

Startup Resolutions for 1000BASE-T

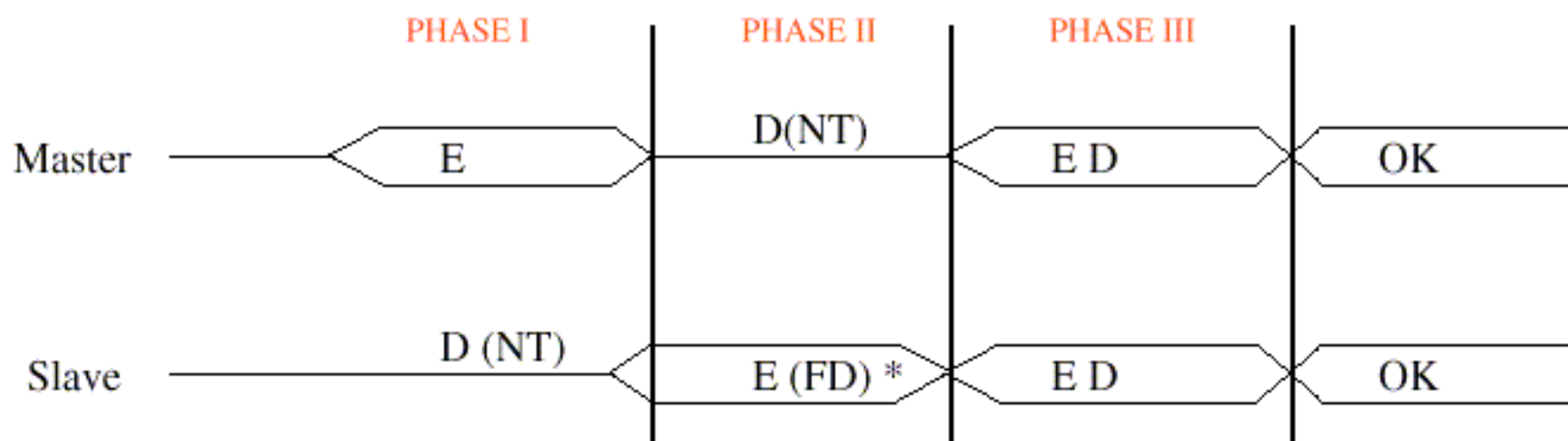
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Outline

- Description of Montreal Startup Protocol
- Synchronization Problem in D1.2 Phy Control State Diagram
- Proposed Resolution in Agazzi/Creigh writeup
- Difficulties with Resolution
 1. Phase Multiplication Problem
 2. Phase Chasing Problem
 3. Continuance of Synchronization Problem
 4. Signal Detect Compliance Problem
- Potential Resolutions
 1. Reduced Phase Approach
 2. Fixed Timer Approach
 3. Blind Startup Approach
- Conclusions



Original Proposal (Passed 11/11/97)



E = Echo/Next Convergence

D = DFE/Timing Convergence

FD = Freeze DFE

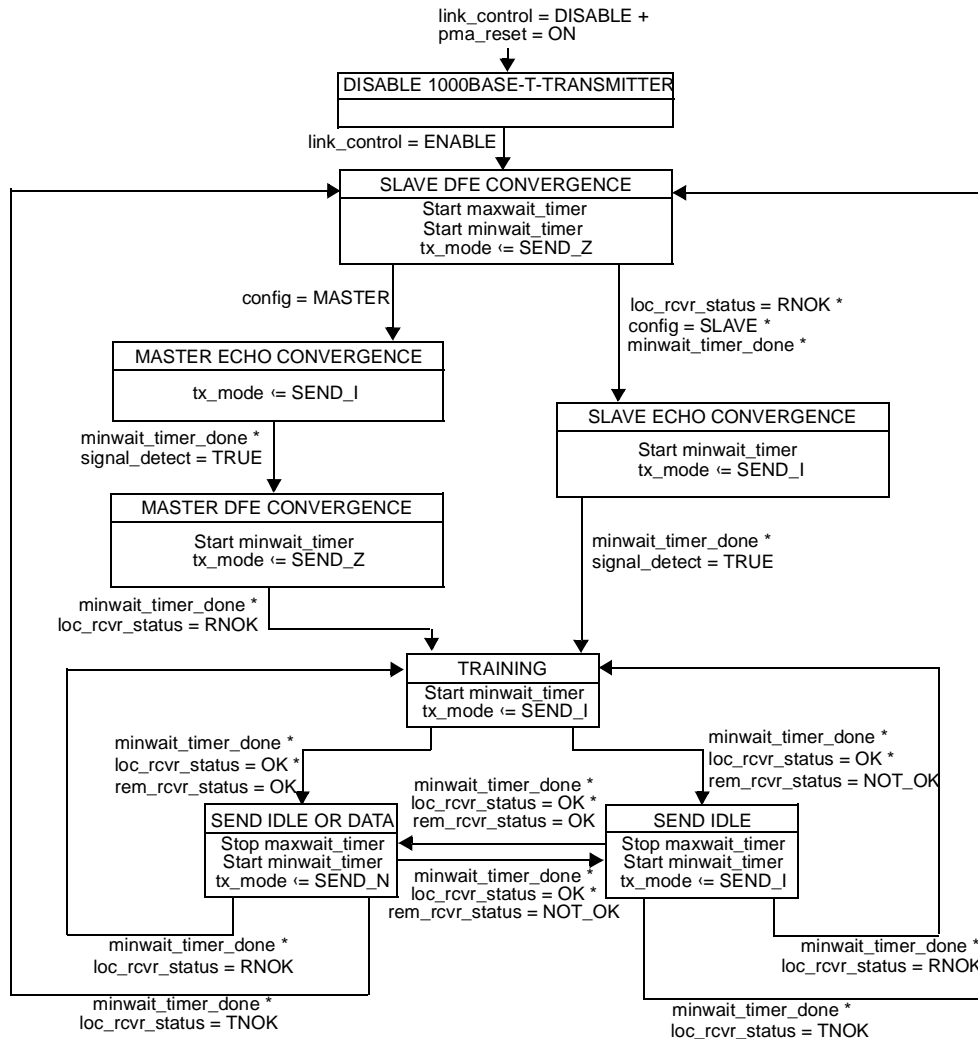
NT = No Timing update (timing may be recovered for DFE convergence)

* Transmit frequency & jitter constrained but not limited to recovered clock

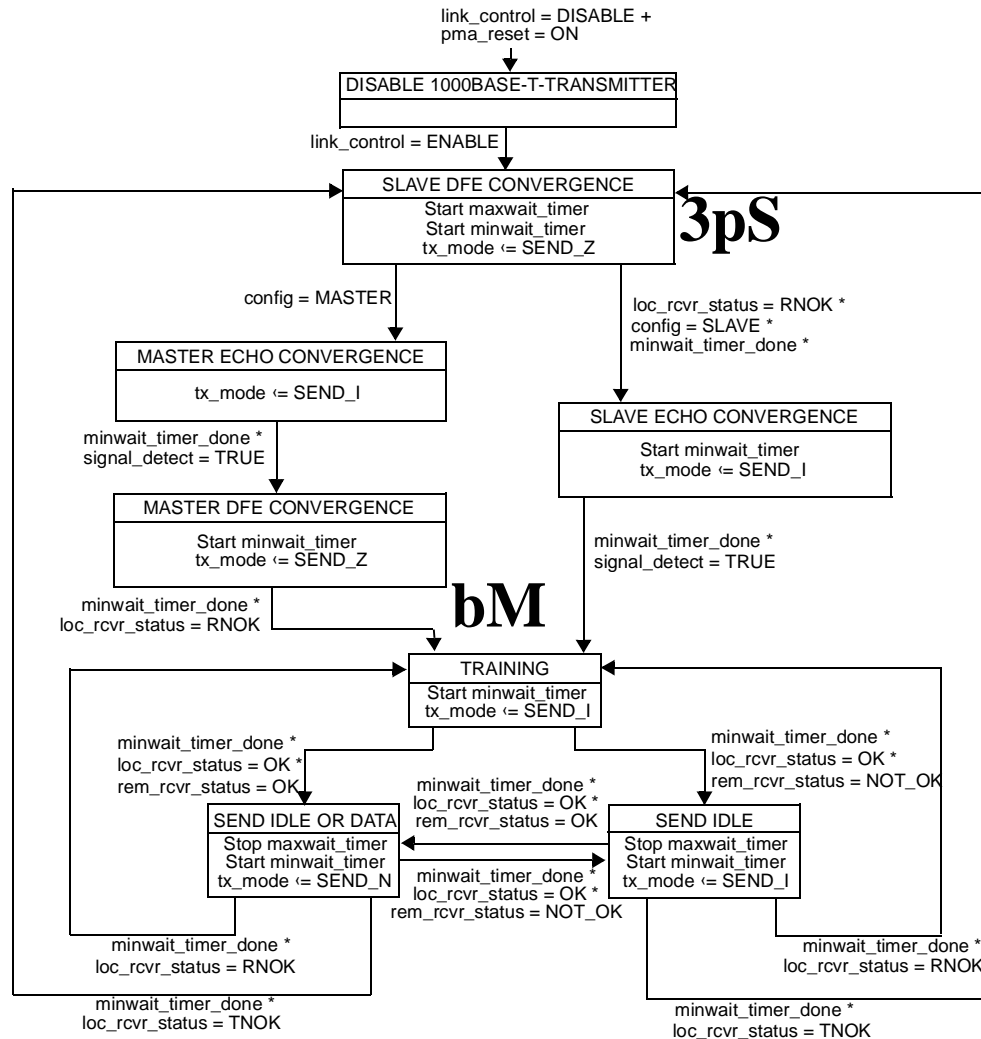
The Montreal Protocol

- Intended to allow both blind startup and 3-phase sequenced startup with minimum impact on either.
- Approved in Montreal, subject to verification of robustness of the implementation.
- Written up in Draft D1.1 using handshake mechanism, but was not fully defined.
- Can be implemented using fixed timers alone provided initial synchronization is achieved via auto-negotiation.

D1.2 PHY Control



Synchronization Problem



Synchronization Problem

- Occurs primarily due to Blind PHY/ 3-phase Sequenced Startup PHY interoperability requirements

Pointed out John Creigh in Comment 69 on D1.1.

- Example problem:

Blind Master transitions to Training State due to

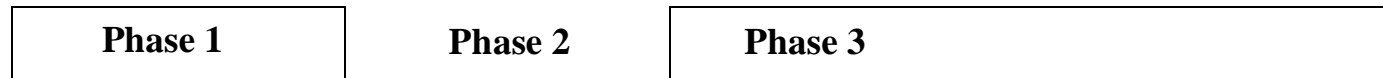
signal_detect = TRUE (noise burst/magnified AGC) in presence of Echo in Master Echo Convergence state - John Creigh reflector e-mail of 1/23/98

Blind Master PHY does nothing during Master DFE Convergence state

3-phase Sequenced Startup Slave PHY is still in auto-negotiation

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B Master



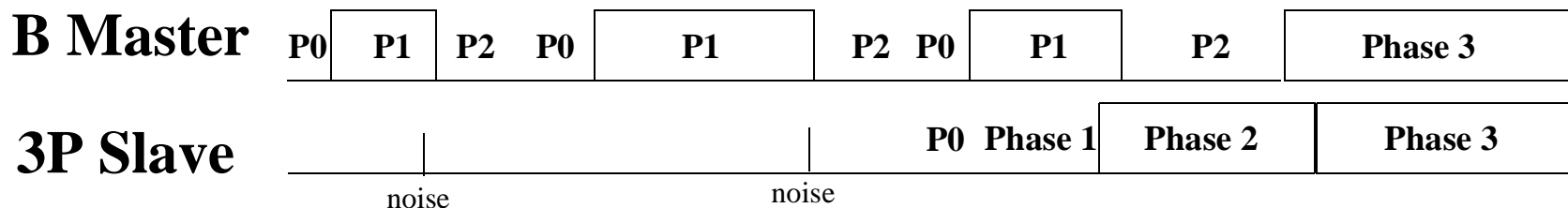
3P Slave



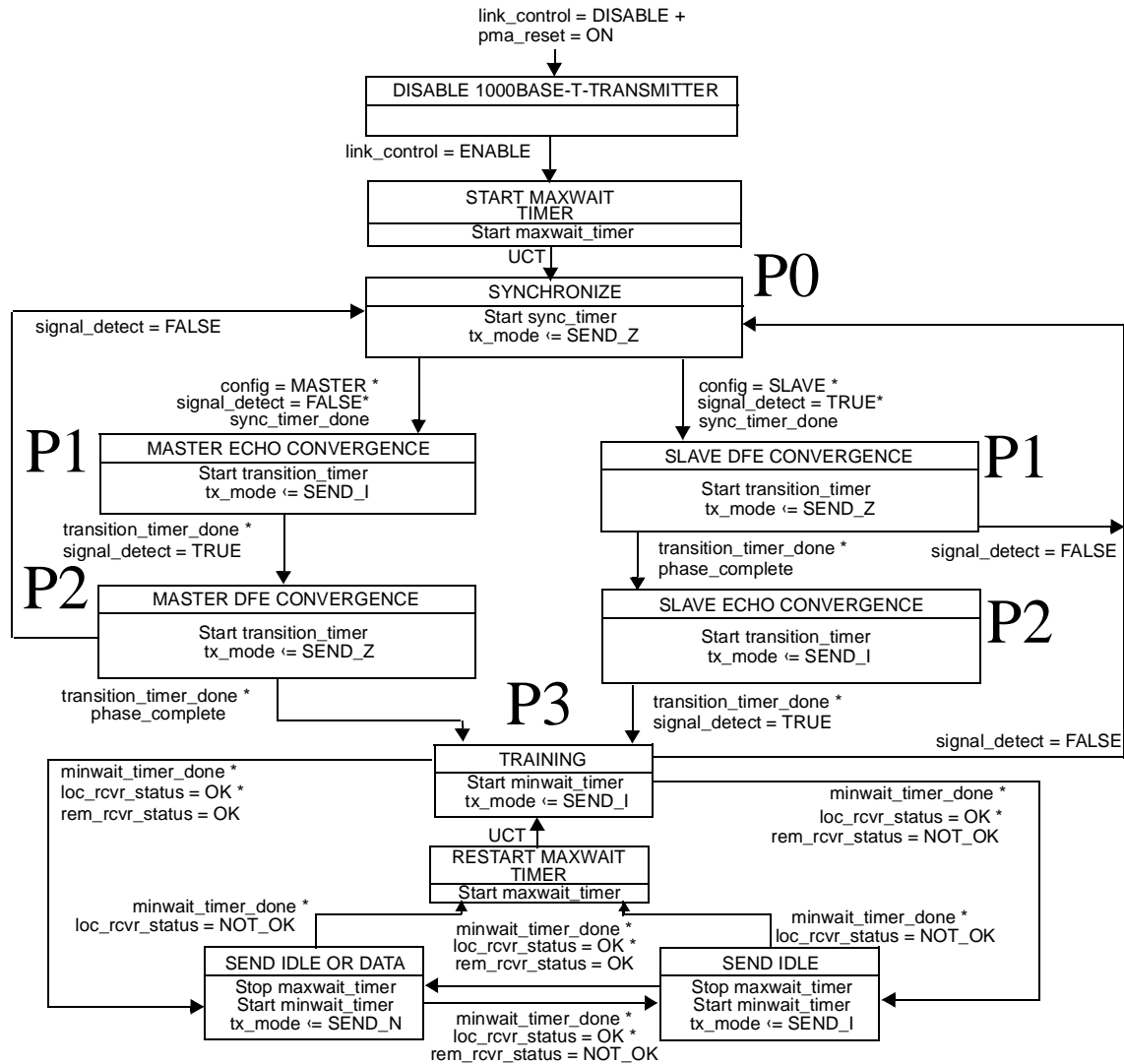
Agazzi/Creigh Proposed Resolution

Dated 2/6/1998

- Insert an initial SEND_Z phase on both Master and Slave (Phase 0)
- Insert a feedback edge based on signal_detect=FALSE condition so that Phase 1/2/3 transitions of Blind Master in previous example can become Phase 0/1/2/0/1/2 ... 0/1/2/3
- Slave must “Lock On” when it comes out of auto-negotiation.



Agazzi/Creigh PHY Control Diagram

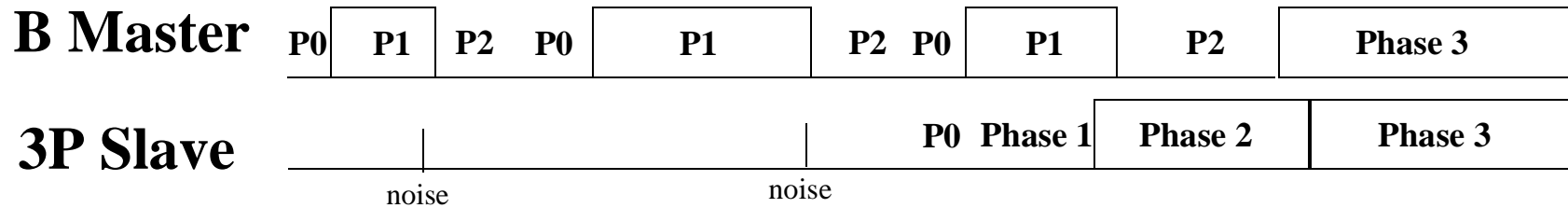


Problems with the A/C resolution

- “Process Problem”:
consistent with Montreal Protocol?
- Technical Problems (BM/BS, 3PM/BS, BM/3PS, 3PM,3PS)
 1. Phase Multiplication Problem (All 4 combinations)
 2. Phase Chasing Problem (BM/3PS, 3PM/3PS)
 3. Continuance of Synchronization Problem (BM/3PS, e.g.)
 4. Signal Detect Compliance Problem.

Phase Multiplication Problem

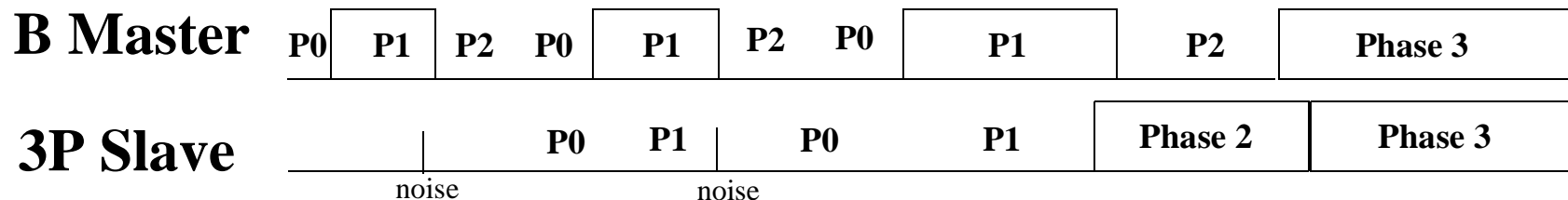
- Number of On/Off phases can multiply to indefinite values, even when startup is successful and even for Blind PHY implementations.



- Example: solved synchronization problem of D1.2, but Blind Master PHY had to do 8 ON/OFF phases.

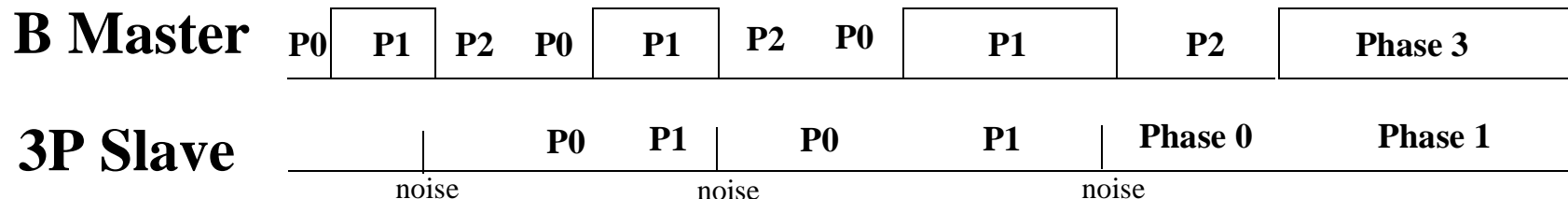
Phase Chasing Problem

- If Master does Phase 0/1/2 loop, Slave must do Phase 0/1 loop!
- Potential difficulty in DFE convergence if Slave resets FFE/DFE in Phase 0, since this is supposed to be the START phase.
- Note: Blind Slave can just ignore Master ON/OFF phases since it ignores Phase 1. Here FFE/DFE convergence will not be an issue.



Continuance of Synchronization Problem

- Probability of Synchronization problem is much reduced.
- Synchronization problem will occur if for some reason (e.g., noise immunity tests being conducted on PHY, bad signal_detect=FALSE implementation), Blind Master skips signal_detect=FALSE transition in Phase 2.
- In example below, only option for 3P Slave is to do 2-phase sequenced startup.



- Note: “noise” could be just poor signal_detect implementation in presence of Echo.

Signal Detect Compliance Problem

- Difficult to expect compliance with signal_detect requirements in presence of Echo/NEXT

Compliance is with respect to signal waveform at input of receiver

Echo/NEXT cancellation occurs after considerable signal processing of waveform

- Hence, difficult to verify if intent of compliance requirements is being met, if there are interoperability problems.

Suggested Resolutions

- **1. Reduced Phase Approach:** If a handshake mechanism is desired for purposes of flexibility in implementation choices, and sequenced startup is desired, reduce the number of phases in the sequenced startup to 2

e.g., eliminate Phase 2 of Montreal protocol.

- **2. Fixed Timer Approach:** Insert Phase 0 as in A/C resolution, but use fixed timers and initial delay on Master PHY transmission.

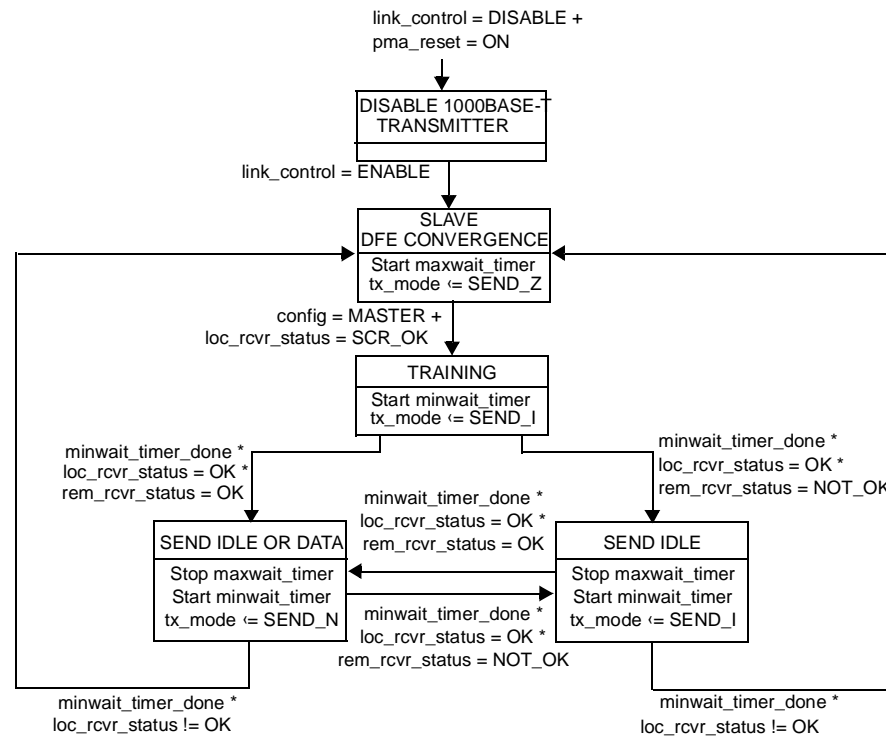
fixes all timer values and potentially restricts implementation choices

uses 3-phase sequencing only during startup and not during retraining

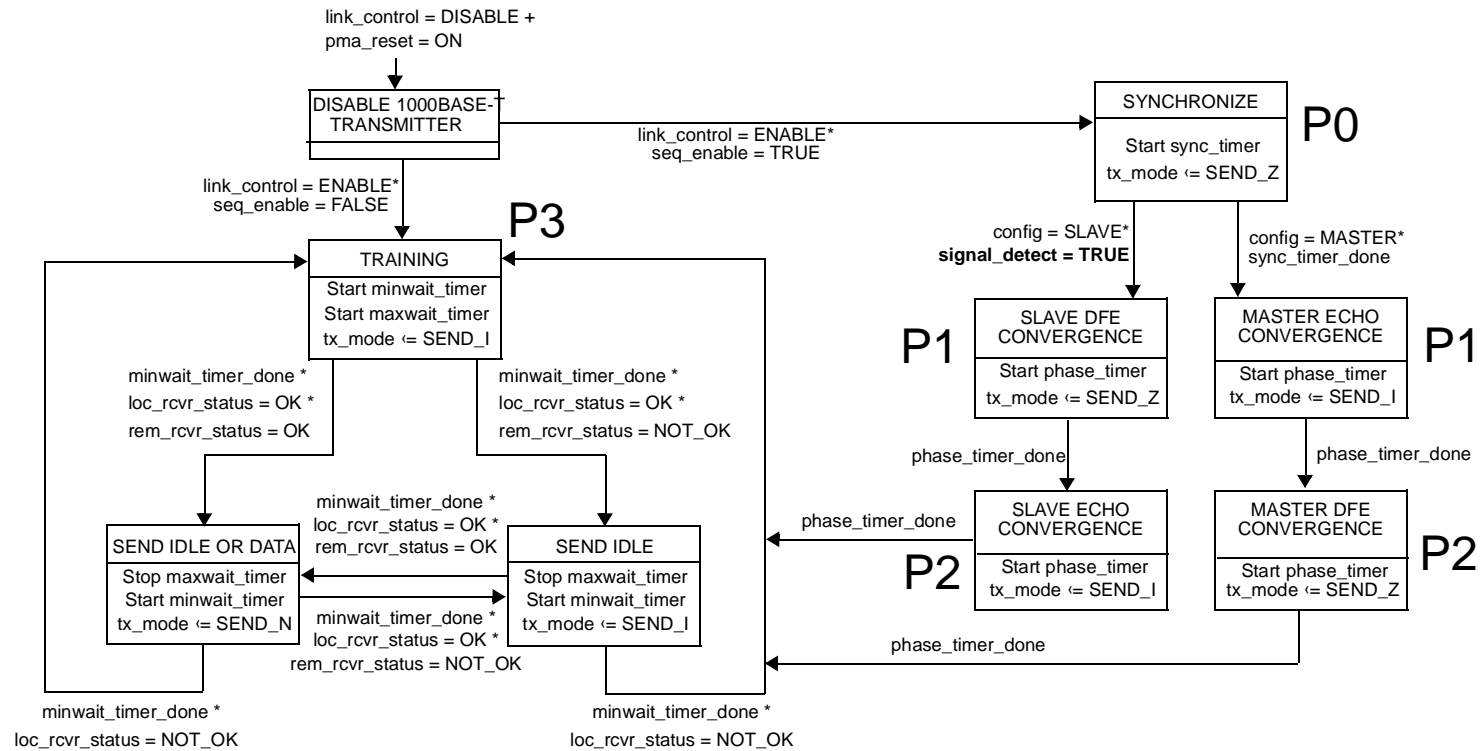
initial delay of 200ms to cover auto-negotiation variability is a fixed penalty on three PHY combinations (3PM/BS, 3PM/3PS, BM/3PS)

- **3. Blind Startup.**

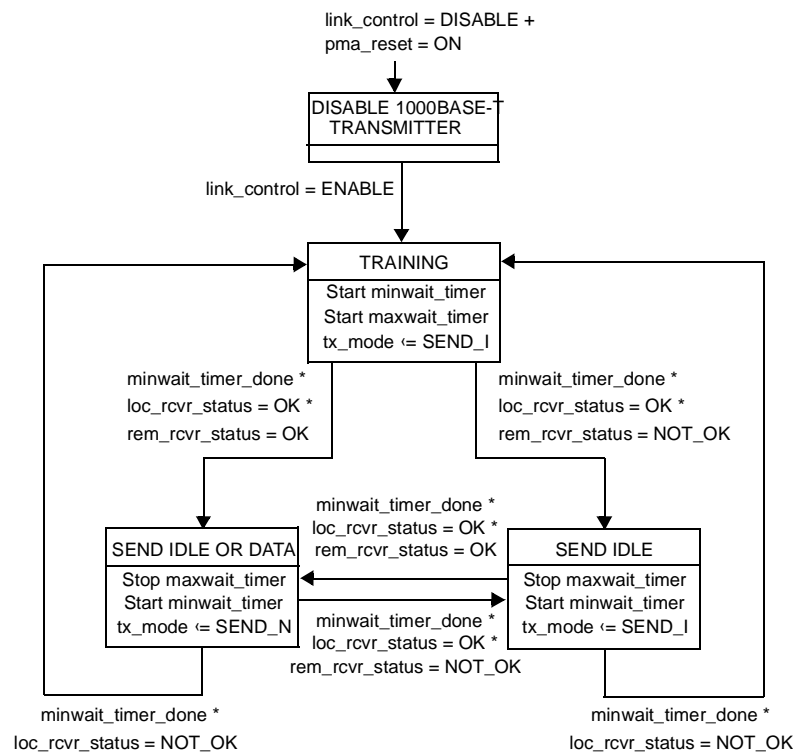
1. Reduced Phase Approach



2. Fixed Timer Approach



3. Blind Startup



Conclusions

- Significant problems with A/C resolution of Phy Control section that makes it technically not robust - does not satisfy the Montreal requirement.
- Presented three other acceptable resolutions
 - Reduced Phase Approach: written as a D1.2 drop in replacement by S. Rao
 - Blind Startup Approach: written as a D1.2 drop in replacement by Ramin Nobakht.
 - Fixed Timer Approach: written as D1.2 change text by John Creigh, analysis pending by A. Castellano.