

# Data Flow Simulation of the ALICE Computing System with OMNET++

Rifki Sadikin<sup>1</sup>, Furqon Hensan Muttaqin<sup>1</sup>, Iosif Legrand<sup>2</sup> for ALICE Collaboration



<sup>1</sup>Indonesian Insitute of Sciences, <sup>2</sup>California Institute of Technology

rifki.sadikin@lipi.go.id — 62 (22) 2504711

### Abstract

The ALICE computing system will be entirely upgraded for Run 3 to address the major challenge of sampling the full 50 kHz Pb-Pb interaction rate increasing by a factor 100 times the present limit. We present, in this paper, models for data flow from detector read-out hosts to storage elements in the upgraded system. The model consists of read-out, network switches, and processing hosts. We simulate storage, buffer and network behavior in discrete event simulations by using OMNET++, a network simulation tool. The simulation assumes that each read-out or processing host is a regular computer host and the event size produced by read-out hosts is set to follow ALICE upgrade requirements. The data, then, flow through TCP/IP-based networks through processing hosts to storage elements. We study the performance of the system for different values of data transfer rate and different data compression/reduction ratio. We use the simulation to estimate storage requirements and the optimal buffer size for network traffic in the upgraded system. Furthermore, we discuss the implications of simulation results for the design.

### Introduction

Data Flow at ALICE data acquisition system according O<sup>2</sup> system consists of: Front-end links from detectors, the FLPs (First Layer Processing) that read-out the raw data from Front-end links and produce STFs (Sub-Time Frame) and the EPNs (Event Processing Node) that collected STFs and integrate them into a Time Frame. The network behaviors of ALICE DAQ's data flow are simulated using the OMNET++ discrete event simulation system and INET framework. OMNET++ is an extensible, modular, component-based C++ simulation library and framework for modeling communication networks, multiprocessors and other distributed or parallel systems. OMNET++ was created for general and large-scale network simulation. While, INET framework is an open source OMNET++ model suite which contains many internet, wired, wireless and mobile networks protocols, such as TCP, UDP, IPv4, IPv6, OSPF, BGP, Ethernet, PPP, IEEE 802.11. The Ethernet and IPv4. In this simulation we use TCP model from INET library.

### Main Objectives

1. To estimate storage requirements and the optimal buffer size for network traffic in the upgraded system.
2. To estimate network latency time and time to create Time Frame of data flow at ALICE data acquisition system.

### Simulation Design

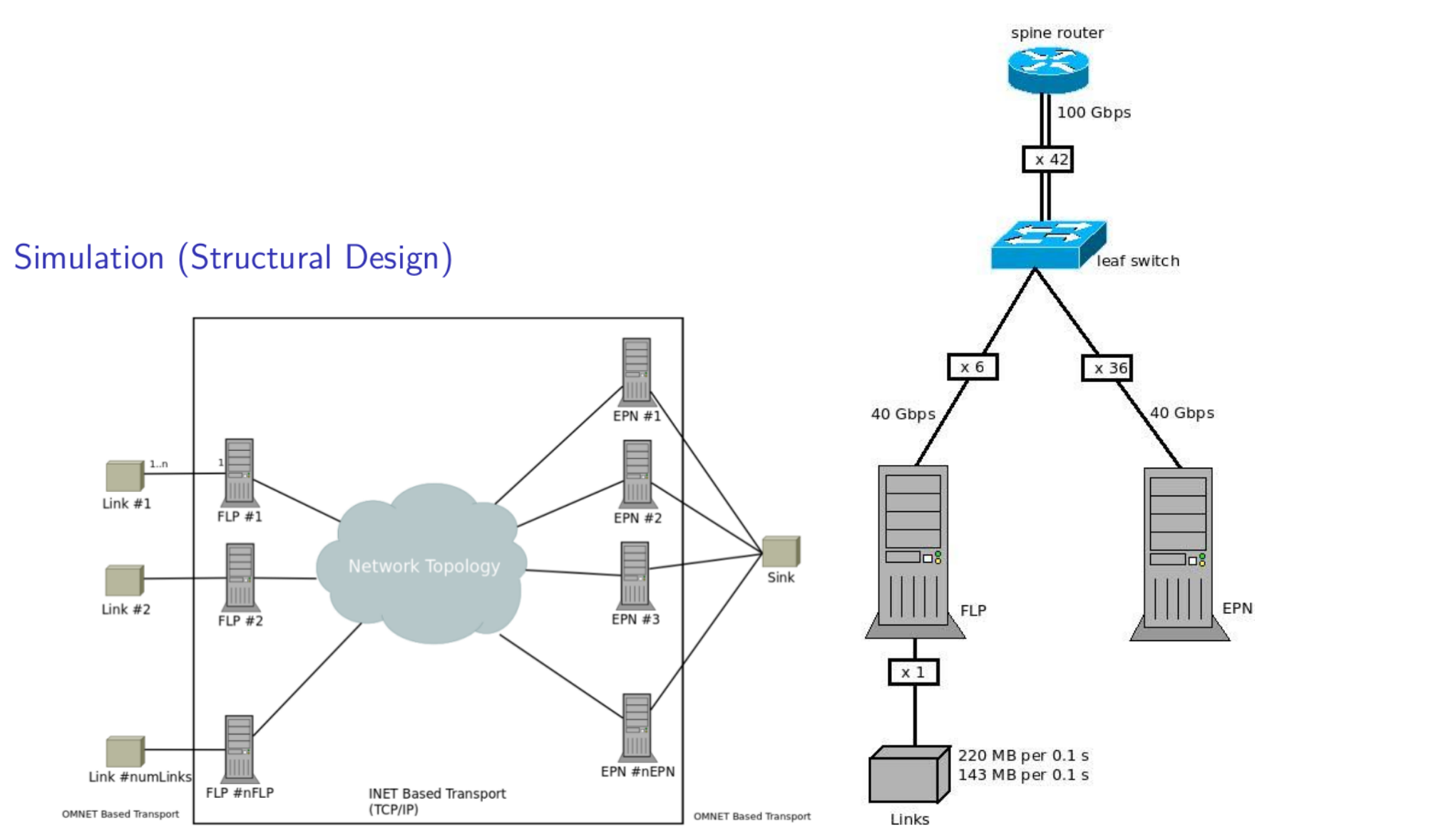
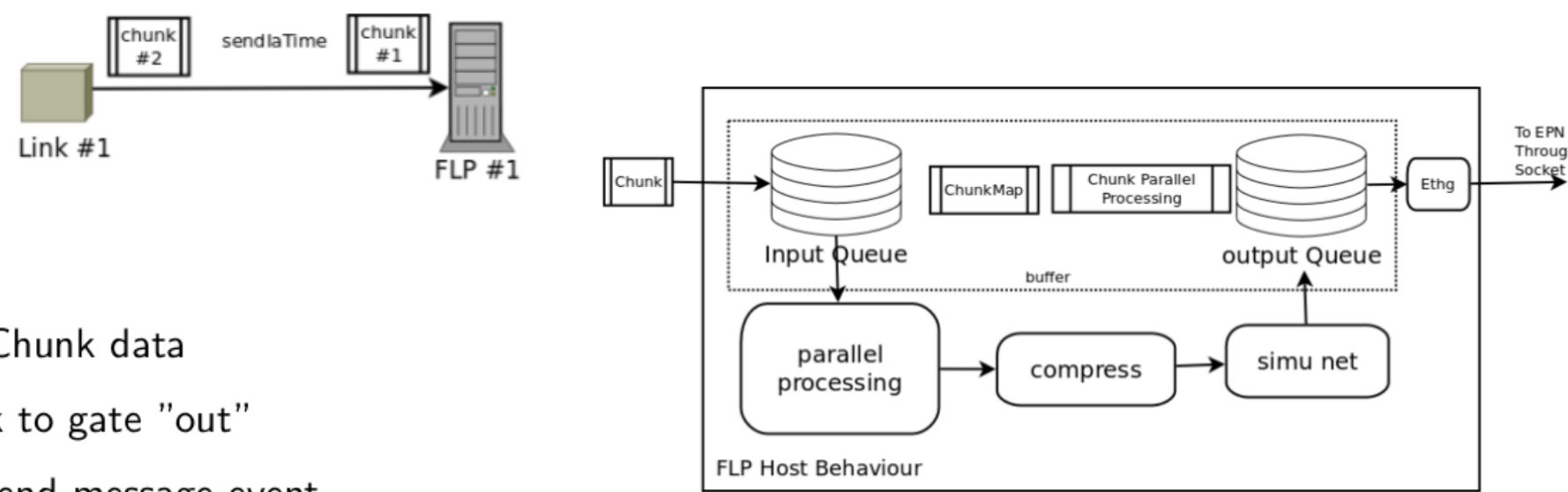


Figure 1: Structural Design of Simulation

### Source (Links)

```
simple Source
{
    parameters:
        volatile double sendTimeUnit(s);
        volatile double meanSendTimeUnit(s);
        volatile bool print = default(false);
        volatile bool readFromFile = default(false);
        volatile int Event_sizeUnit(B);
    gates:
        output out;
}
```



### Handle Messages

1. Prepare Event Chunk data
2. Send the Chunk to gate "out"
3. Schedule next send message event

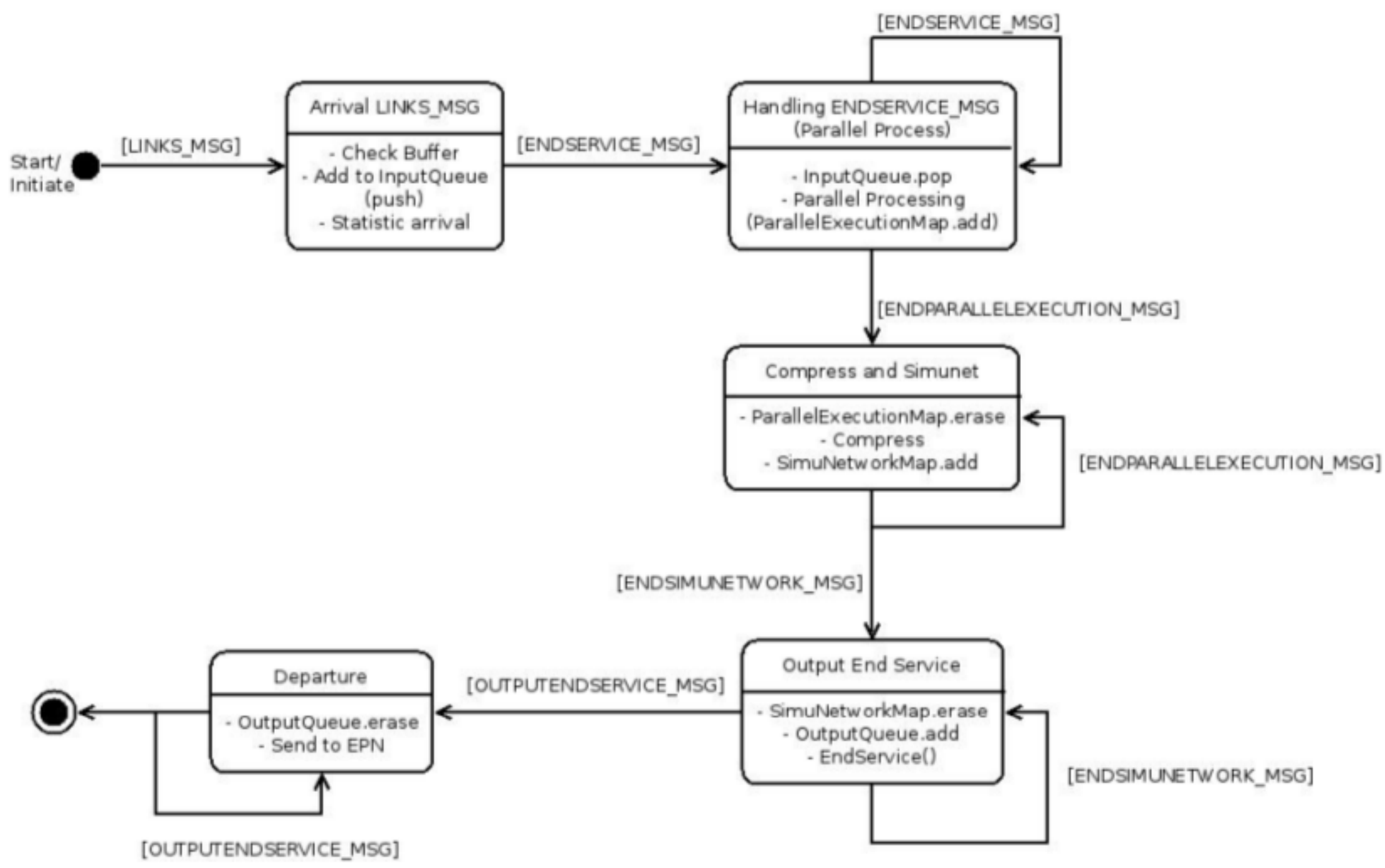


Figure 2: Behaviour Design of Simulation

### Results

#### Buffer Simulation

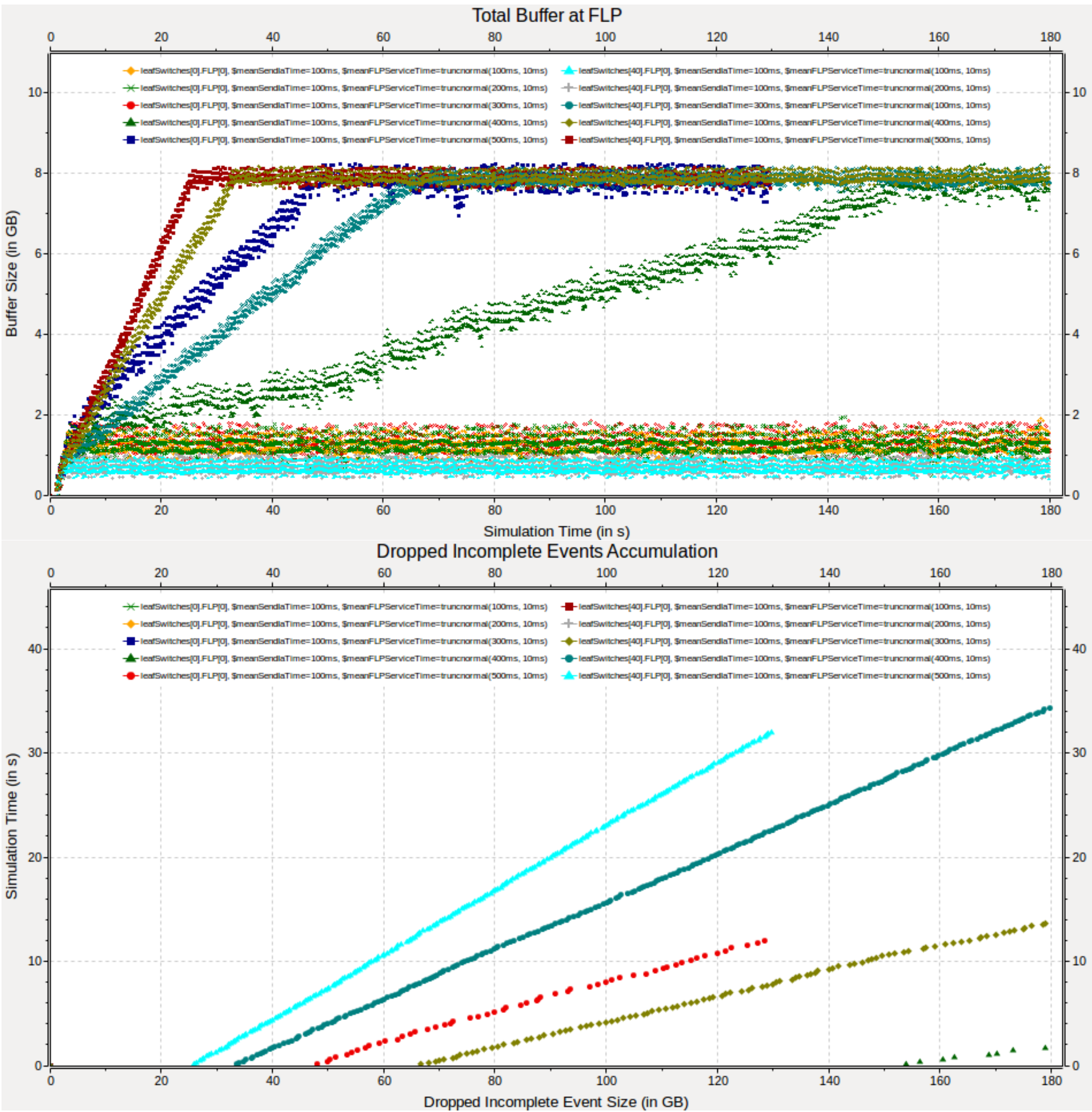


Figure 3: Total Buffer and Drop Event at FLP#0 and #40 with FLP Service Time {100,200,300,400,500} ms and Max Buffer Size 8 GB

#### Data Flow Timing

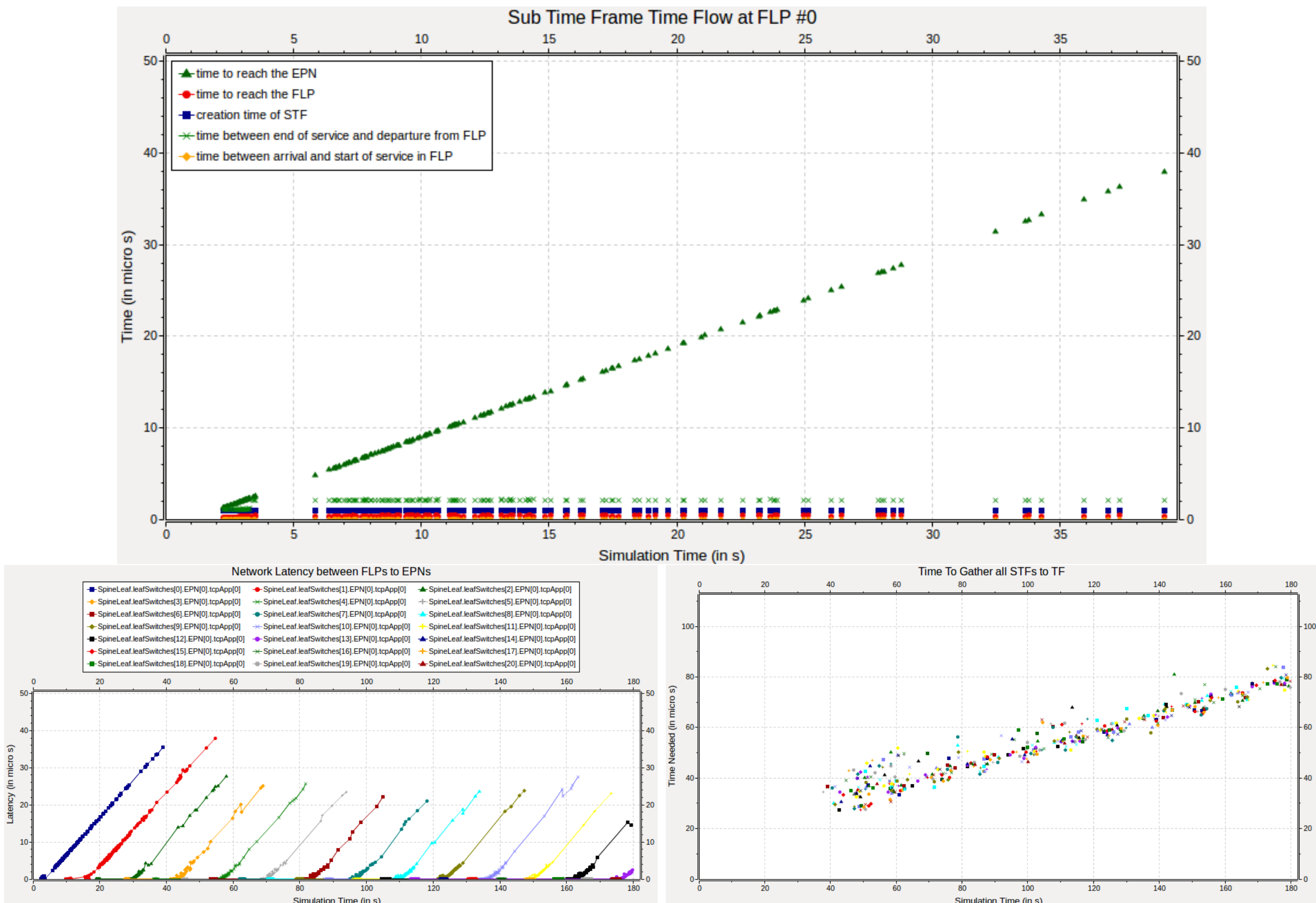


Figure 4: Time Evolution of STF (Sub Time Frame) at FLP#0 and Network Latency in several EPNs with Buffer Size = 8GB, service time at FLP = 100ms and

### Conclusions and Further Works

- Current simulation can produce buffer size and data flow timing for ALICE-DAQ simulation
- The results depends on service time in FLP and EPN, and maximum buffer size
- More refine behavior on FLPs and EPNs internal data flow are needed
- Validation against previous real data

### References

- [1] ALICE Collaboration et al. Technical design report for the muon forward tracker. Technical report, Tech. rep. CERN-LHCC-2015-001. ALICE-TDR-018. Geneva: CERN, 2015.
- [2] W. Asad Malik and U. Samee Khan. *Data Center Modeling and Simulation Using OMNeT++*, pages 839–855. Springer New York, New York, NY, 2015.