# Targeting performance isolation in an experimental testbed

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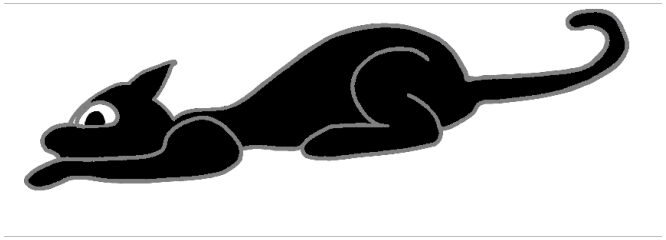


# Workload Interference

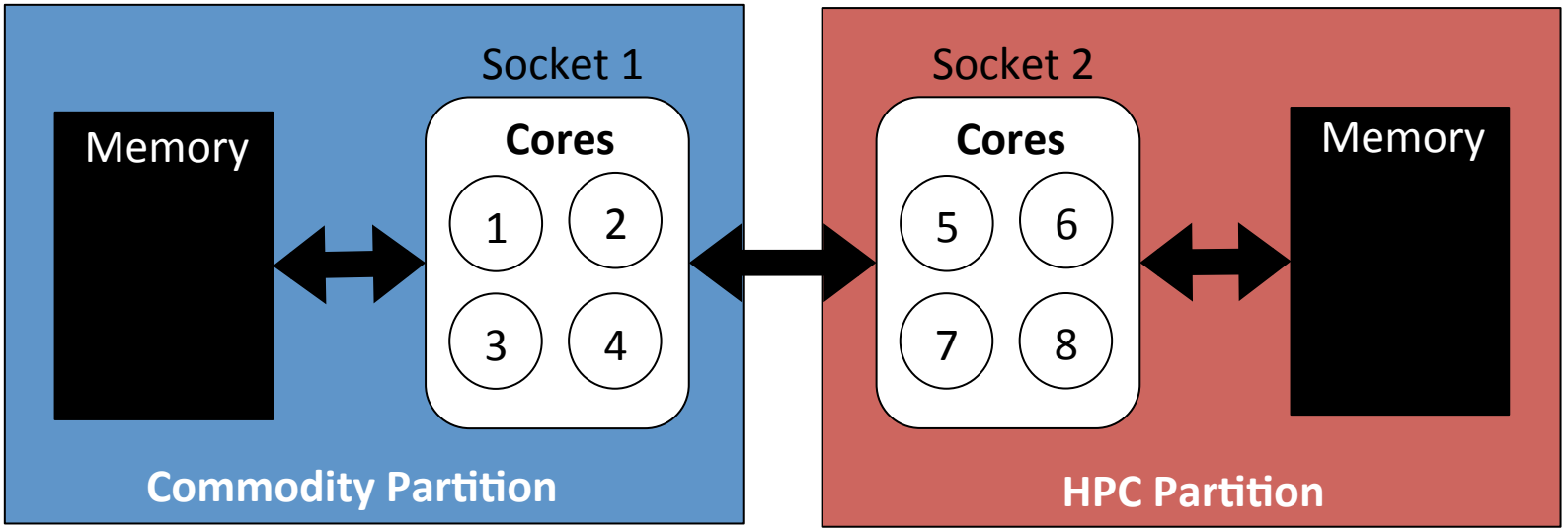
- Cross workload interference is now recognized as a problem for consolidated cloud environments

- There are currently two approaches to address it
  - Modify application behaviors to be resilient to interference effects
    - E.g. Google ("The Tail at Scale" in CACM)
  - Use hardware isolation to prevent workloads from interfering
    - E.g. Amazon EC2 - Space sharing of workloads

- Our work focuses on providing isolation at both the hardware *and System Software* layers

# Hardware Partitioning

- Current approaches emphasize hardware space sharing




- Current systems do support this, but…
- Interference still exists inside the system software
  - Inherent feature of commodity systems

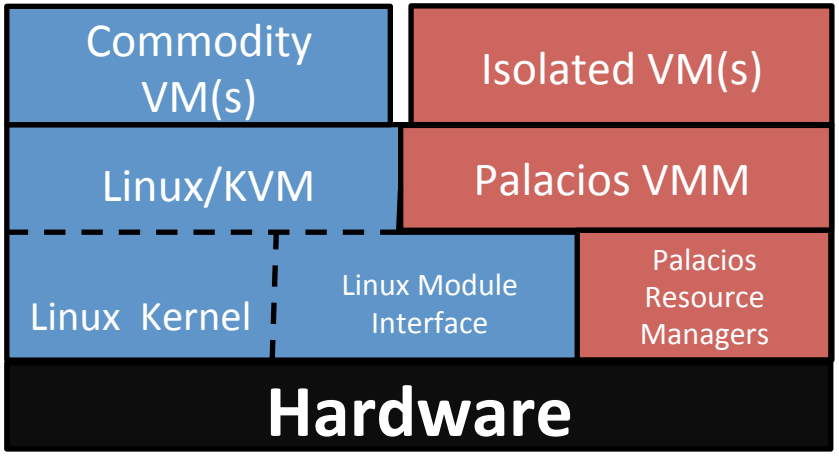
# Multi-stack Approach

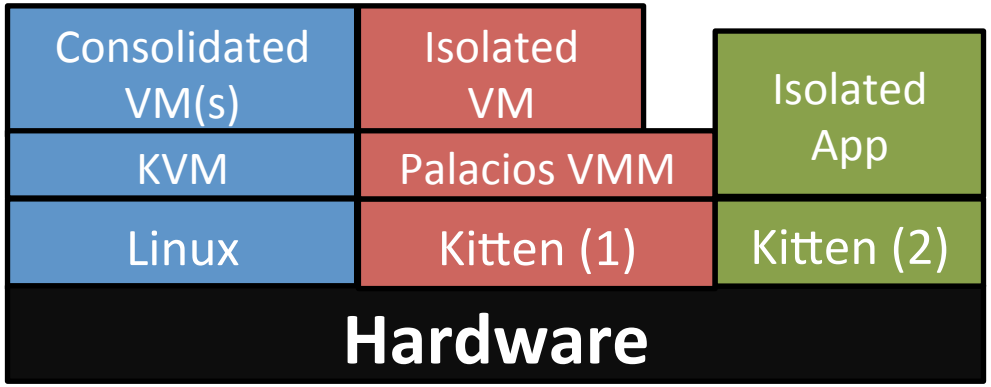
- Dynamic Resource Partitions
  - Runtime segmentation of underlying hardware resources
  - Assigned to specific workloads
- Dynamic Software Isolation
  - Prevent interference from other workloads
  - Execute on separate system software stacks
  - Remove cross stack dependencies

- Implementation
  - Independent system software running on isolated resources

# Multi-stack Architecture

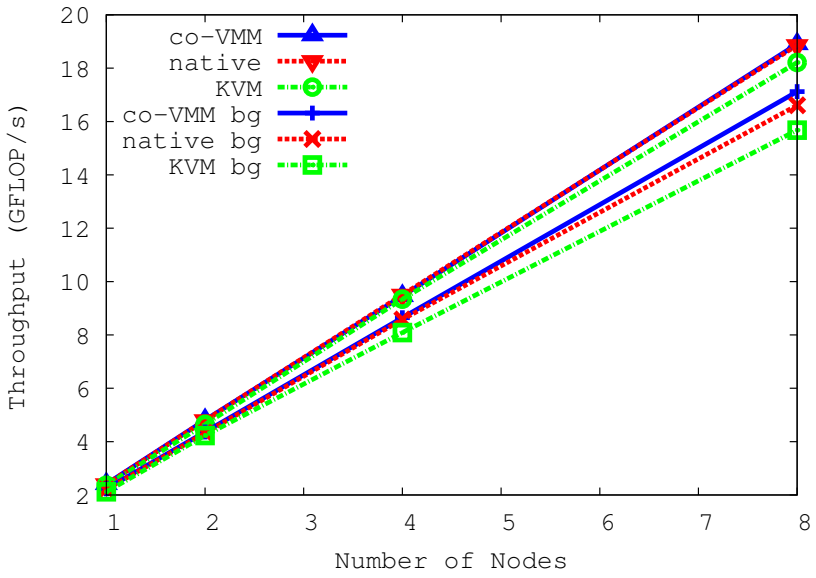
- Allow multiple dynamically created enclaves
  - Based on runtime isolation requirements
  - Provides flexibility of fully independent OS/Rs
    - Isolated Performance and resource management



# Isolation Experiments

- Goal: Measure isolation capabilities of multi-stack system software
  - Measure application performance at scale with/without co-located workloads




**HPCG Benchmark Performance**

- Smallish scale evaluation of Co-VMM architecture
  - Native performance without background workloads
  - Better performance with background workloads as node count increases

# Testbed Requirements

- Experiments at scale
  - Evaluation of isolation approaches requires large scale experiments of custom system software
  - We need to run and measure our own OS/runtime directly on hardware at scale
- Experimental Workloads
  - Workloads exhibit varying behaviors and sensitivities to interference
  - We need access to a collection of realistic workloads to measure and study their behaviors

# Experiments at scale

- Requirements
  - Ability to run custom kernel images
  - Root/sudo access capabilities to insert custom kernel modules and configure system software
  - Hardware support for partitioning
    - SR-IOV capable PCI devices, multi socket/NUMA systems, IOMMUs, etc…

# Experimental Workloads

- Requirements
  - Ability to gather low level performance measurements to identify interference problems
    - At both the hardware and software layers
    - Hardware perf counters, Linux tracepoints, etc
- Preferences
  - Ability to instrument and gather performance measurements in a centralized manner
  - Library of public workloads gathered from actual system users
    - Preconfigured real world benchmarks