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Estimation based Error Reduction Scheme (EBERS) for Scalable HEVC to Support Real Time Video Communication in Wireless AD-HOC Networks

Ganashree T. S, Josephine Prem Kumar

Abstract: - In any network, any video stream is transmitted from one node to another. In the process various video information may be lost due to the channel errors or any other disturbance coming in the channel between the nodes. This paper presents an encoder based prediction model to know the impact of packet loss during video transmission in wireless network. Here we are implementing Scalable high efficiency video coding (SHVC) for video streaming. SHVC further offers a scalable format that can be readily adapted to meet network conditions or terminal capabilities. We implement and evaluate spatial, temporal, and quality scalability schemes for SHVC on a wireless network. Emerging adaptive streaming technologies will further increase the number of required representations due to additional adaptation points. This paper provides the benefits of adopting the Adaptive Streaming over the Scalable Video Coding (SVC) for spreading video streaming over the Internet. It describes how due to the adoption of SVC network resources are more efficiently used, and thus increasing the quality of service (QOS).

Keywords:- SHVC, SVC, QOS, Scalable, Emerging, Adaptive, Streaming, Transmission, wireless network.

I. INTRODUCTION

The use of wireless mobiles and tablets has become too common these days. The transmission of video also has become ordinary in wireless networks. But there will be a large number of packet loss in case of video transmission. In such a scenario, a client provides either a signal that the device is capable or chooses to process joining the broadcast service, requests the scalable layers. From the literature survey it is seen that the transmission of multiple video signals using SVC is much more efficient in terms of bit-rate compared to simulcast transmission. As the video stream is passed from one node to another, in order to reduce the packet losses in the transmission path, several frames are introduced through which transmissions are to take place. The video streams are made to pass through these frames. Each frame is divided into two layers:

Base layer
Enhancement layer

The base layer is the primary layer and the enhancement is the added layer. The video bit stream is carried by the base layer and if not then it is carried by the enhancement layer. Depending on the PSNR, part of the video bit stream passes through the base layer and the remaining part is carried by the enhancement layer. Almost all maximum number of the bits are passed through the base layer. Only the lost packets are retransmitted using the enhancement layer. If the number of packets lost increases then the number of packets to be transmitted through the enhancement layer increases. Thus the base layer and the enhancement layer works in coordination. The packets that are transmitted through the base layer when combined can almost approximately reconstruct back the original video stream at least to some extent. But the packets transferred through the enhancement layer of any frame are random bits that were not passed successfully through the base layer. So these bits when put together can never successfully reconstruct the original bits stream.

The requirement of the enhancement layer arises only for the lost bits in the transmission done through the base layer. In our approach we have introduced an estimation factor which increases from 0 to 1. Whenever enhancement layer is required, the estimation factor needs to be maximized to one and thus enhancement layer is activated and opens to pass the lost packets through it. When there is no loss of the video packets, it is obvious that the enhancement layer is of no use. Therefore, the estimation factor is minimized to 0. The same video when transmitted again and again with different PSNR, the video streaming makes it possible to get the video received in the receiver. Thus it proves its adaptability also. The rest of this paper is organized as follows. Section II describes the related work so far, section III describes the structure of transmission followed by the channel effect on the transmitted bits stream. In Section IV, we provide the experimental study followed by simulation results and a discussion on the particular graphs. Finally section V discusses the conclusion of the paper.

II. RELATED WORK

In 2002, Yufeng Shan, Zakho in their paper" The adaptive video streaming over wireless networks using a Cross layer technique ”, of the end to end application layer planned a set technique for wireless networks, using which adaptive video streaming can be done. Here, it helped in utilization of bandwidth, but didn’t mention any guarantee of better quality of service. In October 2011, Yang Shi; Ning Zhou; Huiping Du; Jin Xu, in their paper, "Scalable video transmission with quality layers over WLAN through a cross-layer design" combined SVC and cross layer for

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correction of errors and thus upgrading the quality of video but mostly in wireless network. In December 2013, Deshpande.S, in the paper “Adaptive HTTP Streaming Utilizing Temporal Sub-layers of High Efficiency Video Coding (HEVC)” adopted temporal scalability only in the server side in order to utilize bandwidth efficiently during video transmission in the wireless network. In April 2014, Min Xing, Siyuan Xiang and Lin Cai, proposed an algorithm called Markov decision in order to reduce the cost of video transmission in the wireless network in their paper “A Real-Time Adaptive Algorithm for Video Streaming over Multiple Wireless Access Networks”. Using in the Markov Decision process the video is segmented and delivered to the receiver. They used SVC for implementing it in mobile.

III. ESTIMATION BASED ERROR REDUCTION SCHEME FOR SCALABLE HEVC (EBERS)

The EBERS scheme proposed, considers a layered encoded video communication streams for transmissions in the network. The video data is encoded using the SHVC into two streams. The important stream namely the Base Layer $(\mathcal{Q})$ and the unimportant stream or the Enhancement Layer $(\mathcal{P})$or $(\mathcal{P}')$ is generally considered to obtain high quality video streams.

Considering both the $\mathcal{P}$ and $\mathcal{Q}$ streams can often lead to higher transmission errors. To minimize the error propagation the EBERS adopts a packetization scheme as shown in the Figure 1 where $\mathcal{P}$ is split into two sub packets $\mathcal{P}'$ and $\mathcal{P}''$ **.**

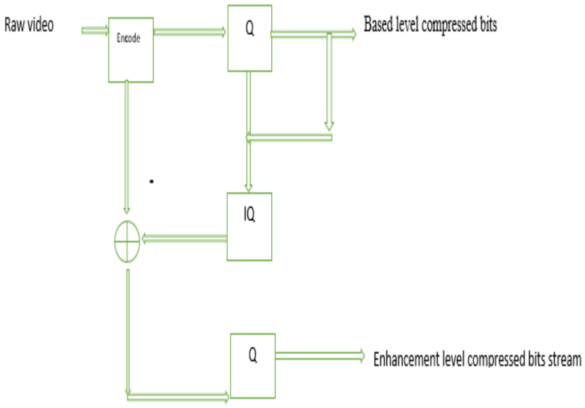

Fig. 1: Scalable encoder

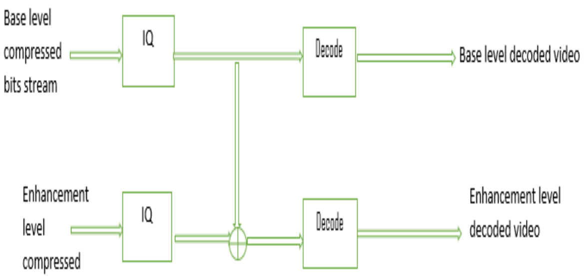

Fig. 2: Scalable decoder

The enhancement layer packet $\mathcal{P}'$ is derived by a forward estimation factor ϵ_l where $\epsilon_l \in [0,1]$.The video message $\mathcal{P}$ bits coded $\mathcal{M}'^{\mathcal{P},cd}_{t}$ at a given time instance t is derived from the preceding $\mathcal{Q}$ $\mathcal{M}^{\mathcal{Q}}_{t-1}$ and the preceding $\mathcal{P}$, $\mathcal{M}^{\mathcal{P}}_{t-1}$ and is defined as

$$\mathcal{M}'^{\mathcal{P},cd}_{t} = \left((1-\epsilon_l)\mathcal{M}^{\mathcal{Q}}_{t-1}\right) + (\epsilon_l \times \mathcal{M}^{\mathcal{P}}_{t-1.}) \tag{1}$$

From the above definition it is clear that if ϵ_l tends towards 0 the $\mathcal{P}$ would be completely eliminated and would result in decreased quality of video transmissions in the network. If the $\epsilon_l \approx 1$ video quality would significantly improve as lost packets will be transmitted by enhancement layer. The packetization scheme constructs $\mathcal{P}'$ and $\mathcal{P}''$ from $\mathcal{P}$ based on the frame estimation factor ϵ_f . The frame estimation factor is an adaptive factor to accommodate varied modes supported in the $SHVC$. Incorporating the frame estimation factor the video message $\mathcal{M}'^{\mathcal{P},cd}_{t}$ could be redefined as

$$\mathcal{M}'^{\mathcal{P},cd,\epsilon_f}_{t} = \left((1-\epsilon_l)\mathcal{M}^{\mathcal{Q}}_{t-1}\right) + \left(\epsilon_l \times \mathcal{M}^{\mathcal{P},\epsilon_f}_{t-1.}\right) \tag{2}$$

In the ad hoc network considered let $r_x[a]$ denote the received signal, $t_x[a]$ denote the transmitted signal and $n_{\mathrm{awgn}}[a]$ denote the additive white Gaussian channel considered in the network. The channel coefficients matrix whose elements are independent and identically distributed variables having a variance defined as $\sigma^2_{\hbar}$ .All the variables of the channel coefficient matrix are assumed to be zero mean complex Gaussian random variables. If the channel coefficient matrix is represented as $\mathcal{H}[a]$ then the received signal for the a^{th} symbol is defined as

$$r_x[a] = \mathcal{H}[a]t_x[a] + n_{awgn}[a] \tag{3}$$

Let $\varepsilon_{xy}[a]$ denote the channel estimation error for the a^{th} symbol transmitted from the y^{th} transmitting node in the considered network to the x^{th} receiving node in the same network, and then $\varepsilon_{xy}[a]$ can be considered as a complex Gaussian variable and the variance is defined as

$$\sigma^2_{\varepsilon}[a] = 1 - \mathcal{W}^*[a]\mathcal{CM}^{-1}\mathcal{W}[a] \tag{4}$$

Where $\mathcal{CM}$ represents the autocorrelation matrix. The covariance vector between $\hbar_{xy}[a] \in \mathcal{H}$ and the received samples is represented as $\mathcal{W}[a]$.In the $EBERS$ considering that all the cannels of the ad hoc nodes are autonomous, the radio layer channel estimation errors can be considered as a matrix whose elements are independent and identically distributed Gaussian variables exhibiting an variance defined in the above equation. The $\mathcal{CM}$ autocorrelation matrix and the received samples $\mathcal{W}[a]$ are dependent on the modulated carrier wave, the signal to noise ratio(SNR) , spreading factors and the frame transmission rate. The $EBERS$ assumes that the SNR of the carrier wave and the frame rate are equivalent to the channel coherence and the data SNR. $QPSK$ modulation scheme is considered in the radio layer of the ad hoc network. The $\mathcal{P}kt$ packets each

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having a symbols are allocated to a frame. Let cr_x denote the channel rate and ρtx_x denote the packet transmission parameter for the x^{th} packet. If the error rate experienced by the x^{th} packet is represented as $e_x(cr_x, \rho tx_x)$and that if z packets are successfully transmitted and a transmission error occurs at the $(z+1)$ packet. The probability $Prob(z \mid \mathcal{P}kt)$ of such an occurrence in the ad hoc network is defined as

$$Prob(z \mid \mathcal{P}kt) = \begin{cases} e_1(cr_1, \rho tx_1), \\ \prod_{y=1}^{z}\left(1 - e_y(cr_y, \rho tx_y)\right) \times \left(e_{z+1}(cr_{z+1}, \rho tx_{z+1}\right. \\ \prod_{y=1}^{\mathcal{P}kt}\left(1 - e_y(cr_y, \rho tx_y)\right), \end{cases} \quad (5)$$

Considering that $\mathcal{M}_y$ is the total number of symbols of the y^{th} packet, the data or the bits received at the receiving node of the ad hoc network when if z packets are successfully transmitted from the source node is defined as

$$\sum_{y=1}^{z}(cr_y \times \mathcal{M}_y) \quad (6)$$

Considering the forward estimation factor ϵ_l and the frame estimation factor ϵ_f , the average distortion is defined as

$$\begin{aligned} \mathcal{A}vg\left[\mathfrak{D}(\epsilon_l,\, \epsilon_f)\right] &= \mathfrak{D}(0, \epsilon_l,\, \epsilon_f)Prob(0 \mid \mathcal{P}kt) \\ &+ \sum_{z=1}^{\mathcal{P}kt}\left(\mathfrak{D}\left(\sum_{y=1}^{z} cr_y, \mathcal{M}_y, \epsilon_l,\, \epsilon_f\right)Prob(z \mid \mathcal{P}kt)\right) \end{aligned} \quad (7)$$

Where the distortion of the bits of the $\mathcal{Q}$ layer and the $\mathcal{P}^{tx}$ bits of the $\mathcal{P}$ layer that are received effectively is represented as $\mathfrak{D}(\mathcal{P}^{tx},\ \epsilon_l\,,\ \epsilon_f)$

From the above equation it is evident the average distortion observed in the transmission depends on the estimation factor ϵ_l and the frame estimation factor ϵ_f. The difference in the $\mathcal{Q}$ layer stream at any given time instance t of the video communication and is defined as

$$\left(\mathcal{M}_t^{\mathcal{Q}} - \mathcal{M}_{t-1}^{\mathcal{Q}}\right) \quad (8)$$

Where $\mathcal{M}_t^{\mathcal{Q}}$ represents the frame consisting of the $\mathcal{Q}$ layer stream at the time instance t.

The $\mathcal{P}$ layer stream of the video communication is computed by utilizing the difference in the $\mathcal{Q}$ layer stream defined above and the reference $\mathcal{P}$ layer encoded frame i.e. $\mathcal{M}'^{\mathcal{P},cd,\,\epsilon_f}_t$ and is defined as

$$\xi_t^{\mathcal{P}} = \mathcal{M}_t - \left(\mathcal{M}_t^{\mathcal{Q}} - \mathcal{M}_{t-1}^{\mathcal{Q}}\right) - \mathcal{M}'^{\mathcal{P},cd,\,\epsilon_f}_t \quad (9)$$

Where $\mathcal{M}_t$ represents the original frame.

The $\mathcal{P}$ layer stream $\xi_t^{\mathcal{P}}$ constructed could be optimized to support QoS if all the bits of the stream are considered for encoding. To transmit the video stream over limited network bandwidth available at the transmitter the less significant bits of the $\xi_t^{\mathcal{P}}$ could be discarded to support the bandwidth but at a reduced QoS. Let $\xi'^{\mathcal{P}}_t$ represent the encoded $\mathcal{P}$ layer stream $\xi_t^{\mathcal{P}}$. The encoded stream $\xi'^{\mathcal{P}}_t$ transmitted experiences a further degradation due to the noise and channel error and the decoded $\mathcal{P}$ layer stream $\xi_t^{\mathcal{P}}$ at the receiver node of the ad hoc network is represented as $\xi''^{\mathcal{P}}_t$. The $\mathcal{Q}$ layer in the $SHVC$ has an inbuilt mechanism to provide for Forward Error Correction (FEC), so assuming error free transmission of the $\mathcal{M}_t^{\mathcal{Q}}$ the reconstructed frame $\mathcal{M}'_t$ at the decoder is defined as

$$\mathcal{M}'_t = \xi''^{\mathcal{P}}_t + \left(\mathcal{M}_t^{\mathcal{Q}} - \mathcal{M}_{t-1}^{\mathcal{Q}}\right) + \mathcal{M}''^{\mathcal{P},dd,\,\epsilon_f}_t \quad (10)$$

Where $\mathcal{M}''^{\mathcal{P},dd,\,\epsilon_f}_t$ is the decoded $\mathcal{M}'^{\mathcal{P},cd,\,\epsilon_f}_t$ at the receiving node and can be defined as

$$\mathcal{M}''^{\mathcal{P},dd,\,\epsilon_f}_t = \left((1-\epsilon_l)\mathcal{M}_{t-1}^{\mathcal{Q}}\right) + \left(\epsilon_l \times \mathcal{M}''^{\mathcal{P},\,\epsilon_f}_{t-1.}\right) \quad (11)$$

The reconstructed frame $\mathcal{M}'_t$ at the receiver node could also be represented as

$$\mathcal{M}'_t = \xi''^{\mathcal{P}}_t + \left(\epsilon_l \times \left(\mathcal{M}''^{\mathcal{P},\,\epsilon_f}_{t-1.} - \mathcal{M}_{t-1}^{\mathcal{Q}}\right)\right) + \mathcal{M}_t^{\mathcal{Q}} \quad (12)$$

The $\mathcal{M}''^{\mathcal{P},\,\epsilon_f}_{t-1.}$ is stored in the decoder at the previous time instance i.e. $t-1$ and is computed using $\mathcal{Q}$ layer and the fractional $\mathcal{P}$ layer stream. The fractional $\mathcal{P}$ layer stream is obtained based on the ϵ_f factor. $\mathcal{M}''^{\mathcal{P},\,\epsilon_f}_{t-1.}$ is defined as

$$\mathcal{M}''^{\mathcal{P},\,\epsilon_f}_{t-1.} = \xi''^{\mathcal{P},\,\epsilon_f}_{t-1} + \left(\mathcal{M}_{t-1}^{\mathcal{Q}} - \mathcal{M}_{t-2}^{\mathcal{Q}}\right) + \mathcal{M}''^{\mathcal{P},dd,\,\epsilon_f}_{t-1} \quad (13)$$

The fractional $\mathcal{P}$ layer encoded frame at the time instance $t-1$ is defined as

$$\mathcal{M}^{\mathcal{P},\,\epsilon_f}_{t-1.} = \xi^{\mathcal{P},\,\epsilon_f}_{t-1} + \left(\mathcal{M}_{t-1}^{\mathcal{Q}} - \mathcal{M}_{t-2}^{\mathcal{Q}}\right) + \mathcal{M}'^{\mathcal{P},cd,\,\epsilon_f}_{t-1} \quad (14)$$

Based on the above mentioned discussions the error observed in the encoded transmission of the frame $\mathcal{M}_t$ and the decoded frame $\mathcal{M}'_t$ is

$$\mathcal{M}_t - \mathcal{M}'_t = \xi_t^{\mathcal{P}} - \xi''^{\mathcal{P}}_t + \mathcal{M}'^{\mathcal{P},cd,\,\epsilon_f}_t - \mathcal{M}''^{\mathcal{P},dd,\,\epsilon_f}_t \quad (15)$$

$$\begin{aligned} \mathcal{M}_t - \mathcal{M}'_t = \xi_t^{\mathcal{P}} - \xi''^{\mathcal{P}}_t \\ + \left(\epsilon_l \times \left(\mathcal{M}^{\mathcal{P},\,\epsilon_f}_{t-1} - \mathcal{M}''^{\mathcal{P},\,\epsilon_f}_{t-1}\right)\right) \end{aligned} \quad (16)$$

The difference $\mathcal{M}^{\mathcal{P},\,\epsilon_f}_{t-1} - \mathcal{M}''^{\mathcal{P},\,\epsilon_f}_{t-1}$ computation would result in an inequality to reconstruct the current frame based on the definitions of $\mathcal{M}^{\mathcal{P},\,\epsilon_f}_{t-1}$ and $\mathcal{M}''^{\mathcal{P},\,\epsilon_f}_{t-1}$ given above. To overcome this inequality the difference is represented based on the time instance $t-2$ as

$$\begin{aligned}\mathcal{M}_{t-1.}^{\mathcal{P},\epsilon_f} - \mathcal{M}''^{\mathcal{P},\epsilon_f}_{t-1.} &= \xi_{t-1}^{\mathcal{P},\epsilon_f} - \xi''^{\mathcal{P},\epsilon_f}_{t-1} \\ &+ \left(\epsilon_l \times \left(\mathcal{M}_{t-2}^{\mathcal{P},\epsilon_f} - \mathcal{M}''^{\mathcal{P},\epsilon_f}_{t-2}\right)\right)\end{aligned} \tag{17}$$

The distortion observed for the $\mathcal{M}_t$ is defined as

$$\mathfrak{D}_t(\mathcal{T}hru, \epsilon_l, \epsilon_f) = \mathcal{A}vg[(\mathcal{M}_t - \mathcal{M}'_t)^2] \tag{18}$$

$$\begin{aligned}\mathfrak{D}_t(\mathcal{T}hru, \epsilon_l, \epsilon_f) &= \mathcal{A}vg\Bigg[\Bigg(\Bigg(\xi_t^{\mathcal{P}} - \xi''^{\mathcal{P}}_t \\ &+ \Bigg(\epsilon_l \\ &\times \left(\mathcal{M}_{t-1}^{\mathcal{P},\epsilon_f} - \mathcal{M}''^{\mathcal{P},\epsilon_f}_{t-1}\right)\Bigg)\Bigg)^2\Bigg]\end{aligned} \tag{19}$$

Where $\mathcal{T}hru$ represents a $t \times 1$ matrix of the throughputs observed from the first to the frame at instance $t-1$. The channels are assumed to be rapidly varying in the ad hoc network.Hence $\left(\xi_t^{\mathcal{P}} - \xi''^{\mathcal{P}}_t\right)$ and $\left(\mathcal{M}_{t-1}^{\mathcal{P},\epsilon_f} - \mathcal{M}''^{\mathcal{P},\epsilon_f}_{t-1}\right)$ are not dependant on each other for the frame at the time instance t. For rapidly varying channels of the ad hoc network the distortion observed for $\mathcal{M}_t$ is defined as

$$\begin{aligned}\mathfrak{D}_t(\mathcal{T}hru, \epsilon_l, \epsilon_f) &= \mathcal{A}vg\left[\left(\xi_t^{\mathcal{P}} - \xi''^{\mathcal{P}}_t\right)^2\right] \\ &+ \Big(2 \times \epsilon_l \times \mathcal{A}vg\left[\xi_t^{\mathcal{P}} - \xi''^{\mathcal{P}}_t\right] \\ &\times \mathcal{A}vg\left[\mathcal{M}_{t-1}^{\mathcal{P},\epsilon_f} - \mathcal{M}''^{\mathcal{P},\epsilon_f}_{t-1}\right]\Big) \\ &+ \Big(\epsilon_l{}^2 \\ &\times \mathcal{A}vg\left[\left(\mathcal{M}_{t-1}^{\mathcal{P},\epsilon_f} - \mathcal{M}''^{\mathcal{P},\epsilon_f}_{t-1}\right)^2\right]\Big)\end{aligned} \tag{20}$$

$$\mathfrak{D}_t \propto \mathfrak{D}_\xi \tag{26}$$

$\xi''^{\mathcal{P}}_t$ is a quantized version of $\xi_t^{\mathcal{P}}$ and the distributions of $\xi''^{\mathcal{P}}_t, \xi_t^{\mathcal{P}}$ are symmetric around 0. Therefore

$$\begin{aligned}\Big(2 \times \epsilon_l \times \mathcal{A}vg\left[\xi_t^{\mathcal{P}} - \xi''^{\mathcal{P}}_t\right] \\ \times \mathcal{A}vg\left[\mathcal{M}_{t-1}^{\mathcal{P},\epsilon_f} - \mathcal{M}''^{\mathcal{P},\epsilon_f}_{t-1}\right]\Big) \\ \cong 0\end{aligned} \tag{21}$$

Hence the distortion observed could be represented as

$$\begin{aligned}\Big(2 \times \epsilon_l \times \mathcal{A}vg\left[\xi_t^{\mathcal{P}} - \xi''^{\mathcal{P}}_t\right] \\ \times \mathcal{A}vg\left[\mathcal{M}_{t-1}^{\mathcal{P},\epsilon_f} - \mathcal{M}''^{\mathcal{P},\epsilon_f}_{t-1}\right]\Big) \\ \cong 0\end{aligned} \tag{22}$$

$$\begin{aligned}\mathfrak{D}_t(\mathcal{T}hru, \epsilon_l, \epsilon_f) &= \mathcal{A}vg\left[\left(\xi_t^{\mathcal{P}} - \xi''^{\mathcal{P}}_t\right)^2\right] \\ &+ \Bigg(\epsilon_l{}^2 \mathcal{A}vg\Bigg[\Bigg(\xi_{t-1}^{\mathcal{P},\epsilon_f} - \xi''^{\mathcal{P},\epsilon_f}_{t-1} \\ &+ \Bigg(\epsilon_l \\ &\times \left(\mathcal{M}_{t-2}^{\mathcal{P},\epsilon_f} - \mathcal{M}''^{\mathcal{P},\epsilon_f}_{t-2}\right)\Bigg)\Bigg)^2\Bigg]\Bigg)\end{aligned} \tag{23}$$

Let $\mathcal{B}_{t-1}$ denote the number of successfully received bits for the packet $\mathcal{P}$ at the $(t-1)^{th}$ instance and the distortion observed for these bits is defined as

$$\mathfrak{D}_\xi(\mathcal{B}_{t-1}, \epsilon_f) = \mathcal{A}vg\left[\left(\xi_{t-1}^{\mathcal{P},\epsilon_f} - \xi''^{\mathcal{P},\epsilon_f}_{t-1}\right)^2\right] \tag{24}$$

Also $\mathfrak{D}_\xi(\mathcal{B}_{t-1}, \epsilon_f) \cong 0$ if $\mathcal{B}_{t-1}$ is greater than $\mathcal{P}$ stream specified by the frame estimation factor ϵ_f.

The distortion $\mathfrak{D}_t(\mathcal{T}hru, \epsilon_l, \epsilon_f)$ can be expressed as

$$\begin{aligned}&\mathfrak{D}_t(\mathcal{T}hru, \epsilon_l, \epsilon_f) \\ &= \mathcal{A}vg\left[\left(\xi_t^{\mathcal{P}} - \xi''^{\mathcal{P}}_t\right)^2\right] \\ &+ \Big(\epsilon_l{}^{2\times(t-1)} \\ &\times \mathcal{A}vg\Big[\Big(\mathcal{M}_1^{\mathcal{P},\epsilon_f} \\ &- \mathcal{M}''^{\mathcal{P},\epsilon_f}_1\Big)^2\Big]\Big) \\ &+ \left(\sum_{x=1}^{t-2} \epsilon_l{}^{2x}\ \mathfrak{D}_\xi(\mathcal{B}_{t-x}, \epsilon_f)\right)\end{aligned} \tag{25}$$

From the above equation it is clear that the distortion observed for a frame $\mathfrak{D}_t$ is directly proportional to the distortion of the bits of the frame i.e.

The proposed *EBERS* considers the bit error rate observed by the frame to compute the total forward error observed in the propogation of video data in the ad hoc network. The subsequent section of the paper discusses the experimental evaluation of the *EBERS* and its efficiency over the existing schemes to support real time video communication over ah-hoc wireless networks.

IV. EXPERIMENTAL STUDY

We have used a multiple transmission network where we have applied 25 frame transmissions between the transmitter and the receiver. The video bits stream are to be transmitted from the transmitting node to the receiving node through the frames which are further divided into two layers i.e., base layer and enhancement layer. The bits are initially sent through the base layer, and the lost bits that are not transmitted by the base layer are retransmitted by the enhancement layer. Approximately if in the first transmission about 40 bits are transmitted through the base layer, then the remaining 40 bits out of total 80 bits can be transmitted through the enhancement layer. As the noise increases the bits in the base layer reduces and the bits in the enhancement layer increases. Thus in multiple transmissions, adaptability is proved. In each sequential transmission, as PSNR ratio increases or decreases the bits are accordingly transmitted either through the base layer or the enhancement layer. In this section the simulation results for multiple transmission is shown. The Simulation shows various results as shown below:

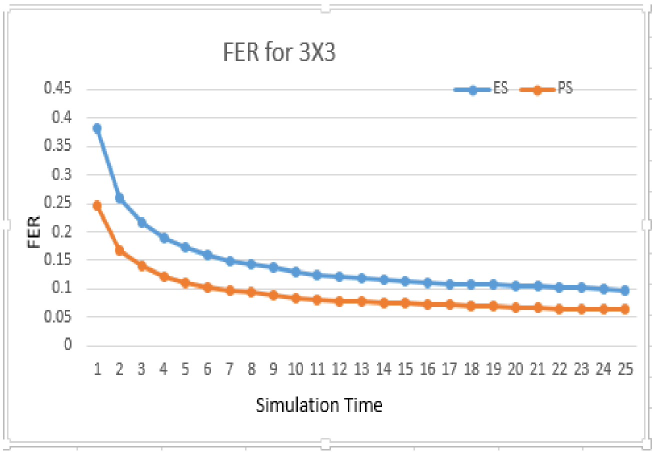

Fig. 1 (a) Frame error rate (FER) vs. Simulation time for 3x3 transmissions.

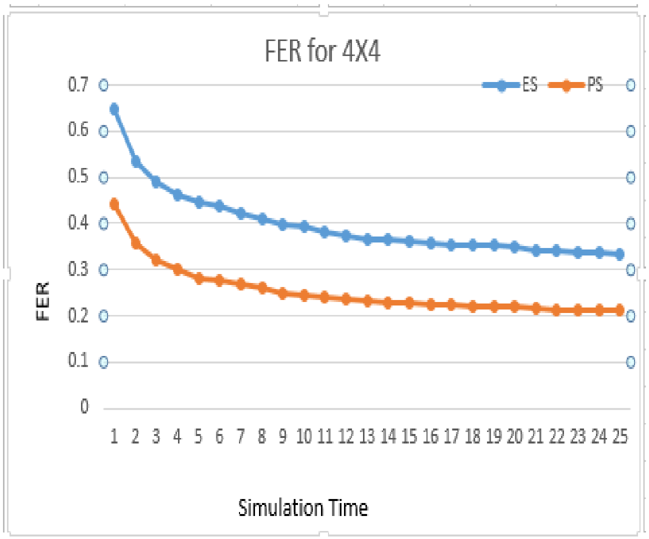

Fig. 1 (b) Frame error rate (FER) vs. Simulation time for 4x4 transmission.

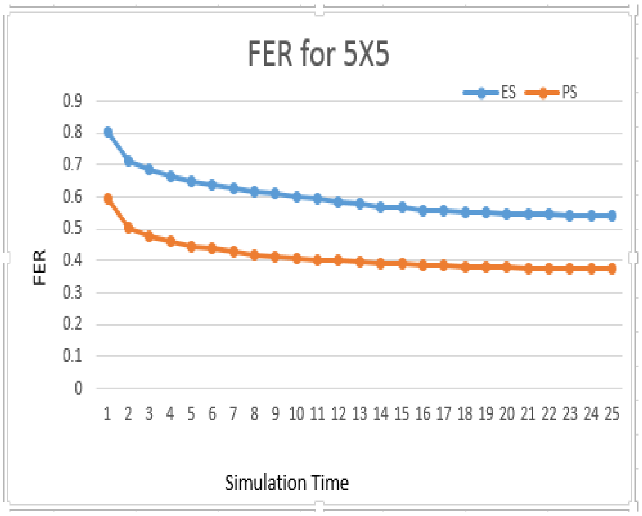

Fig. 1 (c): Frame error rate (FER) vs. Simulation time for 5x5 transmissions.

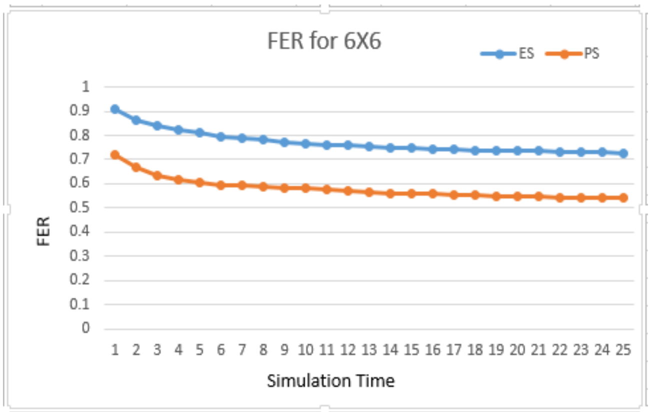

Fig. 1 (d): Frame error rate (FER) vs. Simulation time for 6x6 transmissions.

Fig.1 depicts graphs indicating the frame error of both the proposed system and the existing system versus to the simulation time for the multiple transmissions like 3X3,4X4,5X5,6X6 .In both the systems, as the simulation time increases, the frame error decreases.

Table 1: The increase in frame error rates in each transmission.

FRAME ERROR RATE			
	ES	PS	Efficiency
3X3	0.143235331	0.092861615	35.16%
4X4	0.397810674	0.25368363	36.20%
5X5	0.600153375	0.414521615	30.90%
6X6	0.770773754	0.579102905	24.80%

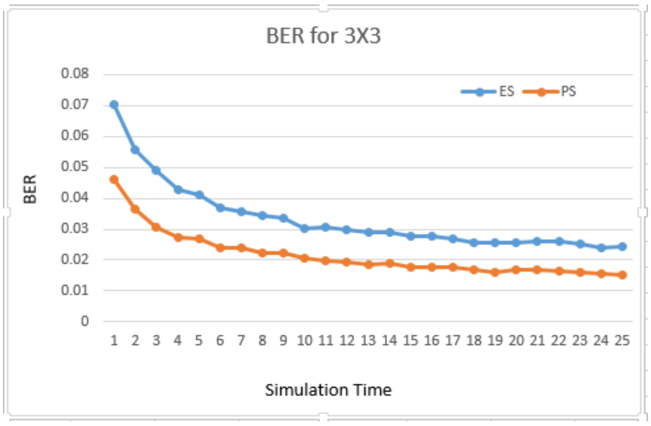

Fig. 2 (a): Bit error rate (BER) vs. Simulation time for 3x3 transmissions.

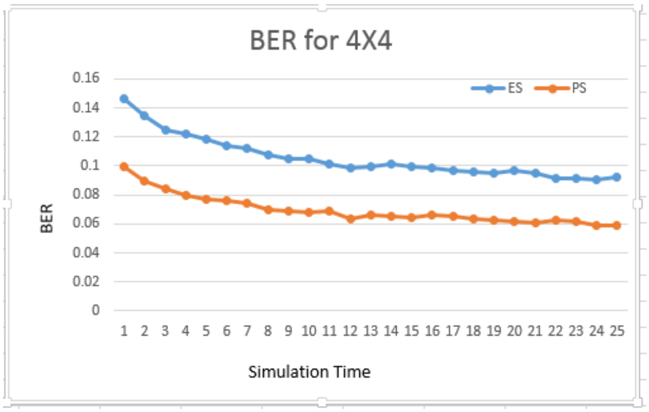

Fig. 2 (b): Bit error rate (BER) vs. Simulation time for 4x4 transmissions.

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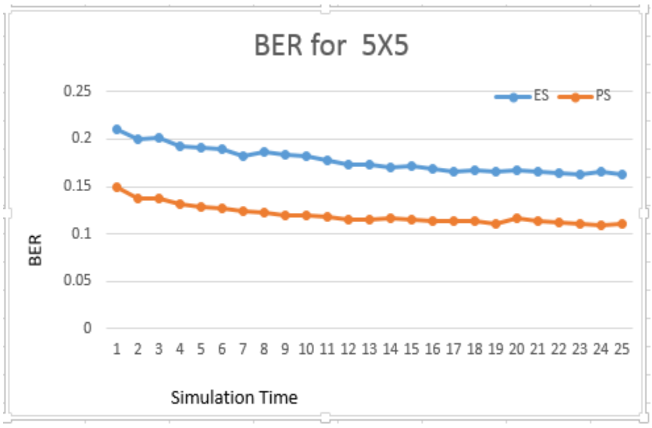


Fig. 2 (c): Bit error rate (BER) vs. Simulation time for 5x5 transmissions.

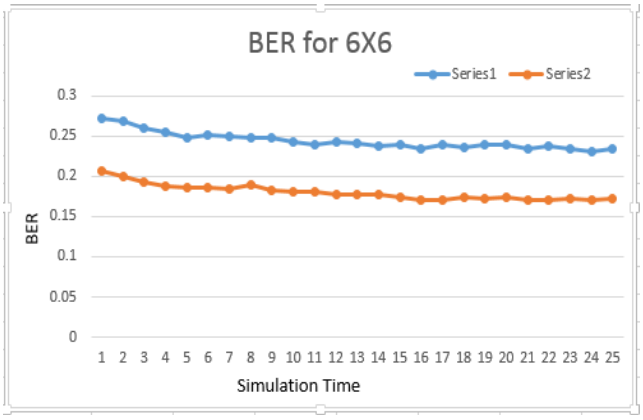


Fig. 2 (d): Bit error rate (BER) vs. Simulation time for 6x6 transmissions.

Fig.2 depicts graphs indicating the Transmission error of both proposed system and the existing system versus the simulation time for the multiple transmissions such as 3x3, 4x4, 5x5, 6x6.In both the systems, as the simulation time increases, the BER decreases.

Table 2: The decrease in BER in each transmission.

	BIT ERROR RATE		
	ES	PS	Efficiency
3X3	0.033288661	0.021566889	35.20%
4X4	0.105384008	0.069536809	34%
5X5	0.177729654	0.120017291	32.40%
6X6	0.244215339	0.179916976	26.30%

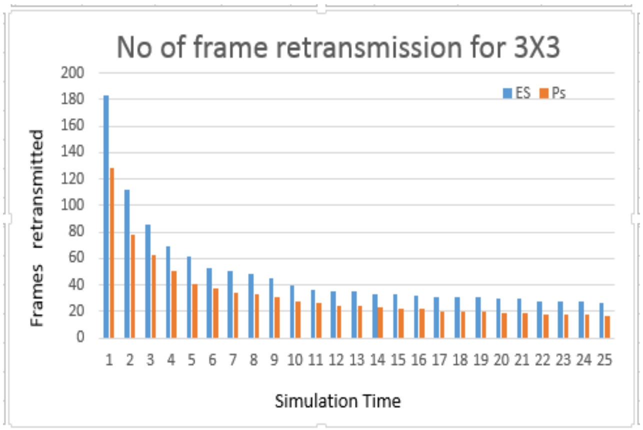


Fig. 3 (a) Frames retransmitted vs. Simulation time for 3x3 transmissions.

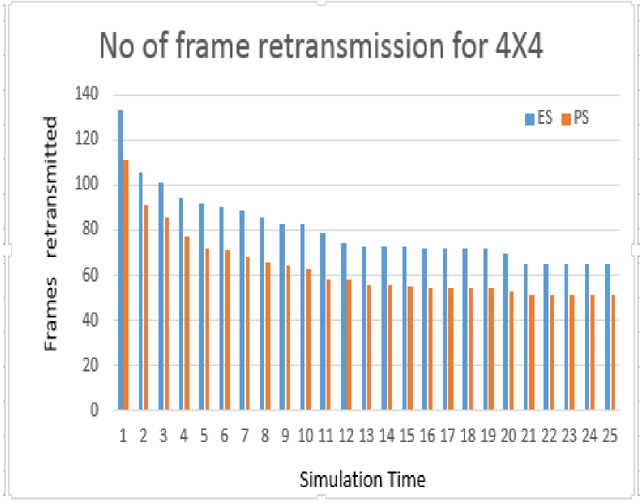


Fig. 3 (b) Frames retransmitted vs. Simulation time for 4x4 transmissions.

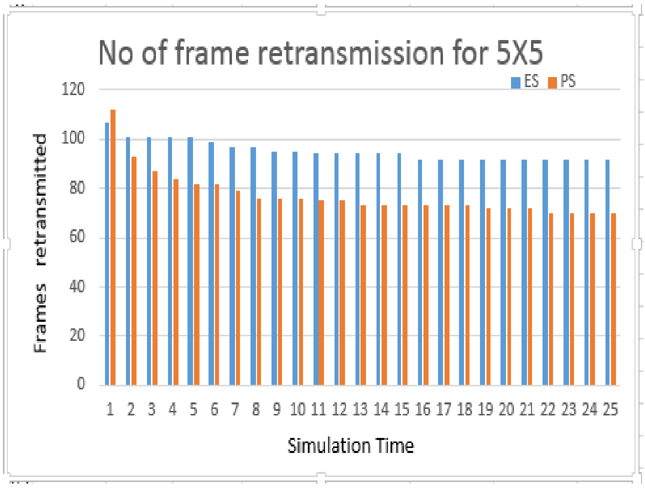


Fig. 3 (c) Frames retransmitted vs. Simulation time for 5x5 transmissions.

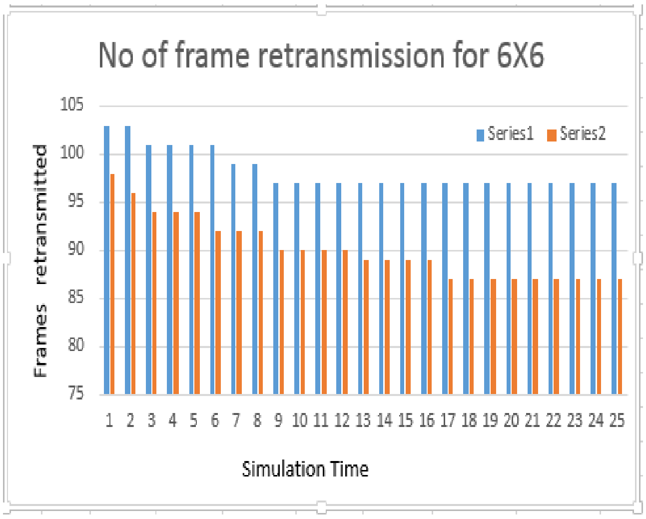
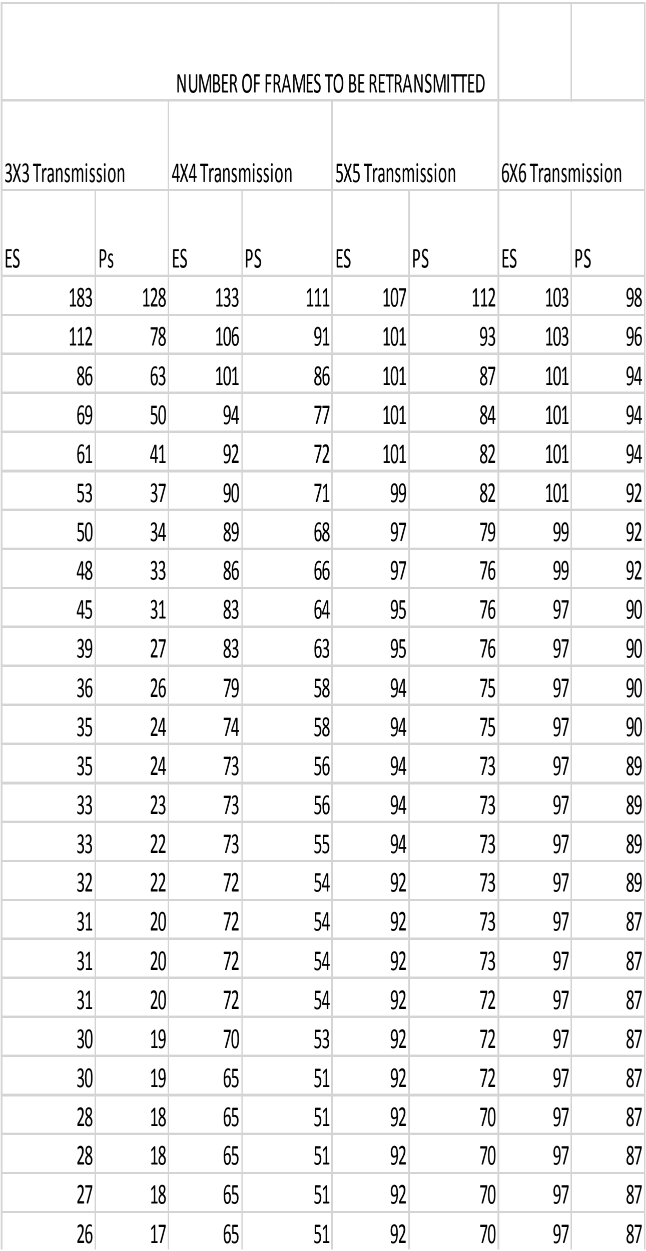


Fig. 3 (d) Frames retransmitted vs. Simulation time for 6x6 transmissions.

Fig.3, depicts graphs indicating the retransmitted frame versus the simulation time of both proposed system and the existing system for the multiple transmissions such as 3x3, 4x4, 5x5 and 6x6. In both the systems, as the simulation time increases, the number of frames to be retransmitted decreases. Thus video transmissions become adaptable to the changing network conditions and frames need not be retransmitted again and again. That is the reason that frame retransmission reduces with time.

Table 3: No of frames needed to be retransmitted in each transmission in both the systems.



NUMBER OF FRAMES TO BE RETRANSMITTED							
3X3 Transmission		4X4 Transmission		5X5 Transmission		6X6 Transmission	
ES	Ps	ES	PS	ES	PS	ES	PS
183	128	133	111	107	112	103	98
112	78	106	91	101	93	103	96
86	63	101	86	101	87	101	94
69	50	94	77	101	84	101	94
61	41	92	72	101	82	101	94
53	37	90	71	99	82	101	92
50	34	89	68	97	79	99	92
48	33	86	66	97	76	99	92
45	31	83	64	95	76	97	90
39	27	83	63	95	76	97	90
36	26	79	58	94	75	97	90
35	24	74	58	94	75	97	90
35	24	73	56	94	73	97	89
33	23	73	56	94	73	97	89
33	22	73	55	94	73	97	89
32	22	72	54	92	73	97	89
31	20	72	54	92	73	97	87
31	20	72	54	92	73	97	87
31	20	72	54	92	72	97	87
30	19	70	53	92	72	97	87
30	19	65	51	92	72	97	87
28	18	65	51	92	70	97	87
28	18	65	51	92	70	97	87
27	18	65	51	92	70	97	87
26	17	65	51	92	70	97	87

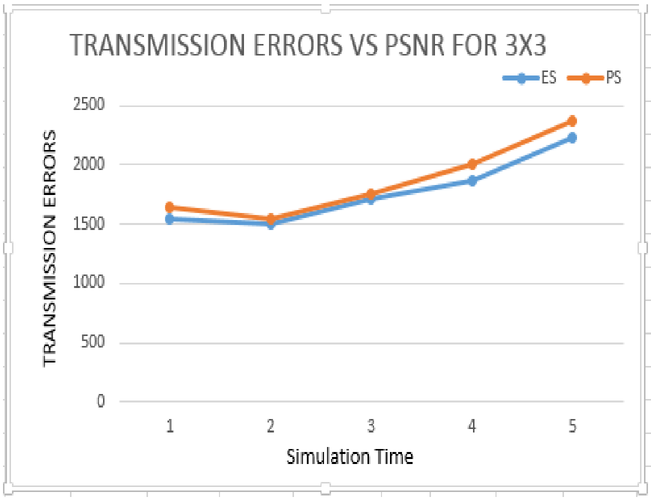


Fig. 4 (a) Transmission errors vs. Peak signal-to-noise ratio (PSNR) for 3x3 transmissions.

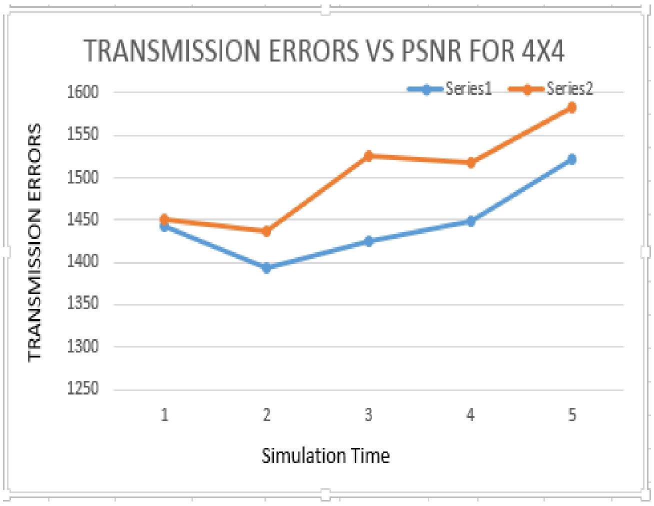


Fig. 4 (b) Transmission errors vs. Peak signal-to-noise ratio (PSNR) for 4x4 transmissions.

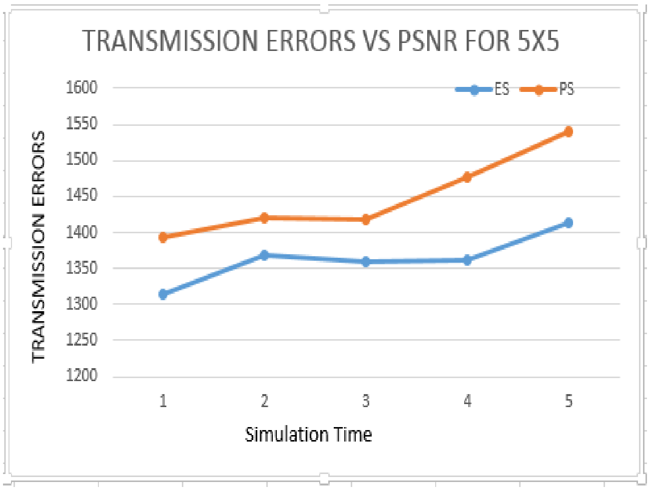


Fig. 4 (c) Transmission errors vs. Peak signal-to-noise ratio (PSNR) for 5x5 transmissions.

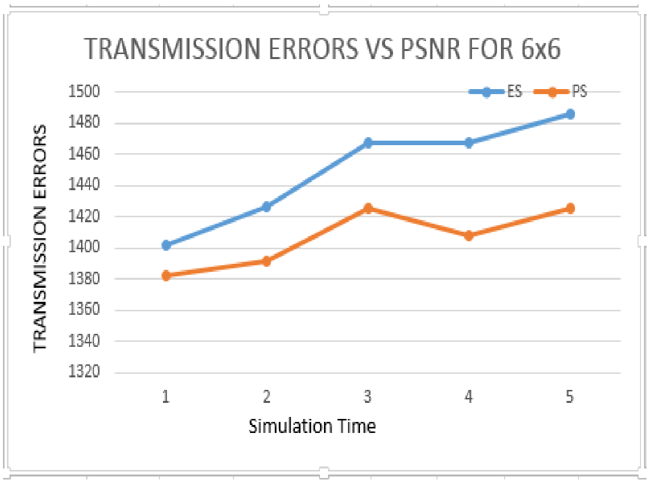
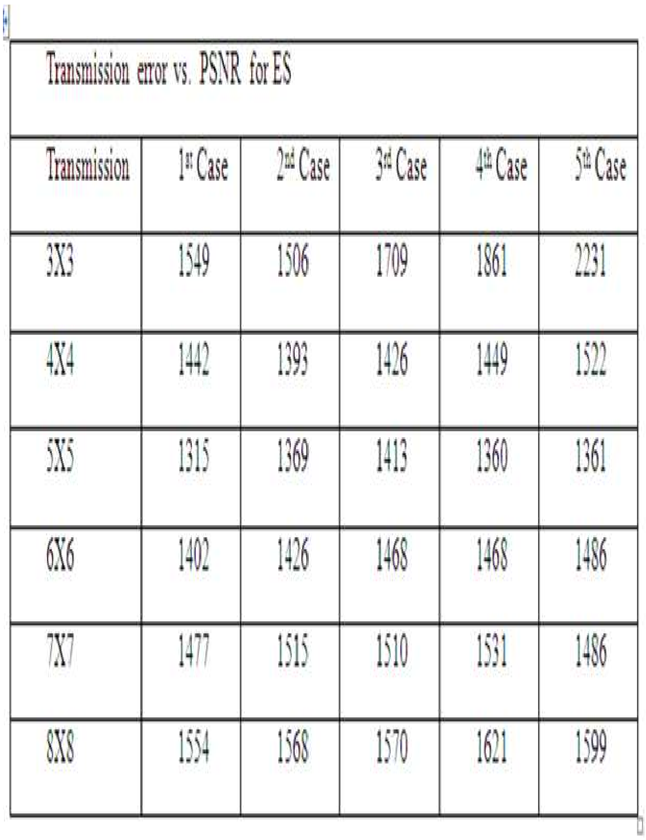


Fig. 4 (d) Transmission errors vs. Peak signal-to-noise ratio (PSNR) for 6x6 transmissions.

Fig.4, represents graph indicating the transmission error versus the PSNR (peak-signal to noise ratio) of both proposed system and the existing system for all the transmissions i.e., 3x3, 4x4, 5x5 and 6x6. In both the systems, as the PSNR increases, the transmission error increases. As the PSNR increases, it increases the transmission errors and effects the speed of transmission, this is because lots of bits will be dropped by the base layer which will be carried by the enhancement layer. Thus due to adaptability the two layers work in coordination and proving its scalability it is able to transmit the video packets overcoming the various changes in different parameters in all the multiple transmissions.

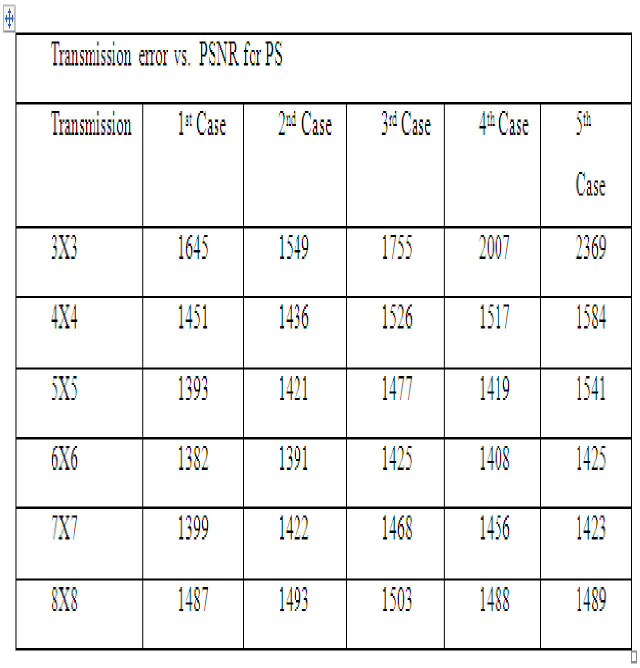
Table 4(a): Transmission errors vs. PSNR in ES



Transmission error vs. PSNR for ES

Transmission	1st Case	2nd Case	3rd Case	4th Case	5th Case
3X3	1549	1506	1709	1861	2231
4X4	1442	1393	1426	1449	1522
5X5	1315	1369	1413	1360	1361
6X6	1402	1426	1468	1468	1486
7X7	1477	1515	1510	1531	1486
8X8	1554	1568	1570	1621	1599

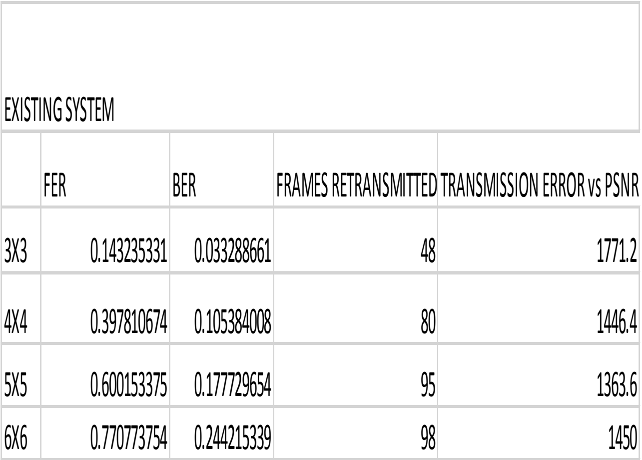
Table 4(b): Transmission errors vs. PSNR in PS



Transmission error vs. PSNR for PS

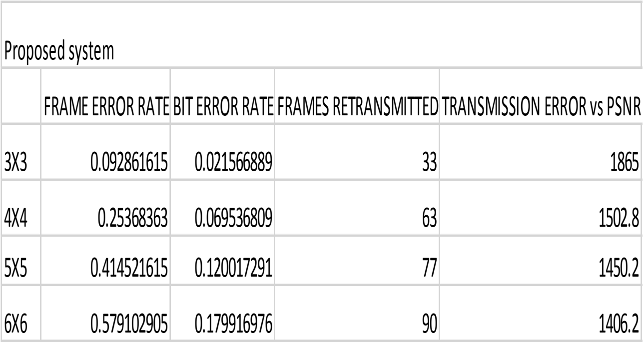
Transmission	1st Case	2nd Case	3rd Case	4th Case	5th Case
3X3	1645	1549	1755	2007	2369
4X4	1451	1436	1526	1517	1584
5X5	1393	1421	1477	1419	1541
6X6	1382	1391	1425	1408	1425
7X7	1399	1422	1468	1456	1423
8X8	1487	1493	1503	1488	1489

Hence our *EBERS* scheme is applicable even in multiple transmission. This proves the scalability in case of multiple transmissions also. In spite of experiencing huge variations in different transmissions, video transmission has been obtained successfully in multiple transmissions .Hence only because our proposed system (PS) is scalable in terms of multiple transmissions, it is able to overcome certain changes and transmit the packets successfully. The various results of different transmissions are shown below:



EXISTING SYSTEM

	FER	BER	FRAMES RETRANSMITTED	TRANSMISSION ERROR vs PSNR
3X3	0.143235331	0.033288661	48	1771.2
4X4	0.397810674	0.105384008	80	1446.4
5X5	0.600153375	0.177729654	95	1363.6
6X6	0.770773754	0.244215339	98	1450



Proposed system

	FRAME ERROR RATE	BIT ERROR RATE	FRAMES RETRANSMITTED	TRANSMISSION ERROR vs PSNR
3X3	0.092861615	0.021566889	33	1865
4X4	0.25368363	0.069536809	63	1502.8
5X5	0.414521615	0.120017291	77	1450.2
6X6	0.579102905	0.179916976	90	1406.2

Our proposed scheme is able to adapt to the changing conditions, transmission errors, and other parameters still overcoming various changes in PSNR and is able to transmit videos proving its scalability in terms multiple transmissions.

V. CONCLUSION

Thus we are able to make video transmission more error free and lossless in a wireless network. Our approach in formulating Estimation factor made it more helpful in carrying the lost packets. As in different transmissions as the noises vary, the layers, i.e. the base layer and the enhancement layer adapt to the varying environment and start transmitting the video bits in spite of the varying noise quantities. The adaptive framework is targeted at quality video transport over near-term QoS enabled broadband wireless networks. It works by detecting the number of packets the base layer has failed to transmit and layer capacity in real time and adjusting the quality of a video stream accordingly. Thus error correction in video transmission, which has also proved its adaptability reduces effect of channel errors and assures better QoS of the transmitted video by the refillment of the packets dropped by the base layer.

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