

Modified Multipath Routing Protocol Applied On Ns3 Dcell Network Simulation System

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Abstract—In communication networks, guidance has become an important factor, with a significant impact on network performance, where the network orientation area has been and continues to be an ongoing development, intensive research for many years aimed at optimizing the network. This paper performs three modifications for a multipath routing protocol to solve the problem of routing in a DCell network simulation and apply online solutions on the network, the goal is to improve the transition efficiency of data. The modifications used to avoid data transmission failures which are delay problem, link failure problem, and power off (rack problem). The implementation multipath routing protocol on DCell network in actual simulation using the NS-3 program, which represents the rule that the DCell network was built and simulated. Finally, the modifications succeeded and return good results decreasing the delay time and solving the data transaction problems.

Keywords—Communication networks, multipath routing protocol, DCell network simulation, data transmission, NS-3 program, link failure, rack problem

1 Introduction

Nowadays, Internet technologies deliver communication services universally. Though, there are definite districts that absent decent substructure to use all the services. In a disastrous place like floods and trembling, the communication systems suffer severely, resulting in the breakage of the links [1]. Therefore, in such circumstances, effectual system design is so essential that it distributes the data in the lack of necessary system infrastructure[1]. Routing is the procedure to gain information and distribute it from one node to another within a network [2]. Routing is accomplished via numerous procedures that create routing tables in the network. Although distributing, an intermediate node is established. Decisions are made to direct the packet via an address that exists within the packet header [3]. Dual choices are establishing Static Besides Dynamic-Routing. Static-Routing is to organize the table manually, requiring routes to each endpoint in the network. Dynamic Routing by which the routing

tables are kept automatically founded on the communication concerning dissimilar routers. As mentioned, Routing is the procedure of choosing the finest routes within a network. Formerly, the word routing was furthermore utilized to mean furthering network traffic between networks[4]. On the other hand, this latter function is greatly improved, labeled as basically furthering. Routing is executed for numerous types of networks, containing the telephone network (circuit switching), electronic data networks (for example, the Internet), plus transportation networks. Routing guides packet sending (the transit of logically addressed network packets from the source headed for their final destination) over intermediate nodes. Intermediate nodes usually are network hardware devices, for instance, routers gateways, bridges, firewalls, or else switches. General-purpose computers may too send packets and execute Routing; however, they aren't specific hardware plus could perform incomplete execution. The routing process typically directs advancing based on routing tables that preserve a record of the routes to numerous network destinations. Therefore, creating routing tables kept in the router's memory is significant for effective Routing. The majority of routing algorithms utilize individual network paths at a time. Multipath routing methods allow the utilize of numerous other paths[5]. In the situation of overlapping/equal routes, the succeeding elements are counted to select routes that obtain the installation in the routing table (organized via importance): Prefix-Length: the lengthier subnet masks are favored A. Metric: A lesser metric/cost is favored (a single usable with single and a similar routing protocol) B. Administrative distance: the favored distance is the lesser distance (individual usable among diverse protocols of routing)[6, 7].

Routing is frequently differed by bridging; Routing has developed the dominant form of addressing on the Internet. Bridging is extensively utilized in localized surroundings. The schemas of routing vary in the distribution semantics:

- Unicast provides information to a solitary exact node
- Broadcast provides information to every node within the network
- Multicast sends information to a collection of nodes that have an interest in getting the message
- Anycast sends information to someone who is not in the collection of nodes, normally a single adjacent to the basis
- Geo cast provides information to a geographic part

Unicast is the dominant procedure of internet information delivery [8-10].

2 Related Work

Many types of research focusing Routing and multipath routing algorithms, some of these researches include:

Dong-Bum Kim and Seung-Ik Lee, 2011, in their paper, said that the Ad-hoc network is developing to be extra significant in numerous parts for wireless communications. Inside a network, routing algorithms own an excessive effect on communication implementation. To diminish network overheads, this paper propositions a hybrid routing algorithm, named Group Hierarchical Routing (GHR) which is a grouping of

proactive plus reactive routing approaches. The evaluation with another hybrid-routing approach displays that Group Hierarchical Routing has fewer communication difficulties within route discovery besides maintenance, [11]. LI Lan¹, LI Li², CHEN Jianya³, 2012, the side that the Internet has developed an important portion of the worldwide communication structure. With the additional fresh services evolving, the present IP network cannot please the user requests in the upcoming. Currently, almost all routing scheme usually routes the traffic entirely across the single exposed distinct path, which is fundamentally slow in responding to congestion and traffic burst. Additionally, utilizing just one path frequently produces unused network sources. One path routing protocol, Open Shortest Path First (OSPF) experiences similar glitches. Another technique to crack the difficulties is Multipath-Routing. With improved sharing, the Multipath-Routing displays improved execution. This paper improves a multipath routing algorithm (DSMC) founded on the multi-metrics of the link bandwidth plus propagation suspension. Then, the simulation outcomes expose the advantage of multipath routing algorithm (DSMC) in different three characteristics that are improved load balancing, slighter queuing postponement, plus improved usual of network use[12]. S. Bhattacharjee and S. Bandyopadhyay, 2013 proposed interferences and congestion-aware routing path choosing algorithms for parallel distribution of data packets in wireless networks. The proposed method finds the node separate path pair with fewer coupling besides congestion levels of the load balancing scheme. In the set of path assortment process, mutually the inter path interference plus interference of nodes past the range of transmission are considered. Founded on the congestion level on every path, traffic is spread consequently on to every path pair. Simulation outcomes display that cramming and interfering aware multipath routing advances network Quality of Services (QoS)[13]. Zhang Yu-tong, 2017, said that the Computer Network has an unlimited outcome on enhancing the effectiveness of the communication system and application supplies within this lifetime. To begin a transmission path with movement features and develop the effectiveness of information transmission in Computer networks, the enhanced clustering routing protocol founded on node location via the smallest space routing competition mechanism was proposed in this paper. This clustering routing procedure offers full consideration to the location of commutation nodes and the transmission way in terms of clustering and routing path selection. The exceptional simulation outcomes display that the novel showed an enhanced clustering routing protocol founded on node location has improved communication performance in the parts of transmission interruption and network load matched with the conventional routing protocol such as AODV besides DSR. At the equal period, it has extra steady construction of cluster associated with further classic clustering routing protocol [14]. An important task in data center networking is in what way effectively connects a significantly cumulative amount of servers. Within this paper, a DCell a new network construction requires countless sorts for data center networking; it is a recursively defined structure. An important-level DCell is created from numerous low-level DCells, plus DCells on the identical level are entirely linked with everyone. DCell scales doubly exponentially as the node degree grows. DCell is fault-tolerant since it does not have a distinct point of the crash. Its distributed fault-tolerant routing protocol executes near shortest-path routing even in severe link or

node disasters. DCell furthermore delivers higher network capability than the basic tree-based structure for numerous kinds of services. Also, DCell can be incrementally extended as well as a partial DCell delivers similar pleasing features. Outcomes from theoretic analysis, simulations, plus experimentations display that DCell is a feasible interconnection structure for data centers [15]. Mobile ad-hoc network (MANET) shows an important part within the arena of communication. Because of the node's dynamic movement, the network structure is regularly altered. Altogether nodes can organize themselves and communicate straight via several intermediate nodes founded on signal strength otherwise via multi-hop routing. The choice of the intermediate nodes will grow, the routing overload in the route finding process. Destination nodes are nominated utilizing in-between nodes aimed at broadcasting data packets using link scalability. The primary mechanism for this owns problematic limits like not flexible to transport the Quality of Service (QoS) within the network model; also, the probability of packet distribution is fewer[16, 17]. Within this study, a Fault-Tolerant Disjoint Multipath Distance Vector Routing Algorithm (FD-AOMDV) is proposed that sprints path discovery stage using a decreased quantity of postponement. It discovers separate paths in a manner that routing overloads is reduced significantly. FD-AOMDV may upsurge the scalability by decreasing the routing overload when the most recent route is recognized. Furthermore, because of the node flexibility within the Mobile ad-hoc network, succeeding breakages of a link will result in the active path interruption plus enlarging routing overload. The outcomes of the simulation verify that the intended work decreases the routing overwork, reductions the end-to-end delay, and decreases the packet delivery ratio matched by AOMDV besides ZD-AOMDV on Network Simulator[18, 19]. Sensor nodes are used in distant Wireless Sensor Networks (WSNs) that are mostly limited via battery lifetime plus communication scope. Only one path routing mechanism in Wireless Sensor Networks proceeds to severe power use plus path malfunction. A multipath routing scheme consuming cooperative neighboring node perception is displayed within this study. Grounded on the accessibility of the energy on the adjacent nodes, multipath routes are known. These simulation outcomes prove the proposed scheme improves the execution in multipath identification postponement, end-to-end delay, packet distribution ratio besides network lifetime[20, 21].

3 Multipath Routing

A multipath computation algorithm mentions the algorithm that calculates many paths between node pairs. The paths calculated between nodes straight interrupt the performance gains a node pair can get. Multipath Routing might be used through end-users to send packets to a terminus over numerous trails. It is a valued extension of a single path-founded routing system, where a node has just a single finest path to reach the destination. Multipath Routing is counted as an encouraging direction of the present routing system as it can advance the network execution in terms of dependability and amount. Edge-Routers within every network acquire numerous paths to get to a specific terminus then stock them entirely in a Routing-table. Using a specific path

from the list of paths in the router operates a group of rules to choose one active route. A router optionally promotes the active route to every adjacent network, dependent on the business-association [11, 22, 23]. The router guides the packets through the links using the bidirectional links assistance. The router chooses the base of information gotten from the routing table around the subsequent continuing destination link to so the packets transfer to. For sample, to design a multi-route, the next three mechanisms are utilized:-

- **Multi route path structure:** The multiple- path discovery processes depend on the quickest path from the source to the destination points. Afterward founding the quickest path rate (the reference rate), every alternate path is calculated whose cost is with a sensible delta of the reference rate. This will guarantee that the latency vs. quantity tradeoff is appreciated.
- **Network Monitoring:** The statistics are polled nearby via the router and directed to adjacent routers. This procedure executes in-band and not through an outside monitoring process. A one-bit demonstration of congestion is utilized, alike to, thus, decreasing to the smallest the scope of the observing information and, so, the influence on the network load. Distributing the congestion data is accomplished via utilizing aggregation procedures alike, consequently permitting real-time statistics to be spread well in the network.
- **Routing-Topology demonstration:** Every Router keeps its routing vector, containing the congestion demonstration of their paths to diverse networks. Routing-Vectors later exchange with the adjacent routers utilizing In-Network Observing. Adjacent-Router is vital to infer this information based on its forwarding table. Consequently, every router necessity to be aware of sending table of every one of its adjacent routers. For this to happen, the perception of the routing mask is presented, which signifies the forwarding tables construct in multipath permitted-routers [24, 25].

4 Enhanced Interior Gateway Routing Protocol (EIGRP)

Is a procedure that has been prepared to function on routers plus switches. It may use on minor, average plus significant level networks also with effectiveness. In its metric computation, Enhanced Interior Gateway Routing Protocol uses bandwidth and delay. Though, it can, too, utilize maximum transmission unit (MTU), load, and reliability and for this purpose. The technicality of Enhanced Interior Gateway Routing Protocol permits it to be termed as the plus progressive distance-vector routing protocol in addition to a hybrid routing protocol. Enhanced Interior Gateway Routing Protocol guarantees the soft drift of the network via assembling information from its surroundings, also delivering the complete route for transmission. Furthermore, Enhanced Interior Gateway Routing Protocol transmits the job of storing the information completely concerning the topologies of every network. Hybrid Protocols are those that make usage of dissimilar dual protocols to choose the route of transmission. In this respect, a Hybrid routing protocol utilizes Distance-Vector Protocol besides Link-State protocol to make the routing resolution. Hybrid routing protocols are currently

most familiar. The utmost famous Hybrid Protocol is the Improved Interior Gateway Routing Protocol [14].

5 Proposal System Model

In this paper, the proposal system begins with building an ns3 simulation network. The network included 5 d cell, each dcell content 5 computers, and 1 router. There are 3 modifications done in this paper. These modifications aim to avoid losing the communication between the nodes in each decll; the problem that the system solved is, delay of data transaction problem, the link interrupted problem, power off problem in the entire dcell (rack), as it showed in Figure 1.

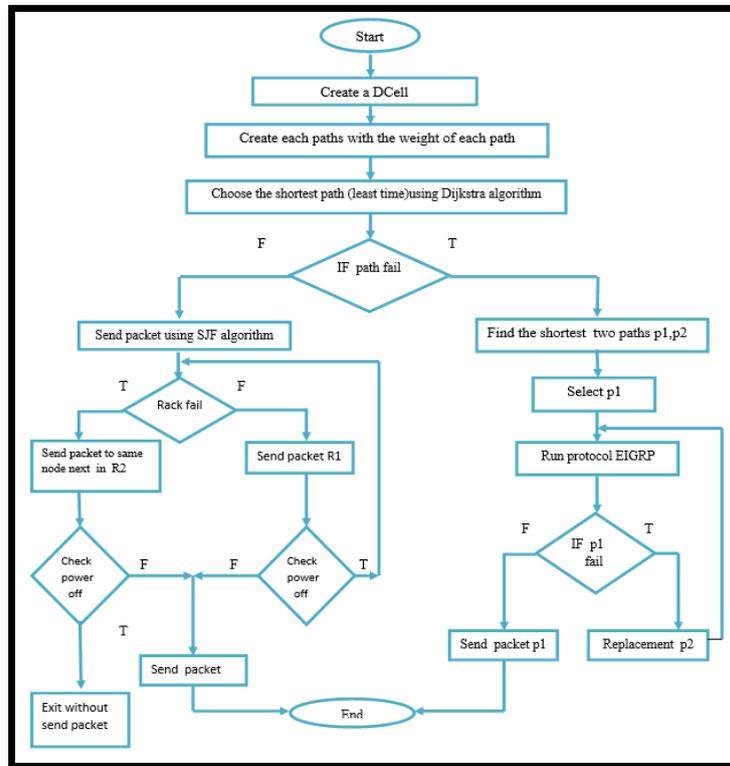


Fig. 1. A DCell Routing Multipath Enhanced (DRMPE)

5.1 Proposal system algorithm

General Implementation of The Proposal System

Input: packet

Output: approved of receiving a packet with the best solution

Begin

Step 1: solving delay problem

Step 1.1: send the packet from the same source to same Destination through different paths.

Step 1.2: select the shortest path (least time) using Dijkstra algorithm.

Step 1.3: the system checks if the packet has successfully sent to the destination.

Step 1.4: if the packet fails then the system checks if it's link failure or rack failure (power off in entire Dcell)

Step 2: solving link failure problem

Step 2.1: if the shortest path fail to send the packet, then the the system chooses two different shortest paths and send the packet through the shortest one of them.

Step 2.2: If the first link fails again then the system automatically chooses the second selected path and send the packet through it.

Step 3: solving power off (rack problem)

Step 3.1: if the entire destination Dcell having power failure problem, then the system will automatically check the best alternative Dcell, and send the packet

Note: If the system has any other failure then the the system will automatically not send the packet and reset the sending packet

End

6 Results

In this section, the proposed methods are displayed in a DCell network using NS3 to solve network failure problems (contact failure, Link failure, and Rack failure), determine the best path in terms of OT, and use bandwidth connections at 100 Mbps. Networks of this approach are built as part of a multipath routing system and are responsible for taking multiple route routing based on a routing protocol, it's responsible for choosing the best route. The router's work is routing the path along the right path. From the source node to the target node, so that all information must set (time, links, speed of data sent, total time, the productivity of the nodes). The network simulation is as the following Figure 2.

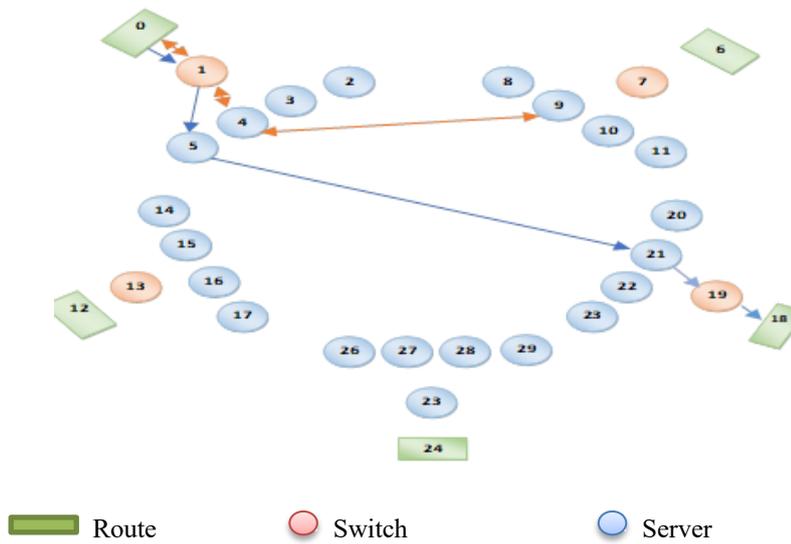


Fig. 2. Proposal Dcells network

As mentioned there are three experimental results in this paper, all will be described as follows:

6.1 Experiment 1 (solving delay problem)

In this experimentation, the system supposed that all links and dcells having no problems, so the goal is finding the shortest path among multiple paths (6 paths), the wave packet from the source node (0) to the target node (18) Bandwidth, representing paths respectively of the proposed node. Tables (1,2,3,4,5 and 6) show the time of the downtime and the total time of each track, with the determination of Throughput, the average of the that packets delivered successfully per unit of time (in seconds) to their destination, the first track is the optimal path.

Table 1. Links Time and Total Time of the First Track in Dcell network (DN1)

1. Link	Time Millie Second(MS)	NO-Node	Total Time Path 1
0 - 1	2	2	0.83276 MS
1 - 5	2.00208	3	
5 - 21	2.00717	4	
21 - 19	2.20725	5	
19 - 18	2.28734	6	
18 - 19	2.46742	6	
19 - 21	2.54751	5	
21 - 5	2.62759	4	
5 - 1	2.82767	3	
1 - 0	2.83276	2	

$T.T.Path1 = (2.83276 - 2) = 0.83276 \text{ MS}$

Table 2. Links Time and Total Time of the Second Track in DCell Network (DN2)

Link	Time Millie Second(MS)	NO-Node	Total Time Path 2
0 - 1	2	2	0.96293 MS
1 - 5	2.00208	3	
5 - 16	2.03217	4	
16 - 9	2.17225	5	
9 - 19	2.23234	6	
19 - 18	2.30242	7	
18 - 19	2.48251	7	
19 - 9	2.66259	6	
9 - 16	2.73267	5	
16 - 5	2.79276	4	
5 - 1	2.93284	3	
1 - 0	2.96293	2	

$T.T.Path2 = (2.96293 - 2) = 0.96293 \text{ MS}$

Table 3. Links Time and Total Time of the Third Track in Dcell network (DN3)

Link	Time Millie Second(MS)	NO-Node	Total Time Path 3
0 - 1	2	2	1.39293 MS
1 - 5	2.00208	3	
5 - 14	2.03217	4	
14 - 26	2.28225	5	
26 - 19	2.38234	6	
19 - 18	2.50242	7	
18 - 19	2.68251	7	
19 - 26	2.86259	6	
26 - 14	2.98267	5	
14 - 5	3.08276	4	
5 - 1	3.33284	3	
1 - 0	3.39293	2	

$T.T. Path 3 = (3.39293 - 2) = 1.39293 \text{ MS}$

Table 4. Links Time and Total Time of the Fourth Track in Dcell network (DN4)

1. Link	Time Millie Second(MS)	NO-Node	Total Time Path 4
0 - 1	2	2	1.36293 MS
1 - 5	2.00208	3	
5 - 16	2.12217	4	
16 -28	2.35225	5	
28 -19	2.46234	6	
19 - 18	2.57242	7	
18 -19	2.68251	7	
19 -28	2.79259	6	
28- 16	2.90267	5	
16 -5	3.01276	4	
5 - 1	3.24284	3	
1 - 0	3.36293	2	

T.T. Path 4= (3.36293 – 2) =1.36293 MS

Table 5. Links Time and Total Time of the Fifth Track in Dcell network (DN5)

1. Link	Time Millie Second(MS)	NO-Node	Total Time Path 5
0 - 1	2	2	1.58293 MS
1 - 5	2.00208	3	
5 - 27	2.03217	4	
27 - 8	2.33225	5	
8 -19	2.41234	6	
19 - 18	2.59242	7	
18 - 19	2.77251	7	
19 - 8	2.95259	6	
8 - 27	3.13267	5	
27 - 5	3.21276	4	
5 - 1	3.51284	3	
1 - 0	3.58293	2	

T.T.Path5 = (3.58293 – 2) = 1.58293 MS

Table 6. Links Time and Total Time of the Sixth Track in Dcell network (DN6)

1. Link	Time Millie Second(MS)	NO-Node	Total Time Path 6
0 - 1	2	2	1.57295 MS
1 - 5	2.00208	3	
5 - 14	2.03217	4	
14 -22	2.33225	5	
22 -19	2.51234	6	
19 - 18	2.60242	7	
18 -19	2.68251	7	
19-22	2.96259	6	
22 14	3.05267	5	
14 -5	3.23276	4	
5 - 1	3.53284	3	
1 - 0	3.57295	2	

T.T. Path 6 = (3.57295 – 2) = 1.57295 MS

$$\text{Throughput} = \frac{0.83276 + 0.96293 + 1.39293 + 1.36293 + 1.58293 + 1.57295}{6} = 1.28456333 \text{ MS}$$

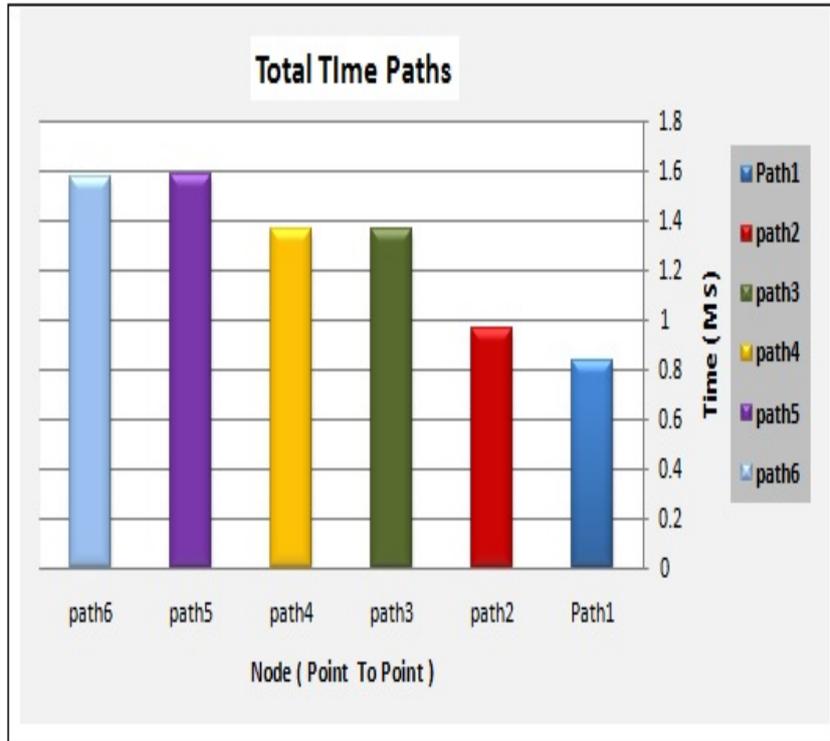


Fig. 3. Total time in charts for each path

6.2 Experiment 2 (Solving link failure problem)

In this experimentation, the system supposed that there is a failure in the link that responsible for data transaction so the system will find two separated paths, and chose the shortest one (less time) for data transaction, if the first link also fails the system will directly choose the second shortest path without having to execute the algorithm again and look for another path, the goal of the experiment is to reduce time and cost. Figure 4 showed the example network of link failure solving, the results in Table 7 show the total time of the two tracks.

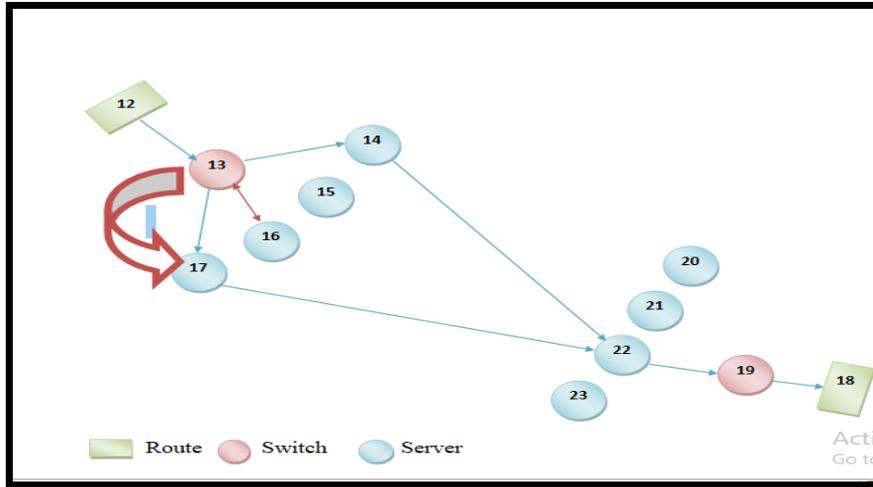


Fig. 4. The solving of link failure problem

Table 7. Calculate the total time of the shortest path

1. Link	Time Millie Second(MS)	Path	Total Time
12 – 13	2	FailedShortest path	0.03217 MS
13 – 17	2.00208		
17 - 13	2.01717		
13 – 12	2.03217		
12 -13	3	Path 1	0.63234 MS
13 -15	3.00208		
15 -22	3.03217		
22 -15	3.33225		
15 -13	3.63234	Path 2	0.74234 MS
12 -13	2		
13 -14	2.00208		
14 -22	2.34217		
22 -14	2.39225		
14 -13	2.74234		

$$T.T.Path1 = (3.63234 - 3) = 0.63234 \text{ MS}$$

$$T.T.Path2 = (2.74234 - 2) = 0.74234 \text{ MS}$$

$$T. T. Failed shortest path = (2.03217 - 2) = 0.03217 \text{ MS}$$

$$\text{Throughput} = \frac{0.63234 + 0.74234}{2} = 0.68734 \text{ MS}$$

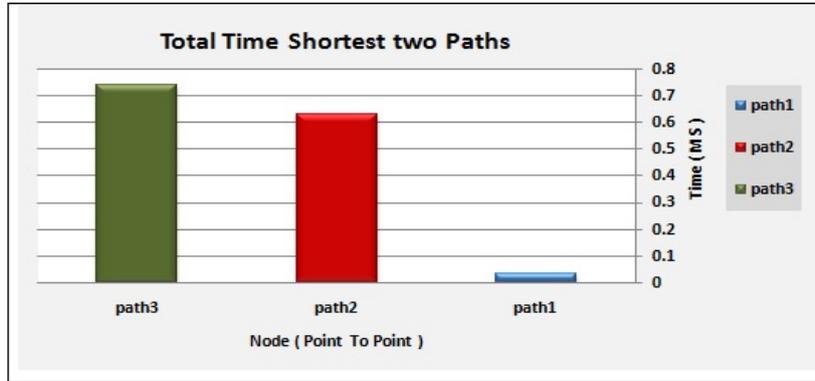


Fig. 5. Total time in charts for the 2 separated paths

6.3 Experiment 3 solving power off (rack problem)

This problem is one of the most difficult problems, talk about a power outage on the entire Rack. When Rack fails, it means disconnecting a part of the entire network, rack consisting of a key and four servers and router, and to avoid this problem a logical solution must be found, the system supposed that the entire dcell including the destination node are down, the system will automatically find replacement dcell and send the packet to it shown in Table 8.

Table 8. Convert the packet data path from Rack1 to Rack2

1.	Link	Time Millie Second(MS)	Rack	Total Time
	0 -1	2	FailureRack 1	0.02526 MS
	1 -4	2.00508		
	4 -9	2.01017		
	9 -4	2.01525		
	4 -1	2.02026		
	1 -0	2.02526		
	0 -1	2.02527	Rack 2	0.04576 MS
	1 -5	2.03035		
	5 -21	2.03544		
	21 -19	2.04052		
	19 -18	2.04561		
	18 -19	2.05069		
	19 -21	2.05578		
	21 -5	2.06086		
	5 -1	2.06594		
	1 -0	2.07103		

T.T. Failure Rack 1= (2.02526 – 2) = 0.02526 MS

T.T. Rack 2 = (2.07103 – 2.02527) = 0.04576 MS

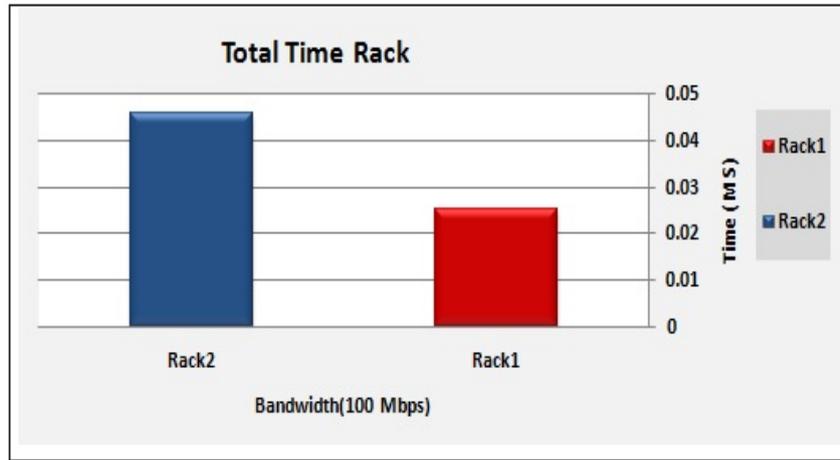


Fig. 6. Total time in charts for the rack 2 paths in each dcell

Note: in experimental above, the presumptive time for the stating is 2 second and the bandwidth for the entire system are 100 Mbps.

7 Conclusion

This paper applied 3 types of modification providing modified multipath routing protocol, NS3-program used to simulate real-world network to improve the modification, the system includes implementing some algorithms such as EIGRP the goal is to Gather information about neighbors nodes, and be placed in the routing table, Determine the best routes in addition to the cost of the value received as guidance information that happens from the router to an alternative, The protocol routing tables are updated periodically, so the update is a topological modification, and the information is updated from one router to another and the outcome is extra convergence. Also, the Shortest Path Dijkstra Algorithm is used the goal is to find the shortest pathways. Finally, and from the results in the tables above it concluded that the proposed modification provides good results in saving time, cost, and data transaction.

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