Relationship between TDD IBG and maximum link propagation delay

Contribution to 802.3dm Task Force

June 26, 2025

Ragnar Jonsson - Marvell

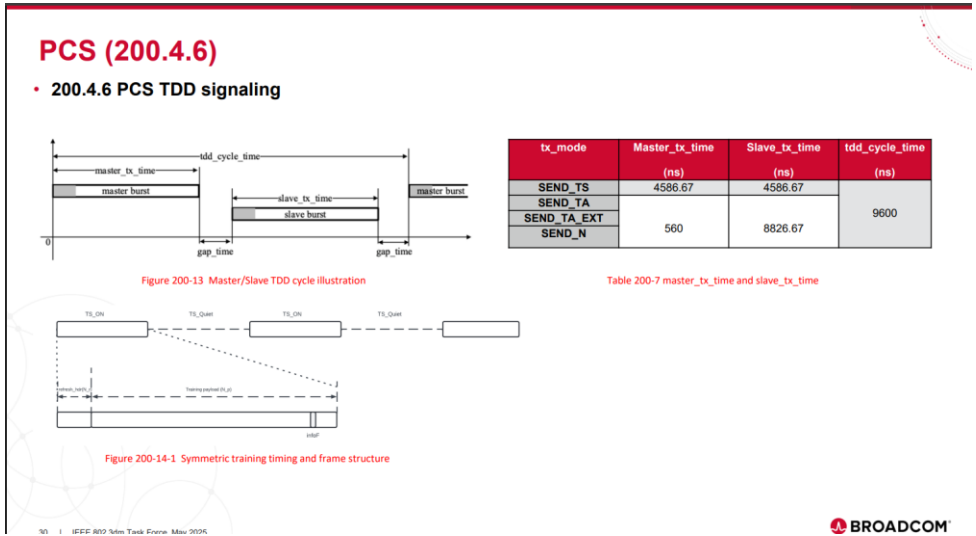
Introduction

- Recently there has been discussion in the 802.3dm task force about maximum propagation delay over the link segment:
  - gorshe_3dm_01a_250501.pdf
  - gorshe_3dm_01_2505.pdf
  - Link Propagation Delay in IEEE 802.3dm – System Implications and Tradeoffs v2.pdf

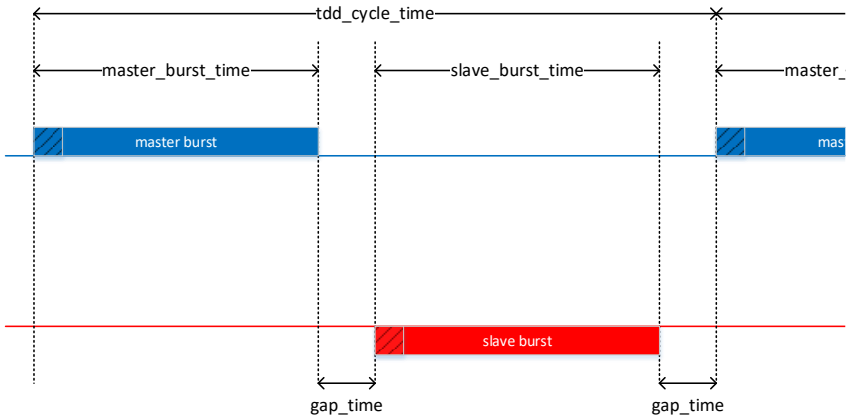
- This presentation looks at the relationship between TDD Inter-Burst Gap (IBG) time and the link segment propagation delay
- It is shown that there will be TDD collisions on the link if the propagation delay exceeds the TDD IBG time

TDD Signaling

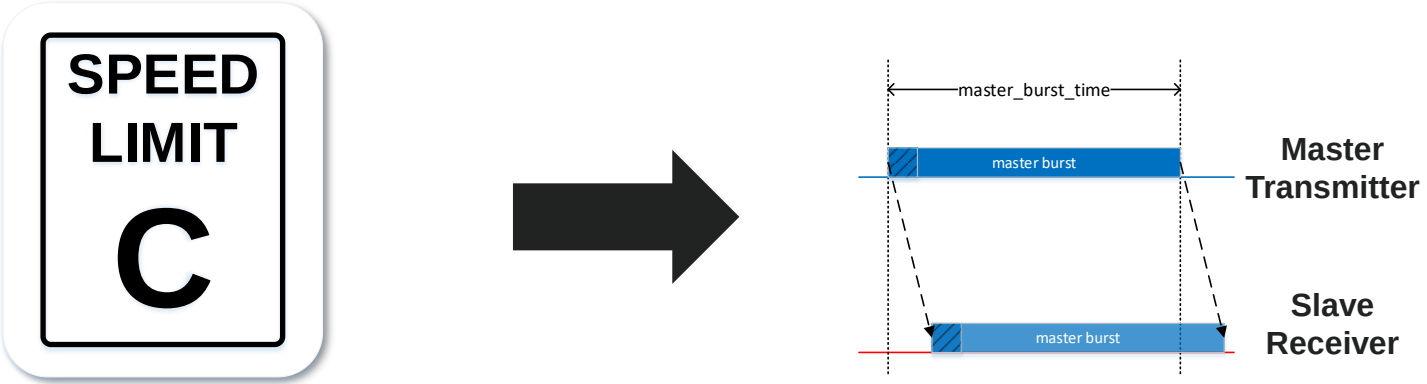
- Time division duplexing modulation does not need echo cancelation, because a PHY is never transmitting and receiving at the same time
- Inter-Burst Gap (IBG) is a silent time period that is used to avoid collision between the transmitter and the receiver



From https://www.ieee802.org/3/dm/public/0525/Baseline_Text_TDD_051125.pdf



Propagation Delay

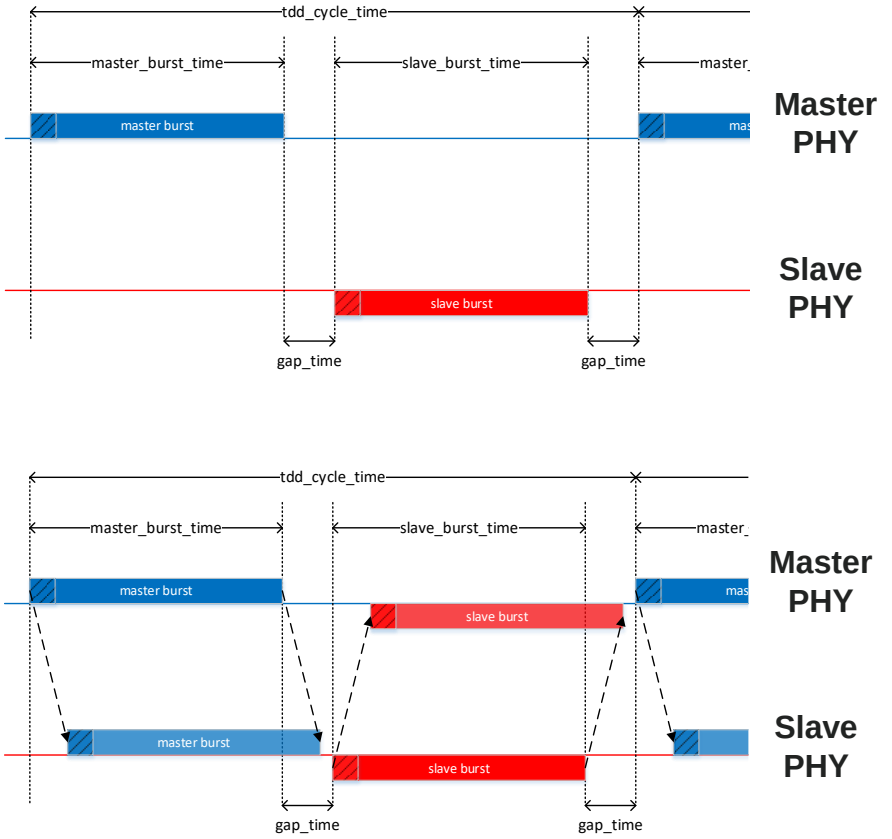


All links will have propagation delay across the link segment!

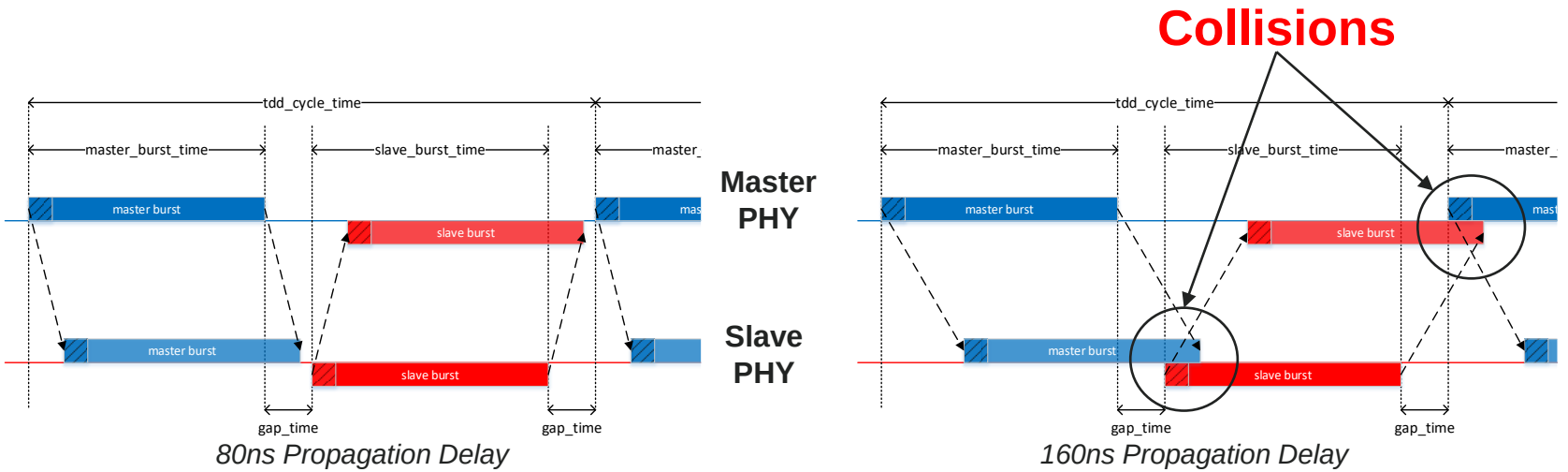
The delay depends on the propagation speed and the length of the cables

Transmit and Receive Signal Alignment

- Propagation delay complicates the time alignment between transmit and receive signals
- The figure on the top right shows the signal relationship if the propagation delay is not considered
- The figure on the bottom right shows the signal relationship between transmitted and received signals with propagation delay



Propagation Delay Collisions



If the link segment propagation delay is longer than the Inter Burst Gap (IBG) time, then TDD will have collisions between transmit and receive signals

Conclusion

- TDD modulation uses Intra-Burst Gap (IBG) to avoid collision between transmitter and receiver
- If the link segment propagation delay is larger than the IBG, then there will be a collision between the transmitter and the receiver
- In TDD modulation it is important to choose the IBG such that it does not limit the maximum cable length that can be supported

Essential technology, done right™