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3.1 The Building Blocks of mCloud: What Software Was Used

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Overview of mCloud OpenStack Deployment

Our mCloud OpenStack deployment is architected to deliver a robust, secure, and highly available cloud platform suitable for both public and private cloud use. It is seamlessly integrated with multiple Ceph storage clusters, including dedicated NVMe storage clusters for high-performance workloads, 10k and 7.5k SAS hard drive storage clusters for balanced performance and capacity, and a geographically distributed NVMe cluster that spans across three physical datacenters to ensure ultimate storage reliability and data redundancy. All components are fully accessible via the OpenStack API, providing users with unparalleled control and automation capabilities.

Keystone (Identity Service)

Keystone is the cornerstone of our cloud's security and multi-tenancy features. It provides authentication and authorization services for all OpenStack components, managing users, projects, roles, and policies. By implementing Keystone, we ensure secure access control and isolate resources between different tenants in our cloud environment. This enhances security by preventing unauthorised access and allows for fine-grained policy management, enabling us to offer both public and private cloud services with confidence in their integrity and confidentiality.

Nova (Compute Service)

Nova is the compute engine of our OpenStack deployment, responsible for provisioning and managing virtual machine instances. It interfaces with hypervisors like KVM to create, schedule, and terminate VM instances on demand. Nova's flexible architecture allows us to offer scalable compute resources, supporting a variety of workloads. By leveraging Nova, we provide users with the ability to rapidly deploy and manage compute instances, ensuring high availability through features like live migration and resource pooling, which contribute to an always-online cloud environment.

Neutron (Networking Service)

Neutron handles all networking aspects within our cloud infrastructure. It

provides APIs for users to define network connectivity and addressing in the cloud. With Neutron, we offer advanced networking features such as customizable virtual networks, subnets, routers, and floating IPs. Integrating Neutron ensures that network resources are isolated per tenant, enhancing security. It also supports plugins for software-defined networking (SDN) solutions, enabling us to provide scalable and flexible networking services critical for high availability and performance.

Cinder (Block Storage Service)

Cinder provides persistent block storage to running instances. It allows users to create and manage volumes, which can be attached to or detached from VM instances. By integrating Cinder with our Ceph storage clusters, we offer scalable and redundant storage solutions. This integration ensures data persistence even if compute nodes fail, contributing to the reliability and high availability of our cloud services. Users can leverage Cinder to handle storage-intensive applications, benefiting from features like snapshotting and backup services.

Glance (Image Service)

Glance manages disk and server images, enabling users to discover, register, and retrieve virtual machine images. It supports a variety of image formats and facilitates rapid deployment of instances. By utilising Glance, we provide a centralised repository for VM images, ensuring consistency and ease of management. Integration with Ceph accelerates image retrieval and storage efficiency. Glance's image management capabilities are essential for maintaining a secure and efficient deployment pipeline, enhancing the user experience and operational efficiency.

Horizon (Dashboard)

Horizon offers a web-based user interface for interacting with all OpenStack services. It provides users with an intuitive platform to manage resources like instances, networks, and storage without the need for command-line interactions. Horizon enhances accessibility and user adoption by simplifying complex cloud operations into manageable tasks. For administrators, it offers visibility into the cloud environment, aiding in monitoring and management. This contributes to the overall usability and attractiveness of our cloud platform.

Heat (Orchestration Service)

Heat enables orchestration of composite cloud applications using templates in the form of text files that are readable and writable by humans. With Heat, users can automate the deployment of infrastructure, reducing manual configuration errors and increasing efficiency. It supports complex workflows

and scaling operations, which are crucial for high availability. By offering Heat, we empower users to manage resources as code, facilitating reproducibility, version control, and collaboration, all of which enhance the reliability and scalability of our cloud services.

Octavia (Load Balancer as a Service)

Octavia provides scalable load balancing services for OpenStack. It distributes incoming network traffic across multiple instances, ensuring that no single instance becomes a bottleneck, thereby improving application responsiveness and availability. Octavia supports advanced features like SSL termination, session persistence, and health monitoring. By integrating Octavia, we enhance the resilience of applications running on our cloud platform, contributing to an always-online experience and enabling users to build robust, scalable services.

Barbican (Key Management Service)

Barbican is responsible for secure storage, provisioning, and management of secrets such as passwords, encryption keys, and certificates. By implementing Barbican, we ensure that sensitive data is handled securely, adhering to compliance and regulatory standards. It provides a centralised service for managing encryption keys, which is critical for data protection both at rest and in transit. Barbican enhances the overall security posture of our cloud platform, making it a trusted environment for users' critical workloads.

Designate (DNS Service)

Designate offers DNS as a Service, allowing users to manage DNS zones and records via API. It integrates with other OpenStack services to automate DNS updates, ensuring that instances and services are reachable. Designate supports multi-tenancy and integrates with Keystone for authentication. By providing Designate, we enhance network manageability and automate service discovery, which is essential for scalable and dynamic cloud environments where resources are frequently provisioned and deprovisioned.

Masakari (Instance High Availability Service)

Masakari provides automated recovery of KVM-based virtual machine instances in the event of compute host failures. It monitors the health of compute nodes and instances, initiating recovery processes when failures are detected. By implementing Masakari, we ensure minimal downtime and service disruption, contributing to the high availability of our cloud platform. This automatic failover capability is critical for maintaining service continuity and meeting the stringent uptime requirements of enterprise applications.

OVN (Open Virtual Network)

OVN is a system for supporting virtual network abstraction. It complements Neutron by providing virtual networking to VMs, containers, and bare-metal hosts. OVN supports logical switching and routing, security groups, and distributed logical routers. By using OVN, we achieve high-performance networking with reduced latency and increased throughput. It enhances scalability and simplifies network management, which is vital for large-scale deployments. OVN's efficient use of network resources contributes to the overall performance and reliability of our cloud services.

OVS (Open vSwitch)

Open vSwitch (OVS) is a multilayer virtual switch used to facilitate network automation while supporting standard management interfaces and protocols. It enables advanced network functions such as VLAN tagging, tunnelling, and traffic shaping. OVS works closely with Neutron and OVN to provide flexible and programmable networking. By leveraging OVS, we offer enhanced network virtualization capabilities, enabling complex network topologies and policies. This flexibility is essential for accommodating diverse networking requirements and optimising network performance.

Placement (Resource Tracking and Scheduling Service)

Placement is responsible for tracking cloud resource inventories and usages, aiding in the efficient scheduling of compute, network, and storage resources. It enables Nova to make informed decisions about where to place workloads based on available resources and policies. By utilising Placement, we optimise resource utilisation, prevent overcommitment, and ensure that workloads are allocated to the most appropriate hosts. This contributes to the stability and efficiency of our cloud platform, enhancing performance and user satisfaction.

API Accessibility for Ultimate Control and Automation

All components of our OpenStack deployment are fully accessible via the OpenStack API. This API accessibility empowers users and administrators to automate tasks, integrate with third-party tools, and develop custom solutions. It enables programmatic control over all aspects of the cloud environment, from provisioning instances to managing networks and storage. This level of automation and control is essential for modern cloud operations, allowing for continuous integration and deployment (CI/CD) pipelines, infrastructure as code (IaC), and seamless scalability.

Conclusion

By integrating these OpenStack modules—each meticulously chosen and implemented—we have built our mCloud platform that offers a safe, secure, and always-online high availability cloud platform. The combination of advanced compute, networking, storage, orchestration, and security services, underpinned by high-performance Ceph storage clusters and accessible via comprehensive APIs, ensures that our cloud environment meets the demanding needs of both public and private cloud users. This robust architecture provides the scalability, flexibility, and reliability required to support a wide range of workloads and applications, empowering our users to focus on innovation and growth.