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QoS Mechanisms in NGN

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***Abstract*—**Next generation network (NGN) is taking the focus of different service providers because the requirement for the bandwidth has increased and the service providers also wants to offer some other services for their users. Next generation network is not handling the voice and data differently but voice and data are congregated. So this congregation has raised some question on the Quality of service (QOS) in NGN. This paper is the result of survey about the QOS mechanisms in NGN. Different mechanisms have been studied and presented their comparison in this paper.

***Keywords*—** Quality of service (QOS), Next generation network (NGN), Voice over IP (VOIP), Internet Protocol television (IPTV)

I. INTRODUCTION

This The difference between the legacy PSTN and NGN is explained in Figure-1. For service provider to provide internet, telephone and wireless services in a particular place they have to install different systems for each of above. It requires a huge investment and place.

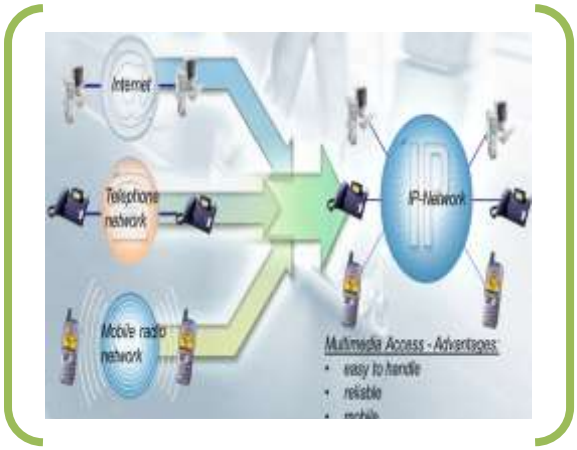

Figure-1

Further the service provider needs human resources of each of above and expertise for the maintenance of their system. In NGN system, service provider needs to install only one network in order to provide internet, telephone and wireless services to the customers. The system will be IP based so it will bypass all the traditional switches used in legacy PSTN. So to expand the network NGN will require not so much investment and place [1]. Further the power consumption of these systems is also smaller than legacy PSTN which will be discuss in coming sections. NGN is completely IP based and we can connect copper, wireless or optical media to it as shown in Figure-2

Figure-2

This system has advantage that all the past technologies and future technologies can be connected to it if they are IP based. If they are not IP based we have to connect a Gateway in between [2].

Because of its construction it is necessary to guarantee the Quality of Service for voice and data. For this purpose different techniques are used for guarantying the QOS. Some techniques are discussed in this paper. This paper is composed of the following sections. The definition of QOS is given in section II. Section III describes the methods for improving QOS in NGN and last section presents conclusion. follow.

II. DEFINITION OF QUALITY OF SERVICE

QOS of a network is defined by the following parameters.

- Network Availability
- Network throughput
- Packet delay
- Jitter
- Packet loss [3]

Network availability is the network up time. Ideally the network should always be available to the users. Network throughput is presented in bits per second (bps). It is the bandwidth which the service provider can achieve using his

network. Packet delay is the time between packet sent from sending side and packet received at receiving side [4].Jitter is the packet delay variation. Packets sent from sender to receiver do not have the same packet delay. There will be some variation in this packet delay and this variation is called the jitter [4].Packet lost is the data lost due to congestion. All the above are the measures for quality of service.

III. METHOD OF IMPROVING OF QOS IN NGN

Next generation network (NGN) is a packet based heterogeneous network and it is completely based on IP. The biggest problem in NGN is to provide end-to-end quality of service. There are a number of methods used to ensure end-to-end quality of service (QoS): resource reservation, admission control and priority scheduling.

A. Resource Prediction at Egress NODE

Egress node is one at which the access and core network are connected. At egress node admission control mechanism is used which is an efficient way to provide end-to-end quality of service (QoS). In this model it is supposed that core network is supporting IP Diffserv and MPLS Diffserv. While RACS is responsible for resource and admission control as well as it also guaranties the availability of the resources of the network for a given session.

In this method RACS check the resources of the network for each session, so it over load the core network because the traffic of each access network accumulates in core network, while the access network is not too much over loaded. So the edge router (ER), which connects the core network with the access network, is responsible for admission control mechanism.

NGN is based on IPV6. The IPV6 header has DSCP which support Diffserv. Here in this mechanism when user request for end-to-end QoS, RACS calculates the number of hops. If the number of hops is small it provides low priority to DSCP and if the number of hope is large it provide high priority to DSCP. RACS continuously check the number of the hops; if the number of the hops decreases then it initializes the RACS. If the number of the hops decreases so much that it meet the required QoS with lower DSCP. It provides low priority DSCP, by this way increase the utility of network component and hence QoS is improved. The egress node prediction base admission control is efficient and less overhead. In this method the current state of the egress node is measure and also predicts its future state. While planning base admission control is simple but not efficient. Also probe base admission control is efficient but overhead in network [5].

B. QOS Scheduler

There are numerous scheduling techniques which are used for QoS improvement like WFQ, Hierarchical queue, DRR and calendar queue. The calendar queue is simple and easily implementing technique and also best for service per-flow base scheduling. The other techniques are complex and also it is very difficult to implement. Although, calendar queue is best but due to fixed slot size the throughput is limited. So we can use an algorithm with this to improve the throughput at some way.

The other scheduling technique used in per-flow base queue. They ensure QoS for high priority traffic and not for low priority traffic. In calendar queue the packets are scheduled and the buffer is shared among the users. The packets arrived are stored in the common buffer for certain interval of time before sending to the calendar queue. If a packet is not served in the given interval, it is simply dropped rather than forwarding into the calendar queue. However, calendar queue used a fixed slots size while handling variable size packet. So some packets have different size than the time slot, so after serving such a variable size packet a blank remain in the slot, which is called a hole. In this technique an algorithm is used to properly utilize these holes to improve the throughput of low priority traffic while maintaining the QoS of high priority traffic. The proposed scheduler is shown in the Figure-3. When a packet reaches, the flow state tables identify the flow id and calculate time to start (TTS). The high priority packets are inserted into the calendar queue according to the value of TTS. While low priority packet are managed by low priority packet management table, and they are ordered by input port and TTS value in the buffer. The high priority packets are inserted into the time slot and a hole may be left. This remaining space is calculated by a recursive equation. In this space a low priority packet is inserted. Hence by this way a large number of holes are properly utilized and the throughput of low priority packet is improved.

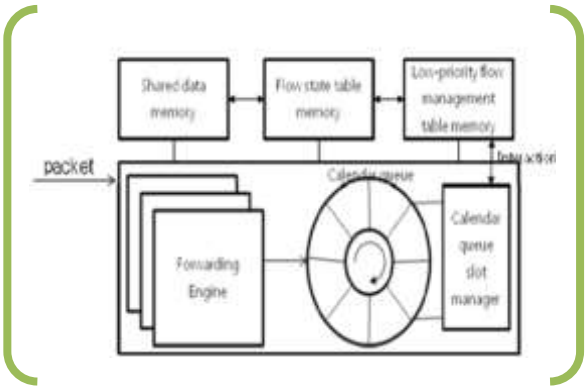

Figure-3

This technique degrades the packet loss and end to end delay. It is easy to implement and also having an easy buffer management. It also has the capability of per-flow base switch [6].

C. Mpls Over Diffserv

NGN is an IP base network, which forwards all types of packets in the same network, so therefore it is some time called heterogeneous network. Therefore, it faces certain type of problem in implementation but among them QoS is the most serious issue. Todays, internet is based on best effort services. So QoS can be achieved in such IP base network by different ways. By providing more resources one can achieve QoS but some time it is not possible. ATM and Intserv are also used for QoS improvement. But ATM has the problem of large

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overhead and Intserve have the problem of scalability. However, Diffserv have the ability of scalability but they give preference to some traffic class over the other. Similarly, MPLS have high speed switches and also have the capability of traffic engineering but have lack of differentiation. Thus, if we combine MPLS and Diffserv, a great improvement can be achieved in QoS parameters. MPLS is a packet based forwarding technique on the basis of label assigned to the packet rather than IP address. When a packet is entering into MPLS network, a 48 bit label is assigned to the packet. This label is assign between layers 2 and layer 3 headers. The protocol like OSPF, RIP and BGP are maintained [4]. All the packets with same destination used the same path and the labels are removed at egress node.

The router when receives a packet, it get the next hop address from the routing table. This is usually done by the link cost and not considering the link state to provide better QoS. This MPLS technique does not replace the IP routing protocol but help in determining the less congested link using traffic engineering principle to give best next hope. In this technique the router tries to find the shortest path, as by using OSPF. It can't use a path which is shortest but over utilized. Hence a packet goes through a path which is shortest as well as less congested.

For video, VoIP and GSM etc. it improves the delay by a factor of 10, while for HTTP it is improved by more than 100% [7]. Similarly, packet loss and jitter is reduced to almost zero. While throughput is increased by 3 to 4 time in MPLS enabled network. Hence, MPLS over Diffserv provides very high QoS in NGN.

D. Parameters which Directly Affect Real Time Data Transmition

As discussed that in NGN data, voice and video all travel in the same network. So QoS is the most important consideration in the implementation of such network. Some data like audio and video need real performance but there are some parameters affecting the real time data, so such parameters must be considered while transmitting such data. These parameters are bandwidth over provisioning, priority queuing and a way of classification.

i. Bandwidth Over Profvisioning

Bandwidth over provisioning means to provide more bandwidth and capacity than what actually needed for the network user. If the bandwidth is more then it simply means that user can transmit more data over the network, which means that throughput is more. Bandwidth is the characteristic of any rich media. All data needs more bandwidth than what it actually needed because of overhead. For example a high quality video call has 768 kbps data. There is 20% overhead, so actually it needs 920 kbps. To provide QoS in such situation, more bandwidth should be provided. But this is not the only solution.

ii. Priority Queuing

In real time data transmission like audio and video, data is sensitive to buffering and skipping. These problems can be overcome by providing queue at switches and routers of the network. So these queues are transmitting "delay and drop sensitive data" in a priority manner. The data is segregated before entering to the switch. According to the segregation each data is placed in an appropriate queue. So "delay and drop sensitive data" are forwarded directly, while the rest if dropped or lost will be re-transmitted.

iii. Classification

The priority queue is working properly, if data is properly classified into groups. The techniques which provide priority to the packet are RSVP, Diffserve, IP precedence and MPLS.

Hence when you have enough bandwidth and a way of proper queuing for each type of data and class and also you have a way of differentiation, one can guaranty QoS.

E. Model Protocol Stack

In this technique a model protocol stack of five layers was developed for the QoS in NGN. In addition the functions are divide into two functional networks i.e. first function network (FFN) and second function network (SFN). In this way a significant improvement occur in through put, jitter, bandwidth utilization and latency. We have

LAYER 1
LAYER 2
LAYER 3
LAYER 4
LAYER 5

LAYER 1

This layer provides services to the lower layer and also gives the function to the lower layer. The functionality of NGN in this model can be divided into two big functional groups: FFN (first functional network) and SFN (second functional network). The former is composed of NGN core network and end devices and the latter is composed of sub network like PSTN and ATM etc. in FFN MPLS is applicable in the core network, which performs the function of traffic engineering and also ensure end to end QoS. The SFN ensure QoS in each sub network because it can't be performed when core network is reached.

LAYER 2

It performs the function of admission control. In NGN each user request for certain services, which is based on service level agreement (SLA). SLA is agreed upon rule between customer and service provider. When a customer requests for a particular service, the admission control will check the resources and gives the response on the basis of available resources [8].

LAYER 3

This layer performs the function of routing. The routing techniques are applied in FFN to select the shortest path by observing the resources of the network. The protocols like OSPF, BGP and RIP provides the QoS in SFN.

LAYER 4

This layer performs the function of signaling. The required QoS parameter are evaluated by this layer and forwarded to the

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other network nodes. The protocol translation is done by the media gateway due to which the signaling is problematic in SFN [8]-[10]. While in FFN signaling is easy because in this network switching is the only function.

LAYER 5

This layer performs like MAC layer. This layer will provide the information of available channel, the maximum bandwidth, modulation scheme etc.

This model improved the parameters on which QoS depends. The delay is improved from 5% to 29%by baseline test and 70% improvement in case of MPLS over the baseline test. The jitter is improved up to 70% while throughput is improved by a factor of 10 [11].

CONCULSION

The work presented in this paper is about the QoS solution for NGN. QoS of a particular network is defined by packet delay, network availability, network throughput, jitter and packet loss. By improving the above parameters the QoS of the network can be improved. NGN is IP based network which transmits the voice, video, and other types of data through the same network so the big problem in NGN is to guarantee the end to end QoS. In order to improve the QoS different techniques are used. Few of the techniques are presented in this paper.

Different techniques are suited for different locations where these types of networks are to be introduced. It is necessary to have a careful look at the suitable technique before implementation process.

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