Project: **T1E1.4: Spectrum Management II**

Title: **Proposal for Study of Dynamic Spectrum Management for the Evolving Unbundling Architecture of DSL (090)**

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Abstract:

This document proposes the general study of *dynamic spectrum management* in Spectrum Management II, as a function of the potential unbundling alternatives that present themselves for DSL evolution. A companion information-only contribution provides example motivation why such study could lead to better DSL performance [1], while a second companion contribution discusses potential evolutionary paths for unbundling not yet considered by spectrum management standards [2].

***Dynamic spectrum management* allows some or all of the spectra of DSL signals in a binder group emanating from a remote terminal to be allocated as a function of situation or loop demographics, rather than be fixed for all situations.**

NOTICE

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Proposal for Study of Dynamic Spectrum Balancing for the Evolving Unbundling Architecture of DSL (2001-090)

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Abstract:

This document proposes the general study of *dynamic spectrum management* in Spectrum Management II, as a function of the potential unbundling alternatives that present themselves for DSL evolution. A companion information-only contribution provides example motivation why such study could lead to better DSL performance [1], while a second companion contribution discusses potential evolutionary paths for unbundling not yet considered by spectrum management standards [2].

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1. Introduction:

Unbundling architecture at the remote terminal, the "central-office side" of a DSL line, is still largely undecided. Spectrum management and DSL standardization to date have investigated only the situation where service providers energize the physical transmission lines with independently generated signals. Spectra for the different types of DSL signals has been specified for worst-case crosstalking situations with the goal of minimum service disruption among the various DSL signals. Necessarily, such worst-case spectrum management reduces achievable data rates and symmetries with DSL.

Varying levels of coordination for different possible evolutionary paths of unbundling should also be studied in terms of the potential benefit to all DSL. A companion contribution suggests some alternatives where spectra and even line signals could be coordinated in emerging DSL architectures where very large improvements in data rate and symmetry levels are possible, as an example [1]. Particular DSL evolutionary architectures include the possibility of a third party assessment and arbitration of DSL component spectra to vectored coordination of the lines housed within common equipment at a remote terminal.

This contribution proposes a section of the Spectrum Management II standard describe possible architectures and expected improvements from dynamic spectrum management. This contribution also outlines some sub-areas for the Living List that would encourage contributions to assist the generation of the dynamic spectrum management area.

2. The Proposal

A section of the SM2 standard/report shall study the potential specification and improvements of *dynamic spectrum management*, with particular emphasis on alternative DSL architecture evolution.

2.1 Sub Areas meriting specific inclusion on Living List under the DSM section

At least 5 sub areas deserve specific investigation under the Dynamic Spectrum Management heading:

1. Crosstalk channel/spectra identification
2. transfer of channel information to remote location for processing
3. remote specification and control of line spectra in DSL modems
4. Coordination of line spectra among DSL modems (spectrum balancing)
5. Coordination of line signals among DSL modems (vectoring)

Items 2 and 3 specifically address a format for specifying maintenance signals that may flow from/to DSL connections and a third party, while items 4 and 5 are distinguished by the level of coordination possible among modems (coordination of only spectra and coordination in the modem generation of signals respectively).

For information only, it was suggested by early readers of this draft that each of the 5 items being somewhat further defined (although clearly that would be ultimate goal of the spectrum management section itself) – we attempt by example here to define so the reader has an idea of what was intended:

1. **Crosstalk channel.spectra definition -** This means that methods for adaptively on-line or otherwise specifying the crosstalk coupling functions, either magnitude only or possibly magnitude and phase, between lines with significant mutual electromagnetic coupling.
2. **Transfer of Channel Info** – the protocol necessary for informing any entity controlling spectra of the identified characteristics in item 1 above or equivalent information.
3. **Remote specification and control** – the protocol necessary to adjust the spectra of any individual DSL line that might allow such specification
4. **Coordination of Line Spectra** – enumeration of algorithms suggested or standardized for computing the spectra of the various DSLs
5. **Coordination of Line Signals** – specification of methods suggested or standardized for simultaneously exciting more than one DSL transmitter with cognizance of other transmit signal values, i.e., vectoring methods.

3. References:

[1] "Example benefits of Dynamic Spectrum Management," J. Cioffi, G. Ginis, W.Yu, and C. Zeng, J, *T1E1.4 Contribution 2001-089,* February 2001, Los Angeles, CA.

[2] "Unbundled DSL Evolution," J. Cioffi, J, *T1E1.4 Contribution 2001-088,* February 2001, Los Angeles, CA.