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A Survey on Scheduling Disciplines for Data Collection in Sensor Networks with Mobile Elements

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Abstract- Wireless Sensor Networks (WSN) is a highly distributed network of small, lightweight wireless nodes which deployed in large numbers. Recent research has provided the means by which a network can take advantage of Mobile Elements.WSN have wide range of applications but data collection is one of the main applications. Here the mobility-assisted data collections with mobile element (i.e., mobile sinks, mobile sensors) have been proposed in an on-demand manner with low and balanced energy consumption for sensor nodes. The mobility assisted data collection can be done based on the scheduling process due to limited mobility of mobile elements. To optimize energy consumption and minimize data delay, the scheduling of Mobile Elements can be done. In this paper the survey of data collection process with Mobile Elements based on some scheduling scenarios like FCFS, SJN, SSTF and NJN can be analyzed.

INDEX TERMS— Mobility assisted data collection, sensor nodes, On-Demand manner.

1. INTRODUCTION

The WSN is built of "nodes"-from a few to several hundreds or even thousands of nodes, where each node is connected to one or sometimes several sensor nodes. Each sensor network node has typically several parts: a radio transceiver with an internal antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, such as a battery or an embedded form of energy harvesting. The WSN is useful for several reasons such as connectivity, cost, reliability and energy efficiency.

Many applications in WSN are data oriented. In this paper a scheduling discipline for data collection process with mobile elements. The main components of WSN with Mobile Elements can be as sensor nodes, sinks (base station) and supporting nodes.

Some of the applications in WSN can be as constant monitoring and detection of specific events, military and battlefield surveillance, forest fire and flood detection, habitat exploration of animals, patient monitoring, home appliances and so on. The main goal of WSN with mobile elements in the scheduling scenario is to minimize the energy consumption, maximize the network nodes lifetime [1] in on demand scenario and to distribute energy load evenly throughout a network. The various scheduling scenario's can be done for minimize the travelling time and to balance the energy consumption in sensor nodes.

2. RELATED WORK

In this paper the survey of data collection process with Mobile Elements based on some scheduling scenarios like FCFS (First Come First Serve), SJN (Shortest Job Next), SSTF (Shortest Seek Time First) and NJN (Nearest Job Next) can be analyzed.

2.1FCFS SERVICE DISCIPLINE

In the FCFS service discipline, the performance is analytically evaluated [2] .i.e., order to serve requests is the same as their arrival order. Here the priority will be given but the time and space domains to serve requests will be high and single Mobile Element can be travelled with constant speed. Sensor nodes initiate data collection requests when their buffers are full and the Mobile Elements maintains a service queue for received requests and serve them with the FCFS discipline.

2.1.1 PROBLEMS WITH FCFS

- Non-preemptive and it does not have optimal Average Waiting Time (AWT).
- Cannot utilize resources in parallel i.e., Assume 1 process CPU bounded and many I/O bounded processes. So the result will be as convey effect, low CPU and I/O device utilization.

Consider an example with the processes request queue 98, 183, 37, 122, 14, 124, 65, 67, with head pointer 53, total head movement is 640 cylinders. Here the first entering processes will be in waiting state so deadlock is the main problem in FCFS service discipline.

2.2 SJN

In the shortest job next scheduling, the algorithm associates with each process the length of the process's next CPU burst. When the burst time of CPU is available, it will assign the process that has the smallest next CPU burst. If the next CPU bursts time of two processes are the same, FCFS scheduling is used to break the tie [2][3]. The SJF scheduling algorithm is provable optimal [4], in that it gives the minimum average waiting time for a given set of processes. When moving a short process before long one decrease the waiting time of the short process more than it increases the waiting time of the long process. Consequently, the average waiting time will be decreases.

2.2.1 PROBLEM WITH SJN

Starvation i.e., in some scenarios, a job may wait for ever. Consider an example for SJN

the Process A with duration time of 1 hour that arrives at time 0 but every 1 minute, a shorter process with duration time of 2 minutes arrive. So the result will be Process A never gets to run.

2.3 SSTF

The main objective of Shortest Seek Time First (SSTF) is to determine the motion of the disks arm and head in serving read and write requests. Here the requests are served according to the next shortest distance. Consider an example, with head pointer at 53, Total head movement: 98 + 183 + 37 + 122 + 14 + 124 + 65 + 67 = 236 tracks or < 30 tracks per access.

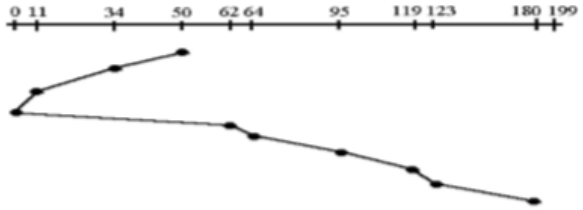

Figure 1: Example for SSTF

2.3.1 PROBLEMS WITH SSTF

- Deadlock and also it should be in One Dimensional space.
- Cannot utilize resources in parallel .i.e., it will take the shortest seek time process so the nearest process have to wait.

2.4NJN

The NJN stands for Nearest-Job-Next, a simple and intuitive discipline adopted by the mobile element(server)to select the next to-be-served request (client).Furthermore, observing that multiple requests can be combined and served together by the mobile element if a collection site within the communication ranges of all the sensor nodes can be found. The NJN discipline can be extended to NJN-with-combination (NJNC), to explore how much gain can be achieved by the possible requests combination. In this service discipline the Mobile Element has been introduced. By introducing the mobility the dimension of the solution space to improve the network performance, and the achievable solutions are always no worse than those obtained in a subspace with a reduced dimension. However, data collection with mobile elements in sensor networks poses its own challenges as well. Due to the relatively lower speed of mobile elements when compared with electromagnetic or acoustic waves, data collection may suffer a much higher latency than multihop forwarding when the latter is feasible at a higher energy cost for sensor nodes. Large data collection latency not only degrades the timeliness of the data, but also may result in the buffer overflow of sensor nodes. The latency, mainly determined by the mobility and scheduling of mobile elements, i.e., how they traverse

through the sensing field and when they collect data from which sensor. The main advantage is to minimize the time constraints and it avoids the data loss in the sensor network. It can also be done in an on demand manner, which can be evaluated from two aspects, first one is about throughput i.e., the throughput of the charging process defined as the number of requests that can serve during a given time period is the essential metric to evaluate the capability of the system in providing the service to individual nodes. In general, a higher system throughput indicates a shorter charger travel time, which in turn means lower charger energy consumption and the second one is about charging Latency On the other hand, the charging latency of the request defined as the time since the request is sent by a node to the time it is fully charged is what the nodes care about the most.

3. CONCLUSION

In this paper, the analyses of four different service discipline scheduling scenarios like FCFS, SJN, SSTF and NJN.Among these scenarios NJN and its combination gained more insights in the starvation problem and give much better performance in the data collection scheme and it considers both the spatial and the temporal properties of incoming requests.

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