TTC Spectrum Management SWG **SMS-04-GSV-01-E**

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TITLE: FDM Quad Spectrum System Spectral Compatibility

ABSTRACT

The present contribution introduces the FDM Quad Spectrum System for high speed ADSL and evaluates its spectral compatibility according to the 2003 revised TTC-Soumusho spectral compatibility rules. The FDM Quad Spectrum System combines an extended downstream Bandwidth PSD (from~ 138KHz up to ~3.75MHz) and the g.992.5 Upstream PSD (with steep side lobes: -95dB per octave slope). The Quad spectrum Downstream channel total power is equal to 20dBm.

The FDM Quad Spectrum Service happens to be spectrally compatible with protected systems in Japan identified as TCM-ISDN, Annex A g.992.1 & g.992.2, Annex C DBM g.992.1 and g.992.2, Annex C FBM g.992.1& g.992.2.

The present contribution recommends to allowing the FDM quad spectrum service to be deployed in the same quad as protected systems.

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1 Introduction

The present contribution introduces the FDM Quad Spectrum System for high speed ADSL and evaluates its spectral compatibility according to the 2003 revised TTC-Soumusho spectral compatibility rules. The FDM Quad Spectrum System combines an extended downstream Bandwidth PSD (from~ 138KHz up to ~3.75MHz) and an Upstream PSD with steep side lobes (-95dB per octave slope). The FDM Quad spectrum Downstream channel total power is equal to 20dBm.

2 FDM Quad Spectrum Masks Definition

2.1 Downstream

Figure 1 and table 2-1 display FDM Quad Spectrum Mask features, based on peak values.

Figure 1. Quad Spectrum Mask Plot, Peak Values

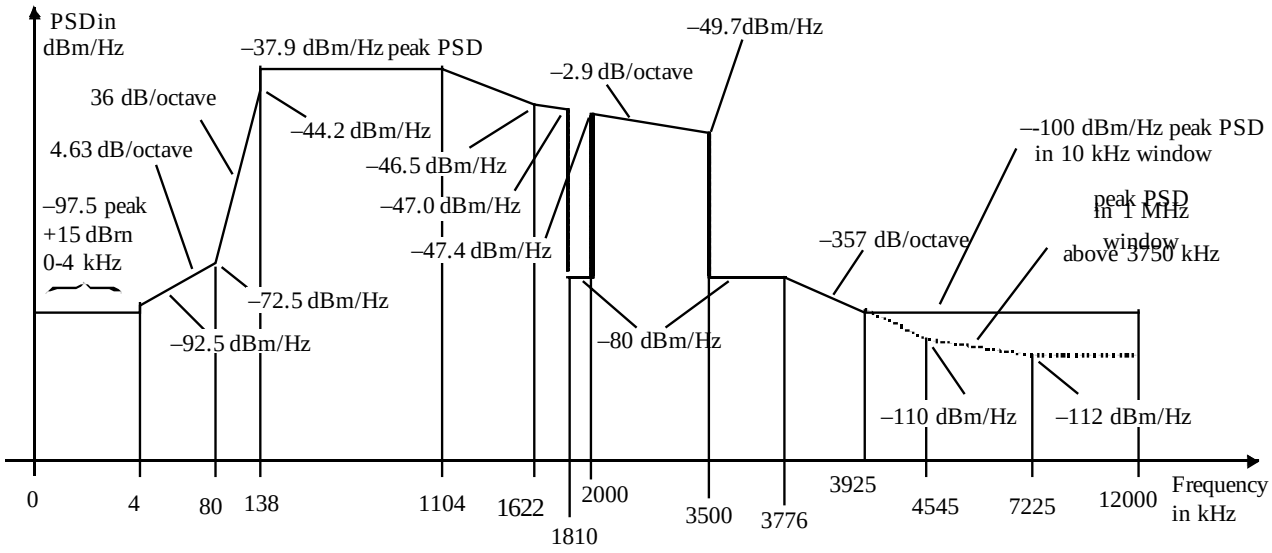


Table 2-1 Quad Spectrum Mask definition, Peak Values

(kHz)	PSD(dBm/Hz)
0	-97.5
4	-97.5
4	-92.5
80	-72.5
138	-37.9
1104	-37.9
1622	-46.5
1810	-47.0
1810	-80.0
2000	-80.0
2000	-47.4
3500	-49.7
3500	-80.0
3776	-80.0
3925	-100
4545	-110
7225	-112
12000	-112

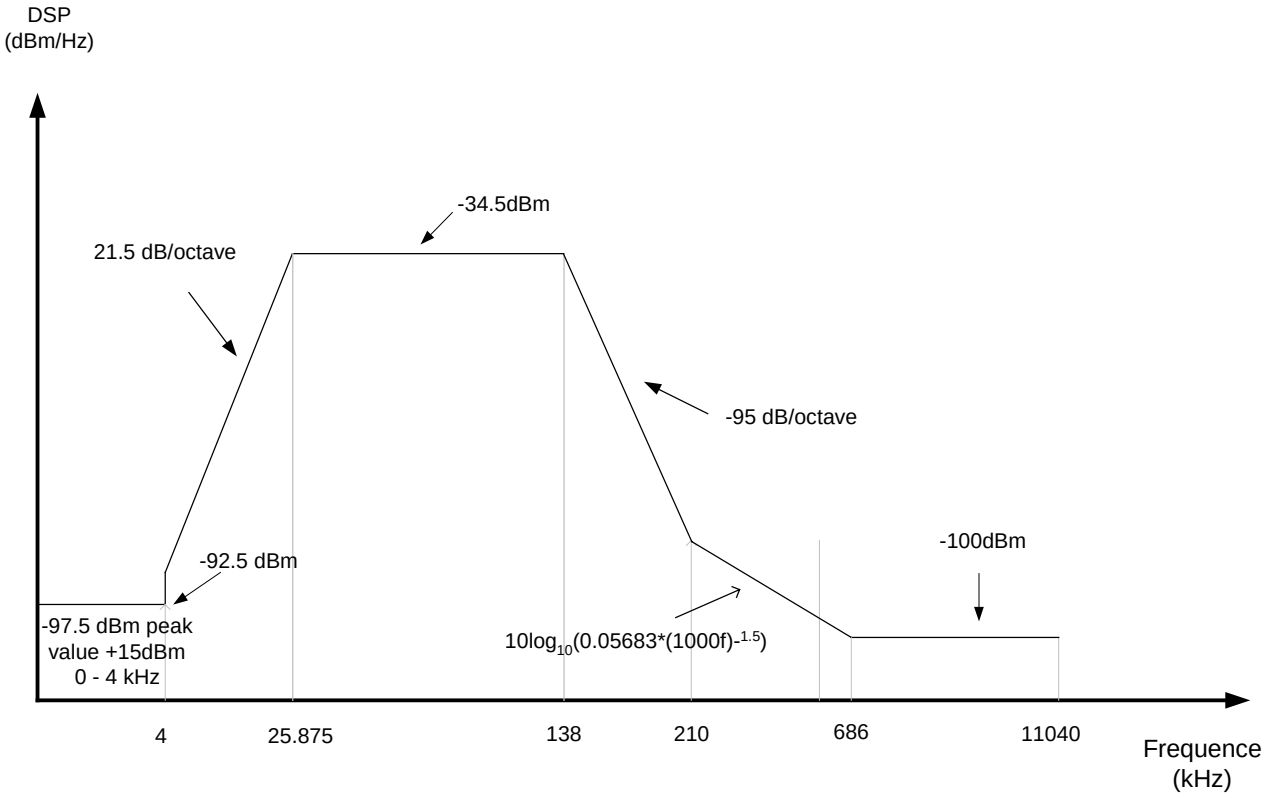
2.2 Upstream

Figure 2 and table 2-2 displays the Upstream Mask features, based on peak values.

Table 2-2. g.992.5 Upstream Mask Definition, Peak Values

Frequency (kHz)	PSD (dBm/Hz) Peak values
0<f<4	-97.5
4<f<25.875	"-92.5 + 21.5.log2.(f/4)"
25.875<f<138	-34.5
138<f<f_int	"-34.5 - 95.log2.(f/138)"
f_int<f<686	10log10(0.05683*(1000f)^(-1.5))
f>686	-100

Figure 2. g.992.5 Upstream Mask Plot, Peak Values



3 Spectral Compatibility Tables

3.1 Reference Tables

Table 3-1 gives the Spectral Compatibility reference performance of protected systems, according to the Revised 2003 Soumusho-TTC rules.

Table 3-1. Spectral Compatibility Reference Performance, Protected Systems

	TCM-ISDN	G.992.1 Annex A		G.992.2 Annex A		G.992.1 Annex C				G.992.2 Annex C				
Dist		(FDM)				DBM			FBM		DBM		FBM	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0.5	144	144	7104	832	3008	832	7104	832	2624	288	3008	832	1088	288
0.75	144	144	6784	832	2944	832	6912	832	2592	288	2944	832	1088	288
1	144	144	5952	832	2624	832	6368	832	2528	288	2752	832	1088	288
1.25	144	144	4896	800	2272	800	5696	800	2496	288	2528	800	1088	288
1.5	144	144	3840	768	1824	768	5024	800	2432	288	2272	800	1088	288
1.75	144	144	2496	736	1440	736	4192	768	2400	288	2016	768	1088	288
2	144	144	1696	704	960	704	3680	736	2336	288	1696	736	1088	288
2.25	144	144	1088	640	640	640	3296	704	2240	288	1504	704	1088	288
2.5	144	144	704	576	352	576	3008	672	2080	288	1312	672	1056	288
2.75	144	144	480	512	160	512	2720	640	1856	288	1216	640	1056	288
3	144	144	320	448	96	448	2368	576	1536	288	1184	576	1024	288
3.25	144	144	224	352	64	352	1984	512	1280	288	1152	512	992	288
3.5	144	0	128	288	32	288	1632	480	1056	288	1120	480	928	288
3.75	0	0	64	224	32	224	1344	448	832	256	1088	448	832	256
4	0	0	32	192	0	192	1088	416	640	256	1024	416	704	256
4.25	0	0	0	160	0	160	928	416	480	256	928	416	576	256
4.5	0	0	0	128	0	128	768	384	352	224	832	384	416	224
4.75	0	0	0	96	0	96	608	352	224	224	704	352	288	224
5	0	0	0	64	0	64	416	352	128	224	544	352	192	224

3.2 Quad Spectrum FDM Spectral Compatibility Impact Tables

Table 3-2 gives the performance of protected systems in the presence of 5 FDM Quad Spectrum systems disturbers.

Table 3-2. Protected Systems performance with 5 FDM Quad Spectrum Systems (1 Intra-Quad,4 Inter-Quad)

	TCM-ISDN	G.992.1 Annex A		G.992.2 Annex A		G.992.1 Annex C				G.992.2 Annex C				
Dist		(FDM)				DBM		FBM		DBM		FBM		
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0.5	144	144	7104	832	3008	832	7104	832	2624	288	3008	832	1088	288
0.75	144	144	7104	832	3008	832	7104	832	2624	288	3008	832	1088	288
1	144	144	7008	832	3008	832	7008	832	2592	288	3008	832	1088	288
1.25	144	144	6912	832	3008	832	6912	832	2560	288	3008	832	1088	288
1.5	144	144	6848	832	3008	832	6848	832	2528	288	3008	832	1088	288
1.75	144	144	6752	832	2976	832	6752	832	2496	288	2976	832	1088	288
2	144	144	6624	832	2976	832	6624	832	2432	288	2976	832	1088	288
2.25	144	144	6496	832	2976	832	6496	832	2400	288	2976	832	1088	288
2.5	144	144	6240	832	2976	832	6240	832	2304	288	2976	832	1088	288
2.75	144	144	5856	800	2944	800	5856	800	2144	288	2944	800	1088	288
3	144	144	5248	800	2944	800	5248	800	1920	288	2944	800	1088	288
3.25	144	144	4416	800	2912	800	4416	800	1632	288	2912	800	1056	288
3.5	144	144	3712	768	2816	768	3712	768	1376	288	2816	768	1024	288
3.75	0	0	3104	736	2688	736	3104	736	1120	256	2688	736	992	256
4	0	0	2560	736	2464	736	2560	736	928	256	2464	736	896	256
4.25	0	0	2080	704	2240	704	2080	704	768	256	2240	704	800	256
4.5	0	0	1696	672	1920	672	1696	672	608	224	1920	672	704	224
4.75	0	0	1344	640	1536	640	1344	640	480	224	1536	640	544	224
5	0	0	1024	608	1184	608	1024	608	352	224	1184	608	448	224

3.3 Delta Reference - Quad Spectrum FDM Spectral Compatibility Tables

Table 3-3 gives the delta between the reference performance (table 3-1) and the performance in the presence of 5 FDM quad spectrum systems (Table 3-2). To be spectrally compatible these numbers shall always by negative:in the presence of anew systems performance of the protected systems shall always be greater or equal to the reference performance.

Table 3-3. Reference Performance minus Performance with 5 FDM Quad Spectrum

	TCM-ISDN	G.992.1 Annex A		G.992.2 Annex A		G.992.1 Annex C				G.992.2 Annex C				
Dist		(FDM)				DBM		FBM		DBM		FBM		
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.75	0	0	-320	0	-64	0	-192	0	-32	0	-64	0	0	0
1	0	0	-1056	0	-384	0	-640	0	-64	0	-256	0	0	0
1.25	0	0	-2016	-32	-736	-32	-1216	-32	-64	0	-480	-32	0	0
1.5	0	0	-3008	-64	-1184	-64	-1824	-32	-96	0	-736	-32	0	0
1.75	0	0	-4256	-96	-1536	-96	-2560	-64	-96	0	-960	-64	0	0
2	0	0	-4928	-128	-2016	-128	-2944	-96	-96	0	-1280	-96	0	0
2.25	0	0	-5408	-192	-2336	-192	-3200	-128	-160	0	-1472	-128	0	0
2.5	0	0	-5536	-256	-2624	-256	-3232	-160	-224	0	-1664	-160	-32	0
2.75	0	0	-5376	-288	-2784	-288	-3136	-160	-288	0	-1728	-160	-32	0
3	0	0	-4928	-352	-2848	-352	-2880	-224	-384	0	-1760	-224	-64	0
3.25	0	0	-4192	-448	-2848	-448	-2432	-288	-352	0	-1760	-288	-64	0
3.5	0	-144	-3584	-480	-2784	-480	-2080	-288	-320	0	-1696	-288	-96	0
3.75	0	0	-3040	-512	-2656	-512	-1760	-288	-288	0	-1600	-288	-160	0
4	0	0	-2528	-544	-2464	-544	-1472	-320	-288	0	-1440	-320	-192	0
4.25	0	0	-2080	-544	-2240	-544	-1152	-288	-288	0	-1312	-288	-224	0
4.5	0	0	-1696	-544	-1920	-544	-928	-288	-256	0	-1088	-288	-288	0
4.75	0	0	-1344	-544	-1536	-544	-736	-288	-256	0	-832	-288	-256	0
5	0	0	-1024	-544	-1184	-544	-608	-256	-224	0	-640	-256	-256	0

Table 3-3 proves the spectral compatibility of FDM Quad Spectrum System.

4 Conclusions-Recommendations

The FDM Quad Spectrum Service happens to be spectrally compatible with protected systems in Japan identified as TCM-ISDN, Annex A g.992.1 & g.992.2, Annex C DBM g.992.1 and g.992.2, Annex C FBM g.992.1& g.992.2.

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