MPCP – Timing Model

Onn Haran, Ariel Maislos – Passave

Bob Gaglianello – Lucent

Dolors Sala – Broadcom

Glen Kramer – UC Davis

Jian Song – Salira

Yinghua Ye – Nokia

Updates From Baseline

- Laser control interface
- Guard band equation - informative
- Guard band for OLT ⇔ ONU clock drift
- PHY ⇔ MAC jitter constraint
- Time information loss fault mechanism

Laser Control Interface

- **There are two options for laser control interface:**
  - MAC control asserts a signal
  - MAC control will set laser control using an internal register
    - The transceiver can read this value using an unspecified interface

Guard Band Definition

- **OLT must maintain a guard band between transmissions from different ONUs to accommodate:**
  - OLT ⇔ ONU clock drift
  - ONU laser turn on and turn off
  - OLT receiver locking
  - Implementation jitter
  - Fiber length changes
  - State machine synchronization

Guard Band Equation - Information

- The equation should be used to analyze the contributors to guard band, in order to set limit where needed

Tguard-band =

Tclock-drift +

max(Tlaser-on, Tlaser-off) +

AGC delay +

CDR acquisition delay +

2 * mac→phy jitter + 2 * phy→mac jitter +

Tthermal-drift +

2 * clock resolution +

comma sync time

Guard Band Equation (cont.)

$$T_{clock\text{-}drift} = \max(T_{grant\ length},\ T_{max\ between\ downlink\ timestamp}) * \text{max OLT}\Leftrightarrow\text{ONU clock ppm difference}$$

$$T_{thermal\text{-}drift} = T_{max\ between\ uplink\ timestamp} * \text{Maximal thermal gradient} * (T_{upsteam\ propagation\ delay} * \text{Upstream propagation gradient} + T_{downsteam\ propagation\ delay} * \text{Downstream propagation gradient})$$

Guard band for OLT ⇔ ONU clock drift

- **The clock drift between OLT and ONU has a significant contribution to guard band size**
- **A strict limit should be set**
  - Suggested value is between 20nSec and 50nSec
- **For example, a value of 40nSec could be reached by setting the following parameters:**
  - Time stamp every 4mSec and +/- 5ppm
  - Time stamp every 200uSec and +/- 100ppm

PHY⇔MAC Jitter Constraint

- **PHY → MAC jitter is accounted twice in guard band**
- **MAC → PHY jitter is also accounted twice**
- **A small constraint must be guaranteed:**
  - Suggested value 20nSec to 50nSec

Fault: Time Information Loss

- **When an ONU loses time information, it may interfere with neighboring ONUs' transmission**
- **The misbehaved ONU's transmissions may not be received, causing collisions**
  - OLT will not succeed at detecting which ONU is at fault
- **The situation is made worse by slow-reacting OLT software implementation**

- **A mechanism for detecting ONU time information loss at ONU should be defined**

Detection Mechanism

- **Define T_D as difference between T_L (local PON clock) and T_S (received timestamp value)**
  - T_D is calculated whenever a valid MPCP message is received.
- **If ABS(T_D) >= 5* $T_{guard\text{-}band\text{-}jitter}$ →**
  Move to reset state
- **Allowed jitter is the part of guard band equation susceptible to jitter:**

$$T_{guard\text{-}band\text{-}jitter} = T_{clock\text{-}drift} + 2 * mac \rightarrow phy\ jitter + 2 * phy \rightarrow mac\ jitter + T_{thermal\text{-}drift} + 2 * clock\ resolution$$

Further Work

- Need to finalize laser control interface
- Need to finalize reset state – soft or hard
- Waiting for inputs from PMD group to fine tune constraints