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From	Jürg Ruprecht
Date	30 September 2015
Subject	xDSL CPE WAN layer 1 test library

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xDSL CPE WAN layer 1 test library

Scope	To list all tests for wireline broadband access CPEs (xDSL)
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Checklist of changes

Version	Date	Released by	Comments

Revisions

Version	Date	Released by	Comments

Release

Version	Date	Released by	Comments
1.90	17-01-2013	Damien Fragnière	Checklist of changes added, Descriptions of test added, Test ID & HPQC ID added, G.INP test changed in order to check the CVs' counter, SRA, G.INP & vectoring test changed in order to check the CVs' counter.
2.00	01-02-2013	Jürg Ruprecht	Title changed from "CPE Factory Acceptance Test" to "xDSL CPE WAN test library". Creation of the separate compliancy sheet "CPE-Requirements-Compliancy-Sheet-WAN-xDSL-&-Fibre.xls" in order to automatically choose the tests applicable to a specific CPE. Significant update based on V1.90, the CO Factory Acceptance Test document [4] and the HP-QC BBLAB instance, with mismatches highlighted as described in Section 1.4. In case of such mismatches, the one of the current test Swisscom Expecco implementation is taken. Addition of the presentation of results sections.
2.01	08-03-2013	Jürg Ruprecht	Update of vectoring CAN specs
2.02	19-03-2013	Jürg Ruprecht	Replacement of severity verdict "urgent" into "critical".
2.03	04-04-2013	Jürg Ruprecht	Description of the lab test setup including cabling, cf. Sections 2.1 and 2.2.
2.04	17-04-2013	Jürg Ruprecht	Datapump recommendation for Broadcom 63168 and 63268 added.
2.05	22-04-2013	Jürg Ruprecht	Update of FTTB / FTTS CANs on input of Andreas Thöny.
2.06	02-05-2013	Jürg Ruprecht	Correction of ADSL performance test – low noise, step 7: No setting, copy from ADSL2+..
2.07	14-05-2013	Jürg Ruprecht	Update VDSL2 8b bit swap US0: New accepted rule for BDCM 6368, ISAM, US0: Sync loss in down to process.
2.08	31-05-2013	Jürg Ruprecht	Include IKNS DPr60 and DPr87 to DPr71 bit swap acceptance conditions.
2.09	09-08-2013	Jürg Ruprecht	Change bit swap test from "mathematical" version back to "popular" version, reduce to only 1dB rather than 3dB, 2dB and 1dB steps, extend to 3 test runs with only output of the "best" result.
3.00	20-09-2013	Jürg Ruprecht	Significant changes regarding inclusion of the Assecco assessment concept: Adding new Section 3 "Test environment "Expecco" vs. test assessment tool "Assecco", changing the test steps "presentation of result" towards Assecco, and changing the bit swap tests back to the former procedure with down to 0 and down to 2, thereby converging US and DS test procedures into one.
3.01	18-10-2013	Jürg Ruprecht	Correction of minor mistakes.
3.20	08-11-2013	Jürg Ruprecht	Generalizing special VDSL2 17a, VDSL2 8b, ADSL2+ and ADSL test cases to the respective generalized xDSL test cases and export of xDSL specific settings to external tables.
3.30	14-05-2014	Jürg Ruprecht	Update with new Assecco header issues
3.31	04-07-2014	Jürg Ruprecht	Update DP settings with V43 = Dynamic ON in Table 20.
3.32	05-08-2014	Jürg Ruprecht	Update of cable lengths in lab setups in Figure 1 and Figure 2.
3.33	06-08-2014	Jürg Ruprecht	RFI noise file name change of e.g. Noise_SCS_RFI_DS_550_127_65.dat into Spirent compatible file names to e.g. Noise_SCS_DS_550_127_65_RFI.dat. Removal of not needed CPE handling and FFM Assecco file definitions.
3.34	16-09-2014	Jürg Ruprecht	Update of FWs and chipset FWs in Table 9.
3.35	03-12-2014	Jürg Ruprecht	Simplification of bit swapping assessment rules in Table 29.
3.36	03-12-2014	Jürg Ruprecht	Name change of "basic tests" into "Single-line tests". Upgrade of CAN FWs of ALU FW 3.7.05i to FW 4.3.05n and and HUA FW R12 / R312 / R313 to HUA

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			FW R15.
3.37	09-03-2014	Jürg Ruprecht	Update of CAN settings in Table 8, Table 9 and Table 10.
3.38	30-09-2014	Jürg Ruprecht	Name change of "single-line tests" and "multi-line tests" back into "basic tests" and "vectoring tests", respectively. Change of the US0 bit swap assessment rules on ALU ISAM73xx in Table 29: At most major severity, no critical severity any more.

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1 Introduction

1.1 Purpose

This document is a generic library of all potential tests for wireline broadband access xDSL customer premises equipment (CPEs) on the wide area network (WAN) side. For a given CPE, a separate Excel test compliancy sheet specifies the required tests for this CPE and allocates whether the tests are

- factory acceptance tests (FAT), i.e., the tests are performed by the CPE vendor,
- customer location tests (CLT), i.e., the tests are performed by Swisscom, or
- intentionally not performed.

1.2 Scope

The scope of this document is to specify all tests related only to the WAN interface of wireline broadband access xDSL CPEs. LAN interface tests must be addressed separately.

1.3 Target readership, requirements of the reader

The document is intended to guide CPE vendors through the Swisscom xDSL CPE FAT required in the additional Excel test compliancy sheet.

1.4 Structure of this library document

This library document lists all potentially required CPE WAN Layer 1 xDSL tests in Sections 4. The test descriptions are copied from the Swisscom HP Quality Centre or, when possible, from other Word files such as [3] and [4] that have copied these tests earlier from the HP Quality Centre. It has been observed that the tests are only inconsistently described. We have therefore changed the order and formulation of the test steps to obtain a more consistent version, of course without changing the tests as such.

The test steps have been colored in order to improve the handling of this document:

Test initiation
Test parameter settings
Test procedure
Test assessment

Table 1: Test step colorings.

1.5 Usage of the Excel test compliancy sheet

The accompanying Excel test compliancy sheet [5] automatically determines the recommended tests of this library based on the xDSL type (VDSL2, ADSL2+, ADSL), the Annex (POTS, ISDN) and the customer facing unit (RES, SME, CBU, CWS). The Swisscom CPE manager then allocates these recommended tests individually to

- factory acceptance tests (FAT), i.e., the tests are performed by the CPE vendor,
- customer location tests (CLT), i.e., the tests are performed by Swisscom, or
- no test, i.e., the tests are intentionally not performed.

The test operators must fill in the verdicts, defect severities and defect priorities as well as, in case of a verdict of fail, a short one line description of the defect in case of a verdict of fail.

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1.6 Test verdicts, defect severities and defect priorities

A test may have one of the following **test verdicts**:

- **Pass:** The test passes the assessment rules.
- **Fail:** The test fails the assessment rules.
- **Accepted:** The test fails the assessment rules, but the device under test is not “guilty”. E.g., a CPE may not pass an assessment rule because of a known limitation of the copper access node (CAN).

Depending on the severances of a fail, the following **defect severities** may apply:

- **–:** None (in case of a verdict of pass or accepted).
- **Minor:** The least severe failing of the assessment rule.
- **Major:** A more severe failing of the assessment rule.
- **Critical:** The most severe failing of the assessment rule.

These defect severities are then translated into the following **defect priorities**:

- **–:** None (default mapping of the severity –).
- **Minor:** Default mapping of the severity minor.
- **Major:** Default mapping of the severity major.
- **Urgent:** Default mapping of the severity critical.

Throughout the assessment, the color codes are used of Table 2 are used.

Test verdict	Test severity
Pass	–
Accepted	–
Fail	Minor
Fail	Major
Fail	Cirtical

Test priority
–
–
Minor
Major
Urgent

Table 2: Color codes of test verdicts, defect severities and defect priorities.

Defect severities are clearly defined by the assessment rules and are not debatable, Defect priorities are debatable and their above default setting can be changed by Swisscom. One or more urgent priorities imply a recommendation of “No go” of the tested device under test; such devices can neither go into pilots nor in operation.

1.7 Terms and abbreviations

ADSL	Asymmetric Digital Subscriber Line
ADSL2+	Asymmetric Digital Subscriber Line 2+
ALU	Alcatel-Lucent
ATM	Asynchronous Transfer Mode
AWGN	Additive Gaussian White Noise (i.e., thermal noise, referred to as Low Noise – LN)
BT	Bridge Tap, i.e., an indeterminate branch that reflects DSL signals; the out of phase echoed signal is mixed with the original signal and creates, among other impairments, attenuation distortion
CAN	Copper Access Node (i.e., DSLAM)
CBU	Corporate Business Units (Swisscom Customer Facing Unit)
CIS	Carrier Internet Service

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CLT	Customer Location Test
CO	Central Office (exchange)
CPE	Customer Premises Equipment
CWS	Corporate Wholesale (Swisscom Customer Facing Unit)
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Server
DoS	Denial of Service
DP	Datapump
DPBO	Downstream Power Back-Off
DS	Downstream
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
FAT	Factory Acceptance Test
FEXT	Far End Crosstalk
FW	Firmware
FTTB	Fiber to the Building
FTTC	Fiber to the Curb
FTTS	Fiber to the Street
HN	High Noise (i.e., SPM3 noise)
HW	Hardware
INP	Impulse Noise Protection
IP	Internet Protocol (according to [RFC 791])
IPoE	IP over Ethernet
IPv4	Internet Protocol Version 4
ISDN	Integrated Services Digital Network
LAN	Local Area Network
LN	Low Noise (i.e., AWGN)
LQD	Line Quality Diagnosis
MT	Monitoring Tones (= DP setting)
NEXT	Near End Crosstalk
POTS	Plain Old Telephony Service
PPP	Point-to-Point Protocol
PPPoE	Point-to-Point Protocol over Ethernet
PTM	Packet Transfer Mode
PSD	Power Spectral Density
MAC	Medium Access Control
RA	Rate Adaptation
RES	Residential (Swisscom Customer Facing Unit)
RFI	Radio Frequency Interference
SDSL	Symmetric Digital Subscriber Line
SpM	Spectrum Management
SPM3	Spectrum Management 3 noise, Swisscom specific noise type taking inter copper line interference into account (referred to as High Noise – HN)
SME	Small and Medium Enterprises (Swisscom Customer Facing Unit)
SRA	Seamless Rate Adaptation
SW	Software
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
UPBO	Upstream Power Back-Off

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US	Upstream
VDSL2	Very High Speed Digital Subscriber Line 2
WAN	Wide Area Network
WLAN	Wireless LAN
xDSL	Generic term covering various DSL techniques such as ADSL, ADSL2, ADSL2+, VDSL2 or SDSL

1.8 Referenced documents

[1] Jürg Ruprecht, xDSL and fiber CPE WAN requirement library, Swisscom document, \\ss002206\DEV-NTD-WAC$\0_Public\WAC_freigegebene_Dokumente\CPE-Requirements-Library-WAN-xDSL-&-Fibre.pdf, January 2013.

[2] Jürg Ruprecht, xDSL and fiber CPE WAN requirement compliancy sheet, Swisscom document, \\ss002206\DEV-NTD-WAC$\0_Public\WAC_freigegebene_Dokumente\CPE-Requirements-Compliancy-Sheet-WAN-xDSL-&-Fibre.xls, January 2013.

[3] Jürg Schmid, Damien Fragnière, CPE Factory Acceptance Test, Swisscom document, Version 1.9, 17-01-2013.

[4] Jürg Schmid, Armin Berchtold, CO Factory Acceptance Test, Swisscom document, Version 2.1, 30-11-2012.

[5] Jürg Ruprecht, xDSL CPE WAN test compliancy sheet, Swisscom document, January 2013.

[6] ITU T G.997.1 (06/12), Physical layer management for digital subscriber line (DSL) transceivers.

[7] Spirent, User Guide, xDSL Custom Noise Generator.

[8] Jürg Ruprecht, Assecco-0-Presentation.pptx, an introductory presentation to Assecco, October 2013.

[9] Jürg Ruprecht, Assecco-1-Vendor-Info-Example.xlsx, an example of the vendor information that must be provided to Swisscom, October 2013.

[10] Jürg Ruprecht, Assecco-1-Vendor-Info-Emty.xlsx, the template of the vendor information that must be provided to Swisscom, October 2013.

[11] Jürg Ruprecht, Assecco-3-L1-Input-Definition.xlsx, a detailed definition of L1 Assecco input, October 2013.

[12] Jürg Ruprecht, Assecco-4-L1-Example.csv, an example of L1 Assecco input, October 2013.

[13] Jürg Ruprecht, Assecco-5-L1-Assessment.xlsx, Assecco L1 assessment file, October 2013.

[14] Jürg Ruprecht, Assecco-6-UL-Assessment.xlsx, the Assecco UL assessment file October 2013.

[15] Jürg Ruprecht, Assecco-7-Assessment-Summary.xlsx, Assecco summary, file October 2013.

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2 Laboratory test setups

2.1 Swisscom vendor laboratory test setups

Swisscom operates a fully automatic laboratory including patch panels, switch matrices as well as Spirent line and noise simulators, cf. Figure 1. Note that Alcatel and Huawei CANs are attached via different cabling.

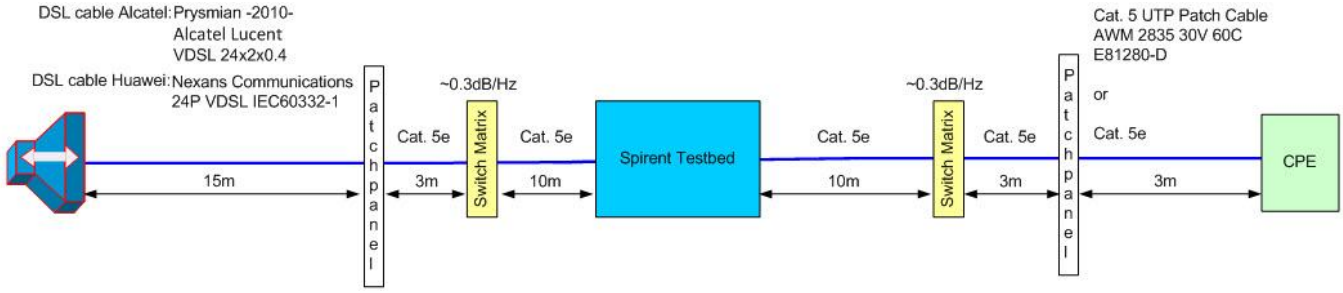

Figure 1: Swisscom lab test setup.

2.2 Recommended CPE vendor laboratory test setup

For the CPE vendors that perform the factory acceptance tests (FAT), we recommend to use a simplified setup with cable lengths derived from the Swisscom setup in Figure 1 above, cf. Figure 2. Again note that Alcatel and Huawei CANs are attached via different cabling.

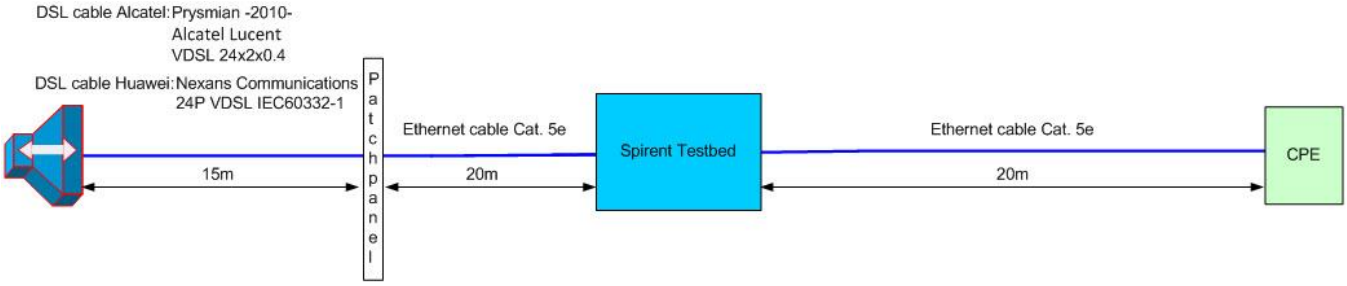

Figure 2:CPE vendor lab test setup.

2.3 Basic protocol test setup

For protocol tests, i.e., Layer 1 CPE inventory information tests and upper layer tests, the CPE can be directly attached to the CAN, i.e., neither a line nor a noise simulator is required, cf. Figure 3.

Figure 3: Basic protocol test setup.

2.4 Basic HF conformance test setup

For legacy HF conformance tests, i.e., all legacy Layer 1 tests (except the inventory information tests), a line and a noise simulator is required between the CPE and the CAN.

For performance low noise, bit swapping, stability and recovery from noise impairment tests, the noise has to be injected on both sides at the same time (cf. Figure 4).

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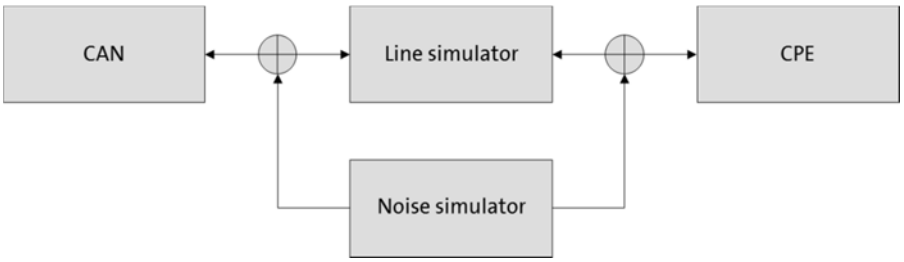

Figure 4: RF conformance test setup in upstream and downstream test direction at the same time.

For the performance high noise test, the noise has to be injected not at the same time (cf. Figure 5):

- For measurements in the downstream direction, the respective noise must only be added between the line simulator and the CPE (full lines in Figure 5).
- For measurements in the upstream direction, the respective noise must only be added between the CAN and the line simulator (dashed lines in Figure 5).

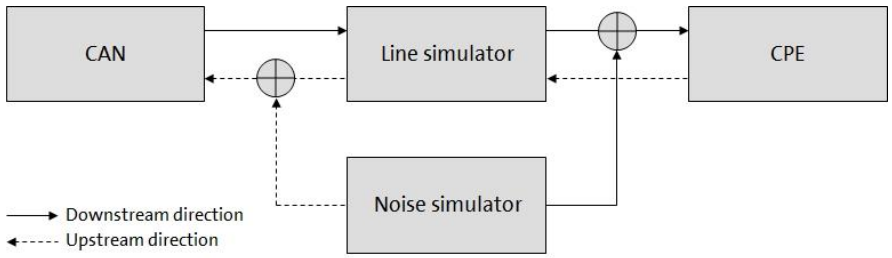

Figure 5: RF conformance test setup with upstream test direction (dashed lines) and downstream test direction (full lines).

2.5 Vectoring HF conformance test setup

Vectoring conformance tests required multiple parallel lines with crosstalk, as is required for vectoring tests. Such tests require as crosstalk simulator also simulating lines and noise types, cf.

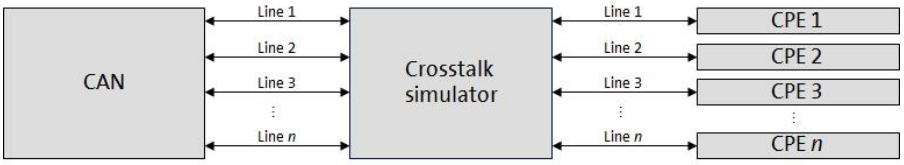

Figure 6: Vectoring HF conformance test setup for vectoring tests.

3 Test environment “Expecco” vs. test assessment tool “Assecco”

3.1 Overview

Swisscom has automated its CPE test and CPE assessment procedures developed these tools:

- **Expecco:** Swisscom hardware / software test environment based on expeccoNET that allows the tests to be executed automatically with csv file output for further assessment processing.
- **Assecco:** Swisscom CPE assessment tool based on Excel that further processes the Expecco csv output files towards the final assessment.

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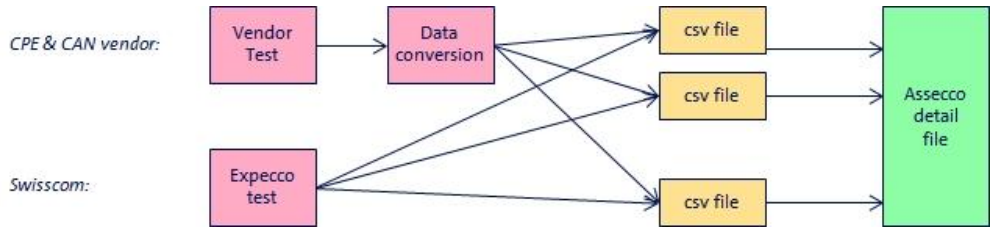

Figure 7: Vendor vs. Swisscom Expecco tests with csv outputs to assessment tool Assecco.

3.2 Assecco files

The following files are parts of the Assecco assessment process and are provided on request:

- Assecco-0-Presentation.pptx: An introductory presentation to Assecco
- Assecco-1-Vendor-Info-Example.xlsx: An example of the vendor information that must be provided to Swisscom (cf. Figure 8).

CPE vendor information		Vendor input		Swisscom input		
CPE (=system)		Name		Inventory info code		
	Country	France		3D00		
	Vendor	Siligence		SLGN		
	Market name	Stargate				
	Model	SGA441SW		SGNP00		
	Firmware	04.01.11		040111		
Chipset		Name		Inventory info code		
	Country	USA		B500		
	Vendor	Broadcom		BDCM		
	Model	63168		16		
Datapump (chipset FW)		POTS		ISDN		
	Name	A2pv6F038q.d24n		n/a		
	Inventory info code	Ap6v38q.24n		n/a		
Datapump settings		POTS US	POTS DS	ISDN US	ISDN DS	
	Phy retransmission	On	On	n/a	n/a	
	G.INP	On	On	n/a	n/a	
	SRA	On	On	n/a	n/a	
	Monitoring tones	On		n/a		
	Vectoring	On		n/a		
	A43 tone set	On		n/a		
	B43 tone set	On		n/a		
	V43 tone set	Off		n/a		
L1 xDSL potential & tests		POTS potential	POTS tests	ISDN potential	ISDN tests	
	Vectoring	x				
	VDSL2	x				
	ADSL2+	x				
	ADSL	x				
	SDSL					
L1 fiber potential	Fiber					
UL potential & tests	Gateway type	Router				
		DHCP potential	DHCP tests	PPP potential	PPP tests	
	VDSL2	x		x		
	ADSL	x		x		
	Fiber	x		x		
CFU operation		RES	SME	CBU	CWS	NIT
		x				

Figure 8: An example of the vendor information that must be provided to Swisscom.

- Assecco-1-Vendor-Info-Emty.xlsx: The above file without example data, ready for use; the yellow cells must be filled in by the vendor, the other cells will be filled in by Swisscom.

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- Assecco-3-L1-Input-Definition.xlsx: A detailed definition of L1 Assecco input.
- Assecco-4-L1-Example.csv: An example of L1 Assecco input.
- Assecco-5-L1-Assessment.xlsx: The Assecco L1 assessment file, referred to as Assecco detail file. One file is needed per CAN and POTS or ISDN.
- Assecco-6-UL-Assessment.xlsx: The Assecco UL assessment file. One files is needed per CPE; this file is not used in this version of this report.
- Assecco-7-Assessment-Summary.xlsx: The Assecco summary file. One files is needed per CPE and may belong to several Assecco detail files, i.e., Assecco-5-L1-Assessment.xlsx (cf. the example in Figure 9).

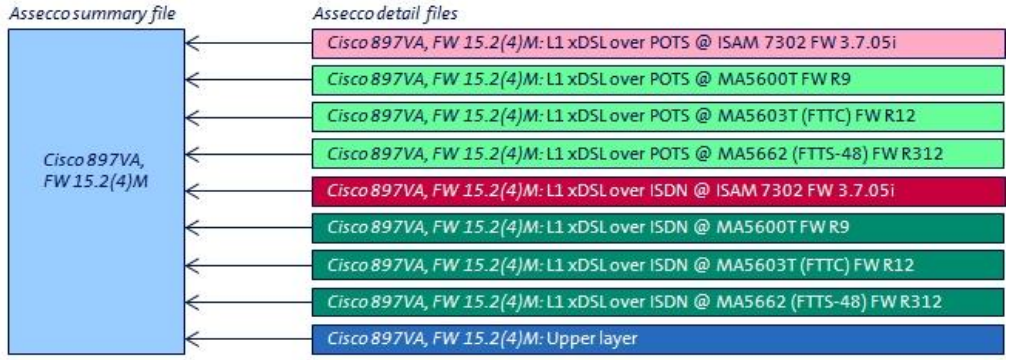

Figure 9: Assessment files – Assecco summary file vs. Assecco detail files.

3.3 Assecco file structure

The structure of the **Assecco summary file** is as follows:

- **Output sheets:**
  - Summary: CPE capability, test priorities outcome summary.
  - Vendor acceptance: General test data, specific test setups (all tests).

The structure of the **Assecco detail file** is as follows:

- **Output sheets:**
  - Overview: CPE capability, test verdicts, severities, priorities, HP-QC, test failures & impact.
  - Info: General test data, specific test setups (all tests).
  - Inventory: CPE inventory assessments (all xDSL types).
  - Rate: Actual bit rate (low noise, high noise) assessments (all xDSL types).
  - Bitswap: Bit swap assessments (all xDSL types).
  - Stability: Stability assessments (all xDSL types).
  - Recovery: Recovery from noise impairment assessments (all xDSL types).
  - LegCpeVecCan: FFM and CPE handling assessments (VDSL2 17a legacy); not needed for L1 basic tests.

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  - VecCpeVecCan: Maximum aggregated data rate G.INP, join, performance vectoring, vectoring stability, error sample feedback, SRA, G.INP, FEXT cancellation control (VDSL2 17a vectoring) ; not needed for L1 basic tests.

- **Data base sheets:**
  - IDs: CPE inventory information IDs and conversions.
  - Ref: Performance reference curves, i.e., pass and defect bounds.
- **Input sheets:**
  - Raw: All Expecco csv outputs of the assessed CPE with the assessed FW.
  - RawCmp: All Expecco csv actual bit rate outputs of the compared CPE (may be the same CPE with a former FW).
- **Evaluation sheets:**
  - Data: Evaluations of all tests of the assessed CPE with the assessed FW.
  - DataCmp: Evaluations of all actual bit rate tests of the compared CPE.

3.4 Test initiation with respect to Assecco

Any test series must be initiated by the following procedure:

- Vendor actions:
  - To provide the CPE inventory information data via the Excel file Assecco-2-Vendor-Info-Empty.xlsx to Swisscom (cf. example in Figure 8).
- Swisscom actions:
  - To copy the above data into the top table of sheet RAW.
  - To update the data base sheet IDS with the new CPE inventory information codes and full names.
  - To provide the corresponding Assecco detail file Assecco-5-L1-Assessment.xlsx together with the corresponding summary file Assecco-7-Assessment-Summary.xlsx to the vendor.
- Vendor actions:
  - To start testing and to use copies of the above files for each POTS / ISDN and CAN assessment (cf. also Figure 9).

3.5 Assecco file naming convention

The **Assecco input file** (i.e., test output file) name shall be chosen as follows:

```
<xDSL type>_<annex>_<test type>_<CPE system vendor>_<CPE system model>_
<CPE system FW>_<CPE chipset vendor>_<CPE chipset FW/DP (short)>_
<CAN system vendor>_<CAN system model>_<CAN system FW>_<Date>_<Time>.csv
```

In the above definition, the **terms** may take the following values:

- <xDSL type>: VDSL17a, VDSL8b, ADSL2p, ADSL
- <annex>: POTS, ISDN
- <test type>: Inventory, HighNoise, LowNoise, Bitswap, Stability, Recovery.
- <CPE system vendor>: CPE inventory info output, e.g., AVM, CSCO, MRCC, PBBS, ZYXE.

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- <CPE system model>: CPE inventory info output, e.g., F!Box7390, 887VA-SE, 7647-47, V226N1W, P870H51A_V2,
- <CPE system FW>: FW + CPE inventory info output, e.g., FW99.04.90, FW15.1(4)M, FW901051-60, FW60200, FW112VFH3.
- <CPE chipset vendor>: CPE inventory info output, e.g., BDCM, IKNS, TCTN.
- <CPE chipset FW/DP (short)>: The short name of the DP, e.g., 30h for Ap6v30h.23j or r71 for 1.0.7r71 (cf. also Assecco-5-L1-Assessment.xlsx, sheet IDs, column AL "Datapump (short)").
- <CAN system vendor>: ALU (= Alcatel Lucent), HUA (= Huawei).
- <CAN system model>: ISAM7302, ISAM7330, MA5600T, MA5603T, MA5611S.
- <CAN system FW>: FW4.3.05n, FWR9, FWR15.
- <Date>: The year, month and day, i.e., YYYY-MM-DD.
- <Time>: The hour and minutes, i.e., HH-MM.

The delimiter symbol shall always be the underline symbol "_". If it is used in one of the terms (e.g. P870H51A_V2 for the respective ZyXEL CPE model), the underline symbol shall be replaced with "-" in this term (e.g., P870H51A-V2).

The corresponding **log file** shall be named as follows (the same as above, except with a txt rather than a csv extension):

```
<xDSL type>_<annex>_<test type>_<CPE system vendor>_<CPE system model>_
<CPE system FW>_<CPE chipset vendor>_<CPE chipset FW/DP (short)>_
<CAN system vendor>_<CAN system model>_<CAN system FW>_<Date>_Time>.txt
```

It shall be in text format and shall contain all essential information about the whole test; the detailed structure is left free to the vendor.

The following **example** is provided for the Assecco input file name and the log file name:

```
VDSL17a_POTS_Inventory_CSCO_C897VA_FW15.2(4)M_BDCM30h_HUA_MA5603T_FWR15_2013-09-30_12-44.csv

VDSL17a_POTS_Inventory_CSCO_C897VA_FW15.2(4)M_BDCM30h_HUA_MA5603T_FWR15_2013-09-30_12-44.txt
```

The Assecco-5-L1-Assessment.xlsx **file name** shall be chosen as follows:

```
YYYY-MM_#_L1-Assessment_<CPE system vendor>_<CPE system model>_
<CPE system FW>_<CPE chipset vendor>_<CPE chipset FW/DP (short)>_
<Annex>_<CAN system vendor>_<CAN system model>_<CAN system FW>
```

In the above definition, the **terms** may take the values as defined above and below:

- YYYY: The year of the assessment, e.g., 2013.
- MM: The number of the month of the assessment, e.g. 09 for September.
- #: A number or letter (1, 2, 3, … 9, A, B, C, …) that orders the files in a logical rather than alphabetical manner.

The following **example** is provided:

```
2013-09_1_L1-Assessment_Cisco_897VA_FW15.2(4)M3_DP30h_POTS_ALU_ISAM7302_FW4.3.05n.xlsx

2013-09_2_L1-Assessment_Cisco_897VA_FW15.2(4)M3_DP30h_POTS_HUA_MA5600T_FWR9.xlsx

2013-09_3_L1-Assessment_Cisco_897VA_FW15.2(4)M3_DP30h_POTS_HUA_MA5603T_FWR15.xlsx

2013-09_4_L1-Assessment_Cisco_897VA_FW15.2(4)M3_DP30h_POTS_HUA_MA5611S_FWR15.xlsx
```

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2013-09_5_L1-Assessment_Cisco_897VA_FW15.2(4)M3_DP30h_ISDN_ALU_ISAM7302_FW4.3.05n.xlsx

2013-09_7_L1-Assessment_Cisco_897VA_FW15.2(4)M3_DP30h_ISDN_HUA_MA5600T_FWR9.xlsx

2013-09_8_L1-Assessment_Cisco_897VA_FW15.2(4)M3_DP30h_ISDN_HUA_MA5603T_FWR15.xlsx

2013-09_9_L1-Assessment_Cisco_897VA_FW15.2(4)M3_DP30h_ISDN_HUA_MA5611S_FWR15.xlsx

The Assecco-5-L1-Assessment.xlsx **file name** shall be chosen as follows:

YYYY-MM_0_Assessment_<CPE system vendor>_<CPE system model>_
<CPE system FW>_<CPE chipset vendor>_<CPE chipset FW/DP (short)>_Summary

In the above definition, the **terms** are defined above. The following example is provided:

2013-09_0_L1-Assessment_Cisco_897VA_ FW15.2(4)M3_DP30h_POTS_Summary.xlsx

3.6 Assecco input file structure: General issues

The **goal** of the csv file input structure is as follows:

- Any order: Assecco shall not care about the order of the Expecco csv output files in the Raw input sheet.
- Prevention of wrong inputs: Assecco shall not evaluate other CPE – CAN tests.
- Specification of test setup: Assecco shall store the setup of all tests.

The **realization** of these goals is as follows:

- Any order: Expecco starts and ends the test data with BEGIN and END command, respectively.
- Prevention of wrong inputs: Expecco complements the BEGIN and END commands with test setup, CPE and CAN data.
- Specification of test setup: All test data are proceeded with test setup, CPE and CAN data.

The following **file structure** is chosen:

```
<begin command>
<header>
<test data>
<end command>
```

Thereby, `<header>` and `<test data>` are defined further below.

When copying data from the Assecco input file name s onto sheet Raw of Assecco, the following **rules** must be followed strictly, for otherwise undefined Assecco behavior may occur:

- Copy only values (with the insert / only text command), never the values with the format (with <Ctrl>-V); only then the conditional formatting is preserved.
- Do neither delete nor add full lines, for otherwise the calculations of the DATA sheet may become erroneous.

3.7 Assecco input file structure: Begin & end commands

The **code** is defined as follows:

- <begin command>:

  BEGIN_<xDSL type>_<annex>_<test type>_<CPE system vendor>_<CPE system model>_
  <CPE system FW>_<CPE chipset vendor>_<CPE chipset model>_<CPE chipset FW/DP>_
  <CAN system vendor>_<CAN system model>_<CAN system FW>

- <end command>: The same as <begin command>, except `BEGIN` replaced with an `END`.

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- Delimiter symbol: If the default delimiter symbol "_" is used in one of the items <xxx> (e.g. ZyXEL system model P870H51A_V2), another delimiter symbol must be chosen; any is allowed not yet used in <xxx>, preferably space (" "), "+", "<" or ">".

In the above definitions, the **terms** may take the following values; they are the same as in the csv file naming rule above, except the chipset information):

- <xDSL type>: VDSL17a, VDSL8b, ADSL2p, ADSL
- <annex>: POTS, ISDN
- <test type>: Inventory, HighNoise, LowNoise, Bitswap, Stability, Recovery.
- <CPE system vendor>: CPE inventory info output, e.g., AVM, CSCO, MRCC, PBBS, ZYXE.
- <CPE system model>: CPE inventory info output, e.g., F!Box7390, 887VA-SE, 7647-47, V226N1W, P870H51A_V2,
- <CPE system FW>: FW + CPE inventory info output, e.g., FW99.04.90, FW15.1(4)M, FW901051-60, FW60200, FW112VFH3.
- <CPE chipset vendor>: CPE inventory info output, e.g., BDCM, IKNS, TCTN.
- <CPE chipset model>: CPE inventory info output, e.g., 68, IK105012, TC3086.
- <CPE chipset FW/DP>: DP + CPE inventory info output, e.g., DPAp6v30h.23j, DP1.0.7r71.
- <CAN system vendor>: ALU (=Alcatel Lucent), HUA (=Huawei).
- <CAN system model>: ISAM7302, ISAM7330, MA5600T, MA5603T, MA5611S.
- <CAN system FW>: FW4.3.05n, FWR9, FWR15.

Note that it is crucial to follow these rules:

- To have the strings FW and DP proceeding the FW and DP names, respectively.
- To have the BEGIN and END commands such that they contain the same characters after BEGIN and END.

The following example is provided:

```
BEGIN_VDSL17a_POTS_Inventory_CSCO_C897VA_FW15.2(4)M_BDCM_68_DPAp6v30h.23j_HUA_MA5603T_FWR15
…
END_VDSL17a_POTS_Inventory_CSCO_C897VA_FW15.2(4)M_BDCM_68_DPAp6v30h.23j_HUA_MA5603T_FWR15
```

3.8 Assecco input file structure: Header

An example is provided in Figure 10 below.

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TEST								
Entity	Company	Test lab	Test bed	Test system	Test person	Date	Time	Test case
TestRun	Swisscom	Zür-Bin17	Messplatz 1	Suite V203	Juerg Schmic	18.12.2013	12:44:03	VDSL17a LowNoise
SETUP								
Entity	SysVendor	SysModel	SysFW	Serial #	Further info			
AccessNode	HUA	MA5603T	R12	4006737	lab-zb1801-s-ch-05			
LineBoard	HUA	H80BVCMM	-	5002576	1/1/2/1 POTS			
LineSimulator	Spirent	DLS 8235	2	8007273	-			
LineSimulator	Spirent	DLS 8235	1	6000732	-			
NoiseGenerat	Spirent	DLS 5500	3.0.3	3001013	-			
TrafficGenera	-	-	-	-	-			
CPE DUT								
Vendor ID or No Sync		System vendor ID		Version number		System version number		
0xB5004244434D0000		0x3D00534C474E0000		Ap6v38q.24n 16		2.61349F0100007 SGNP00 040111		
ASSESSMENT								
Criterium	Verdict	Severity	Test failure					
US	Pass	-	-					
DS	Pass	-	-					

Figure 10: Header example.

The following keywords are crucial for the correct functioning of Assecco:

- **`TEST`**:
  - `TestRun`: General data about the test, cf. line below `TEST`.
- **`SETUP`**:
  - `AccessNode`: General data about the CAN, cf. line below `SETUP`.
  - `LineBoard`: General data about the CAN line board, cf. line below `SETUP`.
  - `LineSimulator`: General data about the line generator, cf. line below `SETUP`. Note that there may be one or two lines specifying one or two line simulators.
  - `NoiseGenerator`: General data about the noise generator, cf. line below `SETUP`.
  - `TrafficGenerator`: General data about the traffic generator, as is used for some vectoring tests in order to simulate interference from other copper cables, cf. line below `SETUP`.
- **`CPE DUT`**:
  - `<vendor ID>`: CPE G.994.1 vendor ID from the CPE inventory information.
  - `<syst. vendor ID>`: CPE G.997.1 system vendor ID from the CPE inventory information.
  - `<version #>`: CPE G.997.1 version number from the CPE inventory information.
  - `<vendor serial #>`: CPE G.997.1 vendor serial number from the CPE inventory information.
  - No sync: in case of no synchronization, `<vendor ID>` is to be replaced by `No sync`.
- **`ASSESSMENT`** (optional): The test operator may assess the test; Assecco will then compare its assessment with the one of the test operator and output an error message `Ambiguous` if not the same.
  - `<Criteria 1>, <Criteria 2>, … <Criteria n>`: The criteria depend on the specific test, cf. below.

Note that, for the user convenience, the following conditional formatting is applied to the `Raw` and `RawCmp` sheets:

- `BEGIN` command: Bold face, with grey background.
- `END` command: Bold face, with white background.
- `TEST`, `SETUP`, `CPE DUT` and `ASSESSMENT` keywords: Bold face, yellow background.
- Liens below `TEST`, `SETUP`, `CPE DUT` and `ASSESSMENT` keywords: Yellow background.

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- CPE inventory information: Marked different in different colors, i.e., <vendor ID>, <system vendor ID>, <version #> and <vendor serial #>.

3.9 Assecco input file structure: Examples

For each test type, Examples of csv input files are shown below; a more detailed input description is given in the test case descriptions of Section 4 and the parameter list in Table 26:

- **CPE inventory information test:** `Inventory`

BEGIN_VDSL17a_POTS_Inventory_SLGN_SGNP00_FW040111_BDCM_16_DPAp6v38q.24n_HUA_MA5603T_FWR12								
TEST								
Entity	Company	Test lab	Test bed	Test system	Test person	Date	Time	Test case
TestRun	Swisscom	Zür-Bin17	Messplatz 1	Suite V203	Juerg Schmic	18.12.2013	12:44:03	VDSL17a Inventory
SETUP								
Entity	SysVendor	SysModel	SysFW	Serial #	Further info			
AccessNode	HUA	MA5603T	R12	4006737	lab-zb1801-s-ch-05			
LineBoard	HUA	H80BVCMM	-	5002576	1/1/2/1 POTS			
LineSimulato	Spirent	DLS 8235	2	8007273	-			
LineSimulato	Spirent	DLS 8235	1	6000732	-			
NoiseGenera	Spirent	DLS 5500	3.0.3	3001013	-			
TrafficGenera	-	-	-	-	-			
CPE DUT								
Vendor ID or No sync		System vendor ID		Version number		System version number		
0xB5004244434D0000		0x3D00534C474E0000		Ap6v38q.24n 16		2.61349F0100007 SGNP00 040111		
END_VDSL17a_POTS_Inventory_SLGN_SGNP00_FW040111_BDCM_16_DPAp6v38q.24n_HUA_MA5603T_FWR12								

Figure 11: csv file example of the CPE inventory information test with the conditional Assecco formatting.

- **Performance test:** `LowNoise, HighNoise`

BEGIN_VDSL17a_POTS_LowNoise_SLGN_SGNP00_FW040111_BDCM_16_DPAp6v38q.24n_HUA_MA5603T_FWR12								
TEST								
Entity	Company	Test lab	Test bed	Test system	Test person	Date	Time	Test case
TestRun	Swisscom	Zür-Bin17	Messplatz 1	Suite V203	Juerg Schmic	18.12.2013	12:44:03	VDSL17a LowNoise
SETUP								
Entity	SysVendor	SysModel	SysFW	Serial #	Further info			
AccessNode	HUA	MA5603T	R12	4006737	lab-zb1801-s-ch-05			
LineBoard	HUA	H80BVCMM	-	5002576	1/1/2/1 POTS			
LineSimulato	Spirent	DLS 8235	2	8007273	-			
LineSimulato	Spirent	DLS 8235	1	6000732	-			
NoiseGenera	Spirent	DLS 5500	3.0.3	3001013	-			
TrafficGenera	-	-	-	-	-			
CPE DUT								
Vendor ID or No Sync		System vendor ID		Version number		System version number		
0xB5004244434D0000		0x3D00534C474E0000		Ap6v38q.24n 16		2.61349F0100007 SGNP00 040111		
ASSESSMENT								
Criterium	Verdict	Severity	Test failure					
US	Pass	-	-					
DS	Pass	-	-					
DATA								
loopLength	iteration	stateUs	stateDs	rateUs	rateDs			
100	1	up	up	28685	100015			
100	2	up	up	28685	100015			
100	3	up	up	28685	100015			
200	1	up	up	28769	100009			
200	2	up	up	28685	100015			
200	3	up	up	28772	100009			
...	...	...	...	...	...			
2500	1	up	up	2373	8360			
2500	2	up	up	2373	8360			
2500	3	up	up	2376	8360			
END_VDSL17a_POTS_LowNoise_SLGN_SGNP00_FW040111_BDCM_16_DPAp6v38q.24n_HUA_MA5603T_FWR12								

Figure 12: csv file example of the performance test – low noise with the conditional Assecco formatting, where" …" indicates that many lines of the same type should be on this line; with HighNoise rather than LowNoise in the BEGIN and END commands, it also applies to the performance test – high noise.

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- **Bit swapping test:** `Bitswap`

BEGIN_VDSL17a_POTS_Bitswap_SLGN_SGNP00_FW040111_BDCM_16_DPAp6v38q.24n_HUA_MA5603T_FWR12													
TEST													
Entity	Company	Test lab	Test bed	Test system	Test person	Date	Time	Test case					
TestRun	Swisscom	Zür-Bin17	Messplatz 1	Suite V203	Juerg Schmic	18.12.2013	12:44:03	VDSL17a Bitswap					
SETUP													
Entity	SysVendor	SysModel	SysFW	Serial #	Further info								
AccessNode	HUA	MA5603T	R12	4006737	lab-zb1801-s-ch-05								
LineBoard	HUA	H80BVCMM	-	5002576	1/1/2/1 POTS								
LineSimulato	Spirent	DLS 8235	2	8007273	-								
LineSimulato	Spirent	DLS 8235	1	6000732	-								
NoiseGenera	Spirent	DLS 5500	3.0.3	3001013	-								
TrafficGenera	-	-	-	-	-								
CPE DUT													
Vendor ID or	No Sync	System vendor ID		Version number		System version number							
0xB5004244434D0000		0x3D00534C474E0000		Ap6v38q.24n 16		2.61349F0100007 SGNP00 040111							
ASSESSMENT													
Criterium	Verdict	Severity	Test failure										
US0	Pass	-	-										
US1	Pass	-	-										
US2	Pass	-	-										
DS1	Fail	Major	-										
DS2	Fail	Major	-										
DS3	Fail	Major	-										
DATA													
band	loopLength	toneRange	initialLoad	initialLoadSu	downToLoad	downToLoadS	autoReturnLo	autoReturnLo	autoReturnSu	forcedReturnL	forcedReturnL	forcedReturnSuccess	
US0	1200	48-57	8 8 8 8 8 7 7	69	0 0 0 0 0 0 0	0	8 8 8 7 7 7 6	66	95.7	-	-	-	
US1	900	906-915	7 7 7 7 7 7 6	69	0 0 0 0 0 0 0	0	6 5 6 5 6 5 6	56	81.2	-	-	-	
US2	300	1996-2005	4 4 4 4 4 4 4	42	0 0 0 0 0 0 0	0	2 2 3 2 3 2 3	26	61.9	-	-	-	
DS1	1200	94-103	11 11 12 12 1	115	0 0 0 0 0 0 0	0	0 0 0 0 0 0 0	0	0	-	-	-	
DS2	300	1230-1239	5 4 5 5 4 4 4	46	0 0 0 0 0 0 0	0	0 0 0 0 0 0 0	0	0	0 0 0 0 0 0 0	0	0	
DS3	100	2830-2839	6 6 5 6 5 6 6	57	0 0 0 0 0 0 0	0	0 0 0 0 0 0 0	0	0	0 0 0 0 0 0 0	0	0	
END_VDSL17a_POTS_Bitswap_SLGN_SGNP00_FW040111_BDCM_16_DPAp6v38q.24n_HUA_MA5603T_FWR12													

Figure 13: csv file example of the bit swapping test with the conditional Assecco formatting.

- **Stability test:** `Stability`

BEGIN_VDSL17a_POTS_Stability_SLGN_SGNP00_FW040111_BDCM_16_DPAp6v38q.24n_HUA_MA5603T_FWR12												
TEST												
Entity	Company	Test lab	Test bed	Test system	Test person	Date	Time	Test case				
TestRun	Swisscom	Zür-Bin17	Messplatz 1	Suite V203	Juerg Schmic	18.12.2013	12:44:03	VDSL17a Stability				
SETUP												
Entity	SysVendor	SysModel	SysFW	Serial #	Further info							
AccessNode	HUA	MA5603T	R12	4006737	lab-zb1801-s-ch-05							
LineBoard	HUA	H80BVCMM	-	5002576	1/1/2/1 POTS							
LineSimulato	Spirent	DLS 8235	2	8007273	-							
LineSimulato	Spirent	DLS 8235	1	6000732	-							
NoiseGenera	Spirent	DLS 5500	3.0.3	3001013	-							
TrafficGenera	-	-	-	-	-							
CPE DUT												
Vendor ID or	No Sync	System vendor ID		Version number		System version number						
0xB5004244434D0000		0x3D00534C474E0000		Ap6v38q.24n 16		2.61349F0100007 SGNP00 040111						
ASSESSMENT												
Criterium	Verdict	Severity	Test failure									
Stability	Pass	-	-									
DATA												
timeStamp	stateUs	stateDs	rateUs	rateDs	attRateUs	attRateDs	noiMarUs	noiMarDs	fecUs	fecDs	cvUs	cvDs
41648.5827	up	up	11008	33021	24525	73019	20.8	23.2	0	0	0	0
41648.5847	up	up	11008	33021	25608	65277	20.7	18.9	0	0	0	0
41648.5867	up	up	11008	33021	22493	65114	16.7	18.8	0	841	0	0
41648.5886	up	up	11008	33021	25078	55402	16.6	14.1	0	891	0	0
41648.5906	up	up	11008	33021	19170	55134	12	14.1	0	871	0	0
41648.5926	up	up	11008	33021	19064	45407	11.9	9.3	0	0	0	0
…	…	…	…	…	…	…	…	…	…	…	…	…
41648.8718	up	up	11008	33021	5082	30467	1.9	1.9	186	13898	0	0
41648.8736	up	up	11008	33021	5092	30471	1.9	1.9	176	14962	0	0
41648.8754	up	up	11008	33021	5082	30420	1.9	1.9	349	14996	0	0
END_VDSL17a_POTS_Stability_SLGN_SGNP00_FW040111_BDCM_16_DPAp6v38q.24n_HUA_MA5603T_FWR12												

Figure 14: csv file example of the stability test with the conditional Assecco formatting, where" …" indicates that many lines of the same type should be on this line.

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- **Recovery from noise impairment test:** `Recovery`

BEGIN_VDSL17a_POTS_Recovery_SLGN_SGNP00_FW040111_BDCM_16_DPAp6v38q.24n_HUA_MA5603T_FWR12								
TEST								
Entity	Company	Test lab	Test bed	Test system	Test person	Date	Time	Test case
TestRun	Swisscom	Zür-Bin17	Messplatz 1	Suite V203	Juerg Schmic	18.12.2013	12:44:03	VDSL8b Recovery
SETUP								
Entity	SysVendor	SysModel	SysFW	Serial #	Further info			
AccessNode	HUA	MA5603T	R12	4006737	lab-zb1801-s-ch-05			
LineBoard	HUA	H80BVCMM	-	5002576	1/1/2/1 POTS			
LineSimulator	Spirent	DLS 8235	2	8007273	-			
LineSimulator	Spirent	DLS 8235	1	6000732	-			
NoiseGenerat	Spirent	DLS 5500	3.0.3	3001013	-			
TrafficGenera	-	-	-	-	-			
CPE DUT								
Vendor ID or No Sync		System vendor ID		Version number		System version number		
0xB5004244434D0000		0x3D00534C474E0000		Ap6v38q.24n 16		2.61349F0100007 SGNP00 040111		
ASSESSMENT								
Criterium	Verdict	Severity	Test failure					
US	Pass	-	-					
DS	Pass	-	-					
DATA								
band	startNoiMar	downToNoiMa	recoveryNoiM	recoverySuccess				
US	23.7	3	23.5	99.2				
DS	26.8	2.9	26.7	99.6				
END_VDSL17a_POTS_Recovery_SLGN_SGNP00_FW040111_BDCM_16_DPAp6v38q.24n_HUA_MA5603T_FWR12								

Figure 15: csv file example of the recovery from noise impairment test with the conditional Assecco formatting.

4 WAN layer 1 xDSL test cases

4.1 General issues

The sections below specify the WAN layer 1 xDSL test cases. They refer to the following Copper Access Nodes (CANs), also referred to as Digital Subscriber Line Access Multiplexers (DSLAMs):

- **Fiber to the Curb (FTTC) CANs:** Cf. Table 8 and Table 9 for exact specifications.
- **Fiber to the Street (FTTS) CANs:** Cf. Table 9 for exact specifications.
- **Fiber to the Building (FTTB) CANs:** Cf. Table 9 for exact specifications.

These test cases are applicable for the following xDSL techniques:

- **VDSL2 17a**, i.e., VDSL2 profile 17a),
- **VDSL2 8b**, i.e., VDSL2 profile 8b,
- **ADSL2+**, and
- **ADSL**.

The formulation of these test cases is for all xDSL techniques the same; they refer to xDSL specific data in tables in the annex.

4.2 xDSL tests – common steps

The Tables below describe test parts that are used by more than one of the xDSL tests thereafter.

Step	Description	Expected results / annotations
1.01	Setup the equipment as shown in: • xDSL CPE inventory test: Figure 3. • xDSL performance – low noise test: Figure 4. • xDSL performance – high noise test: Figure 5. • xDSL bit swapping test: Figure 4. • xDSL stability test: Figure 4. • xDSL recovery from noise impairment test: Figure 4.	
1.02	Prepare the CAN for testing.	Record the type and software release of the CAN.

Step	Description	Expected results / annotations
1.03	Prepare the CPE for testing.	Record the type and firmware release of the CPE.
1.04	Record the serial number of the test equipment (CPE).	Record the serial number of the test equipment (CPE).

Table 3: Test steps for single CPE test preparation.

Step	Description	Expected results / annotations
1.01	Setup the equipment as shown in: • xDSL CPE inventory test: Figure 3. • xDSL performance – low noise test: Figure 4. • xDSL performance – high noise test: Figure 5. • xDSL bit swapping test: Figure 4. • xDSL stability test: Figure 4. • xDSL recovery from noise impairment test: Figure 4.	
1.02	Prepare the CAN for testing.	Record the type and software release of the CAN.
1.03	Prepare the CPEs for testing. For FTTC/S-48: • 24 vectoring CPEs for testing, hereafter referred to as vectoring CPEs or CPE #1 – CPE #24. • 23 legacy CPEs for testing, hereafter referred to as legacy CPEs or CPE #25 – CPE #47. • 1 legacy CPEs, the DUT (Device Under Test), hereafter referred to as DUT or CPE #48. Or for FTTB/S-16: • 8 vectoring CPEs for testing, hereafter referred to as vectoring CPEs or CPE #1 – CPE #8. • 7 legacy CPEs for testing, hereafter referred to as legacy CPEs or CPE #9 – CPE #15. • 1 legacy CPEs is DUT (Device Under Test), hereafter referred to as DUT or CPE #16.	Record the types and firmware releases of the CPEs.
1.04	Record the serial number of the test equipment (CPE).	Record the serial number of the test equipment (CPE).

Table 4: Test steps for multiple CPE test preparation.

Step	Description	Expected results / annotations
2.01	Configure the respective CAN port with the legacy general settings of Table 11 and the legacy rate settings of: • xDSL CPE inventory information test: Table 12. • xDSL performance – low noise test: Table 12. • xDSL performance – high noise test: Table 12. • xDSL bit swapping test: Table 13. • xDSL stability test: Table 14. • xDSL recovery from noise impairment test: Table 15.	
2.02	For CANs with vectoring functionality as well as for VDSL2 17a and VDSL2 8b, configure the CAN (not only the respective CAN port) with the global vectoring settings of Table 16.	
2.03	For CANs with vectoring functionality as well as for VDSL2 17a and VDSL2 8b, configure the respective CAN port with the G.INP settings of Table 17.	
2.04	For CANs with vectoring functionality, for VDSL2 17a and VDSL2 8b, as well as for CPE with vectoring functionality, configure the respective CAN port with the SRA settings of Table 18.	

Table 5: Test steps for CAN configuration for legacy and single CPE vectoring tests.

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Step	Description	Expected results / annotations
2.01	Tbd.	
2.02	Tbd.	
2.03	Tbd.	
2.04	Tbd.	

Table 6: Test steps for CAN configuration for multiple CPE vectoring tests.

Step	Description	Expected results / annotations
4.01	Open the Assecco input file.	Create the Assecco input file named according to the convention of Section 3.5.

4.02	Initialize the Assecco input file.	Write the following input as defined in Section 3 to the Assecco input file:
		`<begin command>`
		`<header>`
		Write the strings of Table 26 (separated below by bullet points and / or commas) in separate adjacent cells of the next line (from left to right) of Assecco input file.

4.03	Write all parameters recorded from the CAN to the Assecco input file.	Write the values of the parameters of Table 26 (separated by bullet points and / or commas) for every subtest run in separate adjacent cells (from left to right) of the next line of Assecco input file.
4.04	Finalize and close the Assecco input file.	Write the following string on the next line as defined in Section 3: `<end command>` Close the file.
4.05	Note: • Assessment verdict: Pass, accepted, fail. • Severity: No defect; minor / major / critical defect.	• xDSL CPE inventory information test: Table 27. • xDSL performance – low & high noise test: Table 28. • xDSL bit swapping test: Table 29. • xDSL stability test:Table 30. • xDSL recovery from noise impairment test: Table 31.
4.06	Assess the test and present the results with the Assecco tool.	The test results shall be copied from the Assecco input file to the RAW sheet of the corresponding Assecco L1 assessment file with naming convention from Section 3.5; this file is always newly provided by Swisscom with CPE specific definitions.
4.07	Note the Assecco assessment.	An analysis of the test is provided together with the verdicts, severities and priorities if the Assecco L1 assessment file on sheets OVERVIEW and: • xDSL CPE inventory information test: INVENTORY. • xDSL performance – low noise test: RATE. • xDSL performance – high noise test: RATE. • xDSL bit swapping test: BITSWAP. • xDSL stability test: STABILITY. • xDSL recovery from noise impairment test: RECOVERY.
4.08	Insert the test verdict, defect severity and defect priority in the Assecco summary file and in the accompanying test compliancy sheet [5].	

Table 7: Test steps for the assessment of the xDSL tests.

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4.3 xDSL CPE inventory information test

CAN & xDSL applicability	FTTC: VDSL2 17a, VDSL2 8b, ADSL2+, ADSL FTTS, FTTB: VDSL2 17a
HP-QC test ID	VDSL2 17a: 8158 VDSL2 8b: 8159 ADSL2+: 5424 ADSL: 1802
CPE WAN test library ID	VDSL2 17a:TST-L1-V17-00 VDSL2 8b: TST-L1-V08-00 ADSL2+: TST-L1-A2P-00 ADSL: TST-L1-ADS-00
Relevant CPE requirement [1] IDs	xDSL: L1-GE-20, L1-GE-21, L1-GE-22
High level test description	The CPE inventory information, i.e., the xTU-R vendor ID, the xTU-R system vendor ID, the xTU-R version number and the xTU-R vendor serial number, is read from the CAN and assessed. Possible assessment verdicts – severities are: • Pass – no defect: CPE inventory information correct. • Fail – critical defect: CPE inventory information not correct.

Step	Description	Expected results / annotations
1.xy	Prepare the test: Do test steps in Table 3.	
2.xy	Configure the CAN for legacy and single CPE vectoring tests: Do test steps in Table 5.	
3.01	Force a resynchronization of the CPE on the line.	
3.02	Wait for CPE to synchronize, for the line to be clear of alarms and failure states, as well as for the far end counters to be available (at least 60 seconds).	
3.03	Record the xTU-R vendor ID from the CAN by means of the CPE inventory information command.	The xTU-R vendor ID as specified in Section 7.4.2 of G.997.1 [6] shall contain • the T.35 country code (2 octets) for the xDSL chipset vendor country, and • the T.35 provider code (vendor identification, 4 octets) for the xDSL chipset vendor. It shall be recorded in hex representation, e.g., 0xB5004244434D0000, where • B500, i.e., the chipset vendor country code of USA, • 4244434D, i.e., the hex representation of the chipset vendor BDCM, i.e., Broadcom, and • 0000, i.e., any information of the chipset vendor.
3.04	Record the xTU-R system vendor ID from the CAN by means of the CPE inventory information command.	The xTU-R system vendor ID as specified in Section 7.4.4 of G.997.1 [6] shall contain • the T.35 country code (2 octets) for the system (CPE) vendor country, and • the T.35 provider code (vendor identification, 4 octets) for the system (CPE) vendor. It shall be recorded in hex representation, e.g., 0x5900504242530000, where • 5900, i.e., the system (CPE) vendor country code of Italy, • 50424253, i.e., hex representation of the system (CPE) vendor PBBS, i.e., ADB, and • 0000, i.e., any information of the system (CPE) vendor.
3.05	Record the xTU-R version number from the CAN by means of the CPE inventory information command.	The xTU-R version number as specified in Section 7.4.6 of G.997.1 [6] shall contain • the xTU-R datapump or chipset firmware version and • the xTU-R chipset model. Both shall be encoded in this order and separated by a space

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Step	Description	Expected results / annotations
		character, i.e. "<xTU-R firmware version> <xTU-R model>". It shall be recorded in ASCII representation, e.g., Ap6v38q.24j 68, where • Ap6v38q.24j, i.e., the datapump or chipset firmware version A2pv6C038q.d24j, and • 68, i.e., the chipset model 6368.
3.06	Record the xTU-R serial number from the CAN by means of the CPE inventory information command.	The xTU-R serial number as specified in Section 7.4.8 of G.997.1 [6] shall contain • the system (CPE) serial number, • the system (CPE) model, and • the system (CPE) firmware version, encoded in this order and separated by space characters, i.e. "<equipment serial number> <equipment model> <equipment firmware version>". It shall be recorded in ASCII representation, e.g., 09001X0040802 V226N1W 60806, where • 09001X0040802, i.e., the system (CPE) serial number 09001X0040802, • V226N1W, i.e., the system (CPE) model V226N1, and • 608030002, i.e., system (CPE) firmware 6.08.06.
4.xy	Assess the test: Do test steps of Table 7.	

4.4 xDSL performance test – low noise

CAN & xDSL applicability	FTTC: VDSL2 17a, VDSL2 8b, ADSL2+, ADSL FTTS, FTTB: VDSL2 17a
HP-QC test ID	VDSL2 17a: 8026 VDSL2 8b: 8027 ADSL2+: 3622 ADSL: 1548
CPE WAN test library ID	VDSL2 17a: TST-L1-V17-10 (actual bit rate Us), TST-L1-V17-11 (actual bit rate DS) VDSL2 8b: TST-L1-V08-10 (actual bit rate Us), TST-L1-V08-11 (actual bit rate DS) ADSL2+: TST-L1-A2P-10 (actual bit rate Us), TST-L1-A2P-11 (actual bit rate DS) ADSL: TST-L1-ADS-10 (actual bit rate Us), TST-L1-ADS-11 (actual bit rate DS)
Relevant CPE requirement [1] IDs	VDSL2 17a: L1-V2-20 (POTS), L1-V2-21 (ISDN) VDSL2 8b: L1-V2-20 (POTS), L1-V2-21 (ISDN) ADSL2+: L1-AP-20 (POTS), L1-AP-21 (ISDN) ADSL: L1-AD-20 (POTS), L1-AD-21 (ISDN)
High level test description	With “low” noise, i.e., Additive White Gaussian Noise (AWGN) or thermal noise, simultaneously added to the line on the CO and CPE side, various line parameters are recorded vs. the length of the copper cable, i.e., loop length, where three test iterations per loop lengths are done. Only the upstream and downstream actual bit rates (rateUs and rateDs) are assessed, the other parameters are only recorded for logging purposes. Only the highest actual bit rates per loop length are assessed verdicts – severities via the following rules: • Pass – no defect: All best actual bit rates above or on the pass bounds. • Accepted – no defect: VDSL2 17a saturation on 70Mb/s @ ISAM 7302 FW 4.3.05n. • Fail – minor defect: Above or on the minor defect and below the pass bound. • Fail – major defect: Above or on the major and below the minor defect bound. • Fail – critical defect: Below the major defect bound. The overall verdict – severity is then given by the worst of the per loop length verdict – severity.

Step	Description	Expected results / annotations
1.0x	Prepare the test: Do test steps in Table 3.	
2.0x	Configure the CAN for legacy and single CPE vectoring tests: Do test steps in Table 5.	
3.01	Configure the noise generator on the CO and the CPE side with low noise, i.e., with additive white Gaussian noise (AWGN) with –130 dBm/Hz (cf. Section 5.4.1).	

Step	Description	Expected results / annotations
3.02	Set iteration, i.e., the test run number per loop length, and loop length as defined in Table 21: • iteration = 1 • loopLength = minLength	
3.03	Force a resynchronization of the CPE on the line.	
3.04	Wait for CPE to synchronize, for the line to be clear of alarms and failure states, as well as for the far end counters to be available (at least 60 seconds).	
3.05	Record the following parameters from the CAN: • loopLength: The length of the loop in meters. • iteration: Test run 1, 2, … maxIteration of loopLength. • stateUs, stateDS: Up or Down depending whether the test achieved sync or not, respectively. • rateUs, rateDs: The actual net data rate (= actual bit rate) US and DS, respectively, in kb/s; if no sync, then record a hyphen "-". • attRateUs, attRateDs: The attainable data rate (= attainable bit rate) US and DS, respectively, in kb/s; if no sync, then record a hyphen "-". • noiMarUs, noiMarDs, noiMarU0, noiMarD1, noiMarU1, noiMarD2, noiMarU2, noiMarD3, noiMarU3: The US, DS, US0, DS1, US1, DS2, US2, DS3, US3 noise margins, respectively, in dB; if not applicable or no sync, then record a hyphen "-". • sigAttUs, sigAttDs, sigAttU0, sigAttD1, sigAttU1, sigAttD2, sigAttU2, sigAttD3, sigAttU3: The US, DS, US0, DS1, US1, DS2, US2, DS3, US3 signal attenuations, respectively, in dB; if not applicable or no sync, then record a hyphen "-". • loopAttUs, loopAttDs, loopAttU0, loopAttD1, loopAttU1, loopAttD2, loopAttU2, loopAttD3, loopAttU3: The US, DS, US0, DS1, US1, DS2, US2, DS3, US3 loop attenuations, respectively, in dB; if not applicable or no sync, then record a hyphen "-". • outPowUs, outPowDs: The US and DS output power, respectively, in dBm; if no sync, then record a hyphen "-". • elecLenEstim, elecLenFinal: The estimated and final electrical length, respectively, in dB; if no sync, then record a hyphen "-". • endFreqUs, endFreqDs: The US and DS end frequency, respectively, in kHz; if no sync, then record a hyphen "-". • syncTimeUs, syncTimeDs: The US and DS sync time, respectively, in s; if no sync, then record a hyphen "-". • fecUs, fecDs: The number of US and DS feed forward error corrections (FEC), respectively; if no sync, then record a hyphen "-". • cvUs, cvDs: The number of US and DS coding violations (CV), respectively; if no sync, then record a hyphen "-".	
3.06	If iteration < maxIteration, cf. Table 21, then: • Increase the iteration by 1. • Go to test step 3.03. Else if iteration = maxIteration and loopLength < maxLength, cf. Table 21, then: • Set the iteration to 1. • Set the loop length to the next higher one. • Go to test step 3.03. Else if iteration = maxIteration and loopLength = maxLength, cf. Table 21, then: • Continue with test steps 4.xy.	
4.xy	Assess the test: Do test steps of Table 7.	Note that only rateUs and rateDs are assessed, all other

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Step	Description	Expected results / annotations
		parameters are required for logging purposes.

4.5 xDSL performance test – high noise

CAN & xDSL applicability	FTTC: VDSL2 17a, VDSL2 8b, ADSL2+, ADSL FTTS, FTTB: VDSL2 17a
HP-QC test ID, CPE WAN test library ID	VDSL2 17a: 7891 VDSL2 8b: 7892 ADSL2+: 3620 ADSL: 8330
HP-QC test ID, CPE WAN test library ID	VDSL2 17a: TST-L1-V17-30 (actual bit rate US), TST-L1-V17-31 (actual bit rate DS) VDSL2 8b: TST-L1-V08-30 (actual bit rate US), TST-L1-V08-31 (actual bit rate DS) ADSL2+: TST-L1-A2P-30 (actual bit rate US), TST-L1-A2P-31 (actual bit rate DS) ADSL: TST-L1-ADS-30 (actual bit rate US), TST-L1-ADS-31 (actual bit rate DS)
Relevant CPE requirement [1] IDs	VDSL2 17a: L1-V2-20 (POTS), L1-V2-21 (ISDN) VDSL2 8b: L1-V2-20 (POTS), L1-V2-21 (ISDN) ADSL2+: L1-AP-20 (POTS), L1-AP-21 (ISDN) ADSL: L1-AD-20 (POTS), L1-AD-21 (ISDN)
High level test description	With “high” noise, i.e., a noise type that mixes Additive White Gaussian Noise (AWGN) or thermal noise with a modeled close to worst case interference from adjacent xDSL lines, added to the line first on the CO side to record various US line parameters and thereafter CPE side to record various DS line parameters vs. the length of the copper cable, i.e., loop length, where three test iterations per loop lengths are done. Only the upstream and downstream actual bit rates (rateUs and rateDs) are assessed, the other parameters are only recorded for logging purposes. Only the highest actual bit rates per loop length are assessed verdicts – severities via the following rules: • Pass – no defect: All best actual bit rates above or on the pass bounds. • Fail – minor defect: Above or on the minor defect and below the pass bound. • Fail – major defect: Above or on the major and below the minor defect bound. • Fail – critical defect: Below the major defect bound. The overall verdict – severity is then given by the worst of the per loop length verdict – severity.

Step	Description	Expected results / annotations
1.xy	Prepare the test: Do test steps in Table 3.	
2.xy	Configure the CAN for legacy and single CPE vectoring tests: Do test steps in Table 5.	
3.01	Configure the noise generator with the high noise file NOISE_SCS_LAB_6_4_CO_TP100_XXXXm_xtk.dat (cf. Section 5.4.2) for the current loop length. Inject noise at the CO (= CAN) side.	
3.02	Set iteration, i.e., the test run number per loop length, and loop length as defined in Table 21: • iteration = 1 • loopLength = minLength	
3.03	Force a resynchronization of the CPE on the line.	
3.04	Wait for CPE to synchronize, for the line to be clear of alarms and failure states, as well as for the far end counters to be available (at least 60 seconds).	
3.05	Record the following parameters from the CAN: • loopLength: The length of the loop in meters. • iteration: Test run 1, 2, … maxIteration of loopLength. • stateUs: Up or Down depending whether the test achieved sync or not, respectively. • rateUs: The actual net data rate (= actual bit rate) US in kb/s; if not applicable or no sync, then record a hyphen “-”. • attRateUs: The attainable data rate (= attainable bit rate) US in kb/s; if not applicable or no sync, then record a hyphen “-”.	

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Step	Description	Expected results / annotations
	• noiMarUs, noiMarU0, noiMarU1, noiMarU2, noiMarU3: The US, US0, US1, US2, US3 noise margins, respectively, in dB; if not applicable or no sync, then record a hyphen "-". • sigAttUs, sigAttU0, sigAttU1, sigAttU2, sigAttU3: The US, US0, US1, US2, US3 signal attenuations, respectively, in dB; if not applicable or no sync, then record a hyphen "-". • loopAttUs, loopAttU0, loopAttU1, loopAttU2, loopAttU3: The US, US0, US1, US2, US3 loop attenuations, respectively, in dB; if not applicable or no sync, then record a hyphen "-". • outPowUs: The US output power in dBm; if not applicable or no sync, then record a hyphen "-". • elecLenEstim, elecLenFinal: The estimated and final electrical length, respectively, in dB; if not applicable or no sync, then record a hyphen "-". • endFreqUs: The US end frequency in kHz; if not applicable or no sync, then record a hyphen "-". • syncTimeUs: The US sync time in s; if not applicable or no sync, then record a hyphen "-". • fecUs: The number of US feed forward error corrections (FEC); if not applicable or no sync, then record a hyphen "-". • cvUs: The number of US coding violations (CV); if not applicable or no sync, then record a hyphen "-".	
3.06	Configure the noise generator with the high noise file NOISE_SCS_LAB_6_4_CUST_TP100_XXXXm_xtk.dat for the current loop length. Inject noise at the CPE (= CUSTomer) side.	
3.07	Force a resynchronization of the CPE on the line.	
3.08	Wait for CPE to synchronize, for the line to be clear of alarms and failure states, as well as for the far end counters to be available (at least 60 seconds).	
3.09	Record the following parameters from the CAN: • loopLength: The length of the loop in meters. • iteration: Test run 1, 2, … maxIteration of loopLength. • stateDS: Up or Down depending whether the test achieved sync or not, respectively. • rateDs: The actual net data rate (= actual bit rate) DS in kb/s; if not applicable or no sync, then record a hyphen "-". • attRateDS: The attainable data rate (= attainable bit rate) DS in kb/s; if not applicable or no sync, then record a hyphen "-". • noiMarDs, noiMarD1, noiMarD2, noiMarD3: The DS, DS1, DS2, DS3, noise margins, respectively, in dB; if not applicable or no sync, then record a hyphen "-". • sigAttDs, sigAttD1, sigAttD2, sigAttD3: The DS, DS1, DS2, DS3 signal attenuations, respectively, in dB; if not applicable or no sync, then record a hyphen "-". • loopAttDs, loopAttD1, loopAttD2, loopAttD3: The DS, DS1, DS2, DS3 loop attenuations, respectively, in dB; if not applicable or no sync, then record a hyphen "-". • outPowDs: The DS output power in dBm; if not applicable or no sync, then record a hyphen "-". • endFreqDs: The DS end frequency in kHz; if not applicable or no sync, then record a hyphen "-". • syncTimeDs: The DS sync time in s; if not applicable or no sync, then record a hyphen "-". • fecDs: The number of DS feed forward error corrections (FEC); if not applicable or no sync, then record a hyphen "-". • cvDs: The number of DS coding violations (CV); if not applicable or no sync, then record a hyphen "-".	
3.10	If iteration < maxIteration, cf. Table 21, then: • Increase the iteration by 1. • Go to test step 3.03.	

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Step	Description	Expected results / annotations
	Else if iteration = maxIteration and loopLength < maxLength, cf. Table 21, then: • Set the iteration to 1. • Set the loop length to the next higher one. • Go to test step 3.03. Else if iteration = maxIteration and loopLength = maxLength, cf. Table 21, then: • Continue with test steps 4.xy.	
4.xy	Assess the test: Do test steps of Table 7.	Note that only rateUs and rateDs are assessed, all other parameters are required for logging purposes.

4.6 xDSL bit swapping test

CAN & xDSL applicability	FTTC: VDSL2 17a, VDSL2 8b, ADSL2+, ADSL FTTS, FTTB: VDSL2 17a
HP-QC test ID	VDSL2 17a 8153 (US0), 8155 (US1), 8157 (US2), 8149 (DS1), 8151 (DS2), 1676 (DS3) VDSL2 8b: 8154 (US0), 8156 (US1), 8150 (DS1), 8152 (DS2) ADSL2+ POTS: 4224 (US), 3557 (DS1a), 3556 (DS1b) ADSL2+ ISDN: 5423 (US), 8355 (DS1a), 8354 (DS1b) ADSL POTS: 1567 (US), 1566 (DS) ADSL ISDN: 4930 (US), 1566 (DS)
CPE WAN test library ID	VDSL2 17a: TST-L1-V17-51 (US), TST-L1-V17-50 (DS) VDSL2 8b:TST-L1-V08-51 (US), TST-L1-V08-50 (DS) ADSL2+: TST-L1-A2P-51 (US), TST-L1-A2P-50 (DS) ADSL: TST-L1-ADS-51 (US), TST-L1-ADS-50 (DS)
Relevant CPE requirement [1] IDs	VDSL2 17a: L1-V2-46. VDSL2 8b: L1-V2-46 ADSL2+: L1-AP-46 ADSL: L1-AD-46
High level test description	The "down to" bit swap capability is tested by adding narrowband (= RFI, radio frequency interference) "in-tone-range" noise with increasing power on the considered tone range in the considered US or DS band in 1 dB steps until either all tones in the considered range have zero bit loading or sync is lost. If sync is lost, this procedure is repeated until either all tones in the considered range have a bit loading of at most 2 bits or sync is lost. If sync is lost, , then the “down to” test failed. If sync is not lost, the "return to" bit swap capability is tested by first removing the above "in-tone-band" noise. If the bits swap automatically back to x% ≥ 60% of the initial bit loading weight, then the “return to” test is successful (i.e., return success = auto return to *x*%), else another narrowband "out-of-tone-band" noise in another tone range of the same US or DS band is added with increasing power (in 1 dB steps) until at least 60% of the initial bit loading sum have swapped back (i.e., return success = forced return to *x*% ≥ 60%), or until sync is lost; then, the last in sync bit loading is taken to define return success = forced return to *x*%.

Step	Description	Expected results / annotations
1.xy	Prepare the test: Do test steps in Table 3.	
2.xy	Configure the CAN for legacy and single CPE vectoring tests: Do test steps in Table 5.	
3.01	Set the band to the first band as given in Table 23.	
3.02	Configure the noise generator on the CO and the CPE side with low noise, i.e., with additive white Gaussian noise (AWGN) with –130 dBm/Hz (cf. Section 5.4.1).	
3.03	Set the loop length for the respective band as given in Table 23.	
3.04	Store the indices of the tone range to be observed as given in Table 23.	
3.05	Store the RFI in-tone-range noise file as given in Table 23 with Noise_SCS_<Input from Table 23>_RFI.dat.	

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Step	Description	Expected results / annotations
3.06	Store the RFI out-of-tone-range noise file as given in Table 23 with Noise_SCS_<Input from Table 23>_RFI.dat.	
3.07	Force a resynchronization of the CPE on the line.	
3.08	Wait for CPE to synchronize, for the line to be clear of alarms and failure states, as well as for the far end counters to be available (at least 60 seconds).	
3.09	Record the following parameters from the CAN: • band, i.e., – VDSL2 17a: US0, US1, US2, DS1, DS2, or DS3. – VDSL2 8b: US0, US1, DS1, or DS2. – ADSL2+: US, DS1a, or DS1b. – ADSL: US, or DS. • loopLength, i.e., the length of the loop in meters. • toneRange, i.e., the tone range, e.g., 48 – 57. • initialLoad, i.e., the bit loadings (separated with a space) of the tones in the considered tone range, e.g.: – Sync: 9 8 9 8 9 8 8 8 7 6 – Loss of sync: – • initialLoadSum, i.e., the sum of the bit loadings, e.g.: – Sync: 80 – Loss of sync: –	Record the initial parameters to the Assecco input file.
3.10	Apply the RFI in-tone-range noise file: • US: On the CO side. • DS: On the CPE side. Wait at least 10 seconds.	
3.11	Increase RFI in-tone-range noise file level in 1 dB steps: • US: On the CO side. • DS: On the CPE side. Until the tones in the considered tone range have 0 bit loadings or sync is lost.	
3.12	If sync is lost in test step 3.11, then remove the RFI in-tone-range noise and repeat test steps 3.07 – 3.08 and then 3.09 – 3.11 until the tones in the considered tone range have ≤ 2 (rather than 0) bit loadings or sync is lost in test step 3.11.	
3.13	Record the following parameters from the CAN: • downtoLoad, i.e., the bit loadings (separated with a space) of the tones in the considered tone range, e.g.: – Sync: 0 0 0 0 0 0 0 0 0 0 – Loss of sync: – • downtoLoadSum, i.e., the sum of the bit loadings, e.g.: – Sync: 0 – Loss of sync: –	
3.14	If loss of sync in test step 3.13, then set: • autoReturnLoad: - • autoReturnLoadSum: - • autoReturnSuccess: - • forcedReturnLoad: - • forcedReturnLoadSum: - • forcedReturnSuccesss: - And go to test step 3.19. Else remove the RFI noise, leave the low (white) noise unchanged and wait 2 minutes.	
3.15	Record the following parameters from the CAN: • autoReturnLoad, i.e., the bit loadings (separated with a space) of the tones in the considered tone range, e.g.:	

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Step	Description	Expected results / annotations
	– Sync: 9 8 9 8 9 8 8 8 7 6 – Loss of sync: – • autoReturnLoadSum, i.e., the sum of the bit loadings, e.g.: – Sync: 80 – Loss of sync: – • autoReturnSuccess, i.e., the quotient (in %) of autoReturnLoadSum and initialLoadSum of the same line, e.g.: – Sync: 100% – Loss of sync: –	
3.16	If loss of sync in test step 3.15, then set: • forcedReturnLoad: - • forcedReturnLoadSum: - • forcedReturnSuccesss: - And go to test step 3.19. Else if autoReturnSuccess ≥ 60% in test step 3.15, then set: • forcedReturnLoad: autoReturnLoad • forcedReturnLoadSum: autoReturnLoadSum • forcedReturnSuccesss: autoReturnSuccess And go to test step 3.19. Else apply the RFI out-of-tone-range noise file: • US: On the CO side. • DS: On the CPE side. Wait at least 10 seconds.	
3.17	Increase RFI out-of-tone-range noise file level in 1 dB steps: • US: On the CO side. • DS: On the CPE side. Until sync is lost.	
3.18	Record the following parameters from the CAN: • forcedReturnLoad, i.e., the bit loadings (separated with a space) of the tones in the considered tone range prior to loosing sync, e.g., 9 8 9 8 9 8 8 8 7 6. • forcedReturnLoadSum, i.e., the sum of the above bit loadings, e.g., 80. • forcedReturnSuccess, i.e., the quotient (in %) of forcedReturnLoadSum and initialLoadSum of the same line, e.g., 100%.	
3.19	If the tested band is the last one according to the bands defined in Table 23, then continue with test steps 4.xy. Else go back to test step 3.04.	
4.xy	Assess the test: Do test steps of Table 7.	

4.7 xDSL stability test

CAN & xDSL applicability	FTTC: VDSL2 17a, ADSL2+, ADSL FTTS, FTTB: VDSL2 17a
HP-QC test ID	VDSL2 17a: 8037 VDSL2 8b: n/a ADSL2+: 4130 ADSL: 1564
CPE WAN test library ID	VDSL2 17a: TST-L1-V17-60 VDSL2 8b: n/a ADSL2+: TST-L1-A2P-60 ADSL: TST-L1-ADS-60

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Relevant CPE requirement [1] IDs	VDSL2 17a: L1-V2-47 VDSL2 8b: n/a ADSL2+: L1-AP-47 ADSL: L1-AP-47
High level test description	With a fix xDSL profile, white noise is step by step increased on the CO and CPE side of the line until the US and DS noise margins are ≤ 2dB or, if sync is lost, ≤ 3dB (= minor defect). Various parameters are recorded every collection period (CP) of 2 minutes during the next 6 hours. Sync shall not be lost, and CV/CP < 1'000 as well as FEC/CP < 50'000.

Step	Description	Expected results / annotations
1.xy	Prepare the test: Do test steps in Table 3.	
2.xy	Configure the CAN for legacy and single CPE vectoring tests: Do test steps in Table 5.	
3.01	Configure the noise generator on the CO and the CPE side with low noise, i.e., with additive white Gaussian noise (AWGN) with –130 dBm/Hz (cf. Section 5.4.1).	
3.02	Set the loop length to as given in Table 24 and the target noise margin tarNoiMar = 2dB.	
3.03	Force a resynchronization of the CPE on the line.	
3.04	Wait for CPE to synchronize, for the line to be clear of alarms and failure states, as well as for the far end counters to be available (at least 60 seconds).	
3.05	Record the following parameters: • Time, i.e., the date / time stamp in Excel format. • stateUs, stateDS: Up or Down depending whether the test achieved sync or not, respectively. • rateUs, rateDs: The actual net data rate (= actual bit rate) US and DS, respectively, in kb/s; if no sync, then record a hyphen "-". • attRateUs, attRateDs: The attainable data rate (= attainable bit rate) US and DS, respectively, in kb/s; if no sync, then record a hyphen "-". • noiMarUs, noiMarDs: The US and DS noise margins, respectively, in dB; if no sync, then record a hyphen "-". • fecUs, fecDs: The number of US and DS feed forward error corrections (FEC), respectively; if no sync, then record a hyphen "-". • cvUs, cvDs: The number of US and DS coding violations (CV), respectively; if no sync, then record a hyphen "-".	
3.06	If US noise margin > tarNoiMar (cf. test steps 3.02 and 3.10), then increase the US noise level on the CO side: • If US noise margin ≥ 10 dB, then step = 5dB. • If 10 dB > US noise margin ≥ tarNoiMar + 1 dB, then step = 1dB. • If 3 dB > US noise margin ≥ tarNoiMar, then step = 0.2dB. If DS noise margin > tarNoiMar (cf. test steps 3.02 and 3.10), then increase the DS noise level on the CPE side: • If DS noise margin ≥ 10 dB, then step = 5dB. • If 10 dB > DS noise margin ≥ tarNoiMar + 1 dB, then step = 1dB. • If 3 dB > DS noise margin ≥ tarNoiMar, then step = 0.2dB.	Synchronization shall not be lost.
3.07	Wait until a collection period (CP) of 2 minutes has elapsed since test step 3.05.	
3.08	If US noise margin > tarNoiMar or DS noise margin > tarNoiMar, and sync is not lost, then go to test step 3.05, else continue with test step 3.09.	
3.09	While a time of less than 6 hours has elapsed since test step 18 and sync is not lost:	

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Step	Description	Expected results / annotations
	• Record the parameters in test step 3.05. • Wait until a collection period of 2 minutes has elapsed.	
3.10	If sync is lost in test steps 3.05 – 3.09, then close and delete the Assecco input file, and repeat test steps 3.01 – 3.09 with tarNoiMar = 3dB and continue with test steps 4.xy.	
4.xy	Assess the test: Do test steps of Table 7.	

4.8 xDSL recovery from noise impairment test

CAN & xDSL applicability	FTTC: VDSL2 17a, ADSL2+, ADSL FTTS, FTTB: VDSL2 17a
HP-QC test ID	VDSL2 17a: 8162 VDSL2 8b: n/a ADSL2+: 5129 ADSL: 1538
CPE WAN test library ID	VDSL2 17a: TST-L1-V17-61 VDSL2 8b: n/a ADSL2+: TST-L1-A2P-61 ADSL: TST-L1-ADS-61
Relevant CPE requirement [1] IDs	VDSL2 17a: Tbd. VDSL2 8b: n/a ADSL2+: Tbd. ADSL: Tbd.
High level test description	With a fix xDSL profile, white noise is step by step increased on the CO and CPE side of the line until the US and DS noise margins are ≤ 3dB. Then the additional white noise is released. The recovery success, i.e., the ratio between the noise margins prior to increasing and after releasing white noise shall be ≥ 90% (for US and DS).

Step	Description	Expected results / annotations
1.xy	Prepare the test: Do test steps in Table 3.	
2.xy	Configure the CAN for legacy and single CPE vectoring tests: Do test steps in Table 5.	
3.01	Configure the noise generator on the CO and the CPE side with low noise, i.e., with additive white Gaussian noise (AWGN) with –130 dBm/Hz (cf. Section 5.4.1).	
3.02	Set the loop length to as given in Table 25.	
3.03	Force a resynchronization of the CPE on the line.	
3.04	Wait for CPE to synchronize, for the line to be clear of alarms and failure states, as well as for the far end counters to be available (at least 60 seconds).	
3.05	Record the following parameters: • startNoiMarUS, i.e., the start noise margin US, i.e., the noise margin US in dB. • startNoiMarDS, i.e., the start noise margin DS, i.e., the noise margin US in dB.	
3.06	Increase the US noise level on the CO side and the DS noise level on the CPE side until US and DS noise margins are both ≤ 3 dB: • If noise margin ≥ 10 dB, then step = 5 dB. • If 10 dB > noise margin ≥ 4 dB, then step = 1 dB. • If 4 dB > noise margin ≥ 3 dB, then step = 0.2 dB. • If 3 dB > noise margin, then step = 0 dB (no action).	Synchronization shall not be lost.
3.07	Leave the line in a steady state for 60 seconds.	Synchronization shall not be lost.
3.08	Record the following parameters: • downtoNoiMarUS, i.e., the down to noise margin US, i.e.,	

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Step	Description	Expected results / annotations
	the noise margin US in dB. • downtoNoiMarDS, i.e., the down to noise margin DS, i.e., the noise margin US in dB.	
3.09	Decrease the noise levels on the CO and the CPE side in one step to low noise levels, i.e., to additive white Gaussian noise (AWGN) with –130 dBm/Hz (cf. Section 5.4.1).	
3.10	Leave the line in a steady state for 60 seconds.	
3.11	Record the following parameters: • recoveryNoiMarUS, i.e., the recovery to noise margin US, i.e., the noise margin US in dB. • recoveryNoiMarDS, i.e., the recovery to noise margin DS, i.e., the noise margin US in dB. Compute the following parameters: • recoverySuccessUS = recoveryNoiMarUS / startNoiMarUS • recoverySuccessDS = recoveryNoiMarDS / startNoiMarDS	
4.xy	Assess the test: Do test steps of Table 7.	

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5 Annex

5.1 CAN types and settings

The CPE must interoperate with the IP CAN types as listed in Table 8 and Table 9 (VDSL2, ADSL2+ and ADSL) as well as Table 10 (only VDSL2) below.

	Huawei CAN
Types	Standard: MA5600T (CO) Option: MA5603T (CO, if MA5600T is not available)
Boards	VDMF
Firmware	R9: V8R9 (V800R009C00, SPC100, SBH105, HP1111)
Chipset vendors	Broadcom
Chipset FW	10.06.110

	Alcatel Lucent ISAM
Types	Standard: ISAM 7302 (CO) Option: ISAM 7330 (CO, if ISAM 7302 is not available)
Boards	POTS: NVLT-C ISDN: NVLT-D
Firmware	4.5.03r : R4.5.03r (Build 45.582)
Chipset vendors	Ikanos (CO5)
Chipset FW	8.10.7_6.7.3.6

Table 8: Central Office (CO) legacy CAN types and configurations for VDSL2, ADSL2+ and ADSL application.

	Huawei CAN
Types	MA5603T (FTTC)
Boards	VCMM
Firmware	R15: R15 (V800R015C00SPH102)
Chipset vendors	Broadcom
Chipset FW	10.9.10
Mode	In vectoring mode

Table 9: Fiber to the Curb (FTTC) vectoring CAN types and configurations for VDSL2, ADSL2+ and ADSL application.

	Huawei Micro CAN
Types	Standard: MA5611S-AE48 (FTTB) and MA5611S-DE16 (FTTS) Options: MA5611S-DE48 (FTTS) and MA5611S-AE16 (FTTB) (if MA5611S-AE48 (FTTS) or MA5611S-DE16 are not available, respectively)
Boards	HS3BVDMM
Firmware	R15 (MA5611S-DE16): V800R015C00HP2005 R15 (MA5611S-DE48): V800R015C00SPC203 R15 (MA5611S-AE16): V800R015C00HP2005 R15 (MA5611S-AE48): V800R015C00SPC203
Chipset vendors	Broadcom
Chipset FW	10.9.10
Mode	In vectoring mode

Table 10: Fiber to the Street (FTTS) and Fiber to the Building (FTTB) vectoring CAN types and configurations for VDSL2 only application.

The tables below specify xDSL specific CAN configurations that are referred to in the test specifications in Section 4.

CAN port legacy general configurations for all xDSL tests					
		VDSL2 17a	VDSL2 8b	ADSL2+	ADSL
Band plan		998ADE17-M2x-M (POTS) & 998ADE17-M2x-B (ISDN)	998-M2x-M (POTS) & 998-M2x-B (ISDN)	G.992.5 Annex A (POTS) & G.992.5 Annex B (ISDN)	G.992.1 Annex A (POTS) & G.992.1 Annex B (ISDN)
Target noise margin	US	6 dB	6 dB	6 dB	6 dB
	DS	8 dB	8 dB	8 dB	6 dB
Notching:		De-activated	De-activated	De-activated	De-activated
Maximum delay	US	8 ms	8 ms	8 ms	0 ms
	DS	8 ms	8 ms	8 ms	0 ms
Impulse noise protection	US	2 symbols	2 symbols	2 symbols	0 symbols
	DS	2 symbols	2 symbols	2 symbols	0 symbols
UPBO: PSD (f) [dB/Hz]	US0	No shaping	No shaping	No shaping	No shaping
	US1	$-47.06 - 21.26\, f^{1/2}$	$-47.06 - 21.26\, f^{1/2}$	n/a	n/a
	US2	$-49.43 - 15.67\, f^{1/2}$	$-49.43 - 15.67\, f^{1/2}$	n/a	n/a
DPBO		CO / disabled	CO / disabled	CO / disabled	CO / disabled
Transfer mode		PTM	PTM	ATM	ATM

Table 11: CAN port legacy general configurations for all xDSL tests.

CAN port legacy rate configurations for xDSL CPE inventory information as well as xDSL low and high noise performance tests					
		VDSL2 17a	VDSL2 8b	ADSL2+	ADSL
RA mode	US	RA at start-up	RA at start-up	RA at start-up	RA at start-up
	DS	RA at start-up	RA at start-up	RA at start-up	RA at start-up
Maximum bit rate	US	Maximum system allows	Maximum system allows	Maximum system allows	Maximum system allows
	DS	Maximum system allows	Maximum system allows	Maximum system allows	Maximum system allows
Minimum bit rate	US	Minimum system allows	Minimum system allows	Minimum system allows	Minimum system allows
	DS	Minimum system allows	Minimum system allows	Minimum system allows	Minimum system allows

Table 12: CAN port legacy rate configurations for xDSL CPE inventory information as well as xDSL low and high noise performance tests.

CAN port legacy rate configurations for xDSL bit swapping tests					
		VDSL2 17a	VDSL2 8b	ADSL2+	ADSL
RA mode	US	Operator controlled	Operator controlled	Operator controlled	Operator controlled
	DS	Operator controlled	Operator controlled	Operator controlled	Operator controlled
Bit rate	US	US0: 1152 kb/s US1: 6656 kb/s US2: 11008 kb/s DS1: 1152 kb/s DS2: 11008 kb/s DS3: 11008 kb/s	US0: 1152 kb/s US1: 6656 kb/s DS1: 1152 kb/s DS2: 6656 kb/s	US: 64 kb/s DS1a (2.2 MHz): 384 kb/s DS1b (1.1 MHz): 128 kb/s	US: 256 kb/s DS: 3072 kb/s
	DS	US0: 13248 kb/s US1: 24256 kb/s US2: 33024 kb/s DS1: 13248 kb/s DS2: 33024 kb/s DS3: 55040 kb/s	US0: 13248 kb/s US1: 24256 kb/s DS1: 13248 kb/s DS2: 24256 kb/s	US: 768 DS1a (2.2 MHz): 5632 kb/s DS1b (1.1 MHz): 3072 kb/s	US: 256 kb/s DS: 3072 kb/s

Table 13: CAN port legacy rate configurations for xDSL bit swapping tests.

CAN port legacy rate configurations for xDSL stability tests					
		VDSL2 17a	VDSL2 8b	ADSL2+	ADSL
RA mode	US	Operator controlled	n/a	Operator controlled	Operator controlled
	DS	Operator controlled	n/a	Operator controlled	Operator controlled
Bit rate	US	11008 kb/s	n/a	384	256
	DS	36352 kb/S	n/a	5632	3072

Table 14: CAN port legacy rate configurations for xDSL stability tests.

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CAN port legacy rate configurations for xDSL recovery from noise impairment tests					
		VDSL2 17a	VDSL2 8b	ADSL2+	ADSL
RA mode	US	Operator controlled	n/a	Operator controlled	Operator controlled
	DS	Operator controlled	n/a	Operator controlled	Operator controlled
Bit rate	US	11008	n/a	384	256
	DS	36352	n/a	5632	3072

Table 15: CAN port legacy rate configurations for xDSL recovery from noise impairment tests.

Global CAN port vectoring configurations for all xDSL tests (VDSL2 only)					
		VDSL2 17a	VDSL2 8b	ADSL2+	ADSL
US0 type	FTTC	998ADE US0-type M	998ADE US0-type M	n/a	n/a
	FTTS/FTTB	998ADE US0-type B	n/a	n/a	n/a
Global vectoring configuration		Enable	Enable	n/a	n/a
RA mode	US	RA at run time	RA at run time	n/a	n/a
	DS	RA at run time	RA at run time	n/a	n/a
FEXT cancel-lation control	US	Disable	Disable	n/a	n/a
	DS	Enable	Enable	n/a	n/a
Fast join gain phase		At init	At init	n/a	n/a
Fast join history coefficient		Disable	Disable	n/a	n/a

Table 16: Global CAN port vectoring configurations for xDSL tests (VDSL2 only).

CAN port G.INP configurations for all xDSL tests for CPEs with vectoring functionality					
		VDSL2 17a	VDSL2 8b	ADSL2+	ADSL
G.INP	US	RTX_PREFERRED	RTX_PREFERRED	n/a	n/a
	DS	RTX_PREFERRED	RTX_PREFERRED	n/a	n/a
Maximum ETR	US	10000 kb/s	10000 kb/s	n/a	n/a
	DS	200000 kb/s	200000 kb/s	n/a	n/a
Minimum ETR	US	32 kb/s	32 kb/s	n/a	n/a
	DS	32 kb/s	32 kb/s	n/a	n/a
Maximum NDR	US	10000 kb/s	10000 kb/s	n/a	n/a
	DS	200000 kb/s	200000 kb/s	n/a	n/a
Maximum delay	US	12 ms	12 ms	n/a	n/a
	DS	12 ms	12 ms	n/a	n/a
Minimum INP against SHINE	US	8 symbols	8 symbols	n/a	n/a
	DS	8 symbols	8 symbols	n/a	n/a
SHINE event ratio	US	0.01	0.01	n/a	n/a
	DS	0.01	0.01	n/a	n/a
Minimum INP against REIN	US	1 symbol	1 symbol	n/a	n/a
	DS	1 symbol	1 symbol	n/a	n/a
iat_rein_flag		0	0	n/a	n/a

CAN port G.INP configurations for all xDSL tests for CPEs without vectoring functionality					
		VDSL2 17a	VDSL2 8b	ADSL2+	ADSL
G.INP	US	RTX_FORBIDDEN	RTX_FORBIDDEN	n/a	n/a
	DS	RTX_FORBIDDEN	RTX_FORBIDDEN	n/a	n/a

Table 17: CAN port G.INP configurations for all xDSL tests (VDSL2 only).

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CAN port SRA configurations for all xDSL tests					
		VDSL2 17a	VDSL2 8b	ADSL2+	ADSL
SNR margin for rate upshift	US	8 dB	8 dB	n/a	n/a
	DS	10 dB	10 dB	n/a	n/a
Minimum upshift time	US	2 s	2 s	n/a	n/a
	DS	2 s	2 s	n/a	n/a
SNR margin for rate downshift	US	5 dB	5 dB	n/a	n/a
	DS	6 dB	6 dB	n/a	n/a
Minimum downshift time	US	2 s	2 s	n/a	n/a
	DS	2 s	2 s	n/a	n/a

Table 18: CAN port SRA configurations for all xDSL tests.

5.2 Basic test equipment specifications

The test equipment shall be used for CPE testing as listed in Table 19 below.

Equipment	Vendor	Model
Noise generator	Spirent	DLS-5500 or DLS-5800
Noise injector	Spirent	DLS-5405 or DLS-5410 DC
Loop simulator	Spirent	DLS-8235

Table 19: Test equipment specifications.

5.3 CPE datapumps

The CPE must operate with one of the datapumps and settings as listed in Table 20 below.

Chipset						Datapump			Datapump settings										
vendor	model	POTS	ISDN	Legacy	Vectoring	Short	Full	Driver	Phy retr. US	Phy retr. DS	G.INP US	G.INP DS	SRA US	SRA DS	Moni-toring tones	Vec-to-ring	pilot tones A43	pilot tones B43	pilot tones V43
Broadcom	6368	x		x		30h	A2pv6C030h	Various	OFF	OFF	OFF	OFF	n/r	n/r	OFF	n/a	n/r	n/r	n/r
Broadcom	6368		x	x		35d	B2pvC035d	Various	OFF	OFF	OFF	OFF	n/r	n/r	ON	n/a	n/r	n/r	n/r
Broadcom	6368		x	x		37e	A2pv6C037e	d24c1	OFF	OFF	ON	ON	n/r	n/r	ON	OFF	n/r	n/r	n/r
Broadcom	6368	x			x	38q	A2pv6C038q	d24j	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	DYN
Broadcom	6368		x		x	38r1	B2pvC038r1	d24j	ON	ON	ON	ON	ON	ON	ON	ON	n/a	ON	DYN
Broadcom	63168	x			x	38q	A2pv6F038q	d24j	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	DYN
Broadcom	63168		x		x	38r1	B2pvF038r1	d24j	ON	ON	ON	ON	ON	ON	ON	ON	n/a	ON	DYN

Table 20: Recommended CPE datapumps, where the driver may be changed according to the vendor needs, and where n/a denotes "not applicable", n/r denotes "no recommendation", and DYN denotes "Dynamic ON".

5.4 Noise definitions

5.4.1 Low noise

Additive Gaussian white noise (AWGN) with –130 dBm/Hz, also referred to as white noise.

5.4.2 High noise

Swisscom specific noise, also referred to as Spectrum Management 3 (SpM3) noise related to an assumed cable fill, i.e., an assumed number of xDSL users in adjacent copper cables that cause interference to the considered cable. Special noise files in Spirent simulator format are available in the file

Noise_SCS_Lab_6_4.zip

with the example naming

Noise_SCS_Lab_6_4_CO_TP100_050m_xtk.dat,

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where

- *SCS* refers to Swisscom,
- *LAB* refers to laboratory,
- *6_4* refers to Version 6.4,
- *CO* refers to Central Office side, as opposed to *CUST* that in turn refers to CUSTomer side,
- *TP100* refers to performance values applying to TP100 cable type, and
- *0050m* refers to a distance of 50m.

The file contents are e.g.

```
$ver<1.1.1>
$dist<ref>
$clk<100 MHz>
$data<begin>
10000 -101.5393331
20000 -97.75068257
30000 -96.39145299
```

where, e.g.,

- 10000 refers to the frequency in [kHz] and
- 101.539333144901 refers to the noise power spectral density (PSD) in [dBm/Hz].

Note that the up- and downstream have to be measured separately, i.e., the noise must not be added on both sides at the same time.

5.4.3 RFI noise

Radio Frequency Interference (RFI) is a narrowband noise that applies the same noise level to certain xDSL tone range and no noise to all other tones. Special noise files in Spirent simulator format are available in the file

Noise_SCS_RFI.zip

with the example naming

Noise_SCS_DS1_400_92_65_RFI.dat

where

- *SCS* refers to Swisscom,
- *DS1* refers to the DS1 band (alternatives: DS2, DS3, US0, US1, US2),
- *400* refers to the frequency in [kHz] of the lowest tone to be disturbed,
- *92* refers to the tone index of the first tone to be disturbed,
- *65* refers to the noise power [dBm] of the lowest tone to be disturbed, and
- *RFI* refers to Radio Frequency Interference.

The file contents are in the Spirent RFI noise format [7], e.g., for the above file

```
0.400E+06    -65    1.00E+04    0.32
0.410E+06    -65.5  1.00E+04    0.32
```

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0.420E+06	-66	1.00E+04	0.32
0.430E+06	-66.5	1.00E+04	0.32
0.440E+06	-67	1.00E+04	0.32
0.450E+06	-67.5	1.00E+04	0.32

where, e.g.,

- 0.400E+06 refers to the frequency in [Hz], i.e., 400 kHz,
- -65 refers to the power in [dBm], i.e., –65 dBm,
- 1.00E+04 refers to modulation width in [Hz], i.e., 10'000 Hz
- 0.32 refers to modulation depth in [m], i.e., 0.32 m.

5.5 Test settings

The tables below specify xDSL specific CAN configurations that are referred to in the test specifications in Section 4.

Test settings for xDSL CPE low noise performance tests					
		VDSL2 17a	**VDSL2 8b**	**ADSL2+**	**ADSL**
Loop lengths (minLength to maxLength)	**POTS**	100m to 2500m in 100m steps	300m, 600m, 800m, then 900m to 2400m in 100m steps	100m to 5900m in 200m steps, and 6000m	100m to 5900m in 200m steps, and 6000m
	ISDN	100m to 1700m in 100m steps	300m, 600m, 800m, then 900m to 1700m in 100m steps		
Number of iterations per loop length (maxIteration)		3	3	3	3

Table 21: Test settings for xDSL CPE low noise performance tests with MIN(loopLength) to MAX(loopLength) and MAX(iteration), the number of tests per loop lengths.

Test settings for xDSL CPE high noise performance tests					
		VDSL2 17a	**VDSL2 8b**	**ADSL2+**	**ADSL**
Loop lengths (minLength to maxLength)	**POTS**	50m to 1700m in 50m steps, and 1700m to 2500m in 100m steps	300m, 600m, 800m, then 900m to 1700m in 50m steps, and 1700m to 2400m in 100m steps	100m to 1000m in 100m steps, and 1000m to 6000m in 200m steps	100m to 1000m in 100m steps, and 1000m to 6000m in 200m steps
	ISDN US	50m to 1700m in 50m steps	300m, 600m, 800m, then 900m to 1700m in 50m steps	100m to 1000m in 100m steps, and 1000m to 4200m in 200m steps	100m to 1000m in 100m steps, and 1000m to 3400m in 200m steps
	ISDN DS			100m to 1000m in 100m steps, and 1000m to 5600m in 200m steps	100m to 1000m in 100m steps, and 1000m to 5800m in 200m steps
Number of iterations per loop length (maxIteration)		3	3	3	3

Table 22: Test settings for xDSL CPE high noise performance tests.

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Test settings for xDSL bit swapping tests					
		VDSL2 17a	VDSL2 8b	ADSL2+	ADSL
Test order & loop length		US0: 1200 m US1: 900 m US2: 300 m DS1: 1200 m DS2: 300 m DS3: 100 m	US0: 1200 m US1: 900 m DS1: 1200 m DS2: 300 m	US: 2600m DS1a: 2000m DS1b: 4000m	US: 2600m DS: 2600m
Indices of tone range to be observed	POTS	US0: 48 ... 57 US1: 906 ... 915 US2: 1996 ... 2005 DS1: 94 ... 103 DS2: 1230 ... 1239 DS3: 2830 ... 2839	US0: 48 ... 57 US1: 906 ... 915 DS1: 94 ... 103 DS2: 1230 ... 1239	US: 25 ... 26 DS1a: 351 ... 354 DS1b: 151 ... 154	US: 25 ... 26 DS: 129 ... 132
	ISDN			US: 46 ... 47 DS1a: 401 ... 404 DS1b: 201 ... 204	US: 46 ... 47 DS: 129 ... 132
RFI in-tone range noise file	POTS	US0: US0_200_46_65 US1: US1_3900_904_65 US2: US2_8600_1994_65 DS1: DS1_400_92_65 DS2: DS2_5300_1228_65 DS3: DS3_12200_2828_65	US0: US0_200_46_65 US1: US1_3900_904_65 DS1: DS1_400_92_65 DS2: DS2_5300_1228_65	US: US_100_24_65 DS1a: DS1_1510_350_65 DS1b: DS1_650_150_65	US: US_100_24_65 DS: DS_550_127_65
	ISDN			US: US_190_45_65 DS1a: DS1_1720_400_65 DS1b: DS1_860_200_65	US: US_190_45_65 DS: DS_550_127_65
RFI out-of-tone range noise file	POTS	US0: US0_100_23_65 US1: US1_4010_930_65 US2: US2_8700_2017_65 DS1: DS1_550_127_65 DS2: DS2_5400_1252_65 DS3: DS3_12300_2852_65	US0: US0_100_23_65 US1: US1_4010_930_65 DS1: DS1_550_127_65 DS2: DS2_5400_1252_65	US: US_060_15_65 DS1a: DS1_1720_400_65 DS1b: DS1_860_200_65	US: US_060_15_65 DS: DS_650_150_65
	ISDN			US: US_160_37_65 DS1a: DS1_1940_450_65 DS1b: DS1_1080_250_65	US: US_160_37_65 DS: DS_650_150_65

Table 23: Test settings for xDSL bit swapping tests, where the file names are to be composed according to the rule Noise_SCS_<Input>_RFI.dat.

Test settings for xDSL CPE stability tests				
	VDSL2 17a	VDSL2 8b	ADSL2+	ADSL
Loop lengths	500m	n/a	2500m	2500m

Table 24: Test settings for xDSL stability tests.

Test settings for xDSL CPE recovery from noise impairment tests				
	VDSL2 17a	VDSL2 8b	ADSL2+	ADSL
Loop lengths	500m	n/a	2500m	2500m

Table 25: Test settings for xDSL recovery from noise impairment tests.

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5.6 Assessment parameters

Table 26 below describes the parameters of xDSL test output files, i.e., the Assecco input files, that are referred to in the test specifications in Section 4.

xDSL test	Parameters in xDSL test output file = Assecco input file	Example
CPE inventory information	No extra information to be written.	Figure 11
Performance – low & high noise	• loopLength, • iteration, • stateUs, stateDs, • rateUs, rateDs, • attRateUs, attRateDs • noiMarUs, noiMarDs, noiMarU0, noiMarD1, noiMarU1, noiMarD2, noiMarU2, noiMarD3, noiMarU3, • sigAttUs, sigAttDs, sigAttU0, sigAttD1, sigAttU1, sigAttD2, sigAttU2, sigAttD3, sigAttU3, • loopAttUs, loopAttDs, loopAttU0, loopAttD1, loopAttU1, loopAttD2, loopAttU2, loopAttD3, loopAttU3, • outPowUs, outPowDs, • elecLenEstim, elecLenFinal, • endFreqUs, endFreqDs, • syncTimeUs, syncTimeDs, • fecUs, fecDs, • cvUs, cvDs.	Figure 12
Bit swapping	• band, • loopLength, • toneRange, • initialLoad, initialLoadSum, • downToLoad, downToLoadSum, • autoReturnLoad, autoReturnLoadSum, autoReturnSuccess • forcedReturnLoad, forcedReturnLoadSum, forcedReturnSuccesss	Figure 13
Stability	• time • stateUs, stateDs, • rateUs, rateDs, • attRateUs, attRateDs, • noiMarUs, noiMarDs, • fecUs, fecDs, • cvUs, cvDs	Figure 14
Recovery from noise impairment	• band, • startNoiMar, • downToNoiMar, • recoveryNoiMar, recoverySuccess.	Figure 15

Table 26: Parameters in xDSL test output file, i.e., Assecco input file; note that, in the test case descriptions in Section 4, these parameters are referred to as strings (to describe the subsequent parameter values) and as values in the subsequent lines.

5.7 Assessment rules

The tables below specify xDSL specific CAN configurations that are referred to in the test specifications in Section 4.

Assessment rules for xDSL CPE inventory information tests				
Verdict – severity	**VDSL2 17a**	**VDSL2 8b**	**ADSL2+**	**ADSL**
Pass – no defect	CPE inventory information complete according to VDSL2 standard (cf. [1], requirements L1-GE-20, 21, 22).			
Fail – accepted	–			
Fail – minor defect	–			
Fail – major defect	–			
Fail – critical defect	CPE inventory information incomplete according to VDSL2 standard (cf. [1], requirements L1-GE-20, 21, 22).			

Table 27: Assessment rules for xDSL CPE inventory information tests.

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Assessment rules for xDSL performance tests (actual bit rates only)					
Verdict – severity		**VDSL2 17a**	**VDSL2 8b**	**ADSL2+**	**ADSL**
Pass & defect bounds	**Low noise**	Cf. Table 32	Cf. Table 34	Cf. Table 36	Cf. Table 38
	High noise	Cf. Table 33	Cf. Table 35	Cf. Table 37	Cf. Table 39
Pass – no defect		• US: rateUs ≥ US pass bound, or no sync if and only if US pass bound = 0 • DS: rateDS ≥ DS pass bound, or no sync if and only if DS pass bound = 0			
Fail – accepted	**Low noise**	ALU ISAM7302, FW 4.3.05n: • US: – • DS: 70Mb/s saturation	–	–	–
	High noise	–	–	–	–
Fail – minor defect		• US: US pass bound > rateUs ≥ US minor defect bound • DS: DS pass bound > rateDS ≥ DS minor defect bound			
Fail – major defect		• US: US minor defect bound > rateUs ≥ US major defect bound • DS: DS minor defect bound > rateDS ≥ DS major defect bound			
Fail – critical defect		• US: US major defect bound > rateUs, or no sync if and only if US pass bound > 0 • DS: DS major defect bound > rateDS, or no sync if and only if DS pass bound > 0			

Table 28: Assessment rules for xDSL performance tests; only actual bit rates US and DS, i.e., the test parameters rateUs and rateDS, are assessed. Only the highest actual bit rates per loop length are assessed with these verdicts – severities. The overall verdict – severity is given by the worst of the per loop length verdict – severity.

Assessment rules for xDSL bit swapping tests				
Verdict – severity	**VDSL2 17a**	**VDSL2 8b**	**ADSL2+**	**ADSL**
Pass – no defect	downtoLoad = 0, and forcedReturnSuccess ≥ 60% or autoReturnSuccess ≥ 60%.			
Fail – accepted - no defect	BDCM, any DP with MT = OFF, ALU ISAMx, DS: • downtoLoad = 0 • forcedReturnSuccess = 0% and autoReturnSuccess = 0% IKNS CPE5, DPr60, DPr71 and DPr87, DS: • downtoLoad ≤ 2 • forcedReturnSuccess ≥ 60% or autoReturnSuccess ≥ 60%		BDCM, DP older than DP38, with MT = ON: • downtoLoad ≤ 2 • ReturnSuccess ≥ 60% BDCM, any DP with DP = OFF, US: • downtoLoad ≤ 2 • forcedReturnSuccess ≥ 60% or autoReturnSuccess ≥ 60% BDCM, any DP with DP = OFF, DS: • downtoLoad ≤ 2 • ALU ISAMx: forcedReturnSuccess = 0% and autoReturnSuccess = 0% • HUA MA56x: forcedReturnSuccess ≥ 60% or autoReturnSuccess ≥ 60% Other chipsets than above, DP older than 2013: • downtoLoad ≤ 2 • forcedReturnSuccess ≥ 60% or autoReturnSuccess ≥ 60%	
Fail – minor defect	• downtoLoad = pass or accepted condition • 0 < forcedReturnSuccess < 60% or 0 < autoReturnSuccess < 60% unless pass or accepted			
Fail – major defect	ALU ISAM 73xx, US0: • Any behavior worse than above. Otherwise: • downtoLoad = pass or accepted condition • autoReturnSuccess = 0% and forcedReturnSuccess = 0% unless pass or accepted		Any behavior worse than above.	
Fail – critical defect	ALU ISAM 73xx, US0: • – Otherwise: Any behavior worse than above: • downtoLoad = neither pass nor accepted condition		–	

Table 29: Assessment rules for xDSL bit swapping tests, where MT = monitoring tones.

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Assessment rules for xDSL stability tests				
Verdict – severity	**VDSL2 17a**	**VDSL2 8b**	**ADSL2+**	**ADSL**
Pass – no defect	Full test without sync loss with target noise margin bound = 2 dB, CV/CP < 1'000 and FEC/CP < 50'000.			
Fail – accepted	–			
Fail – minor defect	–			
Fail – major defect	• Either full test without sync loss with target noise margin bound = 2 dB as well as at least one value CV/CP ≥ 1'000 or FEC/CP ≥ 50'000. • Or full test without spontaneous resyncs with target noise margin bound = 3 dB with any value for CV/CP and FEC/CP.			
Fail – critical defect	Loss of sync in the test procedure with target noise margin = 3dB.			

Table 30: Assessment rules for xDSL stability tests for a collection period (CP) of 2 minutes.

Assessment rules for xDSL recovery from noise impairment tests				
Verdict – severity	**VDSL2 17a**	**VDSL2 8b**	**ADSL2+**	**ADSL**
Pass – no defect	Full test without sync loss with 90% ≤ recovery success.			
Fail – accepted	–			
Fail – minor defect	Full test without sync loss with 80% ≤ recovery success < 90%.			
Fail – major defect	Full test without sync loss with 60% ≤ recovery success < 80%.			
Fail – critical defect	Full test without sync loss with 60% ≤ recovery success < 60% or loss of sync in the test procedure.			

Table 31: Assessment rules for xDSL recovery from noise impairment tests.

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5.8 Actual bit rates: Pass & defect bounds

5.8.1 xDSL over POTS minimum actual bit rate performance: Graphs

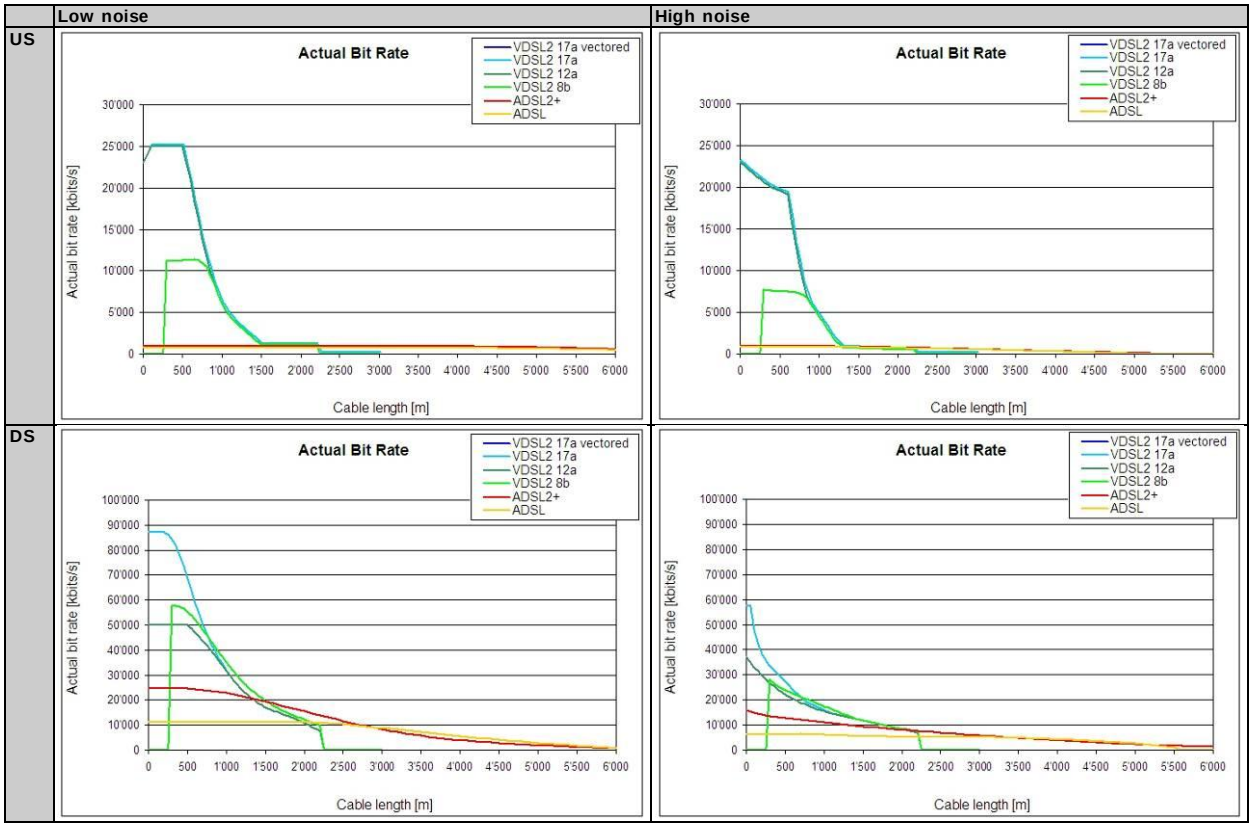

Figure 16: xDSL over POTS minimum actual bit rate performance; for numeric values, cf. Table 32 - Table 39 below.

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5.8.2 xDSL over ISDN minimum actual bit rate performance: Graphs

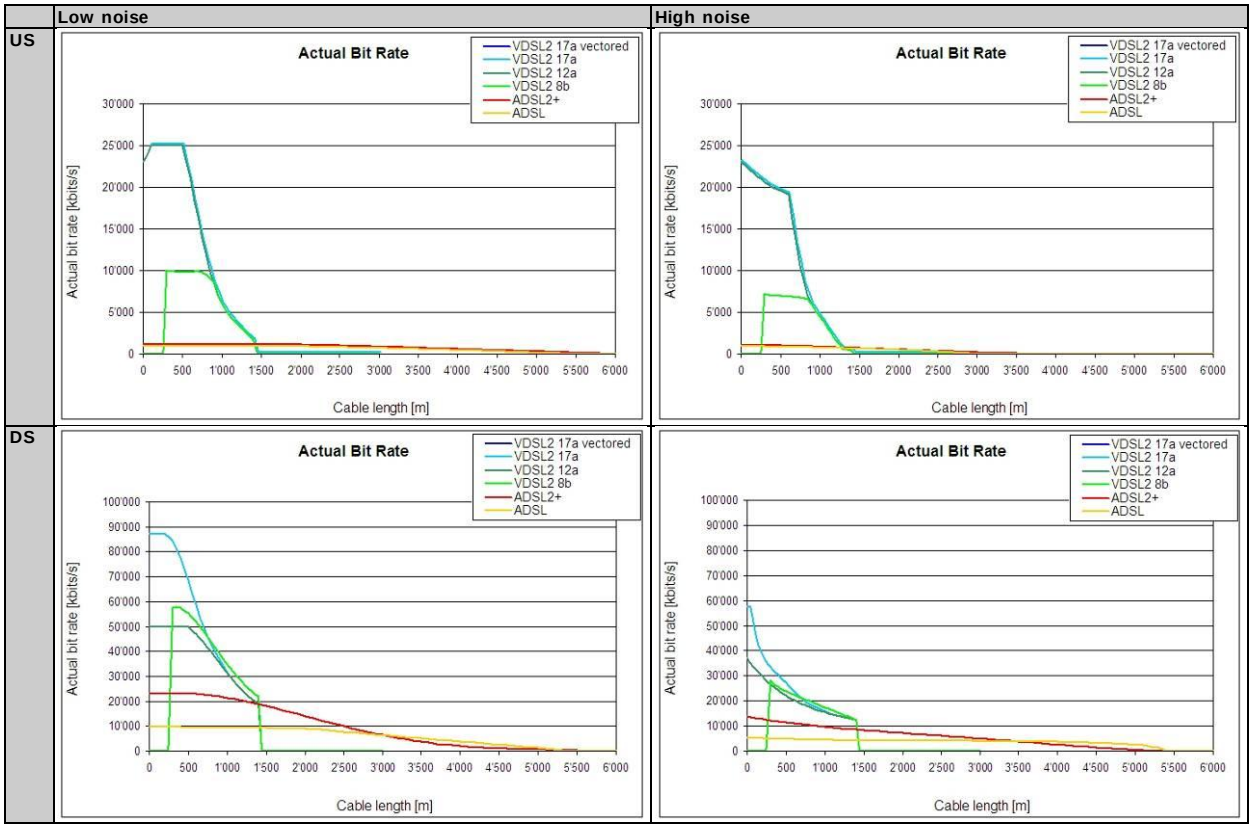

Figure 17: xDSL over ISDN minimum actual bit rate performance; for numeric values, cf. Table 32 - Table 39 below.

5.8.3 VDSL2 (profile 17a) low noise actual bit rates: Pass & defect bounds

Length	VDSL2 (profile 17a) over POTS low noise						VDSL2 (profile 17a) over ISDN low noise					
	Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]		Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]	
[m]	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
0	23'000	87'191	20'700	78'472	18'400	69'753	23'000	87'191	20'700	78'472	18'400	69'753
50	24'000	87'191	21'600	78'472	19'200	69'753	24'000	87'191	21'600	78'472	19'200	69'753
100	25'000	87'191	22'500	78'472	20'000	69'753	25'000	87'191	22'500	78'472	20'000	69'753
150	25'000	87'163	22'500	78'447	20'000	69'731	25'000	87'163	22'500	78'447	20'000	69'731
200	25'000	86'993	22'500	78'294	20'000	69'595	25'000	86'993	22'500	78'294	20'000	69'595
250	25'000	86'136	22'500	77'522	20'000	68'908	25'000	86'136	22'500	77'522	20'000	68'908
300	25'000	84'330	22'500	75'897	20'000	67'464	25'000	84'330	22'500	75'897	20'000	67'464
350	25'000	81'533	22'500	73'379	20'000	65'226	25'000	81'533	22'500	73'379	20'000	65'226
400	25'000	77'848	22'500	70'063	20'000	62'279	25'000	77'848	22'500	70'063	20'000	62'279
450	25'000	73'479	22'500	66'131	20'000	58'783	25'000	73'479	22'500	66'131	20'000	58'783
500	25'000	68'676	22'500	61'809	20'000	54'941	25'000	68'676	22'500	61'809	20'000	54'941
550	22'896	63'699	20'606	57'329	18'317	50'959	22'896	63'699	20'606	57'329	18'317	50'959
600	20'792	58'786	18'713	52'907	16'634	47'029	20'792	58'786	18'713	52'907	16'634	47'029
650	18'444	54'129	16'600	48'716	14'755	43'303	18'444	54'129	16'600	48'716	14'755	43'303
700	16'096	49'860	14'486	44'874	12'877	39'888	16'096	49'860	14'486	44'874	12'877	39'888
750	13'948	46'042	12'553	41'438	11'158	36'834	13'948	46'042	12'553	41'438	11'158	36'834
800	11'800	42'671	10'620	38'404	9'440	34'137	11'800	42'671	10'620	38'404	9'440	34'137
850	10'116	39'682	9'104	35'714	8'093	31'745	10'116	39'682	9'104	35'714	8'093	31'745
900	8'432	36'967	7'589	33'270	6'746	29'574	8'432	36'967	7'589	33'270	6'746	29'574
950	7'260	34'402	6'534	30'961	5'808	27'521	7'260	34'402	6'534	30'961	5'808	27'521
1'000	6'088	31'872	5'479	28'685	4'870	25'498	6'088	31'872	5'479	28'685	4'870	25'498
1'050	5'336	29'680	4'802	26'712	4'269	23'744	5'336	29'680	4'802	26'712	4'269	23'744
1'100	4'584	27'488	4'126	24'739	3'667	21'990	4'584	27'488	4'126	24'739	3'667	21'990
1'150	4'084	25'760	3'676	23'184	3'267	20'608	4'084	25'760	3'676	23'184	3'267	20'608
1'200	3'584	24'032	3'226	21'629	2'867	19'226	3'584	24'032	3'226	21'629	2'867	19'226
1'250	3'172	22'608	2'855	20'347	2'538	18'086	3'072	22'608	2'765	20'347	2'458	18'086
1'300	2'760	21'184	2'484	19'066	2'208	16'947	2'560	21'184	2'304	19'066	2'048	16'947
1'350	2'332	20'052	2'099	18'047	1'866	16'042	2'132	20'052	1'919	18'047	1'706	16'042
1'400	1'904	18'920	1'714	17'028	1'523	15'136	1'704	18'920	1'534	17'028	1'363	15'136
1'450	1'504	18'040	1'354	16'236	1'203	14'432	0	0	0	0	0	0
1'500	1'104	17'160	994	15'444	883	13'728	0	0	0	0	0	0
1'550	1'104	16'460	994	14'814	883	13'168	0	0	0	0	0	0
1'600	1'104	15'760	994	14'184	883	12'608	0	0	0	0	0	0
1'650	1'104	15'160	994	13'644	883	12'128	0	0	0	0	0	0
1'700	1'104	14'560	994	13'104	883	11'648	0	0	0	0	0	0
1'750	1'104	13'984	994	12'586	883	11'187	0	0	0	0	0	0
1'800	1'104	13'408	994	12'067	883	10'726	0	0	0	0	0	0
1'850	1'104	12'784	994	11'506	883	10'227	0	0	0	0	0	0
1'900	1'104	12'160	994	10'944	883	9'728	0	0	0	0	0	0
1'950	1'104	11'452	994	10'307	883	9'162	0	0	0	0	0	0
2'000	1'104	10'744	994	9'670	883	8'595	0	0	0	0	0	0
2'050	1'104	9'948	994	8'953	883	7'958	0	0	0	0	0	0
2'100	1'104	9'152	994	8'237	883	7'322	0	0	0	0	0	0
2'150	1'104	8'324	994	7'492	883	6'659	0	0	0	0	0	0
2'200	1'104	7'496	994	6'746	883	5'997	0	0	0	0	0	0
2'250	0	0	0	0	0	0	0	0	0	0	0	0
2'300	0	0	0	0	0	0	0	0	0	0	0	0
2'350	0	0	0	0	0	0	0	0	0	0	0	0
2'400	0	0	0	0	0	0	0	0	0	0	0	0
2'450	0	0	0	0	0	0	0	0	0	0	0	0
2'500	0	0	0	0	0	0	0	0	0	0	0	0
2'550	0	0	0	0	0	0	0	0	0	0	0	0
2'600	0	0	0	0	0	0	0	0	0	0	0	0
2'650	0	0	0	0	0	0	0	0	0	0	0	0
2'700	0	0	0	0	0	0	0	0	0	0	0	0
2'750	0	0	0	0	0	0	0	0	0	0	0	0
2'800	0	0	0	0	0	0	0	0	0	0	0	0
2'850	0	0	0	0	0	0	0	0	0	0	0	0
2'900	0	0	0	0	0	0	0	0	0	0	0	0
2'950	0	0	0	0	0	0	0	0	0	0	0	0
3'000	0	0	0	0	0	0	0	0	0	0	0	0

Table 32: VDSL2 (profile 17a) over POTS & ISDN low noise actual bit rates (pass & defect bounds); for graphs cf. Figure 16.

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5.8.4 VDSL2 (profile 17a) high noise actual bit rates: Pass & defect bounds

Length	VDSL2 (profile 17a) over POTS high noise						VDSL2 (profile 17a) over ISDN high noise					
	Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]		Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]	
[m]	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
0	23'055	57'269	20'749	51'542	18'444	45'815	23'055	57'269	20'749	51'542	18'444	45'815
50	22'601	57'269	20'341	51'542	18'081	45'815	22'601	57'269	20'341	51'542	18'081	45'815
100	22'147	48'218	19'932	43'396	17'718	38'574	22'147	48'218	19'932	43'396	17'718	38'574
150	21'747	42'240	19'573	38'016	17'398	33'792	21'747	42'240	19'573	38'016	17'398	33'792
200	21'348	38'290	19'213	34'461	17'078	30'632	21'348	38'290	19'213	34'461	17'078	30'632
250	20'999	35'591	18'899	32'032	16'799	28'473	20'999	35'591	18'899	32'032	16'799	28'473
300	20'649	33'591	18'584	30'232	16'519	26'873	20'649	33'591	18'584	30'232	16'519	26'873
350	20'351	31'923	18'316	28'731	16'280	25'539	20'351	31'923	18'316	28'731	16'280	25'539
400	20'052	30'363	18'047	27'326	16'041	24'290	20'052	30'363	18'047	27'326	16'041	24'290
450	19'804	28'796	17'823	25'916	15'843	23'036	19'804	28'796	17'823	25'916	15'843	23'036
500	19'555	27'187	17'600	24'469	15'644	21'750	19'555	27'187	17'600	24'469	15'644	21'750
550	19'357	25'556	17'422	23'000	15'486	20'444	19'357	25'556	17'422	23'000	15'486	20'444
600	19'159	23'948	17'243	21'553	15'328	19'158	19'159	23'948	17'243	21'553	15'328	19'158
650	16'215	22'422	14'593	20'180	12'972	17'937	16'215	22'422	14'593	20'180	12'972	17'937
700	13'270	21'031	11'943	18'928	10'616	16'825	13'270	21'031	11'943	18'928	10'616	16'825
750	10'911	19'814	9'820	17'833	8'728	15'852	10'911	19'814	9'820	17'833	8'728	15'852
800	8'552	18'786	7'696	16'908	6'841	15'029	8'552	18'786	7'696	16'908	6'841	15'029
850	7'236	17'936	6'513	16'143	5'789	14'349	7'236	17'936	6'513	16'143	5'789	14'349
900	5'921	17'227	5'329	15'505	4'737	13'782	5'921	17'227	5'329	15'505	4'737	13'782
950	5'195	16'601	4'676	14'941	4'156	13'281	5'195	16'601	4'676	14'941	4'156	13'281
1'000	4'470	15'986	4'023	14'387	3'576	12'789	4'470	15'986	4'023	14'387	3'576	12'789
1'050	3'814	15'310	3'433	13'779	3'051	12'248	3'814	15'310	3'433	13'779	3'051	12'248
1'100	3'158	14'597	2'842	13'137	2'527	11'677	3'158	14'597	2'842	13'137	2'527	11'677
1'150	2'433	14'209	2'189	12'788	1'946	11'367	2'433	14'209	2'189	12'788	1'946	11'367
1'200	1'707	13'821	1'536	12'439	1'366	11'056	1'707	13'821	1'536	12'439	1'366	11'056
1'250	1'238	13'464	1'114	12'117	990	10'771	1'102	13'464	992	12'117	882	10'771
1'300	768	13'107	691	11'796	615	10'485	497	13'107	447	11'796	397	10'485
1'350	749	12'769	674	11'492	599	10'215	477	12'769	430	11'492	382	10'215
1'400	729	12'432	656	11'188	584	9'945	458	12'432	412	11'188	366	9'945
1'450	710	12'102	639	10'892	568	9'681	0	0	0	0	0	0
1'500	691	11'772	622	10'595	553	9'418	0	0	0	0	0	0
1'550	671	11'446	604	10'301	537	9'157	0	0	0	0	0	0
1'600	652	11'120	587	10'008	521	8'896	0	0	0	0	0	0
1'650	636	10'790	573	9'711	509	8'632	0	0	0	0	0	0
1'700	621	10'460	559	9'414	497	8'368	0	0	0	0	0	0
1'750	601	10'127	541	9'114	481	8'101	0	0	0	0	0	0
1'800	582	9'793	524	8'814	466	7'834	0	0	0	0	0	0
1'850	570	9'448	513	8'503	456	7'558	0	0	0	0	0	0
1'900	559	9'102	503	8'192	447	7'282	0	0	0	0	0	0
1'950	543	8'753	489	7'878	435	7'003	0	0	0	0	0	0
2'000	528	8'404	475	7'564	422	6'723	0	0	0	0	0	0
2'050	516	8'051	464	7'246	413	6'441	0	0	0	0	0	0
2'100	504	7'698	454	6'928	404	6'158	0	0	0	0	0	0
2'150	493	7'341	443	6'607	394	5'873	0	0	0	0	0	0
2'200	481	6'984	433	6'286	385	5'587	0	0	0	0	0	0
2'250	0	0	0	0	0	0	0	0	0	0	0	0
2'300	0	0	0	0	0	0	0	0	0	0	0	0
2'350	0	0	0	0	0	0	0	0	0	0	0	0
2'400	0	0	0	0	0	0	0	0	0	0	0	0
2'450	0	0	0	0	0	0	0	0	0	0	0	0
2'500	0	0	0	0	0	0	0	0	0	0	0	0
2'550	0	0	0	0	0	0	0	0	0	0	0	0
2'600	0	0	0	0	0	0	0	0	0	0	0	0
2'650	0	0	0	0	0	0	0	0	0	0	0	0
2'700	0	0	0	0	0	0	0	0	0	0	0	0
2'750	0	0	0	0	0	0	0	0	0	0	0	0
2'800	0	0	0	0	0	0	0	0	0	0	0	0
2'850	0	0	0	0	0	0	0	0	0	0	0	0
2'900	0	0	0	0	0	0	0	0	0	0	0	0
2'950	0	0	0	0	0	0	0	0	0	0	0	0
3'000	0	0	0	0	0	0	0	0	0	0	0	0

Table 33: VDSL2 (profile 17a) over POTS & ISDN high noise actual bit rates (pass & defect bounds); for graphs cf. Figure 17.

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5.8.5 VDSL2 (profile 8b) low noise actual bit rates: Pass & defect bounds

Length	VDSL2 (profile 8b) over POTS low noise						VDSL2 (profile 8b) over ISDN low noise					
	Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]		Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]	
[m]	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0	0	0
200	0	0	0	0	0	0	0	0	0	0	0	0
250	0	0	0	0	0	0	0	0	0	0	0	0
300	11'183	57'570	10'065	51'813	8'947	46'056	10'013	57'570	9'011	51'813	8'010	46'056
350	11'227	57'708	10'104	51'937	8'982	46'167	9'935	57'708	8'942	51'937	7'948	46'167
400	11'235	57'321	10'111	51'589	8'988	45'856	9'849	57'321	8'864	51'589	7'879	45'856
450	11'236	56'488	10'113	50'839	8'989	45'190	9'785	56'488	8'806	50'839	7'828	45'190
500	11'255	55'284	10'129	49'756	9'004	44'227	9'761	55'284	8'785	49'756	7'809	44'227
550	11'293	53'778	10'164	48'400	9'035	43'022	9'780	53'778	8'802	48'400	7'824	43'022
600	11'335	52'031	10'202	46'828	9'068	41'625	9'826	52'031	8'844	46'828	7'861	41'625
650	11'342	50'100	10'208	45'090	9'073	40'080	9'870	50'100	8'883	45'090	7'896	40'080
700	11'259	48'035	10'133	43'232	9'007	38'428	9'869	48'035	8'882	43'232	7'895	38'428
750	11'026	45'882	9'923	41'294	8'821	36'706	9'772	45'882	8'795	41'294	7'817	36'706
800	10'591	43'680	9'532	39'312	8'473	34'944	9'531	43'680	8'578	39'312	7'625	34'944
850	9'511	41'464	8'560	37'318	7'609	33'172	9'110	41'464	8'199	37'318	7'288	33'172
900	8'432	39'265	7'589	35'339	6'746	31'412	8'493	39'265	7'644	35'339	6'795	31'412
950	7'260	37'108	6'534	33'397	5'808	29'686	7'291	37'108	6'562	33'397	5'832	29'686
1'000	6'088	35'013	5'479	31'512	4'870	28'010	6'088	35'013	5'479	31'512	4'870	28'010
1'050	5'336	32'999	4'802	29'699	4'269	26'399	5'336	32'999	4'802	29'699	4'269	26'399
1'100	4'584	31'077	4'126	27'970	3'667	24'862	4'584	31'077	4'126	27'970	3'667	24'862
1'150	4'084	29'259	3'676	26'333	3'267	23'407	4'084	29'259	3'676	26'333	3'267	23'407
1'200	3'584	27'550	3'226	24'795	2'867	22'040	3'584	27'550	3'226	24'795	2'867	22'040
1'250	3'172	25'953	2'855	23'358	2'538	20'763	3'072	25'953	2'765	23'358	2'458	20'763
1'300	2'760	24'470	2'484	22'023	2'208	19'576	2'560	24'470	2'304	22'023	2'048	19'576
1'350	2'332	23'098	2'099	20'788	1'866	18'479	2'132	23'098	1'919	20'788	1'706	18'479
1'400	1'904	21'834	1'714	19'650	1'523	17'467	1'704	21'834	1'534	19'650	1'363	17'467
1'450	1'504	20'671	1'354	18'604	1'203	16'537	0	0	0	0	0	0
1'500	1'104	19'602	994	17'642	883	15'682	0	0	0	0	0	0
1'550	1'104	18'620	994	16'758	883	14'896	0	0	0	0	0	0
1'600	1'104	17'713	994	15'942	883	14'170	0	0	0	0	0	0
1'650	1'104	16'873	994	15'185	883	13'498	0	0	0	0	0	0
1'700	1'104	16'089	994	14'480	883	12'871	0	0	0	0	0	0
1'750	1'104	15'369	994	13'832	883	12'295	0	0	0	0	0	0
1'800	1'104	14'650	994	13'185	883	11'720	0	0	0	0	0	0
1'850	1'104	13'988	994	12'589	883	11'190	0	0	0	0	0	0
1'900	1'104	13'325	994	11'993	883	10'660	0	0	0	0	0	0
1'950	1'104	12'695	994	11'425	883	10'156	0	0	0	0	0	0
2'000	1'104	12'064	994	10'858	883	9'651	0	0	0	0	0	0
2'050	1'104	11'456	994	10'310	883	9'165	0	0	0	0	0	0
2'100	1'104	10'848	994	9'763	883	8'678	0	0	0	0	0	0
2'150	1'104	10'276	994	9'248	883	8'221	0	0	0	0	0	0
2'200	1'104	9'704	994	8'733	883	7'763	0	0	0	0	0	0
2'250	0	0	0	0	0	0	0	0	0	0	0	0
2'300	0	0	0	0	0	0	0	0	0	0	0	0
2'350	0	0	0	0	0	0	0	0	0	0	0	0
2'400	0	0	0	0	0	0	0	0	0	0	0	0
2'450	0	0	0	0	0	0	0	0	0	0	0	0
2'500	0	0	0	0	0	0	0	0	0	0	0	0
2'550	0	0	0	0	0	0	0	0	0	0	0	0
2'600	0	0	0	0	0	0	0	0	0	0	0	0
2'650	0	0	0	0	0	0	0	0	0	0	0	0
2'700	0	0	0	0	0	0	0	0	0	0	0	0
2'750	0	0	0	0	0	0	0	0	0	0	0	0
2'800	0	0	0	0	0	0	0	0	0	0	0	0
2'850	0	0	0	0	0	0	0	0	0	0	0	0
2'900	0	0	0	0	0	0	0	0	0	0	0	0
2'950	0	0	0	0	0	0	0	0	0	0	0	0
3'000	0	0	0	0	0	0	0	0	0	0	0	0

Table 34: VDSL2 (profile 8b) over POTS & ISDN low noise actual bit rates (pass & defect bounds); for graphs cf. Figure 16.

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5.8.6 VDSL2 (profile 8b) high noise actual bit rates: Pass & defect bounds

Length	VDSL2 (profile 8b) over POTS high noise						VDSL2 (profile 8b) over ISDN high noise					
	Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]		Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]	
[m]	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0	0	0
200	0	0	0	0	0	0	0	0	0	0	0	0
250	0	0	0	0	0	0	0	0	0	0	0	0
300	7'728	28'098	6'955	25'288	6'182	22'478	7'192	28'098	6'472	25'288	5'753	22'478
350	7'651	26'736	6'886	24'062	6'121	21'389	7'094	26'736	6'385	24'062	5'675	21'389
400	7'590	25'606	6'831	23'045	6'072	20'485	7'023	25'606	6'321	23'045	5'619	20'485
450	7'539	24'653	6'785	22'188	6'031	19'722	6'976	24'653	6'278	22'188	5'581	19'722
500	7'500	23'830	6'750	21'447	6'000	19'064	6'943	23'830	6'248	21'447	5'554	19'064
550	7'472	23'100	6'725	20'790	5'977	18'480	6'915	23'100	6'224	20'790	5'532	18'480
600	7'453	22'431	6'708	20'188	5'962	17'945	6'887	22'431	6'199	20'188	5'510	17'945
650	7'434	21'801	6'691	19'621	5'947	17'441	6'857	21'801	6'171	19'621	5'485	17'441
700	7'397	21'190	6'657	19'071	5'917	16'952	6'821	21'190	6'139	19'071	5'457	16'952
750	7'309	20'585	6'578	18'527	5'848	16'468	6'774	20'585	6'096	18'527	5'419	16'468
800	7'125	19'978	6'412	17'980	5'700	15'982	6'694	19'978	6'025	17'980	5'355	15'982
850	6'776	19'362	6'099	17'426	5'421	15'490	6'537	19'362	5'884	17'426	5'230	15'490
900	5'921	18'737	5'329	16'863	4'737	14'990	5'921	18'737	5'329	16'863	4'737	14'990
950	5'195	18'101	4'676	16'291	4'156	14'481	5'195	18'101	4'676	16'291	4'156	14'481
1'000	4'470	17'458	4'023	15'712	3'576	13'966	4'470	17'458	4'023	15'712	3'576	13'966
1'050	3'814	16'810	3'433	15'129	3'051	13'448	3'814	16'810	3'433	15'129	3'051	13'448
1'100	3'158	16'163	2'842	14'547	2'527	12'930	3'158	16'163	2'842	14'547	2'527	12'930
1'150	2'433	15'521	2'189	13'969	1'946	12'417	2'433	15'521	2'189	13'969	1'946	12'417
1'200	1'707	14'891	1'536	13'402	1'366	11'913	1'707	14'891	1'536	13'402	1'366	11'913
1'250	1'238	14'276	1'114	12'849	990	11'421	1'102	14'276	992	12'849	882	11'421
1'300	768	13'684	691	12'315	615	10'947	497	13'684	447	12'315	397	10'947
1'350	749	13'117	674	11'805	599	10'494	477	13'117	430	11'805	382	10'494
1'400	729	12'580	656	11'322	584	10'064	458	12'580	412	11'322	366	10'064
1'450	710	12'075	639	10'867	568	9'660	0	0	0	0	0	0
1'500	691	11'772	622	10'595	553	9'418	0	0	0	0	0	0
1'550	671	11'446	604	10'301	537	9'157	0	0	0	0	0	0
1'600	652	11'120	587	10'008	521	8'896	0	0	0	0	0	0
1'650	636	10'790	573	9'711	509	8'632	0	0	0	0	0	0
1'700	621	10'460	559	9'414	497	8'368	0	0	0	0	0	0
1'750	601	10'127	541	9'114	481	8'101	0	0	0	0	0	0
1'800	582	9'793	524	8'814	466	7'834	0	0	0	0	0	0
1'850	570	9'448	513	8'503	456	7'558	0	0	0	0	0	0
1'900	559	9'102	503	8'192	447	7'282	0	0	0	0	0	0
1'950	543	8'780	489	7'902	435	7'024	0	0	0	0	0	0
2'000	528	8'457	475	7'611	422	6'765	0	0	0	0	0	0
2'050	516	8'215	464	7'393	413	6'572	0	0	0	0	0	0
2'100	504	7'973	454	7'175	404	6'378	0	0	0	0	0	0
2'150	493	7'724	443	6'951	394	6'179	0	0	0	0	0	0
2'200	481	7'475	433	6'728	385	5'980	0	0	0	0	0	0
2'250	0	0	0	0	0	0	0	0	0	0	0	0
2'300	0	0	0	0	0	0	0	0	0	0	0	0
2'350	0	0	0	0	0	0	0	0	0	0	0	0
2'400	0	0	0	0	0	0	0	0	0	0	0	0
2'450	0	0	0	0	0	0	0	0	0	0	0	0
2'500	0	0	0	0	0	0	0	0	0	0	0	0
2'550	0	0	0	0	0	0	0	0	0	0	0	0
2'600	0	0	0	0	0	0	0	0	0	0	0	0
2'650	0	0	0	0	0	0	0	0	0	0	0	0
2'700	0	0	0	0	0	0	0	0	0	0	0	0
2'750	0	0	0	0	0	0	0	0	0	0	0	0
2'800	0	0	0	0	0	0	0	0	0	0	0	0
2'850	0	0	0	0	0	0	0	0	0	0	0	0
2'900	0	0	0	0	0	0	0	0	0	0	0	0
2'950	0	0	0	0	0	0	0	0	0	0	0	0
3'000	0	0	0	0	0	0	0	0	0	0	0	0

Table 35: VDSL2 (profile 8b) over POTS & ISDN high noise actual bit rates (pass & defect bounds); for graphs cf. Figure 17.

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5.8.7 ADSL2+ low noise actual bit rates: Pass & defect bounds

Length	ADSL2+ over POTS low noise						ADSL2+ over ISDN low noise					
	Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]		Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]	
[m]	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
0	950	24'558	855	22'102	760	19'646	1'100	23'100	990	20'790	880	18'480
100	950	24'558	855	22'102	760	19'646	1'100	23'100	990	20'790	880	18'480
200	950	24'558	855	22'102	760	19'646	1'100	23'100	990	20'790	880	18'480
300	950	24'558	855	22'102	760	19'646	1'100	23'100	990	20'790	880	18'480
400	950	24'555	855	22'099	760	19'644	1'100	23'100	990	20'790	880	18'480
500	950	24'534	855	22'080	760	19'627	1'100	23'056	990	20'751	880	18'445
600	950	24'388	855	21'949	760	19'510	1'100	22'902	990	20'612	880	18'321
700	950	24'131	855	21'718	760	19'305	1'100	22'647	990	20'382	880	18'117
800	950	23'775	855	21'397	760	19'020	1'100	22'301	990	20'071	880	17'841
900	950	23'332	855	20'999	760	18'665	1'100	21'872	990	19'685	880	17'498
1'000	950	22'813	855	20'532	760	18'250	1'100	21'371	990	19'234	880	17'097
1'100	950	22'229	855	20'006	760	17'783	1'100	20'804	990	18'724	880	16'643
1'200	950	21'590	855	19'431	760	17'272	1'100	20'181	990	18'163	880	16'145
1'300	950	20'904	855	18'813	760	16'723	1'100	19'508	990	17'557	880	15'607
1'400	950	20'181	855	18'162	760	16'144	1'100	18'794	990	16'915	880	15'035
1'500	950	19'428	855	17'485	760	15'542	1'100	18'045	990	16'240	880	14'436
1'600	950	18'652	855	16'787	760	14'922	1'100	17'268	990	15'541	880	13'814
1'700	950	17'861	855	16'075	760	14'289	1'100	16'470	990	14'823	880	13'176
1'800	950	17'061	855	15'355	760	13'649	1'100	15'656	990	14'090	880	12'525
1'900	950	16'258	855	14'632	760	13'006	1'099	14'833	989	13'349	879	11'866
2'000	950	15'456	855	13'910	760	12'365	1'096	14'005	986	12'605	877	11'204
2'100	950	14'660	855	13'194	760	11'728	1'091	13'178	982	11'860	873	10'543
2'200	950	13'875	855	12'488	760	11'100	1'082	12'357	973	11'122	865	9'886
2'300	950	13'105	855	11'794	760	10'484	1'061	11'546	955	10'392	849	9'237
2'400	950	12'352	855	11'117	760	9'881	1'037	10'750	933	9'675	829	8'600
2'500	950	11'619	855	10'457	760	9'296	1'011	9'971	910	8'974	809	7'977
2'600	950	10'910	855	9'819	760	8'728	984	9'214	886	8'292	787	7'371
2'700	950	10'226	855	9'203	760	8'181	957	8'481	861	7'633	765	6'785
2'800	950	9'569	855	8'612	760	7'655	929	7'776	836	6'998	743	6'221
2'900	950	8'940	855	8'046	760	7'152	901	7'100	811	6'390	720	5'680
3'000	950	8'340	855	7'506	760	6'672	872	6'457	785	5'811	698	5'165
3'100	950	7'770	855	6'993	760	6'216	843	5'847	759	5'262	674	4'678
3'200	950	7'231	855	6'508	760	5'785	814	5'272	733	4'745	651	4'218
3'300	950	6'722	855	6'050	760	5'378	785	4'734	706	4'261	628	3'787
3'400	947	6'244	852	5'619	757	4'995	756	4'233	680	3'810	604	3'386
3'500	943	5'795	848	5'216	754	4'636	726	3'769	654	3'393	581	3'016
3'600	938	5'376	844	4'839	750	4'301	697	3'344	627	3'009	558	2'675
3'700	932	4'986	839	4'487	746	3'989	668	2'956	601	2'660	534	2'365
3'800	926	4'623	833	4'161	741	3'699	639	2'605	575	2'344	511	2'084
3'900	919	4'287	827	3'858	735	3'430	610	2'290	549	2'061	488	1'832
4'000	911	3'976	820	3'578	729	3'181	581	2'010	523	1'809	465	1'608
4'100	903	3'689	812	3'320	722	2'951	553	1'764	497	1'588	442	1'411
4'200	893	3'423	804	3'081	715	2'739	524	1'549	472	1'394	419	1'240
4'300	883	3'179	795	2'861	706	2'543	496	1'365	446	1'228	397	1'092
4'400	872	2'953	785	2'657	697	2'362	468	1'207	421	1'086	374	965
4'500	860	2'743	774	2'469	688	2'195	439	1'073	396	966	352	858
4'600	846	2'549	762	2'294	677	2'039	412	961	370	865	329	768
4'700	832	2'368	749	2'131	666	1'894	384	866	345	779	307	693
4'800	817	2'198	736	1'978	654	1'758	356	785	320	706	285	628
4'900	801	2'037	721	1'833	641	1'630	328	713	295	642	262	570
5'000	784	1'884	706	1'695	627	1'507	300	647	270	582	240	517
5'100	766	1'736	689	1'563	613	1'389	271	581	244	523	217	465
5'200	747	1'592	672	1'433	597	1'274	243	510	219	459	194	408
5'300	726	1'451	654	1'306	581	1'161	214	429	193	386	171	343
5'400	705	1'310	634	1'179	564	1'048	185	332	166	299	148	266
5'500	682	1'168	614	1'051	546	935	155	213	139	191	124	170
5'600	658	1'055	593	949	527	844	125	65	112	58	100	52
5'700	633	941	570	847	507	753	93	0	84	0	75	0
5'800	607	827	546	745	486	662	62	0	55	0	49	0
5'900	580	714	522	642	464	571	29	0	26	0	23	0
6'000	551	600	496	540	441	480	0	0	0	0	0	0

Table 36: ADSL2+ over POTS & ISDN low noise actual bit rates (pass & defect bounds); for graphs cf. Figure 16.

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5.8.8 ADSL2+ high noise actual bit rates: Pass & defect bounds

Length	ADSL2+ over POTS high noise						ADSL2+ over ISDN high noise					
	Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]		Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]	
[m]	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
0	925	15'962	833	14'366	740	12'770	1'061	13'704	954	12'334	848	10'964
100	925	14'967	833	13'470	740	11'974	1'058	13'170	952	11'853	846	10'536
200	925	14'193	833	12'774	740	11'354	1'051	12'671	946	11'403	840	10'136
300	925	13'639	833	12'275	740	10'911	1'039	12'203	936	10'983	832	9'762
400	925	13'205	833	11'884	740	10'564	1'025	11'765	922	10'588	820	9'412
500	925	12'788	833	11'509	740	10'230	1'006	11'354	906	10'219	805	9'083
600	925	12'388	833	11'149	740	9'911	985	10'968	887	9'871	788	8'775
700	924	12'005	832	10'804	739	9'604	961	10'606	865	9'545	769	8'484
800	921	11'636	829	10'472	737	9'309	935	10'264	841	9'237	748	8'211
900	917	11'282	825	10'153	733	9'025	906	9'941	815	8'947	725	7'953
1'000	910	10'940	819	9'846	728	8'752	875	9'635	788	8'671	700	7'708
1'100	903	10'611	812	9'550	722	8'489	843	9'344	759	8'410	674	7'475
1'200	893	10'294	804	9'264	715	8'235	809	9'067	728	8'160	647	7'254
1'300	883	9'987	795	8'988	706	7'990	774	8'802	697	7'922	619	7'041
1'400	871	9'690	784	8'721	697	7'752	738	8'547	664	7'692	590	6'837
1'500	858	9'402	772	8'462	686	7'522	701	8'301	631	7'471	561	6'641
1'600	843	9'123	759	8'211	675	7'299	664	8'062	598	7'256	531	6'450
1'700	828	8'852	745	7'967	662	7'082	626	7'830	564	7'047	501	6'264
1'800	812	8'588	730	7'729	649	6'870	588	7'603	530	6'843	471	6'082
1'900	794	8'331	715	7'498	635	6'665	551	7'380	496	6'642	441	5'904
2'000	776	8'079	698	7'271	621	6'464	513	7'160	462	6'444	410	5'728
2'100	757	7'834	681	7'050	605	6'267	476	6'941	428	6'247	381	5'553
2'200	737	7'593	663	6'834	589	6'075	439	6'724	395	6'052	351	5'379
2'300	716	7'357	645	6'622	573	5'886	403	6'507	362	5'857	322	5'206
2'400	695	7'126	626	6'413	556	5'701	367	6'290	331	5'661	294	5'032
2'500	673	6'898	606	6'208	539	5'519	333	6'073	300	5'465	266	4'858
2'600	651	6'674	586	6'007	521	5'339	299	5'853	270	5'268	240	4'683
2'700	628	6'453	565	5'808	503	5'163	267	5'632	240	5'069	214	4'506
2'800	605	6'236	545	5'612	484	4'989	236	5'409	212	4'868	189	4'327
2'900	582	6'021	523	5'419	465	4'817	206	5'183	186	4'665	165	4'147
3'000	558	5'808	502	5'227	446	4'647	178	4'955	160	4'460	142	3'964
3'100	534	5'605	481	5'044	427	4'484	151	4'724	136	4'252	121	3'780
3'200	510	5'404	459	4'864	408	4'323	125	4'491	113	4'042	100	3'593
3'300	486	5'205	437	4'685	388	4'164	101	4'255	91	3'830	81	3'404
3'400	461	5'009	415	4'508	369	4'007	79	4'017	71	3'615	63	3'213
3'500	437	4'814	393	4'333	349	3'851	58	3'777	53	3'399	47	3'021
3'600	413	4'622	371	4'160	330	3'697	39	3'535	35	3'181	31	2'828
3'700	388	4'432	349	3'988	311	3'545	22	3'291	20	2'962	17	2'633
3'800	364	4'244	328	3'819	291	3'395	6	3'047	5	2'743	5	2'438
3'900	340	4'058	306	3'653	272	3'247	0	2'803	0	2'523	0	2'243
4'000	316	3'876	285	3'488	253	3'100	0	2'560	0	2'304	0	2'048
4'100	293	3'696	264	3'326	234	2'956	0	2'318	0	2'086	0	1'854
4'200	270	3'518	243	3'167	216	2'815	0	2'078	0	1'870	0	1'662
4'300	247	3'345	222	3'010	197	2'676	0	1'841	0	1'657	0	1'473
4'400	224	3'175	202	2'857	179	2'540	0	1'609	0	1'448	0	1'287
4'500	202	3'008	182	2'707	162	2'407	0	1'382	0	1'244	0	1'105
4'600	180	2'846	162	2'562	144	2'277	0	1'161	0	1'045	0	929
4'700	159	2'689	143	2'420	127	2'151	0	949	0	854	0	759
4'800	139	2'537	125	2'283	111	2'029	0	746	0	671	0	596
4'900	118	2'390	107	2'151	95	1'912	0	553	0	498	0	443
5'000	99	2'250	89	2'025	79	1'800	0	373	0	336	0	298
5'100	80	2'116	72	1'904	64	1'693	0	207	0	186	0	166
5'200	61	1'989	55	1'790	49	1'591	0	57	0	51	0	45
5'300	44	1'870	39	1'683	35	1'496	0	0	0	0	0	0
5'400	27	1'760	24	1'584	21	1'408	0	0	0	0	0	0
5'500	10	1'659	9	1'493	8	1'327	0	0	0	0	0	0
5'600	0	1'568	0	1'411	0	1'254	0	0	0	0	0	0
5'700	0	1'487	0	1'339	0	1'190	0	0	0	0	0	0
5'800	0	1'418	0	1'277	0	1'135	0	0	0	0	0	0
5'900	0	1'362	0	1'226	0	1'089	0	0	0	0	0	0
6'000	0	1'318	0	1'186	0	1'055	0	0	0	0	0	0

Table 37: ADSL2+ over POTS & ISDN high noise actual bit rates (pass & defect bounds); for graphs cf. Figure 17.

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5.8.9 ADSL low noise actual bit rates: Pass & defect bounds

Length	ADSL over POTS low noise						ADSL over ISDN low noise					
	Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]		Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]	
[m]	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
0	776	11'155	698	10'040	621	8'924	921	9'693	829	8'723	737	7'754
100	776	11'155	698	10'040	621	8'924	922	9'672	830	8'705	738	7'737
200	776	11'155	698	10'040	621	8'924	923	9'651	831	8'686	739	7'721
300	776	11'155	698	10'040	621	8'924	924	9'630	832	8'667	739	7'704
400	776	11'155	698	10'040	621	8'924	926	9'599	833	8'639	741	7'679
500	776	11'155	698	10'040	621	8'924	928	9'567	835	8'611	742	7'654
600	776	11'155	698	10'040	621	8'924	929	9'536	836	8'582	743	7'629
700	776	11'155	698	10'040	621	8'924	931	9'505	838	8'554	745	7'604
800	776	11'155	698	10'040	621	8'924	932	9'474	839	8'526	746	7'579
900	776	11'155	698	10'040	621	8'924	934	9'442	841	8'498	747	7'554
1'000	776	11'155	698	10'040	621	8'924	936	9'411	842	8'470	748	7'529
1'100	776	11'155	698	10'040	621	8'924	937	9'380	843	8'442	750	7'504
1'200	776	11'155	698	10'040	621	8'924	939	9'348	845	8'414	751	7'479
1'300	776	11'155	698	10'040	621	8'924	940	9'317	846	8'385	752	7'454
1'400	776	11'155	698	10'040	621	8'924	942	9'286	848	8'357	754	7'429
1'500	776	11'155	698	10'040	621	8'924	944	9'255	849	8'329	755	7'404
1'600	776	11'155	698	10'040	621	8'924	939	9'223	845	8'301	751	7'379
1'700	776	11'155	698	10'040	621	8'924	934	9'192	841	8'273	747	7'354
1'800	776	11'155	698	10'040	621	8'924	928	9'161	835	8'245	742	7'329
1'900	776	11'155	698	10'040	621	8'924	922	9'129	829	8'216	737	7'304
2'000	776	11'119	698	10'007	621	8'895	915	9'020	823	8'118	732	7'216
2'100	776	11'083	698	9'975	621	8'866	908	8'800	817	7'920	726	7'040
2'200	776	10'896	698	9'806	621	8'717	885	8'574	797	7'716	708	6'859
2'300	776	10'709	698	9'638	621	8'567	862	8'300	776	7'470	690	6'640
2'400	776	10'483	698	9'435	621	8'387	839	7'978	756	7'180	672	6'382
2'500	776	10'258	698	9'232	621	8'206	817	7'719	735	6'947	653	6'175
2'600	776	9'996	698	8'997	621	7'997	794	7'460	714	6'714	635	5'968
2'700	776	9'734	698	8'761	621	7'787	771	7'202	694	6'481	617	5'761
2'800	776	9'441	698	8'497	621	7'553	748	6'943	673	6'248	598	5'554
2'900	776	9'149	698	8'234	621	7'319	725	6'684	653	6'016	580	5'347
3'000	776	8'832	698	7'949	621	7'066	702	6'425	632	5'783	562	5'140
3'100	776	8'516	698	7'664	621	6'813	679	6'166	611	5'550	544	4'933
3'200	776	8'185	698	7'366	621	6'548	657	5'907	591	5'317	525	4'726
3'300	776	7'854	698	7'068	621	6'283	634	5'649	570	5'084	507	4'519
3'400	776	7'516	698	6'765	621	6'013	611	5'390	550	4'851	489	4'312
3'500	776	7'179	698	6'461	621	5'743	588	5'131	529	4'618	470	4'105
3'600	775	6'844	697	6'159	620	5'475	565	4'872	509	4'385	452	3'898
3'700	773	6'508	696	5'857	618	5'206	542	4'613	488	4'152	434	3'691
3'800	763	6'181	687	5'563	611	4'945	515	4'355	464	3'919	412	3'484
3'900	754	5'854	678	5'269	603	4'683	490	4'096	441	3'686	392	3'277
4'000	743	5'541	668	4'986	594	4'432	465	3'837	419	3'453	372	3'070
4'100	732	5'227	659	4'704	585	4'182	434	3'578	391	3'220	348	2'863
4'200	720	4'930	648	4'437	576	3'944	403	3'319	363	2'987	323	2'655
4'300	708	4'633	637	4'169	566	3'706	372	3'061	335	2'755	298	2'448
4'400	695	4'353	626	3'918	556	3'483	341	2'802	307	2'522	273	2'241
4'500	683	4'074	615	3'667	546	3'259	310	2'543	279	2'289	248	2'034
4'600	670	3'812	603	3'431	536	3'049	279	2'284	251	2'056	223	1'827
4'700	657	3'550	591	3'195	526	2'840	248	2'025	223	1'823	198	1'620
4'800	644	3'303	580	2'973	515	2'642	217	1'767	195	1'590	174	1'413
4'900	631	3'057	568	2'751	505	2'445	186	1'508	167	1'357	149	1'206
5'000	618	2'823	556	2'541	494	2'259	155	1'249	139	1'124	124	999
5'100	605	2'590	544	2'331	484	2'072	124	990	111	891	99	792
5'200	591	2'368	532	2'131	473	1'895	93	731	84	658	74	585
5'300	578	2'146	520	1'932	462	1'717	62	472	56	425	49	378
5'400	564	1'935	508	1'741	451	1'548	0	0	0	0	0	0
5'500	550	1'723	495	1'551	440	1'379	0	0	0	0	0	0
5'600	535	1'524	481	1'371	428	1'219	0	0	0	0	0	0
5'700	520	1'324	468	1'192	416	1'060	0	0	0	0	0	0
5'800	502	1'142	452	1'028	402	914	0	0	0	0	0	0
5'900	485	961	436	865	388	768	0	0	0	0	0	0
6'000	463	807	417	726	370	646	0	0	0	0	0	0

Table 38: ADSL over POTS & ISDN low noise actual bit rates (pass & defect bounds); for graphs cf. Figure 16.

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5.8.10 ADSL high noise actual bit rates: Pass & defect bounds

Length	ADSL over POTS high noise						ADSL over ISDN high noise					
	Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]		Pass bound [kb/s]		Minor defect bound [kb/s]		Major defect bound [kb/s]	
[m]	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
0	794	6'353	715	5'718	635	5'082	912	5'263	821	4'736	730	4'210
100	794	6'301	714	5'671	635	5'041	904	5'176	813	4'659	723	4'141
200	793	6'249	714	5'624	635	5'000	895	5'090	806	4'581	716	4'072
300	793	6'198	714	5'578	634	4'958	887	5'004	798	4'504	710	4'003
400	792	6'172	713	5'555	634	4'937	872	4'895	785	4'406	698	3'916
500	792	6'146	713	5'531	634	4'917	858	4'786	772	4'308	686	3'829
600	791	6'338	712	5'705	633	5'071	841	4'696	757	4'226	673	3'757
700	791	6'531	712	5'878	633	5'225	824	4'605	741	4'145	659	3'684
800	790	6'377	711	5'740	632	5'102	805	4'532	724	4'078	644	3'625
900	790	6'224	711	5'602	632	4'979	786	4'458	707	4'012	629	3'566
1'000	789	6'095	710	5'485	631	4'876	765	4'399	689	3'959	612	3'519
1'100	789	5'966	710	5'369	631	4'773	744	4'340	670	3'906	595	3'472
1'200	788	5'860	709	5'274	630	4'688	721	4'294	649	3'864	577	3'435
1'300	787	5'754	709	5'178	630	4'603	698	4'248	628	3'823	558	3'398
1'400	785	5'668	707	5'102	628	4'535	673	4'213	605	3'791	538	3'370
1'500	783	5'583	705	5'025	627	4'466	647	4'178	583	3'760	518	3'342
1'600	767	5'516	690	4'964	613	4'413	620	4'152	558	3'736	496	3'321
1'700	750	5'448	675	4'904	600	4'359	593	4'126	534	3'713	474	3'301
1'800	734	5'397	661	4'857	587	4'317	564	4'107	507	3'697	451	3'286
1'900	718	5'345	646	4'810	575	4'276	534	4'089	481	3'680	427	3'271
2'000	702	5'306	631	4'776	561	4'245	498	4'076	448	3'668	398	3'261
2'100	685	5'268	616	4'741	548	4'214	465	4'063	419	3'656	372	3'250
2'200	668	5'240	601	4'716	534	4'192	423	4'053	381	3'648	338	3'242
2'300	650	5'212	585	4'691	520	4'169	385	4'044	347	3'639	308	3'235
2'400	632	5'192	569	4'673	505	4'154	340	4'036	306	3'632	272	3'229
2'500	614	5'172	552	4'655	491	4'138	295	4'028	266	3'625	236	3'223
2'600	595	5'158	535	4'642	476	4'126	248	4'020	224	3'618	199	3'216
2'700	576	5'144	518	4'629	461	4'115	201	4'013	181	3'611	161	3'210
2'800	556	5'133	500	4'620	445	4'106	152	4'003	137	3'602	122	3'202
2'900	536	5'122	483	4'610	429	4'097	103	3'993	93	3'594	82	3'194
3'000	516	5'112	464	4'600	412	4'089	52	3'979	47	3'581	41	3'183
3'100	495	5'101	446	4'591	396	4'081	0	3'966	0	3'569	0	3'172
3'200	474	5'020	426	4'518	379	4'016	0	3'946	0	3'552	0	3'157
3'300	452	4'939	407	4'445	362	3'951	0	3'927	0	3'534	0	3'142
3'400	430	4'854	387	4'368	344	3'883	0	3'900	0	3'510	0	3'120
3'500	408	4'768	368	4'292	327	3'815	0	3'873	0	3'486	0	3'098
3'600	386	4'676	347	4'209	308	3'741	0	3'837	0	3'453	0	3'069
3'700	363	4'584	326	4'126	290	3'667	0	3'800	0	3'420	0	3'040
3'800	339	4'483	305	4'035	271	3'586	0	3'753	0	3'378	0	3'002
3'900	315	4'382	284	3'943	252	3'505	0	3'705	0	3'335	0	2'964
4'000	291	4'268	262	3'842	233	3'415	0	3'645	0	3'280	0	2'916
4'100	267	4'155	240	3'740	213	3'324	0	3'584	0	3'225	0	2'867
4'200	241	4'028	217	3'625	193	3'222	0	3'508	0	3'157	0	2'806
4'300	216	3'901	195	3'511	173	3'121	0	3'432	0	3'089	0	2'746
4'400	190	3'757	171	3'381	152	3'005	0	3'340	0	3'006	0	2'672
4'500	164	3'613	148	3'251	132	2'890	0	3'247	0	2'922	0	2'598
4'600	138	3'449	124	3'104	110	2'759	0	3'136	0	2'822	0	2'509
4'700	111	3'286	100	2'958	89	2'629	0	3'024	0	2'722	0	2'420
4'800	84	3'101	75	2'791	67	2'481	0	2'893	0	2'603	0	2'314
4'900	56	2'916	51	2'625	45	2'333	0	2'761	0	2'485	0	2'209
5'000	28	2'680	25	2'412	22	2'144	0	2'513	0	2'261	0	2'010
5'100	0	2'440	0	2'196	0	1'952	0	2'250	0	2'025	0	1'800
5'200	0	2'151	0	1'936	0	1'721	0	1'850	0	1'665	0	1'480
5'300	0	1'804	0	1'624	0	1'443	0	1'346	0	1'211	0	1'077
5'400	0	1'428	0	1'286	0	1'143	0	0	0	0	0	0
5'500	0	1'052	0	947	0	842	0	0	0	0	0	0
5'600	0	0	0	0	0	0	0	0	0	0	0	0
5'700	0	0	0	0	0	0	0	0	0	0	0	0
5'800	0	0	0	0	0	0	0	0	0	0	0	0
5'900	0	0	0	0	0	0	0	0	0	0	0	0
6'000	0	0	0	0	0	0	0	0	0	0	0	0

Table 39: ADSL over POTS / ISDN high noise actual bit rates (pass & defect bounds); for graphs cf. Figure 17.

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