Traffic & Transportation

# Efficient Communication Using Cluster-To-Cluster Source Route Cooperative Data Transmission Approach in Wireless Ad Hoc Networks

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**ABSTRACT**
The wireless ad hoc networks (WANETs) provide a flexible and adaptable infrastructure for transferring data in different environments. It supports multiple description (MD) video transfers, addressing error-prone WANETs, which are becoming increasingly critical as their usage grows. Previous approaches to multicasting MD video in WANETs had significant challenges. Ensuring multimedia streaming quality over WANETs while reducing buffering and traffic are crucial challenges. To overcome the problems, this work proposes a cluster-to-cluster source route cooperative data transmission (C2C-SRCDT) method for packet communication in WANETs. Initially, nodes in cluster formation will be created, and each node's weights will be evaluated for cluster head (CH) selection. Then, Dijkstra's transmission routing aware-multiple description video (DTRA-MDV) method estimates the cluster node to select the shortest distance routes between each cluster to send the multiple (image/videos) data. Finally, the time-slot multiple route selection (TSMRS) technique improves throughput and reduces breakage links. C2C-SRCDT reduces buffering and transfers data quality (image/videos) based on network lifetime, bandwidth and transmission time. The proposed simulation is evaluated using various parameters: data delivery ratio, loss, delay, throughput and energy consumption. The proposed system achieves a data delivery ratio of 92%, a delay of 40 sec and a throughput of 91%. These metrics analysed the improvement in video or image quality and traffic to avoid data transfer and transmit the wireless network better than previous approaches.

**KEYWORDS**
cluster head; clustering; data transmission; image/video quality; reduced traffic; shortest path; wireless ad hoc networks.

## 1. INTRODUCTION

Wireless ad hoc networks have attracted extensive attention in networking, academia and industry. A key advantage of ad hoc networks is their ability to self-organise and deploy over large areas without infrastructure. Wireless ad hoc networks have dynamic network topologies. Network nodes in a wireless ad hoc network are connected to other network nodes through wireless links. Network nodes are primarily mobile. A new network node can join the network if a network node goes out of range. The topology of wireless ad hoc networks changes periodically as existing network nodes leave the network.

The network allows nodes to move randomly anywhere and remain in place. Since nodes are usually not within radio transmission range, each node acts as a host and router, forwarding packets to other mobile nodes. In a typical ad hoc environment, mobile nodes perform specific tasks as groups. Therefore, multicast is more convenient and efficient for supporting cluster-oriented applications. Multicast is essential for many applications, such as video distribution or multiple image/video transmission over a network, where multicast can save bandwidth.

Video multicast in wireless ad hoc networks uses bandwidth more efficiently than multiple unicast sessions. However, video multicasting poses significant challenges to wireless ad hoc networks. Unlike data packets, video packets will be delayed and lost. Video sending to the wireless ad hoc network through the cluster-based architecture is the most common topology in self-organising networks. These architectures organise nodes into small groups that function individually and autonomously. Each cluster node can communicate with other nodes that establish neighbours through neighbour communication.

To address these drawbacks, the new method, cluster-to-cluster source route cooperative data transmission (C2C-SRCDT), reduces energy consumption, delay and traffic. It reduces buffering and traffic based on a data-sending and receiving cooperative network. Then, the data is transferred to the cluster-based transmission routing aware-multiple description video (TRA-MDV) after calculating the node distance between clusters.

Subsequently, the cluster node distance is evaluated, and the transmission time between node links is estimated using time-slot multiple route selection (TSMRS), which is primarily used for shortest-path communication when multicasting multiple videos within network bandwidth. It also estimates the multiple routes for transferring data based on the shortest path time slot selection.

A cluster-based cooperative network communication is implemented in this research for improving the video multicasting service in wireless ad hoc networks. In addition, the distributed time-slot multiple route selection algorithm is proposed to jointly optimise source route allocation and routing schemes for video multicast over wireless ad hoc networks. Specifically, optimisation problems using the network, packet loss and video multicast models are addressed. The distributed network of the proposed algorithm C2C-SRCT is well-suited for wireless ad hoc networks.

### 1.1 Contribution of the research

1) This research focused on efficient cluster-based video/image data transmission to reduce buffering and avoid traffic, delay and link failure during data transmission.
2) Cluster-to-cluster source route cooperative data transmission (C2C-SRCDT) improves the data transmission rate with reliable and compatible data. Multicast requires transmission over multiple networks, which is a relative advantage.
3) There is an increase in the throughput time and a reduction in the execution time for the shortest path between the source node and the destination.
4) Transmission routing aware-multiple description video (TRA-MDV) selects the shortest route for transmitting the data to estimate the possible route for reducing packet losses.
5) Time-slot multiple route selection (TSMRS) evaluates the maximum available shortest path with low time complexity. It sends the data from source to destination via multiple paths in wireless ad-hoc networks.
6) Finally, using the proposed method, multicasting video over an ad-hoc network provides multiple shortest routes from cluster to cluster, reducing buffering from transfers and data transmission from source to destination.

## 2. PRELIMINARY WORKS

Network technologies are overgrown day by day. There is a rapid growth of transmitted information (video, data, image, etc.) through the network [1]. A wireless mesh network is easy to deploy but faces transmission issues, such as traffic congestion and packet loss, and is unable to detect the current communication between the source and its intended destination. Moreover, wireless ad hoc networks transmitting limited legitimate nodes (LNs) consume more energy for transmission [2]. The energy levels in the mobile nodes present in the routing are selected based on throughput scaling to provide the multicast switching communications over a wireless ad hoc network. However, this process is not stable for mobile nodes and delivered results must be transmitted appropriately [3].

The powerful transmission capabilities of smart devices make sharing multimedia services possible with device-to-device (D2D) communication. However, the non-cooperative behaviour of D2D transmission multimedia services needs cluster-based routing to improve the quality of services for communication receivers [4]. The internet of things (IoT) for video transmission in the network generates packet loss, and limited resources are only satisfying in multimedia networks [5]. High-speed data transfer is a problem for multimedia data, but predicting multimedia data requests is an important issue, and security design is essential for advanced cache resource allocation [6]. Efficient multimedia transmission in cognitive radio networks is based on Q-learning spectrum access. Q-learning access is unstable for transmitting data from source to destination [7]. It is exchanged with high-spectrum energy without information exchange among the users. Software-defined networking (SDN) is flexible, easy to manage and adaptable to rapidly changing traffic needs. Multimedia transmission has many disadvantages, such as the difficulty of path allocation in end-to-end transmission [8]. Secure transmission is a significant challenge in multimedia networks. In this proposed study, trust-based multimedia analytics is unreliable, expensive and time-consuming [9]. Multimedia services are processed, uploaded and shared over the network in a long-term task allocation and resource coordination problem [10].

High-efficiency video coding (HEVC) encrypts structural information and transforms information and code words in highly efficient video coding received recently [11]. The use of HEVC encoding in the multimedia network is still a performance issue due to higher delay tolerance in multicast routing neds to optimize the routing. The K-means clustering (K-mc) and weighted K-nearest neighbour (k-NN) regression-based algorithm are used for providing optimal routing selection and data transmission between the multimedia telecasting service. However, it cannot evaluate the absolute values of both sending and receiving time [12]. Still, random transmission LoRaWAN protocol suffers due to the ALOHA protocol. This increases packet collision rate transmission attempts, delay and energy consumption [13]. The potential improvement of multi-point transmission is a feature for mission-critical communications (MCC) over broadcast multimedia services to improve multi-path information. However, it directly impacts the system capacity [14]. Energy management is the most critical issue in wireless sensor networks (WSN). An energy-aware adaptive kernel density estimation algorithm (EAKDE) does not balance the energy level among the cluster nodes [15].

Speaker clustering is an effective tool for mitigating single cluster management of large audio documents. It represents features from a deep convolutional autoencoder network (DCAN) to estimate cluster values, combined with a softmax layer [16]. The difference is that acoustic clustering is an emerging problem that incorporates sound accounts of a similar class into a cluster without utilising essential data and preparing a classifier [17]. Learning adaptive neighbourhood graphs on Grassmann manifolds is unsuitable for multidimensional data with structures, and the quality of clustering performance needs to be considered when considering various systems [18]. A wireless multimedia sensor network (WMSN)-based seamless and authorised streaming (SAMS) architecture causes excessive packet loss and end-to-end latency for multimedia traffic [19]. Generated extensive data from industrial wireless sensor networks (IWSNs) still needs to be improved in achieving predictable and scheduled transmission [20].

Wireless multimedia sensor network nodes reduce accuracy and consume more energy by sending less information from WMS nodes to base stations [21]. The multimedia generated by large multimedia sensor node (MSN) data cannot be stored in the WMSN for long periods [22]. Due to the random nature of hash functions, equal-cost multi-path (ECMP) often distributes traffic randomly, making it difficult to use the total capacity of the link [23]. The challenges of coupled multi-path BBR (C-MPBBR) include low bandwidth and delivery rate [24]. Multimedia data transfer traffic is a critical issue in network-aware multipathing in SDN [25].

Existing multi-path transport has many consequences, such as the need for end-host support (i.e. multi-network configuration and updating operating systems or high-level applications on user devices) and unreasonable transport performance detection [26]. With time-varying networks, it is impossible to reliably determine the performance of previously performed estimates [27]. The quality of these live videos can be adversely affected by various phenomena like capture artefacts and distortions introduced during encoding and transmission [28]. Transmission errors can bring about disentangling disappointments at the less-than-desirable end. Transmission blunders presented in one video edge can engender along the movement assessment way to resulting outlines, fundamentally corrupting video delivering quality [29]. Video conveyance for split-screen services faces a few significant difficulties, including estimating the effect of environmental variables on client quality of experience (QoE) for split-screen services. Every video transfer's bite rate works on the nature of the client experience for split-screen network services. [30]. In this work, the proposed method is an environment-aware adaptive transmission (EAAT) scheme that provides video quality while saving network resources.

## 3. IMPLEMENTATION OF THE PROPOSED WORK

Wireless ad hoc networks (WANETs) provide a flexible and adaptable infrastructure for data transfer across various environments, especially as multimedia (video/image) transmission increases on wireless networks. Proposed new approaches for cluster-to-cluster routing enable traffic avoidance transmission. Cluster-to-cluster source route cooperative data transmission (C2C-SRCDT) performs routing at high speed, and fault tolerance is improved. Because routing depends on the cluster head (CH) address, if any node in the route fails, that cluster head can use another node (available) to forward the packets. It will increase data transmission in the cooperative path. After the cluster head address-based route selection, Dijkstra's transmission routing aware-multiple description video (DTRA-MDV) evaluates the nearest shortest path to selecting the multimedia transmission based on source to destination. Time-slot multiple route selection (TSMRS) is scheduling the available path to avoid traffic between transmissions based on node weights using multiple route selections.

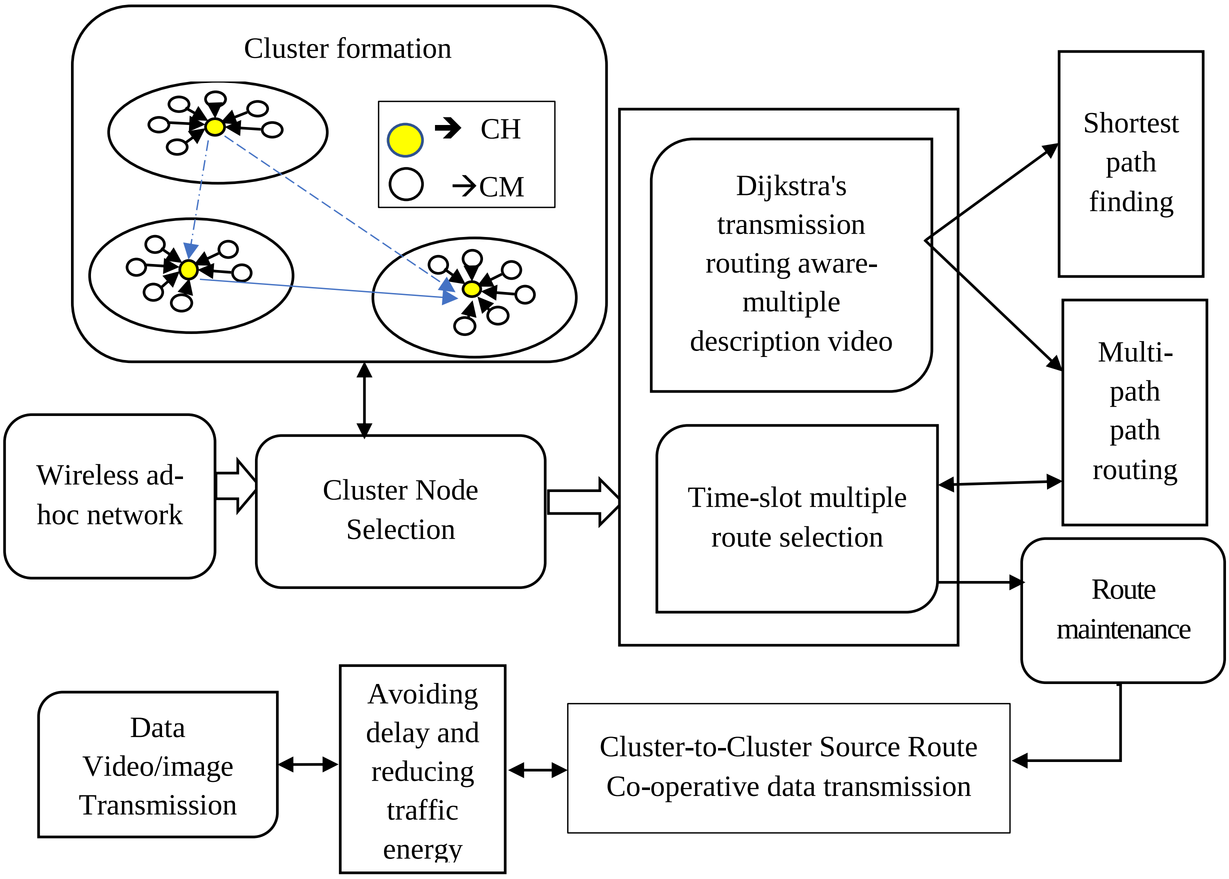


*Figure 1 – Proposed block diagram for cluster-to-cluster source route cooperative data transmission*

*Figure 1* describes the cluster-to-cluster source route cooperative data transmission in a wireless ad hoc network. The network should initialise cluster-based multi-path routing analysis for source and destination data transmission. The cluster node selected based on its node address finds the shortest path for data transmission using Dijkstra's transmission routing aware-multiple description video (DTRA-MDV), sending multiple videos in this routing and maintaining the route for multiple selections using time-slot multiple route selection (TSMRS). Finally, C2CSRDTC avoids delays and reduces traffic to send and receive the data without buffering.

### 3.1 Cluster head selection and formation

*Cluster formation*

It is assumed that the current cluster member (CM) holds the current node, cluster head and member ID because a network can handle one or more clusters simultaneously. In the first step, the node distance and ID are allowed to select themselves as cluster heads (CHs) randomly and then be partitioned into cluster members.

Clusters are formed based on the distance, nodes are distributed in the network, and each node has its coordinates ($c_i$, di). The distance ‘d’ between two nodes is calculated using Euclidean distance [31],

$d = \sqrt{((u_1 - v_1)^2 + (u_2 - v_2)^2)}$, and the ‘d’ between one node and all other nodes is calculated using Euclidean distance calculated based on $d_{ij} = \sum_{i=1}^{n} \sum_{j=1}^{n} \sqrt{((u_1 - v_1)^2 + (u_2 - v_2)^2)}$. The cluster centre is then calculated based on distance $d_{ij}$ between the cluster centre and nodes coordinates between node distance.

**Steps for cluster formation**

Input: Set several nodes
Output: Set of N number of clusters
Begin
The cluster initiate number is 1
Repeat
Select a node (n_i) that is one hop distance from other active nodes with the shortest distance (sd)
Deploy “N” number of nodes
Compute the distance between two nodes

$$d = \sqrt{((u_1 - v_1)^2 + (u_2 - v_2)^2)} \tag{1}$$

Compute the distance between one node and all other nodes in the clusters

$$d_{ij} = \sum_{i=1}^{n} \sum_{j=1}^{n} \sqrt{((u_1 - v_1)^2 + (u_2 - v_2)^2)} \tag{2}$$

Calculate the cluster middle node (CH)

$$cluster_{center(c_i,d_i)} = \left(\frac{u_i + u_j}{2}, \frac{v_i + v_j}{2}\right) \tag{3}$$

Return the number of clusters
End

The above algorithm shows that cluster formation is based on the distance between one or another node and evaluating the cluster head (CH) nodes or coordinate nodes.

*Cluster head selection*

The initial phase of selecting the cluster head within the wireless ad hoc network is to finite the number of sensor nodes deployed. The centre of the network is positioned for an ad hoc wireless network. The data are sent within the wireless network, and the multimedia data evaluates or calculates the data weights by the wireless network. The cluster head can choose from the node with a data weight above the threshold values.

$$V_{CH} = V_{min} * [1 + (\frac{CR_{wn} - CR_{wnmin}}{CR_{wnmax} - CR_{wnmin}})] \tag{4}$$

Here, V is a variable for data, CH is cluster head, CR is cluster radius min and max of the wireless network. $CR_{wnmin}$ denotes the cluster node distance from the wireless network $CR_{wnmin}$. $CR_{wnmax}$ indicates the maximum distance from the cluster network.

$$N_{CH-value} = \propto * N_{des} + \frac{\beta}{MSD_{des}} + \frac{\gamma}{D_{WN}} \tag{5}$$

Here, $MSD_{des}$ denotes the mean distance for all nodes positioned by destination. Threshold values used here are $\alpha, \beta$ $and$ $\gamma$, which give a total of 1 randomly selected value 0 to 1 generated by the sensor nodes of the network.

**Steps for cluster head selection**

Start
Select_Cluster_Head ()
Path total limit: Threshold values for the route number of nodes
Neighbour node movement
T_Threshold values for the node to become CH

$$P = \min_{dis} > do \text{ and } path_{count} < path_{count_{limit}} \text{ and } rel_{thr_{values}} \tag{6}$$

For x=1 to path_number_limit do
If (P=T_threshlod), then
Improve node with node limits and relative value in buffer for each node in BUFF do
Select the node (n) with maximum neighbour_ values of the node
Select the node (n) as the cluster head
  If the node type is N, then
    Link both nodes as a cluster network
    Select the node with the most significant energy as CH
  Nodes (N) can play out the assignment of cluster head and check the node values
    If (P> T_threshlod) then
      Request select CLUSTER_HEAD (CH) ()
    End
End

Cluster head (CH) selection is based on the node values from the network and the node distance between clusters. In the buffer, weights are added to each neighbour or relative of all the nodes. Finally, the highest energy node for cluster head selection is selected.

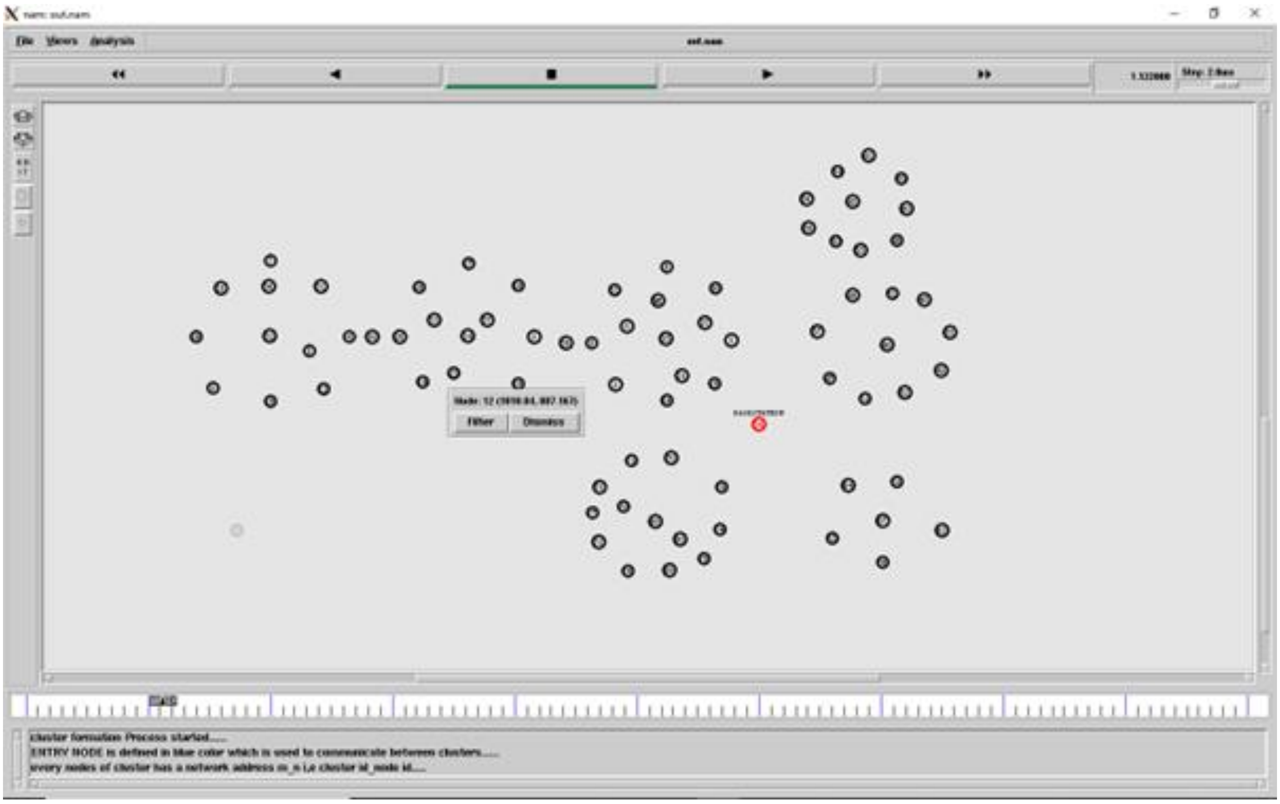

*Figure 2 – Screenshot of cluster formation*

*Figure 2* shows the screenshot of cluster formation starting from source to destination and data transfer for finding the shortest path to sending the cluster member (CM) to the cluster head (CH) address and entry nodes from source to destination for data transmission.

*Dijkstra's transmission routing aware-multiple description video (DTRA-MDV)*

Dijkstra's algorithm is one of the best shortest-path search algorithms. It is used to find the shortest path from source to destination. The proposed DTRA-MDV algorithm finds the minimum node path using the shortest path of links and node weights. This way, the shortest path from the source node to each node is created to the destination. The desired column from the path selection to get the shortest route needs to be selected. Depending on the selected route, the Transmission routing aware-multiple multi-paths are enabled to transmit the video by averaging the closest distance between the clusters to cluster head to transmit the data. It supports selecting multiple paths to keep the redundancy of video sharing in multicasting without buffering and failure transmission from the source to the destination network.

The DTRA-MDV method is used for the data (video) sent from the source node to the next neighbour intermediate node. It waits until the receiver response comes in at a specific time without link failure or packet loss and finds the shortest path for multi-data transmission based on the transmitting node ID and sending and receiving time.

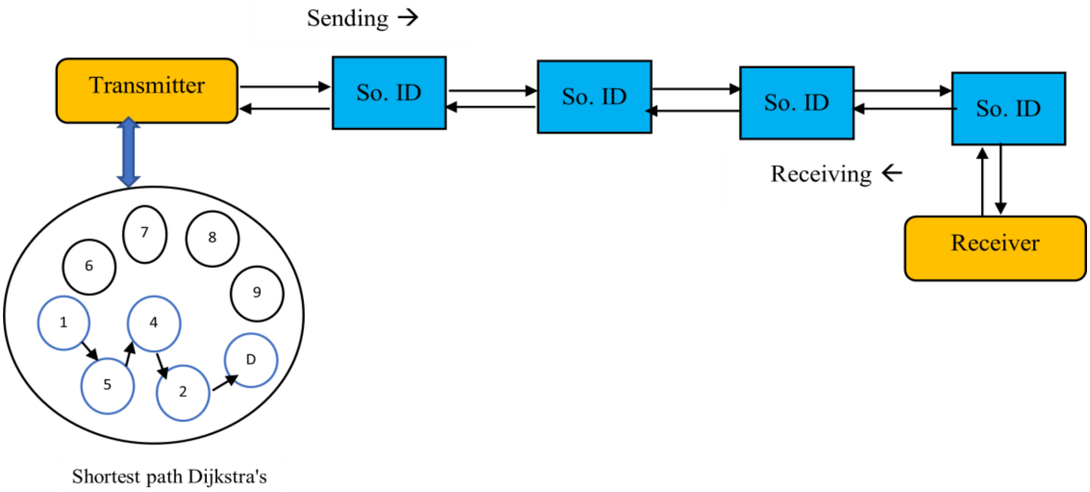


*Figure 3 – Shortest path for routing aware video transmission*

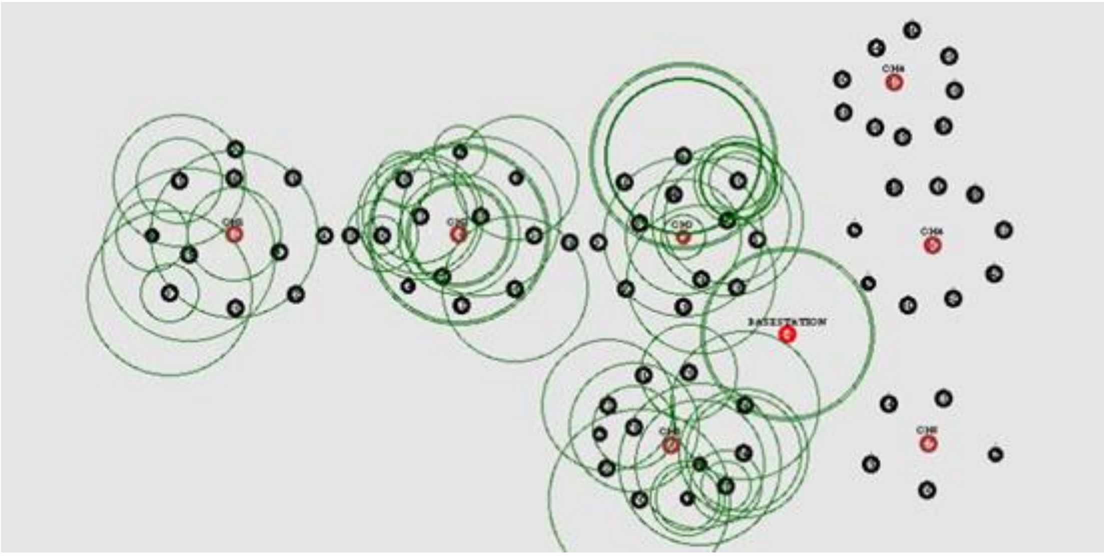

*Figure 4 – Screenshot of cluster shortest path transmission*

*Figure 3* shows the source packets sending the destination using the shortest path transmission based on the DTRA-MDV. This method selects the minimum number of hops during data transmission and finds the shortest path for sending video or multimedia data with a minimum number of intermediate nodes. Then, the receiver gets the video packets to form a source or intermediate node response to the source node using the same short path nodes. Any packet loss or duplicate packets are sent to the receiver or sender between transmissions, and that process starts repeatedly.

*Figure 4* shows the shortest cluster route data transmission method for finding the nearest path or neighbour cluster head selection based on DTRA-MDV using the clusters' source ID and destination ID.

$$\text{Calculating the node distance}=C_{s,d} = {T_{sd}}/{(N_s * N_D)} \tag{7}$$

where $C_{s,d}$ is cluster source and destination, T is transmission node and N is the node. TRA-MDV calculates the shortest path for transmitting the video or images through the network without delay and efficiently sends multicasting multiple description videos through the network based on its cluster head selection.

**Steps for shortest path finding using DTRA-MDV**

Input: D = (N, w): Input nodes weights // N, w is node weights and node distance
Output: Shortest path
Function Dijkstra's transmission routing (N, w)
Initialise the source node
  distance. [Source node]←0
  Input the distance [n] =0 for all $v \in w$ and the n $\neq$ source node
  Add $n$ to S for all $n \in w$
  S←$\emptyset$ //Single source node
While S$\neq \emptyset$ do
  $n$←Multi-path transmission in S with min dijkst [$n$]
  Remove $n \neq \emptyset$
  $m$=extract_min (s)
  Insert m in S
For each distance (d) neighbour of m, do

$$Rd \begin{cases} if\ S \cap n = \emptyset\ then \\ w = D_n from\ m\ to\ s \\ if\ n(m) + w < n(m) then \\ N(w) = N(m) + s \\ R(d) = m \end{cases}$$

Return distance
For each neighbour $n\ of\ m, do$
  If $n \in w$ then
    Continue;
  Alt←distance [$n$] + weights (n,m)
  If alt < distance [n], then
    Distance [n]←alt;
  Update S
Return S, R
End
End
End

where $\mathrm{m-neighbour\ node, S-shortest\ path, n-node, w-weights, alt-alternate, Rd-}$ Routing distance, by representing current node is - n and shortest distance is -S from route table. In the first source, node (S) will choose the distance (d) = 0 in the initialisation. Indicate the node weights to update the distance of current node $distance(d) + weights(w, n) < neighbour\ node\ distance\ (m)$, so update the distance (n) to route table, and process to find the shortest path based on the distance and node weights. Dijkstra is finding the shortest route for multiple video transfers in routing-aware transmission.

*Time-slot multiple route selection (TSMRS)*

Nodes can estimate which data packets are sent simultaneously to facilitate synchronisation. Multiple route selection is critical in planning media access based on time-slot scheduling. A fully synchronised network is required between nodes. To solve this problem, cluster heads must transfer the multimedia to the nearest neighbour node. Each cluster head automatically identifies the cluster by considering the sequence of time slot tasks. Finally, the simulation results demonstrate that more streams are efficiently delivered over time to avoid inter-cluster interference.

$$Total\ delay\ =\ Data\ transmission\ delay\ +Queuing\ delay \tag{8}$$

$$\begin{aligned}&Total\ transmission\ delay\\ &\qquad = Time\ 1\ (for\ packet\ request\ data\ from\ CH)\\ &\qquad + Time\ 2\ (no\ packet\ to\ send\ transfers) - Total\ amount\ of\ data.\end{aligned} \tag{9}$$

The multiple route selection transmission algorithm reduces video distortion by assigning transmission chances to packets (video) controlled by the time slot and transmission delay for packet scheduling using the time slot.

$$T|A_s| = \frac{(1-R^s)(1-R-R(2R)^{s-1})}{2(1-R)(1-2R)}D \tag{10}$$

Here, $T|A_s|$ assign the time slot, $R^s$is routing schedule, D is data (video or images) and several packets (video or images) can be sent to the destination without delay using multi-path routing selection.

If the packets are successfully in the destination stage (p), they have m-1 failed transmission attempts and one successful transfer. The predictable transmission time for data can be expressed as:

$$T|S_a| = \sum_{R=1}^{s}\big((p-1)R_s + R_m\big)R^{p-1}(1-R) + pTR^p) \ = \frac{R(1-R^m)}{1-R} + (1-R^s)T_s \tag{11}$$

The time slot scheduling process transmits packets within the durations. The p is the destination stage, $R^m$ is multipath routing and $T_s$ is the time slot. In the expected time process, the multi-path routing selection using without-delay transmission is scheduled.

*Cluster-to-cluster source route cooperative data transmission (C2C-SRCDT)*

Cluster-to-cluster source route selection of cooperative data transmission for video or multimedia transmission packets sends the destination without buffering or time complexity and reduces energy consumption. The node in the first path becomes the cluster head. From there, it recruits other neighbours with the lowest energy cost. Packets are sent from the sending cluster to the newly established receiving cluster.

The Multicast video transmission-based on cluster to create the source routing point by getting the Min distance between the nodes with maximum number of video descriptions transmitted over multicast routing.

$$Mvd\ (T_1) \leq \min\{P_{t1}, CP(T_l)\} \tag{12}$$

Here, $P_{t1}$ is the cooperative path routing transmitted over multicast with $Bw(P_{t1})$, Let the transmission takes number of routes in the specific path P is represented as $T = \{p_1, p_2, ..p_n\}$ which denotes the set of constructed the multicast video $Bw(P_{t1})$ bandwidth of multicast video transmission.

$$Bw(P_{t1}) = \min_{P\in cp}\{Bw(P)\} \tag{13}$$

The delay of multicast video $T_l$ is evaluated from source to destination on $D(T_l)$, which is given by:

$$D(T_l) = \max_{p_x\in T_l}\{D(T_l)\}, x = |1 \dots n| \tag{14}$$

where n is a number of destinations on $T_l$, containing multiple sources that construct multicast paths to each destination.

**Steps for cluster-based cooperative source routing for multicast video description**

Input: Source node (s), destination address (d), subpath (p)
Output: Source routing from each source to the destination
Initialise the node in cluster formation
For ∀ node x ∈ 1st level, do
  If $Cp$ (x) = 1 then
  If $B(asic, x) = 1$, then

Allocate node x MDC
Else, if $Bf\ (src, x) = n\ than$
Assign node x randomly one description
End if
Evaluating the distance to cluster nodes
For each $T_l \in Cp$, do

$$Bf_{xy}^{R} = \begin{cases} 1, if\{x, y\} \in T_l, N = 1,2 \\ 0, orelse, N = 1,2 \end{cases}$$

$$D(T_l L, cp) = |x_1 - x_2| + |y_1 - y_2| + |z_1 - z_2|$$

End
Creating cooperative source routing buffering (BF)
For each $s_l \in Bf$, do

$$cp\ (s, d) \leftarrow \mathrm{C2C - SRCDT_{based}\ source(s, d)}$$

End
If (N(x) == 1) then
CH Member (x) ← CH1 Member (y) + BF;
C2C-SRCDT →Receiving all CH LINK, node x sends the CH member(x) to the destination to reduce buffering.
The time slot multiple selections to the cluster members.
Else
Drop the packet (video/images);
End if

where Cp is a cooperative path, CH is the cluster head, x,y,z are the packets, d is the destination, T is time, MDC are multiple descriptions, Bf is the buffer, N is the number of nodes, C2C-SRCDT is cluster-to-cluster source route cooperative data transmission. To allocating all the nodes into the cluster formation to evaluating the co-operative source packets to send the source to destination by controlling the transmission with cluster heads. Multiple or multicasting descriptions estimate the distance and proposed multimedia data (video) algorithm, sending a cooperative path to reduce buffering and data loss.

## 4. RESULT AND DISCUSSION

The proposed simulation tool using network simulator-2 (Ns2) is made based on these parameters: data delivery ratio, data loss, delay and throughput reduce buffer rate data transfer, bandwidth, network lifetime, network speed, transmission ratio, energy consumption and time). The transmission takes 500pkts to send the multimedia data from source to destination without buffering and to takes to process with low energy consumption. Through this simulation, the proposed cluster-to-cluster source route cooperative data transmission (C2C-SRCDT) method performance will be analysed and compared with previous methods, such as the energy-aware adaptive kernel density estimation algorithm (EAKDE), K-nearest neighbour (k-NN), deep convolutional autoencoder network (DCAN) and K-means clustering (K-mc).

*Table 1 – Simulation parameters used for the proposed method*

| Parameters | Values |
|---|---|
| Simulation language | Ns2 |
| Method | Cluster-to-cluster source route cooperative data transmission (C2C-SRCDT) |
| No. of packets | 500 |
| Network size | 1200 m x 1200 m |
| Transmission range | 250m–350m |
| Frequency transmission | 5.9 GHz |
| Data size | 500 MB |
| Packet size | 512 kb |
| Speed | 10 m/s |
| Pause time | 30 sec |

*Table 1* shows the simulation parameters analysis of the cluster-to-cluster source route cooperative data transmission (C2C-SRCDT) for each packet that sends out data at a rate of 512 bytes per second. In the simulation, 500 multimedia data were transferred to an area of 1200 x 1200 square meters, with each packet being sent within 100 seconds and having a transmission range of 250 to 350 meters. A framework is provided for the performance evaluation of the various algorithms:

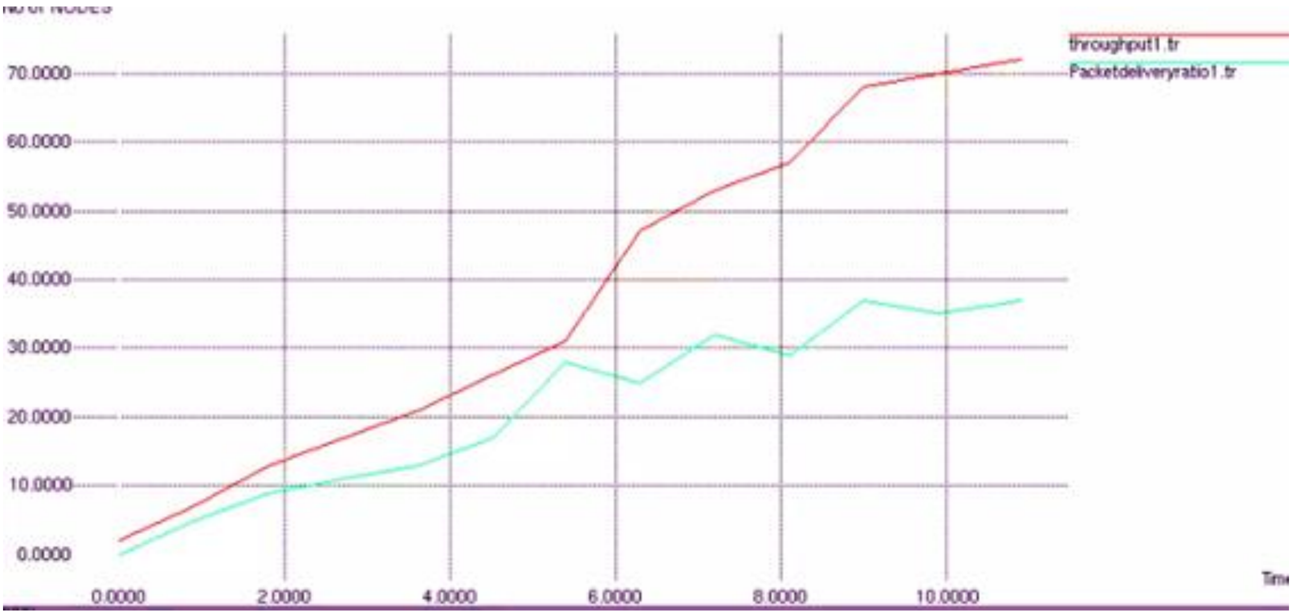


*Figure 5 – Screenshot of the performance of DDR and throughput*

The above graph analyses the throughput and packet delivery ratio performance. It considers calculating the account within the clusters and cluster head shown in *Figure 5*.

*Analysis of data delivery ratio (DDR)*

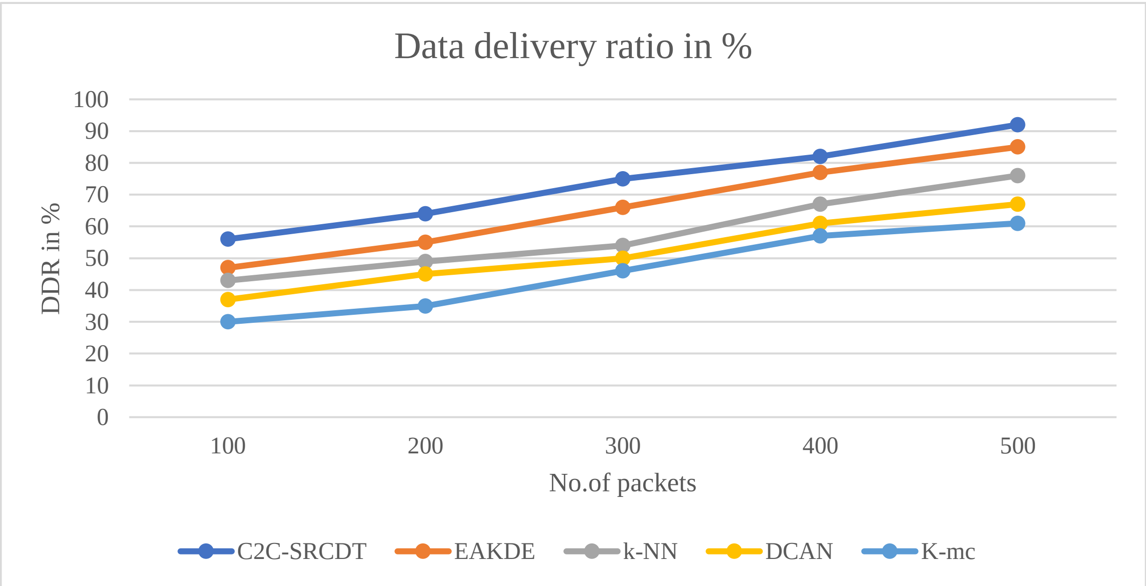


*Figure 6 – Data delivery ratio*

*Figure 6* describes DDR for analysis of the multimedia packets sending the maximum rate compared with the previous algorithm using 500 packets. The proposed algorithm, cluster-to-cluster source route cooperative data transmission (C2C-SRCDT), achieves a 92% delivery ratio, compared to previous algorithms: energy-aware adaptive kernel density estimation (EAKDE) at 85%, K-nearest neighbour (k-NN) at 76%, deep convolutional autoencoder network (DCAN) at 67% and K-means clustering (K-mc) at 61%.

*Analysis of data loss*

*Figure 7* describes the data loss ratio for analysis of the multimedia packets, showing a reduction in the loss rate using the proposed and existing methods, with the proposed method compared to previous algorithms using 500 packets. The proposed algorithm is cluster-to-cluster source route cooperative data transmission (C2C-SRCDT), reducing the loss range to a 35% loss ratio. It is compared with previous algorithms: energy-aware adaptive kernel density estimation algorithm (EAKDE) at 40%, K-nearest neighbour (k-NN) at 46%, deep convolutional autoencoder network (DCAN) at 50% and K-means clustering (K-mc) at 58%.

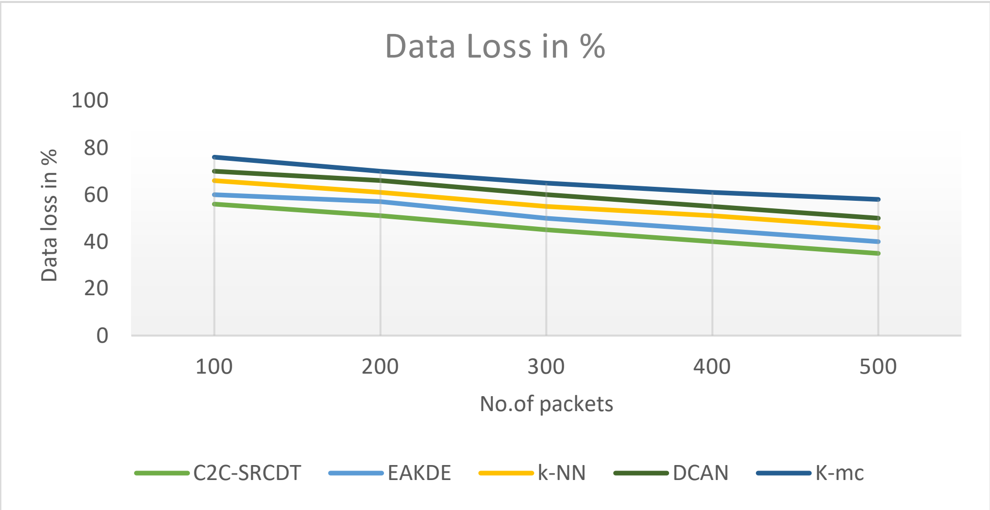


*Figure 7 – Data loss ratio*

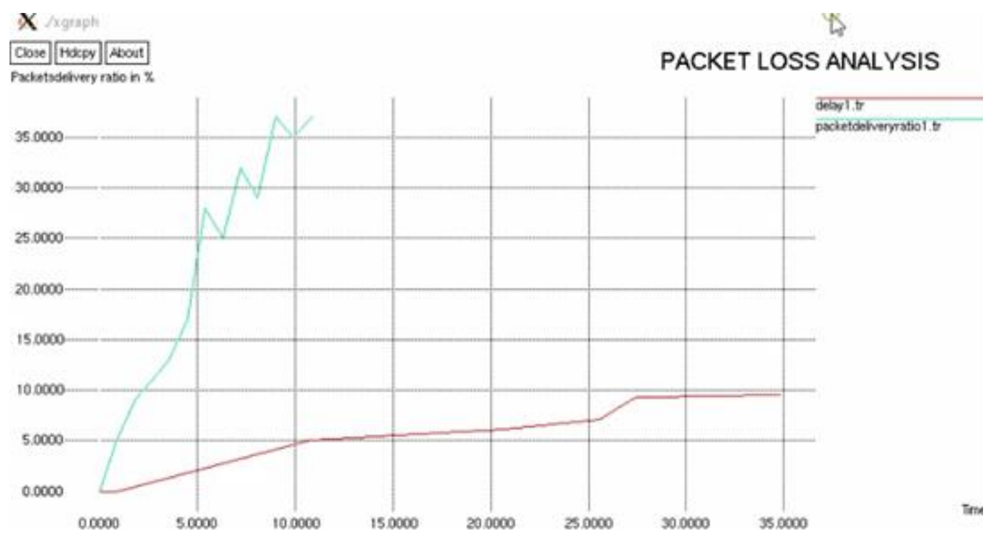


*Figure 8 – Screenshot of data loss*

*Figure 8* describes the above graph and shows the packet loss delivery analysis and the number of dropped packets to be calculated.

*Data delay ratio*

*Figure 9* describes the data delay ratio for analysis the multimedia packets during sending the packets by reducing the delay rate by the proposed system compared with the previous algorithm using 500 packets with a transmission range of 350 meters. The proposed algorithm, cluster-to-cluster source route cooperative data transmission (C2C-SRCDT), reduces the transmission delay to 40 seconds. It is compared to previous algorithms: energy-aware adaptive kernel density estimation algorithm (EAKDE) at 49 seconds, K-nearest neighbour (k-NN) at 50 seconds, deep convolutional autoencoder network (DCAN) at 55 seconds and K-means clustering (K-mc) at 60 seconds.

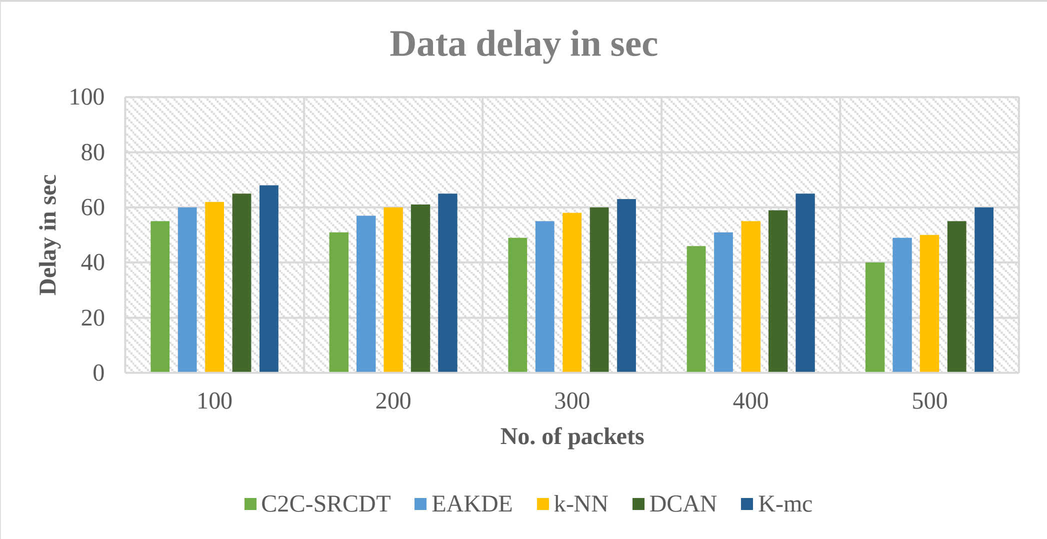


*Figure 9 – Data delay ratio*

*Throughput performance*

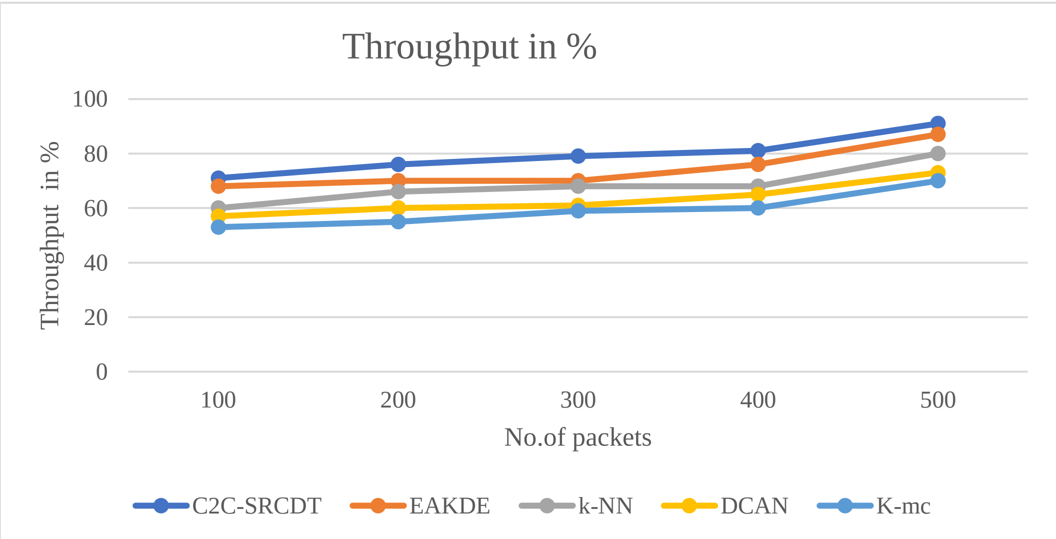


*Figure 10 – Throughput ratio*

*Figure 10* describes throughput for analysis of the multimedia packets sending the packets with the source to destination based on the time and energy transfer over a specific period of time compared with the previous algorithm using 500 packets with a maximum throughput ratio. The proposed algorithm, cluster-to-cluster source route cooperative data transmission (C2C-SRCDT), achieves a 91% throughput ratio. It is compared with previous algorithms, including the energy-aware adaptive kernel density estimation algorithm (EAKDE) at 87%, K-nearest neighbour (k-NN) at 80%, deep convolutional autoencoder network (DCAN) at 73% and K-means clustering (k-mc) at 70%.

*Reduce buffer rate data transfer*

*Figure 11* describes the reduce buffer rate data transfer for analysis of the multimedia packets, evaluating the delivery ratio and loss sending the packets with a source to destination for multimedia data transfer within time to reduce buffering and compared with the previous algorithm using 500 packets with reducing buffer range for transmission based on delivery ratio and loss. The proposed algorithm, cluster-to-cluster source route cooperative data transmission (C2C-SRCDT), achieves a 37% reduced buffer rate data transfer ratio. It is compared with previous algorithms, including the energy-aware adaptive kernel density estimation algorithm (EAKDE) at 40%, K-nearest neighbour (k-NN) at 45%, deep convolutional autoencoder network (DCAN) at 49% and K-means clustering (k-mc) at 52%.

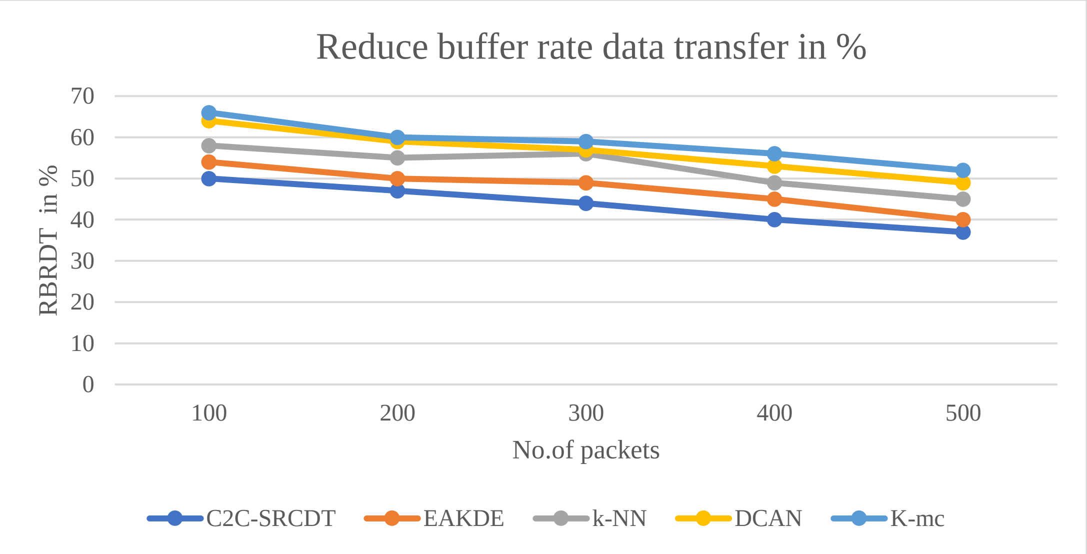


*Figure 11 – Reduce buffer rate data transfer*

*Bandwidth performance and network speed*

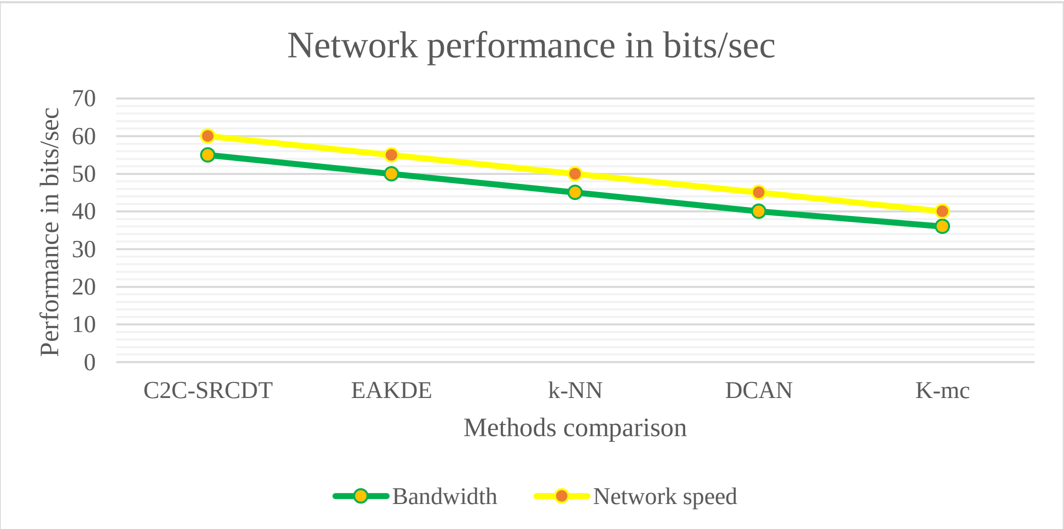


*Figure 12 – Network performance for bandwidth and speed*

*Figure 12* describes network performance for bandwidth and speed range for analysis of the multimedia packets evaluating the delivery ratio and loss and overall throughput range and sending the packets with a source to destination for multimedia data transfer within time to improve the network performance. It is compared with the previous algorithm using 500 packets. The proposed algorithm, cluster-to-cluster source route cooperative data transmission (C2C-SRCDT), achieves a bandwidth of 55 bits/sec and a network speed of 60 bits/sec. It is compared with previous algorithms as follows: energy-aware adaptive kernel density estimation algorithm (EAKDE) with a bandwidth of 50 bits/sec and a network speed of 55 bits/sec, K-nearest neighbour (k-NN) with a bandwidth of 45 bits/sec and a network speed of 50 bits/sec, deep convolutional autoencoder network (DCAN) with a bandwidth of 40 bits/sec and a network speed of 45 bits/sec and K-means clustering (K-mc) with a bandwidth of 36 bits/sec and a network speed of 40 bits/sec.

*Network lifetime and transmission ratio*

*Figure 13* describes performance metrics for network lifetime and transmission ratio range for analysis of the multimedia packets, evaluating the speed and throughput for sending the packets with a source to destination for multimedia data transfer within time to improve the network performance, and it is compared with the previous algorithm using 500 packets. The proposed algorithm, cluster-to-cluster source route cooperative data transmission (C2C-SRCDT), achieves a network lifetime of 88% and a transmission ratio of 90%. It is compared with previous algorithms as follows: energy-aware adaptive kernel density estimation algorithm (EAKDE) with a network lifetime of 80% and a transmission ratio of 86%; K-nearest neighbour (k-NN) with a network lifetime of 70% and a transmission ratio of 81%; deep convolutional autoencoder network (DCAN) with a network lifetime of 67% and a transmission ratio of 77% and K-means clustering (K-mc) with a network lifetime of 60% and a transmission ratio of 72%.

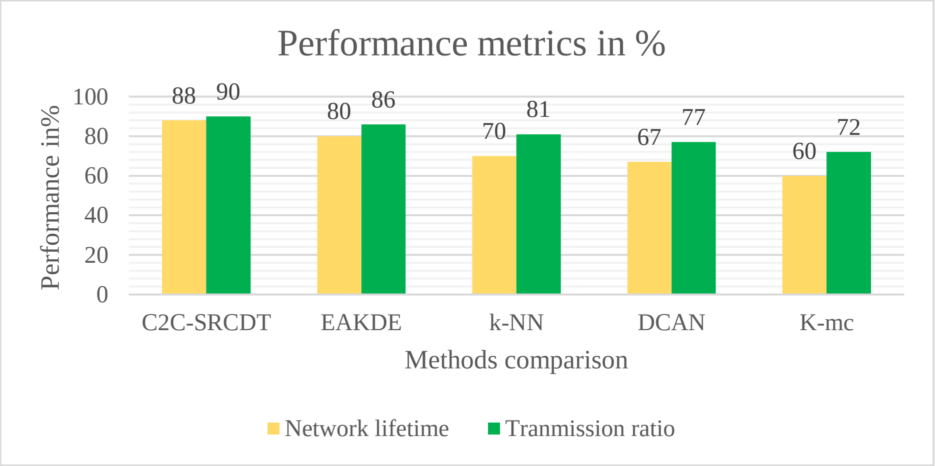


*Figure 13 – Network lifetime and transmission ratio*

*Energy consumption*

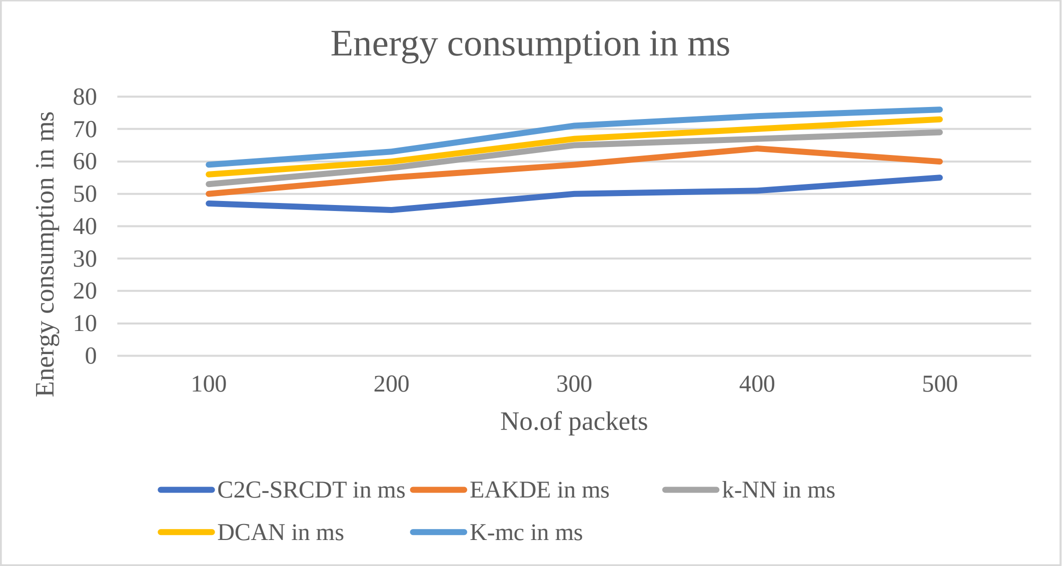


*Figure 14 – Analysis of energy consumption*

*Figure 14* describes energy consumption during the packet transmission. Each node calculates the network's overall energy and compares it with different algorithms. The proposed algorithm, cluster-to-cluster source route cooperative data transmission (C2C-SRCDT), produces a low energy level of 55 ms compared to existing methods: energy-aware adaptive kernel density estimation algorithm (EAKDE) at 60 ms, K-nearest neighbour (k-NN) at 69 ms, deep convolutional autoencoder network (DCAN) at 73 ms and K-means clustering (K-mc) at 76 ms.

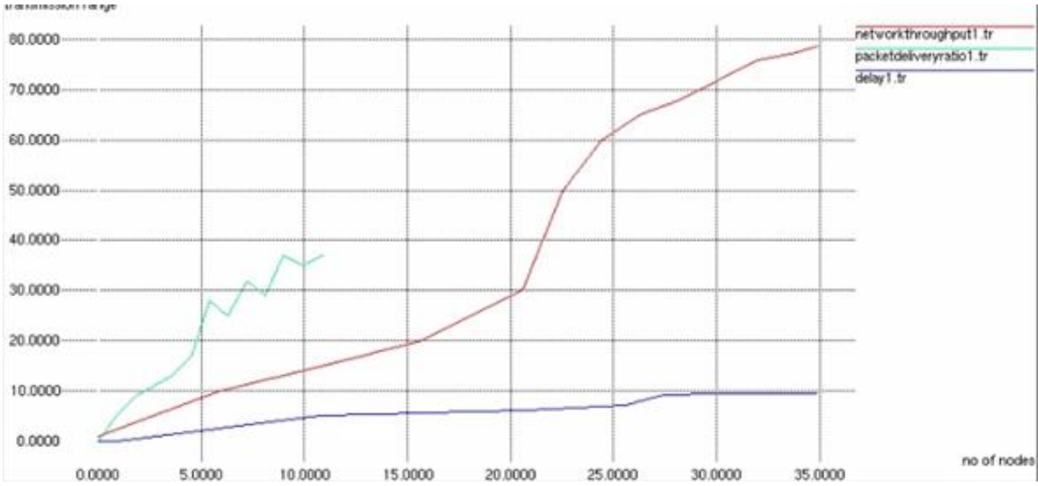


*Figure 15 – Screenshot of energy consumption*

The graph in *Figure 15* shows the energy consumption of several nodes and analyses the throughput and packet delivery ratio performance. It considers calculating the performance by comparing one cluster to another and the cluster head.

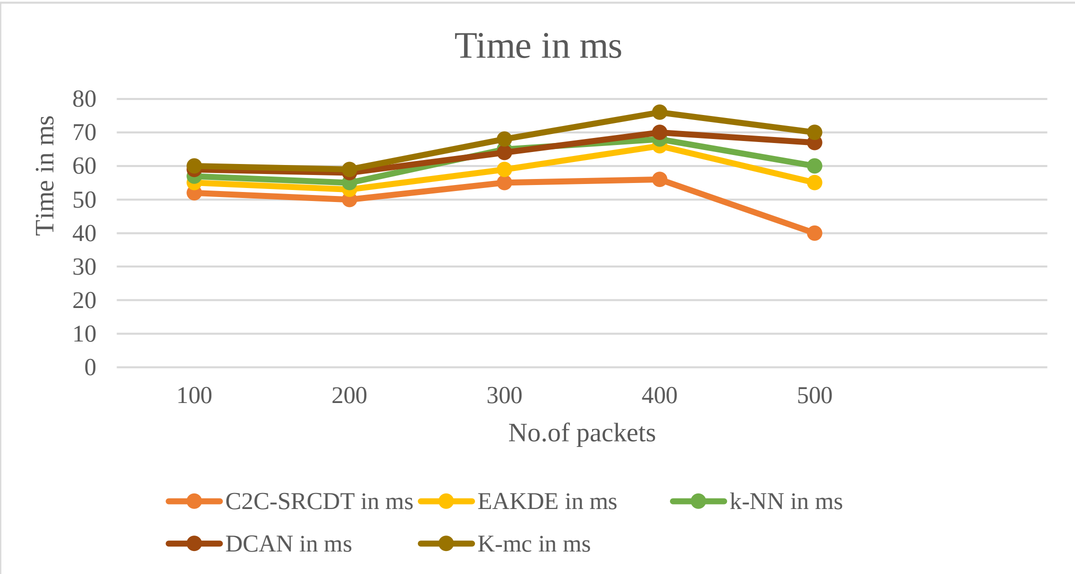


*Figure 16 – Analysis of time complexity*

*Figure 16* describes time complexity as the amount of data transmission to source and destination compared with different algorithms. The proposed algorithm, cluster-to-cluster source route cooperative data transmission (C2C-SRCDT), reduces time complexity to 40 ms compared to existing methods: energy-aware adaptive kernel density estimation algorithm (EAKDE) at 55 ms, K-nearest neighbour (k-NN) at 60 ms, deep convolutional autoencoder network (DCAN) at 67 ms and K-means clustering (K-mc) at 70 ms.

## 5. CONCLUSION

To conclude that the proposed cluster to cluster in Multicasting Multiple Descriptions (MDs) Video in Ad Hoc Networks Using Multiple Sources takes different routing to optimize the energy level to improve the data transmission. Also, each video description is encoded in multiple layers to accommodate changes in the bandwidth of the wireless link. Wireless networks improve reliability, increase network lifetime and reduce data loss. Cluster-based data collection also has low energy consumption and network transmission speed. The source routing path choice is to route packets from the source node to the destination. Hence, the multicasting description sends video transmission, which reduces the energy and buffering to sending limitations that play an essential role in routing in WANET. The proposed method, cluster-to-cluster source route cooperative data transmission (C2C-SRCDT), achieved the following results: a data delivery ratio of 92%, a reduction in data loss between source and destination by 35% and improved data delay performance by reducing delays to 40 seconds. Additionally, it increased the throughput ratio to 91%, reduced the buffer rate for data transfer to 37%, achieved a bandwidth of 55 bits/sec and a network speed of 60 bits/sec, extended the network lifetime to 88%, improved the transmission ratio to 90%, reduced energy consumption to 55 ms and lowered time complexity to 40 ms. C2C-SRCDT algorithms are more efficient than exact analytical solutions. Finding that the C2C-SRCDT algorithm is well suited for such problems, a cluster-based solution to the MD multicast routing problem has been developed. Detailed simulations show significant improvement in video quality compared to existing methods under various network operating conditions. In the future, an optimised technique will be used to improve the throughput and data delivery ratio. The optimised technique will identify the malicious node to reduce packet theft in the WANET.

## ACKNOWLEDGEMENTS

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*சரவணன் முருகன், நித்யகல்யாணி செல்வராஜன்*

*வயர்லெஸ் அட் ஹாக் நெட்வொர்க்குகளில் கிளஸ்டர்-டு-கிளஸ்டர் மூல பாதை கூட்டுத்தரவு பரிமாற்ற அணுகுமுறையை பயன்படுத்தி திறனான தகவல் பரிமாற்றம்*


**Abstract**

*வயர்லெஸ் அட் ஹாக் நெட்வொர்க்குகள்* (WANETs) *பல்வேறு சூழல்களில் தரவை மாற்றுவதற்கான நெகிழ்வான மற்றும் தகவமைக்கக்கூடிய ஒரு உள்கட்டமைப்பை வழங்குகின்றன. பிழைமிக்க* WANET*களைக் கையாளும் மல்டிபிள் டிஸ்கிரிப்ஷன்* (MD) *வீடியோ பரிமாற்றங்களை இது ஆதரிக்கிறது, மேலும் இதன் பயன்பாடு நாளே நாளாக அதிகரித்து வருவதால் இவை மிகவும் முக்கியமானதாகின்றன.* WANET*களில்* MD *வீடியோவை மல்டிகாஸ்ட் செய்ய முந்தைய அணுகுமுறைகள் முக்கியமான சவால்களைக் கொண்டிருந்தன. வயர்லெஸ் அட் ஹாக் நெட்வொர்க்குகளின் வழியாக மல்டிமீடியா ஸ்ட்ரீமிங் தரத்தை உறுதி செய்யும் போதும், இடையறாத நேரத்தை* (buffering) *மற்றும் டிராஃபிக் நெரிசலை குறைப்பதும் மிக முக்கியமான சவால்களாக இருக்கின்றன. இந்த சிக்கல்களை தீர்க்க, இக்கட்டுரை* WANET*களில் பாக்கெட் தகவல்தொடர்புக்காக கிளஸ்டர்-டு-கிளஸ்டர்*

*மூல பாதை கூட்டுத்தரவு பரிமாற்ற* (C2C-SRCDT) *முறையை முன்வைக்கிறது. ஆரம்பத்தில், கிளஸ்டர் அமைப்பில் நோட்கள் உருவாக்கப்படுகின்றன; ஒவ்வொரு நோட்டின் எடையின்படி கிளஸ்டர் தலைமை* (CH) *தேர்வு செய்யப்படுகிறது. பின்னர், டிஜிக்ஸ்ட்ராவின் டிரான்ஸ்மிஷன் ரூட்டிங் அவேர்-மல்டிபிள் டிஸ்கிரிப்ஷன் வீடியோ* (DTRA-MDV) *முறை, பல* (*படங்கள்/வீடியோக்கள்*) *தரவை அனுப்ப, ஒவ்வொரு கிளஸ்டருக்கும் இடையே குறைந்த தூர பாதைகளை தேர்வு செய்ய கிளஸ்டர் நோட்களை மதிப்பீடு செய்கிறது. இறுதியாக, டைம்-ஸ்லாட் மல்டிபிள் ரூட் செலக்ஷன்* (TSMRS) *நுட்பம், பரிமாற்ற திறனை* (throughput) *மேம்படுத்துவதுடன் இணைப்பு துண்டிப்புகளை* (breakage links) *குறைக்க உதவுகிறது.* C2C-SRCDT *முறை இடைநிறுத்தங்களை குறைக்கும் மற்றும் நெட்வொர்க் ஆயுள், அலைவரிசை மற்றும் பரிமாற்ற நேரத்தை அடிப்படையாகக் கொண்டு தரவு தரத்தை மேம்படுத்துகிறது. முன்வைக்கப்பட்ட சிமுலேஷன் பல்வேறு அளவுருக்களின் அடிப்படையில் மதிப்பீடு செய்யப்பட்டுள்ளது: தரவு விநியோக விகிதம், இழப்பு, தாமதம், பரிமாற்ற திறன் மற்றும் ஆற்றல் நுகர்வு. இக்கட்டுரை* 92% *தரவு விநியோக விகிதம்,* 40 *வினாடிகள் தாமதம் மற்றும்* 91% *பரிமாற்ற திறனை அடைந்துள்ளது. இவை, வீடியோ அல்லது படத் தரத்திலும், டிராஃபிக் நெரிசலிலும் ஏற்பட்ட முன்னேற்றங்களை வெளிப்படுத்தி, முந்தைய அணுகுமுறைகளைவிட சிறந்த முறையில் வயர்லெஸ் நெட்வொர்க்கில் தரவுகளை பரிமாறுகிறது.*

**Keyword**

*கிளஸ்டர் தலைமை; கிளஸ்டரிங்; தரவு பரிமாற்றம்; படம்/வீடியோ தரம்; குறைந்த டிராஃபிக்; குறைந்த தூர பாதை; வயர்லெஸ் அட் ஹாக் நெட்வொர்க்குகள்.*