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Wireless sensor networks with data aggregation routing protocols-survey.

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ABSTRACT

The purpose of routing on a wireless sensor network (WSN) is to interconnect sensor nodes via single or multi-hop paths. Routesare set up to forward data packets from sensor nodes to sink. Establishingthe only way to report every data packet is to increase the power consumption in the WSN, therefore, dataaggregation routing is used to combine data packets and consequently reduce the number of transmissions.This reduces the routing overhead by removing unnecessary and meaningless data. There are two models for routing data aggregation in WSN: mobile agent and client / server. In this paper we describe the dataClassifies routing protocols by aggregation routing and network architectureRouting model.

KEYWORDS

WirelessSensorNetworks,RoutingProtocols,DataAggregation,Client/server,Mobile Agent.

1. INTRODUCTION

Awi-fi sensor community (WSN) includes small and tiny computing devices which might be scattered to accumulate and file ambient statistics. The community nodes are generally static and communicate through furnished wi-fi channels which can be restricted (in terms of conversation variety), unreliable and vulnerable to environmental noises, sign reflections, wi-fi interferences and/or physical obstructions. Tthe main objective of WSN status quo is to offer low-cost ambient statistics series services. The nodes normally are small and cheap with limited strength, computation, conversation and garage assets which can be capable of carry out best a hard and fast of primary computation and communication obligations. They measure ambient facts and transmit the result to the customer get admission to factor (sink) as it has much less aid issue. WSN structure is commonly classified as both flat or hierarchical. The flat network is shaped with the aid of the nodes which might be typically randomly scattered inside the area, whereas a hierarchical community is shaped via clusters or the groups of nodes. the important thing gain of WSNs is they can be implemented nearly everywhere without the need for any specific communique infrastructure. It lets in a WSN to be deployed as an alternative to non-existent infrastructure (for cost effectiveness) or if the present infrastructure isn't always suitable to use. as a result of this, WSN technology is utilized in numerous programs like training, ambient tracking, transportation and health. For instance, in the case of training, this technology may be used to make a secure and easy-to-use laboratory in which the students experience clinical concepts in information. WSNs are considered as an application of ad-hoc networks. Similar to ad-hoc networks, there may be no precise infrastructure for WSN and the community is deployed in a self-setting up way with none centralized manipulate. However, there are five differences between WSN andad-hocnetworks:

1. WSNs are densely deployed using a huge variety of sensor nodes, whereas advert-hoc networks typically consist of a fewer variety of nodes with sufficient assets to compute and/or speak.

2. Sensor node assets which include electricity and communique/computation electricity are weaker than advert-hoc node. In other words, sensor nodes are tiny, susceptible and reasonably-priced (i.e TelosB node), while advert-hoc nodes are commonly extra mature (i.e smart telephones and/ PDAs) and have stronger sources. Sensor nodes commonly have restricted processing modules (CPU), so they're now not capable of method complex jobs. they are now not able to hold big-scale facts because they have confined garage capacities. in addition, they're not capable of often talk over lengthy distance wireless hyperlinks as they've constrained radio range and power sources to broadcast wireless alerts.

3. Message broadcasting is typically utilized in WSNs as maintaining a global addressing sample including IP (to assist peer-to-peer communications) could be very expensive in phrases of community useful resource intake. however, an ad-hoc community is capable of aid local communications between any pair of nodes the usage of IP-based verbal exchange protocols.

4. In assessment to ad-hoc, WSN avoids amassing and transmitting redundant facts as it will increase community aid consumption.

5. WSN nature of dynamicity isn't the same as advert-hoc community as sensor nodes are generally stationary in most applications.
WSN routing is in charge of interconnecting sensor nodes via either unmarried or multi-hop hyperlinks. It includes the technique of course discovery, status quo and renovation. The cause of WSN routing is to ahead records packets from event regions to the sink. however, routing raw information packets through wi-fi conversation links from supply areas to the sink will increase network useful resource consumption and therefore reduces the network lifetime. this means that the sensor nodes could devour a fantastic amount of network assets mainly-electricity, in the event that they need to ahead each sensed records sample to the sink.

records aggregation is a way to combine facts packets. This has the ability to take away meaningless/redundant information and decrease the range/length of transmissions. as a result, data aggregation approach can reduce community power consumption if it's far used in a WSN. This approach combines the facts packets the usage of an aggregation function (e.g common, most, minimal, remember, Median, Rank, well known Deviation, Variance and Sum) right into a single one to transmit. it would bring about discounts of transmissions and therefore reducing the communication prices, bandwidth utilization, network congestion, energy intake and network delay in WSN routing.

1. ROUTINGIN WSN

obtaining id deal with of nodes on multi-hop conversation links. by this, WSNs use DC routing protocols to forward facts packets. In statistics-centric routing, a facts packet is forwarded if it's miles applicable for the subsequent node Routing in WSN makes use of a convergence sample to ahead facts packets from supply nodes to sink thru both unmarried or multi-hop hyperlinks. Sensor nodes might also need to ahead community site visitors via multi-hop hyperlinks as they generally have constrained verbal exchange abilties which do now not permit direct communications. As a result, WSN routing wishes to efficiently route the facts packets from source regions to sink based on the network traits, node capacities and alertness necessities.

There are two components in WSN routing that work in parallel to path the network visitors: the protocol mechanism and the routing matrix. The protocol mechanism makes a speciality of statistics transmission scheme, facts forwarding, routing data garage, packets traits and course discovery. The routing matrix works upon the protocol mechanism and its objective is path choice amongst the available ones. path matrix returns the most efficient paths if multiple paths are to be had. it's miles in charge of making the routing choices in keeping with the routing parameters inclusive of ate up electricity, route hop depend, verbal exchange sign power and loop avoidance
the paths are set up in WSNs in schemes: cope with-Centric (AC) and records-Centric (DC). within the former, the nodes bear in mind the deal with of next hop nodes to forward community traffic, while inside the latter the routes

are mounted using an attribute-based totally naming that specifies the residences of data over the wireless hyperlinks. AC protocols do no longer offer benefits in WSNs due to the fact there may be no worldwide addressing scheme consisting of IP in WSN. In reality, lack of world addressing scheme in WSNs limits address-centric communications into nearby region wherein sensor nodes are privy to each different id cope with. moreover, dense, dynamic and/or random WSN deployment complicates.

community topology trade is an issue which have high impact on WSN routing. A node or verbal exchange path fails while the energy level on the nodes falls beneath the specified threshold for being alive or maintaining the communication links. In fact, WSN routing turns into hard because the nodes want to recall energy intake, (wireless) connectivity and coverage to ahead network site visitors.

2. DATA AGGREGATION ROUTING IN WSN

Information conglomeration directing intends to communicate a summed up plan of detected information (without losing information importance and exactness) in a focalized style to the buyer passageway (sink). This prompts decrease transmission rate and thus lessen network asset utilization. Information accumulation directing has two plans: client/server and portable specialist. Client/server lets the middle of the road hubs to gather and total the sent information bundles from the occasion area to the sink, while versatile specialists are sent all through the organization to catch and gather information in the last option. As such, the portable specialists need to move through the ways to catch and total information tests at the source hubs and afterward return the outcomes to sink.

3.1. Client/Server Data Aggregation Routing

Client/server information conglomeration directing structures the ways in one or the other level or progressive. In the previous, the hubs assume same parts and the ways are laid out in a concurrent way from occasion districts to the sink. Aside from sink, middle hubs might act in-network information conglomeration assuming they get different information parcels. Notwithstanding, no hub stays responsible for performing information total interaction. Then again, the hubs might assume various parts, for example, network span, middle aggregator or information customer passageway in progressive organizations. The courses are typically settled through moderate hubs which perform information accumulation. Information bundles are progressively accumulated and sent then from source hubs to the sink.

3.1.1. Flat Architecture

Level information conglomeration directing advances information through least expense ways which are framed from source hubs to the sink. The middle of the road hubs could join the got information parcels when they are being sent to the sink. There are two plans to frame the courses in level information collection: address-driven (AC) or information driven (DC). The hubs consider the location of next bounce hubs to advance organization traffic in AC, while the courses are laid out utilizing a trait based naming that determines the properties of information over the remote connections in DC.

There are three classes to classifications level client/server information conglomeration directing [37]:

1. Push information conglomeration directing: a membership connect at first is shaped from the sink to source hubs to advance information. Source hubs, which get the membership joins, become accessible to report information parcels through similar connections to the sink. The source hubs forward information bundles until the membership joins are accessible. Push information conglomeration directing continually consumes network assets as source hubs would habitually communicate information bundles as long as the membership joins are accessible. In addition, the organization asset utilization is expanded as excess or dreary information may be consistently answered to the sink. Turn convention (Sensor Protocols for Information by means of Negotiation) utilizes push information accumulation steering. Under this convention, meta-information is used rather than unique information to lay out the courses in level. To start with, each source hub acquaints its own information parcel with the single-jump neighborhood by communicating something specific. A neighbor hub answers back assuming it is keen on gathering. Then, at that point, the source hub communicates an information parcel to the neighbor hub. The middle of the road hubs gather and join the got information bundles and perform then a comparable plan to advance the amassed information until

the sink gets.

2. Two-stage pull collection directing: the source hubs heuristically lay out briefest ways to send information parcels to sink after getting the questions. It works on the quality or potentially exactness of information assortment since information bundles are sent by the sink questions and not arbitrarily or occasionally. Notwithstanding, a few full circle correspondences to lay out the ways consumes network assets particularly when organization sent is thick and sink questions are regularly different. Direct dispersion uses a two-stage pull component to gather, total and report information. Under this convention, information naming strategy is utilized to advance information bundles. The target of using the property estimation is to diminish network asset utilization by wiping out superfluous information handling and correspondence. This implies that an information parcel is sent assuming it matches the inquiry characteristic qualities. Information handling and correspondence is decreased as just the hubs that have intriguing information for the sink or can lay out a connection to the source districts perform directing. To begin with, the sink conveys the questions comprising of information trait values. These qualities, for example, information type and topographical region depict the information tests which the sink is keen on gathering. The question messages are incidentally communicated to revive the course accessibility. The transitional hubs update their steering tables after getting the inquiry messages.

The steering data is utilized to act in-network information accumulation and structure the bring ways back. Inquiry message broadcasting is performed until hubs that have intriguing information get. The hubs might have to choose the best accessible way since they get various comparable messages however variation courses. A bunch of boundaries, for example, start to finish deferral or bounce count is considered to shape the best way. The best way (called slope) is utilized to advance information parcel to sink. The hubs additionally may involve different courses as options if the current way (inclination) comes up short. The hubs living on the chose way join and forward information bundles until the sink is reached.

One-stage pull conglomeration steering: a most brief way is framed between the sink and source hubs assuming the questions meet fascinating information to report. This method offers a high upward information conglomeration steering on the grounds that the sink needs to gather area data of source hubs that have intriguing information. A one-stage pull information accumulation steering convention is proposed by in which sink proliferates interest parcels to the organization to lay out most limited ways specifically slopes to the source hubs. Each source hub that gets inquiry parcels chooses the base defer way (least bounce build up) to advance information bundle assuming the question necessity is met.

Level information accumulation directing necessities to manage the accompanying disadvantages:
(1) high upward of laying out most brief ways particularly on account of enormous and thick organizations,
(2) synchronous admittance to the remote channels by the hubs to advance information parcels brings about expanding message disappointment and organization clog,
(3) message re-transmission (because of impact and blockage) upgrades energy utilization,
(4) information conglomeration precision and heartiness is diminished because of information bundles crash and blockage,
(5) the steering ways might offer variation start to finish defers which impact information newness when information parcels are sent through various courses (with variation bounce count).

3.1.1. Hierarchical Architecture

This model of information conglomeration progressively shapes a foundation to gather, consolidate and report information bundles. Using a various leveled framework for information accumulation intends to determine most level information conglomeration disadvantages. Information parcels are not straightforwardly sent to the sink however they are steered to middle of the road hubs which stay responsible for acting in-network accumulation. They get amassed before in progressive organizations when contrasted with level. Indeed, aggregator hubs progressively consolidate information parcels in various leveled steering rather than arbitrary accumulation which are performed by the hubs if dwell on a joint way in level directing. Henceforth, this diminishes the quantity of hand-off hubs and thus brings about decrease of organization traffic and clog. By this, message crash and start to finish delay is diminished, notwithstanding, information assortment precision in expanded. The advantages of progressive directing are laid out as beneath:

1. In-network information conglomeration: this model of steering offers in-network information accumulation. Information parcels are sent from source hubs to more significant levels of ordered progression (i.e pioneer as well as bunch heads) to total. It prompts lessen the quantity of transmissions and organization clogs. All in all, lessening the quantity of information bundles brings about decrease of message impact in various leveled steering. Bunching, for instance, is a procedure which is generally used to lay out various leveled frameworks in WSN. In a bunched WSN, information bundles ordinarily are communicated from source hubs (group individuals) to bunch heads to gather, total or potentially send. Accumulated outcomes are accounted for by bunch heads to sink through either immediate or backhanded connections.

2. Increasing the message conveyance proportion: the likelihood of message disappointment/crash would be diminished in progressive steering as the organization traffic diminishes. In various leveled directing, a bunch of explicit hubs stays accountable for correspondence for a gathering of hubs. Without a doubt, an information test isn't straightforwardly sent to the sink by a source hub. It diminishes the quantity of hubs which attempt to get to the remote channels and the quantity of sending information bundles. In outcome, message impact/disappointment is decreased, bringing about expanding the message conveyance proportion.

3. Fair channel portion: remote correspondence channels can be productively overseen in progressive organization as conflict free planning is upheld. Dispute free booking dispenses remote channel as indicated by the hubs pecking order level or area ahead of interchanges. It can possibly build the decency of channel designation and subsequently decline bundle impacts when contrasted with conflict based booking which is progressively utilized in level organizations.

4. Uniform energy utilization: in progressive steering, there is no brought together information handling except for this is acted in a circulated way. Henceforth, in-network assignments are progressively handled and examined at the transitional hubs. It prompts balance network loads bringing about expanded organization lifetime. Then again, various bottlenecks could emerge in a level organization by the hubs which independently endeavor to advance information parcels. This outcomes in non-uniform energy utilization that builds the gamble of hub disappointments in level steering.

5. Routing defer decrease: correspondence delay is diminished in various leveled steering on account of using equal connects to report information tests. In addition, get (lining) and access delays are diminished because of diminishing the quantity of messages and organization traffic in various leveled directing.

There are a set of different techniques that are used to form hierarchical infrastructures in WSNs.Aggregation tree, clusters and chain are the most commonly used ones that are explained as below:

Aggregate tree: It is set up in which a packet is reported hierarchically from each node to its parent node to aggregate data in the network. The goal is to minimize resource consumption and maximize data collection rate [5]. The tree is formed using source nodes that report interesting data for the sink. TAG (a small Aggregation service for ad-hoc sensor networks)[30] forms a tree-like infrastructure for surrounding data collection and aggregation. At first, the sink sends a level discovery message to assign level labels to the nodes in the network. Each node increments its own level value by one, then forwards the message to the next step if the message is received. This is done continuously until all nodes get the level value. The nodes then forward the data packets if they discover an available path to their higher-level nodes. This procedure is repeated until a composite result is obtained by the receiver. TINA (a scheme for Temporary In-Network Cryptocurrency Aggregation)[1] uses a similar mechanism to establish a tree-like infrastructure in which data aggregation is performed. TiNAis different from TAG because it uses tolerance that is consistent over time. InTiNA, source nodes pass data values if they differ from previous data reports. Therefore, the "tct" parameter is added to queries to show the acceptability of consumer preferences. Therefore, a data sample is passed if it differs from the final value greater than "tct". Since the source nodes do not transmit all the measured data, TiNA reduces the power consumption of the network. This is also supported by the empirical results presented in [1].

Clustering:

The network is partitioned into a set of groups called clusters using clustering techniques. There are two options for forming clusters: address-centric and data-centric. Therefore, nodes that are similar in location or communication characteristics are grouped into a cluster. Nodes located in a cluster are called cluster members (CM). Among all CMs, one or more nodes are still responsible for cluster management. They are called Cluster Heads (CHs). CHs usually collect and combine intracluster data samples. Low Energy Adaptive Clustering Hierarchy (LEACH) [18] is an addresscentric routing algorithm that supports data aggregation. LEACH has two phases: setup and steadystate. The setup phase forms the clusters, whereas the steadystate forwards network traffic to sink. LEACH uses a distributed random algorithm to select CHs. This is done periodically and causes each CH to stay active for a specific turn based on a value (P). This means that CH will not have a chance to get the same role until P on subsequent turns. TDMA (Time Division Multiple Access) [31] is used by source nodes to collect and report network traffic and avoid internal conflicts. In addition, CDMA (Code Division Multiple Access) [7] is used by CHs to transmit aggregate results to the well and avoid interference between layers. Forwarding network traffic in unicast (instead of multicast) reduces power consumption in LEACH. CLUstered Diffusion with Dynamic

Data Aggregation (CLUDDA) protocol [37] sends requests in a clustered network where CHs are responsible for performing network data aggregation. The query includes crawling information such as data types and aggregate functions. Each CH that responds to the request collects and aggregates data samples internally and then transmits the results to the sink. CLUDDA is a data-centric protocol and allows data consumers to partially collect and aggregate data samples from each region of the network where data is desired. It reduces power consumption because data aggregation is performed only by a select set of CHs (instead of all CHs) that match the requirements of the packets of interest.

Hierarchical client/server data aggregation needs to deal with the following issues:

(1) The overhead of hierarchical infrastructure establishment / maintenance: this enhances the network resource consumption (mainly-energy) that consequently results in the reduction of network lifetime. Sensor nodes need to consume a great deal of energy to establish or re-establish the hierarchical structure when network topology ordensity changes,

(2) Leader/CH bottlenecks: the intermediate aggregators on the hierarchical infrastructure such as CHs stay in the duty of managing in-network jobs including computation and communication tasks more than other nodes. Hence,the aggregator nodes have a higher chance to fail (due to running out of energy) asthey need to manage a great number of communication and computation tasks.

3.1. Mobile Agent Data Aggregation Routing

This model of data aggregation routing utilises Mobile Agent (MA) technique to collect and aggregate data froms ource nodes. The key objective is to increase data aggregation accuracy and performance and reduce network resource consumption. This section briefly describes mobile agents structures, capabilities and benefits. A set of mobile agent routing protocols is provided to highligh trouting issues and techniques that need to be considered in WSN data aggregation.

Mobile Agents Structure and Benefits for Data Aggregation

The MAs can be programmed to perform data aggregation in WSNs. They move throughout the network to capture and aggregate data samples which need to be reported to the sink. A mobile agent usually consists of four elements: identification,itinerary,data space and method.The identification maintains the general information of MA such as serial number and/or dispatcher's ID. Itinerary provides the migration information such as current location, traversed paths and/or destination address. Data space keeps the required and/or collected data (i.e aggregated result) during the MA migrations. Method provides the required code/function(i.eaggregation function) that is used by MAs during the migrations between the computing devices. As a result, the Mas would be able to visit the source nodes one by one using the itinerary information that can be provided proactively or reactively.They aggregate captured data at each node using the aggregation function. Aggregated results are maintained and/or updated at data space of MA sun til they are delivered to the sink.

Utilising the MA technique decreases transmission rate in WSN. MA routing forwards the executable sink queries (MAs) to the source nodes to collect and combine data samples,whereas client/server routes a large amounts of raw data from the source nodes to the aggregators/sink. For example, let we assume that a set of particular photos taken by wireless camera sensors need to be collected. In client/server, camera sensors report all their photos to either sink or aggregators for aggregation and/or processing/analysis. On the other hand,a MA can be programmed to move throughout the network to collect the photos which are interesting and met the user requirements. Hence, the number of transmissions is reduced in MA data aggregation.

1. Number of transmissions reduction results in decreasing network resource consumption mainly energy.

2. if MA data aggregation is used the network traffic and transmission rate is reduced.This also reduces in reduction of collisions.

3. Decrease of data aggregation delay in WSNs reduces network traffic leads.

4. data aggregation performance is not dependant to the network size.This increases the scalability of data aggregation.

MA relocation agenda arranging is a difficult issue in MA information conglomeration. It is obviously connected with the Traveling Salesman Problem (TSP) in which ideal agendas are laid out for sales reps to follow. In spite of the fact that tackling TSP (and comparably MA agenda arranging) is commonsense when the quantity of hubs to visit (i.e urban communities) is little, the issue is overall NP-complete. In any case, there are three vital contrasts among TSP and MA agenda arranging:

(1) TSP needs to visits every one of the hubs (i.e urban areas), though MA schedule arranging just visits the hubs which are alluring for the customer.

(2) there is a solitary sales rep which goes through in conventional TSP, while MA agenda arranging centers around steering different MAs all through the organization.

(3) TSP expects worldwide information, while MA schedule arranging in WSN doesn't.

MA relocation agenda arranging needs to consider three issues to find/lay out ideal courses:

(1) Minimizing venture delay: this prompts improve information newness as information tests are gathered with least postponement.

(2) Reducing network asset utilization (principally energy): MAs need to travel through short, minimal expense and proficient energy use courses as WSNs are profoundly asset requirements. (3) Maximizing information test rate: information assortment heartiness is expanded assuming more prominent number of information tests is caught.

GCF (Global Centre First) and LCF (Local Closest First) move a single MA in flat into theevent region(s) for data aggregation. A single MA moves to visit the source nodes (via the shortest path) if they are close to the centre of data region in GCF,whereas LCF utilise sarouting algorithm in which the MA is moved to the next source node if it is the closest one. The complexity of these two algorithms is comparatively low and they are easy to implement. However, data aggregation cost and delay depends on the network size and this is increased if thenetwork becomes large and dense. In addition, the performance of these protocols highly is influenced by the current location of MA. For example, the sink should know the centre of data region to move the MA if GCF isused. Although it is not critical in centralised event distribution model, the MA migration cost is highly increased when random event distribution model is used especially in the network deployed is large and dense.

IEMF(Itinerary Energy Minimum for First-source-selection)and IEMA(Itinerary Energy Minimum Algorithm) move MAs via minimum cost routes to aggregate and report data. The key objective is to decrease MA migration overhead in IEMF. This selects minimum consumed energy paths to route the MA. IEMF allocates an estimated cost value to each route that is established to an event region. According to the cost value, it selects the closest node that resides on minimum cost link to migrate. LCF differs from IEMF as this selects the closest node for migration,whereas IEMF utilises the estimated cost value to select the link. Utilising an iterative process in IEMF to select the next hop nodes forms IEMA. First, each available tie to data regionis assigned by a cost value. Then, the value is iteratively updated if the real cost is measured .Indeed, IEMA considers a number of available links to event regions in an iterative manner to find out the route in which MA migration cost is minimised.

The Near Optimal Itinerary Design algorithm(NOID) utilises multiple Mas whichin dependently travel throughout flat networks to collecta nd aggregate data samples. This enhances the parallel is mof data aggregation routing that consequently reduces delay.This means that this protocol reduces data aggregation delivery time as a number of MAs in parallel collect and report data. The migrations are started from the sink to data regions via the established paths. Each route is extended in a greedy manner to minimise a cost function in which hop count and node energy level is considered. NOID allocates a cost value to each link. It allows the MAs to select the closest node residing on the minimum cost link to move. In otherwords, the MAs move through links which minimise journey hop count (minimum delay) and have sufficient energy to guide them to source regions. NOID also considers the amount of collected data at each nodes to control MAs size. Forwarding MAs without considering the MA size increases the network traffic and network resource consumption. For this reason, NOID monitors the data part of MAs a teach node and avoids continuous node visit. In fact, an MA stops to visit nodes and returns to the sink if it becomes heavy. However, MA migrations to overleaped areas and capturing redundant data samples are the drawbacks of NOID. The MAs only consider the address of nodes instead of their available data during data aggregation journeys. In consequence, they visit overleaped area and capture redundant data. In addition, the migration cost of multiple MAs is increased if the number of data regions rises.

Table2. Client/servervs. Mobile agent data aggregation routing

Protocol	**Network Architecture**	**Mechanism**	**Key Advantage**	**Key Drawback**	**Number of MAs**
LCF	Flat	Closestnode	1- Ease ofimplementation2- lowoverhead	1- AC nodevisit 2- Increaseddelay 3- Location dependant	Single
GSF	Flat	Centre ofeventregions	1- Ease ofimplementation2- lowoverhead	1- Increaseddelay 2- Location dependent	Single
NOID	Flat	Closest nodewith enoughenergy	Reliablemigrations viaenergy-aware links	Overlapped datacollection	Multiple

IEMF &IEMA	Flat	Minimummcost links(energyand distance)	Reducingmigrationcosts	Increasededlay	Single
GA-MIP	Flat	GA for optimising links	Best-fitted routes according to the requirements	Increased delay of route planning	Multiple
TBID	Hierarchical	Tree infrastructure	Reducing MA randomwalks	1- High cost of updatingtreeinfrastructure2-Greatnumber of trees for large network	Multiple
[39]	Hierarchical	Master/Slave MAs	Reducing MAmigration length	1-Overlapped data collection2-High costfor randomdistributed eventsources	Multiple
AERDP	Hierarchical	Master/Slave MAs	Non-over lapped migrations	High cost for random Distributed event sources	Multiple

The introduced mobile agent routing protocol sarehig hlighted and compared in Table2.

4. CONCLUSION

Directing is utilized in WSN to course information tests from information locales to customer passage (sink) in view of particular boundaries like organization design and application. Various steering conventions are proposed in this field to improve directing security, versatility and extendibility. They are arranged by steering highlights, methods and destinations.
WSN Routing is a difficult issues as it very well may be habitually affected by network dynamism and additionally geography changes. Lingering energy level is the key boundary that typically lead to the organization geography changes in WSNs. This influences hub accessibility and remote correspondence quality. Henceforth, it impacts remote interchanges and subsequently directing execution. By this, the accompanying destinations should be considered by WSN directing:

1. The course dependability should be upgraded by laying out/restoring correspondence joins as speedy as conceivable before any further geography change.

2. The unwavering quality of courses should be upgraded by sending network bundles by means of the hubs which have adequate energy to convey.

3. Network lifetime should be boosted by limiting energy utilization. It can decrease hub/interface disappointments that are brought about by running out of energy.

4. A appropriated conspire is expected to process directing upward. This tries not to emerge bottlenecks and thusly brings about decrease of halfway hub disappointment likelihood.

Information conglomeration offers a bunch of advantages, for example, diminishing organization clog and energy utilization in WSN steering by decreasing size/number of transmissions. Information total directing spotlights on two plans: client/server and versatile specialist. In the previous, the courses are shaped between source hubs and the sink as indicated by the organization engineering. The ways guide information parcels from the source districts to the sink through a bunch of halfway hubs which act in-network information total. In MA directing, MA(s) move all through the organization by means of proactive/receptive ways to gather and report information. It offers a bunch of advantages explicitly lessening network traffic, upgrading flexibility and independent calculation when contrasted with client/server model. Nonetheless, schedule wanting to lay out proficient and minimal expense ways for MAs is a difficult issue in MA information collection directing. Table 2summarizes and compares the Key features of data aggregation routing in both schemes.

Parameters	Client/Server	Mobile Agent
Communication	Uni/multi/broadcast (depending on architecture)	(parallel)Unicast
Parallel processing	Yes	Yes
Automaticity	No	Yes
Message Structure	Simple	Complex
Communication Overhead	Number of relay nodes (depending on architecture)	Number/length of MAs
Message Failures	Depending on architecture, traffic and/or energy	Depending on residual energy of nodes
Accuracy of data collection	Depending on data msg. failures	Depending on itinerary planning
Delay of data collection	Depending on traffic and/or architecture	Depending on itinerary and/or number of MAs
Key advantage	Simplicity in deployment	1-Reducing network traffic 2-Adaptability
Key drawback	Message collisions/lost	MA complexity/security

Table2. Client/servervs. Mobile agent data aggregation routing

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