



NVIDIA DOCA Simple Forward VNF

Application

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Chapter 1. Introduction

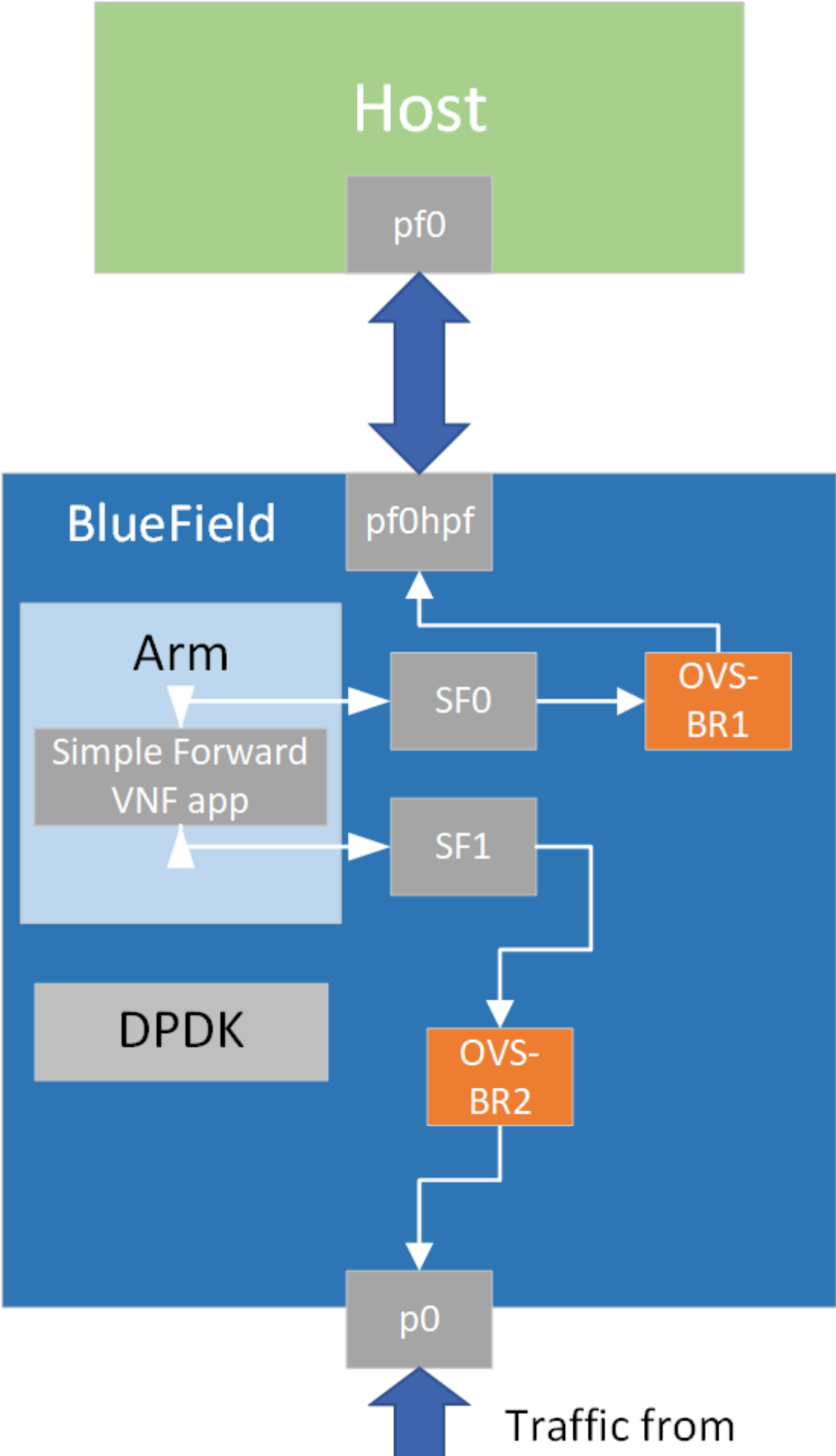
Simple forward is a forwarding application which takes VXLAN traffic from a single RX port and transmits it on a single TX port.

For a packet received on an RX port, simple forward will create a flow based on the packet's tunnel and 5-tuples. For the following packets with the same key, simple forward checks the packet's keys. If it finds that the packet matches the existing flow, then it does not create a new flow. Otherwise, a new flow is created. And then the packets are forwarded on the other port.

Simple forward should be run with dual ports. By using a traffic generator, the RX port receives the VXLAN packets and forwarding forwards them back to the traffic generator.

Chapter 2. System Design

The following diagram illustrates simple forward's packet flows. It receives traffic coming from the wire and passes it to the other port.



Chapter 3. Application Architecture

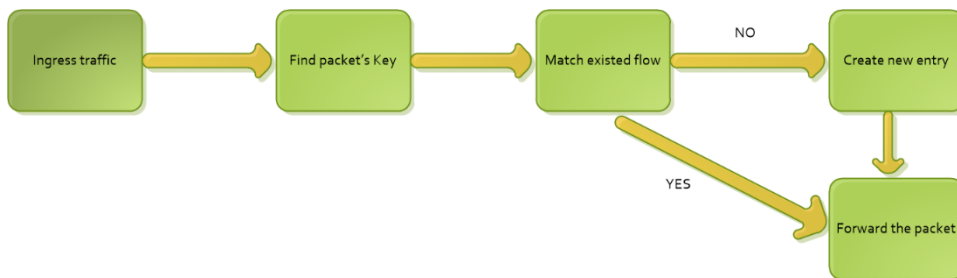
Simple forward first initializes DPDK, after which the application handles the incoming packets.

The following diagram illustrates the initialization process.



1. `Init_DPDK` – EAL init, parse argument from command line and register signal.
2. `Start port` – `mbuf_create`, `dev_configure`, rx/tx/hairpin queue setup and start the port.
3. `simple_fwd INIT` – create flow tables, build default forward pipes.

The following diagram illustrates how to process the packet.



1. Based on the packet's info, find the key values (e.g. src/dst IP, src/dst port, etc).
2. Traverse the inner flow tables, check if the keys exist or not.
 - ▶ If yes, update inner counter
 - ▶ If no, a new flow table is added and new pipes are configured on the DPU
3. Forward the packet to the other port.

Chapter 4. DOCA Libraries

This application leverages the [DOCA Flow Library](#).

Chapter 5. Configuration Flow

1. Parse application argument.

```
doca_argp_init();
```

- a). Initialize arg parser resources.
- b). Register DOCA general flags.

```
register_simple_fwd_params();
```
- c). Register simple fwd application flags.

```
doca_argp_start();
```
- d). Parse DPDK flags and call `rte_eal_init()` function.
- e). Parse APP flags.

2. DPDK port initialization and start.

```
dpdk_init();
```

- a). Initialize DPDK ports.
- b). Create mbuf pool using `rte_pktmbuf_pool_create`
- c). Driver initialization – use `rte_eth_dev_configure` to configure the number of queues
- d). Rx/Tx queue initialization – use `rte_eth_rx_queue_setup` and `rte_eth_tx_queue_setup` to initialize the queues
- e). Rx hairpin queue initialization – use `rte_eth_rx_hairpin_queue_setup` to initialize the queues
- f). Start the port using `rte_eth_dev_start`

3. Simple forward initialization.

```
simple_fwd_init();
```

- a). `simple_fwd_create_ins` - create flow tables using `simple_fwd_ft_create`
- b). `simple_fwd_init_ports_and_pipes` – initialize DOCA port using `simple_fwd_init_doca_port` and build default pipes for each port.

4. Main loop.

```
simple_fwd_process_pkts();
```

- a). Receive packets using `rte_eth_rx_burst` in a loop
- b). Process packets using `simple_fwd_process_offload`
- c). Transmit the packets on the other port by calling `rte_eth_tx_burst`. Or free the packet mbuf if `rx_only` is set to true.

5. Process packets.

```
simple_fwd_process_offload();
```

- a). Parse the packet's `rte_mbuf` using `simple_fwd_pkt_info`.
 - b). Handle the packet using `simple_fwd_handle_packet`. If the packet's key does not match the existed the flow entry, create a new flow entry and PIPE using `simple_fwd_handle_new_flow`. Otherwise, increase the total packet's counter.
6. Simple forward destroy.
`simple_fwd_destroy();`
 7. Simple forward close port and clean the flow resources.
`dpdk_fini();`
 8. Arg parser destroy.
`doca_argp_destroy();`
 - ▶ Free DPDK resources by call `rte_eal_cleanup()` function.

Chapter 6. Running Application

1. Refer to the following documents:

- ▶ [NVIDIA DOCA Installation Guide](#) for details on how to install BlueField-related software.
- ▶ [NVIDIA DOCA Troubleshooting Guide](#) for any issue you may encounter with the installation, compilation, or execution of DOCA applications.

2. The simple forward binary is located under `/opt/mellanox/doca/applications/simple_fwd_vnf/bin/doca_simple_fwd_vnf`. To build all the applications together, Run:

```
cd /opt/mellanox/doca/applications/  
meson build  
ninja -C build
```

3. To build the simple forward sample only:

a). Edit the following flags in `/opt/mellanox/doca/applications/meson_option.txt`:

- ▶ Set `enable_all_applications` to `false`
- ▶ Set `enable_simple_fwd_vnf` to `true`

b). Run the commands in step 2.



Note: `doca_simple_fwd_vnf` is created under `./build/simple_fwd_vnf/src/`.

Application usage:

```
Usage: doca_simple_forward_vnf [DPDK Flags] -- [DOCA Flags] [Program Flags]  
DOCA Flags:  
-h, --help                Print a help synopsis  
-v, --version             Print program version information  
-l, --log-level           Set the log level for the app <CRITICAL=0,  
DEBUG=4>  
Program Flags:  
-t, --stats-timer <time> Set interval to dump stats information  
-q, --nr-queues <num>   Set queues number  
-r, --rx-only            Set rx only  
-o, --hw-offload        Set hw offload  
-hq, --hairpinq         Set forwarding to hairpin queue
```

```
-a, --age-thread          Start thread do aging
```

Note: For additional information on available flags for DPDK, use `-h` before the `--` separator:

```
/opt/mellanox/doca/applications/simple_fwd_vnf/bin/doca_simple_fwd_vnf -h
```

Note: For additional information on the application, use `-h` after the `--` separator:

```
/opt/mellanox/doca/applications/simple_fwd_vnf/bin/doca_simple_fwd_vnf --
-h
```

4. Running the application on BlueField:

► Pre-run setup:

- a). The simple forward example is based on DPDK libraries. Therefore, the user is required to provide DPDK flags, and allocate huge pages.

```
echo 2048 > /sys/kernel/mm/hugepages/hugepages-2048kB/nr_hugepages
```

- b). Make sure the RegEx engine is active:

```
systemctl status mlx-regex
```

If the status is inactive (Active: failed), run:

```
systemctl start mlx-regex
```

► CLI example for running the app:

```
/opt/mellanox/doca/applications/simple_fwd_vnf/bin/doca_simple_fwd_vnf -a
auxiliary:mlx5_core.sf.4 -a auxiliary:mlx5_core.sf.5 -- -l 4
```

Note: The flag `-a auxiliary:mlx5_core.sf.4 -a auxiliary:mlx5_core.sf.5` is mandatory for proper usage of the application. Modifying this flag results unexpected behavior as only 2 ports are supported. The SF number is arbitrary and configurable.

Note: SFs must be enabled according to [Scalable Function Setup Guide](#).

5. Running the application on the host, CLI example:

```
doca_simple_fwd_vnf -a 04:00.3 -a 04:00.4 -- -l 4
```

Note: Refer to section "Running DOCA Application on Host" in [NVIDIA DOCA Virtual Functions User Guide](#).

6. To run `doca_simple_fwd_vnf` using a JSON file:

```
doca_simple_fwd_vnf --json [json_file]
```

For example:

```
cd /opt/mellanox/doca/applications/simple_fwd_vnf/bin
./doca_simple_fwd_vnf --json simple_fwd_params.json
```

Chapter 7. Arg Parser DOCA Flags

Refer to [NVIDIA DOCA Arg Parser User Guide](#) for more information.

Flag Type	Short Flag	Long Flag/JSON Key	Description	JSON Content
DPDK Flags	a	devices	Add a PCIe device into the list of devices to probe	<pre>"devices": [{"device": "sf", "id": "4", "sft": true}, {"device": "sf", "id": "5", "sft": true},]</pre>
General Flags	l	log-level	Set the log level for the application: <ul style="list-style-type: none">▶ CRITICAL=0▶ ERROR=1▶ WARNING=2▶ INFO=3▶ DEBUG=4	<pre>"log-level": 4</pre>
	v	version	Print program version information	N/A

Flag Type	Short Flag	Long Flag/JSON Key	Description	JSON Content
	h	help	Print a help synopsis	N/A
Program Flags	t	stats-timer	Set interval to dump stats information	"stats-timer": 2
	q	nr-queues	Set queues number	"nr-queues": 4
	r	rx-only	Set rx only	"rx-only": false
	o	hw-offload	Set HW offload	"hw-offload": false
	hq	hairping	Set forwarding to hairpin queue	"hairping": false
	a	age-thread	Start thread do aging	"age-thread": false

Chapter 8. References

- ▶ `/opt/mellanox/doca/applications/simple_fwd_vnf/src/simple_fwd_vnf.c`

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