Aglais resource tests

D.Morris – Feb 2021

Resource tests to determine the resources available on the Cumulus Openstack cloud platform.

Project GitHub repository
https://github.com/wfau/aglais

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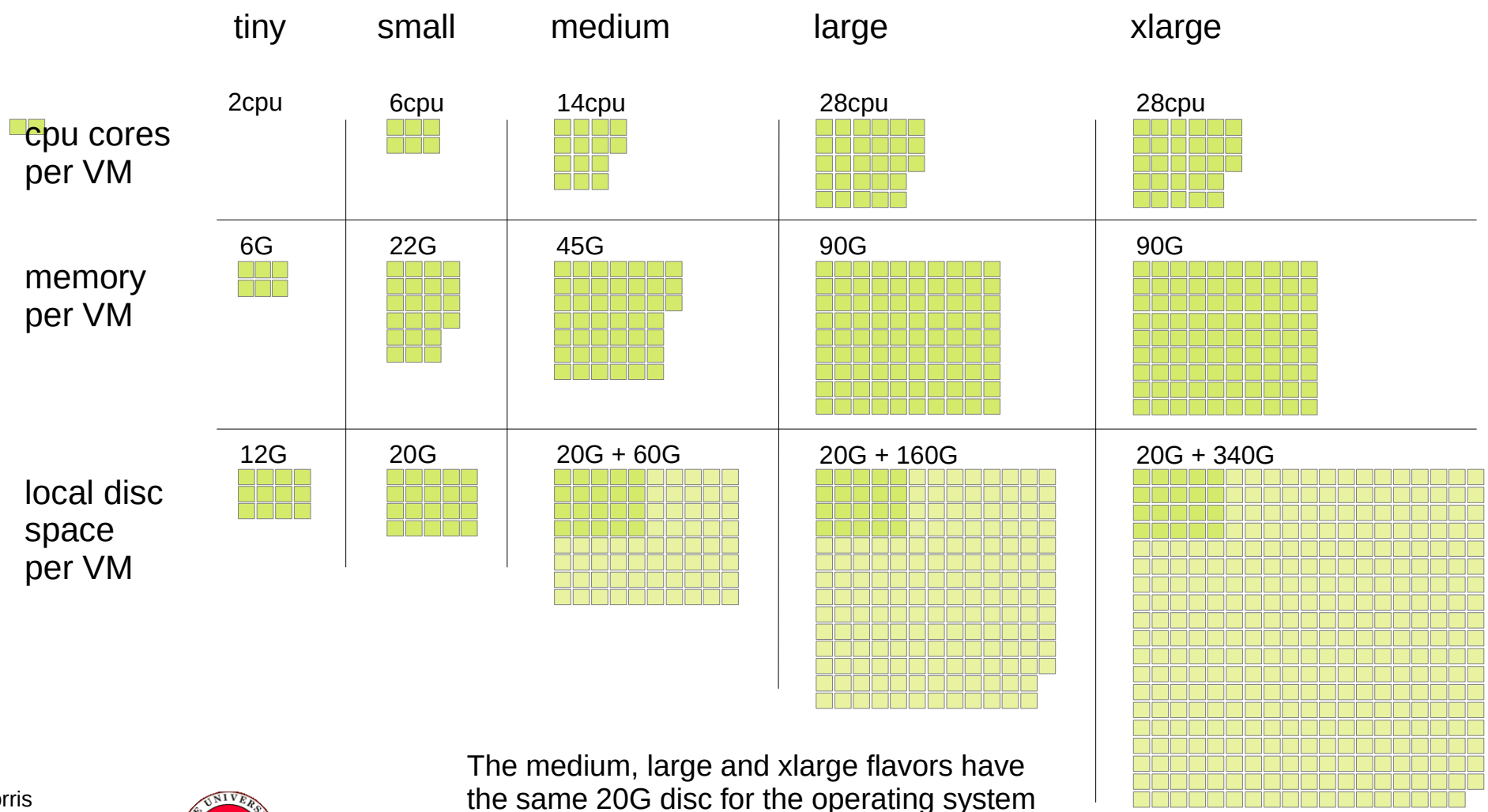
Openstack virtual machines available in 5 flavors



The medium, large and xlarge flavors have the same 20G disc for the operating system plus an extra local disc for data.

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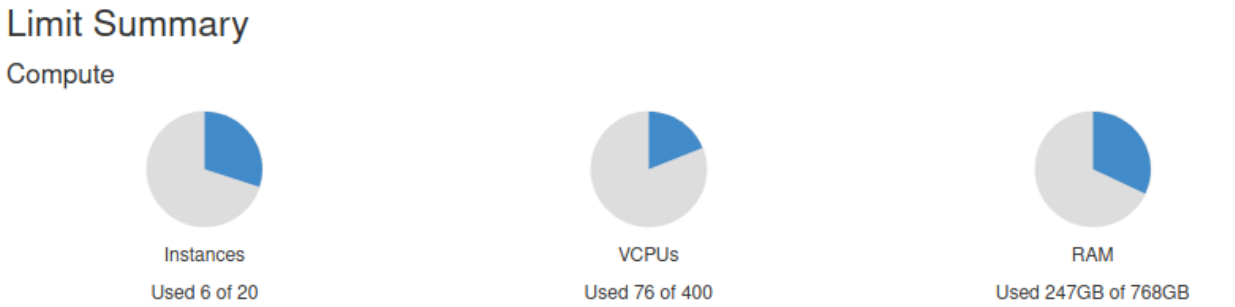
Horizon dashboard:



Appears to show : 400 cpu and 768G memory per project

Numbers do not appear to be consistent with results from using the system.

Developed series of tests to determine what resources are actually available.

Test procedure:

For each VM flavor :

- Delete everything from all three projects
- Attempt to create the maximum number of VMs in each project
- Count how many were successfully created

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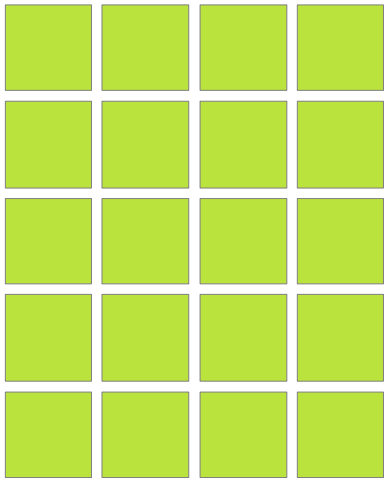
Test #1 - 25 tiny VMs in each Openstack project

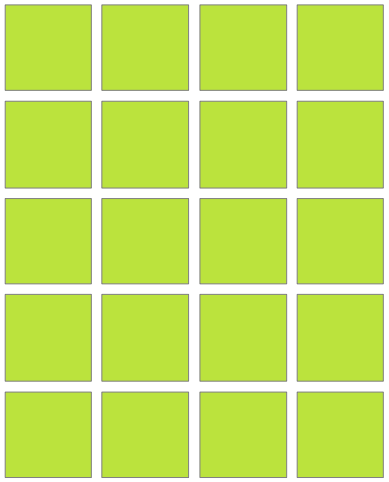
Openstack quota limits us to 20 VMs per project.
Create requests rejected once quota is reached.

→ 20 VMs per project

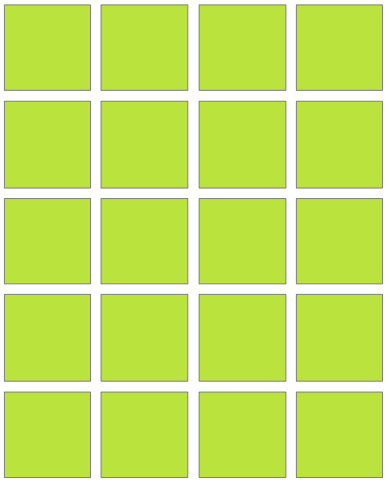
gaia-dev



gaia-test



gaia-prod



Result : 60 ACTIVE tiny VMs in total

Tiny flavor has 2 vcpu cores, 6G of memory and 12G of disc space

60 * 2 = 120 cpu cores
60 * 6 = 360G memory
60 * 12 = 720G local disc

(*) the 20 virtual machine quota is set by the system administrators for operational reasons. We should look at working with them to get this limit increased.

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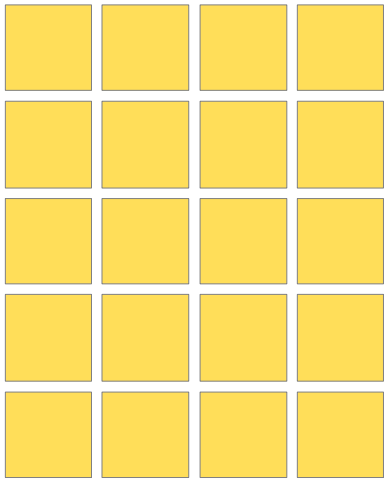
Test #2 - 25 small VMs in each Openstack project

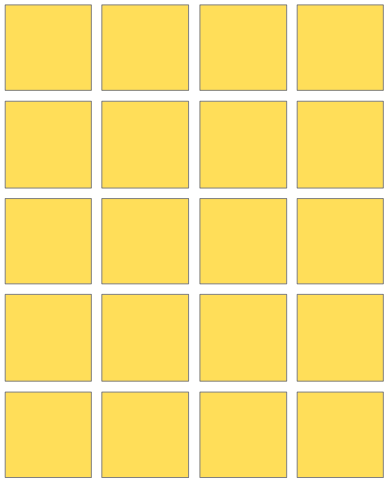
Openstack quota limits us to 20 VMs per project.
Create requests rejected once quota is reached.

→ 20 VMs per project

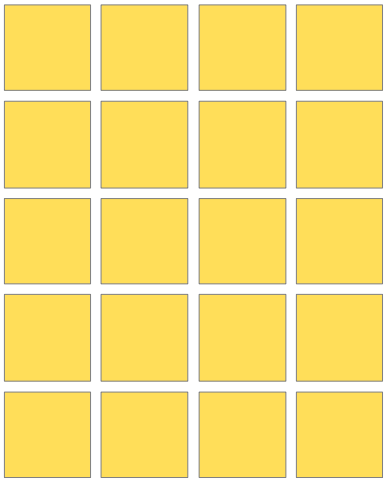
gaia-dev



gaia-test



gaia-prod



Target : 60 small VMs in total

Small flavor has 6 vcpu cores, 22G of memory and 20G of disc space

60 * 6 = 360 cpu cores
60 * 22 = 1320G memory
60 * 20 = 1200G local disc

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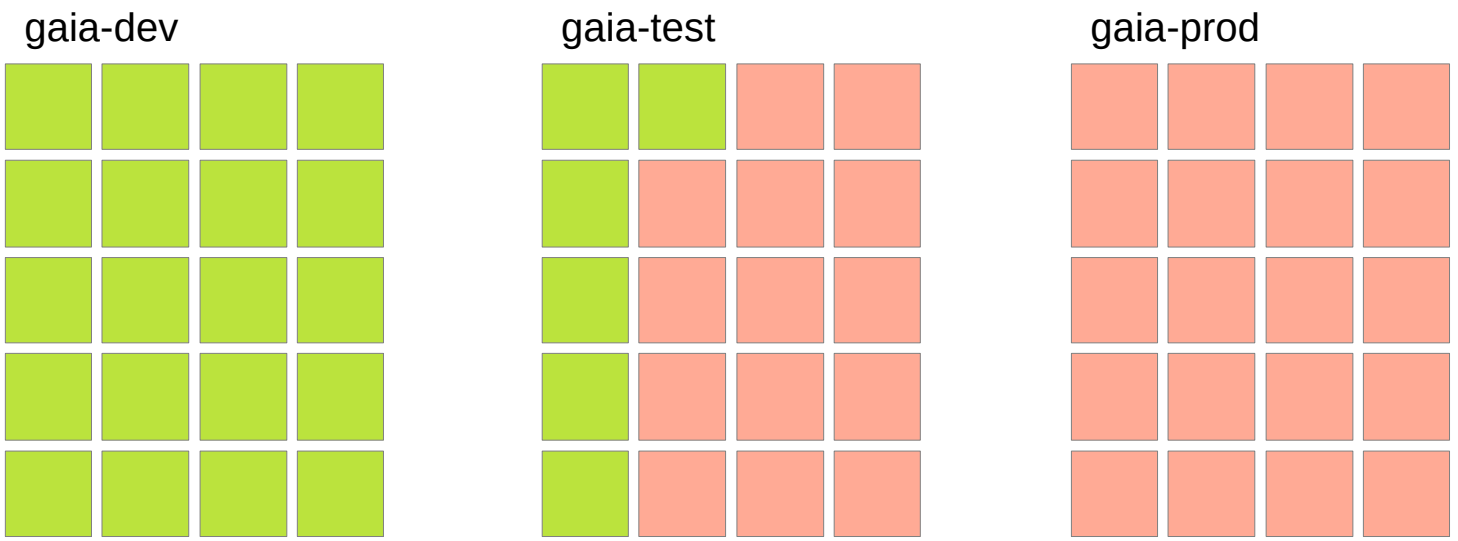
Test #2 - 25 small VMs in each Openstack project

29 of the 60 VMs failed with *'No valid host found'*



Result : 31 ACTIVE and 29 FAILED small VMs

Small flavor has 6 vcpu cores, 22G of memory and 20G of disc space

31 * 6 = 186 cpu cores
31 * 22 = 682G memory
31 * 20 = 620G local disc

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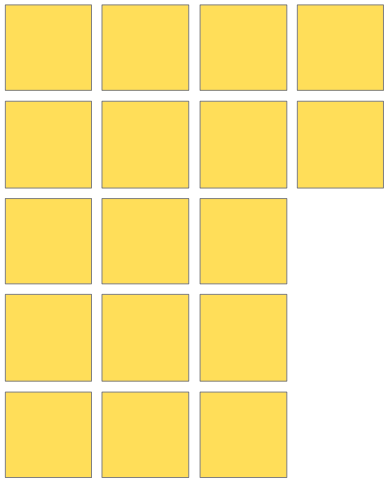
Test #3 - 25 medium VMs in each Openstack project

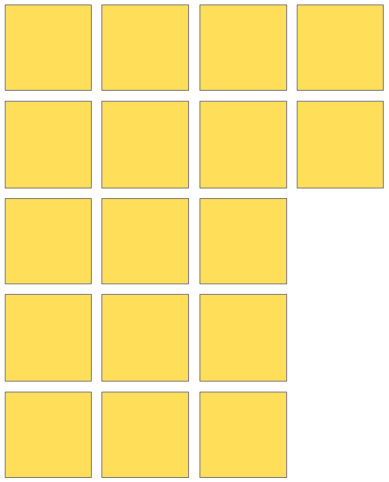
Quota limits us to 768G of memory per project.
Create requests rejected once quota is reached.

→ 17 VMs per project

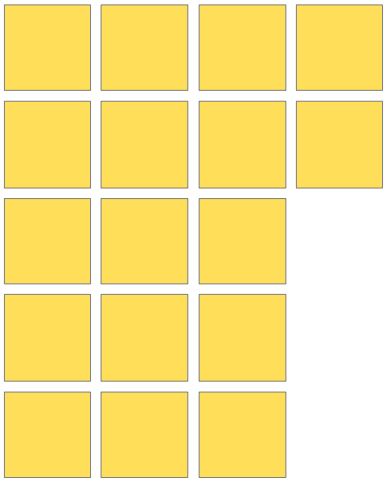
gaia-dev



gaia-test



gaia-prod



Target : 51 medium VMs in total

Medium flavor has 14 vcpu cores, 45G of memory and 80G of disc space

51 * 14 = 714 cpu cores
51 * 45 = 2295G memory
51 * 80 = 4080G local disc

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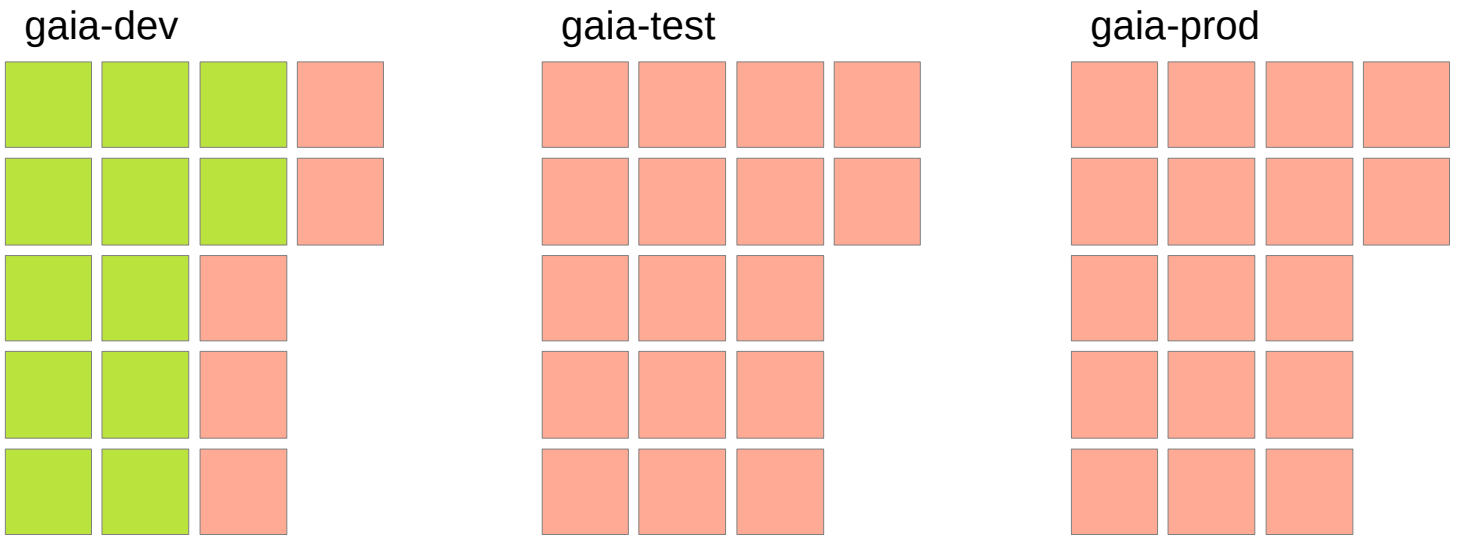
Test #3 - 25 medium VMs in each Openstack project

39 of the 51 VMs failed with *'No valid host found'*



Result : 12 ACTIVE and 39 failed medium VMs

Medium flavor has 14 vcpu cores, 45G of memory and 80G of disc space

12 * 14 = 168 cpu cores
12 * 45 = 540G memory
12 * 80 = 960G local disc

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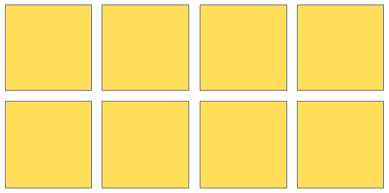
Test #4 - 10 large VMs in each Openstack project

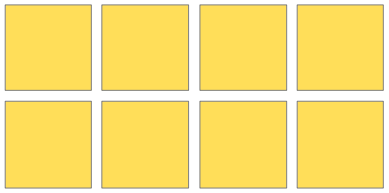
Quota limits us to 768G of memory per project.
Create requests rejected once quota is reached.

→ 8 VMs per project

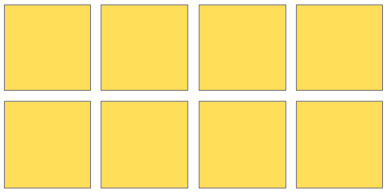
gaia-dev



gaia-test



gaia-prod



Target : 24 large VMs in total

Large flavor has 28 vcpu cores, 90G of memory and 180G of disc space

24 * 28 = 672 cpu cores
24 * 90 = 2160G memory
24 * 180 = 4320G local disc

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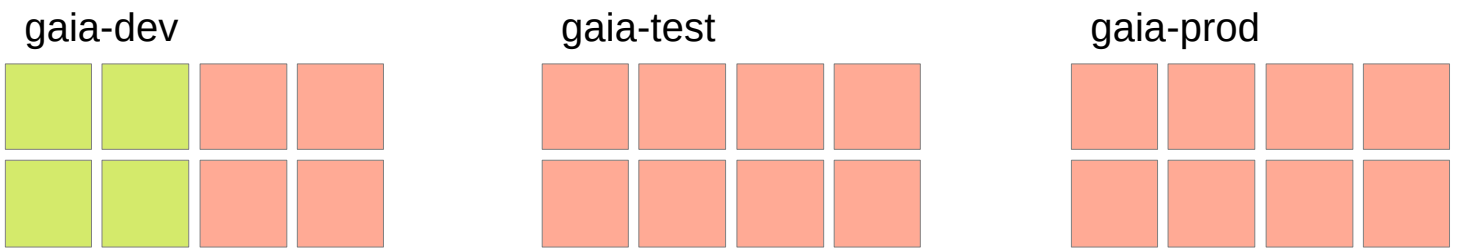
Test #4 - 10 large VMs in each Openstack project

20 of the 24 VMs failed with *'No valid host found'*



Result : 4 large VMs in total

Large flavor has 28 vcpu cores, 90G of memory and 180G of disc space

4 * 28 = 112 cpu cores
4 * 90 = 360G memory
4 * 180 = 720G local disc

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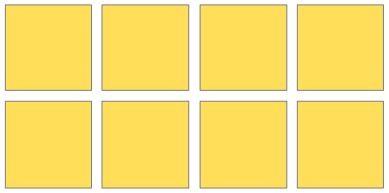
Test #5 - 5 eXtra-large VMs in each Openstack project

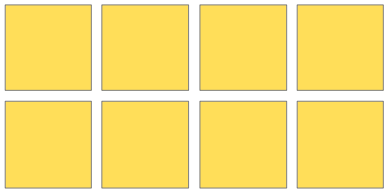
Quota limits us to 768G of memory per project.
Create requests rejected once quota is reached.

→ 8 VMs per project

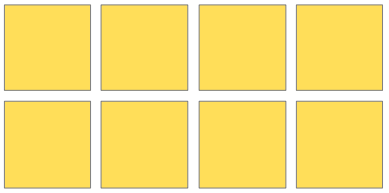
gaia-dev



gaia-test



gaia-prod



Target : 24 XLarge VMs in total

XLarge flavor has 28 vcpu cores, 90G of memory and 360G of disc space

24 * 28 = 672 cpu cores
24 * 90 = 2160G memory
24 * 360 = 8640G local disc

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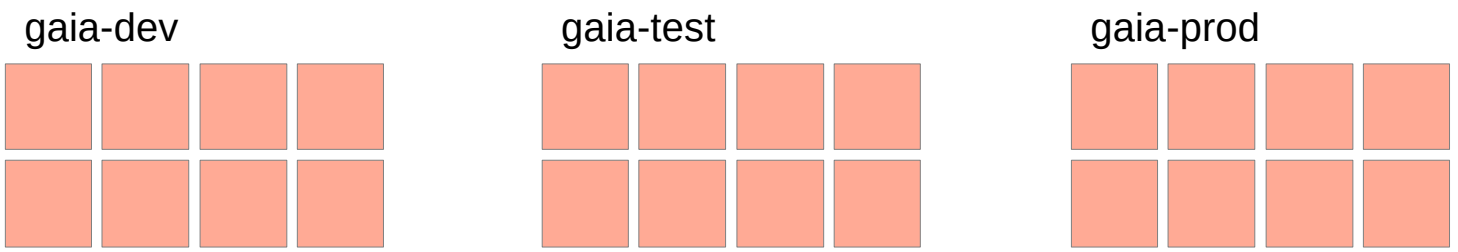
Test #5 - 5 eXtra-large VMs in each Openstack project

All 24 VMs failed with *'No valid host found'*



None of the physical hosts was able to accommodate the 360G local disc needed for a XL machine.

Conclusion : available disc space < 360

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In order to reserve resources for our project, our allocation has been *'pinned'* to four physical machines.

Which means other projects can't use our resources.

When resources are in high demand any resources released will immediately be allocated to another project.

If we delete and re-create a 10 VM cluster, some of those resources can get allocated to another project in the gap between the delete and create commands.

Pinning prevents that from happening.

It also means we can't expand to use other physical machines.

If we release the pinning, we can expand to use all the available space.

If there is space available.

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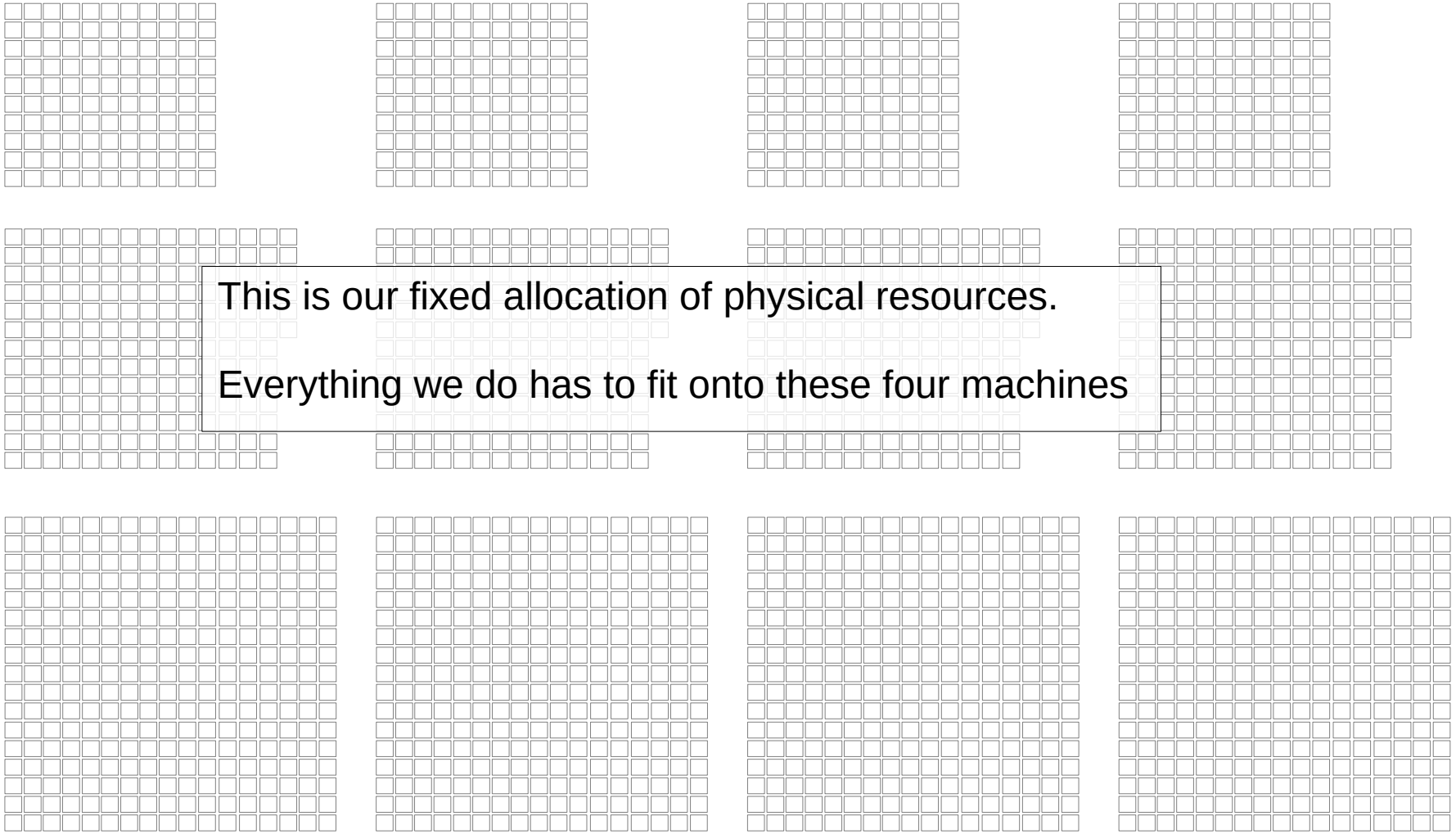
Gaia allocation pinned to 4 physical machines

110 cpu

188G memory

< 360G disc



This is our fixed allocation of physical resources.

Everything we do has to fit onto these four machines

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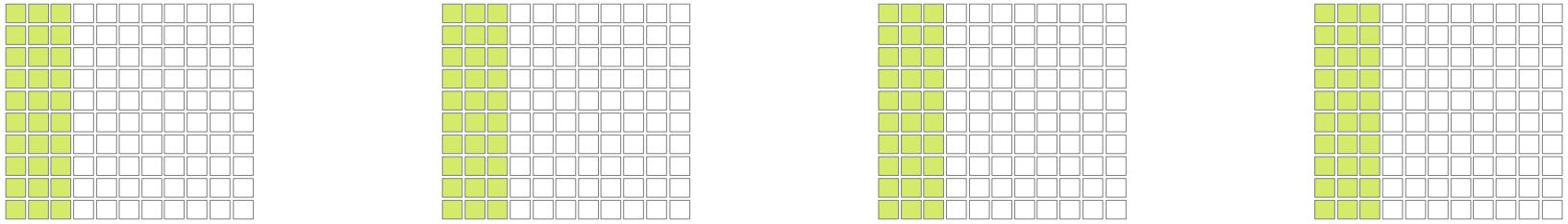
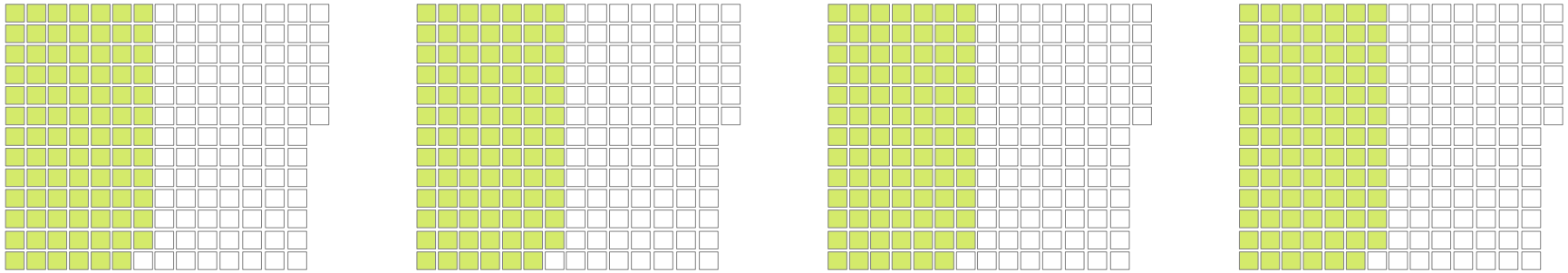
60 tiny VMs, 15 per physical host – limited by 20 VM quota

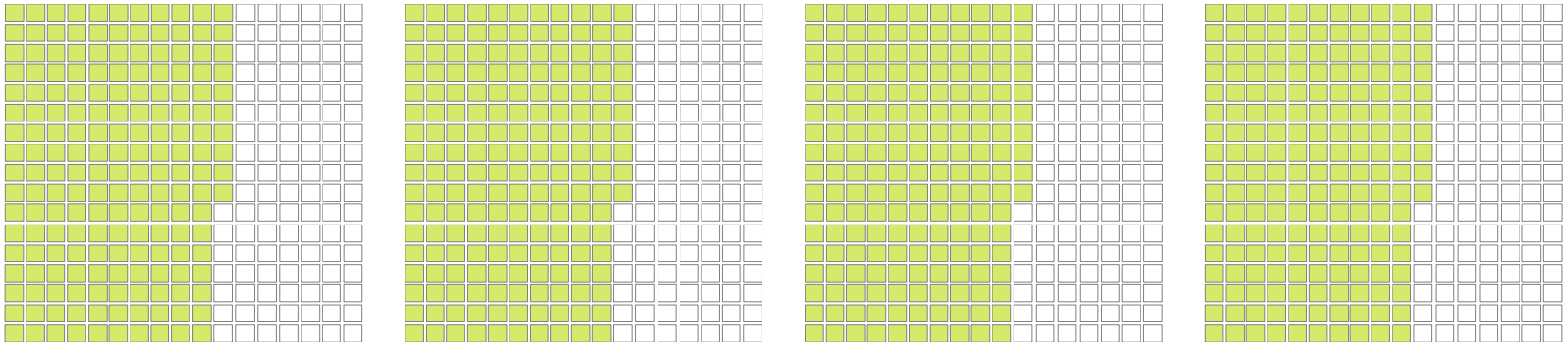
15 * 2 = 30/110
cpu



15 * 6 = 90/188
memory



15 * 12 = 180/360
disc



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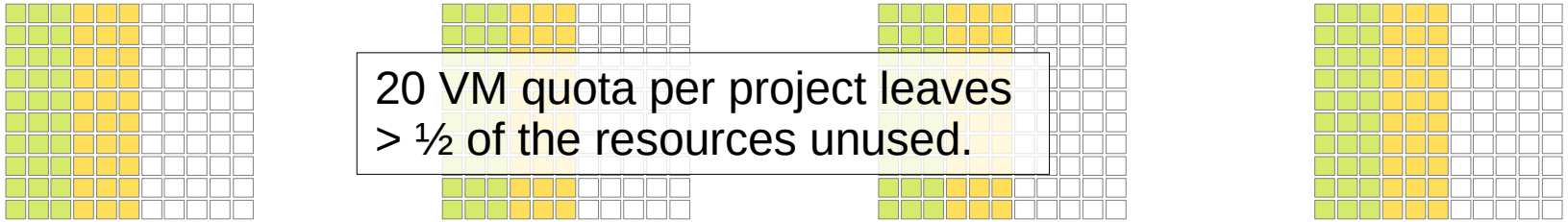
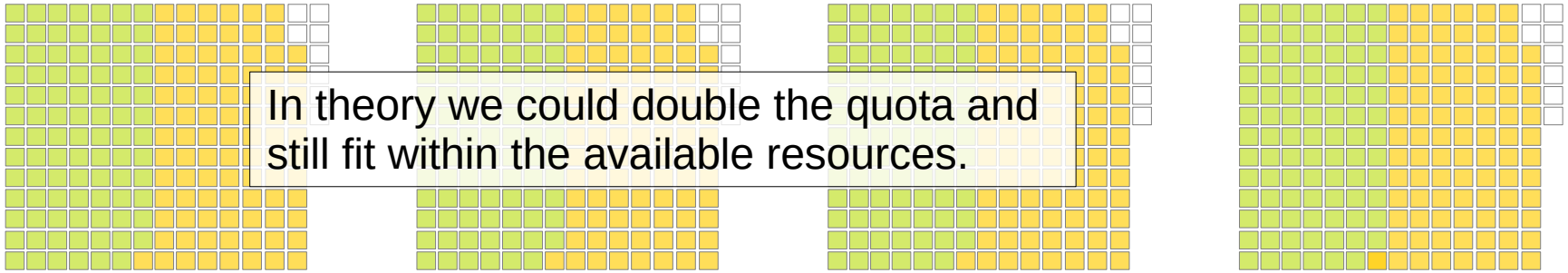
120 tiny VMs, 30 per physical host (double the VM quota)

30 * 2 = 60/110
cpu



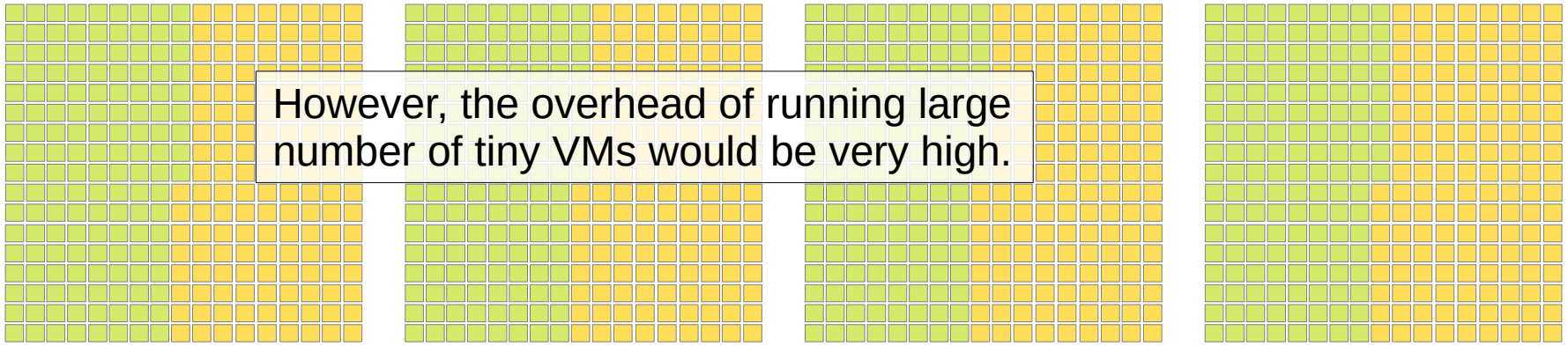
20 VM quota per project leaves
> ½ of the resources unused.

30 * 6 = 180/188
memory



In theory we could double the quota and
still fit within the available resources.

30 * 12 = 360/360
disc



However, the overhead of running large
number of tiny VMs would be very high.

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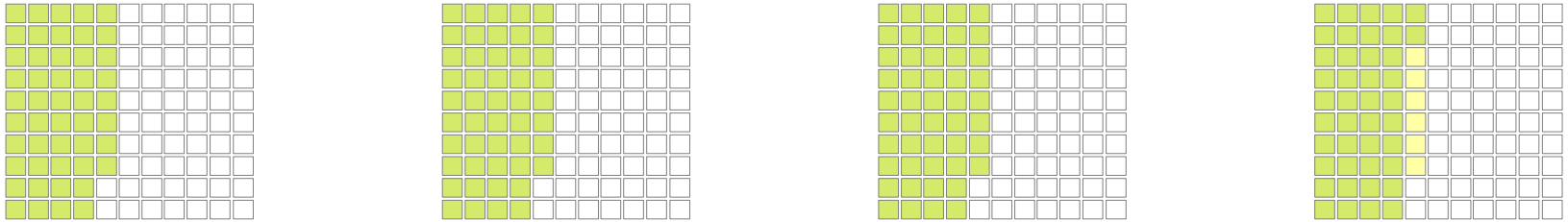
31 small VMs, 8 per physical host – limited by memory

(*) 1 host only has 7

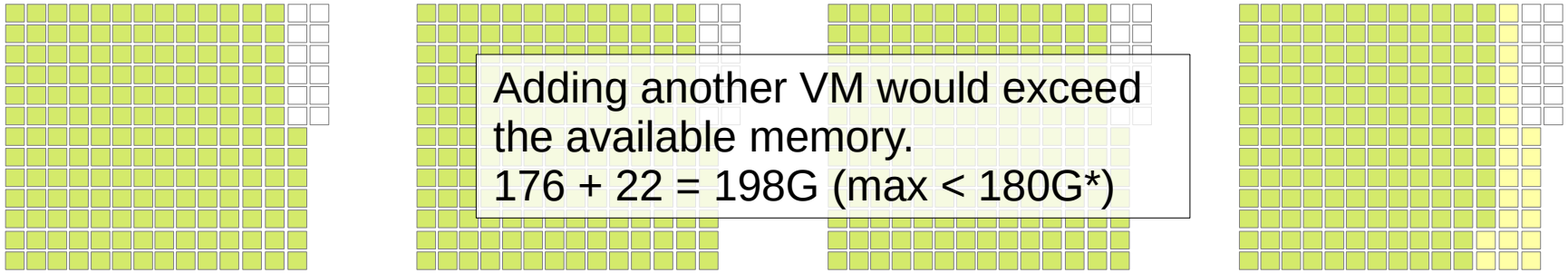
8 * 6 = 48/110
cpu

+1 = 54/110



8 * 22 = 176/188
memory

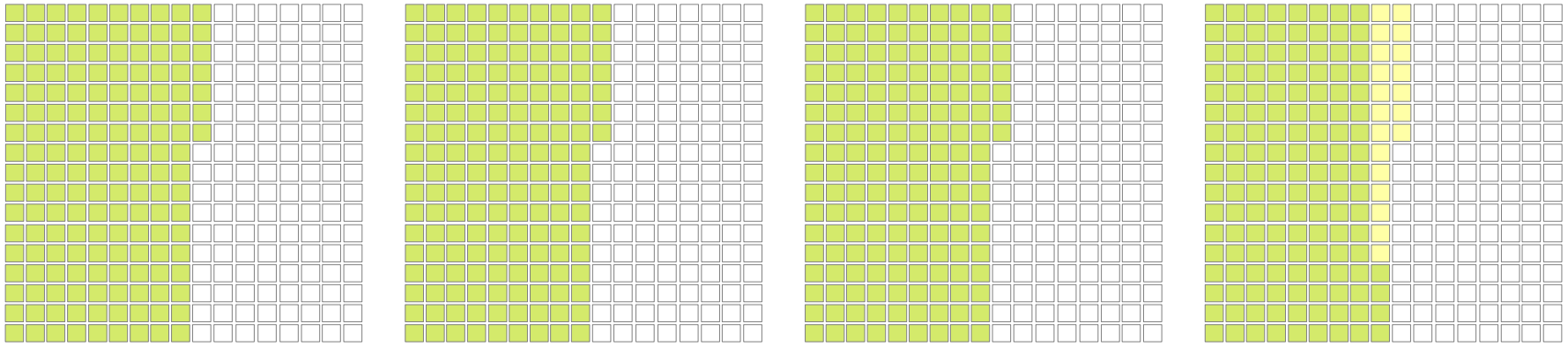
+1 = 198/188



Adding another VM would exceed the available memory.
176 + 22 = 198G (max < 180G*)

8 * 20 = 160/360
disc

+1 = 180/360



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(*) each physical host only has 188G of memory and Openstack reserves ~8G? for the system

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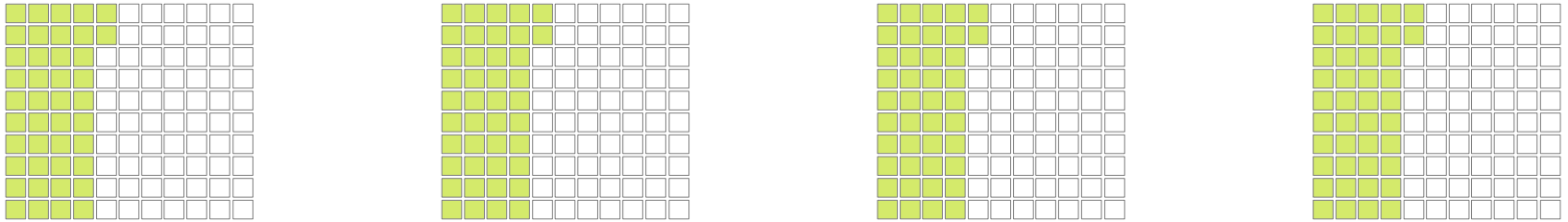
12 medium VMs, 3 per physical host – limited by memory or disc

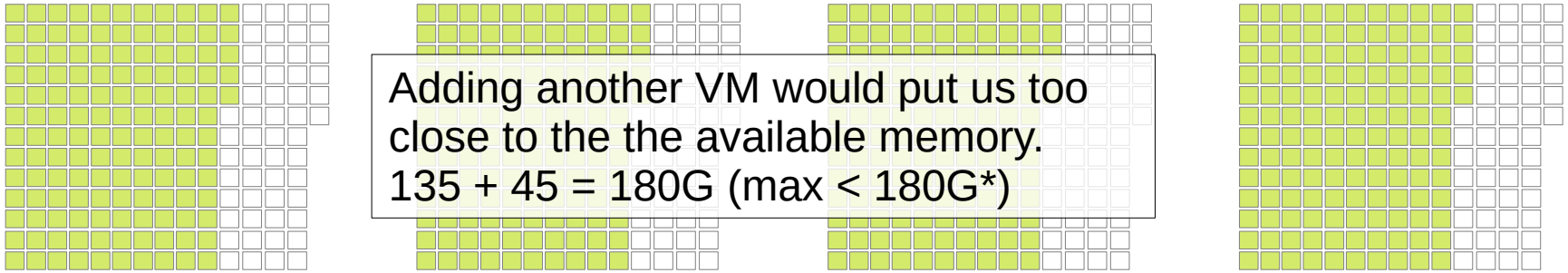
3 * 14 = 42/110
cpu

+1 = 56/110



3 * 45 = 135/188
memory

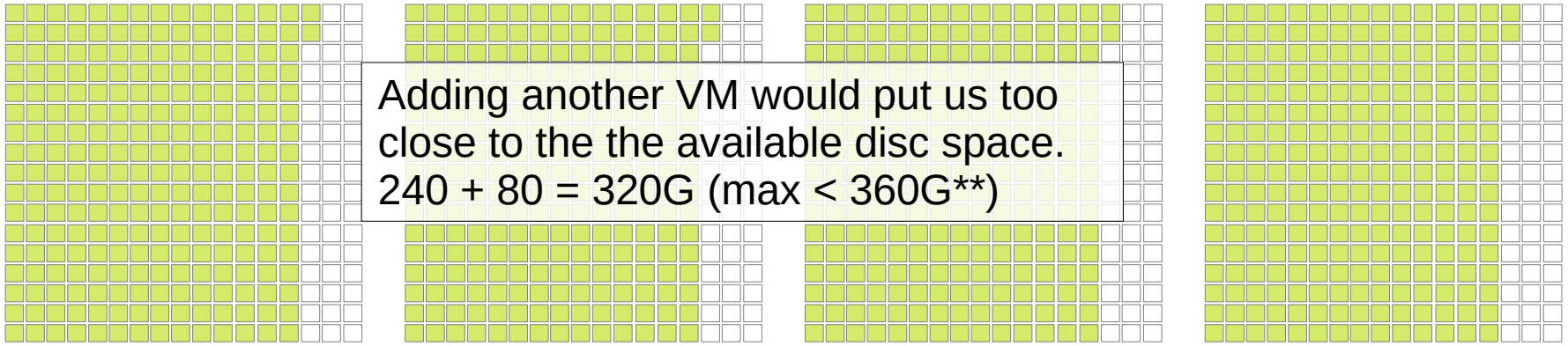
+1 = 180/188



Adding another VM would put us too close to the the available memory.
135 + 45 = 180G (max < 180G*)

3 * 80 = 240/360
disc

+1 = 320/360



Adding another VM would put us too close to the the available disc space.
240 + 80 = 320G (max < 360G**)

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(*) each physical host only has 188G of memory and Openstack reserves ~8G? for the system

(**) the 360G limit on local disc is inferred from the xlarge test

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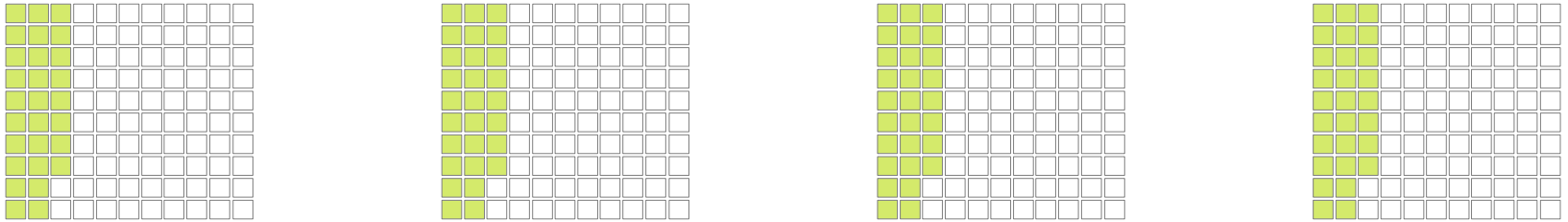
4 large VMs, 1 per physical host – limited by memory and disc

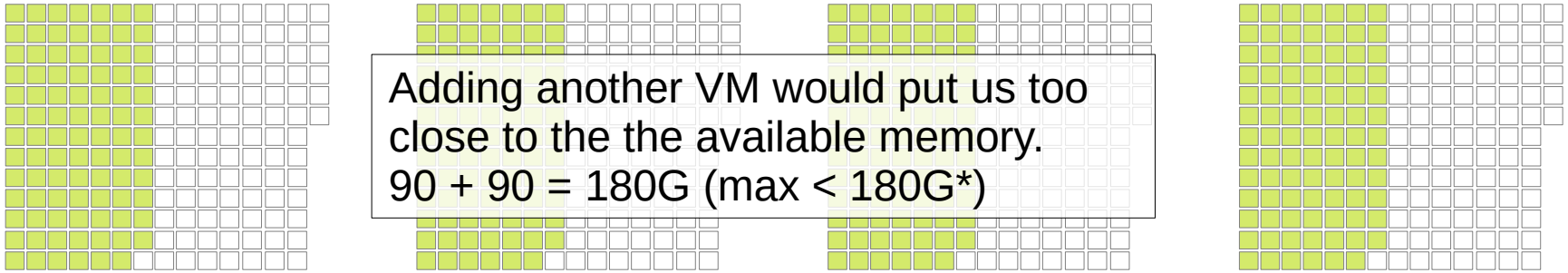
28/110
cpu

+1 = 56/110



90/188
memory

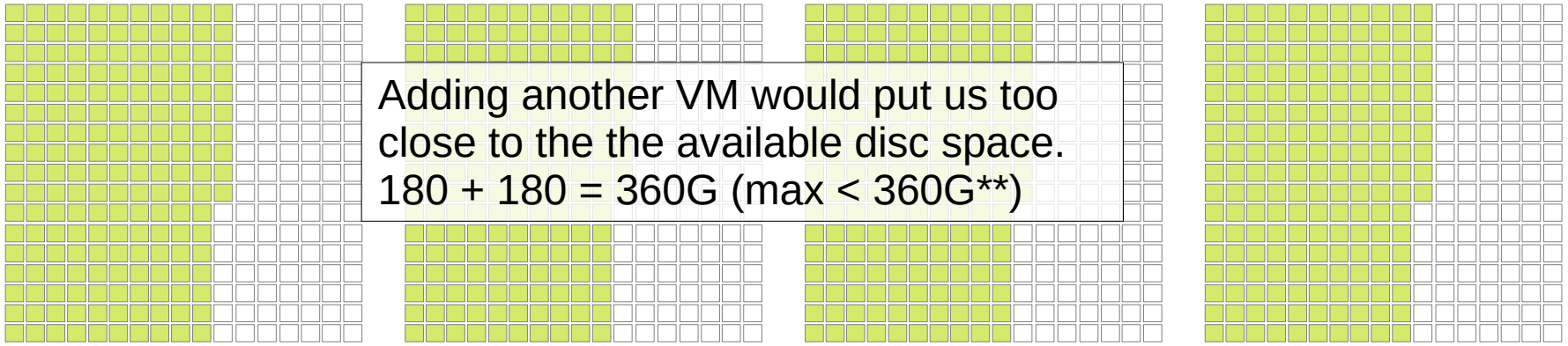
+1 = 180/188



Adding another VM would put us too close to the the available memory.
90 + 90 = 180G (max < 180G*)

180/360
disc

+1 = 360/360



Adding another VM would put us too close to the the available disc space.
180 + 180 = 360G (max < 360G**)

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(*) each physical host only has 188G of memory and Openstack reserves ~8G? for the system

(**) the 360G limit on local disc is inferred from the xlarge test

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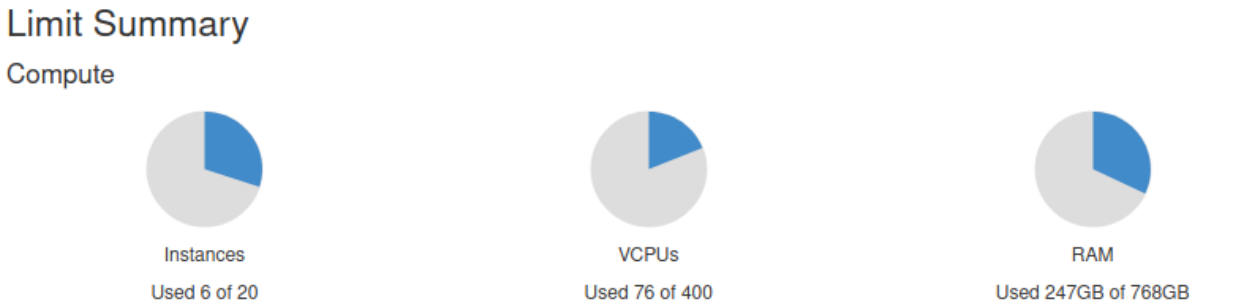
Horizon dashboard:



Horizon appears to show : 400 cpu, 768G memory **per project**

What we physically have : 440 cpu, 752G memory and 1440 local disc **in total**

Maximum we can actually use: 186 cpu, 682G memory and 960 local disc

Resource request for 2021 was 18500 CPU-months

18500/12 ~= 1540 cpu cores

Assuming 3G memory per core ~= 4620G memory

(*) section 5.1 quotes minimum deployment as 6 nodes with 16 cores and 64G memory

(*) nothing in the resource request about dev, test and prod projects

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Resource request for 2021 :

1540 cpu cores
4620G memory

What we currently have :

440 cpu cores
752G memory

(*) assuming cores = cpu months / 12

(**) assuming 3G of memory per core

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For comparison :

DPAC Tech Note on *"Efficient cross-matching in Spark"* by Enrique Utrilla
GAIA-C9-TN-ESAC-EUM-100

- *"A dedicated Apache Spark 2.4 cluster over 30 physical nodes in the Gaia cluster at ESAC, with NETApp storage."*
- *"By default each user session is assigned a maximum of 80 CPU cores."*

Our current live deployment

- Spark 2.4 cluster running in 4 medium virtual machines.
- Maximum of 56 cpu cores for the whole cluster.

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- NetApp is a commercial cloud storage provider offering specialized hardware for cloud and on-premises storage systems (most which are SSD based).
  https://en.wikipedia.org/wiki/NetApp

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Options to explore :

Work with StackHPC & Cambridge to increase the available resources

- Cambridge are limited by the resources they have.
- New resources in December were a welcome increase. It solved the immediate problem, but isn't enough to meet our 2021 allocation.
- What can we do / who can we contact to help get more resources from IRIS allocated to the Cambridge system ?
- Propose a series of gradual increments to get from where we are to our full 2021 and 2022 allocations.
- If we know what equipment is arriving when, then both ourselves and Cambridge can plan ahead.

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Options to explore :

Work with StackHPC & Cambridge to optimize the available resources

- Work with StackHPC & Cambridge to increase the available disc space.
- Can we change the way the local discs are partitioned ?
- How much difference would an extra SSD per machine make ?

- Work with StackHPC & Cambridge to negotiate access to monitoring data from the physical platform. If resources are scarce we need to know how much impact our design choices have.

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Options to explore :

Continue to work on making our deployments portable

- Both the Ansible and Kubernetes deployments could be moved to another platform
  - RAL or Somerville Openstack platforms may have more resources
    - Both would need Rancher deployment for Kubernetes (#386)
    - Both would need Echo S3 storage for data (#246)
  - We have physical machines available at ROE suitable for a Spark platform
    - The two Gaia machines have 96 cores and 250G memory each
    - The four LSST machines have xx cores and yyy memory each
    - Combined they would create a reasonable bare metal deployment
      - Our existing Ansible deployment could be adapted to run on these machines.
      - Our Rancher K8s deployment could be adapted to run on these machines.
  - Commercial cloud platforms have more resources
    - On-deploy deployment on commercial platform, create, analyse, delete
    - Commercial cloud would need S3 storage for data (#246)

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