Maximizing Network Lifetime of Wireless Sensor Network

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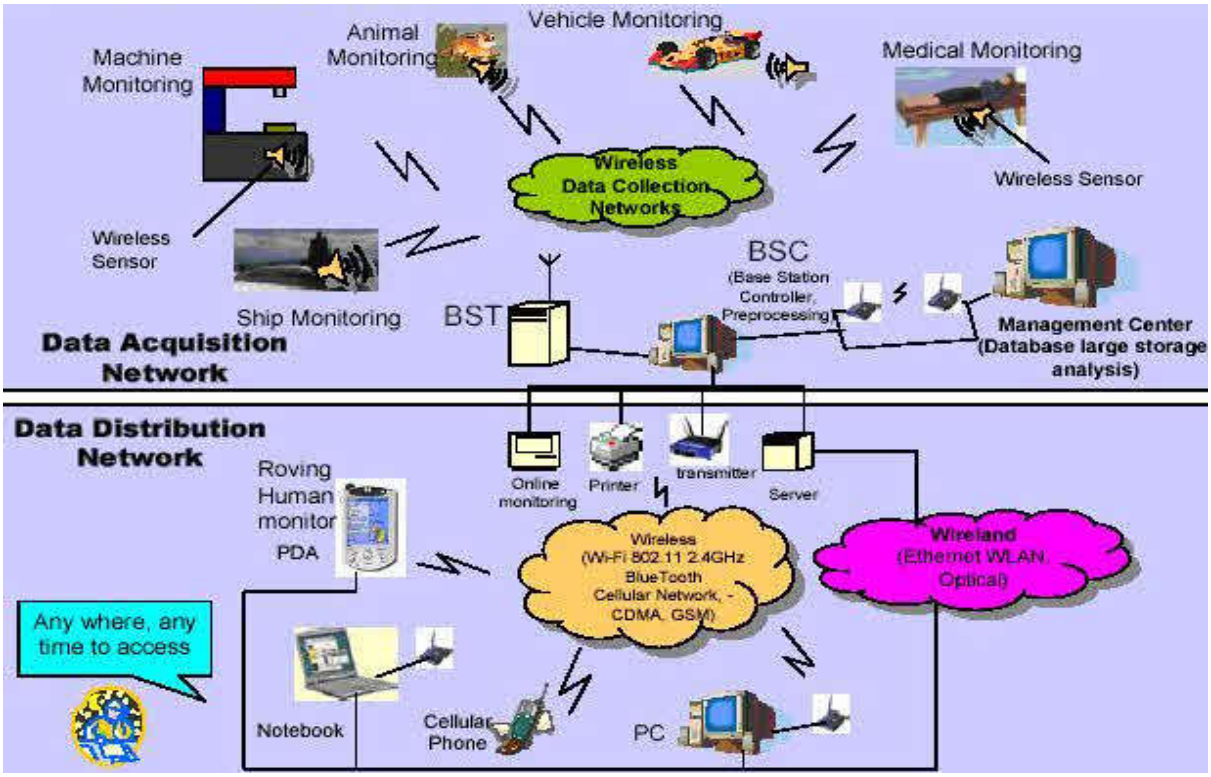
Abstract- Wireless sensor networks are used to extract the various information that are used to collect data. It includes large volume of data so that its performance may get slower and life time of the network may get restricted. This paper deals with the maximum usage period of the network. The modified LEACH protocol is used which supports the mobility of the node and so extends the lifetime of the network. The network may contains large number of sensor nodes in which some are as static refers to Cluster Head(CH) and some are as Mobile Base station(BS). These sensor nodes are consequently detects and sends the sensed data to the nearest CH and later this sends to the Mobile Base Station. This leads to efficient extract of information. To display the improvement and reliability this protocol is compared with the fixed node approach.

I INTRODUCTION

In recent years an efficient design of a Wireless Sensor Network has become a leading area of research. A Sensor is a device that responds and detects some type of input from both the physical or environmental conditions, such as pressure, heat, light, etc. The output of the sensor is generally an electrical signal that is transmitted to a controller for further processing.WSN is a wireless network that consists of base stations and numbers of nodes (wireless sensors).These networks are used to monitor physical or environmental conditions like sound, pressure, temperature and co-operatively pass data through the network to a main location as shown in the figure.



Wireless Sensor Networks

Clustering communication protocols represent a superior approach, and result in more balanced patterns of energy use in WSNs. The first low-energy adaptive clustering hierarchy was LEACH. It showed how energy loads could be well amortized by dynamically creating a small number of clusters.

The technique uses cluster heads (CHs) to mediate data transmission. Simulation results show that the energy dissipation is the same by all nodes because the CH roles are rotated among nodes. Generally, nodes in a WSN are static, i.e. nodes with fixed position. In the literature, the routing protocols do not support sensors mobility. But, few applications, such as the supervision of a complex environment - medical supervision, Natural disaster prevention, etc, require mobile components in a WSN.

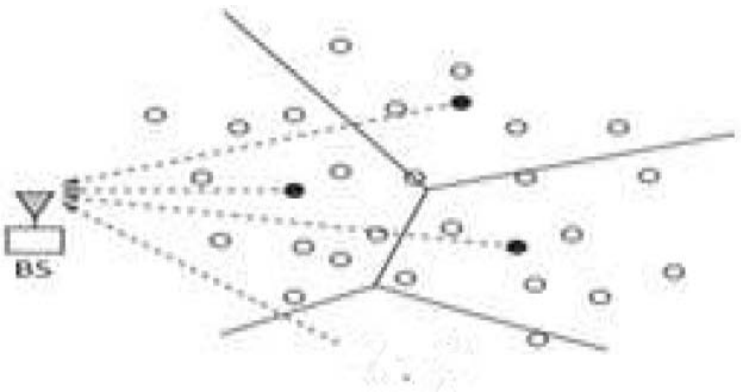
Some approaches in the literature, treat the mobility in a WSN by the modification of the protocol Low Energy Adaptive Cluster Hierarchy (LEACH). In general case, LEACH and its modified versions supporting mobile nodes are based on a mono-hop communication. In fact, it considers that all nodes can exchange data with the sink node. So, it is useful in indoor where the supply and people limit the wireless components radio range. But the multi-hop routing is a necessity to support a widest area like outdoor applications. In this context, we were interested to develop a multi-hop routing protocol respecting the WSN constraints and then it to support mobile nodes. For this, we studied also the contribution of mobility over the WSN lifetime.

This paper is organized as follows: we describe in section 2 our solution to improve the LEACH protocol to support a multichip network topology and to support the presence of mobile nodes. Finally, we summarize our work in the conclusion section.

II THEORET ICAL ANALYSIS

Leach Protocol:

This section deals with the mechanism of LEACH protocol. This approach is used to improve this protocol to support multi hop architecture. One of the interesting techniques is the Hierarchical Routing, which introduces the concept of cluster creation and assigning special tasks to selected sensor node within the cluster called cluster head (CH). Hierarchical Routing is an efficient technique to reduce energy consumption by doing data aggregation and fusion in order to reduce the number of transmissions to the Base Station (BS). The first hierarchical protocol is the Low Energy Adaptive Clustering Hierarchy (LEACH) that was introduced in [3].The idea of LEACH is to form clusters of the sensor nodes based on the received signal strength and use local cluster heads (CHs) as routers to the sink. This enhances the energy consumption since the transmissions will only be done by the cluster heads rather than all sensor nodes. Many hierarchical protocols were emerged based on the idea of LEACH



CLUSTER NODES

MULTIHOP LEACH PROTOCOL:

M-LEACH (Multi-hop LEACH) is one of the descendents of LEACH developed till date. In this, rather than directly communicating to BS, CH transfers the data through CHs, lying in between source CH and the BS. The working of M-LEACH is performed by two forms of communication.

- Intra-cluster communication
- Inter cluster communication.

Although the M-LEACH became successful up-to some extent in resolving the issues of LEACH deployed WSN but still some loopholes are left in M-LEACH. These are: The CH is elected based on probability function as in simple LEACH. The CH rotation is done after each round of communication. The CH is elected from scratch that introduces delay and increased power consumption.

FIXED MULTI HOP LEACH ALGORITHM

BEGIN
Specify the probability Pi(t), nodes number N
(I) PREPARATION PHASE
Repeat (2times) if there is no response:
ask for cluster I D(); I I sensor broadcasts
Iia request to know which cluster it belongs
if (no answer) then
command the BS to add a new cluster to this node
end if
(II)SET UP PHASE
n = N I K; I In = rounds number,
I I K = required C H number and N = nodes number
repeat for n rounds
r = random(O, 1);
if (r < P(i)) then
Actual_CHi = TRUE; I Inode"i" is a CH candidate
Iinode"i" inform the old CH and wait validation
else
Actual_CHi = FALSE; I Inode"i"isnot a CH candidate
end if
(III)STEADYPHASE
if (CHi = TRUE) then
Send_broadcast(IDi,clusterI Di) lithe node
Ilbroadcasts an ADV message to inform other
Iinodes that it has become a CH;
else
Join(IDi); Iinode "i" non - CH join the CH
Capture(2sec); Iinode pick up a measure
I I every 2seconds to control its environment and
I I send this measure to the corresponding C H
while AC K is not received from the C H do

Send_data (I Di, clusterid, data); I I sending
Iidata to the CH
end while
end if
if (ActuaCCH(i) = TRUE) and (node <> sink) then
Receive--:join_Req_fram_member(I Di, clusterJ D)
Send_ACK(CHjD,clusterjD) IlsendACK;
Receive_data(M ember I D, cluster I D, data)
Send_ACK(ID_CH) Iisend data ACK to a member;
Send_data_toSink(I Di, cluster j D);
Receive_ACK_framSink();
if (ACK not received) then
while (delay allow and gateway isn't found) do
Research--9ateway(I Di);
Ilresearch a gateway out of the cluster
if (time is over) then
the node select a gateway in its cluster;
join_gateway(IDi,clusterJD); Ilgw to which
IltheCH transmit its data
end if
end while
Send_data (I Di, cluster _I D, CH, gateway, data);
I I sending the received data to the gateway
I land waiting for an ACK
end if
end if
if ((CH(i) = FALSE)and(node <> sink)) then
while AC K is not received do
Send_data_ToCH(IDi, clusterID, data);
/ / sending data to the C H;
if (Receive data from a node member) then
if (received-fJatewayj D = I Di) then
/ /receiving data from the gateway;
SendDataToCH(I D, cluster j D, Data);
I I send the received data and its coordinates
I Ito the C H (with the same source I D)
else I Ireceive data fram a node member which has
I I not taken the C H change
Send_newCHjD(Actual_C H(cluster I D),
clusterID);
this node should join the new CH and transmit
its sensed data
end if
end if

end while
end if
if (IDi = Sink) then
Receive_data (I Di, cluster I D, CH, Data);
Send_ACK(); I I sending data ACK to the CH
end if

Several applications such as in telemedicine (If an ambulance is equipped by sensors, doctors in the hospital can reach the nurses to help the patient when this vehicle is moving to the hospital or if a patient equipped by sensors, he can be treated at home) or in military the control of mobile units is strongly requested. But, LEACH don't support nodes to be moving. So, we thought to improve this version of LEACH protocols to support mobility.

1) Mobility model: In the topological model, we assume that the BS is mobile and can leave an area to enter in another one. Sensor nodes are fixed. Two cases are considered:

1. If "i" is a non-CH sensor, it should join the corresponding CH. Similarly, it can send its collected data to the CH.

2. If "i" is a CH, it sends its collected data and those received from the other members to the BS. CH nodes must then find the BS in their coverage area to send its data.

2) Mobile mono-hop LEACH: We assume that nodes can directly communicate with BS and nodes radio range is limited to cover a little area like in indoor applications. For example, a person can supervise his habitat using his mobile phone (as a BS) when he practice his activities.

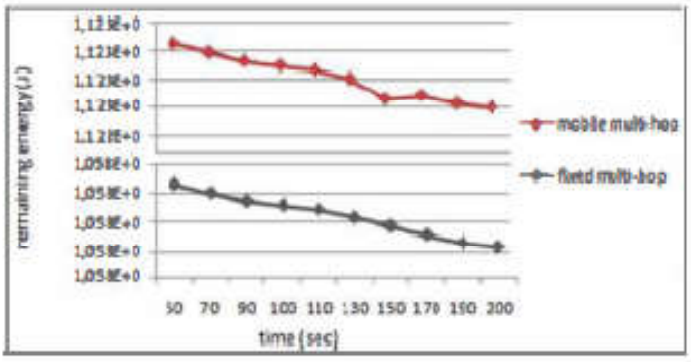
Our approach is based on the following points:

- The network is composed by N homogeneous nodes and some mobile base stations.
- The algorithm operates in n rounds
- Nodes are equal to become CHs and take over to rotate data from other members to the base station.
- Each node, elected to be CH, broadcasts a message to other nodes in the same cluster. These nodes have to join this CH and then send their collected data to their closest CH.
- If a node has not taken the new CH ID, the old one shall inform this node. The CH for each cluster receives the data from cluster members and then searches the BS in its range to send its data through a single-hop relay.

III. RELATED RESULTS

In this component, we submit the assessment and a relative analysis to study the presentation of the protocols which are discussed earlier, secure mono-hop LEACH, secure multi-hop LEACH, mobile mono-hop LEACH and mobile multi-hop LEACH. We used the tinyOS as the operating system and we have written our algorithm with the C language which is a language for the sensors memory limits. We relate the performance of various approaches with a distinct event network simulator.

Impact on Mobility: The evaluation of LEACH was performed with couple of scenarios, the very first based on stationary sensors and the second one is based on stationary sensors with a mobile BS. This is to display the mobility impact on those protocols presentation and to estimate its robustness.



Stationary network and mobile network

CONCLUSION

We considered a heterogeneous WSN which consists of a large number of sensor nodes, a few CHs, and a mobile BS. To rotate sensed event, we were based on the LEACH protocol. This protocol is the famous one used for mono hop WSN. We improved the existing algorithm to support multi hop architecture and to support mobility. In this topic, we considered the problem of maximizing the network life time. We evaluated the performance of the proposed protocols (mobile and fixed LEACH protocol for both mono and multi-hop architecture) in terms of network lifetime, exchanged packet rate and loss packet rate.

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