A survey of content placement strategies for content-centric networking

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A Survey of Content Placement Strategies for Content-Centric Networking

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Abstract. Current Internet design is not sufficient to encounter the huge Internet traffic, so it is converted from the host based oncontentinformation based architecture. Some of new content, information based architectures are PSRIP, CCN, NetInf, and DONA. In these ICN architectures, CCN is more attractive to implement the idea of Information Centric Network. And in network cache is most important part of all ICN architectures to implement the main idea of ICN. Ubiquitous cache is not a proof of good performance of the cache. To produce a high performance of cache there is needed to manage a cache in a more efficient manner. There exist many content placement strategies to manage the cache. In this paper, we briefly explain cache and content placement strategies of Content Centric Network architecture.

INTRODUCTION

The Internet has played a great role in our lives since the 60s to 70s. With the aim of connecting a few of the machines the Internet is always working on the top of the protocols stack TCP/IP. The present Internet paradigm is a host-to-host model, based on host centric communication that depends on both the sender and receivers, for example, PSRIP [1], CCN [2], NetInf, [3] and DONA [4]. The current Internet is a host-oriented system where the data is an exchange between end-host [5]. The network is completely in charge of the communication. The host-oriented architecture is complicated [6]. The host centric Internet is not so efficient and exactly matches the early internet [7]. A transmission is perceived for changing information. Actually, Internet applications are the end-to-end transmission, for example, emails, messages, chat. Based on the previous forecasts, the Internet traffic experienced rapid growth in the past several years. According to the Cisco's VNI report [8], the global IP traffic has increased eight times in past five years, and the CAGR (Compound annual growth rate), is expected to be 29% during 2011-2016. Most of the traffic is related to content retrieval applications, For example, Video on Demand, YouTube. It is expected that video traffic alone will account for 86% of all the IP traffic in 2016 [8]. Today's demand is increasing for UGC (User generated content), time-shift TV, and high definition VoD, traffic generated by the receiver-driven content retrieval will continue its high growth rate [9]. Due to the increasing of the network traffic, the current Internet is not sufficient to control that type of traffic. Therefore, the current host-centric Internet paradigm is converting to the content-centric paradigm.

OVERVIEW OF CCN

CCN (Content-Centric Networking) [10], is a pioneer project to implement the basic ICN paradigm. It was designed at Palo Alto Research Center (PARC) [11], is one of the most attractive ICN based architecture (Jacobson et al., 2009). The goal of CCN is to change the IP-based internet to the named content-based internet paradigm. It decouples the data from its physical location [12]. At CCN, contents have hierarchical naming structure. Hierarchical named content CCN organized in prefix order that makes it as a tree like structure. For example ccnx:/parc.org/video/widget1/version2/chunk2. Each content name is associated with a specific signature (SHA256) assigned by them to provide security to all CCN contents [11]. Therefore, only the authorized peoples can decrypt the real content. The name structure shows that a data object may consist of more than one version of the same information and one content can be divided into several chunks. Therefore, each content name in CCN is ended by

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the version and chunk to simplify the content discovery. CCN, communication carried out by using two types of packets. One is interested packet, and the second is a data packet. The user request in interest peaked. It contains the name of the required content [13]. The request is forward to the data source on the basis of longest prefix matching which is done by FIB. Contents that fulfill the user requirements known as a data packet. Data packet contains on the real binary data. Users can request for a specific content through multicast, broadcast, and anycast in CCN. Each CCN node divided into three parts Content Store (CS), Pending Interest table (PIT) and Forwarding Information Base (FIB). Content store is a type of cache to store a copy of the contents. PIT responsible for managing all the states of each interest [14]. PIT keeps track of the ongoing interests, so that the data can send back to the proper requester. A CCN router does not forward more than one request for a particular content normally. FIB consists of routing information. FIB built a routing map of the network topology. It gives a right direction of interest packet to forward in a right way. It also helps to find a correct interface to forward the user request to the appropriate data source. CCN support "on-path caching" by caches a copy of transmitting content on the CCN router to serve the subsequent requests. CCN can catch both interest packet and data packet along the routing path each node can cache a copy of the requested data packet. At CCN, single packet taken as an atomic object, so it is possible to cache that object.

CONTENT PLACEMENT STRATEGIES FOR CCN

CCN data transmission is based on two types of primitives which are known as interest packet and data packet [1-2]. The user requests taken as interest packet and data that fulfill the user requirements is taken as a data packet. When a user request for a specific NDO the request is forwarded to the data source. So the source response to the user and the requested data is transmitted towards the user and cache a copy of the data at each router along the delivery path from the source to the user. This content placement strategy is working on the popularity of contents. The strategy is used to improve the cache performance of CCN architecture. To improve the network caching is used in network nodes. These network nodes have the ability to cache the transmitted information (contents). To manage the cache and achieve fruitful cache performance. Content placement strategies are used to place the content in the network caching efficiently. Content placement strategies are mechanisms to place the contents in cache efficiently. It also decides which information contents are to be placed at which location (node). It is a smart and hottest research area of ICN cache. It is like web cache [20] and Content Delivery Network (CDN) [21]. These strategies built to manage the cache. Improve the information replication process and decrease the response time. Use to reduce the huge amount of network resources. By using these content placement strategies can reduce the bandwidth and server load [17]

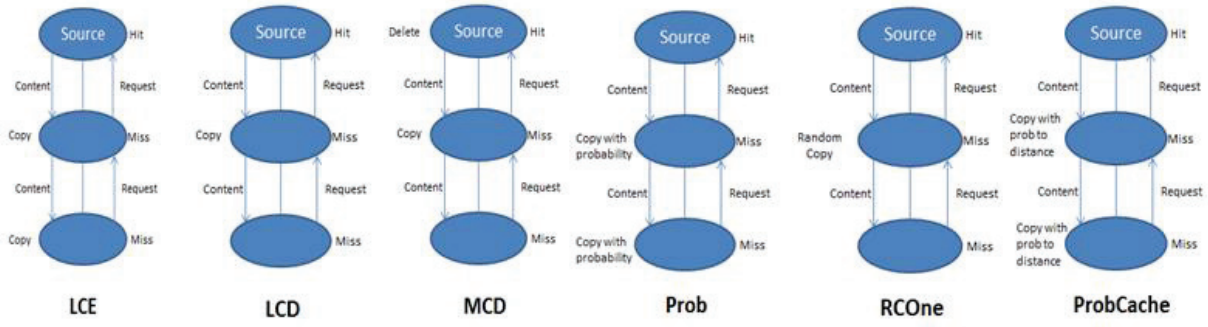

FIGURE 1. The working of different content placement strategies.

Leave Copy Everywhere (LCE)

In CCN, data are transmitted by using in network cache. To manage in a network cache there is need to build an efficient design for content placement in network cache. CCN is a receiver driven content retrieval process. In which, the user sends a request to the network for their required data the network will response to the user. In LCE, during the transmission of data from the data source (where the cache hit occurs) to the user, a copy of that transmitted data is cached at every node along the delivery path from the source to the user. Moreover, the subsequent requests will achieve their required data from any of that node[28]. The process of this strategy illustrated in Figure 1.

Leave Copy Down (LCD)

In this content placement strategy when a request is received from any data source (cache hit occurs), the required data are transmitted to the requester and a copy of that data caches along the routing path only at the node that exists after the hitting location or where the cache hit occurs [22]. The strategy is shown in Figure 1.

Move Copy Down (MCD)

In MCD content placement strategy when a source receives a request for a specific information content (cache hit occurred) the data is transmitted to the requester and deleted this content from the source and cache a copy of that content at the node that exists after the hitting location. This strategy decreases the content redundancy than LCE and LCD more efficient [23].

Leave Copy Probability (LCP)

This strategy works on probabilistic location. After receiving the request contents is transmitted and cache a copy of that transmitted content along the delivery path at the probabilistic location. For instance, content is cached at the intermediate node of the network along the receiving path [21]. This mechanism is also explained in Figure 1.

Randomly Copy One (RC One)

This content placement strategy based random location. Along the returning path cached the copy of the requested content along the returning path randomly at only one node [24]. Strategy work is illustrated in Figure 1.

Probabilistic Cache (Prob Cache)

In this strategy, the requested contents are cached at every node with probability. Probability diverges for each node. If the distance is large from the requester so the rear chance to cache a copy with a low probability of requested data and more chance to cache with high probability for a small distance from the requester. So the probability is proportional to the small distance and inversely proportional to the large distance from the requester [25]. The cache placement mechanism is shown in Figure 1.

Most Popular Cache (MPC)

CCN content placement strategy stores all the contents along the delivery path to attain an effective performance of the cache. This strategy works on a cache of CCN architecture [2]. The strategy gives priorities to the popular contents to cache. At MPC, each network node hasthecapacity to store two types of information into a special table named popularity table. One is “content name” and the second is “popularity count”. All the nodes along the routing path locally, count the number of incoming requests for each content-names. Each popularity table of all routers has the other primitive called threshold. The threshold is a value set by the strategy to show the popular content. When the popularity count for a specific content name achieves threshold value so the content is labeled as popular content [26]. If the node holds that popular content it recommend their neighbor nodes to save the popular content by using new basic recommendations message. The recommendation messages may or may not be accepted. It depends on the resource availability. With the passage of time, the popularity can decrease of a content after the recommendation process. Because the popularity count initiate again to restart the value to prevent the overflow of similar contents to neighbors. The node requirements are directly influenced by this MPC strategy. This placement strategy uses extra space of CCN node cache to store the entries of content names and popularity count in popularity table.

Betweeness Centrality Cache

In this strategy, the requested content is transmitted to the requester and cache a copy of that content in the node that started at betweenness centrality. Mean a copy of the requested data is cached at a node that is connected with a large number of nodes in a network [27].

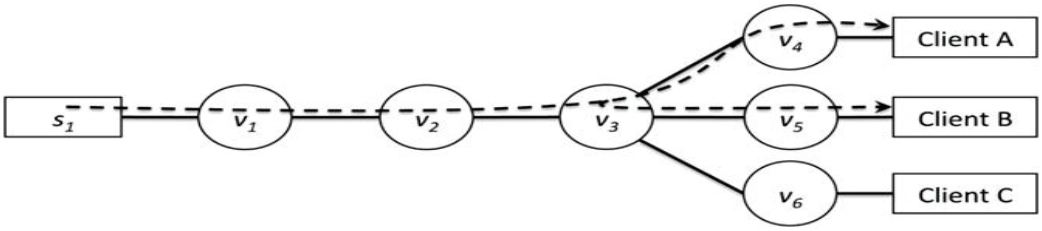

FIGURE 2. Centrality-based cache [20].

Figure 2 shows the betweenness centrally based content placement strategy. A, B and C are the requesters. If a request for a specific content and the request is transmitted along the path nodes v4, v3, v2, v1 to the data source. S1 is data source where the cache hit occurred and v1, v2, v3, v4, v5, v6 is the node the transmitted content will be cached at node v3 that is saturated betweenness centrality. And the remaining subsequent request can get that content from node v3.

Socially Aware Caching Strategy (SACS)

This content placement strategy works on the social information of people. In SACS, users divide into two types on the basis of their social relationship. One is influential (popular) user and another one is a normal user. This strategy gives priorities to the information of popular users. A person which has more social relationships taken as more influential and gives more priority to their information to cache at the network cache. When an influential user produces a content so it will be consumed more people than a normal user. For example, when a popular user of twitter sends a message [28].

CONCLUSION

As the current intern at design is not sufficient to handle hug network traffic. Therefore, the Internet architecture is shifted from host countries to content centric. In network caching is most important for all information-centric architectures. So, it is very important to manage the network caching more efficiently. Content placement strategies are used to fulfill the cache management requirements. But there is need to build a strategy that will manage cache more efficient manner.

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