Volume 4, Issue 3, March 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

An Optimal Checkpoint Interval- a Novel Checkpointing Approach for mobile Consumer Devices

Ms. Sneha R. Kaware
M.E Second Year,
Dept of computer science and Engineering,
H.V.P.M college of Engg & Tech,
Amravati, India

Prof. P. L. Ramteke
Associate Professor,
HOD (Information Technology)
H.V.P.M college of Engg & Tech,
Amravati, India

Abstract-There are number of issues needs to handle in mobile computing systems like mobility, lack of stable storage on mobile nodes, disconnections, limited battery power and high failure rate of mobile nodes which causes loss of computation. Checkpointing is an attractive approach to introduce fault tolerance in mobile distributed systems transparently. A checkpoint is a local state of a process saved on the stable storage. However, a mobile consumer device is not considered to have sufficiently large and stable storage to store its checkpoint data. Therefore, a remote checkpoint technique is preferred in which the checkpoint data of a mobile device is kept in a remote checkpoint server instead of the mobile device. Since battery power is one of the most critical resources for mobile devices, it is important to identify optimal checkpoint intervals that minimize power consumption. The proposed method is used to recover the mobile devices from failures and minimizes power consumption.

Keywords- Mobile computing, fault tolerance, optimal checkpoints, remote checkpoint server.

I. INTRODUCTION

The market of mobile handheld devices and mobile application is growing rapidly. Mobile terminal are become more capable of running rather complex application due to the rapid process of hardware and telecommunication technology. Property, such as portability and ability to connect to network in different places, made mobile computing possible. Mobile computing is the performance of computing tasks whiles the user in on the move, or visiting place other than their usual environment. In the case of mobile computing a user who is away from his "home" environment can still get access to different resources that are too computing or data intensive to reside on the mobile terminal [4].Mobile distributed systems are based on wireless networks that are known to suffer from low bandwidth, low reliability, and unexpected disconnection [3].

Checkpointing / rollback recovery strategy has been an attractive approach for providing fault tolerant to distributed applications [1] [8]. Checkpoints are periodically saved on stable storage and recovery from a processor failure is done by restoring the system to the last saved state. So the system can avoid the total loss of the computation in case of the failure. In a distributed system, since the processes in the system do not share memory, a global state of the system is defined as a set of local states, one from each process. An orphan message is a message whose receive event is recorded, but its sent event is lost. A global state is said to the "consistent" if it contains no orphan message and all the in-transit messages are logged. To recover from failure, the system restarts its execution from a previous consistent global state saved on the stable storage during fault-free execution. This saves all the computation done up to the last checkpoint state and only the computation done thereafter needs to be redone [5], [6], [7]. Synchronous and asynchronous are two fundamental approaches for checkpointing and recovery [2].

In coordinated of synchronous checkpointing, processes take checkpoints in such a manner that the resulting global state is consistent. Coordinated checkpointing algorithms can be blocking and non blocking [3]. The objective is to design a remote checkpoint and rollback strategy that is suitable for mobile computing environment.

II. LITERATURE REVIEW

Many research papers have proposed approximated methods to find out the optimal checkpoint interval that minimizes the expected execution time. Zhan et Al. presented a heuristic method for remote checkpoint systems which dynamically adjusts the checkpoint frequency according to variety of failures when the failure rate is assumed to change over time in wireless networks [16]. Men et al. proposed a remote checkpoint method to obtain the appropriate checkpoint interval by considering not only the failure rate and checkpoint overhead but also the handoff rate of a mobile device in cellular networks when the mobile device frequently moves across the cellular areas [9]. Daly proposed a perturbation solution providing a higher order approximation [10] than Young's approximation. George et al. proposed an aperiodic remote checkpoint scheme in which a mobile device takes checkpoints only when its handoff rate exceeds a predefined threshold value instead of taking checkpoints periodically [11]. Cao and Singhal presents in [3] a non-blocking coordinated checkpointing algorithm with the concept of "Mutable Checkpoint" which is neither temporary nor permanent and can be converted to temporary checkpoint or discarded later and can be saved anywhere. In this scheme MHs save a disconnection checkpoint before any type of disconnection .This checkpoint is converted to permanent checkpoint or discarded later. In this scheme only dependent processes are forced to take checkpoints.

However, previous studies on optimal checkpoint intervals have been focused on reducing the expected execution time [3, 14], but power consumption is also an important performance metric in mobile devices. Most research on remote checkpoint strategies has focused on reducing message overhead between mobile hosts and the mobile support server [12] but determining optimal checkpoint intervals is also important for the time and power efficiency. As a previous work, an approximated method to the energy optimal checkpoint interval to minimize the expected energy expenditure for a mobile device has been proposed [15]. Prakash and Singhal describe in [13] a checkpointing algorithm for Mobile Conputing System. This scheme reduces energy consumption by powering down individual components during periods of low activity [14].

III. PROPOSED MODEL

The mobile system employed in the proposed model consists of mobile devices and mobile support servers as shown in Figure 1.

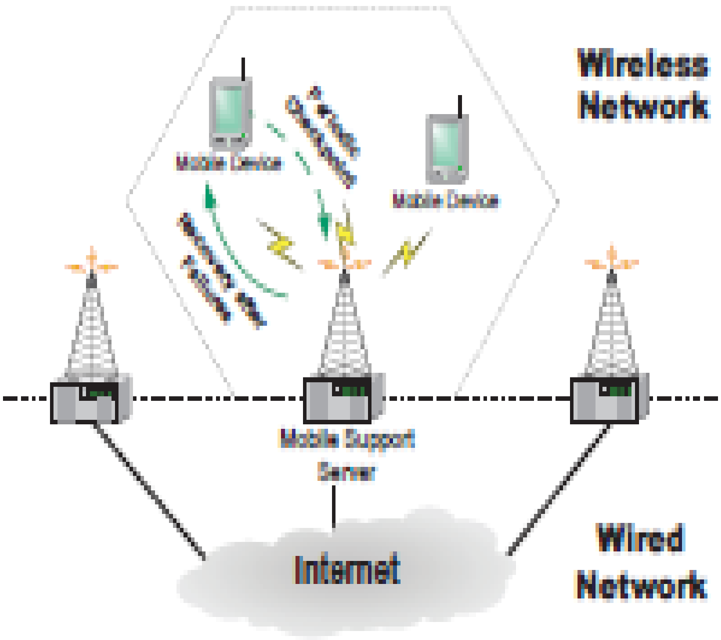

Fig1. Remote checkpoint strategy

It is assumed that wireless communication, as well as local memory access, is required during checkpoint establishment (C) or rollback recovery (R), whereas only local memory access is required during normal local computation (i.e., useful computation). EN denotes the power (watts) consumed for normal local computations, which includes only power consumed by local memory. Let EC the power (watts) consumed for checkpoint or recovery operations, which includes the power consumed by both local memory and a wireless interface. Since EC is the sum of EN and the power consumed by the wireless interface, EC is always greater than EN. Actually, the energy consumption model employed in this paper is similar to the ones used in [18, 19]. The assumptions and main operations are as follows:

- The mobile device saves or loads checkpoint data into/from its covering mobile support server through the wireless communication.
- During checkpoint establishment (C) or rollback recovery (R), wireless links may be disconnected at rate λc, which is governed by a Poisson process [17].
- Once a wireless link error has occurred during checkpoint establishment (C), the transferred checkpoint data for the current interval before the disconnection of the wireless link are lost. Therefore, checkpoint establishment should be restarted after the wireless link is recovered.
- During a checkpoint interval (T), only useful computations for the job are running.
- The same mechanism is applied to rollback recovery (R) operations.

We assume that the wireless link is recovered immediately once it has disconnected, for simplicity.

The proposed system uses Non-blocking Checkpoint Co-ordination scheme having following modules:

1. Data collection module- In this module Call Logs, Messages, Contacts and calendar entries are collected.
2. Online server creation and testing module- A mobile device is able to access the internet by connecting to a mobile support server through wireless interface, in which an application process of the mobile device periodically stores checkpoint data on the mobile support server, and loads the last checkpoint from the server when failures occur.

3. Check point checker module- In case of failure, the mobile device is assumed to lose current states of running processes in the memory. The mobile device may fail during normal, checkpoint, or recovery operations. Therefore check point checker module will be established.

It has been one of the main objectives of the research on checkpoint and rollback schemes to reduce the total overhead which consists of the loss of computation and the checkpoint overhead and to minimize energy expenditure of a mobile device in a wireless remote checkpoint environment.

IV. CONCLUSION

Fault tolerance using checkpoints in a Mobile Computing System imposes more challenges because of some unique characteristics of mobile hosts. A remote checkpoint technique is preferred in wireless environments in which the checkpoint data of a mobile device is kept in a remote checkpoint server instead of the mobile device. Dense checkpoints incur frequent wireless transmissions whereas coarse checkpoints increase the loss of computation. The expected execution time should also be minimized. The proposed method deals with optimal checkpoint intervals that minimize power consumption in wireless remote checkpoint environments by considering environmental parameters.

REFERENCES

[1] Kshemkalyanl Ajay D, Singhal, M.: Distributed Computing Principals, Algorithms, and System Surender Kumar, Parveen Kumar & R.K.Chauhan.

[2] Singhal, M. , Shivaratri, N.-G.: Advanced Concept in Operating System. McGraw Hill,(1994)

[3] Cao, G. and, Singhal, M "Mutable checkpoints: a new checkpointing approach for mobile computing systems,"IEEE Transactions on Parallel and Distributed Systems, vol. 12, Issue 2,pp. 157-172, Feb 2001.

[4] Coulouris, G., Dollimore, J., Kindberg, T., Distributed System Concepts and Design, 3rd edition, Addison-Wesley,(2001), 772p

[5] Randall, B, " System structure for Software Fault Tolerance", IEEE Trans.on Software Engineering, Vol.1,No.2,pp220-232, 1975.

[6] Russell, D.L., "State Restoration in System of Communication Processes", IEEE Trans. Software Engineering, Vol.6,No.2pp 183-194, 1992.

[7] Ziv Avi and Bruck Jehoshua "Checkpointing in Parallel and Distributed Systems", Book Chapter from Parallel and Distributed Computing Handbook edited by Albert Z. H. Zomaya, pp. 274-320, Mc Graw Hill, 1996.

[8] Bhargava B. and Lian S.R., "Independent Checkpointing and Concurrent Rollback for Recovery in Distributed System -An Optimistic Approach," Proceeding of 17th IEEE Symposium on Reliable Distributed System, p. 3-12, 1988.

[9] C. Men, and Z. Xu, "Performance Analysis of Rollback Recovery Schemes for the Mobile Computing Environment," International Conference on Internet Computing in Science and Engineering, Aug. 2008.

[10]. J. T. Daly, A higher order estimate of the optimum checkpoint interval for restart dumps, Future Generation Computer Systems, 22 (2006), 303-312.

[11] S. E. George, I.-R. Chen, Y. Jin, "Movement-based checkpointing and logging for recovery in mobile computing systems," ACM International Workshop on Data Engineering for Wireless and Mobile Access, U.S.A., June 2006

[12] G.-H. Li and H. Wang, A novel min-process checkpointing scheme for mobile computing systems, J. Systems Architecture, 51 (2005), 45-61.

[13] R.Prakash, M.Singhal, (1996) "Low Cost Checkpointing and Failure Recovery in Mobile Computing Systems", IEEE Transacrions on Parallel and Distrinuted Systems, VOL. 7, NO. IO**,** OCTOBER 1996

[14] Taesoon Park, Namyoon Woo, Heon Y. Yeom,(2003) "An Efficient recovery scheme for fault tolerant mobile computing systems", Future Generation Computer System, 19(1): 37-53

[15]. S.-H. Lim, S. W. Lee, B.-H. Lee, S. Lee and H. W. Lee, Energy-aware checkpoint intervals in error prone mobile networks, in proceedings of QTNA, 2011 (2011), 128-133.

[16]. Z. Zhan, Z. De-chaeng, C. Yi-wei, and Y. Xian-zong, " The Checkpoint Interval Optimization of Kernel-level Rollback Recovery based on the Embedded Mobile Computing System," IEEE International Conference on Computer and Information Technology Workshops, Australia, July 2008.

[17] S. Gadiraju and V. Kumar, Recovery in the mobile wireless environment using mobile agents, IEEE Transactions on Mobile Computing, 3 (2004), 180{191.

[18] K.-H. Han, J.-H. Kim, Y.-B. Ko and W.-S. Yoon, An energy e_cient broadcasting for mobile devices using a cache scheme, in Lecture Notes in Computer Science (Proc. ICCS 2004), Springer, (2004), 598{601.

[19] W. R. Heinzelman, A. Chandrakasan and H. Balakrishnan, \Energy-E_cient Communica- tion Protocol for Wireless Microsensor Networks," in proceedings of Hawaii International Conference on System Sciences, (2000), 8020.

