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Optimizing Throughput and TCP Receive Window with Node Connection in Distributed Fuzzy Computing with Enhanced Bandwidth for High Speed TCP in WSN

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Abstract: The high speed sensor causes congestion during communication process, so the sender sends data to the receiver. However, the receiver will not send any acknowledgment to the received data packet. The multi-task process cannot reduce the resource utilization. The Proposed Regiment data scheduler (RDS) algorithm is used to monitor the node capacity and the history of the node based on the information. Moreover, it allocates the routing path effectively. It is easy to access TCP and FTP protocols, which are adjustable sop. It also fixes the threshold values. Reaching the threshold value, the nods perform communication. Otherwise, it is difficult to achieve effective communication. High routine Fuzzy computing is proposed to find window size based on the packet loss information and to define the window size rate. It uses queuing scheme to analyse the behaviour of node. That counter value updates the high speed, which is a modification to TCP's congestion control mechanism and TCP connections with large congestion windows. A set of sampling values from sampling algorithm (Th_N) are applied to both homogeneous and heterogeneous resources. It reduces congestion or attacker rate and increases the Packet delivery rate.

Keywords: Regiment data scheduler, Fuzzy computing, sampling algorithm, TCP congestion window.

1 Introduction

Rapid development of skill necessitates manufacturing cost-effective hardware that reduces energy consumption and organizes all types of information in the network. High-Speed Wireless Sensor Networks are similar in various aspects, including resource constraints, an unstable grouping of overloaded information, packet error, and assessment battery [1, 2]. The fundamental cause of the minimum worth of data packet is split open overload which is suitable for similar communication route or elevated communication speed, in which traffic organizer is the significant difficulty in the Wireless Sensor Network [3]. This scheme of congestion reduces packet latency and maximum trustworthiness. Considering the defined rules, the normal congestion causes two stages: node condition and link condition. The sensor node status is associated with all node buffers and connection status relates to concurrent communication in sensor node. Different schemes are accessible for congestion management.

Resource control scheme improves some network target Nodes. One destination node must be involved in the network, and each sensor node chooses a divided route to the destination node [4]. Transfer management scheme manages the congestion not only in the sender node but also in the available transmission rate using arithmetical process [5]. A Path allocation scheme is employed to assign the defined fixed value for buffer sizes. Even if the output is more efficient than afixed value, traffic occurrence is identified. In precedence alert rules, while intrusion is detected and removed, the remaining nodes are prioritized for the right of entry to the routing path [6].

Congestion management is one of the vital problems in a wireless sensor network. It removes the congestion, such as intrusion identification, intrusion announcement, and intrusion improvement. Intrusion identification part identifies intrusion in the network nodes, then the congestion allotment alerts the packet to intermediate nodes in a network [7]. The Healthcare Aware Optimized Congestion Avoidance (HOCA), which has been launched to intrusion identification rule for a wireless sensor network, reveals that congestion is based on the size of

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wireless routing path and maintains intermediate nodes. Priority-aware downstream Congestion Control Protocol (PCCP) analyzes an intrusion occurrence rate with ranges for packet receiving and packet service instance [8]. Priority technique uses a bright intrusion detection scheme considering the allocated time slot of packet transmission. It uses implicit congestion notification to avoid transmission of additional control messages. PCCP is used to estimate energy performance. Queue based Congestion Control Protocol with Priority Support (QCCP-PS) for wireless sensor network and size of packet waiting condition cause the communication overhead. If all source nodes contain neighbor nodes, the details are preserved in node storage area [9].

Part Two addresses the previous pieces of literature. Parts Three covers the proposed Enhanced Stable channel allotment (ESCA). It provides the best and stable connection in routing path to improve transmission rate. Part Four is dedicated to simulation performance report monitored with various parameters. Part Five comprises future updates.

2 Related Works

Venkata Subba Reddy et al. [10] presented whether a preceding detail is not known to be a subsequent part of solitary fuzzy strong views process with double fuzzy membership operations. Double fold fuzzy set complete particular fuzzy strong views process as Fuzzy Certainty Factor. Sensors (FCF) are briefly detailed as an application for proposed fuzzy conditional congestion. FIS-Fuzzy inference scheme converses for sensor network to identify the Turbo mount Fuzzy Control System. The prim's method is used to design the spanning tree for aggregation of packet information from the source node to sink node.

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Salvatore Gaglio et al. [11] provided programming technique and an unimportant middleware based on programming with implementable data transmission for distributed work in WSNs. Programming is efficiently used on sensor network to conduct a representative analysis. To verify the sequence of probability here, the Fuzzy Logic scheme modifies the data condition in a dispersed direction. Throughout the present scheme, an Ambient Intelligence application is constructed to analyze the characteristics of a WSN node. When the elevated level symbolic programming is authorized, the best stage is fairly dense.

Celia Rosline et al. [12] proposed that fuzzy query outputs are connected with the amount of membership analysis which directly shows each received acknowledgment data packet, competing the semantic goal of the fuzzy question as long as the uses with further details are adopted to provide an answer. Fuzzy queries are valid for the various uses which demand a single query that can calculate values for spatial objects with various threshold values. Thus, data packet broadcast at the sensor nodes with post-hoc monitoring at the exterior attendant should be reduced . It holds various types of a fuzzy query for various scenarios. Capable query processing depends on the communication technique. It utilizes Minimum Bounding Rectangle (MBR) based routing that contains constant capacity nodes as the header of the cluster and sensor nodes as a cluster member to powerfully and dependably distribute question and recover the query output. In the novel, proposed routing performs varied nodes which help distribute the question and organize the query report in a reliable way in a sensor network.

Ioakeim Samaras et al. [13] indicated that the fuzzy rules were invented using real arithmetical information obtained from the sensor network. The experimental report observes the energy usage of each sensor node battery condition. The sequence to model the mistake of the resulting information for the fuzzy intrusion detection scheme with every communication energy usage is estimated. Data correction issues were solved and the cubic polynomial was fixed to the normal data exchange. Performance report and a real-valued cost process were created to obtain the best result for the space within the wireless sensor network considering the sampling time according to experimental result of the FIS that was re-estimated.

Xu Huang et al. [14] indicated that protecting WSN has become an individual worry. ECC prominently provides great possible merits for sensor network safety. It also involves some of the process requirements to be appropriate for sensor network. Moreover, it incorporates extreme self-control organization schemes, including an imperfect battery and the capability of processing. It is an optimized dynamic window based on our existing research mechanism. Entire Quality of service (QoS) is succeeding this scheme in terms of the high capacity of power usage. The NAF scheme occupies modular inversion procedure to obtain the NAF of dual value. The one's complement exclusion should offer a very easy way to record the integer value. Choice always occurs between pre-computing and computing; the former is connected to storage, while the latter is associated with processing facility and ability. The acknowledgment has not been received. The theme of node capacity is analyzed and control is delayed.

Seung Wan Kim et al. [15] indicated that goal is concurrent to increase the reliability for combined data packet and to minimize the packet latency when the network is crowded. Efficient network congestion control and a queue scheduler assign network resources in a confidential queue to process a particular physical connection in the network. In this study, a dynamic queue controlling scheme with fuzzy logic is utilized for routing. The experimental output shows that the present scheme considerably decreases average packet latency and improves the transmission rate comparing with the previous techniques. Queue scheduler has successfully assigned the network resource through leasing a packet in the confidential queue to the right of entry a connection of fixed capacity. The output of the present method considerably outperforms the previous method in its higher packet transmission.

Guohang Huang et al. [16] presented a cluster separation of nodes; a collection based connection scheme is constructed to remove the sightlessness of a link with minimizing operating cost. Next, the actual load estimate for a significant district and a load-balancing operational scheme is planned to stop sightlessness of traffic management and to understand the traffic evaluation. The proposed algorithm minimizes the cost of network arrangement. A non-blind load-balancing operation scheme is constructed to obtain traffic control for trust worthiness of sensor nodes.

Kayiram Kavitha et al. [17] presented a routing channel assign technique used for energy-best communication obtained. When network hierarchy is accepted for RREQ and REP information organization, whether any node failure may direct to connection breakdown of corresponding subtrees resulting from the environment. It causes issues to the life span of the sensor. A viral cause of a node breakdown is power outage in the sensor. The present scheme is used to solve link failure problems, to provide efficient packet communication, to control the overload, to discover different routes, and to remove sub tree paths. Recovering method is traffic aware and its outputs are in lesser energy usage, but with higher efficiency that improves the lifespan of networks. It leads to a successful process of the dangerous information present at single node in the path.

Dr. M.Yuvaraju et al. [18] presented an efficient energy usage of the additional power generating strategy. It proceeds with efficient energy consumption through introducing a new multipath routing protocol known as Secure Energy Efficient Load Balancing Multipath Routing Protocol-SEL with communication energy consumption alteration. Particular path routing protocols may lead to intrusion in the network outstanding to unacceptable traffic rate in the sensor node. Many paths communication obtains best traffic control distinguished with solitary path rules. The TSEL scheme chooses the node to displace numerous routes which distribute traffic occurrence to nodes in a route in better manner using recent load sharing technique. It obtains protection throughout RSA public key with MD5 hash methods.

Cheng et al. [19] proposed an original energy efficient congestion organizing methods, termed enhanced congestion detection and avoidance (ECODA) that distinguish many conditions. Double defenses fixed value with subjective storages for intrusion identification, Supple Queue Scheduler for packet allocation, and large size of the packet will manage traffic rate. The experimental output indicates that ECODA obtains the best intrusion management. Consequently, it obtains better effectiveness and reduces packet latency. It equally identifies intrusion using two buffers for storage to set fixed value and distinguish the storage. It operates on the probability based packet transmission and prevents intrusion effectively. Best connection link is used to achieve communication. It minimizes the packet drop, enhances energy efficiency, and reduces packet latency.

D'Aroncoet et al. [20] illustrated the best method to identify and remove intrusion. Intrusion management in a sensor network gathers the position of information on nodes and monitors its behavior to define the best communication path from the sender node to target. Simulation is performed using Dallas-hybrid Dynamic Alternative Path Selection method to find intrusion in a wireless sensor network. Packet collection is utilized in the nodes to minimize intrusion within the network route. The proposed hybrid algorithm reduces packet latency, improves throughput, and minimizes packet drop rate.

3 Overview of Proposed Scheme

Source node needs to broadcast data packet through relay node to destination node. If the packet is not fully transmitted to target node, it causes damages in relay node, drops the data and creates congestion for communication from the source to the receiver node. Scheduling concept benefits transmission in terms of reducing congestion rate.

Figure (1) shows the high Block diagram for bearing parallelism based Data Scheduler. Congestion of relay node communication occurs between source node and destination node. Threshold sampling schemes can fix the threshold value node and eliminate communication. The heterogeneous resource performs communication in various situations. Fuzzy based computing analyzes node characteristics, increases the packet delivery rate, and reduces the congestion rate.

Regiment data scheduler manages the communication and divides the data packet before transmission process. Nodes capacity is monitored to break the wrong connection and to enhance the packet transmission efficiency. Nodes capacity is compared with a threshold value. The nodes are detected and removed from the entire network environment. If they are attackers, they are higher than the threshold value.

The connection with unusual receiving node and non-disjoint connection with common receiver node from the set of active links schedule the displace connection in initial time slots. The data packets are scheduled in the next available slots. To construct scheduling algorithm, the congestion free communication performs and categorizes the potential congestion of each connection. Sampling enables the algorithm to create feasible sets of non-interfering connections. There is no more congestion between nodes and the algorithm allocates different time period to avoid such congestion. Connections belong to various congestions, so they must not be scheduled in the same time slot However, they utilize a similar route. To facilitate packet transmissions at the beginning of time slots, the algorithm schedules the initial time period for the group with a higher count of connections.

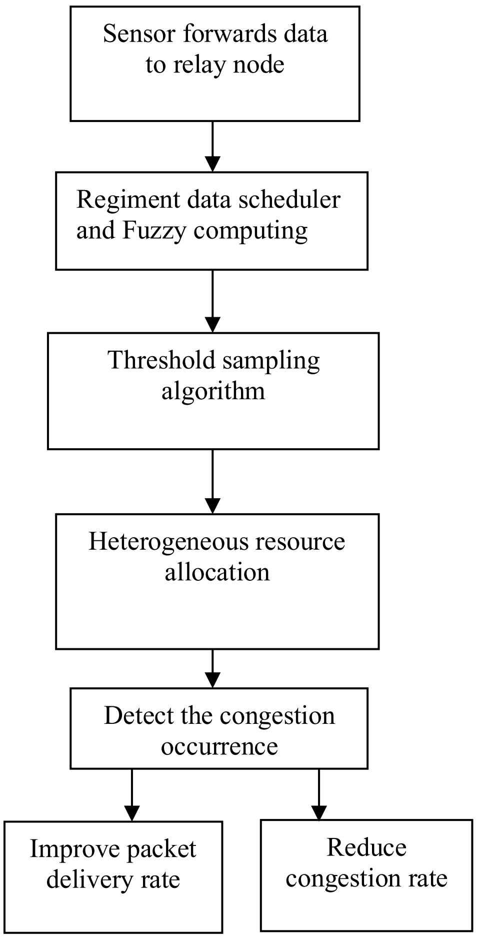

Fig.1: Block diagram for bearing parallelism based Data Scheduler

RDS algorithm is a sampling scheme that defines a plan for all active connections using a minimum count of timeslots.Fuzzy computing is one of computing models [21-24]which solves a wide range of problems. Fuzzy computing is also supported to achieve the best communication technique which contains the separate data packets before getting a transmission for all set of congestion-free connections. Each available connection in the nodes of the packet collection is dedicated to provide a Fuzzy-based data collection with a different range of data transmission and collection.

3.1 Multipath Data Collection

A network with a group of intermediate nodes arbitrarily distributed in a dual-dimensional plane of each direction. All nodes are displayed as a point on the plane with coordinates. A link between nodes is created to design the communication route. The best communication coverage is resolved using this method. First, the larger coverage limit is allocated to a group of nodes, and then it is calculated to equate with a multiple stable and thereby discover an optimal value. Linked nodes may broadcast packet with another neighboring node included in particular coverage limit.

$$ML = Min(Dr(ts),Dr(ts+1)) \quad (1)$$

Where MLis multipath communication among source to target node. Minimum Dr drop rate for particular ts time slot. The data packet collection procedure follows a route-based method, so neighboring nodes in the various ranges will transmit the data packet to their sender nodes. Packet aggregation is permitted at the relay nodes only, i.e. Data collector or Destination node. All nodes in the routing path maintain the relay information if congestion node holds information of their immediate sender node on the routing path. A node assumes a single role within any period, either source or destination node. Intermediate nodes operate as a collector after collecting information from all their relay nodes. Later, the collector node acts as a sender which forwards the sensed information. Last, the destination node collects data locally and forwards the final information to the destination node. Maximum Dr drop rate for particular ts time slot is computed as,

$$ML = Max(Dr(ts),Dr(ts+1)) \quad (2)$$

Multi-path routing rules multiple detects paths from the source node to destination node. The sensing information should be broadcast from sender node to destination node along the different routing paths. First, the network must find the primary route that links the sender node and destination node. The destination node does not send acknowledgment to the network. Consequently, the source node waits an acknowledgment signal from target node for a long time. Subsequently, two packets will convene each other. Then, a routing channel from the sender node to destination node is noticed along the footprint of the two packets. After the initial routing channel is designed, another optional route is identified. Various paths from the source node, which comprises numerous relay nodes, to target node are identified.

3.2 Regiment Data Scheduler (RDS)

RDS schedules the data packet transmission. Before a transmission node splits the data packet into different sectors, the numerous nodes perform packet transmission in a different direction that has chosen a specific path for the proper communication. The sender node is answers the request and presents information concerning the battery condition of the nodes available in the group of connections. The node sends a request packet to entire nodes within coverage range. They are classified as the optimal nodes if they succeed in receiving the packet. All information is maintained within each node and the collector node checks the residual energy level of the nodes.

$$R_d = \infty \int \sin f\,(0) \quad (3)$$

$$f = \hat{e} + 2(\hat{e} - 1) \quad (4)$$

Where f frequency, r_d Regiment data allocation, and $\hat{e}$energy usage for frequency alteration, packets which are forwarded by the source node and the collector node concerning the battery of all nodes. Sensor nodes are frequently arranged. The destination node process starts taking into account the initial energy and amount of hop counts for the sensor node. Selecting destination node, the sensors monitor the infrastructure. Communication is carried out based on main concern. Relay nodes broadcast data packets to the destination node. Higher-level nodes play more roles in the communication process. Urgent situation data packets are broadcast to the end user with minimum possible packet latency. The battery level of the selected relay nodes comes behind the threshold value, then the selection process initiates again by the source node. The collector node sends the information to source and destination node. This node forwards information to the sensor nodes routing path present in the sensor network.

$$R_d = \infty \int \sin \hat{e} + 2(\hat{e} - 1) \quad (5)$$

The time slots are allocated between sensor nodes with partitioned packet data. The information packets are pointed into their individual node information according to their priority. Data packets are broadcast using Time Division Multiple Access. The respective sensor nodes are time period synchronized. Authentic time data packets are maintained in the smallest data packet with the greatest probability. Probability-based transmission is allocated to obtain the lesser packet latency.

$$Pr = Rd * ML \quad (6)$$

The sensor nodes are ready to perform communication for the next time slot with transmitted data packets. Multiple operations are performed with the highest priority nodes which do not give reply acknowledgment for a particular time slot. While a sensor node senses transmit and receive data from relay nodes, they process and broadcast the data in the allotted time slot. Data are divided into minimum size and transmitted in the allocated time period. Then, the remaining packet is transmitted in the next allocated time period. TCP and FTP are supported to transmit a data packet and to enhance the network lifetime.

$$\mathrm{Pr} = \infty \int \sin \hat{e} + 2(\hat{e} - 1) * ML \quad (7)$$

Regiment data scheduling Algorithm

Step 1: Sender check multipath

Step 2: if {Node==Frequency match}

Step 3: for each sender obtains multipath

Step 4: initiate communication

Step 5: if {frequency==mismatch}

Step 6: set frequency of communication

Step 7: S->Pack

Step 8: Pack->D

Step 9: else

Step 10: Continue communication through relay nodes

Step 11: end if.

Step 12: obtain efficient routing path.

Step 13: End of

Step 14: End if.

3.3 Detecting and Removing Congestion Using Fuzzy Computing

The numerous target nodes should not operate in a little condition as node count increases or decreases. A destination node needs to collect data packets regarding sensor node quantity in coverage range at a different velocity. Based on this description method, it presents nominees target node position in order to minimize traffic rate. Furthermore, it depends on present sensor node quantity prototype and target node as these positions are dedicated to energetic state when the target node at remaining candidate locations is planned to slumber state.

$$\mathrm{Pr} = \infty \int \sin \hat{e} + 2(\hat{e} - 1) * \left(Max\big(Dr(ts), Dr(ts + 1)\big) < Min\big(Dr(ts), Dr(ts + 1)\big)\right) \quad (8)$$

Sensing data can be transmitted from source node to destination node along this path. Network nodes must find the initial route that links the source node and the destination node. Fuzzy computing is employed to solve the congestion issues. Data packets are transmitted sequentially to allocate an optimal routing path. Sender node also broadcasts node details to the neighbor node. Following the two packets, request and reply message will assemble each other. Any delay in acknowledgment causes congestion in routing path from the source node to the target node. Congestion is totally removed to find the best path along the sensor network. Behind initial route, the congestion, which designed to the alternative path, is identified. The sender node has various intermediate relay nodes and several routing paths from the source to target node.

Removing Congestion using Fuzzy Computing Algorithm

Step 1: Packet transmission failure.
Step 2: if {Node == congestion}
Step 3: Wasteof resource used for communication.
Step 4: Fuzzy to find congestion based on sampling algorithm.
Step 5: packet failure occurred to adjust the frequency of the node
Step 6: so node moves out of coverage range
Step 7: else
Step 8: Repeatinformation exchange among communicating routes.
Step 10: end if.

$$(Max(Dr(ts), Dr(ts+1)) < Min(Dr(ts), Dr(ts+1))$$
$$=\log(Dr(ts), Dr(ts+1)) \quad (9)$$
$$\Pr = \infty \int \sin\hat{e} + 2(\hat{e}-1) * \log(Dr(ts), Dr(ts+1)) \quad (10)$$

More energy field is inserted into the reply message in which each reply message is received by the destination node. Source node attempts to select different communication route as well as the routing channel with the highest value within each available route. If the mistake path fault message is captured, each path using the broken down connection is rejected from routing information buffer storage. It increases the network lifetime.

Packet ID: Packet ID has nodes characteristics data in the buffer. All nodes are fixed in frequent manner in the wireless sensor network infrastructure.

Source ID	**Destination ID**	**Multipath collection of data**	**Regiment data scheduler**	**Reject intrusion**	**Fuzzy computing**
3	3	4	6	5	6

Fig. 2: CCBFC Packet format.

Figure (2) indicates that the CCBFC packet format is present. The source node ID field occupies 3 bytes and 3 bytes are occupied by destination node ID field. The third one is a multipath collection of data carried on 4 bytes. Packet information is organized by the target node through various routes. In the fourth field, regiment data scheduler carries 6 bytes. It schedules data packets for each node transmission and time slot is also assigned. In the fifth field, it takes 5 bytes to reject intrusion. The packet that loses the intrusion is removed. The last field is fuzzy computing and takes 6 bytes. It solves a lot of intrusion issues and obtains the effective output.

4 PerformanceEvaluations

A. Simulation Model and Parameters

Present CCBFC is simulated by Network Simulator tool (NS 2.34). In this simulation, 100 sensor nodes are moved in the 950-meter x 900-meter square region for 60 milliseconds simulation time. Each sensor node randomly moves in the network at a different speed. Sensor nodes have coverage area. Constant Bit Rate (CBR) provides a constant speed of packet transmission in the network to limit the traffic rate. Ad hoc on Demand Distance (AODV) vector routing protocol is used to obtain enhanced stable channel for packet transmission among senders to sink node. Table (1) indicates that simulation setup is analyzed.

Table 1: Simulation Setup.

No. of Nodes	100
Area Size	950 X 900
Mac	802.1g
Radio Range	250m
Simulation Time	60ms
Traffic Source	CBR
Packet Size	150 bytes
Mobility Model	Random Way Point
Protocol	AODV

Simulation Result: Figure (3) exhibits that the present CCBFC scheme controls congestion based on fuzzy computing. It removes the intrusion within source to destination node compared with existing ECODA [19] and CCHE [20]. CCBFC organizes the behavior of the node. A sender node forwards accurate injected packets that cause packet loss. It easily finds and removes the intruders from the entire routing path. It also improves detection efficiency and reduces packet loss.

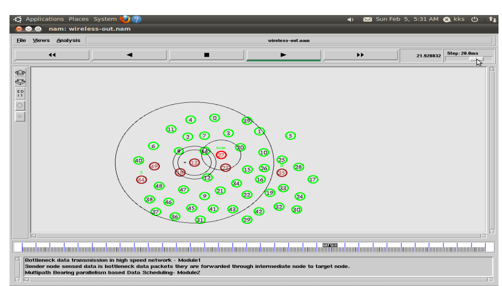

Fig. 3: Proposed CCBFC ResultPerformance Analysis.

In simulation to analyze the following performance metrics using Xgraphs in NS 2.34.

Detection Efficiency

Figure (4) shows detection efficiency, intrusion detection rate with the overall time taken to detect the packet loss. Those communications occurring on the efficient communication path are achieved. CCBFC Scheme Packet Delivery rate increases compared with the previous schemes (i.e. CCHE, BPDS, and RDS).

Table 2: Detection Efficiency

Nodes	Detection Efficiency (%)			
	CCHE	BPDS	RDS	CCBFC
20	43	55	70	86
40	44	56	72	87
60	45	57	73	90
80	47	58	74	89
100	48	59	75	91

$$\boldsymbol{Detection\ Efficiency = Intrusion\ Detection\ Rate\ /Timetaken}$$

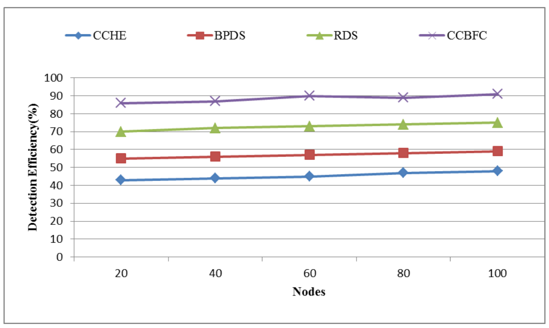

Fig. 4: Graph for Nodes vs. Detection Efficiency.

Network Lifetime: Figure 5 lifetime of the network is calculated based on thequantity of resource used for specified time period instance from the beginning to the end of the process for thewhole network energy present range. In the Proposed CCBFC Method Network life time increases compared to the previous schemes (i.e. CCHE, BPDS, and RDS).

Table 3: Network Lifetime

Speed(ms)	Network Lifetime(%)			
	CCHE	BPDS	RDS	CCBFC
20	50	22	83	89
40	52	23	85	90
60	53	24	86	92
80	56	25	87	93
100	58	27	88	94

$$\boldsymbol{NetworkLifetime = lengthofenergy\frac{usage}{overall}energy}$$

Energy: Figure (6) shows energy consumption, quantity of energy used for packet exchange among sender node to target node that, i.e. estimating energy usage from starting energy level to final energy level. The proposed CCBFC

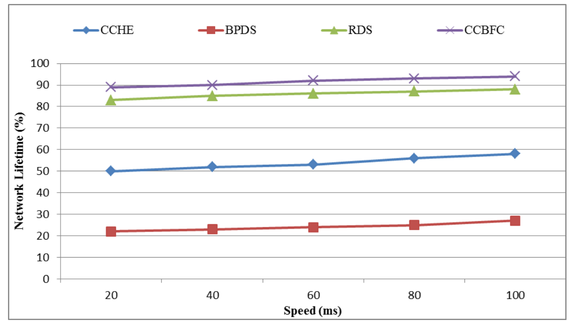

Fig. 5: Graph for Speed vs. Network Lifetime.

Method creates efficient communication routes in the network, and energy usage reduces compared with previous schemes (i.e. CCHE, BPDS, and RDS).

Table 4: Energy Consumption

No. of. Nodes	Energy Consumption(J)			
	CCHE	BPDS	RDS	CCBFC
20	401	214	103	86
40	423	236	126	94
60	436	248	147	110
80	457	261	162	122
100	479	283	173	135

$$\boldsymbol{Energy\ Consumption = InitialEnergy - FinalEnergy}$$

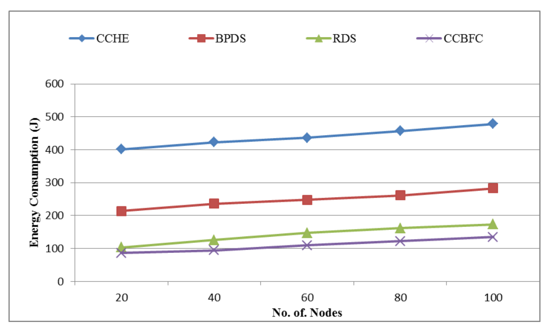

Fig. 6: Graph for No of Nodes vs. Energy Consumption.

Packet Drop Rate: Figure (7) exhibits that Packet Drop rate reduces when a base target node collects data packet from network infrastructure through relay node available in sensor networks. Minimum energy level is used in that situation. In the present CCBFC method, packets drop rate reduces compared with the former schemes (i.e. CCHE, BPDS, and RDS).

Table 5: Packet Drop Rate

Nodes	Packet drop rate (%)			
	CCHE	BPDS	RDS	CCBFC
20	65	40	23	15
40	67	41	24	16
60	68	42	26	18
80	69	43	27	19
100	70	44	28	20

$$\textit{Packet drop rate} = (\textit{NumberofPacketLosses}/\textit{Sent}) * 100$$

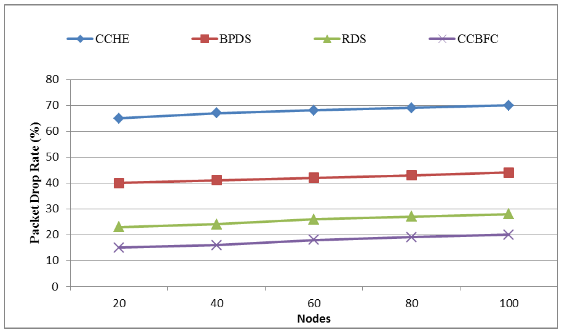

Fig. 7: Graph for Nodes vs. Packet Drop rate.

End to End Delay: Figure 8 shows that end to end delay is evaluated based on the time required to broadcast messages from sender node to target node Also, all node information is stored in the routing table of the network. In CCBFC Method, end to end delay is reduced compared with the previous schemes (i.e. DQMA and TMSP).

Table 6: End to End Delay.

Pause time(ms)	End to End Delay (Sec)			
	CCHE	BPDS	RDS	CCBFC
20	22.01	10.14	3.03	1.26
40	23.79	11.56	5.16	3.74
60	24.26	12.08	6.87	5.60
80	25.03	13.91	7.12	6.18
100	27.14	15.03	8.43	7.51

$$\textit{EndtoEndDelay} = \textit{EndTime} - \textit{StartTime}$$

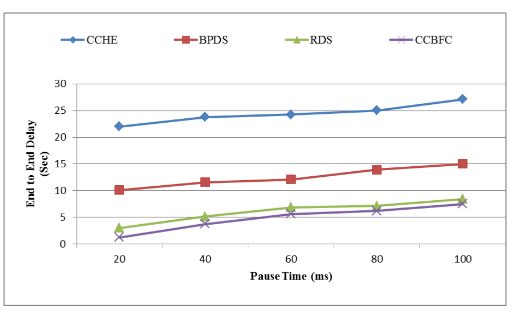

Fig. 8: Graph for Pause time vs. End to End Delay.

Throughput: Figure (9) shows that Throughput is calculated based on the amount of packet captured from the count of packets sent in particular speed. Velocity is varied and experiment velocity is fixed to 100(bps). In CCBFC method, Throughput improves compared with the previous schemes (i.e. CCHE, BPDS, and RDS).

Table 7: Throughput

Mobility (bps)	Throughput (%)			
	CCHE	BPDS	RDS	CCBFC
10	36	72	88	92
20	37	73	89	94
30	39	74	90	93
40	40	75	92	96
50	41	77	93	98

$$\textit{Throughput} = (\textit{Numberofpacketreceived}/\textit{Sent}) * \textit{speed}$$

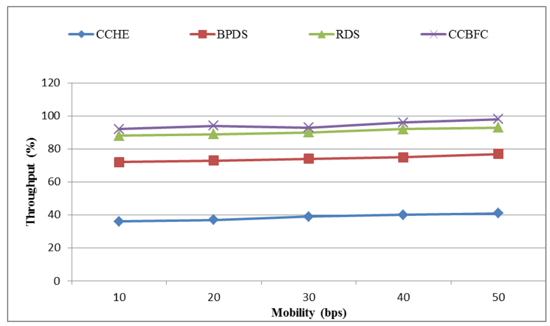

Fig. 9: Graph for Mobility vs. Throughput.

5 Conclusions

Wireless sensor network is arranged in a network infrastructure which includes the sender node that broadcast data packets to target node. Nodes mismatch the frequency range between relay nodes in routing path which causes packet drop and latency. The present Congestion control Maximum bandwidth based Fuzzy Computing-CCBFC sets and adjusts the frequency of node to start communication between sender and target node, fixes the threshold value for every node appropriate for that condition, chooses the relay node, minimizes the packet drop and increases detection efficiency. Irregular connection between sensor nodes, in wireless sensor network will be analyzed in the future phases.

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