資料４－６－１

マルチメディア調査検討会作業部会 TG1 活動報告

2009 年 01 月 26 日

マルチメディア調査検討会作業部会 TG1

１．会議開催

平成 20 年 10 月 27 日　第 1 回マルチメディア調査検討会作業部会 TG1 開催

平成 20 年 11 月 26 日　第 2 回マルチメディア調査検討会作業部会 TG1 開催

平成 21 年 01 月 19 日　第 3 回マルチメディア調査検討会作業部会 TG1 開催

２．活動概要

・ 第 1 回 TG1

以下の当 TG 所掌事項を確認、推奨技術方式(ISDB-Tmm)の基本的な技術資料の作成については方式提案元であるマルチメディア放送企画 LLC（合）（以下、mmbi）に依頼し、その他について TG1 の検討対象とすることを確認した。

- 推奨技術方式(ISDB-Tmm)の基本的な技術資料の作成
- 同技術方式間および同技術方式隣接間の共用条件の検討
- 隣接する他技術方式との共用条件の検討
- 隣接する他の放送・通信システムの調査および共用条件の検討
- 共用条件検討のための実験計画書の作成
- 共用条件に関する実験の実施

・ 第 2 回 TG1

推奨技術方式(ISDB-Tmm)の基本的な技術資料（mmbi 作成）の内容について確認した。

報告すべき事項について整理し、室内実験によるもの、シミュレーションによるもの、過去の答申から引用するものを確認した。

室内実験項目（所要 CN、及び、隣接所要 DU）の実験方法について審議し、試作機や測定器等の必要機材の手配方法を検討した。新しいサービスであるマルチメディア放送に適した所要 CN、所要 DU の評価方法の確立が課題であり、周辺動向を踏まえ継続検討することとした。

マルチメディア放送システム間、及び、隣接業務間の共用検討に必要なネットワークモデル等の前提条件について、KDDI／ソフトバンク／mmbi にて協議し策定することとした。尚、本件については TG2 と連携して進めることとしている。

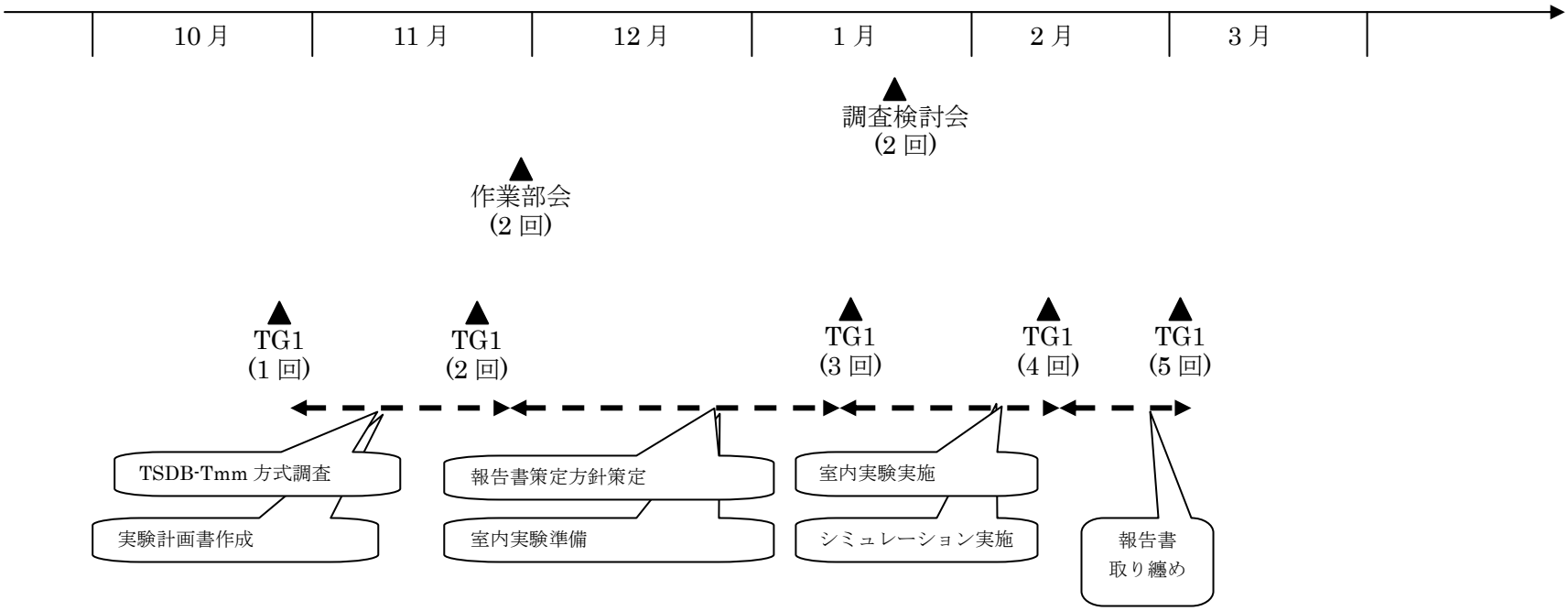
・ 第 3 回 TG1

所要 CN、所要 DU の評価方法について、ITU 等周辺状況を踏まえて審議した結果、SFP（Subjective failure point）を基本とすることとし、実験計画書を作成した。

また、マルチメディア放送システム間の共用条件を検討するためのネットワークモデル策定、所要ガードバンドを求めるための DU 分布のシミュレーションを行うこととした。

３．今後のスケジュール

2 月中旬を目処に、室内実験結果のとりまとめを行う。その結果、及び、シミュレーション結果を踏まえて、2 月末を目処に、報告書案を策定するスケジュールとする。



[添付資料]
別添: マルチメディア放送の置局に関する技術的条件として報告事項と検討方針（第 3 回 TG1 資料 TG 1-3-1 抜粋）
参考: Rec_ITU-R_BT1368-7E（抜粋）

以上

別添

マルチメディア放送の置局に関する技術的条件として報告事項と検討方針

2009年01月26日
mm調査検討会 作業部会 Task Group 1

報告事項

1. 検討周波数帯
2. 所要電界強度と放送区域の定義
3. 共用条件
   - ① マルチメディア放送システム間
     - A) 混信保護比
     - B) 所要ガードバンド
   - ② 隣接する他の放送通信システム間
     - A) 222MHz以上の隣接業務システムとの共用条件
     - B) 202.5MHz以下の隣接業務システムとの共用条件

2．所要電界強度と放送区域の定義

携帯端末向けマルチメディア放送として標準とする受信条件とサービス品質を定義し、それぞれについて以下の回線設計の各項目についての検討結果を報告する。

	項目	記号	単位	移動受信			携帯受信(屋外)			携帯受信(屋内)参考		
1	周波数		MHz		215			215			215	
2	変調方式											
3	符号化率											
4	所要CN	C/N	dB									
5	装置劣化		dB									
6	干渉マージン		dB									
7	マルチパスマージン		dB									
8	瞬時フェージングマージン		dB									
9	受信機所要CN	C/N	dB									
10	雑音指数	NF	dB									
11	雑音帯域幅(1セグメント)	B	kHz									
12	受信雑音電力	Nr	dBm									
13	外来雑音電力	No	dBm									
14	全受信雑音電力	NT	dBm									
15	受信機入力終端電圧	Vin	dBμV									
16	受信アンテナ利得	Gr	dB									
17	アンテナ実行長	λ/π	dB									
18	フィーダー損失	L	dB									
19	最小電界強度	Emin	dBμV/m									
20	時間率補正	T%	dB									
21	場所率補正	L%	dB									
22	壁の通過損		dB									
23	所要電界強度(h=1.5m)	E1.5	dBμV/m									
24	低アンテナ高損(4m→1.5m)		dB									
25	所要電界強度(h=4m)	E4	dBμV/m									
26	Nセグメント換算	E4	dBμV/m									

所要CN基準について

- 所要CN基準は、従来のQEF（ビタビ後2×10^{-4}）ではなく、SFP（Subjective failure point）とする。
  - The SFP method corresponds to the picture quality where no more than one error is visible in the picture for an average observation time of 20. （平均して20秒に1回以下のエラーが検知できる品質）
  - ITU Rec. BT 1368-7 (VHF/UHF帯地上テレビのプランニング基準)のうち、モバイルサービスの所要CN基準として採用されている（参考1)。
  - 上記では、SFPに対応する客観評価手法として5%ESR（Erroneous Second Ratio）を用い、 TU6（Typical Urban6波モデル）における所要CNをモバイルサービスの所要CNとして記載されている。
    - 5%ESRとは、20秒間のうち１つ以上のエラーを含む秒が高々１つである状態
  - そこで、携帯端末向けマルチメディア放送サービス（リアルタイムストリーミング）として標準的な品質の映像（200kbps)を対象とした5%ESRを所要CN基準とし、室内実験により求めることとした。

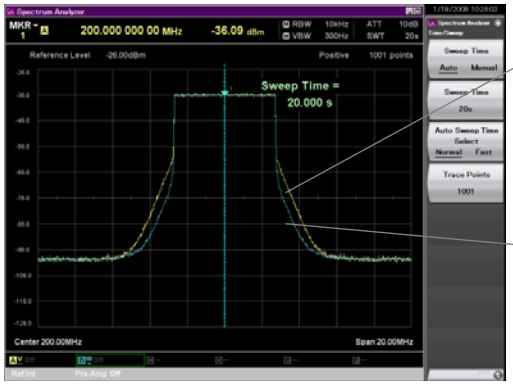
３－①　マルチメディア放送システム間の共用条件

以下の希望波、妨害波の組み合わせにおける混信保護比と、所要ガードバンドについて報告する。

	希望波	妨害波	周波数差	混信保護比
1	ISDB-Tmm 1セグメント形式	ISDB-Tmm	隣接	
2	ISDB-Tmm 13セグメント形式	ISDB-Tmm	隣接	
3	ISDB-Tmm 1セグメント形式	MFLO	隣接	
4	ISDB-Tmm 13セグメント形式	MFLO	隣接	
5	ISDB-Tmm 1/13セグメント形式	ISDB-Tmm 1/13セグメント形式	同一	

所要DU基準について

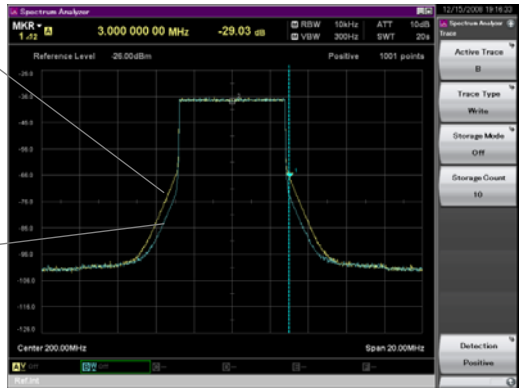
- 所要CN基準と同様に、所要DU基準は、従来のQEF（ビタビ後 2×10^{-4}）ではなく、SFP（Subjective failure point）とする。
  - 携帯端末向けマルチメディア放送サービス（リアルタイムストリーミング）として標準的な品質の映像（200kbps)を対象とした5%ESRを所要DU基準とし、室内実験により求めることとした。
  - 尚、与干渉波スペクトラム波形は、ARIB　STD-B31記載のマスク相当と、現時点の実現性を考慮して検討中のスペクトラムマスクの2通りについて測定する。



MFLO

STD B31
相当

検討中



ISDB-Tmm

所要ガードバンドについて

- 所要ガードバンドについて
  - 認定計画制度の場合、隣接するマルチメディア放送システム間で、局位置やその規模等のネットワーク諸元が異なることが想定される。そこで、典型的なネットワークモデルを定義し、シミュレーションによりを求めることとした。

ネットワークモデルとは、エリア内に配置する局規模とアンテナ高さや指向性についてモデル化したもの。ここでは、典型的な送信局諸元として以下の2種類をモデルとし、検討することとした。

検討に用いる送信局モデル

	大電力	中電力
出力	10KW級	1KW級
送信高	300mAGL	100mAGL
アンテナ構成	2DP8段	2DP4段
利得	6dBd	4dBd
フィーダ損	1dB	1dB
アンテナパターン	水平面: omni 垂直面:別紙	水平面: omni 垂直面:別紙
セル半径	６０km	20km

RECOMMENDATION ITU-R BT.1368-7*

Planning criteria for digital terrestrial television services in the VHF/UHF bands

(1998-1998-2000-2002-2004-2005-2006-2007)

Scope

This Recommendation defines planning criteria for various methods of providing digital terrestrial television services in the VHF/UHF bands.

The ITU Radiocommunication Assembly,

considering

a) that systems are being developed for the transmission of digital terrestrial television services in the VHF/UHF bands;

b) that the VHF/UHF television bands are already occupied by analogue television services;

c) that the analogue television services will remain in use for a considerable period of time;

d) that the availability of consistent sets of planning criteria agreed by administrations will facilitate the introduction of digital terrestrial television services,

recommends

1 that the relevant protection ratios (PRs) and the relevant minimum field strength values given in Annexes 1, 2 and 3, and the additional information given in Annexes 4, 5, 6 and 7 should be used as the basis for frequency planning for digital terrestrial television services.

Introduction

This Recommendation contains the following Annexes:

Annex 1 – Planning criteria for ATSC digital terrestrial television systems in the VHF/UHF bands

Annex 2 – Planning criteria for DVB-T digital terrestrial television systems in the VHF/UHF bands

Annex 3 – Planning criteria for ISDB-T digital terrestrial television systems in the VHF/UHF bands

Annex 4 – Other planning factors

Annex 5 – Subjective comparison method (SCM) with a reference interferer for assessment protection ratios for analogue television system

Annex 6 – Test methods for protection ratio measurements for wanted digital terrestrial signals

Annex 7 – Tropospheric and continuous interference

* The Administrations of the Islamic Republic of Iran, the Syrian Arab Republic and the United Arab Emirates reserve their position and do not fully abide by this Recommendation.

General

The RF protection ratio is the minimum value of wanted-to-unwanted signal ratio, usually expressed in decibels at the receiver input.

The reference level of the digital signal is defined as the r.m.s. value of the emitted signal power within the channel bandwidth. It should preferably be measured with a thermal power meter. All protection ratio values for wanted digital signals are to be measured with a −60 dBm receiver input power.

The reference level of the analogue vision-modulated signal is defined as the r.m.s. value of the vision carrier at peaks of the modulation envelope. All protection ratio values for wanted analogue signals are measured with a receiver input power of −39 dBm (70 dB(μV) at 75 Ω).

1 Wanted digital terrestrial television systems

The protection ratios for digital terrestrial television systems apply to both continuous and tropospheric interference. The protection ratios refer to the centre frequency of the wanted digital terrestrial television system.

Because a digital television receiver needs to operate successfully in the presence of high level analogue signals on nearby channels, a high degree of receiver front-end linearity is required.

The protection ratios for digital terrestrial television systems as the interfering system are those for the case where the wanted and unwanted signals are not synchronized and/or do not have a common programme source. Results relevant to single frequency networks (SFN) are yet to be developed.

For the digital terrestrial television system, ATSC, the protection ratios are measured for a BER = 3×10^{-6} at the input of the MPEG-2 demultiplexer.

For the digital terrestrial television systems (digital video broadcasting-terrestrial (DVB-T) and integrated service digital broadcasting-terrestrial (ISDB-T)) the protection ratios are measured between the inner and outer codes, before Reed Solomon decoding, for a BER = 2×10^{-4}; this corresponds to a BER < 1×10^{-11} at the input of the MPEG-2 demultiplexer. For domestic receivers it may not be possible to measure the BER before Reed-Solomon decoding. The BER for such cases is under study.

To reduce the number of measurements and tables, it is proposed that protection ratio measurements for DVB-T systems should preferably be made with the following three modes shown in Table 1. Protection ratio values for the different required operational modes for fixed, portable or mobile reception can be calculated from the given measured values. A formula for calculation is still under study.

TABLE 43

Protection ratios (dB) for a T-DAB signal interfered with by a DVB-T 7 MHz signal

64-QAM, code rate 2/3									
Δf [(1)] (MHz)	–4.5	–3.7	–3.5	–2.5	0	2.5	3.5	3.7	4.5
PR	–49	0	1	2	2	2	1	0	–49

(1) Δf: centre frequency of the DVB-T signal minus centre frequency of the T-DAB signal.

5 Minimum field strengths for DVB-T terrestrial digital television, fixed reception

The formula for calculating minimum field strength is given in Appendix 1 to Annex 2.

TABLE 44

Calculation of minimum field strength DVB-T 8 MHz system

Frequency (MHz)	200			550			700		
System variant guard interval 1/4	QPSK 2/3	16-QAM 2/3	64-QAM 2/3	QPSK 2/3	16-QAM 2/3	64-QAM 2/3	QPSK 2/3	16-QAM 2/3	64-QAM 2/3
Receiver noise figure, F (dB)	5	5	5	7	7	7	7	7	7
Receiver carrier/noise ratio[(1)] (C/N) (dB)	8	14	20	8	14	20	8	14	20
Feeder loss A_f (dB)	3	3	3	3	3	3	5	5	5
Antenna gain, G (dB)	5	5	5	10	10	10	12	12	12
Minimum field strength for fixed reception, E_{min} (dB(µV/m))[(2)]	27	33	39	33	39	45	35	41	47

(1) For Rice channel.

(2) For formula, see Appendix 1 to Annex 2.

6 Minimum median field strength for mobile DVB-T reception

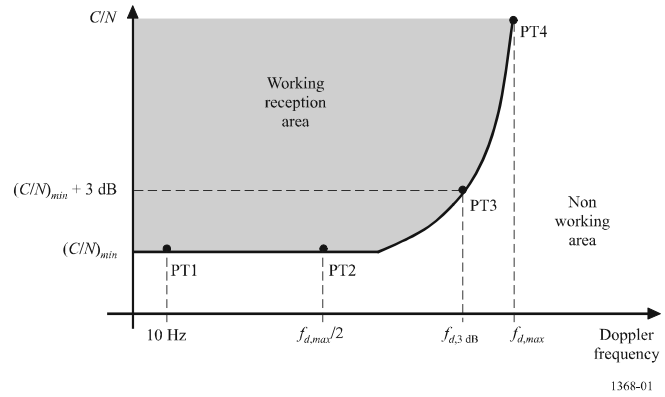
The equations for calculating the minimum median field strength are given in Appendix 1 to this Annex. The input values to the calculation are found in this section and in Annex 4. Mobile reception should be calculated with a location probability of 99%.

6.1 Required average *C/N* for mobile reception

For a given DVB-T mode the required average C/N for a certain quality level is a function of Doppler frequency only, and a graph like the one presented in Fig. 1 can be drawn.

FIGURE 1

Required average *C/N* in a mobile propagation channel



The minimum required average C/N values (C/N_{min}), Doppler frequency for an average C/N equal to C/N_{min} + 3 dB and the maximum Doppler (speed) limits for mobile reception are given in Table 45 and Table 46. The speed limits for C/N_{min} + 3 dB are given for three frequencies (200 MHz, 500 MHz and 800 MHz). The average C/N value, C/N_{min} + 3 dB, is suitable for calculation of required field strength. Table 45 shows values for the required average C/N and the speed limits in the non-diversity case. Table 46 contains the corresponding values for the diversity case. The values are based on the typical channel profile "typical urban" shown in Table 47. Quality criteria is the subjective failure point (SFP) corresponding to erroneous seconds ratio, –ESR = 5%, and packet error ratio, PER = 1×10^{-4}.

TABLE 45

Required average *C/N*, speed limits for mobile reception for the non-diversity case

Guard interval = 1/32			2k						8k					
					Speed at F_d, 3 dB (km/h)						Speed at F_d, 3 dB (km/h)			
Modulation	**Bit rate (Mbit/s)**	**Code rate**	**C/N_{min} (dB)**	**$F_{d,\,max}$ (Hz)**	**F_d at C/N_{min} + 3 dB**	**200 MHz**	**500 MHz**	**800 MHz**	**C/N_{min} (dB)**	**$F_{d,\,max}$ (Hz)**	**F_d at C/N_{min} + 3 dB**	**200 MHz**	**500 MHz**	**800 MHz**
QPSK	6.03	1/2	13.0	318	259	1 398	559	349	13.0	76	65	349	140	87
QPSK	8.04	2/3	16.0	247	224	1 207	483	302	16.0	65	53	286	114	71
16-QAM	12.06	1/2	18.5	224	182	985	394	246	18.5	59	47	254	102	64
16-QAM	16.09	2/3	21.5	176	147	794	318	199	21.5	41	35	191	76	48
64-QAM	18.10	1/2	23.5	141	118	635	254	159	23.5	35	29	159	64	40
64-QAM	24.13	2/3	27.0	82	65	349	140	87	27.0	24	18	95	38	24

TABLE 46

Required average *C/N*, speed limits for mobile reception for the diversity case

Guard interval = 1/32			2k						8k					
					Speed at F_d, 3 dB (km/h)						Speed at F_d, 3 dB (km/h)			
Modulation	**Bit rate (Mbit/s)**	**Code rate**	**C/N_{min} (dB)**	**$F_{d,\,max}$ (Hz)**	**F_d at C/N_{min} + 3 dB**	**200 MHz**	**500 MHz**	**800 MHz**	**C/N_{min} (dB)**	**$F_{d,\,max}$ (Hz)**	**F_d at C/N_{min} + 3 dB**	**200 MHz**	**500 MHz**	**800 MHz**
QPSK	6.03	1/2	7.0	560	518	2 795	1 118	699	7.0	140	129	699	280	175
QPSK	8.04	2/3	10.0	494	447	2 414	966	604	10.0	129	106	572	229	143
16-QAM	12.06	1/2	12.5	447	365	1 969	788	492	12.5	118	94	508	203	127
16-QAM	16.09	2/3	15.5	353	294	1 588	635	397	15.5	82	71	381	152	95
64-QAM	18.10	1/2	17.5	282	235	1 271	508	318	17.5	71	59	318	127	79
64-QAM	24.13	2/3	21.0	165	129	699	280	175	21.0	47	35	191	76	48

TABLE 47

Channel profile for measurement of required average *C/N* for mobile reception of DVB-T reception "typical urban"

Tap number	Delay (µs)	Power (dB)	Doppler category
1	0	–3	Rayleigh
2	0.2	0	Rayleigh
3	0.5	–2	Rayleigh
4	1.6	–6	Rayleigh
5	2.3	–8	Rayleigh
6	5	–10	Rayleigh

The values for the bit rate correspond to the shortest guard interval 1/32 which is the least critical case in terms of Doppler. It is to be expected that when the guard interval increases the maximum speed decreases. For instance with 1/4 guard interval, the maximum Doppler, $F_{d\,max}$, decreases to about 85%.

The performance in a mobile channel depends to large extent on the design of the DVB-T receiver. Improvements may be achieved with receivers particularly designed for mobile reception.

DVB-H uses the DVB-T transmission system as the physical layer and adds extra error correction and time-slicing mechanism on the link layer. The maximum Doppler frequency (speed) in mobile reception will be improved due to the additional time interleaving. *C/N* values for DVB-H reception need to be developed.

6.2 Receiver noise figure

Noise figure of 5 dB is for integrated vehicle mobile receivers. A lower noise figure is possible when the antenna is internally matched to the first amplifier stage without a need for a loop through connection.

7 Minimum median field strength for hand held pedestrian indoor, pedestrian outdoor and mobile DVB-H reception

The equations for calculating the minimum median field strength are given in Appendix 1 to this Annex. The input values to the calculation are found in this section and in Annex 4. Mobile reception should be calculated with a location probability of 99%.

7.1 Channel models for hand held pedestrian indoor and outdoor reception

The pedestrian indoor (PI) and pedestrian outdoor (PO) channel models have been developed for describing the slowly moving hand held reception indoors and outdoors. The channel models are based on measurements in DVB-H Single Frequency Networks and have paths from two different transmitter locations. Definitions of the taps for the channels are given in Table 49 and Table 50. The indicated Doppler frequency of 1.5 Hz is corresponding 3 km/h velocity at middle of UHF-band. The Doppler spectra of various taps are defined in Table 48.

– when domestic sets are used, type, display size and year of production.

3 Table of important parameters

TABLE 66

Basic terms and relations for the SCM

Quality impairment	Grade 3	Grade 4
Interference type	Tropospheric	Continuous
Time allowance	1% to 5% of time	50% of time
Subjective impairment	Slightly annoying	Perceptible, but not annoying
Reference interferer (mV_{p-p})	60	20
RF protection ratio (dB)	30	40

Annex 6

Test methods for protection ratio measurements for wanted digital terrestrial signals

1 Background

Initial studies of the protection ratios for the DVB-T system were based on a target BER of 2×10^{-4} measured between the inner and outer codes, before Reed-Solomon decoding. For the case of a noise-like interferer, this has been taken to correspond to a quasi-error-free (QEF) picture quality with the BER $< 1 \times 10^{-11}$ at the input of the MPEG-2 demultiplexer.

2 Subjective failure point (SFP) method for protection ratio measurements

For domestic receivers it may not be possible to measure the BER and therefore a new method called the SFP method has been proposed for protection ratio measurements in a unified manner. The quality criterion for protection ratio measurements is to find a limit for a just error-free picture at the TV screen. The RF protection ratio for the wanted DVB-T signal is a value of wanted-to-unwanted signal ratio at the receiver input, determined by the SFP method, and rounded to the next higher integer value.

The SFP method corresponds to the picture quality where no more than one error is visible in the picture for an average observation time of 20 s. The adjustment of the wanted and unwanted signal levels for the SFP method is to be carried out in small steps, usually in steps of 0.1 dB. For a "noise-like" interferer the difference in a value of wanted-to-unwanted signal ratio between the QEF method with a BER of 2×10^{-4} and the SFP method is less than 1 dB. All protection ratio values for wanted digital TV signals are measured with a receiver input power of –60 dBm.

It is proposed that the SFP method should be adopted for assessment of all DTTB systems. (For the digital system ISDB-T this method will be studied in Japan.)

Annex 7

Tropospheric and continuous interference

When using the protection ratios in planning, it is necessary to determine whether, in particular circumstances, the interference should be considered as tropospheric or continuous. This can be done by comparing the nuisance fields for the two conditions, the nuisance field being defined as the field strength of the interfering transmitter (at its pertinent e.r.p.) enlarged by the relevant protection ratio.

Thus, the nuisance field for continuous interference:

$$E_C = E(50, 50) + P + A_C$$

and the nuisance field for tropospheric interference:

$$E_T = E(50, t) + P + A_T$$