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CSC724- Advanced Distributed Systems
Paper Review

Distributed Snapshots: Determining Global States of Distributed Systems

Summary:

The paper is about on how to determine the state of process during a computation and capture a snapshot of the global state. The global state consists local states of each processes, and communication channels. This global state is used for termination detection, deadlocks. Hence an algorithm is required to capture the global state which should be consistent across the system, with no recording procedure affecting the underlying system. Since global clock is not in consideration to achieve synchronization, how exactly can we achieve a global state is discussed in this paper.

The paper starts off by defining the model of a distributed systems using five tuple <p,s,s',M,c>, where process, events in a process, states, message and the channel are the discussed entities, along with behavior of single token conservation system. The proposed algorithm uses marker which is sent/ received to record the local states. A rule set which says that record the state of the sender process after the marker is sent and before any other message is sent, and record the state of the channel if the receiver process state is recorded or else record the local state first and record channel state as empty sequence. This algorithm is simple enough to achieve all the channel and local process states. Also this algorithm ensures it terminates by assuming that there's a error-free channel, strongly connected system, and the marker doesn't stay for infinite time in the channel, that is, the receiver will record it in a finite time.

Since the global state detected need not be one of the transition states, the paper provides a formal proof that the transition state detected is reachable from the initial state and to finals state. In addition to this, the authors propose a stability-detection algorithm to address the problems such as deadlock detection. This algorithm is based on – if a stable property exists before the start of the algorithm discussed, it will continue to exist in the global state too. The definition of pre-recorded and post-recorded events and their independence discussed provides an additional insight about the recorded global state.

Strong Points:

1. This paper solves the fundamental problem of distributed systems – determining consistent global states by providing a very simple algorithm which guarantees system invariants maintenance.
2. None of the underlying computations are affected by the proposed algorithm, and a state can be detected at any point of time.
3. The stability of the states in guaranteed by the stability-detection algorithm, which I feel is a plus.

Weak Points:

1. The highly noticeable flaw in this paper is that, the assumptions – error free, infinite buffers which is might not be always the case in large scale systems.
2. Also I feel the service outage issue isn't handled. What if a node is down, the algorithm doesn't guarantee the state is recorded here, also if recorded there's a high chance of it being inconsistent.
3. Loss of markers might impose additional issues, which isn't discussed.