Performance Modeling on Different Queuing Technique for QoS Support over 3G and 4 G Networks

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ABSTRACT
The challenges of new communication architecture are to offer better quality of service (QoS) in internet Network. A large diversity of services based on packet switching in 3G network and beyond 3G leads dramatic changes in the characteristics and parameter of data traffic. Deployment of application server and resource server has been proposed to support both high data rates and quality of service (QoS) for Next Generation Network (NGN).One important generalization of the Next Generation Network is, it’s a queue of network. It is expected that traffic in NGN will undergo both quantitative and qualitative changes. Such networks can model problems of contention that arise when a set of resources is shared. With the rapid transformation of the Internet into a commercial infrastructure, demands for service quality have rapidly developed. In this paper, few components of NGN reference architecture have been taken and system is evaluated in terms of queuing network. This paper gives a comparative analysis of buffer size, queuing delay and amount of traffic sent and traffic received for three queuing systems FIFO, PQ and WFQ. These parameter is evaluated through simulation. Result shows WFQ has better quality comparing with other techniques in a voice based services where as PQ techniques is better in Video based services. Simulation is done using OPNET.

Keywords
QoS-Quality of service, NGN-Next generation network, FIFO, PQ, WFQ.

1. INTRODUCTION
It is essential to understand and take a deep look in to the future, for a view of what a network may look like and explore how a service or group of services may fit together to form a useful example of where next generation network will take us. To offer better quality of service in a network a lot of parameter should be considered such as bandwidth, latency, delay, jitter and packet loss etc. NGN’s architecture is based on decoupling transport layer and service layer. Basically, that means that whenever a provider wants to enable a new service

they can do it straight upon defining it at the service layer without considering it the transport layer. Fig.-1 shows reference architecture of NGN model. Required components of NGN have been extensively discussed in past [1] [2].

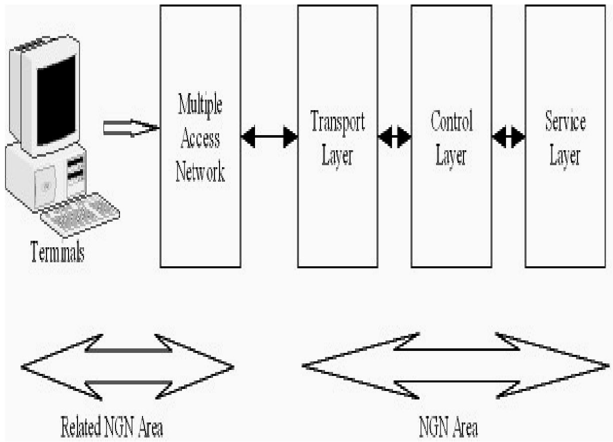

Fig-1(Reference Architecture Diagram of NGN Model)

2. METHODOLOGY & REQUIREMENTS

In next generation proposed architecture, these are following set of requirements.

1. Drivers and basic requirements.
2. NGN QOS standardization.
3. Resource and Admission control Functions.

In order to meet some of the requirements listed for Next generation Network, some proposal has been discussed in past [3].

In the generic model a node or a service center represent each resource. Thus in a model for computer system performance analysis we may have service center for the servers, a service center for each I/O channel [4].

A service center may have one or more server associated with it. If a job requesting service finds all the server at a service center busy, it will join the queue associated with the center and a later point in time when a server becomes idle a job from the queue will be selected for service according to some scheduling discipline.After completion of service at one service center the job may move to another service center for further service, reenter the same service center or leave the system [5].

There are two types of networks.

(i) Open Queuing network: It is characterized by one or more sources of job arrivals and correspondingly one or more sinks that absorb jobs departing from the network.

(ii) Close Queuing network: In this type of network job neither enters nor depart from the network. The probability of transition between service centers and the distribution of job service time characterized the behavior of jobs within the network. For each center the no. of servers the scheduling discipline and the size of the queue must be specified. We assume that the scheduling is FCFS and that each server has a queue of unlimited capacity.

Many efficient algorithms for calculating performance measure for open and closed queuing network have been developed and discussed in past[6][7] [8] [9].

3. VARIOUS QUEUING TECHNIQUES

We treat a number of elementary queuing models. Attention is paid to methods for the analysis of these models, and also to applications of queuing models on 3G and 4G network. Various queuing disciplines can be used to control which packets get transmitted and which packets which packets get dropped. The queuing disciplines are:

1. First-in-first-out (FIFO) queuing.
2. Priority queuing (PQ)
3. Weighted-Fair queuing. (WFQ)

FIFO is an acronym for First in First Out. This expression describes the principle of a queue or first-come first serve behavior: what comes in first is handled first, what comes in next waits until the first is finished etc.

Thus it is analogous to the behavior of persons “standing in a line” or “Queue” where the persons leave the queue in the order they arrive. First In First out (FIFO) is the most basic queuing discipline. In FIFO queuing all packets are treated equally by placing them into a single queue, then servicing them in the same order they were placed in the queue. FIFO queuing is also referred to as First Come First Serve (FCFS) queuing [10]. Although a single FIFO queue seems to provide no QoS features at all, it actually does affect drop, delay, and jitter. Because there is only one queue, the router need not classify traffic to place it into different queues and router need not worry about how to decide from which queue it should take the next packet—there is only one choice. Due to this single queue uses FIFO logic, the router need not reorder the packets inside the queue. With a longer queue, however, the average delay increases, because packets may be enqueued behind a larger number of other packets. In most cases when the average delay increases, the average jitter increases as well.

Priority Queuing assigns multiple queues to a network interface with each queue being given a priority level. A queue with higher priority is processed earlier than a queue with lower priority. Priority Queuing has four preconfigured queues, high medium, normal and low priority queue. Queues are serviced in strict order of queue priority, so the high queue always is serviced first, then the next-lower priority and so on. If a lower-priority queue is being serviced and a packet enters a higher queue, that queue is serviced immediately. This mechanism is good for important traffic, but can lead to queue starvation. If packets arrive in the high queue then priority queuing drops everything its doing in order to transmit those packets, and the packets in other queue is again empty. When a packet is sent out an interface, the priority queues on that interface are scanned for packets in descending order for priority.

The high priority queues are scanned first, then the medium priority queue and then so on. The packet at the head of the highest queue is chosen for transmission. This procedure is repeated every time when a packet is to be sent. The maximum length of a queue is defined by the length limit. When a queue is longer the limit packets are dropped [11]. The idea of the fair queuing (FQ) discipline is to maintain a separate queue for each flow currently being handled by the router. The router then services these queues in a round robin manner.

WFQ allows a weight to be assigned to each flow (queue). This weight effectively controls the percentage of the link’s bandwidth each flow will get. WFQ is a generalization of fair queuing (FQ) [12]. Both in WFQ and FQ, each data flow has a separate FIFO queue.

4. NETWORK DESIGN & CONFIGURATION

The following network design has been taken into consideration to evaluate network performance on various queuing network. At the first step single traffic is used for each of the functions such as Ftp, Video Conferencing and VOIP which is shown in Fig. 3.

Performance based on queuing network has been discussed in past using various queuing policy but failed to achieve wide acceptance due to various complexity [13] [14] [15].

Through this current research work traffic sent and traffic received parameter is evaluated for FIFO, PQ and WFQ queuing discipline and further IP packet drop has been evaluated for voice and video based transmission. The bellow configurations applied in the Opnet Modeler and simulated to get results.

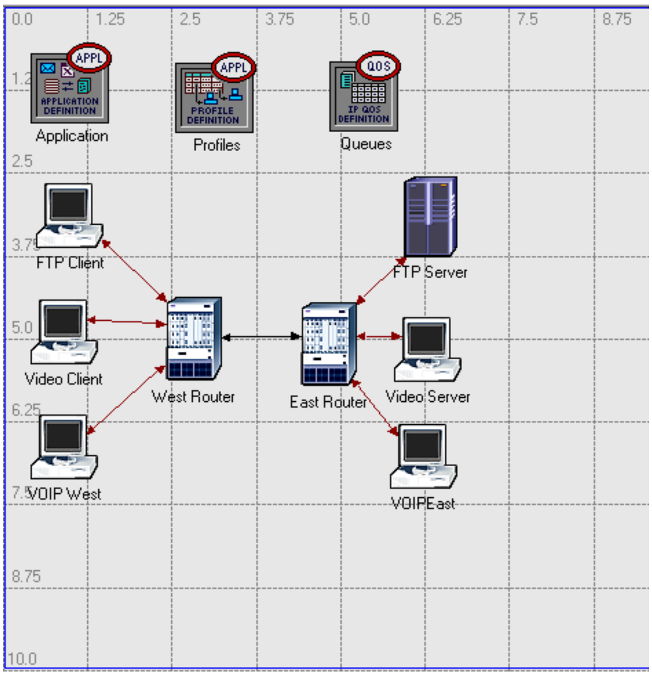

Fig 3. Network Architecture for FIFO, PQ and WFQ

Different queuing discipline in the routers can affect the performance of the applications and the utilization of the network resources. Routers need to be configured for those three Queuing disciplines. The router configuration has been shown in Fig. 4.

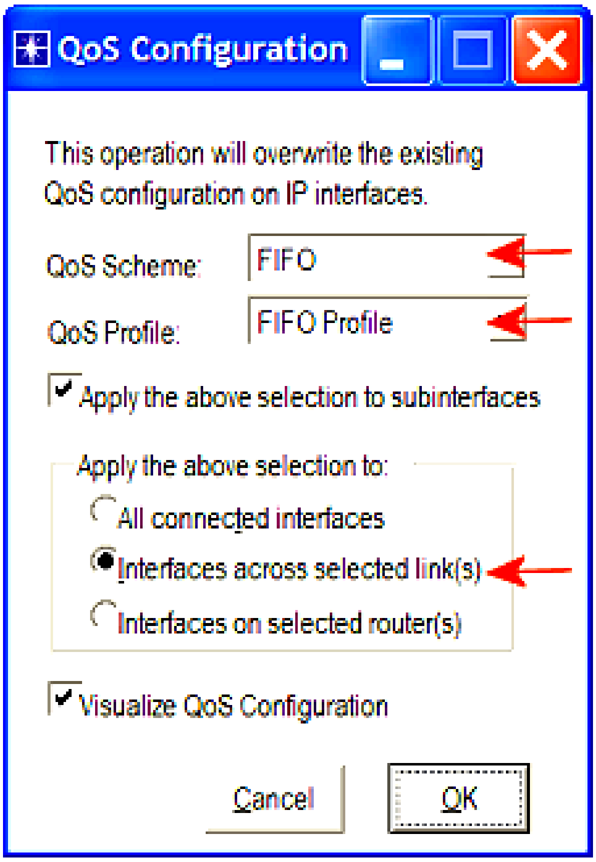

Fig 4.Router Configuration

5. SIMULATIONS RESULTS AND ANALYSIS

Simulation has been done using OPNET software for every queuing scheme and packet dropped, traffic sent, traffic received, Buffer uses is measured. Fig 5, 6, 7 shows traffic sent and received for FIFO, PQ and WFQ for voice transmission. It has been observed that traffic sent and received are fairly matching in case of PQ and WFQ which results minimal packet drop.

Fig 8, 9, 10 shows traffic sent and received for FIFO, PQ and WFQ for video transmission. In this case WFQ shows better results than PQ and FIFO as there is a little variation between traffic sent and traffic received which means there is minimal traffic drop in case of WFQ queuing discipline. Packet drop is always higher in case of FIFO scheme.

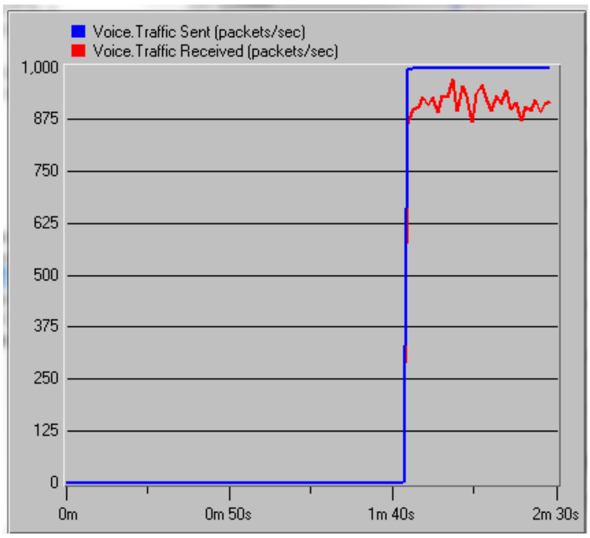

Fig. 5 Traffic Sent and Traffic Received for FIFO (Voice)

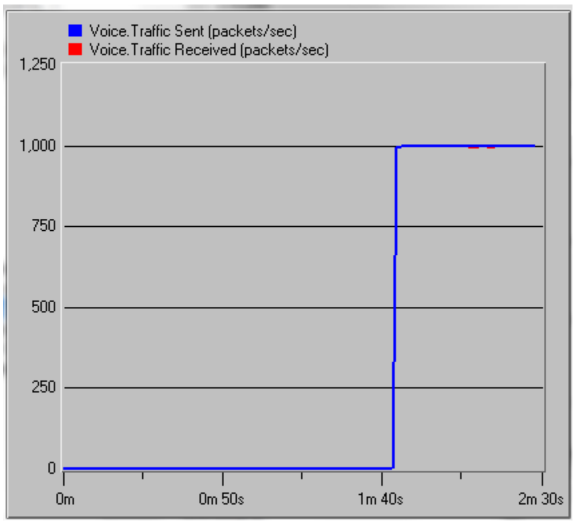

Fig.6 Traffic Sent and Traffic Received for PQ (Voice)

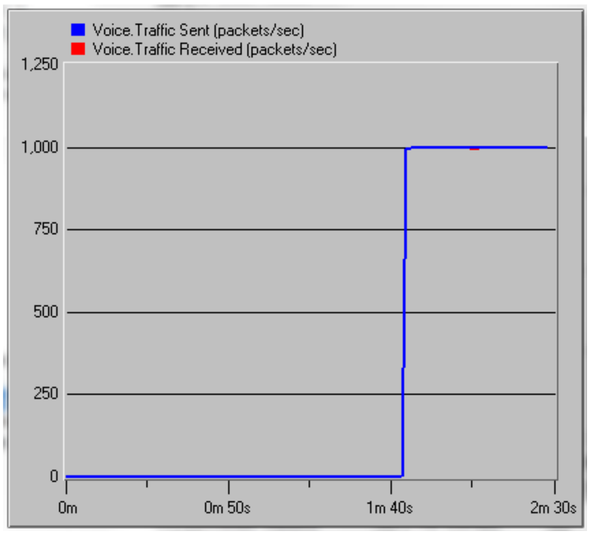

Fig.7 Traffic Sent and Traffic Received for WFQ (Voice)

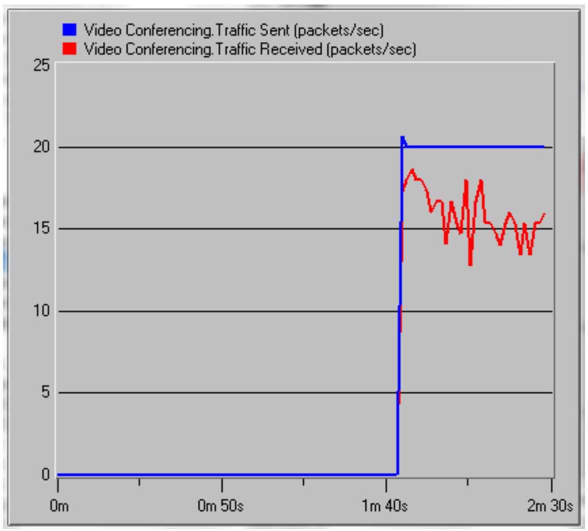

Fig. 8 Traffic Sent and Traffic Received for FIFO (Video)

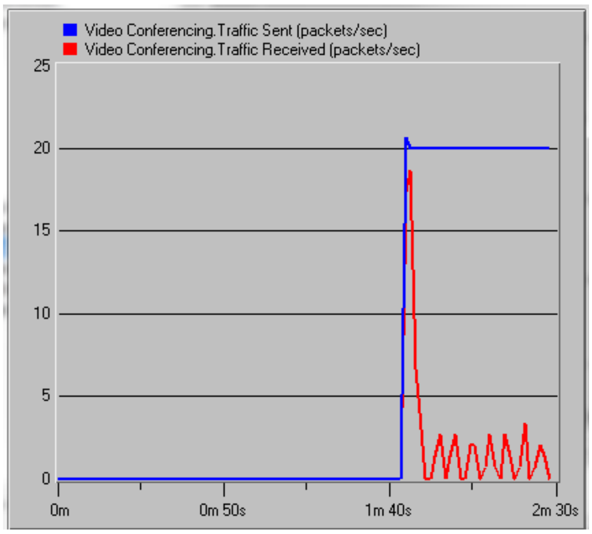

Fig.9 Traffic Sent and Traffic Received for PQ (Video)

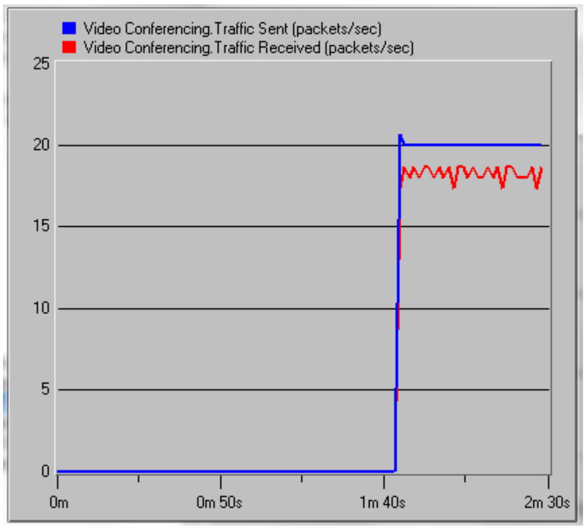

Fig.10 Traffic Sent and Traffic Received for WFQ(Video)

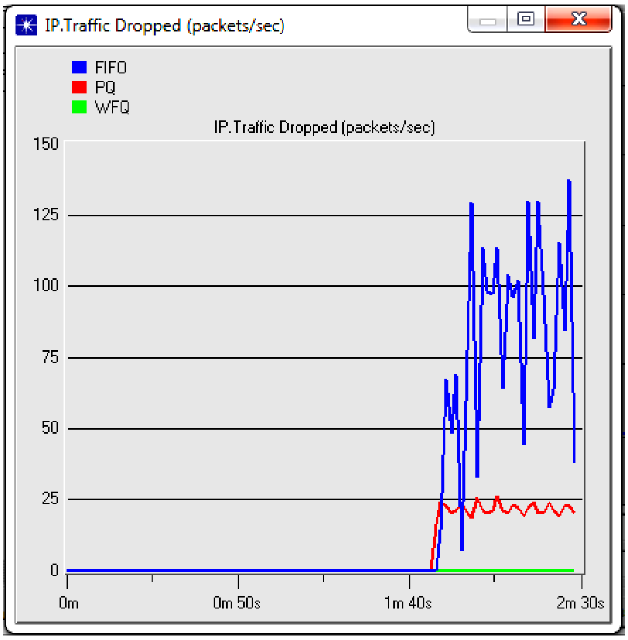

Fig. 11. Traffic drop for FIFO, PQ and WFQ

Fig 9, 10 shows traffic drop statistic. It has been observed that as the traffic drop is higher in FIFO scheme. For WFQ scheme it is almost zero or there is no traffic drop. For PQ groups traffic drop is considerably lower than FIFO. Some attempt has been taken in past to do performance evaluation using various queuing algorithm [16].

6. CONCLUSION

It has been observed after comparing the detail statistics of the result that IP packet drop is always higher in case of FIFO scheme for both voice and video based content deliver over network. PQ scheme gives better result in some cases as packet end to end delay in case of video based content delivery over the network. However WFQ gives best result among them. Result shows that traffic drop is almost zero in case of WFQ scheme. As per the presented result here in case of WFQ scheme IP packet drop are proper for audio and video based content. Results are useful for performance modeling for 3G and 4G network.

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