Reactive Synchronization
Lim and Agarwal

- Protocols
  - Test and Set
  - Queuing
- Waiting
  - Spinning*
  - Blocking
  - Competitive

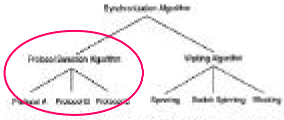


Figure 1: The components of a reactive synchronization algorithm.

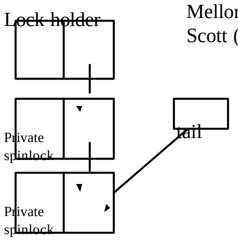
Ski Rental Analogy

- Dynamically choose between two policies such that the performance will be within a constant factor of the optimal off-line choice
- Rent or buy skis?
  - Rent until you spend enough on rentals that you could have bought a pair, then buy
- Spin until you spin long enough to “pay for” cost of context switch to block, then block

Test and Set Variations

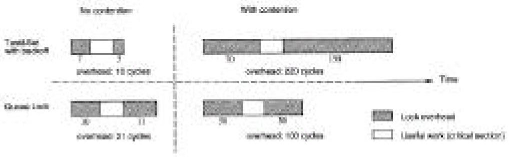
- Dealing with *contention* of Test&Set spinlocks:
  - Don’t execute test&set so much
  - Spin without generating bus traffic
- Test&Set with Backoff
  - Insert delay between test&set operations (not too long)
  - Exponential seems good (k*ci)
  - Not fair
- Test-and-Test&Set
  - Spin (test) on local cached copy *until it gets invalidated*, then issue test&set
  - Intuition: No point in trying to set the location until we know that it’s not set, which we can detect when it get invalidated...
  - Still contention after invalidate
  - Still not fair

Queue Lock Implementations

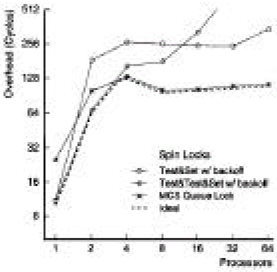


Mellor-Crummey and Scott (MCS locks)

Contention

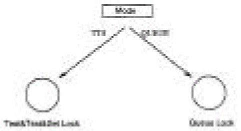


Baseline Performance



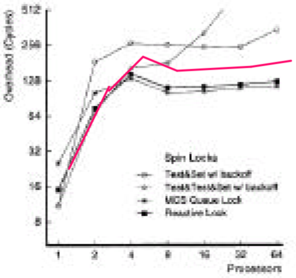
Reactive Lock Algorithm

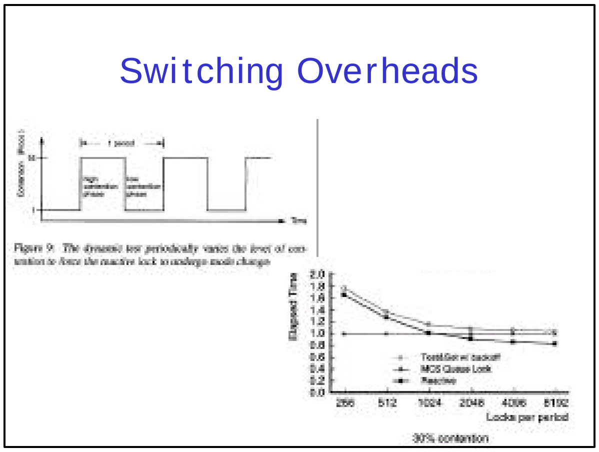
- Only one of TTSL or MCSL will be free
- Mode variable is hint
- To acquire:
  - If mode appears to be TTS, spin with recheck of mode in the loop
  - If mode appears to be Queue, recheck if get a retry signal
- To release:
  - Change mode if approp
  - Queue to TTS, send retry signals
  - release whichever



- Change policy
  - TTS to Queue if # failed TS attempts > threshold
  - Queue to TTS if empty queue for some # of acquires
- Generalize as consensus object

Performance of Reactive Lock





Switching Overheads

Figure 9: The dynamic test periodically varies the level of contention to force the reactive lock to undergo mode changes

30% contention