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CLUSTERING ARCHITECTURE FOR SMART MOBILITY CONTROL: APPLICATION TO PILGRIMS IN THE GREAT MOSQUE IN EL HAJJ

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ABSTRACT

The mobile ad hoc networks are a special case of wireless networks, where we encounter some form of spontaneous communication, in which groups of different mobile nodes forming a network without the need of infrastructure, thus access to information is through the users' mobile equipment's. One of the basic features of this kind of network is the famous principle of routing. However, the users' considerable need to have access to data in the best conditions involves some thinking to pro pose relevant solutions on the whole. In this purpose, our work applies in one particular case. El Hajj is a holy gathering place of millions of Muslim pilgrims from around the world. During this season, the organizers faced a lot of problems related to communication of pilgrims and their position in the area of El Hajj, hundreds of believers acknowledge that they may have difficulties each year at relaying communications and connections during these rituals, others who may have problems with serious situations, especially in large crowds. In this context, we are proposing an architecture that enables optimization of network and routing, depend on a smart mobility with a goal to represent the surrounding area of Mecca as a Smart city to offer a whole of advantages to improve a quality, to make their different services and infrastructure more flexible. It is based on the data compression technique, it depends on the compression of this data sector by implementing a clustering architecture. This solution, present a model for an area, and which can be duplicated for the full area of El hajj. It also facilitates the communication and localization, in real time. The evaluation of this approach leads us to anticipate simulations to do a great job of refinery. We made a choice to perform a number of simulations based on the AODV protocol and implementing the technique of clustering, ideal for identifying performance to consolidate our approach

Keywords: *El Hajj, Smart city, MANET, Cluster, Compression, AODV-C*

1. INTRODUCTION

In General, the wireless networks can be classified into two categories, those with infrastructure including a set of separate entities or communication interfaces to establish data exchange, and those without infrastructure called ad hoc networks.

The mobile ad hoc network, usually called MANET (Mobile Ad Hoc Network) can be defined as a network able to organize without predefined infrastructure, allowing for many of mobile entities to be interconnected by wireless technology [1]. They have the advantage of self-organize without support of any administration. The flow of data is crucial to ensure the independence and mobility, it evokes the notion of routing that includes a set of procedures to ensure an open communication between the entities. To provide these services, routing algorithms take into account several features like changing topologies, consumption of bandwidth, etc. Among emerging types of ad hoc networks, is defined the wireless sensor networks WSN (Wireless Sensors Network) [1], in which the sensors themselves as nodes constitute mobility in the network and are able to manage and transmit data autonomously.

The goal of our proposition is to respond to the relevant question, how to manage the heterogeneity of the communications infrastructure on optimization of routing to access the Data in case of a complex city as Smart City. In another sense how to implement a smart mobility to run data transport infrastructures in the smart city context. The idea is

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to suggest architecture based on the compression technique to reduce the quantity of data, we need to compress them inside the network. When we return to the literature [2], we can distinguish between several data compression techniques used in particular around wireless sensor networks. They can be classified into five categories, namely, the String-Based Compression Techniques; the Image-Based Compression Techniques; the Compressed Sensing Techniques and the Data Aggregation Techniques, the last one involves a select subset of sensor nodes in the network, then one of these sensors is proposed like a responsible for data fusion of other nodes for the purpose of reducing the amount transmission of data.

This paper describes the essentials of the work in this study, it discusses, initially a technique based on an optimized architecture approach and designed for an environment of El-Hajj, and essentially a measurement evaluation of the modified AODV protocol based on the clustering. Subsequently, in this document a comparison of performance is made between the real routing protocol AODV sector and a modified one based on the cluster, closing with an interpretation of reported results.

2. RELATED WORK

Y. Zhu et al. [3] suggested a solution for the aggregation of information from sensors subsets related to the Sink. The proposed sectorial data aggregation system is the semantic/spatial correlation-aware tree (SCT) scheme, the advantages of this technique among others, is scalability and distribution. The design of SCT is related on two key elements. Aggregation Backbone to facilitate the generation of the effective aggregation tree and a fixed structure for the distribution of the source and the density. The observation of this type of technique is based on a version of 'Stochastic Steiner Tree'. The authors [4], had as objective to propose a technique called, Tree-based data aggregation scheme in order to maximize the network lifetime with optimizing data aggregation and routing mechanism. The purpose of this method is to organize the nodes in a tree structure. This data aggregation is carried out at an intermediate node along the tree and the aggregated data of the entire network will eventually be sent to the root node (the Sink).

The work of [5] developed an effective power in data collection based on a certain protocol PEDAP aggregation (Power-efficient data gathering and aggregation protocol), to maximize the lifetime for standard towers, where each turn corresponds to the aggregation of sensor data transmitted from different nodes.

3. MOTIVATIONS AND ARCHITECTURE PROPOSED

The idea was to perform some observations for inspiration in order to propose an adequate architecture, the first phase was supposed to study the concept of the file compression and formatting systems, the systems FAT (File Allocation Table), NTFS (New Technology Filing System) [6] and to search about the techniques used by them to organize the files so that you can easily find them and use as efficiently the data space. When we look to the principle of compression of the data, we find that a space can hold up to a multiple partitions, namely primary and extended partitions, and everything is managed in the form of disk cylinders, however the primary partition can provide a way to bypass the arbitrary limit partitions. NTFS compresses data using the LZNT1 algorithm, a variant of LZ77 (Lempel-Ziv Coding 1977) [7], and stores them in clusters. The concept of volume is the core of management, it represents a succession of all sectors involved a predefined number of bytes, and they have such a logical number from 0 to n-1. That said, the sectors dependent on the size of the support and represents a logical grouping called a cluster. The organization in clusters offers a great advantage, it allows to group in the same area a series of data, which reduces access. This method saves a lot of time, but has one major drawback in the size. Based on the mentioned observations, we propose sector architecture depend on a sectorial data aggregation system, called Semantic/Spatial Correlation-aware Tree (SCT) scheme proposed by [3] and some ideas suggested by [8].

El Hajj, including the pilgrimage to Mecca is the largest gathering of Muslim believers on earth, the multiple facets of the pilgrimage is characterized by individual mystical experience, religious meditation and a source of inspiration and exchange. Therefore, this season was even more difficult, especially when the whole crowd does essentially the same thing at the same times. This generates a series of challenges for the authorities to control the crowd and identify individuals. When we were discussing the challenges faced by the organizers, we could distinguish among these challenges, the control and management of the crowd and technical reason, give the necessary and opportunity for believers to make the delivery of their data in an efficient and timely manner, including the location of pilgrims. The season of El

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Hajj becomes increasingly a tedious task each year, the price to ensure the tranquility of believers, especially in transmitting and receiving information. Faced with growing demand and for a better organization, this engagement is one of the biggest challenges the authorities face each year, to this end, we propose an optimization to minimize these challenges by deploying different architectures to bounce back these problems.

In this article we will try to optimize the packet relay on the links in multi-hop transmissions. We attempt to exploit the properties of architecture to improve the efficiency of relay and reduce the amount of packets sent over the link. In general, we are trying to optimize the performance required in a place that brings together over millions of pilgrims from around the world. In this context, we offer solutions that maximize the best profile network in terms of the routing data. These architectures are based on compression techniques and clustering to reduce not only the amount of packets sent by the source, but also the overall number of packets transmitted to the source and destination link, without increasing the transmission time. We consider in this paper the case of a source transmitting data through one or more relays, to its recipient. However, the transmission being in a free space, the transmitted signal and some sent data packets are lost between relays. In the case of classical protocols, lost packets are retransmitted, causing additional latency in receiving data. It is therefore necessary to find a simple and inexpensive procedure that allows an optimal utilization.

This architecture refers to the definition of a structure based on the compression of sectorial data, implementing an architecture based on clustering by compression (figure 1). The idea is to adapt this mechanism to benefit from the performance by optimizing the architecture, the concept is clear, trying to propose an aggregation system for cluster-based data cutting on the sector. Each CH (Cluster Head) is responsible for the collection and aggregation of sensor data sent via other nodes in the cluster, thereafter, the CH can transmit data directly to the main Sink certainly using a power long-distance transmission or indirectly using one of multi-hop routing protocols.

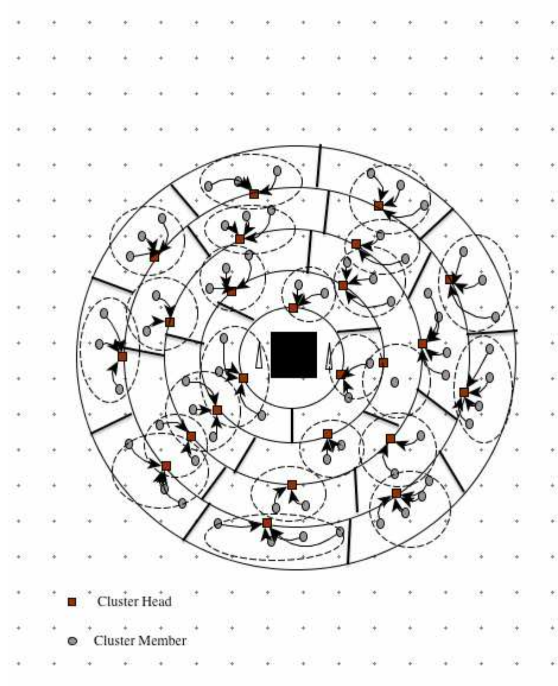

Figure 1: Cluster-Based Architecture Structures

The proposed architecture is a mixture between the two techniques, the goal is to present a method for compressing data by using aggregation based on the division into the sector and the implementation of the clustering technique by mixing everything in a dedicated architecture and designed to optimize the interconnection. The goal of clustering is to provide network scalability and fault tolerance for a more efficient use of network resources surrounded the mosque. In other words, it can be used for resource management, routing and location management to reduce communication and computing.

The facade of the mosque and the surrounding area are divided into N rings in which every cycle has the same width $\frac{R}{n}$. In addition, each ring is divided into a sector with the same size so each sector contains the same environment number of nodes and the same group. All sensor nodes are assumed to know their geographic positions. Then the modular Sink broadcasts a message containing the position, the number of sensor nodes in the network, the radius of the network R, the number of cycle's m, ID of pilgrim and the desirable number of nodes in each area on the network to form the cyclic structure. After receiving such a message via a sectorial Sink, every sensor can determine the ring and the area it should belong. In addition, the sensor node can also determine the boundary of the sector. In particular, by adopting a polar coordinate

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system which is defined as a two-dimensional coordinate system, which each point of the plane is fully determined, the coordinate of every point can be designated by (r, θ), where r is the distance between the point and the polar (the position of the Sink) and θ is the included angle with the polar axis. Note that the point M is perfectly located if we know the distance OM= r, correspond of the radial coordinate. Taking into account the real dimensions of the grand mosque (Figure.3), these sensors are attached and deployed to cover all areas of the grand mosque of El Hajj.

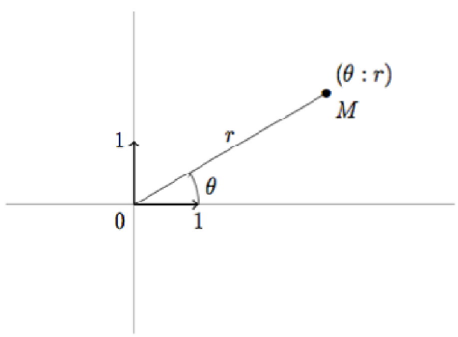

Figure 2: Polar Coordinate System In Two Dimensions

The formulas to move from one system to another are represented by (1), (2), (3), (4).

$$r = \sqrt{x^2 + y^2} \quad (1)$$

$$\cos(\theta) = \frac{x}{r} \quad (2)$$

$$\sin(\theta) = \frac{y}{r} \quad (3)$$

$$x = r\cos(\theta)\ et\ y = r\sin(\theta) \quad (4)$$

Then, the coordinates of the boundary of an area in every cycle can be represented by (5) and (6),

$$((i-1)\cdot\frac{R}{n}, \alpha) \quad (5)$$

$$((i-1)\cdot\frac{R}{n}, \beta) \quad (6)$$

Where α and β are the angles of the boundary of the sector.

Every sector of our network is divided into a several cluster to increase the availability and avoid long-range traffic, also provide fault tolerance. Noted that the Cluster formation is done automatically. Any cluster member will be assigned to a CH, the CH node sends periodically the list of nodes and gateways to the cluster centralized Sink. During the adjustment phase, Sink itself sends its location (X_s, Y_s), the total number of CH, n, the radius of R network, the number of rings n, the average number of nodes in each sector nb.

Each node in the network knows its location. When CH receives these parameters, it calculates the distance between them and the Sink. It aims to determine the ring i, and the sector to which it belongs. Using the same set of parameters, every node may be able to determine the limits of the area in which it is contained. The use of these parameters causes the calculation of the ideal location of the CH in this sector, which is defined as the centroid of the lower arc of the sector (the geometric center). Adopting polar coordinates if α and β are the angles of delimitation of a sector corresponding to each ring, the ideal position of sector Sink in each sector of the ring must be located in the centroid of the inferior arc of the sector (or geometric center) is the coordinate (7).

Once the location of the aggregation node is determined, the source transmits its message to the geometric location of the CH or Sink by using the routing protocols.

$$((i-1)\cdot\frac{R}{n}, \frac{\alpha+\beta}{2}) \quad (7)$$

However, if there is no node located in the ideal position the nearest node of this position will be the aggregation node in the sector. Then all the other nodes can transmit their sensor data to the destination node by one of the routing protocols.

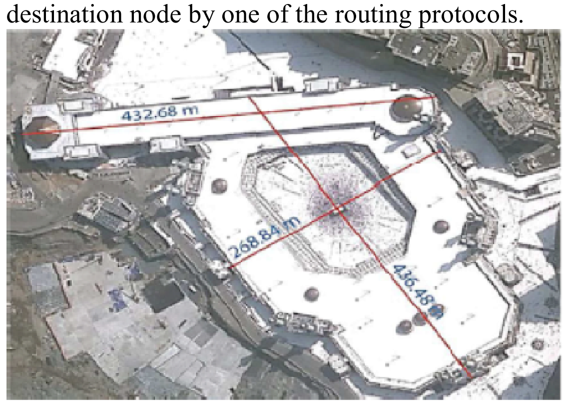

Figure 3: Dimensions Of The Great Mosque

The approach defines three types of actors, namely CH, CM and gateways, as defined before each sector must elect the CH among the nodes that have a higher level of confidence.

- Sectorial Sink – Cluster Head
- Cluster Head – Cluster Member

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4. ROUTING PROTOCOL AODV

In a complementary way of what we have already mentioned, a group of nodes that are interconnected dynamically and arbitrarily represents the label definition of ad hoc network. However, the crucial advantage of using the routing mechanism is to discover the exciting routes between nodes, the primary goal makes this mechanism efficiency is however the advantage of the establishment roads so that they are correct. There are two family types of routing protocols, protocols based on link state, and those based on the distance vector. Both methods use the same function which is the shortest path technique, where a periodic update of routing data proves challenging [9]. We found a set number of routing algorithms, two major classes of routing algorithms will prove crucial in this study, the reactive and proactive algorithms as defined in figure 4.

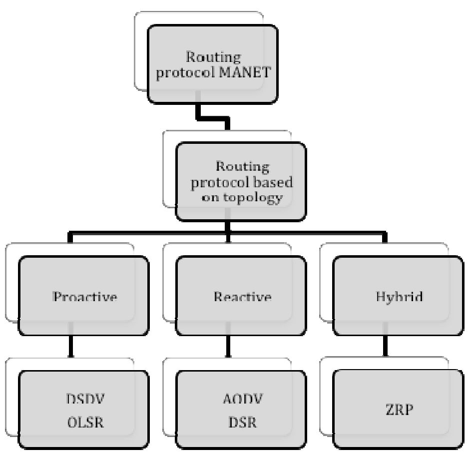

Figure 4: Classification Of Routing Protocols In MANET

A more robust approach is the use of reactive protocols, a path discovery is used only for the initiation of a communication and in response to a need. This process stops when the route is found or all possibilities are considered. The famous types of reactive routing protocols: AODV (Ad hoc On Demand Distance Vector) and DSR (Dynamic Source Routing). The AODV protocol [10] is generally more scalable. In this protocol, nodes collect routing information to the request only when they have data to a certain destination, they build a path. In this way, they significantly reduce the overhead of routing. AODV combines the mechanisms of discovery and route maintenance for DSR [11] by involving the sequence number and periodically update used by DSDV (Destination-Sequenced Distance-Vector) [12], the route discovery is made by a broadcast of the RREQ message (Route Request), once the message reaches the destination it retransmits a RREP message (Route Reply) to the source. The route error packets RERR (Route Error) are used in the case where there has a broken route. These packets are routed control traffic.

4.1 Optimization Proposal Of AODV Protocol

4.1.1 First modification

Still in the case of El Hajj, when a user wants to establish a communication with another on the ad hoc network, the road is made between these two users (nodes), but if during the communication, the user of destination performs a kind of mobility and go out of the scope of other users, normal case of ad hoc networks that recognize mobility and change of regular topology, the node will attempt to find a new route. Based on the principle of the strategy of the AODV routing protocol, when a node wants to discover a new route, it broadcasts a RREQ packet to a given destination. If a RREP response is received, then the route discovery operation is closed. In the opposite case, if the road fails to find a new issue, it rebroadcasts another RREQ message and waits for a period longer than the first one. In the absence of response, this process can be repeated several times in successive ways. If there is still no answer at the end of attempts, the route search process is abandoned. A new route request will be initiated after a timeout. Undiscovered of the route is provoked in this scenario to the remoteness of the destination node.

The problem is as follows, if other users are trying to communicate with the destination user after his removal, they will generate an unnecessary large amount of control messages which consumes the limited resources of the ad hoc network. We suppose that the target node tries to get closer during the waiting period of the source node after a period, the source node does not detect the reconciliation of the remote node. Therefore, the establishment of a new route is made only after the expiry of the waiting time, which increases the duration of discovery of a path. To solve this problem, and as a first task, we modified the source code of the AODV protocol, so that the latter do not test on the number of attempts to broadcast RREQ. However, if the remote node does not close during the waiting period, this version of the protocol continues to generate, unnecessarily, the route request message (RREQ). To remedy these problems, we changed the AODV routing protocol strategy, to make a modified version of AODV.

Algorithm (1)

1. *Source Node broadcasts RREQ*
2. *If (the destination node receive the RREQ) Then*
3. *(Destination Node unicasts RREP)*

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```
Else
//not have a Timeout
//not counting repetition of RREQ-RETRIES
//discarded of max RREQ TIMEOUT not have a
  attempt
rt->rt_req_cnt = 0;
//rt_req_cnt is the number of times we did
  network-wide broadcast
Packet *buf_pkt;
While ((buf_pkt = rqueue.deque(rt->rt_dst)))
{
Drop (buf_pkt, DROP_RTR_NO_ROUTE);
//the route search process is aborted
}
Packet:: free ((Packet *) p);
Return;
End If
} }
```

4.1.2 Second modification

Our second proposal was in the first place to limit the TTL (Time To Live) for RREQ, the problem turned out that the package did not reach the destination, it remained blocked until its destruction, that means we ignored this change. Another trial by making high value of TTL, which mean we will have more breaks. This will cause a decline in terms of packet delivery ratio. Our modification is to limit the number of hops, however, if the condition does not apply, this signify that the package wants to use a larger number of hops to reach its destination, the packet will be rejected, if the number of hops is large, it will take longer to reach the destination, therefore, the resulting traffic occupies the bandwidth. This leads to an improvement in the packet delivery rate and throughput. Note that in a multi-hop topology, it becomes problematic for a lot of hops.

Algorithm (2)

```
Definition of a constant variable in file of references
LNS: Limited of hop count
IF (Route of the last chance < LNS)
{
Then the packets can reach the destination
Else
(The packets is discard) // the packet use a larger
  number of hops to reach destination
End if
}}
```

4.1.3 Third modification

This change affects the internal configurations of the AODV protocol in such a way to optimize performance. As our simulation architecture requires the important performance, find the best configurations AODV proves a crucial task to allow a communication and conduct a proper functioning of the AODV protocol for ad hoc networks.

Table 1: Internal Configuration Parameters.

Parameter	Type	Fields
HELLO_INTERVAL	reel	[1.0, 20.0]
ACTIVE_ROUTE_TIMEOUT	reel	[1.0, 20.0]
MY_ROUTE_TIMEOUT	reel	[1.0, 40.0]
NODE_TRAVERSAL_TIME	reel	[0.01, 15.0]
NET_DIAMETER	integer	[3, 100]
ALLOWED_HELLO_LOSS	integer	[0, 20]
TTL_START	integer	[1, 40]
TTL_INCREMENT	integer	[1, 20]
TTL_THRESHOLD	integer	[1, 60]

4.2 AODV Protocol In An Architecture Based Clustering

In connection with other routing protocols, AODV sends many packages that are considered as small. Therefore, when the size of the network increases, the degree of the nodes also recognizes an augmentation, which causes certain network congestion. Using the technique of clustering may have the effect of reducing this overhead by allowing the location of the discovery and maintenance of routes. The diagram of the proposed AODV cluster uses the clustering architecture and functionalities of the AODV protocol to establish the routing mechanism. In this section, we will define the mechanisms used by AODV-C to reduce the overhead of routing and allow constant evolution, while achieving excellent performance of packet delivery rate. The Figure 5 shown the categories of nodes in cluster.

The architecture consists of three layers:

- The core layer: a powerful base station from which other layers are derived from it, the BS position is very significant.
- The sectorial layer: layer sensor nodes surrounded the base station.
- The extended layer: either we find scattered all nodes.

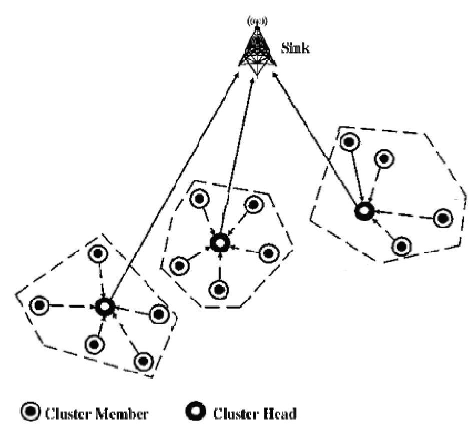

Figure 5: Categories Of Nodes In A Cluster

We will need to define three roles for a node, five types of messages. A node in our cluster

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network could have three roles, node of pilgrim, CM (cluster member), CH (Cluster Head), as defined in figure 6.

Further, our algorithm identifies five types of messages:

1. BD: BD contains the necessary information for the operation of the system, i.e., ID_pilgrim, energy level, capacity and location of the node.
2. INT: a CH sends a usual INT to recruit nodes. INT also contains the type of data needed the CH, so that the receiver can send such data to the CH subsequently when it wants to join the cluster.
3. REP: Two cases are distinguished when sending a REP via a node. When a node receives an INT from a CH, it immediately returns a REP to CH to confirm its participation in this cluster.
4. INV: When the nodes form a cluster, the CH usually chooses the one with the greatest energy. Then the CH sends INV, which contains all the details of its current members at this node.
5. ACK: Nodes usually send this message to acknowledge the receipt of certain messages as INT, INV.

The steps of this work are presented as follows:

1) A clustering-based network architecture approach
2) Creation of network simulation scenario
3) Creation and configuration of Sink
4) Cluster Formation
5) Evaluation of Cluster Head
6) Using the AODV routing protocol based clustering.

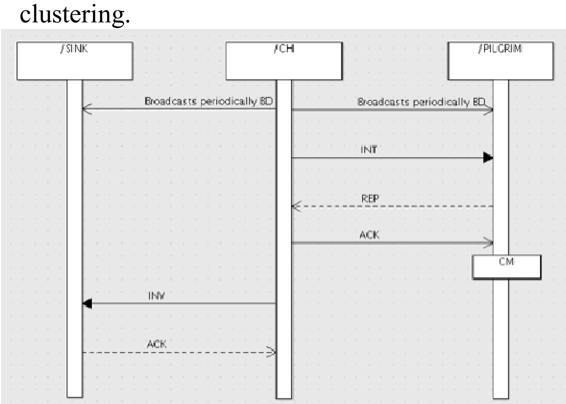

Figure 6: Sequential Function Of Clustering

Algorithm (3)

```
Initialize radius and distance between CH and CM
Choose the ideal position iP (X_s, Y_s)
iP=((i-1)*R/n, α | β/2)
If (the position node <distance of Cluster Head) Then
(Add the node Ni into Cluster Head)
(Count Ni for each CH)
Elect the node wish has high count as Cluster Head
Repeat the steps for cluster formation of various cluster
Choose the node as CH for which the number of count has been high
Source node sends RREQ to its cluster head
If (the Cluster head receive the RREQ) Then
(The cluster head checks whether destination node is in its members predefined)
(If so it unicasts RREP)
Else
//not have a Timeout
//not counting repetition of RREQ-RETRIES
//discarded of max RREQ TIMEOUT not have a attempt
rt->rt_req_cnt = 0;
//rt_req_cnt is the number of times we did network-wide broadcast
Packet *buf_pkt;
While ((buf_pkt = rqueue.deque(rt->rt_dst)))
{
Drop (buf_pkt, DROP_RTR_NO_ROUTE);
//the route search process is aborted
}
Packet:: free ((Packet *) p);
Return;
End If
} }
```

5. SIMULATIONS SCENARIOS

To best analyze the behavior of routing protocol for MANET network, we opted to use the constant rate traffic sources CBR (Constant Bit Rate) using the transport protocol UDP (User Datagram Protocol). The first study based on a comparison of the two protocols, namely the classical AODV protocol by implementing a sector-based architecture and the modified AODV protocol while identifying performance needed to derive the benefits of modified protocols. First to describe the impact of density on the performance of routing protocols, we varied the number of nodes by a study based on a class, a medium-density environment. Then we carried out the study of different measurement of metrics. In addition, the second simulation scenario consists of realization a contribution of CH creation to achieving a study founded on the need to have an ideal number of CH defined in architecture.

The proposed algorithm has been simulated using the NS2 simulator (Network Simulator 2) [13] and the Framework MannaSim [14]. The simulated network consists of a group of Sink, CH and ordinary nodes. In all scenarios, the spacing is set at 120m in a rectangular grid topology, the size of the CH fixed at 25.

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This part defines the experiments by analyzing the performance metrics of the two protocols, namely AODV and AODV-C according to the following evaluation criteria:

- PDR (Packet Delivery Ratio): this metric defines the ratio between the number of packets received by the recipients, and the number of data sent by the source (8).

$$T_{PDR} = \left(\frac{N_r}{N_s}\right) * 100 \qquad (8)$$

Nr Total number of packets received, Ns Total number of transmitted packets.

- End-to-end Delay: refers to the time between sending a packet and its reception (9).

$$T_{AVG} = \left(\frac{\sum (H_r^i - H_t^i)}{Nr}\right) \qquad (9)$$

H_t^i The transmission of the packet i, H_r^i receiving the packet i, Nr total number of packets received.

- Average Throughput: refers to the report of the quality of the delivered data divided the total length of simulation time (10).

$$T = \frac{L}{t} R f(\gamma) \qquad (10)$$

(R) Transmission Rate, (L) Packet Size and $f(\gamma)$ packet success rate based on the signal-to-noise ratio.

- Average Residual Energy: This metric shows how average energy consumption (total residual energy [J] /number of nodes) changes over time.
- Average Energy: The total energy consumed is the sum of the energy consumed by all nodes in the simulation environment. (The energy consumed by an initial node = the energy of the node-the node residual energy).

To study the performance of the proposed protocols and the impact of the network density, we performed several simulations, each time by increasing the number of network nodes. The simulation network is in a medium mobility.

Table 2: Simulation Context 1.

Criterion	Value
Number of nodes	50-100-150-200
Number of access points	3
Number of cluster head	24
Cluster size	25
Transmission range	100m
MAC protocol	IEEE 802.11
Routing protocol	AODV-C
Propagation model	Two ray ground
Scenario size	250-250
Simulation time	100s
TxPower of cluster head	0,6w
RxPower of cluster head	0,3w
Type of traffic	UDP (CBR)

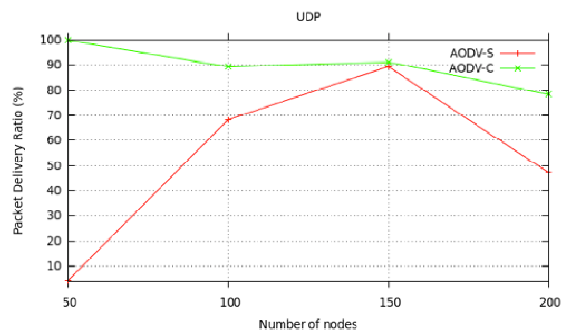

Figure 7: Packet Delivery Ratio Vs. Number Of Nodes

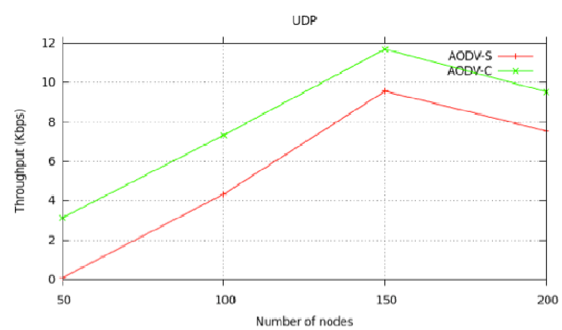

Figure 8: Average Throughput Vs. Density

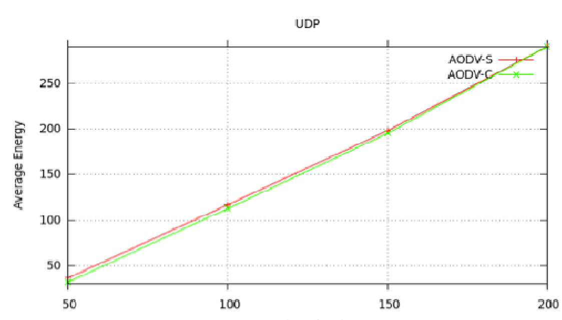

Figure 9: Average Energy, Depending On The Density

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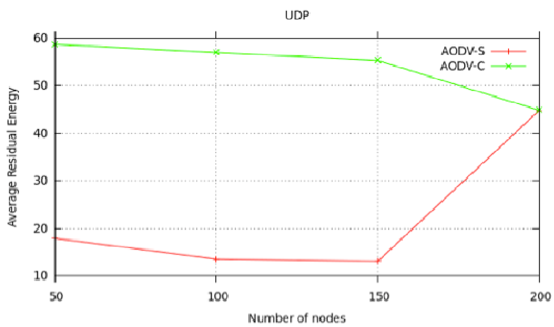

Figure 10: Average Residual Energy Vs. Density

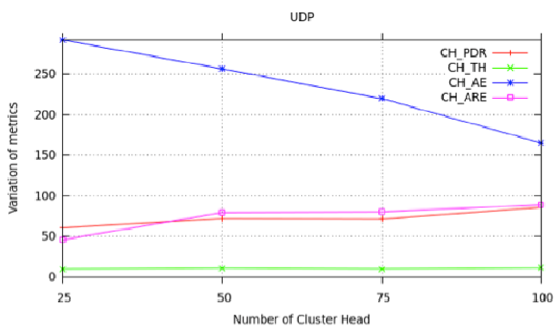

Figure 11: Metrics Variation Vs. CH Densities

TABLE 3: SIMULATION CONTEXT 2

Criterion	Value
Number of nodes	200
Number of sink	1
Number of cluster head	25-50-75-100
Cluster size	25
Transmission range	100m
MAC protocol	IEEE 802.11
Routing protocol	AODV-C
Propagation model	Two ray ground
Scenario size	250-250
Simulation time	100s
TxPower of cluster head	1w
RxPower of cluster head	0,6w
Type of traffic	UDP (CBR)

6. INTERPRETATION OF RESULTS

- Packet Delivery Ratio

It is influenced by the augmentation of the traffic load, using UDP, the highest rate that is anchored by the cluster-based protocol AODV-C compares with the classical AODV. We also see some decline when traffic increases further AODV-C always takes the lead with a mixture of the rise and stability in spite of AODV-S.

- Throughput

When we observed the results identified, it's clear that the throughput of AODV-C protocol is higher by comparing with the other protocol in transmission traffic on UDP. Even with these few significant results both protocols tend to decline, we see a relatively flow down of the number of nodes

- Average Energy Consumption

In general, the energy consumption is relatively associated with the number of packets processed and the type of treatment carried out namely, the transmission and reception. It is noted that the transmission of a packet requires more energy than the reception. For a transport protocol UDP, the amount of energy consumed is average for AODV-C and important for AODV.

- Average Energy Residual

The node sends the data through the Cluster Head node to the Sink consuming energy. As the number of packets received by the destination increases, the average residual energy of the nodes decreases. In the figure, it is found that the difference in energy levels increases as the number of nodes in the network grows.

Looking closely at the results, AODV-C remains the most powerful, it gives good results compared to AODV.

- Cluster Head

We studied the algorithm performance using a variation of the percentage of elected CH. The results show that when the number of CH increases with a rising number of nodes, we get good results. This is due to the increase in the coverage area, however, more nodes are simply involved in the transmission range. This implies an increase in the cluster about the same rate of number of nodes.

To define pilgrim localization, the mechanism is based on broadcasting an ID_piligrim, which refers to the sensor ID. Broadcast is limited to the area cut around the Great Mosque. In general the sending and receiving of necessary information, including ID is focused by routing mechanism, inform the actors of system, We note that the CH that finds the ID, is considered as a reference by his position to locate the pilgrim lost. As shown in the model (figure 12), the pilgrims are equipped by a smart FIBA watch, which content information about lost pilgrim and also gives directions to them.

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Figure 12: Model Of Smart Watch Pilgrim Control Application

CONCLUSION

In this paper, an approach was suggested to offer a smart mobility solution of one of the most problems in El Hajj season related to the control, localization of pilgrims and the optimization network of routing decisions. The presented work was to supervise and guide the believers, also offering optimization relaying real time of data. This approach uses an optimized architecture of the structure of the place of the Great Mosque, which provides a good and fluid performance founded on the compression sector based on clustering.

This solution presents a model for a region, and can be later duplicated for the complete area of El Hajj. It also facilitates communication and real-time localization. An architecture and analytical study proposed, including a pertinent routing protocol, in the perspective of an implementation and in depth study in the environment of the great mosque, for the development and deployment of this solution. As part of future work in terms of routing, we plan to extend the functionality of the protocol for it to be adapted to VANET networks, implementing the principle of Clustering, since it needs a makeover for in networks VANET.

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