Paratrick

Reducing Timer Overhead in Virtual Machines

Stijn Schildermans
Kris Aerts
Jianchen Shan
Xiaoning Ding

ICPP 2021
9-12 August 2021
Online

stijn.schildermans@kuleuven.be
kris.aerts@kuleuven.be
jianchen.shan@hofstra.edu
xiaoning.ding@njit.edu
Introduction & Background

Paratick: Reducing Timer Overhead in Virtual Machines
Stijn Schildermans et. al.
stijn.schildermans@kuleuven.be
ICPP 2021
Timekeeping

```
jiffies++;  
do_tick();
```

```
t_exp = T_JIFF
```

```
softirq(t_exp / T_JIFF)
```

Introduction & Background - Motivation - Concept & Implementation - Evaluation - Conclusion
Periodic Tick

- tick_interrupt
  - do_tick
  - reprogam tick
  - return
Motivation
Virtualizing the Scheduler Tick

Paratick: Reducing Timer Overhead in Virtual Machines
Stijn Schildermans et. al.
stijn.schildermans@kuleuven.be
ICPP 2021
Periodic Tick

- Introduction & Background
- Motivation
- Concept & Implementation
- Evaluation
- Conclusion
Tickless Kernels

Introduction & Background - Motivation - Concept & Implementation - Evaluation - Conclusion
Concept & Implementation
Virtual Scheduler Ticks & Paratick

Paratick: Reducing Timer Overhead in Virtual Machines
Stijn Schildermans et. al.
stijn.schildermans@kuleuven.be
ICPP 2021
Virtual Scheduler Ticks

⇒ Paravirtualize scheduler tick
- Guest request ticks at certain frequency
- Host injects ticks periodically
Paratick -- Host

1. **Introduction & Background**
2. **Motivation**
3. **Concept & Implementation**
4. **Evaluation**
5. **Conclusion**
Paratick -- Guest

Introduction & Background - Motivation - Concept & Implementation - Evaluation - Conclusion
Evaluation

Paratick: Reducing Timer Overhead in Virtual Machines
Stijn Schildermans et. al.
stijn.schildermans@kuleuven.be
ICPP 2021
## Evaluation

### Paratick performance relative to tickless kernel

<table>
<thead>
<tr>
<th>Workload</th>
<th>VM exits</th>
<th>Throughput</th>
<th>Execution time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequential</td>
<td>-50%</td>
<td>+7%</td>
<td>-2%</td>
</tr>
<tr>
<td>Multithreaded</td>
<td>-44%</td>
<td>+14%</td>
<td>-2%</td>
</tr>
<tr>
<td>I/O</td>
<td>-34%</td>
<td>+20%</td>
<td>-18%</td>
</tr>
</tbody>
</table>
Conclusion

Paratick: Reducing Timer Overhead in Virtual Machines
Stijn Schildermans et. al.
stijn.schildermans@kuleuven.be
ICPP 2021
Conclusion

Timekeeping in virtual machines

• Periodic ticks
  • Idle
  • Overcommitted
• Tickless kernels
  • Blocking synchronization
  • I/O

⇒ Virtual scheduler ticks (== Paravirtualizing the scheduler tick)

• VM exits
• Throughput
• Execution time