Nexus

A common substrate for cluster computing

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Google Sun microsystems

Problem

Rapid innovation in cluster computing frameworks

No single framework optimal for all applications

Running multiple frameworks in a single cluster

Solution

Nexus is a resource manager over which frameworks like Hadoop can be written

- » Nexus multiplexes resources between frameworks
- » Frameworks control job execution

Implications

Users can pick best framework for each app

Specialized frameworks, not one-size-fits-all

I only want to use Hadoop

Nexus is a better way to manage Hadoop

Hadoop master is complex,
hard to scale and make robust

Multiple Hadoop instances/versions at same time

Outline

Beyond MapReduce and Dryad

Nexus Architecture

Implementation

Philosophy

Beyond MapReduce & Dryad

1. Iterative Jobs

Many machine learning jobs are of the form:

```
p = random();
while (p not converged) {
    p = f(p, dataset);
}
```

2. Nested Parallelism

Recursion (quicksort), maps within maps

Difficult in MapReduce/Dryad, possible with NESL model

3. Irregular Parallelism

Sometimes, we don't know computation graph

- » Branch-and-bound search
- » Exploring moves in chess
- » Ray tracing

Hard to hack into MapReduce/Dryad, easy with work-stealing programming model (Cilk)

4. Existing Parallel Apps

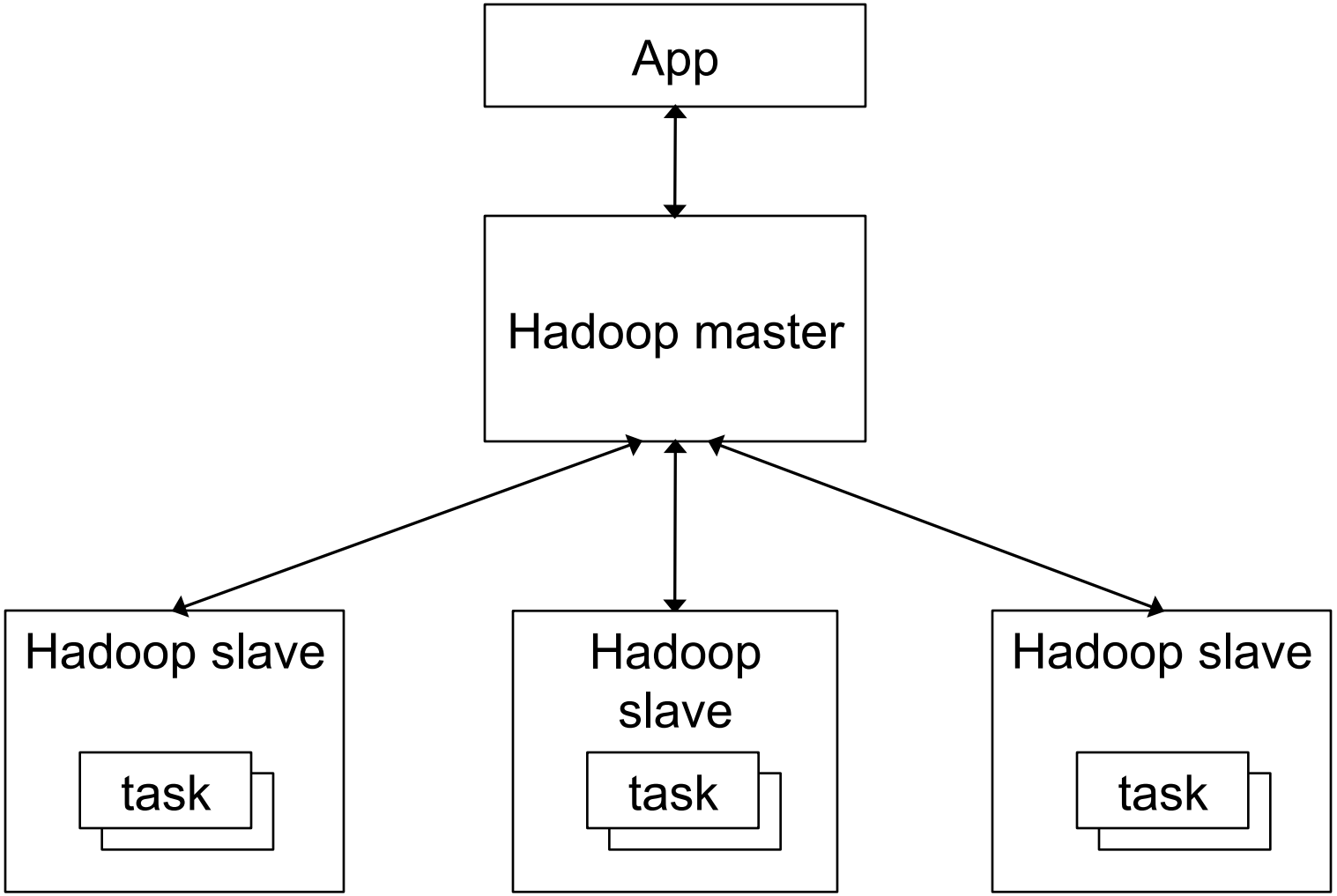
Parallel build (distcc)

Parallel unit test (Selenium Grid)

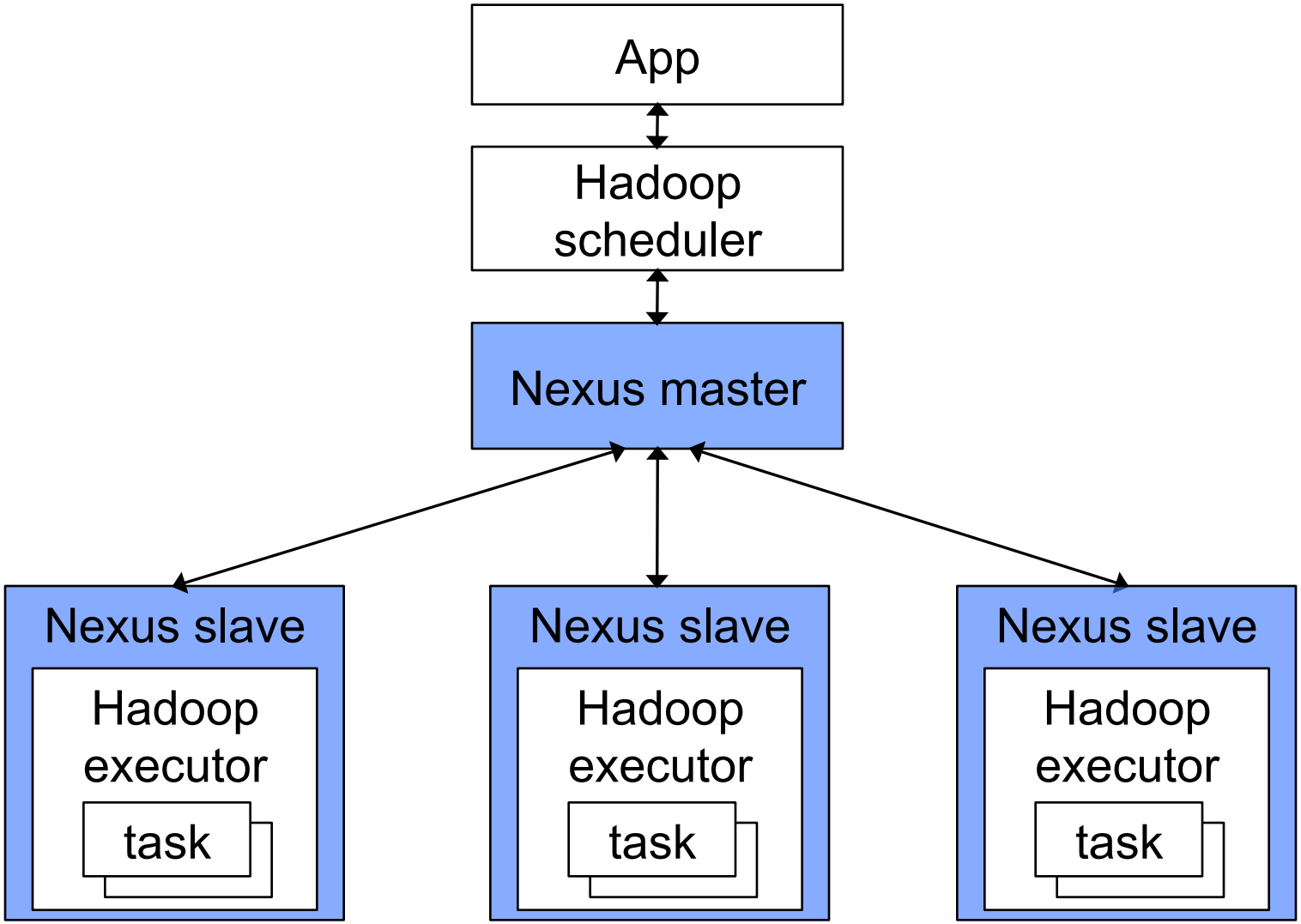
Web servers (!)

Nexus Architecture

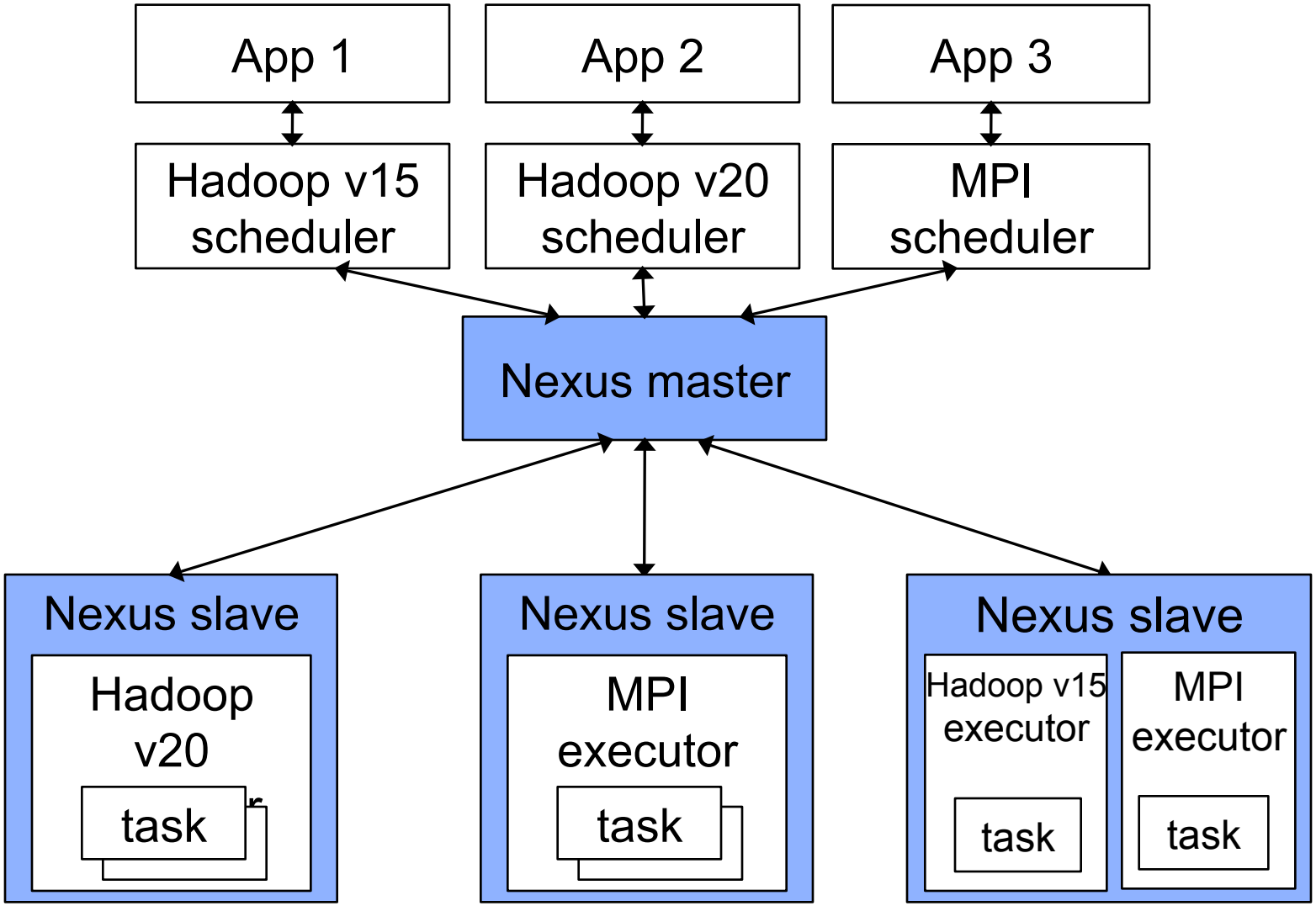
Hadoop



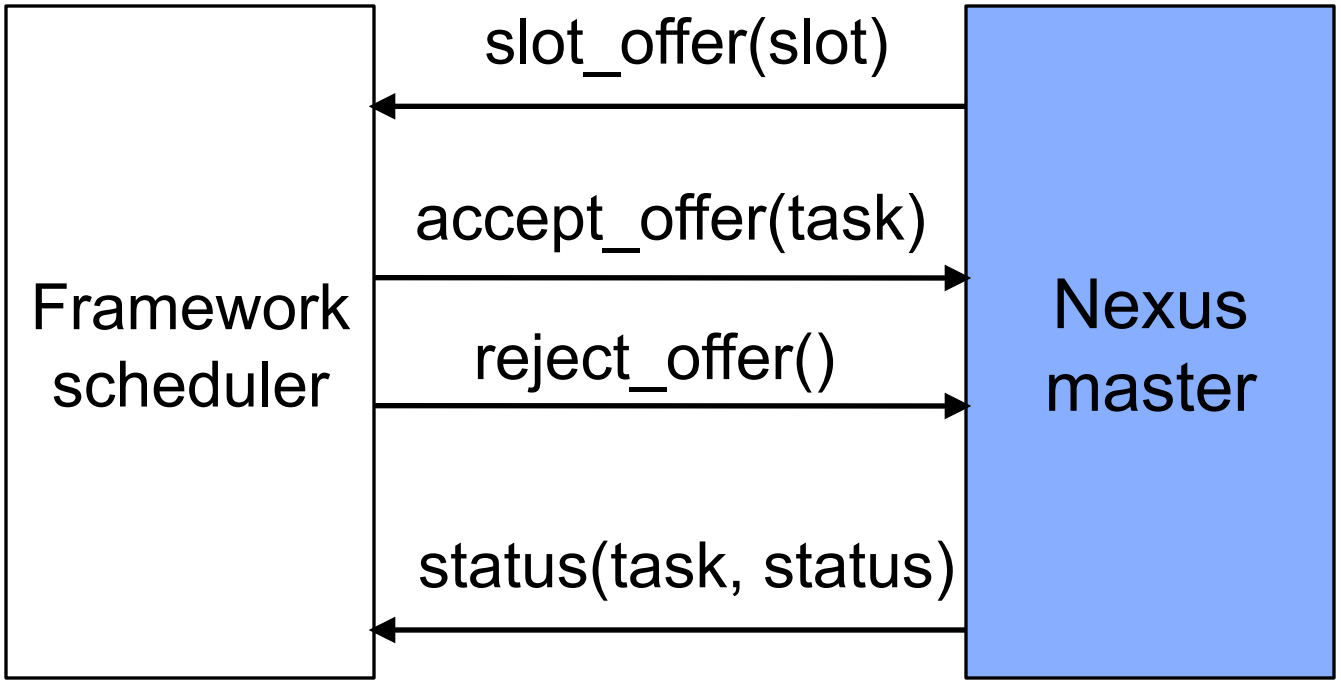
Nexus



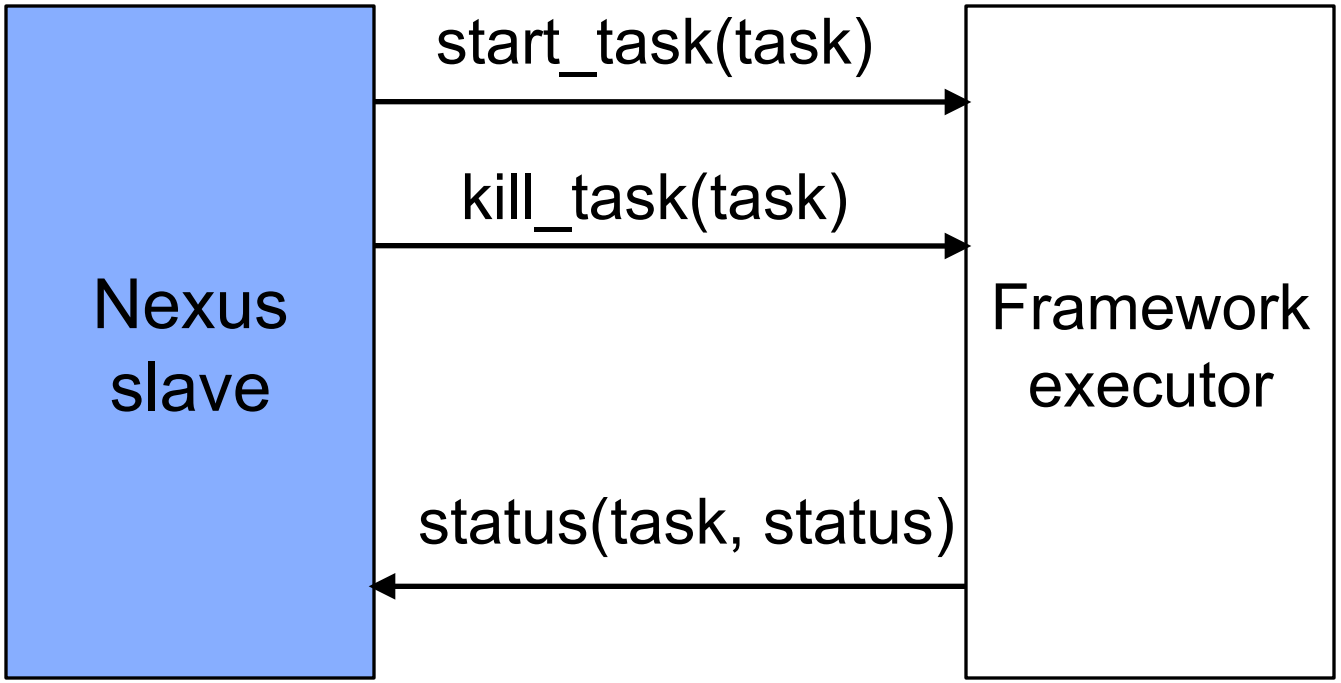
Nexus



Scheduler API



Executor API



Analysis

Frequency of slot offers

t = average task length (e.g. 60s)

r = # replicas (e.g. 3)

s = slots per node (e.g. 8)

Avg slot offer wait time = t / rs (e.g. 2.5s)

Analysis

Right of first refusal
Provides “code locality”

Grab and hold
Avg co-located slot offer wait time = t / s

Implementation

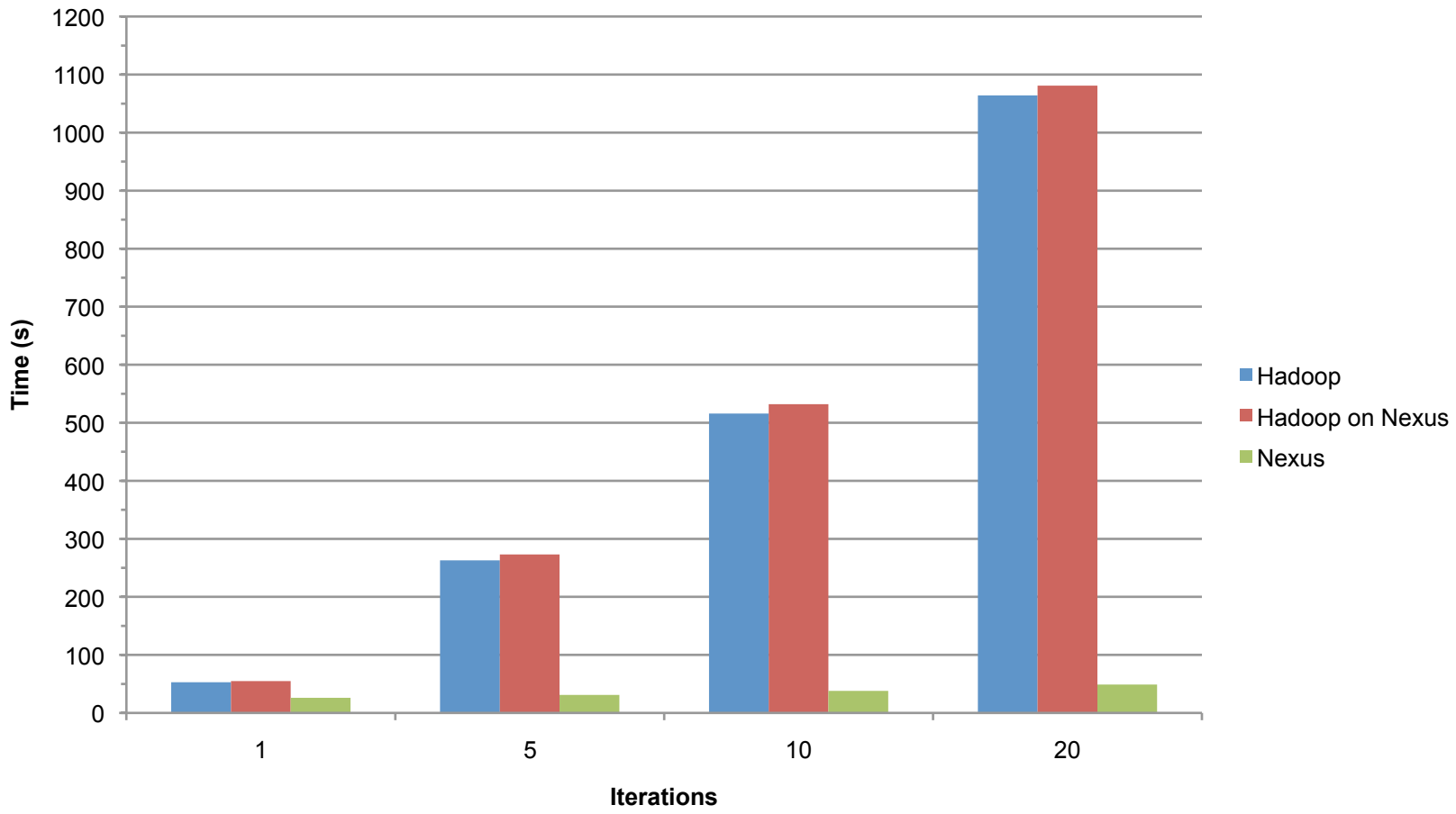
Implementation Status

Simple
2000 lines of C++

Scalable
500 slaves on EC2

Frameworks
Preliminary port of Hadoop, and specialized LR framework

LR Job Comparison



Philosophy

Microkernel

- »Make reliable component as small as possible

Exokernel

- »Give maximal control to frameworks

IP model

- »Narrow waist over which diverse frameworks can run

Questions