40 AND 100 GIGABIT ETHERNET TESTING SERVICE

Clause 95
100GBASE-SR4 PMD Test Plan
Version 1.1
Technical Document

Last Updated: January 23, 2018

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MODIFICATION RECORD

January 23, 2018 Version 1.1

Kathryn Dube: Editorial updates

July 6, 2016 Version 1.0

Michael Klempa: Preliminary release. First draft.

ACKNOWLEDGMENTS

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

Michael Klempa	UNH InterOperability Laboratory
Jeff Lapak	UNH InterOperability Laboratory

INTRODUCTION

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 particular test plan has been developed to help implementers evaluate the functionality of the Physical Medium Dependent (PMD) sublayer of their 100GBASE- SR4 products.

These tests are designed to determine if a product conforms to specifications defined in Clause 95 of the IEEE Std 802.3bm. Successful completion of all tests contained in this plan 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 properly in many 100GBASE- SR4 environments.

The tests contained in this document are organized in such a manner as to simplify the identification of information related to a test, and to facilitate in the actual testing process. Tests are organized into groups, primarily in order to reduce setup time in the lab environment, however the different groups typically also tend to focus on specific aspects of device functionality. A three-part numbering system is used to organize the tests, where the first number indicates the clause of the IEEE 802.3 standard on which the test plan is based. The second and third numbers indicate the test's group number and test number within that group, respectively. This format allows for the addition of future tests to the appropriate groups without requiring the renumbering of the subsequent tests.

The test definitions themselves are intended to provide a high-level description of the motivation, resources, procedures, and methodologies pertinent to each test. Specifically, each test description consists of the following sections:

Purpose

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

References

This section specifies source material *external* to the test plan, including specific subclauses pertinent to the test definition, or any other references that might be helpful in understanding the test methodology and/or test results. External sources are always referenced by number when mentioned in the test description. Any other references not specified by number are stated with respect to the test plan document itself.

Resource Requirements

The requirements section specifies the test hardware and/or software needed to perform the test. This is generally expressed in terms of minimum requirements, however in some cases specific equipment manufacturer/model information may be provided.

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 initial configuration of the test environment. Small changes in the configuration should not be included here, and are generally covered in the test procedure section, below.

Test Procedure

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

Observable Results

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

Possible Problems

This section contains a description of known issues with the test procedure, which may affect test results in certain situations. It may also refer the reader to test plan appendices and/or whitepapers that may provide more detail regarding these issues.

GROUP 1: TRANSMITTER VERIFICATION

Overview:

The tests defined in this section verify the transmitter's optical signaling characteristics of the Physical Medium Dependent (PMD) layer defined in Clause 95 of the IEEE Std. 802.3 2015.

Test 95.1.1 – Signaling Speed

Purpose: To verify that the baud rate of the DUT is within the conformance limits.

References:

[1] IEEE Std. 802.3 2015, Table 95-6 – 100GBASE-SR4 Transmit Characteristics

[2] IEEE Std. 802.3 2015, subclause 95.8 – Definition of optical parameters and measurement methods

Resource Requirements: See Appendix I – Test Fixtures and Setups.

Last Modification: July 6, 2016

Discussion:

Reference [1] specifies the transmitter characteristics for 100GBASE-SR4 devices. This specification includes conformance requirements for the signaling speed which states that the signaling speed should be 25.78125 Gbaud +/- 100 ppm per lane. This translates to 25.78125 Gbaud +/- 2.578125 Mbaud, with a nominal Unit Interval (UI) of 38.7878 ps.

In this test, the signaling speed is measured while the DUT is connected to the test equipment in [2]. The signal being transmitted by the DUT may be any valid 100GBASE-SR4 signal as stated in [2].

Test Setup: See Appendix I – Test Fixtures and Setups.

Test Procedure:

1. Configure the DUT to send PRBS9.
2. Connect the DUT's transmitter to the test equipment.
3. Measure the average TX signaling speed.
4. Repeat steps 1-3 for each transmit lane.

Observable Results:

a. The signaling speed should be within 25.78125 Gbaud +/- 100 ppm per lane.

Possible Problems: None.

Test 95.1.2 – Center Wavelength

Purpose: To verify that the wavelength of the transmitted signal is within the defined limits.

References:

[1] IEEE Std. 802.3 2015, Table 95-6 – 100GBASE-SR4 Transmit Characteristics

[2] IEEE Std. 802.3 2015, subclause 95.8 – Definition of optical parameters and measurement methods

Resource Requirements: See Appendix I – Test Fixtures and Setups.

Last Modification: July 6, 2016

Discussion:

Reference [1] specifies the transmitter characteristics for 100GBASE-SR4 devices. This specification includes conformance requirements for center wavelength range.

Test Setup: See Appendix I – Test Fixtures and Setups.

Test Procedure:

1. Configure the DUT to send PRBS9.
2. Connect the DUT's transmitter to the test equipment.
3. Measure the wavelength of the signal.
4. Repeat steps 1-3 for each transmit lane.

Observable Results:

a. The center wavelength shall be between 840 nm and 860 nm.

Possible Problems: None.

Test 95.1.3 – RMS Spectral Width

Purpose: To verify that the standard deviation of the spectrum is below the specified range.

References:

[1] IEEE Std. 802.3 2015, Table 95-6 – 100GBASE-SR4 Transmit Characteristics

[2] IEEE Std. 802.3 2015, subclause 95.8 – Definition of optical parameters and measurement methods

Resource Requirements: See Appendix I – Test Fixtures and Setups.

Last Modification: July 6, 2016

Discussion:

Reference [1] specifies the transmitter characteristics for 100GBASE-SR4 devices. This specification includes conformance requirements for the RMS spectral width.

Test Setup: See Appendix I – Test Fixtures and Setups.

Test Procedure:

1. Configure the DUT to send PRBS9.
2. Connect the DUT's transmitter to the test equipment.
3. Measure the standard deviation of the spectrum.
4. Repeat steps 1-3 for all lanes.

Observable Results:

a. The maximum standard deviation of the spectrum shall be less than 0.6 nm.

Possible Problems: None.

Test 95.1.4 – Average optical launch power

Purpose: To verify that the average optical launch power of the DUT is within the conformance limits.

References:

[1] IEEE Std. 802.3 2015, Table 95-6 – 100GBASE-SR4 Transmit Characteristics

[2] IEEE Std. 802.3 2015, subclause 95.8 – Definition of optical parameters and measurement methods

Resource Requirements: See Appendix I – Test Fixtures and Setups.

Last Modification: July 6, 2016

Discussion:

There are three sets of average launch powers that are specified in [1]: maximum average launch power, minimum average launch power and average launch power of the laser when turned off.

Test Setup: See Appendix I – Test Fixtures and Setups.

Test Procedure:

1. Configure the DUT to send PRBS9.
2. Connect the DUT's transmitter to the test equipment.
3. Measure the average launch power of the DUT.
4. Repeat steps 1-3 after turning the laser off.
5. Repeat steps 1-4 for all lanes.

Observable Results:

a. The average launch power should fall between -8.4 dBm and 2.4 dBm when turned on.

b. The average off launch power of the DUT should be less than -30 dBm.

Possible Problems: None.

Test 95.1.5 – Optical Modulation Amplitude

Purpose: To verify that the optical modulation amplitude (OMA) of the DUT is within the conformance limits.

References:

[1] IEEE Std. 802.3 2015, Table 95-6 – 100GBASE-SR4 Transmit Characteristics

[2] IEEE Std. 802.3 2015, subclause 95.8 – Definition of optical parameters and measurement methods

Resource Requirements: See Appendix I – Test Fixtures and Setups.

Last Modification: July 6, 2016

Discussion:

The OMA is defined as the difference in optical power for the nominal "1" and "0" levels of the signal. The mean optical "1" and "0" powers are measured over the center 20 % of the unit interval. The difference of these two values determines the OMA.

Test Setup: See Appendix I – Test Fixtures and Setups.

Test Procedure:

1. Configure the DUT so that it is sourcing a PRBS9 pattern.
2. Connect the DUT's transmitter to the test equipment.
3. Process the waveform, measuring the OMA.
4. Repeat steps 1-3 for each transmit lane.

Observable Results:

a. The OMA shall be between -6.4 dBm and 3 dBm.

Possible Problems: None.

Test 95.1.6 – Extinction Ratio

Purpose: To verify that the extinction ratio of the DUT is within the conformance limits.

References:

[1] IEEE Std. 802.3 2015, Table 95-6 – 100GBASE-SR4 Transmit Characteristics
[2] IEEE Std. 802.3 2015, subclause 95.8 – Definition of optical parameters and measurement methods

Resource Requirements: See Appendix I – Test Fixtures and Setups.

Last Modification: July 6, 2016

Discussion:

The extinction ratio is defined as the ratio in optical power for the nominal "1" and "0" levels of the signal. The mean optical "1" and "0" powers are measured over the center 20 % of the unit interval.

Test Setup: See Appendix I – Test Fixtures and Setups.

Test Procedure:

5. Configure the DUT so that it is sourcing a PRBS31 pattern.
6. Connect the DUT's transmitter to the test equipment.
7. Process the waveform, measuring the extinction ratio.
8. Repeat steps 1-3 for each transmit lane.

Observable Results:

a. The extinction ratio shall be greater than 2 dB.

Possible Problems: None.

Test 95.1.7 – Transmitter Eye Mask

Purpose: To verify that transmissions from the DUT meet the defined transmitter eye mask.

References:

[1] IEEE Std. 802.3 2015, Table 95-6 – 100GBASE-SR4 Transmit Characteristics
[2] IEEE Std. 802.3 2015, subclause 95.8.7 – Transmitter optical waveform (transmit eye)
[3] IEEE Std. 802.3 2015, subclause 86.8.4.6.1 – Optical transmitter eye mask
[4] IEEE Std. 802.3 2015, Table 95-9 – Test Patterns

Resource Requirements: See Appendix I – Test Fixtures and Setups.

Last Modification: July 6, 2016

Discussion:

The specified transmitter eye mask definition is contained within reference [1]. Reference [3] states the measurement is made with the DUT transmitting test pattern 3 or 5.

Test Setup: See Appendix I.

Test Procedure:

9. Configure the DUT so that it is sourcing a PRBS31 pattern.
10. Connect the DUT's transmitter to the test equipment.
11. Configure the test equipment to capture the transmissions from the DUT and to place these waveforms into the mask definition.
12. Process the captured waveform, observing the number of mask violations.
13. Repeat steps 1-3 for each transmit lane.

Observable Results:

a. The hit ratio shall be better than 5E-5.

Possible Problems: None.

APPENDICES

Overview:

Test plan appendices are intended to provide additional low-level technical detail pertinent to specific tests contained in this test plan. These appendices often cover topics that are outside of the scope of the standard and are specific to the methodologies used for performing the measurements in this test plan. Appendix topics may also include discussion regarding a specific interpretation of the standard (for the purposes of this test plan), for cases where a particular specification may appear unclear or otherwise open to multiple interpretations.

Scope:

Test plan appendices are considered informative supplements and pertain solely to the test definitions and procedures contained in this test plan.

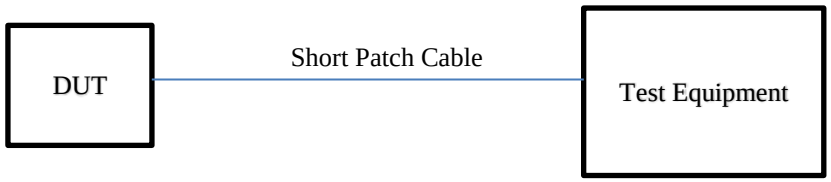
Appendix I – Test Fixtures and Setups

Purpose: To specify the test equipment and setup used to test all electrical characteristic as well as waveform characteristics in this test plan.

Last Modification: July 6, 2016

Equipment List:

1. Digital Storage Oscilloscope, 35 GHz bandwidth (minimum)
2. Short patch cable, between 2 m and 5 m in length



95.I – 1: Setup used for Group 1: Transmitter testing