EVALUATING AVERAGE THROUGHPUT FOR QUANTITY OF DATA STREAM IN AN NDN RENDEZVOUS SERVER

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Abstract

This paper evaluates throughput to improve interest and data content transmission in the proposed distributed rendezvous server stream. An anchor within the network core is not considered but hence anchorless connection is adopted to aid routing between different locations of producer and rendezvous servers.This technique is simulated to present a seamless communication between producers and rendezvous servers.Using ndnSIM 2.1, performance analysis is measured to determine best route forwarding strategy and ensure minimal signalling cost and overhead. The mobile producers and servers were interfaced with Wireshark to capture packet and analyse the network statistics for throughput (moving average), segment length, round-trip time, sequence number and window scaling.

Keywords: *best route, signalling cost, producers and rendezvous servers*

INTRODUCTION

Mobility management in NDN is usually concerned with dynamic roaming, validation, and handoff between devices. Automatic/dynamic roaming comprise of network functions which enable a consumer/subscriber to acquire service from external provider network. This process uses dynamic protocols which require no consumer/subscriber actions. These roaming functions are subdivided into Mobile station (MS) service qualification, MS location management, MS state management and Home location register (HLR) and VLR fault recovery.
Validation require authenticating end users by identifying every consumer/subscriber.
The basic feature of Handoff is to guarantee consumer/subscriber and producer/publisher mobility in the NDN network. Handoff function is a tool that maintain connection to the moving network element. Handoff occur when a content consumer/producer moves from one network to another, new connection is set up with that consumer/producer and that old connection can be released. Managing handoff mechanism is, however, an issue in networking. The figure below present shearing an NDN content between devices [1][5]

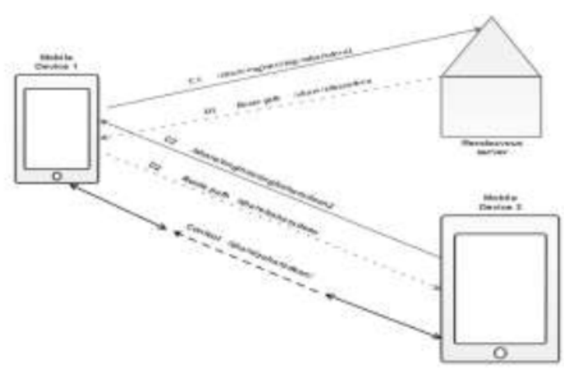

Figure 1.1: Content Shearing [1]

In this proposed content share scenario, a cluster of mobile producers share data with each other within the network. Each mobile producer behaves like a consumer and producer. In the experiment, two mobile producers will be considered as Zaharadeen1 and Zaharadeen2. Both have single data to shear using one prefix in the nearest rendezvous as /shear. Routing plane of the rendezvous is designed to transmit data in multicast form. The prefix is represented as /shear/photo.jpg. therefore, each mobile producer sends its request as C1 to the rendezvous. If the request is valid, a smooth path will be created to the prefix and an acknowledgement will be sent back to both mobile producer as data Data1. However, if more than two mobile producers request data, a forwarding tree will be configured at the rendezvous to serve all the mobile producers dynamically as they connect as leaves of the tree [6][7][9].

RELATED WORK

The structure of Location management is based on the producer's mobility characteristics of incoming and outgoing contents. By using the technique of location update (LU), the NDN network maintain the mobile producer's location to direct incoming/outgoing contents. The process of delivering content (paging) broadcast contents to every cell that can locate a mobile producer. However, there exist an incompatibility between location update and paging cost in networks. This means when location update cost is high, paging cost must be low because paging takes place in limited coverage. On the other hand, when location update cost is low, paging cost becomes high because it takes place in wide coverage. Location management is highly applicable to periodic location update or location update - location areas crossing. The visitor location register deposits/caches the location area identification while Home location register maintains visitor location register identifier. In periodic location update technique, a mobile station transmits its identity in based on time interval to the NDN network. A major challenge of this technique is resource consumption wastage such that when the mobile producer could not achieve handoff from a location area for hours, resources will be consumed[11][12].
Each base station in location update - location areas crossing technique transmit broadcast based on time intervals to identify its location areas. It is necessary for the Mobile Station to frequently listen to content broadcast in the network and deposit/store the existing Location Areas identity when the received identity changes its name from the deposited copy in the Mobile Station. The Mobile Station initiate a dynamic Location Update. Hence, the advantage of this technique is that when the Mobile Station moves, Location Update messages are sent as broadcasts.[8]

Mobile Registration

The process by which a mobile producer is detected at a new Mobile Access Gateway is known as mobile registration. Network registration is a subcategory of dynamic/automatic roaming functions. Network registration comprise of Mobile Station service and Mobile State location management that support a producer in registering on a network. Also, it signifies to the network location register devices, location and situation or status of Mobile Station. Registration processes must be conducted before the NDN network offer its service.[6]

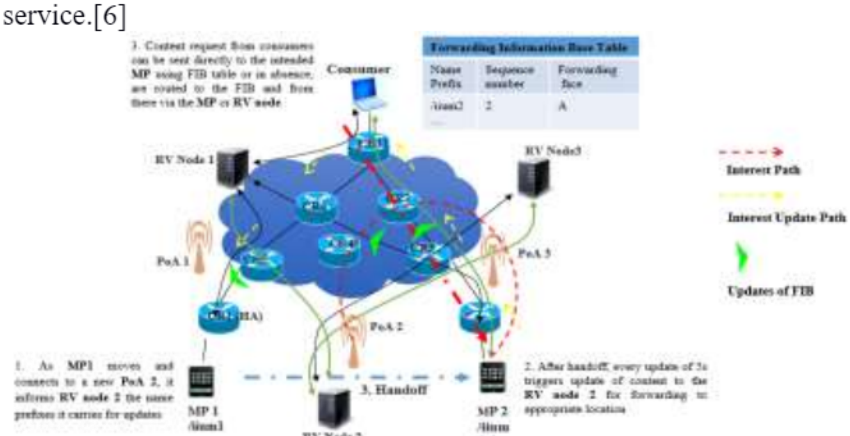

Figure 2.1: Content notification (Updates) [5]

ISSN: 2005-4238 IJAST

In (figure 2.1) above, each time MP1 achieves handoff, a special Interest is being send to RV node 2 called Interest Update of each name it operates. Thus, the interest is further updated on the FIB table to reach MP1 previous location as shown in figure 4.3 above. When the Handover Initiation is delivered, MP2 performs a check on the sequence number. If it matched, MP2 then creates another message for EBU using the content updates it received encapsulated again with Handover Initiation. This process creates a list by MP2 as a new attachment into its FIB including new Home Network Prefix and Mobile Network Prefix (HNP, MNP) [1][2][3].

Table 2.1 summary of Related work

Authors	Contribution	Results Achieved	Limitation
[1]	• Presents KITE as tracing-based technique for producer mobilitysupport • Established oft-stateforwarding links using interest-data exchange validation in between two producersand a rendezvous server.	• Showed locator-freeness, and content reception transparency as positive gains to the rendezvous • Deploy the use of KITE to create application protocolsfor several mobility scenarios. • Presents results of performance evaluation in numerical and content simulations.	• Could not cover distributed server for scalability • Could not cover trace maintenance to minimize signalling overhead.
[2]	• proposed on-demand anchored mobility support • supports on-the-fly path retransmission at previous producer location	• Results validates an algorithm that mitigate network overhead and boost the period content can be retrieved in mobile NDN network	• Could not address anchorless mobility of producers
[3]	• This paper proposes a producer mobility support scheme in NDN specifically for real-time multimedia delivery scenarios to reduce handover delay and to improve consumer experience with delimited overhead	• Analytical result presents the scheme's is enhanced compared to the normal NDN and other approaches on delay with delimited overhead	• Could not present future directions for research.
[4]	• Proposed that prediction approach can offer successful handoff of the producer in an anchor-less mobility situation in real-time	• Present low level of location projection accuracy. • Present less handoff latency and round-trip time with no overhead	• Could not implement location update and registration but proposed as future work.

SIMULATION

This simulation is run to determine the rate of transmission for amount of data stream in each rendezvous server deployed in the network set-up (see figure 3.1). This physical network configuration is conducted using GNS3 to ensure all communication devices have reachability. The coding aspect is run using ndnSIM2.1 which is an NS-3 based Linux software. Hence, results are generated using Wireshark. Packets on each router were captured in Wireshark as configured accurately to produce desired results of network statistics. In figure 3.1, our main focus ison the 4 rendezvous servers each having different network connections and different name prefixes. Each local mobile consumers and producers can request any network applications (audio or video) in real-time.

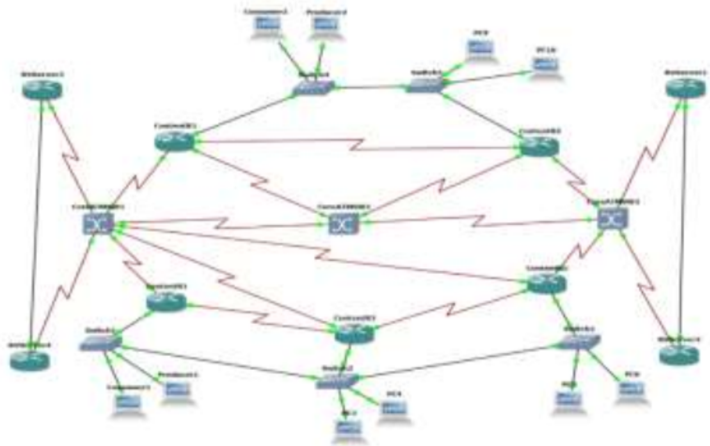

Figure 3.1: Simulation Set-up

In the coding aspect (ndnSIM), the rate of transmission of the four rendezvous server are directly proportional to each other and uses best route forwarding strategy of NDN. Our content store has a storage amount of 150 per rendezvous, speed/velocity of interest/data mobility as 250m/s and the value of best route is set to 5 cycles during each content hit (request).

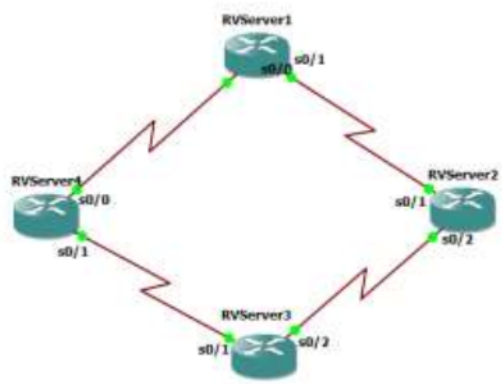

Figure 3.2: Data Stream of the four RV Servers

In this simulation, the consumer acts as the usual NDN Consumer. The mobile producer exchange interest and data between itself and any of the reaching rendezvous server. Then the rendezvous broadcast on-demand content prefix based on intervals of 0.5sec to a desired destination using best route strategy.

For the number of data stream in the four rendezvous servers, each server consists of data content streams of length between 100 to 1500. The amount of data fetching delay is measured in the network for 30 combination of both consumers and producers that are connecting 300 data streams in short period of about 900 seconds (15mins). A fix ratio between the consumer and rendezvous is also constant as 12 consumers per rendezvous.When transmitting an Interest Content, the average time can be computed using the descriptive graph as follows

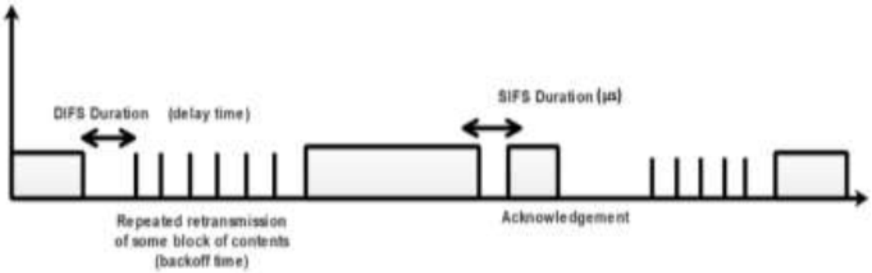

Figure 3.3: Mechanism for IEEE 802.11 wireless [5]

In figure 3.3, DIFS refers to a tool that computes and display variation between two files, SIFS is a Short Interframe Space and is the time Wi-Fi interface computes a received frame and reply with a response frame. Finally, the back off time is only a period [5].

$$SIFS = 20\mu s$$
$$Slot\ Time = 25\mu s$$
$$DIFS = SIFS + (2 \times Slot\ Time) = 20 + (2 \times 25) = 20 + 50 = 70\mu s$$
$$Minimun\ Congestion\ Window = 20slots$$
$$Average\ Backoff\ Time = \frac{Minimum\ Congestion\ Window}{2} \times Slot\ Time = \frac{20}{2} \times 25 = 250\mu s$$

$$Max.packet\ Data\ Unit\ (MPDU)\ size = 1400 + UDP + NDN\ Header + MAC\ header$$
$$\Longrightarrow 1500 + 8 + 20 + 40 = 1468bytes$$
$$Time\ for\ transmitting\ (sending)\ packet = PHY\ overheads + \frac{MPDU\ size}{Data\ Rate}$$
$$= 40 + \frac{1468 \times 8}{72.2} = 40 + 162.7 = 202.7\mu s$$
$$Time\ for\ transmitting\ ACK = PHY\ layer\ overhead + \frac{Ack\ packet\ size}{Ack\ data\ rate\ (1st\ modulation)}$$
$$= 40 + \frac{32 \times 8}{7.2} = 40 + 35.56 = 76\mu s$$
$$Av.time\ per\ content$$
$$= Time\ for\ sending\ ACK + Time\ for\ sending\ content + Av.Backoff\ Time + DIFS$$
$$= 76 + 202.7 + 250 + 70 = 598.7$$
$$Average\ Throughput = \frac{Application\ payload}{Average\ time\ per\ content} = \frac{1500 \times 8}{598.7} = 18.68Mbps$$

Therefore, the proposed average throughput is higher and more feasible as compared to my benchmark [5] which is less by 5.16Mbps.

RESULTS

In the results, we assess attempt rate,probability of interest/data collision and average throughput. We ensured no one-to-one attachment between two mobile producers, rendezvous server and name prefixes. Hence, a mobile producer is always capable of generating data contents even during multiple request by consumers. It can also receive contents of network applications from the rendezvous server such as voice or video.

Communication overhead consists of physical, media access and the upper layer overheads. Usually, overheads are crucial for high data rate as well as small packet size. Network issues such as channel error may affect performance highly. The topmost layers may probably carry excessive overhead in terms of TCP, and ACKs. However, to improve performance, it is important to consider bandwidth management,

ISSN: 2005-4238 IJAST

and content (frame) aggregation for MAC Protocol Data Unit and MAC Service Data Unit to enhance better throughput and efficiency.

In term of random access that is given to gateway routers (producers and consumers) within the proposed network, collision and retransmission can lead to throughput loss, channel access delay and can also have effect on rate adaptation algorithms. The proposed work introduces the concept of Carrier-sense Multiple Access with Collision Avoidance (CSMA/CA) and Request to Send/Clear to Send (RTS/CTS) to the wireless network to overcome and overcome the issue of collision and throughput loss.

From our simulation of packet trace file, we can deduce the attempt rate from benchmark [5] as

Attempt Rate

$$Attempt\ Rate\ = \frac{Number\ of\ transmissions}{Simulation\ Time} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots.1$$

Also, to deduce the collision probability

$$Collision\ Probability = \frac{Number\ of\ collided\ transmissions}{Number\ of\ Transmission} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots.2$$

Finally,

$$Average\ Throughput = \frac{Application\ recieved * 8}{Simulation\ time} \dots\dots\dots\dots\dots\dots\dots\dots..3$$

Therefore, the proposed scheme simulation presents its average throughput as follows

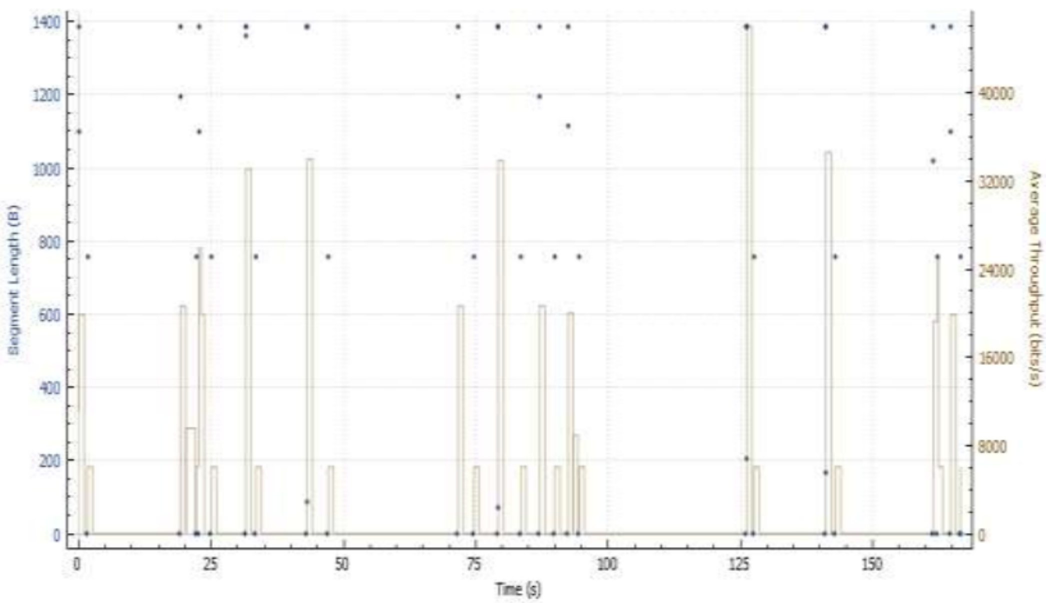

Figure 4.1: Throughput and Segment Length Vs Time

As a result of the data rate used in the analysis and deployed in simulation, the throughput increases with distance covered in the network of 48000meters. The maximum attained throughput is at 125seconds.

For the round-trip time (RTT), the maximum producer mobility is recorded as velocity of 28.5ms, in the first simulation round. See figure below.

ISSN: 2005-4238 IJAST

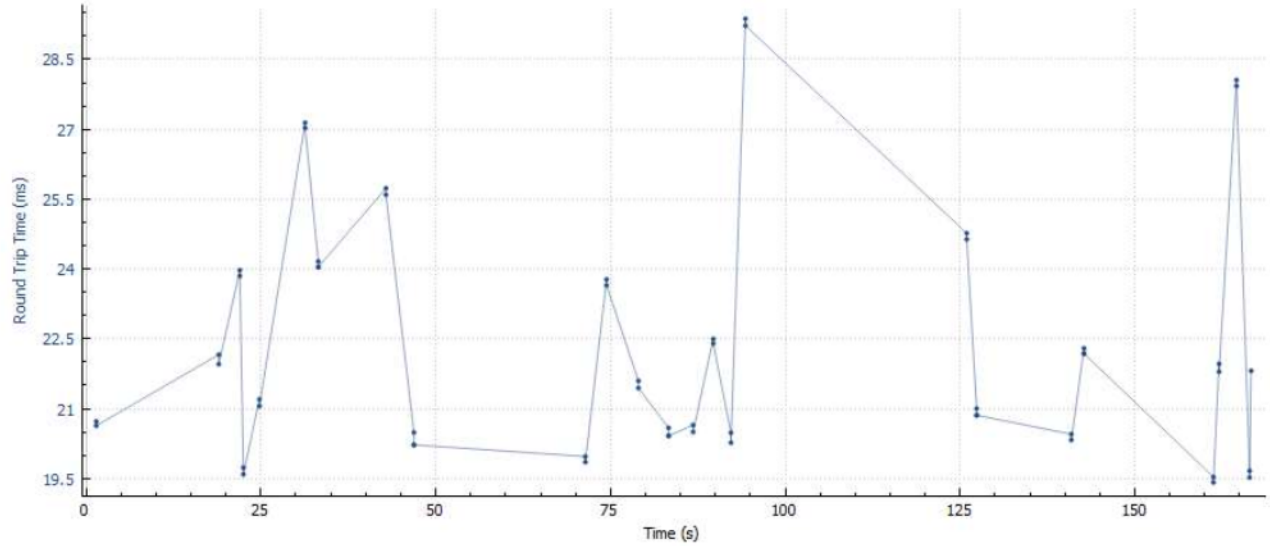

Figure 4.2: Round trip time Vs Time

In the figure below, the RTT is measured for another round of simulation and have recorded consistent producer's movement in the network at about 42ms velocity for a period of 150seconds.

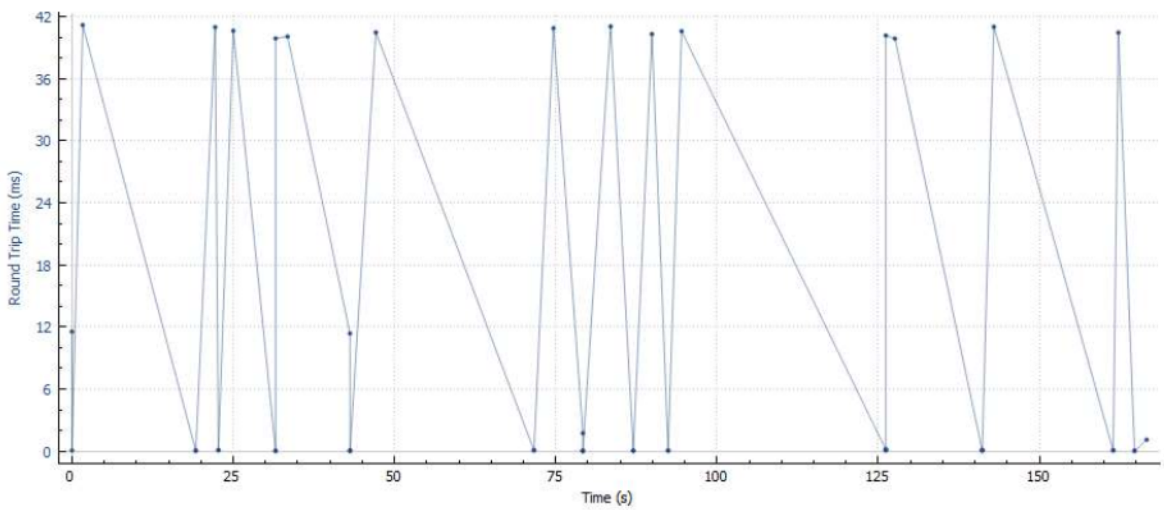

Figure 4.3: Round-Trip Time Vs Time

This means that a single segment of an interest content in every round trip time exist with no regards to the number of acknowledgements received. Also, slow start raises the congestion window by the quantity of acknowledgments received in each round-trip time.

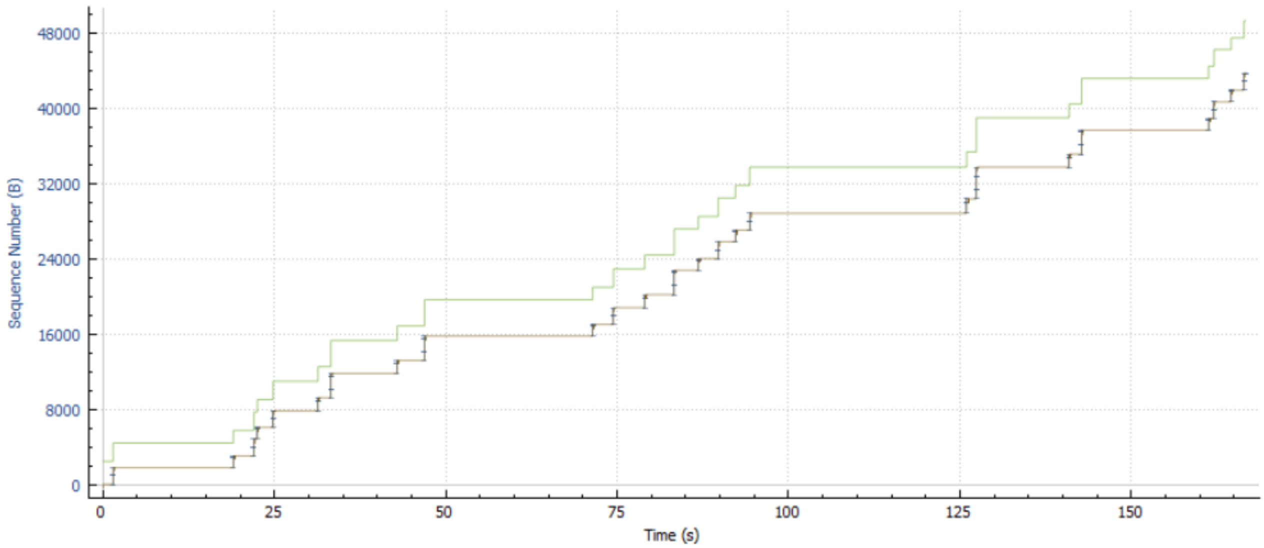

Figure 4.4: Sequence number Vs Time

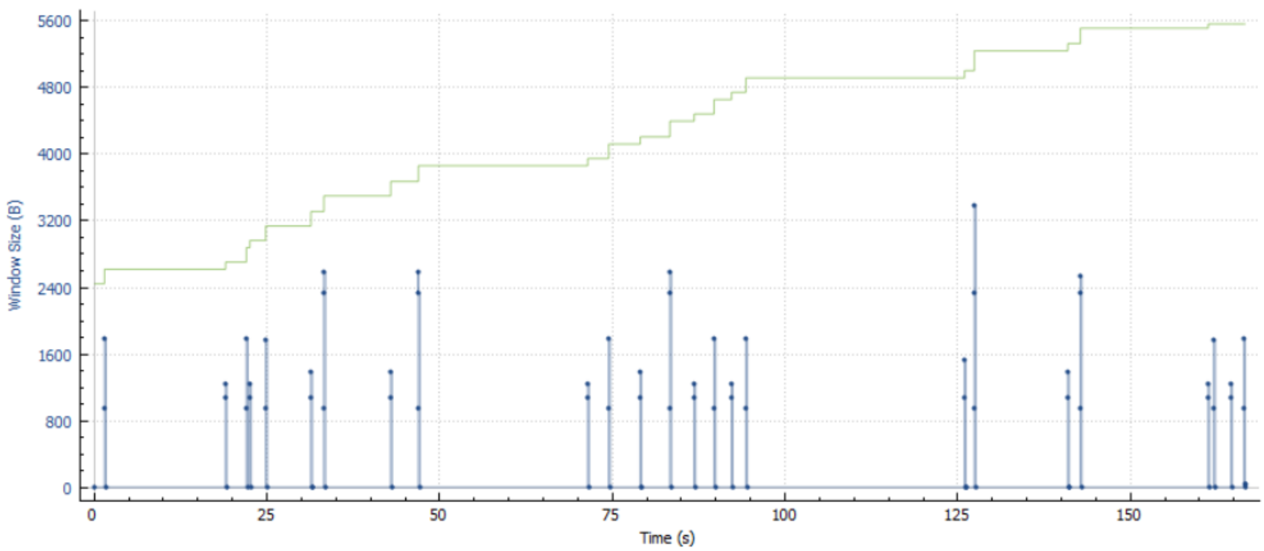

Figure 4.5: Window Scaling Vs Time

For the window scaling in the proposed network, the graph presents the period at which the window size attains its slow start threshold (ssthresh) to avoid congestion. The congestion avoidance is minimized to enhance interest retransmission as compared to the TCP variant (Tahoe, Reno and Sack) of benchmark.

CONCLUSION

This paper present throughput for data stream in an NDN rendezvous server and support producer mobility. This process is established using best route forwarding strategy through unique interest/data content exchange sheared between producers and rendezvous servers. We also ensured anchorless connection between different locations of the rendezvous servers. The physical network setup is designed in GNS3 (graphical) and ensured overall communication between all the devices. The performance of the rendezvous servers is evaluated using ndnSIM 2.1 (NS-3 based) and contents were captured using Wireshark for parameters such as throughput (moving average), segment length, round-trip time, sequence number and window scaling.In future work, packet loss, and handoff delay in communication will be assessed and differentiate by comparing with other benchmarks

ACKNOWLEDGMENT

We are grateful to Kementerian Pendidikan Malaysia for supporting this research under the grant ID of FRGS/1/2019/TK04/UIAM/02/2.

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ISSN: 2005-4238 IJAST