IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Volume-5, Issue-4 E-ISSN: 2347-2693

Wireless Sensor Networks through Clustering in Cross Layer Network

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www.ijcseonline.org

Received: 14/Mar/2017, Revised: 27/Mar/2017, Accepted: 21/Apr/2017, Published: 30/Apr/2017

Abstract— One of the significant justification for execution corruption in Wireless sensor network is the upward because of control bundle and parcel conveyance debasement. Clustering in cross layer network operation is an effective way oversee control parcel upward and which at last work on the lifetime of the network. All these overheads are essential in an adaptable networks. The clustering generally experience cluster head failure which need to be solved effectively in a large network. As the center is to work on the normal lifetime of sensor network the cluster head is chosen in view of the battery duration of nodes. The cross-layer activity model optimize the overheads in numerous layer and at last the utilization of bunching will decrease the significant overheads recognized and their by the energy utilization and throughput of remote sensor network is gotten to the next level. The proposed model works on two layers of organization ie., Network Layer and Transport Layer and Clustering is applied in the network layer.

Keywords— Cross layer design, wireless sensor networks, clustering

I. INTRODUCTION

Wireless sensor network comprises of spatially disseminated independent sensors to screen ecological circumstances, for example, sound, temperature, pressure and so forth. Sensor hubs can detect and distinguish occasions in the area and impart information back to the Base Station (BS). Wireless sensor network have become most fascinating area of exploration. Sensor hubs are furnished with little batteries that can store all things considered I J. Restricting the transmission reach and power utilization are the significant requirements presented for correspondence, and henceforth it is profitable to take care of the sensors into cluster.

Clustering in cross layer networks is one of the significant systems to further develop the energy utilization of sensor organization and in this way increment the organization lifetime. In Clustering, entire sensor network is separated into gathering of groups. Cluster head is chosen in light of the battery duration of a node. Cluster head accumulate and consolidate the information and send it back to the BS.

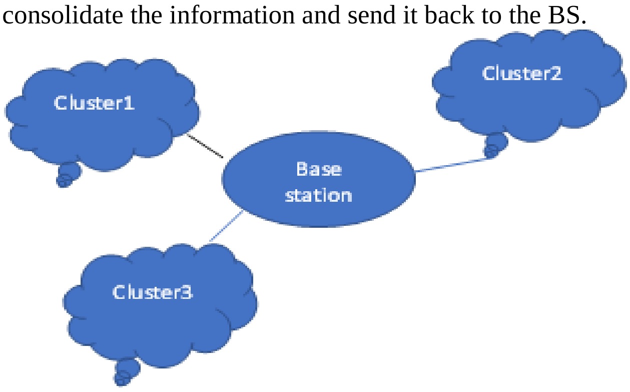

Figure 1. Cluster with single cluster head

The benefit of cluster is to gather information from adjoining node is functionally more advantageous then noticing units spread over a region. Clustering procedure is done in the network layer. In transport layer, nodes are booked based on how long they are dynamic.

The rest of this paper is coordinated as follows. Session 2 describes related work on cross layer network tasks. Session 3 depicts about proposed work and execution. session 4 depicts experimental evaluation . Session 5 concludes up this paper with a discussion of future methodology.
Energy efficiency can be further increased by data aggregation algorithms in WSNs. Data aggregation (DA) techniques enhance the network lifetime by gathering and aggregating the data in an energy-efficient manner. The purpose of DA is to collect the useful information by eliminating repeated readings of a sensor. Aggregation reduces the communication cost by improving the energy consumption and network lifetime of the WSN. DA minimize the congestion by reducing the packet size.

We propose the cross-layer cluster-based energy-efficient (CCBE) algorithm based on the combination of clusters, hybrid MAC and data aggregation. In order to minimize energy consumption, we derive the optimal CH distance, which links to optimal energy consumption. The CCBE algorithm divides the entire sensor nodes in the network to different hexagonal clusters. The CMs of each hexagonal cluster elect a CH based on optimal CH distance and the residual energy of the nodes. The CMs of each cluster are given time slots based on their residual energy in order to increase the network lifetime and synchronize the sleeping period. Furthermore, the energy consumed for the transmission of larger packets is reduced by data aggregation in CHs. The data aggregation is achieved by the fusion of similar data. The decision to fuse data is based on the cost-aware decision scheme introduced in this paper. Additionally, the aggregation level of CH is based on the remaining energy. The remainder of the paper is organized as follows. In Section 2, we continue with related work. Section 3 shows the energy consumption model. In Section 4, we derive the optimal CH distance. In Section 5, we propose the new scheme CCBE. Section 6 shows the performance of the proposed scheme

II. RELATED WORK

Lifetime expansion of wireless sensor network [1] utilizes two group heads and progressive directing. In this paper a calculation Two Cluster Head Energy efficient Wireless Sensor Network (TCHE-WSN) is proposed to work on the lifetime. The utilization of two cluster heads relationship lessens the upward of single group head, dodges bundle crash and further develops solid information transmission.

A clustering based routing protocol called base station controlled dynamic clustering protocol, uses a high energy base station arrangement group heads and perform other energy efficient task and along these lines expanding the lifetime of an organization. A cross layer network activity system [4] which considers the physical and MAC layers to amplify the lifetime of an organization. The model accepts that the issue of organization is curved where G (P, h(ni)) is the organization diagram , P is the arrangement of hubs sent and h(ni) is how much information required from hub I to show the detected occasion in the sending region [6]. The conveyed hubs are static and this model has not been tried for wireless sensor networks with portability attributes.

Load balancing and clustering in Hybrid Sensor network with mobile Cluster Nodes [5] proposed a algorithm which chips away at the place of versatile group heads adjusting of traffic load in sensor network that comprise of versatile and static nodes.

Low-energy adaptive clustering hierarchy (LEACH) [8] is a clustering-based protocol which utilizes randomized rotation of local CHs to evenly distribute the energy load across the network. Contrasted and other common steering conventions like DD, it can draw out the organization lifetime up to multiple times. Not with standing, the 5% of CHs are haphazardly chosen and CHs communicate information straightforwardly to SN. Reference [2] proposed an Energy Efficient and QoS aware multipath directing convention (EQSR) has been proposed for WSNs. This convention is primarily used to figure out the best way from the numerous way from source to objective.

In Energy Efficient Hierarchical Clustering Algorithm [7] a conveyed, randomized it is proposed to group calculation. The calculation creates progressive system of group heads. It has been seen that the energy reserve funds increments with the quantity of levels in the progressive system and accordingly expands the lifetime of an organization.

To suit the periodical information gathering applications an Energy Efficient Clustering plan [3] a novel scheme. (EECS) for single-bounce remote sensor organizations. This paper managed a way to deal with choose bunch heads with more remaining energy in an independent way utilizing neighborhood radio correspondence. It produce great bunch head circulation and balances the heap among group heads utilizing this novel scheme.

This section investigates specific features of WSN that become the drivers for cross layer approaches.

1) Mobility: Sensor nodes may not change their initial location, may change it due to environmental effects or may be carried by mobile entities. This may apply to only subset of nodes against all of them. Mobility causes changes for physical layer (e.g. interference signal levels), data link layer (e.g. access schedules), network layer (e.g. dynamic topology), and transport layer (e.g. connection timeouts). A cross-layer design enhances a node's capability to manage its resources in mobile environments by exploiting these interdependencies between layers.

2) Wireless Transmission media: Wireless media posses some inherent adverse characteristics, like signal attenuation with increase in distance, multipath fading, high Bit Error Rates, Hidden and Exposed Terminal problem, Spatial contention and Reuse, Capture effect, Transmission Interference and Unfairness. All these lead to packet losses requiring retransmission or error control and thereby increase in energy requirements of sensor node. It can be seen that transmission errors, QoS requirements, and energy consumption are closely related. This requires cross-layer solutions to address these problems simultaneously.

3) Size, Resources, Energy: Depending on application requirements size of a single sensor node may vary from size of a brick to a dust particle. Varying size and cost constraint result in varying limits on energy, processing, storage and communication resources. Nodes may have limited stored power source or may replenish it from environment. These constraints limit the complexity of sensor nodes. Cross-layer design approaches can expose power and computation related variables at several layers, enabling nodes to efficiently utilize their energy and computational resources. Since system energy consumption is affected by all layers, they should cooperate to reduce overall system energy consumption. Cross-layer design makes such co-operation possible. Critical parameters like energy can be accessed at multiple layers. Thus each layer can see a bigger picture of the system and make better decisions.

4) Application-Specific Structure: The performance requirements of application vary between applications. For example, a WSN for environmental monitoring prioritizes network lifetime to avoid replenishing power and WSN for intrusion detection emphasizes reliable and timely delivery. Cross-layer can provide application-specific performance requirements. Also the event - centric paradigm of WSNs requires application – aware communication protocols.

5) Dependability and QoS: Depending on the application WSN design must offer reliable and often real time; secured and private communication; and facilitate mobility. For these protocols should offer services such as good coverage; congestion control; active buffer monitoring; acknowledgements; cryptography priority messaging and packet-loss recovery. Cryptography can also be used for packet exchange safety. These requirements directly conflict with computational complexity and energy consumption, since they may require the use of more transmission power to reduce the occurrence of channel errors and a more frequent access to the medium.

6) Network Coverage: It is the ratio of monitored space to entire space. The coverage may be sparse covering only parts of area of interest, dense completely covering area of interest or redundant with multiple sensors covering same physical location. Coverage an issue of physical layer depends on observation accuracy and redundancy required at application layer. In case of dense and redundant deployment transmitting repeated data, results in increase in contention (MAC layer) congestion, and complex routing (Network layer) thereby resulting in waste of energy. In a sparse deployment, more energy will be required to reach intermediate nodes and BS, resulting in network partitioning and decrease in network lifetime.

7) Time Synchronization: The sensors physical hardware clock reference can directly affect an application operation. For instance, a WSN for target tracking is useless if it cannot register position and detection time of an event. The complexity of time synchronization protocol can directly affect network lifetime.

III. PROPOSED MODEL

In this paper, Cross layer network activity is done in two layers which are Network Layer and Transport Layer .In Network Layer bunching technique(LEACH) is utilized and in the Transport layer energy can be improved by detecting the distance of hubs in which how long they are a long way from the radio wire. We can break down the presentation by changing the radio wire range. One of the significant elements to further develop lifetime of remote sensor network is the plan of organization. LEACH(Low-Energy Adaptive Clustering Hierarchy) convention is utilized for grouping.

In LEACH, nodes take autonomous decisions to shape groups by utilizing an appropriated calculation with out any incorporated control. Here no significant distance correspondence with the base station is required and distributed cluster arrangement should be possible without knowing the specific area of any of the hubs in the organization. Also, no worldwide correspondence is expected to set up the cluster .

The cluster formation algorithm should be designed such that nodes are cluster-heads approximately the same number of time, assuming all the nodes start with the same amount of energy. At last, the bunch head hubs ought to be spread all through the organization, as this will limit the distance the non-group head hubs need to send their information. A sensor hub picks an arbitrary number, r, somewhere in the range of 0 and 1. Allow a limit to threshold be T(n)

The steady-state operation is broken into frames where nodes send their data to the cluster-head at most once per frame during their allocated transmission slot. The set-up stage doesn't ensure that hubs are uniformly circulated among the group head hubs. In this way, the quantity of hubs per group is profoundly factor in LEACH, and how much information every node can ship off the cluster head changes relying upon the quantity of nodes in the cluster. To decrease energy dispersal, each non-group head hub utilizes power control to set how much communicates power in light of the got strength of the bunch head commercial. The radio of each non-cluster head hub is switched off until its distributed transmission time. Since every one of the hubs have information to ship off the bunch head and the absolute data transmission is fixed, utilizing a TDMA plan is effective utilization of transfer speed and addresses a low inactivity approach, as well as being energy-proficient. The cluster head should keep its collector on to get every one of the information from the hubs in the group.

A. Sensor Network Architecture (SNA)

Work in proposes SNA with the main objective to provide greater modularity to sensor hardware designs and communication protocols. The suggestion made is to decouple aspects of the software from the underlying hardware in order to abstract the platform on which the network stack is set. To do so, the proposed Sensornet Protocol (SP) bridges the link and network layers by abstracting key parameters of the lower layers such as link quality and scheduling information. The common functionalities are identified for code-reuse and runtime function sharing. SNA maintains a layered stack and provides detailed information to network protocols present on a node. Two data structures defined in SP serve as information repositories: “Neighbor Table,” with information about direct and relevant neighbors, and “Message Pool,” for protocols to request message transmissions. The neighbor table consisting of neighbor address/ID, link quality, scheduling information is used by several protocols to share information. To reduce the number of table entries before adding a new neighbor, SP polls every protocol and if at least one protocol agrees, the node is inserted. Protocols are also notified when a neighbor is driven out from the table. SP asks the network and link layers to provide a new schedule if power management schedule of a listed neighbor is expiring. SNA is a significant jump forward in WSN architectures which provides flexibility and universality under TinyOS.

B. Chameleon

The main goal of Chameleon architecture is to abstract communication layers so that WSN protocols may run over any network, from Zigbee to IP. Abstraction to lower layers is provided by identifying basic protocol primitives and is achieved through packet attributes, an abstract representation of information contained in packets. Additionally, cross-layer interactions are supported through "vertical calibration": information is contained in the attributes of packets that are passed between layers. To propagate information to all layers, the packet headers are not removed after being processed. The architecture contains three parts: Rime stack providing a set of communication primitives to applications running; a set of network protocols running on top of Rime stack; and Chameleon header transformation modules, which creates packets and packet headers from output of Rime stack. Applications run either directly on top of Rime stack, or on top of communication protocols that run on top of Rime. The Chameleon header transformation modules can produce either tightly bit-packed packet headers or headers that conform either to specific MAC or link layer protocols, or to other communication protocols. Some header transformation modules also implement parts of the protocol logic of protocols they mimic. Applications and protocols pass application data down to Rime stack which adds packet attributes to application data before it passes the application data and packet attributes to underlying Chameleon header transformation module. The header transformation module constructs packet headers from packet attributes and sends final packets to link-level device driver or the MAC layer. The MAC layer can inspect packet attributes to decide how packet should be transmitted. For example, broadcast packets may be sent differently from unicast packets, and packets that need single-hop reliability can be sent with link-layer acknowledgements turned on.

C. X-Lisa

X-Lisa is a Cross-Layer Information-Sharing Architecture with support for cross-layer interactions, services, information propagation and event notification. It retains a layered structure with each layer matched to a communication function and also supports fused layer design. The CrossLayer Optimization Interface (CLOI) provided by X-Lisa placed between the routing and MAC layers offers indirect access to a repository of information that may be needed by one or more protocols. Location of CLOI allows the interface to retrieve much of the information sent from the node onto the network as well as many incoming packets. This allows CLOI to directly obtain information needed to fill the neighbor and sink tables without going through the protocols. CLOI maintains this information through three structures, a neighbor table, a sink table and a message pool, and it supports services that fill these data structures either once or continuously, depending on the information. X-Lisa also supports event notifications to ease coordination between various layers. CLOI has no authority to make any routing, node activation or medium access decisions, or packet reordering. It simply acts as an interface to the protocols in stack, allowing them to access common yet important information about the node and its neighbors that can be used to optimize each protocol's performance.

D. Jurdak

Jurdak presents a cross-layer optimization framework for sensor and adhoc network that supports full visibility of relevant state information among communication layers. It gives a detailed specification of both interlayer and internode interactions. The framework's state definition provides the network designer with flexibility in specifying the relevant state variable, to ensure that framework is tunable to the performance requirements of different applications. For example, an ad hoc network for video transfer requires throughput and delay guarantees and long term monitoring sensor networks may require energy efficient behavior. These performance issues cut across layers, and require internode collaboration. The framework adopts a holistic and flexible definition of local node state which can consolidate state information from all layers of communication stack, depending on the application. Each node can declare its state information to its direct neighbors, and nodes maintain a state table of neighboring nodes, which is denoted as the local neighbor state. The combination of the local and neighbor state at each node comprises the overall node state. Each node uses its overall state as input to a locally resident optimization algorithm. The other inputs to the optimization algorithm include a set of local configurations at the node. The local optimization algorithm determines the resulting node behavior

IV. EXPERIMENTAL RESULT

An examination set up has done utilizing Network Simulator 2 rendition 2.29 (ns-2).The Energy imperative is a significant element for Wireless sensor organizations, Leach Protocol is utilized for the recreation. NS-2 is an instrument that give rich climate to reenactment of remote sensor network at various layers. Following are details of the experimental setup and collected result.

Simulation is done on Mannasim test system for figuring out the energy adequacy of organization. Here grouping strategy is utilized based on LEACH protocol. Group head is chosen in light of the battery duration of hub. It detects the sending energy power and handling force of every hub with time. Assuming that the energy of the hub is under 5 J , it is incapacitated from the bunch which it has a place. So energy can be improved and bunch can send the information to base station effectively without losing such a large amount power and consequently expanding the lifetime of an organization.

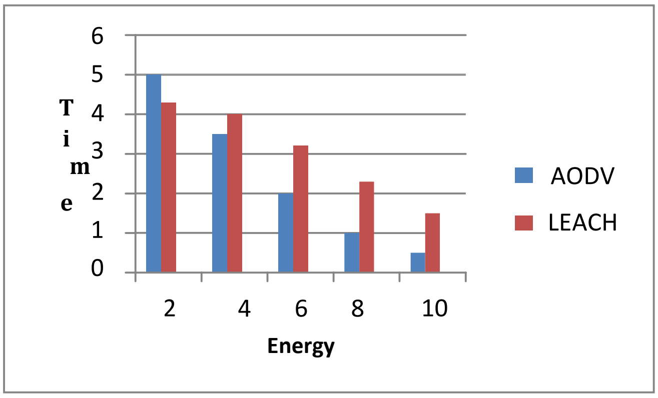

Figure 2 . Comparison of AODV and LEACH

From the figure it is seen that the proposed clustering algorithm accomplishes better organization life time when contrasted with the AODV convention.

V. Conclusion

Packet delivery debasement and control parcel upward are the primary issues happen in cross layer network activity model of wireless sensor networks.. To lessen these issues introduced clustering mechanism in cross layer network activities and subsequently expands the lifetime and throughput of organization. Here, cluster head determination depends on the battery duration of hubs. Simulation results exhibit that proposed clustering algorithm utilizing high energy cluster heads is more compelling in dragging out the lifetime of sensor network than utilizing AODV algorithm. The saved energy in the sensor hubs prompts the drawn out life season of whole wireless sensor networks.

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