OPTIMIZING THE LATENCY OF THE 4G NETWORK BY USING ROUTING ALGORITHM

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1. Introduction

4G is a technology that will revolutionize how people communicate. This technology has been around for a long time and is now widely employed by individuals and businesses. In this research, data from users in the research area is collected to evaluate the services provided to analyze which ones are better and the best mobile operator in providing 4G services. One of the most serious concerns is network latency, which is primarily affected by the operational area and the speed of the servers themselves, and is a disadvantage of all communication networks, including 2G and 3G. Extreme latency is becoming increasingly common as networks grow. This research objective is to determine minimum network latency using a Routing Algorithm in 4G network and to classify which 4G network operators are the best by using Routing Algorithm. The Routing Algorithm has been used to determine the route or path that data packets will take from source to destination. They help to ensure that internet traffic is routed efficiently (Xia, Zhang, Yu, & Pan, 2016).

2. Methodology

There are four main steps to this research. The first stage focuses on collecting the data and measuring the data collected, with a survey done on 9 people who have used different types of network operators. There are three main network operators: National Network, Owned 4G LTE and Mobile Virtual Network Operator (MVNO's) Operator. For each main network, there are three minor network operators beneath each of them that is N1, N2, N3 for National Network, O1, O2, O3 for Owned 4G LTE and M1, M2, M3 for MVNO's. The study was reinforced by determining the source to destination distance, transmission medium speed, packet size, and data transmission rate for each gathered data. The second stage focuses on minimizing the network latency, with the data from the first stage being transformed into a few formulations that was defined as below and then used to run Python coding to determine the propagation delay, serialization delay, and minimum network latency for each mobile network operator. The third stage aims to validate the ranking result obtained in Stage 2 and the final stage is to classify the best 4G network operators.

At each phase, the algorithm chooses the best alternative while attempting to discover the best overall solution to the problem. This method is important for determining the optimum network for the latest gadgets and technologies, as well as optimizing performance and efficiency to enable new user experiences.

Thus, the formulation:

$$T_x(p_x, s_x) = p_x + s_x \quad (1)$$

where:

$p, s > 0$

$p_x = d/c$, *as in terms of wireless communication* $s = c$

$s_x = \alpha/r$

where:

$T_x(p_x, s_x)$	: Minimum network latency for each mobile operator
r	: Data transmission rate
d	: Distance from server to client
c	: Speed of light
px	: Propagation delay
s_x	: Serialization delay
α (constant of file size): 4,000 bytes	
x	: optimal number of hops in detour path

3. Results

As a result, this research discovered the National network operator for N2 is the finest among the others. By using Routing Algorithm, this study shows two crucial discoveries:

a. The network latency result of mobile operators and its propagation delay are lower when the transmission medium speed is higher. With the fastest transmission medium speed, which is 5143 m/s, the network latency becomes 16.46 m/s and the propagation delay is16.33 m/s.

b. The higher network latency of 4G is telco M3 which is categorized in MVNO's operator. The results show its network latency and propagation delay are 34.49 m/s and 34.41 m/s. It has the highest latency compared to the other mobile operators. This means that it has the highest time delay in 4G internet networks. Hence, it can be concluded that the best network operator that provides 4G network is N2 in the National Network Operator since it has the lowest network latency.

4. Conclusion

This method was utilized to determine serialization delay, propagation delay, and network latency for each mobile operator. The serialization delay was designed to accommodate for the time it takes for the network interface to sync a frame into the communication network. The duration of time from when the input to a logic gate or digital circuit becomes consistent and changeable to when the output of that logic gate becomes stable and changeable is known as propagation delay. The results suggest that N2 is the best mobile operator among the others, since it has the lowest network latency of 16.46 milliseconds. The propagation delay appears to be 16.33 milliseconds, with a serialization delay of 0.13 milliseconds, implying that N2 networks traversed the distance and transmitted the data in the least time of all the mobile networks.

5. References

Xia, H., Zhang, R. H., Yu, J., & Pan, Z. K. (2016). Energy-Efficient Routing Algorithm Based on Unequal Clustering and Connected Graph in Wireless Sensor Networks. *International Journal of Wireless Information Networks*, *23*(2), 141–150. https://doi.org/10.1007/s10776-016-0304-5