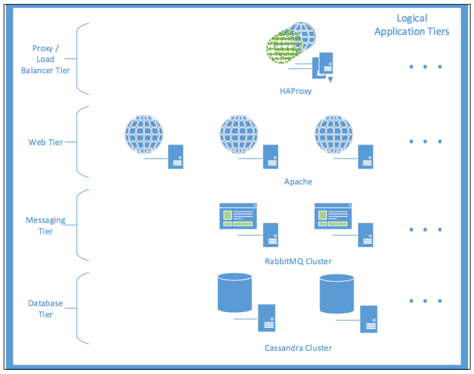
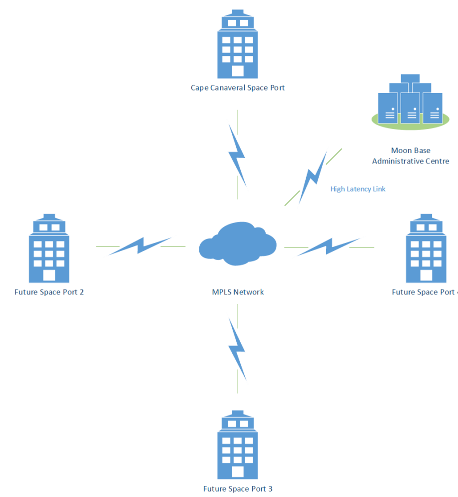
JOEL GIBSON





Design Proposal - Challenge 1

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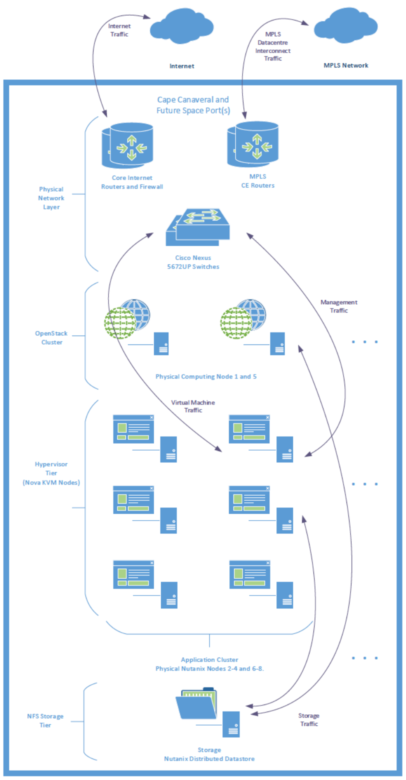
Proposal number: Challenge 1



EXECUTIVE SUMMARY

Objective

The objective of this design is to be support the mission critical space ship depot application.

Goals

This solution should be reliable, easily deployable, and fully orchestrated. Downtime is unacceptable, as human lives are involved.

Solution

With the above goals in mind, the solution has been designed around the following key elements:

- All supporting elements must be highly available.
- The physical and logical infrastructure must be able to scale easily, and quickly.
- The application framework must be able to scale automatically.

The physical infrastructure has been kept simple, and relies heavily on converged systems. It is easy to rack, stack, and cable this design. The Nutanix virtual computing platform was chosen as the scalable compute and storage systems.

This management and application design relies heavily on open source projects, as vendor support may not be available during the present chaos, and community support is strong.

The virtualization and private cloud infrastructure will be based on the OpenStack framework, and will include a highly available management cluster. The virtual servers supporting the space port application will reside on a separate cluster of nodes managed by OpenStack.

The web application will be run on Apache, and load balanced using HAProxy. The supporting services are the database (Cassandra cluster), and messaging (RabbitMQ cluster). These components are all configured in a highly available fashion, and can be easily scaled.

The orchestration framework chosen was two fold: 1) Puppet, for the purpose of OpenStack and Application configuration state, and 2) OpenStack Heat, for the purpose of scaling up instances in tandem with Ceilometer.

PHYSICAL DESIGN

Overview

The Cape Canaveral Space Port is the first, of at least four, critical production facilities. This space port will serve as a framework that will be replicated in future facilities.

The infrastructure and application design for this space ship depot has been configured in a highly available manner. It is the goal of this design to eliminate any potential single points of failure, such that it is able to support the mission critical life sustaining workloads.

The physical design of the infrastructure has been kept relatively simple, so that scarce resources can be best utilized.

As part of this design, the decision was made not to rely on a cloud provider for IaaS services, instead it was deemed too important to run the workloads outside of the production facility.

Infrastructure

As noted earlier, the physical infrastructure has been kept simple, and relies heavily on converged systems. It is easy to rack, stack, and cable this design.

The physical systems will reside in two separate racks, supplied by two UPS systems. The two racks of equipment will closely resemble one another, and will be used to provide physical separation of the key components in support of a highly available architecture.

The racks will be interconnected via the fibre patch panels, and each will contain the required network gear to provide Internet and inter-spaceport MPLS connectivity.

The Cisco Nexus 5672UP was chosen as the top-of-rack switch, which provides ample bandwidth and ports for the existing infrastructure, along with room to grow. It also supports network overlay technology, such as VxLAN should the future need arise.

The Nutanix NX-3060 virtual computing platform was chosen as the scalable compute and storage systems. Each of these systems contains four nodes, one of which will be used for the management framework, and the balance to be used for the application framework. The base configuration will utilize one NX-3060 in each rack, with plenty of room for future growth.

Risks

There is an inherent risk, that while the remaining three space ship ports are being built, the Cape Canaveral site is in itself a single point of failure. This is considered an acceptable risk due to the nature of work being completed in this location. If this site was destroyed, prior to the completion of the other ports, the mission critical work would be delayed, even if the application was still available.

Assumptions

It is assumed that the Cape Canaveral Space Port has been designed and built to Tier 3 or above standards according to the Uptime Institute. In addition, there is enough physical space, and power and cooling capacity available to scale the physical equipment if required.

Figure 1 - Physical Rack Layout

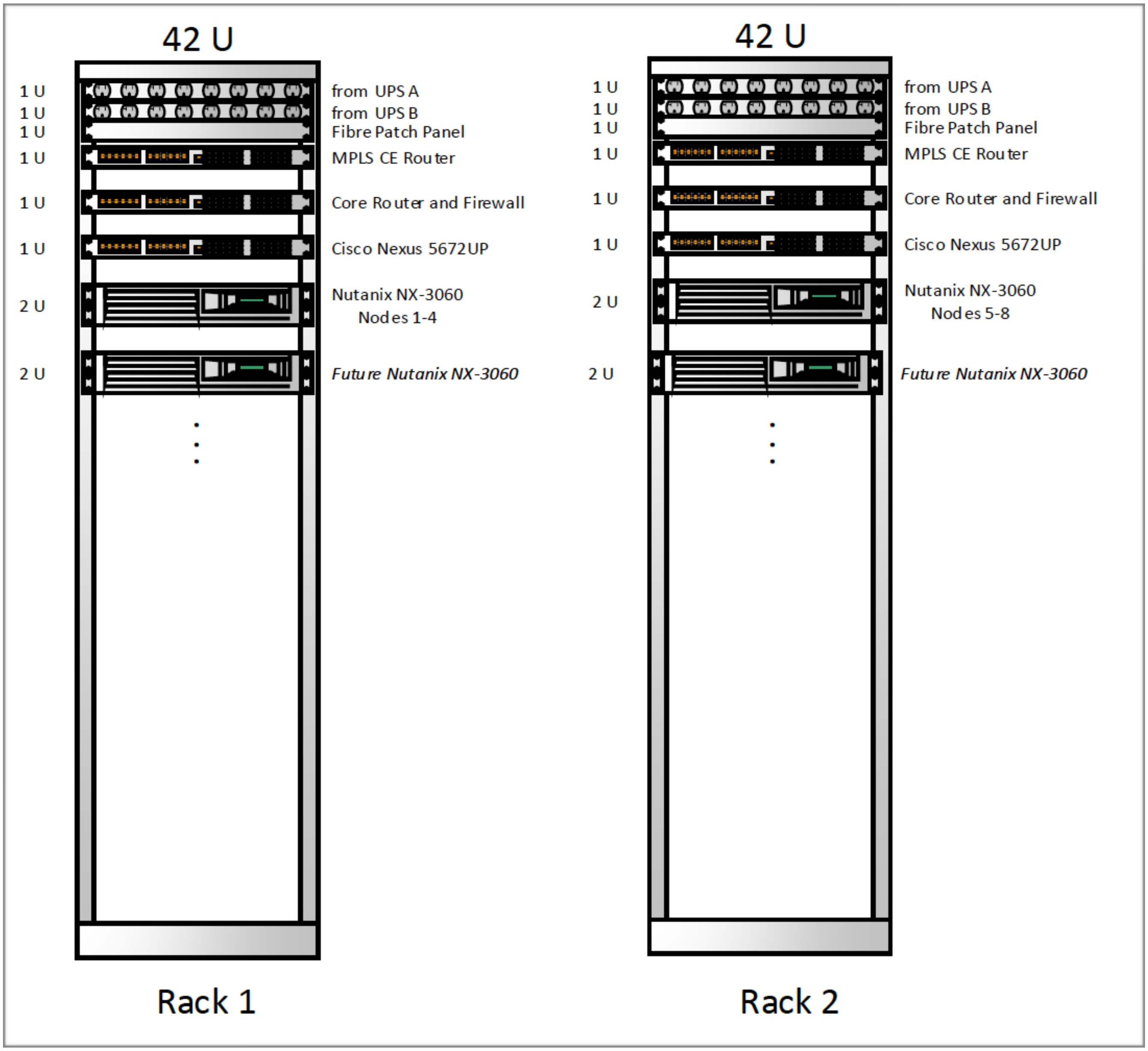
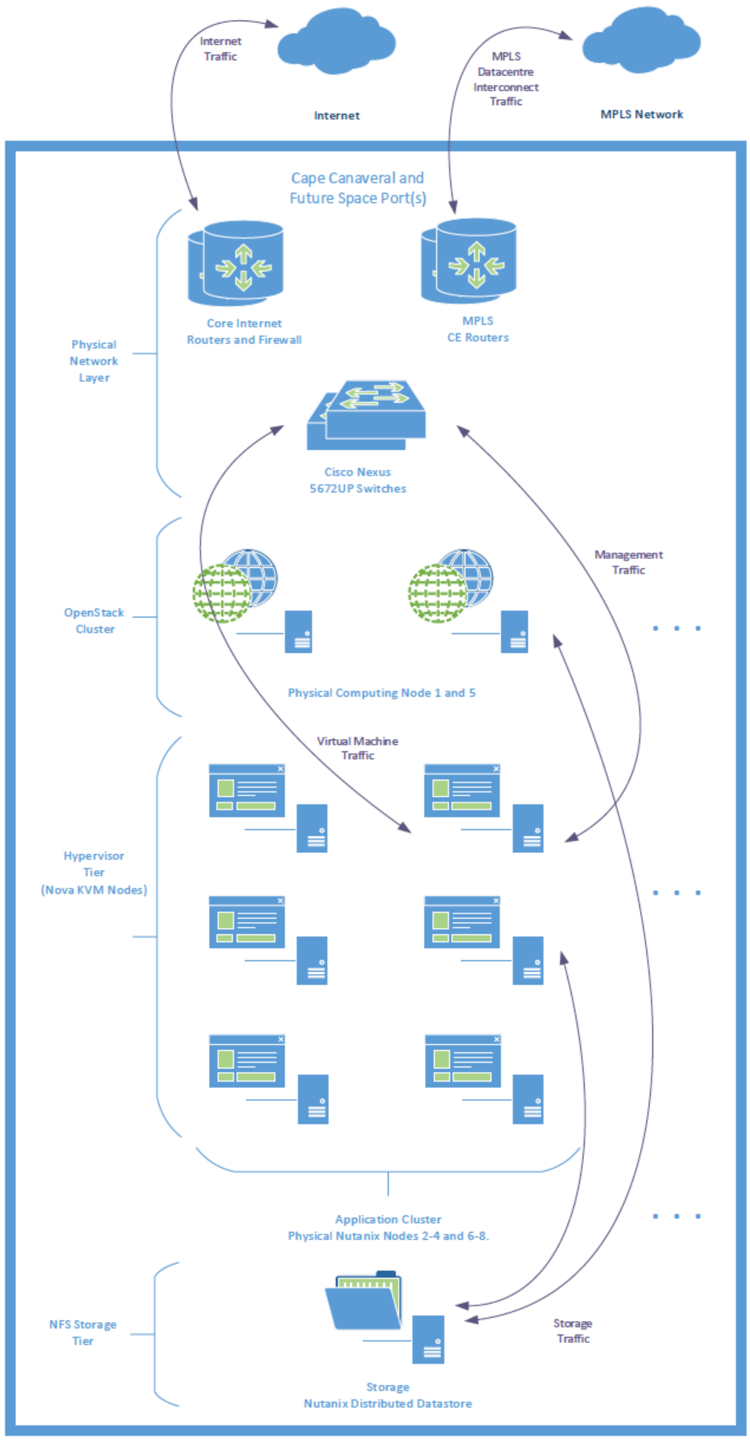


Figure 2 - High-Level Overview of Virtualization and Cloud Infrastructure



LOGICAL DESIGN

Overview

The premise for this design is based on high availability and orchestration. The purpose of this is to protect the critical components (i.e. application workload, and data) at the space ports, and ensure that the infrastructure can scale quickly and efficiently.

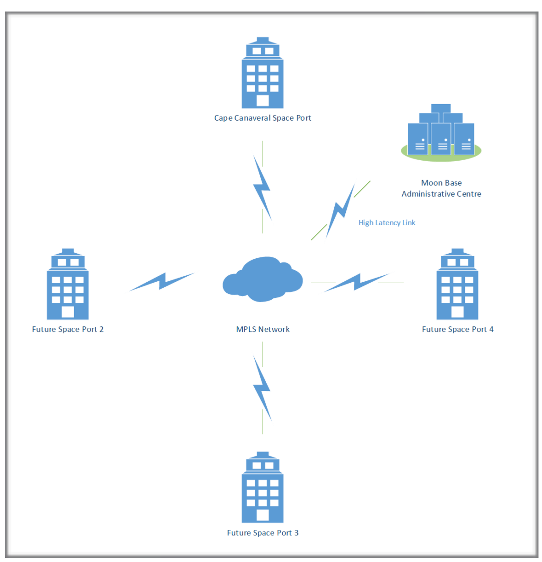
This design relies heavily on open source projects, as vendor support may not be available during the present chaos, and community support is strong.

The virtualization and private cloud infrastructure will be based on the OpenStack framework, and will include a highly available management cluster. The virtual servers supporting the space port application will reside on a separate cluster of nodes managed by OpenStack.

Network

The space ports and moon base will be interconnected via a 3rd party managed redundant carrier-grade MPLS network. The moon base will be connected utilizing a high-latency, but high-bandwidth link for administrative and management purposes. The management and maintenance of the MPLS network remains the responsibility of the 3rd party carrier and is backed by and aggressive SLA.

Figure 2- High-Level Inter-DC Network Layout



OpenStack Cluster

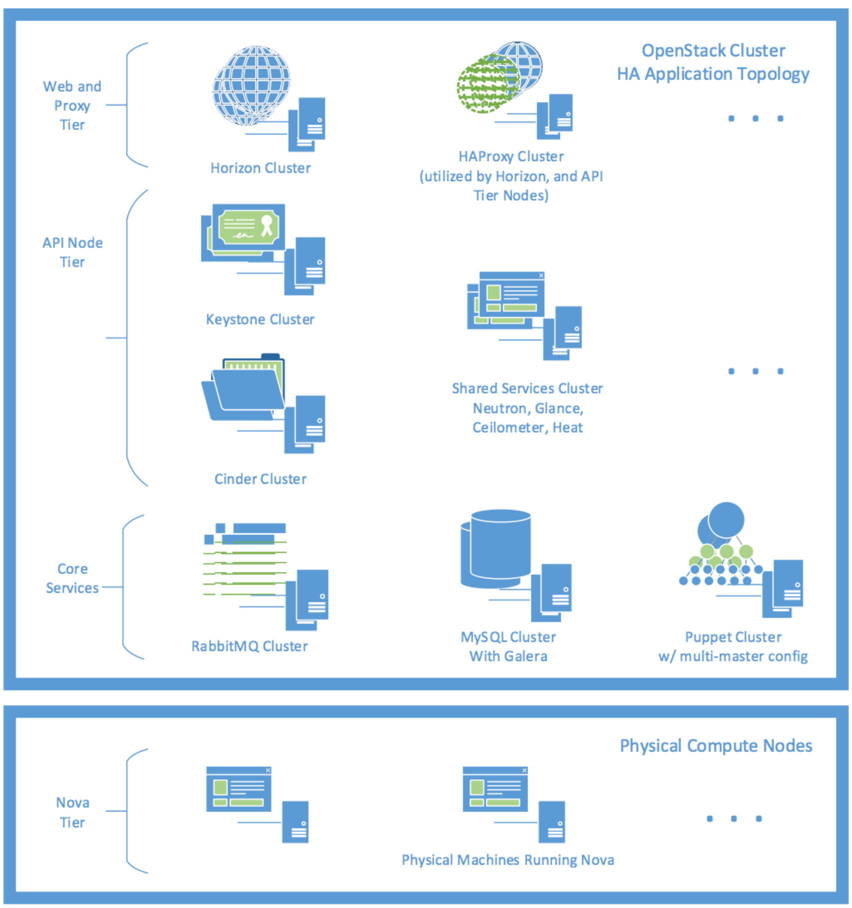
The management cluster will reside on two physical nodes (Nutanix node 1, and node 5) and is based on a highly available application topology.

The chosen operating system for the bare-metal install, as well as the supporting virtual servers is CentOS 7.x. The management components within the cluster will reside on virtual machines, running on top of the KVM hypervisor.

The underlying core services supporting the OpenStack cluster are messaging (RabbitMQ), databases (MySQL with Galera), and orchestration (Puppet with a multi-master config).

HAProxy has been chosen to act as a highly available load-balancer for the web tier (Horizon), as well as the OpenStack API nodes.

Puppet will be used to orchestrate and maintain the state and consistency of the OpenStack cluster. It can easily integrate with, and maintain the desired state of the OpenStack projects, HAProxy, the supporting core services.



Application Cluster

The chosen operating system for the bare-metal install (Nutanix node 2-4, and 6-8) is CentOS 7.x. The type two hypervisor to be used is KVM, and will be managed by OpenStack Nova.

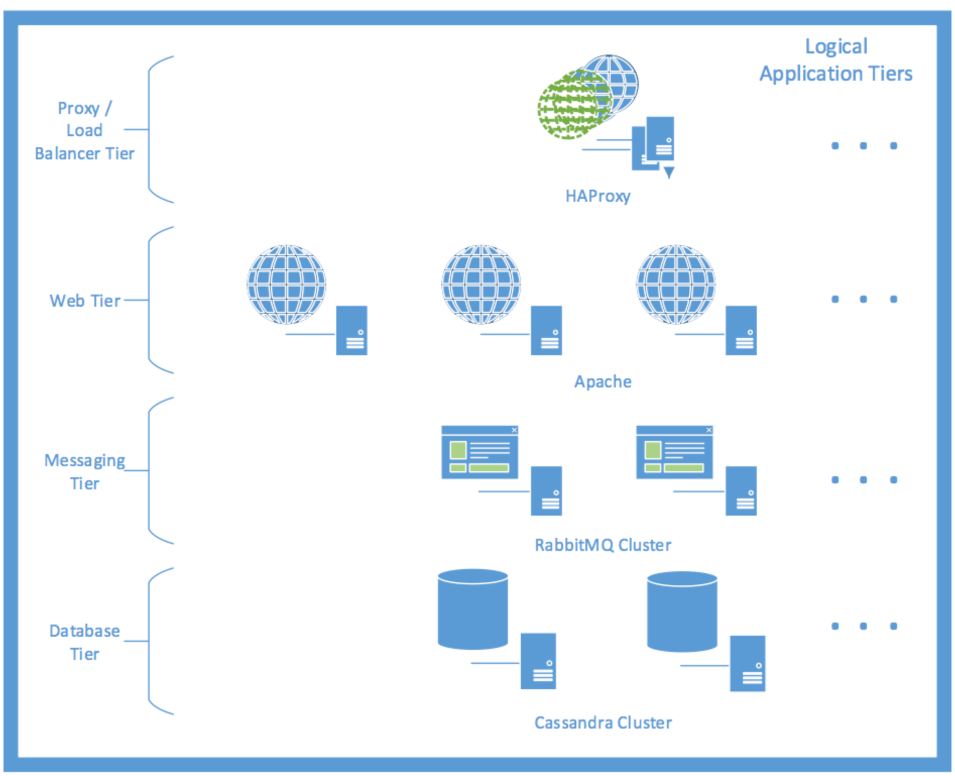
The virtual servers which form the application framework will utilize CentOS 7.x for their guest operating system.

The core services for the web application are the database (Cassandra cluster), and messaging (RabbitMQ cluster). The web application will be run on Apache, and load balanced using HAProxy. These components are all configured in a highly available fashion, and can be easily scaled.

The desired configuration and state of the application virtual servers will be maintained using Puppet.

As part of this design, it was mentioned earlier that the application framework would have the ability to scale automatically. This requirement will be satisfied utilizing OpenStack Heat and Ceilometer to spin-up/down instances based on workload, and Puppet to set the desired state of the application configuration.

It was decided that a combination approach to orchestration would be best suited to this design to enable both automatic scaling, while maintaining desired state.



Storage

The storage utilized by the physical nodes will be presented by the Nutanix virtual computing system in the form of NFS shares. The management and application servers will reside on separate mount points, as well as any additional special configuration required for the highly available databases.

Backups

Due to the highly available nature of the architecture, and the ability to easily reproduce the desired state based on orchestration, it was decided to backup the following components:

- required images, virtual templates
- orchestration repositories (i.e. git repo)
- application and management databases

To simplify the architecture, save resources, and provide off-site backup capabilities, a 3rd party cloud backup provider will be utilized.

Assumptions

It is assumed that any of the space ports, or the moon base may lose connectivity with one or more nodes. In the case of temporary loss of connectivity, the space ports will continue to produce as they are fully independent of one another.