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A Review of Various Protocols for WSNs in Search of Most Efficient Congestion Control and Clustering Techniques

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Abstract: Wireless Sensor Networks consists of sensor nodes which are scattered to sense the environment, gather some relevant data, as per the requirements, and transmit it to a base station for processing. There are many issues in wireless sensor networks like lifetime, security, privacy, energy efficiency; mobility etc .Energy conservation in the Wireless Sensor Networks is a very important task because of their limited battery power. The related work so far has tried to solve the issues in this context, keeping in mind the constraints of WSNs like battery power, capacity, size etc. In this study, many protocols related to WSNs have been studied like routing protocols, communication protocols, clustering protocols, congestion control protocols etc. The most recent work which has been done in this field has presented a priority based application specific congestion control clustering (PASCCC) protocol, which integrates the mobility and heterogeneity of the nodes to detect congestion in a network. The review has shown that the PASCCC suffers from certain limitations so this paper ends up with suitable future directions.

Keywords: WSNs, PASCCC, LEACH, Congestion, Clustering.

I. INTRODUCTION

A. The Area

WSNs consist of a large amount of sensor nodes. Generally WSN architecture has some key features like self organization, local decision making, wireless communication support and unidirectional traffic flow towards sink. A sensor node has embedded processor and storage system. But unlike traditional wireless network, sensor devices in WSN [1] have limited computation and communication capabilities and limited energy because they are battery powered. The sensor nodes can collect the data, analyse them, and send them to a destination and their domain is called sensor field. They communicate with each other as well as making use of their neighbouring domains normally through wireless connection. It acquires the data of its location and position through either a global positioning system (GPS) or some local positioning algorithm. A typical sensor node (or simply sensor node) contains sensing, computing, communication and power components to get information from WSN, the users send queries to the base station and get results from the base station which behaves like an intermediate between the network and the user. So WSNs is in a form of distribute database. The WSN is created of nodes from a few to thousands, where nodes are linked to one another. A sensor node might vary in size.

The topology of the WSNs may differ from a simple star network to an enhanced mesh network and Routing and Flooding can be used as the propagation technique.

B. Important Aspects of the Area

1) Clustering: Grouping nodes right into a hierarchical model is a favourite method to achieve network scalability. Clustering [2] usually localizes the routing setup within the cluster and therefore it reduces the routing overhead by each node and the topology maintenance overhead. Using clustering the network appears smaller and more stable. The data, generated from neighboring sensor nodes, is frequently redundant and majorly correlated, so data aggregation by each cluster head economizes communication bandwidth as well. Moreover, the capability to use various power levels in inter cluster and intra cluster communication reduces the interferences and the collisions in the network resulting in a better throughput.

2) Congestion Control: In data networking and queuing concept when a link or node is carrying so much information that its service quality declines, then congestion [3] occurs. Common results consist of new connections blockage, packet loss, or queuing. The impact of these former two is that when offered load increases incrementally then it results in increase of either of these two parameters and then also a small increase in the throughput of the network or sometimes even decrease in the same.

II. SIGNIFICANT CONTRIBUTIONS

A. WSN Types and its Architectures

There are lots of applications of wireless sensor networks [4] and its design depends extensively on the application and various other factors such as hardware, cost, and design objective of application, environment, and system constraints. The 2 main types of nodes in the WSN are multipurpose nodes called nodes and the bridge nodes known as gateway nodes. Generic nodes collect data from

environment send it to the gateway nodes which in turn send the information to the beds base station. The WSN includes mix of gateway and generic nodes. Gateway nodes have higher transmission range, electric batteries, processing capability. The main types of WSNs include terrestrial, multi-media, underwater, under- ground and mobile WSNs

A WSN can be categorized [5] into two types static WSNs and mobile WSNs. Focus was given on mobile wireless sensor networks. To perform monitoring operations in the required areas, usually a WSN was organized using static sensor nodes but there could be some problems with static WSNs due to the dynamic changes in the intimidating environment and events like connectivity, coverage, replacement of dead nodes, economical lack to support multiple operations, deceasing energy of gateway nodes etc. Mentioned problems could be solved to some extent by introducing mobility to some sensor nodes or all sensor nodes .Mobility increase the competence and ability of the WSNs to support numerous operations. The movement of the mobile sensor nodes could be controlled to perform diverse operations. The various advantages of mobile WSNs include enhancement of lifetime, connectivity, Capacity, Coverage, Targeting, Performance improvement and data accuracy.

Hierarchical multi-tiered [6] architecture for mobile wireless Sensor network had presented and discussed. This architecture was proposed for persistent upcoming computing age. They also detailed the mobility impact on various metrics of performance in mobile WSN. The possible applications are like smart transport system, social interaction, security, health and related technologies which seem to be capable to be integrated with mobile WSN in omnipresent computing e.g. use of mobile phones as a mobile sink. Mobile phones have high computing power, communicating and storage capacities. Hence, there can be benefit in network performance with the help of this architecture with respect to packet delay, scalability, energy efficiency etc. The hierarchical multi-tiered architecture is believed to perform efficiently and is also scalable to large network size.

Three-tier architecture [7] was presented and analysed to accumulate data of sensors in the sparse network .Their approach made use of mobile entities (MULEs) which were present in the environment. MULEs collect data from sensors when they are in sensors close range, buffer the data and then deliver the data to the wired access points. It results in considerable energy saving at the sensors because they have to transmit only over a short-range.

The research is being done on the issue as node has to listen continuously and forward to other node. Three-tier architecture constitutes:-WAN network, mobile agents and wireless sensor. As already discussed the benefits, it is compact, cheap, less modules than fixed base station. No overhead of routing. Robust as connectivity failure is not encountered because of interchange-ability. Both homogeneous and heterogeneous node is connected but data is transferred for short distances. A drawback of this system is High latency or deterministic delay is feasible if MULEs follow fixed routes. Fixed movement is pre supposed and MULE lost is some unexpected failures.

B. Routing Protocols in WSN

A new energy efficient protocol for WSNs called Equalized Cluster Head Election Routing Protocol (ECHERP) [8] was proposed in this paper, which attained energy conservation through balanced clustering. The network was modelled by ECHERP as a linear system calculated the combinations of nodes, using the Gaussian elimination algorithm, that could be chosen as cluster heads with an aim to extend the lifetime of the network .To minimize the net energy consumption of the network, the energy consumed at every single round was computed by the protocol using the Gaussian elimination algorithm. The node which minimizes the total energy consumption in the cluster was elected as a cluster head by the protocol as compared to many other protocols which elected the node with higher energy left. To transfer combined data to the base station a multi hop routing protocol was also adopted by the ECHERP. By simulation tests it was shown that the protocol achieved significant amount of energy efficiency and performed better then protocols which were previously proposed. Metrics related to QoS and time constraints could be taken into consideration to further enhance the ECHERP.

In wireless sensor networks energy conservation is an important concern and for this reason many new protocols are designed specifically for these types of networks. Because of application specific nature of routing protocols they are gaining more attention. Classification of routing protocols [9] had been presented. The routing protocols can be mainly classified as location based routing protocols, hierarchical routing protocols and data centric routing protocols. There are many challenges for routing in wireless sensor networks which give rise to development of a lot of new algorithms for data routing which are generally application and architecture specific.

A routing algorithm [10] which combines with hierarchical routing and geographical routing was proposed considering energy efficiency. On the basis of the hierarchical network architecture, the procedure of forwarding packets between the source nodes in the target region and the base station includes two phases, inter-cluster routing and intra-cluster routing. A greedy algorithm was adopted in the process of the inter-cluster routing and a multi-hop routing algorithm based on the forwarding restriction angle was made for the intra-cluster routing to reduce the energy consumption and the hop-count to a certain extent. Overall, the routing algorithm was better to implement and low computation consumption. It was absolutely ideal for routing in a high-density wireless sensor network.

C. Communication Protocols in WSN

Communication protocols also have great importance in energy consumption of the network. A protocol called LEACH [13] protocol was proposed which stands for Low-Energy Adaptive Clustering Hierarchy. It was a protocol which is adaptive and was based on clustering and evenly distributes the load and energy between

network's sensor nodes. Data aggregation was performed in it, which reduces data transmission amount. It was helpful in energy saving and increasing the lifetime of the network.

A reliability model was provided so as to guarantee reliable data supplies to the sink from sensor nodes in underwater wireless sensor networks [14]. For this function, a method was suggested which decides the best size for data packet for effective data supply. In this method two copies of the same packet of data supply are kept in the network without extra burden on the disposable resources .The method used 2H-ACK model which stands for two-hop acknowledgement .The findings on the link between size of packet of data, range between both communicating nodes, bit mistake rate (BER), and throughput were offered also. The outcomes from the simulation had led completely to another algorithm being proposed .The new algorithm may be implemented in underwater sensor nodes to discover the optimal packets size as qualified by a few of the metrics for efficient data transmission.

Dimensionality reduction of transmitted data is one way for a competent transmission as it cuts down on power consumption wasted in radio transmission. PCA proves becoming a robust dimensionality reduction method in multivariate data analysis. However, its computation complexity hinders that it is a suitable dimensionality reduction way of live WSN applications. Therefore, a lightweight version of PCA called CCIPCA was exploited in this research to make an adaptive dimensionality reduction model APCADR [15] for multivariate data in WSNs. The proposed model was correct monitoring environments that are fitted with dynamic data changes within the time.

D. Clustering Protocols in WSN

The cluster-heads generating algorithm [16] was analysed among LEACH and presents improved approach that adjusting the nodes according to Threshold function called M-LEACH. A distributed, energy efficient and load balanced clustering scheme was presented that was went for periodical data gathering, additionally a novel approach ended up being travelling to distribute the action consumption one of several sensors from the cluster formation phase. Simulation results reveal that M-LEACH prolongs the network lifetime approximately 65 % and the overall energy is efficiently consumed. Emphasize was presented on multi-hop large scale sensor network for the future. Some of the cluster head algorithms are LEACH (Low-Energy Adaptive Clustering Hierarchy) [17] and LEACH with deterministic cluster head selection ,which allow to optimize power intake of the WSN but both rotation of cluster head and measurement of residual energy usually are not sufficient to balance the consumption of energy over the network. So the leach was presented with on decreasing consumption of energy by considering absorbed energy as one of the factor for cluster head selection of the node to enhance network lifetime of WSN instead of residual energy. Hence a fresh threshold formula of LEACH was proposed for cluster head selection algorithm .By extending the formula by using a factor that includes the consumed energy of the nodes of WSN has the capacity to increase network life time. One of the primary attributes of this algorithm was to use longer distances between the base station as well as the nodes; energy consumption had no significant change.

Clustering [18] is really a key routing technique helpful to reduce energy consumption. Clustering arranges sensors into groups, to make sure that sensors communicate information to cluster heads and so that the cluster-heads transfer the aggregated data to base station, saves energy thereby prolonging network lifetime. A power efficient cluster-head selection algorithm was proposed for adjusting clusters and rotating positions of cluster heads to equally distribute the power load among all of the nodes. Proposed design was prolonged to LEACH's stochastic cluster-head choice criteria by changing the possibilities of each node to get cluster-head determined by remaining degree of energy for transmission of sensor nodes. Outcomes of simulation shows that proposed model could better implement load balance reduce the power difference among sensor nodes and prolong network lifetime.

The problems with LEACH protocol [20] was studied and presented improved guidelines to simply find the cluster head node. The major problem while using the LEACH lies while in the random choice of cluster heads. There exists a probability that cluster heads formed are unbalanced and may even live in one portion of network making some portion of network unreachable. So the main purpose was to purchase a cluster head to match its current energy level and distance with the sink node. This increases the energy efficiency so because of this network lifetime. Simulation results demonstrate that the algorithm was a lot more efficient and indicated it can balance nodes energy consumption and prolong the network's life span. It was found to have good stability and extensibility.

An energy-efficiency Optimized LEACH-C [21] was presented through a modified style of the cluster head energy consumption, considering retransmission and acknowledgment plus the secondary simulated annealing algorithm is needed to have a better solution. First, using LEACH-C a group of cluster heads was selected. Secondly, taking acknowledgement as well as retransmission into account, one of cluster head energy consumption was created .Then from each cluster head, the quadratic sum of distances is calculated, to its member nodes in best solution. Finally, the greatest energy consumption for just a single cluster head over the following round would be estimated, and to find a better remedy, all of the nodes which have residual power more than the consumption would instantly get to a fresh round of simulated changes. Thus, loss in the cluster head each round can be minimized, plus the WSN lifetime is often extended ultimately.

E. Congestion Control Protocols for WSN

Congestion control [23] schemes in WSNs were discussed. Wireless sensor networks (WSNs) have exceptional necessities and constraints. It was suggested out that the MAC level and routing level information should be

combined to solve neighbouring contention and total area congestion at the same time. They draw the conclusions that the local consistency was not sufficient for overall consistency and that adaptive cross layer control of congestion was essential. It was observed that minor delays in transmission in time critical applications could make data useless and redundant.

A dynamic priority based congestion control protocol (DPCC) [24] strategy was presented that made two major innovations in WMSNs. Firstly, DPCC employed dynamic priority to signify the significance of packets. Secondly, it gives priority to the traffic of the neighbourhood of motes near the base station when WMSN is extremely congested. Simulation results confirm about the highest efficiency of the Suggested strategy with regard to loss possibility, latency and energy-efficiency also.

A data transfer method that deals with the connection variation and network congestion was proposed called IACC (Interference-Aware Congestion Control) [27] .It allowed maximizing link capacity utilization per node by controlling congestion and interference .It was obtained through reasonable maximum amount management of interfering nodes in inter and intra routes of hot spots. The suggested method ended up evaluated by simulation, where the final results rival the effectiveness of the scheme regarding economical and throughput, packet delivery ratio. Extensive simulation has revealed its efficiency regarding throughput, packet delivery ratio, packet emission etc. A light-weight scheme for avoiding and controlling congestion known as DAIPaS which stands for Dynamic Alternative Path Selection Scheme [28] was presented for WSN. DAl-PaS was an easy to use but effective method for controlling congestion while keeping minimum overhead. The entire process of certainly was in line with the charge of resources rather than managing the sending rate within the source. DAIPas performance evaluation with other such schemes showed results which were promising.

A protocol was proposed which works by integrating node's mobility and heterogeneity and detects network congestion by using a queuing model of the nodes, named as PASCCC [29] which stands for Priority Based Application Specific Congestion Control Clustering Protocol. This protocol maintained the threshold levels for various applications and thus decreased the duty cycle of each node. It also include priority and on demand mobility and suitable for a number of real-world applications such as home automation, bush fire detection and similar applications. Use of the leaky bucket algorithm in the future has been proposed, which ensures that the available bandwidth is utilized efficiently and maintains the flow of data.

TABLE I Comparison of different congestion control and clustering techniques

Ref No.	Technique used	Congestion control	Energy efficiency	Packet loss	Priority	Clustering	Inter-cluster data-agg.	Reactive	Mobile (sink/node)
13	Leach	no	yes	no	no	yes	yes	no	sink
10	Gready Algo, Mutihop routing	no	yes	no	no	yes	yes	no	none
16	leach	no	yes	no	no	yes	No	no	none
17	leach	no	yes	no	no	yes	yes	yes	nodes
18	Leach	no	yes	no	no	yes	No	no	none
19	DR control	yes	yes	yes	yes	yes	yes	no	none
14	2H-ACK	yes	yes	yes	no	yes	No	no	none
24	DPCC	yes	yes	yes	yes	no	no	no	none
20	leach	no	yes	no	no	yes	yes	no	none
21	Leach-c	no	yes	no	no	yes	yes	no	nodes
11	GMCAR	yes	yes	yes	yes	no	no	no	none
25	HTAP	yes	yes	yes	no	no	no	no	none
26	Biologicaly inspired congestion control	yes	yes	yes	no	no	no	no	node
12	LRP-QS	yes	yes	yes	yes	yes	yes	no	none
15	APCADR based on CCIPCA	yes	yes	yes	no	yes	yes	no	both
8	ECHERP	no	yes	no	no	yes	yes	no	node
29	PASCC	yes	yes	yes	yes	yes	yes	yes	node
27	IACC	yes	yes	yes	no	no	no	no	none
28	DAIPaS	yes	yes	yes	yes	no	no	no	none
22	EV-CSC	yes	yes	yes	no	yes	yes	no	none

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III. ANALYSIS OF THE LITRATURE

After analysing the literature following gaps have been found:-

a. The existing methods has used queuing model which may restrict the performance of the congestion control algorithm.
b. The behavior of the queue has been neglected for coverage fidelity, queuing thresholds, number of queues, blocking probabilities etc.
c. The nature of the traffic arrival process exhibits a busty and correlated behavior, which totally degrade the network performance.

IV. CONCLUSION AND FUTURE WORK

After studying different protocols in wireless sensor networks like routing protocols, clustering protocols, communication protocols, congestion control protocols etc in relation to energy efficiency, it has been found that the PASCCC is an evolutionary protocol which has been recently proposed. PASCCC is an energy efficient application specific clustering protocol for detecting congestion in a network using a queuing model. The experimental results indicate that the approach significantly improves the lifetime, energy consumption and data delivery to CH and BS. In this approach nodes only move when there is a demand to cover vacant regions .This on demand movement of nodes saves a significant amount of energy. The existing methods has used queuing model which may restrict the performance of the congestion control algorithm. The behaviour of the queue has been neglected for coverage fidelity, queuing thresholds, number of queues, blocking probabilities etc. The nature of the traffic arrival process exhibits a busty and correlated behaviour, which totally degrade the network performance. So in near future, we will enhance PASCCC further by using some congestion control protocols instead of queue.

REFERENCES

[1]. Sen, Nilanjan, and Indrajit Banerjee. "CAWS-Security Algorithms for Wireless Sensor Networks: A Cellular Automata Based Approach." arXiv preprint arXiv: 1209.0286 (2012).
[2]. Vyas, Gajendra Sanjay, and Vivek S. Deshpande. "Performance of Congestion in Wireless Sensor Network Using Redundant Nodes." In Cloud & Ubiquitous Computing & Emerging Technologies (CUBE), 2013 International Conference on, pp. 73-76. IEEE, 2013.
[3]. Iqbal, Adeel, M. Akbar, Nadeem Javaid, Safdar Hussain Bouk, M. Ilahi, and R. D. Khan. "Advanced LEACH: A Static Clustering-based Heteroneous Routing Protocol for WSNs." arXiv preprint arXiv: 1306.1146 (2013).
[4]. Yick, Jennifer, Biswanath Mukherjee, and Dipak Ghosal. "Wireless sensor network survey." Computer networks 52, no. 12 (2008): 2292-2330.
[5]. Rezazadeh, Javad. "Mobile Wireles Sensor Networks Overview." International Journal of Computer Communications and Networks (IJCCN) 2, no. 1 (2012).
[6]. Munir, Saad Ahmed, Biao Ren, Weiwei Jiao, Bin Wang, Dongliang Xie, and Jian Ma. "Mobile wireless sensor network: Architecture and enabling technologies for ubiquitous computing." In Advanced Information Networking and Applications Workshops, 2007, AINAW'07. 21st International Conference on, vol. 2, pp. 113-120. IEEE, 2007.
[7]. Shah, Rahul C., Sumit Roy, Sushant Jain, and Waylon Brunette. "Data mules: Modeling and analysis of three-tier architecture for sparse sensor networks." Ad Hoc Networks 1, no. 2 (2003): 215-233.
[8]. Nikolidakis, Stefanos A., Dionisis Kandris, Dimitrios D. Vergados, and Christos Douligeris. "Energy efficient routing in wireless sensor networks through balanced clustering." Algorithms 6, no. 1 (2013): 29-42.
[9]. Akkaya, Kemal, and Mohamed Younis. "A survey on routing protocols for wireless sensor networks." Ad hoc networks 3, no. 3 (2005): 325-349.
[10]. Yin, Guisheng, Guang Yang, Wu Yang, Bingyang Zhang, and Wenjin Jin. "An energy-efficient routing algorithm for wireless sensor networks." In Internet Computing in Science and Engineering, 2008. ICICSE'08. International Conference on, pp. 181-186. IEEE, 2008.
[11]. Banimelhem, Omar, and Samer Khasawneh. "GMCAR: Grid-based multipath with congestion avoidance routing protocol in wireless sensor networks." Ad Hoc Networks 10, no. 7 (2012): 1346-1361.
[12]. Akbaş, Mustafa İlhan, and Damla Turgut. "Lightweight routing with dynamic interests in wireless sensor and actor networks." Ad Hoc Networks 11, no. 8 (2013): 2313-2328.
[13]. Heinzelman, Wendi Rabiner, Anantha Chandrakasan, and Hari Balakrishnan. "Energy-efficient communication protocol for wireless microsensor networks." In System sciences, 2000. Proceedings of the 33rd annual Hawaii international conference on, pp. 10-pp. IEEE, 2000.
[14]. 14. Ayaz, Muhammad, Low Tang Jung, Azween Abdullah, and Iftikhar Ahmad. "Reliable data deliveries using packet optimization in multi-hop underwater sensor networks." Journal of King Saud University-Computer and Information Sciences 24, no. 1 (2012): 41-48.
[15]. 15. Rassam, Murad A., Anazida Zainal, and Mohd Aizaini Maarof. "An adaptive and efficient dimension reduction model for multivariate wireless sensor networks applications." Applied Soft Computing 13, no. 4 (2013): 1978-1996.
[16]. 16. Liu, Yuhua, Yongfeng Zhao, and Jingju Gao. "A new clustering mechanism based on LEACH protocol." In Artificial Intelligence, 2009. JCAI'09. International Joint Conference on, pp. 715-718. IEEE, 2009.
[17]. 17. Melese, Desalegn Getachew, Huagang Xiong, and Qiang Gao. "Consumed energy as a factor for cluster head selection in wireless sensor networks." In Wireless Communications Networking and Mobile Computing (WiCOM), 2010 6th International Conference on, pp. 1-4. IEEE, 2010.
[18]. 18.Thein, Ma Chaw Mon, and Thandar Thein. "An energy efficient cluster-head selection for wireless sensor networks." In Intelligent systems, modelling and simulation (ISMS), 2010 international conference on, pp. 287-291. IEEE, 2010.
[19]. Choe, Hyun Jung, Preetam Ghosh, and Sajal K. Das. "QoS-aware data reporting control in cluster-based wireless sensor networks." Computer Communications 33, no. 11 (2010): 1244-1254.
[20]. Munjal, Reetika, and Bhavneesh Malik. "Approach for Improvement in LEACH Protocol for Wireless Sensor Network." In Advanced Computing & Communication Technologies (ACCT), 2012 Second International Conference on, pp. 517-521. IEEE, 2012.
[21]. Shi, Shuo, Xinning Liu, and Xuemai Gu. "An energy-efficiency Optimized LEACH-C for wireless sensor networks." In Communications and Networking in China (CHINACOM), 2012 7th International ICST Conference on, pp. 487-492. IEEE, 2012.
[22]. Jain, Aarti, and BV Ramana Reddy. "Eigenvector centrality based cluster size control in randomly deployed wireless sensor networks." Expert Systems with Applications 42, no. 5 (2015): 2657-2669.
[23]. Wu, Yulei, Geyong Min, and Ahmed Y. Al-Dubai. "A new analytical model for multi-hop cognitive radio networks." Wireless Communications, IEEE Transactions on 11, no. 5 (2012): 1643-1648.
[24]. Lin, Qiao-Min, Ru-Chuan Wang, G. U. O. Jian, and Li-Juan Sun. "Novel congestion control approach in wireless multimedia sensor networks." The Journal of China Universities of Posts and Telecommunications 18, no. 2 (2011): 1-8.
[25]. Sergiou, Charalambos, Vasos Vassiliou, and Aristodemos Paphitis. "Hierarchical Tree Alternative Path (HTAP) algorithm for congestion control in wireless sensor networks." Ad Hoc Networks

11, no. 1 (2013): 257-272.
[26]. Domingo, Mari Carmen. "Marine communities based congestion control in underwater wireless sensor networks." Information Sciences 228 (2013): 203-221.
[27]. Kafi, Mohamed Amine, Djamel Djenouri, Jalel Ben Othman, Abdelraouf Ouadjaout, Miloud Bagaa, Noureddine Lasla, and Nadjib Badache. "Interference-Aware Congestion Control Protocol for Wireless Sensor Networks." Procedia Computer Science 37 (2014): 181-188.
[28]. Sergiou, Charalambos, Vasos Vassiliou, and Aristodemos Paphitis. "Congestion control in Wireless Sensor Networks through dynamic alternative path selection." Computer Networks 75 (2014): 226-238.
[29]. Jan, Mian Ahmad, Priyadarsi Nanda, Xiangjian He, and Ren Ping Liu. "PASCCC: Priority-based application-specific congestion control clustering protocol." Computer Networks 74 (2014): 92-102.

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