

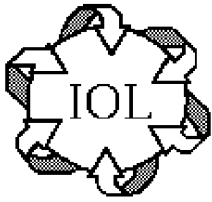
Superseded



As of June 30th, 1997 the Ethernet Consortium Clause # 28 Auto Negotiation State Machine Base Page Exchange Conformance Test Suite version 2.0 has been superseded by the release of the Auto Negotiation State Machine Base Page Exchange Conformance Test Suite version 3.01. 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Please refer to the following site for both current and superseded test suites: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 Consortium Auto-Negotiation Test Suite

Revision 2.0

InterOperability Lab - 220 Morse Hall - Durham, NH - 03824 - (603) 862-1834

Consortium Manager: Barry Reinhold bbr@iol.unh.edu
Suite Technicians: Bob Noseworthy ren@iol.unh.edu
Ben Verschueren btv@iol.unh.edu

UTest Group 1: FLP Burst Transmission

Test #1.28: Separation of FLP Bursts	3
Test #2.28: Internal Separation of FLP Bursts	4
Test #3.28: Number of Pulses in a Burst	5
Test #4.28: NLP Compliance.....	6
Test #5.28: Transmitted Link Code Word (Base Page) Encoding	7

Test Group 2: FLP Burst Reception

Test #6.28: Acknowledge Bit	8
Test #7.28: Refusal of Incomplete FLPs.....	10
Test #8.28: Acceptance of Long FLPs.....	11
Test #9.28: Next Page and Remote Fault Bits	12
Test #10.28: Selector Field Reserved Combinations.....	13
Test #11.28: Technology Ability Field Reserved Bits	14
Test #12.28: Range of NLP Timer.....	15
Test #13.28: Identification of Link Partner as Auto-Negotiation Able	16
Test #14.28: Range of FLP Pulse Timer.....	17
Test #15.28: Range of Data Detect Timer	18
Test #16.28: Consistency Match.....	19
Test #17.28: Range of Break Link Timer	20
Test #18.28: Range of Link Fail Inhibit Timer.....	21
Test #19.28: Range of Auto-Negotiation Wait Timer	22

Test Group 3: Establishing a Link

Test #20.28: Complete Acknowledge.....	23
Test #21.28: Parallel Detection of 10Base-T Devices	25
Test #22.28: Parallel Detection of 100Base-TX Devices	26
Test #23.28: Parallel Detection of 100Base-T4 Devices	27
Test #24.28: Priority Resolution Function.....	28
Test #25.28: Failed Link for HCD.....	29

Test Group 4: Next Page Functionality

Test #26.28: Transmitted Next Pages	30
Test #27.28: Next Page Consistency Match	31
Test #28.28: Null Message Page.....	32
Test #29.28: Next Page Bit	33
Test #30.28: Toggle Bit	34
Test #31.28: Message and Unformatted Pages	35
Test #32.28: Reception of Next Pages	36
Test #33.28: Transmit Disable.....	36
Appendix A: Test Equipment	38

Test Group 1: FLP Burst Transmission

Test #1.28: Separation of FLP Bursts

Purpose: To verify proper separation of consecutive FLP bursts.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.1.4.1, 28.2.1.1, 28.2.1.1.2

Resource Requirements:

- Line Monitor

Last Modification: August 19, 1996

Discussion: A station capable of auto-negotiation must transmit fast link pulse (FLP) bursts. Not only is the content and composition of these bursts important, but also the timing of the bursts. This test is designed to verify that the timing of the device under test's consecutive FLP bursts fall within the specified range.

Test Setup: Set up the devices as shown. Using Category 5 UTP cable, connect the DUT to a 100 Ω line termination. Connect the Line Monitor's first channel to the DUT's receive pair and second channel to the DUT's transmit pair with differential high impedance taps.

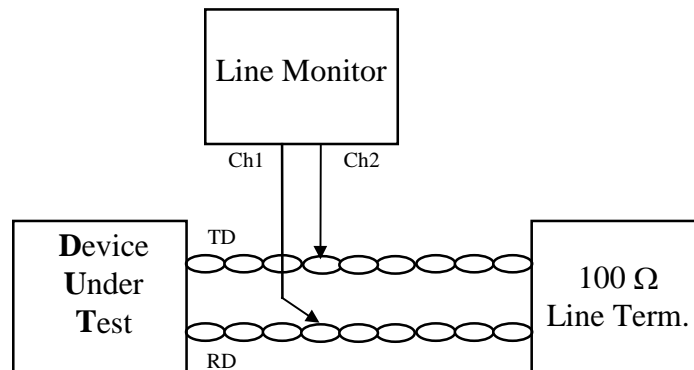


Figure 1.28-1: Test Configuration

Procedure:

1. The DUT is configured to send FLP bursts
2. Monitor the transmitted bursts
3. The separation of each burst is measured

Observable Results:

- The separation of FLP bursts should be 16 ± 8 ms

Test #2.28: Internal Separation of FLP Bursts

Purpose: To verify that the device under test transmits FLPs with valid pulse separation.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.1.4.1, 28.2.1.1, 28.2.1.1.2

Resource Requirements:

- Line Monitor

Last Modification: August 19, 1996

Discussion: To ensure that the content of an FLP burst is interpreted accurately, the individual pulses that make up the burst must be analyzed. This test is designed to verify that the device under test sends FLP bursts whose clock and data pulses are spaced properly.

Test Setup: See Figure 1.28-1

Procedure:

1. The DUT is configured to send FLP bursts
2. Monitor the transmitted bursts
3. The spacing between clock pulses (starting with the first pulse and then every odd pulse after that) is measured
4. The spacing between clock and data pulses is measured

Observable Results:

- The spacing between clock pulses should be $125 \pm 14 \mu\text{s}$
- The spacing between clock and data pulses should be $62.5 \pm 7 \mu\text{s}$

Test #3.28: Number of Pulses in a Burst

Purpose: To verify that the device under test transmits the correct number of pulses in an FLP burst.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Section 28.2.1.1.1

Resource Requirements:

- Line Monitor

Last Modification: August 19, 1996

Discussion: In order for an FLP burst to be considered valid, it must contain a certain number of pulses, namely 17 clock pulses and up to 16 data pulses. This test is designed to verify that the device under test sends FLP bursts with a valid number of pulses.

Test Setup: See Figure 1.28-1

Procedure:

1. The DUT is configured to send FLP bursts
2. Monitor the transmitted bursts
3. The number of pulses present in the burst is measured

Observable Results:

- The number of pulses in a burst should be 17-33 (inclusive)

Test #4.28: NLP Compliance

Purpose: To verify the device under test's link pulse waveforms meet specification.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.1.4.1, 28.2.1.1, 28.4
- ANSI/IEEE Std 802.3, 1993 Edition: Section 14.3.1.2.1, Figure 14-12

Resource Requirements:

- Oscilloscope
- Differential Voltage Probes
- TP Test Card

Last Modification: August 19, 1996

Discussion: All link pulses need to conform to the transmitter waveform specifications for Link Test Pulses defined in IEEE 802.3 Figure 14-12, including those contained in an FLP burst. This test is designed to verify that the device under test produces link pulses within specification.

Test Setup: Set up the devices as shown. Using Category 5 UTP cable, connect the DUT to the TP Test Card. Connect the Oscilloscope to the TP Test Card using Differential Voltage Probes.

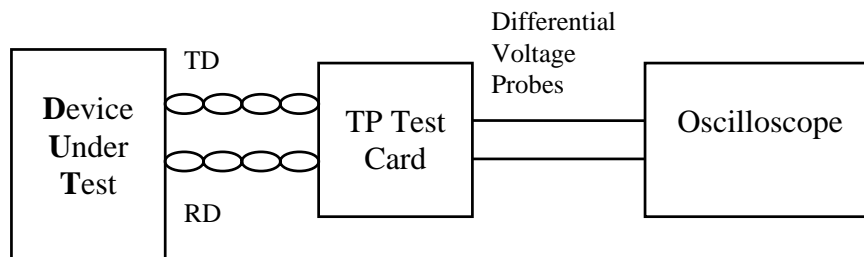


Figure 4.28-1: Test Configuration

Procedure:

1. The DUT is configured to send FLP bursts
2. Monitor the transmitted bursts
3. Observe the link pulse waveforms across each test load defined in fig. 14-11
4. Repeat procedure with loads connected through the TPM

Observable Results:

- Under each test setup, the FLP's link pulses should fit within the NLP template defined in Figure 14-12.
- After the differential output voltage drops below -50 mV, it shall remain below +50 mV.

Test #5.28: Transmitted Link Code Word (Base Page) Encoding

Purpose: To verify that the device under test transmits an acceptable selector field combination, advertises the correct abilities in the technology ability field, and transmits proper initial values for the remote fault, acknowledge, and next page bits.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.1.2, 28.2.1.2.1, 28.2.1.2.2, 28.2.1.2.3, 28.2.1.2.4, 28.2.1.2.5, Annex 28A, 28B, 28B.1, 28B.2

Resource Requirements:

- Line Monitor

Last Modification: January 3, 1997

Discussion: This test is designed to verify that the device under test transmits Link Code words with acceptable content. There are defined selector field combinations that a station is permitted to transmit in its link code word. The technology ability field of the link code word advertises a station's abilities. The final three bits in the link code word (Remote Fault bit, Acknowledge bit, Next Page bit) should all have a proper initial setting. The default value for the RF bit on a non-faulting link is zero. The Ack bit should be initially zero. The NP bit should be one if it supports Next Page exchange and zero if it doesn't or does not wish to implement a NP exchange. In this test, it is confirmed that the device under test transmits a link code word with the selector field combination corresponding to IEEE 802.3, advertises the data service abilities that it supports in its technology ability field, and has the RF, Ack, and NP bits set correctly.

Test Setup: See Figure 1.28-1

Procedure:

1. The DUT is configured to send FLP bursts
2. Monitor the transmitted bursts
3. The contents of the selector field (first five data bits), technology ability field (D[5:12]), and of the Remote Fault bit, Acknowledge bit, and Next Page bit are acquired

Observable Results:

- The selector field combination should correspond to S[4:0]=00001 as defined in table 28-9
- The technology ability field should advertise the correct abilities when referenced to table 28-10
- The DUT should not advertise any abilities that it does not possess
- The value of the Remote Fault bit should be zero
- The value of the Acknowledge bit should be zero
- The value of the Next Page bit should be one if it supports Next Page exchange and zero if it doesn't or does not wish to implement a NP exchange

Test Group 2: FLP Burst Reception

Test #6.28: Acknowledge Bit

Purpose: To verify that the device under test enters the Acknowledge Detect state upon reception of complete, consecutive and consistent FLP bursts, ignoring the value of the Acknowledge bit.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.1.2, 28.1.4.2, 28.2.1.2.4

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 16, 1997

Discussion: Once an auto-negotiation identifies its link partner as auto-negotiation able, it will enter the Acknowledge Detect state only after it receives at least 3 complete, consecutive and consistent link code words from its link partner, ignoring the Acknowledge bit. Once the Acknowledge Detect state is entered, the station should send out FLP bursts containing its link code word with the Acknowledge bit (the fifteenth data pulse) set to logic one. This test is designed to verify that the device under test will set the Acknowledge bit after the reception of 3 or more complete, consecutive and consistent link code words.

Test Setup: Set up the devices as shown. Using Category 5 UTP cable, connect the DUT's transmit pair to a 100 Ω line termination, and the receive pair to a traffic generator. Connect the Line Monitor's first channel to the DUT's receive pair and second channel to the DUT's transmit pair with differential high impedance taps.

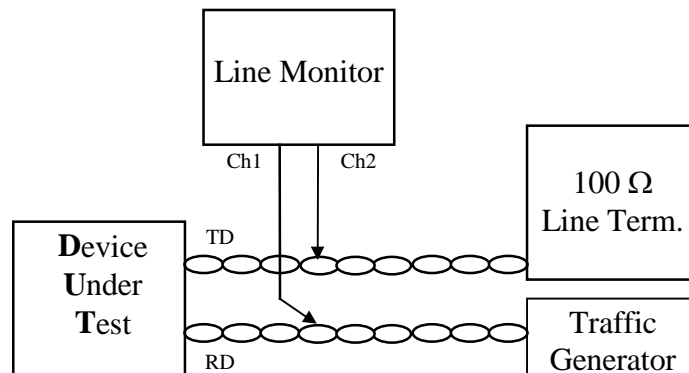


Figure 6.28-1: Test Configuration

Procedure:*Part A:*

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to send a series of 3 FLPs
3. Monitor the FLPs sent back by the DUT and determine whether the Acknowledge bit is set
4. If it was not set, repeat the procedure with an increasing number of FLPs until the bit is set
5. Repeat steps 1-3 sending the number of FLPs that was determined to put the DUT into the Acknowledge Detect state, all with the Acknowledge bit set to a logic one
6. Repeat using FLPs that have Acknowledge bits that alternate between 1 and 0

Part B:

7. Establish a connection (not a link) to the DUT
8. Use the Traffic Generator to send enough FLPs, alternating between valid FLPs containing different advertised abilities, such that the number of FLPs would be enough to put the station into the Acknowledge Detect state
9. Monitor the FLPs sent back by the DUT and determine whether the Acknowledge bit is set

Observable Results:*Part A:*

- The Acknowledge bit should be set after the reception of at least 4 complete and matching FLPs, regardless of the value of the Acknowledge bit
- Record the number of FLPs required to put the DUT into the Acknowledge Detect state for use in later tests

Part B:

- The DUT should not enter the Acknowledge Detect state

Test #7.28: Refusal of Incomplete FLPs

Purpose: To verify that the device under test does not accept incomplete FLP bursts.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.2, 28.2.2.1, Figure 28-15 Receive State Diagram

Resource Requirements:

- Traffic Generator
- Line Monitor

Last Modification: August 19, 1996

Discussion: A complete FLP burst is composed of 17 to 33 pulses. This test is designed to verify that a station will not accept an incomplete FLP burst, as specified in the 802.3u standard. Also, the station should not establish a link based solely on carrier sense.

Test Setup: See Figure 6.28-1

Procedure:

Part A:

1. Establish a connection (not a link) to the DUT
2. Verify that the DUT does not establish a link based on carrier sense
3. Use a Traffic Generator to send the DUT enough incomplete FLPs consisting of only 15 pulses to put the DUT into the Acknowledge Detect state (see test #6.28)
4. Observe whether the DUT entered the Acknowledge Detect state

Part B:

5. Establish a connection (not a link) to the DUT
6. Use a Traffic Generator to send the DUT a series of the following 2 FLPs alternating at 16 ms apart:
 - a 17 pulse FLP containing the following data: 1 1 0 0 0 1 1 1 1 1 with no clock pulse after the final 1
 - an 8 pulse FLP containing the following data: 0 0 0 0 1 0 with a final clock pulse
7. Observe whether the DUT entered the Acknowledge Detect state

Observable Results:

- The DUT should not enter the Acknowledge Detect state in either case

Test #8.28: Acceptance of Long FLPs

Purpose: To verify that the device under test properly accepts FLPs that have more than 33 pulses by ignoring all but the first 16 data bits.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.2, 28.2.2.1, 28.3.3 (Rx_bit_cnt), Figure 28-15 Receive State Diagram

Resource Requirements:

- Traffic Generator
- Line Monitor

Last Modification: August 19, 1996

Discussion: An FLP burst normally consists of 17 to 33 pulses, with normally 16 data bits. However, if a device receives an FLP with more than 33 pulses, it should still accept the burst. The first 16 data bits should be kept and any additional should be ignored. This test is designed to determine whether the Device Under Test properly accepts FLPs with more than 16 data bits.

Test Setup: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT.
2. Use a Traffic Generator to send enough valid FLPs with 5 extra pulses (3 clock pulses and 2 data pulses) attached to the end to put the DUT into the Acknowledge Detect state (see Test #6.28).
3. Observe whether the DUT enters the Acknowledge Detect state.

Observable Results:

- The DUT should enter the Acknowledge Detect state

Test #9.28: Next Page and Remote Fault Bits

Purpose: To verify that the device under test can handle the reception of an FLP from a next page capable device as well as the reception of a flagged remote fault bit.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.1.2, 28.2.1.2.3, 28.2.1.2.5, 28.2.3.4, 28.2.3.5

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 16, 1997

Discussion: When a station is connected to a next page able device, it will receive FLP bursts with set next page bits (the final bit of the link code words set to logic one). Regardless of whether the receiving station is next page able or not, it should still accept the link code word as valid. When connected to any station, it is possible for a device to receive a logic one in the Remote Fault (RF) bit position (bit D13) of the link code word. The only defined behavior for a device to take in this event is that it should set the remote fault bit in the MII status register. Other than that, there is no specification as to what action a device should take upon reception of a remote fault. This test is designed to verify that the device under test is capable of receiving a flagged next page and/or remote fault bit.

Test Setup: See Figure 6.28-1

Procedure:

Part A:

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to send enough FLPs with the next page bit set to a logic one to put it into the Acknowledge Detect state (see test #6.28)
3. Verify that the DUT enters the Acknowledge Detect state

Part B:

4. Repeat with FLPs with the remote fault bit set to a logic one

Observable Results:

- In Part A, the DUT should enter the Acknowledge Detect state
- In Part B, the DUT should set the remote fault bit in its MII status register, and any other behavior is unpredictable

Test #10.28: Selector Field Reserved Combinations

Purpose: To verify that the device under test accepts FLPs with the selector field set to a reserved combination.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.1.2, 28.2.1.2.1, Annex 28A, 28B, 28B.1

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: July 23, 1996

Discussion: There are combinations for the selector field that are reserved by the IEEE. A station never supposed to transmit these combinations, but there are no specifications as to the combinations that can be received. Therefore, as long as complete and consistent link code words are received, a station should accept them as valid regardless of the selector field combination. This test is designed to verify that the device under test will accept a link code word with the selector field set to a reserved combination.

Test Setup: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to send enough FLPs with the selector field combination of 0,0,1,1,1 (ordered bit S0 to S4) to put it into the Acknowledge Detect state (see test #6.28)
3. Verify that the DUT enters the Acknowledge Detect state

Observable Results:

- The DUT should enter the Acknowledge Detect state

Test #11.28: Technology Ability Field Reserved Bits

Purpose: To verify that the device under test accepts FLPs with the reserved bits of the technology ability field set to logic one.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.1.2, 28.2.1.2.2, 28.2.3.3, Annex 28B.2

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: July 23, 1996

Discussion: The last three bits of the technology ability field of a link code word are reserved by the IEEE. A station is supposed to transmit these bits as logic zero, but is supposed to be able to receive these bits set to a one without a problem. This test is designed to verify that the device under test will accept a link code word with the last three bits (the reserved bits) of the technology ability field set to logic one.

Test Setup: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to send enough FLPs with the fifth, sixth, and seventh bits of the technology ability field set to logic one to put it into the Acknowledge Detect state (see test #6.28)
3. Verify that the DUT enters the Acknowledge Detect state

Observable Results:

- The DUT should enter the Acknowledge Detect state

Test #12.28: Range of NLP Timer

Purpose: To verify that the device under test accepts FLP bursts with proper spacing, and refuses those with spacing outside of the acceptable range.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.2.1, 28.3.2

Resource Requirements

- Traffic Generator
- Line Monitor

Last Modification: August 19, 1996

Discussion: As well as characteristic requirements, FLP bursts have requirements for the delay between consecutive bursts. In order to be accepted as valid, received FLP bursts must have a delay between them between “nlp_test_min_timer” and “nlp_test_max_timer.” The value for “nlp_test_min_timer” must be between 5 and 7 ms. The value for “nlp_test_max_timer” must be between 50 and 150 ms. This test is to verify that the device under test accepts FLP bursts with spacing within these ranges, and refuses FLP bursts with spacing outside of these ranges.

Test Setup: See Figure 6.28-1

Procedure:

Part A: Bursts Within Acceptable Range

1. Establish a connection (not a link) to the DUT
2. Use a Traffic Generator to send the DUT enough FLP bursts spaced at 7.1 ms apart to put it into the Acknowledge Detect state (see test #6.28)
3. Observe whether the DUT entered the Acknowledge Detect state
4. Repeat using FLPs spaced at 49.9 ms

Part B: Bursts Outside Acceptable Range

5. Repeat using FLPs spaced at 4.9 ms
6. Repeat using FLPs spaced at 150.1 ms

Observable Results:

- In both cases of Part A, the DUT should enter the Acknowledge Detect state
- In both cases of Part B, the DUT should not enter the Acknowledge Detect state

Test #13.28: Identification of Link Partner as Auto-Negotiation Able

Purpose: To verify that the device under test is able to recognize its link partner as capable of auto-negotiation within specification.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Section 28.2.2.1

Resource Requirements:

- Traffic Generator

Last Modification: January 5, 1997

Discussion: When establishing a link, a station is required to recognize its link partner as auto-negotiation able within a certain range of pulses in an FLP burst. This test is designed to verify that the device under test adheres to this range.

Test Setup: See Figure 6.28-1.

Procedure:

1. Establish a connection (not a link) to the DUT
2. Use a Traffic Generator to send the DUT 6 pulses spaced at 50 μ s, wait 16ms, then send enough valid FLP bursts to put the DUT into the Acknowledge Detect state. The proper number of FLP bursts should be one less than the value determined in #6.28 as that value includes the FLP required to identify a device as auto-negotiation able.
3. Determine whether the DUT has entered the Acknowledge Detect state
4. If the DUT did not enter the Acknowledge Detect state, repeat steps 1 through 3 increasing the number of initial pulses until the DUT enters the Acknowledge Detect state

Observable Results:

- The DUT should recognize the Link Partner as auto-negotiation able within 6 to 17 (inclusive) pulses

Test #14.28: Range of FLP Pulse Timer

Purpose: To verify that the device under test determines that its link partner is auto-negotiation able upon receiving pulses spaced within flp_test_min_timer and flp_test_max_timer, and does not recognize a device as auto-negotiation able upon receiving pulses spaced outside the acceptable range.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.2.1, 28.3.2, Figure 28-15 Receive State Diagram

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 5, 1997

Discussion: As well as characteristic requirements, FLP bursts have requirements for the delay between consecutive pulses within the burst. In order to be accepted as valid, received pulses must have a delay between them between “flp_test_min_timer” and “flp_test_max_timer.” The value for “flp_test_min_timer” must be between 5 and 25 μ s. The value for “flp_test_max_timer” must be between 165 and 185 μ s. This test is to verify that the device under test accepts FLP bursts with pulses spaced within these ranges, and refuses FLPs with pulses spaced outside of these ranges.

Test Setup: See Figure 6.28-1

Procedure:

Part A: Pulses Within Acceptable Range

1. Establish a connection (not a link) to the DUT
2. Use a Traffic Generator to send the DUT enough pulses spaced at 25.1 μ s to identify the link partner as auto-negotiation able (refer to #13.28), wait 16ms, then send enough valid FLP bursts to put the DUT into the Acknowledge Detect state. The proper number of FLP bursts should be one less than the value determined in #6.28 as that value includes the FLP required to identify a device as auto-negotiation able.
3. Observe whether the DUT entered the Acknowledge Detect state
4. Repeat using FLPs with pulses spaced at 164.9 μ s

Part B: Pulses Outside Acceptable Range

5. Repeat using FLPs with pulses spaced at 4.9 μ s
6. Repeat using FLPs with pulses spaced at 185.1 μ s

Observable Results:

- In both cases of Part A, the DUT should enter the Acknowledge Detect state
- In both cases of Part B, the DUT should not enter the Acknowledge Detect state

Test #15.28: Range of Data Detect Timer

Purpose: To verify that the device under test accepts data pulses with proper spacing and refuses data pulses with spacing outside the acceptable range.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.2.1, 28.3.2, Figure 28-15 Receive state diagram

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 15, 1997

Discussion: As well as characteristic requirements, FLP bursts have requirements for the delay between clock and data pulses within the burst. In order to be accepted as valid, received data pulses must have a delay between them and the previous clock pulse between “data_detect_min_timer” and “data_detect_max_timer.” The value for “data_detect_min_timer” must be between 15 and 47 μs . The value for “data_detect_max_timer” must be between 78 and 100 μs . This test is designed to verify that the device under test accepts FLP bursts with data pulses spaced within these ranges, and refuses FLPs with data pulses spaced outside of these ranges. As defined in Figure 28-15, if an FLP containing the data pattern 1,0 is sent with the data 1 transmitted a time exceeding 100 μs following the clock pulse, then the data_detect_max_timer should be violated. In a conformant device, this should result in the interpretation of the data pattern as 0,1. Thus, by alternating the transmission of this test FLP with FLPs containing typical spacing, a conformant device should not enter the Acknowledge Detect state. This technique is used to test the validity of data_detect_max_timer.

Test Setup: See Figure 6.28-1

Procedure:

Part A: Data Pulses Within Acceptable Range

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to send the DUT enough FLPs, alternating between FLPs with the data pulses spaced 47.1 μs from the clock pulses and FLPs with perfect spacing, to put it into the Acknowledge Detect state (see test #6.28)
3. Observe whether the DUT entered the Acknowledge Detect state
4. Repeat using FLPs with the data pulses spaced 77.9 μs from the clock pulses

Part B: Data Pulses Outside Acceptable Range

5. Repeat using FLPs with the data pulses spaced 100.1 μs from the clock pulses
6. Repeat using FLPs with the data pulses spaced 14.9 μs from the clock pulses

Observable Results:

- In both cases of Part A, the DUT should enter the Acknowledge Detect state
- In both cases of Part B, the DUT should not enter the Acknowledge Detect state

Test #16.28: Consistency Match

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

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Section 28.3.1

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 2, 1997

Discussion: Upon entering the Acknowledge Detect state of the auto-negotiation process, a device must receive 3 consecutive and consistent FLPs from its link partner before it can proceed. However, these FLPs must not only be consistent amongst themselves, but also with the FLPs that the device received to put it into the Acknowledge Detect state. To ensure this, a station must perform a consistency match test. If a consistency mismatch occurs, the device should enter the Transmit Disable state and cease sending FLPs. This test is designed to verify that the device under test checks to be sure that the FLPs received in the Acknowledge Detect state are consistent (ignoring the Acknowledge bit) with the FLPs that it received to get it there.

Test Setup: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to send a series of FLPs- first some with the Acknowledge bit not set (enough to put the DUT into the Acknowledge Detect state- refer to results of test #6.28) followed by 3 with the Acknowledge bit set to logic one and bit D10 holding the opposite value as the initial 4 FLPs
3. Monitor the transmit line coming from the DUT

Observable Results:

- The DUT should cease transmitting FLPs immediately once the inconsistent FLPs are received

Test #17.28: Range of Break Link Timer

Purpose: To verify that the device under test recognizes a broken link and restarts the auto-negotiation process within the acceptable range.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Section 28.2.3.2, 28.3

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 3, 1997

Discussion: Once a device has entered the Transmit Disable state, it must wait a specified amount of time before it restarts the auto-negotiation process. This time is defined by the device's "break_link_timer," and is required to be between 1200 and 1500 ms. This test is designed to verify that the device under test restarts the auto-negotiation process after entering the Transmit Disable state within this range.

Test Setup: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to send the same series of FLP bursts as in test #16.28 to put the DUT into the Transmit Disable state
3. Verify that the DUT starts a renegotiation
4. Measure the amount of time between when the station entered the Transmit Disable and when the first FLP of the renegotiation process was transmitted, and this will be the value of break_link_timer

Observable Results:

- The DUT's break_link_timer should be in the range 1200 to 1500 ms

Test #18.28: Range of Link Fail Inhibit Timer

Purpose: To verify that the device under test will wait a specified amount of time between when it parallel detects a link partner and when it establishes that link.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Section 28.2.3.2, 28.3

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 3, 1997

Discussion: Once a device has entered the FLP LINK GOOD CHECK state, it must receive a link_status=OK message from its link partner within a specified amount of time. If this message is not received, it will enter the Transmit Disable state and wait for the duration of its break_link_timer before starting a renegotiation. This time is defined by the device's "link_fail_inhibit_timer," and is required to be between 750 and 1000 ms. This test is designed to verify that the device under test enters the Transmit Disable state from the FLP LINK GOOD CHECK state when a link_status=OK message is not received from its link partner in the acceptable range of time.

Test Setup: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to put the device into the COMPLETE ACKNOWLEDGE state (see test #20.28)
3. Verify that the DUT starts a renegotiation
4. Measure the amount of time between when the station transmitted it's final FLP after entering the COMPLETE ACKNOWLEDGE state (see results of test #20.28) and when the first FLP of the renegotiation process was transmitted, and this will be the value of break_link_timer + link_fail_inhibit_timer
5. Subtract the value of break_link_timer (see results of test #17.28) from this value to acquire the value of link_fail_inhibit_timer

Observable Results:

- The DUT's link_fail_inhibit_timer should be in the range 750 to 1000 ms

Test #19.28: Range of Auto-Negotiation Wait Timer

Purpose: To verify that the implemented value of `autoneg_wait_timer` is within the specified range of 500 to 1000ms.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Section 28.3.2, Figure 28-16 Arbitration state diagram

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 5, 1997

Discussion: In order for an auto-negotiation able device to properly parallel detect a link partner, it must receive a valid `single_link_ready=true` signal from its link partner for a period of time before it negotiates to that link. This time is defined by the device's "autoneg_wait_timer," and is specified to be between 500 and 1000 ms. This test is designed to verify that the device under test does not parallel detect to a link before waiting a time within this range. This approach does introduce an error into the measurement, however. In order to find the point where `autoneg_wait_timer` is started, the point where the device ceased transmission of FLPs must be found. This point could fall between the transmission of two consecutive FLPs, in which case there is no way to find the exact point. Therefore, an error is introduced with a maximum value equal to the gap between two transmitted FLPs (see test #1.28).

Test Setup: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT
2. Send the station valid NLPs with valid spacing
3. Monitor the DUT's transmit line
4. Verify that the DUT establishes a 10Base-T link
5. Measure the time between when the DUT ceased transmission of FLPs and when the DUT began transmitting NLPs. This is the value of `autoneg_wait_timer`

Observable Results:

- The DUT's `autoneg_wait_timer` should be in the range of 500 to 1000 ms

Test Group 3: Establishing a Link

Test #20.28: Complete Acknowledge

Purpose: To verify that the device under test enters the Complete Acknowledge state only after receiving 3 consecutive and consistent FLPs with the Acknowledge bit set, and then sends out a valid number of link code words after the Complete Acknowledge state has been entered.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Section 28.2.1.2.4

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 16, 1997

Discussion: Well into the auto-negotiation process is the Complete Acknowledge state. A station reaches this state after first entering the Acknowledge Detect state (which is done when at least 3 complete, consecutive and consistent FLP bursts are received, ignoring the Acknowledge bit- see Test #6.28), and then receiving 3 complete, consecutive and consistent FLPs with the Acknowledge bit set. Once the Complete Acknowledge state has been entered, a station should send out 6 to 8 (inclusive) more FLPs containing its link code word and with the Acknowledge bit set to 1. This test is designed to verify that the device under test sends out 6 to 8 (inclusive) FLPs after entering the Complete Acknowledge state, and requires the reception of 3 consecutive and consistent FLPs with the Acknowledge bit set before doing so.

Test Setup: See Figure 6.28-1

Procedure:

Part A:

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to send a series of FLPs- first some with the Acknowledge bit not set (enough to put the DUT into the Acknowledge Detect state- refer to results of test #6.28) followed by 3 with the Acknowledge bit set to logic one, to put the DUT into the COMPLETE ACKNOWLEDGE state
3. Monitor the transmit line coming from the DUT and count the number of FLPs sent by the DUT after the COMPLETE ACKNOWLEDGE state has been entered

Part B:

4. Repeat steps 1-2 above, but send FLPs whose Acknowledge bits alternate between 0 and 1
5. Monitor the transmit line coming from the DUT and count the number of FLPs sent by the DUT with the Acknowledge bit set to 1

Observable Results:

Part A:

- After the COMPLETE ACKNOWLEDGE state has been entered, the DUT should send out 6 to 8 (inclusive) FLPs containing its Link Code Word

Part B:

- The DUT should never enter the COMPLETE ACKNOWLEDGE state, and should send out far more FLPs with the Acknowledge bit set to one than it did in Part A

Test #21.28: Parallel Detection of 10Base-T Devices

Purpose: To verify that the device under test can detect that its link partner is a fixed speed 10Base-T device.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.2.2, 28.2.3.1, 28.4
- ANSI/IEEE Std 802.3, 1993 Edition: Section 14.3.1.2.1

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: July 23, 1996

Discussion: A station capable of auto-negotiation should be capable of detecting a 10Base-T device as its link partner solely on the receipt of 10Base-T normal link pulses (NLPs). This should occur before the detection of FLP bursts. When a 10Base-T device is detected, the station should either enable its 10Base-T PMA and establish a link if supported, or simply not allow a link to be established if not supported. Also, the station should be able to accept worst-case NLPs, that have one of the following characteristics (these are achieved using the setup shown in Figure 17.28-1:

1. As in Figure 14-12 in IEEE 802.3: with a peak amplitude of 585 mV, a pulse width of 0.60 BT, and a maximum undershoot.
2. As in Figure 14-12 in IEEE 802.3: with maximum allowed amplitude and pulse width.

Test Setup: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT
2. Use the Test Station to send the DUT a series of NLPs spaces at 16 ms apart
3. If the DUT has a 10Base-T PMA, verify that it is enabled by determining whether a link is established
4. Send the DUT a packet and see if it is accepted
5. If the DUT has no 10Base-T PMA, verify that no link is established
6. Repeat using each worst case NLP

Observable Results:

- If the DUT supports a 10Base-T PMA, a link should be established in each case. If not, a link should be refused.

Test #22.28: Parallel Detection of 100Base-TX Devices

Purpose: To verify that the device under test can properly parallel detect a fixed speed 100Base-TX link partner.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Section 28.2.3.1

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: July 23, 1996

Discussion: A station capable of auto-negotiation should also implement the parallel detection function. This provides for the detection of a 100Base-TX fixed speed device before the detection of FLPs. In this case, a station should either enable its 100Base-TX PMA if supported and establish a link, or otherwise not allow a link to be established. This test is designed to verify that the device under test properly handles the presence of a fixed speed 100Base-TX device as a link partner.

Test Setup: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to simulate the presence of a non-auto-negotiating 100Base-TX device
3. If the DUT has a 100Base-TX PMA, verify that it is enabled by determining whether a link is established
4. Send the DUT a packet and see if it is accepted
5. If the DUT has no 100Base-TX PMA, verify that no link is established

Observable Results:

- If the DUT supports a 100Base-TX PMA, a link should be established. If not, a link should be refused.

Test #23.28: Parallel Detection of 100Base-T4 Devices

Purpose: To verify that the device under test can properly parallel detect a fixed speed 100Base-T4 link partner.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Section 28.2.3.1

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: July 23, 1996

Discussion: A station capable of auto-negotiation should also implement the parallel detection function. This provides for the detection of a 100Base-T4 fixed speed device before the detection of FLPs. In this case, a station should either enable its 100Base-T4 PMA if supported and establish a link, or otherwise not allow a link to be established. This test is designed to verify that the device under test properly handles the presence of a fixed speed 100Base-T4 device as a link partner.

Test Setup: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to simulate the presence of a non-auto-negotiating 100Base-T4 device
3. If the DUT has a 100Base-T4 PMA, verify that it is enabled by determining whether a link is established
4. Send the DUT a packet and see if it is accepted
5. If the DUT has no 100Base-T4 PMA, verify that no link is established

Observable Results:

- If the DUT supports a 100Base-T4 PMA, a link should be established. If not, a link should be refused.

Test #24.28: 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.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.3.3, Annex 28B.2, 28B.3

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: July 23, 1996

Discussion: Once a station has received its link partner's link code word and completed the exchange of FLP bursts, the technology at which communication is to be established 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: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to send a series of FLP bursts that advertise a set of abilities
3. Verify that the DUT establishes a link when it can, and refuses a link otherwise
4. Verify that the DUT resolved the highest common technology by sending a packet to the DUT in that format and determining whether it was received
5. Verify that full duplex was resolved whenever possible
6. Repeat this procedure for all possible combinations of the first five bits of the technology ability field

Observable Results:

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

Test #25.28: Failed Link for HCD

Purpose: To verify that the device under test starts a renegotiation upon the reception of a link_status=FAIL from the resolved highest common denominator (HCD) technology.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Section 28.2.3.2

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: July 23, 1996

Discussion: Once the highest common denominator (HCD) technology has been determined through the parallel detection function, if a station receives a link_status=FAIL message from that priority, it should cause a renegotiation. This test is designed to verify that the device under test does start a renegotiation upon the receipt of a link_status=FAIL message from the HCD technology.

Test Setup: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to send a series of FLP bursts that advertise a set of abilities
3. Verify the DUT resolves the HCD priority and establishes a link
4. Send the DUT a link_status=FAIL for the HCD priority
5. Verify that the DUT starts a renegotiation

Observable Results:

- The DUT should start a renegotiation upon reception of the link_status=FAIL message

Test Group 4: Next Page Functionality

Test #26.28: Transmitted Next Pages

Purpose: To verify that the device under test transmits next pages with valid characteristics after completion of link code word transmission.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.1.4.1, 28.2.1.1, 28.2.1.1.1, 28.2.1.1.2, 28.4
- ANSI/IEEE Std 802.3, 1993 Edition: Section 14.3.1.2.1, Figure 14-3

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 13, 1997

Discussion: After completing the exchange of link code words, if two stations both advertise next page functionality, they are required to send out at least one next page. All next pages are required to meet the same timing and electrical specifications as all other FLPs. This test is designed to verify that a device advertising next page functionality sends out at least one next page and that its next pages have the same timing and electrical characteristics as its other FLPs.

Test Setup: See Figure 6.28-1

Procedure:

1. Establish a connection (not a link) to the DUT
2. Use the Traffic Generator to send the DUT a series of FLPs with the next page bit set to a logic one to put it through the Complete Acknowledge state (see test #20.28)
3. Send the DUT a sequence of next pages containing the null message code, consisting of first the number required with the Ack bit set to zero to put the DUT into the Acknowledge Detect state (see test #6.28), followed by 9 with the Ack bit set to one to get the DUT through the Complete Acknowledge state and into the NEXT PAGE WAIT state
4. Verify that the DUT transmits a next page after completion of the Complete Acknowledge state (see test #20.28)
5. Capture a single next page and verify that it meets the requirements of tests #1.28, #2.28, #3.28 and #4.28

Observable Results:

- The device should transmit at least one next page after completion of the Complete Acknowledge state
- The next pages should meet the requirements of tests #1.28, #2.28, #3.28 and #4.28

Test #27.28: Next Page Consistency Match

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

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Section 28.3.1

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 14, 1997

Discussion: This test is virtually identical to test #16.28, 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 #16.28 for full details.

Test Setup: See Figure 6.28-1

Procedure:

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 #20.28)
3. Send a series of message pages- first some with the Acknowledge bit not set (enough to put the DUT into the Acknowledge Detect state- refer to results of test #6.28) followed by 3 with the Acknowledge bit set to logic one and bit D10 holding the opposite value as the initial 4 message pages
4. Monitor the transmit line coming from the DUT

Observable Results:

- The DUT should cease transmitting next pages immediately once the inconsistent message pages are received

Test #28.28: Null Message Page

Purpose: To verify that the device under test transmits proper null pages if it completes sending message and unformatted pages before its link partner.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 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
- Traffic Generator

Last Modification: January 13, 1997

Discussion: Once a device has finished sending message and unformatted next pages, it is required to send null pages until its link partner is done as well. A null page is defined as a message page that contains the null message code 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 pages until its link partner is done as well.

Test Setup: See Figure 6.28-1

Procedure:

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 #20.28)
3. Send the DUT two more next pages (not null pages) than message or unformatted codes that it has to transmit (for example, if a station has two next pages to transmit before beginning to transmit null pages, send it four next pages)
4. Monitor the next pages transmitted by the DUT
5. Verify that the last two next pages sent by the DUT contained the null message code
6. Verify that no previous next pages transmitted by the DUT contained the null message code

Observable Results:

- The DUT's last two next pages should contain the null message code
- No previous next pages should contain the null message code
- The NP bit in the null message should be set to 0

Test #29.28: 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:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 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
- Traffic Generator

Last Modification: January 13, 1997

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. All null pages should have this bit set to 0 (see results of test #28.28). 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 a device's partner finishes transmitting message or unformatted pages before the device and is sending out null 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 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 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: See Figure 6.28-1

Procedure:

Part A:

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 #20.28)
3. Send the DUT two less next pages than message or unformatted pages that it has to transmit, followed by two null pages (for example, if a device has three next pages to transmit, send it one next page followed by two null pages)
4. Monitor the next pages transmitted by the DUT
5. Verify that the DUT concludes its next page exchange

Part B:

6. Repeat steps 1 through 5 with the following modification to step 3: send the DUT the same number of next pages that it has message and unformatted pages to transmit (for example, if a device has three next pages to transmit, send it three next pages) with the NP bit of the last page set to 0

Observable Results:

- The DUT should set the NP bit to 0 for the last message or unformatted page that it sends
- For all next pages preceding the last page, the NP bit should be set to 1
- In both cases, the DUT should conclude the next page exchange

Test #30.28: Toggle Bit

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, and checks to see if its received next pages follow this pattern.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.1.2, 28.2.3.4, 28.2.3.4.1, 28.2.3.4.6

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 14, 1997

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. 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 sets the toggle bit properly throughout the exchange of next pages, and makes sure that its received next pages are toggled properly as well.

Test Setup: See Figure 6.28-1

Procedure:

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 #20.28)
3. Send the DUT 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)
4. Monitor the transmitted next pages
5. Verify that the DUT sets the toggle bit properly in all of its 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)
- 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

Test #31.28: Message and Unformatted Pages

Purpose: To verify that the device under test transmits properly formatted message and unformatted pages.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.1.2, 28.2.3.4, 28.2.3.4.1, 28.2.3.4.4, 28.2.3.4.7, 28.2.3.4.8, 28.2.3.4.9, 28.2.3.4.10, 28.2.3.4.11, Annex 28C (all parts)

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 14, 1997

Discussion: There are two types of pages that a device may send as next pages: message or unformatted pages. Each type of page has its own formatting. Message pages contain an 11-bit message code field that can contain only a few defined encodings. Unformatted pages contain an 11-bit wide unformatted code field whose encoding is arbitrary. There is also an MP bit, which is required to be set to 1 if the page is a message page, and 0 if it is an unformatted page. If the selector fields in the device's and its link partner's link code words do not match, then every series of unformatted pages must be preceded by a message page that specifies how they should be interpreted. Otherwise, the device is permitted to transmit unformatted pages whenever it desires (this is not a behavior that is expected, but could conceivably occur). This test is designed to verify that the DUT's message pages contain an acceptable message code followed by the appropriate number of unformatted pages (see Annex 28 for the message codes and appropriate number of unformatted pages), and all pages have the MP bit set correctly.

Test Setup: See Figure 6.28-1

Procedure:

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, followed by enough null pages to allow the DUT to transmit all of its next pages
3. Monitor the next pages transmitted by the DUT
4. Verify that the message code field in each message page is valid
5. Verify that the correct number of unformatted pages is sent after each message page
6. Verify that the MP bit is set correctly in all next pages

Observable Results:

- The message pages (including null pages) should contain a message code (bits D[0-10]) with a defined value from Annex 28C
- All message pages should be followed by the number of unformatted pages required by its message code field (see Annex 28C)
- The MP bit should be set to 1 in all message pages and 0 in all unformatted pages

Test #32.28: Reception of Next Pages

Purpose: To verify that the device under test properly receives message and unformatted pages, for both existing message codes as well as reserved.

References:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.2.1.2, 28.2.3.4, 28.2.3.4.1, 28.2.3.4.4, 28.2.3.4.7, 28.2.3.4.8, 28.2.3.4.9, 28.2.3.4.10, 28.2.3.4.11, Annex 28C

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 14, 1997

Discussion: A device supporting next page exchange should be capable of receiving a wide variety of next pages from its link partner. It should properly accept all sequences of message pages and unformatted pages that are attainable from the defined message code fields in Annex 28C. However, it should also be capable of receiving message and unformatted page combinations not yet defined by simply ignoring them. If defined and undefined combinations are mixed, the device should be able to recognize all of the message codes that are defined and ignore those that are not. Presently, there is no way of confirming whether a device ignores or accepts a next page, unless it drops link or reports an error on the reception of an undefined page, so this test is difficult to perform.

Test Setup: See Figure 6.28-1

Procedure:

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
3. Send the device the following sequence of next pages:
 - An unformatted page
 - The first 3 defined (not including the null message code) message and unformatted page sequences defined in Annex 28C
 - A message page containing an undefined encoding for the message code field followed by 3 unformatted pages
 - The other 3 defined sequences
 - If the link partner has not finished transmission of message and unformatted pages, transmit the appropriate number of null pages
4. Monitor the next pages transmitted by the DUT
5. Verify that the DUT concludes its next page exchange

Observable Results:

- The DUT should accept all defined combinations
- The DUT should ignore the first unformatted page as well as the undefined combination
- The DUT should conclude its exchange of next pages

Test #33.28: Transmit Disable

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:

- ANSI/IEEE Std 802.3u/D5 March 23, 1995 Edition: Sections 28.3.1, Figure 28-16 Arbitration State Diagram

Resource Requirements:

- Line Monitor
- Traffic Generator

Last Modification: January 14, 1997

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: See Figure 6.28-1

Procedure:

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 #20.28)
3. Send the DUT a message page with the NP bit set to 1 (going through the Complete Acknowledge state), then cease transmission of next pages
4. Verify that the DUT enters the TRANSMIT DISABLE state

Observable Results:

- After the expiration of nlp_max_timer, the device should enter the TRANSMIT DISABLE state and cease transmission of next pages

Appendix A: Test Equipment

Traffic Generator

An arbitrary waveform generator (AWG) which matches the specifications in IEEE Std 1802.3d-1993 Section 6.3.4.4 with the exception that the sample resolution shall be 4 ns/point

BAL

100 Ω to 50 Ω balun impedance adapter as defined in IEEE Std 1802.3d-1993 Section 6.3.3.3

Oscilloscope

A digitizing signal analyzer which matches the specifications for an oscilloscope as defined in IEEE Std 1802.3d-1993 Section 6.3.4.8

Differential Voltage Probe

Meets specifications defined in IEEE Std 1802.3d-1993 Section 6.3.4.9

TP Test Card

A testing card with an RJ-45 interface containing the following options:

- Cross over at the input
- Cable termination with 100 Ω load, Test Load 1, or Test Load 2 (as defined in IEEE 802.3 Section 14.3.1.2.1 and Figure 14-11)
- Unshielded twisted pair model (as defined in IEEE Std 802.3 Section 14.3.1.2)
- Link test pulse generator

Line Monitor

A device capable of recording and time stamping the pulses that make up transmitted FLPs