Ovid
A Software-Defined Distributed Systems Framework

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Ovid

Build distributed systems that are

- easy to evolve
- easy to reason about
- easy to compose

Approach

Create a theoretical model using abstractions

Deploy the distributed system using this model

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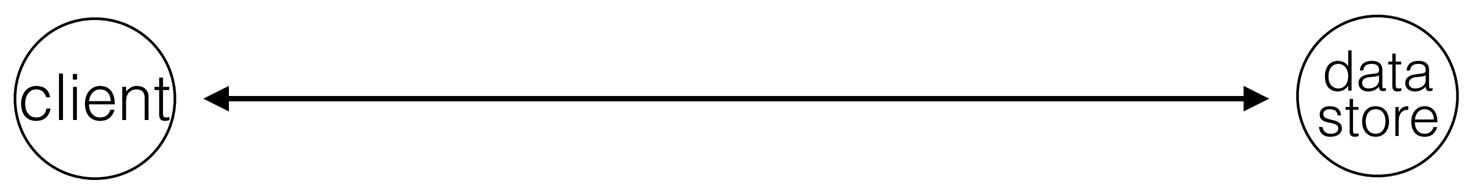
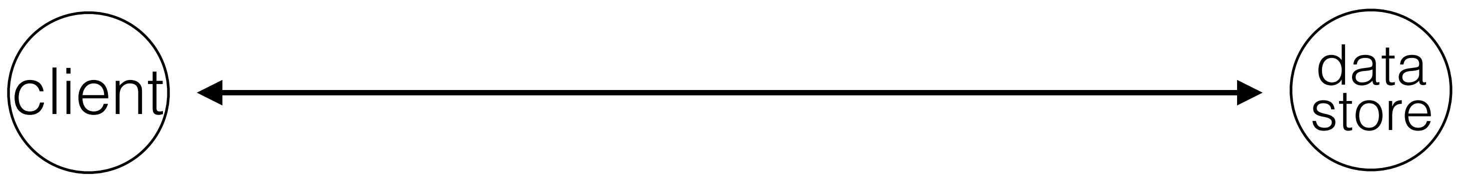
Deploy the distributed system using this model

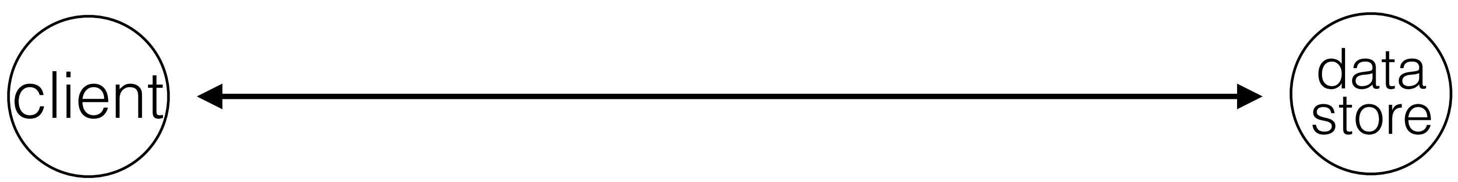

client
data
store


client
agent
data
store
agent

not fault tolerant

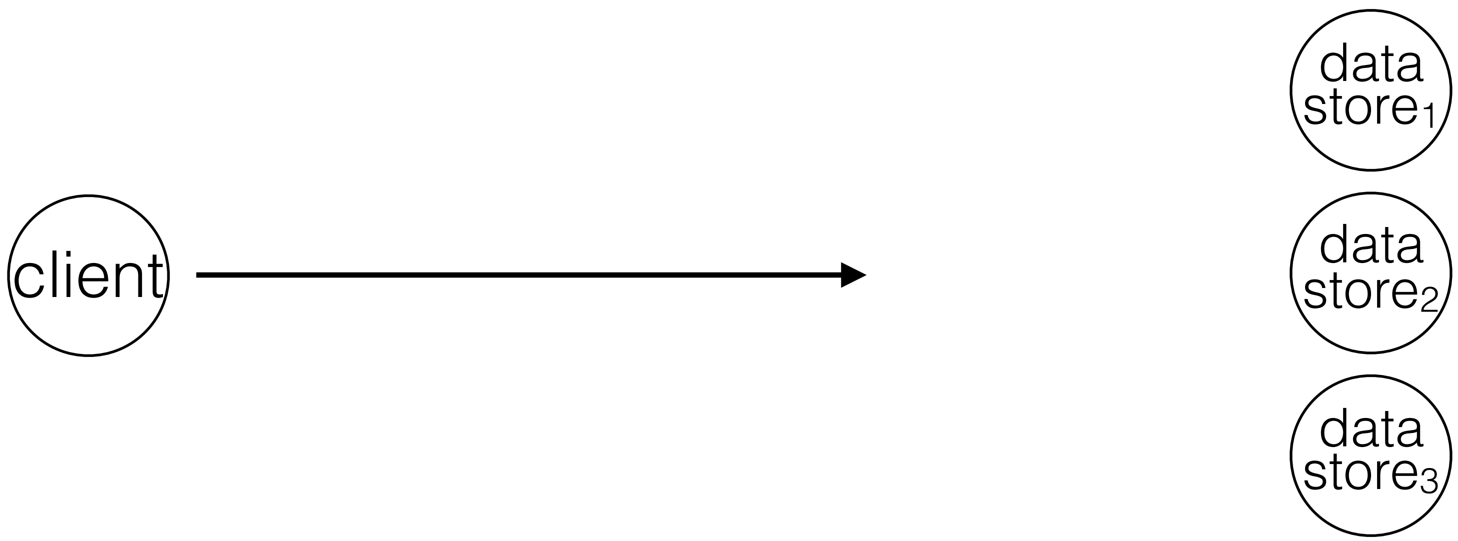


transform data store agent to be fault tolerant



replicate(datastore,3) =

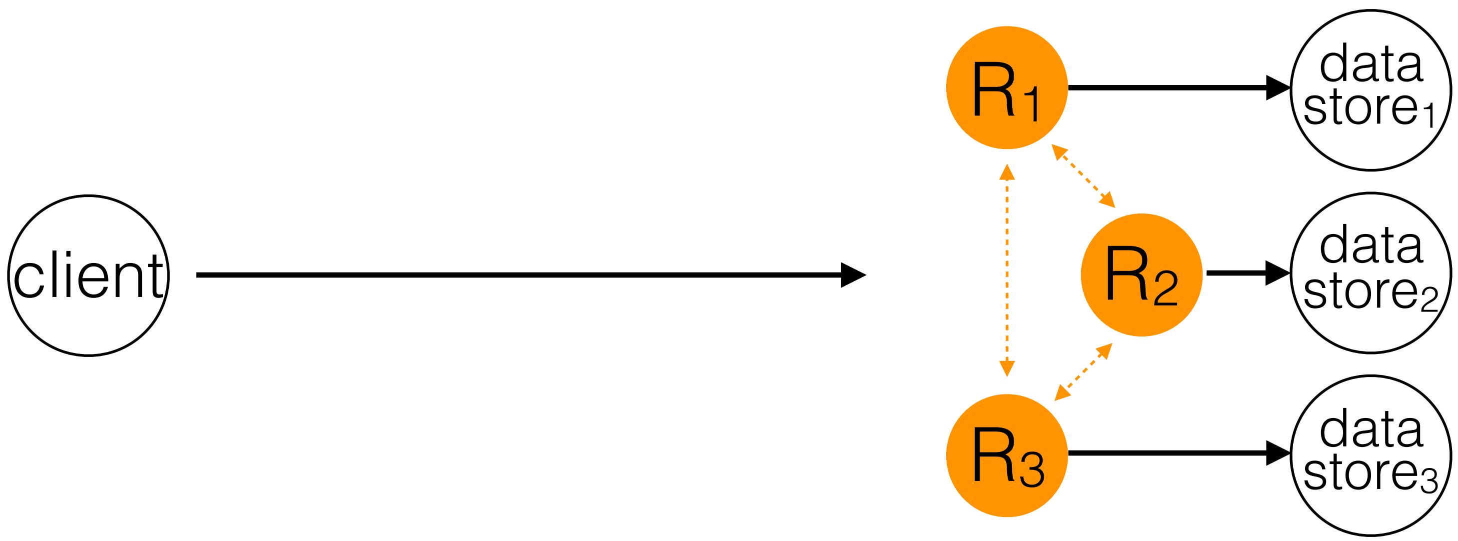
transform data store agent to be fault tolerant



replicate(datastore,3) = datastore*3

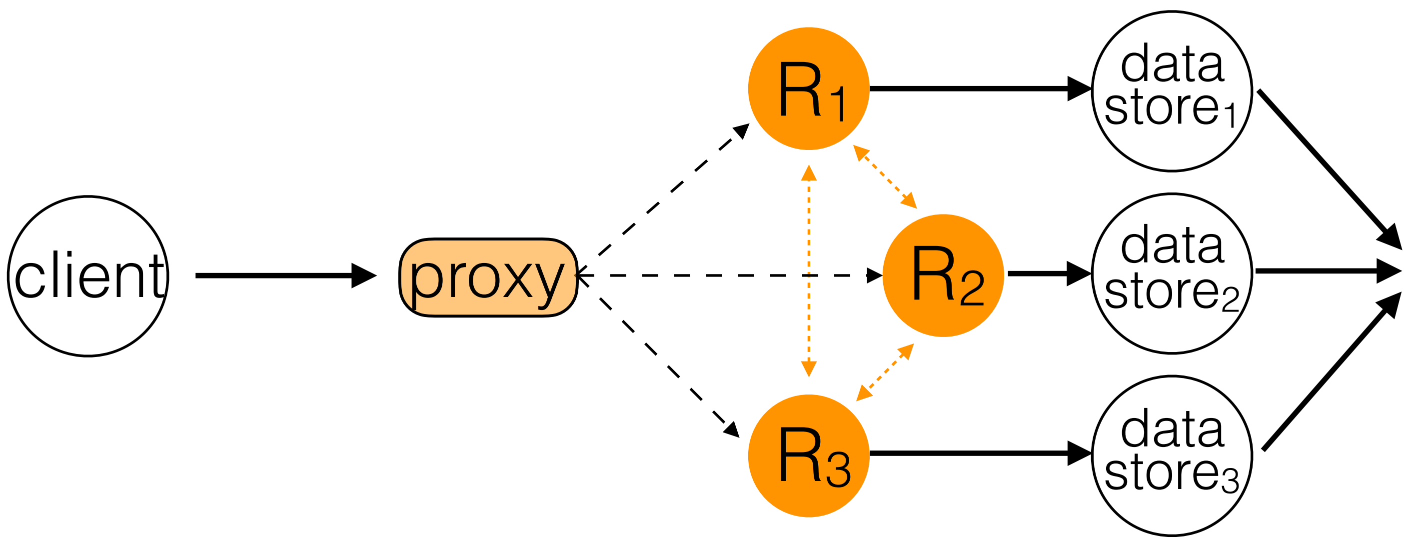
minority of replicas can fail
crash fault tolerant
asynchronous environment
linearizable

} Paxos consensus protocol



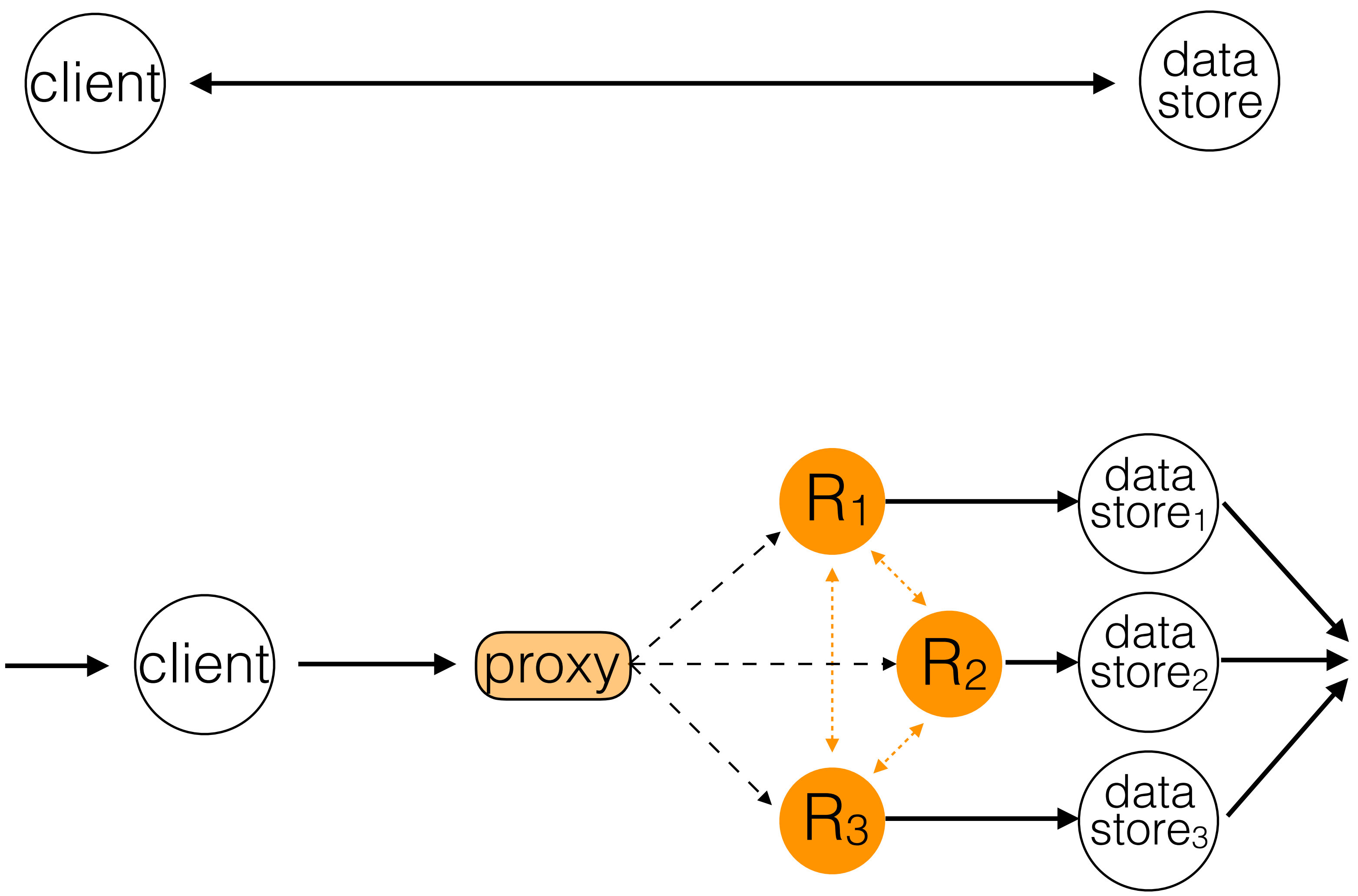
replicate(datastore,3) = R*3 + datastore*3

minority of replicas can fail
crash fault tolerant
asynchronous environment
linearizable



replicate(datastore,3) = proxy + R*3 + datastore*3

How do we know that a transformation did not break an agent?



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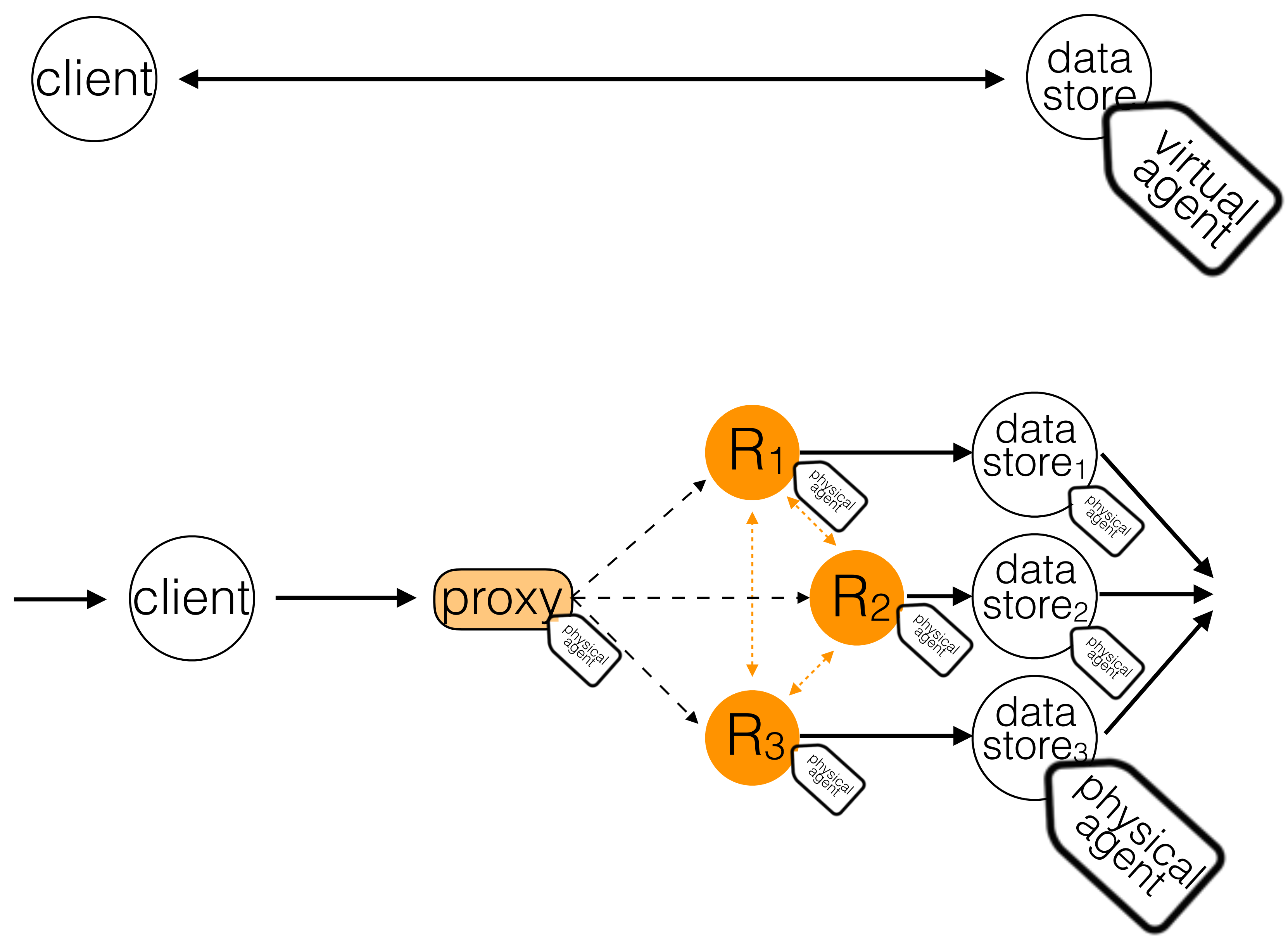
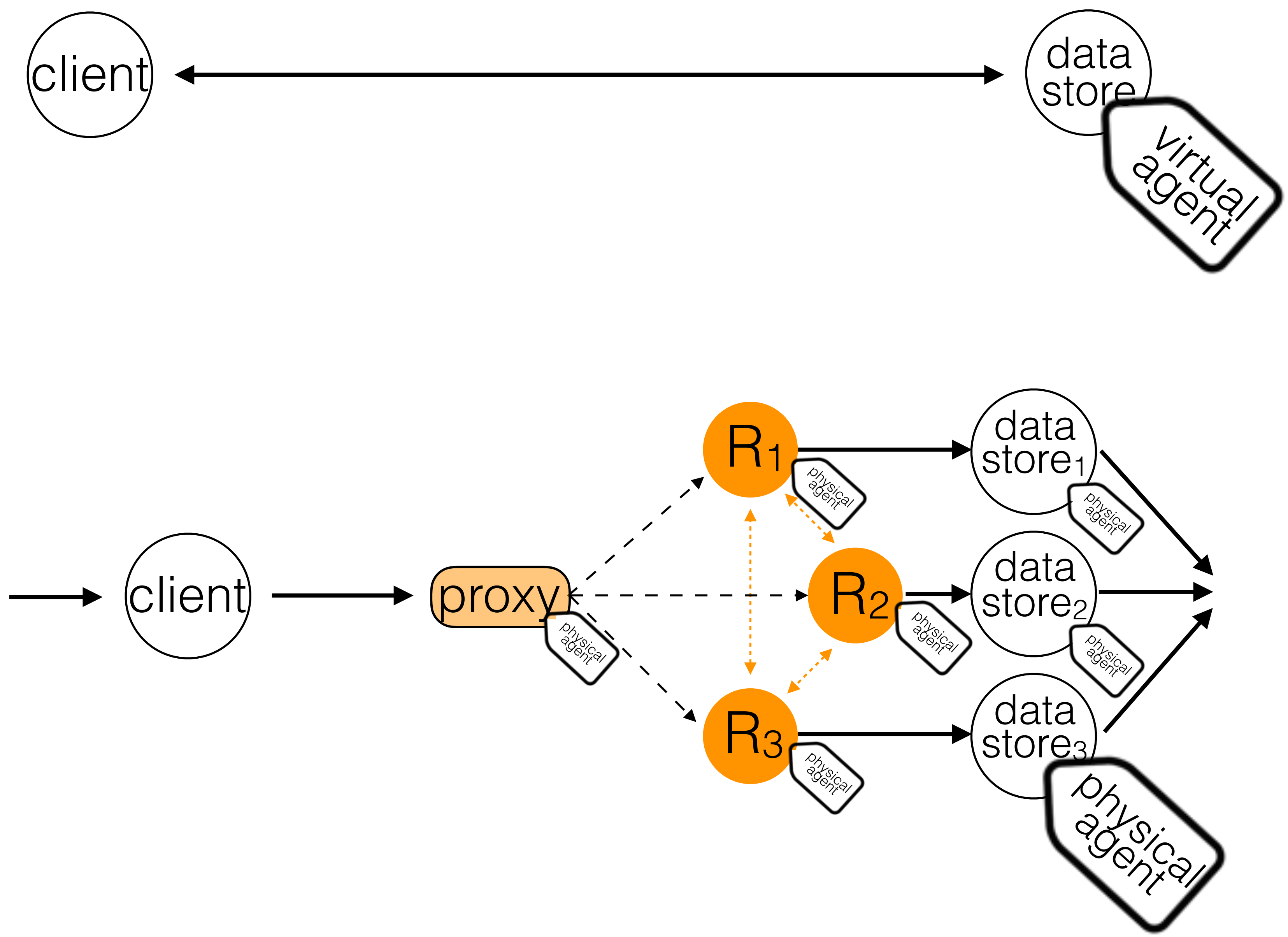
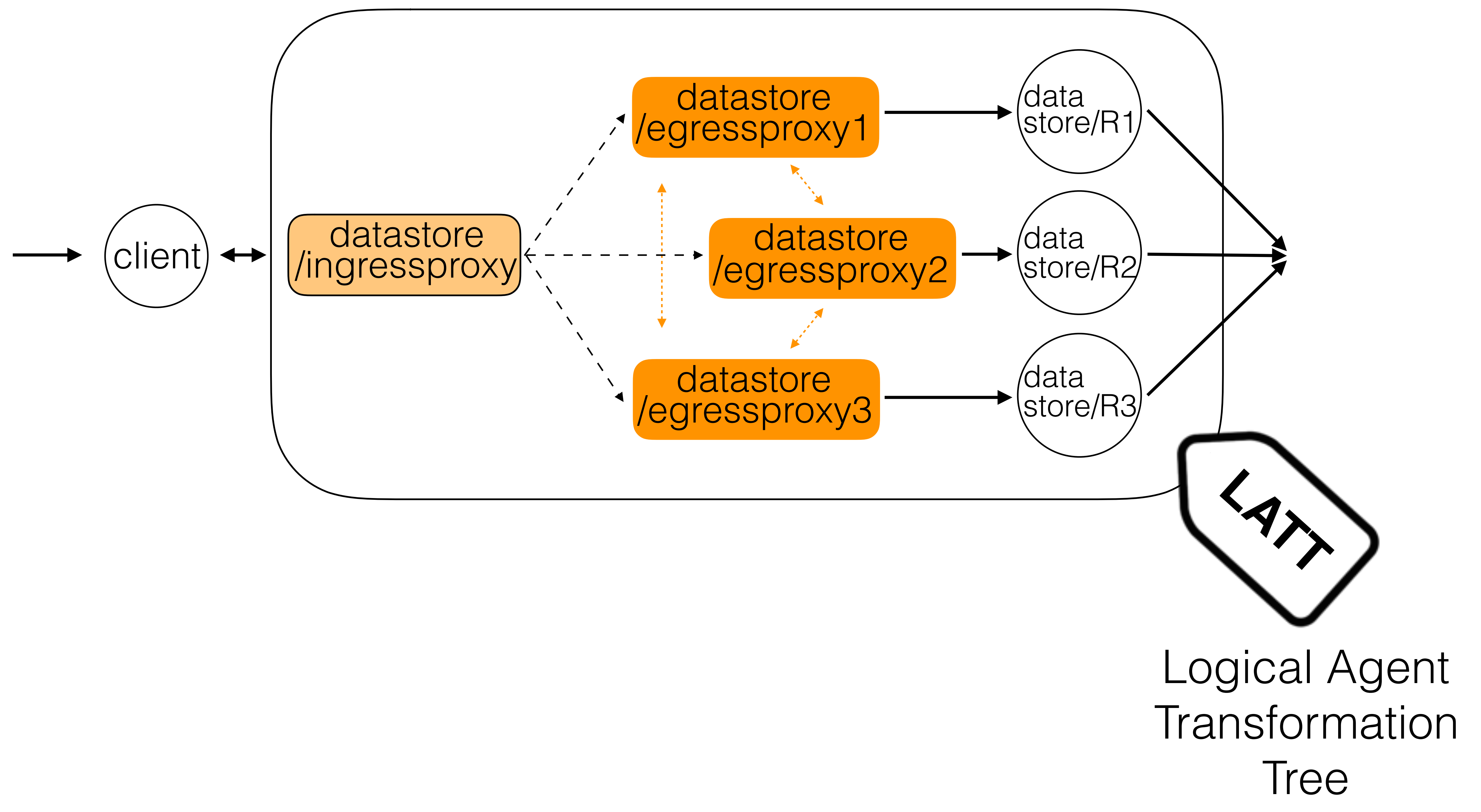


Use refinement mappings to prove equivalence




client
data
store

Use path names to represent transformations



Supported transformations

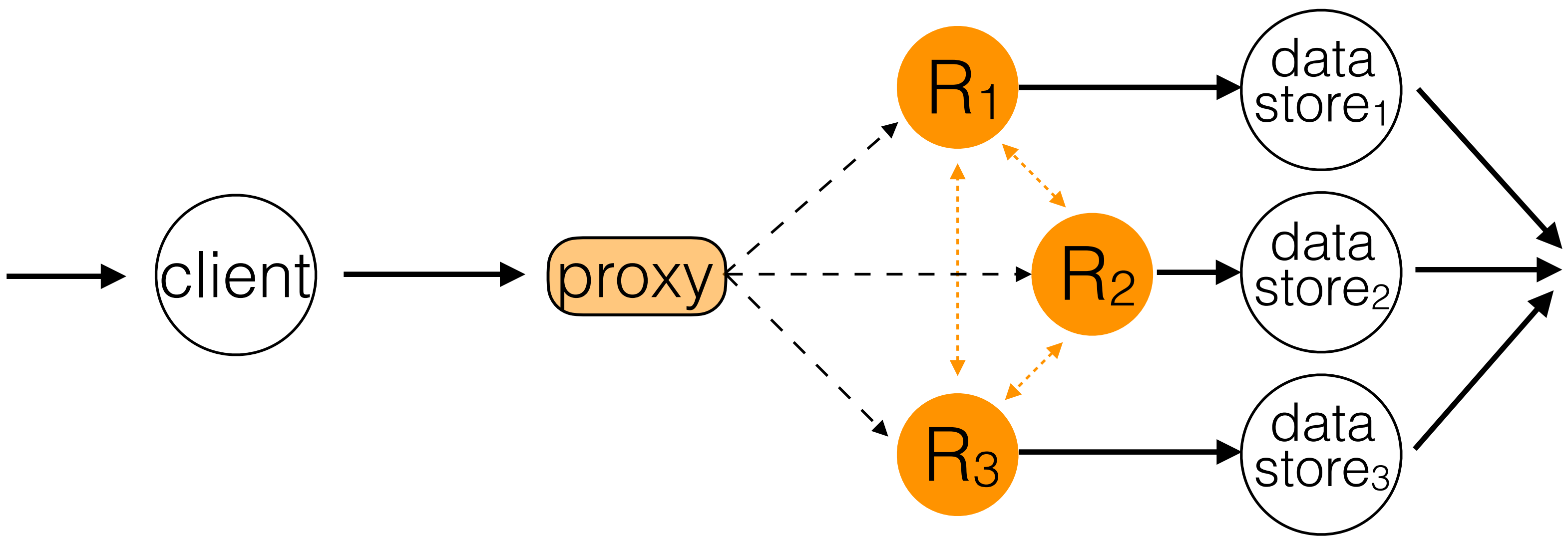
- replication
- byzantine resistance
- batching
- sharding
- encryption/decryption
- compression
- load-balancing
- deduplication

Approach

Create a theoretical model using abstractions

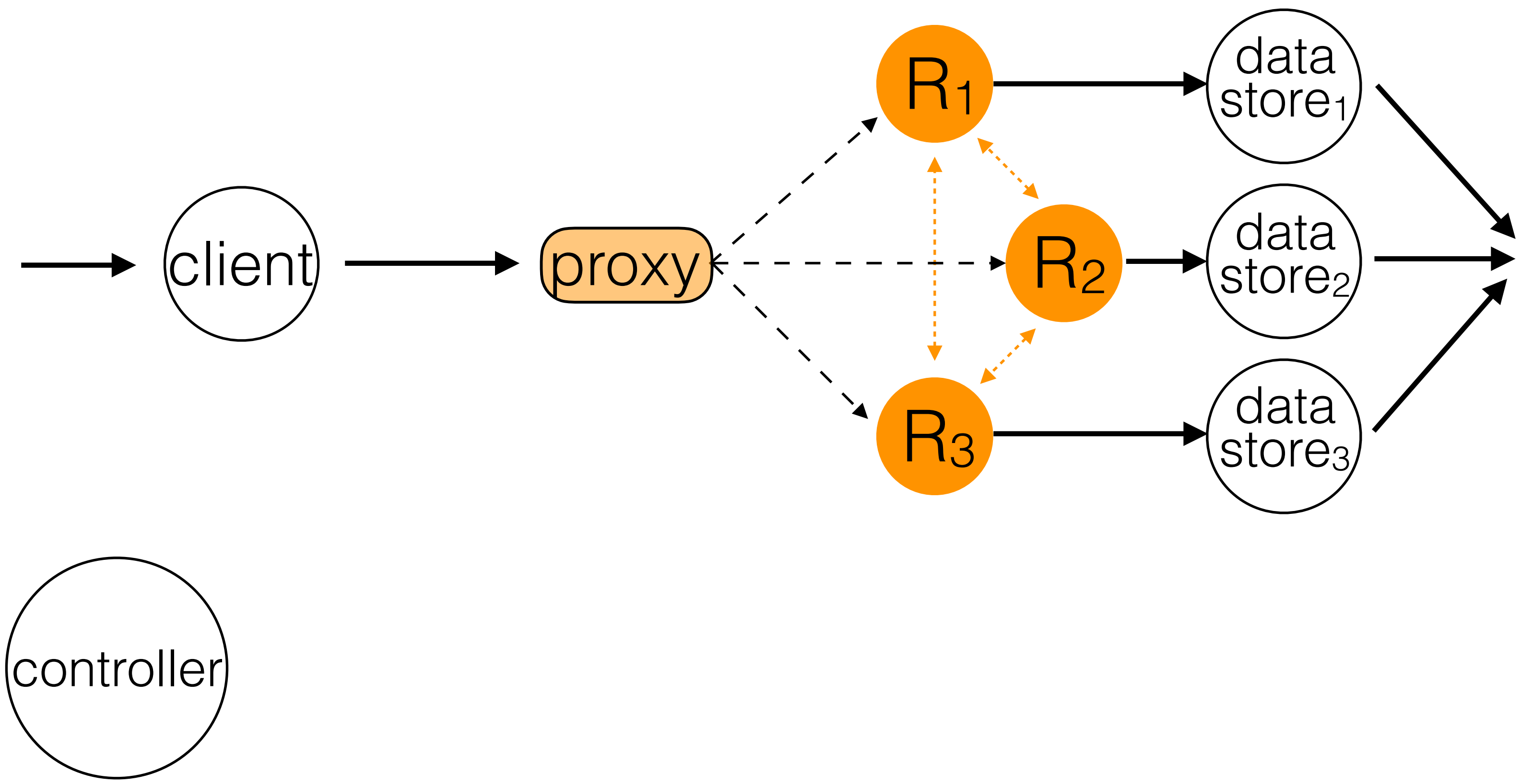
Deploy the distributed system using this model

Deployment



- Create a configuration from the model
- Deploy processes on boxes depending on the configuration

Deployment



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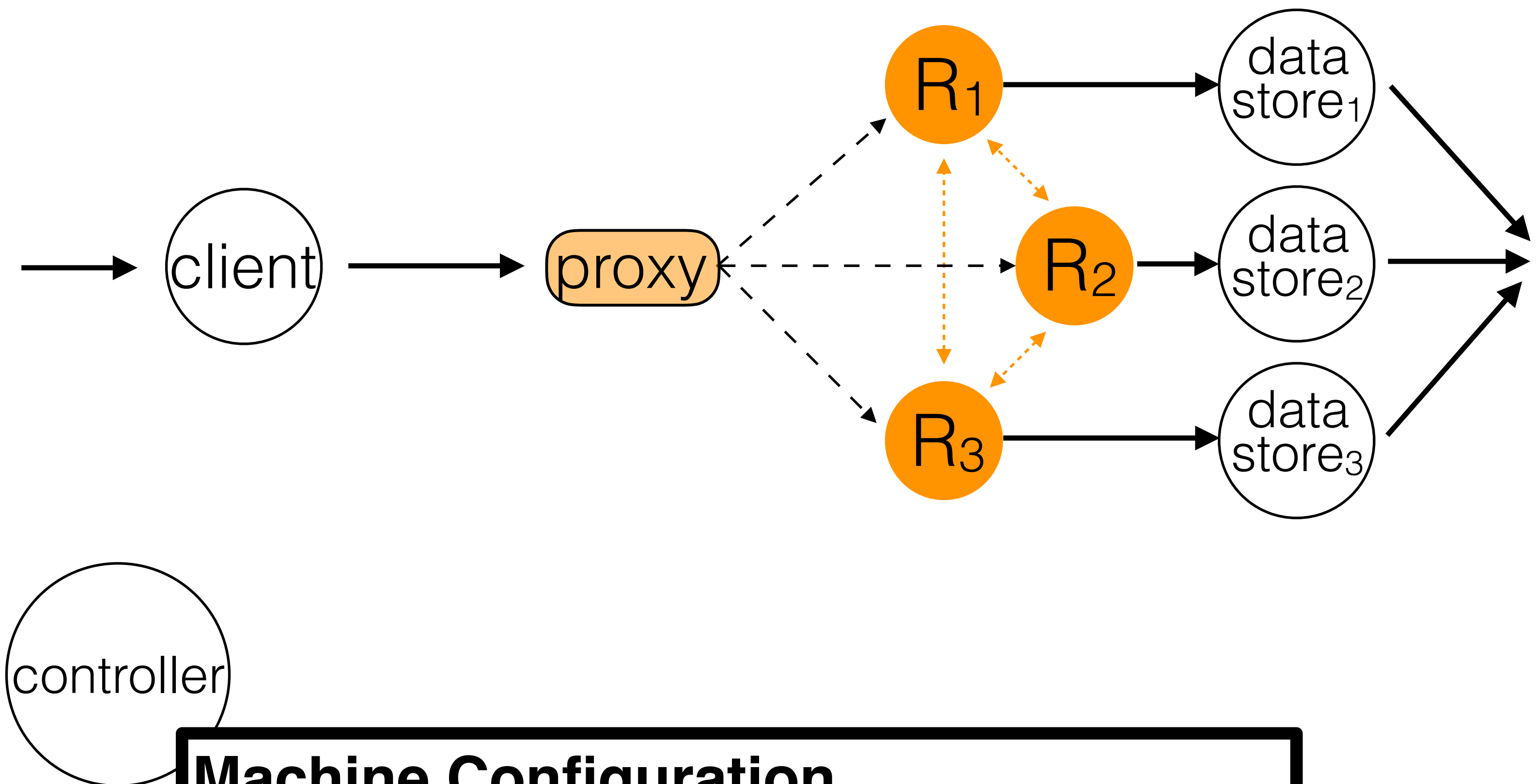
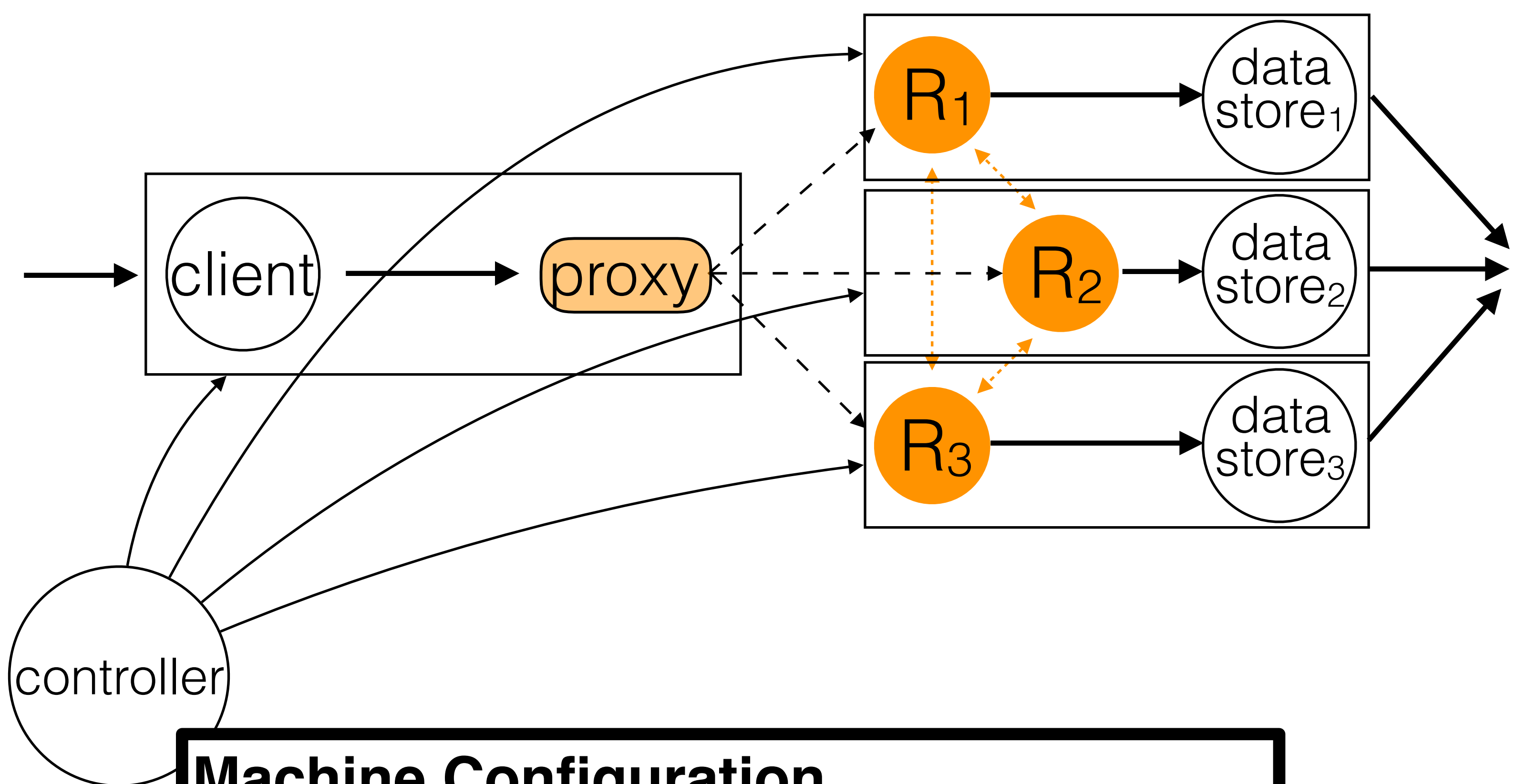


Machine Configuration

client 192.168.7.56 client.cpp
proxy 192.168.7.56 proxy.cpp
R1 192.168.7.80 replica.cpp
R2 192.168.7.81 replica.cpp
R3 192.168.7.82 replica.cpp
data store1 192.168.7.80 datastore.cpp
data store2 192.168.7.81 datastore.cpp
data store3 192.168.7.82 datastore.cpp

Deployment



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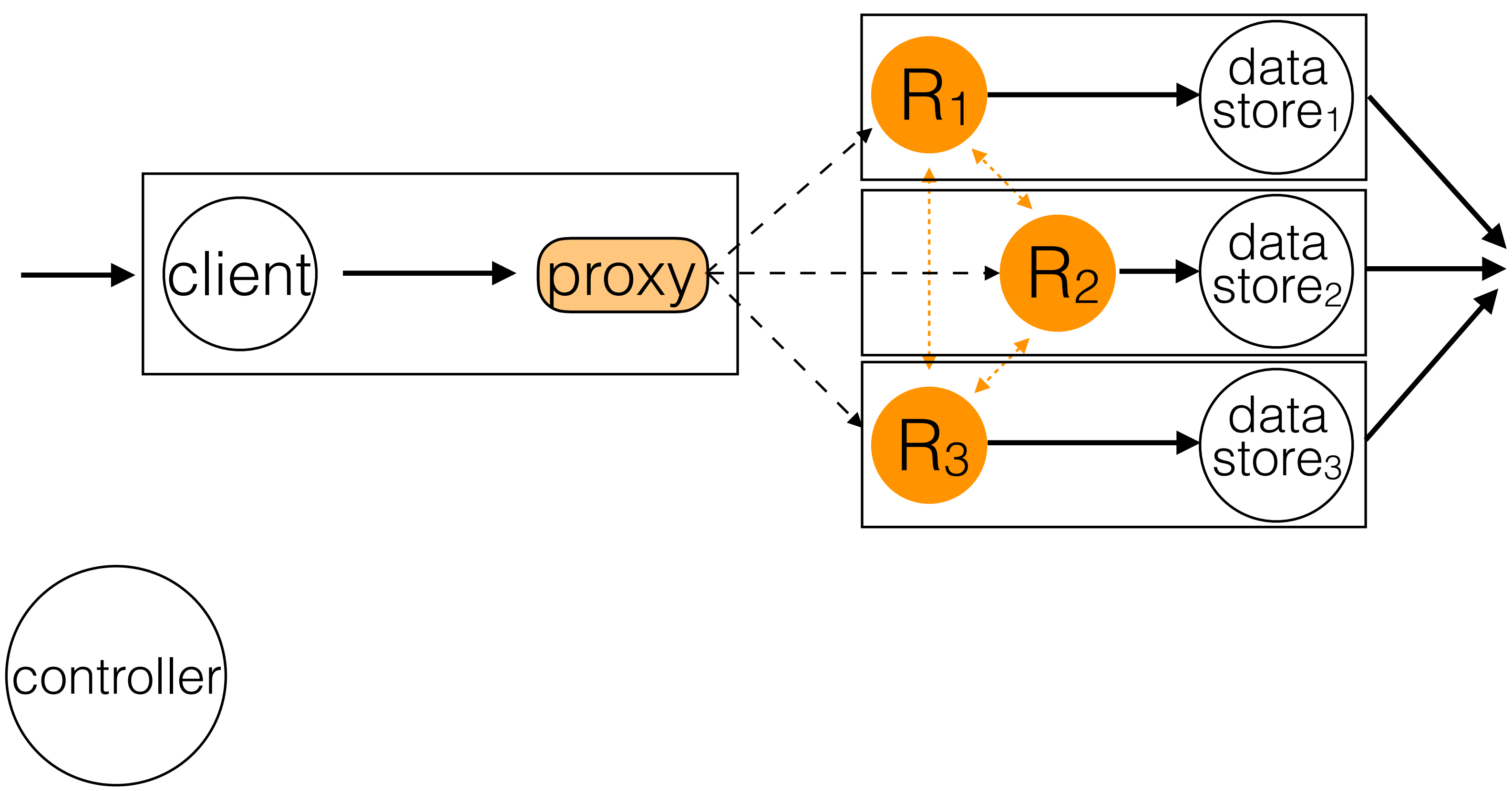
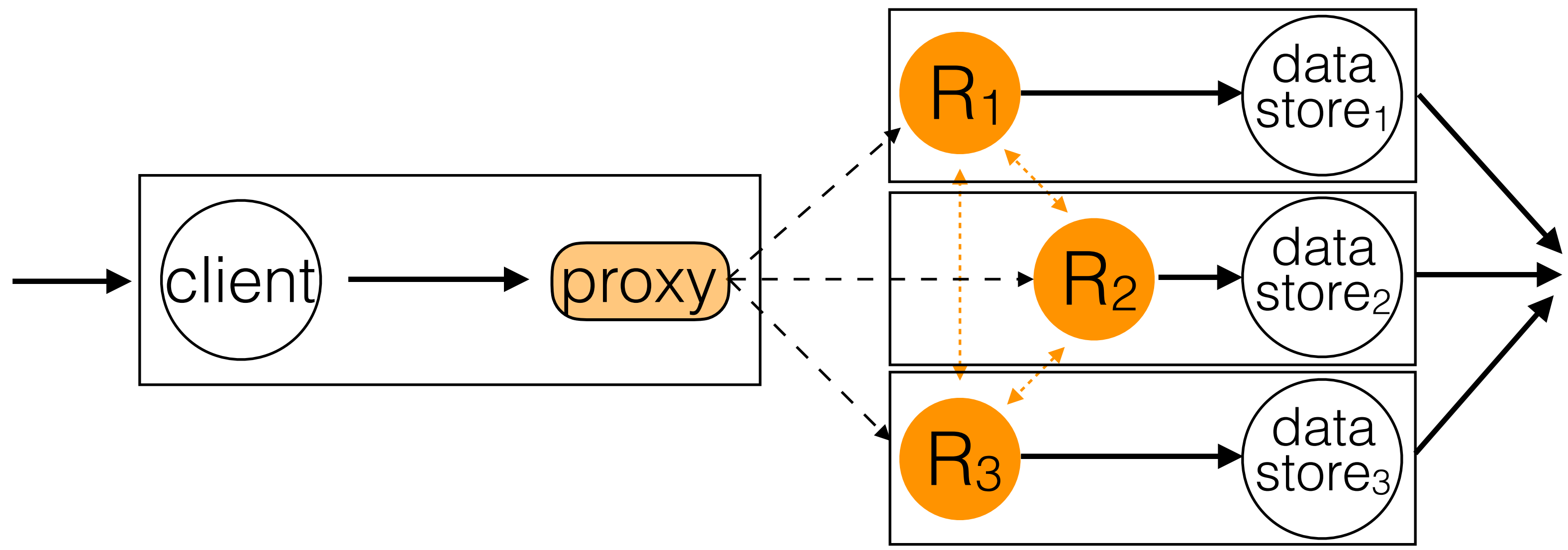
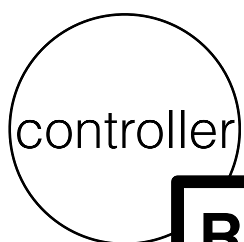
Dynamic Routing



- Create routing tables
- Route messages to destination depending on the model

Dynamic Routing





<u>Routing Configuration</u>

client datastore proxy

proxy datastore R1,R2,R3

R1 datastore datastore1

R2 datastore datastore2

R3 datastore datastore3

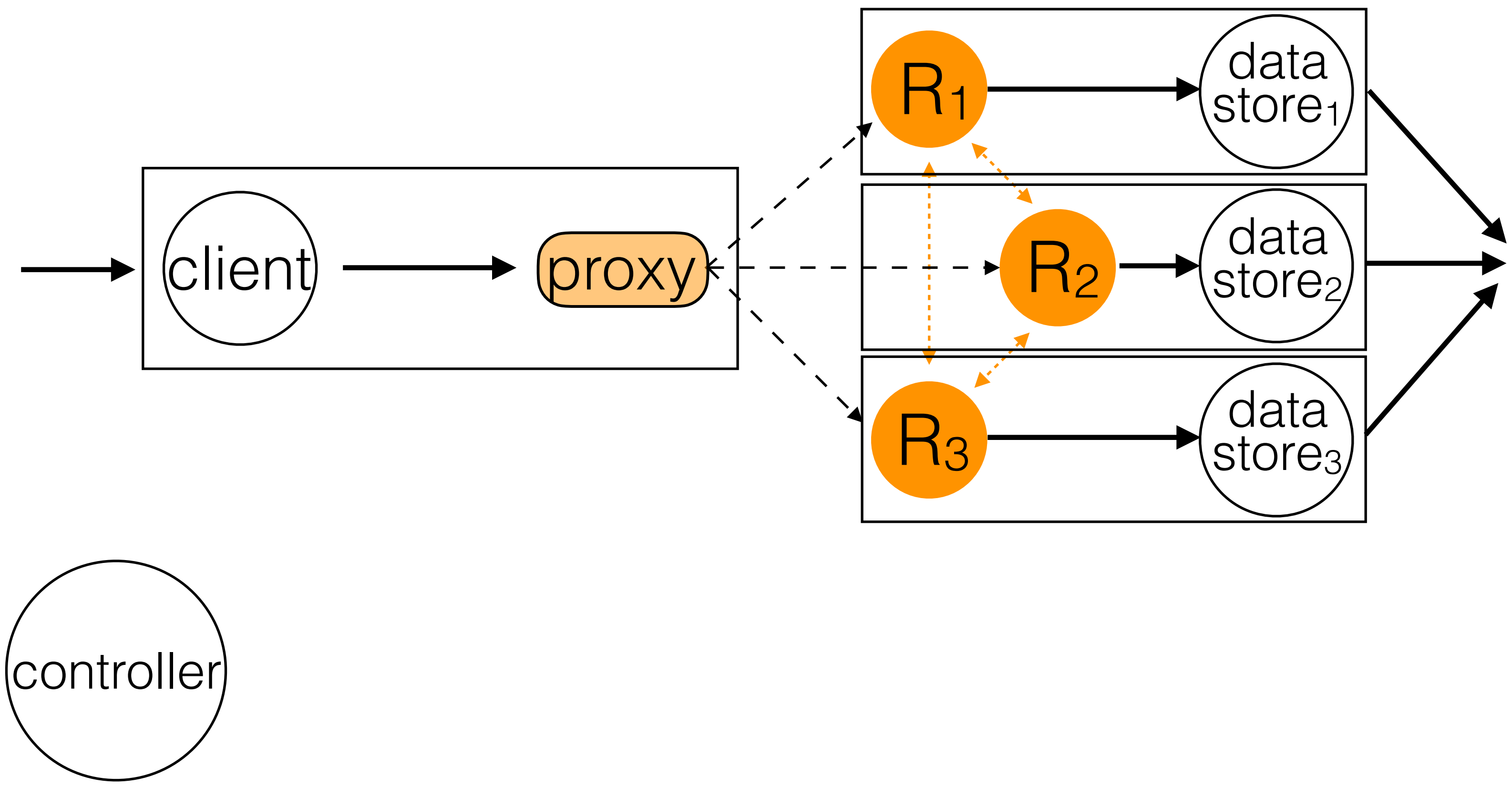
datastore1 client client

datastore2 client client

datastore3 client client

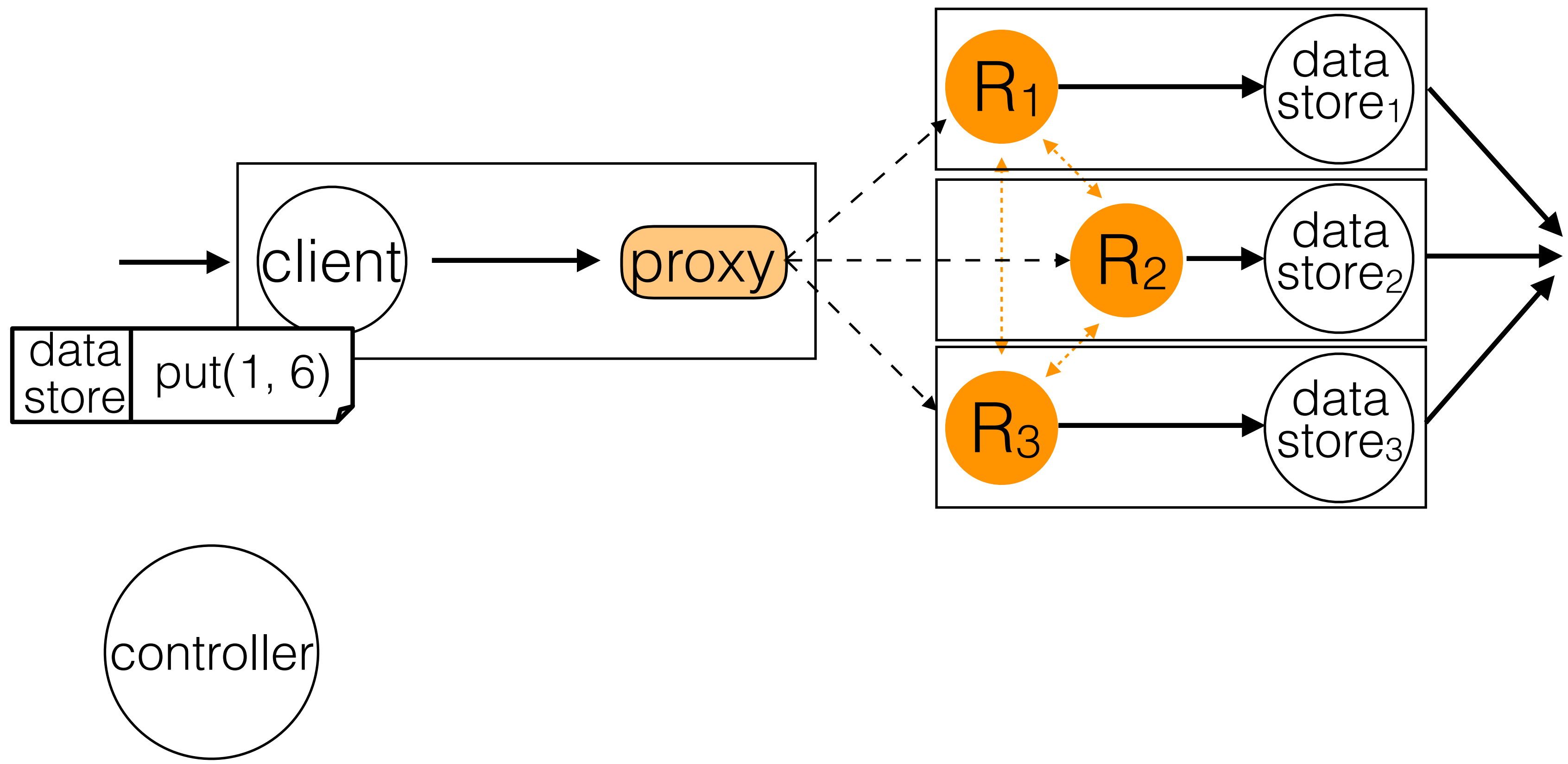
Dynamic Routing

msg:



Dynamic Routing

msg: | dest | payload |



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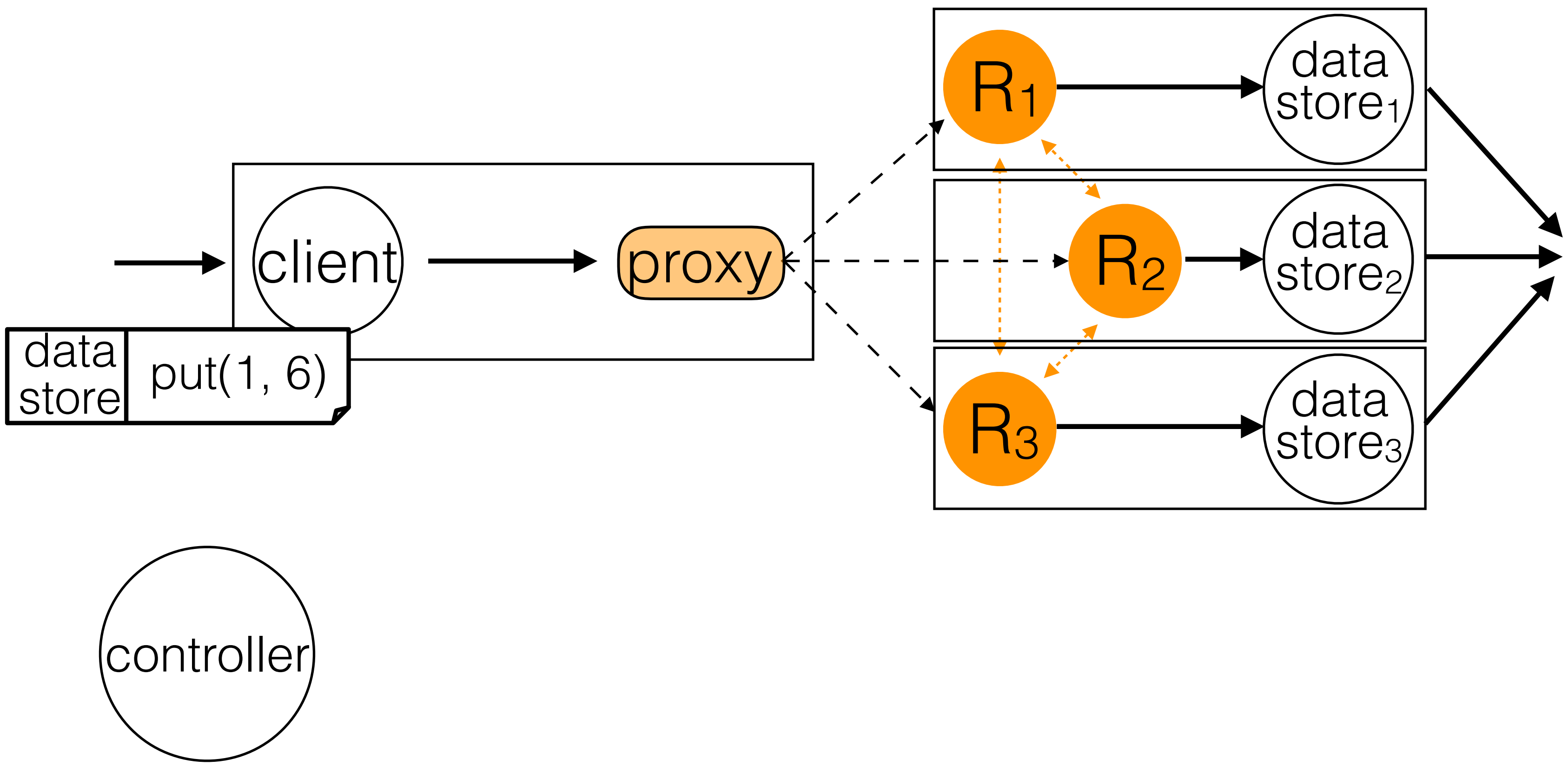
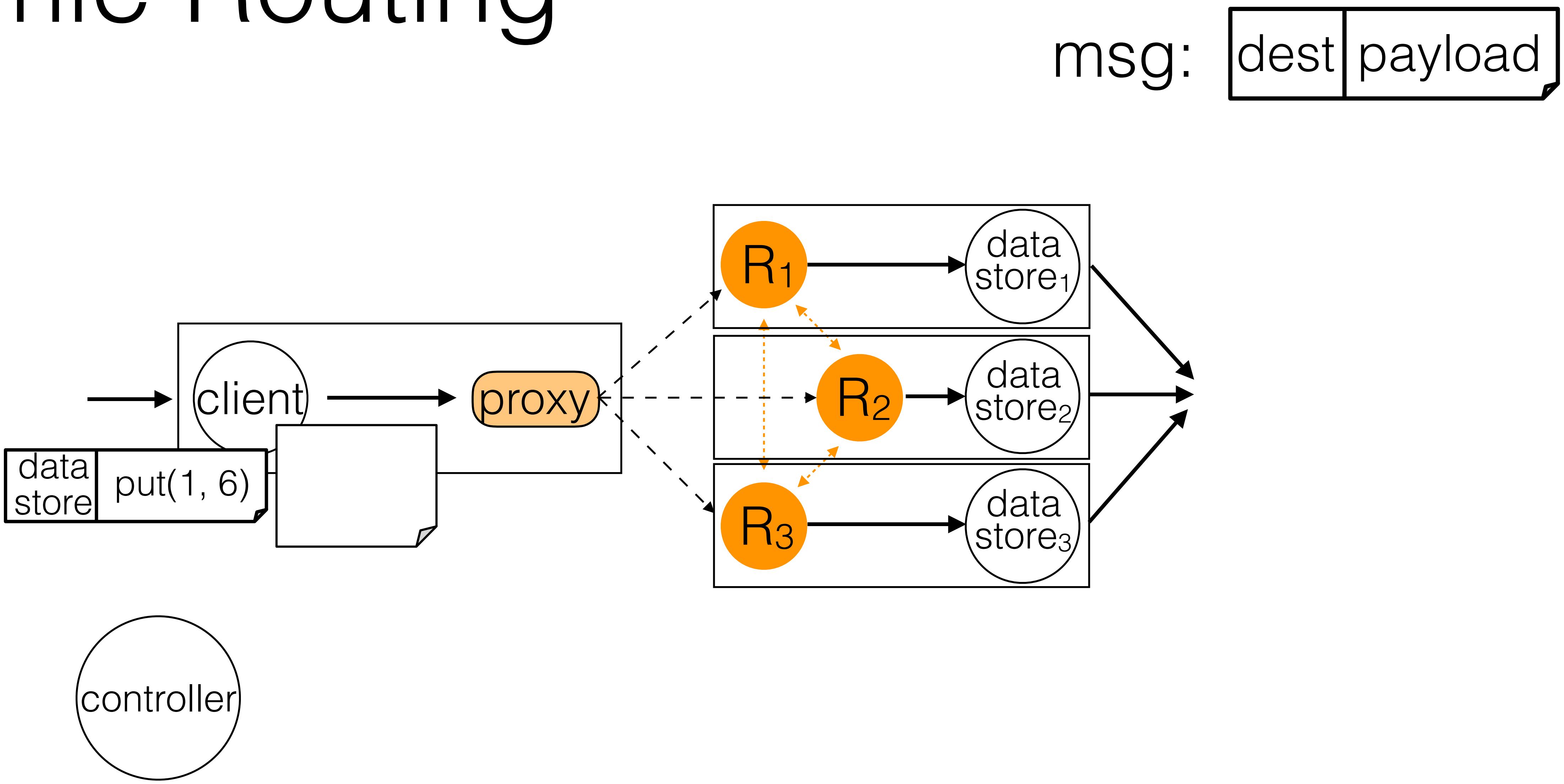


- send msg(dest,payload)

Dynamic Routing



- send msg(dest,payload)
- look for dest in routing table

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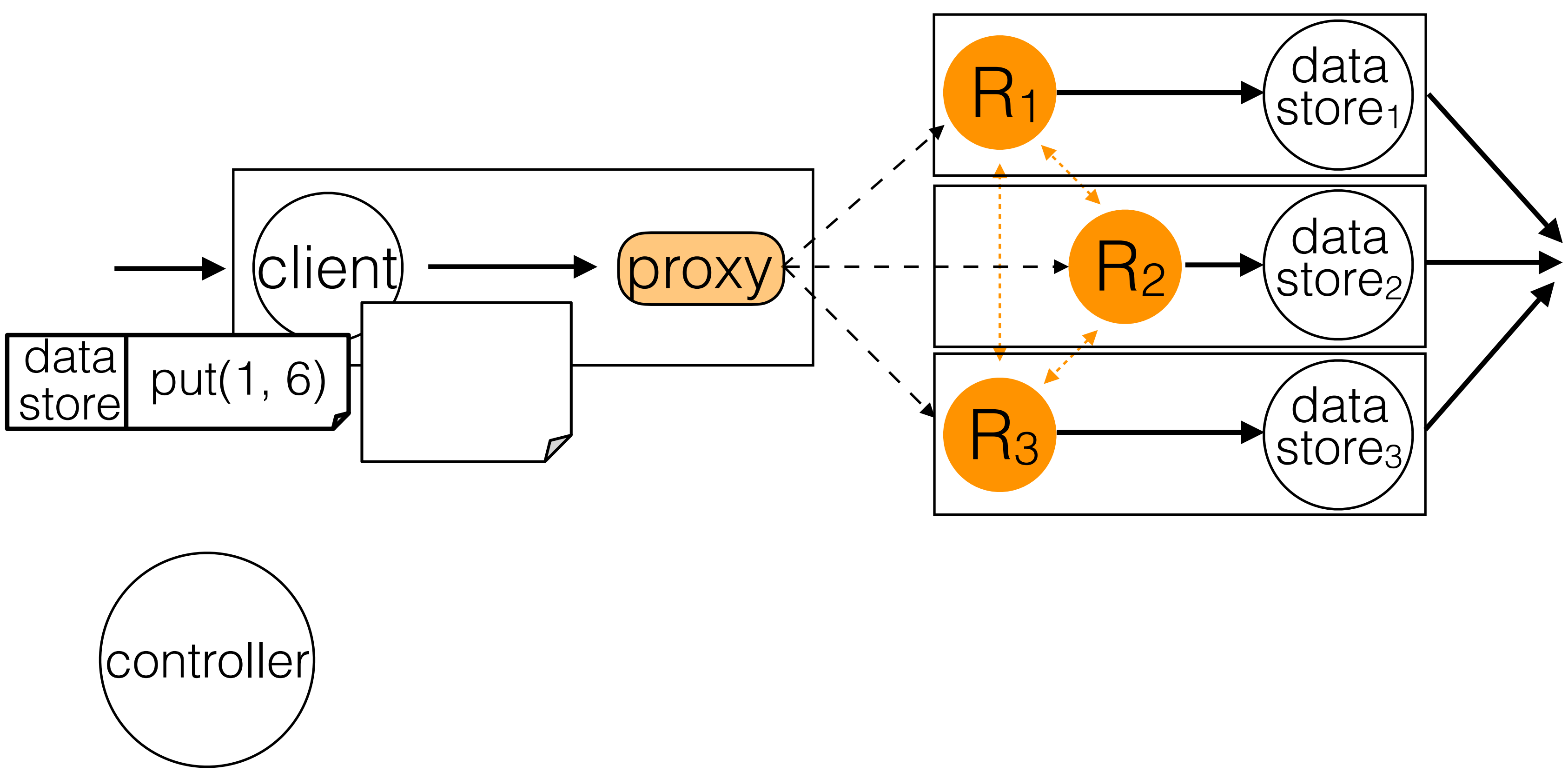
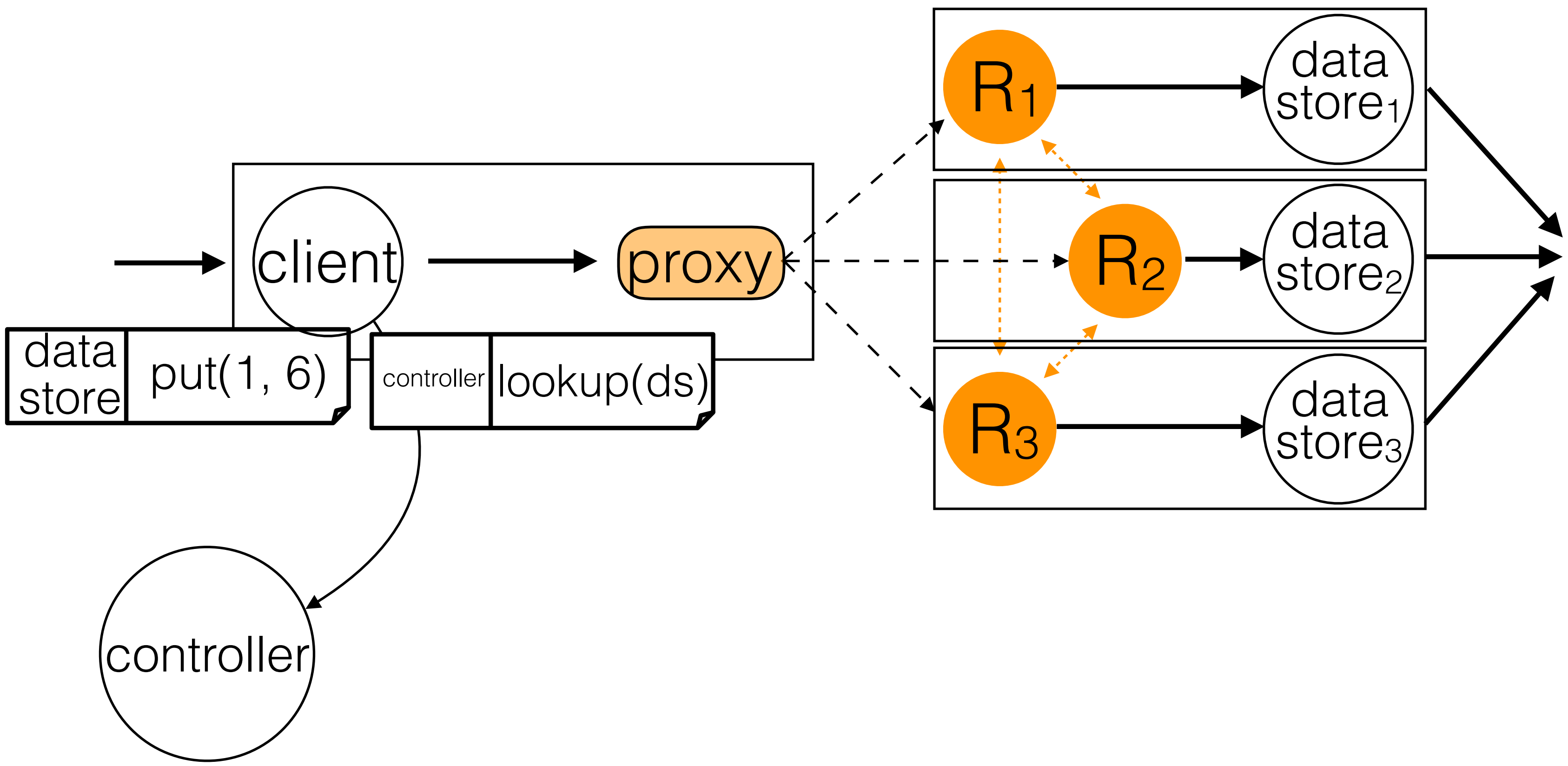


- send msg(dest,payload)
- look for dest in routing table
- dest not present

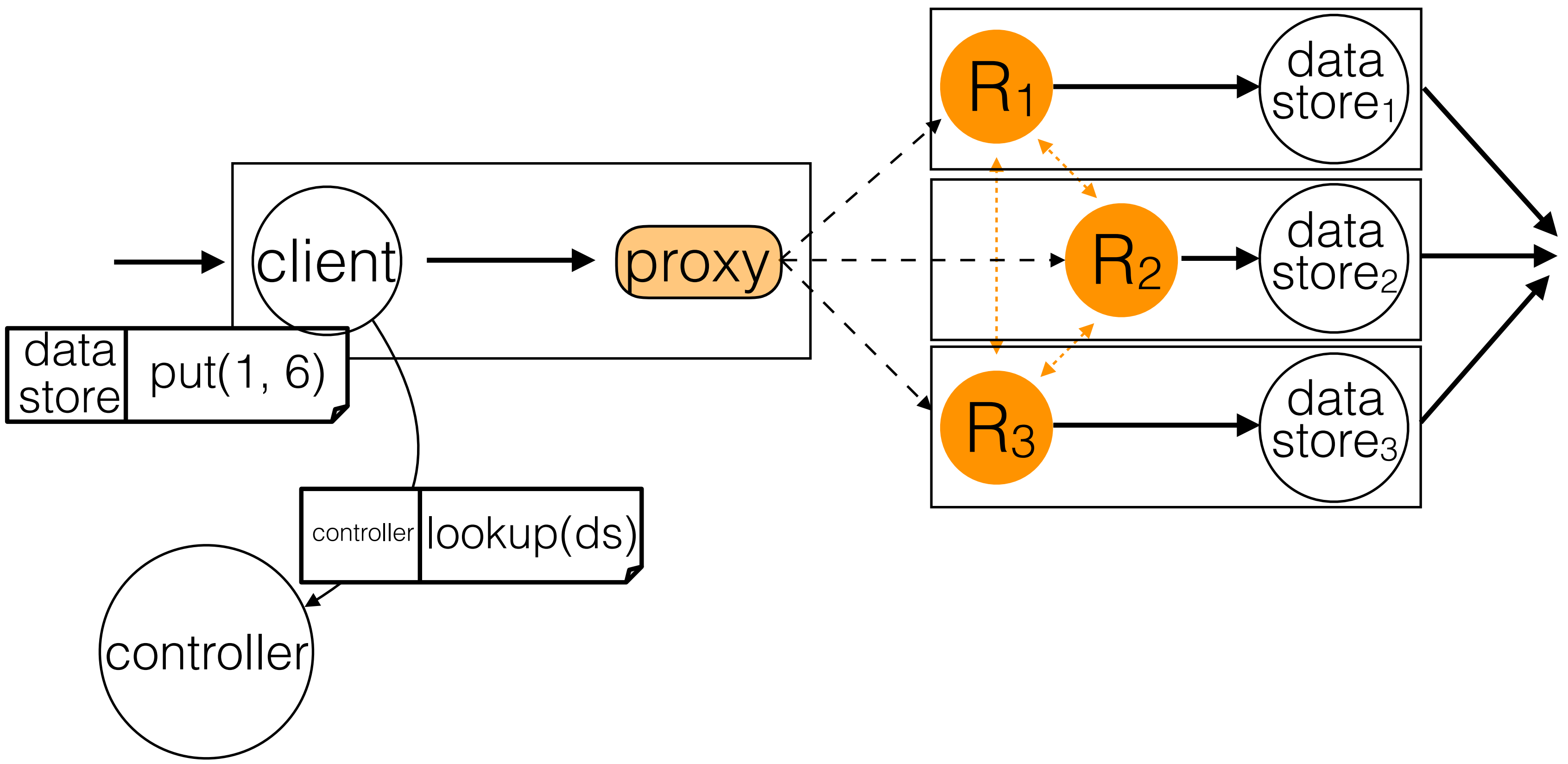
Dynamic Routing



- send msg(dest,payload)
- look for dest in routing table
- dest not present
- send lookup message to controller

Dynamic Routing

msg: 



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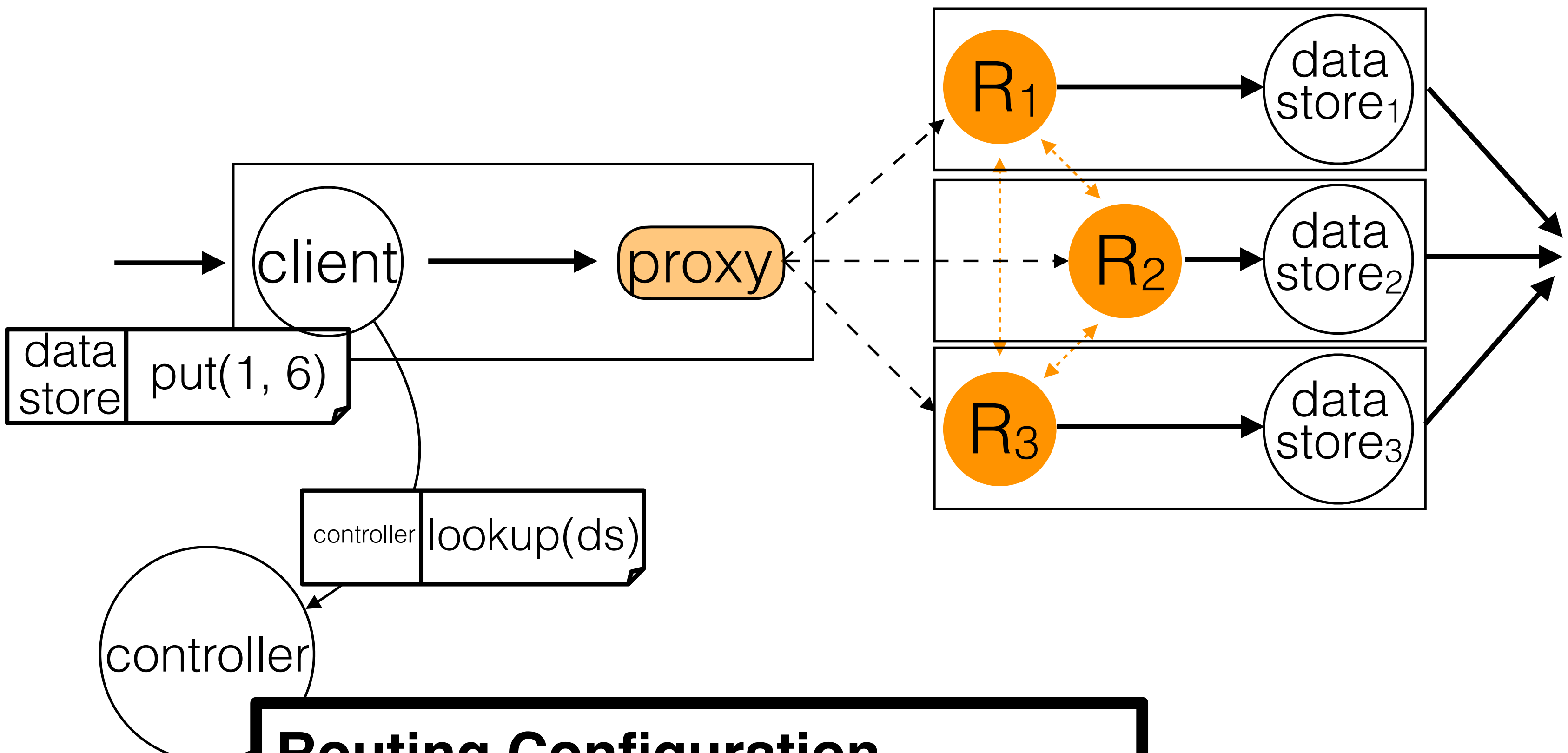
msg: dest | payload



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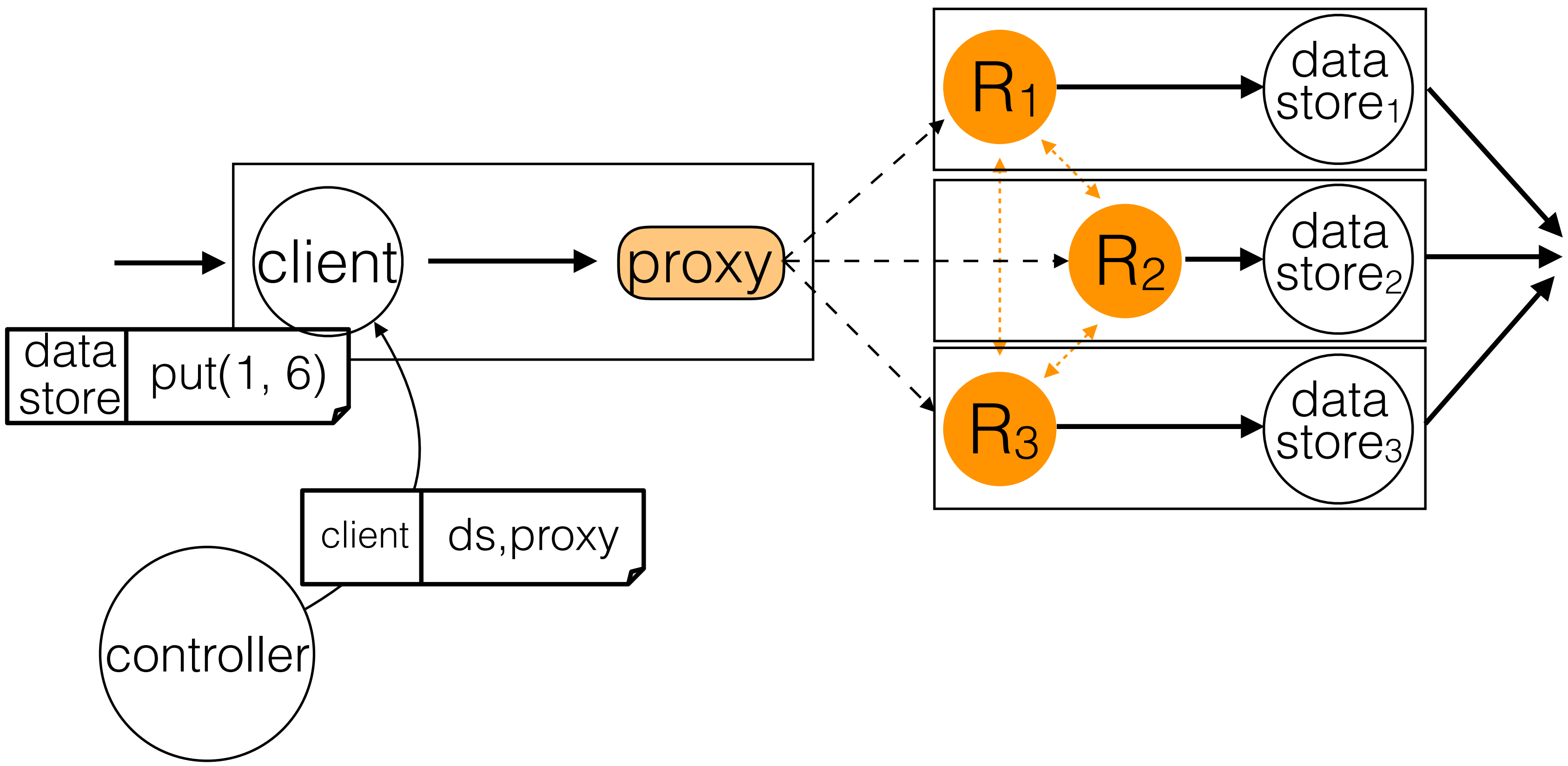

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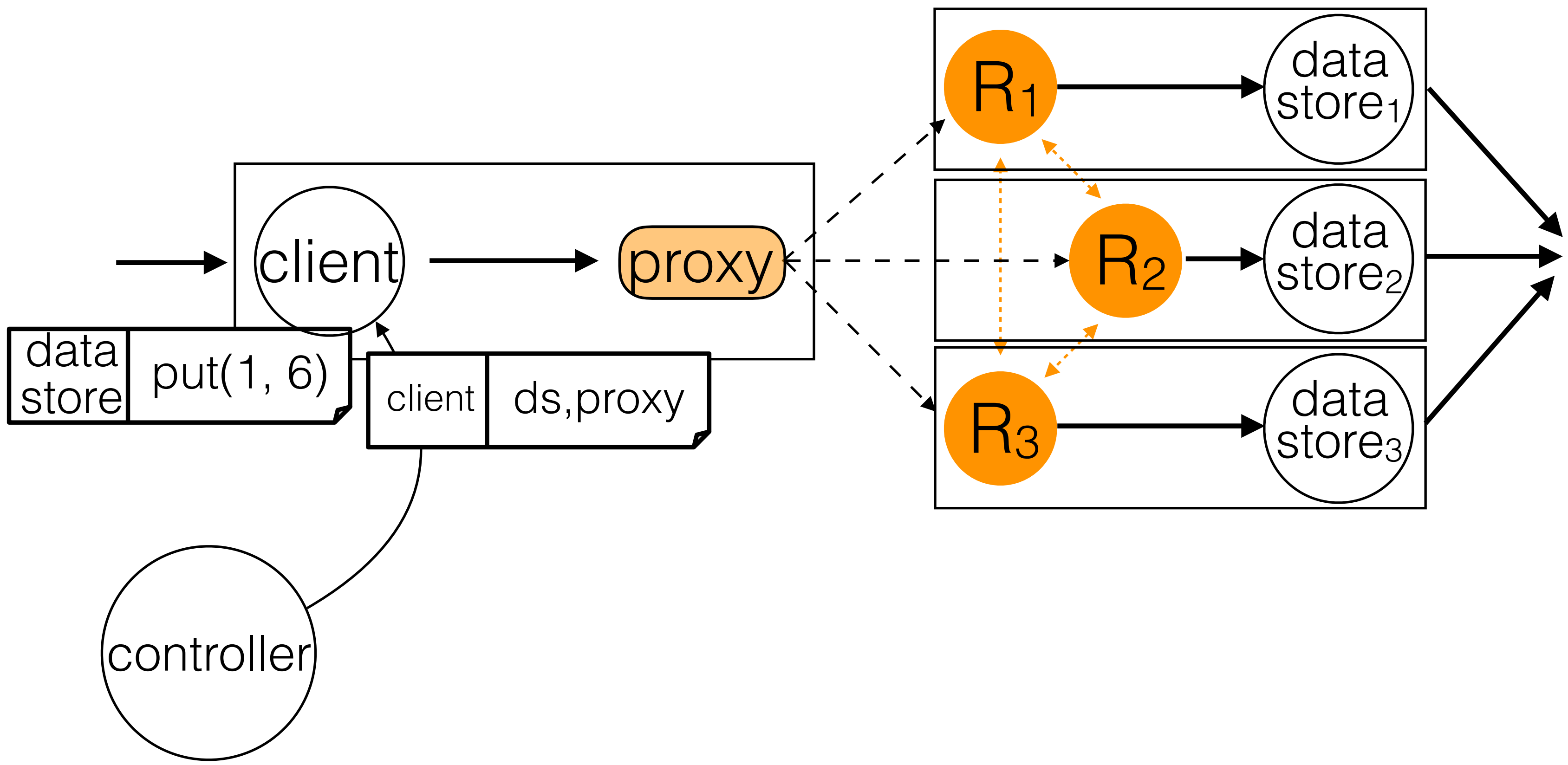

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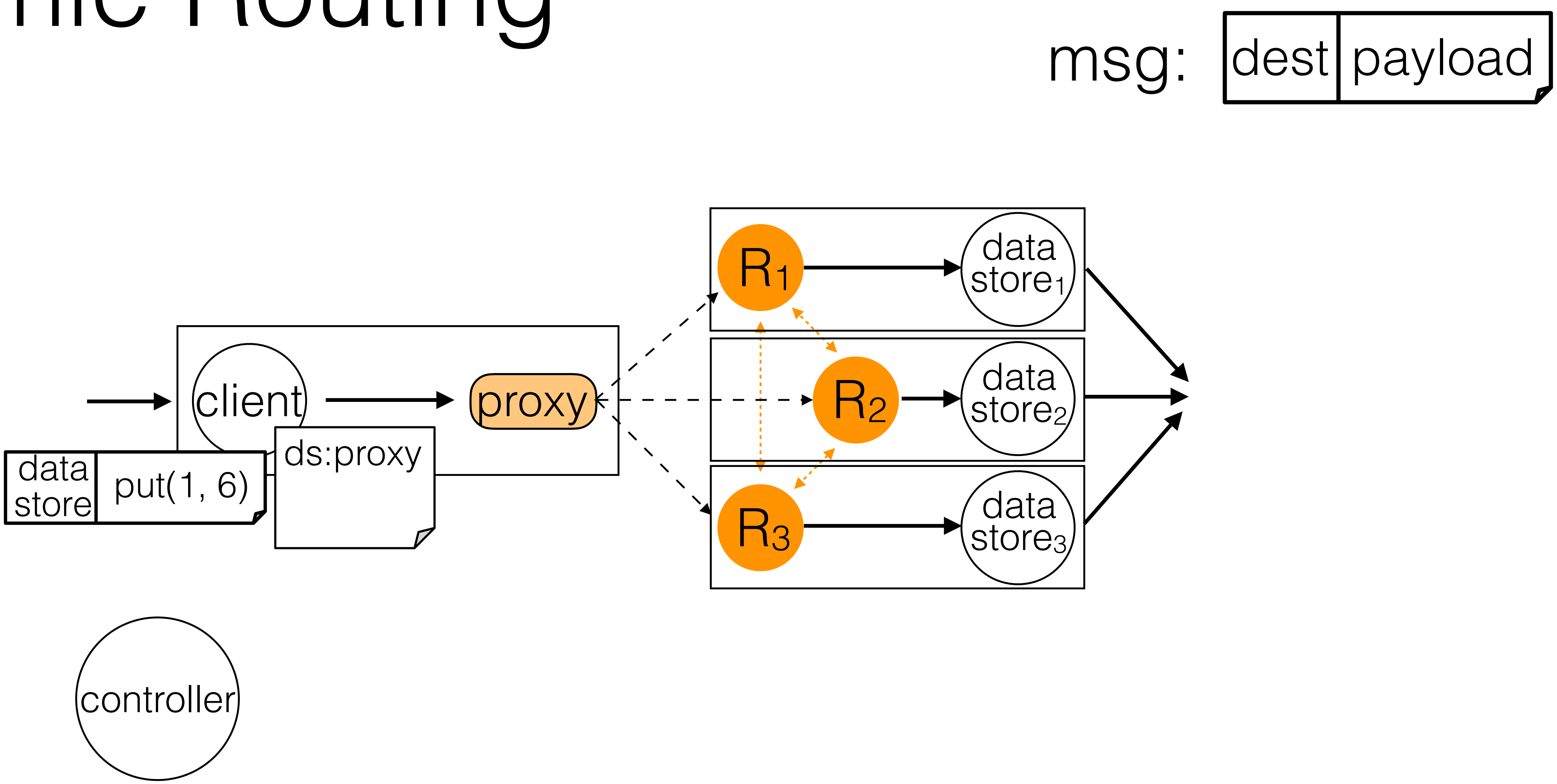

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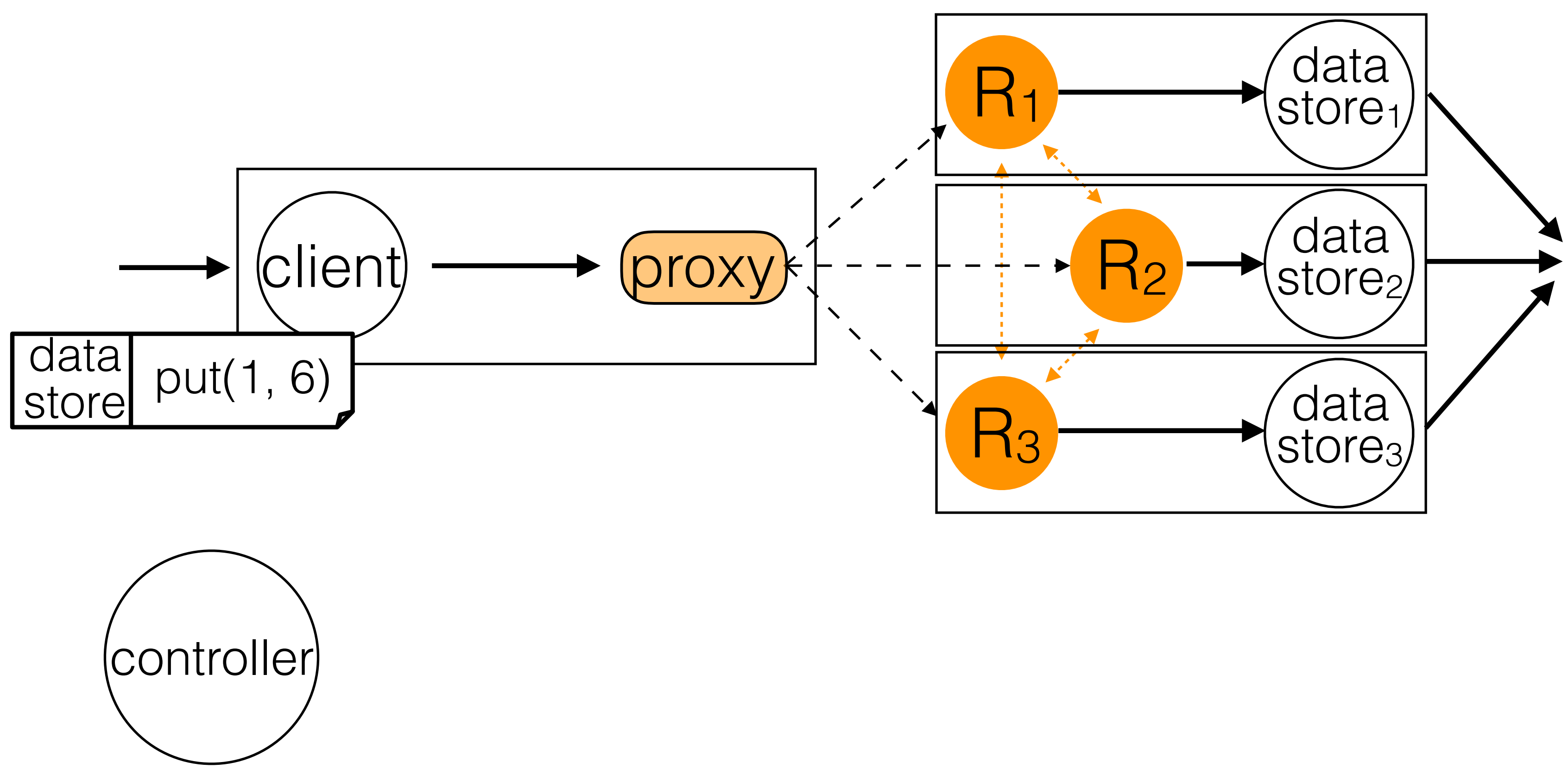

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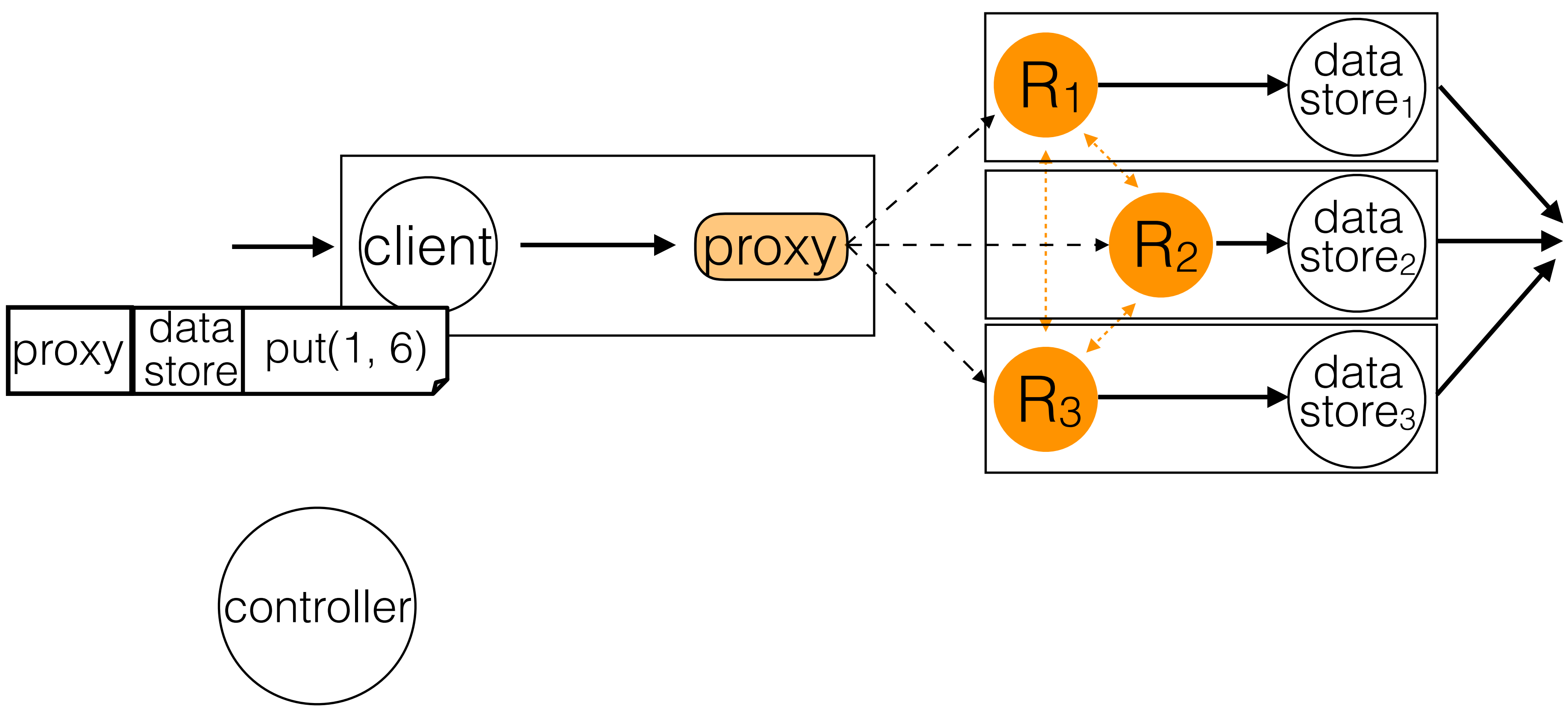

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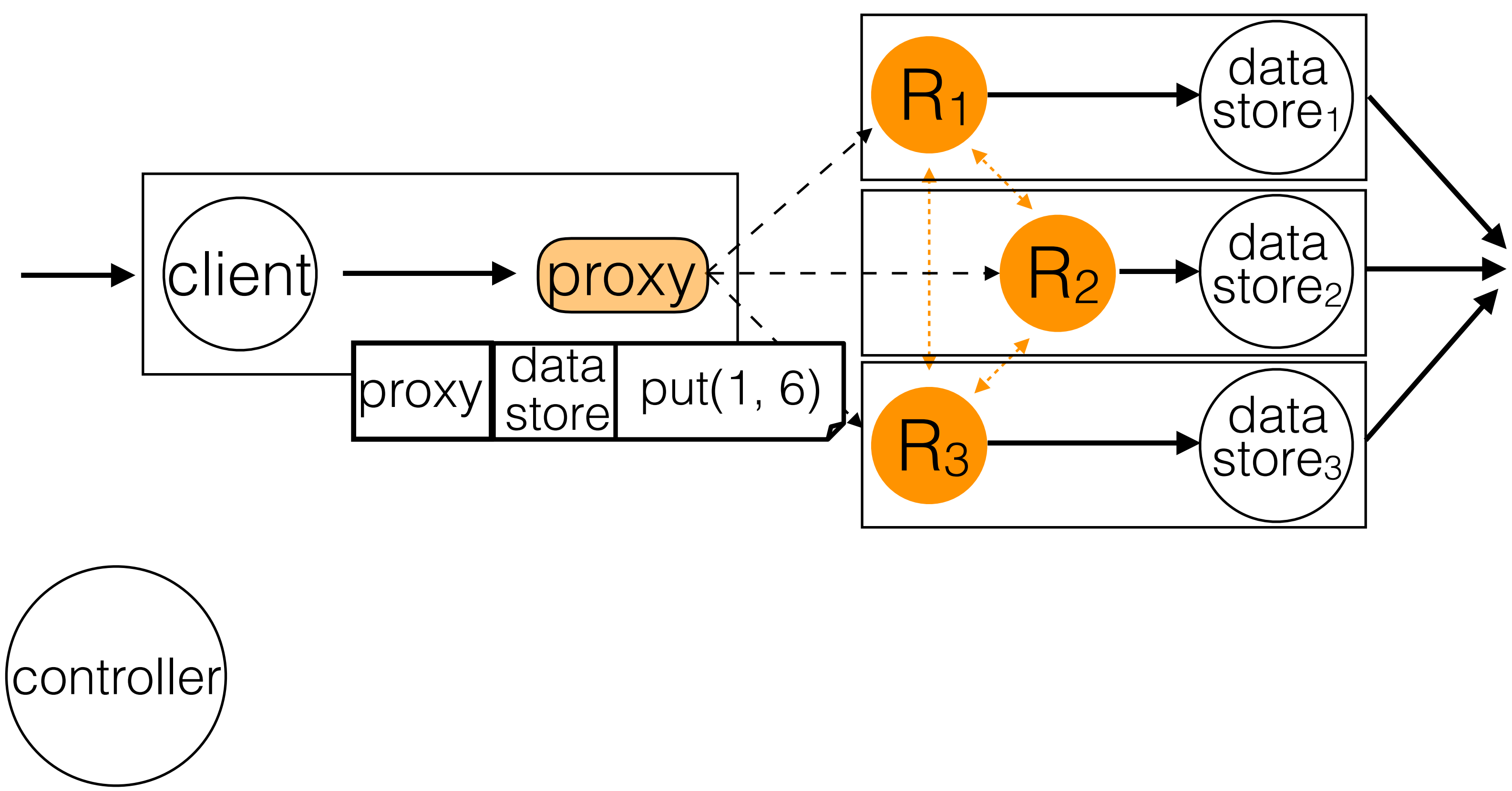

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Conclusion

- Ovid introduces new abstractions and a new way of modeling distributed systems.
- Ovid can create distributed systems that can be reconfigured and deployed on the fly.
- Ovid makes building, running, maintaining and evolving distributed systems an easy task.