Achieving QOS Guarantee’s over IP Networks Using Differentiated Services

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Abstract

Now a day’s internet is providing the best service. Different applications contain, that doesn’t differentiate among packets that may be having different performance requirement. This kind of occurs a problem for real time applications. That’s why we require small amount of resources operate effectively, such as multimedia applications (telephony and audio, video etc). So avoid this problem. International Electro technical Commission (IEC) and International Organization for Standardization (ISO) standards are cooperates with Internet Engineering Task Force (IETF) proposed as differentiated services architecture. The main aim of this paper is to elaborate the performance of differentiate services as prevent to the internet service provider’s. In this paper I’m implemented this concept of simulator is GRPHICAL NETWORK SIMULATOR (GNS3).

Keywords

DSCP (differentiate service code point), PHB (Per-Hop Behavior), QOS.

I. Introduction

The differentiated services is proposed as a response to the scalability problems in the integrated services concept. DS architecture reduces the state of information stored in the network compare to the is architecture, by providing QOS to limited number of classes. Diff services is based on the class identification by using the DS header field, which is intended to supersede the existing definitions of the ipv4 TOS octet and ipv6 traffic class octet. In the DS field, 6-bits out of 8-bits are used as DS code point (DSCP) to specify the QOS requirement, while to remaining bits are currently unused. DSCP is used to differentiate aggregate flows from diff traffic classes. It is incompatible with ipv4 TOS, where the first 3 bits are used to specify the precedence, and next 4 bits are used to specify the requirements on delay, throughput, reliability, and cost.

IP Precedence and Type of Service

Basic principle of DS is packet forwarding treatment, which is defined by per-hop behavior (PHB) basic service in DS. When nothing else is specified, it is the best effort service. DS field differently an handy packets based on their DS fields, we may create several differentiate service classes. Therefore, one may refer to DS as a relative priority scheme. In order for customer to receive DS from his or internet service provider (ISP), the customer must have a service level agreement (SLA) with the agreement ISP. SLA can be static or dynamic. Static SLA is made on daily, weekly, monthly basis. Dynamic SLA requires a signaling protocol, such as RSVP, for requesting services on demand. The network under control of one ISP is usually called a domain.

Figure 1 TOS Byte in IP Header
The pre-eminence was deliberate as an uncomplicated precedence, when precedence is 7 it is best case and precedence is 0 it is the worst case. Differentiate service is used for distant approach, with distant bits recognized as a “low delay,” “high throughput,” and “high reliability.” Unfortunately, there was no architectural framework in which to employ the type of service octet and thus no explanation of how these properties could be implemented across a network. Later work [4] expanded these definitions, but still without an architectural framework. In practice, although some software exists that sets these bits, the TOS bits have been of little use and generally ignored.

**Network service and Service Differentiation**

A Network Service defines the characteristics of packet transmission in a single direction across one or more paths with a network. The characteristics of packet transmission may be defined in quantitative terms such as delay, jitter, and bandwidth and packet loss rate [2]. It may also be defined in terms of the priority of access to network resources.

![Network Diagram for IP with Diff Services](image)

**Figure 2.** Network diagram for IP with Diff Services

**II. Simulation Scenarios**

Different Scenarios are designed including multiple experiments so as to evaluate the performance of DiffServices architecture as compared to the Best Effort services model.

**Scenario_1: Specific Configuration**

**Experiment_1.1:** No specific configuration as the network is Best Effort.

**Experiment_1.2:** the VoIP traffic is assigned the Expedited Forwarding PHB. A priority class is allocated with the required bandwidth for VoIP. Low Latency Queuing mechanism is used to allocate the resources to the priority traffic. A service policy ‘DiffServices_Edge’ is created with falling configuration.

```
Policy-map DiffServices_Edge
Class VoIP
priority 80 2500
class class-default
queue-limit 15
```

**Results**

The TCP band with servers running on the receiving host will generate the graphs showing the throughput and the delay variation (jitter). The graphs are analyzed to study the behavior of the DiffServices architecture as opposed to that of Best Effort Services model. From the graphs the packet loss in delivering the VoIP traffic is also displayed. The transmission of VoIP traffics in both the networks is studied against the standards defined by the ITU-T standard G.114.

![Graph showing throughput and delay variation](image)

**Figure 3.** Transmission of VoIP traffic in Best Effort network

![Graph showing throughput and delay variation](image)

**Figure 4.** Transmission of VoIP traffic in DiffServices network

**Scenario_2: Specific Configuration**
For the three classes C1, C2 and C3 and the four experiments the bandwidth allocations are as shown below:

### Table 1 Bandwidth allocations to different classes in Scenario_2

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Class C1</th>
<th>Class C2</th>
<th>Class C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>2</td>
<td>50%</td>
<td>25%</td>
<td>25%</td>
</tr>
<tr>
<td>3</td>
<td>50%</td>
<td>35%</td>
<td>15%</td>
</tr>
<tr>
<td>4</td>
<td>70%</td>
<td>20%</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Experiment_2.1:** No specific configuration as the network is Best Effort

**Experiment_2.2**

class C1  
bandwidth percent 50  
class C2  
bandwidth percent 25  
class C3  
bandwidth percent 25

**Experiment_2.3**

class C1  
bandwidth percent 50  
class C2  
bandwidth percent 35  
class C3  
bandwidth percent 15

**Experiment_2.4**

class C1  
bandwidth percent 70  
class C2  
bandwidth percent 20  
class C3  
bandwidth percent 10

**Results**

The following figures show the bandwidths achieved by the three traffic classes C1, C2 and C3 in Best Effort in Experiment_2.1 and in DiffServices against the configured levels in Experiments 2.2 through 2.4.
Result Analysis

Scenario_1

The objective of this Scenario is to observe the ability of the DiffServices architecture in delivering the VoIP traffic, by allocating resources in terms of priority when the network is congested as compared to the Best Effort service. The results of Experiment_1.1 show a packet loss of 17% and more jitter (14ms) is observed in delivering the VoIP traffic in the Best Effort network while in experiment_1.2 no packet loss (< 0.3%) and a less jitter of 7ms is achieved in delivering the VoIP traffic in DiffServises network. This is expected because the Low Latency Queuing will give preference to EF class before any other class.

Scenario_2

The objective of this Scenario is to observe the ability of the architecture to allocate resources in terms of bandwidth to different forwarding classes as opposed to Best Effort model. From the Figure - 6.3 it is clear that the Best Effort model will not reserve bandwidth to any class. The Figures - 6.4 through 6.6 showed the DiffServices model’s ability in reserving the bandwidth to particular class of traffic guaranty to minimum bandwidth requirement. The following figure shows the average bandwidth achieved by different forwarding classes in different experiments and it showed that in the DiffServices architecture QOS needs of different classes of traffic are satisfied.

III. Simulation Analysis

A VoIP (Voice over IP)like application is designed using Iperf The codec used is the ITU- G.711. It performs no compression thus ensuring the best voice quality. However as a result, its bandwidth requirements will be higher. The data rate produced by this codec is 64Kbps (at the application layer). The packetize time (20ms) chosen was a tradeoff between end to end delay and bandwidth requirement.

The larger the packetize time, the more voice samples are put in a packet thus requiring fewer packets to be transmitted. However, the end to end delay becomes longer. For shorter packetize times, packets are transmitted more frequently, thus reducing end to end delay. However since packets are transmitted more frequently, each with their own overhead (RTP, UDP, IP protocol headers), more bandwidth is required. So, for small end to end delay and bandwidth requirement a packetize delay of 20ms was chosen.

VoIP call bandwidth calculation- For the conducted evaluation, it was necessary to create a degree of congestion in the network. This requires knowledge of the average data rate the application achieves.

Codec specification- Codec G.711 output = 64kbps, for a packetize time of 20ms per packet, a packet has 160 bytes for its payload.

Overhead calculation- The protocols that are used to transport voice data are UDP (8 bytes), RTP (12 bytes) and IP (20 bytes). “Bandwidth per voice call
(packet payload + (transport and IP header + layer 2 header)) × 50 packets per second”.

\[ [160+(8+12+20)] \times 50 = 10,000 \text{ bytes} = 80,000 \text{ Bits} \]

At IP layer the bandwidth required = 80 Kbps.

IV. Conclusion

This project aimed to investigate the performance benefits of implementing the Differentiated Services architecture as opposed to the Best Effort service. It is clear that DiffServ is able to provide resource allocation to forwarding classes in terms of bandwidth and also it is a scalable. The results of the experiments conclude that DiffServices is able to provide not exactly Quality of Service but a Class of Service. That is, DiffServices is able to provide better performance for certain subsets or classes of traffic but not to individual flows. The flows that use a forwarding class do not have absolute performance guarantees. DiffServices can provide better performance for a service class but the performance of the flows that use that forwarding class is dependent on the provisioning, prioritization and traffic load of the forwarding class. Because of the limited resources, the current DiffServices implementation only considers a single DS domain. It is desired to upgrade this implementation to support DS regions as well with more nodes and different applications. The scalability issues of the architecture are also need to be tested completely.

V. References


http://www.rfc-editor.org/rfcsearch.html


