UNIVERSITÀ DI PISA

DEPARTMENT OF COMPUTER ENGINEERING

Edge Computing
Project Documentation

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Contents

1 Introduction

A cellular network is composed of M base stations, placed within a 2D floorplan of size L $\times$ H according to a regular grid. Each base station also has edge computing capabilities, i.e., it can receive computing tasks from cellular network's users and serve them at a rate equal to S instructions per seconds following a First Come First Served (FCFS) policy. Assume that all base stations are interconnected between each other via mesh topology.

1.1 Problem description

We consider N users placed at random locations `(x, y)` within the same 2D floorplan, where coordinates `x` and `y` are random variables to be defined later. Each user generates a new computing task request every T seconds, and each request consists of I instructions to be executed. T and I are exponentially distributed RVs. In particular, a user sends each new task request to its serving base station (i.e., the closest one), which in turn can follow one of methods below:

a) serve the request locally

b) forward the request to the less-loaded base station

1.2 Objectives

This project aims to fulfill the following:

- Evaluate the time required to complete a computing task for various values of N comparing method a) against method b)
- Evaluate the following scenarios:

  `x` and `y` are *uniform distributed* random variables in range

  $$x \in [0, width] \quad y \in [0, height]$$

  `x` and `y` are distributed as a *lognormal distribution* with parameters defined in subsection 2.2
- `TODO...`

1.3 Performance indexes

- Response time of the system (when a packet leaves the system)
- Response time of each queue
- Packet loss
- `TODO...`

2 Modeling

Our system is described by the following scheme

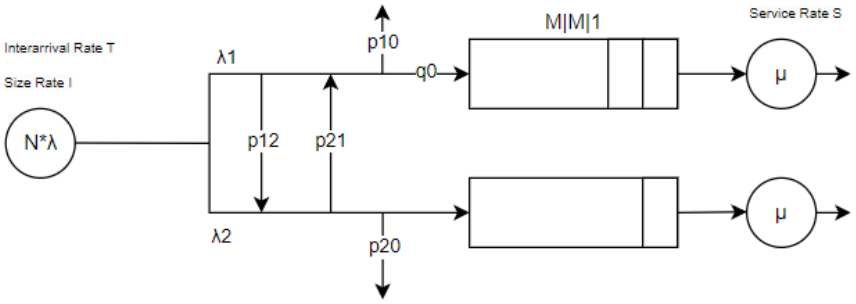

Figure 1: Scheme

As shown in Figure 1, each base station is modeled as an `M/M/1/k` system, as rates λ_i and μ_i are exponentially distributed random variables $\forall\ i \in [1, M]$.

2.1 Assumptions

We make some assumption in order to simplify the implementation of the system.

1. Rerouting propagation delay is constant for each base station.
2. Every job entering a queue is destined to be served and cannot exit the queue in any other way.
3. Each queue length is *finite* with `k` slots.
4. *(work in progress)* Width and height of the grid are such that it results in a square area.

2.2 Factors description

- `N`: number of users
- `k`: length of each queue
- λ_i: Interarrival rate for base station i
- μ: Service rate for each base station
- μ_{log}: Average of lognormal distribution
- σ_{log}: Standard deviation of lognormal distribution

3 Implementation

3.1 Modules

The following modules have been defined:

- **EdgeNetwork**: compound module wich represents the system and hosts the following simple modules
  - **BaseStation**: simple module which receives, precesses and (in case of scenario b)) forwards packets sent by users according to the specified distribution.
  - **User**: simple module which generates and sends packets (with length dependent by the specified distribution) to the nearest base station.

3.2 Modules' behaviour

3.2.1 EdgeComputingNetwork

- TODO...