Design and Analysis of An OMNeT++ based Simulation Framework for Optical Burst Switching

Group Members:

Mohsin Sajjad 22PWCSE2149
Sawaira Haq 22PWCSE2172
Sana Zahir 22PWCSE2151
Muhammad Shafique Qureshi 22PWCSE2189

Supervisor: **ENGR. IHSAN UL HAQ**
Department of Computer Systems Engineering
University of Engineering & Technology Peshawar

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Introduction

“Can today’s internet keep up with tomorrow’s needs?”

- Internet demand is growing fast
- Current optical methods have limits:

  OCS: Reliable but wastes bandwidth

  OPS: due to lack of optical processor it is not implemented

Key question:

- **How to make networks fast and efficient?**

Optical Burst Switching

What is Optical Burst Switching (OBS)?

- Optical high speed switching networks
- Able to efficiently utilize extremely high capacity links
- Groups many small packets into a larger “burst” before sending
- Control packet goes first to set up the path, then the burst follows
- At intermediate nodes:
  - Bursts are switched directly (no need for O/E conversion)
- At the destination:
  - Bursts are split back into packets and delivered

Problem Statement

- Optical Burst Switching (OBS) is still in the research domain, and currently, there is no experimental test bed available. To work on this technology, a test bed is essential, which can be provided in the form of a software-based simulation framework. Previous research was carried out by the Public University of Navarre, Spain, and the University of Algarve, Portugal, where an OBS network model for OMNeT++ was developed and evaluated. However, that work was implemented on older versions of OMNeT++, which are now obsolete and incompatible with modern operating systems, thus further research/evaluation seems difficult. Therefore, our work focuses on using the latest stable release, OMNeT++ 6.2, to develop an updated simulation environment for OBS.

Objectives

- To study the limitations of existing optical switching methods (OCS and OPS).
- To design and implement a framework for Optical Burst Switching (OBS) using OMNeT++ 6.2 frame work.
- To analyze the results obtained from the simulation framework.

OMNET++

- **INTRODUCTION:**
- OMNeT++ is a simulation framework used for modeling and simulating systems including (computer networks).
- It is modular meaning you build networks using modules/sub module and connect them.

Core Files for Building a Network in OMNeT++

- **.ned file (Network Description)**

Defines the topology of the network. Tells what modules exist. Example: Tic and Toc modules connected to each other.

```
simple Txc1
{
    gates:
        input in;
        output out;
}

//
// Two instances (tic and toc) of Txc1 connected both ways.
// Tic and toc will pass messages to one another.
//
network Tictoc1
{
    submodules:
        tic: Txc1 {
            @display("p=18,76");
        }
        toc: Txc1;
    connections:
        tic.out --> {  delay = 100ms; } --> toc.in;
        tic.in <-- {  delay = 100ms; } <-- toc.out;
}
```

Core Files for Building a Network in OMNeT++

- **.cc file (C++ Source Code)**

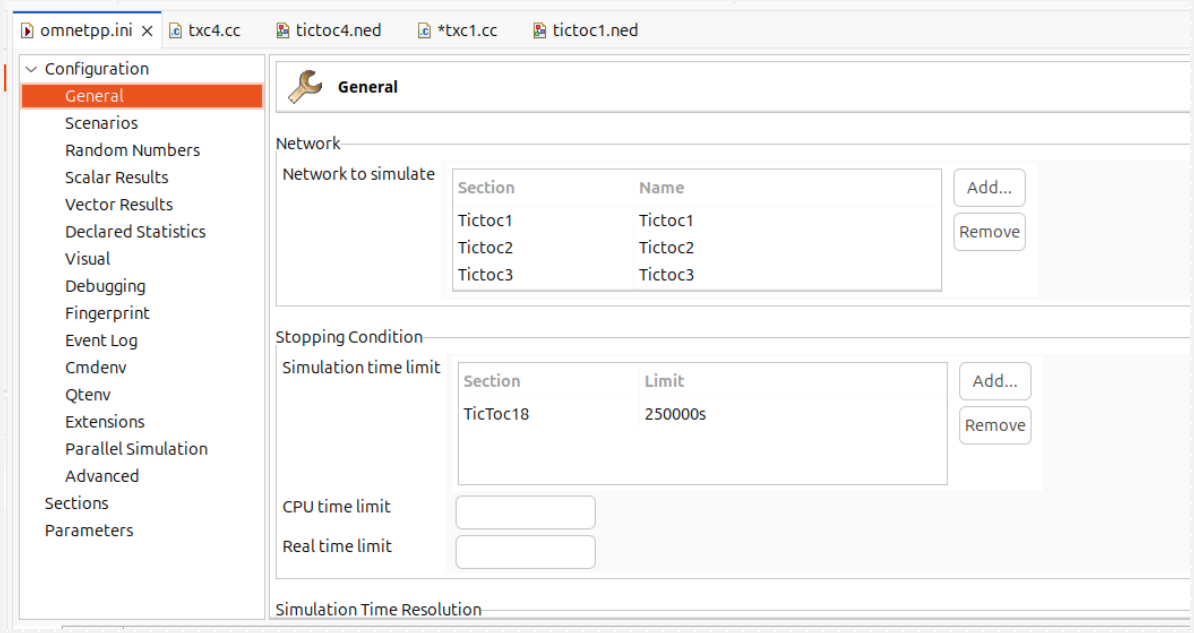
Defines the behavior of modules. Contains logic like sending, receiving messages etc.

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

using namespace omnetpp;

class Txc1 : public cSimpleModule
{
  protected:
    virtual void initialize() override;
    virtual void handleMessage(cMessage *msg) override;
};
Define_Module(Txc1);
void Txc1::initialize()
{
   // 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");
    }
    EV << "Sending initial message\n";
}

void Txc1::handleMessage(cMessage *msg)
{
    // will bounce between the two.
    send(msg, "out"); // send out the message
    EV << "Received message `" << msg->getName() << "', sending it out again\n";
}
```

Core Files for Building a Network in OMNeT++

.ini file (Configuration)

Defines the simulation setup. Tells which network to run, simulation time, parameters.



Linkage of FYP with UN SDGs

Selected Goal:

SDG 9 – Industry, Innovation and Infrastructure
"Build resilient infrastructure, promote sustainable industrialization, and foster innovation."

Relevance to Project:

- The framework contribute to innovation in future network technology.
- By analyzing high-speed optical networks, it helps enhance technological capacity for future demands.

Mapping of FYP with 5 DCSE Courses

S. No.	Course Code	Course Name	Justify the linkage with FYP
1.	CSE-102	Computer Programming	Computer programming enables OBS simulation in OMNeT++.
2.	CSE-209	Probability Methods in Engineering	Probability methods will help to do statistical analysis.
3.	CSE-302	Systems Programming	Systems programming is required to design and manage processes essential for OBS simulation.
4.	CSE-303	Data Communication and Networks	Data Communication and Net works explains burst transmission across optical links in OBS.
5.	CSE-309	Communication Systems	Provide the foundation for un derstanding signal transmission in OBS networks.

Moral and Ethical Considerations

- The project is based on a simulation framework.
- Focus is on improving communication technology in a responsible way.
- Ethical principles followed:
  - **Transparency:** Clear reporting of methods and results.
  - **Integrity:** Ensuring the honesty in analysis.
  - **Responsible Innovation:** Developing solutions that benefit society without causing harm.
- Overall, the project supports safe and sustainable technological progress.

Societal Impact

- Who benefits?
  Researchers, telecom industry, and internet users.
- Broader impact**:**
  Faster and more reliable networks → stronger digital society.
- Real-World Application:
  Can be developed as a simulation tool for research and industry.

Expected Outcome

- **End Product:**
  A working simulation framework for Optical Burst Switching (OBS) built on OMNeT++ 6.2.
- **Deliverables:**
  - Software tool to test and analyze OBS performance.
- **Impact:**
  Provides a practical platform for researchers and industry to explore and improve future high-speed network technologies.

Thank You!