Refined Link Sync Proposal

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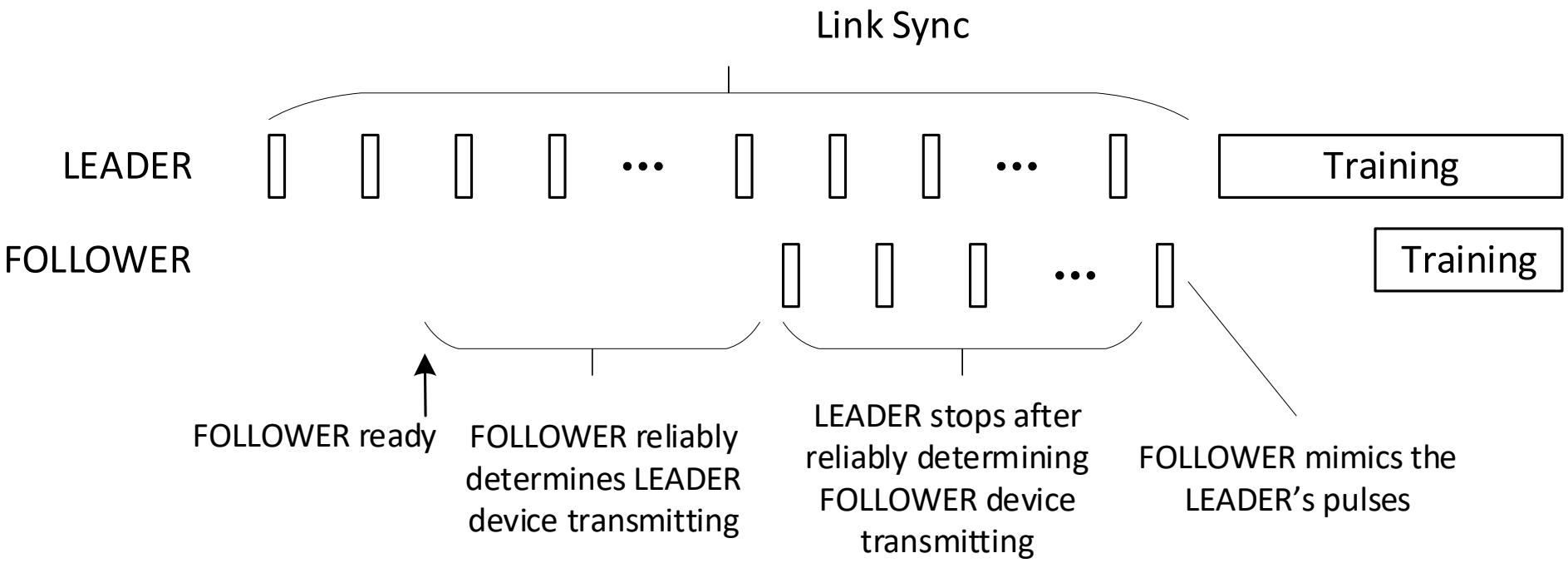
Updates

- Original Intent: Make link sync friendly to crystal-less implementation at the FOLLOWER
  - Don’t need precise frequency lock
  - Allow rough estimation of frequency
- Simplify by removing randomization from Lo_3dm_01_050125.pdf
- razavi_01_3dm_01a_July_2025.pdf showed reliability without any randomization
- zherebtcov_Jonsson_3dm_01a_09_04_25.pdf showed DME bursts robust

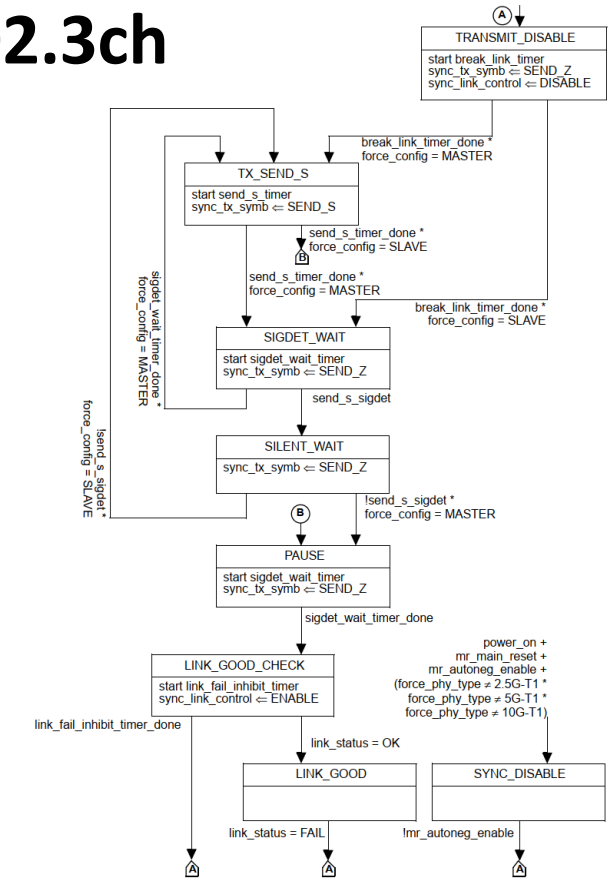
General Process



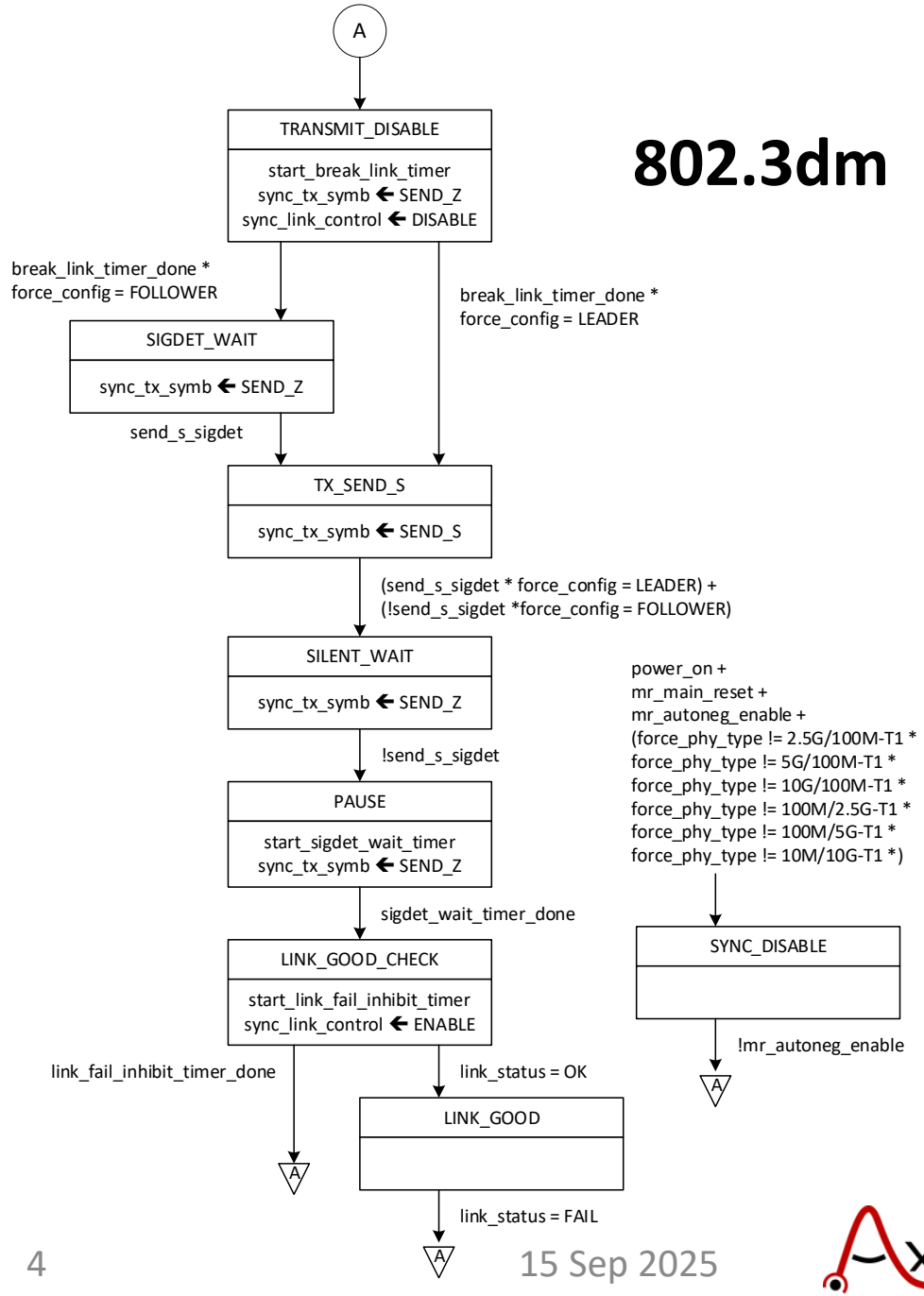
State Diagram

- Similar to 802.3ch but simplified

802.3ch



802.3dm



Definitions

- DME symbol time is nominally 8.533… ns
- SEND_S Pulse
  - Sequence of 4-bit 1001 converted to DME symbols
- SEND_S Signal
  - Some period of quiet followed by SEND_S pulse
  - The quiet period is defined slightly differently for LEADER and FOLLOWER

Variables

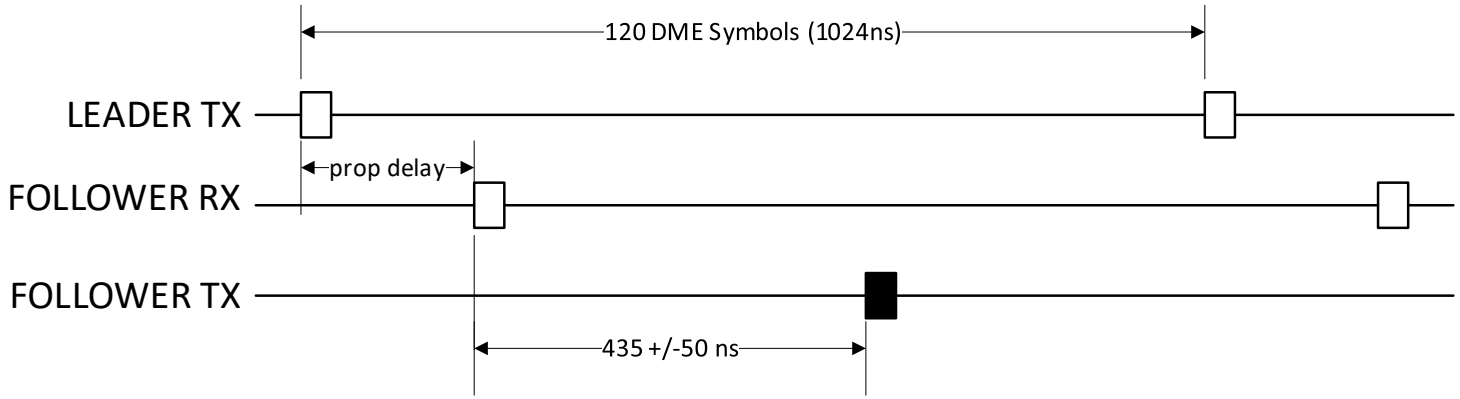
- All variables similar to 802.3ch except the following is redefined
- sync_tx_symb ← SEND_S means:
- At LEADER:
  - Continuous signal of SEND_S pulse followed by 116 DME symbol periods of quiet
- At FOLLOWER:
  - SEND_S pulse sent 435 +/-50ns after detection of LEADER's SEND_S else quiet

What it looks like

- Prop delay is cable propagation delay
- Open rectangle is LEADER's SEND_S pulse, Filled rectangle is FOLLOWER's SEND_S pulse
- The 435ns is chosen so that
  - @LEADER:

    FOLLOWER's SEND_S pulse at 0m cable always arrives later than LEADER's SEND_S pulse reflection at 30m cable
  - @FOLLOWER

    FOLLOWER's SEND_S pulse reflection at 30m cable always arrives earlier than the next LEADER's SEND_S pulse.
- The +/-50ns allows easy implementation at crystal-less FOLLOWER without an accurate clock



Variables (Continued)

- send_s_sigdet
  - Indicates whether sufficient SEND_S pulses of the SEND_S signal was detected with proper spacing.
  - At least 3 consecutive valid SEND_S pulses shall be detected before setting this variable from FALSE to TRUE.
  - At least 3.1us period with no SEND_S pulses detected shall be detected before setting this variable from TRUE to FALSE.

Variables (Continued)

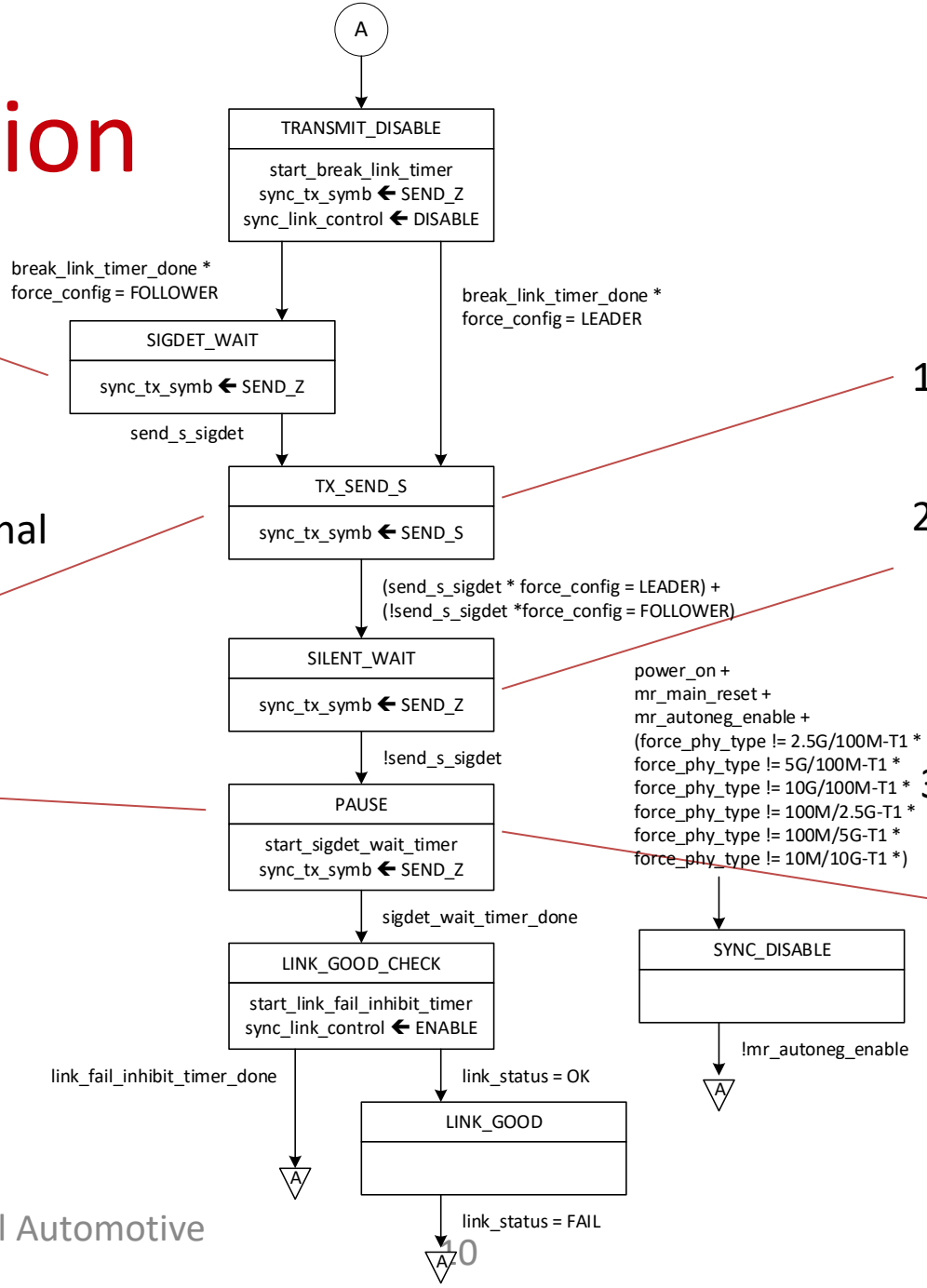
- Modification of SEND_S and send_s_sigdet definitions
  - Considers not just the SEND_S pulses but the entire SEND_S signal
    i.e. valid pulses and proper spacing
  - Simplifies the state diagram
  - Eliminates the send_s_timer

State Interaction

1) FOLLOWER waits until it see at least 3 valid and properly spaced SEND_S pulses from the LEADER (send_s_sigdet)

2) FOLLOWER transmits SEND_S signal until it sees the LEADER stops sending SEND_S signal for at least 3.1us. (!send_s_sigdet)

3) FOLLOWER exits exchange



1) LEADER transmits SEND_S signal

2) LEADER stops transmitting when it see at least 3 valid and properly spaced SEND_S pulses from the FOLLOWER (send_s_sigdet)

3) LEADER exits exchange when it sees the FOLLOWER stops sending SEND_S signal for at least 3.1us. (!send_s_sigdet)

THANK YOU