Building Masterless Distributed Applications

Glue Conference
May 2011

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Basho Technologies

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riak

Riak is
a scalable, highly-available, distributed
open-source key/value store.

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Riak is
a scalable, highly-available, distributed
open-source key/value store.

...but that's not what I'm here to tell you about.

Some features of Riak KV & other dynamo-style DBs:

- simple interface (get, put, delete, list, etc)
- extremely high write-availability
- linear scaling of both capacity and throughput

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Riak KV
& other dynamo-style DBs
achieve this by standing on the shoulders of:

- consistent hashing
- vector clocks
- sloppy quorums
- gossip protocols
- virtual nodes
- hinted handoff

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None of this has much to do with k/v data.

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- vector clocks
- sloppy quorums
- gossip protocols
- virtual nodes
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This is riak core.

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- vector clocks
- sloppy quorums
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Riak KV

Riak Core

Riak Search

Distribution / Scaling / Failure-Tolerance Code

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Riak Core is an

Open Source Erlang library

that helps you build

distributed, scalable, failure-tolerant

applications using a

Dynamo-style architecture.

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Distributed, scalable, failure-tolerant.

Distributed, scalable, failure-tolerant.

No central coordinator.

Easy to setup/operate.

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Distributed, scalable, failure-tolerant.

Horizontally scalable;
add commodity hardware
to get more X.

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Distributed, scalable, failure-tolerant.

Always available.

No single point of failure.

Self-healing.

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Building an Application on Riak Core? Two things to think about:

The Command Set

Command = ObjectName, Payload

The commands/requests/operations that you will send through the system.

The VNode Module

The callback module that will receive the commands.

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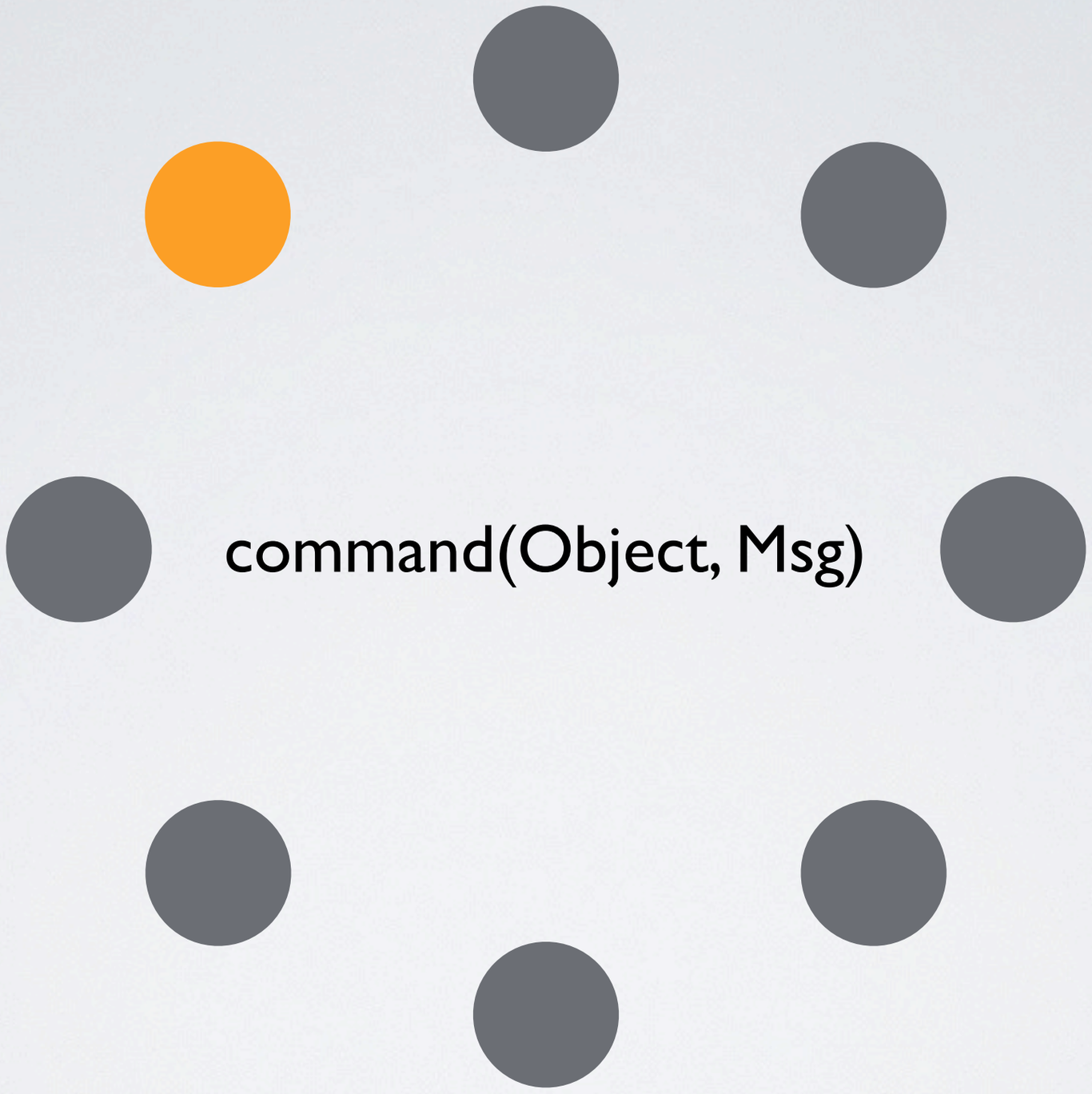

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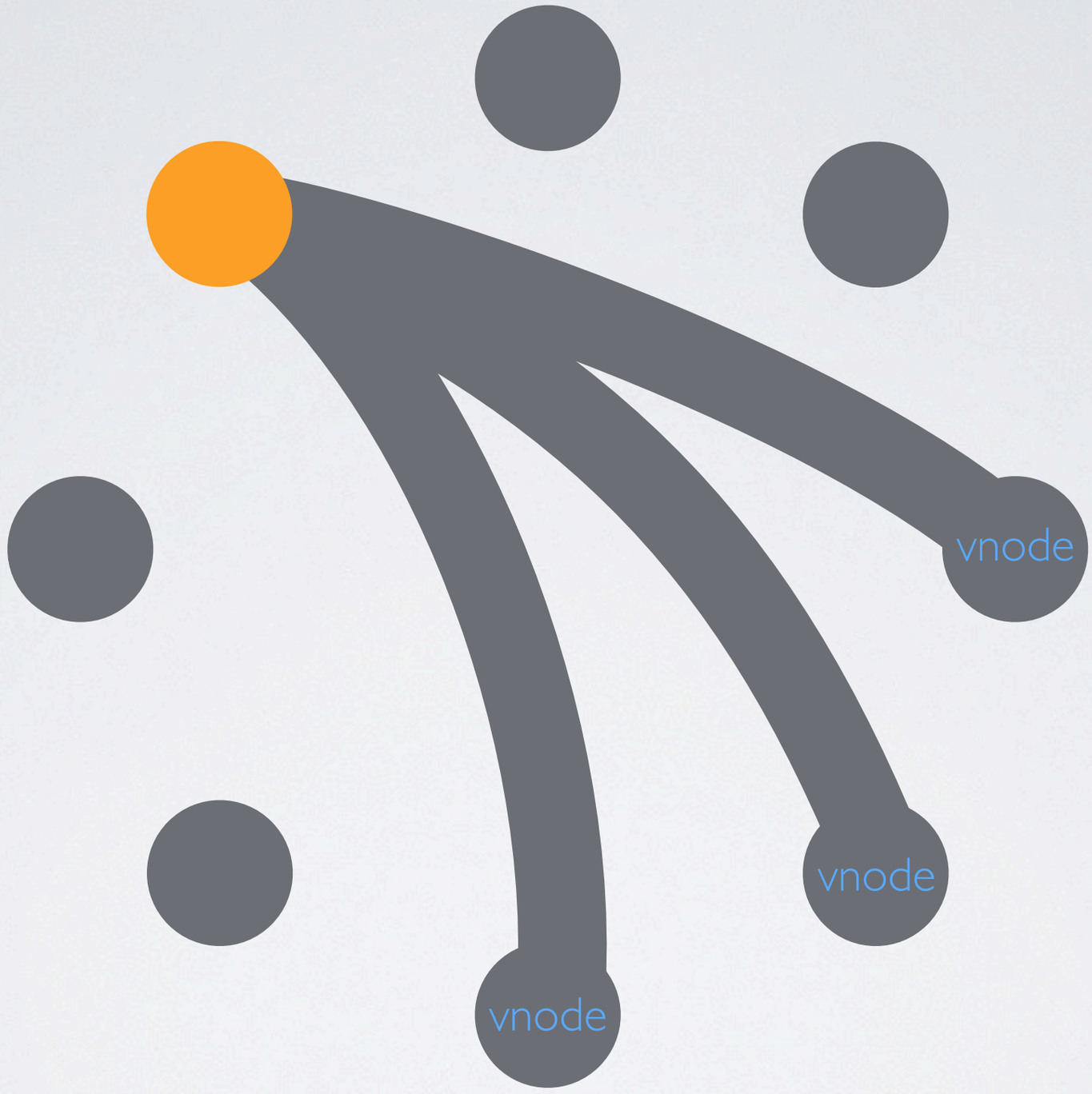

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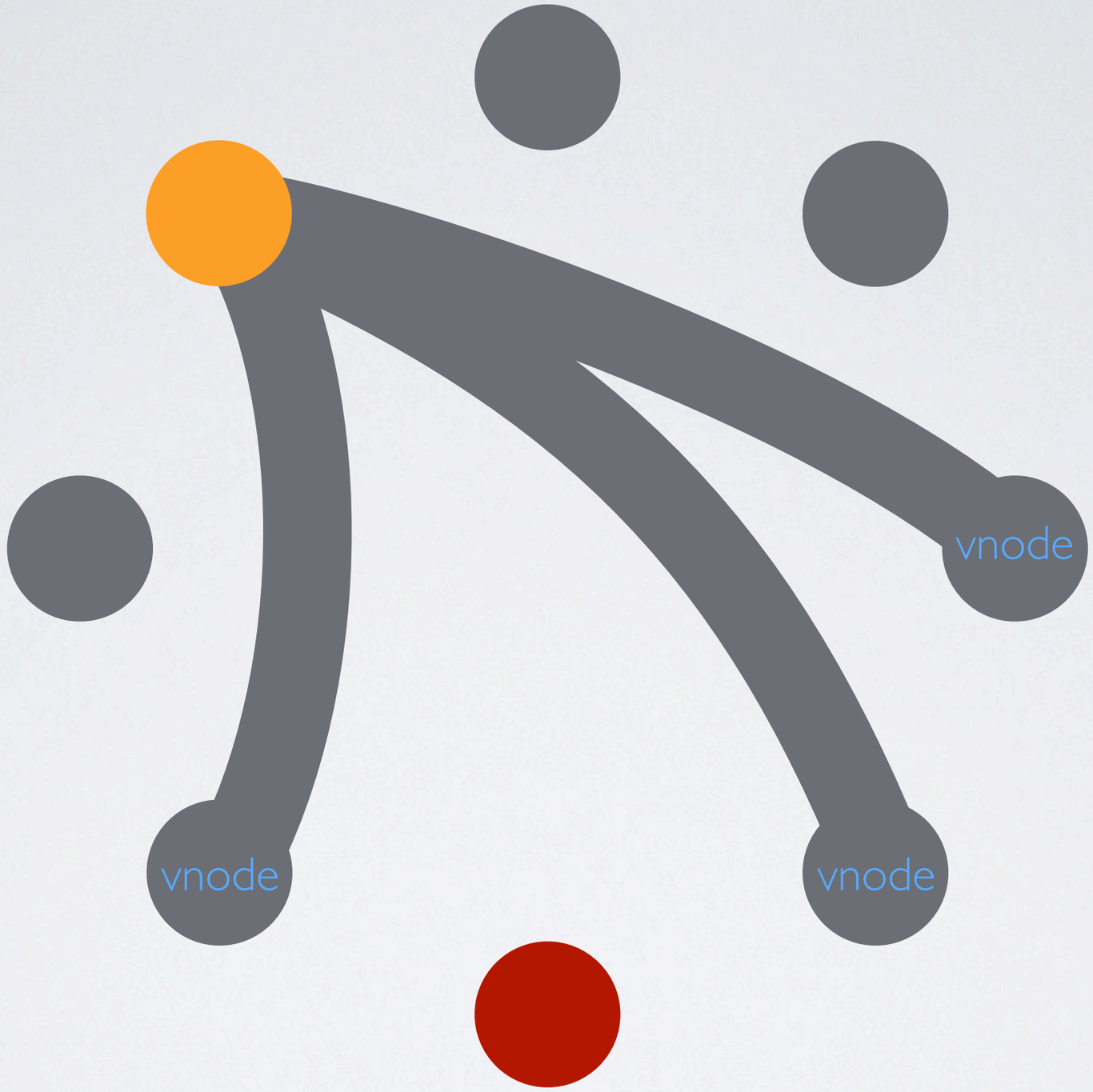

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Core Dynamo Principals

- Scalable
  - Consistent hashing
  - Virtual nodes
- Highly Available + Self Healing
  - Always writeable
  - Sloppy quorums
  - Hinted handoff
- All Nodes Equal / Masterless
  - Gossip protocol

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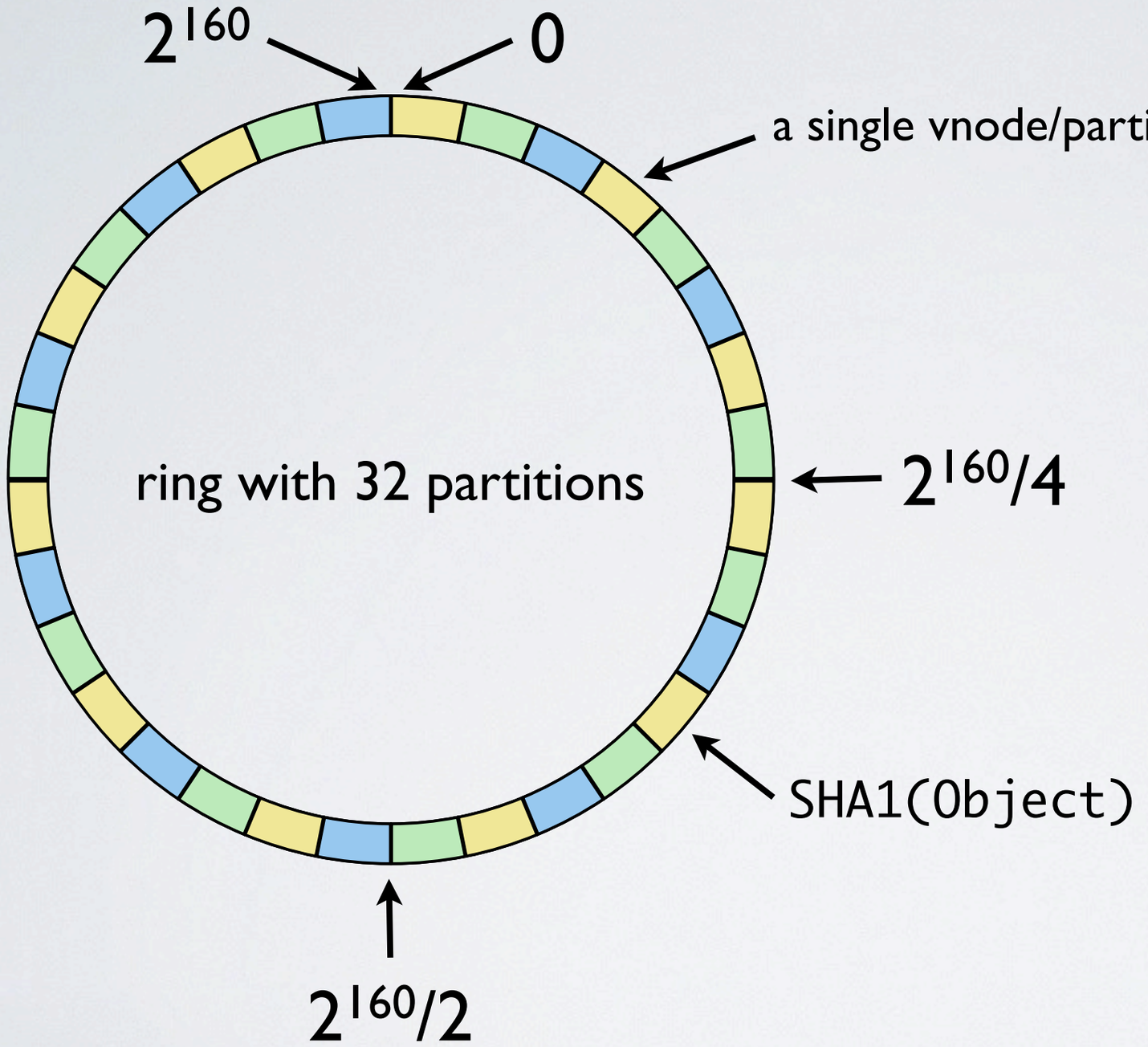
Consistent Hashing



Node 0

Node 1

Node 2

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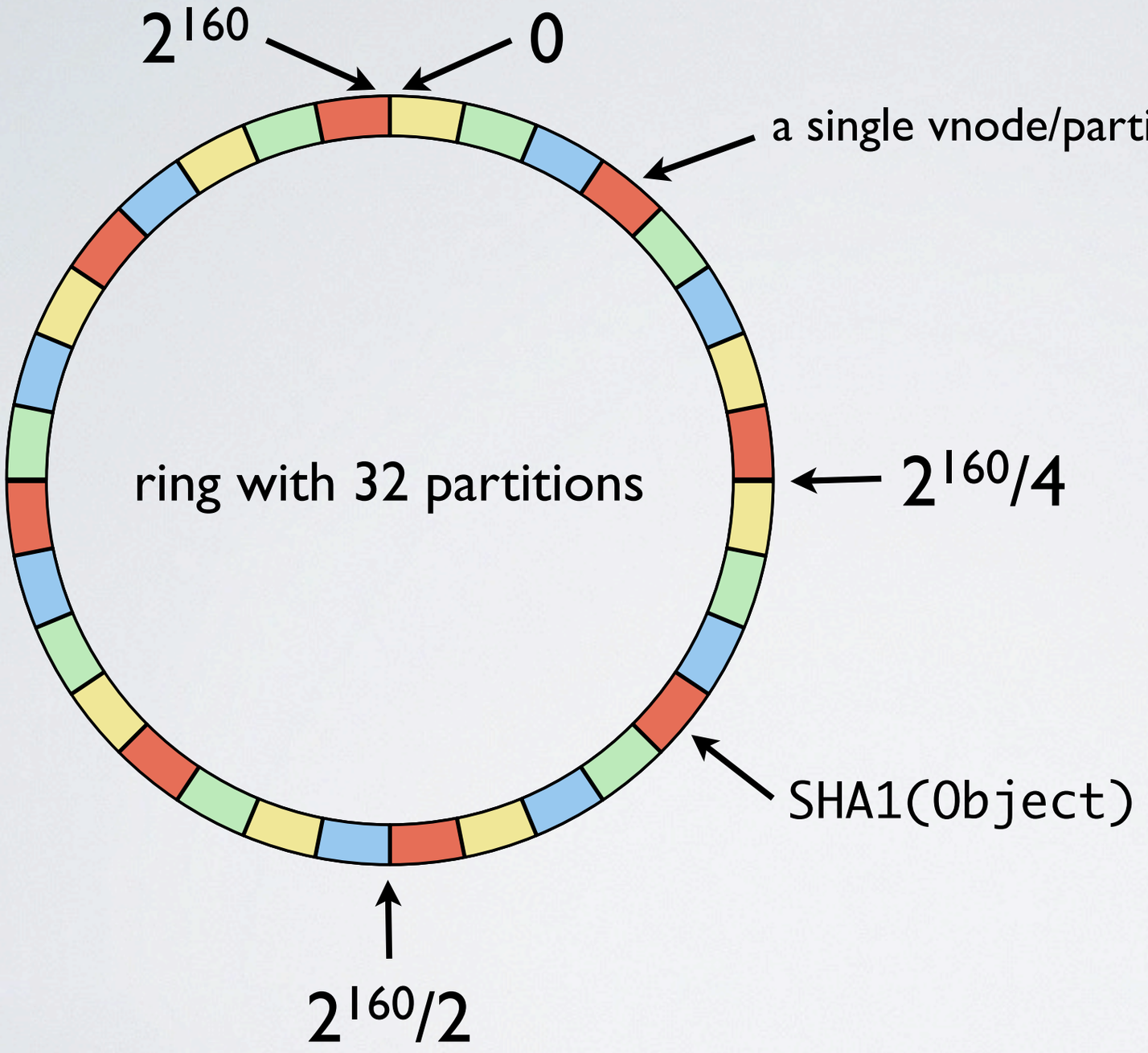
Adding a node



Node 0

Node 1

Node 2

Node 3

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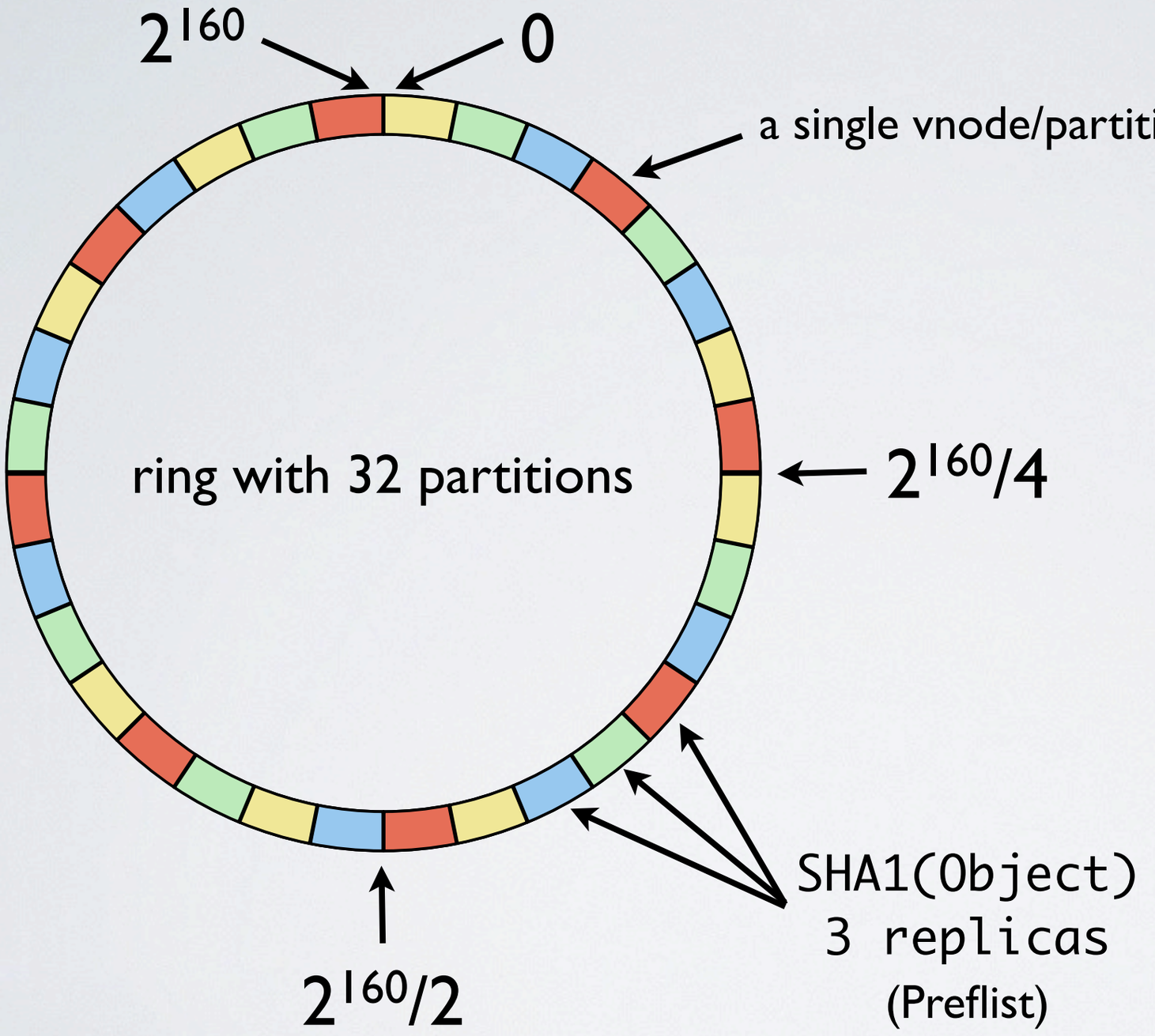
Replication



Node 0

Node 1

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Node 3

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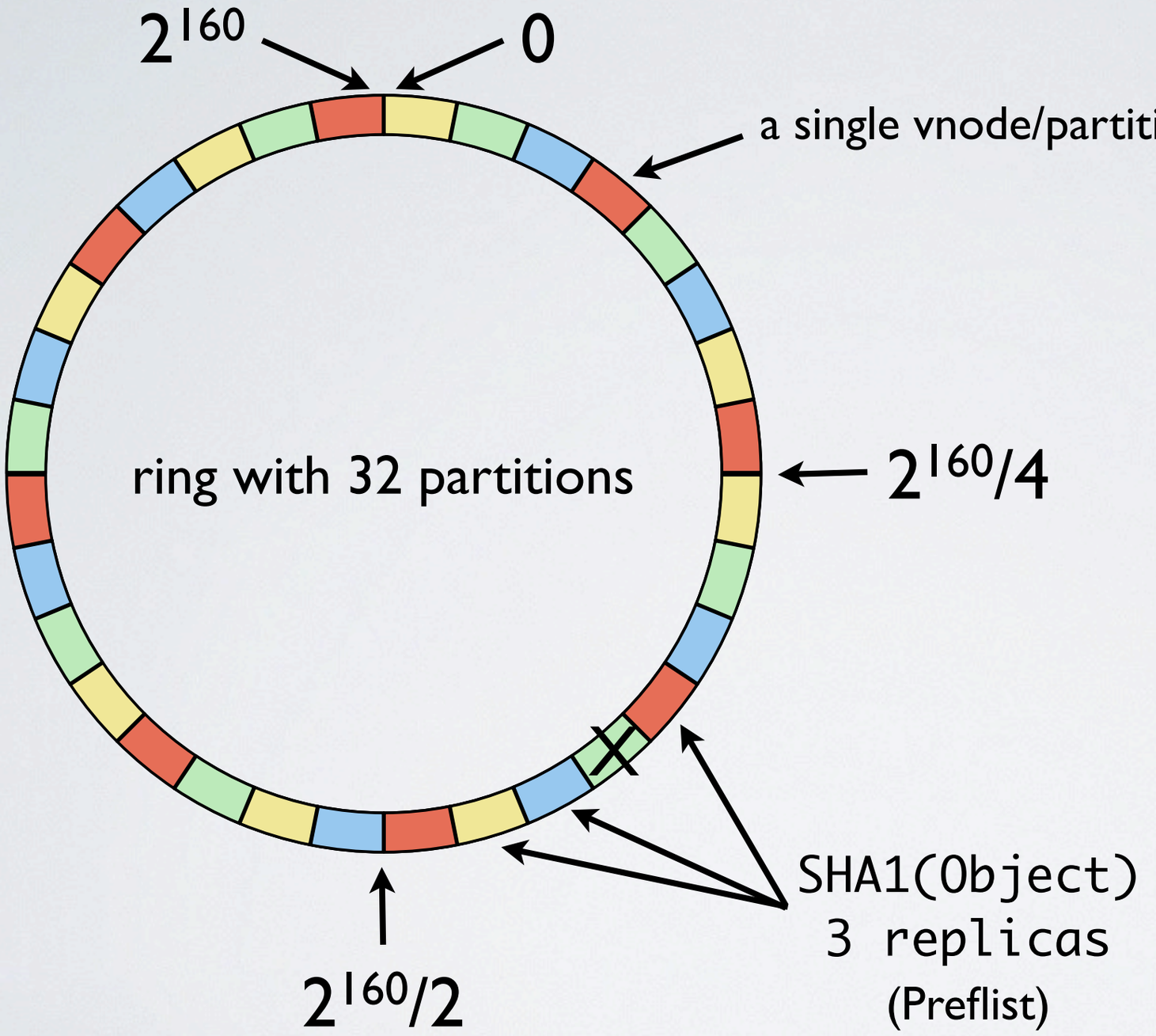
Routing around failures



Node 0

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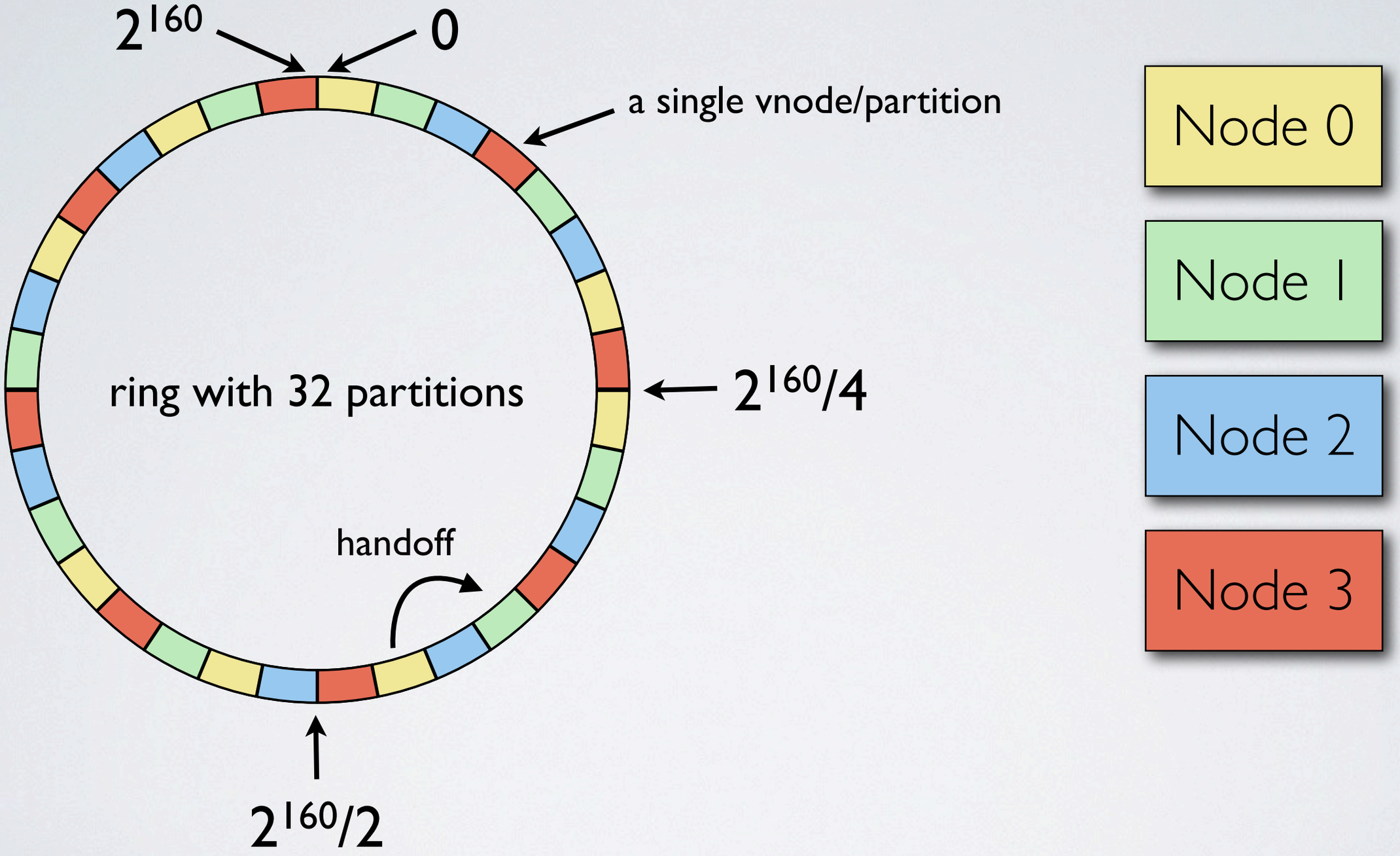
Hinted Handoff



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Let's build something!

Simple Message Server

- Send messages

  send_message(User, Msg)

- Retrieve messages

  get_messages(User)

Get Preflist, Including Fallback Nodes

```
get_preflist(User) ->
  Idx = chash:key_of(User),
  riak_core_apl:get_apl(Idx, 3, chat).
```

Public Chat Server API

```
-define(?CHAT, chat_vnode_master).

send_message(User, Msg) ->
  PL = get_preflist(User),
  Cmd = {send, User, Msg}
  riak_core_vnode_master:command(PL, Cmd, ?CHAT).

get_messages(User) ->
  PL = get_preflist(User),
  riak_core_vnode_master:sync_command(PL,
                                      {get, User},
                                      ?CHAT).
```

Chat Server VNode Module

Startup/Shutdown

```
init([Partition]) ->
  {ok, dict:new()}

terminate(State) ->
  ok
```

Chat Server VNode Module

Handle Send Commands

```
handle_command({send, User, Msg},
                    Sender, State) ->
  State2 = dict:append(User, Msg, State),
  {noreply, State2}.
```

Handle Get Commands

```
handle_command({get, User}, Sender, State) ->
  Msgs = dict:fetch(User, State),
  {reply, Msgs, State}.
```

Chat Server VNode Module

Handling Handoff

```
handle_handoff_command(?FOLD_REQ{foldfun=Fun,
                                 acc0=Acc0},
                       _Sender, State) ->
  Reply = dict:fold(Fun, Acc0, State),
  {reply, Reply, State};

handoff_starting(_Node, State) ->
  {true, State}.

handoff_cancelled(State) ->
  {ok, State}.

handoff_finished(_TargetNode, State) ->
  {ok, State}.
```

Chat Server VNode Module

```
handle_handoff_data(BinObj, State) ->
  {K, V} = binary_to_term(BinObj),
  State2 = dict:store(K, V, Logs),
  {reply, ok, State2}.

encode_handoff_item(K, V) ->
  term_to_binary({K,V}).

is_empty(State) ->
  Empty = (dict:size(Logs) == 0),
  {Empty, State}.

delete(State) ->
  {ok, dict:new()}.
```

Chat Server

- Fairly straight forward chat server

  Define commands

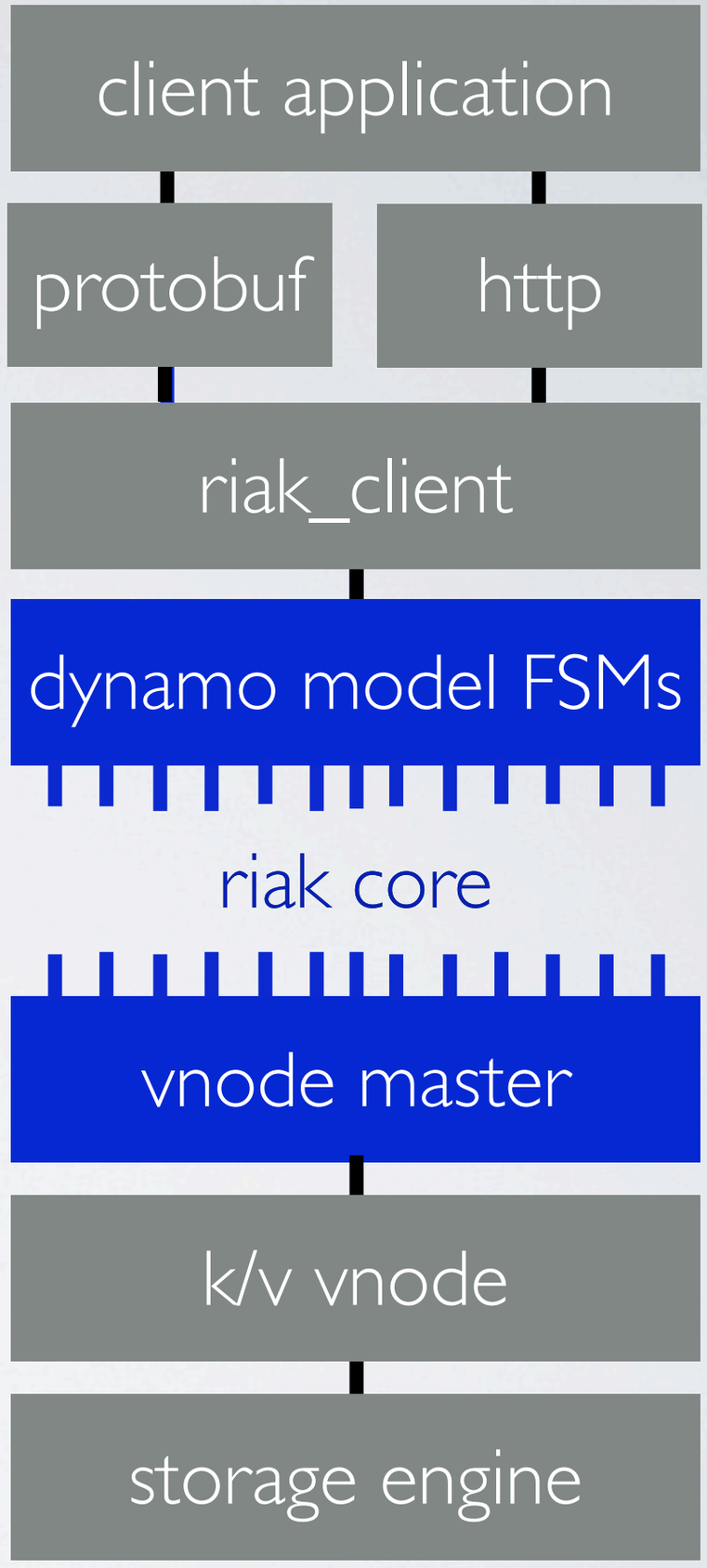
  Implement commands as a callback

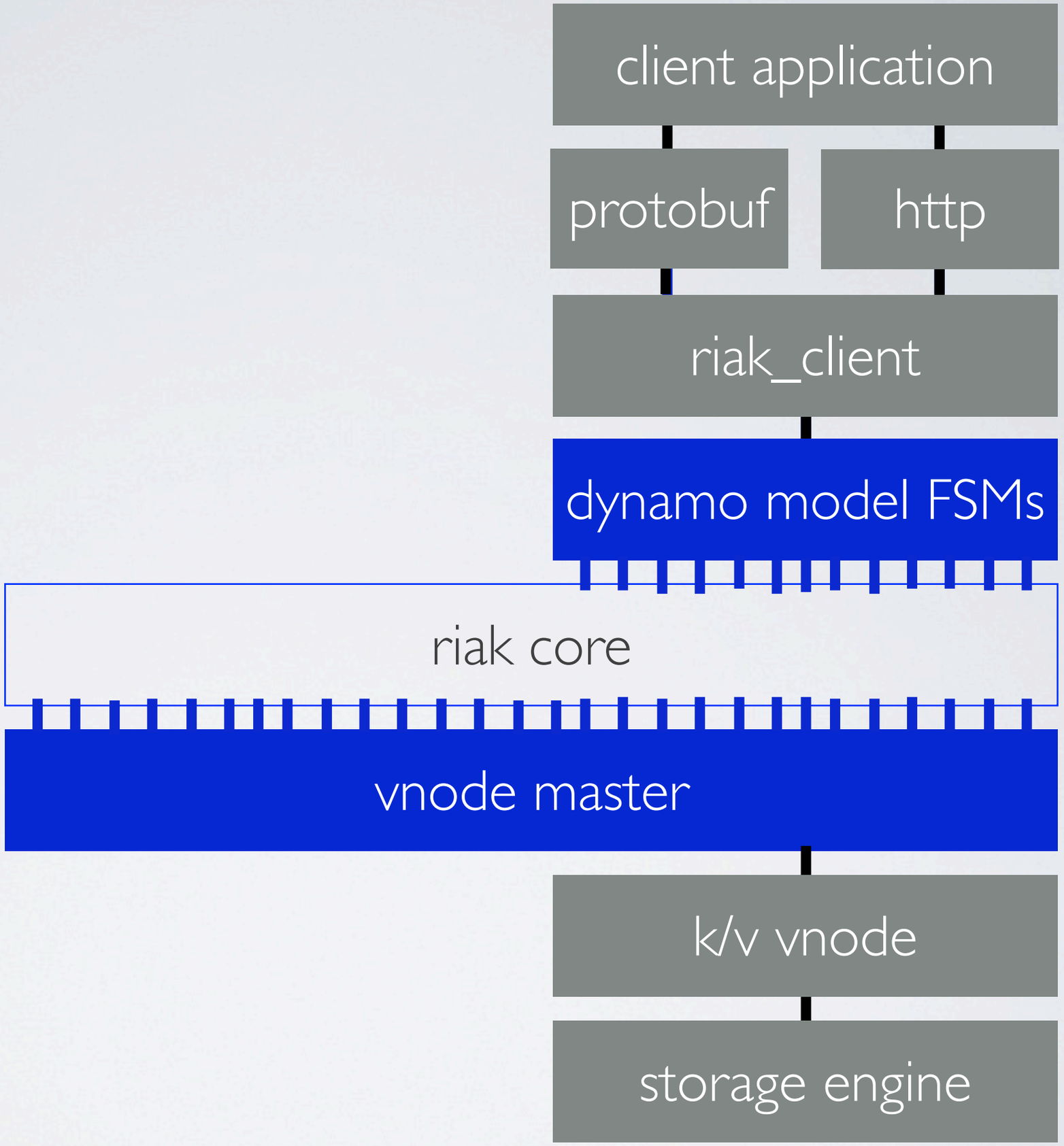
  Provide support for shuffling data between vnodes

- Low complexity

- Distributed, fault tolerance for "free"

  Complexity handled by riak_core


client application
protobuf
http
riak_client
dynamo model FSMs
riak core
vnode master
k/v vnode
storage engine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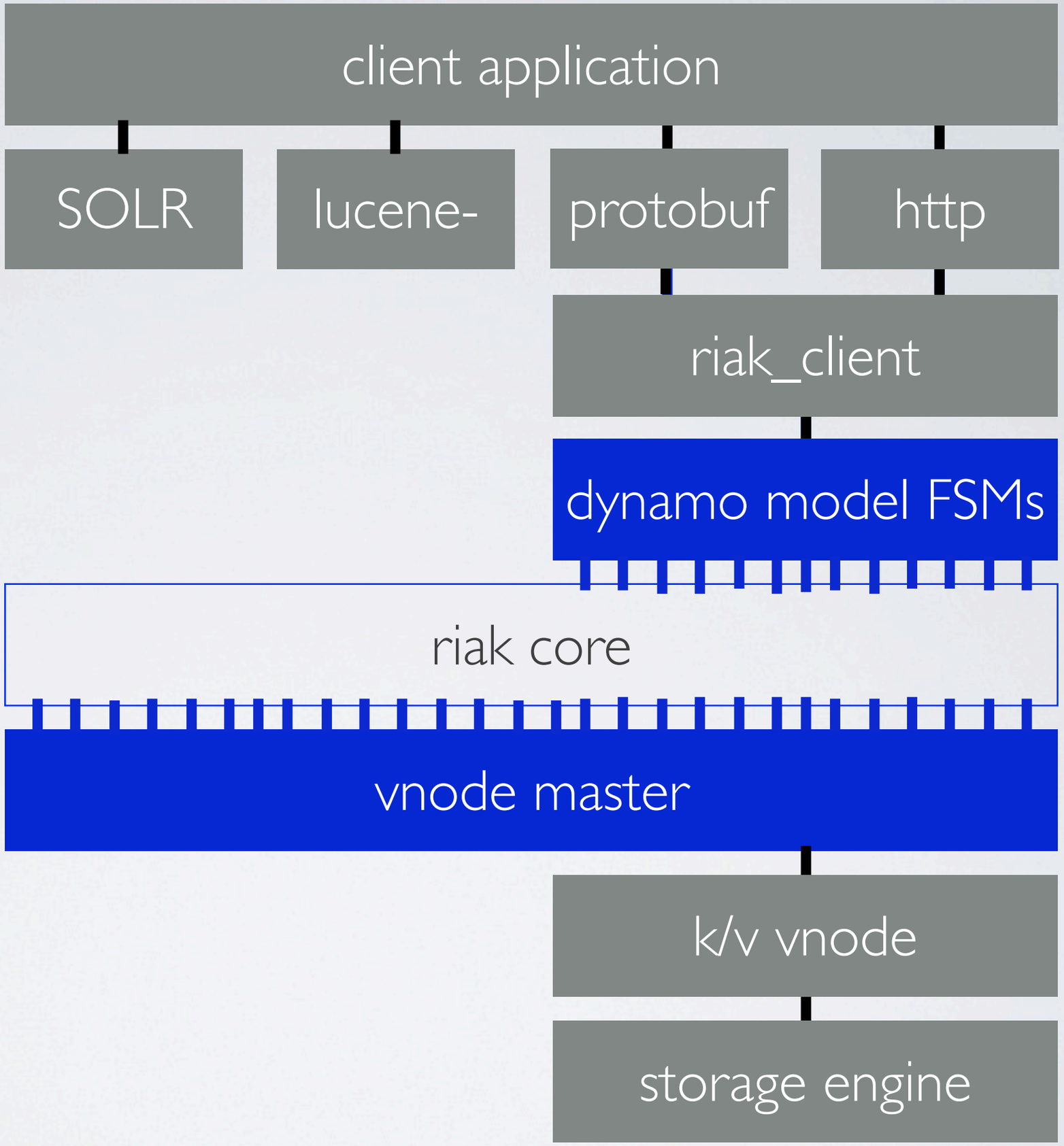
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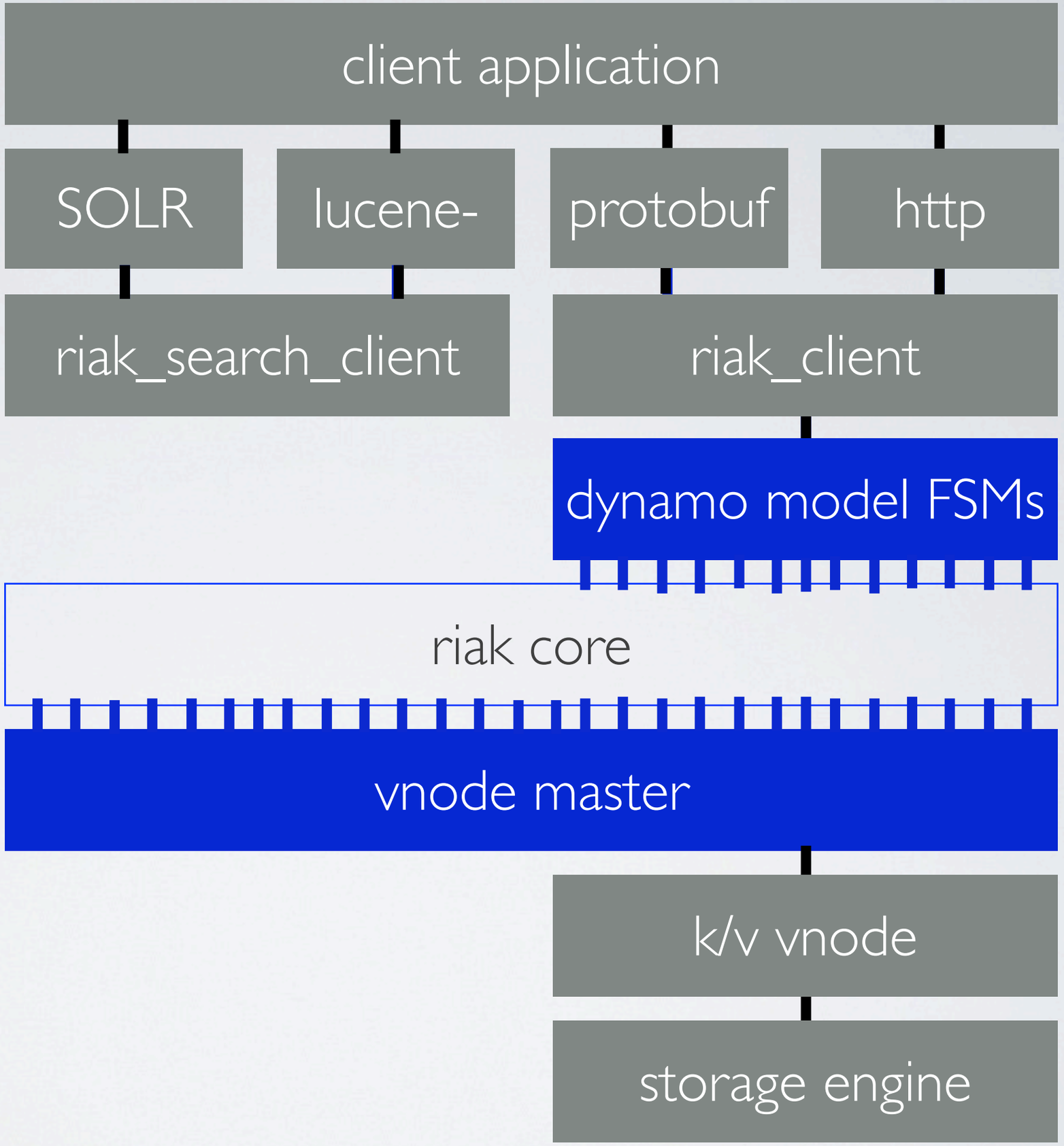
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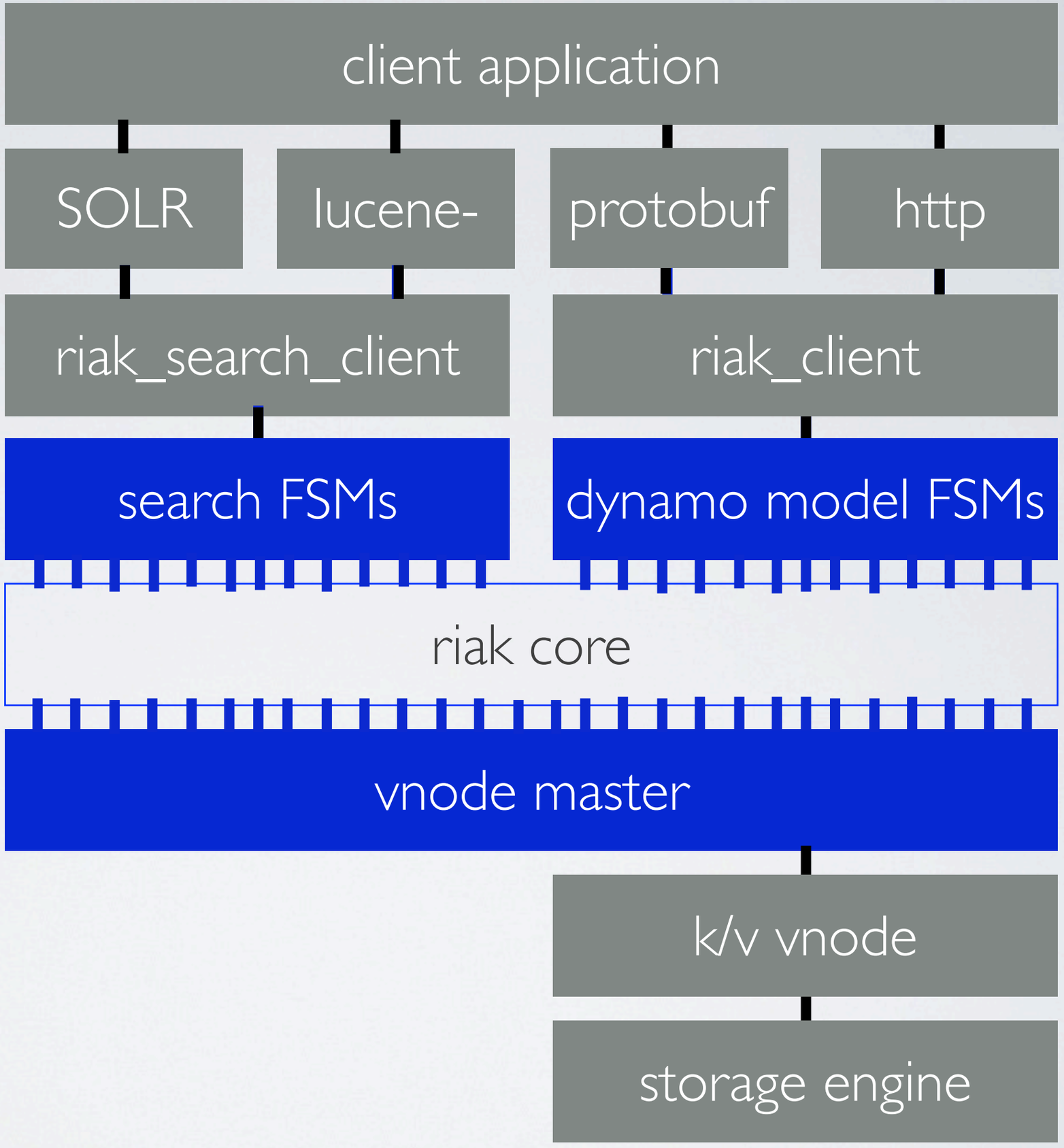
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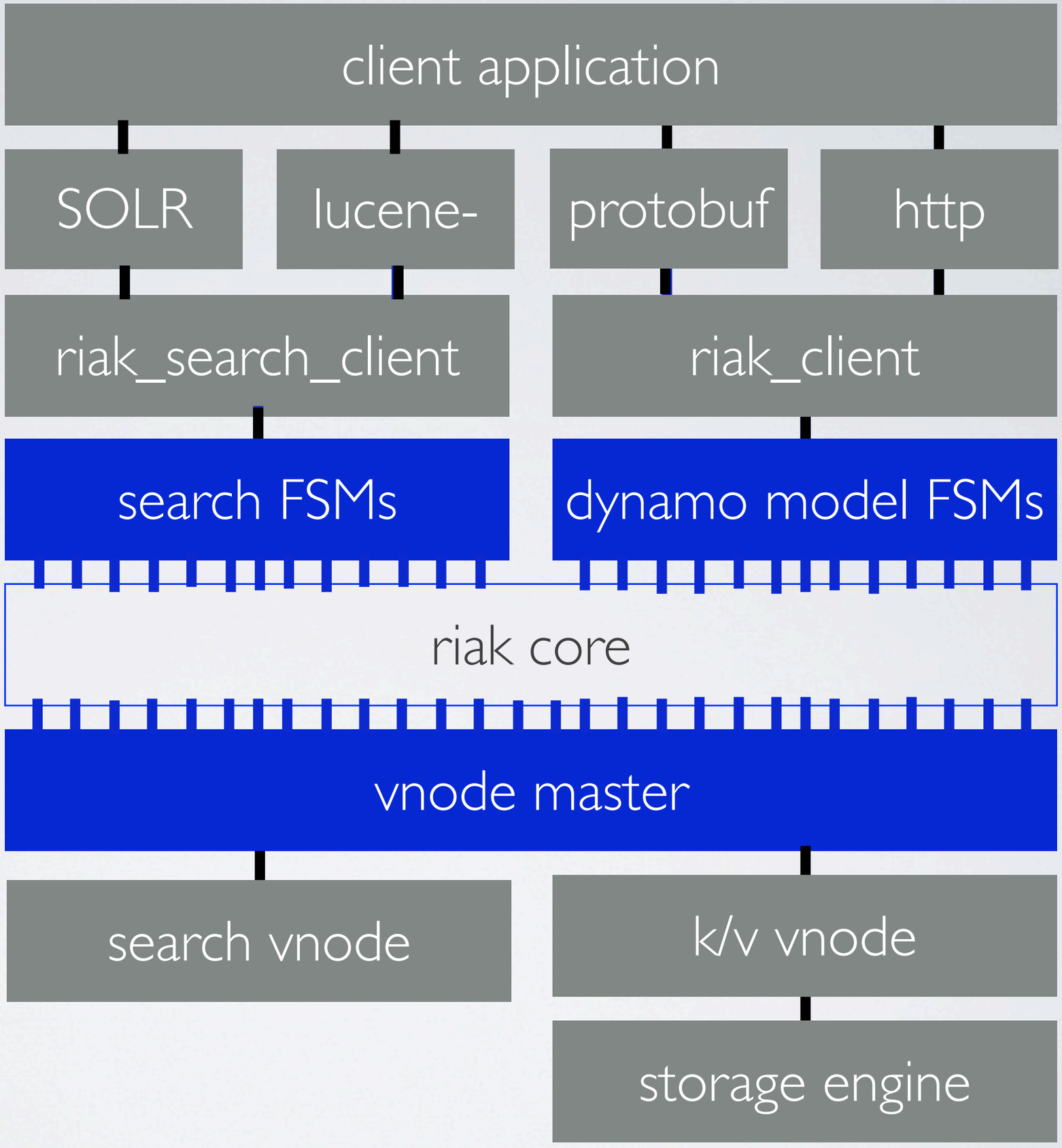
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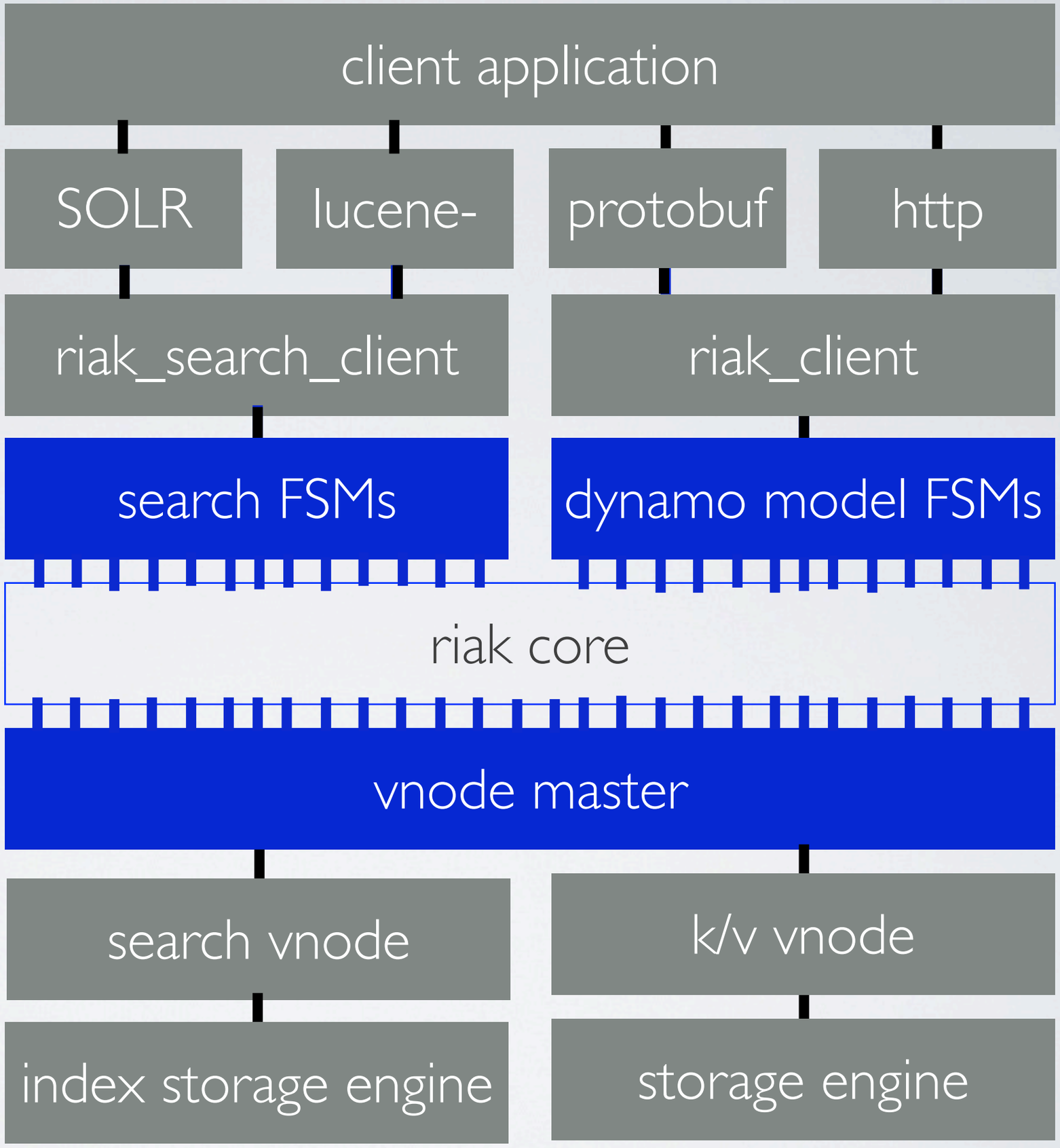
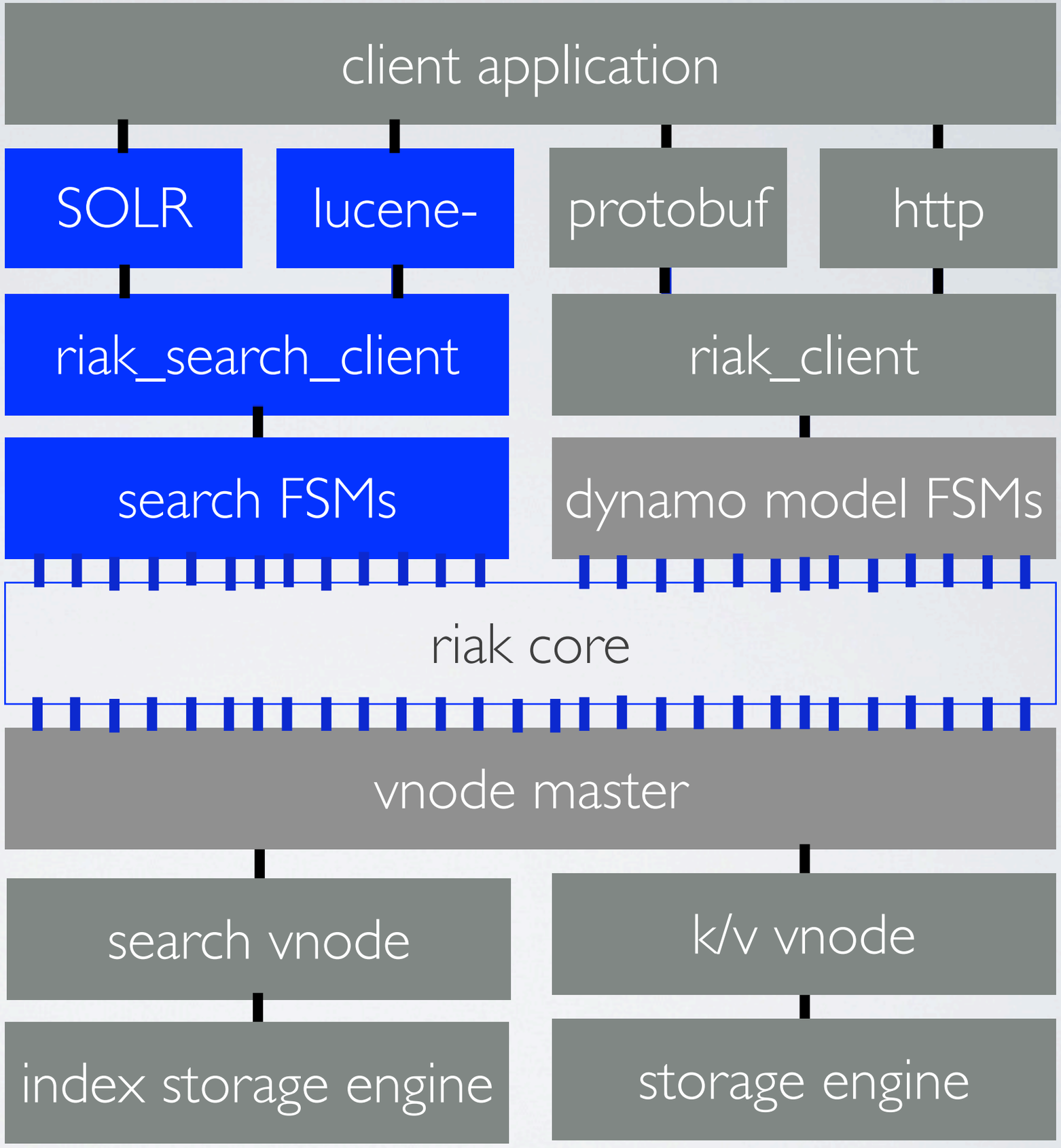
riak core
vnode master
search vnode
k/v vnode
storage engine


client application
SOLR
lucene-
protobuf
http
riak_search_client
riak_client
search FSMs
dynamo model FSMs
riak core
vnode master
search vnode
k/v vnode
index storage engine
storage engine

It's a search engine!



Made possible by Riak Core.

We're just getting started.

What will you build?

Review

Riak KV

Open Source Key/Value datastore.

Riak Search

Full-text, near real-time search engine based on Riak Core.

Riak Core

Open Source Erlang library that helps you build distributed, scalable, failure-tolerant applications using a Dynamo-style architecture.

Thanks! Questions?

Learn More

http://wiki.basho.com

Read Amazon's Dynamo Paper

Get the Code

http://github.com/basho/riak_core

Get in Touch

joe@basho.com on Email

@jtuple on Twitter

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