Chapter 6

ATM VP-Based Ring Network Exclusive Two traffics

In this chapter, the performance characteristic of the ATM VP-Based Ring Network exclusive the integration of video/data traffics and video/voice traffics is considered.

The same characteristics we have studied in chapter 5, have been considered here to study the effects of the integration of two traffics on the networks performance.

A proposed method namely "Control Mechanism Method" [47] to determine the number of cells to be service from each queue traffic is presented. It provides fairness among the traffics as explained in chapter 4.

6-1 The Integration of Video/Data Traffics

In our study, we have defined the number of video sources as (N_{vi}), Video encoding rate as $R_{vi,}$ which equals to 1.5 Mbps as a fixed data rate, and the data traffic as message size (M_{siz}). The interarrival time is represented by an exponential distribution with mean value (m) equals to 5 ms. The study of the integration of video and data traffics starts with M_{siz} having various fixed values. We have to mention here that the maximum N_{vi} depending on both GR_{vi} and GR_{da}. However, the calculation of the ideal values of N_{vi} from equation (6-1), depends on GR_{vi} in cell/ms, where R_T =352 cell/ms depends on SONET physical transmission, and transit rate in cell/ms.

$$\text{Max.}N_{vi} = \frac{[352(cell/ms) - transit\_rate(cell/ms)] - GR_{da}}{GR_{vi}} \quad \text{---------------------} \quad (6\text{-}1)$$

Using equation (6-1) helps to find out the maximum N_{vi} for various values of M_{siz} as shown in Table 6-1. It is to be noted here that the increasing of M_{siz}

decreases the maximum N_{vi}, this is because the long M_{siz} yields less number of messages to serve resulting in few sources get the networks service and vice versa.

M_{siz}	Ideal max. N_{vi}
100 cells	39
200 cells	34
400 cells	24

Table 6-1 Ideal Maximum N_{vi}.

Figure 6-1 illustrates video MWT and data MWT versus N_{vi} for R_{vi} equals to 1.5 Mbps, m =5 ms and M_{siz} equals to 100, 200 and 400 cells respectively. From the Figure it is clear that video and data MWT are slightly increasing with the increasing of N_{vi} up to the saturation limit, which depends upon the M_{siz} length. After that those sharply increase due to the fact that the increasing of N_{vi} increases the number of cells resulting in long queue and MWT. Obviously, MWT increases with the increasing of M_{siz}, this is because the increasing of M_{siz} yields long messages, which require long service time therefore, the queue and MWT increase. The data MWT is longer than video MWT, this is because the highest priority for service is given first to video cells, then followed by data cells.

Figure 6-2 illustrates video MWT and data MWT versus OL, with the same values of R_{vi}, m and M_{siz} used above in Figure 6-1. Clearly that, the video and data MWT behave the same behavior in Figure 6-1. That is video and data MWT slightly increase with the increasing of OL up to the saturation limit, beyond MWT sharply increases, this is due the same reasons we have mentioned above. Also, the increase of data MWT is more than the video MWT, for the same reasons mentioned with Figure 6-1.

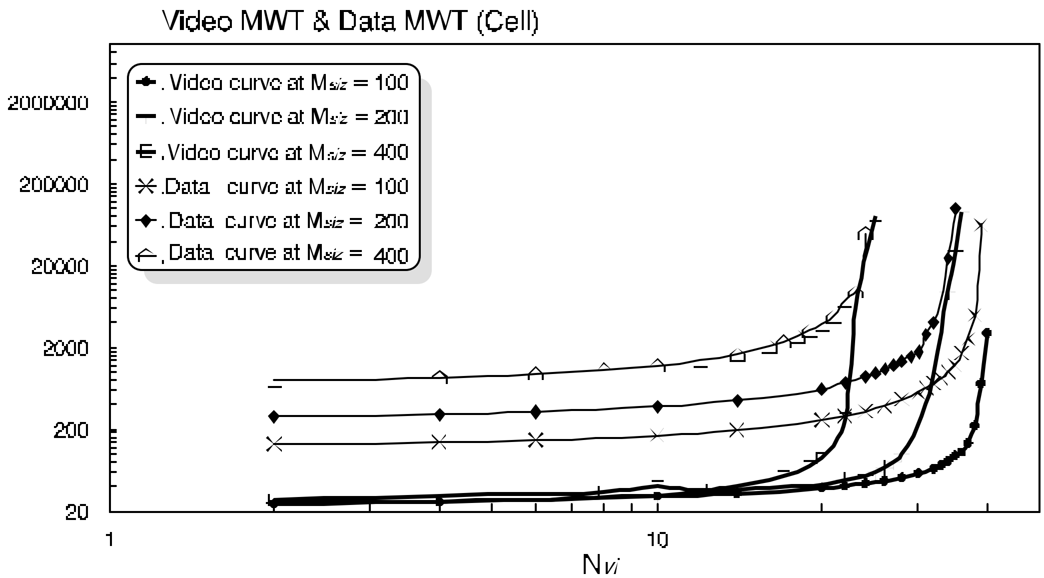

Figure 6-1 Video MWT & Data MWT versus N_{vi}

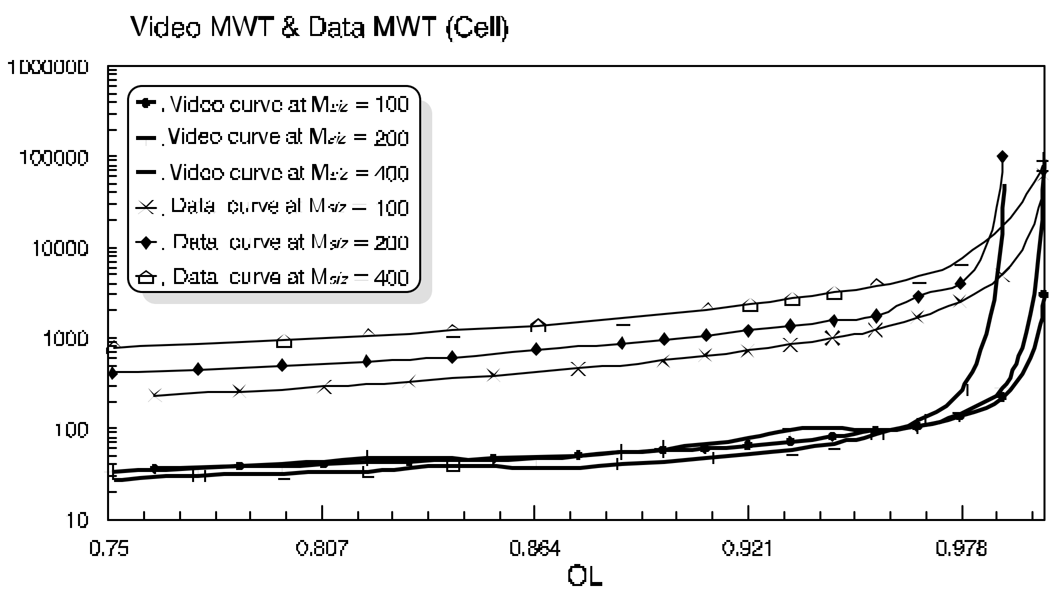

Figure 6-2 Video MWT & Data MWT versus OL

Table 6-2 summaries the simulation results which represents the maximum N_{vi} which can be supported by the network, and the corresponding video and data MWT for various values of M_{siz}.

M_{siz}	N_{vi}	Video MWT (cell)	Data MWT (cell)	OL
100	37	135.81	2556.15	0.98
200	32	148.29	4005.80	0.98
400	22	269.40	7526.24	0.98

Table 6-2 Simulation Results of Figure 6-1 and 6-2.

Figure 6-3 shows video MWT and data MWT versus M_{siz}, for R_{vi} equals to 1.5 Mbps, μ = 5 ms and N_{vi} equals to 10 and 20 respectively. From the Figure, it is clear that video MWT almost remains constant with the increasing of M_{siz}, meanwhile the data MWT slightly increases with increasing of M_{siz} up to the saturation limit, which depends upon the N_{vi}. After that, the data MWT monotonically increases due to the fact that the increasing of M_{siz} increases the number of cells resulting in long queue and MWT. Obviously, MWT increases with the increasing of N_{vi}, this is because the increasing of N_{vi} yields large number of cells which requires long service time therefore the queue and MWT increase. The data MWT is longer than video MWT, this is because the highest priority for service is given first to video cells, then followed by data cells.

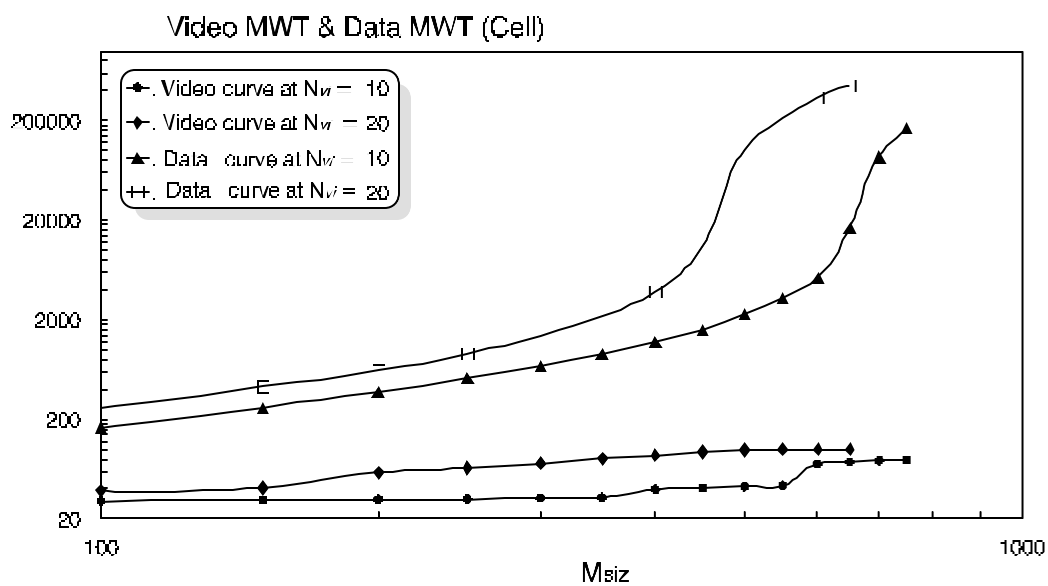

Figure 6-3 Video MWT & Data MWT versus M_{siz}

Figure 6-4 illustrates video MWT and data MWT versus OL, with the same values of R_{vi}, μ, and N_{vi} used above in Figure 6-3. Clearly that the video and data MWT behave the same behavior in Figure 6-3. That is the video MWT almost remains constant, meanwhile, the data slightly increases with the increasing of OL up to the saturation limit, beyond data MWT sharply increases, this is due to the same reasons we have mentioned above.

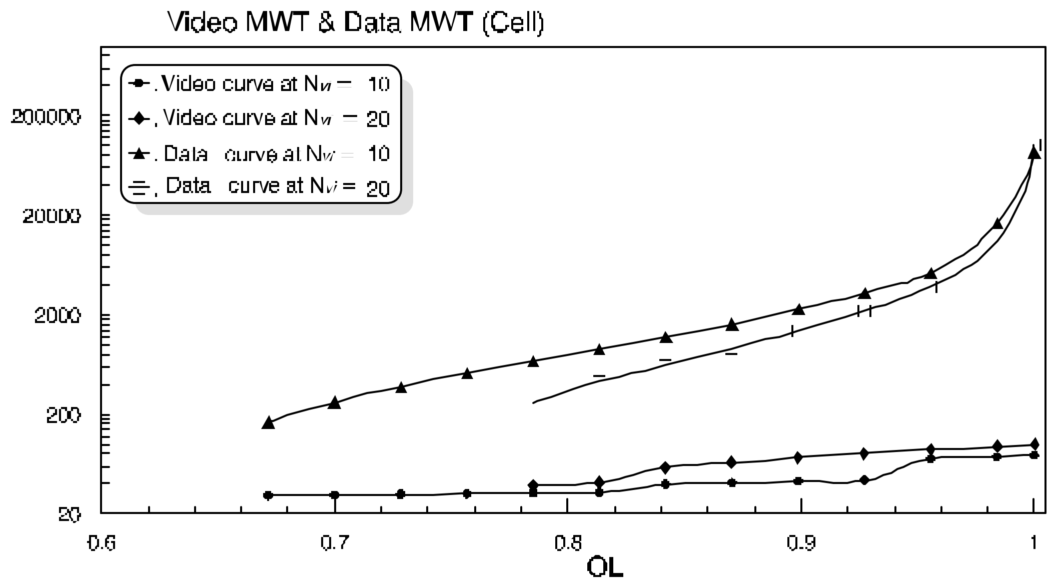

Figure 6-4 Video MWT & Data MWT versus OL

Figure 6-5 and Figure 6-6 indicate the video and data MBS versus N_{vi} and OL (total Offered Load for video and data traffics) respectively. For the same values of R_{vi}, m, and M_{siz} used with Figure 6-1 and 6-2. The characteristics of both Figures are more or less very closed to that of Figure 6-1 and Figure 6-2, for the same reasons.

Table 6-3 summaries the simulation values as that of Table 6-2.

M_{siz} (cell)	N_{vi}	Video MBS (cell)	Data MBS (cell)	OL
100	37	412	1004	0.98
200	32	370	2563	0.98
400	22	380	7201	0.98

Table 6-3 Simulation Results of Figure 6-5 and 6-6.

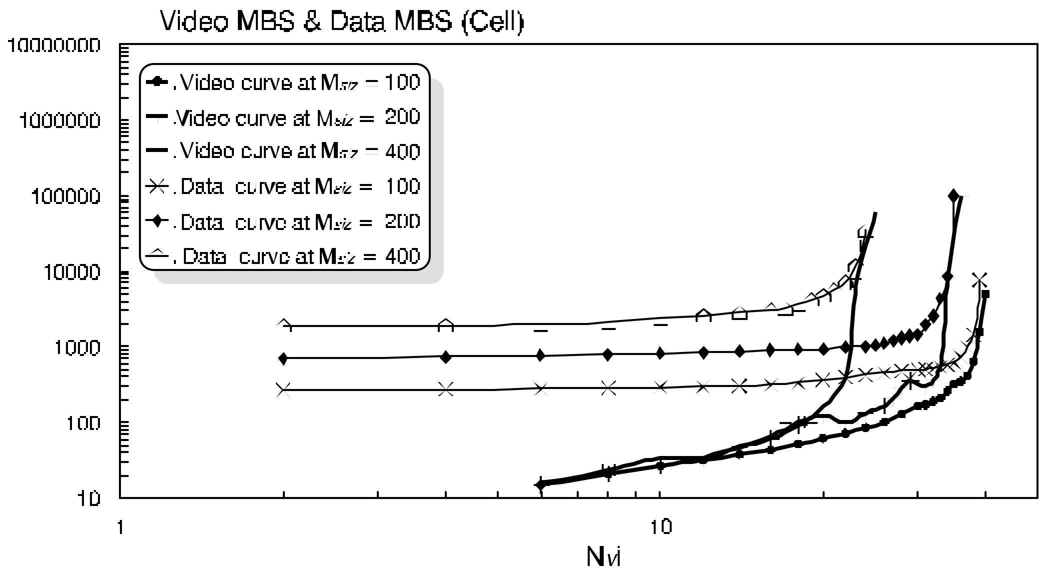

Figure 6-5 Video MBS & Data MBS versus N_{vi}

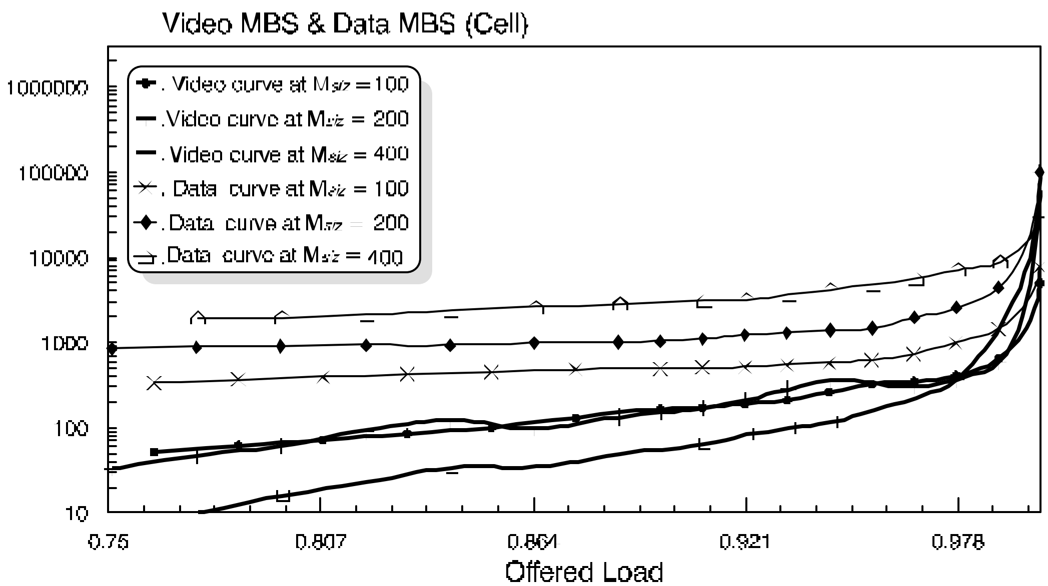

Figure 6-6 Video MBS & Data MBS versus OL

Figure 6-7 and Figure 6-8 illustrate the video and data MBS versus M_{siz} and OL respectively, for the same values of R_{vi}, and μ used above, and N_{vi} equals to 10 and 20. The characteristics of both Figures are more or less very closed to that of Figures 6-3 and 6-4, for the same reasons.

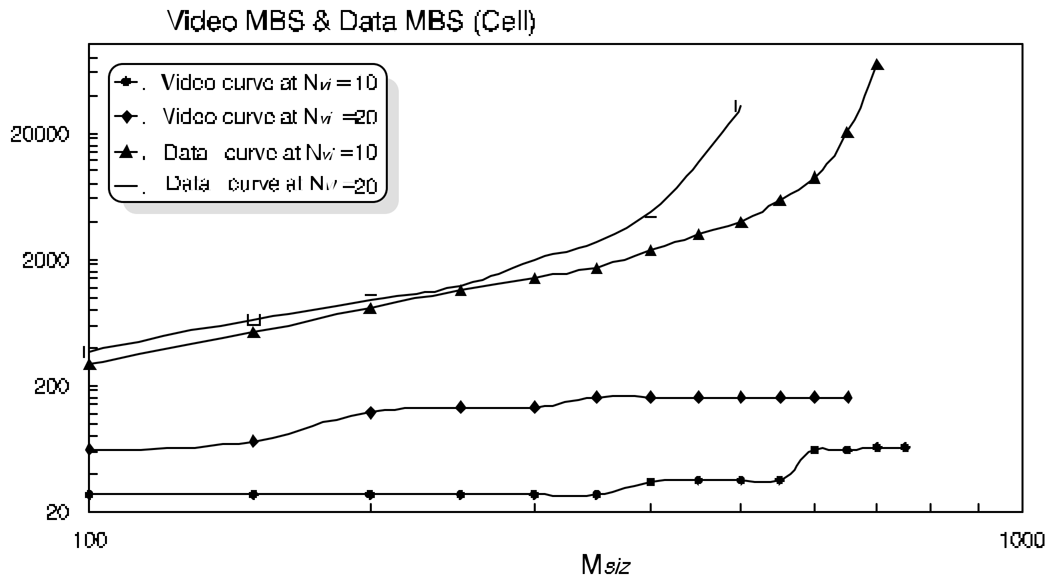

Figure 6-7 Video MBS & Data MBS versus M_{siz}

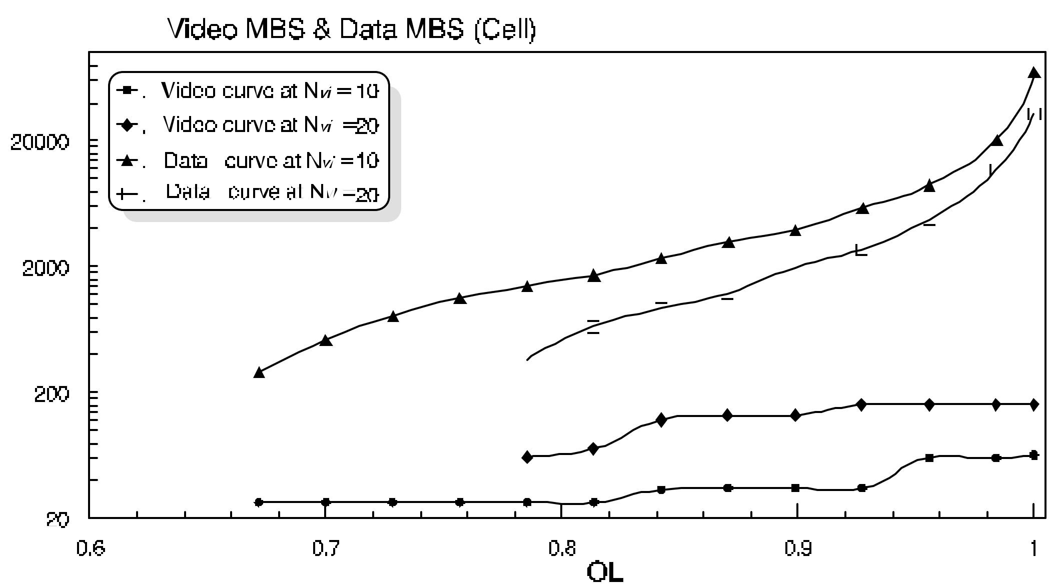

Figure 6-8 Video MBS & Data MBS versus OL

Figure 6-9 shows N_{vi} versus M_{siz}, for the same values of R_{vi}, and m. In the ideal case, the relationship between the N_{vi} and M_{siz} is linear that is clear from the following equations (6-2).

$$\boldsymbol{GR_{vi} + GR_{da} + GR_t = R_T = 352 \text{ cell/ms}} \quad \text{or } \boldsymbol{OL_{vi} + OL_{da} + OL_{tr} = 1} \qquad \text{---------------------- (6-2)}$$

By substituting in equation (6-2), we can note that the increasing of M_{siz}, decreasing the N_{vi} due to the fixed transmission rate (R_T) belongs to the fixed link data rate. In the normal case, the relation is represented by the following inequality equation (6-3).

$$GR_{vi} + GR_{da} + GR_t < R_T = 352 \text{ cell/ms} \quad \text{or } OL_{vi} + OL_{da} + OL_{tr} < 1 \qquad (6\text{-}3)$$

From Figure 6-9, we can observe that the actual curve is closed to the ideal curve. Equation (6-3) is considered in the actual case because at heavy load, the generated cells are accumulated into the queue that is increase video MBS and data MBS due to the long video MWT and long data MWT.

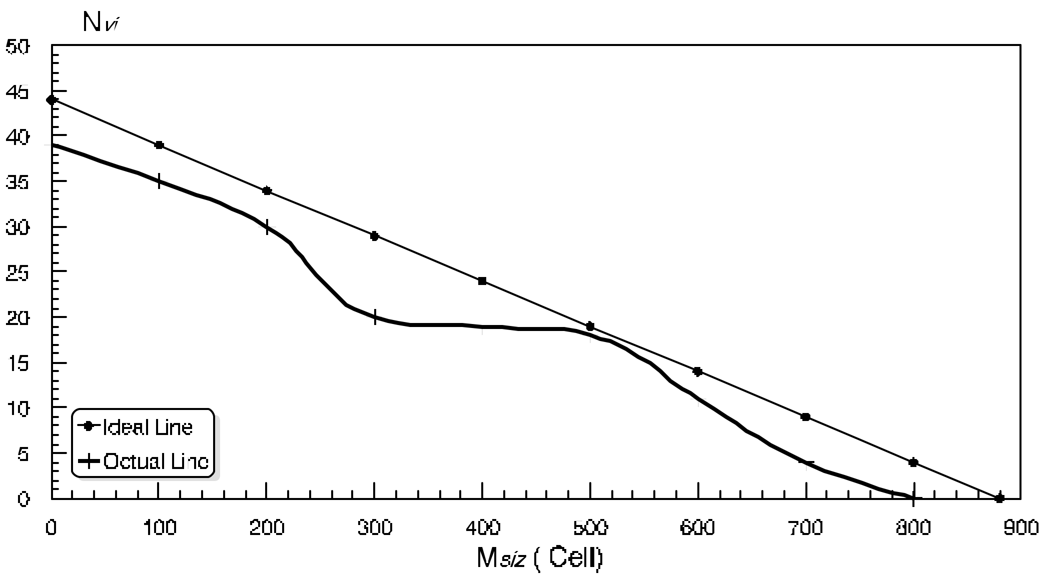

Figure 6-9 N_{vi} versus M_{siz}

Figure 6-10 illustrates TP_{vi} and TP_{da} versus N_{vi}, for R_{vi}=1.5 Mbps, m =5 ms and M_{siz}=100 cells. The Figurer shows that the increasing of N_{vi}, increases TP_{vi} but TP_{da} remains constant almost at 19.5 cells/ms. That is because, the increasing of N_{vi} increases the number of generated video cells. The M_{siz} and m are constant at 100 cells and 5 ms respectively, therefore GR_{da} remains constant. Beyond the saturation limit, TP_{vi} is also increase with the increasing of N_{vi}, and TP_{da} decreases with the increasing of N_{vi}. That is because the increasing of N_{vi}

increases the number of generated video cells, which increases the TP_{vi}. Meanwhile, beyond the saturation limit of TP_{da}, the chance of serve data cells decreases because the video cells are dominant and have also highest priority of service than data cells, resulting in decrease of TP_{da}.

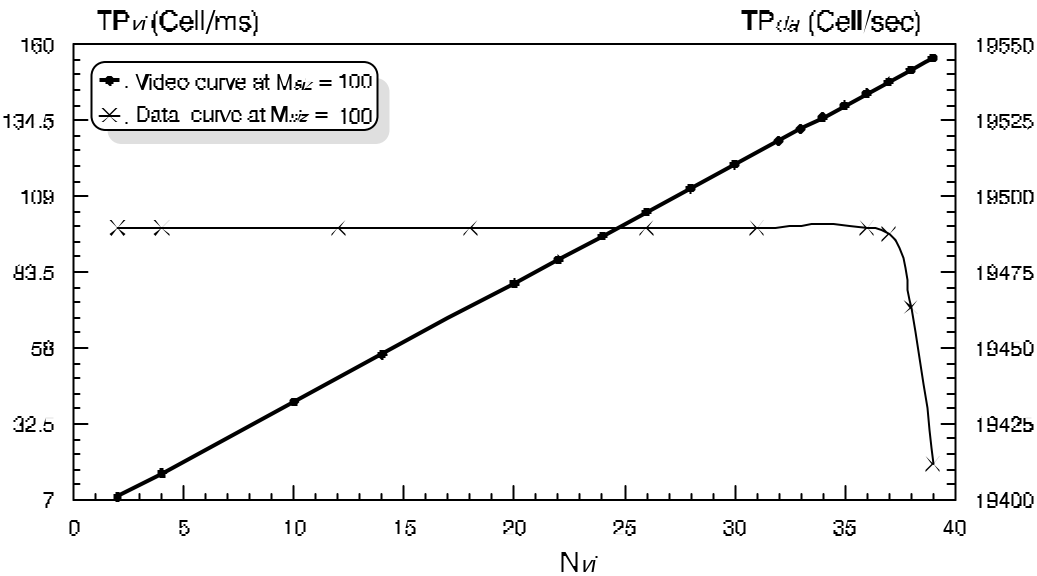

Figure 6-10 TP_{vi} & TP_{da} versus N_{vi}

Figure 6-11 shows the same study of Figure 6-10, for M_{siz} equals to 200 cells. Clearly the behavior is similar to that in Figure 6-10, except that the saturation limit is changed here. So we can recall the reason of that the saturation limit is depends upon the length of M_{siz}, in which as the length of M_{siz} increases the saturation limit decreases, as shown in Figure 6-10 and Figure 6-11.

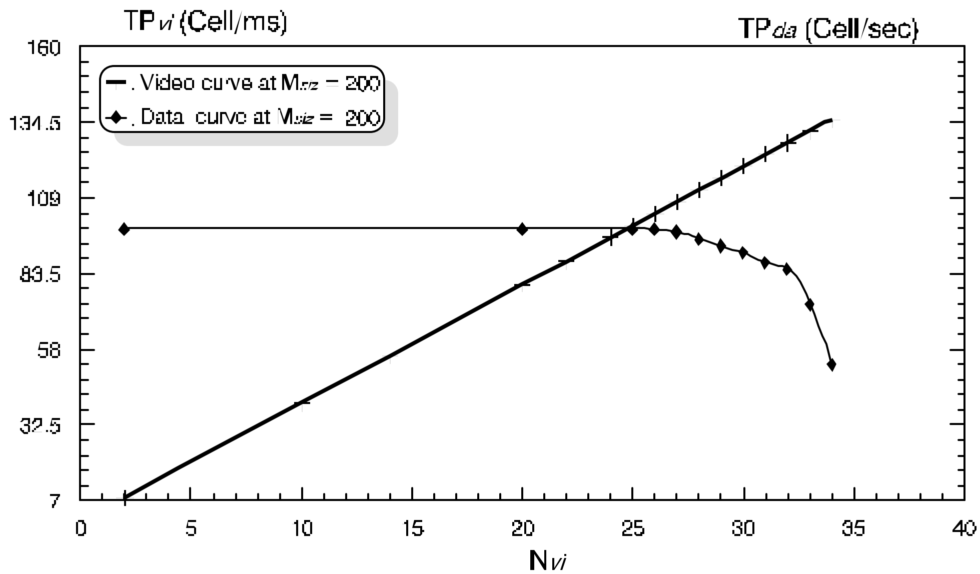

Figure 6-11 TP_{vi} & TP_{da} versus N_{vi}

Figure 6-12 and Figure 6-13 studies the TP_{vi} and TP_{da} versus M_{siz}, for various values of N_{vi}. Obviously, that M_{siz} has no effect on the TP_{vi}. The increasing of M_{siz} increases TP_{da} almost linearly up to the optimal M_{siz}, which represents the saturation limit, after that the TP_{da} remains constant. This is because the service will be saturated with the optimal M_{siz}. Meanwhile TP_{vi} remains constant for all values of M_{siz}. It is to be mention here that the increasing of N_{vi} decreases the saturation limit (optimal M_{siz}), because the chance of serve of data traffic becomes less for the same reasons mentioned above in Figure 6-10 and Figure 6-11.

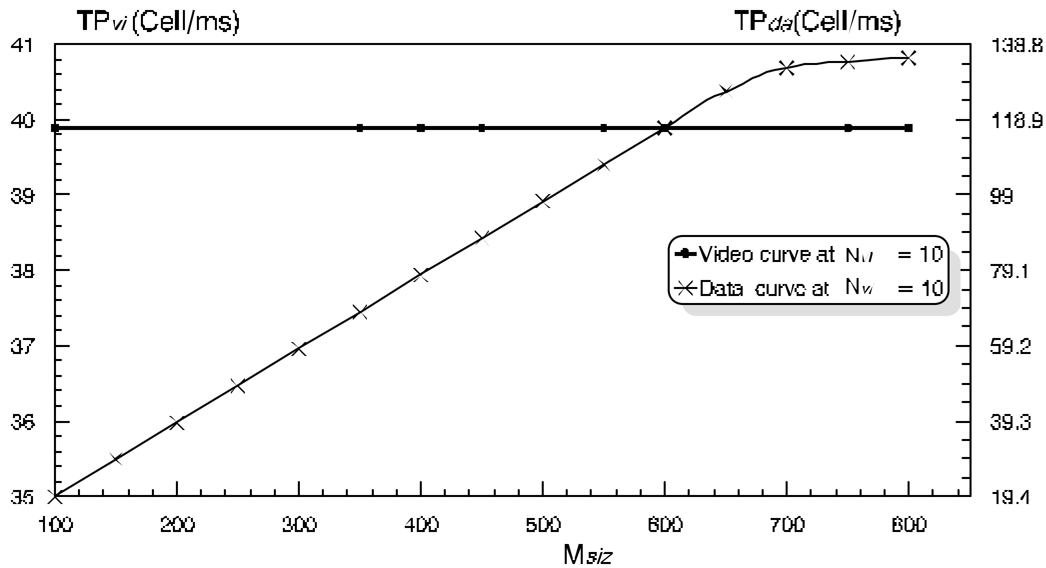

Figure 6-12 TP_{vi} & TP_{da} versus M_{siz}

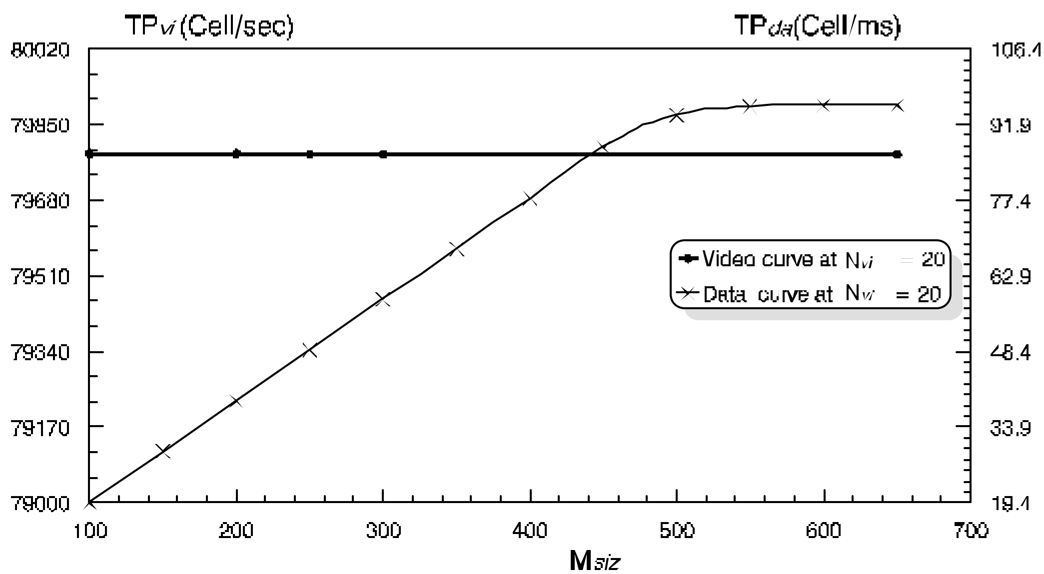

Figure 6-13 TP_{vi} & TP_{da} versus M_{siz}

Figure 6-14 illustrates the video MWT versus N_{vi}, for the same values of R_{vi}, and μ used above and M_{siz} equals to 0, 100, and 200 cells. This Figure summaries the effect of data traffic on the video traffic. Obviously that, the increasing of N_{vi}, slightly increases the video MWT up to the saturation limit, which depends upon the M_{siz}. Beyond the saturation limit, the video MWT sharply increases due to the large number of cells and queuing delays. The increasing of M_{siz}, has slightly effect on the video MWT and the saturation limit.

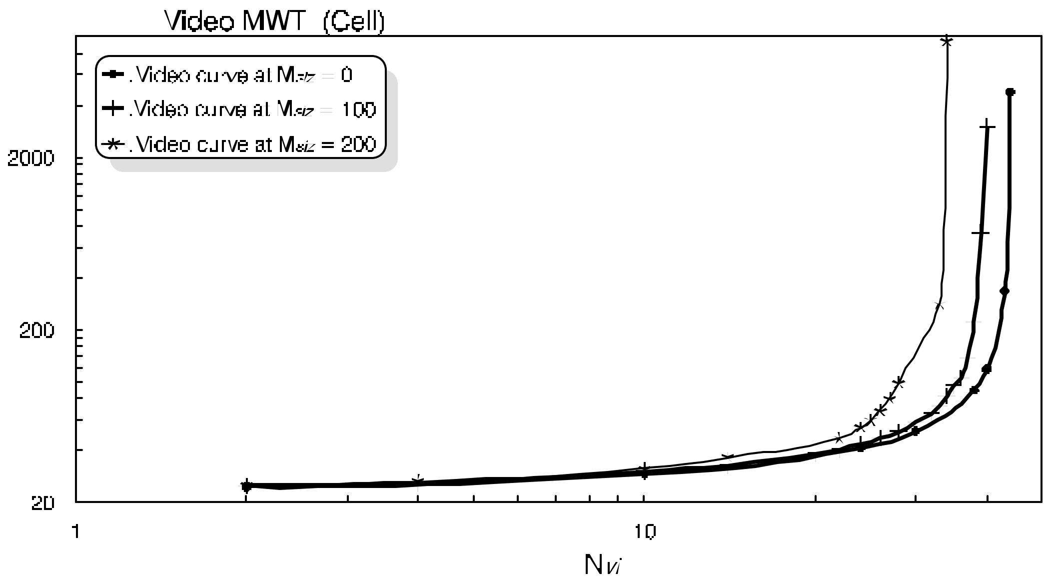

Figure 6-14 Video MWT versus N_{vi}

Figure 6-15 illustrates the data MWT versus M_{siz}, for the same values of R_{vi}, and μ used above and N_{vi} equals to 0, 10, and 20. This Figure summaries the effect of video traffic on the data traffic. It is clear that, the increasing of M_{siz}, slightly increase the data MWT up to the saturation limit, which depends upon the N_{vi}. Beyond the saturation limit, the data MWT monotonically increases due to the large number of cells and queuing delays. The increasing of N_{vi}, slightly increases the data MWT and slightly decreases the saturation limit for M_{siz}.

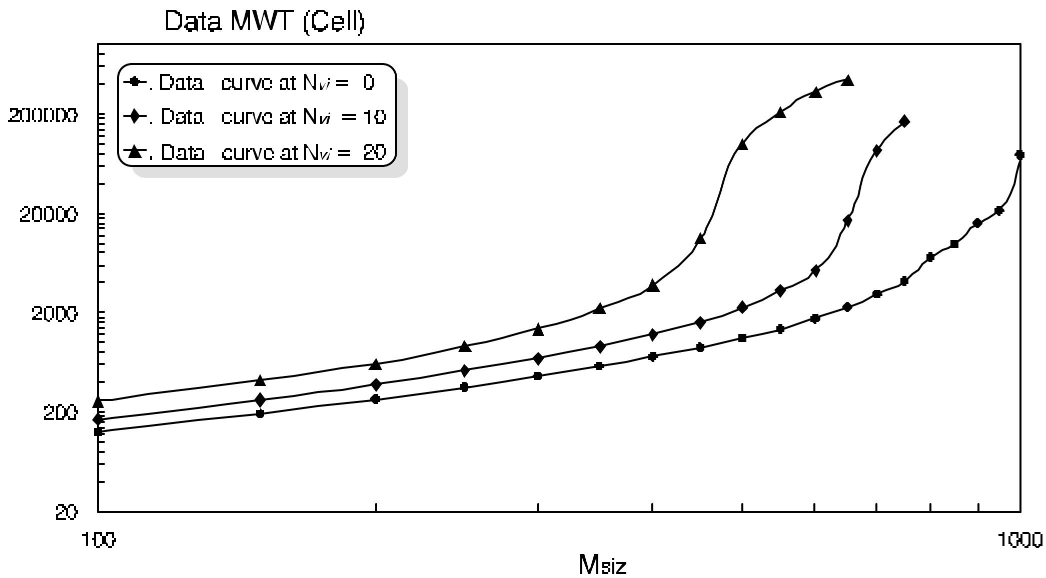

Figure 6-15 Data MWT versus M_{siz}

Table 6-4 summaries the simulation values at two cases: traffic alone and integration video/data. It is clear that the data traffic has slightly effect on video traffic but the video traffic has high effect on data traffic.

At R_{vi} = 1.5 Mbps and μ = 5 ms			
At N_{vi} = 20 sources		At M_{siz} = 350 cells	
M_{siz} (cell)	Video MWT (cell)	N_{vi} Sources	Data MWT (cell)
0 100 200	37 38 58	0 10 20	579 912 2197

Table 6-4 Simulation Results of Figure 6-14 and 6-15