Efficient Duplicate Name Prefix Detection Mechanism in Content-Centric Network

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Abstract. The rapid spread of smart devices gives rise to explosive content creation and sharing of content. Thus new network architectures become necessary. To meet such a trend research works for content-centric network are actively underway. However, in the content-centric network, mobile content source creates problems to waste network resource due to duplicate name prefix detection (DND) processing in tunnel-based redirection (TBR) scheme. So, this paper proposes an efficient DND mechanism in mobile CCN environment to provide lower overhead and content's fast access.

Keywords: Content-centric networking, Mobility, Mobile contents, Device mobility management

1 Introduction

Because of the rapid development of mobile communication technology and the increasing prevalence of smart devices, users create and share content regardless of time and place so they became the new network architecture is necessary. Hence, an efficient networking model that guarantees more efficient use of network resources is required: information-centric networking that data are routed based on content name instead of Internet's host-based communication like source, destination address. There are typical examples: PSIRP, 4WARD, NetInf, DONA and CCN [1, 2]. Among these proposals, this paper mainly deals with the content-centric networking (CCN) architecture.

In CCN, content consumer mobility handled well because CCN's receiver-driven nature that there is no need for location update [1, 3, 4]. But, the movement of content sources includes problems (i.e., frequent routing update, long service disruption). To handle the problems of mobile content sources, the tunnel-based redirection (TBR) [1] scheme is presented. TBR scheme induces problems due to long latency of DND (Duplicate Name prefix Detection) scheme. Thus, this paper proposes an efficient DND mechanism to solve the overhead and long latency as well as to increases efficiency.

2 Inefficiency of duplicate name detection in mobile CCN

CCN using content cache is very efficient for content sharing. However it is not efficient for the node movement. It assumes the CCN's mobile scheme is defined in two types. (The movement of mobile consumer and that of mobile content source) Consumers' movement is not a big problem because content consumer sends again the data from the new location. However, content source's movement has problems. That is, mobile content source induces full routing update, which results in increasing latency. To solve the problems of mobile content source (MCS), TBR scheme is indicated in [1]. In [1], TBR's DND mechanism is required for the new tunneled routing to the new location. However, TBR's DND scheme has inefficiency. Because it assumes typically interest transmission, it waits for 5 seconds to guarantee the uniqueness of the tentative prefix. So, this paper proposes efficient DND mechanisms that consist of message for effective communication named DND request message to reduce process time of DND operation.

3 The proposed fast DND mechanism

This paper proposes message named DND request for effective communication to shorten the latency of DND mechanism in mobile CCN environment by using new fast DND (FDND) mechanism.

3.1 The operation of the fast DND (FDND) mechanism

As indicated in section 2, mobile CCN scheme utilizes DND mechanism to prevent the usage of the same domain name for MCS. However, the DND mechanism assumes interest-based operation, which results in long hand-off latency. (i.e., over 5 seconds) So, the objective of the proposed mechanism is to reduce the latency of DND operation. The proposed mechanism is composed of 3 steps.

Step1. Movement detection: An MCS detects network status' change by using physical link information or network address. At the same time, the MCS enters the network via wireless access points. It is assumed that the initialization data is provided to the MCS by the wireless access points that would contain a collection of CRs available inside the access domain network. The MCS decides whether prefix update message should be sent by the initialization data from wireless node.

Step2. DND operation: After detecting the movement between domains, MCS initiates the proposed DND operation. For DND checking, the new message named 'DND request' is presented. To reduce DND operation latency, the proposed mechanism adopts shorter PIT-timeout than TBR scheme. That is, 1 second PIT-timeout for DND registration is assumed. The new format of DND request message is shown in Figure 1. DND request message is composed of three components. 'Tentative prefix' field means MCS's new prefix. 'DND' field means that this message is for DND operation and then PIT-timeout value is set to 1 second. Finally,

'Hop Count' field is utilized to guarantee that DND request message is transmitted only in the same domain.

Fig. 1. DND request message

Step3. Name registration: MCS registers its tentative prefix to CR_h. After that, when receiving interest packet for the MCS, CR_h generates new interest packet encapsulating original interest packet and then forwards the encapsulated interest packet to MCS's tentative name prefix. So, intermediate CRs deliver the encapsulated interest packet to the MCS through a basic CCN forwarding method.
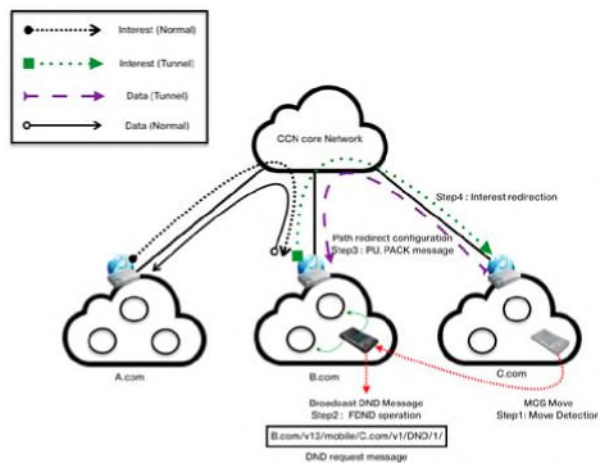

Fig. 2. Operation of the proposed DND scheme

For example, in Fig. 2, MCS moves from C.com to B.com. On detecting B.com, MCS send DND request message in the same domain to find whether the tentative prefix, configured by the MCS, is being utilized by other nodes. If any response is received, MCS has to configure another tentative prefix and then send DND request message again. Otherwise, the tentative prefix is verified in the uniqueness. The PIT timeout for the DND request message is set to 1second. After that, the name registration to CR_h is progressed.

3.2 Comparative analysis

Table 1 shows the comparative analysis of TBR's DND and the proposed FDND. As explained in section2, the proposed scheme has a shorter DND operation time so it can provide the lower amount of interest and retransmitted packet. FDND requires 1 second when TBR's DND has to wait for 5 seconds. Therefore, FDND mechanism

has smaller amount of handoff latency than TBR scheme. FDND can also save content download time and 20% of network resources compared to the original TBR.

Category	FDND mechanism	TBR Scheme
Amount of lost interest packets	Low	High
Content download time	Short	Long
Network resource consumption	Low	High
Handoff latency	Comparatively short	Long
Amount of retransmitted interests	Low	High

Table 1. Compare of FDND vs. TBR scheme

4 Conclusion and Future works

This paper presents the fast DND mechanism to reduce the side effect due to long handoff latency of mobile content sources' movement. When detecting the network change, the mobile content source initiates the uniqueness verification of the new tentative name prefix. For fast DND procedure, the proposed mechanism utilizes shorter timeout value and utilizes interest-type message format to provide backward compatibility. From that, it can save network resource consumption of network devices and reduce content retrieval latency by decreasing the checking time of duplicate name prefix. Future works are required for the performance evaluations of DND mechanism in the real CCN network environment.

References

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