



# NVIDIA DOCA Ethernet Programming Guide

Programming Guide

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# Chapter 1. Introduction

The DOCA ETH library comprises two APIs that represent two DOCA objects, namely `DOCA_ETH_RXQ` and `DOCA_ETH_TXQ`.

The control path API is handled on the host CPU side by the library. `DOCA_ETH_RXQ/DOCA_ETH_TXQ` are configured on the CPU and then exported to the GPU which performs its data path.

`DOCA_ETH_RXQ` offers an API to receive packets on an RX queue. The `doca_eth_rxq` object allows developers to receive Ethernet packets in CPU/GPU memory that they have allocated beforehand (Ethernet receive packets buffer). The library collects the user configuration, creates a receive queue object on the GPU memory (using the `DOCA_GPU` sub-device), and coordinates with the network card (NIC) to receive packets directly into GPU memory.

`DOCA_ETH_TXQ` provides an API to send packets on a TX queue. The library collects the user configuration and creates a send queue object on the GPU memory (using the `DOCA_GPU` sub-device) and exports its configuration to the GPU, enabling developers to send packets on this queue from the GPU side.

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## Chapter 2. Prerequisites

DOCA Ethernet library (Tx/Rx) is supported on the DPU control path and GPU as data path (see [GPUNetIO library](#)).

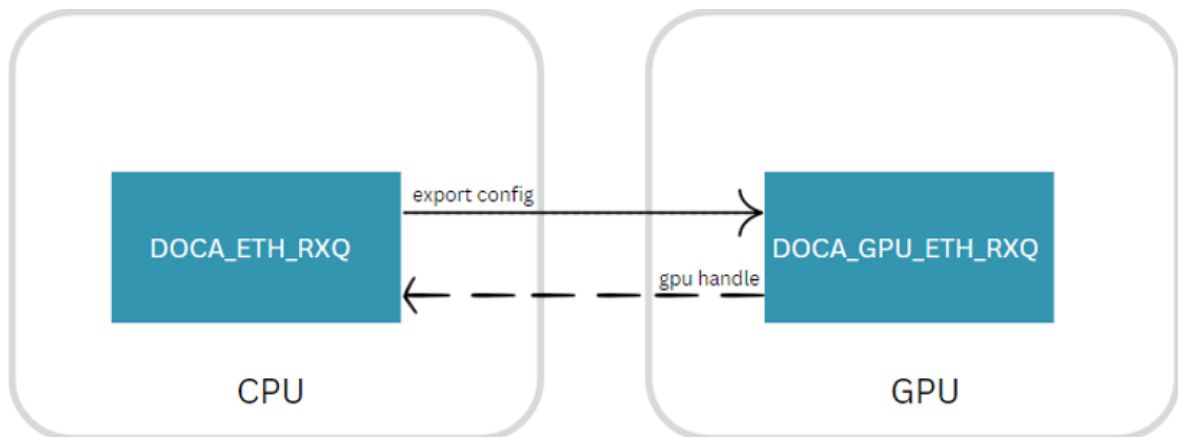
The machine must meet the following prerequisites:

- ▶ DOCA version 2.0.2 or greater
- ▶ BlueField software 4.0.2 or greater
- ▶ BlueField-3 firmware 32.37.1000 or greater
- ▶ BlueField-2 firmware 24.37.1000 or greater

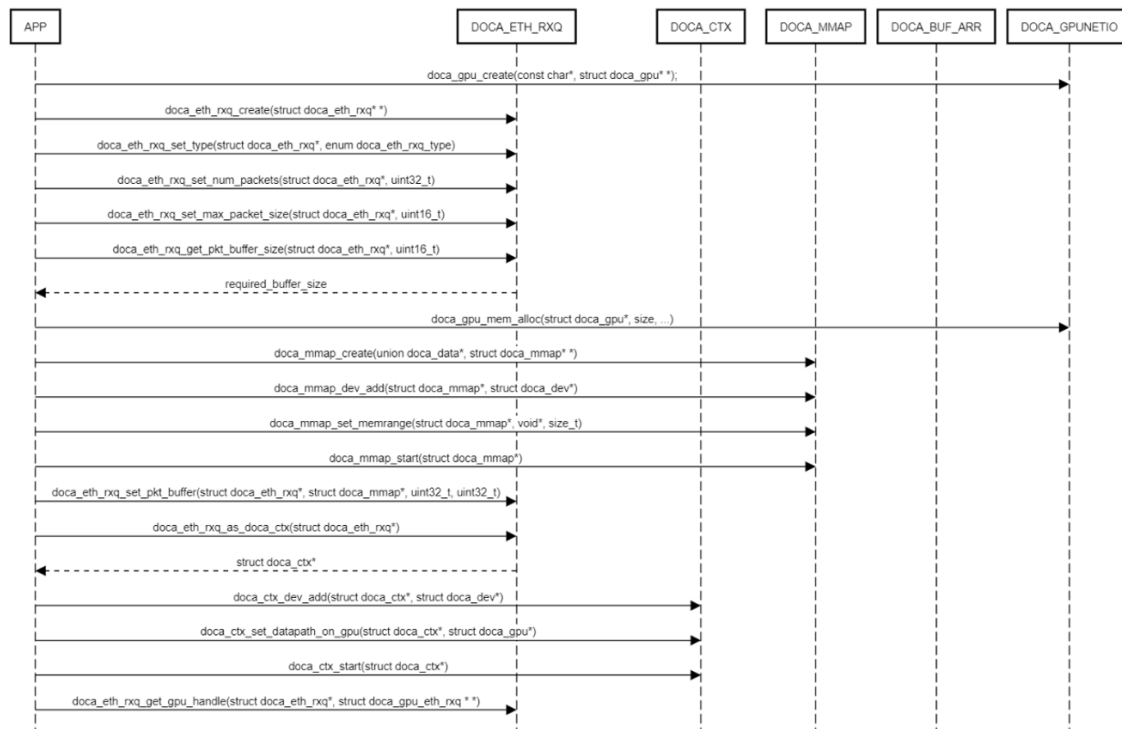
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# Chapter 3. Architecture

1. DOCA ETH provides a set of CPU functions to:
  - a). Create a DOCA ETH context.
  - b). Configure DOCA ETH context.
    - i. Configure RX queue size.
    - ii. Configure TX queue size.
    - iii. Set TX checksum offloads.
  - c). Get a GPU handle of the `DOCA_GPU_ETH` object.
  - d). Destroy a DOCA ETH context.
2. The DOCA ETH context is configured on the CPU and then exported to the GPU:



3. Expected flow (`doca_eth_rxq`)
  - a). Create a `DOCA_GPU` device handler.
  - b). Create a `doca_eth_rxq` and configure its parameters (`type`, `num_packets`, `packet_size`, `packet_buffer`).
  - c). Add a device to the context.
  - d). Set the data path of the context to GPU.
  - e). Start the context.





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# Chapter 4. Dependencies

- ▶ DOCA ETH relies on the `doca_gpunetio` library to use GPU internal operations
- ▶ DOCA ETH relies on the `dpmk_bridge` library to allow interoperability between the library, `dpmk`, and `doca_flow`

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## Chapter 5. Limitations


- ▶ Data path on the CPU is not supported.
- ▶ RX/TX does not handle steering. Use DOCA Flow to do that.

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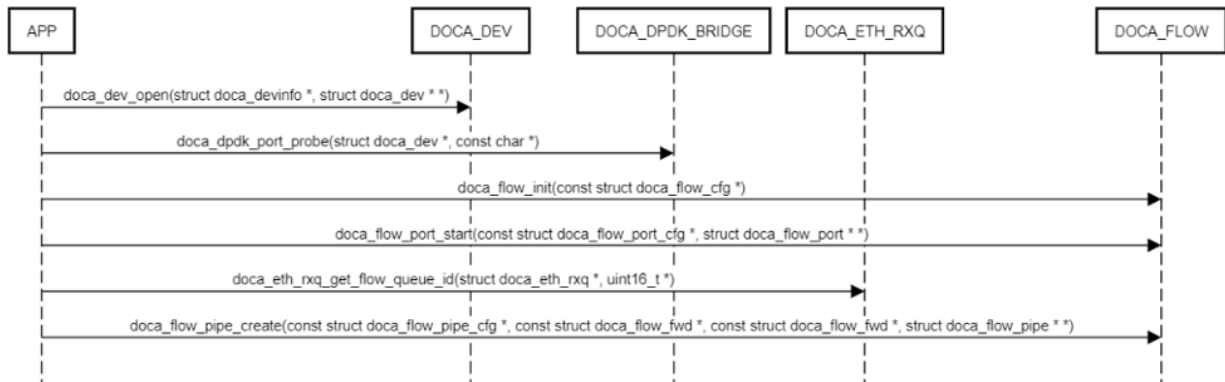
# Chapter 6. DOCA Flow Interoperability

To use `DOCA_FLOW`:

1. Select a device.
2. Probe the device.

 Note: Only one port can be probed for the device.

3. Obtain the DOCA ETH queue ID.
4. Create a DOCA Flow pipe.



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# Chapter 7. API

This chapter provides a detailed description of the specific structures and operations related to the DOCA ETH control path API for general initialization, setup, and clean-up.

## 7.1. DOCA ETH RXQ

The `doca_eth_rxq` object allows querying device capabilities, setting object properties, creating and configuring an instance of `doca_eth_rxq`, and destroying it when no longer needed.

### 7.1.1. Querying Device Capabilities

Querying device capabilities provides information on the derived DOCA Ethernet limitations and enables users to set the properties of a `doca_eth_rxq` object accordingly.

The following subsections describe the functions which allow querying the device capabilities.

#### 7.1.1.1. `doca_eth_rxq_get_max_packet_size_supported()`

This function queries the maximum packet size supported by the device. Any packet size bigger than this value is not accepted when trying to start the `doca_eth_rxq` object.

```
doca_error_t doca_eth_rxq_get_max_packet_size_supported(const struct doca_devinfo *devinfo, uint16_t *max_packet_size);
```

**devinfo [in]**

Pointer to a `doca_devinfo` instance.

**max\_packet\_size [out]**

Maximum packet size.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure.

Possible error values are documented in the header file.

#### 7.1.1.2. `doca_eth_rxq_get_type_supported()`

This function checks if an RX queue type is supported by the device.

```
doca_error_t doca_eth_rxq_get_type_supported(const struct doca_devinfo *devinfo, enum doca_eth_rxq_type type, uint8_t *type_supported);
```

**devinfo [in]**

Pointer to a `doca_devinfo` instance.

**type [in]**

RX queue type (the values are documented in the header file).

**type\_supported [out]**

Flag to indicate if the type is supported.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure.

Possible error values are documented in the header file.

## 7.1.2. Creating and Configuring DOCA\_ETH\_RXQ

### 7.1.2.1. `doca_eth_rxq_create()`

This function creates an instance of `doca_eth_rxq`.

```
doca_error_t doca_eth_rxq_create(struct doca_eth_rxq **eth_rxq);
```

**eth\_rxq [out]**

Pointer to the newly created `doca_eth_rxq` instance.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure.

Possible error values are documented in the header file.

### 7.1.2.2. `doca_eth_rxq_destroy()`

This function destroys a `doca_eth_rxq` instance.

```
doca_error_t doca_eth_rxq_destroy(struct doca_eth_rxq *eth_rxq);
```

**eth\_rxq [in]**

Pointer to the `doca_eth_rxq` to be destroyed.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure.

Possible error values are documented in the header file.

### 7.1.2.3. `doca_eth_rxq_set_num_packets()`

This function sets the number of packets the RX queue can hold.



Note: This function should only be called before invoking `doca_ctx_start()`.

```
doca_error_t doca_eth_rxq_set_num_packets(struct doca_eth_rxq *eth_rxq, uint32_t num_packets);
```

**eth\_rxq [in]**

Pointer to the `doca_eth_rxq` instance.

**num\_packets [in]**

Maximum number of packets the queue can hold in the context.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure.

Possible error values are documented in the header file.

### 7.1.2.4. `doca_eth_rxq_set_max_packet_size()`

This function sets the maximum Ethernet packet size the RX queue can accommodate.



Note: This function should only be called before invoking `doca_ctx_start()`.

```
doca_error_t doca_eth_rxq_set_max_packet_size(struct doca_eth_rxq *eth_rxq, uint16_t
max_pkt_sz);
```

**eth\_rxq [in]**

Pointer to the `doca_eth_rxq` instance.

**max\_pkt\_sz [in]**

Maximum packet size the RX queue can handle in the context.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure.

Possible error values are documented in the header file.

### 7.1.2.5. `doca_eth_rxq_set_type()`

This function sets the RX queue type.



Note: This function should only be called before invoking `doca_ctx_start()`.

```
doca_error_t doca_eth_rxq_set_type(struct doca_eth_rxq *eth_rxq, enum
doca_eth_rxq_type type);
```

**eth\_rxq [in]**

Pointer to the `doca_eth_rxq` instance.

**type [in]**

Type of the RX queue. Possible values are documented in the header file.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure.

Possible error values are documented in the header file.

### 7.1.2.6. `doca_eth_rxq_get_flow_queue_id()`

This function retrieves the DPDK queue ID of the receive queue, which can be used in `rte_flow` or `doca_flow`.



Note: This function should only be called after starting the context.

```
doca_error_t doca_eth_rxq_get_flow_queue_id(struct doca_eth_rxq *eth_rxq, uint16_t
*flow_queue_id);
```

**eth\_rxq [in]**

Pointer to the `doca_eth_rxq` instance.

**flow\_queue\_id [out]**

Queue ID, which can be used in `rte_flow` or `doca_flow`.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure.

Possible error values are documented in the header file.

### 7.1.2.7. `doca_eth_rxq_get_gpu_handle()`

This function retrieves the GPU handle of a `doca_eth_rxq` instance.



Note: This function should only be called after starting the context.

The following is the expected flow:

1. Bind the context to a GPU device using `doca_ctx_set_data_path_on_gpu()`.
2. Start the context using `doca_ctx_start()`.
3. Call `doca_eth_rxq_get_gpu_handle()` to retrieve the `gpu_handle`.

```
doca_error_t doca_eth_rxq_get_gpu_handle(const struct doca_eth_rxq *eth_rxq, struct
doca_gpu_eth_rxq **eth_rxq_ext);
```

**eth\_rxq [in]**

Pointer to the `doca_eth_rxq` instance.

**eth\_rxq\_ext [out]**

Handle for the DOCA GPU `eth_rxq`.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure.

Possible error values are documented in the header file.

### 7.1.2.8. `doca_eth_rxq_get_pkt_buffer_size()`

This function retrieves the size for the Ethernet packet buffer of a `doca_eth_rxq`.



Note: Use this value as the minimum size of the `doca_mmap` given to `doca_eth_rxq_set_pkt_buffer()`.



Note: This function should only be called after `doca_eth_rxq_set_num_packets()` and `doca_eth_rxq_set_max_packet_size()`.

```
doca_error_t doca_eth_rxq_get_pkt_buffer_size(const struct doca_eth_rxq *eth_rxq,
uint32_t *size);
```

**eth\_rxq [in]**

Pointer to the `doca_eth_rxq` instance.

**size [out]**

Required size for the Ethernet packet buffer.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure.

Possible error values are documented in the header file.

### 7.1.2.9. `doca_eth_rxq_set_pkt_buffer()`

This function sets the Ethernet packet buffer of a `doca_eth_rxq`.



Note: This function should only be called before invoking `doca_ctx_start()`.

```
doca_error_t doca_eth_rxq_set_pkt_buffer(struct doca_eth_rxq *eth_rxq, struct
doca_mmap *mmap, uint32_t offset, uint32_t size);
```

**eth\_rxq [in]**

Pointer to the `doca_eth_rxq` instance.

**mmap [in]**

Mmap with the memrange for the Ethernet packet buffer.

**size [in]**

Size of the Ethernet packet buffer.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure. Possible error values are documented in the header file.

## 7.2. DOCA ETH TXQ

The `doca_eth_txq` object allows querying device capabilities, setting object properties, creating and configuring an instance of `doca_eth_txq`, and destroying it when no longer needed.

### 7.2.1. Querying Device Capabilities

Querying device capabilities provides users with information regarding the derived DOCA Eth limitations and enables them to set the properties of a `doca_eth_txq` object accordingly.

The following subsections describe the functions which allow querying the device capabilities.

#### 7.2.1.1. `doca_eth_txq_get_max_queue_size_supported()`

This function queries the maximum queue size supported by the device. Any queue size bigger than this value is not accepted when trying to start the `doca_eth_txq` object.

```
doca_error_t doca_eth_txq_get_max_queue_size_supported(const struct doca_devinfo
*devinfo, uint32_t *max_queue_size);
```

**devinfo [in]**

Pointer to a `doca_devinfo` instance.

**max\_queue\_size [out]**

Maximum queue size supported by the device.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure. Possible error values are documented in the header file.



### 7.2.1.2. `doca_eth_txq_get_type_supported()`

This function checks if a TX queue type is supported by the device.

```
doca_error_t doca_eth_txq_get_type_supported(const struct doca_devinfo
    *devinfo, enum doca_eth_txq_type type, uint8_t *type_supported);
```

**devinfo [in]**

Pointer to a `doca_devinfo` instance.

**type [in]**

TX queue type.

**type\_supported [out]**

Flag to indicate if the type is supported.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure. Possible error values are documented in the header file.

### 7.2.1.3. `doca_eth_txq_get_chksum_offload_supported()`

This function checks if checksum offload is supported by the device.

```
doca_error_t doca_eth_txq_get_chksum_offload_supported(const struct doca_devinfo
    *devinfo, uint8_t *offload_supported);
```

**devinfo [in]**

Pointer to a `doca_devinfo` instance.

**offload\_supported [out]**

Flag to indicate if checksum offload is supported.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure. Possible error values are documented in the header file.

### 7.2.1.4. `doca_eth_txq_get_wait_on_time_offload_supported()`

This function checks if wait-on-time offload is supported by the device.

```
doca_error_t doca_eth_txq_get_wait_on_time_offload_supported(const struct doca_dev
    *dev, enum doca_eth_wait_on_time *wait_on_time_mode);
```

**dev [in]**

Pointer to a `doca_dev` instance.

**wait\_on\_time\_mode [out]**

Wait-on-time mode supported by the device. Valid mode values are documented in the header file.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure. Possible error values are documented in the header file.

## 7.2.2. Creating and Configuring DOCA\_ETH\_TXQ

### 7.2.2.1. `doca_eth_txq_create()`

This function creates an instance of `doca_eth_txq`.

```
doca_error_t doca_eth_txq_create(struct doca_eth_txq **eth_txq);
```

**eth\_txq [out]**

Pointer to the newly created `doca_eth_txq` instance.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure. Possible error values are documented in the header file.

### 7.2.2.2. `doca_eth_txq_destroy()`

This function destroys a `doca_eth_txq` instance.

```
doca_error_t doca_eth_txq_destroy(struct doca_eth_txq *eth_txq);
```

**eth\_txq [in]**

Pointer to the `doca_eth_txq` instance to destroy.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure. Possible error values are documented in the header file.

### 7.2.2.3. `doca_eth_txq_set_queue_size()`

This function sets the size of the TX queue.



Note: This function should only be called before starting the context (i.e., invoking `doca_ctx_start()`).

```
doca_error_t doca_eth_txq_set_queue_size(struct doca_eth_txq *eth_txq, uint32_t size);
```

**eth\_txq [in]**

Pointer to the `doca_eth_txq` instance.

**size [in]**

TX queue size.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure. Possible error values are documented in the header file.

### 7.2.2.4. `doca_eth_txq_set_type()`

This function sets the TX queue type.



Note: This function should only be called before starting the context (i.e., invoking `doca_ctx_start()`).

```
doca_error_t doca_eth_txq_set_type(struct doca_eth_txq *eth_txq, enum doca_eth_txq_type type);
```

**eth\_txq [in]**

Pointer to the `doca_eth_txq` instance.

**type [in]**

Type of the TX queue. Possible values are documented in the header file.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure. Possible error values are documented in the header file.

### 7.2.2.5. `doca_eth_txq_set_l4_chksum_offload()`

This function sets offload for the calculation of TCP/UDP checksum (L4) on transmitted packets.



Note: This function should only be called before starting the context (i.e., invoking `doca_ctx_start()`).

```
doca_error_t doca_eth_txq_set_l4_chksum_offload(struct doca_eth_txq *eth_txq);
```

**eth\_txq [in]**

Pointer to the `doca_eth_txq` instance.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure. Possible error values are documented in the header file.

### 7.2.2.6. `doca_eth_txq_set_l3_chksum_offload()`

This function sets offload for the calculation of IPv4 checksum (L3) on transmitted packets.



Note: This function should only be called before starting the context (i.e., invoking `doca_ctx_start()`).

```
doca_error_t doca_eth_txq_set_l3_chksum_offload(struct doca_eth_txq *eth_txq);
```

**eth\_txq [in]**

Pointer to the `doca_eth_txq` instance.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure. Possible error values are documented in the header file.

### 7.2.2.7. `doca_eth_txq_set_wait_on_time_offload()`

This function retrieves the GPU handle of a `doca_eth_txq` instance.



Note: This function should only be called before starting the context (i.e., invoking `doca_ctx_start()`).

```
doca_error_t doca_eth_txq_set_wait_on_time_offload(struct doca_eth_txq *eth_txq);
```

**eth\_txq [in]**

Pointer to the `doca_eth_txq` instance.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure. Possible error values are documented in the header file.

### 7.2.2.8. `doca_eth_txq_get_gpu_handle()`

This function retrieves the GPU handle of a `doca_eth_txq` instance.



Note: This function should only be called after starting the context (i.e., invoking `doca_ctx_start()`).

The following is the expected flow:

1. Bind the context to a GPU device using `doca_ctx_set_data_path_on_gpu()`.
2. Start the context using `doca_ctx_start()`.
3. Call `doca_eth_txq_get_gpu_handle()` to retrieve the `gpu_handle`.

```
doca_error_t doca_eth_txq_get_gpu_handle(const struct doca_eth_txq *eth_txq, struct
doca_gpu_eth_txq **eth_txq_ext);
```

**`eth_txq` [in]**

Pointer to the `doca_eth_txq` instance.

**`eth_txq_ext` [out]**

Handle for the DOCA GPU `eth_rxq`.

**Returns**

`doca_error_t` value. `DOCA_SUCCESS` if successful or an error value upon failure.

Possible error values are documented in the header file.

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