Multicore OSes

Looking Forward from 1991, er, 2011

David A. Holland, Margo I. Seltzer

{*dholland, margo*}*@eecs.harvard.edu*

May 11, 2011

The Scenario

- Physical limits have been reached.
- Hardware isn’t getting faster any more.
- To go faster we’re going to have to run in parallel.

The Scenario

- Physical limits have been reached.
- Hardware isn't getting faster any more.
- To go faster we're going to have to run in parallel.

Parallel code is hard!

The Scenario

- Physical limits have been reached.
- Hardware isn't getting faster any more.
- To go faster we're going to have to run in parallel.

Parallel code is hard!

Scalable parallel code is harder!

The Scenario

- Physical limits have been reached.
- Hardware isn’t getting faster any more.
- To go faster we’re going to have to run in parallel.

Parallel code is hard!

Scalable parallel code is harder!

CRISIS!!!!!!

Meh.

Ok, it's not *quite* 1991.

From software, multiprocessor ≊ multicore.

Lessons from the past twenty years:

- Shared-memory code with locks doesn't scale.
- Hardware will end up shared-nothing.
- Programming will involve message passing.

Ok, it’s not *quite* 1991.

From software, multiprocessor $\approxeq$ multicore.

Lessons from the past twenty years:

- Shared-memory code with locks doesn’t scale.
- Hardware will end up shared-nothing.
- Programming will involve message passing.

Let’s skip the bankruptcy filings
and go straight to messages.

Lightweight messages and channels

Different programming paradigm.

Has some chance of scaling.

Not actually new:

- Communicating Sequential Processes
- pi calculus
- Erlang
- goroutines

What It Looks Like (in "C")

```
chan <- value;    /* send on channel */
value <- chan;    /* receive from channel */
```

Comparable to procedure calls.

```
choose {
  option x <- c1: foo(x); break;
  option x <- c2: bar(x); break;
}
```

Like `select()`.

```
start { baz(); }
```

Makes a new thread.

The Way Forward

We need whole systems built this way:

language...

and kernel...

and applications.

Not just one research system, either.

The Way Forward

We need whole systems built this way:

language...

and kernel...

and applications.

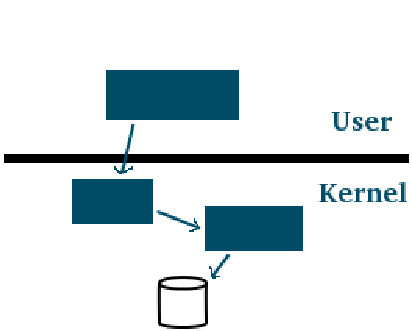
Not just one research system, either.

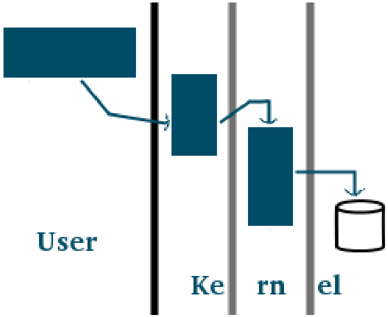
Let’s talk about kernels.

(But don’t worry; I’m not advocating Erlang.)

Channel OS Architecture

- System calls will be messages.
- This enables new OS structures.





- Also need a whole new kernel based on channels...

Foreseeable Issues...

- Implementing choice.
- Waiting for channels to become ready.
- What does virtual memory look like?
- Too much parallelism?
- Partial failure.
- Scheduling.

(and of course scaling is still hard)

Project State

→ hot air

vapourware

slideware

demoware

software

abandonware

Multicore OSes

Looking Forward from 1991, er, 2011

David A. Holland, Margo I. Seltzer

{dholland, margo}@eecs.harvard.edu