What's new in Nova CellsV2?

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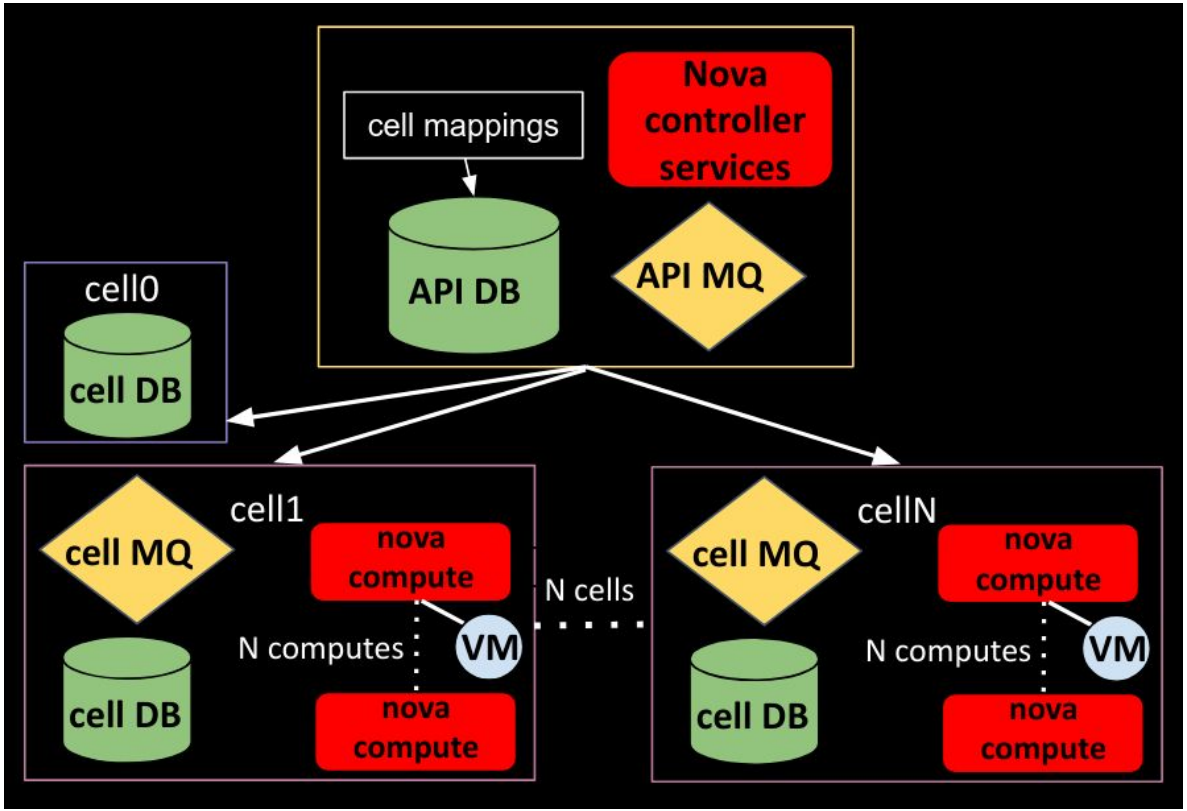
Overview

1. Introduction to Nova Multi-Cells
2. What's new in Cells?
    a. Handling Down Cells
        i. Making listing operations more resilient
        ii. A new mechanism for calculating Quotas
        iii. Operator and user highlights
        iv. Known issues and limitations
    b. Cross-cell Resize
        i. Use cases
        ii. Design specifics and implementation workflow
        iii. Known issues and limitations

Nova Cells (multi-cells-v2)

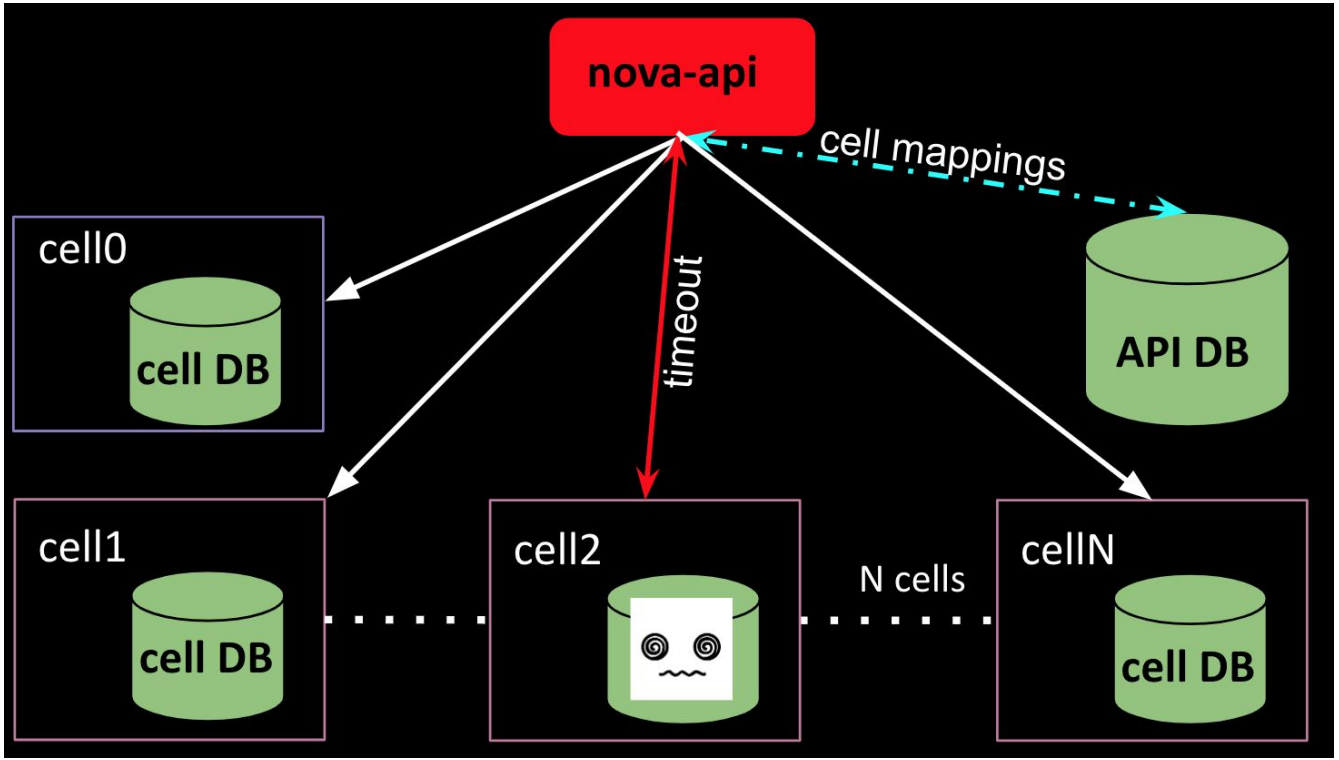


See nova cells for a more detailed view.

Handling Down Cells

- A step towards making cells more resilient.
- Available from the **Stein** release.

Problem Statement



Problem Statement

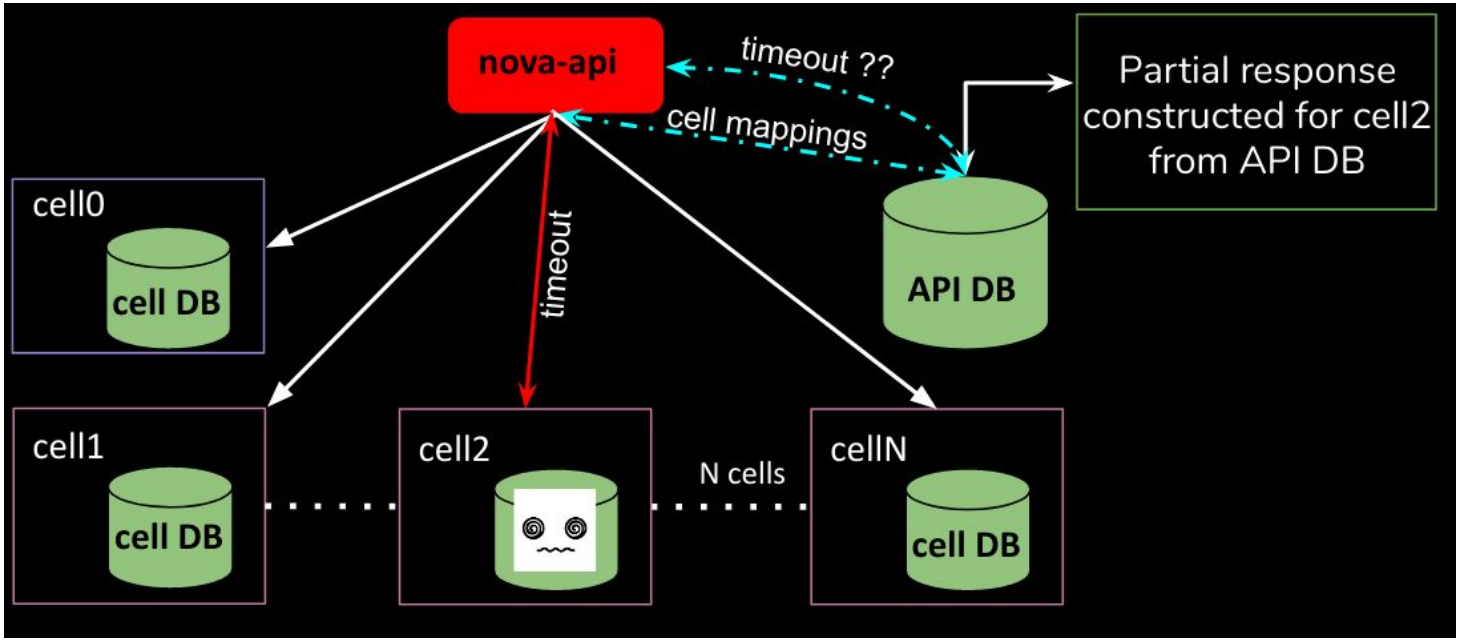
- When a cell goes down basic operations like `GET /servers` and `GET /os-services` stop working for the whole infrastructure.

- However one cell going down should not affect the users and operators from listing resources from the API.

A single cell going down should not impact the whole infrastructure

Implemented Solution

Return partial information for the down cells from the API database



Scoped Use Cases

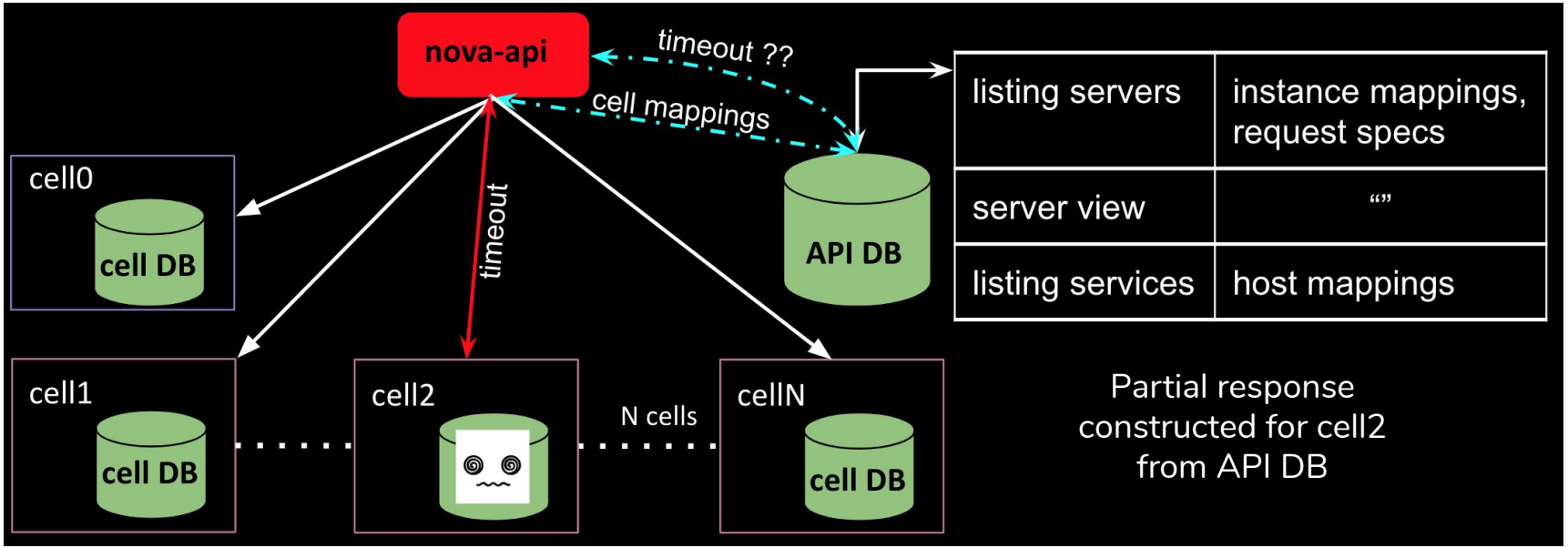
The specific use cases that have been addressed using the aforementioned solution are:

1. Listing Servers
2. Viewing a Server
3. Listing Compute Services
    3.1. Note that this is limited to the “nova-compute” services per cell.

See handling down cells for more information.

Implemented Solution

Return partial information for the down cells from the API database



Example Scenario

We have three cells which are all up:

```
+-------+--------------------------------------+
|  Name |                 UUID                 |
+-------+--------------------------------------+
| cell0 | 00000000-0000-0000-0000-000000000000 |
| cell1 | 808bfe0b-fcb5-429f-a387-604496d3549d |
| cell2 | f61a032f-014b-4193-a74e-fc21db3191d7 |
+-------+--------------------------------------+
```

We force cell2 to go down:

```
Apr 15 08:37:12 surya001 devstack@n-api.service[31379]: ERROR nova.context [None req-c14193de-5ea3-40c3-
ab13-b07f24d80cd6 admin admin] Error gathering result from cell f61a032f-014b-4193-a74e-fc21db3191d7: DB
ConnectionError: (pymysql.err.OperationalError) (2003, "Can't connect to MySQL server on u'137.138.157.1
50' ([Errno 111] ECONNREFUSED)") (Background on this error at: http://sqlalche.me/e/e3q8)
```

Listing Servers

Response when cell0 and cell1 are up but cell2 is down:

```
Apr 15 08:37:12 surya001 devstack@n-api.service[31379]: WARNING nova.compute.api [None req-c14193de-5ea3
-40c3-ab13-b07f24d80cd6 admin admin] Cell f61a032f-014b-4193-a74e-fc21db3191d7 is not responding and hen
ce only partial results are available from this cell.
```

ID	Name	Status	Task State	Power State	Networks
28d36855-8d78-4598-bf16		UNKNOWN	N/A	N/A	
313f19fd-21c6-4c1c-87f1		UNKNOWN	N/A	N/A	
9dfe0a8e-c4b8-41d3-a1cd		UNKNOWN	N/A	N/A	
a36a95a3-fd47-4a5f-8f4e		UNKNOWN	N/A	N/A	
c5124e7c-4f43-4e7d-a964		UNKNOWN	N/A	N/A	
f434d938-33cf-47b8-b0e9		UNKNOWN	N/A	N/A	
bcb67da5-46fa-41b6-b9b1	admintest3	ACTIVE	-	Running	public=2001:db8::155
639135ab-c557-4381-855f	admintest4	ACTIVE	-	Running	public=2001:db8::1ec
0b96767a-a2c6-4bad-88e7	admintest5	ACTIVE	-	Running	public=2001:db8::18c
178bb359-1392-44a2-a155	admintest78	ACTIVE	-	Running	public=2001:db8::35b

Viewing a Server

From a down cell

```
ubuntu@surya001:~/devstack$ nova show 313f19fd-21c6-4c1c-87f1-8469925b6bc6
+------------------------------+--------------------------------------------------------------------+
| Property                     | Value                                                              |
+------------------------------+--------------------------------------------------------------------+
| OS-EXT-AZ:availability_zone  | UNKNOWN                                                            |
| OS-EXT-STS:power_state       | 0                                                                  |
| created                      | 2019-01-25T12:50:07Z                                               |
| flavor:disk                  | 1                                                                  |
| flavor:ephemeral             | 0                                                                  |
| flavor:extra_specs           | {}                                                                 |
| flavor:original_name         | m1.nano                                                            |
| flavor:ram                   | 64                                                                 |
| flavor:swap                  | 0                                                                  |
| flavor:vcpus                 | 1                                                                  |
| id                           | 313f19fd-21c6-4c1c-87f1-8469925b6bc6                               |
| image                        | cirros-0.4.0-x86_64-disk (f36d26a0-c5f4-498e-960f-c6cdc6cad126)    |
| status                       | UNKNOWN                                                            |
| tenant_id                    | 3b6beaf083204623b3f54fdbded16916                                   |
| user_id                      | 6104fcfea7c746f9b0380e6bc64fc906                                   |
+------------------------------+--------------------------------------------------------------------+
```

Listing Services

Normal response when all cells are up:

```
ubuntu@surya001:~/devstack$ nova service-list
+--------------------------------------+------------------+----------+----------+---------+-------+----------------------------+-----------------+-------------+
| Id                                   | Binary           | Host     | Zone     | Status  | State | Updated_at                 | Disabled Reason | Forced down |
+--------------------------------------+------------------+----------+----------+---------+-------+----------------------------+-----------------+-------------+
| 4b45fd51-89fe-4450-bdfe-2e2f3be8dcde | nova-scheduler   | surya001 | internal | enabled | up    | 2019-04-15T08:37:38.000000 | -               | False       |
| 10e2d352-3ee2-4be9-a488-26f6c1377d49 | nova-consoleauth | surya001 | internal | enabled | up    | 2019-04-15T08:37:38.000000 | -               | False       |
| f8b91f2a-c333-4876-ae59-bbe046178494 | nova-conductor   | surya001 | internal | enabled | up    | 2019-04-15T08:37:38.000000 | -               | False       |
| 4977129d-fe28-4656-94f1-2a8bac0613e1 | nova-conductor   | surya002 | internal | enabled | up    | 2019-04-15T08:37:39.000000 | -               | False       |
| c7019841-0b68-4f6a-9812-31dab57ec554 | nova-compute     | surya002 | nova     | enabled | down  | 2019-04-15T08:31:34.000000 | -               | False       |
| 407be032-5046-47c4-b64c-194543a8ce9a | nova-conductor   | surya001 | internal | enabled | up    | 2019-04-15T08:37:40.000000 | -               | False       |
| e394202a-482e-41c8-8de3-842b36a916b3 | nova-compute     | surya001 | nova     | enabled | down  | 2019-04-11T14:17:07.000000 | -               | False       |
+--------------------------------------+------------------+----------+----------+---------+-------+----------------------------+-----------------+-------------+
```

Response when cell0 and cell1 are up but cell2 is down:

```
ubuntu@surya001:~/devstack$ nova service-list
+--------------------------------------+------------------+----------+----------+---------+-------+----------------------------+-----------------+-------------+
| Id                                   | Binary           | Host     | Zone     | Status  | State | Updated_at                 | Disabled Reason | Forced down |
+--------------------------------------+------------------+----------+----------+---------+-------+----------------------------+-----------------+-------------+
| 4b45fd51-89fe-4450-bdfe-2e2f3be8dcde | nova-scheduler   | surya001 | internal | enabled | up    | 2019-04-15T08:37:08.000000 | -               | False       |
| 10e2d352-3ee2-4be9-a488-26f6c1377d49 | nova-consoleauth | surya001 | internal | enabled | up    | 2019-04-15T08:37:08.000000 | -               | False       |
| f8b91f2a-c333-4876-ae59-bbe046178494 | nova-conductor   | surya001 | internal | enabled | up    | 2019-04-15T08:37:08.000000 | -               | False       |
| 407be032-5046-47c4-b64c-194543a8ce9a | nova-conductor   | surya001 | internal | enabled | up    | 2019-04-15T08:37:10.000000 | -               | False       |
| e394202a-482e-41c8-8de3-842b36a916b3 | nova-compute     | surya001 | nova     | enabled | down  | 2019-04-11T14:17:07.000000 | -               | False       |
|                                      | nova-compute     | surya002 |          | UNKNOWN |       |                            |                 |             |
+--------------------------------------+------------------+----------+----------+---------+-------+----------------------------+-----------------+-------------+
```

User highlights

- From microversion 2.69 partial results will be available from the down cells.
- Prior to 2.69, depending on list_records_by_skipping_down_cells user will either get :
  - A response where results are skipped from the down cells when the config option is set to True (default).
  - A 500 error response when the config option is set to False.

All the edge cases that are not supported for minimal constructs would give responses based on the operator's configuration of the deployment, either skipping those results or returning an error.

Edge Cases

- Filtering: partial constructs are not supported with filters since it is not possible to validate the matches from the down cells.
  - “all-tenants/all-projects” and “minimal” are supported.
- Marker: if the marker specified is an instance from a down cell the request will fail with a 500 error code.
- Sorting: partial constructs are not supported like for the filters.
- Paging: partial constructs are not supported like for sorting and filtering.

Operator highlights

- Configuration considerations for a cell timeout
  - database.max_retries: by default 10 times before nova declares the cell is unreachable.
  - database.retry_interval: by default 10 seconds
  - CELL_TIMEOUT: hardcoded to 60 seconds after which nova-api gives up and returns partial constructs.
- Disabling down cells:
  - removed from being a scheduling candidate.

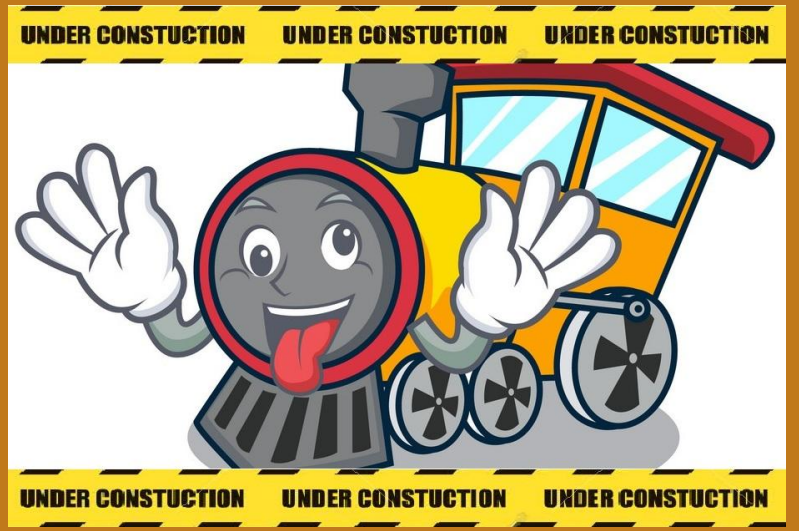
See cellsv2_management for more information.

Known Issues

- nova-api service hangs on startup.
  - if at least one cell is down and upgrade_levels.compute = auto
  - It needs to connect to all the cells to gather the compute service's RPC API version to determine the version cap.
  - See bug 1815697 for more details.
  - workaround is to pin upgrade_levels.compute to a specific release.
- Performance degradation.
  - with regards to operations that need to hit all cells.
- Needless to say that down cell targeted operations like server creation or deletion will not work.

Quota Calculation

- Introducing a new quota calculation system that is independent of cells!



Problem Statement

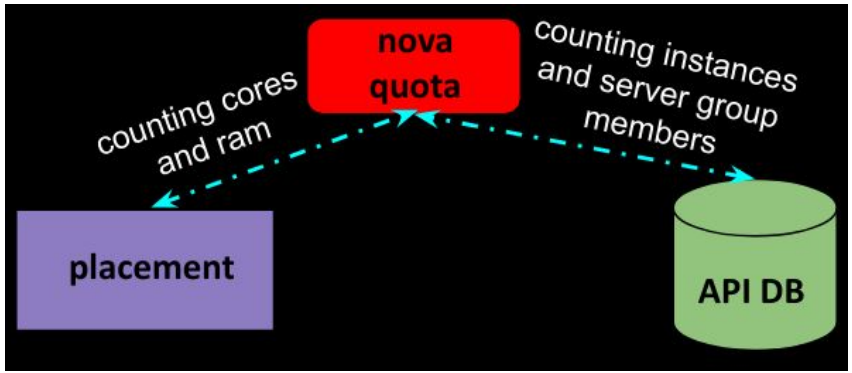
- Cores, RAM and instances are counted by reading all the cell databases and aggregating the results.
  - We use the scatter-gather utility to loop through cells in parallel.
- Quota calculation mechanism skips counting resources from the unreachable cells.
  - Hence if the user had instances in the down cell these would not have been accounted for when they request a new server creation.
  - However when the cell comes up this will have implications since now the user would be using more resources than allowed.

A cell going down should not impact the quota calculation

Implemented Solution

Counting Resources from Placement and API database

- Instead of looping over all the cell databases we simply
  - count instances from the API database
  - count RAM and cores from placement



Implementation credit: Melanie Witt (melwitt on IRC) - RedHat

Operator Highlights

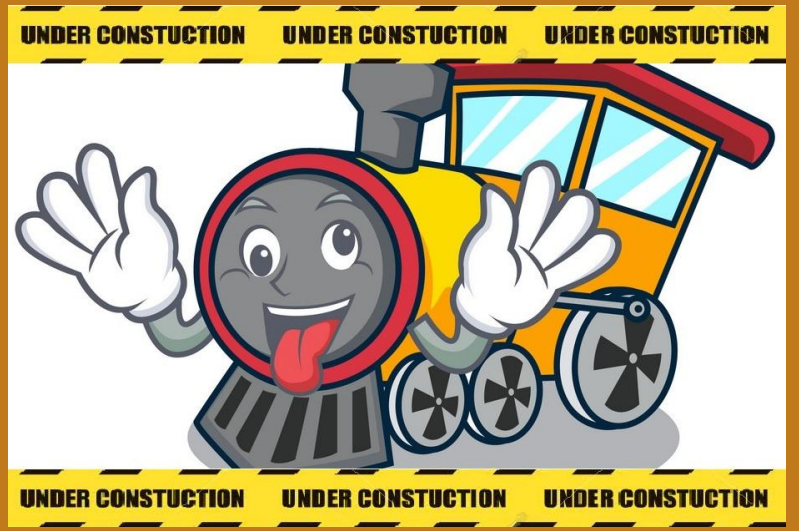
- You have to opt-into the new way of counting by setting [quota]count_usage_from_placement to True.
  - By default nova will still use the legacy way of counting quotas from the cell databases.
- Run online data migrations before using the new system
  - else the mechanism will fallback to the legacy way of counting resources.

See count_quota_usage_from_placement for more details

Operator Highlights (continued)

- Behavior changes from legacy counting for cores and ram:
  - ERROR instances in cell0 will not be counted
  - During resize quota counting is doubled
    - counts allocations against source and destination
- Limitation:
  - Deployments using multiple nova's and a single placement must not use placement to count quotas.

Cross-cell Resize



Use case

- Cloud uses cells to shard by hardware generation and wants to migrate servers from old cells to new cells
- Users can naturally aid in the cell migration by resizing their servers and retain volumes/ports/UUID

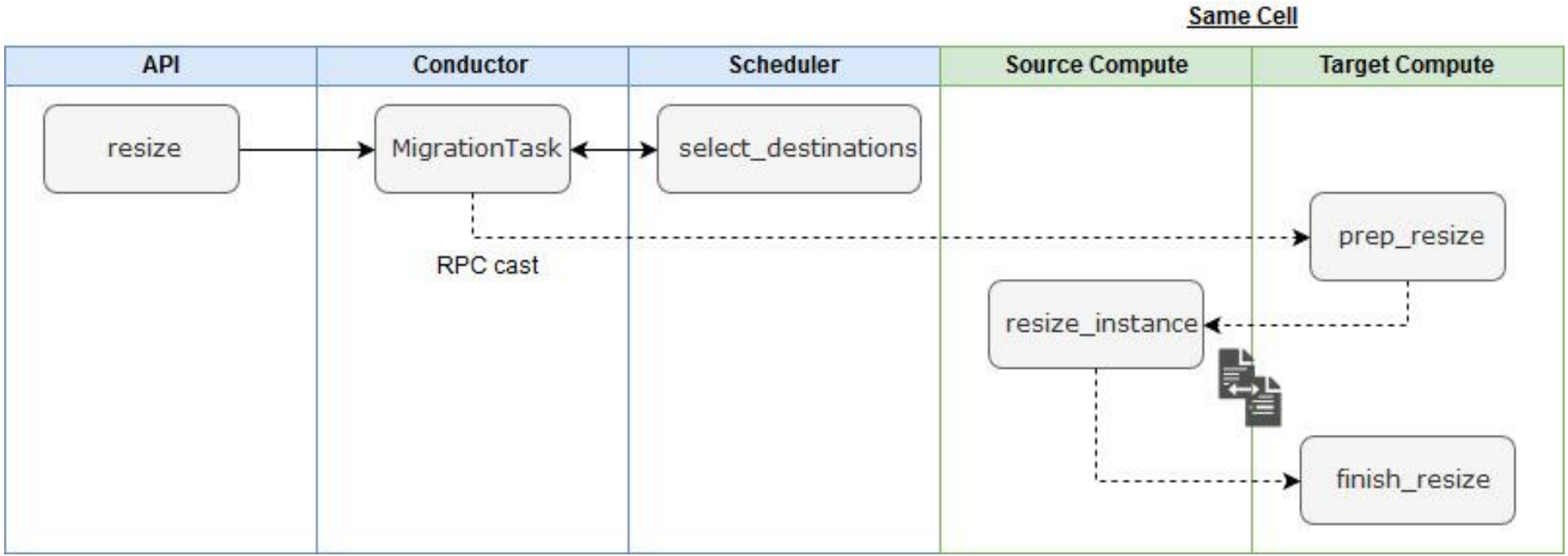
Design overview

- Tries to follow traditional resize flow but with entirely new code
  - Server state transitions will be the same
- Enables cold migrating to a target host in another cell
- Full orchestration from (super)conductor using RPC calls
  - RPC timeout controlled with long_rpc_timeout option
- Target host is validated for volume and port connections

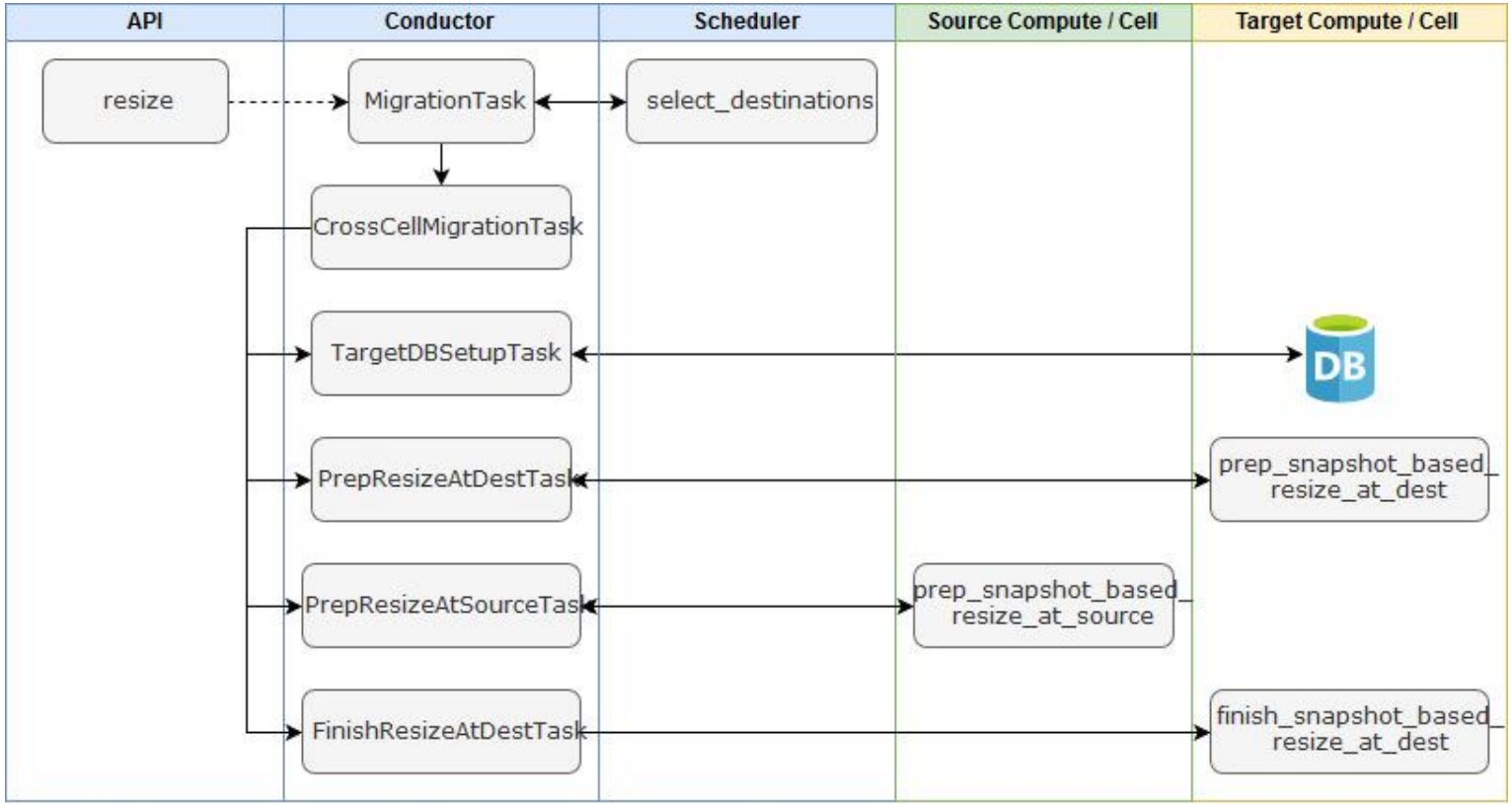
Design overview (continued)

- Instance.hidden field added
- Temporary glance snapshot created for non-volume-backed servers (like shelve)
- New policy rule: `compute:servers:resize:cross_cell`
  - Disabled by default for **all** users
- CrossCellWeigher added

Traditional resize flow



Cross-cell resize flow



Comparison summary

	Traditional	Cross cell
Blocking API	Until prep_resize on dest	Until cast to conductor
Orchestration	Computes RPC to each other	Conductor orchestrates between cells and computes at the top
Root disk file transfer	Direct copy between hosts	Temp snapshot in glance
Database	Single, no duplication	Duplicate records created in the target cell DB

Limitations and known issues

- Personality files are not retained
- Config drive will be rebuilt in the target cell
- _poll_unconfirmed_resizes periodic task may not work
- Some instance action **events** will be different from traditional resize
- Notification source may change (global vs per-cell notification queue)

Help wanted

- Reviews
  - https://review.opendev.org/#/q/status:open+topic:bp/cross-cell-resize
- Testing
  - Manual
  - CI: nova-multi-cell job

Thanks for listening!
Questions??

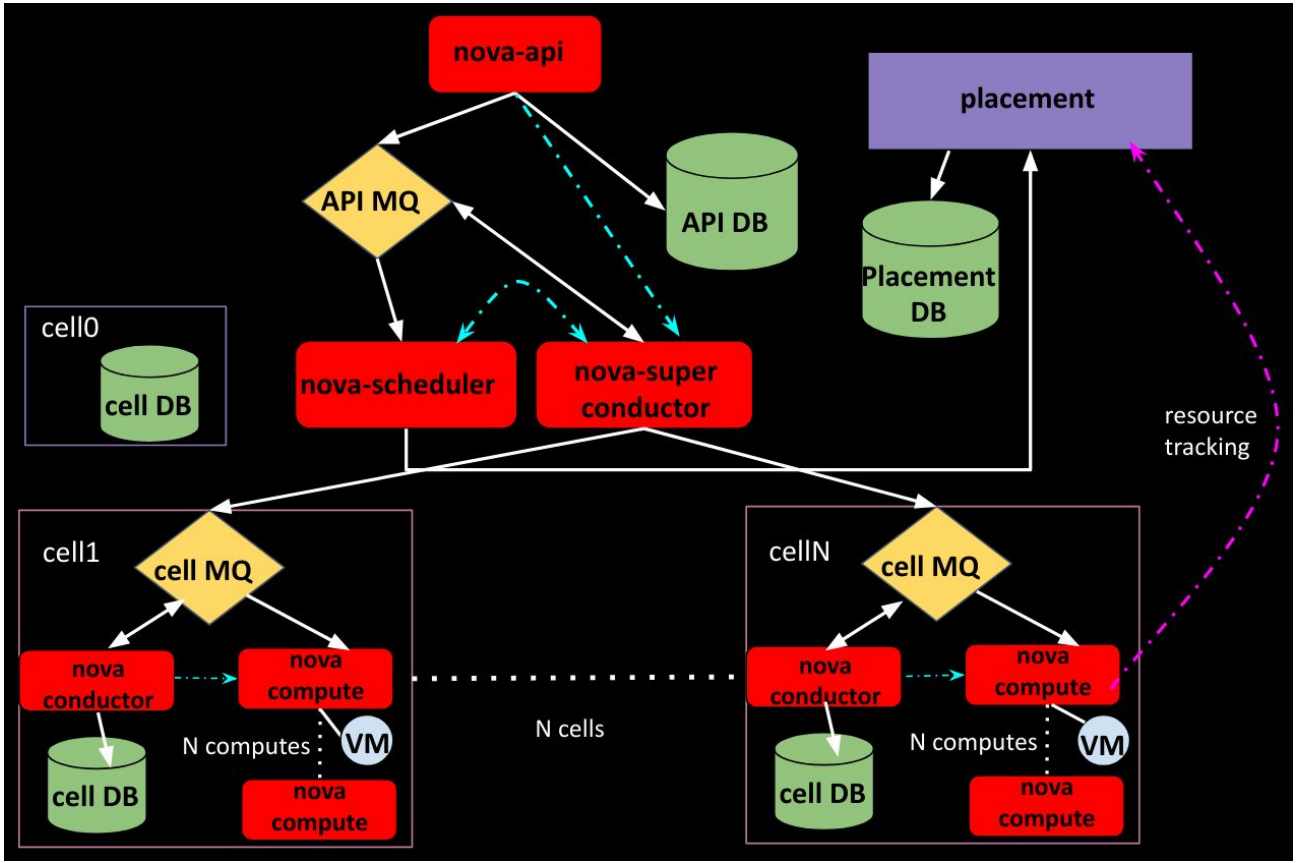
Backup

Discussed Potential Solutions

- Using searchlight to backfill when there are down cells. Check out listing instances using Searchlight for more details.

- Adding backup DBs for each cell database which would act as read-only copies of the original DB in times of crisis.
  - however this would need massive syncing and may fetch stale results.

Reality… :)


nova-api
placement
API MQ
API DB
Placement DB
cell0
cell DB
nova-scheduler
nova-super conductor
resource tracking
cell1
cell MQ
nova conductor
nova compute
N computes
VM
cell DB
nova compute
N cells
cellN
cell MQ
nova conductor
nova compute
N computes
VM
cell DB
nova compute

Implemented Solution

Return partial information for the down cells from the API database

- Gather all the responses for the records from the up cells like normal and when we find down cells,
  - Go to the API database and fill in the available information for those records from the down cells.
  - As a result the response will have missing information for the records from the down cells.
  - The status of such records will be “UNKNOWN” for the users to realize the transient down time.