

TDD Cycle

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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,

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

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

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

- 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

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

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 – Minimum and Maximum Values

- The guard time needs to be 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
- Allowed values of the guard time were straw polled
 - See TDD Opening Report

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 μ s
 - 8K FFT: 40 μ s
- Cyclic prefix values (pietsch_3bn_02_0313)
 - 0.9375, 1.25, 2.5, 3.75 and 5 μ s

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 where 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?
- Allowed values of the downstream time window were straw polled
 - See TDD Opening Report

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)