TTC DSL 専門委員会スペクトル管理 SWG

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**ABSTRACT**

**The present contribution evaluates the Performance of Extended Upstream Systems defined in [1] and [2] by Centilium Communications.**

**In the presence of Annex Abis fdm intra-quad disturbance, EU-64 Upstream performance gain vs Annex Abis fdm decreases very quickly versus distance, although the EU-64 Downstream channel looses ~1.8 Mb/s, versus.**

**In the same situation, GSV EU [4] system exhibits a little smaller upstream rate than CTLM EU but without significant downstream performance loss. GSE EU thus demonstrates a much better balance between Upstream and downstream than CTLM EU systems. <u>This feature is very important since the Japan copper access network is downstream limited.</u>**

**The above conclusions lead thus to question the worthiness of CTLM EU systems. SWG & TTC committee should consider EU solutions that exhibit a much better balance between upstream and downstream than CTLM EU systems, such as GSV EU systems.**

Contact:
Andrew Klaus, GlobespanVirata Inc.; T: 03-5449-7484; E: aklaus@globespanvirata.com
Patrick Duvaut, GlobespanVirata Inc.; T: +1-732-345-6119; E: pdu@globespanvirata.com

# 1 Introduction

The present contribution evaluates the Performance of Extended Upstream Systems defined in [1] and [2] by Centilium Communications. Section 2 & 3 details the Upstream and Downstream masks features. Simulation conditions are given in section 4. Performance is reviewed in section 5.

# 2 Extended Upstream Mask Definition

Figure 1 and Table 1 detail the extended upstream PSD mask copied from G.992.5 Annex M. The parameters for the family of PSDs in Table 1 are proposed for the FEXT bitmap, and those in Table 2 are proposed for the NEXT bitmap, from [2].

**Figure 1. EU g.992.5 Annex M EU Peak values, from [2]**

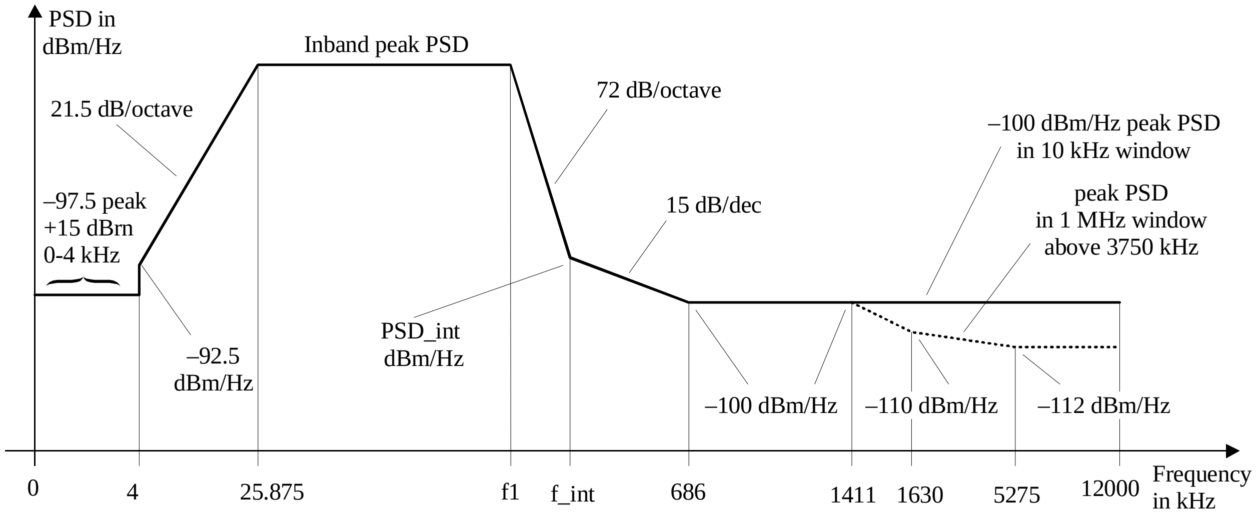



**Table 1. From [2] Annex M g.992.5 EU masks**

| Frequency (kHz) | PSD level (dBm/Hz) | Measurement BW |
|---|---|---|
| 0 | -97.5 | 100 Hz |
| 4 | -97.5 | 100 Hz |
| 4 | -92.5 | 100 Hz |
| 10 | interpolated | 10 kHz |
| 25.875 | Inband_peak_PSD | 10 kHz |
| f1 | Inband_peak_PSD | 10 kHz |
| f_int | PSD_int | 10 kHz |
| 686 | -100 | 10 kHz |
| 5275 | -100 | 10 kHz |
| 12000 | -100 | 10 kHz |

**Table 2. From [2] Parameters for Annex C extended upstream in FEXT bitmap**

| Upstream Mask-Number | *2.1 Designator* | Template Nominal PSD $P_0$ (dBm/Hz) | Template Maximum Aggregate Transmit Power (dBm) | Inband Peak PSD (dBm/Hz) | Frequency *f1* (kHz) | Intercept Frequency *f_int* (kHz) | Intercept PSD Level *PSD_int* (dBm/Hz) |
|---|---|---|---|---|---|---|---|
| 1 | EU-32 | -38.0 | 12.5 | -34.5 | 138.00 | 242.92 | -93.2 |
| 2 | EU-36 | -38.5 | 12.5 | -35.0 | 155.25 | 274.03 | -94.0 |
| 3 | EU-40 | -39.0 | 12.5 | -35.5 | 172.50 | 305.06 | -94.7 |
| 4 | EU-44 | -39.4 | 12.5 | -35.9 | 189.75 | 336.33 | -95.4 |
| 5 | EU-48 | -39.8 | 12.5 | -36.3 | 207.00 | 367.54 | -95.9 |
| 6 | EU-52 | -40.1 | 12.5 | -36.6 | 224.25 | 399.07 | -96.5 |
| 7 | EU-56 | -40.4 | 12.5 | -36.9 | 241.50 | 430.58 | -97.0 |
| 8 | EU-60 | -40.7 | 12.5 | -37.2 | 258.75 | 462.04 | -97.4 |
| 9 | EU-64 | -41.0 | 12.5 | -37.5 | 276.00 | 493.45 | -97.9 |

**Table 3: from [2] Parameters for Annex C extended upstream in NEXT bitmap**

| Upstream Mask-Number | *2.2 Designator* | Template Nominal PSD $P_0$ (dBm/Hz) | Template Maximum Aggregate Transmit Power (dBm) | Inband Peak PSD (dBm/Hz) | Frequency *f1* (kHz) | Intercept Frequency *f_int* (kHz) | Intercept PSD Level *PSD_int* (dBm/Hz) |
|---|---|---|---|---|---|---|---|
| 1 | EU-32 | -38 | 12.5 | -34.5 | 138.00 | 242.92 | -93.2 |
| 2 | EU-36 | -38.7 | 12.5 | -35.2 | 155.25 | 273.47 | -94.0 |
| 3 | EU-40 | -39.9 | 12.5 | -36.4 | 172.50 | 302.26 | -94.7 |
| 4 | EU-44 | -40.7 | 12.5 | -37.2 | 189.75 | 331.87 | -95.3 |
| 5 | EU-48 | -41.4 | 12.5 | -37.9 | 207.00 | 361.55 | -95.8 |
| 6 | EU-52 | -41.8 | 12.5 | -38.3 | 224.25 | 392.16 | -96.4 |
| 7 | EU-56 | -42.1 | 12.5 | -38.6 | 241.50 | 423.12 | -96.9 |
| 8 | EU-60 | -42.3 | 12.5 | -38.8 | 258.75 | 454.51 | -97.3 |
| 9 | EU-64 | -42.3 | 12.5 | -38.8 | 276.00 | 486.91 | -97.8 |

*Note.* There is an inconsistency between Figure 1 and Tables 2 and 3 regarding the slope of the low frequency edge of the Extended Upstream Systems. According to Figure 1, the slope should be constant and equal to 21.5dB/octave. Since the PSD flat peak value changes and since the corner point at 4Khz and the cut-off frequency of 25.875KHz are fixed, then the slope should change. Table 4 gives the slope value of the low frequency edge for both NEXT and FEXT Bit map consistent with tables 2 and 3.

**Table 4. Slopes of the Low frequency edge**

| System | FEXT Slope dB/Oct | NEXT Slope dB/Oct |
|---|---|---|
| EU-32 | 21.53 | 21.53 |
| EU-36 | 21.34 | 21.27 |
| EU-40 | 21.16 | 20.82 |
| EU-44 | 21.01 | 20.53 |
| EU-48 | 20.86 | 20.27 |
| EU-52 | 20.75 | 20.12 |
| EU-56 | 20.64 | 20.01 |
| EU-60 | 20.53 | 19.93 |
| EU-64 | 20.41 | 19.93 |

## 3 Downstream Masks used

Downstream mask have a tunable high pass cut-off frequency to ensure an FDM mode of operation. The DS masks start to be flat at f1. Below f1 they exhibit a 36dB/octave slope down to -97.5dBm/Hz plateau. Above f1, the downstream mask is identical to g.992.1. Pilot Tone 64 is not loaded.

# 4 Simulation Conditions

### *4.1 Loop*

0.4mm Poly, Loops should be 0 – 5km with a 250 meter step size.

### *4.2 Noise Conditions*

See Table 5.

**Table 5. Noises cases**

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

### *4.3 NEXT & FEXT Coupling*

95%

NEXT: 54.3dB

FEXT: 58.4dB

### *4.4 CPE Injection Points*

All the cross talks are co-located at the CPE.

### *4.5 Simulation Tunings*

Generic Tunings, see Tables 6.

**Table 6. Simulation Tunings**

| | |
|---|---|
| **Margin** | 6dB |
| **Bit Loading Range** | 2 bits to 15 bits |
| **Cut back** | Power Cut back OFF |
| **Echo** | 70dB attenuation |

Bit Loading, Channel coding[1] and payload Rate calculation, see [3].

[1] A slight modification has been introduced to take into account an odd number of 2D symbols.

# 5 Simulation Results

### *5.1 Systems Evaluated*

Reference system:

- Annex Abis FDM

EU Systems:

- EU 64 – DS 64---255

### *5.2 Simulations Summary*

Table 7 summarizes the EU performance simulations.

**Table 7. Performance Simulations Summary**

| Disturbers<br>Systems | SELF<br>1 Intra 95% | TCM-ISDN<br>1 Intra 95% | Annex Abis fdm<br>1 intra 95% |
|---|---|---|---|
| **Annex Abis fdm** | rate vs reach DS, US | rate vs reach DS, US | rate vs reach DS, US |
| **EU-36** | rate vs reach DS, US | rate vs reach DS, US | rate vs reach DS, US |

### *5.3 Simulations results*

Figure 2 and 3 gives the simulation results according to table 7. According to figure 4 and 5, we conclude that EU-64 Upstream performance gain vs Annex Abis fdm decreases very quickly versus distance, although the EU-64 Downstream channel looses ~1.8 Mb/s at any distance.

**Figure 2. DS Performance Annex Abis fdm vs EU-64, 1 Intra-Quad SELF Disturber**

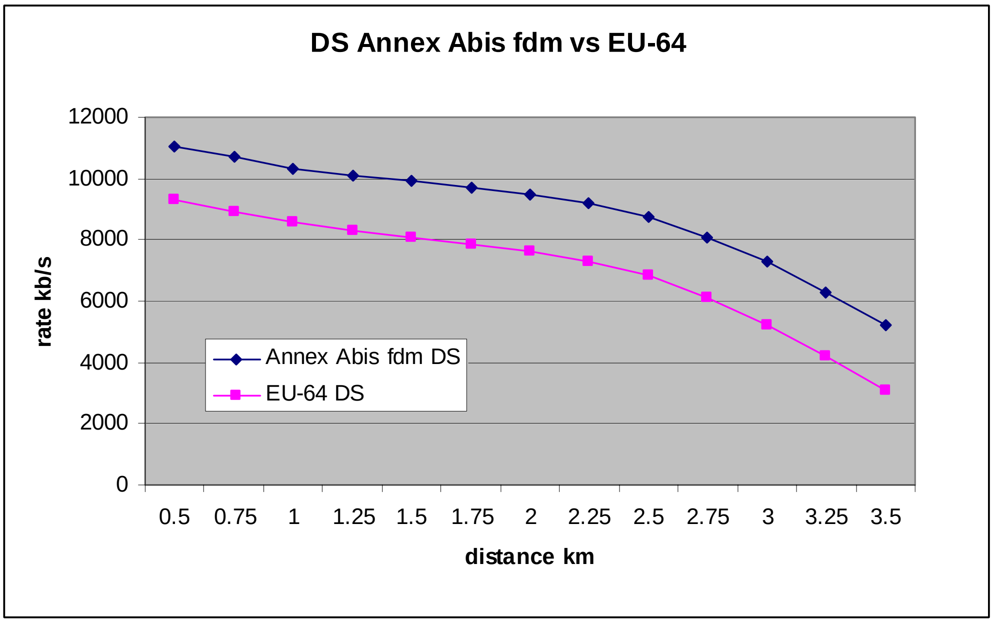



**Figure 3. US Performance g.992.1 fdm vs EU-64, 1 Intra-Quad SELF Disturber**

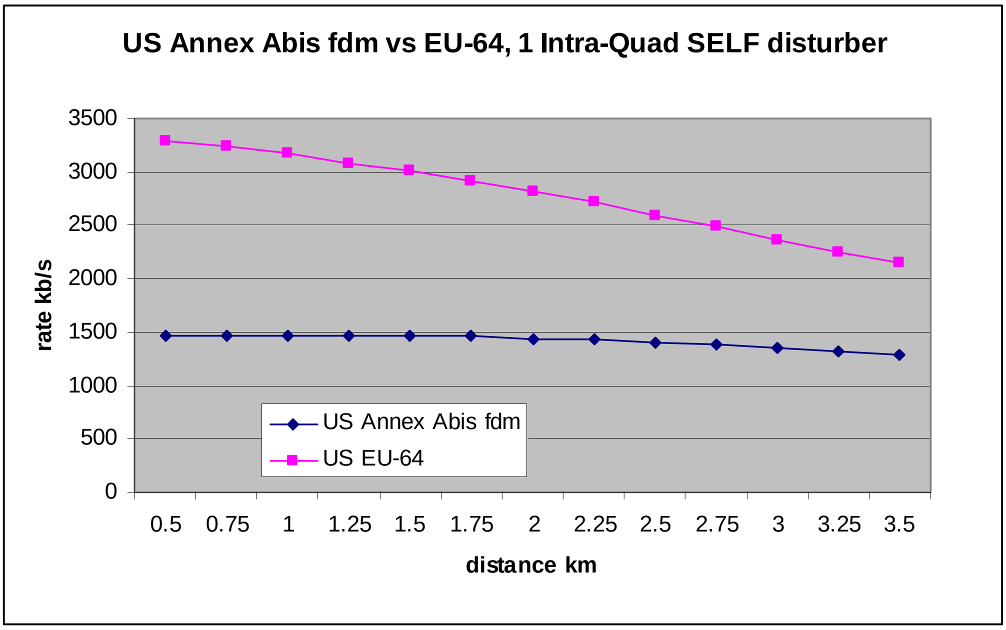


**Figure 4. DS Performance Annex Abis fdm vs EU-64, 1 Intra-Quad Annex Abis fdm Disturber**

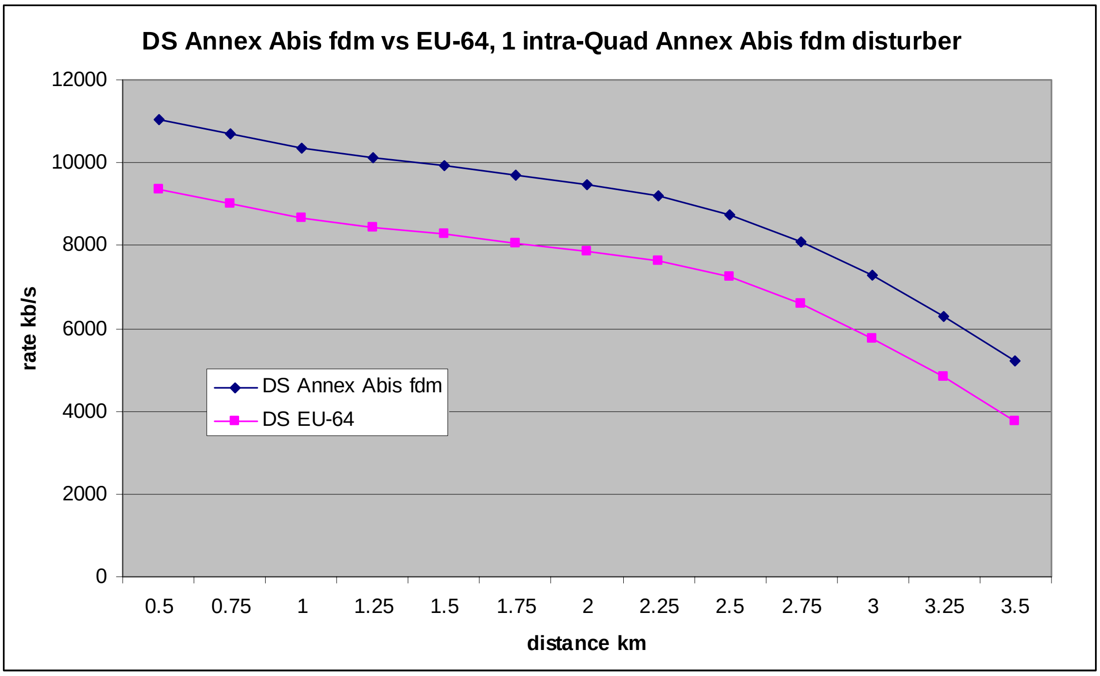



**Figure 5. DS Performance Annex Abis fdm vs EU-64, 1 Intra-Quad Annex Abis fdm Disturber**

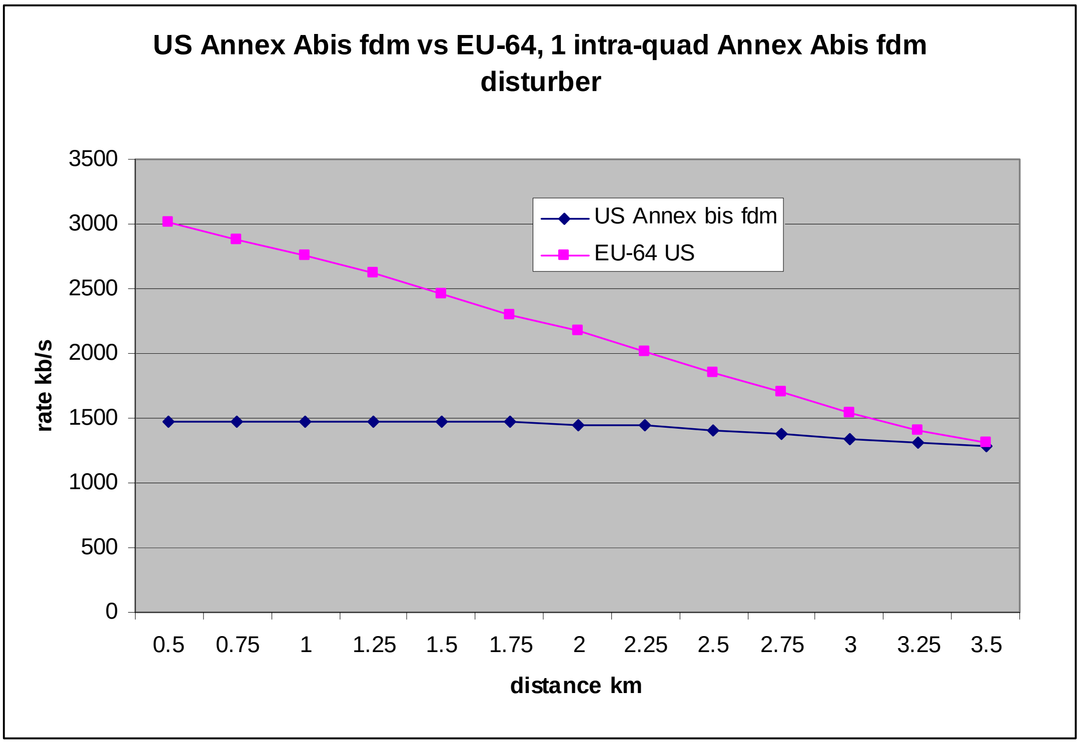


**Figure 6 DS Performance g.992.1 fdm vs EU-64, 1 Intra-Quad TCM-ISDN Disturber**

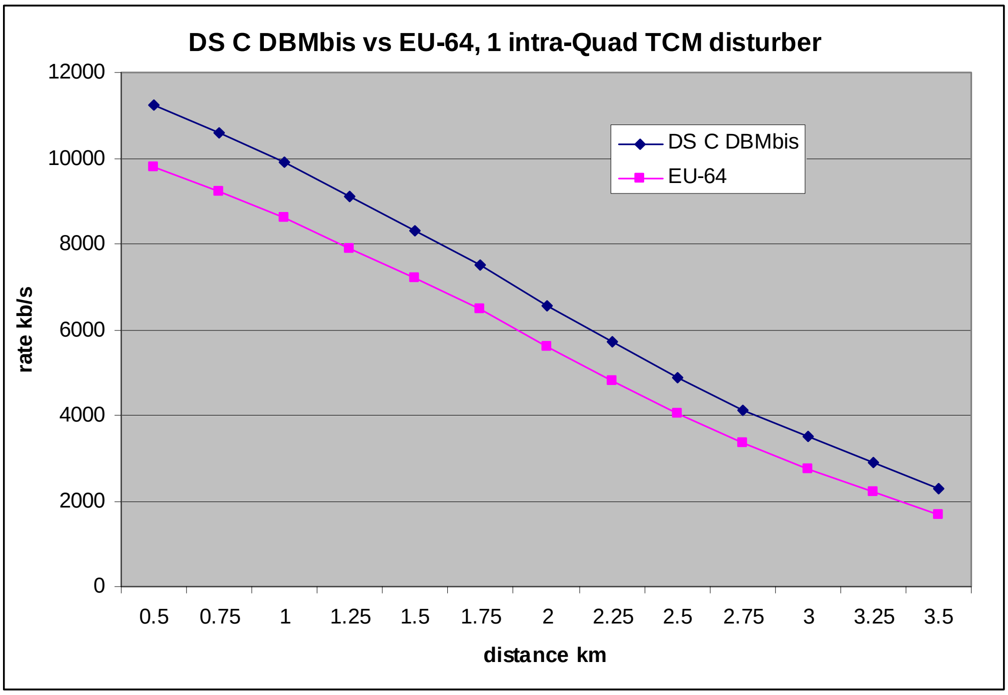



**Figure 7. DS Performance g.992.1 fdm vs EU-64, 1 Intra-Quad TCM-ISDN Disturber**

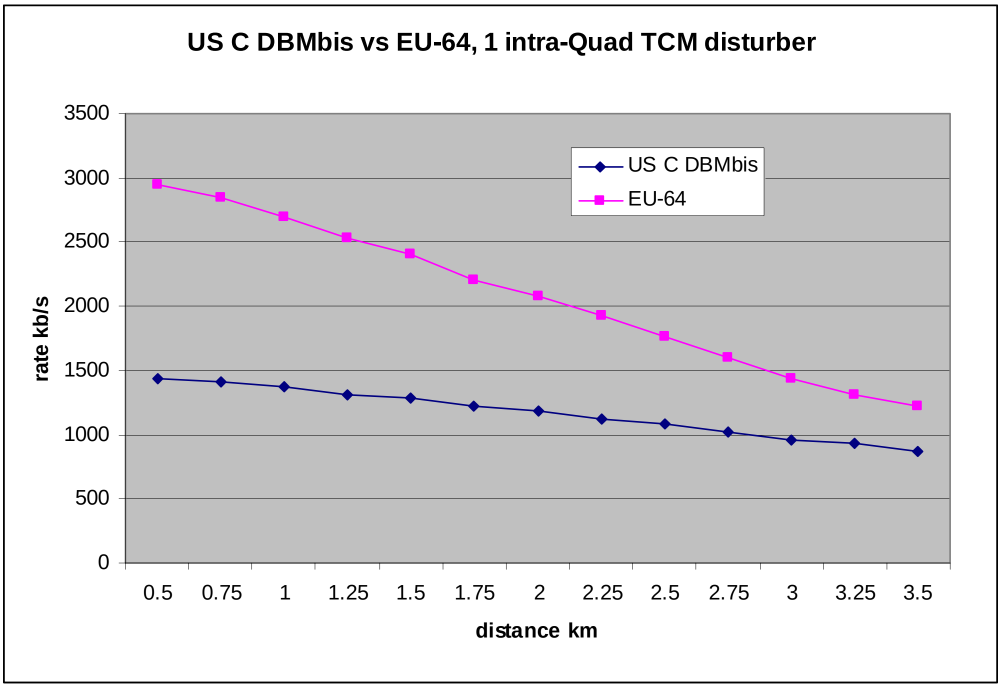



**Figure 8. DS Performance Annex Abis fdm vs GSV EU [4], 1 Intra-Quad Annex Abis fdm Disturber**

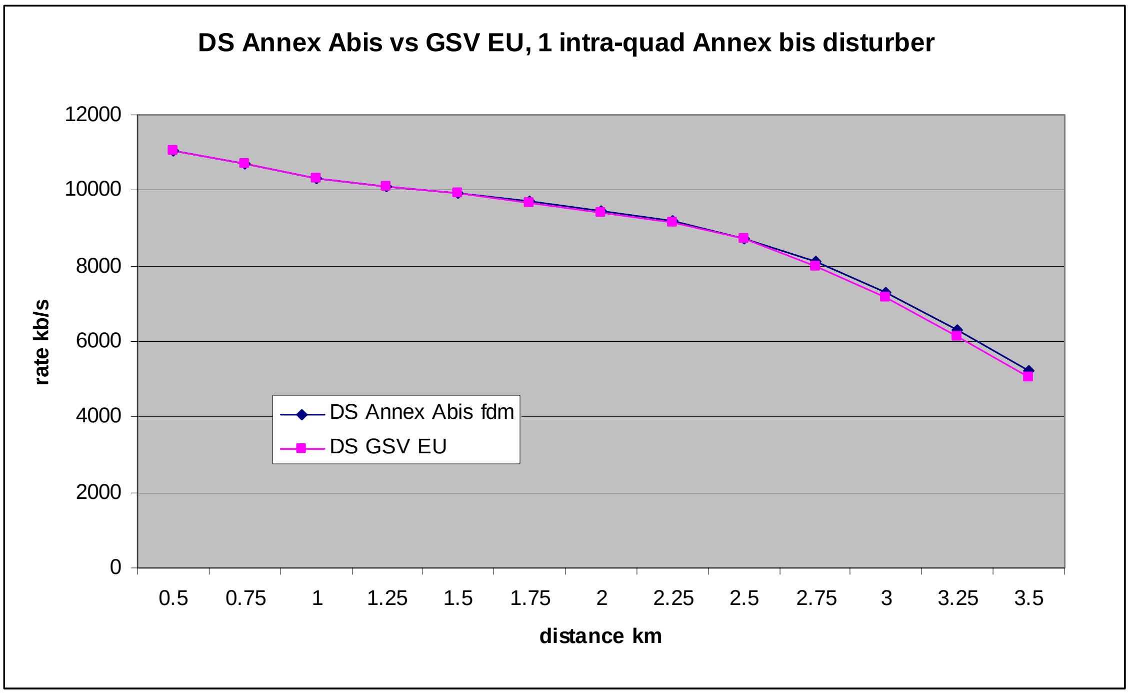
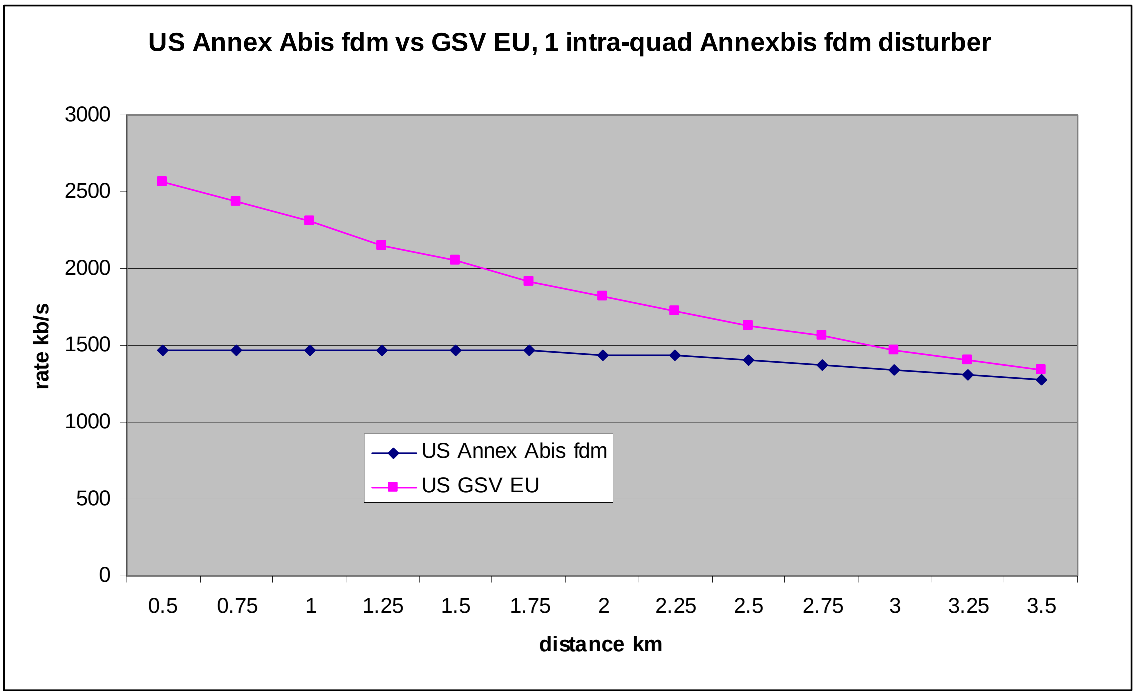



**Figure 9. US Performance Annex Abis fdm vs GSV EU [4], 1 Intra-Quad Annex Abis fdm Disturber**



## 6 Conclusions

The present contribution evaluates the Performance of Extended Upstream Systems defined in [1] and [2] by Centilium Communications.

In the presence of Annex Abis fdm intra-quad disturbance, EU-64 Upstream performance gain vs Annex Abis fdm decreases very quickly versus distance, although the EU-64 Downstream channel looses ~1.8 Mb/s, versus.

In the same situation, GSV EU [4] system exhibit a little smaller upstream than CTLM EU but without significant downstream performance loss. GSE EU thus demonstrates a much better balance between Upstream and downstream than CTLM EU systems. This feature is very important since the Japan copper access network is downstream limited.

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## 7 References

[1] SKS03-CTLM02, “Comparison of Extended Upstream proposals”, Centililium Communications, Tokyo, Japan, September 29-30 2003.

[2] SMS05-CTLM-01, "Update of Extended Upstream proposal", Centilium Communications, Tokyo, November 21, 2003.

[3] SKS-03-CTLM-01, "Extended Upstream performance Criteria", Centilium Communications, Tokyo, September 29-30, 2003.

[4] SKS-03-GSV04, “3/50 Spectral Compatibility revision r1”, GlobespanVirata, Tokyo, September 29-30, 2003.