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Performance Analysis of WMSN Based on Distinct Quality Based Routing Protocols

Dr. P. Bindhu Madhavi

Abstract

Wireless Multimedia Sensor Networks are more dominant distributed systems which belong to an exceptional type of WSN. Like WSN, WMSN network also consist of wireless portable interrelated sensor nodes for data collection, transmission and processing in different application areas. In real the multimedia sensor networks can handle normal data as well as multimedia data, such as image, audio, and video streams. Many routing protocols have been developed for WMSN like WSN to handle variety of data in wireless networks. This paper demonstrates the comparative performance analysis of different quality oriented protocols used in WMSN.

Keywords: WMSN, Qos Routing Protocols, Performance Metrics

Introduction

Wireless multimedia sensor networks (WMSNs) are an exceptional type of WSN which includes audio and video sensors integrated into wireless sensor nodes. Like normal sensor nodes these integrated nodes are also used to provide information about climate, pressure, temperature etc to monitor physical and environmental conditions. Different types of Routing protocols are used based on the design, processing, routing and topology to handle variety of data in wireless networks [4]. In WMSN the selection of routing protocol depends on the type of network application and routing approach. The performance of WMSN depends on the integrated video and audio sensors which improves the reliability and flexibility of application through standard operations and also extract data depending on the requirements of the application. WMSN can be classified into various classes:

(a) Flat and uniform single layered architecture

(b) Clustered and Miscellaneous single layered architecture

(c) Miscellaneous Multi layer architecture.

In Flat and uniform single layered architecture, set of nodes with related substantial capabilities are used [2] for distributed data processing. In Clustered and Miscellaneous single layered architecture, cluster heads (CHs) are used which are set of nodes with different speciation's, such as processing power, ability, batteries, and so on.

Through this architecture nodes communicate with CHs, for data transmission and processing to the base station through network. The information is put away in the central storage point. In Miscellaneous Multi layer architecture; there are numerous layers of hubs with various type of processing tasks at each layer. Here the information is handled and put away in a distributed manner.

WMSN ROUTING PROTOCOLS

As per the current trends in research, various routing protocols have been proposed in WMSN based on the type of Quality constraints [9]. These protocols maintain Quality of Service through quantitative performance parameters and are called as QoS based routing protocols.

QoS Based Routing:

Qos based routing protocols are primarily divided into latency constrained and multi constrained routing protocols [1]. Again, based on the time limitations, latency constrained routing protocols are sub divided into hard-real- time (HRT), soft-real-time (SRT), and firm-real-time (FRT) [7, 8].

QoS requirement for WMSNs is a set of constraints like reliability, latency, and bandwidth. Classification

of different quality based routing protocols for WMSNs is shown in Figure 1.

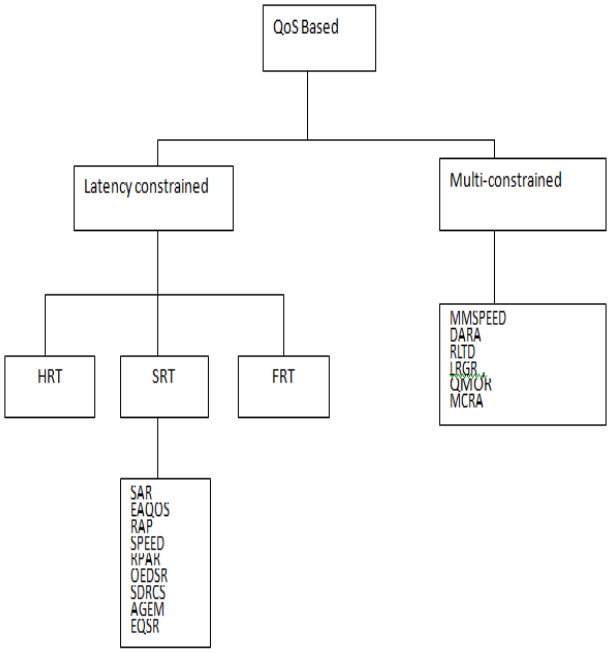

Figure 1: Classification of routing protocols in WMSNs.

Latency Based Constrained Routing.

Latency based routing is further divided into HRT, SRT and FRT based routing protocols. In HRT based systems, failure occurs due the arrival of packets after the predefined delay deadline [7, 8]. Because of lossy connections and mistakes inclined medium, it is practically difficult to ensure HRT in WMSNs. In SRT based systems, the delay limit is acceptable for some missing packet, but in order to restrain the system from a crash probabilistic delay guarantee is mandatory. There are different protocols that can give delay limit guarantees needed and furnish the data packets in SRT. Firm idea is presented in FRT based systems which requests in any event m out of k sequential messages must convey before their postpone due date else it is considered as a framework disappointment. Hence it is important to execute priority based planning of stream parcels In [10], Distance based Priority (DBP) arrangement is utilized to pick between streams. The framework keeps up DBP state for each stream DBP is typically figured at the sink and is utilized to assess the stream not for need task. Recent work in [11] tires to execute cross layer answers for enhance steering.

HRT Based Protocols: The paper proposed delay-obliged steering convention. The principle objective of the convention is to give hard ongoing defer ensures and limit the vitality utilization inside WMSNs. The proposed calculation utilizes worldwide connection state steering calculation, which needs total learning of system topology with a specific end goal to process most ideal ways. The calculation is isolated into three sections.

The initial segment ejects the node with less lingering vitality from the diagram. The second part utilizes Dijkstra calculation keeping in mind the end goal to discover vitality productive courses. At that point, the third part guarantees that every one of the ways meet defer upper bound. In the event that a way does not meet defer limitations, and then another way is registered utilizing Dijkstra calculation and postponement as an execution metric.

Key components of HRT based protocols are as the follows:

(i) It utilizes a global state routing algorithm.

(ii) It concentrates on energy efficiency and QoS.

(iii) It figures delay compelled slightest vitality consumption tree utilizing the Dijkstra calculation.

(iv) It is a multipath and fault-tolerant routing protocol.

The proposed convention ensures hard-continuous defer limits. Be that as it may, the state data traded between hubs expends a tremendous measure of memory and transmission capacity. It is hard to store and keep up state data in expansive WMSNs. Subsequently, it is reasonable for small WMSNs.

(2) SRT Based Protocols: Sequential assignment routing (SAR) [12] considers both QoS and vitality proficiency in course choice process. The primary goal of SAR calculation is to limit the normal weighted QoS metric all through the lifetime of the system. Weighted QoS metric is registered as the result of added substance QoS metric and weight coefficient related with a need level. SAR calculation chooses uncommon hub called the central node (CN) to perform more refined information preparing. Failure recovery in SAR uses a handshaking procedure which enforces table consistency among neighbors. It utilizes Single Winner Election (SWE) calculation and spreading over tree (ST) calculation.

ST calculation figures a base jump crossing tree established at CN. Failure recovery in SAR uses a handshaking technique which maintains table consistency among neighbors. In the event that there is a way disappointment, then a recomputation technique is activated naturally.

SNR utilizes two helpful flag handling strategies: no coherent and reasonable. Broad recreation done in [13] demonstrates that SAR has preferred execution over the base metric calculation.

Key components of SRT based protocols are as the follows:

(i) It is a table driven routing protocol.

(ii) It is both a QoS based and an energy efficient protocol.

(iii) It is a multipath and fault-tolerant routing protocol.

The major drawback of SAR is that it is a table driven protocol and hence it is non scalable. If the number of nodes increases, then the overhead of maintaining the routing table and status information increases drastically [1].

Energy-aware QoS (EAQoS) [14] finds the optimal path to the destination in terms of energy consumption and error rate while meeting the end-to-end delay requirements. EAQoS specifies a queuing model which can handle both nonreal-time and real-time traffic. The implemented queuing model is inspired from class based queuing model [15]. A cost function is associated for each link. This cost function is defined to capture various parameters such as residual energy, transmission energy, and end-to-end delay. EAQoS finds K least cost paths using an extended version of Dijkstra's algorithm. Then, only those paths are chosen that meet the required QoS requirement and maximize network throughput. The cost of each path between nodes is stored. For every discovered path, a tree-like structure is created and total cost of the path between the nodes is recorded. The algorithm terminates when K shortest paths are discovered. If a new path is searched for a particular destination, then only node- disjoint paths are considered. This helps in reducing the congestion over newly found path due to former path.

Key components of SRT based protocols are as the follows:

(i) It is cluster based energy efficient and delay-constrained routing protocol.

(ii) It facilitates both real-time and non real-time best effort traffic simultaneously.

(iii) It ensures guaranteed bandwidth and most energy efficient paths.

(iv) The use of node-disjoint paths helps in reducing congestion over the newly found path.

EAQoS does not treat different real-time traffic separately; therefore, it cannot be used for applications that coexist with other multimedia traffic.

Real-Time Communication Architecture for Large-Scale WSN (RAP) [16] is a priority based, localized routing protocol, which provides soft-real-time delay bounds. RAP introduced a novel packet scheduling policy, Velocity Monotonic Scheduling (VMS). VMS[3][5] schedules packets according to their requested velocity. RAP supports both query oriented and event oriented services. Extensive simulation shows that RAP outperforms DSR [17] and GF [18].

Key features are as follows:

(i) It is a location dependent routing protocol, which implements both VMS and GF.

(ii) It provides soft-real-time delay bound guarantees.

(iii) It provides both query and event based service APIs.

(iv) It is a scalable protocol for multimedia applications.

There is no need to maintain neighbor database and hence the routing overhead is very little as compared to other classical routing algorithms. RAP uses GF, which can deplete the bandwidth quickly. Also, it does not consider hop-count as routing metric and there is no direct metric to show energy conservation [1].

Stateless Protocol for Real-Time Communication (SPEED) [19][6] is a stateless, localized, soft-real-time delay bounded protocol, which requires minimum MAC layer support for QoS based routing. Stateless Nondeterministic Geographic Forwarding (SNGF) method is used for routing in SPEED. SNGF maintains desired delivery speed and traffic balance, to reduce the network congestion. MAC layer adaptation of SNGF drops packets in case of congestion. If congestion remains for a long time, then traffic is redirected to a less congested area. SNGF uses four modules.

(1)Beacon Exchange: SNGF uses two extra beacons. One beacon is for delay estimation and the other is for back pressure.

(ii) Delay Estimation. Round trip single hop delay for each packet is calculated at the sender's site after receiving ACK.

(iii) Neighborhood Feedback Loop (NFL). NFL maintains system performance by maintaining single hop relay speed above a fixed value.

(iv) Back Pressure Rerouting. This module is used to reduce congestion in the network.

Key components of SNGF based protocols are as the follows:

(i) It is an energy efficient and localized routing protocol.

(ii) It handles congestion and provides soft-real-time

delay bounds.

(iii) It avoids the void problem.

(iv) It also supports load balancing.

SPEED uses nondeterministic geographic forwarding and it maintains only localized database. As a result, the routing overhead is minimized. But SPEED is non scalable as it uses the idea of per-flow reservation [1], and its performance degrades when it encounters a large hole and sudden congestion.

Real-time Power-Aware Routing (RPAR) [20] protocol can achieve application specific delay requirements by dynamically adjusting transmission power and other routing metrics. RPAR looks into various serious issues such as network scalability and memory and bandwidth constraints. RPAR have four components: neighborhood manager, delay estimator, forwarding policy, and velocity assignment policy. The delay estimator supports real-time multi-media traffic. It further supports two mechanisms: (1) Power Adaptation and (2) neighbor discovery. The delay estimator

Estimation of delay in contention and number of transmission counts using Jacobson's algorithm. The retransmission timeout is computed by Jacobson's algorithm wherein the average and estimated variable are used. Holes and congestion are handled by RPAR.SPEED, MMSPED and LAP Care related to RPAR. It can be considered different from others because it integrates power efficiency, supports real time communication, handles noisy links and favors novel neighborhood management mechanism. Power consumption can be reduced by Neighborhood Management and Forwarding Policy. Large Holes and sudden Congestion however degrades RPAR's performance.

The information from the CHs to the base station is routed using multihop fashion using the Optimized energy-delay sub network routing (OEDSR), which is a cluster based and event driven routing protocol. The concept of energy-delay metric in OEDR is borrowed by OESDR routing protocol. Available Energy end to end delay corresponding distance depends on the routing decisions: The implementation of loop free routes is ensured by the above protocol. A tem portray header (TH) selected on the basis of maximum available energy is used in calculation and selection of number of CHs in OEDSR protocol. All the information about CHs is broadcasted using the TH after the selection of CHs, thereafter becoming a regular node. Hop-count is not taken as an integral part of the routing metrics. Key features of OEDSR ,DSR and AODV are as follows:

(i) An efficient, proactive cluster based routing algorithm

(ii) Event driven services are well supported.

(iii) The delivery of data is accomplished within delay deadlines, being a multipath and energy efficient protocol.

The cumulative product of available energy average end-end delay is also minimized using the OEDSR, as the number of accessible channel nodes are significantly reduced, the total number of collisions is also minimized.

An event driven routing scheme, Service differentiated real-time communication scheme is known for its unique property for real time traffic routing. Two of the forwarding techniques via Dynamic Forwarding and CSMA/CA are an integrated functionality of the SDRCS. Novel polling contention period based prioritized MAC is one of the techniques used by SDRCS. Bandwidth utilization is highly improved by this design even if there underlies more than four categories.

The formulated protocol also favors light weight packet schedulability estimation mechanism. This makes use of Polling Contention method and techniques related to receive signal strength signal based grouping.

RSS based techniques are used in the grouping mechanism so as to stop layering of the sensor fields

Grouping Granularity is used in order to felicitate the accuracy of distance measures (GRA).

Per-Hop deadline Based Queue is implemented as the prior queuing policy in SDRCS .Packet scheduling of packets is felicitated using FIFO priority queues. Only a limited number of traffic classes' cancan is provided using contention period based MAC. The dropping mechanism of unscheduled packets is implemented using Early Deadline Miss (EDM) policy. SDRCS outperforms MMSPEED and RAP, comparision of throughput, on-time delivery ratio and energy efficiency.

Some of the key features are listed below:

(i) Outlined Routing Protocol is event driven.

(ii) Localization can be achieved without utilization of extra hardware.

(iii) Wide adaptability to network dynamics, examples include channel void and channel quality.

(iv) Multimedia traffic is achieved using cross-layer packet forwarding technique.

(v) Efficient avoiding of voids.

False packet drops can be avoided using SDRCS, usually occurring due to EDM. Location based routing protocols for WMSNs such as Adaptive Greedy-Compass Energy-Aware Multipath (AGEM) are the advanced version of GPSR. The lifetime of the network and balanced queue size of nodes are felicitated by the load balancing feature of AGEM. This is achieved using adaptive greedy compass policy. Selection of only a subset of neighbors is achieved using Adaptive Greedy compass policy. There are two modes of Forwarding Packets of stream of AGEM protocol: (1) smart greedy forwarding and (2) walking back forwarding. GPS or Distributed localization techniques are utilized by the nodes to gather positional information. AGEM outlooks GPSR in accordance to packet-loss, transmission delay and energy efficiency.

The Key features are enlisted below:

(i) The protocol is a location based protocol that emphasizes on Multipath routing.

(ii) The protocol makes use of adaptive greedy compass policy.

(iii) Static and mobile sensor networks can be formulated

(iv) Minimum end-end delay is established using shortest path

Different paths are used for streaming of data in AGEM; this prevents the dying of the mostly used nodes due to energy depletion. For small network size the mean energy consumption for AGEM is greater when compared to GPSR. The routing metrics constitutes of residual energy, available buffer size and signal to noise ratio (SNR) in EQSR. XOR based FEC (forward error correction) technique provides increased reliability factor in EQSR. The real time traffic and normal time traffic is handled in EQSR using queuing model. Utilization of max available network resources is felicitated by network-disjoint paths. Initialization phase, primary path setup phase, and alternate path setup phase are the path discovery phases of EQSR.

Link cost function is used to determine the preferred next hop; this is enabled by using line cost functions.

Before transmission of data the segmentation of data is performed in order to divide the packets into equal sized units. The second phase comprises of error correction code which is added by the allocation scheme. This prevents the node failures and failure recovery, scheduling process, traffic. EQSR outperforms MCMP and RAP [8] based on the features discussed below:

The Key features are enlisted below:

(i) Protocol favors energy efficient multipath routing.
(ii) Real-time and non real-time traffic is effectively handled.

(iii) Reliability of the network is increased using FEC codes.

EQSR in case of node failures adds mechanisms that avoid network-wide flooding of route discovery. It also reduces overhead due to route update messages. Utilization of FEC codes increases redundancy however it reduces the overhead of routing complications.

(3) FRT Based Protocols. Paper [7] illustrates a real-time fault-tolerant mechanism; Local Status Indicator (LSI) is utilized to achieve application QoS requirement .Network faults can be detected along with the local condition of nodes using LSI. Each of the nodes dynamically adjusts its capabilities which further aims to attenuate degradation of performance.

Conclusions

This paper presents review of different QoS routing

protocols, their analytical comparisons and for WMSNs, with summarized description and properties of each algorithm. QoS routing algorithms can be characterized based on different measures however that could make order more unpredictable so to maintain simplicity, protocols are arranged based on classifications in order to solve various problems in routing for WMSNs.

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Author's details

Associate Professor, Department of ISE, T. John Institute of Technology, Bangalore, Karnataka, India, bindumadavi@tjohngoup.com