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Energy-Efficient Assignment of Nodes in MAHCN for Disaster Management

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Abstract: ***Mobile ad hoc computation network (MAHCN) is emerging as a new computing paradigm because of proliferation of advancement in mobile computing and communication technologies. MAHCN is nothing but divide one computation intensive task into several subtasks and allocate those subtasks to the other available mobile devices in the mobile ad hoc network for computation purpose and finally collect results from each mobile node in mobile ad hoc network. Key issues in the MAHCN are mobility of nodes, limited battery of mobile nodes, computation power of nodes etc. This paper focuses on issue of limited battery of nodes, and describes Energy Efficient Resource Allocation scheme for Mobile Ad hoc Computation network. Proposed scheme first analyzes the tasks within an application (task analysis phase) and then uses that analysis information for resource allocation for tasks within Mobile Ad hoc computation grid. EERA scheme also handles the node battery failure case efficiently. Ontology based Multi-document summarization application is implemented and described resource allocation scheme is applied on it to examine performance of the effectiveness of the scheme. EERA is simulated in various environments proves EERA as better resource allocation system.***

Keywords: Mobile Ad Hoc Networks, Disaster Management, Ontology, Multi-document summarization, Mobile computing

1. Introduction

Mobile ad hoc computational network is coordination of computational Grids [1] and mobile ad hoc networks [2]. Hardware and software base that permits distributed computing gadgets to impart computing resources to take care of computationally escalated issues is known as computational network. A mobile ad hoc network is an organizing toward oneself network without any previous foundation of mobile gadgets associated by remote media. One of the key issues in Mobile ad hoc calculation network is constrained battery of the mobile nodes in the network. Mainly energy consumption is due to CPU processing and communication i.e. data transfer. Many research papers worked in the direction of energy consumption due to CPU processing but our work is focuses on energy consumption due to communication in the nodes in network during application execution.

Consider two interdependent tasks are designated to mobile nodes which are far from one another. As tasks distributed to them are interdependent, mobile nodes need to communicate with one another ordinarily. These two nodes are far from one another so to communicate they require high transmission power to communicate. As high transmission is obliged they will devour more battery power for correspondence. Now consider if those two independent tasks are dispensed to mobile nodes which are close-by to one another, they will require less transmission power to communicate and consequently less battery power. Above example shows that ineffective allocation of the tasks to the nodes can increase communication cost i.e. more energy consumption, So there is need of plan or strategy to allocate task to nodes in MACHN.

Most of the existing approaches for resource allocation consider the infrastructure i.e. available node capability or they do not consider task's nature in the application. In this paper we have described the Energy efficient resource (EERA) allocation scheme [13] which considers the task's nature, geographic position and capability of the nodes to allocate interdependent tasks in the application. Dependencies in the tasks of the application are considered, dependencies can be of three type 1) interdependent 2) Dependent 3) Interdependent. Task can be classify on the basis of the its nature. 1) Remote communication bound 2) Local communication bound 3) Computation bound.

Application can be represented using above dependency type and task type as in [10] and called as task graph of the application which will be used for resource allocation. EERA tries to allocate interdependent tasks to the nearly located nodes. In this paper we consider the case of the node failure due to battery problem or mobile nature of the node and propose solution for that. After [10], there was need to develop a application in which we can apply the EERA scheme and test the effectiveness of the scheme. We considered the Ontology based Multi document summarization [13] and implement the Query based summarization for multi documents for disaster management as application. Designed summary generation application contains multiple tasks. EERA scheme is applied on this application for the resource allocation.

Data set taken from: In September 2014, the Kashmir region witnessed disastrous floods across majority of its districts caused by torrential rainfall. The Indian administrated Jammu and Kashmir were affected by these floods. By September 24, 2014, nearly 277 people in India had died due to the floods. The domain experts want to check the status of the Jammu and Kashmir region during flood and after flood has passed. This information is used in our project.

Ontology identified with disaster management, depicting the concepts and the comparing relations of these concepts, is frequently given by area specialists [3]. Such ontology contains ample theoretical information identified with the archive set, which may be valuable for clients to summarize the documents. In our project, we have designed the ontology of the J &K flood in protégé tool

2. Related Work

As Mobile ad hoc computation network is developing field, look into on resource allocation in Mobile ad hoc computation network is still under work. Preetam and Nirmalya in [4] proposed first straightforward resource allocation plan for Mobile ad hoc computation network focused around first come first serve i.e. task is distributed to resource in ad hoc network according to tasks necessity. It underpins redundant execution of tasks to manage task disappointment. This plan was outline to execute mobile ad hoc computation network effectively there was no destination for energy efficient resource allocation. Advantage of this technique is that if any node falls flat due to battery confinement or mobility, that task may be executing on an alternate node redundantly. Energy obliged resource allocation for Grid environments has been addressed in [5] where creators have examined energy minimization and Grid utility optimization issues yet this plan likewise does not consider task dependencies.
To pick the most fitting node for task execution, Gomes in [6] proposed an outline which uses a delayed reply instrument in which a more resourceful node answers sooner than less resourceful nodes. Advantage of this plan is that it is intended for efficient usage of accessible resources. Disadvantage of this plan is that it doesn't consider correspondence cost for execution of interdependent tasks.. In [7] Humphrey displayed a framework uses manager-worker model to dispense tasks and backings application controlled migration to manage disappointment because of low battery power. Advantage of plan is that if any node fizzles because of battery disappointment, task can be migrated from that node to an alternate accessible node. Disadvantage of this is that if manager fails, complete model comes up short and there is no vision for energy productivity resource allocation.

Ray and Turuk [8] have examined the disaster management utilizing wireless ad hoc network. In this procedure, the distinctive stages utilizes the hop count metrics for message transmission, implies when level of seriousness is high the message will convey through less number of hops utilizing higher transmission power. In other circumstance nodes will adaptively adjust the transmission power to lessen the power utilizations in the network. The reproduction results demonstrate the end-to-end unwavering quality at distinctive node density and energy necessity in diverse stage. There are numerous issues in this work; one of the issues is failure to support reliable message transmission with considering power and mobility. Srivastava et al [9] showed and assessed the framework for post disaster mitigation mobility at salvage operation by salvage groups. This framework recreated framework of mobility with three MANET routing algorithms ZRP, AODV and OLSR. This framework had utilized the idea of attraction points for the model. Utilizing these points the mobility situations are designed. The framework takes the preferences of reference point group mobility inside the post disaster mitigation mobility model. The reenactment demonstrates that MANET routing algorithms acts fundamentally distinctive under the mobility situations designed on the same platform.

3. Proposed System

The proposed system can be divided into two parts, namely, Energy efficient assignment of nodes in MAHCN and the Domain specific Ontology based multi document summarization as an application on which we will apply our EERA scheme.

1) Energy Efficient Assignment of Nodes in MAHCN

This section describes how to allocate the tasks to the nodes in the network energy efficiently. This algorithm also tries to reduce the energy consumption in the communication between the nodes. For resource allocation allocator takes four factors of tasks into consideration one is dependency, task type, Location of the node in the network and configuration of the node. Dependency can be of three type's independent, dependent, interdependent tasks, name of them expresses their meaning. Task type can of three types computation bounded, local communication bounded, remote communication bounded. The central node is given the application, that it can analyze the resources before the allocation process takes place. It also needs to get all the interested nodes. So, that each interested nodes will get the nearest nodes at each transmission level. There are three distinct task set allocations [10]. They are:

a) Allocation of independent task set:

Independent task don't have any dependency so task allocation of independent task depends of the task type. If task is computation dependent it is allocated to the high processing power processor otherwise in both cases i.e. if task is local communication bounded or remote communication bounded they are allocated to the lower processing power processor. Weight of node to whom allocate resource is not considered in the allocation of the independent task.

b) Allocation of the interdependent task set

At this step all independent tasks are already allocated to resources in the above step. Interdependent tasks set that need to be allocated must have parallel execution dependencies on one another because in case of precedence dependencies, predecessor tasks should be already allocated. Resource allocation service selects node with highest weight in the mobile ad hoc computation network and resource allocation decision power is given to that node. Remaining resource allocation same as the described in above section, All tasks in the set are allocated simultaneously at the same time approximately.

c) Allocation of dependent task set:

Dependent tasks execution depends on some other tasks execution which is called as reference task of dependent task. Reference task is already allocated to resources in above steps. Dependent task can be one or more. In case of one dependent task, task is allocated to the node accessible at minimum TPL then also considers task type. In order to allocate tasks, resource allocation service locates a reference node, and then checks type of task executing on reference node and its direct dependent task. If both of them are remote communication-bound tasks and other dependent tasks are either local communication-bound or computation-bound tasks then dependent tasks set is allocated to node with highest weight within a range of reference node otherwise a node with highest weight within a Network is selected for allocation. The remaining process is same as mentioned for interdependent tasks set.

d)Node Failure Case

If node n is holding task t and battery level of that node gets low, node will send acknowledgement to central node. If task held by the node is independent then that task will be allocated to any available node. If task held by that node is interdependent or dependent then all other interdependent tasks or dependent tasks are allocated with node failure notification to stop further communication with failed node, then selects available node which is nearest to the failed node to allocate the task of the failed node

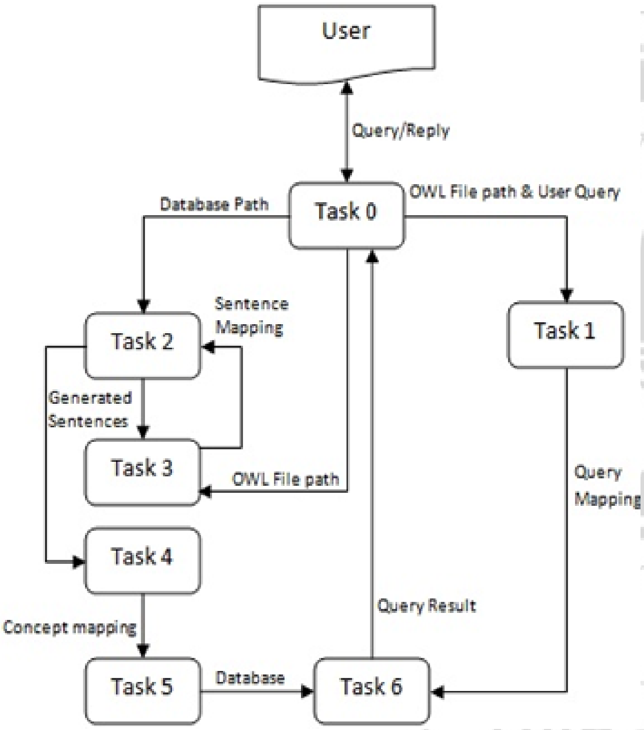

Figure 1: Tasks in the application

e) Computing weights of the nodes

Computing the weights of the node is important as, the tasks are allocated to the available nodes, depending upon the classifications in above paragraph.. Like, interdependent tasks should be assigned to the nearest nodes; whereas the independent tasks can be assigned to far nodes. While, the computational tasks are assigned to the highly weighted nodes, and remaining tasks can be assigned to the low weighted tasks. KNN [12] is algorithm is used for searching the highly weighted nodes from the set of all available nodes.

kNN algorithm works as follows,

1. Integer i=1
2. List kNNList = null
3. while(i<=n)
4. {Broadcast a discovery message at TPLi
5. Collect replies from nodes accessible at TPLi
6. Add nodes to kNNList
7. IF(number of nodes in kNNList >= k) THEN
8. EXIT while loop
9. ELSE i++
10. }

2)Ontology based Multi Document summarization for Disaster Management

We referred [13] to design and implement application for Query based summarization. Application has tasks as shown in figure 1. Brief Description of the tasks are as follows :

Task 0: Scans the memory and collects the path of the source data files and owl file. (Owl file of contains the domain ontology and created using protégé tool). Takes query from user.

Task 1: Reads ontology file and maps the query from user to respective concept in the ontology.

Task 2: Reads all source files, sentence making, stop words are removed, stemming is done and one by one sentence is given to Task 3 as input.

Task 3: Take one by one sentence from the task 2 and maps sentence to respective concept in the ontology.

Task 4: Output of the task 3 is maintained by task 4

Task 5: Output of the task 4 is preprocessed and stored in Hash map for the further use.

Task 6: Collects the concepts name to which query is mapped and access the same concept sentences from the task 5 and gives final summary to the task 0.

Explanation of the System Architecture

a) Application's task graph is taken as input for EERA
b) Node details are collected i.e. Nodes location information and configuration information
c) Tasks are allocated to the nodes in the network
d) Actual tasks are executed and final results are given to the central node

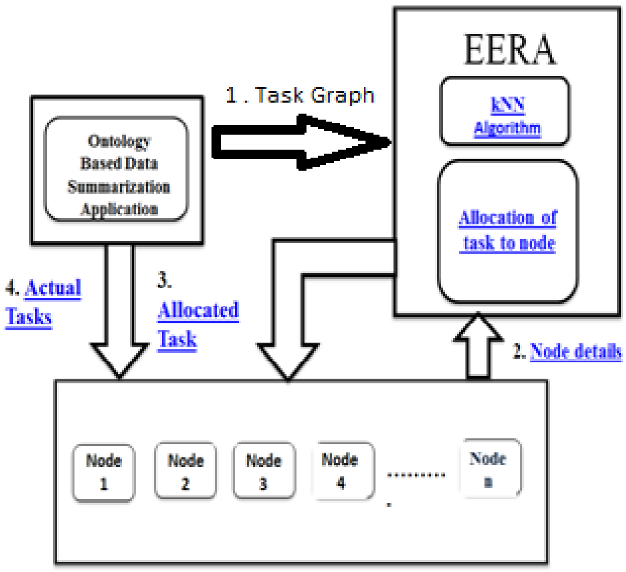

Figure 2: System Architecture

4. Simulation Results

The performance of the scheme is compared with Random resource allocation scheme, in which tasks are allocated to the nodes randomly.

1) **Performance Measure:**
   Energy Consumption: Energy required to for communication during the execution of the application, energy required to process is not considered in this measure in mill joules.

2) **Average end to end Communication Delay:**
   Average time taken to deliver one packet from source to destination in milliseconds

Simulation Environment

We have implemented the simulation environment using swing in Java technology. In which we can create the Mobile ad hoc network, configure nodes in the network, create task graph, store task graph, read task graph, store message counter, read message counter, Allocate the tasks of given task graph to the nodes in the created network , Execute the tasks (Only for one application i.e. Ontology based summary generation), Construct routing table for network for communication, Calculate the Energy consumption and Average end to end communication delay

Scenario 1:

18 nodes are arranged in the network as shown in fig. 3 (At the last of the paper), 3 task graphs of the 3 distinct applications are designed using our simulation environment and stored for further use. Task graphs contains number of tasks 7, 10, 15 respectively. For each task graph, we allocated the tasks to nodes in the network using EERA and RRA and collected the Average end to end communication delay, Energy required. We have performed same experiment in three different scenarios for all three task graphs. Each scenario is different from other with respect to location of the nodes in the network and the range of the node. In this paper we include the results of one of the scenario (Fig 3)

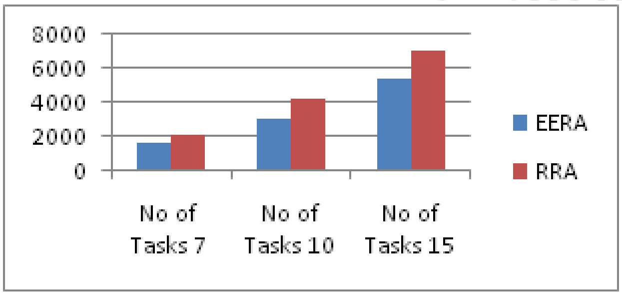

Figure 4: Energy Consumption

In fig 4, x axis represents number of the tasks in the task graph, y represents energy required in mill joules.

Table 1: Energy Consumption in mille Joule

Energy Required in (mJ) By -→	EERA	RRA
Task graph 1	1500	2085
Task graph 2	3000	4125
Task graph 3	5415	7095

Figure 5 is graph of the Avg. end to end communication delay y axis represents time in mille seconds.

Table 1: Avg. end to end communication delay

Avg. communication end to end By -→	EERA	RRA
Task graph 1	1.9	2.2
Task graph 2	1.57	2
Task graph 3	1.77	1.9

From above results we can conclude that EERA allocates tasks so that energy required for execution is less and average end to end communication delay is less than RRA same experiment is carried out for 2 other scenarios, we got the same results. EERA and RRA is used for the allocation of the tasks in ontology based summary generation application, we got the same results.

5. Conclusion

This paper describes, Energy efficient resource allocation scheme for applications in the Mobile ad hoc computation network, which considers dependencies in the tasks, nature of the task, location of the nodes, Configuration of the node to allocate the task to the node. EERA also describes how to handle node failure case. To evaluate the scheme on actual application we designed and implement Ontology based multi document summary generation application. EERA is used for resource allocation of tasks in the above application. Execution of

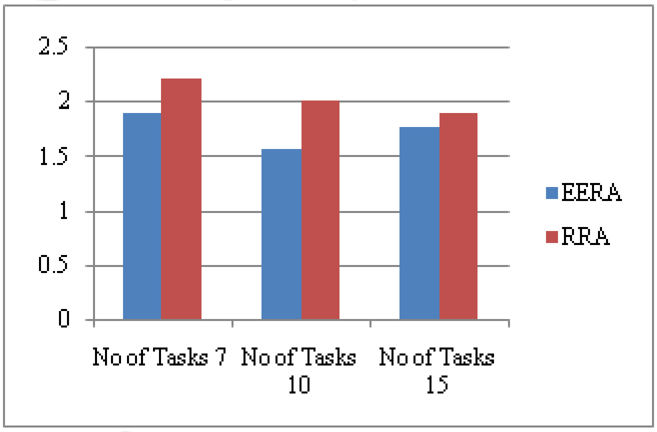

Figure 5: Avg. end to end communication delay

the tasks is done on allocated tasks. Experiments in various scenarios shows that allocation by EERA requires minimum energy consumption and minimum average end to end communication delay. In future we would like to investigate in the direction of problem of node mobility in network

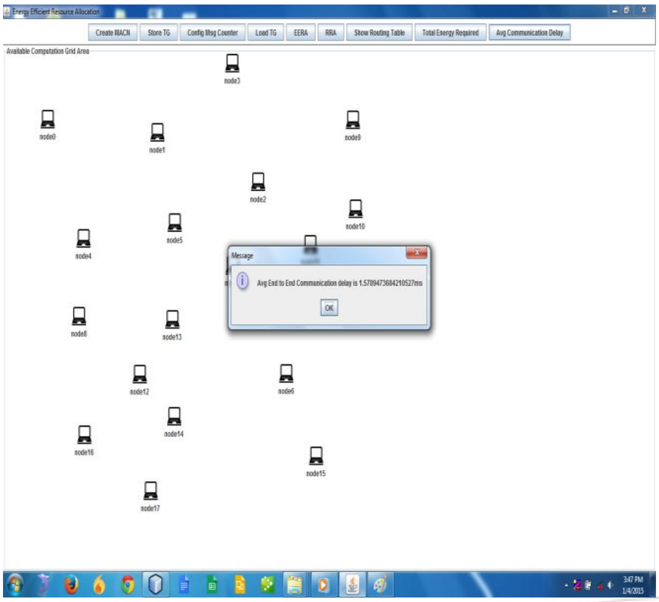

Figure 3: Scenario 1

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