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Variants of pDelay in IEEE P802.1ASdm/D1.3

IEEE Contribution

Disclaimer

If everything in this presentation has been perfectly clear to you before,
then you have understood IEEE 802.1AS-2020 and IEEE P802.1ASdm/D1.3 a lot better than I have.

Congratulations up front!

(that is, assuming at least most of my conclusions are correct!)

This presentation focusses on Questions - Answers need to be discussed in the Comment Resolution!

(all non qualified references in this presentation refer to IEEE P802.1ASdm/D1.3)

Fundamental changes from AS-2020

- domainNumber 0 is no longer mandatory [8.1]
- Clear definition of when to run either CMLDS XOR transport-specific pDealy [11.2.17.1]:
 - **transport-specific** will run **if and ONLY if Domain 0 is the only Domain** on the Port (in no other case is transport-specific running)
 - even if Domain 0 is the only Domain on the Port, CMLDS may still be used
 - if any other (than 0) domainNumber(s) is/(are) active on the Port, then CMLDS must be used
(i.e., even if Domain 0 should be active on the Port together with other Domains, transport-specific is NOT used!)
- neighborRateRatio calculation through Drift_Tracking TLV [5.4.2 n)]
 - this is obviously per Domain,
 - while transport-specific and CMLDS are always per Port

The 4 cases for a (physical) Port

Derived from [11.2.17.1]:

- 1) Only Domain 0 - transport-specific
(therefore w/o CMLDS)
- 2) Only Domain 0 - w/ CMLDS
- 3) Any other domain(s) $\neq 0$ - w/ CMLDS
- 4) Domain 0 and any other domain(s) - w/ CMLDS

CMLDS XOR transport-specific

11.2.17.1 General

Each ~~port~~ PTP Port or Link Port of a time-aware system invokes a single instance of the MDPdelayReq state machine (see 11.2.19) and the MDPdelayResp state machine (see 11.2.20). If the time-aware system implements ⁴⁾ more than one domain or if domainNumber 0 is not present, ³⁾ these two state machines shall provide a Common Mean Link Delay Service (CMLDS), as described in this subclause, that measures mean propagation delay on the PTP Link attached to the port and the neighbor rate ratio for the port (i.e., the ratio of the frequency of the LocalClock entity of the time-aware system at the other end of the PTP Link attached to this port, to the frequency of the LocalClock entity of this time-aware system). The CMLDS makes the mean propagation delay and neighbor rate ratio available to all active domains. If the time-aware system implements ²⁾ one domain, and if ~~(the domainNumber of this domain is 0;~~ (see 8.1), these two state machines may also provide the CMLDS; however, if ~~they~~ the state machines do not provide the CMLDS (i.e., if only the ~~PTP Instance~~ transport-specific peer delay mechanism is provided), they shall be invoked on domain 0. ¹⁾ In other words, if the ~~domain number~~ domainNumber is not 0, portDS.delayMechanism (see Table 14-8 in 14.8.5) must not be P2P. If CMLDS is used, the LocalClock entity for CMLDS and the LocalClock entity for each PTP Instance shall be the same LocalClock.

The variants for each Domain per Port

- Only ONE of either the transport-specific peer-to-peer delay mechanism or CMLDS is active [11.2.17.1]!
 - one of them must always be active to satisfy asCapableAcrossDomains [11.2.2 b)]
 - transport-specific, IFF ONLY domainNumber=0 is active
- meanLinkDelay is always per Port (never per Domain)
 - a. either transport-specific, IFF ONLY domainNumber=0 is active, or
 - b. from CMLDS for any combination of domainNumber(s), including Domain 0
- neighborRateRatio is either
 - i. nrrPdelay - per Port [11.2.13.13] from
 - a. either transport-specific, IFF ONLY domainNumber=0 is active, or
 - b. from CMLDS for any combination of domainNumber(s), including Domain 0
 - ii. nrrSync - per Domain from Drift_Tracking TLV [11.2.13.14]

The 8 Variants of pDelay

- 1) Only Domain 0 active (No CMLDS!)
 - meanLinkDelay is transport-specific per Port
 - neighborRateRatio is either:
 - i. a. transport-specific per Port
 - ii. per (a single) Domain from Drift_Tracking TLV
- 2) Only Domain 0 active, but w/ CMLDS
 - meanLinkDelay is per Port from CMLDS
 - neighborRateRatio is either:
 - i. b. per Port from CMLDS
 - ii. per (a single) Domain from Drift_Tracking TLV
- 3) Any other domain(s), all !=0 (CMLDS required)
 - meanLinkDelay is per Port from CMLDS
 - neighborRateRatio is either:
 - i. b. per Port from CMLDS
 - ii. per Domain from Drift_Tracking TLV
- 4) Domain 0 and any other domain(s) (CMLDS required)
 - meanLinkDelay is per Port from CMLDS
 - neighborRateRatio is either:
 - i. b. per Port from CMLDS
 - ii. per Domain from Drift_Tracking TLV

One single set of pDelay state machine instances per Port

Table 11-2 — Summary of scope of global variables used by time synchronization state machines (see 10.2.4 and 10.2.5)

Variable name	Subclause of definition	Per PTP Instance (i.e., per domain)	Per PTP Instance, per PTP Port	Instance used by CMLDS (i.e., variable is common across all LinkPort Link k Ports)	Instance used by CMLDS, per LinkPort Link Port
currentLogPdelayReqInterval	11.2.13.1	No	Yes ¹	No	Yes
initialLogPdelayReqInterval	11.2.13.2	No	Yes ¹	No	Yes
pdelayReqInterval	11.2.13.3	No	Yes ¹	No	Yes
allowedLostResponses	11.2.13.4	No	Yes ¹	No	Yes
allowedFaults	11.2.13.5	No	Yes ¹	No	Yes
isMeasuringDelay	11.2.13.6	No	Yes ¹	No	Yes
meanLinkDelayThresh	11.2.13.7	No	Yes ¹	No	Yes
syncSequenceId	11.2.13.8	No	Yes	No	No
oneStepReceive	11.2.13.9	No	Yes	No	No
oneStepTransmit	11.2.13.10	No	Yes	No	No
oneStepTxOper	11.2.13.11	No	Yes	No	No
asCapableAcrossDomains	11.2.13.12	No	No	No	Yes
nrrPdelay	11.2.13.13	No	Yes	No	No
nrrSync	11.2.13.14	No	Yes	No	No
nrrCompMethod	11.2.13.15	No	Yes	No	No

¹ The instance of this variable that is per PTP Instance, per PTP Port exists only for domain 0.

¹ The instance of this variable that is per PTP Instance, per PTP Port exists only for domain 0.

Table 10-1—Summary of scope of global variables used by time synchronization state machines (see 10.2.4 and 10.2.5) (continued)

Variable name	Subclause of definition	Per PTP Instance (i.e., per domain)	Per PTP Instance, per PTP Port	Instance used by CMLDS (i.e., variable is common across all LinkPort Link k Ports)	Instance used by CMLDS, per LinkPort Link Port
neighborRateRatio	10.2.5.7	No	Yes ⁺	No	Yes No
meanLinkDelay	10.2.5.8	No	Yes ¹	No	Yes
delayAsymmetry	10.2.5.9	No	Yes ⁺	No	Yes

Why is meanLinkDealy per Domain?

Why the difference?

Why is nrrPdealy per Domain?
(only nrrSync could be per Domain)

“The instance of this variable that is per PTP Instance, per PTP Port exists only for domain 0.”

- Does that variable also exist if Domain 0 is the only Domain, but is using CMLDS (case 2))?
- Does that variable also exist if Domain 0 is one of many Domains, using CMLDS (case 4))?
- If a difference needs to be made for Domain 0 (does there really?), then it should be clearly limited to case 1) - Only Domain 0 on the port and using transport- specific.

Is the Port asCapable?

The per-port global variable `asCapableAcrossDomains` is set by the `MDPdelayReq` state machine (see 11.2.19 and Figure 11-9). For a port attached to a full-duplex point-to-point PTP Link, `asCapableAcrossDomains` shall be set to TRUE if and only if it is determined, via the transport-specific or CMLDS peer-to-peer delay mechanism, that the following conditions hold for the port:

[11.2.2]

- a) The port is exchanging peer delay messages with its neighbor.
- b) The measured delay does not exceed `meanLinkDelayThresh`.
- c) The port does not receive multiple `Pdelay_Resp` or `Pdelay_Resp_Follow_Up` messages in response to a single `Pdelay_Req` message, and
- d) The port does not receive a response from itself or another PTP Port of the same PTP Instance.

The per-PTP Port, per-domain global variable `asCapable` shall be set to TRUE if and only if the following conditions hold:

- e) The value of `asCapableAcrossDomains` is TRUE, and
- f) One of the following conditions holds:
 - 1) The value of `neighborGptpCapable` for this PTP Port is TRUE, or
 - 2) The value of `domainNumber` is zero, and the value of `sdoId` for peer delay messages received on this PTP Port is `0x100`.

CMLDS requires Signaling messages
this is not mentioned in 11.2.17.2

transport-specific

asCapableAcrossDomains - Case 1)

Table 11-2 — Summary of scope of global variable
time synchronization state machines (see 10.2.4)

Variable name	Subclause of definition	Per PTP Instance (i.e., per domain)	Per PTP Instance, per PTP Port
currentLogPdelayReqInterval	11.2.13.1	No	Yes ¹
initialLogPdelayReqInterval	11.2.13.2	No	Yes ¹
pdelayReqInterval	11.2.13.3	No	Yes ¹
allowedLostResponses	11.2.13.4	No	Yes ¹
allowedFaults	11.2.13.5	No	Yes ¹
isMeasuringDelay	11.2.13.6	No	Yes ¹
meanLinkDelayThresh	11.2.13.7	No	Yes ¹
syncSequenceId	11.2.13.8	No	Yes
oneStepReceive	11.2.13.9	No	Yes
oneStepTransmit	11.2.13.10	No	Yes
oneStepTxOper	11.2.13.11	No	Yes
asCapableAcrossDomains	11.2.13.12	No	No
nrrPdelay	11.2.13.13	No	Yes
nrrSync	11.2.13.14	No	Yes
nrrCompMethod	11.2.13.15	No	Yes

Iff only Domain 0 is active, pDelay is transport-specific; i.e. no CMLDS!

[IEEE 802.1AS-2020]

11.2.13.12 asCapableAcrossDomains: A Boolean that is TRUE if and only if conditions a) through d) of 11.2.2 are satisfied. This Boolean is set by the MDPdelayReq state machine and is used in determining asCapable for a port (see 11.2.2). There is one instance of this variable for all the domains (per port). The variable is accessible by all the domains. When only one domain is active, asCapableAcrossDomains is equivalent to the variable asCapable (see 10.2.5.1).

Why?

asCapableAcrossDomains does not exist!

¹ The instance of this variable that is per PTP Instance, per PTP Port exists only for domain 0.

asCapableAcrossDomains - CMLDS

Table 11-2 — Summary of scope of global variables used by time synchronization state machines (see 10.2.4 and 10.2.5)

Variable name	Subclause of definition	Per PTP Instance (i.e., per domain)	Per PTP Instance, per PTP Port	Instance used by CMLDS (i.e., variable is common across all Link Ports)	Instance used by CMLDS, per Link Port
currentLogPdelayReqInterval	11.2.13.1	No	Yes ¹	No	Yes
initialLogPdelayReqInterval	11.2.13.2	No	Yes ¹	No	Yes
pdelayReqInterval	11.2.13.3	No	Yes ¹		
allowedLostResponses	11.2.13.4	No	Yes ¹		
allowedFaults	11.2.13.5	No	Yes ¹		
isMeasuringDelay	11.2.13.6	No	Yes ¹		

[IEEE 802.1AS-2020]

14.16 Common Mean Link Delay Service Link Port Parameter Data Set (cmlDsLinkPortDS)

14.16.5 asCapableAcrossDomains

The value is equal to the value of the Boolean asCapableAcrossDomains (see 11.2.2 and 11.2.13.12).

asCapableAcrossDomains does not exist without CMLDS active

11.2.13.12 asCapableAcrossDomains: A Boolean that is TRUE if and only if conditions a) through d) of 11.2.2 are satisfied. This Boolean is set by the MDPdelayReq state machine and is used in determining asCapable for a port (see 11.2.2). There is one instance of this variable for all the domains (per port). The variable is accessible by all the domains. When only one domain is active, asCapableAcrossDomains is equivalent to the variable asCapable (see 10.2.5.1).

oneStepTransmit	11.2.13.10	No	Yes		
oneStepTxOper	11.2.13.11	No	Yes		
asCapableAcrossDomains	11.2.13.12	No	No	No	Yes
nrrPdelay	11.2.13.13	No	Yes	No	N
nrrSync	11.2.13.14	No	Yes	No	N
nrrCompMethod	11.2.13.15	No	Yes	No	N

Only ONE of either the transport-specific peer-to-peer delay mechanism or CMLDS is active [11.2.17.1]!

¹ The instance of this variable that is per PTP Instance, per PTP Port exists only for domain 0.

Backwards Compatibility?

The per-PTP Port, per-domain global variable asCapable shall be set to TRUE if and only if the following conditions hold:

[11.2.2]

e) The value of asCapableAcrossDomains is TRUE, and

f) One of the following conditions holds:

1) The value of neighborGptpCapable for this PTP Port is TRUE, or

2) The value of domainNumber is zero, and the value of sdoId for peer delay messages received on this PTP Port is 0x100.

transport-specific, i.e. only Domain 0 active

NOTE 2—Condition f) 2) ensures backward compatibility with the 2011 edition of this standard. A PTP Instance compliant with the current edition of this standard that is attached, via a full-duplex point-to-point PTP Link, to a PTP Instance compliant with the 2011 edition of this standard will not receive Signaling messages that contain the gPTP capable TLV and will not set neighborGptpCapable to TRUE. However, condition f) 2) ensures that asCapable for this PTP Port and domain (i.e., domain 0) will still be set to TRUE if condition e) holds because the peer delay messages received from the time-aware system compliant with the 2011 edition of this standard will have sdoId set to 0x100.

The Port at the other end of the Link, operates in transport-specific, i.e. only has Domain 0 active. The Port in question here is running CMLDS. Only in cases 2) and 4) is this not a serious misconfiguration. Can meanLinkDealy or nrrPdelay actually be “computed” and made available to all domains?

meanLinkDelay: “measure” vs. “compute”

11.2.13.6 isMeasuringDelay: A Boolean that is TRUE if the port is measuring PTP Link propagation delay. For a full-duplex point-to-point PTP Link, the port is measuring PTP Link propagation delay if it is receiving Pdelay_Resp and Pdelay_Resp_Follow_Up messages from the port at the other end of the PTP Link (i.e., it performs the measurement using the peer-to-peer delay mechanism). There is one instance of this variable for all the domains, i.e., all the PTP Instances (per port), and also one instance of this variable for domain 0 if domain 0 is implemented. The variable is accessible by all the domains.

10.2.5.11 computeMeanLinkDelay: A Boolean, set by the LinkDelayIntervalSetting state machine (see 11.2.21), that indicates whether meanLinkDelay is to be computed by this port. There is one instance of this variable for all the domains, i.e., all the PTP Instances (per port), and also one instance of this variable for domain 0 if domain 0 is implemented. The variable is accessible by all the domains.

The per-port global variable asCapableAcrossDomains is set by the MDPdelayReq state machine (see 11.2.19 and Figure 11-9). For a port attached to a full-duplex point-to-point PTP Link, asCapableAcrossDomains shall be set to TRUE if and only if it is determined, via the transport-specific or CMLDS peer-to-peer delay mechanism, that the following conditions hold:

[11.2.2]

- a) The port is exchanging peer delay messages with its neighbor,
- b) The measured delay does not exceed meanLinkDelayThresh,

[11.2.13.6]: “measured” in b) is equivalent to a)
How can a value that was not “computed” be compared to anything?

meanLinkDelay is always per Port

Table 10-1—Summary of scope of global variables used by time synchronization state machines (see 10.2.4 and 10.2.5) (continued)

[10.2.3]

Variable name	Subclause of definition	Per PTP Instance (i.e., per domain)	Per PTP Instance, per PTP Port	Instance used by CMLDS (i.e., variable is common across all Link Ports Link Ports)	Instance used by CMLDS, per Link Port Link Port
neighborRateRatio	10.2.5.7	No	Yes [†]	No	Yes No
meanLinkDelay	10.2.5.8	No	Yes ¹	No	Yes
delayAsymmetry	10.2.5.9	No	Yes [†]	No	Yes

[†] The instance of this variable that is per PTP Instance, per PTP Port exists only for domain 0.

10.2.5.8 meanLinkDelay: The measured mean propagation delay (see 8.3) on the link attached to this port, relative to the LocalClock entity of the time-aware system at the other end of the link (i.e., expressed in the time base of the time-aware system at the other end of the link). The data type for meanLinkDelay is UScaledNs. There is one instance of this variable for all the domains, i.e., all the PTP Instances (per port), and also one instance of this variable for domain 0 if domain 0 is implemented. The variable is accessible by all the domains.

Only Domain 0 active?
case 1), 2) or 4)?

Which one, if there
are two instances?

meanLinkDelay in Management Data Sets

14.8 Port Parameter Data Set (portDS)

[IEEE 802.1AS-2020]

14.8.8 meanLinkDelay

The value is equal to the value of the per-PTP Port global variable meanLinkDelay (see 10.2.5.8). It is an estimate of the current one-way propagation time on the link attached to this PTP Port, measured as specified for the respective medium (see 11.2.17, 12.5.2, and 16.4). The value is zero for IEEE 802.3 EPON links and for the master port of an IEEE 802.11 link, because one-way propagation delay is not measured on the latter and not directly measured on the former. The data type shall be TimeInterval. The default value is zero.

There are two instances of this variable in 10.2.5.8 - which one is it?

14.16 Common Mean Link Delay Service Link Port Parameter Data Set (cmldsLinkPortDS)

14.16.6 meanLinkDelay

The value is equal to the value of the per-port global variable meanLinkDelay (see 10.2.5.8). It is an estimate of the current one-way propagation time on the link attached to this Link Port, measured as specified for the respective medium (see 11.2.17, 12.5.2, and 16.4). The value is zero for Link Ports attached to IEEE 802.3 EPON links and for the master port of an IEEE 802.11 link because one-way propagation delay is not measured on the latter and not directly measured on the former. The data type shall be TimeInterval. The default value is zero.

Would they ever both be simultaneously used?

The same variable of 10.2.5.8 is referenced with different names

There is no default value for 10.2.5.8, when is this used?

Conclusions

- With there being always only one single instance of each the MDPdelayReq state machine [11.2.19] and the MDPdelayResp state machine [11.2.20] being invoked [11.2.17.1], the variables used seem “over-instantiated”

Are Congratulations in order?

Do you feel a (new) reader of the document will understand all the (implicit) consequences? (I did not!)



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Thank you for your attention!