DataStax Enterprise Architecture

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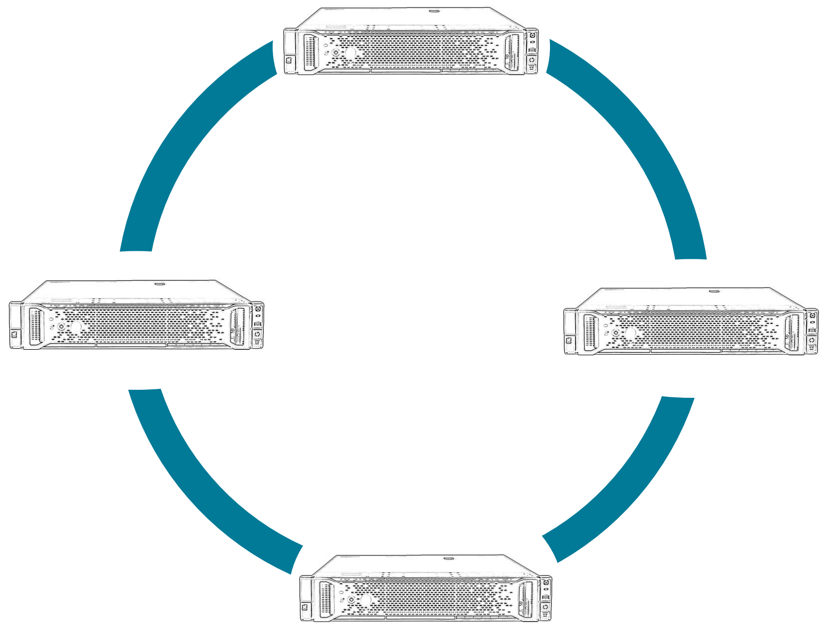
Agenda

Design Goals and Objectives



- Continuously Available
- Master Less
- Fully Distributed
- Shared-Nothing Architecture
- Build In Replication
- Linear Scalability
- Scale out

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Architecture

Apache Cassandra™ Architecture

- Cluster layer
- Amazon DynamoDB paper
- masterless architecture

- Data-store layer
- Google Big Table paper
- Columns/columns family

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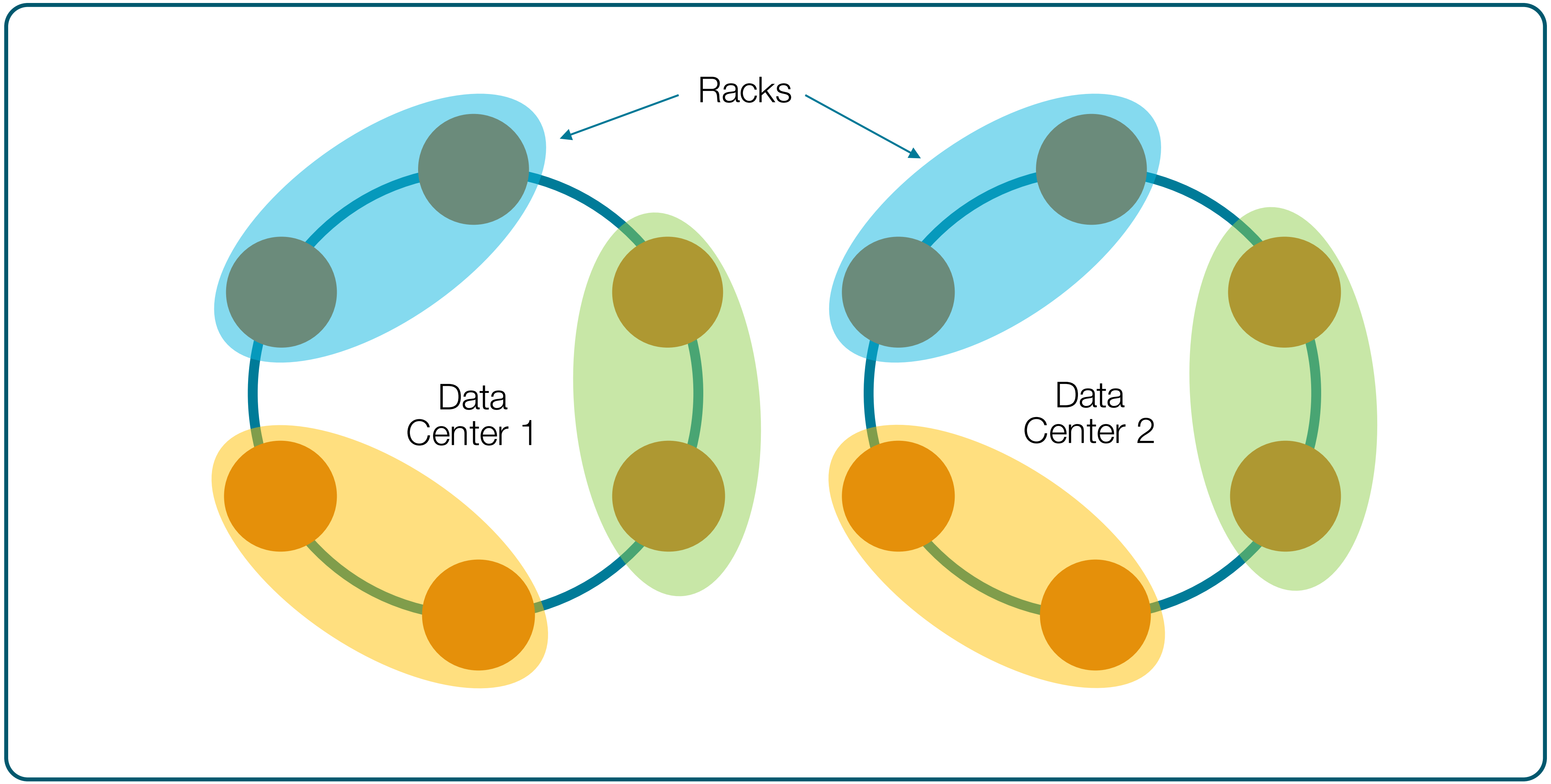
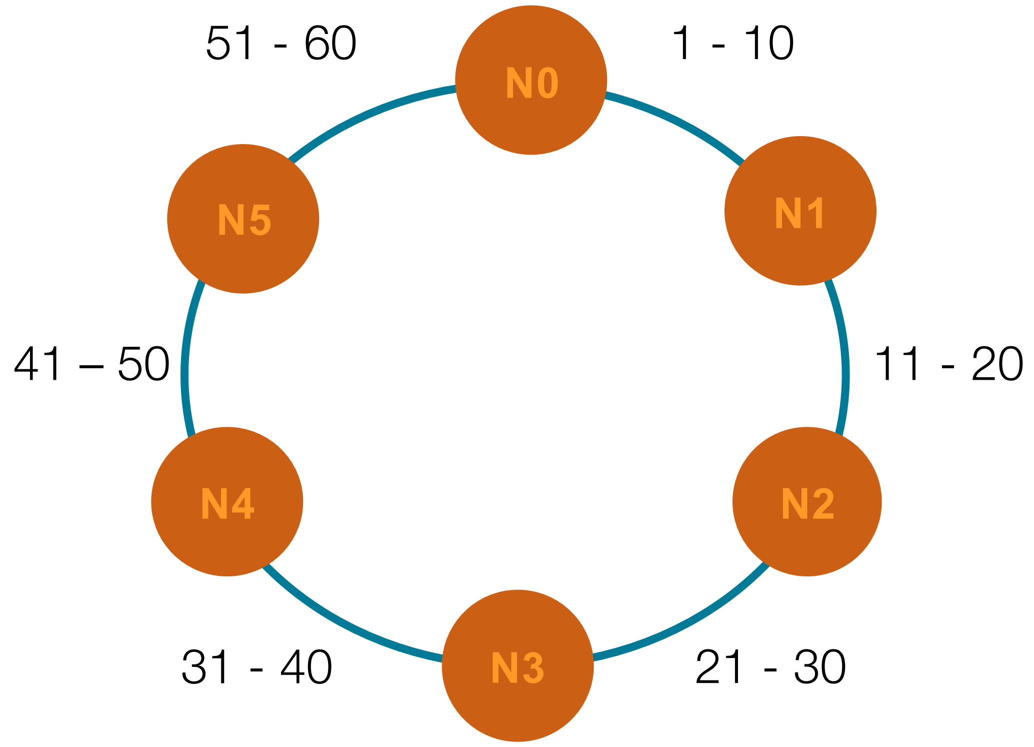
- All nodes are peers
  - Including seed nodes
  - No master
  - Discovery through gossip

- Built-in replication
  - Simplify your architecture!

Cluster



Token Ranges



Token Range : 2^{-63} – 2^{63}

Example with **Replication Factor 3**

N3 will own data for tokens 1 – 30

```
Token Range :  1-10, owned by N1,N2,N3
Token Range : 11-20, owned by N2,N3,N4
Token Range : 21-30, owned by N3,N4,N5
```

- Primary key
  - Partition key
  - Clustering columns
- Partitioner
  - Generates unique hash from partition key
- Replication strategy
  - Token hash determines starting point
  - Determines replica placement

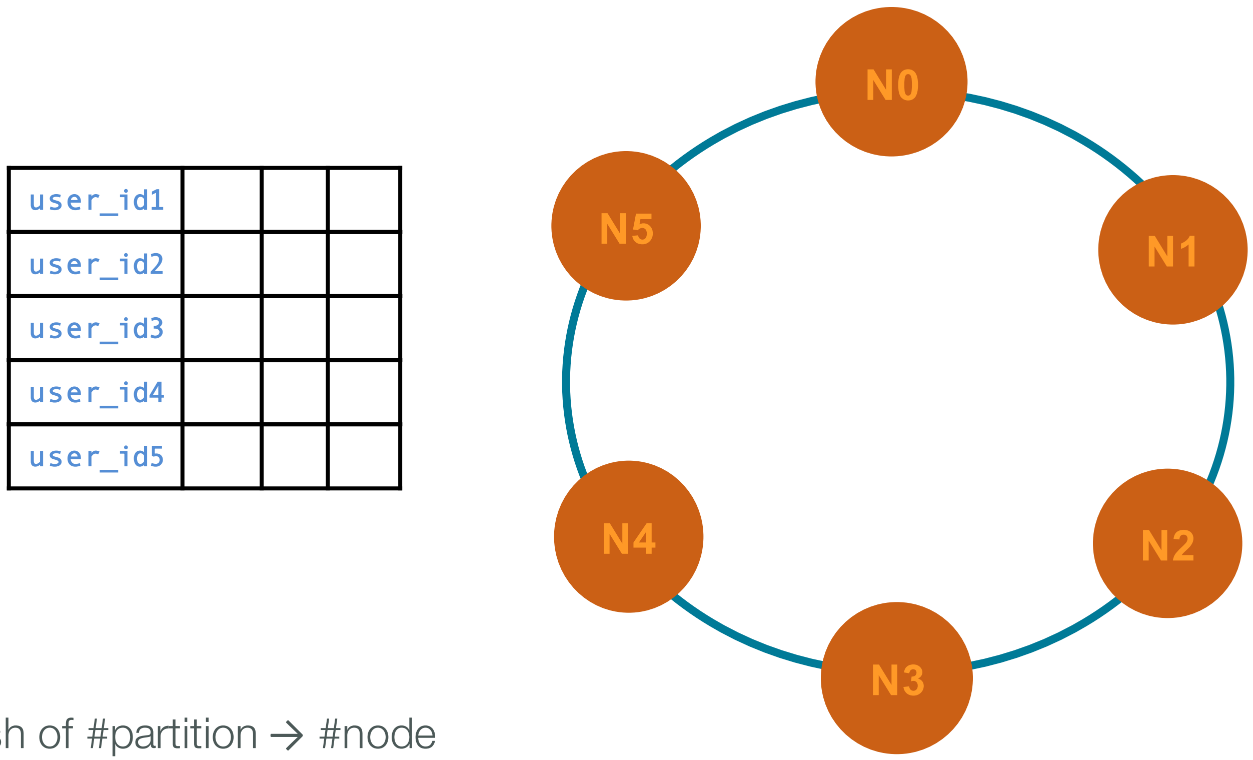
Cassandra Query Language

```
CREATE KEYSPACE negib WITH replication =
{'class': 'NetworkTopologyStrategy', 'DC1': '3'}  ←—— Replication Factor
AND durable_writes = true;
```

```
CREATE TABLE negib.sales (
    name text,
    time int,
    item text,
    price double,                  Partition Key
    PRIMARY KEY (name, time)
) WITH CLUSTERING ORDER BY (time DESC)
```

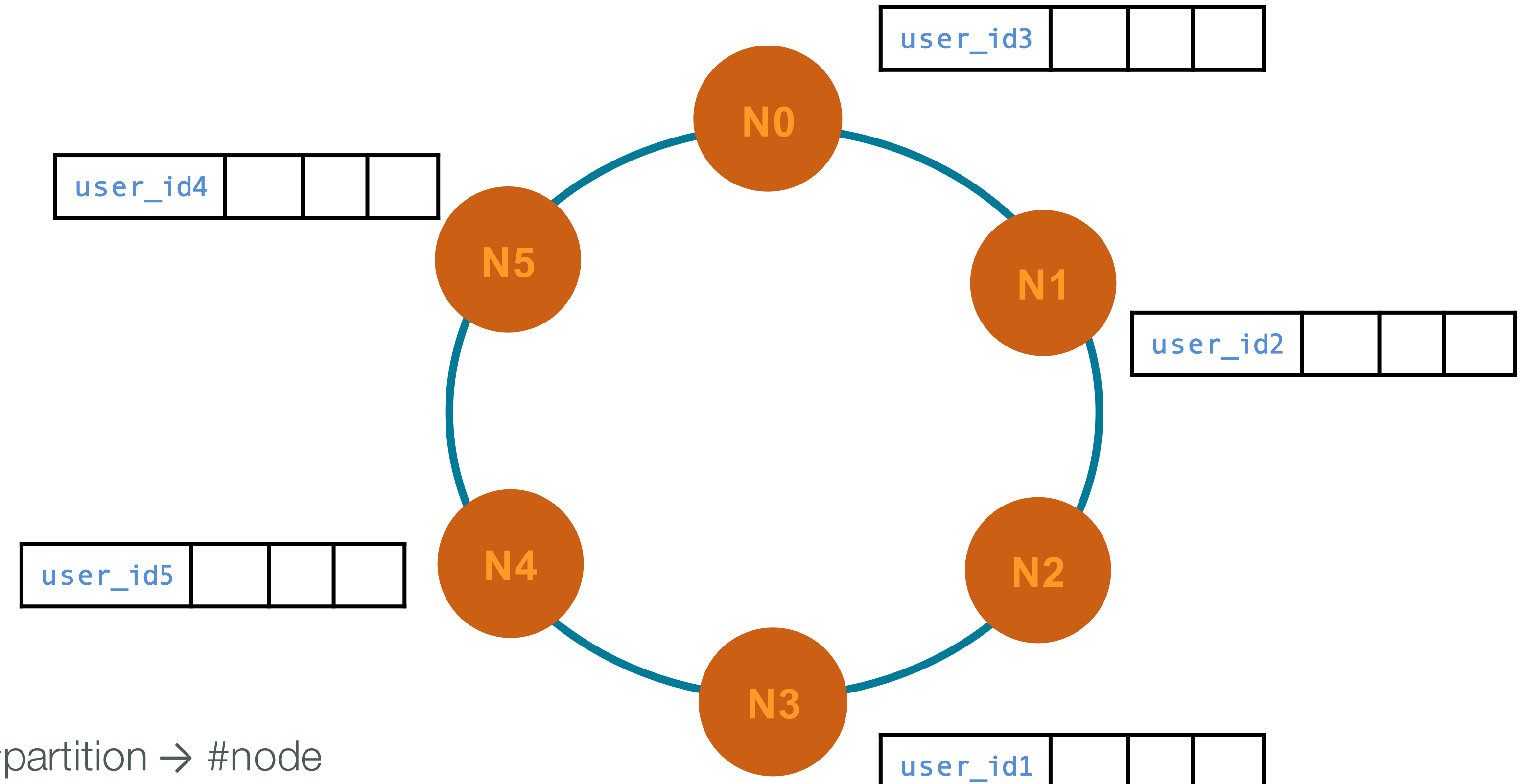
```
SELECT * FROM sales where name='Thomas' OR name='Günther' AND time >=20160401;
```

Data Distribution



Token = hash of #partition → #node
Data is evenly distributed and clock wise replicated

Data Distribution



Token = hash of #partition → #node
Data is evenly distributed and clock wise replicated

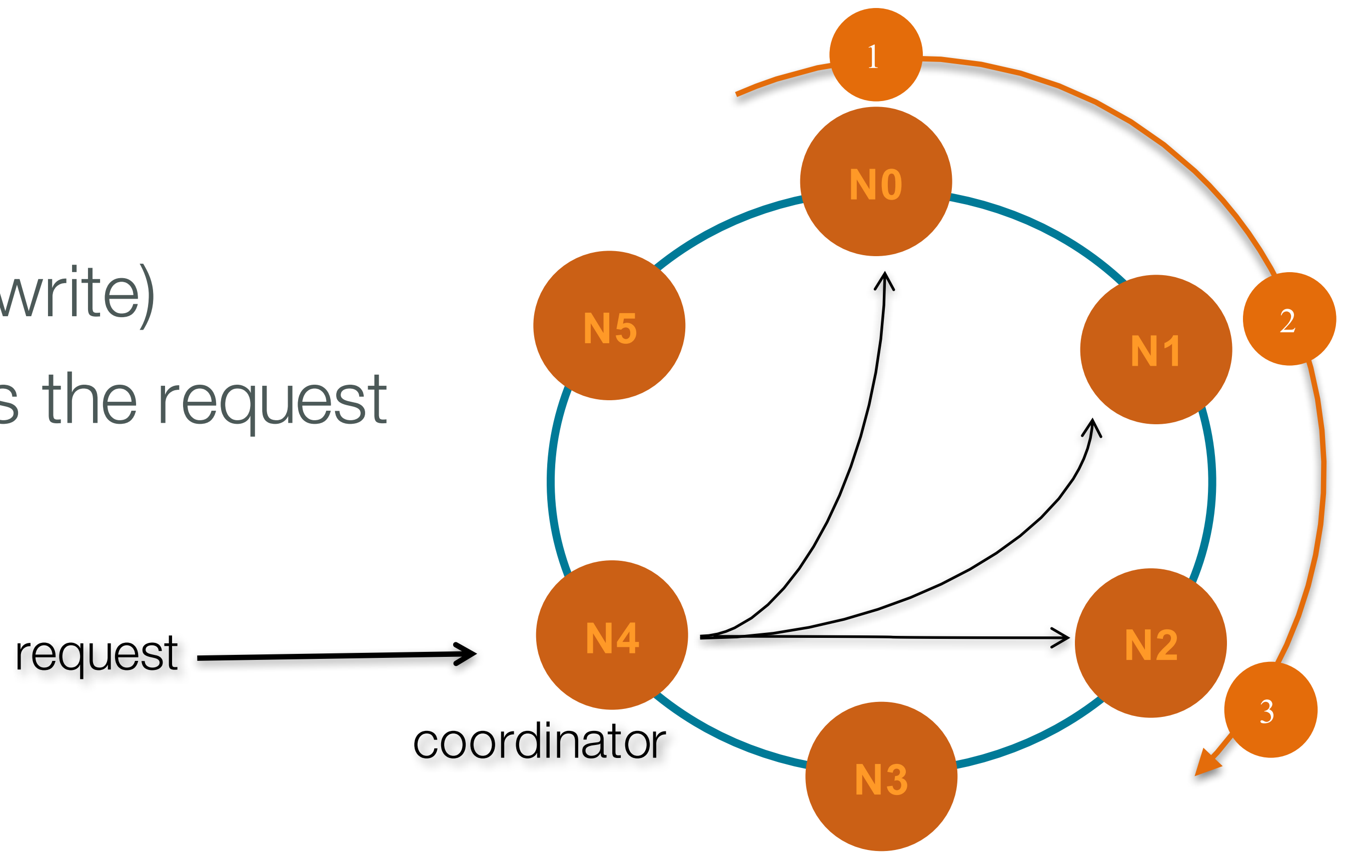
Lab 1 : Accessing the cluster

Read and write request handling

Coordinator node

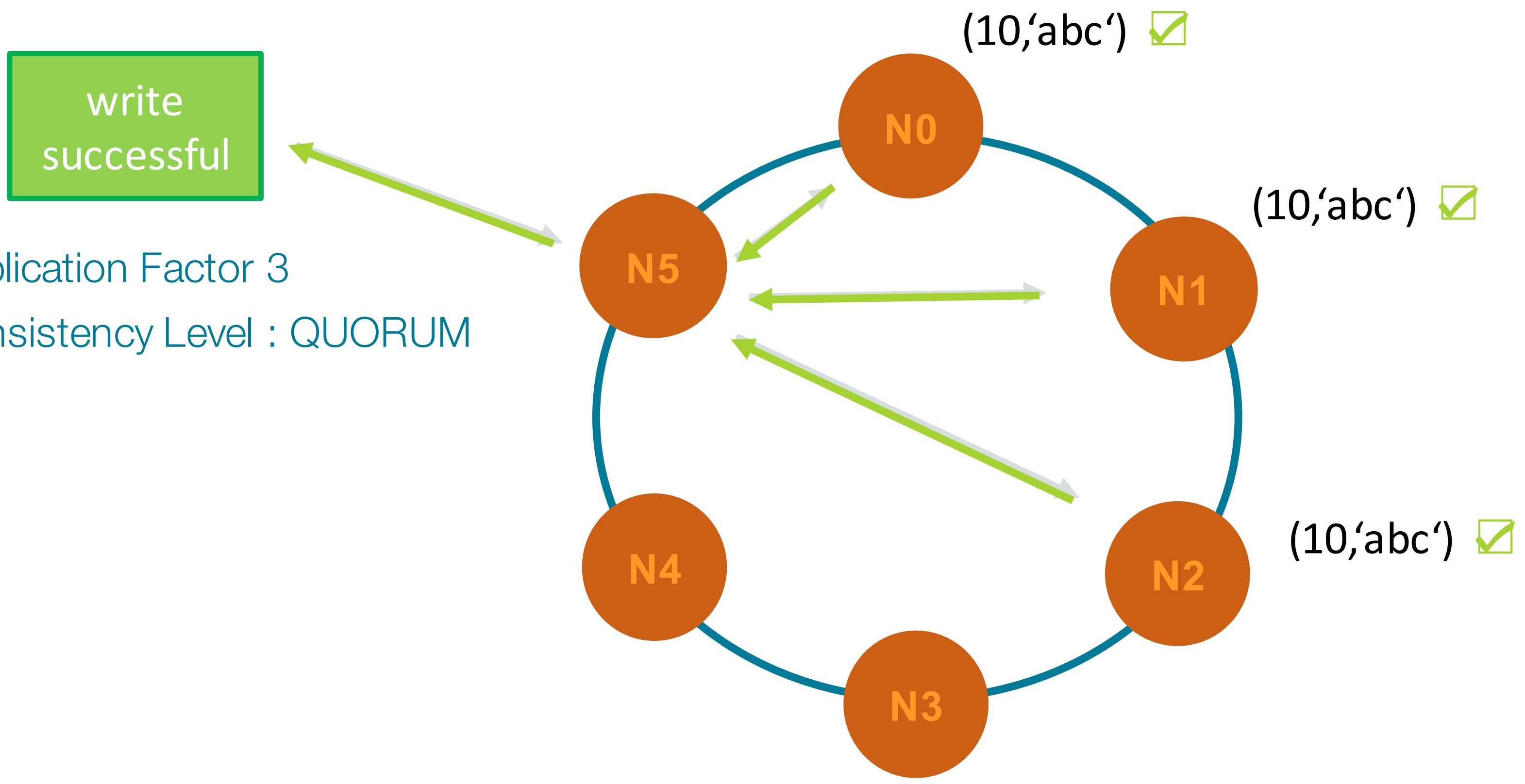
Incoming requests (read/write)

Coordinator node handles the request



Every node can be coordinator → masterless

Write request handling



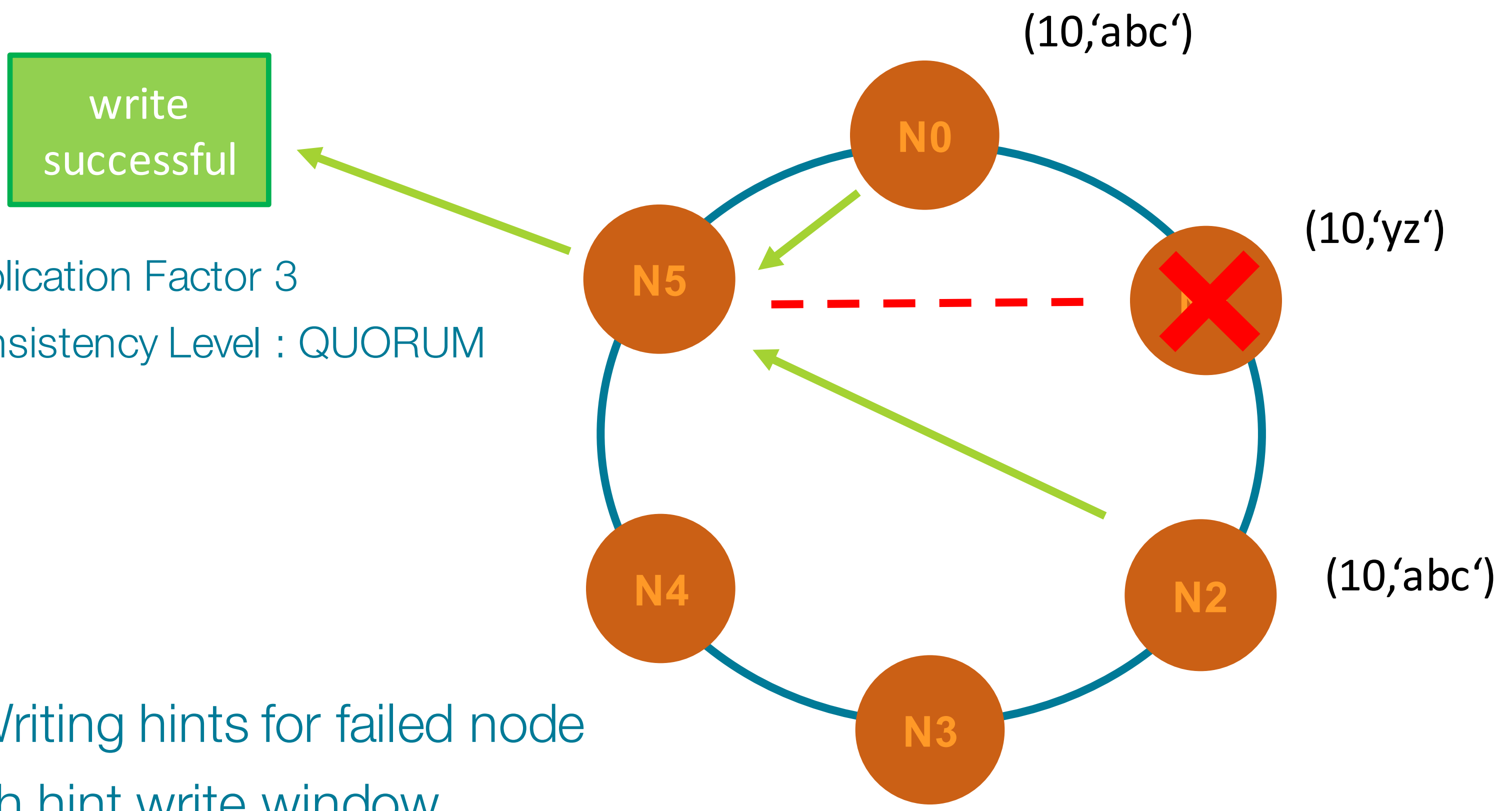
Replication Factor 3

Consistency Level : QUORUM

- Background vs. Forground Read Repair
  - Compare digests
    - If any mismatch
  - re-request to same nodes (full data set)
    - compare full data sets, send update
    - block until out-of-date replicas respond
  - Return merged data set to the client

- Consistency Level
  - one, quorum, all
  - local vs. cluster wide

Write request handling

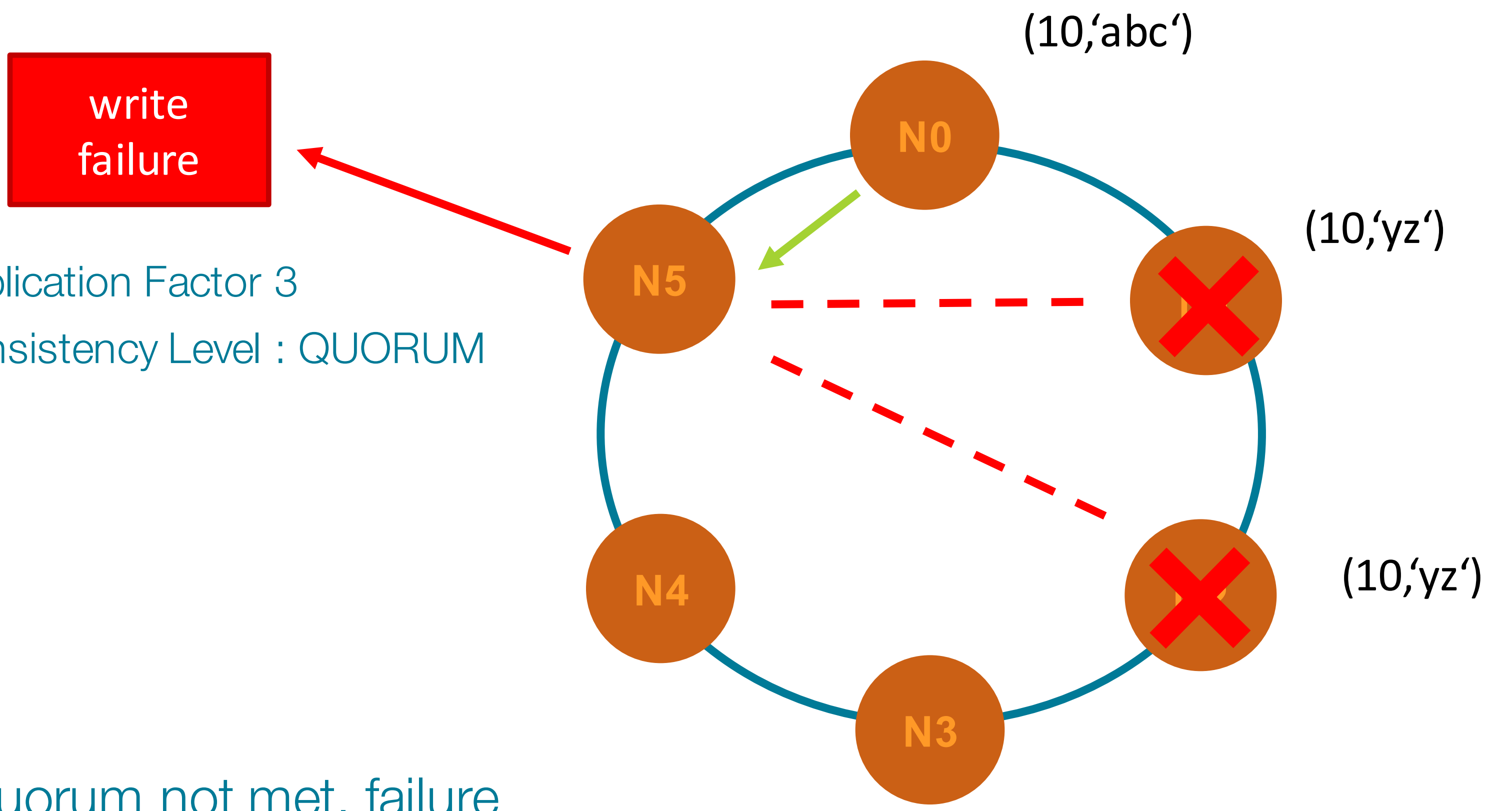


Replication Factor 3

Consistency Level : QUORUM

- Writing hints for failed node
- 3h hint write window
- CL: LOCAL_ALL will fail

Write request handling

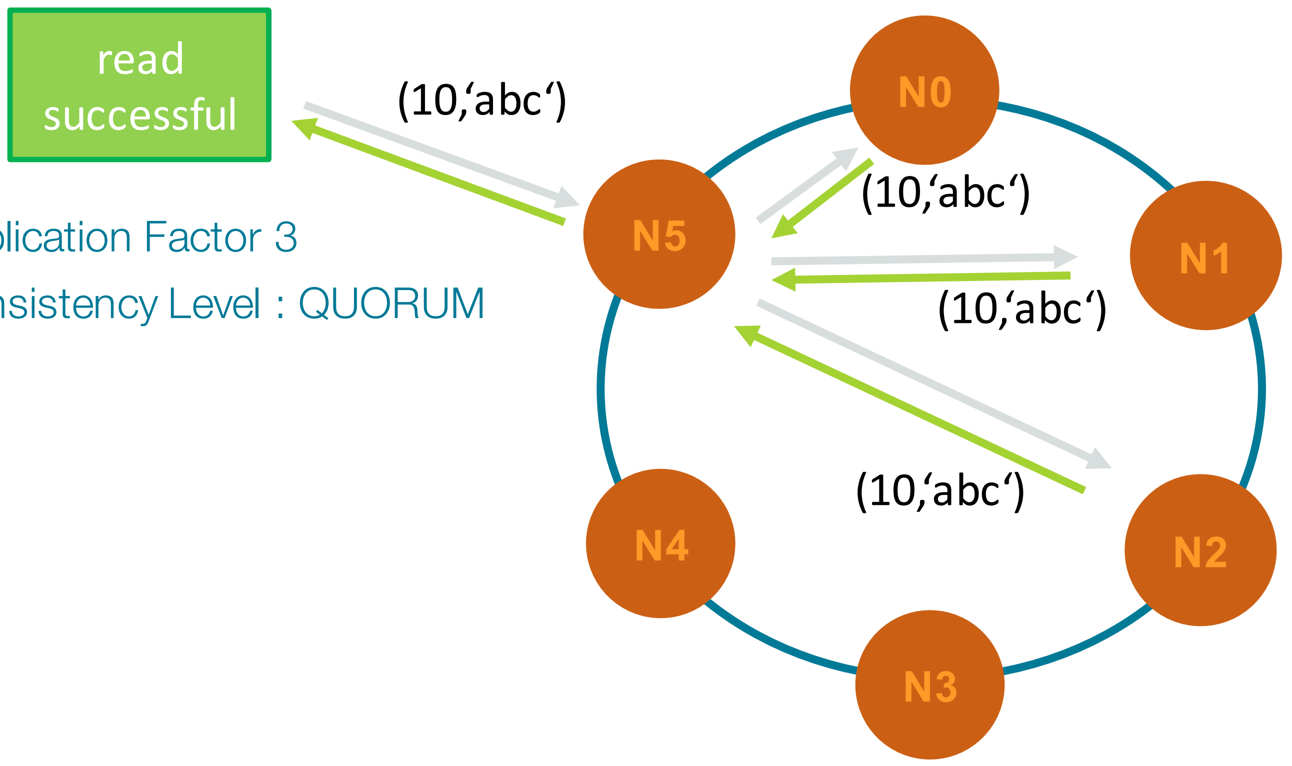


Replication Factor 3

Consistency Level : QUORUM

- quorum not met, failure
- CL: LOCAL_ONE will succeed

Read request handling



Replication Factor 3

Consistency Level : QUORUM

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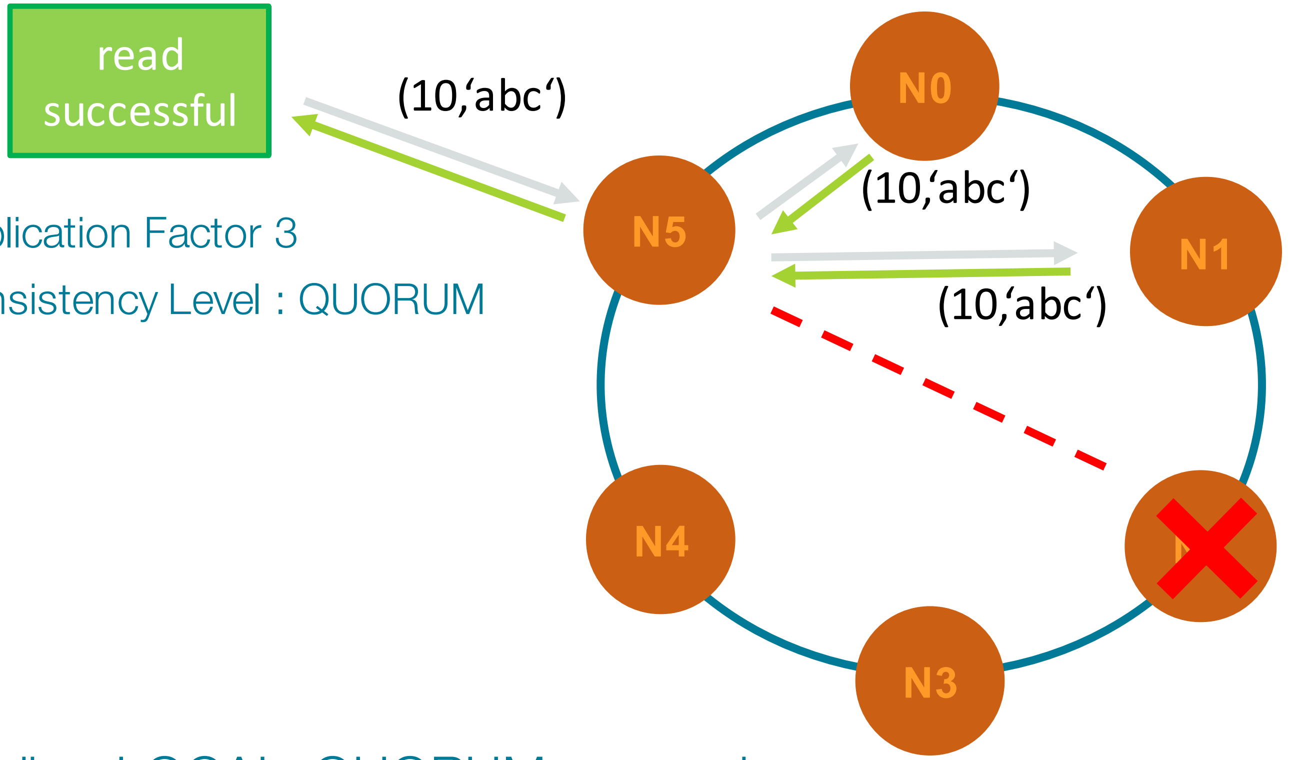
Read request handling

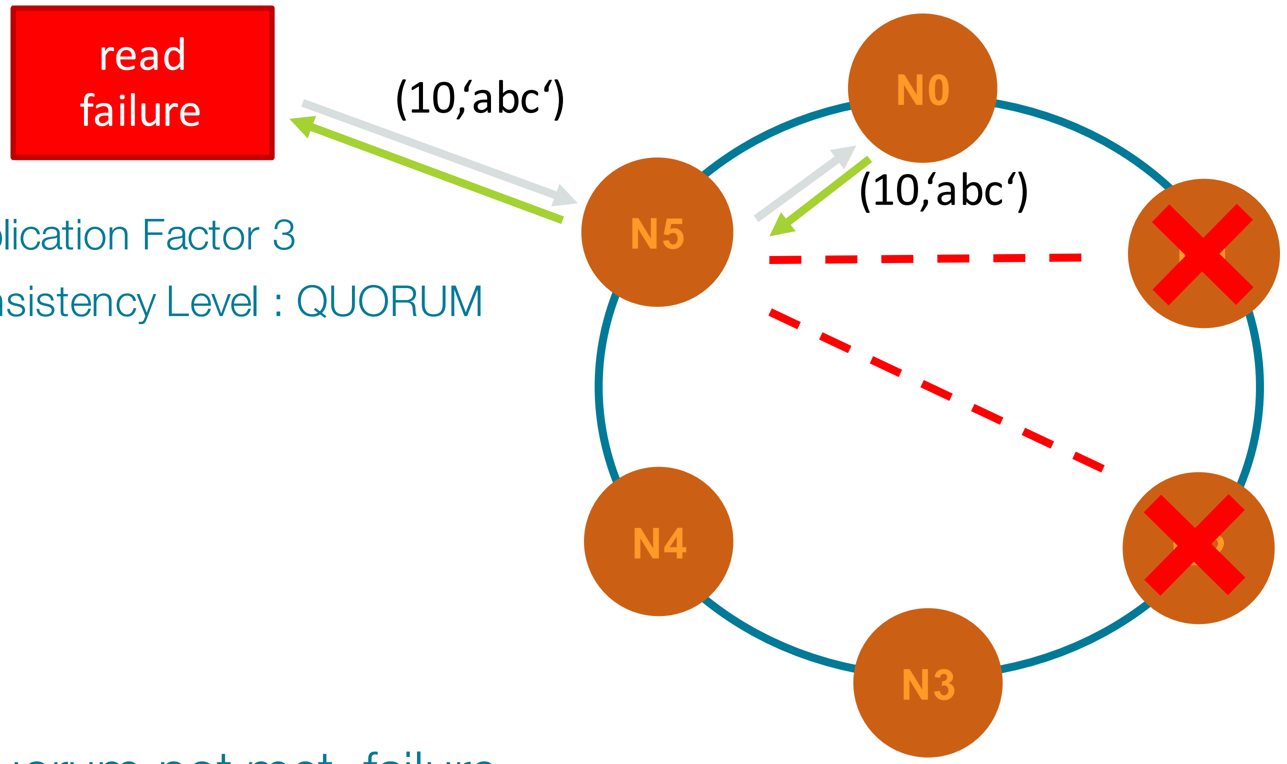


Replication Factor 3

Consistency Level : QUORUM

- Reading LOCAL_QUORUM succeeds
  CL: LOCAL_ALL will fail

Read request handling

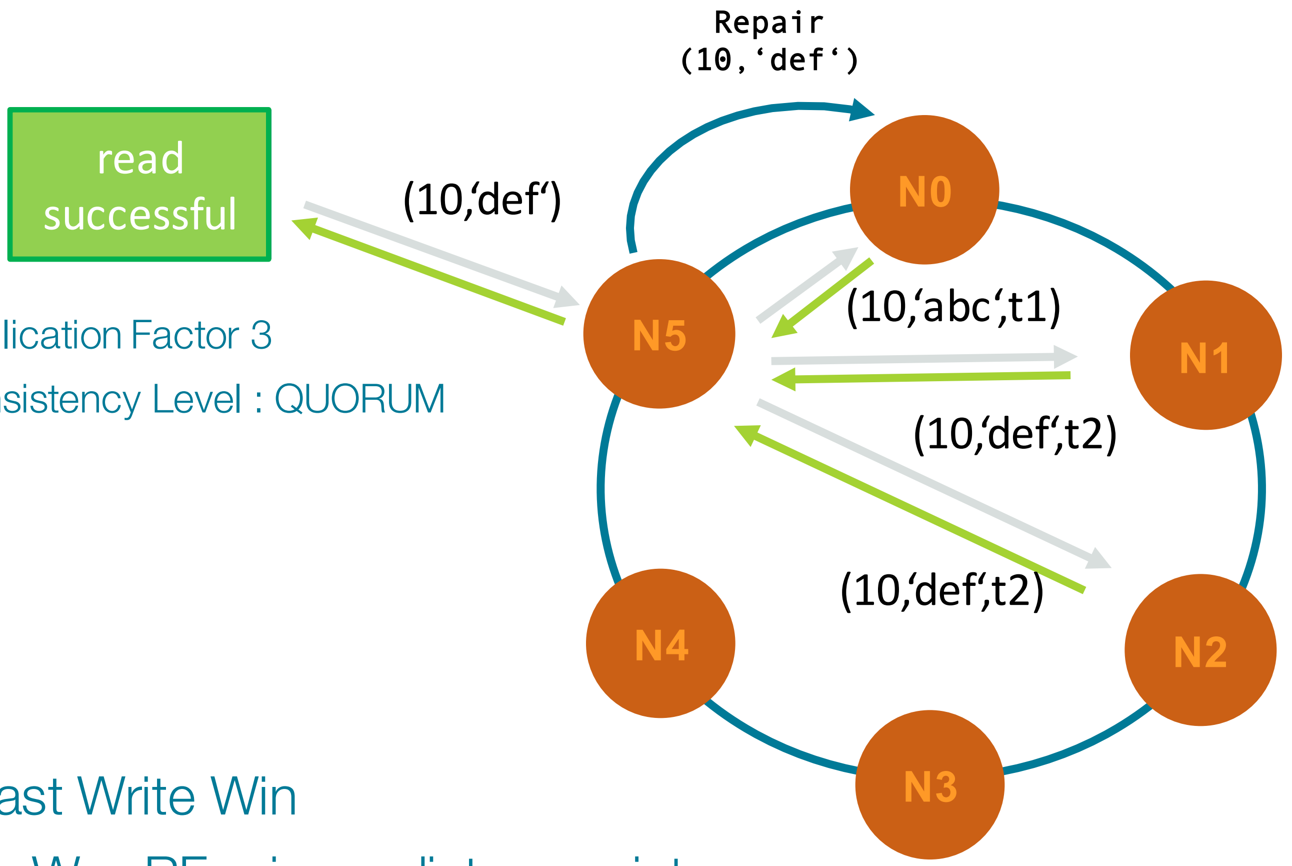


Replication Factor 3

Consistency Level : QUORUM

- quorum not met, failure
- CL: LOCAL_ONE will succeed. See more...

Read request handling – Read Repair



Replication Factor 3

Consistency Level : QUORUM

- Last Write Win
- R+W > RF = immediate consistency
- Background vs. foreground Read Repair. See more…

Driver Code

```
Cluster cluster = Cluster.builder()
      .addContactPoint("127.0.0.1")
      .withLoadBalancingPolicy(new TokenAwarePolicy(DCAwareRoundRobinPolicy.builder()
          .withLocalDc("myLocalDC")
          .build())
      .build();


PreparedStatement prepared = session.prepare
      ( "insert into sales(id, name) values (?, ?)”);

BoundStatement bound = prepared.bind(”4", ”Gregg");

session.execute(bound);  // Throws UnavailableException If consisntency doesn’t met, downgrade is
                            possible with corresponding RetryPolicy. Read More…
```

Take away

- Data distribution (hash, tokens)
- Data replication (RF)
- All nodes are peer nodes , master less
- Background Read Repairs
- RetryPolicy in driver

Lab 2 : Hands-on DSE CQL

Vielen Dank!

Eventuell Bootstrap, ReBalance, Num Tokens VNodes

- All nodes are peers
  - Including seed nodes
  - No master
  - Discovery through gossip

- Built-in replication
  - Simplify your architecture!