ROLE OF HARDWARE TEST FOR ESTABLISHING RELIABLE PATH IN COMPUTER NETWORKS

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Abstract-This research paper is about shortest path algorithms of routing in transportation networks. Efficient management of networks requires that the shortest route from one node to another is known. This research project also focuses in finding the shortest reliable path algorithm. We need to find the path distance from the source to destination which is reliable and found in an optimized way considering the network constraints. Different testing methods are done for getting the accurate results.

Keywords-Reliable Path; Shortest Path; Networks; Network Hardware Test.

1. Introduction

The shortest path problem is concerned with finding the shortest path from a specified origin to a specified destination in a given network while minimizing the total cost associated with the path. The need is to find the path distance from the source to destination which reliable and is found in an optimized way considering the network constraints. For finding reliable path we need to measure some test then calculate result. After that by every algorithm's for finding short path we can find shortest reliable path.

2. Test Classification

Clearly explain the nature of the problem, purpose, and contribution of the paper.

3. Length test

The length test measures the length of each cable pair tested. The main Auto test results screen shows the length of the cable pair having the shortest electrical delay. The length results screen displays the length, limit, and pass/fail result for each cable pair. Length is displayed in meters or feet. The Cable Length test verifies that the cable from the transmitter to receiver does not exceed the maximum recommended distance of 100 meters in a 10BASE-T/100BASE-TX/1000BASE-T network. A 2 to 5 percent difference in measured length between twisted pairs is typical. This difference is due to differences in the number of twists in the cable pairs. Differences between measured and actual values of cable length can be caused by variations in the cable's NVP value. NVP values can vary among cable types, lots, and manufacturers. A pass result means that the measured length is within the specified limit for the selected test standard. A fail result means that the measured length exceeds the limit.

3.1. The Standards

The performance tests and their procedures have been defined in the ANSI/TIA/EIA-568-B.1 standard and the ISO/IEC 11801 standard. The TIA standard defines performance in categories (Cat 3, 5e, 6) and the ISO defines classes (Class C, D, E, and F). These standards define the procedure to certify that an installation meets performance criteria in a given category or class. The significance of each category or class is the limit

values of which the Pass/Fail and frequency ranges are measured; Cat 3 and Class C (no longer used) test and define communication with 16 MHz bandwidth, Cat 5e and Class D with 100 MHz bandwidth, Cat 6 and Class E up to 250 MHz, and Cat 7 and Class F with a frequency range through 600 MHz. The standards also define that data from each test result must be collected and stored in either print or electronic format for future inspection. According to the ANSI/TIA/EIA standard for category 5e cable, (TIA/EIA 568-5-A) the maximum length for a cable segment is 100 m. If longer runs are required, the use of active hardware such as a repeater, or a switch, is necessary. In practice longer lengths are possible. Experiments show that a full 305 meter drum of cable is well above the practical limit, but that reliable transmission with 200 m is often possible.

4. Resistance Test

The resistance test measures the DC Loop Resistance for each cable pair. The resistance results screen displays the resistance, limit, and pass/fail result for each cable pair. A pass result means that the measured resistance is less than the limit. A fail result means that the measured resistance exceeds the limit. DC Loop Resistance measures the total resistance through one wire pair looped at one end of the connection. This will increase with the length of the cable. DC resistance usually has less effect on a signal than insertion loss, but plays a major role if power over Ethernet is required. Also measured in ohms is the characteristic impedance of the cable, which is independent of the cable length.

5. Wire map test

The Wire map test is used to identify physical errors of the installation; proper pin termination at each end, shorts between any two or more wires, continuity to the remote end, split pairs, crossed pairs, reversed pairs, and any other mis-wiring.
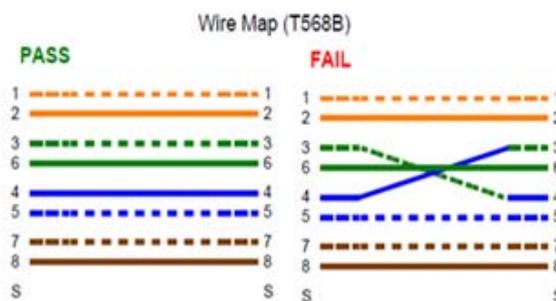

Figure 1.   Example of two Wire Map test

6. Propagation Delay test

The Propagation Delay test tests for the time it takes for the signal to be sent from one end and received by the other end.

7. Delay Skew test

The Delay Skew test tests for the difference in propagation delay between the fastest and slowest set of wire pairs. An ideal skew is between 25 and 50 nanoseconds over a 100 meter cable. The lower this skews the better, less than 25 ns is excellent, but 45 to 50 ns are marginal.

Delay skew in cable ID C02-02 is 3 and result is excellent.

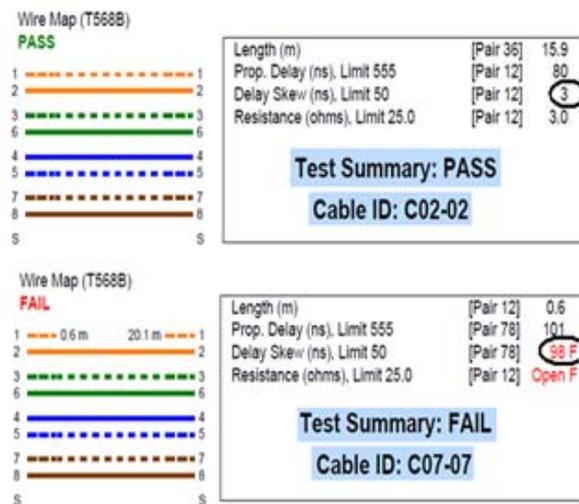Delay skew in cable ID C07-07 is 98 and result is failed.

Figure 2.   Example of Delay Skew test

8. Insertion Loss

Insertion loss, also referred to as attenuation, refers to the loss of signal strength at the far end of a line compared to the signal that was introduced into the line. This loss is due to the electrical resistance of the copper cable, the loss of energy through the cable insulation and the impedance caused by the connectors. Insertion loss is usually expressed in decibels dB with a minus sign. Insertion loss increases with distance and frequency. For every 6dB of loss, the original signal will be half the original amplitude.

9. Return Loss

Return Loss is the measurement (in dB) of the amount of signal that is reflected back toward the transmitter. The reflection of the signal is caused by the variations of impedance in the connectors and cable and is usually attributed to a poorly terminated wire. The greater the variation in impedance is the greater the return loss reading. If 3 pairs of wire pass by a substantial amount, but the 4 pair barely passes, it usually is an indication of a bad crimp or bad connection at the RJ45 plug. Return loss is usually not significant in the loss of a signal, but rather signal jitter.
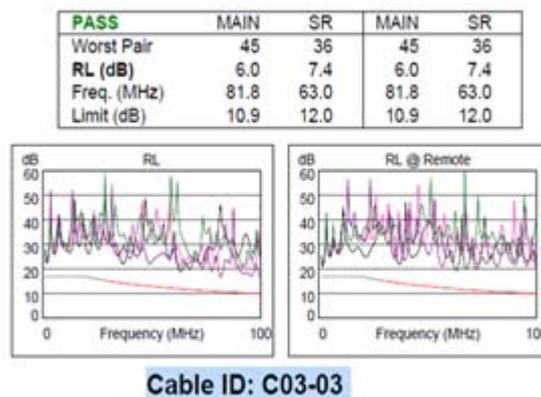

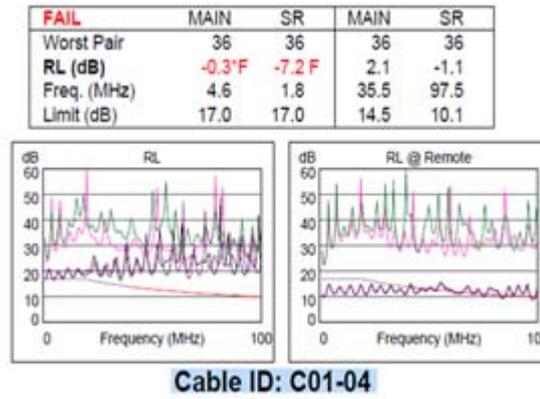Figure 3.   Example of Return Loss test (PASS)

FAIL	MAIN	SR	MAIN	SR
Worst Pair	36	36	36	36
RL (dB)	-0.3'F	-7.2 F	2.1	-1.1
Freq. (MHz)	4.6	1.8	35.5	97.5
Limit (dB)	17.0	17.0	14.5	10.1

Cable ID: C01-04

Figure 4.   Example of Return Loss test (FAIL)

10. Near-End Crosstalk

Near-End Crosstalk (NEXT) is an error condition that describes the occurrence of a signal from one wire pair radiating to and interfering with the signal of another wire pair. It is the difference in amplitude (in dB) between a transmitted signal and the crosstalk received on other cable pairs at the same end of the cabling. Higher NEXT values correspond to better cabling performance. A higher value is desirable as it would indicate that the power transmitted is greater in magnitude than the power induced onto another wire pair given that the NEXT measurement is simply a difference calculation. NEXT must be measured from each pair to each other pair in twisted pair cabling and from each end of the connection. NEXT is measured 30 meters (about 98 feet) from the injector / generator. Lower near end crosstalk values correspond to higher overall circuit performance. High NEXT values on a UTP LAN that will be using an older signaling standard (IEEE 802.3i and earlier) are particularly detrimental. It could be an indication of improper termination. A PASS result means that the measured RL is lower than the specified limit for the selected test standard. A FAIL result means that the measured RL is higher than specified limit.

11. Power Sum NEXT

Power Sum NEXT (PSNEXT) is the sum of NEXT values from 3 wire pairs as they affect the other wire pair. The combined effect of NEXT can be very detrimental to the signal.

	Worst Case Margin		Worst Case Value	
PASS	MAIN	SR	MAIN	SR
Worst Pair	45-78	12-36	12-36	12-36
NEXT (dB)	10.3	14.1	10.6	14.1
Freq. (MHz)	60.3	91.3	91.5	91.3
Limit (dB)	33.9	30.8	30.7	30.8
Worst Pair	36	12	36	12
PSNEXT (dB)	11.9	15.7	11.9	15.7
Freq. (MHz)	91.3	91.5	91.5	91.5
Limit (dB)	27.8	27.7	27.7	27.7

Cable ID: C03-03
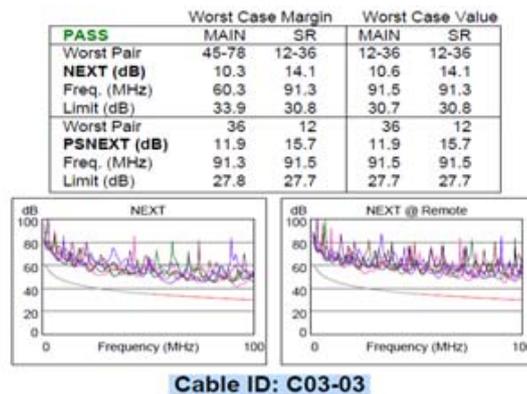
Figure 5.   Example of NEXT and PSNEXT tests (PASS)

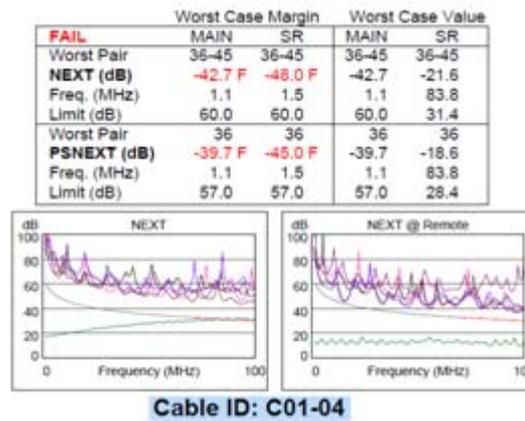|	Worst Case Margin		Worst Case Value	
FAIL	MAIN	SR	MAIN	SR
Worst Pair	36-45	36-45	36-45	36-45
NEXT (dB)	-42.7 F	-48.0 F	-42.7	-21.6
Freq. (MHz)	1.1	1.5	1.1	83.8
Limit (dB)	60.0	60.0	60.0	31.4
Worst Pair	36	36	36	36
PSNEXT (dB)	-39.7 F	-45.0 F	-39.7	-18.6
Freq. (MHz)	1.1	1.5	1.1	83.8
Limit (dB)	57.0	57.0	57.0	28.4

Cable ID: C01-04

Figure 6. Example of NEXT and PSNEXT tests (FAIL)

12. The Equal-Level Far-End Crosstalk

The Equal-Level Far-End Crosstalk (ELFEXT) test measures Far-End Crosstalk (FEXT). FEXT is very similar to NEXT, but happens at the receiver side of the connection. Due to impedance on the line, crosstalk diminishes the signal as it gets further away from the transmitter. Because of this, FEXT is usually less detrimental to a signal than NEXT, but still important nonetheless. A pass result indicates that the NEXT between the cable pairs was higher than the specified NEXT for the selected test standard. A fail result indicates that the NEXT was lower than specifications.

13. Power Sum Elfext

Power Sum ELFEXT (PSELFEXT) is the sum of FEXT values from 3 wire pairs as they affect the other wire pair.
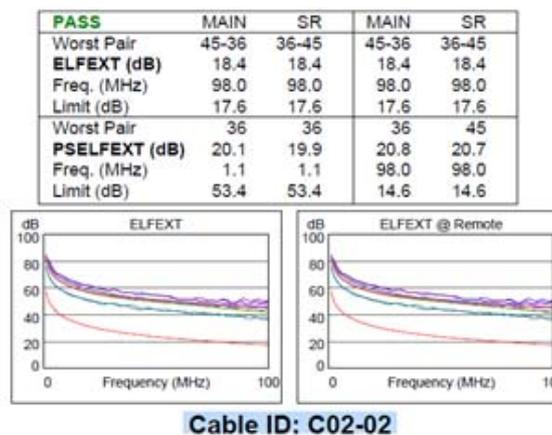

PASS	MAIN	SR	MAIN	SR
Worst Pair	45-36	36-45	45-36	36-45
ELFEXT (dB)	18.4	18.4	18.4	18.4
Freq. (MHz)	98.0	98.0	98.0	98.0
Limit (dB)	17.6	17.6	17.6	17.6
Worst Pair	36	36	36	45
PSELFEXT (dB)	20.1	19.9	20.8	20.7
Freq. (MHz)	1.1	1.1	98.0	98.0
Limit (dB)	53.4	53.4	14.6	14.6

Cable ID: C02-02

Figure 7. Example of ELFEXT and PSELFEXT tests (PASS)

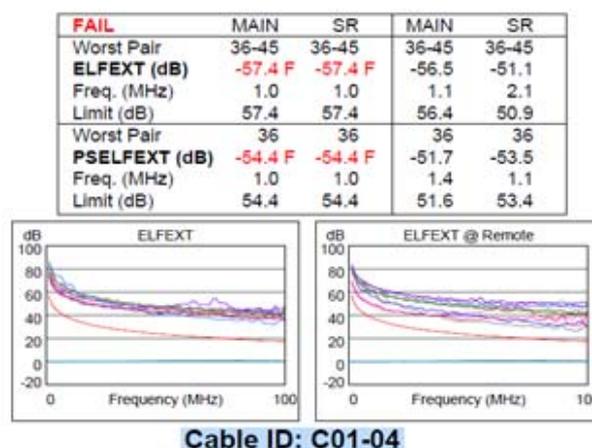| **FAIL**	MAIN	SR	MAIN	SR
Worst Pair	36-45	36-45	36-45	36-45
ELFEXT (dB)	-57.4 F	-57.4 F	-56.5	-51.1
Freq. (MHz)	1.0	1.0	1.1	2.1
Limit (dB)	57.4	57.4	56.4	50.9
Worst Pair	36	36	36	36
PSELFEXT (dB)	-54.4 F	-54.4 F	-51.7	-53.5
Freq. (MHz)	1.0	1.0	1.4	1.1
Limit (dB)	54.4	54.4	51.6	53.4

Cable ID: C01-04

Figure 8. Example of ELFEXT and PSELFEXT tests (FAIL)

14.Attenuation-to-Crosstalk Ratio

Attenuation-to-Crosstalk Ratio (ACR) is the difference between the signal attenuation produced and NEXT and is measured in decibels (dB). The ACR indicates how much stronger the attenuated signal is than the crosstalk at the destination (receiving) end of a communications circuit. The ACR figure must be at least several decibels for proper performance. If the ACR is not large enough, errors will be frequent. In many cases, even a small improvement in ACR can cause a dramatic reduction in the bit error rate. Sometimes it may be necessary to switch from un-shielded twisted pair (UTP) cable to shielded twisted pair (STP) in order to increase the ACR.

15.Power Sum ACR

Power Sum ACR (PSACR) has done in the same way as ACR, but using the PSNEXT value in the calculation rather than NEXT.
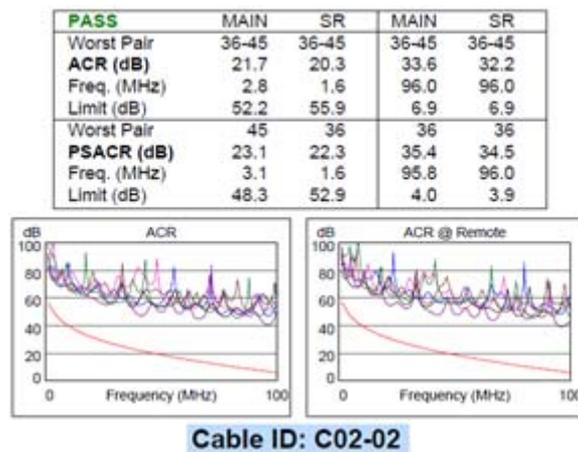
PASS	MAIN	SR	MAIN	SR
Worst Pair	36-45	36-45	36-45	36-45
ACR (dB)	21.7	20.3	33.6	32.2
Freq. (MHz)	2.8	1.6	96.0	96.0
Limit (dB)	52.2	55.9	6.9	6.9
Worst Pair	45	36	36	36
PSACR (dB)	23.1	22.3	35.4	34.5
Freq. (MHz)	3.1	1.6	95.8	96.0
Limit (dB)	48.3	52.9	4.0	3.9

Cable ID: C02-02

Figure 9.   Example of ACR and PSACR tests (PASS)

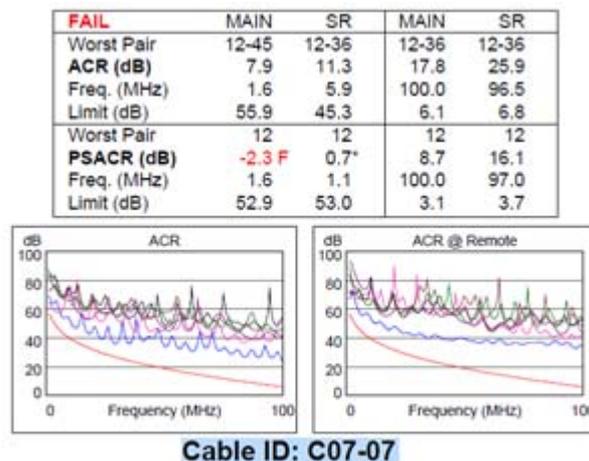| FAIL	MAIN	SR	MAIN	SR
Worst Pair	12-45	12-36	12-36	12-36
ACR (dB)	7.9	11.3	17.8	25.9
Freq. (MHz)	1.6	5.9	100.0	96.5
Limit (dB)	55.9	45.3	6.1	6.8
Worst Pair	12	12	12	12
PSACR (dB)	-2.3 F	0.7*	8.7	16.1
Freq. (MHz)	1.6	1.1	100.0	97.0
Limit (dB)	52.9	53.0	3.1	3.7

Cable ID: C07-07

Figure 10.   Example of ACR and PSACR tests (FAIL)

16.DC Loop Resistance

DC Loop Resistance measures the total resistance through one wire pair looped at one end of the connection. This will increase with the length of the cable. DC resistance usually has less effect on a signal than insertion loss, but plays a major role if power over Ethernet is required. Also measured in ohms is the characteristic impedance of the cable, which is independent of the cable length.

17.Conclusion

This research paper concentrates on the various properties of the network transmission's both hardware and software components which may lead to establish the Reliable shortest path between the nodes. The various tests for the hardware's network components and the standard verification is done which is explained

in the paper. If results be pass means path is Reliable which by using shortest path algorithms, we can select from reliable paths, shortest path.

18. References

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