



# NVIDIA DOCA Simple Forward VNF

Reference 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.

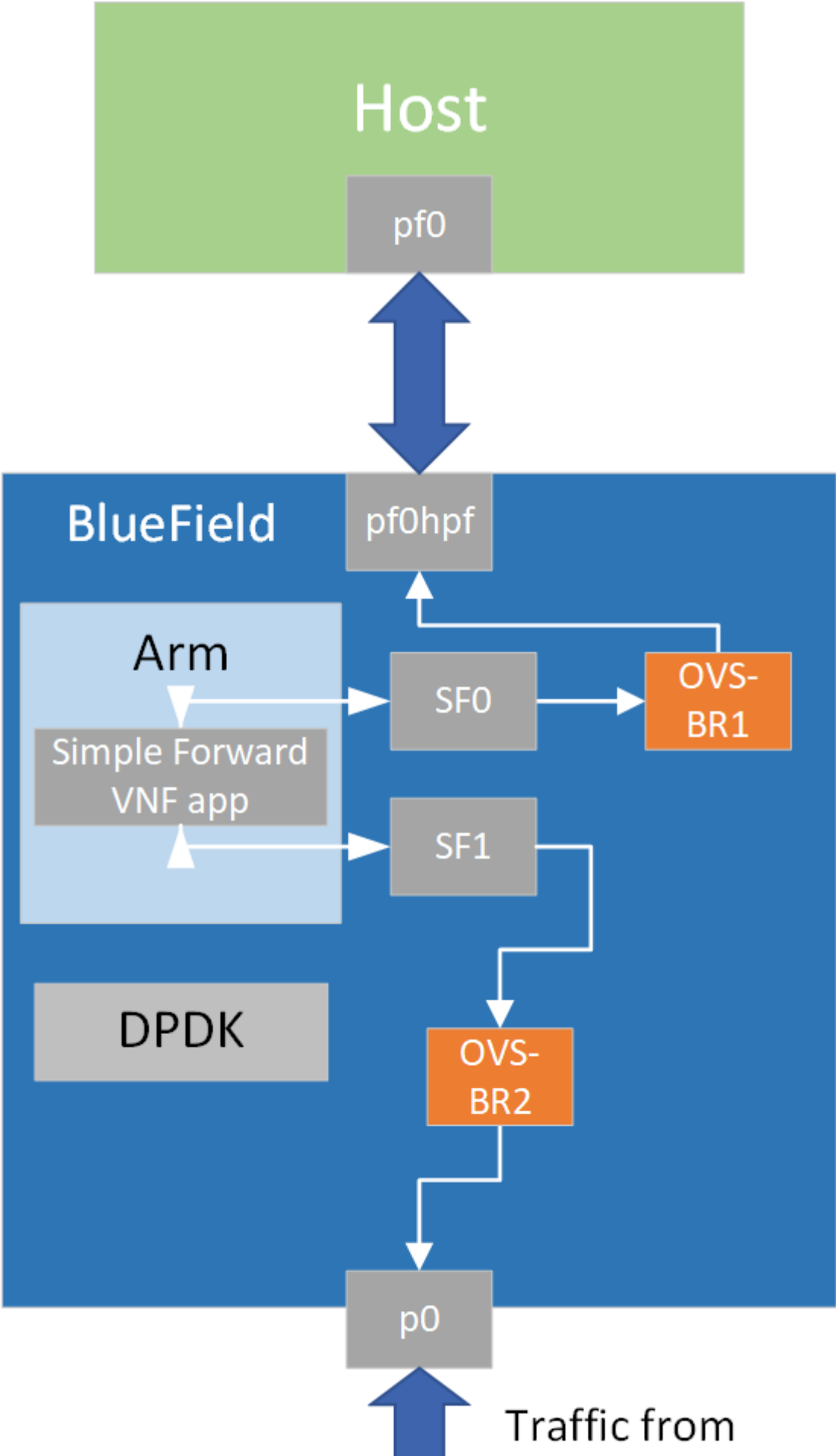
For a packet received on an RX port, simple forward will create a flow based on the packet's tunnel and 5-tuples. For the following packets with the same key, simple forward checks the packet's keys. If it finds that the packet matches the existing flow, then it does not create a new flow. Otherwise,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

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## 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

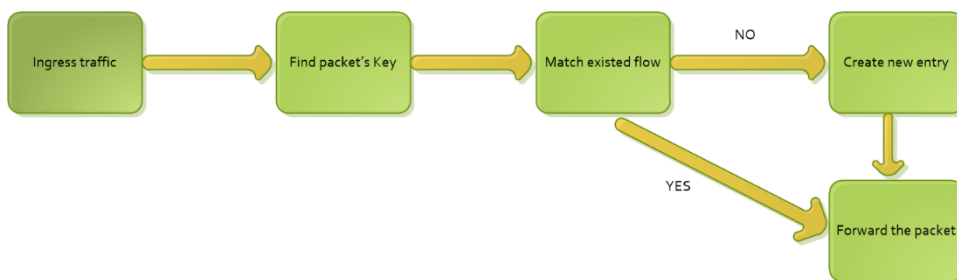
Simple forward first initializes DPDK, after which the application handles the incoming packets.

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.

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# Chapter 4. Configuration Flow

1. Parse application argument.

```
arg_parser_init();
```

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

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

```
arg_parser_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.  
`simple_fwd_close_port()`

---

# Chapter 5. Running Application on BlueField

1. Please refer to the [DOCA Installation Guide](#) for details on how to install BlueField related software.
2. To build the application

- a). The simple forward binary is located under `/opt/mellanox/doca/examples/simple_fwd_vnf/bin/doca_simple_fwd_vnf`. To re-build the simple forward sample, run the following:

```
cd /opt/mellanox/doca/examples/simple_fwd_vnf/src
meson /tmp/build
ninja -C /tmp/build
```

`doca_simple_fwd_vnf` will be created under `tmp/build`.

- b). The build process depends on the `PKG_CONFIG_PATH` environment variable to locate the DPDK libraries. If the variable was accidentally corrupted, and the build fails, run the following command:

- ▶ For Ubuntu:

```
export PKG_CONFIG_PATH=$PKG_CONFIG_PATH:/opt/mellanox/dpdk/lib/aarch64-linux-gnu/pkgconfig
```

- ▶ For CentOS:

```
export PKG_CONFIG_PATH=$PKG_CONFIG_PATH:/opt/mellanox/dpdk/lib64/pkgconfig
```

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

```
echo 1024 > /sys/kernel/mm/hugepages/hugepages-2048kB/nr_hugepages
sudo mkdir /mnt/huge
sudo mount -t hugetlbfs nodev /mnt/huge
```

3. Pre-run setup.

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

```
echo 1024 > /sys/kernel/mm/hugepages/hugepages-2048kB/nr_hugepages
```

4. To run the application:

```
Usage: doca_simple_forward_vnf [DPDK Flags] -- [DOCA Flags] [Program Flags]
DOCA Flags:
  -h, --help                Print a help synopsis
  -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

```

For example:

```

/opt/mellanox/doca/examples/simple_fwd_vnf/bin/doca_simple_fwd_vnf -a
auxiliary:mlx5_core.sf.4 -a auxiliary:mlx5_core.sf.5 -- --nr-queues 4 --stats-
timer 2

```

Using a JSON file:

```

doca_simple_fwd_vnf --json [json_file]

```

For example:

```

/opt/mellanox/doca/examples/simple_fwd_vnf/bin/doca_simple_fwd_vnf --json /root/
simple_fwd_params.json

```



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



**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 will result unexpected behavior as only 2 ports are supported. The SF number is arbitrary and configurable.

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

```

/opt/mellanox/doca/examples/simple_fwd_vnf/bin/doca_simple_fwd_vnf -h

```

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

```

/opt/mellanox/doca/examples/simple_fwd_vnf/bin/doca_simple_fwd_vnf -- -h

```

# Chapter 6. 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"> <li>▶ CRITICAL=0</li> <li>▶ ERROR=1</li> <li>▶ WARNING=2</li> <li>▶ INFO=3</li> <li>▶ DEBUG=4</li> </ul>	<pre>"log-level": 4</pre>
	h	help	Print a help synopsis	N/A
Program Flags	t	stats-timer	Set interval to dump stats information	<pre>"stats-timer": 2</pre>
	q	nr-queues	Set queues number	<pre>"nr-queues": 4</pre>
	r	rx-only	Set rx only	<pre>"rx-only": false</pre>
	o	hw-offload	Set HW offload	<pre>"hw-offload": false</pre>
	hq	hairping	Set forwarding to hairpin queue	<pre>"hairping": false</pre>
	a	age-thread	Start thread do aging	<pre>"age-thread": false</pre>

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# Chapter 7. Running Application on Host

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

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## Chapter 8. References

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

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