

# PCLive: Pipelined Restoration of Application Containers for Reduced Service Downtime

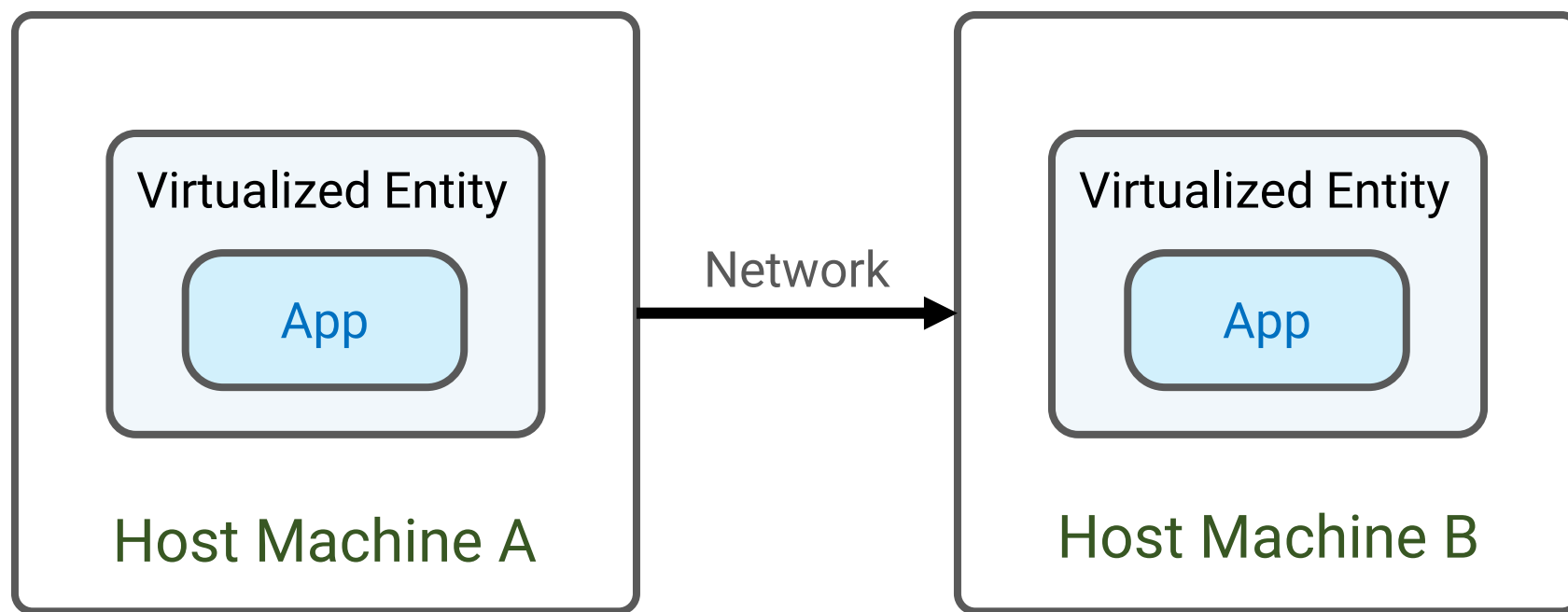
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SCAN ME

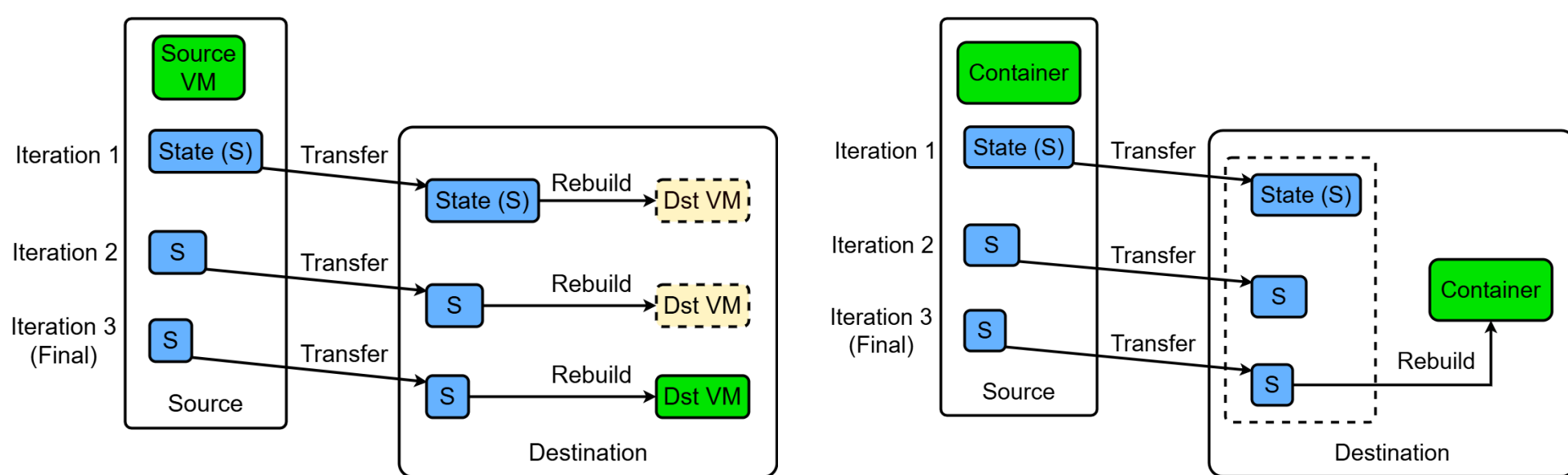
Goal: To reduce service downtime of an application container during live migration.

## Live Migration



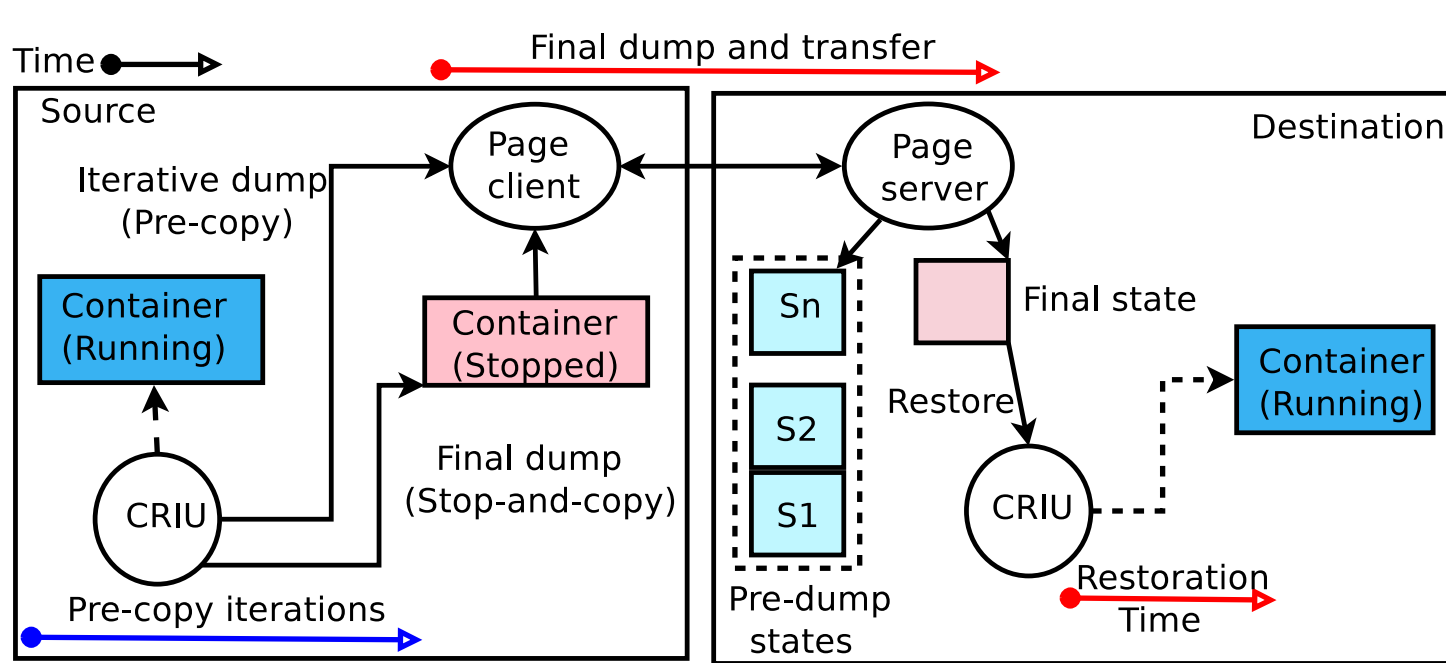
- Usage: Load balancing, system maintenance etc.
- Service downtime is crucial for liveliness of applications.
- Iterative pre-copy is a robust technique to reduce downtime.

## Container Migration: What's the Big Deal

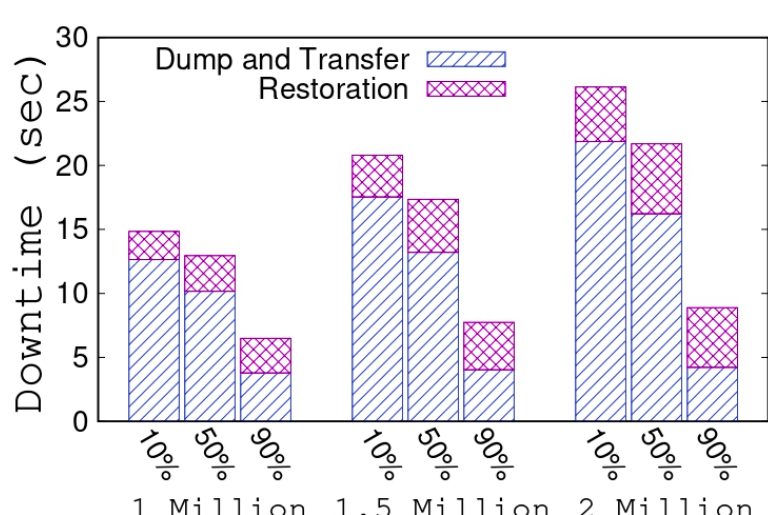


- For VM migration, downtime depends dirty rate.
- For container migration, downtime is dependent on both container size and dirty rate.
- State of VM vs State of container.
- Rebuilding is simpler for VM.

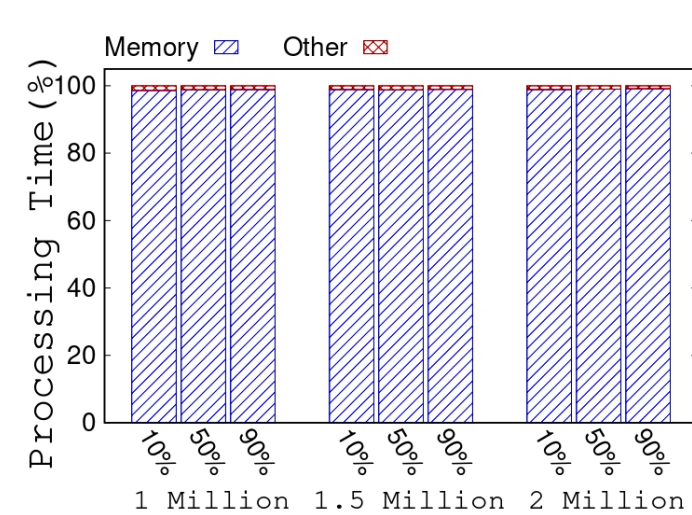
## One shot restore (CRIU)



CRIU One Shot Restore inflates Downtime. Memory state rebuilding dominates the restoration time.

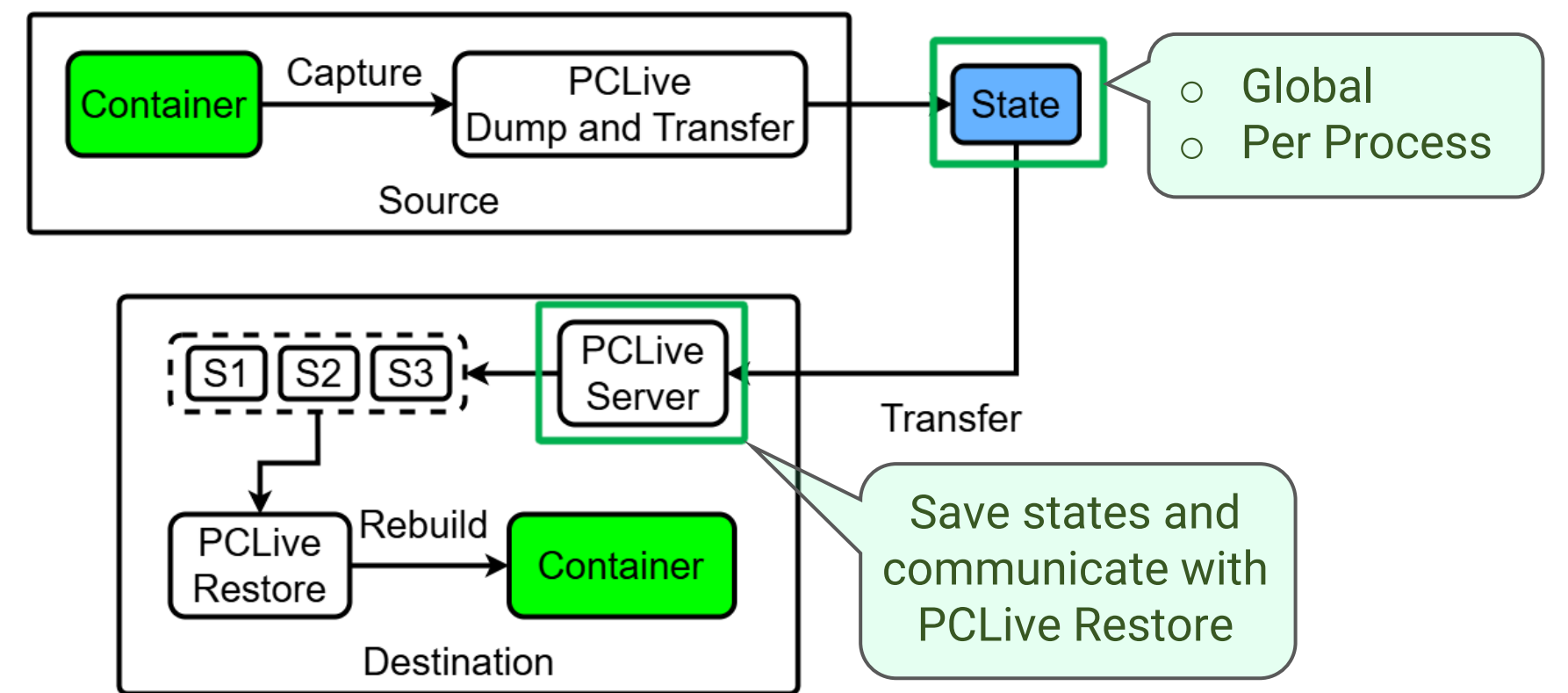


Split Cost of Downtime



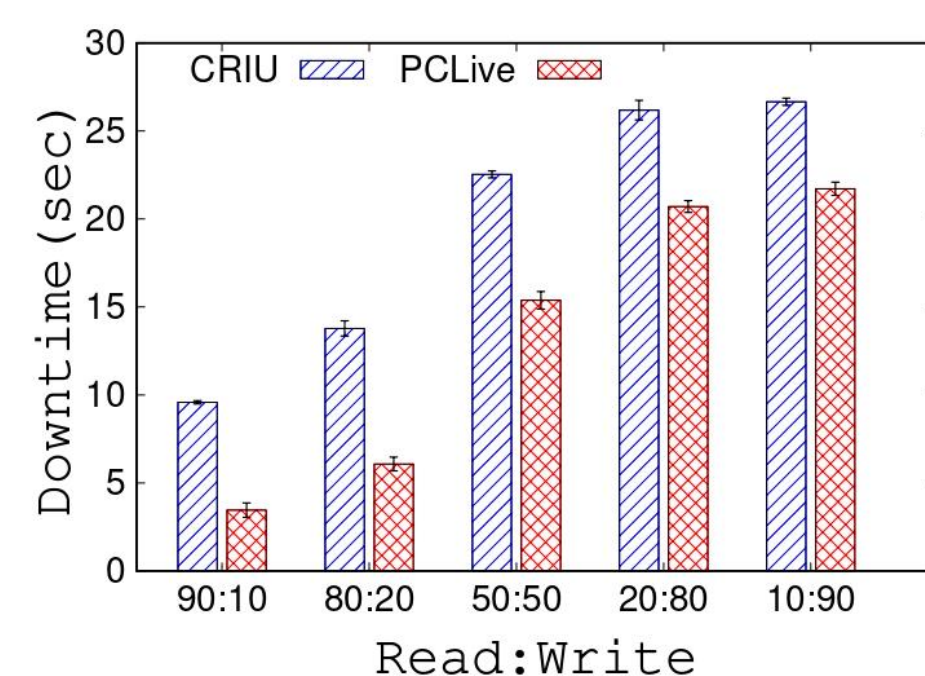
Split Cost of Restore Time

## PCLive

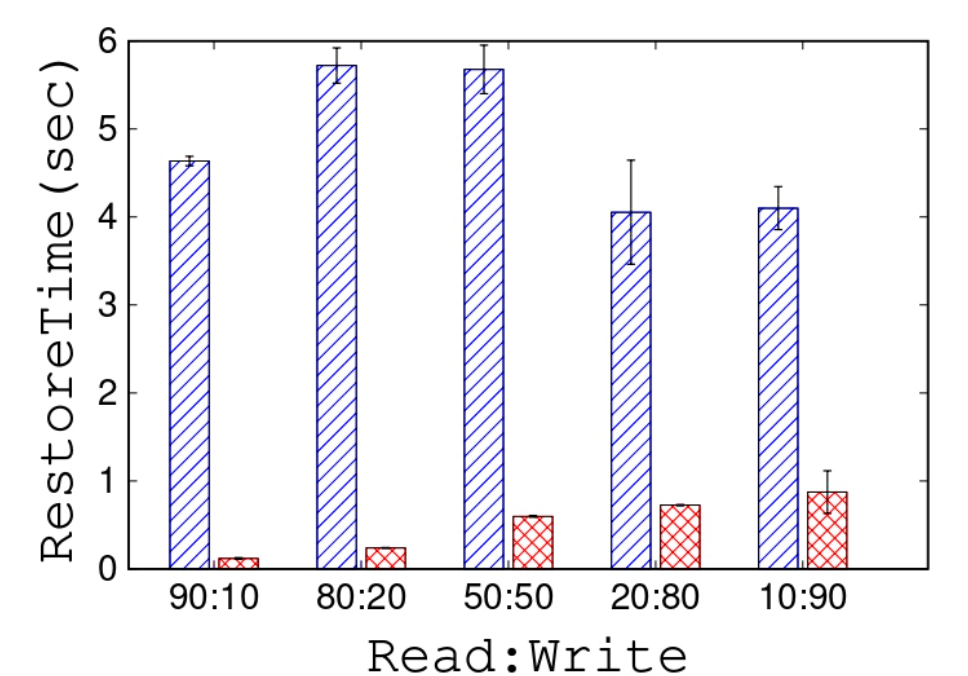


- Transfer only memory state and its dependencies from source and apply this in iteration at destination
- 2 variants depending upon state granularity: PCLive, PCLiveG
- Restoration can start after any iteration

## Experimental Results

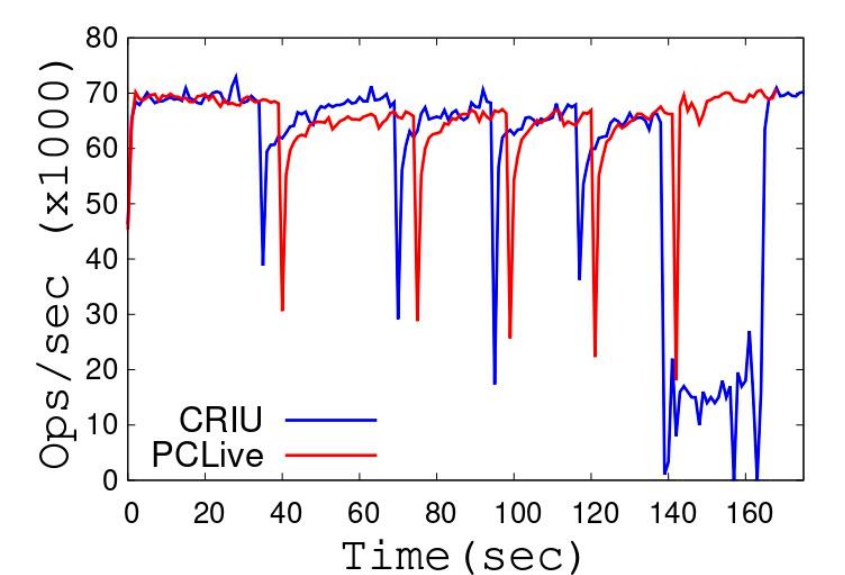


Downtime



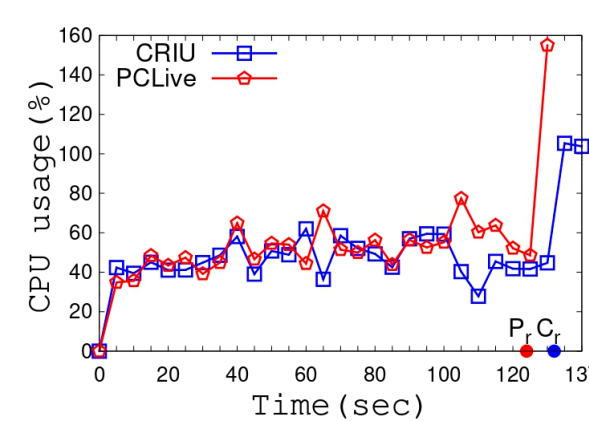
Restore Time

Reduction in restoration time for read intensive Redis workload (90:10) is more than 38x while for write intensive workload (10:90), it is 5.4x.

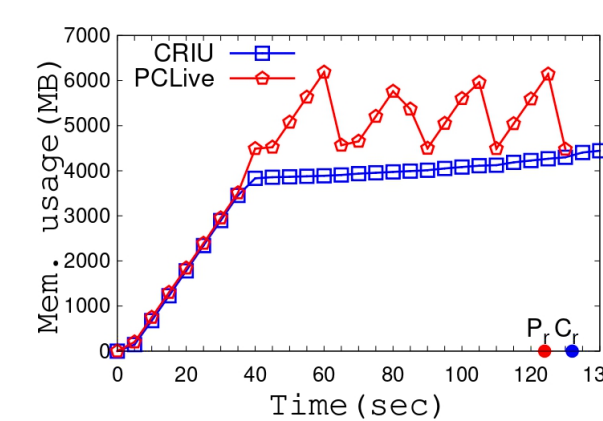


Throughput

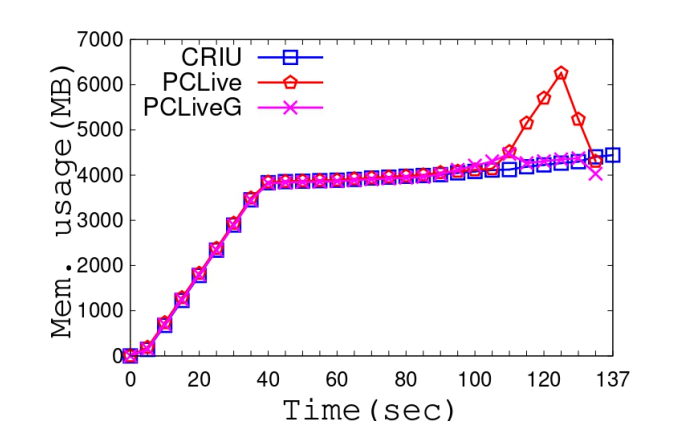
Reduction in service downtime 2.7x for read intensive workload 18% for write intensive workload.



CPU Utilization



Memory Utilization



Optimized Memory Utilization

PCLive: CPU usage 4% more; Memory usage 23% more.  
PCLiveG: CPU usage more (13.5% - 21.8%).  
Delayed Restoration: Memory usage 5% more.

## Summary

- PCLive reduces restoration time by up to 38.8x.
- PCLive reduces downtime by up to 2.7x.
- PCLive introduced Delayed Restoration and PCLiveG to manage CPU and memory overhead.