Comparative Study of Routing Protocols for Wireless Multimedia Sensor Networks

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Certificate

This is to certify that the seminar entitled **Comparative Study of Routing Protocols for WMSN** submitted by **Ohm Trivedi (12BCE054)** towards the partial fulfillment of the requirements for the degree of Bachelor of Technology in Computer Science and Engineering of Nirma University, Ahmedabad is the record of work carried out by him under my supervision and guidance. In my opinion, the submitted work has reached a level required for being accepted for examination. The results embodied in this seminar, to the best of my knowledge, haven't been submitted to any other university or institution for award of any degree or diploma.

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Abstract

Wireless multimedia sensor networks (WMSNs) are a newly developed type of sensor network which has the sensor nodes equipped with cameras, microphones, and other sensors producing multimedia data content. WMSN enhances existing WSN applications and enables a new large range of applications, like multimedia surveillance, traffic management, automated assistance, environmental monitoring, and industrial process control. WMSNs have more additional features and requirements than WSN, such as high bandwidth demand, bounded delay, acceptable jitter, and low packet loss ratio. These characteristics impose more resource constraints that involve energy consumption, memory, buffer size, bandwidth, and processing capabilities.

Routing protocols designed for WMSNs must take into consideration the requirements and resource constraints nature of WMSN, in order to meet the tight QoS requirements. In this paper, various existing Routing Protocols have been discussed and also a brief comparison is provided between them.

Chapter 1

Introduction

1.1 Wireless Multimedia Sensor Networks

The availability of inexpensive hardware such as CMOS cameras and microphones has fostered the development of Wireless Multimedia Sensor Networks (WMSNs), i.e., networks of wirelessly interconnected devices that are able to ubiquitously retrieve multimedia content such as video and audio streams, still images, and scalar sensor data from the environment.
The first step in creating a WMSN is equipping a single sensor device with audio and visual information collection modules. As an example, the Cyclops image capturing and inference module, is designed for extremely light-weight imaging and can be interfaced with a host mote such as Crossbow's MICA2 or MICAz. In addition to the ability to retrieve multimedia data, WMSNs will also be able to store, process in real time, correlate and fuse multimedia data originated from heterogeneous sources. Wireless multimedia sensor networks will not only enhance existing sensor network applications such as tracking, home automation, and environmental monitoring, but they will also enable several new applications such as:

- **Multimedia Surveillance Sensor Networks:** Video and audio sensors will be used to enhance and complement existing surveillance systems against crime and terrorist attacks. Large scale networks of video sensors can extend the ability of law enforcement agencies to monitor areas, public events, private properties and borders.

- **Traffic Congestion Avoidance Systems:** It will be possible to monitor car traffic in big cities or highways and deploy services that offer traffic routing advice to avoid congestion. Automated parking assistance is another possible related application.

- **Advanced Health Care Delivery:** Telemedicine sensor networks can be integrated with 3G multimedia networks to provide ubiquitous health care services. Patients will carry medical sensors to monitor parameters such as body temperature, blood pressure, pulse oximetry, ECG, breathing activity. Similarly, elderly and family monitors will help in providing timely and essential support to the less able sections of society.

- **Industrial Process Control:** Multimedia content such as imaging, temperature, or pressure amongst others, may be used for time-critical industrial process control. The integration of machine vision systems with WMSNs can simplify and add flexibility to systems for visual inspections and automated actions that require high-speed, high-magnification, and continuous operation.

Many of the above applications require the sensor network paradigm to be re-thought in view of the need for mechanisms to deliver multimedia content with a certain level of quality of service (QoS). Since the need to minimize the energy consumption has driven most of the research in sensor networks so far, mechanisms to efficiently deliver application-level QoS, and to map these requirements to network-layer metrics such as latency and jitter, have not been primary concerns in mainstream research on sensor networks.

1.2 Applications

The purpose of existence of WMSNs can be summarized as follows. To provide:

- Predictive Maintenance
- Energy Saving Smart Grid
- High-Confidence Transport and Asset Tracking
- Intelligent Buildings
- Improve Productivity
- Enable New Knowledge
- Improve Food and H2O
- Enhanced Safety & Security
- Smart Home
- Healthcare

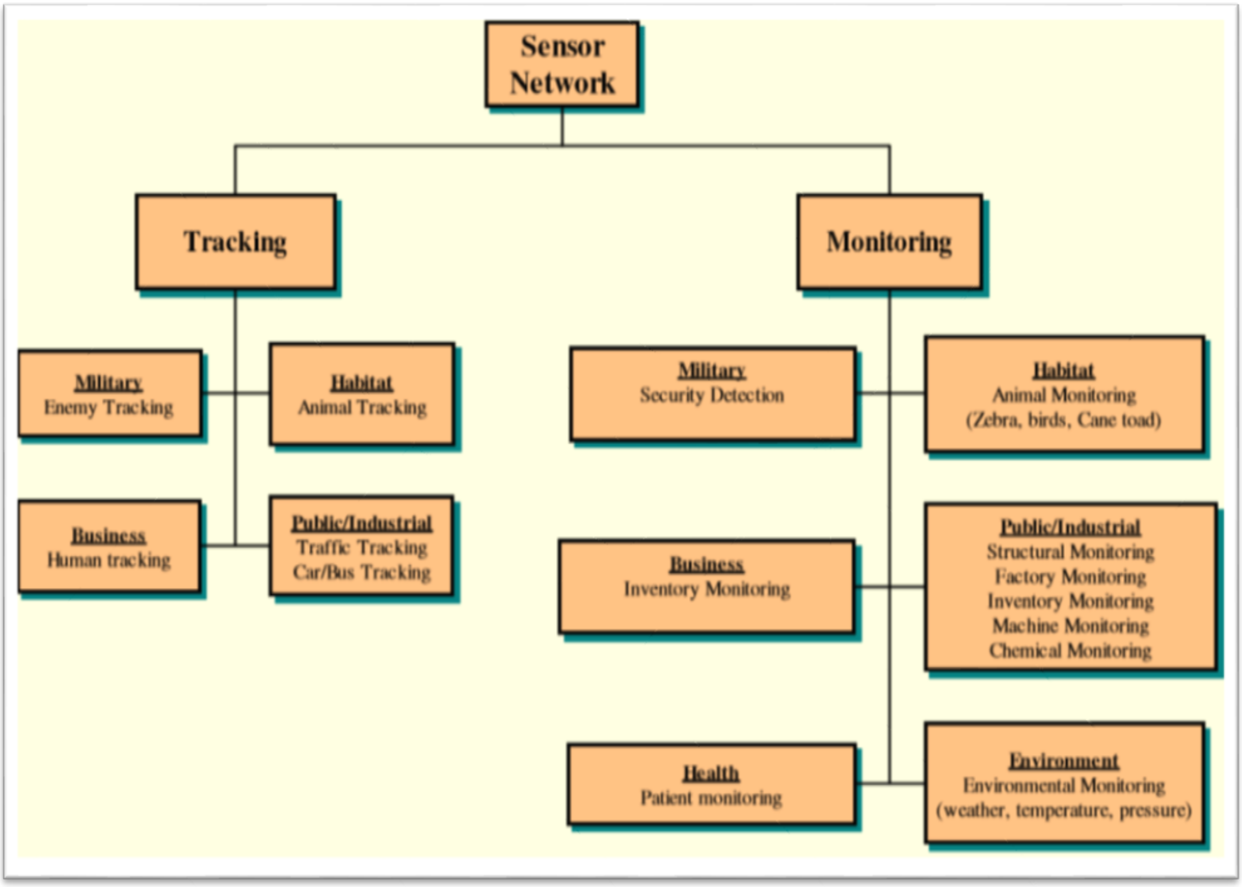

Figure 1.1: Applications of WMSNs

One of the applications of WMSNs is in Vehicles and Traffic Trekking, Figure 1.2. They receive live information from the road authority about the state of the roads, including traffic jams, accidents and weather. The car transmits information to the road authority regarding speed, distance travelled, use of windscreen wipers, etc. Another application is ZebraNet, an application to track zebras on the field, Figure 1.3. The objective of the application is to gather dynamic data about zebra positions in order to understand their mobility patterns. The sensors are deployed in collars that are carried by the animals. The users are the biologists.

1.3 Design of WMSNs

The factors influencing the design of multimedia sensor networks are as follows:

- **Application-specific QoS requirements:** The various applications of WMSNs have varied requirements. Also, multimedia data include *snapshot* and *streaming multimedia* content. Snapshot-type multimedia data contain event triggered observations obtained in a short period of time. Streaming multimedia content

Figure 1.2: Traffic Trekking and Vehicle Trekking

Figure 1.3: ZebraNet

is generated over longer time periods and requires sustained information delivery.

- **High bandwidth demand:** Multimedia content, especially video streams, require transmission bandwidth that is orders of magnitude higher than that supported by by currently available sensors.

- **Multimedia source coding techniques:** Uncompressed raw video streams require excessive bandwidth for a multi-hop wireless environment. Hence, it is apparent that efficient processing techniques for lossy compression are necessary for WMSNs.

- **Multimedia in-network processing:** WMSNs allow performing multimedia in-network processing algorithms on the raw data extracted from the environment.The benefit of this is that the system scalability may increase because of reduction in transmission of redundant information, merging data oriented from multiple views, on different media, and with multiple resolutions. Hence, it is necessary to develop application-independent architectures to flexibly perform in-network processing of the multimedia content gathered from the environment.

- **Power consumption:** Sensors are battery-constrained devices, and multimedia applications produce high volumes of data, which require high transmission rates, and extensive processing.

- **Flexible architecture to support heterogeneous applications:** WMSN architectures will support several heterogeneous and independent applications with different requirements. It is necessary to develop flexible, hierarchical architectures that can accommodate the requirements of all the these applications in the same infrastructure.

- **Multimedia coverage:** Multimedia sensors, in particular video sensors, have larger sensing radii and are sensitive to direction of acquisition (directivity). Also, video sensors can capture images only when there is unobstructed line of sight between the event and the sensor. Hence, coverage models of traditional wireless sensor networks are not sufficient for WMSNs.

- **Integration with Internet (IP) architecture:** Sensor networks can also provide services which allow querying the network to retrieve useful information from anywhere and at any time. For this reason, future WMSNs should be remotely accessible from the Internet, and therefore will need to be integrated with the IP architecture.

- **Integration with other wireless technologies:** Large-scale sensor networks may be created by interconnecting local "islands" of sensors through other wireless technologies. This needs to be achieved without sacrificing on the efficiency of the operation within each individual technology.

1.4 Network Architecture

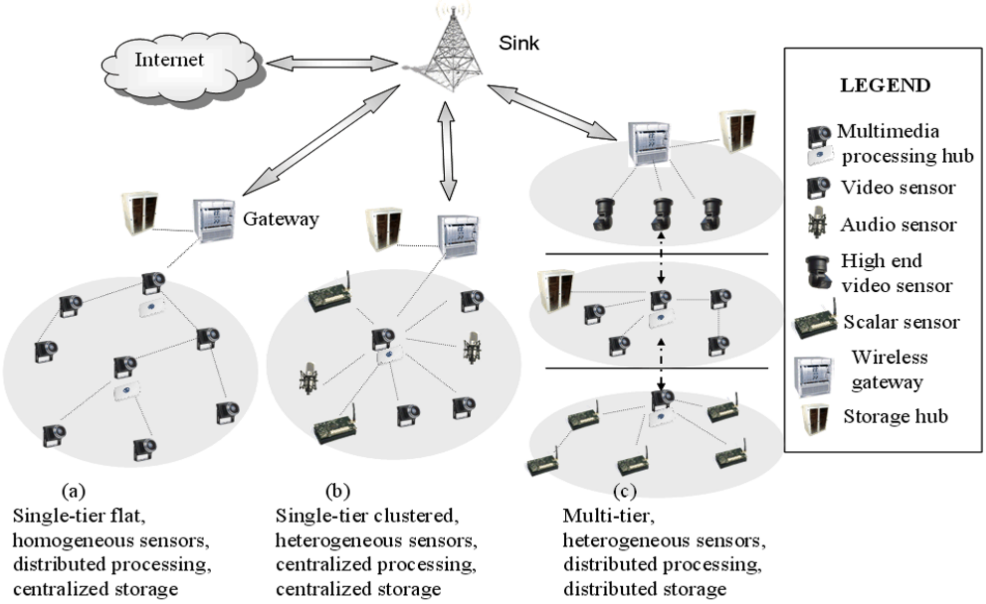

Figure 1.4: Reference Architecture of a WMSN (Ref. [2])

In Figure 1.4, a reference architecture for WMSNs is introduced, where three sensor networks with different characteristics are shown, possbily deployed in different physical locations. The first on the left [Fig. 1.4 (a)] shows a single-tier network of homogeneous video sensors. The second cloud [Fig. 1.4 (b)] represents a single-tiered clustered architecture of heterogeneous sensors. Video, audio, and scalar sensors relay data to a central cluster-head, which also in charge of performing intensive multimedia processing on the data. The last cloud [Fig. 1.4 (c)] on the right represents a multi-tiered network, with heterogeneous sensors. Each tier is in charge of a subset of the functionalities. Resource-constrained, low-power scalar sensors are in charge of performing simpler tasks, such as detecting scalar physical measurements, while resource-rich, high-power devices are responsible for more complex tasks.

Chapter 2

Routing Protocols for WMSNs

WMSN enhances existing WSN applications and enables a new large range of applications, like multimedia surveillance, traffic management, automated assistance, environmental monitoring, and industrial process control. WMSNs have more additional features and requirements than WSN, such as high bandwidth demand, bounded delay,acceptable jitter,and low packet loss ratio.These characteristics impose more resource constraints that involve energy consumption, memory, buffer size, bandwidth, and processing capabilities. A classification of different routing protocols for WMSNs is shown in Figure 2.1.

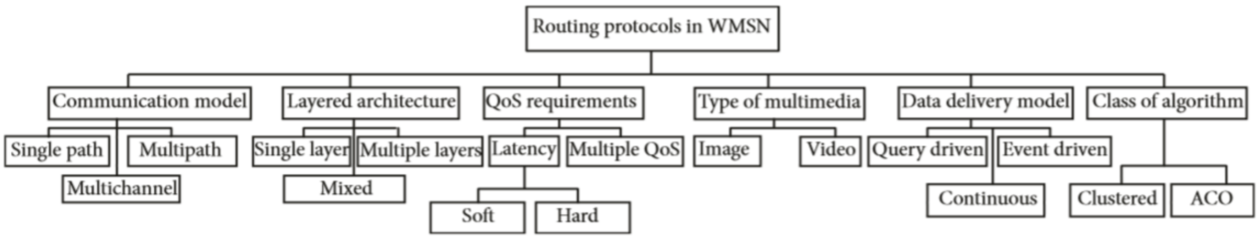

Figure 2.1: Classification of routing protocols for WMSN. (Ref. [3])

2.1 Design Challenge and Resource Constraints

1. **Energy Consumption:** Multimedia applications produce high volume of traffic which requires high transmission rate and processing capabilities which lead to consuming more energy than WSN. While energy consumption is one of the most important performance metrics in WMSN the routing protocols designed for WMSN should be aware of energy consumption to prolong the network lifetime.

2. **QoS Requirements:** QoS requirements differ according to different types of

multimedia applications. QoS metrics such as delay, bandwidth, reliability, and jitter must be disparately taken into account as needed. For example many multimedia applications are time critical - need to be reported within a limited time.

3. **Multimedia Coding Techniques:** Transmission of multimedia content has for long been associated with multimedia source coding techniques because of the large amounts of traffic generated by multimedia sources such as cameras. The compression techniques certainly decrease the information to be transmitted. This compression, however, comes at the cost of degradation of the multimedia quality that is usually referred to as distortion. Effective compression techniques which developed so far result in good rate-distortion levels to efficient multimedia transmission. Despite their significant compression capabilities and good rate-distortion performance, traditional source coding techniques are not directly applicable to resource constrained WMSNs. This is mainly related to the fact that predictive encoding requires complex encoders and powerful processing algorithms, which significantly increase the energy consumption. Multimedia encoding techniques focus on two main goals for efficient transmission of multimedia data. Firstly, the correlation between pixels of an image/frame or between frames of a video stream can be exploited to significantly reduce the information content to be transmitted without major quality degradation. This is usually referred to as source coding. Secondly, the compressed data should be efficiently represented to allow reliable transmission over bad channels. This is usually referred to as channel coding or error-resilient coding. Consequently, the main design objectives of a multimedia encoder for WMSNs are as follows:

   (a) High Compression Efficiency: It is necessary to achieve a high ratio of compression to effectively limit bandwidth and energy consumption.

   (b) Low Complexity: The resource constraints of multimedia sensors in terms of processing and energy consumption require encoder techniques to be of low complexity to reduce cost and form factors and low power to prolong the lifetime of the sensor nodes.

   (c) Error Resiliency: Low-power wireless communication increases the errors in the channel. As a result,the encoders should be designed to account for these effects and provide robust and error-resilient coding.

4. **Multimedia In-Network Processing:** WMSN perform multimedia in-network processing algorithm on the raw data transmitted from environment. In-network

processing requires new network architecture resource constrained processing that makes filtering and extract the useful information at the edge of network. The scalability will increase by reducing redundant data transmission and combined data coming from different sensors. It is important to enhance the applications independently and self-organizing architecture to perform flexibly in-network processing.

5. **High Bandwidth Demand:** Multimedia traffic demands high bandwidth which requires new transmission techniques to provide the required bandwidth with acceptable energy consumption level to optimize the resource constraints nature of WMSN. Anyhow, using multipath or multichannel can be a solution to this issue.

2.2 Swarm Intelligence Routing Protocols

2.2.1 ACOLBR

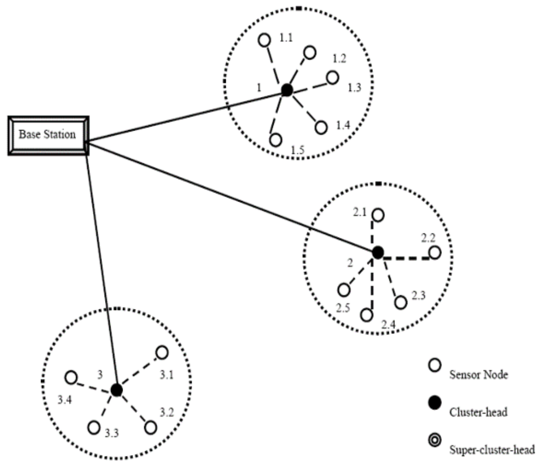

Figure 2.2: ACOLBR

- ACOLBR (Ant Colony Optimization-based Load Balancing Routing Algorithm) is based on ant colony optimization for load balancing and addressing the QoS requirements for WMSN.
- As shown in Figure 2.2, the intra cluster routing is built by minimum spanning tree then inter cluster routing which is built by proposed ant colony optimization algorithm to find optimal and suboptimal paths.
- Suboptimal paths will be used when the amount of data exceeds path flow threshold.

- In case of node failure, the neighbour node will set the pheromone value to zero and send an error message to source node. Then the source node will stop transmission in this path and enable an alternate path for transmission.
- The protocol determines the congestion occurred by monitoring the end to end delay from source to destination. If it exceeds the threshold, a congestion message will be sent to the source node. When the source node gets this message it will reduce the data amount sent in this path and enable an alternate path which increases the reliability.
- The drawbacks of the proposed work are the hierarchical model which introduces bottleneck problem and the optimal path selection that requires extra calculation which may decrease network performance.

2.2.2 ACOWMSN

- ACOWMSN (Ant Colony Optimization based routing algorithm for WMSN) uses the network restrict condition to update the pheromone concentration. The forward ants collects QoS parameters, and the backward ants carry QoS information to update the local node status during returning to source node.
- Each node in the network maintains a set of four QoS metrics elements:
  - $PL(n)$ - the maximum packet loss rate of node n
  - $DL(n)$ - the queuing delay in node n
  - $BD(n)$ - the bandwidth in node n
  - $RE(n)$ - the normalized remaining energy in node n with respect to the initial energy
- ACOWMSN includes two stages: *routing discovery* and *routing confirm*.
- **ROUTING DISCOVERY:** The algorithm constructs two kinds of artificial ants: forward ants and backward ants. When the source node will seek a path to destination node, firstly, it will produce a forward ant to destination node which collects residual energy, delay and packet loss rate, etc. Backward ant is the return artificial ant from the destination node.
- On the basis of whether the current node has the routing information to destination node, the forward ant can either be sent via unicast or broadcast. In ACOWMSN algorithm, routing information shows in pheromones table. If the

current node does not have the routing information to destination node, the node will broadcast the forward ant, but only when next node meets the requirements of the link bandwidth, packet loss rate and residual energy.

- **ROUTING CONFIRM:** Once forward ant reaches the destination node it will convert into backward ant, which returns to the source node along the same path in the opposite direction. The backward ant contains path information and end-to-end delay of the forward ant. In the process of returning to source node, the backward ant updates pheromones of each visited node.

2.3 Geographic Routing Protocols

2.3.1 GEAMS

- GEAMS (Geographic Energy-Aware Multipath Stream) is a geographical multipath routing protocol designed to prolong the network lifetime and reduce queue size of most used nodes by adding a load-balancing feature.
- At each hop, a forwarder node decides through which neighbour it will send the packet. Decision policy at each node is based on these four rules:
  - the remaining energy at each neighbour,
  - the number of hops made by the packet before it arrives at this node,
  - the actual distance between the node and its neighbours, and
  - the history of the packets forwarded belonging to the same stream.
- The GEAMS routing protocol has two modes, the *Smart Greedy Forwarding* and the *Walking Back Forwarding*.
- **Smart Greedy Forwarding Mode:**
  - This mode is used when there is always a neighbour closer to the sink node than the forwarder node.
  - Each sensor node stores some information about its one-hop neighbours. Information includes the estimated distance to its neighbours, the distance of the neighbour to the sink, the data-rate of the link, and the remaining energy. This information is updated by the mean of beacon messages, scheduled at fixed intervals.

  - Packet energy consumption: When a node (A) sends a packet (pk) of n bits size to a node (B), the energy of node A will decrease by $E_{TX}(n,AB)$ while the energy of node B will decrease by $E_{RX}(n)$. Consecutively, the cost of routing decision is $E_{TX}(n,AB)+E_{RX}(n)$ considering the energy of whole network.
  - For each known source node S_i a forwarder node (N) maintains a couple (H_i, j). H_i represents the mean hop count that separates S_i to N and j represent the neighbour whom score is closest to the average score of all closest nodes to the sink. Upon receiving a data packet from the source node S_i, the forwarder node will retransmit the packet to a neighbour that is closest to the sink node and in such a way that the number of hops the packet did, will meet the rank of that neighbour. The main idea is to forward a packet with the biggest number of hops through the best neighbour, consequently a packet with the smallest number of hops through the worst neighbour to allow best load balancing in the network.

- **Walking Back Forwarding Mode:**
  - This mode is used to get out of a blocking situation in which the forwarder node can no longer forward the packet towards the sink node.
  - In such cases, the forwarder node will inform all its neighbours that it cannot be considered as a neighbour to forward packets to the sink. This node will also delegate the forwarding responsibility to the less far of its neighbours to bypass the void. This process is recursively repeated steps back until finding a node which can forward successfully the packet.

2.3.2 TPGF

- TPGF (Two-Phase Geographic Greedy Forwarding) is a geographical multipath routing protocol designed to focus on the exploration and establishment of a maximum number of best disjoint routes in terms of delay end-to-end.
- **1st Phase - Geographic Forwarding:**
  - It is responsible for finding a routing path that offers guaranteed delivery, while avoiding the holes. This phase consists of two methods: *greedy forwarding*, where the node transmitting the information, always chooses the next hop node that is closest to the base station among all neighbouring

nodes. The second method, *step back & mark*, which handles the problem of blocking nodes.

– **GREEDY FORWARDING:** The principle for greedy forwarding is: *a forwarding node always chooses the next-hop node which is closest to the base station among all neighbour nodes, the next-hop node can be further to the base station than itself.* Refer Figure 2.3 for example.

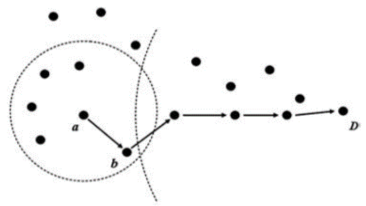

Figure 2.3: Example of Greedy Forwarding (Ref. [6])

– **STEP BACK & MARK:** For any node, during the exploration of a routing path, if it has no next-hop node that is available for transmission except its previous-hop node, this node is defined as a block node, and this kind of situation is defined as a block situation. To handle such situation, we approach this method - *When a sensor node finds that it is a block node, it will step back to its previous-hop node and mark itself as a block node. The previous-hop node will attempt to find another available neighbour node as the next-hop node. Marking the block node is to forbid the loop. The step back & mark will be repeatedly executed until a node successfully finds a next-hop node which allows the path exploration to change back to greedy forwarding*. Refer Figure 2.4 for example.

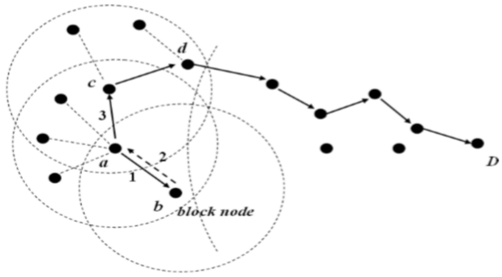

Figure 2.4: *Block node* and *Block situation*: *b* is a **block node** since it has no 1-hop neighbor that is available to be the next-hop node except node *a*, which is the previous-hop node of *b*. This kind of situation is a **block situation**. (Ref. [6])

- **2nd Phase - Path Optimization:**

  – This phase is responsible for optimizing the found routing path with the least number of nodes. The path optimization includes one method: *label based optimization*.

– **LABEL BASED OPTIMIZATION:** As shown in Figure 2.5, whenever a source node starts to explore a new routing path, each chosen node is assigned a label which includes a path number and a digressive node number. In TPGF, whenever a routing path reaches the base station, an acknowledgement is sent back to the source node. During the reverse travelling in the found routing path, as shown in Figure 2.6, the label based optimization is performed to eliminate the path circles. The principle of the label based optimization is: Any node in a path only relays the acknowledgement to its one-hop neighbour node that has the same path number and the largest node number. A release command is sent to all other nodes in the path that are not used for transmission. These released nodes can be reused for exploring additional paths.

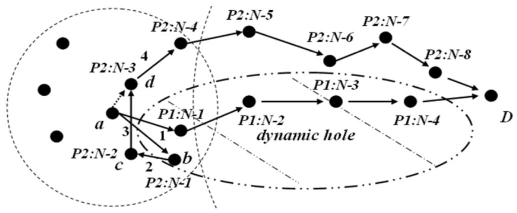

Figure 2.5: Each node in the routing paths is assigned a label which includes a path number and a degressive node number. (Ref. [6])

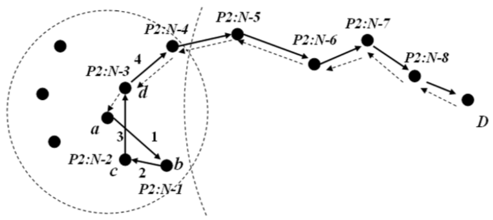

Figure 2.6: The dash line shows the reverse travelling in the found path. *b* and *c* are not used for transmission, and will be released. The **path circle** is eliminated, since *d* directly sends the acknowledgement to *a*. (Ref. [6])

2.4 Routing Protocols Addressing Different Types of Algorithms

2.4.1 MHDMwTS

- MHDMwTS (Minimum Hop Disjoint Multipath routing algorithm with Time Slice load balancing congestion control scheme) is a routing protocol for wireless multimedia sensor network using multipath and load balancing, aiming to increase there liability, save more energy, and control the congestion situation.

- **MHDM ALGORITHM:** It is divided into two phases, the first phase is built up the path, and the second is path acknowledgment. Three full disjoint paths, as shown in Figure 2.7, are built from source node to sink called primary, alternate, and backup paths. The primary path is the least delay path, then the alternate and backup paths. By default the backup path will be used in case the primary or alternative paths fail.

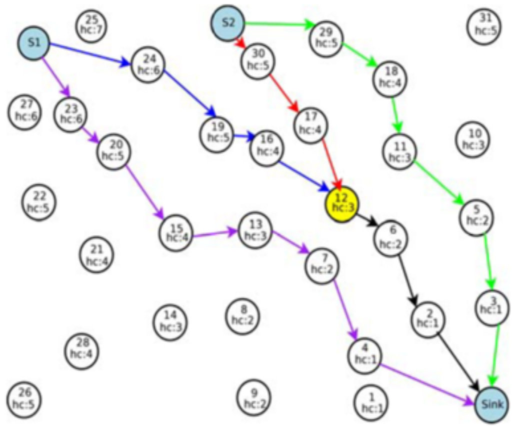

Figure 2.7: Network model for MHDMwTS (Ref. [8])

- **TS LOAD BALANCING CONGESTION CONTROL SCHEME:**
  - The transmission on these paths will be on stable rate and in round robin fashion but with specific time control called time slice control. Each sensor node will use two paths for transmission. As the primary path has less time delay it will get more time than the alternate path.
  - The congestion control mechanism is designed for the major node (joint node) which is a node used by two paths as a relay node and is done by monitoring the queue of this node. If the queue reaches the threshold, a congestion notification is sent back to the source, and then source will stop transmitting in this path and switch to the another path.

2.4.2 MLAF

- MLAF (Multimedia Location Aided Flooding) is used for packet dissemination in WMSN.
- It follows 3 main goals:

    - Sending data to all of network nodes using proper energy consumption.
    - Sending data with different delays based on its priorities.
    - Considering different reliabilities for data with different priorities.

- MLAF considers network as a virtual grid. Network nodes are aware of their own geographical position.

- 2 types of nodes are defined in each cell. Nodes with all their neighbours inside its own cell are called internal nodes, and those with at least one neighbour in another cell are entitled as edge nodes.

- Each MLAF packet has a field in which list of node IDs that receive packet is saved. Whenever any node intends to send a packet to its neighbours, it stores its ID in the mentioned field. Each node evaluates this field after receiving a packet. If it finds its ID in foresaid list, it will destroy the packet; otherwise it forwards the packet to its neighbours.

- **DIRECTIONAL FORWARDING:** We consider traffic with two different priorities.

    - For low priority data, each grid cell should receive data only from the southern (S) cell and other data entering from other side cells should be destroyed. It happens when sink node is one of the southern nodes of network.
    - For high priority data, each grid cell receives data from all its neighbour cells.
    - Each time that there is a need of high reliability, although it consumes more energy, MLAF uses method 2, but when lower reliability is acceptable, packets are sent using method 1. Reliability of method 2 is a bit more than that of method 1.

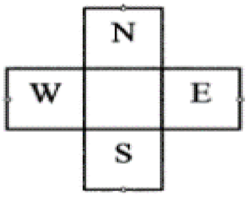

Figure 2.8: A grid cell (Ref. [9])

- **DELAY SENSITIVE FORWARDING:** In MLAF, different traffics with different threshold delay can be sent. So two priorities are considered for traffics - high priority and low priority.
  - Packet with high priority belongs to the traffic which needs less delay comparing to low priority traffic.
  - To send high priority packets, MLAF reduces the number of hops between receiver and transmitter by reducing the number of intermediate nodes.

Chapter 3

Conclusion

3.1 Comparative Study

A comparison among the protocols belonging to the same category is made which is as follows:

3.1.1 ACOLBR vs. ACOWMSN

Attribute	ACOLBR	ACOWMSN
ARCHITECTURE	Hierarchical – the sensor network is divided into clusters and routing occurs in 2 parts, intra and inter cluster routing	Flat – every sensor has same physical capabilities and can only interact with neighbouring sensors
CONGESTION CONTROL	The protocol determines the congestion occurred by monitoring the end to end delay from source to destination	Congestion Control not present
QOS PARAMETERS CONSIDERED	Reliability	Packet loss rate, Queuing Delay, Bandwidth and Remaining Energy of a node
SIMULATION RESULTS (COMPARED TO M-IAR)	Has a better adaptability; it can achieve load balancing, reduce the end to end delay, and prolong the network lifetime	Lesser average end-to-end delay, higher packet delivery ration and higher network lifetime

Table 3.1: ACOLBR vs. ACOWMSN

3.1.2 TPGF vs. GEAMS

Attribute	TPGF	GEAMS
ARCHITECTURE	Flat	Flat
DATA DELIVERY MODEL	Query-Driven - the error is intolerant, while delay is tolerant	Query-Driven
LOCATION AWARENESS	Here, the algorithm is aware of the entire topology of network and also each node is aware of its location and its 1-hop neighbour nodes' location	Here decisions are made at each hop avoiding the algorithm to maintain a global knowledge of the topology
HOLE BYPASSING	Have a method to avoid holes in the routing path	Have a method to avoid holes in the routing path
ENERGY-EFFICIENT	Less because repeated flooding wastes too much energy	More since energy is consumed uniformly throughout the network
SIMULATION RESULTS (COMPARED TO GPSR)	Holes can be efficiently bypassed compared to, suitable for multimedia transmission	More suitable for WMSNs as it ensures uniform energy consumption and meets the delay and packet loss constraint

Table 3.2: TPGF vs. GEAMS

3.1.3 MHDMwTS vs. MLAF

Attribute	MHDMwTS	MLAF
ARCHITECTURE	Flat	Flat
DATA DELIVERY MODEL	Event-Driven – error and delay both are intolerant	Query-Driven
LOCATION AWARENESS	Nodes are not aware of their geographical position	Network nodes are aware of their own geographical position.
CONGESTION CONTROL	Congestion is controlled by assigning a time slice to the different transmission paths	Congestion Control not present
QOS PARAMETERS CONSIDERED	Reliability	Reliability and Delay
SIMULATION RESULTS	Achieving higher data rate and longer network life time. But under higher package transmitting rate from source, receiving rate, and network life time will drop fast	Shows good result in energy consumption, reliability, and end to end delay

Table 3.3: MHDMwTS vs. MLAF

3.2 Conclusion

In this seminar report, we started with an introduction to Wireless Multimedia Sensor Networks and its various applications in diverse fields. Also, we discussed the design of WMSNs taking into consideration various factors. A brief overview of the network architecture of WMSNs was also given.

Following that, a brief overview of existing routing protocols was provided. Also, two protocols each from different categories were thoroughly discussed. Through this study, we can realize that the existing protocols for WMSN have different methodologies, but one specific objective which satisfies the multimedia transmission requirements. The protocols lie under different categories as mentioned, where the first class shows the routing protocols based on ant colony optimization. The ACO displays several features that make it particularly suitable for wireless multimedia sensor networks. Additionally, ant routing has shown excellent performance to solve routing problems in WSNs and ad hoc networks. The second class is geographic routing protocols like TPGF and GEAMS. These protocols achieve good performance in hole bypassing and it is suitable for WMSN as it ensures uniform energy consumption and meets the delay and packet loss constraint. The last class of the proposed protocols follows different algorithm types and addresses different QoS metrics that are required for multimedia transmission with resource constraint nature of WMSN.

As a conclusion, a brief comparitive study compares the routing protocols considering different parameters or characteristics.

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