A framework for representation, configuration, and management of virtual function ports

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Agenda

- Port Representor Concepts
  - SR-IOV NIC
  - Multi-Port NIC
- Library Implementation Details
  - Object Model
  - Broker APIs
  - Port Representor APIs
  - Initialization Sequence
  - Example eth_dev_ops function
- Future Work
Port Representors are virtual poll mode drivers (PMD) which provide a logical representation in DPDK for a port of a multi host port device.

Primary purpose demonstrated in our RFC is to support configuration, management and monitoring of virtual functions of a physical function bound to a userspace control plane application.

Port Representor PMDs are associated with a parent base driver which provide the backend implementations for the representor ports.

Allows VF ports to managed using existing DPDK APIs without the need to create and maintain a set of device specific APIs.
Port Representors for a NIC supporting SR-IOV

Host OS Userspace
- Control Plane Application
- ETH DEV API
- PF PMD
- REPRESENOR PMD
- REPRESENOR PMD

Guest VM Userspace
- Application
- ETH DEV API
- VF PMD
- VF PMD

Guest VM Userspace
- Application
- ETH DEV API
- VF PMD
- VF PMD

Guest VM Kernel
- UIO
- UDO

Guest VM Kernel
- UIO
- UDO

Host OS Kernel
- UIO

HyperVisor

HW (Logical View)
- Physical Function
- Virtual Function
- VEB
- Port 0
- VEB

DATA PATH

CONTROL PATH
Port Representors for a NIC supporting SR-IOV

- Host Control Plane Application
  - Port Representor PMDs are created to represent each virtual function (VF) of the PF PMD.
  - Port Representor PMD control plane is through `eth_dev_ops` implemented by base driver (PF PMD).
  - Port properties configured through representor:
    - MAC, VLAN
    - Promiscuous Mode
    - Multicast/Broadcast

- Guest Application
  - Configuration of data path only:
    - Tx/Rx Queues
    - RSS/Flow Director
    - Offloads

- No data path supported for this use case.
Port Representors for a multi-port devices
Introduces the new concept of switch/control domain to ethdev’s

- Base driver defines the switch/control domain.
- Each representor port inherits the domain from it’s root device.

If hardware supports advance port-to-port switching capabilities then switch domain can be use by application to know whether logical ports are in the same domain.
Library
Implementation
**Port Representor**

**Representor PMD**
- Generic skeleton PMD with infrastructure for creation of representor port and registration with broker.
- All configuration including capabilities and dev_ops functions configured by broker/base driver.
- No restrictions on port representor capabilities set by framework, all are controlled by the base driver.

**Representor Broker**
- Integrates into base driver (eg PF PMD)
- Base driver is not required to be an ethdev.
- Base driver configures number of representor ports supported and provides port configuration functions for representor port initialisation.
Register / Un-Register Broker in base driver

- int rte_representor_broker_register(struct rte_representor_broker *broker);
- int rte_representor_broker_unregister(struct rte_representor_broker *broker);

```c
struct rte_representor_broker {
    TAILQ_ENTRY(rte_representor_broker) next;
    const char *bus;
    const char *device;
    /**< Base Device Bus/Device Name */
    uint16_t nb_virtual_ports;
    struct rte_representor_port *virtual_ports;
    /**< Array of virtual(representor) ports */
    struct rte_representor_broker_port_ops *port_ops;
    /**< Port Initialisation Functions */
    void *private_data;
    /**< Base Driver private data */
};
```

```c
struct rte_representor_broker_port_ops {
    port_priv_data_set;
    port_priv_data_free;
    port_capabilities_set;
    port_ops_get;
};
```
- struct rte_representor_broker *
  
rte_representor_broker_find(const char *bus, const char *device);

- int rte_representor_port_register(struct rte_representor_broker *broker,
  
  uint32_t vport_id,
  
  struct rte_eth_dev *ethdev);

- Int rte_representor_port_unregister(struct rte_eth_dev *ethdev);
Port Representor (Initialisation Sequence)

API/EAL ARGS

EAL

Virtual Bus

Base Driver

Representor Broker

Representor Port

- create vdev
- bus scan/probe
- create representor pmd
- scan bus
- broker_find
- broker id
- port_register()
- private data set()
- capabilities set()
- dev_ops get()
- create ethdev
Example eth_dev_ops function

```c
struct rte_representor_port {
    struct rte_representor_broker *broker;
    uint16_t id;
    struct rte_eth_dev *ethdev;
    enum {
        RTE_REPRESENTOR_PORT_INVALID,
        RTE_REPRESENTOR_PORT_VALID
    } state;
    void *priv_data;
};

struct i40e_representor_priv_data {
    struct rte_eth_dev *pf_ethdev;
};

static void
i40e_port_representor_dev_infos_get(struct rte_eth_dev *ethdev,
                                      struct rte_eth_dev_info *dev_info) {
    struct rte_representor_port *port_rep = ethdev->data->dev_private;
    struct i40e_representor_priv_data *i40e_priv_data = port_rep->priv_data;

    /* Function Implementation */
    ...
};
```
Future Work
Possible Future Work

- Data path enablement (next talk!)

- Enable hot-plug support so representor ports get created automatically, as VF are created.

- Port-to-Port switching through rte_flow using logical port id’s.

- Advance port capabilities management
  - Port representor could be used to define capabilities of the underlying port. e.g. make a VF untrusted so it can change it’s MAC address etc.
  - Limit hardware resources port can use, e.g. number of flow director rules.

- Policy enforcement
  - stop VF over riding configuration applied in control plane application.
  - Would require hooks into base driver to catch configuration requests coming through hardware mailbox
Questions?

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