DPDK
DATA PLANE DEVELOPMENT KIT

THE LINUX FOUNDATION

25GBE INTEL® ETHERNET ADVANCED FEATURES FOR NFV

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Agenda

- **Key Hardware Features**
- **Dynamic Device Personalization (DDP)**
- **Generic Flow API**
- **Virtual Function Daemon (VFD)**
- **Good Performance**
- **Adaptive Virtual Function (AVF)**

Key Hardware Features

- Intel® Ethernet Network Adapter XXV710
  - Single and dual 10/25GbE ports
  - PCIe v3.0, x8
  - New addition to Intel® Ethernet 700 Series
- Network Virtualization Offloads
  - VXLAN, NVGRE, GENEVE, VXLAN-GPE with NSH, MPLS, and more
- Input Set for RSS and Intel® Ethernet Flow Director (FD)
  - Up to 24 of 56 words can be selected
- 3 HASH Algorithms
  - Toeplitz, Simple XOR, Symmetric Simple XOR

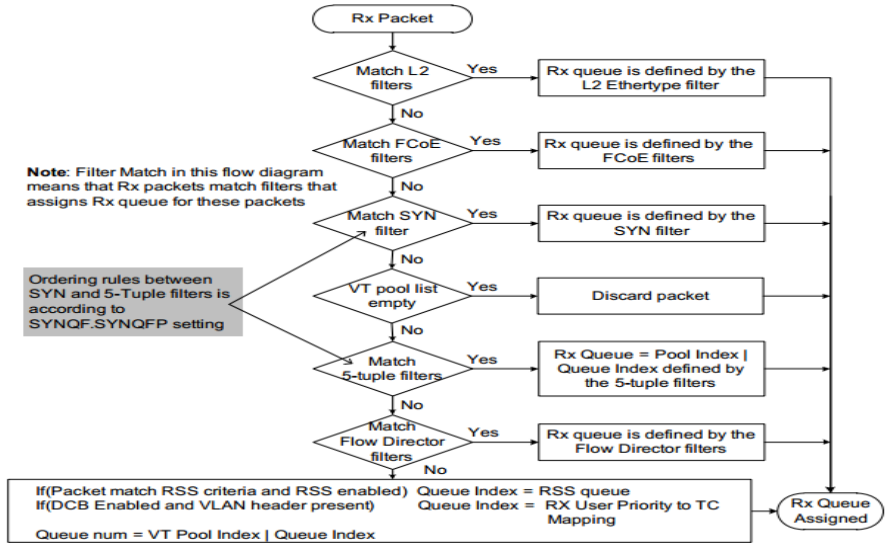
Key Hardware Features for Virtualization

Feature	Intel® 82599EB 10 Gigabit Ethernet Controller	Intel® Ethernet 700 Series
SR-IOV support	Yes	Yes
VF to PF mailbox	Yes	Yes
Max Number of Virtual functions	64 per port (single queue)	128 per device (globally)
Max number of Queues	128	**1536**
Max number of queues per VF	8	**16**
Max number of queues per VMDq2 VSI	8	16
Max Number of VMDq2 ports	64 per port (single queue)	256 per device (globally)
MAC addresses	128 per port	**1024** per device (globally)
VLAN tags	64 per port	**512** per device (global)
Queuing to Pool/VSI method	SA or VLAN or (SA and VLAN)	SA, VLAN pairs or SA or VLAN
Cloud filter in Switch	No	Yes
RSS per VF	No (Single RSS used for all VFs).	**Yes**
Switching modes	VEB*	VEB, VEPA
Promiscuous modes per VM	Multicast	VLAN, Multicast, Unicast

Internal Packet Processing

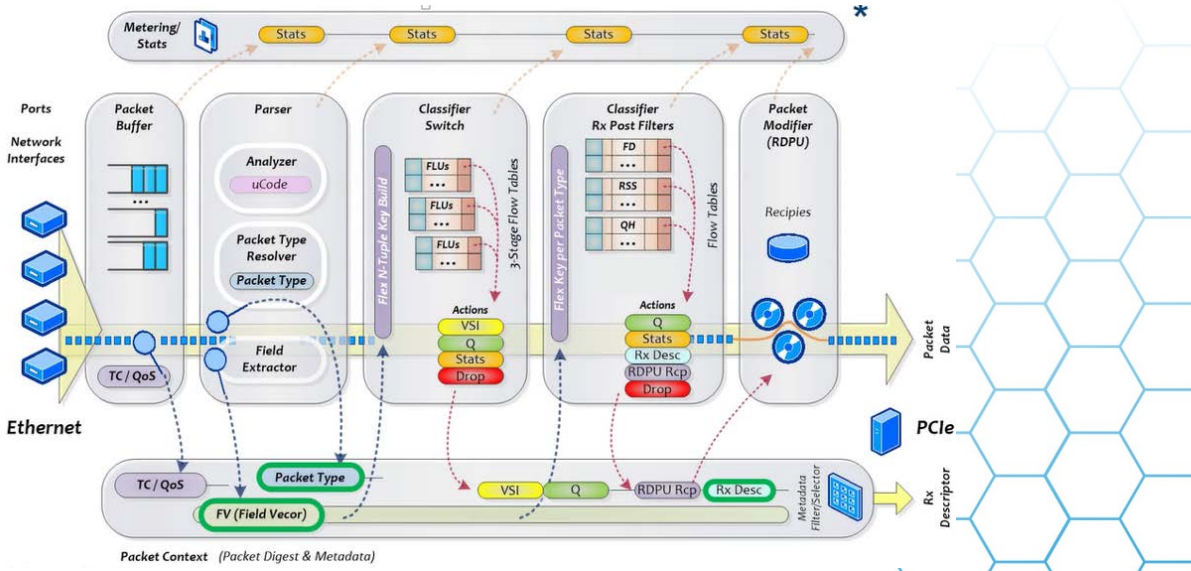
Intel® 82599EB 10 Gigabit Ethernet Controller

- Fixed packets Parse graphic
- Input set of filtering/steering is fixed



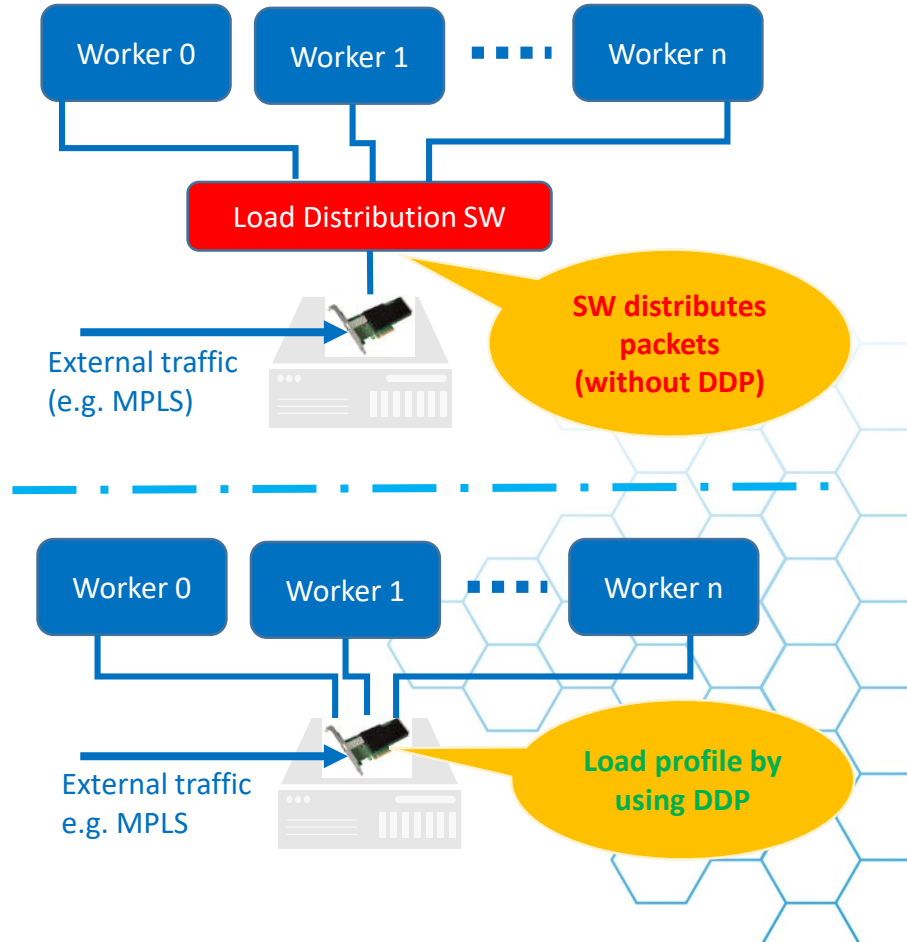
Intel® Ethernet 700 Series

- Configurable input set for RSS and Intel Ethernet Flow Director (Intel Ethernet FD)
- Dynamic Device Personalization (DDP) to support more protocol steering



Dynamic Device Personalization (DDP)

- By default, it supported limited protocols, due to hardware resources
  - e.g. VXLAN, GENEVE, NVGRE, MPLS, VXLAN-GPE
- Loadable profiles for packet classification for extra protocols
  - e.g. MPLSoGRE, GTP-U/GTP-C, PPoE
- Configurable tunnel filters for traffic steering
  - Steering packets to VM queues on QinQ/tunnel ID



Generic Flow API Support

- A generic way to configure the hardware
  - Don’t need to know the HW specific filters
- Flow rule
  - Attributes
  - Matching pattern
  - Actions
- Rule management
  - rte_flow_validate()
  - rte_flow_create()
  - rte_flow_destroy()
  - rte_flow_flush()

Example

- Direct the VXLAN packet with specific inner MAC and VNI to queue #2.

Friendly, and consistent to applications!

Legacy filter control API

```
struct rte_eth_tunnel_filter_conf tunnel_filter_conf = {
      .outer_mac = {0x11, 0x22, 0x33, 0x44, 0x55, 0x66};
      .inner_mac = {0x00, 0x11, 0x22, 0x33, 0x44, 0x55};
      .inner_vlan = 0;
      .ip_type = RTE_TUNNEL_IPTYPE_IPV4;
      .ip_addr.ipv4_addr = 1;
      .filter_type = RTE_TUNNEL_FILTER_IMAC_TENID;
      .tunnel_type = RTE_TUNNEL_TYPE_VXLAN;
      .tenant_id = 1;
      .queue_id = 2;
};
int ret;

ret = rte_eth_dev_filter_ctrl(port_id, RTE_ETH_FILTER_TUNNEL,
RTE_ETH_FILTER_ADD, &tunnel_filter_conf);
```

Generic flow API

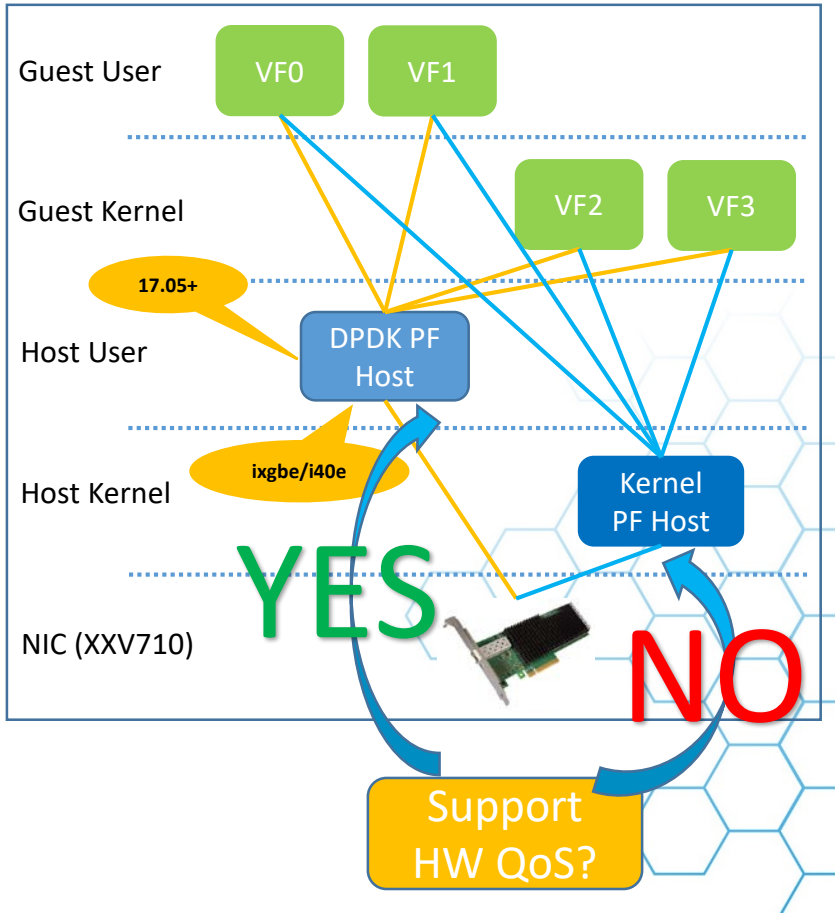
```
const struct rte_flow_item pattern[] = {
      { RTE_FLOW_ITEM_TYPE_ETH, NULL, NULL, NULL},
      { RTE_FLOW_ITEM_TYPE_IPV4, NULL, NULL, NULL},
      { RTE_FLOW_ITEM_TYPE_UDP, NULL, NULL, NULL},
      { RTE_FLOW_ITEM_TYPE_VXLAN, {.vni = 1}, NULL, {.vni = "\xff\xff\xff"}},
      { RTE_FLOW_ITEM_TYPE_ETH,
            {.dst = { 0x00, 0x11, 0x22, 0x33, 0x44, 0x55}}, NULL,
            {.dst = {0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF}}},
      { RTE_FLOW_ITEM_TYPE_END, NULL, NULL, NULL},
};

const struct rte_flow_action actions[] = {
      { RTE_FLOW_ACTION_TYPE_PF, NULL},
      { RTE_FLOW_ACTION_TYPE_QUEUE, { .index = 2}},
      { RTE_FLOW_ACTION_TYPE_END, NULL},
};
struct rte_flow_error flow_err;

flow_err = rte_flow_create(port_id, NULL, pattern, actions, &flow_err);
```

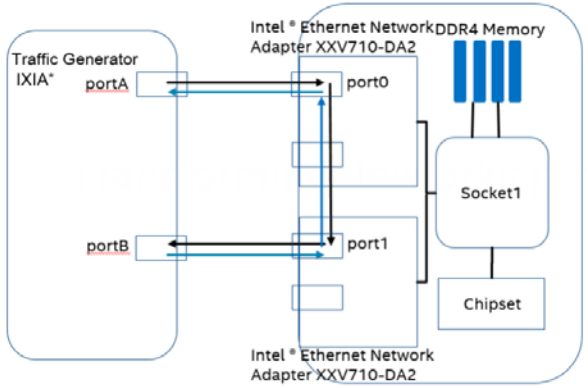
Virtual Function Daemon (VFD) Support

- DPDK PF driver supports both DPDK and kernel VF
- Lots of VF management features are added
- Mailbox messages management are added
  - VF requests can be accepted/rejected by VFD
- Kernel PF driver does not support those features
- Enabled on DPDK PF driver for
  - Intel® Ethernet 500 Series (ixgbe)
  - Intel® Ethernet 700 Series (i40e)
- Refer to https://github.com/att/vfd



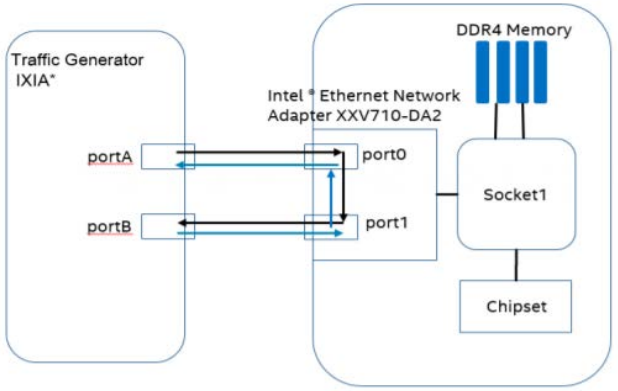
Performance

- 2 Cards



Packet Size (Bytes)	Wire Speed (Mpps)	Packet Rate (Mpps)	%Wire Speed
64	37.2	35.63	95.78%
128	21.1	21.1	100%
256	11.3	11.3	100%

- 1 Cards



Packet Size (Bytes)	Wire Speed (Mpps)	Packet Rate (Mpps)	%Wire Speed
64	37.2	18.1	48.67%
128	21.1	17.26	81.74%
256	11.3	10.5	92.98%
512	5.87	5.71	97.27%
1024	3.03	2.91	97.32%

http://fast.dpdk.org/doc/perf/DPDK_17_05_Intel_NIC_performance_report.pdf

Adaptive Virtual Function (AVF)

AVF -- Adaptive Virtual Function

Needs:

- A single VF driver for all generations of Devices.

Solution:

- Adaptive Virtual Function
  - Base features
  - Negotiated Advanced Features

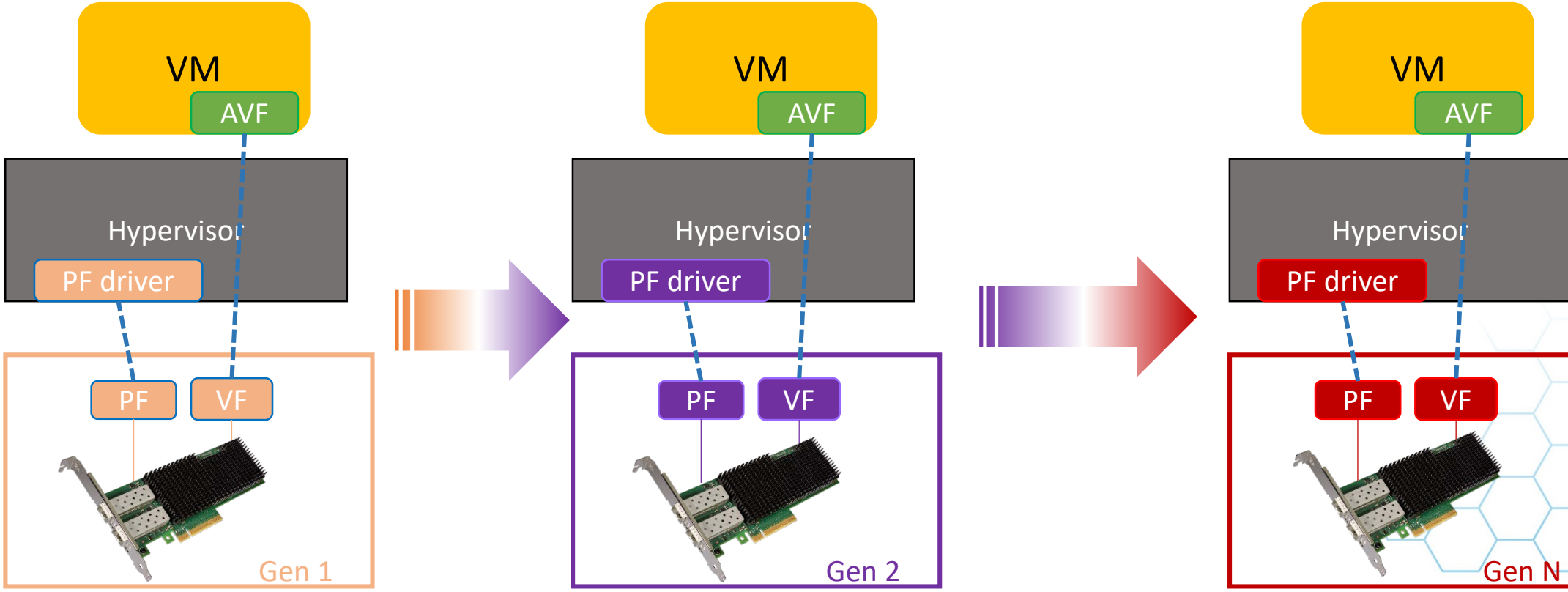
Benefits:

- Existing VM Images will run on the new hardware with **no change**.

From:

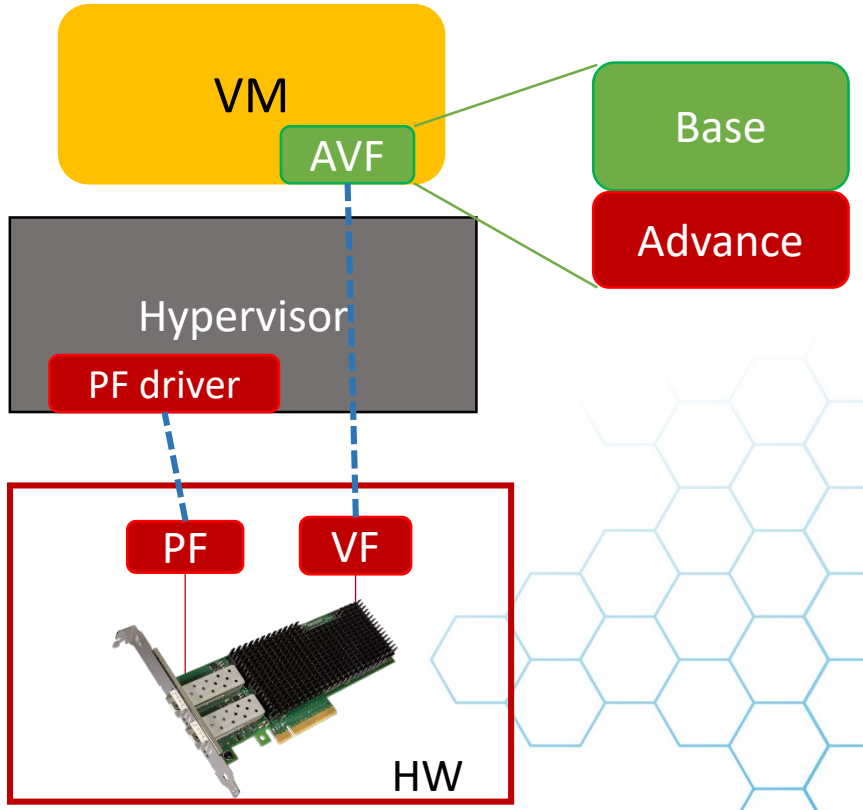
- Intel® Ethernet 700 Series

AVF – HW upgrade



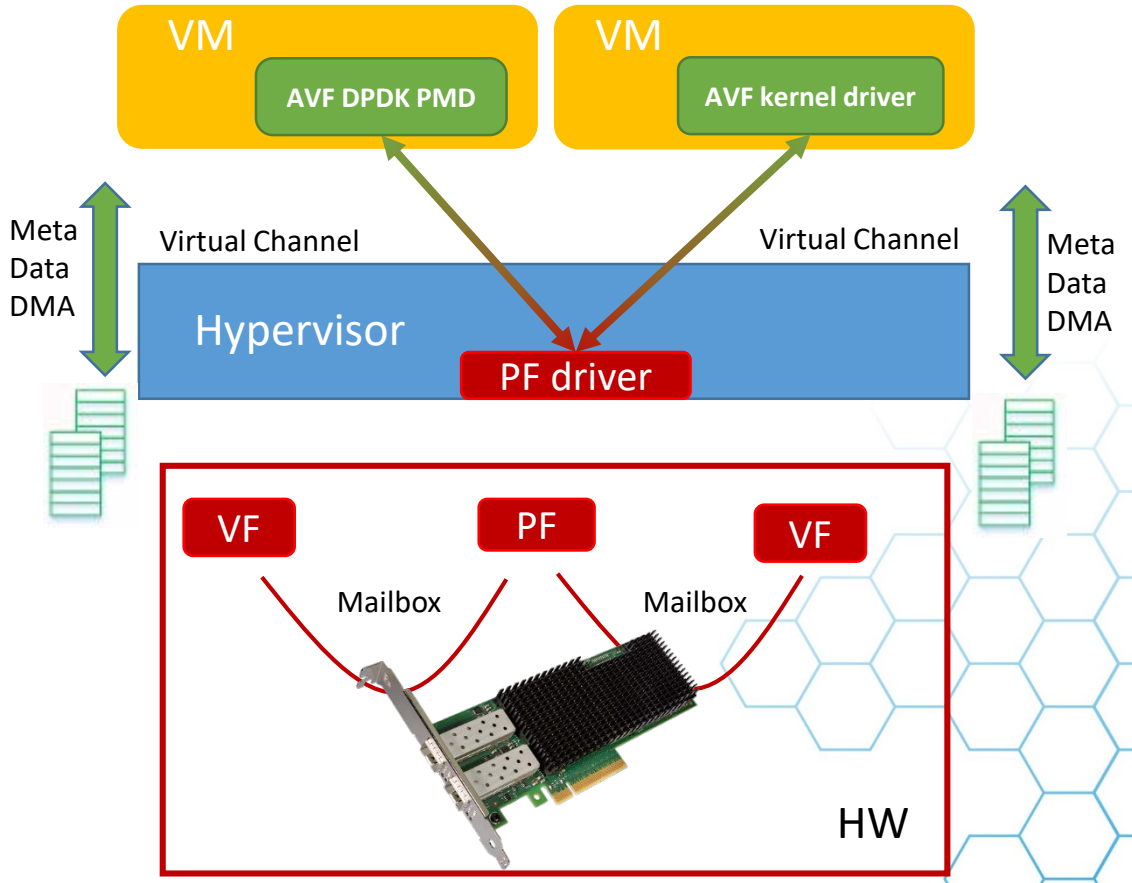
AVF -- Adaptive Virtual Function

- **Base mode supported**
  - Single device ID
  - Support for single level checksum and TSO offload
  - Multi-queue support
  - RSS
- **Advanced features**
  - Advanced feature introduced by new generation HW.
  - Negotiate with PF driver to expose.



Preserving in Hardware and Software

- **Preserving Base mode**
  - Fixed Minimum Register definition
  - A fixed Meta data format for DMA
  - A Hardware generic mailbox to talk to the PF
  - A Software defined Virtual channel layered on top of Hardware mailbox for expansion
- **Room for expansion**
  - Uncompromising on the base functionality.
  - A large range for hot path registers (Queue and Interrupt)
  - Expandable Virtual channel capability negotiation over the agreed upon communication channel between PF and VF.
  - More advanced features would be added with new drops of AVF driver if the underlying HW device supports.
  - Intel is working on the AVF specification.



Key Takeaways

- **25GbE speed, and better hardware capability**
- **Generic, flexible and configurable flow classification**
- **NFV enabled with VFD**
- **Good performance**
- **Adaptive VF driver for all Intel® Ethernet 700 Series Network Adapter**

End

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