Annex G

(informative)

The asymmetry compensation measurement procedure based on line-swapping

G.1 Introduction

This annex describes the asymmetry compensation measurement procedure based on the line-swapping method. The entire procedure is controlled by the Network Management System (NMS), except that the line-swapping is manually operated. This annex is intended to address the delay asymmetry due to length differences between transmit and receive fibers for long fiber runs.

NOTE—When a port is put into asymmetry measurement mode, it is put into this mode on all domains. The per-port global variable asymmetryMeasurement mode is common to, and accessible by, all domains (see 10.2.5.2).

G.2 Pre-conditions for measurement

The following pre-conditions should be met to both improve the accuracy of the measurement and make the measurement procedure more convenient:

a) The measurement environment, including the testing nodes (i.e., the time-aware systems at the endpoint of the link whose asymmetry is being compensated) and related nodes (i.e., nodes in the paths between the testing nodes and the Grandmaster PTP Instance), should enable gPTP and the BMCA so that the test can be made for each link without changing the configuration.
b) The testing nodes should have redundant paths for synchronization so that they remain synchronized to the Grandmaster Clock during the asymmetry compensation measurement.

G.3 Measurement procedure

The assumed measurement environment is shown in Figure G-1. Before the measurement starts, every node has enabled syntonization [i.e., by measuring neighborRateRatio (see 10.2.5.7) for each port of each time-aware system and accumulating the respective values over the synchronization spanning tree paths to obtain rateRatio (see 10.2.8.1.4) relative to the Grandmaster Clock[20]] and time synchronization. The testing link is between Port2 on node ACC1 and Port1 on node ACC2.

The criteria of 11.2.17 for determining whether the peer-to-peer delay mechanism is instance specific or is provided by CMLDS apply here.

[20] This standard neither requires nor prohibits syntonization (see 3.31) at the physical layer, e.g, using Synchronous Ethernet as the physical layer. If frequency is syntonized at the physical layer, the respective neighborRateRatio and rateRatio values are expected to be close to 1.

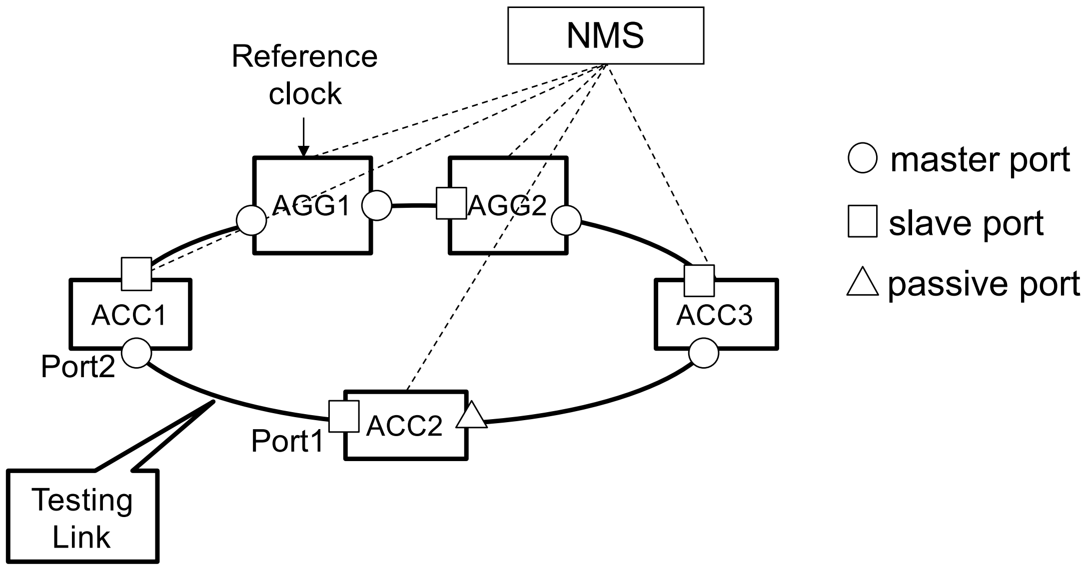

Figure G-1—Asymmetry compensation measurement procedure

The measurement procedure is as follows:

a) The NMS puts Port1 of ACC2 and Port2 of ACC1 into asymmetry measurement mode through the MIB (i.e., by setting the managed object asymmetryMeasurementMode for each port to TRUE). These two ports will not affect the PTP calculations of either node when the ports are in asymmetry measurement mode. If synchronization flowed over the link connecting these ports prior to their being put into asymmetry measurement node, the BMCA will result in a reconfiguration of the synchronization spanning tree so that both ACC1 and ACC2 remain synchronized.

b) Port1 of ACC2 will send Pdelay_Req messages periodically using the peer delay measurement mechanism and receive Pdelay_Resp and Pdelay_Resp_Follow_Up messages. For each set of messages, ACC2 should save t3 [the pdelayRespEventEgressTimestamp (see 11.3.2.1), carried in the Pdelay_Resp_Follow_Up message] and t4 (the pdelayRespEventIngressTimestamp, taken when the Pdelay_Resp message timestamp point crosses the reference plane at Port1 of ACC2 on reception).

c) The NMS reads and saves multiple sets of (t3, t4) from ACC2 through the MIB. It is necessary that each set of (t3, t4) be from the same measurement, i.e., from the same peer delay message exchange. The number of (t3, t4) sets can be decided as required and is outside the scope of gPTP.

d) The tester manually exchanges the transmit and receive fibers of Port2 of ACC1 and Port1 of ACC2. Then the tester waits until the port status and protocol status become stable again.

e) Port1 of ACC2 will again make periodic peer delay measurements and save each set of measurement values (t3', t4') (the primes are used to denote measurements that have occurred after the transmit and receive fibers have been exchanged).

f) The NMS reads and saves the multiple sets of (t3', t4') from ACC2 through the MIB. Then the NMS can compute the delay asymmetry, in units of time, as $(t4' – t4) \times \text{neighborRateRatio} – (t3' – t3)$. The NMS can use multiple sets of (t3, t4, t3', t4') to compute average values to get a more accurate result. The averaging method can be decided as required and is outside the scope of gPTP. If ACC1 and ACC2 are frequency synchronized, then neighborRateRatio is 1, and the delay asymmetry is $(t4' – t3') – (t4 – t3)$.

g) Based on the above result, the NMS sets the asymmetry value for Port1 of ACC2 and Port2 of ACC1 through the MIB.

h) After the NMS sets Port 1 of ACC2 and Port2 of ACC1 into normal mode (i.e., by setting the managed object asymmetryMeasurementMode for each port to FALSE), the delay asymmetry measurement of the testing link is completed. ACC1 and ACC2 will use the computed delay asymmetry as compensation in the PTP calculations.

It is also possible to compute the asymmetry ratio, i.e., the ratio of the delay on the receive fiber at ACC2 (Delay_rx_fiber, the delay of the Pdelay_Resp) to the delay on the transmit fiber at ACC2 (Delay_tx_fiber, the delay of the Pdelay_Req), both after line swapping. In this case, the NMS should collect multiple sets of (t1, t2, t3, t4) and (t1', t2', t3', t4') before and after line-swapping, respectively, where t1 is the pdelayReqEventEgressTimestamp (taken when the Pdelay_Req message timestamp point crosses the reference plane at Port1 of ACC2 on transmission), t2 is the pdelayReqEventIngressTimestamp (carried in the requestReceiptTimestamp field of the Pdelay_Resp message), and t3 and t4 are as given above. The NMS can compute the delay on the receive fiber as [(t4' – t1) × neighborRateRatio – (t3' – t2)] /2 and the delay on the transmit fiber as [(t4 – t1') × neighborRateRatio – (t3 – t2')]/2. Then the asymmetry ratio is as follows:

$$\text{Delay\_rx\_fiber}/\text{Delay\_tx\_fiber} = [(t4' - t1) \times \text{neighborRateRatio} - (t3' - t2)] / [(t4 - t1') \times \text{neighborRateRatio} - (t3 - t2')]$$