Agenda

• PCS State Machines
• MII and PCS Ordered Sets
**PCS State Machines Background**

- Today with 10GBASE-R, there are two state machines operating on the receive stream and looking at the sync bits.

  **Lock state machine**
  - Looks for 64 non-errored sync blocks in a row to declare in sync
  - Looks for 16 errored sync blocks out of 64 to declare out of sync

  **BER state machine**
  - Looks for 16 errored sync blocks out in 125usec window to declare high BER
  - High BER $\sim 10^{-4}$

![Figure 49-12 — Lock state machine](image1)

![Figure 49-13 — BER monitor state machine](image2)
Now for 100/40Ge

- We need SMs operating on each Virtual Lane instead of a single stream
- First we find 66b alignment, then we hunt for alignment markers
- Should we keep the same sync SM, just run 4 or 20 instances of them?
  
  I would assume yes…no need to also run it on the aggregate stream either
- Do we need the BER SM as is, just run 4 or 20 instances of them?
  
  Should be some value in identifying high BER VLs, though we can not always correlate that to a particular physical lane, but if just some are high BER, you could run test patterns to isolate a problem
- Or we could run the BER SM on the aggregate stream?
  
  This makes sense if we don’t care about identifying individual VLs that are misbehaving
100/40Ge Proposed SM Plan

1. The 66b lock SM runs on each Virtual Lane
2. Then an Alignment Marker SM runs on each Virtual Lane
3. The Virtual Lanes are De-skewed
4. Then the BER SM is run on the aggregate data stream
The BER SM will dominate the time to take down the link in low BER situations.
Ordered Sets

- In the 10GBASE-R PCS, two types of ordered sets are supported
  - Sequence ordered sets: Local and remote faults
  - Signal ordered sets: Reserved for future use (used by Fiber Channel)
- In XGMII, only sequence ordered sets are supported
  - Sequence ordered sets: Local and remote faults
Options for Ordered Sets

• In XGMII the ordered sets are defined as follows:

<table>
<thead>
<tr>
<th>Lane 0</th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>Reserved</td>
</tr>
<tr>
<td>Sequence</td>
<td>0x00</td>
<td>0x00</td>
<td>0x01</td>
<td>Local Fault</td>
</tr>
<tr>
<td>Sequence</td>
<td>0x00</td>
<td>0x00</td>
<td>0x02</td>
<td>Remote Fault</td>
</tr>
<tr>
<td>Sequence</td>
<td>( \geq 0x00 )</td>
<td>( \geq 0x00 )</td>
<td>( \geq 0x03 )</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

NOTE—Values in Lane 1, Lane 2, and Lane 3 columns are in hexadecimal, most significant bit to least significant bit (i.e., \(<7:0>\)). The link fault signaling state machine allows future standardization of reserved Sequence ordered sets for functions other than link fault indications.
Ordered Sets

- Proposed ordered set format for the XLGMII/CGMII
- With 8B alignment, ordered sets span 8B

Table 151–5—Sequence ordered_sets

<table>
<thead>
<tr>
<th>Lane 0</th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
<th>Lane 4</th>
<th>Lane 5</th>
<th>Lane 6</th>
<th>Lane 7</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>Reserved</td>
</tr>
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<td>Sequence</td>
<td>0x00</td>
<td>0x00</td>
<td>0x01</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
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<td>0x00</td>
<td>0x00</td>
<td>Remote Fault</td>
</tr>
<tr>
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<td>≥ 0x00</td>
<td>≥ 0x00</td>
<td>≥ 0x03</td>
<td>≥ 0x00</td>
<td>≥ 0x00</td>
<td>≥ 0x00</td>
<td>≥ 0x00</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

NOTE—Values in Lane 1, Lane 2, and Lane 3 columns are in hexadecimal, most significant bit to least significant bit (i.e., <7:0>). The link fault signaling state diagram allows future standardization of reserved Sequence ordered sets for functions other than link fault indications.
Ordered Sets

- With the 10GBASE-R PCS and 4B alignment, there are several block types that can carry ordered sets:

The ‘O’ codes denote signal ordered set (0xF) vs. sequence ordered sets (0x0).

Though signal ordered sets are reserved.
Ordered Sets

- For 100GBASE-R and 40GBASE-R, the proposal is:

A single block type for sequence ordered sets (no ‘O’ code).

If we need to support signal ordered sets use a new block type (0x55).