

ATM Network QoS Parameters and Performance Analysis using OPNET Simulator

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1. INTRODUCTION

1.1 Service Categories in ATM Networks

ATM Network is designed to carry different type of traffic at the same type. Traffic could be voice, video or IP traffic. Internally all different traffic is carried as 53 byte cells.

There are Four categories of Service, the QoS Parameters for those categories are [3] as follows:

- (a) Constant Bit Rate (CBR)
- (b) Variable BIT Rate (VBR)
- (c) Real Time VBR and Non Real Time VBR
- (d) Real Time Variable Bit Rate(Rt-VBR)
- (e) Non Real time Variable Bit Rate(Nrt-VBR)
- (f) Available Bit rate(ABR)
- (g) Unspecified Bit Rate(UBR)

1.2 Quality of Service (QoS)Parameters in ATM Networks

Primary objectives of ATM is to provide QoS Guarantees while transferring cells across the netywork. There are mainly three QoS parameters specified for ATM and they are indicators of the performance of the network.

Cell Transfer Delay(CTD)

Peak to peak Cell Delay Variation(CDV)

Cell loss Ratio(CLR)

. Provide the incoming traffic behaves according to the contract, traffic shaping could handles bursts of traffic from source very well .At the ATM interface large cell buffers are used that can buffer the bursty traffic from the source. ATM network then sends the traffic at proper rate. This smoothes the transmission and also reduces the probability of lost cells and transmissions. If traffic shaping is not done to incoming burst,it may be possible that the incoming traffic may not conform to the contract and the cell has to be dropped in that case.Traffic shaping does introduces some delays,but it's always better to have delay rather than losing the cell and wait for transmission.

1.3Performance Parameters

Following parameters characterize the performance of ATM systems

Throughput,Connection Blocking ,Probability,Cell Loss Probability ,Switch Delay,Jitter on the Delay

Since the project is emphasize in simulation work by OPNET, we'll just simply introduce the basic principles of ATM:

- ATM is considered as a specific packet oriented transfer mode based on fixed length cells. Each cell consists of a 48bytes of information field and a

5bytes of header, which is mainly used to determine the virtual channel and to perform the appropriate routing. Cell sequence integrity is preserved per virtual channel.

- ATM is connection-oriented. The header values are assigned to each section of a connection for the complete duration of the connection. Signaling and user information are carried on separate virtual channels.
- The information field of ATM cells is carried transparently through the network. No processing like error control is performed on it inside the network.
- All services (voice, video, data,) can be transported via ATM, including connectionless services. To accommodate various services an adaptation function is provided to fit information of all services into ATM cells and to provide service specific functions (e.g. clock recovery, cell loss recovery, ...).

2. SIMULATION BY OPNET

Examples of application tasks are sending an e-mail, downloading a .le, and making a voice call. ATM uni-clients can be used only with ATM uni-servers, which are capable of supporting all of the application services. The ATM uni-client and uni-server node models are located in the atm_advanced object palette.

2.1 Simulation results:

The fig1 is the ATM network we constructed by OPNET. This ATM network we are simulating consists of several ATM

switches, server and clients(the reason why we didn't use more ATM switches is the simulation time increase beyond our computer can afford), we use OC3 link to connect the network for supporting maximum 155Mbps traffic.

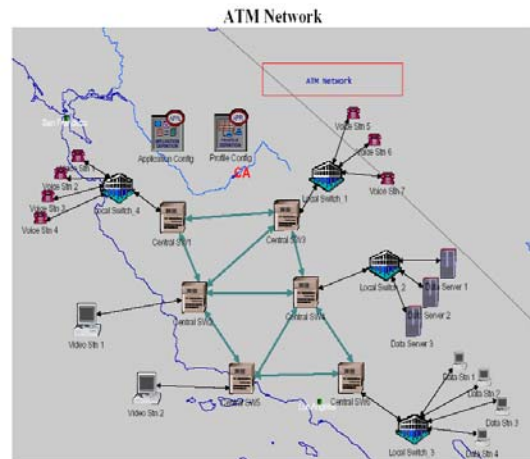
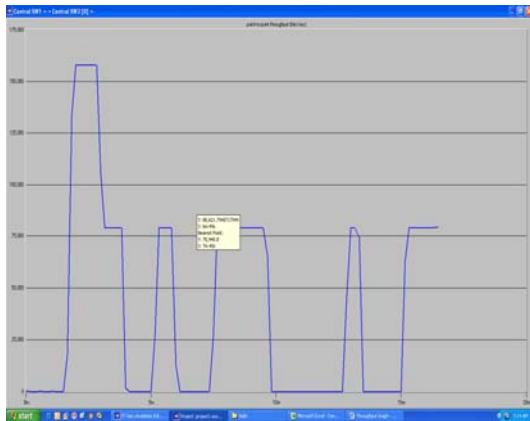


Fig1. ATM network structure

We can simply adjust the traffic load by changing the *Traffic Scaling Factor* in *Configure Simulation* menu before we run the simulation every time. The three traffic components: video, voice and data are generated, we use rt_VBR for video, CBR for the voice, and ABR for data traffic. However, the ratio of the three kinds of traffic are difficult to set to exactly 30%, 40% and 30%. Fig2 is the comparison of the traffic generated by video, voice and data.



Central SW1 <-> Central SW2 [0].point-to-point.throughput (bits/sec) <--.none

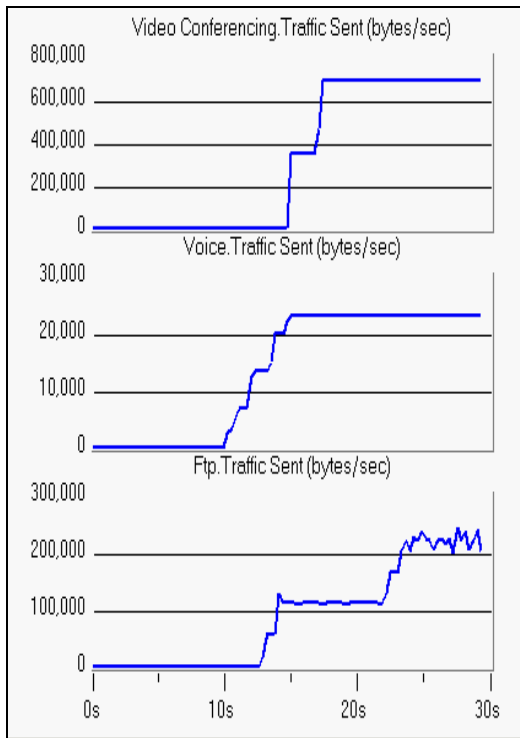


Fig2. Traffic load comparison

The following tables are the statistic results of data, video and voice services.

Statistic	Average	Maximum	Minimum
Ftp Download Response Time (sec)	0.072	0.109	0.059
Ftp Traffic Received (bytes/sec)	84,309	285,440	0
Ftp Traffic Received (packets/sec)	30.7	96.7	0.0
Ftp Traffic Sent (bytes/sec)	84,814	242,267	0
Ftp Traffic Sent (packets/sec)	30.8	93.3	0.0
Ftp Upload Response Time (sec)	0.070	0.107	0.059

Statistic	Average	Max.	Min.
Video Conferencing Packet End-to-End Delay (sec)	0.0708	0.0709	0.0708
Video Conferencing Traffic Received (bytes/sec)	313,018	691,200	0
Video Conferencing Traffic Received (packets/sec)	18.1	40.0	0.0
Video Conferencing Traffic Sent (bytes/sec)	315,350	691,200	0
Video	18.3	40.0	0.0

Conferencing Traffic Sent (packets/sec)			
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The shortest path routing algorithm we are using in OPNET is a dynamic routing protocol, ATM Distance Vector Routing. Since the OPNET only support two types of queuing schemes: *round-robin* and *weighted round-robin*, and the simulation is limited by the time constriction, we can only compare the two queuing schemes running for 30 seconds processing time(the actual time for the simulation is much longer, may take half an hour to several hours). The following two tables are the results for running at two different queuing schemes.

Statistic	Average	Maximum
ATM Call Blocking Ratio (%)	0	0
ATM cell Delay (sec)	0.00370	0.00755
ATM throughput (bits/sec)	1,390,592	3,064,107

Table1. Statistic results in *round-robin*

Statistic	Average	Maximum
ATM Call Blocking Ratio (%)	0	0
ATM cell Delay (sec)	0.00387	0.00910
ATM throughput (bits/sec)	1,390,239	3,064,453

Table2. Statistic results in *weighted round-robin*

3. CONCLUSION

The software simulation package, OPNET, which specializes in discrete-event simulation of communication systems, has

many attractive features and can simulate large communication networks with detailed protocol modeling and performance analysis.

In our study, the performance of different ATM switch buffer queuing schemes for *round-robin* and *weighted round-robin* didn't have too much difference.

In conclusion, discrete-event simulation provides detailed, accurate network simulation results and can observe a wide variety of network statistics. However, this method of simulation generally requires ample significant time and memory.

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