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Implementation and Analysis of LCAS (Link Capacity Adjustment Scheme) Encapsulation on Ethernet Over SDH (Synchronous Digital Hierarchy) for A Reliable Network

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Abstract

Ethernet over SDH (Synchronous Digital Hierarchy) is a popular technology that is able to fulfill the need of reliable and fast data transmission, Ethernet over SDH is able to provide throughput up to 10 Gbps. However, one problem is found when the throughput is being downgraded or upgraded, in Ethernet, the change of throughput value can lead to an interrupt traffic, which is shown by the decline of the throughput value to 0 Mbps. One solution that can be applied to overcome the problem is the LCAS encapsulation. With LCAS, the change of throughput will have no negative effect in the network. The result of this research shown that LCAS is able to avoid interrupt traffic, it is shown that for the LCAS implemented network, the throughput value is only change in accordance to the downgrade and upgrade value, thus maintain the reliability of the network. Meanwhile, for the network that is not implemented with LCAS, the throughput value is decline to 0 Mbps.

Keywords : *Downgrade, Ethernet over SDH, LCAS, throughput, upgrade*

1 INTRODUCTION

Ethernet over SDH (Synchronous Digital Hierarchy) is a technology that enables the payload transmission process is working in synchronous because it uses clock to synchronize the sources bits with the receivers bits. Moreover, Ethernet over SDH is able to provide a fast data transmission with throughput up to 10 Gbps. However, a problem, which is interrupt traffic, arises when the throughput is downgraded or upgraded. Interrupt traffic occurs because when the throughput value is changed, the network will do the cross-connect creation and traffic restarting processes, which are time consuming, thus, cannot accommodate the change. In order to solve this problem, LCAS (Link Capacity Adjustment Scheme) encapsulation technology is presented. One advantage of LCAS encapsulation is, the change of the throughput value will not lead to the interrupt traffic. Ethernet over SDH and LCAS encapsulation are described further in below subsections.

1.1 Ethernet over SDH

Ethernet over SDH is an improvement of the existing SDH. Ethernet over SDH is able to provide not only fast data transmission, but also a reliable network. Two techniques that allow Ethernet traffic to flow in an SDH network is the GFP (Generic Framing Procedure) and the VCat (Virtual Concatenation). The GFP provides functions to adjust the Ethernet traffic to flow in the SDH network; meanwhile the VCat is able to separate the GFP-adapted traffic into different paths in the SDH network.

1.2 LCAS

ITUT Recommendation G.7042/Y.1305 described a protocol that is able to dynamically increase or decrease the available throughput. This method is called LCAS and it allows the throughput value to be adjusted without having interrupt traffic. Illustration of the LCAS can be seen in Figure 1.

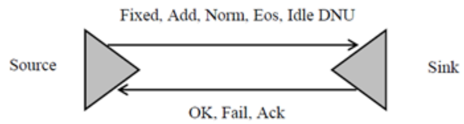

Figure 1: LCAS Illustration

This paper will present the result of the simulation of LCAS encapsulation to an Ethernet over SDH, which prove that LCAS encapsulation will be able to maintain the network reliability.The rest of this paper is organized as follows: In Section 2, the implementation of LCAS on Ethernet over SDH is described. In Section 3, the simulation result as well as the analysis of the result is presented. Finally, the conclusions are discussed in Section 4.

2 IMPLEMENTATION OF LCAS ON ETHERNET OVER SDH

2.1 Simulation Design

This research uses the Multiplexer MN Series 2300, 3100 and 4100. The multiplexers are designed in accordance with the ring topology and it uses 1+1 SNCP (Sub-network Connection Protection) protection. Moreover, the primary route (the working route) is using STM-64 and the secondary route (the protection) is using STM-16. These protections are used to minimalize an error in the SDH transport route when the simulation is run.

Figure 2 illustrates the simulation design that is used in this research, the connection between the multiplexer and the NMS (Network Monitoring System) has to be connected well so that the multiplexer can be monitored in the NMS also it can be configured remotely.

In order to get the result from the network, a BER test tool is used, the series of the BER tester is EXFO-FTB200. Once the entire network element integrated nicely with the NMS, the BER tester is connected to the Ethernet card. The next step is to create the DXC (Digital Cross Connect) of the VC (Virtual Container). There are three level VCs that are used in this research, they are VC-12, VC-3 and VC-4. Each VC has different standard of throughput value, VC-12 has 2.084 Mbps, VC-3 has 48.384 Mbps, and VC-4 has 155.52 Mbps. The purpose of using three different VCs is to show the characteristic of each VC

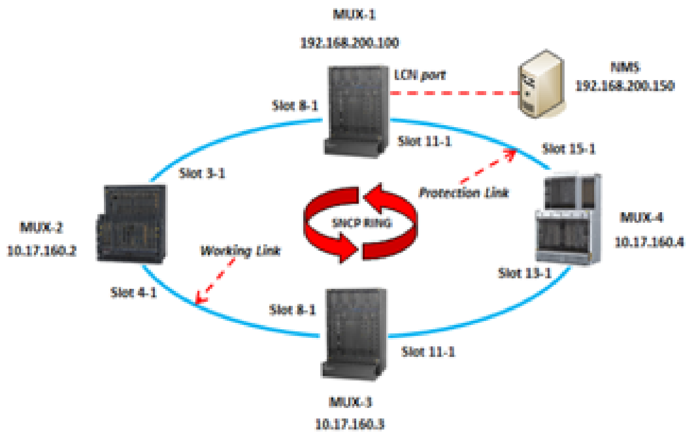

Figure 2: Simulation Design

Table 1: Throughput Allocation for Each VC

Level	Throughput Allocation
VC-12	10.24 Mbps = 5 x VC-12
VC-3	241.92 Mbps = 5 x VC-3
VC-4	777.6 Mbps = 5 x VC-4

when implemented with the Ethernet over SDH. Once the creation of the DXC is done, the next step is to allocate the throughput or making the VCG (Virtual Container Group) on the Ethernet card. This throughput is allocated in MUX 1 and MUX 3, which will play the role of the sender and receiver, respectively. The throughput allocation for each VC level can be seen in Table 1.

The above throughput allocation will be the existing throughput, which is used as the initial point, furthermore, the existing throughput will be downgraded and upgraded to see the effect on the network performance. The result of the simulation is presented in Section 3.

3 RESULTS AND ANALYSIS

The scenario for the simulation is as follow, on each level of the VC (VC-12, VC-3, and VC-4) will be run simulation in the form of throughput downgrade and upgrade. The simulation will be run on a LCAS-implemented Ethernet over SDH network and on a Ethernet over SDH without LCAS. The result will be compared to prove that LCAS is able to prevent the interrupt traffic. The value of throughput after the downgrade and upgrade is shown in the BER tester. The scenario for the simulation can be seen in Table 2.

From the above table can be seen that there are in total 12 downgrading and upgrading scenarios, where the first simulation is by downgrading the throughput of the VC-12 from 5 x VC-12 (10.24 Mbps) by the value of 2 x VC-12 (4.168 Mbps), the second simulation is by downgrading the throughput of the VC-12 from 5 x VC-12 (10.24 Mbps) by the value of 4 x VC-12 (8.336 Mbps), and so on until the twelfth simulation where the throughput of VC-4 is

Table 2: Scenario for Downgrading and Upgrading theThroughput

Level	Existing throughput	Downgrade throughput	Upgrade throughput
VC-12	5 x VC-12 = 10.24 Mbps	2 x VC-12 = 4.168 Mbps	6 x VC-12 = 12.504 Mbps
		4 x VC-12 = 8.336 Mbps	7 x VC-12 = 14.588 Mbps
VC-3	5 x VC-3 = 241.92 Mbps	2 x VC-3 = 96.768 Mbps	6 x VC-3 = 290.304 Mbps
		4 x VC-3 = 193.536 Mbps	7 x VC-3 = 338.688 Mbps
VC-4	5 x VC-4 = 777.6 Mbps	2 x VC-4 = 311.04 Mbps	6 x VC-4 = 933.12 Mbps
		4 x VC-4 = 622.08 Mbps	7 x VC-4 = 1088.64 Mbps

Table 3: VC-12 Simulation Result

Existing Throughput	No.	Downgrade/Upgrade Throughput	Throughput After Downgrade/Upgrade	
			Without LCAS	With LCAS
5 x VC-12 = 10.24 Mbps	1	2 x VC-12 = 4.168 Mbps	0 Mbps	6.072 Mbps
	2	4 x VC-12 = 8.336 Mbps	0 Mbps	1.904 Mbps
	3	6 x VC-12 = 12.504 Mbps	0 Mbps	22.744 Mbps
	4	7 x VC-12 = 14.588 Mbps	0 Mbps	24.828 Mbps

upgraded from 5 x VC-4 (777.6 Mbps) by the value of 7 x VC-4 (1088.64 Mbps). Each of the above scenarios is run without and with LCAS implemented, therefore, there are in total 24 simulations.

The result for VC-12 simulation with and without LCAS implemented can be seen in Table 3.

Figure 3 illustrates the comparison graph of the VC-12 simulation between the without LCAS implemented and with LCAS implemented.

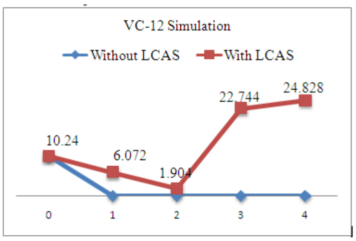

Figure 3: VC-12 Simulation Comparison Graph Between the Without LCAS Implemented and With LCAS Implemented

From the Table 3 and Figure 3 it can be seen that when LCAS is not implemented, the change in the value of the throughput will result in the decline of the throughput value to 0 Mbps, this mean there is an interrupted traffic. Meanwhile, when LCAS is implemented, the change in the value of the throughput will only change the throughput in accordance with the changed value. For example, in simulation no. 1, the existing throughput is 5 x VC-12

Table 4: Examples of writing table

Existing Throughput	No.	Downgrade/Upgrade Throughput	Throughput After Downgrade/Upgrade	
			Without LCAS	With LCAS
5 x VC-3 = 241.92 Mbps	1	2 x VC-3 = 96.768 Mbps	0 Mbps	145.152 Mbps
	2	4 x VC-3 = 193.536 Mbps	0 Mbps	48.384 Mbps
	3	6 x VC-3 = 290.304 Mbps	0 Mbps	532.224 Mbps
	4	7 x VC-3 = 338.688 Mbps	0 Mbps	580.608 Mbps

(10.24 Mbps), then it is downgraded by the value of 2 x VC-12 = 4.168 Mbps, and from the BER tester can be seen that the current throughput is 6.072 Mbps, which is only a reduction between the existing throughput and the downgraded value.

The result for VC-3 simulation with and without LCAS implemented can be seen in Table 4.

Figure 4 illustrates the comparison graph of the VC-3 simulation between the without LCAS implemented and with LCAS implemented.

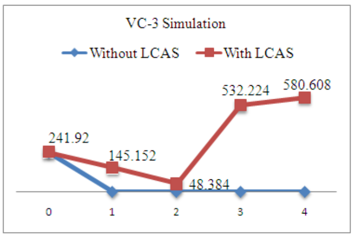

Figure 4: VC-3 Simulation Comparison Graph Between the Without LCAS Implemented and With LCAS Implemented

It can be concluded from the Table 4 and Figure4that when LCAS is not implemented, and when the throughput value is changed, then the current throughput value is down to 0 Mbps, meanwhile, when LCAS is implemented, the change in the value of the throughput will only deduct or add the existing value with the changed value, the same with the VC-12 simulation. The result for VC-4 simulation with and without LCAS implemented can be seen in Table 5.

It can be concluded from Table 5 that LCAS is able to prevent the interrupt traffic because when LCAS is implemented, the change of the throughput value will not bring down the current throughput to 0 Mbps, the current throughput value will only change in accordance to the downgraded and upgraded value instead. For example in simulation number 4, the existing throughput is 777.6 Mbps, then it is upgraded by 1088.64 Mbps, the result is, the current throughput is 1866.24 Mbps, which is an addition between the existing throughput and the upgraded throughput.

Figure 5 illustrates the comparison graph of the VC-4 simulation between the without LCAS implemented and with LCAS implemented.

Table 5: VC-4 Simulation Result

			Throughput After Downgrade/Upgrade	
Existing Throughput	No.	Downgrade/Upgrade Throughput	Without LCAS	With LCAS
	1	2 x VC-4 = 311.04 Mbps	0 Mbps	466.56 Mbps
5 x VC-4 = 777.6 Mbps	2	4 x VC-4 = 622.08 Mbps	0 Mbps	155.52 Mbps
	3	6 x VC-4 = 933.12 Mbps	0 Mbps	1710.72 Mbps
	4	7 x VC-4 = 1088.64 Mbps	0 Mbps	1866.24 Mbps

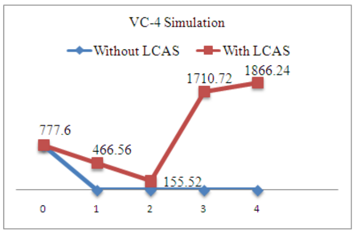

Figure 5: VC-4 Simulation Comparison Graph Between the Without LCAS Implemented and With LCAS Implemented

4 CONCLUSION

Conclusions that can be derived from this research are:

1. The simulations that are run in the non-LCAS network shows that by downgrading or upgrading the throughput then there is interrupt traffic, which is indicated by the current throughput value decline to 0 Mbps.

2. Meanwhile, the simulations that are run in the LCAS-implemented network show that the throughput values only change in accordance with the downgrade and the upgrade value.

3. According to the above results, LCAS is proven to be able to avoid the interrupt traffic, thus, maintaining the reliability of the network.

References

Alberti, Antonio MarcosandFernandes, Roulien, (2011), Ethernet-over-SDH: Technologies Review and Performance Evaluation. *Revista Telecomunicaes*, Vol. *13*, No. 01.

ITU-T., (2011), *Recommendation G.7042/Y.1305, Link Capacity Adjustment Scheme (LCAS) for Virtual Concatenated Signals.*

ITU-T., (2003), *Recommendation G.7041/Y.1303, Generic Framing Procedure (GFP).*

ITU-T., (2000), Recommendation G.707/Y.1322, *Network Node Interface for the Synchronous Digital Hierarchy (SDH).*