Distributed Registry Protocol - DRiP

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Overview

- DRiP is a HTTP based protocol for sharing registry type of information between interconnected nodes across a network
- It uses a gossip protocol for complete distribution across interconnected nodes
- It incorporates a voting mechanism to avoid conflicting data updates or race conditions

Overview

- It is designed to use full reliability in it's transactions, even at the price of inefficiency. Speed or optimization of transactions is only secondary consideration.

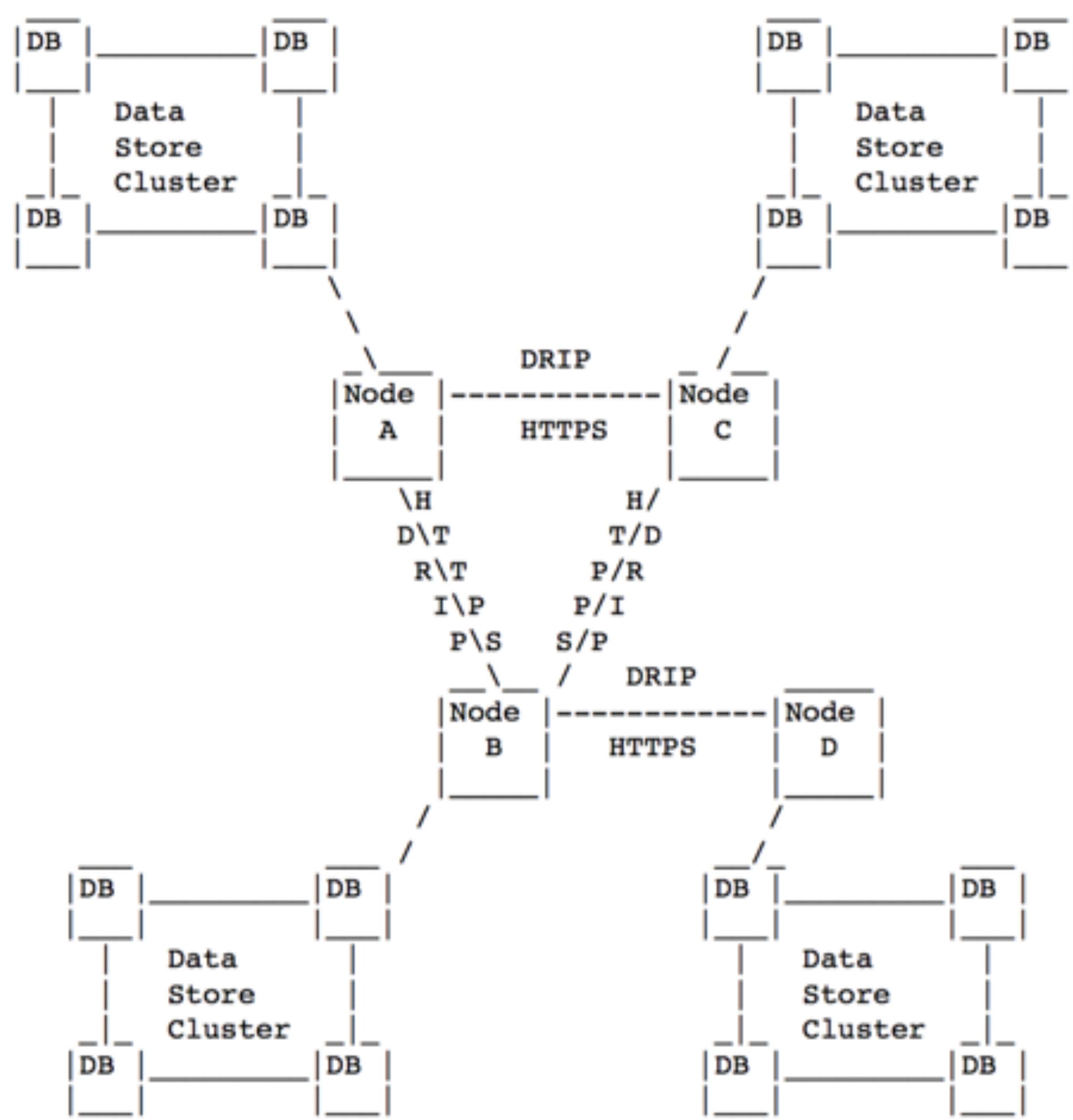
- Conflicting updates, will need to be fully retried.

- Synchronization transactions are comprehensive.

- Conflicts, assuming each participant is managing mostly it's own data, other than change of ownership and other relatively rare occurrences, should happen very infrequently

- Regardless, assuming ~100-1000 node distributed mesh, updates across nodes should be updated in ~seconds time frame assuming all nodes are well connected

Distributed Mesh



Distributed Mesh

- A distributed mesh is a network topology of interconnected nodes that share data.
- There is no assumption of a fully connected mesh, but in general most nodes SHOULD have at least 2 connections to other nodes for redundancy and gossip propagation purposes
- Gossip protocol and the use of a counter allows for all nodes in the mesh to receive updates from all other nodes.

Transactions

- Two basic transactions
  - Update - A node has new or modified key-value data and would like to update peer nodes
  - Sync - A node is either newly established or was in an inactive state for a period of time and requests a peer to provide a full update of data to make sure it is fully synchronized with network.

Node State

- Each node should maintain a state of
  - active
  - inactive
  - sync

Node State - API

```
POST /node/:nodeid/active

POST /node/:nodeid/inactive

GET /state
```

Node-specific info

- Each node should have a globally unique ID
- Node information and other transaction specific info is carried in custom HTTP header fields

Custom HTTP Header Fields

- DRiP-Node-ID
- DRiP-Node-Counter
- DRiP-Node-Counter-reset
- DRiP-Transaction-Type
- DRiP-Sync-Complete

Key-Value Data Propagation Rules

- For update transactions, nodes should propagate key-value data to it’s peer nodes except the node that it received data
- For all transactions,
  - DRiP-Node-ID and associated latest DRiP-Node-Counter values should be recorded by receiver nodes
  - If DRiP-Node-Counter is greater for a particular DRiP-Node-ID the key-value data should be recorded and propagated to peer nodes.
  - DRiP-Node-Counter-reset provide a wrap-around mechanism for DRiP-Node-Counter as a forever incrementing integer

Voting and Commit Phases for Update

- When initiator node has new data, it initiates an Update
- Update consists of a two-phase commit procedure to avoid race conditions or potential error conditions
- Two phases are called:
    - voting phase
    - commit phase

Voting and Commit Phases for Update

```
                          __________
 ------------------------>|          |
|                         | Waiting  |
|                         | For      |
|  -----------------------| Events   |
|  | (Update,             |__________|
|  |  Start Timer)
|  |                                ---------------------------------
|  |                               | Received Update From Peer Node |
|  |                               |                                 |
|  |                _______________|_  If key matches an             |
|  |               |                |   in-progress update           |
|  ------------>   |                |   vote "no".                   |
|                  | Waiting For    |   Otherwise, vote "yes".       |
|                  | Response From  |                                 |
|                  | Peer Nodes     |<--------------------------------
|                  |                |
|             ----|                 |----
|  Timer     |    |________________|    |
|  Expired   |                           | Received Votes
|            |                           | From All Peer
|            |                           | Nodes
|            |     _______________       |
|            |    |                |     |
|            |    |                |     |
|             --->|                |<---
|                 |  Validating    |
| (If all Votes   |  Votes         |
|  are "YES",     |                |
| propagate       |                |
| commit)         |                |
 -----------------|________________|
```

Voting Phase

- An initiator node first sends a voting request to all of its peer nodes.
- Only the initiator node sets a timer for the voting phase to time out if it hasn't received responses from all its peer nodes.
- As in gossip, each receiver node will continue propagating voting requests to its peer nodes until it has received a voting query again.
- If all voting requests result in "yes", the commit phase can be initiated by initiator node.

Voting Phase - API

```
POST /voting
POST /votingphase/node/:nodeid/response/:response
```

Commit Phase

- An initiator node, upon successful voting phase, commits the key-value data to its local data store and sends a commit request to its peers

- Each receiver node commits data to its local data store and, again as in gossip, propagates the commit request to each of its peer nodes, until it receives a duplicate commit request and stops.

Commit Phase - API

```
POST /commit
```

Node Sync

- When a new node is added to a distributed registry, or when a node has been offline or inactive for any period of time, a node sync operation must be completed.
- The node should go to active state to receive updates concurrently with sync operations.
- The node will make a sync request to one of its peer nodes
- The peer node will then sync a complete set of key-value data in the form of commit requests (no voting phase)

Node Sync

- Best practice in terms of rate limiting, priority scheduling, and others should be employed to avoid overwhelming connections or risk interfering with update transactions.
- Best practice for redundancy and fail-over should be followed to avoid as much occurrence of inactive time that requires sync operations.

Sync - API

```
PUT /sync/node/:nodeid
```

Heartbeat

- TBD in next update
- Main issue is best methods to determine how to proceed if a peer node doesn’t send heartbeat and didn’t declare itself “inactive”

Authentication/Entitlement

- Took the approach that scope of this spec only has protocol for exchanging data
- Assumes any authentication or entitlement of write/read capability or permissions sits a layer above this protocol and/or in the key-value data model