Mitigating System Noise With Simultaneous Multi-Threading

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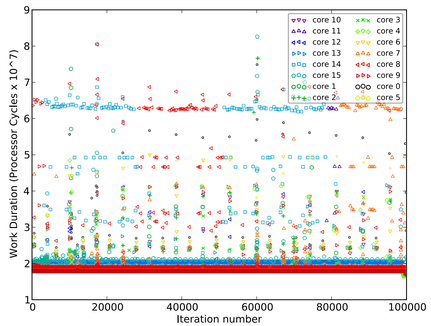
Noise degrades performance on commodity systems

- Sources: OS processes, disk I/O, cache and network contention
- Noise increases with scale
- Mitigation approaches include expensive OS modifications
- Severe impact of noise on next-generation systems

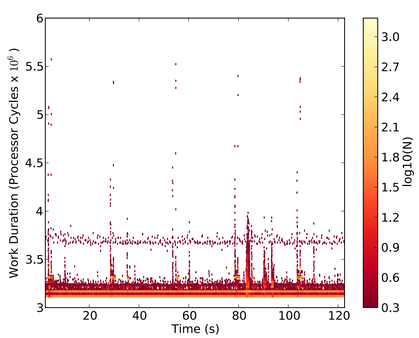
Methodology

- Use parallel Fixed Work Quantum (FWQ) micro-benchmark
- Allocate resources for system processing
  - *Core Specialization*: one core per node
  - *SMT*: one hardware thread per core
- Intel Sandy Bridge nodes, 2 sockets per node, 8 cores per socket, 2 hardware threads per core (Hyper-threading or HT)
- TOSS 2, based on Linux RHEL 6

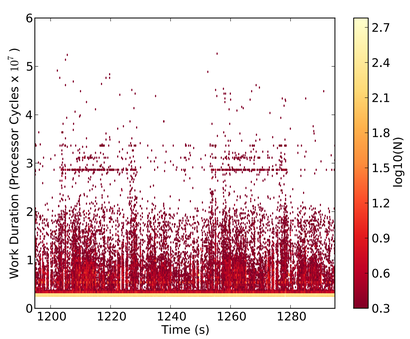


Single-node FWQ on a node
Points above bottom line indicate noise

Noise propagates asynchronously at scale



4-node FWQ



256-node FWQ

Brighter points and spikes indicate noise is happening synchronously

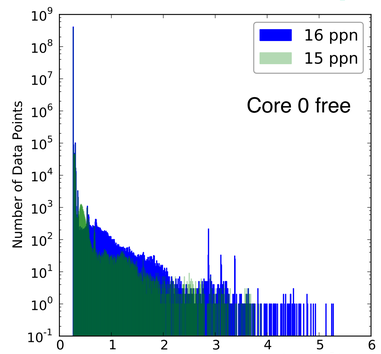
SMT significantly decreases noise and retains all cores

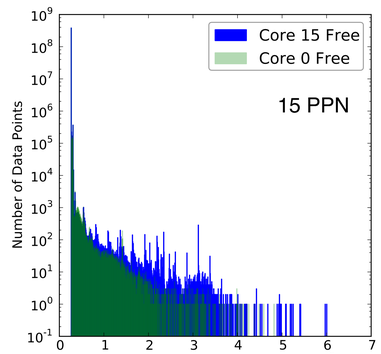
- SMT (HT) significantly more effective than core specialization
- Histograms show spread of data points based on duration of work unit, the tighter the spread and lower work duration, the lower the noise

Results

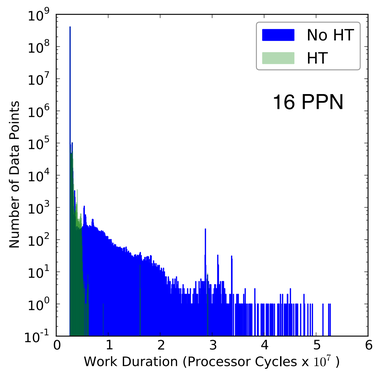
PPN	SMT	Standard Deviation	#Runs ≥ 2x slowdown
16	Off	83757.6	26503
16	On	17070	136
15 (0-14)	Off	84237.5	15778
15 (1-15)	Off	53926.8	12368
15 (0-14)	On	22689.5	647
15 (1-15)	On	18723.8	161

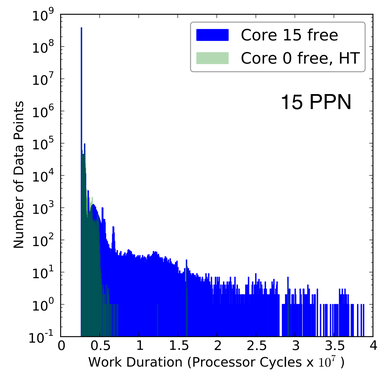
Core Specialization

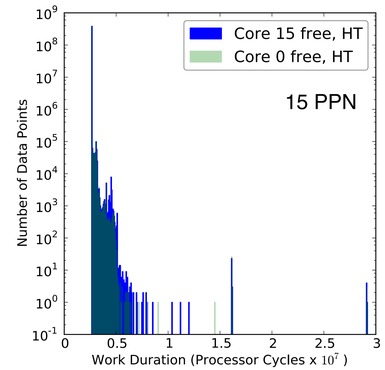




Simultaneous Multi-Threading







Conclusions and future work

- Proposed an evaluated SMT as an effective strategy to mitigate system noise
- SMT decreased incidence of noise by 1000x over core specialization
- Plan on evaluating tradeoff of using secondary threads for system processing versus application's work on real applications

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