## *7-2 Adding Data Traffic to Video/Voice Integration*

The performance measurements of including data traffic with the integrated of video/voice traffics, which has been studied in the previous chapter is considered in this section. The same definitions of all parameters, we have defined earlier which are also used here, such as $N_{vo}$, $N_{vi}$, $R_{vo}$ equals to 192 Kbps, $R_{vi}$ equals to 1.5 Mbps, talkspurt period equals to 352 ms, silent period equals to 650 ms, and $M_{siz}$ with interarrival time represented by an exponential distribution with mean value ($\mu$) equals to 5 ms. Again, we have to mention that the maximum $M_{siz}$ depends upon $GR_{vi}$ and $GR_{vo}$, however the calculation of the ideal maximum values of $M_{siz}$ depends on $\mu$ (ms), $R_T$ = 352 cell/ms, and transit rate (cell/ms) as shown from the following equation (7-3).

$$\text{Max. } M_{siz} = [[352(cell/ms) - transit\_rate(cell/ms)] - (GR_{vi} + GR_{vo})] x m \qquad (7\text{-}3)$$

The generation of video and voice ($GR_{vi}$ + $GR_{vo}$) depends upon $GR_{vi}$, $GR_{vo}$, $N_{vi}$, and $N_{vo}$ as shown from the following equation (7-4).

$$(GR_{vi} + GR_{vo}) = (N_{vi} \; x \; GR_{vi} + N_{vo} \; x \; GR_{vo}) \quad \text{------------------------} \quad (7\text{-}4)$$

Using equation (7-3) and (7-4) helps to determine the ideal maximum $M_{siz}$ for various values of $N_{vi}$ and $N_{vo}$. Table 7-5 summaries the ideal maximum $M_{siz}$. However, the measured values could be less than or equal to those values of $M_{siz}$. The values of the parameters have mentioned above are used here.

| $N_{vi}$ | $N_{vo}$ | ($GR_{vi}$ + $GR_{vo}$) (cell/ms) | $M_{siz}$ (cell) |
|---|---|---|---|
| 10 | 50 | 65 | 555 |
| 10 | 100 | 91 | 425 |
| 20 | 50 | 105 | 355 |

Table7-5 Ideal Maximum $M_{siz}$ (cell).

Figure 7-8 illustrates video and voice MWT versus $M_{siz}$ for the values of $N_{vi}$ equals to 10 and 20, and $N_{vo}$ equals to 50 and 100. The Figure shows the effect of $N_{vo}$ and $N_{vi}$ on the video and voice MWT. The increasing of either $N_{vo}$ or $N_{vi}$ yields increase of video and voice MWT. The absolute value of voice MWT is higher than that of video MWT, this is because the highest priority given to serve video cells first followed by voice cells. The increasing of $M_{siz}$ corresponding slightly increase of video and voice MWT up to the saturation limit (which corresponding the optimal length of $M_{siz}$ and it changes according to the value of $N_{vo}$ and $N_{vi}$). Beyond the saturation limit the video and voice MWT smoothly increase with the increasing of $M_{siz}$, because the increasing of $M_{siz}$, increases the transmission (service) time used for data cells. We have to recall that the effect of the proposed control mechanism method is very clear. So, inspire the heavy load carried by the network and the highest priority given to the real-time traffic (video and voice), the non-real-time served properly, and all traffics served with acceptable delays as shown in Figure 7-8.

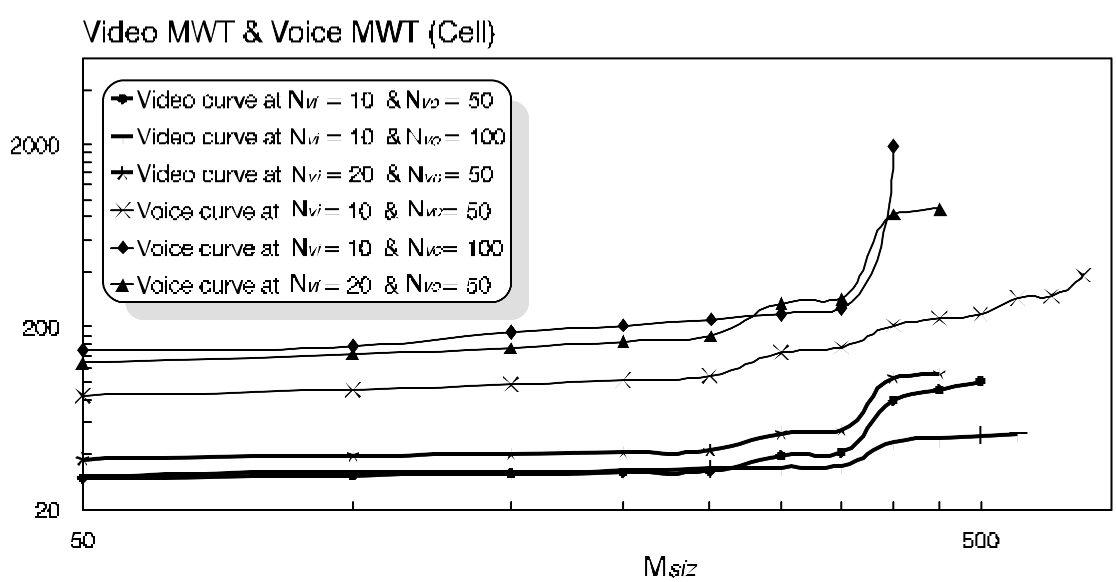


**Figure 7-8 Video MWT & Voice MWT versus $M_{siz}$**

Table 7-6 summaries the simulation results which represents the fixed generation rates of video/voice integration, and corresponding $M_{siz}$, video MWT, and voice MWT.

| $N_{vi}$ | $N_{vo}$ | $(GR_{vi} + GR_{vo})$ (cell/ms) | $M_{siz}$ (cell) | Video MWT (cell) | Voice MWT (cell) |
|---|---|---|---|---|---|
| 10 | 50 | 65 | 500 | 100.84 | 234.76 |
| 10 | 100 | 91 | 400 | 47.08 | 1951.47 |
| 20 | 50 | 105 | 350 | 54.44 | 285.94 |

Table 7-6 Simulation Results of Figure 7-8.

Figure 7-9 illustrates video and voice MBS versus $M_{siz}$ with the same values of $N_{vi}$, and $N_{vo}$ used above in Figure 7-8. From the Figure, obviously that the characteristics behavior are similar to that in Figure 7-8 and for the same resons mentioned. Table 7-7 summaries the simulation results of Figure 7-9.

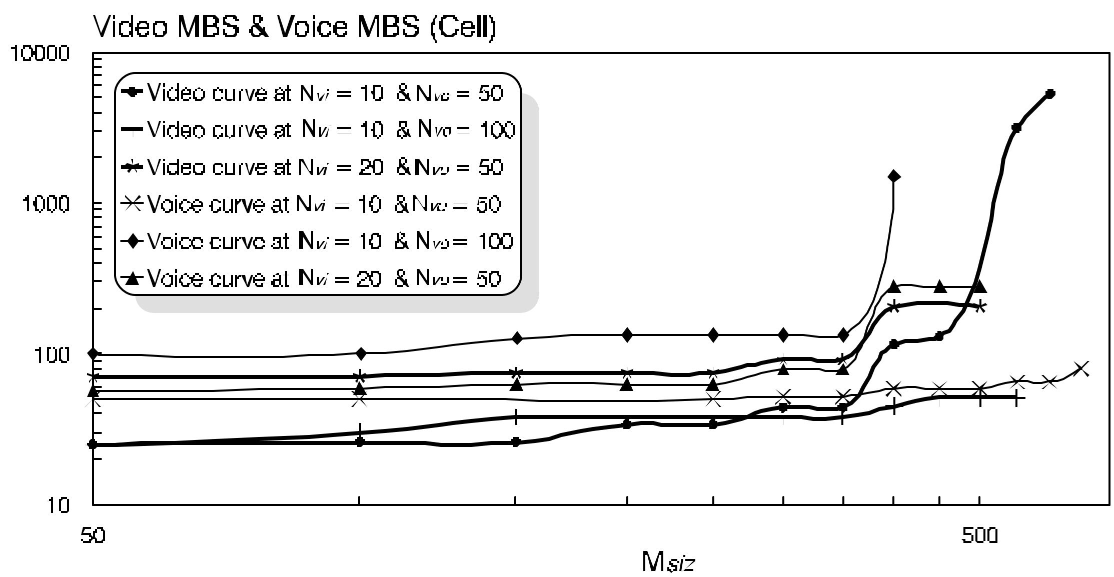


**Figure 7-9 Video MBS & Voice MBS versus $M_{siz}$**

| $N_{vi}$ | $N_{vo}$ | $(GR_{vi} + GR_{vo})$ (cell/ms) | $M_{siz}$ (cell) | Video MBS (cell) | Voice MBS (cell) |
|---|---|---|---|---|---|
| 10 | 50 | 65 | 500 | 130 | 59 |
| 10 | 100 | 91 | 400 | 45 | 1509 |
| 20 | 50 | 105 | 350 | 92 | 79 |

Table 7-7 Simulation Results of Figure 7-9.

Figure 7-10 illustrates $TP_{vi}$ and $TP_{vo}$ versus $M_{siz}$, for $R_{vi}$ = 1.5 Mbps, $R_{vo}$ = 192 Kbps, $N_{vi}$ = 10, $N_{vo}$ = 50, and $m$ = 5 ms. Obviously that the $TP_{vi}$ and $TP_{vo}$ remain constant at 39.89 cell/ms and 5.83 cell/ms respectively with the increasing of $M_{siz}$ up to the saturation limit after that $TP_{vi}$ and $TP_{vo}$ decrease with the increases of $M_{siz}$. In contrast $TP_{da}$ increases linearly with the increasing of $M_{siz}$, that is because, the increasing of $M_{siz}$ increases the number of generated data cells. It is to be mentioning here that the reasons that make both $GR_{vi}$ and $GR_{vo}$ are constant, the $N_{vi}$ and $R_{vi}$ are constant at 10 and 1.5 Mbps respectively therefore $GR_{vi}$ remains constant, the $N_{vo}$ and $R_{vo}$ are constant at 50 and 192 Kbps respectively therefore $GR_{vo}$ remains constant.

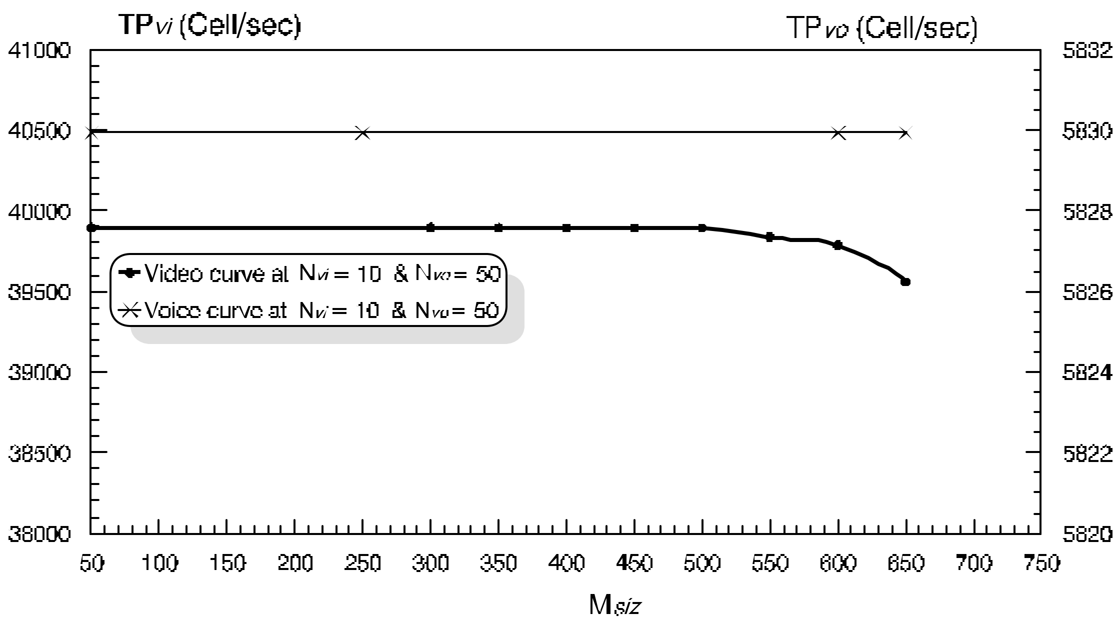


**Figure 7-10 $TP_{vi}$ and $TP_{vo}$ versus $M_{siz}$**

Figure 7-11 shows the same study of Figure 7-10, except the value of $N_{vo}$ equals to 100. Clearly the behavior is similar to that in Figure 7-10, except that the saturation limit is changed here. So, we have to recall reason of that saturation limit is depends upon the values of $N_{vo}$ in which as the value of $N_{vo}$ increases the saturation limit decreases, as shown in Figure 7-10 and Figure 7-11.

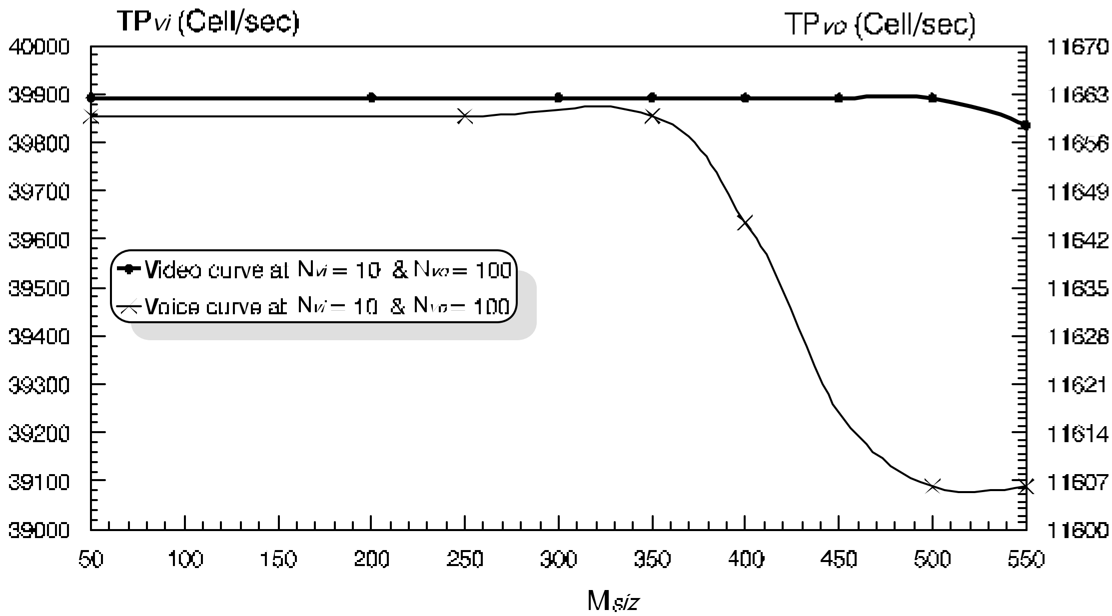


**Figure 7-11 $TP_{vi}$ and $TP_{vo}$ versus $M_{siz}$**

Figure 7-12 shows the same studies of Figure 7-10, except the value of $N_{vi}$ equals to 20. Clearly the behavior is similar to that in Figure 7-10, except that the saturation limit is changed here. So, we have to recall the reason of that saturation limit is depends upon the $N_{vi}$ in which as the value of $N_{vi}$ increases the saturation limit decreases, as shown in Figure 7-10 and Figure 7-12.

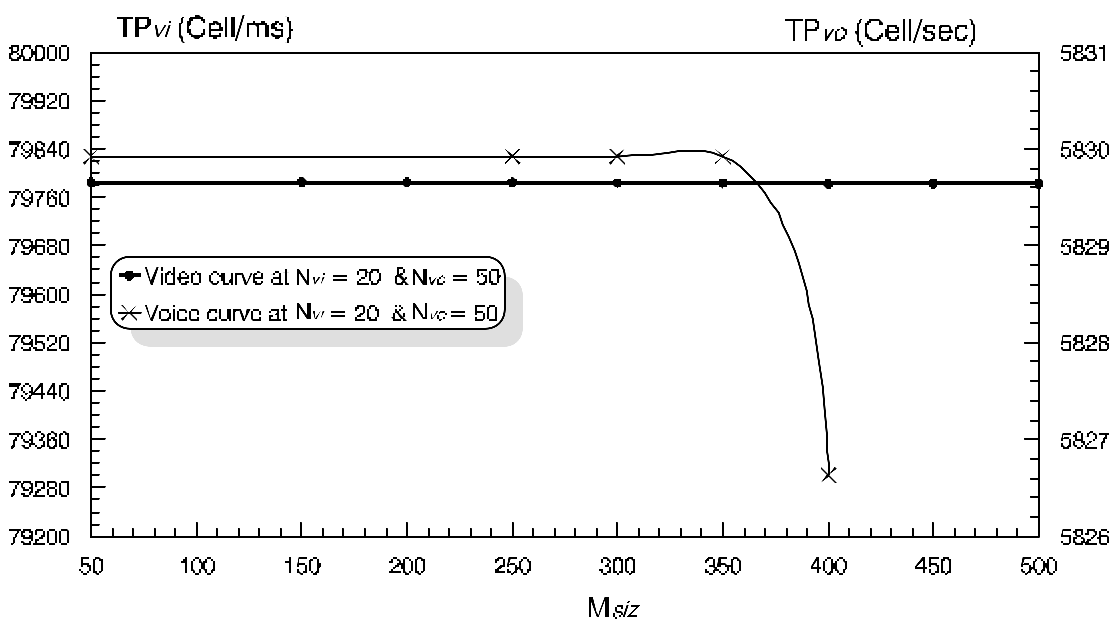


**Figure 7-12 $TP_{vi}$ and $TP_{vo}$ versus $M_{siz}$**

Figure 7-13 illustrates the video and voice MWT versus $N_{vo}$, for the same values of $R_{vi}$, $R_{vo}$, and μ used above, the $N_{vi}$ equals to 10, and the $M_{siz}$ equals to 0, 100, and 300. The Figure summaries the effect of data traffic on the video/voice traffics. Obviously that, the increasing of $N_{vo}$ slightly increases the video and voice MWT up to the saturation limit, which depends up on the $M_{siz}$. Beyond the saturation limit, the video and voice MWT sharply increase due to the large number of voice cells and queuing delays. The increasing of $M_{siz}$, slightly increase the video and voice MWT and decreases the saturation limit for $N_{vo}$.

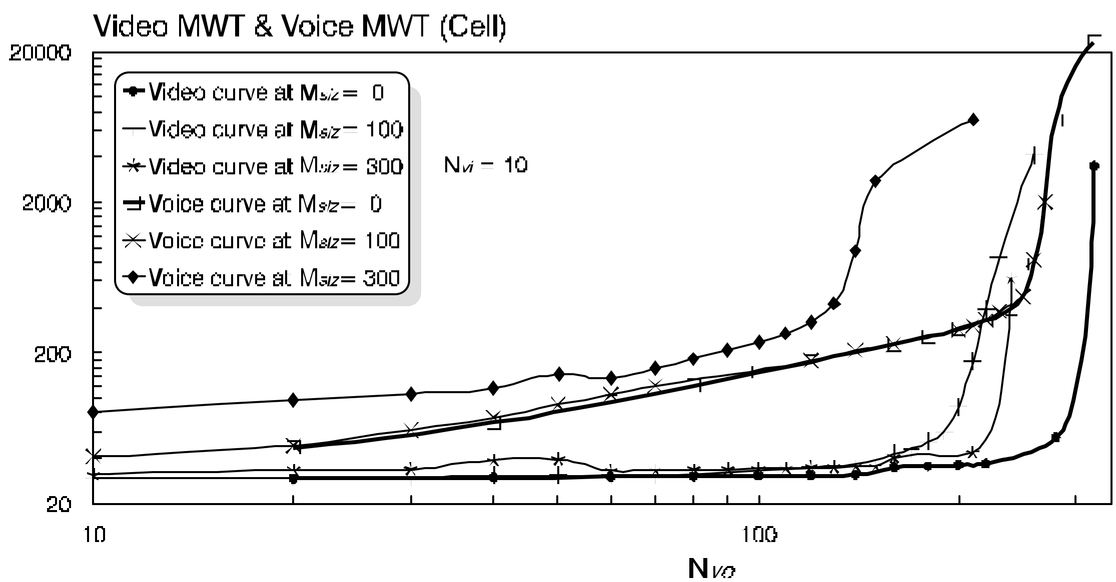


**Figure 7-13 Video MWT and Voice MWT versus $M_{siz}$**

Figure 7-14 illustrates the video and voice MWT versus $N_{vi}$, for the same values of $R_{vi}$, $R_{vo}$, and μ used above, the $N_{vo}$ equals to 50, and the $M_{siz}$ equals to 0, 100, and 300. The Figure summaries the effect of data traffic on the video/voice traffics. Obviously that, the increasing of $N_{vi}$ slightly increases the video and voice MWT up to the saturation limit, which depends up on the $M_{siz}$. Beyond the saturation limit, the video and data MWT sharply increase due to the large number of video cells and queuing delays. The increasing of $M_{siz}$, slightly increase the video and voice MWT and decrease the saturation limit for $N_{vi}$.

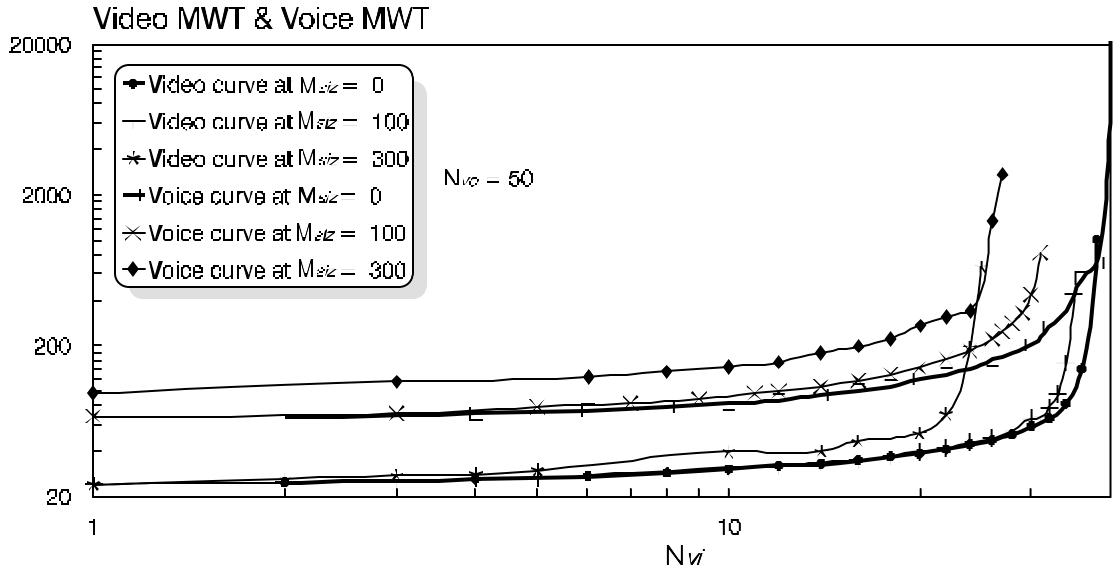


**Figure 7-14 Video MWT and Voice MWT versus $N_{vi}$**

Table 7-8 summaries the simulation values at two cases: integration video/voice and integration data/video/voice. It is clear that the data traffic has very slightly effect on video traffic but the data traffic has a small effect on voice traffic.

| At $R_{vi}$ = 1.5 Mbps, $R_{vo}$ = 192 Kbps, $\mu$ = 5 ms | | | | | |
|---|---|---|---|---|---|
| At $N_{vo}$=100Sources & $N_{vi}$=10 Sources | | | At $N_{vo}$=50 Sources & $N_{vi}$=10 Sources | | |
| $M_{siz}$ (cell) | Video MWT (cell) | Voice MWT (cell) | $M_{siz}$ (cell) | Video MWT (cell) | Voice MWT (cell) |
| 0 100 300 | 30 32 34 | 148 156 236 | 0 100 300 | 30 30 39 | 82 90 144 |

Table 7-8 Simulation Results of Figure 7-13 and 7-14