Recommendation T/R 20-08 E (Lecce 1989 CR))

FREQUENCY PLANNING AND FREQUENCY COORDINATION FOR THE GSM SYSTEM

Recommendation proposed by Working Group T/WG 15 "Radio Administration, Regulation and Frequency Management" (RARF)

Text of the Recommendation adopted by the "Telecommunications" Commission:

"The European Conference of Postal and Telecommunications Administrations,

considering

a) that the GSM system will use the frequency bands 890-915 MHz/935-960 MHz in accordance with relevant agreements, directives and CEPT Recommendations,

b) that in the implementation of the GSM system it is necessary to take account of national policies for the use of the frequency bands in question,

c) that national frequency planning for the GSM system is carried out by the operators and approved by the Radioregulatory Administrations or carried out by such Administrations in cooperation with the operators,

d) that frequency planning in border areas will be based on coordination between Radioregulatory Administrations.

noting

a) that in many CEPT member countries multiple operators for the GSM system are expected,

b) that frequency coordination procedure and interservice sharing is necessary both between countries operating the GSM system and between those countries and countries operating other services in accordance with the Radio Regulations,

recommends

1. That frequency coordination in border areas is based on the following concept:

1. 1. Preferential frequencies or preferential frequency bands shall be agreed between Administrations concerned. Preferential frequencies may be used without coordination with a neighbouring country if the fieldstrengili of each carrier produced by the base station does not exceed a value of 19 dBµV/m for digital systems and 19 dBµV/m for analogue systems at a height of 3 m above ground at a distance of 15 km inside the neighbouring country.
When blocks of preferential frequencies are allocated to different countries in border areas one Rf channel in each end of the blocks shall be treated as non-preferential frequencies, in order to take account of adjacent channel interference.

1.2. All other frequencies are subject to coordination between Administrations if the interfering fieldstrength produced by the base station exceeds 19 dBµV/m at a height of 3 m above ground at the border line between two countries.

1.3. Frequency planning in coastal areas is based on the concept of preferential frequencies and coordinated frequencies assuming a middleline between the countries involved. Other principles for frequency planning and frequency coordination in coastal areas may be agreed between the Administrations concerned.

1.4. Propagation criteria for calculating the interfering fieldstrength is described in Annex 1.

1.5. For adding multiple interferers the simplified algorithm described in Annex 2 can be used.

2. That the technical parameters described in Annex 3 is used in the frequency coordination for the GSM system.

3. That the technical parameters described in Annex 4 is used for frequency coordination between the GSM system and existing fixed services in the frequency bands 890-915 MHz/935-960 MHz.

4. That the following frequency coordination procedure is used:

4.1. When requesting coordination the relevant characteristics of the base station shall be forwarded using the coordination form indicated in Recommendation T/R 25-08 E. Administrations may diverge from the use of this form by common agreement but at least the following characteristics should be forwarded to the Administration affected:

a) frequency in MHz
b) name of transmitter station
c) country of location of transmitter station
d) geographical coordinates
e) effective antenna height
f) antenna polarisation
g) antenna azimuth
h) directivity in antenna systems
i) effective radiated power
j) expected coverage zone
k) date of entry into service.

4.2. The Administration affected shall evaluate the request for coordination and shall within 30 days notify the result of the evaluation to the Administration requesting coordination.

4.3. If in the course of the coordination procedure the Administration affected requires additional information, it may request such information.

4.4. If no reply is received by the Administration requesting coordination within 30 days it may send a reminder to the Administration affected. An Administration not having responded within 30 days following communication of the reminder shall be deemed to have given its consent and the frequency may be put into use with the characteristics given in the request for coordination.

4.5. The periods mentioned above may be extended by common consent.

5. In general Administrations may diverge from the technical parameters and procedures described in this Recommendation subject to bilateral agreements."

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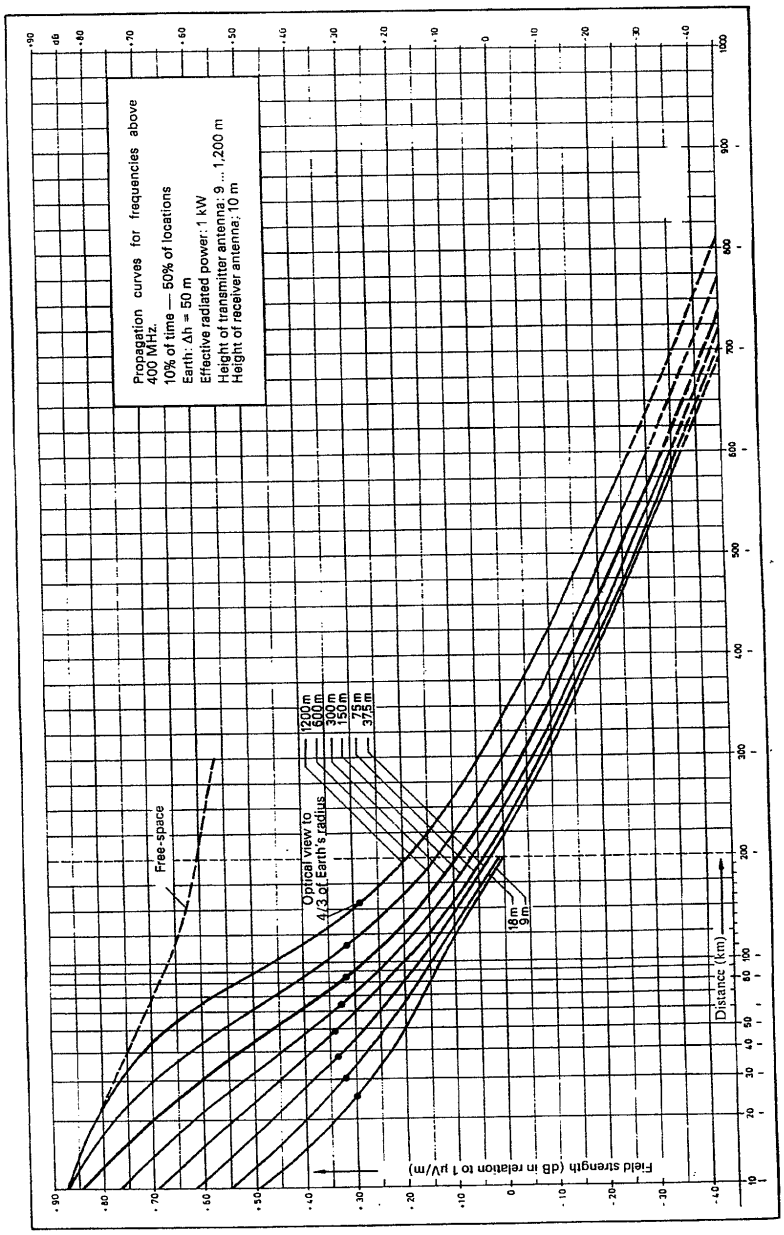
Annex 1

PROPAGATION CURVES FOR FREQUENCIES ABOVE 400 MHz (400-960 MHz)



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Propagation curves

The curves attached to this Annex should be used to determine the interfering fieldstrength. Administrations may agree on other curves, e.g. the latest version of CCIR Report 567.

Correction factors

A general correction factor of -2 dB is used in the 900 MHz band.
Correction factor for receiving antenna from 10 m to 3 m:
Distance < 50 km: - 10 dB
Distance > 100 km: - 3 dB
Linear interpolation is used for intermediate distances.
For sea path propagation the correction factor for receiving antenna from 10 m to 3 in is 10 dB.

Effective antenna height

The effective antenna height used to determine interfering fieldstrength is the difference between the physical height of the antenna and the average height of the terrain. The evaluation of the average height of the terrain may be subject to agreement between Administrations.

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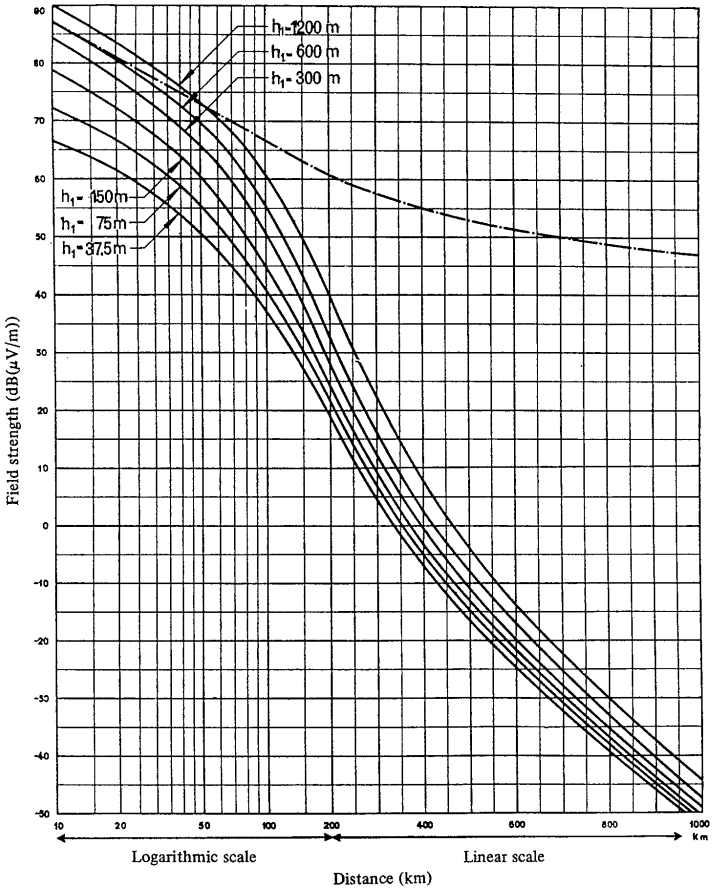

Field strength (dB (μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1000 MHz (Bands IV and V) – Cold sea – 10% of the time – 50% of the locations – h_2 = 10 m

— · — Free space

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Annex 2

1. SIMPLIFIED ALGORITHM FOR FREQUENCY COORDINATION

1. 1. Notation

P = e.i.r.p. of wanted transmitter in direction of receiver (dBm).
L = Isotropic path loss from wanted transmitter to receiver (dB).
P_i = c.i.r.p. of interfering transmitter i in directiou of receiver (dBm).
1_i = Isotropic path loss from interfering transmitter i to receiver (dB).
a = Receiver antenna gain towards wanted transmitter (dBi).
a_i = Receiver antenna gain towards interfering transmitter i (dBi).
β_i = Gain due to receiver filter selectivity on interference from transmitter i (dB).
γ = Estimated shadowing margin to be allowed on C/I value (dB).
C = Total wanted carrier power at receiver input (dBm).
I_i = Effective interfering power due to transmitter i at receiver input (allowing for the effect of receiver filtering) (dBm).
I = Total effective interfering power at receiver input (allowing for shadowing margin) (dBm).
λ =.C/1 threshold value.

1.2 Base-mobile Path Algorithm

(a) For each cell in question, take one or more "worst case" mobile station MS locations. These are locations at which the C/I is known, or believed to be, lowest.
(b) Calculate the wanted carrier power at the receiver input:
$C = P - L + a$
(c) Calculate the effective interfering power due to each potentially interfering transmitter (whether co-channel or adjacent channel) at the receiver input (allowing for the effect of receiver filtering): $I_i = P_i - L_i + a_i + \beta_i$
(d) Sum the interfering powers at the receiver and allow for the shadowing margin:
$I = 10 \log_{10} \Sigma\ 10^{(Ii/10)} + \gamma$
(e) Cheek the effective C/I ratio (C -I) against the threshold value λ.

1.3 Mobile-base Path Algorithm

(a) Take each cell that has a potentially interfering mobile station (MS). If N is the number of carrier frequencies allocated to that cell that can cause potential interference to the base station (BS), assume there are N MS's, one radiating each carrier, in that cell.
A proportion of the total number of MS's so identified (e.g. 20%) should be assumed to be the worst case locations of their cells and the rest at the mid-point of their cells.
Alternatively a "Monte Carlo" simulation can be undertaken in which a number of "snapshots" of the interference scenario are taken. In each snapshot, the interfering MS's are placed at random locations (uniformly distributed) within their cells. To find for example the 90% C/I value. 100 snapshots could be taken, and the C/I which is exceeded by 90 of the snapshots used.
(b) Perform steps (b) to (e) of the base-mobile path algorithm.

1.4 Notes on Calculation of Parameters

(a) P, P_i—These should be supplied by the public land mobile network (PLMN) operators. For GSM transmitters. each P, P_i is the power in the active part of the timeslot.
(b) L, L_i —These can either be calculated using appropriate terrain modelling, or some simplified power distance law, e.g. $d^{-3.3}$.
(c) a, a_i—These should be supplied by the PLMN operators.
(d) β_i—These can be read off Figure A2-1 (T/R 20-08).

(e) If shadowing effects have been allowed for in the calculation of L and L_i, Υ can be set to 0. Otherwise a value of 7 dB could be used (this assumes the wanted and unwanted signals each have a 5 dB shadowing margin (log normal distribution) and the composite shadowing margin is $\sqrt{2}$ x 5 dB, i.e. 7 d B).

(f) χ can be taken as follows:

GSM receiver	= 9 dB
TACS receiver:	= 18 dB
NMT —900 receiver:	= 20 dB

Note. The calculation must take into account all inteflering transmitters from the wanted PLMN as well as those from the neighbouring PLMN's.

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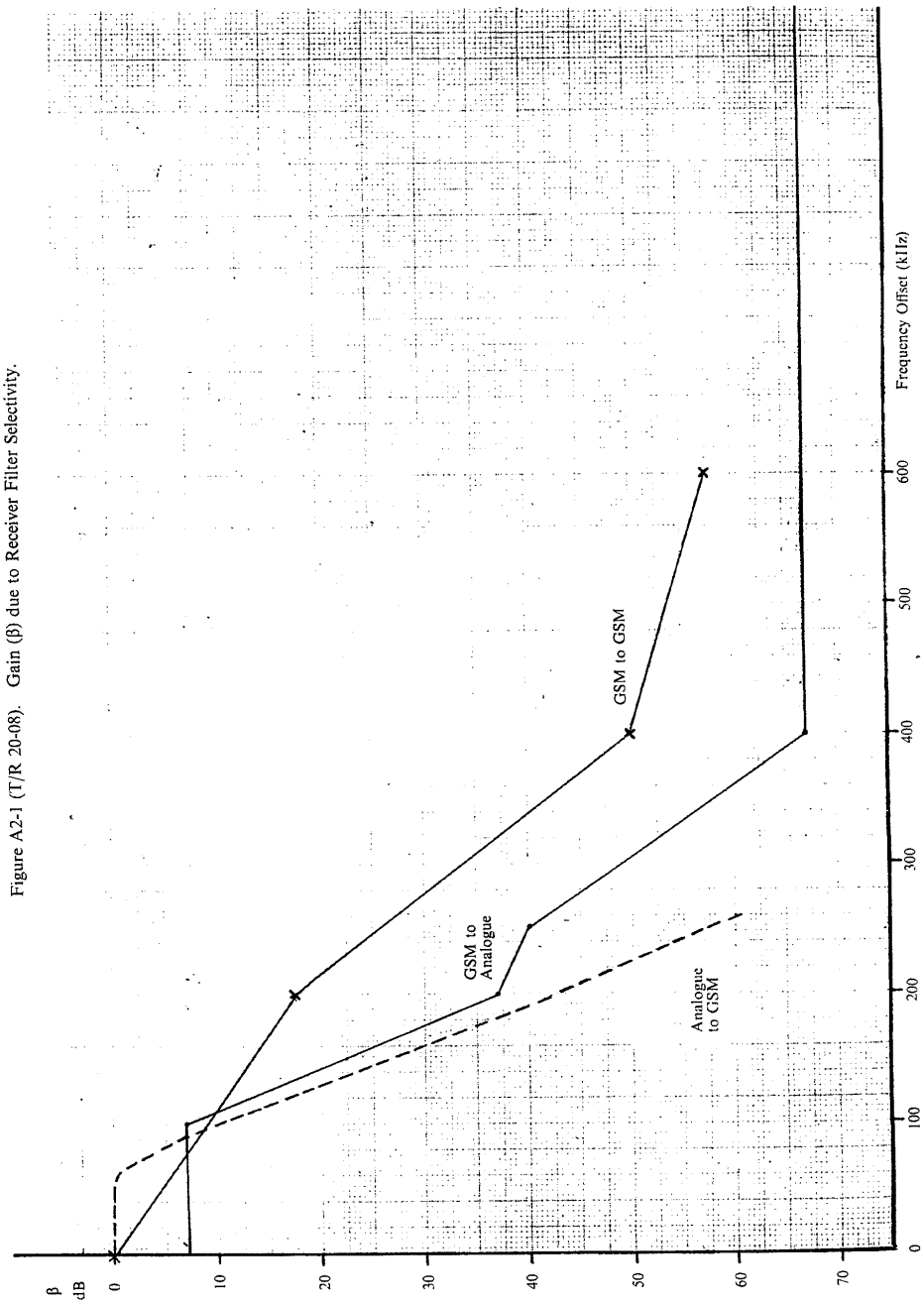

Figure A2-1 (T/R 20-08). Gain (β) due to Receiver Filter Selectivity.

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Annex 3

TECHNICAL PARAMETERS NECESSARY FOR COORDINATION OF THE GSM SERVICE AND ANALOGUE MOBILE SERVICES

C/I ratios

The C/I ratio is the ratio between wanted signal power to interfering signal power at the receiver input during the active part of the GSM timeslot including multiple interferes.

The following C/I ratios apply:

Wanted	Interferer	Co-channel	200 kHz,	400 kHz
GSM	GSM	9 (1)	— 9 (1)	—41 (1)
TACS	GSM	11 (2)	—19(4)	—49 (5)
GSM	TACS	9 (6)	—33 (7)	—5l (9)
GSM	NMT	9 (6)	—33 (7)	—61 (8)
NMT	GSM	10 (3)	—20(4)	—50 (5)

Curves indicating C/I values for intermediate values of frequency offset are attached to this Annex.

Notes.
(1) Values from GSM Recommendation 05-05.
(2) TACS filter (25 kHz) attenuates energy from GSM transmission by 7 dB. C/I at detector requires therefore 11 dB at receiver input.
(3) NMT filter (12 kHz) attenuates energy from GSM transmission by 10 dB. C/I of 20 dB at detector requires therefore 10 dB at receiver input.
(4) 30 dB below co-channel figure, see GSM Recommendation 05-05.
(5) 60 dB below co-channel figure, see GSM Recommendation 05-05.
(6) All TACS energy falls in GSM filter. GSM requires 9 dB C/I.
(7) Assumed GMS filter gives 42 dB attenuation relative to co-channel at 200 kHz.
(8) NMT noise floor (beyond 25 kHz) is —70 dBc/16 kHz.
(9) TACS noise floor (beyond 50 kHz) is —60 dBc.

Minimum fieldstrength to be protected (Emin) for mobile stations:
(50% of location —50% of time in the mobile receive band)
GSM 32 dBµ/ m
NMT 32 dBµ /m
TACS 32 dBµ /m

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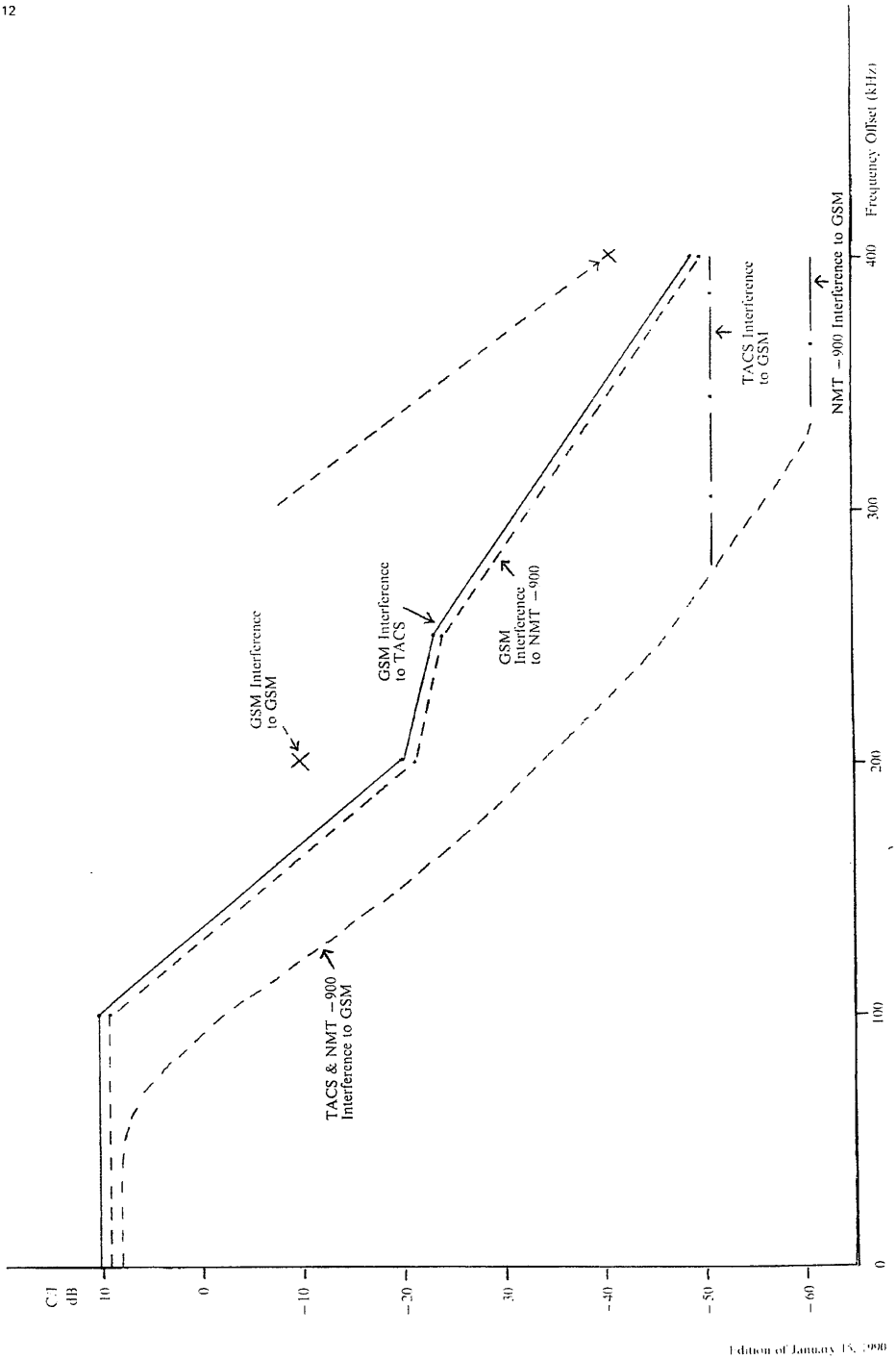

Figure A3-1 (T/R 20-08). Adjacent channel C/I curves.

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Annex 4

TECHNICAL PARAMETERS FOR FREQUENCY COORDINATION BETWEEN THE GSM SYSTEM AND EXISTING FIXED SERVICES IN THE FREQUENCY BANDS 890-915 MHz/935-960 MHz

The following C/I ratios apply:

Wanted	Interferer	Co-channel	200 kHz	400 kHz
GSM	Fixed	9dB	—33 dB	—51 dB
Fixed	GSM	subject to bilateral agreement		