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Applying to Optimization Multi-Hop Layered LEACH Routing Protocols in Wireless Sensor Network

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Abstract

In this paper, the ML-LEACH routing protocol for the improvement of the performance of in wireless sensor networks is studied. ML-LEACH is derived from LEACH routing protocols. ML-LEACH is a Multi-Hop Layer. ML-LEACH is proposed to compensate for a phenomenon that the energy consumption of the protocols of the sharp drop in the disadvantage of a wide sensor field of LEACH routing protocol. ML-LEACH routing protocol is set up in the environment in accordance with the specific number of Layer and a node in a wireless sensor network and its performance is compared. The simulation MATLAB is used to let derives the number of Layer and the number of cluster heads.

Keywords*: WSN, Routing Protocol, LEACH, ML-LEACH, Layered, Multi-Hop*

1. Introduction

Routing protocol in a wireless sensor network is defined a method of setting the transmission and receive paths for the collected data, and a number of network operation in the field between the sensor node of the network. Routing protocols is depending on the operating environment of wireless sensor networks. Life cycle of the network is improved in accordance with the method of the routing protocol. As such the routing protocol has a direct relationship to the life of the network for the life and energy consumption of the network. [1-2] The LEACH (Low Energy Adaptive Clustering Hierarchy) routing protocol is typical hierarchical routing protocols of the routing protocol. LEACH, the cluster as the structural units of the cluster head node and a member node tissue and improve the energy efficiency of the network through it. LEACH changes the role of the cluster head of the sensor nodes in the cluster of the clustering process, each round. The energy consumption of the cluster head, which may be heavy with it thereby, consumes energy uniformly to all sensor nodes within the cluster. However, LEACH routing protocol, which is depending on the field size of the network increases, the energy consumption efficiency of the long-distance has the disadvantage that decreases rapidly. To this end, the improved routing protocol is ML-LEACH routing protocol. ML-LEACH routing protocol is applied with Multi-Hop Layer and which is based on a conventional LEACH routing protocol. ML-LEACH routing protocol divides the network put the Layer field in the network. The transmission distance between the sensor nodes through the data transmission of Multi-Hop is reduced. Energy efficiency in the wide sensor network field is improved than the LEACH routing protocol.

In this paper, the optimum number of layer and cluster head of ML-LEACH routing protocol is derived from a simulation. Routing protocol LEACH is the basis of the typical hierarchical routing protocol. ML-LEACH applied the number of cluster heads and the number of Layer derived from optimal comparing of the performance. Paper is organized as follows: The research in Chapter 2, Chapter 3 was the simulation results. And Chapter 4 presents the conclusions.

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2. Related Researches

2.1. LEACH Routing Protocol

The LEACH (Low Energy Adaptive Clustering Hierarchy) routing protocol is hierarchical clustering based on the proposed routing protocols by Wendi B. Heinzelman. LEACH is formed of a structural unit of the cluster head and the cluster member nodes. [3] This allows to improve energy consumption efficiency of the network. The operation of LEACH process stage is set-up phase and steady state. In the set-up phase of LEACH by working with elected members elect a cluster head node in a clustered configuration steps to configure a cluster. It determined the procedures for transmitting and receiving data through the TDMA schedule. Thus, multiple clusters are formed in the network field through the set-up phase and steady state. It has a hierarchical structure composed of a cluster head and member nodes. The following Figure 1 shows a hierarchical cluster structure of LEACH.

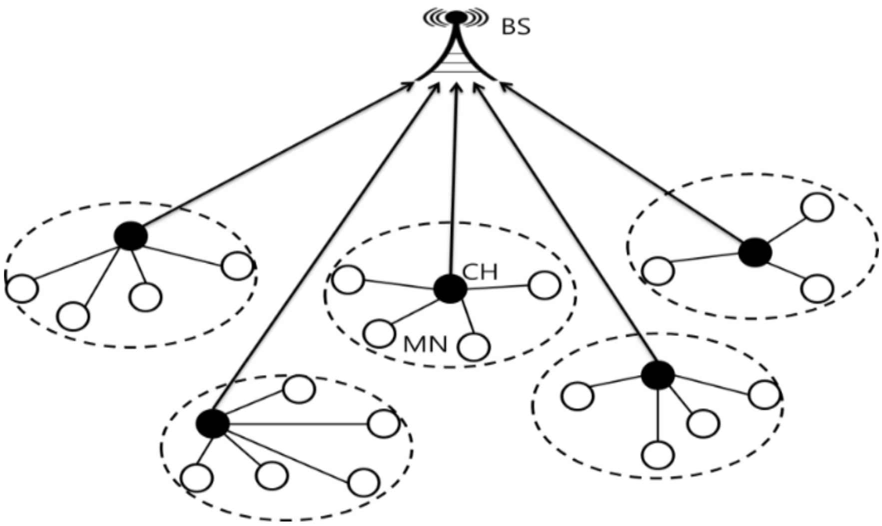

Figure 1. Hierarchical Cluster Structure of LEACH

Firstly, in the set-up phase of LEACH routing protocol consists of a cluster head elected from work required for cluster formation. The cluster head is elected by the probability of expression of a stochastic, Stochastic Threshold. Each round is periodically selected as the cluster head. Every sensor node in the cluster will periodically rotate each round is chosen as cluster head. A threshold is equal to the following expression formula (1) for electing a cluster head in the setup phase.

$$T(n) = \begin{cases} \frac{p}{1-p(r \bmod \frac{1}{p})} & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

Equation (1) is a threshold expression for the average selection of elected cluster head. Following the value of T (n) in the formula represents a threshold between 0 and 1. The value of p is to elect a cluster head ratio. The value of r is currently in service round. The value of G is the set of member nodes that have not been selected as the cluster head in the previous round. The value of T (n) is given by the expression of a threshold. And when random number of the n-th node is compared with T (n) and the value is less, the n-th node is calculated to cluster head node. When a cluster head is elected by the threshold formula, following cluster configuration and TDMA scheduling work is done through the flow chart shown in Figure 2.

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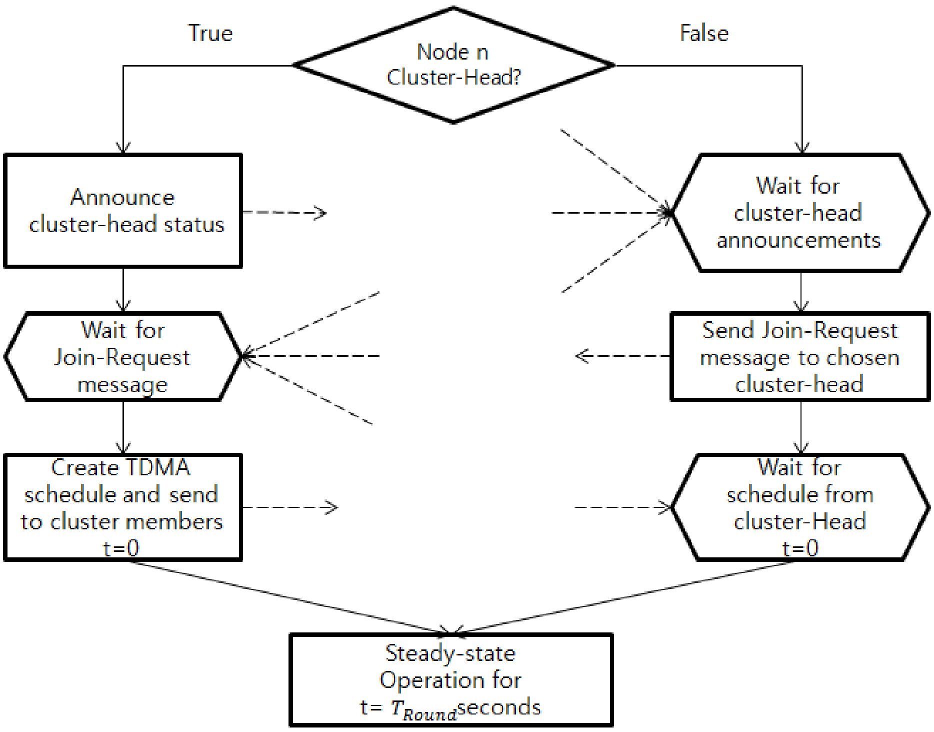


Figure 2. LEACH Set-Up Phase Flow Chart

If the cluster head transmits a Broad-Casting, it messages to the members of node. When receiving this message, the member of node transmits a Join Request message to the cluster head in the minimum distance. When receiving the Join-Request message, the cluster head transmits the TMDA scheduling once again to the member nodes. It sends a data transmission schedule for the network operation. LEACH routing protocol is run through this process. LEACH routing protocol has the advantage of improving the energy efficiency through the selection of the clustering operations and periodic uniform cluster head to evenly consume the energy consumption of each sensor node. However, LEACH routing protocol rapidly reduced to a more energy efficient transmission of a load on the energy consumption sensor node as the maximum transmission distance is increased. LEACH routing protocol is not suitable in the Wide Sensor Network Field.

Advantage of the LEACH routing protocol is as follows.[5-7]

1) Increasing energy consumption efficiency through the cluster head within clustering.

2) Increasing energy consumption efficiency through the data aggregation within clustering.

3) Locally uniform energy consumption can be realized within clustering.

Disadvantage of the LEACH routing protocol is as follows.

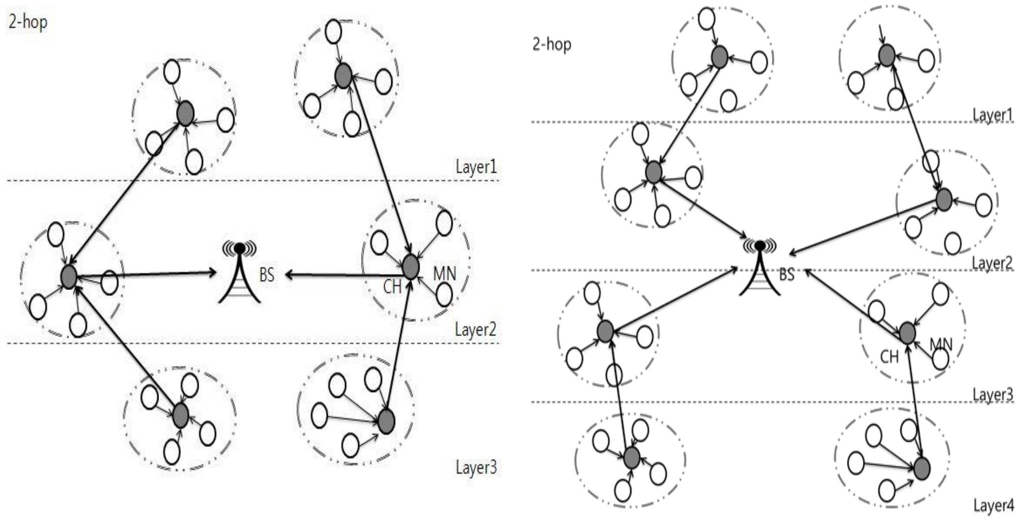
1) Reduced energy efficiency of the wide sensor field.

2) Instability of the cluster head selection number of Stochastic Threshold.

3) Greater the load on the energy consumption in accordance with the transmission distance.

2.2. ML-LEACH Routing Protocol

ML-LEACH (Multi-hop Layered LEACH) routing protocol is proposed Multi-hop Layered protocol by Young-Il Song. ML-LEACH is a routing protocol been proposed to improve the disadvantages of the existing routing protocols typically LEACH routing protocol. ML-LEACH improved energy efficiency in the wide sensor field by reducing the transport distance through the Multi-Hop Layered. In Figure 3 shows structure of layers and a transmission method of the ML-LEACH[4, 9-10].



(a) 3-Layer and 2-Hop (b) 4-Layer and 2-Hop

Figure 3. Multi Hop Transmission and Layered Structure of ML-LEACH

ML-LEACH, which is configured, based on the LEACH, is a form modifying the transmission. LEACH is changed an existing transport system in the transmission method of multi-hop, Energy consumption was improved proportional to the square of the maximum transmission distance and transmission distance between each sensor node. A multi-hop transmission method of the ML-LEACH are transmitted to Layer Unit is set in the field. Layer is set constantly relative to the base station. It is defined as the nearest base station and the more low-level Layer. Clustering performed in the interior of each Layer. Cluster head in ML-LEACH transmits the data belonging to one level lower than Layer accepts all of the data of the member nodes of the cluster.

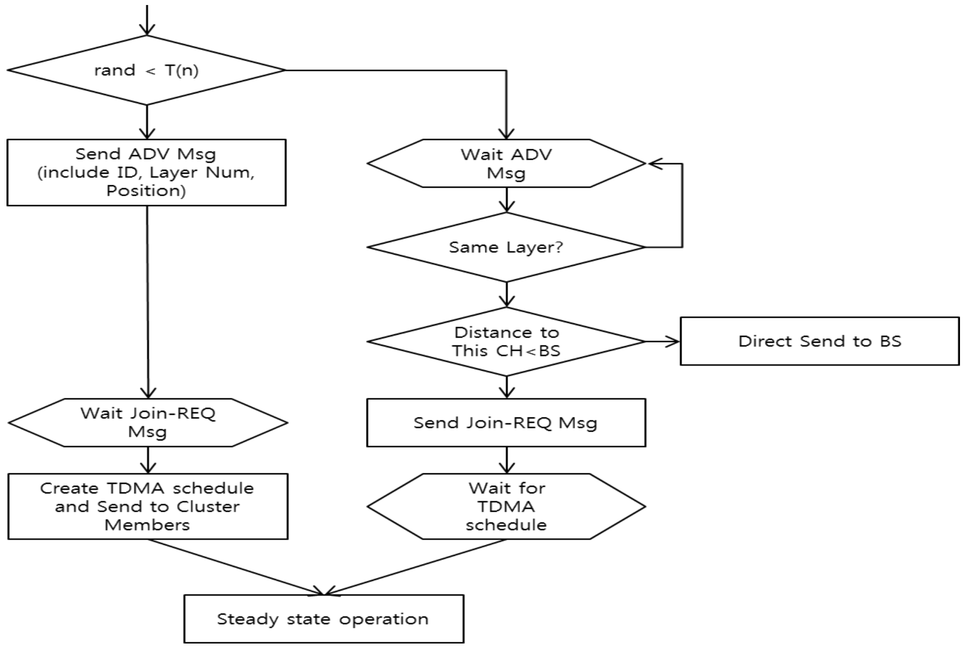


Figure 4. The Process of Cluster Formation for ML-LEACH

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Advantage of the ML-LEACH routing protocol is as follows.

1. The transmission distance between the cluster head with the arrangement of the layers is divided. Reducing the load on the energy consumption of the transceiver is reduced.
2. As the transmission distance is divided, efficiency is reduced in the Wide Area Sensor Field.

Disadvantage of the ML-LEACH routing protocol is as follows.

1) Cluster head close to the base station is very high energy consumption burden. Therefore the time is faster generation of FND.
2) Instability of the cluster head select number of Stochastic Threshold. Accordingly, the cluster does not exist in the layer is the data transmission which does not take place.

3. The Optimization of Cluster Head for ML-LEACH

In this paper, in a multi-hop transmission scheme which has the respective layers configured in accordance with the LEACH routing protocol, the energy consumption model will be proposed as follows. According to the method shown in Figure 3, it sent to the upper layer at the lowest layer. In this case, the Hop number in accordance with the number of layers is defined as below.

$$\text{The number of Hop based on the number of layer}(n) = h_n = \{(n+1)\,\text{QUOTIENT}\,(2)\} \tag{2}$$

Then, the in the each layer is as follows:

The consumed energy of CH in layer 1($E_{CH\text{-}layer1}$) per frame is as below:

$$E_{CH-layer1}(l,k,d) = lE_{elec} \times \left(\frac{N}{k} - 1\right) + lE_{DA}\frac{N}{k} + lE_{elec} + l\epsilon_{fs}d^2_{CH-layer1\ to\ CH-layer2} \tag{3}$$

Where, the each term represents the energy for transmitting the data to the CH of a layer-2, the energy for the receiving data from the cluster member nodes and energy for the aggregation data.

The consumed energy of cluster member nodes in the layer 1($E_{non\text{-}CH\text{-}layer1}$) per frame is follow:

$$E_{non-CH-layer1}(l,d) = lE_{elec} + l\epsilon_{fs}d^2_{MN\ to\ CH-layer1} \tag{4}$$

The consumed energy of one cluster in the layer 1 is as below:

$$E_{cluster-layer1} = E_{CH-layer1}(l,k,d) + \left(\frac{N}{k} - 1\right)E_{non-CH-layer1}(l,d) \approx E_{CH-layer1}(l,k,d) + \left(\frac{N}{k}\right)E_{non-CH-layer1}(l,d) \tag{5}$$

The total consumed energy in the layer 1 is Eq. 6.

$$E_{layer1} = \frac{k}{n}E_{cluster-layer1} \tag{6}$$

Next, the consumed energy of CH in layer 2($E_{CH\text{-}layer2}$) per frame is as below including the energy to receive the data from the $E_{CH\text{-}layer1}$:

$$E_{CH-layer2}(l,k,d) = lE_{elec} + lE_{elec} \times \left(\frac{N}{k} - 1\right) + lE_{DA}\left(\frac{N}{k} + 1\right) + lE_{elec} + l\epsilon_{fs}d^2_{CH-layer2\ to\ CH-layer3} \tag{7}$$

And, the consumed energy of cluster member nodes in the layer 2($E_{non\text{-}CH\text{-}layer2}$) per frame is follow:

$$E_{non-CH-layer2}(l,d) = lE_{elec} + l\epsilon_{fs}d^2_{MN\ to\ CH-layer2} \tag{8}$$

Therefore, the consumed energy of one cluster in the layer 2 is as below:

$$E_{cluster-layer2} \approx E_{CH-layer2}(l,k,d) + \frac{N}{k}E_{non-CH-layer2}(l,d) \tag{9}$$

Then, the total consumed energy in the layer 2 is shown Eq. 10.

$$E_{layer2} = \frac{k}{n}E_{cluster-layer2} \tag{10}$$

In the same method, the consumed energy of CH in layer $(\frac{n}{2}-1)$ ($E_{CH\text{-}layer(n/2\text{-}1)}$) per frame is as below:

$$E_{CH-layer(n/2-1)}(l,k,d) = lE_{elec} + lE_{elec} \times \left(\frac{N}{k} - 1\right) + lE_{DA}\left(\frac{N}{k}+1\right) + lE_{elec} + l\epsilon_{fs} d^2_{CH-layer(n/2-1)\ to CH-layer(n/2)} \quad (11)$$

And, the consumed energy of cluster member nodes in the layer $(\frac{n}{2}-1)$ ($E_{non\text{-}CH\text{-}layer(n/2\text{-}1)}$) per a frame is follow:

$$E_{non-CH-layer(n/2-1)}(l,d) = lE_{elec} + l\epsilon_{fs} d^2_{MN\ to\ CH-layer(n/2-1)} \quad (12)$$

The consumed energy of one cluster in the layer $(\frac{n}{2}-1)$ is as below:

$$E_{cluster-layer\ (n/2-1)} = E_{CH-layer\ (n/2-1)}(l,k,d) + \frac{N}{k} E_{non-CH-layer\ (n/2-1)}(l,d) \quad (13)$$

Therefore, the total consumed energy in the layer $(\frac{n}{2}-1)$ is as below.

$$E_{layer\ (n/2-1)} = \frac{k}{n} E_{cluster-layer\ (n/2-1)} \quad (14)$$

In the same way, the total consumed energy in the layer $\frac{n}{2}$ is as below:

$$E_{layer(n/2)} = \frac{k}{n} E_{cluster-layer(n/2)} \quad (15)$$

Applying the same process in the n-layer, (n-1)- layer, … , $(\frac{n}{2}+1)$-layer, as follows.

The consumed energy of CH, cluster member nodes and total consumed energy in the layer-n is as below:

$$E_{CH-layer(n)}(l,k,d) = lE_{elec} \times \left(\frac{N}{k} - 1\right) + lE_{DA}\frac{N}{k} + lE_{elec} + l\epsilon_{fs} d^2_{CH-layer(n)\ to\ CH-layer(n-1)}$$

$$E_{non-CH-layer(n)}(l,d) = lE_{elec} + l\epsilon_{fs} d^2_{MN\ to\ CH-layer(n)} \quad (16)$$

$$E_{layer(n)} = \frac{k}{n} E_{cluster-layer(n)}$$

And, the consumed energy of CH, cluster member nodes and total consumed energy in the layer-n-1 is as follow:

$$E_{CH-layer(n-1)}(l,k,d) = lE_{elec} \times \left(\frac{N}{k} - 1\right) + lE_{DA}\frac{N}{k} + lE_{elec} + l\epsilon_{fs} d^2_{CH-layer(n-1)\ to\ CH-layer(n-2)}$$

$$E_{non-CH-layer(n-1)}(l,d) = lE_{elec} + l\epsilon_{fs} d^2_{MN\ to\ CH-layer(n-1)} \quad (17)$$

$$E_{layer(n-1)} = \frac{k}{n} E_{cluster-layer(n-1)}$$

Next, the consumed energy of CH, cluster member nodes and total consumed energy in the layer-$(\frac{n}{2}+2)$ is as follow:

$$E_{CH-layer(\frac{n}{2}+2)}(l,k,d) = lE_{elec} \times \left(\frac{N}{k} - 1\right) + lE_{DA}\frac{N}{k} + lE_{elec} + l\epsilon_{fs} d^2_{CH-layer(\frac{n}{2}+2)\ to\ CH-layer(\frac{n}{2}+1)}$$

$$E_{non-CH-layer(\frac{n}{2}+2)}(l,d) = lE_{elec} + l\epsilon_{fs} d^2_{MN\ to\ CH-layer(\frac{n}{2}+2)} \quad (18)$$

$$E_{layer(\frac{n}{2}+2)} = \frac{k}{n} E_{cluster-layer(\frac{n}{2}+2)}$$

Finally, the consumed energy of CH, cluster member nodes and total consumed energy in the layer-$(\frac{n}{2}+1)$ is as below:

$$E_{CH-layer(\frac{n}{2}+1)}(l,k,d) = lE_{elec} + lE_{elec} \times \left(\frac{N}{k} - 1\right) + lE_{DA}\left(\frac{N}{k}+1\right) + lE_{elec} + l\epsilon_{fs} d^2_{to\ BS}$$

$$E_{non-CH-layer(\frac{n}{2}+1)}(l,d) = lE_{elec} + l\epsilon_{fs} d^2_{MN\ to\ CH-layer(\frac{n}{2}+1)} \quad (19)$$

$$E_{layer(\frac{n}{2}+1)} = \frac{k}{n} E_{cluster-layer(\frac{n}{2}+1)}$$

Therefore, Energy consumption of the entire sensor field is as follows.

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$$E = \sum_{i=1}^{n} E_{layer(i)} = \frac{k}{n}\sum_{i=1}^{n} E_{cluster-layer(i)} \tag{20}$$

Where,

$E_{cluster-layer1} =$
$\frac{2N}{k} lE_{elec} + \frac{N}{k} lE_{DA} + \frac{N}{k} l\epsilon_{fs} d^2_{MN\ to\ CH-layer1} + l\epsilon_{fs} d^2_{CH-layer1\ to\ CH-layer2}$

$E_{cluster-layer2} = \left(\frac{2N}{k}+1\right) lE_{elec} + \left(\frac{N}{k}+1\right) lE_{DA} + \frac{N}{k} l\epsilon_{fs} d^2_{MN\ to\ CH-layer2} +$
$l\epsilon_{fs} d^2_{CH-layer2\ to CH-layer3}$

$E_{cluster-layer(\frac{n}{2})} = \left(\frac{2N}{k}+1\right) lE_{elec} + \left(\frac{N}{k}+1\right) lE_{DA} + \frac{N}{k} l\epsilon_{fs} d^2_{MN\ to\ CH-layer(\frac{n}{2})} +$
$l\epsilon_{fs} d^2_{to\ BS}$

$E_{cluster-layer(\frac{n}{2}+1)} = \left(\frac{2N}{k}+1\right) lE_{elec} + \left(\frac{N}{k}+1\right) lE_{DA} + \frac{N}{k} l\epsilon_{fs} d^2_{MN\ to\ CH-layer(\frac{n}{2}+1)} +$
$l\epsilon_{fs} d^2_{to\ BS}$

$E_{cluster-layer(n-1)} = \left(\frac{2N}{k}+1\right) lE_{elec} + \left(\frac{N}{k}+1\right) lE_{DA} + \frac{N}{k} l\epsilon_{fs} d^2_{MN\ to\ CH-layer(n-1)} +$
$l\epsilon_{fs} d^2_{CH-layer(n-1)\ to CH-layer(n-2)}$

$E_{cluster-layer(n)} =$
$\frac{2N}{k} lE_{elec} + \frac{N}{k} lE_{DA} + \frac{N}{k} l\epsilon_{fs} d^2_{MN\ to\ CH-layer(n)} + l\epsilon_{fs} d^2_{CH-layer(n)\ to\ CH-layer(n-1)}$

That is as follows.

$$E = \frac{k}{n}\sum_{i=1}^{n} E_{cluster-layer(i)} = \frac{k}{n}\left\{n\left(\frac{2N}{k}+1\right) lE_{elec} + n\left(\frac{N}{k}+1\right) lE_{DA} - 2lE_{elec} - 2lE_{DA} + \frac{N}{k} l\epsilon_{fs} \sum_{i=1}^{n} d^2_{MN\ to\ CH-layer(i)} + l\epsilon_{fs}\{\sum_{i=1}^{\frac{n}{2}-1} d^2_{CH-layer(i) to CH-layer(i+1)} + \sum_{i=\frac{n}{2}+2}^{n} d^2_{CH-layer(i) to CH-layer(i-1)}\} + 2l\epsilon_{fs} d^2_{to\ BS}\right. \tag{21}$$

Applying the $\left[d^2_{MN\ to\ CH-layer(i)}\right] = \frac{1}{2\pi}\frac{M^2}{k}$, $i = 1, 2, 3, \cdots, n$, $E\left[d^2_{CH-layer(i) to\ CH-layer(i+1)}\right] = \frac{\sqrt{5}}{2}\frac{M^2}{k}$, $i = 1, 2, 3, \cdots, \frac{n}{2} - 1$ and $E\left[d^2_{CH-layer(i)\ to\ CH-layer(i-1)}\right] = \frac{\sqrt{5}}{2}\frac{M^2}{k}$, $i = \frac{n}{2} - 2, \cdots, n$ to Eq. 21, we gets the Eq. 22.

$$E = \frac{k}{n}\sum_{i=1}^{n} E_{cluster-layer(i)} = \frac{k}{n}\left\{n\left(\frac{2N}{k}+1\right) lE_{elec} + n\left(\frac{N}{k}+1\right) lE_{DA} - 2lE_{elec} - 2lE_{DA} + \frac{N}{k} l\epsilon_{fs} \frac{n}{2\pi}\frac{M^2}{k} + l\epsilon_{fs}\left\{\sum_{i=1}^{\frac{n}{2}-1} d^2_{CH-layer(i) to CH-layer(i+1)} + \sum_{i=\frac{n}{2}+2}^{n} d^2_{CH-layer(i) to CH-layer(i-1)}\right\} + 2l\epsilon_{fs} d^2_{to\ BS}\right\} = \frac{k}{n}\{n\left(\frac{2N}{k}+1\right) lE_{elec} + n\left(\frac{N}{k}+1\right) lE_{DA} - 2lE_{elec} - 2lE_{DA} + \frac{N}{k} l\epsilon_{fs} \frac{n}{2\pi}\frac{M^2}{k} + l\epsilon_{fs} \frac{(n-2)\sqrt{5}M^2}{2}\frac{}{k} + 2l\epsilon_{fs} d^2_{to\ BS}\} \tag{22}$$

Differentiating Eq. 22 with respect to k, $\frac{dE}{dk} = 0$, a cluster optimum is calculated.

$$\left(1 - \frac{2}{n}\right)(E_{elec} + E_{DA}) + \frac{2}{n}\epsilon_{fs} d^2_{to\ BS} - \frac{N}{2\pi}\epsilon_{fs}\frac{M^2}{k^2} = 0$$

$$k_{opt} = \sqrt{\frac{N}{2\pi}\frac{\epsilon_{fs}}{\left(1-\frac{2}{n}\right)(E_{elec}+E_{DA}) + \frac{2\epsilon_{fs} d^2_{to\ BS}}{n}}}M \tag{23}$$

4. Simulation Result

Using MATLAB simulation tools is derived optimal number of cluster heads and the number of Layer ML-LEACH. The transmission failure is caused by cluster head node and sensor node of absence as the disadvantage of Layer of ML-LEACH. A sensor node placement for each Layer is arranged evenly. The base station is in the center of the network. The value of the simulation parameters are set for the simulation as shown in Table 1

Table 1. Simulation Parameters in MATLAB

Simulation Parameters	Value
Initial Energy of Node	0.5 J
Consumption Energy for transmit and receive	50 nJ/bit
Amplifier Energy for transmit	100 pJ/bit/m2
Message Packet Size	2000 bit
Field Size of Wireless Sensor Network	200*200/400*400

4.1. Optimal Layer in ML-LEACH

The energy consumption per round until FND to each Layer is measured to derive the optimal route in the ML-LEACH protocol. The Layer of the ML-LEACH has the value of 1, 3, 5, 7, 9-Layers. And ML-LEACH has a transmission system to a 1, 2, 3, 4, 5 - hops. The number of intra-network nodes 50, 100, 200 is arranged. The following Table2 shows the energy consumption each round to FND of each Layer.

Table 2. Consumption Energy of per Round until FND

Node #50		
Layer	Field 200 * 200	Field 400 * 400
#1	0.018159	0.084755
#3	0.012275	0.020116
#5	0.012773	0.027471
#7	0.013611	0.031566
#9	0.015022	0.028813
Node #100		
Layer	Field 200 * 200	Field 400 * 400
#1	0.026597	0.078222
#3	0.025164	0.042001
#5	0.024957	0.043206
#7	0.028762	0.064136
#9	0.032856	0.072548
Node #200		
Layer	Field 200 * 200	Field 400 * 400
#1	0.050947	0.124390
#3	0.050766	0.084091
#5	0.053772	0.093415
#7	0.062953	0.127019
#9	0.069709	0.149098

The each energy consumption of up to Layer FND in Table 2 is shown above. In each field 200*200 and 400*400 at # 3 Layer of Node 50, the highest energy efficiency in energy consumption is 0.012275 and 0.020116. In each field 200*200 and 400*400 at # 3 Layer of Node 100, the highest energy efficiency in energy consumption is 0.025164 and 0.042001. In each field 200*200 and 400*400 at # 3 Layer of Node 200, the highest energy efficiency in energy consumption is 0.050766 and 0.084091. Therefore, the number of optimal is Layer #3 in ML-LEACH. This represents a graph shown in the following Figure 5.

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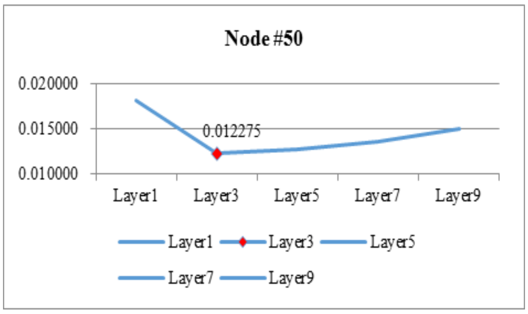
Field 200 * 200 **Field 400 * 400**



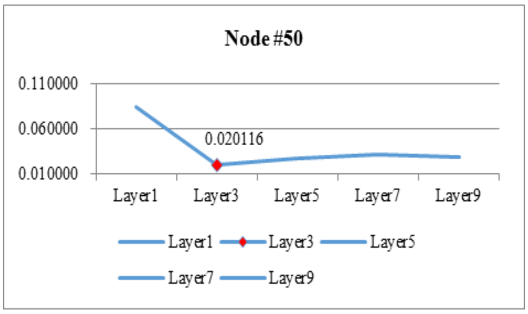
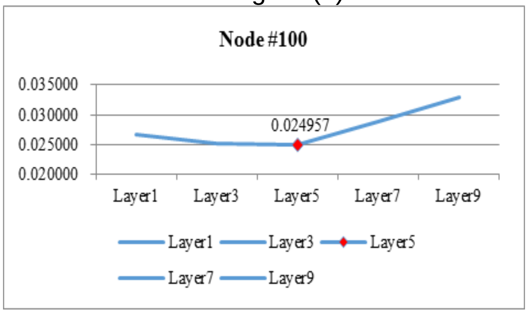


Figure (a) Figure (b)



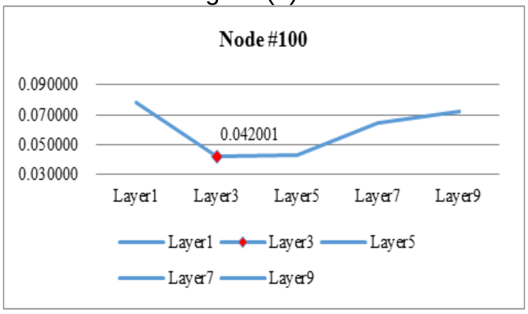
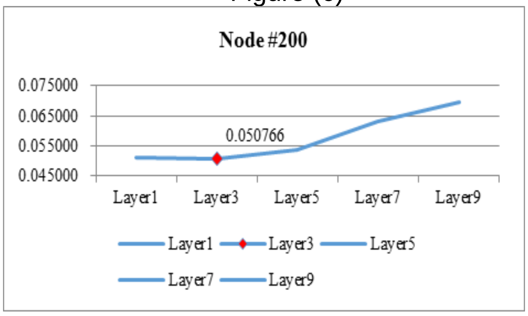


Figure (c) Figure (d)



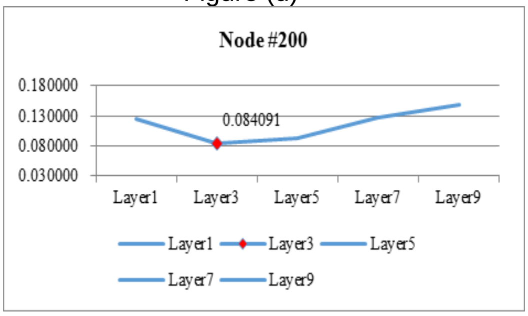


Figure (e) Figure (f)

Figure 5. The Number of Optimal #3 Layer

4.2. Optimal Cluster Head in ML-LEACH

Optimal number of the cluster head in the ML-LEACH is intended to draw a number in applying the previously derived Layer # 3 environment. Comparison of the number of cluster heads is compared by the 10 cluster head. It is compared to the application of the fields 200 and 400. Comparison of the optimal number of clusters about Layer No. 3 is shown in the following Figure 6. The optimum number is found to header cluster # 12. Compared to the number of the cluster head # 10 is compared and has improved energy efficiency of from 1% to 27%.

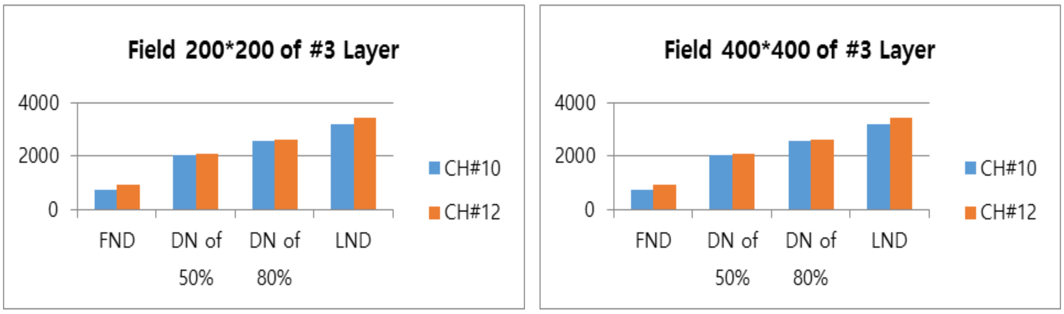


Figure 6. Comparison of the Optimal Number of Clusters

5. Conclusion

ML-LEACH compared to a representative of a hierarchical routing protocol LEACH, it has the advantage of the maximum transmission distance. Layer in the network is set by the separate fields. It improves energy efficiency for maximum transmission distance over. This study has derived a number of optimal cluster header and Layer on ML-LEACH routing protocols. Performance study was conducted in order to increase the efficiency of Layer for the ML-LEACH. As a result of the simulation, the number of transfer Hop is changed depending on the application Layer. Energy efficiency was also a difference depending on the application Layer. Optimal number of Layer exhibited the highest energy efficiency with # 3 Layer. Optimal cluster number in the field 100/200/400 of a limited environment exhibited # 6, # 12, # 12. In further research, an accurate simulation assessment by defining a range of performance evaluation items for the performance evaluation of the simulation Layer could be studied.

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