International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 - 5161

Available at http://inpressco.com/category/ijcet

Research Article

Fuzzy Based Queue Management Policies – An Experimental Approach

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Accepted 06 January 2014, Available online 01 February 2014, **Vol.4, No.1 (February 2014)**

Abstract

In network, queuing of packets is one of the important mechanisms. Packets are queued up into the memory buffers of network devices like routers and switches. Packets are generally arranged in first-in, first-out order, but there are also various mechanisms used for fairly handling of packets. During transmission of data from source to destination, various problems like Dropping of packets, Low Throughput, Out-of-order delivery may arise. To make it efficient, queuing is one of important mechanism. This paper focuses on fuzzy based experimental approach for efficient queue management considering its some important parameters for improving system as well as network performance.

Keywords: *Dropping of packets, Fuzzy, Latency, Throughput, Queue Management.*

1. Introduction

Queuing is an important mechanism for packets leaving the router through an interface. Queuing controls bandwidth allocation, delay variability, timely delivery and delivery reliability. Therefore queues should always be configured on the outgoing interface regarding the traffic flow.

- *Types of Queue Management*

A. FIFO (First-in First-out) - It is the simplest, most common and default queuing mechanism. First job entered in queue is processed first. Following Fig.1 shows how queue of jobs is processed depending on FIFO policy.

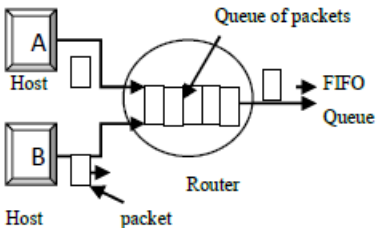
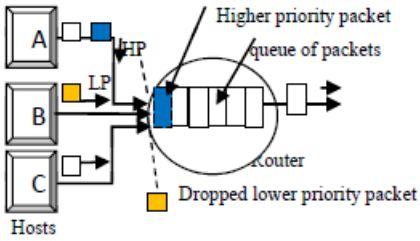


Fig.1 FIFO Queue Processing

B. PQ (Priority Queuing) - It allows network managers to prioritize the network. It uses multiple queues, but queues are serviced with different levels of priority, with the highest priority queues being serviced first. Here one particular kind of network traffic can dominate all others. When congestion occurs, packets are dropped from lower-priority queues. Fig.2 indicates priority queuing policy



HP – Higher priority packet LP – Lower Priority Packet

Fig.2 Priority Queuing Processing

C. FQ (Fair Queuing) – It helps to process queues which are not serviced due to high-priority queues. A round-robin approach is used to service all queues in a fair way. This prevents any one source from overusing its share of network capacity.

D.CQ (Custom Queuing) – It reserves a portion of the bandwidth of a link for each selected traffic type.
If a particular type of traffic is not using the bandwidth reserved for it, then other traffic types may use the unused bandwidth.

2. Problems in Queue Management

Following listed are drawbacks in various queue management techniques:

(i). Bandwidth Management – In FIFO technique when a station starts a file transfer, it can consume all bandwidth of a link. Also it works well if links are not congested, otherwise packets gets dropped and is effective for large links having little delay and minimal congestion.

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(ii). Traffic Management – In Priority Queuing, lower-priority queues may not get serviced at all if high-priority traffic is excessive.
(iii). Time Management - In Fair Queuing problems can occur when packets are variable in length and each queue is allowed to release one packet at a time.
There are different types of techniques, policies to process queues for proper queue management.
Active Queue Management (AQM) is one of the queue management technique, considered as a congestion control method that identifies congestion at router buffers in an early stage, which means before the router buffers have overflowed. It drops incoming packets before the queue is full in contrast to traditional queue management which starts dropping only when the queue in overflowed.
Random Early Detection (RED) is an AQM algorithm considered as a congestion control method. The basic idea of RED is that a router detects congestion early by computing the average queue length and sets two buffer thresholds maximum threshold (maxth) and minimum threshold (minth) for packet drop. But it can degrade the network's performance due to increase in arrival rate aggressively, thus the RED's router buffers may overflow. Therefore, every arriving packet will be lost.

Thus there are some drawbacks in above stated techniques, hence to improve it we have proposed an experimental fuzzy approach for efficient queue management.

3. Fuzzy Logic

Fuzzy means not clear or vague data. A fuzzy logic system is unique as it handles both numerical data and linguistic knowledge. It is a non linear mapping of an input data vector into a scalar output i.e. it maps' numbers into numbers.

The Fuzzy Logic tool was introduced in 1965 by Lotfi Zadeh. It is a mathematical tool for dealing with uncertainty. It offers to a software computing system the important concept of computing with words. It grants a technique to deal with vagueness and information granularity.

It is important to keep in mind that there is a close connection between Fuzziness and Complexity. As the complexity of a task, or of a system for performing that task, exceeds a certain limit, the system must unavoidably become fuzzy in nature.

4. Fuzzy based Experimental Approach to Avoid Problem in Queue Management

To observe effect of various factors affecting queue management techniques, we will focus on few parameters showing their effect on queue management.
We will focus on following parameters:

(i). Queue Length(QueL)
(ii). Incoming Packet Flow (PackF)
(iii).Transmission Delay(TranD)
Among those QueL and PackF are input parameters and TranD is output parameter.

To verify its working we will set rule base and verify our result using FIS.

A. Structure of Fuzzy Inference System

Generally, a fuzzy inference system consists of four modules as shown in Fig.3.

i. Fuzzification module transforms the system inputs, which are crisp numbers into fuzzy sets. This is done by constructing the membership functions.
ii. Knowledge base stores IF-THEN rules provided by experts.
iii. Inference engine simulates the human reasoning process by making fuzzy inference on the inputs and IF-THEN rules.

Defuzzification module transforms the fuzzy set generated by the inference engine into a crisp value.

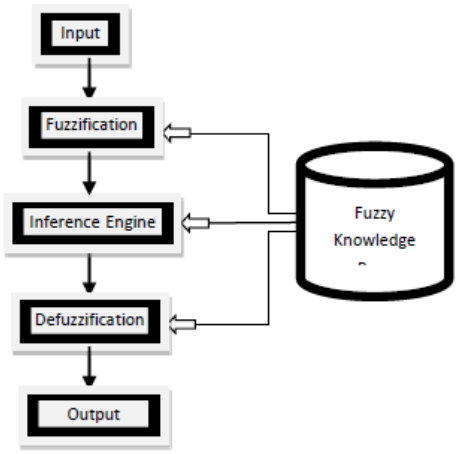

Fig.3. Fuzzy Inference Scheme Diagram

B. Working of FIS

Fig.4 shows our proposed fuzzy based Queue Management Control System using FIS.

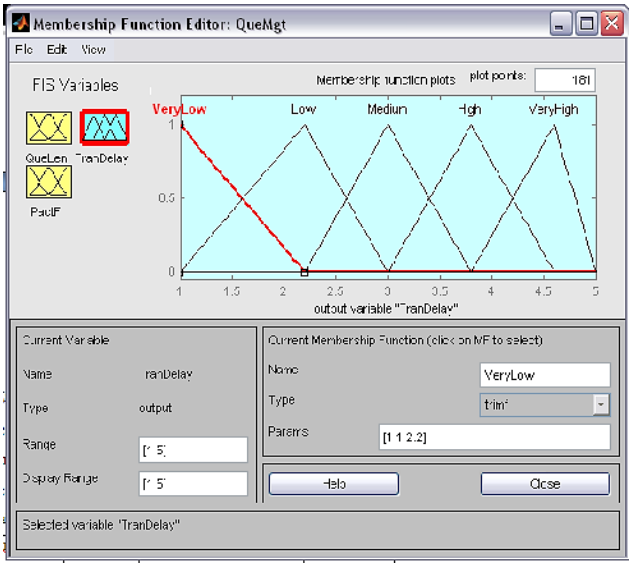

Fig.4 Proposed Working FIS

To verify our result we will categorize input as well as output parameters into different fuzzy set values.

Table I: Input Parameter Values

QueLen	VerySmall	Small	Medium	Large	VeryLarge
PackFlow	VeryLow	Low	Medium	High	VeryHigh

Table II: Output Parameter Values

TransDelay	VeryLow	Low	Medium	High	VeryHigh

Above Table I and Table II shows defined fuzzy values for input as well as output parameter. In FIS triangular membership function is used for all criteria for converting the crisp set into fuzzy set.

C. Working Rule Base

Practically we observe that for larger queue length with low incoming packet flow, transmission delay is high whereas for small queue length with high incoming packet flow, transmission delay is comparatively low. Based on this criteria, distinct fuzzy rules for our FIS are as shown below :

i. If QueLen is small, PackFlow is low then TranD is medium.
ii. If QueLen is small, PackFlow is medium then TranD is medium.
iii. If QueLen is small, PackFlow is high then TranD is low.
iv. If QueLen is medium, PackFlow is low then TranD is medium.
v. If QueLen is medium, PackFlow is medium then TranD is medium.
vi. If QueLen is medium, PackFlow is high then TranD is low.
vii. If QueLen is large, PackFlow is low then TranD is high.
viii. If QueLen is large, PackFlow is medium then TranD is high.
ix. If QueLen is large, PackFlow is high then TranD is medium.
x.

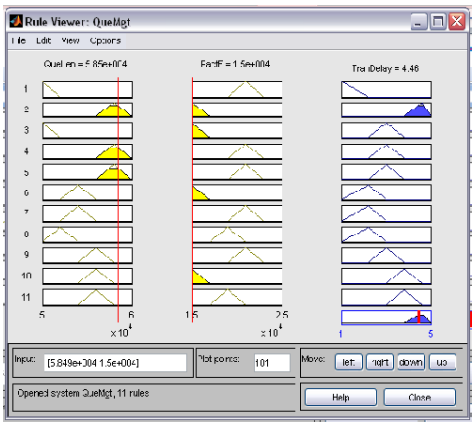

Fig.5 Rule Viewer (For QueLen=58000 and PackF=15000)

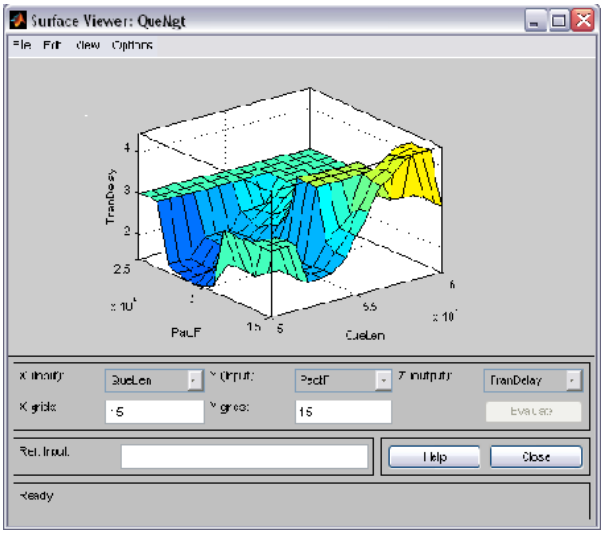

Fig. 6 Surface Viewer

Rule viewer and surface viewer generated using FIS is as shown in Fig.5 and Fig.6. Rule Viewer demonstrates if QueLen is Large and PackF is Verylow then TranDelay is VeryHigh.

As we know that, Queue Length is measured in terms of packets (or bytes). By default queue length is 65536, whereas is generally ranges from 256 (minimum range) to 1073741824 (maximum range).

Packet Flow is measured in terms of packets/sec. It ranges from 15000 to 2,00,000.

Transmission Delay is measured in milliseconds. Generally it is less than 5 milliseconds.

For our Fuzzy based Queue Management Control System we will design our database based on following input as well as output parameter values –

i. QueLen – It ranges from 50000 to 60000.
ii. PackF – It ranges from 15000 to 25000.
iii. TranDelay – It ranges from 1 to 5.

Table III: Database

S.No.	**QueLen**	**PackF**	**TranDelay**
1.	(50000 50000 52000)	(15000 15000 17000)	(1 1 2.2)
2.	(50000 52000 54000)	(15000 17000 19000)	(1 2.2 3)
3.	(52000 54000 56000)	(17000 19000 21000)	(2.2 3 3.8)
4.	(54000 56000 58000)	(19000 21000 23000)	(3 3.8 4.6)
5.	(56000 58000 60000)	(21000 23000 25000)	(3.8 4.6 5)

Above Table III shows database in terms of fuzzy sets for input as well as output parameter.

5. Results and Discussion

In this research paper, proposed Fuzzy Based Queue Management has been implemented in MATLAB. Experiment shows output and its results are more accurate.

6. Conclusion

Queuing is an important mechanism controlling link utilization, bandwidth allocation, delay variability, timely

delivery and delivery reliability which may degrade system performance in terms of security of network, network performance. Therefore queues should always be configured on the outgoing interface regarding the traffic flow. Above stated fuzzy based experiment shows one of proper and efficient queuing mechanism.

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