HAZELCAST

Art of Data Distribution

open source, in-memory data grid

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@oztalip

Who uses Hazelcast?

Financials

Telco

Gaming

e-commerce

Every **sec.** one Hazelcast node starts around the globe

9th Fastest Growing Skill

Hazelcast

ertise

Hazelcast ▲176% y/y

Primary Industry: Computer Software

✓ Listed on your profile | See Suggested Skills

Hazelcast Professionals

Fuad Malikov YOU

Managing Partner at Hazelcast

After several years of consultancy in Tel co and Banking projects I have joined to the Hazelcast team to develop...

Serban Balamaci 2nd

Senior Java Software Developer

Currently 1 year Java Developer at 1&1 Internet Mail&Media: New version of the WEB.DE portal. - New version of...

Matias Sulik 2nd

Sr. Software Architect at Despegar.com

Matías has ten years of professional experience in tasks related to design and development of information systems...

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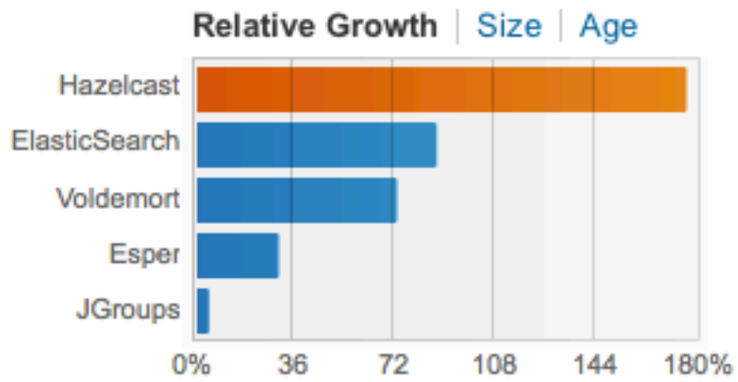
9th Fastest growing skill



Hazelcast Jobs

Software Development Manager

SmartSynch - Foster City, CA or Jackson, MS

Keywords

In-memory data grid

Distributed(Elastic) Cache

NoSQL

Clustering, Scalability, Partitioning

Cloud Computing

Map

```
import java.util.Map;
import java.util.HashMap;

Map map = new HashMap();
map.put(“1”, “value”);
map.get(“1”);
```

Concurrent Map

```
import java.util.Map;
import java.util.concurrent.*;

Map map = new ConcurrentHashMap();
map.put(“1”, “value”);
map.get(“1”);
```

Distributed Map

```
import java.util.Map;
import com.hazelcast.core.Hazelcast;

Map map = Hazelcast.getMap("mymap");
map.put("1", "value");
map.get("1");
```

Why Hazelcast?

To build **highly available** and **scalable** applications

Alternatives

Oracle Coherence

IBM Extreme Scale

VMware Gemfire

Gigaspaces

Redhat Infinispan

Gridgain

Terracotta

Difference

License/Cost

Feature-set

API

Ease of use

Main focus (distributed map, tuple space, cache, processing vs. data)

Light/Heavy weight

HAZELCAST

Apache License

Lightweight without any dependency

1.7 MB jar

Introducing Hazelcast

Map, queue, set, list, lock, semaphore, topic and executor service

Native Java, C#, REST and Memcache Interfaces

Cluster info and membership events

Dynamic clustering, backup, fail-over

Transactional and secure

Use-cases

Scale your application

Share data across cluster

Partition your data

Send/receive messages

Balance the load

Process in parallel on many JVM

Demo

Where is the Data?

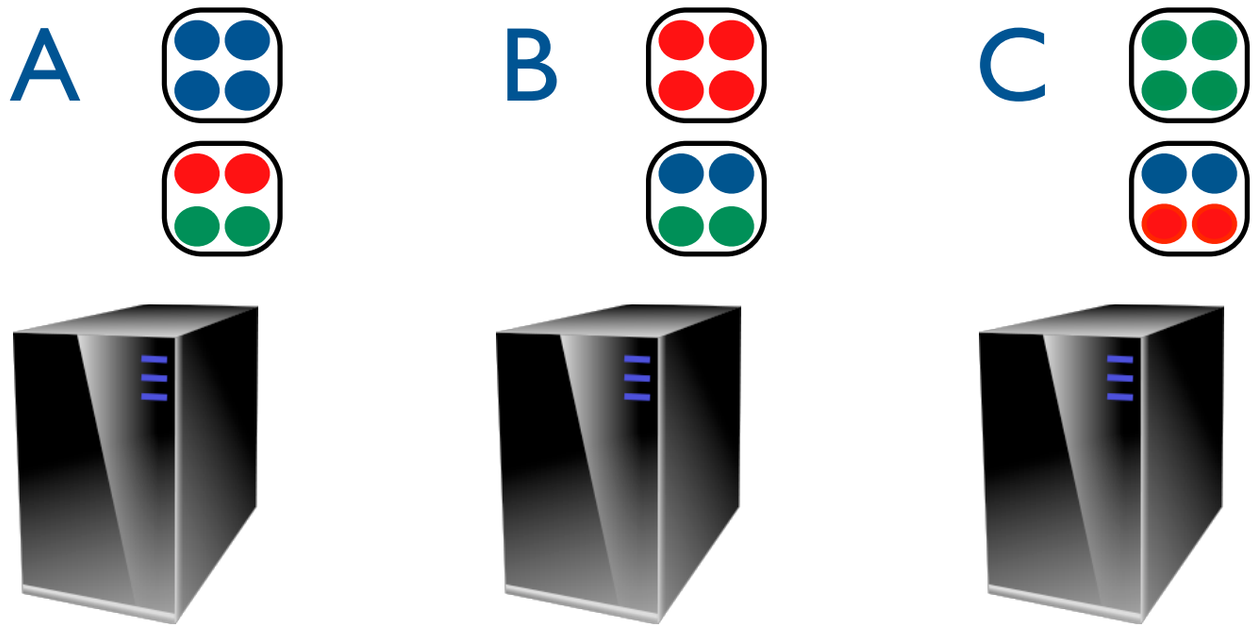
Data Partitioning in a Cluster

Fixed number of partitions (default 271)

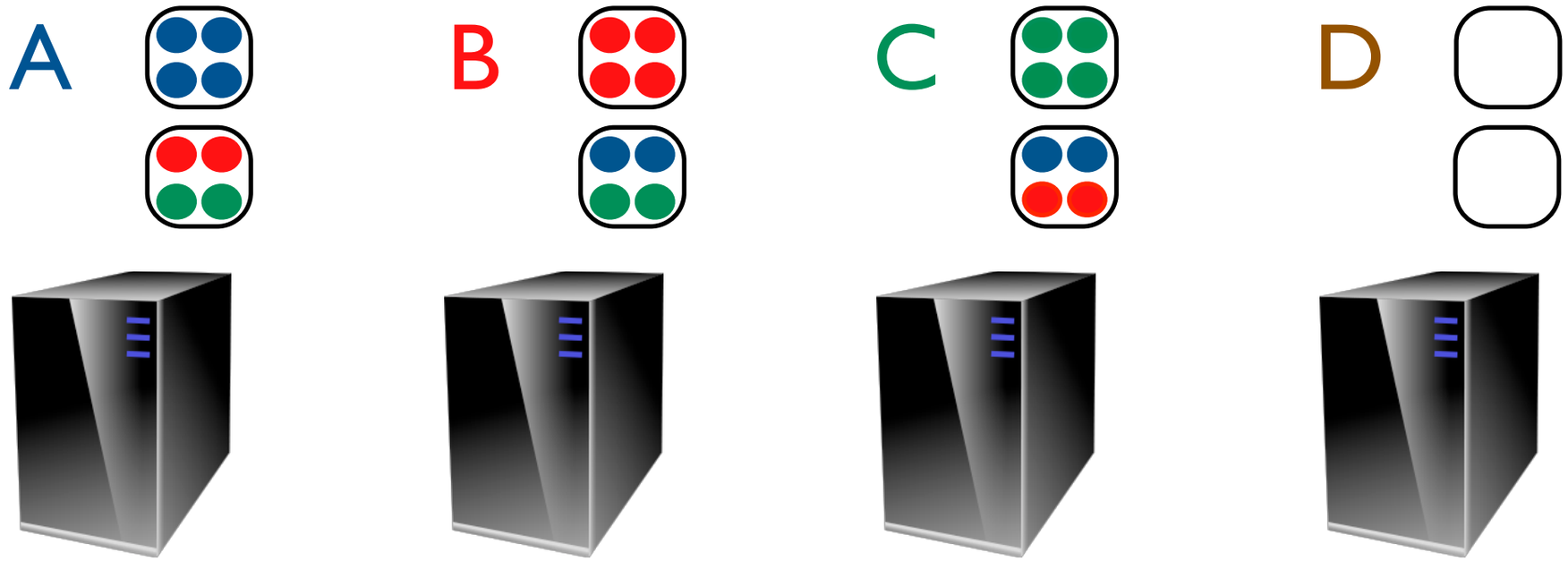
Each key falls into a partition

```
partitionId = hash(keyData)%PARTITION_COUNT
```

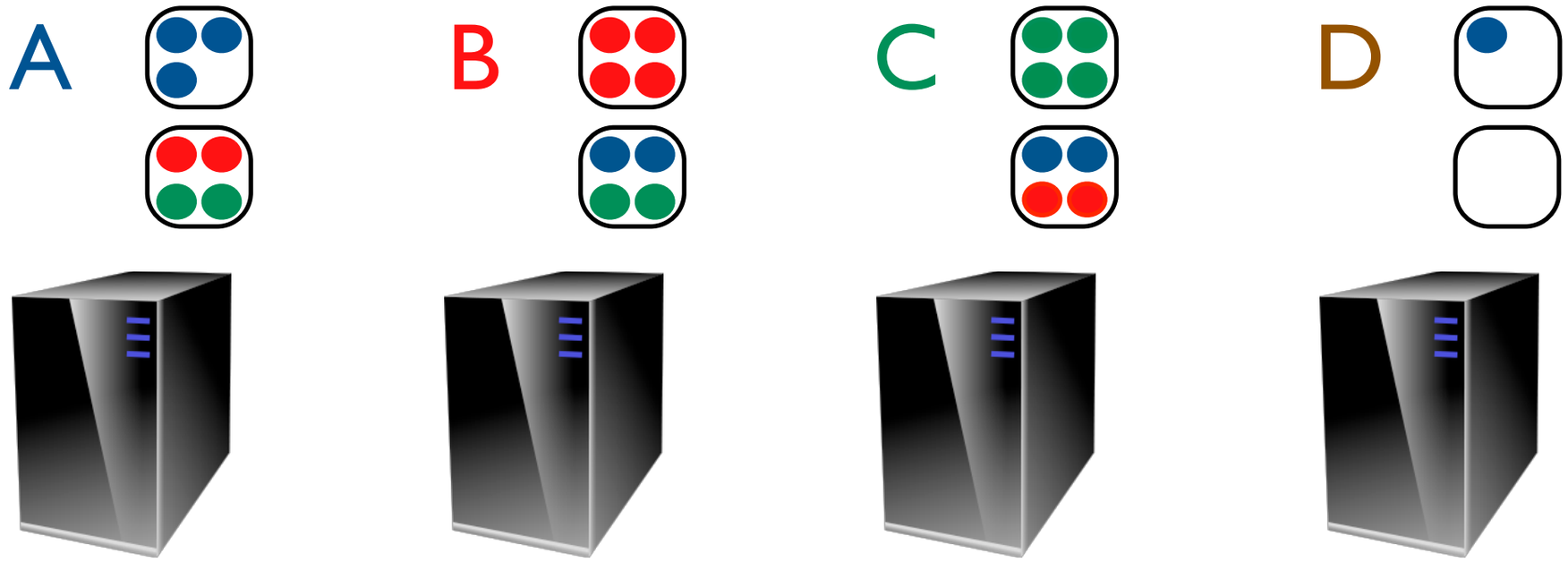
Partition ownerships are reassigned upon membership change



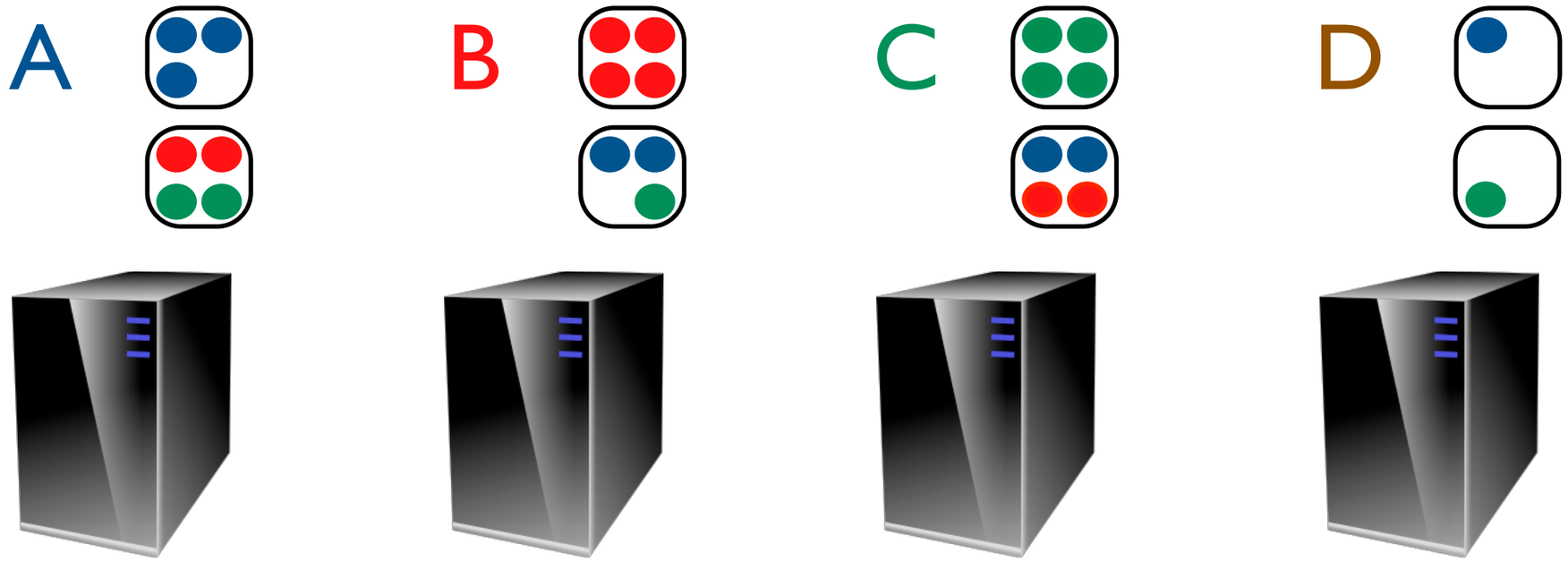
New Node Added



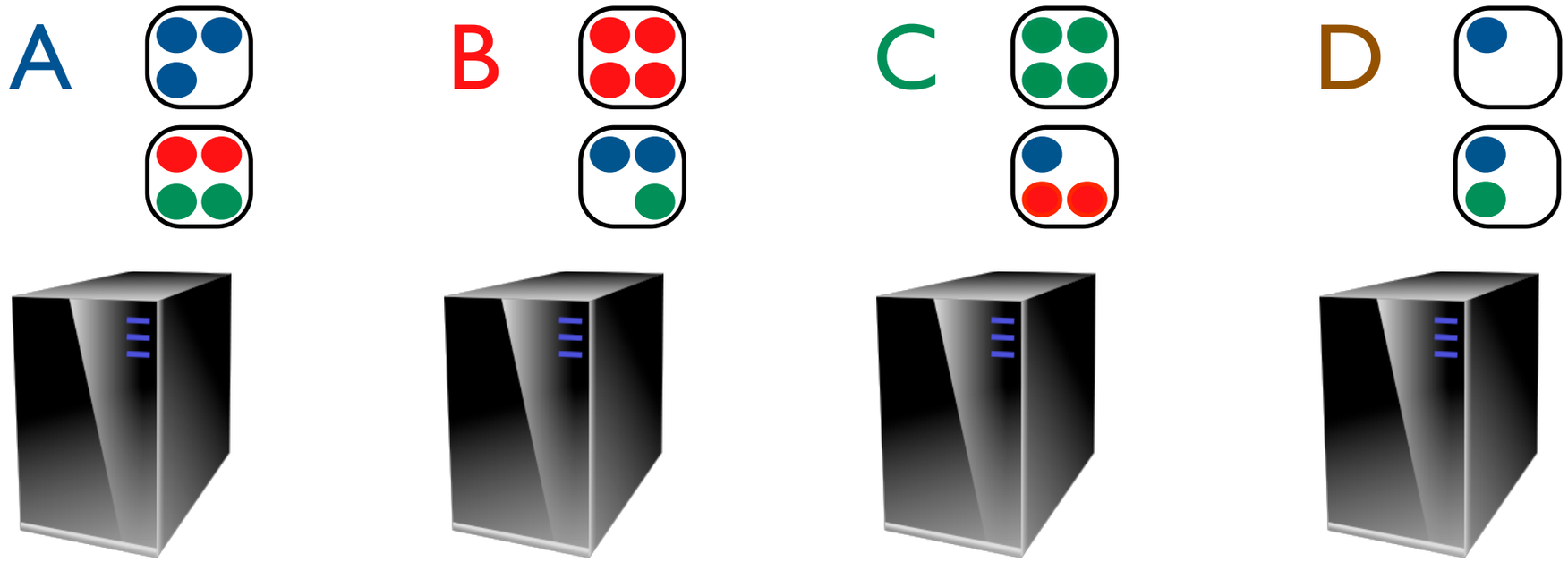
Migration



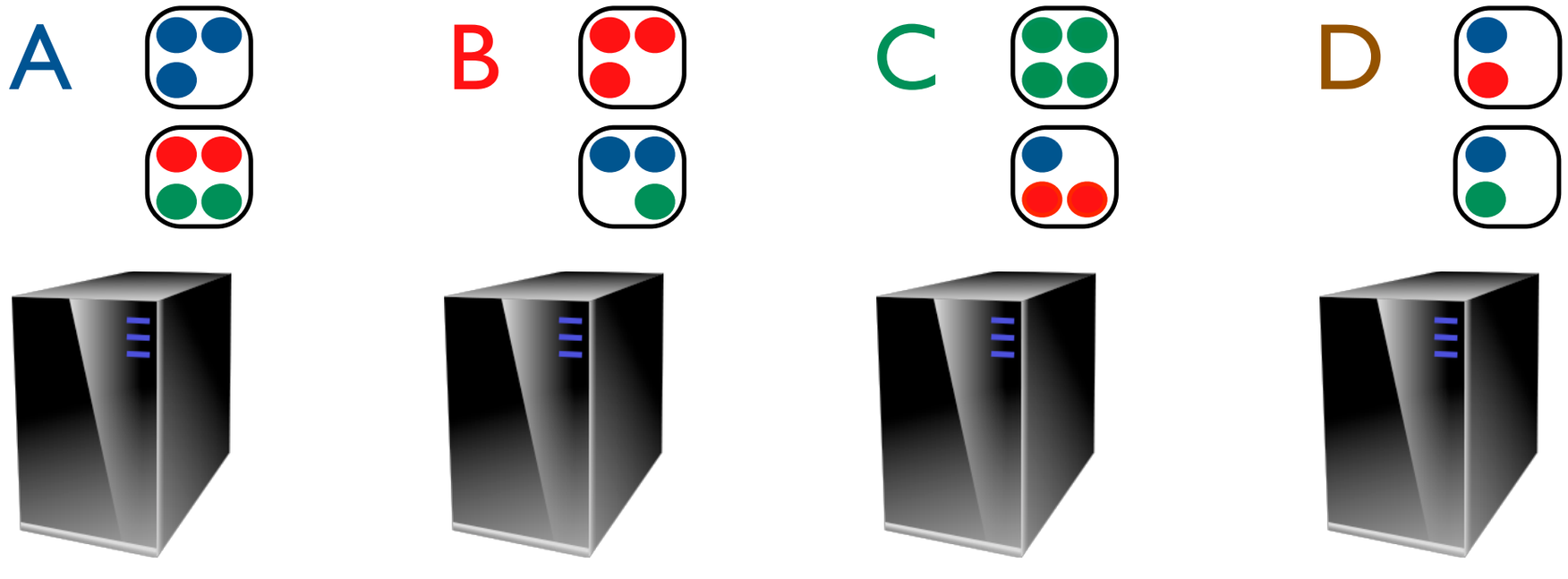
Migration



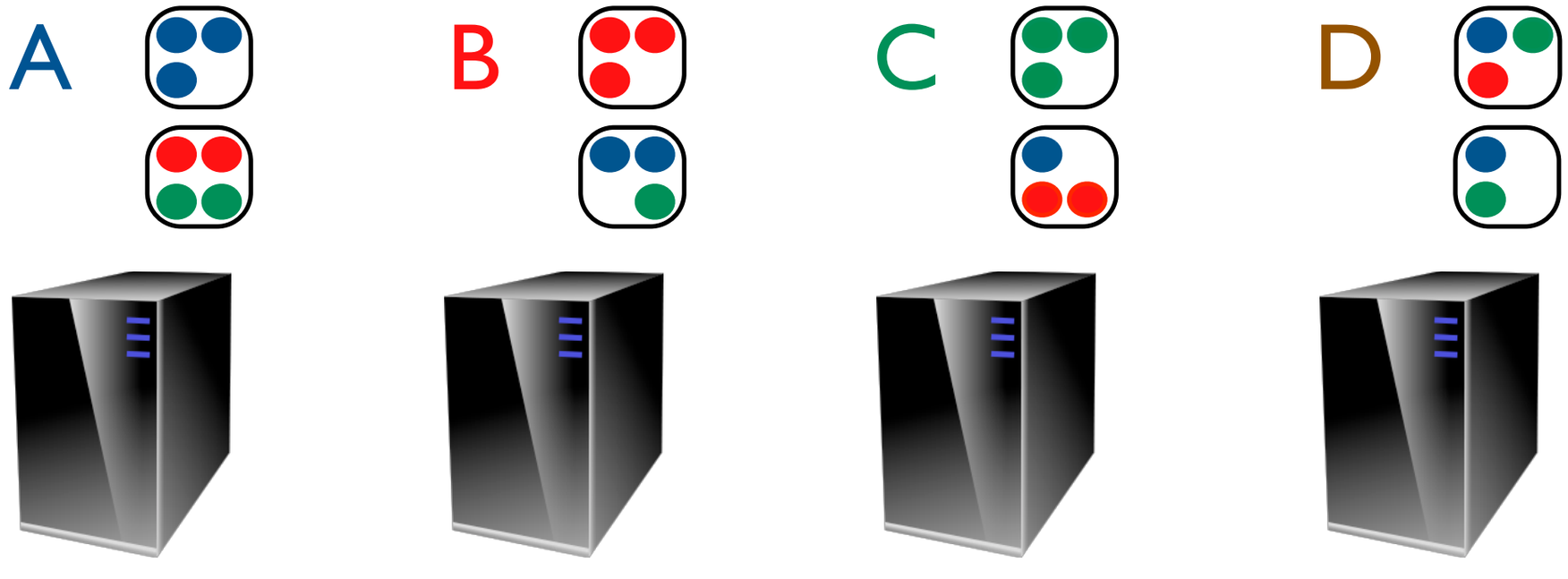
Migration



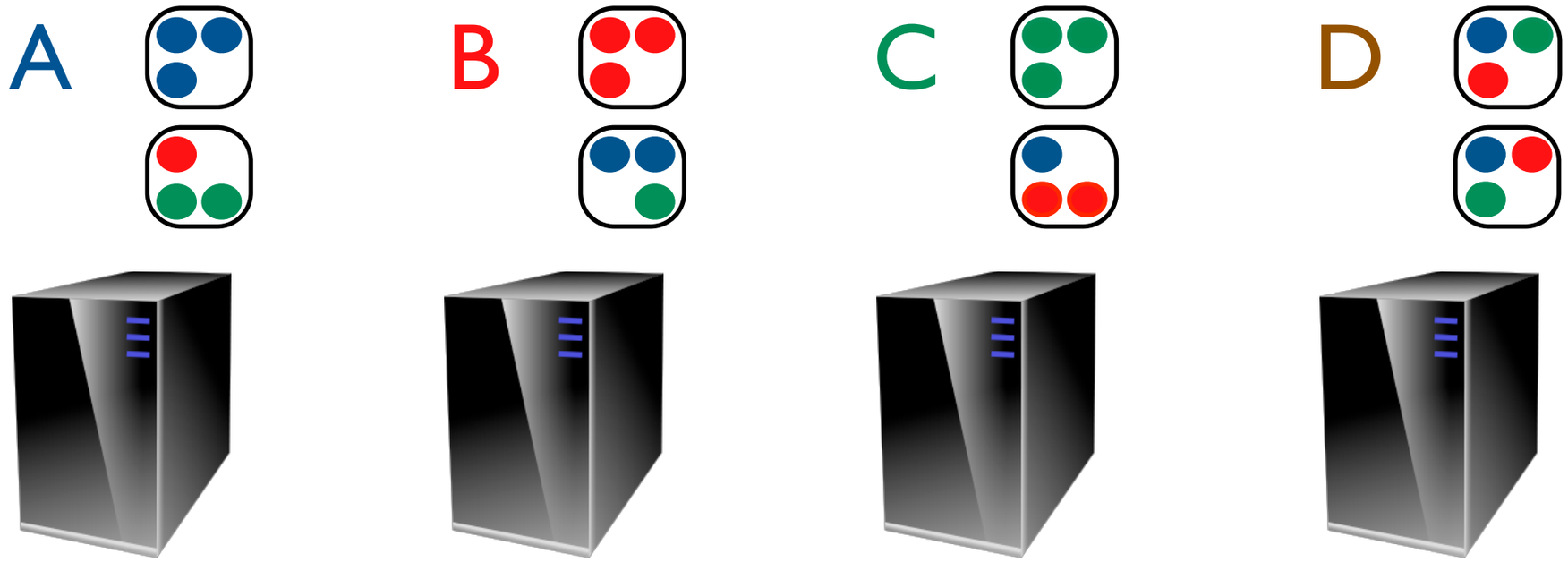
Migration



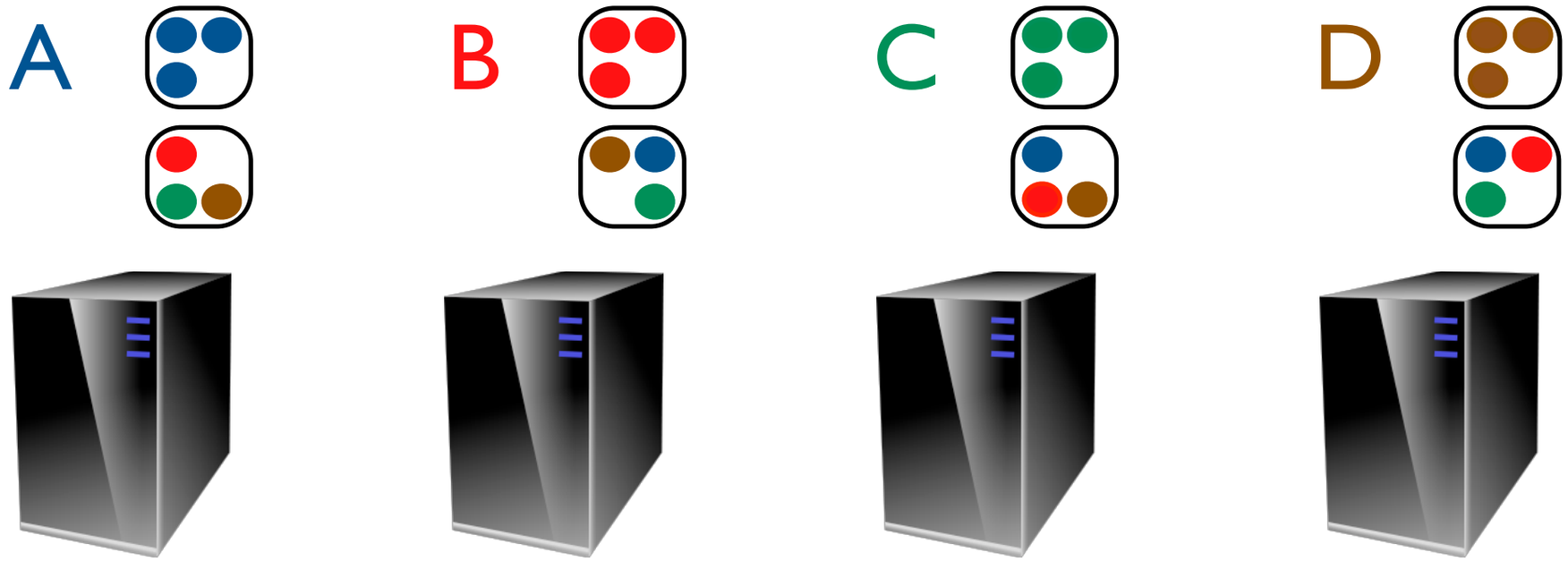
Migration



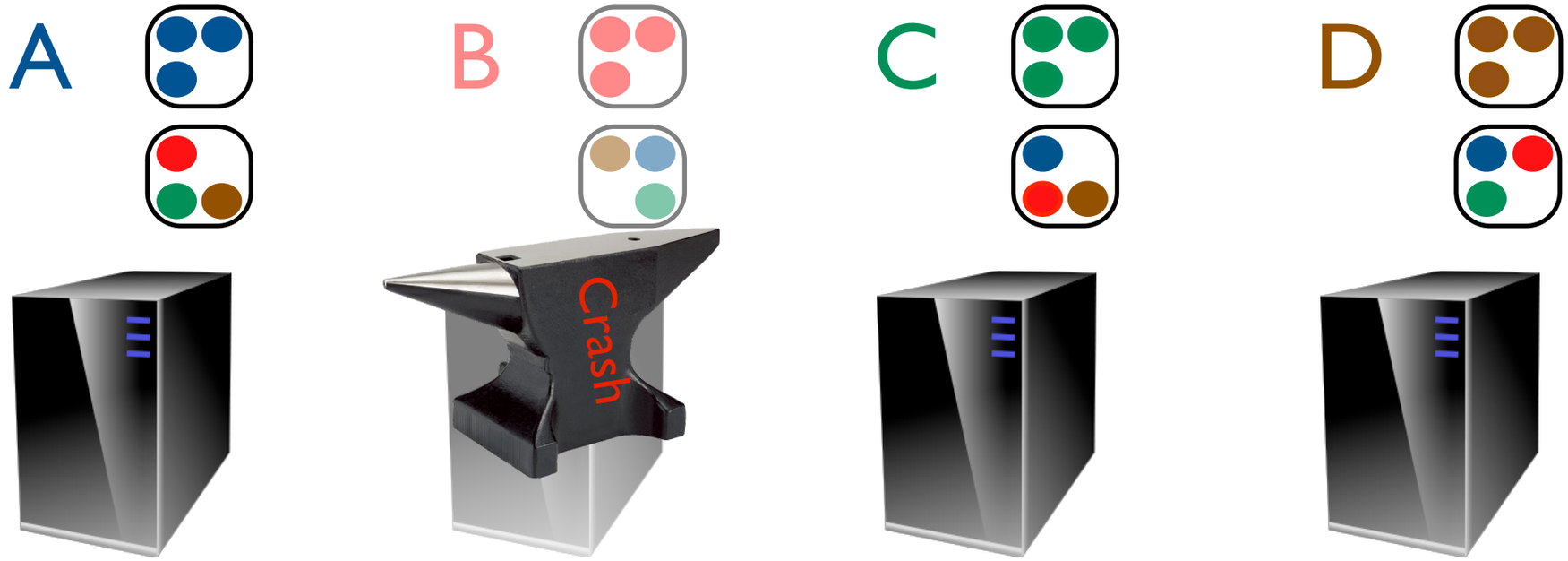
Migration



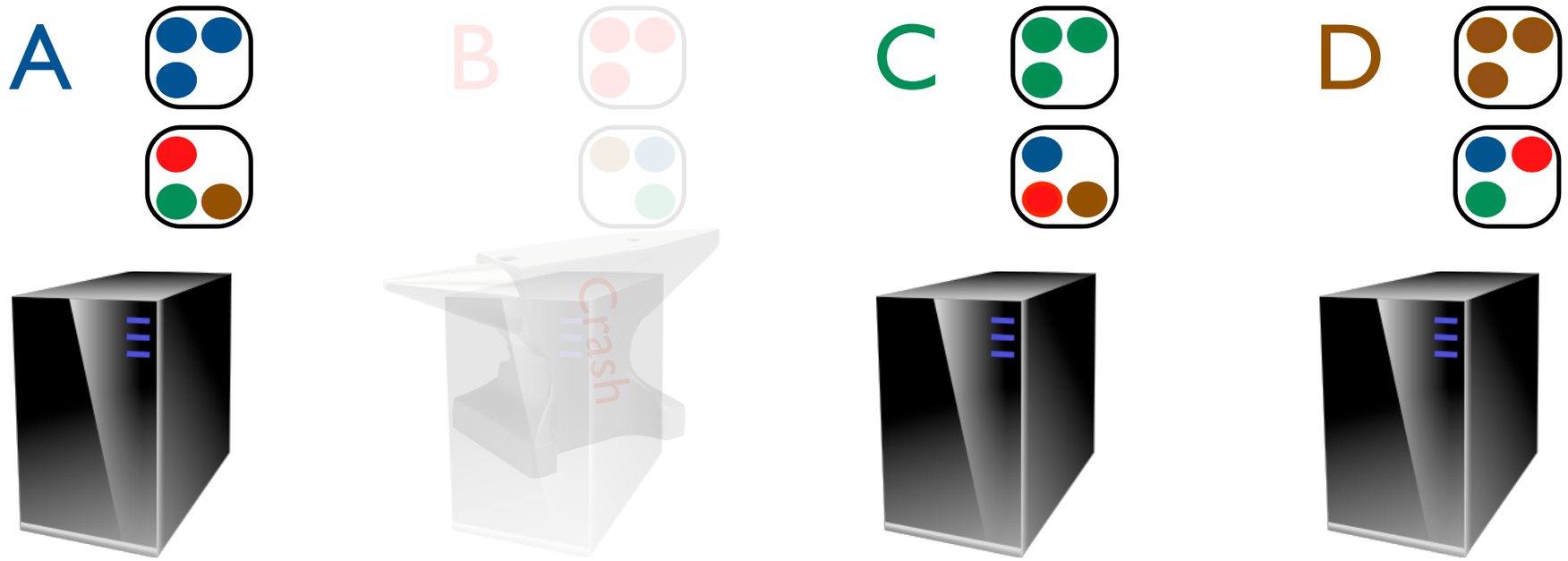
Migration Complete



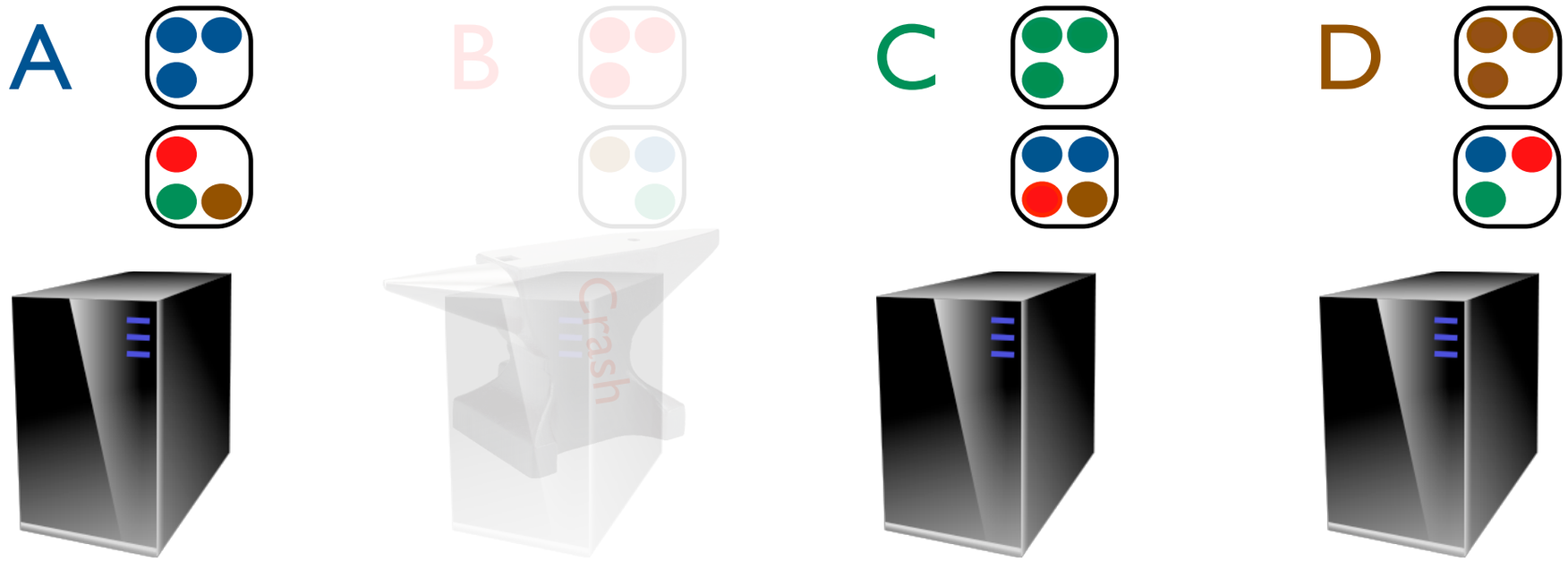
Node Crashes



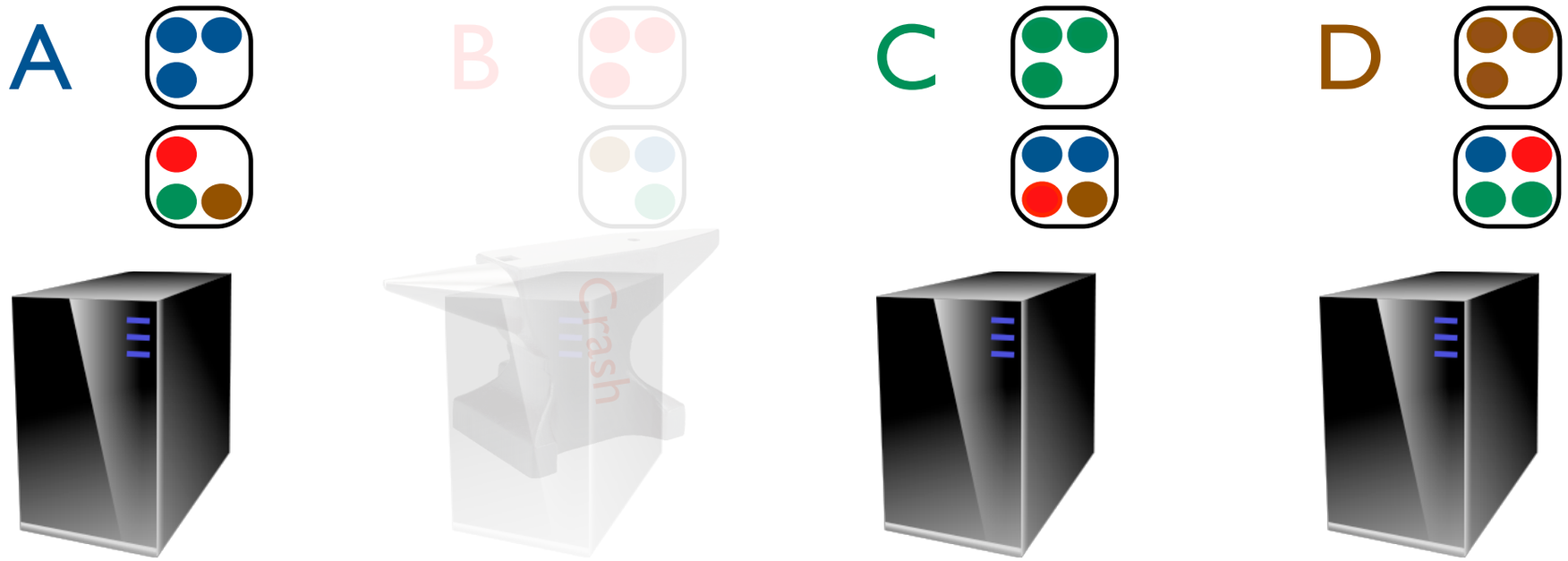
Restoring Backups



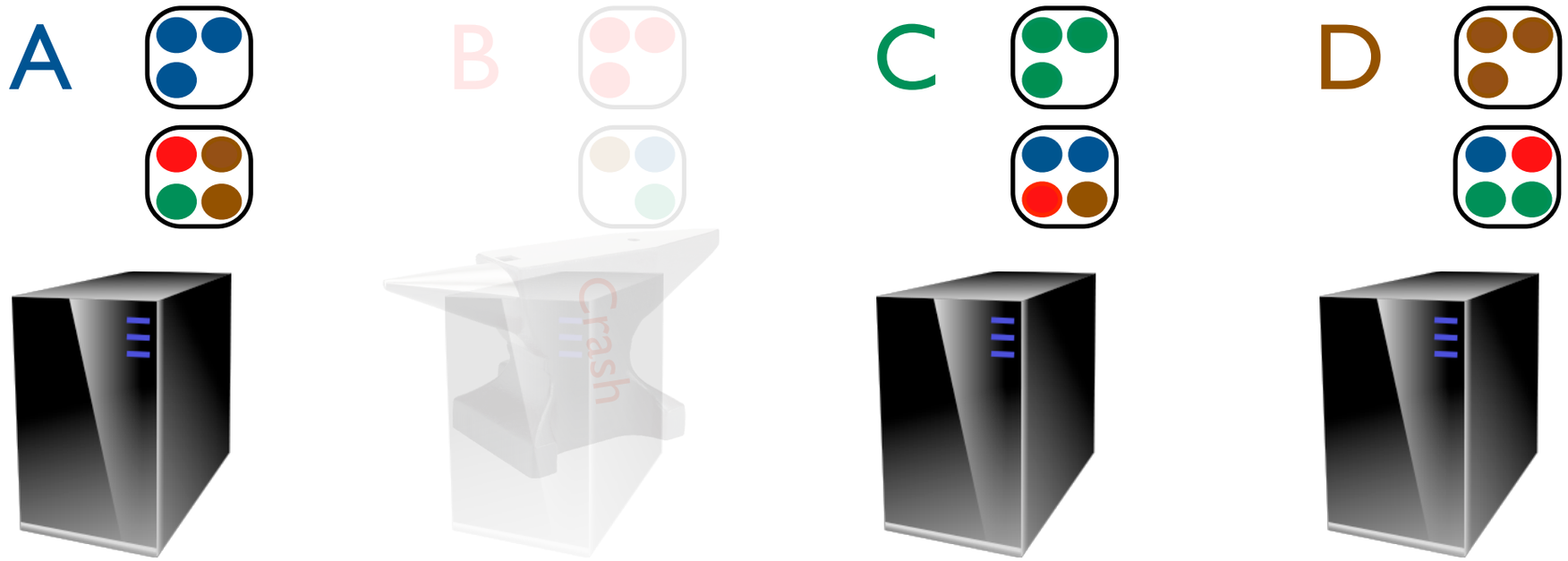
Restoring Backups



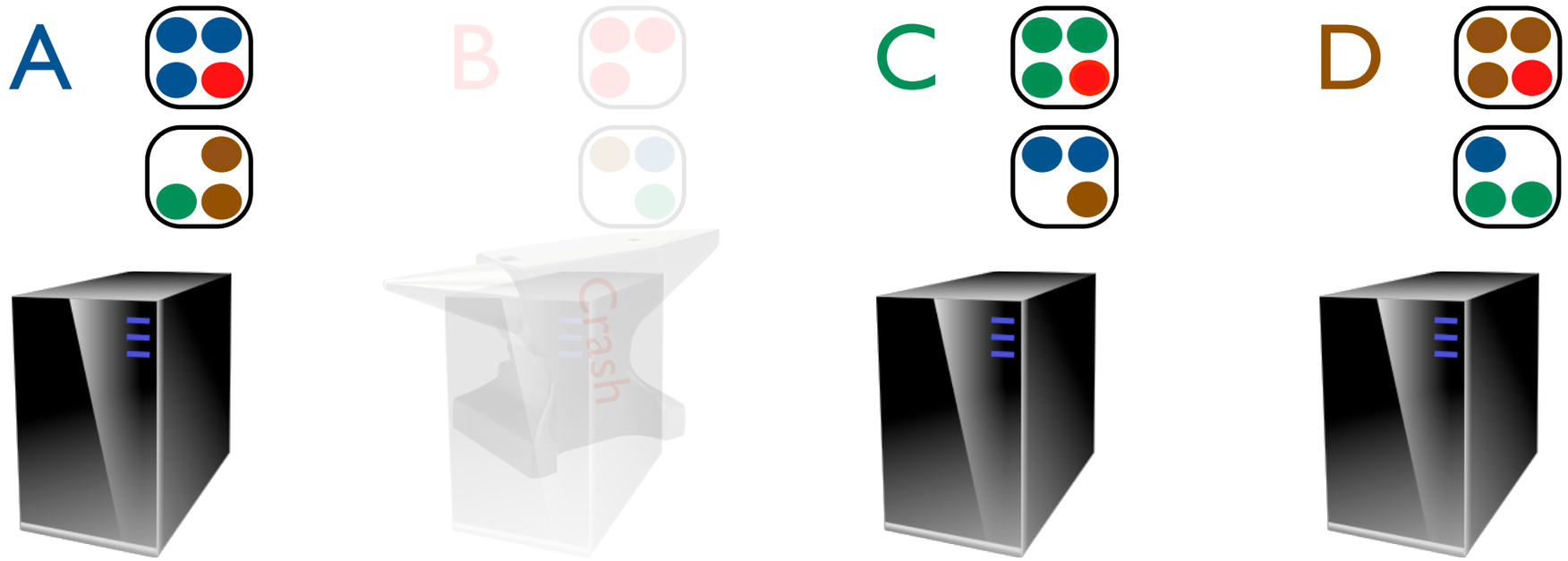
Restoring Backups



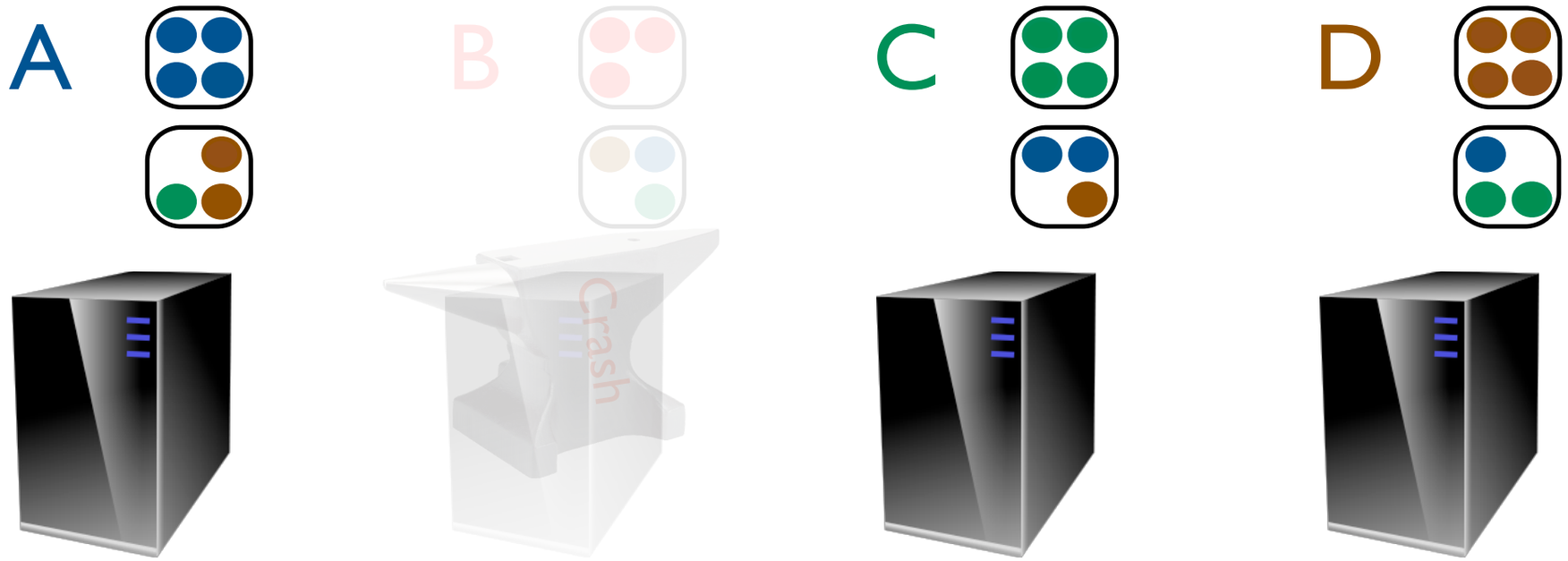
Restoring Backups



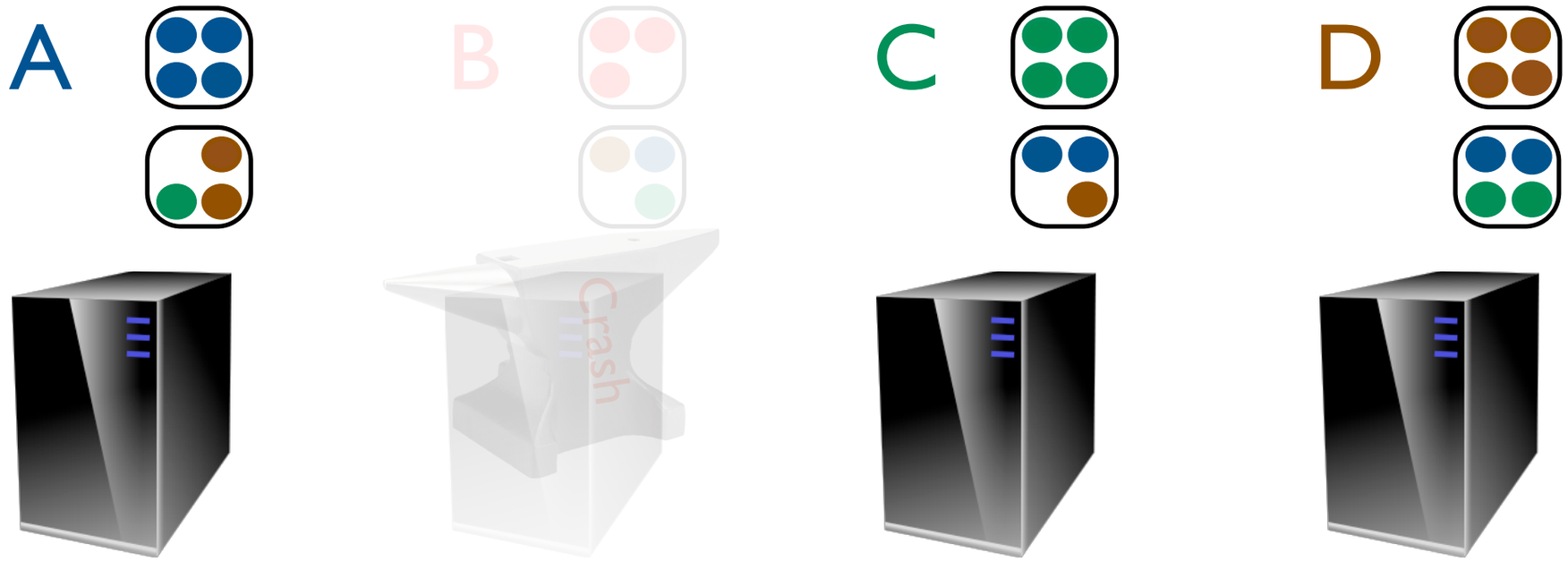
Restoring Data from Backup



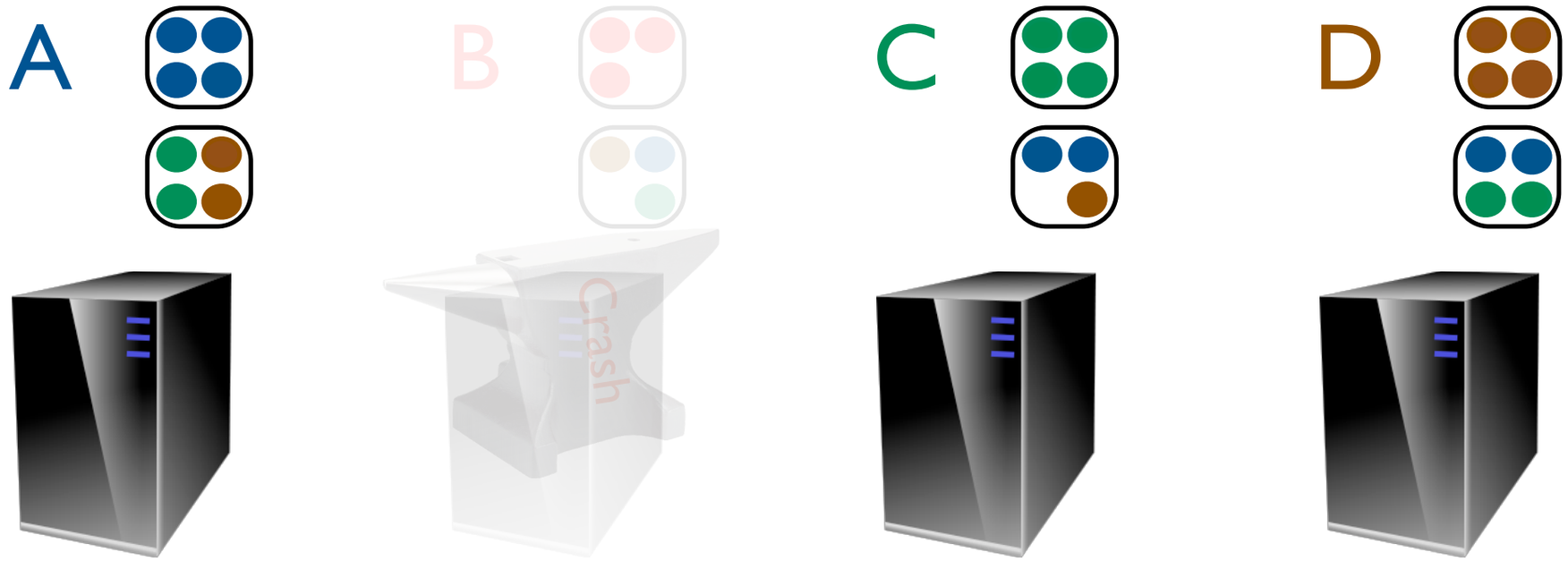
Data is Recovered from Backup



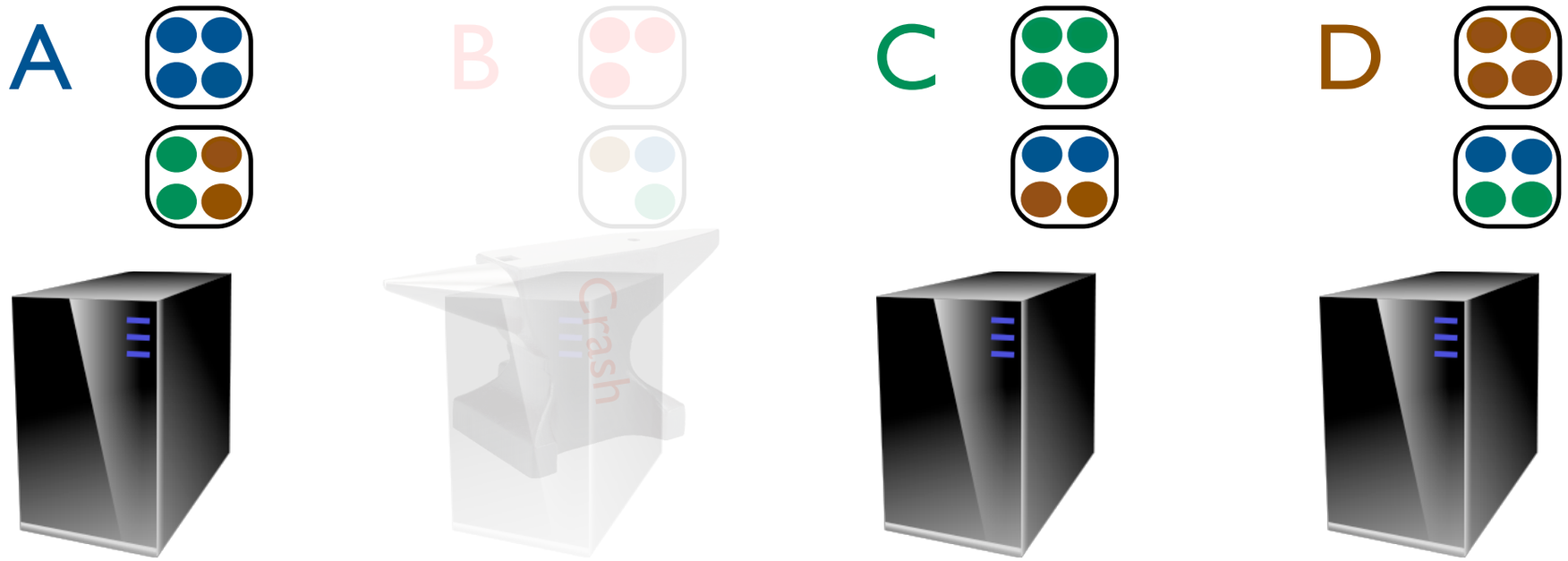
Backup for Recovered Data



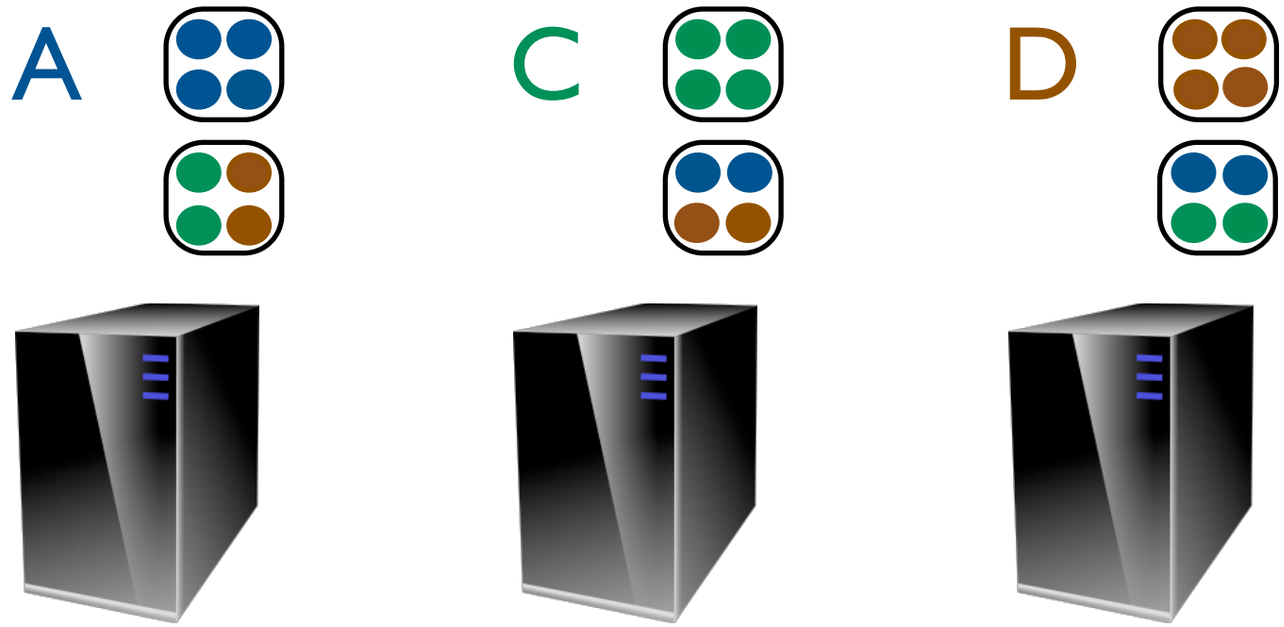
Backup for Recovered Data



Backup for Recovered Data

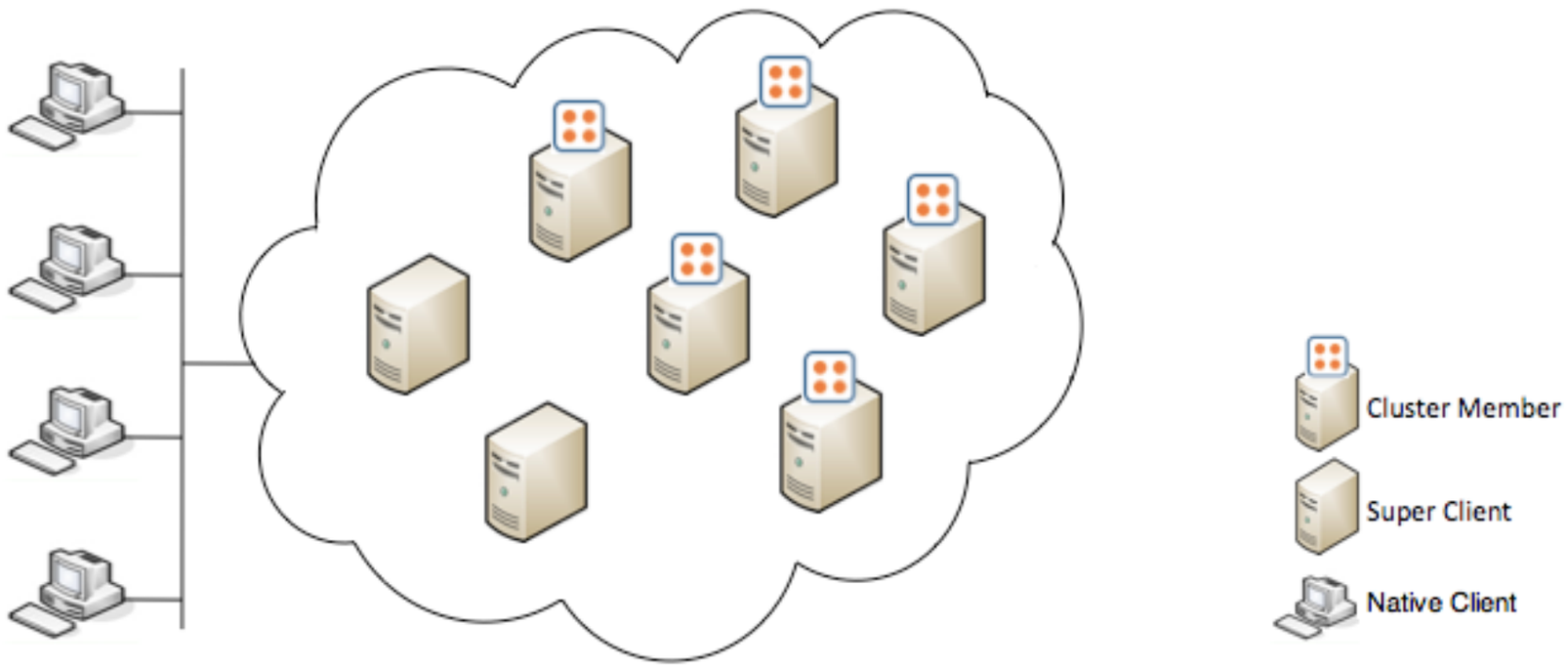


All Safe



Node Types

Topology



Native Client:

```
HazelcastInstance client = HazelcastClient.newHazelcastClient(clientConfig);
```

Lite Member:

-Dhazelcast.lite.member=true

Hazelcast Enterprise

Community vs Enterprise

Enterprise =

Community +

Elastic Memory + Security + Man. Center

Elastic Memory is OFF-HEAP storage

```
<hazelcast>
    ...
    <map name="default">
        ...
        <storage-type>OFFHEAP</storage-type>
    </map>
</hazelcast>
```

JAAS based Security

- Credentials
- Cluster Login Module
- Cluster Member Security
- Native Client Security
  - Authentication
  - Authorization
  - Permission

Code Samples

Hazelcast

Hazelcast is thread safe

```
Map<String, Employee> = Hazelcast.getMap("employees");
List<Users> = Hazelcast.getList("users");
```

Many instances on the same JVM

```
Config config = new Config();
HazelcastInstance h1 = Hazelcast.newHazelcastInstance(config)
HazelcastInstance h2 = Hazelcast.newHazelcastInstance(config)
```

All objects must be serializable

```
class Employee implements java.io.Serializable
 //better
class Employee implements com.hazelcast.nio.DataSerializable
```

Cluster Interface

```
import com.hazelcast.core.*;
import java.util.Set;

Cluster cluster = Hazelcast.getCluster();
cluster.addMembershipListener(listener);

Member localMember = cluster.getLocalMember();
System.out.println (localMember.getInetAddress());

Set<Member> setMembers = cluster.getMembers();
```

Distributed Map

```
import com.hazelcast.core.*;
import java.util.ConcurrentMap;

Map<String, Customer> map = Hazelcast.getMap("customers");
map.put ("1", customer);
Customer c = map.get("1");

//ConcurrentMap methods
map.putIfAbsent ("2", new Customer(“Chuck Norris”));
map.replace ("3", new Customer(“Bruce Lee”));
```

Distributed Queue

```
import com.hazelcast.core.Hazelcast;
import java.util.concurrent.BlockingQueue;
import java.util.concurrent.TimeUnit;

BlockingQueue<Task> queue = Hazelcast.getQueue("tasks");

queue.offer(task);
Task t = queue.poll();

//Timed blocking Operations
queue.offer(task, 500, TimeUnit.MILLISECONDS)
Task t = queue.poll(5, TimeUnit.SECONDS);

//Indefinitely blocking Operations
queue.put(task)
Task t = queue.take();
```

Distributed Lock

```
import com.hazelcast.core.Hazelcast;
import java.util.concurrent.locks.Lock;

Lock mylock = Hazelcast.getLock(mylockobject);
mylock.lock();
try {
// do something
} finally {
     mylock.unlock();
}

//Lock on Map
IMap<String, Customer> map = Hazelcast.getMap("customers");
map.lock("1");
try {
// do something
} finally {
     map.unlock("1");
}
```

Distributed Topic

```
import com.hazelcast.core.*;

public class Sample implements MessageListener {
   public static void main(String[] args) {
      Sample sample = new Sample();
      ITopic<String> topic = Hazelcast.getTopic ("default");
      topic.addMessageListener(sample);
      topic.publish ("my-message-object");
   }
   public void onMessage(Object msg) {
      System.out.println("Got msg :" + msg);
   }
}
```

Distributed Events

```
import com.hazelcast.core.*;

public class Sample implements EntryListener {
    public static void main(String[] args) {
        Sample sample = new Sample();
        IMap map  = Hazelcast.getMap ("default");
        map.addEntryListener (sample, true);
        map.addEntryListener (sample, "key");
    }
    public void entryAdded(EntryEvent event) {
        System.out.println("Added " + event.getKey() + ":" +
                                                  event.getValue());
    }
    public void entryRemoved(EntryEvent event) {
        System.out.println("Removed " + event.getKey() + ":" +
                                                  event.getValue());
    }
    public void entryUpdated(EntryEvent event) {
        System.out.println("Updated " + event.getKey() + ":" +
                                                  event.getValue());
    }
}
```

Executor Service

Hello Task

A simple task

```
public class HelloTask implements Callable<String>, Serializable{
   @Override
   public String call(){
      Cluster cluster = Hazelcast.getCluster();
      return "Hello from " + cluster.getLocalMember();
}
```

Execute on any member

```
ExecutorService ex = Hazelcast.getExecutorService();
Future<String> future = executor.submit(new HelloTask());
// ...
String result = future.get();
```

Attach a callback

```
DistributedTask task = ...
task.setExecutionCallback(new ExecutionCallback() {
   public void done(Future f) {
     // Get notified when the task is done!
   }
});
```

Hazelcast can execute a task ...

1. On a specific node
2. On any available node
3. On a collection of defined nodes
4. On a node owning a key

```
ExecutorService executor = Hazelcast.getExecutorService();
FutureTask<String> task1, task2;


// CASE 1: Run task on a specific member.
Member member = ...
task1 = new DistributedTask<String>(new HelloTask(), member);
executor.execute(task1);

// CASE 2: Run task on a member owning the key.
Member member = ...
task1 = new DistributedTask<String>(new HelloTask(), "key");
executor.execute(task1);

// CASE 3: Run task on group of members.
Set<Member> members = ...
task = new MultiTask<String>(new HelloTask(), members);
executor.execute(task2);
```

Executor Service Scenario

```
public int removeOrder(long customerId, long orderId){
    IMap<Long, Customer> map = Hazelcast.getMap("customers");
    map.lock(customerId);
    Customer customer = map.get(customerId);
    customer.removeOrder (orderId);
    map.put(customerId, customer);
    map.unlock(customerId);
    return customer.getOrderCount();
}
```

Add Bonus Task

```
public class OrderDeletionTask implements Callable<Integer>, PartitionAware, Serializable {

   private long customerId;
   private long orderId;

   public OrderDeletionTask(long customerId, long orderId) {
       super();
       this.customerId = customerId;
       this.orderId = orderId;
   }

   public Integer call () {
       IMap<Long, Customer> map = Hazelcast.getMap("customers");
       map.lock(customerId);
       customer customer = map. get(customerId);
       customer.removeOrder (orderId);
       map.put(customerId, customer);
       map.unlock(customerId);
       return customer.getOrderCount();
   }

   public Object getPartitionKey() {
       return customerId;
   }
}
```

Send computation over data

```
public static int removeOrder(long customerId, long orderId){
    ExecutorService es = Hazelcast.getExecutorService();
    OrderDeletionTask task = new OrderDeletionTask(customerId, orderId);
    Future future = es.submit(task);
    int remainingOrders = future.get();
    return remainingOrders;
}
```

Query

Code Samples – Query

```
public class Customer {
    private boolean active;
    private String name;
    private int age;

    // getters

    // setters

}
```

Code Samples – Query

```
import com.hazelcast.core.Hazelcast;
import com.hazelcast.core.IMap;
import com.hazelcast.query.SqlPredicate;
import java.util.Collection;

IMap map = Hazelcast.getMap("customers");


map.addIndex("active" ,false);
map.addIndex("name" ,false);
map.addIndex("age" ,true);


Collection<Customer> customers =
   map.values(new SqlPredicate("active AND age <= 30"));
```

Persistence

Persistence

```
import com.hazelcast.core.MapStore,
import com.hazelcast.core.MapLoader,

public class MyMapStore implements MapStore, MapLoader {

   public Set loadAllKeys () {
      return readKeys();
    }

   public Object load (Object key) {
     return readFromDatabase(key);
   }

   public void store (Object key, Object value) {
     saveIntoDatabase(key, value);
   }

   public void remove(Object key) {
     removeFromDatabase(key);
   }

}
```

Persistence

Write-Behind : asynchronously storing entries

Write-Through : synchronous

Read-Through : if get(key) is null, load it

Recap

- Distributed implementation of
  - Map
  - Queue
  - Set
  - List
  - MultiMap
  - Lock
  - Executor Service
  - Topic
  - Semaphore
  - AtomicLong
  - CountDownLatch
- Embedded, but accessible through
  - Native Java & C# Client
  - REST
  - Memcache
- Dynamic
  - Cluster
  - Add/ remove nodes
  - Backup
  - Fail-over

Q & A

Talip Ozturk

@oztalip

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use #hazelcast and #jfokus tags