日付：2003 年 11 月 21 日
提出元：DSL 仕様検討 SWG [1]

題名：JLDSL 性能評価基準について

DSL 仕様検討 SWG では新方式についての検討が進められている。そのうちの一つに 5km 以上の長距離での通信にターゲットを置いた JLDSL がある。仕様を検討するにあたり、まずは性能評価基準（本文に添付されている）を作成中である。

性能評価基準は必ずしもスペクトル基準 JJ100.01 を基にして作成されているわけではないが、JJ100.01 を参照して決定されている項目が少なからず存在する。例えば線種もそのうちの一つで、現在の JLDSL 性能評価基準では 0.4mm Poly ループを使用することが合意されている。

11 月 18～20 日に開催された第 4 回 DSL 仕様検討 SWG において、スペクトル管理 SWG に対して、本性能評価基準についての意見を伺うことが合意された。そのため、DSL スペクトル管理 SWG において、スペクトル管理の観点から本性能評価基準についてご意見をいただくことを希望する。

以上

[1] 連絡先：DSL 仕様検討 SWG
堺 和則（リーダ） Tel: 04-7185-7517 E-mail: k-sakai@ap.jp.nec.com
長谷川 一知（サブリーダ） Tel: 044-822-1645 E-mail: hase@access.fujitsu.com

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ABSTRACT

The present contribution gives an update of the JLDSL criteria. This update takes into account the ongoing discussion about HBL and extended Upstream criteria, up to the particular features inherent to Long Reach systems.

Some issues are still open that require further debate, such as the and G.992.1 FDM and Overlap Injection Points.

[1] Contact: JLDSL working Group Coordinator.
Patrick DUVAUT: pdu@globespanvirata.com; Tel: 1 732 345 6119; Fax: 1 732 345 7503
Massimo Sorbara, GlobespanVirata Inc.; T: +1 732-345-7535; E: msorbara@globespanvirata.com
Andrew Klaus, GlobespanVirata Inc.; T: +813-5449-7484; E: aklaus@globespanvirata.com

1 Introduction

The present contribution gives an update of the JLDSL criteria. This update takes into account the ongoing discussion about HBL and extended Upstream criteria, up to the particular features inherent to Long Reach systems.

Some issues are still open that require further debate, such as the and G.992.1 FDM and Overlap Injection Points.

2 JLDSL Performance Evaluation Criteria

2.1 Loop (Agreed)

JLDSL performance is evaluated considering 0.4mm Poly loops.

{###Ed. Note: Per Recommendation from Spectrum Management SWG, it would require that this agreed item be re-opened}

2.2 Noise Conditions (Agreed)

Table 2-1 summarizes the 4 noise conditions.

CO/CP Noise	Self	TCM-ISDN	g.992.1 FDM	g.992.1 OL	Self	WN -140dbm/hz
N1	1 Intra	0	0	0	1 Inter	background
N2	0	1 Intra	0	0	1 Inter	background
N3	0	0	1 Intra	0	1 Inter	background
N4	0	0	0	1 Intra	1 Inter	background

Table 2-1. JLDSL Noise scenarios

Each of the 4 Noise scenarios includes one Inter-Quad Self Interferer plus –140dBm/Hz white Noise.

The total NEXT Cross talk spectral density $\hat{\gamma}_T^{NEXT}(f)$ is equal to:

$$\hat{\gamma}_T^{NEXT}(f) = \hat{\gamma}_{Intra}(f).10^{-\frac{X_{Intra}^{NEXT}}{10}} + \hat{\gamma}_{Inter}(f).10^{-\frac{X_{Inter}^{NEXT}}{10}}$$ **Equation 1**

The total FEXT Cross talk spectral density $\hat{\gamma}_T^{FEXT}(f)$ is equal to:

$$\hat{\gamma}_T^{FEXT}(f) = \left|\hat{h}_{loop}(f)\right|^2 \left(\hat{\gamma}_{Intra}(f).10^{-\frac{X_{Intra}^{FEXT}}{10}} + \hat{\gamma}_{Inter}(f).10^{-\frac{X_{Inter}^{FEXT}}{10}} \right)$$ **Equation 2**

The 4 attenuation values $X_{Intra}^{NEXT}, X_{Inter}^{NEXT}, X_{Intra}^{FEXT}, X_{Inter}^{FEXT}$ in dB are given by JJ-100 R2 Tables for 0.4mm POLY for one Interferer.

2.3 NEXT & FEXT Coupling Values (Agreed)

95%.

2.4 CPE Injection Points (Open)

Cross talks Injection Points are given in Table 2-2.

Self	Co-located at the CPE
TCM-ISDN	**TBD**
g.992.1 FDM	**TBD**
g.992.1 OL	**TBD**
FBMsOL	Co-located at the CPE

Table 2-2. Cross talks injection Points.

2.5 Loops Scenarios (Agreed)

The 9 Loops scenarios are detailed in table 2-3.

Table 2-3. Loop scenarios

L1	5 km 0.4mm POLY
L2	5.5km 0.4 mm POLY
L3	6km 0.4 mm POLY
L4	6.5km 0.4mm POLY
L5	7km 0.4mm POLY
L6	L1 + 1BT
L7	L2 + 1BT
L8	L3 + 2BT
L9	L4 + 1BT

The bridge taps are defined as follows:

BT, L6,7,9 Located at the CPE, 300 m, 0.4mm POLY
BT L8 One Located at the CPE, 300m, 0.4mm POLY Another One located at 3km, 250m, 0.4mm POLY

{###Ed. Note: Per Recommendation from Spectrum Management SWG, it would require that this agreed item be re-opened}

2.6 Simulation Tunings (agreed)

Generic Tunings.

Table 2-3 displays the generic simulation tunings for both Upstream and Downstream Channels.

Table 2-4 Simulation Tunings

Margin	6dB
Bit Loading Range	2bits to 15 bits
Cut back	Power Cut back OFF
Echo	70dB atenuation

Bit Loading Rules, Channel Coding and Payload Rate calculation.

The Gross number of loaded bits g_k per bin k is based on $G = 7.5dB$ Gross Coding gain, $M = 6dB$ Margin and the signal to Noise Ratio per bin in dB snr_k after FEQ.

Let $SNR[n], \quad 2 \le n \le 15$ denotes the signal to Noise ratio in dB required to Load a QAM n Bits, ensuring 10^{-7} Bit Error Rate.

Table 2-5 gives $SNR[n],$ for n ranging from 2bits up to 15 bits.

Table 2-5. Required Signal To Noise ratio $SNR[n],$ to load a QAM n with 10^{-7} of Bit error rate.

n in Bits	SNR[n] in dB
2	14.5
3	18.2
4	21.5
5	24.7
6	27.7
7	30.8
8	33.8
9	36.8
10	39.8
11	42.8
12	45.8
13	48.8
14	51.8
15	54.8

Because of the Gross coding gain G and the Margin M, the required Signal to Noise ratio to load a QAM n ensuring 10^{-7} BER is modified according to the following formula where $MSNR[n]$ stands for the modified Signal to Noise Ratio:

$$MSNR[n] = SNR[n] - G + M, \quad 15 \ge n \ge 2$$ **Equation 3**

Taking into account the 7.5dB gross coding gain G and the 6 dB margin M the modified Signal to Noise ratio is equal to:

$$MSNR[n] = SNR[n] - 1.5dB, \quad 15 \ge n \ge 2$$ **Equation 4**

Then the Gross number of loaded bits per bin k is derived from the following procedure:

$$\begin{aligned} & g_k = n, \\ & if \\ & SNR[n] - 1.5 \le snr_k \; \pi \; SNR[n+1] - 1.5 \\ & for \quad 2 \le n \le 15 \end{aligned}$$ **Equation 5**

&

$$\begin{aligned} & g_k = 0 \\ & if \\ & snr_k \; \pi \; SNR[2] - 1.5 \end{aligned}$$ **Equation 6**

The Payload Rate R in kb/s depends upon Reed Solomon and Trellis efficiencies[2] ρ_{RS} and ρ_{TR} :

$$R = \left\lfloor 4.\rho_{RS}.\rho_{TR}.\sum_{k \in Loaded\ Bins\ Set} g_k \right\rfloor_{Floor} \qquad \textbf{Equation 7}$$

Reed Solomon (resp. Trellis) efficiency is the ratio of number of paylaod bits to the number of transmitted bits after Reed Solomon (resp. Trellis) Coding operation.

Efficiencies are of course smaller than one. If a Reed Solomon $RS[N,K], K \leq N$ is used then:

$$\rho_{RS} = \frac{K}{N} \qquad \textbf{Equation 8}$$

To detail the Trellis efficiency, ρ_{TR} we need to introduce the Gross Number of Loaded bit g_q^{4D} per 4D symbol $q, 1 \leq q \leq N_{DMT}^{4D}$.

N_{DMT}^{4D} designates the number of 4D symbols at the scale of one DMT symbol, then:

$$\rho_{TR} = \frac{\sum_{q=1}^{N_{DMT}^{4D}} \left(g_q^{4D} - 1\right)}{\sum_{q=1}^{N_{DMT}^{4D}} g_q^{4D}} \qquad \textbf{Equation 9}$$

since ADSL Trellis introduces one redundant bit per 4D symbol.

Downstream Channel Assumption

Reed Solomon $RS[255,239]$.

Upstream Channel Assumption

Reed Solomon $RS[255,253]$.

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[2] Usually these numbers are called Code Rates, to avoid confusion with the payload rate, we call them efficiencies.

2.7 Performance evaluation criteria summary & Calibration (Agreed)

Table 2-6 summarizes the 45 JLDSL scenarios.

Table 2-6. 45 JLDSL scenarios summary

JDSL	N1	N2	N3	N4	N5
L1					
L2					
L3					
L4					
L5					
L6					
L7					
L8					
L9					

For calibration purposes performance shall be evaluated against the 9 loops in the presence of –140dBm/Hz white noise only.

3 Conclusion

The present contribution gives an update of the JLDSL criteria. This update takes into account the ongoing discussion about HBL and extended Upstream criteria, up to the particular features inherent to Long Reach systems.

Some issues are still open that require further debate, such as the aggregate NEXT and FEXT calculation and G.992.1 FDM and Overlap Injection Points.