

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.9979

Amendment 1
(02/2016)

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

Access networks – In premises networks

Implementation of the generic mechanism
in the IEEE 1905.1a-2014 Standard to include
applicable ITU-T Recommendations

Amendment 1

Recommendation ITU-T G.9979 (2014) – Amendment 1

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TRANSMISSION MEDIA AND OPTICAL SYSTEMS CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999
MULTIMEDIA QUALITY OF SERVICE AND PERFORMANCE – GENERIC AND USER-RELATED ASPECTS	G.1000–G.1999
TRANSMISSION MEDIA CHARACTERISTICS	G.6000–G.6999
DATA OVER TRANSPORT – GENERIC ASPECTS	G.7000–G.7999
PACKET OVER TRANSPORT ASPECTS	G.8000–G.8999
ACCESS NETWORKS	G.9000–G.9999
Metallic access networks	G.9700–G.9799
Optical line systems for local and access networks	G.9800–G.9899
In premises networks	G.9900–G.9999

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T G.9979

Implementation of the generic mechanism in the IEEE 1905.1a-2014 Standard to include applicable ITU-T Recommendations

Amendment 1

Summary

Recommendation ITU-T G.9979 specifies the necessary details for including Recommendations ITU-T G.9960, ITU-T G.9961 ITU-T G.9962, ITU-T G.9963 and ITU-T G.9964 and ITU-T G.9954 transceivers as supported home networking technologies under the abstraction layer defined by IEEE 1905 technology.

Amendment 1 includes support for Recommendation ITU-T G.9977.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T G.9979	2014-12-05	15	11.1002/1000/12080
1.1	ITU-T G.9979 (2014) Amd. 1	2016-02-26	15	11.1002/1000/12534

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

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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.

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Table of Contents

	Page
1 Scope.....	1
2 References.....	1
3 Definitions	2
4 Abbreviations and acronyms	2
5 Conventions	3
6 ITU-T interface description for 1905.1 devices	3
6.1 ITU-T interfaces in 1905 reference model	3
6.2 ITU-T security mechanisms in 1905 networks	6
7 ITU-T interface Generic PHY device information type TLV	7
8 ITU-T interface technology description	9
8.1 Description of Generic PHY XML fields.....	9
8.2 ITU-T Interface XML Technology description.....	11
9 Test vectors	14
10 ITU-T specific schema	15
11 ITU-T vendor specific TLVs	15

Recommendation ITU-T G.9979

Implementation of the generic mechanism in the IEEE 1905.1a-2014 Standard to include applicable ITU-T Recommendations

Amendment 1

Editorial note: This is a complete-text publication. Modifications introduced by this amendment are shown in revision marks relative to Recommendation ITU-T G.9979 (2014).

1 Scope

This Recommendation makes use of the generic extension mechanism defined in the IEEE 1905.1a 2014 standard to include ITU-T G.9960, ITU-T G.9961, ITU-T G.9962, ITU-T G.9963 and ITU-T G.9964 (referred to hereafter as ITU-T G.996x) and ITU-T G.9954 transceivers [ITU-T G.991.1](#), [ITU-T G.991.2](#), [ITU-T G.992.1](#), [ITU-T G.992.2](#), [ITU-T G.992.3](#), [ITU-T G.992.4](#), [ITU-T G.992.5](#), [ITU-T G.993.1](#), [ITU-T G.993.2](#), [ITU-T G.993.5](#) and [ITU-T G.9701](#) (referred to hereafter as [ITU-T xDSL](#)) as supported ~~home~~ networking technologies under the abstraction layer defined by 1905 technology (see [IEEE 1905.11a 2014]).

The IEEE 1905.1 standard defines an abstraction layer for multiple ~~home~~ networking technologies, which presents a common virtual interface (the 1905 MAC SAP) to upper layers for the underlying networking technologies below the relevant 1905.1 Interface SAP(s).

As indicated in clause 1.1 of the IEEE 1905.1 standard, 1905 is extensible to work with network technologies not included in the original standard. This Recommendation makes use of the generic extension mechanism described in IEEE 1905.1a to specify an extension to the IEEE 1905.1 standard that introduces the ITU-T G.996x and ITU-T G.9954 network technologies as additional underlying network interfaces for the 1905 abstraction layer.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- | | |
|-----------------|---|
| [ITU-T G.991.1] | <u>Recommendation ITU-T G.991.1 (1998), <i>High bit rate digital subscriber line (HDSL) transceivers</i>.</u> |
| [ITU-T G.991.2] | <u>Recommendation ITU-T G.991.2 (2003), <i>Single-pair high-speed digital subscriber line (SHDSL) transceivers</i>.</u> |
| [ITU-T G.992.1] | <u>Recommendation ITU-T G.992.1 (1999), <i>Asymmetric digital subscriber line (ADSL) transceivers</i>.</u> |
| [ITU-T G.992.3] | <u>Recommendation ITU-T G.992.3 (1999), <i>Asymmetric digital subscriber line transceivers 2 (ADSL2)</i>.</u> |
| [ITU-T G.992.5] | <u>Recommendation ITU-T G.992.5 (1999), <i>Asymmetric Asymmetric digital subscriber line 2 transceivers (ADSL2) – Extended bandwidth ADSL2 (ADSL2plus)</i>.</u> |
| [ITU-T G.993.1] | <u>Recommendation ITU-T G.993.1 (2004), <i>Very high speed digital subscriber line transceivers (VDSL)</i>.</u> |

[ITU-T G.993.2]	<u>Recommendation ITU-T G.993.2 (2015), <i>Very high speed digital subscriber line transceivers 2 (VDSL2)</i>.</u>
[ITU-T G.993.5]	<u>Recommendation ITU-T G.993.5 (2015), <i>Self-FEXT cancellation (vectoring) for use with VDSL2 transceivers</i>.</u>
[ITU-T G.9700]	<u>Recommendation ITU-T G.9700 (2014), <i>Fast access to subscriber terminals (G.fast) – Power spectral density specification</i>.</u>
[ITU-T G.9701]	<u>Recommendation ITU-T G.9701 (2014), <i>Fast access to subscriber terminals (G.fast) – Physical layer specification</i>.</u>
[ITU-T G.9954]	Recommendation ITU-T G.9954 (2007), <i>Home networking transceivers – Enhanced physical, media access, and link layer specifications</i> .
[ITU-T G.9960]	Recommendation ITU-T G.9960 (2011), <i>Unified high-speed wire-line based home networking transceivers – System architecture and physical layer specification</i> .
[ITU-T G.9961]	Recommendation ITU-T G.9961 (2010), <i>Unified high-speed wire-line based home networking transceivers – Data link layer specification</i> .
[ITU-T G.9962]	Recommendation ITU-T G.9962 (2014), <i>Unified high-speed wire-line based home networking transceivers – management specification</i> .
[ITU-T G.9963]	Recommendation ITU-T G.9963 (2011), <i>Unified high-speed wire-line based home networking transceivers – Multiple input/multiple output specification</i> .
[ITU-T G.9964]	Recommendation ITU-T G.9964 (2011), <i>Unified high-speed wire-line based home networking transceivers – Power spectral density specification</i> .
[ITU-T G.9977]	<u>Recommendation ITU-T G.9977 (2016), <i>Mitigation of interference between DSL and PLC</i>.</u>
[IEEE 1905.1A]	IEEE Standard 1905.1-2013, <i>IEEE Standard for a Convergent Digital Home Network for Heterogeneous Technologies, including IEEE Standard 1905.1a-2014, Amendment 1 to IEEE Std 1905.1-2013, Support of New MAC/PHYs and Enhancements</i>.
[IEEE 1905.1 2013]	<u>IEEE Standard 1905.1 (2013), <i>IEEE Standard for a Convergent Digital Home Network for Heterogeneous Technologies</i>.</u>
[IEEE 1905.1a 2014]	<u>IEEE Standard 1905.1a (2014), <i>IEEE Standard for a Convergent Digital Home Network for Heterogeneous Technologies, Amendment 1: Support of new MAC/PHYs and enhancements</i>.</u>
[ISO/IEC 8859-1]	ISO/IEC 8859-1:1998, <i>Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1</i> .

3 Definitions

This Recommendation defines the following terms:

3.1 1905 abstraction layer: Layer defined in [IEEE 1905.1a 2014A] that provides a common interface to underlying home network interfaces.

3.2 1905 device: A device with one or more interfaces abstracted by a 1905 abstraction layer.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AL	Abstraction Layer
ALME	Abstraction Layer Management entity
CL	Convergence Layer
DLL	Data Link Layer
<u>DSL</u>	<u>Digital Subscriber Line</u>
HLE	High Level Entity
HNT	Home Networking Transceiver
LLC	Logical Link Control
MAC	Medium Access Control
PHY	Physical
<u>PMD</u>	<u>Physical Media Dependent</u>
<u>PMS</u>	<u>Physical Media Specific</u>
PW	Password
SAP	Service Access Point
SME	Station Management Entity
<u>TC</u>	<u>Transmission Convergence</u>
TLV	Type Length Value
XML	extensible Markup Language

5 Conventions

This Recommendation uses ITU-T G.996x as shorthand to refer to Recommendations ITU-T G.9960, ITU-T G.9961, ITU-T G.9962, ITU-T G.9963 and ITU-T G.9964.

6 ITU-T interface description for 1905.1 devices

6.1 ITU-T interfaces in 1905 reference model

6.1.1 G.996x interface in 1905 reference model

Figure 6-1 shows the G.996x interface position in the IEEE 1905 reference model.

G.996x interfaces shall be connected to 1905 AL through the A interface.

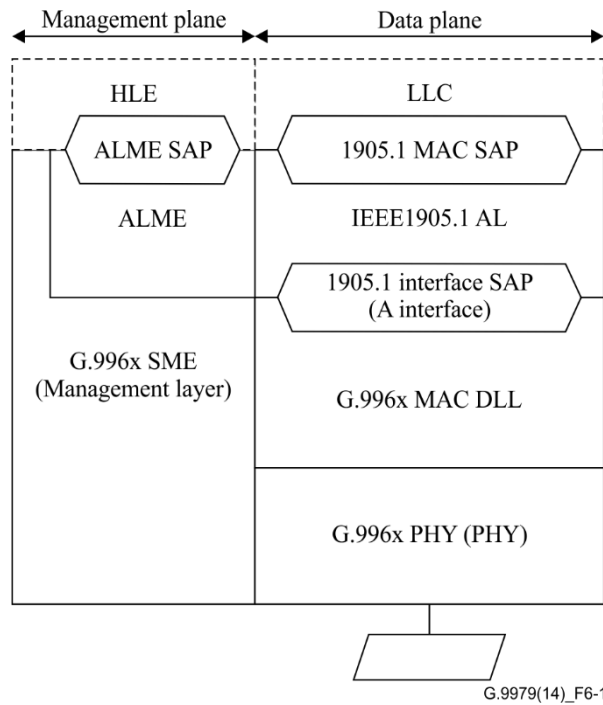


Figure 6-1 – G.996x interface position in 1905 reference model

In this reference model the following equivalences are shown:

- The 1905 interface SAP in 1905 (InterfaceSAPReference parameter of Table 8-1) corresponds to the A interface of ITU-T G.996x (see clause 8.1.2 of [ITU-T G.9961]).
- The SME entity in 1905 (SMEReference parameter of Table 8-1) corresponds to G.996x management layer (see [ITU-T G.9962]).

6.1.2 G.9954 interface in 1905 reference model

Figure 6-2 shows the G.9954 interface position in the IEEE 1905 reference model.

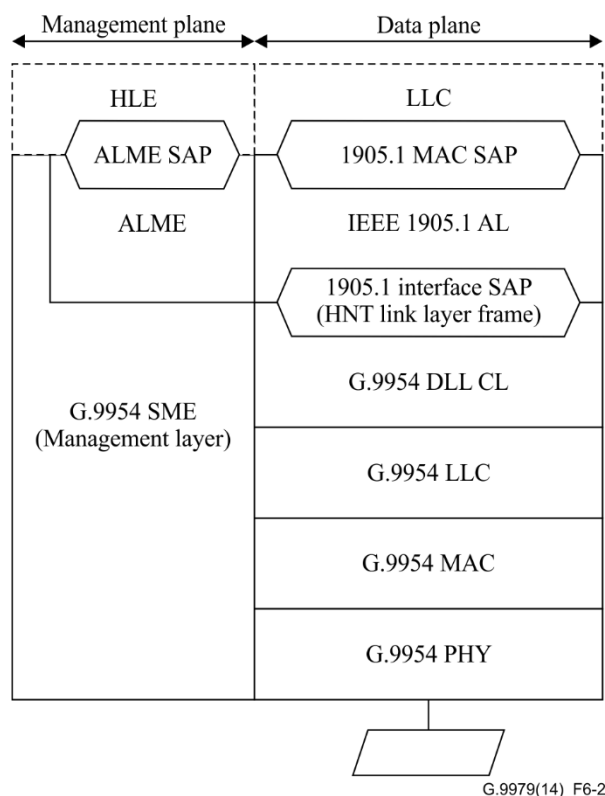


Figure 6-2 – G.9954 interface position in IEEE 1905 reference model

In this reference model the following equivalences are shown:

- The 1905 Interface SAP in 1905 (InterfaceSAPReference parameter of Table 8-1) corresponds to the HNT Link layer frame of [ITU-T G.9954] (see clause 11 of [ITU-T G.9954]).
- The SME entity in 1905 (SMEReference parameter of Table 8-1) corresponds to ITU-T G.996x management layer (see clause 5.3.2.4 of [ITU-T G.9954]).

6.1.3 xDSL interface in 1905 reference model

Figure 6-3 shows the xDSL interface position in the IEEE 1905 reference model.

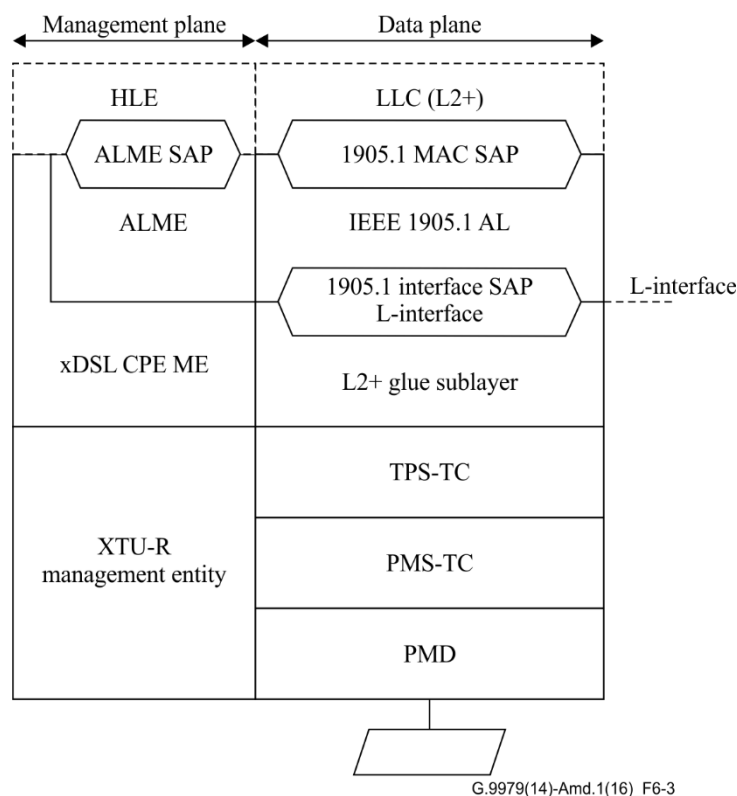


Figure 6-3 – xDSL interface position in IEEE 1905 reference model

In this reference model the following equivalences are shown:

- the 1905 Interface SAP in IEEE 1905.1 (InterfaceSAPReference parameter of Table 8-1) is embedded in the L2+ function of xDSL CPE and corresponds to the L interface of xDSL CPE. The L-interface is logical and facilitates exchange of the primitives defined by this Recommendation.

The SME entity inside IEEE 1905.1 (SMEReference parameter of Table 8-1) corresponds to xDSL CPE high-layer management entity (xDSL CPE ME).

6.2 ITU-T security mechanisms in 1905 networks

6.2.1 Overview

[IEEE 1905.1a 2014A] defines a 1905.1 network key that shall be used as starting point to generate the encryption keys of each of the underlying technologies of a 1905 node.

Clauses 6.2.2, and 6.2.3 and 6.2.4 describe the mechanisms to derive the technology specific encryption keys for ITU-T G.996x, and ITU-T G.9954 and xDSL technologies, respectively.

6.2.2 G.996x u-key derivation

Figure 6-4 shows the ITU-T G.996x passphrase derivation.

The 1905 interface underlying network technology u-key for ITU-T G.996x (node password (PW), see Table 9-7 of [ITU-T G.9961]) shall be derived from the 1905.1 network key (see clause 9.2.1.1 of [IEEE 1905.1a 2014A]) as described below.

The calculation of the hash digest (see clause 9.2.1.1 of [IEEE 1905.1Aa 2014]) shall use as message_array the value of the parameter InterfaceTypeMessageArray of Table 8-1.

Computing the $4 \times n$ least significant bits hash digest (see clause 9.2.1.1 of [IEEE 1905.1a 2014A]) creates the n-character long passphrase expressed in hexadecimal using lowercase ASCII characters.

The PW u-key is a 96-bit binary chain created by converting the passphrase into its 8-bit binary equivalent following [ISO 8859-1]. The length n of the passphrase is 12:

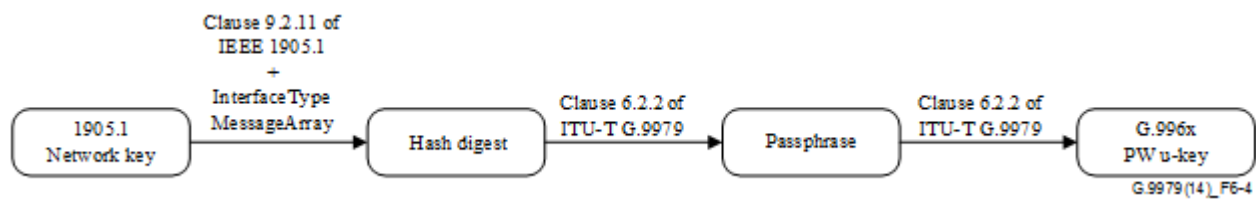


Figure 6-43 – G.996x passphrase derivation

NOTE – The byte ordering of the hash digest is big endian and bit ordering is shown if Figure 6-1 of [IEEE 1905.1a 2014A].

6.2.3 G.9954 u-key derivation

No u-key derivation is needed for ITU-T G.9954 interfaces as underlying network technology does not offer encryption.

6.2.4 xDSL u-key derivation

No u-key derivation is needed for xDSL interfaces as underlying network technology does not offer encryption.

7 ITU-T interface Generic PHY device information type TLV

A 1905 device including an ITU-T ~~a G.996x or G.9954~~ interface shall populate the identified fields of the generic Phy device information type TLV tlvValue field (see Table 6-29 of [IEEE 1905.1a 2014A]) with the information provided in Table 7-1.

**Table 7-1 – Identified fields of the Generic PHY device information type TLV
field for ITU-T ~~G.996x~~ or G.9954 interfaces**

Field	Value (Note 1)
<u>1905 AL MAC address of the device</u>	<u>MAC address of the IEEE 1905 AL of the device implementing the ITU interface (Note 2)</u>
<u>MAC address of the local interface</u>	<u>MAC address assigned to the ITU interface. If the ITU interface has no specific MAC address the AL MAC address may be used (Note 2)</u>
OUI of the Generic PHY networking technology of the local interface	00:19:A7
Variant index of the Generic PHY networking technology of the local interface	See Table 7-2
Variant name	See Table 7-2
Number of octets in ensuing URL field	39
Number of octets in ensuing Media-Specific information field	Length of the Media-Specific information, including all the Media-specific TLVs included in the Media-Specific information of the Variant (5 octets, see Table 8-2 and Table 8-3)
URL to Generic PHY XML Description represented by the OUI. This URL shall be publicly available	http://handle.itu.int/11.1002/3000/1706 (Note 3)
Media-Specific information of the Variant	See Table 8-2 and Table 8-3
<u>NOTE 1 – The format of the different Values provided by this table shall follow the corresponding formats in Table 6-29 of [IEEE 1905.1a 2014]</u>	
<u>NOTE 2 – If the device does not have an AL MAC address, it may use the MAC address of the management layer of the device.</u>	
<u>NOTE 3 – Represented as a string of UTF-8 coded characters (without the quotation marks)</u>	

Table 7-2 – ITU-T technology variant information

Variant index (Note 1)	Variant name (Note 2)	Variant description (Note 2)
00 ₁₆	"ITU-T G.996x Powerline"	"Recommendation ITU-T G.996x (powerline) specifies the system architecture and physical (PHY) layer for wireline-based home networking transceivers capable of operating over premises wiring"
01 ₁₆	"ITU-T G.996x Phoneline"	"Recommendation ITU-T G.996x (phoneline) specifies the system architecture and physical (PHY) layer for wireline-based home networking transceivers capable of operating over premises wiring"
02 ₁₆	"ITU-T G.996x Coax baseband"	"Recommendation ITU-T G.996x (coax baseband) specifies the system architecture and physical (PHY) layer for wireline-based home networking transceivers capable of operating over premises wiring"
03 ₁₆	"ITU-T G.996x Coax RF"	"Recommendation ITU-T G.996x (coax RF) specifies the system architecture and physical (PHY) layer for wireline-based home networking transceivers capable of operating over premises wiring"
04 ₁₆	"ITU-T G.996x POF"	"Recommendation ITU-T G.996x (POF) specifies the system architecture and physical (PHY) layer for wireline-based home networking transceivers capable of operating over premises wiring"

Table 7-2 – ITU-T technology variant information

Variant index (Note 1)	Variant name (Note 2)	Variant description (Note 2)
10 ₁₆	"ITU-T G.9954 Phoneline"	"Recommendation ITU-T G.9954 (phoneline) specifies the system architecture and physical (PHY) layer for wireline-based home networking transceivers capable of operating over premises wiring"
11 ₁₆	"ITU-T G.9954 Coax"	"Recommendation ITU-T G.9954 (coax) specifies the system architecture and physical (PHY) layer for wireline-based home networking transceivers capable of operating over premises wiring"
20 ₁₆	<u>"ITU-T HDSL"</u>	<u>"Recommendation ITU-T G.991.1 specifies the system architecture and physical layer for high bit rate digital subscriber line (HDSL) transceivers"</u>
21 ₁₆	<u>"ITU-T SHDSL"</u>	<u>"Recommendation ITU-T G.991.2 specifies the system architecture and physical layer for single-pair high-speed digital subscriber line (SHDSL) transceivers"</u>
30 ₁₆	<u>"ITU-T ADSL"</u>	<u>"Recommendation ITU-T G.992.1 specifies the system architecture and physical layer for asymmetric digital subscriber line (ADSL) transceivers"</u>
31 ₁₆	<u>"ITU-T ADSL2"</u>	<u>"Recommendation ITU-T G.992.3 specifies the system architecture and physical layer for asymmetric digital subscriber line transceivers 2 (ADSL2)"</u>
32 ₁₆	<u>"ITU-T ADSL2PLUS"</u>	<u>"Recommendation ITU-T G.992.5 specifies the system architecture and physical layer for asymmetric digital subscriber line 2 transceivers (ADSL2) – Extended bandwidth ADSL2 (ADSL2plus)"</u>
40 ₁₆	<u>"ITU-T VDSL"</u>	<u>"Recommendation ITU-T G.993.1 specifies the system architecture and physical layer for very high speed digital subscriber line transceivers (VDSL)"</u>
41 ₁₆	<u>"ITU-T VDSL2"</u>	<u>"Recommendation ITU-T G.993.2 specifies the system architecture and physical layer for very high speed digital subscriber line transceivers 2 (VDSL2)"</u>
42 ₁₆	<u>"ITU-T vectored VDSL2"</u>	<u>"Recommendation ITU-T G.993.5 specifies the system architecture and physical layer for very high speed digital subscriber line transceivers 2 (VDSL2 with Self-FEXT cancellation)"</u>
50 ₁₆	<u>"ITU-T G.fast"</u>	<u>"Recommendation ITU-T G.9970/9701 specify the system architecture and physical layer for fast access to subscriber terminals (G.fast) – Physical layer specification"</u>
NOTE 1 – All other values are reserved by ITU-T. NOTE 2 – Text within quotation marks represents a UTF-8 string that shall be used verbatim (without the quotation marks) in the XML.		

8 ITU-T interface technology description

8.1 Description of Generic PHY XML fields

Table 8-1 provides a description of ITU-T generic Phy XML fields.

Table 8-1 – Description of ITU-T Generic Phy XML fields

Field	Sub-field	Value (Note)		
		G.996x	G.9954	xDSL
OrgName		"ITU"	"ITU"	<u>"ITU"</u>
OrgUrl		<u>"http://www.itu.int"</u>	<u>"http://www.itu.int"</u>	<u>"http://www.itu.int"</u>
Oui		"00:19:A7"	"00:19:A7"	<u>"00:19:A7"</u>
NetworkingTechnologyVariant	GenericPhyIndex	See Table 7-2	See Table 7-2	<u>See Table 7-2</u>
	VariantName	See Table 7-2	See Table 7-2	<u>See Table 7-2</u>
	VariantUrl	<u>"http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15"</u>	<u>"http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15"</u>	<u>"http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15"</u>
	<u>Variant</u> Description	See Table 7-2	See Table 7-2	<u>See Table 7-2</u>
	InterfaceSAPName	"A interface"	"HNT Link layer frame"	<u>"L-interface"</u>
	InterfaceSAPReference	"Clause 6.1 of ITU-T G.9979"	"Clause 6.1 of ITU-T G.9979"	<u>"Clause 6.1 of ITU-T G.9979"</u>
	SMEName	"Management layer"	"Management layer"	<u>"Management layer"</u>
	SMEReference	"Clause 6.1 of ITU-T G.9979"	"Clause 6.1 of ITU-T G.9979"	<u>"Clause 6.1 of ITU-T G.9979"</u>
	IEEE8021Bridging	"True"	"True"	<u>"False"</u>
	MediaSpecificInformation	"TLV structure - see Table 8-2 of ITU-T G.9979"	"TLV structure - see Table 8-2 of ITU-T G.9979"	<u>"TLV structure - see Table 8-2 of ITU-T G.9979"</u>
	InterfaceTypeMessageArray	"1905 easily creates interoperable Hybrid networks with deployed ITU-T G.996x"	"1905 easily creates interoperable Hybrid networks with deployed ITU-T G.9954"	<u>"1905 easily creates interoperable Hybrid networks with deployed ITU-T xDSL"</u>
	UKeyDerivation	"Clause 6.2 of ITU-T G.9979"	"Clause 6.2 of ITU-T G.9979"	<u>"Clause 6.2 of ITU-T G.9979"</u>
	TestVectors	"Clause 9 of ITU-T G.9979"	"Clause 9 of ITU-T G.9979" <u>None</u>	<u>"None"</u>
	CoexistenceProtocols	"ITU-T G.9972"	"None"	<u>"None"</u>

NOTE – Text within quotation marks represents a UTF-8 string that shall be used verbatim (without the quotation marks) in the XML.

Table 8-2 provides a description of ITU-T media specific information fields.

Table 8-2 – Description of ITU-T media specific information fields

Field	Octet	Bits	Description
NumMediaSpecificFields	0	[7:0]	Number of Media-Specific fields (N) <u>that are included for this technology variant (Note 1). If no MediaSpecificFields are required for the technology variant, N equals 0 (00₁₆).</u>
MediaSpecificField[0]	Variable	Variable	First MediaSpecificField. It shall be formatted following Table 8.2.1. This field does not exist if N=0
...	...	...	...
MediaSpecificField[N-1]	Variable	Variable	Last MediaSpecificField. It shall be formatted following Table 8.2.1. This field does not exist if N=0
MediaSpecificFieldType[0]	1	[7:0]	Media-Specific field Type. The format of this field is described in Table 8-3
MediaSpecificFieldLength[0]	2	[7:0]	Length of the MediaSpecificFieldValue[0] field for the type indicated by the MediaSpecificFieldType[0] field, represented as an 8-bit unsigned integer (see Table 8-3).
MediaSpecificFieldValue[0]	Variable	Variable	Value of the type indicated by the MediaSpecificFieldType[0] field (see Table 8-3).
...	...	...	...
MediaSpecificFieldType[N-1]	Variable	[7:0]	Media-Specific field Type. The format of this field is described in Table 8-3
MediaSpecificFieldLength[N-1]	Variable	[7:0]	Length of the MediaSpecificFieldValue[N-1] field for the type indicated by the MediaSpecificFieldType[N-1] field, represented as an 8-bit unsigned integer (see Table 8-3).
MediaSpecificFieldValue[N-1]	Variable	Variable	Value of the type indicated by the MediaSpecificFieldType[N-1] field (see Table 8-3).
NOTE 1 – The MediaSpecificFields that may be included in the ITU-T media specific information fields depend on the Technology Variant (see Table 8-3).			

Table 8-2.1 – Description of a MediaSpecificField

Field	Octet	Bits	Description
MediaSpecificFieldType	0	[7:0]	Media-Specific field Type. The format of this field is described in Table 8-3
MediaSpecificFieldLength	1	[7:0]	Length of the MediaSpecificFieldValue field for the type indicated by the MediaSpecificFieldType field, represented as an 8-bit unsigned integer (see Table 8-3).
MediaSpecificFieldValue	Variable	Variable	Value of the type indicated by the MediaSpecificFieldType field (see Table 8-3).

Table 8-3 provides a list of media specific fields.

Table 8-3 – List of media-specific fields

MediaSpecificField Type (Note)	<u>Technology variant indices for which this Media-Specific Field is valid</u>	MediaSpecificField Name	MediaSpecificField-Length Value (bytes)	MediaSpecificField-Value field
0016	<u>00₁₆ to 04₁₆</u>	DNI	2	See clause 8.6.8.2.1 of [ITU-T G.9961]
NOTE – All other values are reserved by ITU-T.				

8.2 ITU-T Interface XML Technology description

```
<?xml version="1.0" encoding="utf-8"?>
<GenericPhyInfo xmlns="urn:schemas-ieee-org:ieee1905:GenericPhyInfo" xsi:schemaLocation="urn:schemas-ieee-org:ieee1905:GenericPhyInfo 19051a-GenericPhyInfo-140225a.xsd"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <GenericPhy>
    <OrgName>ITU</OrgName>
    <OrgUrl>http://www.itu.int</OrgUrl>
    <Oui>00:19:A7</Oui>
    <NetworkTechnologyVariant>
      <GenericPhyIndex>00</GenericPhyIndex>
      <VariantName>ITU-T G.996x Powerline</VariantName>
      <VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
      <Description>Recommendation ITU-T G.996x (Powerline) specifies the system architecture and physical (PHY) layer for wireline-
based home networking transceivers capable of operating over premises wiring.</Description>
      <InterfaceSAPName>A interface</InterfaceSAPName>
      <InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
      <SMENName>Management Layer</SMENName>
      <SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
      <IEEE8021Bridging>True</IEEE8021Bridging>
      <MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
      <InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T G.996x
    </InterfaceTypeMessageArray>
      <UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
      <TestVectors>Clause 9 of ITU-T G.9979</TestVectors>
      <CoexistenceProtocols>G.9972</CoexistenceProtocols>
    </NetworkTechnologyVariant>
    <NetworkTechnologyVariant>
      <GenericPhyIndex>01</GenericPhyIndex>
      <VariantName>ITU-T G.996x Phoneline</VariantName>
      <VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
      <Description>Recommendation ITU-T G.996x (Phoneline) specifies the system architecture and physical (PHY) layer for wireline-
based home networking transceivers capable of operating over premises wiring.</Description>
      <InterfaceSAPName>A interface</InterfaceSAPName>
      <InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
      <SMENName>Management Layer</SMENName>
      <SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
      <IEEE8021Bridging>True</IEEE8021Bridging>
      <MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
      <InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T G.996x
    </InterfaceTypeMessageArray>
      <UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
      <TestVectors>Clause 9 of ITU-T G.9979</TestVectors>
      <CoexistenceProtocols>G.9972</CoexistenceProtocols>
    </NetworkTechnologyVariant>
    <NetworkTechnologyVariant>
      <GenericPhyIndex>02</GenericPhyIndex>
      <VariantName>ITU-T G.996x Coax Baseband</VariantName>
      <VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
      <Description>Recommendation ITU-T G.996x (Coax baseband) specifies the system architecture and physical (PHY) layer for wireline-
based home networking transceivers capable of operating over premises wiring.</Description>
      <InterfaceSAPName>A interface</InterfaceSAPName>
      <InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
      <SMENName>Management Layer</SMENName>
      <SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
      <IEEE8021Bridging>True</IEEE8021Bridging>
      <MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
      <InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T G.996x
    </InterfaceTypeMessageArray>
      <UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
      <TestVectors>Clause 9 of ITU-T G.9979</TestVectors>
      <CoexistenceProtocols>G.9972</CoexistenceProtocols>
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      <VariantName>ITU-T G.996x Coax RF</VariantName>
      <VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
      <Description>Recommendation ITU-T G.996x (Coax RF) specifies the system architecture and physical (PHY) layer for wireline-based
home networking transceivers capable of operating over premises wiring.</Description>
      <InterfaceSAPName>A interface</InterfaceSAPName>
      <InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
      <SMENName>Management Layer</SMENName>
      <SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
      <IEEE8021Bridging>True</IEEE8021Bridging>
      <MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
      <InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T G.996x
    </InterfaceTypeMessageArray>
      <UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
      <TestVectors>Clause 9 of ITU-T G.9979</TestVectors>
      <CoexistenceProtocols>G.9972</CoexistenceProtocols>
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    <NetworkTechnologyVariant>
      <GenericPhyIndex>04</GenericPhyIndex>
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<VariantName>ITU-T G.996x Plastic Optical Fiber (POF)</VariantName>
<VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
<Description>Recommendation ITU-T G.996x (POF) specifies the system architecture and physical (PHY) layer for wireline-based
home networking transceivers capable of operating over premises wiring.</Description>
<InterfaceSAPName>A interface</InterfaceSAPName>
<InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
<SMENName>Management Layer</SMENName>
<SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
<IEEE8021Bridging>True</IEEE8021Bridging>
<MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
<InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T G.996x
</InterfaceTypeMessageArray>
<UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
<TestVectors>Clause 9 of ITU-T G.9979</TestVectors>
<CoexistenceProtocols>G.9972</CoexistenceProtocols>
</NetworkTechnologyVariant>
<NetworkTechnologyVariant>
<GenericPhyIndex>10</GenericPhyIndex>
<VariantName>ITU-T G.9954 (Phoneline)</VariantName>
<VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
<Description>Recommendation ITU-T G.9954 (Phoneline) specifies the system architecture and physical (PHY) layer for wireline-
based home networking transceivers capable of operating over premises wiring.</Description>
<InterfaceSAPName>HNT Link layer frame</InterfaceSAPName>
<InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
<SMENName>Management Layer</SMENName>
<SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
<IEEE8021Bridging>True</IEEE8021Bridging>
<MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
<InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T G.9954
</InterfaceTypeMessageArray>
<UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
<TestVectors>Clause 9 of ITU-T G.9979</TestVectors>
<CoexistenceProtocols>None</CoexistenceProtocols>
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<NetworkTechnologyVariant>
<GenericPhyIndex>11</GenericPhyIndex>
<VariantName>ITU-T G.9954 (Coax)</VariantName>
<VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
<Description>Recommendation ITU-T G.9954 (coax) specifies the system architecture and physical (PHY) layer for wireline-based
home networking transceivers capable of operating over premises wiring.</Description>
<InterfaceSAPName>HNT Link layer frame</InterfaceSAPName>
<InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
<SMENName>Management Layer</SMENName>
<SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
<IEEE8021Bridging>True</IEEE8021Bridging>
<MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
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</InterfaceTypeMessageArray>
<UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
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<CoexistenceProtocols>None</CoexistenceProtocols>
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<GenericPhyIndex>20</GenericPhyIndex>
<VariantName>ITU-T HDSL</VariantName>
<VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
<Description>Recommendation ITU-T G.991.1 specifies the system architecture and physical layer for high bit rate digital
subscriber line (HDSL) transceivers</Description>
<InterfaceSAPName>L-interface</InterfaceSAPName>
<InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
<SMENName>Management Layer</SMENName>
<SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
<IEEE8021Bridging>False</IEEE8021Bridging>
<MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
<InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T
xDSL</InterfaceTypeMessageArray>
<UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
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<CoexistenceProtocols>None</CoexistenceProtocols>
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<GenericPhyIndex>21</GenericPhyIndex>
<VariantName>ITU-T SHDSL</VariantName>
<VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
<Description>Recommendation ITU-T G.991.2 specifies the system architecture and physical layer for single-pair high-speed digital
subscriber line (SHDSL) transceivers</Description>
<InterfaceSAPName>L-interface</InterfaceSAPName>
<InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
<SMENName>Management Layer</SMENName>
<SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
<IEEE8021Bridging>False</IEEE8021Bridging>
<MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
<InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T
xDSL</InterfaceTypeMessageArray>
<UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
<TestVectors>None</TestVectors>
<CoexistenceProtocols>None</CoexistenceProtocols>
</NetworkTechnologyVariant>
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<GenericPhyIndex>30</GenericPhyIndex>
<VariantName>ITU-T ADSL</VariantName>
<VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
<Description>Recommendation ITU-T G.992.1 specifies the system architecture and physical layer for asymmetric digital subscriber
line (ADSL) transceivers</Description>
<InterfaceSAPName>L-interface</InterfaceSAPName>
<InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
<SMENName>Management Layer</SMENName>
<SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
<IEEE8021Bridging>False</IEEE8021Bridging>
<MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
<InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T
xDSL</InterfaceTypeMessageArray>
<UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
<TestVectors>None</TestVectors>
<CoexistenceProtocols>None</CoexistenceProtocols>
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<GenericPhyIndex>31</GenericPhyIndex>
<VariantName>ITU-T ADSL2</VariantName>
<VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
<Description>Recommendation ITU-T G.992.3 specifies the system architecture and physical layer for asymmetric digital subscriber
line transceivers 2 (ADSL2)</Description>
<InterfaceSAPName>L-interface</InterfaceSAPName>
<InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
<SMEName>Management Layer</SMEName>
<SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
<IEEE8021Bridging>False</IEEE8021Bridging>
<MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
<InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T
xDSL</InterfaceTypeMessageArray>
<UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
<TestVectors>None</TestVectors>
<CoexistenceProtocols>None</CoexistenceProtocols>
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<NetworkTechnologyVariant>
<GenericPhyIndex>32</GenericPhyIndex>
<VariantName>ITU-T ADSL2+</VariantName>
<VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
<Description>Recommendation ITU-T G.992.5 specifies the system architecture and physical layer for asymmetric digital subscriber
line 2 transceivers (ADSL2)- Extended bandwidth ADSL2 (ADSL2plus)</Description>
<InterfaceSAPName>L-interface</InterfaceSAPName>
<InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
<SMEName>Management Layer</SMEName>
<SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
<IEEE8021Bridging>False</IEEE8021Bridging>
<MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
<InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T
xDSL</InterfaceTypeMessageArray>
<UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
<TestVectors>None</TestVectors>
<CoexistenceProtocols>None</CoexistenceProtocols>
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<GenericPhyIndex>40</GenericPhyIndex>
<VariantName>ITU-T VDSL</VariantName>
<VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
<Description>Recommendation ITU-T G.993.1 specifies the system architecture and physical layer for very high speed digital
subscriber line transceivers (VDSL)</Description>
<InterfaceSAPName>L-interface</InterfaceSAPName>
<InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
<SMEName>Management Layer</SMEName>
<SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
<IEEE8021Bridging>False</IEEE8021Bridging>
<MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
<InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T
xDSL</InterfaceTypeMessageArray>
<UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
<TestVectors>None</TestVectors>
<CoexistenceProtocols>None</CoexistenceProtocols>
</NetworkTechnologyVariant>
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<GenericPhyIndex>41</GenericPhyIndex>
<VariantName>ITU-T VDSL2</VariantName>
<VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
<Description>Recommendation ITU-T G.993.2 specifies the system architecture and physical layer for very high speed digital
subscriber line transceivers 2 (VDSL2)</Description>
<InterfaceSAPName>L-interface</InterfaceSAPName>
<InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
<SMEName>Management Layer</SMEName>
<SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
<IEEE8021Bridging>False</IEEE8021Bridging>
<MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
<InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T
xDSL</InterfaceTypeMessageArray>
<UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
<TestVectors>None</TestVectors>
<CoexistenceProtocols>None</CoexistenceProtocols>
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<GenericPhyIndex>42</GenericPhyIndex>
<VariantName>ITU-T vectored VDSL2</VariantName>
<VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
<Description>Recommendation ITU-T G.993.5 specifies the system architecture and physical layer for very high speed digital
subscriber line transceivers 2 (VDSL2)</Description>
<InterfaceSAPName>L-interface</InterfaceSAPName>
<InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
<SMEName>Management Layer</SMEName>
<SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
<IEEE8021Bridging>False</IEEE8021Bridging>
<MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
<InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T
xDSL</InterfaceTypeMessageArray>
<UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
<TestVectors>None</TestVectors>
<CoexistenceProtocols>None</CoexistenceProtocols>
</NetworkTechnologyVariant>
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<GenericPhyIndex>50</GenericPhyIndex>
<VariantName>ITU-T G.Fast</VariantName>
<VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
<Description>Recommendation ITU-T G.9970/9701 specify the system architecture and physical layer for fast access to subscriber
terminals (G.fast) - Physical layer specification</Description>
<InterfaceSAPName>L-interface</InterfaceSAPName>
<InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
<SMEName>Management Layer</SMEName>
<SMEReference>Clause 6.1 of ITU-T G.9979</SMEReference>
<IEEE8021Bridging>False</IEEE8021Bridging>
<MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
<InterfaceTypeMessageArray>1905 easily creates interoperable Hybrid networks with deployed ITU-T
xDSL</InterfaceTypeMessageArray>
<UKeyDerivation>Clause 6.2 of ITU-T G.9979</UKeyDerivation>
<TestVectors>None</TestVectors>
<CoexistenceProtocols>None</CoexistenceProtocols>
</NetworkTechnologyVariant>

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9 Test vectors

The following test G.996x PW u-keys have been generated following the procedure described in [IEEE 1905.1Aa 2014] using as input the 1905.1 Network Passphrase and 1905.1 Salt for each of the test vectors.

Table 9-1 – Test vectors

Test Vector	Test G.996x PW u-key
1	353738376339653765666630
2	663034656532336465343934
3	633631653362646537643635
4	613139303635323138666363
5	663130653138333635363936
6	613461336463616362343035

10 ITU-T specific schema

This clause is for further study.

11 ITU-T vendor specific TLVs

ITU-T vendor specific TLVs follow the format described in section 6.4.2 of [IEEE 1905.1a 2014]. The format of the ITU-T vendor specific fields shall follow that described in Table 11-1.

Table 11-1 – ITU-T vendor specific TLVs

Field	Length	Value range	Description
TLV-Type	1 byte	0B ₁₆	Vendor specific TLV
TLV-Length	2 bytes	3 + 1 + n	Sum of octets of the: ITU-T OUI (3 octets) + ITU-T TLV subtype (1 octet) + information (n octets)
TLV-Value	3 bytes	0019A7 ₁₆	ITU-T OUI (the 24-bit globally unique IEEE-SA assigned value for ITU-T)
	1 byte	00 ₁₆ – FF ₁₆	The ITU-T TLV subtype; the particular subtypes are defined in Table 11-2
	n bytes		message content corresponding to a particular ITU-T TLV subtype defined in Table 11-2

Table 11-2 – List of ITU-T TLV subtypes and their corresponding payloads

ITU-T TLV subtype	Message payload
00 ₁₆ to 01 ₁₆	Reserved by ITU-T for ITU-T G.9977 – See Table A.3 of [ITU-T G.9977]
02 ₁₆ to FF ₁₆	Reserved by ITU-T

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Terminals and subjective and objective assessment methods
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities
Series Z	Languages and general software aspects for telecommunication systems