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| **Title:** | | | Draft Amendment 1 to Recommendation ITU-T G.8275.1/Y.1369.1 (for consent) | | |
| **Purpose:** | | | Discussion | | |
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| **Keywords:** | Insert keywords separated by semicolon (;) |
| **Abstract:** | This document contains the latest draft of the Recommendation G.8275.1 Amendment 1, as agreed during the SG 15 meeting held in Geneva, 19-30 June 2017. |

Draft Amendment 1 to Recommendation ITU-T G.8275.1/Y.1369.1 (2016)

Precision time protocol telecom profile for phase/time synchronization   
with full timing support from the network – Amendment 1

Summary

Amendment 1 to Recommendation ITU-T G.8275.1 (2016/06) provides the following updates:

* Added G.8271 to references
* Addition of a new definition: Special Port
* Clarification on the use of logMessageInterval in Delay\_Resp messages
* Clarification on the behaviour of the T-BC Announce message contents when the T-BC has a parent clock.
* Incremented the minor revision number of the profileVersion
* Correction to the handling of the alternateMasterFlag
* Added informative text on the handling of the synchronizationUncertain flag (Annex E)
* Added monitoring of a PTP MASTER port by a PTP PASSIVE port (Annex G)
* Updates to Announce message fields of currentUtcOffset and synchronizationUncertain when using PTP clock states (Appendix V)
* Update of Appendix VII
* Added informative use cases for the use of the priority2 attribute (Appendix X)
* Added considerations on native access equipment (Appendix XI)
* Added monitoring alternate master time information provided by a peer PTP port (Appendix XII)

Draft Amendment 1 to Recommendation ITU-T G.8275.1/Y.1369.1 (2016)

Precision time protocol telecom profile for phase/time synchronization   
with full timing support from the network – Amendment 1

### 1 Clause 2 References

*Add the following reference:*

[ITU-T G.8271] Recommendation ITU-T G.8271/Y.1366 (2016), *Time and phase synchronization aspects of packet networks*.

### 2 Clause 3.2 Terms defined in this Recommendation

*Add the following definition:*

**Special Port.** A PTP Special Port is a PTP port that translates between the native timing mechanism of a medium and PTP.  Details are for further study.

### 3 Clause 6.2.8 Message rates

*Replace 6.2.8 with the following:*

Within the scope of the profile, the following messages can be used and the corresponding indicated nominal rates must be respected:

*− Sync* messages (if used, *Follow\_up* messages will have the same rate) – nominal rate: 16 packets-per-second.

*− Delay\_Req*/*Delay\_Resp* messages – nominal rate: 16 packets-per-second.

*− Announce* messages – nominal rate: 8 packets-per-second.

The requirements of subclause 7.7.2.1 of [IEEE 1588] must also be respected for the transmission of *Sync* and *Announce* messages. In addition, the time between successive *Sync* messages must not exceed twice the mean *Sync* interval specified above, and the time between successive *Announce* messages must not exceed twice the mean *Announce* interval specified above.

The transmission of *Delay\_Req* messages is specified in subclause 9.5.11.2 of [IEEE 1588].

In addition to sub-bullet 1 and sub-bullet 2 of subclause 9.5.11.2 of [IEEE 1588], a clock compliant to this profile must follow one of the following options:

*−* Transmission time requirements according to sub-bullet 3 of subclause 9.5.11.2 of [IEEE 1588], using an implementation-specific distribution. In this case, the PTP node must, with 90% confidence, issue *Delay\_Req* messages with inter-message intervals within ±30% of 2logMinDelayReqInterval seconds.

*−* Transmission time requirements specified in sub-bullet 4 of subclause 9.5.11.2 of [IEEE 1588].

In addition, the time between successive *Delay\_Req* messages must not exceed 2logMinDelayReqInterval+1 seconds.

As per 9.5.12 of [IEEE1588], the Master sets the logMessageInterval in the header of Delay\_Resp messages to a value accepted by the Master. In this profile that value is -4 (16 pps).

Additional background information concerning the *Delay\_Req* message transmission specified in subclause 9.5.11.2 of [IEEE 1588] is included in Appendix II of this Recommendation.

The use of *Signaling* and *Management* messages is for further study.

### 4 Clause 6.3.4 Clock attribute priority2

*Replace clause 6.3.4 with the following:*

In this PTP profile, the clock attribute priority2 is configurable.

It is initialized to a default value, equal for T-GM and T-BC clocks to the midpoint value, 128, of its range {0-255}. The default value for T-TSC clocks is 255, and the range is {255}.

A T-GM or T-BC compliant with this PTP profile must support all the values of priority2 defined in the range. A T-TSC compliant with this profile must support, on reception, all the values of priority2 defined in the full [IEEE1588] range (i.e., {0-255}).

Appendix IV describes possible use cases for the priority2 attribute; Appendix X describes possible use cases for the priority2 attribute under Note 3 application of Table 2; other cases are for further study.

## 

## 5 Clause 6.4 Phase/time traceability information

*Replace clause 6.4 with the following:*

In order to deliver phase/time traceability information, the clockClass values described in Table 2 below must be used in this PTP telecom profile. Additional information for interworking purposes is provided in Table 4.

The frequencyTraceable flag present in the header of the PTP messages is defined in this profile as follows: if the PTP clock is traceable to a PRTC in locked mode or to a primary reference clock (PRC), e.g., using a PRC-traceable physical layer frequency input, then this parameter must be set to TRUE, otherwise it must be FALSE. This flag is not used in the Alternate BMCA defined in clause 6.3; the values provided for this flag in Table 2 can be used by a network operator for monitoring purposes or by end applications to take definitive action as described in Appendix VIII.

When a T-GM first enters holdover, it downgrades the clockClass value that it uses to 7. It then calculates if the time error at its output is still within the holdover specification. When the T-GM determines that the time error at its output has exceeded the holdover specification, it downgrades the clockClass value that it uses to 140, 150 or 160 depending on the quality of its frequency reference (internal oscillator or received physical layer frequency signal on an external interface).

When a T-BC first enters holdover, it downgrades the clockClass value that it uses to 135. It then calculates if the time error at its output is still within the holdover specification. When the T-BC determines that the time error at its output has exceeded the holdover specification, it downgrades the clockClass value that it uses to 165 (internal oscillator or received physical layer frequency signal on an external interface).

NOTE 1 − The applicable holdover specification depends on the design and budgeting of the synchronization network. See Appendix V of [ITU-T G.8271.1] for examples of network budgeting. A typical value for the holdover budget, described in the failure scenario (b) depicted in [ITU-T G.8271.1] Table V.1, when using the T-GM or T-BC for holdover while still meeting a total time error of 1.5 µs, is 400 ns.

NOTE 2 − When the term clockClass is used with respect to the property of the individual PTP clock (T-GM, T-BC, T-TSC) it is referring to data set member defaultDS.clockQuality.clockClass.

NOTE 3 − For the T-BC, the traceability information of the currently selected best master clock will be passed to the downstream nodes, as per PTP. This means that the attributes & flags in the PTP header will always reflect the phase/time traceability information from the current parent clock, regardless of the frequency traceability of the T-BC’s physical layer clock. Failure scenarios including holdover are for further study.

| Table 2 – Applicable clockClass values | | | |
| --- | --- | --- | --- |
| Phase/time traceability description | defaultDS. clockQuality. clockClass | frequencyTraceable flag | timeTraceable flag |
| T-GM connected to a PRTC in locked mode (e.g., PRTC traceable to GNSS) | 6 | TRUE | TRUE |
| T-GM in holdover, within holdover specification, traceable to Category 1 frequency source (Note 1) | 7 | TRUE | TRUE |
| T-GM in holdover, within holdover specification, non-traceable to Category 1 frequency source (Note 1) | 7 | FALSE | TRUE |
| T-BC in holdover, within holdover specification, traceable to Category 1 frequency source (Note 1) | 135 | TRUE | TRUE |
| T-BC in holdover, within holdover specification, non-traceable to Category 1 frequency source (Note 1) | 135 | FALSE | TRUE |
| T-GM in holdover, out of holdover specification, traceable to Category 1 frequency source (Note 1) | 140 | TRUE | FALSE |
| T-GM in holdover, out of holdover specification, traceable to Category 2 frequency source (Note 1) | 150 | FALSE | FALSE |
| T-GM in holdover, out of holdover specification, traceable to Category 3 frequency source (Note 1) | 160 | FALSE | FALSE | |
| T-BC in holdover, out of holdover specification (Note 1) | 165 | (Note 2) | FALSE |
| T-GM or T-BC without time reference since start-up | 248 | (Note 2) | FALSE |
| Slave only OC (does not send *Announce* messages) | 255 | (Note 2) | As per PTP |
| NOTE 1 − The holdover specification threshold controlling the time spent advertising clockClass values 7 or 135 could be set to zero so that the T-GM or T-BC would advertise a degraded clockClass value directly after losing traceability to a PRTC. In this case, initially after advertising clockClass values 140, 150, 160, or 165, a clock may still be within the holdover specification.  NOTE 2 − The frequencyTraceable flag may be TRUE or FALSE, depending on the availability of a PRC‑traceable physical layer frequency input signal.  NOTE 3 – As an option, the clockClass range of a T-BC can be extended from (135, 165, 248) to (135, 140, 150, 160, 165, 248) for some cases, where (a) 140, 150, 160, and165 are related to the quality of the frequency reference, (b) the applicable circumstances of 140, 150, and 160 are the same as for the T-GM, and (c) 165 corresponds to synchronous Ethernet equipment clock (EEC). Details are in Appendix X. If this option is used, then in a single PTP domain, all PTP clocks should implement this option (and should not be intermixed with clocks that do not implement this option). Details are for further study.  NOTE 4 – The term "holdover" in this table refers to "time holdover".  NOTE 5 – Refer to Appendix VII for more information about the behaviour of a T-BC that was previously synchronizing to a T-GM or a T-BC that is advertising ‘within holdover specification’ or ‘out of holdover specification’ | | | |

Table 3 describes how the clock quality levels (QLs) defined in [ITU-T G.781] are mapped to Category 1, 2 and 3 frequency sources used in Table 2.

| Table 3 − Mapping of [ITU-T G.781] clock QLs to  Category 1, 2, 3 frequency sources | | |
| --- | --- | --- |
| Category  (in Table 2 and 4) | ITU-T G.781  option I QLs | ITU-T G.781  option II QLs |
| Category 1 frequency source | QL-PRC | QL-PRS |
| Category 2 frequency source | QL-SSU-A | QL-ST2 |
| Category 3 frequency source | QL-SSU-B | QL-ST3E |
| NOTE – Other frequency source categories, while not used in Table 2, are possible.  An example is a category containing QL-EEC1 and QL-EEC2. | | |

NOTE 4 − The case of a T-BC acting as a GM, with an external phase/time input coming from a PRTC, is handled by means of a virtual PTP port with associated Erbest attributes as described in Annex C of this Recommendation. The general case of a T-BC with a phase/time external synchronization input different from PRTC is for further study.

Table 4 presents a subset of the clockClass values of Table 2 based on the quality of the frequency reference, and the mapping of the corresponding values used by some equipment deployed prior to this Recommendation.

NOTE 5 − When interoperability with equipment deployed prior to this Recommendation is needed, both sets of clockClass values would need to be supported. Other aspects may be required for full interoperability.

| Table 4 − clockClass values for equipment deployed  prior to this Recommendation | | |
| --- | --- | --- |
| Phase/time traceability description | Values defined in Table 2 | Values prior to this Rec. |
| T-GM connected to a PRTC in locked mode (e.g., PRTC traceable to GNSS) | 6 | 6 |
| T-GM in holdover, out of holdover specification, traceable to Category 1 frequency source (Note 1) | 140 | 7 |
| T-GM in holdover, out of holdover specification, traceable to Category 2 frequency source (Note 1) | 150 | (Note 2) |
| T-GM in holdover, out of holdover specification, traceable to Category 3 frequency source (Note 1) | 160 | 52 |
| T-BC in holdover, out of holdover specification, using unspecified frequency source (Note 1) | 165 | 187 |
| Slave only OC (does not send *Announce* messages) | 255 | 255 |
| NOTE 1 − Initially after advertising clockClass values greater than 6, a clock may still be within the holdover specification.  NOTE 2 − Refer to the applicable value specified for the equipment.  NOTE 3 – The term "holdover" in this table refers to "time holdover". | | |

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## 6 Annex A.1 Profile identification

*Replace clause A.1 with the following:*

profileName: ITU-T PTP profile for phase/time distribution with full timing support from the network

profileVersion: 2.1

profileIdentifier: 00-19-A7-01-02-01

This profile is specified by ITU-T.

A copy may be obtained from [www.itu.int](http://www.itu.int).

NOTE 1 – Version 1 of this profile enforced a limited range on acceptable values for clockClass, clockAccuracy, offsetScaledLogVariance and, for the T-TSC, priority2. Reception of values outside of the acceptable range caused the Announce message to be discarded. Version 2 of the profile increases the range of acceptable values to the full range of PTP. In networks deploying ePRTCs, which use new values of clockAccuracy and offsetScaledLogVariance that are outside of the version 1 range, all clocks need to use version 2 of the profile. If no ePRTCs are to be deployed in the network, then the network can operate with a mixture of version 1 and version 2 clocks.

NOTE 2 – Version 2.1 is backwards compatible with Version 2.0. Equipment with Version 2.1 may be deployed in the same network as equipment with Version 2.0. Version 2.1 adds additional optional functionality that is not present in Version 2.0.

## 7 Annex A.10 PTP common header flags

*Replace clause A.10 with the following:*

The PTP common header flag values, and whether or not each flag is used in this profile, are given in Table A.8.

NOTE − Some of these flags are used only in certain PTP messages, and not in all the PTP messages, see [IEEE 1588] clause 13.3.2.6. The following rule defined in [IEEE 1588] clause 13.3.2.6, must be respected: "For message types where the bit is not defined in Table 20 of [IEEE 1588], the values shall be FALSE."

Table A.8 − PTP flags

| Octet | Bit | Flag | Value to be sent | Behaviour for the receiving node |
| --- | --- | --- | --- | --- |
| 0 | 0 | alternateMasterFlag | FALSE | As per PTP |
| 0 | 1 | twoStepFlag | As per PTP | Used |
| 0 | 2 | unicastFlag | FALSE | Flag is ignored |
| 0 | 5 | PTP profile Specific 1 | FALSE | Flag is ignored |
| 0 | 6 | PTP profile Specific 2 | FALSE | Flag is ignored |
| 0 | 7 | Reserved | FALSE | Reserved by PTP and flag is ignored |
| 1 | 0 | leap61 | As per PTP (Note 2) | Used |
| 1 | 1 | leap59 | As per PTP (Note 2) | Used |
| 1 | 2 | currentUtcOffsetValid | As per PTP (Note 3) | Used (Note 3,4) |
| 1 | 3 | ptpTimescale | TRUE | Used |
| 1 | 4 | timeTraceable | See Table 2 | Used |
| 1 | 5 | frequencyTraceable | See Table 2 | Used |
| 1 | 6 | (Note 1) | (Note 1) | (Note 1) |
| NOTE 1 – An additional flag "synchronizationUncertain" has been defined in Annex E; the use of the "synchronizationUncertain" flag is optional.  NOTE 2 – When a clock is in holdover, within holdover specification, the PTP clock may continue to advertise the last known leap second event. If there was no pending leap second event, then the PTP clock continues to advertise FALSE for the pending leap second fields (leap59 and leap61). If there was a pending leap second event, the PTP clock may choose to either advertise FALSE for the pending leap second fields immediately, or continues to advertise the leap second event. In the latter instance the PTP clock would clear the leap 59 and leap6 second event field(s) and adjust the UTC offset field at the appropriate time based on its local PTP time (i.e., the local PTP time’s UTC timescale rolling over at UTC midnight) if the PTP clock is still in holdover, within holdover specification. When a clock is in holdover, out of holdover specifications, the PTP clock behaviour with respect to leap second event is implementation specific. It is recommended that PTP clock continue to advertise any upcoming leap second event as appropriate.  NOTE 3 – When a clock is in holdover, within holdover specification, the PTP clock may continue to advertise the last known UTC offset with UTC offset valid TRUE. If the last known UTC offset valid was FALSE then the PTP clock continues to advertise FALSE. If the last known UTC offset valid was TRUE then the PTP clock may choose to either advertise UTC offset valid FALSE immediately (freezing the UTC offset value), or continues to advertise the last known UTC offset with UTC offset valid TRUE. The UTC offset field may be updated as described in Note 2 above. When a clock is in holdover, out of holdover specifications, the PTP clock behaviour with respect to UTC offset is implementation specific.  NOTE 4 – Usage of currentUtcOffset from an Announce message, which indicates currentUtcOffsetValid as FALSE, may lead to wrong UTC time calculation. | | | | |

# 8 Annex E Synchronization uncertain indication (optional)

*Add the following paragraph to the end of Annex E:*

The default value for the synchronizationUncertain flag was picked so that the value transmitted out of a PTP clock that does not have the synchronizationUncertain functionality indicates that its timing information can be used. This allows a downstream clock that does support the functionality to use an upstream parent clock that does not support this functionality. The downstream clock considers the timing information from the upstream clock as usable and performs synchronization processing using this timing information. As this situation could lead to misinterpretation of the actual synchronization quality at the end of the network clock chain, it is not recommended to depend on this synchronizationUncertain indication unless all PTP clocks in the network support this functionality.

# 9 Annex G Alternate Master Time Information (optional)

*Add the following Annex G:*

**Annex G**

**Monitoring a PTP MASTER port by a PTP PASSIVE port (optional)**

(This annex forms an integral part of this Recommendation.)

This annex is optional but, if implemented, it is necessary for the equipment to conform to requirements contained herein.

A PTP clock must synchronize only to a PTP port of its parent clock that is in the MASTER state. The synchronization must be received on, and only on, the port of the PTP clock that is in the SLAVE state. However, in some instances it may be desirable for a PTP port in the PASSIVE state to receive time information from its peer, which is in the MASTER state.

When a PTP port is in the PASSIVE state, the PTP port may transmit Delay\_Req messages with the alternateMasterFlag value set to FALSE. A PTP port that receives a Delay\_Req message, if it is in the MASTER state, responds with a Delay\_Resp message with alternateMasterFlag value to set to FALSE.

Note: The Alternate Master Flag can be used in order to exchange PTP messages with ports in the PASSIVE state, including transmission of Delay\_Req to acquire knowledge of the characteristics of the transmission path.

# 10 Appendix V Description of PTP clock states and associated contents of Announce messages

*Replace Table V.2 in clause V.4 and Table V.3 in clause V.5 with the following:*

## V.4 T-GM Announce message contents based on the internal PTP clock states

Table V.2 − T-GM Announce message contents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Announce message fields | Free-Run state | Acquiring state | Locked state | Holdover-In-Specification state | Holdover-Out-Of-Specification state |
| sourcePortIdentity  (header.sourcePortIdentity) | Local clockId of the T‑GM + Port Number | Local clockId of the T‑GM + Port Number | Local clockId of the T‑GM + Port Number | Local clockId of the T‑GM + Port Number | Local clockId of the T‑GM + Port Number |
| leap61 (header.flagField) | FALSE | From Time Source | From Time Source | TRUE/FALSE  (Note 2) | TRUE/FALSE  [Implementation specific]  (Note 2) |
| leap59 (header.flagField) | FALSE | From Time Source | From Time Source | TRUE/FALSE  (Note 2) | TRUE/FALSE  [Implementation specific]  (Note 2) |
| currentUtcOffsetValid (header.flagField) | FALSE | TRUE/FALSE  [Implementation Specific] | TRUE | TRUE/FALSE  (Note 2) | TRUE/FALSE  [Implementation Specific]  (Note 2) |
| ptpTimescale (header.flagField) | TRUE | TRUE | TRUE | TRUE | TRUE |
| timeTraceable (header.flagField) | FALSE | TRUE | TRUE | TRUE | FALSE |
| frequencyTraceable (header.flagField) | FALSE | TRUE/FALSE  based on Frequency Source lock | TRUE | TRUE/FALSE  based on Frequency Source lock | TRUE/FALSE  based on Frequency Source lock |
| currentUtcOffset | As per PTP | Based on input reference UTC offset | Based on input reference UTC offset | Last known  UTC offset  (Note 2) | Last known UTC offset  (Note 2) |
| grandmasterPriority1 | 128 (default) | 128 (default) | 128 (default) | 128 (default) | 128 (default) |
| grandmasterClockQuality.clockClass | 248 | Implementation specific, generally previous state  7/140/150/160/248 | 6 | 7 | 140/150/160 |
| grandmasterClockQuality.clockAccuracy | Unknown (0xFE) | Unknown (0xFE) | 0x21,  0x20 | Unknown (0xFE) | Unknown (0xFE) |
| grandmasterClockQuality.offsetScaledLogVariance | 0xFFFF (default) | 0xFFFF (default) | 0x4E5D,  0x4B32 | 0xFFFF (default) | 0xFFFF (default) |
| grandmasterPriority2 | Configured priority2 of the T-GM | Configured priority2 of the T-GM | Configured priority2 of the T-GM | Configured priority2 of the T-GM | Configured priority2 of the T-GM |
| grandmasterIdentity | Local clockId of the T‑GM | Local clockId of the T‑GM | Local clockId of the T‑GM | Local clockId of the T‑GM | Local clockId of the T GM |
| stepsRemoved | 0 | 0 | 0 | 0 | 0 |
| timeSource | INT\_OSC (0xA0) | INT\_OSC (0xA0) | As per PTP | INT\_OSC (0xA0) | INT\_OSC (0xA0) |
| synchronizationUncertain | TRUE (Note 3) | TRUE | FALSE (Note 3) | FALSE (Note 3) | TRUE (Note 3) |
| NOTE 1 − Time Properties (leap61, leap59, currentUtcOffsetValid, currentUtcOffset) can be obtained from time source (GNSS or TOD) or user configuration.  NOTE 2 − Refer to Table A.8  NOTE 3 – Or as defined in Annex E. | | | | | |

## 

## V.5 T-BC Announce message contents based on the internal PTP clock states

Table V.3 − T-BC Announce message contents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Announce message fields | Free-Run state | Acquiring state | Locked state | Holdover-In-Specification state | Holdover-Out-Of-Specification state |
| sourcePortIdentity  (header.sourcePortIdentity) | Local clockId of the T‑BC + Port Number | Local clockId of the T‑BC + Port Number | Local clockId of the T‑BC + Port Number | Local clockId of the T‑BC + Port Number | Local clockId of the T‑BC + Port Number |
| leap61 (header.flagField) | FALSE | (Note 1) | (Note 1) | TRUE/FALSE  (Note 2) | TRUE/FALSE  [Implementation specific]  (Note 2) |
| leap59 (header.flagField) | FALSE | (Note 1 | (Note 1) | TRUE/FALSE  (Note 2) | TRUE/FALSE  [Implementation specific]  (Note 2) |
| currentUtcOffsetValid (header.flagField) | FALSE | TRUE | (Note 1) | TRUE/FALSE  (Note 2) | TRUE/FALSE  [Implementation Specific]  (Note 2) |
| ptpTimescale (header.flagField) | TRUE | TRUE | (Note 1) | TRUE | TRUE |
| timeTraceable (header.flagField) | FALSE | TRUE | (Note 1) | TRUE | FALSE |
| frequencyTraceable (header.flagField) | FALSE | TRUE /FALSE based on Frequency Source lock | (Note 1) | TRUE /FALSE based on Frequency Source lock | TRUE /FALSE based on Frequency Source lock |
| currentUtcOffset | As per PTP | Last known UTC offset | (Note 1) | Last known UTC offset | Last known UTC offset  (Note 2) |
| grandmasterPriority1 | 128 (default) | 128 (default) | (Note 1) | 128 (default) | 128 (default) |
| grandmasterClockQuality.clockClass | 248 | Implementation specific, generally previous state.  135/165/248 | (Note 1) | 135 | 165 |
| grandmasterClockQuality.clockAccuracy | Unknown (0xFE) | Unknown (0xFE) | (Note 1) | Unknown (0xFE) | Unknown (0xFE) |
| grandmasterClockQuality.offsetScaledLogVariance | 0xFFFF (default) | 0xFFFF (default) | (Note 1) | 0xFFFF (default) | 0xFFFF (default) |
| grandmasterPriority2 | Configured priority2 of the T-BC | Configured priority2 of the T-BC | (Note 1) | Configured priority2 of the T-BC | Configured priority2 of the T-BC |
| grandmasterIdentity | Local clockId of the T‑BC | Local clockId of the T‑BC | (Note 1) | Local clockId of the T‑BC | Local clockId of the T‑BC |
| stepsRemoved | 0 | 0 | Received stepsRemoved +1 | 0 | 0 |
| timeSource | INT\_OSC (0xA0) | INT\_OSC (0xA0) | (Note 1) | INT\_OSC (0xA0) | INT\_OSC (0xA0) |
| synchronizationUncertain | Note 4 | TRUE | Note 4 | Note 4 | Note 4 |
| NOTE 1 − The value sent in the *Announce* message corresponds to the value of the current grandmaster or Time interface (as per G.8272 Appendix III) in case T-BC has selected a virtual port as best master.  NOTE 2 − Refer to table A.8.  NOTE 3 – Valid UTC Offset is one advertised by master with currentUtcOffsetValid value TRUE. In case there is no such value available, either default initializing UTC offset or one advertised by master with currentUtcOffsetValid as false can be used.  NOTE 4 − The value sent in the Announce message corresponds to the value received from the current parent clock or as defined in Annex E. | | | | | |

# 11 Appendix VII Relationship between clockClass and holdover specification

*Replace Appendix VII with the following:*

Appendix VII  
  
Relationship between clockClass and holdover specification

(This appendix does not form an integral part of this Recommendation.)

The clockClass values that are used in this profile are described in Table 2. The values may be divided into four different categories:

1) T-GM locked to a PRTC or ePRTC;

2) T-GM or T-BC in holdover, within holdover specification;

3) T-GM or T-BC in holdover, outside of holdover specification;

4) Slave clock, or clock that has not been synchronized.

A short footnote (Note 1 of clause 6.4) refers to Appendix V of [ITU-T G.8271.1] for more information on the meaning of "in holdover, within holdover specification" and "in holdover, out of holdover specification". That appendix describes possible budget models for the synchronization performance. The exact model depends on the operator's network and design parameters, but each budget is broken down into several components:

1) PRTC/T-GM allocation;

2) Random time error from noise accumulation through the network (dTE);

3) Node asymmetry (cTE, the sum of the asymmetry of all the nodes in the system);

4) Link asymmetry (cTE, the sum of the asymmetry of all the links in the system);

5) Holdover budget;

6) End application budget.

Table V.1 of [ITU-T G.8271.1] shows that for one example budget, 400 ns may be allocated to holdover within the network (this is termed failure scenario (b) in the table). The operator may have different budget allocations, depending on their deployment scenario. The 400 ns holdover budget is allocated to the entire synchronization chain, and not to an individual clock.

The intended operation of the T-GM is, therefore, as follows:

• When the T-GM is synchronised to a PRTC locked to GNSS, it outputs clockClass 6.

• If the PRTC loses its connection to GNSS, it enters holdover. The T-GM should degrade the advertised clockClass to indicate "in holdover, but within holdover specification" (clockClass 7).

• The T-GM estimates when the holdover budget will potentially be exceeded. Factors to consider include the known quality of any external frequency support (e.g., SyncE QL), temperature variations, and/or the quality of the internal oscillator.

• When the T-GM considers that the clock is out of holdover specification (i.e., it is now estimated to have drifted by more than the holdover budget), the T-GM will advertise a clockClass of 140, 150 or 160.

In the event of a network failure, where the T-GM is disconnected from the synchronization chain, a T-BC will take over as the grandmaster of the chain. That T-BC will be operating in holdover. The clockClass that the T-BC is allowed to advertise depends on the clockClass of the T-GM to which it was synchronized prior to losing connectivity.

For example, if the T-BC was synchronized to a T-GM of clockClass 6, none of the holdover budget will have been consumed, and therefore the T-BC may use a clockClass indicating "within holdover specification" (e.g., clockClass 135). This value is chosen to be higher than that of a T‑GM that is out of holdover specification, since the T-BC is likely to have more accurate time because it has been locked to a traceable time source more recently. Therefore, if the two clocks (a T-BC in holdover, within holdover specification and a T-GM in holdover, but out of holdover specification) are compared in the Alternate BMCA operation of a subsequent clock, the subsequent clock will synchronize to the T-BC that is within holdover specification instead of a T-GM that is out of holdover specification.

In another example, if the T-BC was synchronized to a T-GM indicating that the T-GM is in holdover but out of holdover specification (e.g., parentDS clockClass 140, 150 or 160), the T-BC should also use a clockClass indicating "out of holdover specification" (e.g., defaultDS clockClass 165). This is because the T‑GM was indicating that, in its estimation, the holdover budget has already been consumed.

In another example, if the T-BC was synchronized to another T-BC, and the other T-BC indicates that it is in holdover but out of holdover specification (e.g., parentDS clockClass 165), the original T-BC should also use a clockClass indicating “out of holdover specification” (e.g. defaultDS clockClass 165). This is because the other T-BC was indicating that, in its estimation, the holdover budget has already been consumed.

In a final example, if the T-BC was synchronized to a T-GM or another T-BC that was already in holdover but still within the holdover specification, the original T-BC could indicate "within holdover specification". However, some of the holdover budget will have already been consumed by the T-GM or T-BC. If it is not known how much of the budget is left, the T-BC should indicate "out of holdover specification".

NOTE: When the term clockClass is used with respect to the property of the individual PTP clock (T-GM, T-BC, T-TSC) it is referring to data set member defaultDS.clockQuality.clockClass.

# 12 Appendix X Description of T-BC extended clockClass application

*Add the following Appendix X:*

**Appendix X  
  
Description of T-BC extended clockClass application**

(This appendix does not form an integral part of this Recommendation.)

Table 2/G.8275.1 defined T-BC extended clockClass application. This appendix describes the purpose of this extended application, and its corresponding value amendments, including defaultDS data set member specifications of Annex A/ G.8275.1 (corresponding to Table A.1) and T-BC Announce message contents of Appendix V/ G.8275.1 (corresponding to Table V.3).

## X.1Purpose of T-BC extended clockClass application

PTP is the only synchronization source in IEEE 1588v2 network, therefore the clockClass values have been only applied to the GM for its quality variation. The clockClass in TABLE 5 in IEEE 1588v2 specification, such as 6,7,52,187, only represents for GM. The clockClass may not reflect the change of synchronization states in BC networks.

Since it’s possible that there are two separate synchronization sources (GPS time and physical frequency) on Telecom network, ITU-T G.827X provides new extension mechanism of clockClass to cover the case of both T-GM and T-BC network changes. ITU-T G.8275.1 extended the definition of clockClass values into two parts:

- For T-GM, the clockClass includes 6, 7, 140, 150 and 160. The clockClass values of 140/150/160 represent the time output of T-GM when it’s in time holdover instead of tracking to GPS. The time quality could be consistent with the clock quality with QL-1/2/3 in time holdover respectively.

- For T-BC, the clockClass includes 135 and 165 for T-BC. The value of 135 means that when T-BC is in time holdover, the output time signal is within specification, clockClass 165 means that the output time signal is out of time holdover specification.

The case of two separated sources has been considered in G.8271.1 HRM-2 and HRM-3. In order to extend the advantages of two separated sources, T-BC is better to be treated differently when it’s traceable to frequency of different quality. The clockClass of 165 could be assigned to a T-BC when the T-BC is traceable to a frequency in QL=EEC/SEC, and T-BC could share clockClass value of 140/150/160 with T-GM when it’s traceable to different quality of frequency. In this way, appropriate T-BC is possible to be selected to be GM of the network and so that better time signals might be sent till the end-users.

For the Telecom network, it's crucial to make sure that the best clock selection principle is valid in any case of PTP network. Especially in the case that there exist an isolated time region (which can’t receive any signals from T-GM) in the network. In this region, if T-BC has a preferable quality frequency, the T-BC is possible to act as GM, and to send out precise time/phase signals (where the signals quality is still close to the UTC).In Telecom network, from the perspective of synchronization performance, any of the T-BCs could supersede the old-GM to be the new PTP source of the network.

## X.2 DefaultDS data set member specifications under this extended application

In some cases, the values of clockClass/accuracy/variance will be probable same for delivery announce packets from T-GM and T-BC due to using table 2 (under application of note3). At this moment, we believe that T-BC should synchronize the T-GM. So it is suitable for priority 2 to achieve this goal, the range of priority 2 should be divided into two parts, 0-127 for T-GM, 128-255 for T-BC.

In this PTP profile, the clock attribute priority2 is configurable.

If this feature is used, then the *priority2* for the T-GM should be set to a lower value compared to T-BCs, in particular the range for *priority2* could be allocated as follows:

* for T-GM, the range {0 - 127}.
* for T-BC, the range {128 - 255}.

As an example of a default value for *priority2*, it is suggested to set 100 for T-GM and 128 for T-BC.

# 13 Appendix XI Considerations on Native Access Equipment

*Add the following Appendix XI:*

**Appendix XI  
  
Considerations on Native Access Equipment**

(This appendix does not form an integral part of this Recommendation.)

In some deployments native access equipment such as xDSL, xPON or microwave may implemented T-BC functionality. This appendix provides information on how such equipment may be modeled in as a pair of T-BC defined in this recommendation. The following Figure XI.1 shows an example of equipment that is transferring the PTP timing between native PTP and native access media. Examples of such equipment may be xPON OLT & ONU, xDSL DSLAM & RT-DSLAM or microwave. Only one PTP port and one Special port are shown in the diagram, although the equipment may contain multiple ports. Within this simplified diagram there are two PTP ports on the T-BC, one is a normal PTP port and one is a Special PTP port. On both the PTP port and the Special PTP port the Announce information and Signaling messages are handled according to normal T-BC operation. The difference is that on the PTP port the timing messages (Sync, Delay\_Req, Delay\_Resp) are handled normally, while on the Special PTP port they are not present as they are replaced by native timing messages. If the timing flow hierarchy is known in advance (such as that a PON OLT will only transfer timing downstream on its Special PTP ports) then the PTP ports, Special PTP ports, or the PTP clock may be configured with masterOnly or slaveOnly parameters (such as a PON OLT configured with Special PTP ports as masterOnly TRUE, or a PON ONU configured with slaveOnly TRUE).

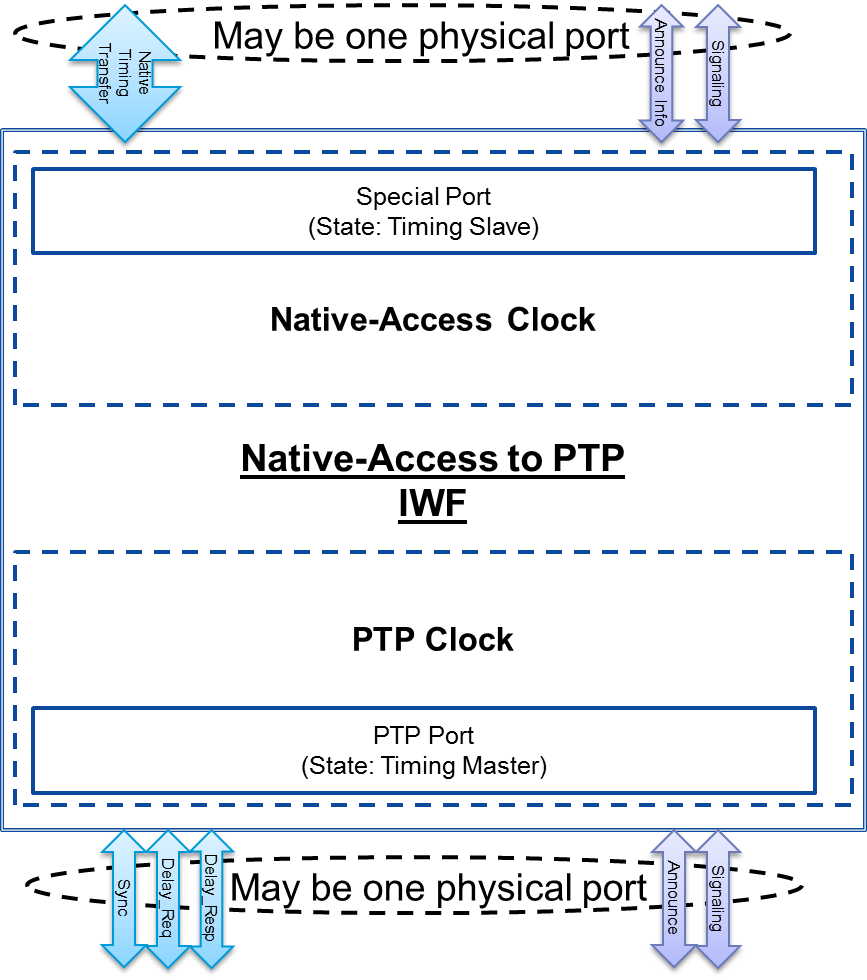


Figure XI.1 − Timing Flow between Native PTP and Native Access Media

Note that this Appendix shows one possible way to model native access media (as a pair of T-BC). Other ways to model native access media may exist.

# 14 Appendix XII Monitoring alternate master time information provided by a peer PTP port

*Add the following Appendix XII:*

**Appendix XII  
  
Monitoring alternate master time information provided by a peer PTP port**

(This appendix does not form an integral part of this Recommendation.)

A PTP clock must synchronize only to a PTP port of its parent clock that is in the MASTER state. The synchronization must be received on, and only on, the port of the PTP clock that is in the SLAVE state. However, in some instances it may be desirable for a PTP port that is in the MASTER or PASSIVE state to receive time information from its peer in the MASTER, SLAVE, or PASSIVE state (see Figure IV.3/G.8271 as an example application). It has been proposed that this monitoring be done using the alternateMasterFlag field defined in 7.3.8.2 of [IEEE1588] and a subset of the option of 17.4 of [IEEE1588]. This functionality, while not listed in 9.2.4 of [IEEE1588], is permitted when invoking 17.4 of IEEE1588. The use of this proposal for monitoring is suitable only for a limited set of use cases, specifically, small ring and small linear chain topologies (i.e., that contain a small number of PTP nodes). The use of the alternateMasterFlag for these use cases is for further study.

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