Australian Journal of Basic and Applied Sciences, 8(2) February 2014, Pages: 37-42

AENSI Journals

Australian Journal of Basic and Applied Sciences

ISSN:1991-8178

Journal home page: www.ajbasweb.com

SODP: A New Paradigm for Mobile Grid

[1]Aghila Rajagopal and [2]M.A. Maluk Mohamed

[1]*Anna University, K.L.N. College of Information Technology, Information Technology, Aghila Rajagopal, Box.3030.Sivagangai, India.*
[2]*Anna University, M.A.M. College of Engineering, Information Technology, M.A.Maluk Mohamed, Box.3030.Tiruchirappalli. India.*

ARTICLE INFO

Article history:
Received 25 December 2013
Received in revised form 22 February 2014
Accepted 26 February 2014
Available online 15 March 2014

Keywords:
Surrogate Object; Mobile Grid; Distributed Pipe.

ABSTRACT

Background: SODP: A New Paradigm for Mobile Grid. Objective: Advancement in Wireless technology together with a huge computing power resulted in a paradigm called as Mobile Grid. Mobile devices play a vital role in day-to-day activities. The paper proposes a novel model for Mobile Grid environment on considering the mobile device constraints using an Object Based Model. Object Model is a method which acts on behalf of mobile device and caches the frequent data and it reduces the communication overhead and increases the performance of the system. An experimental result proves the reliability of the proposed model and showcases its importance against disconnection of mobile devices. Results: To project our Proposed model, we have conducted an experimental to exhibit the usefulness of Surrogate Object with and without, in a Mobile Grid. Figure 3 shows the speed up of the model by comparing it over the memory and proves that the proposed model is effective due to data caching at the surrogate object. Figure 4 shows that the completion time gets reduced when the number of nodes increases. The proposed model shows a better completion time by the introduction of Surrogate Object and distributed pipe. Figure 5 shows that errors get reduced due to connectivity issue as Surrogate object acts as a proxy for mobile devices. Conclusion: In this paper, we have proposed a new model called Surrogate Object with distributed pipe (SODP) which overcomes the mobile devices found in several other techniques. The proposed model uses the distributed pipe for data transfer and the surrogate object which acts as a proxy for mobile devices and also acts as a data cache for storing data. Thus when compared to the existing techniques, the proposed model 1) reduces the completion time 2) speed up the processes and 3) it also reduces the error due to connectivity issues. We have conducted experimental results for both with and without Surrogate Object and showcase their effectiveness over the existing methods. The proposed technique shows a better performance than the existing technique.

To Cite This Article: Aghila Rajagopal and M.A. Maluk Mohamed., SODP: A New Paradigm for Mobile Grid. ***Aust. J. Basic & Appl. Sci.**, 8(2): 37-42, 2014*

INTRODUCTION

The advancement in the field of Computing and Wireless technology has enabled the emergency of Mobile Grid. With this emerging technology, the information retrieval at anytime, anyplace provide very valuable information to the user.

The problem of extracting the information about the mobile node during its mobility is a tedious task. The problem comes to an end with the introduction of Surrogate Object by M.A. Maluk Mohamed in (2005). Surrogate Object SO acts as an information provider about the mobile node during its mobility. As in Grid computing, the problem is divided in to sub problems and the computation is carried out, the exchange of their boundary values is needed.

The objective of this paper is to provide a transparent programmability of Communicating Parallel tasks on heterogeneous node in a Mobile Grid Environment. The Surrogate Object acts as a data cache and provides Mobile node information during its mobility. The exchange of inter task communication can be carried out with Distributed Pipe. Distributed Pipe DP is a Model for transparent programming of communicating parallel tasks (Van Dijk, G.J.W. and M.J. Van Gils, 1992). It provides a better efficiency and reliability in Mobile Grid Environment.

The remaining paper is organized as follows. We present the related work in Section 2 Followed by the description of the proposed method in Section 3. Section 3.1 explains the proposed Surrogate Object based Distributed Pipe SODP Model and Section 3.2 discusses the SODP Algorithm. Section 4 gives the

Corresponding Author: Aghila Rajagopal, K.L.N. College of Information Technology, Information Technology, Aghila Rajagopal, Box.3030.Sivagangai, India.
Ph: +91-452-6562171 E-mail: ssg_akila@mamce.org,

implementation details. Section 5 discusses the experimental results and the paper concludes with a Conclusion at the end in Section 6.

Related Work:

Scientific applications which require huge amount of data are being processed using Grid. As the number of applications, number of users increases enormously, the data processing, storage requirements are to be concentrated. As the world is booming towards the wireless technology, people began to think of mobile Grid. The Proliferation of Mobile devices along with the Computing Technology has made the Mobile Grid Systems a potential computing Paradigm.

Mobile Grid enables both fixed and mobile users to access both fixed and mobile Grid resources. Mobility may be user mobility, device mobility and service mobility. When the user moves around between the terminals, it is referred as user mobility. Device mobility involves the movement of the devices across different localities. Service mobility is the ability to maintain services for a user while he is in movement. Mobile devices are subjected to constraints such as finite energy source, unreliable and bandwidth varying wireless connectivity (Satyanarayanan, M., 1996). The constraints along with device mobility pose serious challenges (Forman, G.H. and J. Zahorjan, 1994). Major constraints such as Node Mobility, Heterogeneity in Architecture and Operating System, Asymmetry in Connectivity, Load Fluctuation, Node availability, Memory and Computing Capability mismatch, Battery Power Constraint.

As mobile nodes are free to move from one cell to another, tracking of mobile node location is difficult. When the node moves, the distance from the information server gets longer and should be replaced by the near one for the retrieval of information. Hence the mobile node location plays a major role in mobile computing. A tracking of mobile node movement is necessary.

Harnessing the idle computing capability of a group of homogenous nodes becomes easier as they posses the similarity between them. By the introduction of heterogeneous nodes, the task becomes still more tedious. Many factors has to be addressed in order to maintain compatibility between the heterogeneity nodes as they differ in architecture and operating system. Wired network do not face much problem even incase of heterogeneity nodes. In case of wireless networks, it suffers from lower bandwidth and higher error rates. Hence an effective programming model is needed to handle asymmetry in connection.

On running parallel applications, the concept of load balancing is an important feature to be considered. In order to increase the system performance, loads on the nodes on the network should be balanced. Efficient dynamic load balancing technique is required as static load balancing is insufficient. The availability of nodes may change dynamically. Mobile nodes keep moving from one cell region to another. It may be due to node failure or link failure. Even when a node moves out or it failed, the remaining nodes should be in a position to continue with the computation.

As the nodes differ in their computing capability and memory, it is necessary to allocate the task to the nodes based on its capability. Mobile nodes possess less computing power and memory than the static nodes. As the technology is getting improved, everything from wired is switched onto wireless technology. The entire processing in wireless technology depends on the battery power. Hence when allocating a task to the nodes, battery power is another important feature to be considered.

These issues are faced by the parallel programming when mobile nodes are introduced. Surrogate object is the key feature for solving the mobility issues. Surrogate Object SO defines architecture [1] that allows the mobile devices to participate seamlessly in Computing and Communication.

An effective parallel programming is achieved with Condor (Litzkow, M. and M. Solomon, 1992), Piranha (Gelernter, D. and D. Kaminsky, 1992), ADM (Joshi, R.K. and D. Janaki Ram, 1999), ARC (Casas, J.,1994) and EMPS (Douglis, F. and J. Ousterhout, 1991). But the inter task communication also has to be addressed. Distributed Pipe was introduced in (Binu K. Johnson) to handle the inter task communication for Cluster Computing. This pipe concept can be extended to mobile grid.

Distributed Pipe is introduced in this environment to handle the inter task communication. The advantages of the proposed model are 1.Mobility issues are easily handled 2.Location Management Problem is solved by using SO 3.Improved Speed of data access 4.Quality of Service is improved 5.Efficiency of the System is good.

Proposed Model:

The proposed Model is a Coordination process in which the coordinator is the node which initiates the computation and the Subordinate is the Cluster of nodes which participate in Parallel Grid Computation. Subordinate processes are called as Mobile Cluster Grid Module MCGM.

3.1 Surrogate Object Based Distributed Pipes:

A Surrogate Object based Distributed Pipe model SODP in Mobile Grid Environment is shown in figure 1. It includes various components 1) the system coordinator SC which act as a master process 2) a few mobile host MH are formed as clusters, where each mobile host are controlled and maintained by mobile Local Host. 3)

Clusters are headed by the co-coordinator CC. It maintains all mobile host information which belongs to its cluster. 4) Each Mobile Host has an surrogate object SO which act as a data cache or a data container addresses mobility issues. The inter task communication between the processes takes place through Distributed Pipes.

Whenever a Mobile Device newly joins the environment, coordinator CC assigns a unique ID (CCID) for that mobile device and it creates a Surrogate Object corresponding to the mobile device and assigns a unique ID (SOID). To showcase the importance of Surrogate Object based Distributed pipe, the following application has been considered.

Consider any scientific applications which involve a huge amount of transactions, processing. The application can be designed using the Surrogate Object based Distributed Pipe and without it. In the latter case, communication takes place directly but in the former case, only the surrogate objects are communicated.

The following algorithm explains how this application would be developed without the Surrogate Object based Distributed Pipe.

3.2 Algorithm without Surrogate Object Based Distributed Pipe:

1) Initializes the Grid Computation Work.
2) Decides the number of Mobile Host MH.
3) Each MH collects the allotted task, data and Result Pipe Name.
4) When MH-r needs the data/result from MH-p the following different mechanism followed are

Case 1: MH-r is in CC-r and MH-p is in CC-p, a distributed pipe is created between them. The data are forwarded through the distributed pipe. This represents the best case.

Case 2: MH-r is in CC-r and MH-p moves out of coverage area. Location awareness of MH-p is difficult. Hence MH-r wants to wait for MH-p for its work completion. It results in worst case.

Case 3: MH-r is in CC-r and MH-p is in CC-p for a while. Pipe is created between the nodes. As the mobile devices are free to move, the mobile device may move out of coverage after the pipe creation, which again results in worst case.

Case 4: MH-r is in CC-r and MH-p is in CC-p. Pipe is created between the nodes and the data are being forwarded to MH-r. As mobile device suffer from constraints like memory, they may not be able to buffer the data. It again results in worst case.

5) After the transfer of result through distributed pipe, the pipes are closed and deleted.

As we discussed in the above algorithm, case 2 and 3 problems can be solved when mobile node mobility is addressed. By providing a data cache or storage, case 4 can be made effective.

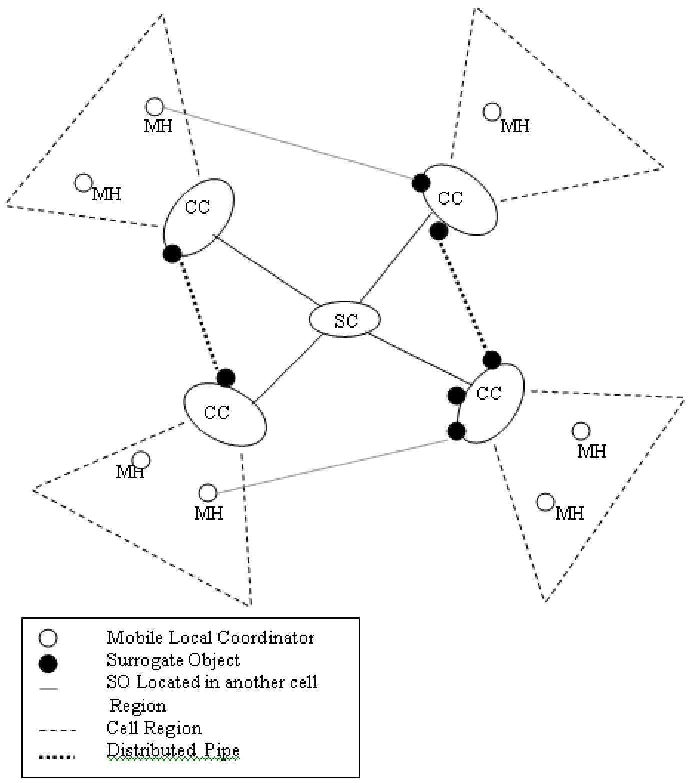

Fig. 1: Structure of Surrogate Object Based Distributed Pipes.

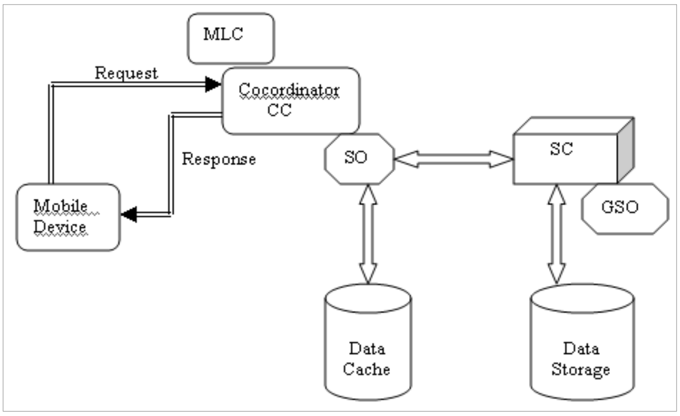

Fig. 2: Interaction of Surrogate Object.

3.3 Algorithm with Surrogate Object Based Distributed Pipe:

1) This is same as step 1,2,3 of algorithm described in section 3.2

2) When MH-r needs the data/ result from MH-p the following scenarios are to be considered.

Case 1: MH-r and MH-p is in the same co-coordinator, the requested data can be received without the need to establish the distributed pipe. This is the best case.

Case 2: MH-r is in CC-r and MH-p is in CC-p. Whenever a MH-r sends a request, Surrogate Object checks the requested data in its Cache. If cache hit, this is again the best case in the proposed model.

Case 3: MH-r is in CC-r and MH-p is in CC-p. Distributed pipe is established between the Surrogate Object of MH-r and MH-p and the data are forwarded. A data Cache is maintained in the Surrogate Object for future easier access. This is the best case again in the proposed model.

Case 4: MH-r is in CC-r and MH-p is in CC-p. Even when MH-p moves out of coverage area, pipe can be created between the Surrogate Object of MH-r and MH-p. The Surrogate Object of MH-r stores the data for MH-p. Surrogate Object of MH-p act as a data holder of MH-p during its absence. This is the average case in the proposed model.

Case 5: MH-r is in CC-r and MH-p is in CC-p. Pipes are established between their Surrogate Object and data forwarding takes place. Even if a huge amount of data needs to be forwarded, the data can be buffered in the cache. This is again the best case.

3) This is same as step 5 of algorithm described in section 3.2

Implementation:

The SODP model provides Parallel programming on a mobile grid. It improves the utilization of the idle computing resources of the participating nodes. SODP supports heterogeneity, mobility and other mobile issues discussed previously. We have implemented our proposed model in java as part of our Mobile Grid Middleware Architecture. Implementation model is a coordination process. The system coordinator is the coordinating process which initiates the process. The subordinate process forms a cluster. Distributed Pipe is established whenever two processes want to send their data. In our proposed model, Distributed Pipe is developed between the Surrogate Object.

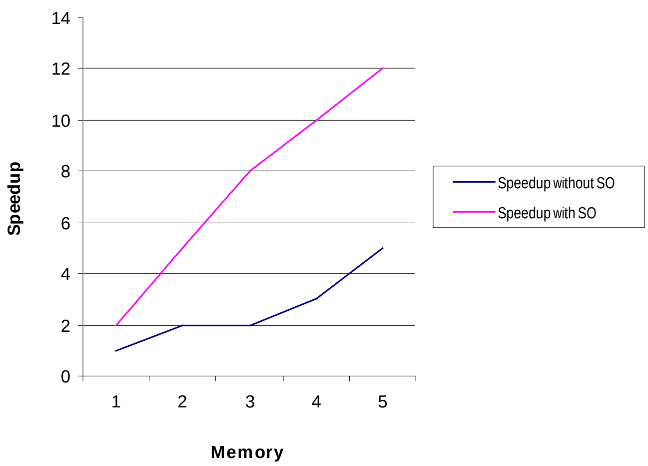

Fig. 3: Graph showing Memory Vs Speed up With and Without Surrogate Object.

Experimental Results:

To project our Proposed model, we have conducted an experimental to exhibit the usefulness of Surrogate Object with and without, in a Mobile Grid. Figure 3 shows the speed up of the model by comparing it over the memory and proves that the proposed model is effective due to data caching at the surrogate object. Figure 4 shows that the completion time gets reduced when the number of nodes increases. The proposed model shows a better completion time by the introduction of Surrogate Object and distributed pipe. Figure 5 shows that errors get reduced due to connectivity issue as Surrogate object acts as a proxy for mobile devices.

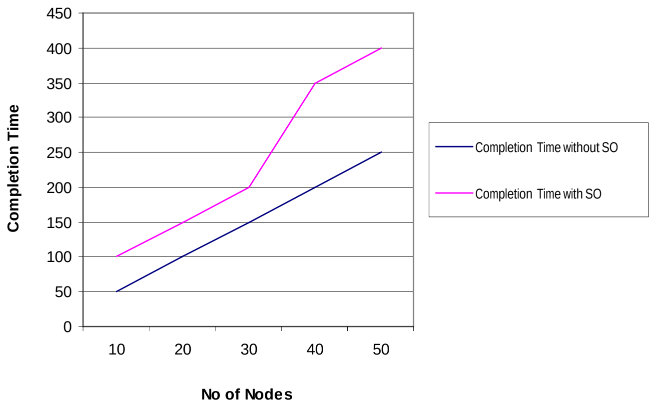

Fig. 4: Shows No of nodes Vs Completion Time With and Without Surrogate Object

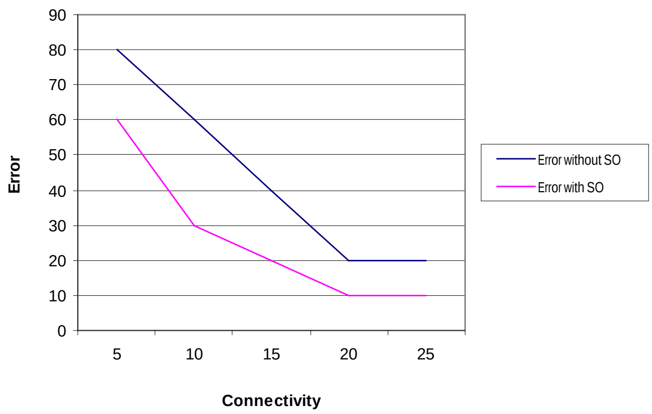

Fig. 5: Shows Connectivity Vs Error With and Without Surrogate Object.

Conclusion:

In this paper, we have proposed a new model called Surrogate Object with distributed pipe (SODP) which overcomes the mobile devices found in several other techniques. The proposed model uses the distributed pipe for data transfer and the surrogate object which acts as a proxy for mobile devices and also acts as a data cache for storing data. Thus when compared to the existing techniques, the proposed model 1) reduces the completion time 2) speed up the processes and 3) it also reduces the error due to connectivity issues. We have conducted experimental results for both with and without Surrogate Object and showcase their effectiveness over the existing methods. The proposed technique shows a better performance than the existing technique.

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