

**Infineon**

# Start-up Training Sequence Proposal

May 9, 2006 T10/05-397r3

Harvey Newman  
Sr. Staff Engineer

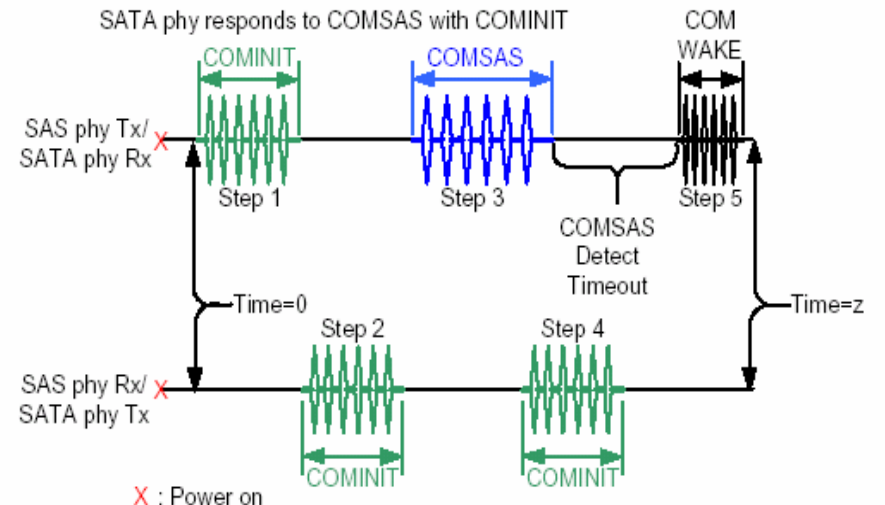
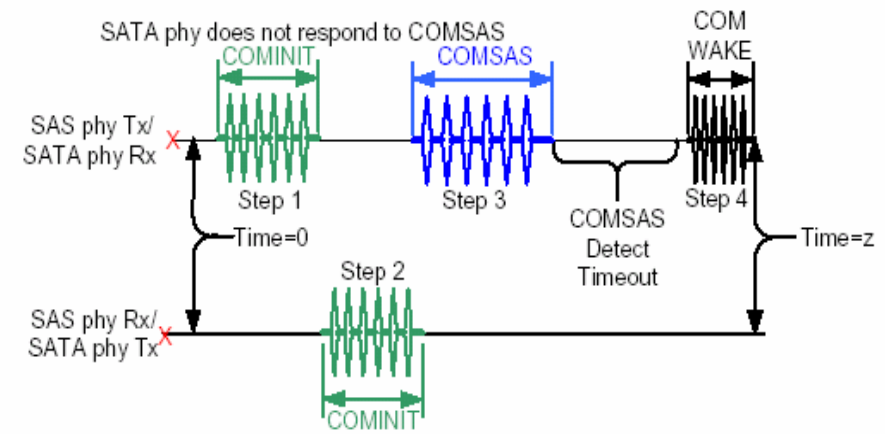


Never stop thinking

- DFE receivers may require training before speed negotiation takes place.
- Applying a known pattern for training greatly improves time required for training.
- Ensure backwards compatibility.
- Use current protocol.
- Introduce training sequence only where needed.
- Leverage off existing spec based on DFE architecture.

# OOB Sequence

stop thinking  
Never



X : Power on

Time 0: OOB sequence begins  
Time z: Speed negotiation sequence begins

Figure 116 — SAS to SATA OOB sequence

# SATA Speed Negotiation (Training not required)

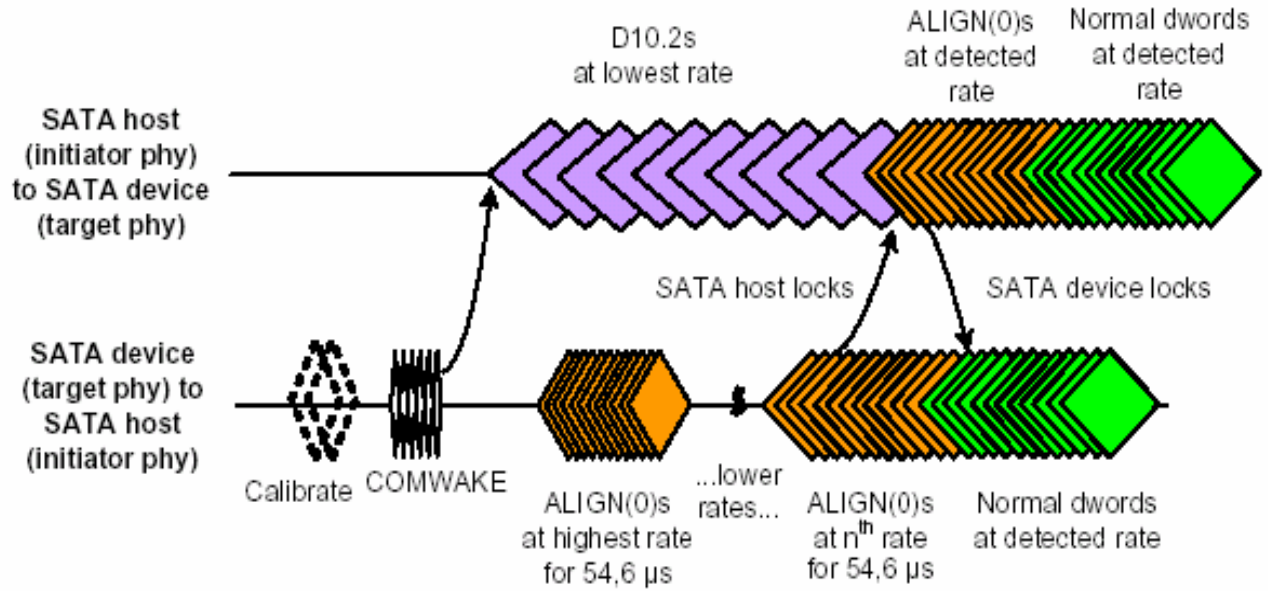


Figure 115 — SATA speed negotiation sequence

# SAS Speed Negotiation Window

stop thinking  
Never

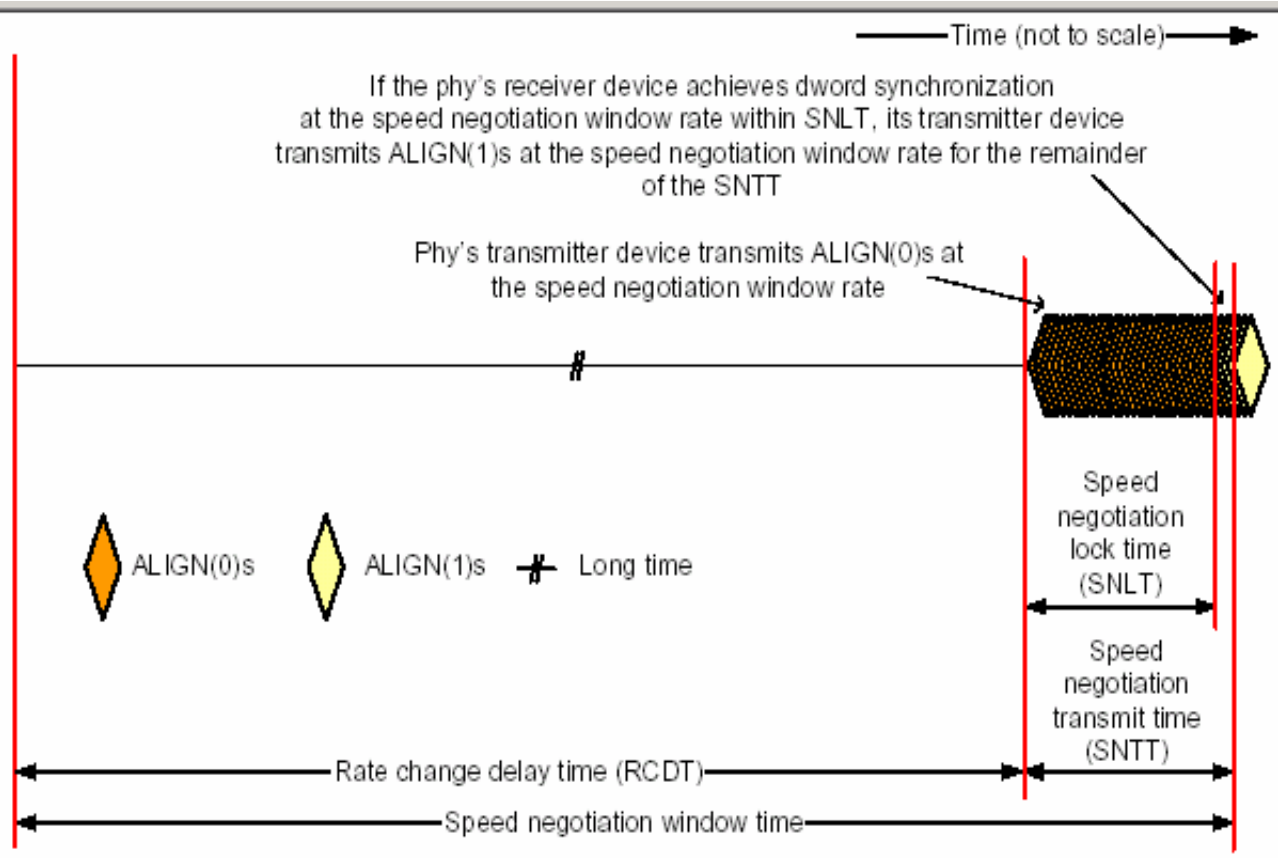


Figure 118 — SAS speed negotiation window



# SAS Speed Negotiation Table

Table 66 defines the timing specifications for the SAS speed negotiation sequence.

**Table 66 — SAS speed negotiation sequence timing specifications**

Parameter	Time	Comments
Rate change delay time (RCDT)	750 000 OOBIs	The time the transmitter device shall transmit D.C. idle between rates during speed negotiation. <b>500µs</b>
Speed negotiation transmit time (SNTT)	163 840 OOBIs	The time during which ALIGN (0) or ALIGN (1) is transmitted at each physical link rate during the speed negotiation sequence. Derived from: OOBI x 4 096 x 40. <b>109µs</b>
Speed negotiation lock time (SNLT)	153 600 OOBIs	The maximum time during the speed negotiation window for a transmitter device to reply with ALIGN (1). Derived from: OOBI x 3 840 x 40 <b>102µs</b>
Speed negotiation window time	913 840 OOBIs	The duration of a speed negotiation window. Derived from: RCDT + SNTT. <b>609µs</b>

stop thinking  
Never

# SAS Speed Negotiation Sequence

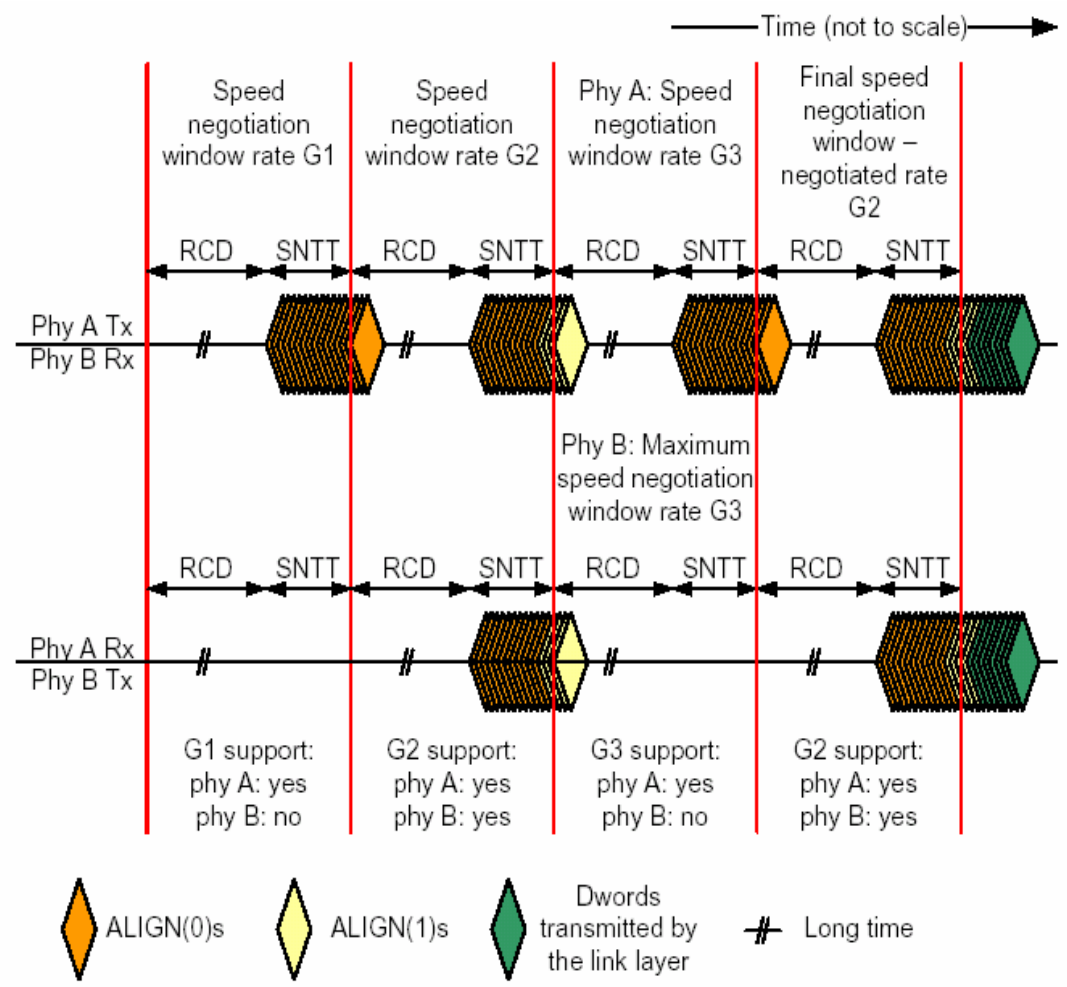


Figure 119 — SAS speed negotiation sequence (phy A: G1, G2, G3, phy B: G2 only)



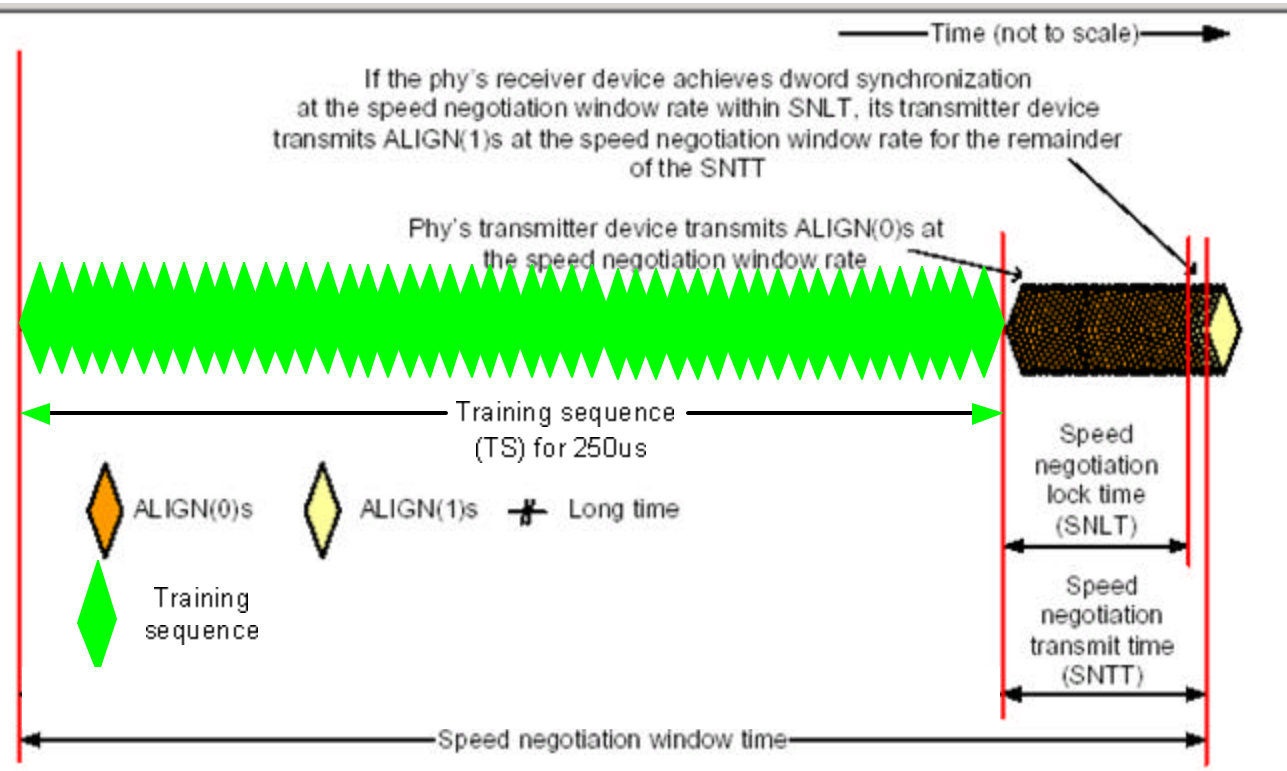
# New table for Speed Negotiation Window Rate G3

stop thinking  
Never

Parameter	Time	Comments
		The time the transmitter device shall transmit D.C. idle between rates during speed negotiation.
Speed negotiation transmit time (SNTT)	163 840 OOB1	The time during which ALIGN (0) or ALIGN (1) is transmitted at each physical link rate during the speed negotiation sequence. Derived from: $OOB1 \times 4\ 096 \times 40$ .
Speed negotiation lock time (SNLT)	153 600 OOB1	The maximum time during the speed negotiation window for a transmitter device to reply with ALIGN (1). Derived from: $OOB1 \times 3\ 840 \times 40$
Speed negotiation window time	913 840 OOB1	The duration of a speed negotiation window. Derived from: $RCDT + SNTT$ .
Training sequence (TS)	750 000 OOB1	Training sequence.



# Training Sequence Only Used for G3 Speed Negotiation



Pattern	Purpose	Time
Primitive sent twice	80 bits - Status or request	13.3ns
Scrambled data starting with seed 0h	800 bits - pseudo-random	133.3ns

D30.3 = 0111100011 1000011100b low frequency to provide an open eye.

Train<sub>p</sub>: training receiver K28.5 D30.3 D30.3 D30.3

~~IncEmp<sub>p</sub>: increase transmitter emphasis K28.5 D10.2 D30.3 D30.3~~

~~DecEmp<sub>p</sub>: decrease transmitter emphasis K28.5 D30.3 D10.2 D30.3~~

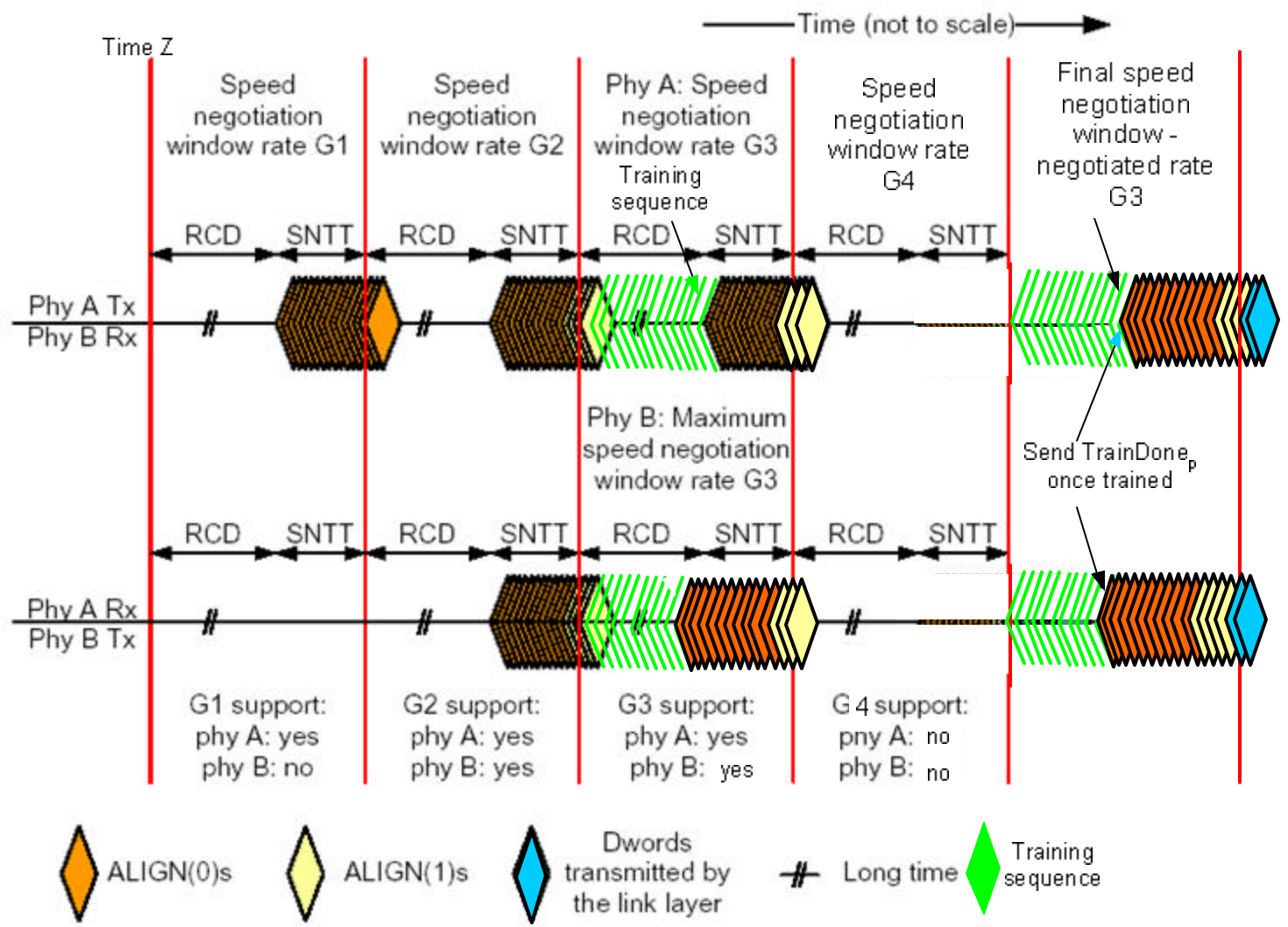
TrainDone<sub>p</sub>: training complete K28.5 D30.3 D30.3 D10.2

~~Done (Phy Adjust)<sub>p</sub>: adjustment acknowledged K28.5 D30.0 D16.7 D01.4~~

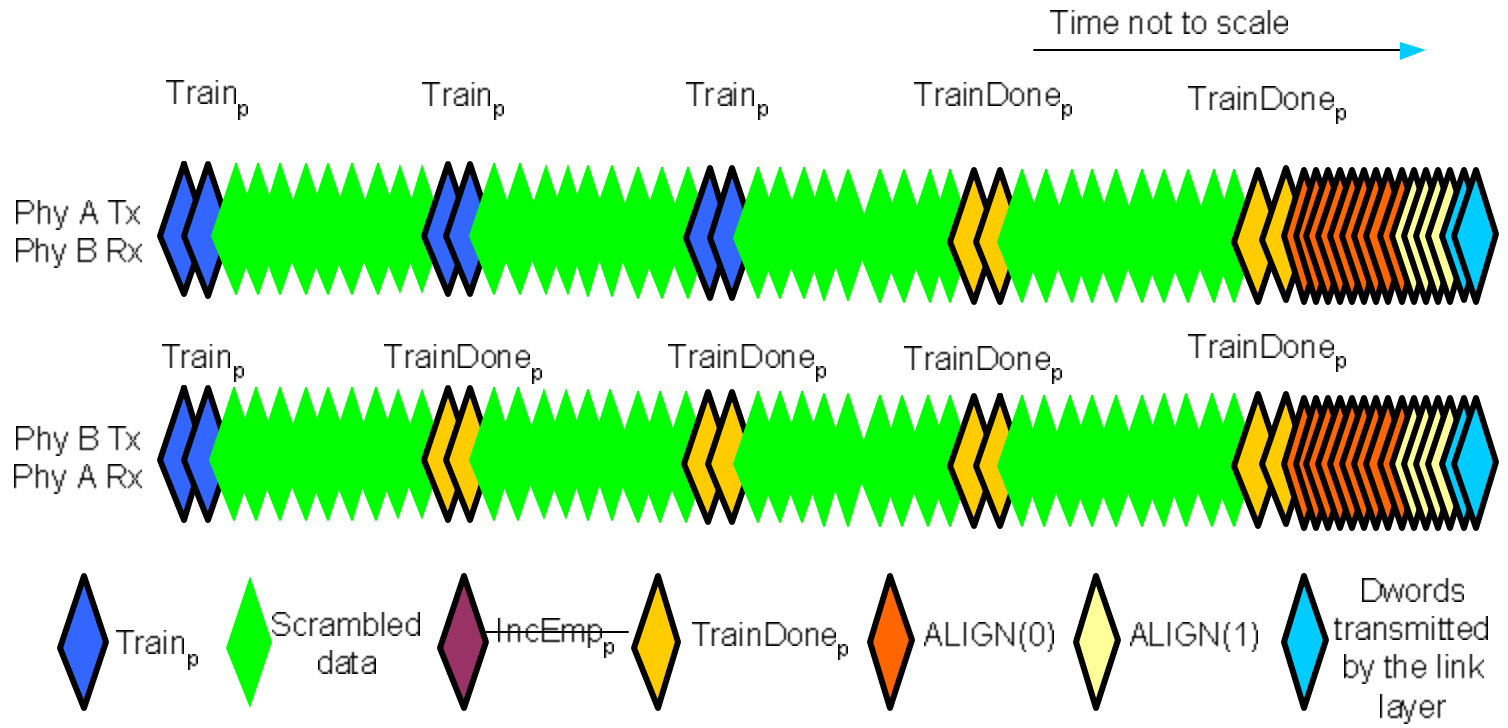
~~NAK (Phy Adjust)<sub>p</sub>: adjustment not acknowledged K28.5 D01.4 D31.4 D29.7~~

~~Amplitude adjustment?~~

# Training Sequence Only Used for G3 Speed Negotiation



# Final G3 Speed Negotiation Window Expanded



If  $TrainDone_p$  not received from both phys within 20ms then restart OOB.

# Change to SAS Phy State Machine

Normal state machine startup with new training sequence

