



NVIDIA DOCA Switch

Application Guide

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Chapter 1. Introduction

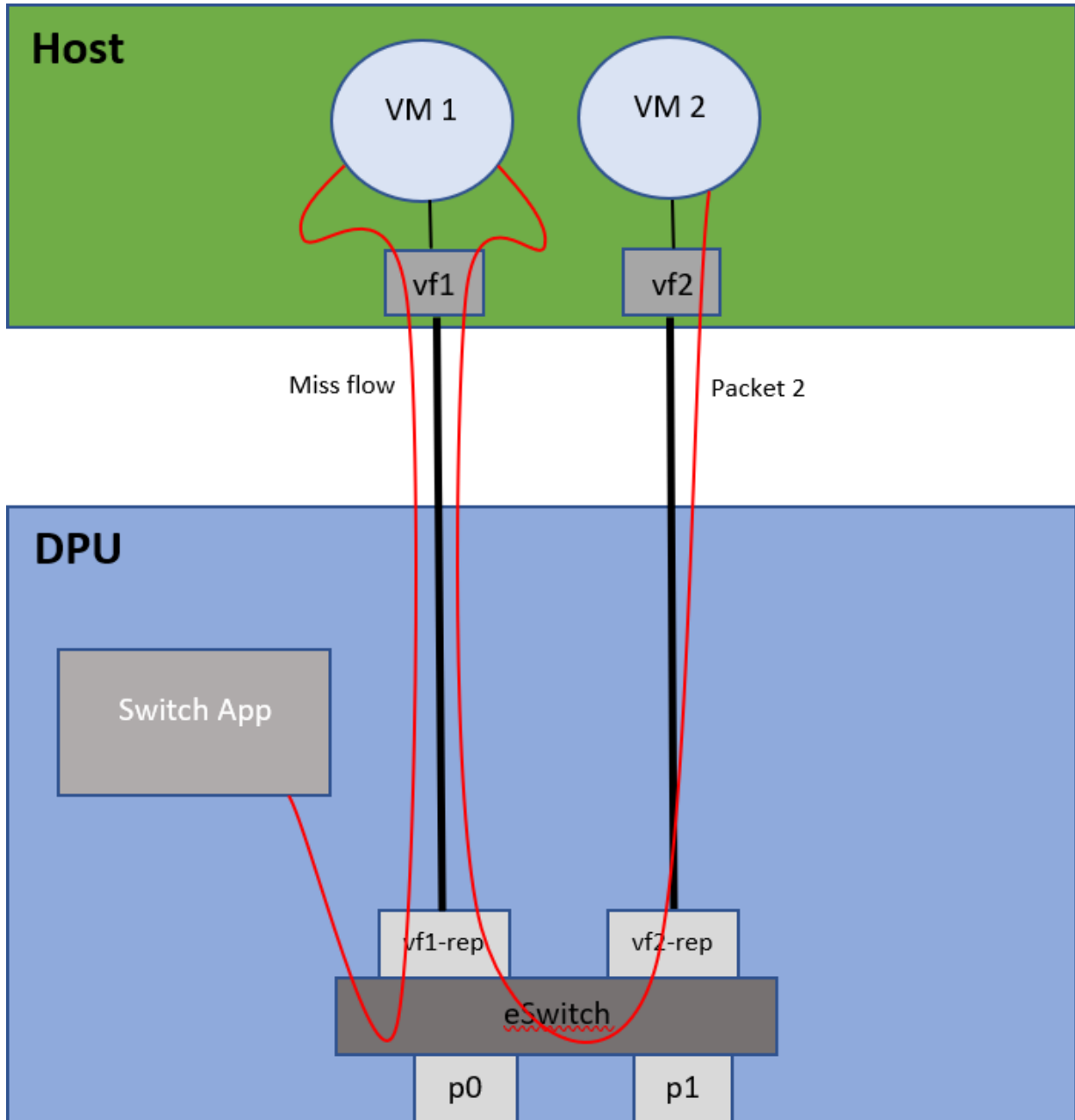
DOCA Switch is a network application that leverages the DPU's hardware capability for internal switching between representor ports on the DPU.

DOCA Switch is based on the DOCA Flow library. As such, it exposes a command line interface which receives DOCA Flow like commands to allow adding rules in real time.

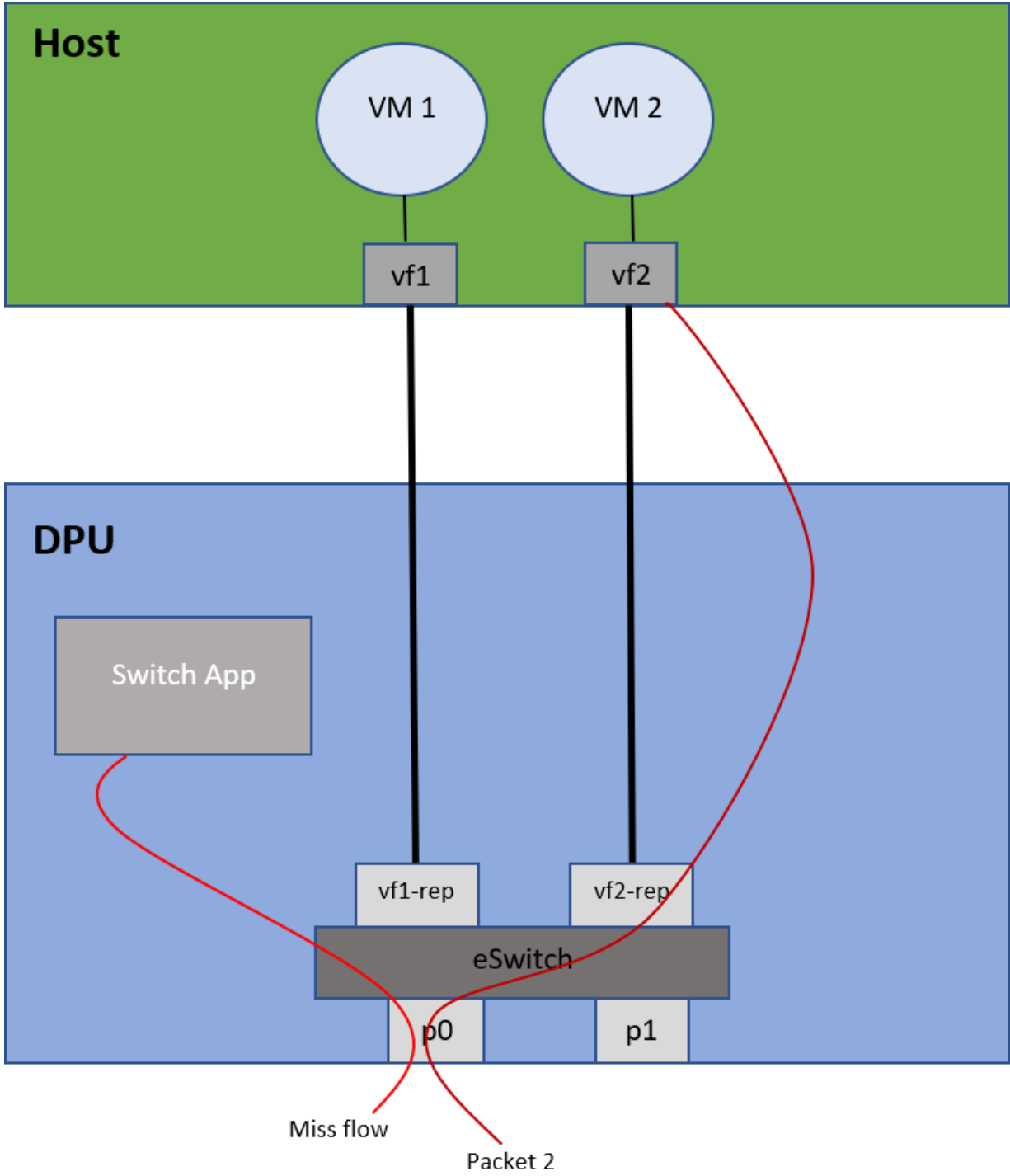
Chapter 2. System Design

DOCA Switch is designed to run on the DPU as a standalone application (all network traffic goes directly through it).

Traffic flows between two VMs on the host:



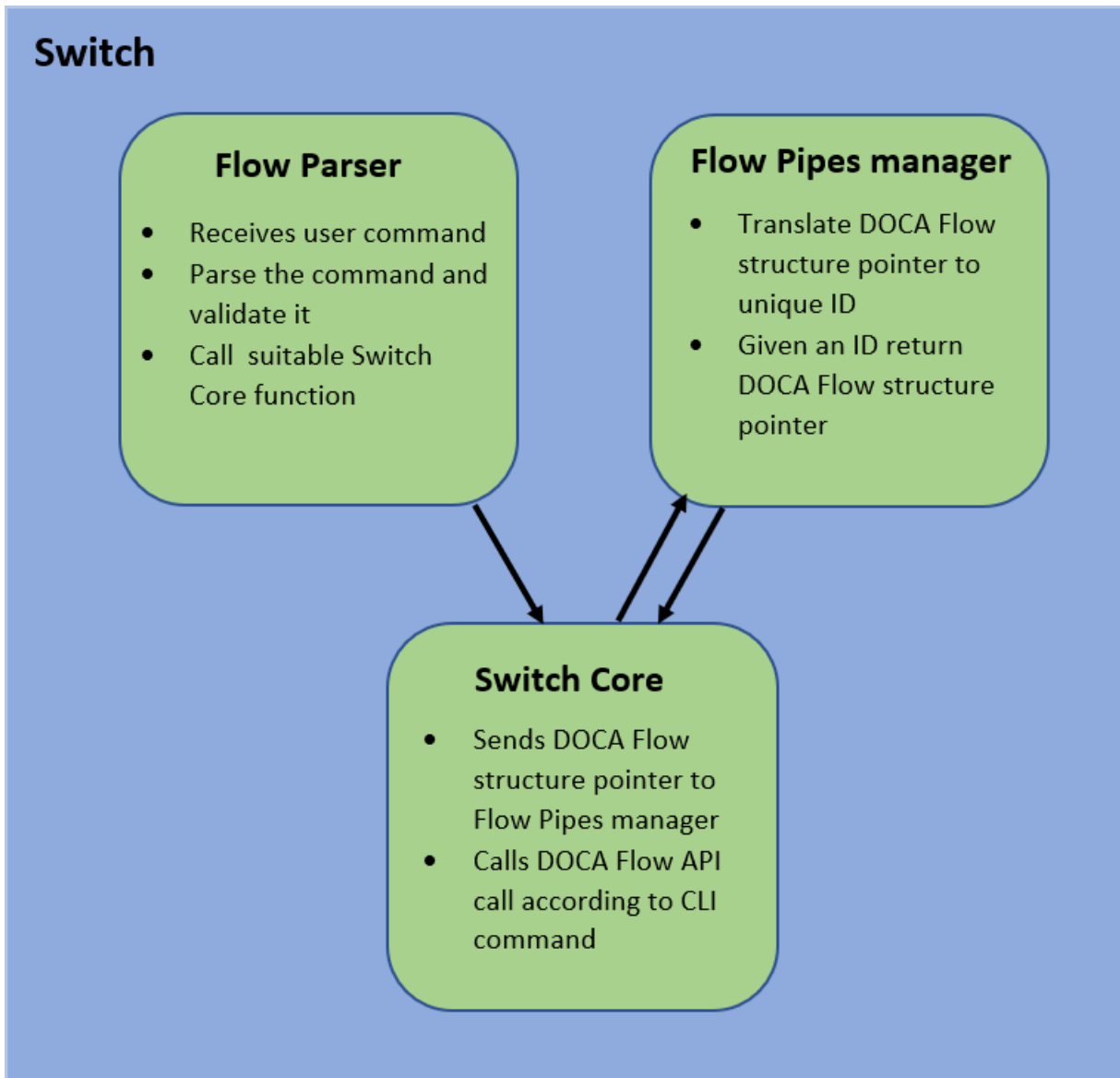
Traffic flow from a physical port to a VM on the host:



Chapter 3. Application Architecture

DOCA Switch is based on 3 modules:

- ▶ Command line interface – receives pre-defined DOCA Flow-like commands and parses them
- ▶ Flow pipes manger – generates a unique identification number for each DOCA Flow structure created
- ▶ Switch core – combines all modules together and calls necessary DOCA Flow API



Port initialization cannot be made dynamically. All ports must be defined when running the application with standard DPDK flags.

- ▶ When adding a pipe or an entry, the user must run commands to create the relevant structs beforehand
- ▶ Optional parameters must be specified by the user in the command line; otherwise, `NULL` is used
- ▶ After a pipe or an entry is created successfully, the relevant ID is printed for future use

Available commands:

- ▶ `create pipe port_id=[port_id] [, <optional_parameters>]`

Available optional parameters:

- ▶ name=<pipe-name>
 - ▶ root_enable=[1|0]
 - ▶ monitor=[1|0]
 - ▶ match_mask=[1|0]
 - ▶ fwd=[1|0]
 - ▶ fwd_miss=[1|0]
 - ▶ type=[basic|control]
 - ▶ add entry
pipe_id=<pipe_id>,pipe_queue=<pipe_queue>[,<optional_parameters>]
- Available optional parameters:**
- ▶ monitor=[1|0]
 - ▶ fwd=[1|0]
- ▶ add control_pipe entry
priority=<priority>,pipe_id=<pipe_id>,pipe_queue=<pipe_queue>[,<optional_parameters>]
- Available optional parameters:**
- ▶ match_mask=[1|0]
 - ▶ fwd=[1|0]
- ▶ destroy pipe port_id=[port_id],pipe_id=<pipe_id>
 - ▶ rm entry pipe_queue=<pipe_queue>,entry_id=[entry_id]
 - ▶ port pipes flush port_id=[port_id]
 - ▶ port pipes dump port_id=[port_id],file=[file_name]
 - ▶ query entry_id=[entry_id]
 - ▶ create [struct] [field=value,...]
- ▶ **Struct options:** pipe_match, entry_match, match_mask, actions, monitor, fwd, fwd_miss

- ▶ **Match struct fields:**

Fields	Field Options
flags	
port_meta (source port)	According to the number of physical ports
out_src_mac	
out_dst_mac	
out_eth_type	
out_vlan_id	
out_src_ip_type	ipv4, ipv6
out_src_ip_addr	

Fields	Field Options
out_dst_ip_type	ipv4, ipv6
out_dst_ip_addr	
out_l4_type	tcp, udp, gre
out_tcp_flags	FIN, SYN, RST, PSH, ACK, URG, ECE, CWR
out_src_port	
out_dst_port	
tun_type	
vxlan-tun_id	
gre_key	
gtp_teid	
in_src_mac	
in_dst_mac	
in_eth_type	
in_vlan_id	
in_src_ip_type	ipv4, ipv6
in_src_ip_addr	
in_dst_ip_type	ipv4, ipv6
in_dst_ip_addr	
in_l4_type	tcp, udp
in_tcp_flags	FIN, SYN, RST, PSH, ACK, URG, ECE, CWR
in_src_port	
in_dst_port	

► Actions struct fields:

Fields	Field Options
decap	true, false
mod_src_mac	
mod_dst_mac	
mod_src_ip_type	ipv4, ipv6
mod_src_ip_addr	
mod_dst_ip_type	ipv4, ipv6
mod_dst_ip_addr	
mod_src_port	
mod_dst_port	
dec_ttl	true, false
has_encap	true, false
encap_src_mac	
encap_dst_mac	

Fields	Field Options
encap_src_ip_type	ipv4, ipv6
encap_src_ip_addr	
encap_dst_ip_type	ipv4, ipv6
encap_dst_ip_addr	
encap_tup_type	vxlan, gtpu, gre
encap_vxlan-tun_id	
encap_gre_key	
encap_gtp_teid	

► FWD struct fields:

Fields	Field Options
type	rss, port, pipe, drop
rss_flags	
rss_queues	
num_of_queues	
rss_mark	
port_id	
next_pipe_id	

► Monitor struct fields:

- flags
- id
- cir
- cbs
- aging

Consider that the physical port number (only one physical port is supported) will always be 0 and all representor ports are numbered from 1 to N where N is the number of representors being used. For example:

- Physical port ID: 0
- VF0 representor port ID: 1
- VF1 representor port ID: 2
- VF2 representor port ID: 3

The following is an example of creating a pipe and adding one entry into it:

1. Pipe is configured on port ID 0 (physical port).
2. Entry is configured to forward all traffic directly into port ID 1 (VF0).
3. When the forwarding rule is no longer needed, the entry is deleted.

4. Ultimately, both entries are deleted, each according to the unique random ID it was given:

```
create fwd type=port,port_id=0xffff
create pipe port_id=0,name=p0_to_vf1,root_enable=1,fwd=1
create fwd type=port,port_id=1
add entry pipe_queue=0,fwd=1,pipe_id=1012
....
rm entry pipe_queue=0,entry_id=447
```

Chapter 4. DOCA Libraries

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

Chapter 5. Configuration Flow

1. Parse application argument.

- a). Initialize the arg parser resources and register DOCA general parameters.

```
doca_argp_init();
```

- b). Register application parameters.

```
register_switch_params();
```

- c). Parse application flags.

```
doca_argp_start();
```

2. Count total number of ports.

```
switch_ports_count();
```

- a). Check how many ports are entered when running the application.

3. Initialize DPDK ports and queues.

```
dpdk_queues_and_ports_init();
```

4. Initialize DOCA Switch.

```
switch_init();
```

- a). Initialize DOCA Flow.
- b). Create port pairs.
- c). Create Flow Pipes Manger module
- d). Register an action for each relevant CLI command.

5. Initialize Flow Parser.

```
flow_parser_init();
```

- a). Reset all internal Flow Parser structures.
- b). Start the command line interface.
- c). Receive user commands, parse them, and call the required DOCA Flow API command.
- d). Close the interactive shell once a "quit" command is entered.

6. Clean Flow Parser resources.

```
flow_parser_cleanup();
```

7. Destroy DOCA Switch resources.

```
switch_destroy();
```

- a). Destroy Flow Pipes Manager resources.

8. Destroy DOCA Flow.

```
switch_destroy();
```

9. Destroy DPDK ports and queues.

```
dpdk_queues_and_ports_fini();
```

10. DPDK finish.

```
dpdk_fini();
```

a). Call `rte_eal_destroy()` to destroy initialized EAL resources.

11. Arg parser destroy.

```
doca_argp_destroy();
```

Chapter 6. Running the Application

1. Refer to the following documents:

- ▶ [NVIDIA DOCA Installation Guide for Linux](#) 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.
- ▶ [NVIDIA DOCA Applications Overview](#) for additional compilation instructions and development tips for the DOCA applications.

2. The DOCA Switch example binary is located under `/opt/mellanox/doca/applications/switch/bin/doca_switch`. To build all the applications together, run:


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

3. To build only the Switch application:

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

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

b). Run the commands in step 2.


 **Note:** `doca_switch` will be created under `./build/switch/src/`.

Application usage:

```
Usage: doca_switch [DPDK Flags] -- [DOCA Flags]
```

DOCA Flags:

```
-h, --help          Print a help synopsis  
-v, --version       Print program version information  
-l, --log-level     Set the log level for the program  
<CRITICAL=20, ERROR=30, WARNING=40, INFO=50, DEBUG=60>
```

 **Note:** For additional information on the app, use `-h`:
`/opt/mellanox/doca/applications/switch/bin/doca_switch -h`

4. CLI example for running the app on BlueField with 3 VF representors (`dv_flow_en=2` is necessary to run the application with hardware steering):

```
/opt/mellanox/doca/applications/switch/bin/doca_switch -a  
03:00.0,representor=[0-2],dv_flow_en=2 -- -l 30
```

Chapter 7. Arg Parser DOCA Flags

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

Flag Type	Short Flag	Long Flag/ JSON Key	Description	JSON Content
General flags	l	log-level	Sets the log level for the application: <ul style="list-style-type: none">▶ CRITICAL=20▶ ERROR=30▶ WARNING=40▶ INFO=50▶ DEBUG=60	<code>"log-level": 60</code>
	v	version	Print program version information	N/A
	h	help	Print a help synopsis	N/A

Chapter 8. References

► `/opt/mellanox/doca/applications/switch/src`

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