CHAPTER I

INTRODUCTION

1.1 Background

Current internet networks still use the host-to-host communication concept from 1960 to 1970, which is used to resolve the resource-sharing problem. The concept is no longer relevant to current internet users who prioritize the data rather than the location of the data or content-sharing. In 2009, Van Jacobson proposed a new network architecture based on the name of the content itself rather than the address on the IP and improving the content-sharing performance, namely Named Data Networking (NDN) [1]. The NDN router also has a cache mechanism to improve performance on the edge network, considering trending content cached on the edge router [2, 3, 4].

The widely used NDN routing mechanism based on decentralized routing, namely NDN Link State Routing (NLSR), cannot adapt to network quality changes, thus lowering the network adaptability. Several approaches are taken to improve the ability of the NDN routing; one of these approaches is using centralized routing or implementing a Software Defined Network (SDN), which can ensure the quality of the selected path, provide managing/monitoring tools, and offer higher adaptability by utilizing the managed global view topology. Several studies have used a similar approach, such as SDAR, which uses a centralized routing mechanism to create multi-lane routing and increases route selection responses [5]. SDN-Enabled control for Multipath Forwarding (S-MP) uses Content Store (CS) status in every router to determine the best route to better throughput over the current strategy. It leads to a more excellent Cache Hit Ratio [6]. Similar to S-MP, SDN-based Routing Scheme (SRSC) mainly focused on increasing Cache Hit Ratio in the network by

selecting the nearest cached content [7].

In contrast, CRoS-NDN focused on reducing routing overhead by separating the Control and Data plane and not consider the cached content on the nearest node [8, 9, 10]. Controller-based Broadcast Storm Avoidance Mechanism (CBAM) focused on resolving the Broadcast storm problem on a wireless network; CBAM uses a modified NDN packet as communication between node and controller, resulting in better performance than Geographic interest forwarding based on provider aware forwarding (GIF) and conventional flooding mechanism [11]. To provide adaptability, the Reactive routing mechanism by Kalafatidis uses a layer two routing protocol named B.A.T.M.A.N. to gather the network quality and select the best route, resulting in better adaptability than other methods [12].

All of the routing protocols mentioned above utilize additional protocols or modify NDN packets, which can make NDN increasingly dependent on other protocols. To address this issue, Assyifatunisa et al. [13] developed a centralized routing system based on hop count that only uses the NDN protocol. However, a hop count cannot assess current network conditions. Therefore, their implementation is no longer relevant.

To address the issues mentioned above, and based on the survey conducted by Ramadha et al. [14], this thesis proposes a Centralized Adaptive Routing (CARI) protocol utilizing NDN packets with a passive network quality measurement to support the path selection. With these approaches, this research expects better route selection, better Quality of Service (QoS) performance, and lower dependency on another protocol, such as SDN or B.A.T.M.A.N. Furthermore, this approach aims to meet the demand for networks with high adaptability considering that 74% of total connections are end users with mobile or fixed networks and network requirements are more complex than before [15, 16].

1.2 Problem Identification

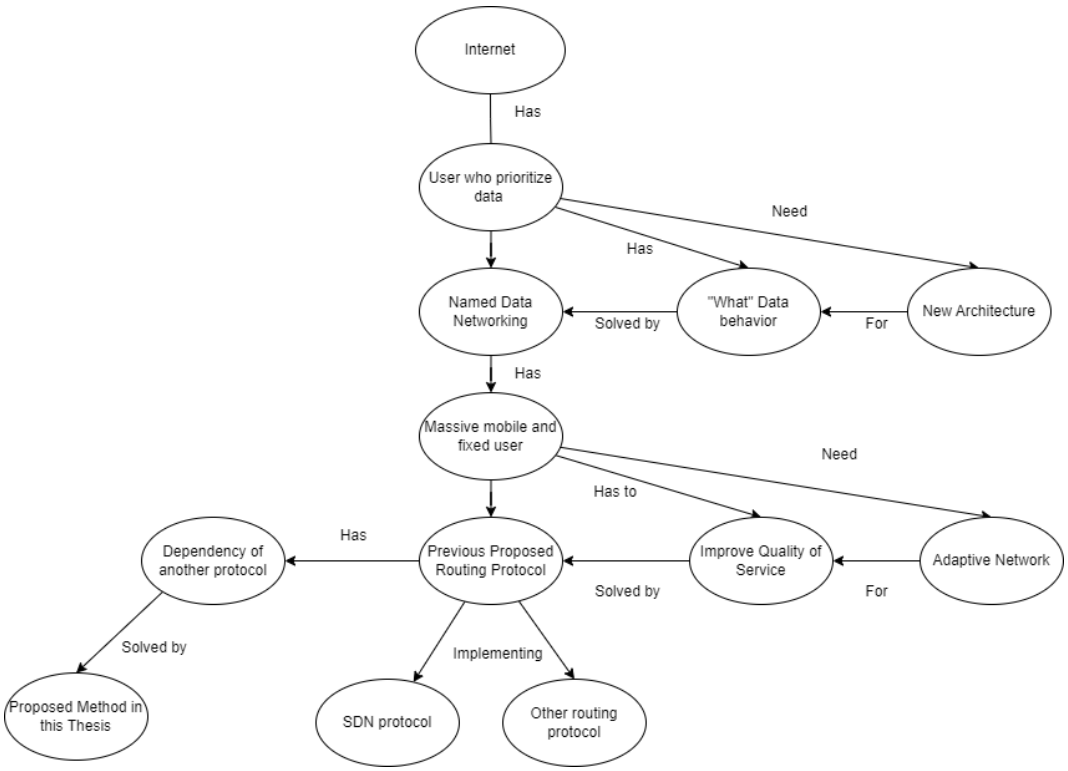

Figure 1.1. Mindmap used in this thesis

According to Figure 1.1, the internet currently has the problem of users prioritizing data rather than the location of the data. This problem can be resolved using a new architecture based on content, namely Named Data Networking (NDN). Increasing the internet for mobile and fixed users massively leads to lower QoS performance, and the need for an adaptive network arises. Several new NDN routing protocols address these challenges by implementing non-NDN protocol, another routing protocol, or modifying the NDN Packet. This approach can lead to higher dependence on other protocols, increase the complexity of the routing protocol itself, and harder to implement in NDN Testbed. To solve these problems, a new adaptive routing protocol with native NDN support is needed.

1.3 Objectives

Several objectives of this thesis are:

1. This thesis proposes a new routing protocol for NDN called Centralized Adaptive Routing (CARI)

2. CARI is an adaptive centralized routing for NDN, independent to Non-NDN Protocol.

3. Provide the best Quality of Service (QoS) possible in any situation or scenarios.

1.4 Scope of Work

1. Design a new centralized adaptive routing protocol called CARI.

2. CARI is implemented using GO Programming language.

3. Testbed is emulated on Packet Network emulator Tool Lab (PNETLab).

4. Adaptive mechanisms are based on Round Trip Time (RTT), Throughput, and Reliability.

1.5 Expected Results

Based on previous works, methods in [12] is considered the best practice for adapting to network topology and quality. It shows excellent results and high adaptability on the route selected compared to other works [5]-[11]. However, the methods still highly depend on another layer two routing protocol, thus increasing mechanism complexity. Centralized Routing proposed in [13] has addressed this problem, but the implementation still uses hop counts to determine the best path. Hop counts cannot account for network conditions, resulting in inaccuracies when determining the best path. CARI aims to simplify and reduce reliance on other protocols by utilizing NDN packets without additional routing protocols. CARI also provides adaptability by using a passive network quality measurement to achieve better route

selection and Quality of Service (QoS) performance, such as Throughput, RTT, and packet loss.

1.6 Research Methodology

Several work-packages (WP) are used in this thesis. These are the following WP includes in this thesis :

- **WP1:** Evaluate current implemented routing mechanism/protocol.
- **WP2:** Create centralized routing using only NDN packets.
- **WP3:** Evaluate several parameters that affect the route selection process and select the optimal routes.
- **WP4:** Implement parameters and route calculations to centralized routing.
- **WP5:** Evaluate and compare the CARI with the currently implemented routing mechanism/protocol.