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INTEGRATED CROSS LAYER OPTIMIZATION APPROACH FOR QUALITY OF SERVICE ENHANCEMENT IN WIRELESS NETWORK

Pundalik Chavan

Research Scholar, Visvesvaraya Technological University and
Assistant Professor, Department of Computer Science and Engineering,
Sri Venkateshwara College of Engineering, Bengaluru, Karnataka, India
pundalik.chavan29@gmail.com

Dr. K. Satyanarayan Reddy

Professor and Head, Dept. of Information Science and Engineering,
Cambridge Institute of Technology, Bengaluru Karnataka, India
satyanarayan.reddy@gmail.com

Abstract - Wireless network has emerged as the primary technology for the next generations networks and it adopts various feature such as ease of deployment, low cost, increased coverage which forms the self-organized structure without relying on any fixed network. Wireless network possesses various multimedia transmission application such as real time delivery of audio, video and VOIP; out of these services video transmission is considered as more challenging as it requires high QoS as the QoS are degraded often due to unreliable nature of network, fading radio signals, node's mobility. Moreover, high quality video transmission requires high QoS such as efficient bandwidth utilization, high throughput, low delay and high PSNR value for video transmission; in order to utilize the network resources, guaranteed QoS is essential requirement which has been researched by several researchers, however main issue of these approaches are missing end-to-end QoS guarantee for video transmission. In this paper we design and develop an ICLO (Integrated Cross Layer optimization) approach which aims to enhance the Quality of Service; considering two major issue i.e. video encoding and packet transmission. Further, these problem are solved through various optimization model such as optimization of channel modelling, obstacle aware interference modelling, queueing model and video distortion model. Further these optimization are integrated to solve the designed problem which enhances the Quality of Service. Further, we evaluate the ICLO considering the performance metrics like bandwidth efficiency, PSNR, Throughput and End-to-End delay.

Keywords: ICLO, Wireless Ad-hoc Network, Video Transmission, QoS.

1. Introduction

Multimedia streaming service and applications have increased in exponential manner and it has shaped telecommunication industry into whole new dimensions with rise in video application; further wireless communication model is expected to grow in terms for multimedia service including data, voice and video [1]-[3]. Moreover, this phenomenon has provided unanimous impact on individual communication and information accessed; further enhancement in networking, electronics and video coding will lead to designing of wireless service [3], however it requires efficient mechanism for transporting the video applications over the wireless networks.

Moreover, wireless ad hoc network is one of the decentralized wireless network where network do not rely on pre-existing network infrastructure; moreover, wireless ad hoc network has varied application such as battlefield communication, health care, video conferencing and discover recovery where video/audio are transmitted; further other multimedia applications includes monitoring, security, entertainment, education, surveillance and so on. However, such unanimous growth and demand requires QoS (Quality of Service) provision [3] especially in video based application due to delay constraint [4]- [7].

In general, video application adds various interface such as remote surveillance, interactive gaming, video telephony, distance learning and video conferencing; moreover, different devices and application require different QoS (Quality of Service) mainly high throughput with wide range of capabilities, and also user preference is very much crucial. Moreover, ability to access the video content requires considering the user interaction, hence it requires atobridge gap between the mechanism and content used. QoS ensuring guarantee depends on the resilience and robustness of mechanism used [8]- [10]; hence it is obvious to develop robust, efficient and adaptable strategy for video transmission over the wireless network [11]- [14]. In order to support and transmit the video data over the wireless network and for ensuring the trade-off among the energy consumption, implementation complexity and video quality [15] proposed similar approach such as mitigation impact of time varying channels needs to be considered over the video transmission; interestingly one of the approach i.e. Cross Layer Design (CLD) is one approach which adopts the possible solution for channel conditions adoption to provide the efficient QoS required for video transmission over the wireless network. Hence efficient mechanism needs to be developed that can mitigate the any impact on the time varying channels for video data transmission; further development in QoS optimization was observed through Cross Layered Design aka CLD approach which provides the possible solution for adopting the channel condition for providing the required QoS. Although cross layer approach seems little sophisticated for layered communication and fair resource distribution, cross layer approach can be adopted and modified further. Moreover, it has become quiet challenging to provide the QoS guarantee in the wireless network since earlier approach lacks the resource scheduling and satisfactory management through central node. Furthermore, it also suffers from internal and external interference failures. Other existing cross layer approach can be highlighted such as first, change in nodes mobility changes the topology of the network through unpredicted manner and this affects the link stability [16]; also when the nodes are battery based, any failure in node affects the established link and network topology as well. Third, meeting the communication quality requirement with restricted resources such as bandwidth and queue length [17][18]. Furthermore, while designing the cross layer approach, apart from the above three concern is time sensitive application. In, wireless network most of the network are time sensitive application such as ad-hoc network, D2D network, M2M network, vehicular network, thus providing high throughput possesses challenge along with optimized delay requirements since it has fast varying channels and complicated interference [19] [20]. Thus, providing the QoS guarantees for video based application is the key issue and can be identified as the problem in wireless network domain; further the video packet data demands optimized utilization of energy and secure video packet data transmission. Moreover, despite having several shortcomings in cross layered approach, it has been possibly best solution for QoS guarantee. Thus this paper focuses on the designing the QoS optimization of wireless network for video data transmission through adopted cross layered approach.

1.1 Motivation and Contribution of Research Work

In past decades, multimedia streaming has possessed unprecedented challenge due to the dynamic nature of network such as random packet loss and bandwidth consumption and other parameter optimization. Hence, to address issue of parameter optimization based on the layered based approach; further several research work has been carried out for parameter optimization. Moreover, most of the architecture focused on the transport layer and application layer. At transport layer, congestion control is utilized over the streaming application through fairly share of the network resources. Furthermore, UDP (User Datagram Protocol) is adopted that avoids the congestion control mechanism, however congestion control mechanism was designed on the top of UDP (User Datagram Protocol) which was subjected to QOS optimization. However, the existing mechanism suffers from the communication among the layers which creates huge gap for the QoS requirement. Thus, motivated by the above phenomena, we tend to design the QoS aware mechanism which adopts the requirement of same. Moreover, contribution of research work is highlighted through below points;

1. Review the existing mechanism of QoS enhancement and analyze their shortcoming.
2. Design and develop integrated cross layer optimization model aka ICLO for enhancing the Quality of Service metrics.
3. Integrated-cross layer optimization model is an optimization based mechanism where at first the two distinctive problem related to video encoding and optimal transmission is designed; further several optimization is carried out such as channel modelling, optimal queue modelling, optimal transmission policy.
4. Moreover these problems are integrated and ICLO algorithm is proposed in iterative manner for QoS enhancement in wireless network model.
5. Theproposed model is evaluated considering metrics like bandwidth efficiency, delay, PSNR and throughput; further comparative analysis is carried out to prove the model efficiency.

This research is organized as follows, first section starts with generalization and importance of wireless network and selection of wireless network, further same section proceeds with video transmission and QoS requirement of video transmission in wireless network; this section ends with motivation and contribution of research work.

Second section focuses on the extensive review of various QoS-aware mechanism. Third section presents the Integrated cross layer optimization mechanism along with architecture diagram and mathematical formulation; fourth section evaluates the proposed model through comparison with existing model.

2. Literature Survey

Multimedia communications has observed continuous growth due to various challenges and opportunities; wireless technology has been one of the promising technologies for efficient communication. Considering the Quality of Service as aconstraint, considerable amount of research have been carried to enhance the various metrics of QoS; some of them especially for video transmission.

In [21] AOMDV (Adhoc on demand multipath)-Vector is proposed which provides partial QoS which assures the alternative path when one of the path is interrupted; further to improvise the communication, QoS aware AOMDV mechanism is proposed in [22]which gathers the information of remaining energy as well as queue length through cross layer approach and further integrated these information to choose the high end quality path; however in adecentralized wireless network , QoS is degraded when the nodes are mobilized. Moreover, rapid change in network topology causes the frequent path interruption and designed mechanism has to choose path in frequent manner, this leads to degradation in QoS; thus considering the issue of path stability, several research worksconsidered the alternative path based mechanism. few compute the probability of stability of choosing the corresponding path based on defined distance between the RSS (Received Signal Strength) or the distance among nodes. Similarly, [23] proposed link reliable MR (Multipath routing); several link reliable path is find between source node to destination node through using Quality estimator and link quality. Furthermore, it minimizes the routing probability in decentralized wireless network; however it does not consider the node resource like remaining energy or bandwidth which restricts the QoS with certain extent. End-to-end mechanism for efficient energy and QoS enhancement through multipath routing is proposed in [24]; in here P-LQE protocol were used and further an estimator was used for estimating the various reliable and energy aware multipath routing for the data transmission. Moreover, authors in [25] proposed path selection mechanism considering the link stability which utilizes the delay parameter of QoS in sending and receiving time for estimating the link stability; further, authors in [26] used a mechanism named PRIME which is mainly based on the design of probabilistic approach to enhance the route stability. In [27], authors proposed a mechanism named RRMP aka reliable multipath based routing protocol; in here dual path selection were considered i.e. time constraint and stability factor providing the delay and low link interruption optimization. Authors in [28] developed an estimator Link Quality Estimator (LQE) to be applied in industrial based WSN; in here dedicated nodes are used for estimating the link quality considering the signal strength. However, link stability estimation through using only distances cannot influence node speed and hence fails to optimize the QoS performance. [29] developed cross layer based mechanism for designing the robust and durable routing for uniform node motion scenario; uniform nodes motion is designed through distance consideration among the two vehicles for estimating Link Residual Time (LRT). [30] developed an integrated multimedia transmission for enhancing the QoS and also they addressed the multiple issue related to wireless ad-hoc network; in here threshold selection was used for the video packet based formulation of threshold and optimal route for the videos transmission. The main issue with this mechanism is that it involves high delays that directly impacts on the packet loss.

3. Proposed Methodology

In this section, we design and develop an integrated cross layer optimization mechanism to enhance the Quality of Service; in general Quality of Service enhancement refers to various metrics enhancement like bandwidth efficiency, End-to-End delay, PSNRand throughput.

3.1 Problem Definition

Based on the critical review of various existing model of video transmission, it was observed that maximizing the video quality is equivalent to problem of maximizing the average metrics which includes delay, bandwidth, PSNR and throughput, this whole parameter optimization can lead to enhancing the QoS where queuing delay, video encoding rate and transmission threshold are considered in integrated manner.

Let's consider two distinctive optimization parameter indicated as $\beth = (\beth_n)_{n\in N}$ and $R = (R_n)_{n\in N}$ where N indicates total number of instance carried out, then the problem is can be design such as

For given $C_{0,m}, \delta_m, Q_{0,m}, Q_m^k, j_m, M, C_m^{req}, K_m, \hat{f}_r, \aleph, E, O_m, S_r\ for\ all\ m\epsilon M$, find $\beth$ and Q such that maximize Qos_param with respect to below three condition;

Condition1: $\beth_n$ is greater than or equal to 0

Condition2: $\beth_n\ is\ less\ than - \aleph lm\left[1-\left(1-\frac{S_r}{K_m}\right)^{E^{-1}}\right]$

Condition3: Q_m is greater than Q_m^K for all m

Moreover, we design iterative approach based algorithm and the designed QoS problem is divided into two distinctive sub-problem i.e. video encoding rate optimization and transmission optimization, which is solved through integrated level

3.2 System Model and Preliminaries

Let's consider a wireless network that has various communication instance$M$ for video transmission through unit-hop route; in general such network is utilized for video transmission in network. In case of each instance$m$, $m\epsilon M$ where the source and destination both are identified; entire instance distribute the spectrum and these spectrum are parted into various channels indicated as E.

Wireless video transmission time is parted into various time slots; for the given time slots, at first each instance selects the optimal frequency channel in E and later arrival packet is decided through comparing it with threshold. If channel gain is more than the threshold then the packet is transmitted else it is queued for buffer, further it should be noted that link channel condition and video encoding both has to considered for each instance with its threshold.

Video packet loss aka which further leads to QoS degradation is mainly due to the problem of packet delay and link transmission; for instance high transmission threshold leads to fair probability of choosing a channel and minimize the error rate but leads to queueing delay whereas low transmission threshold gives high transmission probability but leads to high transmission error. Furthermore video encoding rate have direct impact on queue state and causes delay.

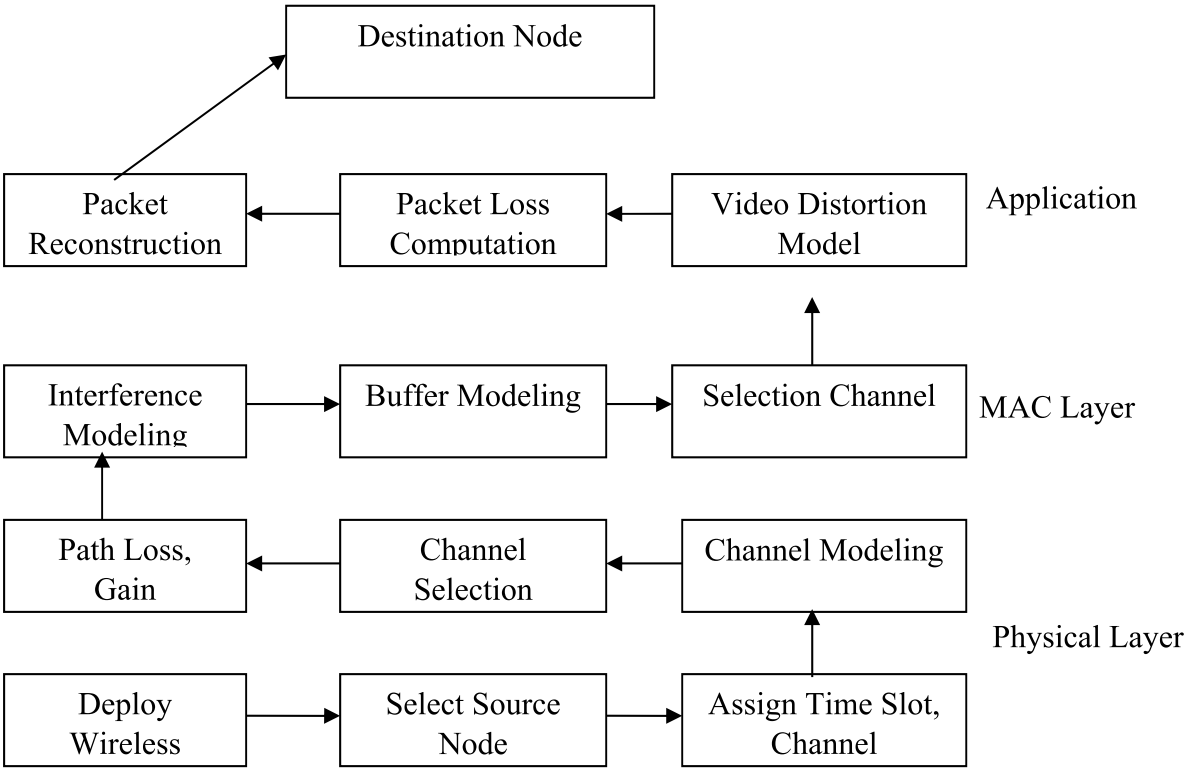

Figure 1: ICLO workflow

Figure 1 presents the ICLO mechanism flow which comprises three distinctive layer physical , MAC and application layer; video packet is transmitted from source node to destination node and in between several optimization is carried out which is discussed in further sub-section.

3.3 Channel Modeling

In general channel model suffers from the Rayleigh fading and large scale path loss; small scale fading is considered as independent as well as distributable for every instance occurred; let's consider channel gain denoted as f_r^e of instance$m$ which belongs to M among the transmitter and receiver for given channel $e\epsilon E$ which is denoted through below equation.

$$f_r^e = \hat{f}_r \hat{f}_r^e \quad (1)$$

In above equation, $\hat{f}_r^e$ is considered as the fading gain and $\hat{f}_r$ is considered as the channel; moreover we consider path loss model of non-singular as singular loss model tends to be in infinity if receiver and transmitter is 0; hence in our case path loss is unit and further path loss model is modified as:

$$\hat{f}_r = \frac{1}{\left(1 + c_r^{\complement}\right)} \tag{2}$$

In above equation, $\complement$ indicates the path loss exponent an $c_r^{\complement}$ indicates the communication distance of designed instance; also it is assumed that $\hat{f}_r^e$ remains constant throughout the given time interval and only varies through various interval. Furthermore, in case of each model having fading parameter as $\aleph$ with channel fading $\hat{F}_s^f$, probability of identical distribution is given as:

$$Probaility(\hat{g}_r^e = w) = \text{exponential}\left(-\frac{w^2}{\tau}\right)\frac{2w}{\tau}.(\forall r \quad \in M, e \in E) \tag{3}$$

Further, considering the exponential parameter$1/\tau$and fading gain, probability function of channel gain is given through below equation.

$$Probability\left(\hat{f}_r^e = x\right) = \text{exponenital}\left(-\frac{x}{\tau}\right)\frac{1}{\tau}.x \geq 0, e \in E \tag{4}$$

3.4 Optimal Transmission Policy Design

Considering the channel modelling in above section, we design optimal transmission approach for video packet transmission; let's consider the threshold of channel fading for defined instance where $m\epsilon\, M$, then optimized transmission equation is formulated as:

$$e^* = \underset{e \in E}{\arg max} \hat{f}_m^e = \underset{e \in E}{\arg max} \hat{f}_m \hat{f}_m^e \tag{5}$$

Moreover, in equation 4, optimal channel gain is comparatively lower than defined threshold φ_m then transmission probability is given as:

$$Probabiltiy\left(\hat{f}_m^e < \varphi_m\right) = \int_0^{\varphi_m} \text{exponential}\left(-\frac{x}{\tau}\right).\frac{1}{\tau}dx \tag{6}$$

Further, packet transmission for unit time slot for designed instance$m$ is give as:

$$\rho(\varphi_m) = 1 - \left(1 - \exp\left(-\frac{\varphi_m}{\tau}\right)\right)^{|F|} \tag{7}$$

3.5 Obstacle aware optimal modeling

Once we optimize the channel modeling and packet transmission approach, we develop interference model. For instance, if particular channel gets selected by various instance to transmit the packet in simultaneous manner, this causes interference in network. Hence we need to develop an optimal modeling; let usconsider ω_m^r as the SINR (integration of noise ration and signal to interference) for the defined instance earlier on given frequency channel at receiver side, then successful packet transmission for instance is given as:

$$P\left(\omega_m^r > \omega_s\ \right) == Probability(\frac{O_m \hat{f}_r \hat{f}_m^e}{\Xi_m^2 + obs_m^e(\varphi_{-m})} > \omega_s \tag{8}$$

In above equation, ω_s indicates SINR threshold and as per equation 4, $\hat{f}_m^e$ is exponential distribution, O_m indicates the instance power transmission, Ξ_m^2 indicates noise induced and interference observed is denoted by $obs_m^e(\varphi_{-m})$. Moreover, interference depends on the channel fading discussed earlier, hence optimal threshold of entire instance is given as:

$$obs_m^e(\varphi_{-m}) = \sum_{l \in M} \hat{f}_{lm} \hat{f}_{lm}^e O_l \chi_l^e(\varphi_{-m}) \tag{9}$$

In above equation, $\hat{f}^{e}_{lm}$ indicates channel fading and $\hat{f}_{lm}$ indicates path loss gain at source node instance (denoted as m),$\chi^{e}_{l}(\varphi_{-m})$ is optimal instance selection which select unit while transmission and chooses null when not transmitting.

3.6 Optimal interference distribution

In order to design optimal interference distribution, we select the random deployment model with PPP (Poison Point Process) then we compute the probability of optimal interference distribution through logarithmic function, thus $obs^{e}_{m}(\varphi_{-m})$ is represented as:

$$e_m(w) \cong \text{Probability}(obs^{e}_{m}(\varphi_{-m}) = w) \quad (10)$$

$$e_m(w) = \left(w\omega\ \ (\varphi_{-m})2\pi^{0.5}\right)^{-1}\text{exponential}(-[\ln w - \varpi(\varphi_{-m})])\left(\omega^2(\varphi_{-m})\right)^{-1}$$

In above equation, $\varpi(\varphi_{-m})$ and $\omega\ \ (\varphi_{-m})$indicates mean and standard deviation of variable's natural algorithm, both have dependency on φ_{-m}. Further we compute the transmission probability of packet error and given as:

$$Probaility^{\xi}_{m}(\varphi_{-m},\ \varphi_m) = \int_{\varphi_m}^{\infty} \frac{1}{2\tau}\text{exponential}\left(-\frac{w}{\tau}\right)\xi e\left(\frac{\ln(wz-a) - \varpi(\varphi_{-m})}{\sqrt{2}\,\omega\ \ (\varphi_{-m})}\right)dx + 0.5\ \exp\left(\frac{(\varphi_{-m})}{\tau}\right) \quad (11)$$

In above equation, $z = \frac{o_m f^{'}_m}{\omega_s}$ and $= \Xi^2_m$.

3.7 Queuing approach at MAC layer

In order to determine packet loss model, queueing model has to be designed; let's consider w_m be the time slots for packet transmission, thus probable mass function is given as

$$Probability(W_m = j) = \left(1 - \varpi(\varphi_{-m})\right)^{j-1}\varpi(\varphi_m) \quad (12)$$

Further, first instance of W_m is computed as:

$$opW_m = \left(\varpi(\varphi_m)\right)^{-1} \quad (13)$$

In above equation, $op[.]$ represents expectation operator; further let's consider u_m for the simplicity and further probability is given as:

$$Probability(W_m = h) \approx u_m\text{exponential}(-u_m j) \quad (14)$$

Let's consider the time duration asS_r , then average service rate for video packets denoted by Ξ_m and computed as:

$$\Xi_m = \frac{\varpi(\varphi_m)}{S_r} \quad (15)$$

Further, let's assume packet arrival with fixed parameter Λ_r computed through where video packet length is computed through K_m and video encoding rate is presented through Q_m at source node.

$$\Theta_r = \frac{\mathrm{Q}_m}{\mathrm{K}_m} \quad (16)$$

Moreover, we compute the load factor

$$L_s = \frac{\Lambda_r}{\Xi_m} \quad (17)$$

Moreover, it is required to keep the queue stability hence through the substitution we compute upper bound through below equation.

$$\varphi_m \le -\tau \ln\left[1-\left(1-\frac{S_r, Q_m}{K_m}\right)^{\frac{1}{|E|}}\right] \tag{18}$$

Further, it is observed that packets are discarded, thus we compute delay

$$Probable_m^{\varrho}(Q_m, \varphi_m) = \exp(-\left(\frac{\varpi(\varphi_m)}{S_r} - \frac{Q_m}{K_m}\right) Distort_m^{\xi}) \tag{19}$$

Further we design an integrated algorithm which is carried out in the iterative manner for two different sub-problems designed in same section.

3.8 Optimal Video Distortion Model

In this subsection of the research work, we consider the integrated packet loss which occurs at MAC layer and physical layer; PSNR is one of the highly appreciated metric for video quality measurement; further model for the designed instances o is given as

$$PSNR_o = 10\log_{10}(\frac{E_{max}}{E_o}) \tag{20}$$

In above equation, $E_o$is distorted model for designed instance o; further designed instance comprises integration of two types of distortion i.e. lossy video and packet loss distortion. Lossy video compression is computed through below equation.

$$E_o^{lc} = \varepsilon_o\left(S_o - S_{0,o}\right)^{-1} + E_{0,o} \tag{21}$$

In above equation, $S_{0,o}$, ε_o, o are special parameter that are estimated through different traditional approach and S_o indicates video encoding output rate; further packet loss contribution to video degradation is formulated as:

$$E_o^{pl} = l_o Q_o^{pl} \tag{22}$$

both integrated are formulated as:

$$E_o = E_o^{lc} + E_o^{pl} \tag{23}$$

Total video degradation for entire session is computed as:

$$E_o = E_{o,0} + \varepsilon_o\left(S_o - S_{0,o}\right)^{-1} + E_{0,o} + Q_o^{error}(\varphi_m, \varphi_{-m})) \tag{24}$$

Also, above formula concatenate the application layer and physical layer and performs the integration architecture of channel modelling, obstacle aware, queue modelling and video distortion model to enhance the cross layer design

Tables

Step1:	Take input as the network information, $M = \|M\|, O_m, S_r$
Step2:	video and queue sequence information $C_{0,m}, Q_{0,m}$
Step3:	Set the max iteration and compute PSNR value
Step4:	Initialization
Step5:	Fix iteration count and repeat$i = 0,\ Q(0) = (Q_m^k)_m$
Step6:	Given vector, obtain the optimal solution for $\varphi'\ (i) =\ \varphi^{*\ \prime}{}_{m\in M}(i)$
Step7:	Find optimization sub problem through optimization
Step8:	Further integrate and optimize the parameter like bandwidth, delay and throughput
Step9:	Repeat until $QoS_{param(i)} - QoS_{param(i-1)}$ for all instances

Table-1. Integrated QoS aware optimization

4. Performance Evaluation

In this section of the research, we evaluate the proposed model to prove the model efficiency; moreover proposed model is designed using the MATLAB Tool with system configuration of windows 10 with 16 GB RAM and 4 GB NVidia Graphics.

Further model is designed through considering network area with nature of single –hop network and area of $100m \times 100m$ for communication, also communication nodes are randomly distributed in 2D-configuration. Moreover designed network topology is parted into 100 distinctive network with each $10m \times 10m$ grid. Nodes are distributed in uniform manner where video transmission packet is transmitted from source node to target node, also destination node is created in random direction with assigned random distance. Further system configuration is given through below table.

$\boldsymbol{Model\ configuration}$	$\boldsymbol{Assigned\ Value}$
$Absolute\ packet\ count\ to\ be\ transmitted$	200
$Simulation\ Area$	$100\ m \times 100\ m$
$Grid\ Area$	$10m \times 10m$
$Loss\ Factor\ of\ Path$	3
$Parameter\ of\ Rayleigh\ Fading$	1
$Slot\ Time\ Duration$	$5\ ms$
$Number\ of\ Network\ Grid$	100
$Video\ packet\ Length$	$3.04\ kbps$
$Noise\ Power$	$10^{12}\ mW$
$Transmission\ Power$	$1000\ mW$
$SINR\ Threshold$	10

Table-2. Model Configuration

Table 2 shows the considered configuration for simulation, in here we choose fixed frequency channel of one, five and ten for addressing the relation among transmission probability and different channels.

4.1 Performance Metric Evaluation

In this section of the research, we evaluate the model considering bandwidth efficiency, PSNR, throughput and end-to-end delay.

4.2 PSNR (Peak to Signal)-Noise Ratio

is defined as the ratio of maximum signal power to corrupting Noise which affects the representation; PSNR is computed for each frame of received video sequence as the data input for programs are divided into various frames. It is considered as one of the important metrics for video quality evaluation, the higher value of PSNR indicates the better video quality; figure 2 presents comparison of existing and proposed model where y-axis PSNR with different iteration. It is observed that PSNR value in each iteration is performed to be better than the existing model. Further in graph, we observe that for early instance i.e. for first four instance proposed model observes less PSNR value i.e. 0.5044, 0.50525, 0.5031 and 0.5002 in respective manner; however for other instances proposed model simply outperforms and video degradation quality is marginally optimized in comparison with existing model.

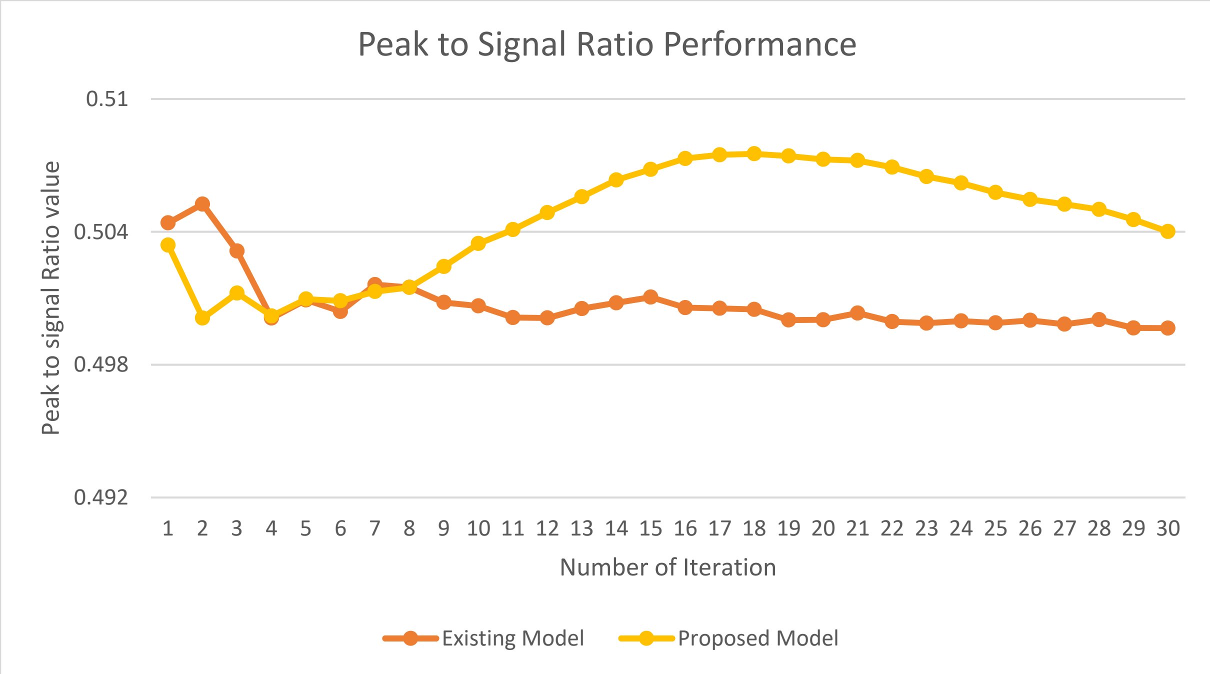

Figure 2: Peak to signal ratio performance

4.3 Bandwidth Efficiency

Bandwidth consumption is a highly important criterion for evaluating the performance of the proposed method, as it determines the network data transmission and latency. Bandwidth consumption is defined as the amount of data transmitted over time; it is another major parameter to evaluate the model for QoS metrics; figure 4 presents the bandwidth efficiency comparison where the graph is plotted as threshold selection vs bandwidth efficiency rate observed. Furthermore, threshold value is selected from o to 0.55 with interval of 0.05and bandwidth utilization for same threshold occurs between 0.6 and 0.65 whereas bandwidth utilization of ICLD remains between 0.7 and 0.8; also it is to be observed that it remains stable over the various threshold selection.

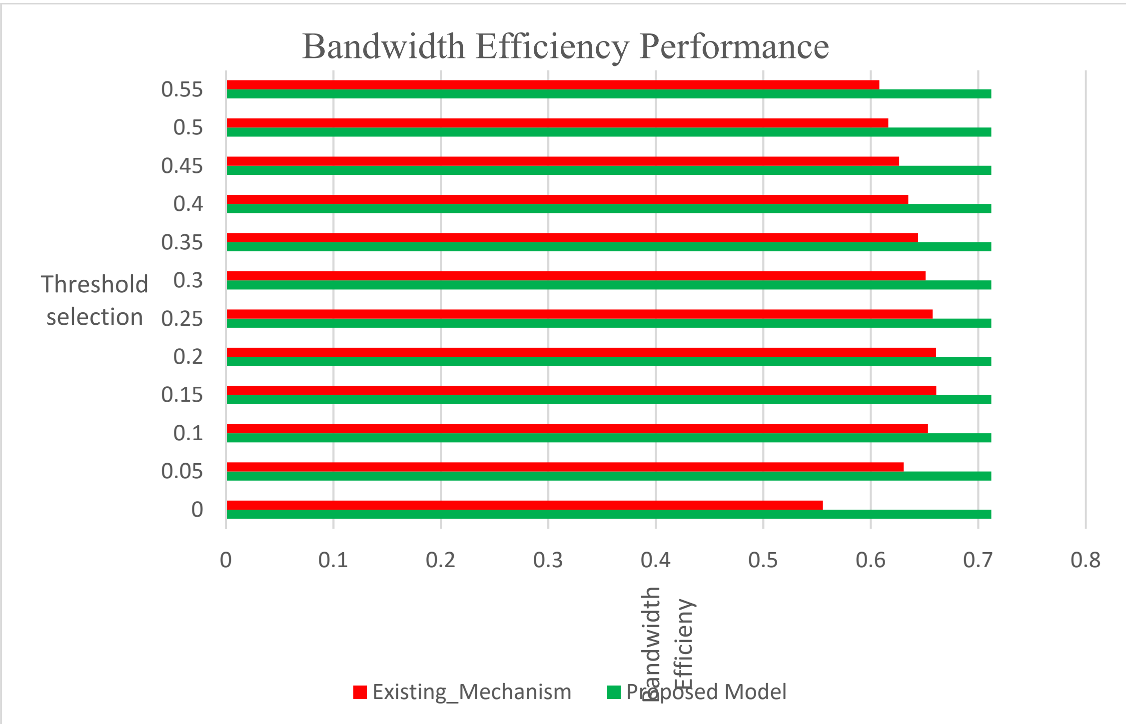

Figure 3:Bandwidth Efficiency Performance.

4.4 End- to-End Delay

End-to-end delay is also an important parameter for evaluating an integrated wireless network. It indicates the effectiveness of data transmission and is defined as the time taken for transmitting the packets from a source to the destination. Figure 5 presents the delay comparison by varying the various threshold variation; in here x-axis presents the different threshold variation and y-axis presents the delay. Moreover, for 0 threshold existing model observes the delay of 0.5333 whereas ICLD observes 0.49875; similarly, for 0.05, 0.1 and 0.15 threshold, existing model observes 0.5333, 0.543 and 0.547 whereas ICLD observes delay 0.517, 0.525 and 0.530 respectively. Further for threshold variation of 0.2 and 0.25 existing model gets delay of 0.550 and 0.551 whereas proposed model of 0.534 and 0.537, delay is computed in ms.

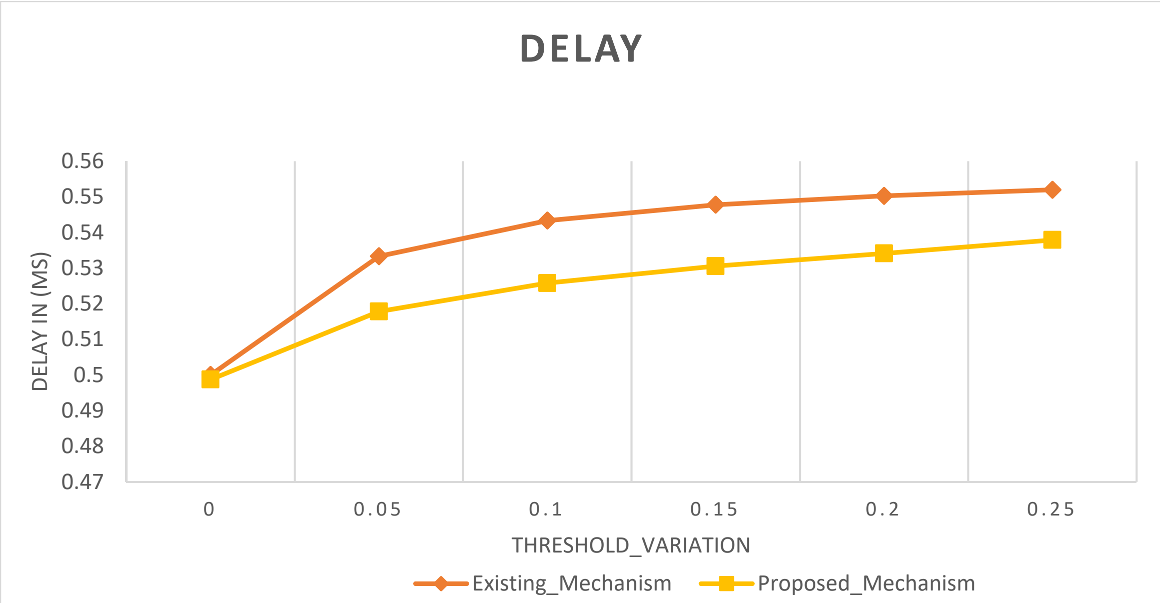

Figure 4: End-to-End Delay.

4.5 Throughput

Throughput is important for evaluating the packet transmission ability of the network. It can be defined as the rate of successful packet deliveries; figure 6 presents throughput considering the various packet arrival rate; in here y-axis presents throughput and x-axis presents video packet arrival rate. In video transmission, time at which packet arrives. In below graph for each packet arrival throughput is computed and observed

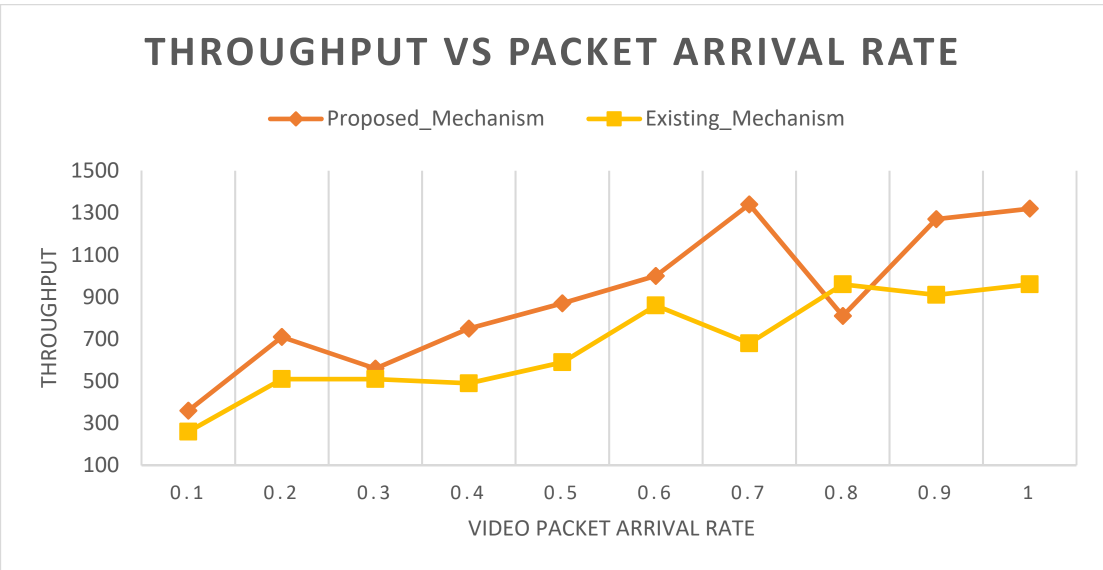

Figure 5: Throughput vs packet arrival rate.

4.6 Throughput with Different Cases

Figure 7 presents throughput variation by considering different scenario, in case of first scenario transition probabilities of value 0.2 is selected, in second scenario transition probabilities of 0.5 and in third transition probabilities of value 0.5 is selected. Further, simulation time considered is 30 on the single channel.

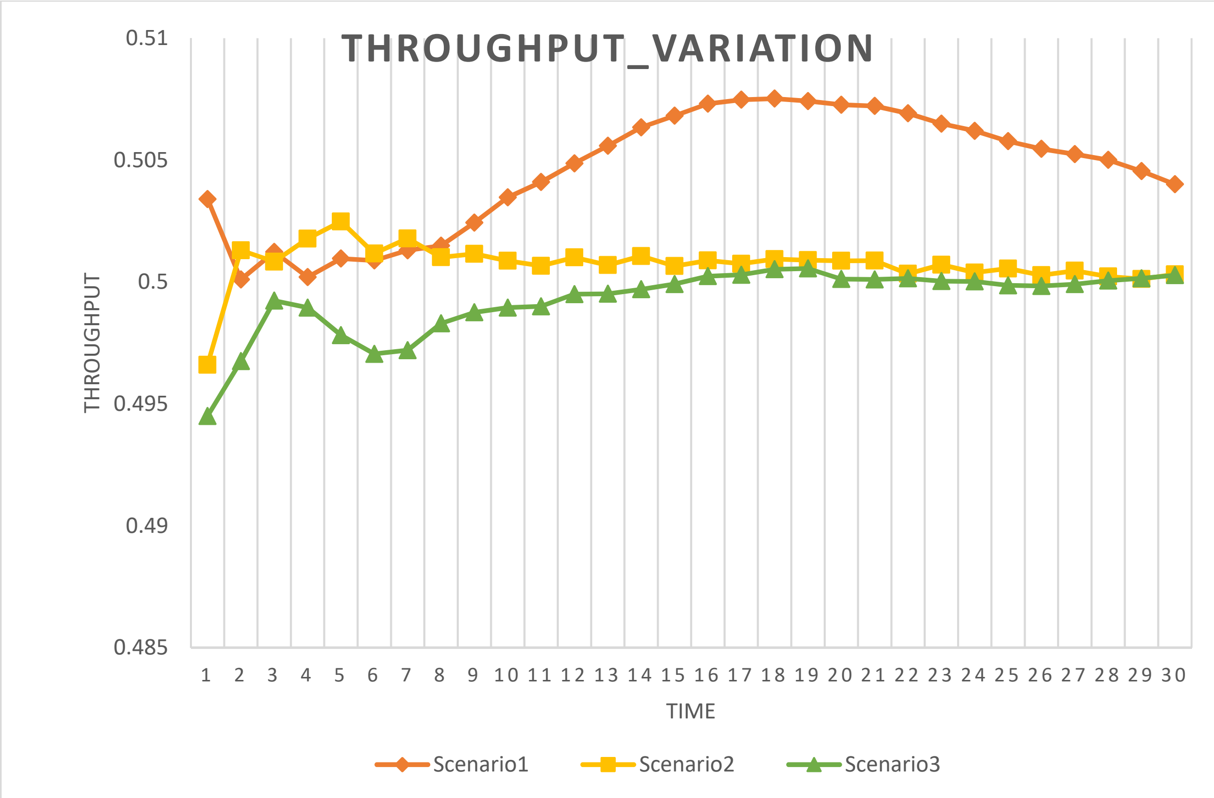

Figure 6: Throughput variation graph against time

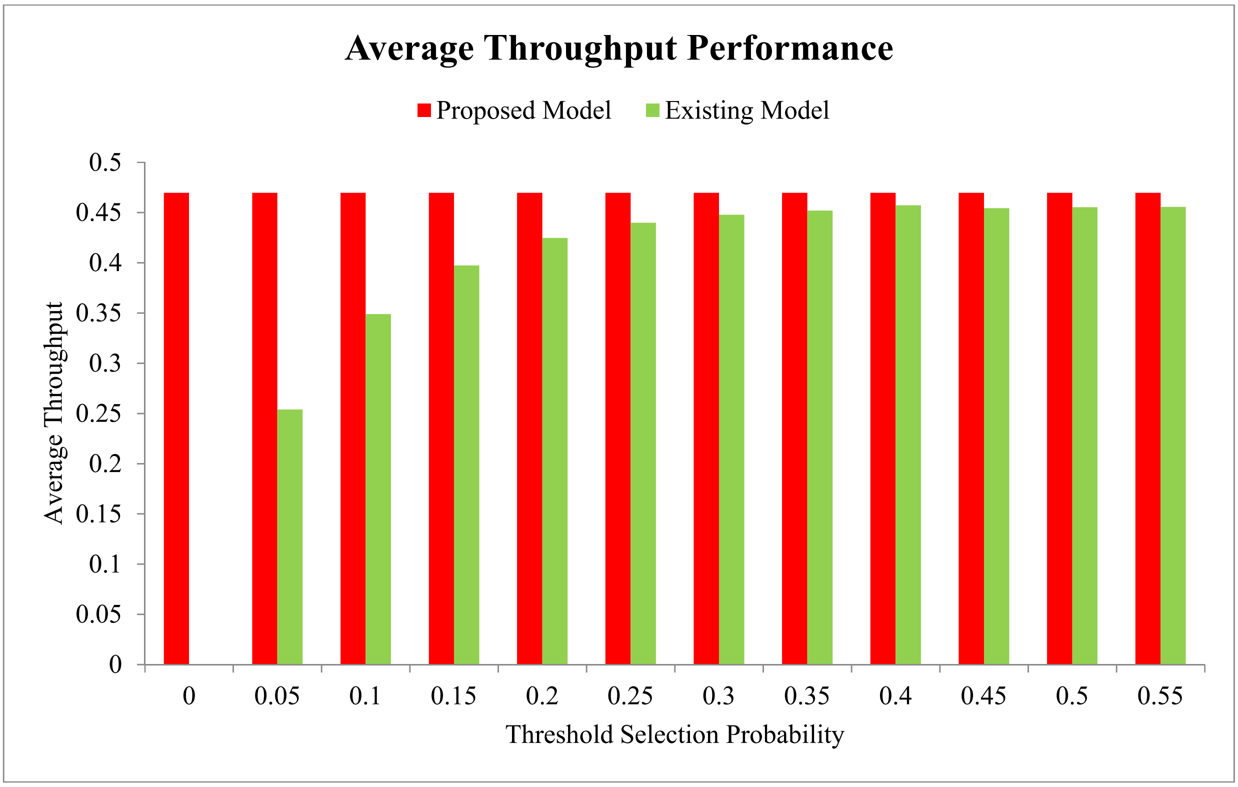

Figure 7: Average throughput performance

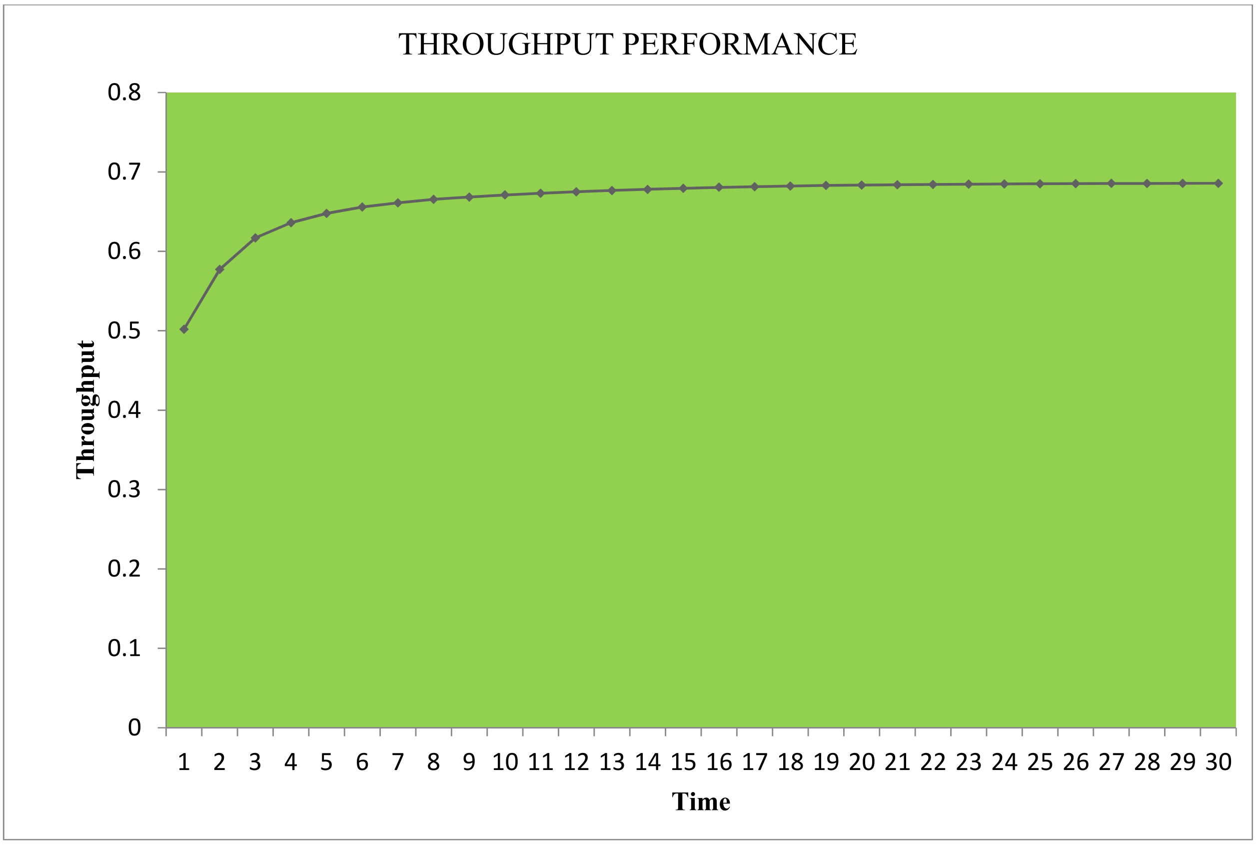

Figure 8: Throughput performance

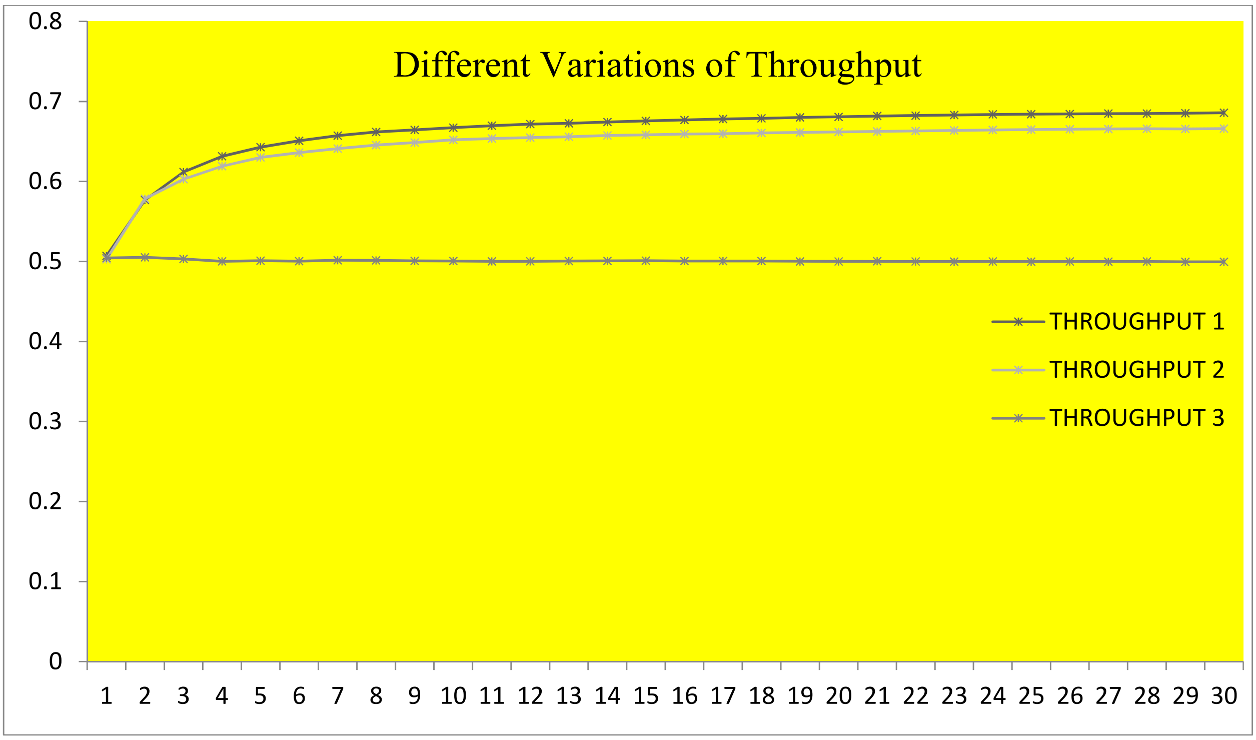

Figure 9: Throughput Variations

4.7 Comparative Analysis

We analyze the enhancement of ICLD over the existing model in terms of various parameter discussed above; moreover, in terms of PSNR 0.72 % of improvisation is observed; further in terms of bandwidth utilization existing model achieves an average utilization of 0.6720 whereas proposed model observes bandwidth utilization of

0.7903, thus improvisation of 17.60 % is observed.Similarly, average delay for plotted graph observed by proposed model is 0.52408 whereas existing model delay is 0.539; this shows that ICLD observes enhancement of nearly 3%. Furthermore, throughput is computed against the various packet arrival rate and it is observed through graph (figure 6) that average throughput observed is 673 whereas ICLD observed throughput of 899 which shows that proposed model observes 33.58% of enhancement in terms of throughput. Further figure 7 shows the consistent performance of ICLD by varying the time with respect to instance.

5. Conclusion

Providing real-time multimedia services over wireless network represent a very promising and attractive topic due to its interesting applications and challenges; in this research work we design and develop integrated-cross layer optimization for QoS enhancement. Our model follows the optimality of channel modelling, obstacle aware interference modelling and video distortion modelling, also problem formulation is carried out with two sub problem i.e. video interface and optimal transmission policy. Moreover these issue are integrated and cross layer optimization mechanism is design that enhances the QoS metrics; further ICLO mechanism is evaluated considering the parameter like throughput, packet arrival rate, bandwidth efficiency, PSNR and end-to-end delay. Simultaneously, comparative analysis is carried out with same parameter with existing model and graph shows that ICLO (Integrated Cross Layer Optimization) outperforms the existing model.

Although, it was observed that ICLO outperforms the existing model, there are several areas which has to be investigated mainly energy and security; further in future work we would be considering the optimized energy model.

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Authors Profile

Author1:

Prof. Pundalik Chavan received the Bachelor of Engineering (B.E) Degree in Computer Science and Engineering from Viswesvarayya Technological University, Belagavi, Karnataka, India, in 2010, the Master of Engineering (M.E) Degree from UVCE, Bangalore University, Bengaluru, Karnataka, India, in 2013. He is pursuing towards his Ph.D in VTU-RC at Cambridge Institute of Technology, Bengaluru, Karnataka, India. He is having total 10+ Years of work experience in Teaching/Research field. Life-Time Membership of ISTE and IAENG. He is currently working as an **Assistant Professor** in Department of Computer Science and Engineering in **Sri Venkateshwara College of Engineering**, Bengaluru. Organized and conducted FDP/SDP/Webinars/Conferences. His areas of research are Wireless Networks, Data Communications, Network Security, and Computer Networks, IOT, Blockchain Tchnology. He has 07 publications to his credit in various National & International Journals and conferences.

Author2:

Dr. K. Satyanarayan Reddy received his M.Sc. & M.Phil. (Mathematics) Degrees from Nagpur University, Maharashtra State, and M. Tech. (CSE with specialization in Computer Applications) from Indian School of Mines [now IIT (ISM)], Dhanbad, Jharkhand in 1987, 1988 and 2000 respectively. He received PhD (Computer Science) degree in the year 2012 from School of Science & Technology, Dept. of Computer Science at Dravidian University, Kuppam, AP, India. He is currently working as Head of the Department of Information Science & Engineering, Cambridge Institute of Technology, Bangalore, Karnataka State, India. His current areas of research are High Speed Networks, Data Communications, Network Security, Wireless Sensor Networks, Big Data, and Artificial Intelligence. Currently he is guiding 7 PhD Scholars under VTU, Belagavi, KN, India. He has 60 publications to his credit in various National & International Journals & international conference.