

光アクセスネットワーク装置  
相互接続試験  
実施要領

HATS 推進会議  
(高度通信システム相互接続推進会議)  
実施推進部会

## 光アクセスネットワーク装置 相互接続試験 実施要領

## 改訂履歴

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1.0	2012/12/19	初版	西原,滝澤, 大西,草野
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1.3	2014/12/25	<ul style="list-style-type: none"> <li>・光アクセスアドホックの連絡会昇格により、名称を光アクセス相互接続試験実施連絡会へ更新</li> <li>・第 2.1 章で参照する SIEPON ドラフトバージョンから Draft を削除し IEEE Std 1904.1 へ更新</li> <li>・IEEE P 1904.1 と IEEE Std 1904.1 の表記が混在していたため、これらを IEEE Std 1904.1 に表記統一</li> <li>・第 4.7 章の参照章番号を第 4.2 章～第 4.6 章へ変更</li> <li>・別紙 光アクセスネットワーク装置相互接続試験結果 チェックリストに参照 PICS を追加</li> </ul>	大西, 中野 滝澤, 草野

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## 1. 背景及び目的

### 1.1. 背景

IEEE (Institute of Electrical and Electronics Engineers)によって標準化が進められている、IEEE Std 1904.1 (システム相互接続対応 Ethernet PON) 仕様は、EPON Optical Line Terminator (OLT)及びEPON Optical Network Unit (ONU)間の相互接続を実現するプロトコルセットを規定する。該プロトコルは、それを実装した装置がマルチベンダ環境を実現することを想定している。その健全な発展と普及を図るためには、技術の可用性を実証すると共に、相互接続に関するさまざまな課題を解決し、その成果を標準に反映する必要がある。

### 1.2. 目的

前記標準に基づいた製品市場の進展に伴い、EPON 光アクセスシステムの利用促進のため、各製品間での相互接続性の確保が必要不可欠である。IEEE Std 1904.1 (SIEPON)は、OLT と ONU 間のシステムレベル機能の相互接続をサポートする初の試みであり、規定される要求機能を各システムが適切かつ十分に相互接続試験の実施による接続性の確認が重要である。標準との整合性の観点で各システムの完成度を理解するに当たり、システム間の相互接続試験実施が望まれている。

本ガイドラインは、異なるベンダで製造されたデバイス間の相互接続規定を確認する試験手順を提供する。

この相互接続試験は、HATS 実施推進部会・光アクセス相互接続試験実施連絡会が運営する。試験では製品間の接続性を確認するだけでなく、EPON のシステムレベルでの相互接続性の完成度の向上に資することを期待する。

### 1.3. 相互接続試験の範囲

本ガイドラインの範囲は、IEEE が規定する IEEE Std 1904.1 に基づく装置間の相互接続である。本ガイドラインは、IEEE Std 1904.1 に規定される幾つかの機能セットの内、パッケージ B と呼ばれる機能セットに関する認証試験を規定した、IEEE Std 1904.1 Conformance02 に原則として準拠する。本ガイドラインは相互接続試験環境に関する最小限必要とされる手順を提供する。必要並びに要請に応じ、今後新たな機能試験を追加する可能性もある。

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## 2. 試験の前提条件

### 2.1. 準拠すべき標準

The following referenced documents are indispensable for the application of the standard to be complied for the interoperability test (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEEE Std 1904.1™ Standard for Service Interoperability in Ethernet Passive Optical Networks (SIEPON)

### 2.2. 前提条件

Prior to attending the interoperability test, each participant is requested to conduct a test described in this test guideline using devices at his/her own control and confirm normality which means be able to pass all tests with owning devices and test environment.

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### 3. 試験装置及び試験環境

#### 3.1. 試験装置の機能要件

##### 3.1.1. イントロダクション

This subclause provides definitions of the critical elements of the conformance test setup, namely the Packet Analyzer, Packet Generator, and ODN, which are connected together as defined in more detail in 3.2.

Individual devices are specified in terms of functional requirements and do not impose specific implementation. For test purposes, functions of two or more device described in the following subclause may be combined into a single functional device, as long as the new functional device meets all the requirements outlined below, when connected in the conformance test configuration defined in 3.2.

##### 3.1.2. パケットアナライザ (Packet Analyzer)

The Packet Analyzer is a device, which is connected to the OLT NNI and ONU UNI interfaces in a way defined in more details in 3.2, and supports the following functions:

- captures all packets transmitted by the OLT across the NNI interface towards the metro/aggregation network;
- captures all packets transmitted by the ONU across the UNI interface towards connected CPEs;
- examines the content of the captured OAMPDUs, as defined in IEEE Std 802.3, providing a way to list, display and examine content of individual fields in the captured packets;

##### 3.1.3. PON プロトコルアナライザ (PON Protocol Analyzer)

The PON Protocol Analyzer is a device that is connected to the ODN as shown in 3.2, and that supports the following functions:

- Capture of upstream packets, including MPCPDUs, OAMPDUs, eOAMPDUs, and data frames, as specified in IEEE Std 802.3, and IEEE Std 1904.1, transmitted by any of the connected ONUs towards the OLT.
  - Capture of downstream packets, including MPCPDUs, OAMPDUs, eOAMPDUs, and data frames, as specified in IEEE Std 802.3, and IEEE Std 1904.1, transmitted by the OLT towards any of the connected ONUs.
  - Simultaneous capture of the downstream and upstream packets i.e., support at least two capture interfaces, one of which is configured to capture upstream packets and the other is configured to capture downstream packets.
-



- Analysis of the content of the captured packets, including a capability to examine and display/output the content of individual fields in the captured packets.

The PON Protocol Analyzer does not modify the content of any upstream or downstream packets. Additionally, when connected to the ODN, this device does not increase the channel insertion loss in a way that would cause it to exceed the maximum channel insertion loss value specified in 3.1.5.

#### 3.1.4. パケットジェネレータ (Packet Generator)

The Packet Generator is a device, which is connected to the OLT NNI and ONU UNI interfaces in a way defined in more details in 3.2, and supports the following functions:

- generates a pre-defined number of data packets of pre-configured type, meeting specific packet size distribution and type requirements, as configured on the device using the user interface;
- provides a user interface for configuration of the following (examples) parameters of the packet stream:
  - number of packets to be generated (specific number, continuous mode, burst mode etc.);
  - type(s) of packets to be generated (OAMPDU, MPCPDU, eOAMPDU, IPv4 packets, IPv6 packets etc.);
  - packet size distribution in case of IP packets, using a predefined or random packet size distribution;
- provides a user interface for configuration of specific packet types i.e. constriction of specific packet types based on configuration of specific fields in the packet through assignment of user-provided values to such fields as EtherType, Size, Payload, VLANs etc.

The Packet Generator is not connected to the ODN and does not influence the loss observed between the OLT\_MDI and ONU\_MDI interfaces. This device may be connected to the OLT NNI and ONU UNI via copper or fiber links, depending on the interface types supported on the OLT and ONUs under test.

#### 3.1.5. ODN

Testing conformance of the optical distribution network (ODN) with the respective IEEE Std 802.3 requirements is outside of the scope of this conformance plan. Various aspects of physical layer transmission e.g. target sensitivities, launch powers, immunity to dispersion etc. are not part of the conformance tests.

However, to guarantee smooth execution of any conformance tests described in this standard, a set of basic requirements regarding the ODN is needed to make sure that stable data link can be established between the OLT and ONUs. In this way, optimum operating conditions can be achieved, resulting in a minimum packet loss required by some of the tests.

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The target channel insertion loss for the ODN used during the conformance tests under this standard is recommended to range between 15 dB and 20 dB. The ODN can be realized by connecting the splitter with either fiber cables of appropriate length or attenuators to achieve the minimum required channel insertion loss of 15 dB. The recommended split ratio for PS (see 3.2 for more details) is 2:16. The recommended maximum distance between the OLT and the furthest ONU is 20 km, to limit the observed signal dispersion. During the design of the ODN for conformance testing under this standard, the loss introduced by the PON Protocol Analyzer needs to be accounted for.

Special care should be taken to guarantee the minimum channel insertion loss for the ODN, especially in case of 10G-EPON devices subject to conformance tests. Specific requirements for the minimum channel insertion loss for specific PMDs can be found in IEEE Std 802.3, Clause 75 for 10G-EPON devices and Clause 60 for 1G-EPON devices

## 3.2. 試験構成

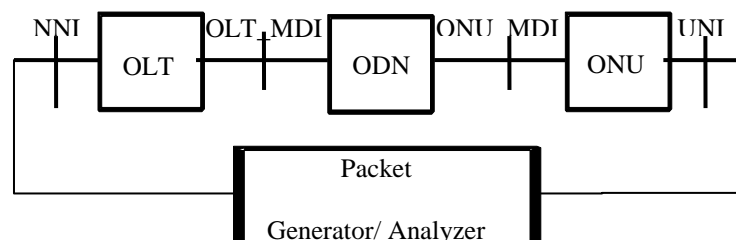
### 3.2.1. イントロダクション

This subclause outlines the common test configuration used by individual conformance test cases defined in Clause 4.

Individual test case covered in Clause 4 may specify their own modified test configurations, as needed, building from the generic test configurations defined in the following subclauses.

### 3.2.2. 単体 ONU 接続時の試験系 (PON プロトコルアナライザ不使用)

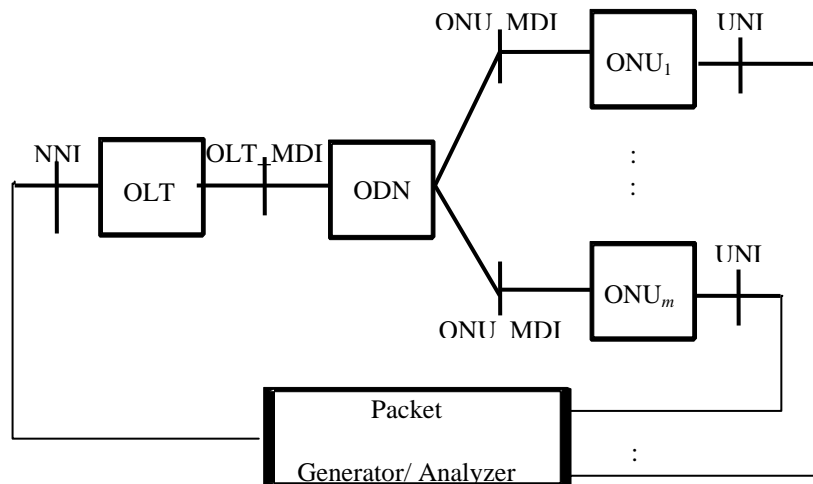
- (1) Use a dedicated private network which is isolated from a local area network used for general communication.
- (2) Figure 3-1 shows connections among components required for the test.



**Figure 3-1— Test equipment configuration**

### 3.2.3. 複数 ONU 接続時の試験系 (PON プロトコルアナライザ不使用)

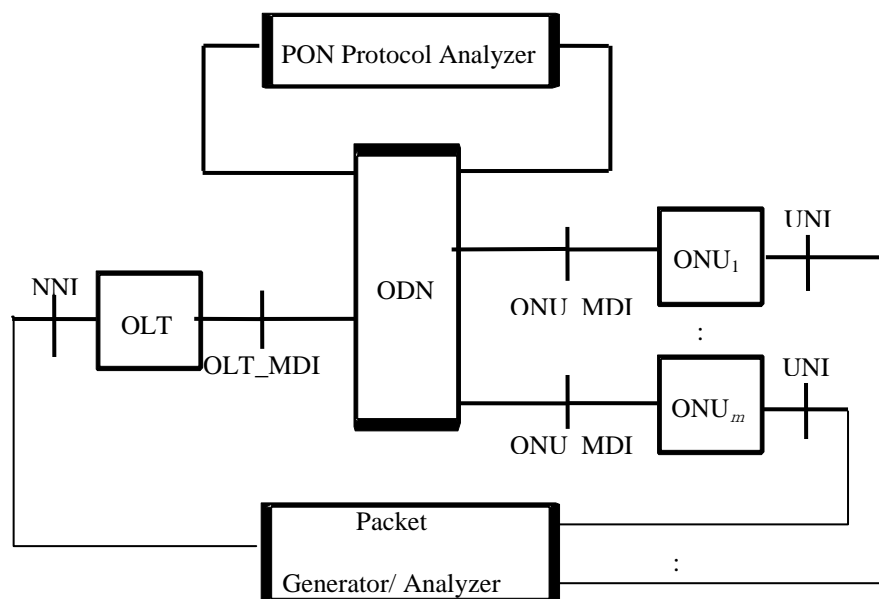
- (1) Use a dedicated private network which is isolated from a local area network used for general communication.
- (2) Figure 3-2 shows connections among components required for the test.



**Figure 3-2 Test equipment configuration in the case with multiple ONUs**

### 3.2.4. 複数 ONU 接続時の試験系 (PON プロトコルアナライザ使用)

- (1) Use a dedicated private network which is isolated from a local area network used for general communication.
- (2) Figure 3-3 shows connections in case of using PON Protocol Analyzer.



**Figure 3-3 Test equipment configuration in the case with multiple ONUs, with PON Protocol Analyzer**

## 4. 相互接続試験

This section consists from; general instruction in Section 4.1 and individual test cases in the followed by section from 4.2 and after.

### 4.1. イントロダクション

On the date arranged beforehand, the test must be conducted according to the procedures described in the Section 4.2 and after. It is requested to execute the test following to the listed order of the sections of test case descriptions.

The combination of the participants will be arranged in a round robin manner.

Note that the interoperability test between the products made by the same manufacturer is assumed to have been completed prior to the interoperability test and it is not included in the combination.

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## 4.2. Group DCD: Device and capability discovery

### 4.2.1. eOAM 及び capability discovery process 試験

This test case group covers verification of the interoperability for the negotiation flow between OLT and ONU to establish the data channel.

#### 4.2.1.1. 試験環境及び構成

Test configuration per 3.2.2 shall be used to complete this test case.

#### 4.2.1.2. 試験概要

This test verifies DUTs compliance with;

- OAM discovery process defined in IEEE Std 1904.1, 12.2.2.1, including the sequence, format and values of *Information* OAMPDU generated by DUTs.

Specifically, the following conditions are tested:

- Successful completion of OAM discovery process with a correct *Local Information* TLV.

#### 4.2.1.3. 試験手順及び期待される結果

##### Start of Test

##### Step 1 Initial configuration and provisioning

- 1.1 Connect all equipment as defined in the test setup configuration per 4.2.1.1.
- 1.2 Power on DUTs, allow DUTs to complete IEEE Std 802.3 MPCP discovery process.

##### Step 2 Successful IEEE Std 802.3 Clause57 OAM discovery process

- 2.1 The OAM discovery process defined in IEEE Std 802.3, Clause 57 is executed.

**Expected result 1:** *The OAM discovery process shall succeed. OLT and ONU shall keep OAM link for 60 seconds.*

End of Test

---

### 4.3. Group UVM/TVM: ONU/OLT VLAN mode

#### 4.3.1. UVM/TVM 試験

This test case group covers verification of the interoperability for the data transmission associated with the following VLAN modes, as defined in IEEE Std 1904.1, 7.2.2.1, namely:

- ONU Tagging VLAN mode; and
- OLT Translation VLAN mode.

##### 4.3.1.1. 試験環境及び構成

Test configuration per 3.2.2 shall be used to complete this test case.

ONU with one or more UNIs is connected to the packet generator/analyzer. Individual ports are designated as  $UNI_x$ , where  $x$  corresponds to the port number, as reported by ONU. OLT is connected to the packet generator/analyzer via the NNI.

For the purpose of this test, ONU and OLT are configured to operate in the following configurations.

ONU configurations:

- Authentication: disabled
- Encryption: disabled
- VLAN mode: ONU Tagging VLAN mode
- VLAN based multicast filtering: disabled
- MAC address based multicast filtering: disabled

OLT configurations:

- Authentication: disabled
  - Encryption: disabled
  - VLAN mode: OLT Translation VLAN mode
  - VLAN based multicast filtering: disabled
  - MAC address based multicast filtering: disabled
-

The provisioning for ONU and OLT may use vendor-specific mechanisms and are outside the scope of this test case.

Both Authentication and Encryption are disabled for the ONU and the OLT, and are not tested in this test case. In this test, ONU and OLT do not perform authentication after the registration process and data transmission between ONU and OLT is realized as defined in IEEE Std 802.3 without encryption mechanism.

The packet generator is configured to generate flows of Ethernet frames with or without VLAN tags. The flows of Ethernet frames are shown in Table 4-1 for the upstream direction and in Table 4-2 for the downstream direction. Each flow consists of K packets (K=2000). The size of each Ethernet frame is 1000 octets. The order of frames belonging to different flows in the aggregated stream is not specified.

**Table 4-1 Test flow in the upstream direction for packet generator**

#	DA	SA <sup>a</sup>	VLAN0-VID
1	0x90-82-60-22-22-00	0x90-82-60-11-11-UNI <sub>N</sub>	not present

<sup>a)</sup> The lowest octet in the MAC is derived from the UNI<sub>N</sub> number, represented in a 1 octet-wide format. For example, for UNI<sub>1</sub>, the MAC is equal to 0x90-82-60-11-11-01, for UNI<sub>21</sub>, the MAC is equal to 0x90-82-60-11-11-15.

**Table 4-2 Test flow in the downstream direction for packet generator**

#	DA <sup>b</sup>	SA	VLAN0-VID <sup>a</sup>
1	0x90-82-60-11-11-UNI <sub>N</sub>	0x90-82-60-22-22-00	0x2-00

<sup>a)</sup> The remaining fields in the VLAN0 tag shall use IEEE Std 802.1Q-compliant values (default values)

<sup>b)</sup> The lowest octet in the MAC is derived from the UNI<sub>N</sub> number, represented in a 1 octet-wide format. For example, for UNI<sub>1</sub>, the MAC is equal to 0x90-82-60-11-11-01, for UNI<sub>21</sub>, the MAC is equal to 0x90-82-60-11-11-15.

#### 4.3.1.2. 試験概要

This test verifies the interoperability for the data transmission between ONU and OLT when configured in the specific VLAN modes. Specifically, the following conditions are tested:

- Interoperability for the upstream and downstream data transmission when ONU is operating in the ONU Tagging VLAN mode, and OLT is operating in the OLT Translation VLAN mode, per IEEE Std 1904.1, 7.2.2.1.



### 4.3.1.3. 試験手順及び期待される結果

#### Start of Test

##### Step 1 Initial configuration and provisioning

- 1.1 Connect all equipment as defined in the test setup configuration per 4.3.1.1.
- 1.2 Configure the PON-VID value to 0x100 for ONU, as defined in IEEE Std 1904.1, 7.2.2.1.4. Configure the user-side VID value to 0x100 and the network-side VID value to 0x200 for the given LLID for OLT, as defined in IEEE Std 1904.1, 7.2.2.1.5.
- 1.3 Reboot ONU or connect the PON link between ONU and OLT to allow ONU to register at OLT.

##### Step 2 VLAN mode configuration tests, upstream direction

- 2.1 Start the packet analyzer. Start the packet generator in the upstream direction, transmitting the test flow per Table 4-1 simultaneously across each UNI<sub>N</sub> on ONU towards NNI on OLT. Allow the packet generator to complete its data trace for all UNI<sub>N</sub>.

**Expected result 1:** *Packet analyzer connected to NNI on OLT shall receive the following number and type of packets for each of frame flows from each UNI<sub>N</sub>, as defined in Table 4-3:*

— *K frames for each of frame flows per UNI on ONU.*

**Table 4-3— Packets received by the packet analyzer in the upstream direction**

#	DA	SA <sup>b</sup>	VLAN0-VID <sup>a</sup>
1	0x90-82-60-22-22-00	0x90-82-60-11-11-UNI <sub>N</sub>	0x2-00

<sup>a)</sup> The remaining fields in the VLAN0 tag shall use IEEE Std 802.1Q-compliant values (default values)

<sup>b)</sup> The lowest octet in the MAC is derived from the UNI<sub>N</sub> number, represented in a 1 octet-wide format. For example, for UNI<sub>1</sub>, the MAC is equal to 0x90-82-60-11-11-01, for UNI<sub>21</sub>, the MAC is equal to 0x90-82-60-11-11-15.

##### Step 3 VLAN mode configuration tests, downstream direction

- 3.1 Start the packet analyzer. Start the packet generator in the downstream direction, transmitting the test flow per Table 4-2 across NNI towards each UNI<sub>N</sub> on ONU. Allow the packet generator to complete its data trace for all UNI<sub>N</sub>.

**Expected result 2:** *Packet analyzer connected to each  $UNI_N$  on ONU shall receive the following number and type of packets for each of frame flows, as defined in Table 4-4:*

—  $K$  frames for each of frame flows per UNI on ONU.

**Table 4-4— Packets received by the packet analyzer in the downstream direction**

#	DA <sup>a</sup>	SA	VLAN0-VID
1	0x90-82-60-11-11- $UNI_N$	0x90-82-60-22-22-00	not present

<sup>a)</sup> The lowest octet in the MAC is derived from the  $UNI_N$  number, represented in a 1 octet-wide format. For example, for  $UNI_1$ , the MAC is equal to 0x90-82-60-11-11-01, for  $UNI_{21}$ , the MAC is equal to 0x90-82-60-11-11-15.

**End of Test**

#### 4.3.2. UVM/TVM, OLT 及び複数 ONU 間データ導通試験

This test case covers verification of the interoperability for the data transmission in the case that multiple ONUs under test are connected to a single OLT.

In addition, this test case also covers verification of the interoperability for the data transmission associated with the following VLAN modes, as defined in IEEE Std 1904.1, 7.2.2.1, namely:

- ONU Tagging VLAN mode; and
- OLT Translation VLAN mode.

##### 4.3.2.1. 試験環境及び構成

Test configuration per 3.2.3 shall be used to complete this test case.

ONU<sub>*m*</sub> with one or more UNIs is connected to the packet generator/analyzer via UNI<sub>*m,n(m)*</sub>, where *m* indicates the ONU number, and *n(m)* corresponds to the UNI number in ONU<sub>*m*</sub>, as reported by ONU. OLT is connected to the packet generator/analyzer via the NNI.

For the purpose of this test, ONUs and OLT are configured to operate in the following configurations.

ONU configurations:

- Authentication: disabled
- Encryption: disabled
- VLAN mode: ONU Tagging VLAN mode
- VLAN based multicast filtering: disabled
- MAC address based multicast filtering: disabled

OLT configurations:

- Authentication: disabled
  - Encryption: disabled
  - VLAN mode: OLT Translation VLAN mode
  - VLAN based multicast filtering: disabled
  - MAC address based multicast filtering: disabled
-

The provisioning for ONUs and OLT may use vendor-specific mechanisms and are outside the scope of this test case.

Both Authentication and Encryption are disabled for the ONUs and the OLT, and are not tested in this test case. In this test, ONUs and OLT do not perform authentication after the registration process and data transmission between multiple ONUs and OLT is realized as defined in IEEE Std 802.3 without encryption mechanism.

The packet generator is configured to generate flows of Ethernet frames with or without VLAN tags. The flows of Ethernet frames are shown in Table 4-5 for the upstream direction and in Table 4-6 for the downstream direction. Each test flow consists of  $K$  packets ( $K=2000$ ). The size of each Ethernet frame is 1000 octets. The order of frames belonging to different flows in the aggregated stream is not specified.

**Table 4-5 Test flow in the upstream direction for packet generator to UNI <sub>$m,n(m)$</sub>  port on ONU <sub>$m$</sub>**

Test flow number	DA	SA <sup>a</sup>	VLAN0-VID
1	0x90-82-60-22-22-00	0x90-82-60-11-11-UNI <sub><math>m,n(m)</math></sub>	not present

<sup>a)</sup> The lowest octet in the MAC is derived from the UNI <sub>$m,n(m)$</sub>  number, represented in a 1 octet-wide format. For example, for UNI <sub>$m,1$</sub> , the MAC is equal to 0x90-82-60-11-11-01, for UNI <sub>$m,21$</sub> , the MAC is equal to 0x90-82-60-11-11-15.

**Table 4-6 Test flows in the downstream direction for packet generator**

Test flow number	DA <sup>a,c</sup>	SA	VLAN0-VID <sup>a,b</sup>
1	0x90-82-60-11-11-UNI <sub><math>1,n(1)</math></sub>	0x90-82-60-22-22-00	0x2-01
2	0x90-82-60-11-11-UNI <sub><math>2,n(2)</math></sub>	0x90-82-60-22-22-00	0x2-02
:	:	:	:
$m$	0x90-82-60-11-11-UNI <sub><math>m,n(m)</math></sub>	0x90-82-60-22-22-00	0x2-ONU <sub><math>m</math></sub>

<sup>a)</sup>  $m$  represents ONU number.

<sup>b)</sup> The remaining fields in the VLAN0 tag shall use IEEE Std 802.1Q-compliant values (default values). The lowest octet in the VLAN0 VID is derived from the ONU number, represented in a 1 octet-wide format.

<sup>c)</sup> The lowest octet in the MAC is derived from the UNI <sub>$m,n(m)$</sub>  number, represented in a 1 octet-wide format. For example, for UNI <sub>$m,1$</sub> , the MAC is equal to 0x90-82-60-11-11-01, for UNI <sub>$m,21$</sub> , the MAC is equal to 0x90-82-60-11-11-15.

#### 4.3.2.2. 試験概要

This test verifies the interoperability for the data transmission between OLT and multiple ONUs when configured in the specific VLAN modes. Specifically, the following conditions are tested:

- Interoperability for the upstream and downstream data transmission when ONUs are operating in the ONU Tagging VLAN mode, and OLT is operating in the OLT Translation VLAN mode, per IEEE Std 1904.1, 7.2.2.1.

#### 4.3.2.3. 試験手順及び期待される結果

##### Start of Test

##### Step 1 Initial configuration and provisioning

- 1.1 Connect all equipment as defined in the test setup configuration per 4.3.2.1.
- 1.2 Configure the PON-VID value to 0x100 for all ONUs under test, as defined in IEEE Std 1904.1, 7.2.2.1.4. For the OLT, configure the user-side VID value to 0x100 and the network-side VID value to 0x2-ONU<sub>m</sub> for the ONU<sub>m</sub>, as defined in IEEE Std 1904.1, 7.2.2.1.5.
- 1.3 Reboot ONUs or connect the PON link between ONUs and OLT to allow ONUs to register at OLT.

##### Step 2 VLAN mode configuration tests, upstream direction

- 2.1 Start the packet analyzer. Start the packet generator in the upstream direction, transmitting the test flows per Table 4-5 simultaneously across each UNI<sub>m,n(m)</sub> on ONU<sub>m</sub> towards NNI on OLT. Allow the packet generator to complete its data trace for all UNI<sub>m,n(m)</sub>.

**Expected result 1:** *Packet analyzer connected to NNI on OLT shall receive the following number and type of packets for each of frame flows from each UNI<sub>m,n(m)</sub> of ONU<sub>m</sub>, as defined in Table 4-7:*

- *K frames for each of frame flows per UNI<sub>m,n(m)</sub> of ONU<sub>m</sub>.*

**Table 4-7— Packets received by the packet analyzer in the upstream direction**

Frame flow number	DA	SA <sup>a,c</sup>	VLAN0-VID <sup>a,b</sup>
1	0x90-82-60-22-22-00	0x90-82-60-11-11-UNI <sub>1,n(1)</sub>	0x2-01
2	0x90-82-60-22-22-00	0x90-82-60-11-11-UNI <sub>2,n(2)</sub>	0x2-02
:	:	:	:
M	0x90-82-60-22-22-00	0x90-82-60-11-11-UNI <sub>m,n(m)</sub>	0x2-ONU <sub>m</sub>

<sup>a)</sup>  $m$  represents ONU number.

<sup>b)</sup> The remaining fields in the VLAN0 tag shall use IEEE Std 802.1Q-compliant values (default values). The lowest octet in the VLAN0 VID is derived from the ONU number, represented in a 1 octet-wide format.

<sup>c)</sup> The lowest octet in the MAC is derived from the UNI<sub>m,n(m)</sub> port number, represented in a 1 octet-wide format. For example, for UNI<sub>m,1</sub>, the MAC is equal to 0x90-82-60-11-11-01, for UNI<sub>m,21</sub>, the MAC is equal to 0x90-82-60-11-11-15.

### Step 3 VLAN mode configuration tests, downstream direction

- 3.1 Start the packet analyzer. Start the packet generator in the downstream direction, transmitting the test flow per Table 4-6 across NNI towards each UNI<sub>m,n(m)</sub> on ONU<sub>m</sub>. Allow the packet generator to complete its data trace for all UNI<sub>m,n(m)</sub>.

**Expected result 2:** *Packet analyzer connected to each UNI<sub>m,n(m)</sub> on ONU<sub>m</sub> shall receive the following number and type of packets for each of frame flows, as defined in Table 4-8:*

—  $K$  frames for each of frame flows per UNI<sub>m,n(m)</sub> on ONU<sub>m</sub>.

**Table 4-8— Packets received by the packet analyzer in the downstream direction from UNI<sub>m,n(m)</sub> on ONU<sub>m</sub>**

Frame flow number	DA <sup>a</sup>	SA	VLAN0-VID
1	0x90-82-60-11-11-UNI <sub>m,n(m)</sub>	0x90-82-60-22-22-00	not present

<sup>a)</sup> The lowest octet in the MAC is derived from the UNI<sub>m,n(m)</sub> port number, represented in a 1 octet-wide format. For example, for UNI<sub>m,1</sub>, the MAC is equal to 0x90-82-60-11-11-01, for UNI<sub>m,21</sub>, the MAC is equal to 0x90-82-60-11-11-15.

**End of Test**

#### 4.4. Group MC: Multicast connectivity

This test case group covers verification of the interoperability for the multicast connectivity.

##### 4.4.1. マルチキャスト接続, マルチキャストデータ導通試験

This test case covers verification of the interoperability for the multicast data transmission associated with the following VLAN modes, as defined in IEEE Std 1904.1, 7.2.2.1, namely:

- ONU Tagging VLAN mode; and
- OLT Translation VLAN mode.

##### 4.4.1.1. 試験環境及び構成

Test configuration per 3.2.3 shall be used to complete this test case.

ONU<sub>*m*</sub> with one or more UNIs is connected to the packet generator/analyzer via UNI<sub>*m,n(m)*</sub>, where *m* indicates the ONU number, and *n(m)* corresponds to the UNI number in ONU<sub>*m*</sub>, as reported by ONU. OLT is connected to the packet generator/analyzer via the NNI.

For the purpose of this test, ONUs and OLT are configured to operate in the following configurations.

ONU configurations:

- Authentication: disabled
- Encryption: disabled
- VLAN mode: ONU Tagging VLAN mode
- VLAN based multicast filtering: disabled
- MAC address based multicast filtering: disabled

OLT configurations:

- Authentication: disabled
  - Encryption: disabled
  - VLAN mode: OLT Translation VLAN mode
  - VLAN based multicast filtering: disabled
  - MAC address based multicast filtering: disabled
-

The provisioning for ONUs and OLT may use vendor-specific mechanisms and are outside the scope of this test case.

Authentication and Encryption are disabled for the ONUs and the OLT, and are not tested in this test case. In this test, ONUs and OLT do not perform authentication after the registration process and data transmission between multiple ONUs and OLT is realized as defined in IEEE Std 802.3 without encryption mechanism.

The packet generator is configured to generate flows of Ethernet frames with VLAN tags. The flows of Ethernet frames are shown in Table 4-9 for the downstream direction. Each test flow consists of  $K$  packets ( $K=2000$ ). The size of each Ethernet frame is 1000 octets. The order of frames belonging to different flows in the aggregated stream is not specified.

**Table 4-9 Test flow in the downstream direction for packet generator**

Test flow number	DA	SA	VLAN0-VID <sup>a</sup>
1	0x33-33-00-01-00-00	0x90-82-60-22-22-00	0x4-00

<sup>a)</sup> The remaining fields in the VLAN0 tag shall use IEEE Std 802.1Q-compliant values (default values).

#### 4.4.1.2. 試験概要

This test verifies the interoperability for the multicast data transmission from OLT to ONUs, when configured in the specific VLAN modes. Specifically, the following conditions are tested:

- Interoperability for the multicast data transmission when ONUs are operating in the ONU Tagging VLAN mode, and OLT is operating in the OLT Translation VLAN mode, per IEEE Std 1904.1, 7.2.2.1.

#### 4.4.1.3. 試験手順及び期待される結果

##### Start of Test

##### Step 1 Initial configuration and provisioning

- 1.1 Connect all equipment as defined in the test setup configuration per 4.4.1.1.
- 1.2 For the OLT, configure the allowed network-side multicast VID value to 0x4-00 and the user-side multicast VID value to 0x8-00, as defined in IEEE Std 1904.1, 7.2.2.1.5.
- 1.3 Reboot ONUs or connect the PON link between ONUs and OLT to allow ONUs to register at OLT.



**Step 2 Multicast transmission test**

- 2.1 Start the packet analyzer. Start the packet generator in the downstream direction, transmitting the test flow per Table 4-9 across NNI towards each  $UNI_{m,n(m)}$  on  $ONU_m$ . Allow the packet generator to complete its data trace for all  $UNI_{m,n(m)}$ .

**Expected result 1:** *Packet analyzer connected to each  $UNI_{m,n(m)}$  on  $ONU_m$  shall receive the following number and type of packets for each of frame flows, as defined in Table 4-10:*

—  $K$  frames for each of frame flows per  $UNI_{m,n(m)}$  of  $ONU_m$ .

**Table 4-10— Packets received by the packet analyzer in the downstream direction  
 $UNI_{m,n(m)}$  on  $ONU_m$**

Frame flow number	DA	SA	VLAN0-VID
1	0x33-33-00-01-00-00	0x90-82-60-22-22-00	not presented

**End of Test**

#### 4.5. Group DE: Data Encryption

This test case group covers verification of the interoperability for data encryption process as defined in IEEE Std 1904.1, 11.2.3.

##### 4.5.1. データ暗号化, IEEE Std 802.1ae-2006 正常終了試験

###### 4.5.1.1. 試験環境及び構成

Test configuration per 3.2.3 shall be used to complete this test case.

ONU<sub>*m*</sub> with one or more UNIs is connected to the packet generator/analyzer via UNI<sub>*m,n(m)*</sub>, where *m* indicates the ONU number, and *n(m)* corresponds to the UNI number in ONU<sub>*m*</sub>, as reported by ONU. The OLT is connected to the packet generator/analyzer via the NNI.

For the purpose of this test, ONU and OLT are configured to operate in the following configurations.

ONU configurations:

- Authentication: disabled
- Encryption: enabled
- VLAN mode: ONU Tagging VLAN mode
- VLAN based multicast filtering: disabled
- MAC address based multicast filtering: disabled

OLT configurations:

- Authentication: disabled
- Encryption: enabled
- VLAN mode: OLT Translation VLAN mode
- VLAN based multicast filtering: disabled
- MAC address based multicast filtering: disabled

In this test case, key exchange is disabled for the ONUs and the OLT, and is not tested. The fixed key and parameters are provisioned for each ONU and OLT. Both upstream and downstream encryptions are enabled. The same key and parameters are used in both directions.

Other configurations for encryption are as follows.

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- Security TAG: short
- Confidential offset: disabled

The provisioning for ONU and OLT may use vendor-specific mechanisms and are outside the scope of this test case.

Authentication is disabled for the ONU and the OLT, and is not tested in this test case. In this test, ONU and OLT do not perform authentication after the registration process.

The packet generator is configured to generate flows of Ethernet frames with or without VLAN tags. The flows of Ethernet frames are shown in Table 4-11 for the upstream direction and in Table 4-12 for the downstream direction. Each test flow consists of  $K$  packets ( $K = 2000$ ). The size of each Ethernet frame is 1000 octets. The order of frames belonging to different flows in the aggregated stream is not specified.

**Table 4-11 Test flow in the upstream direction for packet generator to UNI <sub>$m,n(m)$</sub>  on ONU <sub>$m$</sub>**

Test flow number	DA	SA <sup>a</sup>	VLAN0-VID
1	0x90-82-60-22-22-00	0x90-82-60-11-11-UNI <sub><math>m,n(m)</math></sub>	not present

<sup>a)</sup> The lowest octet in the MAC is derived from the UNI <sub>$m,n(m)$</sub>  number, represented in a 1 octet-wide format. For example, for UNI <sub>$m,1$</sub> , the MAC is equal to 0x90-82-60-11-11-01, for UNI <sub>$m,21$</sub> , the MAC is equal to 0x90-82-60-11-11-15.

**Table 4-12 Test flows in the downstream direction for packet generator**

Test flow number	DA <sup>a,c</sup>	SA	VLAN0-VID <sup>a,b</sup>
1	0x90-82-60-11-11-UNI <sub><math>1,n(1)</math></sub>	0x90-82-60-22-22-00	0x2-01
2	0x90-82-60-11-11-UNI <sub><math>2,n(2)</math></sub>	0x90-82-60-22-22-00	0x2-02
:	:	:	:
$M$	0x90-82-60-11-11-UNI <sub><math>m,n(m)</math></sub>	0x90-82-60-22-22-00	0x2-ONU <sub><math>m</math></sub>

<sup>a)</sup>  $m$  represents ONU number.

<sup>b)</sup> The remaining fields in the VLAN0 tag shall use IEEE Std 802.1Q-compliant values (default values). The lowest octet in the VLAN0 VID is derived from the ONU number, represented in a 1 octet-wide format.

<sup>c)</sup> The lowest octet in the MAC is derived from the UNI <sub>$m,n(m)$</sub>  number, represented in a 1 octet-wide format. For example, for UNI <sub>$m,1$</sub> , the MAC is equal to 0x90-82-60-11-11-01, for UNI <sub>$m,21$</sub> , the MAC is equal to 0x90-82-60-11-11-15.

### 4.5.1.2. 試験概要

This test case covers verification of the interoperability for the successful data encryption and decryption defined in IEEE Std 1904.1 11.2.3.

### 4.5.1.3. 試験手順及び期待される結果

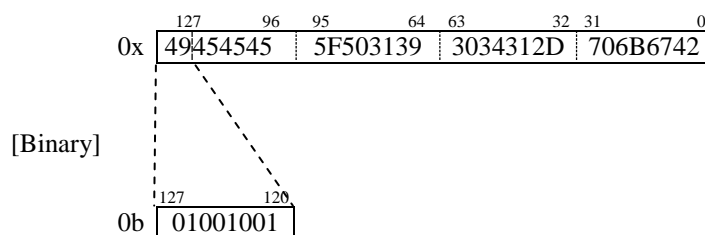
#### Start of Test

#### Step 1 Initial configuration and provisioning

- 1.1 Connect all equipment as defined in the test setup configuration per 4.5.1.1.
- 1.2 Configure the PON-VID value to 0x1-00 for all ONUs under test, as defined in IEEE Std 1904.1, 7.2.2.1.4. For the OLT, configure the user-side VID value to 0x1-00 and the network-side VID value to 0x2-ONU<sub>m</sub> for the ONU<sub>m</sub>, as defined in IEEE Std 1904.1, 7.2.2.1.5.
- 1.3 Configure the OLT with the following settings.

- Secure Association Key (SAK) for all ONU is “IEEE\_P19041-pkgB”, UTF-8 string, without a null or other termination, exactly 16-octet length. The hexadecimal value and the transmission bit ordering of SAK are shown in Figure 4-1.

[Hexadecimal]



**Figure 4-1— Hexadecimal value and transmission bit ordering of SAK**

- Association Number (AN) for all ONU is fixed and the value is 0.
  - Secure Channel Identifier (SCI) for ONU<sub>m</sub>: The same SCI value is used in the upstream and the downstream channels for the ONU<sub>m</sub>. Octets 1 through 6 are OLT MAC address. Octets 7 through 8 vary and depend on the OLT. Thus the OLT operator is expected to notify the ONU<sub>m</sub> operator of the entire value of SCI.
- 1.4 Configure the ONU<sub>m</sub> with the following setting.

- SAK is “IEEE\_P19041-pkgB”, UTF-8 string, without a null or other termination, exact 16-octet length.
  - AN is fixed and the value is zero (0).
  - SCI is the value given by the OLT operator, i.e., the same SCI value is used for the upstream and the downstream channels both at the ONU<sub>m</sub> and at the OLT.
- 1.5 Reboot ONUs or connect the PON link between ONUs and the OLT to allow ONUs to register at the OLT.

## Step 2 Successful data encryption in upstream direction

- 2.1 Start the packet analyzer. Start the packet generator in the upstream direction, transmitting the test flows per Table 4-11 simultaneously across each UNI<sub>m,n(m)</sub> on ONU<sub>m</sub> towards the NNI on the OLT. Allow the packet generator to complete its data trace for all UNI<sub>m,n(m)</sub>.

**Expected result 1:** *Packet analyzer connected to the NNI on the OLT shall receive the following number and type of packets for each of frame flows from each UNI<sub>m,n(m)</sub> of ONU<sub>m</sub>, as defined in Table 4-13:*

- *K frames for each of frame flows per UNI<sub>m,n(m)</sub> of ONU<sub>m</sub>.*

**Table 4-13— Packets received by the packet analyzer in the upstream direction**

Frame flow number	DA	SA <sup>a,c</sup>	VLAN0-VID <sup>a,b</sup>
1	0x90-82-60-22-22-00	0x90-82-60-11-11-UNI <sub>1,m(1)</sub>	0x2-01
2	0x90-82-60-22-22-00	0x90-82-60-11-11-UNI <sub>2,m(2)</sub>	0x2-02
⋮	⋮	⋮	⋮
<i>M</i>	0x90-82-60-22-22-00	0x90-82-60-11-11-UNI <sub>m,n(m)</sub>	0x2-ONU <sub>m</sub>

<sup>a)</sup> *m* represents ONU number.

<sup>b)</sup> The remaining fields in the VLAN0 tag shall use IEEE Std 802.1Q-compliant values (default values). The lowest octet in the VLAN0 VID is derived from the ONU number, represented in a 1 octet-wide format.

<sup>c)</sup> The lowest octet in the MAC is derived from the UNI<sub>m,n(m)</sub> number, represented in a 1 octet-wide format. For example, for UNI<sub>m,1</sub>, the MAC is equal to 0x90-82-60-11-11-01, for UNI<sub>m,21</sub>, the MAC is equal to 0x90-82-60-11-11-15.

## Step 3 Successful data encryption in downstream direction

- 3.1 Start the packet analyzer. Start the packet generator in the downstream direction, transmitting the test flow per Table 4-12 across the NNI towards each  $UNI_{m,n(m)}$  on  $ONU_m$ . Allow the packet generator to complete its data trace for all  $UNI_{m,n(m)}$ .

**Expected result 2:** *Packet analyzer connected to each  $UNI_{m,n(m)}$  on  $ONU_m$  shall receive the following number and type of packets for each of frame flows, as defined in Table 4-14:*

—  $K$  frames for each of frame flows per  $UNI_{m,n(m)}$  on  $ONU_m$ .

**Table 4-14— Packets received by the packet analyzer in the downstream direction from  $UNI_{m,n(m)}$  on  $ONU_m$**

Frame flow number	DA <sup>a</sup>	SA	VLAN0-VID
1	0x90-82-60-11-11- $UNI_{m,n(m)}$	0x90-82-60-22-22-00	not present

<sup>a)</sup> The lowest octet in the MAC is derived from the  $UNI_{m,n(m)}$  number, represented in a 1 octet-wide format. For example, for  $UNI_{m,1}$ , the MAC is equal to 0x90-82-60-11-11-01, for  $UNI_{m,21}$ , the MAC is equal to 0x90-82-60-11-11-15.

**End of Test**

## 4.6. Group MG: Management

This test case group covers verification of the interoperability for eOAM management as defined in IEEE Std 1904.1, 13.1, 13.3, and 14.3.

### 4.6.1. eOAM 成功シーケンス及びメッセージフォーマット試験

#### 4.6.1.1. 試験環境及び構成

Test configuration per 3.2.3 shall be used to complete this test case. If PON Protocol Analyzer is available, test configuration per 3.2.4 may be used.

In this test case, ONUs shall operate in ReturnCode mode, as defined in IEEE Std 1904.1, 13.3.3.4. Each eOAMPDU shall contain no more than one TLV, i.e., does not contain *Object\_ID* TLV.

#### 4.6.1.2. 試験概要

This test verifies the interoperability for the eOAM sequence and message format between OLT and ONUs. Specifically, the following conditions are tested:

- To get *ONU System Info* TLV (0xB7/0x00-40), as defined in IEEE Std 1904.1, 14.3.1.37, using *GetRequest/GetResponse* eOAMPDU,
- To set *VLAN Mode* TLV (0xB7/0x00-0B), as defined in IEEE Std 1904.1, 14.3.1.5, using *SetRequest/SetResponse* eOAMPDU, and
- To set *PON-VID Value* TLV (0xB7/0x00-15), as defined in IEEE Std 1904.1, 14.3.1.13, using *SetRequest/SetResponse* eOAMPDU.

#### 4.6.1.3. 試験手順及び期待される結果

##### Start of Test

##### Step 1 Initial configuration and provisioning

- 1.1 Connect all equipment as defined in the test setup configuration per 4.6.1.1.
- 1.2 Reboot ONUs or connect the PON link between ONUs and OLT to allow ONUs to register at OLT.

##### Step 2 eOAM sequence and message format test, *GetRequest/GetResponse* eOAMPDU

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- 2.1 Configure the OLT to send the *GetRequest* eOAMPDU to get *ONU System Info* TLV (0xB7/0x00-40) to a given ONU.

**Expected result 1:** *The OLT shall transmit GetRequest eOAMPDU.*

The verification of this step may use vendor-specific mechanisms or PON Protocol Analyzer and is outside the scope of this test case. Also, at the following expected results, the verification methodology is outside the scope of this test case.

- 2.2 Wait at least 1 second.

**Expected result 2:** *The ONU shall transmit GetResponse eOAMPDU including ONU System Info TLV without any error codes. The value of TLV shall be the same as the ONU responds.*

- 2.3 Repeat step 2.1 to 2.2 for each ONU.

### **Step 3 eOAM sequence and message format test, *SetRequest/SetResponse* eOAMPDU**

- 3.1 Configure the OLT to send the *SetRequest* eOAMPDU to set *VLAN Mode* TLV (0xB7/0x00-0B) to a given ONU.

**Expected result 3:** *The OLT shall transmit SetRequest eOAMPDU.*

- 3.2 Wait at least 1 second.

**Expected result 4:** *The ONU shall transmit SetResponse eOAMPDU without any error codes.*

- 3.3 Configure the OLT to send the *SetRequest* eOAMPDU to set *PON-VID Value* TLV (0xB7/0x00-15) to the ONU.

**Expected result 5:** *The OLT shall transmit SetRequest eOAMPDU.*

- 3.4 Wait at least 1 second.

**Expected result 6:** *The ONU shall transmit SetResponse eOAMPDU without any error codes.*

- 3.5 Repeat step 3.1 to 3.4 for each ONU.

**End of Test**

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#### 4.7. 試験の結果判定

第4.2章～第 4.6 章の試験手順に記載される “Expected Result” を満足した場合、合格とする。なお合格判定は項目ごとに行う。

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#### 4.8. 試験結果のとりまとめ

期待値を記載する各試験ステップにおいて、試験結果を本書末尾に添付されている 別紙 光アクセスネットワーク装置相互接続試験結果 チェックリスト に記録すること。試験実施中に確認された失敗並びにエラーとその詳細（現象、状況、原因、対応策等）につき、別紙に記載すること。

本文書に添付の装置構成シートに、試験に用いた OLT および ONU の組み合わせを記録すること。

被験者が再試験を希望する場合、その要望につき別紙のノート欄に記載すること。

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## 5. 結果の取り扱いと今後の検討課題

### 5.1. 結果の取り扱い

参加者より提供された相互接続試験の結果については、HATS 実施推進部会・光アクセス相互接続試験実施連絡会が収集し取りまとめる。取りまとめた試験結果は、試験効率、手順、方法、運用、等の相互接続試験の改善に役立てるために使用される。

原則として整理した試験結果につき、参加者の合意の基、公開する場合がある。

相互接続試験実施時に生じた、試験ガイドラインに対する要望・提案については、その採否を判断する機関である HATS 実施推進部会・光アクセス相互接続試験実施連絡会に随時報告のこと。

### 5.2. その他

試験により確認された標準規定内容の問題等については、適宜標準化活動へのフィードバックを検討する。

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## 別紙 光アクセスネットワーク装置相互接続試験結果 チェックリスト

## Recorder

OLT		ONU	
Name		Name	
Affiliation		Affiliation	
TEL		TEL	
FAX		FAX	

Date and Time: [ \_\_\_\_\_ (YYYY/MM/DD) From \_\_\_\_:\_\_\_\_ To \_\_\_\_:\_\_\_\_ (HH:MM)]

Testing Site: [ \_\_\_\_\_ ]

Test Configuration [ \_\_\_\_\_ ]

OLT: [Manufacture: \_\_\_\_\_ Model No: \_\_\_\_\_ ]

ONU: [Manufacture: \_\_\_\_\_ Model No: \_\_\_\_\_ ]

Group	Step	Sub-Step	IEEE Std 1904.1 PICS List	Pass/Fail	Note
4.2 DCD	1	1.1	NA	NA	
		1.2	NA	NA	
	2	2.1	BU-DCD0 BU-DCD1 BT-DCD0 BT-DCD1		
4.3.1 UVM/TVM	1	1.1	NA	NA	
		1.2	NA	NA	
		1.3	NA	NA	
	2	2.1	BU-UVM3c BT-TVM4b		
	3	3.1	BU-UVM3a BT-TVM4a		
4.3.2 UVM/TVM with multiple ONUs	1	1.1	NA	NA	
		1.2	NA	NA	
		1.3	NA	NA	
	2	2.1	BU-UVM3c BT-TVM4b		
	3	3.1	BU-UVM3a BT-TVM4a		
4.4 MC	1	1.1	NA	NA	
		1.2	NA	NA	
		1.3	NA	NA	
	2	2.1	BU-UVM3c BT-TVM4b		

Group	Step	Sub-Step	IEEE Std 1904.1 PICS List	Pass/Fail	Note	
4.5 DE	1	1.1	NA	NA		
		1.2	NA	NA		
		1.3	NA	NA		
		1.4	NA	NA		
		1.5	NA	NA		
	2	2.1	BU-DE0			
			BU-DE1			
	BU-DE3					
	BT-DE0					
	BT-DE1					
BT-DE3						
3	3.1	BU-DE0				
		BU-DE1				
BU-DE3						
BT-DE0						
BT-DE1						
BT-DE3						

Group	Step	Sub-Step	IEEE Std1904.1 PICS List	Pass/Fail	Note	
4.6 MG	1	1.1	NA	NA		
		1.2	NA	NA		
	2	2.1	BT-MG0			
			BT-MG1			
			BT-MG2			
			BT-MG3			
			BT-MG4			
			BT-MG7			
	2.2	2.2	BU-MG0			
			BU-MG1			
BU-MG2						
BU-MG3a						
BU-MG4						
BU-MG5						
BU-MG6						
BU-MG7						
BU-MG8a						
BU-MG8b						
BU-ME38						

Group	Step	Sub-Step	IEEE Std1904.1 PICS List	Pass/Fail	Note
		2.3	BT-MG0 BT-MG1 BT-MG2 BT-MG3 BT-MG4 BT-MG7 BT-ME38 BU-MG0 BU-MG1 BU-MG2 BU-MG3a BU-MG4 BU-MG5 BU-MG6 BU-MG7 BU-MG8a BU-MG8b BU-ME38		
	3	3.1	BT-MG0 BT-MG1 BT-MG2 BT-MG3 BT-MG5 BT-MG9 BT-ME6		
		3.2	BU-MG0 BU-MG1 BU-MG2 BU-MG3a BU-MG4 BU-MG5 BU-MG6 BU-MG10a BU-MG10b BU-MG10c BU-MG26a BU-MG26b BU-MG26c BU-ME6		
		3.3	BT-MG0 BT-MG1 BT-MG2 BT-MG3 BT-MG5 BT-MG9 BT-ME14		

Group	Step	Sub-Step	IEEE Std1904.1 PICS List	Pass/Fail	Note
		3.4	BU-MG0 BU-MG1 BU-MG2 BU-MG3a BU-MG4 BU-MG5 BU-MG6 BU-MG10a BU-MG10b BU-MG10c BU-MG26a BU-MG26b BU-MG26c BU-ME14		
		3.5	BT-MG0 BT-MG1 BT-MG2 BT-MG3 BT-MG5 BT-MG9 BT-ME6 BT-ME14 BU-MG0 BU-MG1 BU-MG2 BU-MG3a BU-MG4 BU-MG5 BU-MG6 BU-MG10a BU-MG10b BU-MG10c BU-MG26a BU-MG26b BU-MG26c BU-ME6 BU-ME14		

Note

Description for Observed Issues .....

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**添付資料**      **装置構成シート**

[Test Configuration #1]

OLT: \_\_\_\_\_

ONUs: \_\_\_\_\_

[Test Configuration #2]

OLT: \_\_\_\_\_

ONUs: \_\_\_\_\_

[Test Configuration #3]

OLT: \_\_\_\_\_

ONUs: \_\_\_\_\_

[Test Configuration #4]

OLT: \_\_\_\_\_

ONUs: \_\_\_\_\_

Note: Add a sheet(s) for the test configuration when filled up.

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