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Virtual Shared/Distributed Virtual Memory

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Thus this is also called *distributed virtual memory* and *distributed shared memory*
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The programmer writes “x = y” and the compiler/OS converts this into a shared memory access or a message call as appropriate.
Unfortunately, programmers do have to care as the speed of a program will be very hard to predict or control, depending on how data is distributed across memory.
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This would strongly affect how we would employ variables in a program.
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Compare with “how fast is $x = y$?” in VSM.
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- in the Operating System, such as *Mosix*. This means all standard system libraries and user code can be used unchanged and a cluster looks like a single big machine
- by the programming language and libraries, such as Cluster OpenMP or Unified Parallel C (see later), so the language may need a bit of learning
VSM is currently fairly rare in practice, though as NUMA techniques improve, people are starting to talk about *shared memory clusters* as being a viable and useful way to proceed.
Latency numbers every programmer should know

<table>
<thead>
<tr>
<th>Operation</th>
<th>Time (ns)</th>
<th>Time (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 Cache hit</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Mutex lock/unlock</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Main memory access</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Read 1MB from memory</td>
<td>250,000</td>
<td>2.9</td>
</tr>
<tr>
<td>Round trip within datacentre</td>
<td>500,000</td>
<td>5.8</td>
</tr>
<tr>
<td>Read 1MB from disk</td>
<td>30,000,000</td>
<td>1</td>
</tr>
<tr>
<td>Send a packet California →</td>
<td>150,000,000</td>
<td>4.8</td>
</tr>
<tr>
<td>Netherlands → California</td>
<td></td>
<td>two round trips</td>
</tr>
</tbody>
</table>

https://gist.github.com/hellerbarde/2843375