EPON Protocol over Coax

TDD Cycle Updated

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Description of TDD Cycle

- The TDD cycle consists of four time segments
  - Downstream (DS) Time Window
  - Upstream (US) Time Window
  - Two Guard Times (GT)

- The values of these time segments needs to be configured at the CLT
- This values of these time segments will be sent over the downstream PLC
- It may be possible to reconfigure these values over the OAM

TDD Cycle Descriptor

- We need to be able to describe the TDD cycle so it can be configured at CLT, communicated over PLC and possibly over OAM
- We need to decide on the range of values these time segments can take on and in what units we measure them

Guard Time

- The guard time needs to be at least as long as the maximum of these two times
  - RF switching time for the device to switch from transmit to receive or from receive to transmit
  - The round trip time (RTT) from the CLT to the CNU and back
- RF switching time of 1 to 2 μs is reasonable
- The RTT depends on the length of the passive network
- Let *d* be the distance from the CLT to the CNU in meters
- Velocity factor on coax depends on the dielectric constant
- Typical values vary from 0.66 (solid polyethylene dielectric) to 1 (air) [Wikipedia]
- Let's use worst case at 0.66, giving a speed on the coax of,

$$s = 0.66 \times 3 \times 10^8 m/s \approx 2 \times 10^8 m/s \approx 200\ m/\mu s$$

Guard Time

- Round trip time (RTT) values,

$$RTT \approx \frac{2d}{s} \approx \frac{d}{100} \ \mu s$$

d (m)	RTT (μs)
200	2
500	5
1000	10

Guard Time – Configuration Resolution

- We will specify a number of possible guard times

$$\{T_1, T_1 + \Delta T, T_1 + 2\Delta T, T_1 + 3\,\Delta T, \ldots\}$$

  - What resolution should we allow in these configurations? What should be the value of ΔT?
  - It should be an integer multiple of the OFDM clock period

$$\Delta T = k\,\frac{1}{204.8\,MHz} = k \times 4.88281\,ns$$

Guard Time – Configuration Resolution

- Possible values of ΔT

Number of Clock Periods	ΔT (µs)
128	0.625
256	1.25
512	2.5
1024	5.0

Guard Time Configuration Resolution – Straw Poll

- What value of ΔT do think we should use?
  - 0.625 µs 0
  - 1.25 µs 6
  - 2.5 µs 0
  - 5 µs 3
  - Other

Guard Time – Minimum and Maximum Values

- The guard time needs to as large as, or larger than, the maximum of the RF switching time and the RTT
- The RTT varies by deployment
- The guard time can be longer than both the RF switching time and the RTT, the only impact is an increase in overhead

Minimum Guard Time – Straw Poll

- What is the minimum guard time that should be specified in the standard?
  - 2.5 µs 6
  - 3.75 µs 0
  - 5.0 µs 2
  - Other

Maximum Guard Time – Straw Poll

- What is the minimum guard time that should be specified in the standard?
  - 10 µs
  - 12.5 µs
  - Other

Downstream Time Window

- The DS Time Window should be a multiple of the symbol duration (including the cyclic prefix)
- We need to specify a minimum number of symbols and a maximum number of symbols in the DS time window
- Symbol duration (excluding cyclic prefix)
  - 4K FFT: 20 µs
  - 8K FFT: 40 µs
- Cyclic prefix values (pietsch_3bn_02_0313)
  - 0.9375, 1.25, 2.5, 3.75 and 5 µs

Downstream Time Window

- Range of Downstream Time Window
- To avoid high overhead from the guard time we want to have

$$T_{DS} \gg T_{GT} \approx 2.5 \text{ to } 10\ \mu s$$

- To avoid high latency we want to have

$$T_{DS} \ll 1000\ \mu s$$

- It may not be possible to meet both of these requirements in a single configuration

Downstream Time Window

- Want to allow the operator the ability to configure the downstream time window to allow for a trade-off between latency and overhead
- There may be networks were latency is critical and higher overhead will be allowed
- There are also networks where latency is not so critical and lower overhead is preferred

- Does the PHY require a minimum number of symbols in the downstream time window?

Minimum Downstream Time Window – Straw Poll

- For the 4k FFT version what value do you believe should be the <u>minimum</u> configurable downstream time window (measured in symbols including cyclic prefix)
  - 1symbol = 20.9375 to 25 µs 0
  - 2 symbols = 41.875 to 50 µs 0
  - 4 symbols = 83.75 to 100 µs 4
  - 8 symbols = 167.5 to 200 us 2

Minimum Downstream Time Window – Straw Poll

- For the 8k FFT version what value do you believe should be the <u>minimum</u> configurable downstream time window (measured in symbols including cyclic prefix)?
  - 1symbol = 40.9375 to 45 µs 0
  - 2 symbols = 81.875 to 90 µs 1
  - 4 symbols = 163.75 to 180 µs 4
  - 8 symbols = 327.5 to 360 µs 1

Maximum Downstream Time Window – Straw Poll

- For the 4k FFT version what value do you believe should be the maximum configurable downstream time window (measured in symbols)
  - 32 symbol = 670 to 800 µs
  - 48 symbols = 1005 to 1200 µs

Maximum Downstream Time Window – Straw Poll

- For the 8k FFT version what value do you believe should be the maximum configurable downstream time window (measured in symbols)
  - 16 symbol = 655 to 720 µs
  - 24 symbols = 982.5 to 1080 µs

Upstream Time Window

- Should the allowed values of the upstream time window be the same values allowed for the downstream time window?
  - Measured in multiples of symbol+CP (since CP for upstream may be different than downstream)