

10Gig MDIO feasibility study

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Abstract:

A two-bit Start-of-Frame (ST) field defined as "01b" exists between the Preamble and OpCode of the MII Management frame. The possibility of using two MII Management Frames with an ST field of "00b" (as outlined by IEEE P802.3ae 10Gb/s Ethernet MDC/ MDIO Proposal By David Law et al.) was found to be feasible after investigating twenty two Fast Ethernet and Gigabit Ethernet PHYs from various vendors. All 24 PHYs ignored frames with ST field of "00b" even when received with no idle gap. 21 single port Fast Ethernet PHYs, 1 four port Fast Ethernet PHY, and 2 single port Gigabit Ethernet PHYs were tested.

Resources:

A HP16500B Logic Analysis System, with a HP16552a Pattern Generator (with 3-state TTL Data Pods) and a HP16555 Logic Analyzer module was used to provide MDC, generate MDIO Management Frames, and observe MII Management responses from the PHY. A 2.5MHz Clock was used in most cases.

Brief:

Test 1: System Setup Verification

Standard Read and write frames were sent to DUT, and correct response was verified.

Test 2: Test rejection of "ST=00" field frames

Read and write frames with a "00b" ST field were sent to the DUT, rejection of these frames was verified.

Test 3: Dual Frame test verification

Two concatenated frames were sent to the DUT and correct response was verified.

Test 4: Dual Frame w/ "ST=00" field test

Two concatenated frames with a "00b" ST field were sent to the DUT and rejection of these frames was verified.

Procedure:

1. Standard MDIO Frame Test

Check if DUT responds to standard MDIO frames generated by the test unit. In this test both read and write frames were tested with the DUT to make sure that there were no problems between the test setup and the DUT. Further tests are not valid if the DUT does not respond as expected to these frames.

Registers 0 and 4 were written with standard MII Management Frames, and then the same written registers were read with standard frames to verify the write frames. The following is a binary representation of the frames sent. This does not include 32 bits of preamble that preceded the frames:

a) read frame	011000000000000ZZZZZZZZZZZZZZZZZZZZ
b) write one	010100000000000100010000100000000
c) write two	010100000000000100001001000000000
d) write three	01010000000100100000000001100001
e) write four	010100000001001000000000111100001

Registers 0 and 4 were both written, to place them in a known state, then read to verify the state. The registers were then changed again, and their state was verified by reading. Note that Z represents a high impedance state on the transmitter side. High impedance in this case represents the 2 bits of turn-around and the 16 bits in which the PHY responds with the register content.

2. MDIO Frames with ST=00 Field

This tests sends frames similar to the first test, however the ST field is set to "00". The DUT is checked with standard frames (ST=01) to make sure that the ST=00 frames were discarded or ignored. This is the first part of the 10Gig MDIO feasibility study.

Registers 0 and 4 were again written with standard frames so that they would begin in a known state. The DUT was then sent frames with a "00b" ST field. First a read frame was sent, to verify that the PHY would not respond. Then "00b" ST field write frames were sent. The registers were then read with standard frames so as to that the "00b" write frame was ignored.

Example of a "00b" ST field write frame:

000100000000000100010000100000000

3. Concatenated MDIO Frames

Registers 0 and 4 of the PHY are set to known values with standard MII Management Frames (see test 1). Then this test sends two frames back to back, with the standard 32 bits of preamble in between the DATA field of the first frame and the ST field of the second frame. Four combinations of frames are sent: (each set of frames was preceded by 32 bits of preamble)

a) Read-Read

```
0110000000000000ZZZZZZZZZZZZZZZZZZZZ111111111111111111111111111111-  
0110000000000000ZZZZZZZZZZZZZZZZZZZZ
```

b) Read-Write

```
0110000000000000ZZZZZZZZZZZZZZZZZZZZ111111111111111111111111111111-  
0101000000000001000100001000000000
```

c) Write-Read

```
0101000000000001000100001000000001111111111111111111111111111-  
0110000000000000ZZZZZZZZZZZZZZZZZZZZ
```

d) Write-Write

```
0101000000000001000100001000000001111111111111111111111111111-  
010100000001001000000000001100001
```

The purpose of this test is to explore if the DUT has issues with two frames being sent with no idle in between. (Note: The standard does not have a minimum idle requirement for MDIO transfers)

This test is in regards to the new proposal for 10Gig MDIO feasibility.

4. Concatenated MDIO frames w/ ST=00

This test is similar to test 3, however all test frames send now have the ST field set to "00". This assures that the DUT will ignore ST=00 Frames when concatenated. Again all four sequences of frames are tested. Note that case C and case D with the ST=00 field (referencing test 3) represent the Read, and Write frames for the 10Gig proposal.

Here is an example of these transmitted frames:

```
0010000000000000ZZZZZZZZZZZZZZZZZZZZ111111111111111111111111111111-  
0010000000000000ZZZZZZZZZZZZZZZZZZZZ
```

Matrix of Test Results

PHY	READ	WRITE	READ-00	WRITE-00	R-R	R-W	W-R	W-W	R-R-00	R-W-00	W-R-00	W-W-00
Test #	1	1	2	2	3	3	3	3	4	4	4	4
Vendor 1, phy 1	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 1, phy 2	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 1, phy 3	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 2	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 3	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 4	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 5, phy 1	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 5, phy 2	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 6	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 7, phy 1	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 7, phy 2	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 8, phy1	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 8, phy 2	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 9	pass	pass	ignore	ignore	fail	fail	pass	pass	ignore	ignore	ignore	ignore
Vendor 10, phy 1	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 10, phy 2	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 11	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 12, phy 1	pass	pass	ignore	ignore	pass	fail	pass	fail	ignore	ignore	ignore	ignore
Vendor 12, phy 2	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 12, phy 3	pass	pass	ignore	ignore	pass	pass	pass	pass	ignore	ignore	ignore	ignore
Vendor 14, phy 1	pass	pass	ignore	ignore	pass	fail	pass	fail	ignore	ignore	ignore	ignore
Vendor 14, phy 2	pass	pass	ignore	ignore	pass	fail	pass	fail	ignore	ignore	ignore	ignore
Vendor 15	pass	pass	ignore	ignore	pass	fail	fail	fail	ignore	ignore	ignore	ignore

Key:

pass	The DUT responded correctly to the standard MDIO frames sent to it.
ignore	The DUT properly ignored the ST=00 field MDIO frames.
fail	The DUT did not respond correctly to one of the concatenated frames