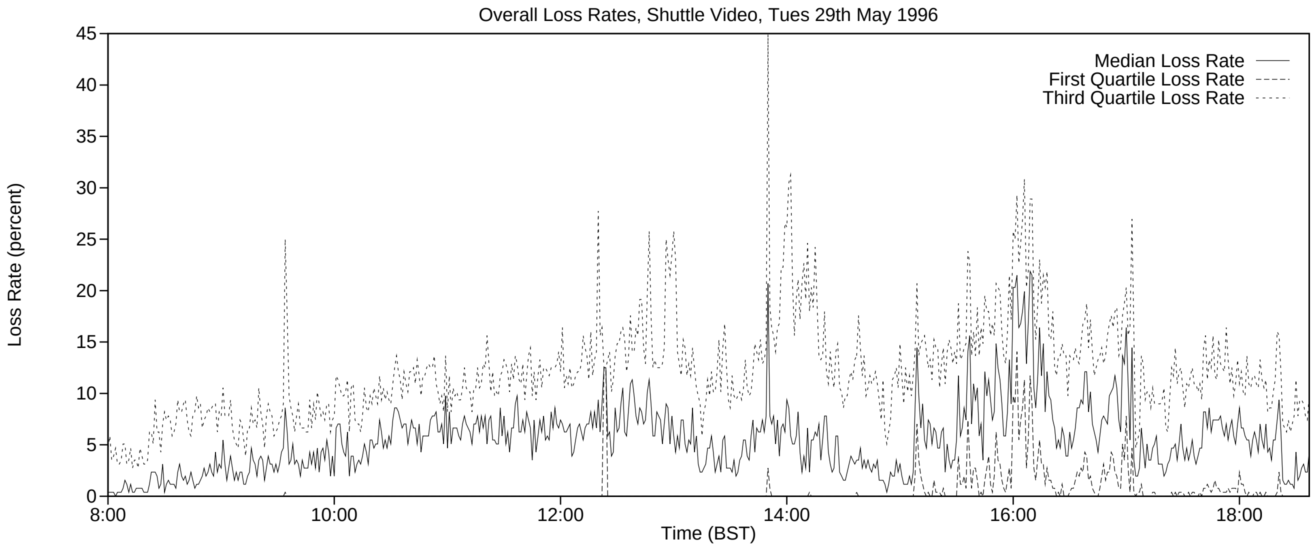

Figure 5: Loss Rate Distribution against Time

These graphs show the loss distribution to be very long tailed, with large amounts of relatively low loss rates observed, and although very high loss rates are seen, they are rare. 80% of all reports give loss rates of less than 20%.

Loss Rate Distribution with Time

Figure 5 shows the loss rate distribution against time in minutes for the shuttle video session on Tuesday 29th May. Three lines are shown, giving the median loss rate reported from all receivers reporting in one minute interval, and the first and third quartiles. Note that although 25% of the receivers are suffering no loss for much of the day, the median loss rate is between 5 and 10% for the majority of the day. Also 25% of receivers are suffering loss rates of greater than 15% for all the afternoon (between 12:00 and 4:30 UTC) when both the European and US communities are active.

Figure 4 shows the loss rate against time for each receiver during a 33 minute interval of the shuttle video session from 11:30am BST on Tuesday 29th May and for two intervals on Tuesday 17th Sept 1996. These graphs were obtained from the RTCP receiver reports for each receiver by taking a 3 minute windowed average to minimize boundary effects caused by the de-synchronized nature of RTCP receiver reports. Receivers are shown in order of mean loss rate. Although the precise time intervals are arbitrary, they were deliberately chosen from a period when fairly high loss rates are visible in figure 5 and the equivalent for the 17th Sept. Several graphs were taken from these data sets collected on 29th May and 17th Sept, and show similar degrees of correlation of loss between receivers.

The graphs shown are representative of the range seen, and vary from reasonably good correlation (on May 29th) to less good correlation (on the first graph from Sept 17th). They show some correlation of loss between receivers, as would be expected, but they also show a large amount of additional low amplitude noise, which would only be expected if many different points in the distribution tree are causing usually small amounts of loss independently. In addition, there are always a small number of receivers suffering very high uncorrelated loss. This agrees acceptably well with the loss distribution shown in figure 1, which shows a small number of high loss links which are responsible for the larger scale correlation in 4 and a large number of links.with low loss rates which add noise to the correlation.

Figures 6 and 7 show loss rate against time measured from the RTP traffic received at UCL, London from NASA. Unlike 4 these give very fine grain loss statistics, but only does so for one site. The first graph in figure 6 was taken early in the morning (UK time) on Tuesday 28th May 1996, when the networks were lightly loaded. The second graph was taken at the time of maximum loss as shown on figure 5. Both graphs show a clear 31 second periodic loss pattern, although this is less obvious in the second graph because of other loss. The loss autocorrelation graphs taken from the same RTP loss data in figure 8 do show that this effect is still significant when the network loss levels are high. Yatnik et al [14] also reported similar periodic losses.

We have attempted to verify that this effect is not a measurement artifact by performing the same dump on different workstations running different operating systems. The main dumps are all taken on a SparcStation 20 run-