



**PIERGIORGIO BERUTO**  
**ANTONIO ORZELLI**

*IEEE 802.3cg*

10BASE-T1S Autoneg and Link Status Indication

*September 10<sup>th</sup>, 2018*



- **Gergely Huszak (Kone)**
  - editor of Clause 147
- **Steffen Graber (Pepperl & Fuchs)**
  - commenter (#204)



- 10BASE-T1S defines support for Clause 98 Auto-Negotiation (AN)
  - Defined for Point-To-Point, both Full-Duplex (FD) and Half-Duplex (HD)
  - Not defined for multidrop operation
- Clause 98 Auto-Negotiation does not handle the case where one PHY supports AN and the other PHY does not
  - In this scenario the link-up just doesn't happen, AN is stuck
- AN requires a link status indication to work properly
  - Comment #204 from Steffen Graber
  - 10BASE-T1S in current draft has no such concept of link status (see comment #204 from Steffen Graber)
    - There is no training phase and no continuous IDLE indication on the line
  - We need to design something ad-hoc to satisfy this requirement



- The idea is to add an heartbeat (HB) concept to 10BASE-T1S to generate link status indication.
  - No need for HB in multidrop mode or when AN is not supported or not enabled
- Requirements:
  - Reception of a number of HB in a certain time indicates the link is up
  - Missing HB / packets for a certain amount of time results in reporting the link to be down
  - HB should not significantly affect traffic during normal operation



- PLCA is designed for avoiding physical collisions on half-duplex **mixing-segments (multidrop)** CSMA/CD networks
- Current wording in Clause 148.1 allows PLCA to work on half-duplex **point-to-point** networks as well
  - *148.1 “PLCA is defined for half-duplex mode of operation only”*
- Having an additional heart-beat concept with PLCA (which already provides BEACON), without triggering physical collisions, is quite cumbersome and the hassle outweighs the benefits.
  - Propose to change text to limit PLCA to work on mixing-segment (multidrop) only
    - Add *“PLCA is not defined for point-to-point operation”*
  - This won't prevent having PLCA running on a two nodes mixing-segment network



# Problems & proposed solutions

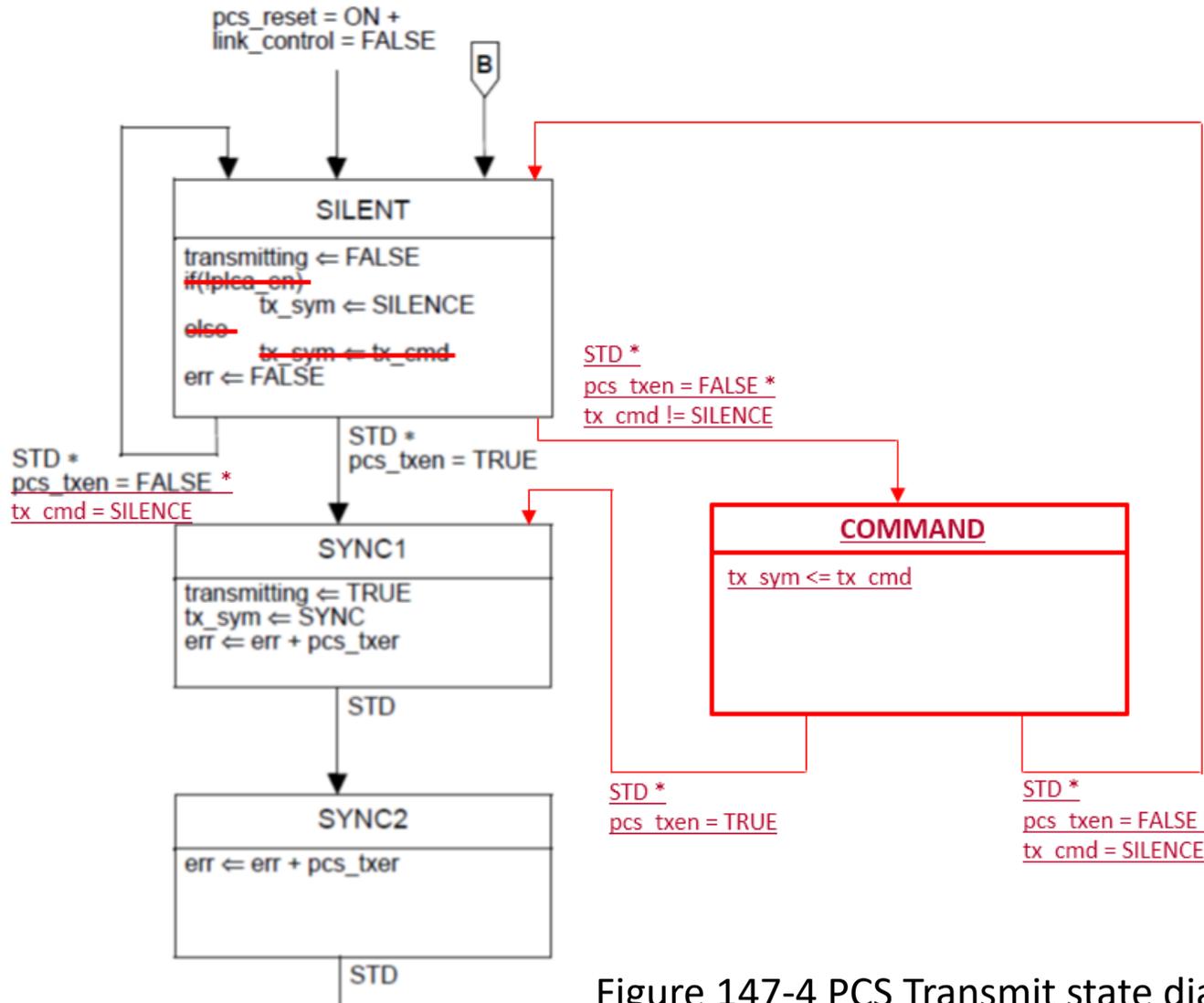


Figure 147-4 PCS Transmit state diagram (1 of 2)

Not interfering with TX from MII: re-use of PCS TX COMMAND state to send HB on the line

HEART BEAT is a new defined 5B symbol (TBD)

It is transmitted by PCS TX, using the already available tx\_cmd variable.

tx\_cmd is already used by PLCA to convey BEACON and COMMIT commands to the PHY, but PLCA is never active when HB is enabled

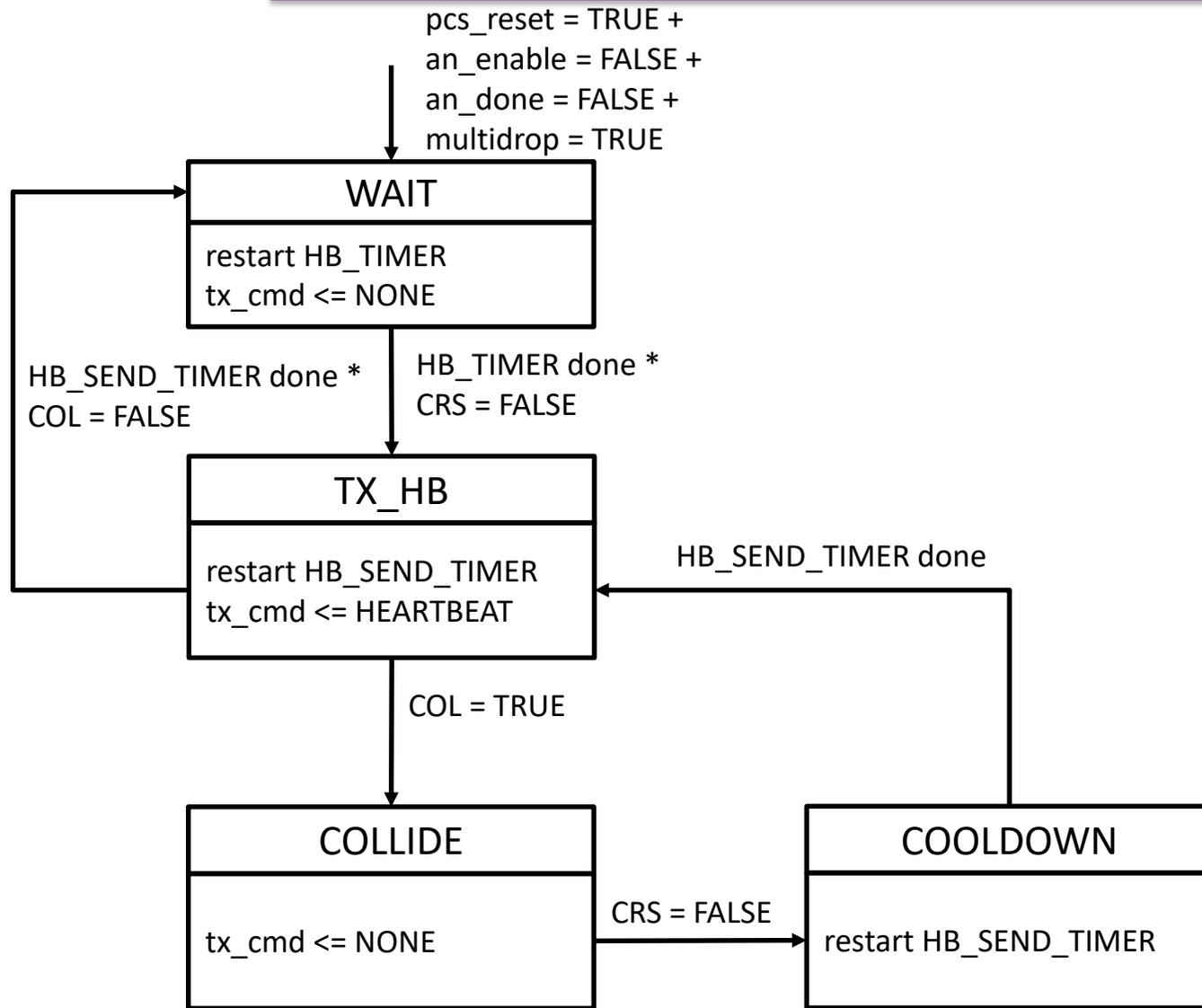


- Point-to-Point full-duplex case
  - No additional problems
- Point-to-Point half-Duplex case
  - Possible collisions between HB and data packets
    - Data will be re-transmitted by MAC (normal CSMA/CD behavior)
    - HB re-transmitted after jamming, during IPG (collision no more possible)
  - Use auto-neg master/slave negotiation to select which PHY has to send unsolicited HB
    - NOTE: 10BASE-T1S does not require master/slave negotiation for normal operation
      - Not a far-end echo canceled system, no clock looping
  - Slave PHY replies to HB messages with HB in turn
  - This minimizes the chance of collision between packets and HB
    - Collisions between HB are not possible



HB\_SEND\_TIMER done \*  
CRS = FALSE

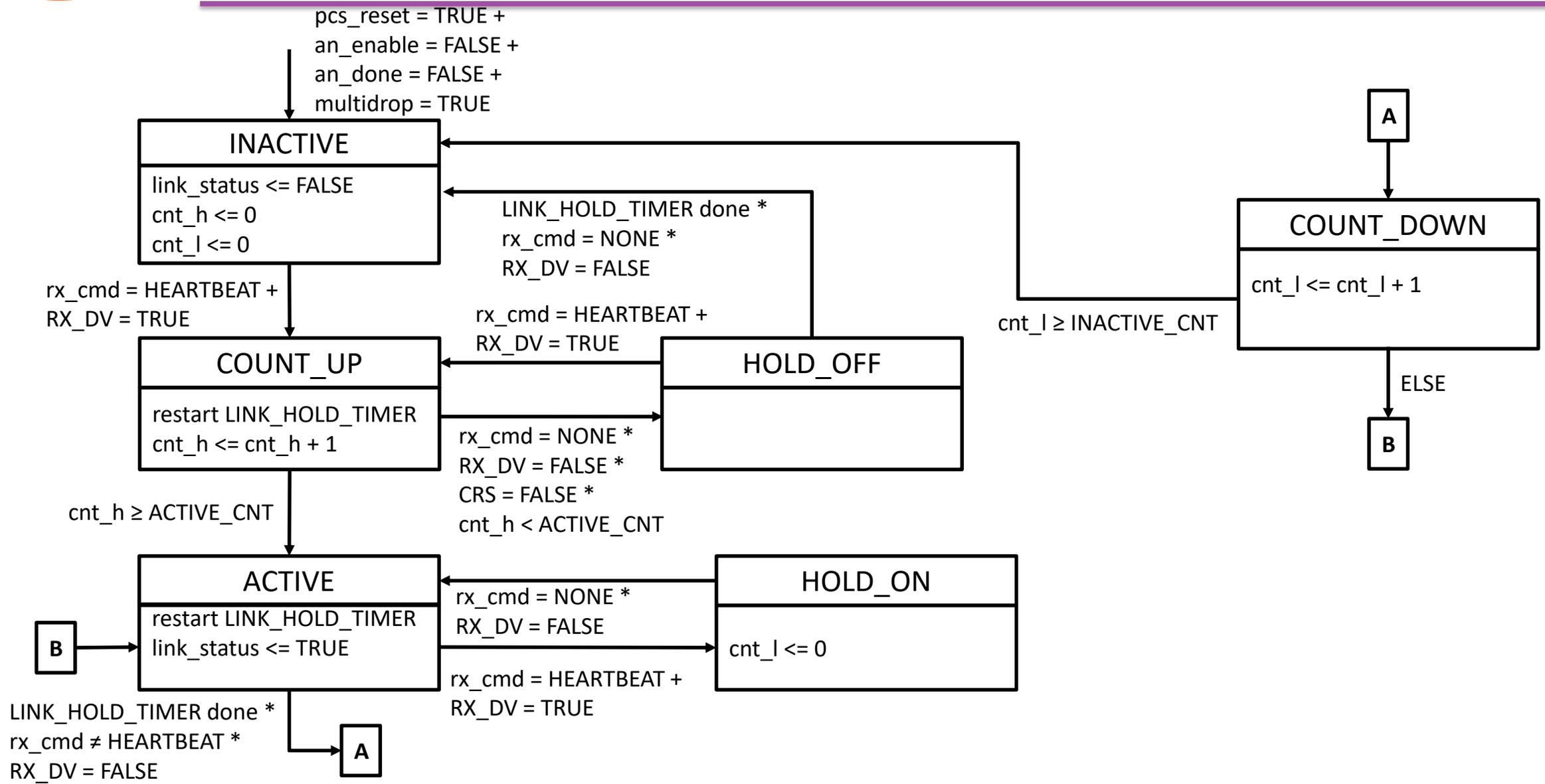
# HB Transmit FSM (master only)



- HB\_TIMER = 50 ms
- HB\_SEND\_TIMER = duration of HB on the line = 20 bit-times
- an\_enable = Auto-Negotiation supported and enabled
- an\_done = Auto-Negotiation complete
- multidrop = Multidrop mode (register 1.2299.10)



# Link Status FSM



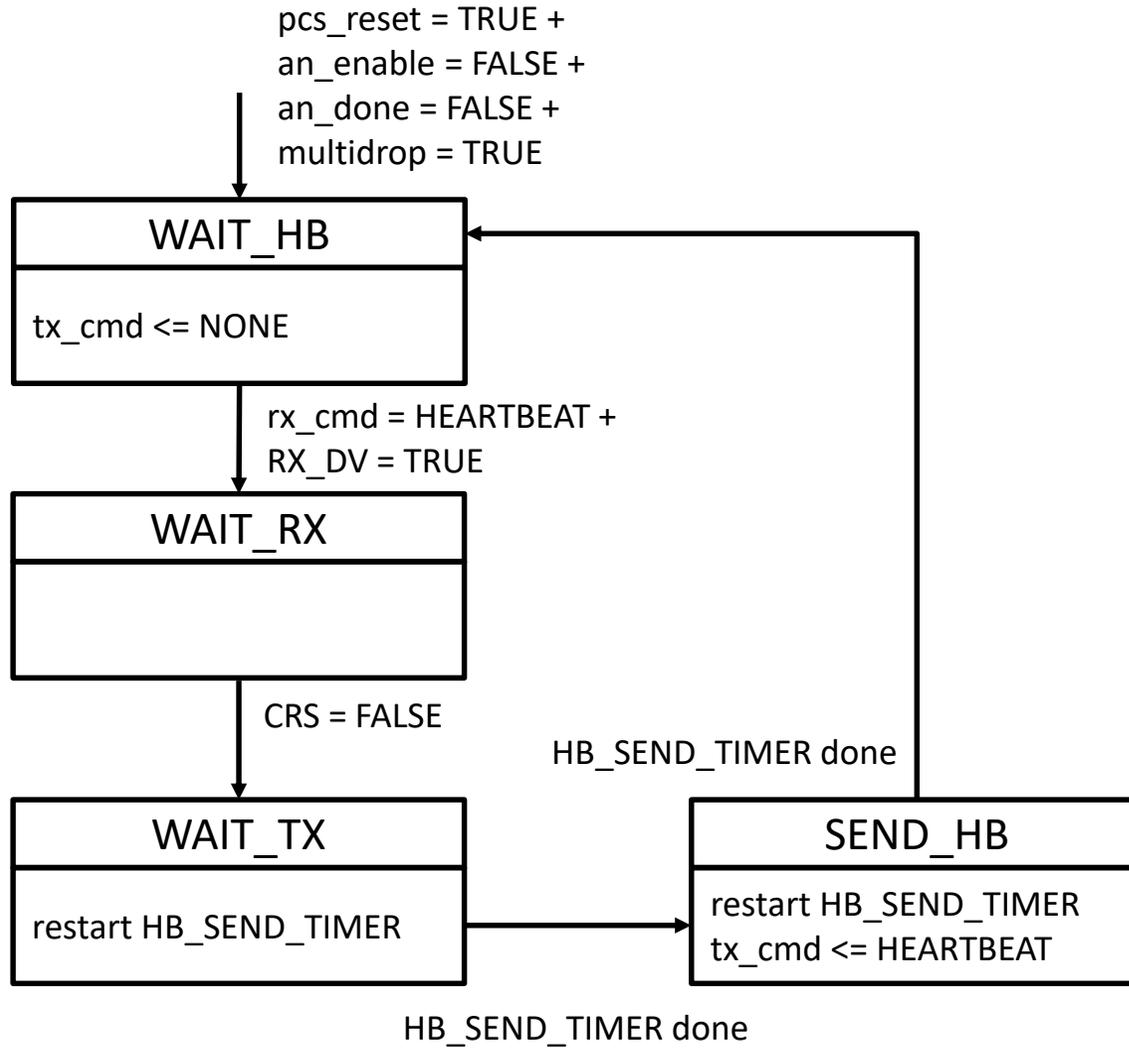


- `cnt_l` = counter of HB when `link_status` is TRUE
- `cnt_h` = counter of HB when `link_status` is FALSE
- `rx_cmd` = set by the PHY when a special signaling is detected on the line  
Values: COMMIT, BEACON, HEARTBEAT, NONE (already defined for PLCA)
- `ACTIVE_CNT` = number of HB required to signal `link_status` = TRUE  
Value: TBD
- `INACTIVE_CNT` = number of HB required to signal `link_status` = FALSE  
Value: TBD
- `LINK_HOLD_TIMER`: time after which the count of HB is reset  
Value: TBD



HB\_SEND\_TIMER done \*  
CRS = FALSE

# HB Receive FSM (slave only)



**THANK YOU!**