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ANMAC-Based Energy Development for Wireless Sensor Networks Incorporated With Mobile Cloud Computing

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ABSTRACT: Aiming at providing mobile users with the WSN data gathered by the powerful cloud computing exploiting the advantages of evolving mobile cloud computing with respect to wireless sensor networks. Current scenario presented with the below limitations.1. The specific data mobile users request usually depends on the current locations of mobile users 2. Most sensors are usually equipped with non-rechargeable batteries with limited energy. Planned Angle based Medium Access Control (ANMAC) protocol that avoids each issue through medium access tables in the nodes that keep track of the locations of the destination nodes in addition as all act neighbours. During this paper, elaborated performance analysis of ANMAC considering totally different topologies and traffic eventualities, and we show that SDMA cannot be totally exploited while not a smart computer hardware. Proposed ANMAC with Location based programming (ANMAC-LS) and compare its performance with alternative sensible antenna approaches and omni 802.11 MAC. Tend to prove the potency of location based programming in wireless networks with sensible antennas, and that we conjointly show the consequences of antenna orientation on turnout, mistreatment realistic antenna patterns and ANMAC protocol.

KEYWORDS: Wireless Sensor Networks, Mobile cloud computing, ANMAC, CLSS.

1 INTRODUCTION

Wireless sensor network are one of the category belongs to ad-hoc networks. Sensor network are also composed of nodes. Actually the node has a specific name that is "Sensor" because these nodes are equipped with smart sensors. A sensor node is a device that converts a sensed characteristic like temperature, vibrations, pressure into a form recognize by the users. In wireless sensor network data are requested depending upon certain physical quantity. So, wireless sensor network is data centric. A sensor consists of a transducer, an embedded processor, small memory unit and a wireless transceiver and all these devices run on the power supplied by an attached battery. The following steps can be taken to save energy caused by communication in wireless sensor networks.

- To schedule the state of the nodes (i.e. transmitting, receiving, idle or sleep).
- Changing the transmission range between the sensing nodes.
- Using efficient routing and data collecting methods.
- Avoiding the handling of unwanted data as in the case of overhearing.

In WSNs the only source of life for the nodes is the battery. Communicating with other nodes or sensing activities consumes a lot of energy in processing the data and transmitting the collected data to the sink. In many cases (e.g. surveillance applications), it is undesirable to replace the batteries that are depleted or drained of energy. Many researchers are therefore trying to find power-aware protocols for wireless sensor networks in order to overcome such energy efficiency problems as those stated above.

WIRELESS SENSOR NETWORK MODEL

Unlike their ancestor ad-hoc networks, WSNs are resource limited, they are deployed densely, they are prone to failures, the number of nodes in WSNs is several orders higher than that of ad hoc networks, WSN network topology is constantly changing, WSNs use broadcast communication mediums and finally sensor nodes don't have a global identification tags. The major components of a typical sensor network are:

SENSOR FIELD

A sensor field can be considered as the area in which the nodes are placed.

SENSOR NODES

Sensors nodes are the heart of the network. They are in charge of collecting data and routing this information back to a sink.

SINK

A sink is a sensor node with the specific task of receiving, processing and storing data from the other sensor nodes. They serve to reduce the total number of messages that need to be sent, hence reducing the overall energy requirements of the network. Sinks are also known as data aggregation points.

TASK MANAGER

The task manager also known as base station is a centralized point of control within the network, which extracts information from the network and disseminates control information back into the network. It also serves as a gateway to other networks, a powerful data processing and storage centre and an access point for a human interface. The base station is either a laptop or a workstation.

Data is streamed to these workstations either via the internet, wireless channels, satellite etc. So, hundreds to several thousand nodes are deployed throughout a sensor field to create a wireless multi-hop network. Nodes can use wireless communication media such as infrared, radio, optical media or Bluetooth for their communications. The transmission range of the nodes varies according to the communication protocol is used.

MOBILE CLOUD COMPUTING

The development of mobile cloud computing has become an important research field in mobile-oriented world, providing new supplements, consumption, and delivery models for IT services. As reported by ABI Research, more than 240 million business customers will be leveraging cloud computing services through mobile devices by 2015, driving revenues of $5.2 billion. In mobile cloud computing, mobile users can access computation results, resources, applications, and services that are stored, implemented, and deployed in cloud computing environments by using mobile devices through an insecure wireless local area network (WLAN) or 3G/4G telecommunication networks. When a user intends to access a mobile cloud computing service, he/she activates the service through a Web browser or a cloud service application (i.e., App) installed on his/her mobile device. The Web browser or the cloud service application will then mutually authenticate both the cloud service provider and the user. After authentication, the user can access the resources and available services from the cloud service provider.

In the early days of computing technology, when computers took up the space of an entire room, many 'dumb' terminals, or clients, would be connected to a main computer. Many clients could utilize the computational power and storage of the mainframe at the same time. As transistors and CPUs came into play, shrinking personal computers, it became more feasible for a user to purchase their own computer.

However, today, mobile devices are becoming smaller and smaller and we are seeing that there is either a physical or economic limit to the amount of storage and processing power that can fit into these devices. It seems that the original model of client-mainframe computing may be a good answer for this situation. However, we can now utilize existing wireless networks to connect mobile devices to servers in massive datacentres, rather than hardwiring all clients to a server. This idea of connecting to unseen data may be where the term “cloud” came from, since it seems that the extra power is coming out of nowhere.

Companies are only just beginning to investigate the possibilities of the cloud and provide cloud services for business and personal use. There is much potential in utilizing the resources of the cloud, most of which has not been researched yet. Client machines can become much more powerful by connecting to these cloud datacentres, but what are the options of doing so? Furthermore, integrating mobile devices with the cloud could prove even more advantageous. As these devices become smaller and smaller, consumers are conversely demanding more functionality and features. Bridging the gap between high-end servers and mobile devices could solve the computing problem, though research is needed to identity the advantages and limitations.

Mobile devices, such as smart phones, PDAs and net books, continue to grow in popularity. However, cell phones are no longer considered to be simple communication devices. Today most mobile devices incorporate various functions, such as music players or games. A shortcoming of mobile devices is their limited computing capabilities due to portability and cost issues. Bridging the gap between high- end servers and mobile devices could solve the computing problem and is an important research focus of distributed computing.

2 RELATED WORK

W. Wang, K. Lee, and D. Murray [19], proposed a framework to integrate WSNs and CC is shown. Particularly, a lightweight component model and a dynamic proxy-based approach are combined to connect the sensors with the cloud.

Recently, integration of MCC with WSNs has been proposed in several research works [9], [10], [11], [12], [13], [14], [15], [16], [17]. This trend is induced by the advantages of incorporating the powerful data storage and data processing abilities of MCC as well as the ubiquitous data sensing and data gathering capabilities of WSNs for mobile users. Particularly, the key idea of such integrations is to utilize the powerful cloud to store and process the sensory data collected by WSNs.

MCC applications are often utilized in a location specific way [23], [25]. For example, the online work schedule application might be useful when the mobile user is on the way to work, but not when the mobile user is in a restaurant in the even- ing. Similarly, the traffic news application may be accessed by the mobile user to obtain the traffic information of a certain region before the mobile user actually gets there, while it is unlikely that the mobile user will always pay attention to the traffic news regardless of his or her current location. Also, thinking about a tourism navigation application which guides the mobile user to walk directly to the specific sightseeing place, such an application might be favourable when the mobile user is in fact in or near the tourism area.

Most sensors are usually equipped with non-rechargeable batteries with limited energy [26], [27]. If the sensor nodes continuously transmit the collected data to the cloud, the energy of these sensor nodes will be depleted quickly and the life-time of the WSN will be short.

The performance of smart antenna systems is limited because of the increased hidden terminal problem and deafness of nodes. [04] The proposed Angular MAC (ANMAC) protocol that avoids both problems through medium access tables in the nodes that keep track of the locations of the destination nodes as well as all communicating neighbours.

3 MOBILE USER LOCATION LIST

MOBILE USER LOCATION HISTORY LIST

To achieve the location list L of mobile user u, the location history of u is extracted by the cloud c based on the StarTrack service. Specifically, StarTrack is a mobile client application and it periodically captures the user’s current location (e.g., with GPS) and relays the location information to the StarTrack server which runs as a service in the cloud c. Further, the StarTrack server processes these location data and decomposes them into various tracks (i.e., discrete representations of trips taken by the mobile user). The points of these tracks are operational and retrievable through a high-level application programming interface and they make up the location history list named as Lh.

MOBILE USER PREDICATION LOCATION LIST

To obtain the mobile user predication location list Lp, we utilize the following method that is similar with the Place Transition Graph utilized. The key idea is that the future locations of the mobile user would be associated with the frequently visited locations of the mobile user, thus it is likely that the future track of the mobile user will be constituted by these frequently visited locations. For instance, if a mobile user goes to restaurant A and gym B from office C very often, it is obvious that the mobile user will go to gym B from restaurant A, or go to restaurant A from gym B someday in the future.

Particularly, we compute a frequently visited location list Lf first. This Lf is obtained by iterating over all the retrieved tracks and selecting the end points of the retrieved tracks of the mobile user. Then Lf is updated by further removing the end points of the tracks that only appear once. With that, an adjacency matrix in which the numbers of rows and columns correspond to the number of the elements in the updated Lf is constructed. Finally, the match of each element in the row and the column except the match with two same points becomes a new track (i.e., the prediction track).

All points without repetition excluding the starting and end points of the prediction tracks constitute the mobile user predication location list Lp. The mobile user location history list Lh and mobile user predication location list Lp constitute the location list L of the mobile user.

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4 ARCHITECTURE AND CLSS ALGORITHM

ARCHITECTURAL DESIGN SPECIFICATION

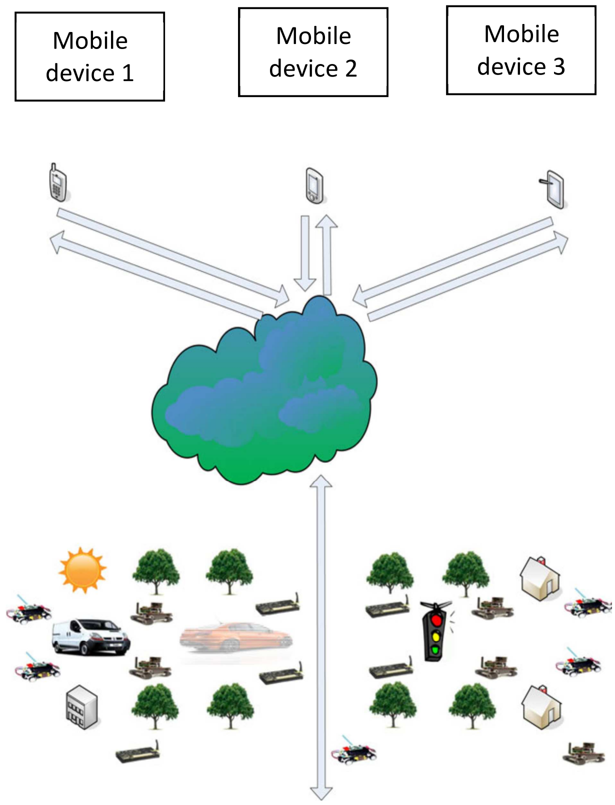

Fig. 1 Example of MCC-WSN integration

Recently, integration of MCC with WSNs has been proposed in several research works. This trend is induced by the advantages of incorporating the powerful data storage and data processing abilities of MCC as well as the ubiquitous data sensing and data gathering capabilities of WSNs for mobile users. Particularly, the key idea of such integrations is to utilize the powerful cloud to store and process the sensory data collected by WSNs. Then any mobile user who wants to access the sensory data can simply issue a data request to the cloud and the sensory data will be returned from the cloud to the mobile user.

Figure shows such an integration example. Various sensor nodes (e.g., static sensors, mobile sensors, video sensors) are deployed to gather weather, traffic, temperature, and house monitoring information. These real-time sensory data are transmitted from the WSN to the cloud. Mobile users issue data requests asking for these sensory data and in response the cloud sends the sensory data to the mobile users.

For the state of the art, since the data requests of mobile users generally require the cloud to respond in real-time, all current MCC-WSN integration schemes make use of always on (AO) WSNs in which sensor nodes are always working to transmit the sensory data to the cloud, and then center on improving the performance of the integrated WSN or better utilizing the data gathered by the integrated WSN.

For instance, an integration architecture based on CC and WSNs is presented. It assumes that the cloud acts as a virtual sink with many sink points collecting sensing data from sensors. In addition, each sink point is in charge of gathering the sensory data in a zone. Then the cloud stores and processes the collected sensing data in a distributed manner. The main focus of the integration is to improve the packet transmission error rate as well as the number of end-to-end hops of WSNs.

Another framework to integrate WSNs and CC is shown. Particularly, a lightweight component model and a dynamic proxy-based approach are combined to connect the sensors with the cloud. Lightweight component model utilizes the publicly available Loosely Coupled Component Infrastructure (LooCI) middleware for component management and dynamic proxies are added to the LooCI middleware. It aims at enhancing the latency performance as well as the memory of WSNs during CC and WSNs integration.

A framework is proposed to integrate CC and WSNs. In this framework, the deployed WSN is connected to the cloud first. Then the requests of users are served via three service layers (i.e., Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS)) either from an archive collecting sensory data from WSN to data centers, or from a live query which is issued to the corresponding WSN.

CLSS SCHEMES

There are two collaborative location-based sleep scheduling schemes for the integrated WSN and the pseudo codes of these two CLSS schemes (i.e., CLSS1 and CLSS2) in each time epoch TP are shown as follows.

CLSS1

Regarding CLSS1 scheme, cloud c first obtains the current location lu of mobile user u (Step 1 of CLSS1). Then according to whether lu is in the location list L or not, a flag A or Z is sent to base station s by cloud c (Step 2 of CLSS1). Base station s further broadcasts the flags. At last, each sensor node i determines its awake or asleep state according to the flag it receives in each time epoch TP (Steps 3 to 5 of CLSS1).

PSEUDO CODE OF CLSS1 SCHEME

Step 1: Cloud c obtains mobile user u’s current location lu.

Step 2: If lu 2 L, c sends flag A to base station s. Otherwise, c

sends flag Z.

Step 3: s broadcasts flags to sensor nodes.

Step 4: Run Step 5 at each node i.

Step 5: If node i receives flag A, remain awake. Otherwise, go to sleep.

CLSS2

In terms of CLSS2, the first four steps are the same as that of CLSS1. The difference between CLSS2 and CLSS1 lies in Step 5. In Step 5 of CLSS2, when sensor node i receives flag Z, i will be sleep scheduled using the energy-consumption based connected k-neighbourhood (EC-CKN) sleep scheduling scheme [30]. Regarding EC-CKN, the current residual energy rank (i.e., Eranki) of each node i is obtained first (Step 6 of CLSS2) and the subset Ci of i’s currently awake neighbours that have Erank > Eranki is computed (Step 10 of CLSS2). Before a node i can go to sleep in each time epoch TP, the following two conditions should hold: (1) all nodes in Ci are connected by nodes with Erank > Eranki (2) each of its neighbours owns at least k neighbours from Ci (Step 11 of CLSS2).

PSEUDO CODE OF CLSS2 SCHEME

Step 1: Cloud c obtains mobile user u's current location lu.

Step 2: If lu 2 L, c sends flag A to base station s.

Otherwise, c sends s flag Z.

Step 3: s broadcasts flags to sensor nodes.

Step 4: Run Step 5 at each node i.

Step 5: If node i receives flag A, remain awake. Otherwise, run

Steps 6 to Step 12 are the pseudo codes of EC-CKN scheme

Step 6: Get the current residual energy Eranki.

Step 7: Broadcast Eranki and receive the ranks of its currently awake neighbours Ni. Let Ri be the set of these ranks.

Step 8: Broadcast Ri and receive Rj from each j 2 Ni.

Step 9: If jNij < k or jNjj < k for any j 2 Ni, remain awake. Go to Step 12.

Step 10: Compute Ci ¼ fjjj 2 Ni and Erankj > Erankig.

Step 11: Go to sleep if both the following conditions hold.

Remain awake otherwise. Any two nodes in Ci are connected either directly themselves or indirectly through nodes within i's 2-hop neighbourhood that have Erank more than

Eranki. Any node in Ni has at least k neighbours from Ci.

Step 12: Return

5 SYSTEM ARCHITECTURE

ANMAC PROTOCOL

In ANMAC, every station has beams of 90° beam width that covers 360° by four antennas. Stations can monitor the signal level on all beams, and choose the best one. The best beam is defined as the beam over which a station gets a signal with maximum Signal-to-Noise Ratio (SNR). Each station keeps a medium access table (Figure 1), where it stores its best beam number to communicate with a neighbor and the neighbor's best beam number to communicate with itself. The blocking condition for every beam indicates whether that beam is busy or not, so as to avoid deafness and collisions. ANMAC uses modified RTS/CTS messages, namely Angular RTS/CTS to signal the information about the locations of communicating nodes to other stations in the medium, which are used in updating medium access tables in the stations.

The receiver, node B, sends an AN-CTS packet in response to AN-RTS. AN-CTS frame is also sent in all directions to prevent the hidden terminal problem. As node A gets the AN-CTS packet, it finds out that the medium is available for communication, and also selects the best beam, beam with highest signal level, as beam #3. In the AN-CTS packet (Figure 3), the beam number in "transmitter's best beam number" field indicates that this beam was chosen and will be used during data exchange by source node and the beam number in "receiver's best beam number" field indicates that this beam was chosen and will be used during data exchange by destination node. After angular ANRTS/ AN-CTS handshake, node A sends the data over its best beam and node B gets the data packet by its best beam. The directional transmission will reduce the interference and establish a reliable and high quality channel between communicating nodes.

My Address	Neighbor's Address	My Beam	Neighbor's Beam	Blocking			
				Beam 0	Beam 1	Beam 2	Beam 3

Fig. 2 The medium access table

Frame control	Duration	Receiving Address	Transmitting Address	Transmitter Beam Number	FCS

Fig. 3 AN-RTS Frame Format

Frame control	Duration	Receiving Address	Transmitting Address	Receiver's Best Beam Number	Transmitter Beam Number	Transmitter's Best Beam Number	FCS

Fig. 4 AN-CTS Frame format

ANMAC-LS fully exploits the advantage of directional transmission in spatially divided channels, while still avoiding the hidden terminal problem and deafness, and guaranteeing range extension by using only directional antennas. The location-based scheduler utilizes the location information, which is already available through the medium access table of ANMAC protocol.

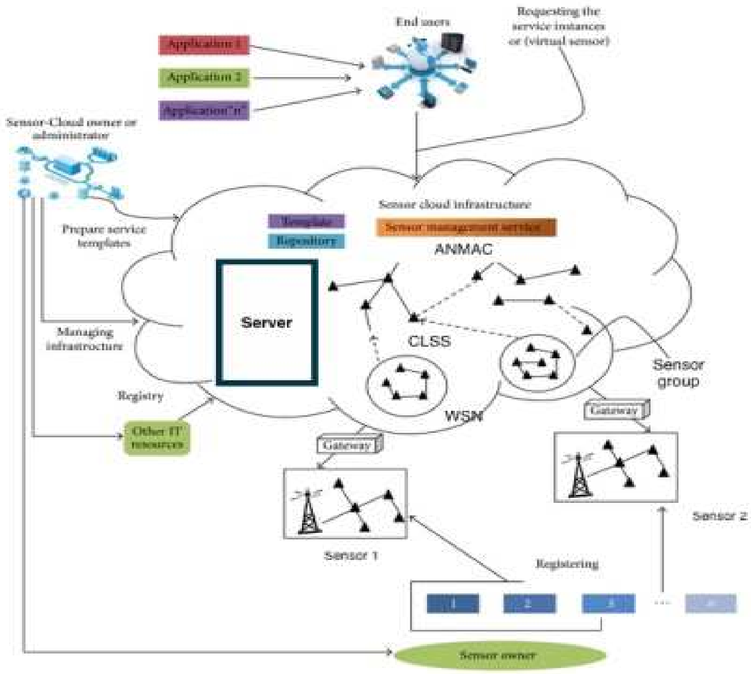

Fig. 5 System Architecture

6 Conclusion

Proposed two CLSS schemes (i.e., CLSS1 and CLSS2) with ANMAC for WSNs integrated with MCC. CLSS schemes involve both the WSN and the cloud and then dynamically change the awake or asleep status of the sensor node in the integrated WSN, based on the locations of mobile users. CLSS1 focuses on saving the most energy consumption of the integrated WSN and CLSS2 further pays attention to the scalability and robustness of the integrated WSN. For the integration of MCC and WSNs, both CLSS1 and CLSS2 could prolong the lifetime of the integrated WSN while still satisfying the data requests of mobile users.

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