



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.994.1

Amendment 9
(12/2017)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
DIGITAL SYSTEMS AND NETWORKS

Digital sections and digital line system – Metallic access
networks

Handshake procedures for digital subscriber line
transceivers

Amendment 9

CAUTION !

PREPUBLISHED RECOMMENDATION

This prepublication is an unedited version of a recently approved Recommendation. It will be replaced by the published version after editing. Therefore, there will be differences between this prepublication and the published version.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU [had/had not] received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <http://www.itu.int/ITU-T/ipr/>.

© ITU 2018

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

Amendment 9 to Recommendation ITU-T G.994.1 (2012)

Handshake procedures for digital subscriber line transceivers: Amendment 9

Summary

Amendment 9 to Recommendation ITU-T G.994.1 (2012) includes:

- Codepoint for the support of G.993.5 Annex A (Mitigating Strong FEXT)
- Codepoints for the support of G.993.5 Annex B (Vectored Long Reach VDSL) and G.993.2 Annex D (Unvectored Long Reach VDSL).

Amendment 9 to Recommendation ITU-T G.994.1 (2012)

Handshake procedures for digital subscriber line transceivers: Amendment 9

1) Codepoint for the support of G.993.5 Annex A (Mitigating Strong FEXT)

Add table 11.68.10.1:

**Table 11.68.10.1 – Standard information field – ITU-T G.993.2
ITU-T G.993.5 NPar(3) coding Octet 2**

		Bits						
8	7	6	5	4	3	2	1	ITU-T G.993.5 Vectoring NPar(3)s – Octet 2
x	x	x	x	x	x	x	1	Support of strong FEXT mitigation
x	x	x	x	x	x	1	x	Reserved for allocation by ITU-T
x	x	x	x	x	1	x	x	Reserved for allocation by ITU-T
x	x	x	x	1	x	x	x	Reserved for allocation by ITU-T
x	x	x	1	x	x	x	x	Reserved for allocation by ITU-T
x	x	1	x	x	x	x	x	Reserved for allocation by ITU-T
x	x	0	0	0	0	0	0	No parameters in this octet

2) Codepoints for the support of G.993.5 Annex B (Vectored Long Reach VDSL) and G.993.2 Annex D (Unvectored Long Reach VDSL)

Modify table 11.68.0.1 as follows:

Table 11.68.0.1 – Standard information field – ITU-T G.993.2 SPar(2) coding – Octet 2

		Bits						
8	7	6	5	4	3	2	1	ITU-T G.993.2 SPar(2)s – Octet 2
x	x	x	x	x	x	x	1	Annex A US0
x	x	x	x	x	x	1	x	Annex B US0
x	x	x	x	x	1	x	x	Annex C US0
x	x	x	x	1	x	x	x	ITU-T G.993.5
x	x	x	1	x	x	x	x	ITU-T G.998.4 extensions
x	x	1	x	x	x	x	x	Support of VDSL2-LR Reserved for allocation by ITU-T
x	x	0	0	0	0	0	0	No parameters in this octet

Add table 11.68.0.2 and 11.68.0.3:

Table 11.68.0.2 – Standard information field – ITU-T G.993.2 SPar(2) coding – Octet 3

Bits		ITU-T G.993.2 SPar(2)s – Octet 3						
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	VDSL2-LR Spectrum bounds upstream
x	x	x	x	x	x	1	x	VDSL2-LR Spectrum shaping upstream
x	x	x	x	x	1	x	x	VDSL2-LR Spectrum bounds downstream
x	x	x	x	1	x	x	x	VDSL2-LR Spectrum shaping downstream
x	x	x	1	x	X	x	x	VDSL2-LR Transmit signal images above Nyquist frequency
x	x	1	x	x	X	x	x	VDSL2-LR Offset IDFT sample #0 downstream
x	x	0	0	0	0	0	0	No parameters in this octet

Table 11.68.0.3 – Standard information field – ITU-T G.993.2 SPar(2) coding – Octet 4

Bits		ITU-T G.993.2 SPar(2)s – Octet 4						
8	7	6	5	4	3	2	1	
x	x	x	x	x	X	x	1	VDSL2-LR Offset IDFT sample #0 upstream
x	x	x	x	x	X	1	x	Reserved for allocation by ITU-T
x	x	x	x	x	1	x	x	Reserved for allocation by ITU-T
x	x	x	x	1	X	x	x	Reserved for allocation by ITU-T
x	x	x	1	x	X	x	x	Reserved for allocation by ITU-T
x	x	1	x	x	X	x	x	Reserved for allocation by ITU-T
x	x	0	0	0	0	0	0	No parameters in this octet

Add table 11.68.12 to 11.68.19:

Table 11.68.12 – Standard information field – Support of VDSL2-LR NPar(3) coding

Bits		Support of VDSL2-LR NPar(3)s						
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Foreed-s Short loop operation type
x	x	x	x	x	x	1	x	Foreed long loop Medium loop operation type
x	x	x	x	x	1	x	x	FMT-C-TREF2 Long loop operation type
x	x	x	x	1	x	x	x	FMT-O-P-TREF2 Reserved for allocation by ITU-T
x	x	x	1	x	x	x	x	Reserved for allocation by ITU-T
x	x	1	x	x	x	x	x	Reserved for allocation by ITU-T
x	x	0	0	0	0	0	0	No parameters in this octet

Table 11.68.13 – Standard information field – VDSL2-LR spectrum bounds upstream NPar(3) coding – Octet 1

Bits		VDSL2-LR spectrum bounds upstream NPar(3)s – Octet 1						
8	7	6	5	4	3	2	1	
x	x	0	0	0	x	x	x	NOMPSDus (bits 9 to 7)

Table 11.68.13.1 – Standard information field – VDSL2-LR spectrum bounds upstream NPar(3) coding – Octet 2

		Bits						
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	VDSL2-LR spectrum bounds upstream NPar(3)s – Octet 2
								NOMPSDus (bits 6 to 1)

Table 11.68.14 – Standard information field – VDSL2-LR spectrum shaping upstream NPar(3) coding – Octet 1

		Bits						
8	7	6	5	4	3	2	1	
x	x	*	*	*	x	x	X	VDSL2-LR spectrum shaping upstream NPar(3)s – Octet 1
								"First" subcarrier index i (bits 12-9 to 7)
								<u>0</u> <u>0</u> <u>0</u>

Table 11.68.14.1 – Standard information field – VDSL2-LR spectrum shaping upstream NPar(3) coding – Octet 2

		Bits						
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	X	VDSL2-LR spectrum shaping upstream NPar(3)s – Octet 2
								"First" subcarrier index i (bits 6 to 1)

Table 11.68.14.2 – Standard information field – VDSL2-LR spectrum shaping upstream NPar(3) coding – Octet 3

		Bits						
8	7	6	5	4	3	2	1	
x	x	x					X	VDSL2-LR spectrum shaping upstream NPar(3)s – Octet 3
								"First" subcarrier in the supported set SUPPORTEDCARRIERSset
								"First" log ₂ tss _i (bit 7)

Table 11.68.14.3 – Standard information field – VDSL2-LR spectrum shaping upstream NPar(3) coding – Octet 4

		Bits						
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	X	VDSL2-LR spectrum shaping upstream NPar(3)s – Octet 4
								"First" log ₂ tss _i (bits 6 to 1)

Table 11.68.14.4*(j-1) – Standard information field – VDSL2-LR spectrum shaping upstream NPar(3) coding – Octet 4*(j-1)+1

		Bits						
8	7	6	5	4	3	2	1	
x	x	*	*	*	x	x	X	VDSL2-LR spectrum shaping upstream NPar(3)s – Octet 4*(j-1)+1
								"Last" subcarrier index i (bits 12-9 to 7)
								<u>0</u> <u>0</u> <u>0</u>

NOTE 1 – j is the number of subcarrier indices used to specify the spectral shape.

NOTE 2 – Octets 4*(k-1)+1 with k=2..j-1 shall contain the description for the 2nd to (j-1)th subcarriers used to specify the spectral shape. These octets shall have the same coding as defined for octet 4*(j-1)+1

Table 11.68.14.4*(j-1)+1 – Standard information field – VDSL2-LR spectrum shaping upstream NPar(3) coding – Octet 4*(j-1)+2

Bits		VDSL2-LR spectrum shaping upstream NPar(3)s – Octet 4*(j-1)+2					
8	7	6	5	4	3	2	1
x	X	x	x	x	x	x	X
"Last" subcarrier index i (bits 6 to 1)							
NOTE 1 – j is the number of subcarrier indices used to specify the spectral shape.							
NOTE 2 – Octets 4*(k-1)+2 with k=2..j-1 shall contain the description for the 2 nd to (j-1) th subcarriers used to specify the spectral shape. These octets shall have the same coding as defined for octet 4*(j-1)+2							

Table 11.68.14.4*(j-1)+2 – Standard information field – VDSL2-LR spectrum shaping upstream NPar(3) coding – Octet 4*(j-1)+3

Bits		VDSL2-LR spectrum shaping upstream NPar(3)s – Octet 4*(j-1)+3					
8	7	6	5	4	3	2	1
x	X	x					
"Last" subcarrier in the SUPPORTEDCARRIERSset supported set							
"Last" log ₂ tss _i (bit 7)							
NOTE 1 – j is the number of subcarrier indices used to specify the spectral shape.							
NOTE 2 – Octets 4*(k-1)+3 with k=2..j-1 shall contain the description for the 2 nd to (j-1) th subcarriers used to specify the spectral shape. These octets shall have the same coding as defined for octet 4*(j-1)+3							

Table 11.68.14.4*(j-1)+3 – Standard information field – VDSL2-LR spectrum shaping upstream NPar(3) coding – Octet 4*(j-1)+4

Bits		VDSL2-LR spectrum shaping upstream NPar(3)s – Octet 4*(j-1)+4					
8	7	6	5	4	3	2	1
x	X	x	x	x	x	x	x
"Last" log ₂ tss _i (bits 6 to 1)							
NOTE 1 – j is the number of subcarrier indices used to specify the spectral shape.							
NOTE 2 – Octets 4*(k-1)+4 with k=2..j-1 shall contain the description for the 2 nd to (j-1) th subcarriers used to specify the spectral shape. These octets shall have the same coding as defined for octet 4*(j-1)+4							

Table 11.68.15 – Standard information field – VDSL2-LR spectrum bounds downstream NPar(3) coding – Octet 1

Bits		VDSL2-LR spectrum bounds downstream NPar(3)s – Octet 1					
8	7	6	5	4	3	2	1
x	X	0	0	0	x	x	x
NOMPSDds (bits 9 to 7)							

Table 11.68.15.1 – Standard information field – VDSL2-LR spectrum bounds downstream NPar(3) coding – Octet 2

Bits		VDSL2-LR spectrum bounds downstream NPar(3)s – Octet 2					
8	7	6	5	4	3	2	1
x	X	x	x	x	x	x	x
NOMPSDds (bits 6 to 1)							

Table 11.68.16 – Standard information field – VDSL2-LR spectrum shaping downstream NPar(3) coding – Octet 1

Bits		VDSL2-LR spectrum shaping downstream NPar(3)s – Octet 1					
------	--	---	--	--	--	--	--

8	7	Bits					
6	5	4	3	2	1		
x	x	*	*	*	x	x	"First" subcarrier index i (bits 4-9 to 7)
		<u>0</u>	<u>0</u>	<u>0</u>			

Table 11.68.16.1 – Standard information field – VDSL2-LR spectrum shaping downstream NPar(3) coding – Octet 2

VDSL2-LR spectrum shaping downstream NPar(3)s – Octet 2								
		Bits						
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	"First" subcarrier index i (bits 6 to 1)

Table 11.68.16.2 – Standard information field – VDSL2-LR spectrum shaping downstream NPar(3) coding – Octet 3

VDSL2-LR spectrum shaping downstream NPar(3)s – Octet 3								
		Bits						
8	7	6	5	4	3	2	1	
		x						"First" subcarrier in supported set the SUPPORTEDCARRIERSset
x	x	0	0	0	0	0	x	"First" log ₂ tss _i (bit 7)

Table 11.68.16.3 – Standard information field – VDSL2-LR spectrum shaping downstream NPar(3) coding – Octet 4

VDSL2-LR spectrum shaping downstream NPar(3)s – Octet 4								
		Bits						
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	"First" log ₂ tss _i (bits 6 to 1)

Table 11.68.16.4*(j-1) – Standard information field – VDSL2-LR spectrum shaping downstream NPar(3) coding – Octet 4*(j-1)+1

VDSL2-LR spectrum shaping downstream NPar(3)s – Octet 4*(j-1)+1								
		Bits						
8	7	6	5	4	3	2	1	
x	x	*	*	*	x	x	x	"Last" subcarrier index i (bits 4-9 to 7)
		<u>0</u>	<u>0</u>	<u>0</u>				

NOTE 1 – j is the number of subcarrier indices used to specify the spectral shape.

NOTE 2 – Octets 4*(k-1)+1 with k=2..j-1 shall contain the description for the 2nd to (j-1)th subcarriers used to specify the spectral shape. These octets shall have the same coding as defined for octet 4*(j-1)+1

Table 11.68.16.4*(j-1)+1 – Standard information field – VDSL2-LR spectrum shaping downstream NPar(3) coding – Octet 4*(j-1)+2

VDSL2-LR spectrum shaping downstream NPar(3)s – Octet 4*(j-1)+2								
		Bits						
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	"Last" subcarrier index i (bits 6 to 1)

NOTE – j is the number of subcarrier indices used to specify the spectral shape.

NOTE 2 – Octets 4*(k-1)+2 with k=2..j-1 shall contain the description for the 2nd to (j-1)th subcarriers used to specify the spectral shape. These octets shall have the same coding as defined for octet 4*(j-1)+2

Table 11.68.16.4*(j-1)+2 – Standard information field – VDSL2-LR spectrum shaping downstream NPar(3) coding – Octet 4*(j-1)+3

Bits		VDSL2-LR spectrum shaping downstream NPar(3)s – Octet 4*(j – 1) + 3					
8	7	6	5	4	3	2	1
x	x	x					
		"Last" subcarrier in supported set the SUPPORTEDCARRIERSset					
		"Last" log ₂ tss _i (bit 7)					

NOTE 1 – j is the number of subcarrier indices used to specify the spectral shape.
NOTE 2 – Octets 4*(k-1)+3 with k=2..j-1 shall contain the description for the 2nd to (j-1)th subcarriers used to specify the spectral shape. These octets shall have the same coding as defined for octet 4*(j – 1) + 3

Table 11.68.16.4*(j-1)+3 – Standard information field – VDSL2-LR spectrum shaping downstream NPar(3) coding – Octet 4*(j-1)+4

Bits		VDSL2-LR spectrum shaping downstream NPar(3)s – Octet 4*(j – 1) + 4					
8	7	6	5	4	3	2	1
x	x	x	x	X	x	x	x
		"Last" log ₂ tss _i (bits 6 to 1)					

NOTE 1 – j is the number of subcarrier indices used to specify the spectral shape.
NOTE 2 – Octets 4*(k-1)+4 with k=2..j-1 shall contain the description for the 2nd to (j-1)th subcarriers used to specify the spectral shape. These octets shall have the same coding as defined for octet 4*(j – 1) + 4

Table 11.68.17 – Standard information field – VDSL2-LR transmit signal images above the Nyquist frequency NPar(3) coding

Bits		VDSL2-LR transmit signal images above the Nyquist frequency NPar(3)s					
8	7	6	5	4	3	2	1
x	x	x	x	X	x		
		IDFT size N					
		IFFT fill					

Table 11.68.18 – Standard information field – VDSL2-LR Offset IDFT sample #0 downstream NPar(3) coding - Octet 1

Bits		VDSL2-LR Offset IDFT sample #0 downstream NPar(3)s – Octet 1					
8	7	6	5	4	3	2	1
x	x	x	x	X	x	x	x
		Offset IDFT sample #0 (bits 6 to 1)					

Table 11.68.18.1 – Standard information field – VDSL2-LR Offset IDFT sample #0 downstream NPar(3) coding - Octet 2

Bits		VDSL2-LR Offset IDFT sample #0 downstream NPar(3)s – Octet 2					
8	7	6	5	4	3	2	1
x	x	0	0	0	0	0	X
		Offset IDFT sample #0 (bit 7)					

**Table 11.68.19 – Standard information field – VDSL2-LR
Offset IDFT sample #0 upstream NPar(3) coding**

		Bits						
8	7	6	5	4	3	2	1	VDSL2-LR Offset IDFT sample #0 upstream NPar(3)s
x	x	0	0	0	x	x	x	Offset IDFT sample #0 (bits 3 to 1)
