Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 7 July 2021: 13252 – 13261

A Novel Fast Re-Routing Mechanism for Improvement of QoS in Data Transmission of Multimedia Applications Using P2P Network

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Abstract

The Peer-to-Peer(P2P) network have tremendous changes in the multimedia applications. The novel technologies and standards increase the use of multimedia applications. The ubiquitous nature of multimedia services in P2P networks requires the integration of different features to improve the QoS of multimedia applications. The traditional wireless network services is unable to guarantee the multimedia user requirements. To address the limitations of traditional approaches, Michael Brinkmeier et al,. introduced an analytical model to overcome the stability of overlay streaming topology . This model also denied the denial of service attacks in P2P networks. Even though, the analytical model works effectively and improved the performance of multicast wireless networks. But the model does not optimize performance of the P2P network for multimedia transmission. To optimize the network performance in multimedia distribution proposed DoS Resilient - Optimal P2P Topology Construction (DR-OPTC) Framework in previous research work. This framework construct optimal topologies for multimedia transmission. But the DR-OPTC Framework only focus on topology constructions and still the unable resolve node or link failure occur in the P2P networks. The node or link failure leads to degrade network performance. Presently the multimedia data transmission affected by node or link failure and dos attacks in network. To overcome the problem of present network, in this research paper proposed a Novel Fast Re-Routing(NFRR) mechanism for optimal multimedia transmission. The proposed mechanism maintains the secure path for data transmission.

Keywords: P2P network, Trust Routing, Reputation Signal, DoS Attacks

1. Introduction

The advance enhancement in wireless communications is more useful to the P2P networks . The each node in the P2P networks can establish a dynamic network for multimedia distribution without need of a fixed infrastructure. Due to lack of resource sharing mechanism traditional client-server model is not suitable for multimedia transmission. In previous client-server model depends on server resources only. So its leads to bottleneck in the network. But the P2P networks have rapid development in multimedia streaming. This model is ideal solution for bottleneck problem in the network. The P2P network utilize the client resources also for multimedia distribution[1]. The P2P networks are classified into different P2P network structure. In P2P networks every node can contribute resources for sharing multimedia content. So the total capacity of the network increase by arrives new nodes in the network. The P2P network enable different wireless devices to access the multimedia content. Multicast streaming is very useful for broadcast of multimedia live contents[9]. In P2P networks multicast streaming make revolutionary changes for multimedia applications. The P2P networks achieved better performance due to scalability and reliability in multimedia data transformation. But the transfer of multimedia content through P2P networks have different performance issues. Such as QoS, security, node or link failure issues.[2][14] The performance issues resolved by the application layer multicast

P2P network. The multimedia content distribute from source to destination and the network constructed in the form of single spanning tree. The single spanning tree structures network easily attacked by the DoS attacks and its leads degrade the performance of the network[11].

The security issues is overcome by constructing the optimal dynamic topology. The optimal dynamic network is formed by using the cost functions. The P2P network is divided into stripes and each node in the stripe have the cost function values. So the cost based optimal network avoid the DoS attacks. This phenomenon improved the QoS of multimedia streaming in P2P network. High quality multimedia content transmission is preferred[3][12]. The requirement is fulfilled with the dynamic optimal network . However, there are different issues when multimedia streaming over the P2P networks. The issues are sudden fluctuations and node or link failure. These issues can cause the reduction multimedia transmission quality. Many researchers focused on this area[4] However, finding a better solution in P2P network is still an open problem that can be addressed. In this paper proposed a better solution for node or link failure and also achieved maximum QoS in P2P network.

The remainder of the paper is structured as follows. Section II provides review of literature on different approaches for improving QoS in multimedia streaming in P2P applications. Section III provides problem definition and the methodology employed. Section IV presents simulation results with comparisons while section VII concludes the paper besides providing directions for future work.

2. Related Work

This section provides review of literature on multimedia distribution approaches including security improvements and other insights. Satoshi Itaya et al. proposed Heterogeneous Asynchronous Multi-source Streaming (HAMS) model to improve the QoS of multimedia applications in P2P networks. The HAMS schema achieved high performance in terms throughput, reliability and scalability in P2P networks. Due to limited computation resources some peers of the network not transfer the multimedia packets. The HAMS model overcome the limitations of the multimedia streaming. However, the model perform high throughput rate and shorter transmission time with the evaluation of other models. But the HAMS model doest resolve the security issues while transferring multimedia content in P2P networks[5].

Previously internet was designed for only one to one applications. But the technological growth with hardware and software paved the paths of modern digital evolution of internet. Multimedia applications are witness for the growth of internet. Due to the huge demand of multimedia applications, heterogeneity of demands and limited resource availability there is a dire need of adaptive multimedia streaming[6].

Tz-Heng Hsu et al. proposed a Weighted Fair Queue(WFQ) model for multimedia transmission based on different queuing priority class. The proposed social aware video transmission in P2P network used priority classes to with given weighted factor. Trust associated with social links and reduce impact on multimedia sharing. The model does not have privacy maintains of peers in the network[7].

Kunwar Pal et al. discusses about the adaptive multimedia streaming over peer to peer networks. The adaptive mechanism provide better performance. But the propose streaming does not have authentication and have less scalability[8].

3. Proposed Methodology

3.1 Problem Definition

Multimedia streaming is a next evolution of the internet that will enable a network infrastructure that connects a large number of nodes to allow them to transfer content and communicate with each other in order to make processed smart services. P2P network provides cost effective business model for multimedia applications. The P2P technology is also an enable of a hyper-connected nodes and can be used to optimize transportation and mobility. However, the multimedia transformation in P2P network faces a lot of security and node or link failure issues.

The limitations of present multimedia transformation in P2P network need to be addressed and the possible solutions to the problems. The multimedia users face significant peril by security issues in P2P network. The proposed NFRR mechanism address various security and routing challenges in P2P network.

3.2 Proposed System

The multimedia transformation in P2P network is reliable and low energy consumption. The routing mechanism is essential to present multimedia distribution and it effected by many challenges issues. Such as node or link failure and security issues. To overcome limitations of the P2P network and improve the performance , in this research work proposed a Novel Fast Re-Routing (NFRR) mechanism. Several factors are involved in this routing mechanism. The proposed protocol significantly effects on the performance of P2P networks. The major issues are low power and fast reliable multimedia transmission in P2P networks. These performance metrics are mostly effected by the node or link failure problem.

The routing mechanism is essential in the selection of optimal paths. Its depend on the trust factor of routing paths in the network. The trust model can discover a potential trust route for reliable data distribution. The proposed architecture can be found in figure 3.1. The NFRR mechanism select the optimal path using the routing mechanism based on the current trust levels of the nodes in the network. Trust report distribution mechanism is necessary for the nodes to receive indications of potential trustable behaviors in the network. In P2P network before initiate multimedia transformation start routing mechanism for route discovery process to select the optimal paths.

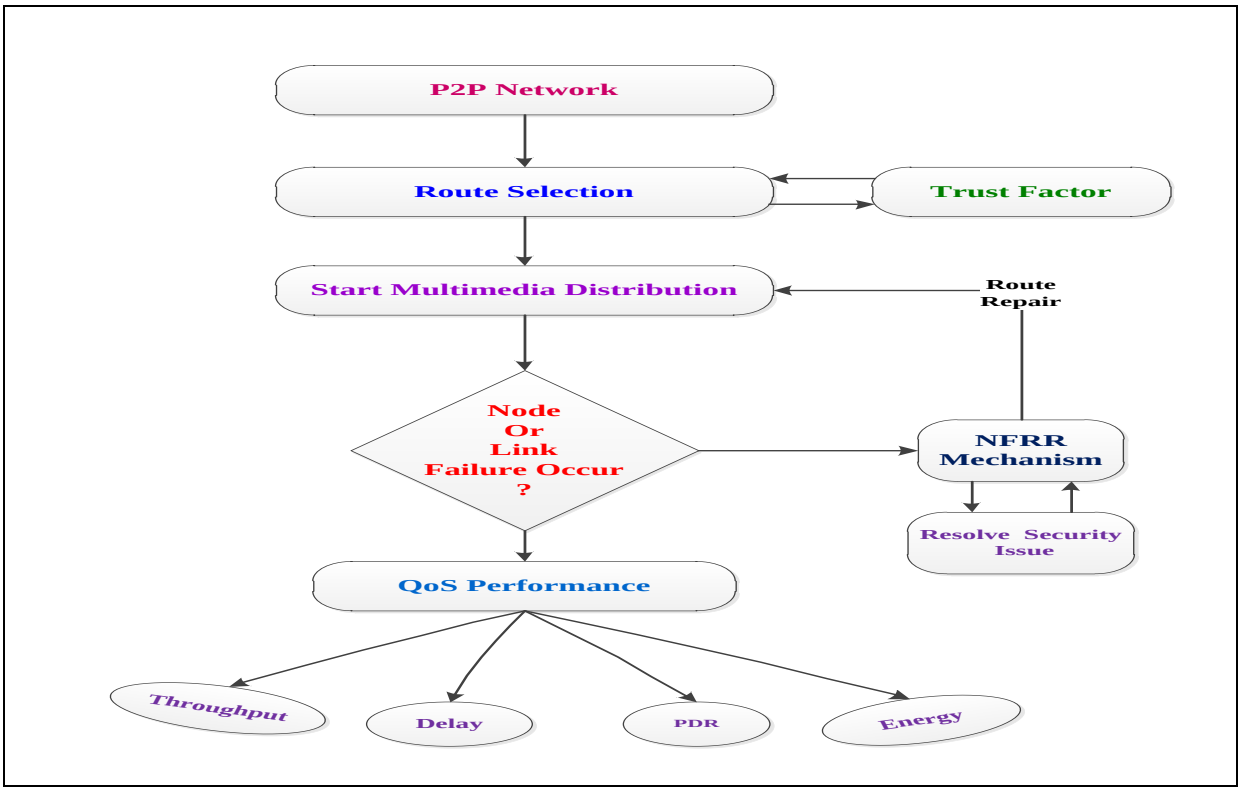

Fig 3.1 A Model Architecture for Proposed System

The path selection is based on the trust factor of link. The minimum trust value path is the primary path in the network. The proposed NFRR mechanism maintain the information of each node status including the trust factor. The multimedia distribution starts through the primary path in the network. The performance is evaluate in terms of throughput, packet delivery ratio(PDR), delay and energy.

3.3 NFRR Mechanism

3.3.1 Trust Route Discovery

In proposed NFRR mechanism follow the two main procedures for optimal secure routing in P2P network. Initially its starts route discovery process and then start multimedia transmission. In route discovery process, source node send RREQ packet and it broadcast from intermediate nodes to destination node. Here intermediate nodes add the previous nodes trust value and then send to its neighbor nodes. The actual destination node receive RREQ from multiple nodes using different paths.

Algorithm 1 **: Route Discovery Algorithm Based on Trust Value**

Input: Network nodes with trust factors

Output: Secure paths with highest trust values

1. Start
2. Source node send RREQ packet
3. First intermediate node broadcast the RREQ packet by adding trust factor
4. Second intermediate node again add trust factor and broadcast
5. At destination node calculate total trust value of path
6. Trust value of path = Ts +Tn1 + Tn2 + ------- +Tnn + Td
7. Arrange the trust value paths in descending order
8. Select highest trust value path
9. Unicast the RREP packet.
10. Then source node start data transmission.
11. If any error occur
12. Select second highest trust value path
13. Start data transmission through secondary path.
14. End

At the destination node calculate the trust value of all paths. The destination node can send the RREP packet to destination node through the highest trust value path. The second highest trust values of path keep it as back up paths. These paths uses when attacks or link failure occurs in the networks. So the source node transmit the data packets through the second highest trust value path. In Algorithm 1 presented proposed route discovery algorithm based on trust value.

3.3.2 Malicious Node Detection

In malicious node detection the proposed algorithms which is utilize in proposed methodology to mitigate DoS attacks in the network. In case of malicious node detection, using NFRR mechanism start send priority packets when the ack packets not received by the trust value paths. The priority packets search the data packet transmission information in the node routing table. In routing table data packet information is check with the priority packet.

Algorithm 2 Attack Node Detection

Input : Priority Packets

Output : Attack Node

1. Start
2. Let's take Source Node *SN*, Destination Node *DN*, Intermediate Node IN, Priority Packet *PP*
3. Node Routing Table with sent packets information NRT
4. SN sends PP's to DN
5. At each IN compare PP's status with NRT of IN
6. If (PP's == IN$\sum_{i=0}^{n} Pi$)
7. {
8. PP's forward to next IN
9. and
10. Update the current node status
11. }
12. Else
13. {
14. Dropped PP's
15. Attacked node status updated
16. }
17. Repeat from Line No 5
18. End

If the priority packet information is match with that data packet, the node forward the priority packet to next node. If finding any mismatch its stop forwarding and generate malicious notification in the network. In algorithm 2 presented detection of malicious node.

3.3.3 Change Node Behavior

Its essential to change malicious node behavior in P2P network to improve the performance of multimedia distribution. The proposed NFRR mechanism change node behavior from malicious to normal. To perform this operation in P2P network, implement a reputation sense algorithm. This algorithm applied on malicious node in the network.

Algorithm 3 Reputation Algorithm

Input Sense Signal

Output Node Status

1. Start
2. Lets take Sense Signal SS, Malicious Node MN, Source Node SN, Signal In Reputation SIR, Signal Out Reputation SOR, Sense Time.
3. SN sends SS to MN
4. If(MN receives SS)
5. {
6. SIR = SIR + 1
7. }
8. IF(MN farward SS)
9. {
10. SOR = SOR + 1
11. }
12. Calculate Total Node Reputation TNR
13. TNR $= \frac{(SIR+SOR)}{ST}$
14. If(TNR>= Threshold)
15. {
16. MN Change to Normal Node
17. }
18. End

4. Result Analysis

NS2 version 2.35 is used to implement the proposed Novel Fast Re- Routing mechanism for mitigation of DoS attacks and improve performance in P2P networks. With proposed NFRR, the performance of the P2P network with multimedia transmission is studied through simulations. The observations are presented in this section. Table 4.1 shows the simulation environment used for the study.

S NO	Parameter Type	Parameter Value
1	Channel Type	Wireless Channel
2	Radio-Propagation	Propagation/TwoRayGround
3	Network Interface	WirelessPhy
4	Interface Queue Type	DropTail
5	Antenna Model	OmniAntenna
6	Interface Queue Length	50
7	Routing Protocol	AODV
8	No.of Nodes	50
9	dataRate_	2MB
10	basicRate_	1MB
11	Simulation Time	30

Table 4.1: Simulation Environment

As shown in Table 4.1, it is evident that different parameters are used as part of the simulation environment. The radio propagation used for simulation is two ray ground. To evaluate the proposed mechanism, different performance metrics are used. They are provided in the next sub section. The performance metrics such as throughput, packet delivery ratio and delay are used to evaluate the efficiency of the proposed mechanism for improving quality of service of network. The proposed NFRR is compared with previous mechanisms, such as Improved QoS for Multimedia Transmission using Buffer Management(IQMTBM), Dynamic Video Frame Mapping(DVFM) schema and Stateless QoS(SQoS) routing [15][16][17]. These metrics are briefly described in the following sub sections.

4.1 Delay

The Figure 4.1 presented delay performance with simulation time. The delay performance of the proposed mechanism is compare with standard previous mechanism.

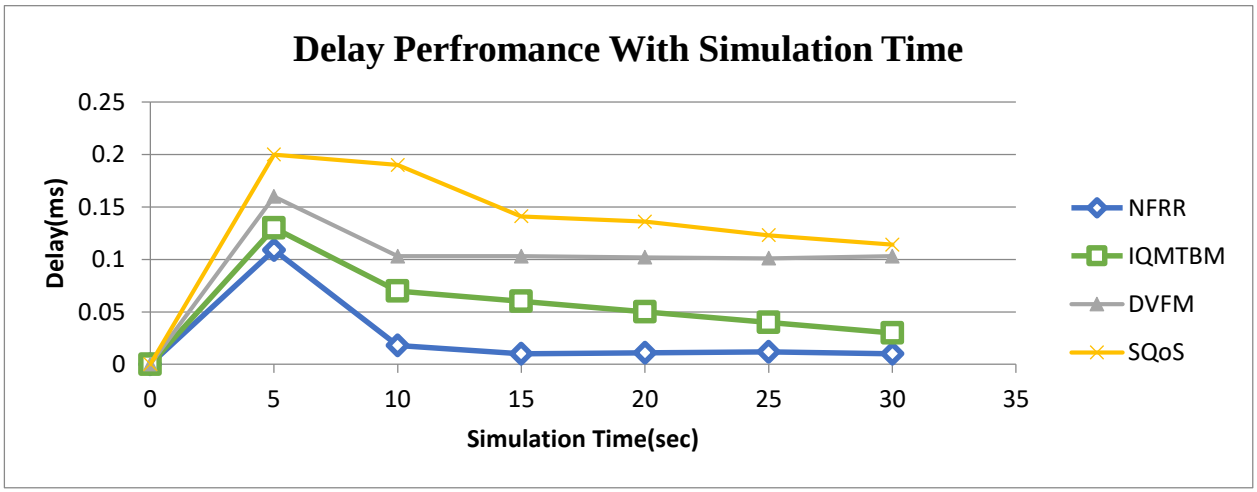

Figure 4.1 Comparison on Delay Performance

As shown in Figure 4.1, the horizontal axis represents the simulation time in seconds while the vertical axis represents end to end delay performance exhibited. The results revealed that the proposed system and existing

system have same performance to some extent up to 30 seconds of simulation time. Afterwards, interestingly, the proposed system showed significance performance improvement. Similar trend is with the existing system. However, the performance of the proposed system at all simulation points where more than 0 milliseconds is recorded is significantly better.

4.2 PDR

The figure 4.2 presented PDR performance with simulation time. The PDR performance of the proposed mechanism is compare with previous mechanism.

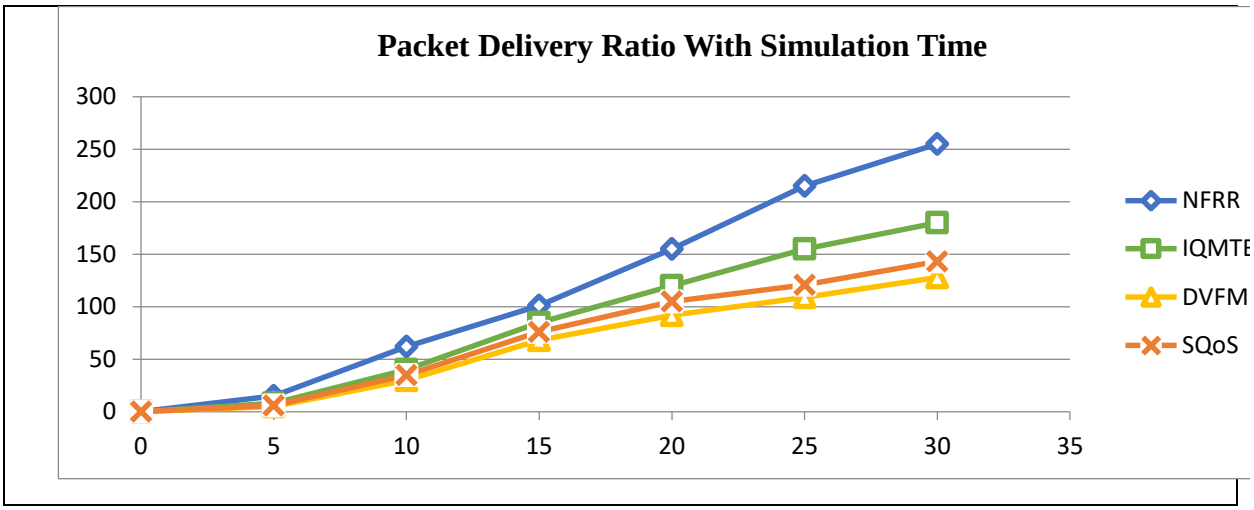

Figure 4.2 Comparison on PDR performance

As shown in Figure 4.2, the performance of the proposed mechanism NFRR with respect to PDR is compared with that of standard mechanism . The horizontal axis represents simulation time in seconds while the vertical axis represents PDR value. The results revealed that the proposed protocol has comparable performance upgrading as simulation time is increased. From simulation time 5 to 30 sec, the proposed protocol shows improved PDR over the existing protocol.

4.3 Throughput

The table 4.3 presented throughput performance with simulation time. The throughput performance of the proposed mechanism is compare with standard mechanism.

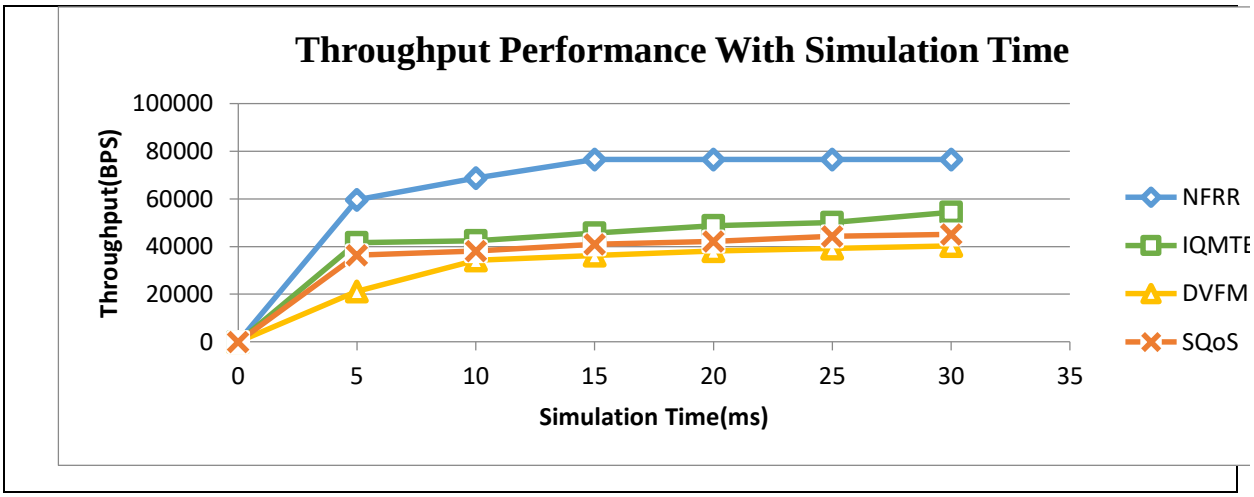

Figure 4.3 Comparison on Throughput performance

As shown in Figure 4.3, the simulation results in terms of throughput are presented. The simulation time is considered from 0 seconds to 30 seconds with 5 seconds interval. The throughput is measured in bytes of data transmitted. The throughput of the proposed protocol is 76608 bytes consistently while the previous mechanism IQMTBM, DVFM and SQoS[15][16][17] measured 54347, 40264, and 45106 respectively. There is significant difference between the proposed mechanism and standard mechanism. The proposed NFRR for enhancing multimedia transmission over P2P networks with respect to multimedia streaming applications shows higher performance over an existing protocols with respect to throughput.

4.3 Energy

The figure 4.4 presented energy performance with simulation time. The residual energy of the proposed mechanism is compare with standard mechanism.

When simulation is at 0 seconds, 100 joules of energy is assigned for each node in the network. As simulation time increases, the energy consumption is recorded. More energy is consumed means the efficiency is less. Thus the results reveal two trends in the performance with respect to energy efficiency. First trend is that residual energy of the two approaches is decreased when simulation time is increased. The second trend is that the proposed network with NSTBR showed higher residual energy at every interval when it is compared with an standard routing protocols.

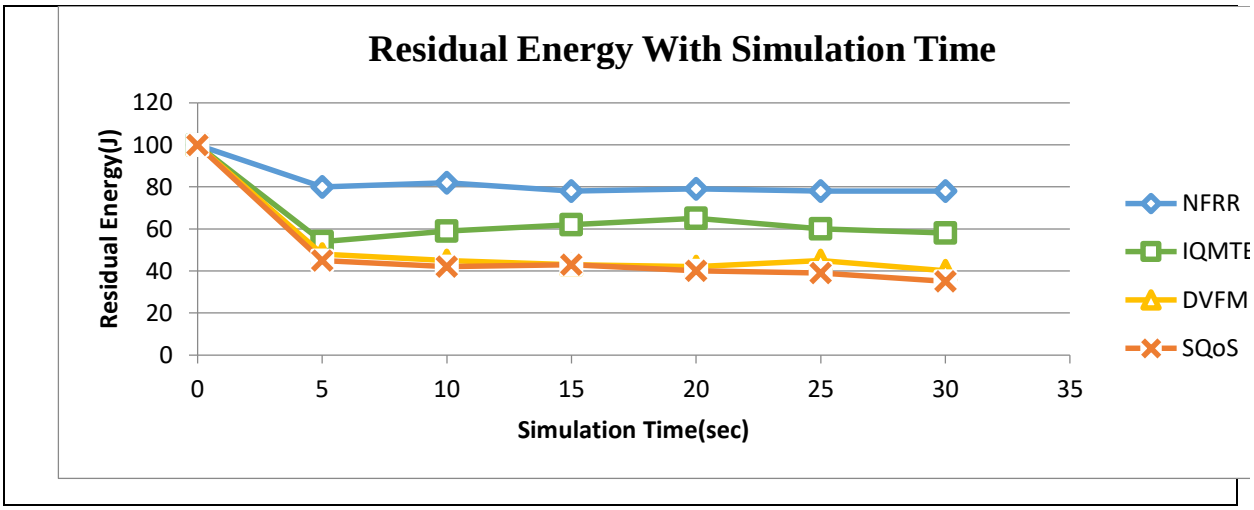

Figure 4.4 Comparison on Residual Energy

The residual energy of the proposed NFRR at the end of simulation is 79 joules while the EQMTBM, DVFM and SQoS[15][16][17] is 58, 40 and 35 respectively.

5. Conclusion

In this paper, mainly focus on the node or link failure issues in P2P networks for enhancing the capability for supporting multimedia streaming applications with quality of service. Many factors leads to node or link failure problem. Such as link bandwidth, high network traffic and malicious attacks. To resolve the problems in multimedia distribution and improve the performance in P2P networks proposed a Novel Fast Re-Routing mechanism. This mechanism have high efficiency is route repair and mitigate the DoS attacks. Besides the proposed mechanism improved the QoS in P2P network for multimedia transmission. The NFRR mechanism is implemented using NS2 simulations. The results revealed that the proposed mechanism has significant performance improvement over standard mechanisms.

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