European Radiocommunications Committee (ERC) within the
European Conference of Postal and Telecommunications Administrations (CEPT)

FREQUENCY SHARING BETWEEN UMTS AND EXISTING FIXED SERVICES

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1 INTRODUCTION

This report addresses co-frequency sharing and compatibility issues surrounding the implementation of UMTS, given the operation of existing fixed service systems in some European countries in the bands identified in ERC Decision DEC (97) 07 on UMTS.

The report examines the geographical separation distances that may be required between UMTS stations and fixed services.

2 FIXED LINK DEPLOYMENT AND PARAMETERS

The ERO Study on UMTS [1] contains details of the current fixed link deployment within the UMTS bands in Europe. Most countries have some fixed links in operation at present in the bands identified for UMTS, many having several hundred transmitters.

Fixed links in the UMTS bands are deployed mainly in accordance with ITU-R Rec. F.382 and F.283 channel plans. The sharing parameters of typical 2GHz fixed links can be found in ITU-R Recommendation F.759.

The key fixed link parameters required for the co-frequency sharing studies are listed in Table 1.

Results of the ERO Survey on existing use of the 2 GHz band are shown in Annex A.

3 UMTS SHARING PARAMETERS

The key UMTS radio system parameters required for the frequency sharing studies are shown in Table 2 below.

At the current time (July 1998) the UMTS radio parameters are not yet fully defined within ETSI. However, in liaison with ETSI SMG2 (see Doc ERC TG1 (97) 66), some example values have been derived for the key parameters which are relevant to co-channel frequency sharing and it is therefore possible to undertake some preliminary example calculations.

4 MODEL FOR STUDY OF FREQUENCY SHARING

4.1 Propagation model

The standard model agreed in the ITU and CEPT for terrestrial interference assessment at microwave frequencies is ITU-R Recommendation P.452-8. It is therefore proposed that this model is used in the assessment of interference potential between UMTS and fixed links using MCL methods.

For Monte Carlo simulations the “WG-SE” (Hata based) model developed in CEPT is recommended.

4.2 Interference calculation model

There are two basic approaches to calculating the interference potential between systems that have been used in previous CEPT ERC WG-SE work, namely minimum coupling loss (MCL) and the Monte Carlo statistical method.

The former model is simpler to implement, but is conservative and can give more pessimistic results than are obtained in reality in cases where some of the input parameters in practice have a probability associated with

them. CEPT ERC WG-SE is in the process of developing a software implementation of the Monte Carlo model (via a MoU between interested parties), however this may not be available until Summer 1999.

For the purposes of this ERC Report the MCL method is adopted in order to carry out a first assessment in short timescales. It is considered that the MCL method is sufficient for examining co-frequency sharing between fixed links and base stations (a relatively static situation), whereas this approach is slightly pessimistic in the case of fixed links vs mobiles. However, it is not envisaged that a Monte Carlo analysis would give very different results from the MCL approach in the specific co-channel sharing situation covered by this Report.

5 CO-CHANNEL FREQUENCY SHARING ANALYSES

5.1 Sharing combinations

There are four interference modes that need to be considered :

UMTS Mobile transmitter → Fixed Link Receiver
UMTS Base transmitter → Fixed Link Receiver
Fixed link transmitter → UMTS Mobile Receiver
Fixed link transmitter → UMTS Base Station Receiver

The various fixed link equipment types and UMTS environments need to be considered in order to get a view of the scale of the typical co-channel frequency sharing problem between UMTS and co-channel fixed links.

Although these studies apply to co-channel interference problems, the same method could be applied to adjacent band compatibility issues. In this case the receiver blocking performance and the transmitter out of band emissions need to be taken into account.

5.2 Example results

Example 1 : UMTS Base station transmitter → Fixed Link Receiver

Figure 1 shows the results of long-term (20% time) interference calculations around an example 2 GHz fixed link in the United Kingdom from a single multichannel UMTS wide-area coverage base station. Similar calculations done for propagation conditions at shorter time percentages (e.g. 0.01%) and the example fixed link sharing criterion for that time percentage are shown in Figure 2.

The sharing parameters used in this example study are listed below.

UMTS Base Tx (W-CDMA)		**Fixed link receiver** (960cct FM FDM)	
Carrier Frequency	2 .15 GHz	Antenna gain and radiation pattern	35 dBi (measured RPE)
Location	Trial located every 0.25 sq km	Feeder and multiplexer losses	3 dB
Ground height	(Database)	Antenna height a.g.l.	48m
Antenna height	20m agl	3dB IF bandwidth (and preferably Rx filter mask)	29 MHz
Antenna pointing	Towards FS	Nominal Rx input level	N/A
3dB channel bandwidth	4.1 MHz		
Power into antenna	11 dBW	Maximum permissible interference power density	-141 dBW/MHz (20% of time)
Antenna gain	14.5 dBi	(long and short-term time %)	-111 dBW/ MHz (0.01 % time)
Channeling and frequency re-use plan	Single multi-channel BS		

The shaded areas on the plot represent locations where, if a UMTS base station is located, the interference level at the fixed service receiver is predicted to exceed the sharing criterion. Additional contours are included to illustrate the improvement in the sharing situation if additional losses were available (e.g. Frequency Offset Rejection for adjacent channel sharing, additional losses due to clutter and site shielding etc.).

In this particular example it can be seen that the potential interference zones extend to many 10s of km, particularly along the fixed link receiver antenna boresight.

Example 2 : Fixed link transmitter → UMTS base station receiver

Figure 3 shows the results of long-term (20% time) interference calculations around an example 2 GHz fixed link transmitter in the United Kingdom into a UMTS wide-area coverage base station receiver. The short term interference requirements of the UMTS receivers are unspecified (as is normally the case with such mobile systems) and so this has not been evaluated.

The sharing parameters used in this example study are listed below.

UMTS BS receiver (W-CDMA)		**Fixed link transmitter** (960 cct FM FDM)	
Carrier Frequency	1.95 GHz	Antenna gain and radiation pattern	35 dBi (measured RPE)
Location	Trial located every 0.25 sq km	Feeder and multiplexer losses	3 dB
Ground height	(Database)	Antenna height a.g.l.	48m
Antenna height	20m agl	Ground height	(Database)
Antenna pointing	Towards FS	Transmitter power (in UMTS receiver bandwidth)	0 dBW
3dB channel bandwidth	4.1 MHz		
Maximum permissible interference power density	-133 dBW (20% of time)		
Antenna gain	14.5 dBi		

The shaded areas on the plot represent locations where, if a UMTS base station receiver is located, the interference level from the fixed service transmitter is predicted to exceed the sharing criterion. Additional contours are included to illustrate the improvement in the sharing situation if additional losses were available

(e.g. Frequency Offset Rejection for adjacent channel sharing, additional losses due to clutter and site shielding etc.).

6 DISCUSSION AND CONCLUSION

The sharing situation between UMTS and existing fixed services will depend on the exact operational parameters of the UMTS and fixed service systems as well as factors such as the terrain features at the particular geographical location under consideration. The UMTS sharing parameters are not yet fully defined, particularly those parameters needed to assess adjacent band compatibility.

It is therefore not possible to give definitive results on the separation/coordination distances required between these systems. However, the methods described above and the results of example studies can provide guidance to administrations planning deployment or coordination of UMTS with existing fixed services.

7 REFERENCE

1. ERO report on UMTS
European Radio Office, Copenhagen, September 1996

Table 1: Fixed link sharing parameters

Transmitter	Receiver
Centre Frequency	Antenna gain and radiation pattern
Modulation & Capacity	Feeder and multiplexer losses
3dB Bandwidth	Antenna height a.g.l.
Antenna gain and radiation pattern	3dB IF bandwidth
Feeder and multiplexer losses	Nominal Rx input level
Antenna height a.g.l.	Maximum permissible interference power density (long and short-term time %)
Tx output power	
Polarization	
Transmitter mask	Frequency offset attenuation

Table 2: UMTS Parameters for frequency sharing

Base / Mobile Tx	Base / Mobile Rx
Carrier Frequency	Centre Freq.
Location or density	Location or density
Ground height	Ground height
Antenna height	Antenna height
Antenna pointing and radiation pattern	Antenna pointing and radiation pattern
3dB channel bandwidth	3dB channel bandwidth
Power into antenna	Noise figure
Antenna gain	Sensitivity
Channeling and frequency re-use plan	Intrasystem C/Ic

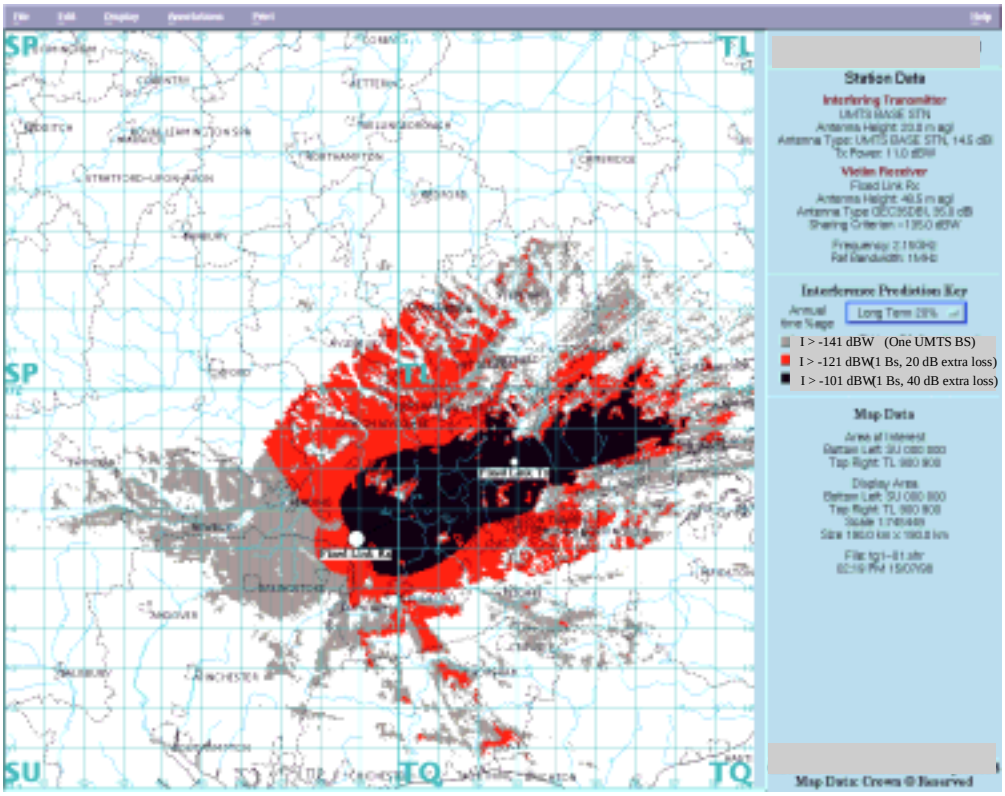

Figure 1 : Example Sharing Study (UMTS BS Tx into FS Rx) –Long term interference

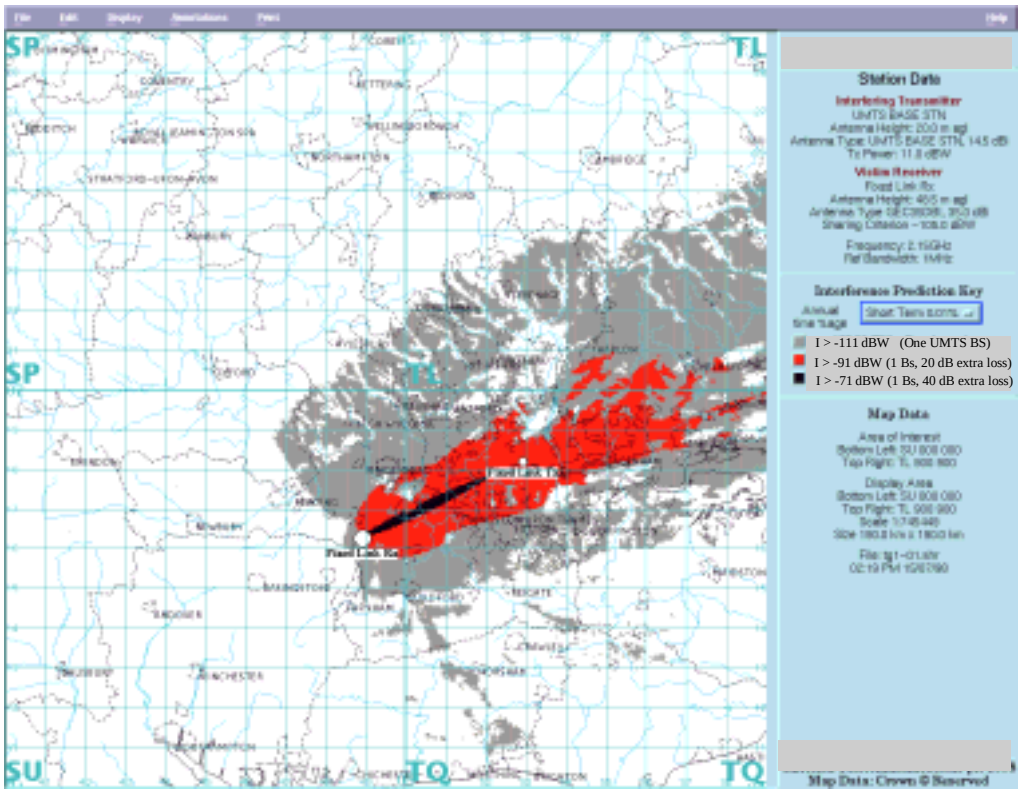

Figure 2 : Example Sharing Study (UMTS BS Tx into FS Rx) –Short term interference

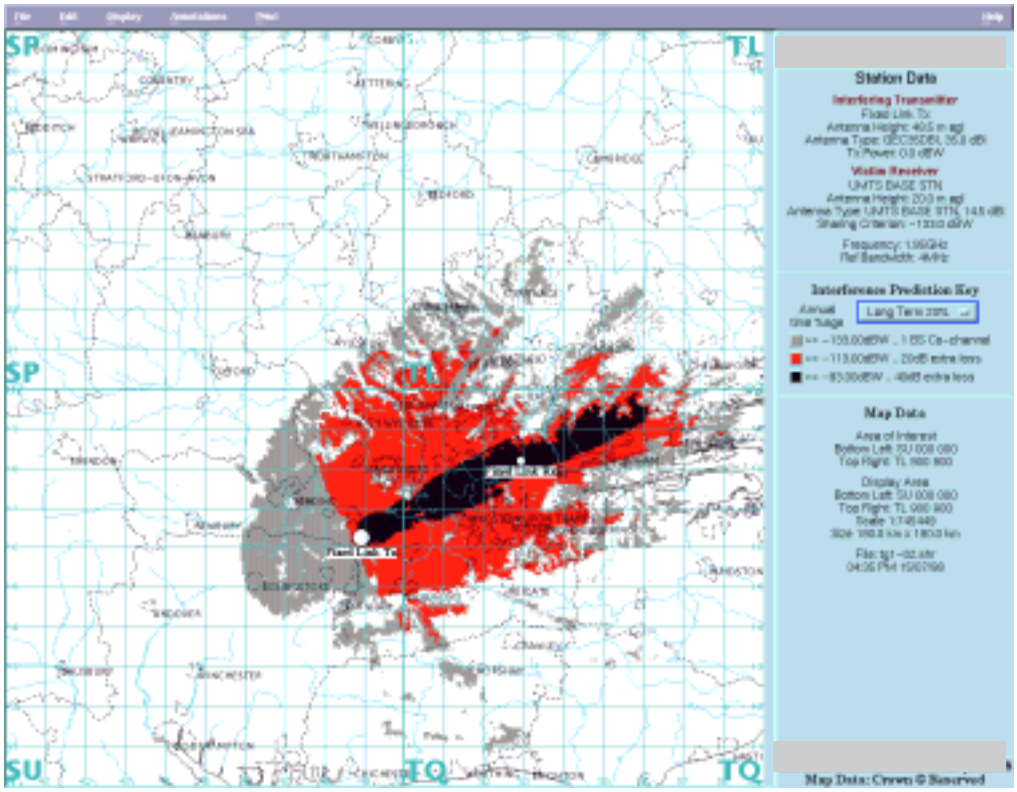

Figure 3 : Example Sharing Study (FS Tx into BS Rx) –Long term interference

ANNEX A : Existing Services in the Frequency Bands designated for UMTS in accordance with the ERC Decision (97)07 (January 1998)

Country	Frequency range 1900 - 1980 MHz			Frequency range 2010-2025 MHz			Frequency range 2110-2170 MHz		
	Y2002	Y2005	> Y2005	Y2002	Y2005	> Y2005	Y2002	Y2005	> Y2005
Austria	1920-1980 40 links R- 382	Free		2012-2025 10 links R-382	Free		2120-2170 10 ENG-OB	Free	
Belgium	Free			Free			Fixed Service		
Cyprus	Free			Free			Fixed service - 2130 MHz		
Denmark	Free			Free			Free		
Estonia	Fixed Service 10 links (35 dBW)								
Spain	Fixed Service 350 High Capacity links			Fixed Service 150 High Capacity links			Fixed Service 450 High Capacity links		
Finland	Fixed Service 1919.5-1975.5 197 links 2*8 Mbit/s			Free			Free		
France	No info			No info			No info		
Germany	Free			2020-2025 Tactical Radio Relay			Free		
Iceland	Fixed Service 30 links (ITU-R F 283)			Fixed Service 4 links (ITU-R F 283)			Fixed Service 54 links (ITU-R F 283)		
Italy	Fixed links (BC distribution) 600 links			Fixed links (BC distribution) 100 links			Fixed links (BC distribution) 400 links		
Latvia	Fixed Service 1930-1980 ITU-R 382	Free		Fixed Service 2010-2025 ITU-R 382	Free		Fixed Service 2110-2170 ITU-R 382	Free	
Luxembourg	Military use			Military use			Military use		
Poland	Fixed Service 1900-1980 Military / 1900-1960 Civil 22 analogue links			Fixed Service 2015-2025 Civil 1 analogue link 1985-2015 Military (Altimeter)			2120-2170 Military Radiolocation		
Portugal	Fixed Service 35 links 9 analogue links 16links 8Mbit/s - 19 links 34 Mbit/s			Fixed Service 5 links 1 analogue link 4 links 34 Mbit/s			Fixed Service 17 links 7 analogue links 10 links 34 Mbit/s		
Slovak Republic	ENG 1900-2000 2 links (28 MHz 30dBm) Military Fixed Mobile			ENG 2016.5 1 link (28 MHz 30dBm) Military Fixed/Mobile			MVDS 2100-2300 MHz Military Fixed		
Sweden	Military use 150 links 3.5/14 MHz channels			Military use 150 links 3.5/14 MHz channels			Military use 100 links 3.5/7 MHz channels		
Turkey	Rural Telephone 50 links (34 Mbit/s)			Rural Telephone 7 links (34 Mbit/s)			Rural Telephone 1 link (34 Mbit/s)		
United Kingdom	Fixed Service 13 Analogue TROPO FMTV,QPSK,FMFDM			Fixed Service 14 Analogue TROPO FMTV,QPSK,FMFDM			Fixed Service 24 Analogue TROPO FMTV,QPSK,FMFDM		