An Adaptable And Energy-Efficient Routing Protocol In Wireless Sensor Networks Based On Cloud Computing

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Abstract

In this paper we present a survey on mobile cloud computing in wireless sensor networks. After referring to previous work and researches about wireless sensor networks and mobile cloud computing, communication problems and challenges, reference and data management in this networks is studied, then with combination of the ability to collect information in wireless sensor networks and the ability to data storage and data processing in mobile cloud computing, we present a new method that makes the transmission of sensors' data easy by a reliable, fast and safe way. In this method the sensor wireless network requires less storage space for sensor nodes. In addition using the EDDEEC routing protocol, energy consumption is optimized in the sensor nodes communication with each other and in presence mobile cloud, the required energy consumption for data transmission in a communication field decreases and a better bandwidth and higher storage and processing power is provided for these networks.

Introduction

Due to the ability to store and high processing data in mobile cloud computing, we can establish wireless sensor networks that transfers the sensor's collected data for users in a faster, more reliable and safer way by using mobile cloud environment.

Wireless Sensor Networks

In wireless sensor networks all of the nodes must transfer the collected information to one basic station often called Sink. Typically the nodes in these networks face the restriction on the use of energy due to their limited battery supply capacity. However, after the development of the nodes in the network, because of not having access to them there is no possibility of recharging or battery replacement for nodes (Akyildiz et al, 2002) (M. Li et al, 2009).

So routing protocol plays an important role in optimized energy consumption in these networks. Clustering is one of the strategies used by routing protocol in wireless sensor networks in order to minimize power consumption in wireless sensor networks. In this strategy some nodes form a cluster and in every cluster one node is selected as the head cluster. In order to reduce energy consumption all of the nodes belong to a cluster transfer their data to the selected head cluster in that cluster. After receiving data, head cluster collects and finally transfers them to the Sink.

When using clustering techniques, we have two types of networks:

1. Homogenous Wireless Sensor Networks:

In these networks the energy level of all nodes is the same. Protocols like HEED, PEGASIS and Leach are some of routing protocols in these networks.

2. Heterogeneous Wireless Sensor Networks:

In these networks the initial energy level of nodes is different. Protocols like SEP, DEEC and DDEEC are some of routing protocols in these networks (Javaid et al, 2013).

Cloud Computing

Cloud, is an abstract image of huge network and a large mass which allows the internet users to store their data, documents and even applications in its space. Cloud has some benefits such as easy access to these data from anywhere around the world, ability to buy computing power and required service instead of buying expensive softwares, No need to buy expensive computers with high processing power for calculating, etc that have attracted the attention of many organizations.

Mobile Cloud Computing:

On the other hand the mobile devices, including smartphones and tablets are one of the most convenient and widely used communication tools that there is no particular time and place restriction for using them. These devices have become an essential part of human life. These devices' users have earned a lot of experience in the context of local or remote services that provided on them.

The rapid growth of mobile computing has become a powerful approach for development of IT in industrial and commercial fields. Of course, mobile communication devices face many challenges in use and management of resources including limited battery life, storage space, bandwidth, mobility in communication and security. In this case limited resources disrupted the quality improvement of services significantly.

This paper reviews the ability to collect data in wireless sensor networks and the ability to store and process information in mobile cloud computing to introduce optimized type of wireless sensor network that processes and stores received data more effectively and more powerfully (Wang et al, 2013) (Fortino et al, 2012).

Mobile Cloud Computing Architecture

General structure of mobile cloud computing is shown in figure 1. In this figure in order to construct and control the communication links, mobile devices are connected to mobile networks by basic stations. Mobile users create their demands for connecting to this network by sending their identity and location characteristics. These central processors are connected to the servers which provide the users with required services. Mobile network operators perform these services with a series of operations such as: authentication, access control and subscriber account control based on their information which is stored in a database.

After sending the requests from customers, they are transmitted to a cloud environment by the internet. Then the controllers in this environment process these requests to provide the users with the on-demand service proportional to their requests (Dinh et al, 2013).
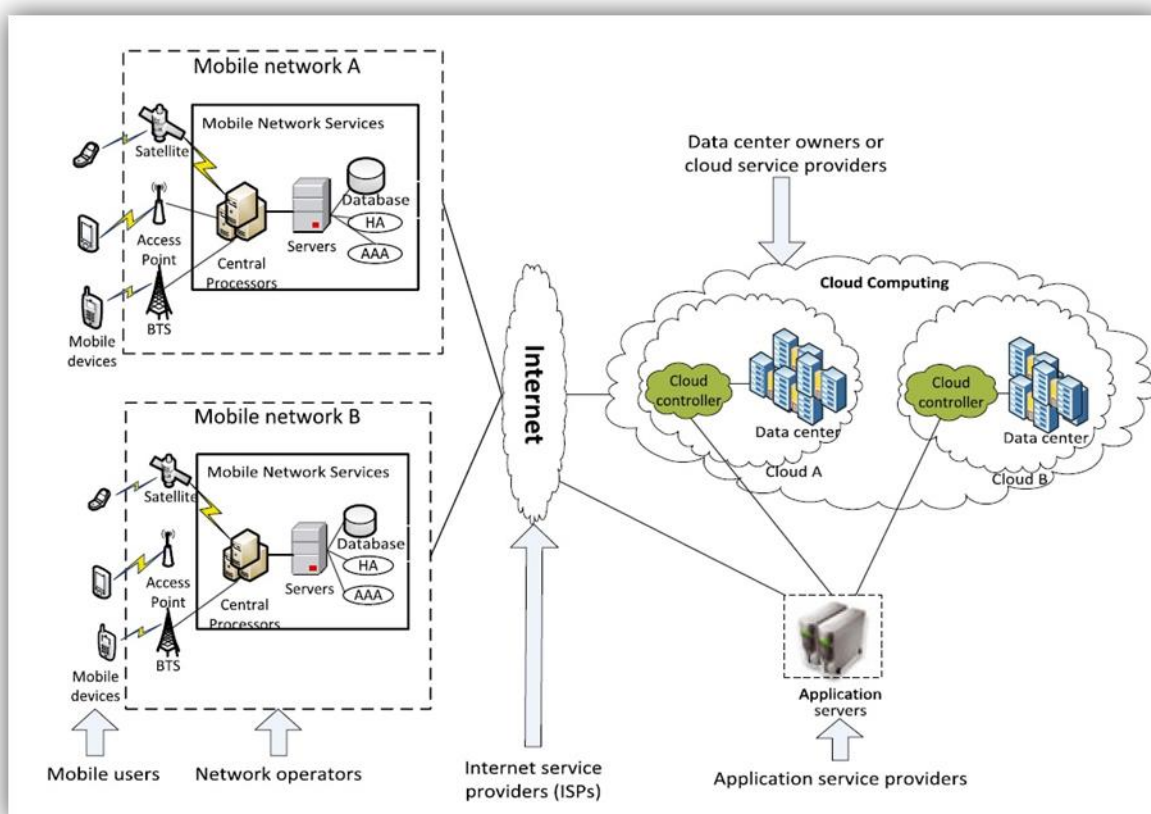

Figure 1. Mobile Cloud Computing Architecture

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The Proposed Model

In this method we perform the efficient routing operations in terms of energy consumption, using the EDDEEC protocol before transferring data to the mobile cloud.

This protocol is optimized version of DDEEC routing protocol and select the head cluster in one cluster of nodes according to probabilities which are based on the amount of initial energy, the amount of remaining energy level of nodes and the average energy consumption in the network.

The EDDEEC protocol is adaptable protocol to changing amount of energy in sensor nodes. This energy changes in nodes lead to change of probability which are being calculated to select the appropriate and optimal head cluster node. Figure 2 shows the proposed model for wireless sensor networks integrated with mobile cloud computing structure.
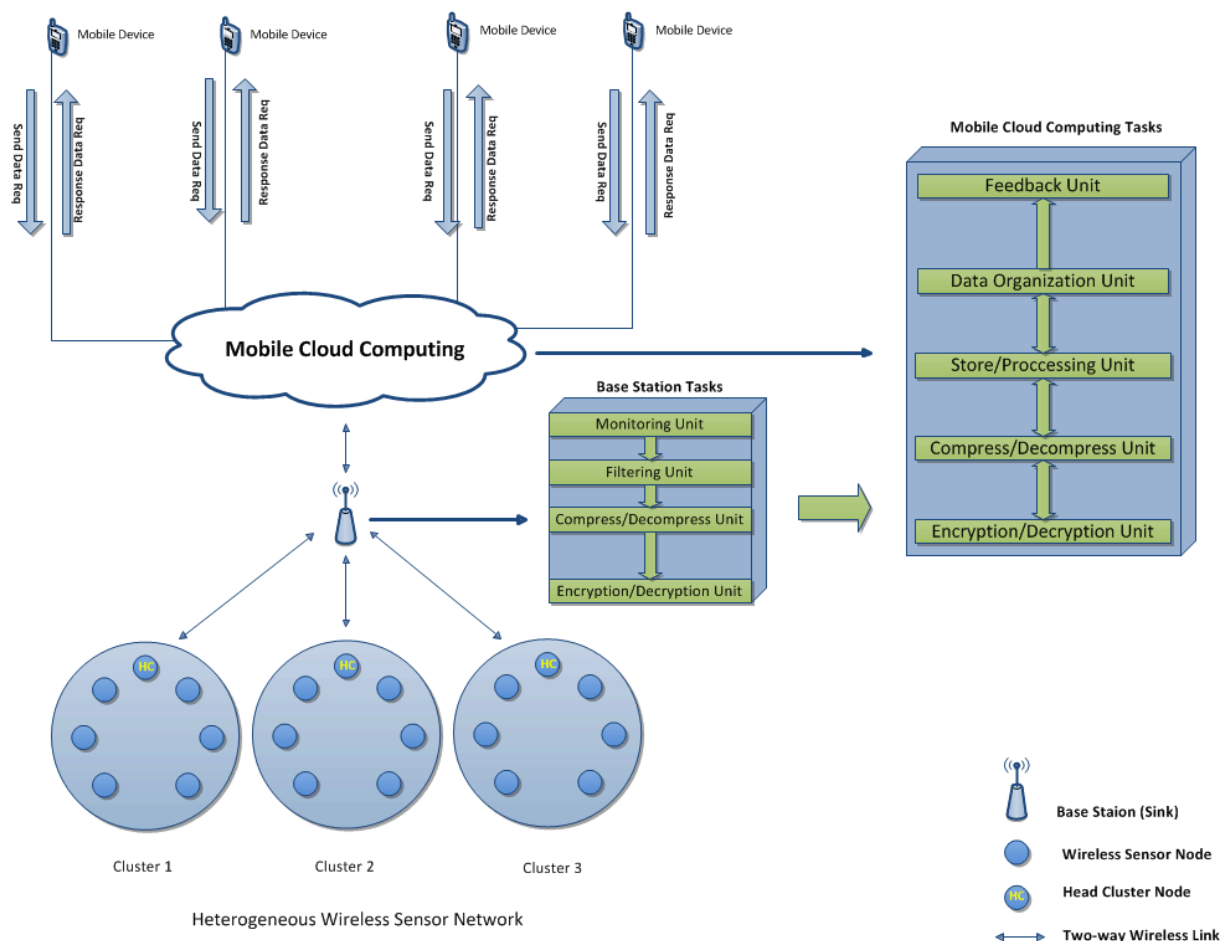

Figure 2. The proposed model for sensor networks integrated with mobile cloud computing

The Proposed Model Operating Procedures

1. At the beginning in each cluster the head cluster transfers collected information from the other nodes to the basic station.
2. After receiving data by a basic station, the initial processing data is done based on a series of pre-defined rules. These rules are applied by data monitoring and filtering units, data

compression unit and data encryption unit. Then the correct data is separated from the other ones is compressed and encrypted.

3. Then these data is transferred to the cloud for next processing procedures. In cloud, first the data is decrypted and then decompressed.

4. In this step the data is stored and processed by powerful servers so that they can be easily available for mobile users. In addition, in the cloud, one unit will be considered for classifying information to separate the information stored in sensor nodes based on different categories for mobile users' better access.

5. To enhance data security in the cloud, the data classified by the encryption unit in cloud will be re-encrypted. If a user needs to have access to this information, it is decoded in user's mobile device and then becomes available for user. User's requests sent from their mobile devices are also encrypted by applications that have been developed in order to access the cloud and then will be transferred to the cloud. Requests decryption is a part of the encryption unit tasks implemented in the cloud.

6. Finally, the feedback of users' requests will be transferred to the sensor network management units for receiving information demand from sensor networks. When these units received these information they decide to develop new nodes in places where users need place information about.

The Proposed Model Features

1. Extend the lifespan of a wireless sensor network: Using discharge (transfer) process data from the sensor to the cloud and also utilizing the efficient clustering routing method are the causes of significant reduction in energy consumption and in amount of sensor nodes power. Thus the lifespan of a wireless sensor network increases considerably.

2. Significant reduction of the need to high storage space in the sensors and basic stations: In the presented model all of the complex computational activities that require high data processing are removed from the sensor nodes and basic stations and then delegated to the cloud; therefore, the need to storage space in the sensor nodes is minimized.

3. Reduce the required bandwidth to transmit sensors data: Because of the gained data from the sensors pass from a filtering method and are compressed before sending to cloud, as a result, less bandwidth will be required to transfer data that leads to Reduction of the overhead traffic.

4. Optimize security in sending data: According to the fact that the data is encrypted by encryption algorithms before sending to the cloud, the data security is increasing against the threats.

Conclusion

Integrating mobile cloud computing with wireless sensor networks is very useful and important research topic. In this paper we focus on better data processing by cloud computing to develop the sensor networks that don't meet the previous and fundamental problems and challenges of usual networks. Accordingly a model which has different operating units is presented that performs the gathering, monitoring, processing, storage, compression, encryption and data classification tasks in a reliable, fast and safe way.

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