Target-Controlled Packet Forecast and Communication in Wireless Multimedia Sensor Networks

S. Ambareesh and A. Neela Madheswari

Abstract The two main factors which are vital in present multimedia applications are Target-controlled packet forecast and communication. The degradation of Quality of Service (QoS) is because the packets miss their targets and become useless and are often dropped. As the consumption of real-time hypermedia applications and Internet of Things (IoT) has grown into more, multimedia data communication is a key cause to endorse the QoS of citizens. To accomplish the QoS prerequisite in Wireless Multimedia Sensor Networks (WMSNs) the mixture of multiple communication methods is stimulated for packet sending, counting Conventional Network Coding (CNC), Analog Network Coding (ANC), Plain Routing (PR) and Direct Broadcast (i.e., No-Relaying, NR). The combination and integration of communication methods lowers packet falling probability, but complicates the packet transferring and forecast process instead. Hence, an exhaustive search scheme is introduced to get the optimal forecast sequence and equivalent communication method for target constrained multimedia broadcasts in WMSNs. With respect to promote computing proficiency for the formulated problem, two heuristic methods based on Markov chain approximation and dynamic graph is proposed.

Keywords Quality of service · Target constrained packet scheduling and transmission · Wireless multimedia sensor networks

S. Ambareesh (✉)
CSE, Anna University, Chennai, Tamil Nadu, India
e-mail: ambihce@gmail.com

A. Neela Madheswari
CSE, Mahendra Engineering College, Mallasamudram, Tamil Nadu, India
e-mail: neela.madheswari@gmail.com

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1 Introduction

Wireless Multimedia Sensor Networks (WMSNs) are the networks of wirelessly connected sensor nodes which include multimedia devices, for example cameras, microphones and they are skilful to obtain video and audio streams, motionless 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 audio, visuals, animatronics, images, text, etc. The greatest illustrations are nonstop or connected mass media such as animatronics, audial and video that are built on time, i.e., each audio clip or video casing has a time duration linked with it, signifying the performance. Multimedia records should be accessible always in continuous manner, in authoritative in which they are related with their time stamp. E.g., 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. Figures 1 and 2 are the examples of real-time applications.

There are numerous 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 consume strict target restrictions and must reach at their termini before their limits. If they are reached on time, they turn into unacceptable and are fallen, which shrink and reduce the Quality of Service (QoS). It is the complete representation of a computer system, majorly it is the enactment visualized by the users of the system. Mainly 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 allocated into 8 sections, in which, Sect. 1 provides the introduction of WSN and WMSN.

Fig. 1 Video conferencing of real-time application

Fig. 2 Social networking sites of real-time application

Section 2 provides the detailed Literature Survey of latest peer reviewed papers related to WMSN. Section 3 provides the discussion on the Existing System. Section 4 provides the Problem Statement with respect to packet dropping node in WMSN. Section 5 provides the details of Proposed System with the approaches to minimize packet dropping in WMSN. Section 6 provides the detail System Architecture, Data Flow Diagram (DFD) and Class Diagram. Section 7 concludes research work with Future Enhancement. Section 8 provides References used for research work.

2 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 QoS warranty for hypermedia, the broadcast of multiple forms of information depends on a routing protocol. As there are numerous problems like inadequate network resources, complex procedures of multiple media presentations and dynamic fluctuations of network situation is an exciting 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 effective 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 is focused 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-constructed adaptive broadcast device is proposed to progress the system connectivity and quantity in Internet of Things (IoT) for smart cities. To make the network connectivity strong, a societal leaning double mart grounded relay medley scheme is explored to encourage the relay smartphones to transmit the packets for others. For gaining maximal throughput in IoT 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. First, by the friendship the social features of smartphones are modeled and a relay selection method has been offered. Secondly, to educate the interaction amongst NC and spatial recycle by synchronously triggering associations 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 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 Control (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 intake of the proposed method is higher to both the IEEE 802.15.4 standard and ESS system.

In [4], deterministic delay constraints are difficult to guarantee due to the fundamentally stochastic environment of wireless vanishing stations. 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 spread over 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 difficulty of fairness driven resource distribution is solved whereby the concept is to improve the lowest video quality through users.

Finally, user presence and forecast 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. The concept of effective capacity is used in this paper to provide a framework for statistical delay provisioning for multiple users sharing a wireless network. The resource distribution policies were prolonged to capture video quality based adaptive user subcarrier project in wideband networks as well as the effect of adaptive modulation and coding. This paper [6] focuses on the video quality driven resource sharing which are referenced where the comparable perceptual feature optimizations is proposed in a client based environment without contact to the reference. This has the main advantages that the user dignified video quality includes the effect of channel misrepresentations along with the source alterations which is opposite to the server dignified video quality which only imprisons source distortions. The quality assessment to the user is enabled which shrinks the server capacity and ignores upholding a large session state for each user at the server.

3 Existing System

For lowering of packet communication interrupt in WMSNs, some work has been made on unlike facets, such as QoS-based routing mechanisms, target concerned stand in line approaches [7] in relays, well-organized access approaches in Media Access Control (MAC) layer [8], and cross-layer optimization procedures that not only reflect the transmission rate in physical layer systematically [9], but also relaying method in network layer. Even though some QoS methods have been specified in IEEE 802.15.4 standard [10] for WSNs, the difficulty of endwise interval quiet resides. The supportive MAC protocol aimed at on-time data broadcast was discovered in [11], which mainly concentrates on the inspiration aided method in star net topology and can be seen as a thoughtful of complement of IEEE 802.15.4 regular standard. A multi-user system for users with interruption QoS limitations has stayed measured in [12], and the supply division rule has also been extracted for sum video worth improvement.

It is broadly addresses that Predictable non-physical-layer Network Coding (NC) prominently improves the grid material when packet target restrictions are not measured [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, NC is likewise one of the efficient solutions to hand the problem of packet broadcast with limited restrictions with supportive

communications. But, the decrypting interval in CNC may be higher if the terminus nodes cannot obtain enough amount of packets for deciphering [14].

Hence, CNC ought to be cautiously applied in target-controlled packet communications. Compared with CNC, Analog Network Coding (ANC), as a kind of Physical layer Network Coding (PNC), can be added lower diffusion time by permitting two signals to be communicated instantaneously on or after the spring nodules and depend one upon another at the relay nodule [15]. However, ANC has further severe restraints on network topologies (star, mesh, bus, etc.,) and channel conditions. Hence, it is stimulated to combine the unlike program approaches to fullfill their benefits.

4 Problem Statement

This paper 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 neutral is to find a superlative system adaptively to reduce the amount of packets mislaid their limits rendering to dissimilar 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.

5 Proposed System

In direction to agreement with present programs in multi-rate WMSNs, an adaptive incorporation system for unlike communication approaches is proposed, counting CNC, ANC, PR, and NR. Two methods one based on Markov Chain and other based on Dynamic Chart method are proposed, to top quality the optimum transmission approaches and series of packets.

5.1 Markov Chain Approximation Approach

Markov guesstimate has been used to answer the Extreme Biased Configuration delinquent [16, 17], such as, scheming the Carrier Sense Multiple Access (CSMA) device to attain the optimum throughput, selecting path in wire line networks, or deciphering the channel assignment problem in wireless LANs. Many real and key

complications can be communicated in the practice of Extreme Biased Configuration delinquent, and so is the optimization problem in this paper. Markov guesstimate method obtains the procedures which are very adjacent to the finest outcomes, when the amount of formal conversions is huge ample. As the extent of the states, i.e., the likely arrangement and broadcast systems, growths hastily by total number of packets, and the parallel density is still very great which is illustrated. Furthermore, a method with less computational complexity is extracted. 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 t_i 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 in 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.

5.2 Dynamic Chart Method

The Dynamic grid centered methodology is introduced and delinquent is solved by building a chart for the collection of suitable packet(s) of each broadcast. Dynamic graph approach is based on following statements,

- Statement 1: Amongst the total optimum well-ordered set barriers, the unintentional that additional packages are supportively transferred through CNC is infrequent.
- Statement 2: In PNC-based optimal ordered set barriers, once a packet in one subset misses its target, the packet(s) in its subsequent subset(s) will also miss its targets, if any.

Hence, based on the overhead statements, three directions on packet forecast 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 among the number of packets in the division and the number of fallen packets affected by this broadcast. The subset with the maximum broadcast efficiency should be organized with the maximum importance.

6 System Design

6.1 System Architecture

System architecture also called as system planning is the intangible strategy that defines the anatomy and performance of an organization. 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 organization.

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.

Simulator Node communicate through simulator module.

Node Node module has three applications,

- Packet Generator: Packet Generator application generates and sends the multimedia packet, i.e., source node at configured rate.
- Packet Reception: 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: 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.

System planning is publicized in Fig. 3 as follows.

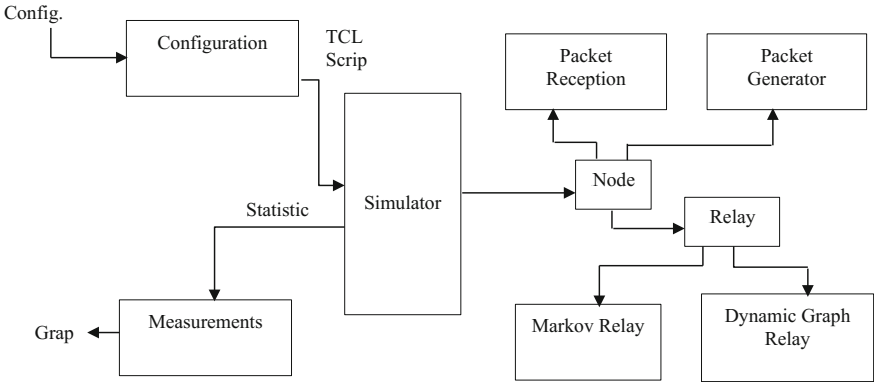

Fig. 3 System architecture

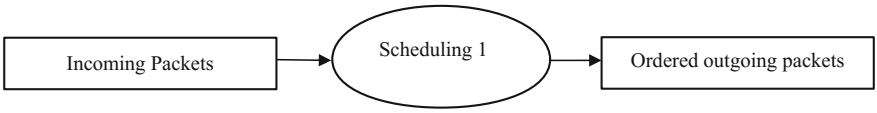

Fig. 4 Level 0 DFD

6.2 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.

6.3 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 distinct process, and gives no evidences as to its interior group.

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 undergo Scheduling process and the output is generated, i.e., ordered outgoing packets.

6.4 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 an 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.

The incoming packets can undergo either Markov chain approximation scheduling method as showed in Fig. 5 or dynamic graph method as showed in Fig. 6 and generate the ordered outgoing packets.

Fig. 5 Level 1 DFD depicting Markov scheduling

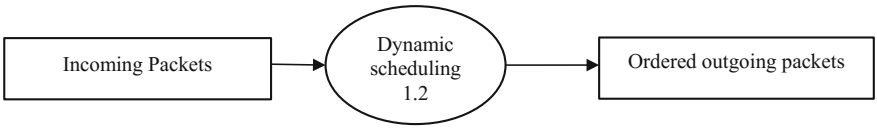

Fig. 6 Level 1 DFD depicting dynamic graph scheduling

6.5 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 recognizes interior data basis which should be existing in demand for the structure to perform the task, and illustrates the stream of information amid the numerous fragments of the structure.

Figure. 7 shows the Level 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).

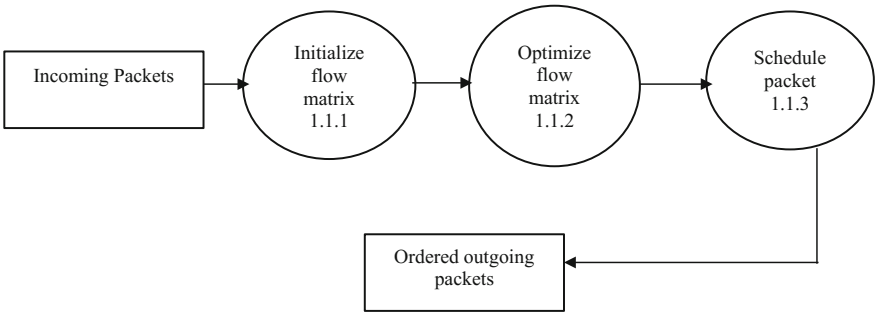

Fig. 7 Level 2 DFD depicting Markov scheduling in detail

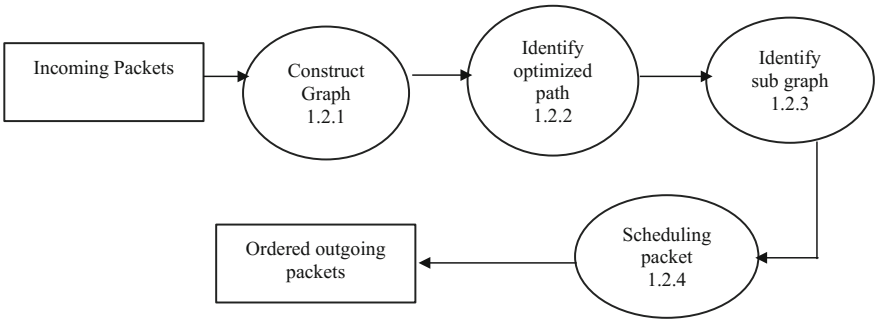

Fig. 8 Level 1 DFD depicting Markov scheduling in detail

Figure. 8 illustrates Level 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).

6.6 Class Diagram

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

Class figure is illustrated in Fig. 9 as follows,

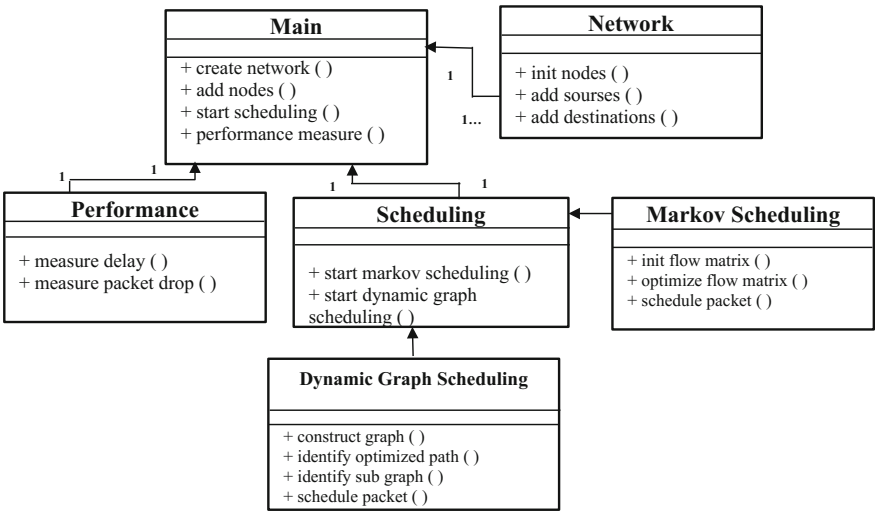

Fig. 9 Class diagram

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 ()

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 ()

7 Conclusion

In this paper, packet arranging and broadcast with time limit restrictions in multi-rate WMSNs by conjointly linking ANC, CNC, PR, and NR have been focused. An optimized method has been formulated, by which we can excellent the ideal diffusion scheme via exhaustive search. Meanwhile, the computational convolution of the conveyed optimization anomaly is more, a Markov chain constructed estimate system is offered by moving the optimization badly behaved in the form of the extremely biased conformation tricky. By constructing the graph the dynamic grid based technique was offered for reducing computational complexity. Furthermore, with low computational complexity the suggested heuristic policies can tactic the optimal network concert efficiently, this can be developed for unlike network consequences successfully.

In future work, with the problem of overcome the implementation problematic from two facets. In command to coordinate programs in PNC, one of the result is to transfer the forecast of PNC-created communication from time domain to frequency domain. Alternative solution is to plan abrasive management policy and study the outcome of network presentation carried by the node barrier.

References

1. Shen, H., & Bai, G. (2016). Routing in wireless multimedia sensor networks: A survey and challenges ahead. *Journal of Network and Computer Applications*.
2. Ning, Z., Xia, F., Hu, X., Chen, Z., & Obaidat, M. (2016). Social-oriented adaptive transmission in opportunistic internet of smartphones, accepted. In *IEEE Transactions on Industrial Informatics*.
3. Kim, J., Barrado, J., & Jeon, D. (2015). An energy-efficient transmission scheme for real-time data in wireless sensor networks. *Sensors*.
4. Khalek, A., Caramanis, C., & Heath, R. (2015). Delay-constrained video transmission: Quality driven resource allocation and scheduling. In *IEEE Journal of Selected Topics in Signal Processing*.
5. Fortino, G., & Trunfio, P. (2014). *Internet of things based on smart objects: Technology, middleware and applications*. Springer.
6. Chen, H., Chan, H., Chan, C., & Leung, V. (2013). QoS-based cross-layer scheduling for wireless multimedia transmissions with adaptive modulation and coding. In *IEEE Transactions on Communications*.
7. Xiao, Y., Thulasiraman, K., Fang, X., Yang, D., & Xue, G. (2012). Computing a most probable delay constrained path: NP-hardness and approximation schemes. In *IEEE Transactions on Computers*, May 2012.
8. Mao, Z., Koksal, C., & Shroff, N. (2013). Online packet scheduling with hard deadlines in multi-hop communication networks. In *Proceedings IEEE*, April 2013.
9. Anbagi, I. S., Erol-Kantarci, M., & Mouftah, H. T. (2014). Delay-aware medium access schemes for WSN-based partial discharge measurement. In *IEEE Transactions on Instrumentation and Measurement*.
10. Ning, Z., Song, Q., Guo, L., Chen, Z., & Jamalipour, A. (2016). Integration of scheduling and network coding in multi-rate wireless mesh networks: Optimization models and algorithms. *Ad Hoc Networks*.
11. Mali, G., & Misra, S. (2016). TRAST: Trust-based distributed topology management for wireless multimedia sensor networks. In *IEEE Transactions on Computers*.
12. Ning, Z., Liu, L., & Xia, F. (2016). CAIS: A copy adjustable incentive scheme in community-based socially-aware networking. In *IEEE Transactions on Vehicular Technology*.
13. Li, X., Wang, C.-C., & Lin, X. (2011). On the capacity of immediately decodable coding schemes for wireless stored-video broadcast with hard deadline constraints. In *IEEE Journal on Selected Areas in Communications*, May 2011.
14. Yeow, W.-L., Hoang, A. T., & Tham, C.-K. (2009). Minimizing delay for multicast-streaming in wireless networks with network coding. In *INFOCOM*, IEEE, April 2009.
15. Katti, S., Gollakota, S., & Katabi, D. (2007, October). Embracing wireless interference: Analog network coding. *ACM SIGCOMM Computer Communication Review*.
16. Zhan, C., & Xu, Y. (2010). Broadcast scheduling based on network coding in time critical wireless networks. In *IEEE International Symposium on Network Coding (NetCod)*, June 2010.
17. Wang, X., Yuen, C., & Xu, Y. (2012). Joint rate selection and wireless network coding for time critical applications. In *Wireless Communications and Networking Conference (WCNC)*, IEEE, April 2012.