

Oracle® Communications

Networks Data Analytics Function

Benchmarking Guide



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ORACLE®

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Acronyms

The following table provides information about the acronyms and the terminology used in the document.

Table Acronyms

Acronym	Description
3GPP	3rd Generation Partnership Project
5GC	5G Core Network
5GS	5G System
AF	Application Function
API	Application Programming Interface
AMF	Access and Mobility Management Function
CNC	Cloud Native Core
CNE	Oracle Communications Cloud Native Core, Cloud Native Environment (CNE)
FQDN	Fully Qualified Domain Name
GUI	Graphical User Interface
HTTPS	Hypertext Transfer Protocol Secure
KPI	Key Performance Indicator
HA	High Availability
IMSI	International Mobile Subscriber Identity
K8s	Kubernetes
ME	Monitoring Events
Network Slice	A logical network that provides specific network capabilities and network characteristics.
NEF	Oracle Communications Cloud Native Core, Network Exposure Function (NEF)
NF	Network Function
NRF	Oracle Communications Cloud Native Core, Network Repository Function (NRF)
NSI	Network Slice Instance. A set of Network Function instances and the required resources (such as compute, storage and networking resources) which form a deployed Network Slice.
NSSF	Oracle Communications Cloud Native Core, Network Slice Selection Function (NSSF)
NWDAF	Network Data Analytics Function
OAM	Operations, Administration, and Maintenance
PLMN	Public Land Mobile Network
REST	Representational State Transfer
SBA	Service Based Architecture
SBI	Service Based Interface
SMF	Session Management Function
SNMP	Simple Network Management Protocol
SUPI	Subscription Permanent Identifier
UDM	Unified Data Management

Table (Cont.) Acronyms

Acronym	Description
UE	User Equipment
URI	Uniform Resource Identifier

What's New in This Guide

This section introduces the documentation updates for Release 23.1.0 in *Oracle Communications Networks Data Analytics Function Benchmarking Guide*.

Release 23.1.0 - F79476-01, April 2023

This is the first published version of the document.

1

Introduction

Oracle Communications Networks Data Analytics Function (OCNWDAF) is a Network Function (NF) that assists in collecting and analyzing data in a 5G network.

The 5G technology requires prescriptive analytics to drive closed-loop automation and self-healing networks. In a 5G network, the consumers of data are 5G NFs, Application Functions (AFs), and Operations, Administration, and Maintenance (OAM) and the data producers are 5G NFs. An OCNWDAF consumer can avail analytics information for different analytic events. Alternatively, the consumers can subscribe or unsubscribe for specific analytics information as a one-time event or periodically get notified when a specifically defined event (for example, a threshold is breached) is detected.

1.1 Purpose and Scope

This document is designed to help operators measure the capacity and performance of OCNWDAF, OCNWDAF microservices, and deployment environment setup software such as Cloud Native Environment (CNE) and cnDBTier.

This document provides OCNWDAF performance and capacity data.

It is recommended that OCNWDAF is run through a benchmark on the target cloud native infrastructure to determine the capacity and performance in the target infrastructure. This information can be used to adjust the initial deployment resources and to help predict resource requirements when OCNWDAF is scaled up.

1.2 References

For more information about OCNWDAF, see the following documents:

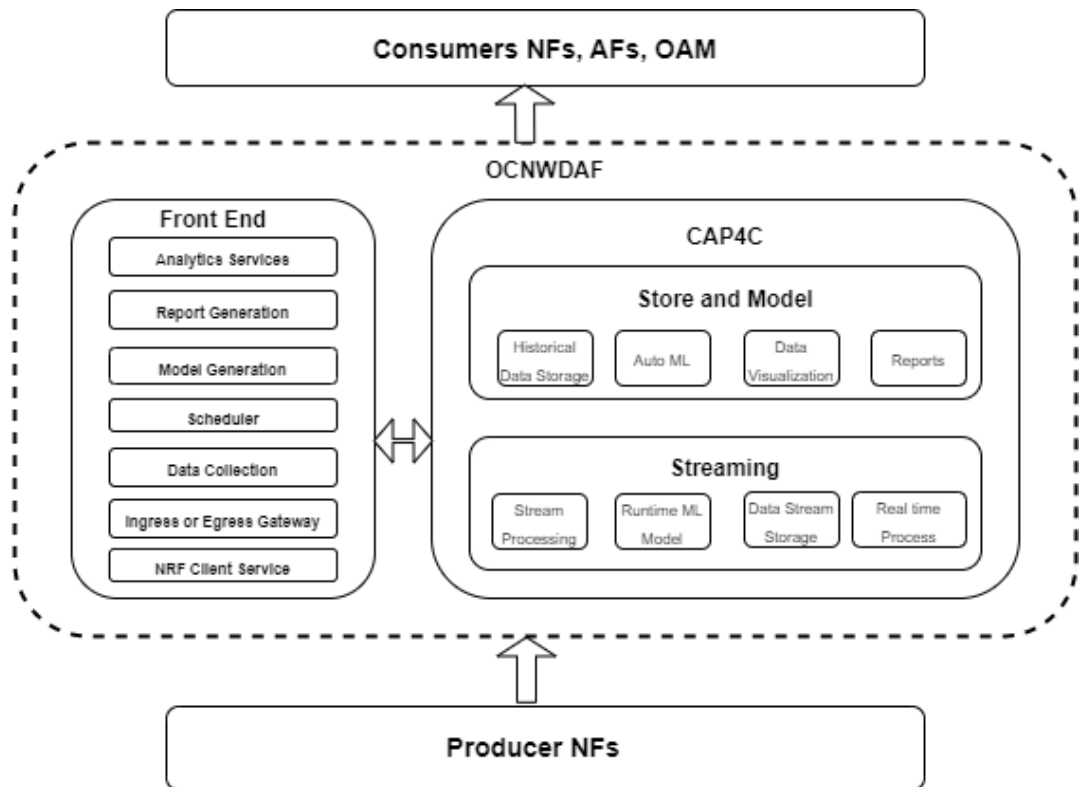
- *Oracle Communications Networks Data Analytics Function Installation and Fault Recovery Guide*
- *Oracle Communications Networks Data Analytics Function User Guide*
- *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Network Analytics Automated Testing Suite Guide*

2

Deployment

OCNWDAF can be deployed in CNE and OCI environments. For more information about OCNWDAF installation, see *Oracle Communications Networks Data Analytics Function Installation and Fault Recovery Guide*. The following diagram depicts the OCNWDAF deployment in the 5G architecture:

Figure 2-1 OCNWDAF in a 5G Network



OCNWDAF uses the following common services of CNE:

- Kubernetes
- HELM
- cnDBTier
- CNC Console
- Prometheus
- Metallb (Load balancer)

3

Resource Requirement

This section provides information about the resource requirements to install and run Oracle Communications Networks Data Analytics Function (OCNWDAF).

Kubernetes Resources

The following table displays the Kubernetes resource requirements:

Table 3-1 Kubernetes Resources

Instance	No. of instances	CPU/Instance	Total CPU
K8s Master	3	4	12
K8s Worker	12	16	192
LB	2	2	4
Total			208

OCNWDAF Deployment

The following table displays the OCNWDAF deployment details:

Table 3-2 OCNWDAF Deployment

Deployment Type	CPUs	Memory (in GB)	Storage (in GB)
Default	105	969	5000

Microservice Port Mapping

The following table displays the microservices port mapping information:

Table 3-3 Port Mapping

Service	Port Type	IP Type	Network Type	Service Port	Container Port
ocn-nwdaf-analytics	Internal	ClusterIP	Internal/K8s	8083/TCP	8080/TCP
ocn-nwdaf-communication	Internal	ClusterIP	Internal/K8s	8082/TCP	8080/TCP
ocn-nwdaf-configuration-service	Internal	ClusterIP	Internal/K8s	8096/TCP	8080/TCP
ocn-nwdaf-data-collection	Internal	ClusterIP	Internal/K8s	8081/TCP	8080/TCP
ocn-nwdaf-gateway	Internal	ClusterIP	Internal/K8s	8088/TCP	8080/TCP
ocn-nwdaf-mtlf	Internal	ClusterIP	Internal/K8s	8093/TCP	8080/TCP
ocn-nwdaf-subscription	Internal	ClusterIP	Internal/K8s	8087/TCP	8080/TCP

OCNWDAF Core Microservices Requirements

The following table displays the core microservices resource requirements:

Table 3-4 Core Microservices Resource Requirements

Microservice Name	POD Replica		CPU/POD		Memory/POD (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	Min	Max	Min (Mi)	Max (GB)
ocn-nwdaf-analytics-info-service	1	2	1	2	1	2	78.1	1
ocn-nwdaf-gateway-service (ingress gateway)	1	2	1	2	1	2	78.1	1
nwdaf-cap4c-spring-cloud-config-server	1	1	2	2	1	1	78.1	1
ocn-nwdaf-communication-service (egress gateway)	1	2	1	2	1	2	78.1	1
ocn-nwdaf-data-collection-service	2	4	2	4	2	4	78.1	1
ocn-nwdaf-subscription-service	1	2	1	2	1	2	78.1	1
ocn-nwdaf-mtlf-service	1	2	1	2	1	2	78.1	1
ocn-nwdaf-configuration-service	1	2	1	2	1	2	78.1	1
ocn-nwdaf-cap4c-model-controller	1	2	4	8	1	2	78.1	1
ocn-nwdaf-cap4c-model-executor	2	4	2	4	1	2	78.1	1
ocn-nwdaf-cap4c-stream-analytics	2	4	4	8	1	2	78.1	1
ocn-nwdaf-cap4c-portal	1	2	2	4	1	2	78.1	1
ocn-nwdaf-cap4c-portal-service	1	2	2	4	1	2	78.1	1
ocn-nwdaf-cap4c-scheduler-service	1	2	1	2	1	2	78.1	1
ocn-nwdaf-cap4c-kafka-ingestor	2	4	1	2	1	2	78.1	1
ocn-nwdaf-cap4c-reporting-service	1	2	1	2	1	2	78.1	1
ocn-nwdaf-geo-redundancy-agent	1	1	1	1	1	2	78.1	1
Total	21	40	28	52	17	35		

NRF Client Resources

The following table displays the NRF Client resource requirements:

Table 3-5 NRF Client Resource Requirements

Microservice Name	POD Replica		CPU/POD		Memory/POD (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	Min	Max	Min (Mi)	Max (G)
nrfclient-appinfo	1	2	1	2	1	2	78.1	1
nrfclient-ocnf-nrf-client-discovery (2 instances)	1	2	1	2	1	2	78.1	1
nrfclient-ocnf-nrf-client-nfmanagement	1	2	1	2	1	1	78.1	1
nrfclient-ocpm-config	1	2	1	2	1	4	78.1	1
Total	4	8	4	8	4	9		

ATS and Stubs Requirements

The following table displays the ATS and Stubs resource requirements:

Table 3-6 ATS and Stubs Requirements

Microservice	CPUs required per POD	Memory required per POD	Storage PVC required per POD	# Replicas (regular deployment)	# Replicas (ATS deployment)	CPUs required total	Memory required total (GB)	Storage PVC required total (GB)
ocats-nwdaf-sub	2	1	0		1	2	1	0
ocats-nwdaf-notify-api	2	1	0		1	2	1	0
Total	4	2				10	9	0

CNC Console Requirements

The following table displays the CNC Console resource requirements:

Table 3-7 CNC Console Requirements

Service Name	Limits		Requests	
	CPU	Memory (in GB)	CPU	Memory (in GB)
M-CNCC IAM	10.5	11.5	5.3	5.8

Redis Requirements

The following table displays the Redis requirements:

Table 3-8 Redis Requirements

Microservice Name	POD Replica		CPU/POD		Memory/POD (in GB)		Storage	
	Min	Max	Min	Max	Min	Max	Min (Mi)	Max (G)
Redis	1	3	2	4	4	8	500	1
Total	1			4		8	500	

cnDBTier Requirements

For information on cnDBTier requirements see, *Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide*.

Kafka Requirements

The following tables display the Kafka requirements:

Each entry is per broker (with at least three brokers and three zookeepers).

Table 3-9 Broker Configuration

Kafka	vCPU Req	vCPU Limit	Memory Req (Gi)	Memory Limit (Gi)	Min Replicas	Max Replicas	Storage
Kafka	2	5	4	24	3	3	30 -200GB

Table 3-10 Zookeeper Configuration

Zookeeper	vCPU Req	vCPU Limit	Memory Req (Gi)	Memory Limit (Gi)	Min Replicas	Max Replicas	Storage
Zookeeper	1	1	1	2	3	3	10GB

With a minimum of three nodes in the cluster, the expected data transfer rate is 225 MB/sec.

4

OCNWDAF Benchmarking Testing

This chapter describes various testing scenarios and the results obtained by running performance tests on Oracle Communications Networks Data Analytics Function.

A series of scripts is created to simulate the entire flow of CAP4C model execution and to extract the performance metrics of the models created. The scripts perform the following tasks:

- Inserts synthetic data into the database.
- Calls the Model Controller API to train the models and perform the prediction tasks.
- Retrieves the metrics from Jaeger.
- Deletes the synthetic data in the database.

The table below displays the expected performance metrics (per model), on completion of the flow of CAP4C model executions:

Table 4-1 Expected Performance Metrics

Metric Name	Description
UE Mobility models trained	6
UE Mobility model trained max time	275202.415ms
UE Mobility model trained avg time	56976.9326ms
UE Mobility model trained min time	2902.839ms
NF Load models trained	5
NF Load model trained max time	9606.666 ms
NF Load model trained avg time	8852.0124 ms
NF Load model trained min time	8272.789 ms
Abnormal behavior models trained	8
Abnormal behavior m model trained max time	8297.173 ms
Abnormal behavior m model trained avg time	7504.53 ms
Abnormal behavior m model trained min time	7094.006 ms

Script Execution

The following two scripts are created to simulate the CAP4C model execution and to extract the performance metrics of the models:

- SQL script to insert data and call the Model Controller API.
- Script to extract Jaeger Metrics and delete synthetic data from the database.

A docker image is provided with the scripts, deploy the image in the Kubernetes cluster where all the OCNWDAF services are running. The docker image is provided in the images folder of OCNWDAF installer.

- To deploy and run the image create the values.yml file. To create the values.yml file, use the following content:

```
global:
  projectName: nwdaf-cap4c-initial-setup-script
  imageName: nwdaf-cap4c/nwdaf-cap4c-initial-setup-script
  imageVersion: 23.1.0.0.0
config:
  env:
    APPLICATION_NAME: nwdaf-cap4c-initial-setup-script
    APPLICATION_HOME: /app
deploy:
  probes:
    readiness:
      enabled: false
    liveness:
      enabled: false
```

- Run the following command:

```
$ helm install <deploy_name> <helm_chart> -f <path_values_file>/values.yml
-n <namespace_name>
```

For example:

```
$ helm install nwdaf-cap4c-initial-setup-script https://artifactory-
phx.oci.oraclecorp.com/artifactory/ocnwdaf-helm/nwdaf-cap4c-deployment-
template-23.1.0.tgz -f <path_values_file>/values.yml -n <namespace_name>
```

- A container will be running inside the Kubernetes cluster. Identify the container and note down the name of the container for reference in subsequent steps. Run the following command:

```
$ kubectl get pods -n <namespace_name>
```

For example:

NAME	READY	STATUS	RESTARTS	AGE
nwdaf-cap4c-initial-setup-script-deploy-64b8fbcd9-2vqf9	1/1			
Running	0	55s		

- Run the following command to access the container:

```
$ kubectl exec -n <namespace_name> <pod_name> -it bash
```

- Once inside the container, navigate to the path /app/performance. The scripts to be run are located in this path. Follow the steps below to run the scripts:
 - SQL Script to insert data / script to call model controller api:** This script handles the insertion of the synthetic data into the DB. Once all the tables are inserted a

process runs to call the Model Controller API. The models are generated and execution tasks are created to use the models. Run the script:

```
$ python3 performance/integration_script.py -h <host> -p <path> -t  
<type> -n <number_tests>
```

Table 4-2 Parameters

Parameter	Description	Default Value
-h	The Model controllers host name or address	localhost
-p	Path of the .csv files that have to create the request to controller	../integration/data/
-t	The files extension to read the data to generate payloads	CSV
-n	Number of tests flows that the script will do. The recommended value of number of tests to be performed per pod.	10

Note

If the parameters are not set, the script uses the default values.

Example:

```
$ python3 integration_script.py -h http://cap4c-model-  
controller.ocnwdaf-ns:8080 -p /app/performance/integration/data/ -t CSV  
-n 10
```

Sample output:

Figure 4-1 Sample Output

```

Model: ABNORMAL_BEHAVIOUR
Request type: EXECUTION
Models: 16
Min time: 2005.943ms
Max time: 10706.774ms
Avg time: 6298.1315ms
Request type: TRAIN
Models: 8
Min time: 7094.006ms
Max time: 8297.173ms
Avg time: 7504.525625ms
Model: NF_LOAD
Request type: EXECUTION
Models: 10
Min time: 3177.181ms
Max time: 6255.129ms
Avg time: 4704.9093ms
Request type: TRAIN
Models: 5
Min time: 8272.789ms
Max time: 9606.666ms
Avg time: 8852.0124ms

```

- **Script to extract Jaeger Metrics/Script to delete synthetic data from DB:** This script extracts the metrics and then deletes the dummy data from the DB. Run the script:

```
$ python3 performance/report_script.py -h <host> -p <port> -m
<options> -u <prefix> -y <types>
```

Table 4-3 Parameters

Parameter	Description	Default Value
-h	Jaeger host name or address	localhost
-p	Jaeger UI port	16686
-m	Available options: ABNORMAL_BEHAVIOUR, NF_LOAD.	all
-u	Set a URL prefix if needed, such as '/blurr7/jaeger'	NA
-y	Type of execution: TRAIN, EXECUTION, all.	all

Note

If the parameters are not set, the script uses the default values.

Example:

```
$ python report_script.py -t occne-tracer-jaeger-query.occne-infra -p
80 -u /blurr7/jaeger
```

Sample output:

Figure 4-2 Sample Output

```
Model: UE_MOBILITY
Request type: EXECUTION
Models: 0
Min time: 0.0ms
Max time: 0.0ms
Avg time: 0.0ms
Request type: TRAIN
Models: 8
Min time: 5564.09ms
Max time: 11002.851ms
Avg time: 8555.22675ms
```

Figure 4-3 Sample Output

```
Model: ABNORMAL_BEHAVIOUR
Request type: EXECUTION
Models: 16
Min time: 2005.943ms
Max time: 10706.774ms
Avg time: 6298.1315ms
Request type: TRAIN
Models: 8
Min time: 7094.006ms
Max time: 8297.173ms
Avg time: 7504.525625ms
Model: NF_LOAD
Request type: EXECUTION
Models: 10
Min time: 3177.181ms
Max time: 6255.129ms
Avg time: 4704.9093ms
Request type: TRAIN
Models: 5
Min time: 8272.789ms
Max time: 9606.666ms
Avg time: 8852.0124ms
```

ATS NWDAF Perfgo Performance Results

Below are the results for PerfGo tool to execute performance testing on ATS NWDAF:

- Create Subscription
- Update Subscription
- Delete Subscription

Create Subscription

Table 4-4 Create Subscription

Request Base	Total	Success	Failure	Rate	Latency	Average Rate	Average Latency
ue-mobility-create.create-ue-mob-statistics. [CallFlow]	622	417	194	16.0	734.3ms	9.6	1030.6ms
ue-mobility-create.create-ue-mob-predictions. [CallFlow]	637	430	196	11.0	749.6ms	9.8	996.0ms
abnormal-behaviour-create.create-ab-predictions. [CallFlow]	781	39	731	7.0	1145.5ms	12.1	806.0ms
abnormal-behaviour-create.create-ab-statistics. [CallFlow]	748	34	703	5.0	1201.1ms	11.6	830.4ms
slice-load-level-create.create-sll-statistics. [CallFlow]	295	32	252	13.0	860.6ms	4.6	2256.8ms
slice-load-level-create.create-sll-predictions. [CallFlow]	304	27	266	14.0	842.8ms	4.7	2177.7ms
nf-load-create.create-nf-load-predictions. [CallFlow]	691	247	434	9.0	813.7ms	10.6	911.7ms
nf-load-create.create-nf-load-statistics. [CallFlow]	705	260	434	11.0	805.9ms	10.9	892.0ms

Update Subscription

Table 4-5 Update Subscription

Request Base	Total	Success	Failure	Rate	Latency	Average Rate	Average Latency
ue-mobility-update.update-ue-mob. [CallFlow]	80	80	0	3.0	953.4ms	1.4	870.7ms
abnormal-behaviour-update.update-ab. [CallFlow]	80	80	0	3.0	577.1ms	1.5	555.8ms
slice-load-level-update.update-sll. [CallFlow]	70	70	0	2.0	4119.4ms	1.1	1441.4ms
nf-load-update.update-nf-load. [CallFlow]	73	73	0	2.0	610.3ms	1.3	552.4ms

Delete Subscription**Table 4-6 Delete Subscription**

Request Base	Total	Success	Failure	Rate	Latency	Average Rate	Average Latency
ue-mobility-delete.delete-ue-mob. [CallFlow]	80	80	0	6.0	799.4ms	1.4	611.2ms
abnormal-behaviour-delete.delete-ab. [CallFlow]	80	80	0	2.7	577.1ms	1.4	591.0ms
slice-load-level-delete.delete-sll. [CallFlow]	65	65	0	2.0	777.3ms	1.2	890.6ms
nf-load-delete.delete-nf-load. [CallFlow]	59	59	0	2.0	474.6ms	1.0	536.1ms