6-2 The Integration of Video/Voice Traffics.

In our study of the performance characteristics of the integration of video/voice traffics, we have defined the following: the number of voice sources as N_{vo}, voice-encoding rate as R_{vo}, and the definition of video sources and its encoding rate is the same as we have used earlier (N_{vi} and R_{vi} = 1.5 Mbps).

It is well known that the voice source is represented by the two periods, which defined as talkspurt and silent periods. In our study, we have represented both by using an exponential distribution with mean value equals to 352 ms for talkspurt period and 650 ms for silent period. It is to be mentioning here that all the voice sources have the same mean values of talkspurt and silent periods.

The video and voice MWT versus N_{vi} for various values of N_{vo}, video and voice MBS versus offered load (OL) for various values of N_{vo}, and the maximum N_{vi} have been discussed.

The GR_{vi} and GR_{vo} have serious effect on the maximum N_{vi} for clarification we can calculate the ideal values of N_{vi}, using equation (6-4), which very depend upon GR_{vi} in cell/ms, and R_T =352 cell/ms which depends on SONET physical transmission, and transit rate in cell/ms.

$$\text{Max.}N_{vi} = \frac{[352(cell/ms) - transit\_rate(cell/ms)] - GR_{vo}}{GR_{vi}} \qquad (6\text{-}4)$$

Using equation (6-4) helps to calculate the maximum N_{vi} for various values of N_{vo} as shown in Table (6-5).

N_{vo}	Ideal maximum N_{vi}
50	37
200	18
250	12

Table 6-5 Ideal Maximum N_{vi}.

Obviously, from Table 6-5 the increasing of N_{vo} corresponding decreases of N_{vi} that is because the network can only support maximum number of sources which is distributed between the different traffics.

Figure 6-16 shows video MWT and voice MWT versus N_{vi} for R_{vi} equals to 1.5 Mbps, R_{vo} =192 Kbps, and N_{vo} equals to various values such as 50, 200 and 250. From the Figure it is very clear that the effect of N_{vo} on the MWT particularly on the voice MWT because the increasing of N_{vo} increases the number of generated voice cells, which increases the queue and MWT. The video MWT is slightly effect with the increases of N_{vo}, because the priority of serve is given to the video cells, then followed by voice cells.

Also, the increasing of N_{vi} has slightly effect on the increasing of video and voice MWT up to the saturation limit. Beyond the saturation limit the video and voice MWT sharply increase due to the large number of cells which yields long queues and delays. Obviously, the saturation limit varied according to the values of N_{vo}, however with the increasing of the value of N_{vo}, resulting in decreases the value of N_{vi} caused the saturation limit which corresponding the maximum N_{vi} very early as shown from Figure 6-16.

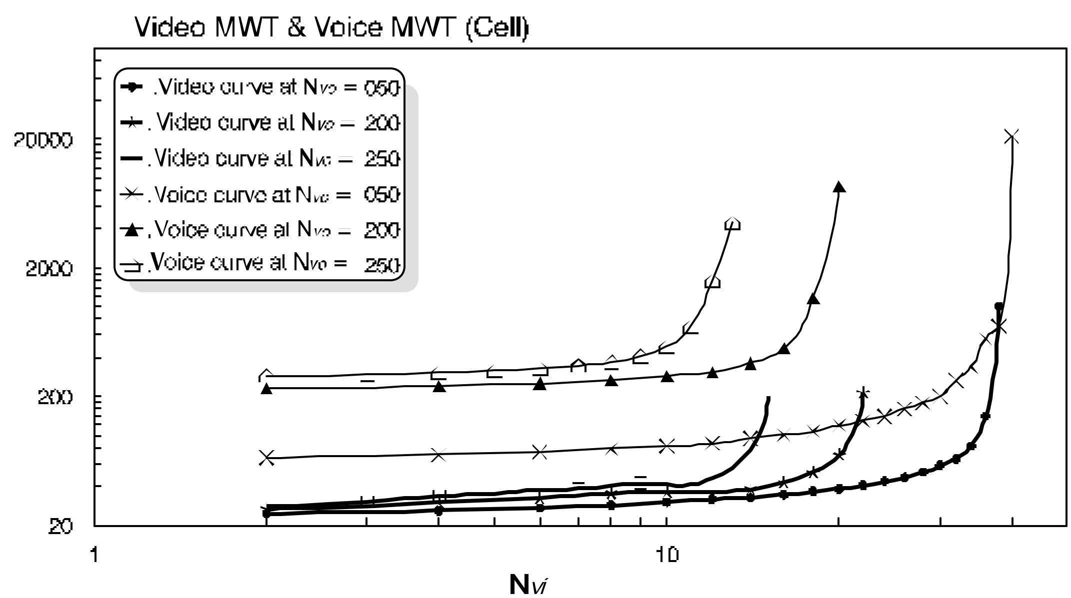

Figure 6-16 Video MWT & Voice MWT versus N_{vi}

Figure 6-17 illustrates video and voice MWT versus OL, for the same values of R_{vi}, R_{vo}, and N_{vo} used above. The behavior is similar to that in Figure 6-16 for the same reasons. Table 6-6 summaries the simulation results of Figure 6-16 and 6-17.

N_{vo}	N_{vi}	Video MWT (cell)	Voice MWT (cell)	OL
50	34	82.23	339.77	0.96
200	16	42.97	471.45	0.97
250	11	41.43	695.06	0.98

Table 6-6 Simulation Results of Figure 6-16 and 6-17.

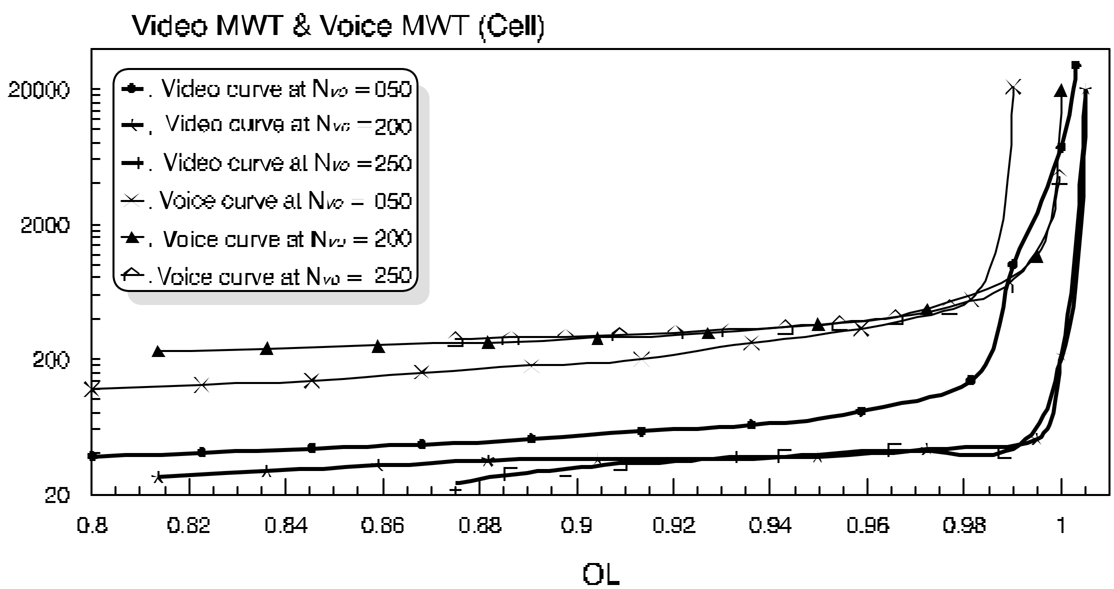

Figure 6-17 Video MWT & Voice MWT versus OL

Figure 6-18 shows the video MWT and voice MWT versus N_{vo} for R_{vi} equals to 1.5 Mbps, R_{vo} equals to 192 Kbps, and N_{vi} equals to 10, and 20 respectively. From the Figure, the effect of N_{vi} on the MWT of video and voice is clear.

The increasing of N_{vo} has slightly effect on the increasing of video and voice MWT up to the saturation limit. Beyond the saturation limit the video and voice MWT sharply increase due to the large number of cells, which yields long queues and delays. Obviously, the saturation limit depends on the value of $N_{vi,}$ however the increasing of N_{vi} resulting in decreases the value of N_{vo} as shown from Figure 6-18.

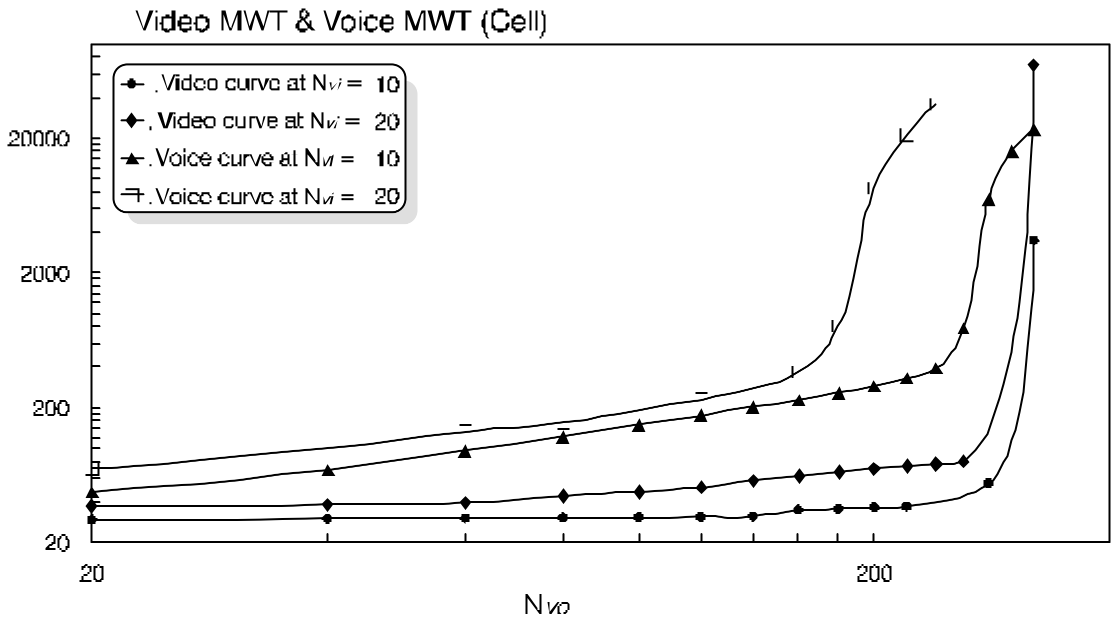

Figure 6-18 Video MWT & Voice MWT versus N_{vo}

Figure 6-19 illustrates video and voice MWT versus OL (for both traffics), for the same values of R_{vi}, R_{vo}, and N_{vi} used above. The behavior is similar to that in Figure 6-18 for the voice MWT, for the same reasons. However, the video MWT slightly increases with the increasing of OL, because the video cells have higher priority than voice cells.

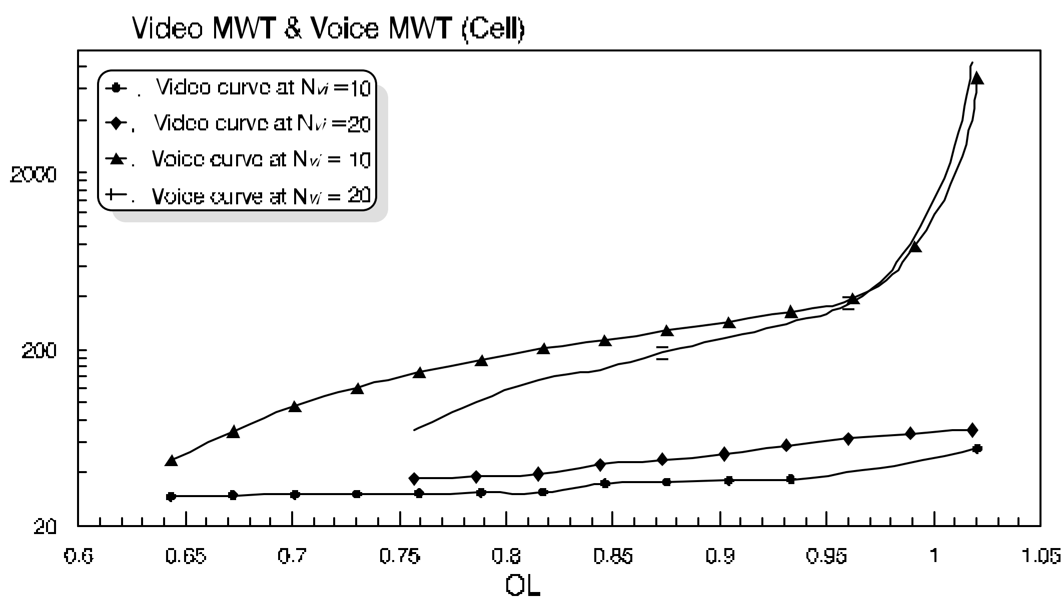

Figure 6-19 Video MWT & Voice MWT versus OL

Figure 6-20 and 6-21 show video and voice MBS versus N_{vi} and OL respectively, for the same values of R_{vi}, $R_{vo,}$ and N_{vo} used in Figure 6-16 and Figure 6-17. The behavior of both carves is similar to the previous carves for the same reasons. Table 6-7 summaries the simulation results of both Figure 6-18 and 6-19.

N_{vo}	N_{vi}	Video MBS (cell)	Voice MBS (cell)	OL
50	34	297	131	0.96
200	16	61	571	0.97
250	11	41	1032	0.98

Table 6-7 Simulation Results of Figures 6-18 and 6-19.

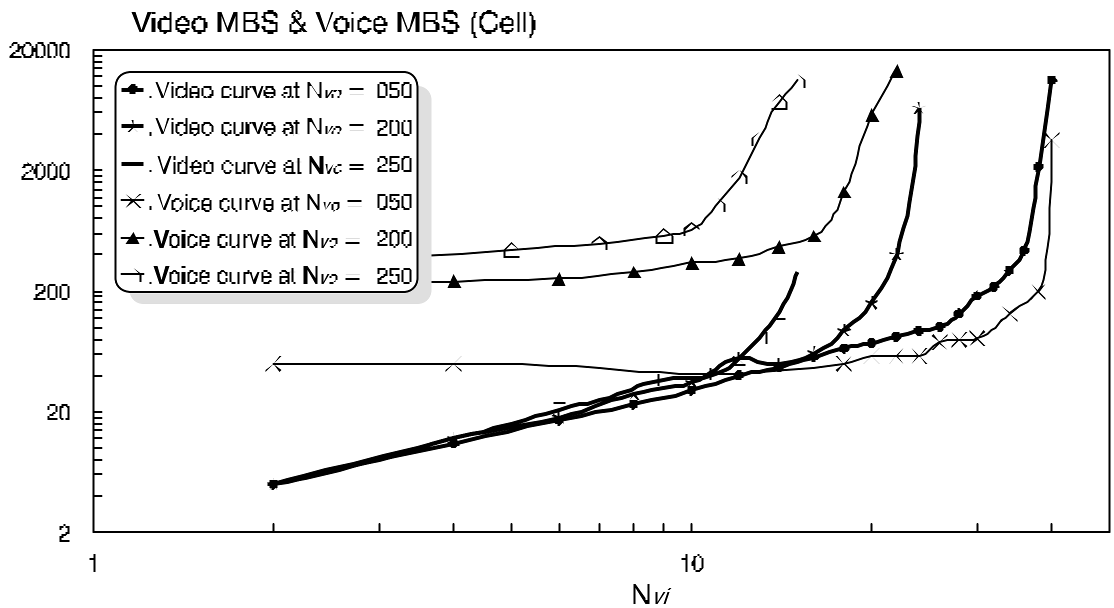

Figure 6-20 Video MBS & Voice MBS versus N_{vi}

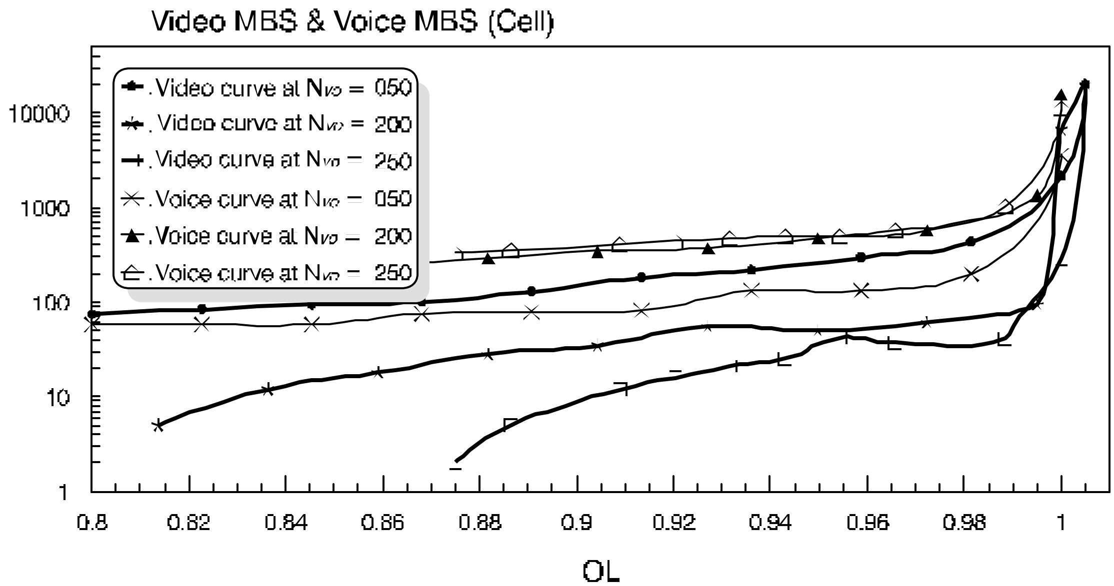

Figure 6-21 Video MWT & Voice MWT versus OL

Figure 6-22, and Figure 6-23 illustrates video and voice MBS versus N_{vo} and OL respectively, for the same values of R_{vo}, R_{vo} and N_{vi} used with Figure 6-18 and 6-19. The characteristics of both Figures are more or less very closed to that of Figures 6-18 and 6-19, for the same reasons.

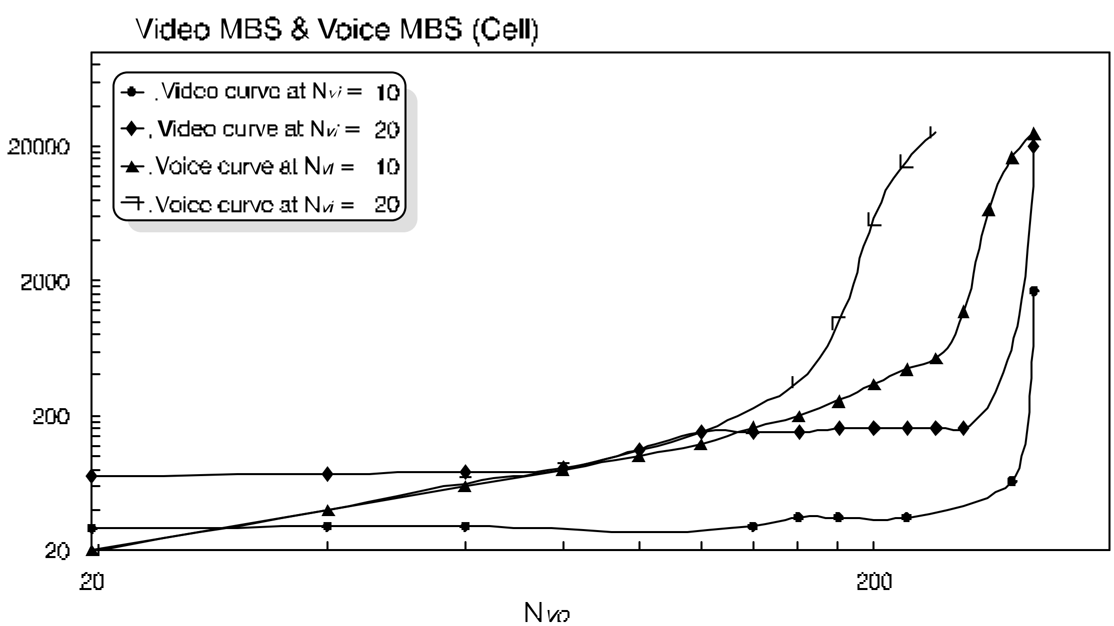

Figure 6-22 Video MBS & Voice MBS versus N_{vo}

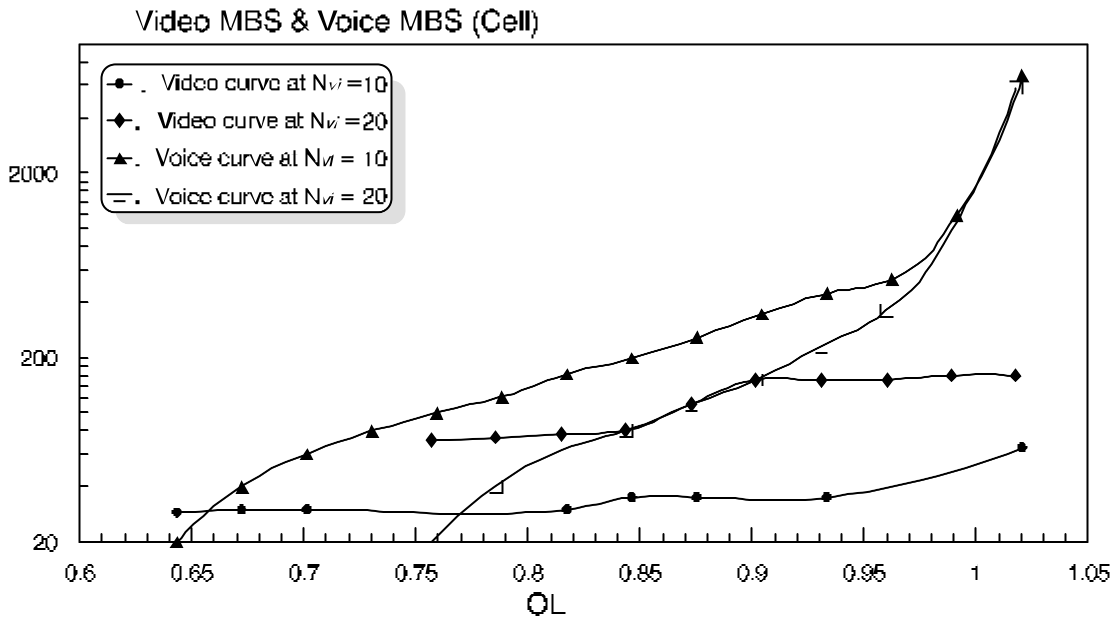

Figure 6-23 Video MBS & Voice MBS versus OL

Figure 6-24 illustrates N_{vi} versus N_{vo} for the same values used earlier. Using equation (6-5) which represents ideal case and the equation (6-6) which represents normal case, confirm that the increasing of N_{vo} corresponding decreasing of N_{vi}, for the same reason we have mentioned earlier, in which that the network can support maximum number of sources, that can distributed between all traffics. It is to be mention here that the equation which represents normal case is considered, because at heavy load the number of generated cells are accumulated in queues resulting in increases of video and voice MBS due to the large number of cells, long queues and delays. For the ideal case the relation is linear, and is represented by equation (6-5) and the normal case can be represented by equation (6-6).

$$GR_{vi} + GR_{vo} + GR_{t} = R_{T} = 352 \text{ cell/ms} \quad \text{or } OL_{vi} + OL_{vo} + OL_{tr} = 1 \qquad (6\text{-}5)$$

$$GR_{vi} + GR_{vo} + GR_{t} < R_{T} = 352 \text{ cell/ms} \quad \text{or } OL_{vi} + OL_{vo} + OL_{tr} < 1 \qquad (6\text{-}6)$$

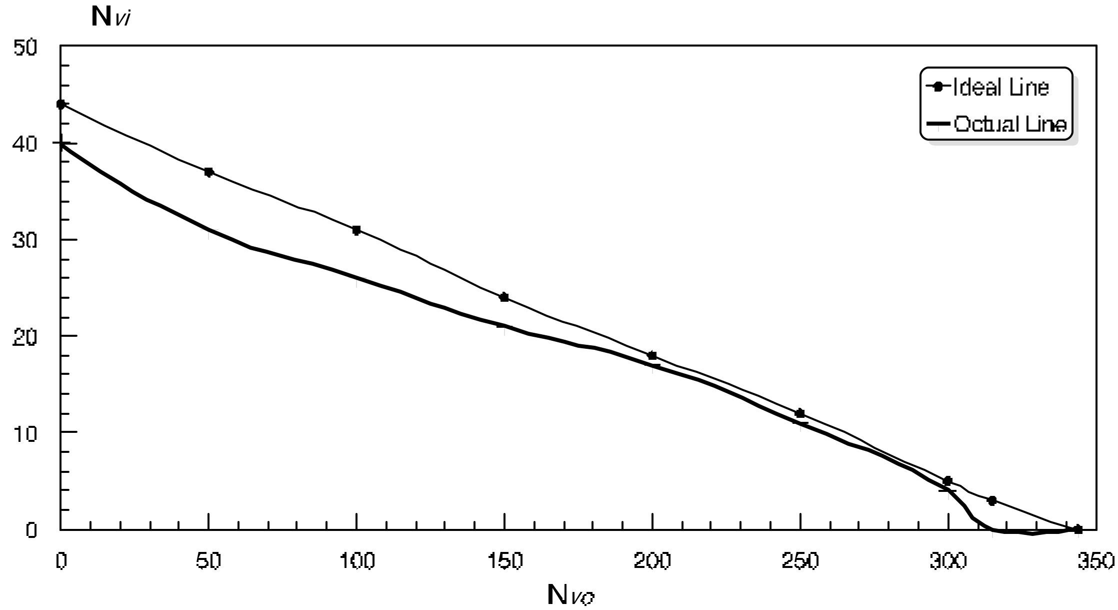

Figure 6-24 N_{vi} versus N_{vo}

Figure 6-25 illustrates TP_{vi} and TP_{vo} versus N_{vi}, for R_{vi} =1.5 Mbps, R_{vo} =192 Kbps and N_{vo} =50. From the Figure clearly the increasing of N_{vi}, increases TP_{vi} linearly but TP_{vo} remains constant at 12.9 cells/ms. That is because, the increasing of N_{vi} increases the number of generated video cells but voice cells are with the same number. Since the N_{vo} and R_{vo} are constant at 50 and 192 Kbps respectively therefore, GR_{vo} remains constant. Beyond the saturation limit, the TP_{vi} continually increases with the increasing of N_{vi}, and TP_{vo} 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_{vo}, the chance of serve voice cells decreases because the video cells are dominant and have also highest priority of service than voice cells, resulting in decrease of TP_{vo}.

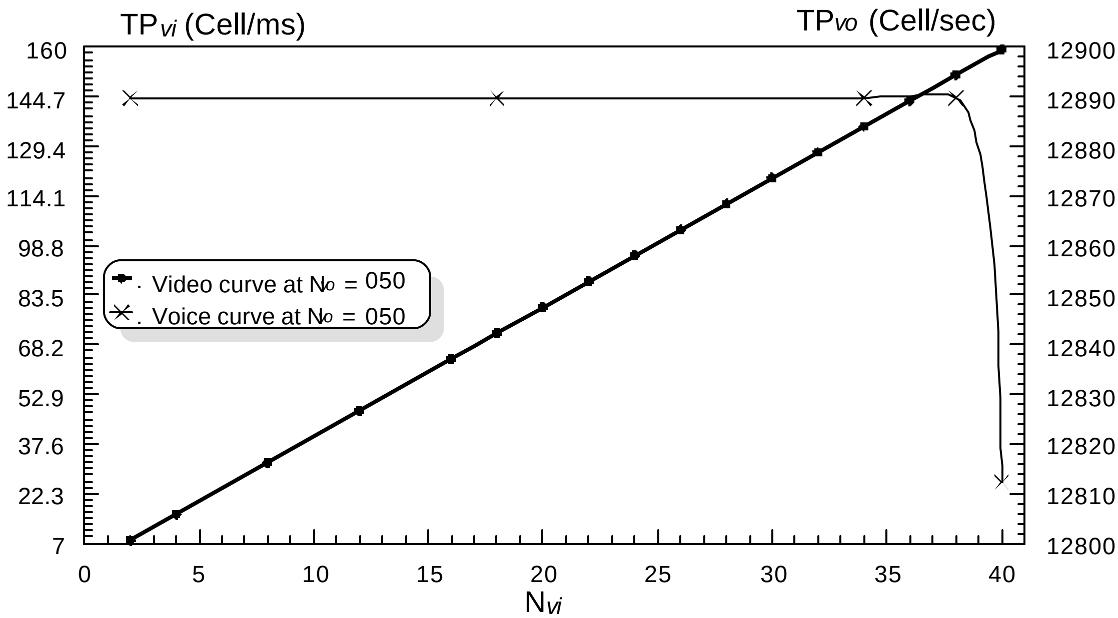

Figure 6-25 TP_{vi} & TP_{vo} versus N_{vi}

Figure 6-26 shows the same study of Figure 6-25, for N_{vo} equals to 250. Clearly the behavior is similar to that in Figure 6-25, as excepted that the saturation limit should change. So we have to recall the reasons of that the saturation limit depends upon the N_{vo}, in which as the N_{vo} increases the saturation limit decreases, as shown in Figure 6-25 and Figure 6-26.

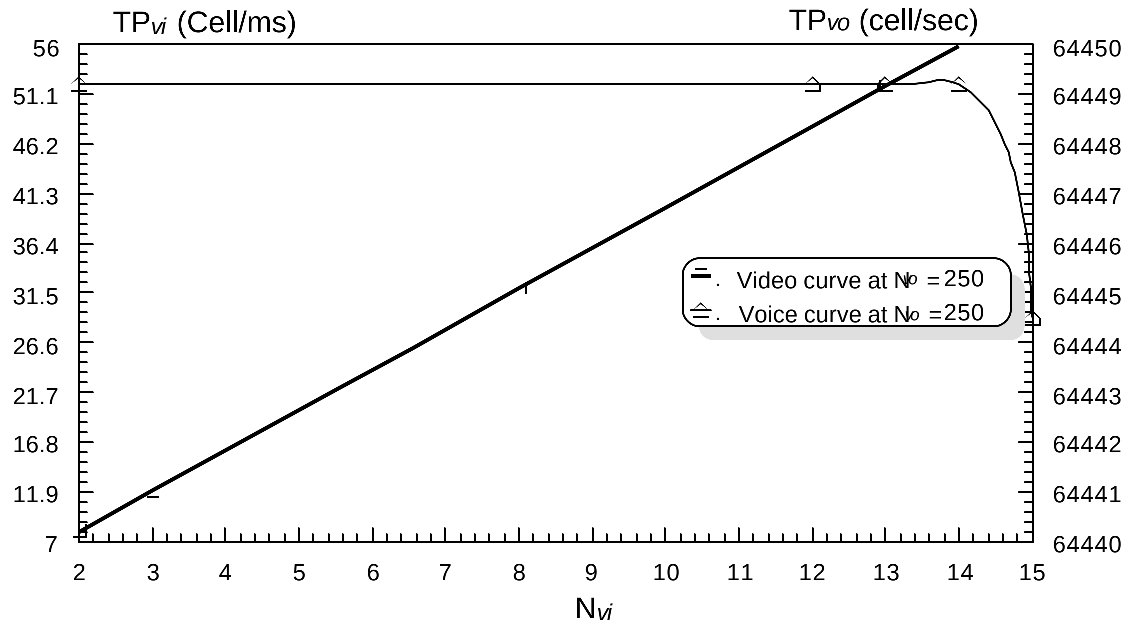

Figure 6-26 TP_{vi} & TP_{vo} versus N_{vi}

Figure 6-27 and Figure 6-28 studies the TP_{vi} and TP_{vo} versus N_{vo}, for various values of N_{vi}. Obviously, that N_{vo} has no effect on the TP_{vi}. The increasing of N_{vo} increases TP_{vo} almost linearly up to the allowed number of N_{vo} to be served, which represents the saturation limit, after that the TP_{vo} remains constant. Meanwhile TP_{vi} remains constant for all values of N_{vo}, because the increasing of N_{vo} has no effects on the number of video cells. It is to be mention here that the increasing of N_{vi} decreases the saturation limit (allowed number of N_{vo}), because the chance of serve of voice cells becomes less for the same reasons mentioned above to Figures 6-24 and 6-25.

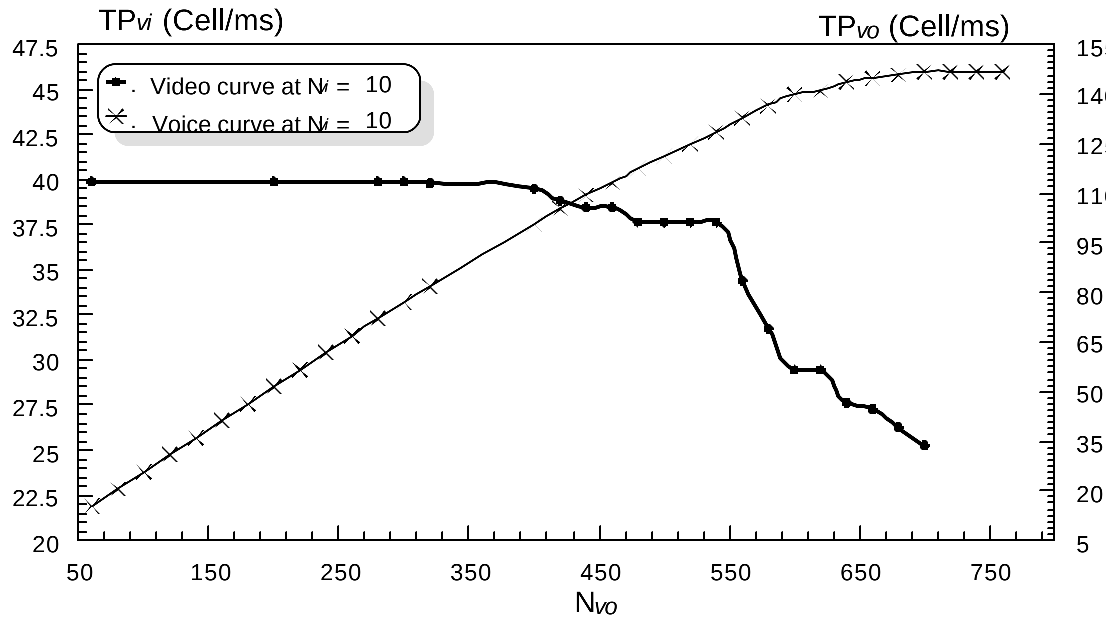

Figure 6-27 TP_{vi} & TP_{vo} versus N_{vo}

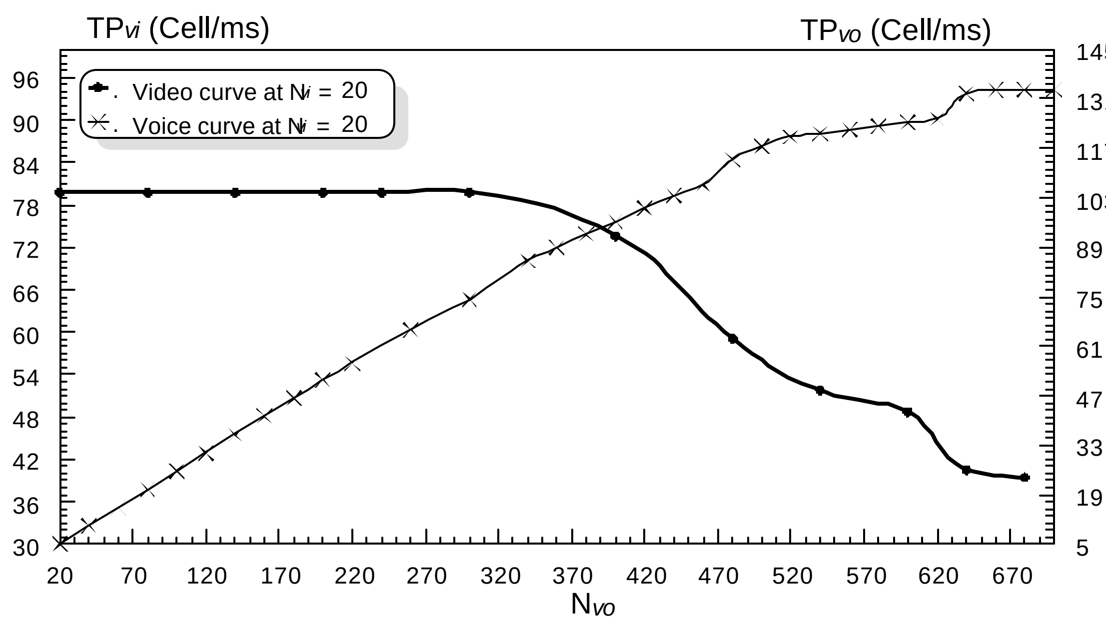

Figure 6-28 TP_{vi} & TP_{vo} versus N_{vo}

Figure 6-29 illustrates the video MWT versus N_{vi}, for the same values of R_{vi} and R_{vo} used above and N_{vo} equals to 0, 50, and 250. The Figure summaries the effect of voice traffic on the video traffic. Obviously that, the increasing of N_{vi}

slightly increases the video MWT up to the saturation limit, which depends up on the number of N_{vo}. Beyond the saturation limit, the video MWT sharply increases due to the large number of cells and queuing delays. The increasing of N_{vo}, slightly increases the video MWT and decreases the saturation limit, which corresponding to the maximum allowed number of N_{vi} to be served by the network.

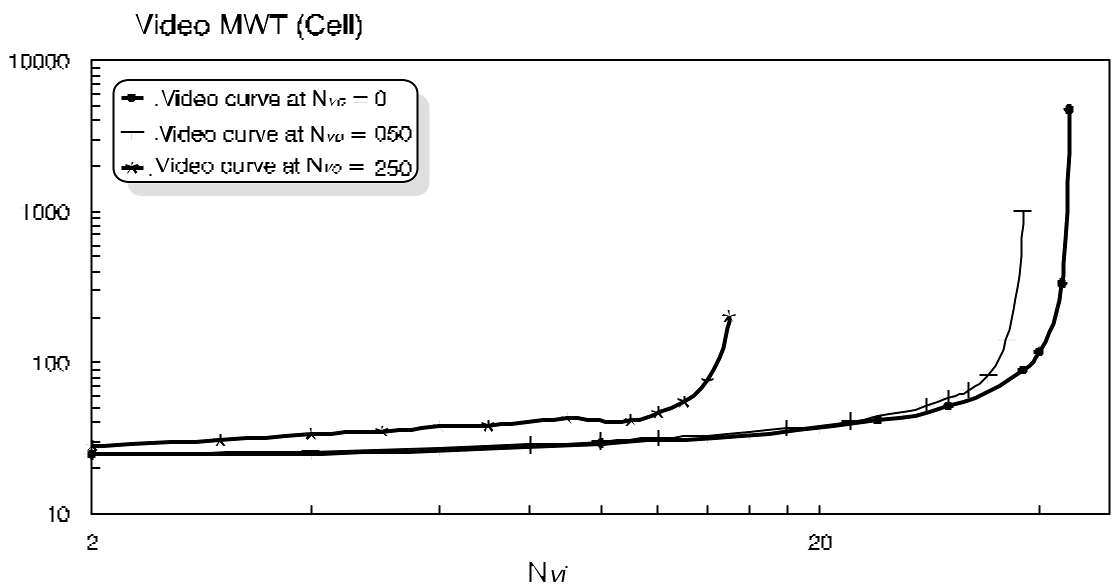

Figure 6-29 Video MWT versus N_{vi}

Figure 6-30 illustrates the voice MWT versus N_{vo}, for the same values of R_{vi}, and R_{vo} used above and N_{vi} equals to 0, 10, and 20. The Figure summaries the effect of video traffic on the voice traffic. It is clear that, the increasing of N_{vo} slightly increase the voice MWT up to saturation limit, which depends upon the N_{vi}. Beyond the saturation limit, the voice MWT sharply increases due to the large number of cells and queuing delays. The increasing of N_{vi}, increases the voice MWT and decreases the saturation limit for N_{vo}, for the same reasons mentioned earlier.

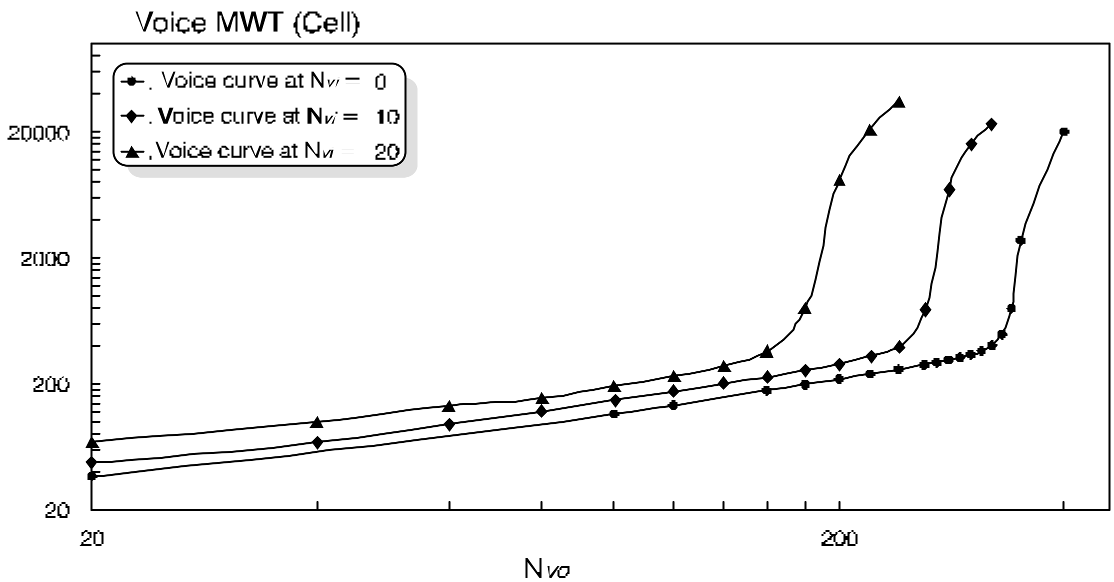

Figure 6-30 Voice MWT versus N_{vo}

Table 6-8 summaries the simulation values at two cases: traffic alone and integration video/voice. It is clear that the voice traffic has slightly effect on video traffic but the video traffic has high effect on voice traffic.

At R_{vi} = 1.5 Mbps and R_{vo} = 192 Kbps			
At N_{vi} = 12 Sources		At N_{vo} = 140 Sources	
N_{vo} (Sources)	Video MWT (cell)	N_{vi} (Sources)	Voice MWT (cell)
0 50 250	30 31 46	0 10 20	156 202 278

Table 6-8 Simulation Results of Figure 6-29 and 6-30