Technical considerations

« (compute-focus.html) » (compute-focus-operational-considerations.html) (https://bugs.launchpad.net/openstack-manuals/+filebug?field.title=Technical%20considerations%20in%20Architecture%20Design%20Guide&field.comment=%0A%0A----------------------------------%0ARelease:%200.9%20on%202016-07-03%2008:27%0ASHA:%200dfb9ebe70dab715364a1897829ede28d0a029d7%0ASource:%20http://git.openstack.org/cgit/openstack/openstack-manuals/tree/doc/arch-design-rst/source/compute-focus-technical-considerations.rst%0AURL: http://docs.openstack.org/arch-design/compute-focus-technical-considerations.html&field.tags=arch-design)

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In a compute-focused OpenStack cloud, the type of instance workloads you provision heavily influences technical decision making.

Public and private clouds require deterministic capacity planning to support elastic growth in order to meet user SLA expectations. Deterministic capacity planning is the path to predicting the effort and expense of making a given process perform consistently. This process is important because, when a service becomes a critical part of a user's infrastructure, the user's experience links directly to the SLAs of the cloud itself.

There are two aspects of capacity planning to consider:

- Planning the initial deployment footprint
- Planning expansion of the environment to stay ahead of cloud user demands

Begin planning an initial OpenStack deployment footprint with estimations of expected uptake, and existing infrastructure workloads.

The starting point is the core count of the cloud. By applying relevant ratios, the user can gather information about:

- The number of expected concurrent instances: (overcommit fraction × cores) / virtual cores per instance
- Required storage: flavor disk size × number of instances

These ratios determine the amount of additional infrastructure needed to support the cloud. For example, consider a situation in which you require 1600 instances, each with 2 vCPU and 50 GB of storage. Assuming the default overcommit rate of 16:1, working out the math provides an equation of:

- 1600 = (16 × (number of physical cores)) / 2
- Storage required = 50 GB × 1600

On the surface, the equations reveal the need for 200 physical cores and 80 TB of storage for `/var/lib/nova/instances/`. However, it is also important to look at patterns of usage to estimate the load that the API services, database servers, and queue servers are likely to encounter.

Aside from the creation and termination of instances, consider the impact of users accessing the service, particularly on nova-api and its associated database. Listing instances gathers a great deal of information and given the frequency with which users run this operation, a cloud with a large number of users can increase the load significantly. This can even occur unintentionally. For example, the OpenStack Dashboard instances tab refreshes the list of instances every 30 seconds, so leaving it open in a browser window can cause unexpected load.

Consideration of these factors can help determine how many cloud controller cores you require. A server with 8 CPU cores and 8 GB of RAM server would be sufficient for a rack of compute nodes, given the above caveats.

Key hardware specifications are also crucial to the performance of user instances. Be sure to consider budget and performance needs, including storage performance (spindles/core), memory availability (RAM/core), network bandwidth (Gbps/core), and overall CPU performance (CPU/core).

The cloud resource calculator is a useful tool in examining the impacts of different hardware and instance load outs. See: https://github.com/noslzzp/cloud-resource-calculator/blob/master/cloud-resource-calculator.ods (https://github.com/noslzzp/cloud-resource-calculator/blob/master/cloud-resource-calculator.ods)

Expansion planning¶

A key challenge for planning the expansion of cloud compute services is the elastic nature of cloud infrastructure demands.

Planning for expansion is a balancing act. Planning too conservatively can lead to unexpected oversubscription of the cloud and dissatisfied users. Planning for cloud expansion too aggressively can lead to unexpected underuse of the cloud and funds spent unnecessarily on operating infrastructure.

The key is to carefully monitor the trends in cloud usage over time. The intent is to measure the consistency with which you deliver services, not the average speed or capacity of the cloud. Using this information to model capacity performance enables users to more accurately determine the current and future capacity of the cloud.

CPU and RAM¶

OpenStack enables users to overcommit CPU and RAM on compute nodes. This allows an increase in the number of instances running on the cloud at the cost of reducing the performance of the instances. OpenStack Compute uses the following ratios by default:

- CPU allocation ratio: 16:1
- RAM allocation ratio: 1.5:1

The default CPU allocation ratio of 16:1 means that the scheduler allocates up to 16 virtual cores per physical core. For example, if a physical node has 12 cores, the scheduler sees 192 available virtual cores. With typical flavor definitions of 4 virtual cores per instance, this ratio would provide 48 instances on a physical node.

Similarly, the default RAM allocation ratio of 1.5:1 means that the scheduler allocates instances to a physical node as long as the total amount of RAM associated with the instances is less than 1.5 times the amount of RAM available on the physical node.

You must select the appropriate CPU and RAM allocation ratio based on particular use cases.

Additional hardware¶

Certain use cases may benefit from exposure to additional devices on the compute node. Examples might include:

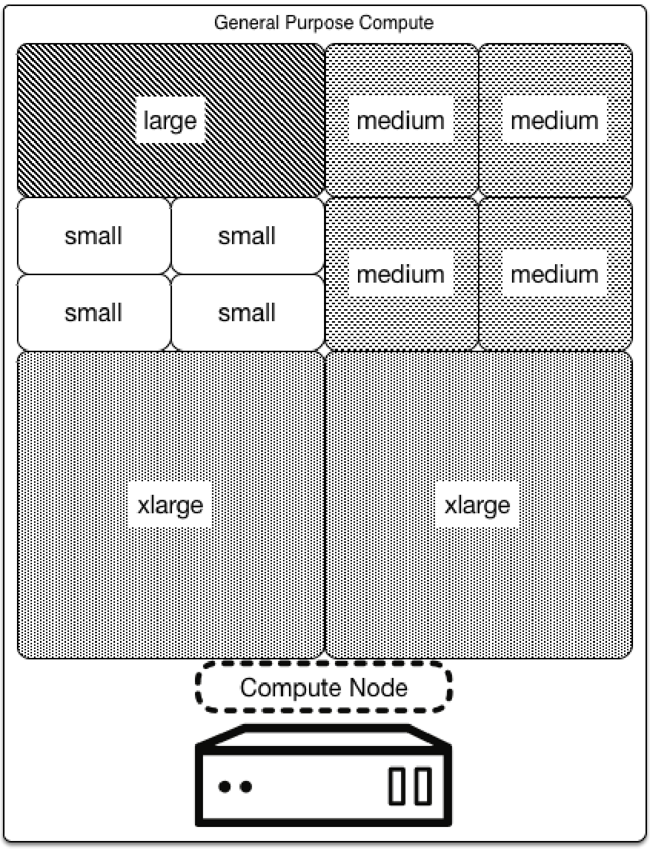
- High performance computing jobs that benefit from the availability of graphics processing units (GPUs) for general-purpose computing.
- Cryptographic routines that benefit from the availability of hardware random number generators to avoid entropy starvation.
- Database management systems that benefit from the availability of SSDs for ephemeral storage to maximize read/write time.

Host aggregates group hosts that share similar characteristics, which can include hardware similarities. The addition of specialized hardware to a cloud deployment is likely to add to the cost of each node, so consider carefully whether all compute nodes, or just a subset targeted by flavors, need the additional customization to support the desired workloads.

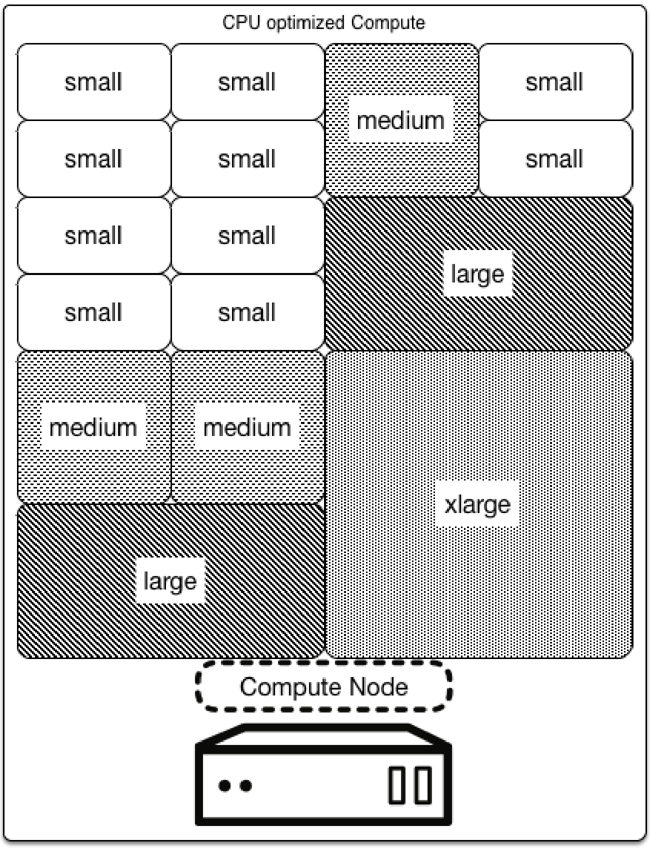
Utilization¶

Infrastructure-as-a-Service offerings, including OpenStack, use flavors to provide standardized views of virtual machine resource requirements that simplify the problem of scheduling instances while making the best use of the available physical resources.

In order to facilitate packing of virtual machines onto physical hosts, the default selection of flavors provides a second largest flavor that is half the size of the largest flavor in every dimension. It has half the vCPUs, half the vRAM, and half the ephemeral disk space. The next largest flavor is half that size again. The following figure provides a visual representation of this concept for a general purpose computing design:



The following figure displays a CPU-optimized, packed server:



These default flavors are well suited to typical configurations of commodity server hardware. To maximize utilization, however, it may be necessary to customize the flavors or create new ones in order to better align instance sizes to the available hardware.

Workload characteristics may also influence hardware choices and flavor configuration, particularly where they present different ratios of CPU versus RAM versus HDD requirements.

For more information on Flavors see OpenStack Operations Guide: Flavors (http://docs.openstack.org/ops-guide/ops_user_facing_operations.html#flavors).

OpenStack components¶

Due to the nature of the workloads in this scenario, a number of components are highly beneficial for a Compute-focused cloud. This includes the typical OpenStack components:

- *Compute service* (common/glossary.html#term-142) (nova)
- *Image service* (common/glossary.html#term-image-service) (glance)
- *Identity service* (common/glossary.html#term-identity-service) (keystone)

Also consider several specialized components:

- ***Orchestration service* (common/glossary.html#term-orchestration-service) (heat)**
  Given the nature of the applications involved in this scenario, these are heavily automated deployments. Making use of Orchestration is highly beneficial in this case. You can script the deployment of a batch of instances and the running of tests, but it makes sense to use the Orchestration service to handle all these actions.

- ***Telemetry service* (common/glossary.html#term-telemetry-service) (ceilometer)**
  Telemetry and the alarms it generates support autoscaling of instances using Orchestration. Users that are not using the Orchestration service do not need to deploy the Telemetry service and may choose to use external solutions to fulfill their metering and monitoring requirements.

- ***Block Storage service* (common/glossary.html#term-block-storage-service) (cinder)**
  Due to the burst-able nature of the workloads and the applications and instances that perform batch processing, this cloud mainly uses memory or CPU, so the need for add-on storage to each instance is not a likely requirement. This does not mean that you do not use OpenStack Block Storage (cinder) in the infrastructure, but typically it is not a central component.

- ***Networking service* (common/glossary.html#term-networking-service) (neutron)**
  When choosing a networking platform, ensure that it either works with all desired hypervisor and container technologies and their OpenStack drivers, or that it includes an implementation of an ML2 mechanism driver. You can mix networking platforms that provide ML2 mechanisms drivers.

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