Leaping Shadows: Adaptive and Power-aware Resilience for Extreme-scale Systems

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Introduction

Lazy Shadowing

- Each process is associated with a “shadow”
- Shadow processes initially execute at reduced rate
- Upon failure of a main process, its shadow process increases execution rate to recover and complete task

Shadow Collocation

- Collocate multiple shadow processes on each node
  - Reduces shadow processes’ execution rate
  - Reduces hardware and power requirement

Shadow Leaping

- The lagging shadow processes can benefit from the faster execution of the main processes
- Sync states from the main processes to the shadows

World’s #1 Open Science Supercomputer

Flagship accelerated computing system | 200-cabinet Cray XK7 supercomputer
18,688 nodes (AMD 16-core Opteron + NVIDIA Tesla K20 GPU)
CPUs/GPUs working together – GPU accelerates | 20+ Petaflops

The Fault Tolerance Spectrum

- Enables trade-off between time and space redundancy
- Fault Tolerance
  - Roll-back
  - Leaping Shadows
  - Replication

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