RAE 555 Teletrafic theory.Course report

Salvador Moreno Carrillo StudentID:230AEB151

May 2024

Contents

1 Traffic and its metrics

1.1 Introduction and theory

Definition of teletraffic

Teletraffic engineering is the aplication of traffic engineering to comunication networks.

Traffic engineering is a branch of civil engineering that uses engineering techniques to achieve the safe and efficient movement of people and goods on roadways; knowing this we can say that teletraffic studies the flow of information through a telecomunication network and its main objective is to optimise the data transmition.
All in all the objective of the teletraffic engeeniering is to deliver as much data as posible, as fast as posible,as reliable as posible and as inexpesive as posible.

Traffic metrics

Traffic is defined by the following metrics.

•**Load** The amount of data that goes throug the system

•**Capacity** The maximum amount of data that can flow through a chanel or the whole syste.

•**Waiting time**

1.2 Problems

Problem Nrº1 In the context of the image, Tele-Traffic is related to the flow and management of data or information associated with the parcel locker machine of the delivery platform company. It involves the communication and coordination aspects to ensure efficient parcel delivery.

Problem Nº2 In this scenario, Tele-Traffic is evident in the entire process of parcel delivery. It involves the flow and exchange of information among the person at the first package locker, the parcel service truck, and the person at the second package locker. Tele-Traffic manages the communication and coordination needed for seamless parcel transfer between different locations.

Problem Nº2 Arrival Rate (λ): The arrival rate indicates the pace at which entities enter a system. In the scenario of the parcel locker machine, an arrival occurs when a person arrives to utilize the locker, whether it's for depositing or retrieving a package.
So, in this scenario: Arrival: A person approaching the parcel locker machine to perform a delivery or retrieve a package.

Arrival Rate (λ): The frequency at which people come to use the parcel locker machine for deliveries or pickups.

Problem Nº3 In this visual representation, the cloud at the center symbolizes a hub or distribution centre of a network.

The connected images around the cloud represent diferent serivices provided through the network.

• Phone: Provide voice and video calls in a mobile network.

• Shopping Cart: Representing e-commerce transactions and online shopping activities.

• Globe: Indicating global connectivity and international data exchange.

• Computer: Highlighting data processing and information exchange through computing devices.
•Lock: Suggesting security measures and encryption in telecommunication.

• Light Bulb: Could simbolize either an AI powered through the network or Smart house and domotics

• Web Browser Search: Representing online search and information retrieval.

Problem Nº4 In this illustration, Tele-Traffic can be found by the connection between "Alice's PC" and "Bob's PC" where the internet is the network and the data is the traffic load.

Problem Nº5 We may asume that the differnce in thickness can represent the difference of capacity in each Chanel.

Problem Nº6 Here we see a Petri net representation of the previous scenario ehre

The traffic is in the entities that are connect by both, sender and responder ($P_1, P_2, P_3, P_4, P_5, P_6, P_7, P_8$).

$T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8$ are the components which work in transmission.

The connection between each component symbolizes the flow of data and interactions among different components. Traffic occurs within the pathways and interactions among these elements. Traffic could is defined by its load and it is usually measured in a

$Mem \to Gbps/MaxGbpsStorage \to GiB/MaxGiBCPU \to TFLOPS/MaxTFLOPS$

Problem Nº7 The traffic in the HPC cluster anatomy is primarily distributed across the connections between different components. The flow of data occurs from the HPC user to the laptop, then to the login node through a secure connection. From the login node, the scheduler manages the distribution of tasks, and a dedicated network facilitates data exchange between the login node, computing nodes, and network storages.

Problem Nr 8 Understanding the relationship between reality, model, and application is essential for effectively managing and optimizing network performance. Firstly, we have a definition of these concepts.

- Reality: it refers to the real world what is actually happening.

- Model: it is a simplified representation of reality that captures essential aspects of a telecommunications network.

- Application: refer to the practical use of models to address real-world problems.

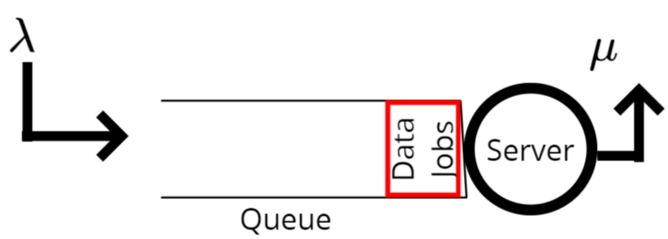
Problem Nº 9 In this scenario, data packets are transmitted from Alice's PC to Bob's PC via the web.

We can calculate $X(t)$ just subtracting $A(t)$ and $D(t)$. $X(t) = A(t)–D(t)$

2 Queueing Systems

2.1 Definition

Here we can see a model of a queueing system. Where jobs/data wait to be processed or served.



L=Load
λ=Arrival rate

μ=Departure rate
W=Waiting time

$$\lambda = \frac{k}{T_{obs}} \tag{1}$$

$$\mu = \frac{k}{T_{bussy}} = \frac{1}{W} \tag{2}$$

Little's formula

$$L = \lambda * W \tag{3}$$

Earlang's A formula

$$\rho = \frac{\lambda}{\mu} \tag{4}$$

From 1 and 2 we can define the next equations:

For M/M/1

$$P_0 = 1 - \rho \tag{5}$$

$$P_n = P_0 * \rho^n \tag{6}$$

$$L_q = \frac{\lambda^2}{\mu * (\mu - \lambda)} = \rho * L_s \tag{7}$$

$$L_s = \frac{\lambda}{\mu - \lambda} \tag{8}$$

$$W_q = L_q/\lambda \tag{9}$$

$$W_s = L_s/\lambda \tag{10}$$

For M/M/S

$$\rho = \frac{\lambda}{S * \mu} \tag{11}$$

$$P_0 = \frac{1}{\sum_{n=0}^{s} \frac{\frac{\lambda}{\mu}^n}{n!} + \frac{(\lambda/\mu)^s}{s! * (1-\rho)}} \tag{12}$$

If $0 \geq n \leq S$

$$P_n = P_0 * (\frac{(\frac{\lambda}{\mu})^n}{n!}) \tag{13}$$

If $n \geq S$

$$P_n = P_0 * (\frac{(\frac{\lambda}{\mu})^n}{S! * S^{n-S}}) \tag{14}$$

$$L_q = \frac{P_0 * (\frac{\lambda}{\mu})^S * \rho}{S! * (1-\rho)^2} \tag{15}$$

$$L_s = L_q + \frac{\lambda}{\mu} \tag{16}$$

$$W_q = L_q/\lambda \tag{17}$$

$$W_s = W_q + \frac{1}{\mu} \tag{18}$$

3 Analitical models

SAMPLE TXT

4 Markov Chains models

SAMPLE TXT

5 Petri nets model

SAMPLE TXT

6 Prism model checker

SAMPLE TXT

7 RabbitMQ

SAMPLE TXT