

Configuration Manual

MSc Research Project
Cloud Computing

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Programme:	Cloud Computing
Year:	2024
Module:	MSc Research Project
Supervisor:	Ahmed Makki
Submission Due Date:	12/12/2024
Project Title:	Configuration Manual
Word Count:	700
Page Count:	6

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Configuration Manual

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1 Introduction

This Document offers comprehensive guidelines for configuring and executing the research experiments. It also provides the requisite software and platforms utilized in this study. This study evaluated the solution's effectiveness in improving cold start latency, by comparing it to Apache OpenWhisk *Apache OpenWhisk Documentation* (n.d.). The main tools, systems, and software libraries and packages used in this study are shown in Table 1. A quick look at the files and folders in SmartFasS can be found in Table 2. '

Component	Details
Virtual Machines	Google Cloud Platform (GCP) Compute Engine
Operating System	Ubuntu 22.04 LTS
Serverless Platform	OpenWhisk
Kubernetes Cluster	KinD (Kubernetes in Docker) for running OpenWhisk
Container Technology	Docker (27.3.1)
Cache Manager	Redis 6.0.16
Machine Learning	Google Colab & Keras TensorFlow
Programming Languages	Node js 20.18 & Bash
Performance/Load Testing	Java (openjdk-11) & Apache JMeter 5.6.3
Docker Image	node:20-alpine

Table 1: System Configuration & Prerequisite

File/Folder	Description
colab/	Folder containing Jupyter notebooks for analysis and modeling.
dataset/	Folder containing Azure dataset and ML results.
function.js	Lodash Node.js app for execution
jmeter/	Folder containing JMeter scripts for load testing.
logs/	Folder containing log files and results from the experiments.
main.js	Index file for the project.
package.json	Configuration file for Node.js project dependencies and scripts.
scripts/	Folder containing shell scripts for setup and utilities.
utils/	Folder containing utility JavaScript files for SmartFasS.

Table 2: SmartFasS files and folders

2 Configuration

This section will outline the whole installation procedure to set up a virtual machine in Google Cloud Platform (GCP) *Google Cloud Console - Compute Engine* (n.d.), along with the installation of SmartFasS and OpenWhisk on the created virtual machine.

2.1 Creating VM

Two GCP `e2-standard-2` instances will be used for the implementation, To use the framework without memory issues, This will ensure that both the framework and OpenWhisk will run smoothly on virtual machines.

Configure Your Project

1. **Log in to GCP Console:.**
2. **Select/Create a Project:**
 - (a) Choose an existing project or create a new one by clicking **New Project** and following the prompts.

Instance Creation

1. Create an instance by navigating to Compute Engine, selecting the tire as seen in Figure 1, and selecting the `e2-standard-2` with the default configuration of 2 vCPUs and 8 GB of RAM.

Shared-core	e2-standard-2 2 vCPU (1 core), 8 GB memory
Standard	
High memory	e2-standard-4 4 vCPU (2 core), 16 GB memory
High CPU	e2-standard-8 8 vCPU (4 core), 32 GB memory
	e2-standard-16 16 vCPU (8 core), 64 GB memory
	e2-standard-32 32 vCPU (16 core), 128 GB memory

Figure 1: Tire Selection

2. Choose the Ubuntu as Operating system and choose the version 22.04 LTS with `x86/64 jammy image` and 64 GB storage Figure 2
3. Next, grant access to both HTTP and HTTPS traffic. Ensure that the access scope covers all cloud APIs, and then proceed to install the Ops Agent for monitoring and logging Figure 3.
4. Reiterate steps 1-3 to create another instance for OpenWhisk.

Operating system
Ubuntu

Version *
Ubuntu 22.04 LTS
x86/64, amd64 jammy image built on 2024-11-19

Boot disk type *
Balanced persistent disk

COMPARE DISK TYPES

Size (GB) *
64
Provision between 10 and 65536 GB

Figure 2: OS Configuration

Identity and API access ?

Service accounts ?
Service account
Compute Engine default service account
Requires the Service Account User role (roles/iam.serviceAccountUser) to be set for users who want to access VMs with this service account. [Learn more](#)

Access scopes ?
☐ Allow default access
☒ Allow full access to all Cloud APIs
☐ Set access for each API

Firewall ?
Add tags and firewall rules to allow specific network traffic from the Internet
☒ Allow HTTP traffic
☒ Allow HTTPS traffic
☐ Allow Load Balancer Health Checks

Observability - Ops Agent ?
Monitor your system through collection of logs and key metrics.
☒ Install Ops Agent for Monitoring and Logging

Figure 3: Identity and Firewall Configuration

2.2 SmartFasS and OpenWhisk installation

SSH into the server by clicking the SSH button in the Compute engine page as shown in Figure 4



Filter	Status: Running	Enter property name or value						X	?	
<input type="checkbox"/> Status	Name ↑	Zone	Recommendations	In use by	Internal IP	External IP	Connect			
<input type="checkbox"/>	<input checked="" type="checkbox"/> openwhisk	us-central1-a			10.128.0.14 (nic0)	34.28.52.72 (nic0)	SSH	▼	⋮	
<input type="checkbox"/>	<input checked="" type="checkbox"/> smartfaas	us-central1-a			10.128.0.13 (nic0)	34.45.220.36 (nic0)	SSH	▼	⋮	

Figure 4: SSH into server

1. Run the following command to clone the repository:

```
git clone https://github.com/Hariharan-Sathiyamoorthy/SmartFasS.git
```

2. cd into the SmartFasS/scripts folder
3. Execute the command `./env_setup.sh` it will prompt you to select an option based on whether the instance is OpenWhisk or SmartFaaS server Figure 5. Choose the appropriate option to continue with the installation. The installation will take approximately 15mins



```
hari73118@openwhisk:~/SmartFasS/scripts$ ./env_setup.sh
Select an option:
1. Install SmartFasS setup
2. Install OpenWhisk setup
Enter your choice (1 or 2):
```

Figure 5: Choose Installation

4. After installation, simply run this command to set the path variables.

```
source ~/.bashrc
```

5. The full installation log will be in `root/env_setupOut.log`. If there were any errors, they will be shown there.
6. On an OpenWhisk server, run this command to see if the KinD cluster is working correctly. It will show the pods running in the `openwhisk` namespace Figure 6.

```
sudo kubectl get pods -n openwhisk
```

```

hari73118@openwhisk:~$ sudo kubectl get pods -n openwhisk
NAME                                READY   STATUS    RESTARTS   AGE
owdev-alarmprovider-5d57d4b879-82lrg 1/1     Running   0           30h
owdev-apigateway-d6d756db8-mwx8v     1/1     Running   0           30h
owdev-controller-0                   1/1     Running   0           30h
owdev-couchdb-89b8469bc-zf94g        1/1     Running   0           30h
owdev-gen-certs-6hpcr                 0/1     Completed 0           30h
owdev-init-couchdb-zm2dw              0/1     Completed 0           30h
owdev-install-packages-f6hnn         0/1     Completed 0           30h
owdev-invoker-0                       1/1     Running   2           30h
owdev-kafka-0                         1/1     Running   0           30h
owdev-kafkaprovider-7867778f74-5bvz  1/1     Running   0           30h
owdev-nginx-67b8974c77-rxkxb        1/1     Running   0           30h
owdev-redis-74d7479464-g2zhn        1/1     Running   0           30h
owdev-wskadmin                       1/1     Running   0           30h
owdev-zookeeper-0                   1/1     Running   0           30h
wskowdev-invoker-00-198-prewarm-nodejs14 1/1     Running   0           3m38s

```

Figure 6: OpenWhisk Installation

2.3 Running the Experiments

2.3.1 SmartFasS Experiments

1. To run the experiments, navigate to the **SmartFasS** folder on SmartFasS server.
2. Run the following command to install all the dependencies:

```
npm install
```

3. Run this command to execute the orchestrate function and start the JMeter script parallelly

```
npm run coldMitigation
```

4. there will be two logs files will be generated from this experiment output **node.log** and **inIntiatorOutput.csv** both will be in the **SmartFasS/logs** folder, this will contain comprehensive information about the experiment Figure 7.

```

hari73118@openwhisk:~/SmartFasS/logs/results$ tail InitiatorOutput 2024-11-27.csv
2024-11-27T16:43:13.644Z,coldMitigation_node_27f1fc36-b9ea-4360-8fed-b1c9cd5d92c,warm,164.61914600000006
2024-11-27T16:43:21.693Z,coldMitigation_node_724ba342-2dcf-4b07-bbaa-ab2a306054f5,cold,157.21063700000013
2024-11-27T16:43:22.637Z,coldMitigation_node_a5b1e313-251f-4623-93d6-abb0bd6291c8,warm,174.819055
2024-11-27T16:43:35.347Z,coldMitigation_node_ac9e83b2-9101-4ee8-8145-1319e4814432,warm,151.14810799999998
2024-11-27T16:43:43.669Z,coldMitigation_node_30977d08-3423-4611-bd89-1b7821ef09c2,cold,228.50852200000008
2024-11-27T16:43:56.070Z,coldMitigation_node_8f8cc954-24ed-43c3-89d8-be7b1fia3651,warm,150.74437799999993
2024-11-27T16:44:11.730Z,coldMitigation_node_52399784-ecbc-4417-a01f-64b7a5260e70,warm,147.927618
2024-11-27T16:44:19.716Z,coldMitigation_node_714d31c6-8128-4bfb-8a9a-7a8e5cf00c73,cold,169.518016
2024-11-27T16:44:23.096Z,coldMitigation_node_c615b300-f24c-4ff0-9978-f707b262fa29,cold,179.20648500000016
2024-11-27T16:44:26.509Z,coldMitigation_node_dbe96fca-7e18-4d88-821f-6f6dd75ff7b3,cold,153.98893799999996

```

(a) Initiator Logs

```

hari73118@openwhisk:~/SmartFasS/logs$ tail output_node.log
sleeping for: 7060
Starting Orchestration
Orchestration Complete: coldMitigation_node_1436f945-7ba7-4c47-ad60-51a182797cc4 warm
sleeping for: 7060
Starting Orchestration
Orchestration Complete: coldMitigation_node_1436f945-7ba7-4c47-ad60-51a182797cc4 warm
sleeping for: 7060
Starting Orchestration
Orchestration Complete: coldMitigation_node_1436f945-7ba7-4c47-ad60-51a182797cc4 warm
sleeping for: 7060

```

(b) Orchestration Logs

Figure 7: SmartFasS Logs

2.3.2 OpenWhisk Experiments

1. To run the experiments, navigate to the **SmartFasS** folder on OpenWhisk server.
2. Run the following command to install all the dependencies:

```
npm install
```

3. Run this command to execute the OpenWhisk function through JMeter script.

```
npm run OpenWhisk
```

4. This experiment is being run entirely with JMeter. The JMeter logs and results can be found in the **SmartFasS/logs** folder, where they are named **output_jmeter.log** and **inInitiatorOutput.csv**. This will have all the details about the experiment shown in Figure 8.

```
hari73118@openwhisk:~/SmartFasS/logs$ tail output_jmeter.log
summary = 188 in 00:04:45 = 0.7/s Avg: 1342 Min: 790 Max: 3680 Err: 0 (0.00%)
summary + 16 in 00:00:34 = 0.5/s Avg: 1445 Min: 799 Max: 2236 Err: 0 (0.00%) Active: 1 Started: 1 Finis
hed: 0
summary = 204 in 00:05:18 = 0.6/s Avg: 1350 Min: 790 Max: 3680 Err: 0 (0.00%)
summary + 22 in 00:00:27 = 0.8/s Avg: 1234 Min: 821 Max: 2151 Err: 0 (0.00%) Active: 1 Started: 1 Finis
hed: 0
summary = 226 in 00:05:46 = 0.7/s Avg: 1339 Min: 790 Max: 3680 Err: 0 (0.00%)
summary + 24 in 00:00:29 = 0.8/s Avg: 1000 Min: 798 Max: 1449 Err: 0 (0.00%) Active: 1 Started: 1 Finis
hed: 0
summary = 250 in 00:06:15 = 0.7/s Avg: 1306 Min: 790 Max: 3680 Err: 0 (0.00%)
summary = 250 in 00:06:15 = 0.7/s Avg: 1306 Min: 790 Max: 3680 Err: 0 (0.00%)
Timing up ... # 2024 Dec 9 12:03:50 UTC (1733745810277)
... end of run
```

(a) JMeter Logs

```
hari73118@openwhisk:~/SmartFasS/logs/results$ tail OpenWhiskOutput_2024-12-09.csv
2024-12-09T12:02:16.549Z,bd5be891d0d10fbc3c59215d5f8159ea496433bc41adba7d8d10ea21d35c3e3a,1071.905972
2024-12-09T12:02:17.940Z,bd5be891d0d10fbc3c59215d5f8159ea496433bc41adba7d8d10ea21d35c3e3a,668.6497220000001
2024-12-09T12:02:19.804Z,bd5be891d0d10fbc3c59215d5f8159ea496433bc41adba7d8d10ea21d35c3e3a,782.0929539999998
2024-12-09T12:02:28.163Z,bd5be891d0d10fbc3c59215d5f8159ea496433bc41adba7d8d10ea21d35c3e3a,665.976053
2024-12-09T12:02:33.482Z,bd5be891d0d10fbc3c59215d5f8159ea496433bc41adba7d8d10ea21d35c3e3a,1111.636572
2024-12-09T12:02:35.663Z,bd5be891d0d10fbc3c59215d5f8159ea496433bc41adba7d8d10ea21d35c3e3a,1128.0276199999998
2024-12-09T12:02:37.205Z,bd5be891d0d10fbc3c59215d5f8159ea496433bc41adba7d8d10ea21d35c3e3a,830.783977
2024-12-09T12:02:38.772Z,bd5be891d0d10fbc3c59215d5f8159ea496433bc41adba7d8d10ea21d35c3e3a,776.3080299999999
2024-12-09T12:02:40.343Z,bd5be891d0d10fbc3c59215d5f8159ea496433bc41adba7d8d10ea21d35c3e3a,705.2323769999999
2024-12-09T12:02:42.315Z,bd5be891d0d10fbc3c59215d5f8159ea496433bc41adba7d8d10ea21d35c3e3a,1044.301839
```

(b) OpenWhisk results

Figure 8: OpenWhisk Logs

2.4 Evaluating the Experiments

1. To evaluate the experiments, navigate to the **SmartFasS/colab** folder.
2. Inside the folder, the **analysis.ipynb** file can be found. This file contains the code to analyze the results of the experiments.

References

Apache OpenWhisk Documentation (n.d.). <https://openwhisk.apache.org/documentation.html>.

Google Cloud Console - Compute Engine (n.d.). <https://console.cloud.google.com/compute>.