Chapter 3

Energy Efficient Congestion Control in Wireless Sensor Networks

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ABSTRACT

Avoiding from congestion and provision of reliable communication characterising the low energy consumption and high data rate is one of the momentous challenges at Media Access Control (MAC) layer. This become more difficult to achieve when there is energy constraint mixed with mobility of nodes. Same issue is addressed in this underlying paper. Here we have proposed a Time-Sharing Energy Efficient Congestion Control (TSEEC) technique for Mobile Wireless Sensor Networks. Time Division Multiple Access Protocol (TDMA) and Statistical Time Division Multiple Access Protocol (STDMA) are major constituents of this technique. These helps in conserving the energy by controlling the sleeping, waking up and listening states of sensor nodes. Load Based Allocation and Time Allocation Leister techniques further helps in conserving the network energy minimizing the network congestion. First mentioned technique is designed on the basis of STDMA Protocol and uses the sensor node information to dynamically assign the time slots while later said technique is does the job of mobility management of sensor node. This Time Allocation Leister techniques further comprises of Extricated Time Allocation (ETA), Shift Back Time Allocation (SBTA), and eScaped Time Allocation (STA) sub techniques for

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Managing the joining and leaving of nodes to cluster and redundancy of data for communication respectively. To control the movement of mobile sensor nodes, we have also introduced mobility pattern as part of TSEEC that helps in making the protocol adaptive to traffic environment and to mobility as well. A comparative analysis of proposed mechanism with SMAC is performed in NS2 along with mathematical analysis by considering energy consumption, and packet deliver ratio as performance evaluation parameters. The results for the former outperform to that of later. Moreover, comparative analysis of the proposed TSEEC with other MAC protocols is also presented.

INTRODUCTION

Wireless interconnection of autonomous sensors over some shared medium make up wireless sensor network. This emerged network has its large number of applications including temperature, pressure, vibration, sound and etc. The collected data from the target environment is passed on to base station either directly or through multihop communication fashion. The new set of mobile WSN is the result of advancement in static WSN along with distributed robotics (Bergbreiter and Pister 2003). The network architecture of MWSN is same as is of WSN, however implicit or explicit mechanism are provided to move these sensors in space over time (Zeinalipour et al. 2008). Relative means or absolute means are used to derive the coordinates of MWSN. Localization techniques is a typical example of former while Geographical Positioning System is of later (Lingxuan and David 2004). Based on movement speed, MWSN are categorized into i) highly mobile ii) mostly static and iii) hybrid. In the first case, movement is of the speed of human, cars or airplanes. Very low velocity such as that of moving robotics comes under second given case. The third category is the combination of both above. Such as moving cars with sensors installed therein (Zeinalipour et al. 2008). Some exceptional challenges such as energy efficiency and congestion are posed due to the perceptibly dynamic characteristics of MWSN as well as applications of traditional wireless networks.

Since the sensor nodes are battery operated and replenishment of battery is almost impossible in some scenarios especially in the applications related to MWSN. So, energy is considered as the most vital design confront in such networks. This is also important in increasing the network lifetime and ultimately comes up with better performance with respect to latency, throughput and bandwidth parameters. This is one of the key reason that current research is mainly focused on minimizing the energy consumption ratio.
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