GR failover triggers and scenarios

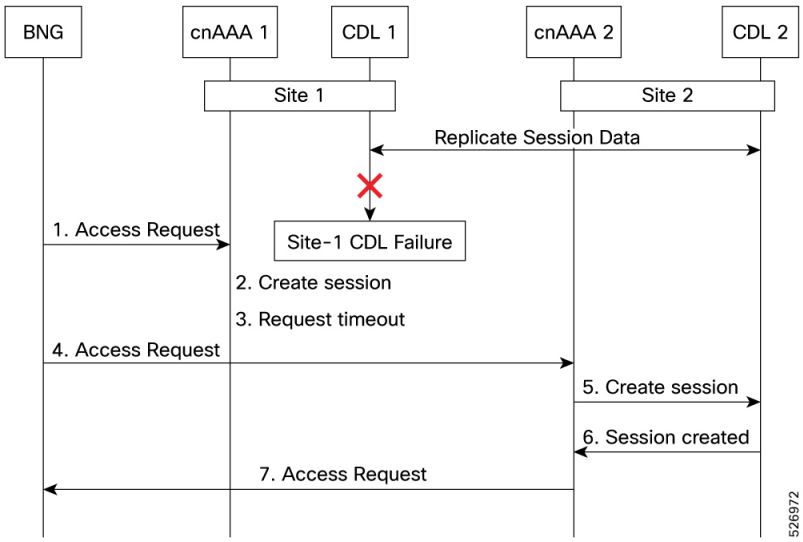
- CDL endpoint failure, on page 1
- Indexing shard failure, on page 2
- Slot replica set failure, on page 3
- Replication link failure, on page 4
- MongoDB site failover scenarios, on page 6

CDL endpoint failure

CDL Endpoint Failure

A CDL endpoint failure occurs when the primary site's data layer becomes unreachable. The cnAAA relies on the CDL to manage session state. If the endpoint becomes unresponsive, the primary site cannot complete AAA transactions.

Figure 1: CDL endpoint failure call flow



These stages describe the call flow and system behavior during a CDL endpoint failure:

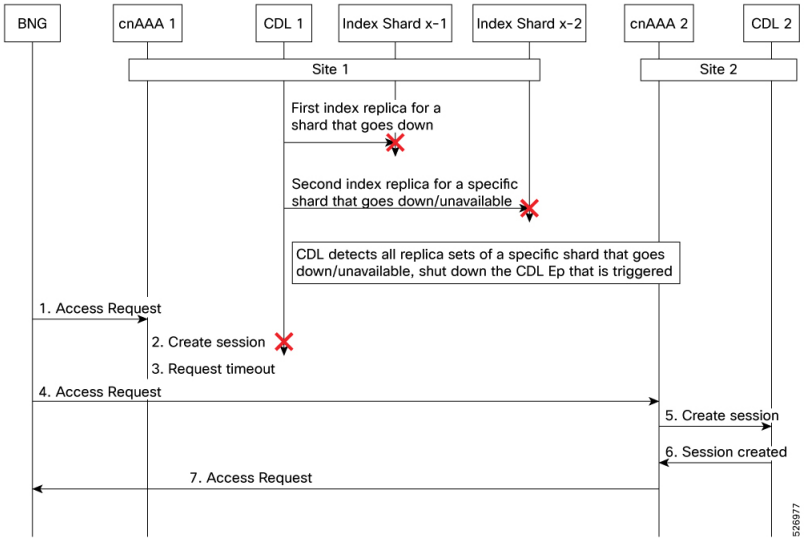
Stage	Description
1	The BNG sends a RADIUS Access-Request to Site 1.
2	Site 1 sends a session creation request to CDL 1.
3	Site 1 does not send a response because the CDL endpoint is down. The Access-Request times out on the BNG.
4	The BNG identifies Site 1 as unavailable and redirects the request to Site 2.
5	Site 2 sends a session creation request to CDL 2.
6	CDL 2 responds with a success message.
7	Site 2 sends a RADIUS Access-Accept message to the BNG.

Indexing shard failure

An indexing shard failure occurs when two index replicas that belong to the same shard are unavailable. This scenario represents two points of failure, which typically occurs when replicas reside on different virtual machines or hosts.

If the primary CDL site (Site 1) is unavailable, the cnAAA RADIUS endpoint and engine redirect traffic to the secondary site (Site 2) based on the highest available rating.

Figure 2: Indexing shard failure call flow



These stages describe the sequence of events during an indexing shard failure:

Table 1: Indexing shard failure call flow description

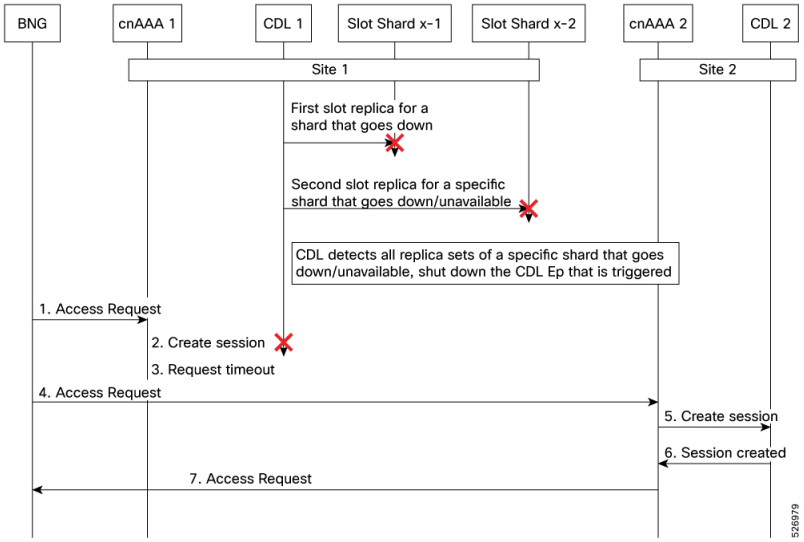
Stage	Description

1	The Broadband Network Gateway (BNG) sends a RADIUS Access-Request to Site 1.
2	The RADIUS endpoint receives the request and forwards it to the Policy Engine.
3	The Policy Engine attempts to send a session creation request to the CDL, but the connection fails.
4	Site 1 does not respond to the BNG, and the request times out.
5	The BNG identifies **Site 1** as unavailable and redirects the request to Site 2.
6	Site 2 sends a session creation request to CDL 2.
7	CDL 2 responds with a success message.

Slot replica set failure

A slot replica set failure occurs when two slot replicas that belong to the same replica set are unavailable. This scenario represents two points of failure, which typically occurs when replicas reside on different virtual machines or hosts.

Slot replica set failure call flow



These stages describe the sequence of events during a slot replica set failure:

Table 2: Slot replica set failure call flow description

Stage	Description
1	The BNG sends a RADIUS Access-Request to Site 1.
2	The RADIUS endpoint receives the request and forwards it to the Policy Engine.

3	The Policy Engine attempts to send a session creation request to the CDL, but the connection fails.
4	Site 1 does not respond to the BNG, and the request times out.
5	The BNG identifies Site 1 as unavailable and redirects the request to Site 2.
6	Site 2 sends a session creation request to CDL 2 and receives a success message.
7	Site 2 sends a RADIUS Access-Accept response to the BNG.

Replication link failure

This section describes how the system manages data synchronization during a replication network failure for the CDL and MongoDB.

CDL replication failure

If the replication network fails, CDL synchronization with the remote site stops. The system writes data to the Kafka cluster. After the network is restored, the system synchronizes with remote members. Synchronization uses the offset where the system last read the data before the failure.

MongoDB replication failure

The system writes data to the operation log (oplog), which is configured with a 5 GB capacity. Secondary members read from the oplog to stay synchronized with the primary member.

If the replication network fails, secondary members on the remote site lose synchronization with the primary member. These members remain in the secondary state. They are available for read operations only to the engine pod running on the same node.

Example replica set configuration

This example describes a five-member replica set (`scdb-spr01`) distributed across three sites:

- **Site 1**: Contains two data members.
- **Site 2**: Contains two data members.
- **Site 3**: Contains the arbiter.

This table shows the status of the replica set members from Site 1 before a link failure occurs.

Table 3: Replica set member status (scdb-spr01)

MongoDB member	Site ID	Priority	Status
sdb-rs1-s1-arbiter1 (10.1.41.37)	Site 3	—	Arbiter
sdb-rs1-s1-m1 (10.1.47.244)	Site 1	104	Primary
sdb-rs1-s1-m2 (10.1.42.206)	Site 1	103	Secondary
sdb-rs1-s2-m1 (10.1.43.219)	Site 2	102	Secondary

sdb-rs1-s2-m2 (10.1.44.174)	Site 2	101	Secondary

Status of replica members from site-1 before link was down:

```
HostName     ...   State      IsArbiter  Replication-lag  Site
10.1.41.37   ...   ARBITER    true       N/A              remote
10.1.47.244  ...   PRIMARY    false      0.0              local
10.1.42.206  ...   SECONDARY  false      0.0              local
10.1.43.219  ...   SECONDARY  false      0.0              remote
10.1.44.174  ...   SECONDARY  false      0.0              remote
```

Troubleshoot MongoDB replication

Use these commands to check the health and capacity of the MongoDB replication system.

oplog status

To check the oplog window, you must first access the MongoDB shell. Run this command to log in to the MongoDB pod:

```
kubectl exec -it <mongodb-pod-name> -n <namespace> -- mongo --port 65001
```

After accessing the shell, run these commands to verify the replication health and the oplog window:

1. Check the oplog window: `rs.printReplicationInfo()`
2. Check the replication lag status: `rs.printSecondaryReplicationInfo()`

   - **Run on the primary node**: This provides the authoritative status of the replication history. If the log length is 10 hours, a secondary site that remains down for more than 10 hours will become stale and require a full resynchronization.
   - **Run on a secondary node**: This displays the statistics for that specific secondary node's local copy of the oplog. Use this to verify that the secondary node has allocated the same amount of space as the primary node.

Key output fields:

- **configured oplog size**: The maximum disk space allocated for the oplog.
- **log length start to end**: The `oplog window` in hours or seconds. This field represents the time difference between the oldest and newest entry.
- **oplog first/last event time**: The exact timestamps of the oldest and newest operations.

Replication lag status

Use the `rs.printSecondaryReplicationInfo()` command to identify how far behind the secondary nodes are from the primary node. Ideally, this value should be 0 seconds.

Key output fields:

- **source**: The hostname and port of the secondary node.
- **syncedTo**: The timestamp of the last operation that the secondary node successfully replicated.
- **replLag**: The actual replication lag (e.g., 0 secs).

MongoDB site failover scenarios

This table describes the system behavior and member status during various site and link failure scenarios.

Table 4: MongoDB failover scenarios

Failure scenario	Site 1 status	Site 2 status	Site 3 status	Observation
Site 1 down	sdb-rs1-s1-m1:Down sdb-rs1-s1-m2: Down	sdb-rs1-s2-m1: : Secondary sdb-rs1-s2-m2: : Secondary	sdb-rs1-s1-arbiter1:Down	As site-1 is down the member in Site 2 with the highest priority (102) becomes the primary.
Site 2 down	sdb-rs1-s1-m1: Primary sdb-rs1-s1-m2: Secondary	sdb-rs1-s2-m1: : Secondary sdb-rs1-s2-m2: : Secondary **Note** Site-1 members are not reachable.	sdb-rs1-s1-arbiter1:Arbiter	When Site 2 is down, Site 1 does not experience any change because the primary is already running at Site 1.
Site 3 down	sdb-rs1-s1-m1: Primary sdb-rs1-s1-m2: Secondary	sdb-rs1-s2-m1: : Secondary sdb-rs1-s2-m2: : Secondary	sdb-rs1-s1-arbiter1:Down	When Site 3 is down, the arbiter becomes unreachable, but the status of the remaining members remains unchanged.
Replica link failure occurs when the connection between site-1 and site-2 is down in either direction. In this scenario, site-3 remains reachable from both site-1 and site-2.	sdb-rs1-s1-m1: Primary sdb-rs1-s1-m2: Secondary **Note** Site-2 secondary members will not be reachable.	sdb-rs1-s2-m1: : Secondary sdb-rs1-s2-m2: : Secondary **Note** Site-1 members are not reachable	sdb-rs1-s1-arbiter1: Arbiter	Write operations fail on Site 2. Read operations succeed. **Note** The CLI status in Ops Center may indicate that the primary device is reachable from site-2. This is because the status check uses a different management interface.

Replica set status during failover scenarios

Site-1 down

The status of replica-set when site-1 is down.

```
HostName     Port     MemberName           NodeName                          Priority
       State                          IsArbiter          Replication-lag Site
  (IP)                                                                     Running  Config
    From-Primary   From-Member    Running   Config          (Seconds)
10.1.41.37   65001    sdb-rs1-s1-arbiter1  rid8040557-system-1-master1     0
     ARBITER     ARBITER        true      true         N/A               remote
10.1.47.244  65001    sdb-rs1-s1-m1        UNKNOWN                           UNKNOWN    104
      DOWN        NO_CONNECTION  false     false        UNKNOWN           remote
10.1.42.206  65001    sdb-rs1-s1-m2        UNKNOWN                           UNKNOWN    103
      DOWN        NO_CONNECTION  false     false        UNKNOWN           remote
10.1.43.219  65001    sdb-rs1-s2-m1        rid8447988-system-3-master1     102        102
     PRIMARY     PRIMARY        false     false        0.0               local
10.1.44.174  65001    sdb-rs1-s2-m2        rid8447988-system-3-master1     101        101
     SECONDARY   SECONDARY      false     false        0.0               local
```

Site-2 down

The status of replica-set when site-2 is down.

```
HostName          Port     MemberName          NodeName
Priority                  State                  IsArbiter           Replication-lag   Site
  (IP)                                                                                 Running
   Config   From-Primary   From-Member    Running   Config        (Seconds)
10.1.41.37       65001    sdb-rs1-s1-arbiter1  rid8040557-system-1-master1           0
              ARBITER        ARBITER        true      true        N/A           remote
10.1.47.244      65001    sdb-rs1-s1-m1        rid8834195-system-2-master1          104
      104      PRIMARY        PRIMARY        false     false       0.0           local
10.1.42.206      65001    sdb-rs1-s1-m2        rid8834195-system-2-master2          103
      103      SECONDARY      SECONDARY      false     false       0.0           local
10.1.43.219      65001    sdb-rs1-s2-m1        UNKNOWN
UNKNOWN    102      DOWN           NO_CONNECTION  false     false       UNKNOWN       remote
10.1.44.174      65001    sdb-rs1-s2-m2        UNKNOWN
UNKNOWN    101      DOWN           NO_CONNECTION  false     false       UNKNOWN       remote
```

Site-3 down:

The status of replica-set when site-3 is down.

```
HostName          Port      MemberName          NodeName                              Priority
                 State                   IsArbiter        Replication-lag Site
  (IP)                                                                                 Running
   Config   From-Primary   From-Member    Running   Config    (Seconds)
10.1.41.37       65001     sdb-rs1-s1-arbiter1  UNKNOWN                              UNKNOWN
            DOWN           NO_CONNECTION  false     true      UNKNOWN      remote
10.1.47.244      65001     sdb-rs1-s1-m1        rid8834195-system-2-master1     104
 104      PRIMARY        PRIMARY        false     false     0.0          local
10.1.42.206      65001     sdb-rs1-s1-m2        rid8834195-system-2-master2     103
 103      SECONDARY      SECONDARY      false     false     0.0          local
10.1.43.219      65001     sdb-rs1-s2-m1        rid8447988-system-3-master1     102
 102      SECONDARY      SECONDARY      false     false     0.0          remote
10.1.44.174      65001    sdb-rs1-s2-m2         rid8447988-system-3-master1     101
 101      SECONDARY      SECONDARY      false     false     0.0          remote
```

Replica-link failure: (inter-site failure)

From Site-1:

```
=============================================================================================================
HostName      Port      MemberName          NodeName                                    Priority
              State                   IsArbiter          Replication-lag   Site
  (IP)                                                                                  Running
Config   From-Primary   From-Member    Running   Config          (Seconds)
=============================================================================================================
10.1.41.37    65001    sdb-rs1-s1-arbiter1  rid8040557-system-1-master1       0
        ARBITER        ARBITER        true      true         N/A                 remote
10.1.47.244   65001    sdb-rs1-s1-m1        rid8834195-system-2-master1       104
104      PRIMARY        PRIMARY        false     false        0.0                 local
10.1.42.206   65001    sdb-rs1-s1-m2        rid8834195-system-2-master2       103
103      SECONDARY      SECONDARY      false     false        0.0                 local
10.1.43.219   65001    sdb-rs1-s2-m1        UNKNOWN                          UNKNOWN
 102      DOWN           NO_CONNECTION  false     false        UNKNOWN             remote
10.1.44.174   65001    sdb-rs1-s2-m2        UNKNOWN                          UNKNOWN
 101      DOWN           NO_CONNECTION  false     false        UNKNOWN             remote
=============================================================================================================
```

From Site-2:

```
=============================================================================================================
HostName       Port      MemberName          NodeName                                    Priority
                 State                       IsArbiter          Replication-lag   Site
  (IP)                                                                             Running
  Config   From-Primary   From-Member    Running   Config          (Seconds)
=============================================================================================================
10.1.41.37     65001     sdb-rs1-s1-arbiter1  rid8040557-system-1-master1         0
            ARBITER        ARBITER        true      true         N/A               remote
10.1.47.244    65001     sdb-rs1-s1-m1        rid8834195-system-2-master1         104
   104      PRIMARY        PRIMARY        false     false        0.0               remote
10.1.42.206    65001     sdb-rs1-s1-m2        rid8834195-system-2-master2         103
   103      SECONDARY      SECONDARY      false     false        0.0               remote
10.1.43.219    65001     sdb-rs1-s2-m1        rid8447988-system-3-master1         102
   102      DOWN           SECONDARY      false     false        UNKNOWN           local
10.1.44.174    65001     sdb-rs1-s2-m2        rid8447988-system-3-master1         101
   101      DOWN           SECONDARY      false     false        UNKNOWN           local
=============================================================================================================
```

Note The CLI status from Ops-Center may indicate that the primary node is reachable from site-2, because the status is checked through a different management interface.

The `rs.status()` command provides a comprehensive overview of the replica set's current state, including health, membership, and connectivity. In a Geo-Redundant (GR) environment, this is the primary tool for diagnosing site-to-site communication failures or node outages.

Site-1 Unreachable from Site-2

When the connection between sites is severed, or if the primary site (Site-1) goes offline, running `rs.status()` from a node in the secondary site (Site-2) will reveal the connectivity status of all members in the cluster.

```
sdb-spr01 [direct: secondary] test> rs.status()
{
  set: 'sdb-spr01',
  date: ISODate('2026-02-04T12:15:21.713Z'),
  myState: 2,
  term: Long('5'),
  syncSourceHost: '',
  syncSourceId: -1,
  heartbeatIntervalMillis: Long('300'),
  majorityVoteCount: 3,
```

```
writeMajorityCount: 3,
votingMembersCount: 5,
writableVotingMembersCount: 4,
optimes: {
  lastCommittedOpTime: { ts: Timestamp({ t: 1770207149, i: 1 }), t: Long('5') },
  lastCommittedWallTime: ISODate('2026-02-04T12:12:29.107Z'),
  readConcernMajorityOpTime: { ts: Timestamp({ t: 1770207149, i: 1 }), t: Long('5') },
  appliedOpTime: { ts: Timestamp({ t: 1770207149, i: 1 }), t: Long('5') },
  durableOpTime: { ts: Timestamp({ t: 1770207149, i: 1 }), t: Long('5') },
  lastAppliedWallTime: ISODate('2026-02-04T12:12:29.107Z'),
  lastDurableWallTime: ISODate('2026-02-04T12:12:29.107Z')
},
lastStableRecoveryTimestamp: Timestamp({ t: 1770207149, i: 1 }),
members: [
  {
    _id: 1,
    name: '10.1.43.219:65001',
    health: 1,
    state: 2,
    stateStr: 'SECONDARY',
    uptime: 2599,
    optime: { ts: Timestamp({ t: 1770207149, i: 1 }), t: Long('5') },
    optimeDate: ISODate('2026-02-04T12:12:29.000Z'),
    lastAppliedWallTime: ISODate('2026-02-04T12:12:29.107Z'),
    lastDurableWallTime: ISODate('2026-02-04T12:12:29.107Z'),
    syncSourceHost: '',
    syncSourceId: -1,
    infoMessage: '',
    configVersion: 153209,
    configTerm: -1,
    self: true,
    lastHeartbeatMessage: ''
  },
  {
    _id: 2,
    name: '10.1.44.174:65001',
    health: 1,
    state: 2,
    stateStr: 'SECONDARY',
    uptime: 2597,
    optime: { ts: Timestamp({ t: 1770207149, i: 1 }), t: Long('5') },
    optimeDurable: { ts: Timestamp({ t: 1770207149, i: 1 }), t: Long('5') },
    optimeDate: ISODate('2026-02-04T12:12:29.000Z'),
    optimeDurableDate: ISODate('2026-02-04T12:12:29.000Z'),
    lastAppliedWallTime: ISODate('2026-02-04T12:12:29.107Z'),
    lastDurableWallTime: ISODate('2026-02-04T12:12:29.107Z'),
    lastHeartbeat: ISODate('2026-02-04T12:15:21.652Z'),
    lastHeartbeatRecv: ISODate('2026-02-04T12:15:21.706Z'),
    pingMs: Long('0'),
    lastHeartbeatMessage: '',
    syncSourceHost: '',
    syncSourceId: -1,
    infoMessage: '',
    configVersion: 153209,
    configTerm: -1
  },
  {
    _id: 3,
    name: '10.1.47.244:65001',
    health: 0,
    state: 8,
    stateStr: '(not reachable/healthy)',
    uptime: 0,
    optime: { ts: Timestamp({ t: 0, i: 0 }), t: Long('-1') },
```

```
    optimeDurable: { ts: Timestamp({ t: 0, i: 0 }), t: Long('-1') },
    optimeDate: ISODate('1970-01-01T00:00:00.000Z'),
    optimeDurableDate: ISODate('1970-01-01T00:00:00.000Z'),
    lastAppliedWallTime: ISODate('2026-02-04T12:09:49.100Z'),
    lastDurableWallTime: ISODate('2026-02-04T12:09:49.100Z'),
    lastHeartbeat: ISODate('2026-02-04T12:15:20.778Z'),
    lastHeartbeatRecv: ISODate('2026-02-04T12:09:54.367Z'),
    pingMs: Long('0'),
    lastHeartbeatMessage: "Couldn't get a connection within the time limit",
    syncSourceHost: '',
    syncSourceId: -1,
    infoMessage: '',
    configVersion: 153209,
    configTerm: -1
  },
  {
    _id: 4,
    name: '10.1.42.206:65001',
    health: 0,
    state: 8,
    stateStr: '(not reachable/healthy)',
    uptime: 0,
    optime: { ts: Timestamp({ t: 0, i: 0 }), t: Long('-1') },
    optimeDurable: { ts: Timestamp({ t: 0, i: 0 }), t: Long('-1') },
    optimeDate: ISODate('1970-01-01T00:00:00.000Z'),
    optimeDurableDate: ISODate('1970-01-01T00:00:00.000Z'),
    lastAppliedWallTime: ISODate('2026-02-04T12:09:49.100Z'),
    lastDurableWallTime: ISODate('2026-02-04T12:09:49.100Z'),
    lastHeartbeat: ISODate('2026-02-04T12:15:20.778Z'),
    lastHeartbeatRecv: ISODate('2026-02-04T12:09:54.438Z'),
    pingMs: Long('0'),
    lastHeartbeatMessage: "Couldn't get a connection within the time limit",
    syncSourceHost: '',
    syncSourceId: -1,
    infoMessage: '',
    configVersion: 153209,
    configTerm: -1
  },
  {
    _id: 5,
    name: '10.1.41.37:65001',
    health: 1,
    state: 7,
    stateStr: 'ARBITER',
    uptime: 545,
    lastHeartbeat: ISODate('2026-02-04T12:15:21.710Z'),
    lastHeartbeatRecv: ISODate('2026-02-04T12:15:21.552Z'),
    pingMs: Long('0'),
    lastHeartbeatMessage: '',
    syncSourceHost: '',
    syncSourceId: -1,
    infoMessage: '',
    configVersion: 153209,
    configTerm: -1
  }
],
ok: 1,
'$clusterTime': {
  clusterTime: Timestamp({ t: 1770207319, i: 1 }),
  signature: {
    hash: Binary.createFromBase64('AAAAAAAAAAAAAAAAAAAAAAAAAAA=', 0),
    keyId: Long('0')
  }
},
```

```
  operationTime: Timestamp({ t: 1770207149, i: 1 })
}
```