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題名: Annex M および Annex C におけるシェーピングされた上り拡張 PSD について

概要

来週開催予定の次回 ITU-T 会議に提出する文書を本寄書に添付する。本シェーピングされた PSD を G.992.3 Annex M/C 標準および G.992.5 M/C 標準に加えることを提案する。たとえば、イギリスでは、Annex M で定義された現行の PSD は、いかなる距離でも収容不可能である。スペクトル適合性を満足する PSD を定義することにより、われわれは性能と許容可能干渉の最適な妥協点を得ることができる。提案する PSD は、イギリス通信網での導入に関する ANFP ガイドラインにも従うものである。

また、われわれは日本の通信網における性能劣化を最小限に抑えるため、TTC が上り拡張システムに、このようなシェーピングされた PSD を採用することを提案する。

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TITLE: Revised Proposed Shaped Extended Upstream PSD for Inclusion in Annex M

ABSTRACT

This contribution provides a revision to the shaped extended upstream PSD proposed in D-1058 and D-1083. This revision scales the shaped extended upstream PSD to fit under the medium reach PSD mask defined in the ANFP for the UK. The transmit power of the PSD mask is 12.5 dBm. We provide an analysis demonstrating the impact onto ADSL downstream channel and the performance in presence of different crosstalk environments. This contribution recommends including the shaped extended upstream PSD in Annex M of G.992.3 and Annex M of G.992.5.

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1 Introduction

This contribution provides a revision to the shaped extended upstream PSD proposed in D-1058 and D-1083. This revision scales the shaped extended upstream PSD to fit under the medium reach PSD mask defined in the ANFP for the UK. The transmit power of the PSD mask is 12.5 dBm. We provide an analysis demonstrating the impact onto ADSL downstream channel and the performance in presence of different crosstalk environments. This contribution recommends including the shaped extended upstream PSD in Annex M of G.992.3 and Annex M of G.992.5.

We first provide a comparison of the impact of various flat and shaped extended upstream channel PSDs on to the downstream channel of ADSL. We then demonstrate the tradeoff between performance and crosstalk impact of the various PSDs. In section we describe a shaped extended upstream PSD with 64 tones. The flat extended upstream PSDs here are EU-40, 44, 48, and 64 as defined in draft G.992.3 Annex M. Also considered is the shaped extended upstream with 112 tones (EU-S112) taken from MC-110. We conclude that shaping of the extended upstream channel PSD beyond 32 tones allows for improvements in upstream channel capacity over flat PSDs that have comparable levels of crosstalk impact onto downstream channel ADSL.

2 Shaped Extended Upstream PSD Definition

Figure 1 and **エラー! 参照元が見つかりません。** give the definition of the shaped extended upstream (sEU) PSD mask. The values in the mask definition are peak values. The nominal PSD is 3.5 dB below the mask values. The transmit power for the nominal PSD is 12.5dBm, which is obtained by integration between 25.875 kHz and 276 kHz. In this paper, we refer to this shaped extended upstream PSD as sEU12.5.

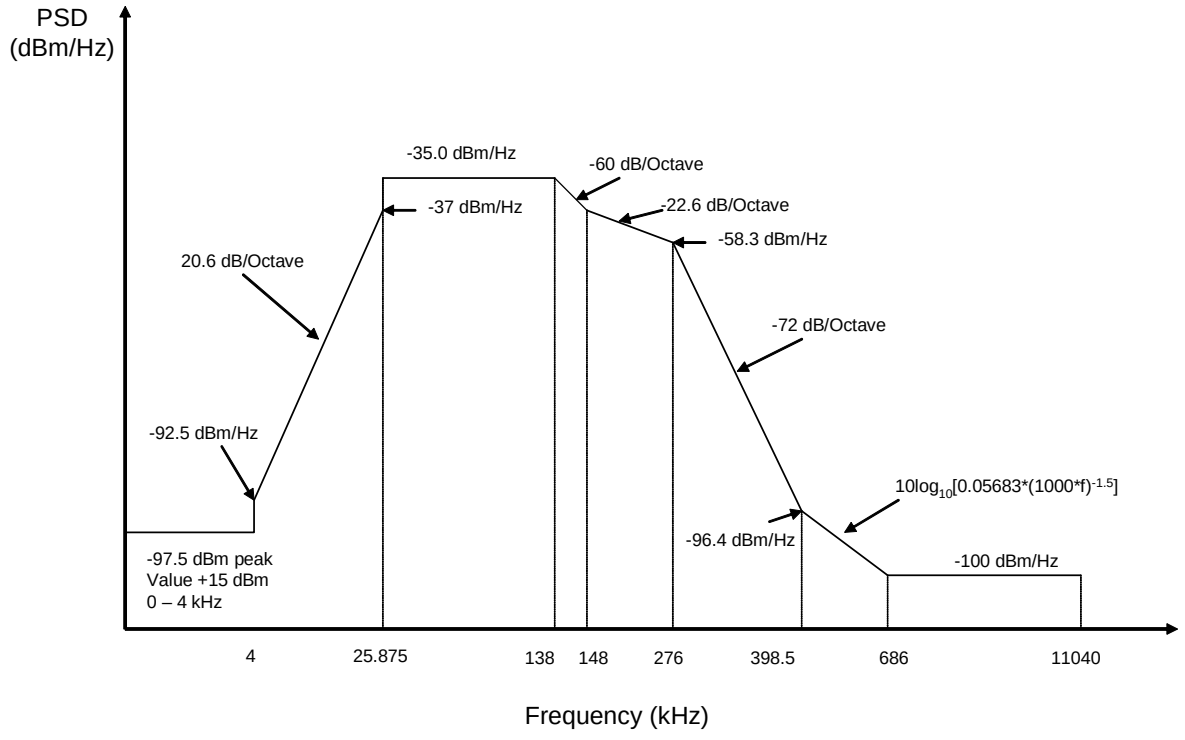

Figure 1: Graph of Shaped Extended Upstream PSD Mask (Peak Values, 12.5dBm Transmit Power).

Table 1: Values of Shaped Extended Upstream PSD Mask (Peak Values, 12.5dBm Transmit Power).

Frequency (kHz)	PSD (dBm/Hz) Peak values
0<f<4	-97.5
4<f<25.875	$-92.5 + 20.6 \cdot \log_2(f/4)$
25.875 ≤ f < 138	-35.0
138 ≤ f < 148	$-35 - 60 \cdot \log_2(f/138)$
148<f<276	$-41.06 - 22.6 \cdot \log2(f/148)$
276<f<398.5	$-58.3 - 72 \cdot \log2(f/276)$
398.5<f<686	$10\log10[0.05683*(1000f)^{-1.5}]$
f>686	-100

3 Impact on ADSL Downstream

In this section we evaluate the impact of various extended upstream PSDs into downstream ADSL. Included are the following: sEU12.5, EU-S112 from MC-110, and EU-64, 48, 44, and 40 from draft G.992.3 Annex M. Note that the PSDs of EU-64, 48, 44, and 40 are also referred to as TCM-ISDN Friendly PSDs, namely TIF-64, 48, 44, and 40 per the notation in contribution MC-110. Throughout the remainder of this paper, both the EU-xx and TIF-xx terminologies are used interchangeably.

The conditions for evaluating the impact into ADSL downstream are as follows:

- Test Loop: 0.4 mm Poly
- Five disturbers (1 intra-quad plus 4 inter-quad) with 99% worst case coupling.
- NEXT & FEXT Coupling for 99% worst case: NEXT: 50.0 dB and FEXT: 51.5 dB.
- Simulation Tunings: 6 dB Margin, 2-5 bits/tone, Power Cutback is OFF, and 70 dB echo attenuation.

Figure 2 shows plots of the various PSDs identified above. All of the PSDs in Figure 2 have a nominal transmit power of 12.5 dBm. With this constant transmit power constraint, the wider the bandwidth, the lower is the nominal PSD level.

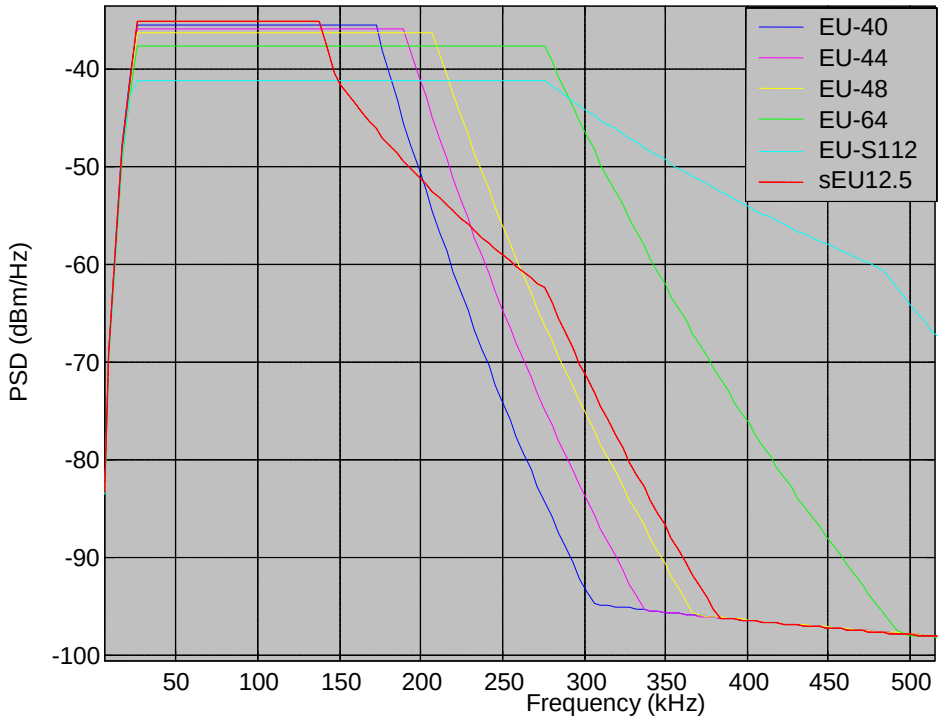

Figure 2: Various Extended Upstream PSDs.

For each of the above mentioned PSDs, we compute the impact into ADSL downstream. The graphs in Figure 3 provide a summary of the impact of various extended upstream PSDs into downstream ADSL.

Clearly the wider the bandwidth of the extended upstream PSD, the greater is the impact onto ADSL downstream. The 23 dB/octave rolloff of the shaped EU PSD above 138 kHz has less crosstalk into ADSL than the wider band flat PSDs. Of the extended upstream PSDs shown in this figure, EU-40 is closest in impact to ADSL downstream as that of sEU12.5; although at distances less than 2.8 km, there is significantly less impact than from EU-40.

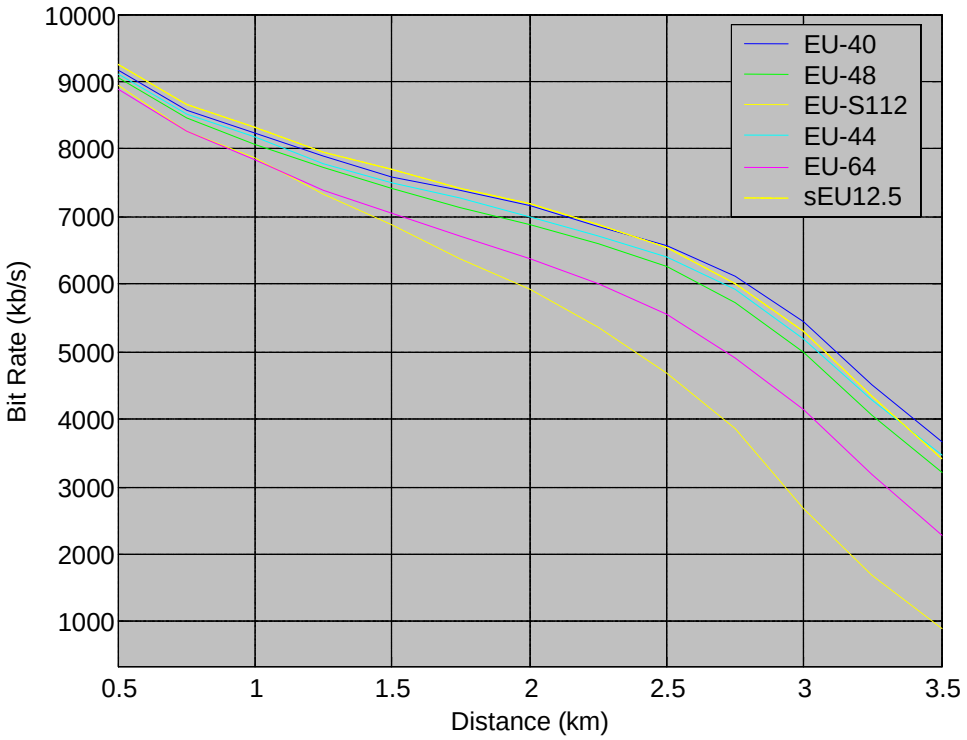

Figure 3: Impact of various EU PSDs on ADSL Downstream.

4 Performance of EU PSDs

Performance Evaluation Conditions:

- .4 mm Poly cable
- 5 disturbers (1 intra-quad plus 4 inter-quad) with 50% worst case coupling.
- NEXT & FEXT Coupling for 50% worst case: NEXT: 61.1 dB and FEXT: 62.8 dB
- Simulation Tunings: 6 dB Margin, 2-5 bits/tone, Power Cutback is OFF, and 70 dB echo attenuation.

Figure 4 shows the performance comparison of the sEU12.5 PSD with the EU-40 PSD in the presence of AWGN with value of −140 dBm/Hz. Figure 5 shows the performance comparison in the presence of 5-self disturbers and Figure 6 provides the comparison in the presence of ADSL (FDM) crosstalk. Significant gains can be achieved in upstream channel capacity with the shaped PSD than with a corresponding flat PSD that provides a comparable level of disturbance into ADSL downstream.

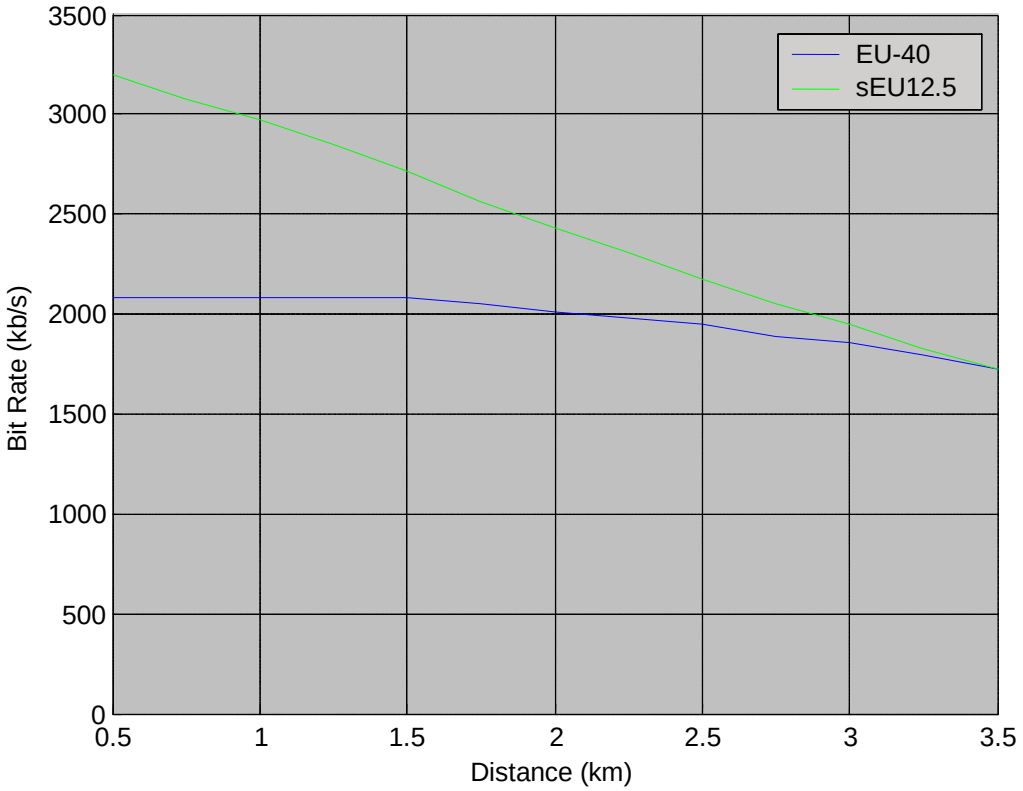

Figure 4: Performance of various EU PSDs in presence of AWGN.

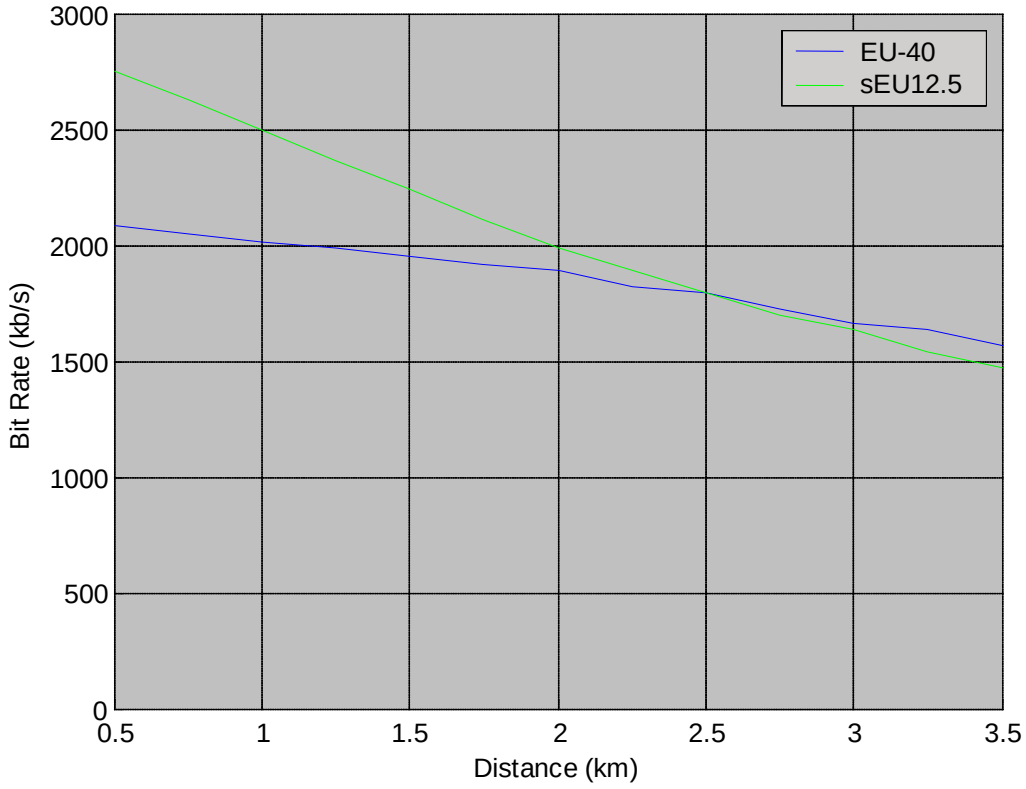

Figure 5: Performance of various EU PSDs in presence of 5 Self disturbers.

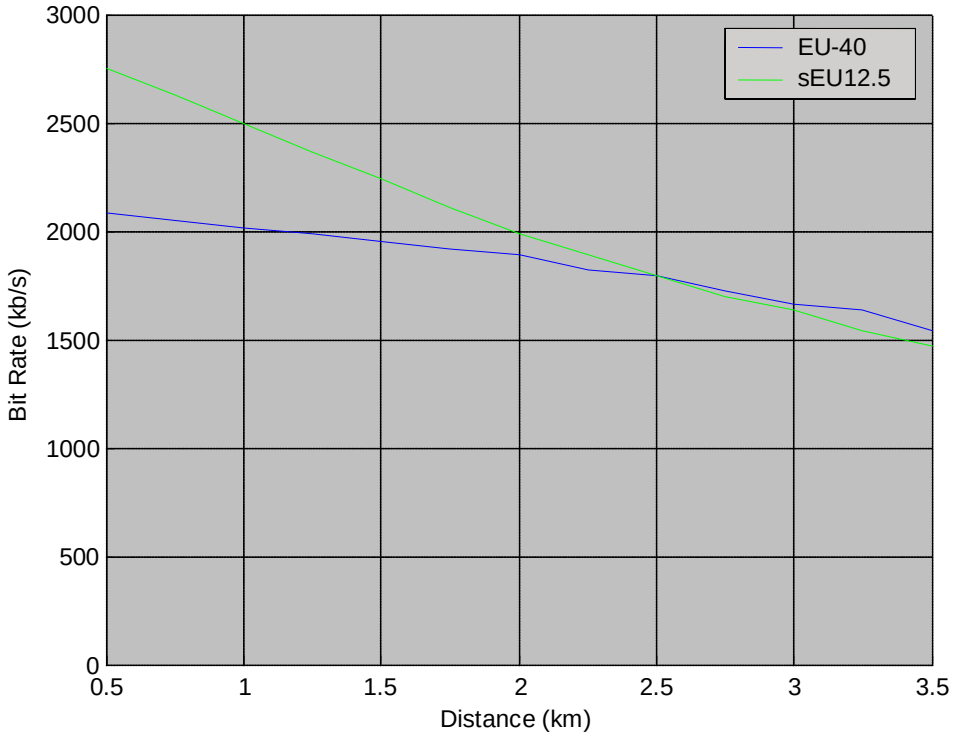

Figure 6: Performance of various EU PSDs in presence of 5 ADSL FDM disturbers.

5 Summary

In summary, for comparable levels of disturbance into ADSL FDM downstream, greater capacities can be achieved in an extended upstream channel capacity with shaping than with the corresponding flat PSD. The PSD defined in Section 2 is compliant with the medium range PSD in the ANFP. We recommend the following:

- That G.992.3 Annex M and G.992.5 Annex M should define shaped extended upstream channel PSDs to maximize performance of the upstream channel while minimizing impact into ADSL downstream.
- That the shaped extended upstream channel PSD defined in section 2 of this contribution be included in G.992.3 Annex M and G.992.5 Annex M.