International Journal of Multimedia and Ubiquitous Engineering
Vol. 10, No. 2 (2015), pp. 171-186
http://dx.doi.org/10.14257/ijmue.2015.10.2.16

A Mechanism to Avoid Call Retransmission Using Consistent Shortcut Transfigure Path Construction in Wireless Network

S.Sreethar[1] and E.Baburaj[2]

[1]Research Scholar, Computer and Information Technology,
Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu, India
[2]Professor, Department of Computer Science and Engineering,
Sun College of Engineering and Technology, Nagercoil, Tamilnadu, India
[1]sreethar78@yahoo.co.in, [2]alanchybabu@gmail.com

Abstract

To ensure fair packet broadcasting without service disruption in wireless network from one network cell to another is the key to successful mobile services. However, enforcing fair packet broadcasting is challenging because decision policies within the network cell though works efficiently, considerably reduces the energy consumption level. Using MAC protocol, communication framework gets improved by cooperatively localizing the system and achieves space-time synchronization. But redundancy occurs on cellular wireless network for higher energy levels. This work presents the design and implementation of collision free packet broadcasting in wireless network known as Consistent Shortcut Transfigure Path Construction (CSTPC) mechanism. Under this mechanism the main objective is to develop a transfigure path (i.e., alter path) when the link failure occurs during broadcasting (i.e.,) handover the call. Initially, consistent shortcut is created for constructing alter path and when the link gets failed packet handover takes place. Consistent shortcut is created by combining the Midpoint and Simpsons rule procedure. The Midpoint and Simpsons procedure creates the shortcut and with this reduces the rate of energy consumption gradually. Secondly, error rate on call handover is reduced using CSTPC mechanism by applying Estimation of Distribution algorithm. The constructed Estimation of Distribution algorithm in CSTPC mechanism feasibly handover the packets to neighboring base station with minimal error rate. In this way, minimal error rate avoids retransmission of packets due to the collision and path failure. Furthermore, the CSTPC mechanism reduce the energy consumption level on transfigure path construction and also avoids the retransmission of packets (i.e.,) call in wireless network. Experimental work is carried out using factors such as avoidance of retransmission rate, energy consumption rate, and call broadcasting efficiency.

Keywords: *Handover process, Consistent Shortcut Transfigure Path, Wireless Network, Midpoint and Simpsons rule, Estimation of Distribution algorithm*

1. Introduction

Due to ease of formation and simplicity, fair packet transmission with wireless network using Medium Access Control (MAC) protocols is extensively applied in computer networks in order to analytically transmit the packet during data transmissions. In wireless networks, the main drawback is the rate of collision to be observed during packet transmissions. As a result, the energy consumption level gets reduced during packet transmission resulting in minimization of call broadcasting efficiency. Many research works has concentrated in minimizing the retransmission and therefore collision rate.

ISSN: 1975-0080 IJMUE

Store-Carry and Forward (SCF) [1] was designed for successful relaying within the cell in order to achieve end-to-end communication for cellular networks. SCF was efficiently applied in multi-user environment using mathematical modeling to evaluate optimal routing and different types of scheduling policies. The application of SCF though achieved maximum energy savings, but data rate considered for transmission was only limited. A wireless type of communication system called, Space-Time Synchronization (STS) [2] for mesh topology was introduced for advanced health care applications. STS used two types of probabilistic model referred to as the Bayesian Networks for high quality healthcare applications and state sequence were made using Hidden Markov model. The drawback observed in STS was that the energy level increased with the redundancy level.

With the significant revolution in the Internet, the rate at which the information are requested and posted and rendered to the user has changed the market of business ever before. Energy consumption in wired and wireless networks were observed in [3] to optimize the energy consumption level using data obtained from the manufacturer to reduce time and energy consumption. Though passive optical networks and point-to-point were observed to be the most energy efficient model, it was restricted with only these two types.

One of the fundamental operations to be performed in wireless network is the efficient broadcasting that has to transmit or broadcast a packet from a source node to all other destination nodes in the wireless network. A distributed greedy algorithm [4] was presented to enhance the ratio of gain at each node. The application of the algorithm proved that it ensured efficient broadcasting and also minimized the number of total retransmissions in wireless network.

With the high increase in the communication range between the source and destination nodes in Multi-Hop Wireless Networks (MHWNs), the problem of cooperativeness [5] was extensively studied. To minimize the total retransmission in MHWNs, classification of networks was performed according to the broadcasting distance and level between the nodes. The method also measured the level of frequency to analyze the frequency under different traffic scenarios. Though retransmission was reduced in MHWNs, the performance of network deteriorated and increased the number of nodes in MHWNs. An energy efficient MAC protocol was designed in [6] that avoids overhead and as a result contention was reduced to certain extent by introducing the sleep and wake up time of the nodes in networks.

Many researchers have provided insight into underwater wireless sensor networks (UWSNs). Different routing protocols have been designed so far for efficient packet transmission in order to reach the sink node on sea surface. But, for significant packet delivery, end-to-end communication is highly desirable. In [7], two retransmission techniques were presented to provide solution related to ACK. The retransmission techniques used duplicated ACK segments with an additional temporary file in the header file. Minimum number of retransmission was also achieved by evaluating ACK files received. However, trances of files included certain unnecessary retransmissions.

In order to ensure scalability and enhance the reliability, relay technologies has received increasing attention. In conventional relay technologies, data or packet transmission takes place using store-and-forward mechanism and as a result, the conventional relay technology did not provided accurate transmission rate. Distributed relay-assisted retransmission (DRR) scheme [8] was introduced to retransmit the packets on behalf of sender node once block acknowledgement (B-ACK) is obtained from destination node. Though DRR scheme provided throughput improvement and energy efficiency, but degraded the performance of network during retransmission.

To improve the network performance, Low power listening with Wake up after Transmissions (LWT)-MAC protocol [9] was designed that alleviated the problem of network performance by waking up the sensor nodes at the end of transmission. In addition, channel contention was also reduced by deploying a retransmission mechanism called as the non-aggressive. But the main drawback of the method being observed was that, with less amount of load the energy consumption increased gradually. An optimized header A-MSDU frame aggregation (OHA-MSDU) [10] was presented to increase the level of throughput. With the application of OHA-MSDU, the network performance was also improved. Though throughput was improved it did not support multi-hop wireless networks.

In this paper, we propose an efficient mechanism called Consistent Shortcut Transfigure Path Construction (CSTPC), which is capable of developing a transfigure path in wireless network during the occurrence of link failure and thereby reduce frequent retransmission timeouts for improving performance of energy consumption and call broadcast efficiency. The Consistent Shortcut Transfigure Path Construction (CSTPC) includes two main elements:

(i) Midpoint and Simpsons rule procedure: This procedure, Midpoint and Simpsons rule creates consistent shortcut in an intermittent manner and with this significant shortcut being created, the rate of energy consumption gets reduced gradually.

(ii) Estimation of Distribution algorithm: Occurrence of collision in wireless network is removed with the application of estimation of distributed algorithm that uses joint probability distribution functions to obtain neighboring node and forward accordingly.

The remainder of this paper is organized as follows. Section 1 describes the problem of fair packet broadcasting under the view of retransmission rate in wireless networks. Section 2 provides a brief summary of the related work. The new mechanism Consistent Shortcut Transfigure Path Construction (CSTPC) with neat architecture diagram and algorithm process is described in Section 3. Section 4 provides performance evaluation of CSTPC with analysis of results included in Section 5 and finally concludes with Section 6.

2. Related Work

There have been a set of minimizing call retransmission procedures presented for improving the performance of packets during packet transmission in wireless networks. In this section, we briefly describe the avoidance of retransmission procedures that are compared to in this paper.

In wireless networks increasing the lifetime of the network is one of the most promising issues to be solved due to the restricted nature of energy of the sensor nodes. As a result, efficient organization of sensor nodes is one of the key successes for maximizing the lifetime of the network. Particle Swarm Optimization (PSO) [11] approach was introduced for the selection of cluster head in an optimal manner. Though the approach was easily implemented, optimization was not included for increasing dimension.

Increasing the latency in wireless networks has been an active research area for over a decade. One of the major factors for performance degradation in wireless network is the habitual retransmission timeouts in wireless networks. Retransmission timeouts cannot be prevented in wireless networks. Timestamp based Detection of Loss of Fast Retransmitted Packets (T-DLRP) [12], efficiently identified the occurrence of fast retransmitted packets to improve latency. However, congestion was not controlled during retransmission.

A congestion control scheme [13] was presented in wireless using two strategies namely, congestion detection strategy and congestion control strategies. Initially, the congestion was detected using Morkov chain that efficiently measured two types of congestion conditions. Followed by this, a strong congestion control strategy was formulated to control heavy congestion to efficiently reduce energy consumption during retransmission. However, the order with which the packets transmitted differed with the level of congestion observed. To effectively determine the order of retransmission of packets, MIM-aware reordering [14] improves the level of throughput.

Incast congestion occurs in Transport Control Protocol (TCP) when multiple servers post's their request to the same receiver in parallel manner resulting in higher bandwidth and lower latency. Incast Congestion control for TCP (ICTCP) [15] concentrated on the relationships between throughput and round-trip time (RTT) of TCP on the receiver side. Though performance was improved, it cannot be applied in multi hop network. In [16], optimality of throughput was ensured using per-flow or information, with the effective construction of single data queue during each link by using only the local information. However, security was not addressed.

In recent emerging trends, broadcasting packet to remote cooperative groups has to be performed efficiently for ensuring security. A new key management paradigm [17] was included which consisted of both traditional broadcast encryption and group key agreement. Though security was provided, reliability remained unaddressed. A Congestion Aware Reliable Information Transport (ReCAIT) [18] ensured reliability in wireless sensor networks using the combined acknowledgement and retransmission scheme under different network conditions. In [19], an intelligent methodology for efficient data collection in wireless networks was presented using nonlinear cost function. Though efficient in terms of throughput, the correlation among the inputs remains unaddressed. In [20], a new technique for minimizing the level of collision was introduced to reduce the energy consumption in wireless network using Source Count Value. With this, substantial amount of energy was reduced and throughput was increased.

Based on the aforementioned methods and techniques, a consistent shortcut transfigure path construction mechanism is designed in wireless network to minimize call retransmission by reducing the energy consumption rate and increasing the call broadcasting efficiency.

3. Consistent Shortcut Transfigure Path Construction Mechanism in Wireless Network

In this section, we illustrate the consistent shortcut transfigure path construction mechanism in wireless network challenge of enforcing minimal energy consumption during transfigure path construction. The main objective of CSTPC mechanism is to develop a transfigure path for link failure wireless network system by reducing the energy level. The energy level is reduced in CSTPC mechanism by avoiding call retransmission in wireless network. Wireless network performing wide broadcasting is a fundamental operation in CSTPC mechanism where call forwarding or call broadcasting transmits a message from source node to destination node in wireless network. With collision free, retransmission of packet gets avoided from source to destination in wireless cellular network.

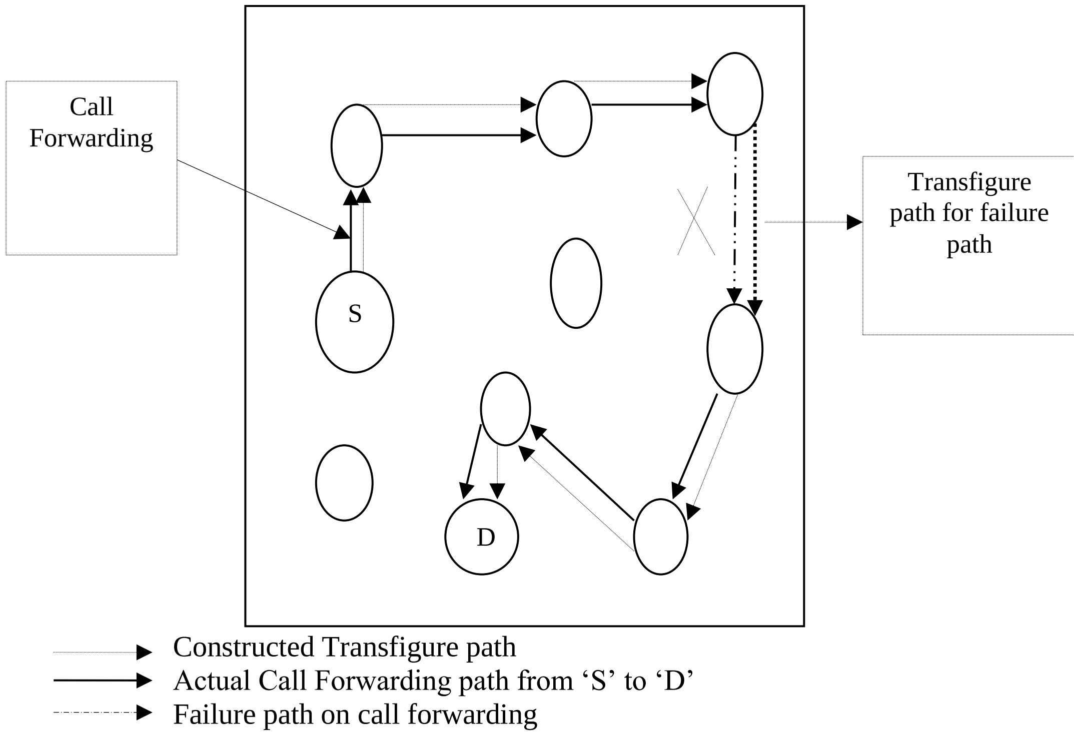

Figure 1. Transfigure Path Construction using CSTPC

To avoid path failure during call forwarding task, transfigure path is constructed in wireless network. The diagrammatic form of transfigure path is illustrated in Figure 1. It initially the call forwarding is placed to the source node though the intermediate nodes in the network. The transfigure path is constructed behind the actual call forwarding path in wireless network. Whenever the actual path gets failed during the call forwarding, to the same neighboring node at the same time (*i.e.,*) collision occurs in wireless network. To avoid collision, CSTPC mechanism developed the transfigure path by combining the Midpoint and Simpsons rule procedure. The developed Midpoint and Simpsons rule procedure creates the shortcut for easy design and implementation of transfigure link with minimal energy consumption. With this, the transfigure path constructed in CSTPC mechanism reduces the error rate and collision using the estimation of distribution mechanism. The estimation of distribution mechanism uses joint probability distribution function as depicted in Figure 2 using the flow chart given below.

The overall flowchart of the estimation distribution procedure is depicted in Figure 2. To start with, the initial link is generated for call forwarding. The forwarded call counts the administrated source 'S' nodes for effective transmission. The joint probability distribution function (PDF) in CSTPC mechanism estimates the distributed distance from source 'S' to destination 'I'.

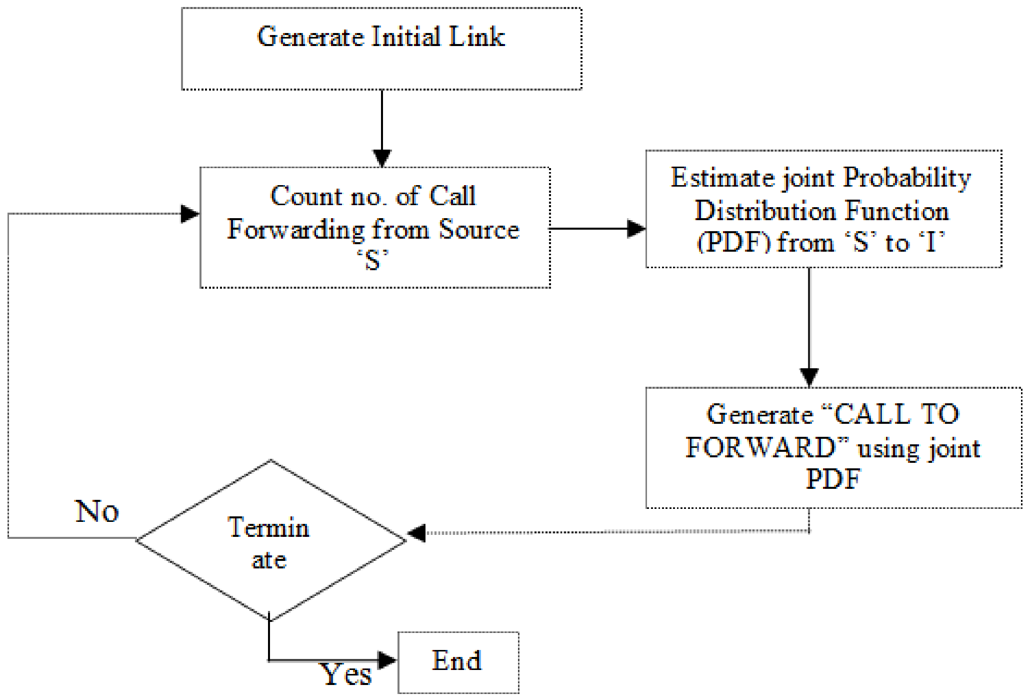

Figure 2. Flowchart of Estimation Distribution

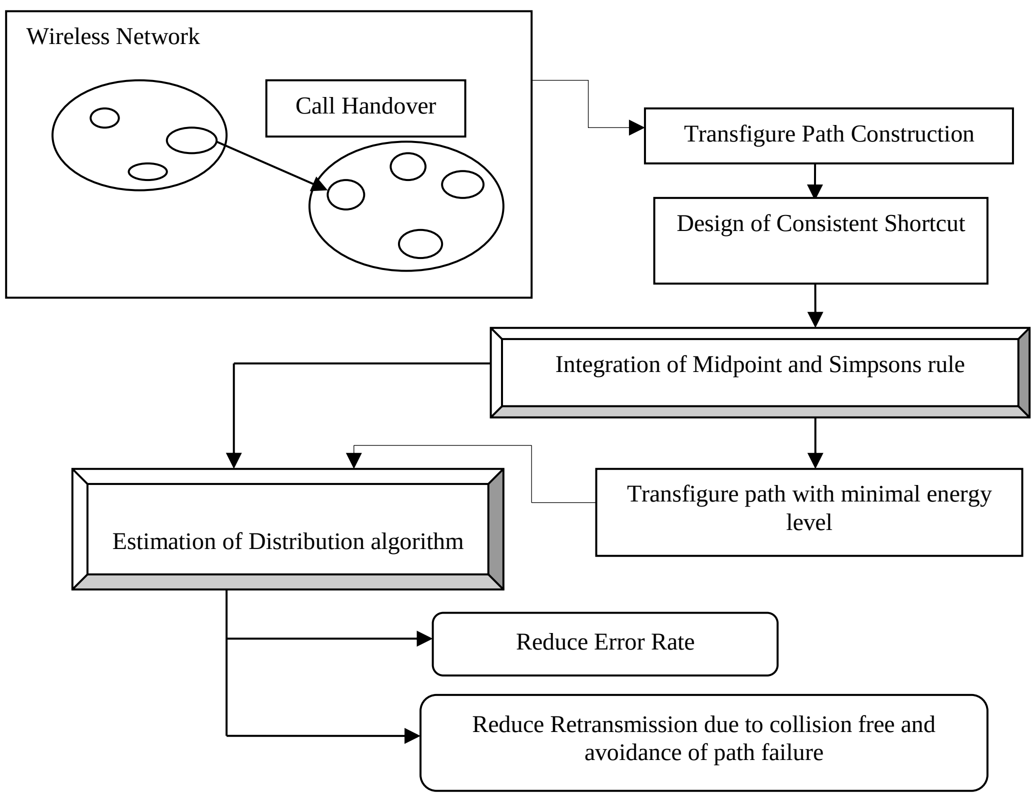

Figure 3. Architecture Diagram of CSTPC Mechanism

The advantage of the application of estimated joint PDF in CSTPC mechanism is that it avoids the collision in wireless network. The overall architecture diagram of CSTPC mechanism is depicted in Figure 3.

As illustrated in Figure 3, the overall architecture diagram illustrates the call handover processing with efficient transfigure path construction. The transfigure path constructed using CSTPC mechanism is represented using consistent shortcut. With the application of consistent shortcut, the energy consumption gets reduced by combining the Midpoint and Simpsons rule. The Midpoint and Simpsons rule in CSTPC mechanism is used for effective construction of transfigure link in wireless network. The error rate is easily evaluated in CSTPC mechanism using the estimation of distribution procedure. The estimated distributed procedure uses the joint probability distribution function to easily compute the distance and as a result avoid the occurrence of collision.

3.1. Design Considerations of Midpoint and Simpsons Rule Procedure

CSTPC mechanism develops a consistent shortcut with nodes points which are more closely to the average actual link in wireless network. The development of consistent shortcut in wireless network with closer average midpoints reduces the energy consumption rate. The midpoints average on the 'i' interval of call is measured as Eq. 1.

$$Node\ Points\ (NP) = \frac{NP_i + NP_{i+1 \ldots} NP_{i+n}}{2} \qquad (1)$$

The node points 'NP' measures the overall midpoints during packet forwarding from the source to destination nodes. The source node NP_1 to the NP_n destination node takes the 'i' intermediates node during call forwarding in wireless network. Let us consider that CSTPC mechanism uses '5' nodes for experimental illustration. Then, the length of each node points is measured as Eq. 2.

$$\Delta NP = NP_{i+n} - NP_{i+n} \qquad (2)$$

Using ΔNP from (2) the midpoint value is easily identified in the CSTPC mechanism. With this, the measure of all the '5' sensor nodes ΔNP value is measured as,

$$\left.\begin{aligned} \Delta NP\ of\ (5,4) &= D(NP_5) - D(NP_4) = 12 - 10 = 2 \\ \Delta NP\ of\ (4,3) &= D(NP_4) - D(NP_3) = 10 - 7 = 3 \\ \Delta NP\ of\ (3,2) &= D(NP_3) - D(NP_2) = 7 - 6 = 1 \\ \Delta NP\ of\ (2,1) &= D(NP_2) - D(NP_1) = 6 - 3 = 3 \end{aligned}\right\} \qquad (3)$$

The node point's distance 'D' is measured to easily evaluate the midpoint value using CSTPC mechanism. From the above Eq. 3, we can see to that the node point '5' is located in the wireless network at '12'meter and node point '4' is located at '10' meter. So with this, the difference between the two meters helps to easily measure the distance between node points for call forwarding in wireless network. All the above distance computed value measure the midpoints using CSTPC mechanism. With this, the midpoint helps to averagely construct the transfigure link in wireless network.

The midpoint rule in CSTPC mechanism combines with the Simpsons rule to reduce the energy level drastically when compared to the existing mechanism. Simpsons rule is used in transfigure link construction for easy integration of the system. The CSTPC mechanism Simpsons rule is represented as Eq. 4.

$$SR = 1/2\ [NP] \qquad (4)$$

The sinusoidal rule 'SR' uses the node point value to divide the computed value into two. The obtained value from sinusoidal rule helps to construct the transfigure path with the closest average distance and therefore reduces the energy consumption rate. The integration work is carried out in CSTPC mechanism to reduce the ‘2n’ distance interval to ‘n/2’ distance. Finally, the combined Midpoint and Simpsons rule reduces in an average to closer distance in CSTPC mechanism by reducing the energy consumption rate.

3.2. Estimation of Distribution Algorithm

Collision is a fundamental limiting factor to be achieved in the CSTPC mechanism. A collision is said to occur when two or more node transmits a call to a common neighbor node at the same time. This type of collision is effectively removed in the CSTPC using the Estimation of Distribution mechanism. Estimation of Distribution mechanism uses the joint probability function to compute the error rate. The joint probability distribution forwards the calls from common neighboring nodes by reducing the error rate. The joint probability distribution using CSTPC mechanism is computed as

$$Joint\ Probability\ Distribution\ (N1, N2) = P(X = N1, Y = N2) \qquad (5)$$

Joint Probability distribution functions for two neighbor nodes ‘N1’ and ‘N2’ in wireless network is demonstrated in Eq. 5. The estimation of distribution mechanism uses the joint probability distributions function to obtain neighboring node call and simultaneously forwarding without any collision occurrence. The algorithmic steps involved in the Estimation of Distribution algorithm are described in Figure 4.

// Estimation of distribution Procedure
Begin
Step 1: Initialized node point ‘NP’ =0
Step2: While (Error value > specified value)
Step 3: Generate the Actual link for call Forwarding
Step 4: Count the no. of call forwarding from source ‘S’
Step 5: If actual link gets failed
Step 5.1: Utilize the transfigure link constructed on closest average
Step 6: Else transferred call using the joint Probability Distribution Function
Step 7: End If
Step 8: Estimate Joint Probability distribution from ‘S’ to intermediate node ‘I’
Step 9: Repeat until criteria is meet (i.e.,) collision free and error free
Step 10: End While
End

Figure 4. Estimation of Distribution Algorithm

The algorithmic steps for estimation of distribution procedure clearly describe the procedure used for call forwarding in wireless network without any collisions. The ‘while loop’ used in CSTPC mechanism compares the error value with the specified value easily identifies the error rate and accordingly measures the collision rate criteria. The ‘while’ loop is executed in CSTPC mechanism and ensures that it get processed until the procedure attain an error free call forwarding system. During call forwarding, when there occurs a path failure, the transfigure path is constructed with the help of the ‘if’ loop. With this, the retransmission is avoided using the transfigure path in CSTPC mechanism, and as a result, the energy consumption level also gets minimized.

4. Experimental Evaluation

Consistent Shortcut Transfigure Path Construction (CSTPC) mechanism is experimented using the NS-2 network simulator. The movement of all the nodes generated over a 900m x 900m cellular network field is used for simulation purpose. The network is taken to experiment the handover process while discovering the service on mobile nodes where CSTPC holds 100 to750 (m/s) simulation results. Dynamic Source Routing (DSR) Protocol is used in CSTPC mechanism for effective route discovery and handover process. The erratically selected location with a selected velocity offers a predefined speed. Random Waypoint model is developed to randomly choose and move to another node location point by forwarding the call to the neighboring base station. RWM model shifts to a randomly chosen location.

The position with an arbitrarily chosen field contains a predefined amount and speed count. An arbitrary sequence is carried out with mobile nodes during the simulation period in wireless network. The experimental work is compared against the Store-Carry and Forward (SCF) decision policies [1] and Space-Time Synchronization (STS) [2] for mesh topology. CSTPC mechanism experiment the factors such as retransmission rate, energy consumption rate, error rate, collision probability.

The retransmission rate using CSRPC measures the retransmission rate in terms of segments which is the ratio of retransmitted segments $Retransmitted_{segment}$ to total packets $Total\ Packets_{segment}$ in the segment using Eqn 6.

$$RR = \frac{Retransmitted_{segment}}{Total\ Packets_{segment}} * 100 \quad (6)$$

The energy consumption rate EC during transfigure path construction using CSTPC mechanism is the product of power in watts (W) $Power_{in\ watts}$ and number of transfigure paths $Transfigure\ _{paths}$ to be created divided by 1000 watts per kilowatt using Eq. 7.

$$EC = \frac{(Power_{in\ watts} * Transfigure\ _{paths})}{1000} \quad (7)$$

The error rate observed in CSTPC mechanism is evaluated using Eqn 8, that efficiently measures the joint probability distribution function of two neighboring nodes $(N_1\ and\ N_2)$. The collision probability CP is the number of data packet collisions occurring in a network over a specified period of time. The collision probability is evaluated which measures the difference between the packets sent $Packets_{sent}$ and packets received $Packets_{received}$ over a period of time $Simulation\ Time$.

$$CP = \frac{(Packets_{sent} - Packets_{received} * Simulation\ Time)}{Packets_{sent}} \quad (8)$$

5. Result Analysis of CSTPC Mechanism

The proposed mechanism, Consistent Shortcut Transfigure Path Construction (CSTPC) has been simulated using NS simulator and several statistics values have been provided in order to validate it. The NS2 simulator toolkit is selected as a simulation platform for experimental purposes. The proposed mechanism, Consistent Shortcut Transfigure Path Construction (CSTPC) is compared against the existing Store-Carry and Forward (SCF) decision policies [1] and Space-Time Synchronization (STS) [2] for mesh topology. The experiment is conducted on the factors such as retransmission rate, energy consumption rate, and error rate and collision probability.

To measure and evaluate the efficacy of the proposed CSTPC mechanism, substantial experimental results are tabulated in table 1. The CSTPC mechanism is compared against the existing SCF [1] and STS [2]. For experimental purposes, NS2 simulator is used to experiment the factors and analyze the measures with the aid of table and graph values.

5.1. Scenario 1: Evaluation of Retransmission Rate

Results are presented for different number of packets being placed by the nodes. The retransmission rate for different number of packets measures the ratio of number of times retransmitting the packets due to collision or error and so on to the total number of packets being placed as in table (1). The tabulation clearly shows that higher the number of packets placed in the wireless network, the more retransmission takes place. The results reported here confirm that with the increase in the number of packets being placed, the rate with which the retransmission takes place also gets increased. The process is repeated till 175 packets are sent in the network for the purpose of experiment.

Figure 5 illustrate the retransmission rate on varying number of packets. Our proposed CSTPC mechanism performs relatively well when compared to two other mechanisms SCF [1] and STS [2]. The mechanism had better changes using the transfigure paths being generated whenever there occurs an erroneous path decreased the retransmission rate for different number of packets rapidly by 10 – 42 % when compared to SCV [1]. Moreover, with the occurrence of link failure, during broadcasting handover is efficiently performed by reducing the retransmission rate by 30 – 78 % when compared to STS.

Table 1. Tabulation for Retransmission Time

Number of Packets	Retransmission rate		
	CSTPC	SCF	STS
25	45	64	75
50	65	84	116
75	80	100	132
100	100	116	147
125	125	141	174
150	135	151	177
175	150	166	196

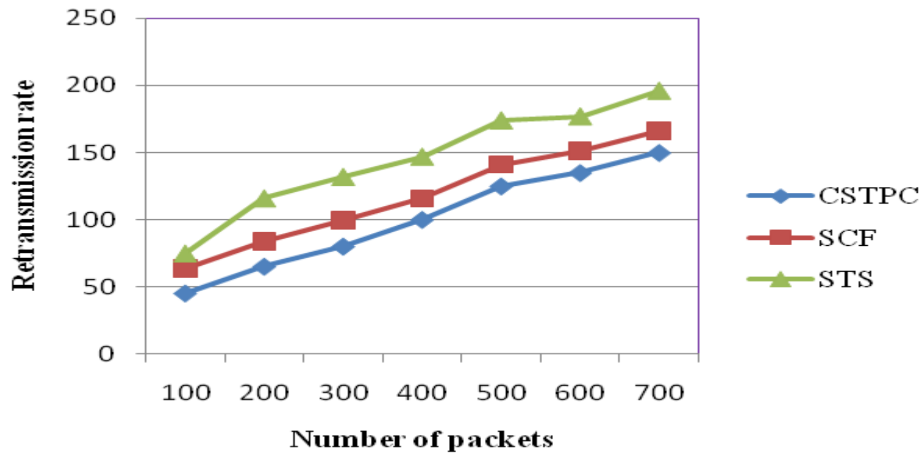

Figure 5. Measure of Retransmission Rate

5.2. Scenario 2: Evaluation of Energy Consumption Rate

In order to minimize the energy consumption rate efficiency with respect to call forwarding path, the power required and number of transfigure paths is considered. In the experimental setup, the number of call forwarding path ranges from 1 to 7. The results for 7 different call forwarding paths are listed in Table 2. As listed in Table 2, the CSTPC mechanism measures the energy consumption efficiency which is measured in terms of Joules (J). The resultant energy consumption rate using the proposed CSTPC mechanism provides an insight with comparable better values than the two other existing mechanisms.

Table 2. Tabulation for Energy Consumption Rate

Call forwarding path	Energy Consumption rate (Joules)		
	CSTPC	SCF	STS
1	0.125	0.157	0.179
2	0.148	0.180	0.205
3	0.156	0.188	0.212
4	0.172	0.204	0.228
5	0.188	0.220	0.246
6	0.190	0.222	0.249
7	0.205	0.237	0.259

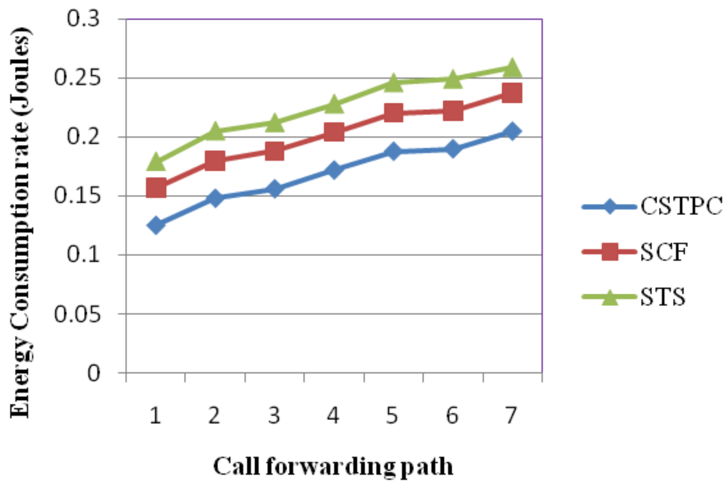

Figure 6. Measure of Energy Consumption Rate

The targeting results of energy consumption rate efficiency using CSTPC mechanism is compared with two state-of-the-art mechanisms [1, 2]. Figure 6 represents the visual comparison based on the number of call forwarding paths. Our mechanism differs from the SCF [1] and STS [2] in that we have incorporated Midpoint and Simpsons procedure that efficiently creates the shortcut for different call forwarding path that evaluate under different traffic conditions by improving the energy consumption rate by 15 – 21 % than when compared to SCF. In addition with the application of consistent shortcut, with closer average points in wireless networks further reduces the energy consumption rate by 26 – 43 % when compared with the STS.

5.3. Scenario 3: Evaluation of Error Rate

In Table 3 we show the analysis of error rate using CSTPC mechanism with respect to the number of neighbor nodes present in the network ranging between 2 and 14 that measures the error rate for call handover between the neighboring nodes and measured in terms of percentage (%).

Table 3. Tabulation for Error Rate

Neighbor nodes	Error Rate (%)		
	CSTPC	SCF	STS
2	35	38	40
4	40	44	45
6	42	48	50
8	45	49	53
10	48	55	60
12	50	58	65
14	55	62	70

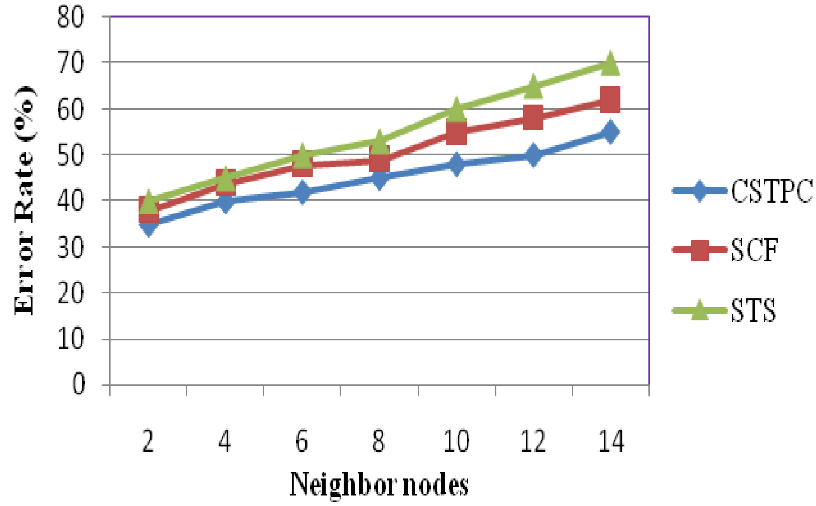

Figure 7. Measure of Error Rate

Figure 7 shows the error rate for CSTPC mechanism, SCF [1] and STS [2] versus increasing number of neighbor nodes from N = 2 to N = 14. The error rate improvement returned over SCF and STS increases gradually as the number of neighbor node also gets increased. For example for N = 8, the percentage improvement of CSTPC mechanism compared to SCF is 8.88 percent and compared to STS is 17.77 percent, whereas for N= 10 the error rate is increased are around 14.58 and 25 percent compared to SCF and STS respectively. The reason is that with the application of estimation of distribution algorithm, the joint probability distribution forwards the calls from common neighboring nodes and therefore reduces the error rate by 8 – 16 % when compared to SCF and 12 – 30 % when compared to STS respectively.

5.4. Scenario 4: Evaluation of Collision Probability

Finally, Table 4 provides the collision probability measure for different number of packets between 25 and 175 taken for experimental purposes. Higher the number of packets, higher the collision probability using CSTPC mechanism and is measured in terms of percentage (%).

Table 4. Tabulation for Collision Probability

Number of packets	Collision probability (%)		
	CSTPC	SCF	STS
25	32	40	43
50	37	43	47
75	41	46	52
100	48	56	58
125	51	60	62
150	52	61	67
175	55	65	72

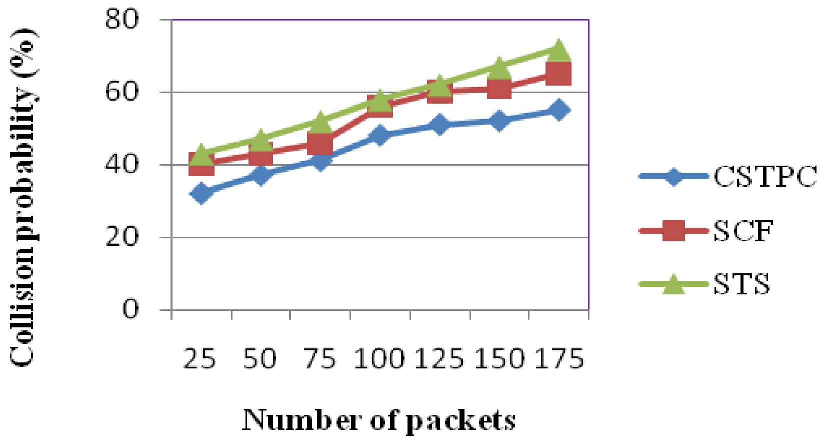

Figure 8. Measure of Collision Probability

Figure 8 illustrates the collision probability for different number of packets ranging between 25 and 175. As illustrated in the figure, the collision probability increases linearly with different number of packets. This is because with the constructed Estimation of Distribution algorithm in CSRPC mechanism, the feasible handover the packets are placed with the neighboring nodes by minimizing the collision probability by 12 – 25 % when compared to SCF. Furthermore, with the construction of alter path during link failures, the collision probability is reduced by trust success ratio is improved by 20 – 30 % when compared to STS.

6. Conclusion

In this paper, we proposed a collision free packet broadcasting mechanism called, Consistent Shortcut Transfigure Path Construction (CSTPC) in wireless network. The CSTPC mechanism develops a transfigure path whenever the link gets failed. The packet handover is carried out using consistent shortcut that is more closely to the average actual link with closer average point minimizing the energy consumption rate. Consistent shortcut is constructed by combining the Midpoint and Simpsons rule procedure. Followed by this, the node points measures the overall midpoints for efficient packet forwarding and minimizes the rate of collision. Finally, the error rate during call handover is efficiently handled using estimation of distribution algorithm using nearby neighbor node that reduces the retransmission rate. We used four metrics to prove the efficacy of the CSTPC mechanism in terms of retransmission rate, energy consumption rate, and error rate and collision probability. Experimental results demonstrate that the proposed CSTPC mechanism not only leads to noticeable improvement over the call broadcast efficiency and energy consumption, but also minimizes the collision probability and error rate on varied packet sizes over mechanism, namely, SCF and STS. Results from experiments using NS2 reveals that our mechanism reduces the retransmission rate by 10 -78 % compared to SCF, STS respectively. Compared to the state-of-the-art methods used, CSTPC mechanism reduces the energy consumption rate by 15 – 43 %. As a future work, we will implement CSTPC mechanism over Linux environment and evaluate the rate or retransmission with the objective of minimizing the collision under real environments.

References

[1] P. Kolios, V. Friderikos and K. Papadaki., “Energy-Efficient Relaying via Store-Carry and Forward within the Cell”, IEEE Transactions on Mobile Computing, vol. 13, no. 1, **(2014).**

[2] F. Chiti, R. Fantacci, F. Archetti, E. Messina and D. Toscani, “An Integrated Communications Framework for Context Aware Continuous Monitoring with Body Sensor Networks,” IEEE Journal on Selected Areas in Communications, vol. 27**,** no. 4, **(2009).**

[3] J. Baliga, R. Ayre, K. Hinton and R. S. Tucker, ”Energy Consumption in Wired and Wireless Access Networks”, IEEE Communications Magazine, vol. 49, no. 6, **(2011).**

[4] G. K.W. Wong, H. Liu, X. Chu, Y. Leung and C. Xie, ”Efficient broadcasting in multi-hop wireless networks with a realistic physical layer”, Ad Hoc Networks, Elsevier, vol. 12, no. 10, **(2010).**

[5] A. Majeed , B. Nael, A. Ghazaleh, S. Razak and K. A. Harras, ”Analysis of TCP performance on multi-hop wireless networks: A cross layer approach”, Ad Hoc Networks, Elsevier, vol. 6, no. 2, **(2011).**

[6] B. Jang, J. B. Lim and M. L. Sichitiu, “An asynchronous scheduled MAC protocol for wireless sensor networks”, Computer Networks, Elsevier, vol. 57, no. 1, **(2013).**

[7] S. Lee and D. Kim, “Two Fast Retransmit Techniques in UWSNs with ACK Indiscretion Problem”, International Journal of Distributed Sensor Networks, vol. 2014, no. 160541, **(2014).**

[8] S. Park, H. Park and Eui-Jik Kim, “Distributed Relay-Assisted Retransmission Scheme for Wireless Home Networks”, International Journal of Distributed Sensor Networks vol. 2014, no. 683146, **(2014).**

[9] C. Cano, B. Bellalta and M. Oliver, “Wake up after transmissions and reduced channel contention to alleviate the hidden terminal problem in preamble sampling WSNs”, Computer Networks, Elsevier, vol. 2014, no. 46852, **(2011).**

[10] A. Saif, M. Othman, S. K. Subramaniam and N. A. W. A. Hamid, “An Optimized A-MSDU Frame Aggregation with Subframe Retransmission in IEEE 802.11n Wireless Networks”, International Conference on Computational Science, ICCS 2012, vol. 9, no. 4, **(2012)**.

[11] B. Singha and D. K. Lobiyala, “Energy-aware cluster head selection using particle swarm optimization and analysis of packet retransmissions in WSN”, Procedia Technology, Elsevier, vol. 4, no. 15, **(2012).**

[12] P. Sreekumari, S. Chung, M. Lee and W.S. Kim, “T-DLRP: Detection of Fast Retransmission Losses Using TCP Timestamp for Improving the End-to-End Performance of TCP over Wireless Networks”, International Journal of Distributed Sensor Networks, vol. 2013, no. 592502, **(2013).**

[13] S. Park and S. Hwang, “A Design of a Congestion Control Scheme Based on Multichannel in Wireless Sensor Networks”, International Journal of Distributed Sensor Networks, vol. 3, no. 783609, **(2013).**

[14] J. Manweiler, N. Santhapuri, S. Sen, R. R. Choudhury, S. Nelakuditi and K. Munagala, “Order Matters: Transmission Reordering in Wireless Networks”, IEEE Transactions on Networking, vol. 20, no. 2, **(2012).**

[15] H. Wu, Z. Feng, C. Guo and Y. Zhang, “ICTCP: Incast Congestion Control for TCP in Data-Center Networks”, IEEE/ACM Transactions on Networking, vol. 21, no. 2, **(2013).**

[16] B. Ji, C. Joo and N. B. Shroff, “Throughput-Optimal Scheduling in Multi hop Wireless Networks Without Per-Flow Information”, IEEE/ACM Transactions on Networking, vol. 21, no. 2, **(2013).**

[17] Q. Wu, B. Qin, L. Zhang, J. Domingo-Ferrer and J. A. Manjón, “Fast Transmission to Remote Cooperative Groups: A New Key Management Paradigm”, IEEE/ACM Transactions on Networking, vol. 21, no. 2, **(2013).**

[18] F. K. Shaikh, A. Khelil, A. Ali and N. Suri, “Reliable congestion-aware information transport in wireless sensor networks”, Int. J. Communication Networks and Distributed Systems, vol. 7, no. 2, **(2011).**

[19] Y. Lim1 and S. Kang, “Intelligent Approach for Data Collection in Wireless Sensor Networks”, The International Arab Journal of Information Technology, vol. 10, no. 1, **(2013).**

[20] M. N. Sudha, M. L. Valarmathi, G. Rajsekar, M. K. Mathew, N. Dineshraj and S. Rajbarath, ”Minimization of Collision in Energy Constrained Wireless Sensor Network”, Scientific Research, Wireless Sensor Network, vol. 1, no. 4, **(2009)**.

Authors

S. Sreethar was born in India. He received his B.E degree from Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu, India, in 2001 and M. Tech degree from Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India, in 2005. He is currently working towards the Ph.D. degree in the Department of Computer and Information Technology, Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu, India.

His research interest includes Wireless Networks, service-oriented computing, and quality of service management, protocols design and networking.

E. Baburaj was born in India. He received his M.E. degree in computer science and Engineering from Madurai Kamaraj University, Madurai, Tamil Nadu, India, in 2002 and the Ph.D degree in Computer Science and Engineering from Anna University, Chennai, Tamil Nadu, India, in 2009.

He is currently Professor at Sun College of Engineering and Technology, Nagercoil, Tamilnadu, India. His research interest includes Adhoc Networks, service-oriented computing, and Intelligent Computing. He has published over 25 papers in international journals.

