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Practical Congestion Control Scheme with hop-by-hop Control in Wireless Sensor Networks

K. Rangaswamy[1], C. Rajabhushanam[2]
[1] *Research Scholar*, [2]*Professor*
[1, 2] *Dept. of C.S.E, Bharath Institute of Higher Education and Research,* Chennai, Tamilnadu.
E-mail: [1]rangaswamy19@gmail.com, [2] rajabhushanamc.cse@bharathuniv.ac.in

Abstract

In named data networking the data is transmitted in the form of data packets from source node to destination node through multiple paths. During this transmission the congestion will occur at each node. This should be controlled for efficient data transmission. The existing congestion control algorithms available will not work efficiently in the NDN (Named data networking) architecture. In the existing we used EDGE a greedy algorithm for transmitting the data packets from the source node to destination server. This algorithm selects the shortest path for transmitting these data packets. Even though we are selecting the shortest path for transmission we are getting packet drop and packet delay as high values. This algorithm does not calculate the data packet size and also packet queuing time. To overcome the above mentioned problems and to maintain the packet delay and packet drop as low as possible we are proposing this PCON algorithm. This PCON (practical congestion control) scheme which detects the congestion by measuring the packet queuing time then marks some data packets explicitly. Then the selected downstream router will effectively send the data packets to alternate paths. On calculating the packet queuing time we can quickly transmit the data from source node to destination with low packet drop. The final simulation results shows that our proposed PCON algorithm get very less packet drop and packet delay than compared to the traditional congestion controlling algorithms.

Keywords: *NDN (named data networking), EDGE a greedy algorithm, PCON, congestion, packet queuing time.*

1. Introduction

For providing the point to point conversation between two end hosts we use the internet and it was designed thirty years ago and this internet allows the users to fetch and get the information from the well-known sources. After the introduction of TCP/IP protocol [7] users are allowed to transfer the data in the form of data packets from one place to another place. So we need an efficient architecture for transmitting these data packets effectively from one place to another place. The data transmitted may be text, audio and video in the form of data packets [6]. Named data networking (NDN) [8] is the better architecture proposed which can replaces the existing host to host communication to the a new communication process which will fetch and send the data packets based on content names. In this the consumers will send the interest data packets to the network. In this architecture we can easily control the congestion occurrence which is somewhat difficult to control in the previous architectures. This architecture also has the properties of multicast data delivery, opportunistic in networking and multipath forwarding [8, 9]. Named data networking forwarding plane enables the routers to check the congestion control at each node by delivering them to the alternate paths. There are two main advantages in the NDN architecture they are security and routing and forwarding strategy. NDN architecture provides the security by signing the all named data in the data packets. Whereas in the conventional architectures security will be provided to the location/server and not to the content. Every chunk of the data is forwarded using multiple paths [10]. So we are using the NDN architecture for efficient and secured data transmission in the network. In this NDN network architecture the essential data is transmitted from the source hub to the destination hub in the form of data packets. This network is made up of sensor hubs. These sensor hubs will transfer these data packets through the selected paths. While transmitting the data packets through the selected paths packet loss will occur in the network. If the packet loss is high then the data packets reached at the destination will not contain the efficient information. So we have to choose the efficient path for maintaining this packet drop as low as possible.

The data packets will take certain time to reach the destination node. The time taken to transmit these data packets is called as packet delay. This packet delay also maintained as low as possible for quick data transmissions in the named data network. As the data packets are transmitting from source node to the destination server these data packets will choose the specified router to reach the destination. Each router is capable of accepting up to some range of data packets only. This is known as buffer router threshold value. This router will accept the data packets up to this threshold value only. If excess data packets arrived at this router then we will loss these excess data packets. This is known as congestion. If congestion occurs then the data finally reaching at destination is not same as data which is sent at the source. So we have to control this congestion occurrence in the network. This congestion occurrence in the network can be controlled by assigning the excess data packets to the next selected router. In the existing system we used the EDGE a greedy algorithm for transmitting the data packets from source node to the destination node/server. This algorithm will select the path from source hub to the destination node by selecting the nearest neighbor node among the available neighbor node. This algorithm will calculate the distance from the source node to all the neighbor nodes. The node which has shortest distance from source node will be selected for transmitting the data instead of selecting the random node for data transmission. Although it selects the neighbor node for data transmission the packet drop and packet delay are high in the network. So it is necessary to propose an algorithm which maintains this packet drop and packet delay as low as possible.

To maintain this packet drop and packet with low values in this paper we proposed a PCON algorithm a practical congestion scheme. This technique will calculate the packet queue time at each and every node which is used for data transmission from source node to destination server. If the packet transmission time is more through the selected path/route/link then will automatically choose the alternate path available for transmitting the data packets. Then we automatically take less time for transmitting the data packets. As we calculating congestion occurrence at each node then the packet drop is also maintained as less value. The simulation results showed that our proposed algorithm PCON will provide the less packet drop and packet delay in the wireless sensor network than compared with the existing EDGE algorithm used for data transmission. This paper is organized as follows in the section2 we will gone through related work ,in section3 we gone through proposed system ,in section4 we explained about algorithm used in the paper and in the section5 we explained about the results.

2. Related Work

In this paper "**An Improved Hop-by-hop Interest Shaper for Congestion Control in Named Data networking** "[1] the congestion occurrence in the named data networking can be controlled by Hop-by-Hop interest shaping. To control the returning data rate interest shaping developed the strict receiver driven traffic pattern and symmetric bidirectional forwarding. In this paper we observed that both interests and contents both will contribute for congestion to occur and their interdependencies should be considered in any interest shaping algorithm. To get the optimal shaping rate we analyzed this issue mathematically. To get the high link utilization with zero congestive data loss here we proposed a practical shaping algorithm. We concluded that our proposed hop-by-hop interest shaper in conjunction with simple additive increase multiplicative decrease (AIMD) will efficiently control the congestion and reach the near-optimal throughput value.

"**A Service-based Congestion Control Strategy for Content Centric Networking**" [2] in this paper we discuss about congestion control in content centric network. In content centric network congestion control is the one of the hottest research topic. Most of the existing systems use the TCP congestion control. The quality of service in the content centric network can reduces due to indistinguishibity of the traffic classes. To overcome this problem in this problem in this paper we proposed a service based congestion control strategy for CCN. In this algorithm we assigned a service client to provide the feedback about the congestion level in the network by observing the queue value in the CCN router. The simulation results showed that our proposed method will increase the QOS effectively.

"**A Game Theoretic Framework for Congestion Control in Named Data Networking**" [3] in this paper we are going to discuss about congestion control in the named data networking architecture (NDN).in NDN architecture congestion control is the essential building block. The internet protocol (IP) counterpart and the unique features available in the NDN architecture made the congestion control is the major requirement in this architecture. For controlling the flow rate in the NDN we proposed a game theoretic framework and it is based on the concept of Nash bargaining from the cooperative game theory and we proposed a distributed flow-aware hop by hop congestion control mechanism on a solid analytical basis. To study the behavior of our scheme we done the simulations and performance evaluations on the NDN architecture. The simulation results showed that our proposed method game theoretic frame work will effectively enhances the performance of our network.

"**A Proactive Transport Mechanism with Explicit Congestion Notification for NDN**" [4] in this paper we discuss about a transport mechanism in NDN architecture. The named data networking (NDN) transfers the data from the source to the consumer who requested the content. In such network architecture transmission control mechanisms should be designed carefully for efficient data transmissions. The existing systems use the TCP mechanisms for transmission control. These protocols will not provide the efficient data transmission. In this paper we proposed explicit congestion notification (ECN) which will send the notifications about the network conditions through communication lane. This mechanism provides the high link data transmissions for the fast data transmissions and with low packet drop. To provide the optimal data transmission globally we also proposed the smart forwarding mechanism which selects the forwarding paths for individual flows by utilizing the network wide information. The simulation results showed that our proposed ECN-based approach which is coupled with smart forwarding will provide the best results in terms of best link utilization, low packet dropping rate and less flow completion time.

"Energy-efficient ICN routing mechanism with QoS support" [5] in information centric networking the communication mode is different from the existing communication modes in which the routing decision is mainly depends on the unknown and named content instead of depending on the IP address. In this paper we proposed a new Energy efficient quality of service routing mechanism for ICN (EQRI).for providing the quality of service first we evaluated about the link suitability by using Cauchy distribution model and we calculate the energy efficiency of the link by observing the traffic. Secondly based on Qos and energy efficiency we proposed a priority determination strategy and we also designed a color management strategy for allocating the color for the outgoing interface and backtracking strategy for the failed interest packet. On using these three strategies namely priority determination strategy, color management strategy and backtracking strategy we proposed a link selection algorithm. The experimental results showed that our proposed method will provide better results than compared with the existing methods available for content retrieval.

3. Proposed System

In the existing system if we want to transmit the data from consumer node to the destination server in the network we will transmit this data in the form of data packets. These data packets are transmitted from one node to another node by selecting the nearest neighbor node among the all available nodes. Initially the consumer node sends the data packets from the source node to the nearest neighbor node then this node will send the data packets to the next neighbor node. This process is continued until the data packets are reaching the final destination server. During this transmission the data packets will go through the selected router. Every router has some specific buffer threshold value. This router accept the data packets up to this threshold value only. If packet rate exceeds this threshold value then congestion will occur at the router. For handling this congestion occurrence and for transmitting this data we used the EDGE a greedy algorithm in the existing. This algorithm does not provide the efficient data transmission at the receiver. Because packet drop and packet delay is high.

To maintain this packet drop and packet delay with minimum values here we proposed a PCON algorithm a practical congestion control scheme for controlling the congestion occurrence in the network. The most suitable place where we can detect the congestion is at link where it occurs. Here we detect the congestion by monitoring the outgoing queues of each router. To detect the congestion on router queues here we used AQM and CoDel mechanisms [11, 12]. These methods detect the congestion at the router before it overflows. CoDel detect the queuing time on each link.if this queuing time over the time period exceeds the threshold value then we identify that the link is get congested. As we initially detecting the congestion occurrence at the router so we can easily assign the excess traffic data packets to the next face router without losing the data packets. So we can automatically minimize the packet drop and packet delay in the data transmission.

3.1 Algorithm

This paper proposes a PCON a practical congestion scheme and this PCON detects the congestion at their local links by using an active queue management (AQM) scheme which is extended from CODel. Whenever we identified that congestion is occurred at the router then it will send this intimate to the consumer and downstream router to handle the excessive data packets. The downstream router controls the congestion by transmitting the data packets in alternative paths and then passing this signaling message to further downstream nodes. Since the routers which are present in the network will participate in avoiding the congestion so PCON is considered as “hop-by-hop” control scheme. This PCON monitors the queue at their outgoing link which signals the congestion occurrence early.

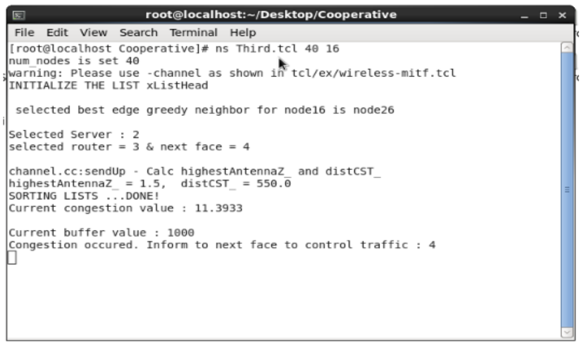
The pseudo code for this PCON algorithm is represented below

```
Step1:-enter total no of nodes for creating the network.
Step2:-select the consumer node.
Step3:-for (int i=first router; i<last router; i++)
        {
                Calculate the distance from consumer node each router.
        }
```

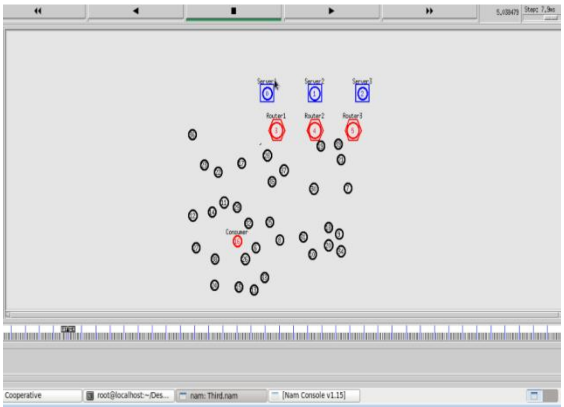
Distance d=$\sqrt{(x_2 - x_1)^2 + (y - y_1)^2}$
Step4:-assign nearest ith router as selected router.
Step5:-assign (i+1)th router as next face router.
Step6:-calculate the packet queue time.
Step7:-if (packet queue time is higher value)
Step8:-calculate the current congestion value.
Step9:-now inform the next face router to handle the traffic.

4. Results and Discussion

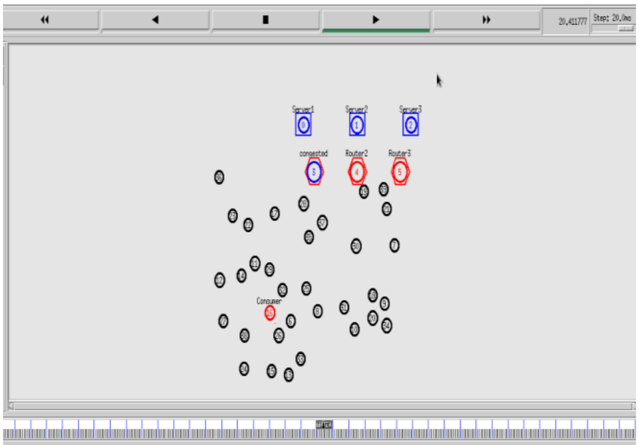
In the below represented screen we can run the EDGE a greedy algorithm by running the third. Tcl .here the 40represents the total no of nodes with which we want to form a network.16 represents the source node and according to greedy algorithm the best neighbor node chosen for transmitting the data is 26.here we can also view the selected router as 3 and next face router used for controlling the traffic is router 4.here we can also view the selected server also known as destination node as server2.



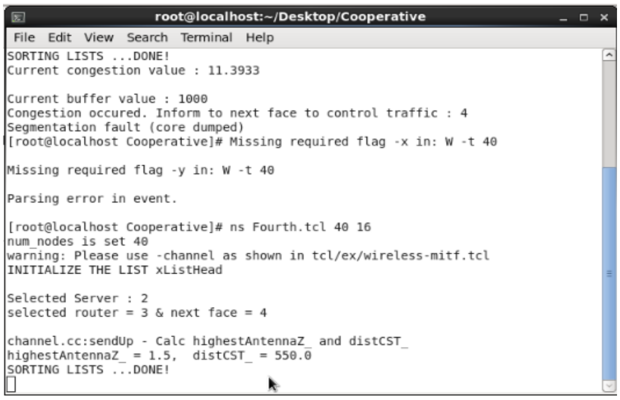
The below screen we can see the network is formed with no of nodes entered and this network consists of servers, routers and nodes. Here the source node is represented in red color.



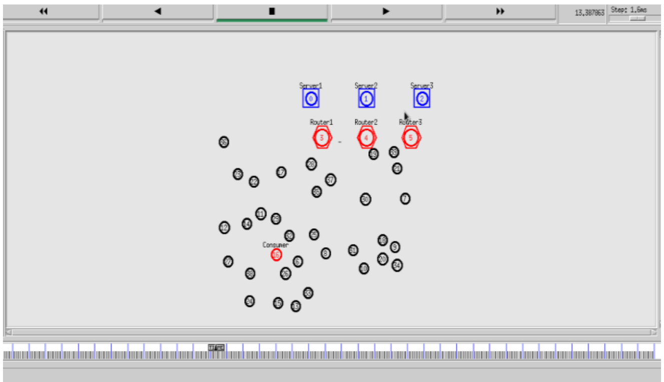
On transferring the data from the source node to the destination server via selected router congestion will occur then congestion can be controlled by transferring the excess data packets to the next assigned router. When the congestion is occurred at the router then the router color is changed and renamed as congested.



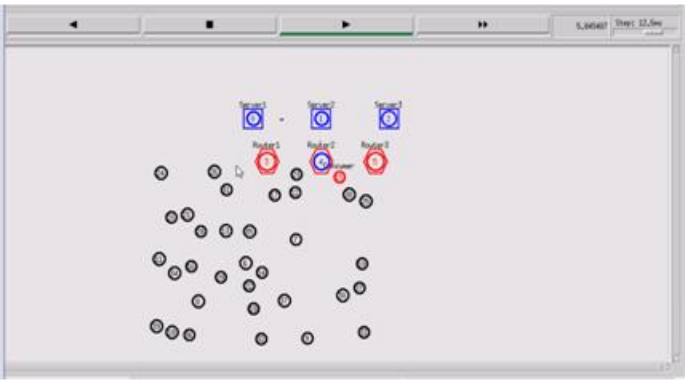
Here the PCON algorithm concept can be run by running the fourth.tcl file. Here 40 represents the total no of nodes should be present in the network.16 represents the consumer node. Here we can also view the selected router node, selected server and the selected next face router.



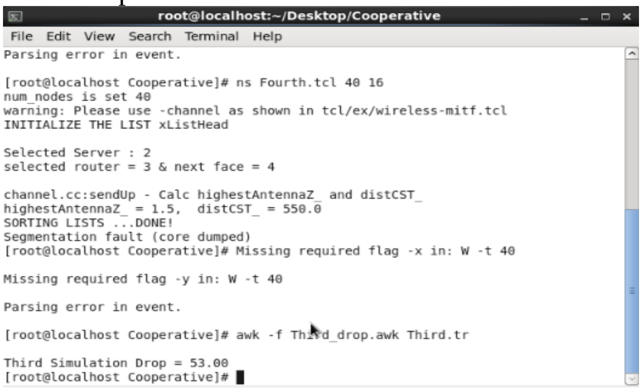
In this below screen we can see that the data packets are transmitted from the source node that is node16 to the destination server that is server2 via selected router 3.



In this below screen whenever the data packet rate exceeds the queue threshold value then congestion will occur in the network. Whenever the congestion occurs then the node color changes and name is renamed as congested.

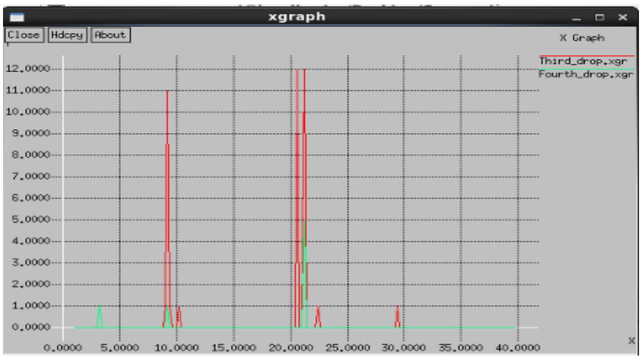


In this below shown screen the simulation packet drop occurrence in the network due to EDGE a greedy algorithm can be calculated by running the file thitd_drop.awk file. From here we can observe the drop is 53.



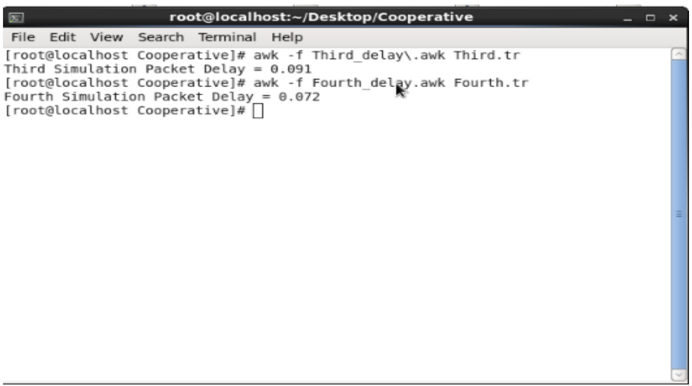
In this screen we can observe that the packet drop in the network due to PCON algorithm can be viewed by running the fourth_drop.awk file and here we can observe that the packet drop is 23.

The below screen represents the graphical comparison between the EDGE a greedy algorithm and PCON algorithm in terms of simulation drop.

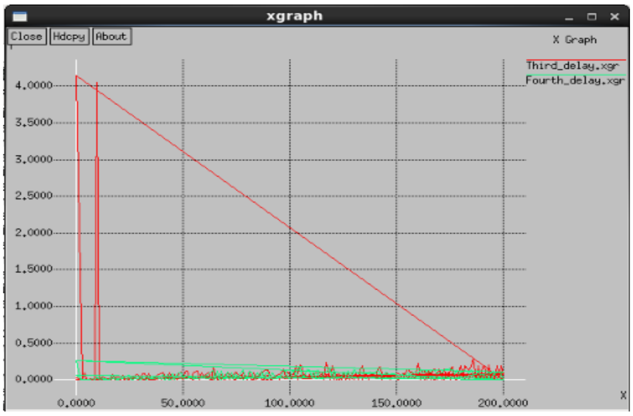


In the below screen we can get the simulation delay for the EDGE a greedy algorithm by running the thid_delay\.awk file. And we get the delay value as 0.091.

In the below screen we can get the packet delay for the PCON technique by running the fourth_delay\.awk file. Here we can see the delay value as 0.072.



The below screen shows the graphical comparison between the EDGE and PCON algorithms in terms of packet delay from this graph we can also observe that delay is high in EDGE algorithm and delay is less in PCON algorithm. So PCON algorithm is better for efficient data transmissions in the network.



5. Conclusion

In this paper we proposed a PCON algorithm for estimating the congestion in the network. This calculates the packet queue time at each node. This packet queue time is the time required to transmit these data packets through the selected router. If this packet queue time is high then we intimate the next face router to handle the data traffic. Here we are handling the excessive traffic data by using the PCON algorithm. The major advantages of this proposed algorithm are 1. Packet drop is less. 2. Packet delay is less. 3. We do not require the in network routers for measuring the capacity of the links. Here PCON uses the hop-by-by control mechanism which is integrated with AQM scheme for detecting the congestion.

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