Initialization

$init \longrightarrow pinit(p, l)$

$pinit(p, l) \longrightarrow pinit(p', l') \mid linit(r, k) \;:\; p' > p, l' = l, r = p, k = l$

$linit(p, l) \longrightarrow invalid(q, m) \mid linit(p', l') \;:\; p = q, l = m, p' = p, l' > l$

Read Miss

$$\begin{array}{ll} invalid(p, l) & \longrightarrow valid(p', l') \\ \quad [\; dirty(q, k) & \hookrightarrow invalid(q', k') \;] \end{array} \;:\; p' = p, l' = l, q \neq p, k = l, k' = k$$

Write Miss

$$\begin{array}{ll} invalid(p, l) & \longrightarrow dirty(p', l') \\ \quad [\; dirty(q, k) & \hookrightarrow invalid(q', k'), \\ \quad\; valid(r, j) & \hookrightarrow invalid(r', j') \;] \end{array} \;:\; p' = p, l' = l, q \neq p, k = l, k' = k, r \neq p, r' = r, j = l, j' = j$$

Write Hit

$$\begin{array}{ll} valid(p, l) & \longrightarrow dirty(p', l') \\ \quad [\; dirty(q, k) & \hookrightarrow invalid(q', k'), \\ \quad\; valid(r, j) & \hookrightarrow invalid(r', j') \;] \end{array} \;:\; p' = p, l' = l, q \neq p, k = l, k' = k, r \neq p, r' = r, j = l, j' = j$$

Replacement

$valid(p, l) \longrightarrow invalid(p', l') \;:\; p' = p, l' = l$

$shared(p, l) \longrightarrow invalid(p', l') \;:\; p' = p, l' = l$

Fig. 3. Specification of the Synapse cache coherence protocol