Comparative Study of Flow Based load Adaptive Schemes

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Abstract: Today, Network Failure is the most probable cause of congestion, packet loss and has notable impact on maintaining high Quality if service. We analyzed a flow based architectures are focused on access network. There is an important aspect in flow based networking is flow Aggregation Scheme. We show that it is possible and profitable to this scheme in (FA-LAR) Flow Aware load adaptive Routing, which is a new multipath solution for the IP networks. By aggregating flows, core routers do not need to maintain full flow tables, which make them less expensive to build and operate. Results show that the proposed aggregation mechanism provides the same overall network performance with flow tables significantly smaller in size.

Keywords – Flow, multipath, Aggregation, routing, Energy consumption.

1. INTRODUCTION

Flow-based routing or QoS routing "is the routing technique where packets are router from source to destination, selecting the path that satisfies all QoS (i.e., Bandwidth and Delay) requirements. Routing based on flows enables a router to manage traffic data streams as separate flows. Flow-based routers have the capability to improve the QoS, performance, and utilization of existing IP networks by keeping track of flow-state information. By maintaining a flow database, the IP router would be able to support "rate guarantees, delay guarantees, and eliminate packet loss for flows of any size, while still maintaining high line and trunk utilization". After a router has collected and stored all state information, any packets belonging to the same flow will be routed on the same route. When routing decisions are made for a particular flow an alternate, backup route is also decided upon so the flow can be rerouted in the event of a hardware failure on the device.

Flow-based routing is also capable of offering a variety of enhancements including guaranteed bandwidth, fast error recovery, and dynamic load balancing. Applications are capable of transmitting traffic up to the burst limit, but on the average, the transmission rate is controlled and the need to do this is minimized. Fast error recovery is achieved by storing multiple backup, alternate routes in the event of link failure. If a failure in the path occurs, the first packet in the flow to reach the failure point will be sent back to the source- this indicates a failure, and that this packet and all succeeding packets should be transmitted over an alternate route. The flows that were being transmitted across the original path path will be mutually distributed across various alternate paths."With near-equal cost route information, a router can distribute the load over all near-equal paths based on the current load information" – this is how flow-based routing satisfies dynamic load balancing. Flow-based routing to achieve over 80% of link utilization on all paths/ports. Furthermore, flow-based routers are able to route flows across different paths without causing issues with packets being out of order.

Flow-based routing provides the ability to select a path that can guarantee QoS requests, as well as reserving the resources required along the path. Implementing flow-based routing with the added capabilities of resource reservation protocols provides for the most control over both the path and resources needed to satisfy QoS requirements. Flow-based routing, where the traffic is identified and routed as flows, can provide multipath and load-balancing capabilities. FAMTER provides the ability to use multiple paths between two points in a network. The key idea of FAMTER which distinguishes it from the other multipath approaches is to use alternative paths only if necessary and only for new flows, upon congestion, new flows use alternative paths, whereas the old ones remain on their primary paths. Alternative paths are found and used dynamically as needed.

2. FAMTAR

Flow-Aware-Topology Adaptive Routing (FAMTER) is a Dynamic Multipath Adaptive Routing scheme introduced by Jerzy Domzal [2]. It works purely based on flows. FAMTER is called adaptive because it works with all routing protocols to establish communication between source and destination with shortest path. This shortest path will be used for all the data transmission until it found congestion occurs, the optimal path can change as per the status of congestion indication. During the bottleneck of congestion the new flows are redirected to travel via new path, and old flow will be permitted to travel in the same link. So, FAMTAR is taking responsibility to identify the optimal paths and also identify new path when bottleneck arises. To attain this, a FAMTAR router Flow Forwarding Table (FFT) along with routing table. For each and every flow, the respective FFT entry shows that packet routes that have to forward the current flow. It is extracted from the present routing table when first packet appears in the FFT. The Flow Forwarding Table is facilitating to identify the packet routing mechanism. Based on the FFT, the outgoing connections are identified and flow will be redirected if necessary. The FFT remains static and it won't change even the routing table entries are changed.
If congestion is identified at any one of the links, then the corresponding router will increase the link cost by higher value. Once the link assigned with higher value then it is considered to be a congested link. The updated cost makes change at the routing protocol, which broadcast the information in all the links. Upon receiving this information, the routers calculate new link to mange and avoid congested links. The newly calculated links are updated in the routing table. This change is applicable for new flows alone. The flows which are already in active state will follow the same route as per the float state stored in the FFT. So, the congested links will not stop the packet flows even as the route was identified as congestion earlier. The actual costs of overview links and to identify congestion on the link stops. FAMTAR needed routers to overview links and to identify congestion on those links. It uses congestion indicator like packet Queuing Delay, Link Load, and Queue Occupancy etc.If the link or node failure occurs, the active flows along with identifiers registered to the FFT, are still uses the older route stored in the FFT. As a result, the active flows are possible to route through to the failed links. This problem was identified and solved in [4] by introducing a Time To Live based scheme so that it can be detected failure links and it is also will find routing loops.

3. Flow Aggregation Mechanism for FAMTAR

The Flow Aggregation Mechanism for FAMTER (FAMF) assumes that only border nodes of autonomous systems maintain flow lists, which means that they are not present in the core nodes. Edge nodes are able to operate with flow lists because the number of flows they need to process is significantly lower than for similar routers in the core:

The border nodes in FAMF have to maintain two lists:

- A Flow Forwarding Table (FFT) which contains flow identifier (flow_id), aggregate identifier (aggr_id), output interface (int_id) and arriving time of last packet (timestamp),
- An Aggregation Table (AT) which contains aggregate identifier (aggr_id) and output interface (int_id).

The route can be determined based information collected by a routing protocol, e. g. by OSPF. In OSPF, all routers within an area have the exact link-state database. After each update, routers run Dijkstra algorithm to determine the shortest path. While they put only outgoing to the destination node. The router is represented by the identifier (aggr_id) and is recorded to FFT. Moreover, it is also added to AT along with the output identifier for the selected path. All core routers maintain only ATs. The aggr_id is a concatenation of all routers IDs on the path from the edge router's perspective. The aggr_id used in AT is written to a packet header when it arrives at a border router. This value is equal to aggr_id from FFT, determined for flow represented by the incoming packet .FAMF ensures that the number of entries in the list maintained by core nodes is limited to the number of possible routers in the networks, because different flow transmitting traffic along the same route are aggregated under one entry in the table. The number of entries in the table is significantly lower than the number of flows currently served by the router, which can be very high. Finally, the problem of scalability associated with handling of flows in FAMTAR is solved.

In edge nodes more operations are necessary to conduct for the first packet of a flow. Besides adding a new registration to the FFT, we also need to calculate aggr_id and add it to the AT. On the other hand, for further packets we only analyze registrations in AT, which usually is less loaded than FFT. The computational savings in this area are even more significant in core nodes, when difference between number of flows and aggregates is higher than in edge nodes. Replacing FFTs with ATs the operational complexity in core routers is reduced.

4. Proposed model: Flow Aware –Load Adaptive Routing (FA-LAR)

The proposed model: Flow Aware –Load Adaptive Routing Scheme is developed base on the models of both load Adaptive Sequence Arrangement (LASA) and Flow –Aware Multi –Topology Adaptive Routing (FAMTAR). This is the hybrid mechanism which developed to address Load Deviation, Energy Consumption to Maximize Network Life Time and to predict and detect Interval Heavy Flow or Bulk Flow. The flow chart of the proposed Flow-Aware Load Adaptive Routing Scheme was as shown in the Fig3.
As shown in the Fig.3, the proposed model has report message with Label to confirm Polling Sequence. This is used to saved energy by preventing inefficient sequence arrangement. In other words, the proposed scheme provides sleeping time when route is congested and it can increase average cycle time. This facilitates for optimizing the performance of energy consumption under low-traffic and high traffic as well.

As per the traffic load, the scheme can be improved the energy efficiency of network. The polling sequence arrangement is executing through label process which was is added in report message as described earlier. While polling sequence was changed, the proposed model will allocate lengthier idle times will sleep longer. This facilitates significant effect on the energy efficiency of the network. These Load Adaptive Sequence Model forward packets to Flow Aggregation Scheme which aggregates flows to improve Network performance in terms of Throughput, Delay and Load Deviation. The detailed procedure of the proposed model is described in the Fig.3 as follows.

4.1 Working Procedure and Operations of Flow Aware – Load Adaptive Routing (FA-LAR)

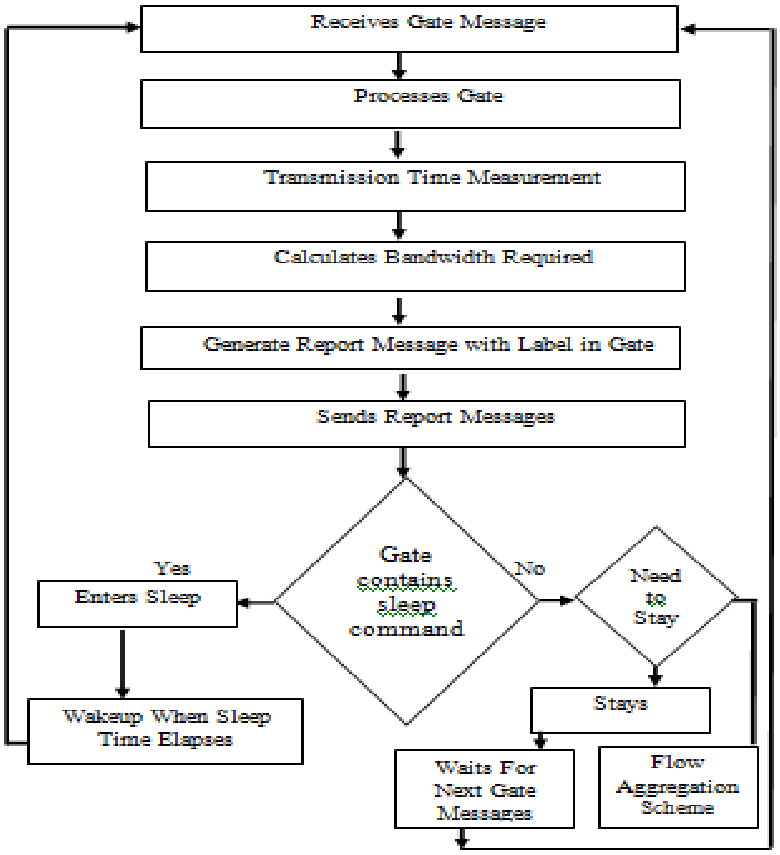

Fig.3 FA – LAR Scheme

Throughput:FA-LAR VS FAMTAR,FAMF

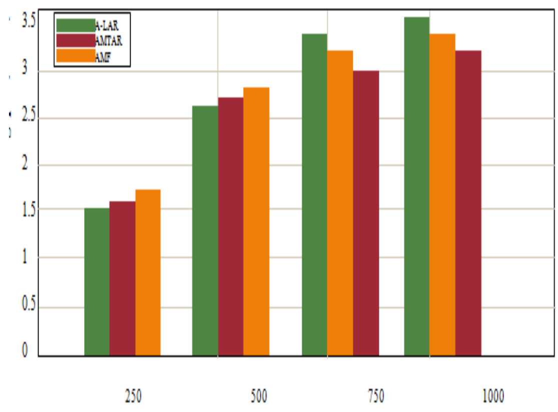

Figure.4 Throughput Analysis of the Proposed FA-LAR

The procedure and operations of the proposed hybrid FA-LAR is narrated in the Fig.3. This proposed mechanism is an intelligent method that establishing the all possible routes that aggregate flows through edge routers. The route can be identified and selected based on the collected information with the help of the proposed model.

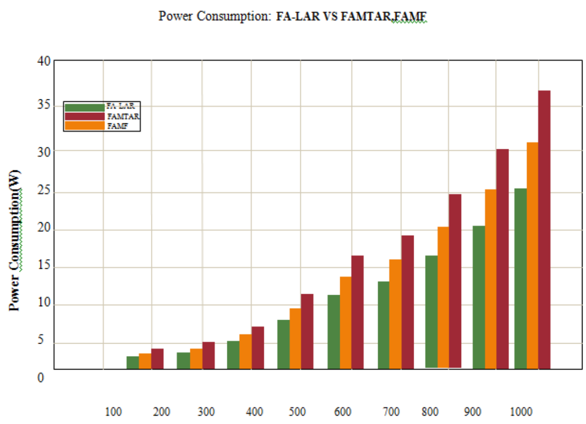

Figure.6 Power Consumption Analysis of the Proposed FA-LAR

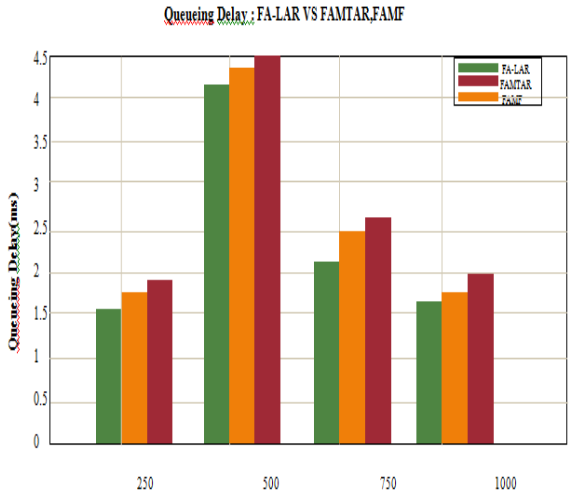

Figure. 5 Queuing Delay Analysis of the Proposed FA-LAR

5. Performances analysis

This research work is implemented the Flow-Aware Multi –Topology Adaptive Routing (FAMTAR) Flow Aggregation of FAMTAR (FAMF) and the proposed Flow Aware- Load Adaptive Routing (FA-LAR) Schemes in ns3. For each flow, 0.1 GB is reserved. We created 100x100 Nodes Clusters with a fixed Topology and introduced 1 ms delay. The simulation was carried out for 350 seconds.

The proposed Flow Aware-Load Adaptive Routing (FA-LAR) is studied thoroughly and analyzed in terms of Throughput, Queuing Delay, Power Consumption (Energy Dissipation), and Load Deviation.

The experimental results of the simulation are shown at the Figures Fig.4 to Fig7. As shown in the Fig.4, the proposed FA-LAR is achieving higher Throughput as compared with the existing FAMTAR, FAMF for heavy volume to Networks. That is the FA-LAR is achieving higher Throughput for more than 500 Flows. At the same time, the proposed model unable to provide higher Traffic Loss and Maintain Deviation of Links Load against Traffic Load as well. As this research work proposed an efficient Flow –Aware mechanism, it handles Traffic Congestion situation efficiently and effectively that facilitate to achieve lesser Queuing Delay as compared with FAMTAR.

The proposed Flow-Aware mechanism handles Energy Dissipation and Traffic Losses as well and hence the proposed FA-LAR achieves better Power Consumption and Load Deviation with Link Load against Traffic Load as well. These are shown in the Fig. 6 and Fig. 7.

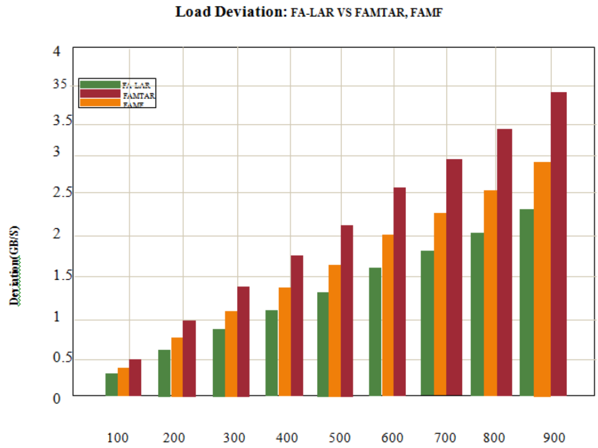

Fig.7 Load Deviation Analysis of the proposed FA-LAR

6. CONCLUSION

This research work implemented Flow-Aware Multi-Topology Adaptive Routing (FAMTAR) in ns3 and studied thoroughly and revealed that this model unable to i. detect manage bulk flow ii. Control Traffic Loss and iii. Maintain Deviation of Links Load against Traffic Load. This research work proposed an efficient Flow-Aware Load based Adaptive Routing (FA-LAR) to address the above mentioned issue. The proposed Model is implemented in ns3 and the proposed Model, FA-LAR is outperforming the existing FAMTAR, FAMF in terms of Throughput, Queuing Delay, and Power Consumption (Energy) and Load Deviation.

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