Release 6 Test Document of IEC Type 3: Android cloud native applications on Arm servers in edge

Introduction

Integrated Edge Cloud(IEC) is an Akraino approved blueprint family and part of Akraino Edge Stack, which intends to develop a fully integrated edge infrastructure solution, and the project is completely focused

towards Edge Computing. This open source software stack provides critical infrastructure to enable high performance, reduce latency, improve availability, lower operational overhead, provide scalability, address

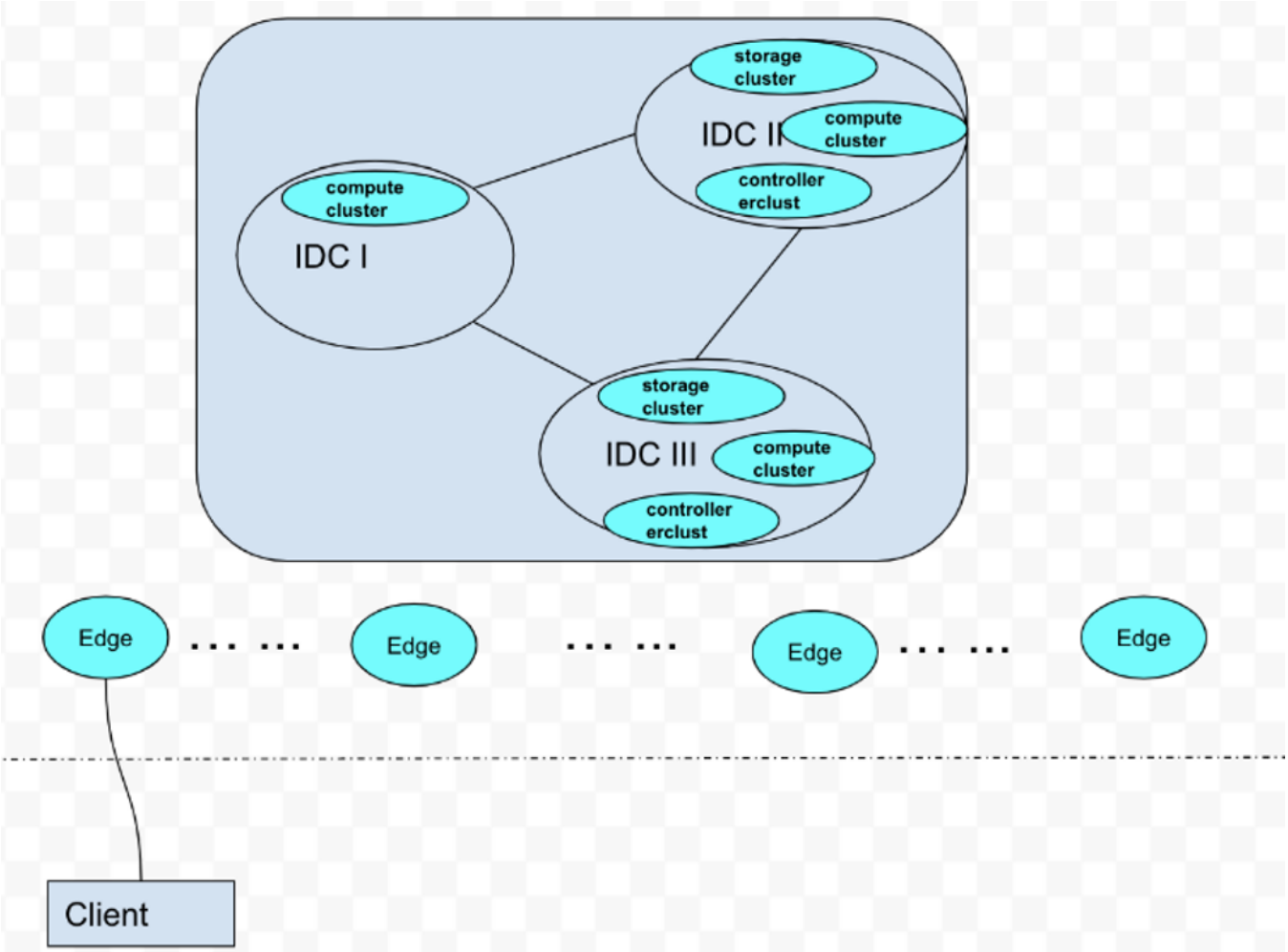
security needs, and improve fault management.

The first step test mainly focus on the Android system running on edge ARM Cloud environment and make sure the Android system available.

Akraino Test Group Information

Testing Working Group Resources

Test Architecture



As picture aboved show, an android phone (Client) connect to our Edge Android Cloud. We plan to test the functional completeness and performance:

> 1. *application operation on the client side by adb*
> 2. *deploy robox by k8s*
> 3. *system performace monitor by prometheus*

Test Bed

The testbed setup is shown in the below diagram.

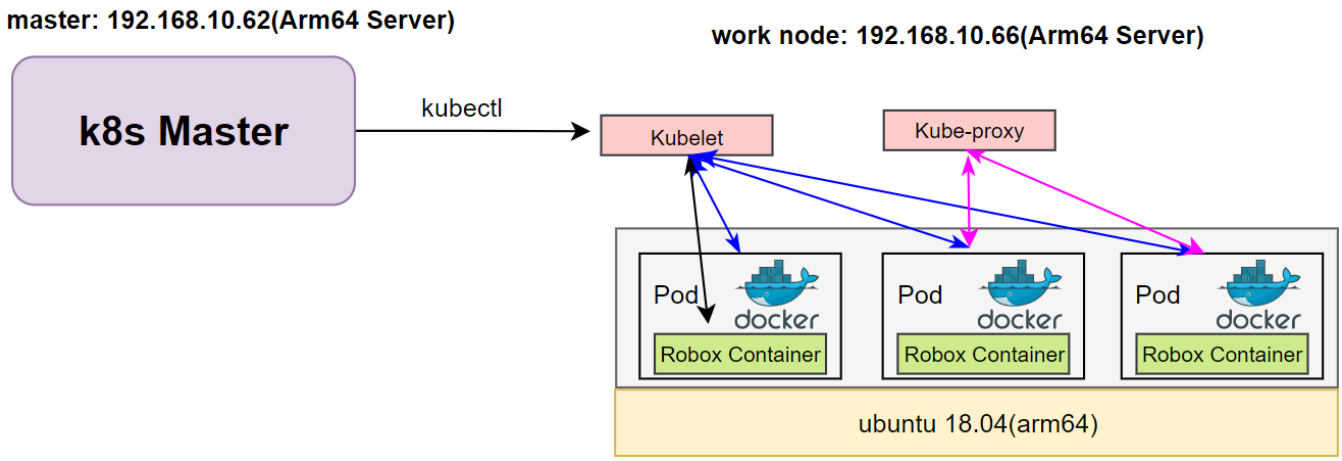


Figure1 Run Robox Through K8s

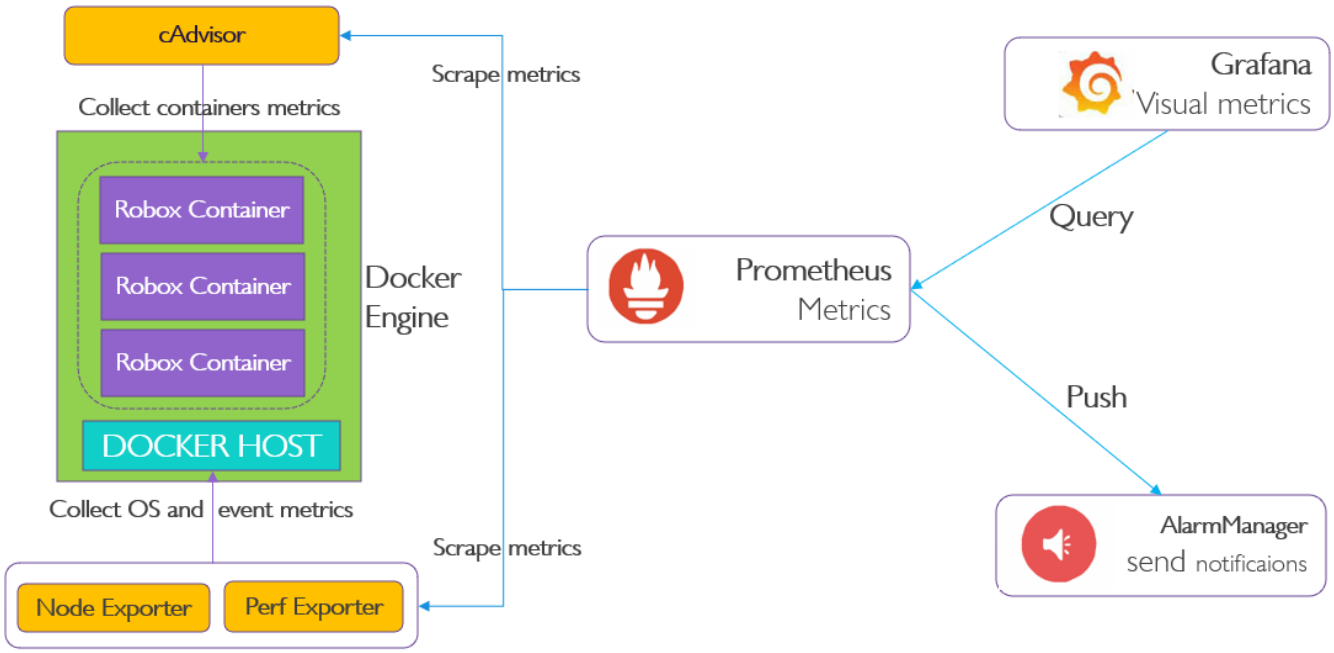


Figure2 Collect Data From Node

Test Environment

Hardware Requirements

2*arm64 server:

Arch	Aarch64
Processor model	1*Aarch64 processor, 1* Aarch64 processor,

RAM	16*DDR4-2933
Storage	10*2.5 inch SAS/SATA/SSD or 8*2.5 inch NVMe SSD
Network	1 onboard network card, each card supports 4*GE port or 4*10GE port or 4*25GE port
Power Supply	Power 100~240V AC240V DC

ARM Server satisfies the Arm Server Ready certified.

Software Perequisites

item	description	addition
os	ubuntu 18.04.3(key)	
robox	Android container	*https://github.com/lag-linaro/robox.git*
docker	container for android image	apt-get install docker.io

Components Version

Anbox	Run Android applications on any GNU/Linux operating system.	
Grafana	Compose and scale observability with one or all pieces of the stack	8.4.3
Prometheus	Cloud native system performance monitoring	2.34.0
K8s	container orchestration engine for automating deployment, scaling, and management of containerized applications	k8s: v1.23.5; kube-apiserver:v1.21.11 kube-scheduler:v1.21.11 kube-proxy:v1.21.11 etcd:3.4.13-0 coredns:v1.8.0

Bootup Basic components

We have cloned the iec repository code to github, the link is:

https://github.com/ysemi-computing/iec.git

then do as follow steps, all operations are on master node.

Step1: startup the k8s cluster by execute “deploy/compass/deployIEC.sh”

```
cd iec && bash deploy/compass/deployIEC.sh
```

Step2: mount the robox image and start the session_manager

```
ssh robox@192.168.10.66 bash iec/src/foundation/scripts/robox/loadimages.sh
ssh robox@192.168.10.66 bash iec/src/foundation/scripts/robox/sm_ctrl.sh
```

Step3: run some components for Cluster

```
ssh robox@192.168.10.66 bash iec/src/foundation/scripts/robox/ load_components.sh
```

Step4: run robox by K8S

```
bash iec/src/foundation/scripts/robox/test_robox.sh  a
```

Display data through different components

1. By kubectl

```
kubectl get node,pods,svc -o wide -n kube-system -n default

NAME      STATUS   ROLESAGE    VERSION   INTERNAL-IP     EXTERNAL-IP   OS-IMAGE   KERNEL-VERSION
node/master  Ready  control-plane,master 2d14h  v1.21.5  192.168.10.66   <none>      Ubuntu 18.04.6 LTS4.15.18          docker://20.10.14
node/work    Ready    <none>         2d14h   v1.21.5   192.168.10.62   <none>     Ubuntu 18.04.3 LTS   4.15.18          docker://20.10.14

NAME    READY   STATUS    RESTARTS   AGE     IP          NODE     NOMINATED NODE   READINESS GATES
pod/anbox-6c447fbd7-k8zl7   1/1     Running   0      76s     10.244.1.4   work     <none>          <none>
pod/nginx-c9zr9             1/1     Running   0     2d14h   10.244.1.3   work     <none>          <none>

NAME              TYPE       CLUSTER-IP     EXTERNAL-IP   PORT(S)         AGE     SELECTOR
service/anbox       NodePort       172.16.1.74    <none>       8888:31000/TCP          76s     app=android
service/kubernetes   ClusterIP   172.16.1.1     <none>       443/TCP          2d14h   <none>
service/nginx       NodePort    172.16.1.138   <none>       80:31778/TCP     2d14h   app=nginx
```

2. By Kuboard

Do as the install documentation, then deploy the kuboard

```
kubectl apply -f https://addons.kuboard.cn/kuboard/kuboard-v3-swr.yaml
```

login web browser, then switch to the Pods tab, it display as follow:

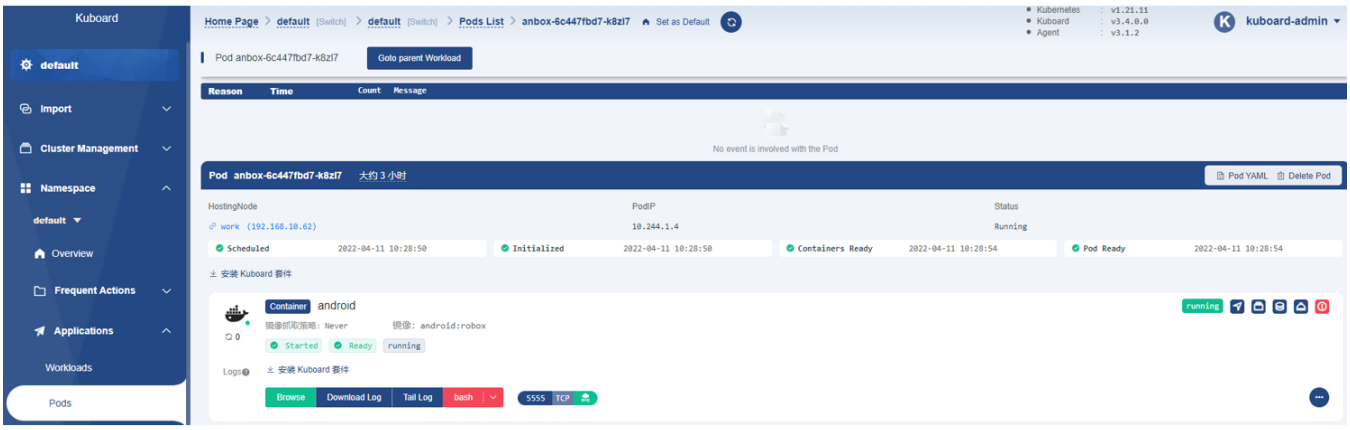


Figure3 Watch cluster pod status through kuboard

3. By Prometheus

login web browser, then switch to the Targets tab, it display as follow:

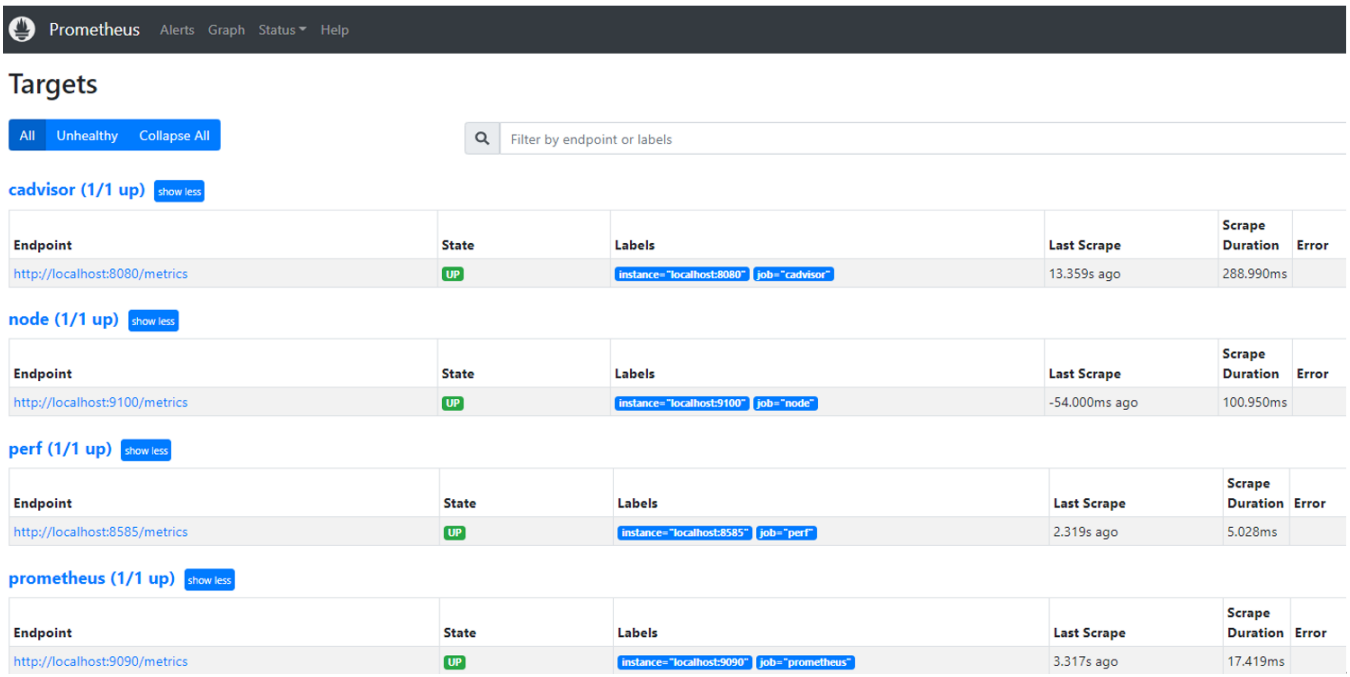


Figure4 Components on Prometheus

Then switch to the “Status” tab, the box is the event what we want to query, and type “perf_sched_sched_migrate_task”, After a few minutes, you can see

the monitoring curve as bellow:

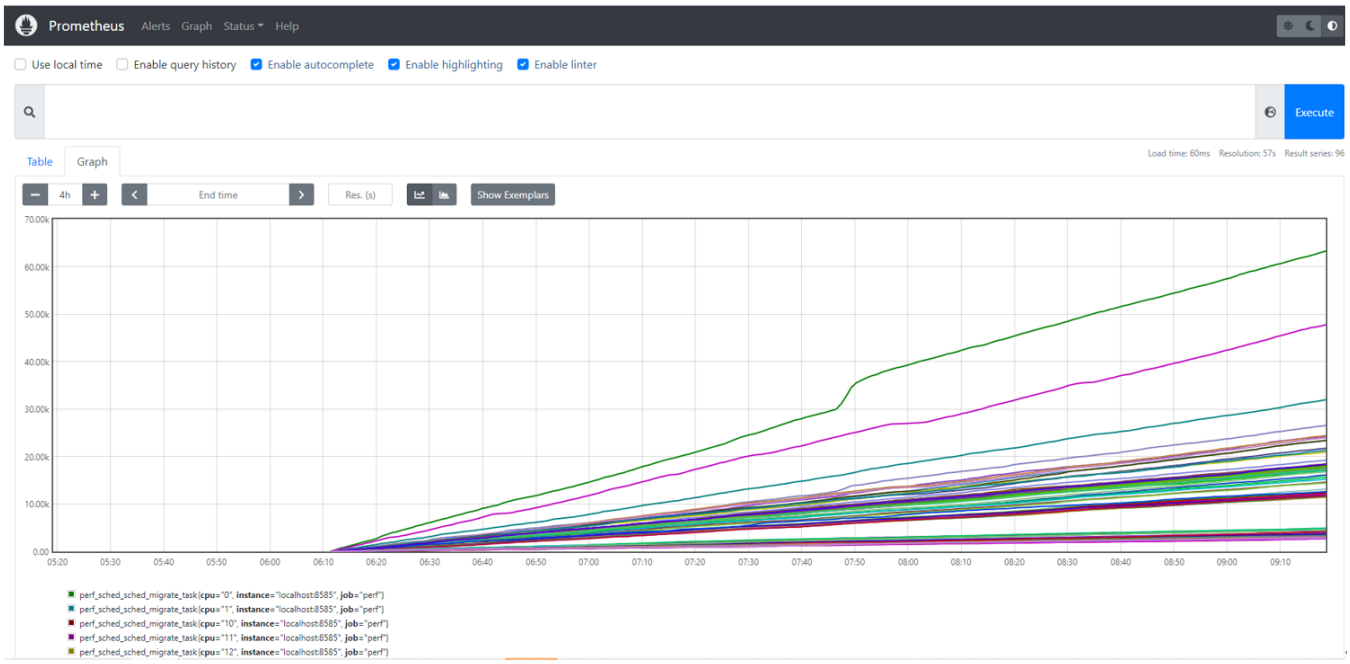


Figure5 Event Statistics On Prometheus

4. By grafana

step1: add data source

> *url: http://localhost:3000*
>
> *user: admin*
>
> *password: admin*
>
> *Click the below on dashboard*
>
> *Setting->Add Data Sources->Add data source*
>
> *Select prometheus, where URL http://192.168.10.62:9090 or http://localhost:9090 Click save&test.*

step2: import data source

> *Click the below on dashboard*
>
> *+ -> import -> enter dashboardid 1860(prometheus node is 1860)*
>
> *Just click load.*

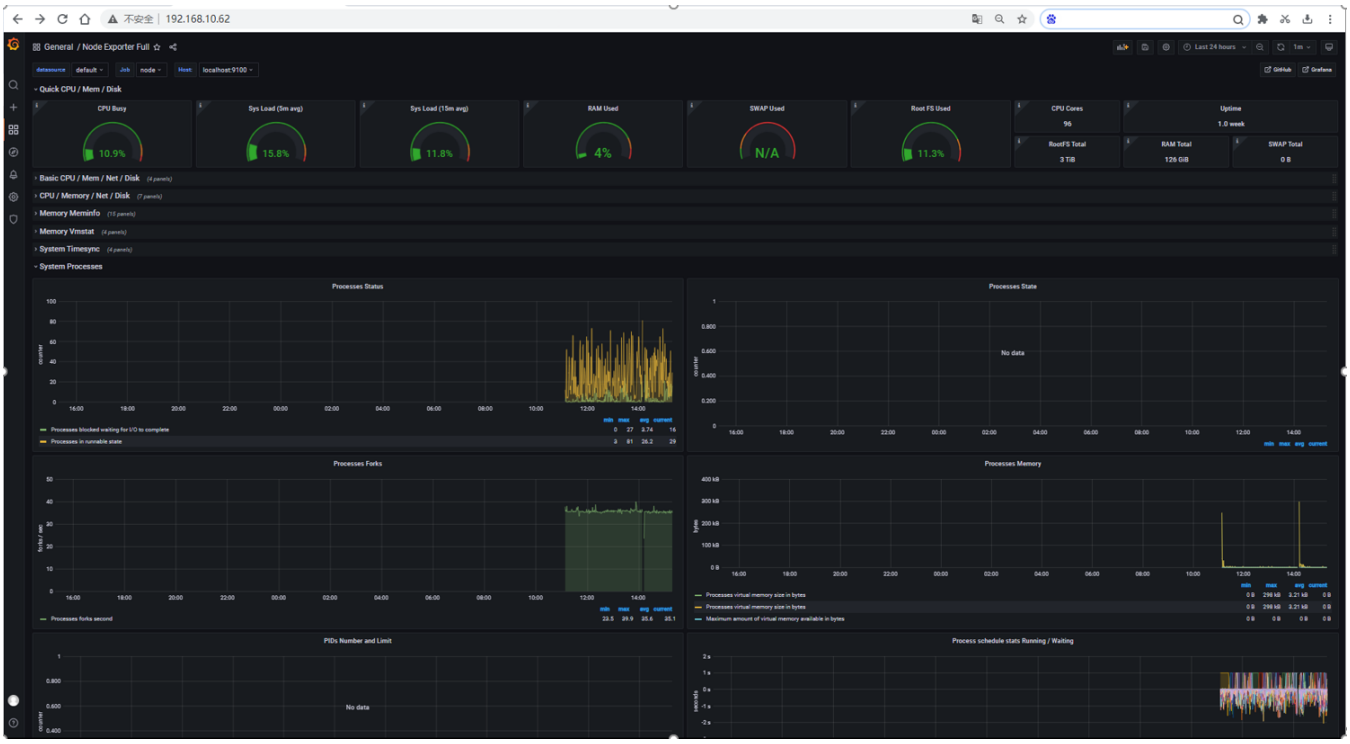


Figure6　Display Data Through Grafana

Test API description

The test is to evaluate the Android container available.

Thus we currently don't have any Test APIs provided.

Node Proformance Test

1. Install bomb squad on every Robox

Since the instance runs on the server, we need to use the remote tool vnc, so that we can interact through GUI.

To increase the workload, we need to start more robox instances.

Download bomb squad apk on googleplay and install via adb

> *adb connect nodeip:port*
>
> *adb install zdxfd.apk*

2. Start the bomb squad and do the settings

Click on the application icon, and then make the relevant settings, such as Auto test modeShow FPS.

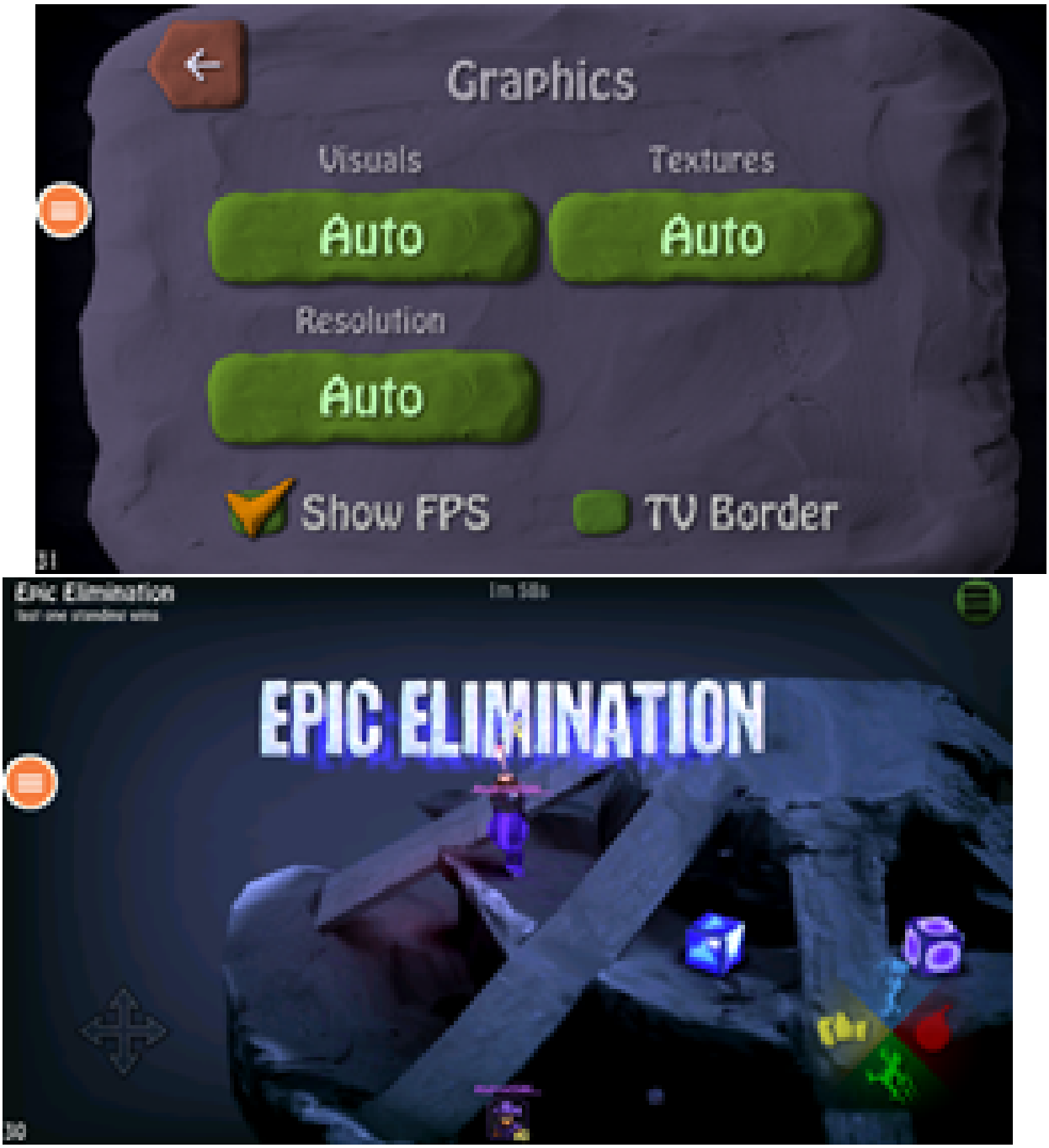


Figure7 Install Apk On Robox Container, Watched By VNC

We ran up to 20 instances on a single node, each instance ran an auto-tested bomb squad app, and we could watch the realtime fps.

3. Run perf in the background for event collection

When the node is running at full load, you can collect the corresponding system events through perf, and execute the following commands to collect different events.

```
sudo perf stat -e cycles,instructions,cache-references,cache-misses,bus-cycles -a sleep 10
```

```
sudo perf stat -e dTLB-load-misses,l1d_tlb_refill,iTLB-load-misses,l1i_tlb_refill sleep 10

sudo perf sched latency --sort runtime

sudo perf sched latency --sort switch
```

4. Generate flame graph

We save the events collected by perf locally, and then generate a flame graph, so that we can more intuitively see the system performance bottleneck.

```
sudo perf record -e cache-misses -ag -- sleep 10
sudo perf script -i perf.data |../FlameGraph/stackcollapse-perf.pl > out.perf-folded
cat out.perf-folded | ../FlameGraph/flamegraph.pl > perf_cache.svg

sudo perf record -e probe_libc:malloc -agR sleep 10
sudo perf script -i perf.data |../FlameGraph/stackcollapse-perf.pl > out.perf-folded
cat out.perf-folded | ../FlameGraph/flamegraph.pl > perf_malloc.svg
```

The flame graph display effect is as follows

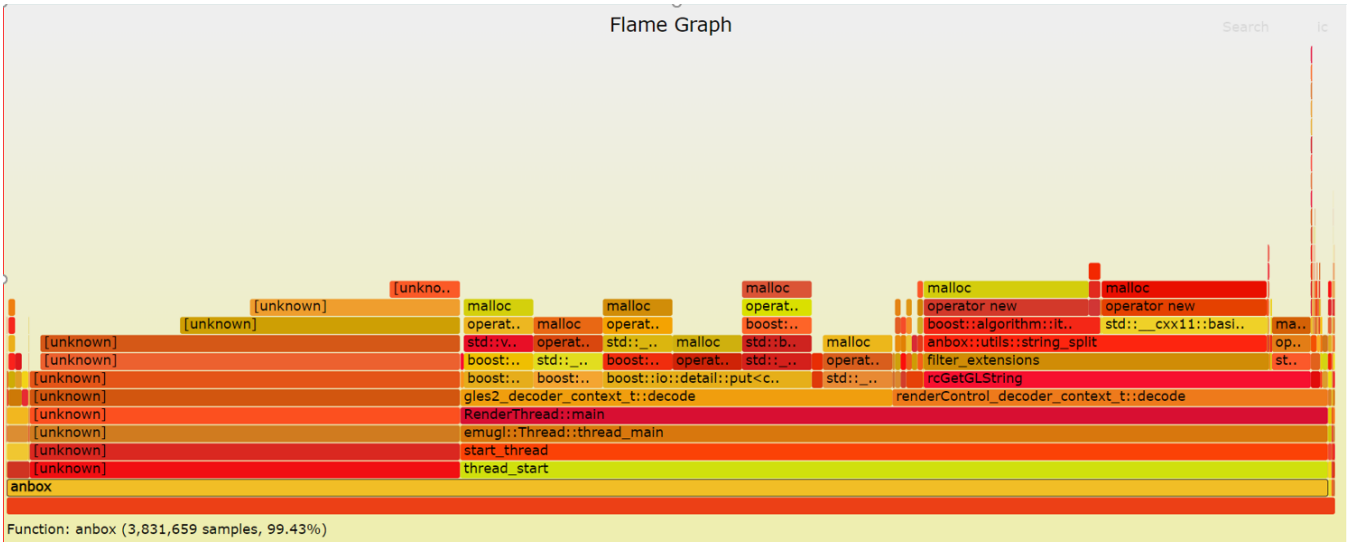


Figure8 Generate Flame Graph From Perf Events

Blueprint extension tests

The Test inputs

Test	Description	Result	Reference
Robox Image	Robox Image Auto build	PASS	Installation Doc
Robox Startup	Start Robox By Script	PASS	Installation Doc

App Installation	Install and run app on a robox	PASS	Current Doc
Edge Cluster Deployment	Deploy Edge K8S Clusters	Pass	Installation Doc
Deploy Robox	Run Robox By K8s	PASS	Installation Doc
Deploy Prometheus	Run Prometheus on Work node	PASS	Installation Doc
Deploy Grafana	Run Grafana on Work node	PASS	Installation Doc
Perf events	Run Perf Background to Fetch System Events	PASS	Current Doc
Flame graph	Generate Flame Graph	PASS	Current Doc

BluVal Tests

The Test inputs

BluVal Test Environment setup according to:

Bluval User Guide

Test Procedure

> 1. *Clone BluVal Validation Framework into a arm64 Server:*
> 2. *Copy .kube/config file and SSH key to the Test Machine*
> 3. *Configure validation environment:*

cat validation/bluval/bluval-robox.yaml

```
blueprint:
  name: robox
  layers:
    - os
    - docker
    - k8s
  # Any hardware some basic tests
  os: &os_robox
    -
      name: ltp
      what: ltp
      optional: "True"
    -
      name: cyclictest
      what: cyclictest
```

```
        optional: "True"
    -
        name: lynis
        what: lynis
        optional: "False"
    -
        name: vuls
        what: vuls
        optional: "False"
  docker: &docker_base
    -
        name: docker_bench
        what: docker_bench
        optional: "True"
  k8s: &k8s
    -
        name: conformance
        what: conformance
        optional: "False"
    -
        name: etcd_ha
        what: etcd_ha
        optional: "True"
    -
        name: kube-hunter
        what: kube-hunter
        optional: "False"
```

cat validation/bluval/volumes.yaml

```
volumes:
  ssh_key_dir:
    local: '/root/.ssh'
    target: '/root/.ssh'
  kube_config_dir:
    local: '/root/.kube/'
    target: '/root/.kube/'
  custom_variables_file:
    local: '/opt/akraino/validation/tests/variables.yaml'
```

```
        target: '/opt/akraino/validation/tests/variables.yaml'
    blueprint_dir:
        local: '/opt/akraino/validation/bluval'
        target: '/opt/akraino/validation/bluval'
    results_dir:
        local: '/opt/akraino/results'
        target: '/opt/akraino/results'
    openrc:
        local: ''
        target: '/root/openrc'
layers:
    common:
        - custom_variables_file
        - blueprint_dir
        - results_dir
    hardware:
        - ssh_key_dir
    os:
        - ssh_key_dir
    networking:
        - ssh_key_dir
    docker:
        - ssh_key_dir
    k8s:
        - ssh_key_dir
        - kube_config_dir
    k8s_networking:
        - ssh_key_dir
        - kube_config_dir
    openstack:
        - openrc
    sds:
    sdn:
    vim:
```

cat validation/tests/variables.yaml

```
### Input variables cluster's master host
host: 192.168.10.66            # cluster's master host address
username: root          # login name to connect to cluster
```

```
password: 123456        # login password to connect to cluster
ssh_keyfile: /root/.ssh/id_rsa # Identity file for authentication
```

Since lynis execution requires root privileges, the username here needs to be specified as root

1. Run BluVal Robot:

bash validation/bluval/blucon.sh robox

1. Install LFTOOLS:

```
sudo apt install python3-pip
sudo python3 -m pip install -U pip
sudo python3 -m pip install -U setuptools
sudo -H pip3 install --ignore-installed PyYAML
pip3 install lftools
```

2. Push BluVal Results to Akraino Nexus

```
 # Create .netrc file
vi ~/.netrc
machine nexus.akraino.org login ysemicn password xxx

# Archive log files
zip -r results.zip ./results

# Push logs to Nexus
lftools deploy nexus-zip https://nexus.akraino.org logs ysemi/job/v1 results.zip
```

Expected output:

```
 Loading KWallet
Loading SecretService
Loading Windows
Loading chainer
Loading macOS
Zip file upload complete.
```

Test Results

https://nexus.akraino.org/content/sites/logs/ysemi/job/v1/ak_results/

Vuls

Vuls Report

Generated
20220418 10:42:24 UTC+08:00
3 hours 4 minutes ago

Summary Information

Status:	All critical tests passed
Start Time:	20220418 10:41:21.798
End Time:	20220418 10:42:24.886
Elapsed Time:	00:01:03.088
Log File:	log.html

Test Statistics

Total Statistics	Total	Pass	Fail	Elapsed	Pass / Fail
Critical Tests	0	0	0	00:00:00	
All Tests	1	0	1	00:01:01	

Statistics by Tag	Total	Pass	Fail	Elapsed	Pass / Fail
non-critical (non-critical)	1	0	1	00:01:01	

Statistics by Suite	Total	Pass	Fail	Elapsed	Pass / Fail
Vuls	1	0	1	00:01:03	
Vuls . Vuls	1	0	1	00:01:03	

Test Details

Totals | Tags | Suites | Search

Type:
- Critical Tests
- All Tests

Lynis

Lynis Report

Generated
20220417 23:45:45 UTC+08:00
14 hours 2 minutes ago

Summary Information

Status:	All critical tests passed
Start Time:	20220417 23:37:18.274
End Time:	20220417 23:45:45.117
Elapsed Time:	00:08:26.843
Log File:	log.html

Test Statistics

Total Statistics	Total	Pass	Fail	Elapsed	Pass / Fail
Critical Tests	0	0	0	00:00:00	
All Tests	1	0	1	00:08:23	

Statistics by Tag	Total	Pass	Fail	Elapsed	Pass / Fail
non-critical (non-critical)	1	0	1	00:08:23	

Statistics by Suite	Total	Pass	Fail	Elapsed	Pass / Fail
Lynis	1	0	1	00:08:27	
Lynis . Lynis	1	0	1	00:08:27	

Test Details

Totals | Tags | Suites | Search

Type:
- Critical Tests
- All Tests

K8S Conformance

Conformance Report

Generated
20220418 11:49:12 UTC+08:00
2 hours 1 minute ago

Summary Information

Status:	1 critical test failed
Start Time:	20220418 11:47:59.486
End Time:	20220418 11:49:12.854
Elapsed Time:	00:01:13.368
Log File:	log.html

Test Statistics

Total Statistics	Total	Pass	Fail	Elapsed	Pass / Fail
Critical Tests	1	0	1	00:01:13	
All Tests	1	0	1	00:01:13	

Statistics by Tag	Total	Pass	Fail	Elapsed	Pass / Fail
non-critical (non-critical)	0	0	0	00:00:00	

Statistics by Suite	Total	Pass	Fail	Elapsed	Pass / Fail
Conformance	1	0	1	00:01:13	
Conformance . Conformance	1	0	1	00:01:13	

Test Details

Totals | Tags | Suites | Search

Type:
- Critical Tests
- All Tests

Kube-Hunter

Kube-Hunter Report

Generated
20220418 11:49:45 UTC+08:00
2 hours 2 minutes ago

Summary Information

Status:	All critical tests passed
Start Time:	20220418 11:49:17.235
End Time:	20220418 11:49:45.479
Elapsed Time:	00:00:28.244
Log File:	log.html

Test Statistics

Total Statistics	Total	Pass	Fail	Elapsed	Pass / Fail
Critical Tests	1	1	0	00:00:00	
All Tests	3	1	2	00:00:28	

Statistics by Tag	Total	Pass	Fail	Elapsed	Pass / Fail
non-critical (non-critical)	2	0	2	00:00:28	

Statistics by Suite	Total	Pass	Fail	Elapsed	Pass / Fail
Kube-Hunter	3	1	2	00:00:28	
Kube-Hunter . Kube-Hunter	3	1	2	00:00:28	

Test Details

Totals | Tags | Suites | Search

Type:
- Critical Tests
- All Tests

Test Dashboards

Single pane view of how the test score looks like for the Blue print.

Test Group	Total Tests	Pass	Fail
Blueprint Extension Tests	10	10	0
Vuls	1	1	0
Lynis	1	1	0
K8S Conformance	1	0	1
Kube-Hunter	1	1	0

Additional Testing

N/A

Bottlenecks/Errata

N/A