

PAM2 Training States and InfoField for 1000BASE-T1

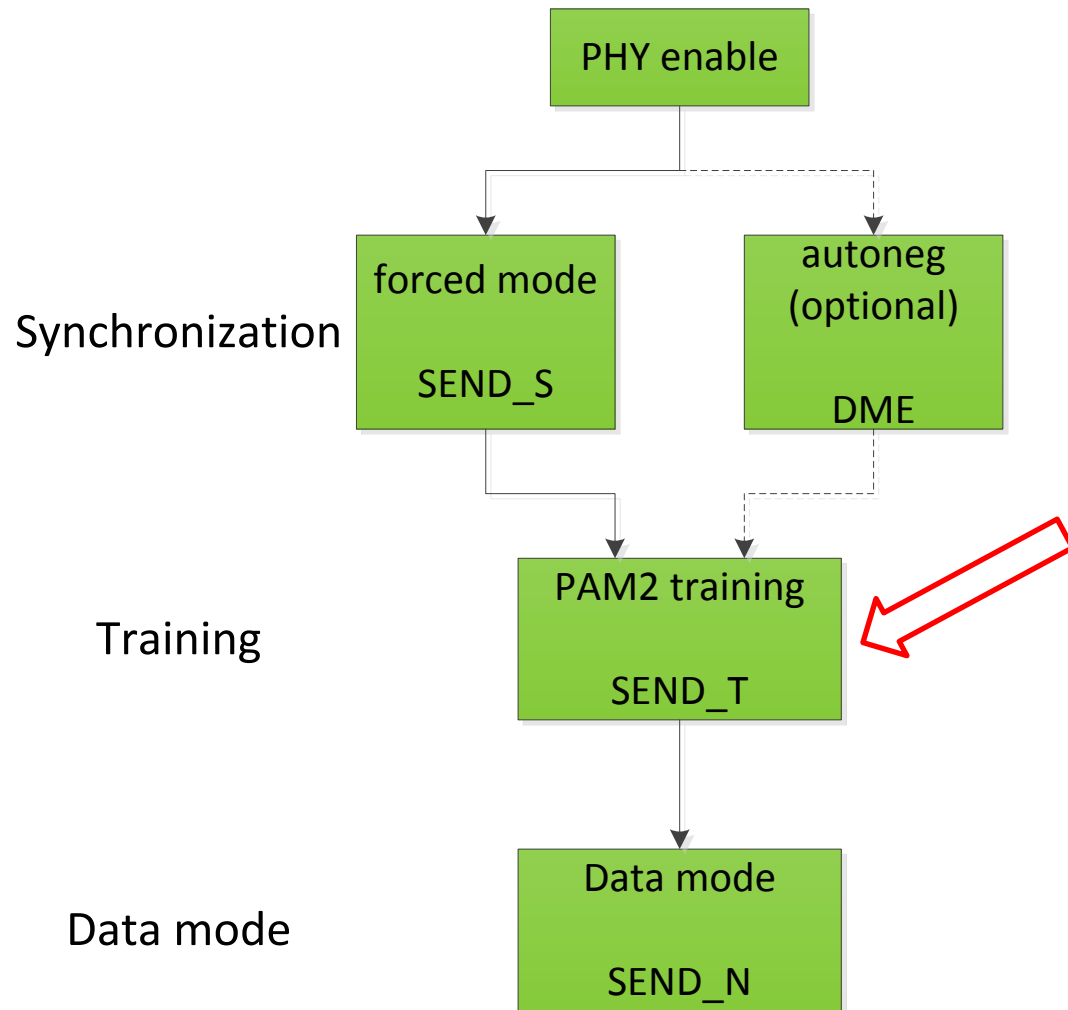
San Antonio, TX, USA
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Mike Tu
tum@broadcom.com

Contributors

- Jane Fridley
- Peiqing Wang
- Ahmad Chini
- Mehmet Tazebay

Overall Startup Sequence

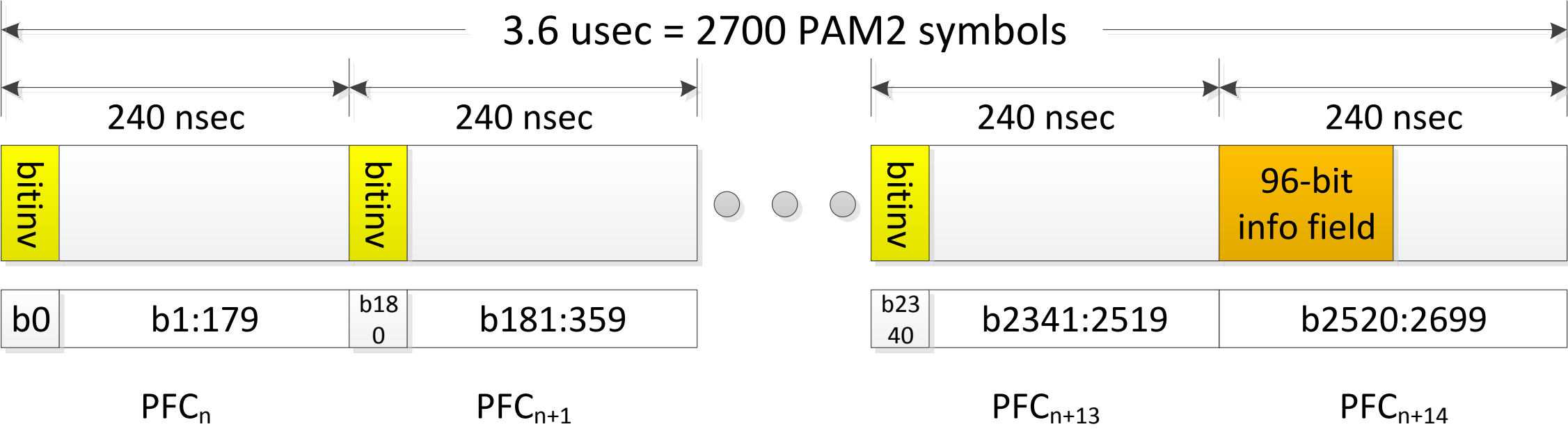


TX Mode	Definition
SEND_Z	Send all zeros
DME	Differential Manchester encoding for autoneg
SEND_S	Send special periodic PAM2 sequences with good correlation properties
SEND_T	Send PAM2 training sequence
SEND_N	Send normal data

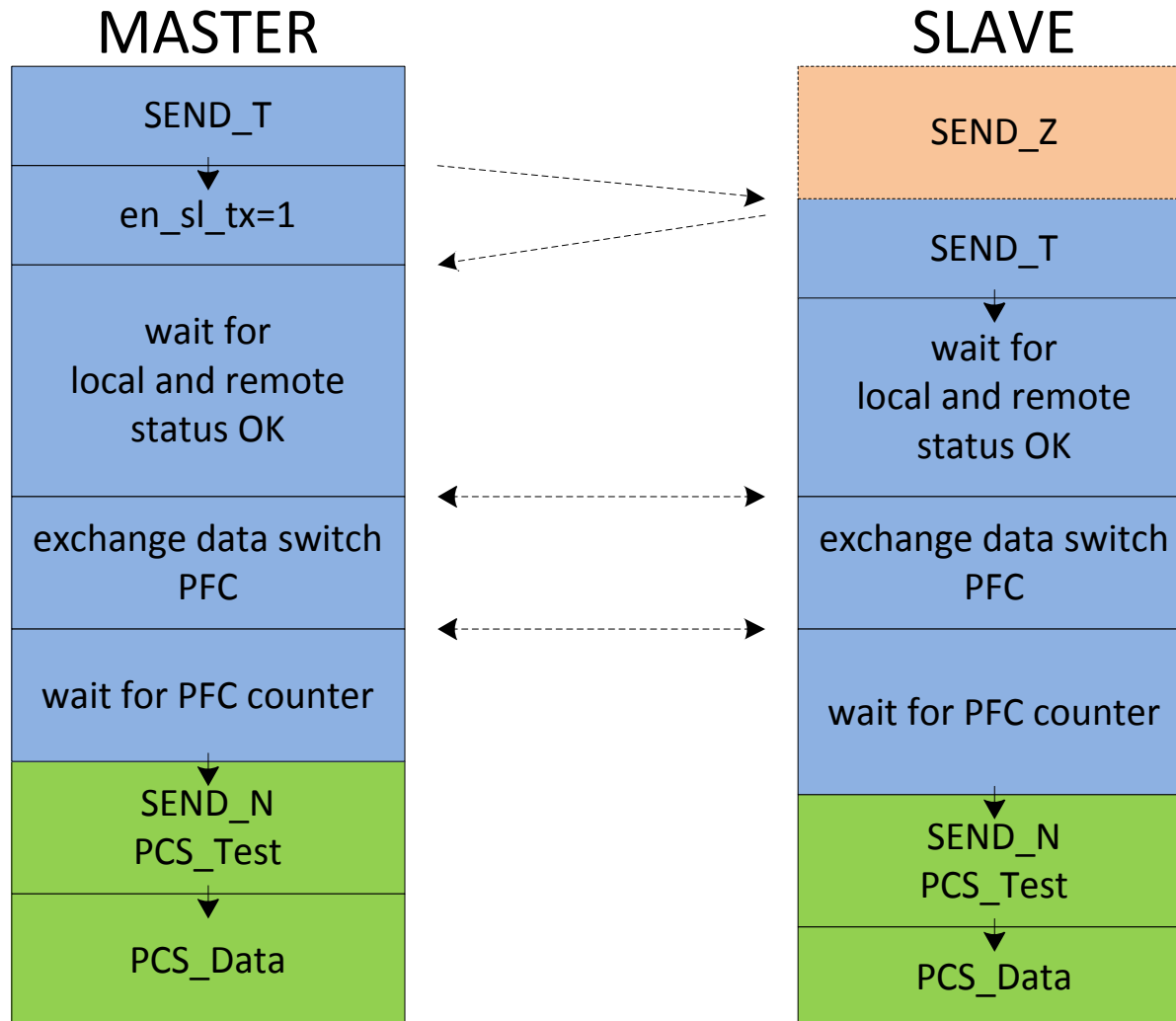
Outline

- Adopted from prior proposal
 - PAM2 training frame is 3.6usec, aligned with data mode FEC frame
 - InfoField per PAM2 training frame
 - One bit inversion every 240nsec (i.e., 180 PAM2 symbols)
 - “Partial RS Frame Count” (PFC) within InfoField, incremented by 15 per frame
 - See “Lo_3bp_01a_0914”
- Proposed changes
 - State transitions based on InfoField message exchanges and PFC counts
 - Increase InfoField to 96 bits to support message exchanges
 - Increase PFC to 24 bits to avoid wrap-around ambiguity
 - Exchange data mode starting time via the PFC24 message
 - Define valid InfoField messages

Frame Format in PAM2 Training Mode



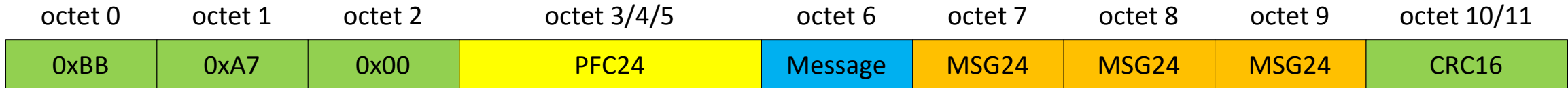
PAM2 Training Sequence



- PAM2 state transition based on InfoField message exchanges.
- Send and acknowledge PFC24 counts when switching into data mode.

96-bit InfoField Format

96-bit Infofield



set_data_sw_pfc = 1



all others



- PFC24 incremented by 15 per frame.
- Each message lasts at least 256 (TBD) frames (<1msec) to ensure detection at link partner.
- With 24-bit PFC it takes > 4 seconds without counter wrap-around ($2^{24} * 3.6 \text{ usec} / 15 = 4.0265 \text{ seconds}$).
- The “set_data_sw_pfc=1” message shall specify the exact time to switch into data mode.

Valid InfoField Messages – MASTER

	InfoField message field valid MASTER settings						
PMA states	PMA_state <7:6>	loc_rcvr_status	en_slave_tx	reserved	reserved	set_data_sw_pfc	ack_data_sw_pfc
PMA_Train_Init_M	00	0	0	0	0	0	0
PMA_Train_Init_M	00	0	1	0	0	0	0
PMA_Train_Init_M	00	1	1	0	0	0	0
PMA_Exchange	01	1	1	0	0	1	0
PMA_Exchange	01	1	1	0	0	0	1
PMA_Exchange	01	1	1	0	0	1	1
PMA_Sw_to_Data	10	1	1	0	0	0	1

- Definition of “loc_rcvr_status” is different from 10GBASE-T. Might need a different name.

Valid InfoField Messages – SLAVE

	InfoField message field valid SLAVE settings						
PMA states	PMA_state <7:6>	loc_rcvr_status	timing_lock_OK	reserved	reserved	set_data_sw_pfc	ack_data_sw_pfc
PMA_Train_Init_S	00	0	0	0	0	0	0
PMA_Train_Init_S	00	0	1	0	0	0	0
PMA_Train_Init_S	00	1	1	0	0	0	0
PMA_Exchange	01	1	1	0	0	1	0
PMA_Exchange	01	1	1	0	0	0	1
PMA_Exchange	01	1	1	0	0	1	1
PMA_Sw_to_Data	10	1	1	0	0	0	1

State Transition Rules

- Each state shall last at least 256 frames to ensure detection at link partner.
- Initial training
 - SLAVE shall remain in silent until it receives “en_slave_tx=1”.
 - SLAVE shall set “timing_lock_OK=1” once it has acquired the loop timing.
 - After both sides report “loc_rcvr_status=1”, either MASTER or SLAVE can initiate exchanges of data switch PFC counts.
- Message exchanges
 - Receive side shall set “ack_data_sw_pfc=1” once it detects the “set_data_sw_pfc” message.
- Entering data mode
 - Transition from PAM2 training SEND_T mode into data SEND_N mode shall be based on the received PFC24 counter value.