An Effective CCN Forwarding at Gateway Router

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Abstract

Content-Centric-Networking (CCN) architecture brings contents near to the users through caching. If the requested contents location is unknown, the Content Router (CR) floods the user's requests to all of its neighbor routers for finding the content. This results in forwarding many unnecessary requests outside of the Autonomous System (AS), and also consumes uplink bandwidth. In this paper, we proposed a forwarding mechanism which is implementable at the gateway router for making a decision on which interest packets to forward to the outside of the AS. The simulation results show that our proposed mechanism performs better that existing proposals.

1. Introduction

Content-centric-networking (CCN) [1] has evolved as a new paradigm of content distribution framework which moves ahead of general IP based addressing to named data, provides name-based routing lookup, and adopts in-networking caching policy [2]. CCN features two types of packets: an interest packet and a content packet, each of them will be routed and forwarded upon their name base.

In based name forwarding, on receiving a request message for a particular content the CR checks for it at its content store (CS) locally. If the content is not found in CS, it will look for pending entries about the requested content in Pending Interest Table (PIT); if no match if found in the table, the request will be forwarded by Forwarding Information Base (FIB) [3] [4]. The interest packet is flooded to all of the faces in FIB but this flooding of requests in the network is not necessarily required at the Content Gateway Router (CGR) where it can at first check for the availability of the content in its own domain (inside the AS) . In [5] the authors proposed a new forwarding strategy that focuses on downloading delay and bandwidth consumption for a requested content by a user for the CCN network. This strategy employs caching replacement policy on the basis of improved least recently used (ILRU) algorithm for the CRs. In [6], authors proposed an adaptive forwarding algorithm to resolve scalability and effectiveness issues. In additional to these proposed strategies, R chiocchetti, D Rossi and G.Rossini proposed and implemented CCN nearest replica routing (NNR) and shortest path routing (SPR) [7]

In this paper, we propose an effective CCN interest packet forwarding at gateway router, in order to minimizing unnecessary Interest packets forwarding, which consumes uplink bandwidth and increases retrieving cost. For this case we attach additional message in the interest packet about the access content router along with the content information. When an interest message arrives at the CGR, and if it does not have the content in its cache then before flooding the requests for the content it will at first check the information table maintained at CGR about the same content request previously made along with the

requesting CRs. Based on this table, the flooding decision will be made by the CGR. We compared our proposal with nearest replica routing and shortest path routing; the simulation results show that our proposal performs well than existing proposals in terms retrieving content.

2. System Model

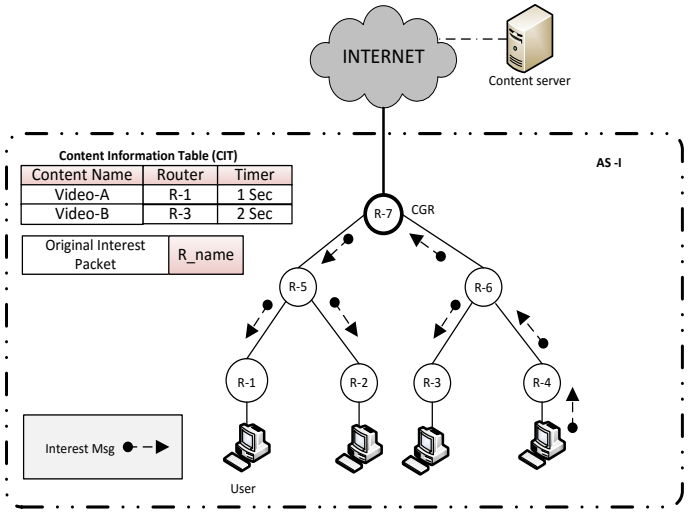

Fig.1: System Model

The system model is shown in Fig. 1, where R-1, R-2, R-3, R-4 are Content Routers (CRs) and R-7 is a Content Gateway Router (CGR), and these routers are located in an Autonomous System (AS). In this model, CGR is responsible for handling Interest packets forwarding to the other ASs. CGR maintains Content Information Table (CIT) table which contains information to estimate the contents possible availability location.

3. Proposed Solution

In this paper, we proposed a forwarding decision algorithm at the CGR in order to minimizing the unnecessary retrieving cost. We first modify the Interest packet by attaching one new field called R_name to store the Access Router information (the router attached with users as shown in Fig.1). Then we add a new table, Content Information Table (CIT) only at the gateway router to help the forwarding decision of the gateway router. The proposed forwarding process is as follows:

Firstly, an user attached with R-1 request the content Video-A. When R-1 receives the Interest packet for the content, router first checks its Content Store (CS). If the requested content Video-A is not located in the CS, router will forward the unsatisfied Interest packet to the R-5.

Here, while R-1 prepares to forward the Interest to R-5. It will at first look in its PIT in order to know where the Interest packet for Video-A is already forwarded. If the Interest is not forwarded yet, R-1 adds the Video-A information in PIT list, and then forwards to R-5 by using Forwarding Information Base (FIB). If the requested content Video-A is also not located in the router R-5 cache, R-5 forwards Interest packet towards the R-7 and R-2. At GCR R-7, if it also does not have the requested content, before forwarding the request R-7 adds content information (Content Name and Router Name) in the CIT. So far there is no information about the timer. When the requested Content Video arrives back to the R-7, the router R-7 sets the time for information of Video-A (e.g., 1 sec). When the timer reaches to 0 the information related with Video-A will be deleted.

In this paragraph, we will discuss about the CIT, when an interest about Video-A arrives from R-6 to R-7. At first, R-7 checks its CS, and then checks the CIT. If the request content is listed in CIT, R-7 will forward the Interest packet to the router R-1. If the content is found, the router R-1 will reply the Video-A to the R-7. Then R-7 distributes the Video-A to R-6. If the requested content is not located in R-1 cache, nothing is returned. It means R-7 will wait for the sometime interval (request time out), and then only floods the Interest packet to the network.

4. Proposed forwarding decision algorithm

For an interest packet to a particular content the proposed forwarding decision algorithm is formulated as below. As discussed in section 3 of this paper, an additional field (R_name) is attached to the interest packet of the user and at CGR CIT is referred to check the availability of the requested contents inside the AS

before flooding the interest message outside of the network for getting the content.

Algorithm 1: IM Forwarding decision at CGR

```
1.  On the arrival of an Interest packet attached with
    content name and router name
2.  if the content is available in CS then
3.      serve the request
4.      update the CIT field with content name and
        router name
5.  else check the CIT
6.      if requested content is listed then
7.          forward the interest message to router
            associated with content name in CIT
8.      if the content is available in the requested
        router's cache
9.      serve the request
10. else if no reply ( Request time out)
11.     Flood the interest packet
12.     When the chunk is returned from the publisher
13.     serve the request
14.     Set the content cache timer at the CGR
```

5. Simulation Result

We formulated the scenario (no.of: users, = 100, CRs =15, CGR=1), and analyzed the performance of our proposed interest packet forwarding algorithm at the CGR using ccnSim. The simulation results in Fig.2 shows improved cache hit probability at CGR versus regular SPR-LCE, and NRR1-LCE.

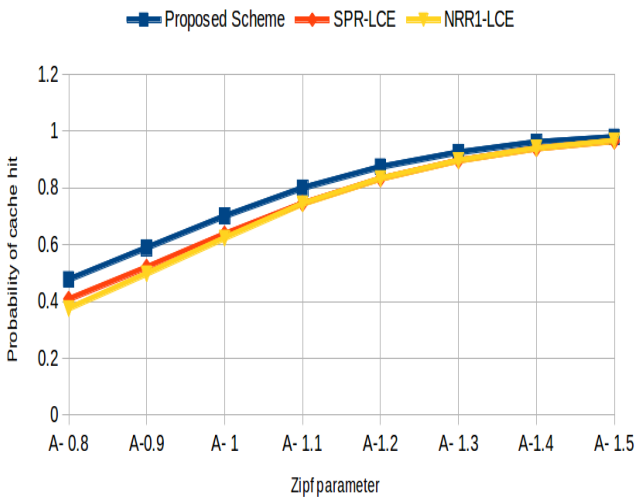

Fig.2: Probability of cache hit

6. Conclusion

In this paper we have proposed an effective CCN interest packet forwarding at gateway router. The CGR maintains CIT about the information on contents served to the access routers which will provide a reference for forwarding interest messages for the upcoming requests on same content. With this algorithm at CGR the unnecessary retrieving cost due to interest flooding can be eliminated. The algorithm can further be improved with efficient assignment of field parameter in CIT such as cache timer.

Acknowledgment

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