MARVELL

ACT Link Synchronization for Crystal-less Camera Links

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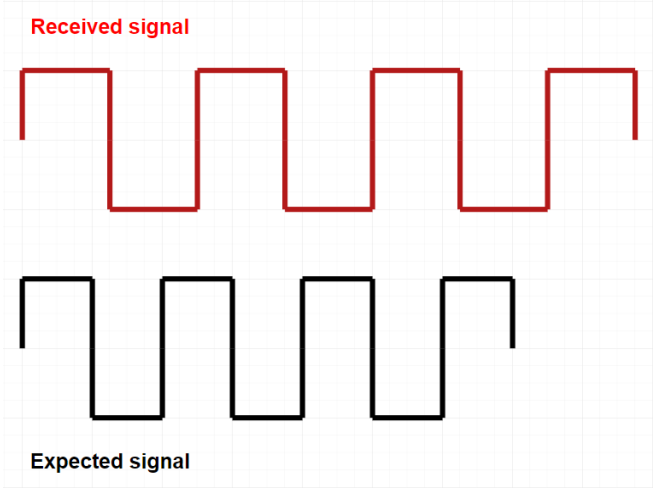
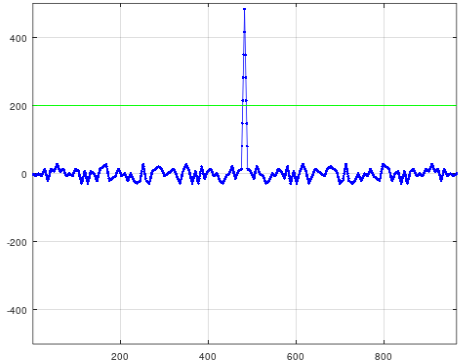
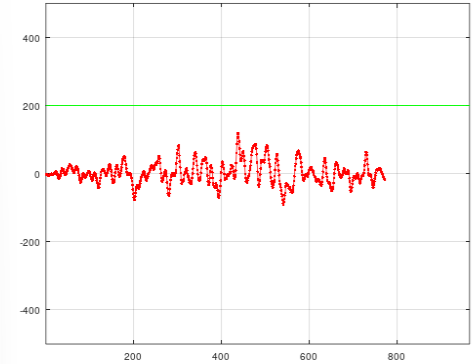
Related work

- Link synchronization ensures that both sides of the link is ready to start training
  - https://www.ieee802.org/3/dm/public/0524/Lo_01_0524.pdf
- Link synchronization is challenging in crystal-less camera mode
  - https://www.ieee802.org/3/dm/public/0125/Zherebtsov_razavi_Ragnar_3dm_01_Jan_2025.pdf
  - A synchronization method is proposed for crystal-less mode.

Link synchronization is challenging in crystal-less mode







Signal is detected **Signal is not detected**

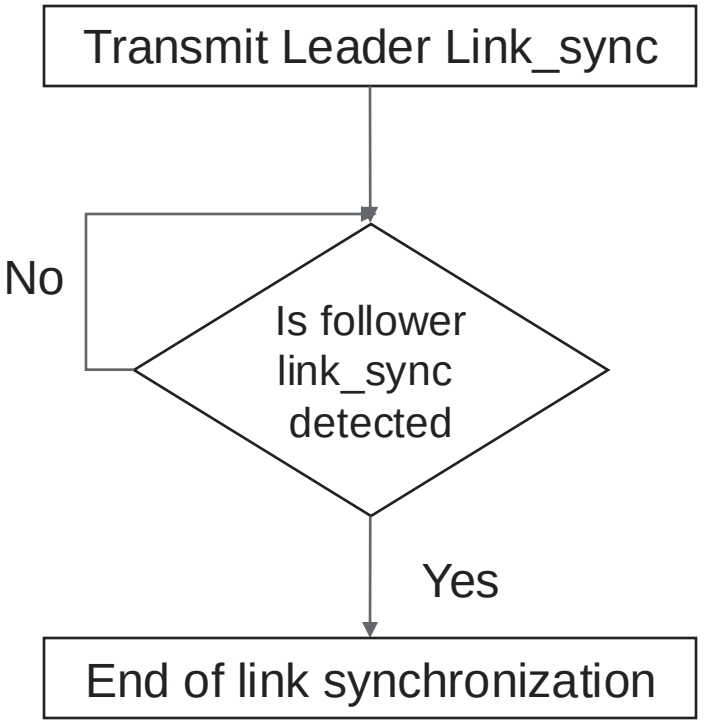
- When the frequency offset between the camera and switch is too large, the conventional matched filter detector fails to detect the link synchronization signal

Low data Rate training is simple and low power

- Low Data Rate (LDR) PMA training is limited to CDR acquisition and timing recovery
  - No initialization based on the remote signal
  - No equalizer training
  - No echo cancellation

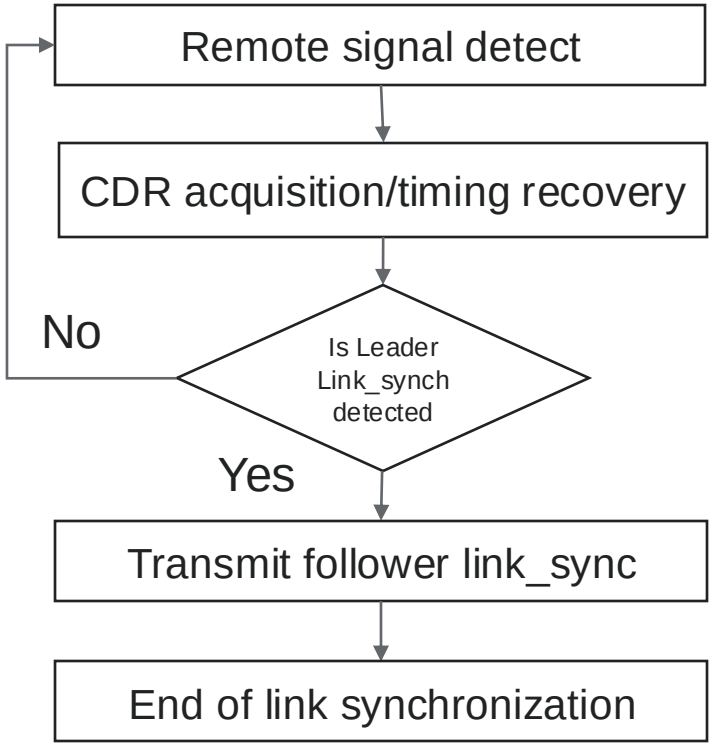
Link synchronization: Leader (switch)

- Leader link_sync will be a short 8-bit PRBS, Manchester-coded signal transmitted at 117MHz
- The leader must detect the follower link_sync while continuously transmitting the link_sync signal

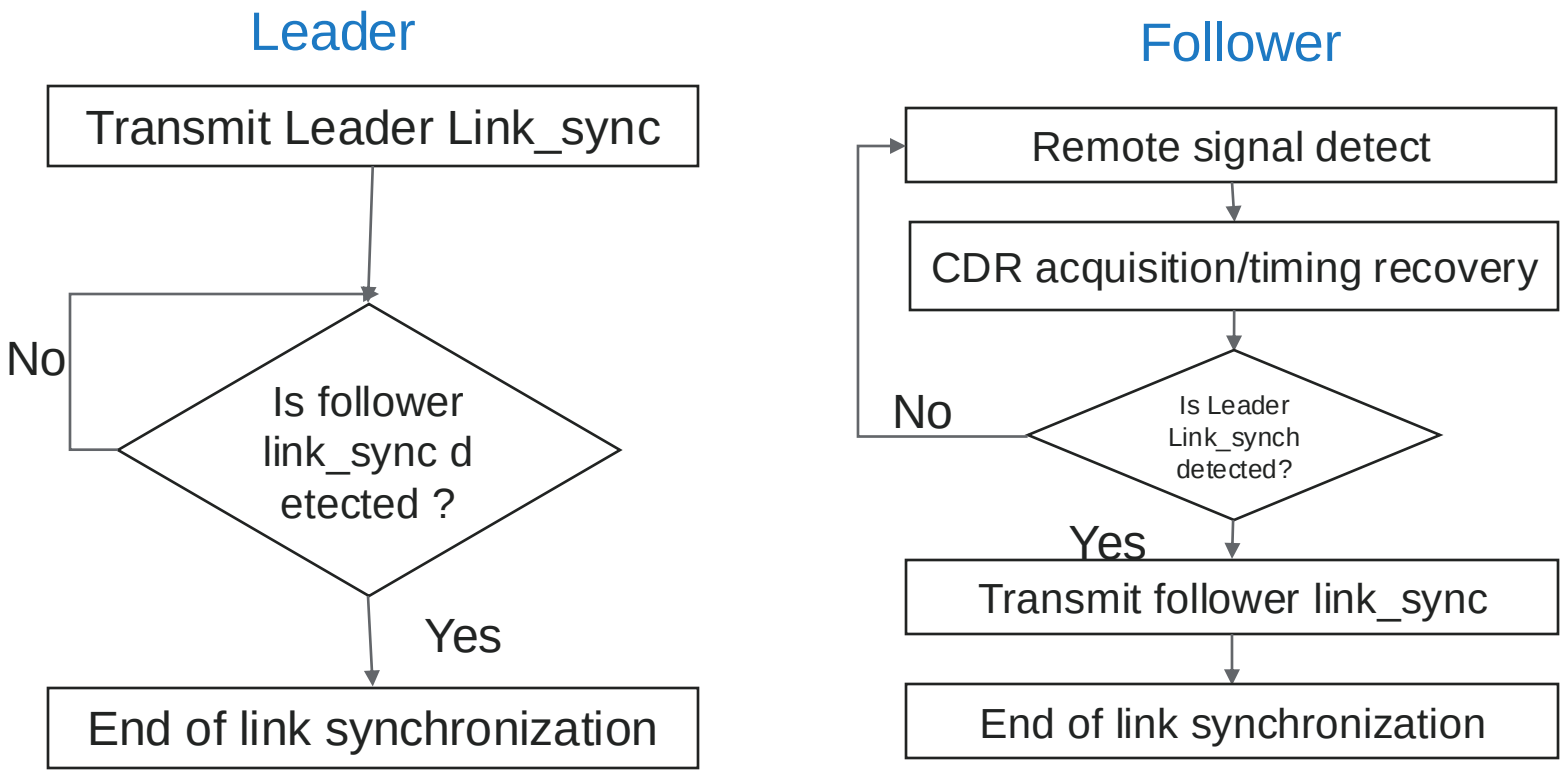


Link synchronization: Follower(camera)

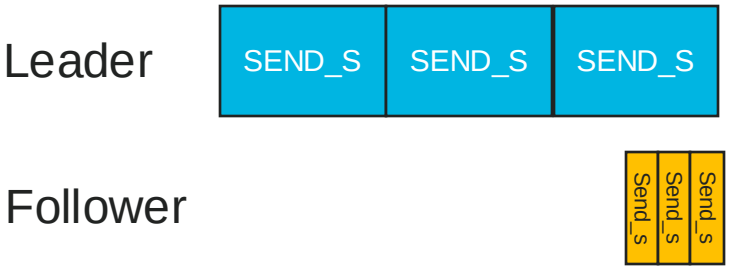
- Follower link_sync signal is the SEND_S signal in 802.3ch (Clause 149)
  - It is an 8 bit PRBS sent at 703.125 MHZ
  - No quiet time



Leader-Follower together

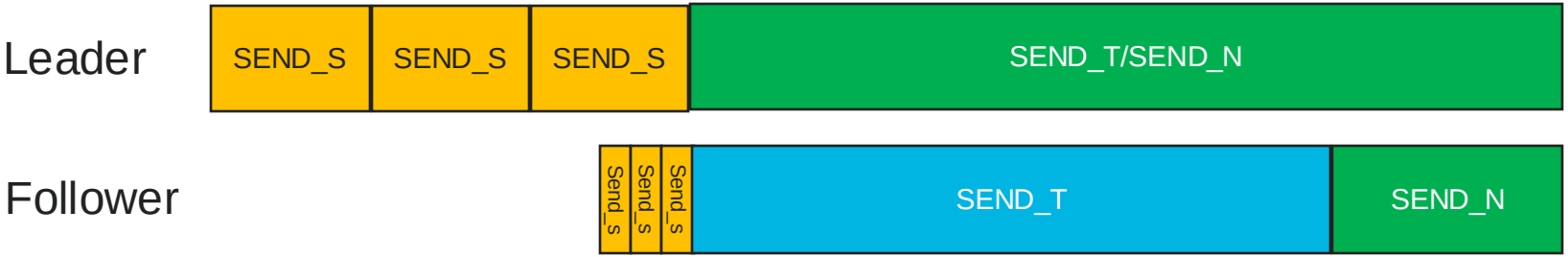


Signal on the line during the link synchronization



- Follower always receives the leader signal used for timing recovery
  - Suitable for crystal-less mode

Link synchronization and training



- Follower always receives the leader signal
  - Suitable for crystal-less mode
- Most of Follower PMA training is done at the end of link synchronization
  - Follower can start receiving data needed to initialize the camera while Leader side is still training
- Leader PMA should still be trained

Link_sync detectors

- Simple Follower (camera side) Link_sync detector
  - use 8 symbols from the received signal as a seed for a PRBS generator

- The Leader-side SEND_S detector can be similar to 802.3ch design

Conclusion

- A new synchronization method has been proposed for 802.3dm
- Looking forward to collaboration on this subject