Modified Flexible Bandplan 998 for Variable Rate Symmetric VDSL Applications

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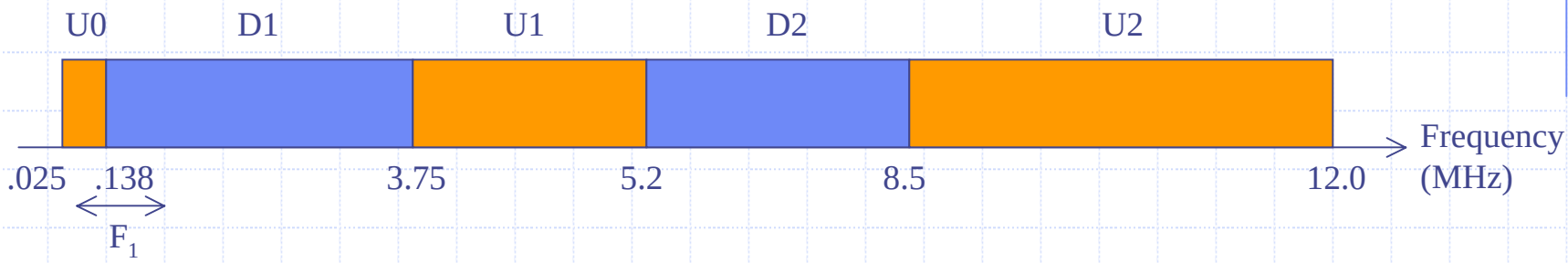
Introduction

- Target Improved Performance of Symmetric Transport using VDSL
- Modified Version of Band Plan 998 with variable low frequency region
- Also may use to extend reach for asymmetric applications
- Improve Mid-reach Performance:
  - 5Mb/s up to ~2 km
  - 10 Mb/s up to ~1 km

Plan 998 w/ Variable LF Region

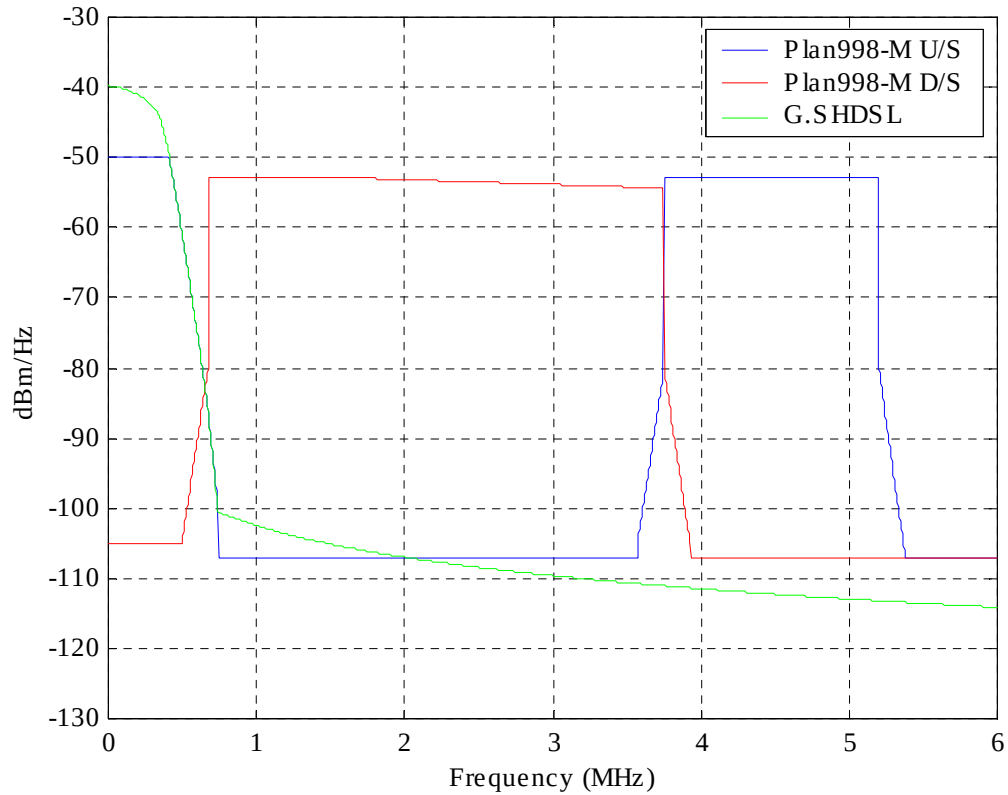


- Vary transition frequency F_1 between U0 and D1 to boost upstream channel bit rate
- F_1 vary between 25 kHz and 490 kHz
- Derived via variable bandwidth capability of SHDSL (G.991.2)
- Define supporting PSD
  - Improve upstream channel performance at reduced downstream channel rate
  - Spectrally Compatible per T1.417

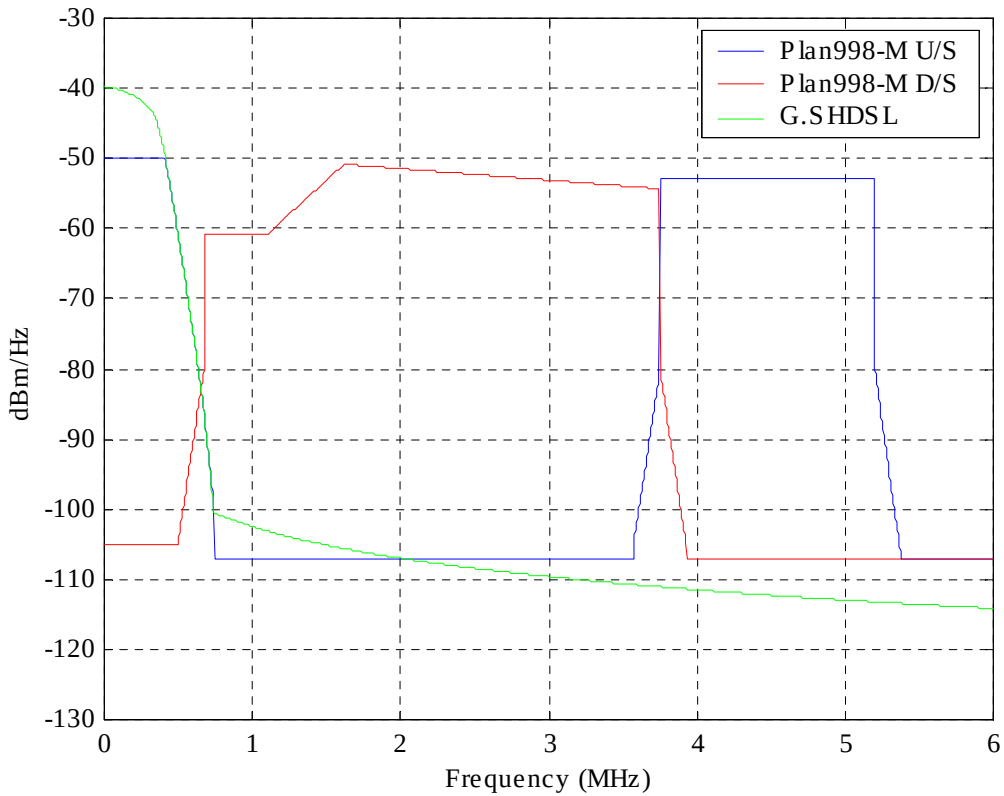
PSD Masks for Modified Plan 998

- U0 band:
  - -50 dBm/Hz maximum from 25 – 490 kHz
  - Based on 2.32 Mb/s SHDSL Bandwidth
- PSD Masks shown in subsequent charts
  - Based on Mask M2 defined in T1.424
  - Similar may be defined based on M1 in T1.424
- PSD Nomenclature
  - Plan998-M: Bands U0, D1, and U1
  - Plan998-M+: Bands U0, D1, U1, D2, and U2

Plan998-M PSD Mask for Exchange



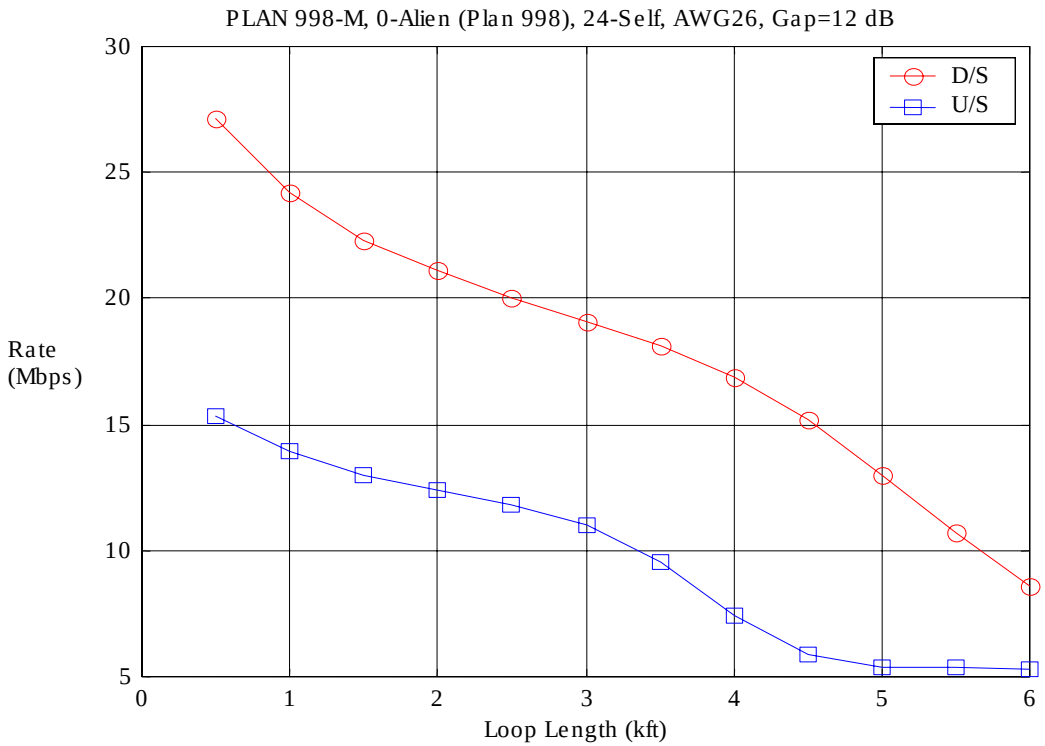
Plan998-M PSD Mask for Cabinet



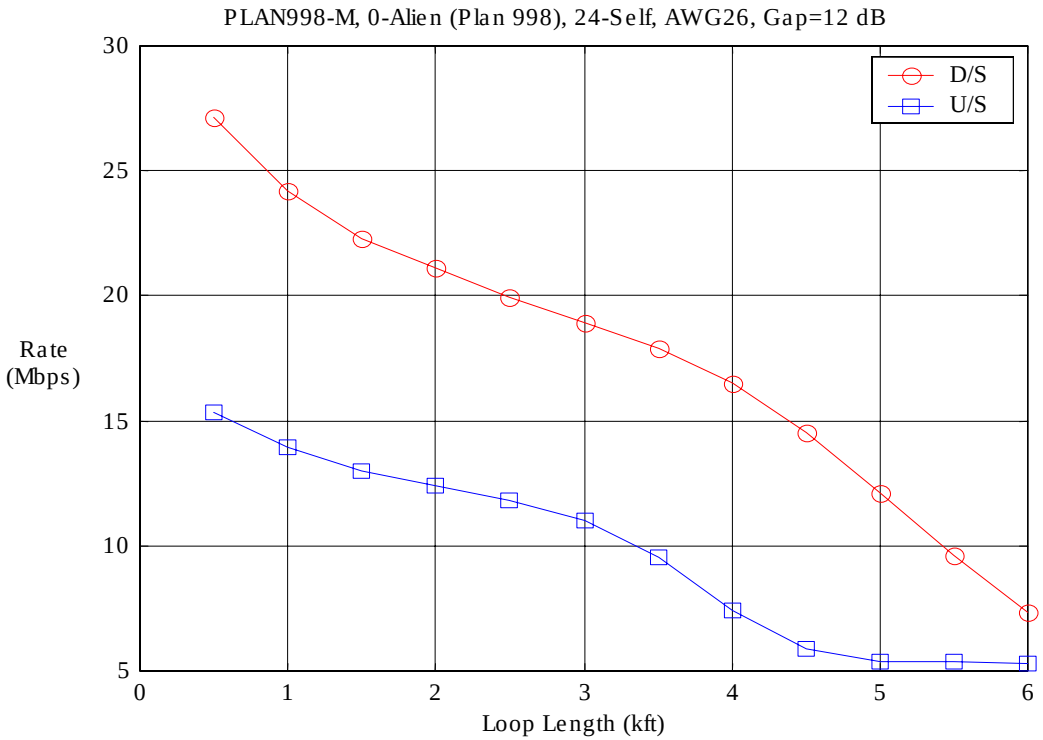
Performance

- Exchange and Cabinet Scenarios
  - 24-Self Cross-talk Disturbers
  - 12-Alien plus 12-Self Disturbers
- -140 dBm/Hz AWGN
- Alien Disturbers based on VDSL FTTex M2 Mask in T1.424 for exchange deployment
- Alien Disturber based on VDSL FTTCab M2 Mask in T1.424 for cabinet deployment
- SNR Gap = 12 dB
- Line Code Independent

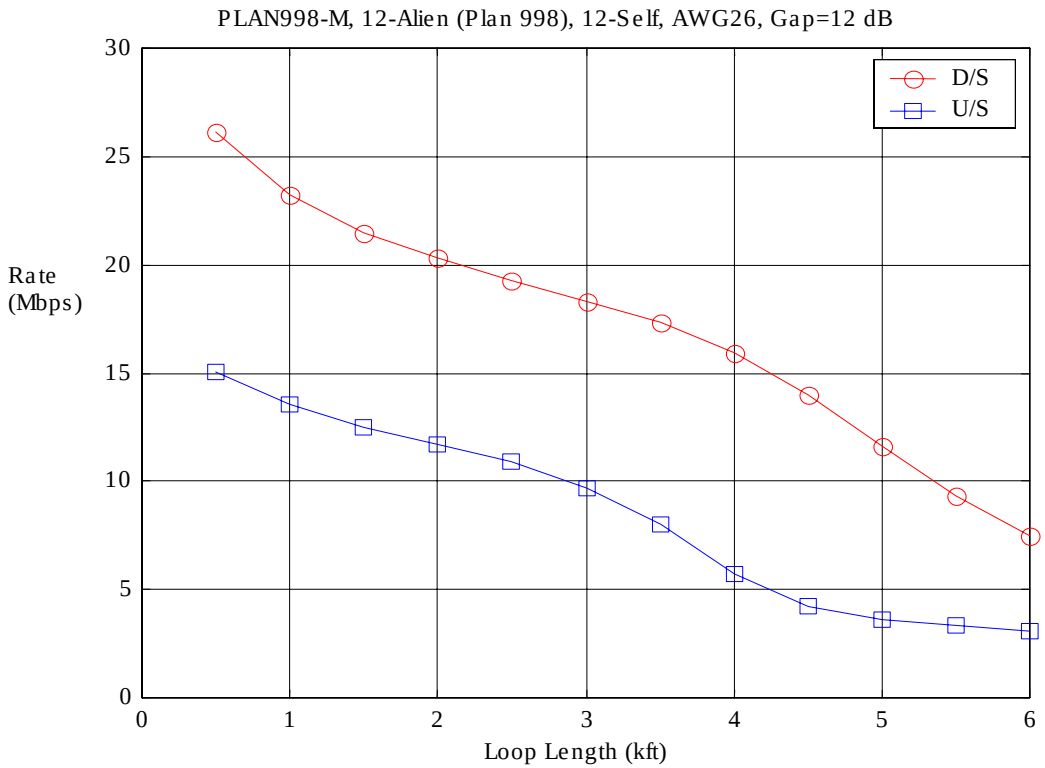
Exchange Deployment Performance: 24-Self Crosstalk



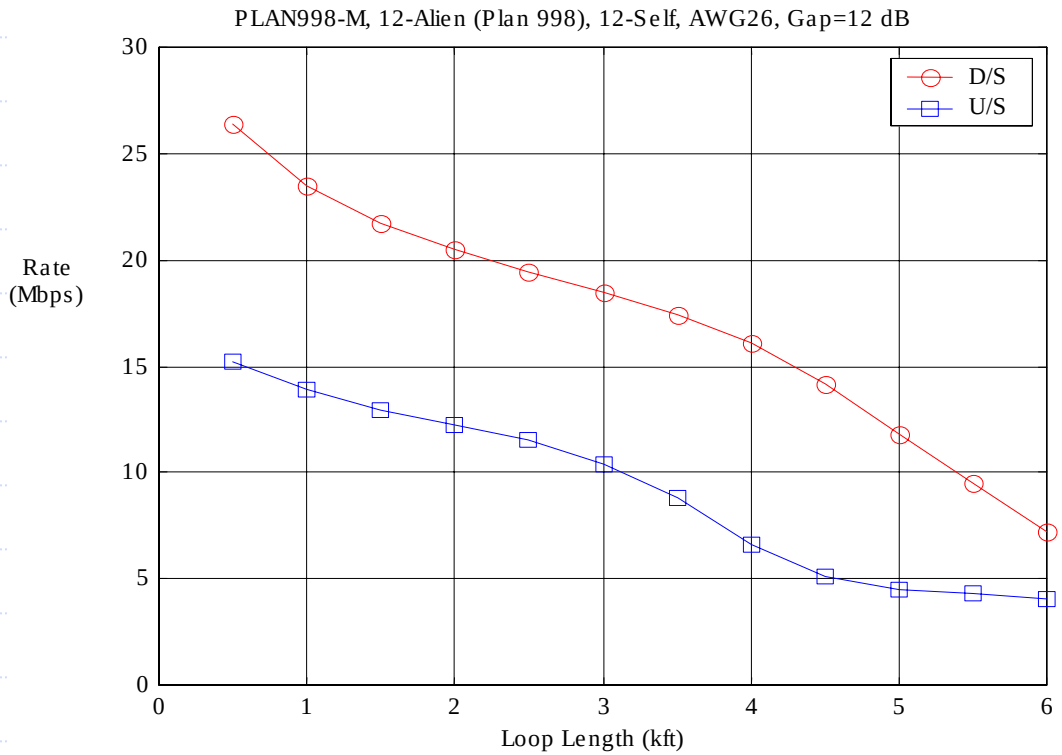
Cabinet Deployment Performance: 24-Self Crosstalk



Exchange Deployment Performance: 12-Self plus 12-VDSL(Plan 998) Crosstalk



Cabinet Deployment Performance: 12-Self plus 12-VDSL(Plan 998) Crosstalk



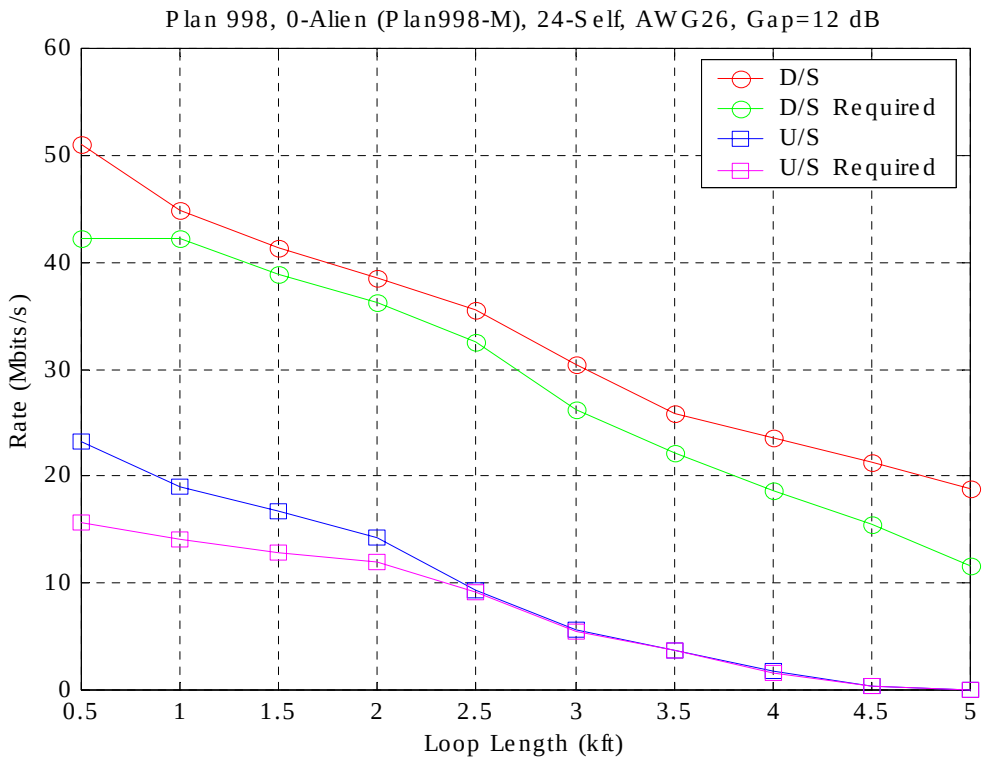
Some Observations on Performance

- Asymmetric Profile: 2.5Mb/s upstream
  - Plan998 provides reach to ~1.1 km
  - Plan998-M(+) provides reach to ~ 2 km
- UPBO
  - U0 may be enabled based on UPBO status
  - When UPBO is needed, band U0 may be turned off
  - May apply extended upstream band (F_1 > 25 kHz) on loops longer than ~1 km

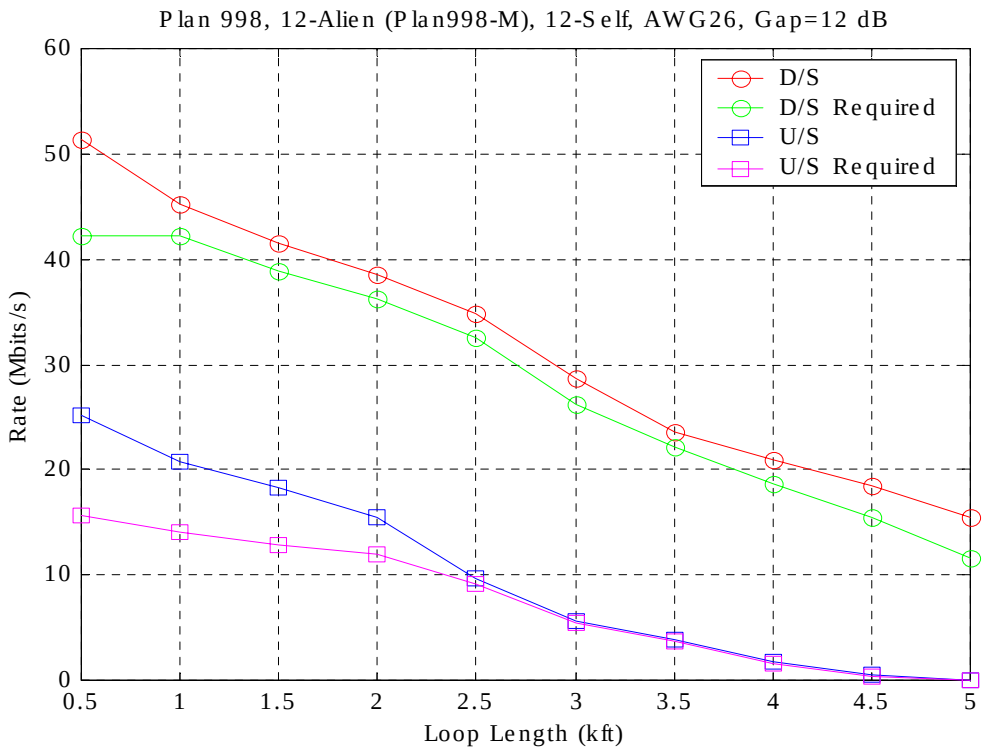
Spectral Compatibility per T1.417

- Spectral Compatibility (SC) computed using the Telcordia SC Computer
- SC tested with ADSL, ISDN, HDSL, HDSL2, 2B1Q SDSL, and SHDSL (G.991.2)
- Show SC with VDSL per criteria in the Draft T1.417 issue 2

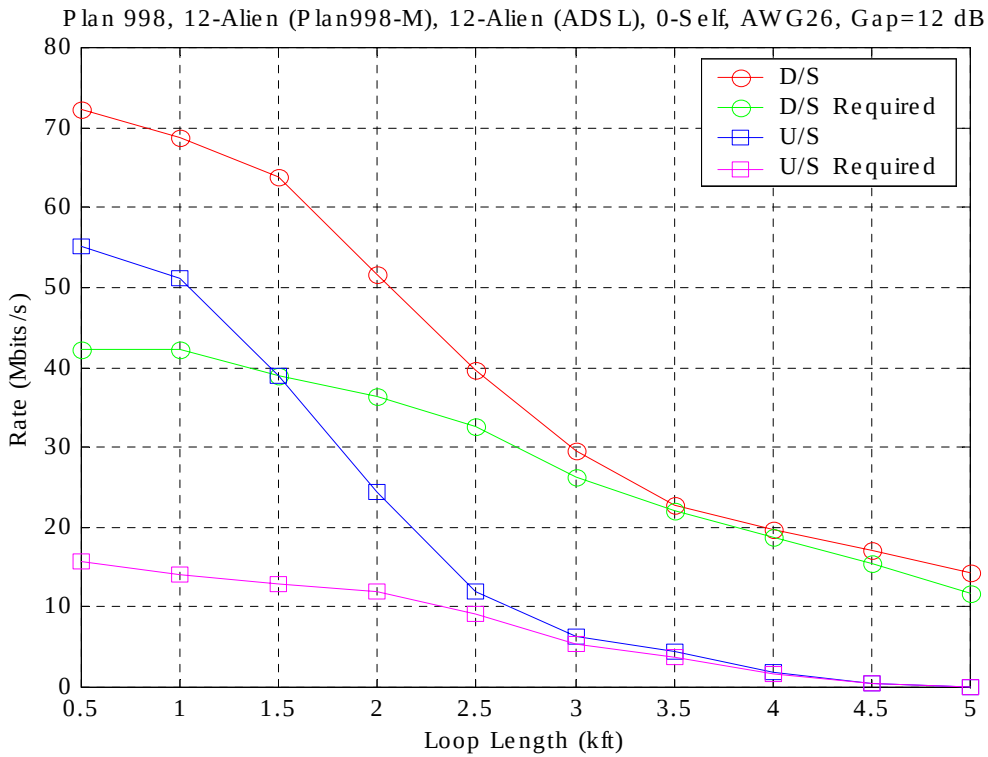
SC of Cabinet PSD: VDSL Plan 998 with 24-Plan998M Cabinet PSD disturbers



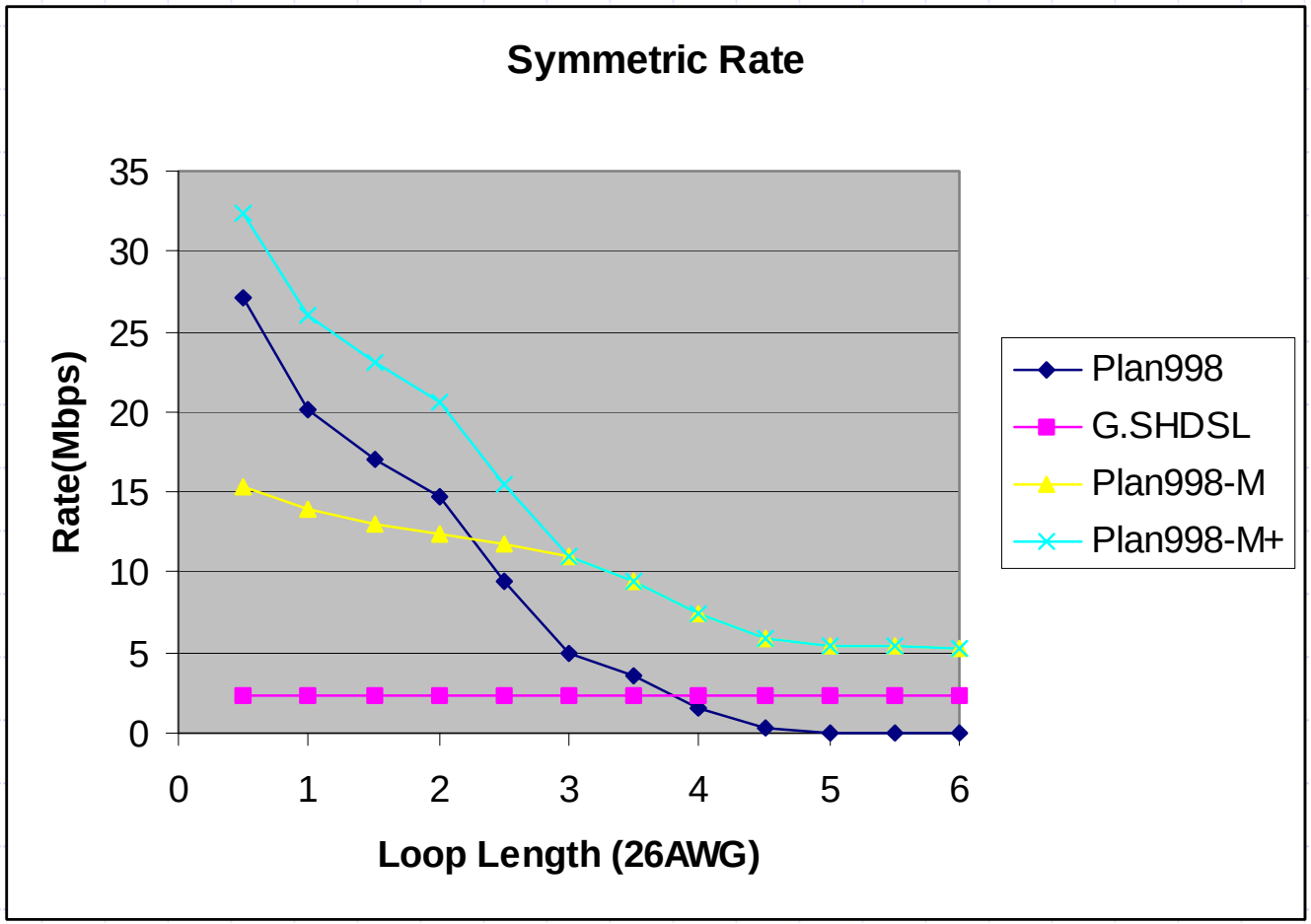
SC of Cabinet PSD: VDSL Plan 998 with 12-Self plus 12-Plan998M Cab disturbers



SC of Exchange PSD: VDSL Plan 998 with 12-CL6 plus 12-Plan998M Ex disturbers



Performance Summary



Summary

- Recommend Variable F_1: 25 – 490 kHz
- Enhance performance of Upstream Channel → More Symmetric Profile
- Enhance service performance on loops beyond ~1 km
- Apply F1>25 kHz on loops where UPBO cannot be used.

Conclusion

- We recommend inclusion of the modified bandplan 998 and the supporting PSDs in the P802.3ah Copper specification, D1.4