Virtual Machine Snapshot Improvements
Timekeeping

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bhyve – VM Snapshot

Virtual Machine
- CPU
- Memory
- Devices

Disk Files

Virtual Machine
- CPU
- Memory
- Devices
Timekeeping issues - Linux

```
a@test-server:~$ while sleep 1; do date; done
Thu Jan 17 20:35:29 UTC 2019
Thu Jan 17 20:35:30 UTC 2019
Thu Jan 17 20:35:31 UTC 2019
Thu Jan 17 20:35:32 UTC 2019
```
Timekeeping issues - Windows
• Used by OS for periodic tasks

shell# sleep $N

https://en.wikipedia.org/wiki/Timer
LAPIC Virtualization - Snapshot

- Save Current Count Register
- Reprogram callouts at reset time
HPET Virtualization - Snapshot

• Save the value of the counter

• Add offset to the current value of the counter
Clocksource

- Used by the OS to measure time
- Monotonic counter
Time Stamp Counter

• Per-CPU register

• Incremented at CPU core frequency

• Incremented at a static rate
• Shared with host

• Intel/AMD CPUs have a TSC Offset register

• TSC\_guest = TSC\_system + TSC\_offset
Timekeeping Virtualization - Results

- VM does not freeze or complain about time
Special Thanks

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- Marcelo Araujo
Online Resources

https://github.com/FreeBSD-UPB/freebsd/
- projects/bhyve_snapshot branch

https://reviews.freebsd.org/D19495