International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-2, December 2019

Factor Influencing the Convergence Time in Border Gateway Protocol (BGP)

Kashif Ishaq, Adnan Abid, Kamran Abid, Qasim Ali, Mustansar Ijaz,

Abstract: ***Border Gateway Protocol (BGP) is the protocol which helps to route the traffic over the internet, it also helps to interchange reachability and routing information between diverse Autonomous systems (AS). The major operations of Border gateway Protocol (BGP) takes place at transport layer. When BGP works with TCP it removes the need for acknowledgement, sequence number. The major problem which occurs over the network is due to delay during the process of path selection and due to change in routing table [2]. This degradation convergence and delay can occur due to defined policy in between the peers of network. BGP performance can be improved by implementing different techniques such as MD5 Authentication, 16 bits Autonomous system, 32 bits Autonomous system, Classless Inter Domain Routing (CIDR), IPSec over BGP and consistency assertions. In this paper we have used CIDR technique to enhance BGP performance as well as we have focused on identifying and calculating affects on convergence time of BGP protocol due to the variation in the number of nodes and complex topology design. We have designed simulation based topology over OpNet, to analyze the impact of convergence time of BGP. Simulation results show that we can minimize the convergence time due to link failure.***

Keywords: ***Border Gateway Protocol (BGP), Autonomous systems (AS), Route Flap Damping (RFD), Transmission Control Protocol (TCP), Finite State Machine (FMS)***

I. INTRODUCTION

Border gateway protocol (BGP) is a de- Facto protocol which helps routers to interchange routing information between different AS. BGP makes decision for path selection according to the policies and constraints defined in the network, but selection of path on the foundation of hop count is done by other distance vector protocol. The researchers have found that BGP has an issue with the convergence time, many researchers have proposed multiple solutions for it. And many of these alternatives have an ability to provide faster convergence comparatively BGP [1]. BGP has faced major issue due to the fluctuation of routing table and convergence time is also increased due to the path selection between different AS [2]. Another reason for delayer convergence and instability is local policies used for the network.

Revised Manuscript Received on December 30, 2019.
***** Correspondence Author
Kashif Ishaq*, Universiti Kebangsaan Malaysia (MALAYSIA) Email.id P97710@siswa.ukm.edu.my.
Dr. Adnan Abid, University of Management and Technology (PAKISTAN) Email.id adnan.abid@umt.edu.pk
Dr. Kamran Abid, University of the Punjab Email.id kamran@pu.edu.pk .
Qasim Ali, University of Management and Technology (PAKISTAN) Email.id qasimali15001@gmail.com
Mustansar Ijaz, University of Management and Technology (PAKISTAN) Email.id mustansar_ijaz@ymail.co

BGP has an ability to overcome these issues because BGP used its own standardized mechanism [3].

In this paper we discuss the factors which effects the convergence time of BGP. For this purpose we have designed two different sized topologies. First network is small sized fully mesh and the other network is large and complex but it is be fully meshed as well. We have performed different experiments of link failure and node failure to monitor the convergence time of BGP. And CIDR mechanism is being used among different AS to minimize convergence time of BGP.

II. RELATED WORK

Many investigators have introduced solutions to minimize convergence time of BGP. E.A Alabdulkreem et al. [4] explains that BGP has convergence issue and they have introduced fight or flight system to improve BGP's convergence and according to the results they have improved BGP convergence time by 29%. Similarly another mechanism is introduced by modifying Route Flap Damping (RFD) mechanism. Operators normally turned off the RFD. E.A Alabdulkreem et al. [5] describes that RFD is modified by enabling it and inserting new values in it. This will help to minimize the convergence time of BGP. Researchers have proposed different mechanism to overcome this issue of convergence time of BGP.

A. BGP Operations

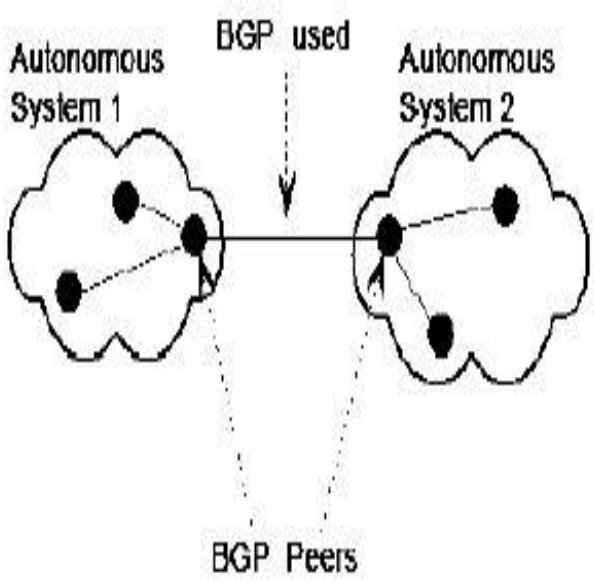


Fig-1 Two AS having BGP peers

Maximum of the operations of BGP are performed over transport layer of OSI reference model, whereas reliability of BGP is attained by using connection oriented protocol over transport layer named as Transmission Control Protocol (TCP). TCP 179 port is being used by BGP to exchange different message types between different AS within the network. The major operation of Border Gateway protocol is to create Peer by exchanging routing information in network with the help of TCP connection.

There are two terminologies "speaker" and "neighbour" are being used to identify peer in network [6]. The Fig-1 is clarifying to two BGP autonomous systems peer relation. Burst message through BGP is being sent to the peers to advertise the local routes [7]. After the routing process completed in network all the routing tables are exchanged between neighbouring routers. Non participating BGP peers are remove from routing tables, this updating of routing tables is a continuous process [8].

B. Types of BGP

There are three types of BGP these types are as follows.The Exterior Border Gateway Protocol (EBGP) helps to create connection between routers to form neighbour relationship in different AS. The Interior Border Gateway Protocol helps to develop connection between routers to form neighbour relationship with in same AS. Pass through is the type of BGP wich helps to develop a connection between two or more than two peers on BGP, which is exchanging traffic with non BGP AS [9]. Finite State Machine-BGP Finite state machine (FSM) is the principle function according to which BGP works. As BGP process starts in router, FSM starts with that. Different stages are defined in every state of FSM-BGP. These states are followed by BGP router during the runtime process of BGP [10]. The key goal of this paper is to identify those factors which effects the convergence time of BGP. For this purpose we have use OpNet simulation software to perform our experiments on two different topologies. We have designed two different fully meshed networks one is small and the other network is large and complex as well. to identify the convergence time of BGP we have performed different experiments based on different scenarios it is explained in result and evaluation section of this paper.

III. TOPOLOGY DESIGN

A. BGP Simulation We have used the OPNet simulator to perform our experiments and to ananlyze tresults. OPNet is simulator which is extensively used by the network researchers for perform various experiments. We have designed two different sized networks but both are fully meshed. We have configured BGP so that all the peers AS can easily swap their routing information with their neighbouring routers. We use CIDR technique which helps to summarize over routing tables inside the routers. These simulations have been shown in Fig-2 and Fig-3. For performing the experiments using the different sized topologies as mentioned earlier in this paper. First topology design is full mesh small sized network. It consists of four different Autonomous systems (AS).BGP is enabled on all these AS to exchange their routing information with other AS connected in mesh as shown in fig-2.

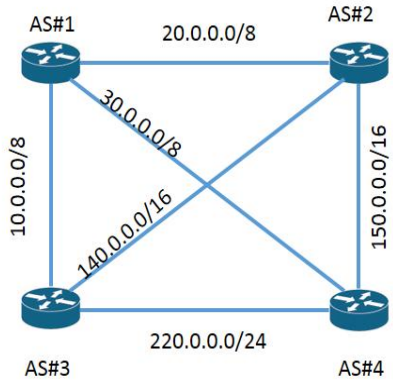


Fig-2: Small topology design based on 4 AS

Other network is fully meshed as well but it consists of 8 number of AS. These all autonomous systems are connected in fully mesh topology. And all these AS are sharing their routing information with each other by using BGP over the wide area network as shown in fig-3.

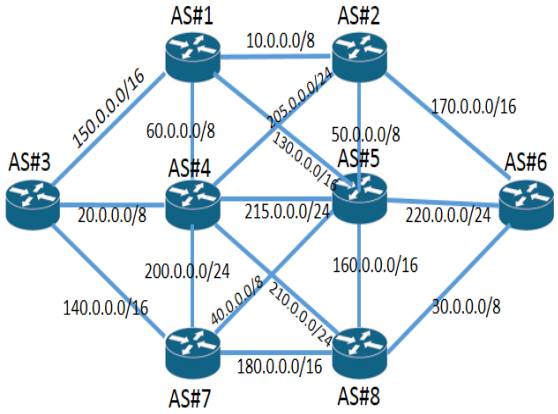


Fig-3 Large network model based on 8 AS

IV. RESULTS AND EVALUATION

To analyze the performance of BGP different scenario has been made for both small and large network to perform different experiment. These scenarios are as follows

i. Single Link Failure
ii. Multi Link Failure
iii. Single Node Failure
iv. Multi Node failure

While performing experiment over the small topology BGP is not affecting due to single link or multi link failure, because BGP is a very efficient protocol to reroute the traffic over different link. But when we perform an experiment of single node or multi node failure BGP take some time to recreate the routing tables according to the topology Fig-5 shows all the detail about affect on BGP. And Fig-4 indicate the convergence time of BGP in case of node failure

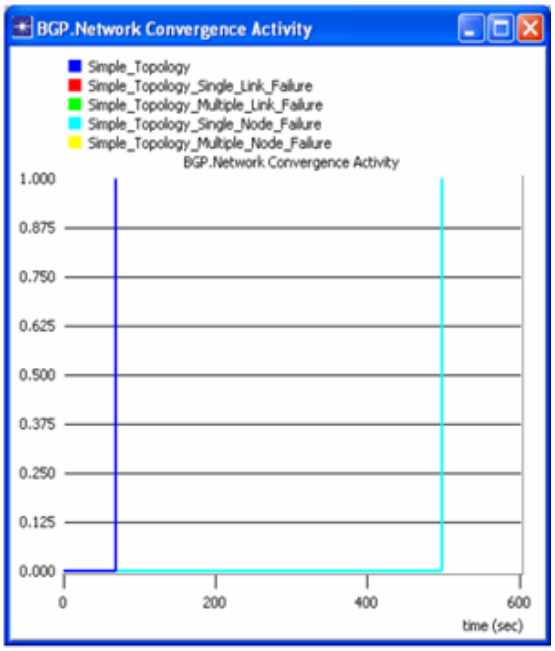


Fig-4 BGP convergence during node failure

As it is very clearly observe in Fig-4 that Link failure does not affect the convergence time of BGP. This small sized network consists of 4 router which are connected in full mesh topology, Full mesh between these routers help BGP to solve this link failure issue [11]. Similarly, CIDR (Classless Inter Domain Routing) IP Addressing also helps to prevent from consuming more convergence time by BGP. CIDR provides efficient super netting feature which helps in updating the routing tables of the router in case of link failover [12]. On the other hand full Mesh and CIDR cannot help BGP in minimizing convergence time in case of node failure. Because in case of node failure router re-exchange and advertise their routing information which effects the convergence time of BGP [13].

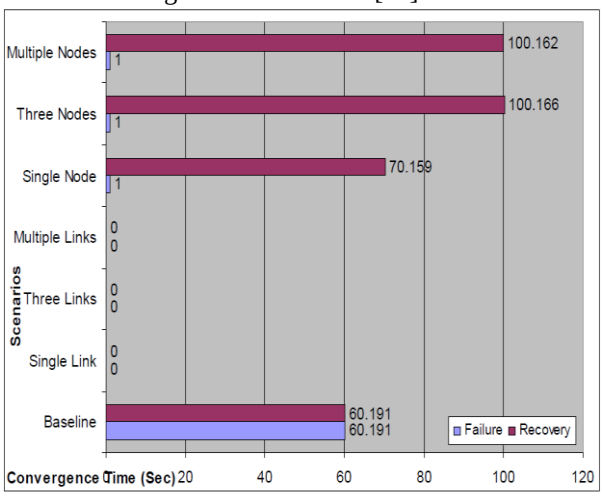


Fig-5 Detail of all experiments performed on small network

In consideration of large and complex network model in which we have 8 routers connected in full mesh. These 8 routers contain multiple Autonomous systems. While performing all above mentioned experiments on this complex network model we have observed that complexity in network model also affect the convergence time of BGP. Fig-6 indicates the convergence time of BGP due to single and multinode failure.

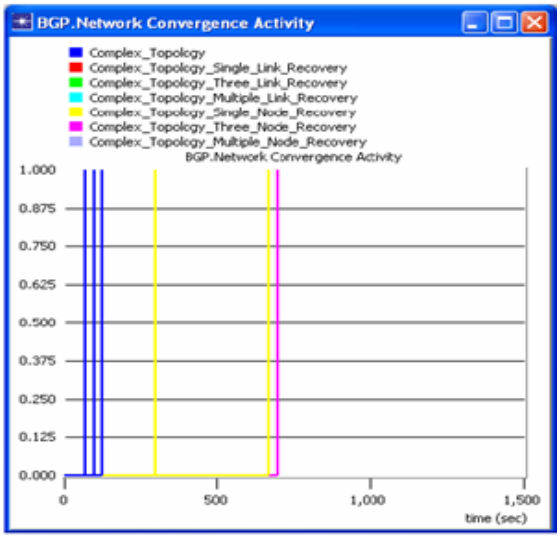
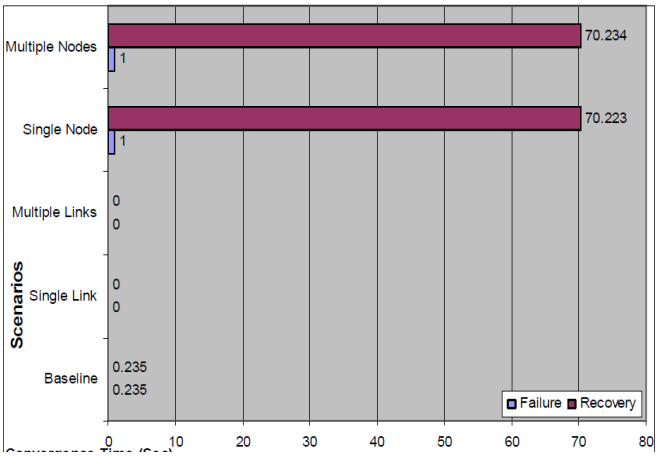


Fig-6 convergence time due to single and multi node failure

In the Fig-6, blue spikes indicate that topology is working properly when suddenly one the single node is failover, it takes few seconds to overcome a single node failure and yellow spike represents the convergence time taken by BGP in case of single node failure. When we have multi node failure in large network model, it is observed that the convergence time taken by BGP will also increase. Indigo coloured spike indicate the convergence time of BGP in case of multi node failure. More over Fig-7 gives a detail analysis of all the experiments performed on complex topology design. It is undoubtedly observe that BGP can handle the single or multi link failure without taking any time. As it is mentioned in previously performed experiments, that full mesh and CIDR is actually helping BGP, to prevent from high convergence time for complex network. On the other hand BGP cannot handle node failure in large networks as well. Infect it takes more convergence time as compare to the small topology. Because when multi node failover occurs in large network, all routers inside the network will advertise their routing information to all their neighbouring routers. This advertisement of prefixes to all the neighbouring routers will increase the time to update the routing tables of all routers [14]. This is the reason the convergence time of BGP is severely affected due to multi node failure.



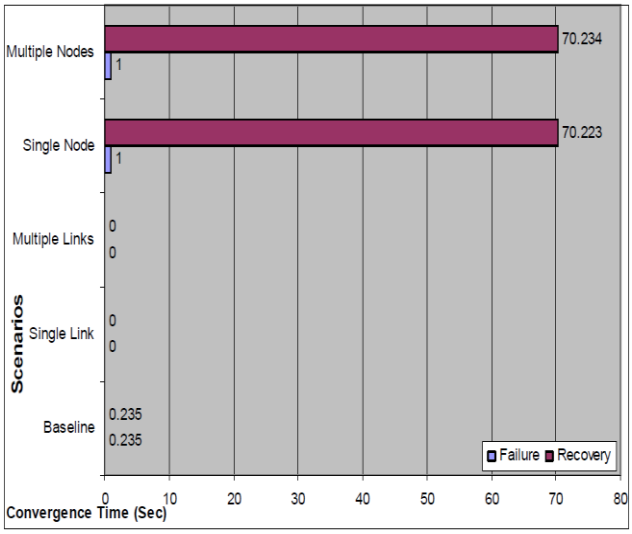


Fig-7 Detail of all experiments performed on large network

V. CONCLUSION

In concluding all above discussion we have analyzed those factors which effect the convergence time of BGP such as link failure and node failure. To minimize this convergence time of we have used CIDR technique. According to the simulation results the convergence time increases due to the complexity of the network when we have more number of AS in network. With the help of CIDR technique we can minimize the convergence time of BGP due to link failure but due to node failure convergence time cannot be minimized.

VI. REFERENCES

1. Filsfils, C., Bettink, J.,Mohapatra, P., De Vriendt, P., Tsier, Y., & Francois, P. BGP prefix independent convergence (PIC) technical report, 2011, Cisco Tech Rep.
2. Mujtaba, M.,He, X., & Nanda, P.June, 2012. In Trust, Security and Privacy in Computing and Communications (TrustCom), Border gateway protocol anomaly detection using failure quality control method, 2012 IEEE 11th International Conference on (pp. 1239-1244) IEEE.
3. Reyes, R. C. H. & Alzate, J. R, May, 2012 Evaluation of improvement proposals for Border Gateway Protocol (BGP), In Communications Conference COLCOM, IEEE Colombian, pp, 1-6
4. Alabdulkreem, E.A., H. S. Al-Raweshidy (2014). Using a fight-or-flight mechanism to reduce BGP convergence time. In Communications and Networking (ComNet), 2014 International Conference on. Tunisia, 22 March 2014. IEEE: pg 2-4
5. E.A, Alabdulkreem, (2016). Route flap damping mechanism modification to improve BGP convergence. In Electrical and Computer Engineering (CCECE), 2016 IEEE Canadian Conference on. Canada, May, 2016. IEEE.
6. Haxell, P. E.& Wilfong, G. T, January, 2008 A fractional model of the border gateway protocol BGP, Society for Industrial and Applied Mathematics, In Proceedings of the nineteenth annual ACM-SIAM symposium on Discrete algorithms pp. 193-199.
7. Buzzi, L., Siracusa, D., Paolucci, F., Bardellini, M. C., Cugini, F., Castoldi, P., & Maier, G., May, 2010. Hierarchical border gateway protocol (HBGP) for PCE-based multi-domain traffic engineering. IEEE international conference ICC on pp. 1-6
8. Masahito, A., Masayuki, O., (2017). Simulation Study of BGP Origin Validation Effect against Mis-Origination with Internet Topology. In Information Security (AsiaJCIS), 2017 12th Asia Joint Conference on. South Korea, Aug 2017. IEEE: IEEE. 1-2
9. Cisco, (2011). BGP Commands: M through neighbor soo, Cisco Paper, [Online], Available from: http://www.cisco.com/c/en/us/td/docs/ios/iproute_bgp/command/reference/irg_book/irg_bgp3.html [Last Accessed:, December, 2017].
10. Muthuswamy, P. K., Kar, K., Gupta, A., Karaoglu, H. T., & Yuksel, M. (2012, June). ISPs as nodes or sets of links?. In Communications (ICC), 2012 IEEE International Conference on (pp. 2796-2800). IEEE.
11. Huston, G., Rossi, M., & Armitage, G. (2011). Securing BGP—A literature survey. Communications Surveys & Tutorials, IEEE, 13(2), 199-222.
12. Amin, S., Ahthasham, S., Shaikh, A. A., Sajid, A., & Mehmood, M. A. (2012). Improvement of BGP Session Maintenance. International Journal of Engineering & Technology, 1(2), 94-104.
13. Schapira, M., Zhu, Y., & Rexford, J. (2010, October). Putting BGP on the right path: A case for next-hop routing. In Proceedings of the 9th ACM SIGCOMM Workshop on Hot Topics in Networks (p. 3). ACM.
14. Patel, K., Chen, E., & Venkatachalapathy, B. (2014). Enhanced Route Refresh Capability for BGP-4 (No. RFC 7313).