



TECHNICAL REPORT

TR-129

Protocol-Independent Management Model for Next
Generation DSL Technologies

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Summary

This document specifies a protocol-independent management model for ADSL, ADSL2, ADSL2plus and VDSL2 based on the parameters described in the ITU-T Recommendation G.997.1.

The Broadband Forum Technical Report TR-129

Protocol-Independent Management Model for Next Generation DSL Technologies

1 Purpose

The purpose of this technical report is to provide a management model for ADSL, ADSL2, ADSL2plus and VDSL2 based on the parameters described in the ITU-T Recommendation G.997. 1 [1]. The management model is independent of any protocol.

2 Scope

Although most of the parameters in G.997.1 apply to ADSL [2, 3], ADSL2 [4,5], ADSL2plus [6] and VDSL2 [7] there are some that only apply to one or more of the transmission technologies. The model in this report places all the parameters into a unified model so that any of the technologies may be managed using it. The applicability of a parameter to a technology is defined in ITU-T Recommendation G.997. 1.

3 References

- [1] ITU-T Recommendation G.997. 1 (2006), *Physical layer management for Digital Subscriber Line (DSL) Transceivers*
- [2] ITU-T Recommendation G.992. 1 (1999), *Asymmetric digital subscriber line (ADSL) transceivers.*
- [3] ITU-T Recommendation G.992.2 (1999), *Splitterless asymmetric digital subscriber line (ADSL) transceivers.*
- [4] ITU-T Recommendation G.992.3 (2002), *Asymmetric digital subscriber line transceivers 2 (ADSL2).*
- [5] ITU-T Recommendation G.992.4 (2002), *Splitterless asymmetric digital subscriber line transceivers 2 (ADSL2).*
- [6] ITU-T Recommendation G.992.5 (2003), *Asymmetric digital subscriber line (ADSL) transceivers – Extended bandwidth ADSL2 (ADSL2+).*
- [7] ITU-T Recommendation G.993 .2 (2006), *Very high speed digital subscriber line 2 (VDSL2).*

4 xDSL Managed Object Model

This specification is based on the managed objects listed in Revision 3 of ITU-T Recommendation G.997. 1 [1]. The object model in this specification only specifies the structure of the managed objects, the detailed parameter definitions and their access mode (read-only vs read-write) is specified in references [1-7].

Figure 1 illustrates notations used in this specification for illustrating the object model.

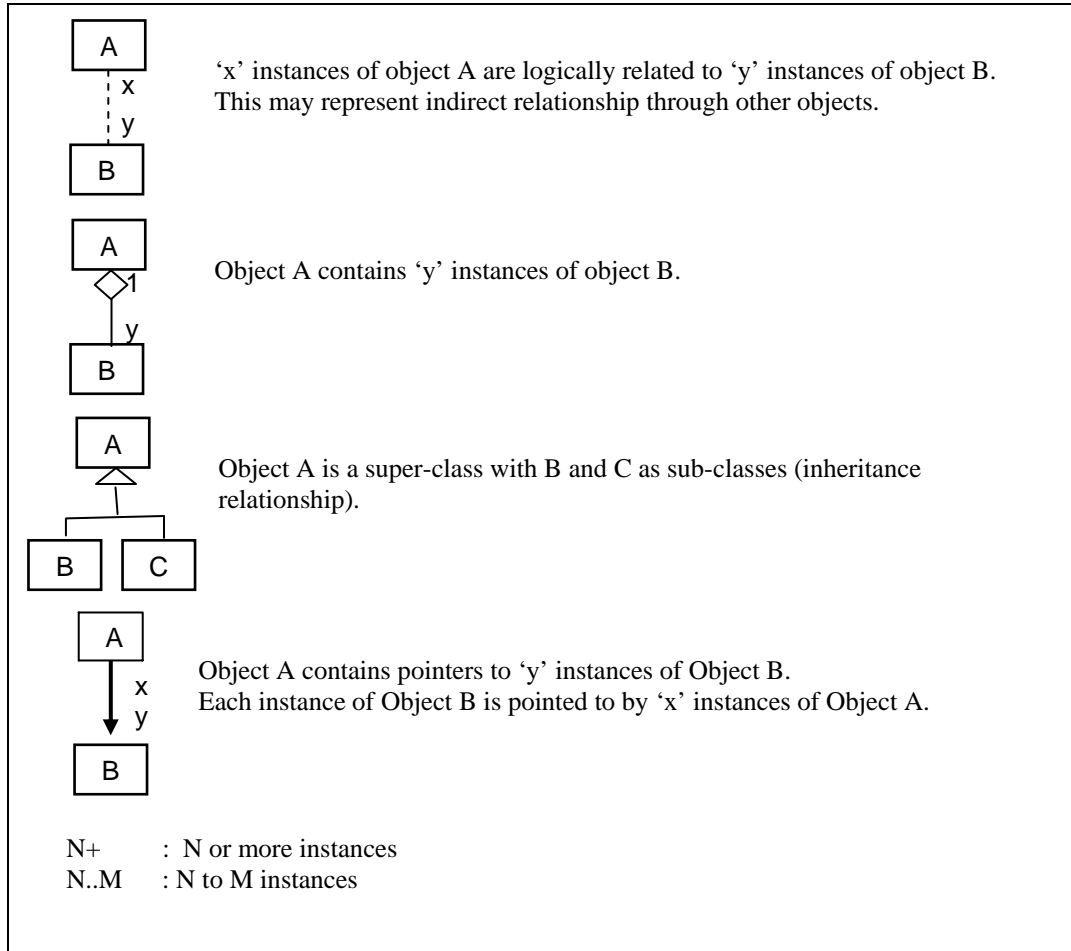


Figure 1/TR-129 - Notation

5 Configuration Management

Figure 2 provides an overview of the object model of objects used for configuration management of xDSL lines

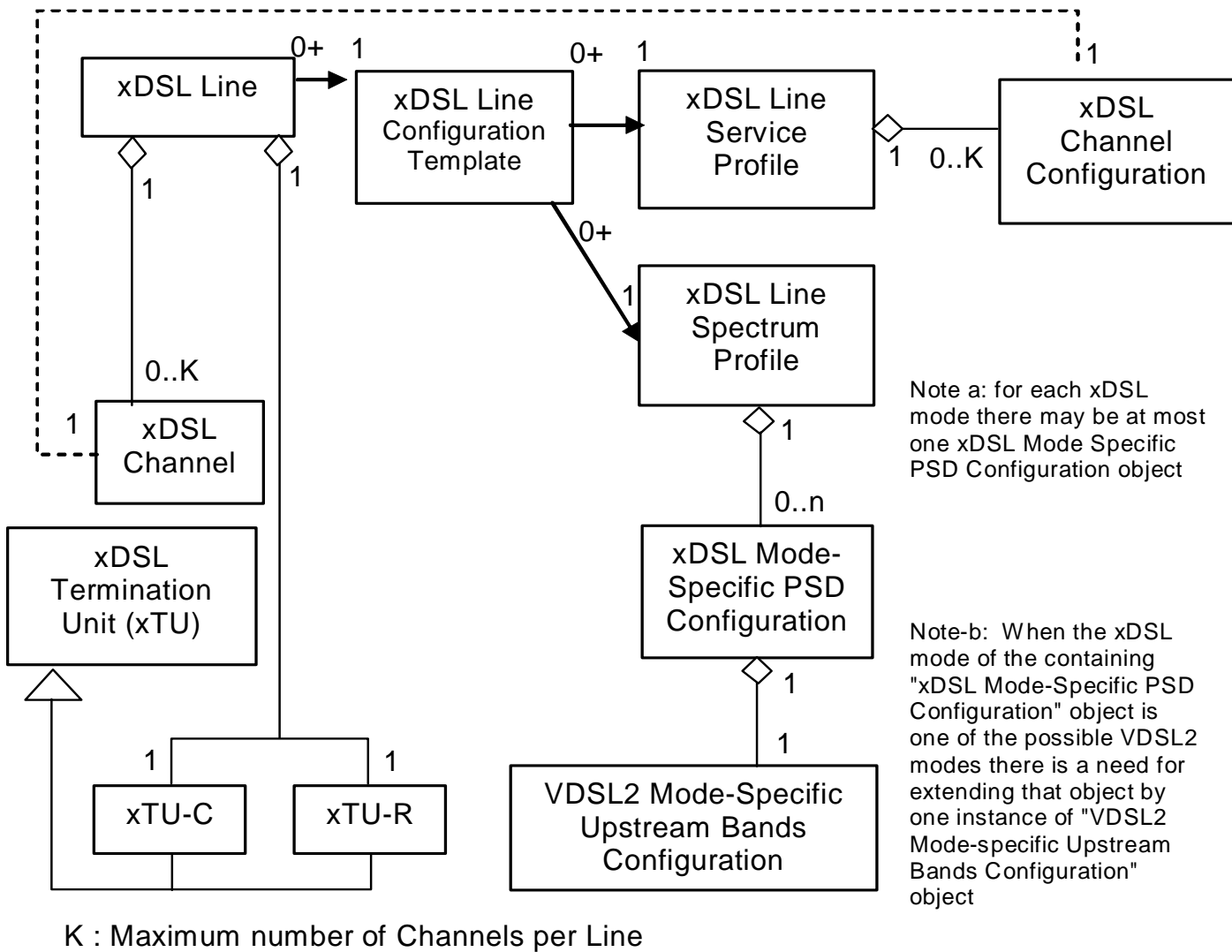


Figure 2/TR-129 - Managed object model: configuration management

5.1 xDSL Line

The xDSL Line object represents an individual physical transmission line and its associated parameters and states.

Following attributes are supported by the xDSL Line object:

- Pointer to xDSL Line Configuration Template
- Pointer to xDSL Line Threshold Template
- Power Management State Forced (PMSF)
- Loop Diagnostics Mode Forced
- Automode Cold Start Forced
- xDSL Transmission System
- Power Management State
- Success/Failure Cause

5.2 xDSL Channel

The xDSL Channel object represents an individual logical transmission channel over the xDSL Line and its associated parameters and states.

Following attributes are supported by the xDSL Channel object:

- Channel Number (Numeric ID for a channel in a Line – 1 to K)

One or more instances of xDSL Channel object may be supported by an xDSL Line Object.

5.3 xDSL Termination Unit (xTU)

An xDSL Termination Unit object represents an xDSL Modem at either end of the xDSL Line. The xTU object only represents a super-class that cannot be instantiated. It has two sub-classes that are instantiated - xTU-C (central office modem), and an xTU-R (Remote modem). The xDSL Line is always terminated by an xTU-C at the central office (or at a cabinet) and an xTU-R at the remote subscriber location.

Following attributes are supported for xDSL Termination Units:

- xTU G.994.1 Vendor ID
- xTU System Vendor ID
- xTU Version Number
- xTU Serial Number
- xTU Self-Test Result
- xTU xDSL Transmission System Capabilities
- Current 15-minute Interval Elapsed Time (0 to 900 sec)
- Number of previous 15-minute Intervals (0 to N)
- Number of previous invalid 15-minute Intervals (0 to N)
- Current 1 -day Interval Elapsed Time (0 to 86400 sec)
- Number of previous 1-day Intervals (0 to M)
- Number of previous invalid 1 -day intervals (0 to M)

5.4 xDSL Line Configuration Template

The xDSL Line Configuration Template is the object representing a complete configuration for an xDSL Line. The template simply contains pointers to specific xDSL Line Service Profile and xDSL Line Spectrum Profile instances.

The xDSL Line Configuration Template object supports following attributes:

- Template Name
- Pointer to xDSL Line Service Profile
- Pointer to xDSL Line Spectrum Profile

5.4.1 xDSL Line Service Profile

The xDSL Line Service Profile is the object containing all xDSL service specific configuration parameters for a line. Any number of xDSL Lines can be provisioned to use a particular xDSL Line Service Profile. It ensures that all lines sharing the Profile will be provisioned identically with respect to the parameters associated with the Profile.

The xDSL Line Service Profile object supports following attributes:

- Profile Name

In addition, it logically contains one or more instances of xDSL Channel Configuration objects for each channel to be supported for the line.

5.4.2 xDSL Channel Configuration

The xDSL Channel Configuration object represents configuration for an individual xDSL Channel in an xDSL Line.

Depending on the number of xDSL Channels to be supported by an xDSL Line, the corresponding instances of the xDSL Channel Configuration objects are logically contained in an xDSL Line Service Profile.

- Channel Number
- Minimum Data Rate downstream
- Minimum Data Rate upstream
- Minimum Reserved Data Rate downstream
- Minimum Reserved Data Rate upstream
- Maximum Data Rate downstream
- Maximum Data Rate upstream
- Rate Adaptation Ratio downstream
- Rate Adaptation Ratio upstream
- Minimum Data Rate in low power state downstream
- Maximum Bit Error Ratio downstream
- Maximum Bit Error Ratio upstream
- Data Rate Threshold Upshift downstream
- Data Rate Threshold Upshift upstream
- Data Rate Threshold Downshift downstream
- Data Rate Threshold Downshift upstream
- Force framer setting for impulse noise protection (FORCEINP)
- Minimum Impulse Noise Protection (INPMIN)
- Minimum Impulse Noise Protection 8kHz (INPMIN8)
- Maximum Interleaving Delay

5.4.3 xDSL Line Spectrum Profile

The xDSL Line Spectrum Profile object represents a specific configuration of transmission spectrum and power spectral density related parameters for an individual xDSL Line. It supplements the xDSL Line Service Profile.

Following attributes are supported for the xDSL Line Spectrum Profile object:

- Profile Name
- xTU Transmission System Enabling (XTSE)
- Power Management State Enabling (PMMODE)
- L0-TIME
- L2-TIME
- L2-ATPR
- L2-ATPRT
- CARMASK downstream
- CARMASK upstream
- VDSL2-CARMASK
- RFIBANDS
- Downstream Rate Adaptation Mode (RA-MODE downstream)
- Upstream Rate Adaptation Mode (RA-MODE upstream)
- Downstream Up-shift Noise Margin (RA-USNRM downstream)
- Upstream Up-shift Noise Margin (RA-USNRM upstream)
- Downstream Minimum Time Interval for Up-shift Rate Adaptation (RA-UTIME downstream)
- Upstream Minimum Time Interval for Up-shift Rate Adaptation (RA-UTIME upstream)
- Downstream Down-shift Noise Margin (RA-DSNRM downstream)
- Upstream Down-shift Noise Margin (RA-DSNRM upstream)
- Downstream Minimum Time Interval for Downshift Rate Adaptation (RA-DTIME downstream)
- Upstream Minimum Time Interval for Downshift Rate Adaptation (RA-DTIME upstream)
- Downstream Target Noise Margin (TARSNRM downstream)
- Upstream Target Noise Margin (TARSNRM upstream)
- Downstream Maximum Noise Margin (MAXSNRM downstream)
- Upstream Maximum Noise Margin (MAXSNRM upstream)
- Downstream Minimum Noise Margin (MINSNRM downstream)
- Upstream Minimum Noise Margin (MINSNRM upstream)
- Minimum Overhead Rate Upstream (MSGMIN upstream)
- Minimum Overhead Rate Downstream (MSGMIN downstream)
- VDSL2 Profiles Enabling (PROFILES)
- VDSL2 US0 PSD Masks Enabling (US0MASK)
- Optional Cyclic Extension Flag (CEFLAG)
- Signal-to-Noise Ratio Mode (SNRMODEs / SNRMODEus)
- Transmitter Referred Virtual Noise (TXREFVNs / TXREFVNus)

5.5 xDSL Mode-Specific PSD Configuration

The xDSL Mode-Specific PSD Configuration object represents a specific configuration of transmission spectrum and power spectral density related parameters for an individual mode (flavour) of xDSL (eg. ADSL, ADSL2, ADSL2plus, VDSL2....).

Each instantiation of the xDSL Mode-Specific PSD Configuration object contains a sub-set of the attributes for each mode of xDSL operation Depending on the various modes of xDSL

operation that may be supported by an xDSL Line, corresponding instances of this object will be contained in the xDSL Line Spectrum Profile. This enables multi-mode operation (support for multiple xDSL flavours for a given line).

Following attributes are supported for xDSL Mode-Specific PSD Configuration object:

- xDSL mode (possible value from the list in G.997.1)
- Downstream Maximum Nominal Power Spectral Density (MAXNOMPSD downstream)
- Upstream Maximum Nominal Power Spectral Density (MAXNOMPSD upstream)
- Downstream Maximum Nominal Aggregate Transmit Power (MAXNOMATP downstream)
- Upstream Maximum Nominal Aggregate Transmit Power (MAXNOMATP upstream)
- Upstream Maximum Aggregate Receive Power (MAXRXPWR upstream)
- Downstream PSD Mask (PSDMASK downstream)
- Downstream Power Back-Off assumed Exchange PSD mask (DPBOEPSD)
- Downstream Power Back-Off E-side Electrical Length (DPBOESEL)
- Downstream Power Back-Off E-side Cable Model (DPBOESCMA, DPBOESCMB and DPBOESCMC)
- Downstream Power Back-Off Minimum Usable Signal (DPBOMUS)
- Downstream Power Back-Off span Minimum Frequency (DPBOFMIN)
- Downstream Power Back-Off span maximum frequency (DPBOFMAX)
- Upstream PSD mask selection
- Upstream PSD Mask (PSDMASK upstream)
- Upstream Power Back-Off electrical loop length (UPBOKL)
- Force CO-MIB electrical loop length (UPBOKLF)
- VDSL2 Limit PSD Masks and bandplans enabling (LIMITMASK)
- VDSL2 US0 Disabling (US0DISABLE)
- VDSL2 PSD Mask Class Selection (CLASSMASK)

5.5.1 VDSL2 Mode-Specific Upstream Bands Configuration

The VDSL2 Mode-Specific Upstream Bands Configuration object represents a specific configuration of band related parameters for an individual mode (flavour) of VDSL2.

Depending on the various modes of VDSL2 operation that may be supported by an xDSL Line, corresponding instances of this object will be contained in the xDSL Line Spectrum Profile, extending the xDSL Mode-Specific PSD Configuration object. This enables multi-mode operation, when it requires support for multiple VDSL2 flavours for a given line.

Following attributes are supported for VDSL2 Mode-Specific Upstream Bands Configuration object:

- xDSL mode (applicable only for VDSL2 based modes)
- Upstream band number (1, N)
- Upstream Power Back-Off reference PSD per band (UPBOPSD-pb parameters a and b)

6 Object model for xDSL Status Monitoring

Figure 3 shows the object model relating to xDSL Line status monitoring.

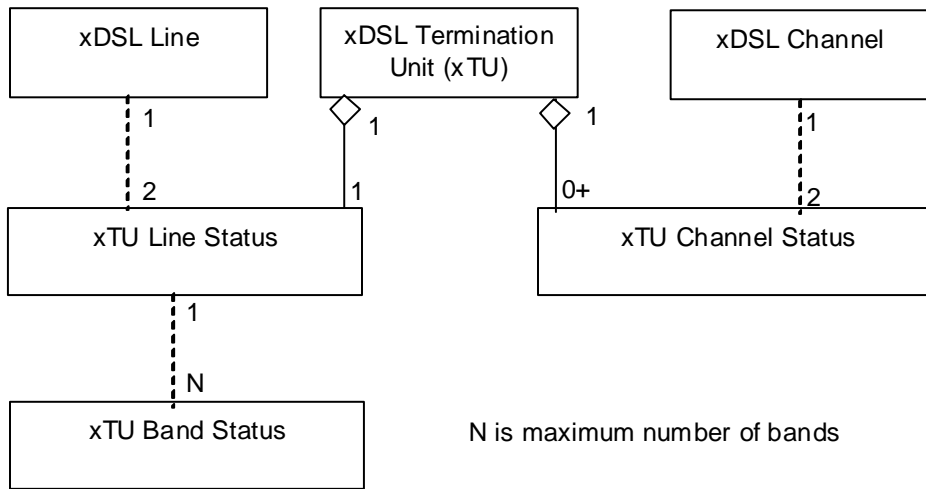


Figure 3/TR-129 - Managed object model: xDSL status monitoring

6.1 xTU Line Status

The xTU Line Status object represents current line status / measurements at a particular xTU.

Following attributes are supported for xTU Line Status object:

- xTU Current Status (Near-End Failures for xTU-C/ Far-End Failures for xTU-R)
NOTE - Line Init (LINIT) Failure is reported by both xTU-C and xTU-R NOTE - Should include Loss of Signal Quality condition per RFC 2662.
- Last State Transmitted (Downstream for xTU-C / Upstream for xTU-R)
- Signal-to-Noise Ratio Margin (SNRMDs for xTU-R / SNRMus for xTU-C)
- Actual Signal-To-Noise Ratio mode (ACTSNRMODEs for xTU-R / ACTSNRMODEus for xTU-C)
- Maximum Attainable Data Rate (ATTNDRds for xTU-C / ATTNDRus for xTU-R)
- Actual Power Spectrum Density (ACTPSDds for ATU-C / ACTPSDus for ATU-R)
- Actual Aggregate Transmit Power (ACTATPds for xTU-R / ACTATPus for xTU-C)
- VDSL2 Profile
- VDSL2 Limit PSD Mask and Bandplan
- VDSL2 US0 PSD Mask
- Estimated Upstream Power Back-Off Electrical Loop Length (UPBOKLE)
- Trellis Use (TRELLISds /TRELLISus)
- Actual Cyclic Extension (ACTUALCE)

6.1.1 xTU Band Status

The xTU Band Status object represents current band status / measurements at a particular xTU.

Following attributes are supported for xTU Band Status object:

- Band number (1, N)
- Line Attenuation per band (LATNds for xTU-R / LATNus for xTU-C)
- Signal Attenuation per band (SATNds for xTU-R / SATNus for xTU-C)
- Signal-to-Noise Ratio Margin per band (SNRMpbds for xTU-R / SNRMpbus for xTU-C)

6.2 xTU Channel Status

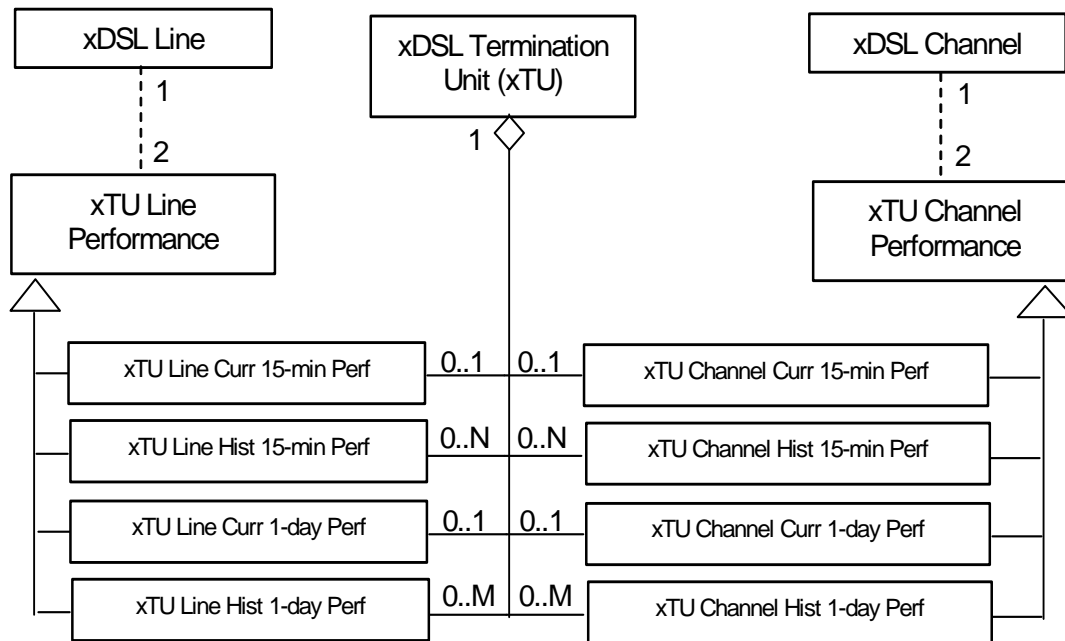
The xDSL Channel Status object represents current channel status / measurements at a particular xTU.

Following attributes are supported for xTU Channel Status object:

- Actual Data Rate (Downstream for xTU-C / Upstream for xTU-R)
- Previous Data Rate (Downstream for xTU-C / Upstream for xTU-R)
- Actual Interleave Delay (Downstream for xTU-C / Upstream for xTU-R)
- Actual Impulse Noise Protection
- Impulse Noise Protection Report (INPREPORT)
- Actual size of Reed-Solomon codeword (NFEC)
- Actual number of Reed-Solomon redundancy bytes (RFEC)
- Actual number of bits per symbol (LSYMB)
- Actual interleaving depth (INTLVDEPTH)
- Actual interleaving block length (INTLVBLOCK)
- Actual Latency Path (LPATH)

7 Object model for xDSL Performance Management

Figure 4 shows the object model relating to xDSL Line performance management.



N : Maximum number of 15-min intervals supported

M : Maximum number of 1-day intervals supported

Figure 4/TR-129 - Managed object model: xDSL performance management

7.1 xTU Line Performance

The xTU Line Performance object represents line performance related data for a given xTU. It is only a super-class that cannot be instantiated. It supports following sub-classes that are instantiated:

- xTU Line Current 1 5-min Performance
- xTU Line History 1 5-min Performance
- xTU Line Current 1-day Performance
- xTU Line History 1-day Performance

Following attributes are supported for xTU Line Performance object:

- Interval Number (0 for current; 1..N/M for previous/history intervals)
- Interval Status (valid – Data is valid and complete; invalid – Data is invalid or incomplete)
- Forward Error Correction Seconds - Line (FECS-L/LFE)
- Errored Seconds – Line (ES-L/LFE)
- Severely Errored Seconds – Line (SES-L/LFE)
- Loss of Signal Seconds – Line (LOSS-L/LFE)
- Unavailable Seconds – Line (UAS-L/LFE)
- Full Initializations **
- Failed Full Initializations * *

- Short Initializations **
- Failed Short Initializations **

NOTE - Object instances associated with the xTU-C use the xxx-L version of the parameter while those associated with the xTU-R use xxx-LFE version of the parameter.

** These parameters apply only to instances of the object associated with the xTU-C.

Instances of this object are supported for each xTU (xTU-C or xTU-R) for the current and previous N 15-minute intervals, as well as for current and previous M 1-day intervals.

7.2 xTU Channel Performance

The xTU Channel Performance object represents channel performance related data for a particular channel associated with a particular xTU. It is only a super-class that cannot be instantiated. It supports following sub-classes that are instantiated:

- xTU Channel Current 15-min Performance
- xTU Channel History 15-min Performance
- xTU Channel Current 1-day Performance
- xTU Channel History 1-day Performance

Following attributes are supported for xDSL Channel Performance object:

- Interval Number (0 for current; 1..N/M for previous/history intervals)
- Interval Status (valid – Data is valid and complete; invalid – Data is invalid or incomplete)
- Code Violations – Channel (CV-C/CFE)
- Forward Error Corrections – Channel (FEC-C/CFE)

NOTE - Object instances associated with the xTU-C use the xxx-C version of the parameter while those associated with the xTU-R use xxx-CFE version of the parameter.

Instances of this object are supported for each channel associated with each xTU (xTU-C or xTU-R) for the current and previous N 15-minute intervals, as well as for current and previous M 1-day intervals.

8 Object model for xDSL Performance Threshold Management

Figure 5 shows the object model relating to xDSL Line performance threshold management.

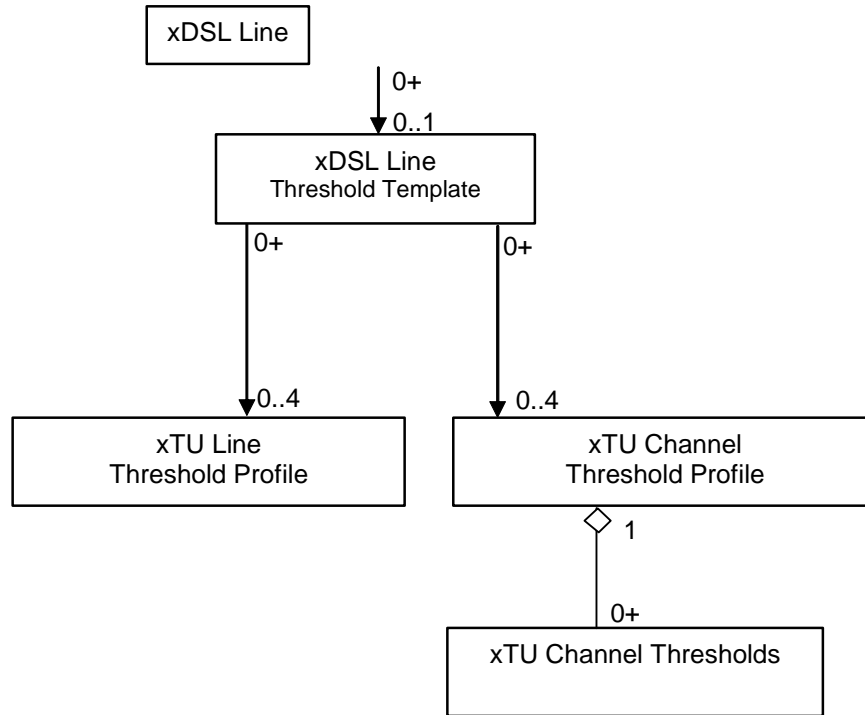


Figure 5/TR-129 - Managed object model: xDSL performance threshold management

8.1 xDSL Line Threshold Template

The xDSL Line Threshold Template object represents a complete set of performance monitoring thresholds for an xDSL Line.

Following attributes are supported by the xDSL Line Threshold Template object:

- Template Name
- Pointer to the xTU-C 1 5-min Line Threshold Profile
- Pointer to the xTU-C 1-day Line Threshold Profile
- Pointer to the xTU-R 1 5-min Line Threshold Profile
- Pointer to the xTU-R 1-day Line Threshold Profile
- Pointer to the xTU-C 1 5-min Channel Threshold Profile
- Pointer to the xTU-C 1-day Channel Threshold Profile
- Pointer to the xTU-R 1 5-min Channel Threshold Profile
- Pointer to the xTU-R 1-day Channel Threshold Profile

8.2 xTU Line Threshold Profile

The xTU Line Threshold Profile object represents a set of performance monitoring thresholds for an xDSL Line at a particular xTU.

Following attributes are supported by the xTU Line Threshold Profile object:

- Profile Name
- Forward Error Correction Seconds - Line Threshold (FECS-L/LFE)
- Errored Seconds – Line Threshold (ES-L/LFE)
- Severely Errored Seconds – Line Threshold (SES-L/LFE)
- Loss of Signal Seconds – Line Threshold (LOSS-L/LFE)
- Unavailable Seconds – Line Threshold (UAS-L/LFE)
- Full Initializations Threshold * *
- Failed Full Initializations Threshold **
- Short Initializations Threshold * *
- Failed Short Initializations Threshold **

NOTE - Object instances associated with the xTU-C use the xxx-L version of the threshold while those associated with the xTU-R use xxx-LFE version of the threshold.

** These thresholds apply only to instances of the object associated with the xTU-C.

8.3 xTU Channel Threshold Profile

The xTU Channel Threshold Profile object is a logical-container of performance monitoring thresholds for all channels associated with an xDSL Line at a particular xTU.

Following attributes are supported by the xTU Channel Threshold Profile object:

- Profile Name

8.4 xTU Channel Thresholds

The xTU Channel Thresholds object represents a set of performance monitoring thresholds for a particular channel associated with an xDSL Line at a particular xTU.

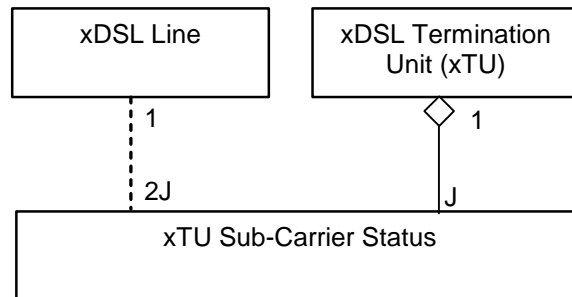
Following attributes are supported by the xTU Channel Thresholds object:

- Channel Number
- Code Violations – Channel Threshold (CV-C/CFE)
- Forward Error Corrections – Channel Threshold (FEC-C/CFE)

NOTE - Object instances associated with the xTU-C use the xxx-C version of the threshold while those associated with the xTU-R use xxx-CFE version of the threshold.

9 Object model for xDSL Testing / Diagnostics

Figure 6 shows the object model relating to detailed xDSL Line testing / diagnostics.



J : Maximum number of Sub-Carriers supported

Figure 6/TR-129 - Managed object model: xDSL testing/diagnostics

9.1 xTU Sub-Carrier Status

The xTU Sub-Carrier Status object represents current detailed status / measurements relating to a particular sub-carrier in an xDSL Line at a particular xTU.

Following attributes are supported for xTU Sub-Carrier Status object:

- Sub-Carrier Number (1..J)
- Channel Characteristics Function Linear Representation Scale (HLINSCds / HLINSCus)
- H(f) linear subcarrier group size (HLINGds / HLINGus)
- Channel Characteristics Function Linear Representation (HLINpsds / HLINpsus)
- Channel Characteristics Function Logarithmic Measurement Time (HLOGMTds / HLOGMTus)
- H(f) logarithmic subcarrier group size (HLOGGds / HLOGGus)
- Channel Characteristics Function Logarithmic Representation (HLOGpsds / HLOGpsus)
- Quiet Line Noise PSD Measurement Time (QLNMTds / QLNMTus)
- QLN(f) subcarrier group size (QLNGds / QLNGus)
- Quiet Line Noise PSD (QLNpsds / QLNpsus)
- Signal-to-Noise Ratio Measurement Time (SNRMTds / SNRMTus)
- SNR(f) subcarrier group size (SNRGds / SNRGus)
- Signal-to-Noise Ratio (SNRpsds / SNRpsus)
- Bits Allocation (BITSpsds / BITSpsus)
- Gains Allocation (GAINSpds / GAINSpus)
- Transmit Spectrum Shaping (TSSpsds / TSSpsus)
- MEDLEY Reference PSD (MREFPSDds / MREFPSDus)

NOTE - Object instances associated with the xTU-C use the xxxds version of the parameter while those associated with the xTU-R use xxxus version of the parameter.