XOS: An Application Defined Operating System in User-space designed for Datacenter

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Motivation
Enhance OS performance utilizing virtualization hardware.

Key issue of monolithic kernel (Linux):
1. Applications cannot touch hardware,
2. Resource competitions,
3. Poor scalability.

VT-x: breaks current CPU modes into two new modes, while allowing applications to touch privileged hardware features.

SR-IOV: multiplex a device into several virtual functions, each of which has independent space.

XOS Prototype

Goals:
1. Bypass OS kernel,
2. Reduce interference,
3. Scales well.

Design Principles:
1. Applications define their own kernel subsystem in user-space,
2. Spatial partition.

User-space application-defined OS model

The XOS Architecture

Implementation

- Built on Linux
- Leverage VT-x to control hardware in user-space,
- Application-defined XOS runtime:
  ✓ User-space memory and device management,
  ✓ User-space interrupt/exception handler (pagefault handler, etc.),
  ✓ Message-based I/O system call.

Preliminary Results

<table>
<thead>
<tr>
<th>OS</th>
<th>null syscall</th>
<th>lgdt</th>
<th>gettsc</th>
<th>malloc</th>
</tr>
</thead>
<tbody>
<tr>
<td>XOS</td>
<td>42</td>
<td>114</td>
<td>45</td>
<td>126</td>
</tr>
<tr>
<td>Linux</td>
<td>174</td>
<td>N/A</td>
<td>45</td>
<td>312</td>
</tr>
</tbody>
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