3000 – INFT Capstone

Kubernetes Server Project

Standard Operating Procedure



Date: 2025-02-27

Name: Pod 5 AKS Avenger

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# Updated SOP Documentation

# **Purpose**

to deploy and manage containerized applications on a small-scale using Kubernetes. Using Azure Kubernetes Service (AKS), the purpose is to create an infrastructure for managing a cluster of deployed workloads. This project focuses on unifying the deployment process, cluster management, and utilizing centralized tools to monitor and maintain containerized applications within a Kubernetes cluster. The aim is to improve our ability to handle workloads, improve server efficiency, and provide the team with the necessary skills and experience to manage Kubernetes and Azure services.

# **Project Scope**

As Pod 5, we are working together to design, deploy, and manage a fully operational Kubernetes cluster using Azure Kubernetes Service (AKS). This project involves creating a virtual machine to host the Kubernetes service and configuring Microsoft Entra ID in the Azure cloud for remote access and management.

Our scope includes defining user roles, and assigning permissions to ensure the cluster operates efficiently and securely. We will also use tools like Azure CLI, kubectl, and Helm to establish connections, workload deployments, and monitor the cluster. Our key milestone is the migration of the Kubernetes cluster from the VM to a physical server.

The goal of this project is to build a Kubernetes cluster that supports cloud-based workload management through AKS.

# **Terminologies**

**Kubernetes:** Is a container orchestrator, like Docker this open-source service provides a platform made for managing and maintaining containerized applications and instances. This service provides a foundation for automatically deploying, managing and upkeep of containers within the service.

**AKS (Azure Kubernetes Service):** This service provides ways for organizations to manage and deploy desired containerized applications at a company scale. AKS is managed by Microsoft in relation to the Azure cloud platform and can utilize features that Kubernetes offers.

**RBAC (Role Based Access Control):** Kubernetes supports the ability to manage authorization and hierarchical decisions, allowing authorized users to easily use and configure access control policies within the Kubernetes API.

# **Roles and Responsibilities**

* **Franklin Fiske:**
  + Responsible for the creation and management of the VM.
  + Oversees the creation and management of the Azure ID account.
  + Ensures proper integration and functionality of cloud services associated with the VM and Azure.
* **Evan:**
  + Primarily focuses on the creation and management of the Azure ID account.
  + Works alongside Franklin to troubleshoot and ensure seamless access and functionality within the Azure environment.
* **Kyle:**
  + Leads research and optimization efforts for both the VM and the physical machine.
  + Tasked with the creation of the physical machine and ensuring its readiness for migration.
  + Works on optimizing the performance and setup of the physical server.
* **Jack Gordon:**
  + Responsible for monitoring and logging important activity on the server to maintain accountability and track changes.
  + Assists in the overall management of the server and contributes to maintaining its stability and functionality.

**Challenges**

Possible future issues could include:

* Configuration of the Kubernetes server on the VM.
* Gaining access to Entra ID and the Microsoft tenant, including troubleshooting Azure CLI, kubectl, and Helm setup.
* Connection to the Azure Arc service via a browser.
* The need for physical or virtual deployment of the server.
* Differences between the testing environment and the production environment potentially causing inconsistencies in workflows.
* Extensive research required to address knowledge gaps during the project.
* Team inexperience with Azure, Kubernetes, and cloud-based services as a whole.
* Proper division of tasks for each node in the cluster to ensure efficiency.
* Attendance challenges among group members affecting productivity and coordination.
* Managing and troubleshooting 2FA issues that may impact access to cloud services and resources.

# **Procedures**

Tentative steps for completion include:

* Creation of the server hosting the Kubernetes service.
* Configuration of the initial Kubernetes service.
* Gaining access to Entra ID and setting up the Microsoft tenant using Azure CLI.
* Setting up kubectl for cluster access and deploying Helm for managing packages.
* Deployment and connection of the Kubernetes cluster to AKS.
* Configuration of AKS tools and allocation of team member permissions.
* Migrating the Kubernetes service from VM to a physical server.
* Testing and optimizing the Kubernetes cluster on the physical server.
* Finalizing documentation and conducting a project review to ensure successful completion.

# **Estimated Milestones**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Milestone No.** | **Milestone** | **Mandatory/Optional** | **Requirement** | **Completion Date** | **Verification** |
| 001 | Research Kubernetes Server requirements | Mandatory | Study Kubernetes and AKS documentation online | Jan 14th, 2025 | Confirm with team documentation |
| 002 | Set up development environment | Mandatory | Install necessary tools like linux VM and Minikube/ microk8s | Jan 21st, 2025 | installations are functioning and running |
| 003 | Install Kubernetes on VM | Mandatory | Install and configure Kubernetes on the VM | Jan 28th, 2025 | Verify Kubernetes service is running and actively connected to Azure Arc cluster |
| 004 | Configure Kubernetes network | Mandatory | Set up basic network addressing for pod communication | Feb 4th, 2025 | Verify network addressing with test workloads |
| 005 | Configure Kubernetes cluster users | Mandatory | Create and assign roles and permissions | Feb 11th, 2025 | Confirm using Kubernetes dashboard |
| 006 | Test Kubernetes workload deployment | Mandatory | Run and verify a test workload with deployment | Feb 18th, 2025 | Validate workload deployment functionality |
| 007 | Set up persistent storage for Kubernetes | Mandatory | Configure and test persistent storage volumes | Feb 25th, 2025 | Validate storage with a persistent test pod |
| 008 | Prepare for VM to physical server migration | Mandatory | Back up Kubernetes server and prepare migration | Mar 3rd, 2025 | Backup and migration tools and settings are ready |
| 009 | Perform VM to physical server migration | Mandatory | Migrate VM state to physical server | Mar 10th, 2025 | Confirm physical server running Kubernetes |
| 010 | Test physical server Kubernetes cluster | Mandatory | Run test workloads on physical server | Mar 17th, 2025 | Workloads running on physical server |
| 011 | Optimize Kubernetes cluster performance | Mandatory | Adjust resource allocation for efficiency | Mar 24th, 2025 | Compare performance metrics to previous VM state as well as hardware limitations |
| 012 | Manage Kubernetes pods and workloads | Mandatory | Utilize Kubernetes tools to manage pods, workloads, and services | Mar 31st, 2025 | Performing management using built-in tools |
| 013 | Conduct final review and documentation | Mandatory | Compile project documentation and conduct review | Apr 2nd, 2025 | Review completed documentation with the team |

# **Next Steps**

Our next steps focus on completing the setup and ensuring the Kubernetes cluster is functional. Key tasks include planning and documenting processes, finalizing the VM setup, integrating with AKS, testing workloads, configuring storage, and migrating to a physical server all while ensuring system integrity.

* **Planning and Documentation**
* Develop an Install Plan detailing steps and information for setting up the Kubernetes cluster and integrating with Azure.
* Maintain a Change Log to document progress, challenges, and resolutions for future reference.
* **Finalize VM Setup and Kubernetes Installation**
* Complete the VM setup and install Kubernetes as the foundation for the cluster.
* Validate Kubernetes services by conducting initial tests to ensure proper functionality.
* **Microsoft Entra ID and Azure Setup**
* Configure Microsoft Entra ID for authentication and management using Azure CLI.
* Assign roles and permissions to team members and verify successful access.
* **Integration with AKS**
* Use Azure CLI, kubectl, and Helm to connect the Kubernetes cluster on the VM to AKS.
* Deploy a sample application to test and validate functionality.
* **Migration and Optimization**
* Back up the Kubernetes cluster and prepare a Migration Plan for transitioning to a physical server.
* Complete the migration, optimize cluster performance on the physical server, and perform final tests.

# **Team Charter**

**Team Rules**

***Communication***

Each member should retain a consistent mind-set by showing up, putting in the effort to ensure the team is succeeding. Each member must have **consistent communication** and inform on the progress of the project and what the team is struggling with for troubleshooting.

***Attendance/Meetings***

It is expected that **every member** of the team to be **present** and participate. If a member can’t participate that day, they will be expected to **notify the team** at least **1 hour before class with a reasonable excuse**. If a situation happens where the team works from home due to weather, it is expected to be working on the project online and constantly communicate.

***Quality***

Every member will be **expected to finish their work and check it over for any mistakes**, and if there are any mistakes, **correct immediately** before handing in. Individual work to be checked by team members to ensure quality meets team standards.

***Workload***

**Each Member** will be expected to complete 100% of their assigned work. The team should have a **balanced workload**. No member should be doing more work than the other. If a situation happens where a member feels like they’ve been **given too much**. The member can **speak to the team** and the team can make changes if possible.

***Conflict Resolution***

If a conflict arises, the other members will be **expected to listen to both sides** and try to resolve the conflict peacefully. If any of the above values are consistently not being met, the team will meet with faculty and escalate accordingly.

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