ISSN (Print) : 2319-5940
ISSN (Online) : 2278-1021

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 2, Issue 7, July 2013

Implementation of Energy Efficient technique using distribution election scheme based on GRMAC for Wireless Sensor Network

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Abstract: The gridlock robust medium access control (GRMAC) is introduced in wireless sensor networks for collision-free channel access. GRMAC decreases the consumption of energy by allowing low-power and idle state to nodes whenever they are free i.e. neither transmitting nor receiving which ensures that all transmissions have no collisions including broadcast, unicast and multicast. GRMAC uses a time slot and a distribution election scheme which contains the information about the traffic at each node to find out which node can transmit at a particular time slot. GRMAC does not provide time slots to nodes which have no traffic to send, and also enable nodes to find out whether they are idle or not using the traffic information. GRMAC is good enough as no idle node is an intended receiver and no receiver suffers collisions. The efficiency of GRMAC can be find out through extensive simulations using both scenarios synthetic- as well as sensor-network. The results indicate that GRMAC gives contention-based protocols (e.g., CSMA, 802.11 and S-MAC) as well as scheduling-based protocols (e.g., NAMA) with significant energy savings.

Keywords: GRMAC (gridlock robust medium access control), wireless sensor network, collision free channel, CSMA (carrier sense multiple access).

I. INTRODUCTION

The interconnected nodes that are capable of processing and communication are referred as Sensor networks with one or more sensors. Such networks are deployment usually in an ad-hoc manner which implies that sensor-network nodes need to self-organize into a multi-hop wireless network. Many sensor networks using as large scale of the future will consist of battery-powered sensor nodes but the problem is that the battery of sensor node may be difficult to recharge, or also the nodes may be so cheap that recharging them may not be cost effective [1][2]. As the hardware for sensor nodes has become cheap to be use, sensor networks have become solution for number of applications in military as well as civilian scenarios, which include monitoring and surveillance large number of remote and inaccessible areas. However, deployment of large- scale sensor networks is a major challenge in scheduling of transmissions among nodes with self adaptive to changes in traffic or connectivity and more battery life of each node. A distributed election algorithm is used by the Node Activation Multiple Access (NAMA) to get a collision-free transmission. NAMA [3][4][5] which does not address energy conservation, selects only one transmitter per two-hop neighbourhood for each time slot and therefore all nodes in the one-hop neighbourhood of the transmitter are able to receive data which is collision-free[6].

II. BACKGROUND

A MAC (medium access control) protocol has an extensive body of work for multi-hop wireless networks [6], dating back to the DARPA packet radio program. These MAC protocols can be categorized into as contention- based and schedule-based. The distributed coordination function (DCF)[8][9] of the IEEE 802.11b standard is the best example of contention- based protocol, which uses the carrier sense multiple access (CSMA) technique combined with a four-way handshake that attempts to avoid collisions of data packets. In context of energy consumption a key limitation for contention-based is that nodes waste energy as they needlessly consume energy when they are idles i.e., not transmitting or receiving. Recently, a very little work has been reported on contention-based schemes that focus on energy efficiency. One of the earliest contention-based proposals for power efficiency in channel access is PAMAS [11][12].PAMAS avoid over-hearing among neighbouring nodes and saves energy and to achieve this, PAMAS uses out-of channel signalling. Woo and Culler address

ISSN (Print) : 2319-5940
ISSN (Online) : 2278-1021

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 2, Issue 7, July 2013

variations of CSMA tailored for sensor networks, and propose an adaptive rate control mechanism to achieve fair bandwidth allocation among sensor network nodes. In the power save (PS) mode in IEEE 802.11 DCF, nodes sleep periodically [15]. The three sleep modalities in 802.11 DCF in multi-hop networks. The S-MAC (sensor-MAC protocol), has similar functionality that of PAMAS and the protocol by Tseng et al. S-MAC also avoids overhearing and nodes periodically sleep like the other approaches. However, S-MAC uses in-line signalling, and unlike modalities of the PC mode in 802.11 DCF unlike PAMAS [16], neighbouring nodes can synchronize their sleep schedules.

In any contention-based scheme the probability of collisions of control or data packets increases with the load offered, which reduces battery life and low downs the channel utilization [17][18]. Therefore the need for establishing transmission schedules statically or dynamically is required to permit nodes to receive data packets without any collision. The schedule for transmission is established in a wireless network can be independent or dependent of topology also describes the scheduled-access MAC protocol uses a combination of TDMA [19] and FDMA or CDMA for accessing the channel. The main disadvantage of this scheme is that, like most scheduling mechanisms, if a node is idle then the time slots are wasted. A distributed election algorithm is used by the Node Activation Multiple Access (NAMA) to get a collision-free transmission. NAMA [20][22], which does not address energy conservation, selects only one transmitter per two-hop neighbourhood for each time slot and therefore all nodes in the one-hop neighbourhood of the transmitter are able to receive data which is collision-free.

III. PROPOSED WORK

Mechanism & Architecture:

PHASE - I: CALCULATING THE UNMITIGATED WINNER OF NODE ( )

Step 1- Assign node_id for each node in WSN:

```
No. of node=N
For ( i=0 ; i < N ; i++)
{
Rxid [i] = RandomNoGenerator ( );                    //
Rxid = Random Id of Nodes //
}
```

Step 2-Calculate the UW ( )
// UN = Unmitigated Winner //

```
UW ( )
{
For (Rxid=0; Rxid < N; Rxid++)
{
If (UW (Rxid)) = TRUE for announced Scheduled)
        {
let Rxid = UW;
let Rxid.receive = Rxid.reported;
Transmit the packet and Update the announced scheduled;
}
`       Else if (Rxid.giveup = TRUE)
{
Call HNT;
// HNT=Handle Need Transmission //
}
}
}
```

Step 3-Calculate the UW for SNE1H (N)

UWSNE1H ( )
// UWSNE1H = Unmitigated Winner for set of neighbours of node which are one hope away //

```
{
If (UW (N) € SNE1H (N))
{
If ((UW (N).announcedScheduleIsValid = TRUE && UW (N).announcedGiveup = TRUE)
{
call HNT;
}
Else if (UW (N).announcedScheduleIsValid = FALSE || UW (N).announced Receiver = N)
{
let N.mode = RE;
// RE = Receive //
}
Else
   {
   let N.mode=SL;
   // SL = Sleep //
   Update Schedule for UW (N);
   }
}
}
```

PHASE-II: CALCULATING THE ALTERNATE WINNER OF NODE (N)

Calculate the ALW ()

ALW ( )

```
{
For (Rxid = 0; Rxid < N; Rxid ++)
{
if (ALW (Rxid) hidden from UW (Rxid) && ALW(Rxid) € PTS(Rxid))
{
if (ALW (Rxid)announcedScheduleIsValid = TRUE && ALW (Rxid).announcedGiveup = TRUE)
{
call HNT;
```

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```
}
Else if (ALW (Rxid).annoucedScheduledIsValid = FALSE
|| ALW (Rxid).announcedReceive = Rxid)
{
let Rxid.mode = RE;                    }
Else
    {
     let Rxid.mode = SL;
    Update Schedule for
    ALW(Rxid);
    }
}
Else
{
Call HNT;
}
}
}
```

PHASE III-PROCEDURE OF HANDLENEED TRANSMITTER ()

Procedure HNT ( )

```
HNT ( )
{
For (Rxid = 0; Rxid < N; Rxid ++)
{
If (NT (Rxid) = Rxid)
{
let Rxid. State = TM;
let Rxid.receive = Rxid.reported. Rxid;
Transmit the packet and update the announced schedule;
}
Else if (NT (Rxid).announcedScheduleIsValid = FALSE ||
NT (Rxid).announcedReceive = Rxid)
{
let Rxid.mode = RE;
}
Else
     {
     let Rxid.mode = SL;
     }
     Update the Schedule for NT (Rxid);
}
}
```

IV. ARCHITECTURE:

The architecture consists of three Phases:

Phase I: Calculating the UW (Unmitigating Winner)
It consists of mainly three steps:

Step 1: Assign Node_ID for each node

Step 2: Calculate the UM from the basis and if transmissions & updations are not working then HNT is called i.e. Phase III

Step 3: Calculate UM for one hop away

Phase II: Calculation of ALW (Alternate Winner) node and if its announced schedule & giveup is true then HNT is called i.e. Phase III

Phase III: Procedure of HNT (Handle need transmitter)

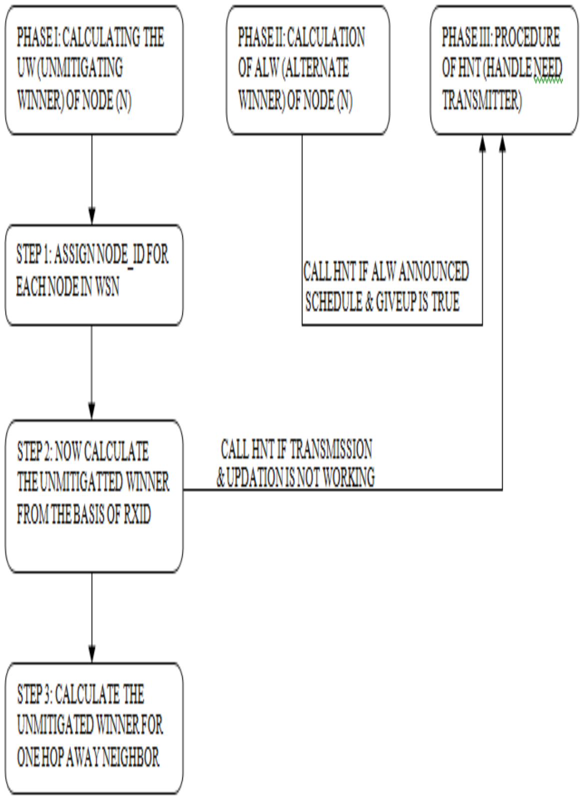

Fig 1: Architecture of GRMAC (Gridlock Robust Medium Access Control)

V. CONCLUSION

The GRMAC (Gridlock Robust Medium Access Control) is used in sensor networks for collision free channel access for improving the energy consumption. Wireless sensor networks consume much more energy while working which lead to wastage of energy and power, energy is consumed when node is free or in idle state. GRMAC is introduced to overcome this disadvantage by allowing low-power and idle state to nodes whenever they are free. In this paper a powerful algorithm is presented which is capable of consumption of energy of nodes while they are not receiving or transmitting any data. The technique proposed in this paper is reliable for a small area of network and more research work can be done in this for a

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International Journal of Advanced Research in Computer and Communication Engineering
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large network as the network is scalable, heterogeneous, mobility- used approach and is fully composite with respect to the ongoing advancement in this field.

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BIOGRAPHY

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