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Improving OSPF Protocol based Latency : A new algorithm based on Dijkstra by using OSPF existing Metrics in SDN networks

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Abstract

SDN (software defined networking)-based networks may be defined as a new generation of networks using virtual layers and switches and central controller which try to handle a few controlling and managerial tasks of switches and rotors of networks in upper layers on a software basis. In fact, it reduced dependence to hardware and increases software capabilities. These networks face challenges such as quality of relationship between controller and devices existing in the network and delay in network that is subject of this thesis. According to the applied researches, one of offered solutions for reduction of delay is using path finding algorithms. Rotors' task is transfer of information. Algorithms must be implemented on these rotors to choose the best path for data transfer in the network. Path finding table is used in rotor. According to the data available in path finding table, the best path is found. Each path finder must have complete information of network's communication infrastructure and calculate and identify all other paths of communications between them and their costs. Later, data collection forms the data structure related to network infrastructure graph. In these conditions, to find the best path between path finders, the shortest path algorithms (SPT) are used such as Dijkstra. Since rotors receive the sent update massages due to network changes, path finding table amends itself and identifies the new probability path. Selection of best path is made by massages metric. Upon processor fastening and hardware cheapening, a standard protocol in the name of OSPF was presented that manufactured by CISCO, particularly in a network that its equipment are not necessarily made by CISCO is based on Dijkstra and uses cost and band broadness as metric, transfer the data related to connected network and rotors connected to network between adjacent rotors and records all of its information in the table. Later, Dijkstra's algorithm is implemented and the best paths led to different destinations are inserted in the path finding table. The objective of this study was presenting an algorithm based on Dijkstra there in addition to cost Metric, another metric to be used that highly reduces traffic in the network and improves delay time in the network.

Keywords: *SDN, METRIC ، DIJKSTRA ، DELAY ، OSPF*

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1 Introduction

This document specifies an Internet Best Current Practices for the Internet Community, and requests discussion and suggestions for improvements. Distribution of this memo is unlimited. This document recommends methods that are intended to improve the scalability and stability of large networks using Open Shortest Path First (OSPF) Version 2 protocol. The methods include processing OSPF Hellos and Link State Advertisement (LSA) Acknowledgments at a higher priority compared to other OSPF packets, and other congestion avoidance procedures. A large network running OSPF protocol may occasionally experience the simultaneous or near-simultaneous update of a large number of link state advertisements, or LSAs.

This is particularly true if OSPF traffic engineering extension is used that may significantly increase the number of LSAs in the network. We call this event an LSA storm and it may be initiated by an unscheduled failure or a scheduled maintenance event. The failure may be hardware, software or procedural in nature. The LSA storm causes high CPU and memory utilization at the router causing incoming packets to be delayed or dropped. Delayed acknowledgments (beyond the retransmission timer value) result in retransmissions, and delayed Hello packets (beyond the router-dead interval) result in neighbor adjacencies being declared down. The retransmissions and additional LSA originations result in further CPU and memory usage, essentially causing a positive feedback loop, which, in the extreme case, may drive the network to an unstable State.

The default value of the retransmission timer is 5 seconds and that of the router-dead interval is 40 seconds. However, recently there has been a lot of interest in significantly reducing OSPF convergence time.

U(t) = Number of unacknowledged LSAs to neighbor at time t.
H = A high-water mark (in units of number of unacknowledged LSAs).
L = A low-water mark (in units of number of unacknowledged LSAs).
G(t) = Gap between sending successive LSAs to neighbor at time t.
F = The factor by which the above gap is to be increased during congestion and decreased after coming out of congestion.
T = Minimum time that has to elapse before the existing gap is considered for change.
Gmin = Minimum allowed value of gap.
Gmax = Maximum allowed value of gap.

The equation below shows how the gap is to be changed after a time T has elapsed since the last change:

(1)

Min(FG(t),Gmax) if U(t+T) > H
G(t+T) = | G(t) if H >= U(t+T) >= L
Max(G(t)/F,Gmin) if U(t+T) < L

Min(.,.) and Max(.,.) represent the minimum and maximum values of the two arguments, respectively. Example values for the various parameters of the algorithm are as follows:

H = 20, L = 10, F = 2, T = 1 second, Gmin = 20 ms, Gmax= 1 second.

One might argue that the scalability issue of large networks should be solved solely by dividing the network hierarchically into multiple areas so that flooding of LSAs remains localized within areas. However, this approach increases the network management and design complexity and may result in less optimal routing between areas. Also, Autonomous System External (ASE) LSAs are flooded throughout the AS, and it may be a problem if there are large numbers of them. Furthermore, a large number of summary LSAs may need to be flooded across areas, and their numbers would increase significantly.

R(i) = RxmtInterval value used during the i-th retransmission of an LSA.
Rmax = The maximum allowed value of RxmtInterval . Example value is 40 seconds.
Rmin = The minimum allowed value of RxmtInterval . Example value is 5 seconds.
T = Minimum time that has to elapse before the existing gap between sending successive LSAs to

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a neighbor is considered for change . Example value is 1 second.
t = Number of unacknowledged LSAs to a neighbor at time t.

2 Methodology

Further priority setting of OSPF packets: In addition to the designed packets as high priority in suggestion 1, part 2, separation of further priority among low priority OSPF packets may be needed. In this paper, we propose three classes of high, middle and low priorities. To the best knowledge of us, OSPF protocol uses COST as delay evaluation factor and crow and traffic existing in the network. In this paper, in addition to COST parameter, another factor in the name of CLP was used. CLP parameter has an output 0 and 1. The packet that is 0 has more priority and maintains the packet and if packet is 1, has no priority and may be ignored and deleted. Use of this method is a new method for reduction of crowd in the network and can be used for the delay improvement. Whereas OMNET is one of the strong simulators that OSPF protocol, therefore in this paper, we used this simulator for implementation of our objective. In this implementation, an array of ten is assumed that keeps the delay of 10 last packets. Whenever the packet is arrived, a shift to the right is ordered until a complete round of this packet is read by the counter. A general delay in the name of Delay End to End is calculated based on the following formula.

(2)

N= Number of Router+1=Number of Link
Delay End To End= (Transmission Delay+ Propagation Delay + Procssing Delay)N

When Delay End to End was estimated, it is compared to the last packet. If it was smaller denotes by P++ and if higher P—. In fact, when the delay is increased or decreased, calls the Bernoulli function. According to Bernoulli function, P is called that for instance with the probability of 30% gives the probability of 0 to a few packets, and with the probability of 70% gives the probability of 1 to a few packets. Output P is poured into the CLP. This parameter has also packets with more priority and keeps that packet and if priority is 1, that packet may be ignored.

7 Conclusion

According to the comparison of results of simulator OMNET++ implementation, (once by initial values and once by inserting parameter CLP and use of Bernoulli function), it is concluded that:
In table 1, summary of simulation by initial values for OSPFHelloPacket packets is provided.

Table 1: Sources obtained using Default values by simulator OMNET++ for OSPFHelloPacket

Event	T	Scheduled	Existing	Created
24	0	62	153	176
25	0	61	152	176
26	0	60	151	176
27	0	59	150	176
28	0	58	149	176
29	0	57	148	176
30	0	56	147	176
31	0	55	146	176
32	0.0878277	54	145	176
33	0.0878277	55	147	178
34	0.0878277	55	149	180
35	0.0878277	55	151	182
36	0.0878349	56	155	186
37	0.0878349	56	154	186
38	0.08783586	55	154	186
39	0.08922842	56	156	188
40	0.08922842	56	158	190
41	0.08922842	56	160	192
42	0.08923562	57	164	196
43	0.08923658	57	163	196
44	0.0894701	56	163	196
45	0.0894701	57	165	198
46	0.0894701	57	167	200
47	0.0894701	57	169	202
48	0.0894773	58	173	206

As it is specified in table 1, number of generated packets within specified time period is 206 and its diagram is observable in figure 1.

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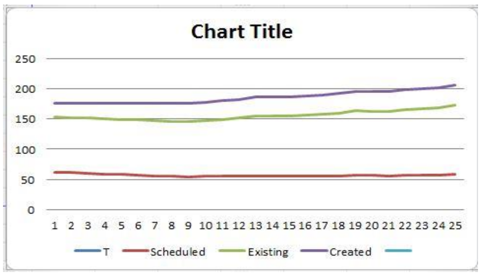

Figure 1: The diagram obtained using default values for OSPFHelloPacket

In table 2, summary of results of simulation was provided for OSPFHelloPacket packets by inserting parameter CLP in program C++ and using Bernoulli function defined on the delay.

Table 2: Sources obtained using changes made in code C++ by simulator OMNET ++ for OSPFHelloPacket

Event	T	Scheduled	Existing	Created
24	0	62	153	176
25	0	61	152	176
26	0	60	151	176
27	0	59	150	176
28	0	58	149	176
29	0	57	148	176
30	0	57	147	176
31	0	55	146	176
32	0.087827704	54	145	176
33	0.087827704	55	147	178
34	0.087827704	55	149	180
35	0.087827704	55	152	183
36	0.087834904	56	158	189
37	0.087835864	56	157	191
38	0.089228423	55	157	191
39	0.089228423	56	159	193
40	0.089228423	56	161	195
41	0.089228423	56	164	198
42	0.089235623	57	170	204
43	0.089236583	57	169	206
44	0.089470098	56	169	206
45	0.0894701	57	171	208
46	0.089470098	57	173	210
47	0.089470098	57	176	213
48	0. 089477298	58	182	219

And Figure 2 is as follows:

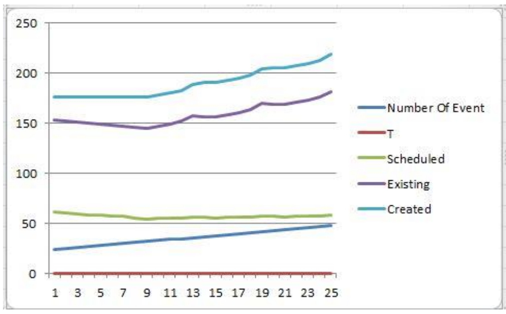

Figure 2: Diagram obtained using changes mades in code C++ by simulator OMNET ++ for OSPFHelloPacket.

Comparison between table 1-5 and 2-5 and their diagrams, it is concluded that the changes made in program C++ of this simulator increases the number of generated packets as well as available packets and their exchange in the network is specified within time period and it demonstrates that the traffic and crowd existing in the network was reduced and whereas within a time period causes increase of packet generation and their exchange in the network, delay time in the network was improved.

As described completely in this paper, in order to reduce the traffic of packets in the network, their further priority setting was propounded. To find the best path between pathfinders, shortest path algorithm (SPT) is used such as digestra and whereas protocol OSPF is formed based on digestra was used for simulation of this idea. This protocol uses COST parameter as metric. The new innovation mentioned in this paper is that in addition to COST parameter, another parameter in the name of CLP was used that results in reduction of packets' traffic in the network. In other word, it causes the packets to be displaced in the network between the nodes and results in improvement of delay in the network. Parameter CLP is used for reduction of crowd and traffic in the network that has an output 0 and 1. Packets 0 have more priority and keeps the packet and if packet is 1, it has no priority and may be ignored and the packet is deleted. Use of this method is a new method for reduction of network crowd that can be used for improvement of delay in the network. Whereas OMNET is one of the strong simulators that use protocol OSPF, therefore in this paper, this simulator was used to implement its objective. As mentioned above, the quality of

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implementation was described completely, comparison of results shows that the objective of this paper means reduction of packets traffic within a specified time period in the network was achieved. It is the instance of delay time improvement in the network.

PROPOSALS

We hope to implement further priority setting of packets in different simulators in the future, based on protocols more appropriate than OSPF.

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