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*10GBASE-T start up:  
new concepts and proposed text  
(slide version of submitted Word document)*

**IEEE P802.3an Task Force  
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# Main points

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- Interaction between Auto Negotiation and PHY Control clarified. Duplicate function of maxwait\_timer and link\_fail\_inhibit\_timer removed.
- MASTER functions of state PMA\_Traing\_Init\_M partitioned in states PMA\_Train1\_M and PMA\_Train2\_M.
- SLAVE functions of states SILENT and PMA\_Traing\_Init\_S partitioned in states PMA\_Train1\_S and PMA\_Train2\_S.
- In state PMA\_Train1\_M, MASTER sends invitations to SLAVE to start transmission at specified times.
- Sending invitations to the SLAVE (by announcing “zero power changes”) and announcing changes in transmit power are clearly separated.

# Main points

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- **Final transmit power** adjustments made in states PMA\_Train2\_M and PMA\_Train2\_S, i.e., **before coefficients are exchanged**.
- In state PMA\_Coeff\_Exch **only coefficients** are exchanged.
- 16-octet InfoField of Draft 2.2 shortened to **8-octet InfoField**. Redundancies eliminated. New payload formats introduced.
- All PMA state transitions announced by single **state\_transition\_flag = 1** and **transition\_count  $\geq$  min\_transition\_count**.
- Link Control **integrated** into PHY Control
- Number of state diagrams reduced to **one**.

# Interaction between PHY Control and Auto Negotiation

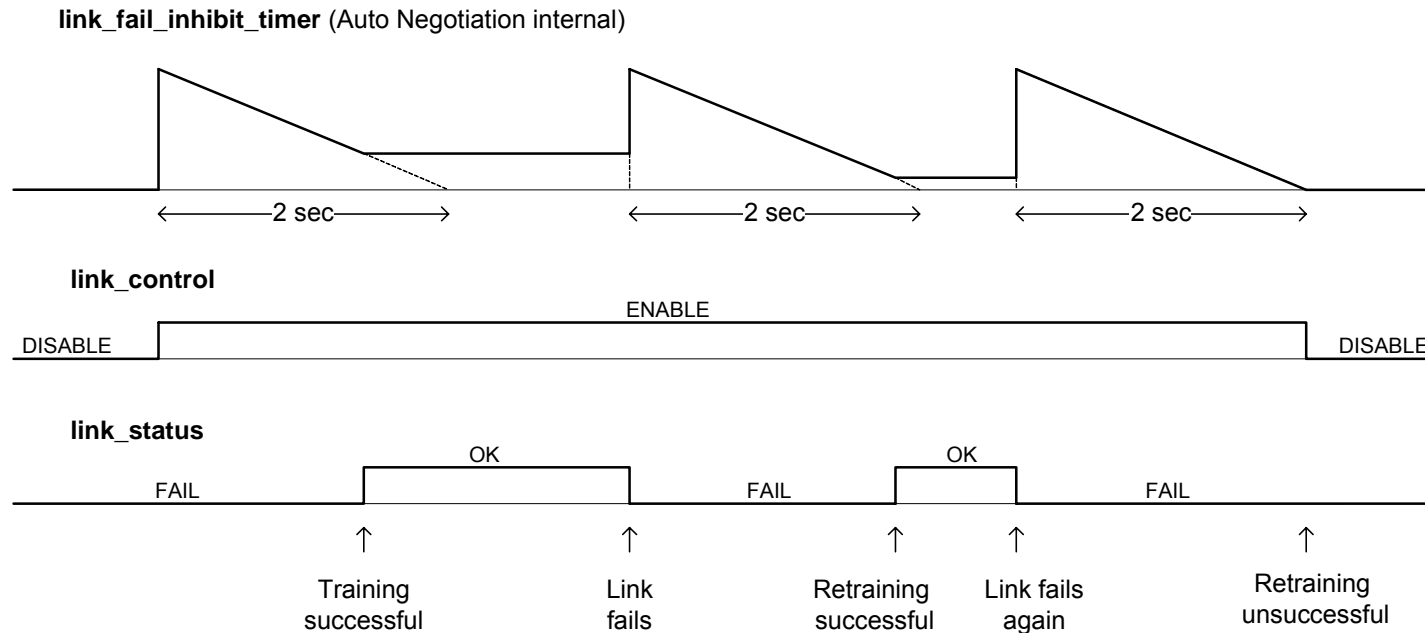
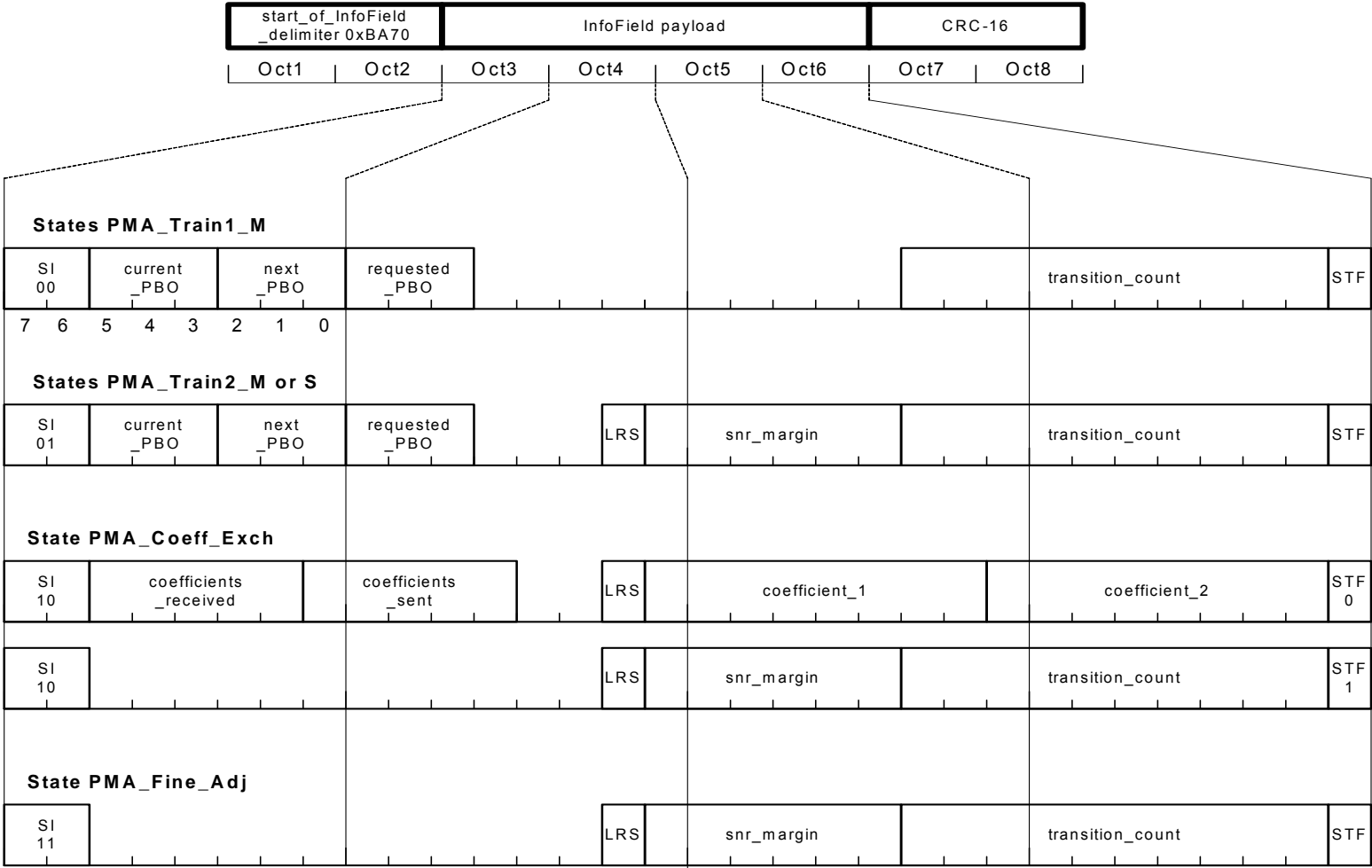


Figure 55-aa—Interaction between Auto Negotiation and PHY Control

# InfoField format and payloads



SI ... state\_indicator, LRS ... loc\_rcv\_status, STF ... state\_transition\_flag

Figure 55-bb—InfoField format and payloads

# Local receiver status and SNR margin

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## 55.4.2.5.6 InfoField payload: local receiver status and SNR margin

The `loc_rcvr_status` (LRS, Oct4<1>) bit is transmitted during all PMA training states except `PMA_Train1_M`. *[In state `PMA_Train1_M`, the MASTER has to detect the beginning of SLAVE transmission, but may not yet decode InfoFields]. ...*

.... `loc_rcvr_status` reflects a judgment of the local receiver on the projected decision-point SNR margin for reliable decoding of LDPC-coded 128 DSQ signals, i.e., decoding of PCS frames, with the current setting of PBO by the link partner and the adjustments of the local echo and next cancellers and the equalizer. `loc_rcvr_status` = OK indicates sufficient SNR margin and that a different PBO setting of the link partner and/or further training of the local cancellation and equalization filters is not warranted.

The information provided by `local_rcvr_status` is further qualified by the 6-bit field `snr_margin` (Oct4<0>,Oct5<7:3>). The field conveys the anticipated SNR margin for decoding PCS frames with the current PBO setting of the link partner and the local adaptive filter adjustments. The field is included for monitoring and diagnostic purposes. The `snr_margin` values 000000, 000001, ... 111110, 111111 shall indicate decision-point SNR margins of  $\leq -8.00$ ,  $-7.75$ , ...  $7.50$ ,  $\geq 7.75$  dB, respectively.

# PHY Control state diagram and relation with Auto Negotiation

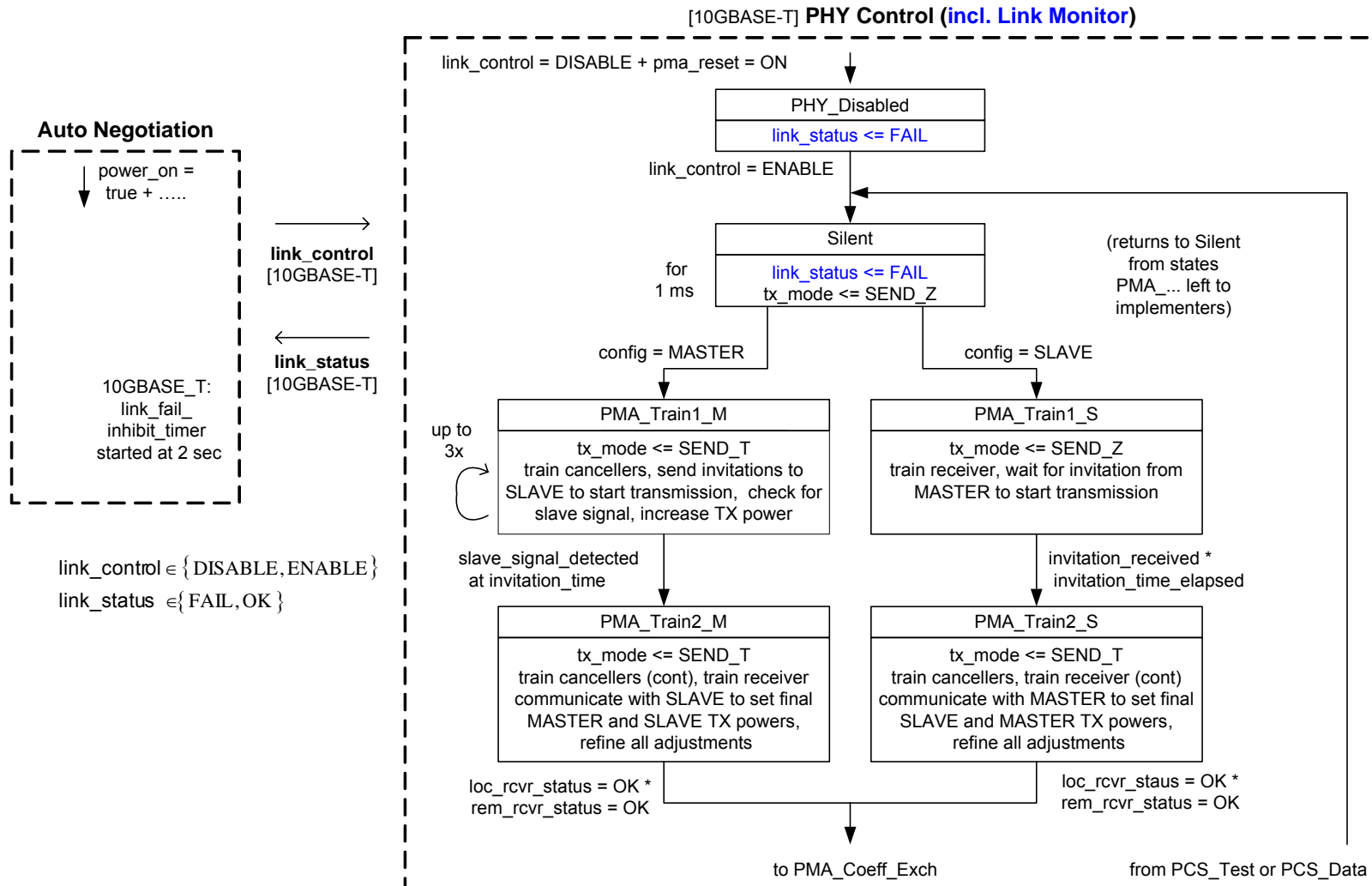


Figure 55-cc—PHY Control state diagram ... (upper part)

# PHY Control state diagram and relation with Auto Negotiation

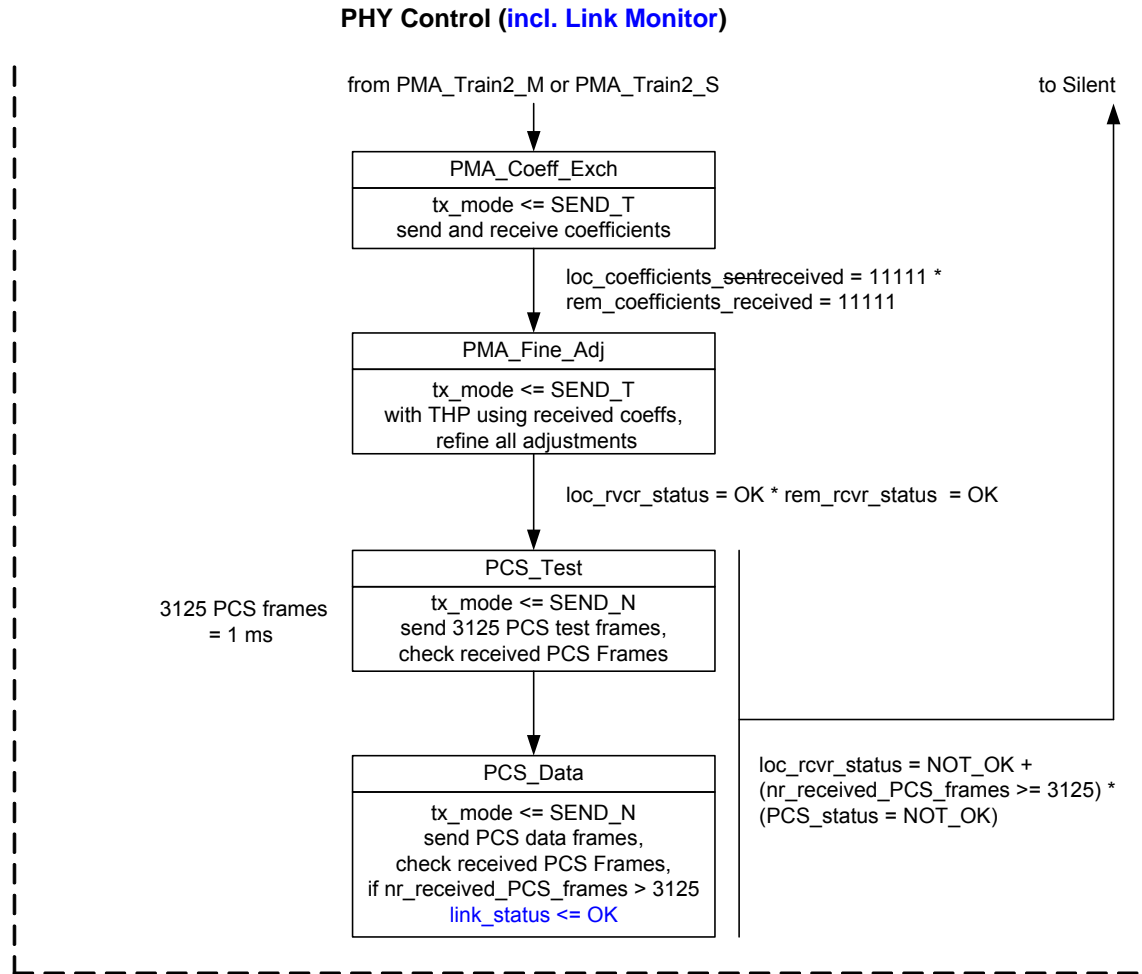


Figure 55-cc—PHY Control state diagram ... (lower part)



# State description

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## State PMA\_Train1\_M

*[Summary]* In state PMA\_Train1\_M, the MASTER sends PMA training frames (tx\_mode = SEND\_T), which includes transmission of InfoFields. The MASTER increases transmit power in up to three steps, adjusts echo and next cancellers, and sends invitations to the SLAVE to start transmission at specified times until the start of SLAVE transmission is detected.

Upon entering state PMA\_Train1\_M, the MASTER sets *max\_incr\_timer to 168±5 ms [≈ 8200 PMA training frames]* and *master\_step = 1*. This corresponds to sending PMA training frames at minimum transmit power level by using *PBO = 7 [nominal power -14 dB]*. If the MASTER is required to use fixed TH precoding, *PBO = 7* implies the fixed THP setting  $THP_{Short}$ . In the InfoField the MASTER sends *current\_PBO = requested\_PBO = 7*. After the MASTER has sufficiently adjusted its echo and next cancellers, it begins to send invitations to the SLAVE to start transmission at specified times. The invitations are expressed by sending in the InfoField *next\_PBO = current\_PBO* together with a non-zero value of *transition\_count*, i.e., by announcing a "zero power change". ....

## State description

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### State PMA\_Train1\_M: continued (1)

.... If the SLAVE is already able to decode InfoFields with an SNR margin of at least 6 dB for binary symbol decisions, SLAVE transmission with a PBO setting equal to the value in the received `current_PBO = requested_PBO` fields is started when the `transition_count` becomes zero. ....

.... The start of transmission shall be timed such that at the MDI of the SLAVE *[the AFE of the SLAVE]* the first transmitted PMA training frame and the PMA training frame received following the InfoField in which the `transition_count` becomes zero are time aligned within  $\pm 500$  ns. This alignment ensures that the MASTER has to check for reception of the SLAVE signal only within a time window, whose width is determined by the alignment tolerance of  $\pm 500$  ns and the maximum round-trip propagation delay of the link. If the MASTER detects the beginning of SLAVE transmission in this window, it announces a transition to state PMA\_Train2\_M by inserting into the InfoField a non-zero `transition_count` together with `STF = 1`. Otherwise, the MASTER sends further invitations to the SLAVE at appropriate time intervals and checks for arrival of the SLAVE signal until the `max_incr_timer` expires.

## State description

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### State PMA\_Train1\_M: continued (2)

When the `max_incr_timer` expires and the MASTER has not yet detected the SLAVE signal, the MASTER sets `max_incr_timer` to  $100 \pm 5$  ms [*≈ 4880 PMA training frames*] and `master_step` = 2. This corresponds to sending PMA training frames at minimum transmit power level + 4 dB by using `PBO` = 5 [*nominal power -10 dB*]. If the MASTER is required to use fixed TH precoding, `PBO` = 5 implies the fixed THP setting  $\text{THP}_{\text{Med}}$ . The MASTER announces the increase in transmit power by sending in the InfoField `current_PBO` = 7 and `next_PBO` = 5 together with a non-zero value of `transition_count`. The change in transmit power occurs immediately after the InfoField, in which `transition_count` becomes zero. In the InfoField the MASTER then sends `current_PBO` = `requested_PBO` = 5. After the MASTER has sufficiently readjusted its echo and next cancellers, it begins to send invitations to the SLAVE to start transmission at specified times. Further operations are as described above for `master_step` = 1.

## State description

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### State PMA\_Train1\_M: continued (3)

When `max_incr_timer` expires again and the MASTER has still not detected the SLAVE signal, the MASTER proceeds to `master_step = 3`. This corresponds to sending PMA training frames at minimum transmit power level +8 dB by using `PBO = 3` [*nominal power -6 dB*]. If the MASTER is required to use fixed TH precoding, `PBO = 3` implies the fixed THP setting `THPLong`. The MASTER announces the increase in transmit power by sending in the InfoField `current_PBO = 5` and `next_PBO = 3` together with a non-zero value of `transition_count`. The change in transmit power occurs immediately after the InfoField, in which `transition_count` becomes zero. ...

.... In the InfoField the MASTER then sends `current_PBO = requested_PBO = 3`. At this maximum transmit power level for state PMA\_Train1\_M, the MASTER continues operations as described above for `master_step = 1` and `2`, but without setting a time limit for the detection of the SLAVE signal. The dwell time is only limited by the expiration of `link_fail_inhibit_timer` in Auto Negotiation. If `link_fail_inhibit_timer` expires, PMA training has failed. Auto Negotiation sets `link_enable = DISABLE` and thus forces PHY Control into state PHY\_Disabled.

# State description

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All PHY Control states are described in this manner in

**10GBASE-T Startup GU 12Sep05.doc**