Unikernel Linux


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Problem:
General Purpose Operating Systems (GPOS) have high overhead for modern application deployments, but unikernels require significant developer effort and sacrifice common admin tools.

Solution:
Unikernel Linux (UKL) offers a configuration spectrum between GPOSs and traditional Unikernels. Starting by linking a privileged application with the kernel, then exploring optimizations enabled by this linkage.

Architecture:
UKL differs from a unikernel by maintaining the process abstraction and allowing a standard user space to coexist with the linked application.

Implementation:
- Base UKL is implemented in ~500 lines of code and being prepared for submission to the upstream Linux kernel.
- Full list of currently supported optimizations is ~1k lines of code.
- Each optimization is independently configurable, allowing developers to trade between GPOS compatibility and unikernel performance in discreet steps.

Performance:
Micro-benchmarks demonstrate savings on system calls.

Application Performance:

Using the ability to call directly into the kernel internals, gives an 8% improvement in queries per second under the 500us SLA.

Memcached

<table>
<thead>
<tr>
<th>System</th>
<th>99% tail (ms)</th>
<th>Tail improv. (%)</th>
<th>Throughput (Kb/s)</th>
<th>T-put improv. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linux</td>
<td>3.26</td>
<td>--</td>
<td>6375.20</td>
<td>--</td>
</tr>
<tr>
<td>UKL_BYP</td>
<td>2.91</td>
<td>11%</td>
<td>7154.68</td>
<td>12%</td>
</tr>
<tr>
<td>UKL_BYP w/Shortcut</td>
<td>2.54</td>
<td>22%</td>
<td>8022.54</td>
<td>26%</td>
</tr>
</tbody>
</table>

Redis

Redis saw good improvements with no code modifications (11% in tail latency, 12% in throughput). However, making redis interact with the TCP stack directly, tail latency improved by 22% and throughput by 26%.

Results:
- Performance improves with base UKL for most applications
- Significant improvements come with using optimization techniques that require more developer effort.
- It’s “just Linux” so tools like ftrace, top, and perf still work!

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Visit our project site at https://github.com/unikernelLinux/ukl
Or with the QR code