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Intentional Caching in Disruption Tolerant Network

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ABSTRACT

Disruption Tolerant Network (DTN) is a networking architecture that is designed to provide communications in the most unstable and stressed environments. DTN route network messages through intermittently connected mobile devices. It uses carry-and-forward method for data transmission. The greatest challenge in DTN network is to reduce the data access delay between the sender and receiver. The solution is to intentionally cache data into a set of Network Caching Nodes (NCNs), which have high accessibility and buffer capacity. Its specify an efficient scheme for selecting NCNs and its associative caching nodes. Latest data items are cached on the NCNs and cache replacement is based on the popularity of data. Through the simulation verify the performance of the system.

Keywords- *Intentional caching, data popularity,disruption tolerant network, network caching node, cache replacement*

INTRODUCTION

Disruption Tolerant Networks (DTNs) contains mobile devices, due to the mobility of nodes only intermittent network connection exists. It's mainly used in challenged networks like Military Ad-hoc Network, Terrestrial Mobile Network .It ensure data should be available to the requester with some delay. A widely used method to improve data access is caching, store data in to a set of nodes other than the data generator. Caching nodes are easily accessible by other nodes in the network. Due to the mobility of nodes in DTN it's very difficult to find caching nodes as compared to other networks. Improve caching performance through cooperative caching; the central caching nodes use a set of associative nodes to store data.

In intentional cashing scheme data sender send data to the NCN and the requester can access data directly from the NCN or its associative caching nodes. All the nodes in the network have information about the NCNs available in the network. The requester node, multicast the request to all the NCNs available in the network. The requester may get more than one response for the same request to ensure the availability of data in DTN network.

RELATED WORKS

Cooperative Caching in DTN network [1] helps to reduce data access delay in Disruption Tolerant Networks. This system uses NCL selection metric to find Network Central Locations for caching data. It considers only the popularity of nodes for selecting caching nodes. If NCLs have limited caching capacity, nearest nodes are used for cooperative caching. Data caching and cache replacements are based only on the popularity of data. In most cases the latest data available in cooperative nodes instead of NCL, its very time consuming.

Cooperative Caching in Ad Hoc Networks [2], in which each node caches pass-by data based on the popularity, so that queries can be responded with less delay. Caching locations are selected incidentally among all the network nodes.

Summary Cache [3] is a Scalable Wide-Area Web Cache Sharing Protocol for implementing cooperative caching through web proxies. The sharing of caches among Web proxies is an important technique to reduce Web traffic. Here each proxy keeps a summary of the cache directory of each participating proxies. This protocol reduce the overhead through the summaries are updated only periodically, and the directory representations are very economical.

Cooperative Caching in Wireless P2P Networks [4] proposes solutions to find layer on which cooperative cache functions can implements. This system propose a novel asymmetric cooperative cache approach, where the data requests are transmitted to the cache layer on every node, but the data replies are only transmitted to the cache layer at the intermediate nodes that need to cache the data.

Spray and Wait [5] is the routing scheme used in DTN network, reduces the number of data copies as compared to other protocol. In this routing scheme sprays number of data copies into the network and then waits till one of these nodes meets the destination.

Uncertainty about network conditions makes routing in DTN is a challenging problem. Intentional Routing [6] can optimize the delivery delay through RAPID mechanism. In this scheme routes a packet by opportunistically replicating until a copy reaches the destination. Replicates the data packet based on the popularity of data.

User-centric data dissemination [7] is more cost effective than network-centric. Data can be distributed only to the interested users other than all the users in the network. Interested users can be finding out based on their profile, in some cases non-interested nodes are used as relays based on this forwarding capabilities.

INTENTIONALLY CACHING SYSTEM

Intentional caching is used to improve the data access in DTN network. Unlike incidentally caching, here first select the NCNs for data caching based on some features of nodes. The system does not allow the communication between data sender and the data requester because its very time consuming and expensive. All the latest and popular data will be available in NCNs and its associative nodes .So each nodes can access the data form NCNs with easiest and cheapest way.

NCN Selection

NCNs are the most popular nodes in the network ,system also consider buffer capacity and processing capability while selecting the NCNs. Using adjacency metric based on the distance between the nodes is used to find the popular nodes. While selecting a new NCN, existed NCNs and its associative nodes are not consider for avoiding the overlapping between nodes. After selecting the NCNs, the network administrator is responsible for notifying the information of NCNs to each node in the network.

Associative Nodes Selection

Associative nodes which are within the communication range of NCNs. Due to the limited caching buffer of NCNs, multiple associative nodes may be involved in caching. Associative nodes are not overlapped, each associative node should be part of one NCN. While selecting the associative nodes consider its distance from NCNs, Mobility of the node and its energy.

Data Caching and Cache Replacement

Data source generates data and forward it to the NCNs for caching. Latest data should be available in NCNs for ensuring the fast response. If NCNs have no buffer space to cache the new data,it forward the old data to its associative nodes and cache the new data. Cache replacement is based on the popularity of data. Popularity of a data item is estimated based on past requests to this data.

ARCHITECTURE

The data source S send data to the NCNs N1 and N2.N1 and N2 are the mobile nodes in the network which are selected based on the popularity, buffer capacity and processing capability. The dotted line represents the communication range of the NCNs. If the buffer of a caching node is full, data cached at associative nodes based on its mobility, energy and its distance from the caching node. If N1 has no enough space it move the old data to its associative node A. Each node in the network has a list of available NCNs in the network. A requester R pulls data by querying NCNs, and data copies from multiple NCNs are returned to ensure data availability. If the data is not available in a NCN, it forwards the request to its associative node which holds the data. Each NCN maintain a list of its associative nodes for its fast access. If N2 and its associative nodes haven't the data copy so it does not provide any response to the requester. The system also calculates the demand of the data based on the requests for data replacement. Due to the mobility of nodes the network architecture changed frequently so we need to find new NCLs periodically.

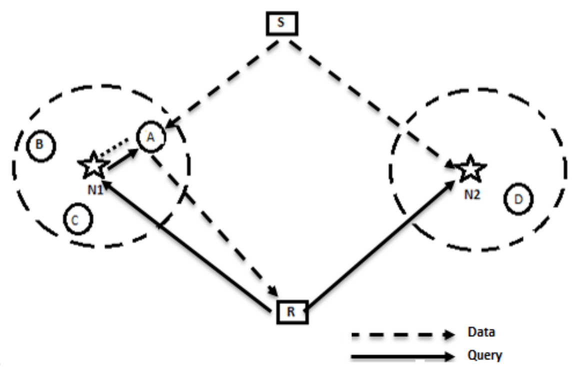

Fig. 1.System Architecture

EXPERIMENTAL RESULTS

Performance evaluation of the system is conducted by one simulator tool. First select the requested number of NCNs then data and requests are generated. Evaluate the data access performance of the proposed system with the following caching schemes:

No Cache: caching is not used, the data source will respond to the user requests.

Cooperative Cache: which support cooperative caching, each node in DTN cache the data based on the popularity.

Intentional Cache: which support cooperative caching, intentionally cache data to a set of nodes in DTN.

The simulation shows performance of the system with Intentional Cachingimproves data access performance as compared to other schemes. In No Cache scheme data access delay is very high.

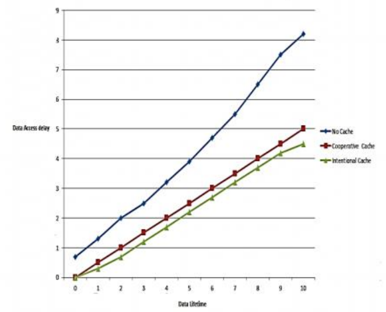

Fig. 2. Data access performance with different caching schemes .

Evaluate the performance of data access based on the number of NCNs in the network. If number of NCN is less it increases data access delay, it require more network resources when it is too large. For good performance Number of NCNs should be a medium based on the number of nodes in the network. The following graph shows performance of data access with different number of NCNs.

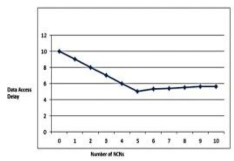

Fig. 3. Performance with number of NCNs

CONCLUSION

Intentional caching is used to improve the data access performance in DTN network. In this system data is intentionally cached into NCNs and its associative nodes for fast response. The selection of NCNs and its associative nodes are based on a probabilistic selection metric. In Data caching latest data should be stored in NCNs for fast access. In this system cache replacement is based on the demand of data.

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