

Lab 5 Report

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1. Why are transient states necessary?

The transition between different states is not done instantaneously. The action needs to traverse the interconnection network and experience delay before reaching the directory, and it may wait in the queue before it gets processed. During this time, another request may have arrived the directory first and been processed. This will cause a fault. So we need an intermediate state between two stable states to issue this problem.

2. Why does a coherence protocol use stalls?

When one lock is in the transition state, any read/ write request to this block will be stalled, so that the transition between different states is safe. We can make sure that the former request can be issued before the request coming later.

3. What is deadlock and how can we avoid it?

When two events depend on each other to execute, it will lead to a no forward progress. By using different queues to store different types of requests to separate the data depending and thus to eliminate the cyclic-depending. This idea can be implemented by virtual networks

4. What is the functionality of Put-Ack (i.e., WB-Ack) messages? They are used as a response to which message types?

When a cache wants to evict a block, it will send a PUT message to the directory. And after the directory change the LLC/memory, it will send the Put-Ack to the cache controller. Only after the Put-Ack is received by the cache controller, can the block state been changed into I.

The Put-Ack is in response to the Put request.

5. What determines who is the sender of a data reply to the requesting core? Which are the possible options?

The directory decides who is the sender of a data reply. The sender could be the directory or other cache controllers in M state.

6. What is the difference between a Put-Ack and an Inv-Ack message?

The Put-Ack is sent from the directory to the requestor (a cache controller) in response to the Put request. The Put-Ack indicates that the directory has already changed the LLC/ memory. After the requester receives the Put-Ack, the block state can change to I.

The Inv-Ack is sent by cache controllers who have the block copies to a requestor to say that the copies have been invalidate.

1.

SD stage is a transient block state between transit from M stage to S stage in the directory controller. After the directory receive GetS, it changes to SD state and waits for the data from the owner before it complete and changes to S state.

2.

SD stage happens only when a block state M in directory receives a GetS request and then transit to SD stage. After receiving the GetS request, directory add req and owner to sharers and clear owner, at this point the owner is the directory. When a cache block is replaced and it is in M state, it sends a PutM message to directory. This scenario happens when the cache block receives replacement message before receiving Fwd-GetS from the directory, the cache block will send PutM and data to directory. Because the directory changed the owner, thus it receives data from non-owner and cannot receive data from owner. Because directory is the owner now, it cannot send PutM messages.