Performance Evaluation of an Efficient Schduling Algorithm for Surviellance Monitoring System Using WiMAX

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ABSTRACT: *The application areas of video surveillance are increased in recent days. It is mostly used in static areas such as airport, train stations, shopping malls and road traffic signals. In particular WIMAX networks were expected to support several broadband technologies that provide various services which are video surveillance, audio and data. These services include different classes of Quality of Service (QoS). Scheduling in WiMAX is one of the most challenging issues since it might distribute its resources to all the users in the network. So, an effective scheduling is very critical in WIMAX networks. More number of scheduling algorithms is available for WiMAX network. In this paper we propose a Priority Queue (PQ), Time expire (TE) scheduling and hybrid between (TE and PQ) queue scheduling algorithms. In this paper we take video, audio and text data for analyzing which one can efficiently support these three scheduling algorithms between (TE and PQ) queue scheduling.*

Keywords: WiMAX, Scheduling, PQ, and Time Expire (TE) Scheduling

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1. Introduction

THE number of people using the wireless networks to login into Internet has increased because it is more suitable and supplies mobility. For example a metropolitan network intend for wireless communication is defined as WiMAX. It is also named as IEEE 802.16 wireless digital communications system. WiMAX achieves high quality of speed to access to the internet, Sustain with quality of service, low cost and broad coverage range and fast deployment. It can reach 75 Mbps as the data rate and it can achieve up to 50 Km as the extreme distance for mobile station with a maximum data rate up to 70 mbps as compare to IEEE 802.11a with 54 Mbps up to several hundred meters. It provides and fast and reliable internet connectivity with limited existing bandwidth among several number of subscribers.

An IEEE 802.16 supports multiple traffic flows with diverse channel characteristics. The advance antenna usage and flexible sub channelization, the emerging speed internet and Multimedia, video broadcasting applications have led trend of IEEE 802.16 system enables peek download. The architecture of IEEE 802.16 consists of one Base Station (BS) and number of Sub Stations (SS). BS is responsible for data transmission from SS through two important operational modes. Two independent channels also used in WiMAX, the channel used by the BS to SS Downlink channel are shared to all SS. In the concept of surveillance monitoring system, the cameras have been widely used to monitor the environmental conditions. In this case, the camera can control the behavior and changes made in normal environment.

Surveillance applications have implemented on a WiMAX network, such as multi-surveillance cameras placed on high rooftops in urban areas, high speed point-to-point wireless surveillance, and multi-node rural and mobile surveillance. In recent days many number of mobile video cameras (e.g., videocomm RT mobile systems, intelligent analysis of CCTV) has being employed in today market for video surveillance monitoring. From that we can easily identify the misbehavior or tracking their trajectories of a human or vehicle. Such cameras can be placed in any fields like airports, road traffic signals, shopping malls, railway station etc. In fixed-camera video surveillance, this could aid human operators which is used to monitor many video streams, and may focus their attention on possible incidents.

In these live video surveillance systems we can easily tracks multiple objects simultaneously and will deliver high throughput. However, in some cases the video information is not sufficient to understand or identify the activity of vehicles or to detect some hazardous situations. When an abnormal event happens in an outside of the camera surroundings, it is not possible to detect by a human operator. In such situations, a microphone is employed since it processes an audio stream as a complementary tool. This can improve the video analysis detection abilities of security systems. In recent days, IP cameras are used for surveillance that is normally equipped with embedded microphones that facilitate the deployment of audio analysis systems. The audio surveillance system does not respond with variations in the illumination conditions and it will work normally during day and nights.

The main problem associated with an audio surveillance system is that an event of interest is superimposed to a significant level with background noise. In some other cases the surveillance system may use normal data. In this paper we considered three kinds of data for our analysis which are normal data, also data and video data. The load balancing and scheduling are the major problem in surveillance system. In this case are used in WiMAX system resolve the contention of bandwidth allocation and to satisfy the QoS among users with different traffic classes. Scheduling algorithms are depends on their implementation specified and depends on their standard what we specified. Scheduling is one of the way not only efficient utilization of radio resources but also satisfied the QoS requirements.

There are number of scheduling schemes used in WiMAX such as Weighted Fair Queuing (WFQ), Round Robin (RR), Strict Priority (SP) and Self Clocked Fair Queuing (SCFQ). The main aim of scheduling algorithm is to distribute resources among all the users in the network. The scheduling scheme that has higher throughput and lower delay is required to have better network environment. In other words, it is adopted to decide the first packet to serve in the particular queue to assure the QoS requirements. This paper is focusing on various scheduling approaches their comparison based on various parameters and its Design issues.

3. Previous Works

In paper [14] Julian F. P. Kooij, Gwenn Englebienne, and Dariu M. Gavrila were discussed with Mixture of Switching Linear Dynamics to Discover Behavior Patterns in Object Tracks. This process is used to discover normative actions and their temporal relations at the object level. In this paper, they used continuous distributions in the feature space to capture variance in action execution. In this unsupervised approach, they used tracks which were clustered into behaviors, each behavior defining transition probabilities between actions. It is referred to as topics in the remainder of this paper, to follow the nomenclature of topic models. Topics can be shared between different behaviors, thus multiple behaviors may contain the same topic. At the same time it uses different topic transition probabilities.

Aneel Oad, Shamala K Subramaniam and Zuriati Ahmad Zukarnain had proposed an Enhanced uplink scheduling algorithm for efficient resource management in IEEE 802 [8]. In this paper they majorly focused on the WiMAX uplink traffic scheduling where the algorithm had enhancing the collective performance of hybrid algorithms in WiMAX. The proposed earliest expiry first (EEF) algorithms were designed as an extraction. Actually it extracted from the hybrid sub scheduling EDF algorithm. An EEF algorithm controlled and monitored packets using their corresponding deadline and respective expiry. An EEF algorithm offered a major

solution to avoid from packet waiting time, reducing delay, missed deadline, and increasing better performance of the system. The selection of such metrics fully based on the substantial adoption of those parameters used in the simulation analysis.

Po-Han Wu, Chih-Wei Huang, Jenq-Neng Hwang, Jae-Young Pyun had proposed a Video-Quality-Driven Resource Allocation for Real-Time Surveillance Video Uplinking Over OFDMA-Based Wireless Networks in paper [13]. An effective real-time video uplink (UL) framework for mobile wireless camera networks (WCN) was proposed in this paper. An UL resource allocation based problems were formulated and which can be optimized in two key steps. Those are: In first step the system utility maximization and a long-term encoding rate assignment problem were formulated to decide the target bit rates for all CSs. In second step, each CS's target, a real-time scheduling problem can be solved. In this both frequency and time domains were allocated to the by the radio resource in WiMAX.

Abhay Pandey and Bhavana Jharia were proposed a Survey of WiMAX Scheduling Algorithm Key Issue and Design Challenges [6]. In this paper, they discussed with WiMAX architecture and its functionalities associated with it. In particular, IEEE 802.16 OSI standard and defines the PMP (Point to Multipoint) and Mesh modes. At Media Access Control (MAC) layer WiMAX define the various QoS parameters which used to provide multiple services like voice, data and videos. To meet such QoS requirements an efficient scheduling algorithm should be defined. For that they had discussed with various scheduling algorithm and its design challenges which had used to improve such quality of service in WiMAX networks. The scheduling algorithms were discussed in this paper includes:

Round Robin Scheduling (RR), Weighted Round Robin (WRR), Earliest Deadline first(EDF), Weighted Fair Queuing (WFQ), Deficit Round Robin (DRR), Proportional Fair (PF), Channel Aware scheduling. Algorithm comparison based on various aspects of designing and its Qos services. The QOS parameters considered in this paper are: Throughput, Average Delay or Latency, Jitter or Delay variation, Traffic priority, Maximum sustained traffic rate, Minimum reserved traffic rate, Maximum latency, and Request/ transmission policy. The paper Grouping Based Job Scheduling Algorithm Using Priority Queue, Shortest Job First, Round Robin and First Come First Serve [2] were proposed by Qudsia Mateen, Ujala Niazi, Marwah, Sobia Khalid.

This paper had majorly concentrated on group based job scheduling. The priority based scheduling algorithms were proposed in grid computing. Since, it maximizes the resource utilization and reduces the total time. The main reason of discussed with this group based job scheduling was to minimize overhead time and computational time. In that firstly they had implemented RR and FCFS on the basis of FFS. Finally, they had proved that, the processing loads among the selected resources were balanced at the same time it minimized the processing time of the jobs.

Pasquale Foggia, Nicolai Petkov, Alessia Saggese, Nicola Strisciuglio, and Mario Vento had proposed a concept of Audio Surveillance of Roads: A System for Detecting Anomalous Sounds [15]. In this paper, they had proposed an audio stream which was used to identify the road side accidents such as tire skidding and car crashes. For that they proposed a method that was based on a two-layer representation of an audio stream which includes: low level and high level. In low level, the system extracts a set of features that can able to capture the discriminate properties of the events of interest. The high level layer was used to detect both short and sustained events. In this paper, they employed a k-Nearest Neighbor (kNN) classifier in order to evaluate the generalization capabilities of high-level representation.

One of the major benefits of audio analysis systems is that they do not have to deal with variations in illumination conditions such as day and nights. In the proposed data set, the sounds of interest were not isolated and it was superimposed on different typical background sounds of roads and also in traffic jam that were used to estimate the abnormal conditions occurring in the real world conditions. So, the proposed system separates an audio signal from the background noise in a given timing interval. Finally, the authors were proved that the proposed system can be effectively used in noisy road environments. It provided an average accuracy of 78.95% at a maximum distance of 120 meters in country roads and of 25 meters on highways.

4. Proposed Method

In this section we are going to discuss with the scheduling algorithms and its working functionalities. Figure 1 shows that the working process of our proposed system. Our proposed system consists of six stages. In first stage, the data gathered from the environment is captured by surveillance camera. Then these captured data is forward to the WiMAX router in the network. Here only we are performing various scheduling techniques such as priority queue (PQ), Time Expire (TE) schedules and the hybrid

scheduling algorithm which is designed by the combination of both PQ and TE scheduling algorithms. WiMAX router forwards those details to the corresponding base station. After the reception of message, the base station sends back to the WiMAX surveillance monitor. Then WiMAX surveillance monitor forwards it to the storage server. Finally, the corresponding message can be viewed in the monitor. So, our proposed video surveillance monitoring system starts with camera and ends with a monitor.

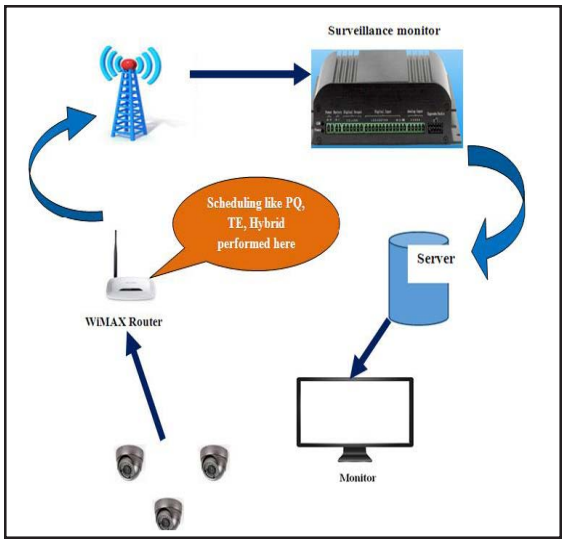

Figure 1. Architecture of proposed video surveillance

The scheduling functionalities performed in the WiMAX routers are described in the below section in more detail.

(i) Priority Queue (PQ) Scheduling

The working process of priority queue scheduling is same as SJF scheduling algorithm. However, in priority queue each job is assigned a priority and the job with the highest priority gets scheduled first. Priority queue scheduling only selects the process with the highest priority to run. If there is more than one process having the currently highest priority, you need a second schedule. The job with lower priority can be made to wait for some times until the completion of high priority job.

```
Input: A Collection S storing n elements
Output: Packet Executed

      1. Begin
      2. Intialize S = n;
      3. P = new P Queue()
      4. while !S.is Empty() do
            a. e = S.removeFirst()
            b. P.insert(e)
      5. End while
      6. while !P.is Empty()
            a. e = P.removeMin()
            b. S.addLast(e)
      7. Endwhile
      8. End
```

Figure 2. Pseudo code for Priority Queue scheduling

Figure 2 shows the pseudo code of priority queue scheduling where the queue is kept in empty when no one process comes i.e. initial period of time. After that the queue is fully filled with a set of elements **e** with an associated priority. If an element e in a queue has a highest priority remove it from the queue. Then add new element into the queue. This process is continued until the node

with lowest priority has been removed from the queue. In some critical cases two or more processes are having same level of priority; those processes are scheduled in FCFS order. Commonly, priority scheduling can be classified into two different categories which include:

- Primitive
- Non-primitive

The primitive priority algorithm is a type of priority scheduling algorithm. In this case, if the priority of the newly arrival process is higher than the priority of the currently running process. But in case of non-primitive priority queue scheduling algorithm puts the new process at the head of the ready queue. The main benefit associated with a priority based scheduling is provides a good mechanism where the relative importance of each process may be precisely defined.

In that a priority may be allocated in two different ways such as:

- Internal
- External

```
Input: Packet, hostm TE, packet, reqRes
Output: Packet Execute

      1. Begin
      2. Intialize Packet, Host, TE, packetReq, reqRes
      3. while TRUE do
            packetProcessed = False
            TE = MAx TE
            WaitForpacketSubmission(packet);
            GETpacketInfo(packet, HOst, TE, packetReq, reqRes);
      4. if Host ∈ remote VO then
                  TE---;
          O If AvailableRes(reqREs) then
                  Assignpacket(packet, reqRes);
                  packetProcessed = TRUE;
      5. End if
      6. End if
      7. if NOT packetProcessed then
                  bestRes = CalcUtility(packet, packetReq);
            O if bestRes ∈ res[local] then
                    Assignpacket(packet, bestRes);
            O Else
                  O if TE = = 0 then
                        SubmissionFail(Host, Packet);
                  O Else
                        PutpacketInfo(packet, Host, TE, bestRes);
                        Forwardpacket(packet);
      8. End if
      9. End if
      10. End if
      11. End while
      12. End
```

Figure3. Pseudo code for Time Expire scheduling algorithm

In internal priority which uses a set of measurable quantity or quantities for calculating priority of a process. An example of internal priority are: memory requirements, number of open files, ratio of average I/O burst to average CPU burst have been used in computing priorities. But in external case the priority is set some set of criteria that is very external to the operating system. The major drawback of priority queue scheduling is that cannot execute a process with low priority. In priority Scheduling the time progresses increases the priority of the processes which solves the starvation problem.

(ii) Time Expire scheduling algorithm:

The time expire scheduling algorithm is explained in detailed manner in figure 3. In time expired scheduling, when operating system

```
Input: A Collection S storing n elements, Packetsm Host, TE, packetReq, reqRes
Output: Packet Executed

      1. Begin
      2. Intialize s = n, Packet, Host, TE, packetReq, reqRes
      3. P = new P Queue()
      4. while !S is Empty() do
            e = S.removeFirst()
            P.insert(e)
      5. End while
      6. while !P is Empty() do
            e = P.removeMin()
            S.addLast(e)
      7. Endwhile
      8. while TRUE do
            packetProcessed = FALSE;
            TE = MAx TE;
            WaitForpacketSubmission(packet);
            GETpacketInfo(packet, Host, TE, packetReq, reqRes);
      9. if Host ∈ remoteVO then
                  TE---;
          O If AvailableRes(reqREs) then
                  Assignpacket(packet, reqRes);
                  packetProcessed = TRUE;
      10. End if
      11. End if
      12. if NOT packetProcessed then
                  bestRes = CalcUtility(packet, packetReq);
            O if bestRes ∈ res[Local] then
                    Assignpacket(packet, bestRes);
            O Else
                   if TE == 0 then
                      SubmissionFail(Host, packet);
                    Else
                      PutpacketInfo(packet, Host, TE, bestRes);
                      Forwardpacket(packet);
      13. End if
      14. End if
      15. End if
      16. End while
      17. End
```

Figure 4. Pseudo code for Hybrid scheduling algorithm

is installed for the first time, it begins with time quantum. The calculated time quantum represents real and optimal value since it is based on real burst time unlike the other methods, which depend on fixed time quantum value. This process is continued when a new process is entered in to the queue; the operating system starts its time quantum value. If the defined time quantum expire within a time in time quantum had expired. Figure3 provides a detail explanation for our time expiration scheduling.

The time expire scheduling algorithm processed the given job within expiration of given time. If the time extended beyond that limit, our proposed scheduling algorithm does not support any process server request. So, our proposed scheduling algorithm is majorly designed to support the time quantum features. Initially we are setting out the expiration time for each process in the queue. After some times it waits for a packet submission time if it get information about the packet then the process will be started. If the packet not processed means utility function is called for getting the process become response. The main aim of time expire scheduling to minimize packet delivery ratio, End to end delay.

(iii) Hybrid Scheduling Algorithm

Hybrid scheduling is the combination of both priority queue and time expire scheduling algorithms. In hybrid scheduling algorithm, first we are setting out the timer. If the timer is not set wait for some time until the timer gets become start. Then we Gets the timer identifier which is inserted into each timer message. Then set the timer identifier which is inserted into each timer message. In generic timer interface a multi timer is inserted which is a timer that handles many events. Events are just added to the multi-timer, which will dispatch them all when needed. To distinguish between different events, the module handler will receive a message with an event id specified by user.

In multi timer interface, add an event to the multi-timer, with a specified parameter. After setting of time we are calculating the priority for each process based on priority queue scheduling algorithm. Based on the priority value each job is allocated and it should complete their process with the time interval. That is the time quantum allocated for each processes.

4. Performance Evaluation

In this section we are going to evaluate the performances of our proposed scheduling algorithms by means of different input data. An input data taken for our research include the following which are:

- Video data input
- Audio (or) Voice input
- General data input

Here we are evaluating the performance on omnet++ simulation environment. By using omnet++ simulator we compare which one scheduling algorithm provide better performance when conducting simulation for different input data. Each scheduling algorithms performance efficiency can be calculated by using different performance metrics such as packet delivery ratio, end to end delay and jitter.

Simulation Environment

For evaluating the aforementioned algorithms we perform simulation in OMNeT ++. We perform simulation in OMNeT++on considering the following parameters specified in table 1. In our simulation we used 4 nodes which are 3 cameras and 1 server node. For conducting our simulation we have to create 4 numbers of nodes to be created which includes 3 cameras and one server for storing all the captured videos. Simulation consists of IEEE 802.16 MAC protocol are uniformly distributed. In our simulation, we consider one access point for accessing WiMAX. The coverage area used in our simulation is 737 × 492 meter. The table clearly gives the parameters considered involved in simulation. The power of transmitter used in our analysis is 2MW.

A one second of beacon interval is used in this simulation. We conducting our simulation on WiMAX so what we used a channel as wireless channel. We used the camera sensitivity of 85 dBM which give more accurate sensitive nature to our camera nodes. In our simulation model we used the packet size of five hundred and twelve bytes. Finally, our summation is successfully evaluated with these three scheduling algorithm by of packet delivery ratio.

Comparative Analysis

PARAMETERS	VALUES
SIMULATOR	Omnet++
NUMBER OF NODES	3 camera, 1 server
AP (WiMAX)	100MPS
SIMULATION AREA	737 × 492 meter
TRANSMITTER POWER	2 MW
BEACON INTERVAL	1 Second
SENSITIVITY	85 dBM
PACKET SIZE	512 bytes
PROTOCOL NAME	PQ, TE and Hybrid
CHANNEL	Wireless channel
MAC TYPE	Mac/802_16

Table 1. Simulation Parameters

In this paper, we compared these three scheduling algorithms by means of parameter metrics such as:

- End to End delay
- Packet Delivery Ratio (PDR)
- Jitter

In this section we are going to discuss with various scheduling algorithms like Priority Queue (PQ), Time Expire (TE and Hybrid algorithm (combination of TE+PQ) by means of various networking parameters.

(i) End to end Delay

The amount time taken to arrive at a given destination is defined as end to end delay of a packet. The lower value of end to end delay offers better network performances. An end to end delay of a packet should have lower delay during its packet transmission. It does not exceed its delay will increase so much of packet loss.

Figure5 shows the comparative analysis of scheduling algorithms like PQ, TE and Hybrid by means of end to end delay. Here we evaluated end to end delay by varying time intervals. From our analysis we can evaluate the hybrid scheduling has low end to end delay when compared to individual performances PQ and TE.

(ii) Packet Delivery Ratio (PDR)

Packet delivery ratio is defined as the ratio of the number of data packet delivered to the destination. This illustrates the level of delivered data packet to the corresponding destination. The greater value of packet delivery ratio means the better performance of the network. Packet delivery ratio is calculated by,

$$PDR = \frac{N_R}{N_S} \times 100$$

Where,

N_R – Number of Packets Received

N_S – Number of Packets Sent

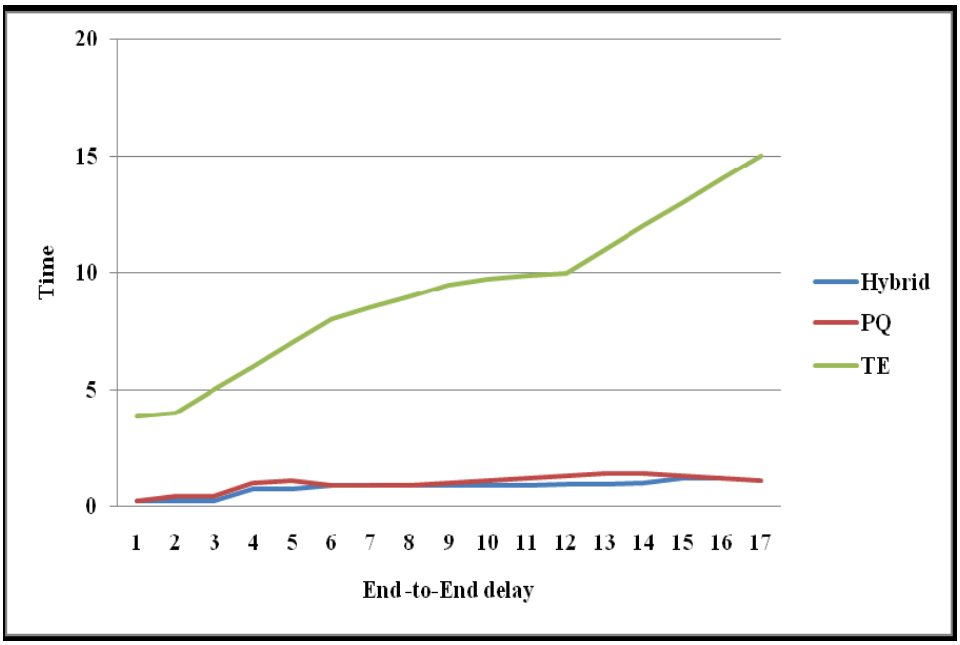

Figure 5. Comparative analysis of end to end delay

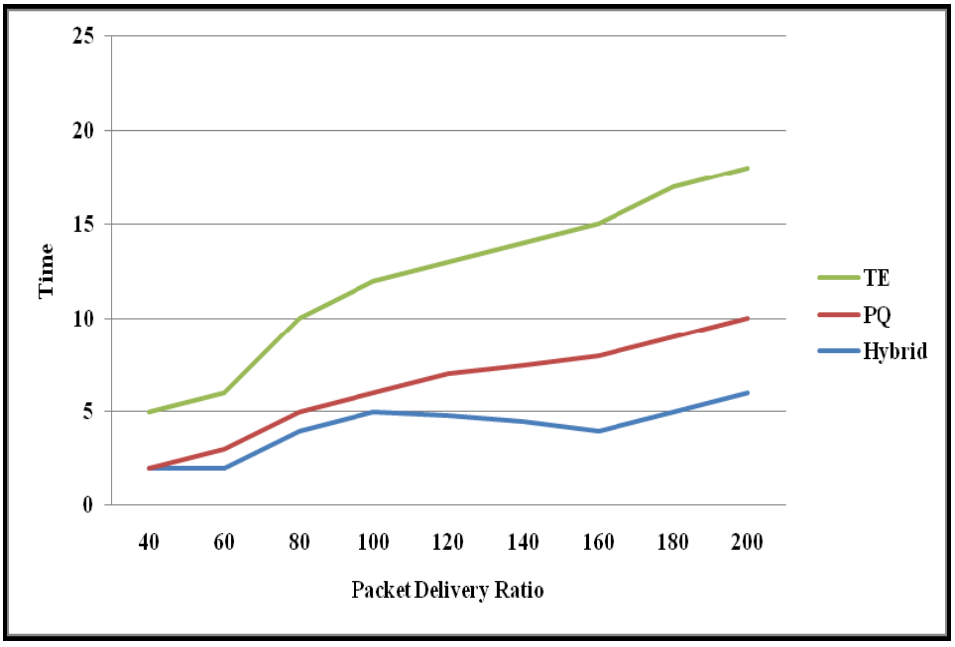

Figure 6. Comparative analysis of PDR

The above figure6 illustrates comparison results of packet delivery ratio with respect to different timing intervals. From the graph we can analyze packet delivery ratio of hybrid scheduling is very low when compared to other scheduling algorithms (like PQ, TE).

In worst case, the time expire scheduling offers very poor performance on PDR.

(ii) Jitter

Jitter of a given packet is defined as deviations in packet inter arrival time to reach corresponding destination. The large value of jitter intimate that packet to be received out of range of i.e. overflow its buffer size.

Out of range packets are discarded from the buffer which results in larger value of jitter. Figure 7 shows a comparative analysis of scheduling algorithm by means of its Jitter. Here we are also analyzed the jitter value is very high in time expired scheduling. Since, it takes too much of time to schedule each of its processes.

5. Conclusion

From the above designed project we can conclude that the proposed surveillance monitoring system performs well and its transmission speed and bandwidth also efficient. This system is very comfortable because of using WiMAX technology. This paper offers various scheduling algorithms such as priority queue scheduling and time expired scheduling. The combination of both PQ and TE scheduling are forms hybrid scheduling algorithm. All these three scheduling algorithms performance results are evaluated individually by means of PDR, end to end delay and jitter. From the simulation result we analyzed TE scheduling algorithm provides poor performance when compare to other two (PQ and Hybrid) scheduling algorithms. The simulation result

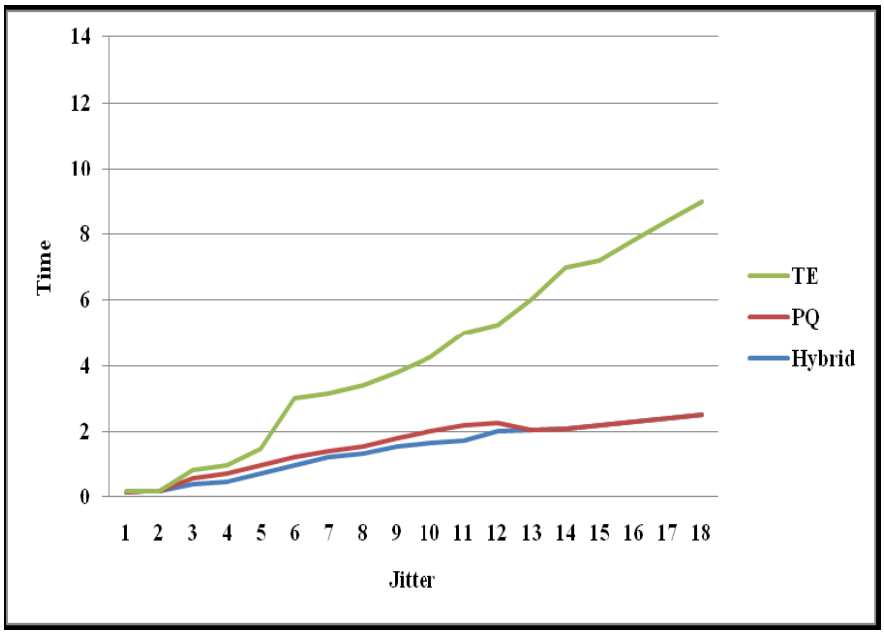

Figure 7. Comparative analysis of Jitter

analyzed in section IV proves that our proposed WIMAX based video surveillance system improved its video transmission rate and improved packet delivery ratio, reduced end to end delay and reduced jitter when it is scheduled with hybrid scheduling algorithm.

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