Project: SpM

Title: Simulation Guide for ADSL and SDSL Power Back-Off

Source: FTW

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Abstract:

This paper tries to simplify the simulation of power back-off for spectrum management simulation purposes.

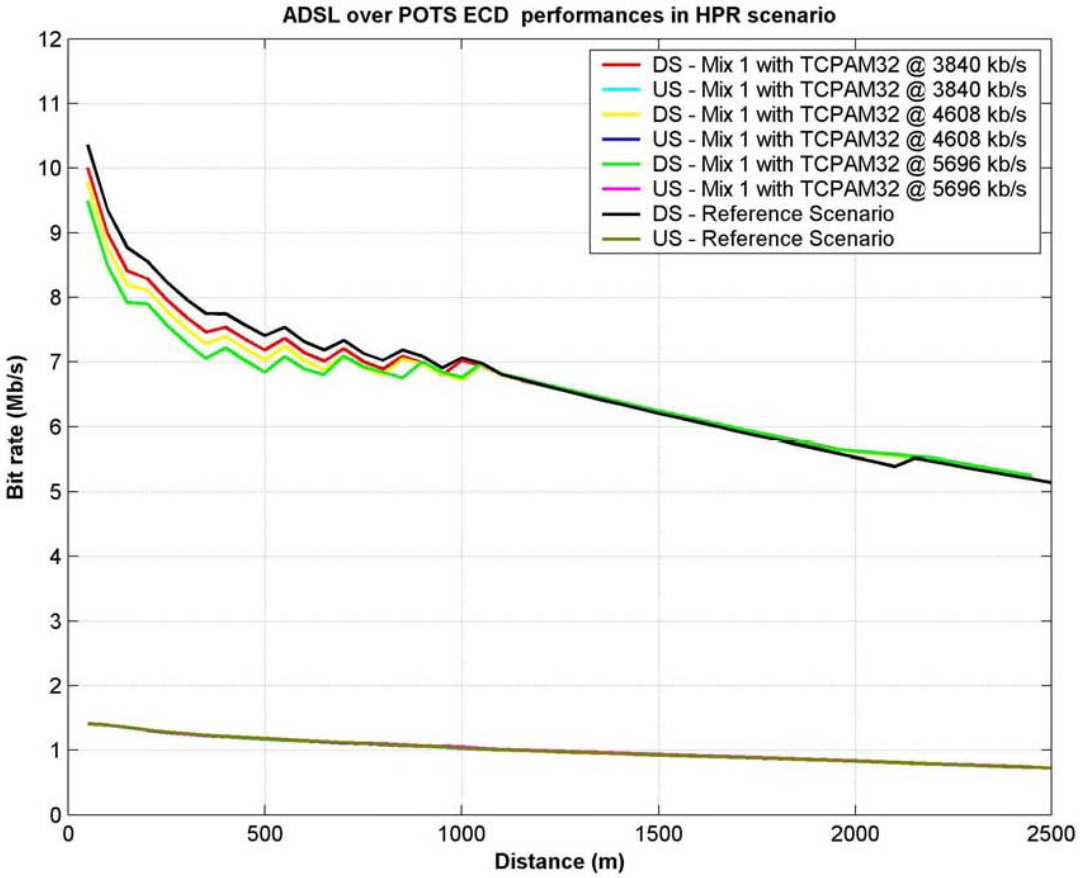
Distribution: ETSI STC TM6 working group members

Status: For decision

Introduction

While doing simulations for the SpM [1,2] it has been clear that the step-like definition of downstream and upstream power back-off (PBO) makes some reach computations unstable and unreliable.

The effect can be seen in many simulations done in 041w02 [5], below Figure 13 from that document is shown. Here we see the bit-rate for the green curve ripple around 7 Mbit/s and if a reach for this bit-rate is to be established all these local minima makes it very difficult to make a stable computation of the reach.



This is a problem for both ADSL and SDSL that typically appears below a loop length of 1000m.

Current power cut-back tables

Below I have collected the relevant PBO information for SDSL [4] and ADSL [3] (annex A and B)

G.991.2 (SDSL)

6.1.5 Power Backoff

SHDSL devices shall implement Power Backoff, as specified in this section. The selected power backoff value shall be communicated during preactivation through the use of G.994.1 parameter selections.
The power backoff value shall be selected to meet the requirements shown in Table 6-2. The power backoff calculations are based on Estimated Power Loss (EPL), which is defined as: Estimated Power Loss (dB) = TX Power (dBm) – Estimated RX Power (dBm), evaluated for the data mode PSD.
No explicit specification is given herein for the method of calculating Estimated RX Power. Depending upon the application, this value may be determined based on line probe results, *a priori* knowledge, or G.994.1 tone levels.
The Power Backoff that is applied shall be no less than the Default Power Backoff, and it shall not exceed the Maximum Power Backoff Value.

TABLE 6-2

Required Power Backoff Values

Estimated Power Loss (dB)	Maximum Power Backoff (dB)	Default Power Backoff (dB)
EPL > 6	31	0
6 ≥ EPL > 5	31	1
5 ≥ EPL > 4	31	2
4 ≥ EPL > 3	31	3
3 ≥ EPL > 2	31	4
2 ≥ EPL > 1	31	5
1 ≥ EPL > 0	31	6

992.1 (ADSL)

A.3.1 Power cut-back (supplements 10.4.5.1)

If the total upstream power measured on subcarriers 7-18 during R-REVERB1 is greater than 3 dBm, then the PSD for C-REVERB1 and all subsequent downstream signals shall be as shown in Table A.1.

Table A.1/G.992.1 – Power cut-back: downstream PSD as a function of upstream received power

Upstream received power (dBm) <	3	4	5	6	7	8	9
Max downstream PSD (dBm/Hz)	–40	–42	–44	–46	–48	–50	–52

This chosen level shall become the reference level for all subsequent gain calculations.

B.3.3 Power Cut-back (supplements 10.4.5.1)

If the total upstream power measured on 12 consecutive subcarriers in the range 36 to 51 during R-REVERB1 is greater than 3 dBm, then the PSD for C-REVERB1 and all subsequent downstream signals shall be as shown in Table B.5.

The ATU-C shall choose 12 consecutive subcarriers in the range 36 to 51 actually transmitted at nominal power by the ATU-R. In the case where the ATU-C cannot find 12 such subcarriers, the ATU-C is allowed to use less subcarriers in the upstream power measurement, but shall compensate the measurement accordingly.

Table B.5/G.992.1 – Power cut-back: downstream PSD as a function of upstream received power

Upstream received power (dBm) <	0	1.5	3	4.5	6	7.5	9
Max downstream PSD (dBm/Hz)	–40	–42	–44	–46	–48	–50	–52

This chosen level shall become the reference level for all subsequent gain calculations.

992.3 ADSL2

3.1. power cutback: reduction of the transmit PSD level (expressed in dB) in any one direction, relative to the nominal transmit PSD level. The same transmit PSD level reduction is applied over the whole frequency band (i.e., flat cutback).

<Not time to wade through the standard and extract what is actually done as PBO/PCB>

Suggested Models

For simulation (SpM and performance) purposes it seems possible that a linear PBO model matching the step function would alleviate most of the problems that we have with stability in our simulations. Thus, this contribution suggests that we establish linear models for all variants of SDSL and ADSL that we want to simulate.

The proposed (piecewise) linear PBO models:

SDSL

```
If  EPL<=6
        DefaultPBO = 6–EPL
else
        DefaultPBO = 0
end
```

ADSL Annex A

```
if URP > 3
        if URP > 9
                MaxDS_PSD = –52
        else
                MaxDS_PSD = –2*(URP–3) –40
        end
else
        MaxDS_PSD = –40
end
```

ADSL Annex B

```
if URP > 0
        if URP > 9
                MaxDS_PSD = –52
        else
                MaxDS_PSD = –2*URP –40
        end
else
        MaxDS_PSD = –40
end
```

ADSL Annex J

TBD

ADSL Annex M

TBD

References

[1] R. Persico, “Framework for spectral management studies on e-SDSL and ADL-64”, Sophia Antipolis, September 2003, contribution 033t04
[2] R. Persico, “Additional assumptions and requirements for the simulations on SP15”, Sophia Antipolis, November 2003, contribution 033w08
[3] ITU-T Recommendation G.992.1, Asymmetric digital subscriber line (ADSL) transceivers, 1999
[4] ITU-T Recommendation G.991.2, Single-Pair High-Speed Digital Subscriber Line (SHDSL) Transceivers, 2001
[5] R. Persico, “Performances and spectral impact of e-SDSL in the New European Spectral Platform (NESP)”, Sophia Antipolis, Feb. 2004, contribution 041w02