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A *Trust-based* Uncoordinated Checkpointing Algorithm in Mobile Ad hoc Networks (MANETs)

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Abstract

The paper presents a *trust-value* based uncoordinated check pointing algorithm in Mobile Ad Hoc Networks (MANETs). We aim to improve the overall check pointing overhead incurred in the execution of recovery protocols. Most check pointing algorithms do not consider the mobility rate of nodes while taking a periodic checkpoint, thereby, resulting in poor utilization of resources and increased latency. However, the proposed trust-value based check pointing scheme captures a check point only after a node has endured certain movements. Hence, whenever a node move from one cluster to another, the node moves from a cluster with high trust value to a cluster with low trust value and vice-versa. Therefore, nodes do not rely on any fixed threshold value in order to take a checkpoint. This is due to dependency of trust value of a node on the previous and current trust value of its cluster. Thus, each time a node moves or change to a new cluster, its *cluster_change_count* is compared with a fixed threshold value. The information, hence, is restrained for communication ifthe count is greater than threshold in order to maintain its safety. The proposed algorithm comprises of three phases, namely, *multi-checkpointing phase*, *trust node evaluation phase* and *recovery phase*. The analysis shows better performance of the proposed protocol over existing mobility- based protocol in terms of probability of recovery of failed nodes, residual energy and simulation time.

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*Keywords:*Distributed Systems, Coordinated Checkpointing, Uncoordinated Chechpointing, Recovery, Trust, MANETs

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1. Introduction

A mobile ad hoc network (MANET) is a continually self-configuring, infrastructure-less network of mobile nodes connected without any link. Such networks may operate by themselves or may be connected to the Internet which may result in a dynamic and autonomous topology[1]. Further, distributed transaction processing in MANETs is a major application that requires huge computing capability wherein the inherent failures may degrade the overall performance[2]. The existing literature consists of protocols that increase reliability and minimize the number of failures that includes group communication and rollback recovery. Here, rollback recovery considers a distributed system as a group of processes that communicate through a wireless network. These processes have access to a steady storage to survive different failures by saving the corresponding recovery information. In case of failure, the processes may recover with the help of saved information from these devices. The recovery information contains the state of the processes known as *check points.* However, message passing systems make rollback recovery more complicated due to inter-dependencies as shown in fig. 1. If failure occurs in any process, the dependencies may force a number of processes to rollback leading to a problem called *rollback propagation.* Under some circumstances, rollback propagation may extend back to the initial state of computation leading to the failure of all computations. The resulting condition is called *domino effect.*

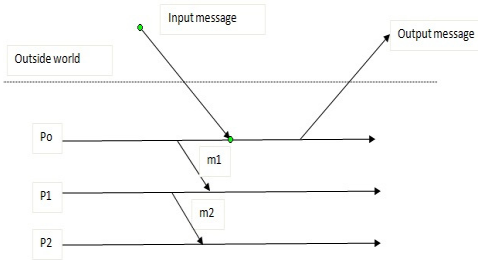

Fig.1. Message passing system

1.1. General Recovery Terms and Definitions

Consistent System State
A *consistent system state* is one in which if a receiver receives a message, then the sender instantly shows the receipt of sent message, *i.e.*, every received message is already sent by sender. The important goal of rollback recovery protocol is to bring a system into consistent state.

Interaction with the Outside World
A message passing system communicates with outside world while taking some input from outside and showing some output to the outside world. It is important that the outside world recognize the system as failure free. Therefore before sending any message the system assures that the state of system is recoverable despite any failure *i.e., output commit proble*m.

In-Transit Message
When a message is being sent and not received at receiver's site, it is called *in-transit* message. If a system assumes communication channels to be reliable, rollback recovery protocols should handle in-transit messages.

Stable Storage
Rollback recovery needs stable storage to save checkpoint data in order to recover from any kind of failures.

Garbage Collection
All checkpointing algorithms consume resources. As the computation increases, the amount of information collected increases. However, most of the data may not be of any use after some time. Therefore, garbage collection should be ensured.