Link Training FSM update

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1 November, 2016

Supporters

- Me
- Myself
- I

Port bring-up modes

- Auto-neg
  - Runs CI73 to determine the highest PHY rate supported on both ends
  - Once rate is determined, rate swap and Link Training begins
  - Provides mechanism to start the Link Training on both sides of link at same time
- Forced rate
  - Both ends programmed by pervasive management to “a common PHY rate”
  - Link training is skipped since no method available to align start of Link training timeout timers
  - TxEq is then set based on each ends “best guess”
  - RxEq then adapts to “whatever” it’s receiving

Proposal

- Add a wait state in Link Train FSM such that the Link Training timeout timer does not start until “frame lock” is seen. Exact definition of frame lock could take on several forms. To be discussed later on.

- Enables forced rate mode to run Link Training with Link Train timeout timer still in affect, start of timeout is delayed until both sides are transmitting frames between each other

- By running Link Training the Rx is allowed to equalize the channel using both Tx & Rx Equalization

Why

- Currently the only way to get access to Link training is to run AN.
- Adding a wait state would allow for 3 start-up scenarios
  1. AN – auto Tx + Rx Eq
  2. Forced Rate Link Train – auto Tx + Rx Eq (new)
  3. Forced Rate PCS – Fixed Tx Eq, auto Rx Eq, PAM4 only signaling (Link train starts in PAM2 mode)

AN startup

- When running AN management commonly does
  - Configures AN
  - Configures SerDes
  - Starts AN process
  - Waits for an_good status
  - Reads result
  - Reconfigures SerDes
  - Launches Link Training
  - Enables MAC & PCS at HCD
  - Check PCS status and set link_status[HCD]

- Waiting on an_good status and reacting to HCD result requires “fast” reaction time.

Fixed Rate startup

- When running Fixed rate management commonly does
  - Configures SerDes
  - Enables MAC & PCS
  - Rx tune SerDes
  - Check PCS status

- Rx Tune begins once data is “detected”

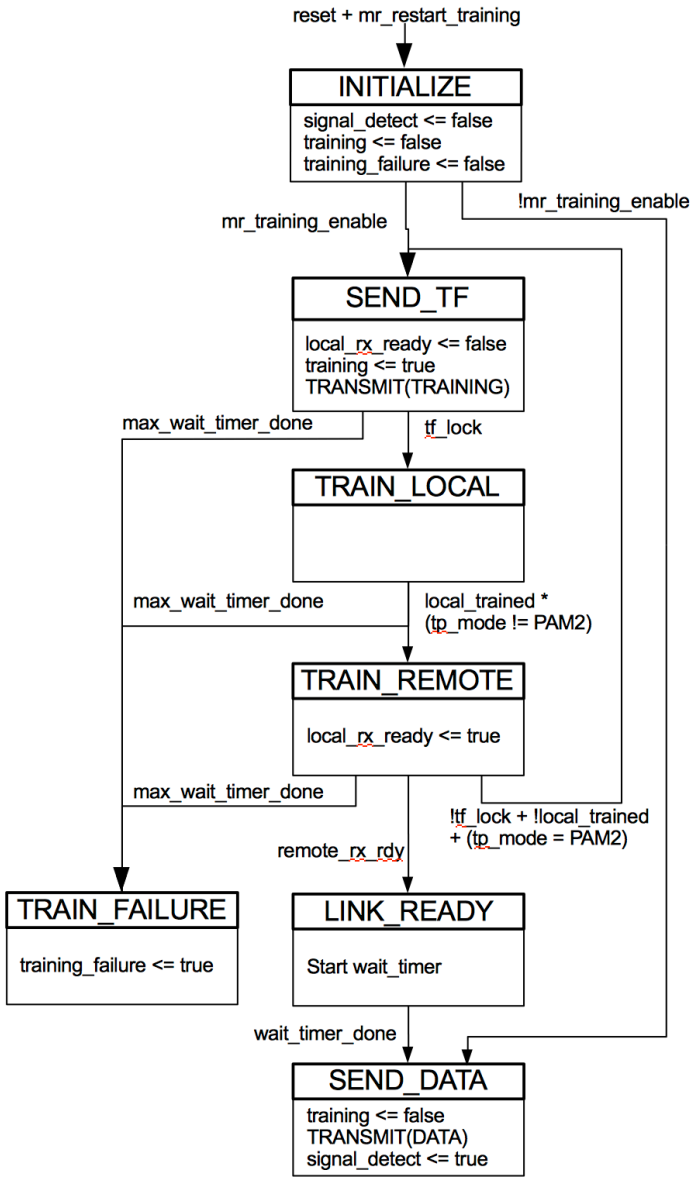
Skipping AN but running Link Train

- When running Fixed rate with Link Train management would
  - Configures SerDes
  - Enables MAC & PCS
  - Launches Link Training
  - Wait for Link Train failure or MAC up

- No timeline to port-up is required, no AN timeout
- So it's more fire and forget based sequence
- Provides a mechanism still get optimized Equalization for the channel

Clause 136 FSM

- Start max_wait_timer begins as soon as reset condition goes away. So part of the 1500ms bring up time is spent waiting for other end start sending frames



802.3cd D1.0
Figure 136-7 – PMD control state diagram

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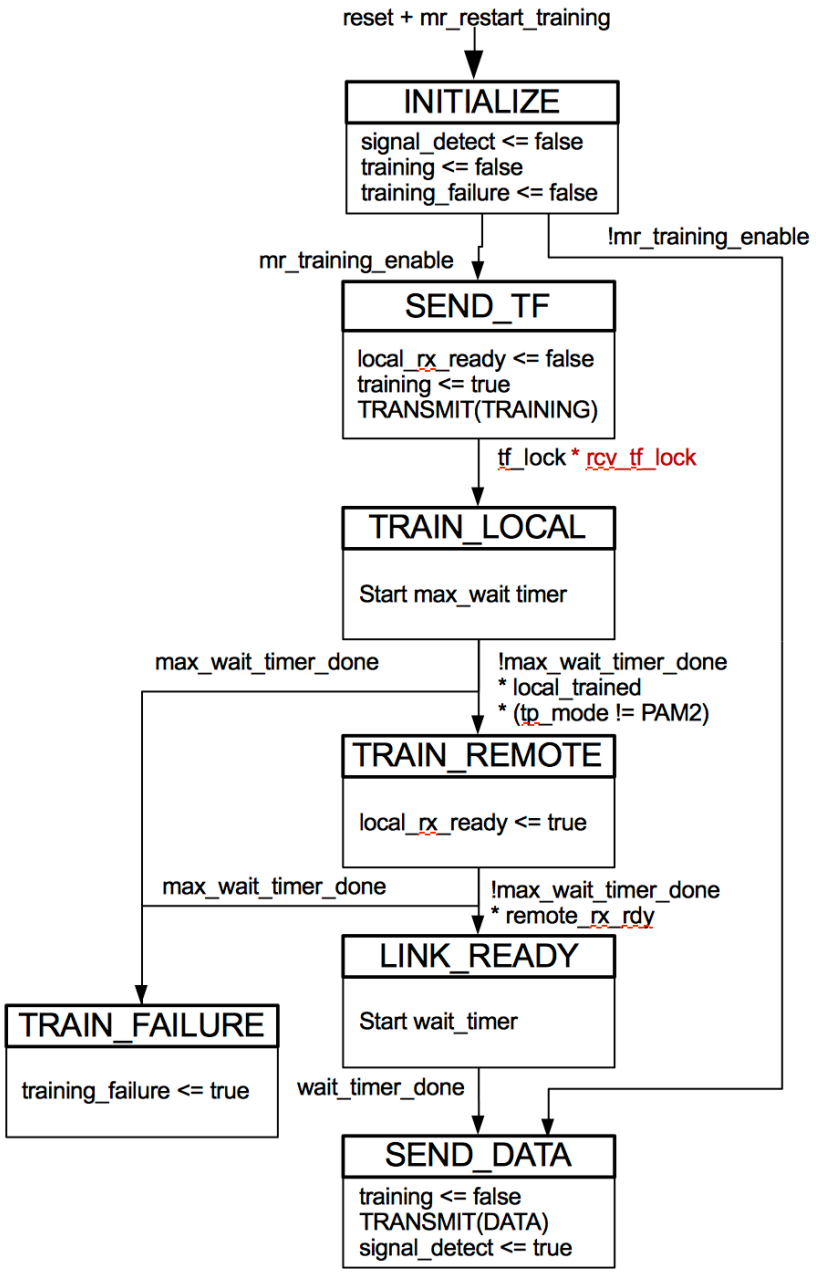
Proposed Change

- Shift start of max_wait_timer to TRAIN_LOCAL state.
- Once trained, you wait for other end to indicate it's done or timeout.
- Red text would be an option to include to wait for both sides to ACK they're locked before starting timer.



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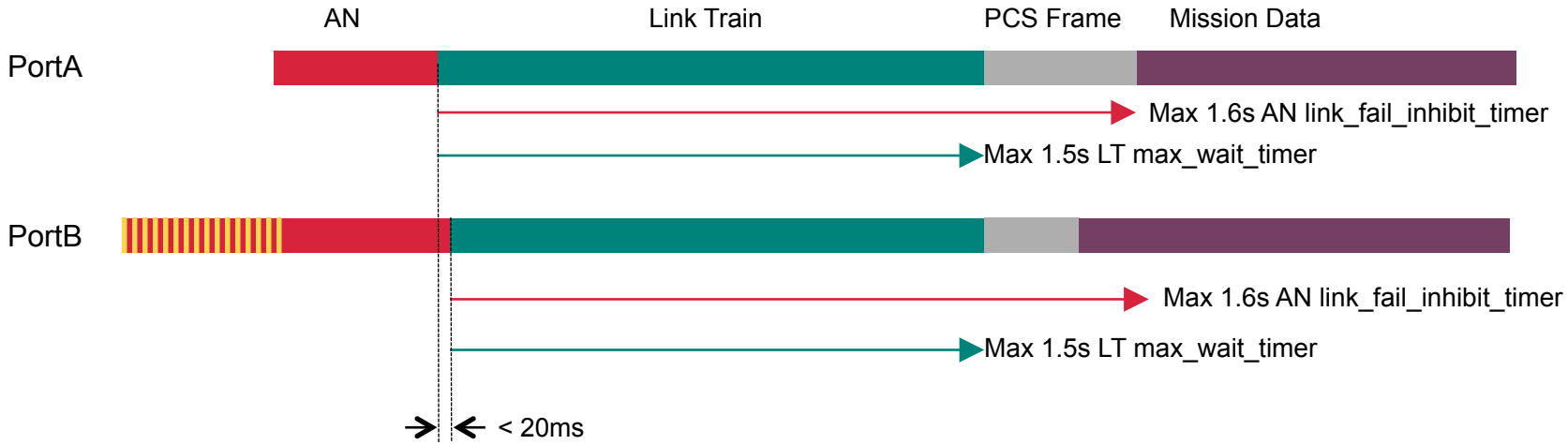
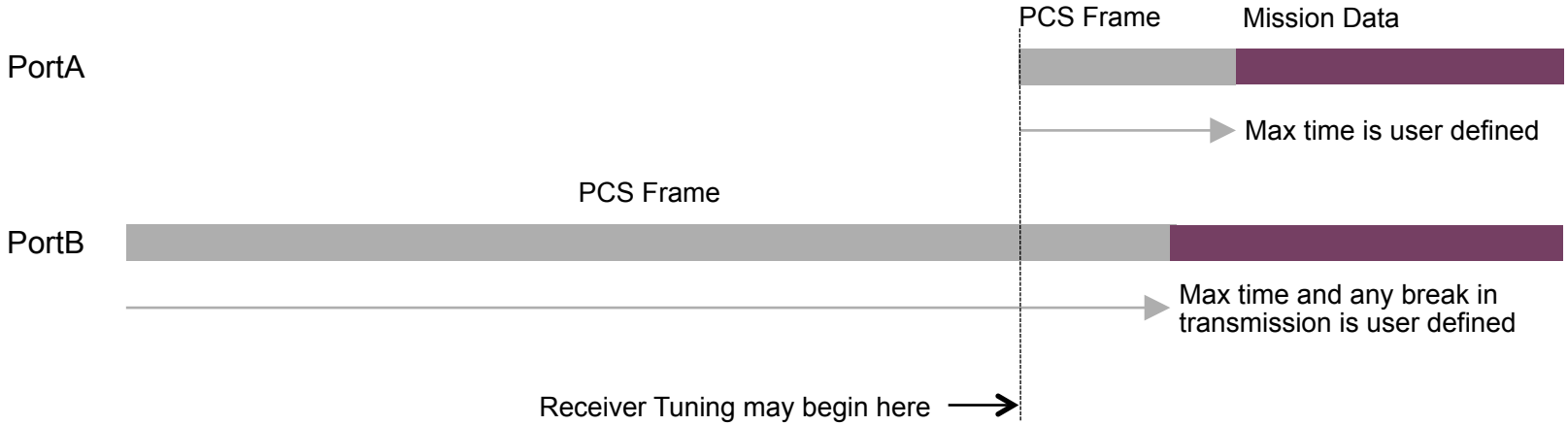
AutoNegotiation Port bring-up timeline



Forced Rate no Link Train Port bring-up timeline



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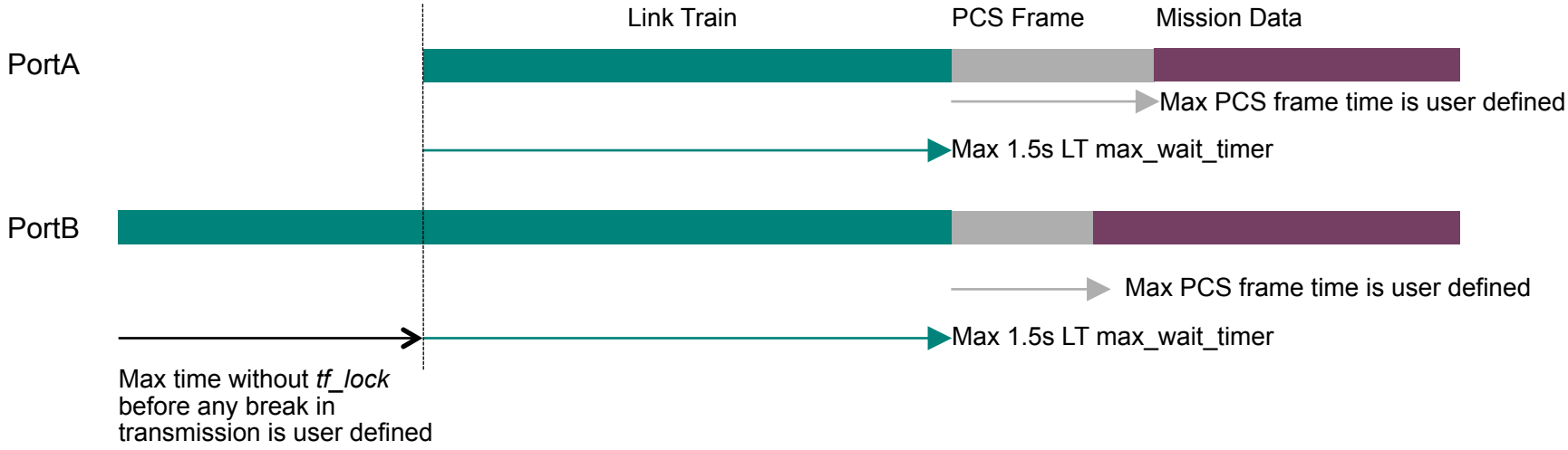
Forced Rate with Link Train bring-up timeline



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Conclusion

- With a slight tweak to the Link Training State Diagram we can provide the ability for users to bypass AN but still get the advantage of automatic channel adaptation of both Transmit and Receiver Equalization via Link Training.