Exercise 1: The rate at which the packets are received at node 1 converges to a constant value of around 500kbytes/s which equals the maximum download speed of 4Mbit/s. The little hills on top of the download rate can be explained by the inaccuracy of the perl visualization script.A description...A description...

Question 2: In the beginning of the TCP transfer the slow start is observed. When the UDP transmission kicks in, a significant drop in TCP throughput is observed. This is caused by the upload bandwidth limitation of the cable modem: TCP sends an acknowledgement for each received packet but the upload line is congested with UDP traffic as can be seen on the figure above. TCP throughput drops because acknowledgements are lost due to the overloaded buffer. After the loss of these acknowledgements the slow start mechanism of TCP will kick in again.

Question 3: the acknowledgements of the TCP connection can then be transferred. If the assigned bandwidth for TCP is large enough to transfer the acknowledgements without congesting the buffer, the TCP throughput will sustain its maximum value. The UDP throughput will adapt to the assigned bandwidth.

Question 4: If we take the case where the 100 Mbit uplinks and downlinks are preserved, the traffic will be even more distorted. Because a bigger packet loss rate occurs at the buffers even more TCP acknowledgements will be discarded which results in a lower TCP throughput. UDP throughput also drops

A description...

Question 5: The TCP throughput doesn't drop that much as the situation where the rate of sending UDP packets isn't limited to 30kbytes/s. Although TCP experiences some jitter as it needs a higher bandwidth to transmit all its acknowledgements immediately. A possible solution to this jitter would be to increase TCP packet size and by this reduce the acknowledgement rate which leads to a maximum use of the 4 Mbit bandwidth.

Question 6:

Gnuplot:

set terminal postscript eps enhanced colour dashed lw 1 "Helvetica" 14

set output "Question5.eps"

plot "./ThroughputTCP" w l, "./ThroughputUDP" w l