COMMITTEE T1 - TELECOMMUNICATIONS

STUDY PROJECT CONTRIBUTION

TITLE: Updated OPTIS PSD Mask and Power Specification for HDSL2

Authors: Jim Girardeau, Level One Communications, (916) 855-5177 x4822
Mike Rude, ADC Telecommunications (612) 936-8308
Hiroshi Takatori, Level One Communications, (916) 855-5000
George Zimmerman, PairGain Technologies (714) 730-2312

Contact: Jim Quilici
LEVEL ONE Communications, Inc
Phone (916)-854-2853
Fax   (916)-854-2804
Email: jquilici@level1.com

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ABSTRACT:
This contibution refines the PSD mask and power specification for OPTIS [1]. Modifications to the upstream mask provide additional margin for crosstalk compatibility with existing HDSL services. The modifications include a 1 dBm reduction in power (upstream). OPTIS performance is not affected by these modifications.

NOTICE

1. Introduction

The previous OPTIS specification [1] provides a clear and verifiable measure of the OPTIS PSD, while allowing margin for vendor specific implementations. This contribution refines the original specification to eliminate spectral compatibility problems [2] with existing HDSL services.

The changes to the specification include:
1. a power reduction in the upstream template to reduce interference with existing HDSL services.
2. tightened bounds on the upstream and downstream mask to provide better assurance of spectral compatibility with existing services.

2. Filter Specification

The OPTIS mask is specified as a series of straight line segments. The mask provides an absolute upper bound on power. A specification is given for total transmitted power, which is less than the total power under the mask. The following tables give the end points of each line segment:

TABLE 1. OPTIS Downstream Mask Specification

Frequency (kHz)	Maximum Power (dBm/hz)
<= 1	-54.2
2	-42.2
12	-39.2
190	-39.2
236	-46.2
280	-35.7
375	-35.7
400	-40.2
440	-68.2
600	-76.2
1000	-89.2
2000	-99.7
>=3000	-108

TABLE 2. OPTIS Upstream Mask Specification

Frequency (kHz)	Maximum Power (dBm/hz)
<= 1	-54.2
2	-42.1
10	-37.8
175	-37.8
220	-34.4
255	-34.4
276	-41.1
300	-77.6
555	-102.6
800	-105.6
1400	-108
>=2000	-108

TABLE 3. OPTIS Power Specification

Direction	Frequency range	Power dBm	Tolerance dBm
Upstream	0 to 350 kHz	16.4	+- 0.5
Downstream	0 to 450 kHz	16.4	+- 0.5

FIGURE 1. OPTIS Template

OPTIS Upstream/Downstream Template

FIGURE 2. Expanded OPTIS Template

OPTIS Upstream/Downstream Template
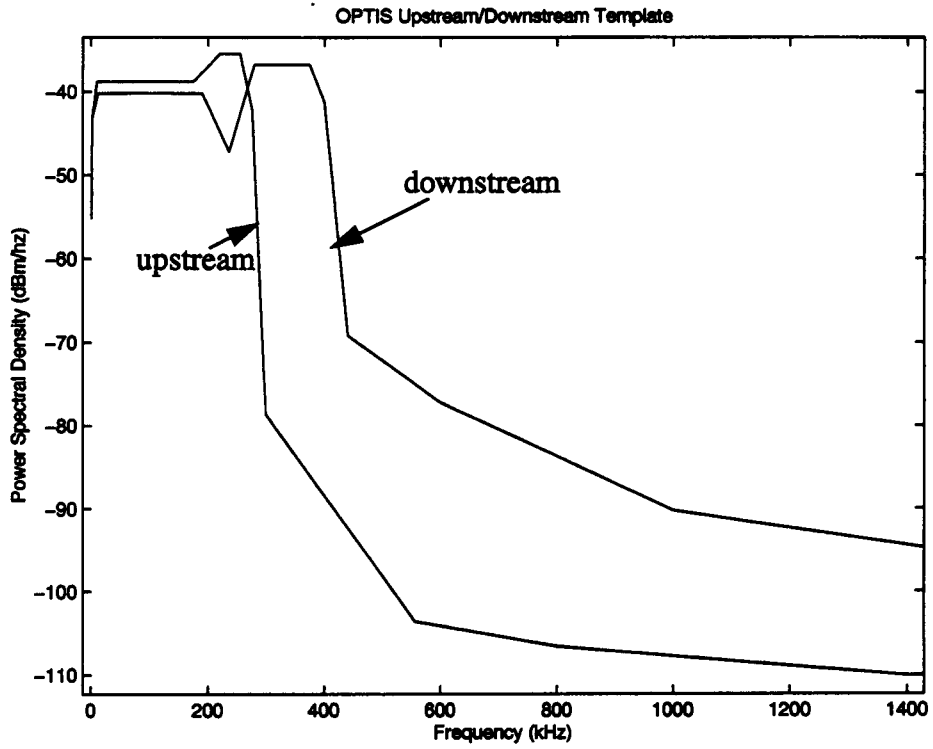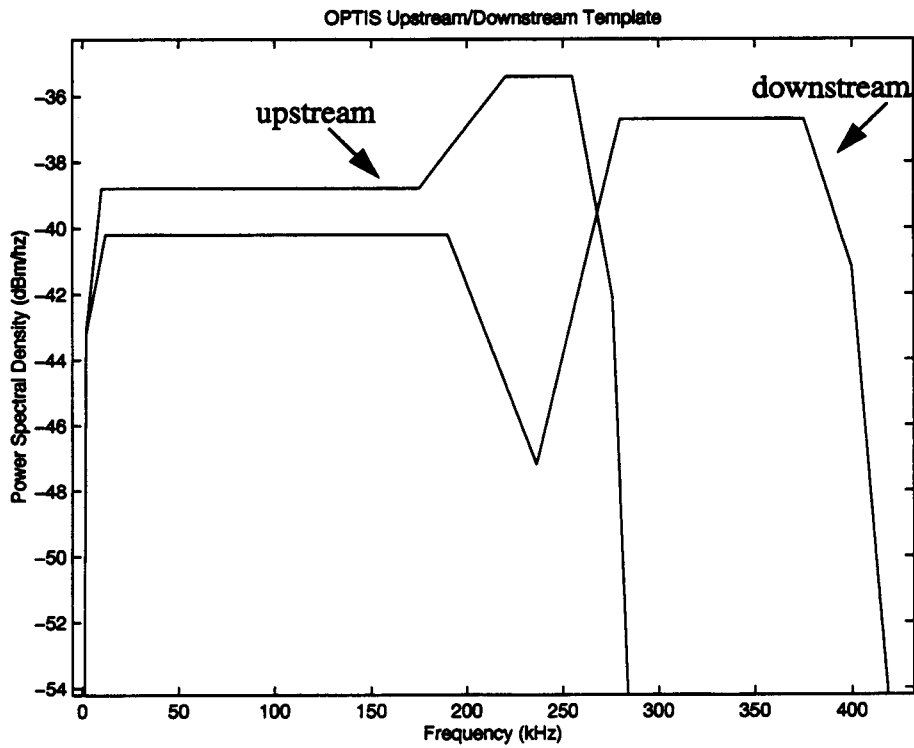
3. Uncoded Noise Margin of OPTIS TEMPLATE

A nominal template was formed from the OPTIS mask by reducing the mask 1 dBm/hz. Noise margins for the OPTIS template and a realizable test filter were computed over various crosstalk conditions for CSA Loop 4 and CSA Loop 6. The results are provided in the tables below. Computations are based on optimal DFE integration with a 500 Hz resolution rectangular rule integration. The baud rate is 517.3 kHz; the reference SNR is 27.7 dB.

TABLE 4. OPTIS Performance with Template -- Uncoded Noise Margin, CSA4

Crosstalk Interferer (NEXT/FEXT) with -140 dBm/Hz AWGN, 500Hz integration	OPTIS Template Loop 4 Down (dB)	Test Filter Loop 4 Down (dB)	OPTIS Template Loop 4 Up (dB)	Test Filter Loop 4 Up (dB)
39 SELF	9.0	9.2	1.1	1.5
49 HDSL	10.8	10.5	1.7	1.6
25 T1	16.5	16.2	18.8	18.8
49 FDM ADSL (120kHz high pass)	15.4	15.1	8.0	7.5
39 EC ADSL	15.4	15.1	1.4	1.4
24 SELF + 24 T1	0.9	0.9	7.5	3.6
24 FDM ADSL + 24 HDSL	10.7	10.5	0.9	0.9

TABLE 5. OPTIS Performance with Template -- Uncoded Noise Margin, CSA6

Crosstalk Interferer (NEXT/FEXT) with -140 dBm/Hz AWGN, 500Hz integration	OPTIS Template Loop 6 Down (dB)	Test Filter Loop 6 Down (dB)	OPTIS Template Loop 6 Up (dB)	Test Filter Loop 6 Up (dB)
39 SELF	9.0	9.2	2.1	2.3
49 HDSL	12.2	11.9	2.7	2.7
25 T1	17.5	17.1	19.9	20.0
49 FDM ADSL (120kHz high pass)	15.0	14.7	8.9	8.9
39 EC ADSL	15.0	14.7	2.4	2.4
24 SELF + 24 T1	1.7	1.6	4.3	4.7
24 FDM ADSL + 24 HDSL	11.0	10.8	1.9	1.9

4. Spectral Compatibility of OPTIS TEMPLATE

3.1 HDSL
Measured spectral compatibility with HDSL is provided in contribution [3].

3.2 ADSL
Spectral compatibility with ADSL is computed in the table below. Interference from the OPTIS template and the test filter is similar to that of HDSL systems. EC ADSL downstream begins at tone 7, and FDM begins at tone 28. The target bit rate is 6784 kbps (6144 down + 640 duplex), and margin is computed according to the DMT capacity relations, with a 12 dB SNR gap, as agreed for the spectral comptibility technical report in T1E1.4/97-180r1. 4 dB coding gain has been assumed.

TABLE 6. OPTIS Compatibility with EC ADSL

Configuration	Loop 6 Down
39 SELF	9.0
49 HDSL	9.0
39 HDSL	9.2
39 OPTIS TEMPLATE	9.2
39 OPTIS, Test filter	9.3

TABLE 7. OPTIS Compatibility with 6784 kpbs FDM ADSL

Configuration	Loop 6 Down
39 HDSL	8.3
39 OPTIS, TEMPLATE	8.3
39 OPTIS, Test filter	8.3

4. Conclusion

A refinement to the OPTIS mask and power specification reduces interference with existing HDSL systems. The upstream power requirement was reduced to 16.4 dBm. Both a realizable test filter and the OPTIS mask (normalized) were shown to meet performance goals. Combined with a suitable code, OPTIS can achieve a stable 6 dB performance margin for HDSL2 systems under worst case noise environments.

5. References

[1] J. Girardeau, H Takatori, M. Rude, G. Zimmerman, "OPTIS PSD Mask and Power Specification for HDSL2", T1E1.4-320, September 22, 1997.

[2] P. Brackett & K. Schneider, "The Importance of Testing Widely Deployed Equipment in the Presence of Interference from New Line Codes", ADTRAN, T1E1.4-339, Sept. 22-26, 1997.

[3] Mike Rude, "Measured Spectral Compatibility of HDSL2 with Deployed HDSL", T1E1.4-434, Dec 8, 1997.