Fast Ethernet

Clause 27
Repeater Test Suite
Version 1.2

Technical Document

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MODIFICATION RECORD

- 13 September 2004, Version 1.2 Released.
  Gerard Nadeau: Released version 1.2 of the Test Suite. Formatting changes, and an edit to the procedure in test 27.5.5.
- Date Unknown, Version 1.1 Released
  Adam Healey: Released initial version of the Repeater Test Suite.

ACKNOWLEDGMENTS

The University of New Hampshire would like to acknowledge the efforts of the following individuals in the development of this test suite.

Adam Healey	University of New Hampshire
Gerard Nadeau	University of New Hampshire
Bob Noseworthy	University of New Hampshire
Peter Scruton	University of New Hampshire

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 27 Repeater based products. The tests do not determine if a product conforms to the IEEE Std 802.3™-2002:, nor are they purely interoperability tests. Rather, they provide one method to isolate problems within a Repeater device. Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other 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 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 by similar functions and further organized by technology. 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 specific items that can be examined by the tester to verify that the DUT is operating properly. When multiple values are possible for an observable result, 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 result.

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

TABLE OF CONTENTS

GROUP 1: Data Handling Functions

Scope: The following tests cover Repeater operations specific to data handling functions

Overview: These tests are designed to verify that the device under test properly handles data frames, handles code violations and speed. The Repeater functions explored are defined in Clause 27 of IEEE Std 802.3™-2002.

Test #27.1.1 – Data Frame Forwarding

Purpose: To verify that the repeater set properly forwards data frames

References: IEEE Std 802.3™-2002: subclause 27.3.1.2.1, figures 27-2 and 27-4

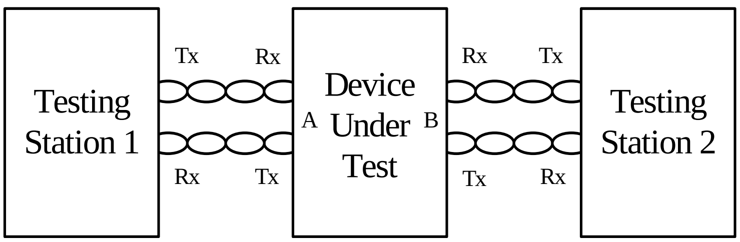
Resource Requirements:

- Two testing stations capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: July 12, 1995

Test Setup:

Using category 5 UTP cable, connect testing station 1 to port A and testing station 2 to port B of the repeater under test.



Procedure:

1. Command testing station 1 to send a properly encapsulated, 64-byte, valid MAC frame. Testing station 1 will monitor transmit activity from port A. Testing station 2 will monitor transmit activity from port B.

Observable results:

a. Verify that the MAC frame sent by testing station 1 is reproduced on the transmitter of port B.
b. Verify that the transmitter of port A sources only /I/ code groups.

Existing Problems: None.

Test #27.1.2 – Received Code Violation Handling

Purpose: To verify that the repeater set properly forwards invalid code groups.

References: IEEE Std 802.3™-2002: subclause 27.3.1.2.2, figure 27-6, table 24-1.

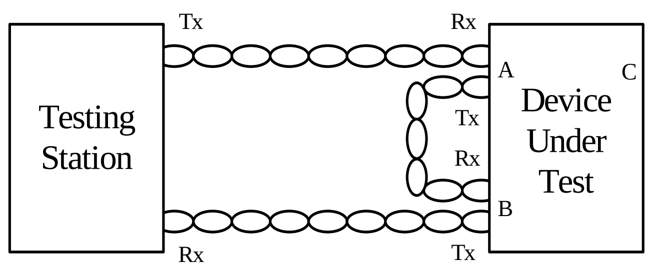
Resource Requirements:

- A testing station capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25. The testing station must capable of transmitting invalid code groups.

Last Modification: July 12, 1995

Test Setup:

Connect the transmitter of the testing station to the receiver of port A and the transmitter of port B to the receiver of the testing station. Connect the transmitter of port A to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Command the testing station to send a valid preamble (defined as the physical layer stream /J/K/A/A/A/A/A/A/A/A/A/A/A/A/A/B/) followed by 64 code group pairs. This stream will contain at least one invalid code group. The invalid code group will not be the last code group sent. The testing station will observe transmit activity from port B.

Observable results:

a. Verify that:
   1. The repeater forwards the invalid code group and all subsequent code groups, unaltered, to all other attached ports, or...
   2. The repeater substitutes the /H/ code group for the violation code group and all subsequent code groups.

Existing Problems: None.

Test #27.1.3 – Speed Handling

Purpose: To verify that the repeater blocks the flow of non-100Mbps signals.

References: IEEE Std 802.3™-2002: subclause 27.3.1.5.2.

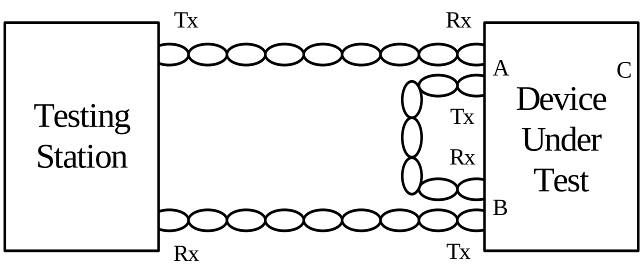
Resource Requirements:

- A testing station capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25. The testing station must be capable of generating arbitrarily long bit streams. The testing station must be capable of generating 10Mbps data streams using the signaling method described in section 14 of IEEE Standard 802.3.

Last Modification: July 20, 1995

Test Setup:

Connect the transmitter of the testing station to the receiver of port A and the transmitter of port B to the receiver of the testing station. Connect the transmitter of port A to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Command the testing station to apply a 10Mbps Manchester encoded, 64-byte, valid MAC frame to port A of the repeater under test. The testing station will monitor transmit activity on port B.

Observable results:

a. Verify that the repeater under test blocks the flow of the 10Mbps signal.

Existing Problems: This test does not apply to those repeaters that incorporate both 10Mbps and 100Mbps repeater functionality.

GROUP 2: Propagation Delays

Scope: The following tests cover Repeater operations specific to propagation delays.

Overview: These tests are designed to verify that the device under test does not induce delays in excess of those defined. The Repeater functions explored are defined in Clause 27 of IEEE Std 802.3™-2002.

Test #27.2.1 – Start of Packet Propagation Delay

Purpose: To measure the start of packet propagation delay for the repeater set.

References: IEEE Std 802.3™-2002: subclause 24.6, subclause 27.3.1.3.3, table 27-2, annex 27A

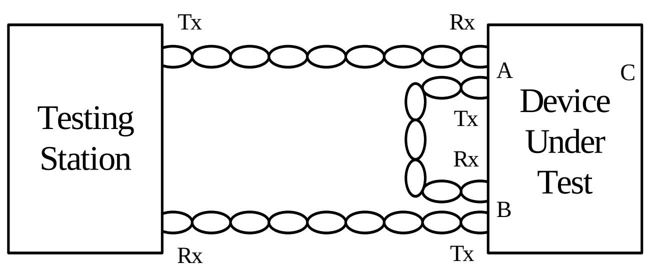
Resource Requirements:

- A testing station capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25. The testing station must be able to time-stamp transmitted (received) streams.

Last Modification: July 12, 1995

Test Setup:

Connect the transmitter of the testing station to the receiver of port x and the transmitter of port y to the receiver of the testing station. Connect the transmitter of port x to the receiver of port y to ensure that link_status(y)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Connect the testing station and the device under test so that x=A and y=B. Command the testing station to send a properly encapsulated, 64-byte, valid MAC frame. Let $t = t_0$ represent the 50% point of the mid-cell transition corresponding to the leading bit of the /J/ code group arriving at port x. Let $t = t_1$ represent the 50% point of the mid-cell transition corresponding to the leading bit of the /J/ code group appearing on port y. The time difference $t_1 - t_0$ is SOP(AB).
2. Connect the testing station and the device under test so that x=B and y=C. Repeat step 1. This time difference is SOP(BC).
3. Connect the testing station and the device under test so that x=A and y=C. Repeat step 1. This time difference is SOP(AC).

Observable results:

a. Verify that SOP(xy), in conjunction with the results from test #6.27, meets the constraint shown below.

Repeater Class	I	II (all ports FX/TX)
SOP+SOJ Constraint	SOP + SOJ ≤ 140BT	SOP ≤ 46BT SOJ ≤ 46 BT

b. Verify that SOP(AC) < SOP(AB) + SOP(BC).

Existing Problems: The value of SOP(xy) measured by the testing station is inaccurate due to cable propagation delays and the testing station's internal propagation delay. If t_{PDS} is the total propagation delay through the testing station and t_{PDC} is the total cable propagation delay, then:

$$SOP(xy) = t_1 - (t_0 + t_{PDS} + t_{PDC})$$

Accuracy can be improved if the t_{PDS} is known (and consistent) and all cable lengths are kept short (t_{PDC} is approximately zero).

Test #27.2.2 – Start of Packet Propagation Delay Variability

Purpose: To measure the start of packet propagation delay variability for the repeater set.

References: IEEE Std 802.3™-2002: subclause 27.3.1.3.4, table 27-1.

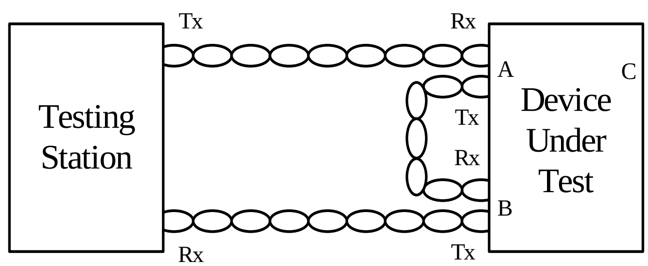
Resource Requirements:

- A testing station capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25. The testing station must be able to time-stamp transmitted (received) streams.

Last Modification: July 12, 1995

Test Setup:

Connect the transmitter of the testing station to the receiver of port A and the transmitter of port B to the receiver of the testing station. Connect the transmitter of port A to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Command the testing station to send consecutive, properly encapsulated valid MAC frames spaced by 96BT for class I repeaters and 89BT for class II repeaters. The MAC frame length should alternate between 1,518 and 64 bytes, the first packet sent being 1,518 bytes long. The difference in SOP(AB) for successive packets is the start of packet propagation delay variability.

Observable results:

a. Verify that SOP(AB) does not vary by more than 7BT for successive packets.

Existing Problems: The accuracy of the measured start of packet propagation delay variability is dependent on the accuracy of the measured SOP(AB).

Test #27.2.3 – Collision-Jam Propagation Delay

Purpose: To measure the collision-jam propagation delay for the repeater set.

References: IEEE Std 802.3™-2002: subclause 27.3.1.4.3, table 27-2, figures 27-2 and 27-4.

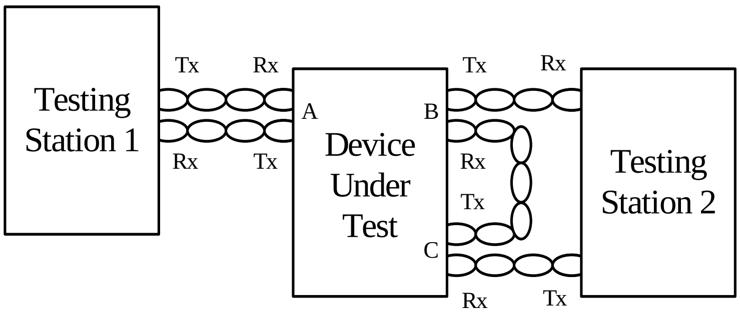
Resource Requirements:

- Two testing stations capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: July 12, 1995

Test Setup:

Connect testing station 1 to port A. Connect the transmitter of the testing station 2 to the receiver of port C and the transmitter of port B to the receiver of the testing station 2. Connect the transmitter of port C to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Command testing station 1 to send a properly encapsulated, 64-byte, valid MAC frame. The loopback connection between ports B and C will cause the repeater under test to set command(ALL)=collision. Testing station 2 will monitor transmit activity from port B. Let $t = t_0$ represent the 50% point of the mid-cell transition corresponding to the leading bit of the /J/ code group arriving at port B (appearing on port C). Let $t = t_1$ represent the 50% point of the mid-cell transition corresponding to the first bit of Jam sourced by port B. The time difference $t_1 - t_0$ is SOJ(AB).

Observable results:

a. Verify that Jam message (JamX or any other well formed arbitrary data pattern) is sourced on all ports SOJ(AB) bit times after the appearance of the first bit of the /J/ code group on ports B and C.
b. Verify that SOJ(AB), in conjunction with the results from test #4.27, meets the constraint shown below.

Repeater Class	**I**	**II (all ports FX/TX)**
SOP+SOJ Constraint	SOP + SOJ ≤ 140BT	SOP ≤ 46BT SOJ ≤ 46 BT

Existing Problems: If SOP(AB) does not equal SOP(AC), the measured value of SOJ(AB) will be inaccurate. Also, all cable propagation delays are assumed to be zero. These inaccuracies can be minimized if any difference between SOP(AB) and SOP(AC) is known (and consistent) and all cable lengths are kept short.

Note that, depending on the contents of the Jam message (and the bit sequence preceding Jam), SOJ(AB) may be difficult to determine.

Test #27.2.4 – Cessation of Jam Propagation Delay

Purpose: To measure the cessation of collision jam propagation delay for the repeater set.

References: IEEE Std 802.3™-2002: subclause 27.3.1.4.4, figures 27-2 and 27-4, annex 27A

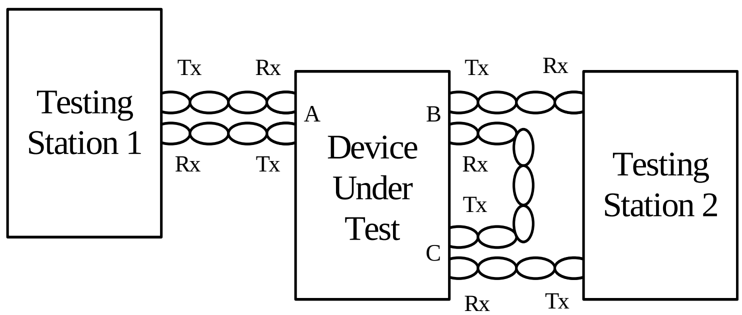
Resource Requirements:

- Two testing stations capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: November 20, 1997

Test Setup:

Connect testing station 1 to port A. Connect the transmitter of the testing station 2 to the receiver of port C and the transmitter of port B to the receiver of the testing station 2. Connect the transmitter of port C to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Command the testing station to send a properly encapsulated, 64-byte, valid MAC frame. The loopback connection between ports B and C will cause the repeater under test to set command(ALL)=collision. Let L_1 be the number of bit times from the first bit of the /J/ code group to the first bit of idle pattern arriving at port A. Let L_2 be the number of bit times from the first bit of the /J/ code group to last bit of Jam appearing on port B. EOJ(AB) = SOP(AB) + L_2 - L_1.

Observable results:

a. Verify that the Jam message (JamX or any other well formed arbitrary data pattern) is sourced on all ports SOJ(AB) bit times after the appearance of the first bit of the /J/ code group on ports B and C.
b. Verify that SOP(AB) ≥ EOJ(AB) and that EOJ(AB) ≥ SOJ(AB) - 4BT.

Existing Problems: The accuracy of the measured EOJ(AB) is dependent on the accuracy of the measured SOP(AB).

GROUP 3:Receive Jabber Function

Scope: The following tests cover Repeater operations specific to receive jabber function.

Overview: These tests are designed to verify that the device under test properly handles jabber events. The Repeater functions explored are defined in Clause 27 of IEEE Std 802.3™-2002.

Test #27.3.1 – Jabber Timer

Purpose: To measure the value of jabber_timer for the repeater port.

References: IEEE Std 802.3™-2002: subclause 27.3.1.7, 27.3.2.1.4, figure 27-7.

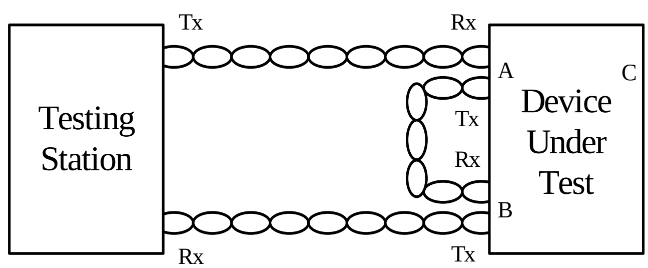
Resource Requirements:

- A testing station capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25. The testing station must be capable of generating arbitrarily long bit streams.

Last Modification: July 12, 1995

Test Setup:

Connect the transmitter of the testing station to the receiver of port A and the transmitter of port B to the receiver of the testing station. Connect the transmitter of port A to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Command the testing station to send a valid preamble (defined as the physical layer stream /J/K/A/A/A/A/A/A/A/A/A/A/A/A/A/B/) followed by 10,000 code group pairs. Let $t = t_0$ represent the 50% point of the mid-cell transition corresponding to leading bit of the /K/ code group appearing on port A. Let $t = t_1$ represent the 50% point of the mid-cell transition corresponding to the last bit of data sourced by port B. The time difference $t_1 - t_0$ is jabber_timer

Observable results:

a. Verify that the output of the DUT transitions from repeated data to idle pattern (the end of shell delimiter is optional) once jabber_timer expires.
b. Verify that jabber_timer is in the range of 40,000BT to 75,000BT.

Existing Problems: None.

Test #27.3.2 – Receive Jabber Function

Purpose: To verify the conditions for a jabber(X)=false to jabber(X)=true transition, to observe the effects of jabber(X)=true, and to verify the conditions for a jabber(X)=false to jabber(X)=true transition.

References: IEEE Std 802.3™-2002: subclauses 27.3.1.7, 27.3.2.1.2, 27.3.2.1.4, figure 27-7.

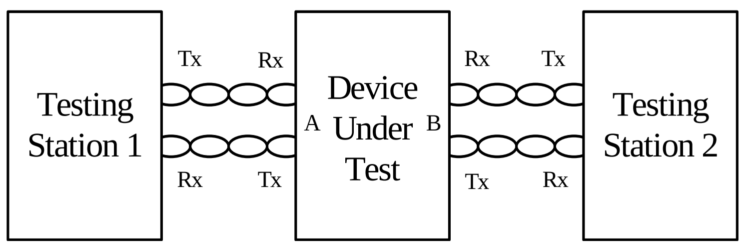
Resource Requirements:

- Two testing stations capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25. At least one testing station must be capable of generating arbitrarily long bit streams.

Last Modification: July 12, 1995

Test Setup:

Using category 5 UTP cable, connect testing station 1 to port A and testing station 2 to port C of the repeater under test.



Procedure:

1. Command the testing station to send a valid preamble (defined as the physical layer stream /J/K/A/A/A/A/A/A/A/A/A/A/A/A/A/B/) followed by a continuous code group sequence. This will set and hold jabber(A)=true. Command testing station 2 to send a properly encapsulated, 64-byte, valid MAC frame. Testing station 1 will monitor transmit activity from port A.
2. Command testing station 1 to transition from continuous data generation to idle pattern generation. This will reset and hold jabber(A)=false. Command testing station 2 to send a properly encapsulated, 64-byte, valid MAC frame. Testing station 1 will monitor transmit activity from port A.

Observable results:

a. Verify that packets are not forwarded to port A when link_status(A)=OK and jabber(A)=true.
b. Verify that packets are forwarded to port A when link_status(A)=OK and jabber(A)=false.

Existing Problems: None.

GROUP 4: Partition Function

Scope: The following tests cover Repeater operations specific to partition functions.

Overview: These tests are designed to verify that the device under test properly implements timers and counters related to partition functions.. The Repeater functions explored are defined in Clause 27 of IEEE Std 802.3™-2002.

Test #27.4.1 - CCLimit

Purpose: To measure the value of CCLimit for the repeater set.

References: IEEE Std 802.3™-2002: subclause 27.3.1.6, subclause 27.3.2.1.1, figure 27-8.

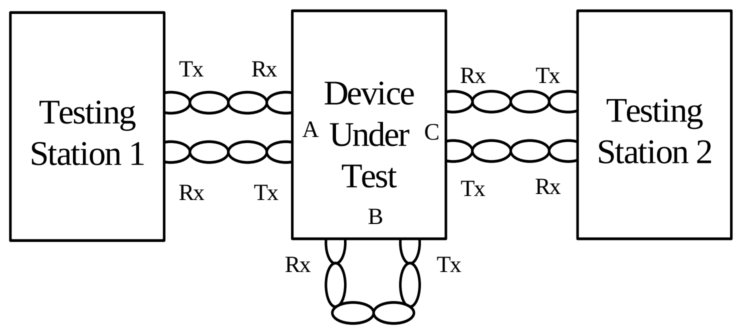
Resource Requirements:

- A testing station capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: July 5, 1995

Test Setup:

Using category 5 UTP cable, connect the testing station to port A of the repeater under test. Insert a loopback plug into port B of the repeater under test.



Procedure:

1. Power-cycle reset the repeater under test.
2. Command the testing station to send a valid preamble (defined as the physical layer stream /J/K/A/A/A/A/A/A/A/A/A/A/A/A/A/B/) followed by four bytes of data and the end of shell delimiter (/T/R/). The loopback connection on port B will guarantee that this transmission will suffer a collision. The testing station will monitor activity from port A.
3. The repeater shall enforce the collision by sourcing the Jam message (JamX or any other well formed arbitrary data pattern) on all ports. Verify that the testing station has detected the Jam message.
4. Repeat steps 1 and 2 until the testing station no longer detects the Jam message. This is an indication that the carrier activity from port A is not reaching the repeater unit or that the carrier activity is not being propagated to port B. The former is a result of the partition condition being detected on port A and latter is a result of the partition condition being detected on port B (a conformant repeater will partition both ports). The number of collisions required to reach this state is CCLimit.

Observable results:

a. Verify that the partition condition is detected on port A and port B after a number of consecutive collisions equaling CCLimit.

b. Verify that CCLimit is greater than 60.

Existing Problems: The testing station will fail to detect the Jam message following the generation of a carrier event when port A, port B, or both port A and port B are partitioned. Since the testing station cannot determine which of three events actually happened, extra steps must be taken to ensure that partition condition was detected on both ports.

Test #27.4.2 – Effects of Partition

Purpose: To verify that the repeater port under test disables its receive path upon detection of the partition condition.

References: IEEE Std 802.3™-2002: subclause 27.3.1.6, figure 27-8.

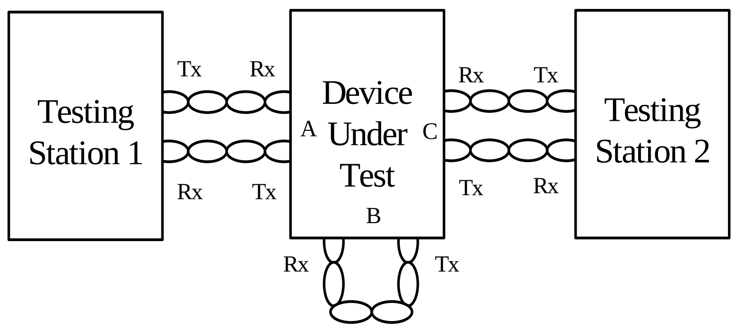
Resource Requirements:

- Two testing stations capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: July 11, 1995

Test Setup:

Using category 5 UTP cable, connect testing station 1 to port A and testing station 2 to port C of the repeater under test. Insert a loopback plug into port B of the repeater under test.



Procedure:

1. Power-cycle reset the repeater under test.
2. Command testing station 1 to send a valid preamble (defined as the physical layer stream /J/K/A/A/A/A/A/A/A/A/A/A/A/A/A/B/) followed by four bytes of data and the end of shell delimiter (/T/R/). The loopback connection on port B will guarantee that this transmission will suffer a collision.
3. Repeat step 1 until CCLimit collisions have been generated (refer to test #10.27). Both port A and port B of the repeater under test should be partitioned.
4. Command testing station 1 to send two properly encapsulated, 64-byte, valid MAC frames separated by the minimum inter-frame gap (96BT). Testing station 2 will monitor transmit activity from port C.
5. Command testing station 2 to send a valid preamble followed by four bytes of data and the end of shell delimiter. Testing station 1 will monitor transmit activity from port A.

Observable results:

a. Verify that the Partition condition is detected on port A and port B after a number of consecutive collisions equaling CCLimit.
b. Verify that the packets generated by testing station 1 were not repeated to port C of the repeater under test.
c. Verify that the fragment generated by testing station 2 was repeated to port A of the repeater under test.
d. Verify that port A and port B do not reset the partition function as a result of the transmitted packets/fragments.

Existing Problems: None.

Test #27.4.3 – No Collision Timer

Purpose: To measure the value of no_collision_timer for the repeater port.

References: IEEE Std 802.3™-2002: subclause 27.3.1.6, subclause 27.3.2.1.4, figure 27-8.

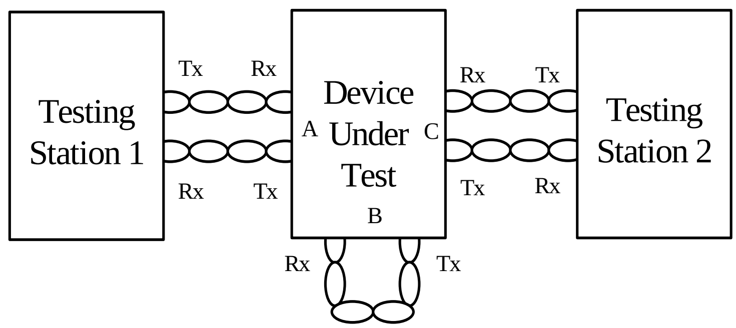
Resource Requirements:

- Two testing stations capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: July 11, 1995

Test Setup:

Using category 5 UTP cable, connect testing station 1 to port A and testing station 2 to port C of the repeater under test. Insert a loopback plug into port B of the repeater under test.



Procedure:

1. Command testing station 1 to send a valid preamble (defined as the physical layer stream /J/K/A/A/A/A/A/A/A/A/A/A/A/A/A/B/) followed by four bytes of data and the end of shell delimiter (/T/R/). The loopback connection on port B will guarantee that this transmission will suffer a collision.
2. Repeat step 1 until CCLimit collisions have been generated (refer to test #10.27). Both port A and port B of the repeater under test should be partitioned.
3. Command testing station 2 to send a valid preamble, eight nibbles of data, and end of shell delimiter. Command testing station 1 to send a properly encapsulated, 64-byte, valid MAC frame. Testing station 2 will monitor transmit activity from port C.
4. Testing station 2 will fail to capture the carrier event generated by testing station 1 as long as port A is partitioned. Repeat step 3, incrementing the number of nibbles sent by testing station 2 with each iteration, until testing station 2 captures the frame sent by testing station 1. The terminal length (in bit times) of the fragment sent by testing station 2 is no_collision timer.

Observable results:

a. Verify that the partition condition is detected on port A and port B after a number of consecutive collisions equaling CCLimit.

b. Verify that the port resets the partition function when there is transmit activity on the port for more than the number of bits specified by no_collision_timer.
c. Verify that no_collision_timer is in the range of 450 to 560 bit times.

Existing Problems: None.

Test #27.4.4 – Partition Function Reset

Purpose: To verify the conditions under which a repeater port will reset the partition function.

References: IEEE Std 802.3™-2002: subclause 27.3.1.6, figure 27-8.

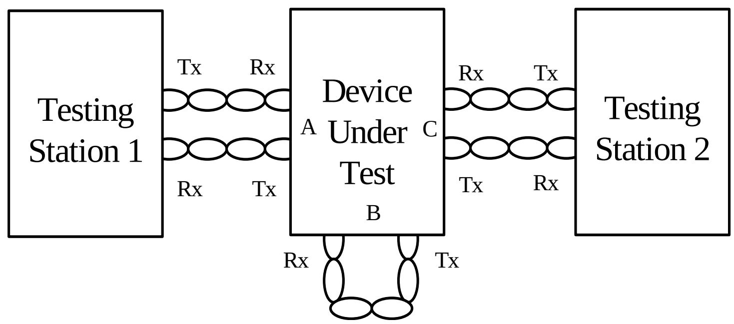
Resource Requirements:

- Two testing stations capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: July 14, 1995

Test Setup:

Using category 5 UTP cable, connect testing station 1 to port A and testing station 2 to port C of the repeater under test. Insert a loopback plug into port B of the repeater under test.



Procedure:

1. Power-cycle reset the repeater under test.
2. Command testing station 1 to send a valid preamble (defined as the physical layer stream /J/K/A/A/A/A/A/A/A/A/A/A/A/A/A/B/) followed by four bytes of data and the end of shell delimiter (/T/R/). The loopback connection on port B will guarantee that this transmission will suffer a collision.
3. Repeat step 1 until CCLimit collisions have been generated (refer to test #10.27). Both port A and port B of the repeater under test should be partitioned.
4. Disconnect testing station 1 from port A of the repeater under test. This will force link_status(A)≠OK. Reconnect testing station 1 to port A of the repeater under test. Verify that the partition function was not reset on port A.
5. If the partition function was reset as a result of step 3, repeat steps 1 and 2 to ensure that both port A and port B of the repeater under test are partitioned. Command testing station 2 to send a valid preamble followed by a sufficient number of data nibbles to make the overall fragment length exceed no_collision_timer (refer to test #12.27). Verify that the partition function is reset on port A of the repeater under test.
6. Repeat steps 1 and 2 to ensure that both port A and port B of the repeater under test are partitioned. Power-cycle reset the repeater under test. Verify that the partition condition is reset on both port A and port B of the repeater under test.

Observable results:

a. Verify that the partition condition is detected on port A and port B after a number of consecutive collisions equaling CCLimit.
b. Verify the transition to link_status(A)≠OK does not reset the partition function on port A of the repeater under test.
c. Verify that port A resets the partition function when there is transmit activity on the port for more than the number of bits specified by no_collision_timer.
d. Verify that a power-cycle reset will reset the partition function on both port A and port B of the repeater under test.
e. Verify that the DUT will not reset the partition function on a port for a transmitted event exceeding no_collision_timer if there is still receive activity at the port.

Existing Problems: None.

Test #27.4.5 – Consecutive Collision Count

Purpose: To verify that the repeater port consecutive collision count increments and clears under the appropriate conditions.

References: IEEE Std 802.3™-2002: subclause 27.3.1.6, 27.3.2.1.1, figure 27-8.

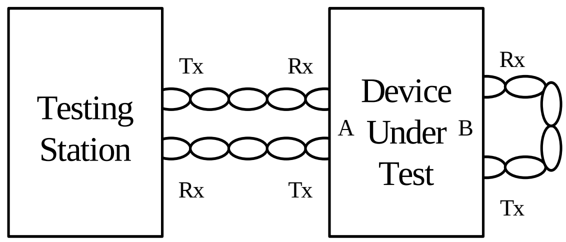
Resource Requirements:

- Two testing stations capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: July 14, 1995

Test Setup:

Using category 5 UTP cable, connect testing station 1 to port A of the repeater under test. Insert a loopback plug into port B of the repeater under test.



Procedure:

1. Power-cycle reset the repeater under test.
2. Command the testing station to send a valid preamble (defined as the physcial layer stream /J/K/A/A/A/A/A/A/A/A/A/A/A/A/A/B/) followed by four bytes of data and the end of shell delimiter (/T/R/). The loopback connection on port B will guarantee that this transmission will suffer a collision. The testing station will monitor transmit activity on port A.
3. Repeat step 2 until CCLimit/2 (refer to test #10.27) collisions have been generated. Remove the loopback plug and command the testing station to send a valid preamble followed by a sufficient number of data nibbles to make the overall fragment length greater than no_collision_timer (refer to test #12.27).
4. Re-insert the loopback plug and repeat step 2 until the testing station fails to detect the Jam message from port A of the repeater under test. Verify that exactly CCLimit collisions were required to reach this state.
5. Power-cycle reset the repeater under test and repeat step 2 until CCLimit/2 collisions have been generated. Remove the loopback plug and command the testing station to send a valid preamble and any number of data nibbles that make the overall fragment length less than no_collision_timer.
6. Re-insert the loopback plug and repeat step 2 until the testing station fails to detect the Jam message from port A of the repeater under test. Verify that exactly CCLimit/2 collisions were required to reach this state.

Observable results:

a. Verify that the Partition condition is detected on port A and port B after a number of consecutive collisions equaling CCLimit.
b. Verify that the port clears the consecutive collision count when there is transmit activity on the port for more than the number of bits specified by no_collision_timer without incurring a collision.
c. Verify that the port does not increment or clear the consecutive collision count when there is transmit activity on the port for a number of bits less than no_collision timer without incurring a collision.

Existing Problems: None.

GROUP 5: Carrier Integrity Monitor

Scope: The following tests cover Repeater operations specific to carrier integrity monitor.

Overview: These tests are designed to verify that the device under test properly handles carrier events implements timers. The Repeater functions explored are defined in Clause 27 of IEEE Std 802.3™-2002.

Test #27.5.1 – False Carrier Detect

Purpose: To verify that the repeater set can detect false carrier events.

References: IEEE Std 802.3™-2002: subclause 24.3.4.3, subclause 27.3.1.5.1, figures 24-14 and 27-9.

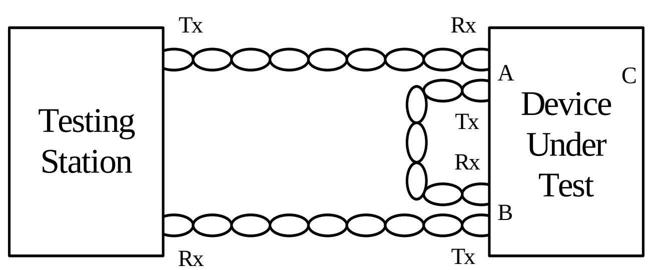
Resource Requirements:

- A testing station capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25. The testing station should be capable of transmitting invalid code groups.

Last Modification: July 20, 1995

Test Setup:

Connect the transmitter of the testing station to the receiver of port A and the transmitter of port B to the receiver of the testing station. Connect the transmitter of port A to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Let bad_ssd be a vector of 10 code-bits and let bad_ssd[0] be fixed at ZERO. Initialize bad_ssd[9:2] to the code-bit pattern "1111110". Command the testing station to send bad_ssd (most significant bit first) followed by four bytes of data. The testing station will monitor transmit activity from port B of the repeater under test.
2. Shift bad_ssd[9:2] left one code-bit, discarding the carry bit and setting bad_ssd[2] to ONE. Command the testing station to send bad_ssd followed by four bytes of data. The testing station will monitor transmit activity from port B of the repeater under test.
3. Repeat step 2 until bad_ssd[9:2] contains the pattern "11111111".
4. Set bad_ssd[9:5] to the /J/ code group and set bad_ssd[4:0] to the code-bit pattern "00000". Command the testing station to send bad_ssd followed by four bytes of data. The testing station will monitor transmit activity from port B of the repeater under test.
5. Increment bad_ssd[4:0]. Command the testing station to send bad_ssd followed by four bytes of data. The testing station will monitor transmit activity from port B of the repeater under test.
6. Repeat step 5 until bad_ssd[4:0] exceeds "11111". Skip the iteration in which bad_ssd[4:0] equals "10001" as this is the /K/ code-group (this makes bad_ssd[9:0] /J/K/, the valid start of shell delimiter).

Observable results:

a. Verify that, for each bad_ssd applied to port A, port B sources a valid start of shell delimiter followed by the Jam message (JamX or any other well formed arbitrary data pattern).
b. Verify that the length of the Jam message sourced by port B does not exceed the length of the false carrier event applied to port A by more than 4 BT.

Existing Problems: None.

Test #27.5.2 - FCCLimit

Purpose: To measure the value of FCCLimit for the repeater set.

References: IEEE Std 802.3™-2002: subclause 24.3.4.3, subclause 27.3.1.5.1, subclause 27.3.2.1.1, figures 24-14, and figure 27-9.

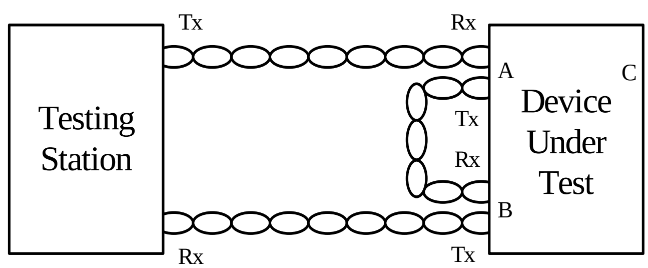
Resource Requirements:

- A testing station capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: July 17, 1995

Test Setup:

Connect the transmitter of the testing station to the receiver of port A and the transmitter of port B to the receiver of the testing station. Connect the transmitter of port A to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Power-cycle reset the repeater under test.
2. Command the testing station to generate three consecutive false carrier events 40 BT in length and spaced by the minimum inter-frame gap (96 BT). A false carrier event is defined as a stream of non-idle code groups that does not begin with a valid start of shell delimiter (/J/K/). The testing station will monitor transmit activity from port B.

Observable results:

a. Verify that, after FCCLimit consecutive false carrier events, the link unstable condition is detected on port A of the repeater under test. The port will disable its transmit and receive paths while in the link unstable state. This will prevent any remaining false carrier events from propagating to port B of the repeater under test.
b. Verify that FCCLimit is 2.

Existing Problems: None.

Test #27.5.3 – False Carrier Timer

Purpose: To measure the value of false_carrier_timer for the repeater set.

References: IEEE Std 802.3™-2002: subclause 24.3.4.3, subclause 27.3.1.5.1, subclause 27.3.2.1.4, figures 24-14, and figure 27-9.

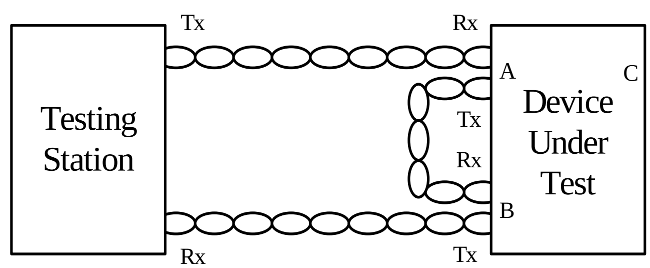
Resource Requirements:

- A testing station capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: July 18, 1995

Test Setup:

Connect the transmitter of the testing station to the receiver of port A and the transmitter of port B to the receiver of the testing station. Connect the transmitter of port A to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Command the testing station to send an invalid start of shell delimter followed by 100 code group pairs. Let $t = t_0$ represent the 50% point of the mid-cell transition corresponding to the first bit of data (following the invalid start of shell delimiter) arriving on port A. Let $t = t_1$ represent the 50% point of the mid-cell transition corresponding to the last bit of Jam sourced by port B. The time difference $t_1 - t_0$ is false_carrier_timer.

Observable results:

a. Verify that a false carrier event with duration exceeding false_carrier_timer will cause the link unstable condition to be detected on port A of the repeater under test. The port will disable its transmit and receive paths while in the link unstable state. This will terminate the propagation of the false carrier event to port B of the repeater under test.
b. Verify that false_carrier_timer is in the range of 450 to 500 BT.

Existing Problems: None.

Test #27.5.4 – IPG Timer

Purpose: To measure the value of ipg_timer for the repeater set.

References: IEEE Std 802.3™-2002: subclause 24.3.4.3, subclause 27.3.1.5.1, subclause 27.3.2.1.4, figures 24-14, and figure 27-9.

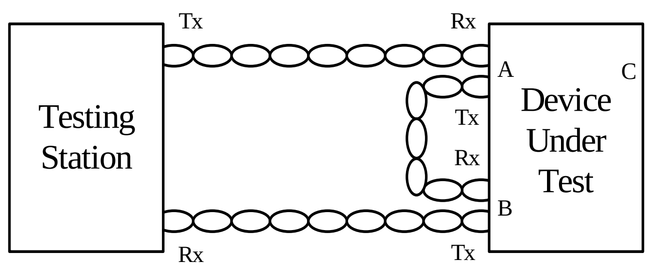
Resource Requirements:

- A testing station capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: July 19, 1995

Test Setup:

Connect the transmitter of the testing station to the receiver of port A and the transmitter of port B to the receiver of the testing station. Connect the transmitter of port A to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Power-cycle reset the repeater under test.
2. Let S be a sequence of carrier events. The sequence begins with FCCLimit (refer to test 16.27) false carrier events 40BT long and seperated by a 96BT inter-packet gap. Two properly encapsulated, 64-byte, valid MAC frames seperated by 96BT follow the false carrier events after an *n*BT delay. Set *n* to 48 and command the testing station to send S. The testing station will monitor transmit activity on port B.

   Example for FCCLimit=2:

   S =

false	96BT	false	*n*BT IPG	valid	96BT	valid

3. A valid carrier event of duration greater than valid_carrier_timer preceeded by idle of duration greater than ipg_timer will cause the repeater port under test to reset the link unstable state. This will allow any subsequent carrier events received on port A to be propagated to the other ports of the repeater under test. Increment *n* by 4 and

command the testing station to send S. The testing station will monitor transmit activity on port B.

4. Repeat step 3 until the second valid carrier event is detected by the station under test. The terminal value of *n* is ipg_timer.

Observable results:

a. Verify that a valid carrier event of duration greater than valid_carrier_timer preceeded by idle of duration greater than ipg_timer will cause the repeater port under test to reset the link unstable state.
b. Verify that ipg_timer is in the range of 64 to 86 BT.

Existing Problems: None .

Test #27.5.5 – Valid Carrier Timer

Purpose: To measure the value of valid_carrier_timer for the repeater set.

References: IEEE Std 802.3™-2002: subclause 24.3.4.3, subclause 27.3.1.5.1, subclause 27.3.2.1.4, figures 24-14, and figure 27-9.

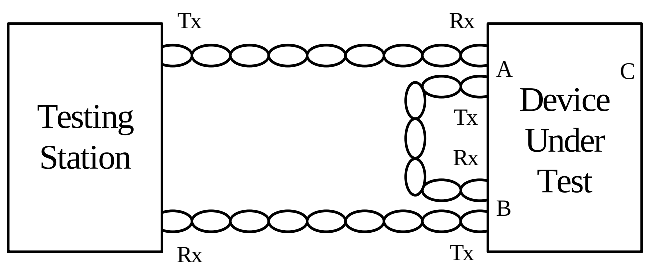
Resource Requirements:

- A testing station capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: January 27, 2005

Test Setup:

Connect the transmitter of the testing station to the receiver of port A and the transmitter of port B to the receiver of the testing station. Connect the transmitter of port A to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Power-cycle reset the repeater under test.
2. Let S be a sequence of carrier events. The sequence begins with FCCLimit (refer to test 16.27) false carrier events 40BT long and seperated by a 96BT inter-packet gap. A fragment consisting of a valid preamble (defined as the physical layer stream /J/K/A/A/A/A/A/A/A/A/A/A/A/A/A/B/) and *n* bits of data follows after a delay of ipg_timer bit times (refer to test 18.27). The sequence ends with a properly encapsulated, 64-byte, valid MAC frame that follows the fragment after 96BT. Set *n* to 32 and command the testing station to send S. The testing station will monitor transmit activity on port B.

   Example for FCCLimit=2:

   S =

false	96BT	false	ipg_time	preamble	*n* data	96BT	valid

3. A valid carrier event of duration greater than valid_carrier_timer preceeded by idle of duration greater than ipg_timer will cause the repeater port under test to reset the link unstable state. This will allow any subsequent carrier events received on port A to be

propagated to the other ports of the repeater under test. Increment *n* by 4 and command the testing station to send S. The testing station will monitor transmit activity on port B.

4. Repeat step 3 until the second valid carrier event is detected by the station under test. The terminal value of the carrier event (preamble + *n* bytes) is valid_carrier_timer.

Observable results :

a. Verify that a valid carrier event of duration greater than valid_carrier_timer preceeded by idle of duration greater than ipg_timer will cause the repeater port under test to reset the link unstable state.
b. Verify that valid_carrier_timer is in the range of 450 to 500 BT.

Existing Problems: None.

Test #27.5.6 – Idle Timer

References: IEEE Std 802.3™-2002: subclause 24.3.4.3, subclause 27.3.1.5.1, subclause 27.3.2.1.4, figures 24-14, and figure 27-9.

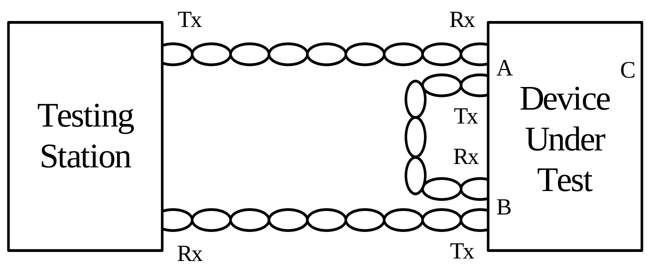
Resource Requirements:

- A testing station capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: July 20, 1995

Test Setup:

Connect the transmitter of the testing station to the receiver of port A and the transmitter of port B to the receiver of the testing station. Connect the transmitter of port A to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Power-cycle reset the repeater under test.
2. Let S be a sequence of carrier events. The sequence begins with FCCLimit consecutive false carrier events 40BT long and spaced by a 96BT inter-packet gap. A properly encapsulated, 64-byte, valid MAC frame follows after an *n*BT delay. Set n to ipg_timer (refer to test 18.27) and command the testing station to send S.

   Example for FCCLimit=2:

   S =

false	96BT	false	*n*BT IPG	valid

3. When the false carrier count for port A exceeds FCCLimit, the port will enter the link unstable state and disable its transmit and receive paths. The link unstable state will be reset if no activity is detected on port A for more than ipg_timer plus idle_timer bit times. Repeat step 1, incrementing *n* by 4 with each interation, until the testing station detects the valid MAC frame applied to port A. The terminal value of *n* is ipg_timer plus idle_timer.

Observable results:

a. Verify that the link unstable state is reset when no activity is detected on a port for more than ipg_timer plus idle_timer bit times.
b. Verify that idle_timer is in the range of 24,750 to 41,250 BT.

Existing Problems: None.

Test #27.5.7 – False Carrier Count

Purpose: To verify consecutive false carrier count for the repeater port increments and clears under the appropriate conditions.

References: IEEE Std 802.3™-2002: subclauses 27.3.1.5.1, 27.3.2.1.5, figure 27-9.

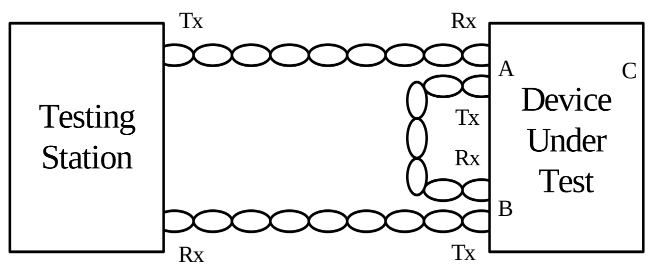
Resource Requirements:

- Two testing stations capable of encoding (decoding) data nibbles to (from) five-bit code groups as specified in clause 24 and sending (receiving) these code groups using the signaling method described in clause 25.

Last Modification: July 20, 1995

Test Setup:

Connect the transmitter of the testing station to the receiver of port A and the transmitter of port B to the receiver of the testing station. Connect the transmitter of port A to the receiver of port B to ensure that link_status(B)=OK. All connections are made with category 5 UTP wire.



Procedure:

1. Power-cycle reset the repeater under test.
2. Command the testing station to send a false carrier event 40BT long (a false carrier event is defined to be a non-idle data stream that does not begin with a valid start of shell delimiter).
3. Command the testing station to send a properly encapsulated, 64-byte, valid MAC frame.
4. Command the testing station to send FCCLimit+1 (refer to test 16.27) false carrier events 40BT long and seperated by a 96BT inter-packet gap. The testing station will monitor transmit activity from port B. It should detect FCCLimit Jam messages from port B indicating that the valid MAC frame send in step 3 cleared the false carrier count.

Observable results:

a. Verify that the consecutive false carrier count is reset upon the reception of a valid carrier event.

b. Verify that, after FCCLimit consecutive false carrier events, the link unstable condition is detected on port A of the repeater under test. The port will disable it's transmit and receive paths while in the link unstable state. This will prevent any remaining false carrier events from propagating to port B of the repeater under test.

Existing Problems: None.

ANNEX A (informative) Table of Acronym Definitions

(informative)

Table of Acronym Definitions

Table 4 - 1 Acronym Definitions

8802-3	ISO/IEC 8802-3 (IEEE Std 802.3)
ANSI	American National Standards Institute
ASIC	application-specific integrated circuit
ASN.1	abstract syntax notation one as defined in ISO/IEC 8824: 1990
MDI, AUI	attachment unit interface
BER	bit error ratio
BPSK	binary phase shift keying
BR	bit rate
BT	bit time
CAT3	Category 3 balanced cable
CAT4	Category 4 balanced cable
CAT5	Category 5 balanced cable
CD0	clocked data zero
CD1	clocked data one
CMIP	common management information protocol as defined in ISO/IEC 9596-1: 1991
CMIS	common management information service as defined in ISO/IEC 9595: 1991
CMOS	complimentary metal oxide semiconductor
CRC	cyclic redundancy check
CRV	code rule violation
CS0	control signal zero
CS1	control signal one
CVH	clocked violation high
CVL	clocked violation low
CW	continuous wave
DA	Destination Address
DTE	data terminal equipment
DUT	Device Under Test
EIA	Electronic Industries Association.
ELFEXT	equal-level far-end crosstalk
EMB	effective modal bandwidth
EMI	Electromagnetic Interference
EPD	End_of_Packet Delimiter
ESD	end of stream delimiter
FCS	Frame Check Sequence
FC-PH	Fibre Channel - Physical and Signaling Interface
FOTP	fiber optic test procedure
GMII	Gigabit Media Independent Interface
IEC	International Electrotechnical Commission
IFG	interFrameGap

IFSP1	inter-frame spacing part 1
IFSP2	inter-frame spacing part 2
IH	intermediate hub
IRL	inter-repeater link
ISI penalty	intersymbol interference penalty
ISO	International Organization for Standardization
LAN	local area network
LLC	logical link control
LSDV	link segment delay value
MAC	medium access control
MAU	medium attachment unit
MC	message code
MDELFEXT	multiple-disturber equal-level far-end crosstalk
MDFEXT	multiple-disturber far-end crosstalk
MDI	medium dependent interface
MDNEXT	multiple-disturber near-end crosstalk
MIB	management information base
MII	media independent interface
MMF	multimode fiber
MP	message page
NEXT	near-end crosstalk
NLP	normal link pulse
NPA	next page algorithm
NRZI	non return to zero and invert on ones
OFL	overfilled launch
OFSTP	optical fiber system test procedure
PCS	physical coding sublayer
PDV	path delay value
PHY	Physical Layer entity sublayer
PICS	protocol implementation conformance statement
PLS	physical signaling sublayer
PMA	physical medium attachment
PMD	physical medium dependent
PMI	physical medium independent
PPD	peak-to-peak differential
PVV	path variability value
RD	running disparity
RFI	Radio Frequency Interference
RIN	relative intensity noise
ROFL	radial overfilled launch
RS	reconciliation sublayer
SA	Source Address
SDV	segment delay value
SFD	start-of-frame delimiter
SMF	singlemode fiber
SPD	Start_of_Packet Delimiter
SR	symbol rate
SSD	start-of-stream delimiter

ST	symbol time
STE	station management entity
STP	shielded twisted pair (copper)
SVV	segment variability value
TDR	Time Domain Reflectometer
TIA	Telecommunications Industry Association
UCT	unconditional transition
UP	unformatted page
UTP	unshielded twisted pair
WCMB	worst case modal bandwidth

ANNEX B (informative) Testing Requirements

(informative)

Testing requirements.

A testing station that implements transmit (encoding) and receive (decoding) functions specific to the Fast Ethernet PHY in use by the device under test (DUT). MDI access by the testing station is ideal.

Typical Testing Stations:

Arbitrary Waveform Generator
Logic Analyzer with Pattern Generator
Symbol Generating Device
Sniffer, traffic generator (i.e. SmartBits…)