To: T10 Technical Committee
From: Robert Sheffield (Robert.L.Sheffield@intel.com), Intel Corporation
Date: October 23, 2002
Subject: T10/02-433r0, SAS Link Rate Clarification

## Revision History

Revision 0 (October 23, 2002) first revision

## Related Documents

SAS-r02b – Serial Attached SCSI revision 02b.

## Overview

The term “link rate” usage in the overall SAS specification is not clear and has conflicting meaning.

## Suggested Changes

Add the following Link Rate Terms and Definitions:

| Link Rate Term | Definition |
|---|---|
| Hardware Minimum Physical Link Rate | Minimum link rate capability of the PHY based on its electrical properties. |
| Hardware Maximum Physical Link Rate | Maximum link rate capability of the PHY based on its electrical properties. |
| Programmed Minimum Link Rate | Minimum operational link rate of the PHY as programmed during initialization (defaults to the Hardware Minimum Physical Link Rate) |
| Programmed Maximum Link Rate | Maximum operational link rate of the PHY as programmed during initialization (defaults to the Hardware Maximum Physical Link Rate) |
| Negotiated Link Rate | The current operational link rate of a SAS link established after link speed negotiation between two PHYs. |
| End-to-End Data Rate | The effective data rate of a pathway between an initiator and a target established as the data rate specified in a successful connection request. The initiator normally requests the slowest negotiated link rate along the fastest pathway between the initiator and the designated target. The initiator determines the negotiated link rates along all pathways by querrying all of the relevant PHYs during discovery. |

Update the Rate Matching Diagram.

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Section 7.7.3 Page 145, third complete paragraph –

The CONNECTION LINK RATE field indicates the rate at which all physical links on the pathway need to support,…

Change to:

The CONNECTION LINK RATE field is the requested End-to-End Data Rate of the pathway between the OPEN address frame originator and the specified destination,…

Following Table 61 add,

The CONNECTION LINK RATE for a successful connection request shall not exceed the slowest negotiated link along the pathway from initiator to target established by the connection.

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Page 147, clause 7.8.2 –

When this is done after a link reset sequence, this lets the initiator discover information about the devices in the domain.

Change to:

When this is done after a link reset sequence, this lets the initiator discover the negotiated link rate value of all links on all the devices connected in the domain.

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Page 155, clause 7.12.2.1 –

The (OPEN Address) frame contains source SAS address, destination SAS address, protocol (SSP, STP, or SMP), and link rate.

Change to:

The (OPEN Address) frame contains source SAS address, destination SAS address, protocol (SSP, STP, or SMP), and End-to-End data rate.

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Page 155 -

The OPEN address frame flows through expander devices onto intermediate physical links. If one of the intermediate physical links does not support the requested link rate, the expander device shall return OPEN_REJECT(LINK RATE NOT SUPPORTED). If the OPEN address frame reaches the destination, it shall return either OPEN_ACCEPT or OPEN_REJECT. Rate matching is used on any physical links in the pathway that are faster than the requested rate.

Change to:

The OPEN address frame flows through expander devices onto intermediate physical links. If one none of the prospective intermediate

physical links supports the requested End-to-End data rate, the expander shall return OPEN_REJECT(LINK RATE NOT SUPPORTED). If the OPEN address frame reaches the destination, it shall return either OPEN_ACCEPT or OPEN_REJECT. Rate matching is used on any physical links in the pathway that the negotiated link rate does not match the requested End-to-End data rate.

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Page 179, clause 7.15 –

Each connection request contains the link rate of the source port.

Initiator ports shall use SMP to determine the rate of the target port and the rates of every intermediate expander device-to-expander device physical link and shall not request a rate that is greater than the slowest physical link rate found.

If the rates do not match, the faster phy shall insert ALIGNs between dwords to match the slower rate."

Change to:

Each connection request contains the End-to-End data rate of the prospective pathway satisfying the connection request. Initiator ports shall use SMP to determine the link rate of the target port and the rates of every intermediate expander device-to-expander device physical link, and shall not request an End-to-End data rate that is greater than the slowest negotiated link rate on the fastest pathway found.

The initiator and the target outbound PHYs shall insert ALIGNs between dwords to match the End-to-End data rate. All expander inbound phys shall insert/delete ALIGNs to match the outbound phys link rate on the same pathway."

Figure 63 should be updated to reflect the changes.

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State Machine diagram updates:

There are a lot of references to "link rates" in all the link state machines that need to be updated to reflect the updated link rate definitions.

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