DOCA UROM Service Guide

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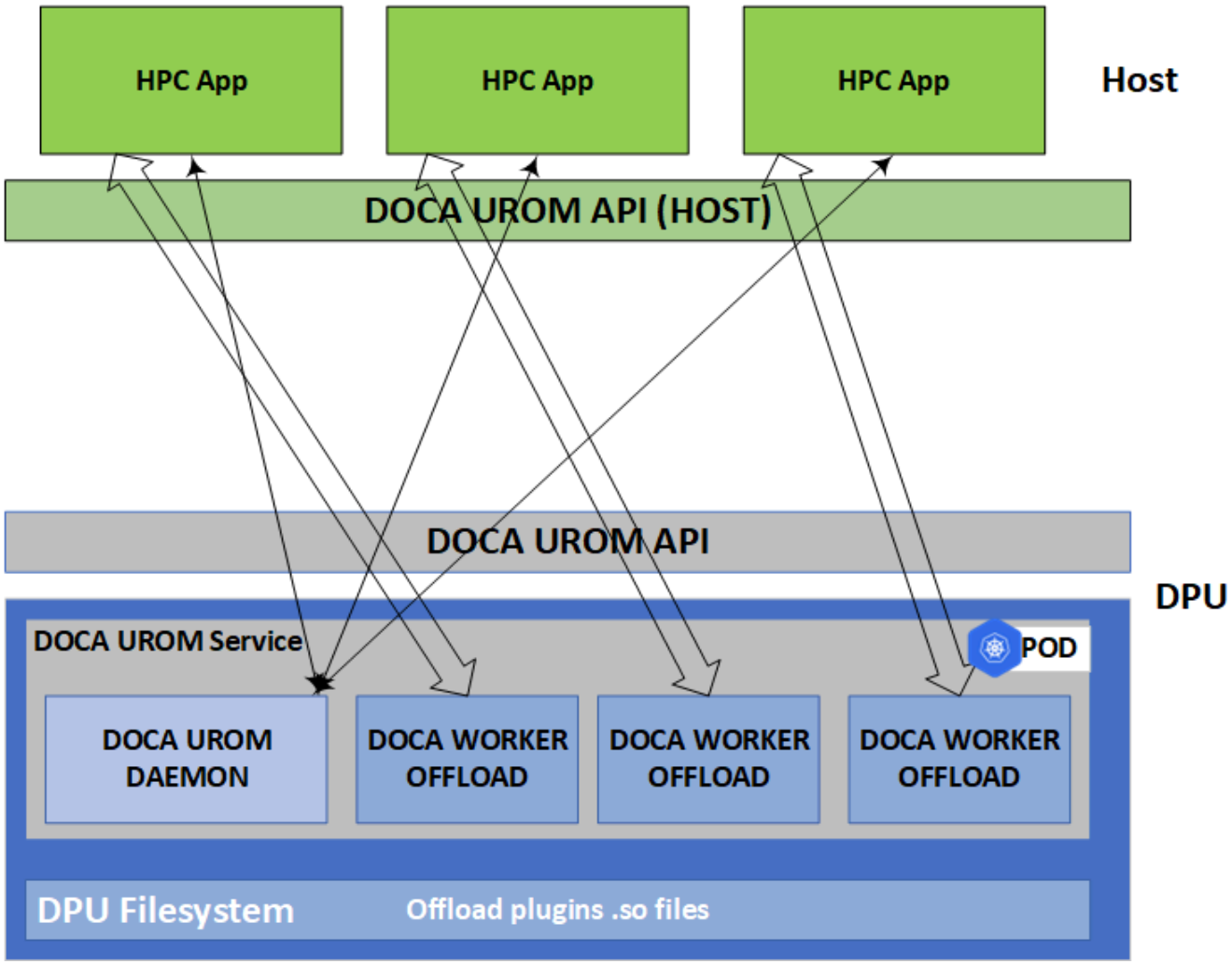
This guide provides instructions on how to use the DOCA UROM Service on top of the NVIDIA® BlueField® networking platform.

Introduction

The DOCA UROM service provides a framework for offloading significant portions of HPC software stack directly from the host and to the BlueField device.

Using a daemon, the service handles the discovery of resources, the coordination between the host and BlueField, and the spawning, management, and teardown of the BlueField workers themselves.



The first step in initiating an offload request involves the UROM host application establishing a connection with the UROM service. Upon receiving the plugin discovery command, the UROM service responds by providing the application with a list of plugins available on the BlueField. The application then attaches the plugin IDs that correspond to the desired workers to their network identifiers. Finally, the service triggers UROM worker

plugin instances on the BlueField to execute the parallel computing tasks. Within the service's Kubernetes pod, workers are spawned by the daemon in response to these offload requests. Each computation can utilize either a single library or multiple computational libraries.

Requirements

Before deploying the UROM service container, ensure that the following prerequisites are satisfied:

- Allocate huge pages as needed by DOCA:

```
$ echo '2048' | sudo tee -a /sys/kernel/mm/hugepages/hugepages-2048kB/nr_hugepages
$ sudo mkdir /mnt/huge
$ sudo mount -t hugetlbfs -o pagesize=2M nodev /mnt/huge
```

Service Deployment

For information about the deployment of DOCA containers on top of the BlueField, refer to the NVIDIA BlueField Container Deployment Guide.

Service-specific configuration steps and deployment instructions can be found under the service's container page .

Description

Plugin Discovery and Reporting

When the application initiates a connection request to the DOCA UROM Service, the daemon reads the `UROM_PLUGIN_PATH` environment variable. This variable stores directory paths to `.so` files for the plugins with multiple paths separated by semicolons. The daemon scans these paths sequentially and tries loading each `.so` file. Once the daemon finishes the scan, it reports the available BlueField plugins to the host application.

The host application gets the list of available plugins as a list of `doca_urom_service_plugin_info` structures:

```
struct doca_urom_service_plugin_info {
    uint64_t id;          // Unique ID to send commands to the plugin
    uint64_t version;     // Plugin version
    char plugin_name[DOCA_UROM_PLUGIN_NAME_MAX_LEN]; // .so filename
};
```

The UROM daemon is responsible for generating unique identifiers for the plugins, which are necessary to enable the worker to distinguish between different plugin tasks.

Loading Plugin in Worker

During the spawning of UROM workers by the UROM daemon, the daemon attaches a list of desired plugins in the worker command line. Each plugin is passed in a format of `so_path:id`.

As part of worker bootstrapping, the flow iterates all `.so` files and tries to load them by using `dlopen` system call and look for `urom_plugin_get_iface()` symbol to get the plugin operations interface.

Yaml File

The `.yaml` file downloaded from NGC can be easily edited according to users' needs:

```
 env:
      # Service-Specific command line arguments
      - name: SERVICE_ARGS
        value: "-l 60 -m 4096"
      - name: UROM_PLUGIN_PATH
        value:
"/opt/mellanox/doca/samples/doca_urom/plugins/worker_sandbox/;/opt/mellanox/doca/samples/doca_urom/
```

- The `SERVICE_ARGS` are the runtime arguments received by the service:
  - `-l`, `--log-level <value>` – sets the (numeric) log level for the program `<10=DISABLE, 20=CRITICAL, 30=ERROR, 40=WARNING, 50=INFO, 60=DEBUG, 70=TRACE>`
  - `--sdk-log-level` – sets the SDK (numeric) log level for the program `<10=DISABLE, 20=CRITICAL, 30=ERROR, 40=WARNING, 50=INFO, 60=DEBUG, 70=TRACE>`
  - `-m`, `--max-msg-size` – specify UROM communication channel maximum message size
- The `UROM_PLUGIN_PATH` is an env variable that stores directory paths to `.so` files for the plugins

For each plugin on the BlueField, it is necessary to add a volume mount inside the service container. For example:

```
volumes:
  - name: urom-sandbox-plugin
    hostPath:
      path:
/opt/mellanox/doca/samples/doca_urom/plugins/worker_sandbox
      type: DirectoryOrCreate
...
volumeMounts:
    - mountPath:
/opt/mellanox/doca/samples/doca_urom/plugins/worker_sandbox
      name: urom-sandbox-plugin
```

Troubleshooting

When troubleshooting a container deployment issues, it is highly recommended to follow the deployment steps and tips found in the "Review Container Deployment" section of the DOCA Container Deployment Guide .

One could also check the `/var/log/doca/urom` log files for more details about the running cycles of service components (daemon and workers).

The log file name for workers is `urom_worker_<pid>_dev.log` and for the daemon it is `urom_daemon_dev.log`.

Pod is Marked as "Ready" and No Container is Listed

Error

When deploying the container, the pod's STATE is marked as `Ready` and an image is listed, however, no container can be seen running:

```
$ sudo crictl pods
POD ID              CREATED             STATE               NAME
NAMESPACE           ATTEMPT             RUNTIME
3162b71e67677           4 seconds ago       Ready
doca-urom-my-dpu                            default
0                   (default)

$ sudo crictl images
IMAGE                                               TAG
IMAGE ID            SIZE
k8s.gcr.io/pause                                    3.2
    2a060e2e7101d                   487kB
nvcr.io/nvidia/doca/doca_urom             1.0.0-doca2.7.0
2af1e539eb7ab       86.8MB

$ sudo crictl ps
CONTAINER           IMAGE               CREATED             STATE
NAME                     ATTEMPT             POD ID
POD
```

Solution

In most cases, the container did start but immediately exited. This could be checked using the following command:

```
$ sudo crictl ps -a
CONTAINER           IMAGE               CREATED             STATE
NAME                ATTEMPT             POD ID
POD
556bb78281e1d       2af1e539eb7ab       6 seconds ago
Exited              doca-urom           1
3162b71e67677       doca-urom-my-dpu
```

Should the container fail (i.e., reporting a state of `Exited`), it is recommended to examine the UROM's main log at `/var/log/doca/urom/urom_daemon_dev.log`.

In addition, for a short period of time after termination, the container logs could also be viewed using the container's ID:

```
$ sudo crictl logs 556bb78281e1d
...
```

Pod is Not Listed

Error

When placing the container's YAML file in the Kubelet's input folder, the service pod is not listed in the list of pods:

```
$ sudo crictl pods
POD ID              CREATED             STATE               NAME
NAMESPACE           ATTEMPT             RUNTIME
```

Solution

In most cases, the pod has not started because of the absence of the requested hugepages. This can be verified using the following command:

```
$ sudo journalctl -u kubelet -e. . .
Oct 04 12:12:19 <my-dpu> kubelet[2442376]: I1004 12:12:19.905064
2442376 predicate.go:103] "Failed to admit pod, unexpected error while attempting to
recover from admission failure" pod="default/doca-urom-service-<my-dpu>" err="preemption: error
finding a set of pods to preempt: no set of running pods found to reclaim resources: [(res: hugepages-2Mi,
q: 104563999874), ]"
```