Critique for “Using prediction to accelerate coherence protocols”

This paper proposes general prediction logic to accelerate coherence protocols in shared memory multiprocessors (SMPs). The new predictor, Cosmos, is a two step adaptive predictor like the dynamic branch predictor and maintains a Message and Pattern History Table to make predictions.

Strengths:

1> Unlike other optimizations using prediction, the proposed prediction logic is separate from standard coherence logic. This makes it easier to debug. If the logic is integrated with the protocol, it may undergo state explosion.

2> The predictor can discover and track application specific patterns and dynamically adapt to the conditions. This gives improved performance in all applications. This feature is not present in other implementations of prediction logic.

Weaknesses

1> The prediction logic helps to reduce the latencies of remote accesses. In the current CMPs, as opposed to shared memory multiprocessors, remote access latencies are not as critical as the on-chip capacity. This is because all remote accesses are on-chip. The prediction logic further increases the capacity pressure while reducing latency. Thus, it is not practical for CMPs.

2> The authors have not discussed anything about the power budget. Considering the complex logic, the implementation will be power hungry as it involves directory based protocol and two-step prediction. Thus it may not be feasible at all in today's CMPs where power budget is critical.

3> The way to handle mis-predictions is discussed in the paper. However, the mis-prediction penalty is not quantified.

4> The results quantify the number of accurate predictions but do not give any relation between the number of accurate predictions and performance.

5> The implementation has a large memory overhead. In some applications, memory requirement is as high as 63%. This may be feasible in SMPs with large off-chip memories but is infeasible in modern CMPs where capacity is more critical than on-chip latency.

6> As the prediction logic is not integrated with the coherence protocol, it requires more hardware resources to store the Message and pattern history tables. Also it is less cost effective as compared to the integrated optimizations.

7> Unlike the branch prediction, where the state machine has 1-2 bits for encoding, Cosmos has multiple bits to handle prediction. Thus the logic is highly complex.