USC University of Southern California

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Enhancing Server Energy Efficiency by Shifting Light Burden to an Assistant

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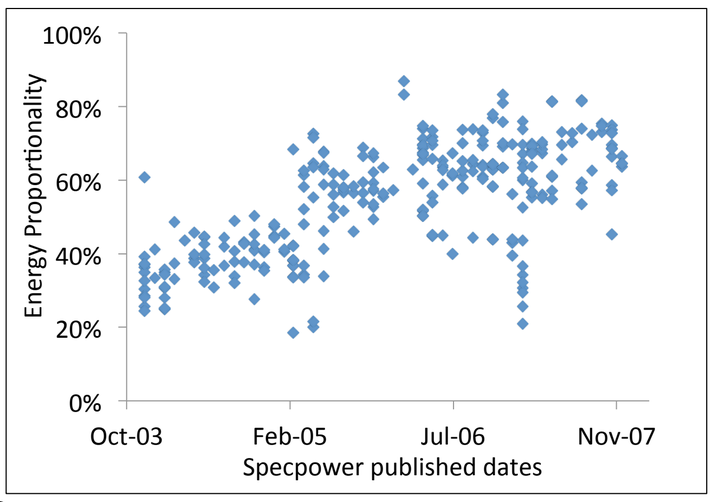
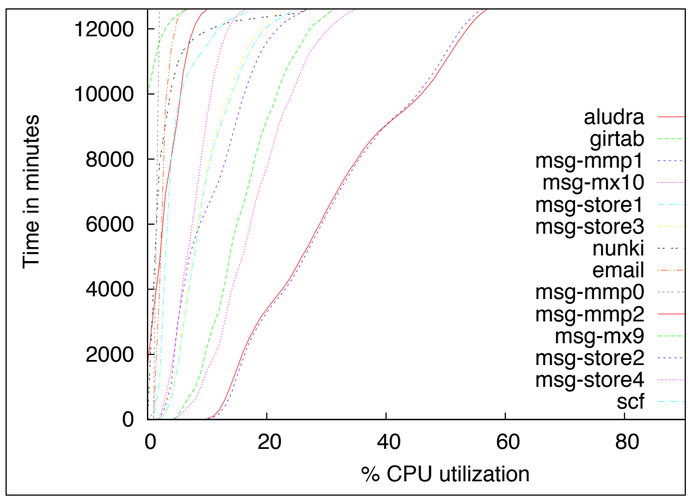
Introduction

- Datacenter servers mostly operate at low utilization levels
- Even when idle, server consumes majority of peak power
- Server shutdown is not ideal
- Energy proportionality scaling trend has stalled
- Solution -- *KnightShift*: Front server with low power assist node (Knight)



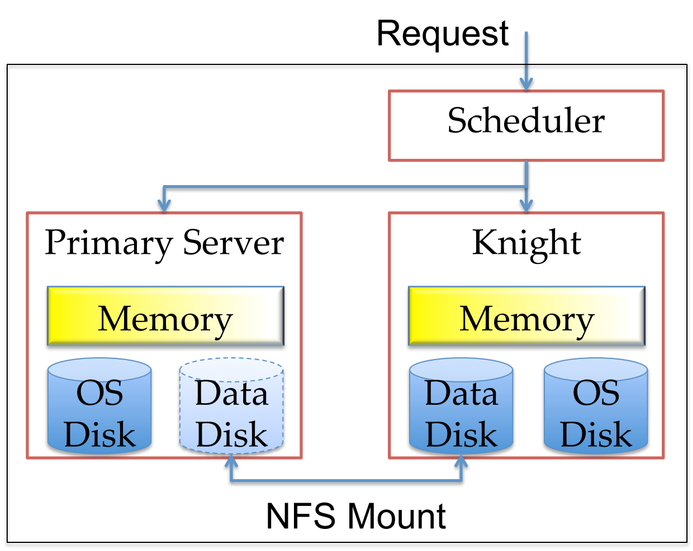
Scaling of Energy Proportionality of production servers has stalled



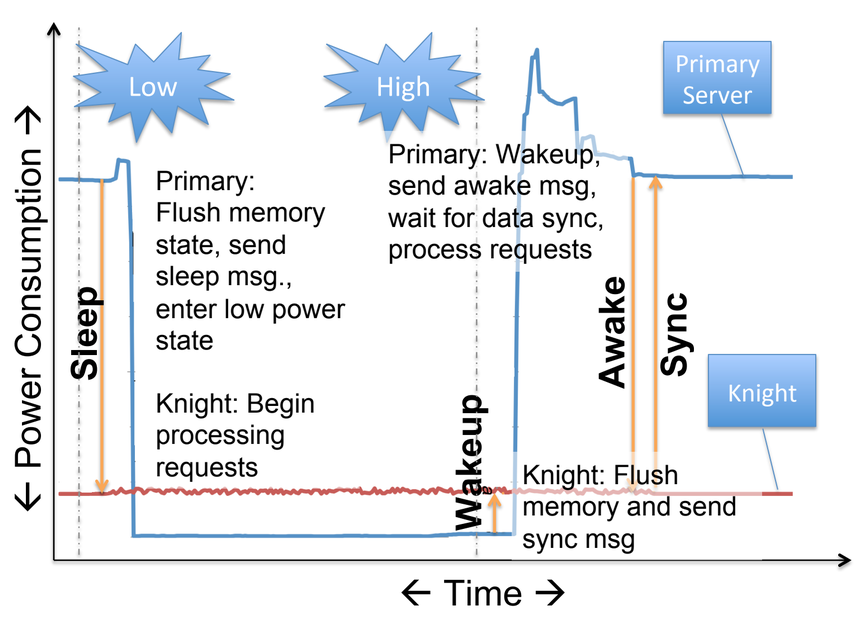
CDF of CPU utilization in USC datacenters shows 20% utilization or less is common

The KnightShift System

- Primary server and Knight has independent:
  - Power supply
  - Memory
  - System Disk
- Primary server and Knight shares data through NFS or Southbridge modifications
- Scheduler directs request
- Knightshiftd daemon coordinates system



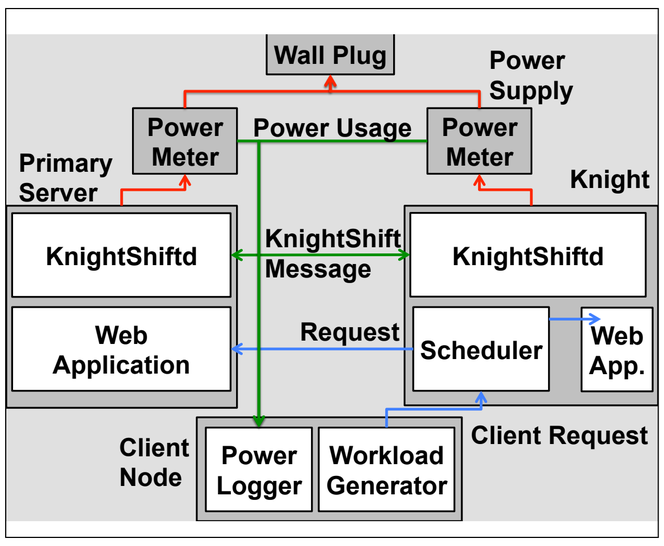
KnightShift Architecture



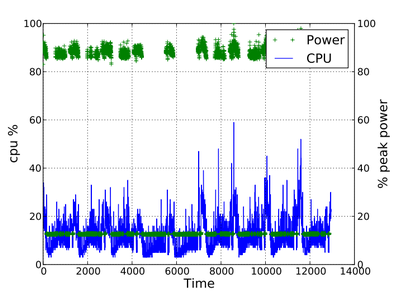
KnightShiftd Coordination

Evaluation

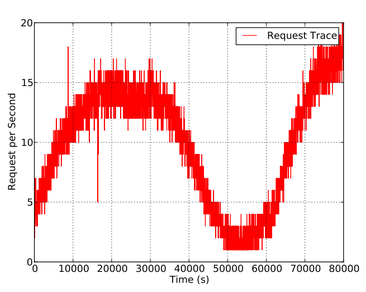
- Primary Server
  - Xeon-based
  - 156-205W
- Knight
  - Atom-based
  - 15W-16.7W
  - 15% Capable
- Wikibench workload
- USC datacenter traces



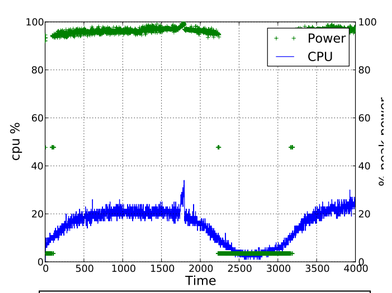
Evaluation Setup



Msg-mmp1 trace



Wikibench request trace



Utilization and power usage during test

Results

	Energy Consumption KWH (Savings %)		Latency Impact (%)
Trace	Baseline	KnightShift-enabled	
Aludra	34.2	3.6 (89.4%)	6.36%
Email	40.0	3.4 (90.0%)	0.98%
Girtab	33.8	3.7 (88.9%)	26.36%
Msg-mmp1	37.8	38.2 (-1.1%)	44.41%
Msg-mx10	36.3	28.2 (22.4%)	218.67%
Msg-store1	35.3	10.4 (70.7%)	62.21%
Nunki	34.2	6.1 (82.1%)	327.11%
Scf	34.5	5.7 (83.5%)	42.93%
Wikibench	11.6	7.68 (33.8%)	4.17%

- For compatible workloads, significant power savings with minimal impact on performance
- Incompatible workloads due to bursty workloads and lack of low-utilization periods

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