A Review on performance for information centric network with Cooperative caching

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Abstract: in existing internet type of network whole information is published at single machine. All the clients requiring this information will sends the request to the single machine. This will make central machine to be overloaded with high number of requests. This type of network architecture will be fail for those network where there are large number of clients requests for same information. In today's environment this type of architecture may not be suitable when there are large number of contents are related to multimedia type of contents. There requires distributed cache at the edge the network. So that few repetitive contents can be served from these machines will automatically downgrade the requirements for request to be collected at single machine. This type of technique will be more suitable for multimedia contents sharing.

Keyword: information centric, cache, distributed

I. INTRODUCTION

It is an approach to change the infrastructure of internet away from host- centric paradigm. This is based on end to end principle and perpetual connectivity of network architecture. In this there is one focal point which can be information, content or data. In this model, connectivity may be irregular, end host and in network storage. The mobility and value of bits present inside the network and on data storage devices are same. Any cast, multicast and broadcast all the three can be supported by information centric networking. The data becomes independent from location, storage, application, enabling in-work caching, replication and means of transportation. The benefits of improved efficiency with respect to information/bandwidth demand can be achieved by this network.

The content discovery and content delivery are the two parts of ICN content retrieving. The process of content discovery is based on how content is named, published and how an ICN node addresses it. The ICN routing protocol are defined by content delivery. The routing protocol defines how content provider propagates its contents into the network and how ICN router routes the end users interest. Every content object has one identifier that permits the end user or intermediate networking unit to locate the best content holder. The content name is a globally unique identifier but the unique content name can be break into different containers like in origin content server, the CDN repositories or the on-path caches.

1.1 Challenges of Centric Network

Security: Nowadays host-centric security like challenges in ICN requires location independent security mechanism to enable ubiquitous in-network caching system. So, the newly generated security models need to provide information oriented data integrity and authentication check mechanism. In current data integrity checking process the used model should be able to get rid of trusted third party that assemble the trusted authorities in the current data integrity checking process. The ICN are immune to host-oriented attack because of communication based on content along with solution of denial of service attack [8].

Congestion Control: DONA, PERSUIT like most of the ICN architecture provides fault features like flow control mechanisms that uses hop-by-hop request and reply mechanism. Numbers of replies it can handle are reduced by on limited number of requests node issues. In these kinds of architectures, congestion is considered as a bottleneck. The delay is significantly reduced by incorporating network caching mechanisms name as NDN. If multiple requests and responses comes than the delays will increase by same proportion that result in collisions, huge delays and packet loss. Receiver-driven TCP-Reno congestion control and Multi-thread congestion protocol etc are a mechanism that has been proposed for multiple congestion control [7]. The two above mentioned mechanisms works only in limited scenarios.

Availability: ICN incorporates caching mechanisms at the network layer with purpose of availability of data or path towards data. The capabilities of caching mechanisms affect the availability parameter in different scenarios. Therefore, there should be appropriate caching mechanisms, or a node can face several issues like, overflow memory and timing updates etc. Several caching strategies are under consideration i.e. Ubiquitous LRU and intra-AS coop etc [9].

Sporadic behavior: The support of sporadic behavior is one of the challenges for the ICN architectures. Delay Tolerant Network (DTN) is a classical example for the sporadic behavior where a node has intermittent connectivity. Limited implementations are available for such features like Haggle [10, 11] which is an implementation that combines CCN approach with DTN. 5) Multiple-source Multiple-destination: The use of multiple-source multiple-destination applications becomes increasingly popular. Few implementations of ICN support this feature. Like in CCN architecture [12], a node may send data to different nodes and may receive data from different nodes due to caching provision. So, it is important for CCN to provide such support. Usually, with the help of multiple thread approaches, they achieve this requirement.

1.2 Cooperative Caching

The performance of network file system has been improved by cooperative caching that cooperate with contents of client caches and allow requests no satisfied by a client. The client's local in-memory cache file has to be satisfied by the cache of another client.

The performance of processor is increasing more than the performance of disk is one of the technology trends that force to consider cooperative caching. This difference between the performances of both, leads to reduce in number of disk access by file system. The emerging high speed low latency networks are able to supply file system blocks across the network in a much faster way than standard Ethernet is the second factor. The fetching of data from remote memory has become three times faster than getting the data from remote dist ask compared to older network. Due to new technology we are able to access a remote memory ten to twenty times faster as disk that results to increase use of cooperative caching. A three level memory hierarchy has been used in existing file systems that implementing a limited form of "cooperative caching" by locating a shared cache in server memory to supplement the other two memory levels, client memory and server disk. There are four factors of cooperative caching due to which it has become more useful than physically moving the memory from clients to server given below:

- **Better performance is provided by cooperative caching:** An approach can improve the global hit rate and thus reduce the system's disk accesses. The cooperative caching leaves large memories at the clients that helps in maintaining high hit rates in the clients local caches saves the latencies of network as compared to going to the server.
- **Load:** The cooperative caching system server will be less loaded as it can satisfy number of requests by small packets to forward requests rather than large data transfers.
- **Use of memory:** The memory is physically located at the clients that makes is more flexible by allowing it for client virtual memory as system demands warrant.
- **Cost effective:** Cooperative cache systems are more cost effective than building a system with an extremely large server cache.
  For example, it would be significantly cheaper to add 16 MB of industry-standard SIMM memory to each of one hundred clients than it would be to buy a specialized server machine capable of holding the additional 1.6 GB of memory.

In network file systems cache hierarchy a fourth level is introduced by cooperative caching. The data can be found in local memory, in server memory, on server dist and in another client's memory. Depending on the cooperative caching algorithm used, this new level may be found between a client's local memory and the server memory or between the server memory and the disk.

1.3 Techniques for Router positioning

Router position-based cooperative caching (RPC): The main idea of RPC is to push popular content closer to the customers (users or enterprises). Along the content delivery path, the RPC allows a router to calculate its own topology level value by adding 1 to the value of its immediate upstream router's topology level [15]. A router also track the access count for each content locally and stores all the access counts as a key-value structure (content name; access count). The principle of RPC is described as follows:

- Each router has a caching threshold and keeps track of an access count for each content (indicating content popularity).
- A router decides what content to be cached based on its caching threshold and storage space.
- LRU (Least Recently Used) is used for replacement policy. However, we can also use other replacement policies, such as LFU (Least Frequently Used).
- Along the content delivery path, routers need to transmit their topology level value and root router's caching threshold value to their immediate downstream routers. This coordination happens only once during the procedure of determining the caching threshold, which has low overhead.

Named Data Networking (NDN): In NDN, users obtain the requested contents by using Interest and Data packet, the working is given below [17]:

When the new request for getting content arrived at a user, the user transmits the new Interest packet for getting the content. The Interest packet is forward over the network toward a CRs or Server which have the corresponding content. If the Interest packet is arrived at the CRs/Server, corresponding content is returned as Data packet to the user. The Data packet is returned along with the reverse path of the Interest packet. Both of Interest and Data packet contain the "Content Name" field. "Content Name" is defined as layer format and it is a readable format like URL (Uniform Resource Locator).

For routing a Interest/Data packet, NDN routers maintain the 3 tables as given below:

- **Forwarding Information Base (FIB):** FIB is used for routing a Interest packet toward a CR/server having destined content, according to the content name of the Interest. In the FIB, every table entry consists of two attributes: prefix of requested content, and interface number which the Interest will be forwarded. When a CR receives a Interest packet, the CR forwards it to the next CR according to the FIB entry corresponding to the contents name of received Interest. By referring the FIB table, CR on NDN can mitigate the redundant Interest forwarding for the CR/server having desired content.
- **Pending Interest Table (PIT)**: PIT is used for keeping the information relating a forwarded Interest packet. When a CR forwards a Interest packet, the CR register the both of a contents name and incoming face of the Interest into the PIT. Hence, if the Data packet corresponding the forwarded Interest is received, the CR can return the Data packet to the direction which the Interest packet came from [16].
- **Content Store (CS):** CS is the buffer for storing the caches of the content which is transited over the CR. When the content transits over a CR, the CR stores the copy of the content as a cache into its CS. The cache stores with the content and content name for reusing the cache for the future content request from the other users. If the cache will be reused by the other users' request, the amount of network traffic can be reduced together with the turnaround time for obtaining content.

Mobility management scheme based on software defined controller [12]: Mobility management aims to ensure communication continuity when the users move to the new attachment points [19]. Even though CCN is efficient for the retrieval, sharing and propagation of content, there may be problems in which these inherent benefits are lost under content source mobility. In SDC-CCN, scheme they have deployed software defined controller to manage the content name and interfaces in the content source handoff scenario. To enable this scheme, a novel routing table has been designed to update and rewrite the route entries and send the configuration to the relevant CRs. In this scheme, there is no need to change the content name after the content source has moved, and the Interest and Data packets are transmitted according to the new routing table rewritten by SDC.

II. LITERATURE SURVEY

Muhammad Sajjad Akbar, et.al, (2017), have analyzed that with the advantages of ICN such as efficient content delivery, better bandwidth utilization and improved mobility support it has emerged as a promising approach for content dissemination. It has become difficult to choose particular architecture because from past few years' number of ICN architectures have been proposed with different set of features and characteristics. These characteristics include IP compatibility, and choice of naming structures etc. Nobody has explained how ICN approaches behave with different emerging network environments such as user-centric networking, object centric networking, Software-Defined networking and Cloud Computing. Researchers have given a little review on number of challenging areas including congestion control, availability, sporadic behavior, multi-source multi-destination and security etc.

Reza Tourani, et.al, (2017), have analyzed that in communication networks (Such as Internet and mobile ad hoc network) uses host-centric networking has been replaced by Information-Centric Networking (ICN). In ICN paradigm there is inbuilt provision of identity privacy, provenance, content and client security as compared to the current host centric paradigm where they have been instrumented. the proposed approaches drawback and given a direction to future research. The denials of service, cache pollution, and content poisoning attacks have been review in security. The user privacy and anonymity, name and signature privacy, and content privacy have been discussed under privacy section. They have given a review on existing access control mechanisms based on encryption, attribute, session and proxy re-encryption.

Rihab Jmal, et.al, (2017), have concluded that Content Centric Networks (CCN) have received a lot of interest as one of the major innovative Future Internet paradigms. The CCN key feature is built around the named content which can be requested, replayed, routed by name and stored through in-network caching. A new concept has been represented by Software Defined Networking (SDN) that can influence the research and innovation enabling migration to future internet.

Marica Amadeo, et.al, (2016), have recommended ICN as a communication model in order to develop the infrastructure for internet. This model is different from the traditional IP address-centric model. The ICN approach consists of the retrieval of content by (unique) names, regardless of origin server location (i.e., IP address), application, and distribution channel, thus enabling in-network caching/replication and content-based security. In IoT domain, ICN is considered as a high potential innovative network paradigm due to its benefits of improved data dissemination efficiency and robustness in challenging communication scenarios.

Chao Fang, et.al, (2015), have proposed an innovative Information-Centric Networking (ICN) architectures in order to manage with the internet usage shift from host-centric end-to-end communication to receiver-driven content retrieval. The global network traffic is getting increased day by day that results in issue of energy efficiency in ICN. In order to address the energy efficiency issue in ICN, number of researchers has proposed new schemes. However, several significant research challenges remain to be addressed before its widespread deployment, including shutdown, slowdown, mobility and cloud computing.

III. CONCLUSION

From the study of various research papers it is clear that compared to publishing the contents at single machine and all the clients for that information request to the central servers. This type of contents delivery will overload the single machine. For making system efficient various researches has been focused on contents cache at the edge nodes of the network. These edge nodes can be routers. Once the network any client need those contents will request for it. The request will be converted to reply immediately from the router cache itself. This type of network also remain cost efficient. Multiple research has been done on network with different types of topologies and also different types of contents.

IV. FUTURE WORK

Current being cached at the edge router is being research is current research paper. It is based on distributed kind of architecture. In future this research can further enhanced by having cache in more type of topologies like Grid and Mesh topologies. In these topologies there are more number of users per router. So this type of technique will test route cache load at run time.

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