ENSC 427: COMMUNICATION NETWORKS

FINAL PROJECT

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Analysis on the Performance of ATM Network Based on CBR and UBR

Group 12

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List of Acronyms

ATM: Asynchronous Transfer Mode

ABR: Available Bit Rate

CBR: Constant Bit Rate

FTP: File Transfer Protocol

LAN: Local Area Network

QoS: Quality of Service

UBR: Unspecified Bit Rate

VBR: Variable Bit Rate

WAN: Wide Area Network

1. Abstract

ATM network is a data transport technology which is applicable on both LAN and WAN. The transport rate is high and it supports variable types of communication, such as voice, data, fax, real-time video, and image. It was firstly developed in mid 1980s [1].This project will investigate the performance of two service classes of ATM on several applications, compared each other, to determine the most feasible one for each application.

2. Introduction

2.1 What is ATM?

ATM is a connection-oriented, cell based, packet-switched technology. The packets switched in an ATM network are always in a fixed length, 53 bytes, which are called cells. ATM provides QoS through its 4 service classes: CBR, VBR, ABR, and UBR. In this project, we are going to analyze ATM performance on different service classes. We focus on CBR and UBR by comparing their performance on transferring different types of data and demonstrate the effectiveness of each service classes. The following graph shows the layout of the basic structure of ATM network. The basic idea of the project came out from this picture.

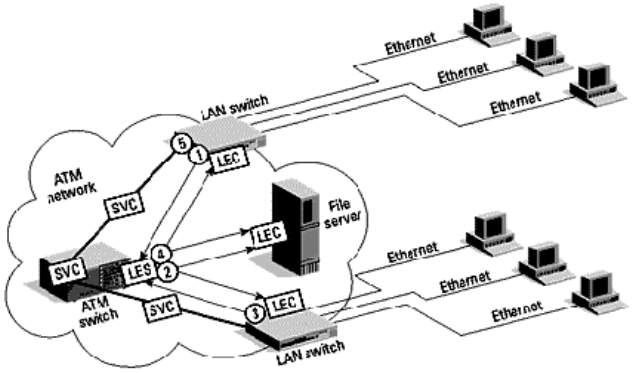


Figure 1. layout of ATM [2]

2.2 What is CBR?

The CBR service class is designed for ATM virtual circuits needing a static amount of bandwidth that is continuously available for the duration of the active connection [3].It is strict with QoS, transfer delay, packet loss and jitters. It can be used for instant service which is in specified bandwidth, such as voice transmission.

2.3 What is UBR?

The UBR service class is intended for delay-tolerant or non-real-time applications, i.e., those which do not require tightly constrained delay and delay variation, such as traditional computer communications applications [4]. It does not provide any guarantee for service. UBR service supports a high degree of statistical multiplexing among sources. UBR service may be considered as interpretation of the common term "best effort service".

2.4 Project overview

In order to compare performance of these two service classes, we are concerned about the following statistics: download response time, packet delay variation, jitters in two applications, which are Voice, and Ftp. After analyzing these statistics, we will make a claim for the best choice for each application.

3. **OPNET simulation**

3.1 Workspace

We need the following objects to develop our topology of ATM network.

Figure 2. Objects were used in project

In order to simulate an ATM network in US, we put four subnets in the different locations of US and two switches in the middle of workspace. Atm_adv links are used to connect among them.

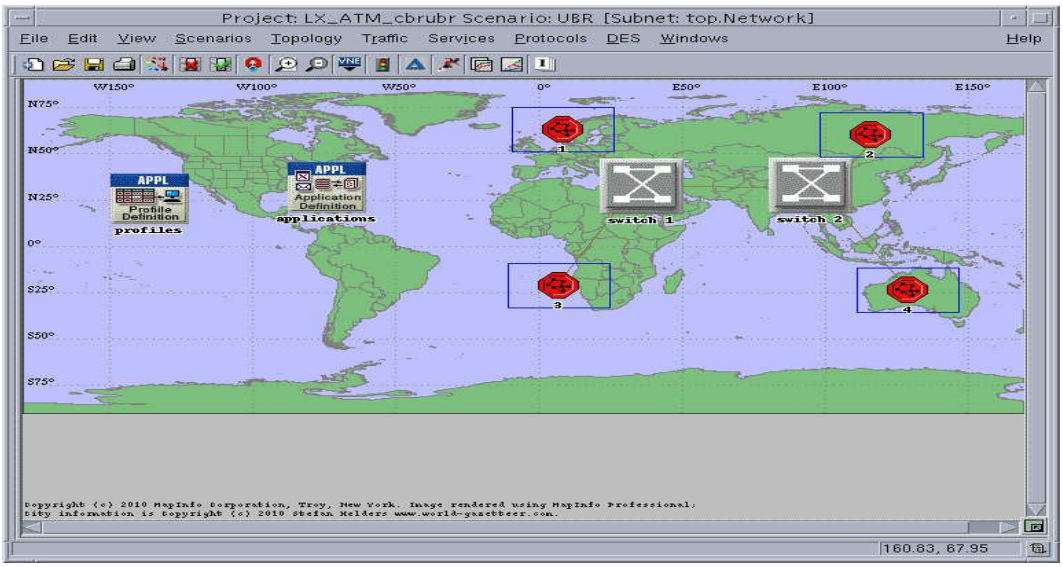


Figure 3. Network topology

3.2 Setting Attributes

Then we start to set up the attributes of them. Because we focus on two applications in our project: FTP and VOICE. For the application node, we set two applications inside, which are High Load FTP and PCM Quality Speech for VOICE.

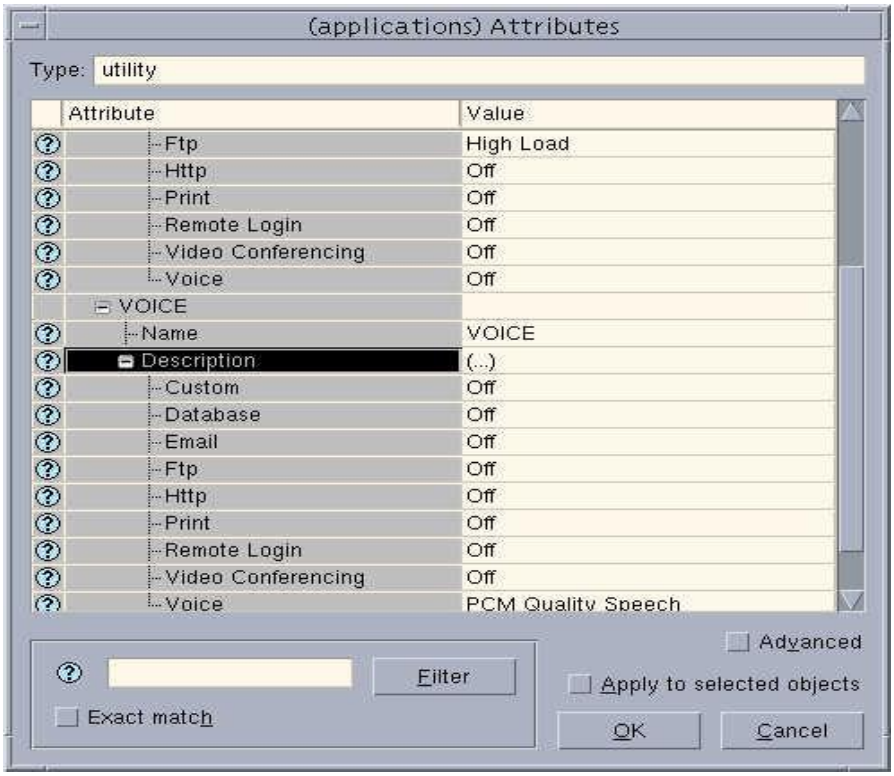


Figure 4. Application attributes table

For the profile node, we also set number of row to two, row one is

for FTP and row two is for VOICE.

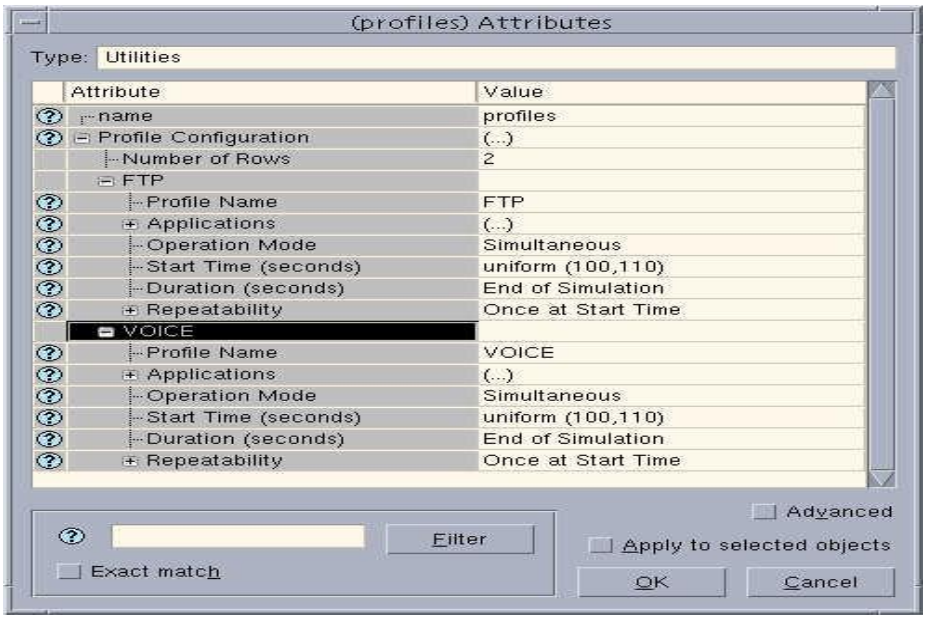
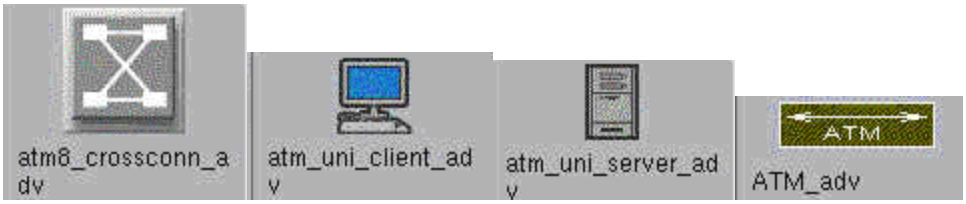


Figure 5. Profile attributes table

3.3 Subnet creation

After we finish those settings, then we start to create the topology of four subnets and we need the following objects.



Similar as the topology before, we put the switch in the middle of workspace, on the top; there are two client nodes for voice application, on the bottom, there are two client nodes for FTP applications, also, there is one server which support the data transfer in each subnet. The following graph is the topology of subnet.

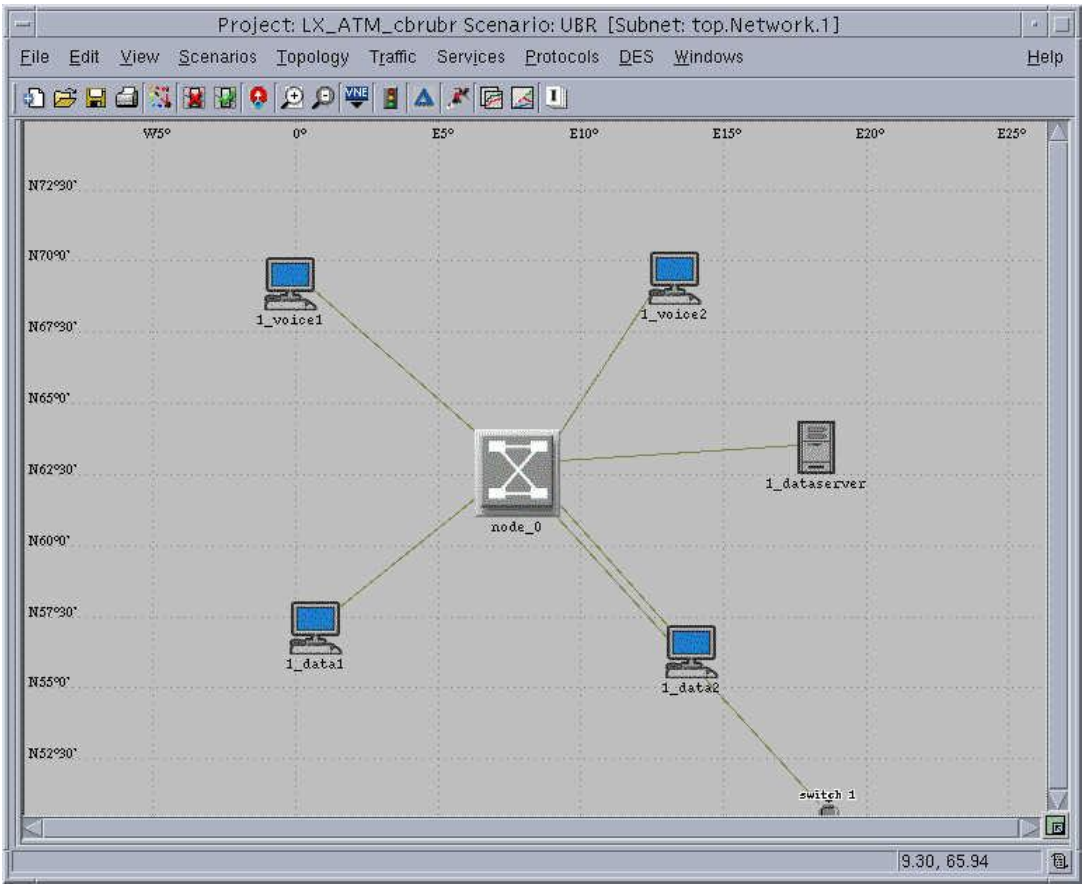


Figure 6. Subnet view

After we finish the topology of subnet, we start to set up the attributes for the four nodes and the server. We focus on the difference between CBR and UBR on the two applications, thus, we create two scenarios, and one is named CBR, which stands for CBR for FTP and VOICE application. Another one is named UBR, which stands for UBR for FTP and VOICE application. For scenarios CBR, we set the ATM application parameters and Queue Configuration of four client nodes as CBR ONLY.

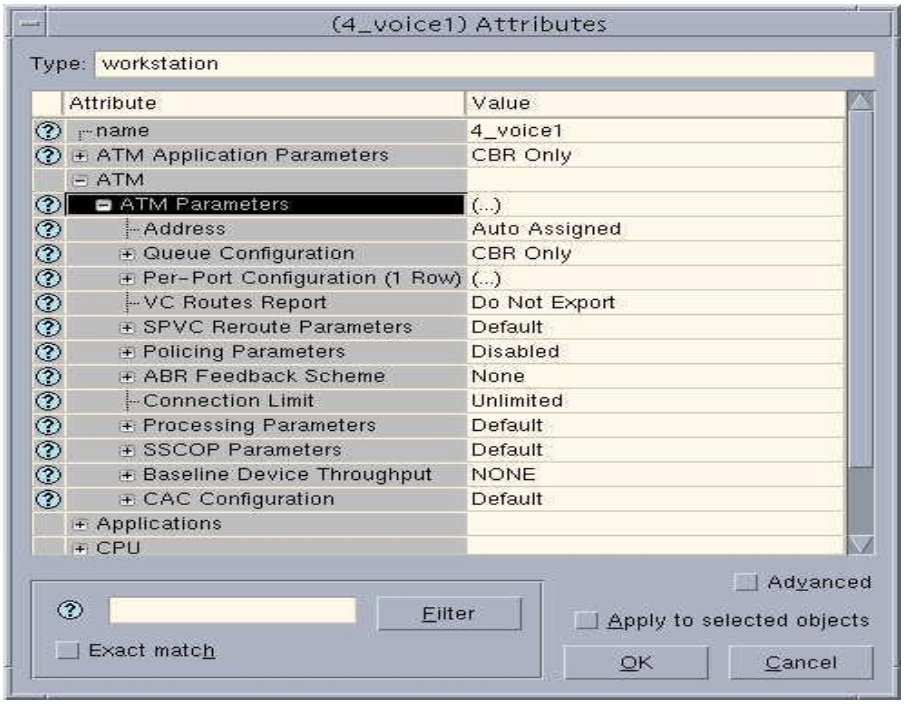


Figure 7. Attributes setting for Voice stations in CBR

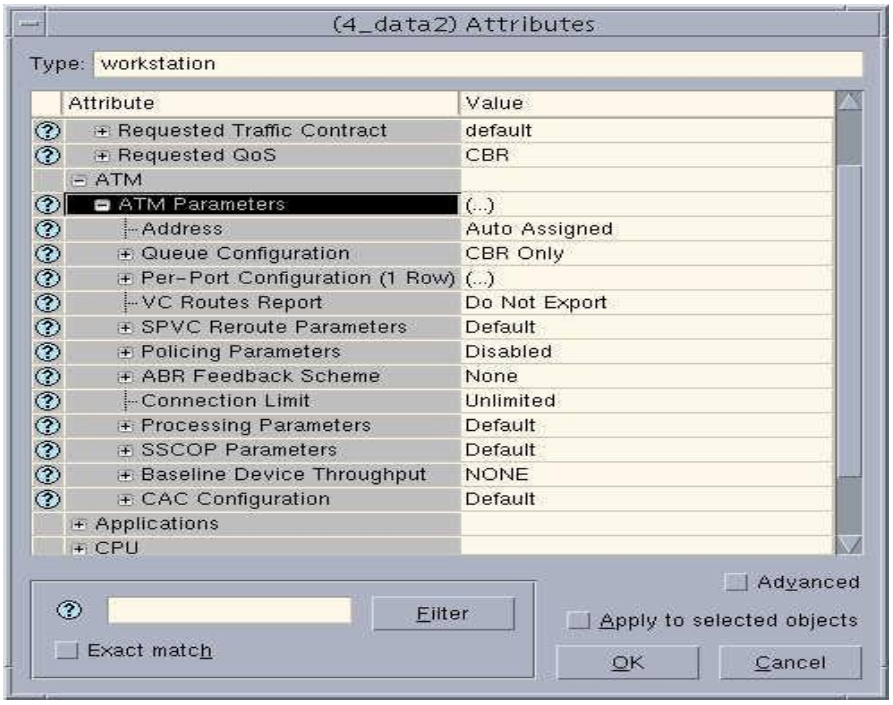


Figure 8. Attributes setting for Data stations in CBR

For scenario UBR, similar as CBR, , we set the ATM application parameters and Queue Configuration of four client nodes and one data server node as UBR ONLY.

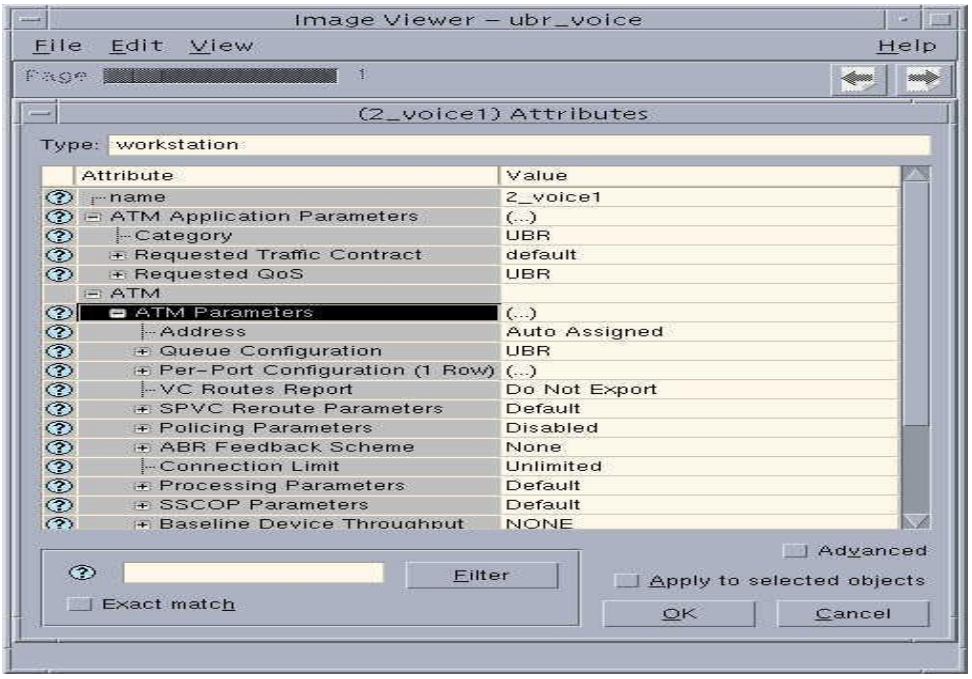


Figure 9. Attributes table of Voice station in UBR

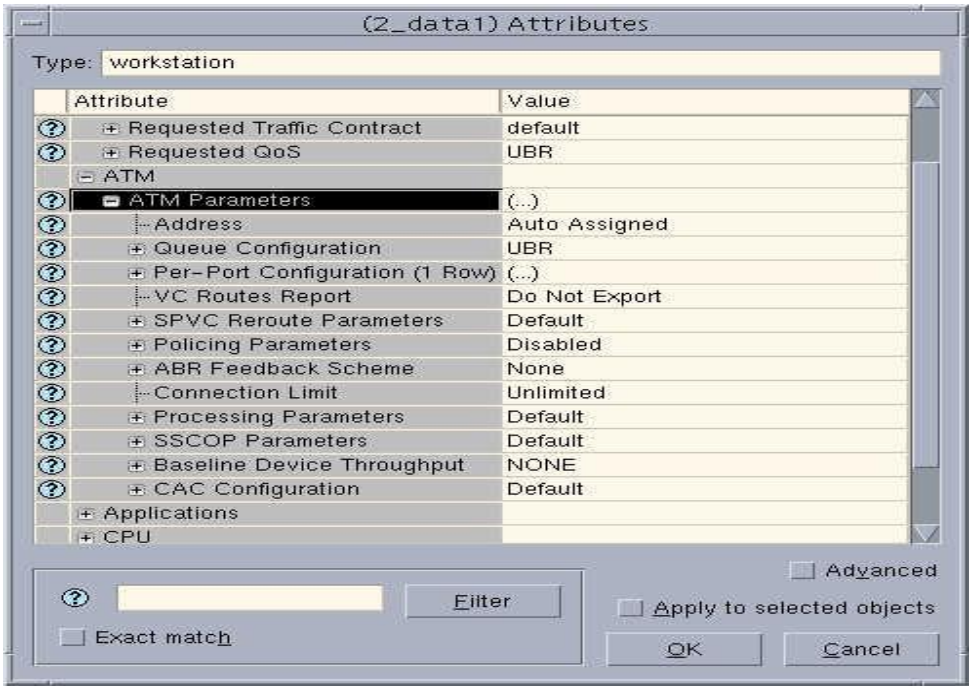


Figure 10. Attributes table of Data station in UBR

Furthermore, we also need to set the ATM application parameters and Queue Configuration of data server to the related class: CBR and UBR.

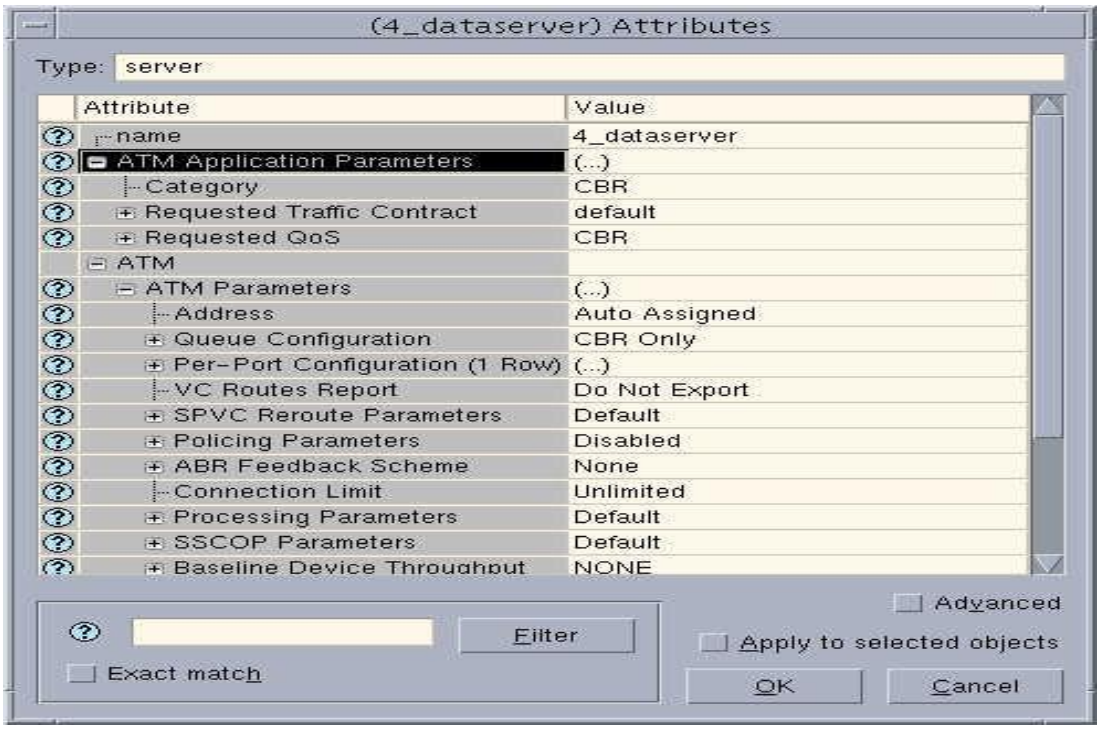


Figure 11. data server attributes in CBR

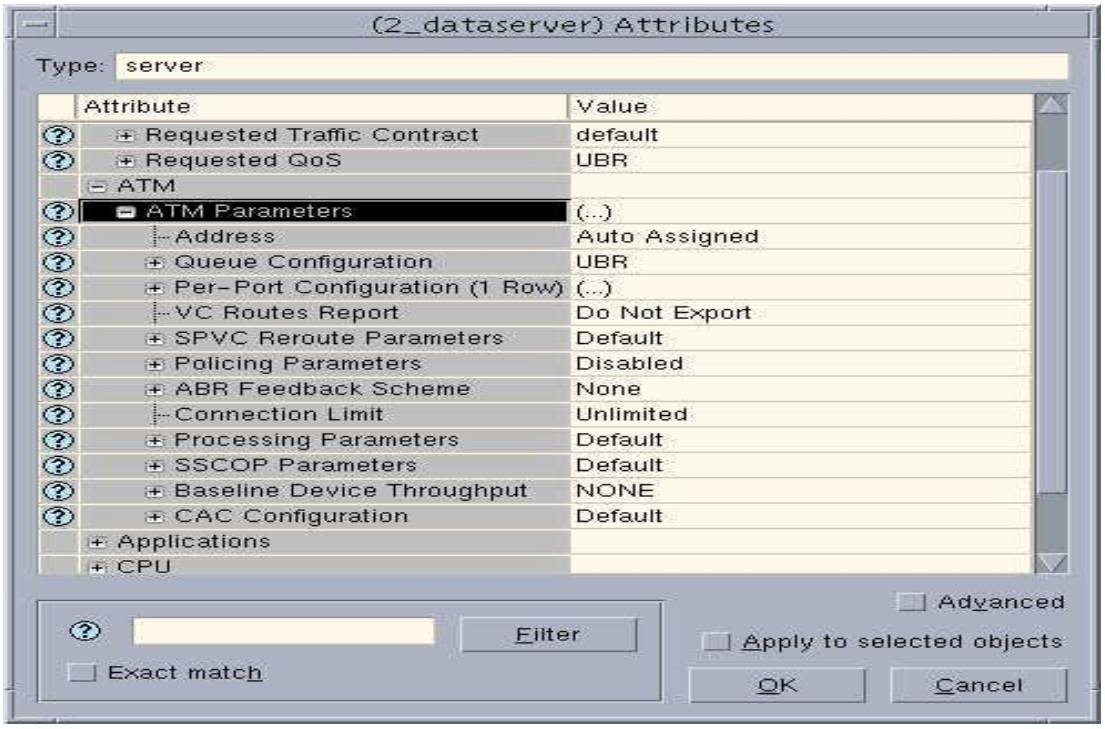


Figure 12. data server attributes in UBR

For all switches, we also need to set the Max_Avail_BW, it is the maximum bandwidth allocated to the queen, only if the calls are in the maximum available bandwidth, and they will be admitted.

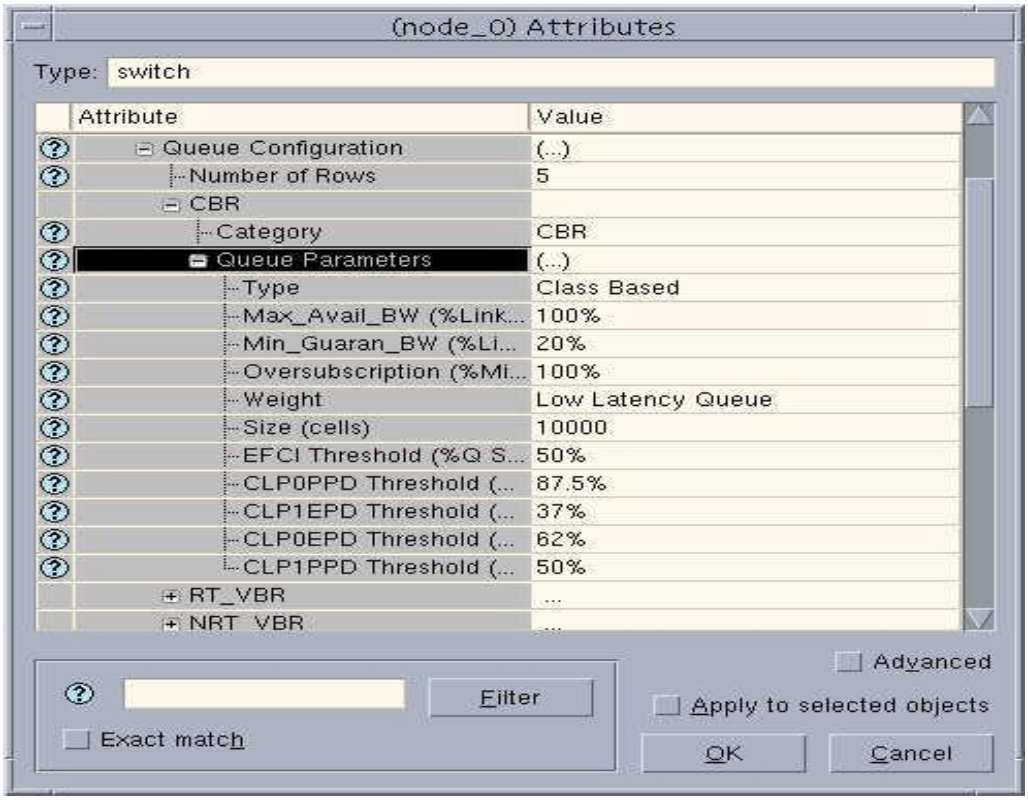


Figure 13. Switch attributes table

To test the performance of the applications defined in the network, we will collect the following statistics: Download Response time for FTP application, Packet Delay Variation, end-to-end delay and Jitter for VOICE application. Then, we start to collect the results for both scenarios in five minutes each.

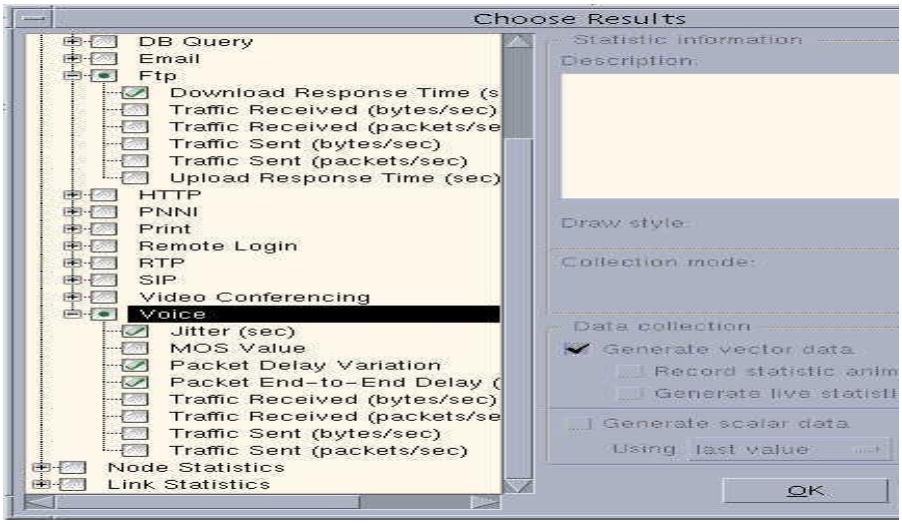


Figure 14. Results collected from simulation

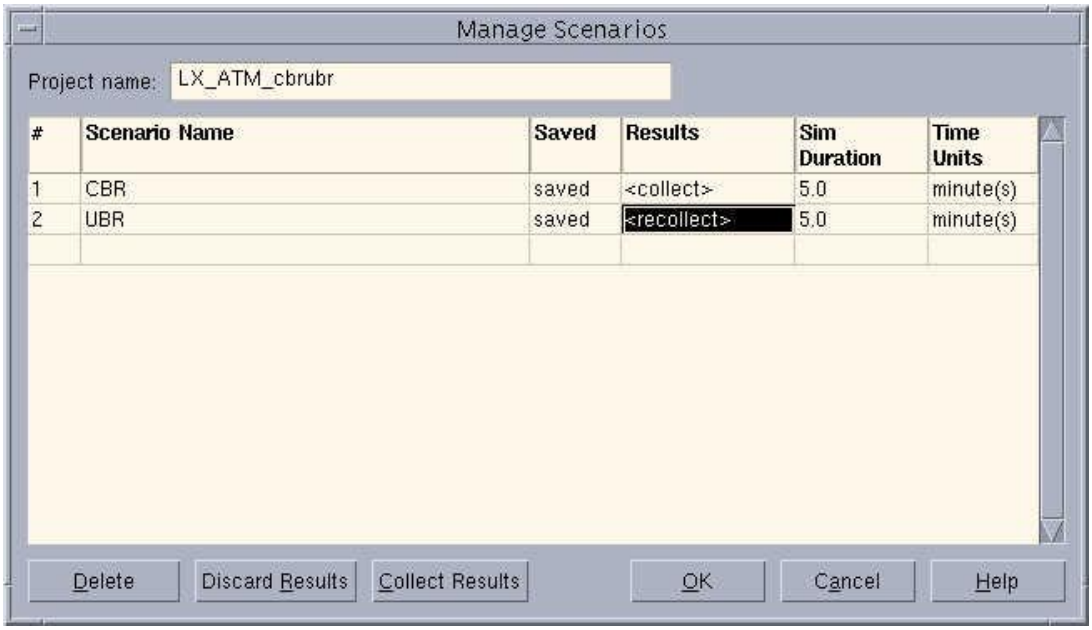


Figure 15. Simulation settings table

4. Results Analysis

4.1 Ftp downloading response time

After the simulation, we get several results. We will analyze the results of FTP application first.

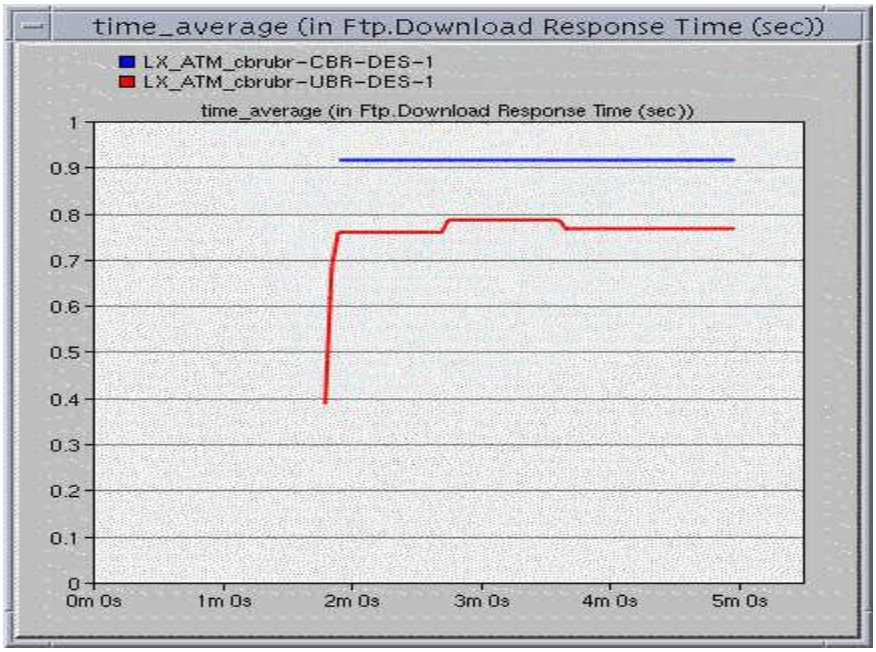


Figure 16. Downloading response time of Ftp

From the graph above, we can clearly see that the download response time of UBR is shown as red line is much lower than CBR which is shown as blue line. This means UBR is more suitable for FTP application. As expected, UBR is suitable for the application which does not require tightly constrained delay and delay variation, such as traditional computer communications applications. Compared with FTP application, VOICE requires constrained delay and delay variation. Thus, we conclude that our result is reasonable and totally matches the specification of UBR class.

4.2 Voice Packet Delay Variation

Next, we will focus on the results simulated from VOICE application. The first one is Packet Delay Variation.

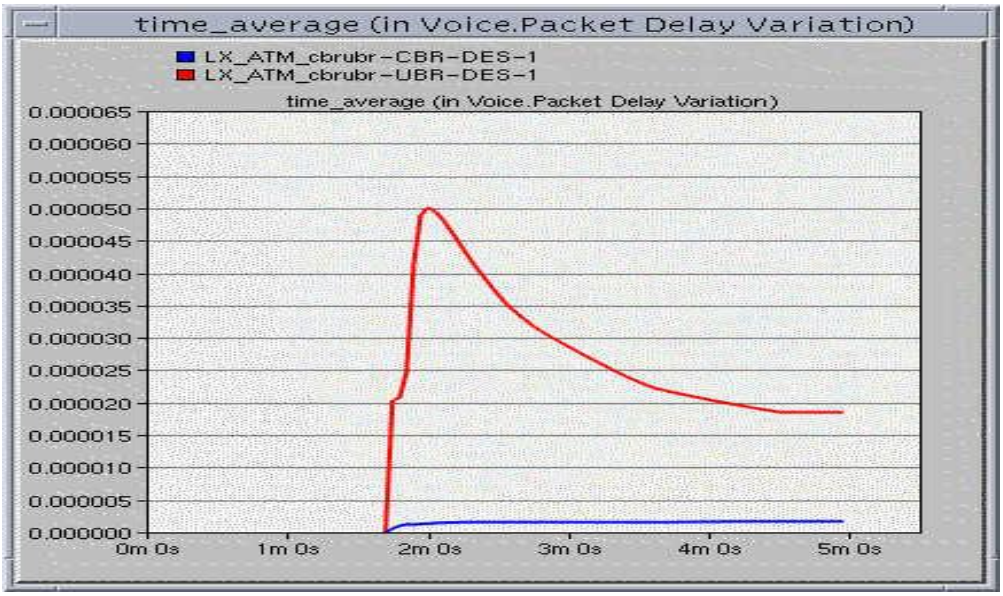


Figure 17. Packet delay variation of Voice

From the graph, we can see that packet delay of UBR which is red line fluctuates dramatically; the delay goes very high at first and then goes down, however, the packet delay in CBR class which is blue line goes very stable and is very close to zero. We can assume that the delay in CBR class could be ignored. Just as expected, the CBR class is intended for real-time applications, i.e. those requiring tightly constrained delay and delay variation: Voice application. UBR is for the service which does not require constrained delay. Thus, what we got from the above graph is meaning and reasonable. The graph shows the advantage of CBR class compared with UBR class based on Voice application.

4.3 Voice Packet End-to-End Delay

The second graph of VOICE application is to analyze the end-to-to delay.

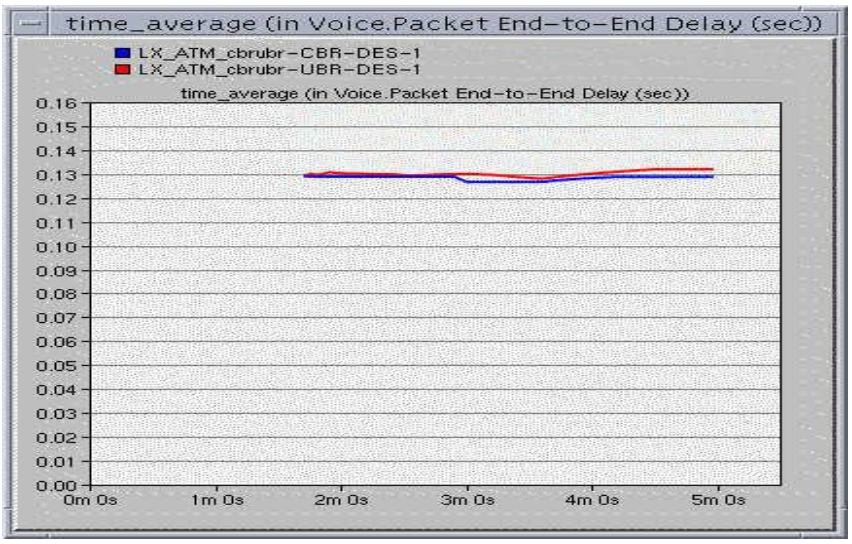


Figure 18. Packet End-to-End Delay of Voice

From the graph above, we can not even tell the difference of time delay between CBR class and UBR class roughly. As time going, the end-to-end delay of UBR class which is red line goes a little bit higher than UBR class which is blue line. Although there is no large difference between them, considering we only develop four subnets to simulate the whole ATM network, in the real life, there are millions of subnets located in the world. Thus, as the numbers of clients go higher, the end-to-end delay of CBR class would be smaller and smaller than UBR.

From the results of Packet delay and end-to-end delay, we clearly see that CBR class is extremely advanced and most suitable for those applications which require tightly constrained delay and delay variation, such as Voice application compared with UBR class.

4.4 Jitters

However, we still need to test the Jitter in VOICE application.

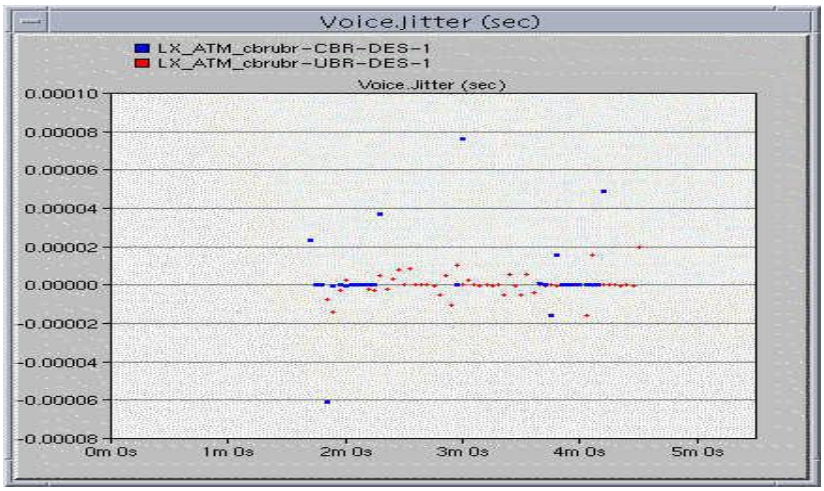


Figure 19. Jitter time of Voice

From the above graph, we can see that number of Jitter in CBR which is blue dot is less than UBR which is red dot. Determining the largest Jitter, it is about 0.00008 seconds, which is very small that we can assume it won't be noticeable to the users.

5. Conclusion and Future work

This project explored the practicality of UBR and CBR over different applications. By using OPNET, we have successfully created the network topology of ATM and set its attributes to demonstrate these two service classes. After comparing and studying results, we claim that CBR would be much better for Voice transmission while UBR would be good for Ftp. It is consistent with what we expect by researching from other related websites and books.

The biggest challenge in the project was lacking of related knowledge in ATM field, since many attributes had to be set up in the OPNET model. This required many trials to determine which attributes are appropriate for a successful simulation.

Furthermore, this project has raised some future studies for us. Firstly, we can

try different service classes, as we known, in ATM network, there are totally four classes: ABR, CBR, UBR and VBR. In our project, we only simulate, test and analyze the functions of CBR and UBR. We have no idea about the left two service class. Thus, we believe implementing four service classes in one project to test and analyze each function of class would be nice. Secondly, we would like to test more different types of applications in each serve class. In our project, we only have two applications, FTP and VOICE. In the future, we could add more applications, like Email, Image and Video Conferencing. Finally, In the ATM network, not only service class would affect the function in each application, but also there exits adaptation layer. Our group only has some basic knowledge about it; we only know that there are several different layers such as AAL2 and AAL5. AAL2 is best for Voice application and AAL5 is best for FTP application. If time allows, we would like to research this area in ATM network and try to simulate and test the related function in different adaptation layer.

6. Reference

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