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Fog Node Cooperation Level Caching

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Abstract — *Wireless sensor networks are using maximum in latest communication applications. Energy limitations are the main issue in latest networks. We propose a fog node cooperation level caching called (FNC) in wireless technology with energy consumption and data caching. In FNC scheme, one-hop neighbor of a sensor node from a fog level and share the cached data with each other.Simulations readings show that the FNC caching gets proper improvement in hit ratio and latency with fog computing.*

Keywords- *Fog Computing, Internet of Thing, Data Caching, fog node cooperation level caching (FNC), latency.*

I. INTRODUCTION

Recent compression in devices and network led to more interest in wireless sensor networks. Lots of internet devices are connected to internet and generating traffic. These networks contains low cost, battery operated wireless sensors, it can be using for more surveillance and control applications. Disastermanagement, military, homeappliances, security are the use of these wireless devices. Compressed networks gave huge success to many wireless devices. Due to the low cost of wireless sensors, these can be using in many environments. Other than sensing ,Data processing and communication are functionalities of wireless equipment's.Energy consumption contains three functionalities : (1) sensing (2) data processing (3) device communication with data transfer less Number of communications among the sensors is directly proportional to lower latency and minimum energy consumption. Network strength can be more accurate if the rate of energy use is less. It can occur because of less communication. It is achieved by caching useful data.

II. RRELATED WORK

According to studies of network caching,IOT data item is uniquely defined not only by its time and location tags, but also a time-range value set by end-users.

S.Hussain et al. [7] propose effective caching by data flow between sender node andreceiver sensors node, developing expectancy of data change and data vanishing.

J. Xu et al. [8] proposed a data return time method which waits for the data of the same node until it becomes usable within a threshold, aggregating it with the packet from the lower cluster and then sending it to the sink, thus reducing n the network traffic.

K.S. Prabh et al. [9] consider the whole network to be a Steiner Data Caching hierarchy which actually is a binary tree and buffers data at some intermediate node (data cache) such that it decreases the network traffic by multicast.

In [10], M.N. Al-Ameen et al. exploit caching for imperfect nodes in WSNs and design an algorithm to manage the packets when node fails.

T.P. Sharma et. al [11] proposed a cooperative caching scheme which exploits proper communication between various sensor nodes in a given network area.Apart from its own local memory, a node uses memory of nodes from some region around it to form maximum number of cache storage known as cumulative cache. A token driven cache control scheme is implemented where node keeps the token can cache or replace data item. Disadvantage of proposed model is that, there are overheads to manage and rotate the token.

N. Dimokaset. al [12, 17], have given different aims which are necessary to be optimized such as energy consumption, access latency, number of replica of data items to be placed at different locations. Disadvantage of strategy is that node

importance (NI) calculates neighborhood of a particular node. So, overhead to find NI for all the nodes abstains energy which in turn decreases the lifetime of sensor network.

III. SYSTEM ENVIRONMENT

We expect a remote sensor organize comprising of sensor hubs (SNs) that associate with the earth and sense the physical information. It contains original file of a data file. A user request started by a user is forwarded hop-by-hop along the hierarchy until it returns original file Fog node frequently access the data, and cache some file locally for less traffic and data access delay. As fog node does not contain enough space for cache storage, it share data to other fog node.

Network topology is indicated by an undirected graph G=(V,E) ,where V is the set of fog nodes FN1,FN2,..... and E is the set of link between fog node. The existence of the link (FNi,FNJ) belongs to E.The fog nodes might be dead at any time, so the set of working nodes varies with time.

Possibilities derived:

1. Fog nodes are static, the communication links are bidirectional, and the multi-hop is the main communication scheme.
2. The Wireless Networks with sensors have equal computation and communication capability.
3. Each fog node contains whole network topology through localize method
4. Each single node contains unique id.
5. The group of data items is denoted by D={d1,d2…}
6. All files have different size.it is represented by si.
7. Each fog node contains a cache space of N bytes and it directly proportional to size of data items.
8. Data value sensed at a source may change with time. Afterupdating of file, it is invalid for one or more node.
9.

IV. FNC CACHING

Here we describe our FCS caching scenario for data retrieval in compressed networks.In FCS caching, it is good point for sensor node to share cached data with its neighbor node in the zone.It means sensor which is accessible in one-hop. Sensor node which contains fog node of given node then from a cooperative cache system for this node since the cost for communicating with them is low both in terms of energy consumption and message exchange.

For each user request, one of the following possibility occurs:

Case 1: Local hit occurs when copy of the requested data item is stored in fog node. If the desired data is there, it will return file no other process is necessary.

Case 2: Fog hit happens when the requested file is stored in cache of neighbor fog node .message exchange within the second

Case 3: remote hit happens when the data is found with a node belonging to fog node other than home zone of the requester along the routing path to the data source.

Case 4: Global hit happens when data item is retrieved from the fog node or cloud node.

A.CACHE DISCOVERY

FCS uses a cache discovery mechanism to calculate the fog node which has cached the necessary data item.When a user request starts from node,it first search for the data file in its local cache.If there is a own cache miss,the node send request to all nodes to verify if the data item is cached in other nodes within the higher zone.When a sensor gets request and contains the desired file in its own cache,it will send a reply packet to the sender node.If fog node miss,the request is forwarded to other nearby sensors along the path searches the file in its own cache or fog node cache.If data file is not there on the fog nodes with all fog nodes,the request finally goes to source.When a sensor receives a reply packet,it sends ack packet against reply packet. When a sensor receives anackpacket, it replies back with desired data to the request user.

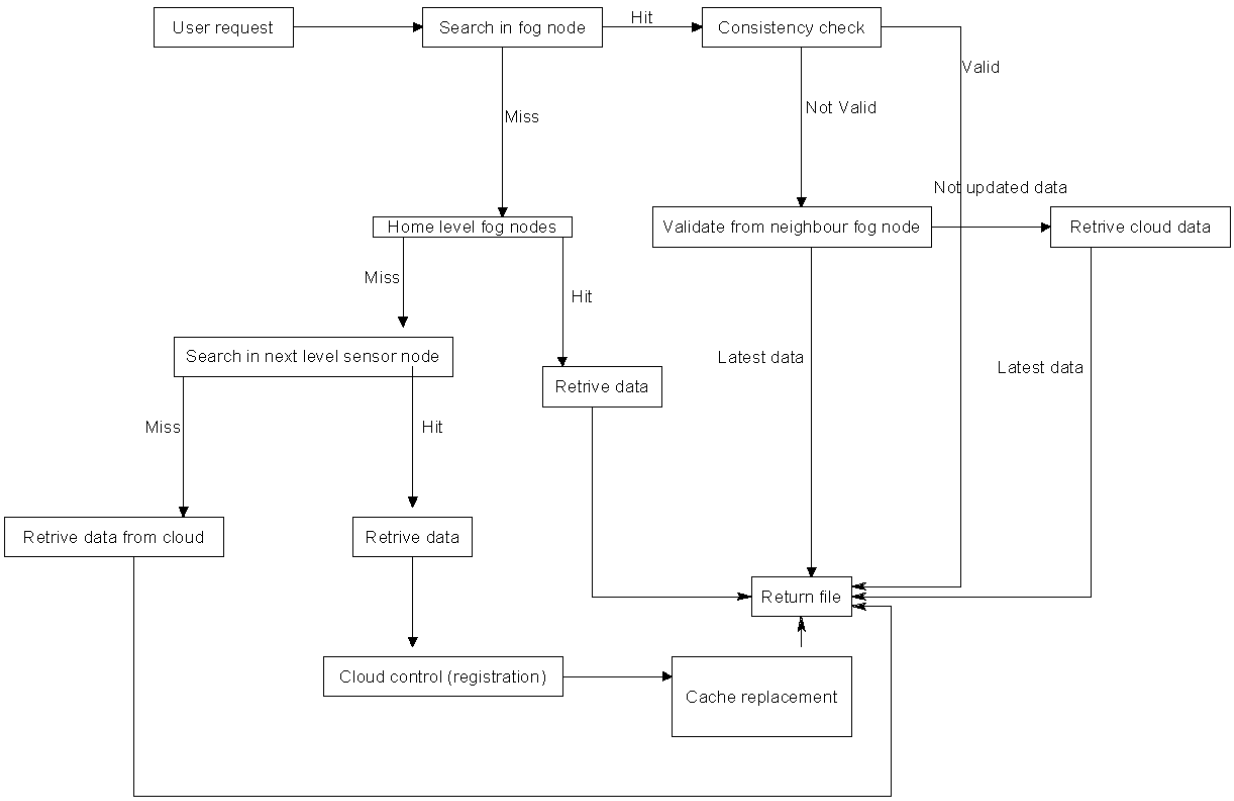


Fig 1 : Flow of Data Fetching from Fog Node cooperation level Caching

B. CACHE ADMISSION CONTROL

During the communication of any data item, a cache admission control is triggered to decide it should be stored into cache or not store in cache memory. Every file will not be stored in cache memory, because wrong decision can decrease the utilization of the power and caching mechanism FNC, the cache admission decision at a fog node is based on two features: (1) number of hops between fog nodes and source of the data item from where the cached copy is shared (2)number of hops between FN and sink.

If the sensor is less than N hops away from the requesting node FNi,then it will not cache the data, otherwise it caches the data. Itmeans, same data items are cached at least N hops away. With a small N,the number of copies for each data item is high and access delay for this data file is less. Forlarger N,each file has a small number of copies, and the access delay can belonger. Benefitis that fog node can cache more precise data file and still provide requests when the source is not accessible. InFNC,we have use N=2,i.e. if the cache of the data remain in same zone of the requested node, then the item is not cached, because it is not required to copy data file in the same zone since cached data can be used by nearbysensors. So in FNC,the same data file is copied at least two hops away.

C.CACHE CONSISTENCY

Cache consistency shows that Fog node only insert valid condition of the data and no old data is used to provide the requests. Two mostly used cache consistency models are the weak consistency model and strong consistency model. In weak consistency model, a old data can be return to the node. In the strong consistency model, no old copy of the changed data will be returned to the node.

Due to multi-hop scenario, limited bandwidth and energy constraints in wireless sensor networks, the weak consistency model is more useful. The FNC caching uses a simple weak consistency model based on time -to-live(TTL),in which a FN takes a cached copy updated if it's TTL has not expired. The node takes a data file as victim for replacement if its TTL expires. A FN updates a cached data file and keeps updated its TTL if a latest copy of the same data passes by.

D.CACHE REPLACEMENT POLICY:

We have developed utility based cache replacement policy,where data items with the lowest utility are removed from the cache.Four factors are considered while computing utility value of a data item at a sensor node:popularity(pi),Distance(D),Consistency (C),Size(S).

UTILITY=PDC/S

V. PERFORMANCE EVALUATION

In this section, we evaluate the performance of FNC cooperative caching through simulation experiments.

TABLE I: RADIO CHARACTERISTICS

Operation	**Energy dissipated**
Transmitter/receiver electronics	30 nJ/bit
Transmit amplifier if $d_{toBS} \leq d_0$ (e_{fs})	10 pJ/bit/m^2
Transmit amplifier if $d_{toBS} > d_0$ (e_{mp})	0.0013410 pJ/bit/m^4
Data aggregation (E_{DA})	3 nJ/bit/signal

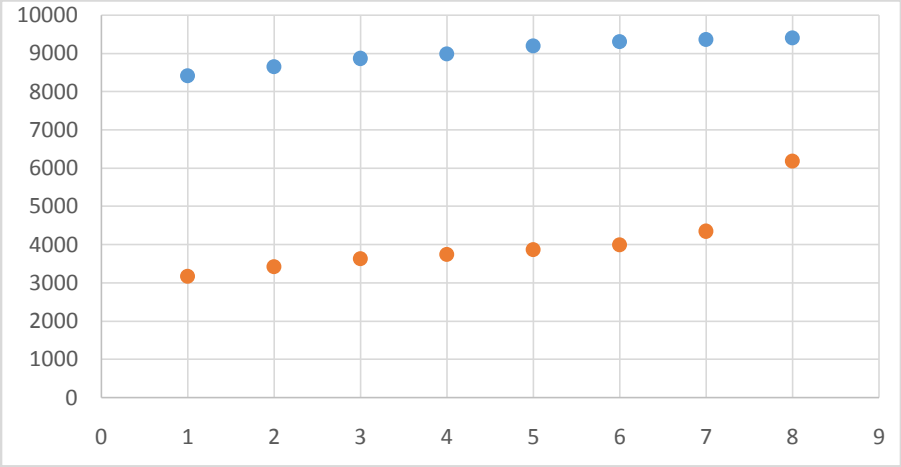
TABLE II: SIMULATION PARAMETERS

Parameter	**Default Value**	**Range**
Number of Data Items(N)	1000	100~1000
Number of sensor nodes	100	100~500
bandwidth	2mbps	
Transmission range(r)	40m	15~40m
Mean query generate time	5 sec	2~100 sec
Cache size (c)	1000KB	200~1400 KB
Skewness parameter(θ)	0.8	0.0~1.0
TTL	300 sec	100~300sec

Table 2:Comparison Data Caching Readings with and without usingFNC

No of interest Packets with caching	**No of Consumers**	**No of interest Packets**
	1	3662
	2	8423
	3	8653
	4	8875
	5	8992
	6	9200
	7	9311
	8	9365
	9	9410
No of interest Packets without caching	**No of Consumers**	**No of interest Packets**
	1	3057
	2	3178
	3	3422
	4	3641
	5	3744
	6	3879
	7	4005
	8	4355
	9	6187

Graph 1: Comparison of FNC and without FNC Data



VI. SIMULATION MODEL

During the simulation, Ad Hoc On-Demand Vector [15] has been used as underlying routing algorithm to route the data traffic in the wireless sensor network. The number of nodes chosen is 500 802.11 as the MAC protocol and the free.

Space model as the radio propagation model.The time interval between two consecutive queries generated from sink follows an exponential distribution with mean T q . After a query is sent out the sink does not generate new query until the pending query is served. The sinkgenerates accesses to the data items following Zipf distribution [16] with a skewness parameter θ. If θ = 0, sink uniformly accesses the data items. As θ is increasing, the access to the data items becomes more skewed. We chose θ to be 0.8.

VII. PERFORMANCE METRICS

Here we examine the impact of cache size on the performance of proposed FNC caching strategy. For performance comparison with FNC, is also simulated. We can see that the proposed scheme FNC performs much better than other scheme due to cooperation within a zone. When the cache size is small, more required data items can be found in local zone cache for ZCS as compared to other which utilizes only the local cache. Thus, the need for accessing the remote and global cache in ZCS is alleviated. When the cache size is large enough, the nodes can access most of the required data items from local, zone and remote cache, that reduces query latency. The byte hit increases with the increasing cache size because with large cache size more data can be stored locally and the size of zone cache increases. Due to use of utility based replacement, the FNC has the higher byte hit ratio at all cache sizes. Due to cooperation within a zone, the byte hit ratio of FNC is always higher than other because each node shares caches of its one-hop neighbors. When the cache size is small, the contribution due to zone hit and remote hit is more significant.

VIII. CONCLUSION

This research work presents a cooperative caching scheme FNC to improve the performance of the wireless sensor networks. The scheme enables nodes in a zone to share their data which helps alleviate the longer query latency and limited data accessibility problems at a node and prolongs the lifetime of WSN. The FNC caching scheme includes a cache discovery process, distance based admission control, consistency check and utility based cache replacement policy. The admission control prevents high data replication by enforcing a minimum distance between the same data item, while the utility based replacement policy helps in improving the byte hit ratio.

IX. REFERENCES

[1] A. Tripathi, P. Gupta, Aditya Trivedi and Rahul Kala, "Wireless Sensor Node Placement Using Hybrid Genetic Programming and Genetic Algorithms," International Journal of Intelligent Information Technologies, Vol. 7, No. 2, pp. 63-83, 2011.

[2] A. Abbasi and M. Younis, "A Survey on Clustering Algorithms for Wireless Sensor Networks," ACM Journal of Computer Communications, Vol. 30, No. 14-15, pp. 2826-2841, 2007.

[3] T.P. Sharma, R.C. Joshi and M. Misra, "Dual Radio Based Cooperative Caching for Wireless Sensor Networks," IEEE International Conference on Networking, pp. 1-7, 2008.

[4] E. Fasolo, M. Rossi, J. Widmer and M. Zorzi, "In-Network Aggregation Techniques for Wireless Sensor Networks: A Survey," IEEE Wireless Communications, Vol. 14, No. 2, pp. 70-87, 2007.

[5] N. Kimura and S. Latifi, "A Survey on Data Compression in Wireless Sensor Networks," International Conference on Information Technology: Coding and Computing, Vol. 2, pp. 8-13, 2005.

[6] J. Li, S. Li and J. Zhu, "Data Caching Based Queries in Multi-Sink Sensor Networks," International Conference on Mobile Ad-hoc and Sensor Networks, pp. 9-16, 2009.

[7] Md. A. Rahman and S. Hussain, "Effective Caching in Wireless Sensor Network," International Conference on Advanced Information Networking and Applications Workshops, Vol. 1, pp. 43-47, 2007. [8] J. Xu, K. Li, Y. Shen and J. Liu, "An Energy-Efficient Waiting Caching Algorithm in Wireless Sensor Network," International Conference on Embedded and Ubiquitous Computing, Vol. 1, pp. 323 - 329, 2008.

[9] K.S. Prabh and T.F. Abdelzaher, "Energy-Conserving Data Cache Placement in Sensor Networks," ACM Transactions on Sensor Networks, Vol. 1, No. 2, pp. 178–203, 2005.

[10] M.N. Al-Ameen and Md. R. Hasan, "The Mechanisms to Decide on Caching a Packet on Its Way of Transmission to a Faulty Node in Wireless Sensor Networks Based on the Analytical Models and Mathematical Evaluations," International Conference on Sensing Technology, pp. 336-341, 2008.

[11] H. Luo, F. Ye, J. Cheng, S. Lu and L. Zhang, "A Two-Tier Data Dissemination Model for Large-scale Wireless Sensor Networks," International Conference on Mobile Computing and Networking, pp. 148-159, 2002.

[12] N. Dimokas, D. Katsaros, L. Tassiulas and Y. Manolopoulos, "High Performance, Low Complexity Cooperative Caching for Wireless Sensor Networks," Springer International Journal of Wireless Networks, Vol. 17, No. 3, pp. 717-737, 2011.

[13] B. Xiao, H. Chen and S. Zhou, "Distributed Localization Using a Moving Beacon in Wireless Sensor Networks", IEEE Transactions on Parallel and Distributed Systems, Vol. 19, No. 5, pp. 587-600, 2008.

[14] L. Yin and G. Cao, "Supporting Cooperative Caching in Ad Hoc Networks," IEEE Transactions on Mobile Computing, Vol. 5, No. 1, pp. 77-89, 2006.

[15] C. Perkins and E.M. Royer, "Ad Hoc On-Demand Distance Vector Routing," IEEE Workshop on Mobile Computing Systems and Applications, pp. 90-100, 1999.

[16] L. Breslau, P. Cao, L. Fan, G. Phillips and S. Shenker, "Web Caching and Zipf-Like Distributions: Evidence and Implications," IEEE International Conference on Computer Communications, Vol. 1, pp. 126-134, 1999.

[17] N. Dimokas, D. Katsaros and Y. Manolopoulos,"Cooperative Caching in Wireless Multimedia Sensor Networks," Springer Journal of Mobile Network Applications, pp. 337-356, 2008.

