International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.9979

(12/2014)

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

Recommendation ITU-T G.9979

International Telecommunication Union

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Recommendation ITU-T G.9979

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

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.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T G.9979	2014-12-05	15	11.1002/1000/12080

* 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.

FOREWORD

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

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Recommendation ITU-T G.9979

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

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 as supported home networking technologies under the abstraction layer defined by 1905 technology (see [IEEE 1905.1A]).

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.9954] Recommendation ITU-T G.9954 (2007), *Home networking transceivers – Enhanced physical, media access, and link layer specifications*.

[ITU-T G.9960] Recommendation ITU-T G.9960 (2011), *Unified high-speed wire-line based home networking transceivers – System architecture and physical layer specification*.

[ITU-T G.9961] Recommendation ITU-T G.9961 (2010), *Unified high-speed wire-line based home networking transceivers – Data link layer specification*.

[ITU-T G.9962] Recommendation ITU-T G.9962 (2014), *Unified high-speed wire-line based home networking transceivers – management specification*.

[ITU-T G.9963] Recommendation ITU-T G.9963 (2011), *Unified high-speed wire-line based home networking transceivers – Multiple input/multiple output specification*.

[ITU-T G.9964] Recommendation ITU-T G.9964 (2011), *Unified high-speed wire-line based home networking transceivers – Power spectral density specification*.

[IEEE 1905.1A] IEEE Standard 1905.1-2013, *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*.

[ISO/IEC 8859-1] ISO/IEC 8859-1:1998, *Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1*.

3 Definitions

This Recommendation defines the following terms:

3.1 1905 abstraction layer: Layer defined in [IEEE 1905.1A] 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

HLE High Level Entity

HNT Home Networking Transceiver

LLC Logical Link Control

MAC Medium Access Control

PHY Physical

PW Password

SAP Service Access Point

SME Station Management Entity

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

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

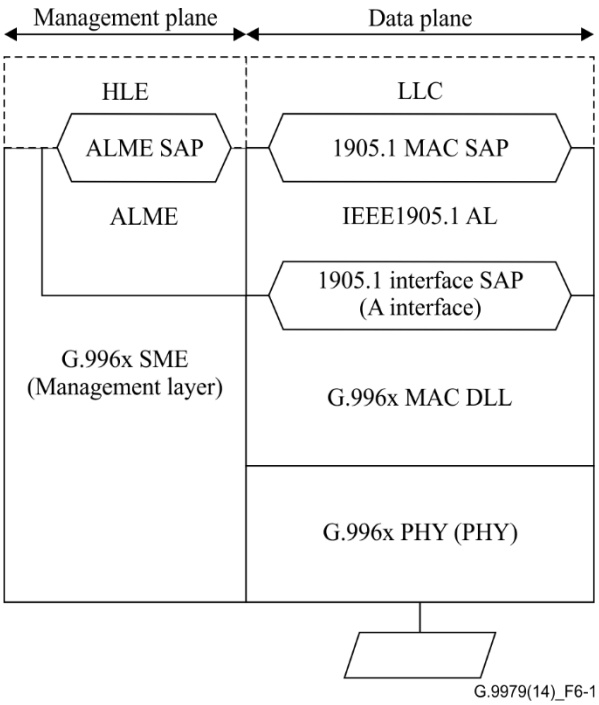

Figure 6-1 – G.996x interface position in 1905 reference model

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

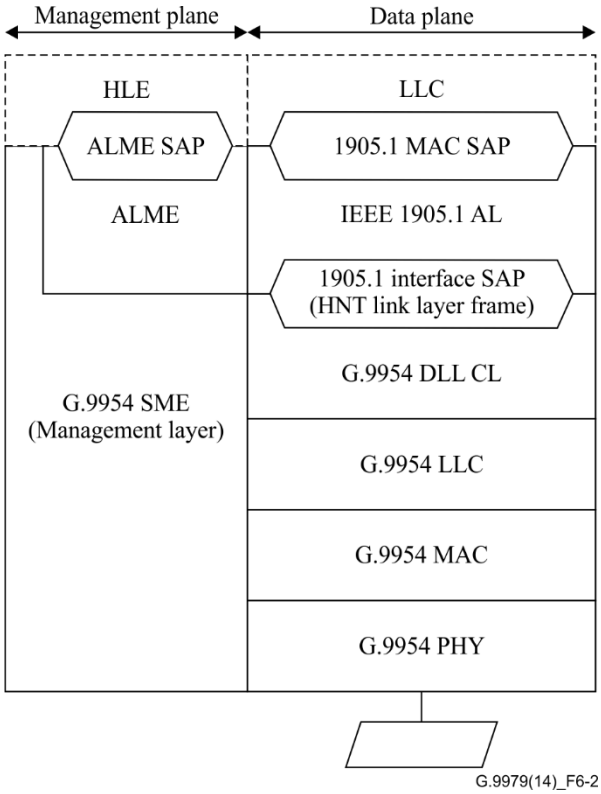

Figure 6-2 – G.9954 interface position in IEEE 1905 reference model

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]).

6.2 ITU-T security mechanisms in 1905 networks

6.2.1 Overview

[IEEE 1905.1A] 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 describe the mechanisms to derive the technology specific encryption keys for ITU-T G.996x and [ITU-T G.9954] respectively.

6.2.2 G.996x u-key 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]) as described below.

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

Computing the 4 × n least significant bits hash digest (see clause 9.2.1.1 of [IEEE 1905.1A]) 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:

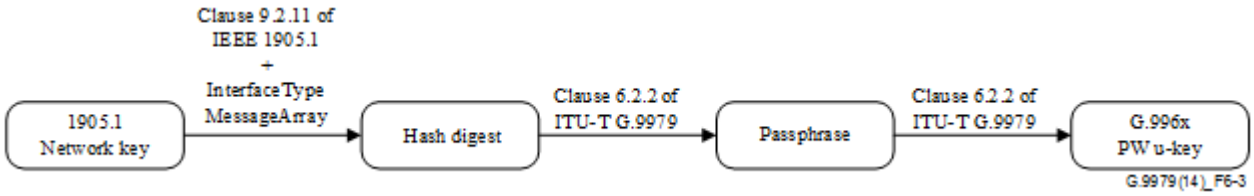

Figure 6-3 – G.996x passphrase derivation

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

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.

7 ITU-T interface Generic PHY device information type TLV

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

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

Field	Value
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
Media-specific information of the variant	See Table 8-2 and Table 8-3

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"
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"
NOTE 1 – All other values are reserved by ITU-T. NOTE 2 – Text within quotation marks represents an 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 – Description of ITU-T Generic Phy XML fields

Field	Sub-field	Value (Note)	
		G.996x	G.9954
OrgName		"ITU"	"ITU"
OrgUrl		"http://www.itu.int"	"http://www.itu.int"
Oui		"00:19:A7"	"00:19:A7"
NetworkingTechnologyVariant	GenericPhyIndex	See Table 7-2	See Table 7-2
	VariantName	See Table 7-2	See Table 7-2
	VariantUrl	"http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15"	"http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15"

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

Field	Sub-field	Value (Note)	
		G.996x	**G.9954**
	Description	See Table 7-2	See Table 7-2
	InterfaceSAPName	"A interface"	"HNT Link layer frame"
	InterfaceSAPReference	"Clause 6.1 of ITU-T G.9979"	"Clause 6.1 of ITU-T G.9979"
	SMEName	"Management layer"	"Management layer"
	SMEReference	"Clause 6.1 of ITU-T G.9979"	"Clause 6.1 of ITU-T G.9979"
	IEEE8021Bridging	"True"	"True"
	MediaSpecificInformation	"TLV structure – see Table 8-2 of ITU-T G.9979"	"TLV structure – see Table 8-2 of ITU-T G.9979"
	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"
	UKeyDerivation	"Clause 6.2 of ITU-T G.9979"	"Clause 6.2 of ITU-T G.9979"
	TestVectors	"Clause 9 of ITU-T G.9979"	"Clause 9 of ITU-T G.9979"
	Coexistence Protocols	"ITU-T G.9972"	"None"
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 – Description of ITU-T media specific information fields

Field	Octet	Bits	Description
NumMediaSpecificFields	0	[7:0]	Number of Media-Specific fields (N)
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).

Table 8-3 – List of media-specific fields

MediaSpecificField Type (Note)	MediaSpecificField Name	MediaSpecificField Length Value	MediaSpecificField Value field
00_{16}	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          xsi:schemaLocation="urn:schemas-ieee-org:ieee1905:GenericPhyInfo          19051a-GenericPhyInfo-140225a.xsd"
xmlns="urn:schemas-ieee-org:ieee1905:GenericPhyInfo"  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>
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      <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>
      <SMEName>Management Layer</SMEName>
      <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>
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      <CoexistenceProtocols>G.9972</CoexistenceProtocols>
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      <VariantName>ITU-T G.996x Phoneline</VariantName>
      <VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
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      <MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
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</InterfaceTypeMessageArray>
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      <TestVectors>Clause 9 of ITU-T G.9979</TestVectors>
      <CoexistenceProtocols>G.9972</CoexistenceProtocols>
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    <NetworkTechnologyVariant>
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      <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>
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      <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>True</IEEE8021Bridging>
      <MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
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home networking transceivers capable of operating over premises wiring.</Description>
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      <InterfaceSAPReference>Clause 6.1 of ITU-T G.9979</InterfaceSAPReference>
      <SMEName>Management Layer</SMEName>
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      <IEEE8021Bridging>True</IEEE8021Bridging>
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</InterfaceTypeMessageArray>
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      <TestVectors>Clause 9 of ITU-T G.9979</TestVectors>
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      <VariantUrl>http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15</VariantUrl>
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       <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>
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       <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>
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       <MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
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       <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>
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       <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>True</IEEE8021Bridging>
       <MediaSpecificInformation>TLV structure - see Table 8-2 of ITU-T G.9979</MediaSpecificInformation>
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</InterfaceTypeMessageArray>
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       <TestVectors>Clause 9 of ITU-T G.9979</TestVectors>
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9 Test vectors

The following test G.996x PW u-keys have been generated following the procedure described in [IEEE 1905.1A] 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.

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