

# **TECHNICAL REPORT**

## **DSL Forum TR-033**

### **ITU-T G.992.2 (G.lite) ICS**

**March 2000**

**Notice:**

The DSL Forum is a non-profit corporation organized to create guidelines for DSL network system development and deployment. This Technical Report is a draft, and has not been approved by members of the Forum. Even if approved, this document is not binding on the DSL Forum, any of its members, or any developer or service provider involved in DSL. The document is subject to change, but only with approval of members of the Forum.

©2000 Digital Subscriber Line Forum. All Rights Reserved.

DSL Forum technical reports may be copied, downloaded, stored on a server or otherwise re-distributed in their entirety only.

Notwithstanding anything to the contrary, the DSL Forum makes no representation or warranty, expressed or implied, concerning this publication, its contents or the completeness, accuracy, or applicability of any information contained in this publication. No liability of any kind shall be assumed by the DSL Forum as a result of reliance upon any information contained in this publication. the DSL Forum does not assume any responsibility to update or correct any information in this publication.

The receipt or any use of this document or its contents does not in any way create by implication or otherwise any express or implied license or right to or under any patent, copyright, trademark or trade secret rights which are or may be associated with the ideas, techniques, concepts or expressions contained herein.

# Table of Contents

<b>1. REVISION HISTORY .....</b>	<b>4</b>
<b>2. INTRODUCTION.....</b>	<b>4</b>
<b>3. SCOPE.....</b>	<b>4</b>
<b>4. A GUIDE TO THE USE OF THE ADSL ICS PROFORMA .....</b>	<b>5</b>
4.1 Abbreviations and conventions.....	5
4.2 Instructions for completing the ICS Proforma.....	6
4.3 Examples .....	6
<b>5. REFERENCES.....</b>	<b>7</b>
<b>6. LIST OF TABLES .....</b>	<b>8</b>
<b>ANNEX A: PHYSICAL LAYER ADSL ICS.....</b>	<b>10</b>
A.1 Identification of the implementation .....	10
A.2 Date of the statement .....	10
A.3 Implementation Under Test (IUT) identification .....	10
A.4 System Under Test (SUT) identification.....	10
A.5 Product supplier Name .....	10
A.6 Client (if different from product supplier) Name.....	11
A.7 Identification of the reference standard.....	11
A.8 Global statement of conformance .....	12
<b>A.9 Initialization sequence .....</b>	<b>12</b>
A.9.1 Activation and acknowledgment .....	12
A.9.2 Transceiver training .....	14
A.9.2.1 Method of loop timing acquisition .....	14
A.9.2.2 Tones used in REVERB.....	14
A.9.2.3 Used tones during SEGUE.....	15
A.9.2.4 ECT Signal.....	15
A.9.2.5 R-QUIET3/R-REVERB2 symbol alignment.....	16
A.9.3 Channel analysis.....	16
A.9.3.1 MSG1 messages .....	16

A.9.3.2	RATES1 messages .....	17
A.9.3.3	Tones used in MEDLEY .....	19
A.9.4	Exchange .....	19
A.9.4.1	MSG-RA messages .....	20
A.9.4.2	RATES-RA messages .....	20
A.9.4.3	MSG2 messages .....	20
A.9.4.4	RATES2 messages .....	21
A.9.4.5	B&G tables.....	22
<b>A.10</b>	<b>Showtime.....</b>	<b>23</b>
A.10.1	Steady state PSD .....	23
A.10.2	Framing .....	23
A.10.3	Embedded Operations Channel (EOC) .....	24
A.10.4	ADSL Overhead Channel (AOC).....	25
<b>A.11</b>	<b>OAM.....</b>	<b>26</b>
A.11.1	Indicator bits, ADSL line related .....	26
A.11.2	Indicator bits, ATM data path related .....	27
A.11.3	Failure counters .....	27
A.11.4	ADSL line related failures.....	28
A.11.5	ATM data path related failures.....	28
A.11.6	Performance monitoring.....	29
A.11.7	Test parameter Support .....	30

# 1. Revision History

Date (M/D/Y)	Version	Major Changes.
3/13/1999	1	Creation of First draft - Bill Tim/Jim Carlo.
3/18/1999	1	Made changes to format and references
5/26/1999	2	Editorial changes.
9/1/99, 9/9/99	3	Editorial changes and editing notes. Note: section references and message names for G.992.2, G.994.1, G.997.1 for tables have not been updated, but needs to be done; 9/9/99: further editing (version numbers...).
10/15/99	4	Changes made to update Section references to the ITU-T March 1999 versions of the G.992.2 and G.994.1 documents. In addition, minor editorial changes were made.
2/9/00	5	Changes made according to contribution 036, Annex B and C were deleted. Editing errors were corrected. Correction of changes made according to contribution 036, editing corrections.
3/13/00	6	Minor editing (cover page, version number, use of proforma, spacing, italics, page breaks, grammar). Deletion of editing notes for references (addressed during 11/99 and 2/00 meetings).

# 2. Introduction

The DSL Forum testing and interoperability working group is working on the development of an ADSL ICS (ADSL Implementation Conformance Statement).

The ADSL ICS can be used for several purposes:

1. As a starting document used by two equipment vendors to qualify their respective implementations and to determine their degree of interoperability.
2. As a guide for selection of the appropriate test cases to build a test suite.
3. For self-verification or certification of compliance with a specific standard, when comparing to an ADSL ICS filled out with the requirements of this standard.

When this proforma list is filled out by both parties and a match is obtained, then interoperability should be possible. Having a match for Interoperability does not imply that the systems are [ITU-T G.992.2 (G.lite)] compliant.

# 3. Scope

This Working Text presents an ADSL ICS list targeting an [ITU-T G.992.2 (G.lite)] compliant system. This ADSL ICS contains an ICS for an ATM based implementation.

The format of the ADSL ICS is according to the guidelines specified in [ETR212]. [ETR212] also references [IEC9646].

ANNEX A contains the Physical Layer ADSL ICS.  
ANNEX A can be used as a Proforma.

## 4. A guide to the use of the ADSL ICS Proforma

### 4.1 Abbreviations and conventions

The information in this document is comprised of information in tabular form in accordance with the guidelines of [ETR212] and [IEC9646]. A detailed description of how to create or fill out the ICS can be found in these documents.

#### Item column

The item column contains a number, which identifies the item in the table.

#### Item description column

The item description column describes in free text each respective item (*e.g.*, parameters, timers). It implicitly means "is <item description> supported by the implementation?".

#### Status column

The following notations, defined in [IEC 9646], are used for the status column:

m	mandatory - the capability is required to be supported.
o	optional - the capability may be supported or not.
n/a	not applicable - in the given context, it is impossible to use the capability.
x	prohibited (excluded) - there is a requirement not to use this capability in the given context.
o.i	qualified optional - for mutually exclusive or selectable options from a set. "i" is an integer which identifies an unique group of related optional items and the logic of their selection which is defined immediately following the table.

NOTE: In the case where items of the group do not always belong to the same table, all o.i shall be defined in the last sub clause of the ICS Proforma.

ci	conditional - the requirement on the capability ("m", "o", "x" or "n/a") depends on the support of other optional or conditional items. "i" is an integer identifying an unique conditional status expression which is defined immediately following the table.
----	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

#### Reference column

The reference column makes references to [ITU-T G.992.2 (G.lite)], except where explicitly stated otherwise.

#### Support column

The support column shall be filled in by the supplier of the implementation. The following common notations, defined in [IEC 9646], are used for the support column:

Y or y	supported by the implementation
N or n	not supported by the implementation
N/A, n/a or -	no answer required (allowed only if the status is n/a, directly or after evaluation of a conditional status).

#### Values allowed column

The values allowed column contains the type, the list, the range, or the length of values allowed. The following notations are used:

- range of values: <min value> .. <max value>  
example: 5 .. 20

- list of values: <value1>, <value2>, ....., <valueN>  
example: 2,4,6,8,9  
example: '1101'B, '1011'B,  
example: '0A'H, '34'H, '2F'H
- list of named values: <name1>(<val1>), <name2>(<val2>), ....., <nameN>(<valN>)  
example: reject(1), accept(2)
- length: size (<min size> .. <max size>)  
example: size (1 .. 8)
- comment: one can give additional useful information an item in the form “ -- <comment>“  
For example in case of a list of values, a unit of measurement can be added  
example: 1..63 -- dB

**Values supported column**

The values supported column shall be filled in by the supplier of the implementation. In this column, the values or the ranges of values supported by the implementation shall be indicated.

**References to items**

For each possible item answer (answer in the support column) within the ICS Proforma, a unique reference exists, used, for example, in the conditional expressions. It is defined as the table identifier, followed by a solidus character "/", followed by the item number in the table. If there is more than one support column in a table, the columns are discriminated by letters (a, b, etc.), respectively.

EXAMPLE 1: A.5/4 is the reference to the answer of item 4 in table A.5.

EXAMPLE 2: A.6/3b is the reference to the second answer (i.e., in the second support column) of item 3 in table A.6.

**4.2 Instructions for completing the ICS Proforma**

The supplier of the implementation shall complete the ICS Proforma in each of the spaces provided. In particular, an explicit answer shall be entered, in each of the support or supported column boxes provided, using the notation described in clause A.1.

If necessary, the supplier may provide additional comments in the space provided at the bottom of the tables, or separately on sheets of paper. More detailed instructions are given at the beginning of the different sub clauses of the ICS Proforma.

Roles: The supplier should only fill in the items depending on the role of his implementation (e.g., ATU-R vendors should fill out the tables marked ATU-R and ATU-C vendors should fill out the tables marked ATU-C). When a table contains both roles, then only the appropriate role should be filled out.

**4.3 Examples**

Following is an example of an optional item. The answer can be ‘yes’ or ‘no’. Both are allowed and the system can still be compliant.

**Table X.1: ATU-C send C-tone**

Item	tx-signal	Reference	Status	Support
1	C-tone	9.2.1.3	o	y

Following is an example of an mandatory item. The answer can be ‘yes’ or ‘no’. The answer must be ‘yes’ for the system to be compliant.

**Table X.2: ATU-R receive C-Tone**

Item	rx-signal	Reference	Status	Support
1	C-tone	9.2.1.3	m	y

Following is an example of a mandatory item including a range of values. The answer can be 'yes' or 'no'. The answer must be 'yes' for the system to be compliant. Supported values must be the complete range or a subset of the range for the system to be compliant. In the case of table X.3 the full range is needed for the system to be compliant. In the case of table X.4 a subset of the range is sufficient for the system to be compliant. Refer to the indicated reference to determine if the full range or subset of the range is required.

**Table X.3: ATU-C detection & response to R-ACT-REQ**

Item	rx-signal	Reference	Status	Support	Values	
					Allowed	Supported
1	R-ACT-REQ	9.2.1.1	m	y	-32..48	-32..48

**Table X.4: ATU-C C-SEGUE used tones**

Item	Signal	Reference	Status	Support	Values	
					Allowed	Supported
1	C-SEGUE1	9.6.1	m	y	5..255	48.255
2	C-SEGUE2	9.8.2	m	y	5..255	48.255

Following is an example of a qualified optional item. The qualifier is mentioned below the table.

**Table X.5: ATU-R response to C-ACTx**

Item	tx-signal	Reference	Status	Support
1	R-ACK1	9.3.3	o.2	n
2	R-ACK2	9.3.3	o.2	y
3	R-ACK3	9.3.3	n/a	-

o.2: The ATU-R shall transmit only one of these signals.

Following is an example of a conditional item. The answer depends on the response to the question put under the table. For example if in table A.23 item 2 OR in table A.23 item 3 have been answered 'yes', then this item is mandatory, ELSE it is prohibited.

**Table X.6: Downstream sub channel support**

Item	Subchannel	Reference	Status	Support	
				ATU-C	ATU-R
1	AS0	5.2	m	y	y
2	AS1	5.2	c2401	n	n

c2401: If Table A.23/2 A.23/3 THEN m ELSE x.

## 5. References

- [G.992.2] ITU-T, Splitterless Asymmetric Digital Subscriber Line (ADSL) Transceivers, Draft G.992.2, March 1999 (G.lite).
- [G.994.1] ITU-T, Handshake Procedures for Digital Subscriber Line (DSL) Transceivers, Draft G.994.1, March 1999 (G.hs).
- [G.997.1] ITU-T, Physical Layer Management for Digital Subscriber Line (DSL) Transceivers, G.997.1, June 1999 (G.ploam).

[ETR212] Methods for testing and Specification (MTS). Implementation Conformance Statement Proforma style guide. ETR 212 December 1995 (DTR/MTS-00004).

[IEC9646] ISO/IEC 9646-1 (1991): Information technology - open systems interconnection - conformance testing methodology and framework.

## 6. List of Tables

Table X.1: ATU-C send C-tone	6
Table X.2: ATU-R receive C-Tone	7
Table X.3: ATU-C detection & response to R-ACT-REQ	7
Table X.4: ATU-C C-SEGUE used tones	7
Table X.5: ATU-R response to C-ACTx	7
Table X.6: Downstream sub channel support	7
Table A.1: Carrier Set A43 for the 4.3125 kHz Signaling Family	12
Table A.2: CL Capabilities List	12
Table A.3: CLR Capabilities List Request	12
Table A.4: MR Mode Request	12
Table A.5: MS Mode Select	13
Table A.6: ACK(1) Acknowledge, Type 1	13
Table A.7: ACK(2) Acknowledge, Type 2	13
Table A.8: NAK-EF Negative Acknowledge, Errored Frame	13
Table A.9: NAK-NR Negative Acknowledge, Not Ready	13
Table A.10: NAK-NS Negative Acknowledge, Not Supported	13
Table A.11: NAK-CD Negative Acknowledge, Clear Down	13
Table A.12: REQ-MS Request MS Message	13
Table A.13: REQ-MR Request MR Message	13
Table A.14: REQ-CLR Request CLR Message	13
Table A.15: ATU-C C-PILOT1 duration	14
Table A.16: ATU-C C-PILOT1A duration	14
Table A.17: ATU-C C-QUIET3A duration	14
Table A.18: ATU-R R-QUIET duration	14
Table A.19: ATU-C C-REVERB used tones	14
Table A.20: ATU-R R-REVERB used tones	15
Table A.21: ATU-C C-SEGUE used tones	15
Table A.22: ATU-R R-SEGUE used tones	15
Table A.23: ATU-R support of C-ECT	15
Table A.24: ATU-C support of R-ECT	15
Table A.25: Shortened R-QUIET3	16
Table A.26: ATU-R R-REVERB2 duration	16
Table A.27: C-MSG1 configuration	16
Table A.28: R-MSG1 configuration	17
Table A.29: Transport type	17
Table A.30: ATM latency support	17
Table A.31: Downstream sub channel support	17
Table A.32: Upstream sub channel support	17
Table A.33: ATU-C ATM bit rate support	17
Table A.34: ATU-R ATM bit rate support	18
Table A.35: ATU-C FEC coding support	18
Table A.36: ATU-R FEC coding support	18
Table A.37: ATU-C C-Medley used tones	19
Table A.38: ATU-R R-Medley used tones	19
Table A.39: ATU-C exchange tones	19
Table A.40: ATU-R exchange tones	19
Table A.41: C-MSG-RA configuration	20
Table A.42: R-MSG-RA configuration	20
Table A.43: Expanded exchange rates support	20
Table A.44: C-MSG2 configuration	21



Table A.45: R-MSG2 configuration	21
Table A.46: R-RATES2 configuration	21
Table A.47: C-RATES2 configuration	21
Table A.48: Bits and Gains message support	22
Table A.49: ATU-C C-B&G support	22
Table A.50: ATU-R R-B&G support	22
Table A.51: ATU-R steady state PSD (Non-overlapped spectrum)	23
Table A.52: ATU-C steady state PSD (Non-overlapped spectrum)	23
Table A.53: ATU-R steady state PSD (Overlapped spectrum)	23
Table A.54: ATU-C steady state PSD (Overlapped spectrum)	23
Table A.55: Framing structure support	23
Table A.56: ATU-C Network timing reference support	23
Table A.57: ATU-R Network timing reference support	23
Table A.58: ATU-C byte boundary preservation between T-R and U-R interface	23
Table A.59: ATU-C byte boundary preservation between V-C and U-C interface	24
Table A.60: EOC support (bi-directional messages)	24
Table A.61: EOC support (ATU-C to ATU-R)	24
Table A.62: EOC support (ATU-R to ATU-C)	24
Table A.63: AOC message support	25
Table A.64: bitswap request message support	25
Table A.65: ADSL line related near-end anomalies	26
Table A.66: ADSL line related far-end anomalies	26
Table A.67: ADSL line related near-end defects	26
Table A.68: ADSL line related far-end defects	26
Table A.69: ATM data path near-end anomalies	27
Table A.70: ATM data path far-end anomalies	27
Table A.71: ATM data path near-end defects	27
Table A.72: ATM data path far-end defects	27
Table A.73: Other	27
Table A.74: ATU-C Failure count parameters	27
Table A.75: ATU-R Failure count parameters	27
Table A.76: ADSL line related near-end failures	28
Table A.77: ATU-C ADSL line related far-end failures	28
Table A.78: ATU-R ADSL line related far-end failures	28
Table A.79: ATM related near-end failures	28
Table A.80: ATU-C ATM related far-end failures	28
Table A.81: ATU-R ATM related far-end failures	29
Table A.82: ADSL near-end related performance counters	29
Table A.83: ADSL far-end related performance counters	29
Table A.84: ATM data path related near-end performance counters	29
Table A.85: ATM data path related far-end performance counters	30
Table A.86: Near-end test parameter support	30

## **ANNEX A: Physical Layer ADSL ICS**

### **A.1 Identification of the implementation**

Identification of the Implementation Under Test (IUT) and the system in which it resides (the System Under Test (SUT)) should be filled in so as to provide as much detail as possible regarding version numbers and configuration options.

The product supplier information and client information should both be filled in if they are different.

A person who can answer queries regarding information supplied in the ICS should be named as the contact person.

### **A.2 Date of the statement**

.....

### **A.3 Implementation Under Test (IUT) identification**

IUT name:

.....  
.....

IUT version:

.....

### **A.4 System Under Test (SUT) identification**

SUT name:

.....  
.....

Hardware configuration:

.....  
.....  
.....

Operating system:

.....

### **A.5 Product supplier Name**

.....

Address:

.....  
.....  
.....

Telephone number:

.....

Facsimile number:

.....

E-mail address:

.....

Additional information:

.....  
.....  
.....

**A.6 Client (if different from product supplier) Name**

.....

Address:

.....  
.....  
.....

Telephone number:

.....

Facsimile number:

.....

E-mail address:

.....

**A.7 Identification of the reference standard**

This ICS Proforma applies to the following standard:

ITU-T G.992.2 (G.lite) ATM based implementation

## A.8 Global statement of conformance

Are all mandatory capabilities implemented? (Yes/No) .....

NOTE: Answering "No" to this question indicates nonconformance to the [ITU-T G.992.2 (G.lite)] specification. Non-supported mandatory capabilities are to be identified in the ICS, with an explanation of why the implementation is non-conforming, on pages attached to the ICS Proforma.

## A.9 Initialization sequence

The following section discusses implementation details and options as applicable to the interoperability testing.

### A.9.1 Activation and acknowledgment

The Activation and Acknowledgement section of the G.992.2 recommendation, hereinafter simply referred to as [G.992.2] recommendation, refers back to the G.994.1 recommendation [G.994.1] for the entirety of its contents. Therefore, the following information has been taken from the [G.994.1] recommendation.

The table below does not include the carrier set for Annex C. These shall be added with the next revision of this document.

**Table A.1: Carrier Set A43 for the 4.3125 kHz Signaling Family**

Item	Carrier-set	Reference	Status	Support
1	A43	6.1.1	m	

Upstream Carrier Set			Downstream	
Frequency Indices	Maximum Power Level/Carrier	Frequency Indices	Maximum Power Level/Carrier	
(N)	(dBm)	(N)	(dBm)	
9 17 25	-1.65	40 56 64	-3.65	

**Table A.2: CL Capabilities List**

Item	tx-message	Reference	Status	Support
1	CL	7.1	m	

**Table A.3: CLR Capabilities List Request**

Item	tx-message	Reference	Status	Support
1	CLR	7.2	m	

**Table A.4: MR Mode Request**

Item	tx-message	Reference	Status	Support
1	MR	7.3	m	

**Table A.5: MS Mode Select**

Item	tx-message	Reference	Status	Support
1	MS	7.4	m	

**Table A.6: ACK(1) Acknowledge, Type 1**

Item	tx-message	Reference	Status	Support
1	ACK(1)	7.5	m	

**Table A.7: ACK(2) Acknowledge, Type 2**

Item	tx-message	Reference	Status	Support
1	ACK(2)	7.6	m	

**Table A.8: NAK-EF Negative Acknowledge, Errored Frame**

Item	tx-message	Reference	Status	Support
1	NAK-EF	7.7	m	

**Table A.9: NAK-NR Negative Acknowledge, Not Ready**

Item	tx-message	Reference	Status	Support
1	NAK-NR	7.8	m	

**Table A.10: NAK-NS Negative Acknowledge, Not Supported**

Item	tx-message	Reference	Status	Support
1	NAK-NS	7.9	m	

**Table A.11: NAK-CD Negative Acknowledge, Clear Down**

Item	tx-message	Reference	Status	Support
1	NAK-CD	7.10	m	

**Table A.12: REQ-MS Request MS Message**

Item	tx-message	Reference	Status	Support
1	REQ-MS	7.11	m	

**Table A.13: REQ-MR Request MR Message**

Item	tx-message	Reference	Status	Support
1	REQ-MR	7.12	m	

**Table A.14: REQ-CLR Request CLR Message**

Item	tx-message	Reference	Status	Support
1	REQ-CLR	7.13	m	

Note: Information Fields will be included in the next version of this document.

## A.9.2 Transceiver training

### A.9.2.1 Method of loop timing acquisition

**Table A.15: ATU-C C-PILOT1 duration**

Item	Tx-signal	Reference	Status	Support
1	C-PILOT1	11.7.2	m	

**Table A.16: ATU-C C-PILOT1A duration**

Item	Tx-signal	Reference	Status	Support
1	C-PILOT1A	11.7.3	m	

**Table A.17: ATU-C C-QUIET3A duration**

Item	Tx-signal	Reference	Status	Support
1	C-QUIET3A	11.7.4	m	

[G.992.2] allows the ATU-R to send an R-QUIET2 of short length (less than 256 symbols) without loop-timing acquisition during R-REVERB1 or long length (at least 1024 symbols) with loop-timing acquisition during R-QUIET2. The ATU-R may extend the timing (up to 4000 symbols) to improve synchronization stability.

**Table A.18: ATU-R R-QUIET duration**

Item	Signal	Reference	Status	Support	Values	
					Allowed	Supported
1	R-QUIET2	11.8.1	o.3		128..256	
2	R-QUIET2	11.8.1	o.3		257..1024	
3	R-QUIET2	11.8.1	o.3		1025..6000	

o.3: The ATU-R shall use one of these options.

### A.9.2.2 Tones used in REVERB

**Table A.19: ATU-C C-REVERB used tones**

Item	signal	Reference	Status	Support	Values	
					Allowed	Supported
1	C-REVERB1	11.7.5	m.1		5..127	
2	C-REVERB2	11.7.8	m.1		5..127	
3	C-REVERB3	11.7.11	m.1		5..127	
4	C-REVERB4	11.11.1	m.1		5..127	
5	C-REVERB5	11.11.15	m.1		5..127	
6	C-REVERB-RA	11.11.7	m.1		5..127	

m.1: The ATU-C shall use the same values for all REVERB signals.

**Table A.20: ATU-R R-REVERB used tones**

Item	Signal	Reference	Status	Support	Values	
					Allowed	Supported
1	R-REVERB1	11.8.2	m.2		5..31	
2	R-REVERB2	11.8.5	m.2		5..31	
3	R-REVERB3	11.10.2	m.2		5..31	
4	R-REVERB4	11.10.9	m.2		5..31	
5	R-REVERB5	11.12.12	m.2		5..31	
6	R-REVERB6	11.12.16	m.2		5..31	
7	R-REVERB-RA	11.12.6	m.2		5..31	

m.2: The ATU-R shall use the same values for all REVERB signals.

### A.9.2.3 Used tones during SEGUE

**Table A.21: ATU-C C-SEGUE used tones**

Item	Signal	Reference	Status	Support	Values	
					Allowed	Supported
1	C-SEGUE1	11.9.1	m.3		5..127	
2	C-SEGUE2	11.11.2	m.3		5..127	
3	C-SEGUE3	11.11.16	m.3		5..127	
4	C-SEGUE-RA	11.11.8	m.3		5..127	

m.3: The ATU shall use the same number of carriers for SEGUE and REVERB.

**Table A.22: ATU-R R-SEGUE used tones**

Item	Signal	Reference	Status	Support	Values	
					Allowed	Supported
1	R-SEGUE1	11.10.1	m.3		5..31	
2	R-SEGUE2	11.10.3	m.3		5..31	
3	R-SEGUE3	11.12.1	m.3		5..31	
4	R-SEGUE4	11.12.13	m.3		5..31	
5	R-SEGUE5	11.12.17	m.3		5..31	
6	R-SEGUE-RA	11.12.7	m.3		5..31	

m.3: The ATU shall use the same number of carriers for SEGUE and REVERB.

### A.9.2.4 ECT Signal

During x-ECT a vendor defined signal can be sent. The remote side must ignore any signal being received during this period

**Table A.23: ATU-R support of C-ECT**

Item	Rx-signal	Reference	Status	Support
1	C-ECT	11.7.7	m	

**Table A.24: ATU-C support of R-ECT**

Item	Rx-signal	Reference	Status	Support
1	R-ECT	11.8.4	m	

### A.9.2.5 R-QUIET3/R-REVERB2 symbol alignment

[G.992.2] allows the ATU-R to shorten the last symbol of R-QUIET3 by any number of samples to obtain frame alignment between transmitter and receiver.

**Table A.25: Shortened R-QUIET3**

Item	Tx-signal	Reference	Status	Support	
				ATU-C	ATU-R
1	R-QUIET3	11.8.3	o		

The ATU-R can lengthen R-REVERB2 such that C-SEGUE1 and R-SEGUE1 can start at the same time

**Table A.26: ATU-R R-REVERB2 duration**

Item	Signal	Reference	Status	Support	Values	
					Allowed	Supported
1	R-REVERB2	11.8.5	m		1024..1056	

### A.9.3 Channel analysis

#### A.9.3.1 MSG1 messages

These messages should be compared to the capabilities of the other sides modem

**Table A.27: C-MSG1 configuration**

Item	Bits	Name	Ref	Status	Support	Values	
						Allowed	Supported
1	47-44	Minimum required noise margin	11.9.4.1	m		0..15 -- dB	
2	43-17	Reserved	11.9.4	m			
3	16	Echo cancellation option	11.9.4.2	m		0,1	
4	15	Unused	11.9.4.3	m		1	
5	14-12	Reserved	11.9.4	m		0	
6	11	Network Timing Reference	11.9.4.4	m		0,1	
7	10-9	Framing Mode	11.9.4.5	m		3	
8	8-6	Transmit PSD during initialization	11.9.4.6	m		1..7	
9	5-4	Reserved	11.9.4	m		0	
10	3-0	Max #bits per sub-carrier	11.9.4.7	m		2..15	



**Table A.28: R-MSG1 configuration**

Item	Bits	Name	Ref	Status	Support	Values	
						Allowed	Supported
1	47-17	Reserved	11.10.6	m		0	
2	16	Echo cancellation option	11.10.6.1	m		0,1	
3	15	Unused	11.10.6.2	m		1	
4	14-11	Reserved	11.10.6	m		0	
5	10-9	Framing Mode	11.10.6.3	m		3	
6	8-5	Reserved	11.10.6	m		0	
7	4	Network Timing Reference	11.10.6.4	m		0,1	
8	3-0	Max #bits per sub-carrier	11.10.6.5	m		2..15	

### A.9.3.2 RATES1 messages

The rates messages contains a proposed allocation of the data bytes and the Reed Solomon parameters. Framing structure will depend on the transport type.

**Table A.29: Transport type**

Item	Type	Reference	Status	Support	
				ATU-C	ATU-R
1	ATM	4.2	m		

**Table A.30: ATM latency support**

Item	Latency	Reference	Status	Support	
				ATU-C	ATU-R
1	SINGLE down/up	5	m		

**Table A.31: Downstream sub channel support**

Item	Subchannel	Reference	Status	Support	
				ATU-C	ATU-R
1	AS0	5	m		

**Table A.32: Upstream sub channel support**

Item	Subchannel	Reference	Status	Support	
				ATU-C	ATU-R
1	LS0	5	m		

Bitrate is allocated in a 'nx32kbit' fashion.

**Table A.33: ATU-C ATM bit rate support**

Item	Sub channel	Reference	Status	Support	Values of 'n'x 32 kbps	
					Allowed	Supported
1	down AS0	5	m		1..48	
2	up LS0	5	m		1..16	

**Table A.34: ATU-R ATM bit rate support**

Item	Sub channel	Reference	Status	Support	Values of 'n'x 32 kbps	
					Allowed	Supported
	down					
1	AS0	5	m		1..48	
	up					
2	LS0	5	m		1..16	

The ATU-C shall support any combination of RS FEC coding as indicated in Table A.35.

**Table A.35: ATU-C FEC coding support**

Item	Parameter	Reference	Status	Support	Values	
					Allowed	Supported
	down					
1	R	7.5	m		0,4,8	
2	R	7.5	o		16	
3	S	7.5	m		1,2,4,8	
4	S	7.5	o		16	
5	D	7.5	m		1,2,4,8,16	
	up					
6	R	7.5	m		0,4,8	
7	R	7.5	o		16	
8	S	7.5	m		1,2,4,8	
9	S	7.5	o		16	
10	D	7.5	m		1,2,4,8	

R: Parity bytes per Reed-Solomon codeword.

S: DMT symbols per Reed-Solomon codeword

D: interleave depth

**Table A.36: ATU-R FEC coding support**

Item	Parameter	Reference	Status	Support	Values	
					Allowed	Supported
	down					
1	R	7.5	m		0,4,8	
2	R	7.5	o		16	
3	S	7.5	m		1,2,4,8	
4	S	7.5	o		16	
5	D	7.5	m		1,2,4,8,16	
	up					
6	R	7.5	m		0,4,8	
7	R	7.5	o		16	
8	S	7.5	m		1,2,4,8	
9	S	7.5	o		16	
10	D	7.5	m		1,2,4,8	

R: Parity bytes per Reed-Solomon codeword

S: DMT symbols per Reed-Solomon codeword

D: interleave depth

This results in the following C-RATES1 configuration (4 options coded the same):

**C-RATES1 Fast buffer configuration**

AS0	AS1	AS2	AS3	LS0	LS1	LS2	Up	LS0	LS1	LS2
0	0	0	0	0	0	0		0	0	0

**C-RATES1 Interleaved buffer configuration**

AS0	AS1	AS2	AS3	LS0	LS1	LS2	Up	LS0	LS1	LS2
6	0	0	0	0	0	0		2	0	0

**C-RATES1 Error protection down&up configuration**

RFd	RI d	Sd	Dd	FSd	RFu	Riu	Su	Du	FSu
8	0	1	1	0	8	0	1	1	0

Since R-RATES1 is copied from C-RATES1, the same R-RATES1 message should be sent by the ATU-R.

**R-RATES1 configuration**

LS0f	LS1f	LS2f	LS0i	LS1i	LS2i	RF	RI	S	D	FS
12	0	0	0	0	0	6	0	1	1	0

**A.9.3.3 Tones used in MEDLEY**

**Table A.37: ATU-C C-Medley used tones**

Item	Signal	Reference	Status	Support	Values	
					Allowed	Supported
1	C-MEDLEY	11.9.6	m		5..127	

**Table A.38: ATU-R R-Medley used tones**

Item	Signal	Reference	Status	Support	Values	
					Allowed	Supported
1	R-MEDLEY	11.10.8	m		5..31	

**A.9.4 Exchange**

The exchange modulation of one byte per symbol is using the two sets of tones.

**Table A.39: ATU-C exchange tones**

Item	Tones	Reference	Status	Support	Values	
					Allowed	Supported
1	Nominal set	11.11	m		43..46	
2	Backup set	11.11	m		91..94	

**Table A.40: ATU-R exchange tones**

Item	Tones	Reference	Status	Support	Values	
					Allowed	Supported
1	Nominal set	11.12	m		10,,13	
2	Backup set	11.12	m		20,23	

### A.9.4.1 MSG-RA messages

If both modems indicate they support the expanded exchange sequence in C-MSG1 and R-MSG1 then the following messages should be checked for support by the other side

**Table A.41: C-MSG-RA configuration**

Item	Bits	Name	Ref	Status	Support	Values	
						Allowed	Supported
1	47-44	New minimum noise margin	11.11.5	m		0..15 --dB	
2	43-38	Maximum noise margin in steady state	11.11.5	m		-32..+31 dB	
3	37-32	Minimum noise margin in steady state	11.11.5	m		-32..+31 dB	
4	31-0	Reserved	11.11.5	m		0	

**Table A.42: R-MSG-RA configuration**

Item	Bits	Name	Ref	Status	Support	Values	
						Allowed	Supported
1	79-56	Reserved	11.12.2	m		0	
2	55-49	# RS overhead bytes ( R)	11.12.2.1	m		0..127	
3	48-40	# RS payload bytes (K)	11.12.2.2	m		0..511	
4	39-32	# Tones carrying data	11.12.2.3	m		0..127	
5	31-25	Estimated average loop attenuation (downstream)	11.12.2.4	m		0..127 --½ dB	
6	24-21	Coding gain	11.12.2.5	m		0..15 --½ dB	
7	20-16	Performance margin with selected rate option	11.12.2.6	m		0..31 --dB	
8	15-12	Reserved	11.12.2	m		0	
9	11-0	Max # bits per symbol	11.12.2.7	m		0..4095	

### A.9.4.2 RATES-RA messages

The content of the RA message is determined by the line quality.

**Table A.43: Expanded exchange rates support**

Item	Signal	Reference	Status	Support	
				ATU-C	ATU-R
1	C-RATES-RA	11.11.3	m		
2	R-RATES-RA	11.12.4	m		

### A.9.4.3 MSG2 messages

C-message2 is a 32 bit message and contains the total number of bits per symbol supported, the estimated upstream loop attenuation, and the performance margin with the selected rate option.

**Table A.44: C-MSG2 configuration**

Item	Bits	Name	Ref	Status	Support	Values	
						Allowed	Supported
1	31-26	Estimated average loop attenuation (upstream)	11.11.9.1	m		0..63 -- ½dB	
2	25-22	Reserved	11.11.9	m		0	
3	21	Erase all profiles	11.11.9.2	m		0,1	
4	20-16	Performance margin with selected rate option	11.11.9.3	m		0..31 --dB	
5	15-9	Reserved	11.11.9	m		0	
6	8-0	Max # bits per symbol	11.11.9.4	m		0..511	

R-message2 is a 32 bit message and contains the total number of bits per symbol supported, the estimated downstream loop attenuation, and the performance margin with the selected rate option.

**Table A.45: R-MSG2 configuration**

Item	Bits	Name	Ref	Status	Support	Values	
						Allowed	Supported
1	31-25	Estimated average loop attenuation (downstream)	11.12.8.1	m		0..127 --½dB	
2	24-22	Reserved	11.12.8	m		0	
3	21	Erase all profiles	11.12.8.2	m		0,1	
4	20-16	Performance margin with selected rate option	11.12.8.3	m		0.31 --dB	
5	15-12	Reserved	11.12.8	m		0	
6	11-0	Max # bits per symbol	11.12.8.4	m		0..4095	

#### A.9.4.4 RATES2 messages

In R-RATES2, the ATU-R sends the selected downstream option.

**Table A.46: R-RATES2 configuration**

Item	Bits	Name	Ref	Status	Support	Values	
						Allowed	Supported
1	7..0	Selected downstream option	11.12.10	m		11,22,44,88 00 --hex	

In C-RATES2, the ATU-C sends the selected upstream option, combined with the downstream option as selected by the ATU-R in R-RATES2.

**Table A.47: C-RATES2 configuration**

Item	Bits	Name	Ref	Status	Support	Values	
						Allowed	Supported
1	7..0	Selected down & up options	11.11.11	m		11,12,14,18 21,22,24,28 41,42,44,48 81,82,84,88 00 --hex	

#### A.9.4.5 B&G tables

The ATU-C sends the upstream B&G table in C-B&G

**Table A.48: Bits and Gains message support**

Item	Message	Reference	Status	Support	
				ATU-C	ATU-R
1	C-B&G	11.11.13	m		
2	R-B&G	11.12.14	m		

**Table A.49: ATU-C C-B&G support**

Item	Name	Ref	Status	Support	Values	
					Allowed	Supported
1	Bi tone 16	11.11.1 3	m		0	
2	Gi tone 16	11.11.1 3	m		1	
3	Bi unused tones	11.11.1 3	m		0	
4	Gi unused tones	11.11.1 3	m		0	
5	Bi monitored tones	11.11.1 3	m		0	
6	Gi monitored tones	11.11.1 3	m		0.19..1.33	
7	Bi used tones	11.11.1 3	m		0..Nupmax	
8	Gi used tones	11.11.1 3	m		0.19..1.33(1)	

Nupmax: value indicated in Table A.27/10

(1) not clearly specified in [G.922.2]

The ATU-R sends the downstream B&G table in R-B&G

**Table A.50: ATU-R R-B&G support**

Item	Name	Ref	Status	Support	Values	
					Allowed	Supported
1	Bi tone 64	11.12.14	m		0	
2	Gi tone 64	11.12.14	m		1	
3	Bi unused tones	11.12.14	m		0	
4	Gi unused tones	11.12.14	m		0	
5	Bi monitored tones	11.12.14	m		0	
6	Gi monitored tones	11.12.14	m		0.19..1.33	
7	Bi used tones	11.12.14	m		0..Ndomax	
8	Gi used tones	11.12.14	m		0.19..1.33(1)	

Ndomax: value indicated in Table A.28/7

(1) not clearly specified in [G.922.2]

## A.10 Showtime

### A.10.1 Steady state PSD

**Table A.51: ATU-R steady state PSD (Non-overlapped spectrum)**

Item	Mask	Reference	Status	Support
1	TX-PSD	A.1	m	

**Table A.52: ATU-C steady state PSD (Non-overlapped spectrum)**

Item	Mask	Reference	Status	Support
1	TX-PSD	A.2	m	

**Table A.53: ATU-R steady state PSD (Overlapped spectrum)**

Item	Mask	Reference	Status	Support
1	TX-PSD	B.1	m	

**Table A.54: ATU-C steady state PSD (Overlapped spectrum)**

Item	Mask	Reference	Status	Support
1	TX-PSD	B.2	m	

### A.10.2 Framing

Four different framing structures have been defined but only one is supported by G.992.2.

**Table A.55: Framing structure support**

Item	Framing structure	Reference	Status	Support
				<i>ATU-C</i> <i>ATU-R</i>
1	3: reduced overhead, merged fast & sync	7.3.1	m	

**Table A.56: ATU-C Network timing reference support**

Item		Reference	Status	Support
1	NTR	7.2.1,7.2.2	o	

**Table A.57: ATU-R Network timing reference support**

Item		Reference	Status	Support
1	NTR	7.2.1,7.2.2	o	

**Table A.58: ATU-C byte boundary preservation between T-R and U-R interface**

Item	Byte boundary preservation	Reference	Status	Support
1	Framing structure 3	7.1.3	m	

**Table A.59: ATU-C byte boundary preservation between V-C and U-C interface**

Item	Byte boundary preservation	Reference	Status	Support
1	Framing structure 3	7.1.3	m	

### A.10.3 Embedded Operations Channel (EOC)

The EOC channel is used for communication between the ATU-C and ATU-R for maintenance and status information.

**Table A.60: EOC support (bi-directional messages)**

Item	Message	Reference	Status	Support	
				<i>ATU-C</i>	<i>ATU-R</i>
1	HOLD	8.3	m		
2	RTN	8.3	m		
3	SLFTST	8.3	m		
4	REQCOR	8.3	m		
5	REQEND	8.3	m		
6	NOTCOR	8.3	m		
7	NOTEND	8.3	m		
8	EOD	8.3	m		
9	REQTPU	8.3	m		
10	GNTPDN	8.3	m		
11	REJPDN	8.3	m		
12	WRITE	8.3	m		
13	READ	8.3	m		
14	Autonomous	8.3.4 and 8.5	m		

**Table A.61: EOC support (ATU-C to ATU-R)**

Item	Message	Reference	Status	Support	
				<i>ATU-C</i>	<i>ATU-R</i>
1	NEXT	8.3	m		

**Table A.62: EOC support (ATU-R to ATU-C)**

Item	Message	Reference	Status	Support	
				<i>ATU-C</i>	<i>ATU-R</i>
1	REQPDN	8.3	m		
2	UTC	8.3	m		
3	DGASP	8.3	m		



## A.10.4 ADSL Overhead Channel (AOC)

The AOC channel is used for online adaptation and reconfiguration of the number of bits and gain assigned per subcarrier

**Table A.63: AOC message support**

Item	Message	Reference	Status	Support	
				<i>ATU-C</i>	<i>ATU-R</i>
1	Vendor specific	9.2.1	o		
2	Unable to comply	9.2.1	o1, o2		
3	Extended bit swap request	9.2.1	o		
4	Bit swap request	9.2.1	o1		
5	Bit swap acknowledge	9.2.1	m		
6	Profile management request	9.2.1	m		
7	Profile management ack	9.2.1	m		

o.1: the ATU shall reply with one of these options to a bit swap request.

o.2: the ATU shall reply with UTC when it cannot perform a requested action.

**Table A.64: bitswap request message support**

Item	Message	Reference	Status	Support	
				<i>ATU-C</i>	<i>ATU-R</i>
1	Do nothing	9.2.4	o		
2	Increase #bits by one	9.2.4	o		
3	Decrease #bits by one	9.2.4	o		
4	Increase power by 1 dB	9.2.4	o		
5	Increase power by 2 dB	9.2.4	o		
7	Increase power by 3 dB	9.2.4	o		
8	Decrease power by 1 dB	9.2.4	o		
9	Decrease power by 2 dB	9.2.4	o		
10	Vendor commands	9.2.4	o		

## A.11 OAM

### A.11.1 Indicator bits, ADSL line related

**Table A.65: ADSL line related near-end anomalies**

Item	Primitive	Reference	Status	Support	
				<i>ATU-C</i>	<i>ATU-R</i>
1	fec-I	10.1.1	m		
2	crc-I	10.1.1	m		

**Table A.66: ADSL line related far-end anomalies**

Item	Primitive	Reference	Status	Support	
				<i>ATU-C</i>	<i>ATU-R</i>
1	ffec-I	10.1.2	m		
2	febe-I	10.1.2	m		

**Table A.67: ADSL line related near-end defects**

Item	Primitive	Reference	Status	Support	
				<i>ATU-C</i>	<i>ATU-R</i>
1	Los	10.1.3	m		
2	Sef	10.1.3	m		

**Table A.68: ADSL line related far-end defects**

Item	Primitive	Reference	Status	Support	
				<i>ATU-C</i>	<i>ATU-R</i>
1	Flos	10.1.4	m		
2	Frdi	10.1.4	m		

### A.11.2 Indicator bits, ATM data path related

**Table A.69: ATM data path near-end anomalies**

Item	Primitive	Reference	Status	Support	
				ATU-C	ATU-R
1	ncd-I	10.2.1	m		
2	ocd-I	10.2.1	m		
3	hec-I	10.2.1	m		

**Table A.70: ATM data path far-end anomalies**

Item	Primitive	Reference	Status	Support	
				ATU-C	ATU-R
1	fncd-I	10.2.2	m		
2	focd-I	10.2.2	m		
3	fhec-I	10.2.2	m		

**Table A.71: ATM data path near-end defects**

Item	Primitive	Reference	Status	Support	
				ATU-C	ATU-R
1	lcd-I	10.2.3	m		

**Table A.72: ATM data path far-end defects**

Item	Primitive	Reference	Status	Support	
				ATU-C	ATU-R
1	flcd-I	10.2.4	m		

**Table A.73: Other**

Item	Primitive	Reference	Status	Support	
				ATU-C	ATU-R
1	lpr	10.3.1	m		
2	flpr	10.3.2	m		

### A.11.3 Failure counters

**Table A.74: ATU-C Failure count parameters**

Item	Failure counter	Reference	Status	Support
1	far-end	10.3.3	m	
2	near-end	10.3.3	m	

**Table A.75: ATU-R Failure count parameters**

Item	Failure counter	Reference	Status	Support
1	far-end	10.3.3	o	
2	near-end	10.3.3	o	

#### A.11.4 ADSL line related failures

This section references [G.997.1] parameters.

**Table A.76: ADSL line related near-end failures**

Item	Failure	Reference	Status	Support	
				ATU-C	ATU-R
1	LOS	7.1.1.1.1	m		
2	LOF	7.1.1.1.2	m		
3	LPR	7.1.1.1.3	m		

**Table A.77: ATU-C ADSL line related far-end failures**

Item	Failure	Reference	Status	Support
1	FLOS	7.1.1.2.1	m	
2	FLOF	7.1.1.2.2	m	
3	FLPR	7.1.1.2.3	m	

**Table A.78: ATU-R ADSL line related far-end failures**

Item	Failure	Reference	Status	Support
1	FLOS	7.1.1.2.1	o	
2	FLOF	7.1.1.2.2	o	
3	FLPR	7.1.1.2.3	o	

#### A.11.5 ATM data path related failures

This section references [G.997.1] parameters.

**Table A.79: ATM related near-end failures**

Item	Failure	Reference	Status	Support	
				ATU-C	ATU-R
1	NCD-I	7.1.2.1.1	m		
2	NCD-F	7.1.2.1.2	m		
3	LCD-I	7.1.2.1.3	m		
3	LCD-F	7.1.2.1.4	m		

**Table A.80: ATU-C ATM related far-end failures**

Item	Failure	Reference	Status	Support
1	FNCD-I	7.1.2.2.1	m	
2	FNCD-F	7.1.2.2.2	m	
3	FLCD-I	7.1.2.2.3	m	
3	FLCD-F	7.1.2.2.4	m	

**Table A.81: ATU-R ATM related far-end failures**

Item	Failure	Reference	Status	Support
1	FNCD-I	7.1.2.2.1	o	
2	FNCD-F	7.1.2.2.2	o	
3	FLCD-I	7.1.2.2.3	o	
3	FLCD-F	7.1.2.2.4	o	

#### A.11.6 Performance monitoring

This section references [G.997.1] parameters.

**Table A.82: ADSL near-end related performance counters**

Item	Counter	Reference	Status	Support	
				ATU-C	ATU-R
1	CVI-L	7.2.1.1.1	o		
2	CVF-L	7.2.1.1.2	o		
3	ECI-L	7.2.1.1.3	o		
4	ECF-L	7.2.1.1.4	o		
5	ECS-L	7.2.1.1.5	o		
6	ES-L	7.2.1.1.6	o		
7	SES-L	7.2.1.1.7	o		
8	LOSS-L	7.2.1.1.8	o		
9	UAS-L	7.2.1.1.9	o		

**Table A.83: ADSL far-end related performance counters**

Item	Counter	Reference	Status	Support	
				ATU-C	ATU-R
1	CVI-LFE	7.2.1.2.1	o		
2	CVF-LFE	7.2.1.2.2	o		
3	ECI-LFE	7.2.1.2.3	o		
4	ECF-LFE	7.2.1.2.4	o		
5	ECS-LFE	7.2.1.2.5	o		
6	ES-LFE	7.2.1.2.6	o		
7	SES-LFE	7.2.1.2.7	o		
8	LOSS-LFE	7.2.1.2.8	o		
9	UAS-LFE	7.2.1.2.9	o		

**Table A.84: ATM data path related near-end performance counters**

Item	Counter	Reference	Status	Support	
				ATU-C	ATU-R
1	HEC-violation-I	7.2.2.1.1	m		
2	HEC-total-cell-I	7.2.2.1.3	m		
3	User-total-cell-I	7.2.2.1.5	m		
4	Idle-cell-bit-error-count-I	7.2.2.1.7	m		

**Table A.85: ATM data path related far-end performance counters**

Item	Counter	Reference	Status	Support	
				<i>ATU-C</i>	<i>ATU-R</i>
1	HEC-violation-I	7.2.2.2.1	m		
2	HEC-total-cell-I	7.2.2.2.3	m		
3	User-total-cell-I	7.2.2.2.5	m		
4	Idle-cell-bit-error-count-I	7.2.2.2.7	m		

#### A.11.7 Test parameter Support

This section references [G.997.1] parameters.

**Table A.86: Near-end test parameter support**

Item	Parameter	Reference	Status	Support	
				<i>ATU-C</i>	<i>ATU-R</i>
1	ATN	7.4.4,7.4.5	m		
2	SNR	7.4.6,7.4.7	m		

Note: Missing parameters from [G.997.1] will be added in the next version of this document.