University of New Hampshire InterOperability Laboratory
Ethernet Consortium

Superseded

As of August 23rd, 2002 the Ethernet Consortium Clause # 28 Auto Negotiation Next Page Exchange Conformance Test Suite version 2.0 has been superseded by the release of the Clause # 28 Auto Negotiation Next Page Exchange Conformance Test Suite version 2.1. This document along with earlier versions, are available on the Ethernet Consortium test suite archive page.

Please refer to the following site for both current and superseded test suites:

http://www.iol.unh.edu/testsuites/ethernet/archive.html

FAST ETHERNET
&
GIGABIT ETHERNET

Clause 28 Auto-Negotiation
Next Page Exchange Test Suite

Technical Document

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MODIFICATION RECORD

- November 7, 2001 Version 2.0 Released

  Modifications since last revision:
  Updated to IEEE Std. 802.3, 2000 Edition

  Test Group 1: Next Page Transmission
  - Test #28.1.1: Next Page Bit
  - Test #28.1.2: Transmitted Toggle Bit Value
  - Test #28.1.3: Null Message Page Generation

  Test Group 2: Next Page Reception
  - Test #28.2.1: Next Page Wait State
  - Test #28.2.2: Next Page Exchange Restart
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  - Test #28.2.4: Reception of Toggle Bit
  - Test #28.2.5: Reception of rx_link_code_word[NP]=0
  - Test #28.2.6: Priority Resolution Function

- June 27, 2000 Version 1.0 Released

  Initial Release

  Test Group 1: Next Page Functionality
  - Test #28.1.1 Next Page Exchange Restart
  - Test #28.1.2 Next Page Consistency Match
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INTRODUCTION

Overview

The University of New Hampshire's InterOperability Laboratory (IOL) is an institution designed to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard. This suite of tests has been developed to help implementers evaluate the functioning of their Clause 28 Auto-Negotiation based products. The tests do not determine if a product conforms to the IEEE 802.3 standard, nor are they purely interoperability tests. Rather, they provide one method to isolate problems within an auto-negotiating device. Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other auto-negotiating capable devices. However, combined with satisfactory operation in the IOL's interoperability test bed, these tests provide a reasonable level of confidence that the Device Under Test (DUT) will function well in most auto-negotiating environments.

Organization of Tests

The tests contained in this document are organized to simplify the identification of information related to a test and to facilitate in the actual testing process. Each test contains an identification section that describes the test and provides cross-reference information. The discussion section covers background information and specifies why the test is to be performed. Tests are grouped in order to reduce setup time in the lab environment. Each test contains the following information:

Test Number

The Test Number associated with each test follows a simple grouping structure. Listed first is the Test Group Number followed by the test's number within the group. This allows for the addition of future tests to the appropriate groups of the test suite without requiring the renumbering of the subsequent tests.

Purpose

The purpose is a brief statement outlining what the test attempts to achieve. The test is written at the functional level.

References

The references section lists cross references to the IEEE 802.3 standards and other documentation that might be helpful in understanding and evaluating the test and results.

Resource Requirements

The requirements section specifies the hardware, and test equipment that will be needed to perform the test. The items contained in this section are special test devices or other facilities, which may not be available on all devices.

Last Modification
This specifies the date of the last modification to this test.

Discussion
The discussion covers the assumptions made in the design or implementation of the test as well as known limitations. Other items specific to the test are covered here.

Test Setup
The setup section describes the configuration of the test environment. Small changes in the configuration should be included in the test procedure.

Procedure
The procedure section of the test description contains the step-by-step instructions for carrying out the test. It provides a cookbook approach to testing, and may be interspersed with observable results.

Observable Results
The observable results section lists observables that can be examined by the tester to verify that the DUT is operating properly. When multiple values are possible for an observable, this section provides a short discussion on how to interpret them. The determination of a pass or fail for a certain test is often based on the successful (or unsuccessful) detection of a certain observable.

Possible Problems
This section contains a description of known issues with the test procedure, which may effect test results in certain situations.

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GROUP 1: NEXT PAGE TRANSMISSION

Scope: The following tests cover Auto-Negotiation operation specific to the Next Page exchange process.

Overview: These tests are designed to verify that the device under test reacts properly to the receipt of both valid and invalid Next Pages.

NOTE: THESE TESTS CANNOT BE PERFORMED IF THE DUT DOES NOT SUPPORT A NEXT PAGE EXCHANGE OR ALLOW A NEXT PAGE EXCHANGE TO BE INITIATED.

Test #28.1.1: Next Page Bit

Purpose: To verify that the device under test makes proper use of the Next Page bit throughout the Next Page Exchange process.

References:

[1] IEEE Std 802.3, 2000 Edition: Sections 28.2.1.2, 28.2.1.2.5, 28.2.3.4, 28.2.3.4.1, 28.2.3.4.2, 28.2.3.4.11

Resource Requirements:

- Line Monitor: A system capable of detecting, time-stamping, and recording normal link pulses (NLPs) on both the receive and transmit channels of the DUT. The channel signaling should pass through the line monitor with minimal distortion.
- Traffic Generator: A system capable of generating and transmitting normal link pulses (NLPs) and fast link pulses (FLPs) while connected to the receiver of the DUT.

Last Modification: November 7, 2001

Discussion: During the exchange of Next Pages, the NP bit plays a simple role. It is to have the value 1 if a station has further Next Pages to transmit, and 0 if it is transmitting its last page of information. Once both a device and its link partner have transmitted all of their Next Pages, the Next Page process should end and a link should be established. If the link partner finishes transmitting Message or Unformatted Pages before the device and is sending out Null Message Pages, then the device should go directly from its last Message or Unformatted Page to a link. If both devices transmit their last Message or Unformatted Page at the same time, they should both go straight to a link and no Null Message Pages should be sent. This test is designed to verify that the device under test properly sets the NP bit throughout the Next Page process, and does not transmit any Null Message Pages if its link partner either finishes transmitting its Message and Unformatted Pages before it or at the same time that it does.

Test Setup: Using Cat 5 cords, connect the DUT and the Traffic Generator to the Line Monitor such that the traffic generator's signaling will be seen by the DUT's receiver. Terminate the DUT's transmit channel with a 100Ω line termination.

Procedure:

DUT is an unmanaged PHY and the tester controls the Next Page exchange:
Part A: Send More Next Pages than DUT has to transmit

1. Establish a connection (not a link) to the DUT.
2. Use the Traffic Generator to send the DUT enough FLPs to get it through the COMPLETE ACKNOWLEDGE state (see test #28.2.2, Clause 28 Auto-Negotiation State Machine Base Page Exchange Test Suite).
3. Write any value (typically 2001h) to Register 7 to cause the DUT to enter the NEXT PAGE WAIT state.
4. Use the Traffic Generator to send the DUT validly formed Next Pages with NP=1 and proper toggle bit values to put it through the COMPLETE ACKNOWLEDGE state.

5. Write any value with NP=0 to Register 7 to cause the DUT to enter the NEXT PAGE WAIT state.
6. Send one additional Next Page with NP=1, followed by a final Next Page with NP=0.
7. Monitor the Next Pages transmitted by the DUT. Count the number (n) of Next Pages (not FLPs) sent by the DUT.

Part B: Send same number of Next Pages as DUT has to transmit

8. Repeat steps 1 - 4 above, but send 'n' Next Pages to the DUT (where 'n' is the value found in part a, the number of pages the DUT transmits), setting NP=0 in the final Next Page sent to the DUT.
9. Monitor the Next Pages transmitted by the DUT.

Part C: Send fewer Next Pages than DUT has to transmit

10. Use the Traffic Generator to send the DUT validly formed Base Pages and 'n' Next Pages. All Next Pages sent by the Traffic Generator should be Null Message pages with NP=0.
11. Monitor the Next Pages transmitted by the DUT.

DUT has a management entity controlling Next Page exchange:
Parts A, B, C:

1. Repeat steps 1–10 described above, however, in step 4 continue sending new Next Pages until the DUT sets NP=0 in its outgoing pages, and omitting step 3.

Observable Results:

a) The DUT should keep the NP bit set in all but the last three Next Pages sent by the DUT.
b) The DUT should keep the NP bit set in all but the last Next Page sent by the DUT.
c) The DUT should keep the NP bit set in all but the last Next Page sent by the DUT.

Possible Problems: If the DUT does not desire a Next Page exchange, then this test cannot be performed.

Test #28.1.2: Transmitted Toggle Bit Value

Purpose: To verify that the device under test properly alternates values of 0 and 1 in the toggle bit position (bit D11) of its Next Pages.

References:

[1] IEEE Std 802.3, 2000 Edition: Sections 28.2.1.2, 28.2.3.4, 28.2.3.4.1, 28.2.3.4.6

Resource Requirements:

- Line Monitor: A system capable of detecting, time-stamping, and recording normal link pulses (NLPs) on both the receive and transmit channels of the DUT. The channel signaling should pass through the line monitor with minimal distortion.
- Traffic Generator: A system capable of generating and transmitting normal link pulses (NLPs) and fast link pulses (FLPs) while connected to the receiver of the DUT.

Last Modification: November 7, 2001

Discussion: During Next Page exchange, the Toggle bit (bit D11) of the transmitted Next Pages serves a simple purpose. The value of this bit alternates between 0 and 1 in consecutive pages, and therefore provides the receiving station with a quick and easy check to verify that it is receiving Next Pages in the proper order. Therefore, it is important that the DUT sets these bits properly, starting with its first Next Page, whose Toggle bit value takes the opposite value of bit D11 in the device's Link Code Word. This test is designed to verify that the device under test sets the Toggle bit properly throughout the exchange of Next Pages.

Test Setup: Using Cat 5 cords, connect the DUT and the Traffic Generator to the Line Monitor such that the traffic generator's signaling will be seen by the DUT's receiver. Terminate the DUT's transmit channel with a 100Ω line termination.

Procedure:

DUT is an unmanaged PHY and the tester controls the Next Page exchange:

1. Establish a connection (not a link) to the DUT.
2. Use the Traffic Generator to send enough FLPs to put the DUT through the COMPLETE ACKNOWLEDGE state (see test #28.2.2, Clause 28 Auto-Negotiation State Machine Base Page Exchange Test Suite).
3. Write any value (typically 2001h) to Register 7 to cause the DUT to enter the NEXT PAGE WAIT state.
4. While the DUT is in NEXT PAGE WAIT, send enough Next Pages, all with proper Toggle values, to put it through the COMPLETE ACKNOWLEDGE state.
5. Repeat steps 3 and 4 varying the value written to Register 7, so that the DUT sends a total of 3 Next Pages.
6. Monitor the transmitted Next Pages.
7. Verify that the DUT sets the Toggle bit properly in all of its transmitted Next Pages.

DUT has a management entity controlling Next Page exchange:

1. Perform steps 1 and 2 described in the previous section.

2. Send the DUT enough Next Pages to allow it to send all of its Message and Unformatted Pages.
3. Monitor the transmitted Next Pages.
4. Verify the DUT sets the Toggle bit properly in all of its transmitted Next Pages.

Observable Results:

- The value of the toggle bit in the first Next Page should have the opposite value of bit D11 in the DUT's Link Code Word.
- The value of the Toggle bit of the Next Page transmitted by the DUT's should always take the opposite value of the Toggle bit of the previous Next Page (if the previous value was a 0, it should be a 1, and vice versa).

Possible Problems: If the DUT does not support a Next Page exchange, then this test cannot be performed.

Test #28.1.3: Null Message Page Generation

Purpose: To verify that the device under test transmits proper Null Message pages if it completes sending Message and Unformatted Pages before its link partner.

References:

[1] IEEE Std 802.3, 2000 Edition: Sections 28.2.3.4, 28.2.3.4.1, 28.2.3.4.7, 28.2.3.4.8, 28.2.3.4.11, Annex 28C, 28C.2

Resource Requirements:

- Line Monitor: A system capable of detecting, time-stamping, and recording normal link pulses (NLPs) on both the receive and transmit channels of the DUT. The channel signaling should pass through the line monitor with minimal distortion.
- Traffic Generator: A system capable of generating and transmitting normal link pulses (NLPs) and fast link pulses (FLPs) while connected to the receiver of the DUT.

Last Modification: November 7, 2001

Discussion: Once a device has finished sending Message and Unformatted Next Pages, it is required to send Null Message Pages until its link partner is done as well. A Null Message Page is defined as a Message Page that contains the Null Message code 0 0 0 0 0 0 0 0 0 0 1 (bits M[10:0]). This test is designed to verify that once the device under test completes its transmission of Message and Unformatted Pages, it sends out valid Null Message Pages until its link partner is done as well. Alternatively, a device may solely transmit Next Pages containing Null Message codes. This would allow a device with no Next Page data to transmit to still receive Next Page information from its link partner.

Test Setup: Using Cat 5 cords, connect the DUT and the Traffic Generator to the Line Monitor such that the traffic generator's signaling will be seen by the DUT's receiver. Terminate the DUT's transmit channel with a 100Ω line termination.

Procedure:

DUT is an unmanaged PHY and the tester controls Next Page exchange:
Part A: Send More Next Pages than DUT has to transmit

1. Use the Traffic Generator to send the DUT validly formed Base and Next Pages with NP=1 and proper Toggle bit values.
2. Write any value with NP=0 in Register 7 to cause the DUT to enter the NEXT PAGE WAIT state. Send one additional Next Page with NP=1, followed by a final Next Page with NP=0.
3. Monitor the Next Pages transmitted by the DUT. Count the number (n) of Next Pages (not FLPs) sent by the DUT.

Part B: Send same number of Next Pages as DUT has to transmit

4. Repeat step 1 above, but send 'n' Next Pages to the DUT (where 'n' is the value found in part a, the number of pages the DUT transmits), setting NP=0 in the final Next Page sent to the DUT.
5. Monitor the next pages transmitted by the DUT.

DUT has a management entity controlling Next Page exchange:
Part A: Send More Next Pages than DUT has to transmit

1. Perform steps 1 – 5 as described in the previous section, however, in step 2, continue sending new Next Pages until the DUT sets NP=0 in its outgoing Pages.

Part B: Send same number of Next Pages as DUT has to transmit

2. Perform steps 4 and 5 as described in the previous section.

Observable Results:

a) The DUT's last two Next Pages should contain validly formed Null Message Pages.
b) When both devices exchange the same number of Next Pages, there is no need to transmit Null Message Pages. However, if a device did do this, it would be considered acceptable (though wasteful) as long as the page sent by the DUT before the Null Message Page still had NP=1.

Possible Problems: If the DUT does not support a Next Page exchange, then this test cannot be performed.

GROUP 2: NEXT PAGE RECEPTION

Scope: The following tests cover Auto-Negotiation operation specific to the reception of Next Pages.

Overview: These tests are designed to verify that the device under test reacts properly to the receipt of both valid and invalid Next Pages.

NOTE: THESE TESTS CANNOT BE PERFORMED IF THE DUT DOES NOT SUPPORT A NEXT PAGE EXCHANGE OR ALLOW A NEXT PAGE EXCHANGE TO BE INITIATED.

Test #28.2.1: Next Page Wait state

Purpose: To verify that the device under test enters the NEXT PAGE WAIT state when both a device and its link partner desire a Next Page exchange to occur and mr_next_page_loaded=true.

References:

[1] IEEE Std 802.3, 2000 Edition: Sections 28.3.1, 28.3.4 Figure 28-16

Resource Requirements:

- Line Monitor: A system capable of detecting, time-stamping, and recording normal link pulses (NLPs) on both the receive and transmit channels of the DUT. The channel signaling should pass through the line monitor with minimal distortion.
- Traffic Generator: A system capable of generating and transmitting normal link pulses (NLPs) and fast link pulses (FLPs) while connected to the receiver of the DUT.

Last Modification: June 14, 2001

Discussion: While in the COMPLETE ACKNOWLEDGE state, a device will transition to the NEXT PAGE WAIT state only if both the device and its link partner desire a Next Page Exchange to occur. Before entering the NEXT PAGE WAIT state, a device should load a new Next Page to be transmitted, thus setting mr_np_loaded=true. This test is designed to verify that the device under test properly transitions to the NEXT PAGE WAIT state.

Test Setup: Using a Cat 5 cord, connect the DUT's transmitter to the Line Monitor. Terminate the DUT's transmit channel with a 100Ω line termination. Using a Cat 5 cord, connect the DUT's receiver to the Traffic Generator using a 100Ω line termination.

Procedure:

DUT is an unmanaged PHY and the tester controls the Next Page exchange:
Part A: mr_next_page_loaded

1. Establish a connection (not a link) to the DUT.
2. Use the Traffic Generator to send the DUT enough FLPs to put it into the COMPLETE ACKNOWLEDGE state (see test #28.2.2, Clause 28 Auto-Negotiation State Machine Base Page Exchange Test Suite).
3. While the DUT is in the COMPLETE ACKNOWLEDGE state, send enough Message Pages with the NP bit set to 1 and proper Toggle and ACK bit values that would normally put the DUT into the COMPLETE ACKNOLWEDGE state if a proper Next Page exchange occurred.
4. Monitor the transmit line.

Part B: Proper Next Page exchange

5. Write any value with NP=0 to Register 7 to cause the DUT to enter the NEXT PAGE WAIT state.

6. While the DUT is in the NEXT PAGE WAIT state, send enough Next Pages with NP=0, all with proper Toggle and ACK bit values, to put it through the COMPLETE ACKNOWLEDGE state.
7. Verify that the NEXT PAGE WAIT state was entered and that the DUT began transmitting its first Next Page.

DUT has a management entity controlling Next Page Exchange:
Part A: mr_np_loaded

1. Not Applicable

Part B: Proper Next Page exchange

2. Perform steps 6 & 7 to ensure the DUT will go through a proper Next Page exchange.

Observable Results:

a) The DUT should not enter the NEXT PAGE WAIT state until mr_next_page_loaded is set to true.
b) The DUT should enter the NEXT PAGE WAIT state and engage in a valid Next Page exchange.

Possible Problems: If the DUT does not support a Next Page exchange, then this test cannot be performed.

Test #28.2.2: Next Page Exchange Restart

Purpose: To verify that the device under test enters the TRANSMIT DISABLE state from the NEXT PAGE WAIT state if flp_receive_idle becomes true.

References:

[2] IEEE Std 802.3, 2000 Edition: Sections 28.3.1, 28.3.4 Figure 28-16

Resource Requirements:

- Line Monitor: A system capable of detecting, time-stamping, and recording normal link pulses (NLPs) on both the receive and transmit channels of the DUT. The channel signaling should pass through the line monitor with minimal distortion.
- Traffic Generator: A system capable of generating and transmitting normal link pulses (NLPs) and fast link pulses (FLPs) while connected to the receiver of the DUT.

Last Modification: April 12, 2001

Discussion: Once the Next Page exchange process has begun, if a device's link partner, for some reason, stops sending Next Pages, the device should cease transmission as well. When in the NEXT PAGE WAIT state, if a device detects flp_receive_idle=true, then it should immediately transition to the TRANSMIT DISABLE state. This test is designed to verify that the device under test exits the Next Page exchange process if flp_receive_idle becomes true.

Test Setup: Using a Cat 5 cord, connect the DUT's transmitter to the Line Monitor. Terminate the DUT's transmit channel with a 100Ω line termination. Using a Cat 5 cord, connect the DUT's receiver to the Traffic Generator using a 100Ω line termination.

Procedure:

DUT is an unmanaged PHY and the tester controls the Next Page exchange:

1. Establish a connection (not a link) to the DUT.
2. Use the Traffic Generator to send the DUT enough FLPs to put it through the COMPLETE ACKNOWLEDGE state (see test #28.2.2, Clause 28 Auto-Negotiation State Machine Base Page Exchange Test Suite).
3. Write any value (typically 2001h) to Register 7 to cause the DUT to enter the NEXT PAGE WAIT state.
4. While the DUT is in NEXT PAGE WAIT, send a Message Page with the NP bit set to 1 and proper Toggle bit value, then cease transmission of Next Pages.
5. Verify that the DUT enters the TRANSMIT DISABLE state.

DUT has a management entity controlling Next Page exchange:

1. Perform steps 1 - 5 described in the previous section, omitting step 3.

Observable Results:

- After the expiration of nlp_test_max_timer, the device should enter the TRANSMIT DISABLE state and cease transmission of Next Pages.

Possible Problems: If the DUT does not support a Next Page exchange, then this test cannot be performed.

Test #28.2.3: Next Page Consistency Match

Purpose: To verify that the device under test performs a consistency match test on received Next Pages.

References:

[1] IEEE Std 802.3, 2000 Edition: Section 28.3.1, 28.3.4 Figure 28-16

Resource Requirements:

- Line Monitor: A system capable of detecting, time-stamping, and recording normal link pulses (NLPs) on both the receive and transmit channels of the DUT. The channel signaling should pass through the line monitor with minimal distortion.
- Traffic Generator: A system capable of generating and transmitting normal link pulses (NLPs) and fast link pulses (FLPs) while connected to the receiver of the DUT.

Last Modification: January 31, 2001

Discussion: This test is virtually identical to test #28.2.3 in the Clause 28 Auto-Negotiation State Machine Base Page Exchange test suite, but is repeated here to verify that the consistency match test is carried through to the Next Page exchange process and is performed on Next Pages. See test #28.2.3 for full details.

Test Setup: Using Cat 5 cords, connect the DUT and the Traffic Generator to the Line Monitor such that the traffic generator's signaling will be seen by the DUT's receiver. Terminate the DUT's transmit channel with a 100Ω line termination.

Procedure:

DUT is an unmanaged PHY and the tester controls the Next Page exchange:

1. Establish a connection (not a link) to the DUT.
2. Use the Traffic Generator to send the DUT enough FLPs to get it through the COMPLETE ACKNOWLEDGE state (see test #28.2.2, Clause 28 Auto-Negotiation State Machine Base Page Exchange Test Suite).
3. Write any value (typically 2001h) to Register 7 to cause the DUT to enter the NEXT PAGE WAIT state.
4. While the DUT is in NEXT PAGE WAIT, send a series of Message Pages - first some with the Acknowledge bit not set (enough to put the DUT into the ACKNOWLEDGE DETECT state) followed by 3 with the Acknowledge bit set to logic one and bit D10 holding the opposite value as the initial 4 Message Pages, all with proper toggle bit values. For example, send 4 Message Pages encoded with A801h, followed by 3 Message Pages encoded with EC01h.
5. Monitor the transmit line coming from the DUT.

DUT has a management entity controlling Next Page exchange:

1. Perform steps 1 – 5 described in the previous section, omitting step 3.

Observable Results:

- The DUT should cease transmitting Next Pages immediately once the inconsistent Message Pages are received.

Possible Problems: If the DUT does not support a Next Page exchange, then this test cannot be performed.

Test #28.2.4: Reception of Toggle Bit

Purpose: To verify that the device under test checks the value of the Toggle Bit when transitioning from NEXT PAGE WAIT to ACKNOWLEDGE DETECT to see if the received Next Pages correctly alternate the value of the Toggle Bit.

References:

[1] IEEE Std 802.3, 2000 Edition: Sections 28.2.1.2, 28.2.3.4, 28.2.3.4.1, 28.2.3.4.6

Resource Requirements:

- Line Monitor: A system capable of detecting, time-stamping, and recording normal link pulses (NLPs) on both the receive and transmit channels of the DUT. The channel signaling should pass through the line monitor with minimal distortion.
- Traffic Generator: A system capable of generating and transmitting normal link pulses (NLPs) and fast link pulses (FLPs) while connected to the receiver of the DUT.

Last Modification: January 31, 2001

Discussion: During Next Page exchange, the Toggle bit (bit D11) of the received Next Pages serves a simple purpose. The value of this bit alternates between 0 and 1 in consecutive pages, and therefore provides the receiving station with a quick and easy check to verify that it is receiving Next Pages in the proper order. If a device receives consecutive pages without the Toggle bit toggled, it should sit in the NEXT PAGE WAIT state until it receives a Next Page with the proper Toggle bit value. This test is designed to verify that the device under test makes sure that its received Next Pages are toggled properly.

Test Setup: Using Cat 5 cords, connect the DUT and the Traffic Generator to the Line Monitor such that the traffic generator's signaling will be seen by the DUT's receiver. Terminate the DUT's transmit channel with a 100Ω line termination.

Procedure:

DUT is an unmanaged PHY and the tester controls the Next Page Exchange:

1. Establish a connection (not a link) to the DUT.
2. Use the Traffic Generator to send enough FLPs to put the DUT through the COMPLETE ACKNOWLEDGE state (see test #28.2.2, Clause 28 Auto-Negotiation State Machine Base Page Exchange Test Suite).
3. Write any value (typically 2001h) to register 7 to cause the DUT to enter the NEXT PAGE WAIT state.
4. While the DUT is in NEXT PAGE WAIT, send 3 Next Pages with the following modification: reverse the values of the Toggle bit of the last 2 pages (by doing this, you end up with toggle values of either 0 0 1 or 1 1 0 for the last 3 pages). For example, send a Message Page encoded with 2801h, a first Null Message Page encoded with 2801h, and a second Null Message Page encoded with 2001h.
5. Monitor the transmission from the DUT.

DUT has a management entity controlling Next Page exchange:

1. Perform steps 1 and 2 described in the previous section.
2. While the DUT is in NEXT PAGE WAIT, send enough Next Pages to allow it to send all of its Message and Unformatted Pages with the following modification: reverse the values of the Toggle bit of the last 2 pages (by doing this, you end up with toggle values of either 0 0 1 or 1 1 0 for the last 3 pages).
3. Monitor the transmission from the DUT.

Observable Results:

- The DUT should not leave the NEXT PAGE WAIT state on reception of the second to last page, but should accept the last page and conclude the Next Page exchange

Possible Problems: If the DUT does not support a Next Page exchange, then this test cannot be performed.

Test #28.2.5: Reception of rx_link_code_word[NP]=0

Purpose: To verify that the DUT will properly complete a Next Page exchange when rx_link_code_cord[NP]=0 while tx_link_code_word[NP]=0 in the ACKNOWLEDGE DETECT state.

References:

[1] IEEE Std 802.3, 2000 Edition: Sections 28.3.1, 28.3.4, Figure 28-16

Resource Requirements:

- Line Monitor: A system capable of detecting, time-stamping, and recording normal link pulses (NLPs) on both the receive and transmit channels of the DUT. The channel signaling should pass through the line monitor with minimal distortion.
- Traffic Generator: A system capable of generating and transmitting normal link pulses (NLPs) and fast link pulses (FLPs) while connected to the receiver of the DUT.

Last Modification: June 18, 2001

Discussion: When a device has finished transmitting Next Pages, and its link partner still has more Next Pages to send, the device should set its Next Page bit to zero and transmit Null Message Pages. Once the device receives the last Next Page from its link partner, which will have the Next Page bit set to zero, the two devices can exit COMPLETE ACKNOWLEDGE and enter FLP LINK GOOD CHECK. It is possible that a device that has its Next Page bit set to zero, while in COMPLETE ACKNOWLEDGE, will begin to receive a page from its link partner with the Next Page bit also set to zero. Once the device has sent its remaining abilities with the acknowledge bit set, ack_finished=true, tx_link_code_word[NP]=0, and rx_link_code_word[NP]=0. This could possibly cause a premature transition to FLP LINK GOOD CHECK. The link partner would still have its last Next Page to send, and the device would have ended the Next Page exchange to attempt to establish a link. A device should not act on reception of rx_link_code_word[NP]=0 until the NEXT PAGE WAIT state has been entered. Only if a page received here has the Next Page bit set to zero should the DUT then transition to FLP LINK GOOD CHECK after exiting COMPLETE ACKNOWLEDGE.

Test Setup: Using Cat 5 cords, connect the DUT and the Traffic Generator to the Line Monitor such that the traffic generator's signaling will be seen by the DUT's receiver. Terminate the DUT's transmit channel with a 100Ω line termination.

Procedure:

DUT is an unmanaged PHY and the tester controls the Next Page exchange:

1. Establish a connection (not a link) to the DUT.
2. Use the Traffic Generator to send enough FLPs to put the DUT through the COMPLETE ACKNOWLEDGE state (see test #28.2.2, Clause 28 Auto-Negotiation State Machine Base Page Exchange Test Suite).
3. Write any value (typically 2001h) to register 7 to cause the DUT to enter the NEXT PAGE WAIT state.

4. While the DUT is in NEXT PAGE WAIT, send enough Next Pages, all with proper Toggle values, to put it through the COMPLETE ACKNOWLEDGE state.
5. Write any value to Register 7 with the Next Page bit set to zero to cause the DUT to enter the NEXT PAGE WAIT state.
6. Send a Null Message Page with the Next Page bit set to one enough times to put the DUT in COMPLETE ACKNOWLEDGE.
7. Before the DUT exits COMPLETE ACKNOWLEDGE, send the DUT a Null Message Page with the Next Page bit set to zero.
8. Observe transmissions from the DUT.

DUT has a management entity controlling Next Page Exchange:

1. Perform steps 1 and 2 described in the previous section.
2. Send a series of FLPs to the DUT such that the DUT proceeds to transmit all of its Next Pages, and sets its Next Page bit to zero.
3. Send a Null Message page with the Next Page bit set to one enough times to put the DUT in COMPLETE ACKNOWLEDGE.
4. Before the DUT exits COMPLETE ACKNOWLEDGE, send the DUT a Null Message Page with the Next Page bit set to zero.
5. Observe transmissions from the DUT.

Observable Results:

- The DUT should not enter FLP LINK GOOD CHECK.

Possible Problems: If the DUT does not support a Next Page exchange, then this test cannot be performed.

Test #28.2.6: Priority Resolution Function

Purpose: To verify that the device under test properly configures the highest common denominator (HCD) technology for the transmitted technologies in a link code word after a Next Page exchange has occurred.

References:

[1] IEEE Std 802.3, 2000 Edition: Section 28.2.3.3, Annex 28.B.2, 28B.3

Resource Requirements:

- Line Monitor: A system capable of detecting, time-stamping, and recording normal link pulses (NLPs) on both the receive and transmit channels of the DUT. The channel signaling should pass through the line monitor with minimal distortion.
- NLP Generator: A system capable of generating and transmitting normal link pulses (NLPs) and fast link pulses (FLPs) while connected to the receiver of the DUT.

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Discussion: Next Page transmission ends when both a device and its link partner set their Next Page bits to logic zero, indicating that neither has anything additional to transmit. Once the Next Page Exchange has completed, the technology at which communication is to be established that was exchanged during the initial Base Page exchange must be resolved. Through the priority resolution function, the highest common denominator (HCD) technology should be found. This test is designed to verify that the device under test resolves the proper HCD for all possible technology combinations.

Test Setup: Using Cat 5 cords, connect the DUT and the NLP Generator to the Line Monitor such that the Traffic Generator's signaling will be seen by the DUT's receiver. Terminate the DUT's transmit channel with a 100Ω line termination.

Procedure:

DUT is an unmanaged PHY and tester controls Next Page Exchange:

1. Establish a connection (not a link) to the DUT.
2. Use the Traffic Generator to send enough FLPs advertising a set of abilities to put the DUT through the COMPLETE ACKNOWLEDGE state (see test #28.2.2, Clause 28 Auto-Negotiation State Machine Base Page Exchange Test Suite).
3. Write any value with NP=0 to Register 7 to cause the DUT to enter the NEXT PAGE WAIT state.
4. While the DUT is in NEXT PAGE WAIT, send enough Null Message Pages, all with proper Toggle values, to put it through the COMPLETE ACKNOWLEDGE state.
5. Verify that the DUT establishes the HCD link whenever possible, and refuses a link otherwise.
6. Repeat steps 1 – 6 for all possible combinations of the first five bits of the technology ability field.

DUT has a management entity controlling Next Page Exchange:

1. Perform steps 1 – 6 described in the previous section, omitting step 3.

Observable Results:

- In every case, the DUT should resolve the highest priority possible based on the priority resolution function for the technologies advertised

Possible Problems: If the DUT does not support a Next Page exchange, then this test cannot be performed.