Implementation of Mod RED AQM Technique for Wireless Networks with Strict Priority Scheduling

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Abstract—We propose modified random early detection(ModRED) active Queue Management Scheme for congestion control in wireless IP networks with Diffserv Scheduling. Our AQM aims at providing better control over the burstiness level while remaining the advantages of Basic RED. We use Qual Net to simulate a series of network configurations and the numerical results demonstrate that Our Mod REDAQM can achieve better results in Packets Received better in Average End-To-End Delay,Jitter,Packets Enqueued in Queue Packets Drop,Average Time in Queue,Peak Queue length,Throughput. compared to RED without sacrificing its advantages in all simulation scenarios. The improvement becomes more significant under bursty traffic.
Keywords — Active queue management (AQM), congestion control, Random early detection (RED), QualNet.

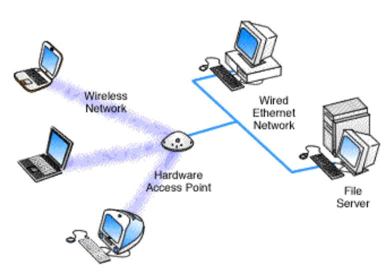
1 Introduction

1.1 Wireless Networks

A wireless network, which uses high-frequency radio waves rather than wires to communicate between nodes, is another option for home or business networking. Individuals and organizations can use this option to expand their existing wired network or to go completely wireless. Wireless allows for devices to be shared without networking cable which increases mobility but decreases range. There are two main types of wireless networking; peer to peer or ad-hoc and infrastructure.

An ad-hoc or peer-to-peer wireless network consists of a number of computers each equipped with a wireless networking interface card. Each computer can communicate directly with all of the other wireless enabled computers. They can share files and printers this way, but may not be able to access wired LAN resources, unless one of the computers acts as a bridge to the wired LAN using special software.

An infrastructure wireless network consists of an access point or a base station. In this type of network the access point acts like a hub, providing connectivity for the wireless



computers. It can connect or bridge the wireless LAN to a wired LAN, allowing wireless computer access to LAN resources, such as file servers or existing Internet Connectivity. (compnetworking.about.com)

There are four basic types of transmissions standards for wireless

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networking. These types are produced by the Institute of Electrical and Electronic Engineers (IEEE). These standards define all aspects of radio frequency wireless networking. They have established four transmission standards; 802.11, 802.11a, 802.11b, 802.11g.

The basic differences between these four types are connection speed and radio frequency. 802.11 and 802.11b are the slowest at 1 or 2 Mbps and 5.5 and 11Mbps respectively. They both operate off of the 2.4 GHz radio frequency. 802.11a operates off of a 5 GHz frequency and can transmit up to 54 Mbps and the 802.11g operates off of the 2.4 GHz frequency and can transmit up to 54 Mbps. Actual transmission speeds vary depending on such factors as the number and size of the physical barriers within the network and any interference in the radio transmissions.

Wireless networks are reliable, but when interfered with it can reduce the range and the quality of the signal. Interference can be caused by other devices operating on the same radio frequency and it is very hard to control the addition of new devices on the same frequency. Usually if your wireless range is compromised considerably, more than likely, interference is to blame.

A major cause of interference with any radio signals are the materials in your surroundings, especially metallic substances, which have a tendency to reflect radio signals. Needless to say, the potential sources of metal around a home are numerous--things like metal studs, nails, building insulation with a foil backing and even lead paint can all possibly reduce the quality of the wireless radio signal. Materials with a high density, like concrete, tend to be harder for radio signals to penetrate, absorbing more of the energy. Other devices utilizing the same frequency can also result in interference with your wireless. For example, the 2.4GHz frequency used by 802.11b-based wireless products to communicate with each other. Wireless devices don't have this frequency all to themselves. In a business environment, other devices that use the 2.4GHz band include microwave ovens and certain cordless phones.

On the other hand, many wireless networks can increase the range of the signal by using many different types of hardware devices. A wireless extender can be used to relay the radio frequency from one point to another without losing signal strength. Even though this device extends the range of a wireless signal it has some drawbacks. One drawback is that it extends the signal, but the transmission speed will be slowed.

There are many benefits to a wireless network. The most important one is the option to expand your current wired network to other areas of your organization where it would otherwise not be cost effective or practical to do so. An organization can also install a wireless network without physically disrupting the current workplace or wired network. (Wi-Fi.org) Wireless networks are far easier to move than a wired network and adding users to an existing wireless network is easy. Organizations opt for a wireless network in conference rooms, lobbies and offices where adding to the existing wired network may be too expensive to do so.

1.2 Wired vs. Wireless Networking

The biggest difference between these two types of networks is one uses network cables and one uses radio frequencies. A wired network allows for a faster and more secure connection and can only be used for distances shorter than 2,000 feet. A wireless network is a lot less secure and transmission speeds can suffer from outside interference. Although wireless networking is a lot more

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mobile than wired networking the range of the network is usually 150-300 indoors and up to 1000 feet outdoors depending on the terrain. (Homelanextream.com)

The cost for wired networking has become rather inexpensive. Ethernet cables, hubs and switches are very inexpensive. Some connection sharing software packages, like ICS, are free; some cost a nominal fee. Broadband routers cost more, but these are optional components of a wired network, and their higher cost is offset by the benefit of easier installation and built-in security features.

Wireless gear costs somewhat more than the equivalent wired Ethernet products. At full retail prices, wireless adapters and access points may cost three or four times as much as Ethernet cable adapters and hubs/switches, respectively. 802.11b products have dropped in price considerably with the release of 802.11g. (Homelanextream.com)

Wired LANs offer superior performance. A traditional Ethernet connection offers only 10 Mbps bandwidth, but 100 Mbps Fast Ethernet technology costs a little more and is readily available. Fast Ethernet should be sufficient for file sharing, gaming, and high-speed Internet access for many years into the future. (Wi-Fi.org) Wired LANs utilizing hubs can suffer performance slowdown if computers heavily utilize the network simultaneously. Use Ethernet switches instead of hubs to avoid this problem; a switch costs little more than a hub.

Wireless networks using 802.11b support a maximum bandwidth of 11 Mbps, roughly the same as that of old, traditional Ethernet. 802.11a and 802.11g LANs support 54 Mbps, that is approximately one-half the bandwidth of Fast Ethernet. Furthermore, wireless networking performance is distance sensitive, meaning that maximum performance will degrade on computers farther away from the access point or other communication endpoint. As more wireless devices utilize the 802.11 LAN more heavily, performance degrades even further. (Wi-Fi.org)

The greater mobility of wireless LANs helps offset the performance disadvantage. Mobile computers do not need to be tied to an Ethernet cable and can roam freely within the wireless network range. However, many computers are larger desktop models, and even mobile computers must sometimes be tied to an electrical cord and outlet for power. This undermines the mobility advantage of wireless networks in many organizations and homes.

For any wired network connected to the Internet, firewalls are the primary security consideration. Wired Ethernet hubs and switches do not support firewalls. However, firewall software products like Zone Alarm can be installed on the computers themselves. Broadband routers offer equivalent firewall capability built into the device, configurable through its own software.

In theory, wireless LANs are less secure than wired LANs, because wireless communication signals travel through the air and can easily be intercepted. The weaknesses of wireless security are more theoretical than practical. (Wi-Fi.org) Wireless networks protect their data through the Wired Equivalent Privacy (WEP) encryption standard that makes wireless communications reasonably as safe as wired ones.

No computer network is completely secure. Important security considerations for organizations tend to not be related to whether the network is wired or wireless but rather ensuring that the firewall is properly

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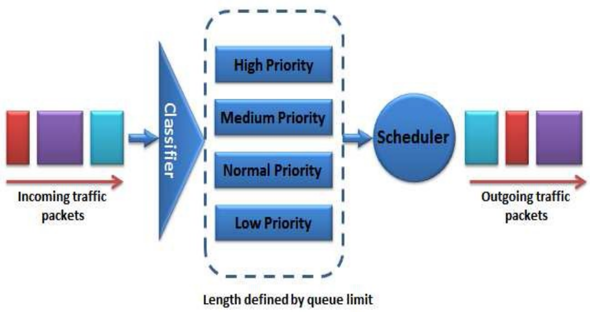
configured, employees are aware of the dangers of spoof emails, they are away of spy ware and how to avoid and that anyone outside the organization does not have unauthorized access to the network.

1.3 Strict Priority (SP) Scheduling

In this algorithm packets are represented by the scheduler depending on the QoS class and then they are assigned into different priority queues, these queues are served according to their priority from the highest to the lowest as shown in below, in which this mechanism may causes some priority QoS classes to be starved



2. ModRED AQM Algorithm

The main idea of the approach is to restrict the TCP transmission window with the flow control window instead of the congestion control window, thus controlling the transmission window with a finer granularity. Results from simulations show that the our algorithm modified queues improve on the average queue size, one-way packet delay, delay jitter, number of packet drops and throughput as compared to RED queues, especially in paths that have non-ECN compliant routers. Moreover, Modified RED (ModRED) does not require modification to TCP implementations at servers or clients Mod RED is based on the two-drop precedence policy. A packet is marked at the edge of the network as IN or OUT of its service contract and it is treated differently inside the network, on the basis of this priority classification. The router inside the network keeps just one queue for IN and OUT packets and apply to them two different RED algorithms as we can see in Figure 3.1. Instead of using the same average queue size for both priorities, it uses the average queue size for OUT (out of profile) packets, and the average queue size without taking into account the queued OUT packets for IN (in profile) packets. In time of congestion the router starts to drop OUT packets and eventually, if congestion persists, will start to discard IN packets, as well.

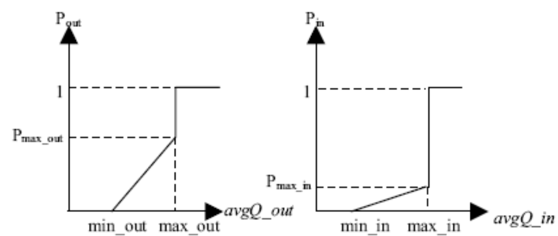


Figure: 2.**1 The marking/dropping behavior of ModRED**

We are proposing to use flow control feedback to reduce congestion at routers. In this thesis, we will deal with congestion occurring at the ingress and gateway routers two major congestion areas within the network. Our algorithm sets the window field to one maximum segment size (MSS) in the ACK packets 1 that are going towards the sender from the receiver, instead of dropping or marking the packets at the queue. (The only exception that it will not modify the receiver window field is when the field has a value of 0. This occurs when a TCP application wants to tell its peer not to send any more data). We denote our algorithm as modification to RED schemes by affixing "mod(M)" before the name of the RED. In our algorithm the field is set to 1 only if the average queue length is between *Thmin* and *Thmax*, where *Thmin* and *Thmax*, are the minimum and maximum threshold values respectively. However, if

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the average queue length is greater than *Thmax,* the packet is dropped

4.Performance Evalution

To evaluate the performance of ModRED, we use QualNet simulator to simulate a series of scenarios. In this simulation the data is transferred from UMTS nodes to IP nodes. We created different test cases with different number of nodes like 16nodes, 32nodes, 64, nodes, 128nodes.In each case we varied the following Queue parameters and finally we collected the statistics for best configured values. Below are the configured parameters for the Scenario used for test cases.

Area of Simulation	3000 Sq meters for (16, 32, 64 nodes) 6000Sq meters for 128 nodes.
Simulation Time	100 seconds
Queue Mechanisms	RED, WRED, AVQ, MODRED
Queue Schedulers	ROUND-ROBIN, STRICT-PRIORITY, DIFFSERV
No of IP nodes	16, 32, 64, and 128

Table 4.1 Simulation Parameters

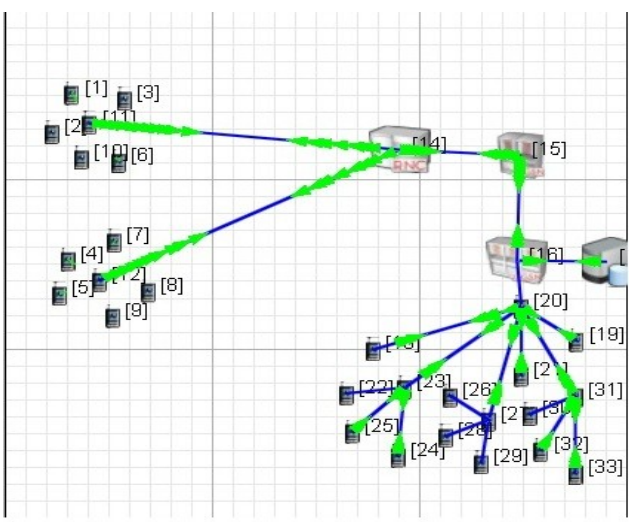

Fig4.1 16 node Wireless Networks

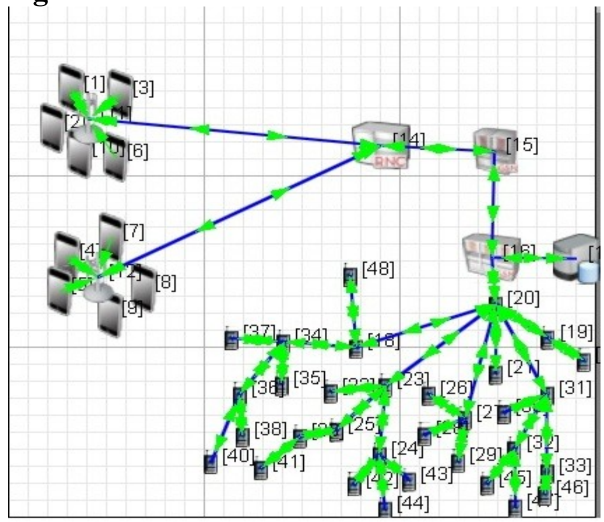

Fig 4.2 32 node Wireless Networks

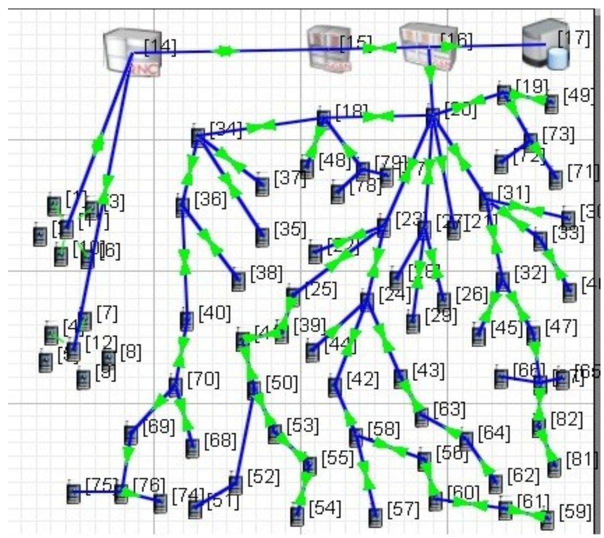

Fig4.3 64 node Wireless Networks

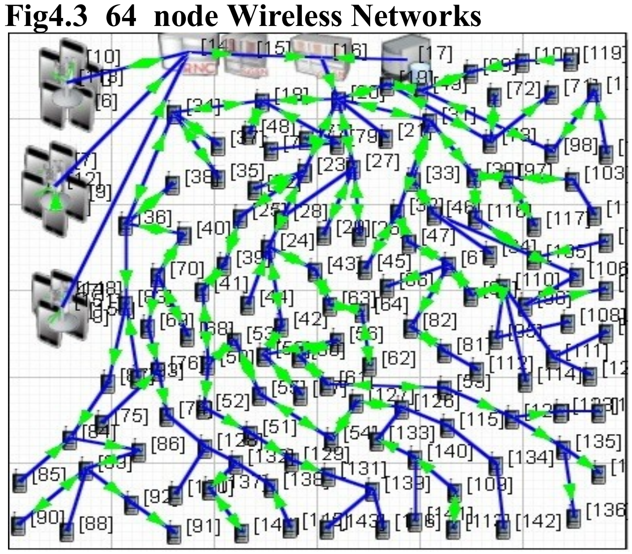

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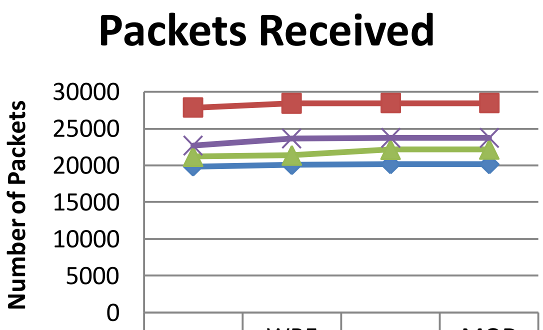
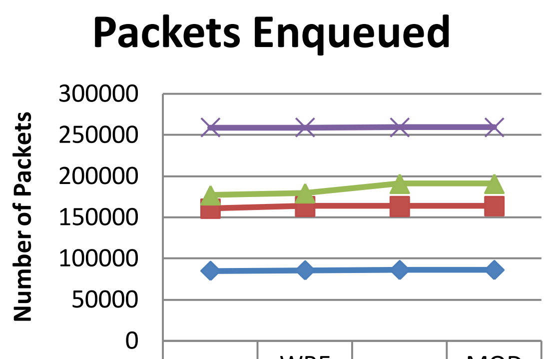
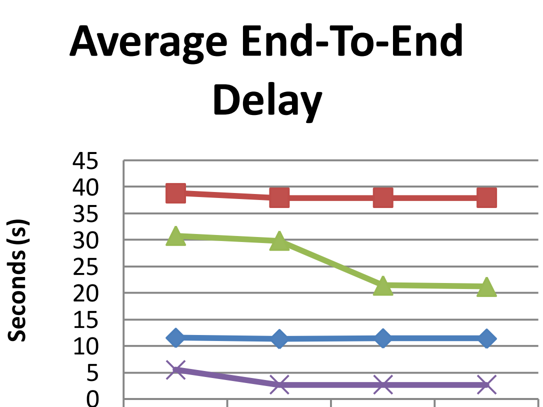
Fig4.4 128 node Wireless Networks



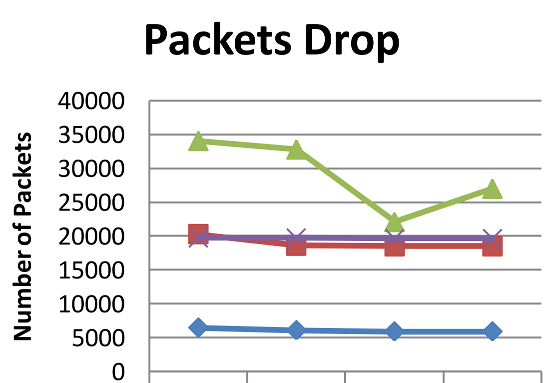
	RED	WRED	AVQ	MODRED
16	19850	20045	20153	20155
32	27847	28414	28454	28456
64	21212	21365	22145	22169
128	22686	23659	23745	23740



	RED	WRED	AVQ	MODRED
16	84579	85291	85644	85645
32	160693	163208	163379	163471
64	176910	179324	190879	190911
128	259035	258884	259223	259199



	RED	WRED	AVQ	MODRED
16	11.548	11.3149	11.4476	11.3948
32	38.8253	37.9717	37.9669	37.9717
64	30.7977	29.8707	21.422	21.1907
128	5.50591	2.67929	2.66722	2.67114



	RED	WRED	AVQ	MODRED
16	6450	6068	5887	5882
32	20247	18650	18545	18510
64	34030	32772	22127	27014
128	19718	19696	19643	19643

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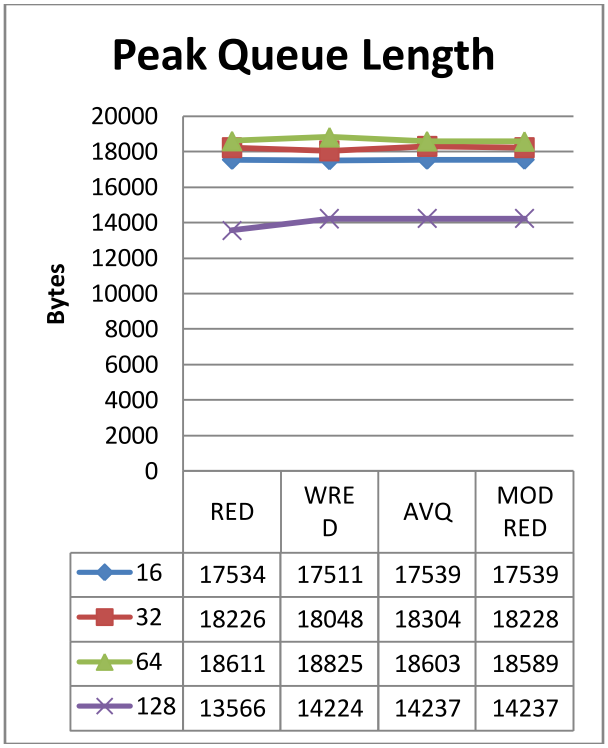
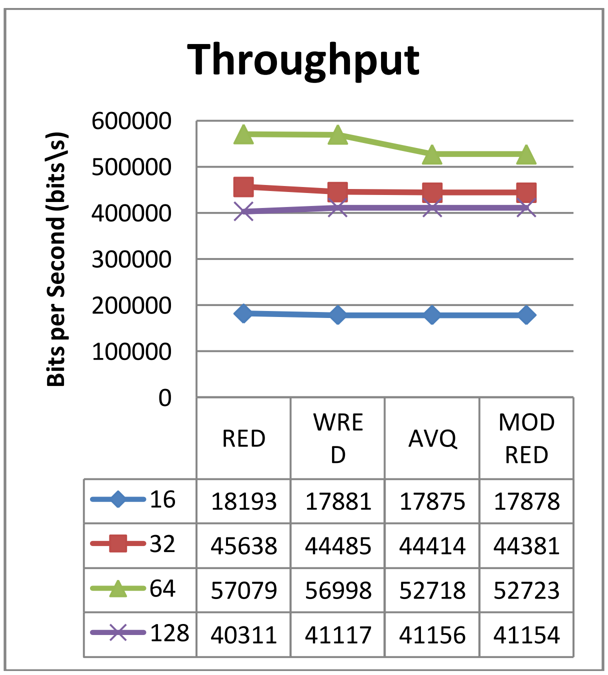


	RED	WRED	AVQ	MOD RED
16	17534	17511	17539	17539
32	18226	18048	18304	18228
64	18611	18825	18603	18589
128	13566	14224	14237	14237



	RED	WRED	AVQ	MOD RED
16	18193	17881	17875	17878
32	45638	44485	44414	44381
64	57079	56998	52718	52723
128	40311	41117	41156	41154

The RED,WRED,AVQ & Mod RED AQMs were tested under different traffic loads, with Strict Priority by varying the number of Nodes in terms of 16,32,64,128 .

This section describes the qualnet simulator. simulation details associated with our comparison study of the performance of RED ModRED. Above graphs shows the results for Packets Received better in Average End-To-End Delay, Jitter, Packets Enqueued in Queue Packets Drop, Average Time in Queue, Peak Queue length, Throughput. Throughput of Simulation results Mod RED queues of any packet loss enjoy good response times with a small drop-tail queue, especially those that are small.

Simulation results demonstrate that in all scenarios performance improvements can be achieved by ModRED in terms of link utilization/node throughput without sacrificing other advantages of RED, such as congestion avoidance as opposed to congestion reaction, avoiding global synchronization of source backoff, etc. This performance gain depends on the bursty nature of traffic at the gateway. Significant higher link utilization and/or node throughput is found for some cases of bursty traffic at the Route. Because of this, flows that do not experience any packet loss enjoy good response times with a small drop-tail queue, especially those that are small. Mod RED queue reduce the packet loss rate but subjects flows to more queuing delay.

Hence, for large flows that dominate the links (in terms of number of packets) and are likely to experience some packet losses (assuming that packets are dropped randomly and uniformly), the impact of increased queuing delay is out weighted by the effects of reduced packet losses. Thus, large flows receive better performance under a large ModREDl queue. Overall, the ModRED queue chosen as a baseline for comparison with AQM algorithms because it appears to achieve a good trade-off for drop-tail queues between improving response times for a large number of small objects and a small number of large objects.

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As the offered load increased , ModRED obtain significant performance improvement over packet dropping.

5. Conclusion

In this Paper we have designed and simulated a ModRED AQM scenario in which there is communication between wireless network and IP network. In order to evaluate the performance of the network (Delay, Jitter, Packets Received .etc...) . we have compared with ModRED with different Active Queue Mechanisms like RED,WRED,AVQ .We configured different queue scheduling mechanisms. As each Queue mechanism has its own characteristics the network performance is varied based on certain parameters of the Queue such as Queue weight, Minimum Drop Probability, Maximum Drop probability etc… As wireless network (UMTS) Gateway (GGSN) is responsible for routing the Internet traffic from Wireless Networks to IP network. We interfaced the Wireless network to IP network via GGSN. In this experiment the data is transferred from Wreless networks nodes to IP nodes. We created different test cases with different number of nodes like 16nodes, 32nodes, 64, nodes, 128nodes.In each case we varied some Queue parameters and finally we collected the statistics for best configured values. Below are the configured parameters for the Scenario used for test cases. We shown that our approach ModRED AQM is deliverd good performance over other AQM techniques.

Overall ModRED AQM algorithm reduce loss rates, increase link utilization, and provide significant performance improvement for response times. In future work, it would be interesting to evaluate performance of ModRED AQM algorithms under different conditions such as multihop networks, wireless networks, or gigabit networks. Further, it would be very interesting to perform these experiments either with standard protocol .

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