CHAPTER 1

INDTRODUCTION

1.1 Background of the Problem

Information data exchange is currently based on the Internet Protocol (IP) network architecture. IP network architecture provides identity to data regarding the source and destination addresses. In an IP network, the most important thing is to know the source and destination IP addresses. Without thinking about how far the device with the destination IP address is located. Most data delivery models prioritize what data is needed without thinking about server and host locations. Even though the farther the distance between the server and the host will affect the quality of the resulting delay.

Named Data Networking (NDN), as a future internet network architecture design that is being developed, changes the viewpoint of a network that was previously host-centric to data-centric. If on an IP network, each device must know who or the IP address of the data content provider (server) and must arrive at that IP address, then on an NDN, the user does not have to know who the data content provider is, but which device is close to the user and owns the content. can send to users. This can happen because, in NDN, each router has a caching algorithm to store duplicate data from content providers (producers) and forwarding algorithms for data transmission mechanisms that make NDN able to speed up information exchange efficiently.

Although NDN was originally designed to improve the Internet communication structure. Currently, several research efforts are investigating the expansion of NDN in wireless networks, such as Vehicular Ad-hoc Networks (VANETs). NDN can natively provide many benefits, ranging from mobility and configuration support with low *cost*. VANET is a special network that provides wireless communication for moving vehicles and other infrastructure to reduce accident rates and collect various information related to the vehicle environment that is useful as a support for driver navigation to increase the safety of drivers and vehicle passengers. The traditional Internet architecture, namely TCP/IP, provides applications with a stable end-to-end connection between clients and servers to send information. However, in a vehicular environment, this connection is unstable due to the mobility of the vehicle which results in a change of location, of the client, server, or both. To overcome this situation, Named Data Networking (NDN) has been proposed as a new architecture for data capture and mobility support.

This new paradigm improves content access and dissemination by separating content from its original location (producer) [2]. The main objective of the forwarding and routing aspects of NDN networks is to overcome the routing inefficiencies that exist in current IP-based networks and ensure efficient data deployment, especially in vehicle environments. Stateful and adaptive forwarding operations have tremendous benefits for vehicle communications. To answer the VANET challenge in terms of links available in the data transmission process, a forwarding strategy scheme is needed that can support the VANET network using the NDN network architecture.

Broadcast-based self-learning forwarding is a data packet forwarding mechanism in network design. Self-Learning broadcasts the first packet with an unknown path across the network. When, and if, the response packet returns, a routing table entry is made towards the destination, so that future packets only need to be unicast in exchange for packet information [9]. Forwarding strategy on NDN, generally running the routing protocol in the packet forwarding process on the network. However, the forwarding approach will cause extra maintenance, configuration, and complexity in its implementation. To avoid running the routing protocol, self-learning forwarding is used, in this scheme, the network can learn routes by itself after broadcasting Interest packets based on the successful data packet retrieval route [6].

In previous research, self-learning was developed on Edge networks by carrying out developments in studying all routes in the network and being able to recognize network routes that are multiple paths that can support edge networks using the NDN [6] architecture. Another research that has been done is to develop self-learning forwarding for the MANETs network by balancing the flooding and self-learning mechanisms in building an NDN baseline in MANET [7]. The initial self-learning forwarding proposed has several limitations, including self-learning forwarding that can only learn one path, even though the network has more than one data transmission path, then interest flooding is sent in the process of sending data. Learning is carried out every time an interest arrives which can result in overhead on the network and cannot optimally support mobile networks with fast link changes.

In this research, optimization of self-learning forwarding algorithms will be carried out on VANET networks with NDN network architectures to support links available on mobile networks and reduce the overhead that can occur due to relatively fast delivery which is also supported by the advantages of this algorithm in simplifying routing protocol computations. on the forwarding scheme in the VANET network based on the NDN architecture.

1.2 Research purposes

The purpose of this study is to modify the self-learning forwarding algorithm on a VANET network with an NDN network architecture to support performance on a VANET-NDN network to reduce overhead due to flooding interest in forwarding schemes in a network based on an NDN architecture VANET.

1.3 Statement of the Problem

Forwarding Self-learning Algorithm, basically sends interest flooding in the learning process which is carried out every time an interest arrives which can result in overhead on the network and cannot support optimally for cellular networks with fast link changes such as VANET networks.

In this study, the self-learning forwarding algorithm used focuses on the goal of being able to reduce the Round-Trip Time on networks that can support VANET networks using NDN network architectures.

1.4 State of The Art

In [9] research, Self-learning mechanisms, such as broadcast-based self-learning, enable networks to adapt to fluctuating environments and support mobility without the use of routing or other control protocols. These advantages are especially apparent in mobile ad hoc and wireless network scenarios, where there is no stable infrastructure in place and repeated routing announcements would require excessive computation time and energy. Because self-learning does not require prior knowledge of the location of data, it also works well with data-centric network topologies like Named Data Networking (NDN). Although each forwarding technique may eventually identify a connection loss and move to a different path, emulation showed that bandwidth utilization and recovery times differ significantly. Self-learning NDN transmitted fewer packets during our experiments than broadcast and Ethernet.

In the next research [6], The prior method of self-learning had some shortcomings. First of all, even in the presence of numerous paths or data sources, it can only learn one path. Second, unlike faces, which have diverse ways of behaving—multicast Wi-Fi behavior is worse than unicast, for instance—it cannot learn and distinguish between different faces. Third, he does not take into account instances of delay tolerance where faces might not be present. Furthermore, the NDN forwarding plane's self-learning design is not entirely evident.

The following characteristics of the original self-learning are enhanced by this work: It can use many paths in the network and learn all of the current paths. After exchanging Interest-Data via multicast face over Wi-Fi, it is able to learn and select unicast face. The forwarding plane will buffer interests and forward them as routes become available in order to function in delay-tolerant settings. As they addressed the shortcomings of the original self-learning, such as only learning one path, being unable to learn and select among different faces, and not taking delay-tolerant cases where faces may not exist into account, these enhancements were more suitable for edge networks.

iVisa, an NDN adaptive streaming service, was used for the experiments. According to the experiment, if the active view producer goes down while a video is playing, the network would effortlessly switch to a different route without the user noticing. Last but not least, test cases using edge networks connected to gateways In the beginning, gateways have routes to external networks but edge networks do not. The nodes on the edge network learn the route from the gateway by self-learning once the consumer connects to a forwarder there. As a result, instances involving numerous network hops can be effectively handled by applied self-learning with the fewest possible hops.

Then in [7] research, According to this study, self-learning has some drawbacks, including the inability of nodes to determine which upstream creates NACK, which makes it challenging to take the appropriate course of action. Due to movement, NACK can be lost, which can result in an interest timeout. Sending NACKs may increase transmission overhead akin to exchanging protocol messages. Based on FIB incompatibilities, self-learning can discard unicast interests. Self-learning can broadcast unicast interests to FIB entries that have expired. Only the consumer decides on discovery, which results in numerous application-level timeouts and delayed responses to mobility, both of which are undesirable.

In order to build an NDN baseline in MANETs, the earlier self-learning was transformed into a data-centric ad-hoc forwarding (DAF) technique that strikes a compromise between flooding and self-learning. DAF only creatively modifies the NDN architecture to make it appropriate for MANETs, much like AODV does for IP-based MANETs. The next-hop over the shortest path to an IP address or a data name is something that both AODV and DAF attempt to understand.

To build an NDN baseline in MANETs, the suggested Data-centric Ad-hoc Forwarding (DAF) technique strikes a balance between flooding and self-learning. Like a self-learning method, DAF learns the next hop(s) to the data node(s). However, DAF relies on an in-network feedback-reaction mechanism rather than a consumer timeout-based broadcast and responds decentralizedly and opportunistically to any failures.

DAF establishes and updates FIB entries via positive and negative feedback, which reduces packet collisions and protocol messages. As a result of several application-level timeouts and slow responses to mobility, the prior self-learning technique used a consumer timeout-based broadcast to learn next-hop nodes towards data.

The findings of this study show that the topology-agnostic NDN design enables DAF to flexibly investigate and enhance the path between users and network nodes. It is feasible to avoid explicitly specifying routes before data exchange thanks to DAF.

The Ad-hoc on Demand Distance Vector (AODV) [7] on IP MANETs is the source of inspiration for data-centric ad-hoc forwarding (DAF). DAF aims to discover the subsequent hop along the shortest path to an IP address or data name, much as AODV. AODV, on the other hand, learns Routes before delivering or requesting data, while DAF broadcasts requests to the network using NDN interest packets. Similar to a self-learning forwarding mechanism, DAF learns the following hop to the data node. Instead of relying on consumer time-out-based broadcast interests, DAF uses network feedback reaction mechanisms to opportunistically detect potential faults.

1.5 Hypotheses

From the results of previous research related to the development of self-learning forwarding, it can increase throughput on the network because it can reduce the effect of a link failure on the network, then can reduce delivery delays, and ensure the availability of links properly.

Although self-learning can decrease retransmissions, it also causes high broadcast interest and packet loss. The process of broadcasting interest from consumers after an interest timeout is insufficient on mobile networks [7], where the probability of losing the link is quite high and can be disrupted with very frequent events, compared to utilizing a fixed network, of course.

As a result of the aforementioned claim, it is clear that the self-learning algorithm needs to be modified or optimized in order to support mobile networks, particularly those with very rapid rates of changing node positions on the VANET network, which have different needs than fixed networks.

1.6 Research Method

The research was carried out with the following steps:

1. Literature Study: Required to obtain a basis for conducting system modeling and working on forwarding strategy formulation.

2. Traffic Modeling item: perform network topology modeling and changes in the number of vehicle nodes that will be passed on the network.

3. Designing forwarding strategy algorithms, starting with identifying existing algorithms and developing forwarding mechanisms.

4. Writing the forwarding strategy code, so that the algorithm can be used, it is necessary to write the algorithm code on NFD.

5. Testing the forwarding strategy: Testing the forwarding strategy proposed in this thesis is compared with the existing forwarding strategy.

6. Data Analysis: Analysis of simulation results to determine network QoS performance, including Round-Trip Time (RTT), Cache Hit Ratio (CHR), and Throughput.

1.7 Problem Limitation

The scope of work of this research is:

1. The system is modeled using the NDN-based NDN4IVC Framework by combining the ndnSIM (NS-3-based NDN Simulator) and SUMO (Simulation of Urban Mobility) simulators for visualization of the vehicle node environment.

2. Not discussed the routing mechanism and path selection in the network.

1.8 Contribution

The contribution that can be made to this thesis research is to be able to improve the performance of the self-learning forwarding algorithm to match the characteristics of Named Data Networking (NDN)-based VANET networks by minimizing the value of Round-Trip time and maximizing the value of Cache Hit Ratio and Throughput in the VANET- NDN.