Start-up Training Sequence Proposal

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Overview

- 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 and modify where needed.
- Introduce training sequence only where needed.
- Leverage off existing spec based on DFE architecture.
OOB Sequence

Figure 116 — SAS to SATA OOB sequence

Time 0: OOB sequence begins
Time z: Speed negotiation sequence begins
SATA SpeedNegotiation (Training not required)

Figure 115 — SATA speed negotiation sequence
SAS Speed Negotiation Window

If the phy's receiver device achieves dword synchronization at the speed negotiation window rate within SNLT, its transmitter device transmits ALIGN(1)s at the speed negotiation window rate for the remainder of the SNTT.

Phy's transmitter device transmits ALIGN(0)s at the speed negotiation window rate.

Figure 118 — SAS speed negotiation window
Table 66 defines the timing specifications for the SAS speed negotiation sequence.

Table 66 — SAS speed negotiation sequence timing specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Time</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate change delay time (RCDT)</td>
<td>750 000 OOBI</td>
<td>The time the transmitter device shall transmit D.C. idle between rates during speed negotiation.</td>
</tr>
<tr>
<td>Speed negotiation transmit time (SNTT)</td>
<td>163 840 OOBI</td>
<td>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.</td>
</tr>
<tr>
<td>Speed negotiation lock time (SNLT)</td>
<td>153 600 OOBI</td>
<td>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</td>
</tr>
<tr>
<td>Speed negotiation window time</td>
<td>913 840 OOBI</td>
<td>The duration of a speed negotiation window. Derived from: RCDT + SNTT.</td>
</tr>
</tbody>
</table>
SAS Speed Negotiation Sequence (SAS1)

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

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Purpose</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primitive sent four times</td>
<td>160 bits - Status</td>
<td>26.6ns</td>
</tr>
<tr>
<td>Series of 00h bytes transmitted scrambled per the existing scrambler and 8B/10B encoder</td>
<td>1600 bits - pseudo-random Provide broad spectral content for a DFE to train.</td>
<td>266.7ns</td>
</tr>
</tbody>
</table>

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

Train_p: training receiver K28.5 D30.3 D30.3 D30.3

TrainDone_p: training complete K28.5 D30.3 D30.3 D10.2

The number of bit is the requirement.
The time is for reference based on 6Gb/s operation.

Either running disparity is allowed.
New configuration window uses OOB signaling method to identify supported functions.
New configuration window.

This gives 58 configurations with only 6 used.

Use OOB bursts for 10us to indicate each configuration supported. Send the same as OOB at 1.5Gb/s except at SAS amplitude. Use threshold detector for decoding.
If a phy has not both transmitted and received TrainDone within 20 ms then report an error in speed negotiation. Higher levels will then decide what to do.

Note removal of final ALIGN(0) ALIGN(1) sequence at the end. TrainDone_p shall indicate Dword alignment and ready for communication.