Real world tales of repair

THE LAST PICKLE

APACHE BIGDATA - MAY 2017

Alexander Dejanovski

@alexanderdeja

Consultant

www.thelastpickle.com

Datastax MVP for Apache Cassandra

About The Last Pickle

We help people deliver and improve Apache Cassandra based solutions.

With staff in 5 countries :
New Zealand, Australia, France, Spain, USA

What and why ?

Full repair

Incremental repair

How to make it work

What is repair ?

A maintenance operation that (briefly) restores strong consistency throughout the cluster

www.thelastpickle.com

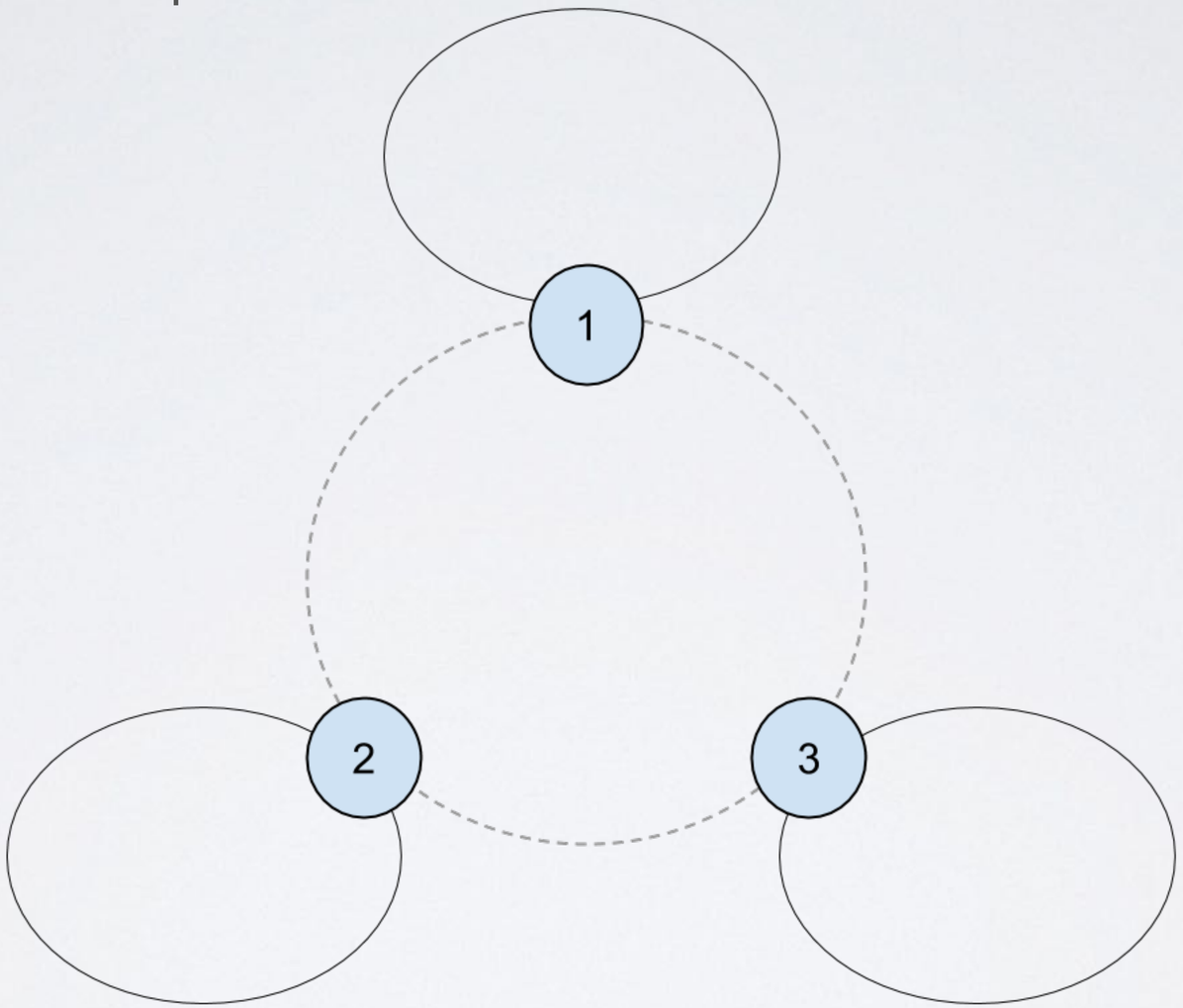
Why do we need repair ?

- Eventual consistency
- Downtime / failure recovery
- Safe deletes

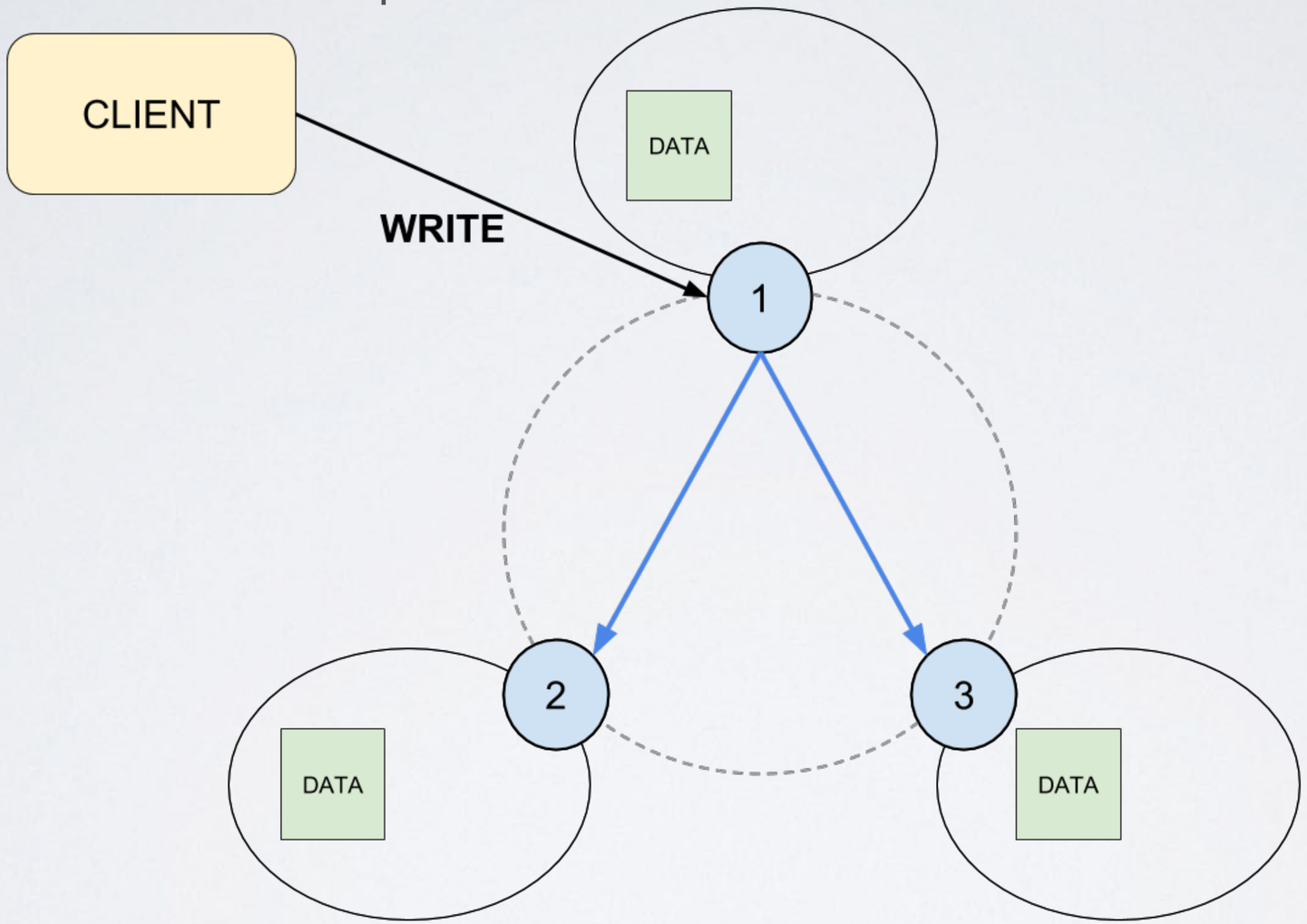
Tombstones need repair too

Missing tombstones can lead to zombie data
(repair within gc_grace_seconds)

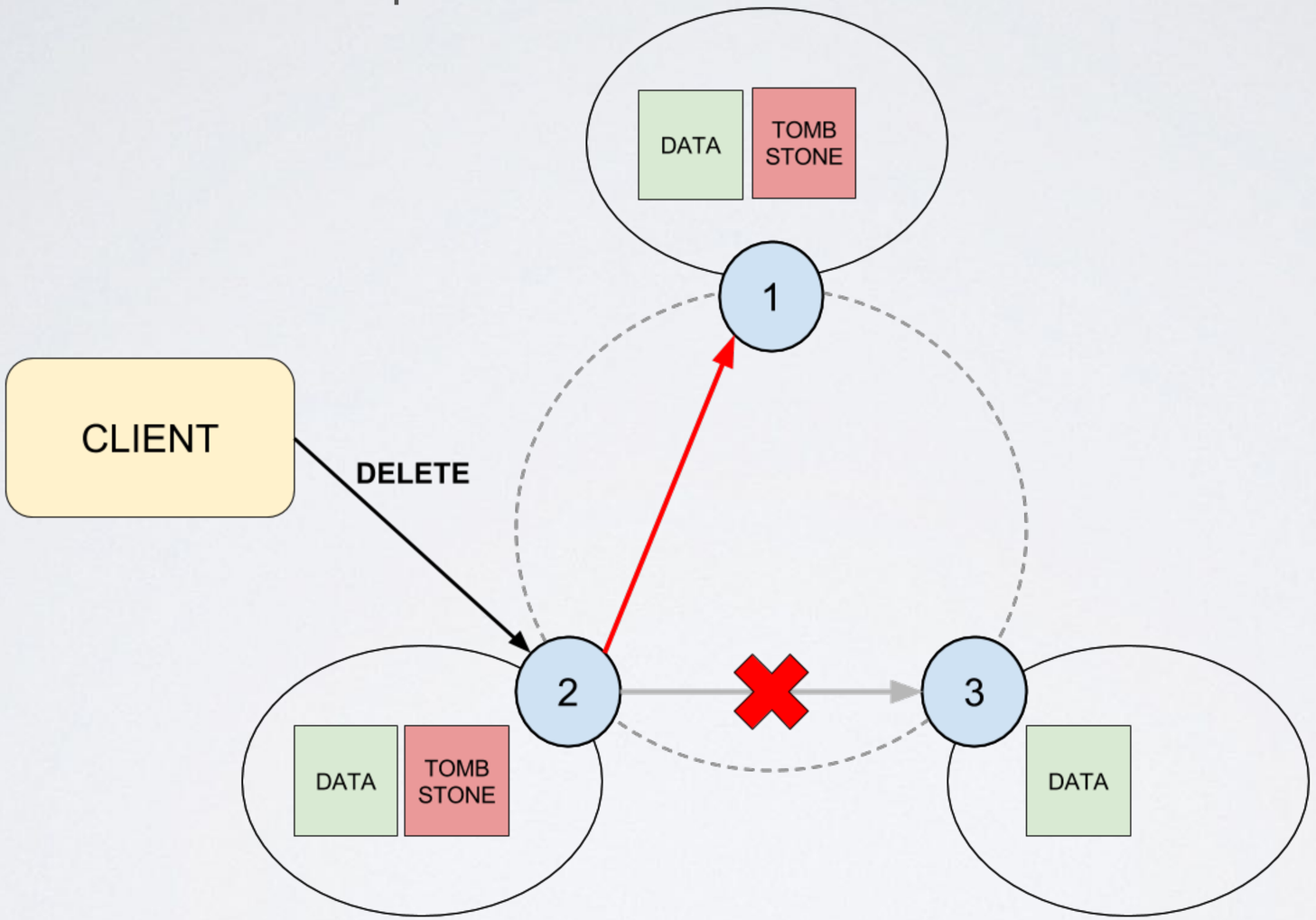
Tombstones need repair too



Tombstones need repair too

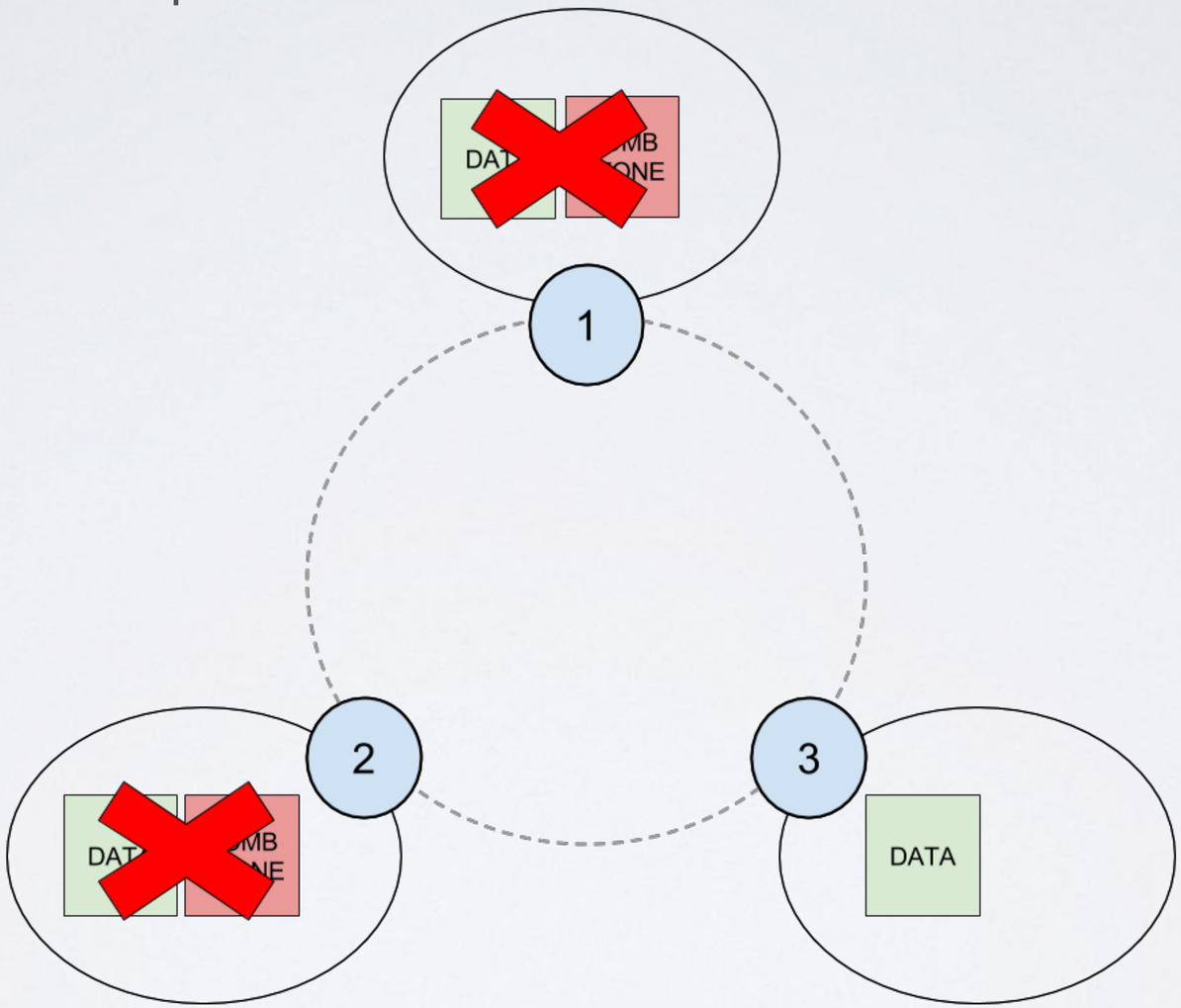


Tombstones need repair too

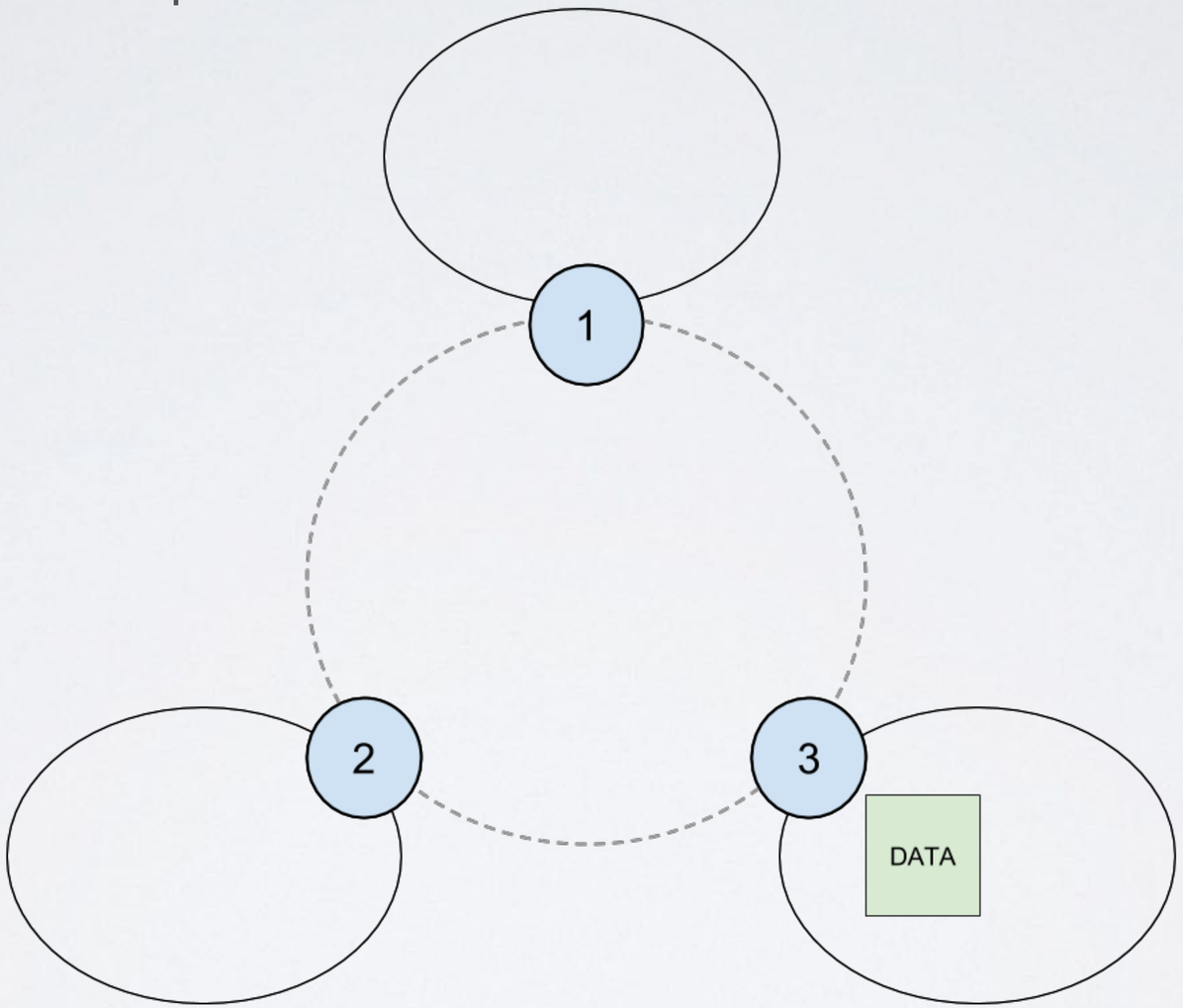


www.thelastpickle.com

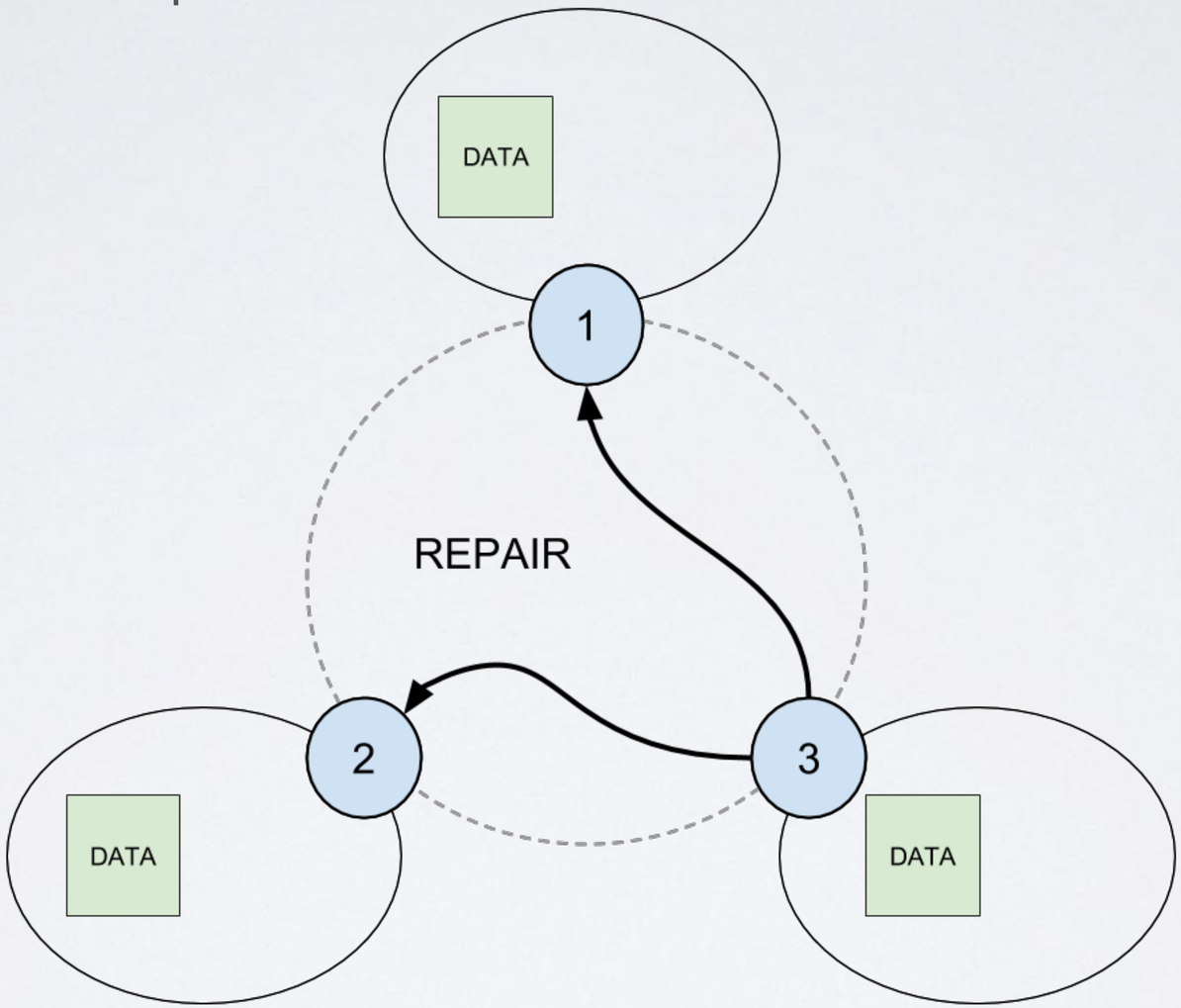
Tombstones need repair too



Tombstones need repair too



Tombstones need repair too



What and why ?

Full repair

Incremental repair

How to make it work

How does anti-entropy repair works ?

Reads all data

How does anti-entropy repair works ?

Reads all data

Calculates hashes

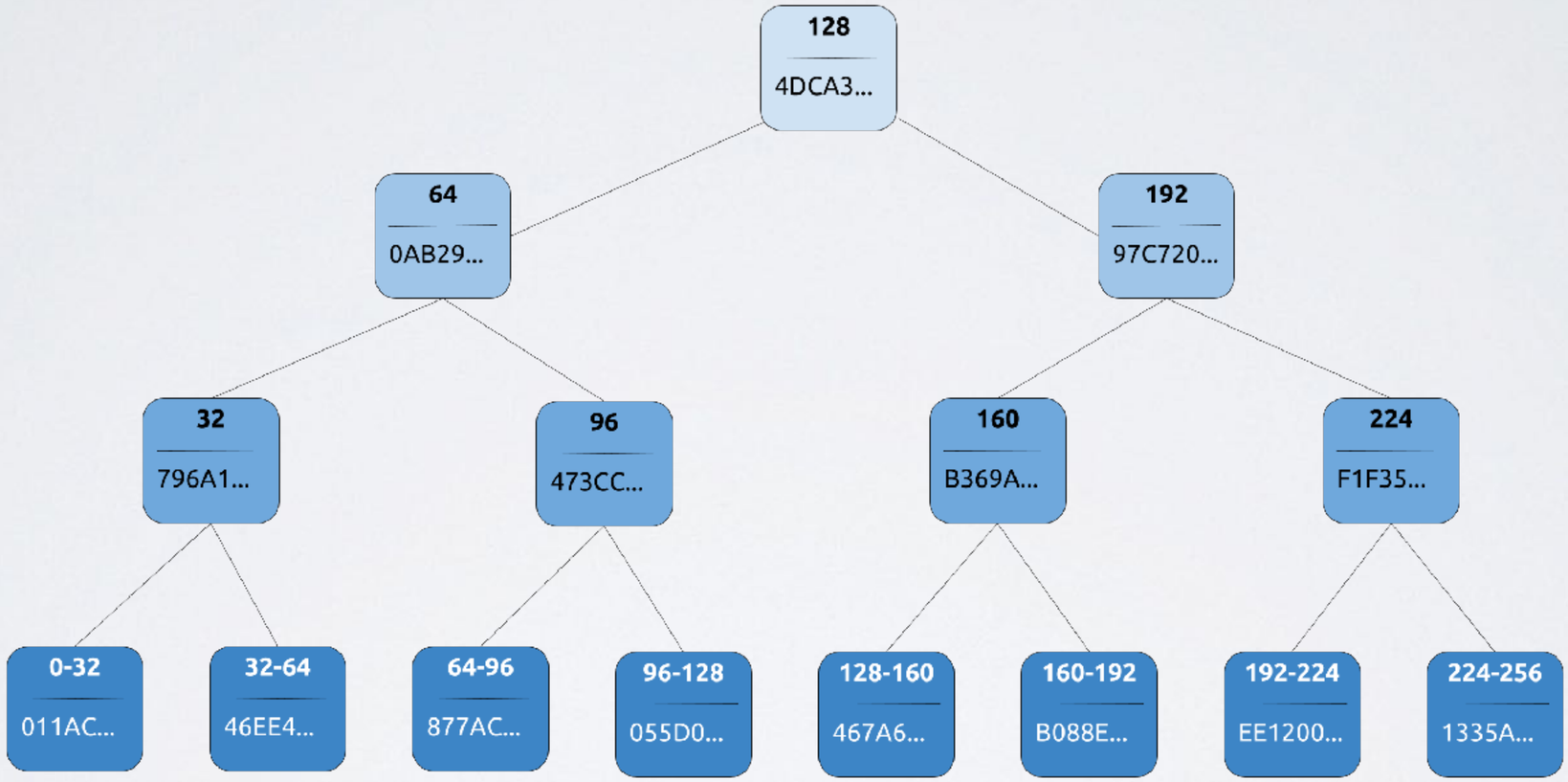
How does anti-entropy repair works ?

Reads all data
Calculates hashes
Compares hashes

How does anti-entropy repair works ?

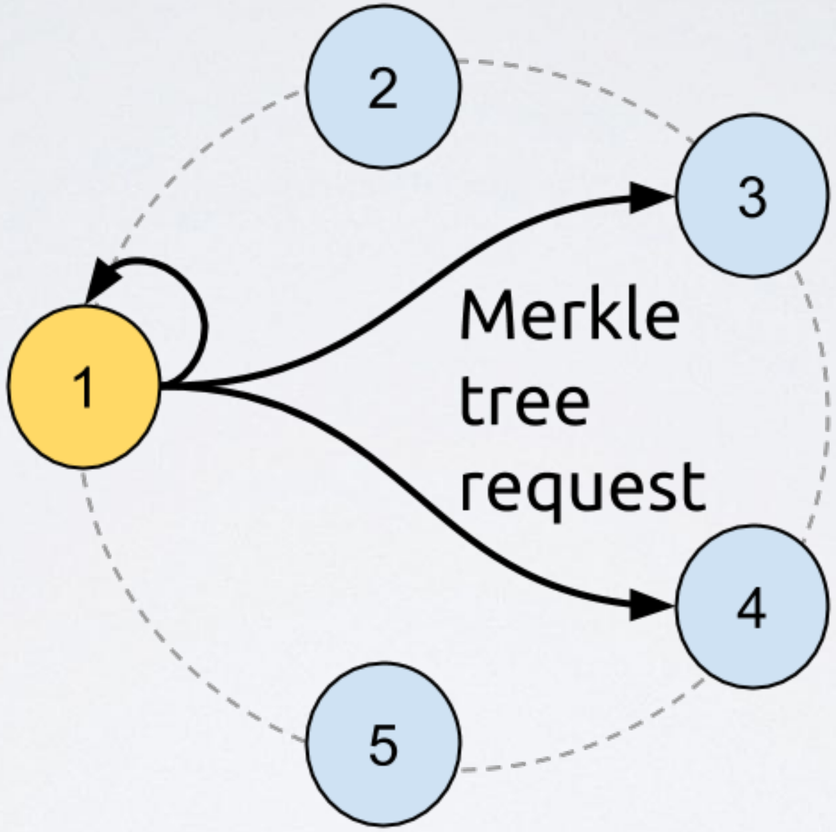
Reads all data
Calculates hashes
Compares hashes
Streams mismatching partitions

How does anti-entropy repair works ?

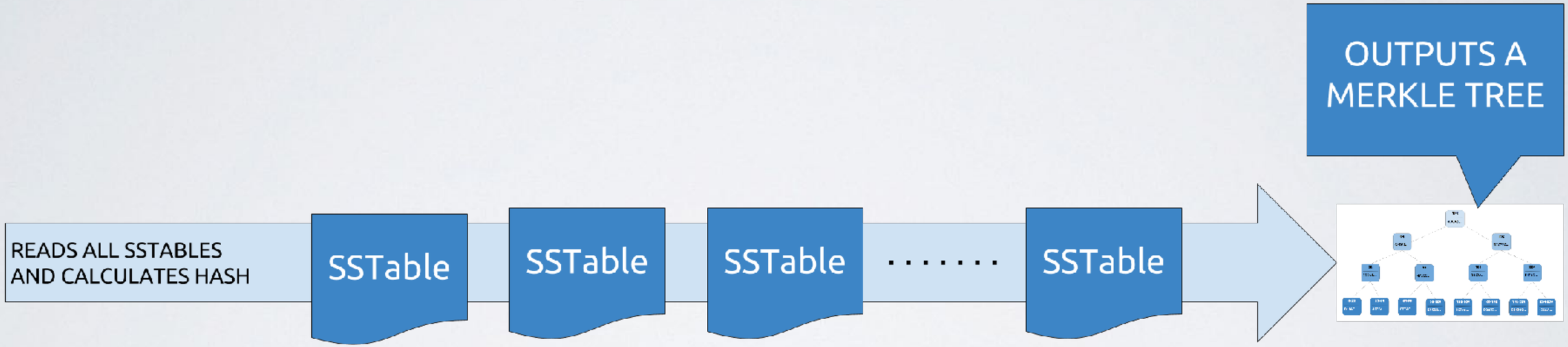


www.thelastpickle.com

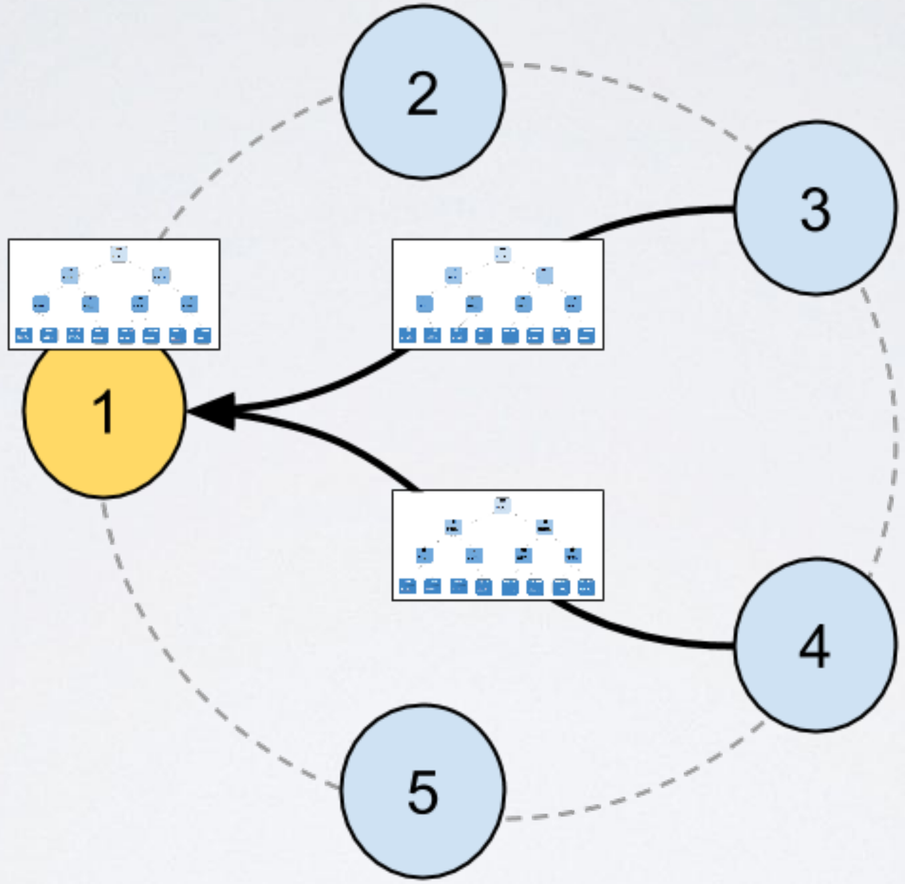
Merkle tree is requested to all replicas



Validation compaction

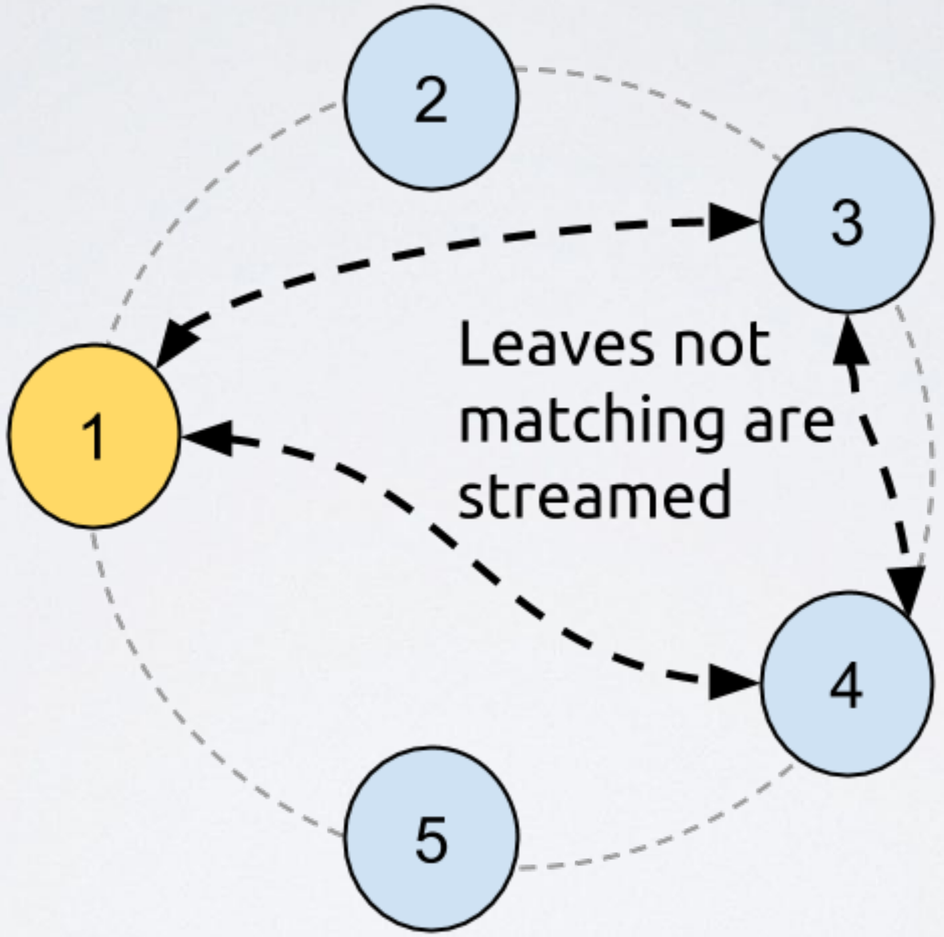


Merkle tree comparison



www.thelastpickle.com

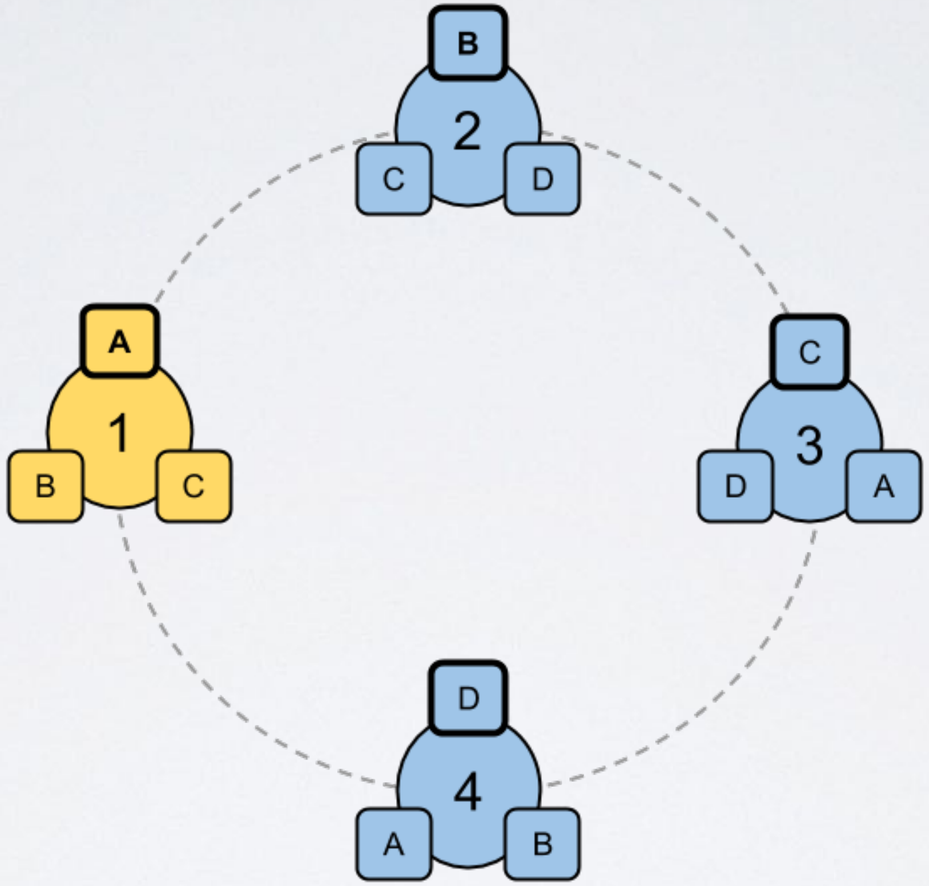
Streaming



How do we run repair ?

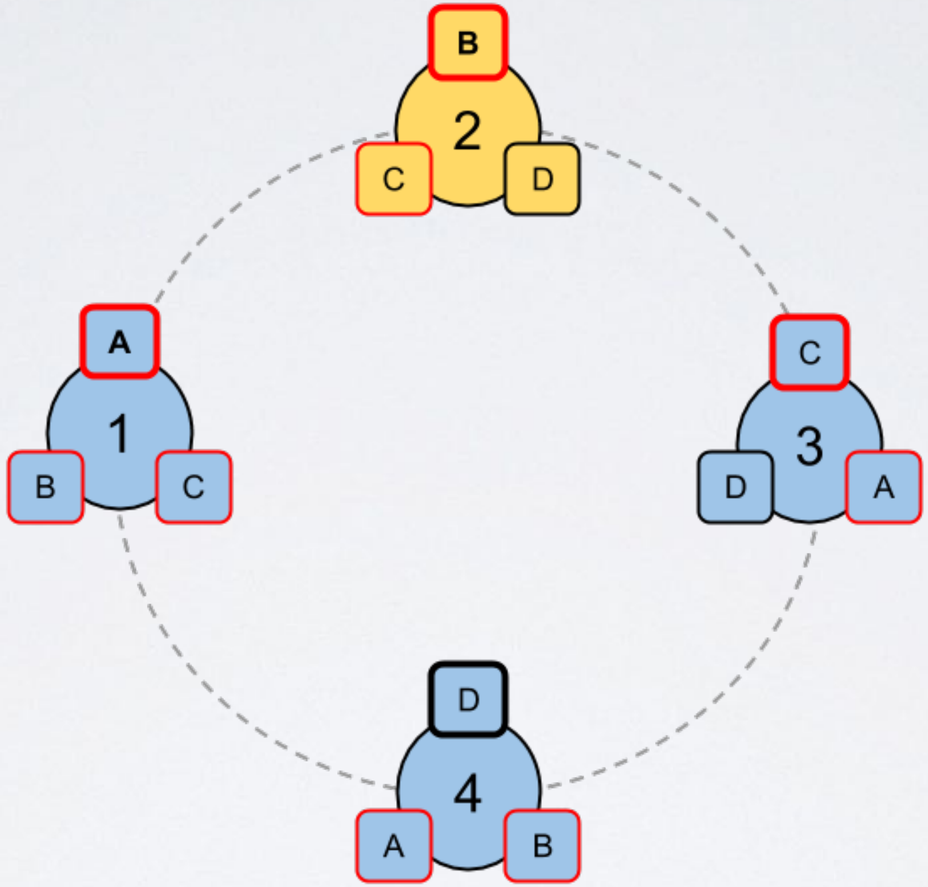
nodetool repair

Improving repair



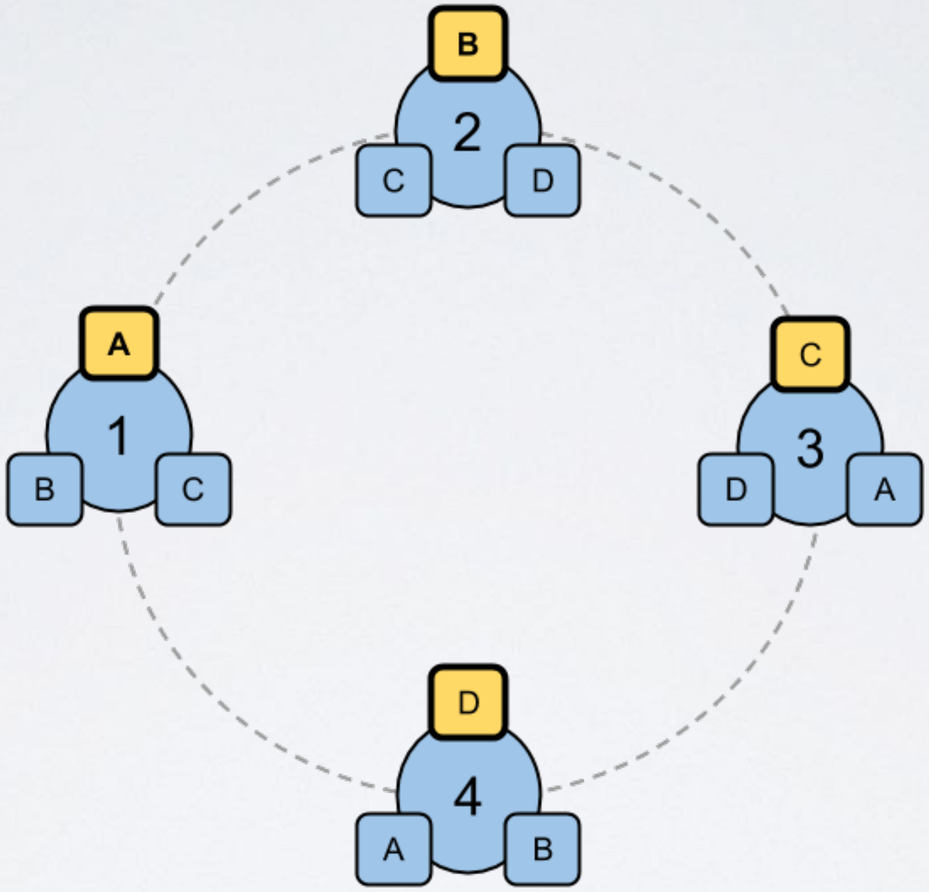
www.thelastpickle.com

Improving repair



www.thelastpickle.com

Improving repair



www.thelastpickle.com

Improving repair

repairing each range **once** is enough

nodetool repair -pr

nodetool repair -pr

not suitable for node recovery

Sequential or parallel ?

Sequential : takes a snapshot on all replicas and computes merkle trees one replica at a time (on the snapshots)

Sequential or parallel ?

Parallel : No snapshot, all replicas compute merkle trees at the same time

Repair too slow ?

Sequential repair is the default since C* 2.0

Repair too slow ?

nodetool repair -par

The problem with dense nodes

Overstreaming

Leaves of the Merkle tree contain **several** partitions.

32k leaves at most.

The solutions with dense nodes

cassandra_range_repair
(Matt Stump & Brian Gallew)
Breaks the repair sessions in **n** steps

Cassandra reaper
(Spotify)
Full orchestration tool for repairs + sub range repair support

The solutions with dense nodes

vnodes : one repair session per vnode

Drawback : if you have many vnodes, repair takes longer

Repair in…

www.thelastpickle.com

The early days of your cluster

Node density is low, repair works just fine however you run it.

So maybe like I did,
you run « nodetool repair »
on all nodes… at the same
time

The (not so) early days of your cluster

As nodes gets higher in density, repair takes longer… and longer…

The (not so) early days of your cluster

… and latencies rise
as repair is a CPU and
I/O intensive operation

Your cluster is a grown up now

… until it breaks your cluster

How can it break ?

Load gets too high

How can it break ?

Load gets too high

You don't meet your latency SLA anymore

How can it break ?

Load gets too high

How can it break ?

Load gets too high

Streams get stuck

How can it break ?

Load gets too high
Streams get stuck
and out of nowhere, all nodes start to eat
all your CPU doing nothing

The fun part ?

You need to run repair to recover from the repair outage !

The cluster keeps growing

And you realize orchestration is needed to stop blowing up your cluster

Orchestrating repair

Repair must not run on all nodes at the same time

Tools to orchestrate repairs

OpsCenter repair service (DSE users)
Cassandra reaper

Cassandra reaper

https://github.com/spotify/cassandra-reaper
https://github.com/thelastpickle/cassandra-reaper

Performs subrange repair

Cassandra reaper

Performs subrange repair

Limits repair pressure

Cassandra reaper

Performs subrange repair

Limits repair pressure

Retries failed sessions

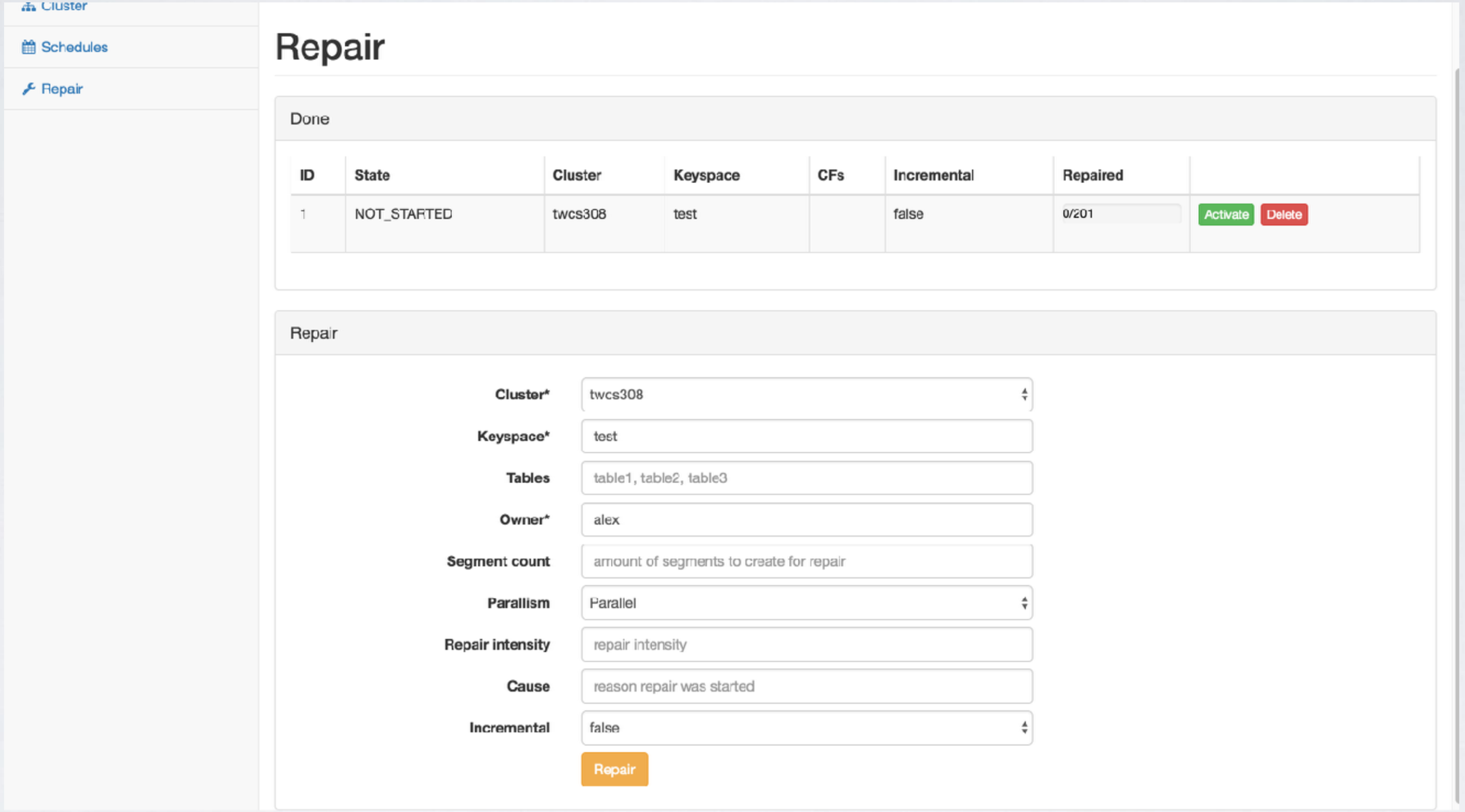
Cassandra reaper

Performs subrange repair
Limits repair pressure
Retries failed sessions
(auto-)Schedules cyclic repairs

Cassandra reaper

Performs subrange repair
Limits repair pressure
Retries failed sessions
(auto-)Schedules cyclic repairs
Optimizes cluster load

Cassandra reaper - with UI (thx Stefan Podkowinski)



www.thelastpickle.com

What and why ?

Full repair

Incremental repair

How to make it work

Automated repairs

What if we stopped repairing repaired data ?

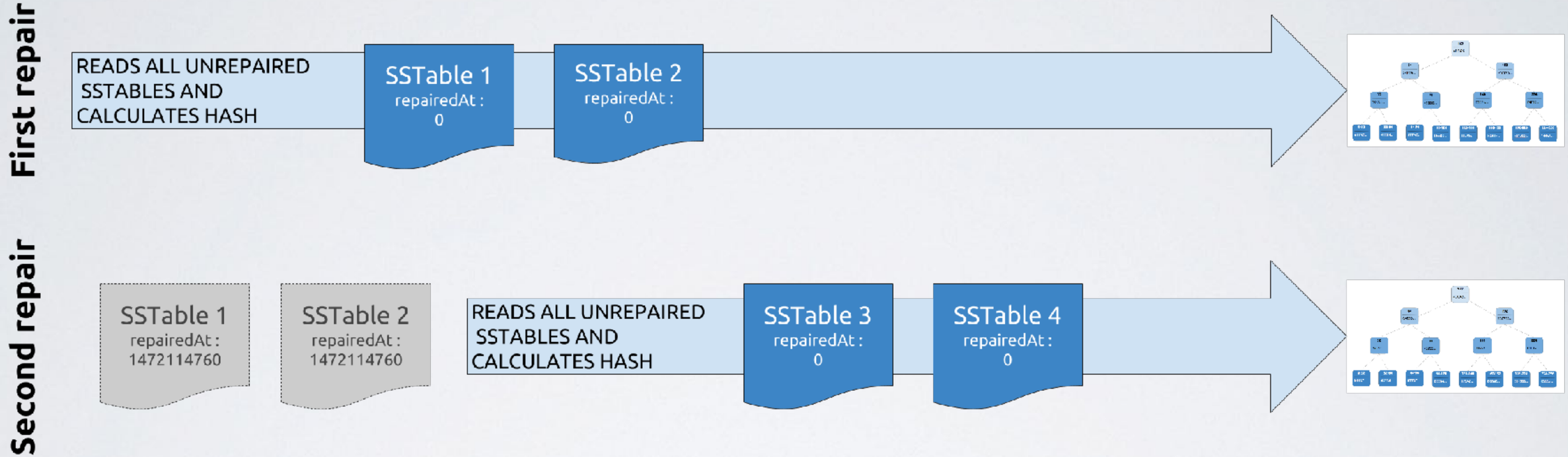
www.thelastpickle.com

Here comes the savior !

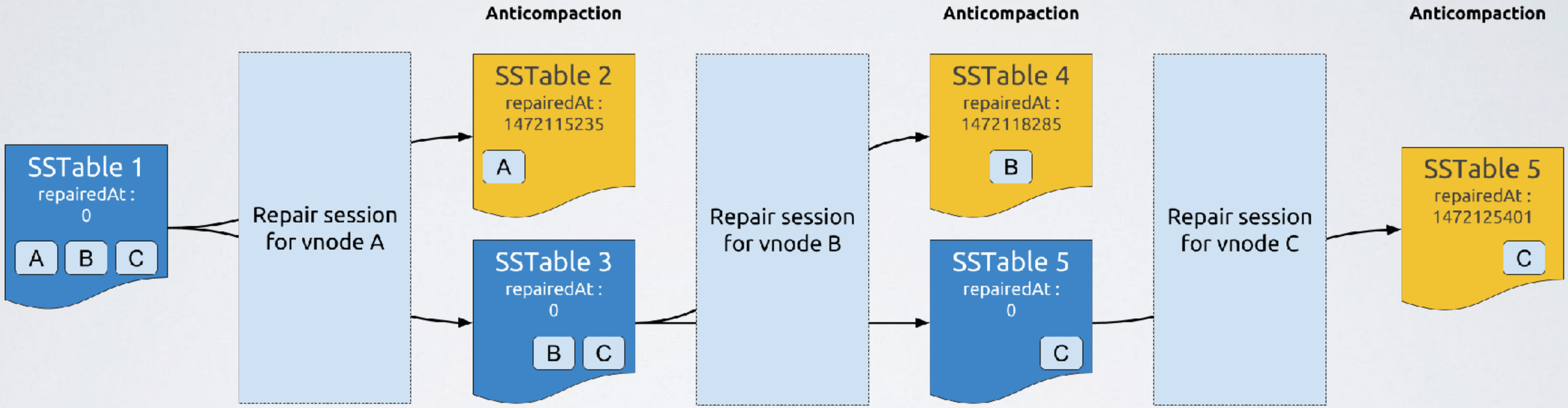
C* 2.1 introduces incremental repair

Default repair mode since C* 2.2

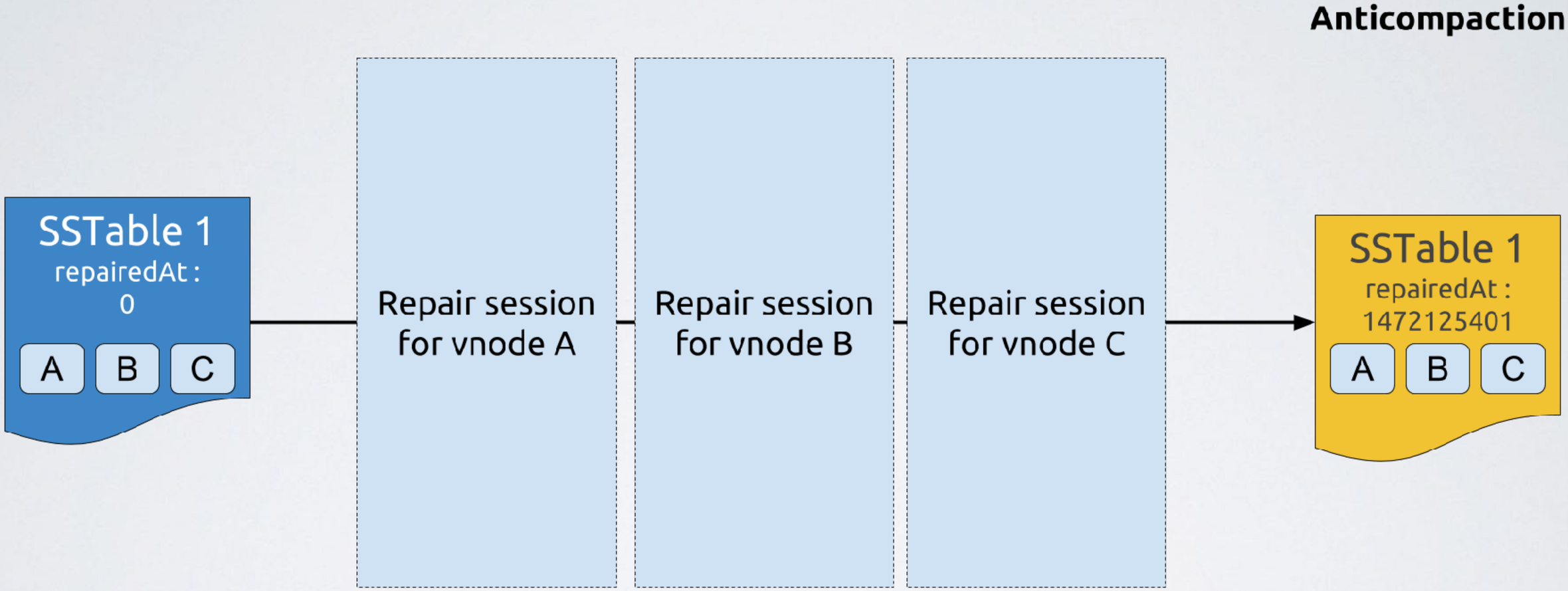
How does incremental repair work ?



Anticompaction



Anticompaction (repair on all ranges on local node)



Incremental repair looks awesome…

…but has flaws and drawbacks

Carefully prepare your switch to incremental repair

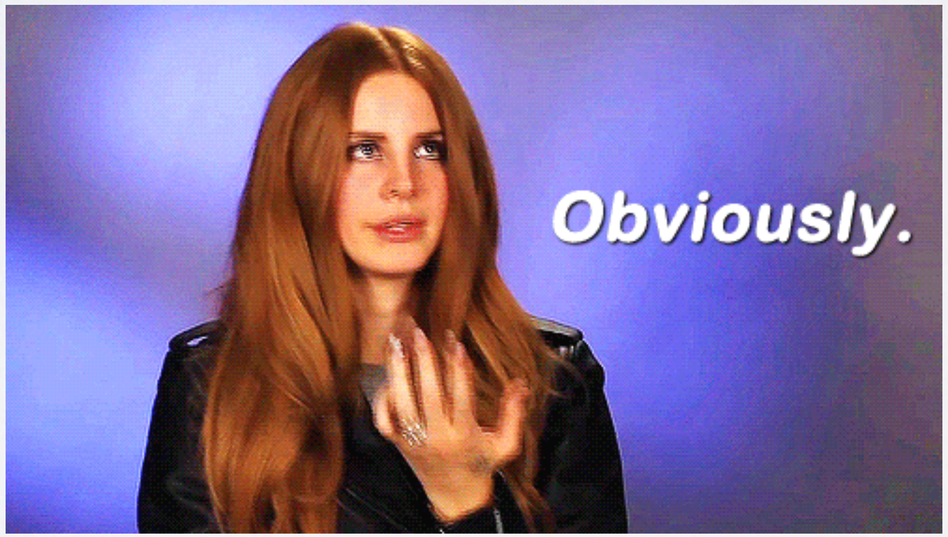
Incremental repair caveats

Carefully prepare your switch to incremental repair

i.e. do not run « nodetool repair -inc » straight away…

Incremental repair caveats

It doesn't handle missing/corrupted data that was already repaired



Incremental repair caveats

It splits SSTables in 2 sets that cannot be compacted together (think tombstone purge)

Incremental repair caveats

It is incompatible with subrange repair (anticompaction)

It doesn't like concurrency very much

Incremental repair caveats

Validator.java:261 -
Failed creating a merkle tree for [repair #e4c782d0-11fc-11e6-b616-51a3849870bb on table_v2/table_attributes, [(8835460833482333317,8838777311566358575], (-7300486781514672850,-7298192396576668423], (-9592984746751672 25,-9591779641060742 09]]], /10.10.10.33 (see log for details)

Incremental repair caveats

CompactionManager.java:1320 - **Cannot start multiple repair sessions over the same sstables**

Incremental repair caveats

CASSANDRA-8316

A running anticompation prevents validation compaction

Incremental repair caveats

Do not use -pr with incremental repair

Do not use -pr with incremental repair

Useless : data is repaired once only

Do not use -pr with incremental repair

Useless : data is repaired once only anyway
Misleading : anticompaction partially disabled

CASSANDRA-11696

Fixed in 2.1.15, 2.2.7, 3.0.8, 3.8

Incremental repairs can mark too many ranges as repaired

Incremental repair bugs

CASSANDRA-13153

Fixed in 2.2.10, 3.0.13, 3.11.0, 4.0

Reappearing Data when Mixing Incremental and Full Repairs

Incremental repair bugs

CASSANDRA-9143

Fix planned for 4.0

SSTables marked as repaired on some nodes only

Because : **node can fail during anti compaction**
or : **SSTables can get compacted during repair**

CASSANDRA-10446

Fix planned for 4.0

Spotted by Paulo Motta in the comments :
SSTables are streamed with a repairedAt value.

Incremental repair will not…

Fix a poor repair strategy

Incremental repair will not…

Prevent you from having to run full repair

Reaper does support incremental repair

github.com/thelastpickle

No subrange repair

Reaper and incremental repair

No subrange repair

Single repair thread => no concurrency

What and why ?

Full repair

Incremental repair

How to make it work

Put your repair strategy in place on day 1

Use appropriate tooling or build your own

Spread repair over
a gc_grace_seconds cycle

Adjust repair pressure on your cluster (Reaper does that)

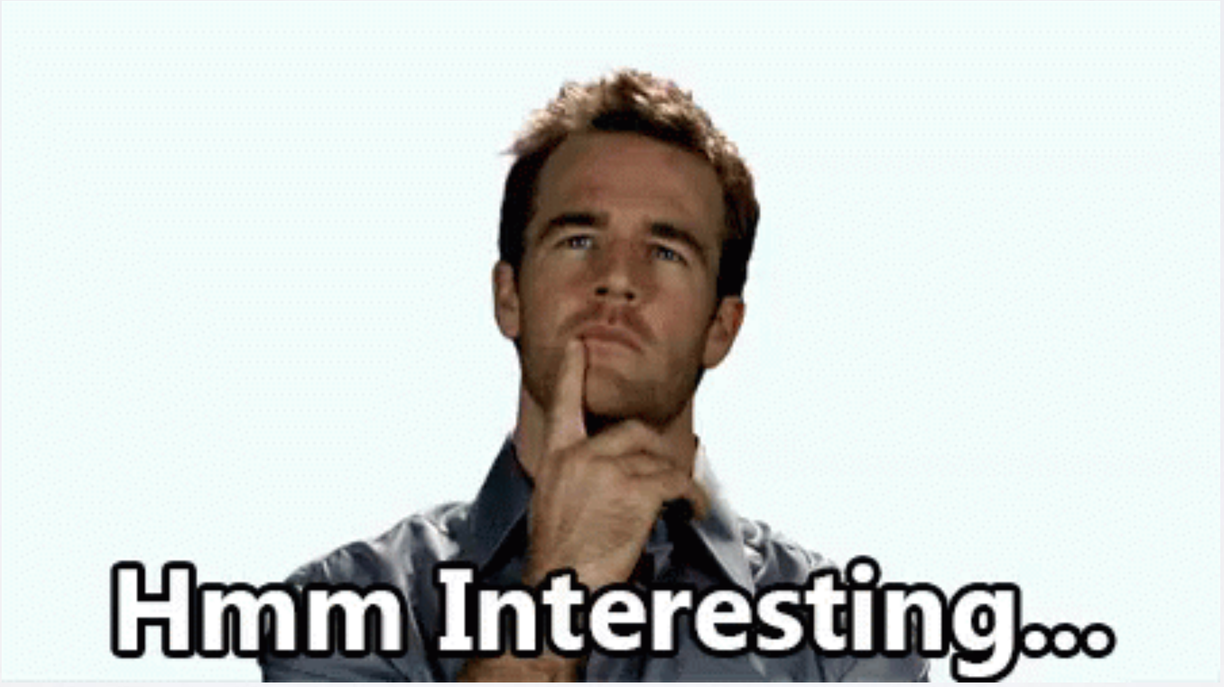
Repair best practices

Don’t repair everything !

Pick tables with deletes and those with critical data

Repair best practices

If every data is critical, then none is ;)



Repair best practices

Be tight on your schedule with inc repair

Tombstones and anticompaction

www.thelastpickle.com

Repair best practices

Avoid concurrency with inc repair

One node at a time

www.thelastpickle.com

Wait for 4.0.x before moving to incremental repair…?

Thanks!

@alexanderdeja