VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

OPERATING SYSTEMS

PROJECT REVIEW 3

TITLE: Scheduling Algorithms and Performing Wireless Communication between Server and Client in Omnet++

DONE BY: VIBHOR SHARMA

17BCE2152

ABSTRACT:

Wireless technology is advancing rapidly and new enhancements are proposed on a regular basis. In computer networks, new, untested protocols cannot be launched on a large scale due to uncertainty of its successful outcome. Therefore, the new protocols/schemes are tested with analytical modelling or simulation tools. After the simulation, if the new protocols show promising results, the protocols are implemented in the real world.

OMNET++ has been available to the public since September 1997 and currently has a large number of users. Unlike ns-2 and ns-3, OMNET++ is not only designed for network simulations. It can be used for modeling of multiprocessors, distributed hardware systems and performance evaluation of complex software systems. However, it is most commonly used for computer networks simulation. OMNET++ is a general discrete event, component-based (modular) open architecture simulation framework.

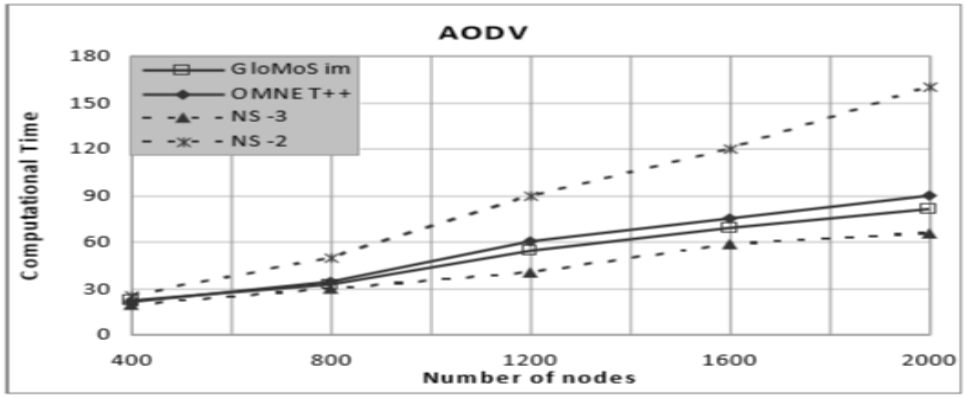


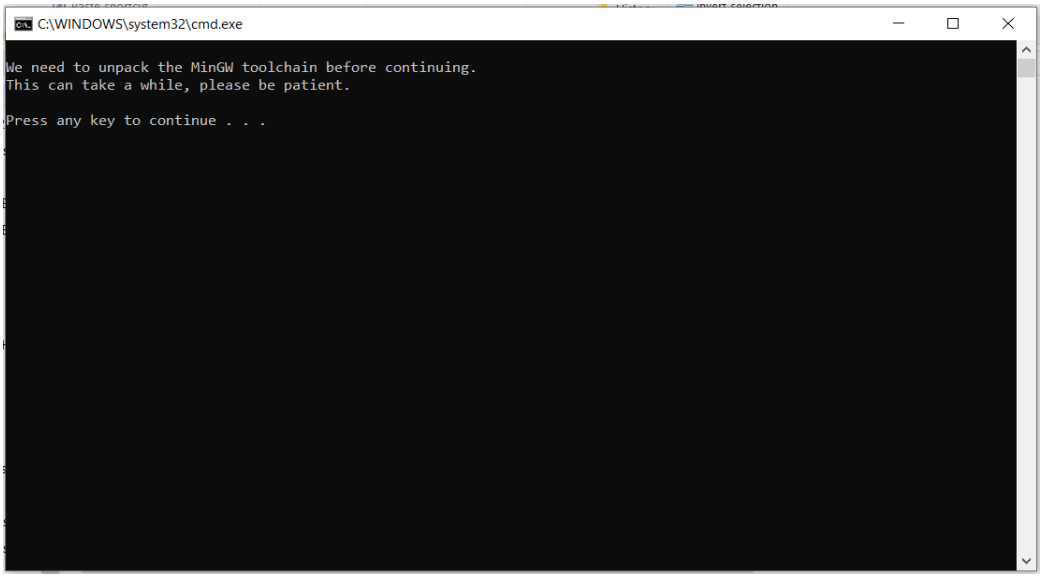
Figure 8: Number of nodes vs Computational Time

Introduction about Installation and Tools Used with relevant screen shots:

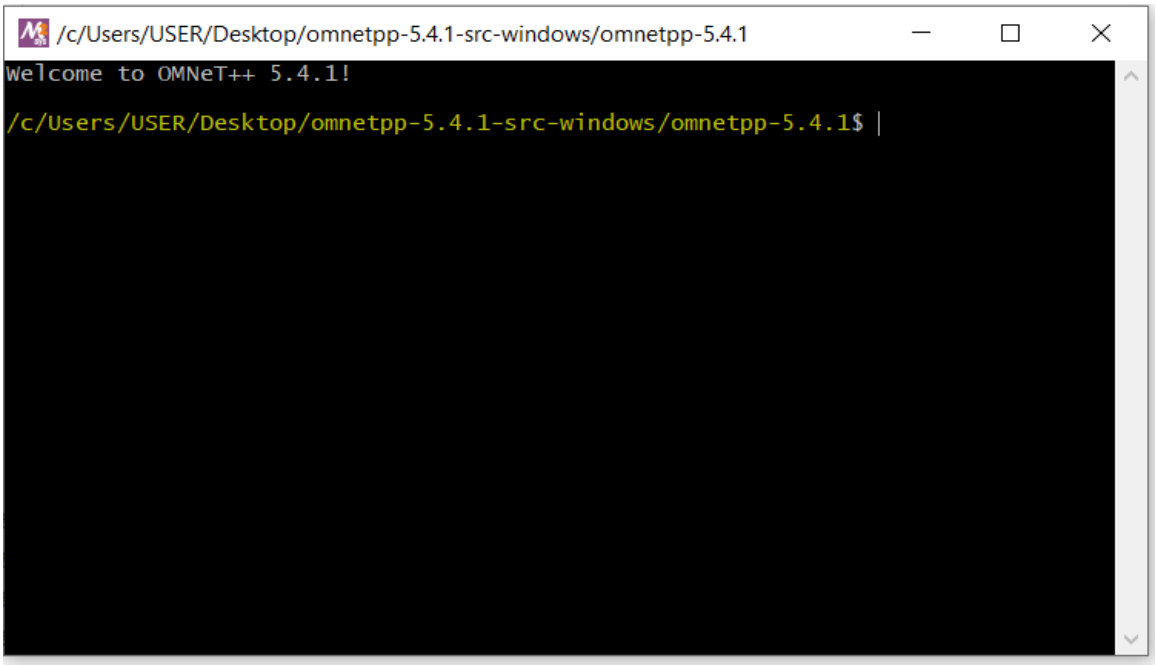
The software which we need to download is Omnet++ which can be downloaded from the link: https://omnetpp.org/omnetpp

Installation steps:

1. After downloading we need to extract the files and after that click on the “mingwenv” which is the Windows command script and press Enter.



Then this will open



In this enter these two commands:

a. $ ./configure
b. $ make

Introduction about the concept/methodology taken:

Omnet++ has the following components:

Components

- simulation kernel library
- NED topology description language
- OMNeT++ IDE based on the Eclipse platform
- GUI for simulation execution, links into simulation executable (Tkenv)
- command-line user interface for simulation execution (Cmdenv)
- utilities (makefile creation tool, etc.)

- documentation, sample simulations, etc

So for performing the First Come First Serve scheduling algorithm, we make the following modules one is Distributor, Operating System and the different processes.

And for doing the wireless communication between the client and the server, we need two modules: one for the client and one for the server.

Running few basic examples to ensure proper installation.

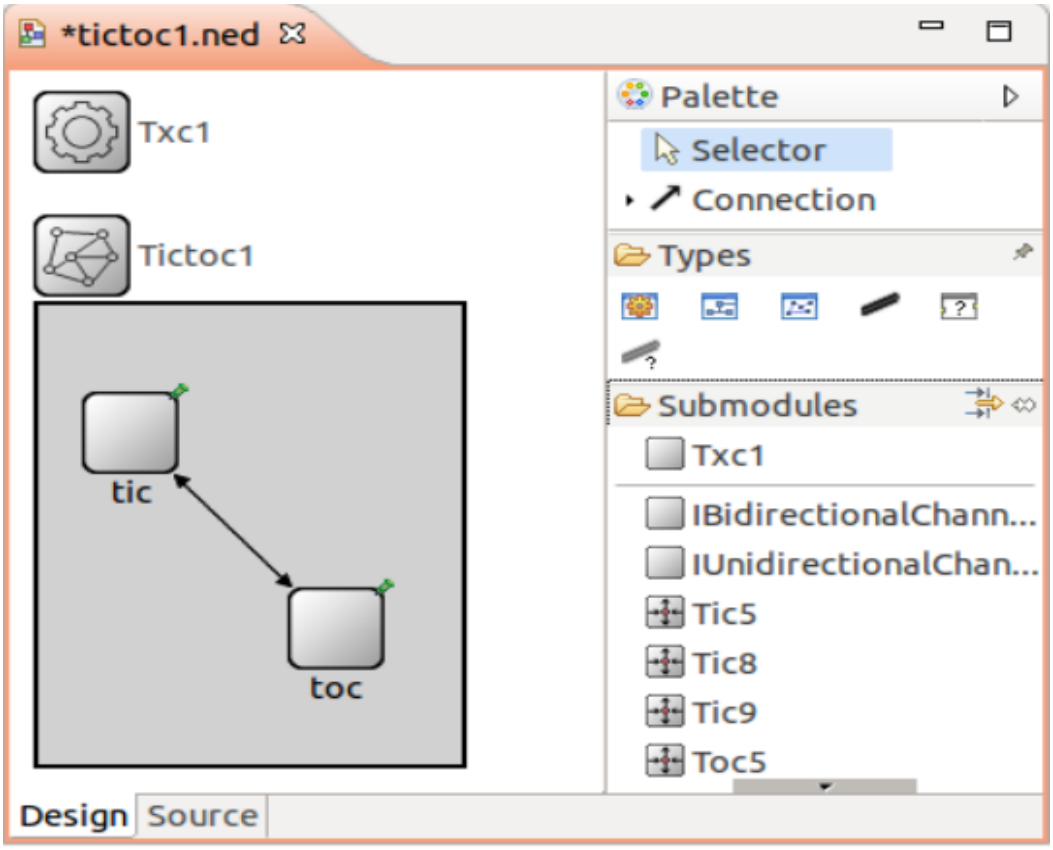
Example: Tic-toc

Network Description File:

Tictoc.NED

```
simple Txc1
{
        gates:
                input in;
```

```
        output out;
}

network Tictoc1
{
    submodules:
        tic:Txc1;
        toc:Txc1;
    connections:
        tic.out --> {delay = 100ms; } -->toc.in;
        tic.in <== { delay = 100ms; } <-- toc.out;
}
```



Adding the C++ files

txc1.cc

```
#include<string.h>
#include<omnetpp.h>

using namespace omnetpp;
/**
 * Derive the Txc1 class from cSimpleModule. In the Tictoc1 network,
 * both the `tic' and `toc' modules are Txc1 objects, created by OMNeT++
```

```
 * at the beginning of the simulation.
 */
class Txc1:public cSimpleModule
{
        protected:
        //The following redefined virtual function holds the algorithm
        virtual void initialize() override;
        virtual void handleMessage(cMessage *msg) override;
};

//The module class needs to be registered with Omnet++
Define_Module(Txc1);

void Txc1 :: Initialize()
{
        // Initialize is called at the beginning of the simulation.
   // To bootstrap the tic-toc-tic-toc process, one of the modules needs
   // to send the first message. Let this be `tic'.

   // Am I Tic or Toc?
   if (strcmp("tic", getName()) == 0) {
      // create and send first message on gate "out". "tictocMsg" is an
```

```
        // arbitrary string which will be the name of the message object.
        cMessage *msg = new cMessage("tictocMsg");
        send(msg, "out");
         }
}
void Txc1::handleMessage(cMessage *msg)
{
    // The handleMessage() method is called whenever a message arrives
    // at the module. Here, we just send it to the other module, through
    // gate `out'. Because both `tic' and `toc' does the same, the message
    // will bounce between the two.
    send(msg, "out"); // send out the message
}
```

Initialization file which is needed to run the simulation:

omnetpp.ini

```
[General]
Network = Tictoc1
```

Scheduling Algorithms in Omnet++

1. First Come First Serve Scheduling Policy:

C++ Files:

Process Module

```
/*
 * Process.cc
 *
 *  Created on: Sep 16, 2018
 *      Author: USER
 */
#include<string.h>
#include<omnetpp.h>
using namespace omnetpp;
class Process:public cSimpleModule{
   protected:
    virtual void initialize() override;
    virtual void handleMessage(cMessage *msg) override;
};
Define_Module(Process);
void Process::initialize()
{
    int range = 9 - 1 + 1;
    int num = rand() % range + 1;
    char message[20];
    sprintf(message, "P%c %d",getName()[7],num);
    cMessage *msg= new cMessage(message);
    cMessage *copy=(cMessage *)msg->dup();
    send(copy,"out");
}
void Process::handleMessage(cMessage *msg)
{
/* int range = 9-1+1;
int num = rand() % range + 1;
char message[20];
sprint(message, "P%c %d",getName()[7],num);
cMessage *msg= new cMessage(message);
cMessage *copy=(cMessage *)msg->dup();
send(copy,"out");*/
}
```

Operating System Module

```
/*
 * OperatingSystem.cc
 *
 *  Created on: Sep 16, 2018
 *      Author: USER
 */

#include<string.h>
#include<omnetpp.h>

using namespace omnetpp;

class OperatingSystem:public cSimpleModule{
    private:
    int n=8;
    int processqueue[8];
    int processburst[8];
    int front=0,rear=0;
    protected:
    virtual void initialize() override;
    virtual void handleMessage(cMessage *msg) override;
};

Define_Module(OperatingSystem);

void OperatingSystem::initialize()
{

}
void OperatingSystem::handleMessage(cMessage *msg)
{
    processqueue[rear]=(msg->getName()[1]-'0');
    processburst[rear]=(msg->getName()[3]-'0');
    rear++;
    if(rear==n)
    {
        float x=0.0;
        for(int i=front;i<rear;i++)
        {
            char message[20];
            sprintf(message,"P%d",processqueue[i]);
            cMessage *msg2=new cMessage(message);
            cMessage *copy=(cMessage *)msg2->dup();
            send(copy,"out");
        }
            front=0;
            rear=0;
     }
```

```
}
```

Distributor Module

```
/*
 * Distributor.cc
 *
 *  Created on: Sep 16, 2018
 *      Author: USER
 */


#include<string.h>
#include<string>
#include<omnetpp.h>
using namespace omnetpp;
class Distributor:public cSimpleModule{
    private:
    int counter=0;
    int x=0;
    protected:
    virtual void initialize() override;
    virtual void handleMessage(cMessage *msg) override;
};
Define_Module(Distributor);
void Distributor::initialize()
{
}

void Distributor::handleMessage(cMessage *msg)
{
cMessage *msg2=new cMessage("Complete");
std::string received=msg->getName();
EV<<msg->getName() << "\n";
if(received[1]=='1')
   sendDelayed(msg2,x,"out1");
else if(received[1]=='2')
   sendDelayed(msg2,x,"out2");
else if(received[1]=='3')
   sendDelayed(msg2,x,"out3");
else if(received[1]=='4')
   sendDelayed(msg2,x,"out4");
else if(received[1]=='5')
   sendDelayed(msg2,x,"out5");
else if(received[1]=='6')
   sendDelayed(msg2,x,"out6");
else if(received[1]=='7')
   sendDelayed(msg2,x,"out7");
else if(received[1]=='8')
   sendDelayed(msg2,x,"out8");

counter++;
```

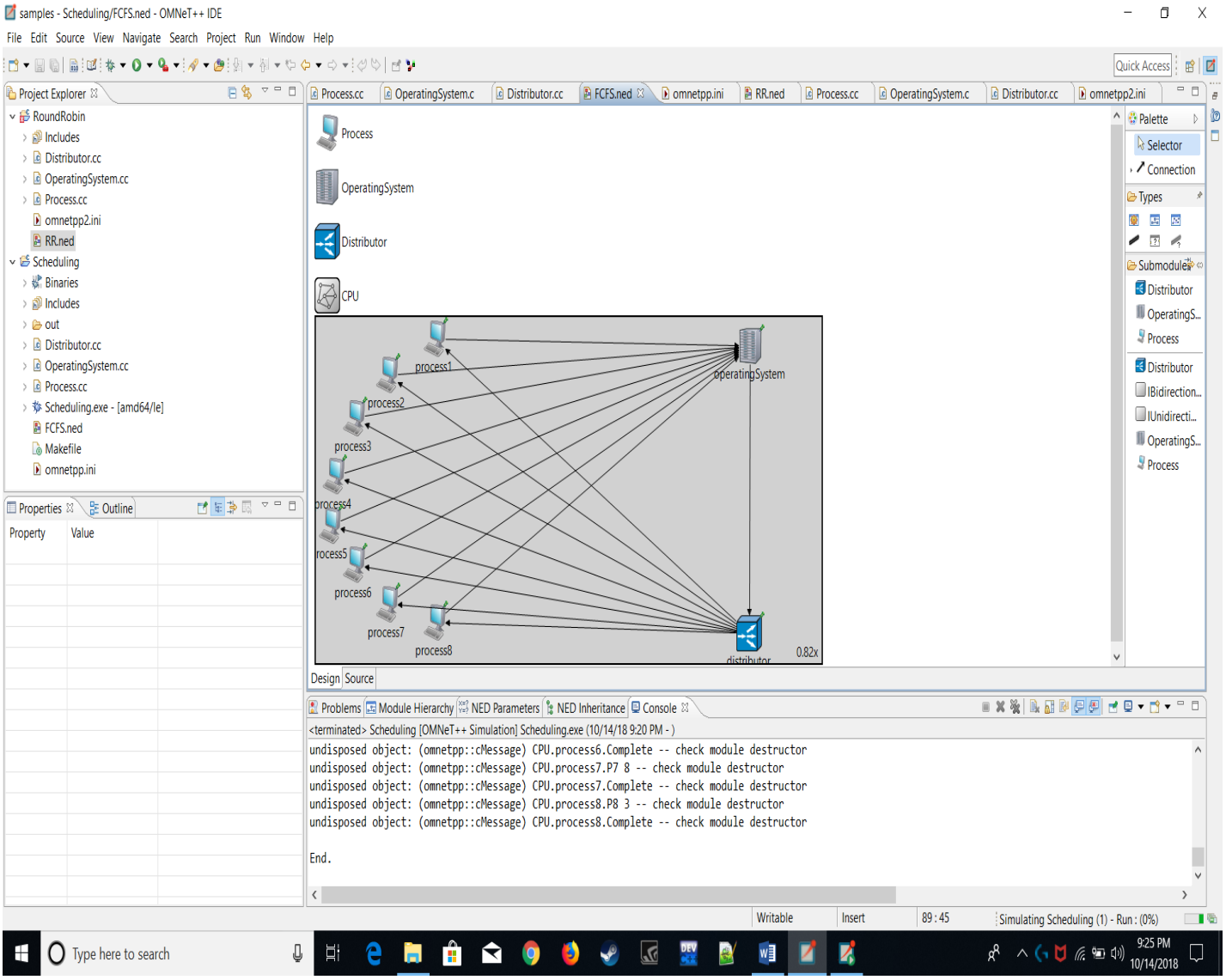
```
x+=2;
if(counter==8)
{
counter=0;
x=0;
}
}
```

FCFS.NED

```
//
// This program is free software: you can redistribute it and/or modify
// it under the terms of the GNU Lesser General Public License as published by
// the Free Software Foundation, either version 3 of the License, or
// (at your option) any later version.
//
// This program is distributed in the hope that it will be useful,
// but WITHOUT ANY WARRANTY; without even the implied warranty of
// MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
// GNU Lesser General Public License for more details.
//
// You should have received a copy of the GNU Lesser General Public License
// along with this program.  If not, see http://www.gnu.org/licenses/.
//
import ned.DelayChannel;
simple Process
{
@display("i=device/pc");
gates:
input in;
output out;
}

simple OperatingSystem
{
@display("i=device/router");
gates:
input in1;
input in2;
input in3;
input in4;
input in5;
input in6;
```

```
input in7;
input in8;
output out;
}

simple Distributor
{
@display("i=abstract/dispatcher");
gates:
 input in;
 output out1;
 output out2;
output out3;
 output out4;
 output out5;
 output out6;
 output out7;
 output out8;
}
network CPU
{
@display("bgb=969,467");
submodules:
   process1: Process{
        @display("p=228,30");
 }
 process2: Process{
        @display("p=137,78");
 }
 process3: Process{
        @display("p=74,137");
 }
 process4: Process{
        @display("p=35,215");
 }
operatingSystem: OperatingSystem{
 @display("p=832,39");
}
distributor: Distributor{
 @display("p=830,426");
}
 process5: Process{
        @display("p=27,282");
 }
 process6: Process{
        @display("p=74,334");
 }
 process7: Process{
        @display("p=137,387");
 }
 process8: Process{
        @display("p=228,412");
 }
connections:
process1.out --> DelayChannel{ delay=200ms; } --> operatingSystem.in4;
```

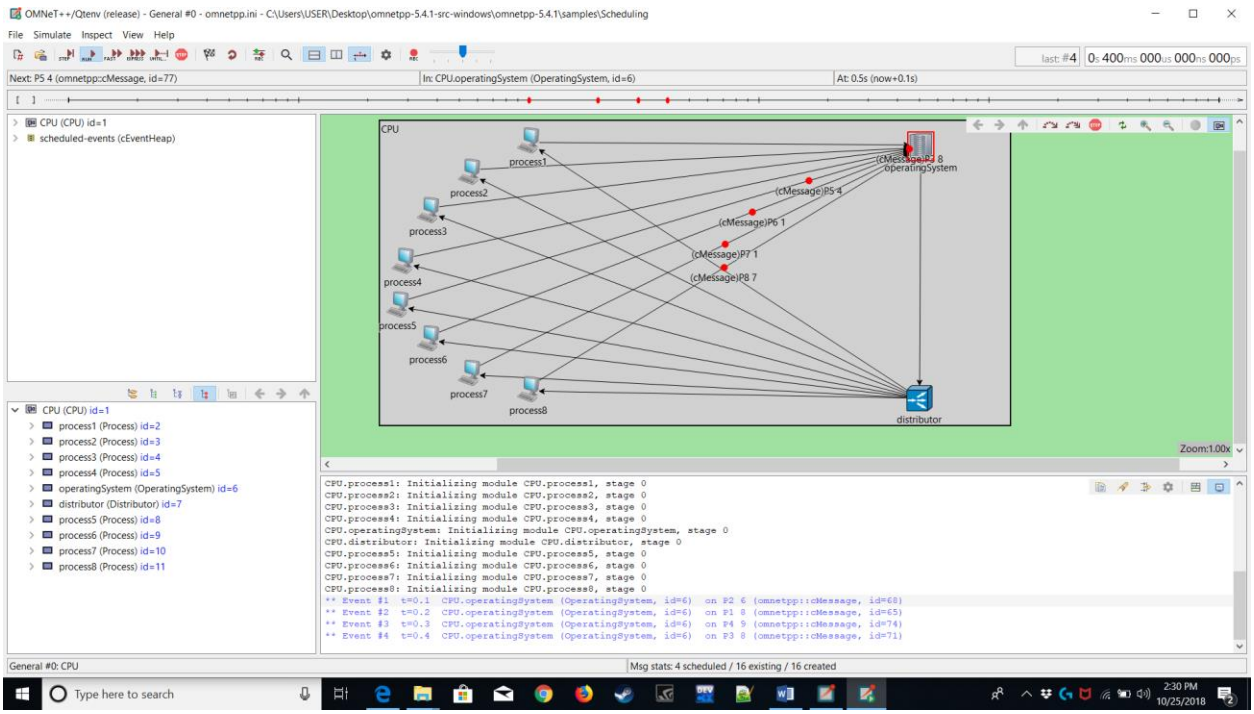
```
process2.out --> DelayChannel{ delay=100ms; } --> operatingSystem.in1;
process3.out --> DelayChannel{ delay=400ms; } --> operatingSystem.in2;
process4.out --> DelayChannel{ delay=300ms; } --> operatingSystem.in3;
process5.out --> DelayChannel{ delay=500ms; } --> operatingSystem.in5;
process6.out --> DelayChannel{ delay=600ms; } --> operatingSystem.in6;
process7.out --> DelayChannel{ delay=700ms; } --> operatingSystem.in7;
process8.out --> DelayChannel{ delay=800ms; } --> operatingSystem.in8;
operatingSystem.out --> DelayChannel --> distributor.in;
distributor.out1 --> DelayChannel --> process1.in;
distributor.out2 --> DelayChannel --> process2.in;
distributor.out3 --> DelayChannel --> process3.in;
distributor.out4 --> DelayChannel --> process4.in;
distributor.out5 --> DelayChannel --> process5.in;
distributor.out6 --> DelayChannel --> process6.in;
distributor.out7 --> DelayChannel --> process7.in;
distributor.out8 --> DelayChannel --> process8.in;
}
```

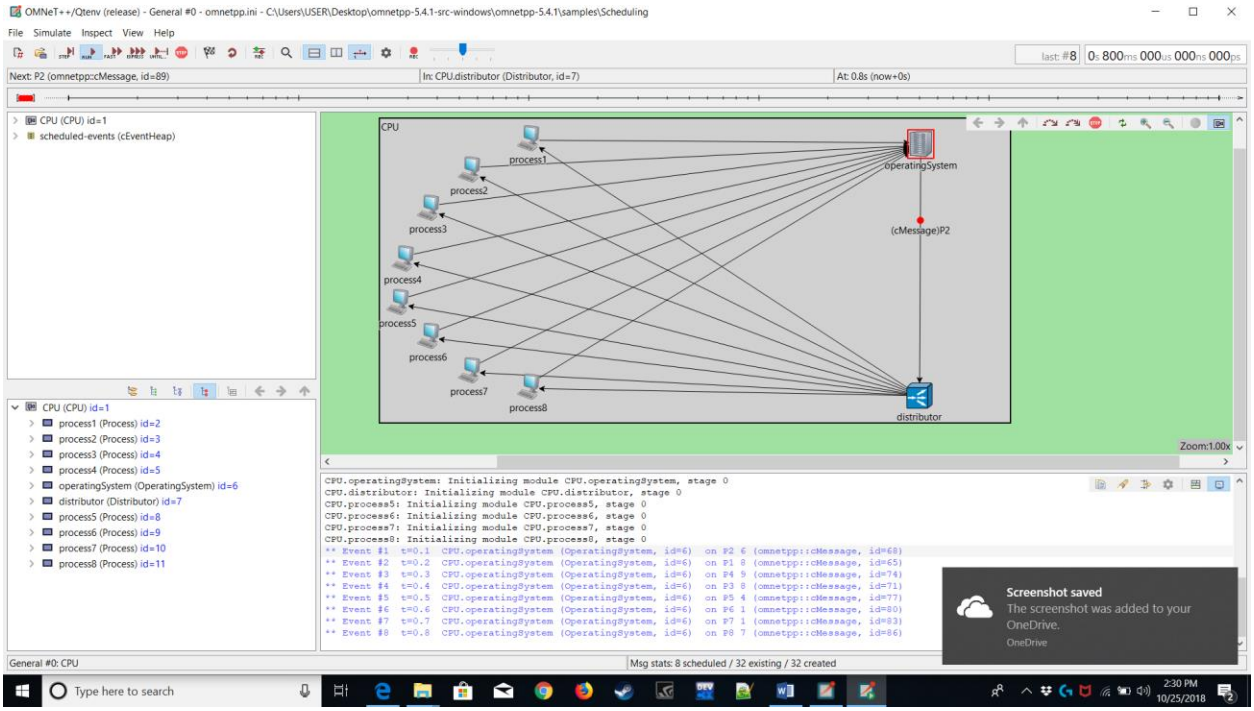


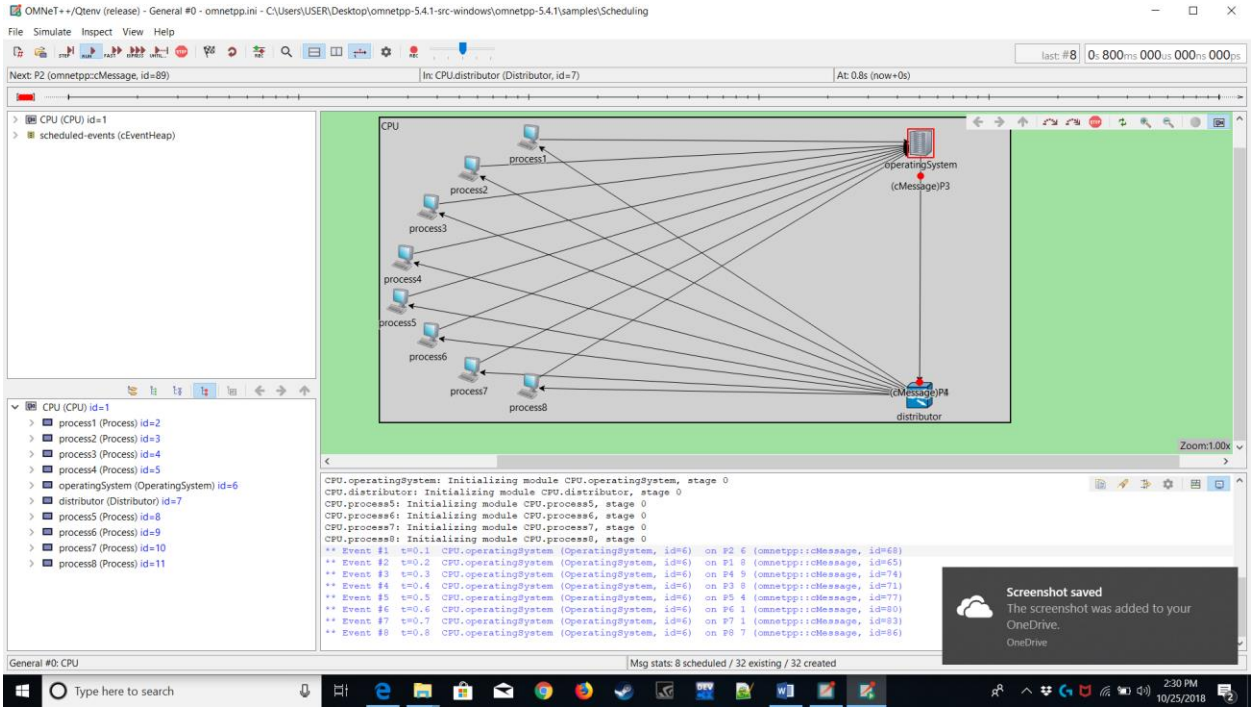
Initialization file:

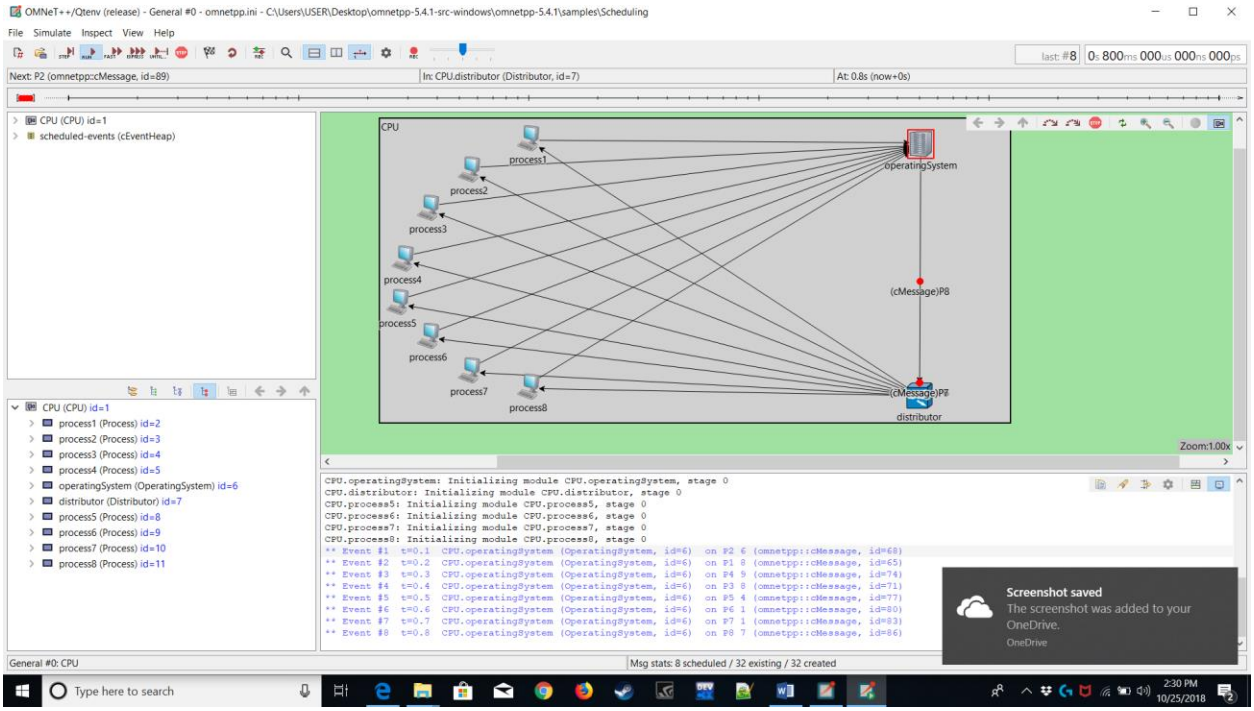
```
[General]
network =CPU
```

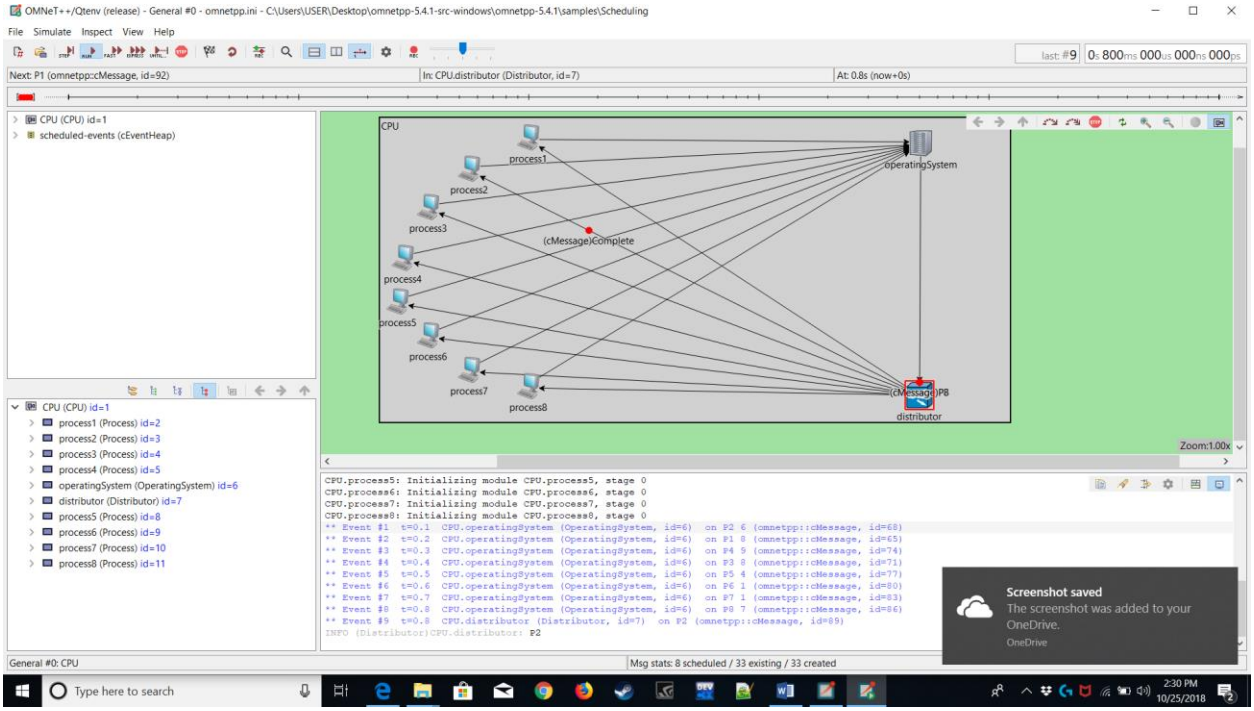
Screenshots of running simulation:

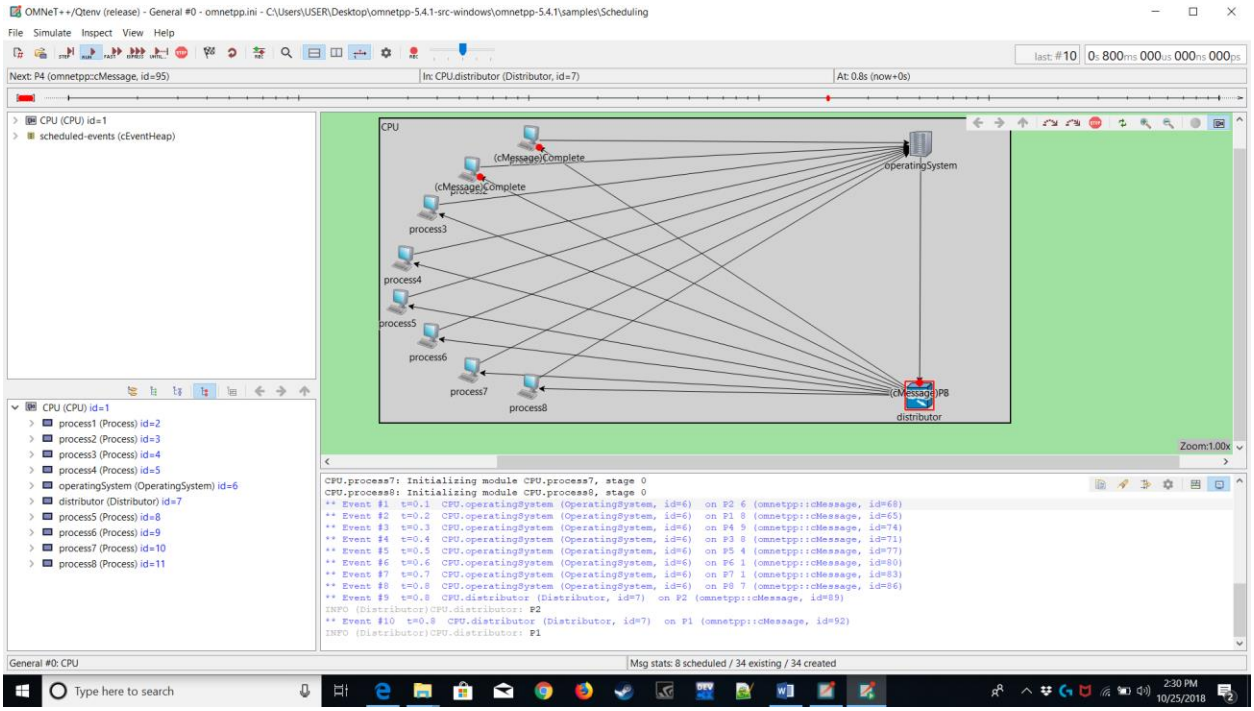


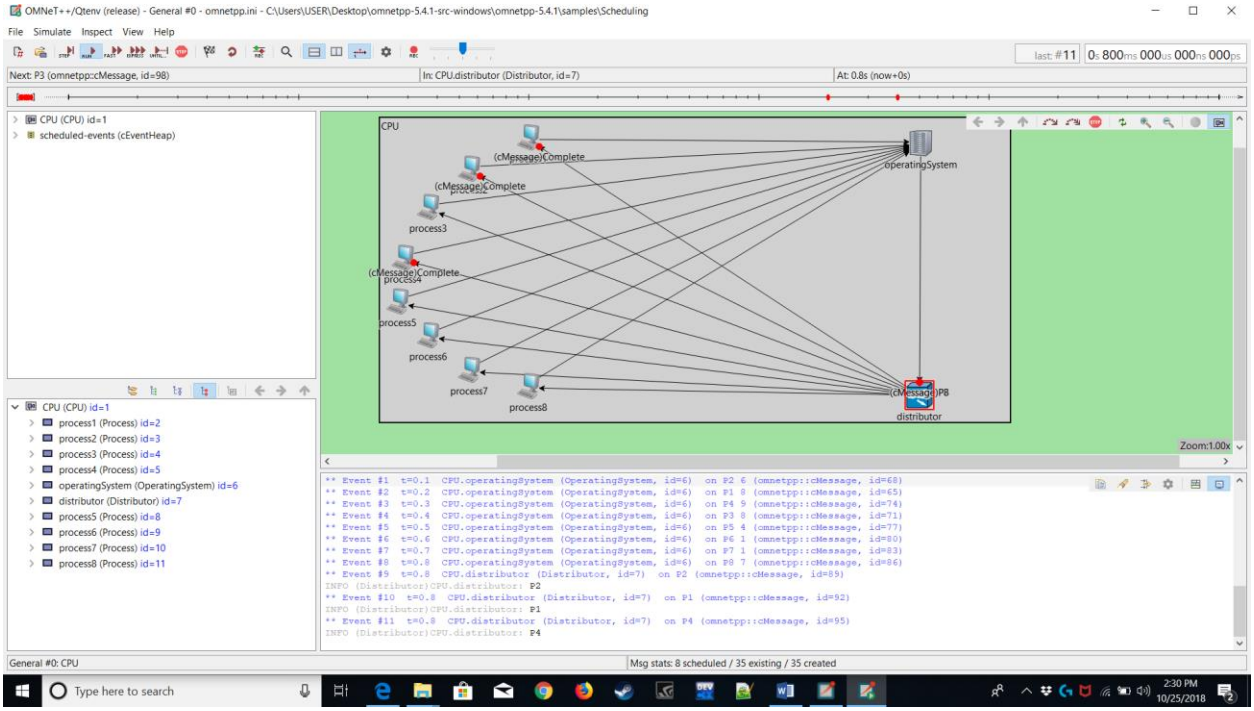

OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Scheduling
File Simulate Inspect View Help
Next: P2 (omnetpp::cMessage, id=89)
In: CPU.distributor (Distributor, id=7)
At: 0.8s (now+0s)
CPU (CPU) id=1
scheduled-events (cEventHeap)
CPU
process1
process2
process3
process4
process5
process6
process7
process8
operatingSystem
(cMessage)P2
distributor
Zoom:1.00x
CPU.operatingSystem: Initializing module CPU.operatingSystem, stage 0
CPU.distributor: Initializing module CPU.distributor, stage 0
CPU.process5: Initializing module CPU.process5, stage 0
CPU.process6: Initializing module CPU.process6, stage 0
CPU.process7: Initializing module CPU.process7, stage 0
CPU.process8: Initializing module CPU.process8, stage 0
** Event #1 t=0.1 CPU.operatingSystem (OperatingSystem, id=6) on P2 6 (omnetpp::cMessage, id=68)
** Event #2 t=0.2 CPU.operatingSystem (OperatingSystem, id=6) on P1 8 (omnetpp::cMessage, id=65)
** Event #3 t=0.3 CPU.operatingSystem (OperatingSystem, id=6) on P4 9 (omnetpp::cMessage, id=74)
** Event #4 t=0.4 CPU.operatingSystem (OperatingSystem, id=6) on P3 8 (omnetpp::cMessage, id=71)
** Event #5 t=0.5 CPU.operatingSystem (OperatingSystem, id=6) on P5 4 (omnetpp::cMessage, id=77)
** Event #6 t=0.6 CPU.operatingSystem (OperatingSystem, id=6) on P6 1 (omnetpp::cMessage, id=80)
** Event #7 t=0.7 CPU.operatingSystem (OperatingSystem, id=6) on P7 1 (omnetpp::cMessage, id=83)
** Event #8 t=0.8 CPU.operatingSystem (OperatingSystem, id=6) on P8 7 (omnetpp::cMessage, id=86)
Screenshot saved
The screenshot was added to your OneDrive.
OneDrive
General #0: CPU
Msg stats: 8 scheduled / 32 existing / 32 created
Type here to search
2:30 PM
10/25/2018

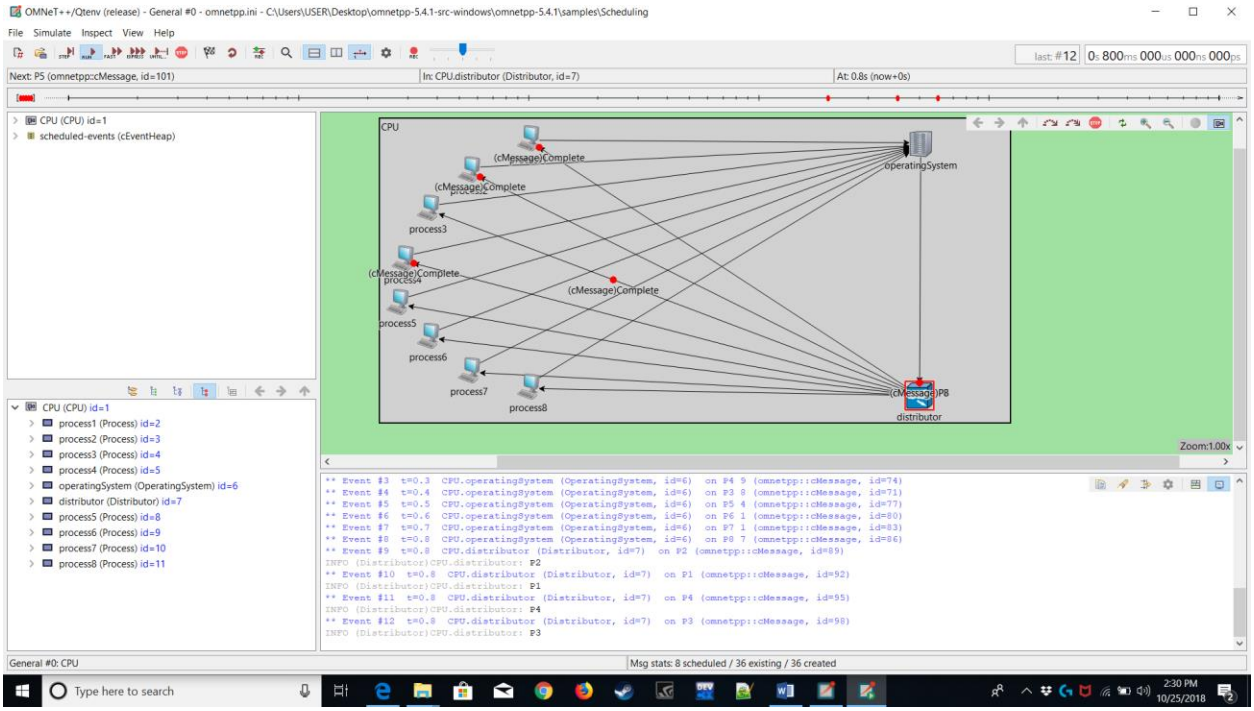

OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Scheduling
File Simulate Inspect View Help
Next: P2 (omnetpp::cMessage, id=89)
In: CPU.distributor (Distributor, id=7)
At: 0.8s (now+0s)
CPU (CPU) id=1
scheduled-events (cEventHeap)
CPU
process1
process2
process3
process4
process5
process6
process7
process8
operatingSystem
(cMessage)P3
(cMessage)P4
distributor
Zoom:1.00x
CPU.operatingSystem: Initializing module CPU.operatingSystem, stage 0
CPU.distributor: Initializing module CPU.distributor, stage 0
CPU.process5: Initializing module CPU.process5, stage 0
CPU.process6: Initializing module CPU.process6, stage 0
CPU.process7: Initializing module CPU.process7, stage 0
CPU.process8: Initializing module CPU.process8, stage 0
** Event #1 t=0.1 CPU.operatingSystem (OperatingSystem, id=6) on P2 6 (omnetpp::cMessage, id=68)
** Event #2 t=0.2 CPU.operatingSystem (OperatingSystem, id=6) on P1 8 (omnetpp::cMessage, id=65)
** Event #3 t=0.3 CPU.operatingSystem (OperatingSystem, id=6) on P4 9 (omnetpp::cMessage, id=74)
** Event #4 t=0.4 CPU.operatingSystem (OperatingSystem, id=6) on P3 8 (omnetpp::cMessage, id=71)
** Event #5 t=0.5 CPU.operatingSystem (OperatingSystem, id=6) on P5 4 (omnetpp::cMessage, id=77)
** Event #6 t=0.6 CPU.operatingSystem (OperatingSystem, id=6) on P6 1 (omnetpp::cMessage, id=80)
** Event #7 t=0.7 CPU.operatingSystem (OperatingSystem, id=6) on P7 1 (omnetpp::cMessage, id=83)
** Event #8 t=0.8 CPU.operatingSystem (OperatingSystem, id=6) on P8 7 (omnetpp::cMessage, id=86)
Screenshot saved
The screenshot was added to your OneDrive.
OneDrive
General #0: CPU
Msg stats: 8 scheduled / 32 existing / 32 created
Type here to search
2:30 PM
10/25/2018

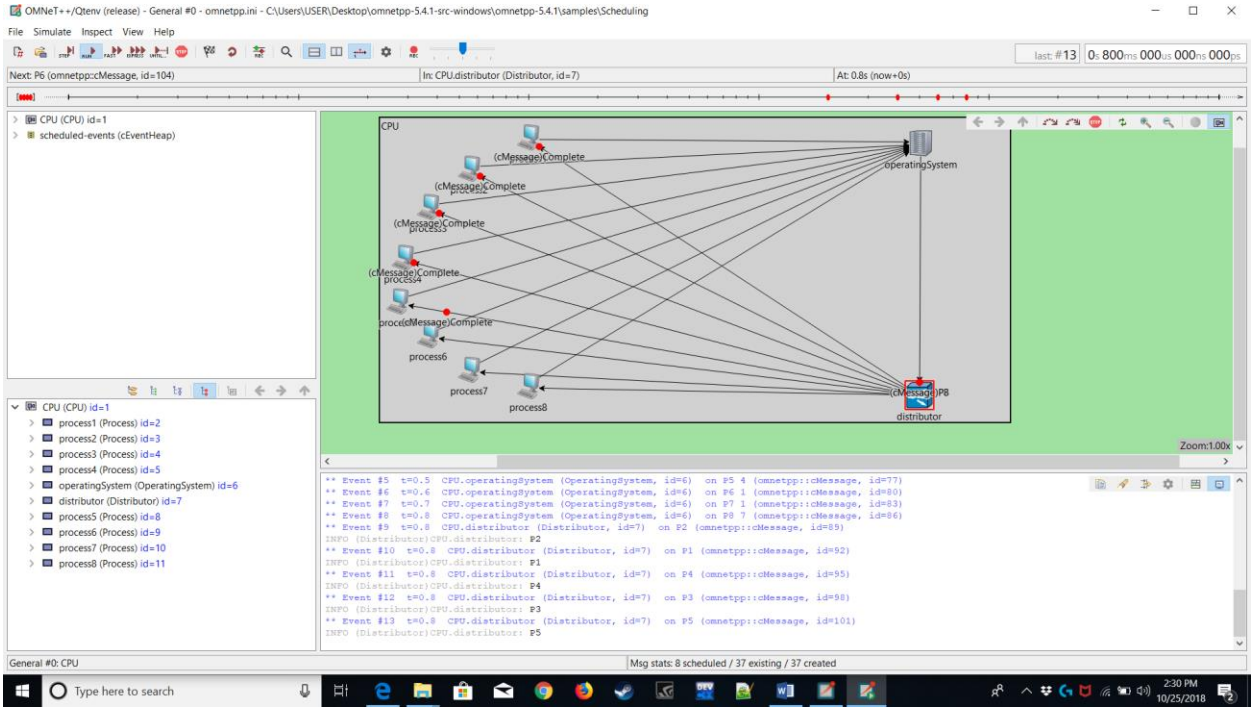

OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Scheduling
File Simulate Inspect View Help
Next: P2 (omnetpp::cMessage, id=89)
In: CPU.distributor (Distributor, id=7)
At: 0.8s (now+0s)
last: #8
CPU (CPU) id=1
scheduled-events (cEventHeap)
CPU
process1
process2
process3
process4
process5
process6
process7
process8
operatingSystem
(cMessage)P8
distributor
Zoom:1.00x
CPU.operatingSystem: Initializing module CPU.operatingSystem, stage 0
CPU.distributor: Initializing module CPU.distributor, stage 0
CPU.process5: Initializing module CPU.process5, stage 0
CPU.process6: Initializing module CPU.process6, stage 0
CPU.process7: Initializing module CPU.process7, stage 0
CPU.process8: Initializing module CPU.process8, stage 0
** Event #1 t=0.1 CPU.operatingSystem (OperatingSystem, id=6) on P2 6 (omnetpp::cMessage, id=68)
** Event #2 t=0.2 CPU.operatingSystem (OperatingSystem, id=6) on P1 8 (omnetpp::cMessage, id=65)
** Event #3 t=0.3 CPU.operatingSystem (OperatingSystem, id=6) on P4 9 (omnetpp::cMessage, id=74)
** Event #4 t=0.4 CPU.operatingSystem (OperatingSystem, id=6) on P3 8 (omnetpp::cMessage, id=71)
** Event #5 t=0.5 CPU.operatingSystem (OperatingSystem, id=6) on P5 4 (omnetpp::cMessage, id=77)
** Event #6 t=0.6 CPU.operatingSystem (OperatingSystem, id=6) on P6 1 (omnetpp::cMessage, id=80)
** Event #7 t=0.7 CPU.operatingSystem (OperatingSystem, id=6) on P7 1 (omnetpp::cMessage, id=83)
** Event #8 t=0.8 CPU.operatingSystem (OperatingSystem, id=6) on P8 7 (omnetpp::cMessage, id=86)
Screenshot saved
The screenshot was added to your OneDrive.
OneDrive
General #0: CPU
Msg stats: 8 scheduled / 32 existing / 32 created
Type here to search
2:30 PM
10/25/2018

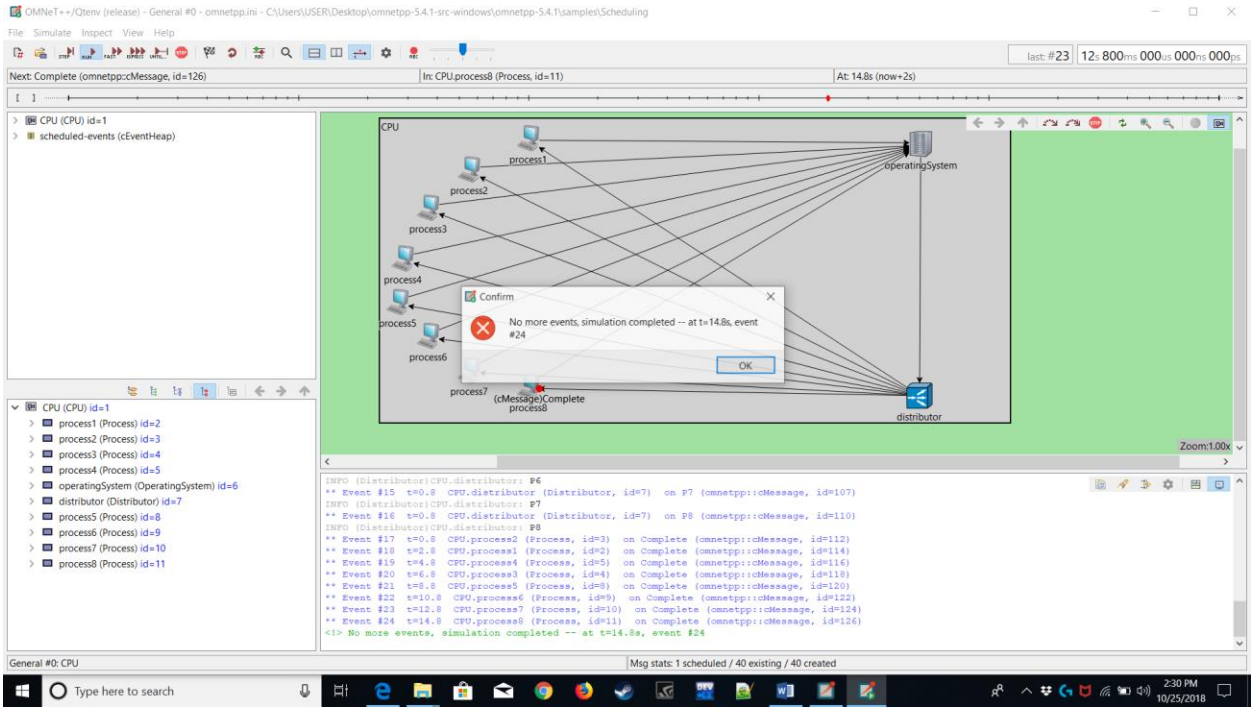

OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Scheduling
File Simulate Inspect View Help
Next: P1 (omnetpp::cMessage, id=92)
In: CPU.distributor (Distributor, id=7)
At: 0.8s (now+0s)
last: #9
CPU (CPU) id=1
scheduled-events (cEventHeap)
CPU
process1
process2
process3
(cMessage)Complete
process4
process5
process6
process7
process8
operatingSystem
(cMessage)P8
distributor
Zoom:1.00x
CPU.process5: Initializing module CPU.process5, stage 0
CPU.process6: Initializing module CPU.process6, stage 0
CPU.process7: Initializing module CPU.process7, stage 0
CPU.process8: Initializing module CPU.process8, stage 0
** Event #1 t=0.1 CPU.operatingSystem (OperatingSystem, id=6) on P2 6 (omnetpp::cMessage, id=68)
** Event #2 t=0.2 CPU.operatingSystem (OperatingSystem, id=6) on P1 8 (omnetpp::cMessage, id=65)
** Event #3 t=0.3 CPU.operatingSystem (OperatingSystem, id=6) on P4 9 (omnetpp::cMessage, id=74)
** Event #4 t=0.4 CPU.operatingSystem (OperatingSystem, id=6) on P3 8 (omnetpp::cMessage, id=71)
** Event #5 t=0.5 CPU.operatingSystem (OperatingSystem, id=6) on P5 4 (omnetpp::cMessage, id=77)
** Event #6 t=0.6 CPU.operatingSystem (OperatingSystem, id=6) on P6 1 (omnetpp::cMessage, id=80)
** Event #7 t=0.7 CPU.operatingSystem (OperatingSystem, id=6) on P7 1 (omnetpp::cMessage, id=83)
** Event #8 t=0.8 CPU.operatingSystem (OperatingSystem, id=6) on P8 7 (omnetpp::cMessage, id=86)
** Event #9 t=0.8 CPU.distributor (Distributor, id=7) on P2 (omnetpp::cMessage, id=89)
INFO (Distributor)CPU.distributor: P2
Screenshot saved
The screenshot was added to your OneDrive.
OneDrive
General #0: CPU
Msg stats: 8 scheduled / 33 existing / 33 created
Type here to search
2:30 PM
10/25/2018

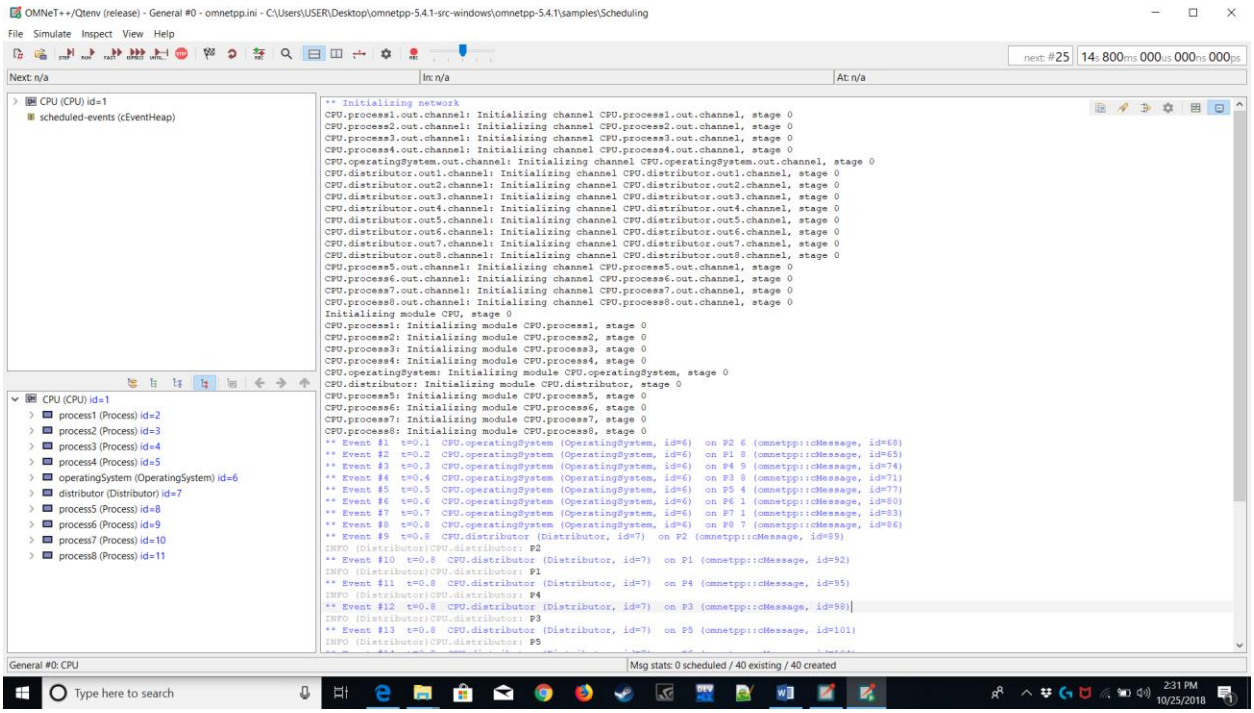

OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Scheduling
File Simulate Inspect View Help
Next: P4 (omnetpp:cMessage, id=95)
In: CPU.distributor (Distributor, id=7)
At: 0.8s (now+0s)
last: #10
0s 800ms 000us 000ns 000ps
CPU (CPU) id=1
scheduled-events (cEventHeap)
CPU
(cMessage)Complete
operatingSystem
process3
process4
process5
process6
process7
process8
(cMessage)PB
distributor
Zoom:1.00x
CPU (CPU) id=1
process1 (Process) id=2
process2 (Process) id=3
process3 (Process) id=4
process4 (Process) id=5
operatingSystem (OperatingSystem) id=6
distributor (Distributor) id=7
process5 (Process) id=8
process6 (Process) id=9
process7 (Process) id=10
process8 (Process) id=11
CPU.process7: Initializing module CPU.process7, stage 0
CPU.process8: Initializing module CPU.process8, stage 0
** Event #1 t=0.1 CPU.operatingSystem (OperatingSystem, id=6) on P2 6 (omnetpp::cMessage, id=68)
** Event #2 t=0.2 CPU.operatingSystem (OperatingSystem, id=6) on P1 8 (omnetpp::cMessage, id=65)
** Event #3 t=0.3 CPU.operatingSystem (OperatingSystem, id=6) on P4 9 (omnetpp::cMessage, id=74)
** Event #4 t=0.4 CPU.operatingSystem (OperatingSystem, id=6) on P3 8 (omnetpp::cMessage, id=71)
** Event #5 t=0.5 CPU.operatingSystem (OperatingSystem, id=6) on P5 4 (omnetpp::cMessage, id=77)
** Event #6 t=0.6 CPU.operatingSystem (OperatingSystem, id=6) on P6 1 (omnetpp::cMessage, id=80)
** Event #7 t=0.7 CPU.operatingSystem (OperatingSystem, id=6) on P7 1 (omnetpp::cMessage, id=83)
** Event #8 t=0.8 CPU.operatingSystem (OperatingSystem, id=6) on P8 7 (omnetpp::cMessage, id=86)
** Event #9 t=0.8 CPU.distributor (Distributor, id=7) on P2 (omnetpp::cMessage, id=89)
INFO (Distributor)CPU.distributor: P2
** Event #10 t=0.8 CPU.distributor (Distributor, id=7) on P1 (omnetpp::cMessage, id=92)
INFO (Distributor)CPU.distributor: P1
General #0: CPU
Msg stats: 8 scheduled / 34 existing / 34 created
Type here to search
2:30 PM
10/25/2018

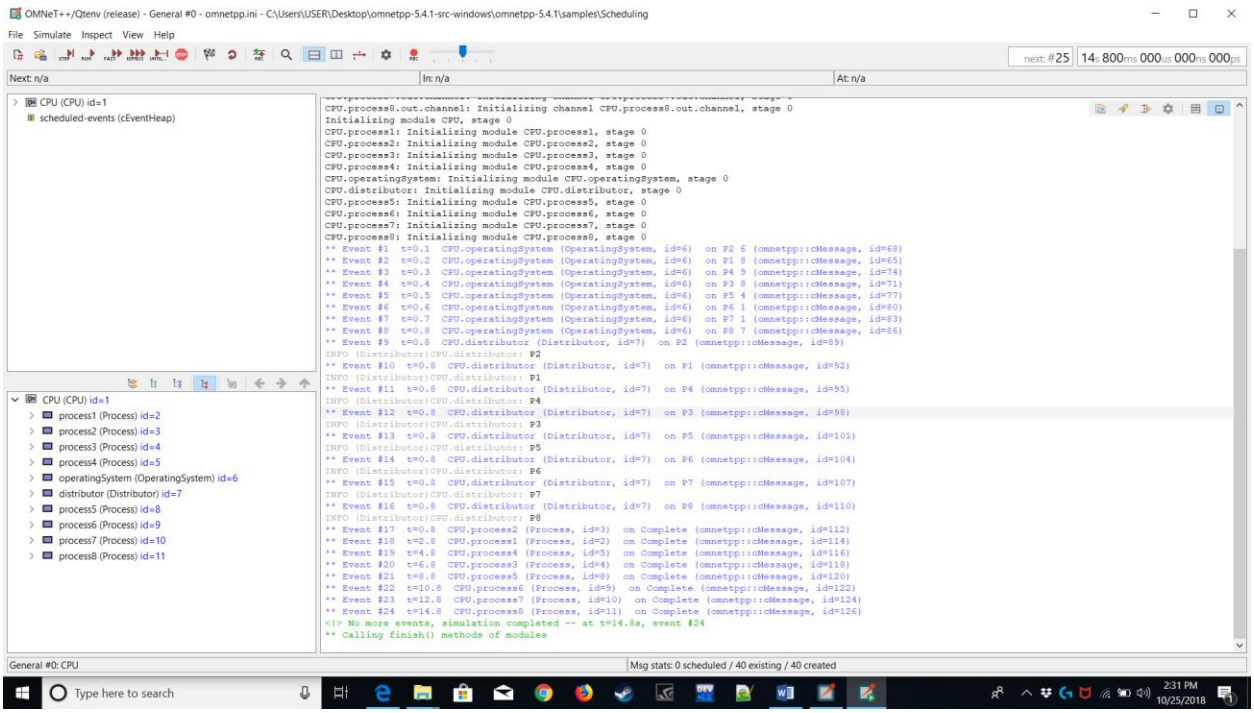

OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Scheduling
File Simulate Inspect View Help
Next: P3 (omnetpp:cMessage, id=98)
In: CPU.distributor (Distributor, id=7)
At: 0.8s (now+0s)
last: #11
0s 800ms 000us 000ns 000ps
CPU (CPU) id=1
scheduled-events (cEventHeap)
CPU
(cMessage)Complete
operatingSystem
process3
process4
process5
process6
process7
process8
(cMessage)PB
distributor
Zoom:1.00x
CPU (CPU) id=1
process1 (Process) id=2
process2 (Process) id=3
process3 (Process) id=4
process4 (Process) id=5
operatingSystem (OperatingSystem) id=6
distributor (Distributor) id=7
process5 (Process) id=8
process6 (Process) id=9
process7 (Process) id=10
process8 (Process) id=11
** Event #1 t=0.1 CPU.operatingSystem (OperatingSystem, id=6) on P2 6 (omnetpp::cMessage, id=68)
** Event #2 t=0.2 CPU.operatingSystem (OperatingSystem, id=6) on P1 8 (omnetpp::cMessage, id=65)
** Event #3 t=0.3 CPU.operatingSystem (OperatingSystem, id=6) on P4 9 (omnetpp::cMessage, id=74)
** Event #4 t=0.4 CPU.operatingSystem (OperatingSystem, id=6) on P3 8 (omnetpp::cMessage, id=71)
** Event #5 t=0.5 CPU.operatingSystem (OperatingSystem, id=6) on P5 4 (omnetpp::cMessage, id=77)
** Event #6 t=0.6 CPU.operatingSystem (OperatingSystem, id=6) on P6 1 (omnetpp::cMessage, id=80)
** Event #7 t=0.7 CPU.operatingSystem (OperatingSystem, id=6) on P7 1 (omnetpp::cMessage, id=83)
** Event #8 t=0.8 CPU.operatingSystem (OperatingSystem, id=6) on P8 7 (omnetpp::cMessage, id=86)
** Event #9 t=0.8 CPU.distributor (Distributor, id=7) on P2 (omnetpp::cMessage, id=89)
INFO (Distributor)CPU.distributor: P2
** Event #10 t=0.8 CPU.distributor (Distributor, id=7) on P1 (omnetpp::cMessage, id=92)
INFO (Distributor)CPU.distributor: P1
** Event #11 t=0.8 CPU.distributor (Distributor, id=7) on P4 (omnetpp::cMessage, id=95)
INFO (Distributor)CPU.distributor: P4
General #0: CPU
Msg stats: 8 scheduled / 35 existing / 35 created
Type here to search
2:30 PM
10/25/2018


OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Scheduling
File Simulate Inspect View Help
Next: P5 (omnetpp::cMessage, id=101)
In: CPU.distributor (Distributor, id=7)
At: 0.8s (now+0s)
last: #12
0s 800ms 000us 000ns 000ps
CPU (CPU) id=1
scheduled-events (cEventHeap)
CPU
operatingSystem
process3
process5
process6
process7
process8
distributor
(cMessage)P8
Zoom:1.00x
** Event #3 t=0.3 CPU.operatingSystem (OperatingSystem, id=6) on P4 9 (omnetpp::cMessage, id=74)
** Event #4 t=0.4 CPU.operatingSystem (OperatingSystem, id=6) on P3 8 (omnetpp::cMessage, id=71)
** Event #5 t=0.5 CPU.operatingSystem (OperatingSystem, id=6) on P5 4 (omnetpp::cMessage, id=77)
** Event #6 t=0.6 CPU.operatingSystem (OperatingSystem, id=6) on P6 1 (omnetpp::cMessage, id=80)
** Event #7 t=0.7 CPU.operatingSystem (OperatingSystem, id=6) on P7 1 (omnetpp::cMessage, id=83)
** Event #8 t=0.8 CPU.operatingSystem (OperatingSystem, id=6) on P8 7 (omnetpp::cMessage, id=86)
** Event #9 t=0.8 CPU.distributor (Distributor, id=7) on P2 (omnetpp::cMessage, id=89)
INFO (Distributor)CPU.distributor: P2
** Event #10 t=0.8 CPU.distributor (Distributor, id=7) on P1 (omnetpp::cMessage, id=92)
INFO (Distributor)CPU.distributor: P1
** Event #11 t=0.8 CPU.distributor (Distributor, id=7) on P4 (omnetpp::cMessage, id=95)
INFO (Distributor)CPU.distributor: P4
** Event #12 t=0.8 CPU.distributor (Distributor, id=7) on P3 (omnetpp::cMessage, id=98)
INFO (Distributor)CPU.distributor: P3
CPU (CPU) id=1
process1 (Process) id=2
process2 (Process) id=3
process3 (Process) id=4
process4 (Process) id=5
operatingSystem (OperatingSystem) id=6
distributor (Distributor) id=7
process5 (Process) id=8
process6 (Process) id=9
process7 (Process) id=10
process8 (Process) id=11
General #0: CPU
Msg stats: 8 scheduled / 36 existing / 36 created
Type here to search
2:30 PM
10/25/2018


OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Scheduling
File Simulate Inspect View Help
Next: P6 (omnetpp::cMessage, id=104)
In: CPU.distributor (Distributor, id=7)
At: 0.8s (now+0s)
last: #13
0s 800ms 000us 000ns 000ps
CPU (CPU) id=1
scheduled-events (cEventHeap)
CPU
operatingSystem
process3
process5
process6
process7
process8
distributor
(cMessage)P8
Zoom:1.00x
** Event #5 t=0.5 CPU.operatingSystem (OperatingSystem, id=6) on P5 4 (omnetpp::cMessage, id=77)
** Event #6 t=0.6 CPU.operatingSystem (OperatingSystem, id=6) on P6 1 (omnetpp::cMessage, id=80)
** Event #7 t=0.7 CPU.operatingSystem (OperatingSystem, id=6) on P7 1 (omnetpp::cMessage, id=83)
** Event #8 t=0.8 CPU.operatingSystem (OperatingSystem, id=6) on P8 7 (omnetpp::cMessage, id=86)
** Event #9 t=0.8 CPU.distributor (Distributor, id=7) on P2 (omnetpp::cMessage, id=89)
INFO (Distributor)CPU.distributor: P2
** Event #10 t=0.8 CPU.distributor (Distributor, id=7) on P1 (omnetpp::cMessage, id=92)
INFO (Distributor)CPU.distributor: P1
** Event #11 t=0.8 CPU.distributor (Distributor, id=7) on P4 (omnetpp::cMessage, id=95)
INFO (Distributor)CPU.distributor: P4
** Event #12 t=0.8 CPU.distributor (Distributor, id=7) on P3 (omnetpp::cMessage, id=98)
INFO (Distributor)CPU.distributor: P3
** Event #13 t=0.8 CPU.distributor (Distributor, id=7) on P5 (omnetpp::cMessage, id=101)
INFO (Distributor)CPU.distributor: P5
CPU (CPU) id=1
process1 (Process) id=2
process2 (Process) id=3
process3 (Process) id=4
process4 (Process) id=5
operatingSystem (OperatingSystem) id=6
distributor (Distributor) id=7
process5 (Process) id=8
process6 (Process) id=9
process7 (Process) id=10
process8 (Process) id=11
General #0: CPU
Msg stats: 8 scheduled / 37 existing / 37 created
Type here to search
2:30 PM
10/25/2018


OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Scheduling
File Simulate Inspect View Help
Next: Complete (omnetpp::cMessage, id=126)
In: CPU.process8 (Process, id=11)
At: 14.8s (now+2s)
CPU (CPU) id=1
scheduled-events (cEventHeap)
CPU
process1
process2
process3
process4
process5
process6
process7
process8
operatingSystem
distributor
(cMessage)Complete
Confirm
No more events, simulation completed -- at t=14.8s, event #24
OK
Zoom:1.00x
CPU (CPU) id=1
process1 (Process) id=2
process2 (Process) id=3
process3 (Process) id=4
process4 (Process) id=5
operatingSystem (OperatingSystem) id=6
distributor (Distributor) id=7
process5 (Process) id=8
process6 (Process) id=9
process7 (Process) id=10
process8 (Process) id=11
** Event #15 t=0.8 CPU.distributor (Distributor, id=7) on P7 (omnetpp::cMessage, id=107)
** Event #16 t=0.8 CPU.distributor (Distributor, id=7) on P8 (omnetpp::cMessage, id=110)
** Event #17 t=0.8 CPU.process2 (Process, id=3) on Complete (omnetpp::cMessage, id=112)
** Event #18 t=2.8 CPU.process1 (Process, id=2) on Complete (omnetpp::cMessage, id=114)
** Event #19 t=4.8 CPU.process4 (Process, id=5) on Complete (omnetpp::cMessage, id=116)
** Event #20 t=6.8 CPU.process3 (Process, id=4) on Complete (omnetpp::cMessage, id=118)
** Event #21 t=8.8 CPU.process5 (Process, id=8) on Complete (omnetpp::cMessage, id=120)
** Event #22 t=10.8 CPU.process6 (Process, id=9) on Complete (omnetpp::cMessage, id=122)
** Event #23 t=12.8 CPU.process7 (Process, id=10) on Complete (omnetpp::cMessage, id=124)
** Event #24 t=14.8 CPU.process8 (Process, id=11) on Complete (omnetpp::cMessage, id=126)
<!> No more events, simulation completed -- at t=14.8s, event #24
General #0: CPU
Msg stats: 1 scheduled / 40 existing / 40 created
Type here to search
2:30 PM
10/25/2018


OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Scheduling
File Simulate Inspect View Help
Next: n/a
In: n/a
At: n/a
CPU (CPU) id=1
scheduled-events (cEventHeap)
process1 (Process) id=2
process2 (Process) id=3
process3 (Process) id=4
process4 (Process) id=5
operatingSystem (OperatingSystem) id=6
distributor (Distributor) id=7
process5 (Process) id=8
process6 (Process) id=9
process7 (Process) id=10
process8 (Process) id=11
** Initializing network
CPU.process1.out.channel: Initializing channel CPU.process1.out.channel, stage 0
CPU.process2.out.channel: Initializing channel CPU.process2.out.channel, stage 0
CPU.process3.out.channel: Initializing channel CPU.process3.out.channel, stage 0
CPU.process4.out.channel: Initializing channel CPU.process4.out.channel, stage 0
CPU.operatingSystem.out.channel: Initializing channel CPU.operatingSystem.out.channel, stage 0
CPU.distributor.out1.channel: Initializing channel CPU.distributor.out1.channel, stage 0
CPU.distributor.out2.channel: Initializing channel CPU.distributor.out2.channel, stage 0
CPU.distributor.out3.channel: Initializing channel CPU.distributor.out3.channel, stage 0
CPU.distributor.out4.channel: Initializing channel CPU.distributor.out4.channel, stage 0
CPU.distributor.out5.channel: Initializing channel CPU.distributor.out5.channel, stage 0
CPU.distributor.out6.channel: Initializing channel CPU.distributor.out6.channel, stage 0
CPU.distributor.out7.channel: Initializing channel CPU.distributor.out7.channel, stage 0
CPU.distributor.out8.channel: Initializing channel CPU.distributor.out8.channel, stage 0
CPU.process5.out.channel: Initializing channel CPU.process5.out.channel, stage 0
CPU.process6.out.channel: Initializing channel CPU.process6.out.channel, stage 0
CPU.process7.out.channel: Initializing channel CPU.process7.out.channel, stage 0
CPU.process8.out.channel: Initializing channel CPU.process8.out.channel, stage 0
Initializing module CPU, stage 0
CPU.process1: Initializing module CPU.process1, stage 0
CPU.process2: Initializing module CPU.process2, stage 0
CPU.process3: Initializing module CPU.process3, stage 0
CPU.process4: Initializing module CPU.process4, stage 0
CPU.operatingSystem: Initializing module CPU.operatingSystem, stage 0
CPU.distributor: Initializing module CPU.distributor, stage 0
CPU.process5: Initializing module CPU.process5, stage 0
CPU.process6: Initializing module CPU.process6, stage 0
CPU.process7: Initializing module CPU.process7, stage 0
CPU.process8: Initializing module CPU.process8, stage 0
** Event #1 t=0.1 CPU.operatingSystem (OperatingSystem, id=6) on P2 6 (omnetpp::cMessage, id=68)
** Event #2 t=0.2 CPU.operatingSystem (OperatingSystem, id=6) on P1 8 (omnetpp::cMessage, id=65)
** Event #3 t=0.3 CPU.operatingSystem (OperatingSystem, id=6) on P4 9 (omnetpp::cMessage, id=74)
** Event #4 t=0.4 CPU.operatingSystem (OperatingSystem, id=6) on P3 8 (omnetpp::cMessage, id=71)
** Event #5 t=0.5 CPU.operatingSystem (OperatingSystem, id=6) on P5 4 (omnetpp::cMessage, id=77)
** Event #6 t=0.6 CPU.operatingSystem (OperatingSystem, id=6) on P6 1 (omnetpp::cMessage, id=80)
** Event #7 t=0.7 CPU.operatingSystem (OperatingSystem, id=6) on P7 1 (omnetpp::cMessage, id=83)
** Event #8 t=0.8 CPU.operatingSystem (OperatingSystem, id=6) on P8 7 (omnetpp::cMessage, id=86)
** Event #9 t=0.8 CPU.distributor (Distributor, id=7) on P2 (omnetpp::cMessage, id=89)
INFO (Distributor)CPU.distributor: P2
** Event #10 t=0.8 CPU.distributor (Distributor, id=7) on P1 (omnetpp::cMessage, id=92)
INFO (Distributor)CPU.distributor: P1
** Event #11 t=0.8 CPU.distributor (Distributor, id=7) on P4 (omnetpp::cMessage, id=95)
INFO (Distributor)CPU.distributor: P4
** Event #12 t=0.8 CPU.distributor (Distributor, id=7) on P3 (omnetpp::cMessage, id=98)
INFO (Distributor)CPU.distributor: P3
** Event #13 t=0.8 CPU.distributor (Distributor, id=7) on P5 (omnetpp::cMessage, id=101)
INFO (Distributor)CPU.distributor: P5
General #0: CPU
Msg stats: 0 scheduled / 40 existing / 40 created
Type here to search
2:31 PM
10/25/2018



SHORTEST REMAINING TIME FIRST SCHEDULING ALGORITHM:

C++ Files:

Process module:

```
/*
 * SRTF_Process.cc
 *
 *  Created on: Oct 28, 2018
 *      Author: USER
 */

#include<string.h>
#include<string>
#include<omnetpp.h>
#include<cstring>

using namespace omnetpp;
```

```
class SRTF_Process : public cSimpleModule {
protected:
    virtual void initialize() override;
    virtual void handleMessage(cMessage *msg) override;
};

Define_Module(SRTF_Process);

void SRTF_Process::initialize()
{
    int range = 9 - 1 + 1;
    int num = rand() % range + 1;
    char message[20];
    sprintf(message, "P%c %d",getName()[7],num);
    cMessage *msg= new cMessage(message);
    cMessage *copy=(cMessage *)msg->dup();
    send(copy,"out");
}

void SRT_Process::handleMessage(cMessage *msg)
{

}
```

Distributor module:

```
/*
 * SRTF_Distributor.cc
 *
 *  Created on: Oct 28, 2018
 *      Author: USER
 */

#include<string.h>
#include<string>
#include<omnetpp.h>
#include<cstring>

using namespace omnetpp;

class SRTF_Distributor : public cSimpleModule {
private:
    int counter=0;
    int x=0;
protected:
    virtual void initialize() override;
    virtual void handleMessage(cMessage *msg) override;
};
```

```
Define_Module(SRTF_Distributor);

void SRTF_Distributor::initialize()
{

}
 void SRTF_Distributor::handleMessage(cMessage *msg)
 {
     cMessage *msg2= new cMessage("Complete");
     std::string received=msg->getName();
     EV<<msg->getName() << "\n";

     if(received[1]=='1')
        sendDelayed(msg2,x,"out1");
     else if(received[1]=='2')
        sendDelayed(msg2,x,"out2");
     else if(received[1]=='3')
        sendDelayed(msg2,x,"out3");
     else if(received[1]=='4')
        sendDelayed(msg2,x,"out4");
     else if(received[1]=='5')
        sendDelayed(msg2,x,"out5");
     else if(received[1]=='6')
        sendDelayed(msg2,x,"out6");
     else if(received[1]=='7')
        sendDelayed(msg2,x,"out7");
     else if(received[1]=='8')
        sendDelayed(msg2,x,"out8");

     counter++;
     x+=2;

     if(counter==8)
     {
     counter=0;
     x=0;
     }
 }
```

Operating System module:

```
 * SRTF_OS.cc
 *
 *  Created on: Oct 28, 2018
 *      Author: USER
 */

#include<string.h>
#include<string>
```

```
#include<omnetpp.h>
#include<cstring>

using namespace omnetpp;

class SRTF_OS : public cSimpleModule {
private:
    int n=8;
    int processqueue[8];
    int processburst[8];
    int arrivaltime[8]={0,0,1,4,2,5,6,6};
    int remainingtime[8+1];
    int counter=0;

protected:
    virtual void initialize() override;
    virtual void handleMessage(cMessage *msg) override;
};

Define_Module(SRTF_OS);

void SRTF_OS::initialize()
{

}

void SRT_OS::handleMessage(cMessage *msg)
{
    processqueue[counter]=(msg->getName()[1]-'0');
    processburst[counter]=(msg->getName()[3]-'0');
    remainingtime[counter]=processburst[counter];
    counter++;
    if(counter==8)
    {
        remainingtime[n+1]=9999;
        int remain=0;
        for(int time=0;remain!=n;time++)
        {
            int smallest=n+1;
            for(int i=0;i<n;i++)
            {
                if(arrivaltime[i]<=time && remainingtime[i]<remainingtime[smallest]
&& remainingtime[i]>0)
                {
                    smallest=i;
                }
            }
            remainingtime[smallest]--;

            char message[20];
            sprintf(message,"P%d",processqueue[smallest]);
            cMessage *rrmsg2=new cMessage(message);
            cMessage *rrcopy = (cMessage *)rrmsg2->dup();
            send(rrcopy,"out");
```

```
            if(remainingtime[smallest]==0)
                remain++;
        }
    }
}
```

Initialization file:

```
[General]
network =SRTF

**.scalar-recording = true
**.vector-recording = true
```

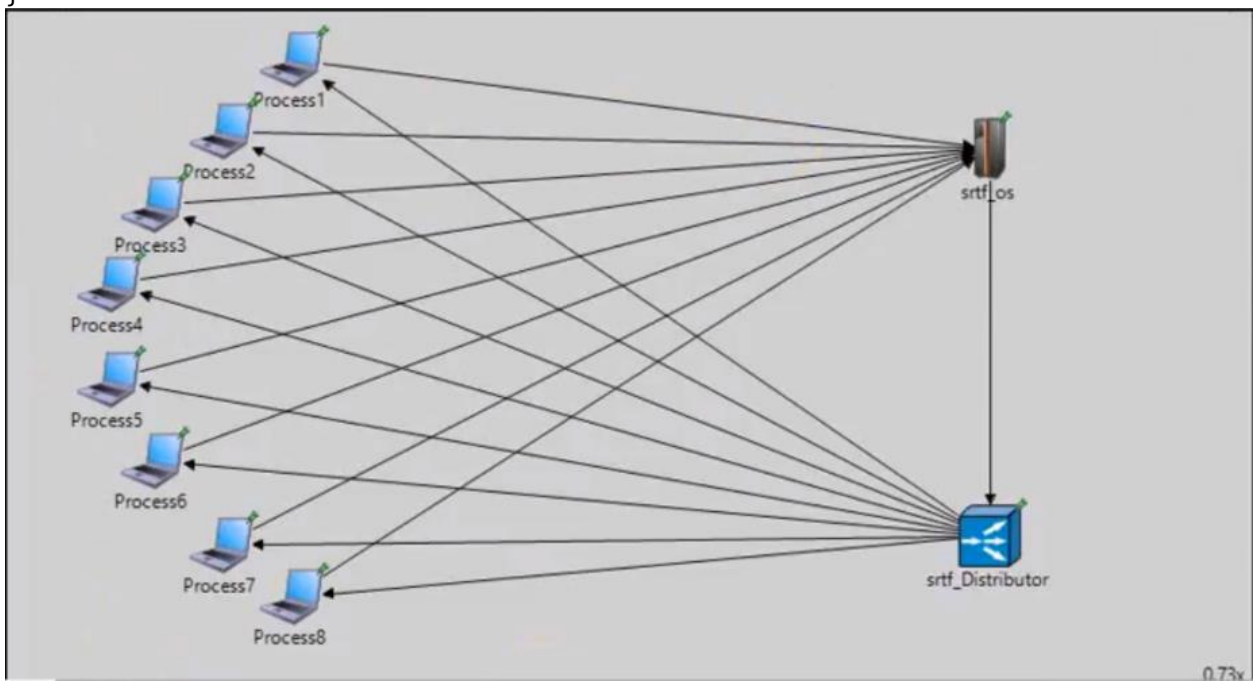
Ned File:

SRTF.NED

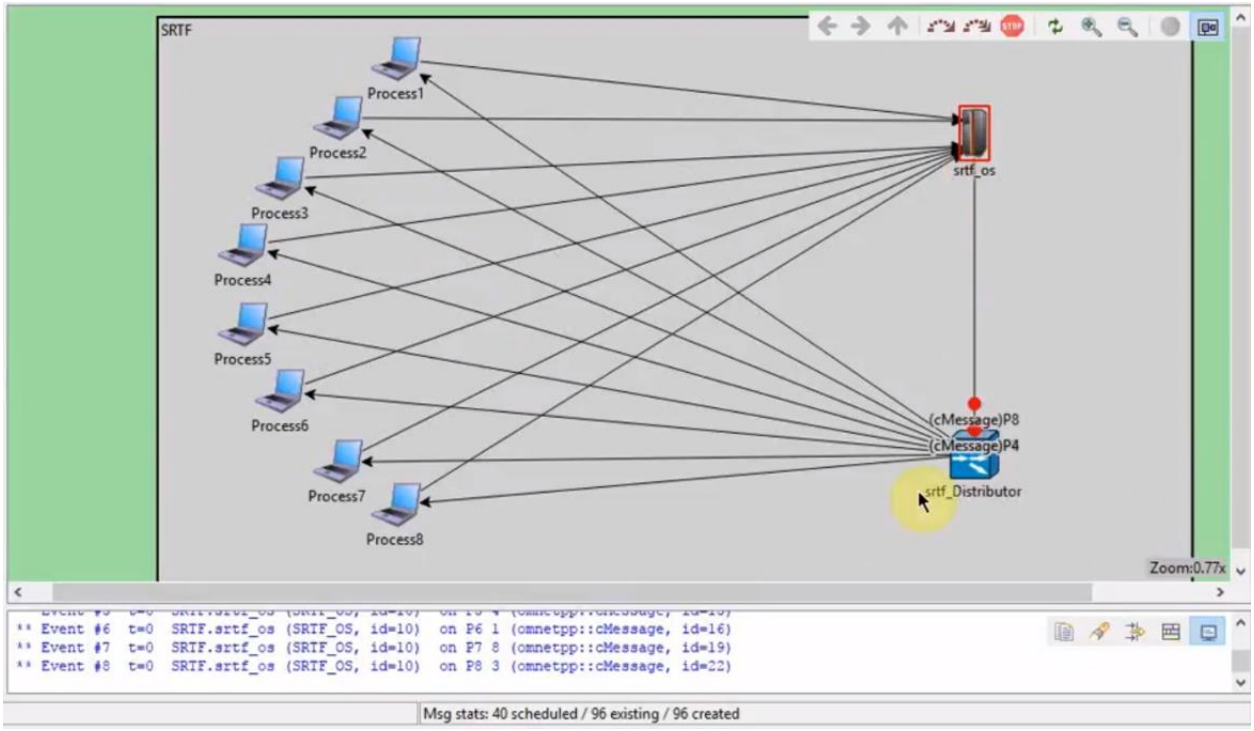
```
import ned.DelayChannel;

simple Process
{
@display("i=device/pc");
gates:
input in;
output out;
}

simple SRTF_OS
{
@display("i=device/router");
gates:
input in1;
input in2;
input in3;
input in4;
input in5;
input in6;
input in7;
input in8;
output out;
}
```

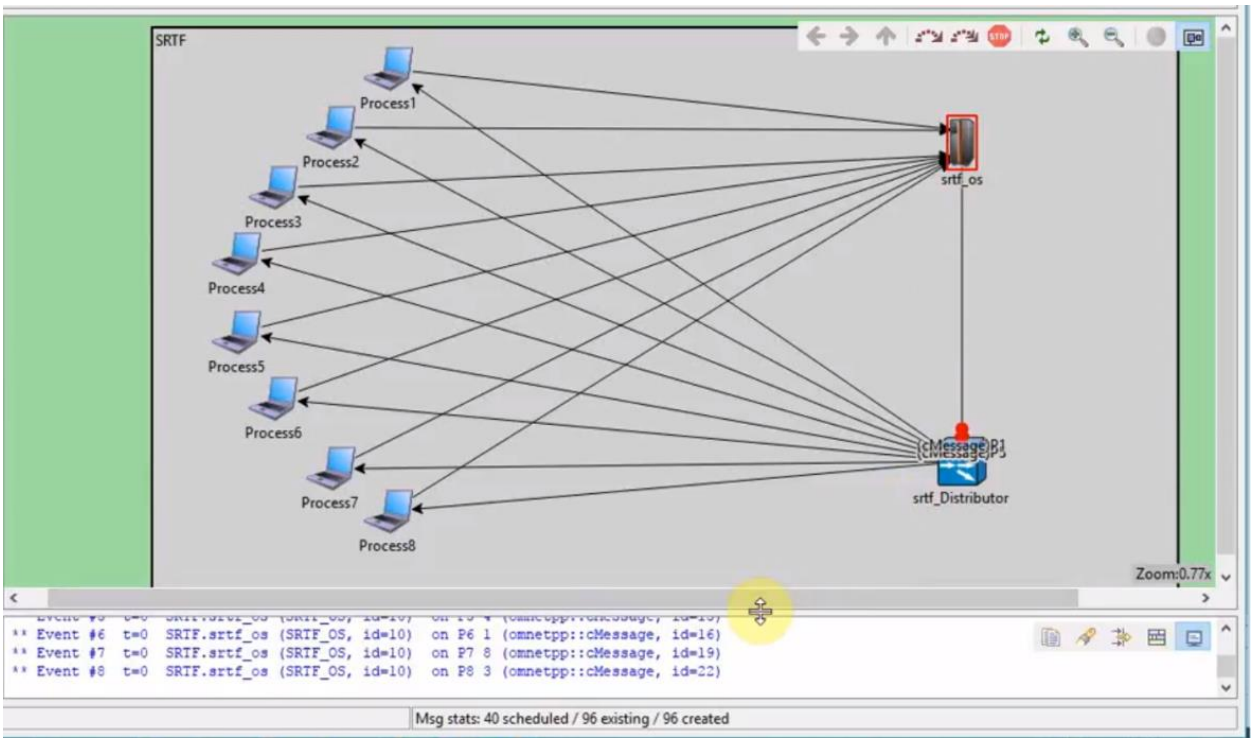
```
simple Distributor
{
@display("i=abstract/dispatcher");
gates:
 input in;
 output out1;
 output out2;
output out3;
 output out4;
 output out5;
 output out6;
 output out7;
 output out8;
}

network SRTF
{
@display("bgb=969,467");
submodules:
   process1: Process{
        @display("p=228,30");
 }
 process2: Process{
        @display("p=137,78");
 }
 process3: Process{
        @display("p=74,137");
 }
 process4: Process{
        @display("p=35,215");
 }
srtf_os: SRTF_OS{
 @display("p=832,39");
}
Srtf_Distributor: Distributor{
 @display("p=830,426");
}
 process5: Process{
        @display("p=27,282");
 }
 process6: Process{
        @display("p=74,334");
 }
 process7: Process{
        @display("p=137,387");
 }
 process8: Process{
        @display("p=228,412");
 }
connections:
process1.out --> DelayChannel{ delay=200ms; } --> srtf_os.in4;
process2.out --> DelayChannel{ delay=100ms; } --> strf_os.in1;
process3.out --> DelayChannel{ delay=400ms; } --> srtf_os.in2;
process4.out --> DelayChannel{ delay=300ms; } --> srtf_os.in3;
```

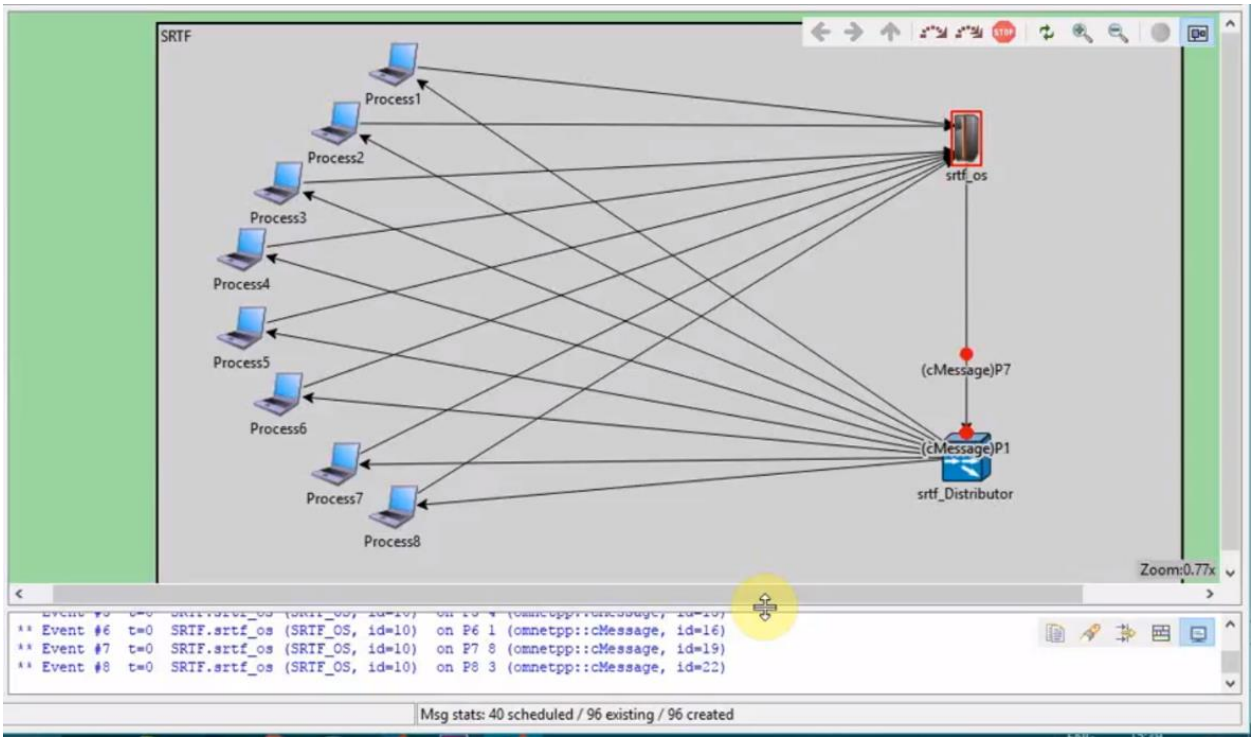
```
process5.out --> DelayChannel{ delay=500ms; } --> srtf_os.in5;
process6.out --> DelayChannel{ delay=600ms; } --> srtf_os.in6;
process7.out --> DelayChannel{ delay=700ms; } --> srtf_os.in7;
process8.out --> DelayChannel{ delay=800ms; } --> srtf_os.in8;
srtf_os.out --> DelayChannel --> srtf_Distributor.in;
srtf_Distributor.out1 --> DelayChannel --> process1.in;
srtf_Distributor.out2 --> DelayChannel --> process2.in;
srtf_Distributor.out3 --> DelayChannel --> process3.in;
srtf_Distributor.out4 --> DelayChannel --> process4.in;
srtf_Distributor.out5 --> DelayChannel --> process5.in;
srtf_Distributor.out6 --> DelayChannel --> process6.in;
srtf_Ddistributor.out7 --> DelayChannel --> process7.in;
srtf_Distributor.out8 --> DelayChannel --> process8.in;
}
```

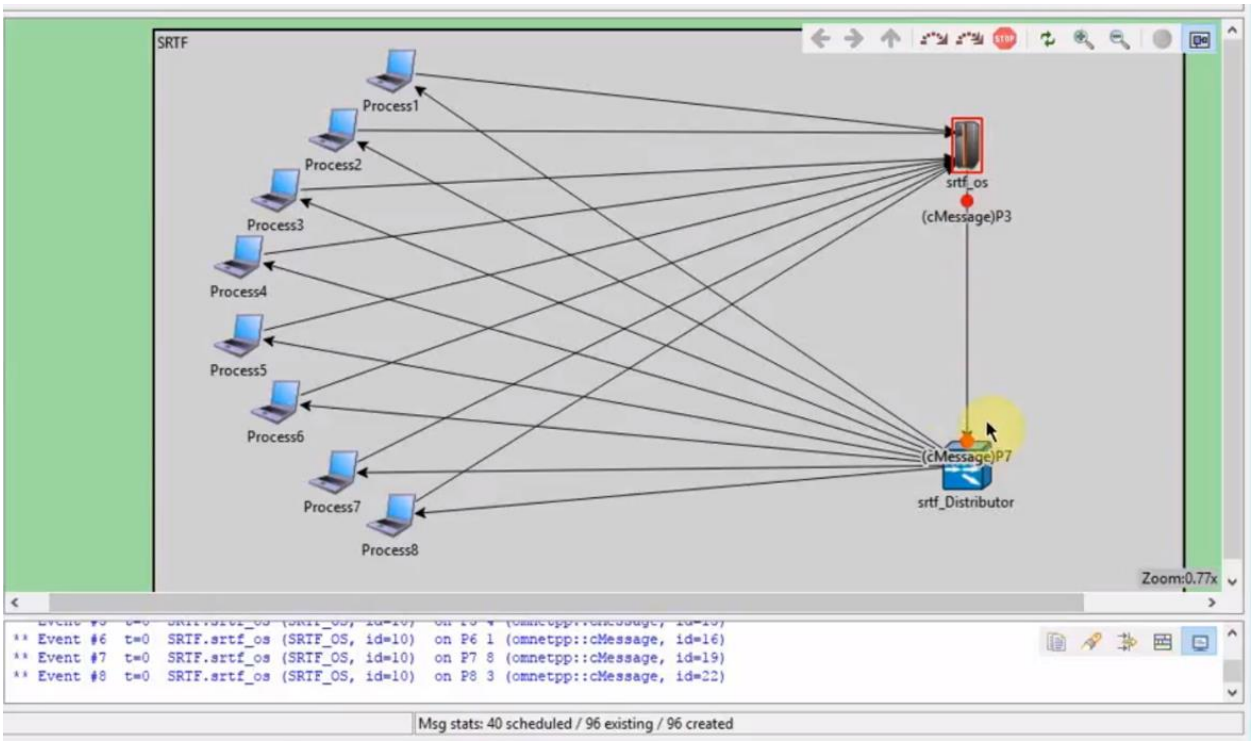


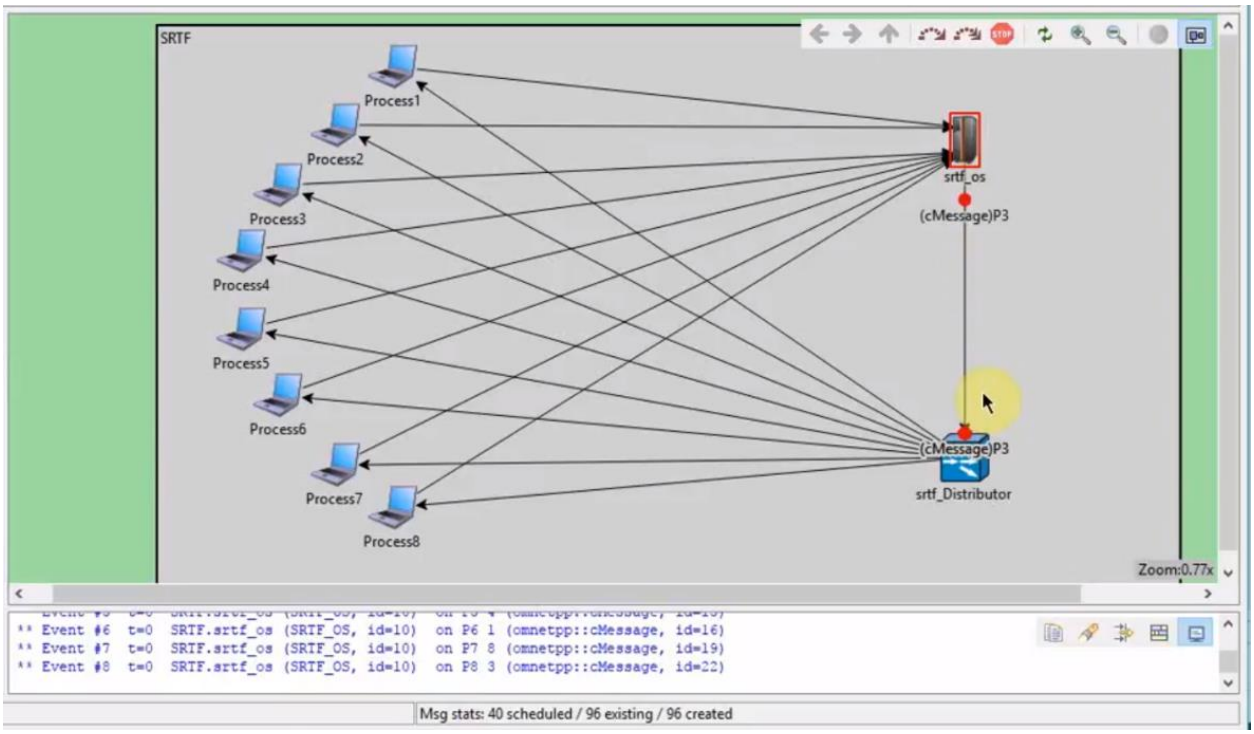
Screenshots of running simulation:

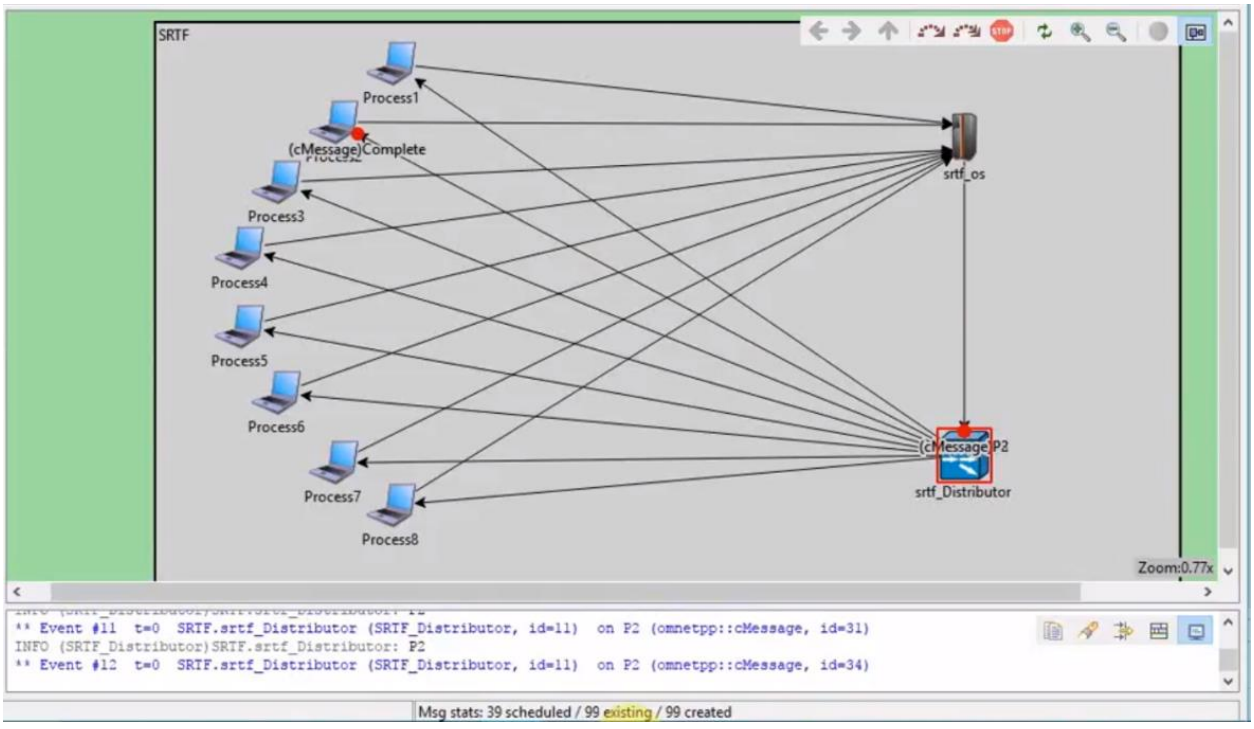


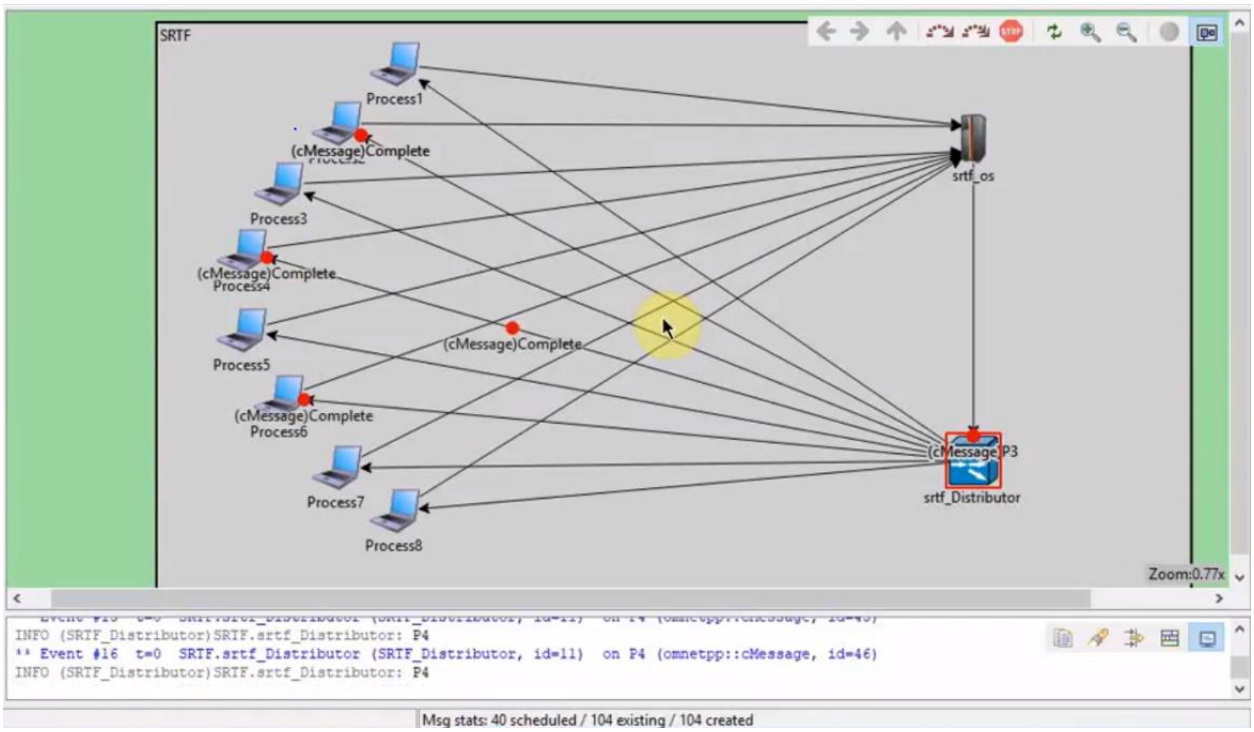


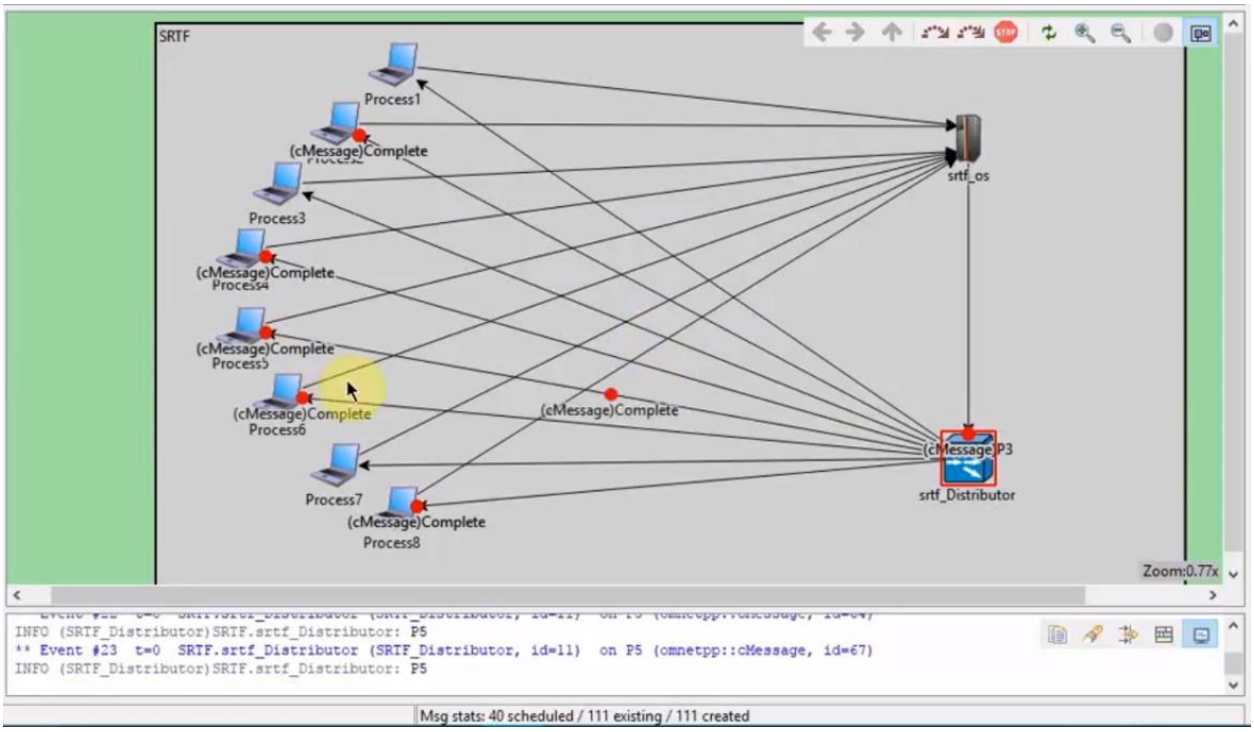

SRTF
Process1
Process2
Process3
Process4
Process5
Process6
Process7
Process8
srtf_os
(cMessage)P7
(cMessage)P1
srtf_Distributor
Zoom:0.77x
** Event #6 t=0 SRTF.srtf_os (SRTF_OS, id=10) on P6 1 (omnetpp::cMessage, id=16)
** Event #7 t=0 SRTF.srtf_os (SRTF_OS, id=10) on P7 8 (omnetpp::cMessage, id=19)
** Event #8 t=0 SRTF.srtf_os (SRTF_OS, id=10) on P8 3 (omnetpp::cMessage, id=22)
Msg stats: 40 scheduled / 96 existing / 96 created

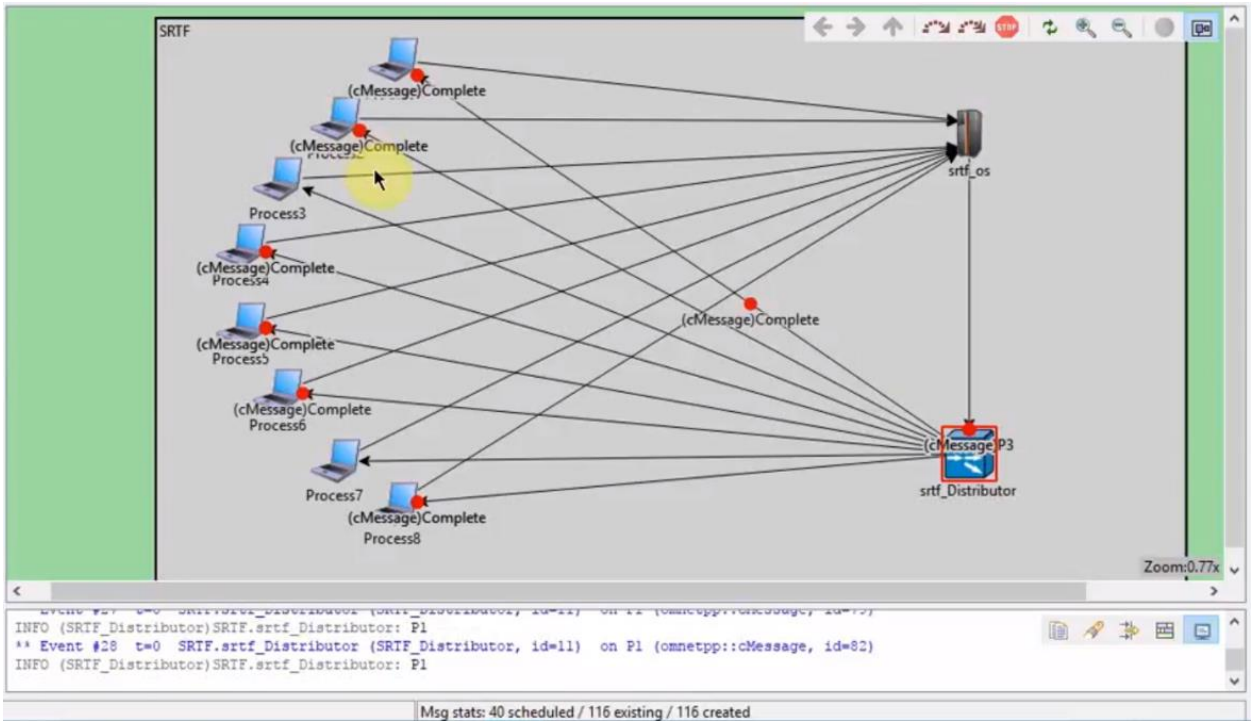

SRTF
Process1
Process2
Process3
Process4
Process5
Process6
Process7
Process8
srtf_os
(cMessage)P3
(cMessage)P7
srtf_Distributor
Zoom:0.77x
** Event #6 t=0 SRTF.srtf_os (SRTF_OS, id=10) on P6 1 (omnetpp::cMessage, id=16)
** Event #7 t=0 SRTF.srtf_os (SRTF_OS, id=10) on P7 8 (omnetpp::cMessage, id=19)
** Event #8 t=0 SRTF.srtf_os (SRTF_OS, id=10) on P8 3 (omnetpp::cMessage, id=22)
Msg stats: 40 scheduled / 96 existing / 96 created

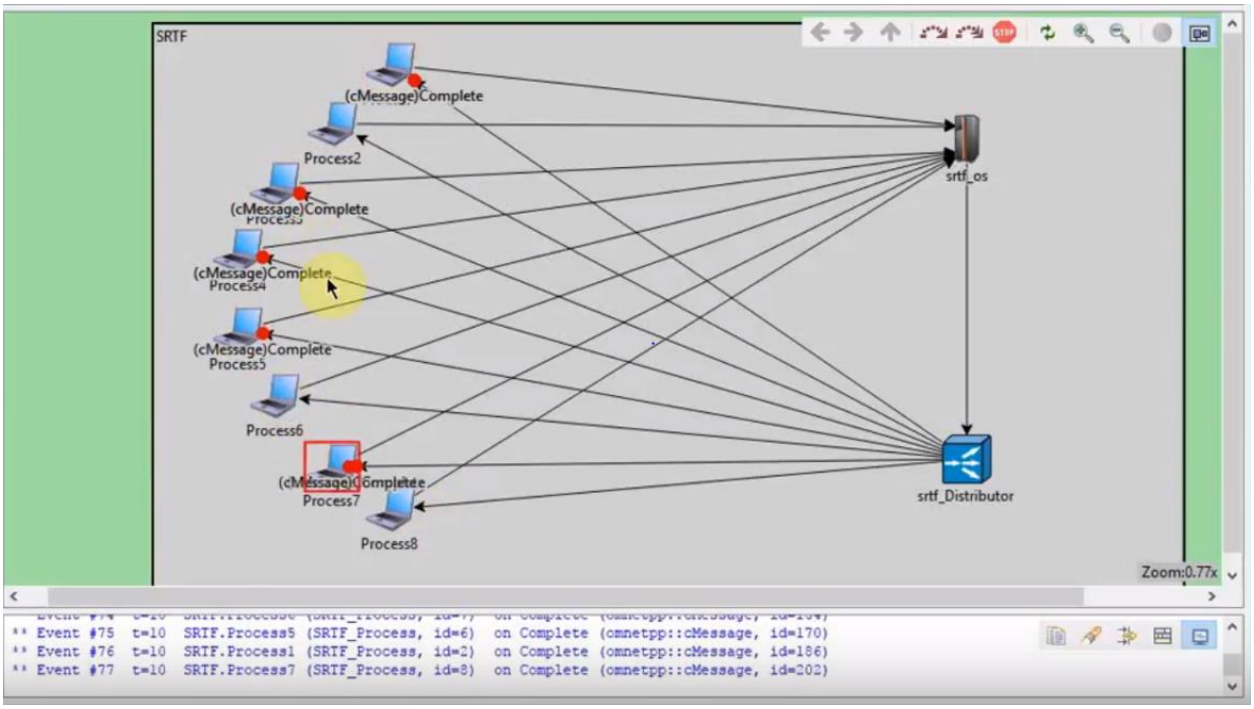

SRTF
Process1
Process2
Process3
Process4
Process5
Process6
Process7
Process8
srtf_os
(cMessage)P3
(cMessage)P3
srtf_Distributor
Zoom:0.77x
** Event #6 t=0 SRTF.srtf_os (SRTF_OS, id=10) on P6 1 (omnetpp::cMessage, id=16)
** Event #7 t=0 SRTF.srtf_os (SRTF_OS, id=10) on P7 8 (omnetpp::cMessage, id=19)
** Event #8 t=0 SRTF.srtf_os (SRTF_OS, id=10) on P8 3 (omnetpp::cMessage, id=22)
Msg stats: 40 scheduled / 96 existing / 96 created

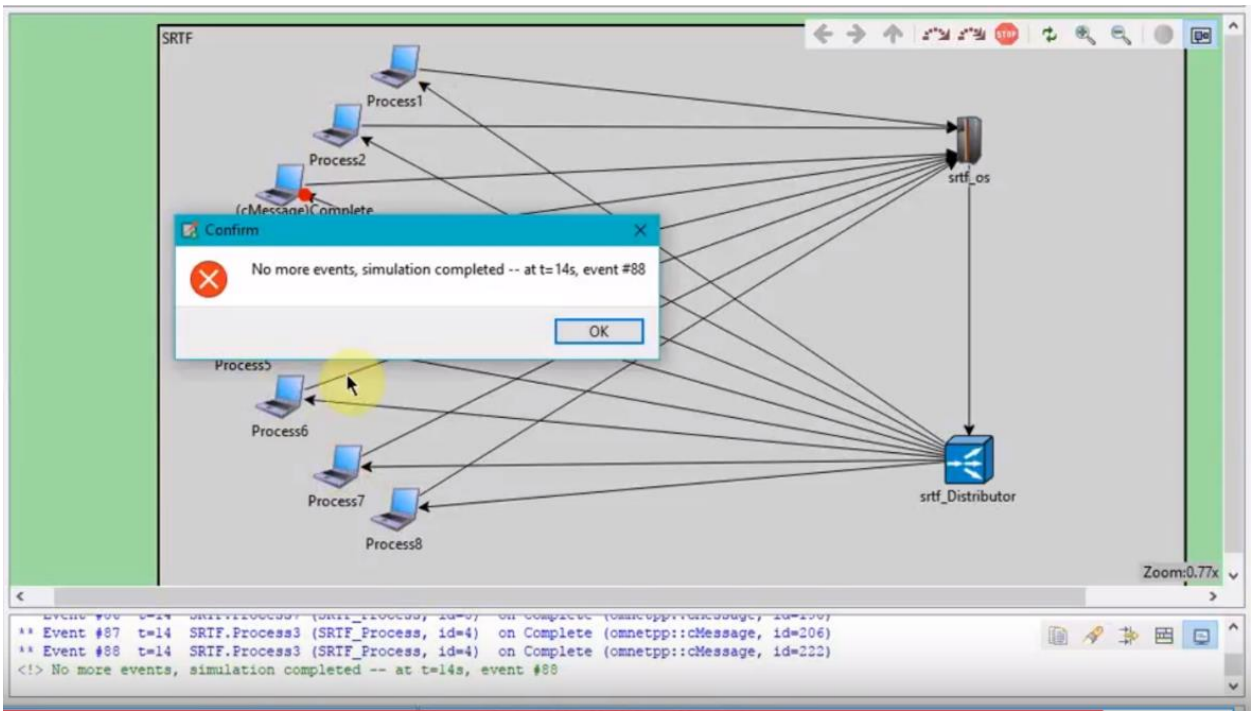

SRTF
Process1
(cMessage)Complete
Process3
Process4
Process5
Process6
Process7
Process8
srtf_os
(cMessage)P2
srtf_Distributor
Zoom:0.77x
** Event #11 t=0 SRTF.srtf_Distributor (SRTF_Distributor, id=11) on P2 (omnetpp::cMessage, id=31)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P2
** Event #12 t=0 SRTF.srtf_Distributor (SRTF_Distributor, id=11) on P2 (omnetpp::cMessage, id=34)
Msg stats: 39 scheduled / 99 existing / 99 created


SRTF
Process1
(cMessage)Complete
Process3
(cMessage)Complete
Process4
Process5
(cMessage)Complete
(cMessage)Complete
Process6
Process7
Process8
srtf_os
(cMessage)P3
srtf_Distributor
Zoom:0.77x
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P4
** Event #16 t=0 SRTF.srtf_Distributor (SRTF_Distributor, id=11) on P4 (omnetpp::cMessage, id=46)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P4
Msg stats: 40 scheduled / 104 existing / 104 created


SRTF
Process1
(cMessage)Complete
Process3
(cMessage)Complete
Process4
(cMessage)Complete
Process5
(cMessage)Complete
Process6
(cMessage)Complete
Process7
(cMessage)Complete
Process8
srtf_os
(cMessage)P3
srtf_Distributor
Zoom:0.77x
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P5
** Event #23 t=0 SRTF.srtf_Distributor (SRTF_Distributor, id=11) on P5 (omnetpp::cMessage, id=67)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P5
Msg stats: 40 scheduled / 111 existing / 111 created


SRTF
(cMessage)Complete
(cMessage)Complete
Process3
(cMessage)Complete
Process4
(cMessage)Complete
Process5
(cMessage)Complete
Process6
Process7
(cMessage)Complete
Process8
srtf_os
(cMessage)Complete
(cMessage)P3
srtf_Distributor
Zoom:0.77x
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P1
** Event #28 t=0 SRTF.srtf_Distributor (SRTF_Distributor, id=11) on P1 (omnetpp::cMessage, id=82)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P1
Msg stats: 40 scheduled / 116 existing / 116 created


SRTF
(cMessage)Complete
Process2
(cMessage)Complete
(cMessage)Complete
Process4
(cMessage)Complete
Process5
Process6
(cMessage)Complete
Process7
Process8
srtf_os
srtf_Distributor
Zoom:0.77x
** Event #75 t=10 SRTF.Process5 (SRTF_Process, id=6) on Complete (omnetpp::cMessage, id=170)
** Event #76 t=10 SRTF.Process1 (SRTF_Process, id=2) on Complete (omnetpp::cMessage, id=186)
** Event #77 t=10 SRTF.Process7 (SRTF_Process, id=8) on Complete (omnetpp::cMessage, id=202)




```
** Event #2  t=0  SRTF.srtf_os (SRTF_OS, id=10)  on P2 5 (omnetpp::cMessage, id=4)
** Event #3  t=0  SRTF.srtf_os (SRTF_OS, id=10)  on P3 9 (omnetpp::cMessage, id=7)
** Event #4  t=0  SRTF.srtf_os (SRTF_OS, id=10)  on P4 2 (omnetpp::cMessage, id=10)
** Event #5  t=0  SRTF.srtf_os (SRTF_OS, id=10)  on P5 4 (omnetpp::cMessage, id=13)
** Event #6  t=0  SRTF.srtf_os (SRTF_OS, id=10)  on P6 1 (omnetpp::cMessage, id=16)
** Event #7  t=0  SRTF.srtf_os (SRTF_OS, id=10)  on P7 8 (omnetpp::cMessage, id=19)
** Event #8  t=0  SRTF.srtf_os (SRTF_OS, id=10)  on P8 3 (omnetpp::cMessage, id=22)
** Event #9  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P2 (omnetpp::cMessage, id=25)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P2
** Event #10  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P2 (omnetpp::cMessage, id=28)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P2
** Event #11  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P2 (omnetpp::cMessage, id=31)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P2
** Event #12  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P2 (omnetpp::cMessage, id=34)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P2
** Event #13  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P2 (omnetpp::cMessage, id=37)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P2
** Event #14  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P6 (omnetpp::cMessage, id=40)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P6
** Event #15  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P4 (omnetpp::cMessage, id=43)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P4
** Event #16  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P4 (omnetpp::cMessage, id=46)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P4
** Event #17  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P8 (omnetpp::cMessage, id=49)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P8
** Event #18  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P8 (omnetpp::cMessage, id=52)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P8
** Event #19  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P8 (omnetpp::cMessage, id=55)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P8
** Event #20  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P5 (omnetpp::cMessage, id=58)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P5
** Event #21  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P5 (omnetpp::cMessage, id=61)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P5
** Event #22  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P5 (omnetpp::cMessage, id=64)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P5
** Event #23  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P5 (omnetpp::cMessage, id=67)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P5
```

```
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P7
** Event #36  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P7 (omnetpp::cMessage, id=106)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P7
** Event #37  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P7 (omnetpp::cMessage, id=109)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P7
** Event #38  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P7 (omnetpp::cMessage, id=112)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P7
** Event #39  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P7 (omnetpp::cMessage, id=115)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P7
** Event #40  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P3 (omnetpp::cMessage, id=118)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P3
** Event #41  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P3 (omnetpp::cMessage, id=121)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P3
** Event #42  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P3 (omnetpp::cMessage, id=124)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P3
** Event #43  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P3 (omnetpp::cMessage, id=127)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P3
** Event #44  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P3 (omnetpp::cMessage, id=130)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P3
** Event #45  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P3 (omnetpp::cMessage, id=133)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P3
** Event #46  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P3 (omnetpp::cMessage, id=136)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P3
** Event #47  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P3 (omnetpp::cMessage, id=139)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P3
** Event #48  t=0  SRTF.srtf_Distributor (SRTF_Distributor, id=11)  on P3 (omnetpp::cMessage, id=142)
INFO (SRTF_Distributor)SRTF.srtf_Distributor: P3
** Event #49  t=0  SRTF.Process2 (SRTF_Process, id=3)  on Complete (omnetpp::cMessage, id=144)
** Event #50  t=0  SRTF.Process8 (SRTF_Process, id=9)  on Complete (omnetpp::cMessage, id=160)
** Event #51  t=0  SRTF.Process1 (SRTF_Process, id=2)  on Complete (omnetpp::cMessage, id=176)
** Event #52  t=0  SRTF.Process7 (SRTF_Process, id=8)  on Complete (omnetpp::cMessage, id=192)
** Event #53  t=0  SRTF.Process3 (SRTF_Process, id=4)  on Complete (omnetpp::cMessage, id=208)
** Event #54  t=2  SRTF.Process2 (SRTF_Process, id=3)  on Complete (omnetpp::cMessage, id=146)
** Event #55  t=2  SRTF.Process8 (SRTF_Process, id=9)  on Complete (omnetpp::cMessage, id=162)
** Event #56  t=2  SRTF.Process1 (SRTF_Process, id=2)  on Complete (omnetpp::cMessage, id=178)
** Event #57  t=2  SRTF.Process7 (SRTF_Process, id=8)  on Complete (omnetpp::cMessage, id=194)
** Event #58  t=2  SRTF.Process3 (SRTF_Process, id=4)  on Complete (omnetpp::cMessage, id=210)
```

```
** Event #55  t=2  SRTF.Process8 (SRTF_Process, id=9)  on Complete (omnetpp::cMessage, id=162)
** Event #56  t=2  SRTF.Process1 (SRTF_Process, id=2)  on Complete (omnetpp::cMessage, id=178)
** Event #57  t=2  SRTF.Process7 (SRTF_Process, id=8)  on Complete (omnetpp::cMessage, id=194)
** Event #58  t=2  SRTF.Process3 (SRTF_Process, id=4)  on Complete (omnetpp::cMessage, id=210)
** Event #59  t=4  SRTF.Process2 (SRTF_Process, id=3)  on Complete (omnetpp::cMessage, id=148)
** Event #60  t=4  SRTF.Process8 (SRTF_Process, id=9)  on Complete (omnetpp::cMessage, id=164)
** Event #61  t=4  SRTF.Process1 (SRTF_Process, id=2)  on Complete (omnetpp::cMessage, id=180)
** Event #62  t=4  SRTF.Process7 (SRTF_Process, id=8)  on Complete (omnetpp::cMessage, id=196)
** Event #63  t=4  SRTF.Process3 (SRTF_Process, id=4)  on Complete (omnetpp::cMessage, id=212)
** Event #64  t=6  SRTF.Process2 (SRTF_Process, id=3)  on Complete (omnetpp::cMessage, id=150)
** Event #65  t=6  SRTF.Process5 (SRTF_Process, id=6)  on Complete (omnetpp::cMessage, id=166)
** Event #66  t=6  SRTF.Process1 (SRTF_Process, id=2)  on Complete (omnetpp::cMessage, id=182)
** Event #67  t=6  SRTF.Process7 (SRTF_Process, id=8)  on Complete (omnetpp::cMessage, id=198)
** Event #68  t=6  SRTF.Process3 (SRTF_Process, id=4)  on Complete (omnetpp::cMessage, id=214)
** Event #69  t=8  SRTF.Process2 (SRTF_Process, id=3)  on Complete (omnetpp::cMessage, id=152)
** Event #70  t=8  SRTF.Process5 (SRTF_Process, id=6)  on Complete (omnetpp::cMessage, id=168)
** Event #71  t=8  SRTF.Process1 (SRTF_Process, id=2)  on Complete (omnetpp::cMessage, id=184)
** Event #72  t=8  SRTF.Process7 (SRTF_Process, id=8)  on Complete (omnetpp::cMessage, id=200)
** Event #73  t=8  SRTF.Process3 (SRTF_Process, id=4)  on Complete (omnetpp::cMessage, id=216)
** Event #74  t=10  SRTF.Process6 (SRTF_Process, id=7)  on Complete (omnetpp::cMessage, id=154)
** Event #75  t=10  SRTF.Process5 (SRTF_Process, id=6)  on Complete (omnetpp::cMessage, id=170)
** Event #76  t=10  SRTF.Process1 (SRTF_Process, id=2)  on Complete (omnetpp::cMessage, id=186)
** Event #77  t=10  SRTF.Process7 (SRTF_Process, id=8)  on Complete (omnetpp::cMessage, id=202)
** Event #78  t=10  SRTF.Process3 (SRTF_Process, id=4)  on Complete (omnetpp::cMessage, id=218)
** Event #79  t=12  SRTF.Process4 (SRTF_Process, id=5)  on Complete (omnetpp::cMessage, id=156)
** Event #80  t=12  SRTF.Process5 (SRTF_Process, id=6)  on Complete (omnetpp::cMessage, id=172)
** Event #81  t=12  SRTF.Process1 (SRTF_Process, id=2)  on Complete (omnetpp::cMessage, id=188)
** Event #82  t=12  SRTF.Process7 (SRTF_Process, id=8)  on Complete (omnetpp::cMessage, id=204)
** Event #83  t=12  SRTF.Process3 (SRTF_Process, id=4)  on Complete (omnetpp::cMessage, id=220)
** Event #84  t=14  SRTF.Process4 (SRTF_Process, id=5)  on Complete (omnetpp::cMessage, id=158)
** Event #85  t=14  SRTF.Process1 (SRTF_Process, id=2)  on Complete (omnetpp::cMessage, id=174)
** Event #86  t=14  SRTF.Process7 (SRTF_Process, id=8)  on Complete (omnetpp::cMessage, id=190)
** Event #87  t=14  SRTF.Process3 (SRTF_Process, id=4)  on Complete (omnetpp::cMessage, id=206)
** Event #88  t=14  SRTF.Process3 (SRTF_Process, id=4)  on Complete (omnetpp::cMessage, id=222)
<!> No more events, simulation completed -- at t=14s, event #88
** Calling finish() methods of modules
```

Performing Wireless Communication between server and client in Omnet++

i.e. passing message from one module to another without there being any direct physical connection between them.

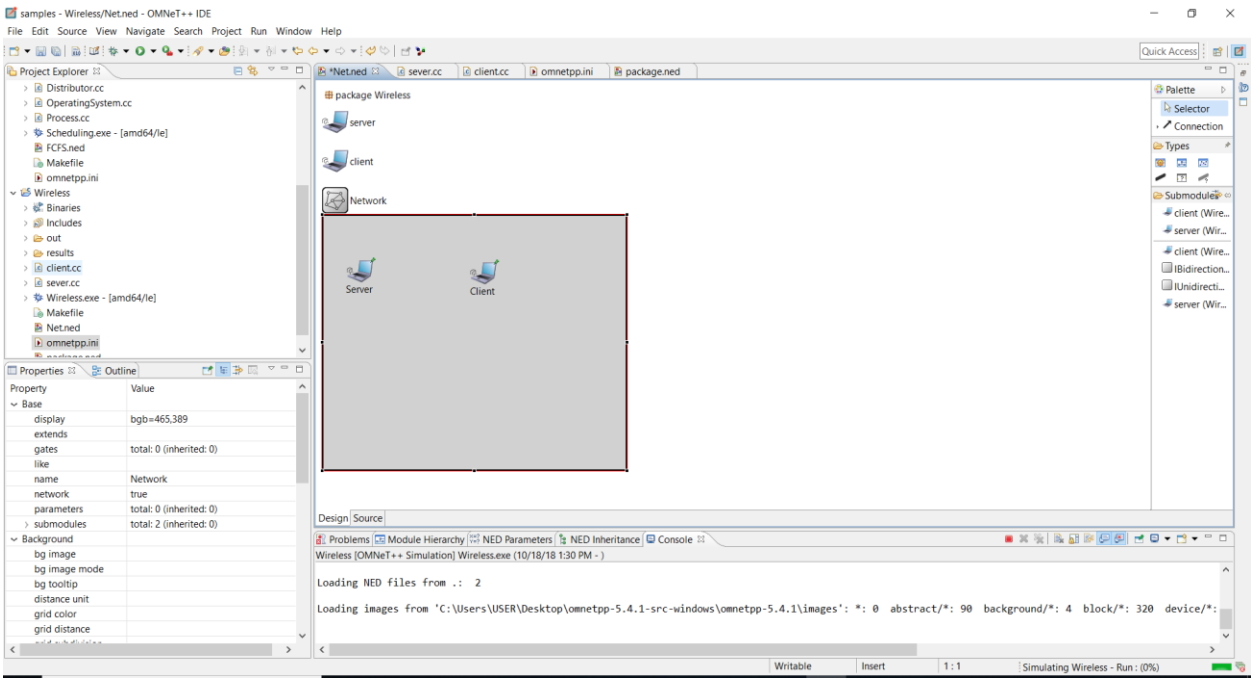
NED FILE:

NET.ned

Source:

```
package Wireless;

simple server
{
    @display("i=device/wifilaptop;p=230,40");
      gates:
          input radioIn @directIn;
}

simple client
{
      @display("i=device/wifilaptop;p=230,40");
      gates:
          input radioIn @directIn;
}

network Network
{
      @display("bgb=327,200");
      submodules:
          Server:server {
              @display("p=56,85");

          }
          Client:client {
              @display("p=246,88");
          }
}
```

Form:

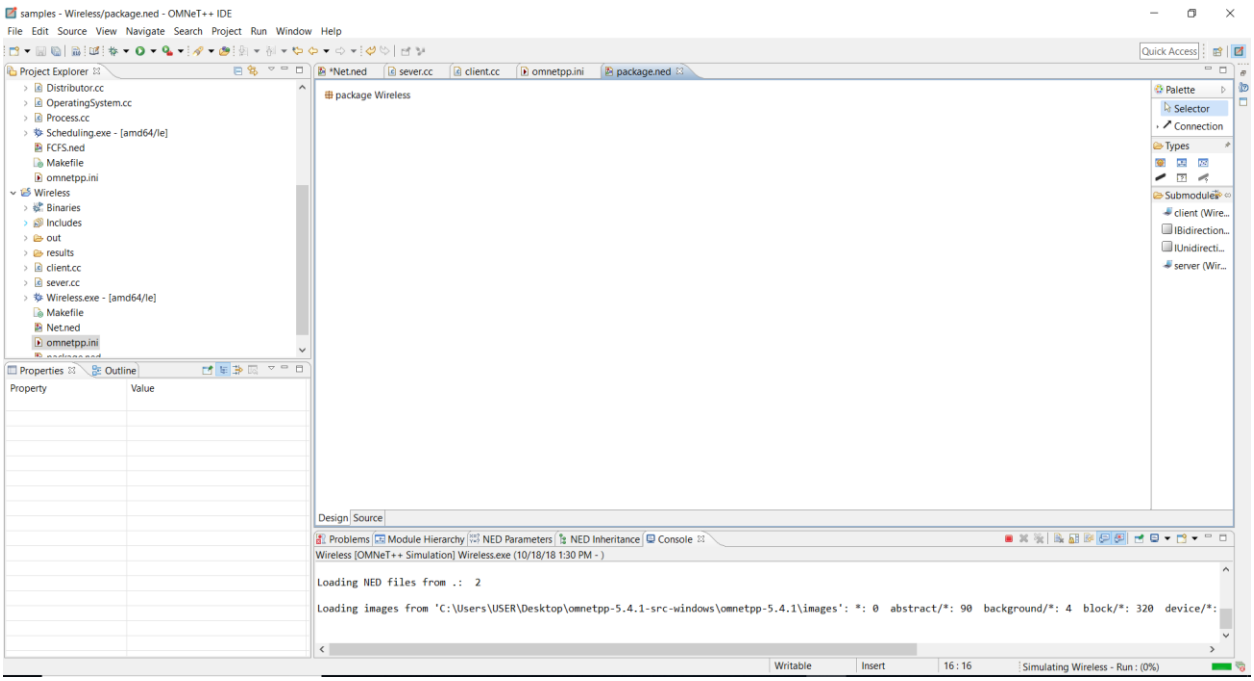


Package.ned

Source:

```
package Wireless;
@license(LGPL);
```

Form:



Source Files:

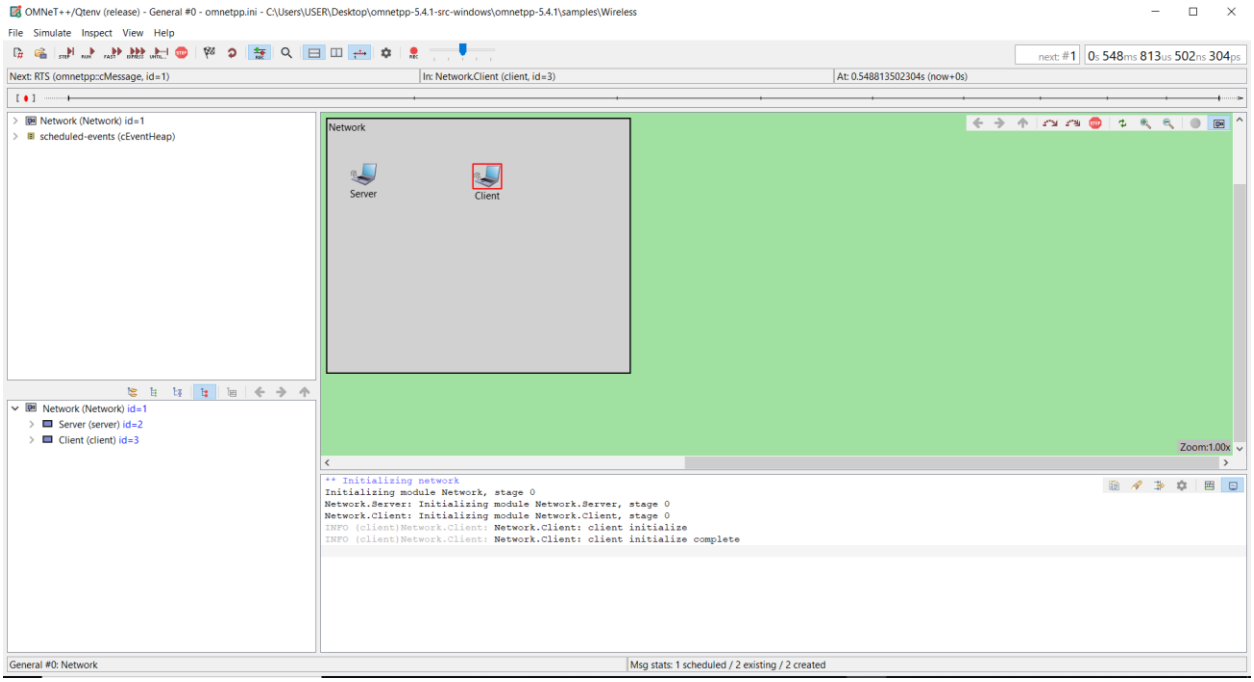
```
/*
 * sever.cc
 *
 *  Created on: Oct 18, 2018
 *      Author: USER
 */

#include<omnetpp.h>
using namespace omnetpp;
class server: public cSimpleModule {
    cMessage * sg;
    virtual void initialize();
    virtual void handleMessage(cMessage *msg);
};

Define_Module(server);

void server::initialize() {


}

void server::handleMessage(cMessage *msg)
```

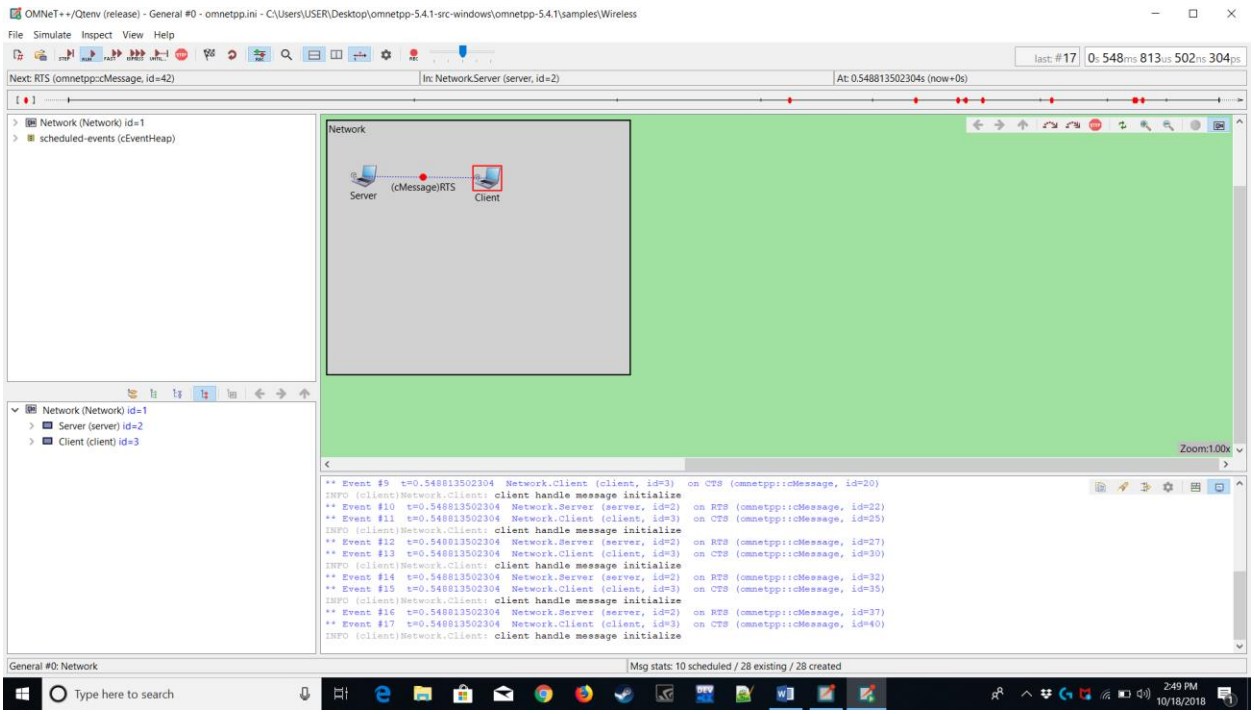
```
{
    msg = new cMessage("CTS");
    cModule *target=getParentModule()->getSubmodule("Client");
    sendDirect(msg,target,"radioIn");
}



/*
 * client.cc
 *
 *  Created on: Oct 18, 2018
 *      Author: USER
 */


#include<omnetpp.h>
using namespace omnetpp;
class client : public cSimpleModule {
    cMessage *msg;
    virtual void initialize();
    virtual void handleMessage(cMessage *msg);
};
Define_Module(client);

void client::initialize() {
    EV <<"client initialize" << "\n";
    msg=new cMessage("RTS");
    scheduleAt(simTime() + dblrand(),msg->dup());
    EV<<"client initialize complete" << "\n";
}
void client::handleMessage(cMessage *msg)
{
    EV <<"client handle message initialize" << "\n";
    cModule *target;
    msg=new cMessage("RTS");
    target=getParentModule() -> getSubmodule("Server");
    sendDirect(msg,target,"radioIn");
    scheduleAt(simTime() + dblrand(),msg->dup());
}
```

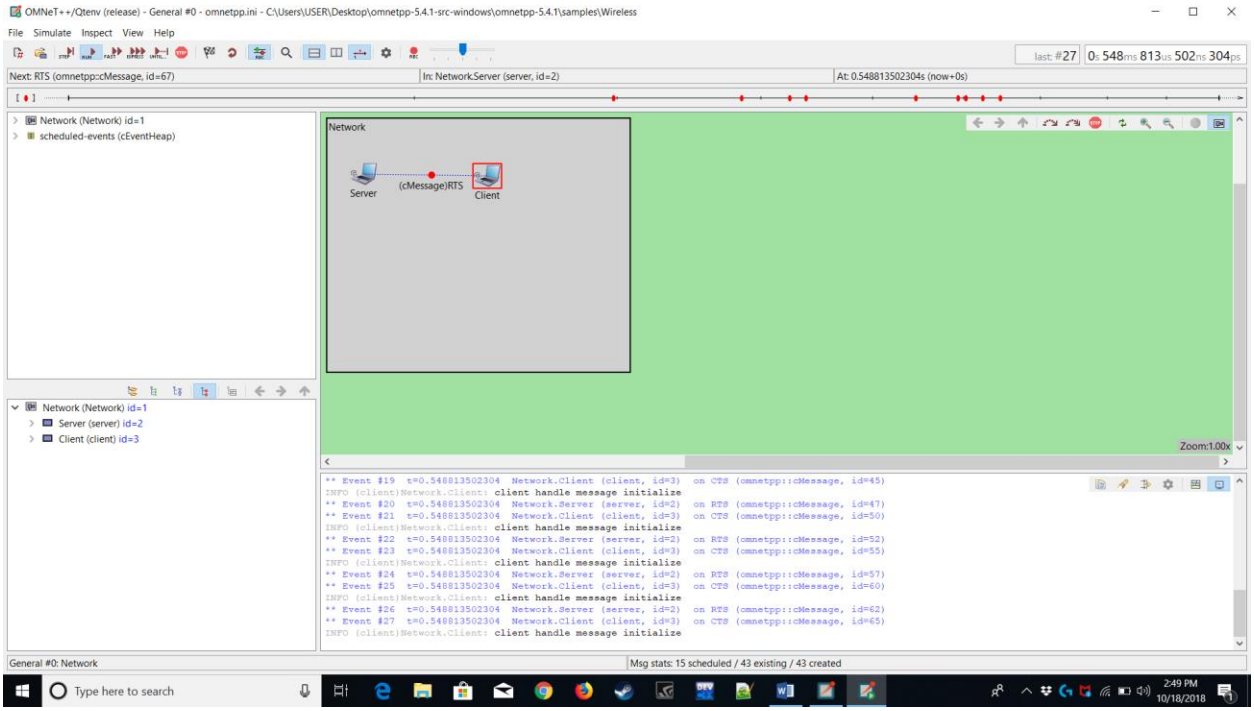
Initialization file:

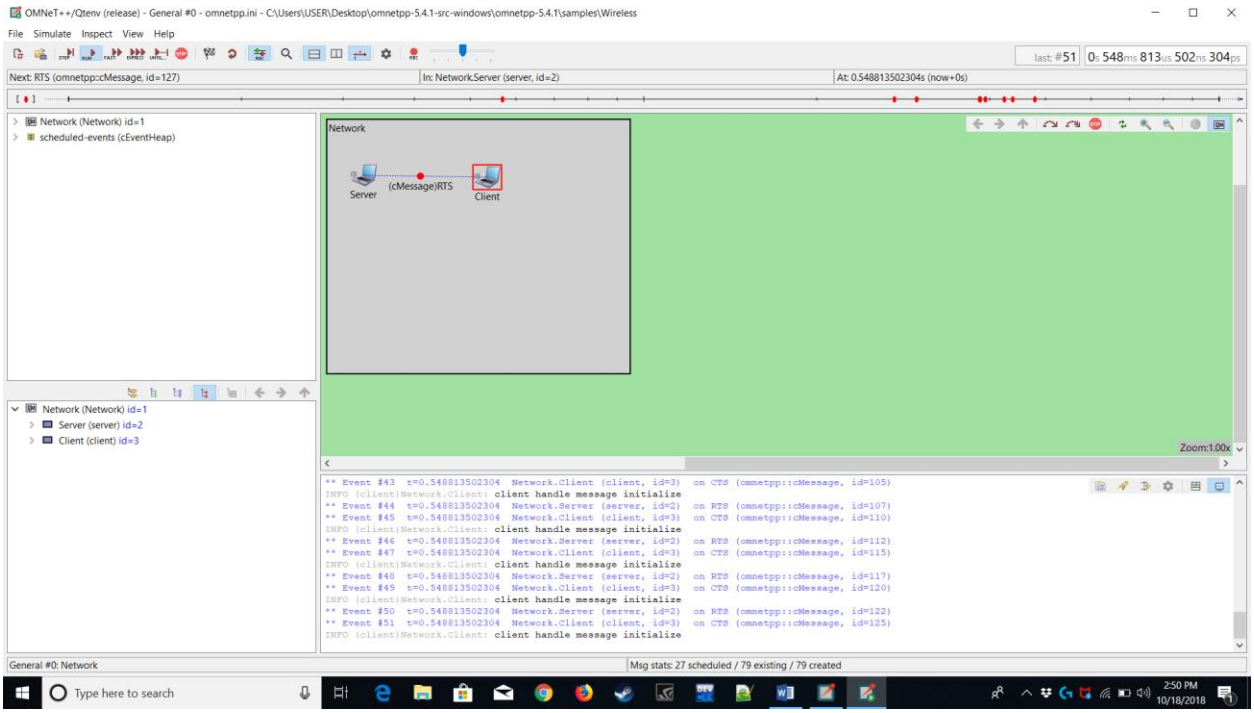
```
[General]
network = Network
record-eventlog=true
```

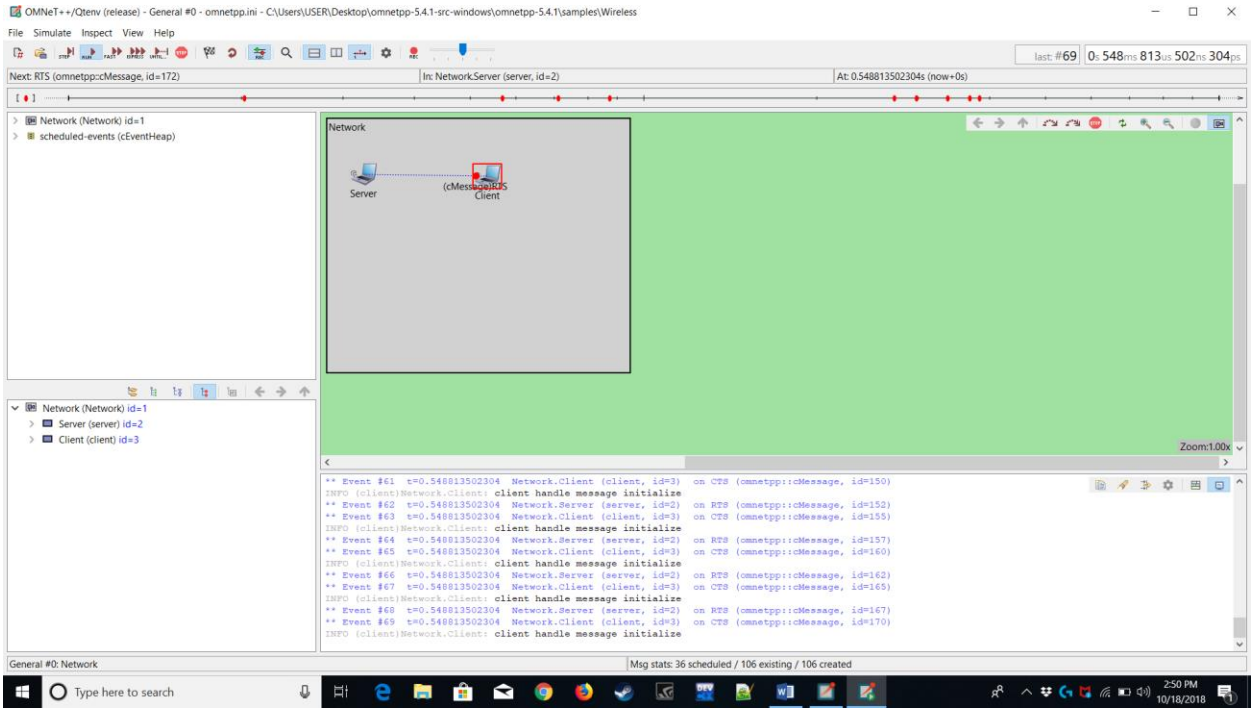
Screenshots of running simulation:

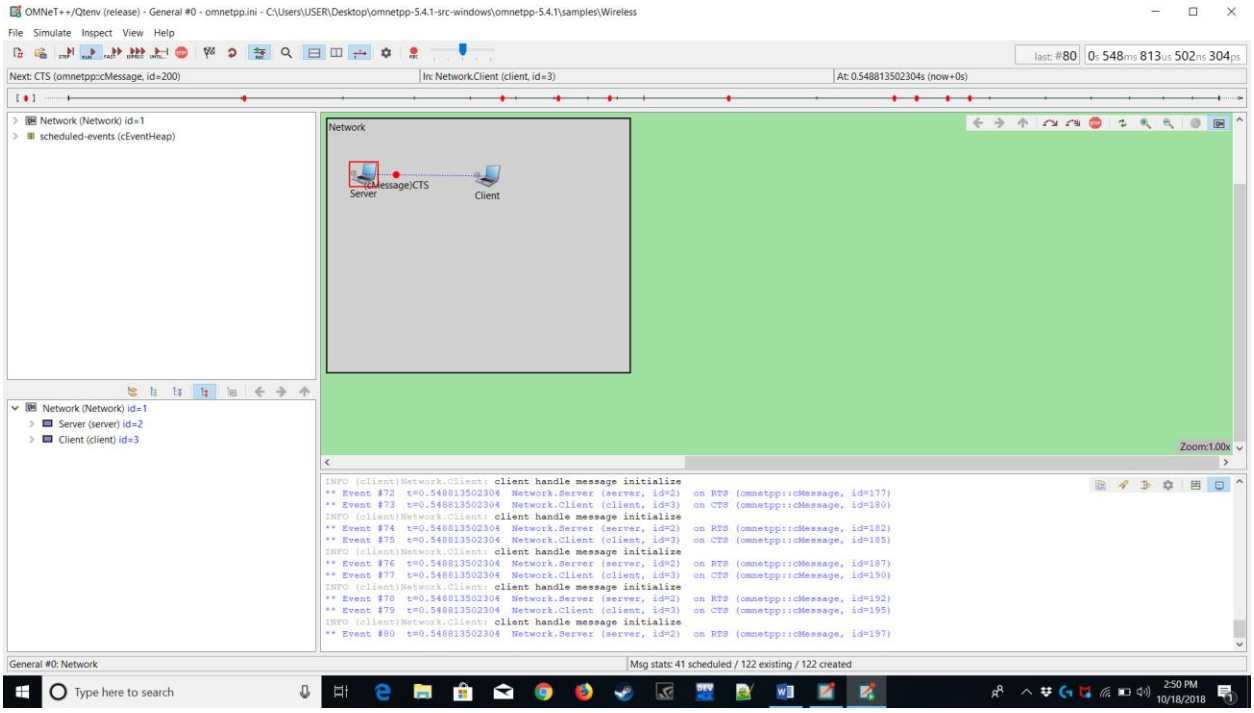





OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Wireless
File Simulate Inspect View Help
Next: RTS (omnetpp::cMessage, id=67)
In: Network.Server (server, id=2)
At: 0.548813502304s (now+0s)
Network (Network) id=1
scheduled-events (cEventHeap)
Network
Server
(cMessage)RTS
Client
Server (server) id=2
Client (client) id=3
Zoom:1.00x
** Event #19 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=45)
INFO (client)Network.Client: client handle message initialize
** Event #20 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=47)
** Event #21 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=50)
INFO (client)Network.Client: client handle message initialize
** Event #22 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=52)
** Event #23 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=55)
INFO (client)Network.Client: client handle message initialize
** Event #24 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=57)
** Event #25 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=60)
INFO (client)Network.Client: client handle message initialize
** Event #26 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=62)
** Event #27 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=65)
INFO (client)Network.Client: client handle message initialize
General #0: Network
Msg stats: 15 scheduled / 43 existing / 43 created
Type here to search
2:49 PM
10/18/2018

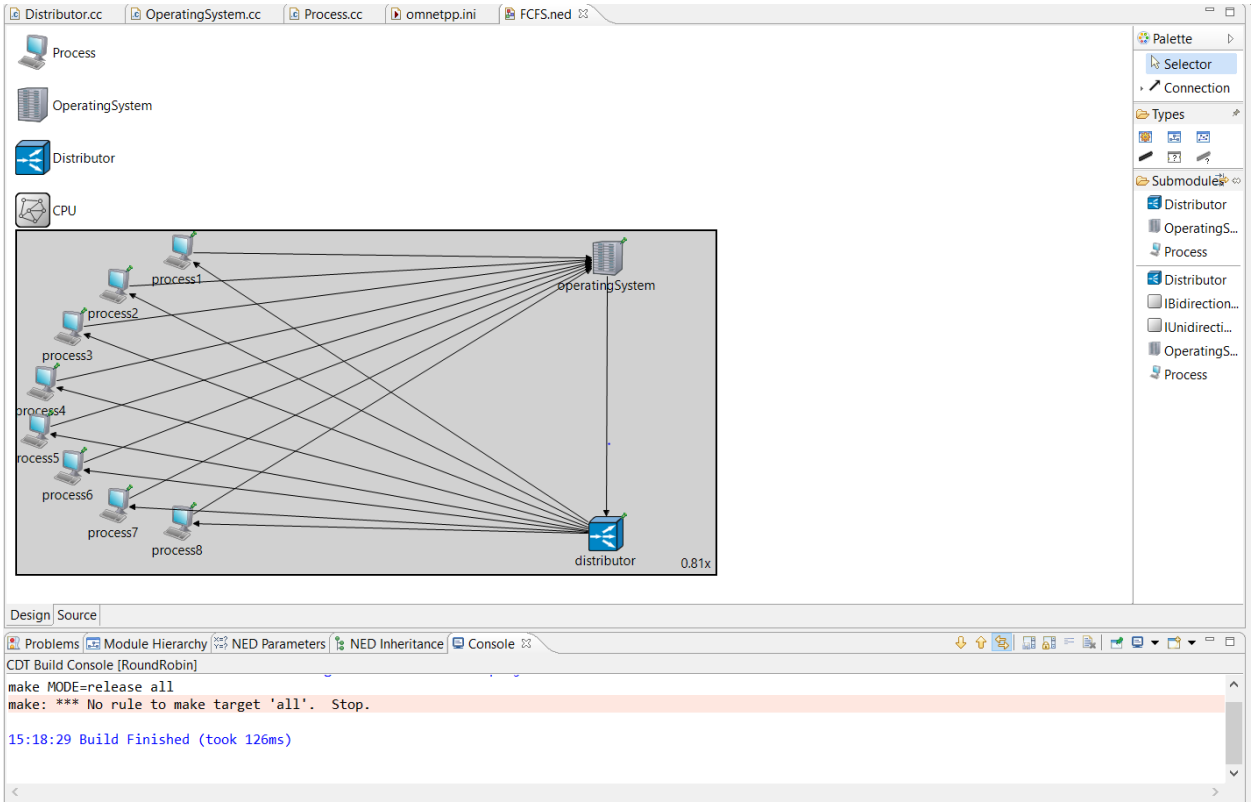

OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Wireless
File Simulate Inspect View Help
Next: RTS (omnetpp::cMessage, id=127)
In: Network.Server (server, id=2)
At: 0.548813502304s (now+0s)
Network (Network) id=1
scheduled-events (cEventHeap)
Network
Server
(cMessage)RTS
Client
Server (server) id=2
Client (client) id=3
Zoom:1.00x
** Event #43 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=105)
INFO (client)Network.Client: client handle message initialize
** Event #44 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=107)
** Event #45 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=110)
INFO (client)Network.Client: client handle message initialize
** Event #46 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=112)
** Event #47 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=115)
INFO (client)Network.Client: client handle message initialize
** Event #48 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=117)
** Event #49 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=120)
INFO (client)Network.Client: client handle message initialize
** Event #50 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=122)
** Event #51 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=125)
INFO (client)Network.Client: client handle message initialize
General #0: Network
Msg stats: 27 scheduled / 79 existing / 79 created
Type here to search
2:50 PM
10/18/2018


OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Wireless
File Simulate Inspect View Help
Next: RTS (omnetpp::cMessage, id=172)
In: Network.Server (server, id=2)
At: 0.548813502304s (now+0s)
Network (Network) id=1
scheduled-events (cEventHeap)
Network
Server
(cMessage)RTS
Client
Server (server) id=2
Client (client) id=3
Zoom:1.00x
** Event #61 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=150)
INFO (client)Network.Client: client handle message initialize
** Event #62 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=152)
** Event #63 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=155)
INFO (client)Network.Client: client handle message initialize
** Event #64 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=157)
** Event #65 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=160)
INFO (client)Network.Client: client handle message initialize
** Event #66 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=162)
** Event #67 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=165)
INFO (client)Network.Client: client handle message initialize
** Event #68 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=167)
** Event #69 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=170)
INFO (client)Network.Client: client handle message initialize
General #0: Network
Msg stats: 36 scheduled / 106 existing / 106 created
Type here to search
2:50 PM
10/18/2018


OMNeT++/Qtenv (release) - General #0 - omnetpp.ini - C:\Users\USER\Desktop\omnetpp-5.4.1-src-windows\omnetpp-5.4.1\samples\Wireless
File Simulate Inspect View Help
Next: CTS (omnetpp::cMessage, id=200)
In: Network.Client (client, id=3)
At: 0.548813502304s (now+0s)
Network (Network) id=1
scheduled-events (cEventHeap)
Network
Server
(cMessage)CTS
Client
Server (server) id=2
Client (client) id=3
Zoom:1.00x
INFO (client)Network.Client: client handle message initialize
** Event #72 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=177)
** Event #73 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=180)
INFO (client)Network.Client: client handle message initialize
** Event #74 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=182)
** Event #75 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=185)
INFO (client)Network.Client: client handle message initialize
** Event #76 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=187)
** Event #77 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=190)
INFO (client)Network.Client: client handle message initialize
** Event #78 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=192)
** Event #79 t=0.548813502304 Network.Client (client, id=3) on CTS (omnetpp::cMessage, id=195)
INFO (client)Network.Client: client handle message initialize
** Event #80 t=0.548813502304 Network.Server (server, id=2) on RTS (omnetpp::cMessage, id=197)
General #0: Network
Msg stats: 41 scheduled / 122 existing / 122 created
Type here to search
2:50 PM
10/18/2018

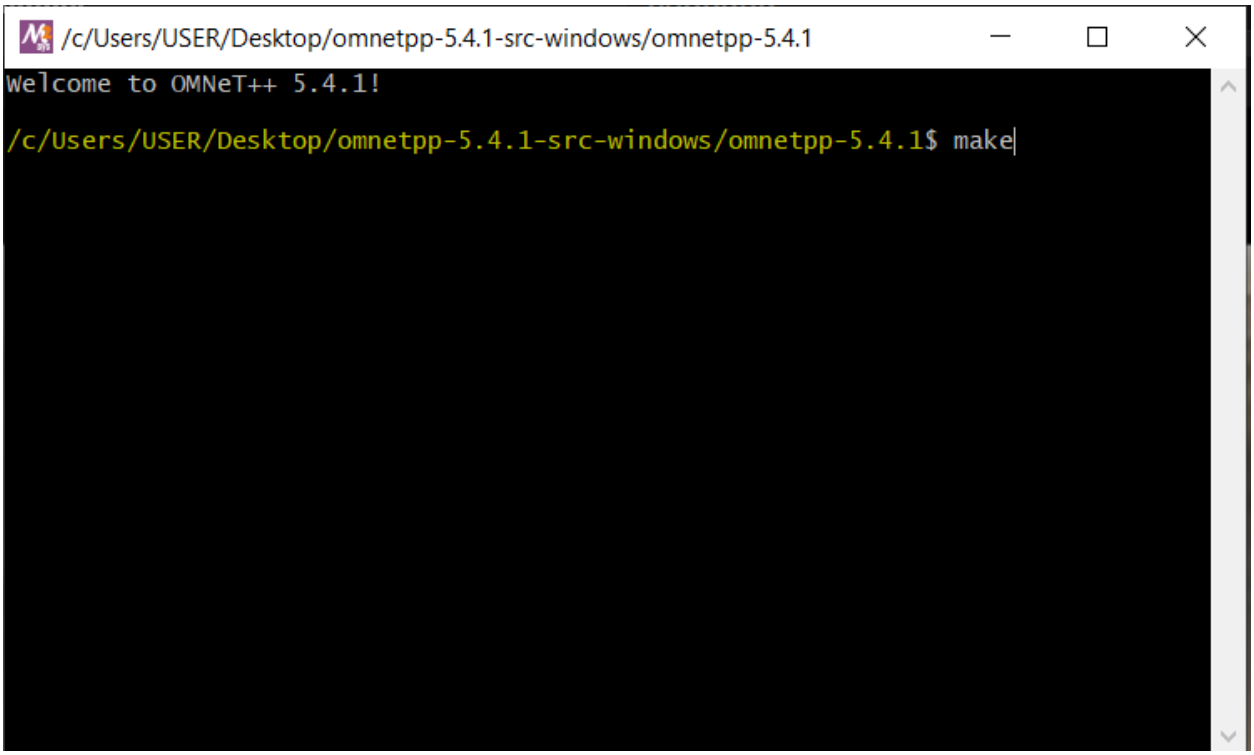
Issues faced (with relevant screenshots in all reviews)

When performing the scheduling algorithm, I faced an error during building of the NED File, which is given in the Screenshot below.



Error: No rule to make target ‘all’

On doing proper study of it, I found out that some files may not have copied to the libraries while giving the make command during the installation of Omnet++. So I opened “mingwenv” gave the make command. After all the libraries were imported, then I again ran the same NED file and this time it ran successfully.



References:

1. https://omnetpp.org/intro

2. https://stackoverflow.com/questions/49735971/hnocs-make-error-in-omnet

3. https://www.utwente.nl/en/eemcs/dacs/assignments/completed/bachelor/reports/B-assignment_ldserda.pdf

Inference from the project work:

After working on omnet++ I have come to know that unlike ns-2 and ns-3, OMNET++ is not only designed for network simulations. It can be used for modeling of multiprocessors, distributed hardware systems and performance evaluation of complex software systems.

It is a powerful opensource discrete event simulation tool that can be used by academic, educational and research-oriented commercial institutions for the simulation of computer networks, distributed and parallel systems.

It can very well be used for showing the implementation of all the Scheduling Algorithms: FFCS, SJF, RR, SRTF, Priority(Both pre-emptive and non-preemptive) and also for showing wireless communication as well as mobility.

Also, one more thing is that in omnet++ we can see heterogeneity as we can set the Ram size, bandwidth etc. different for each module which makes omnet++ a heterogenous platform which is very useful for creating different simulation frameworks.

One more interesting feature is that although OMNeT++ provides a powerful and clear simulation framework, it lacks of direct support and a concise modeling chain for wireless communication. Both is provided by MiXiM. It joins and extends several existing simulation frameworks developed for wireless and mobile simulations in OMNeT++. It provides detailed models of the wireless channel (fading, etc.), wireless connectivity, mobility models, models for obstacles and many communication protocols especially at the Medium Access Control

(MAC) level. Further, it provides a user-friendly graphical representation of wireless and mobile networks in OMNeT++, supporting debugging and defining even complex wireless scenarios. Though still in development, MiXiM already is a powerful tool for performance analysis of wire- less networks.

It is a merger of several OMNeT++ frameworks written to support mobile and wireless simulations.

Flowchart of showing the order of execution of an omnet++ file: