

DSL Forum

Technical Report

TR-057

(Formerly WT-068v5)

VDSL

Network Element Management

February 2003

Abstract:

This document specifies the management framework for managing VDSL lines at the NE-EMS (Network Element to Element Management System) interface. The framework is specified in a management protocol independent manner.

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1 Background

VDSL standardization work is being done by ANSI^{[1][2][3]}, ETSI^{[10][11]}, and ITU-T^[4]. There is also a draft VDSL MIB proposal in IETF^[6].

This working-text specifies the management framework for managing VDSL lines at the NE-EMS (Network Element to Element Management System) interface. The framework specifies the parameters to be used at this interface in a management protocol independent manner. This framework is expected to form the basis for protocol-specific MIB development.

2 VDSL Configuration Parameters

This section lists the parameters necessary for the configuration of VDSL lines.

2.1 *Applicable Standard*

This parameter specifies the applicable VDSL standard (if any) that is associated with this VDSL line.

The following options are available:

- *ITU-T*
- *ANSI*
- *ETSI*
- *Other*

2.2 *Deployment Scenario*

This parameter specifies the deployment scenario applicable to this VDSL line.

The options are:

- *FTTC*
- *FTTEx*

2.3 *Spectrum Management*

VDSL spectral usage is defined by the band plan. The various standard bodies have defined a number of band plans that have regional significance. This configuration can be achieved by the following parameters per VDSL line.

2.3.1 *VDSL Band Plan:*

Selected from one of the following:

- *ITU-T G.993.1 Bandplan-A* (same as ANSI Plan 998, ETSI bandplan)
- *ITU-T G.993.1 Bandplan-B* (same as ANSI Plan 997, ETSI bandplan)
- *ITU-T G.993.1 Bandplan-C*
- *Other* (for non-standard bandplans)

2.3.2 *Band Plan C Variable Frequency (Fx):*

ITU-T G.993.1 Bandplan-C supports a variable frequency (Fx) which can be in the range of 3.75 to 12 MHz.

2.3.3 *Optional Band Usage:*

ITU-T, ETSI and ANSI describe optional use of the spectrum in the range of 25 kHz to 138 kHz. This parameter specifies if the band is used, and if so, whether it is used for downstream or upstream transmission. The values may be:

- *Up*
- *Down*
- *Not Used*

2.3.4 *ADSL Service:*

This parameter provisions the presence of ADSL service in the associated cable bundle/binder. Selected from one of the following:

- *None* (no ADSL service present)
- *ADSL over POTS*
- *ADSL over ISDN*

2.4 *Power Spectral Density (PSD) Management*

The power spectral density must be controlled in the downstream and upstream directions. The standard bodies have defined a number of PSD Templates. PSD configuration can be done by following parameters per VDSL line.

2.4.1 *Downstream PSD Template Mask:*

Selected from one of the standard PSD template Masks:

- *Mask-1*
- *Mask-2*

2.4.2 *Upstream PSD Template Mask:*

Selected from one of the standard PSD template Masks:

- *Mask-1*
- *Mask-2*

2.5 *Power Backoff Control*

Optional power backoff is supported in the upstream direction. Downstream power backoff is presently not standardized, but may be supported by vendor-specific implementations. The backoff can be controlled by the following parameters per VDSL line.

2.5.1 *Power Backoff Mode - Upstream*

This parameter selects the backoff mode from one of the following:

- *No Backoff* (backoff disabled)
- *Manual Backoff* (per Manual Backoff Level - Upstream)
- *Automatic Backoff* (based on line measurements per Power Back-off Mask calculation in § 7.1.3.1.1 ^[1])

2.5.2 Manual Power Backoff Level - Upstream

This parameter specifies the upstream power backoff level to be used when Power Backoff Mode - Upstream is set to Manual Backoff. The level may be specified in the range of 0 to 40 dB in 0.25 dB steps, with a default value of 0 dB.

2.5.3 Power Backoff Mode - Downstream (Optional)

This parameter selects the backoff mode from one of the following:

- *No Backoff* (backoff disabled)
- *Manual Backoff* (per Manual Backoff Level - Downstream)
- *Automatic Backoff* (based on line measurements per vendor-specific method)

2.5.4 Manual Power Backoff Level - Downstream (Optional)

This parameter specifies the downstream power backoff level to be used when Power Backoff Mode - Downstream is set to Manual Backoff. The level may be specified in the range of 0 to 12 dB in 0.25 dB steps, with a default value of 0 dB.

2.6 HAM Band Notching

The VDSL spectrum covers a number of HAM radio bands. To avoid interference it is necessary to introduce power control (notching) in one or more of these bands. Following parameters are configured to support HAM band notching per VDSL line.

2.6.1 HAM Band Template

The HAM Band Template configures the HAM bands that should be notched. Following standard HAM bands are defined in the VDSL spectrum:

Start Frequency	Stop Frequency
1810 kHz	2000 kHz
3500 kHz	3800 kHz (ETSI); 4000 kHz (ANSI)
7000 kHz	7100 kHz (ETSI); 7300 kHz (ANSI)
10100 kHz	10150 kHz

Notching for each standard band above can be enabled or disabled.

In addition, at least two more custom notches may be specified:

- *Custom Notch 1:*
 - *Start Frequency in Hz in 10 Hz steps.*
 - *Stop Frequency in Hz in 10 Hz steps.*
 - *Enabled/Disabled*

- *Custom Notch 2:*
 - *Start Frequency in Hz in 10 Hz steps.*
 - *Stop Frequency in Hz in 10 Hz steps.*
 - *Enabled/Disabled*

2.7 Noise Margin Management

The Noise Margin configuration for VDSL is similar to that for ADSL. Following parameters need to be configured per VDSL line.

2.7.1 Maximum Noise Margin - Downstream

The noise margin may be configured between 0 to 31.75 dB in steps of 0.25 dB.

2.7.2 Minimum Noise Margin - Downstream

The noise margin may be configured between 0 to 31.75 dB in steps of 0.25 dB.

2.7.3 Target Noise Margin - Downstream

The noise margin may be configured between 0 to 31.75 dB in steps of 0.25 dB.

2.7.4 Maximum Noise Margin - Upstream

The noise margin may be configured between 0 to 31.75 dB in steps of 0.25 dB.

2.7.5 Minimum Noise Margin - Upstream

The noise margin may be configured between 0 to 31.75 dB in steps of 0.25 dB.

2.7.6 Target Noise Margin - Upstream

The noise margin may be configured between 0 to 31.75 dB in steps of 0.25 dB.

2.8 Data Rate Management

The line data rate management for VDSL is similar to that for ADSL, except that no dynamic rate adaptation is supported for VDSL. As such, following parameters are configurable per VDSL line.

2.8.1 Fast Channel Maximum Data Rate - Downstream

The data rate may be specified in 1 kbps steps.

2.8.2 Fast Channel Minimum Data Rate - Downstream

The data rate may be specified in 1 kbps steps.

2.8.3 Slow Channel Maximum Data Rate - Downstream

The data rate may be specified in 1 kbps steps.

2.8.4 Slow Channel Minimum Data Rate - Downstream

The data rate may be specified in 1 kbps steps.

2.8.5 Rate Selection Mode - Downstream

This parameter specifies the rate selection behavior for the line in the downstream direction. It can be set to one of following modes:

- *Manual* (based on configured Fast and Slow Channel Maximum Data Rates)
- *Adapt at Startup* (adapted between Minimum and Maximum Channel Data Rates)

2.8.6 Rate Adaptation Ratio - Downstream

When *Rate Selection Mode - Downstream* is set to *Adapt at Startup*, the allocation of data rate in excess of the minimum rate for each channel is controlled by this parameter. This parameter specifies the ratio of the allocation of the excess data rate between the Fast and the Slow channels (ie. Fast Channel Allocation / Slow Channel Allocation). The value can be 0 to 100 % in 10% steps.

2.8.7 Fast Channel Maximum Data Rate - Upstream

The data rate may be specified in 1 kbps steps.

2.8.8 Fast Channel Minimum Data Rate - Upstream

The data rate may be specified in 1 kbps steps.

2.8.9 Slow Channel Maximum Data Rate - Upstream

The data rate may be specified in 1 kbps steps.

2.8.10 Slow Channel Minimum Data Rate - Upstream

The data rate may be specified in 1 kbps steps.

2.8.11 Rate Selection Mode - Upstream

This parameter specifies the rate selection behavior for the line in the upstream direction. It can be set to one of following modes:

- *Manual*
- *Adapt at Startup*

2.8.12 Rate Adaptation Ratio - Upstream

When *Rate Selection Mode - Upstream* is set to *Adapt at Startup*, the allocation of data rate in excess of the minimum rate for each channel is controlled by this parameter. This parameter specifies the ratio of the allocation of the excess data rate between the Fast and the Slow channels (ie. Fast Channel Allocation / Slow Channel Allocation). The value can be 0 to 100 % in 10% steps.

2.9 Interleaving Depth / Delay Management

The interleaving depth / delay management for VDSL is similar to that for ADSL. The following parameters are configurable per VDSL line.

2.9.1 *Maximum Interleave Delay - Downstream*

The maximum interleave delay for the Slow Channel: 0 to 255 ms in 1 ms steps.

2.9.2 *Maximum Interleave Delay - Upstream*

The maximum interleave delay for the Slow Channel: 0 to 255 ms in 1 ms steps.

3 **VDSL Operation Monitoring Parameters**

Following parameters are used to monitor operation of VDSL lines.

3.1 **Line Status**

The Line Status will indicate whether the line is operational, or it has one or more failure conditions. This is similar to ADSL lines. Following status is indicated per VTU-x:

- *No Defect*
- *Loss of Framing* (per LOF⁽¹⁾)
- *Loss of Signal* (per LOS⁽¹⁾)
- *Loss of Power* (per LPR⁽¹⁾)
- *Loss of Signal Quality* :
Declared when Noise Margin falls below the Minimum Noise Margin, or the bit-error-rate exceeds 10^{-7} .
- *Loss of Link* (VTU-C only):
Declared when persistent LOS is present for 2 ± 0.5 s without being preceded by a power down event (LPR⁽¹⁾).
- *Data Initialization Failure* (VTU-C only):
VTU-C failure during initialization due to bit errors corrupting startup exchange data.
- *Configuration Initialization Failure* (VTU-C only):
VTU-C failure during initialization due to peer VTU not able to support requested configuration.
- *Protocol Initialization Failure* (VTU-C only):
VTU-C failure during initialization due to incompatible protocol used by the peer VTU.
- *No peer modem detected* (VTU-C only):
VTU-C failure during initialization due to no activation sequence detected from peer VTU.

3.2 **Line Measurements**

Following parameters indicate current line performance measurements similar to that for ADSL lines.

3.2.1 *Current Line Data Rate - Downstream*

The line data rate in kbps in steps of 1 kbps.

3.2.2 *Current Line Data Rate - Upstream*

The line data rate in kbps in steps of 1 kbps.

3.2.3 *Current Line Attainable Data Rate - Downstream*

The line data rate in kbps in steps of 1 kbps.

3.2.4 Current Line Attainable Data Rate - Upstream

The line data rate in kbps in steps of 1 kbps.

3.2.5 Current Line SNR Margin - Downstream

The line SNR margin: -31.75 to +31.75 dB in steps of 0.25 dB.

3.2.6 Current Line SNR Margin - Upstream

The line SNR margin: -31.75 to +31.75 dB in steps of 0.25 dB.

3.2.7 Current Aggregate Output Power - Downstream

The line aggregate output power: -5 to 15 dBm in 0.5 dBm steps.

3.2.8 Current Aggregate Output Power - Upstream

The line aggregate output power: -25 to 15 dBm in 0.5 dBm steps.

3.2.9 Current Line Attenuation - Downstream

The line attenuation: 0 to 63.75 dB in 0.25 dB steps.

3.2.10 Current Line Attenuation - Upstream

The line attenuation: 0 to 63.75 dB in 0.25 dB steps.

3.2.11 Current Interleave Delay - Downstream

Current downstream Interleave Channel delay in 1 ms steps.

3.2.12 Current Interleave Delay - Upstream

Current upstream Interleave Channel delay in 1 ms steps.

3.2.13 Current Loop Length Estimate

Estimated loop length in feet assuming a 26 AWG (0.4 mm) loop.

4 VDSL Line Code Specific Configuration Parameters

This specification does not address line-code-specific configuration parameters.

5 VDSL Performance Monitoring Counters

Following counters are used to monitor performance of VDSL lines. Counters may be maintained in following formats:

- Raw Counters (O)
- Current 15-minute Interval Counters (R)
- Previous N 15-minute Interval Counters (R)
- Current 1-Day interval Counters (O)
- Previous 1-Day interval Counters (O)

NOTE: (O) - Optional support; (R) - Required support.

5.1 VDSL Line Counters

The following counters are envisioned for VDSL Line at each VTU-x.

5.1.1 *Errored Seconds – ES (R)*

5.1.2 *Severely Errored Seconds – SES (R)*

5.1.3 *Unavailable Seconds – UAS (R)*

5.1.4 *Loss of Frame Seconds – LOFS (O)*

5.1.5 *Loss of Signal Seconds – LOSS (O)*

5.1.6 *Loss of Power Seconds – LPRS (O)*

5.1.7 *Loss of Link Seconds – LOLS (O)*

5.1.8 *Line Initialization Attempts – INITS (O)*

5.2 VDSL Channel Counters

Following PM counters are envisioned for VDSL Channels (Fast and Slow) at each VTU-x.

5.2.1 *Transmitted Blocks – TXB (O)*

5.2.2 *Received Blocks – RXB (O)*

5.2.3 *Corrected Blocks – CB (O)*

5.2.4 *Uncorrectable Blocks – UB (O)*

5.3 VDSL Equipment Inventory Management

Following parameters are supported for VDSL modem inventory management per VTU-x.

5.3.1 Vendor ID

5.3.2 Version Number

5.3.3 Serial Number

6 REFERENCES

- [1] ANSI T1.424 - Part-1: "Very-high-bit-rate Digital Subscriber Line (VDSL) Metallic Interface, Part 1: Functional Requirements and Common Specification", 2002.
- [2] ANSI T1.424 - Part-2: "VDSL Technical Specification, Part 2: Technical Specification for a Single-Carrier Modulation (SCM) Transceiver", 2002.
- [3] ANSI T1.424 - Part-3: "Very-high-bit-rate Digital Subscriber Line (VDSL) Metallic Interface, Part 3: Technical Specification for a Multi-Carrier Modulation (MCM) Transceiver", 2002.
- [4] ITU-T G.993.1 (** Draft **) "Very-high-speed Digital Subscriber Line Foundation", November 2001.
- [5] DSL Forum WT-068 Revision-4: "VDSL Network Element Management", August 2002.
- [6] IETF draft-ietf-adslmib-vdsl-03.txt, "Definition of Managed Objects for VDSL Lines", June 2002.
- [7] ITU-T G997.1 "Physical layer management for DSL transceivers".
- [8] IETF RFC 2662 "Definitions of Managed Objects for the ADSL Lines".
- [9] IETF draft-ietf-adslmib-adslext-08.txt "Definition of Extension Managed Objects for ADSL Lines".
- [10] ETSI TS 101 270-1 V1.2.1: " Very high speed Digital Subscriber Line (VDSL); Part 1: Functional requirements", July, 2002.
- [11] ETSI TS 101 270-2 V1.1.1: " Very high speed Digital Subscriber Line (VDSL); Part 2: Transceiver specification ", February, 2001.

7 APPENDIX-A : Relevance of ADSL parameters for VDSL

This appendix provides a comparison of management parameters defined for managing ADSL lines as specified in DSL Forum TR-005, IETF RFC2662, and ITU-T G.997.1 along with their relevance to VDSL.

NOTE: This appendix is for information only. Actual VDSL management parameters are specified in the main document.

ADSL Management Parameter	xTU-C / xTU-R / Line	Phys / Fast / Slow	Apply to VDSL	Comments
Configuration Management				
Vendor ID	C, R	P	Yes	no difference
Version Number	C, R	P	Yes	no difference
Serial Number	C,R	P	Yes	no difference
Line type	L	P	Yes	no difference
Line coding	L	P	Yes*	was DMT/CAP/QAM, now SCM/MCM
Line Rate Adaptation Mode	C	P	Yes*	"manual" and "at-init" rate adaptation modes only; no "dynamic RA"
Line Target SNR Margin	C,R	P	Yes*	Unit and Range is different for VDSL.
Line Max Additional SNR Margin	C, R	P	Yes*	Unit and Range is different for VDSL.
Line Min SNR Margin	C, R	P	Yes*	Unit and Range is different for VDSL.
Channel desired min bitrate	C,R	S,F	Yes*	Unit and Range is different for VDSL.
Channel desired max bitrate	C,R	S,F	Yes*	Unit and Range is different for VDSL.
Max slow channel delay	C,R	S	No	no difference
Upshift Noise Margin	C,R	P	No	no dynamic RA support
Min Time Interval for Upshift RA	C,R	P	No	no dynamic RA support
Downshift Noise Margin	C,R	P	No	no dynamic RA support
Min Time Interval for Downshift RA	C,R	P	No	no dynamic RA support
Rate Up threshold	C,R	S,F	No	no dynamic RA support
Rate Down threshold	C,R	S,F	No	no dynamic RA support
Rate adaptation ratio	C,R	P	Yes*	Used only for rate adaptation at startup.
LOSS 15' alarm threshold	C,R	P	Yes	no difference
LOFS 15' alarm threshold	C,R	P	Yes	no difference
LPRS 15' alarm threshold	C,R	P	Yes	no difference
LOLS 15' alarm threshold	C	P	Yes	no difference
ES 15' alarm threshold	C,R	P	Yes	no difference
SES 15' alarm threshold ^[1]	C,R	P	Yes	no difference
UAS 15' alarm threshold ^[1]	C,R	P	Yes	no difference
Fault Management				
Line Current Operational Status	C,R	P	Yes	no difference
LOS 15' count exceeded fault	C,R	P	Yes	no difference
LOF 15' count exceeded fault	C,R	P	Yes	no difference
LPR 15' count exceeded fault	C,R	P	Yes	no difference
LOL 15' count exceeded fault	C	P	Yes	no difference
ES 15' count exceeded fault	C,R	P	Yes	no difference

SES 15' count exceeded fault ^[1]	C,R	P	Yes	no difference
UAS 15' count exceeded fault ^[1]	C,R	P	Yes	no difference
Init failure	C	P	Yes	no difference

Performance Management

Line Current Attenuation	C,R	P	Yes*	Unit and Range is different for VDSL.
Line Current SNR Margin	C,R	P	Yes*	Unit and Range is different for VDSL.
Line Current Output Power	C,R	P	Yes	no difference
Line Current Attainable Bitrate	C,R	P	Yes*	Unit and Range is different for VDSL.
Chan Current Tx Bitrate	C,R	S,F	Yes*	Unit and Range is different for VDSL.
Chan CRC Block Data Length	C,R	S,F	Yes	no difference
Current Interleave Delay	C,R	S	Yes	no difference
Line LOF raw counter	C,R	P	Yes	no difference
Line LOS raw counter	C,R	P	Yes	no difference
Line LPR raw counter	C,R	P	Yes	no difference
Line LOL raw counter	C	P	Yes	no difference
Line ES raw counter	C,R	P	Yes	no difference
Line SES raw counter ^[1]	C,R	P	Yes	no difference
Line UAS raw counter ^[1]	C,R	P	Yes	no difference
Line init attempts raw counter ^[2]	C	P	Yes	no difference
Chan Tx Blocks raw counter	C,R	S,F	Yes	no difference
Chan Rx Blocks raw counter	C,R	S,F	Yes	no difference
Chan FEC (corrected blocks) raw counter	C,R	S,F	Yes	no difference
Chan CV (uncorrectable blocks) raw counter	C,R	S,F	Yes	no difference
Line LOF seconds interval-counter	C,R	P	Yes	no difference
Line LOS seconds interval-counter	C,R	P	Yes	no difference
Line LPR seconds interval-counter	C,R	P	Yes	no difference
Line LOL seconds interval-counter	C	P	Yes	no difference
Line ES interval-counter	C,R	P	Yes	no difference
Line SES interval-counter ^[1]	C,R	P	Yes	no difference
Line UAS interval-counter ^[1]	C,R	P	Yes	no difference
Line init attempts interval-counter ^[2]	C	P	Yes	no difference
Chan Tx Blocks interval-counter	C,R	S,F	Yes	no difference
Chan Rx Blocks interval-counter	C,R	S,F	Yes	no difference
Chan FEC (corrected blocks) interval-counter	C,R	S,F	Yes	no difference
Chan CV (uncorrectable blocks) interval-counter	C,R	S,F	Yes	no difference

VDSL Status / Diagnostics

Self Test ^[3]	C,R		Yes	no difference
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NOTE:

^[1] These parameters are specified by G.997.1.

^[2] These parameters are specified by RFC 2662.

^[3] These parameters are specified by TR-005.