Mobile Station	BS
Any frequency	- 23 dBm	- 23 dBm

Table B.4.3: Receiver Blocking for 12.5 kHz FM Systems

B.5 TETRAPOL

TETRAPOL parameters have been obtained from the TETRAPOL's publicly available specification.

Parameter	Mobile Station	BS
Channel Spacing	10 kHz	10 kHz
Transmit Power	33 dBm	38 dBm
Receiver Bandwidth	8 kHz	8 kHz
Antenna Height	1.5 m	30 m
Antenna Gain	0 dBi	9 dBi
Receiver Sensitivity	- 111 dBm	- 113 dBm
Receiver Protection Ratio	15 dB	15 dB
Power Control Characteristic	2 dB steps to a minimum of 21 dBm.	not used

Table B.5.1: System Parameters for TETRAPOL

d.f. (kHz)	Blocking (dBm)
13.5 to 25 kHz	- 65 dBm
25 to 40 kHz	- 55 dBm
40 to 100 kHz	- 50 dBm
100 to 150 kHz	- 40 dBm
150 to 500 kHz	- 35 dBm
> 500 kHz	- 25 dBm

Table B.5.2: Receiver blocking for the TETRAPOL system (MS and BS)

Frequency offset	Mobile Station	BS
8.5 to 21 kHz	Max (p - 60, - 36)	Max (p - 60, - 36)
21 to 25 kHz	Max (p - 70, - 36)	Max (p - 70, - 36)
25 to 40 kHz	p - 70	p - 70
40 to 100 kHz	p - 75	p - 75
100 to 150 kHz	p - 85	p - 85
150 to 500 kHz	p - 90	p - 95
> 500 kHz	p - 100	p - 105
In the corresponding receiving band	- 80	-100

with p = transmit power in dBm.

Table B.5.3: Unwanted emissions for the TETRAPOL system (in 8 kHz bandwidth)

B.6 CDMA PAMR

Parameter	Mobile Station	BS
Channel Spacing	1250 kHz	1250 kHz
Transmit Power	23 dBm	40 dBm *
Receiver Bandwidth	1250 kHz	1250 kHz
Antenna Height	1.5 m	30 m
Antenna Gain	0 dBi	9 dBi
Active Interferer Density Range	Variable	variable
Receiver Static Sensitivity	- 117 dBm	- 124 dBm
Receiver Dynamic Sensitivity 75% system loading	- 107 dBm	- 113dBm
Power Control Characteristic	Used at SEAMCAT Simulation	Used at SEAMCAT Simulation

Table B.6.1: Parameters Assumed for CDMA PAMR Systems

*: Given the 40 dBm for the transmit power; the 15% control power has been used for this report resulting in 31dbm which has been used to determine the cell radius.

Frequency Offset	Mobile Station	BS
> 900 kHz	- 30 dBm	- 21 dBm

Table B.6.2: Receiver Blocking for CDMA PAMR Systems

Separation from centre frequency	Emission limit
750 kHz	-45 dBc / 30kHz
885 kHz	-60 dBc / 30kHz
1.125 to 1.98 MHz	-65 dBc / 30kHz
1.98 to 4.00 MHz	-75 dBc / 30kHz
4.00 to 6.00 MHz	-36 dBm / 100 kHz
> 6.00 MHz	-45 dBm / 100 kHz

Table B.6.3: Unwanted emission limits for base stations

Separation from centre frequency	Emission limit
885 kHz	-47 dBc / 30kHz
1.125 MHz	-54 dBc / 30kHz
1.98 MHz	-67 dBc / 30kHz
4.00 MHz	-82 dBc / 30kHz
4.00 to 10.0 MHz	-51 dBm / 100kHz

Table B.6.4: Unwanted emission limits for mobile stations

Appendix C. AGA Parameters used for calculations

References: STANAG 4205 (Minimal performance of an UHF A/G/A radio) and typical values in NATO HQ database

Frequency band	225 – 400 MHz, simplex communications (uplink and downlink on same frequency)
Antenna Gain	0 dBi
Ground TX Power	20 and 100 W
Aircraft TX Power	10 W
Ground Antenna Height	30 m
Aircraft Altitude	10000 m
Bandwidth	25 or 75 kHz (only 25 kHz used for the calculations)
RX Sensitivity	-115 dBm
Protection Ratio	14 dB

ΔF (kHz)	0	±12.5	±12.6	±100	±101
TX spectrum (dBc)	0	0	-40	-40	-60

Table C.1: AGA transmitter spectrum (25 kHz BW)

ΔF (kHz)	0	±12	±12.1	±25	±1000
Rx selectivity (dB)	0	0	-6	-60	-100

Table C.2: AGA receiver selectivity and blocking (25 kHz BW)

Appendix D. Minimum Coupling Loss Calculations

Formulas used to compute the MCL:

$$p = \sum_{f=f_1}^{f_2} \frac{dP(f - F_{src})}{Select(f - F_{vic})} df \qquad \text{and } P_{src} = 10 \log(p) + 30$$

f_1 = Min(F_{src} - 10 MHz, F_{vic} - 10 MHz)
f_2 = Max(F_{src} + 10 MHz, F_{vic} + 10 MHz)
df = frequency step (kHz)
dP = power density of the interferer (W / kHz)
Select = selectivity of the victim (linear > 1)
p = total power received after the filtering (in W)
P_{src} = total power in dBm

The total interfering signal at the victim receiver must be below the (sensitivity – protection ratio) of the victim. Therefore,

$L_{min} = P_{src} + G_{src} + G_{vict} - (S_{vic} - PR_{vic})$

L_{min} = minimum loss (dB)
G_{src} , G_{vict} = antenna gains of the interferer / victim (dBi)
S_{vic} = sensitivity level of the victim (dBm)
PR_{vic} = protection ratio of the victim (dB)

From L_{min}, the minimum separation distance may be derived by using a propagation model:

$D_{min} = Propag^{-1}(L_{min}, Freq, H_{src}, H_{vic}, area)$

Freq = frequency (MHz)
H_{src} , H_{vict} = antenna heights of the interferer / victim (m)
area = type of area for the propagation model (urban, suburban, rural)
Propag = propagation model, $Propag^{-1}$ = inverse function of the propagation

Appendix E. Tabular Results for Military applications

The tables below show the complete set of MCL calculations. The columns present the following data:

df: Separation between the two centre frequencies (kHz)

intf: Intermediate result; total power received by the victim in dBm, taking into account the transmitter mask and the receiver selectivity ("p" in the formula of appendix D); used as a quick validity check: the very first value of each case gives the total power of the interferer (minus the bandwidth ratio if the interferer is wider than the victim; the difference between the first and the last values gives the receiver selectivity at this frequency offset).

lmin: Minimum propagation loss necessary to get the required protection, in dB

dmin: Minimum separation distance in km, derived from lmin using the given propagation model

I: Intermediate result; used as a validity check: signal level received from the interferer at distance dmin (= $P_{src} + G_{src} + G_{vict} - L(dmin)$)

MCL for TEDS25base1_AGAbase - propag=HATA
Pint=40 W (46.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=1.482 integrated pwr=40.000 W)
Hvic=30.0 m Gvic=0.0 dBi BwInt/BwVic=0.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km) Open area	dmin (km) Suburban
1	45.7	183.7	-128.61	104.02	104.02
25	32.2	170.2	-115.22	91.72	91.72
50	-13.2	124.8	-69.76	44.3	17.23
75	-14.9	123.1	-68.08	40.86	15.44
100	-16.2	121.8	-66.74	38.19	14.15
150	-17.9	120.1	-65.08	35.13	12.69
200	-19.4	118.6	-63.53	32.62	11.47
250	-21.3	116.7	-61.73	29.62	10.19
300	-23.5	114.5	-59.52	26.27	8.82
400	-25.8	112.2	-57.2	23.2	7.58
500	-28.5	109.5	-54.42	17.82	6.32
750	-33.8	104.2	-49.17	9.72	4.48
1000	-34.2	103.8	-48.75	9.26	4.36
2000	-34.2	103.8	-48.75	9.26	4.36

MCL for TEDS25base4_AGAbase – propag=HATA
Pint=10 W (40.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.371 integrated pwr=10.000 W)
Hvic=30.0 m Gvic=0.0 dBi BwInt/BwVic=0.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km) Open area	dmin (km) Suburban
1	39.6	177.6	-128.6	98.46	98.46
25	26.2	164.2	-115.18	86.2	86.2
50	-19.2	118.8	-69.84	32.97	11.68
75	-20.9	117.1	-68.09	30.12	10.42
100	-22.2	115.8	-66.75	28.17	9.55
150	-24	114	-65.02	25.58	8.53
200	-25.4	112.6	-63.59	23.67	7.77
250	-27.3	110.7	-61.69	20.54	6.86
300	-29.5	108.5	-59.46	15.93	5.93
400	-31.8	106.2	-57.2	12.26	5.11
500	-34.6	103.4	-54.48	8.91	4.28
750	-39.8	98.2	-49.13	4.86	3.02
1000	-40.2	97.8	-48.75	4.63	2.94
2000	-40.2	97.8	-48.74	4.63	2.94

MCL for TEDS50base1_AGAbase - propag=HATA
Pint=40 W (46.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.769 integrated pwr=40.000 W)
Hvic=30.0 m Gvic=0.0 dBi BwInt/BwVic=3.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km) Open area	dmin (km) Suburban
1	42.9	180.9	-125.82	101.44	101.44
25	40.2	178.2	-123.14	98.97	98.97
50	-11.7	126.3	-71.37	47.64	19.14
75	-14.8	123.2	-68.17	40.92	15.53
100	-16.1	121.9	-66.82	38.41	14.22
150	-18.1	119.9	-64.92	34.76	12.56
200	-19.7	118.3	-63.35	32.24	11.33
250	-21	117	-61.92	29.99	10.32
300	-23.7	114.3	-59.21	25.95	8.64
400	-26.2	111.8	-56.72	22.67	7.35
500	-29.1	108.9	-53.89	16.73	6.1
750	-34.6	103.4	-48.47	8.91	4.28
1000	-37.9	100.1	-45.15	6.1	3.45
2000	-49.9	88.1	-33.03	1.52	1.52

MCL for TEDS50base4_AGAbase – propag=HATA
Pint=10 W (40.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.192 integrated pwr=10.000 W)
Hvic=30.0 m Gvic=0.0 dBi BwInt/BwVic=3.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km) Open area	dmin (km) Suburban
1	36.9	174.9	-125.84	95.92	95.92
25	34.2	172.2	-123.15	93.47	93.47
50	-17.7	120.3	-71.33	35.59	12.88
75	-20.8	117.2	-68.17	30.29	10.47
100	-22.2	115.8	-66.84	28.21	9.6
150	-24.1	113.9	-64.86	25.42	8.44
200	-25.7	112.3	-63.29	23.33	7.62
250	-27.1	110.9	-61.92	21.13	6.96
300	-29.8	108.2	-59.22	15.49	5.84
400	-32.2	105.8	-56.78	11.65	4.98
500	-35.1	102.9	-53.88	8.37	4.12
750	-40.6	97.4	-48.41	4.46	2.88
1000	-43.9	94.1	-45.09	3.05	2.32
2000	-56	82	-33.03	0.76	0.76

MCL for TEDS100base1_AGAbase - propag=HATA
Pint=40 W (46.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.392 integrated pwr=40.000 W)
Hvic=30.0 m Gvic=0.0 dBi BwInt/BwVic=6.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km) Open area	dmin (km) Suburban
1	39.9	177.9	-122.93	98.79	98.79
25	39.9	177.9	-122.93	98.79	98.79
50	37.3	175.3	-120.29	96.35	96.35
75	-13.1	124.9	-69.84	44.37	17.32
100	-15.2	122.8	-67.83	40.17	15.19
150	-16.5	121.5	-66.47	37.78	13.9
200	-17.5	120.5	-65.5	35.94	13.04
250	-18.3	119.7	-64.72	34.57	12.39
300	-22	116	-60.98	28.52	9.71
400	-23.6	114.4	-59.38	26.13	8.74
500	-24.5	113.5	-58.54	24.97	8.27
750	-32.7	105.3	-50.33	11.06	4.84
1000	-33.1	104.9	-49.87	10.51	4.7
2000	-51.5	86.5	-31.5	1.27	1.27

MCL for TEDS100base4_AGAbase – propag=HATA
Pint=10 W (40.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.098 integrated pwr=10.000 W)
Hvic=30.0 m Gvic=0.0 dBi BwInt/BwVic=6.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km) Open area	dmin (km) Suburban
1	33.9	171.9	-122.92	93.26	93.26
25	33.9	171.9	-122.92	93.26	93.26
50	31.2	169.2	-120.21	90.78	90.78
75	-19.1	118.9	-69.86	33.01	11.7
100	-21.2	116.8	-67.77	29.66	10.21
150	-22.5	115.5	-66.52	27.8	9.41
200	-23.5	114.5	-65.51	26.32	8.8
250	-24.3	113.7	-64.66	25.18	8.33
300	-28	110	-60.98	18.92	6.55
400	-29.7	108.3	-59.31	15.66	5.87
500	-30.5	107.5	-58.54	14.27	5.58
750	-38.7	99.3	-50.29	5.53	3.26
1000	-39.2	98.8	-49.82	5.25	3.16
2000	-57.5	80.5	-31.5	0.64	0.64

MCL for TEDS150base1_AGAbase - propag=HATA
Pint=40 W (46.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.263 integrated pwr=40.128 W)
Hvic=30.0 m Gvic=0.0 dBi BwInt/BwVic=7.8 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km) Open area	dmin (km) Suburban
1	38.2	176.2	-121.19	97.19	97.19
25	38.2	176.2	-121.19	97.19	97.19
50	38.2	176.2	-121.19	97.19	97.19
75	35.5	173.5	-118.48	94.7	94.7
100	-14.3	123.7	-68.68	41.82	16.06
150	-17	121	-66.03	36.74	13.5
200	-18.2	119.8	-64.74	34.61	12.41
250	-19.3	118.7	-63.69	32.83	11.59
300	-20.1	117.9	-62.88	31.44	10.99
400	-23.4	114.6	-59.59	26.47	8.86
500	-24.2	113.8	-58.8	25.35	8.42
750	-31.5	106.5	-51.45	12.7	5.21
1000	-31.7	106.3	-51.26	12.32	5.14
2000	-52.1	85.9	-30.89	1.18	1.18

MCL for TEDS150base4_AGAbase – propag=HATA
Pint=10 W (40.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.066 integrated pwr=10.032 W)
Hvic=30.0 m Gvic=0.0 dBi BwInt/BwVic=7.8 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km) Open area	dmin (km) Suburban
1	32.2	170.2	-121.17	91.65	91.65
25	32.2	170.2	-121.17	91.65	91.65
50	32.2	170.2	-121.17	91.65	91.65
75	29.5	167.5	-118.5	89.22	89.22
100	-20.4	117.6	-68.64	30.99	10.8
150	-23	115	-66.03	27	9.11
200	-24.3	113.7	-64.74	25.21	8.37
250	-25.3	112.7	-63.75	23.92	7.85
300	-26.1	111.9	-62.96	22.81	7.45
400	-29.4	108.6	-59.59	16.13	5.98
500	-30.2	107.8	-58.75	14.72	5.66
750	-37.5	100.5	-51.46	6.35	3.51
1000	-37.8	100.2	-51.24	6.16	3.47
2000	-58.1	79.9	-30.89	0.59	0.59

MCL for TEDS25base1_AGAair - propag=FRSP
Pint=40 W (46.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=1.482 integrated pwr=40.000 W)
Hvic=10000.0 m Gvic=0.0 dBi BwInt/BwVic=0.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km)
1	45.7	183.7	-128.63	480.47
25	32.2	170.2	-115.17	467.25
50	-13.2	124.8	-69.81	104.06
75	-14.9	123.1	-68.08	85.1
100	-16.2	121.8	-66.76	72.9
150	-17.9	120.1	-65.03	59.52
200	-19.4	118.6	-63.55	49.91
250	-21.3	116.7	-61.69	39.86
300	-23.5	114.5	-59.49	30.26
400	-25.8	112.2	-57.21	22.4
500	-28.5	109.5	-54.44	14.77
750	-33.8	104.2	-49.39	0
1000	-34.2	103.8	-49.39	0
2000	-34.2	103.8	-49.39	0

MCL for TEDS25base4_AGAair – propag=FRSP
Pint=10 W (40.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.371 integrated pwr=10.000 W)
Hvic=10000.0 m Gvic=0.0 dBi BwInt/BwVic=0.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km)
1	39.6	177.6	-128.66	474.58
25	26.2	164.2	-115.25	461.42
50	-19.2	118.8	-69.81	51.31
75	-20.9	117.1	-68.08	41.67
100	-22.2	115.8	-66.76	35.41
150	-24	114	-65.03	28.48
200	-25.4	112.6	-63.55	23.41
250	-27.3	110.7	-61.69	17.96
300	-29.5	108.5	-59.49	12.42
400	-31.8	106.2	-57.21	7.13
500	-34.6	103.4	-55.42	0
750	-39.8	98.2	-55.42	0
1000	-40.2	97.8	-55.42	0
2000	-40.2	97.8	-55.42	0

MCL for TEDS50base1_AGAair - propag=FRSP
Pint=40 W (46.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.769 integrated pwr=40.000 W)
Hvic=10000.0 m Gvic=0.0 dBi BwInt/BwVic=3.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km)
1	42.9	180.9	-125.82	477.71
25	40.2	178.2	-123.19	475.13
50	-11.7	126.3	-71.32	124.06
75	-14.8	123.2	-68.16	85.93
100	-16.1	121.9	-66.84	73.6
150	-18.1	119.9	-64.87	58.41
200	-19.7	118.3	-63.31	48.5
250	-21	117	-61.94	41.07
300	-23.7	114.3	-59.24	29.33
400	-26.2	111.8	-56.77	21.06
500	-29.1	108.9	-53.89	13.44
750	-34.6	103.4	-49.39	0
1000	-37.9	100.1	-49.39	0
2000	-49.9	88.1	-49.39	0

MCL for TEDS50base4_AGAair – propag=FRSP
Pint=10 W (40.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.192 integrated pwr=10.000 W)
Hvic=10000.0 m Gvic=0.0 dBi BwInt/BwVic=3.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km)
1	36.9	174.9	-125.81	471.78
25	34.2	172.2	-123.21	469.23
50	-17.7	120.3	-71.32	61.42
75	-20.8	117.2	-68.16	42.09
100	-22.2	115.8	-66.84	35.78
150	-24.1	113.9	-64.87	27.9
200	-25.7	112.3	-63.31	22.66
250	-27.1	110.9	-61.94	18.63
300	-29.8	108.2	-59.24	11.85
400	-32.2	105.8	-56.77	6.02
500	-35.1	102.9	-55.42	0
750	-40.6	97.4	-55.42	0
1000	-43.9	94.1	-55.42	0
2000	-56	82	-55.42	0

MCL for TEDS100base1_AGAair - propag=FRSP
Pint=40 W (46.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.392 integrated pwr=40.000 W)
Hvic=10000.0 m Gvic=0.0 dBi BwInt/BwVic=6.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km)
1	39.9	177.9	-122.88	474.83
25	39.9	177.9	-122.88	474.83
50	37.3	175.3	-120.24	472.22
75	-13.1	124.9	-69.85	104.61
100	-15.2	122.8	-67.8	82.34
150	-16.5	121.5	-66.52	70.94
200	-17.5	120.5	-65.49	62.8
250	-18.3	119.7	-64.69	57.14
300	-22	116	-60.98	36.51
400	-23.6	114.4	-59.34	29.69
500	-24.5	113.5	-58.53	26.74
750	-32.7	105.3	-50.29	4.78
1000	-33.1	104.9	-49.85	3.31
2000	-51.5	86.5	-49.39	0

MCL for TEDS100base4_AGAair – propag=FRSP
Pint=10 W (40.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.098 integrated pwr=10.000 W)
Hvic=10000.0 m Gvic=0.0 dBi BwInt/BwVic=6.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km)
1	33.9	171.9	-122.92	468.95
25	33.9	171.9	-122.92	468.95
50	31.2	169.2	-120.25	466.33
75	-19.1	118.9	-69.85	51.59
100	-21.2	116.8	-67.8	40.25
150	-22.5	115.5	-66.52	34.4
200	-23.5	114.5	-65.49	30.19
250	-24.3	113.7	-64.69	27.23
300	-28	110	-60.98	16.08
400	-29.7	108.3	-59.34	12.08
500	-30.5	107.5	-58.53	10.21
750	-38.7	99.3	-55.42	0
1000	-39.2	98.8	-55.42	0
2000	-57.5	80.5	-55.42	0

MCL for TEDS150base1_AGAair - propag=FRSP
Pint=40 W (46.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.263 integrated pwr=40.128 W)
Hvic=10000.0 m Gvic=0.0 dBi BwInt/BwVic=7.8 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km)
1	38.2	176.2	-121.21	473.18
25	38.2	176.2	-121.21	473.18
50	38.2	176.2	-121.21	473.18
75	35.5	173.5	-118.54	470.56
100	-14.3	123.7	-68.64	90.81
150	-17	121	-65.99	66.65
200	-18.2	119.8	-64.73	57.45
250	-19.3	118.7	-63.71	50.87
300	-20.1	117.9	-62.91	46.2
400	-23.4	114.6	-59.6	30.69
500	-24.2	113.8	-58.8	27.7
750	-31.5	106.5	-51.49	7.86
1000	-31.7	106.3	-51.23	7.24
2000	-52.1	85.9	-49.39	0

MCL for TEDS150base4_AGAair – propag=FRSP
Pint=10 W (40.0 dBm) Hint=30.0 m Gint=9.0 dBi
(pwr/kHz=0.066 integrated pwr=10.032 W)
Hvic=10000.0 m Gvic=0.0 dBi BwInt/BwVic=7.8 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km)
1	32.2	170.2	-121.25	467.31
25	32.2	170.2	-121.25	467.31
50	32.2	170.2	-121.25	467.31
75	29.5	167.5	-118.54	464.65
100	-20.4	117.6	-68.64	44.58
150	-23	115	-65.99	32.19
200	-24.3	113.7	-64.73	27.39
250	-25.3	112.7	-63.71	23.92
300	-26.1	111.9	-62.91	21.43
400	-29.4	108.6	-59.6	12.69
500	-30.2	107.8	-58.8	10.83
750	-37.5	100.5	-55.42	0
1000	-37.8	100.2	-55.42	0
2000	-58.1	79.9	-55.42	0

MCL for TEDS50mob1_AGAbase - propag=HATA
Pint=30 W (44.8 dBm) Hint=1.5 m Gint=0.0 dBi
(pwr/kHz=0.577 integrated pwr=30.000 W)
Hvic=30.0 m Gvic=0.0 dBi BwInt/BwVic=3.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km) Open area	dmin (km) Suburban
1	41.6	170.6	-125.84	76.22	45
25	38.9	167.9	-123.13	73.76	39.51
50	-12.9	116.1	-71.34	4.96	1.58
75	-16.1	112.9	-68.13	4.02	1.28
100	-17.4	111.6	-66.8	3.69	1.17
150	-19.4	109.6	-64.89	3.26	1.03
200	-20.9	108.1	-63.31	2.93	0.93
250	-22.3	106.7	-61.95	2.69	0.85
300	-25	104	-59.25	2.25	0.71
400	-27.5	101.5	-56.81	1.91	0.61
500	-30.3	98.7	-53.86	1.58	0.5
750	-35.8	93.2	-48.44	1.11	0.35
1000	-39.1	89.9	-45.11	0.89	0.28
2000	-51.2	77.8	-33.02	0.41	0.13

MCL for TEDS50mob4_AGAbase – propag=HATA
Pint=1 W (30.0 dBm) Hint=1.5 m Gint=0.0 dBi
(pwr/kHz=0.019 integrated pwr=1.000 W)
Hvic=30.0 m Gvic=0.0 dBi BwInt/BwVic=3.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km) Open area	dmin (km) Suburban
1	26.9	155.9	-125.84	51.15	20.96
25	24.2	153.2	-123.21	45.27	17.81
50	-27.7	101.3	-71.32	1.89	0.6
75	-30.8	98.2	-68.12	1.53	0.49
100	-32.2	96.8	-66.83	1.41	0.45
150	-34.1	94.9	-64.87	1.24	0.39
200	-35.7	93.3	-63.3	1.12	0.35
250	-37.1	91.9	-61.93	1.02	0.32
300	-39.8	89.2	-59.23	0.86	0.27
400	-42.2	86.8	-56.79	0.73	0.23
500	-45.1	83.9	-53.88	0.6	0.19
750	-50.6	78.4	-48.39	0.42	0.13
1000	-53.9	75.1	-45.16	0.34	0.11
2000	-66	63	-33.02	0.08	0.05

MCL for TEDS150mob1_AGAbase - propag=HATA
Pint=30 W (44.8 dBm) Hint=1.5 m Gint=0.0 dBi
(pwr/kHz=0.198 integrated pwr=30.096 W)
Hvic=30.0 m Gvic=0.0 dBi BwInt/BwVic=7.8 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km) Open area	dmin (km) Suburban
1	37	166	-121.16	72.04	35.83
25	37	166	-121.16	72.04	35.83
50	37	166	-121.16	72.04	35.83
75	34.3	163.3	-118.51	69.65	31.33
100	-15.6	113.4	-68.66	4.15	1.32
150	-18.2	110.8	-65.99	3.5	1.11
200	-19.5	109.5	-64.76	3.23	1.03
250	-20.5	108.5	-63.71	3.01	0.96
300	-21.3	107.7	-62.9	2.86	0.91
400	-24.6	104.4	-59.63	2.31	0.73
500	-25.4	103.6	-58.83	2.19	0.7
750	-32.7	96.3	-51.5	1.36	0.43
1000	-33	96	-51.22	1.33	0.42
2000	-53.3	75.7	-30.86	0.35	0.11

MCL for TEDS150mob4_AGAbase – propag=HATA
Pint=1 W (30.0 dBm) Hint=1.5 m Gint=0.0 dBi
(pwr/kHz=0.007 integrated pwr=1.003 W)
Hvic=30.0 m Gvic=0.0 dBi BwInt/BwVic=7.8 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km) Open area	dmin (km) Suburban
1	22.2	151.2	-121.16	41.21	15.58
25	22.2	151.2	-121.16	41.21	15.58
50	22.2	151.2	-121.16	41.21	15.58
75	19.5	148.5	-118.48	36.03	13.08
100	-30.4	98.6	-68.59	1.58	0.5
150	-33	96	-65.97	1.33	0.42
200	-34.3	94.7	-64.75	1.23	0.39
250	-35.3	93.7	-63.67	1.15	0.36
300	-36.1	92.9	-62.96	1.09	0.35
400	-39.4	89.6	-59.59	0.88	0.28
500	-40.2	88.8	-58.81	0.83	0.26
750	-47.5	81.5	-51.51	0.52	0.16
1000	-47.8	81.2	-51.24	0.51	0.16
2000	-68.1	60.9	-30.87	0.06	0.05

MCL for TEDS50mob1_AGAair - propag=FRSP
Pint=30 W (44.8 dBm) Hint=1.5 m Gint=0.0 dBi
(pwr/kHz=0.577 integrated pwr=30.000 W)
Hvic=10000.0 m Gvic=0.0 dBi BwInt/BwVic=3.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km)
1	41.6	170.6	-125.89	450.5
25	38.9	167.9	-123.15	447.81
50	-12.9	116.1	-71.32	36.91
75	-16.1	112.9	-68.16	24.63
100	-17.4	111.6	-66.84	20.52
150	-19.4	109.6	-64.87	15.21
200	-20.9	108.1	-63.31	11.47
250	-22.3	106.7	-61.94	8.29
300	-25	104	-59.67	0
400	-27.5	101.5	-59.67	0
500	-30.3	98.7	-59.67	0
750	-35.8	93.2	-59.67	0
1000	-39.1	89.9	-59.67	0
2000	-51.2	77.8	-59.67	0

MCL for TEDS50mob4_AGAair – propag=FRSP
Pint=1 W (30.0 dBm) Hint=1.5 m Gint=0.0 dBi
(pwr/kHz=0.019 integrated pwr=1.000 W)
Hvic=10000.0 m Gvic=0.0 dBi BwInt/BwVic=3.0 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km)
1	26.9	155.9	-125.85	435.98
25	24.2	153.2	-123.17	433.35
50	-27.7	101.3	-74.44	0
75	-30.8	98.2	-74.44	0
100	-32.2	96.8	-74.44	0
150	-34.1	94.9	-74.44	0
200	-35.7	93.3	-74.44	0
250	-37.1	91.9	-74.44	0
300	-39.8	89.2	-74.44	0
400	-42.2	86.8	-74.44	0
500	-45.1	83.9	-74.44	0
750	-50.6	78.4	-74.44	0
1000	-53.9	75.1	-74.44	0
2000	-66	63	-74.44	0

MCL for TEDS150mob1_AGAair - propag=FRSP
Pint=30 W (44.8 dBm) Hint=1.5 m Gint=0.0 dBi
(pwr/kHz=0.198 integrated pwr=30.096 W)
Hvic=10000.0 m Gvic=0.0 dBi BwInt/BwVic=7.8 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km)
1	37	166	-121.17	445.87
25	37	166	-121.17	445.87
50	37	166	-121.17	445.87
75	34.3	163.3	-118.57	443.32
100	-15.6	113.4	-68.64	26.23
150	-18.2	110.8	-65.99	18.14
200	-19.5	109.5	-64.73	14.87
250	-20.5	108.5	-63.71	12.4
300	-21.3	107.7	-62.91	10.53
400	-24.6	104.4	-59.67	0
500	-25.4	103.6	-59.67	0
750	-32.7	96.3	-59.67	0
1000	-33	96	-59.67	0
2000	-53.3	75.7	-59.67	0

MCL for TEDS150mob4_AGAair - propag=FRSP
Pint=1 W (30.0 dBm) Hint=1.5 m Gint=0.0 dBi
(pwr/kHz=0.007 integrated pwr=1.003 W)
Hvic=10000.0 m Gvic=0.0 dBi BwInt/BwVic=7.8 dB

df (kHz)	intf (dBm)	lmin (dB)	I (dBm)	dmin (km)
1	22.2	151.2	-121.2	431.42
25	22.2	151.2	-121.2	431.42
50	22.2	151.2	-121.2	431.42
75	19.5	148.5	-118.56	428.83
100	-30.4	98.6	-74.44	0
150	-33	96	-74.44	0
200	-34.3	94.7	-74.44	0
250	-35.3	93.7	-74.44	0
300	-36.1	92.9	-74.44	0
400	-39.4	89.6	-74.44	0
500	-40.2	88.8	-74.44	0
750	-47.5	81.5	-74.44	0
1000	-47.8	81.2	-74.44	0
2000	-68.1	60.9	-74.44	0