Measurement of link delay asymmetry

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Lu Huang, China Mobile (huanglu@chinamobile.com)
Liuyan Han, China Mobile (hanliuyan@chinamobile.com)

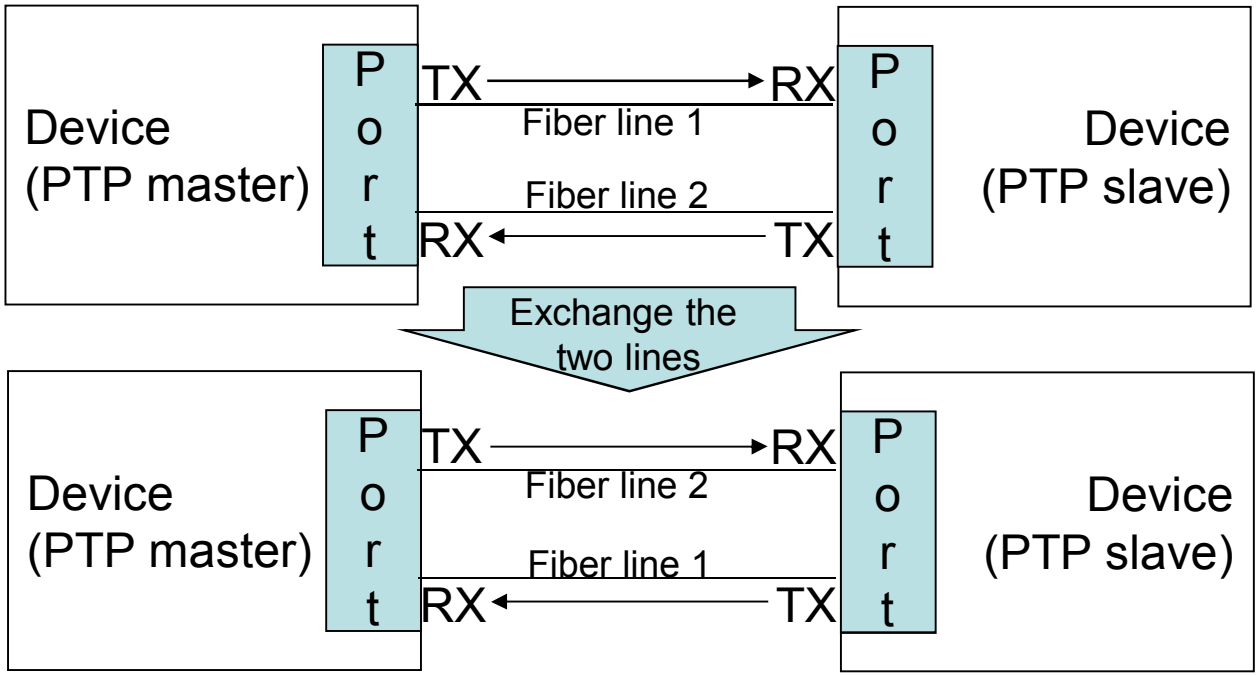
Requirement

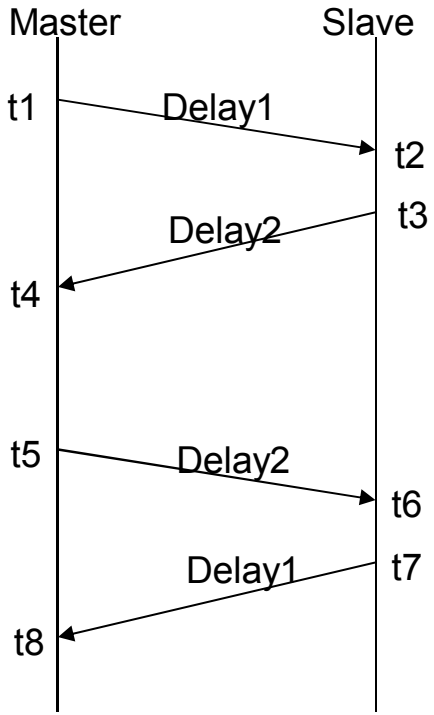
- **Sync accuracy requirement in TD-SCDMA/TD-LTE**
  - Base stations need frequency sync: +/- 0.05ppm, and phase sync: +/- 3us
  - Time sync between NodeB/eNB and Reference clock: +/- 1.5us
  - Considering RNC and NodeB will introduce time offset, backhaul network (PTN for China Mobile) need more precise time synchronization: **+/- 1us**
- **Requirement for link delay asymmetry**
  - The transport delay of optical fiber is 5us per 1km, so 100 meters length difference will introduce 250ns error
  - In our backhaul network, Some of physical lines had serious asymmetry, **whose error was even up to 6us**

- **China Mobile has large backhaul network, compensation for asymmetry of physical line is really a mandatory requirement**
- **This problem is really slowing down the large scale deployment of 1588**

Possible solution

- **Manual/automatic Line-swapping for error calculation**





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

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

- **In China Mobile's PTN network, only one vendor can support manual line-swapping to calculate the error**
- **The status (before or after line-swapping) is informed to the PTN equipments by the network management system**

Suggestions for IEEE 802.1ASbt (1)

If the device or modules support automatic line-swapping

- **In order to ensure interoperability, the management parameters and negotiation mechanism should be standardized**
  - Define the management parameters for the asymmetry error calculation
  - Define the negotiation mechanism to help upstream node and downstream node do line-swapping at the same time and know whether the undergoing recording is before or after line-swapping
- **There may be two ways to add a negotiation mechanism in the PTP packets to trigger line-swapping on both sides and announce the status to each other(before or after line-swapping)**
  - In the PTP header, there are messageType and Reserved bits which can be utilized
  - In the PTP frame TLV. The TLV could be inserted after the 1588 payload and used to distinguish the packets before or after line-swapping
- **Based on the data before and after line-swapping, calculate delay asymmetry and record it for the future time synchronization**

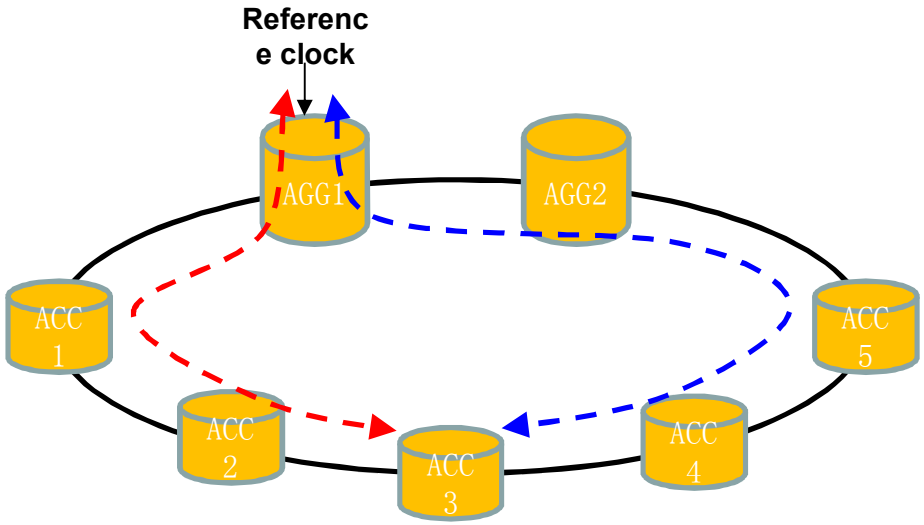
Suggestions for IEEE 802.1ASbt (2)

If only manual line-swapping

- **Management system should be able to controll the slave to start asymmetry error compensation and inform the status (before or after line-swapping) to devices**
  - Define the management parameters for the asymmetry error calculation
  - Define the management parameters for the status of line-swapping
- **Based on the data before and after line-swapping, calculate delay asymmetry and record it for the future time synchronization**

Other consideration

- **Detecting line asymmetry quickly in some specific topology, e.g. ring topology**



- Choose ACC3, which has a PTP passive port based on default BMC algorithm, to detect line asymmetry of the ring
- ACC3 could run 1588 with upstream nodes through different paths (different directions)
- **Based on the synchronization results of different paths, it can find whether the whole ring is asymmetry or not**

- **When it's ring topology, you can quickly discover the asymmetry to decide whether a compensation is necessary**
- **Maybe, we can define some similar mechanism in ASbt to detect line asymmetry before doing compensation**

Summury

- Compensation for line asymmetry is really a mandatory requirement
- Now it seems that line swapping is a relatively simple way to calculate asymmetry error, although no automatic line-swapping device exists
- In ASbt, it’s better to define some parameters or steps to manage the whole process of line-swapping
- Maybe, we could define some simple mechanisms in ASbt to detect line asymmetry quickly before doing compensation

Thank you

Q&A