Exercise 5

Result Analysis

In Exercise 4 you created a Client-Server network with the INET framework as shown in Figure 1. Re-use this network and make sure to set the parameters as in the provided omnet.ini at the end of this exercise sheet.

This exercise will explain the importance of warmup period and confidence intervals for the evaluation of simulation results.

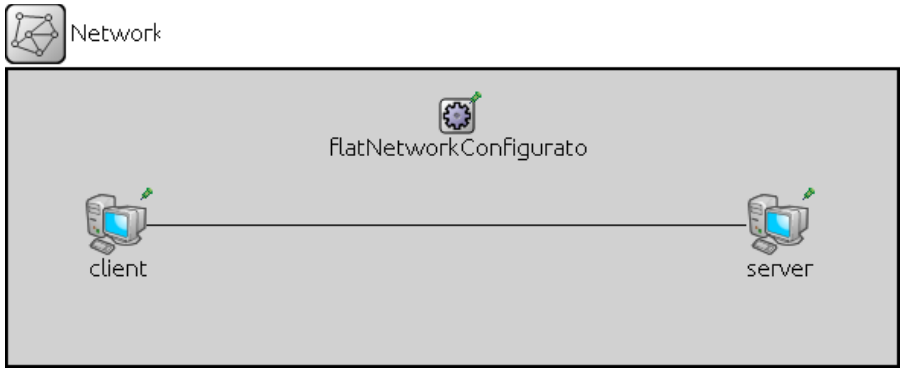

Figure 1: Network

1) Simulate your network for 10 seconds, for 100 seconds and for 1000 seconds. After each run, have a look at the vector results for the throughput.
   What do you notice at the beginning of the simulation? What does your observation mean for the data analysis?

2) The average throughput over the whole simulation run is also recorded as a scalar value. Now repeat the simulation for 10 seconds 10 times with different seeds.
   What do you notice about the scalar values for the average throughput?

3) Find out how to calculate the confidence intervals for the average throughput. Give a pseudo-code example for the calculation and explain your solution.

4) Implement your pseudo-code example in MATLAB and calculate confidence intervals for your simulation results from task 2.

5) Also repeat the simulation runs with a duration of 100 seconds and 1000 seconds. Calculate the 95% confidence intervals for each simulation duration. Draw all results in one graph. What do you notice about the confidence intervals?

6) What will happen if you repeat your simulations 30 times instead of 10 times?

```
[General]
network = your_network
sim-time-limit = ${simtime=10, 100, 1000}s
repeat = 1
**.networkConfiguratorModule = ""

**.ppp[*].numInputHooks = 1
**.ppp[*].inputHook[0].typename = "ThruputMeter"
**.ppp[*].inputHook[0].maxInterval = 1s
**.ppp[*].inputHook[0].batchSize = 10000
**.ppp[*].inputHook[0].**.vector-recording = true

**.vector-recording = false

# Client settings
**.client.numTcpApps = 1
**.client.tcpApp[0].typename = "TCPSessionApp"
**.client.tcpApp[0].active = true
**.client.tcpApp[0].localPort = -1
**.client.tcpApp[0].connectAddress = "server"
**.client.tcpApp[0].connectPort = 1000
**.client.tcpApp[0].tOpen = 0
**.client.tcpApp[0].tSend = 0
**.client.tcpApp[0].sendBytes = 5000MiB
**.client.tcpApp[0].tClose = 0

# Server settings
**.server.numTcpApps = 1
**.server.tcpApp[0].typename = "TCPSinkApp"
**.server.tcpApp[0].localPort = 1000

# TCP settings
**.tcpType = "TCP"
**.tcp.advertisedWindow = 22*this.mss
**.tcp.mss = 1460
```