Details of PHY OAM in 1000BASE-X

R0-4
June25-2002
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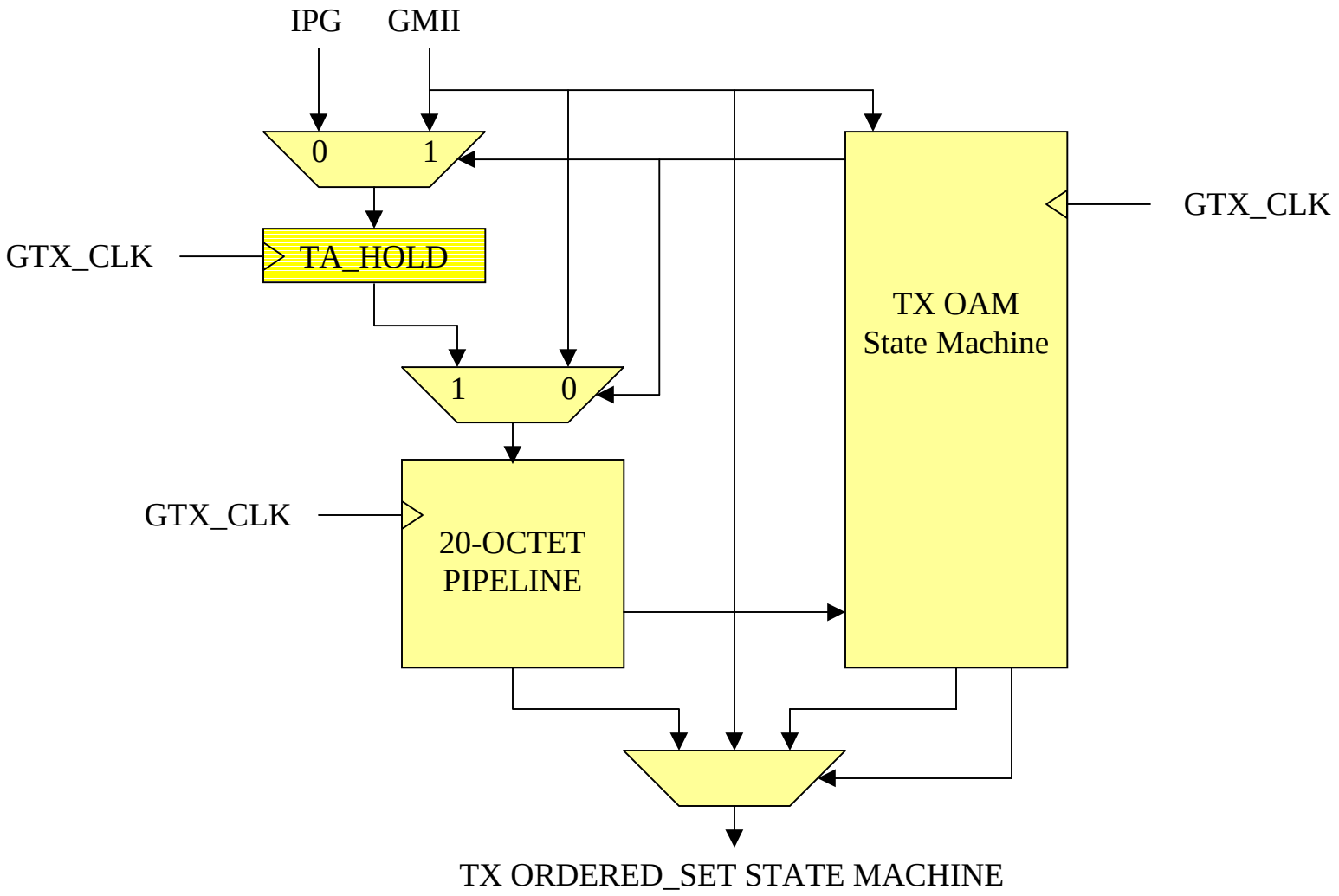
TX Requirements

- Pipeline for “OAM Preamble Only” insertion
- Pipeline depth is 20 octets
- Alignment to TX_EVEN at SOP
- Preamble replacement with “OAM Preamble Normal Frame”
- Idle replacement with “OAM Preamble Only”

Alignment to TX_EVEN at SOP

- Use a Deficit Idle Count concept as in 46.3.1.4, option 2, with the modification of limiting the maximum value to 1 rather than 3.
- First byte of packet (preamble) is written to pipeline when TX_EVEN=FALSE.

TX Pipeline Structure



TX OAM State Machine Features

- Monitor the GMII for SOP (Rising edge of TX_EN)
- Monitor alignment of SOP and TX_EVEN to control the Deficit Idle Count
- Control the pipeline input and DIC octet
- Monitor the contents of the pipeline
- Monitor the request to insert an OAM Message
- Replace Preamble or IPG with OAM Message

  Forward PHY ID in EPON mode
- Control data to TX Ordered_Set state machine

Preamble replacement with "OAM Preamble Normal Frame"

- **Replace the 8 bytes of Preamble at the end of the pipeline under the following conditions:**
  - **An OAM Message is available**
  - **The entire pipeline is full of DATA**
  - **The PCS transmit ordered_set state machine is in the XMIT_DATA state**
- **Forward PHY ID in EPON mode**

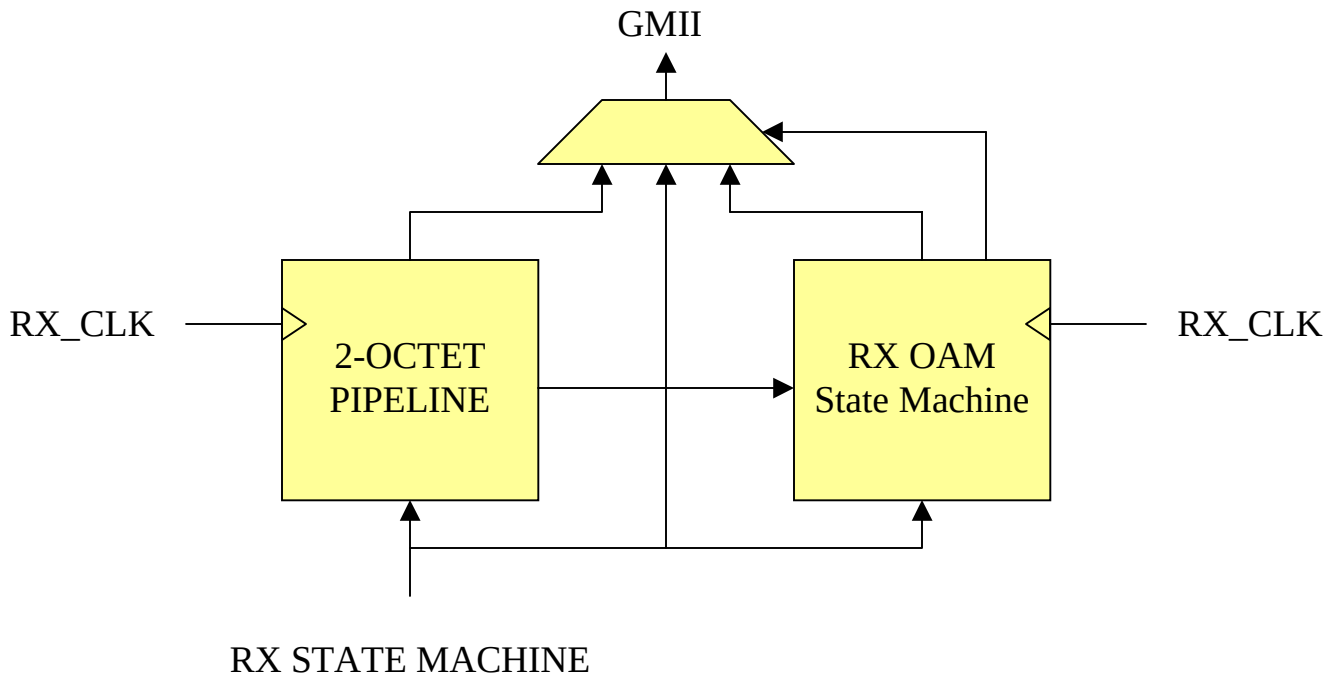
Idle replacement with "OAM Preamble Only"

- **Replace the 8 bytes of IPG at the end of the pipeline under the following conditions:**
  - **An OAM Message is available**
  - **The entire pipeline is full of IPG**
  - **The PCS transmit ordered_set state machine is in the XMIT_DATA state**
  - **The last 12 bytes out of the pipeline were IPG**
  - **TX_EVEN = FALSE**

RX Requirements

- Pipeline for “OAM Preamble Only” removal
- Pipeline depth is 2 bytes
- “OAM Preamble Normal Frame” replacement with Preamble
- “OAM Preamble Only” replacement with Idle
- Forward of errors
- Set RX_ER on SFD if CRC8 is bad in EPON mode only

RX Pipeline Structure



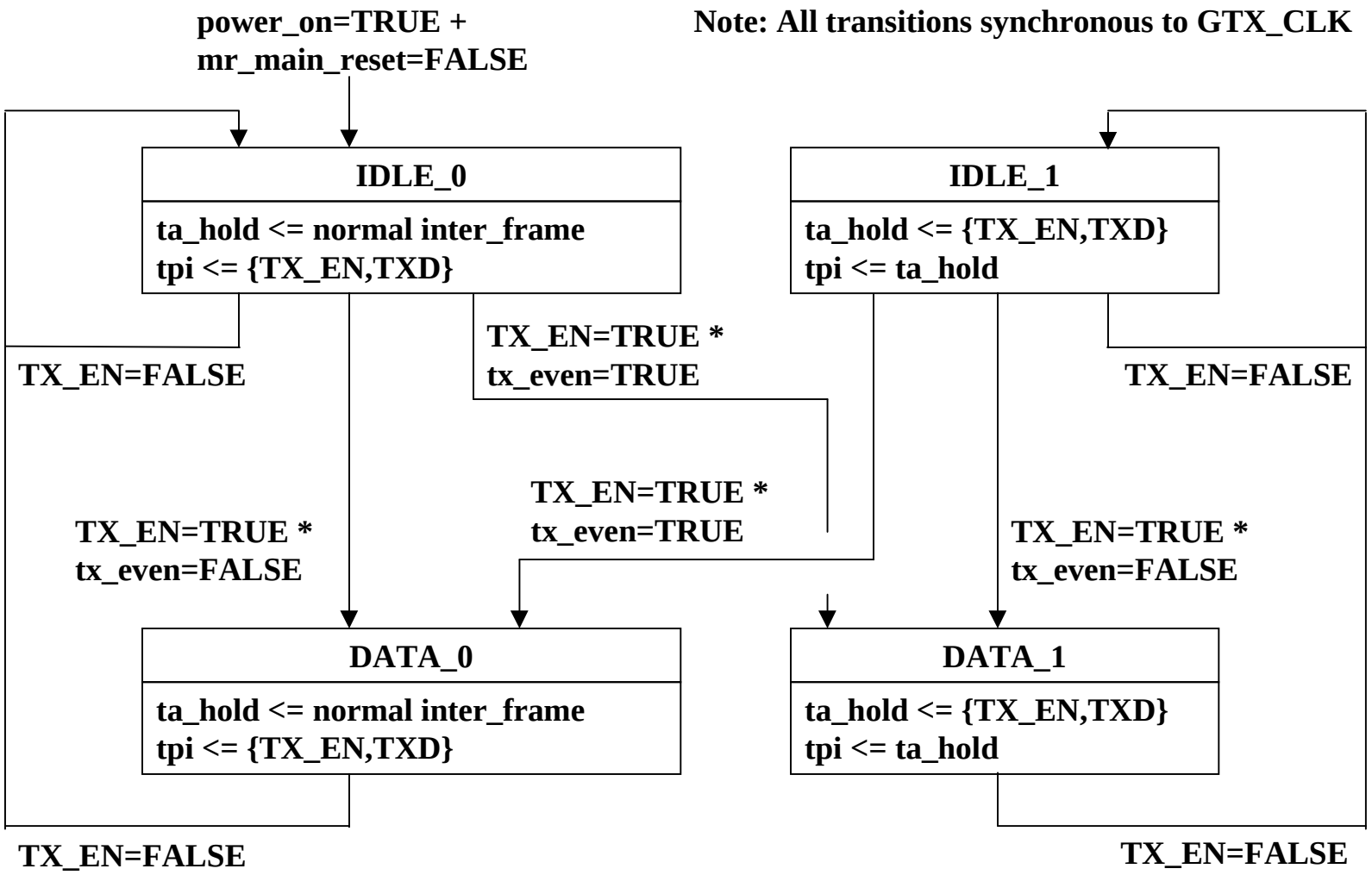
RX OAM State Machine Features

- Monitor the contents of the pipeline
- Monitor the OAM byte for Preamble/Frame type
- Replace “OAM Preamble Only” with IDLE
- Replace “OAM Preamble Normal Frame” with Preamble/SFD

  Forward PHY ID in EPON mode
- Extract OAM Message
- Force RX_ER on SFD for bad CRC8 in EPON mode only
- Control data to GMII

State Machines, Variable & Functions

TX_EVEN Alignment State Machine



TX OAM Variables

- **ta_hold - Transmit Alignment Hold register**

  A 9-bit vector for storing TX_EN & TXD<7:0> when aligning data to TX_EVEN.

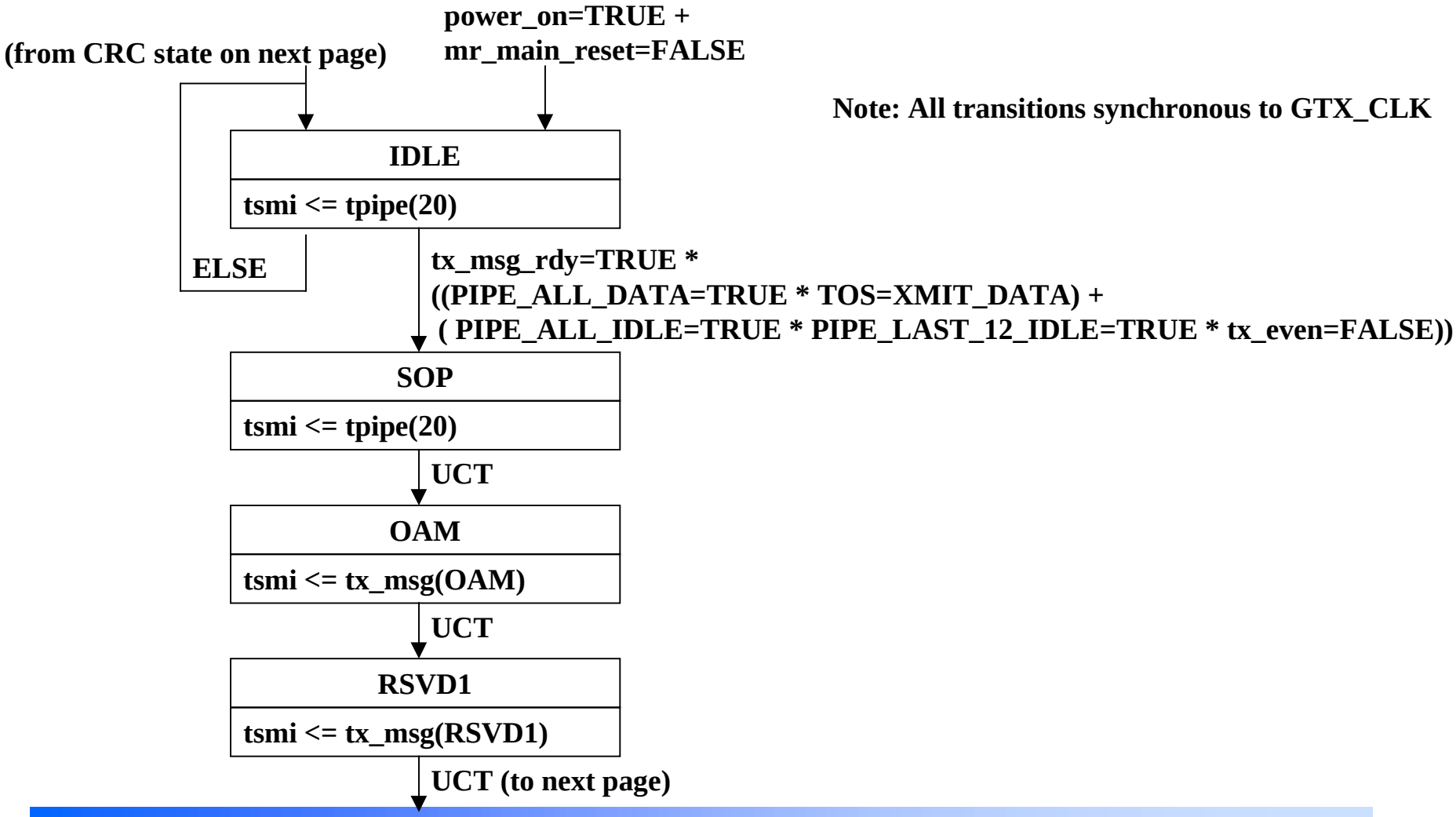
  Needs to reflect that this is a storage element

- **tpi - TX Pipeline Input**

  A 9-bit vector used as input to the TX OAM pipeline. It either reflects the current contents of the TX_EN & TXD<7:0> or the contents of the TA_HOLD register.

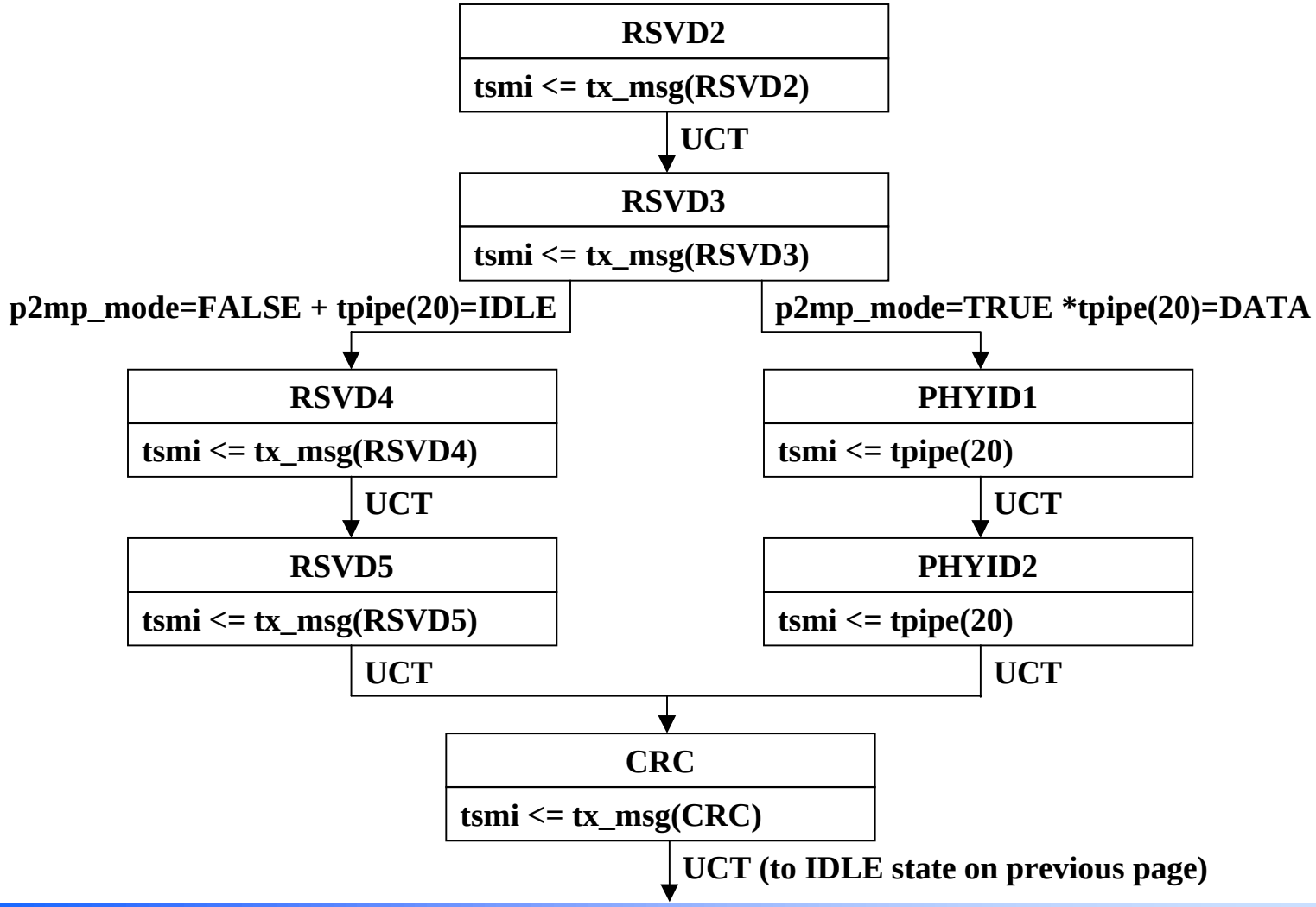
  Needs to reflect that this is NOT a storage element

TX OAM State Machine (page 1)



Note: All transitions synchronous to GTX_CLK

TX OAM State Machine (page 2)



TX OAM Variables

- **tsmi - Transmit Ordered_Set State Machine Input**

  A 9-bit vector used as input to the transmit ordered_set state machine. This vector is only used when Transmit OAM is enabled. Otherwise, the GMII is the direct input to the state machine.

  Needs to reflect that this is NOT a storage element

- **tpipe(#) - TX Pipeline Stage #**

  A 9-bit vector that reflects the contents of a particular stage of the transmit pipeline. #=1..20 where 1 is the first stage of the transmit pipeline and 20 is the last. When enabled and on every GTX_CLK rising edge, tpipe(1) takes the value tpi, tpipe(n+1) takes the value tpipe(n) for all n>1. The reset value of tpipe(#) is normal inter_frame.

TX OAM Variables

- **tx_msg(x) - TX OAM Message**

  x consists of OAM, RSVD1, RSVD2, RSVD3, RSVD4, RSVD5, CRC

  Contains the TX OAM message to be inserted in the place of a packet's preamble or inserted into the IDLE stream.

  OAM - OAM byte from (insert reference here)

  RSVDx - RSVD bytes from (insert reference here)

  CRC - CRC8 of TX OAM message from (insert reference here)

TX OAM Functions

- **PIPE_ALL_DATA**

  This is an indication that all 20 stages of the TX OAM pipeline contain DATA octets. That is, for each stage, the TX_EN bit is TRUE.

- **PIPE_ALL_IDLE**

  This is an indication that all 20 stages of the TX OAM pipeline contain IDLE octets. That is, for each stage, the TX_EN bit is FALSE.

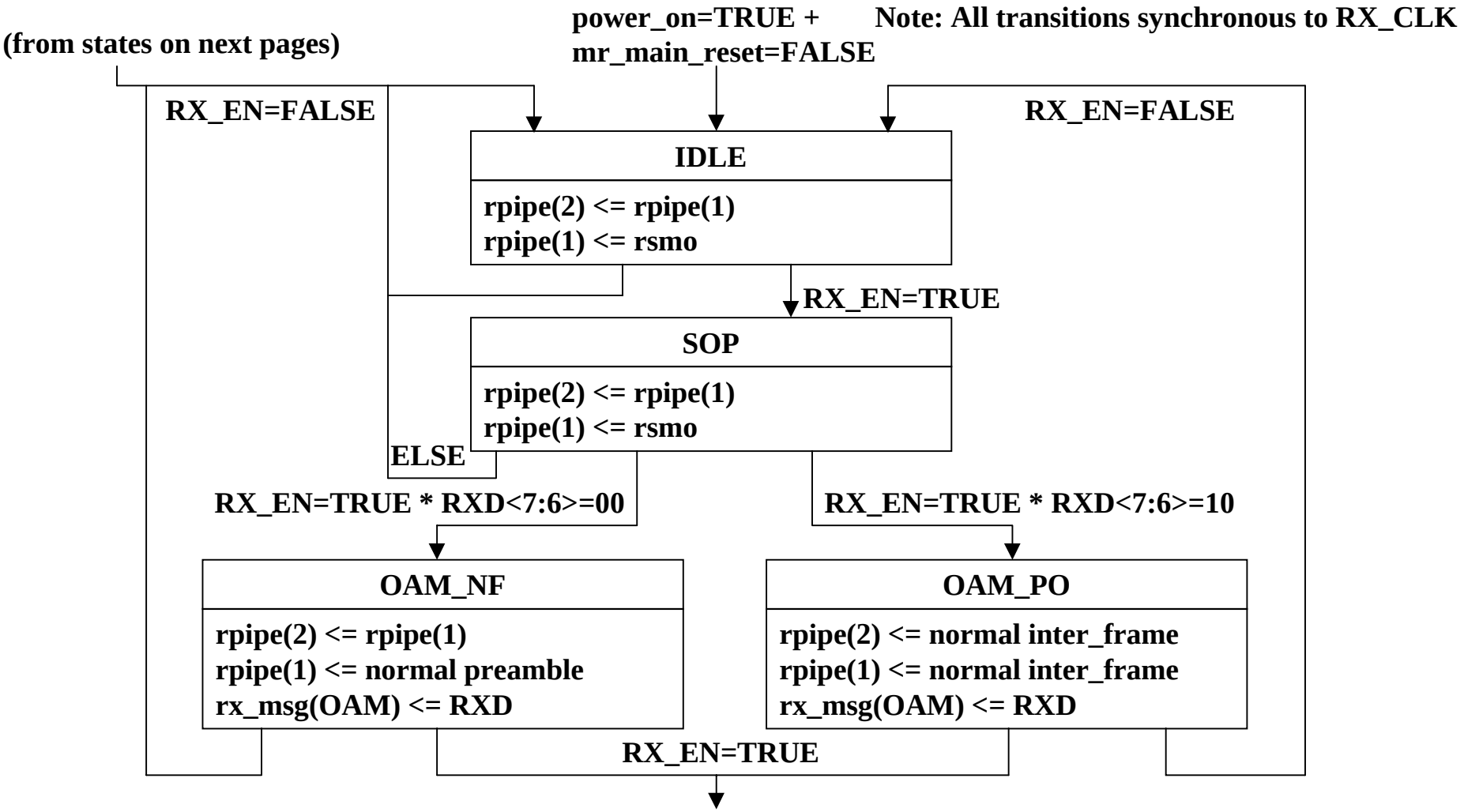
- **PIPE_LAST_12_IDLE**

  This is an indication that the last 12 octets transferred from the TX OAM pipeline to the transmit ordered_set state machine were IDLE octets.

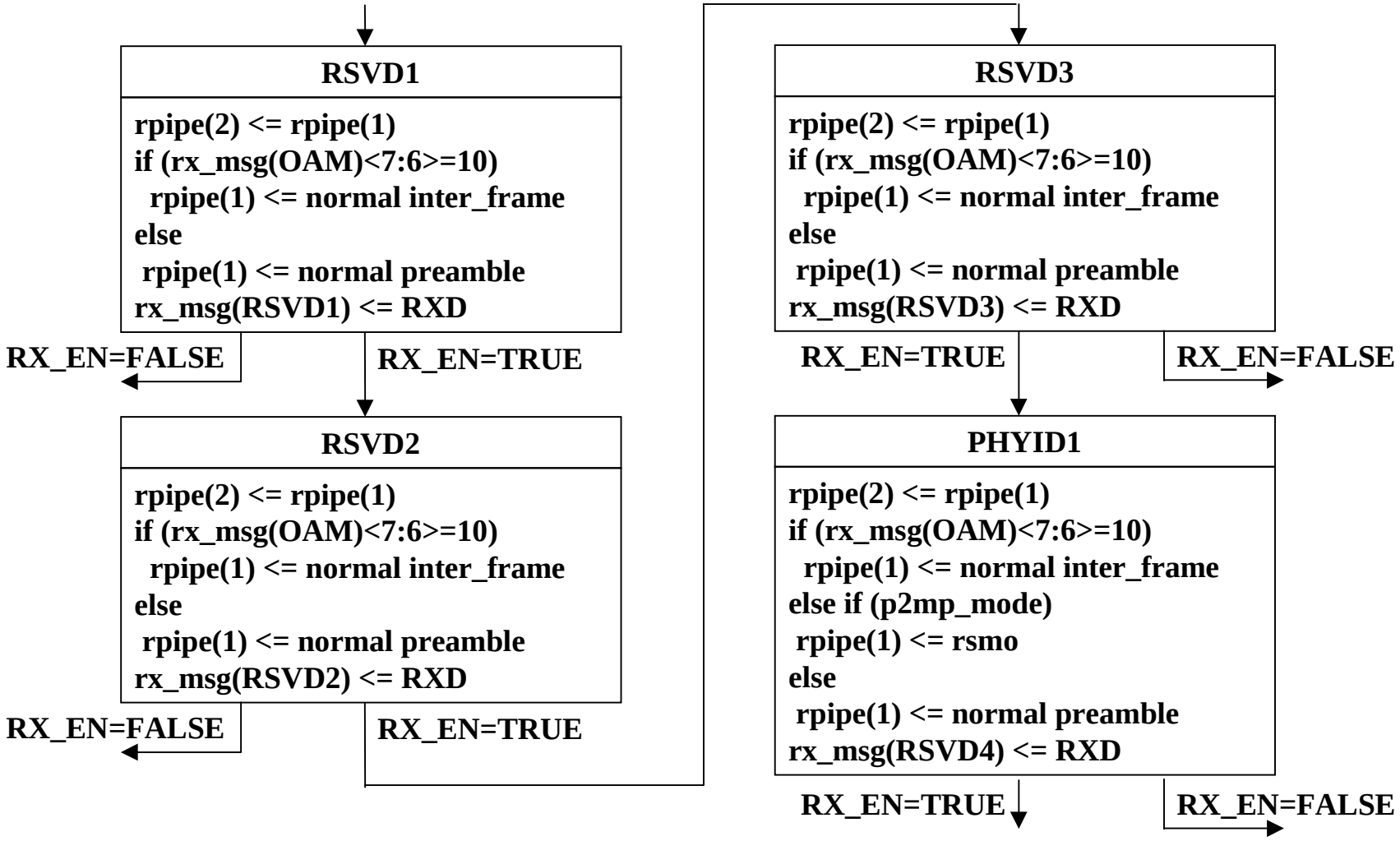
- **tx_msg_rdy**

  A boolean indicating that a TX OAM message is available and ready to be inserted by the TX OAM state machine.

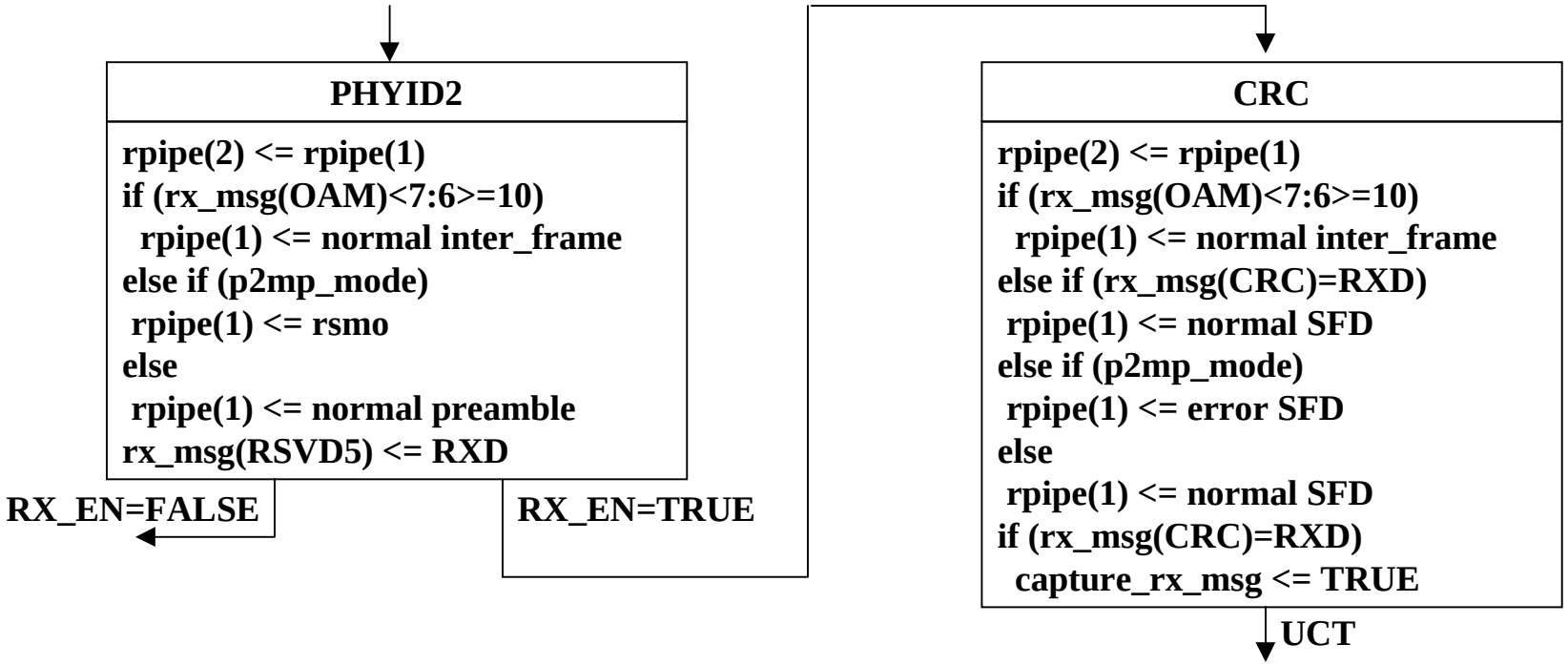
RX OAM State Machine (page 1)



RX OAM State Machine (page 2)



RX OAM State Machine (page 3)



RX OAM Variables

- **rsmo - Receive State Machine Output**

  The 10-bit vector output from the Receive State Machine and used by the RX OAM state machine. When Receive OAM is not enabled, rsmo is the source of RX_ER, RX_EN & RXD<7:0>.

- **rpipe(#) - RX Pipeline Stage #**

  A 10-bit vector that reflects the contents of a particular stage of the receive pipeline. #=1 & 2 where 1 is the first stage of the transmit pipeline and 2 is the last. Both stages are directly controlled by the RX OAM state machine. The reset value of rpipe(#) is normal inter_frame.

  When Receive OAM is enabled, rpipe(2) is the source of RX_ER, RX_EN & RXD<7:0>.

RX OAM Variables

- **rx_msg(x) - RX OAM Message**

  x consists of OAM, RSVD1, RSVD2, RSVD3, RSVD4, RSVD5, CRC

  Contains the RX OAM message to be inserted in the place of a packet's preamble or inserted into the IDLE stream.

  OAM - OAM byte from (insert reference here)

  RSVDx - RSVD bytes from (insert reference here)

  CRC - CRC8 of RX OAM message from (insert reference here)

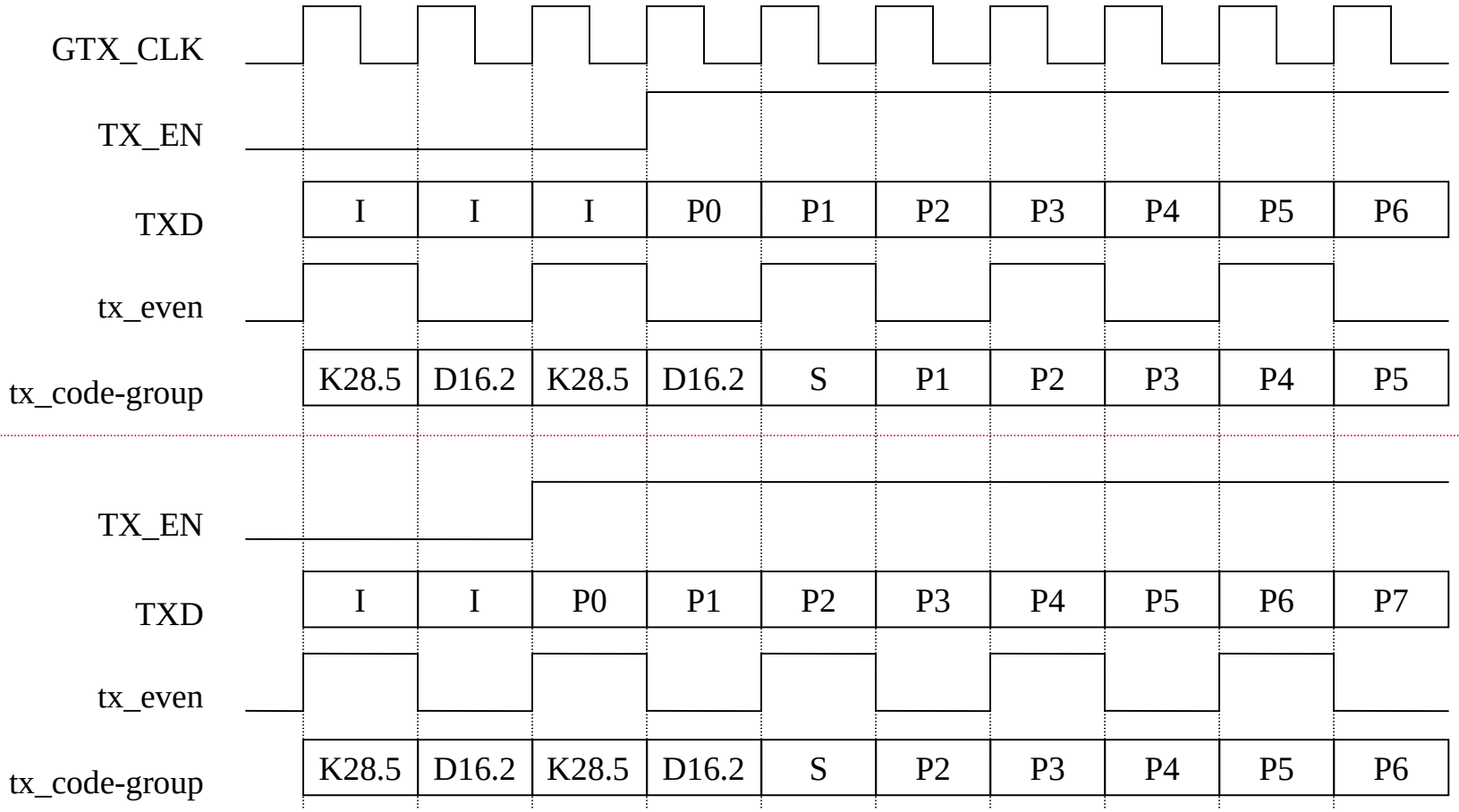
  The CRC parameter is expected to be continuously calculated so after all other parameters have been written, the CRC parameter can be used to determine if the received CRC is valid.

- **capture_rx_msg**

  Indication to the Message Handler that an OAM message is available in rx_msg and should be captured.

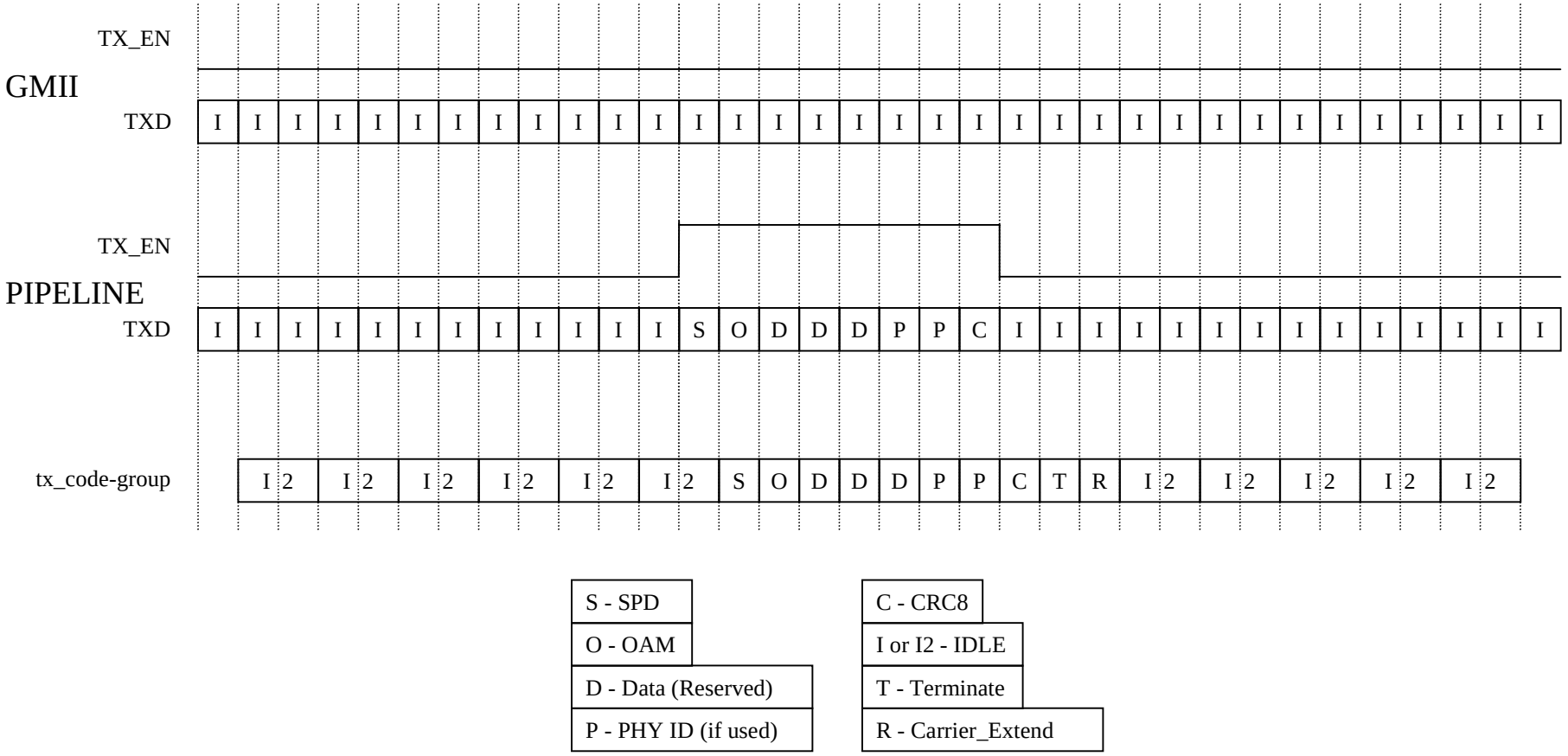
Backup Slides

PCS TX State Machine Alignment



GMII to tx_code-group Mapping

OAM Preamble Only



S - SPD	C - CRC8
O - OAM	I or I2 - IDLE
D - Data (Reserved)	T - Terminate
P - PHY ID (if used)	R - Carrier_Extend