**k8s Environment Setup Summary**

**Total VMs: 9-10**

| **VM Type** | **Number of VMs** | **Shell Script** | **Purpose** | **Resource Requirements** |
| --- | --- | --- | --- | --- |
| **Control-Plane Node** | 3 | ubuntu\_24\_init\_k8s\_control\_plane.sh | Manages Kubernetes control-plane components like etcd, API server, controller manager, and scheduler for high availability (HA). | 4 vCPUs, 8 GB RAM, 50 GB SSD per VM |
| **Worker Node** | 3 (scalable) | ubuntu\_24\_init\_k8s\_worker.sh | Hosts application workloads (pods) and scales based on workload demands. | 4 vCPUs, 8 GB RAM, 100 GB SSD per VM |
| **GitLab CE Node** | 1 | uinit-v18-gitlab-ce.sh | Manages CI/CD workflows and integrates with the Kubernetes cluster for deploying applications. | 4 vCPUs, 8-16 GB RAM, 200 GB SSD |
| **Monitoring Node** | 1 | uinit-v18-monitoring.sh | Runs monitoring tools such as Prometheus, Grafana, and the EFK stack (Elasticsearch, Fluentd, Kibana) to offload monitoring workload from the application nodes. | 4 vCPUs, 8 GB RAM, 100 GB SSD |
| **Storage/Backup Node** | 1 | uinit-v18-storage-backup.sh | Manages storage solutions (NFS/Ceph) and backup services (Velero) for persistent storage and disaster recovery. | 4 vCPUs, 8 GB RAM, 100 GB SSD |

**Shell Scripts Overview**

1. **ubuntu\_24\_init\_k8s\_control\_plane.sh**
   * **Purpose**: Sets up the control-plane nodes for the Kubernetes cluster, includes server hardening, network security, TLS/SSL configurations, Ingress, Horizontal Pod Autoscaling (HPA), Cluster Autoscaler, and disaster recovery (Velero).
   * **Resource Requirements**: 3 VMs with 4 vCPUs, 8 GB RAM, and 50 GB SSD each.
2. **ubuntu\_24\_init\_k8s\_worker.sh**
   * **Purpose**: Configures worker nodes to join the Kubernetes cluster with server hardening, network configuration, and scaling settings.
   * **Resource Requirements**: 3 VMs (minimum) with 4 vCPUs, 8 GB RAM, and 100 GB SSD each.
3. **uinit-v18-gitlab-ce.sh**
   * **Purpose**: Sets up GitLab CE for CI/CD integration with the Kubernetes cluster using GitLab Runner, includes server hardening and network configuration.
   * **Resource Requirements**: 1 VM with 4 vCPUs, 8-16 GB RAM, and 200 GB SSD.
4. **uinit-v18-monitoring.sh**
   * **Purpose**: Configures a dedicated monitoring VM to run Prometheus, Grafana, EFK stack (Elasticsearch, Fluentd, Kibana), and Alertmanager, ensuring application performance and observability.
   * **Resource Requirements**: 1 VM with 4 vCPUs, 8 GB RAM, and 100 GB SSD.
5. **uinit-v18-storage-backup.sh**
   * **Purpose**: Sets up storage (NFS or Ceph) and backup services (Velero) for persistent storage and disaster recovery, isolating storage and backup workloads from the application nodes.
   * **Resource Requirements**: 1 VM with 4 vCPUs, 8 GB RAM, and 100 GB SSD.

**Important Considerations for Setup**

1. **Network Setup**:
   * Ensure reliable network connections with low latency and high throughput, especially between control-plane nodes for etcd and API server communication.
   * Implement network policies in Kubernetes for secure pod-to-pod and pod-to-external traffic management.
2. **TLS/SSL Certificates**:
   * Generate and configure TLS/SSL certificates for Ingress controllers and GitLab CE. For production, use trusted certificates (e.g., Let’s Encrypt) instead of self-signed certificates.
3. **Resource Monitoring and Scaling**:
   * Use Prometheus and Grafana for monitoring and configure Alertmanager for alerting on resource bottlenecks and failures.
   * Set up Horizontal Pod Autoscaling (HPA) to adjust pod count automatically based on CPU and memory usage.
   * Configure the Cluster Autoscaler to dynamically add or remove worker nodes based on workload changes.
4. **Security Enhancements**:
   * Apply server hardening measures across all VMs, including SSH hardening, firewall rules (UFW), and kernel-level security configurations (e.g., sysctl).
   * Use Open Policy Agent (OPA) or Kubernetes Pod Security Policies (PSP) to enforce security standards for workloads.
5. **Disaster Recovery and Backup**:
   * Set up Velero on the storage/backup VM for cluster state and application backups, ensuring recovery capabilities in case of failures.
   * Automate database and critical application backup processes.
6. **Scaling Recommendations**:
   * Begin with the 9 VM configuration and monitor performance, scaling worker nodes and adding more VMs as application and cluster load grows.