Deadline Constrained Scheduling To Reduce Packet Loss in Wireless Multimedia Sensor Networks

Shazia Sultana, S. Ambareesh and Kantharaju H.C

***Abstract*—The two main factors which are important in real-time multimedia applications are Deadline constrained packet scheduling and transmission. The degradation of Quality of Service (QoS) is because the packets miss their deadlines and become useless and are frequently dropped. As the utilization of real-time multimedia applications and Internet of Things (IoTs) has become more, multimedia data transmission is a key component to promote the QoS of citizens. To fulfil the QoS requirement in Wireless Multimedia Sensor Networks (WMSNs) the integration of multiple transmission methods is encouraged for packet forwarding, including Conventional Network Coding (CNC), Analog Network Coding (ANC), Plain Routing (PR) and Direct Transmission (i.e. No-Relaying, NR). The combination and integration of transmission methods lowers packet dropping probability, but complicates the packet transmitting and scheduling process instead.Therefore, an exhaustive search scheme is introduced to obtain the optimum scheduling sequence and corresponding transmission method for deadline constrained multimedia transmissions in WMSNs. With respect to promote computing efficiency for the formulated problem, two heuristic methods based on Markov chain approximation and dynamic graph is proposed, respectively.**

***Index Terms*—Deadline constrained packet scheduling and transmission, Wireless Multimedia Sensor Networks (WMSNs), Quality of Service (QoS).**

I. INTRODUCTION

Wireless Multimedia Sensor Networks (WMSNs) are the networks of wirelessly interconnected sensor nodes which include multimedia devices, such as cameras, microphones, and they are capable to retrieve video and audio streams, still images, as well as scalar sensor data. Real-time multimedia are the applications in which audio-visual aid information has to be carried and passed in real time. Multimedia is a word that represent several forms of material, containing audial, visuals, animatronics, images, text, etc. The greatest illustrations are nonstop or connected mass media such as animatronics, audial and video that are based on time, i.e., each audial clip or video casing has a time duration linked with it, signifying the performance. Multimedia records should be accessible always in continuous manner, in order in which they are associated with their time stamp. For example, consider a video should process 30 frames per second so that the user can view the output video continuously without any interruption, if the network fails to render 30 frames per second or if the network renders 25 frames per second, then there will surely an interruption occurring in the output video. Therefore, real time hypermedia presentations naturally have restriction on time, i.e., the records has to be conveyed in factual period. Fig 1 and Fig 2 are the examples of real time applications.

Fig. 1: Video Conferencing an example of real-time application

Fig. 2: Social Networking sites another example of real time application

There are many other examples for multimedia applications like online education, Internet Gaming, Live Streaming etc., all these real time multimedia applications have strict deadline constraint. For example, if we take a you tube application consider the user is watching a video in you tube, if video is not played back continuously the user may lose interest to watch the video, hence all real time application have strict deadline constraint. In these real time applications, packets nothing but the data or information have strict deadline restrictions and mustreach at their termini before their deadlines. If they are reached on time,they become invalid and are dropped, which degrade and reducethe Quality of Service (QoS).It is the complete enactment of acomputer system, majorly it is the enactment visualized by the users of the system. Mainly

Shazia Sultana, PG scholar with Department of Computer Science and Engineering,Vemana Institute of Technology, Bengaluru-34, India.(Corresponding author to provide a phone: +91-8904502099; E mail:shazia.icon@gmail.com).

S. Ambareesh, Associate Professor, is with Department of Computer Science and Engineering, Vemana Institute of Technology, Bengaluru-34, India.(Email: ambareeshs@vemanait.edu.in)

Kantharaju H.C Assistant Professor, is with Department of Computer Science and Engineering, Vemana Institute of Technology, Bengaluru-34, India.(E mail: kantharajuhc@vemanit.edu.in)

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to mark the service quality, numerous linked features of the network package are frequently measured, like fault rates, bit amount, output, broadcast delay, accessibility, jitter, etc.

This paper is divided into 8 sections, in which, Section I provides the introduction of WSN and WMSN. Section II provides the detailed Literature Survey of latest pear reviewed papers related to WMSN. Section III provides the discussion on the Existing System. Section IV provides the Problem Statement with respect to packet dropping node in WMSN. SectionV provides the details of Proposed System with the approaches to minimize packet dropping in WMSN. Section VI provides the detail System Architecture, Data Flow Diagram (DFD) and Class Diagram. Section VI concludes our research work with Future Enhancement. Section VII provides References used for our research work.

II. LITERATURE SURVEY

In [1], the latent effect on technical investigation as well as abundant presentations on WMSNs have drawn more attention. To govern steady as well as source effective path and to offer variable stages of Quality-of-Service (QoS) warranty for hypermedia, the broadcast of multiple forms of information depends on a routing protocol. As there are several problems like inadequate network resources, complex procedures of multiple media presentations and dynamic fluctuations of network situation is a challenging task in WMSNs. The tests as well as necessities, a complete review on routing of presentation necessities and key procedures are illustrated in this paper. The proposed directing resolutions in this paper deals with the five key types based on their architecture along with optimization qualities, provision on QoS, multiple media responsiveness, energy effectiveness, bottle neck prevention, optimizing . At last, the open investigation topics in steering metrics are depicted with some efficacious investigation zones concerning routing in embryonic WMSNs presentation states are discussed. The objective of this survey is to deal with the ventures and current tendencies in routing in WMSNs. This paper deals with the experiments in the design of transmitting packets in WMSNs, and then surveys on recent research progress in area of WMSNs. More importantly, future enhancement will be focussed on research areas of WMSN/IoMT systems.

In [2], stability and reliability in wireless communication is one of the major fact for connecting people using the smart devices in the cities. In this paper, a societal leaning smartphone-based adaptive broadcast mechanism is proposed to improve the system connectivity and quantity in Internet of Things (IoTs) for smart cities. To make the network connectivity strong, a social leaning double auction grounded relay selection scheme is explored to stimulate the relay smartphones to transmit the packets for others. For gaining maximal throughput in IoTs based on smartphones, and also the relay scheme selection is dogged by combining numerous kinds of broadcast methods in an optimum manner to make maximum use of wireless scale resource. A method based on a firefly procedure is determined to answer the high computational complexity. The proposed mode has two steps. Firstly, by the friendships the social features of smartphones are modelled and a relay selection method has been presented. Secondly, to study the interaction between NC and spatial recycle by synchronously triggering links in an ideal way a variety spatial recycle aware relay system selection process is proposed. To deal with the computational complexity and to achieve the optimal network performance, a firefly procedure based empirical approach is obtained.

In [3], the Internet of Things (IoT) relates to the real life scenario where most of the belongings, objects or human being in everyday life should interconnect with added systems and deliver facilities on Internet. Substances identify, sense, interacting as well as process the abilities to mark the IoT model a real time. IoT defines IEEE 802.15.4 standard as the major inter-connection procedures. The IEEE 802.15.4 standard gives guaranteed time slot (GTS) apparatus which complements QoS for the on time documents communication. Even there are many QoS structures in IEEE 802.15.4 standard, even though major difficulty of endways delay resides. For overcoming this end-to-end delay problem, a supportive Medium Access Scheme (MAC) protocol for on time information broadcast is proposed. The presentation of the proposed scheme is illustrated through the simulations. The proposed scheme improves network performance which is demonstrated. The proposed method overcomes the difficulty of GTS tradition on less duty sequence along with the straight broadcast amid finale systems. The planned method similarly lowers the delays produced by PAN controller relays meanwhile systems using the planned method can straightly transfer the on time information not checking a PAN controller. Since the proposed method selects the pathway with the improved linkage feature, which reduces the energy intake by re-broadcast, and increases the system performance. The energy consumption of the proposed method is superior to both the IEEE 802.15.4 standard and the ESS scheme.

In [4], deterministic delay bounds are difficult to guarantee due to the fundamentally stochastic environment of wireless vanishing channels. Using the thought of operative size, the proposed system provides statistical delay guarantees. Considering a large amount of user setup where different kind of users have different delay QoS restrictions. The resource distribution is derived strategy which exploits the sum video feature and applies to any quality metric with hollow rate-quality plotting. The resource distribution policy is extended to imprison the video quality based adaptive user subcarrier transfer in wideband networks as well as imprison the impact of adaptive variation and coding. Another difficultly of fairness driven resource

distribution is solved whereby the concept is to improve the minimum video quality across users.

Finally, user presence and scheduling strategies are derived which enable selection of a large number of user subcategory such that all nominated users can meet their geometric delay condition. The cinematic users with differentiated QoS [5] necessities can attain similar video quality with massively diverse resource necessities which is shown results. The concept of effective capacity is used in this paper to providea framework [6] for statistical delay provisioning for multipleusers sharing a wireless network. The resource distribution policies were prolonged to capturevideo quality based adaptive user subcarrier projectin wideband networks as well as the effect of adaptive modulationand coding. Future work focuses on the videoquality driven resource sharing which are not referenced where the comparable perceptualfeature optimizations can be proposed in a client based environmentwithout contact to the reference. This has the main advantagesthat the user dignified video quality includes the effectof channel misrepresentations along with the source alterations which is opposite to the server dignified video quality which only imprisonssource distortions. The quality assessmentto the user is enabled which shrinks the server capacity and ignores upholding a large session state for each user at the server.

III. EXISTING SYSTEM

For lowering of packet transmission delay in WMSNs, some effort has been made on different facets, such as QoS based routing mechanisms [7], deadline concerned queuing strategies in relays [8], efficient access methods in Media Access Control (MAC) layer [9], and cross-layer optimization algorithms that not only consider the transmission rate in physical layer systematically [10], but also relaying method in network layer. Even though some QoS methods have been specified in IEEE 802.15.4 standard for WSNs, the difficulty of endwise delay still resides. A supportive MAC protocol for on time data broadcast was discovered in [11], which mainly concentrates on the beacon aided method in star network topology and can be seen as a kind of supplement of IEEE 802.15.4 standard. A multi-user setup for users with delay QoS constraints has been measured in [12], and the resource allocation policy has also been extracted for sum video quality improvement.

It is widely addresses that Conventional non-physical-layer Network Coding (CNC) greatly improves the network throughput when packet deadline constraints are not considered [13]. The broadcast nature of wireless channel is advantageous in CNC. The transmission time can be reduced by authorizing a relay to encrypt at minimum two packages, these are acknowledged disjointedly from dissimilar foundation nodes, into single package as well as transmit it to termini causing decryption of the projected packages. Therefore, CNC is also one of the efficient solutions to handle the problem of packet transmission with deadline restrictions in supportive communications. But, the decrypting delay in CNC may be higher if the terminus nodes cannot receive enough amount of packets for decoding [14].

Hence, CNC should be cautiously applied in deadline constrained packet transmissions. Compared with CNC, Analog Network Coding (ANC), as a type of Physical layer NetworkCoding (PNC), can further lower transmission time by permitting two signals to be transmitted instantaneously from the spring nodules and depend one upon another at the relay nodule [15]. Nevertheless, ANC has more severe restrictions on network topologies (star, mesh, bus etc.,) and channel conditions. Hence, it is encouraged to combine the different transmission methods to full fill their advantages.

IV. PROBLEM STATEMENT

This project is intended to solve following problems,

1. Reduce the packet drop.
2. Ensure more packets are reached in deadline.

The problem is to be solved by integration of scheduling methods and proper scheduling of packets according to their deadline. The main objective is to find a best scheme adaptively to minimize the number of packets missing their deadlines according to different network. Packet Dropping Probability can be calculated as the proportion of the amount of packages omitted by their targets to the entire amount of packages that has to be transferred.

V. PROPOSED SYSTEM

In order to deal with real-time transmissions in multi-rate WMSNs, an adaptive integration scheme for different transmission methods is proposed, including CNC, ANC, PR and NR. Two methods one based on Markov Chain and other based on Dynamic Graph are proposed, to select the optimal transmission methods and sequences of packets.

A. Markov Chain Approximation Approach

Markov approximation has been used to solve the Maximum Weighted Configuration problem [16], [17], such as, designing the Carrier Sense Multiple Access (CSMA) mechanism to achieve the optimal throughput, selecting path in wireline networks, or solving the channel assignment problem in wireless LANs. Many practical and important problems can be formulated in the form of Maximum Weighted Configuration problem, and so is the optimization problem in this paper.A transition matrix is defined. In which the number of vertex is the number of source + number of destination.

The transition matrix value is 1 when the packet is transferred at time ti from node m to node n, else it is 0.

The transition matrix is updated in every time interval to check if more packets meet their deadline. According to this, an element is transition is set 1 or 0. The transition is made according to constraint of maximum possible transition possible at that time. Due to this updation of transition matrix at every time interval, a near optimum schedule would be achieved in later time period.

B.Dynamic Graph Approach

Markov approximation approach obtains the methods which are very close to the optimum results, when the number of state transitions is large enough. As the amount of the states, i.e., the possible scheduling and transmission schemes, increases rapidly with the number of packets, and the corresponding complexity is still very high which is illustrated. Furthermore, a method with less computational complexity is extracted. In this section, the dynamic graph based approach is introduced and the problem is solved by constructing a graph for the selection of appropriate packet(s) of each transmission.

Dynamic graph approach is based on following statements,

• Statement 1: Amongst the total optimum well-ordered set partitions, the unintentional that more than two packages are supportively transferred through CNC is infrequent.

• Statement 2: Now PNC-based optimal ordered set dividers, as soon as a packet in unique subset fails its target, the package(s) in the consequent subset(s) should also fails their target(s), if any deadline. T

Hence, based on the above statements, three directions on packet scheduling and broadcast are defined:

• Direction 1: The maximum number of packets in one subset should not be greater than two.

• Direction 2: The packet(s) has to be broadcasted successfully which are scheduled in subset.

• Direction 3: The broadcast of packets should be done sequentially one after the other subset if not the packets of the subsets fails to meet their deadlines.

So, considering all the above directions and statements, the efficiency of one subset broadcast is observed as the change between the number of packets in the subset and the number of dropped packets caused by this broadcast. The subset with the maximum broadcast efficiency should be organised with the maximum importance.

VI. SYSTEM DESIGN

System Architecture

System architecture also called as system planning is the intangible strategy that defines the anatomy and performance of an organisation. A planning explanation is a proper explanation of a scheme, prearranged in a way that provisions intellectual about the operational stuffs of the organisation. It describes the organization apparatuses or building wedges and offers a plan using which merchandises can be obtained, and organizations established, which will toil together to appliance the complete organisation.

System planning is publicized in Fig 3 as follows,

Configuration: Based on configuration details like number of nodes, area of simulation, deadlines for packet and transmission range, configuration module generates the TCL script and invokes on the simulator.

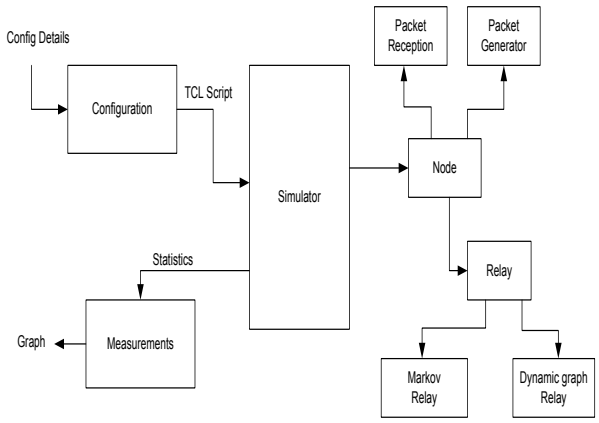

Fig. 3. System Architecture

Simulator: Node communicate through simulator module

Node: Node module has 3 applications,

- Packet Generator
- Packet Reception
- Relay Application

Packet Generator application generates and sends the multimedia packet ie source node at configured rate.

Packet Reception application receives the packet and compare the deadline of packet, with the receive time. If the packet is received at time it is accepted, if the packet misses the deadline the packet is dropped.

Relay application can be either implement Markov Chain approximation Scheduling approach or can implement Dynamic Graph Scheduling approach.

Measurements: collects the statistics i.e. the information from simulator, for example how many are sent or how many packets are dropped.

Based on this information the performance graph is drawn.

Data Flow Diagram

A Data Flow Diagram (DFD) is a pictorial demonstration of "stream" of data over a statistics organization. DFDs are being recycled for the conception of information handling (organized project). On a DFD, information objects moves from an exterior

data basis or an interior data basis to an inner data basis or an exterior data basis, through an inner procedure.

Level 0 DFD

A perspective level can also be called Level 0 DFD illustrates the interface amid the organization as well as exterior mediators that enact as documents bases and documents descends. Another context illustration is the system's interfaces with the external world are modeled virginally in terms of data flows across the system edge. The context Fig 4 illustrates the entire system as a distinctprocess, and gives no evidences as to its interiorgroup.

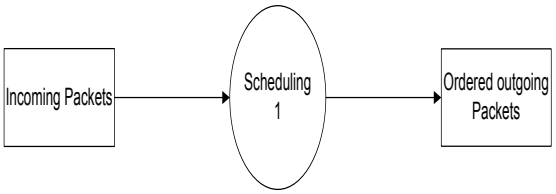

Fig 4: Level 0 DFD

Scheduling is the main process in the project where we need input as packets and give an output in ordering of packets. Here the input is Incoming Packets which under-go Scheduling process and the output is generated i.e. ordered outgoing packets

Level 1 DFD

Level 1 DFD illustrates the reason for division of the structure into sub-structures (procedures), everyone that contracts with one or the other of the data streams from an outward mediator either to an outward mediator, it also deliver total functions of the structure as a entire. It also recognizes interior data basis which should be existing in accordance to complete the task, and displays the stream of facts amid the numerous portions of the structure.

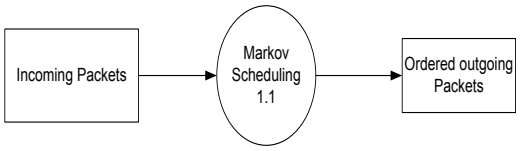

Fig 4.1: Level 1 DFD depicting Markov scheduling

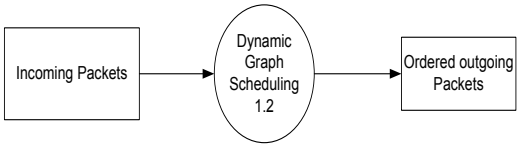

Fig 4.2: Level 1 DFD depicting Dynamic Graph scheduling

The incoming packets can undergo either Markov chain approximation scheduling method as showed in Fig 4.1 or dynamic graph method as showed in Fig 4.2 and generate the ordered outgoing packets.

Level 2 DFD

Level 2 DFD illustrates the division of sub structure into substitute procedures, every one of that treaties with one or the other of the records streams from an exterior agent, as well it provides total of the functions of the structure as an entire. Along with that it recognises interior data basis which should be existing in demand for the structure to perform the task, and illustrates the stream ofinformation amid the numerous fragments of the structure.

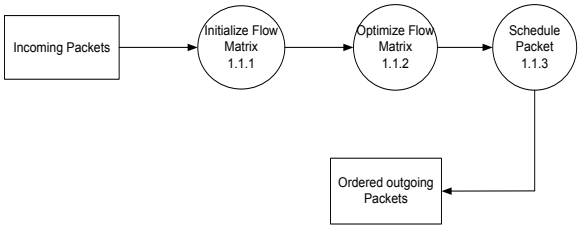

Fig 4.3: Level 2 DFD depicting Markov scheduling in detail

The Fig 4.3shows theLevel 2 DFD is the sub-process depicting the Markov chain approximation scheduling method, where firstly a flow matrix needs to initialized (1.1.1), further the initialized flow matrix needs to optimized (1.1.2) and later packet is scheduled (1.1.3).

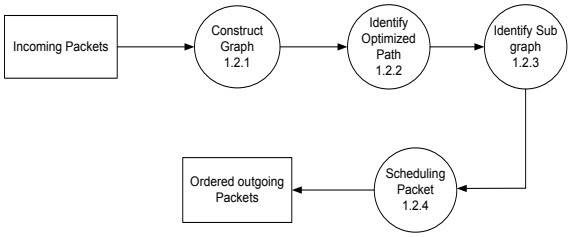

Fig 4.4: Level 1 DFD depicting Markov scheduling in detail

The Fig 4.4illustratesLevel 2 DFD is the sub-process depicting the Dynamic Graph scheduling method, where firstly a graph is constructed (1.2.1), further the optimized path is identified (1.2.2) then the sub graph (1.2.3) is identified and later packet is scheduled (1.2.4).

Class Diagram

A class figure in the Modeling Language (ML) is a type of stationary organisation figure which defines complete construction of a scheme which presents the attributes classes and their relation.

Class figure is illustrated in Fig 5 as follows,

Main class is the user interface class, in this main class the major functions are,

Create network
Add nodes
Start scheduling
Performance measure

Main class is the GUI interface class. The main class will have the sub class

NETWORK

- Initialize nodes()
- Add sources()
- Add destinations()

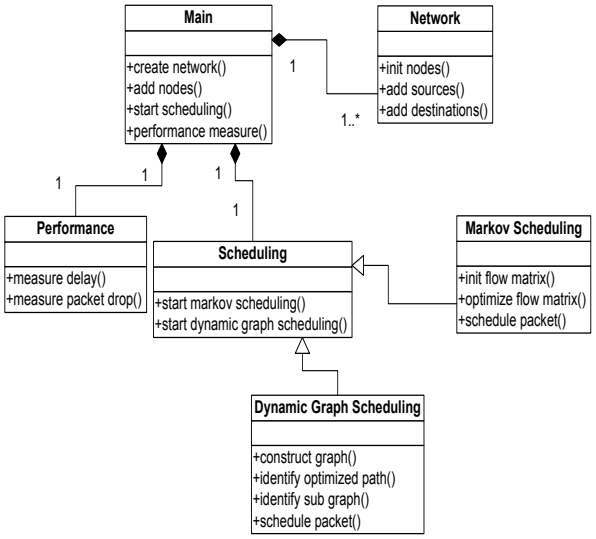

Fig 5: Class Diagram

SCHEDULING

Scheduling has two sub process called Markov Scheduling and Dynamic Graph Scheduling.

- Start Markov Scheduling()
- Start Dynamic Graph Scheduling()

PERFORMANCE

- Measure delay()
- Measure packet drop()

VII. CONCLUSION

Since the volume and characteristics of real-time multimedia data have different characters compared with the conventional generated data in WSNs, the corresponding features desire to be extracted. In this paper, packet arranging and broadcast with deadline constraints in multirate WMSNs by jointly combining ANC, CNC, PR, and NR have been focused. An optimized method has been formulated, by which we could select the optimal transmission method via exhaustive search. Since the computational convolution of the conveyed optimization problem is more, a Markov chain based approximation system is presented by moving the optimization problem to the form of the maximum weighted configuration problem. By constructing the graph the dynamic graph based method has been proposed for reducing computational complexity. Furthermore, with low computational complexity the proposed heuristic strategies can approach the optimal network performance effectively, this can be utilized for different network scenarios successfully.

Future work, with the problem of overcome the implementation problems from two aspects. In order to synchronize transmissions in PNC, one of the solution is to transfer the scheduling of PNC-based transmission from time domain to frequency domain. Another solution is to design coarse synchronization strategy and consider the effect of network performance brought by the node buffer.

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