A Review on MAC Protocol for WSN

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ABSTRACT

Because of the sensor radio's half-duplex feature and the broadcast nature of wireless media, restricted bandwidth remains a significant challenge for wireless sensor networks (WSNs). Designing multi-channel MAC protocols has drawn many academics' attention as a cost-effective way to fulfil the greater bandwidth demand for WSN's restricted capacity. In this study, we introduce a planned multi-channel MAC protocol to enhance network performance. In our protocol, each receiving node picks (schedules) specific timeslots to receive data from the intended sender (s). Selection of timeslots is done in a conflict-free way, where a node avoids slots previously picked in its interference range by others. To avoid conflicts during selection of timeslots, we suggest a novel strategy by separating nearby nodes into distinct groups, where group nodes may pick only the slots allotted to that group. We illustrate the success of our strategy in performance indicators such as aggregate throughput, packet delivery ratio, end-to-end latency and energy usage.

Keywords: MAC Protocol, WSN, Network.

INTRODUCTION

Because of fast technological improvements, a specific geographic place may be seen as a completely linked information space employing fine granularity processing that can be performed utilising sensor technologies. Sensor nodes may be seen as atomic computing particles, which may be placed to geographic regions to capture and analyse data from their surroundings. The intended accomplishment of such sensor networks is to provide long-term global information from local data detected by individual sensors. Harmonizing sensor nodes into complex computing and communication infrastructure, known as the Wireless Sensor Network (WSN), may have a major influence on a broad range of sensitive applications[1-4] including military, scientific, industrial, health and residential networks. However, owing to the half-duplex aspect of sensor radio and wireless media broadcast nature, restricted bandwidth remains a serious problem for wireless sensor networks. Bandwidth issue is especially problematic for multi-hop wireless sensor networks (WSNs) owing to interference between consecutive hops along the same route as nearby pathways. As a consequence, the standard MAC protocol cannot sufficiently handle the bandwidth needs.

MAC Protocol

In state-of-the-art research, much emphasis was dedicated to designing MAC (Media Access Control) protocols that operate effectively while using one physical channel. Due to the restricted radio bandwidth in WSNs (e.g. 19.2 Kbps in MICA2[12], 250 Kbps in MICAz[13] and Telos[14]), single channel MAC protocols further restrict increased bandwidth requirements. Radio transceivers for wireless sensor networks are usually low bandwidth communication devices. When real-world physical events generate spontaneous communication in multiple nodes, the single communication channel is under severe pressure, and many messages are lost due to collisions. CSMA/CA systems are good for spontaneous communication, but do not offer great channel usage under heavy load. Therefore, another cost-effective alternative highlighted the potential of using numerous channels. The approach works for parallel data transmission based on existing WSN hardware, such as MICAz and Telos, providing single-radio many channels.

Several multi-channel MAC techniques were designed for single-radio general wireless networks[15-17]. Considering normal applications and WSN capabilities, these protocols are inadequate. Because of the short MAC layer packet size in WSN compared to normal wireless networks, techniques such as [15-17] built with RTS/CTS or 3-way handshake for channel/time negotiation enable considerable overhead control for restricted sensor nodes. Hence, multi-channel MAC protocol for WSN should consider the least overhead for negotiating time/channel selection. Researchers presented several multi-channel MAC protocols[18-21] that use several channels to boost WSN network throughput. However, these protocols have significant overhead control.

WIRELESS SENSORS NETWORK

Recent ideas exist in the area of wireless sensor networks, using multi-channel media access methods to increase network performance. Zhou et al.[18] recently presented the MMSN multi-frequency MAC scheme for WSN. It is a slotted CSMA protocol and at the beginning of each timelot nodes must compete for the medium before they may broadcast. MMSN allocates recipient channels. When a node plans to send a packet, it must listen to the incoming packets on its own frequency and frequency of the destination. A spying method is employed to identify packets at various frequencies, making nodes often move between channels. MMSN employs a separate broadcast channel for broadcast traffic and each time slot is dedicated for broadcasts. MMSN needs a dedicated channel.

The MC-LMAC protocol[21] employs a scheduled access where each node is given a timeslot in advance and utilises this timelot uncontestedly. At the start of each timeslot, all nodes must listen on a common channel to exchange control information. However, the overhead protocol is substantial. TMCP[22] is a multi-channel tree for data collecting applications. The purpose is to divide the network into numerous subtrees, reducing intra-tree interference. The protocol divides the network into subtrees, assigning various channels to nodes on different trees. TMCP is meant to enable convergecast traffic and the partitions make effective broadcasts challenging. Contention within branches is not addressed, since nodes interact on the same channel.

Many MAC protocol approaches explore single-channel communication [5,7,8,10] in the wireless sensor network sector. These protocols work well in single-channel contexts where the major design aim is energy efficiency[23], scalability, and change adaptability[24].

There are single-channel MAC protocols that enable high-throughput, particularly with planned communication such as Z-MAC[25], Burst-MAC[26]. While these protocols perform well in single-channel circumstances, concurrent transmissions over several channels may further increase performance by reducing single-channel conflict and interference.

Besides multi-channel communication, there are additional approaches to limit interference impacts such as transmission power control[27], building minimal interference sink trees[28]. In a prior work[29] authors evaluated in a realistic scenario the effects of transmission power management on network performance, and discovered that discrete and limited levels of changeable transmission power on radios may not entirely prevent the effects of interference.

CONCLUSION

Data transmission and reception scheduling and actual data transfer are accomplished in a collision-free way in our suggested methodology. Unlike previous protocols, we divide a cycle in three pieces. In the initial half of a cycle, each node merely gets the order in which each node announces the schedule of data transmission/reception. Nodes in the second portion

Broadcast according to this sequence. Each node broadcasts its transmission schedule together with its neighbour node scheduling information just once. Finally, each node actually sends data packets as stated in the second portion of the cycle. Because each node utilises one broadcast to communicate its scheduling information; 2-hop nodes cannot hear the schedule. To tackle this difficulty, we suggest a novel method by partitioning the time slots for data transmission into various groups, where each node transmits/receives real data packets in one group. Each node generates its group using group number and order. This frees scheduling collision.

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