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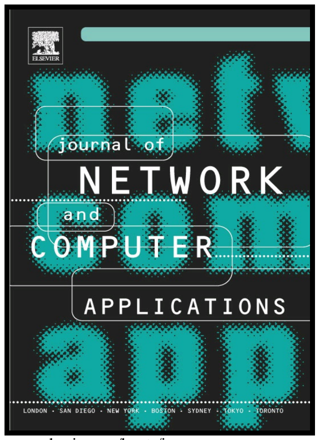

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Raaid Alubady, Suhaidi Hassan, Adib Habbal

PII: S1084-8045(17)30360-0
DOI: https://doi.org/10.1016/j.jnca.2017.11.002
Reference: YJNCA2005

To appear in: *Journal of Network and Computer Applications*

Received date: 16 June 2017
Revised date: 22 September 2017
Accepted date: 10 November 2017

Cite this article as: Raaid Alubady, Suhaidi Hassan and Adib Habbal, Pending Interest Table Control Management in Named Data Network, *Journal of Network and Computer Applications,* https://doi.org/10.1016/j.jnca.2017.11.002

Pending Interest Table Control Management in Named Data Network

Raaid Alubady[1, 2], Suhaidi Hassan[1], Adib Habbal[1]

[1]InterNetWorks Research Laboratory. School of Computing, University Utara Malaysia, 06010 Sintok, Kedah, Malaysia

[2]Information Technology Collage, University of Babylon, Babylon, Iraq

raaid.alubady@internetworks.my

suhaidi, adib@uum.edu.my

Abstract

Named Data Networking (NDN) is an emerging Internet architecture that employs a new network communication model based on the identity of Internet content. Its core component, the Pending Interest Table (PIT) serves a significant role of recording Interest packet information which is ready to be sent but in waiting for matching Data packet. In managing PIT, the issue of flow PIT sizing has been very challenging due to massive use of long Interest lifetime particularly when there is no flexible replacement policy, hence affecting PIT performance. The aim of this study is to propose an efficient PIT Control Management (PITCM) approach to be used in handling incoming Interest packets in order to mitigate PIT overflow thus enhancing PIT utilization and performance. PITCM consists of Adaptive Virtual PIT (AVPIT) mechanism, Smart Threshold Interest Lifetime (STIL) mechanism and Highest Lifetime Least Request (HLLR) policy. The AVPIT is responsible for obtaining early PIT overflow prediction and reaction. STIL is meant for adjusting lifetime value for incoming Interest packet while HLLR is utilized for managing PIT entries in efficient manner. A specific research methodology is followed to ensure that the work is rigorous in achieving the aim of the study. The network simulation tool is used to design and evaluate PITCM. The results of study show that PITCM outperforms the performance of standard NDN PIT with 45% higher Interest satisfaction rate, 78% less Interest retransmission rate and 65% less Interest drop rate. In addition, Interest satisfaction delay and PIT length is reduced significantly to 33% and 46%, respectively. The contribution of this study is important for Interest packet management in NDN routing and forwarding systems. The AVPIT and STIL mechanisms as well as the HLLR policy can be used in monitoring, controlling and managing the PIT contents for Internet architecture of the future.

Keywords
Future Internet, Information-Centric Networking, NDN routing, Network simulation.

1. INTRODUCTION

Over the years, the number of people using Internet has escalated [1]. Hence, the Internet has become the most important medium for information exchange and the core communication environment for business relations as well as for social interactions [2]. In addition, The dramatic growth in online video, e-commerce, social networking and smart phones has been led to the dominant use of the Internet as a distribution network [3]. Therefore, it is expected that the number of devices (e.g., mobile devices, computers and sensors) of the Internet will soon grow to be more than 100 billion [4], which may result in a huge amount of data being requested and transferred over the Internet, reaching approximately 1,000 Zettabyte in 2016 based on the Cisco Virtual Network Index (CVNI) [5]. The success of the Internet has created higher hopes and anticipations for new services and applications. Consequently, the current Internet nowadays may not be able to support sufficiently [6].

Today's applications are characterized in terms of what that the subscriber wants, rather than thinking about where it is located. This new proposed architectural design for the future Internet is termed as Information-Centric Networking (ICN) [7]. The ICN paradigm consists of redesigning the future Internet architecture, placing named data rather than host locations (i.e., IP addresses) at the core of the network design. The design concepts of ICN, as discussed in [8]–[13], is one of the important efforts of several global future Internet research actions. In such systems, the central paradigm is not End-to-End (E2E) correspondence between endpoints, as in the present Internet design. Rather, an expanding interest for profoundly adaptable and proficient content distribution has motivated the advancement of architectures that focus on data objects, their properties, and user's interest for the system to accomplish a reliable and efficient distribution of such objects [14]. While mounting the future Internet architecture, many challenges occur that may attract the attention of the researchers, such as routing naming, name resolution, mobility and security [15] as well as scalability, bandwidth, network management, network security, content protection and privacy, trust models, fast forwarding, performance reliability, intelligent distribution of information, robustness and efficiency [16]. Thus, to cope with these challenges, different Internet architectures of the future emerged under the umbrella of ICN, such as 4WARD-NetInf [17], Content Centric Networking (CCN) [18] and Named Data Networking (NDN) [19].

NDN is a proposed new architecture of the future, which is based on networking basics that are driven by hierarchical content names [9]. Hence, It is resolve a traffic explosion problem resulting from the repeated delivery of a large amount of contents [20]. Thus, it leads to support applications with implications for social and economic dimensions of today's Internet environmental system [21]. The new architecture proposed a