Management Support for Automatic Measurement of Link Delay Asymmetry

802.1 ASbt, 201111 IEEE 802 plenary

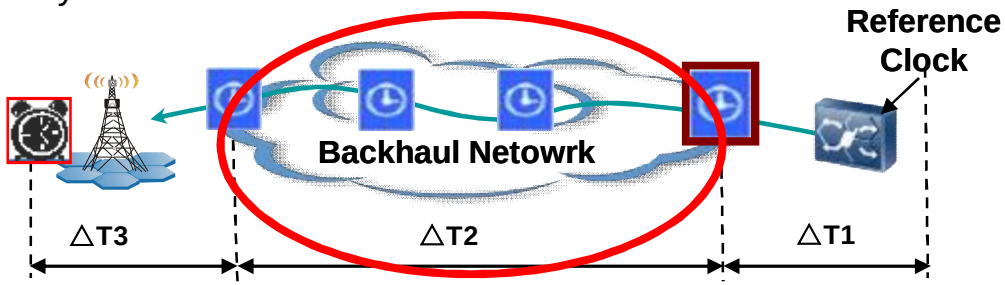
Lu Huang (huanglu@chinamobile.com)

Agenda

- **Backgroud**
- **Management support for automatic measurement of link delay asymmetry**
- **Proposal**

Reason for compensation for asymmetry of physical line

- **Sync accuracy requirement in backhaul network**
  - Time sync between NodeB and Reference clock: +/- 1.5us
  - Considering elements outside PSN will introduce time offset, PSN need more precise time synchronization: +/- 1us



Suggestion:
| △T1 | < 250ns
| △T3 | < 250ns
| △T2 | < 1000ns

- **PTP(1588v2) can't eliminate delay asymmetry of physical fiber line**
  - Ethernet ports are usually full-duplex, which means upstream and downstream packets go through different physical links, such as fibers
  - The transport delay of optical fiber is 5us per 1km, so 100 meters length difference will introduce 250ns error

For large backhaul network, compensation for asymmetry of physical line is really a mandatory requirement.

Current compensation method

- **Hop by hop compensation**
  - Through some measurement equipment, measure asymmetric error of every physical line between any two directly connected nodes
  - **Problems**
    - It is hard work to measure asymmetric error hop by hop
    - Accumulated error from measurement of every hop maybe considerable
- **End to End compensation**
  - Use GPS to measure the end-to-end compensation value at the endpoint (e.g. mobile base station)
  - **Problems**
    - It is hard work to measure compensation value at every endpoints
    - It is hard to get GPS signal in some places, e.g. subway
    - If data path switch to the redundancy one, the compensation should be measured again

Above methods are manual mode, which will lead to large work in the deployment of 1588v2. Furthermore, when network changes (e.g. repair fiber line break), compensation should be manually measured again.

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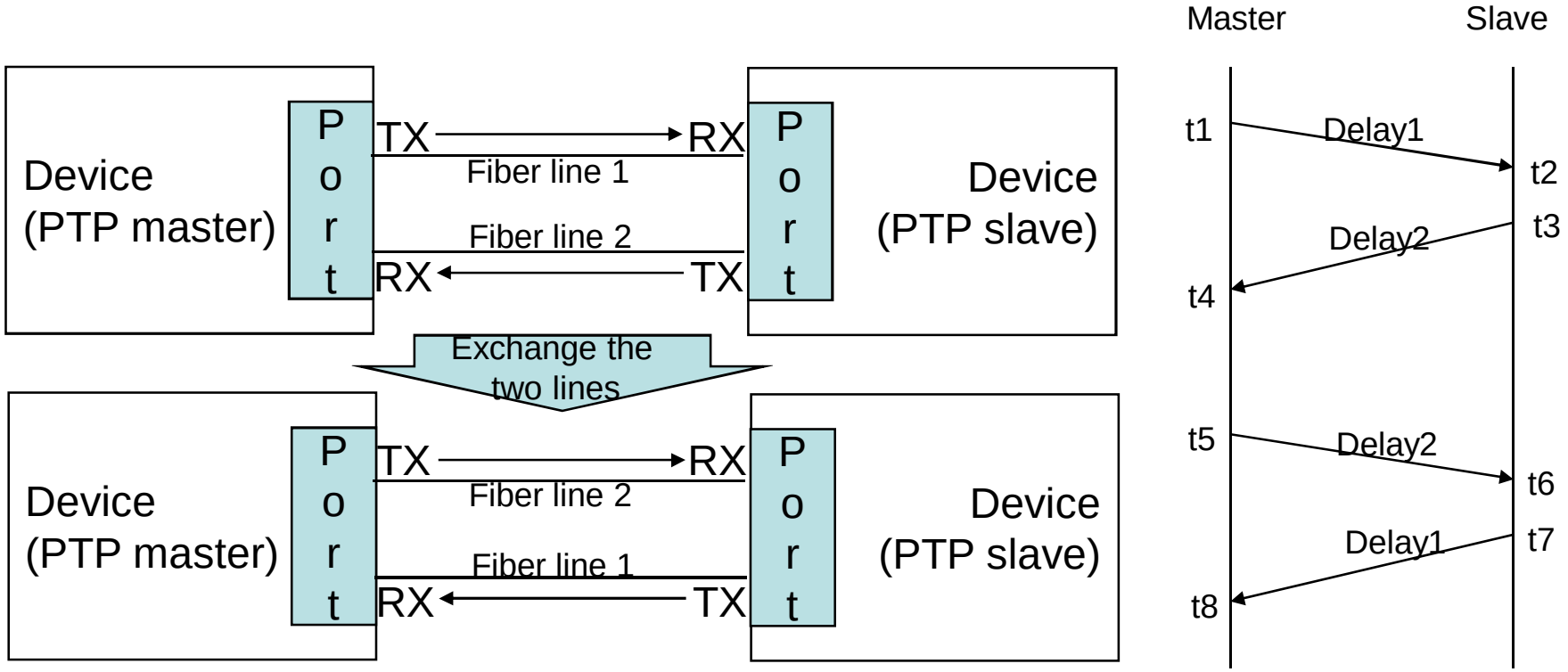
Prefered solution for measurement

- **Mechanism**
  - As the mechanism of standard PTP, after getting t1,t2,t3,t4 timestamps, exchange the TX and RX fiber lines manually or automatically, then get t5,t6,t7,t8 to calculate the link delay respectively for the two fiber lines. As the following:

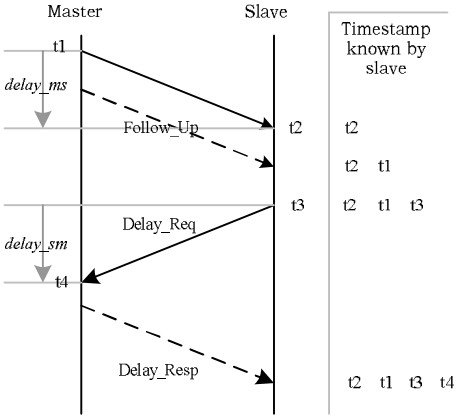


$$Delay1=(t2+t8-t1-t7)/2$$

$$Delay2=(t4+t6-t3-t5)/2$$

Prefered solution for measurement

- **Processing Flow**
  - When the PTP port become active, run PTP to get t1,t2,t3,t34.
  - Exchange the TX and RX fiber lines manually or automatically, run PTP again to get t5,t6,t7,t8
  - Calculate delay1 and delay2 and then get the ratio of delay2 to delay1, which is saved for the following PTP calculation. (m = delay2/delay1)
- **Correction for PTP**
  - The corrected equation is



$$Delay\_ms/Delay\_sm = m$$

$$t2 - t1 = Delay\_ms + Offset$$

$$t4 - t3 = Delay\_sm - Offset$$

$$Offset = [(t2-t1)+m(t3-t4)]/2m$$

$$Delay\_ms = [m(t2-t1)+m(t3-t4)]/(m+1)$$

$$Delay\_sm = [(t2-t1)+(t4-t3)]/(m+1)$$

Management support for automatic measurement of link delay asymmetry

- **For ASbt, there are the following requirement for Management support for automatic measurement of link delay asymmetry**
  - Calculate line delay precisely through t1 to t8
  - Management for exchanging tx and rx line
    - Manually: run PTP and record t1 to t4, after manually exchanging tx and rx line, run PTP again and record t5 to t8
    - Automatically: run PTP and record t1 to t4, control to exchange tx and rx line, run PTP again and record t5 to t8. ASbt could control the optical module or other elements to exchange tx and rx line
    - Time of exchanging should be less than a few seconds, otherwise new error will be introduced because of the shifting of local clock (This point is still under research)

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Proposal

- **For ASbt, we propose to support management of measurement of asymmetry compensation:**
  - **Calculate line delay precisely through t1 to t8**
  - **Be able to control the exchange of tx and rx line as fast as possible**

Thank you

Q&A